Response to Submissions

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Main Roads Western Australia

Manuwarra Red Dog Highway Revised Proposal (Assessment No. 2273)

Response to Submissions

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Contents

1. Introduction 2
1.1 Proposal Background 2
1.2 Revised Proposal Environmental Assessment Process 2
1.3 Submissions Received 2
2. Response to Submissions 4

Appendices

Appendix A. Validation of Vegetation Mapping (Biota 2022) 33
Appendix B. Baseline modelling of surface water flows (Cardno report CW1128800, D22#293340) 34
Appendix C. Hydrological Risk Assessment for Manuwarra Red Dog Highway (Stage 4) (WSP Golder, 2022) 35
Appendix D. Borehole Locations 36
Appendix E. Revised Chapter 5 – Social Surrounds 37
Appendix F. Incoming Corres. from EPA RE MS 677 May16 38
Appendix G. D21#530943 PL05-CEMP-MRWA-KTP Rev 1.2 Construction Environmental Management Plan 39
Appendix H. D18#626232 Karratha Tom Price Road EPA Approved 6136933-REP_Water Management Plan_Rev025062018 40
Appendix I. D18#626301 Karratha Tom Price Road EPA Approved Vegetation Protection and Rehabilitation Management Plan KTP Rev 1 41
Appendix J. D20#630068 05 20200707 KTP CAR Report Appendix E Stage 3 and 4a Weed Control and Management Plan 42
Appendix K. Cultural Heritage Management Plan for the Proposed Stages 3 and 4A Upgrade of the Karratha – Tom Price Road in the Pilbara Region of Western Australia, Brad Goode & Associates, June 2018 (D18#626240) 43
Appendix L. D18#1115728 6137267_REP_National Park Management Plan KTP_Rev3 final approved 20 Dec 2018 44
Appendix M. Ministerial Statement 677 Compliance Assessment Report October 2021 45
Appendix N. Ministerial Statement 677 Compliance Assessment Report Sept 19 46
Appendix O. Impact Reconciliation Procedure (IRP) for Stage 4 of the Revised proposal 47

Tables

Table 2-1. Response to EPA Services Comments 4
Table 2-2. Environmental Management Commitments 24

1. Introduction

1.1 Proposal Background

The requirement for a direct sealed road between the Pilbara coastal communities and inland communities was identified in the 1990s. Prior to the commencement of construction of Stages 1 to 3 of the Karratha – Tom Price Road (now known as the Manuwarra Red Dog Highway), access between the Karratha/Dampier and Roebourne coastal communities to Tom Price/Paraburdoo on the public road system was via the Roebourne – Wittenoom Road, the Nanutarra – Munjina Road, and the Tom Price Spur Road. However, historical traffic data showed that most vehicles commuting between Karratha and Tom Price were using the shorter Pilbara Rail Company's Dampier to Paraburdoo railway access road rather than the public roads.

The 'Roads 2020 Regional Road Development Strategy: Pilbara Region', developed by Main Roads Western Australia (Main Roads) together with local government authorities (Main Roads, 1997), and the 'Pilbara Regional Transport Strategy', developed by the Department of Transport (DoT), recognised there was a requirement for a more direct link between Karratha and inland communities such as Tom Price and Paraburdoo. The completed road will ultimately provide a sealed link between the coastal and inland communities of the central Pilbara that will best meet the needs of all stakeholders.

Main Roads referred the Manuwarra Red Dog Highway (then known to as the Karratha – Tom Price Road) to the WA Environmental Protection Authority (EPA), under section 38 of the *Environmental Protection Act 1986* (EP Act), in September 1998. The EPA determined that the potential environmental impacts were sufficient to warrant formal assessment of the Proposal. In October 1998, the EPA determined the level of assessment to be a Consultative Environmental Review (CER – Assessment Number 1244). The CER was prepared by Main Roads and released for public review in January 2003. In January 2005, the EPA finalised its decision report and recommended conditional approval of the Proposal to the Minister for the Environment. Subsequent to this, the Proposal was granted conditional Ministerial approval via Ministerial Statement (MS) 677 in April 2005.

Since the Manuwarra Red Dog Highway Project was originally approved, there have been significant changes to road design standards and community expectations regarding safety of regional roads. As a result, design standards that were acceptable in the early and mid-2000's are now outdated and no longer considered appropriate. In order to meet the requirements of the current design standards (as detailed in the 'AustRoads Guide to Road Design' (2020) and Main Roads' supplements to this) a larger area of disturbance has been required than originally anticipated for the previous stages of construction, and will also be required for construction of Stage 4.

Stage 4 of the Proposal involves construction of 112 km of new road from the southern end of Stage 3 of the Manuwarra Red Dog Highway (Wallyinya Pool) to the intersection with Nanutarra - Munjina Road. The road will be a standard two-lane single carriageway with associated waterway crossings and fencing where required or agreed with landowners/managers.

1.2 Revised Proposal Environmental Assessment Process

The changes required to construct Stage 4 of the Proposal were referred to the EPA under section 38 of the EP Act as a Revised Proposal on 27 November 2020. On 7 January 2021, the Chairman of the EPA requested additional information from Main Roads to assist the EPA in its assessment of the Revised Proposal. An Environmental Review Document (ERD) was prepared to provide the additional information requested. The ERD was published on 08 August 2022 for public review and comment for a period of four weeks.

The Proposal (EPBC 2017/8035) has also been determined to be a controlled action under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) and will be assessed via Preliminary Documentation. The controlling provision under Part 3 of the EPBC Act is:

- Listed threatened species and communities (Sections 18 and 18A).

1.3 Submissions Received

No public submissions on the Revised Proposal were received via the EPA's consultation hub, nor were any public submissions received via email or mail. The Department of Water and Environmental Regulation's

Environmental Protection Authority Services (EPAS) provided comments on the ERD on 15 September 2022. This included preliminary comments from the Department of Biodiversity, Conservation and Attractions (DBCA), however it was noted that further comments would be provided by DBCA once additional information from recent surveys was provided by Main Roads.

2. Response to Submissions

Responses to the comments provided by EPAS are presented in Table 2-1.

Table 2-1. Response to EPA Services Comments

EPA Services comment	Proponent response
Spatial data	
1. It is acknowledged that spatial data was not required for the original Consultative Environmental Review (CER). However, all areas subject to conditions under a Ministerial statement must now be spatially defined. As Stages 2 and 3 are part of the revised proposal, these areas will need to be digitised for condition setting. If spatial data does not exist for Stages 2 and 3, this will need to be created based on the constructed road and provided to EPA Services for digitisation.	Main Roads has provided spatial data for Stage 2 and 3 as part of this response. The data includes the as built vegetation clearing footprints. As per the EPA Services request (23 December 2022), a Development Envelope has also been provided for Stage 3.
Flora and vegetation	
1. Please clarify the amount of clearing that is proposed for Stage 4. The proposal content document (PCD) and environmental review document (ERD) mostly refer to an area of clearing of 665 ha. However, the tables within the ERD that defines the extent of permanent disturbance to flora and vegetation calculates to a total area of 650 ha. Please explain this discrepancy and revise any impact assessment, if required.	As described in the ERD and consistent with the EPA guidance, Main Roads is proposing a Development Envelope for Stage 4 of the Revised Proposal to provide flexibility as to the location of the ultimate footprint. This is because the design of Stage 4 of the Revised Proposal is in the alignment definition phase and is being further refined based on planning, stakeholder consultation and investigations, particularly in relation to Aboriginal heritage. An Indicative Disturbance Footprint and Indicative Temporary Clearing Areas (both for Stage 4) has been provided as the basis of the assessment and to enable the determination of the significance of potential impacts. The Indicative Disturbance Footprint and Indicative Temporary Clearing Areas are subject to change; however, they will remain within the Development Envelope and impacts such as disturbance to vegetation and habitats for significant species will not exceed the limits detailed in the assessment, and the environmental outcomes described in the ERD will be achieved. The extent of clearing provided in Table 5-8 of the ERD reflects the most likely case (i.e. the Indicative Disturbance Footprint). The extent of clearing for the refinement cases is shown in Table 5-9 of the ERD. Within the ERD, 665 ha total clearing (with no more than 650 ha of vegetation in Good to Excellent condition) was proposed. This provided an additional allowance above the 660 ha (total native vegetation in refinement case A including 650 ha of Good to Excellent condition) to account for future refinements to the disturbance footprint. On further review, refinement case A has been determined to require 657 ha of clearing of native vegetation. Main Roads acknowledges that the EPA require a shape file of the disturbance footprint, and the best practice requires the minimum possible vegetation disturbance. As such, Main Roads proposes to reduce the total native vegetation clearing amount sought to 657 ha (the same as refinement case A).

	That is, there will be no more than 657 ha of clearing of native vegetation. This includes up to 546 ha of permanent clearing of native vegetation in Good to Excellent condition and 100 ha of temporary clearing of native vegetation in Good to Excellent condition. This temporary clearing will be revegetated once construction is complete and will avoid areas that contain significant flora or vegetation. Based on further consultation with EPA Services, refinement case A will be considered to be the revised Indicative Disturbance Footprint going forward. A Section 43a application has been submitted in relation to this change. Spatial data of the Indicative Disturbance Footprint and Refinement Case A has been provided with this Response to Submissions.
2. Main Roads' response to EPA comments on the draft ERD (May 2022) advised that additional survey work, involving the resampling of eight quadrats, was scheduled for May 2022. Main Roads advised that following the survey, the floristic analysis will be re-run and that the report will be updated to explain any discrepancies in the classification of quadrats between mapped vegetation and the floristic classification. It is understood that this survey work has been completed, however, a revised report has not yet been submitted to EPA Services. Please provide the updated survey report, and if required, an updated impact assessment on vegetation. Please also be advised that the Department of Biodiversity, Conservation and Attractions (DBCA) has not provided specific comments on the ERD and will do so once the additional survey data is provided.	Biota Environmental Services completed resampling of eight quadrats and one relevé (previously sampled in October 2020) in July 2022. The additional data collected during the 2022 survey were included in a revised floristic analysis that is provided in Appendix A. Analyses were run using both % cover and presence/absence datasets. Biota (2022) reported that the % cover data provided more realistic groupings of the vegetation communities compared to the analysis based on presence-absence data. The floristic groupings generated from the % cover analysis, were found to align more closely with field observations which included vegetation structure, vegetation composition, landforms, habitat characteristics and soil types. This correlation with % cover data can be attributed to the distinctiveness of plant communities and landforms in the Pilbara. It is well established that vegetation mapping should not rely solely on floristic analysis as this approach has a number of limitations. Consequently, examination of field data relating to habitat features (as has been applied by Biota), are crucial to properly define and map vegetation assemblages. It should be noted that the revised analysis only showed minor discrepancies between outcomes from the % cover and presence/absence datasets. These minor variations had no repercussion in the description and delineation of the vegetation units previously mapped for the survey area.
3. Main Roads' response to EPA comments on the draft ERD (May 2022) advised that no further targeted survey work on unresolved taxa will be undertaken, as it is unlikely to provide substantive information for the EIA of the project, nor resolve the identity of the problematic taxa. One species, *Polymeria* sp. is of interest. Potential direct impact to this, or any other unresolved taxa have not been quantified, and it is unclear whether the specimens were	Biota assigned *Polymeria* sp. as a 'species of interest' for the purposes of the Manuwarra Red Dog Highway Stage 4 Biological Survey report as it could not be identified as any currently recognised species in the Perth collection, by either Biota botanists, nor Mike Hislop (identification botanist at the WA Herbarium). Whilst Biota had assigned *Polymeria* sp. as a 'species of interest' for the purposes of the survey report, within the current taxonomic framework, this collection is not recognised as a species of significance. This species was submitted to the WA Herbarium for paid general identification and was formally identified as *Polymeria* sp. by Mike Hislop. This collection 'likely represents an unrecognised (at least at PERTH) species of *Polymeria*… and it may align with *Polymeria* sp. *Aurukun* (J.R. Clarkson 4320), however further work is required' (Mike Hislop pers. comm, 26/5/2021). Biota have submitted this specimen as a voucher for further evaluation and management by the WA Herbarium. This specimen was located within REL08, a relevé within the D1 vegetation type of the Coolawanyah section of the survey area, specifically at 50 547619E, 7601588N, where one individual was recorded. The D1 vegetation type is characterised by E*ucalyptus victrix (E. camaldulensis*

recorded within the indicative disturbance footprint or the two alignment cases. Please provide further clarification on the location of the unresolved taxa, and quantity the potential direct impact on unresolved taxa.	*subsp. refulgens*) woodland over *Melaleuca glomerata* tall open shrubland over *Triodia epactia* scattered hummock grasses over mixed tussock grasses and sedges. Site REL08 is located approximately 150 m from the Indicative Disturbance Footprint and Refinement Case A and approximately 450 m from Refinement Case B. Accordingly, neither the Indicative Disturbance Footprint nor potential alternative alignments identified in the ERD will impact on REL08 or the identified location of the *Polymeria sp.* individual. The following image shows the location of Site REL08 in relation to the Indicative Disturbance Footprint. Refinement Case A mirrors the Indicative Disturbance Footprint in this area. Refinement Case B is located further north 

Inland water

1. Environmental outcomes in relation to inland waters is that there will be no significant impact to groundwater and surface water quality, groundwater levels, or to environmental values caused by changes to existing surface water flow. It is noted that detailed design work will inform appropriate water crossings, culverts, and floodway design. The ERD does not provide further information on baseline conditions or predicted impacts (modelling) of the road to groundwater and surface water. Therefore, there is uncertainty on whether the construction of the road can achieve the above environmental outcomes. Although it is acknowledged that this uncertainty may be resolved during the final road design, it is unclear how Main Roads intends to demonstrate that the environmental outcomes are achieved post-construction. Please provide further information on how Main Roads intends to monitor potential impact to inlands waters, and any contingency measures that may be available, to ensure that the environmental outcomes are met.	Main Roads has undertaken baseline modelling of surface water flows (Cardno report CW1128800, D22#293340, (Appendix B). This study provides an understanding of the current surface water regime throughout the study area so that hydrological risk factors can be appropriately identified and managed in the road design and route selection processes. The figures in Appendix G of the report indicate Annual Exceedance Probability (AEP) flow velocity and flood depth at critical locations such as Weelumurra Creek (Figures G-3, H-3). This information is also provided in digital formats used to facilitate design of bridges and other drainage infrastructure. The baseline modelling will be used as a reference point to ensure that bridges and culverts have sufficient capacity to achieve their design objectives and maintain existing surface water flows. WSP Golder (2022,Appendix C) undertook a hydrogeological risk assessment to assess potential environmental impacts due to groundwater drawdown, including on groundwater dependent vegetation. The assessment found that estimated groundwater drawdown for each aquifer is low and that impacts to groundwater dependent vegetation is anticipated to be minimal. WSP Golder (2022) concluded that with implementation of the design elements recommended by Cardno (2022), changes to surface flows are unlikely to impact on ecosystems or environmental receptors. To minimise potential impacts to inland waters, Main Roads will: 1. use baseline modelling of surface water flows as a point of reference for drainage design 2. design to maintain surface water flows at current baseline levels, ensuring drainage works: - are designed to minimise interruption to existing drainage systems or modification of surface flow patterns - avoid water shadows and other adverse impacts on the environment - maintain existing flow regimes and water balance of the site as much as possible - are designed to mitigate scour 1. install culverts in sheet flow areas to maintain flows to mulga vegetation that is dependent on surface flows. 2. obtain any necessary licences under the *Rights in Water and Irrigation Act* 1914 or other applicable legislation 3. establish, implement, and maintain a Dewatering Management Plan to the satisfaction of the Department of Water and Environmental Regulation (DWER) to control dewatering activities 4. avoid impact or damage to surrounding buildings, vegetation, existing water bores or any other feature caused by changes to groundwater flow or water table height, both during construction and post construction 5. monitor dewatering (based on Ground and Surface Water Operating Strategy (GSWOS) trigger levels) to ensure no effects on groundwater levels, surface flows or environmental receptors including the Weelamurra Creek and associated pools. Throughout the project design and construction phases, further studies focused on sustainable abstraction of construction water will reduce project water use as far as practicable. Main Roads will develop and implement a Groundwater and Surface Water Operating Strategy (GSWOS). The objectives of the GSWOS will be to ensure: 1. no impacts to groundwater dependent vegetation and threatened fauna habitat due to stream flow sedimentation and erosion arising from the construction of waterway crossings; and 2. no impacts to groundwater dependent vegetation and threatened fauna habitat due to groundwater drawdown arising from dewatering or groundwater abstraction activities.

	3. no impacts to semi-permanent pools present within Weelamurra Creek. The GSWOS will detail: ▪ an erosion monitoring program that includes baseline and ongoing monitoring upstream and downstream of the construction sites, to detect erosion that could potentially increase sedimentation into the streams throughout the construction of significant waterway crossings. Monitoring locations will include as a minimum: - upstream and downstream of the crossing at the Fortescue River - immediately upstream of the confluence of Weelumurra Creek with Fortescue River and upstream of the project at the Weelumurra Creek (or as far upstream as is possible given the ephemeral nature of the creek) - Caves Creek and/or its tributaries ▪ thresholds and triggers, and associated management actions that will be put in place to manage erosion risks during construction; ▪ groundwater level thresholds and triggers based on further assessment of potential drawdown; ▪ corrective actions to be implemented if groundwater level triggers and thresholds are exceeded; and ▪ reporting requirements including six monthly reporting of groundwater levels for bores in the vicinity of groundwater dependent vegetation. Main Roads does not intend to monitor groundwater post-construction. Any impacts to groundwater through abstraction and dewatering will be minor (compared to other dewatering impacts in the region), temporary and short term. Once the abstraction and dewatering has ceased, groundwater levels are expected to return rapidly to pre-construction levels. The road infrastructure will not impede groundwater flows during operation. Culverts, bridges and other drainage structures will be designed in accordance with road standards to accommodate the predicted surface flow levels and maintain the current surface hydrology. While there are already significant changes to the natural hydrology of sheet flows due to existing infrastructure in the vicinity of the Proposal, Main Roads is committed to maintaining the existing flows. Main Roads will monitor surface water flows through routine road maintenance activities. Road maintenance will detect scour and deposition affecting the road and remediate to ensure that the road continues to function. Other than maintenance for scour and deposition, no other contingency actions are proposed.
2. In addition to the environmental values outlined in the ERD, please be advised that there are permanent and semi-permanent pools present within Weelamurra Creek. The pools are located outside (eastern side) and upstream of the development envelope. It is evident through the results of Aboriginal heritage surveys that these pools, and areas around Weelamurra Creek are highly important to both the Yinjibarndi and Wintawari Guruma Peoples. As these pools are not mentioned in the ERD, it is unclear whether the assessment has considered potential impact to the pools.	The assessment did not consider surface flows to the permanent and semi-permanent pools present within Weelamurra Creek, as the pools are located outside (eastern side) and upstream of the Development Envelope. The Revised Proposal will not impact surface water bodies **upstream** of the Revised Proposal. Main Roads does not intend to install new water abstraction bores in the vicinity of Weelamurra Creek or the permanent and semi-permanent pools present within Weelamurra Creek, located outside (eastern side) and upstream of the Development Envelope. Existing licensed Rio Tinto bores which may be used to obtain construction water are located approximately 150m from Weelamurra Creek at its closest point. Main Roads plans to obtain construction water from existing licensed Rio Tinto bores for the northern 78% of the 112 km long road footprint, which includes Weelamurra Creek and surrounding areas. One existing Rio Tinto bore is located approximately 300 m from a semi-permanent pools present within Weelamurra Creek as identified in the Solomon Iron Ore Project Sustaining Production Public Environmental Review (FMG 2015). Given this distance, no impact is expected to the semi-permanent pools from water abstraction. Main Roads will need to construct a bridge over the Weelamurra Creek, requiring dewatering to install bridge piers / footings. It is noted that this bridge construction will be approximately 11 km downstream of the closest semi-permanent pools present within Weelamurra Creek as

For your information, Fortescue Metals Group (FMG) are required to supplement into Weelamurra Creek via a re-injection network to minimise dewatering drawdown.

In providing a response to Item 1 above, please ensure that these pools are considered.

identified during the heritage surveys (WG Site 1). Given this distance, no impact to the pools from dewatering for bridge construction is predicted. It is noted that the closest Rio Tinto bore is over 2 km from WG Site 1.

As detailed above, Main Roads will develop and implement a Groundwater and Surface Water Operating Strategy (GSWOS). The objectives of the GSWOS will include ensuring no impacts to semi-permanent pools present within Weelamurra Creek.

Distance from dewatering location for Bridge crossing at Weelamurra Creek to WG Site 1 (semi-permanent pools):

Main Roads commissioned WSP Golder to model four groundwater abstraction scenarios:

- **Scenario A:** This scenario assumes the total water demand would be pumped progressively along the 112 km alignment from one pumping well. This scenario is unrealistic but is included as a worst-case scenario.
- **Scenario B**: This scenario, assumes Main Roads obtains 100% of the water demand, without drawing water for any existing Rio Tinto bores, but with pumping from three wells at any one time (rather than 1 well in Scenario A).
- **Scenario C**: This is a scenario, assuming Main Roads obtains water from existing Rio Tinto bores except for the southern 25 km of the alignment (22% of the total water demand) pumping from one well at any one time.
  Scenario D: This scenario is similar to Scenario C except that the daily water demand would be supplied by three wells at any one time (rather than one well in Scenario C). This is a likely scenario given that the southern 15 km of the alignment is located in the Fractured Rock aquifer and there is a risk that the well yield could be quite low (<1 L/s).

Water Supply Scenarios

Scenario	Supply of Water	Alignment Length Requiring MRWA Water Supply (km)	Wells Covering the Alignment	Wells Pumping at Any One Time	Duration of Pumping per Well (Days)	Pumping Rate	
						kL/d	L/s
A	100% MRWA	112	15	1	61	162	1.88
			15	1	61	451	5.22
B	100% MRWA	112	15	3	183	54	0.63
			15	3	183	150	1.74
C	22% MRWA	25	5	1	183	36	0.41
			5	1	183	99	1.15
D	22% MRWA	25	5	3	548	12	0.14
			5	3	548	33	0.38

Appendix C provide results of the estimated groundwater level drawdown for each of the Scenarios, at distances of 0 m, 100 m, 500 m and 1,000 m from the pumping well, over pumping durations relevant to each scenario. Results are presented at the end of the pumping periods, as this provides the greatest drawdown and extent.

Scenario A - 100% MRWA Water Supply over 112 km of Alignment - 1 Well Providing Daily Water Supply

Aquifer	Pumping Rate (L/s)	Drawdown (m) after 61 days *			
		0 m	100 m	500 m	1,000 m
Channel Iron Deposits	1.88	0.23	0.07	0.04	0.03
	5.22	0.64	0.19	0.11	0.07
Valley-fill and Inland Alluvial	1.88	0.37	0.11	0.07	0.05
	5.22	1.02	0.31	0.19	0.13
Karstified/Weathered Dolomite	1.88	0.26	0.08	0.05	0.04
	5.22	0.72	0.23	0.14	0.10
Fractured Rock	1.88	0.50	0.13	0.07	0.04
	5.22	1.40	0.37	0.19	0.11
Mineralised BIF	1.88	0.33	0.08	0.04	0.02
	5.22	0.92	0.23	0.10	0.05

Scenario B - 100% MRWA Water Supply over 112 km of Alignment - 3 Wells Providing Daily Water Supply

Aquifer	Pumping Rate (L/s)	Drawdown (m) after 183 days *			
		0 m	100 m	500 m	1,000 m
Channel Iron Deposits	0.63	0.08	0.03	0.02	0.01
	1.74	0.22	0.07	0.04	0.03
Valley-fill and Inland Alluvial	0.63	0.13	0.04	0.03	0.02
	1.74	0.35	0.12	0.08	0.06
Karstified/Weathered Dolomite	0.63	0.09	0.03	0.02	0.02
	1.74	0.25	0.09	0.06	0.04
Fractured Rock	0.63	0.18	0.05	0.03	0.02
	1.74	0.49	0.14	0.08	0.06
Mineralised BIF	0.63	0.12	0.03	0.02	0.01
	1.74	0.32	0.09	0.05	0.03

Scenario C - 22% MRWA Water Supply over 25 km of Alignment - 1 Well Providing Daily Water Supply

Aquifer	Pumping Rate (L/s)	Drawdown (m) after 183 days *			
		0 m	100 m	500 m	1,000 m
Channel Iron Deposits	0.41	0.05	0.02	0.01	0.01
	1.15	0.15	0.05	0.03	0.02
Valley-fill and Inland Alluvial	0.41	0.08	0.03	0.02	0.01
	1.15	0.23	0.08	0.05	0.04
Karstified/Weathered Dolomite	0.41	0.06	0.02	0.01	0.01
	1.15	0.17	0.06	0.04	0.03
Fractured Rock	0.41	0.12	0.03	0.02	0.01
	1.15	0.32	0.09	0.05	0.04
Mineralised BIF	0.41	0.08	0.02	0.01	0.01
	1.15	0.21	0.06	0.03	0.02

Scenario D - 22% MRWA Water Supply over 25 km of Alignment - 3 Wells Providing Daily Water Supply

Aquifer	Pumping Rate (L/s)	Drawdown (m) after 543 days *			
		0 m	100 m	500 m	1,000 m
Channel Iron Deposits	0.14	0.02	0.01	0.00	0.00
	0.38	0.05	0.02	0.01	0.01
Valley-fill and Inland Alluvial	0.14	0.03	0.01	0.01	0.01
	0.38	0.08	0.03	0.02	0.02
Karstified/Weathered Dolomite	0.14	0.02	0.01	0.01	0.00
	0.38	0.06	0.02	0.01	0.01
Fractured Rock	0.14	0.04	0.01	0.01	0.01
	0.38	0.11	0.04	0.02	0.02
Mineralised BIF	0.14	0.03	0.01	0.00	0.00
	0.38	0.07	0.02	0.01	0.01

* The end of the pumping period for the specific scenario

Note that the analysis method does not consider any recharge over the pumping period. This assumption is unrealistic as reinjection (infiltration) and groundwater recharge is expected for all realistic scenarios. The estimated groundwater level drawdowns are therefore considered to be conservative or worst case.

	The results show that the groundwater level drawdown extent is not linear (it is logarithmic) and that the groundwater level drawdown is low only 100 m from the well. The results also indicate: ▪ The greatest groundwater level drawdown will occur for Scenario A (worse-case scenario). The groundwater level drawdown for Scenario A is still low, ranging between 0.07 m and 0.37 m, 100 m from the well, and 0.04 m to 0.19 m, 500 m from the well. ▪ Scenario B would result in reduced groundwater drawdown compared to Scenario A being 0.03 m to 0.14 m at 100 m and0.02 m to 0.08 mat 500 m ▪ For Scenarios C and D where 78% of the water demand will be provided by Rio Tinto bores, the estimated groundwater level drawdown is lower than for Scenarios A and B. For Scenario C the estimated groundwater level only ranges between 0.02 m and 0.09 m at 100 m from the well, and 0 m to 0.05 m at 500 m from the well. For Scenario D these groundwater level drawdowns reduce even further by up to 2.5 times to 0.01 m to 0.04 m at 100 m, and 0 m to 0.02 m at 500 m. Scenarios B, C and D are feasible and realistic options, and are options that best predict proposal impacts. Option D is the most likely project scenario. Scenarios B, C and D would result in minimal or no short-term environmental impact due to groundwater supply abstraction. A groundwater supply system can therefore be established, operated and managed with minimum impact to groundwater, and no expected detrimental impact to other water users or environmental receptors. Dewatering for the Weelamurra Creek bridge is also predicted to have only a minor temporary effect on the local groundwater system given: ▪ dewatering for bridge structures will be of short duration (approximately 2 months at each bridge support location) and to a maximum depth of no more than 5 m below ground. ▪ any ground water extracted will be infiltrated/recharged back into the groundwater aquifer near the site, resulting in a net abstraction volume close to zero. ▪ The recharge/infiltration areas will be strategically located between the dewatering area and any identified environmental sensitive area (e.g., a pool). This allows for the groundwater level to be controlled and managed at the environmental sensitive area, resulting in negligible/minimal drawdown at these locations. ▪ any dewatering operations will be subject to requirements of the RIWI Act ensuring impacts to sensitive environmental receptors are either avoided or minimised. A site specific dewatering management plan will be developed, which will outline the dewatering, monitoring and management requirements including the location and extent of the infiltration/recharge areas. The Dewatering Management Plan will also outline specific trigger levels and contingency requirements. Potential groundwater drawdown due to bridge construction at Weelamurra Creek was also assessed by WSP Golder based on the following assumptions: ▪ the groundwater level is 2 m bgl at the bridge structure locations (although no groundwater level data is available at this time in this area, groundwater could be expected to be close to surface, especially during the wet season). ▪ the bridge structure excavation will be 30 m (length) by 10 m (width) by 5 m (depth) ▪ dewatering is required up to 1 m below the excavation level, resulting in a required groundwater level drawdown of 4 m ▪ the dewatering period will be 2 months for the bridge structure ▪ the site is located within the Wittenoom Formation. The Transmissivity is set at 1330 m2/d (from Jacobs report) while the specific yield (storage coefficient) has been assumed to be 0.25 since it is the groundwater table that is being dewatered (i.e. unconfined conditions exist).

	It is expected that the dewatering rate could be high to very high, 75+ L/s for installation of the bridge structures. The groundwater level drawdown is estimated to be around 0.5 m at 100 m from the excavation with the groundwater level drawdown extending up to 800 m from the excavation. Note the groundwater level drawdown can be controlled in specific areas (e.g., near pools) by recharge/infiltration of the extracted water between the excavation and the pool. Recharge/Infiltration of the water at the site would result in a net abstraction rate close to zero (except for losses). As mentioned in the response to EPAS comment 1, Main Roads will monitor, control and prevent impacts form groundwater drawdown resulting from dewatering activities, during the project construction. Main Roads will monitor groundwater to ensure dewatering does not affect groundwater dependent ecosystems including the Weelamurra Creek and associated pools. The injection by FMG referred to is related to significant water abstraction for mining operations and is not comparable to the minor dewatering required for bridge construction.
3. Section 5.3.6.1 states that existing bores will be utilised in the first instance, and that abstraction will be managed to minimise groundwater drawdown. Please provide a map indicating the location of these bores. It is noted that licencing under the *Rights and Water Irrigation Act 1914* may be able to manage the requirement for additional bores such that the EPA's objectives can be met. Please provide further information regarding the likelihood of additional bores and any further information, if available, regarding the quantity of water, potential location, and potential impacts of additional bores. The Mid-West Gascoyne Water licencing team advise that any additional bores should avoid Weelamurra Creek, and the Priority 1 and 2 Millstream Water Reserve.	1. Main Roads has been in discussions with Rio Tinto about the use of water from existing licensed Rio bores. There is in principal agreement between Main Roads and Rio Tinto that there is sufficient allocation under Rio Tinto licenses to meet all Main Roads construction water needs. However, there are insufficient Rio Tinto bores located in the southern section of the alignment (approximately 25 km) to meet Main Roads construction water requirements. Main Roads may need to secure alternative construction water supplies for this southern section. Appendix D shows the locations of the bores. 2. Main Roads met with DWER officers, Stephanie Pham and Gary Humphreys, to discuss potential construction water supplies for the MRDH project in April 2022. Main Roads was told at this meeting: - Discussion and agreement needed with Rio Tinto on the use of each Rio Tinto bore asset - Need to ensure total abstraction (Rio Tinto + MRWA) is under each licence allocation - Separate application needed for every Rio Tinto license – Form 4a (water online) - Need to measure and report all water use from each bore and license - DWER would likely support a separate Main Roads allocation of certain water resources for short term (2 years) construction water supply at some locations to supplement Rio Tinto bore allocations. - Such allocations would need to be outside Hammersley – Millstream water resource areas As there are insufficient Rio Tinto bores located in the southern 25 km of the development envelope, Main Roads may need to apply for water licences to abstract construction water under the RIWI Act for this southern 25 km section of the development envelope. Potential abstraction bore locations are distant from Weelamurra Creek, and the Priority 1 and 2 Millstream Water Reserve. Currently Main Roads has no knowledge of water quality in these potential bore locations. Based on estimates from the Technical Memorandum, Hydrological Risk Assessment for Manuwarra Red Dog Highway (Stage 4), WSP Golder (2022), it is likely that one bore pump would operate in the southern 25 km section of the 112 km alignment development envelope, moving sequentially across the 25 km over the 2-year pumping time. The total water demand for this section is between 36 kL/d and 101 kL/d (22% of the total demand for the entire 112 km). The tables provided in the above response provide the predicted drawdown at increasing distance from the bore of intended pumping within the southern 25 km of the 112 km development envelope. Given minor drawdown effects it is unlikely there will be material impacts on sensitive receptors, including groundwater dependent ecosystems.

Social surroundings

1. Please provide the following heritage survey reports:
   - Yinjibarndi Ethnographic Survey Trip 2
   - Final Report of an Ethnographic Survey Karratha to Tom Price Road Alignment in Eastern Guruma Country Trip 1
   - Report on a site avoidance archaeological heritage survey of the Karratha Tom Price Road Stage 4 Alignment Tom Price Railway Rd SLK0-51 undertaken in Eastern Guruma Country by the Wintawari Guruma representatives and Yulur Heritage Trip 1
   - Report on the trip 2 site avoidance archaeological heritage survey of the Manuwarra Red Dog Highway Karratha Tom Price Road Stage 4 Alignment Tom Price Railway Rd SLK0-50 undertaken in Eastern Guruma Country by the Wintawari Guruma representatives and Yulur Heritage

   Please also provide a summary/update on the outstanding Aboriginal heritage survey work. It is acknowledged that there may be some delay in the ability to complete such work, please provide an update on potential approaches to resolving the delays.

Main Roads has provided these reports separately to this response to submissions due to the confidential nature of the report contents. The following reports have either been provided or, in the case of three outstanding reports, will be provided when available.

Yindjibarndi:

Report Title:	TRIM Ref:
Preliminary advice of an Aboriginal archaeological survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor (Roebourne Wittenoom Rd SLK58-74 & Tom Price Railway Rd SLK51-106), Pilbara, Western Australia **Trip 1** (July 2020).	D20#616715
Report of an Aboriginal archaeological survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor (Roebourne Wittenoom Rd SLK58-74 & Tom Price Railway Rd SLK51-106), Pilbara, Western Australia **Trip 1** (August 2020).	D20#810745
Preliminary Advice following an Yindjibarndi Ethnographic Site Identification Heritage Survey of the Karratha Tom Price Road Stage 4 Alignment Corridor; Roebourne Wittenoom Rd SLK58-74 and Tom Price Railway Rd SLK51-106 in the West Pilbara **Trip 1** (June-July 2020).	D20#616719
Report of a Yindjibarndi Ethnographic Site Identification Heritage Survey of the Karratha Tom Price Road Stage 4 Alignment Corridor; Roebourne Wittenoom Rd SLK58-74 and Tom Price Railway Rd SLK51-106 in the West Pilbara **Trip 1** (June – July 2020).	D20#810739
Preliminary advice of an Aboriginal archaeological Site Avoidance survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor (Roebourne Wittenoom Rd SLK68-74 & Tom Price Railway Rd SLK51-108), Pilbara, Western Australia **Trip 2** (October 2020).	D20#1024503
Report of an Aboriginal archaeological Site Avoidance survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor (Roebourne Wittenoom Rd SLK68-74 & Tom Price Railway Rd SLK51-108), Pilbara, Western Australia **Trip 2** (October 2020).	D20#1025052
Preliminary advice of an Aboriginal archaeological Site Avoidance survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor (Roebourne Wittenoom Rd SLK68-74 & Tom Price Railway Rd SLK51-108), Pilbara, Western Australia **Trip 3** (January 2021).	D21#75070
Report of an Aboriginal archaeological Site Avoidance survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor (Roebourne Wittenoom Rd SLK68-74 & Tom Price Railway Rd SLK51-108), Pilbara, Western Australia **Trip 3** (January 2021).	D21#131933
Preliminary advice of an Aboriginal archaeological Site Avoidance survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor (Roebourne Wittenoom Rd SLK68-74 & Tom Price Railway Rd SLK51-108), Pilbara, Western Australia **Trip 4** (March 2021).	D22#1129373
Report of an Aboriginal archaeological Site Avoidance survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor (Roebourne Wittenoom Rd SLK68-74 & Tom Price Railway Rd SLK51-108), Pilbara, Western Australia **Trip 4** (March 2021).	D21#389565

	Preliminary advice of an Aboriginal archaeological Site Avoidance survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor (Roebourne Wittenoom Rd SLK68-74 & Tom Price Railway Rd SLK51-108), Pilbara, Western Australia **Trip 5** (September 2021). — D22#1129374 Report of an Aboriginal archaeological Site Avoidance survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor (Roebourne Wittenoom Rd SLK68-74 & Tom Price Railway Rd SLK51-108), Pilbara, Western Australia **Trip 5** (November 2021). — D22#252637 Karratha Tom Price Rd Stage 4 (Millstream to Hamersley) - Yindjibarndi Section (Ethnographic Survey 2) — To be provided to Main Roads **Eastern Guruma:** **Report Title:** / **TRIM Ref:** Karratha Tom Price Rd Stage 4 (Hamersley to Nanutarra Munjina Rd) - Eastern Guruma Section (Ethno Survey 1) — D20#1131034 Preliminary advice of a site avoidance archaeological heritage survey for the Karratha Tom Price Road Stage 4 Alignment Tom Price Railway Rd **trip 1**, SLK0-51, Eastern Guruma Country (November 2020). — D21#79564 Report on a site avoidance archaeological heritage survey for the Karratha Tom Price Road Stage 4 Alignment Tom Price Railway Rd **trip 1**,SLK0-51, Eastern Guruma Country (November 2020). — D21#306411 Preliminary advice of the **trip 2** site avoidance archaeological heritage survey of the Manuwarra Red Dog Highway Karratha Tom Price Road Stage 4 Alignment Tom Price Railway Rd SLK0-50 undertaken in Eastern Guruma Country by the Wintawari Guruma representatives and Yulur Heritage (April 2021). — D22#1129393 Report on the trip 2 site avoidance archaeological heritage survey of the Manuwarra Red Dog Highway Karratha Tom Price Road Stage 4 Alignment Tom Price Railway Rd SLK0-50 undertaken in Eastern Guruma Country by the Wintawari Guruma representatives and Yulur Heritage (May 2021). — D21#587414 Preliminary advice of the **trip 3** site avoidance archaeological heritage survey of the Manuwarra Red Dog Highway Karratha Tom Price Road Stage 4 Alignment Tom Price Railway Rd SLK0-50 undertaken in Eastern Guruma Country by the Wintawari Guruma representatives and Yulur Heritage (April 2021). — D21#1129395 Report on the **trip 2** site avoidance archaeological heritage survey of the Manuwarra Red Dog Highway Karratha Tom Price Road Stage 4 Alignment Tom Price Railway Rd SLK0-50 undertaken in Eastern Guruma Country by the Wintawari Guruma representatives and Yulur Heritage (May 2021). — D22#647459 Karratha Tom Price Rd Stage 4 (Hamersley to Nanutarra Munjina Rd) - Eastern Guruma Section (Arch Survey 4 and Ethnographic Survey 2) — Final surveys to be scheduled
2. Results from Trip 5 of heritage surveys undertaken on Yinjibarndi country has not been incorporated into the ERD. Please review section 5.4 and provide an updated assessment of impacts as part of the Response to Submissions.	Chapter 5 of the ERD has been updated to include results of Trip 5 (Appendix E).
3. It is understood that all heritage sites to be avoided within the development envelope will	If impacts to any registered Aboriginal heritage site or any site associated with the Stage 4 of the Revised Proposal likely to be protected by the ACH Act are unavoidable, Main Roads will undertake an archaeological investigation with the relevant traditional owners and provide the

be demarcated and no-go zones established. However, there is no indication of which sites can be avoided.

It is understood that disturbance to some heritage sites will be unavoidable, and that the disturbance footprint has not yet been finalised. However, there has been no quantitative assessment of impact to heritage sites (registered, lodged or newly identified) based on the indicative disturbance footprint, or the two alignment refinement cases. Please review the location of heritage sites (registered, lodged or newly identified) against the indicative disturbance footprint and refinement cases to determine potential impact to heritage sites, and to identify heritage sites where there is high confidence of avoidance.

results of the investigation to the Registrar of Aboriginal Sites prior to commencing ground disturbing works. Lodged and Registered Aboriginal Heritage Places are shown in Figure 8 of the ERD.

Chapter 5 of the ERD lists the Registered Aboriginal Heritage Places that are present in the Development Envelope. These are repeated here with details of how these locations related to the Indicative Disturbance Footprint. It is noted that none of the refinement cases differ from the Indicative Disturbance Footprint in these locations.

- **Site ID 17332: Horseshoe Bore 02 – Artefacts/Scatter:** The Indicative disturbance footprint intersects this site for ~0.03 km (~0.01 ha)
- **Site ID 17335: Mt Margaret 96-1 (Hamersley Plateau) – Modified Tree**: The Indicative disturbance footprint intersects this site for ~2.16 km (~23 ha)
- **Site ID 18173: Weelamurra Creek Ceremonial Ground - Artefacts / Scatter, Ceremonial and Historical site:** The Indicative disturbance footprint intersects this site for ~2.05 km (~11 ha)
- **Site ID 37670: Narraminju (Caves Creek) – Mythological site associated with Caves Creek and its tributaries:**
- **Site ID 38183: Weelamurra Wuntu (Willamarranha, Wilumarra and Wirlumarra) – a complex of Ceremonial, Mythological, and Water Sources associated with Weelamurra Creek:** The Indicative disturbance footprint intersects this site for ~0.2 km (~1.3 ha)

The following lodged Aboriginal Heritage Sites are located in the Development Envelope. Also provided is details of how these locations related to the Indicative Disturbance Footprint. It is noted that none of the refinement cases differ from the Indicative Disturbance Footprint in these locations.

- **Site ID 21075: RTC03-E1:** The Indicative disturbance footprint intersects this site for ~0.35 km (~1.4 ha).
- **Site ID 37886: Jurkanunha Marnta:** The Indicative disturbance footprint does not intersects this site.

Site ID 19906: KTP/FS3: The Indicative disturbance footprint intersects this site for ~0.65 km (~3.7 ha).

The following newly identified sites are located in the Development Envelope. Also provided are details of if these locations are impacted by the Indicative Disturbance Footprint and refinement cases.

Site	Area intersected by Indicative Disturbance Footprint (ha)	Refinement Case A	Refinement Case B
WG Site 1	0.00	0.00	0.00
WG Site 2	**0.39**	**0.39**	**0.39**
WG Site 3	0.00	0.00	0.00
WG Site 4	0.00	0.00	0.00
WG Site 5	0.00	0.00	0.00
WG Site 6	0.00	0.00	0.00
WG Site 7	**0.14**	0.00	0.00
WG Site 8	0.00	0.00	0.00
WG Site 9	0.00	0.00	0.00
WG Site 10	0.00	0.00	0.00
WG Site 11	0.00	0.00	0.00

WG Site 12	**0.29**	**0.29**	**0.29**
WG Site 13	**0.55**	**0.55**	**0.55**
WG Site 14	0.00	0.00	0.00
WG Site 15	**0.05**	0.00	0.00
WG Site 16	**0.66**	**0.66**	**0.66**
WG Site 17	0.00	0.00	0.00
WG Site 18	0.00	0.00	0.00
WG Site 19	0.00	0.00	0.00
WG Site 20	0.00	0.00	0.00
WG Site 21	**0.18**	**0.18**	**0.18**
WG Site 22	**0.20**	**0.2**	**0.2**
WG Site 23	**0.22**	**0.22**	**0.22**
WG Site 24	**0.08**	**0.08**	**0.08**
WG Site 25	0.00	0.00	0.00
WG Site 26	**0.15**	0.00	0.00
WG Site 27	**0.02**	0.00	0.00
WG Site 28	**0.31**	0.00	0.00
WG Site 29	**12.15**	**12.15**	**12.15**
WG Site 30	0.00	0.00	0.00
WG Site 31	**0.30**	**0.30**	**0.30**
Yin Site 1	0.00	0.00	0.00
Yin Site 2	0.00	0.00	0.00
Yin Site 3	0.00	0.00	0.00
Yin Site 4	0.00	0.00	0.00
Yin Site 5	0.00	0.00	0.00
Yin Site 6	0.00	0.00	0.00
Yin Site 7	**0.12**	0.00	0.00
Yin Site 8	0.00	0.00	0.00
Yin Site 9	**0.11**	0.00	0.00

	Yin Site 10	0.00	0.00	0.00
	Yin Site 11	**0.06**	0.00	0.00
	Yin Site 12	**0.14**	0.00	0.00
	Yin Site 13	**0.02**	0.00	0.00
	Yin Site 14	**0.04**	0.00	0.00
	Yin Site 15	**0.36**	0.00	0.00
	Yin Site 16	**0.03**	0.00	0.00
	Yin Site 17	**0.32**	0.00	0.00
	Yin Site 18	0.00	0.00	0.00
	Yin Site 19	0.00	0.00	0.00
	Yin Site 20	0.00	0.00	0.00

As noted in the revised Section 5.4 (Appendix F) Main Roads will adopt the recommendations of Eastern Guruma Country archaeological site avoidance survey reports. Places MR_EAS_21_007, MR_EAS_21_008, MR_EAS_21_009, MR_EAS_21_010, MR_EAS_21_011, and MR_EAS_21_012, S11-181, Weelamurra Creek Ceremonial Ground, and Weelamurra Ceremonial HRZ will be avoided and protected from damage, as far as is practicable. Further design work and liaison with Eastern Guruma representatives is required to determine whether these sites can be completely avoided. Relevant approvals under the AH Act or ACH Act will be obtained for any impacts to identified sites.

Main Roads will adopt all the recommendations of the Yindjibarndi Country archaeological site avoidance survey reports.

4. Sections 5.4.3.2.1 and 5.4.3.2.2 of the ERD lists the recommendations made to Main Roads by Wintawari Guruma People and Yinjibarndi People. However, not all recommendations are included in Table 5-34, which outlines the proposed management measures for social surroundings.

   For example, the Yinjibarndi People have recommended that if newly identified heritage sites are to be disturbed, then these sites should be surveyed to a Site Identification Standard and the Yinjibarndi People are afforded the opportunity to salvage any Aboriginal heritage sites that may be impacted.

   Please clarify which of the recommendations will be undertaken by Main Roads.

Main Roads will undertake all recommendations made to Main Roads by the Wintawari Guruma People and Yinjibarndi People. Table 5-34 and Chapter 5.4 of the ERD have been updated to include all recommendations and results from Trip 5 heritage surveys (Appendix E).

Greenhouse gas emission estimates

1. The greenhouse gas estimate provided for the revised proposal only considers Stage 4. This is adequate for construction elements, however, an estimate for Stages 2 and 3 are required in regard to operational maintenance and road users.

It is noted that the majority (but not all) of road users for Stage 2 and 3 will also be road users for Stage 4. A small percentage of users of Stage 3 will exit the highway where Stage 3 and Stage 4 will meet. Similar maintenance requirements will apply to Stages 2, 3 and 4.

Given this, operations GHG emissions for Stage 2 and 3 are estimated to be similar (but slightly higher to account for slightly higher road use) to Stage 4 on a per kilometre basis. Based on this, Main Roads has used the assessment made for Stage 4 (as presented in the ERD) to estimate the operational GHG emissions from Stage 2 and 3. Main Roads has used a conservative estimate of 20% higher road usage in Stage 2 and 3 compared to Stage 4.

		Stage 2	Stage 3	Stage 4	Total
Scope 1	Total tCO2e for maintenance (50-year life)	25,727	12,725	30,983	69,435
Scope 2	Total tCO2e for maintenance (50-year life)	0	0	0	0
Scope 3	Total tCO2e for supply of maintenance materials (50-year life)	6,227	3,080	7,499	16,806
	Total tCO2e from road users (50-year life)	1,201,816	495,372	1,005,103	2,702,291

Cumulative impact assessment

1. Existing impacts from Stages 2 and 3 of the proposal have not been considered in assessing the cumulative impacts on significant environmental values, such as significant fauna habitat, ecological communities and/or priority flora. Further estimates of cumulative impacts with consideration to Stages 2 and 3 is required to fully understand the combined effect of the revised proposal.

   It is acknowledged that the CER does not provide the same level of detail as would be required in a current environmental impact assessment. Surveys from other projects, data from compliance monitoring and reporting,

To provide further estimates of cumulative impacts with consideration to Stages 2 and 3, Main Roads has digitized historic vegetation mapping undertaken for the CER and overlain Stage 2 and 3 clearing footprints to provide an estimate of impacts. The vegetation types as described in the CER have been correlated with those described by Biota, and these have been associated with the fauna habitat preferences of the threatened species that are known, likely or may occur identified in the ERD as well as the Priority species known to occur in the Development Envelope.

Vegetation Type

Vegetation Type (CER)	Correlates with Biota 2021 Vegetation Type	Stage 2 Clearing (ha)	Stage 3 Clearing (ha)	Stage 4 - Refinement Case A + Temp Clearing Areas (ha)	Total (ha)

or broad mapping of vegetation and land systems, may assist to provide reasonable estimates about previous and realised impacts.

Barren rocky scree slopes with Snappy Gum (*Eucalyptus leucophloia* over Spinifex steppe)	Vegetation of Stony Plains and Sloping Plains	16.5	3.1	179.3	198.9
Floodplain vegetation of *Acacia* species and scattered *Corymbia hamersleyana*	Vegetation of Floodplains	10.48	5.65	228.3	244.43
- Acacia shrubland of mixed *Acacia* species - Grassland with mixed scattered *Acacia* species - Plain of mixed Spinifex and grass species -Mixed *Acacia* species over Spinifex steppe	- Vegetation of Cracking Clays - Mulga Woodland Plain.	132.51	26.14	72.0	230.65
Vegetation of major and minor drainage lines	Vegetation of Drainage Lines	19.62	8.85	20.10	48.57

It is noted that that the remainder of the disturbance footprint for Stages 2 and 3 were previously cleared and as such, not included in the assessment.

Threatened Ecological Communities and Priority Ecological Communities.

No Threatened Ecological Communities and Priority Ecological Communities were cleared as part of Stage 2 or 3.

Threatened and Priority Fauna

Species Habitat	Stage 2 Clearing (ha)	Stage 3 Clearing (ha)	Stage 4 - Refinement Case A) + Temp Clearing Areas[1]	Total (ha)
Northern Quoll – habitat critical to the survival of a species	0	0	4.0	4.0
Northern Quoll – supporting habitat	36.1	12.0	177.2	225.3

[1] These estimated habitat impact areas include an allowance of approximately 10% more than the habitat area mapped within the Indicative Disturbance Footprint and Indicative Temporary Clearing Areas. This provides flexibility in the location of the road and construction areas for access and laydown.

Pilbara Leaf-Nosed Bat – supporting habitat	36.1	12.0	181.0	229.1
Ghost Bat – supporting habitat	46.6	17.6	364.5	428.7
Pilbara Olive Python – supporting habitat	46.6	17.6	364.3	428.5
Night Parrot – supporting habitat	0	0	29.1	29.1
Grey Falcon – supporting habitat	179.1	43.8	700.4	923.3
Peregrine Falcon – supporting habitat	179.1	43.8	700.4	923.3
Western Pebble-mound Mouse – supporting habitat	149.0	29.3	245.2	423.5

As described in the ERD, the extent of habitat that will be lost represented a very small component of the overall similar habitat that exists in the Pilbara region. Based on the cumulative loss in regard to land systems and vegetation associations (Section 9.1 and Section 9.2 of the ERD) it can be seen that over 99% of the pre-European extents remain and Stage 4 of the Revised Proposal will result in the removal of <0.2% of this extent. The loss of vegetation associations (ie based on the Beard data), was updated in 2017 so already includes losses from Stage 2. The clearing of 43 ha of vegetation for Stage 3 will not materially change the cumulative impacts described in the ERD.

It is noted that no Northern Quoll denning habitat was identified in the clearing footprint for Stage 2 and 3. As such, the conclusions in the ERD that the cumulative impacts to Northern Quoll as a result of habitat loss is not considered significant

The inclusion of clearing under taken as part of Stage 2 and 3 of the revised proposal does not change the overall conclusions that it is not expected that habitat loss as a result of the Revised Proposal will contribute cumulatively to similar threats in the region such that significant impacts occur to significant fauna species.

Implementation Conditions and Environmental Management Commitments

1. The ERD does not provide a review of what conditions and commitments under Ministerial statement 677 are complete, and what remain relevant for Stages 2 and 3. The proposal is currently subject to six approved environmental management plans (EMPs).

   Under section 40AA(6) of the EP Act, a statement can either apply only to the significant amendment, or a statement can include the implementation conditions for the

Stage 2 and Stage 3 completion status

Stage 2 construction was completed in 2008. Stage 2 is compliant with existing MS 677 conditions and commitments. The Stage 2 compliance status is complete.

A letter of 23 May 2016 from Ian Munro the then Manager Compliance Branch, Office of the Environmental Protection Authority (Appendix F) found through a desktop audit that, Stage 2 (90km between Northwest Coastal Highway and the junction of the Roebourne- Wittenoom Road), Main Roads was compliant with implementation conditions and proponent commitments.

This desktop audit by the Office of the Environmental Protection Authority of the implementation of MS 677 (see Audit Table, Appendix F) also found that management plans relevant to Stage 2 were compliant, and that plan implementation was also compliant.

Stage 3 construction was completed on the 30/08/2020. Actions required under specific Stage 3 environmental management plans are complete, other than ongoing monitoring and remediation (as necessary) of rehabilitation and weed control areas.

approved proposal as amended by the significant amendment, and supersedes the previous Ministerial statement relating to the approved proposal. It is understood that Main Roads' preference would be that the new statement applies to Stage 4 only. However, Ministerial statement 677 includes conditions/commitments that are relevant to Stage 4 (for example, Themeda grasslands TEC management plan). Ministerial statement 677 also contains conditions/commitments that may no longer be relevant (outdated) or complete. Noting this, it may be more appropriate for a new statement that supersedes Ministerial statement 677. EPA Services will continue to discuss options for Ministerial statements with Main Roads throughout the assessment stage. Please provide a summary of the EMPs that are currently being implemented for the proposal, and what stage of the proposal the EMPs apply to. Please also provide further information on which stages of the proposal are considered to be complete, that is, there is no monitoring/management requirements remaining. Clarification is also required on whether existing commitments within existing EMPs have been considered, and are consistent, with management measures proposed for Stage 4 of the revised proposal.	The success of the rehabilitation program is measured by criteria related to landforms, soil stability, weed levels and vegetation cover. The time frames for measurement of the criteria may be dependent upon seasonal conditions. Main roads anticipates that the criteria will be successfully achieved by the end of 2025. Stage 3 MS 677 compliance can be assured through regular auditing, assessment and submission of ongoing annual Compliance Assessment Reports until all completion criteria have been achieved. **EMP Implementation status** The first column of Table 2-2 below indicates the Stage 3 EMPs that are being implemented. The actions arising from requirements of these plans are either completed or in progress. The completion status of each plan is provided in the fifth column of Table 2-2. The management plans that having ongoing compliance requirements are: • Vegetation Protection and Rehabilitation Management Plan • Weed Control and Management Plan Actions arising from requirements of all other plans are completed. **Relevance of EMP commitments to Stage 4 of Revised Proposal** Table 6-2 of the ERD indicates MS 677 proponent commitments relevant to Stage 4 of the Revised Proposal. These are: • Prepare and implement a Surface Drainage Management Plan • Prepare and implement a Vegetation Protection and Rehabilitation Management Plan. • Prepare and implement a TEC Protection and Management Plan. • Prepare an Aboriginal Heritage Management Plan (in compliance with the *Aboriginal Heritage Act 1972*). The Aboriginal Heritage Management Plan will now need to comply with the *Aboriginal Cultural Heritage Act 2021* once he act comes into force. The existing stages 3a and 3b EMPs have some commitments specific to Stage3 rather than to Stage 4 management. However, most of the Stage 3 EMP commitments, objectives or outcomes contain relevant management principles that have been considered, and are consistent, with management measures proposed for Stage 4 of the Revised Proposal. The Stage 3 EMPs having relevant commitments and objectives are: • Construction Environmental Management Plan • Surface Drainage Management Plan • Vegetation Protection and Rehabilitation Management Plans • Weed control and management plan • Aboriginal Heritage Management Plans These plans and relevant commitments / outcomes are listed in Table 2-2 below (see particularly column 6 and 7). The Stage 3 National Park Management Plan is not considered relevant to Stage 4, given Stage 4 does not affect the Millstream Chichester National Park. The management intent of a TEC Protection and Management Plan (Proponent Commitments 6 and 7 of MS 677) is considered relevant for Stage 4. This plan was not required nor developed for Stages 2 and 3.

The outcome-based condition proposed in Table 6-3 of the ERD addresses this requirement:

Element	Location	Limitation or Maximum Extent
Themeda Grasslands TEC	Within Development Envelope	Permanent clearing of 15 ha

2-2 The proponent shall undertake measures while implementing Stage 4 of the Revised Proposal to avoid where possible, otherwise minimise, direct and indirect impacts to:
(a) Threatened Ecological Communities

Application of section 40AA(6) of the EP Act

A new Ministerial statement could apply only to the significant amendment, rather than applying to the existing implementation conditions as amended by the significant amendment.

MS 677 uses management measures to minimise impacts rather than environmental outcomes. A new set of specific Stage 4 outcome-based implementation conditions (see Table 6-3 of the ERD) is recommended for Stage 4 of the Revised Proposal.

As indicated in Table 2-2, outstanding Stage 3 EMP actions requiring compliance assessment are limited to ongoing monitoring and remediation (as necessary) of rehabilitation and weed control areas. The compliance of outstanding MS 677 conditions and commitments can be assured through regular auditing, assessment, and submission of ongoing annual Compliance Assessment Reports.

Offsets

1. Please prepare and provide an Impact Reconciliation Procedure (IRP) for the proposal following the Instructions for preparing Impact Reconciliation Procedure and Impact Reconciliation Reports.	Main Roads has prepared an Impact Reconciliation Procedure (IRP) for Stage 4 of the Revised Proposal (Appendix O).

Table 2-2. Environmental Management Commitments

Stage 3 EMP	Document Title (s)	Commitments / Objectives / KPIS	Compliance	Plan requirements completed	Used to derive Stage 4 Management	Management target / indicator in ERD
Construction Management Plan	D21#530943 PL05-CEMP-MRWA-KTP Rev 1.2 Construction Environmental Management Plan (Appendix G).	Clearing amounts ▪ dates of clearing ▪ shapefile of the clearing area	**Complete** Stage 3 construction management complete Stage 3 Construction Management Plan requirements integrated into project design and Construction Environmental Management Plan, included as Appendix D of 2021 CAR Report. (Stage 3 construction was completed on the 30/08/2020) (Appendix M)	Yes	Yes ERD Table 5-7	Impacts to native flora and vegetation are avoided or minimised as far as practicable during implementation of Stage 4 of the Revised Proposal.
		Material usage			Yes- ERD Section 4.1	Stage 4 of the Revised Proposal will be subject to an Infrastructure Sustainability Council of Australia (ISCA) sustainability rating, which will assess the environmental, social and economic impacts of Stage 4 of the Revised Proposal, including its waste streams and the resources used for construction.
		Operational controls			Yes -ERD Section 11	Main Roads' EMS is independently certified and covers the processes and activities that have the potential to impact the environment, including mitigation and management measures proposed as part of the action. The EMS ensures compliance with Main Roads' environment and heritage compliance obligations, providing the framework for driving environmental requirements through leadership, planning, support, operation, performance evaluation and improvement actions..
		Information to track performance			Yes -ERD Section 11	See above entry
		Offset compliance			Yes -ERD Section 7.5	It is envisaged that the conditions of any approval of the Revised Proposal under the EP Act will specify the requirement for

Stage 3 EMP	Document Title (s)	Commitments / Objectives / KPIS	Compliance	Plan requirements completed	Used to derive Stage 4 Management	Management target / indicator in ERD
						Main Roads to contribute to the fund. A Main Roads Impact Reconciliation Procedure will be developed for approval by the DWER CEO.
		Environmental incidents			Yes -ERD Tables 5-7, 5-21, 5-31, 5-34, 5-37	Corrective Action Column
		Audit results (measuring suitability of the CEMP, measuring compliance against CEMP)			No – Not applicable	This requirement is specific to the CEMP
		Customer complaints relating to the environment and other environmental approval requests			No – Not applicable	This requirement is specific to the CEMP
Surface Drainage Management Plan	D18#626232 Karratha Tom Price Road EPA Approved 6136933-REP_Water Management Plan_Rev025062018 (Appendix H)	No environmental harm to waterways or underground water due to erosion, vegetation loss or contamination	**Complete** Stage 3 construction management complete Stage 3 Surface Drainage Management Plan requirements integrated into project design and Construction Environmental Management Plan, included as Appendix D of 2021 CAR Report. (Stage 3 construction was completed on the 30/08/2020) (Appendix M)	Yes	Yes -ERD Table 5-31 Yes -see Inland Waters response to submissions	Under ERD Table 5-31 Management response or actions column see multiple applicable management or response actions
		Design of the alignment to minimise the 'footprint' and disturbance to watercourses where possible.			Yes -ERD Table 5-31 Yes- see Inland Waters response to submissions	Under ERD Table 5-31 Management response or actions column see multiple applicable management or response actions
		Design of adequate protection to minimise risk of future environmental degradation and maximise longevity of existing waterways.			Yes -ERD Table 5-31 Yes -see Inland Waters response to submissions	Under ERD Table 5-31 Management response or actions column see multiple applicable management or response actions

Stage 3 EMP	Document Title (s)	Commitments / Objectives / KPIS	Compliance	Plan requirements completed	Used to derive Stage 4 Management	Management target / indicator in ERD
		Design to incorporate scour protection (where necessary).			Yes -ERD Table 5-31 Yes -see Inland Waters response to submissions	Under ERD Table 5-31 Management response or actions column see multiple applicable management or response actions
		Minimise the impacts of construction on the natural functions, water quality and environmental values of existing waterways.			Yes -ERD Table 5-31 Yes -see Inland Waters response to submissions	Under ERD Table 5-31 Management response or actions column see multiple applicable management or response actions
		Minimise the risk of erosion and sedimentation during the construction phase.			Yes -ERD Table 5-31 Yes -see Inland Waters response to submissions	Under ERD Table 5-31 Management response or actions column see multiple applicable management or response actions
		All staff have been inducted to site and are aware of their obligations under the SDMP.			Main Roads requires all project staff and contractors to be inducted and to understand Inland Waters obligations and management measures	
		Erosion and sediment controls installed during construction to manage erosion risk.			Yes -ERD Table 5-31 Yes -see Inland Waters response to submissions	Under ERD Table 5-31 Management response or actions column see multiple applicable management or response actions
		No erosion rills greater than 50 cm in depth at completion of the construction maintenance phase.			Yes -ERD Table 5-31 Yes -see Inland Waters response to submissions	Under ERD Table 5-31 Management response or actions column see multiple applicable management or response actions

Stage 3 EMP	Document Title (s)	Commitments / Objectives / KPIS	Compliance	Plan requirements completed	Used to derive Stage 4 Management	Management target / indicator in ERD
		No degradation of PDWSA.			Yes -ERD Table 5-31 Yes -see Inland Waters response to submissions	Under ERD Table 5-31 Management response or actions column see multiple applicable management or response actions
		No significant spills of fuel or chemicals with the PDWSA			Yes -ERD Table 5-31 Yes -see Inland Waters response to submissions	Under ERD Table 5-31 Management response or actions column see multiple applicable management or response actions
		No site facilities to be located within 500 m of surface waterbodies			No storage of fuel or chemicals, site offices or laydowns are to be located within 100 m of a surface water body	
		Minimise the risks of chemical spillage and other polluting activities during the road construction phase			Yes -ERD Table 5-31 Yes -see Inland Waters response to submissions	Under ERD Table 5-31 Management response or actions column see multiple applicable management or response actions
		No significant environmental harm from hydrocarbon / fuel incidents			Yes -ERD Table 5-31 Yes -see Inland Waters response to submissions	Under ERD Table 5-31 Management response or actions column see multiple applicable management or response actions
		All spills greater than 25L reported to Main Roads and spill response actions undertaken and documented.			Yes -ERD Table 5-31	Under ERD Table 5-31 Management response or actions column see multiple applicable management or response actions
		Design of adequate protection to minimise risk			Yes -ERD Table 5-31	Under ERD Table 5-31 Management response or actions column see multiple

Stage 3 EMP	Document Title (s)	Commitments / Objectives / KPIS	Compliance	Plan requirements completed	Used to derive Stage 4 Management	Management target / indicator in ERD
		of future environmental degradation and maximise longevity of existing waterways.			Yes- see Inland Waters response to submissions	applicable management or response actions
Vegetation Protection and Rehabilitation Management Plan.	D18#626301 Karratha Tom Price Road EPA Approved Vegetation Protection and Rehabilitation Management Plan KTP Rev 1 (Appendix I)	Undertake design to minimise vegetation clearing and damage	**Compliant** Stage 3 rehabilitation has been completed, however monitoring of rehabilitation and weeds is not complete. Depending on monitoring results potential remedial actions may be required to achieve completion criteria. This information was provided in 2021 CAR (Appendix M) and will be updated in 2022 CAR.	No – ongoing rehabilitation monitoring and weed control required until completion criteria are achieved.	Yes - ERD Table 5-7	See Table 5-7 elements related to the management target or indicator – "Impacts to native flora and vegetation are avoided or minimised as far as practicable during implementation of Stage 4 of the Revised Proposal."
		Undertake road construction planning and works to minimise vegetation clearing and damage			Yes - ERD Table 5-7	See Table 5-7 elements related to the management target or indicator – "Impacts to native flora and vegetation are avoided or minimised as far as practicable during implementation of Stage 4 of the Revised Proposal."
		Locations of key weed species within the construction zones are known prior to construction commencement.			Yes - ERD Table 5-7	See Table 5-7 elements related to the management target or indicator – "No introduction or spread of declared weeds, WONS or serious environmental weed species into surrounding native vegetation adjacent to the Development Envelope during and attributable to construction."
		No new weed species are introduced into the project area and adjoining areas. Existing key weed species infestations are not extended within the works areas.			Yes - ERD Table 5-7	See Table 5-7 elements related to the management target or indicator – "No introduction or spread of declared weeds, WONS or serious environmental weed species into surrounding native vegetation adjacent to the Development Envelope during and attributable to construction."
		Pre-existing weed infestations are reduced wherever possible through active management.			Yes - ERD Table 5-7	See Table 5-7 elements related to the management target or indicator – "No introduction or spread of declared weeds, WONS or serious environmental weed

Stage 3 EMP	Document Title (s)	Commitments / Objectives / KPIS	Compliance	Plan requirements completed	Used to derive Stage 4 Management	Management target / indicator in ERD
						species into surrounding native vegetation adjacent to the Development Envelope during and attributable to construction."
		Staff carrying out pre-construction works will be provided with a suitable induction regarding weeds of concern in order to avoid disturbing areas of infestation			Main Roads requires all project staff and contractors to be inducted and to understand all Flora and Vegetation obligations and management measures	
		All machinery and plant equipment moving from weed infested areas to areas free of weeds must always be cleaned down in order to minimise the spread or introduction of weeds			Yes - ERD Table 5-7	See Table 5-7 elements related to the management target or indicator – "No introduction or spread of declared weeds, WONS or serious environmental weed species into surrounding native vegetation adjacent to the Development Envelope during and attributable to construction."
		No fires are caused by construction activities.			Main Roads requires effective fire management by all project staff and contractors through the development and implementation of a Construction Environmental Management Plan	
		Borrow pits are designed and managed so as to minimise vegetation clearing and impacts on biodiversity.			Yes - ERD Table 5-7	See Table 5-7 elements related to the management target or indicator – "…the selection of areas where temporary clearing will be required for construction activities such as camps, laydown areas, stockpile areas and vehicle turnarounds has been based on the vegetation type (within the constraints of factors such as heritage). Existing cleared areas and areas of lower environmental value will be prioritised and TECs, PECs and vegetation associated with drainage lines avoided".

Stage 3 EMP	Document Title (s)	Commitments / Objectives / KPIS	Compliance	Plan requirements completed	Used to derive Stage 4 Management	Management target / indicator in ERD
		All areas not required for the ongoing operation of the road will be revegetated			Yes - ERD Table 5-7	See Table 5-7 elements related to the management target or indicator – "Rehabilitation of all temporary clearing not required for permanent infrastructure.."
Weed Control and Management Plan	D20#630068 05 20200707 KTP CAR Report Appendix E Stage 3 and 4a Weed Control and Management Plan (Appendix J)	Prevent the introduction of new weed species into the project area and adjoining areas.	**Compliant** Stage 3 rehabilitation has been completed, however monitoring of rehabilitation and weeds is not complete. Depending on monitoring results potential remedial actions may be required to achieve completion criteria. This information was provided in 2021 CAR (Appendix M) and will be updated in 2022 CAR.	No – ongoing monitoring and weed control required until completion criteria are achieved.	Yes - ERD Table 5-7	See Table 5-7 elements related to the management target or indicator – "No introduction or spread of declared weeds, WONS or serious environmental weed species into surrounding native vegetation adjacent to the Development Envelope during and attributable to construction."
		Ensure that existing weed infestations are not extended within the work area.			Yes - ERD Table 5-7	See Table 5-7 elements related to the management target or indicator – "No introduction or spread of declared weeds, WONS or serious environmental weed species into surrounding native vegetation adjacent to the Development Envelope during and attributable to construction."
		Reduce weed infestations wherever possible through active management			Yes - ERD Table 5-7	See Table 5-7 elements related to the management target or indicator – "No introduction or spread of declared weeds, WONS or serious environmental weed species into surrounding native vegetation adjacent to the Development Envelope during and attributable to construction."
		Minimise the risk of weed infestations developing in rehabilitated areas.			Yes - ERD Table 5-7	See Table 5-7 elements related to the management target or indicator – "No introduction or spread of declared weeds, WONS or serious environmental weed species into surrounding native vegetation adjacent to the Development Envelope during and attributable to construction."

Stage 3 EMP	Document Title (s)	Commitments / Objectives / KPIS	Compliance	Plan requirements completed	Used to derive Stage 4 Management	Management target / indicator in ERD
Aboriginal Heritage Management Plan	Cultural Heritage Management Plan for the Proposed Stages 3 and 4A Upgrade of the Karratha – Tom Price Road in the Pilbara Region of Western Australia, Brad Goode & Associates, June 2018 (D18#626240) (Appendix K)	Project personnel and contractors undergo cultural heritage management obligations training	**Complete** Stage 3 Aboriginal heritage management complete. Plan accepted (see Appendix B of the 2019 CAR (Appendix N)) Stage 3 Aboriginal Heritage Management Plan requirements integrated into project design and Construction Environmental Management Plan,. (Stage 3 construction was completed on the 30/08/2020)		Yes - ERD Table 5-34	Prevent unauthorised or undesired impacts to Aboriginal heritage sites or values during construction.
		Engage Aboriginal heritage monitors			Yes – ERD Section 5.4.5 Mitigation	
		Aboriginal Heritage Sites and Places to be delineated and/or barriers installed			Yes - ERD Table 5-34	
		Aboriginal Heritage Surveys are undertaken by heritage professionals and Traditional Owners			Yes – ERD Section 5.4.3.2	Prevent unauthorised impacts to Aboriginal heritage sites during design / pre-construction.
		Statutory approvals obtained for all ground disturbance			Yes - ERD Table 5-34	Prevent unauthorised impacts to Aboriginal heritage sites through implementation of Division 6 of the Aboriginal Cultural Heritage Act 2021.
TEC Protection and Management Plan.	N/A	N/A	Not prepared as not relevant to Stages 2 & 3		Yes - ERD Table 6-2	MS 677 Commitment 6, "Prepare a TEC Protection and Management Plan", is specific to Stage 4 of MRDH. As indicated in Table 6-2 of the ERD, the intent of this condition is to minimise disturbance to Themeda grassland TEC by establishing a maximum extent of disturbance to the Themeda grassland TEC. Proposed Stage 4 outcome-based implementation conditions responding to this intention are prescribed in Table 6-3 of the ERD:
National Park Plan	D18#1115728 6137267_REP_National		**Compliant**		No – not relevant to Stage 4	Not relevant to Stage 4

Stage 3 EMP	Document Title (s)	Commitments / Objectives / KPIS	Compliance	Plan requirements completed	Used to derive Stage 4 Management	Management target / indicator in ERD
	Park Management Plan KTP_Rev3 final approved 20 Dec 2018		Plan accepted (see 2019 CAR Appendix B) Discussions regarding rest-bays ongoing (see Appendix B of the 2019 CAR (Appendix N))			

Appendix A. Validation of Vegetation Mapping (Biota 2022)

Biota Environmental Sciences

Biota (n): The living creatures of an area; the flora and fauna together

2 November 2022

John Morrell
Principal Environmental Planner
Environment Branch (OMTID)
Planning and Technical Services Directorate
Main Roads Western Australia
Via email

Dear John

Response to Agency and Client Comments: Draft ERD – Manuwarra Red Dog Highway

As discussed, please see below a response to comments and advice made by the EPA Services on the ERD, and specific queries made by Main Roads WA via email, with respect to the key matter of flora and vegetation, specifically Point 2 on floristic analyses.

2: Vegetation classification and analysis

Comments: Biota 2021 described the vegetation using structural vegetation classification, rather than classifying the vegetation based on floristic composition. EPA Guidance (Flora and Vegetation Surveys for Environmental Impact Assessment 2016) states that while structural classification is appropriate for reconnaissance surveys, floristic composition is the preferred vegetation classification system for a detailed survey.

Biota 2021 (p. 42) states that two floristic analyses were run, one using percent cover data and the other using presence/absence data. The results of a floristic analysis based on cover data are presented in Appendix 6 and discussed on p. 80 of Biota 2021. EPA (2016a) recommends that the primary multivariate analyses should be performed on a species-by-site matrix (i.e. presence/absence). Analyses of alternative variables, such as cover, can be considered as supplementary classification information.

There was little alignment between the cover-based floristic vegetation units (Biota 2021, p. 80) and the structural vegetation units used throughout Biota 2021 and the ERD. No details have been provided to explain the discrepancies and there is no evidence that the floristic analysis was used to inform the vegetation classification.

Action/s

- *The floristic analyses should be re-run, incorporating any additional/rescored quadrats from the upcoming 2022 survey season. The results of a presence/absence analysis should be presented and discrepancies in the classification of quadrats between mapped vegetation and the revised floristic classification should be specifically addressed. Professional judgement is expected in data interpretation, but the reasons for decisions to include quadrats in vegetation units other than those defined in the floristic analysis should be clearly communicated.*

1.0 Methodology for Floristic Analysis

To assist with defining the vegetation types from the survey area, hierarchical clustering analyses were conducted in PRIMER v6 (Clarke and Gorley 2006) to investigate the similarity of sampling sites based on their floristic composition.

A combined species list was generated from all sites in the data set from the survey, including the 2022 resample data from sites Q119, Q122, Q123, Q124, Q125, Q126, Q127, Q128 and REL21. Taxon names and records were then rationalised as follows:

- Species that were present at only a single site were removed to reduce 'noise' in the data set.
- Taxa that could potentially refer to more than one entity (e.g. "*Sida* sp.") were removed.
- Some taxa were merged, where considered appropriate (e.g. records of sterile material of *Evolvulus alsinoides* were merged with both identified varieties).
- All weeds were removed with the exception of **Cenchrus ciliaris* and **C. setiger;* these were merged into a single taxon, "**Cenchrus* spp.".

Two analyses were run, using:

1. Percent cover data (square-root transformed); and
2. Presence-absence data.

In each case, the Bray-Curtis measure of similarity was used to produce a similarity matrix and the group average method cluster analysis was used to determine floristic groups. Statistically different groups were identified through similarity profile analysis (SIMPROF). The similarity percentage test (SIMPER) was used to determine which species contributed most to the similarities between groups.

Results were investigated through outputs including dendrograms (tree diagrams) of site similarity, and Non-metric Multi-Dimensional Scaling plots (NMDS plots) (see Appendix 1).

2.0 Results of the Floristic Analysis

Some minor changes to the rationalised species list were observed, once the 2022 subset of resample data was included within the site vs species matrix, and the methodology described in Section 1. 0 above was applied (Appendix 1). This resulted in some minor floristic grouping changes when compared with the 2021 analysis. These changes have no impact on the assignment of vegetation types or the corresponding mapping.

Of the two analyses run, percent cover data (square-root transformed) was found to be more informative and more closely correlated with defined vegetation units than the analysis based on presence-absence data only.

A comparison of floristic groupings between the 2021 and 2022 datasets and associated SIMPER output, using the SIMPROF test for percent cover data, is presented in Table 3, Appendix 1. There was largely very good correlation between the vegetation types defined for the current survey and the 58 floristic groups identified through the SIMPROF test, although the relationship was not always exact, which is not unusual or unexpected. In particular, there was strong support for the vegetation types C2, D2, H2 and M4, with all sites from these units occurring in distinct floristic groups (Table 3; see also Figure 1 and Figure 3 in Appendix 1). With regards to the other units, which were split across more than one floristic group, the species driving these differences were typically relatively minor (see Table 3 in Appendix 1).

A summary of the number of floristic groups comparing 2021 and 2022 datasets, and the analyses conducted, are presented in Table 1 below. Specific results of floristics analysis

using a 25% similarity level for both percentage cover and presence absence are discussed in Section 2.1 and 2.2.

Table 1: Summary of floristic analyses run in 2021 and 2022.

Analysis	2021 Dataset	2022 Dataset
No. Floristic groups (% cover)	58	58
No. Floristic groups @25% similarity (% cover)	13	13
No. Floristic groups (pres/abs)	71	69
No. Floristic groups @25% similarity (pres/abs)	9	9

2.1 Percentage Cover Analysis

At a 25% level of similarity for percent cover data, the sites were divided into 13 floristic groups (Table 2 below; see also Figure 5 in Appendix 1) where:

- Approximately half (15) of the 29 vegetation types formed cohesive floristic groups.
- Vegetation of the plains habitat were distributed amongst 7 floristic groups, which is not surprising given the variety of dominant species across plains habitat and the length and linear nature of the corridor.
- Relatively good correlation between the mulga sites was observed, with the four vegetation types distributed amongst three floristic groups.
- Vegetation types of cracking clays clustered in distinct groups, particularly C2, C3 and C4.
- Drainage vegetation types D1 and D2 directly correlated with FG_h and FG_e, respectively.
- FG_a contained a single site from the D1 vegetation type; comprising the woodland of a major drainage line; this site was characterised by riparian species such as *Eucalyptus victrix* and *Melaleuca glomerata* over a variable understorey of shrubs, grasses and sedges.
- FG_b contained three sites from C1, and all sites from vegetation types C5 and D3, which were dominated by *Eriachne benthamii.*
- FG_c contained all sites from C4, P3 and P6 vegetation types. These vegetation types represent vegetation of clay plains within or in the vicinity of the "Brockman Iron cracking clay communities of the Hamersley Range" PEC and "Themeda grasslands on cracking clays (Hamersley Station, Pilbara)" TEC. *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) contributed the most to similarity (35%), in addition to other tussock and bunch grasses. *Hakea lorea* subsp. *lorea* was dominant in the upperstorey.
- FG_d represented all sites from two vegetation types of clay plains (C3 and P8), within or in the vicinity of the "Brockman Iron cracking clay communities of the Hamersley Range" PEC and "Themeda grasslands on cracking clays (Hamersley Station, Pilbara)" TEC, as well as one site from C1. *Urochloa occidentalis* contributed the most to similarity (19%) as well as other tussock and bunch grasses.
- FG_e contained all sites from the D2 vegetation type, which represents vegetation of Weelumurra Creek and its tributaries, where *Melaleuca argentea* and *Eucalyptus camaldulensis* subsp. *refulgens* are dominant.
- FG_f contained all three sites from vegetation type C2, where *Acacia xiphophylla* was dominant.
- FG_g was represented by four vegetation types of broad open floodplains and plains (F2, F3, P1 and P2), where *Triodia epactia* and *Acacia atkinsiana* contributed the most towards similarity.
- FG_h represented a mixture of sites from five different landforms and 11 different vegetation types. There was a strong correlation between vegetation types from the floodplains habitat, D1 vegetation type and FG_h. This floristic group also contained one site from H3, P4

and P7, four sites from M3 and five sites from P2. *Triodia epactia, Corymbia hamersleyana* and **Cenchrus* spp. contributed the most towards similarity.

- *FG$_i$* contained a single site from vegetation type M2; comprising an open woodland of *Acacia pruinocarpa* with *A. aptaneura* and *Corymbia deserticola* subsp. *deserticola* over an understorey of *Triodia melvillei.*
- *FG$_j$* contained two M2 sites, where *Aristida contorta* and *Acacia macraneura* contributed most towards similarity.
- *FG$_k$* contained Mulga sites only; the majority of M1 sites (seven), two M2 sites, one M3 site and both M4 sites, where *Acacia aptaneura* was the dominant Mulga species and *Triodia epactia* the most common hummock grass species.
- *FG$_l$* contained four sites from vegetation type P5, where *Triodia angusta* was dominant.
- *FG$_m$* represented nine vegetation types in total, and contained 95% of sites from the stony hillslopes, hillcrests and foothills landform (H1, H2, H3 and H4), as well as the majority of sites from P1. *FG$_m$* also include one site from F1, P2, and P5, two sites from P7. *Triodia wiseana* and *Eucalyptus leucophloia* subsp. *leucophloia* were the two most dominant species in this floristic group.

Table 2: Floristic groups at the 25% level of similarity for percent cover data.

Floristic Group	Top 5 Species Contributing to Similarity (cumulative %)	Vegetation Types
a	NA (<2 samples)	D1 (1 site)
b	*Eriachne benthamii, Cullen cinereum, Eragrostis tenellula, Cynodon convergens, Cullen graveolens* (29%)	C1, C5 (1 site) and D3
c	*Themeda* sp. Hamersley Station (M.E. Trudgen 11431), *Hakea lorea* subsp. *lorea, Chrysopogon fallax, Urochloa occidentalis, Dicanthium sericeum* (49%)	C4, P3, P6
d	*Urochloa occidentalis, Dactyloctenium radulans, Dicanthium sericeum, Chrysopogon fallax, Ptilotus exaltatus* (36%)	C1 (1 site), C3 and P8
e	*Melaleuca argentea, Eucalyptus camaldulensis* subsp. *refulgens, Cyperus vaginatus, Gossypium robinsonii, Acacia bivenosa* (66%)	D2
f	*Acacia xiphophylla, Triodia epactia, Eragrostis xerophila, Arivela viscosa, Boerhavia burbidgeana* (52%)	C2
g	*Triodia epactia, Acacia atkinsiana, Triodia wiseana, Acacia ancistrocarpa, Senna notabilis* (71%)	F2 (1 site), F3 (1 site), P1 and P2
h	*Triodia epactia, Corymbia hamersleyana, *Cenchrus* spp., *Ptilotus exaltatus, Arivela viscosa* (38%)	D1, F1, F2, F3, F4, F5, H3 (1 site), M3, P2, P4 (1 site) and P7 (1 site).
i	NA (<2 samples)	M2 (1 site)
j	*Aristida contorta, Acacia macraneura, Acacia tetragonophylla, Grevillea berryana, Areocleome oxalidea* (48%)	M2
k	*Acacia aptaneura, Triodia epactia, Eriachne benthamii, Spermacoce brachystema, Evolvulus alsinoides* (24%)	M1, M2, M3 (1 site) and M4
l	*Triodia angusta, Eucalyptus xerothermica, Eulalia aurea, Acacia bivenosa, Eragrostis desertorum* (85%)	P5
m	*Triodia wiseana, Eucalyptus leucophloia* subsp. *leucophloia, Eriachne pulchella, Senna glutinosa* subsp. *glutinosa, Corymbia hamersleyana* (80%)	F1 (1 site), H1, H2, H3, H4 (1 site), P1, P2 (1 site), P5 (1 site) and P7

2.2 Presence Absence Analysis

At a 25% level of similarity for presence absence data, the sites were divided into 9 floristic groups (Table 3 below, Figure 5, Appendix 1)). The following observations were made:

- Relatively good correlation was observed between some habitat types and the nine broad floristic groups, particularly sites of the floodplains, drainages and hillslope habitats.
- Less cohesion was observed between vegetation types and floristic groupings at 25% similarity, in comparison with percent cover data.
- *FG$_a$* contained a single site from the D1 vegetation type, comprising the woodland of a major drainage line; this site was characterised by riparian species such as *Eucalyptus victrix* and *Melaleuca glomerata* over a variable understorey of shrubs, grasses and sedges.
- *FG$_b$* contained four of the five P5 sites, where *Cassytha capillaris* and *Codonocarpus cotinifolius* were most commonly present.
- *FG$_c$* contained a mixture of sites from the F3, H1 and P2 vegetation types, where *Acacia ancistrocarpa, Senna notabilis* and *Triodia epactia* were common.
- *FG$_d$* represented two sites from the P1 vegetation type, where *Acacia atkinsiana* and *Acacia pruinocarpa* were present in both.
- *FG$_e$* aligned specifically with Q39 from the H3 vegetation type; comprising scattered low trees of *Eucalyptus leucophloia* subsp. *leucophloia* over *Acacia trudgeniana* scattered tall shrubs over *Triodia wiseana* hummock grassland.
- *FG$_f$* contained the majority of sites on hillslopes (20 of 23), as well as 80% of the P1 vegetation type, and a single site from F1, where *Triodia wiseana* and *Senna glutinosa* subsp. *glutinosa* were most commonly encountered.
- *FG$_g$* aligned with all sites from the cracking clays habitat (C1, C2, C3, C4 and C5). It also included both D2 sites, and all sites from, P3, P6 and P8. Some of these vegetation types represent vegetation of clay plains within or in the vicinity of the "Brockman Iron cracking clay communities of the Hamersley Range" PEC and /or the "Themeda grasslands on cracking clays (Hamersley Station, Pilbara)" TEC.
- *FG$_h$* is the largest floristic group, containing 67 sites, and a mixture of 11 different vegetation types, where common species *Triodia epactia, Ptilotus exaltatus* and *Arivela viscosa* were frequently recorded. The majority of sites found in floodplain and drainage habitats aligned with this floristic grouping.
- *FG$_i$* represents all Mulga sites and one site from the H3 vegetation type, where *Evolvulus alsinoides, Ptilotus helipteroides* and *Enneapogon polyphyllus* were most commonly observed.

Table 3: Floristic groups at the 25% level of similarity for percent cover data.

Floristic Group	Top 5 Species Contributing to Similarity (cumulative %)	Vegetation Types
a	NA (<2 samples)	D1 (1 site)
b	*Cassytha capillaris, Codonocarpus cotinifolius, Eragrostis desertorum, Eucalyptus xerothermica, Eulalia aurea* (58%)	P5
c	*Acacia ancistrocarpa, Senna notabilis, Triodia epactia, Ptilotus calostachyus, Acacia atkinsiana* (56%)	F3 (1 site), H1 (1 site), P2
d	*Acacia atkinsiana, Acacia pruinocarpa, Aristida holathera* var. *holathera, Eriachne pulchella, Sida* sp. Pilbara (A.A. Mitchell PRP 1543) (83%)	P1
e	NA (<2 samples)	H3 (1 site)

Floristic Group	Top 5 Species Contributing to Similarity (cumulative %)	Vegetation Types
f	*Triodia wiseana, Senna glutinosa* subsp. *glutinosa, Eriachne pulchella, Eucalyptus leucophloia* subsp. *leucophloia, Ptilotus calostachyus* (46%)	F1 (1 site), H1, H2, H3, H4, P8
g	*Sporobolus australasicus, Rhynchosia minima, Dichanthium sericeum, Cynodon convergens, Cucumis picrocarpus* (18%)	C1, C2, C3, C4, C5, D3, P3, P6, P7, P8
h	*Triodia epactia, Ptilotus exaltatus, Arivela viscosa, *Cenchrus* spp., *Evolvulus alsinoides* (19%)	D1, D2, F1, F2, F3, F4, F5, M3, P2, P4 (1 site), P5 (1 site)
i	*Evolvulus alsinoides, Ptilotus helipteroides, Enneapogon polyphyllus, Ptilotus gaudichaudii, Spermacoce brachystema* (16%)	H3 (1 site), M1, M2, M3, M4

3.0 Validation of Vegetation Type Mapping

The vegetation types for this study were described at the association level (level V as per the National Vegetation Information System; NVIS)[1]. This level of detail would be considered fine-scale (intra-locality) delineation of vegetation types as per EPA (2016a). In general, minor variations in the vegetation were not clearly defined on aerial photography or were not practical to accurately map in the field. These minor variations were incorporated into the surrounding 'parent' vegetation type, thus resulting in differences in alignment between vegetation types and floristic groups identified through PRIMER v6 analysis.

Vegetation types and boundaries were verified using both the data collected in the field and digital imagery supplied by Main Roads, in conjunction with floristic analysis, where support was found. Each vegetation type mapped for this assessment was given a unique alphanumeric code, comprising a character representing the broad landform group (i.e. 'P' for plain, 'H' for hills, and 'D' for drainage), followed by a number sequence.

No updates are required for the vegetation mapping, as the minor changes observed through the re-run of the floristic analysis of the entire dataset (156 sites), including resample data collected in 2022, had no impact on the assignment of vegetation types or the corresponding mapping.

We trust the above is sufficient for your current requirements.

Yours sincerely,

Biota Environmental Sciences Pty Ltd

Rebecca Mason
Senior Botanist

[1] http://www.environment.gov.au/land/publications/nvis-taxonomic-review/introduction#del

Table 1: List of taxa that were omitted or treated as other taxa for the purposes of the floristic analysis.

Taxon	Name Referred to for Analysis
**Cenchrus ciliaris*	*Cenchrus* spp.
**Cenchrus setiger*	*Cenchrus* spp.
Dichanthium sericeum subsp. *humilius*	*Dichanthium sericeum*
Dichanthium sericeum subsp. *polystachyum*	*Dichanthium sericeum*
Dichanthium sericeum subsp. *sericeum*	*Dichanthium sericeum*
Dysphania rhadinostachya subsp. *inflata*	*Dysphania rhadinostachya*
Eremophila ? fraseri subsp. *fraseri*	*Eremophila fraseri* subsp. *fraseri*
Evolvulus alsinoides var. *decumbens*	*Evolvulus alsinoides*
Evolvulus alsinoides var. *villosicalyx*	*Evolvulus alsinoides*
Gossypium australe (Burrup Peninsula form)	*Gossypium australe*
Grevillea wickhamii subsp. *aprica*	*Grevillea wickhamii*
Grevillea wickhamii subsp. *hispidula*	*Grevillea wickhamii*
Portulaca ? decipiens	*Portulaca decipiens*
Senna artemisioides subsp. *oligophylla* x *? S. glutinosa* subsp. *glutinosa*	*Senna artemisioides* subsp. *oligophylla*
Senna glutinosa subsp. *glutinosa* x	*Senna glutinosa* subsp. *glutinosa*
Senna glutinosa subsp. *glutinosa* x *S. stricta*	*Senna glutinosa* subsp. *glutinosa*
Urochloa occidentalis var. *ciliata*	*Urochloa occidentalis*
Urochloa occidentalis var. *occidentalis*	*Urochloa occidentalis*
Calandrinia sp.	omitted; indeterminate taxon
Corchorus sp.	omitted; indeterminate taxon
Dysphania sp.	omitted; indeterminate taxon
Euphorbia sp. (*boophthona/tannensis*)	omitted; indeterminate taxon
Haloragis sp.	omitted; indeterminate taxon
Panicum sp.	omitted; indeterminate taxon
Ptilotus sp.	omitted; indeterminate taxon
Sida sp.	omitted; indeterminate taxon
Calotis hispidula	omitted; singleton
Haloragis maierae	omitted; singleton
Nicotiana obliqua	omitted; singleton
Sida sp. Supplejack Station (T.S. Henshall 2345)	omitted; singleton
Sida trichopoda	omitted; singleton
Vittadinia eremaea	omitted; singleton
Plantago cunninghamii	omitted; singleton
Chara sp.	omitted; singleton
Cheilanthes brownii	omitted; singleton
Cyperus pulchellus	omitted; singleton
? Bothriochloa ewartiana	omitted; singleton
Aristida ? inaequiglumis	omitted; singleton
Paspalidium ? basicladum	omitted; singleton
Triodia basitricha	omitted; singleton
Aristida jerichoensis var. *subspinulifera*	omitted; singleton
Aristida sp.	omitted; singleton
Chloris pumilio	omitted; singleton
Cymbopogon sp.	omitted; singleton
Enneapogon avenaceus	omitted; singleton
Enneapogon robustissimus	omitted; singleton
Eragrostis elongata	omitted; singleton
Eragrostis exigua	omitted; singleton
Eragrostis setifolia	omitted; singleton
Eriachne mucronata (typical form)	omitted; singleton
Eriochloa pseudoacrotricha	omitted; singleton
Paspalidium basicladum	omitted; singleton
Setaria surgens	omitted; singleton
Triodia longiceps	omitted; singleton
Triraphis mollis	omitted; singleton
Urochloa piligera	omitted; singleton
Grevillea ? pyrimidalis subsp. *leucadendron*	omitted; singleton
Grevillea pyramidalis	omitted; singleton
Grevillea wickhamii subsp. *macrodonta*	omitted; singleton
Gonocarpus ephemerus	omitted; singleton
Acacia ? victoriae	omitted; singleton

Taxon	Name Referred to for Analysis
Acacia ancistrocarpa x *trachycarpa*	omitted; singleton
Acacia exigua	omitted; singleton
Senna glutinosa subsp. *glutinosa* x subsp. x *luerssenii*	omitted; singleton
Senna stricta x *S. glutinosa* subsp. *glutinosa*	omitted; singleton
Swainsona ? formosa	omitted; singleton
Tephrosia sp. Newman (A.A. Mitchell PRP 29) PN	omitted; singleton
Cullen martinii	omitted; singleton
Indigofera rugosa	omitted; singleton
Senna artemisioides subsp. x *artemisioides*	omitted; singleton
Senna ferraria	omitted; singleton
Senna sp. Meekatharra (E. Bailey 1-26)	omitted; singleton
Senna stricta	omitted; singleton
Senna venusta	omitted; singleton
Sesbania formosa	omitted; singleton
Swainsona sp.	omitted; singleton
Tephrosia rosea var. *clementii*	omitted; singleton
Acacia melleodora	omitted; singleton
Acacia pteraneura	omitted; singleton
Acacia pyrifolia	omitted; singleton
Acacia sp.	omitted; singleton
Stylobasium spathulatum	omitted; singleton
Ficus brachypoda	omitted; singleton
Euphorbia inappendiculata var. *inappendiculata*	omitted; singleton
Euphorbia sp. (*biconvexa/coghlanii/trigonosperma*; sterile)	omitted; singleton
Euphorbia careyi	omitted; singleton
Euphorbia sp.	omitted; singleton
Flueggea virosa subsp. *melanthesoides*	omitted; singleton
Corymbia ferriticola	omitted; singleton
Alectryon oleifolius subsp. *oleifolius*	omitted; singleton
Dodonaea lanceolata var. *lanceolata*	omitted; singleton
Seringia ? exastia	omitted; singleton
Seringia sp.	omitted; singleton
Sida ? laevis	omitted; singleton
Abutilon sp.	omitted; singleton
Corchorus aestuans	omitted; singleton
Hibiscus brachysiphonius	omitted; singleton
Sida clementii	omitted; singleton
Sida rohlenae subsp. *rohlenae*	omitted; singleton
Sida sp. dark green fruits (S. van Leeuwen 2260)	omitted; singleton
Sida sp. Hamersley Range (K. Newbey 10692) PN	omitted; singleton
Sida sp. Shovelanna Hill (S. van Leeuwen 3842)	omitted; singleton
Pimelea ammocharis	omitted; singleton
Pimelea holroydii	omitted; singleton
Amyema preissii	omitted; singleton
Diplatia grandibractea	omitted; singleton
Lysiana casuarinae	omitted; singleton
Rumex vesicarius	omitted; singleton
Ptilotus ? xerophilus	omitted; singleton
Achyranthes aspera	omitted; singleton
Gomphrena canescens	omitted; singleton
Gomphrena canescens subsp. *canescens*	omitted; singleton
Ptilotus incanus	omitted; singleton
Dissocarpus paradoxus	omitted; singleton
Enchylaena tomentosa	omitted; singleton
Maireana georgei	omitted; singleton
Boerhavia sp.	omitted; singleton
Glinus lotoides	omitted; singleton
Portulaca conspicua	omitted; singleton
Cynanchum viminale subsp. *australe*	omitted; singleton
Heliotropium sp.	omitted; singleton
Heliotropium tanythrix	omitted; singleton
Bonamia alatisemina	omitted; singleton
Cuscuta victoriana	omitted; singleton
Polymeria sp.	omitted; singleton

Taxon	Name Referred to for Analysis
Solanum cleistogamum	omitted; singleton
Solanum horridum	omitted; singleton
Solanum sp.	omitted; singleton
Eremophila ? clarkei	omitted; singleton
Eremophila cuneifolia	omitted; singleton
Eremophila forrestii	omitted; singleton
Eremophila forrestii x *latrobei*	omitted; singleton
Eremophila lanceolata	omitted; singleton
Eremophila latrobei	omitted; singleton
Eremophila latrobei subsp. *filiformis*	omitted; singleton
Eremophila maculata subsp. *brevifolia*	omitted; singleton
Josephinia sp. Woodstock (A.A. Mitchell PRP 989) PN	omitted; singleton
? Buchnera / Striga sp.	omitted; singleton
Dolichandrone occidentalis	omitted; singleton
Brunonia sp. Long hairs (D.E. Symon 2440) PN	omitted; singleton
Pterocaulon serrulatum var. *velutinum*	omitted; singleton
Chrysocephalum gilesii	omitted; singleton
Peripleura virgata	omitted; singleton
Pluchea dunlopii	omitted; singleton
Pluchea ferdinandi-muelleri	omitted; singleton
Pterocaulon serrulatum	omitted; singleton
Streptoglossa liatroides	omitted; singleton
Streptoglossa sp.	omitted; singleton
Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)	omitted; singleton
**Aerva javanica*	omitted; weed
**Bidens bipinnata*	omitted; weed
**Flaveria trinervia*	omitted; weed
**Sonchus oleraceus*	omitted; weed
**Vachellia farnesiana*	omitted; weed
**Malvastrum americanum*	omitted; weed
**Cynodon dactylon*	omitted; weed
**Echinochloa colona*	omitted; weed
**Setaria verticillata*	omitted; weed
**Portulaca pilosa*	omitted; weed
**Datura leichhardtii* subsp. *leichhardtii*	omitted; weed
**Tribulus terrestris*	omitted; weed

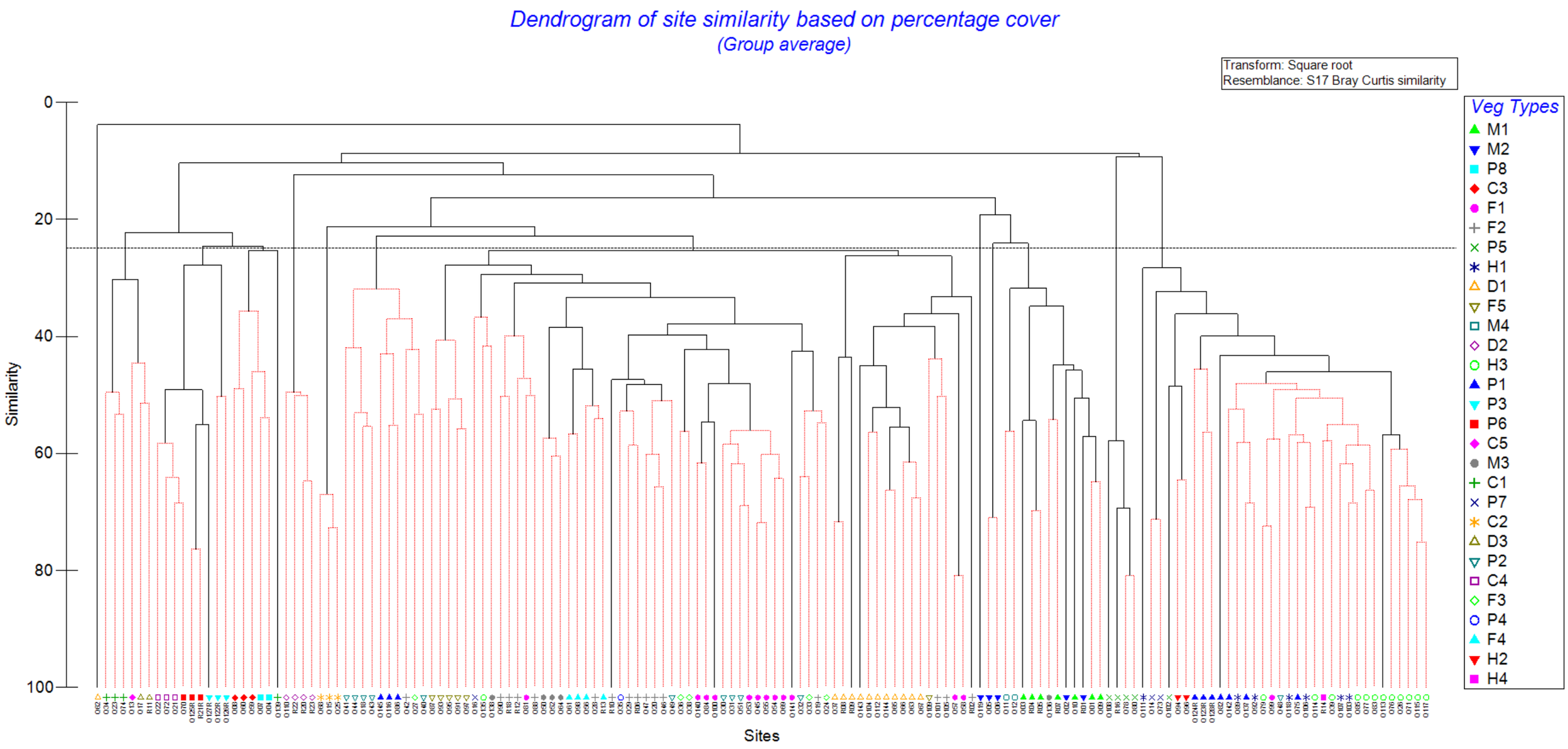

Figure 1: **Dendrogram based on percent cover of rationalised species at each site sampled during the survey (2022 dataset).**

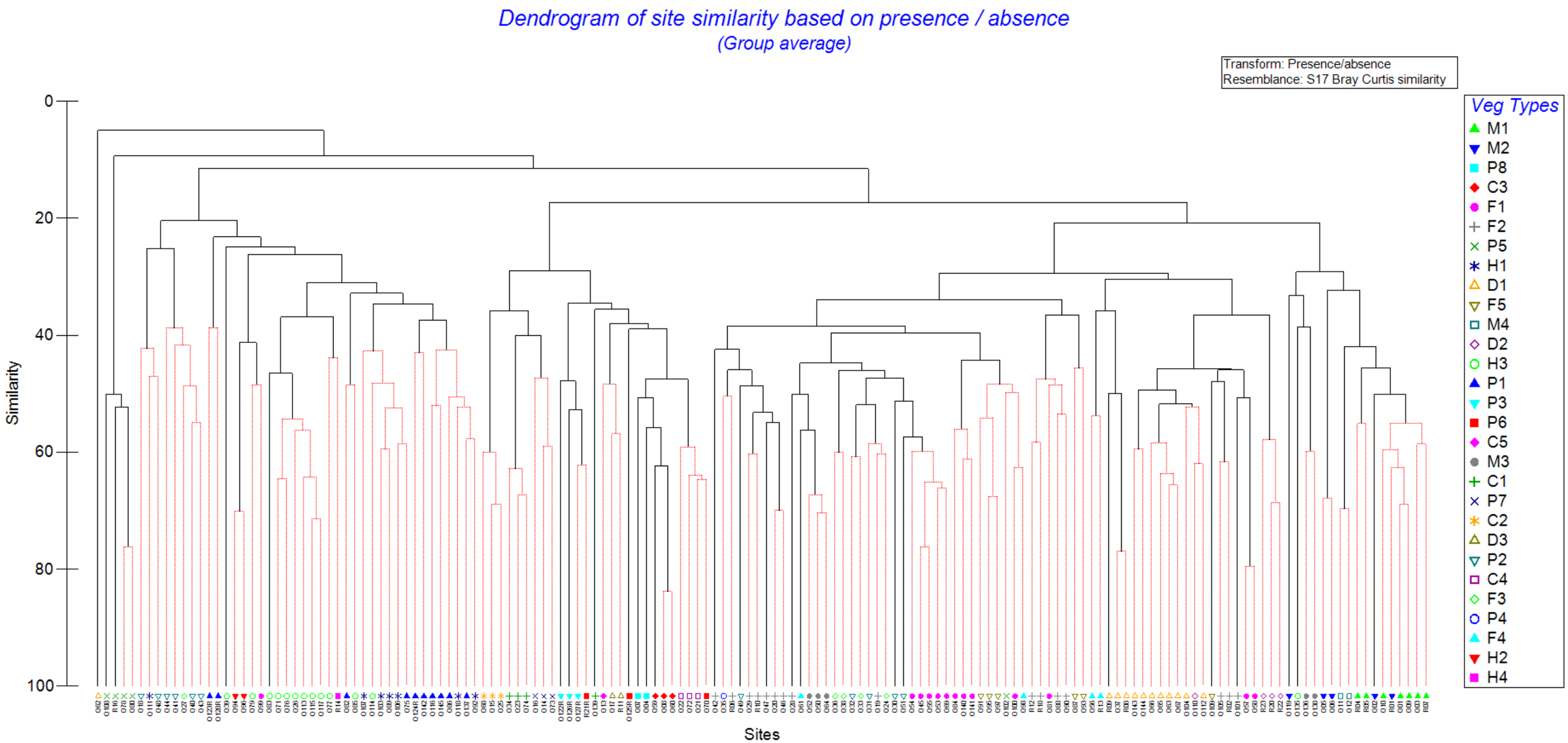

Figure 2: **Dendrogram based on presence/absence of rationalised species at each site sampled during the survey (2022 dataset).**

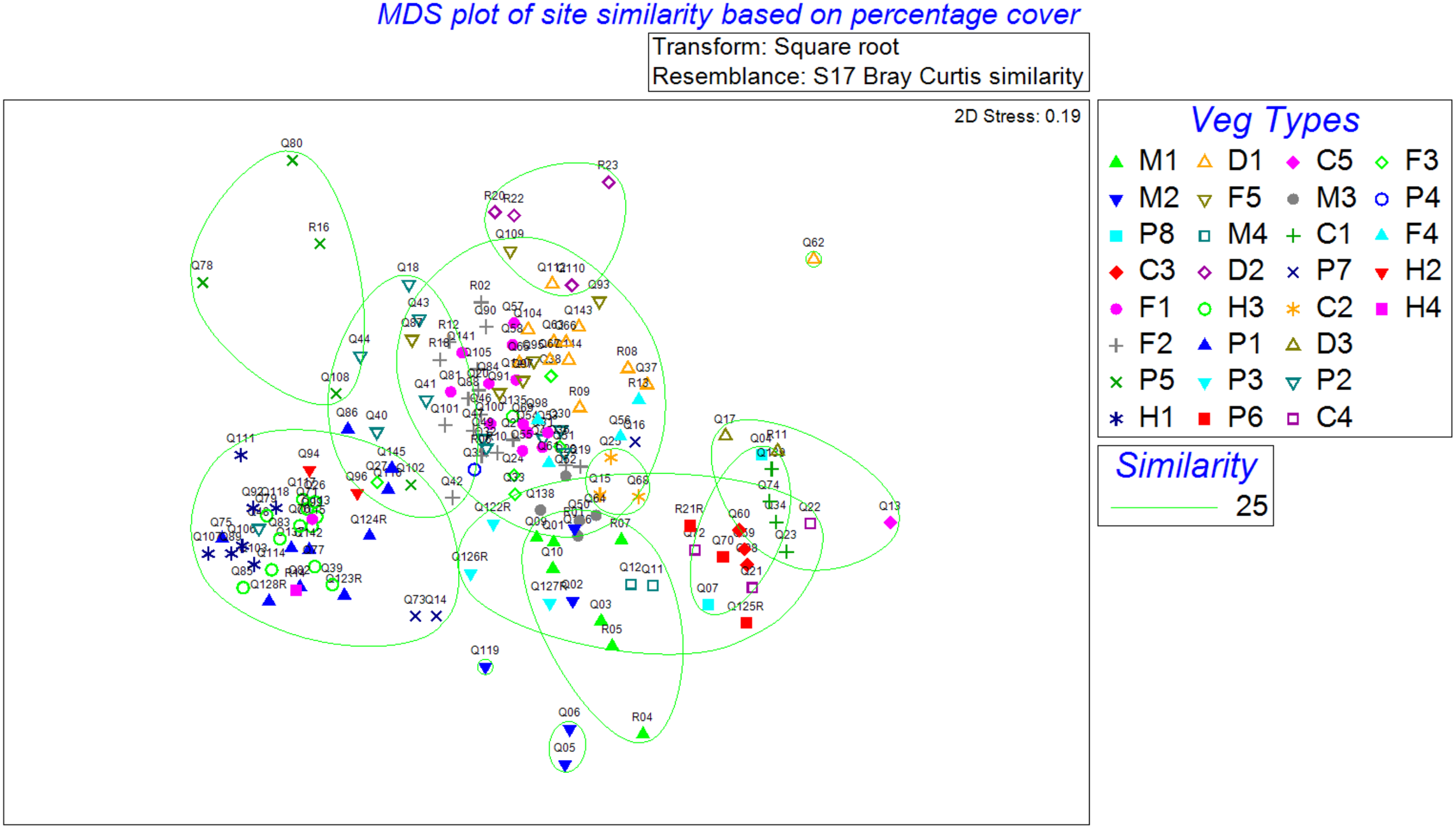

Figure 3: **NMDS plot showing clustering of sites coded by assigned vegetation type (using percentage cover data).**

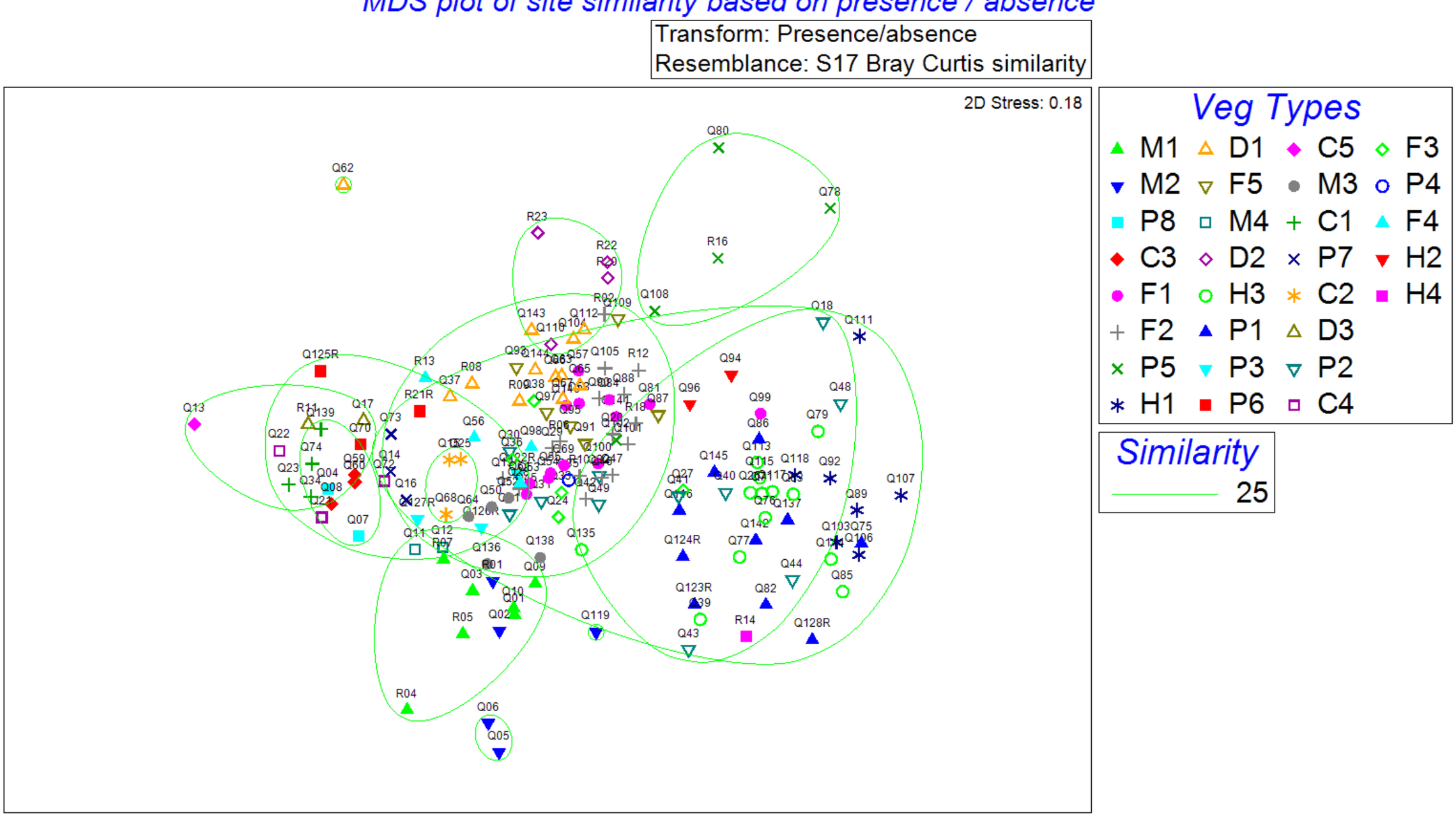

Figure 4: **NMDS plot showing clustering of sites coded by assigned vegetation type (using presence absence data).**

Table 3: Indicator species for the floristic groups identified from the current survey (based on percent cover of all species), together with sites in each vegetation type.

Floristic Group 2021	Floristic Group 2022	Floristic Grouping Change?	SIMPER Indicator Species (maximum of top 5) (Cumulative Similarity)	Veg Code	Sites
a	*a*	No	NA (<2 samples)	D1	1 (Q62)
b	*i*	No	*Urochloa occidentalis, Chrysopogon fallax, Dactyloctenium radulans, Chloris pectinata, Cullen cinereum* (50%)	C3	1 (Q59)
				P8	2 (Q04, Q07)
c	*b*	No	*Cynodon convergens, Eragrostis xerophila, Eragrostis tenellula, Astrebla elymoides, Operculina aequisepala* (29%)	C1	3 (Q23, Q34, Q74)
d	*c*	No	*Eriachne benthamii, Eucalyptus victrix, Cullen cinereum, Cullen graveolens, Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (50%)	C5	1 (Q13)
				D3	2 (Q17, R11)
e	*g*	No	*Themeda* sp. Hamersley Station (M.E. Trudgen 11431), *Hakea lorea* subsp. *lorea, Chrysopogon fallax, Urochloa occidentalis, Acacia victoriae* subsp. *victoriae* (76%)	P6	2 (Q125, R21)
f	*e*	No	*Themeda* sp. Hamersley Station (M.E. Trudgen 11431), *Polymeria longifolia, Cullen cinereum, Crotalaria dissitiflora* subsp. *benthamiana, Panicum laevinode* (51%)	C4	3 (Q21, Q22, Q72)
				P6	1 (Q70)
g	*h*	No	NA (<2 samples)	C1	1 (Q139)
h	*i*	No	*Abutilon malvifolium, Alysicarpus muelleri, Boerhavia burbidgeana, Chloris pectinata, Corchorus tridens* (13%)	C3	2 (Q08, Q60)
i	*au*	No	NA (<2 samples)	P5	1 (Q108)
j	*av*	No	NA (<2 samples)	P5	1 (R16)
k	*aw*	No	*Triodia angusta, Eucalyptus xerothermica, Acacia bivenosa, Eulalia aurea, Eragrostis desertorum* (90%)	P5	2 (Q78, Q80)
l	*d*	Yes	*Triodia wiseana, Acacia inaequilatera, Hakea lorea* subsp. *lorea, Themeda* sp. Hamersley Station (M.E. Trudgen 11431), *Abutilon otocarpum* (46%)	P3	2 (Q122, Q126)
	f	Yes	NA (<2 samples)	P3	1 (Q127)
m	*ay*	No	*Triodia wiseana, Eriachne flaccida, Arivela viscosa, Bulbostylis turbinata, Chrysopogon fallax* (68%)	P7	2 (Q14, Q73)
n	*ax*	Yes	NA (<2 samples)	H1	1 (Q111)
	bb	Yes	*Triodia wiseana, Acacia pruinocarpa, Acacia atkinsiana, Aristida holathera var. holathera, Eriachne pulchella (86%)*	P1	3 (Q123, Q124, Q128)
o	az	No	NA (<2 samples)	P5	1 (Q102)
p	*ba*	No	*Triodia wiseana, Acacia inaequilatera, Corchorus tectus, Corymbia hamersleyana, Acacia ancistrocarpa* (51%)	H2	2 (Q94, Q96)
q	*bb*	No	*Triodia wiseana, Acacia pruinocarpa, Acacia atkinsiana, Aristida holathera var. holathera, Eriachne pulchella (86%)*	P1	3 (Q123, Q124, Q128)
r	bc	No	NA (<2 samples)	P1	1 (Q82)
s	bd	No	NA (<2 samples)	H3	1 (Q113)
t	*be*	No	*Triodia wiseana, Eucalyptus leucophloia* subsp. *leucophloia, Corymbia hamersleyana, Eriachne mucronata, Acacia adoxa* var. *adoxa* (58%)	H3	5 (Q26, Q71, Q76, Q115, Q117)
u	*bf*	No	*Triodia wiseana, Eucalyptus leucophloia* subsp. *leucophloia, Eriachne pulchella, Senna glutinosa* subsp. *glutinosa, Ptilotus calostachyus* (84%)	F1	1 (Q99)
				H1	6 (Q89, Q92, Q103, Q106 Q118, Q107)
				H3	6 (Q39, Q77, Q79, Q83, Q85, Q114)
				H4	1 (R14)
				P1	3 (Q75, Q137, Q142)
				P2	1 (Q48)
v	*j*	No	*Melaleuca argentea, Eucalyptus camaldulensis* subsp. *refulgens, Cyperus vaginatus, Gossypium robinsonii, Acacia bivenosa,* 66%)	D2	3 (Q110, R20, R22)
w	*k*	No	*Acacia xiphophylla, Triodia epactia, Eragrostis xerophila, Arivela viscosa, Boerhavia burbidgeana* (52%)	C2	3 (Q15, Q25, Q68)
x	*l*	No	*Triodia epactia, Acacia atkinsiana, Triodia wiseana, Acacia ancistrocarpa, Senna notabilis,* (71%)	F2	1 (Q42)
				F3	1 (Q27)
				P1	3 (Q86, Q116, Q145)
				P2	5 (Q18, Q40, Q41, Q43, Q44)
y	*m*	No	*Acacia bivenosa, Cenchrus* spp., *Triodia epactia, Corymbia hamersleyana, Chrysopogon fallax* (59%)	F5	5 (Q87, Q91, Q93, Q95, Q97)
Z	*n*	No	*Triodia epactia, Eriachne pulchella, Chrysopogon fallax, Goodenia muelleriana, Polygala glaucifolia* (68%)	H3	1 (Q135)
				M3	1 (Q138)
				P7	1 (Q16)

Floristic Group 2021	Floristic Group 2022	Floristic Grouping Change?	SIMPER Indicator Species (maximum of top 5) (Cumulative Similarity)	Veg Code	Sites
aa	*o*	No	*Triodia epactia, Eulalia simonii, Corymbia hamersleyana, Themeda triandra, Eucalyptus xerothermica* (48%)	F1	1 (Q81)
				F2	4 (Q88, Q90, R12, R18)
ab	*p*	No	*Arivela viscosa, Acacia pruinocarpa, Sporobolus australasicus, Acacia aneura / aptaneura, Acacia citrinoviridis* (20%)	M3	3 (Q50, Q52, Q64)
ac	*q*	No	*Acacia citrinoviridis, Triodia epactia, Corymbia hamersleyana, Abutilon otocarpum, Acacia pyrifolia* var. *pyrifolia* (47%)	F4	2 (Q61, Q98)
ad	*r*	No	*Acacia citrinoviridis, Triodia epactia, Eucalyptus victrix, Arivela viscosa, Corchorus tridens* (56%)	F2	1 (Q28)
				F4	1 (Q56, R13)
ae	s	No	NA (≤2 samples)	F1	1 (Q141)
af	*t*	No	*Acacia ancistrocarpa, Corymbia hamersleyana, Chrysopogon fallax, Triodia epactia, Acacia trachycarpa* (48%)	F2	1 (Q19)
				F3	2 (Q24, Q33)
				P2	1 (Q32)
ag	*v*	Yes	*Triodia epactia, Triodia wiseana, Corymbia hamersleyana, Acacia ancistrocarpa, Abutilon lepidum* (46%)	F2	1 (R06)
				P4	1 (Q35)
ah	w	Yes	*Triodia epactia, Corymbia hamersleyana, Acacia atkinsiana, Acacia trachycarpa, Indigofera monophylla* (51%)	P2	1 (Q49)
ai	w	Yes	*Triodia epactia, Corymbia hamersleyana, Acacia atkinsiana, Acacia trachycarpa, Indigofera monophylla* (51%)	F2	3 (Q20, Q46, Q47)
	u	Yes	NA (≤2 samples)	F2	1 (R10)
	v	Yes	*Triodia epactia, Triodia wiseana, Corymbia hamersleyana, Acacia ancistrocarpa, Abutilon lepidum* (46%)	F2	1 (Q29)
aj	x	No	*Triodia epactia, Carissa lanceolata, Acacia ancistrocarpa, Acacia trachycarpa, Cenchrus* spp. (35%)	F3	2 (Q36, Q38)
ak	*y*	No	*Triodia epactia, Acacia ancistrocarpa, Cenchrus spp., Eriachne pulchella, Euphorbia boophthona* (40%)	F1	5 (Q45, Q53, Q54, Q55, Q69)
				P2	3 (Q30, Q31, Q51)
al	z	No	NA (<2 samples)	F1	1 (Q100)
am	*aa*	No	*Triodia epactia, Cenchrus* spp., *Acacia bivenosa, Corymbia hamersleyana, Acacia ancistrocarpa* (51%)	F1	2 (Q140, Q84)
an	ab	No	NA (<2 samples)	D1	1 (R09)
ao	*ac*	No	*Eucalyptus camaldulensis* subsp. *refulgens, Cenchrus* spp., *Eulalia aurea, Melaleuca glomerata, Carissa lanceolata* (22%)	D1	2 (Q37, R08)
ap	ad	No	NA (<2 samples)	F2	1 (R02)
aq	*ae*	No	*Arivela viscosa, Corymbia hamersleyana, Eriachne tenuiculmis, Corchorus crozophorifolius, Abutilon* sp. Pilbara (W.R. Barker 2025) PN (45%)	F1	2 (Q57, Q58)
ar	af	No	NA (<2 samples)	D1	1 (Q143)
as	*ag*	No	*Cenchrus* spp., *Corchorus crozophorifolius, Eucalyptus victrix, Atalaya hemiglauca, Acacia pyrifolia* var. *pyrifolia* (55%)	D1	2 (Q104, Q112)
at	*ah*	No	*Triodia epactia, Eucalyptus victrix, Corchorus crozophorifolius, Eriachne tenuiculmis, Atalaya hemiglauca* (49%)	D1	2 (Q65, Q144)
au	*ai*	No	*Eucalyptus victrix, Cenchrus spp., Indigofera monophylla, Corchorus crozophorifolius, Triodia epactia,* (36%)	D1	3 (Q63, Q66, Q67)
av	*aj*	No	*Eriachne tenuiculmis, Cenchrus* spp., *Acacia pyrifolia* var. *pyrifolia, Indigofera monophylla, Grevillea pyramidalis* subsp. *leucadendron* (41%)	F2	2 (Q101, Q105)
				F5	1 (Q109)
aw	ak	No	NA (<2 samples)	M2	1 (Q119)
ax	*al*	No	*Aristida contorta, Acacia macraneura, Acacia tetragonophylla, Grevillea berryana, Areocleome oxalidea* (48%)	M2	2 (Q05, Q06)
ay	*am*	No	*Urochloa occidentalis, Arivela viscosa, Eragrostis pergracilis, Ptilotus xerophilus, Bulbostylis turbinata* (20%)	M4	2 (Q11, Q12)
az	an	No	NA (<2 samples)	M1	1 (Q03)
ba	*ao*	No	*Eriachne benthamii, Acacia aptaneura, Acacia tetragonophylla, Areocleome oxalidea, Aristida obscura* (67%)	M1	2 (R04, R05)
bb	*ap*	No	*Acacia aptaneura, Triodia epactia, Chrysopogon fallax, Abutilon lepidum, Abutilon otocarpum* (34%)	M1	1 (R07)
				M3	1 (Q136)
bc	aq	No	NA (<2 samples)	M2	1 (Q02)
bd	ar	No	NA (<2 samples)	M1	1 (Q10)
be	as	No	NA (<2 samples)	M2	1 (R01)
bf	*at*	No	*Triodia epactia, Acacia aptaneura, Acacia pruinocarpa, Abutilon otocarpum, Aristida contorta* (34%)	M1	2 (Q01, Q09)

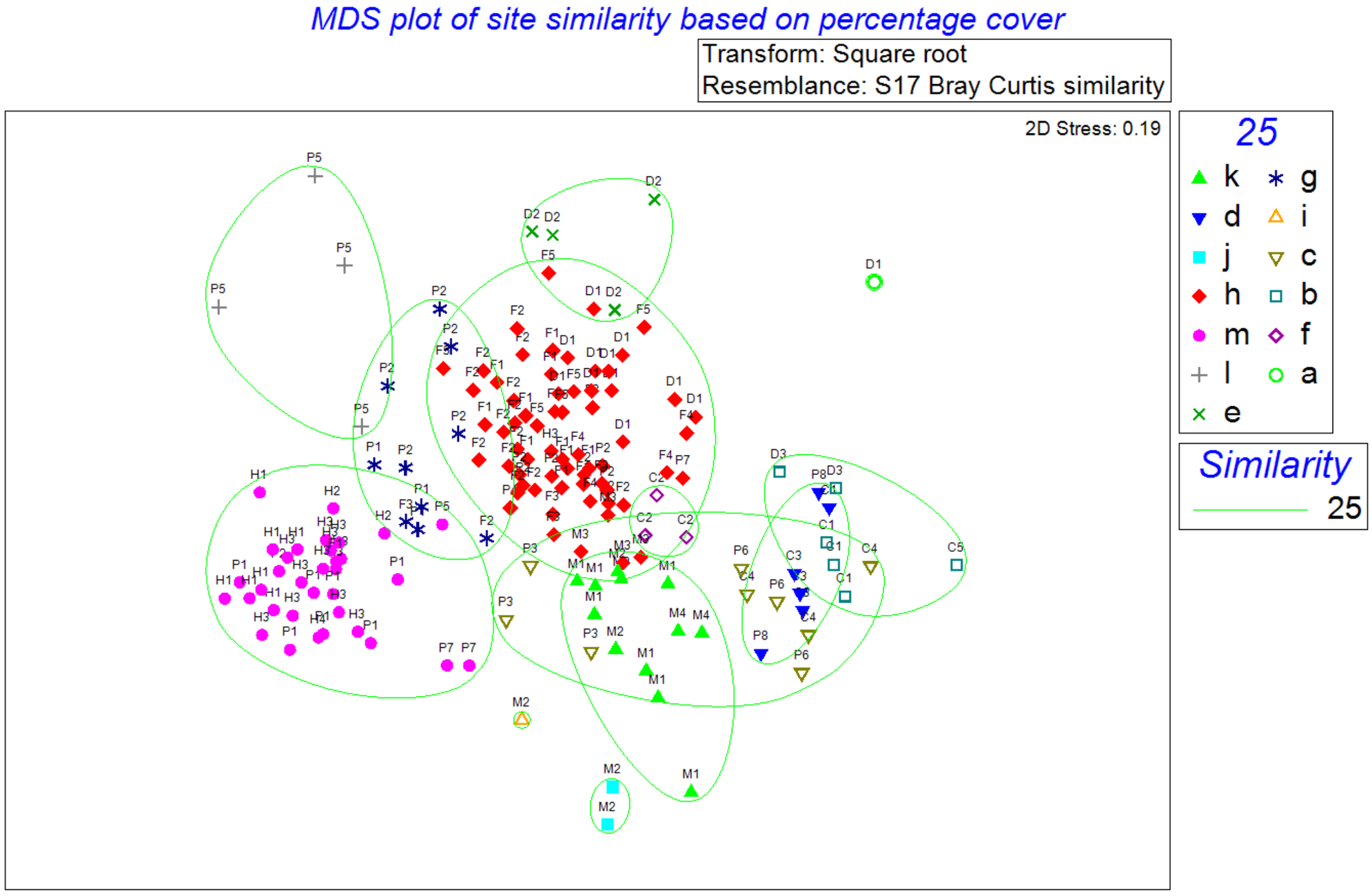

Figure 5: **NMDS plot based on percent cover of rationalised species at each site sampled during the survey (letters indicate floristic group at 25% similarity).**

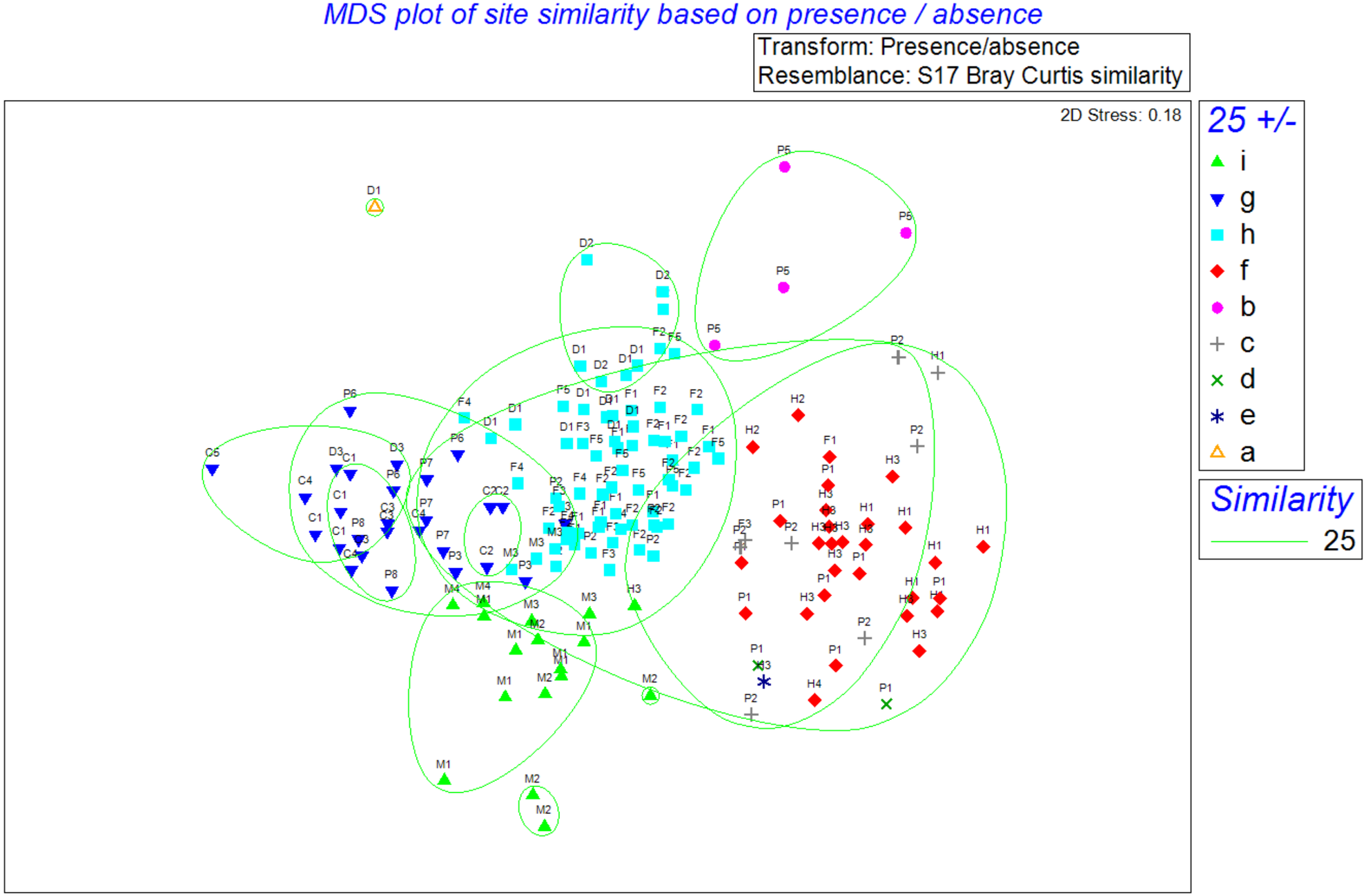

Figure 6: NMDS plot based on presence/ absence of rationalised species at each site sampled during the survey (letters indicate floristic group at 25% similarity).

Appendix B. Baseline modelling of surface water flows (Cardno report CW1128800, D22#293340)

Fortescue River, Weelamurra Creek and Caves Creek Waterways Summary Report

Manuwarra Red Dog Highway Stage 4

CW1128800

Prepared for

Main Roads Western Australia

22 April 2022

Cardno

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Contents

1 Background and Purpose 1
2 Summary of Hydrologic and Hydraulic Analysis 3
2.1 Model Area 3
2.2 Pre-Development Analysis 5
2.3 Post-Development Analysis 6
2.3.1 Consideration of risks during Alignment Definition 7
2.3.2 RTIO Levees 7
2.4 Climate Change & Environmental Considerations 7
2.4.1 Climate Change 7
2.4.2 Environmental Risks 8
2.5 “Pilbara Proof” Design 8
2.6 Anecdotal Considerations 8
3 Waterways Design Recommendations 9
3.2 Other Design Recommendations 9
3.3 Opportunities for Innovation and Sustainability 10
3.4 Limitations and Recommendations for Future Design Stages 10
Appendix A - ‘Pre-Development’ Model Outputs 12
Appendix B - Anecdotal Information from Coolawanyah Station 19
Appendix C - RTIO Levee Failure Scenario 23

Figures

Figure 1 - Study Area and Major Waterways 2
Figure 2 - Catchment Area and Model Extent 4
Figure A01 - 1:10 year 'Pre-Development' Maximum Flood Depths (m) – Coolawanyah Section 13
Figure A02 - 1:10 year 'Pre-Development' Maximum Flood Depths (m) – Hamersley Section 14
Figure A03 - 1:10 year 'Pre-Development' Maximum Flood Depths (m) – Tom Price Section 15
Figure A04 - 1:10 year 'Pre-Development' Maximum Flood Velocity (m/s) – Coolawanyah Section 16
Figure A05 - 1:10 year 'Pre-Development' Maximum Flood Velocity (m/s) – Hamersley Section 17
Figure A06 - 1:10 year 'Pre-Development' Maximum Flood Velocity (m/s) – Tom Price Section 18
Figure B01 - 12 Mile mill and tank – 25 January 2013 20
Figure B02 - Hoppy's Camp upstream of Rio Tinto Fortescue crossing – 25 January 2013 20
Figure B03 - Looking north at Rio Tinto Fortescue crossing – 25 January 2013 21
Figure B04 - Level difference across Rio Tinto Fortescue crossing railway floodway – 25 January 2013 21
Figure B05 - Looking south at Rio Tinto Fortescue crossing – 25 January 2013 22
Figure B06 - Looking east at Rio Tinto Fortescue crossing – 25 January 2013 22
Figure C01 - First Coolawanyah levee failure – 2% AEP 24
Figure C02 - First and second Coolawanyah levee failure – 2% AEP 25
Figure C03 - Second Coolawanyah levee failure (First levee intact) – 2% AEP 26

Tables

Table 2-1 Peak design flows at selected major tributaries (m^3/s) 5
Table 2-2 Identified high waterways risk locations 6
Table 3-1 Waterways Design Criteria 9

1 Background and Purpose

KBR+CCS have been commissioned by MRWA to undertake a preliminary hydrologic and hydraulic assessment ("Study") of the Weelamurra Creek, Fortescue River, and Caves Creek watersheds located in the Pilbara region of Western Australia as part of the proposed Manuwarra Red Dog Highway (MRDH) Stage 4 design (refer Figure 1 below). This work is being undertaken in support of Alignment Definition activities with the primary outcome being a Preferred Project Development Corridor and concept design based on a thorough understanding of waterways management requirements.

Stream flows and roadway crossings (such as floodways, bridges and culverts) within these three watersheds will have a significant impact on the selection of an appropriate Preferred Development Corridor and the associated road concept design. As waterways management is a primary design consideration for MRDH Stage 4, it is important to have a thorough understanding of risks and opportunities related to these major waterways.

This summary report is intended to provide an understanding of the surface water regime throughout the study area, describe the identified hydrological risk factors and present the resulting proposed design criteria for adoption in managing major waterways. The report presents a clear way forward for design development that supports a regionally-considered and site-appropriate solution for management of the major waterways based on the outcomes of the following detailed investigations:

1. The **Fortescue River, Weelamurra Creek and Caves Creek Flood Study** ("Flood Study", Cardno, 2021a) which presents the data used, methodology implemented and factual results of the hydrology and modelling processes undertaken for the abovementioned major waterways and their confluence within the project area for the 'pre-development' scenario. This flood study covers over 40,000sqkm of terrain to model ad validate the statistical events driving design flows.
2. The **Fortescue River, Weelamurra Creek and Caves Creek Waterways Risks Report** ("Waterways Risks Report", Cardno, 2021b) which considers waterways risk, regional characteristics of the hydrological conditions and the development of 'Pilbara Proof' design serviceability and resilience. Climate change impacts, as they relate to the hydrologic modelling and waterways design, have been investigated with appropriate design criteria developed to manage these risks.

This Summary Report contains a high-level synopsis of the hydrologic and hydraulic analyses performed for the pre-development and post-development scenarios, a discussion of the associated risks and implications for roadway design, as well as recommendations for further waterways design development.

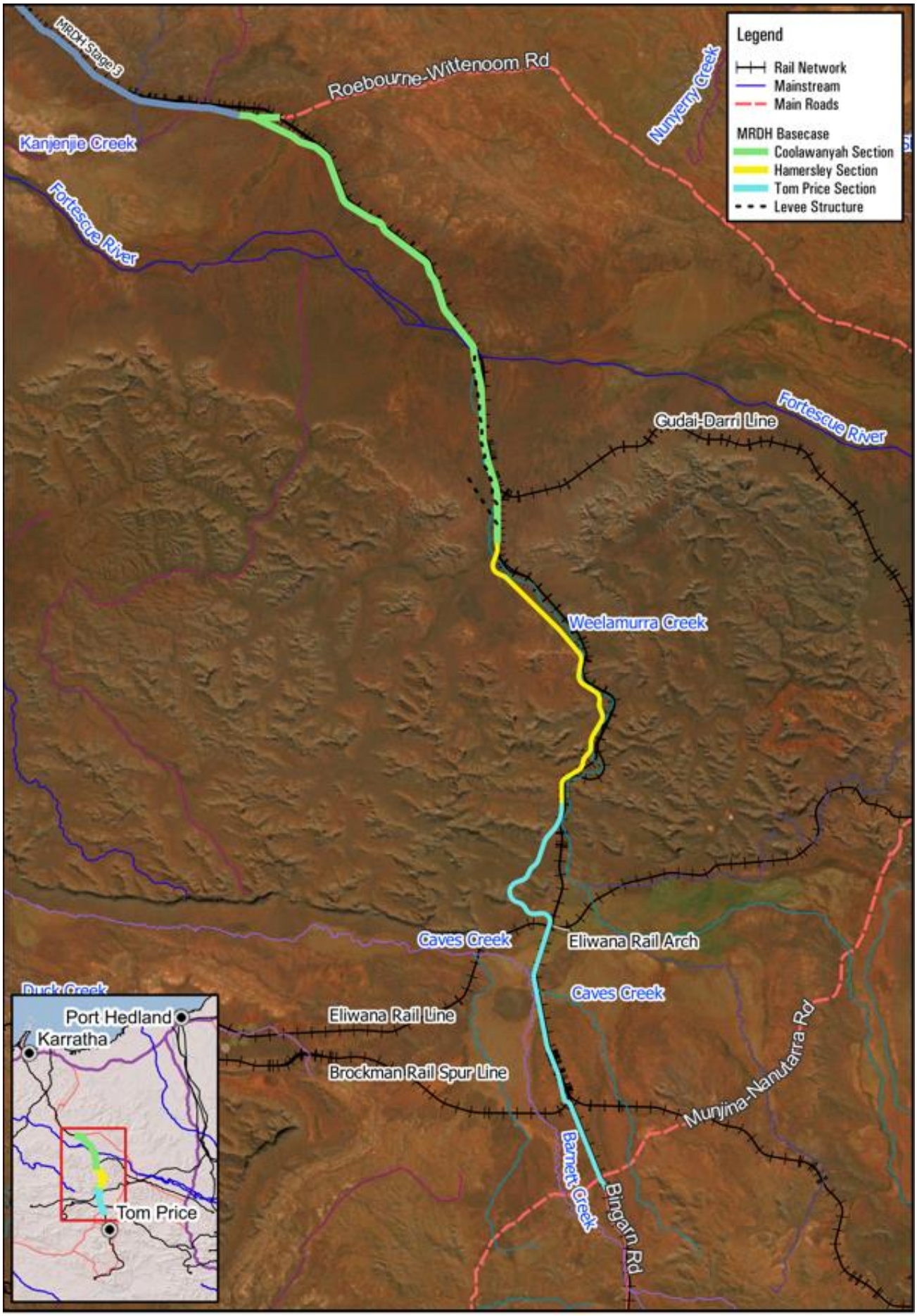


Figure 1 - Study Area and Major Waterways

2 Summary of Hydrologic and Hydraulic Analysis

2.1 Model Area

The model area for the hydraulic & hydraulic analysis includes the following large and complex catchments interacting with the MRDH Stage 4 Preliminary Project Development Corridor:

- The Coolawanyah Hydraulic model extends from the northern tie-in (to Stage 3) at Roebourne – Wittenoom Road to the Fortescue river crossing
    - The relatively small catchments in this model grade towards the Fortescue River (downstream of the project development corridor) and do not interact with the Weelamurra Creek
- The Fortescue River was considered separate to all other watercourses due to its size and complexity however the confluence with Weelamurra Creek was assessed for its impacts on the preliminary project development corridor.
- South of the Fortescue River crossing, Weelamurra Creek is modelled and includes for:
    - RTIO levee controls
    - Parallel flows to the RTIO railway (and the MRDH Preliminary Project Development Corridor)
    - Multiple sub-catchments throughout the Hamersley Ranges that flow both west to east and east to west across the RTIO rail infrastructure and MRDH Preliminary Project Development Corridor.
- South of the Hamersley Ranges, the Eliwana floodplain, Caves Creek, and Barnett Creek interact and eventually flow into the Ashburton River.

The above catchments and model extents are provided in Figure 2.

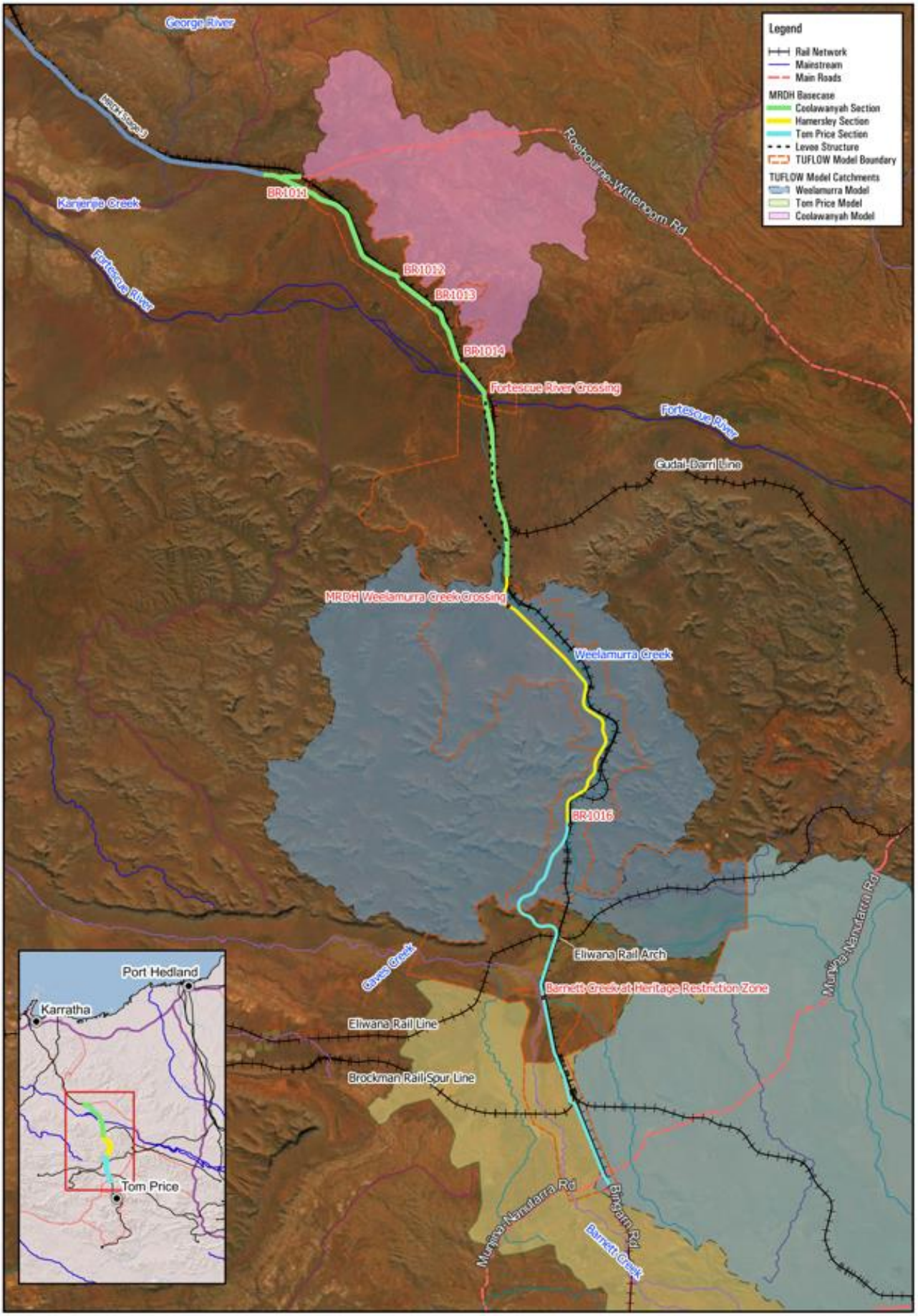


Figure 2 - Catchment Area and Model Extent

2.2 Pre-Development Analysis

To achieve the Flood Study objective, hydrologic and hydraulic models of the study area were developed using RORB Runoff Routing software and TUFLOW Hydraulic Modelling software. The design rainfalls for the 50%, 20%, 5%, 2% and 1% AEP events were applied to the runoff routing models using coarse elevation data. The output from these models were hydrographs which provide information about the critical rainfall durations in the Study area. The hydrographs were then used as inputs for more detailed TUFLOW 2D hydraulic models which showed how the runoff performs on the existing topography, including flow velocities and depths.

Existing infrastructure developed by mining companies are included in the 'pre-development' model as these attenuate and control the watersheds, significantly altering the 'natural' flows. In particular, the RTIO main rail alignment and Brockman spur line, associated culverts and bridge structures control east to west flow on the eastern side of the MRDH corridor. The RTIO levee system at Weelamurra Creek controls the watershed to the west of the road corridor as seen in Figure 2. The FMG Eliwana rail line bisects the road corridor and crosses the RTIO main alignment in the Caves Creek floodplain. This data was sourced from the asset owners, aerial imagery and LIDAR survey.

The adopted hydrological methodology is consistent with the latest industry and current best practice for hydrological modelling as defined by:

- Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia (2019).
- Design Flood Estimation in Western Australia, Australian Journal of Water Resources (2012).
- Estimation of RORB Kc parameter for ungauged catchments in the Pilbara Region of Western Australia, Proceedings of the 2014 Hydrology and Water Resources Symposium, 24 – 27 February, Perth (2014).

Throughout the model development, advice was sought from Jerome Goh, a waterways specialist with substantial experience in the Pilbara region. Jerome assisted with the development and validity assessment of the models using his extensive knowledge of local conditions.

The hydraulic model outputs were analysed, validated and used to create detailed maximum depth, velocity and hazard plans across the study area for the 'pre-development' scenario (refer Appendix A). These are also provided as layers in 'ProjectMapper' for full interrogation by the project team. From the model outputs and this mapping, it is apparent that the hydrologic risks of note are:

- High flow depths at major crossings in the Coolawanyah section and at Fortescue River.
- Interaction with existing Rio Tinto levees which direct Weelamurra Creek.
- Braided flows and narrow widths in Weelamurra Creek may cause difficulty for road crossings.
- Water levels in the flood plain at the Eliwana railway road under rail arch.
- Confluence of flows of Barnett Creek and Caves Creek near the proposed road alignment and the Rio Tinto railway.

The peak design flows at selected major tributaries are summarised in Table 2-1 below (locations are provided in Figure 2:

Table 2-1 Peak design flows at selected major tributaries (m^3/s)

Location / Landmark	20% AEP	5% AEP	2% AEP	1% AEP
Coolawanyah – Bridge 1011, Cowcumba Creek	63	461	792	1049
Coolawanyah – Bridge 1012	8	44	78	101
Coolawanyah – Bridge 1013, Ballyeerina Creek (north)	9	61	107	139
Coolawanyah – Bridge 1014, Ballyeerina Creek (south)	8	52	91	119
Coolawanyah – Fortescue River crossing	656	1525	2070	2371
Hamersley - MRDH Weelamurra Creek crossing		700	1200	
Tom Price - Upstream of Bridge 1016	13	39	60	77
Tom Price - Barnett Creek at heritage restriction zone	149	406	685	969

2.3 Post-Development Analysis

Hydrologic and hydraulic models of the study area were further developed from the 'pre-development' model with the inclusion of the Base Case Concept Design (the 'post-development' scenario). RORB Runoff Routing software and TUFLOW Hydraulic Modelling software evaluated the design rainfalls for the 50%, 20%, 5%, 2% and 1% AEP events.

Throughout the 'post-development' model development, advice was sought from Jerome Goh, a waterways specialist with substantial experience in the Pilbara region. Jerome assisted with the development and validity assessment of the models using his extensive knowledge of local conditions. Mr Goh also provided input to options at waterways crossings or suggested alternatives for consideration that are discussed within this report.

The hydraulic model outputs were analysed, validated and used to create detailed maximum depth, velocity and hazard plans across the study area for the 'pre-development' and 'post-development' scenarios, as well as comparative mapping comparing between the two scenarios. From the model outputs and this mapping, the hydrologic locations of note are:

- High flow depths at major crossings in the Coolawanyah Section and at the Fortescue River crossing.
- Interaction with existing Rio Tinto levees which direct the Weelamurra Creek parallel flow away from the RTIO rail alignment.
- Braided flows and narrow widths in Weelamurra Creek may cause difficulty for road crossings.
- Water levels in the floodplain in the vicinity of the FMG Eliwana railway crossing both the Preferred Project Development Corridor and the RTIO main rail alignment.
- Confluence of flows of Barnett Creek and Caves Creek near the proposed road alignment and the Rio Tinto railway.

Key risks associated with the hydrology within, and influencing, the project area that have an immediate impact on design outcomes include:

- Backwater impacts on third party infrastructure (Rio Tinto or FMG rail and access track embankments)
- Serviceability – road closure frequency and duration during storm events
- Resilience – ability of the road embankment to withstand storm events with minimal remediation or maintenance activities to resume normal operations
- Complexity and variability of channel flows (confluence areas impacting road design, main channel variability in different events, parallel creek flows)
- Complexity of the likely waterways design solution(s) to manage the above risks

These hydrological risks are further detailed in the table below and were assessed using the approved project risk tables.

Table 2-2 Identified high waterways risk locations

Hazard	Consequence	Severity	Likelihood	Risk
Backwater impacts from MRDH on third party infrastructure	Closure of railway Embankment and track reconstruction	Catastrophic	Possible	Extreme
Reduced serviceability due to high flows	Closure of road for long periods during events while the upstream catchment is draining	Major	Possible	High
Insufficient resilience of MRDH to high flows	Failure of road pavement, embankment or other component due to high flow velocities or inundation Failure of levees, bridge abutments, scour protection	Major	Possible	High
Insufficient design appreciation of complex channel flow	Changing upstream main channel flows	Major	Possible	High

	Embankment scour – reduced resilience Overtopping of road – reduced serviceability			
Insufficient design appreciation of complex waterways design requirements	Embankment scour – reduced resilience Overtopping of road – reduced serviceability Under / over design of drainage controls Longer periods of inundation adjacent to the road in floodplains – reduced resilience of the road embankment & pavement	Major	Possible	High

2.3.1 Consideration of risks during Alignment Definition

Upon completion of the base case design, the hydrologic & hydraulic models were updated to understand the resulting changes to watershed within the Preliminary Project Development Corridor. Alignment Definition activities have aimed to address the above risks, in the first instance, through the investigation of alternative horizontal and vertical road geometries. In particular, the proximity of the road alignment to the existing Rio Tinto railway requires that the design of the road appropriately considers how the change in flow conditions caused by the road could impact Rio Tinto assets. This involves issues such as increased water levels due to flow constrictions that could cause overtopping, or scour to embankments or other structures. The post-development model provided design teams with outputs to evaluate the impact of different design solutions across all the above identified risks, determined which alignment resulted in fatally flawed outcomes and provided guidance on the final offsets and/or treatments at major waterways crossings (refer “Waterways Risks Report”, Cardno, 2021b).

This refinement will continue throughout final Concept Design, with the ‘Post-Development’ hydraulic & hydrologic models being updated to include the final concept alignment and resulting watershed impacts.

2.3.2 RTIO Levees

Two sets of levees constructed by Rio Tinto are present within the Coolawanyah Section of the MRDH4 project. The levee banks are constructed to provide protection to the Rio Tinto railway line and provide protection against flood waters which occur during large rainfall events in the region. Should these levee banks fail, there is the potential for washout of infrastructure to the east of the levees. A review of historical imagery suggests the second levee was built in the 1960s at the same time as the original railway, while the upstream levee was built separately in the 1970s.

Modelling indicates that some 50-year flood events could cause overtopping at the upstream levee, which would be generally managed by the second levee (modelling indicates this would not be overtopped in this scenario). Failure of both levees is likely to result in damage to the Rio Tinto railway and the proposed MRDH4 road. Figures presenting these situations are provided in Appendix C.

A site inspection at the second levee indicated substantial deterioration to the structure from apparent parallel flow. A failure of only the second levee, at a location in the vicinity of the observed deterioration is unlikely to substantially impact infrastructure (refer “Waterways Risks Report”, Cardno, 2021b).

2.4 Climate Change & Environmental Considerations

2.4.1 Climate Change

Future climate change impacts on hydrology and hydraulics were considered using current rainfall data with 2050 RCP4.5 and 2070 RCP8.5 interim climate change factors. It is recommended that 2070 RCP 8.5 rainfall data be adopted for design to ensure due consideration is given for whole-of-design-life road serviceability and resiliency.

Whole-of-life project costs (including the operations & maintenance implications of climate change) must be balanced with the associated climate change storm event risks when deciding the design criteria for waterways infrastructure. It is recommended that further investigation into balancing the costs and benefits of this ‘whole of life’ approach be undertaken to assess the value of early investment into the road design.

2.4.2 Environmental Risks

Identification of areas in which flow conditions may change following construction of the road were identified through the use of difference maps which compare pre- and post-development flow depths and were discussed when evaluating alignment options. These results should be communicated to stakeholders, such as pastoralists and Traditional Owners, as the change in flow conditions has the potential to adversely affect vegetation.

The extent of impact in an area will generally depend on terrain slopes in the area and the angle of the road compared to the terrain. In gently sloping areas the impact of the road could be substantial as it has the potential to obstruct considerable flow if it is perpendicular to the natural flow direction.

In particular, the Mulga communities present in the southern portion of the Tom Price Section (approx. cha 22,300 to 38,300) are susceptible to changes in flow conditions. The Base Case road alignment generally (and deliberately) matches the direction of fall in the area, resulting in a low risk of substantial changes in flow obstruction to the sensitive community.

2.5 "Pilbara Proof" Design

At the behest of the Regional Manager, Pilbara, a key philosophy driving waterways design is the understanding of local conditions and the undertaking of a 'Pilbara-Proof' design. In the context of waterways design, the development of 'Pilbara-Proof' design criteria is focussed on serviceability and resilience outcomes based on a comprehensive understanding of local hydrological conditions and Stakeholder expectations.

The project team undertook workshops and community consultation to better understand Stakeholder expectations for MRDH serviceability and continuity of access during severe weather events. The key finding from this process was that road closures are acceptable for short periods (less than a week) during (and directly after) major storm events, as there are alternative routes available between major centres serviced by MRDH. However; closures for remediation and maintenance are considered unacceptable, particularly for events considered 'normal' in this region (i.e. cyclones).

2.6 Anecdotal Considerations

Anecdotal evidence, or ground truthing of prior flood events, is of significant value in ungauged catchments like those considered for MRDH4. An example of information provided by local Stakeholders is provided in Appendix B, with photographs and discussion provided by Coolawanyah Station regarding a 2013 flood event.

Jerome Goh, who has substantial waterways experience in the Pilbara region, has assisted in development of the hydrologic and hydraulic models, as well as assisted in the identification of waterways risks and opportunities. His ongoing advice throughout model development and interpretation, based on over 40 years' experience, has been instrumental in ensuring model outputs are valid for the level of detail they are being used.

Additional information on actual conditions during flood events will assist to calibrate and validate the hydrologic and hydraulic models on which the models and risk assessments are founded.

3 Waterways Design Recommendations

Through an informed understanding of key hydrologic risk areas, the implications of climate change, and the requirements for a 'Pilbara-Proof' design, the following design criteria are recommended for adoption in the waterways design going forward:

Table 3-1 Waterways Design Criteria

Element	Location	Criteria	Value	Unit
Serviceability / maximum road closure time due to flood water *i.e. normal crossings should be designed to be closed for no longer than 12 hours in a 5% AEP event.*	Normal crossings	10% AEP	0	hours
		5% AEP	12	hours
		2% AEP	72	hours
	Fortescue River floodway crossing	50% AEP	12	hours
		20% AEP	72	hours
		5% AEP	120	hours
	Bridges	1% AEP	12	hours
	Overall MRDH4 alignment	50% AEP	12	hours
		20% AEP	72	hours
		5% AEP	120	hours
Road closure in both directions for reconstruction following flooding	All crossings	2% AEP	0	hours
Floodway dry serviceability	Normal crossings	50% AEP		
Floodway wet serviceability	Normal crossings	20% AEP		
Culvert capacity	Non-floodway crossings	10% AEP		
Culvert scour treatments extents & sizing	All culverts	1% AEP		
Resistance to scour scenarios	All potential overtopping locations	1% AEP		
Pavement inundation duration without specialist treatment *i.e. all crossings & drains that are inundated for longer than 24 hours in a 10% AEP event will require specialist treatment in consideration of pavement resilience.*	All crossings and drains	10% AEP	24	hours
Roadside/formation drains	All locations	10% AEP		
Bridge dry serviceability	All locations (Weelamurra Creek Crossing)	2% AEP		
Levees – overtopping avoidance or scour protection	All locations	1% AEP		
Third party adverse backwater impacts	All locations	2% AEP	0	mm

3.2 Other Design Recommendations

Other design considerations when adopting the above design events and outcomes should be included in design calculations:

1. Design criteria adopted in each instance & location are to be 'worst-case' up to (and including) the proposed design event

2. Pavement inundation durations and impacts should be reviewed and adjusted if required by the project geotechnical consultant once detailed geotechnical data is available. This may result in greater embankment heights to accommodate capillary rise in locations of long duration inundation (i.e. floodplains)
3. Allowance for climate change has been included by adopting a rarer storm event using current (RCP 4.5) IFD data that is equivalent to worst case RCP 8.5 modelling.
4. All adverse impacts to third-party infrastructure (especially to assets within State Agreements) should be avoided as a general rule. Detailed investigation must be conducted at locations where this is likely to determine if an increase in backwater is acceptable to the asset owner. For example, a water level increase could be considered an acceptable risk when it occurs downstream of an existing culvert which is operating under inlet control conditions as it is likely to result in any adverse impact (i.e. changes to flow rate).
5. Impacts on sensitive environmental & heritage receptors to be evaluated for high probability events together with key stakeholders in all locations
6. Check to ensure the MRDH embankment is not impacted by downstream turbulence caused by flows controlled by the adjacent railway infrastructure i.e. high velocities and flows through rail culverts or bridges may result in dangerous velocities and flow depths across the road if not sufficiently controlled.
7. An important lesson learned from previous stages of MRDH development is the careful and comprehensive consideration of waterways risks. Ad hoc discussions with previous stage Site Superintendents, Jerome Goh and private asset owners directly impacted by Stage 4 have identified the following design suggestions to be adopted going forward:
    a. Roadside drains to be trapezoidal (not V-shaped) with a 1% min grade away from the road embankment
    b. Concrete floodways to be adopted for major floodway locations

3.3 Opportunities for Innovation and Sustainability

The following considerations identified within Alignment Definition Phase are not included in the above design criteria, but may provide opportunities for efficient management of waterways risks and are presented for consideration in delivery:

- Use of ITS for real-time floodway monitoring and road closures. There is an opportunity to install remote signage with a pre-warning system (ITS) that can warn road users of road closures and/or flooding during significant events well before they arrive at the crossing, allowing them to choose alternative and safer routes.
- Road furniture design – consideration of resilience during periods of significant inundation, or damage to other significant events (i.e. bushfires). This may necessitate a higher design standard but will minimise maintenance costs and extend the serviceable life of the asset.
- Fencing design – installation of fencing system in major waterways that will break back and/or blow over at a certain pressure and then reposition after the event to minimise maintenance and intrusion of livestock into the road reserve where it is fenced.
- Consideration of Rest Area locations between, or adjacent to, major waterways likely to be closed during severe events to provide safety & shelter until the road is safely traversable. Suggest that these locations also provide public facilities such as water tanks and toilets for hygiene.

3.4 Limitations and Recommendations for Future Design Stages

Key limitations of the current studies that are recommended to be rectified prior to further ‘Business as Usual’ model development beyond concept design include:

- Updating the topographical & survey data used to generate the hydrologic and hydraulic models to rectify the current varied levels of accuracy and resolution

- A ground survey of the existing waterways and infrastructure adjacent to the MRDH alignment including road & rail embankments, culverts, levees, and bridges. Adjacent infrastructure information used for the current study has not been received directly from the asset owners and can therefore not be relied upon.
- Discussions regarding waterways management with the Traditional Owner's should continue and may result in additional design considerations
- Further modelling will be required to perform detailed design, including consideration of culvert crossing sizes, bridge scour analysis, roadway embankment stability, etc.

APPENDIX

A

‘PRE-DEVELOPMENT’ MODEL OUTPUTS

The following figures have been extracted from ProjectMapper for information purposes only. Detailed data for other events and at specific locations can be provided upon request.

Figure A01 - 1:10 year 'Pre-Development' Maximum Flood Depths (m) – Coolawanyah Section

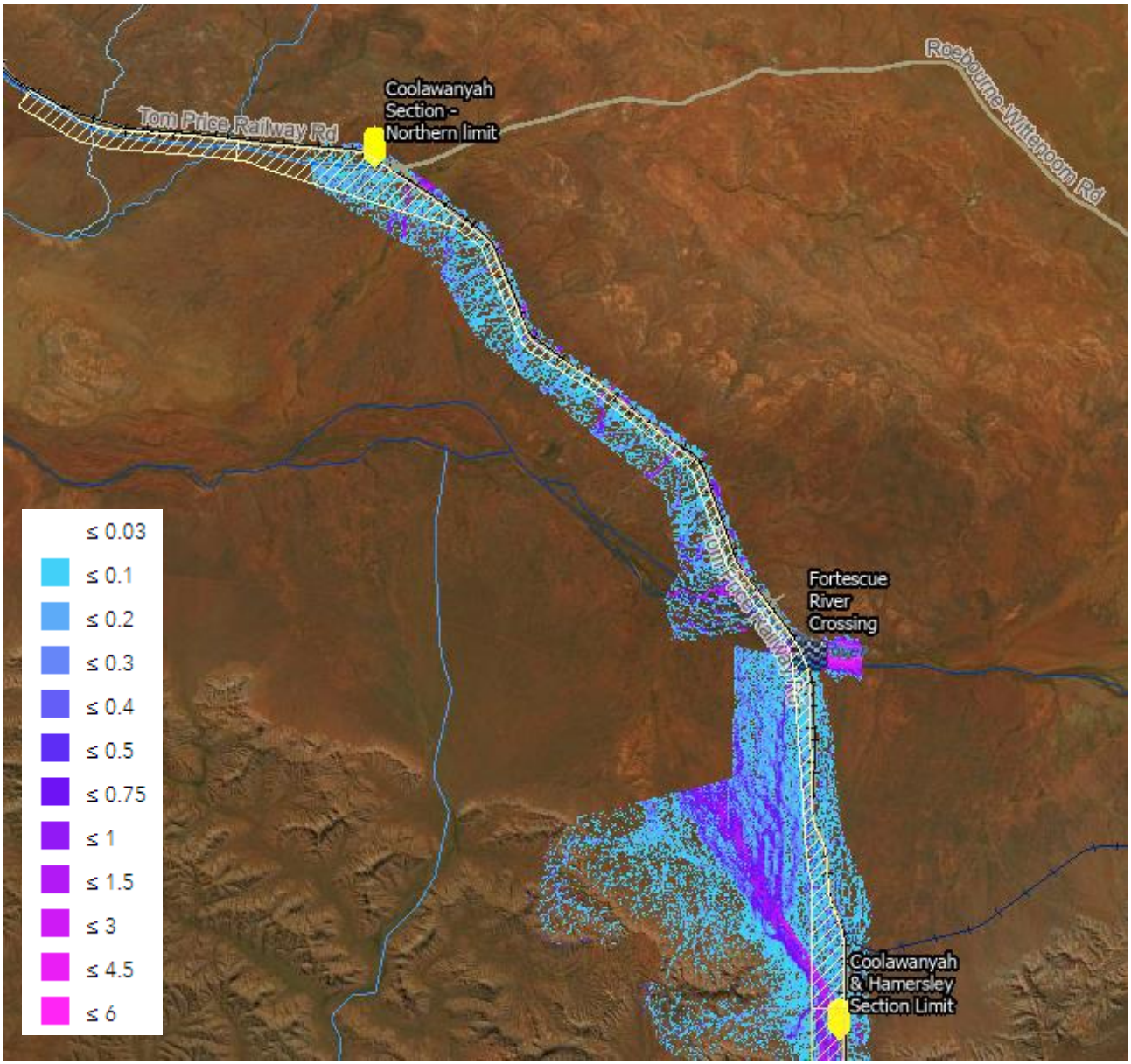


Figure A02 - 1:10 year 'Pre-Development' Maximum Flood Depths (m) – Hamersley Section

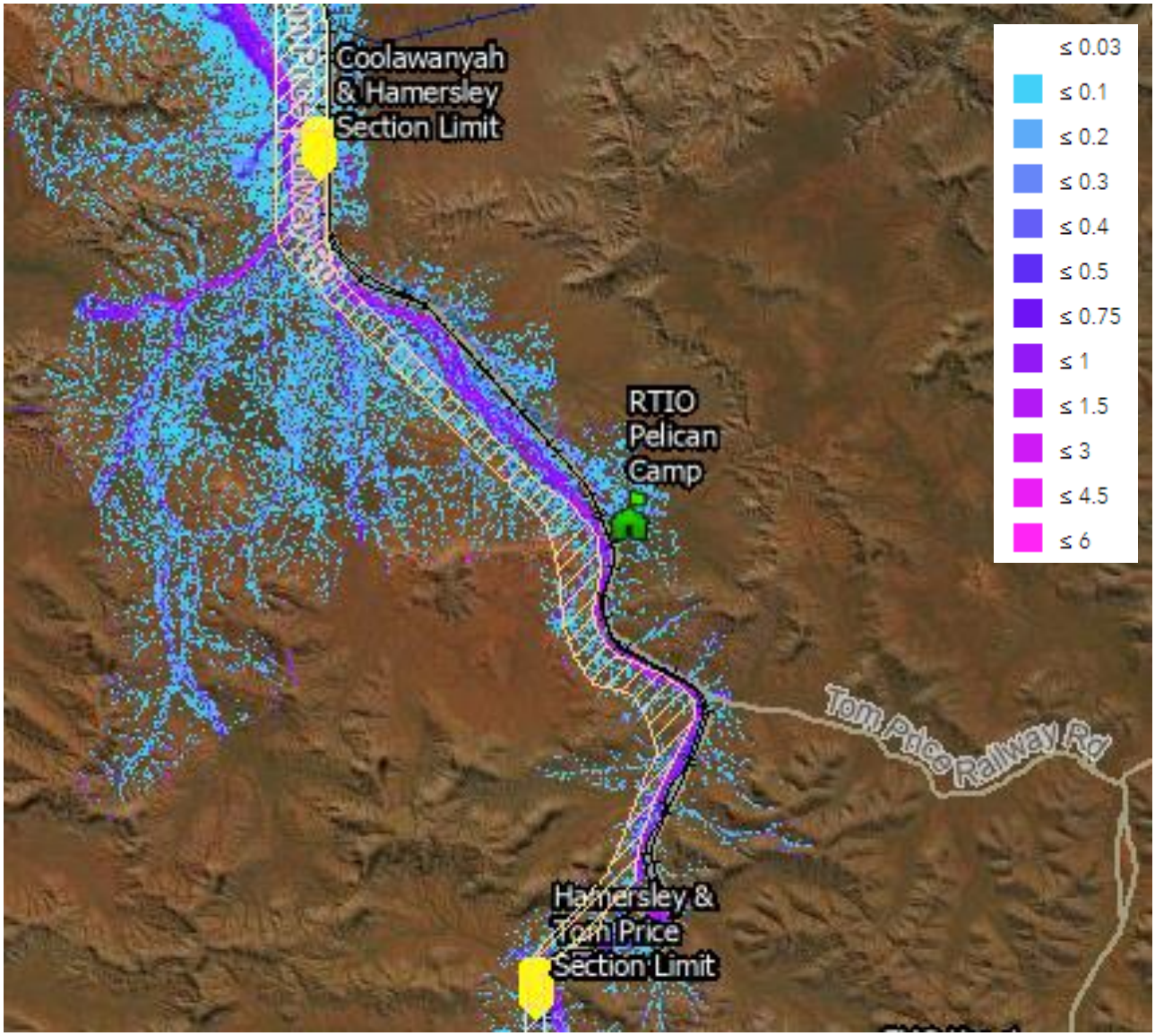


Figure A03 - 1:10 year 'Pre-Development' Maximum Flood Depths (m) – Tom Price Section

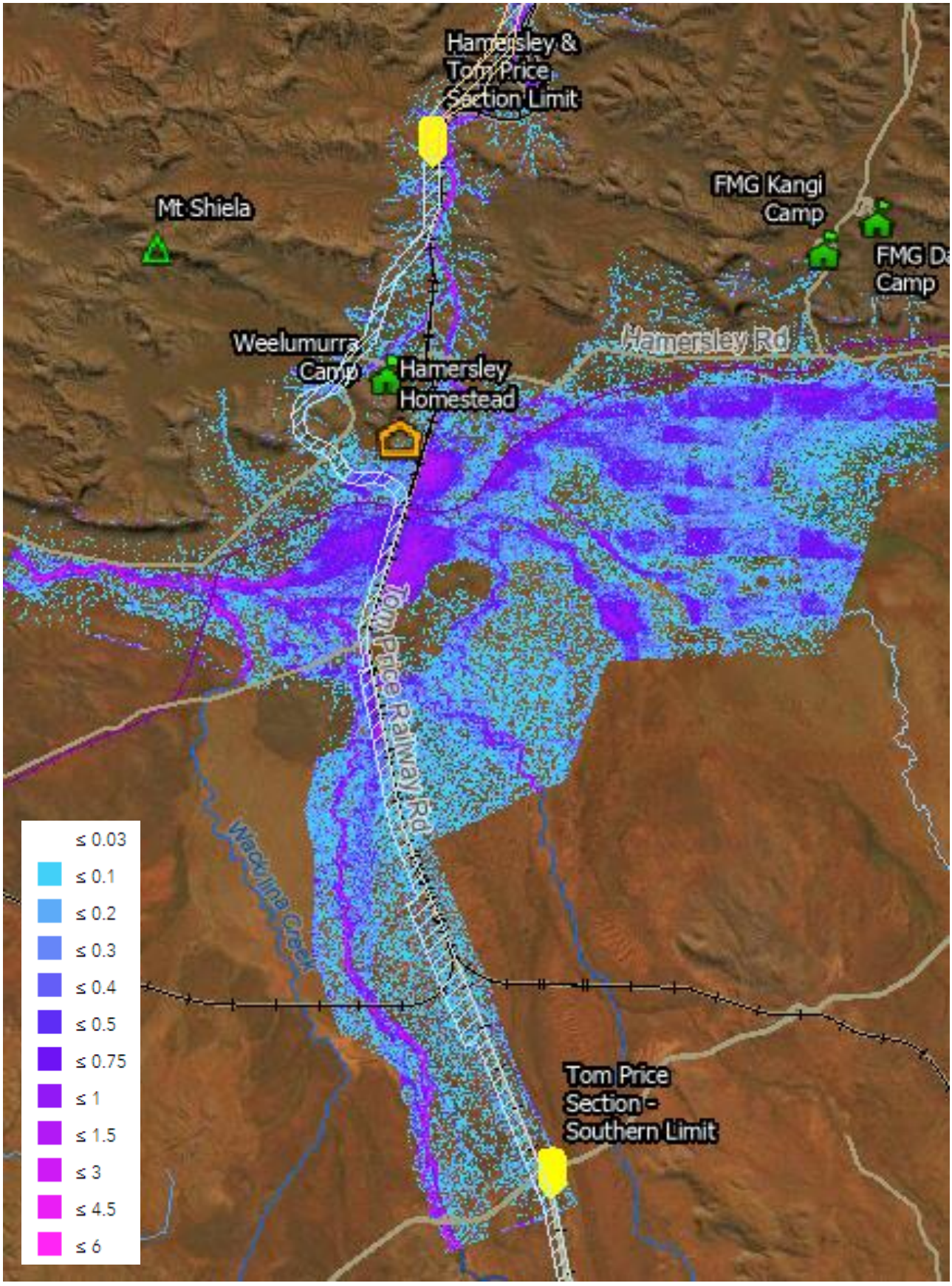


Figure A04 - 1:10 year 'Pre-Development' Maximum Flood Velocity (m/s) – Coolawanyah Section

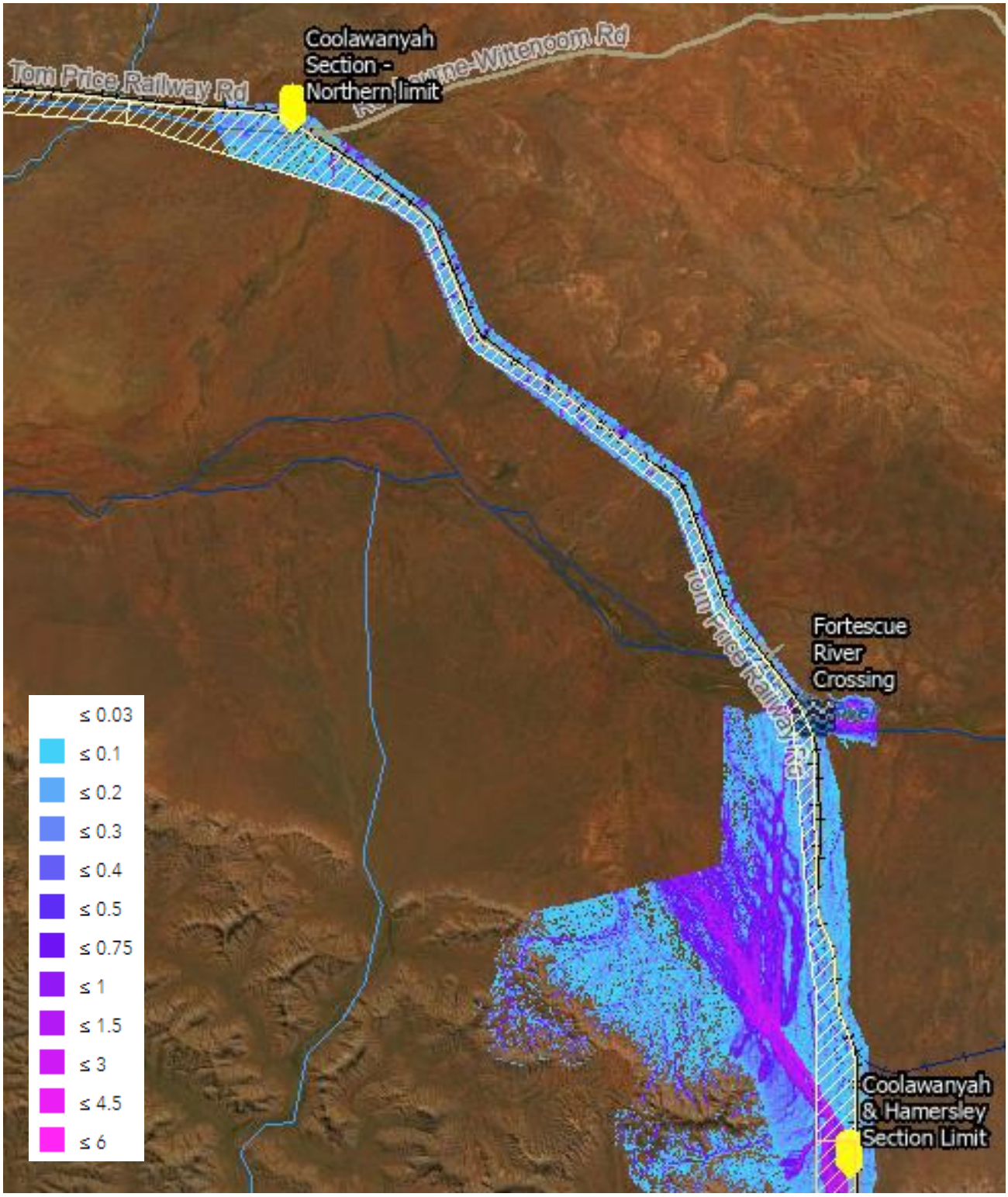


Figure A05 - 1:10 year 'Pre-Development' Maximum Flood Velocity (m/s) – Hamersley Section

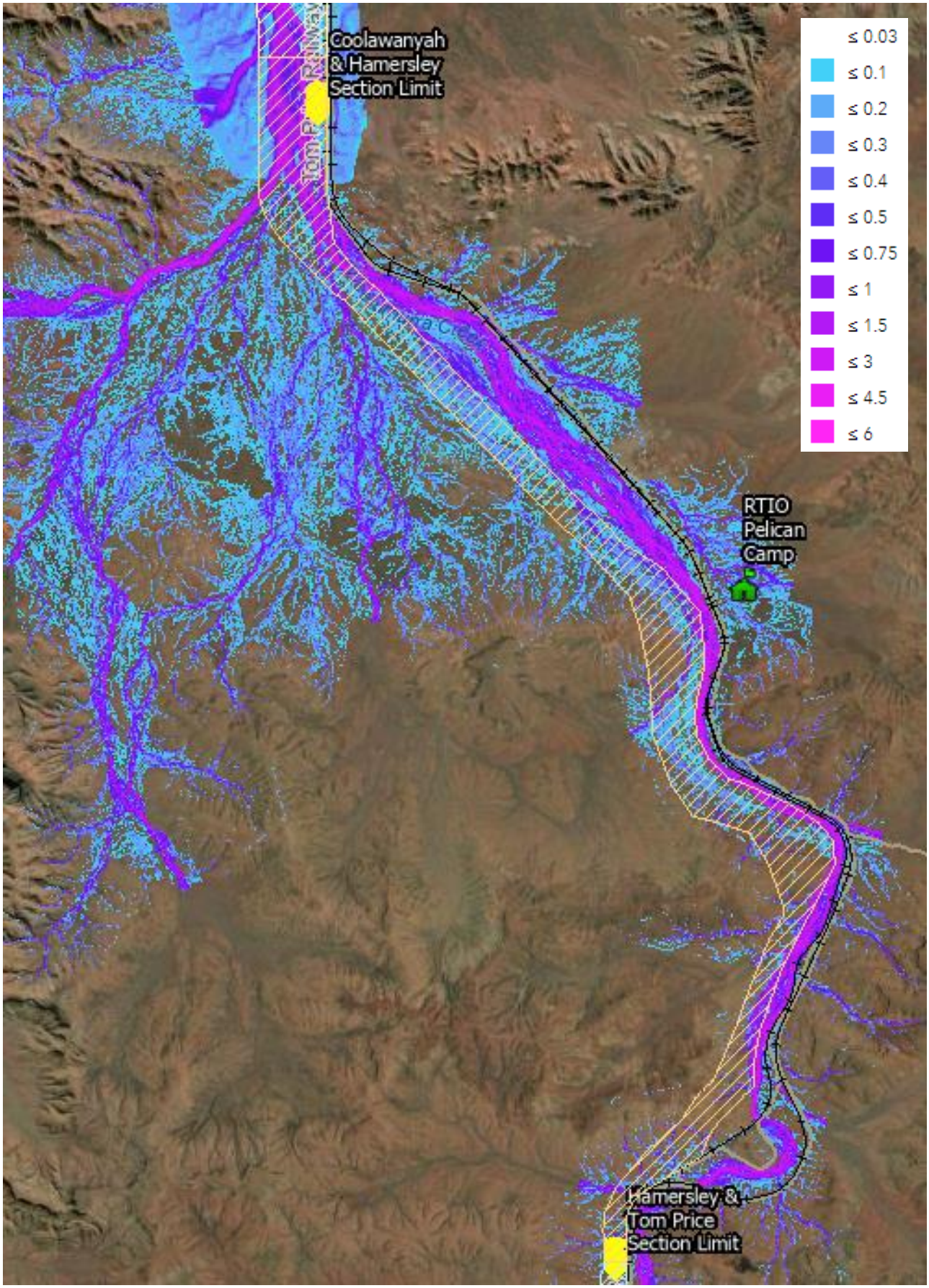
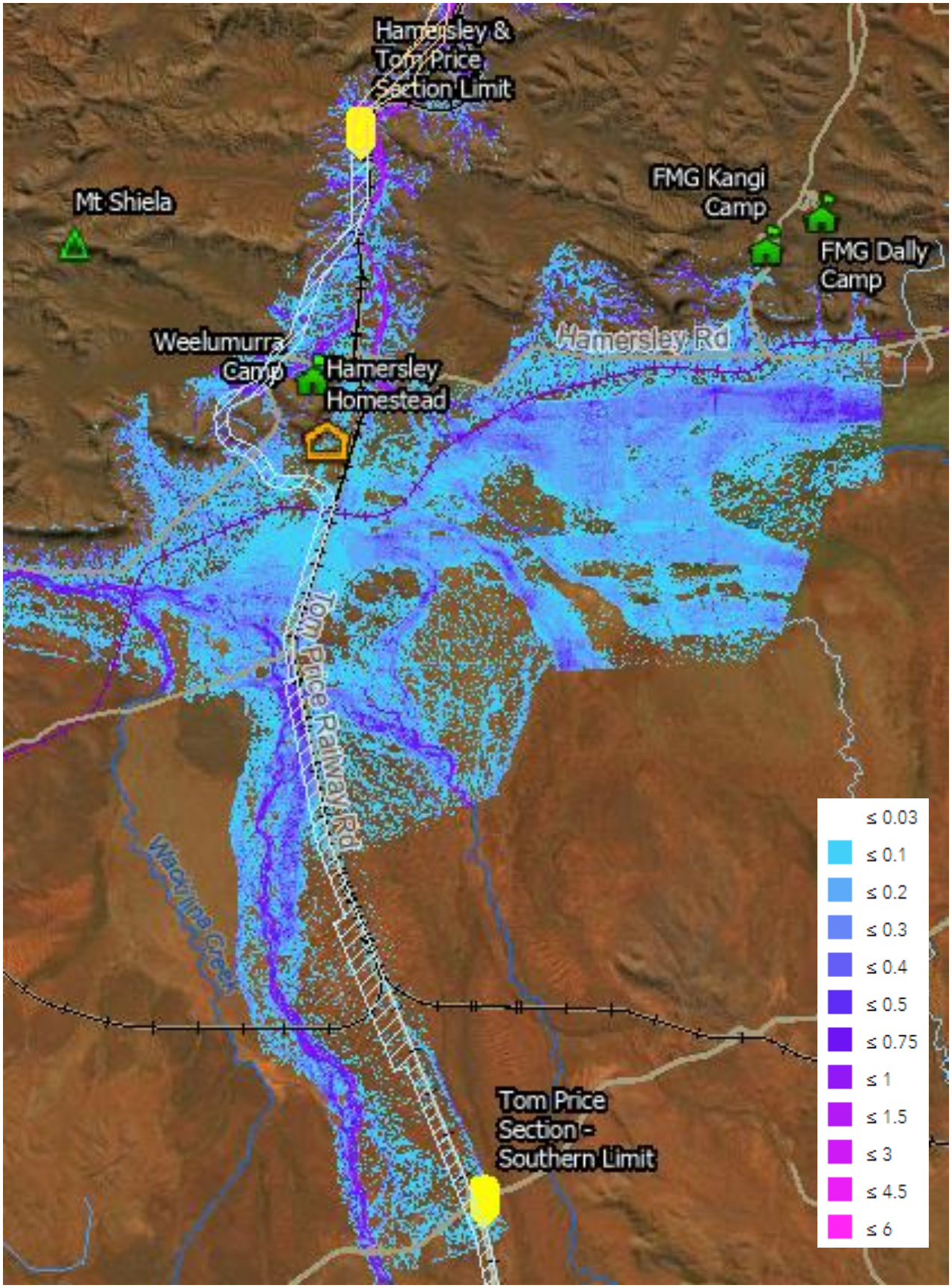


Figure A06 - 1:10 year 'Pre-Development' Maximum Flood Velocity (m/s) – Tom Price Section



APPENDIX

B

ANECDOTAL INFORMATION FROM COOLAWANYAH STATION

Figure B01 - 12 Mile mill and tank – 25 January 2013

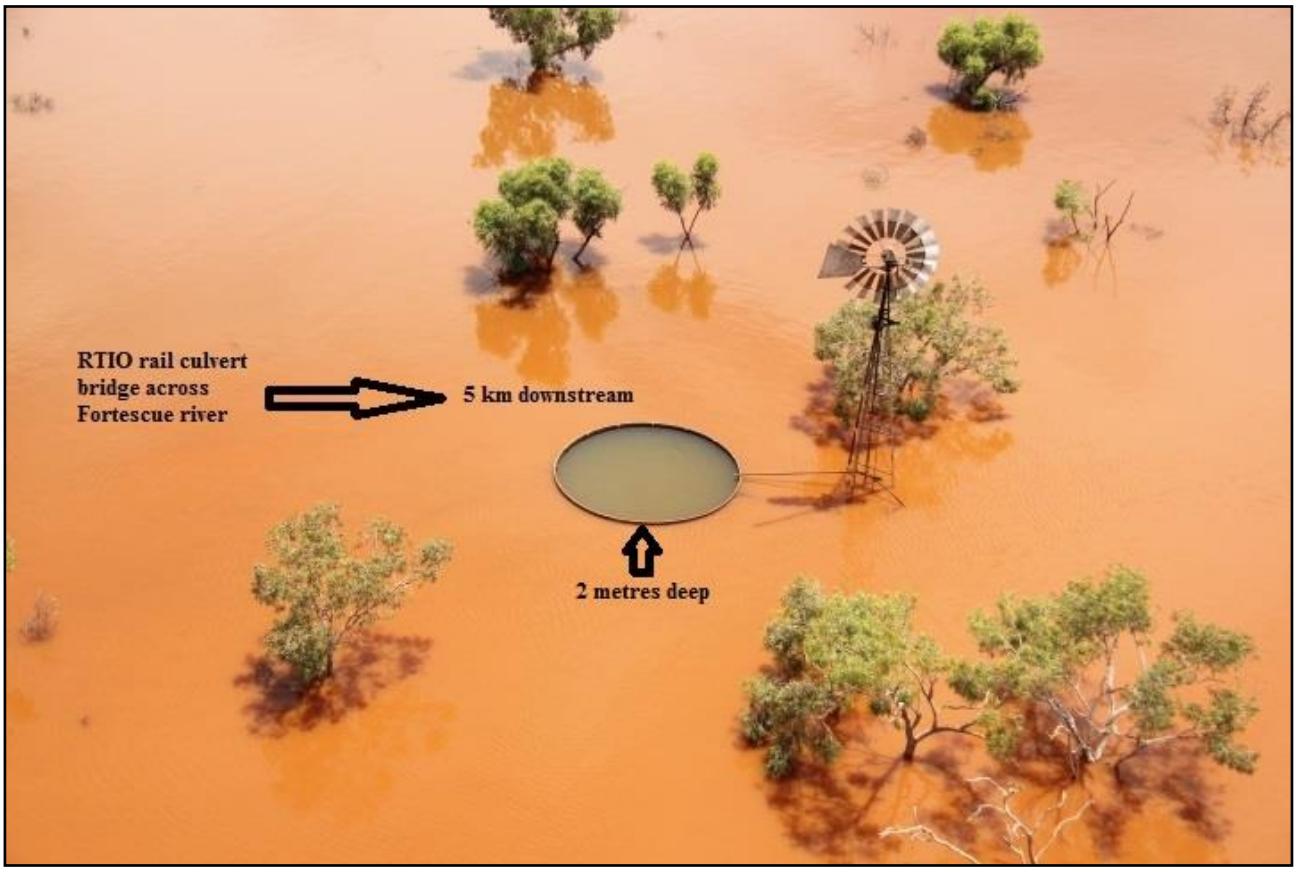


Figure B02 - Hoppy's Camp upstream of Rio Tinto Fortescue crossing – 25 January 2013

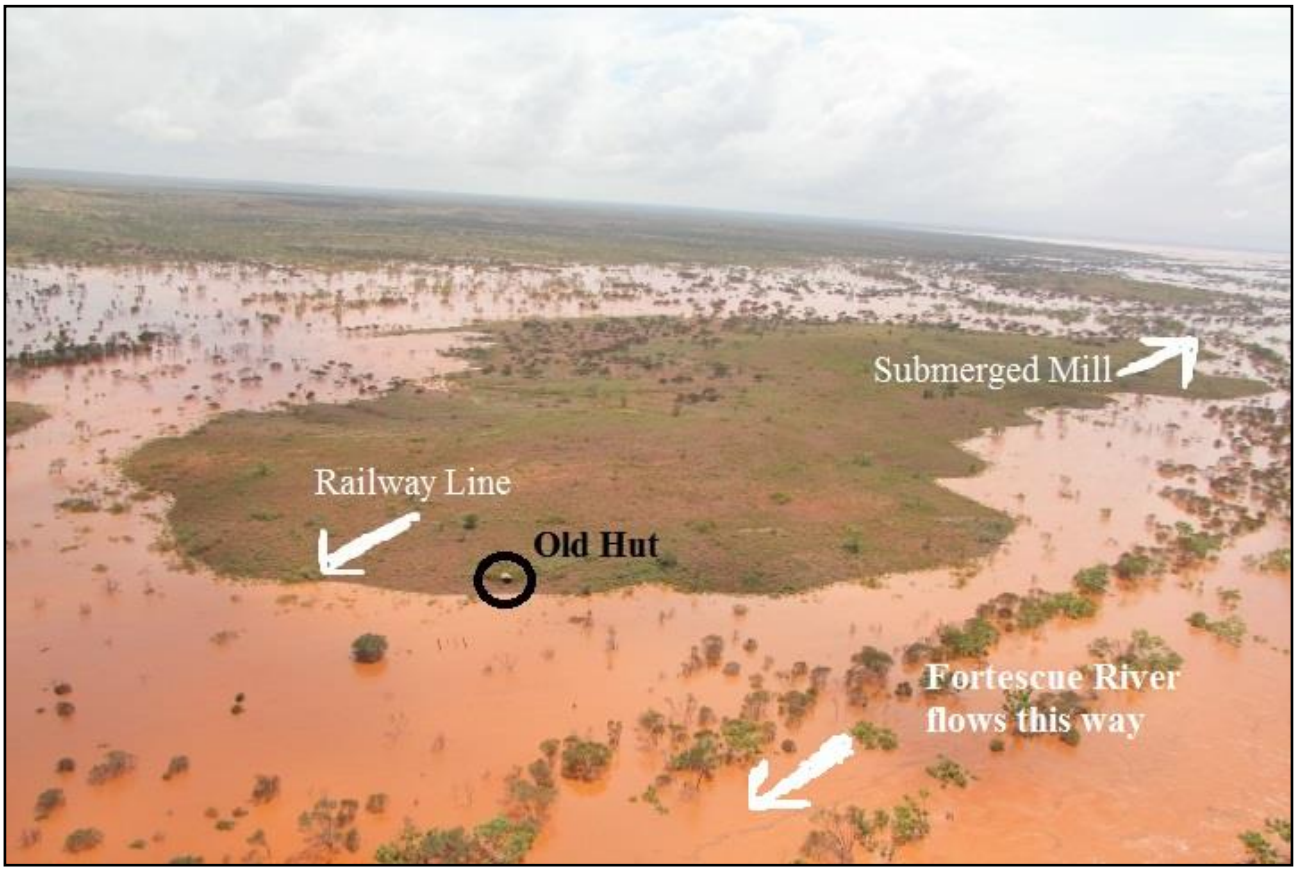


Figure B03 - Looking north at Rio Tinto Fortescue crossing – 25 January 2013

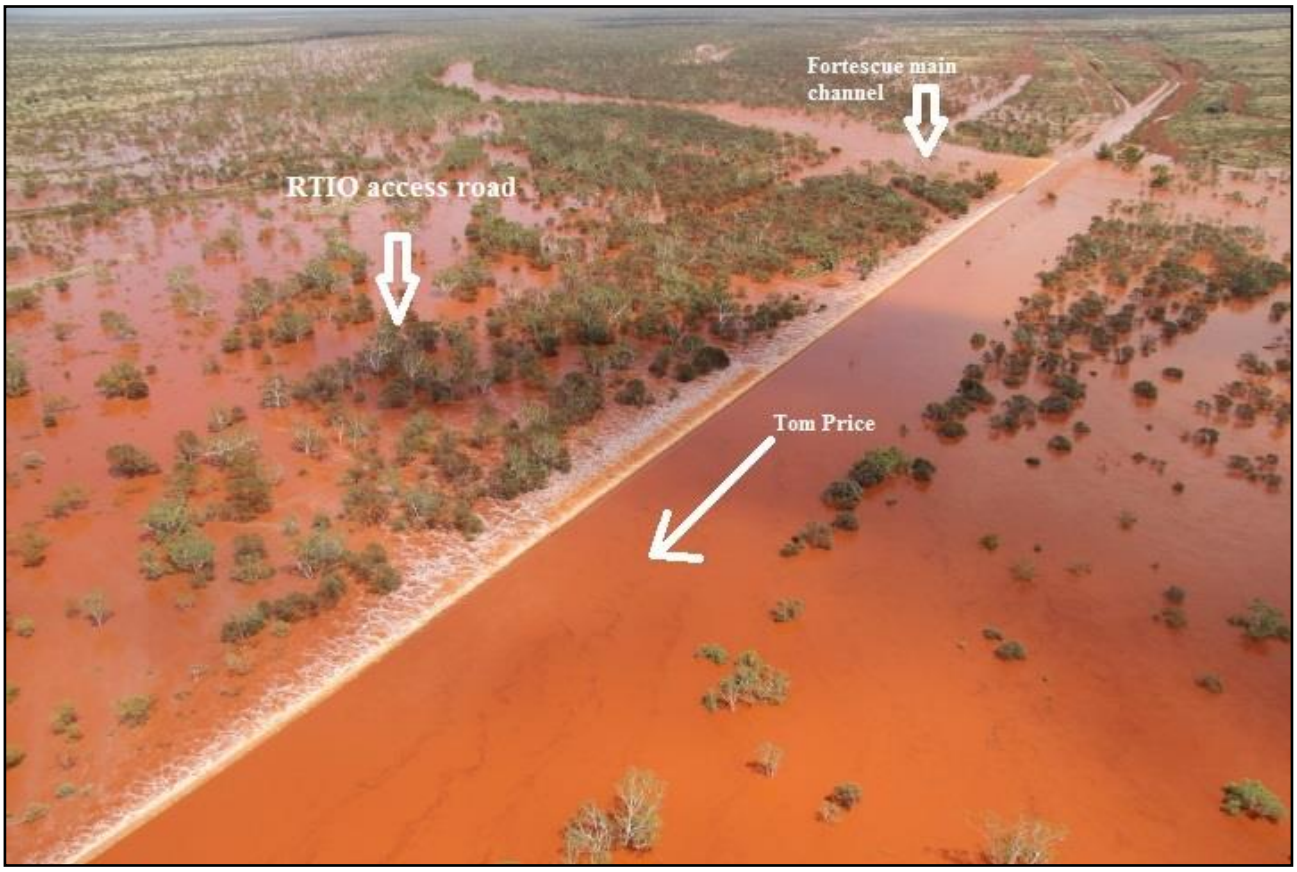


Figure B04 - Level difference across Rio Tinto Fortescue crossing railway floodway – 25 January 2013

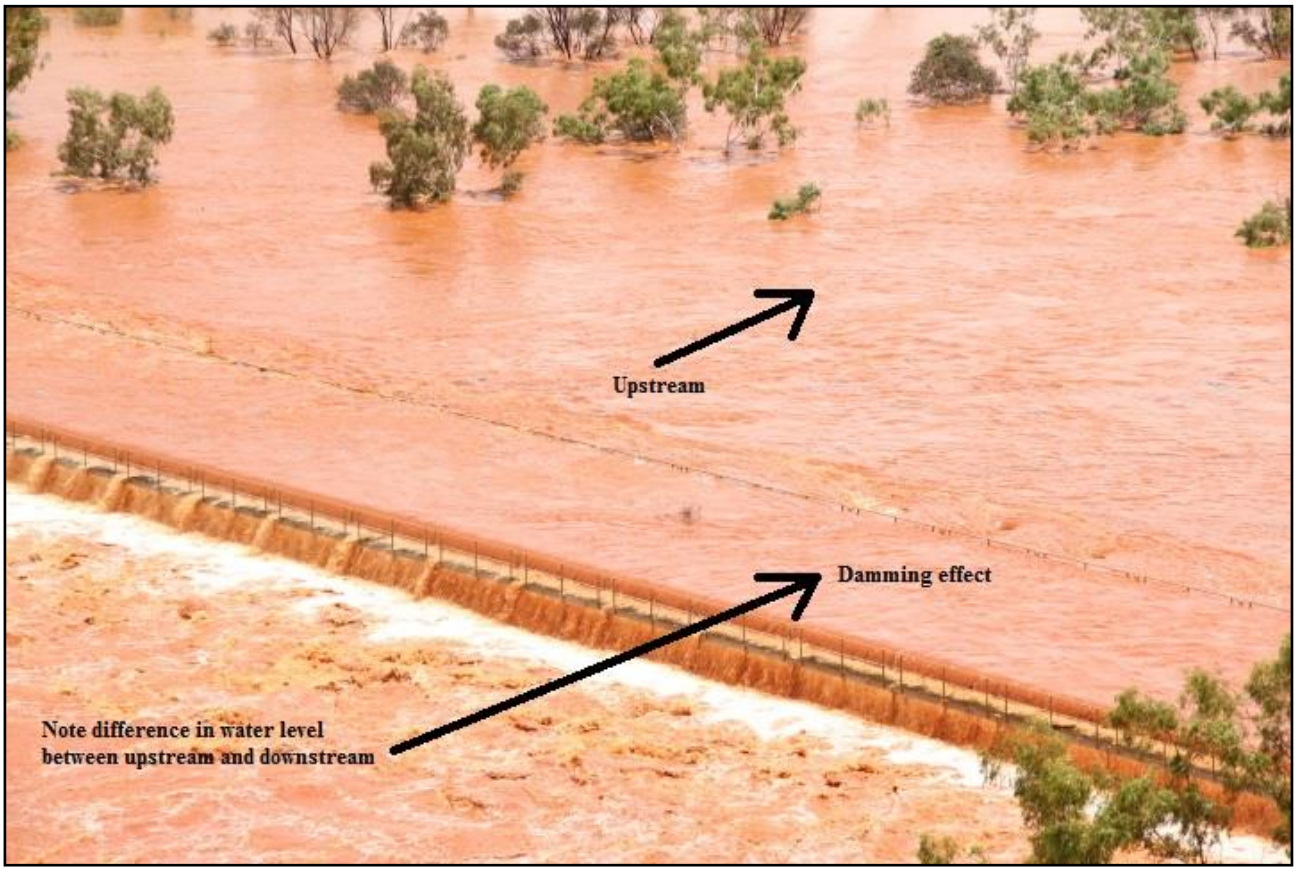


Figure B05 - Looking south at Rio Tinto Fortescue crossing – 25 January 2013

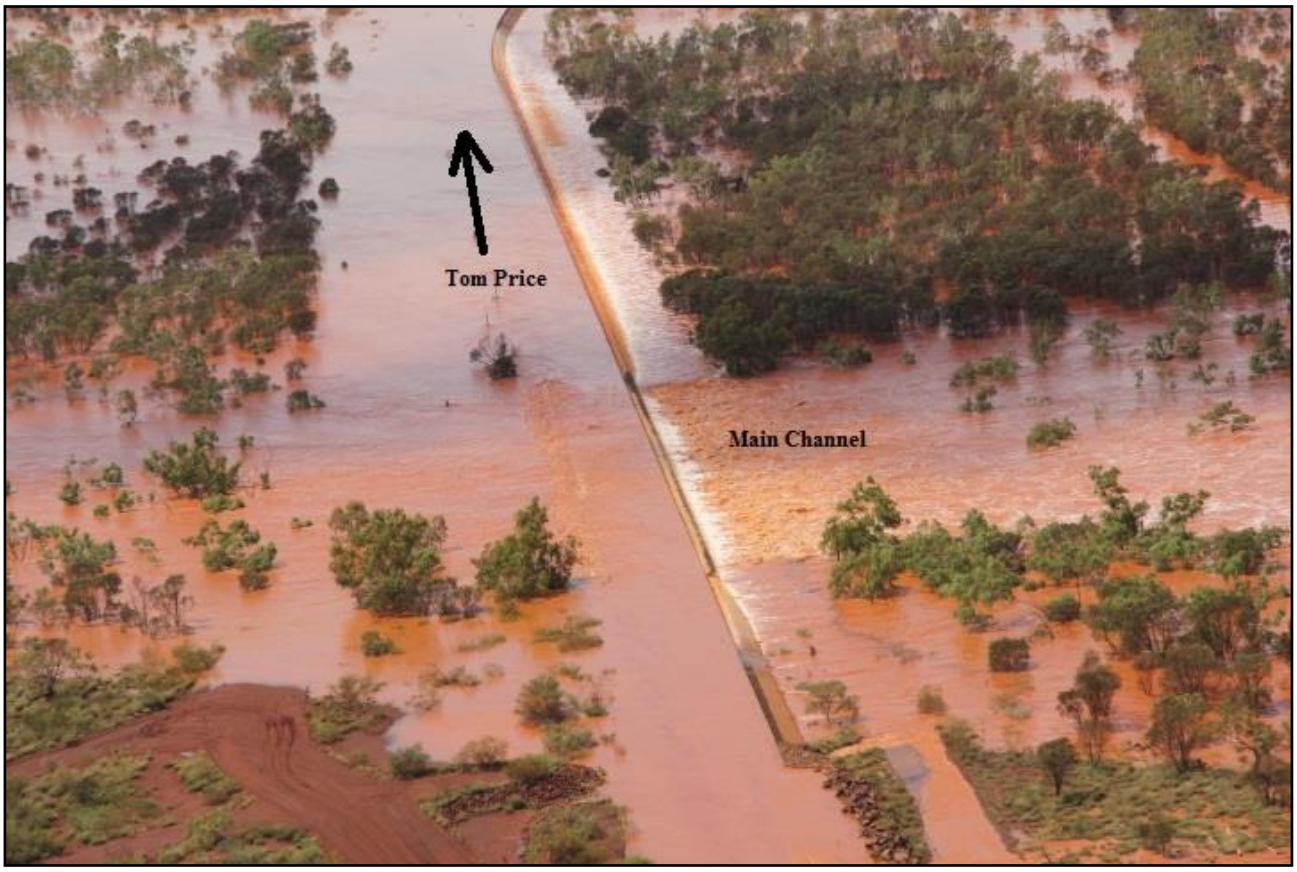
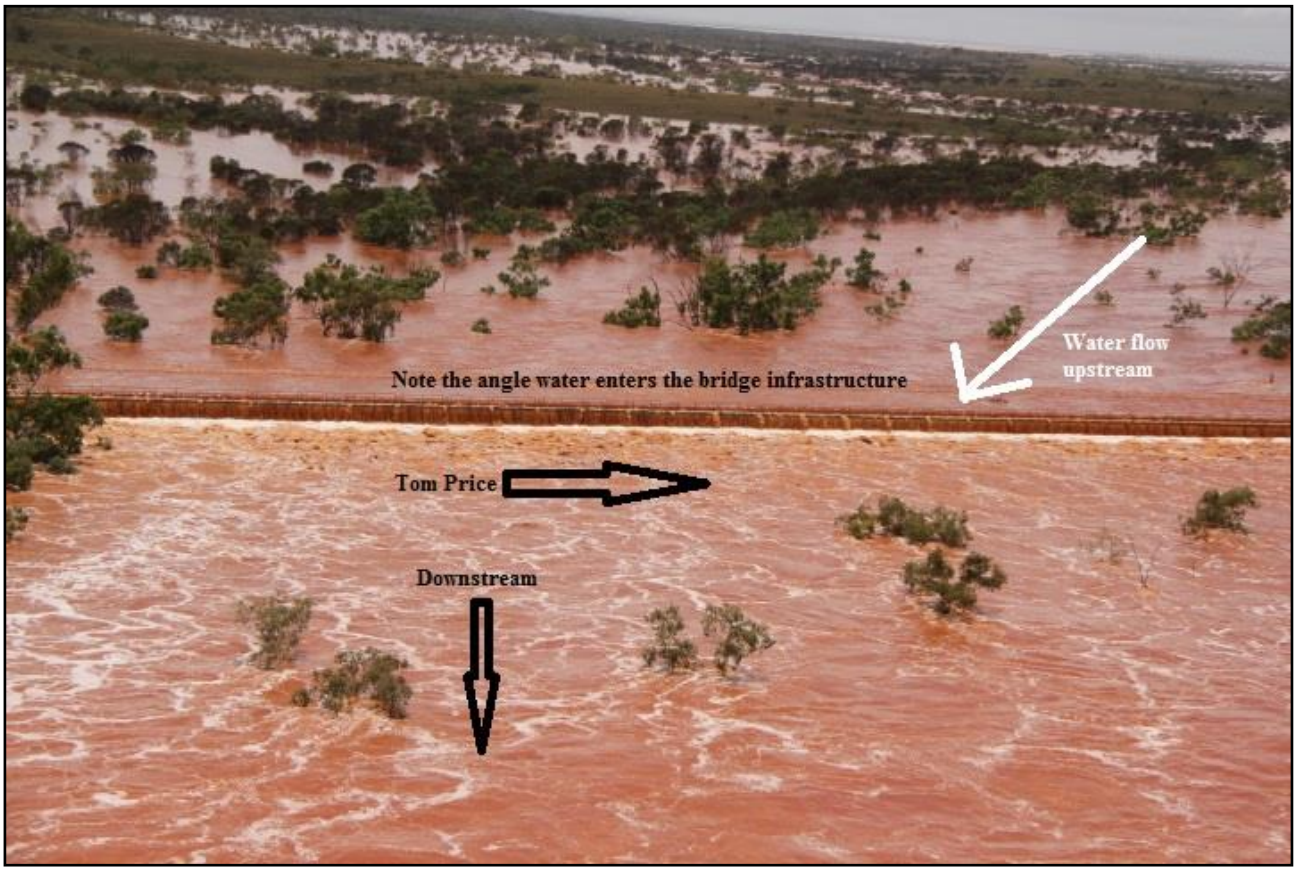


Figure B06 - Looking east at Rio Tinto Fortescue crossing – 25 January 2013



APPENDIX C

RTIO LEVEE FAILURE SCENARIO

Figure C01 - First Coolawanyah levee failure – 2% AEP

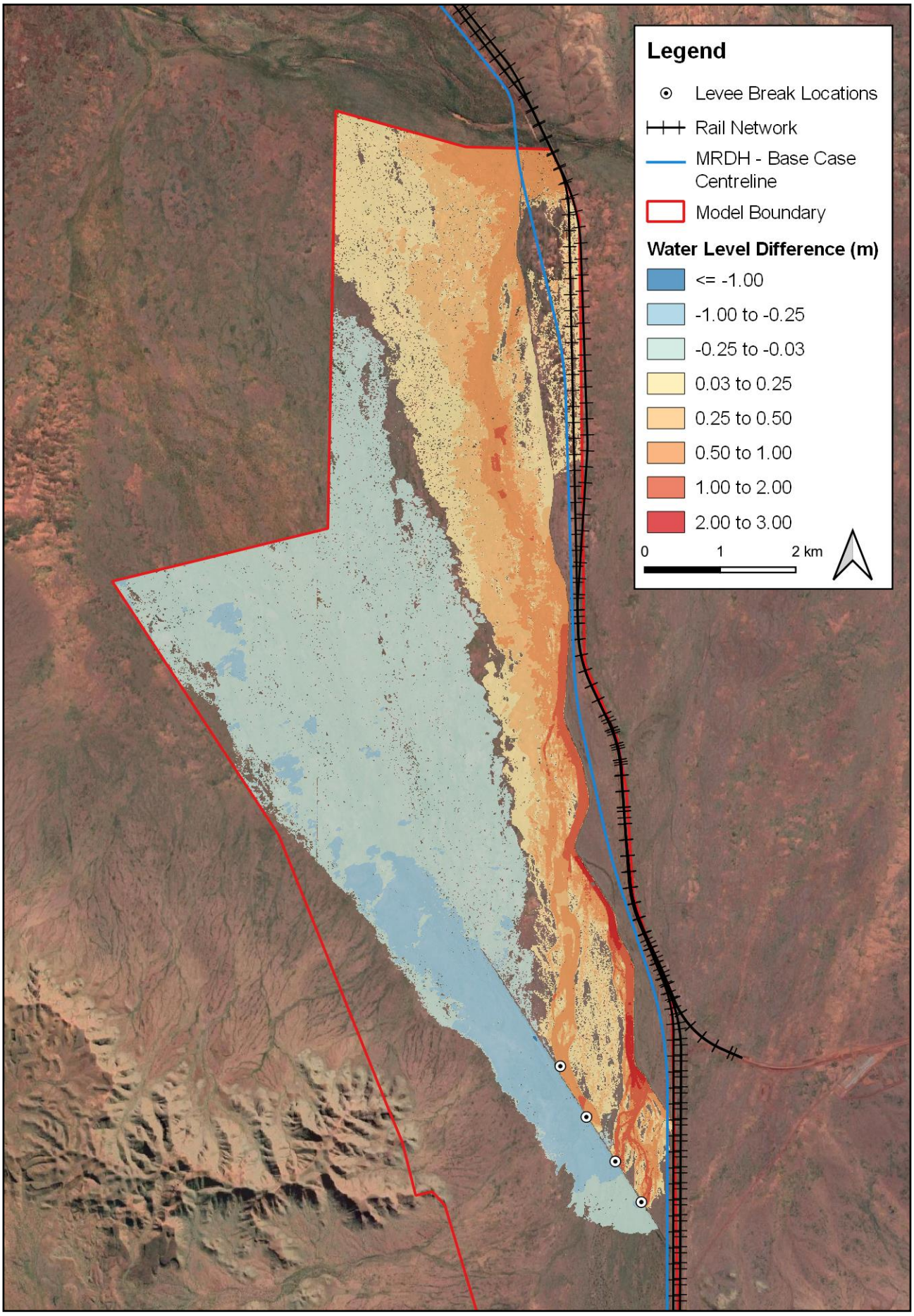


Figure C02 - First and second Coolawanyah levee failure – 2% AEP

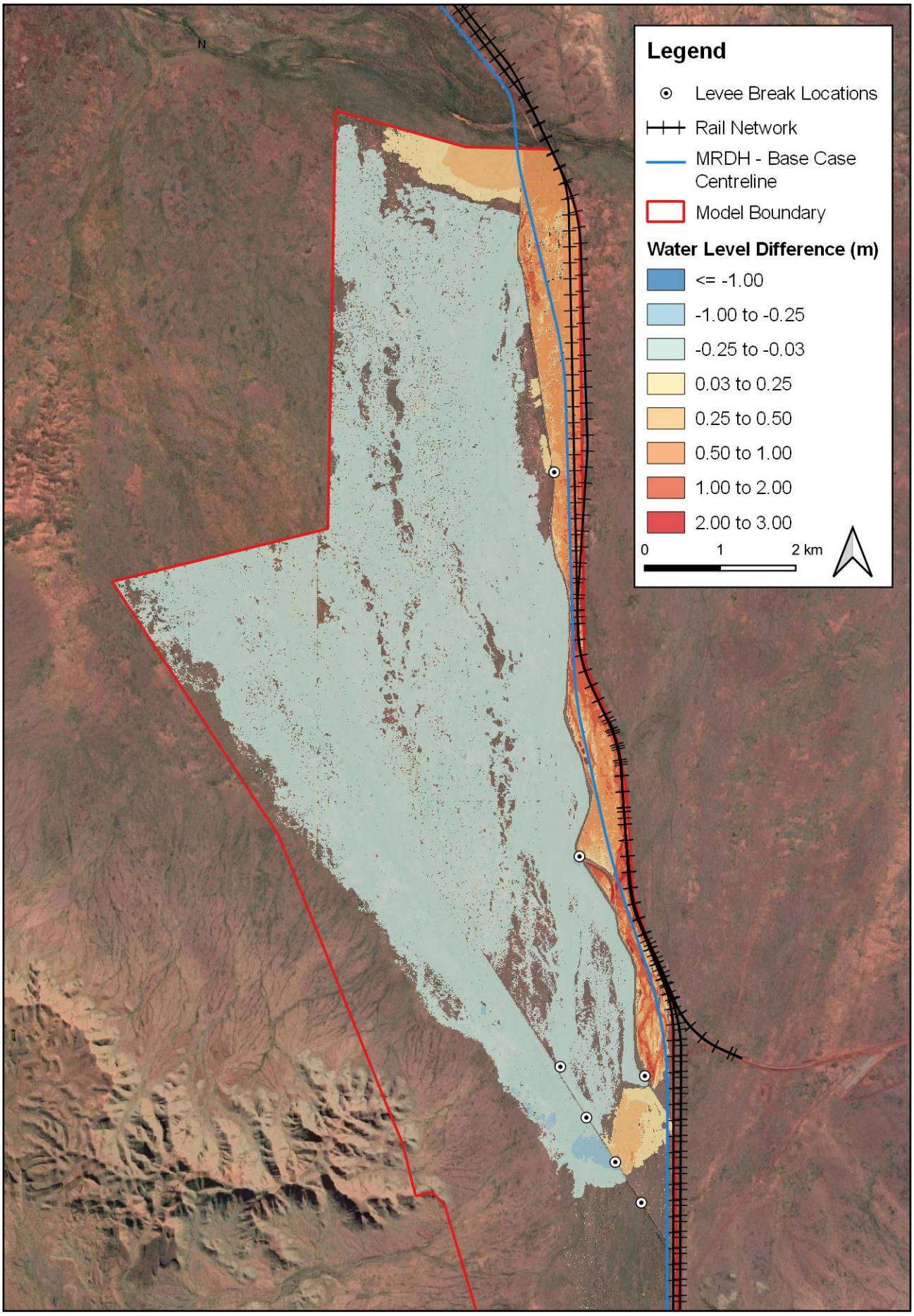
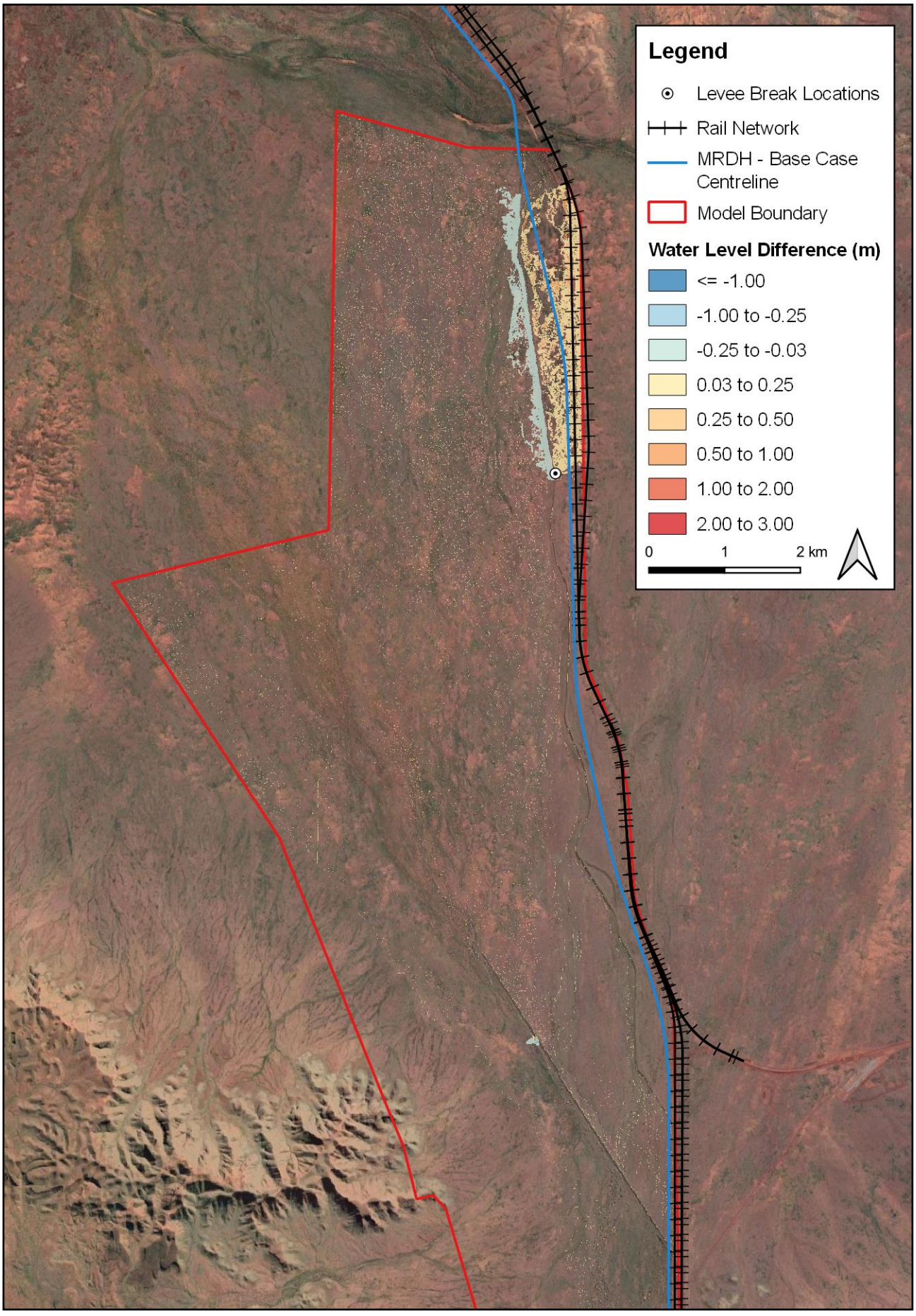


Figure C03 - Second Coolawanyah levee failure (First levee intact) – 2% AEP



Appendix C. Hydrological Risk Assessment for Manuwarra Red Dog Highway (Stage 4) (WSP Golder, 2022)

TECHNICAL MEMORANDUM

DATE 3 November 2022 **Reference No.** PS131971-001-M-Rev2

TO John Morrell
Main Roads WA

CC

FROM Allan Lundorf **EMAIL** allan.lundorf@wsp.com

HYDROLOGICAL RISK ASSESSMENT FOR THE MANUWARRA RED DOG HIGHWAY (KARRATHA TO TOM PRICE ROAD)

1.0 INTRODUCTION

Main Roads Western Australia (MRWA) has engaged WSP Golder to undertake a hydrological risk assessment for the Stage 4 of the Manuwarra Red Dog Highway (MRDH) Project (formerly known as the Karratha – Tom Price Road). Stage 1 to 3 of the MRDH has already been completed and Stage 4 comprises the design and construction of approximately 112 km of new road from Wallyinya Pool to Nanutarra Munjina Road which will complete a sealed link between Karratha and Tom Price.

MRWA submitted EPBC Referral Preliminary Documentation (MRWA, 2021) and a Construction Water Strategy (Jacobs, 2020) to the Department of Agriculture, Water and Environment (DAWE) in October 2021. The Construction Water Strategy stated that the construction phase of Stage 4 of the MRDH requires water mainly for dust suppression and material conditioning (substrate engineering/compaction) and it is proposed that the water is sourced primarily from groundwater along the alignment. In response to the submissions, the DAWE has raised concerns regarding the abstraction of groundwater and the potential impact of the road on surface water (Attachment A). In addition the Environmental Protection Agency (EPA) has also raised a comment regarding potential impact from construction dewatering on permanent or semi-permanent pools.

This technical memorandum has been prepared to address DAWE's concerns and support the EPBC Referral Preliminary Documentation. The scope of this work is comprised of the following:

- Review and collation of existing data and information (geology, hydrogeology, environmentally sensitive areas, and groundwater level data).
- Assess publicly available hydrogeological data as well as data provided by Rio Tinto to MRWA.
- Develop a potential construction bore water supply system based on the geology and minimum required/desired distances between bores to predict potential extraction rate, volume, and duration.
- Estimate the groundwater level drawdown in wells based on the above potential construction bore water supply system using available information.
- Assess potential environmental impacts based on the estimated groundwater level drawdown.

- Prepare this document which includes:
  - Groundwater level drawdown impact assessment.
  - Commentary on water crossing considerations to minimise risks of detrimental environmental impacts from surface water flows.
  - Estimate hydrogeological assessment requirements based on Table 1 of State (DWER) Operations Policy 5.12.
  - Assess potential impacts from construction dewatering and identify mitigation options.

2.0 WATER SUPPLY DEMAND AND SOURCE OPTIONS

The Construction Water Strategy stated that the construction phase of Stage 4 of the MRDH requires water mainly for dust suppression and material conditioning (substrate engineering/compaction) and it is proposed that the water is sourced primarily from groundwater along the alignment. WSP Golder understands that currently the water demand for Stage 4 (112 km) of the MRDH will range between 148,000 and 412,000 kL over a period of 30 months (2.5 years), corresponding to between 59,200 and 164,800 kL/year or 162 kL/d and 451 kL/d.

For the hydrogeological assessment the following has been assumed:

- The construction water demand is required equally along the alignment as the required water demand distribution is currently unknown.
- A groundwater abstraction bore will be located every 5 to 10 km along the alignment, although the final number and location of the bores is currently unknown. This results in a total of around 15 bores equally spaced along the alignment.
- The bores will pump 24 hours day to fill a storage basin/tank from which water will be taken for the daily water supply.
- Given the length of the alignment the construction will be undertaken in incremental stages. For each stage one to three bores will provide the daily water supply demand.

Main Roads is currently in discussions with Rio Tinto about the potential use of Rio Tinto bores for the water supply over part of the alignment. If this materialises then the Rio Tinto bores would provide the water supply coverage over approximately 87 km out of the 112 km part of alignment amounting to around 78% of the alignment. The remaining 25 km portion of the alignment (the most southerly part where Rio Tinto do not have bores) would then be sourced from new water supply bores installed by Main Roads.

The following scenarios have therefore been assessed in this report.

- **Scenario A**: Main Roads will provide 100% of the water from new bores along the whole alignment and 1 bore will provide the daily water supply demand for a particular stage of the road (e.g. Bore 1 will supply water from CH0 to CH7500 and then Bore 2 would provide water for the next section (CH7500 to CH15000), etc.).
- **Scenario B**: This scenario is similar Scenario A where Main Roads will supply 100% of the water demand from new bores along the whole alignment, but the daily water supply will be obtained from pumping 3 bores at any one time. This means that the bores in this scenario will have a three times lower pumping rates than for Scenario A, but the pumping period/duration will be three times as long.

- **Scenario C**: Main Roads will only supply 22% of the water demand over the last 25 km of the alignment, pumping from 1 bore at any one time.
- **Scenario D**: This scenario is similar to Scenario C where Main Roads will only supply 22% of the water demand over the last 25 km of the alignment, but the daily water supply will be obtained from pumping 3 bores at any one time.

Table 1 presents the different scenarios including the required duration of pumping and pumping rate from each well.

Table 1 : Different Water Supply Scenarios

Scenario	Supply of Water	Water Supply Demand (kL/yr)	Alignment Length Requiring MRWA Water Supply (km)	Wells Covering the Alignment	Wells Pumping at Any One Time	Duration of Pumping per Well (Days)	Pumping Rate	
							kL/d	L/s
A	100% MRWA	148,000	112	15	1	61	162	1.88
		412,000		15	1	61	451	5.22
B	100% MRWA	148,000	112	15	3	183	54	0.63
		412,000		15	3	183	150	1.74
C	22% MRWA	32,560	25	5	1	183	36	0.41
		90,640		5	1	183	99	1.15
D	22% MRWA	32,560	25	5	3	548	12	0.14
		90,640		5	3	548	33	0.38

Since Scenario D is considered is to be the most likely scenario to be adopted, this scenario has been assessed in the hydrogeological risk assessment section (refer to Section 4.0). The results and what it means on potential environmental impacts from the other scenarios are discussed in Section 4.6.1.

3.0 SITE DESCRIPTION

The MRDH Stage 4 alignment has been separated into 3 sections – Coolawanyah (approximately 46 km), Hamersley (approximately 27 km), and Tom Price (approximately 39 km). Figure 1 presents the proposed MRDH alignment.

3.1 Geology

The proposed alignment is located within the Hamersley Basin of the Pilbara Craton which contains volcanic-sedimentary rocks of the Mount Bruce Supergroup that overlies a granite-greenstone terrane. The Mount Bruce Supergroup is divided into the Fortescue, Hamersley, and Turee Creek groups. Formations belonging to the Hamersley group are encountered along most of the alignment, and formations belonging to the Fortescue Group are generally encountered at the southern end of the alignment. Figure 2 presents the interpreted geological formations along the proposed alignment based on published information. The formations are also summarised in Table 2.

Table 2: 1:500,000 Interpreted Bedrock Geology for the MRDH Alignment

Group	Formation	Description
Hamersley Group	Brockman Iron Formation	Banded iron-formation, chert, mudstone, and siltstone.
	Marra Mamba Iron Formation	Chert, banded iron-formation, shale, siltstone, and mudstone.
	Mount McRae Shale and Mount Sylvia Formation	Mudstone, siltstone, chert, banded iron-formation, and dolomite.
	Wittenoom Formation	Dolomite and dolomitic shale, with minor chert, shale, banded iron-formation, and sandstone.
Fortescue Group	Bunjinah Formation	Pillowed and massive basaltic flows, basaltic breccia and volcanic sandstone, and minor chert.
	Jeerinah Formation	Shale, sandstone, siltstone, mudstone, dolomite, local micro-banded chert, and jaspilite.
	Pyradie Formation	Pyroxene spinifex-textured basaltic flows and pillow lava with mafic volcaniclastic rock, minor chert and local komatiite.

3.2 Hydrogeology

3.2.1 Groundwater Resources

The groundwater resources along the alignment are covered by the Pilbara Groundwater Allocation Plan and fall under the Ashburton groundwater sub-area. Four groundwater resources are encountered along the alignment which are presented in Figure 3 and summarised in Table 3. The Coolawanyah section of the MRDH Stage 4 alignment covers the Millstream, Fortescue, and Wittenoom groundwater resources, and the Hamersley and Tom Price sections cover the Wittenoom and Fractured Rock groundwater resources.

The Department of Water and Environmental Regulation's (DWER) online Water Register provides a summary of the water availability for each of the groundwater resources. Allocation limits for the groundwater resources covering the alignment are provided in the Pilbara Groundwater Allocation Plan (DoW, 2013). Although, it should be noted that allocation limits may have been updated since the publication of the plan.

Table 3: Water availability information from DWER's online Water Register

Groundwater Area	Groundwater Subarea	Aquifer	General Licensing Allocation Limit (kL/year) (DoW, 2013)	Water Availability
Pilbara	Ashburton	Hamersley – Fortescue	Not set (case-by-case)	Limited Information
		Hamersley – Fractured Rock	Not set (case-by-case)	Limited Information
		Hamersley – Millstream	682,500	Allocation Available
		Wittenoom – Wittenoom	19,980,000	Allocation Available

Notes: * Water Register online database was accessed on 30 May 2022.

3.2.2 Aquifers

A data review and gaps analysis (Jacobs, 2020) outlined four main aquifers present beneath the alignment based on Rojas et al. (2018). Aquifer types occurring along and surrounding the alignment include channel iron deposit (CID) aquifers, valley-fill aquifers, karstified dolomite aquifers, and fractured rock aquifers which are summarised as follows:

- Channel Iron Deposit (CID) – iron-rich, highly porous and permeable deposits underlying current valleys and paleo-valleys. These units can behave as unconfined aquifers when in hydraulic connection with overlying sediments, or as confined aquifers when overlain by poorly transmissive sediments.

- Valley-fill and inland alluvial – occur along the Fortescue River Valley channel. Valleys in the Hamersley Basin show a common sequence of CIDs at the bottom, overlain by calcrete, lacustrine clay and varying alluvium varying from gravel to clay, with an upper layer of calcrete commonly developed in the zone of water table fluctuation.
- Karstified/weathered dolomite – underlies the major valleys of the Hamersley Range. The dolomite is highly variable in nature ranging from massive to highly karstified.
- Fractured rock – occur within the upper weathered zone of granite basement rocks where secondary porosity has been developed due to weathering, fractures, joints, and quartz veining or in greenstone rocks where brittle deformation has occurred. Generally, do not contain regionally substantial groundwater resources. This type of aquifer is subdivided into granite–greenstone terrane and iron-rich deposits showing well-developed fractures due to ore mineralisation (mineralised BIFs).

Figure 3 shows the historical abstraction rates for the groundwater bores along the existing Rio Tinto rail. Typically, the Hamersley – Millstream groundwater resource produces the lowest yield compared to the Hamersley – Fortescue, Hamersley – Fractured Rock and Wittenoom – Wittenoom resources.

The properties of the aquifers across the alignment are summarised in Table 4.

Table 4: Properties for aquifer types (Jacobs, 2020)

Aquifer Type	Total Dissolved Solids (mg/L)	Hydraulic Conductivity (m/day)	Mean Transmissivity (m^2/day)	Storativity (-)
CID (Hamersley – Fortescue)	< 200	14.85	1450	1.05×10^{-2}
Valley-Fill (Hamersley – Fortescue)	200 – 1,500	7.44	930	4.17×10^{-3}
Karstified/weathered dolomite (Hamersley – Millstream and Wittenoom – Wittenoom)	150 – 1,500	1.56	1330	4.02×10^{-2}
Fractured Rock (Hamersley – Fractured Rock)	480 – 3,000	2.26	638	1.27×10^{-2}
Mineralised BIF (Hamersley – Fractured Rock)	200 – 1,400	3.42	950	3.31×10^{-2}

3.2.3 Groundwater Levels

Groundwater level information is available on the DWER online Water Information Reporting tool. The database noted 95 groundwater bores were identified within 5 km of the alignment although groundwater level data is limited. The available information is shown on Figure 3.

Groundwater level information for 19 bores owned by Rio Tinto has been provided to WSP/Golder by MRWA and indicates that groundwater levels range between 4.1 m and 27.3 m below ground level (bgl) along the MRDH Stage 4 development envelope (Figure 3).

3.2.4 Groundwater Users

Groundwater within and surrounding the MRDH development envelope has beneficial uses and supports ecosystem health. The beneficial uses, include public drinking water source areas (PDWSA) and water extraction by 5C Licence holders. Ecosystems such as GDEs may be supported. Groundwater abstraction bores for MRDH, have the potential to impact on beneficial uses and ecosystem values, if close to those beneficial users or ecosystems.

3.2.4.1 Public Drinking Water Source Areas (PDWSAs)

The Millstream Water Reserve is a Public Drinking Water Source Area (Millstream Water Reserve) containing Priority 1 and Priority 2 Groundwater Protection Areas and covers a large portion of the MRDH development envelope. The Millstream bore field for the PDWSA is located approximately 30 km north-west of the development envelope and the Pilbara Groundwater Allocation Plan (DoW, 2013) indicates that the bore field is used when water is not available from Harding Dam or for short periods when demand is high. The PDWSAs are presented in Figure 3.

3.2.4.2 5C Licences to Take Water

The DWER online Water Register indicates that 5C Licences to abstract groundwater are located along the entire alignment, although the licenced bores are for the Pilbara Iron Company Pty Ltd (Rio Tinto) for which MRWA is seeking permission from Rio Tinto to use some of these licenced bores for MRDH construction water supply.

3.2.4.3 Groundwater Dependent Ecosystems

The Bureau of Meteorology's online *Groundwater Dependent Ecosystems Atlas*[1] contains information about three types of groundwater dependent ecosystems:

- Aquatic ecosystems (rely on surface expression of groundwater and includes surface water ecosystems which may have a groundwater component, such as rivers, wetlands, and springs).
- Terrestrial ecosystems (rely on the subsurface presence of groundwater and includes all vegetation ecosystems).
- Subterranean ecosystems (includes cave and aquifer ecosystems).

The GDE Atlas indicates that the MRDH alignment and surrounding area includes known aquatic GDEs from regional studies, and moderate to high potential aquatic and terrestrial GDEs from national assessments. Information pertaining to the GDEs is summarised in Table 5.

Table 5: Information for aquatic and terrestrial ecosystems from BOM GDE Atlas

Ecosystem Class	Feature	Ecosystem Type	GDE Potential	Alignment Section
Terrestrial GDE	Fortescue River	Riparian vegetation	Known	Coolawanyah
Aquatic GDE	Fortescue River	River	High	Coolawanyah
Aquatic GDE	Weelumurra Creek	River	High	Coolawanyah, Hamersley, Tom Price

In addition to the GDE Atlas, the EPBC Preliminary Documentation detailed that the occurrence of Eucalyptus and Melaleuca species (*Melaleuca argentea*, *Eucalyptus camaldulensis,* and *Eucalyptus victrix*) along the alignment is generally associated with drainage lines. These species are also known to be largely restricted to mesic environments such as riparian zones and wetlands (DoW, 2010). Two types of habitats were identified as part of the EPBC Preliminary Documentation which contain these species – Eucalyptus fringed major drainage lines and associated tributaries (MDE) and Melaleuca Forest/major drainage lines (MDM). These habitats support the Pilbara Leaf-nosed Bat, Pilbara Olive Python, Grey Falcon, Northern Quoll, and Ghost Bat generally for foraging, dispersal, and drinking.

The groundwater dependent ecosystems are presented in Figure 4.

[1] Bureau of Meteorology's *Groundwater Dependent Ecosystem Atlas* – http://www.bom.gov.au/water/groundwater/gde/map.shtml

3.3 Hydrology

The proposed development envelope for Stage 4 of the MRDH crosses rivers and creeks throughout the development envelope and are summarised as follows:

- The MRDH crosses the Fortescue River alignment at the confluence with Weelamurra Creek between around Chainage 30,000 of the Coolawanyah section.
- The MRDH alignment follows the Weelamurra Creek between Chainage 30,000 of the Coolawanyah section and Chainage 5,000 of the Tom Price section.
- The MRDH crosses the confluence of Barnett Creek and an unnamed minor river around Chainage 20,000 of the Tom Price section.

The surface water features along the alignment are presented in Figure 5.

4.0 HYDROGEOLOGICAL RISK ASSESSMENT

In response to the DAWE's concerns a preliminary hydrogeological assessment in general accordance with DWER (previously DoW) Operational Policy 5.12 (DoW, 2009) has been undertaken to support MRWA's EPBC submission for Stage 4 of the MRDH. The assessment takes into consideration the following:

- Volume and pumping regime requested (construction water supply)
- Level of use in groundwater management area (groundwater area or subarea)
- Potential impacts upon other users and groundwater-dependent ecosystems, and
- Existing salinity of the groundwater resource.

The decision table for the hydrogeological assessment is presented in Table 6.

Table 6: DWER Operational Policy 5.12 Decision Table for Hydrogeological Assessments

Volume Requested (kL/year)	Level of Allocation*	Potential for Unacceptable Impacts		Existing Salinity (mg/L)
		Other Users	GDEs	
<10,000 (0 points)	0 to <30% (C1) (0 points)	Impacts unlikely (0 points)	Impacts unlikely (0 points)	Fresh TDS <500 mg/L (4 points)
10,001–50,000 (2 points)	30 to <70% (C2) (1 point)	Impacts possible (2 points)	Impacts possible (2 points)	Marginal TDS 501–1,500 mg/L (3 points)
50,001–250,000 (4 points)	70 to <100% (C3) (3 points)	Impacts likely (5 points)	Impacts likely (5 points)	Brackish TDS 1,501–5,000 mg/L (2 points)
250,001–500,000 (6 points)	100% and over (C4) (5 points)			Saline TDS 5,001–50,000 mg/L (1 point)
500,001–1,000,000 (8 points)				Hypersaline TDS >50,000 mg/L (0 points)
1,000,001–2,500,000 (15 points)				
>2,500,000 (20 points)				
Points assigned = a	Points assigned = b	Points assigned = c	Points assigned = d	Points assigned = e

Notes: * Points are not applied if drawing from a fractured rock aquifer

Points are assigned for each column in the table (i.e., volume, allocation, potential impacts – users, GDEs, and salinity), and add to arrive at a score (*a+b+c+d+e*):

- 0 – 7 points: Generally, no assessment required, unless other knowledge of risks indicates that H1 level assessment (desktop hydrogeological assessment) is warranted.
- 8 – 12 points: H1 level of assessment (desktop hydrogeological assessment). However, low volume applications with low risk of impacts may not warrant an assessment. These cases can be discussed with DWER's hydrogeologists.
- 12 – 18 points: H2 level of assessment (basic hydrogeological assessment, including installation and testing of investigation bores).
- > 19 points: H3 level of assessment (detailed hydrogeological assessment including installation and testing of investigation bores and a groundwater model).

4.1 Construction Water Supply

For the hydrogeological assessment, Water Supply Scenario D has been used as this scenario would have the greatest potential environmental impact on other users and the environment. As outlined in Section 2.0 it is for this scenario assumed that:

- The construction water demand is required equally along the 25 km of alignment that MRWA will supply through new bores.
- A total of 5 approximately equally spaced new Main Road bores will be constructed along the southern 25 km alignment.
- 3 bores will be used at any one time for supply of the southern 25 km alignment.
- Using 3 bores along the alignment, the required pumping duration for each bore is around 548 days.

4.2 Level of Allocation

The construction water supply, given the above assumptions, is not above 30% of the allocation limits for the Hamersley – Millstream and Wittenoom – Wittenoom aquifers (refer to Table 5).

Allocation limits are not set for fractured rock aquifers because of their complex and irregular characteristics and therefore water availability, recharge and storage are very localised. Licence applications for fractured rock aquifers are assessed on a case-by-case basis.

4.3 Potential for Unacceptable Impacts

The abstraction of groundwater will draw down the groundwater level around the draw point (bore) and the extent of the drawdown will vary depending on the characteristics of the aquifer and the volume and duration of pumping. There is the potential for existing groundwater users and GDEs (i.e., wetlands, streams, and springs) to be impacted due to the drawdown of the groundwater level.

The groundwater level drawdown likely to be observed for each aquifer at three distances from the point of abstraction (0 m, 500 m and 1000 m) has been calculated using the Cooper-Jacob (1946) solution and aquifer properties described in Section 3.2.2. Using proposed total project water demand volumes provided by Main Roads, an estimated volume of between 148,000 and 412,000 kL was used to calculate minimum and maximum pumping rates of 1.9 L/s and 5.4 L/s and is presented in Table 7.

The Cooper-Jacob equation used is as follows:

$$s = \frac{Q}{4\pi T} \ln\left(2.2459 \frac{Tt}{r^2 S}\right)$$

Where:

- s – drawdown
- Q – pumping rate (L/s)
- T – transmissivity (m^2/day)
- t – time (days)
- r – radial distance from pumping well (m)
- S – storage coefficient.

Table 7 : Estimated Groundwater Level Drawdown (metres) During Pumping (Scenario D)

Aquifer	Pumping Rate (L/s)	Drawdown (m) after 548 days *			
		0 m	100 m	500 m	1,000 m
Channel Iron Deposits	0.14	0.02	0.01	0.00	0.00
	0.38	0.05	0.02	0.01	0.01
Valley-fill and Inland Alluvial	0.14	0.03	0.01	0.01	0.01
	0.38	0.08	0.03	0.02	0.02
Karstified/Weathered Dolomite	0.14	0.02	0.01	0.01	0.00
	0.38	0.06	0.02	0.01	0.01
Fractured Rock	0.14	0.04	0.01	0.01	0.01
	0.38	0.11	0.04	0.02	0.02
Mineralised BIF	0.14	0.03	0.01	0.00	0.00
	0.38	0.07	0.02	0.01	0.01

* The end of the pumping period for the specific scenario.

The estimated groundwater level drawdown for each aquifer is very low and therefore the potential for impacts to groundwater dependent ecosystems is anticipated to be minimal/unlikely. The groundwater level at WARP13, WARP15, and WARP24 within the Eucalyptus and Melaleuca vegetated drainage lines has also been recorded at greater than 15 m below ground level.

Where abstraction bores are not located in close proximity to groundwater dependent ecosystems it is considered that impacts to GDEs are unlikely. Where abstraction bores are located within or in close proximity to a GDE, impacts are possible, but not considered detrimental given the short duration of abstraction.

4.4 Existing Salinity

As detailed in Table 4 the anticipated TDS is <3000 mg/L which corresponds to salinity ranging between fresh and brackish along the alignment.

4.5 Risk Assessment

The hydrogeological impact assessment is based on the volume of groundwater requested, the level of allocation from the corresponding groundwater resource, the potential for unacceptable impacts on groundwater users, known GDEs and the groundwater salinity. In undertaking the impact assessment, the extent of the groundwater level drawdown from pumping has been estimated. Given that the number of and

location of wells has not yet been determined, this assessment provides general estimates and discussion on impacts based on an annual demand of 164,800 kL/year. The groundwater level drawdown estimates show that the maximum drawdown over 90 days should not have a significant impact on other groundwater users or known GDEs.

The results of the assessment are presented in Table 8 and indicate that a H1 (desktop) level assessment may be required by DWER as part of the 5C licence application for the Coolawanyah section of the alignment, as the Hamersley-Fortescue aquifer may yield fresh water and there are known GDEs within the area. The Tom Price section of the alignment may not require any hydrogeological assessment, though DWER may request one if deemed necessary during the licence application process.

Table 8: Level of Hydrogeological Assessment Using DWER Operational Policy 5.12 Decision Table

Alignment Section	Maximum No. Points	Level of Assessment Required	Comments
Coolawanyah	8	H1	Assumed fresh water (TDS <500 mg/L) is located in areas along the alignment and there are possible impacts to GDEs depending on the final location of the abstraction bores.
Hamersley	7	No assessment	Assumed marginal to brackish water (TDS 501 – 5,000 mg/L) is located along the alignment
Tom Price	7	No assessment	Assumed marginal to brackish water (TDS 501 – 5,000 mg/L) is located along the alignment

4.6 Risk Management

The risk of environmental harm as a result of groundwater abstraction will be dependent on the groundwater level drawdown and abstraction duration. The risk of impacts resulting from groundwater level drawdown can be reduced further by implementing the following measures:

- Installing a greater number of bores along the alignment which will reduce the discharge rate from each bore.
- Operate more bores at any one time, which will reduce the required the discharge rate from each bore.
- Performing pumping tests in proposed water supply bores and measuring drawdown and recovery in the pumping bore and surrounding observation bores to:
  - Determine sustainable pumping rates.
  - Confirm aquifer properties such as specific capacity, hydraulic conductivity, transmissivity, and storativity.
  - Confirm the extent of the groundwater level drawdown caused by abstraction.
  - Determine minimum separation distances between bores to reduce well-interference effects, and between bores and GDEs to minimise drawdown impacts.
- Reduce pumping rates to decrease the groundwater level drawdown if groundwater level monitoring indicates drawdown near GDEs is too high.
- Monitoring of groundwater levels and water quality between groundwater dependent ecosystems and groundwater abstraction bores before, during, and after pumping.

4.6.1 Results from Different Water Supply Sourcing and Operation

Attachment B presents a summary table with the estimated groundwater level drawdown extent for the four different scenarios described in Section 2.0. Scenarios A, B and C are considered potential water supply options that could reduce any potential environmental impacts. The results in Attachment B indicate:

- For Scenarios C and D where 78% of the water demand will be provided by Rio Tinto, the estimated groundwater level drawdown will be lower than for Scenarios A and B:
  - For Scenario C the estimated groundwater level only range between 0.02 m and 0.09 m at a distance of 100 m from the well and 0 m to 0.05 m at a distance of 500 m from the well.
  - For Scenario D these groundwater level drawdowns reduce even further by up to 2.5 times to 0.01 m to 0.04 m at 100 m distance and 0 m to 0.02 m at 500 m distance.

  The smallest groundwater level will, as expected, occur for Scenario D.
- The greatest groundwater level drawdown will occur for Scenario A. The groundwater level drawdown is still considered to be small, ranging between 0.07 m and 0.37 m at a distance of 100 m from the well and 0.04 m to 0.19 m at a distance of 500 m from the well.
- Scenario B will result in a reduction in the groundwater level of around 2 to 2.5 times at 100 m distance (0.03 m to 0.14 m) and 500 m distance (0.02 m to 0.08 m) compared to Scenario A. The operation of more bores along the alignment would therefore reduce the impact at each bore.

4.7 Construction Dewatering

Main Roads will need to construct a new bridge over the Weelamurra Creek, which may require dewatering during construction of the bridge piers/footings.

For the potential dewatering impact assessment the following assumptions were made:

- The groundwater level is 2 m below ground level at the bridge structure locations. There is currently no specific groundwater level at the bridge location, but groundwater would be expected to be close to surface, especially during the wet season.
- The bridge structure excavation will be 30 m (length) by 10 m (width) by 5 m (depth).
- Construction dewatering is required to 1 m below the excavation level. This results in a required groundwater level drawdown of 4 m.
- Construction dewatering will be required for 2 months for the bridge structure.
- According to the geological map the site is located within the Wittenoom Formation. The Transmissivity is set at 1330 m^2/d as provided in (Jacobs, 2020) for this formation. This transmissivity is considered to be a conservative value.
- Since it is the groundwater table that is being dewatered (i.e. unconfined conditions exist), the specific yield (storage coefficient) has been set to be 0.25.

Based on the hydrogeology at the bridge and above assumptions the results indicate:

- The dewatering rate could be high to very high. Based on simplistic analysis the dewatering rate could be 50 L/s to 100 L/s

- The groundwater level drawdown is estimated to be around 0.5 m at a distance of 100 m from the excavation with the groundwater level drawdown extending up to 800 m from the excavation. This is assuming that no infiltration will occur back into the aquifer (i.e. worse-case scenario).

It is noted that the groundwater level drawdown can be controlled in specific areas (e.g. near pools) by recharging/infiltrating the extracted groundwater in between the excavation and the potential environmental impact area (e.g. pools).

Recharging/Infiltrating the extracted groundwater at the site would also result in a net abstraction rate close to zero (except for some small losses).

Based on the above it is therefore anticipated that with proper dewatering management, the dewatering for this bridge will have only a minor and temporary effect on the local groundwater system given:

- Dewatering for bridge structures will be of short duration (approximately 2 months at each bridge support location) and to a maximum depth of no more than 5 m below ground.
- Any extracted groundwater can be infiltrated/recharged back into the groundwater aquifer near the site, resulting in a net abstraction volume close to zero from the groundwater aquifer.
- The recharge/infiltration areas can be strategically located between the dewatering area and any identified environmental sensitive area (e.g. a pool) in the area, if any. This allows for the groundwater level to be controlled and managed at the environmental sensitive area, resulting in negligible/minimal drawdown at these areas. We understand that this is the same strategy that Fortescue Metals Group (FMG) applies to minimise mine dewatering drawdown impacts on Weelamurra Creek.

It is also noted that any dewatering operations will be subject to requirements of the Rights and Water Irrigation Act 1914 (RIWI Act) ensuring impacts to sensitive environmental receptors are either avoided or minimised. As part of this approval a site specific Dewatering Management Plan (DMP) would be required to be developed which will outline the dewatering, monitoring and management requirements including outlining the location and extent of the infiltration/recharge areas. The Dewatering Management Plan will also outline specific groundwater level trigger levels and contingency requirements.

5.0 HYDROLOGICAL RISK ASSESSMENT

A hydrological risk assessment was undertaken by Cardno (2022) for the proposed MRDH alignment which provides an understanding of the surface water regime throughout the study area; identifies and describes the hydrological risk factors associated with the MRDH; and proposes a design criteria to be adopted in managing the major waterways. The assessment, utilising RORB Runoff Routing software and TUFLOW hydraulic modelling software, also discusses the interaction between the proposed MRDH with the existing railways and the changing rainfall patterns to be considered in the design of the crossings.

WSP Golder understands that the hydrological assessment addresses concerns raised by the DAWE relating to potential environment impacts from surface water flows potentially altered by the MRDH and this technical memorandum hereby presents a summary of their assessment.

5.1 Hydrological Risks

The assessment identified risks for both pre- and post-development of Stage 4 of the MRDH. The risks identified pre-development of the MRDH include:

- High flow depths at major crossings in the Coolawanyah section and at Fortescue River.
- Interaction with the existing Rio Tinto levees which direct Weelamurra Creek.

- Braided flows and narrow widths in Weelamurra Creek which may cause difficulty for road crossings.
- Water levels in the flood plain at the Eliwanna railway road under the rail arch.
- The confluence of flows of Barnett Creek and Caves Creek near the proposed MRDH alignment and the Rio Tinto railway.

The risks identified for post-development of the MRDH include:

- Backwater impacts from the MRDH on third party infrastructure (Rio Tinto and/or FMG rail and access track embankments) resulting in closure of the railway, and embankment and track reconstruction.
- Reduced serviceability of the MRDH during storm events resulting in road closures for long periods of time while upstream catchments are draining.
- Insufficient resilience of the MRDH to withstand high flows during storm events resulting in failure of the road pavement, embankment or other components due to high flow velocities or inundation, and/or the failure of levees, bridge abutments, and scour protection.
- Insufficient design appreciation for the complexity and variability of the channel flows resulting in changing the upstream main channel flows, embankment scour, and/or overtopping of the road.
- Insufficient design appreciation of design requirements for managing the risks of complex waterways resulting in embankment scour, overtopping of the road, under/over designing of the drainage controls, and/or longer periods of inundation adjacent to the MRDH in the flood plain areas.

5.2 Design Considerations

The assessment recommends the following design considerations for the waterways design based on an informed understanding of the key hydrological risk areas, the implications of climate change, and the requirements for a ‘Pilbara-Proof’ design. Changing rainfall patterns were included in the assessment by the modelling of several rainfall scenarios using current rainfall data with interim climate change factors (i.e., 2050 RCP4.5 and 2070 RCP8.5) and annual exceedance probabilities (AEP) ranging from 1% to 50%. These rainfall scenarios where then applied to scenarios which addressed design criteria for the elements:

- Serviceability/maximum road closure time due to flood water.
- Road closure in both directions for reconstruction following flooding.
- Floodway dry and wet serviceability.
- Culvert capacity.
- Culvert scour treatments extents and sizing.
- Resistance to scour scenarios.
- Pavement inundation duration without specialist treatment.
- Roadside/formation drains.
- Bridge dry serviceability.
- Levees – overtopping avoidance or scour protection.
- Third party adverse backwater impacts.

The assessment identified that the existing infrastructure developed by mining companies alters the natural surface water flows. In particular, the Rio Tinto main rail alignment and Brockman spur line, and associated culverts and bridge structures which control the east to west flow on the eastern side of the proposed MRDH. Furthermore, the proximity of the proposed MRDH alignment to the existing Rio Tinto railway requires that the road design considers how the change in the flow caused by the MRDH could impact on Rio Tinto assets and the surface water regime. The MRDH if not designed appropriately has the potential for increased water levels that could cause overtopping or scour to the embankments or other structures.

However, to minimise the potential impacts of the MRDH of surface water regimes the assessment by Cardno recommends incorporating the following in future design calculations:

1) Adopt design criteria reflective of a 'worst-case' up to (and including) the proposed design event.

2) Review of the embankment heights by a geotechnical consultant to accommodate capillary rise in areas prone to long duration inundations.

3) Adopt a rarer storm event using current IFD data which is equivalent to worst case RCP 8.5 modelling.

4) Avoid adverse impacts to third-party infrastructure through detailed investigations at likely locations with increased backwater.

5) Evaluate potential impacts on sensitive environmental and heritage receptors during high probability events.

6) Ensure the MRDH embankment is not impacted by downstream turbulence caused by clows controlled by adjacent railway infrastructure.

7) Implementation of:

a) Trapezoidal roadside drains with a 1% min grade away from the road embankment.

b) Concrete floodways for major floodway locations.

The assessment recommends further modelling to develop the detailed design for items such as culvert crossing sizes, bridge scour analysis and roadway embankment stability. Golder understands that this is currently in progress. The incorporation of these additional elements when assessing the design criteria during the detailed design and construction phases of the project should ultimately minimise the risks from changed surface water regimes, particularly with respect to environmental receptors within the surface water regimes.

6.0 SUMMARY

The key conclusions of the hydrogeological and hydrological risk assessment are:

- The groundwater level has been recorded for several of the proposed abstraction bores and ranges between 4.35 m and 27.27 m bgl, although it is unknown if these levels were recorded during the wet season or dry season.
- The estimated groundwater level drawdown for abstraction bores along the alignment is low. The lowest potential environmental impact would occur from adopting Scenario D with only 0.01 m to 0.04 m at 100 m distance and 0 m to 0.02 m at 500 m distance.
- The low groundwater level drawdown is not anticipated to cause any detrimental impacts to groundwater dependent ecosystems in the area; however, several of the proposed bores are located within Eucalyptus and Melaleuca vegetated areas along drainage lines.

- A H1 (desktop) level hydrogeological assessment may be required to support a 5C licence application along the Coolawanyah section of the proposed MRDH alignment; and a hydrogeological assessment to support a 5C licence application may not be required for the Hamersley and Tom Price sections of the alignment.
- It is recommended that pumping tests and groundwater monitoring be undertaken to confirm aquifer properties and groundwater salinity where final bore locations are near GDEs to have a better understanding of the impacts of groundwater abstraction.
- Potential impacts to surface water resulting from the MRDH and its alignment parallel to the Rio Tinto rail infrastructure includes altering the surface water flow regime and Cardno (2022) has recommended the consideration of numerous design elements to mitigate these impacts. Provided Main Roads implements recommended mitigation measures changes to surface water flows are unlikely to impact on ecosystems or environmental receptors.

7.0 REFERENCES

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Biota Environmental Services (2022), *Manuwarra Red Dog Highway Stage 4 Biological Survey*: Prepared for Main Roads Western Australia Rev.D, April 2022.

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Mainroads Western Australia (2021), *EPBC Referral Preliminary Documentation: Manuwarra Red Dog Highway (MRDH) - Stage 4*, EOS 1813, EPBC 2020/8725, Document No: D21 #299061, October 2021

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Loomes, R (2010), *Determining water level ranges of Pilbara riparian species*, Environmental water report series, report no. 17, Department of Water, Government of Western Australia.

Braimbridge, M, Antao, M and Loomes, R (2010), *Groundwater dependent ecosystems for Millstream: ecological values and issues*, Environmental water report series, report no. 13, Department of Water, Government of Western Australia.

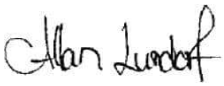
Rojas R, Commander P, McFarlane D, Ali R, Dawes W, Barron O, Hodgson G and Charles S (2018). Groundwater Resource Assessment and Conceptualization in the Pilbara Region, Western Australia. Earth Systems and Environment. Springer International Publishing 1-21.

8.0 IMPORTANT INFORMATION

Your attention is drawn to the document titled - “Important Information Relating to this Report”, which is included in Attachment C of this report. The statements presented in that document are intended to inform a reader of the report about its proper use. There are important limitations as to who can use the report and how it can be used. It is important that a reader of the report understands and has realistic expectations about those matters. The Important Information document does not alter the obligations Golder Associates has under the contract between it and its client.

Golder Associates Pty Ltd

Haylee Thomas
Environmental Scientist/Hydrogeologist



Allan Lundorf
Principal Water Resources Engineer

DD,HT,AL/KM,DMS,AL/al

Attachments: Figure 1 – Site Location
Figure 2 – Geology
Figure 3 – Hydrogeology and Groundwater Users
Figure 4 – Groundwater Dependent Ecosystems
Figure 5 – Hydrology
A – DAWE Comments on MRDH Preliminary Documentation
B – Estimated Groundwater Level Drawdown for Four Water Supply Scenarios
C – Important Information

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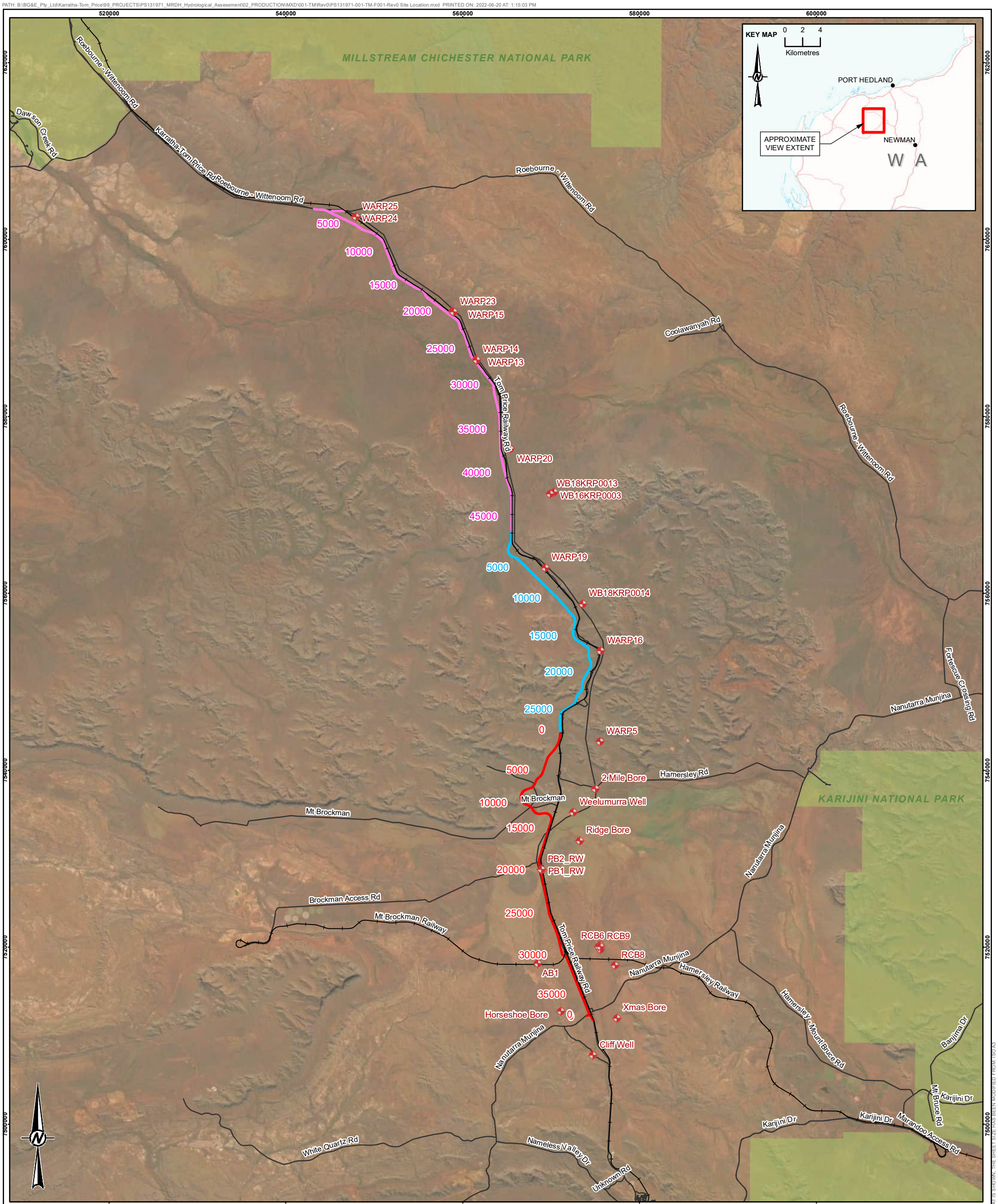

LEGEND

- Main Roads WA Road Network
- Railway Lines
- Existing and Proposed Groundwater Bores

Manuwarra Red Dog Highway Stage 4

- Coolawanyah Alignment Section Chainage (m)
- Hamersley Alignment Section Chainage (m)
- Tom Price Alignment Section Chainage (m)

0 10,000 20,000

1:400,000 METRES

NOTE:
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 50

REFERENCES:
BASED ON INFORMATION PROVIDED BY AND WITH THE PERMISSION OF THE WESTERN AUSTRALIAN LAND INFORMATION AUTHORITY TRADING AS LANDGATE (2018)

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AERIAL IMAGERY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

CLIENT
MAIN ROADS WESTERN AUSTRALIA

PROJECT
MANUWARRA RED DOG HIGHWAY HYDROLOGICAL RISK ASSESSMENT

TITLE
SITE LOCATION

CONSULTANT
WSP GOLDER

YYYY-MM-DD	2022-06-20
DESIGNED	HT
PREPARED	HT
REVIEWED	KM
APPROVED	KM

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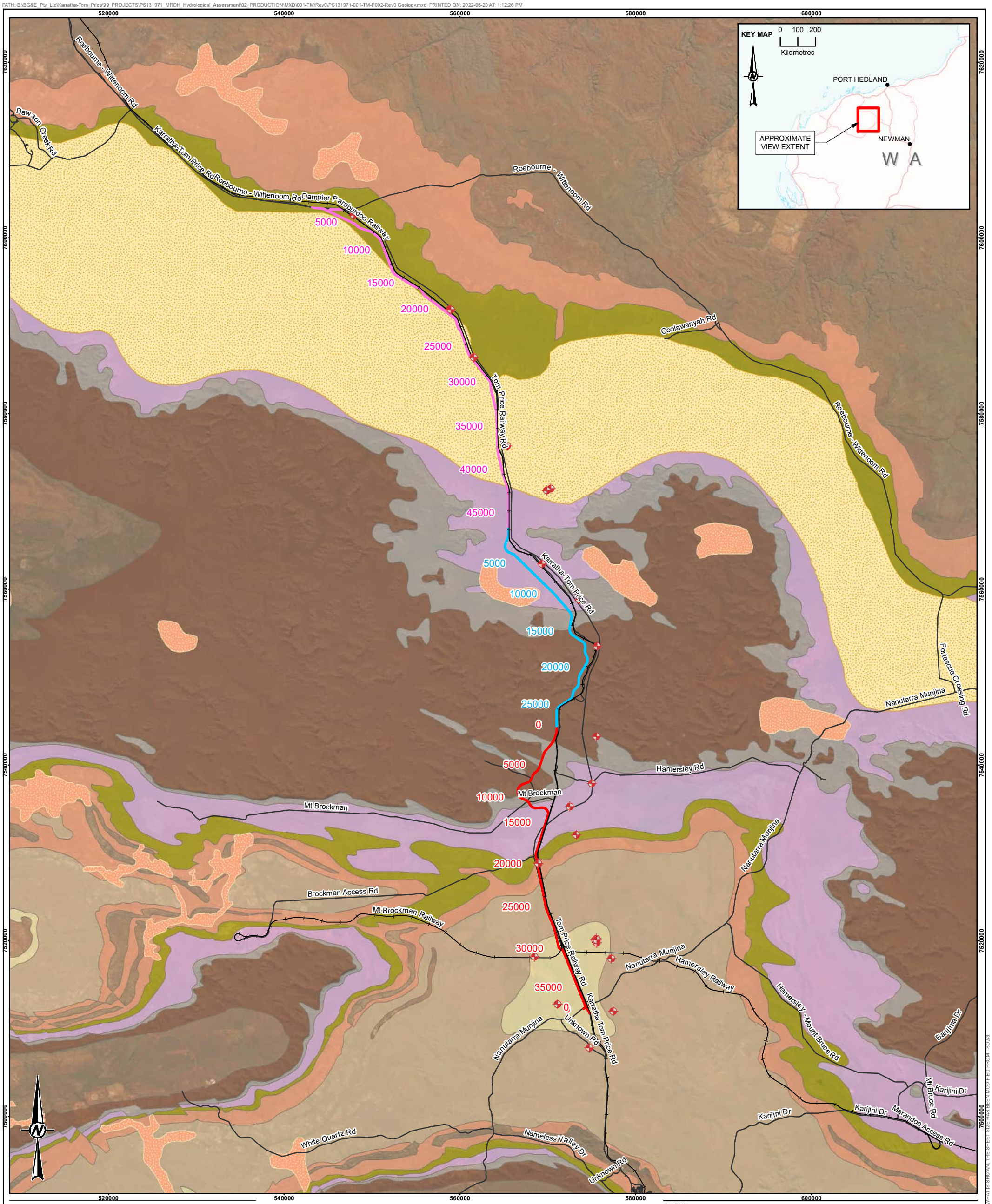

LEGEND

- Main Roads WA Road Network
- Railway Lines
- Existing and Proposed Groundwater Bores

Manuwarra Red Dog Highway Stage 4

- Coolawanyah Alignment Section
- Hamersley Alignment Section
- Tom Price Alignment Section

1:500K Cenozoic Geology

UNITNAME

- Miocene channel iron deposits
- Valley-fill deposits

1:500K Bedrock Geology

UNITNAME

- Brockman Iron Formation
- Bunjinah Formation
- Jeerinah Formation
- Marra Mamba Iron Formation
- Mount McRae Shale and Mount Sylvia Formation
- Pyradie Formation
- Wittenoom Formation

0 10,000 20,000

1:400,000 METRES

NOTE:
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 50

REFERENCES:
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CLIENT
MAIN ROADS WESTERN AUSTRALIA

PROJECT
MANUWARRA RED DOG HIGHWAY HYDROLOGICAL RISK ASSESSMENT

TITLE
GEOLOGY

CONSULTANT
WSP GOLDER

YYYY-MM-DD	2022-06-20
DESIGNED	HT
PREPARED	HT
REVIEWED	KM
APPROVED	KM

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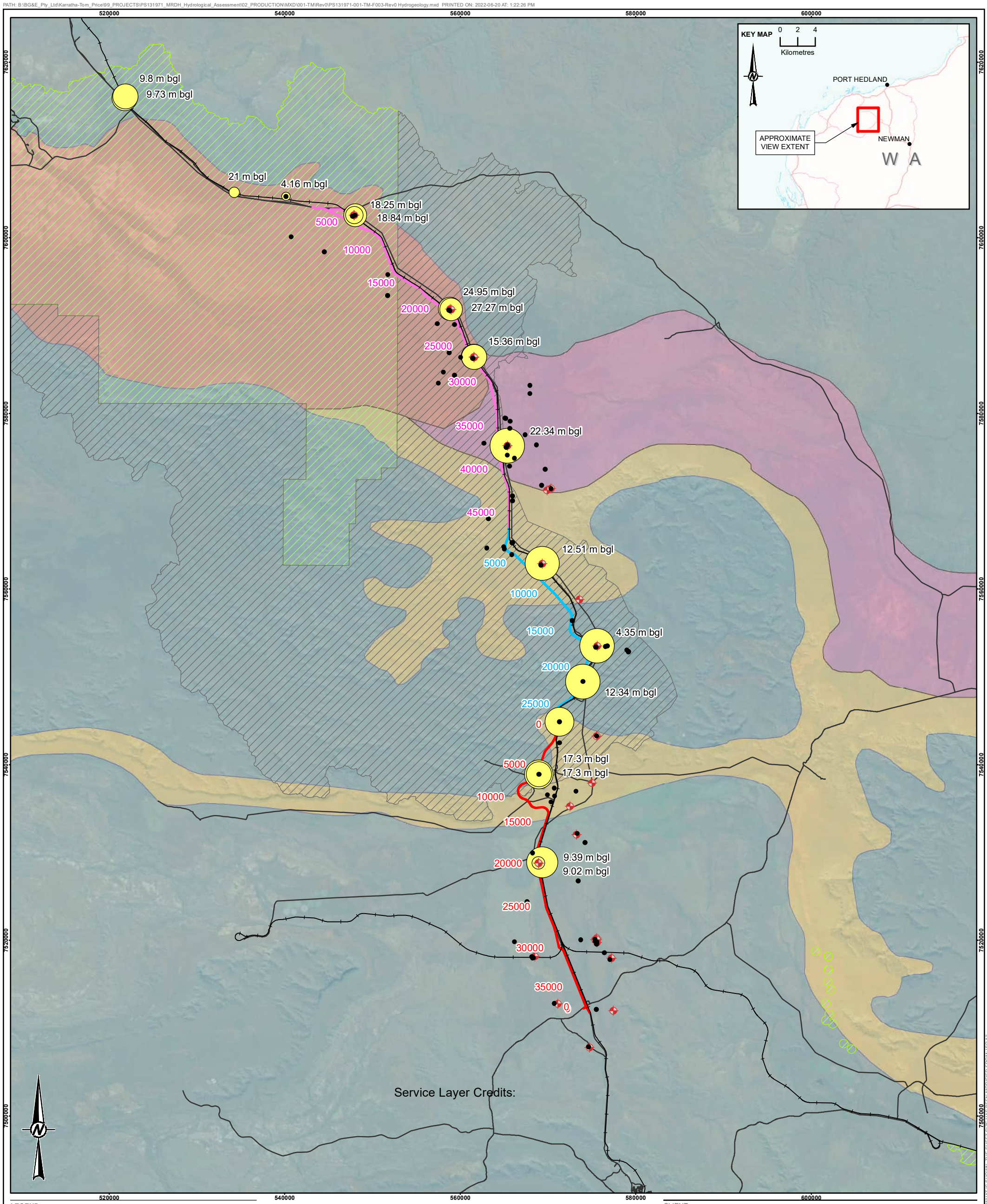

LEGEND

- Main Roads WA Road Network
- Existing and Proposed Groundwater Bores
- Water Information Reporting Bores
- Railway Lines

Manuwarra Red Dog Highway Stage 4

- Coolawanyah Alignment Section
- Hamersley Alignment Section
- Tom Price Alignment Section

Groundwater Source/Aquifer

- Hamersley - Fortescue
- Hamersley - Fractured Rock
- Hamersley - Millstream
- Wittenoom - Wittenoom

Public Drinking Water Source Areas

- Priority 1
- Priority 2

Existing Bores with Historical Abstraction Rates (L/s)

1, 2.5, 5, 7.5, 10

9.39 m bgl
Static Water Level

0 10,000 20,000
1:400,000 METRES

NOTE:
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 50

REFERENCES:
BASED ON INFORMATION PROVIDED BY AND WITH THE PERMISSION OF THE WESTERN AUSTRALIAN LAND INFORMATION AUTHORITY TRADING AS LANDGATE (2018)

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CLIENT
MAIN ROADS WESTERN AUSTRALIA

PROJECT
MANUWARRA RED DOG HIGHWAY HYDROLOGICAL RISK ASSESSMENT

TITLE
HYDROGEOLOGY AND GROUNDWATER USERS

CONSULTANT
WSP GOLDER

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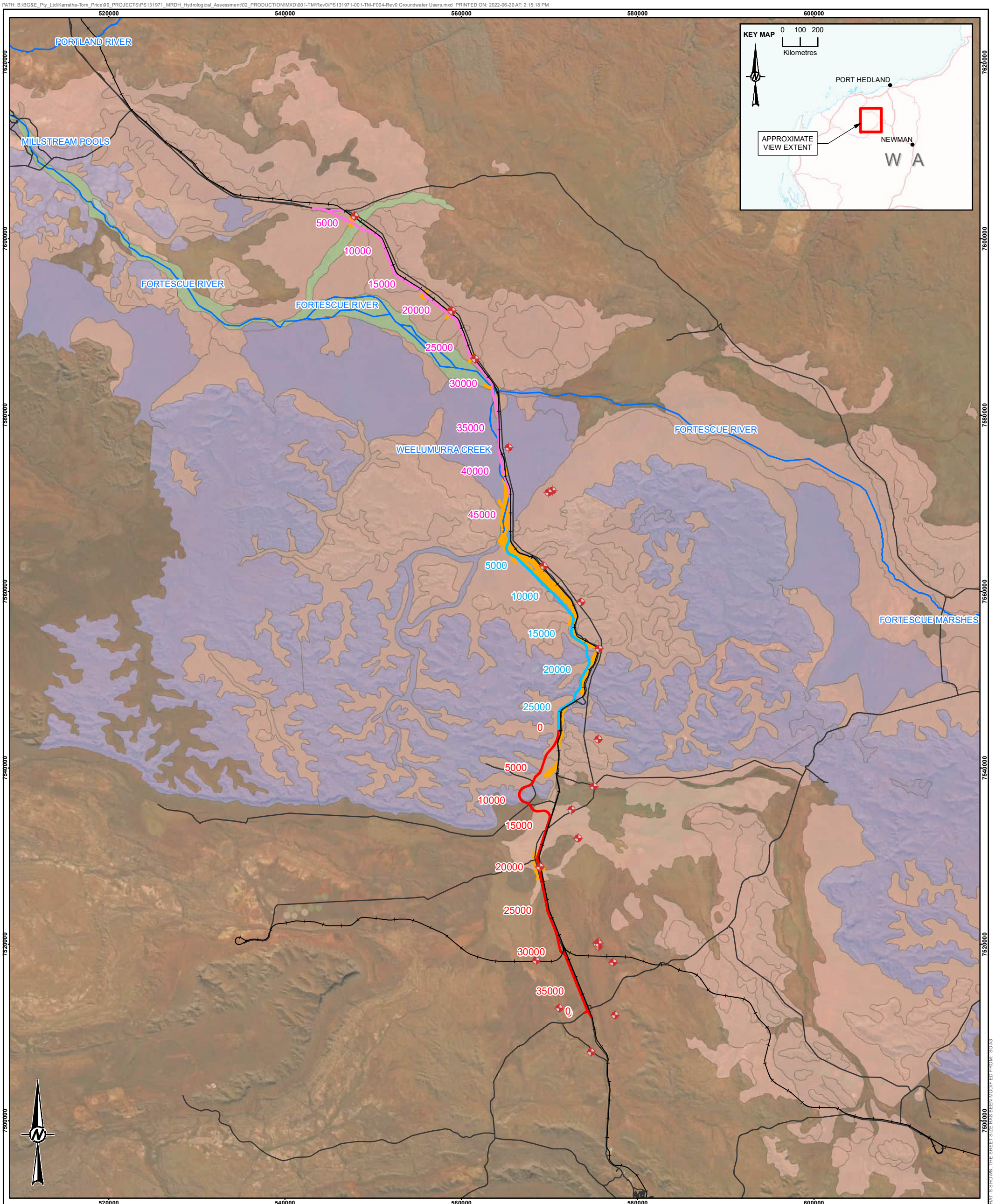

LEGEND

- Main Roads WA Road Network
- Railway Lines
- Existing and Proposed Groundwater Bores

Manuwarra Red Dog Highway Stage 4

- Coolawanyah Alignment Section
- Hamersley Alignment Section
- Tom Price Alignment Section

MRWA EPBC Referral Preliminary Documentation Provided Information

- Eucalyptus and Melaleuca Vegetation along Drainage Lines

Bureau of Meteorology (BOM) Groundwater Dependent Ecosystem Atlas

Aquatic

- High potential GDE - from national assessment

Terrestrial

- Known GDE - from regional studies
- High potential GDE - from national assessment
- Moderate potential GDE - from national assessment
- Low potential GDE - from national assessment

0 10,000 20,000

1:400,000 METRES

NOTE:
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 50

REFERENCES:
BASED ON INFORMATION PROVIDED BY AND WITH THE PERMISSION OF THE WESTERN AUSTRALIAN LAND INFORMATION AUTHORITY TRADING AS LANDGATE (2018)

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CLIENT
MAIN ROADS WESTERN AUSTRALIA

PROJECT
MANUWARRA RED DOG HIGHWAY HYDROLOGICAL RISK ASSESSMENT

TITLE
GROUNDWATER DEPENDENT ECOSYSTEMS

CONSULTANT
WSP GOLDER

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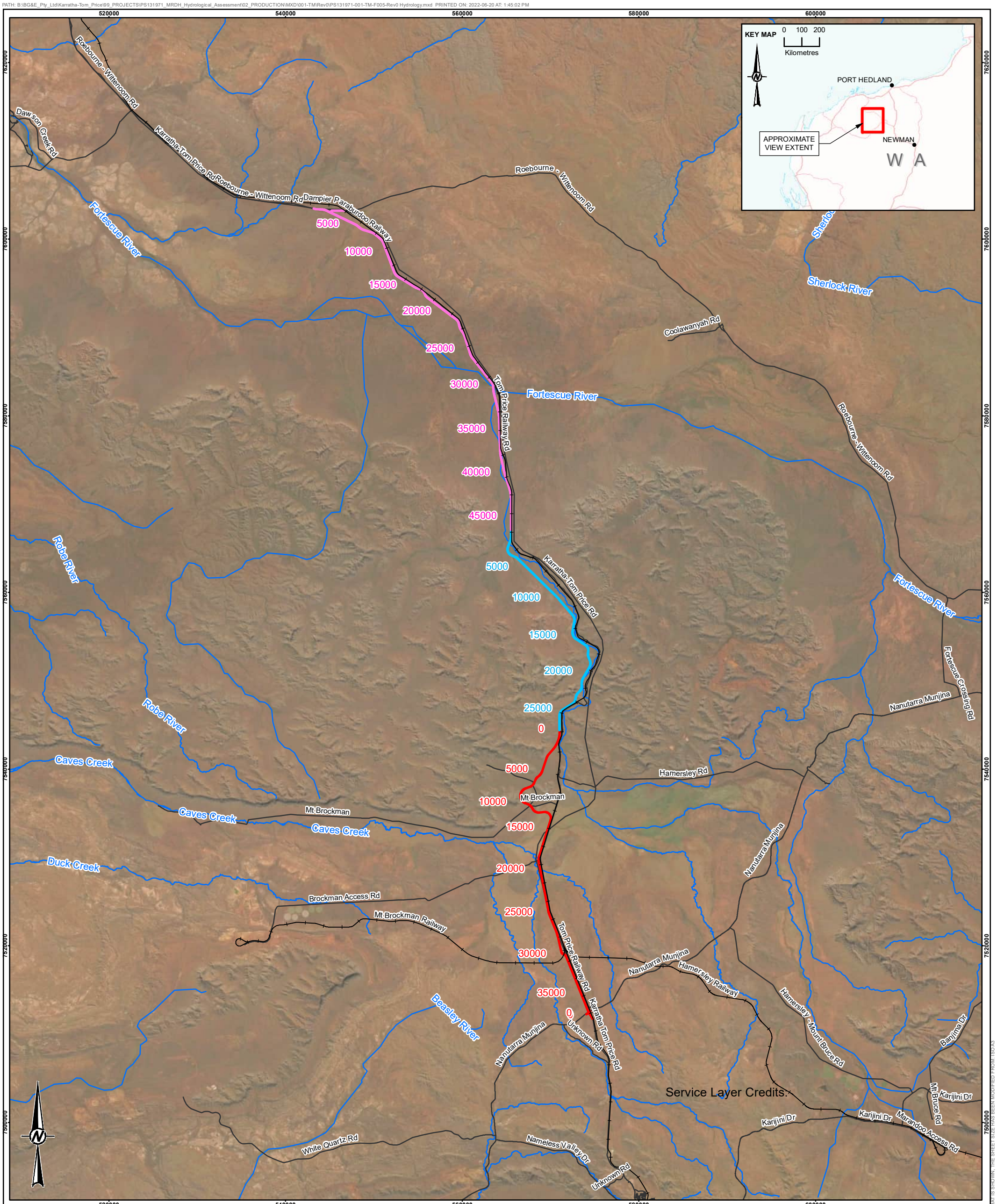

LEGEND

- Main Roads WA Road Network
- Railway Lines

Manuwarra Red Dog Highway Stage 4

- Coolawanyah Alignment Section
- Hamersley Alignment Section
- Tom Price Alignment Section
- Surface Water

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1:400,000 METRES

NOTE:
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CLIENT
MAIN ROADS WESTERN AUSTRALIA

PROJECT
MANUWARRA RED DOG HIGHWAY HYDROLOGICAL RISK ASSESSMENT

TITLE
HYDROLOGY

CONSULTANT
WSP GOLDER

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ATTACHMENT A

DAWE Comments on MRDH Preliminary Documentation

Section 2.3.3 Groundwater

A. The Department notes that as a part of construction activities, 0.148 – 0.412 ML of water is proposed to be extracted from new or existing bores over a period of up to three years in a manner which minimises drawdown and potential impacts on water-dependent ecosystems. Please provide the following additional information:

i. the location of existing and proposed bores, as well as predicted extraction volumes and rates at each bore per annum;

ii. an assessment of the impacts of extracting water from new bores that the Department notes Main Roads WA are seeking additional licences for, and

iii. site-specific information to justify how drawdown will be minimised.

B. The draft Preliminary Documentation states that significant groundwater is associated with the alluvium and colluvium of low-lying areas of the coastal plain, Fortescue River valley and the upper reaches of Weelumurra Creek to the south of Hamersley Station. Depending on the location of abstraction, drawdown has the potential to impact groundwater-dependent terrestrial vegetation and river pools (indicating groundwater discharge areas) known to occur in the area. Please provide the following additional information:

i. the Department considers that the depth to the water table should be confirmed at the site, as the water table has been recorded approximately 5-15 metres (m) below ground level within the Millstream Water Reserve1. The groundwater dependence of Eucalyptus and Melaleuca species identified along tributaries should be verified, as this may be habitat for the Pilbara Leaf Nosed Bat (Rhinonicteris aurantia), Ghost Bat (Macroderma gigas) and Grey Falcon (Falco hypoleucos). (The IESC's Information Guidelines Explanatory Note on assessing groundwater-dependent ecosystems (GDEs)2 provides information on techniques for identifying and characterising GDEs.)

Section 2.3.4 Surface water

A. A number of waterway crossings will be required for the construction of the road, including crossings for Fortescue River, Weelumurra Creek and a number of smaller creeks; however, the location, type and number of crossings has not been provided. The Department notes from satellite imagery that the existing railway line adjacent to the proposed action includes at least 10 waterway crossings. The proponent stated that the design and construction method for any bridges that may be required cannot be confirmed at this stage. Without this information, it is difficult to provide specific advice regarding surface water impacts due to the construction of the crossings. The following assessment should be undertaken based on available information:

i. the interaction between the proposed road crossings with the existing railway crossings as this could have a cumulative impact on surface water (e.g., for general flow behaviour and flood events);

ii. the changing rainfall patterns (i.e., duration, frequency, and intensity) when finalising the design of the crossings to ensure that the crossings are not only sufficient to withstand extreme events, but also do not impact flow behaviour and water-dependent ecosystems in the area under these conditions.

iii. mitigation strategies to avoid and minimise surface water impacts including erosion and contamination during the construction of the proposal. A monitoring regime for water quality should also be developed, which includes baseline monitoring prior to construction, and regular monitoring during and at completion of construction. Monitoring points should be considered in the following locations:

   a) upstream and downstream of the crossing at the Fortescue River;

   b) immediately upstream of the confluence of Weelumurra Creek with Fortescue River and upstream of the proposal in Weelumurra Creek (or as far upstream as is possible given the ephemeral nature of the creek); and Caves Creek and/or its tributaries (it is unclear if the project crosses Caves Creek, but it may cross tributaries).

ATTACHMENT B

Estimated Groundwater Level Drawdown for Four Water Supply Scenarios

Scenario A - 100% MRWA Water Supply over 112 km of Alignment - 1 Well Providing Daily Water Supply

Aquifer	Pumping Rate (L/s)	Drawdown (m) after 61 days *			
		0 m	100 m	500 m	1,000 m
Channel Iron Deposits	1.88	0.23	0.07	0.04	0.03
	5.22	0.64	0.19	0.11	0.07
Valley-fill and Inland Alluvial	1.88	0.37	0.11	0.07	0.05
	5.22	1.02	0.31	0.19	0.13
Karstified/Weathered Dolomite	1.88	0.26	0.08	0.05	0.04
	5.22	0.72	0.23	0.14	0.10
Fractured Rock	1.88	0.50	0.13	0.07	0.04
	5.22	1.40	0.37	0.19	0.11
Mineralised BIF	1.88	0.33	0.08	0.04	0.02
	5.22	0.92	0.23	0.10	0.05

Scenario B - 100% MRWA Water Supply over 112 km of Alignment - 3 Wells Providing Daily Water Supply

Aquifer	Pumping Rate (L/s)	Drawdown (m) after 183 days *			
		0 m	100 m	500 m	1,000 m
Channel Iron Deposits	0.63	0.08	0.03	0.02	0.01
	1.74	0.22	0.07	0.04	0.03
Valley-fill and Inland Alluvial	0.63	0.13	0.04	0.03	0.02
	1.74	0.35	0.12	0.08	0.06
Karstified/Weathered Dolomite	0.63	0.09	0.03	0.02	0.02
	1.74	0.25	0.09	0.06	0.04
Fractured Rock	0.63	0.18	0.05	0.03	0.02
	1.74	0.49	0.14	0.08	0.06
Mineralised BIF	0.63	0.12	0.03	0.02	0.01
	1.74	0.32	0.09	0.05	0.03

Scenario C - 22% MRWA Water Supply over 25 km of Alignment - 1 Well Providing Daily Water Supply

Aquifer	Pumping Rate (L/s)	Drawdown (m) after 183 days *			
		0 m	100 m	500 m	1,000 m
Channel Iron Deposits	0.41	0.05	0.02	0.01	0.01
	1.15	0.15	0.05	0.03	0.02
Valley-fill and Inland Alluvial	0.41	0.08	0.03	0.02	0.01
	1.15	0.23	0.08	0.05	0.04
Karstified/Weathered Dolomite	0.41	0.06	0.02	0.01	0.01
	1.15	0.17	0.06	0.04	0.03
Fractured Rock	0.41	0.12	0.03	0.02	0.01
	1.15	0.32	0.09	0.05	0.04
Mineralised BIF	0.41	0.08	0.02	0.01	0.01
	1.15	0.21	0.06	0.03	0.02

Scenario D - 22% MRWA Water Supply over 25 km of Alignment - 3 Wells Providing Daily Water Supply

Aquifer	Pumping Rate (L/s)	Drawdown (m) after 548 days *			
		0 m	100 m	500 m	1,000 m
Channel Iron Deposits	0.14	0.02	0.01	0.00	0.00
	0.38	0.05	0.02	0.01	0.01
Valley-fill and Inland Alluvial	0.14	0.03	0.01	0.01	0.01
	0.38	0.08	0.03	0.02	0.02
Karstified/Weathered Dolomite	0.14	0.02	0.01	0.01	0.00
	0.38	0.06	0.02	0.01	0.01
Fractured Rock	0.14	0.04	0.01	0.01	0.01
	0.38	0.11	0.04	0.02	0.02
Mineralised BIF	0.14	0.03	0.01	0.00	0.00
	0.38	0.07	0.02	0.01	0.01

* The end of the pumping period for the specific scenario

ATTACHMENT C

Important Information

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

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Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

By date, or revision, the Report supersedes any prior report or other document issued by Golder dealing with any matter that is addressed in the Report.

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Appendix E. Revised Chapter 5 – Social Surrounds

Manuwarra Red Dog Highway

Environmental Review Document incorporating Additional Information Request Response – Revised Section 5.4 Social Surroundings

EPA Assessment Number 2273

20/1/2023

Main Roads Western Australia

Manuwarra Red Dog Highway

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Contents

5 Key Environmental Factors 2
5.4 Social Surroundings 2
5.4.1 EPA Objective 2
5.4.2 Policy and Guidance 2
5.4.3 Receiving Environment 2
5.4.4 Potential Impacts 17
5.4.5 Mitigation 18
5.4.6 Assessment of Impacts 26
5.4.7 Predicted Outcome 26

Tables

Table 5-33 Social Surroundings Studies Undertaken for Stage 4 of the Revised Proposal 2
Table 5-34 Social Surroundings Management 22
Table 5-35 Environmental Outcomes for Revised Proposal – Social Surroundings 28

5 Key Environmental Factors

5.4 Social Surroundings

5.4.1 EPA Objective

The WA EPA states that 'social surroundings is a part of the environment that may require consideration' where there is 'clear link between a proposal or scheme's impact on the physical or biological surroundings and the subsequent impact on a person's aesthetic, cultural, economic or social surroundings' (EPA, 2016d).

The WA EPA objective for social surroundings is 'to protect social surroundings from significant harm'.

5.4.2 Policy and Guidance

The following EPA policies and guidelines have been considered for Stage 4 of the Revised Proposal in order to meet the EPA's objective in relation to this factor:

- *Statement of Environmental Principles, Factors and Objectives* (EPA, 2020a);
- *Environmental Factor Guideline – Social Surroundings* (EPA, 2016d);
- Environmental Protection (Noise) Regulations 1997 (Noise Regulations);
- State Planning Policy 5.4 Road and Rail Noise;
- *Aboriginal Heritage Act 1972* (AH Act); and
- *Aboriginal Cultural Heritage Act* (2021) (ACH Act).

5.4.3 Receiving Environment

The receiving environment in relation to social surroundings is made of many elements including land tenure, historic and cultural features, tourism and recreational features, and amenity.

5.4.3.1 Surveys and Studies

The studies relating to the social surroundings undertaken for the Revised Program are described in Table 5-33.

Table 5-33 Social Surroundings Studies Undertaken for Stage 4 of the Revised Proposal

Report title	Consultant	Scope
Preliminary advice of a site avoidance archaeological heritage survey for the Karratha Tom Price Road Stage 4 Alignment Tom Price Railway Rd trip 1, SLK0-51, Eastern Guruma Country (November 2020).	Yulur Heritage	Aboriginal Archaeological site avoidance survey of a single polygon (7.9 km^2) identified as Tom Price Railway Rd (the SLK0-51 project area – Trip 1) which runs adjacent to the existing Tom Price Railway Road for approximately 51 km (with consistent width of 150 m). All survey work was conducted with the participation of Eastern Guruma Tradition Owners as nominated by their representative, the Wintawari Guruma Aboriginal Corporation.

Report on a site avoidance archaeological heritage survey for the Karratha Tom Price Road Stage 4 Alignment Tom Price Railway Rd trip 1,SLK0-51, Eastern Guruma Country (November 2020).	Yulur Heritage	Aboriginal Archaeological site avoidance survey of a single polygon (7.9 km^2) identified as Tom Price Railway Rd (the SLK0-51 project area – Trip 1) which runs adjacent to the existing Tom Price Railway Road for approximately 51 km (with consistent width of 150 m). All survey work was conducted with the participation of Eastern Guruma Tradition Owners as nominated by their representative, the Wintawari Guruma Aboriginal Corporation.
Preliminary advice of the trip 2 site avoidance archaeological heritage survey of the Manuwarra Red Dog Highway Karratha Tom Price Road Stage 4 Alignment Tom Price Railway Rd SLK0-50 undertaken in Eastern Guruma Country by the Wintawari Guruma representatives and Yulur Heritage (April 2021).	Yulur Heritage	Further Aboriginal Archaeological site avoidance heritage survey of a single polygon identified as Tom Price Railway Rd (the SLK0-50 project area) comprising two polygons that run adjacent to the existing Tom Price Railway Road for approximately 14 and 17 km. The survey area measured approximately 4.9 km^2 comprised of Hamersley Section (2.77 km^2) and Tom Price Section (2.11 km^2). All survey work was conducted with the participation of Eastern Guruma Tradition Owners as nominated by their representative, the Wintawari Guruma Aboriginal Corporation.
Report on the trip 2 site avoidance archaeological heritage survey of the Manuwarra Red Dog Highway Karratha Tom Price Road Stage 4 Alignment Tom Price Railway Rd SLK0-50 undertaken in Eastern Guruma Country by the Wintawari Guruma representatives and Yulur Heritage (May 2021).	Yulur Heritage	Further Aboriginal Archaeological site avoidance heritage survey of a single polygon identified as Tom Price Railway Rd (the SLK0-50 project area) comprising two polygons that run adjacent to the existing Tom Price Railway Road for approximately 14 and 17 km. The survey area measured approximately 4.9 km^2 comprised of Hamersley Section (2.77 km^2) and Tom Price Section (2.11 km^2). All survey work was conducted with the participation of Eastern Guruma Tradition Owners as nominated by their representative, the Wintawari Guruma Aboriginal Corporation.
Preliminary advice of the trip 3 site avoidance archaeological heritage survey of the Manuwarra Red Dog Highway Karratha Tom Price Road Stage 4 Alignment Tom Price Railway Rd SLK38-51 undertaken in Eastern Guruma Country by the Wintawari Guruma representatives and Yulur Heritage (September 2021)	Yulur Heritage	Further Aboriginal Archaeological site avoidance heritage survey of five polygons identified as Tom Price Railway Rd (the SLK38-51 project area) The SLK38-51 project area runs adjacent to the existing Tom Price Railway Road for approximately 20 km with a variable width between 150 m and 700 m. The total SLK38-51 project area measures approximately 7.76 km^2. The SLK38-51 heritage survey was completed with the assistance of representatives of the Wintawari (Eastern) Guruma native title determination area (Wintawari Guruma representatives), who were selected by WGAC on behalf of the Wintawari Guruma Heritage Sub-Committee. The SLK38-51 heritage survey was also conducted with assistance of Yulur Heritage representatives.
Report on the trip 3 site avoidance archaeological heritage survey of the Manuwarra Red Dog Highway Karratha Tom	Yulur Heritage	Further Aboriginal Archaeological site avoidance heritage survey of five polygons identified as Tom Price Railway Rd (the SLK38-51 project area)

Price Road Stage 4 Alignment Tom Price Railway Rd SLK38-51 undertaken in Eastern Guruma Country by the Wintawari Guruma representatives and Yulur Heritage (September 2021).		The SLK38-51 project area runs adjacent to the existing Tom Price Railway Road for approximately 20 km with a variable width between 150 m and 700 m. The total SLK38-51 project area measures approximately 7.76 km². The SLK38-51 heritage survey was completed with the assistance of representatives of the Wintawari (Eastern) Guruma native title determination area (Wintawari Guruma representatives), who were selected by WGAC on behalf of the Wintawari Guruma Heritage Sub-Committee. The SLK38-51 heritage survey was also conducted with assistance of Yulur Heritage representatives.
Final Report of an Ethnographic Survey Karratha to Tom Price Road Alignment in Eastern Guruma Country (3 August – 8 August 2020). Trip 1.	Yulur Heritage	Main Roads specified two priority sections be investigated within the Survey Area. The proposed new road alignment is to the west of the Rio Tinto Railway. The northern section (Priority 1) runs parallel with the Weelumurra Wuntu site ID 38183 and the southern section (Priority 2) intersects with Narraminju (Caves Creek) ID 36670. The survey area was originally 51 km but was revised by Main Roads prior to the survey commencing to exclude the area south of the Nanutarra Munjina Road (towards Tom Price). The survey area is approximately 45 km in length and between 400 m and 1 km at its widest point in the northern section (Priority 1).
Preliminary advice of an Aboriginal archaeological Site Avoidance survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor (Manuwarra Red Dog Highway SLK134.97–135.87 & Tom Price Railway Rd SLK51-108), Pilbara, Western Australia Trip 5 (September 2021).	Gavin Jackson Cultural Resource Management	The Heritage Project Area comprises nine polygons (Polygon 1 – Polygon 9) of which three were given levels of priority (Priority 1 – Priority 3). The Heritage Project Area is located to the west of the Tom Price Railway Road and to the south of the Manuwarra Red Dog Highway and is approximately 27 km in length with a combined area of approximately 4.32 km^2.
Report of an Aboriginal archaeological Site Avoidance survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor (Roebourne Wittenoom Rd SLK68-74 & Tom Price Railway Rd SLK51-108), Pilbara, Western Australia Trip 5 (November 2021).	Gavin Jackson Cultural Resource Management	The Heritage Project Area comprises nine polygons (Polygon 1 – Polygon 9) of which three were given levels of priority (Priority 1 – Priority 3). The Heritage Project Area is located to the west of the Tom Price Railway Road and to the south of the Manuwarra Red Dog Highway and is approximately 27 km in length with a combined area of approximately 4.32 km^2.
Preliminary advice of an Aboriginal archaeological Site Avoidance survey of works associated with the Karratha to	Gavin Jackson Cultural Resource Management	The Heritage Project Area comprises six polygons (Priority Area 1 – Priority Area 6) and four additional polygons located adjacent to these priority areas. These polygons are situated within or adjacent to the Main

Tom Price Road Stage 4 Alignment Corridor (Roebourne Wittenoom Rd SLK68-74 & Tom Price Railway Rd SLK51-108), Pilbara, Western Australia Trip 4 (March 2021).		Roads Karratha Tom Price Stage 4 Heritage Survey Corridor. The Heritage Project Area is located to the west of the Tom Price Railway Road and to the south of the Manuwarra Red Dog Highway, and is approximately 26 km in length with a combined area of approximately 3.97 km^2.
Report of an Aboriginal archaeological Site Avoidance survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor (Roebourne Wittenoom Rd SLK68-74 & Tom Price Railway Rd SLK51-108), Pilbara, Western Australia Trip 4 (March 2021).	Gavin Jackson Cultural Resource Management	The Heritage Project Area comprises six polygons (Priority Area 1 – Priority Area 6) and four additional polygons located adjacent to these priority areas. These polygons are situated within or adjacent to the Main Roads Karratha Tom Price Stage 4 Heritage Survey Corridor. The Heritage Project Area is located to the west of the Tom Price Railway Road and to the south of the Manuwarra Red Dog Highway and is approximately 26 km in length with a combined area of approximately 3.97 km^2.
Preliminary advice of an Aboriginal archaeological Site Avoidance survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor (Roebourne Wittenoom Rd SLK68-74 & Tom Price Railway Rd SLK51-108), Pilbara, Western Australia Trip 3 (January 2021).	Gavin Jackson Cultural Resource Management	The Heritage Project Area comprises six polygons (Priority Area 1 – Priority Area 6) located adjacent to the Manuwarra Red Dog Highway and the Tom Price Railway Road and is approximately 50 km in length with a combined area of approximately 7.20 km^2.
Report of an Aboriginal archaeological Site Avoidance survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor (Roebourne Wittenoom Rd SLK68-74 & Tom Price Railway Rd SLK51-108), Pilbara, Western Australia Trip 3 (January 2021).	Gavin Jackson Cultural Resource Management	The Heritage Project Area comprises six polygons (Priority Area 1 – Priority Area 6) located adjacent to the Manuwarra Red Dog Highway and the Tom Price Railway Road and is approximately 50 km in length with a combined area of approximately 7.20 km^2.
Preliminary advice of an Aboriginal archaeological Site Avoidance survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor (Roebourne Wittenoom Rd SLK68-74 & Tom Price Railway Rd SLK51-108), Pilbara, Western Australia Trip 2 (October 2020).	Gavin Jackson Cultural Resource Management	The Heritage Project Area comprises four polygons located adjacent to the Roebourne Wittenoom Road and the Tom Price Railway Road and is approximately 60 km in length and has a combined area of approximately 18.8 km^2. The Heritage Project Area features three Priority Areas (Priority Area 1 – Priority Area 3) that cover a combined total area of 8.93 km^2 of the entire Heritage Project Area.
Report of an Aboriginal archaeological Site Avoidance survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor	Gavin Jackson Cultural Resource Management	The Heritage Project Area comprises a single polygon, approximately 60 km in length, located adjacent to the Roebourne Wittenoom Road and the Tom Price Railway Road. There are three Priority Areas (Priority Area 1 –

(Roebourne Wittenoom Rd SLK68-74 & Tom Price Railway Rd SLK51-108), Pilbara, Western Australia Trip 2 (October 2020).		Priority Area 3) within the Heritage Project Area covering a combined total area of 18.8km^2.
Preliminary advice of an Aboriginal archaeological survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor (Roebourne Wittenoom Rd SLK58-74 & Tom Price Railway Rd SLK51-106), Pilbara, Western Australia Trip 1 (July 2020).	Gavin Jackson Cultural Resource Management	The Heritage Project Area comprises a single polygon located adjacent to the Roebourne Wittenoom Road and the Tom Price Railway Road that measures approximately 51.8 km^2. The Heritage Project Area includes five Survey Priority Areas (Survey Priority Area 1 – Survey Priority Area 5) that cover a combined total 21.5 km^2 of the entire Heritage Project Area.
Report of an Aboriginal archaeological survey of works associated with the Karratha to Tom Price Road Stage 4 Alignment Corridor (Roebourne Wittenoom Rd SLK58-74 & Tom Price Railway Rd SLK51-106), Pilbara, Western Australia Trip 1 (August 2020).	Gavin Jackson Cultural Resource Management	The Heritage Project Area comprises a single polygon located adjacent to the Roebourne Wittenoom Road and the Tom Price Railway Road that measures approximately 51.8 km^2. The Heritage Project Area includes five Survey Priority Areas (Survey Priority Area 1 – Survey Priority Area 5) that cover a combined total 21.5 km^2 of the entire Heritage Project Area.
Preliminary Advice following an Yindjibarndi Ethnographic Site Identification Heritage Survey of the Karratha Tom Price Road Stage 4 Alignment Corridor; Roebourne Wittenoom Rd SLK58-74 and Tom Price Railway Rd SLK51-106 in the West Pilbara Trip 1 (June-July 2020).	Stevens Heritage Services	The ethnographic component of the heritage survey intended to concentrate on site assessments and values within five priority areas, as well as provide an overview of any areas throughout the entire corridor that may be of major cultural concern to Yindjibarndi, such as impact to waterways. An overview of the entire survey route was undertaken, and detailed assessments of areas and sites was undertaken in the whole of Priority areas 1 and 2 and most of Priority area 3
Report of a Yindjibarndi Ethnographic Site Identification Heritage Survey of the Karratha Tom Price Road Stage 4 Alignment Corridor; Roebourne Wittenoom Rd SLK58-74 and Tom Price Railway Rd SLK51-106 in the West Pilbara Trip 1 (June – July 2020).	Stevens Heritage Services	The ethnographic component of the heritage survey intended to concentrate on site assessments and values within five priority areas, as well as provide an overview of any areas throughout the entire corridor that may be of major cultural concern to Yindjibarndi, such as impact to waterways. An overview of the entire survey route was undertaken, and detailed assessments of areas and sites was undertaken in the whole of Priority areas 1 and 2 and most of Priority area 3.

5.4.3.2 Native Title, Aboriginal Heritage and Culture

The Development Envelope is located within two Native Title areas. The northern portion of the Development Envelope sits within Yindjibarndi Country while the southern portion is within Wintawari Guruma country (Figure 7). The Federal Court assessed the Native Title claims submitted by each group under the *Native Title Act 1993* and determined that Native Title does exist in the claim areas. These determinations were made in 2005 and 2007 respectively.

A search of the Department of Planning Lands and Heritage's Aboriginal Heritage Inquiry System (AHIS) database (DPLH, 2020) identified 32 registered sites within 2.5 km of the Development Envelope (Figure 8). The following sites overlap the Development Envelope:

- Site ID 17332: Horseshoe Bore 02 – Artefacts/Scatter;
- Site ID 17335: Mt Margaret 96-1 (Hamersley Plateau) – Modified Tree;
- Site ID 18173: Weelamurra Creek Ceremonial Ground - Artefacts / Scatter, Ceremonial and Historical site;
- Site ID 37670: Narraminju (Caves Creek) – Mythological site associated with Caves Creek and its tributaries; and
- Site ID 38183: Weelamurra Wuntu (Willamarranha, Wilumarra and Wirlumarra) – a complex of Ceremonial, Mythological, and Water Sources associated with Weelamurra Creek.

Over 50 Aboriginal heritage surveys have been undertaken across the general area of Stage 4 of the Revised Proposal since the 1970's. These have been undertaken for a range of proposed developments, including for the original Manuwarra Red Dog Highway proposal.

Main Roads has undertaken additional Archaeological and Ethnographic Surveys within the Development Envelope to adequately understand the cultural heritage of the area, to confirm the values present for the existing registered sites and identify any additional sites that may not have been found during previous surveys (Table 5-33). The information gathered from these surveys will be used to inform ongoing consultation with the Yindjibarndi and Wintawari Guruma Traditional Owners.

5.4.3.2.1 Wintawari (Eastern) Guruma Native Title Determination Area

A desktop assessment for the Wintawari (Eastern) Guruma native title determination area (WC2007/001) located in the southern portion of the Development Envelope identified a total of 33 relevant heritage survey reports.

As indicated in Table 5-33 three archaeological surveys were undertaken on Eastern Guruma Country.

Assessments of this portion of the Development Envelope and surrounding areas emphasise Wintawari Guruma peoples' strong and unceasing connection to their culture and country. These heritage assessments found:

- the waterways within this area are of special cultural importance and have an intrinsic connection to cultural heritage places both within and beyond Wintawari Guruma country. Wintawari Guruma representatives stated that it is vital to ensure the health of the waterways and the flow of water is not negatively impacted;
- the Wintawari Guruma peoples' wish to protect and preserve their cultural heritage places and particularly requested that the Weelamurra Creek Ceremonial Ground (DPLH RS ID 18173), Kartaynha Law Ground (DPLH ID 20473), and Nguan Munda (DPLH ID 12070), Jurkanunha Marnta (DPLH OHP ID 37886), Partririnha, Nhuwarnmunha (Four Mile Bore / EAS-ETH-016), and Martangngartana (Barnett Creek) not be disturbed;
- Weelamurra Creek Ceremonial Ground (DPLH RS ID 18173) intersects both the Development Envelope and Indicative Disturbance Footprint, Martangngartana (Barnett Creek) is within the Development Envelope but is not within the Indicative Disturbance Footprint, whilst Kartaynha Law Ground (DPLH ID 20473), and Nguan Munda (DPLH ID 12070), Partririnha, Nhuwarnmunha (Four

Mile Bore / EAS-ETH-016) are not in either the Development Envelope or Indicative Disturbance Footprint;

- Twenty-three newly identified sites were recorded to a Site Avoidance standard[1]:
  - WG Site 1 - place of an old government well located on the western side of Weelumurra Creek. The well is on an old station track that used to be the main thoroughfare traveling north to south. The elders described this place as a meeting place in the old days where people came before going to the Weelumurra Ceremonial Grounds;
  - WG Site 2 - a permanent water source associated with a well-known mythological narrative. The knowledge holders noted that the rocky outcrop is known to contain engravings although a cursory inspection did not identify any. The site contains hundreds of artefacts indicating visitation and usage of the place;
  - WG Site 3 - an important rockhole located in the Mallumallu between Wilarratarkkiangu Marnta (Mount Sylvia) ID 20614 Jurkanunha Marnta ID 37886. The Survey Party noted that the site is not within the proposed alignment but is immediately adjacent to it;
  - WG Site 4 - is the birthplace of a recently deceased director of WGAC and a prominent female Eastern Guruma elder who grew up on Hamersley Station. The site is located next to a small hill on the western side of tributary of Narraminju (Caves Creek) ID 37670. The area is known as Four Mile Bore;
  - WG Site 5 - a modified pantalpa (*Grevillea striata*), ethnobotanical resource, and an associated artefact scatter which includes both panilpa (a flat basal stone on which materials are ground) and karnju grinding material (stone pestle used to grind materials). The modified pantalpa is approximately 7 m in height with a 12 m canopy diameter;
  - WG Site 6 - modified kartapirangu (*Eucalyptus leucophloia*) tree's canopy;
  - WG Site 7 - a series of three tharra (rockshelters) situated within a steep valley in a low ironstone range. The Wintawari Guruma representatives noted that this place and the sites surrounding it are located along an ancestral travel route following major tributaries of the Narraminju (DPLH ID RS 37670) and Weelumurra Wuntu (DPLH RS ID 38183) between the Yulurngulurngkamu (Dreaming) site Jawunpa (DPLH ID RS 38488) and the highly culturally significant Weelumurra Creek Ceremonial Ground (DPLH ID RS 18173) where Lore Business has been conducted for many generations. They commented that people using the site and area were likely travelling along the ancestral route during lore time to conduct Lore and Culture Business at the Weelumurra Creek Ceremonial Ground (DPLH ID RS 18173);
  - WG Site 8 - a culturally modified kartapirangu tree (*Eucalyptus leucophloia*) with an exceptionally large scar. Wintawari Guruma representatives informed the survey team that their Ancestors removed the bark from the kartapirangu tree for sacred and ceremonial purposes relating to Men's Business;
  - WG Site 10 - an artefact scatter with panilpa grinding material, and ethnobotanical resource area located in the central extent of the SLK0-51 project area within the Weelumurra Wuntu Cultural Catchment area;

- WG Site 11 - a tharra (rockshelter) with a potential cultural deposit and panilpa and karnju grinding material on the surface. The Wintawari Guruma representatives consider the site to be an ethnobotanical resource area due to two mature bushfood plants winyarrpa (*Ficus platypoda*), and a water source due to the site's location in a well-watered riverine gully which pools water in front of the tharra after seasonal rainfall;
- WG Site 12 - a wintertime ngurra (campsite) with stone cultural material and ethnobotanical resources that was used by Ancestral Guruma people. The artefactual assemblage consists of modified ironstone, dolerite, chert, chalcedony, and pitan (white quartz) raw material types. These raw material types are not available in the area surrounding this place and were carried into the site by Ancestral Guruma people;
- WG Site 13 - a large and significant ngurra (campsite) used recurrently by Wintawari Guruma people for their cultural practice. The heritage place comprises of highly diverse stone cultural material, a water source, yurrama (soak), and ethnobotanical resources used by Ancestral Guruma people. The site has also been identified by the Wintawari Guruma representatives to have high potential to contain subsurface cultural material;
- WG Site 14 - a ngurra (campsite), likely occupied on multiple occasions, which contains a moderate artefact assemblage including multiple panilpa (basal grindstone) fragments, a water source, and ethnobotanical resources;
- WG Site 15 - a ngurra (campsite) that was likely occupied on multiple occasions by Ancestral Guruma groups travelling through the floodplains. The ngurra (campsite) contains an artefact scatter with at least one panilpa (basal grindstone) fragment, two complete karnju (stone pestle), two karnju (stone pestle) fragments, complete flakes, transversely broken flakes, longitudinally broken flakes, two utilised pieces, and one single platform core;
- WG Site 16 - a ngurra (campsite), associated artefact scatter, and resource hub that was likely occupied and utilised on numerous occasions by Ancestral Guruma making use of the waterway-based travel route connecting lore places in the north and south of Guruma country;
- WG Site 17 - a small panilpa (basal grindstone) within an ethnobotanical resource area. The panilpa (basal grindstone) measures 13 cm wide, 11 cm long, and 2 cm high with the ground surface occupying 9.5 cm x 8 cm of this space;
- WG Site 18 - a culturally modified kartapirangu *(Eucalytpus leucophloia*) with ceremonial affiliations located within an ethnobotanical resource area situated along a known Ancestral pathway through Guruma Country;
- WG Site 19 – a culturally modified kartapirangu (*Eucalyptus leucophloia*) located within an ethnobotanical resource area situated along a known Ancestral pathway through Guruma country;
- WG Site 20 - a meeting place with a tradition of continuous use that spans from pre-colonisation up until as recently as the mid-late 20th century. The heritage values that comprise this place include an artefact concentration, a water source in the form of a rockhole, and a varied ethnobotanical resource area;

  - WG Site 21 - a ngurra (campsite) with ceremonial affiliation that is believed to have been occupied on numerous occasions by Ancestral Guruma to prepare for upcoming law and ceremonial business occurring at the Weelumurra Wuntu Ceremonial area located approximately 5.7 km to the north. The site contains an artefact scatter, reduction area, panilpa (basal grindstone) grinding material, ochre, water sources (in the form of a rock hole and multiple jartungu [gnamma holes]), and a modified tree, that is surrounded by ethnobotanical resources;
  - WG Site 22 - two tharra (rockshelters) with associated artefact concentrations, ochre sources, cached artefacts, evidence of quarrying, and subsurface cultural material. Both of the tharras (rockshelters) offer expansive views over the undulating topography and thoroughfare, heading south, created by Weelumurra Wuntu (DPLH RS ID 38183);
  - WG Site 23 - is comprised of one large multiple chambered tharra (rockshelter) with evenly dispersed artefactual material across the surface, numerous panilpa (basal grindstone) and karnju (top stone) grinding implements, some additional cached cultural material, including an anvil and additional panilpa (basal grindstones), and a deep stratified deposit likely containing additional cultural material; and
  - WG Site 24 - a culturally modified kartapirangu (*Eucalyptus leucophloia*) with ceremonial affiliations located within an ethnobotanical resource area situated along a known Ancestral pathway through Guruma country in the northern portion of the Weelumurra Wunutu Cultural Catchment area.
- Eight previously identified heritage places were reassessed to a site avoidance standard:
  - WG Site 9 - an artefact scatter with panilpa (flat basal stone on which materials are ground) grinding material and two separate reduction areas distributed throughout the boundary in moderately dense concentrations, on either side of the bisecting access track that runs northwest-southeast through the site. Previously two separate places, now amalgamated into WG Site 9;
  - WG Site 25 – a previously recorded modified kartapirangu (*Eucalyptus leucophloia*) located in the central extent of the SLK0-51 project area and situated within undulating terrain in the foothills of a low ironstone range of the Weelumurra Wuntu Cultural Catchment;
  - WG Site 26 - a previously recorded artefact scatter with panilpa grinding material;
  - WG Site 27 – a previously recorded artefact scatter and knapping floor with panilpa grinding material, and an ethnobotanical resource area
  - WG Site 28 – a previously recorded artefact scatter. The raw materials identified at this heritage place are diverse and include modified chert (very high quality in varying colours), chalcedony, and pitan (white quartz). The majority of these lithologies are not available in the surrounding area indicating that most of the recorded assemblage was deliberately transported to this site by groups of Ancestral Guruma people.;
  - WG Site 29 – Also known as Four Mile HRZ, a preliminary boundary which encompasses a highly significant cultural area including WG Site 4; and
  - WG Site 30 - a previously recorded artefact scatter with panilpa grinding material (basal grindstone).

  - WG Site 31 - a previously recorded rockshelter, subsurface material, panilpa grinding material, pulpu (stone axe)

- the Wintawari Guruma representatives identified an expansive and significant cultural area known as Nhuwarnmunha (Four Mile) and established a preliminary HRZ boundary known as the Four Mile HRZ to encompass the associated heritage values;
- the Wintawari Guruma representatives identified the preliminary boundary for this Four Mile HRZ site known as Nhuwarnmunha (Four Mile) and indicated the site must extend further southwards to encapsulate additional heritage values and should have further site-specific assessment on a subsequent Main Roads heritage survey.; and
- the Wintawari Guruma representatives confirmed that the health and wellbeing of the waterways associated with the Narraminju (Caves Creek) and Weelamurra Wuntu, is of vital importance to them, as both waterways have deep significance to Wintawari Guruma traditions and beliefs, and are intrinsically connected to the surrounding cultural landscape within Wintawari Guruma country. They requested that Main Roads ensure that the water flow is not impeded and ensure that the quality of the water is not compromised during the Main Roads land use, including the construction, and maintenance of the project.

The Wintawari Guruma representatives recommended that the proposed works are clear to proceed subject to the following:

- where possible, heritage places be avoided and protected from damage;
- Main Roads employees and contractors are advised of the contents of this report and their obligations under the ACH Act;
- if newly identified heritage values are identified, Main Roads must stop work immediately in vicinity of the area and contact the Wintawari Guruma traditional owners through Wintawari Guruma Aboriginal Corporation as soon as possible to enable culturally appropriate management of any heritage values;
- if human remains, skeletal material that may be human, or material that potentially belongs to a human burial are identified, Main Roads must stop work immediately in vicinity of the area and follow the DPLH procedures. The materials and surrounding area must be left undisturbed and the Western Australian Police informed immediately, as required by law. Main Roads must contact the Wintawari Guruma traditional owners through Wintawari Guruma Aboriginal Corporation as soon as possible to enable culturally appropriate management of any human remains;
- Main Roads continue discussion with Wintawari Guruma traditional owners regarding any future matters relating to the Wintawari Guruma heritage places and surveyed project areas, including any further ground disturbing activities;
- Main Roads ensure that the water flow is not impeded and ensure that the quality of the waterways including Narraminju (Caves Creek) and Weelumurra Wuntu is not compromised during the Main Roads land use, including the construction, and maintenance of the project;
- a large nesting tree directly adjacent to a waterhole is used by a hawk family group. At the time of the heritage survey, three adult hawks were using the location as a nesting site. The Wintawari Guruma representatives instructed Yulur Heritage to create a restriction zone around the extent of

the nesting tree and waterhole. They further stated the restriction zone is to be avoided by Main Roads to conserve the nesting site;

- Main Roads should avoid the restriction zone (identified as HRZ_01) around the extent of a distinctive rock formation to conserve the formation integrity;
- Main Roads integrate a high portion of culverts in the road design to ensure the movement of water through their country is not blocked by the new road alignment. The representatives indicated that it is especially important that culverts are used abundantly in the floodplain areas and area around Hamersley Station to allow water to flow unimpeded through the country and ensure the health of the vegetation;
- windrows should not be utilised in the new road alignment design due to environmental concerns. They explained that windrows block the water flow and facilitate concentrated growth of vegetation along the roadside. They expressed concern that animals native to their country may be drawn to such build ups of vegetation and be killed by traffic;
- accordingly, Main Roads are requested to consult with WGAC regarding the design and location of the culverts and the utilisation of windrows in the Stage 4 Karratha Tom Price Road design;
- Main Roads discuss Mt Brockman Road access with WGAC to ensure their access to the Mt Brockman Road and cultural heritage is not impeded;
- Main Roads undertakes further site-specific assessment to sufficiently understand and characterise the heritage features and determine the site's boundary for the preliminary Weelamurra Ceremonial HRZ;
- Main Roads consult with WGAC to determine alternative alignment options around the Weelamurra Ceremonial HRZ; and
- Places MR_EAS_21_007, MR_EAS_21_008, MR_EAS_21_009, MR_EAS_21_010, MR_EAS_21_011, and MR_EAS_21_012, S11-181, Weelamurra Creek Ceremonial Ground, and Weelamurra Ceremonial HRZ be avoided and protected from damage.

Main Roads will adopt the recommendations of Eastern Guruma Country archaeological site avoidance survey reports. Places MR_EAS_21_007, MR_EAS_21_008, MR_EAS_21_009, MR_EAS_21_010, MR_EAS_21_011, and MR_EAS_21_012, S11-181, Weelamurra Creek Ceremonial Ground, and Weelamurra Ceremonial HRZ will be avoided and protected from damage, as far as is practicable. Further design work and liaison with Eastern Guruma representatives is required to determine whether these sites can be completely avoided. Relevant approvals[1] under the AH or ACH Act will be obtained for any impacts to identified sites.

An ethnographic survey of the Main Roads Karratha to Tom Price Road Project Alignment in Guruma Country recommended Main Roads:

- notes that the proposed road alignment through the Eastern Guruma native title determination area is supported by Wintawari Guruma Aboriginal Corporation (WGAC);
- notes that four new Eastern Guruma ethnographic sites were recorded during the field work between 3 – 8 August 2020;
- aligns the road to avoid these four sites;

- notes that a section 18 consent under the AH or ACH Act[2] will be required for impacts to Weelumurra Wuntu ID 38183 and Narraminju 37670;
- consults with WGAC regarding the design of the culverts before they are installed in the creeks; and

  consults with WGAC regarding facilitating unrestricted access to the Eastern Guruma people for Mount Brockman Road and for important cultural sites.

Main Roads will adopt all the recommendations of the Eastern Guruma Country ethnographic site identification survey reports.

5.4.3.2.2 Yinjibarndi Heritage Survey Area

The northern portion of the Development Envelope lies within the traditional lands of the Yindjibarndi people, located within the northern half of the Ngarluma Yindjibarndi native title determination (WCD2005/001; WAD6017/1996) and within the Yindjibarndi #1 determination area (WCD2017/010; WAD6005/2003).

As indicated in Table 5-33 five archaeological surveys were undertaken on Yindjibarndi Country:

- Nineteen newly identified sites were recorded to a Site Avoidance standard[3];
  - Yin Site 1 – a medium sized artefact scatter located on a flat terrace within a gibber plain, with rolling hills to the north and east and ironstone ridges to the south and west. Weelamurra Creek, a tributary of the Fortescue River, is located approximately 620 m to the northeast. The artefact assemblage includes complete flakes, retouched flakes, single and multi-platform cores, grinding material and a tula adze manufactured on banded iron formation, chert, ironstone and basalt;
  - Yin Site 2 – a modified snappy gum (*Eucalyptus leucophloia*) tree with a single northwest facing oval shaped scar;
  - Yin Site 3 – large sized, medium density artefact scatter located in an alluvial fan located within an undulating plain. The plain is bordered by ironstone ridges and ranges. The artefact assemblage includes complete flakes, single and multi-platform cores, a muller fragment and several grinding base fragments;
  - Yin Site 4 - a large sized, medium density artefact scatter located on a flat gravel terrace on an interbank between two branches of Weelumurra Creek. The artefact assemblage includes unmodified flakes, single platform cores, grinding material banded iron formation, chert, dolerite, and mudstone;
  - Yin Site 5 – a large sized, low to medium density artefact scatter located on a flat gravel terrace on an interbank between two branches of Weelumurra Creek. The artefact assemblage includes complete flakes, single platform cores, and grinding material of banded iron formation, chert, dolerite, and ironstone;
  - Yin Site 6 – a large sized, low density artefact scatter located within a snakewood (*Acacia xiphophylla*) grove on an alluvial plain. The artefact assemblage includes complete flakes, flake

[2] Approval will be via an Aboriginal Cultural Heritage Management Plan in accordance with Division 6 of the ACH Act post 22/12/2022.

fragments, multi and single platform cores and grinding bases of iron formation, chert, basalt, ironstone, quartzite, and mudstone;

- Yin Site 7 - a medium sized, low density artefact scatter located on a flat gravel terrace. The artefact assemblage includes complete flakes, flake fragments and retouched flakes of ironstone, quartz, chert, and bottle glass;
- Yin Site 9 – medium sized, medium density artefact scatter located on a gently sloping gravel terrace within a wide open plain to the north of the Hamersley Ranges. The artefact assemblage includes complete flakes, retouched flakes, single and multi-platform cores One of the observed retouched flakes is a tula adze. The artefact assemblage of basalt, banded iron formation, chert, ironstone, and chalcedony;
- Yin Site 10 – a large sized, medium density artefact scatter located on a gravel terrace on the southeast bank of a creek. The artefact assemblage includes complete flakes, flake fragments, retouched flakes, single and multi-platform cores, mullers, grinding bases and grinding base fragments. Some flakes at in the assemblage are macro-blades. The observed stone artefact assemblage is manufactured on basalt, chert, dolerite, mudstone, quartz, quartzite, and banded iron formation;
- Yin Site 11 - a large sized low to medium density artefact scatter and three modified trees located on a banded iron formation and ironstone gravel floodplain. The artefact assemblage includes flaked bottle glass, single and multi-platform cores, grinding bases, grinding base fragments, mullers, retouched flakes, and a range of historical artefacts including five horsehoes, glass bottle fragments, square nails, a tobacco tin, and a harness buckle. One of the observed retouched flakes is a tula adze. The observed stone artefact banded iron formation. assemblage is manufactured on basalt, ironstone, chert, quartzite, siliceous sedimentary and banded iron formation. Modified Trees 1 and 2 were interpreted as honey trees, with the multiple scars on each tree including evidence of the removal of heartwood. The size and shape of the scar on Modified Tree 3 and lack of heartwood removal suggests it may be associated with the removal of bark for the manufacturing of cultural material such as a yandi;
- Yin Site 12 – medium sized, low to medium density artefact scatter located in a snakewood grove within a flat gilgai/crabhole clay plan. The observed artefact assemblage 1 includes complete flakes, flake fragments, retouched flakes, and retouched flake fragments, mullers and grinding base fragments. One of the observed retouched flakes is a tula adze. A yellow chert knapping floor was noted. The observed artefact assemblage is manufactured on banded iron formation, ironstone, chert, quartzite, and chalcedony;
- Yin Site 13 - a modified mature coolibah (*Eucalyptus microtheca*) tree with a singular scar. The tree is located on the southeast bank of Cowcumba Creek, which is a major tributary of the Fortescue River;
- Yin Site 14 – large sized, low to medium density artefact scatter located on an open gravel clearing within a snakewood grove. The snakewood grove is encircled by a gilgai clay pan. Cowcumba Creek is located approximately 1 km to the southeast of the site, and is a major tributary of the Fortescue River. The artefact assemblage includes complete flakes, flake fragments, retouched flakes, mullers, and single and multi-platform cores. Retouched microblades and a microblade core were also noted. The observed artefact assemblage is manufactured on basalt, ironstone, banded iron formation, chert, quartzite, and chalcedony;

  - Yin Site 15 – is a very large sized, low to medium density artefact scatter located in an open gravel clearing. The artefact assemblage includes complete flakes, flake fragments, retouched flakes, mullers, and grinding base fragments. Retouched micro-blades, macro-blades and a backed artefact were noted. The artefacts were manufactured on basalt, ironstone, chert, quartzite and chalcedony. Two horseshoes were also noted at the site;
  - Yin Site 16 - a very large sized, low density artefact scatter located on a flat plain, approximately 20 m to the south of the Roebourne-Wittenooom Road. The artefact assemblage includes complete flakes, transversely broken flakes, retouched flakes, single platform cores, and multi-platform cores. Some flakes at in the assemblage are macro-blades. The observed stone artefact assemblage is manufactured on basalt, chert, and mudstone;
  - Yin Site 17 – a medium sized, low density artefact scatter located on a small gravel rise within an open plain. The artefact assemblage includes compete flakes, retouched flakes, single platform cores, multi-platform cores and a grinding base fragment The observed stone artefact assemblage is manufactured on ironstone, banded iron formation, quartzite, and dolerite;
  - Yin Site 18 - a medium sized, low density artefact scatter located on a flat plain. The artefact assemblage includes complete flakes, retouched flakes, single platform cores, multi-platform cores, grinding base fragments and muller fragments. Some flakes in the observed assemblage are macro-blades. Additionally, one rock with evidence of pitting that may have been used as an anvil was observed. There are three concentrations of artefacts in the site. The observed stone artefact assemblage is manufactured on ironstone, chert, basalt, and quartzite;
  - Yin Site 19 – a medium sized, medium density artefact scatter located on a flat plain. The artefact assemblage includes compete flakes, broken flakes, retouched flakes, single platform cores, multi-platform cores, muller fragments and hammerstones. The observed stone artefact assemblage is manufactured on basalt, banded iron formation, chert, chalcedony, dolerite, and quartzite; and
  - Yin Site 20 - medium sized, low density artefact scatter located on a flat plain, approximately 170 m to the west of the Tom Price Railway Road. Weelumurra Creek is located approximately 400 m to the west. The artefact assemblage includes complete flakes, broken flakes, single platform cores, mullers and muller fragments. Some flakes at in the assemblage are macro-blades. The observed stone artefact assemblage is manufactured on entirely on dolerite.
- One previously identified heritage place was reassessed to a site avoidance standard:
  - Yin Site 8 - a medium sized, low density artefact scatter located on a flat sand wash. The artefact assemblage includes complete flakes, flake fragments, single and multi-platform cores, mullers, muller fragments, grinding bases, macro-blades and small blades of ironstone, quartzite, mudstone, chert, and quartz.

These newly identified Aboriginal archaeological sites are likely to constitute Aboriginal heritage sites to which the AH or ACH Act applies and should, therefore, be avoided. Several hundred isolated artefacts and finds recorded are not considered likely to constitute Aboriginal sites as defined under the AH or ACH Act.

Yindjibarndi representatives recommended all Aboriginal heritage sites remain in situ and be avoided by Main Roads. Should Main Roads and the Yindjibarndi representatives agree that it is necessary to

disturb the above sites, it is recommended that an application, seeking consent to do so, be made to the Minister for Aboriginal Affairs under Section. 18 of the AH or ACH Act[4] under condition that:

- such an application is acceptable to the Yindjibarndi People;
- all Yindjibarndi sites MR_YIN_20_001 through to MR_YIN_21_004, are recorded to a Site Identification standard with the involvement and collaboration of the Yindjibarndi People; and
- the Yindjibarndi People are afforded the opportunity to salvage any Aboriginal heritage sites that will be impacted by the proposed works.

Main Roads will adopt all the recommendations of the Yindjibarndi Country archaeological site avoidance survey reports.

An ethnographic site identification heritage survey undertaken on portions of the Ngarluma Yindjibarndi and Yindjibarndi #1 determination areas within the Karratha - Tom Price Road Stage 4 Alignment Corridor recommended Main Roads:

- avoid impacting the following identified sites: Yin Site 1, Yin Site 2 and Yin Site 3;
- avoid impacting the identified (Gurdi) pebble mound mouse mounds 1 and 2;
- avoid impacting the Weelamurra Creek;
- avoid impacts to the (Wirlamarra Birdirra) Law Ground;
- avoid impeding the natural flow of water along west-east oriented creeks and tributaries; and should seek to minimise impact upon all other waterways to the best of their ability;
- aim to select a route that will have the least impact upon water flow;
- minimise impact upon the natural environment, such as avoiding impact upon large trees wherever possible, and removing any debris which is a result of the works;
- design a route that has the least negative impact upon their landscape in this order:
  - avoid impacting creeks;
  - avoid impacting sites;
  - avoid impacting the pebble mound mouse mounds, and
  - avoid large trees.
- discuss with the Yindjibarndi Community (via Yindjibarndi Ngurra Aboriginal Corporation (YNAC)) the possibility of organising an elders ‘Respect’ ritual at Manggurdu (Fortescue River) prior to any works beginning that will impact or cross or intersect in some manner with any of the waterways (river, creeks, major drainage channels);
- meet with Yindjibarndi to discuss the final route and determine final feedback and recommendations from the Yindjibarndi community;
- discuss with Yindjibarndi (YNAC) incorporating dual English – Yindjibarndi names and signage for any named bridges, parking areas and so forth;

[4] Consent will be via an Aboriginal Cultural Heritage Management Plan in accordance with Division 6 of the ACH Act post 22/12/2022

- If Main Roads personnel or any of its contractors become aware of any cultural materials or of places believed to be of Indigenous cultural significance, including possible human remains or goods belonging to a human grave, they are to cease work immediately and contact the YNAC (or JAC) for further advice and in the instance of suspected human remains they must also inform the police and the DPLH; and
- seek to extend their activities in the area or undertake other associated works they should maintain communications with YNAC (or JAC) regarding these requirements, and in undertaking any associated consultations.

The ethnographic site identification heritage survey report recommended that Main Roads WA may proceed with their proposed work subject to the report's recommendations.

Main Roads will adopt all the recommendations of the Yindjibarndi Country ethnographic site identification survey reports.

5.4.3.3 Historic Heritage

There are no known historic heritage places listed on either the State Heritage List, National Heritage lists, or local Municipal heritage lists associated with Stage 4 of the Revised Proposal.

5.4.3.4 Amenity

The Development Envelope is located in a remote area and is not close to any towns or population centres. Hamersley Homestead is the closest residence to the Development Envelope at approximately 2 km to the east. The nearest recreational or tourism areas are Millstream-Chichester National Park and Karijini National Park, 14 km and 18 km from the Development Envelope, respectively.

5.4.4 Potential Impacts

Potential direct and indirect impacts to the Social Surrounds of the Development Envelope may result from the following project activities:

- permanent clearing of vegetation and topsoil removal including all clearing for construction of the road and ongoing maintenance activities;
- temporary clearing for associated access and facilities including site offices, camps, stockpile and laydown areas, turnarounds and access tracks;
- constructing watercourse crossings (bridges, culverts and other drainage) including any associated dewatering;
- constructing off formation drainage;
- constructing the road formation, including applying asphalt and bitumen;
- earthworks and materials haulage;
- blasting (required in areas of cut which cannot be excavated by standard earthmoving machinery);
- movement of construction vehicles and machinery around the site;
- abstraction of water for construction purposes;

- completing landscaping and revegetation; and
- undertaking ongoing maintenance activities.

Potential impacts to the social surrounds of the Development Envelope include:

- physical damage to Aboriginal heritage sites (physical artefacts including artistic creations, built heritage such as buildings and monuments, and other physical or tangible products of human creativity); and
- impacts to anthropological values of heritage sites (Country – spiritual, physical, emotional values inherent to the identity of the Traditional Owners).

Impacts to amenity during construction or operation of Stage 4 of the Revised Proposal are expected to be insignificant given the nearest residence is approximately 2 km from the Development Envelope and the nearest recreational or tourism areas are over 10 km away. Blasting and dust generation will by managed to avoid impacting any local resident or community members.

5.4.5 Mitigation

Construction of Stage 2 and 3 of the Revised Proposal is completed. Therefore, mitigation is focussed on Stage 4 of the Revised Proposal.

The alignment of the road near the Hamersley Homestead has been modified in order to avoid potential amenity impacts to the homestead. This realignment also reduces potential security risks from increased traffic passing by the homestead's driveway, within sight of the Homestead and associated station buildings and equipment. Consultation was undertaken with the residents of Hamersley Homestead to determine an appropriate alignment.

The following measures, based on recommendations from all Aboriginal heritage surveys conducted on Yinjibarndi and Eastern Guruma Country, have been proposed to manage and mitigate the potential impacts to social surroundings from Stage 4 of the Revised Proposal:

- construction noise will be managed in accordance with the Environmental Protection (Noise) Regulations 1997;
- consultation with Traditional Owners will continue to be undertaken to understand the significance of the area and specific sites to the relevant Traditional Owners;
- in consultation with Traditional Owners, where practicable avoid impacting natural features including waterways, large trees and identified (Gurdi) pebble mound mouse mounds;
- the selection of areas where temporary clearing will be required for construction activities such as camps, laydown areas, stockpile areas and vehicle turnarounds will avoid registered heritage places;
- where practicable heritage sites identified during surveys will be protected from disturbance during construction;
- where disturbance to Aboriginal heritage sites is unavoidable, approval under the ACH Act will be sought to disturb these sites;
- a buffer of 1.2 km will be implemented around the Hamersley Homestead to minimise amenity impacts;

- All personnel and contractors engaged on the Project will undergo an induction which includes:
  - the cultural importance of Aboriginal sites (including social sites of significance);
  - requirements to report any Aboriginal material that may be discovered during pre-construction or construction works;
  - responsibilities with regards to the ACH Act; and
  - Main Roads internal requirements relating to the management of ground disturbance activities on the Project.
- the use of dual language signs for locations such as bridges and parking areas will be considered;
- all personnel and contractors engaged on the Project will complete cultural awareness training with the local Traditional Owners; and
- Aboriginal Cultural Heritage Monitors will be engaged to to observe ground disturbance as it is occurring in order to prevent or mitigate possible harm to Aboriginal cultural heritage.

Table 5-34 details the measures that are proposed to manage and mitigate the potential environmental impacts from Stage 4 of the Revised Proposal on Social Surrounds.

Table 5-34 Social Surroundings Management

EPA factor: Social Surroundings EPA objective: to protect social surroundings from significant harm Proposal objective: To minimise as far as practicable the direct and indirect impacts to social surroundings from Stage 4 of the Proposal Key environmental values: Aboriginal heritage and amenity Key impacts and risks: Loss of Aboriginal heritage sites and degradation of amenity								
Management targets or indicators	Hierarchy	Management or response actions	Monitoring	Timing/Frequency	Reporting	Corrective action trigger	Corrective actions	Corrective action responsibility
Prevent unauthorised impacts to Aboriginal heritage sites during design / pre-construction.	Avoid	Detailed design and construction planning to avoid direct impacts to identified Aboriginal heritage sites of significance where practicable. Specifically avoid impacts to Hamersley Homestead by implementing a 1.2 km buffer to avoid amenity impacts.	• Written records of avoidance during planning / design phase.	• Pre-construction.	• Pre-construction environmental audit.	• Detailed design does not contain measures to avoid direct impacts to Aboriginal heritage sites of significance or a buffer to Hamersley Homestead.	• Amend designs to avoid direct impacts to Aboriginal heritage (archaeological or ethnographic) sites of significance where practicable.	• Project Manager
Prevent unauthorised or undesired impacts to Aboriginal heritage sites or values during construction..	Avoid	Site induction and cultural awareness training will include recognition of aboriginal heritage sites, artifacts or possible remains and include individuals' responsibilities under the ACH Act and the Coroners Act.	• Environmental audit.	• Prior to staff/ contractors commencing on site.	• Environmental audit report; and • Induction material.	• Induction material does not contain information on site survey findings, management requirements and/or procedures.	• Incident will be recorded, and the cause investigated; and • Induction material revised.	• Construction Contractor Environmental Management Representative; and • Main Roads Superintendent.
	Avoid	All site personnel will complete site induction and cultural awareness training including obligations under the ACH Act.	• Written records; and • Training records.	• Prior to staff/ contractors commencing on site.	• Review of training records; and • Environmental audit report.	• Site personnel identified as not having completed site induction.	• Training administered.	
	Avoid	Conduct ongoing consultation with Traditional Owner representatives of Yindjibarndi or Wintawari Guruma about cultural heritage matters including access to Mt Brockman Road and nearby cultural sites, and water flow issues associated with the use of windrows and sufficient culverts.	• Records of consultation.	• Prior to ground disturbance.	• Consultation records.	• No consultation conducted following issue of site reports.	• Consult with Traditional Owner representatives of Yindjibarndi or Wintawari Guruma to rectify any issues of concern.	

Management targets or indicators	Hierarchy	Management or response actions	Monitoring	Timing/Frequency	Reporting	Corrective action trigger	Corrective actions	Corrective action responsibility
	Avoid	• Heritage areas to be avoided within the DE must be clearly demarcated on all project drawings and no-go zones established on site prior to construction activities. • In consultation with Traditional Owners, where practicable avoid impacting natural features including waterways, large trees and identified (Gurdi) pebble mound mouse mounds. • The selection of areas where temporary clearing will be required for construction activities such as camps, laydown areas, stockpile areas and vehicle turnarounds will avoid registered heritage places; • The large nesting tree directly adjacent to a waterhole used by a hawk family group identified by Wintawari Guruma representatives during a heritage survey, will be avoided if possible, by the creation of a restriction zone around the nesting tree and nearby waterhole. If construction activities must disturb the tree measures will be taken to ensure the hawks are not harmed, including employment of Aboriginal Heritage Monitors in the vicinity of the nesting tree during construction activities. • The restriction zone (identified as HRZ_01) around the extent of a distinctive rock formation will be avoided.	• Site inspection prior to ground disturbance to confirm heritage areas are appropriately flagged.	• Prior to ground disturbance; and • During construction.	• Site inspection report/confirmation.	• If flagging is not undertaken around heritage sites; • If heritage sites are accidentally impacted; • Drawings do not show correct approved clearing areas; and • Measures not in place to protect hawk family group using identified nesting tree.	• Construction in the direct vicinity will cease immediately if trigger is met; • Works will not recommence until no go areas have been reviewed and confirmed to be in place correctly, and Main Roads Superintendent provides approval to recommence; • Consultation with DPLH will be undertaken as required; • Incidents will be recorded and the cause investigated; • Inspect and amend pegging and outlines on maps; • Remedial actions as instructed by DPLH; • Refresher or updated training will be conducted (if appropriate); and • Review management actions (and revise if required).	

Management targets or indicators	Hierarchy	Management or response actions	Monitoring	Timing/Frequency	Reporting	Corrective action trigger	Corrective actions	Corrective action responsibility
	Minimise	If newly identified heritage values are discovered during construction, such as Aboriginal heritage objects or remains, including human remains, skeletal material that may be human or material that potentially belongs to a human burial, an unexpected finds protocol will be implemented including: ▪ Stop works immediately within 20 m of the find ▪ Notify construction manager. ▪ Contact Traditional Owner representatives of either Yindjibarndi or Wintawari as soon as possible to ensure culturally appropriate heritage management measures are implemented. ▪ Implement a chance finds process incorporating notifications to relevant authorities and DPLH procedures.	• Visual monitoring during clearing and excavation works.	• During ground disturbance; and • When an unexpected find occurs.	• Find reported to DPLH.	• Unknown heritage values, artifacts or remains are uncovered during ground disturbance.	• Notification to DPLH; • Where appropriate, a qualified heritage specialist will be engaged to survey and manage Aboriginal heritage sites/materials; and • Where appropriate, approvals sought to disturb the new site.	
Prevent unauthorised impacts to Aboriginal heritage sites through implementation of Division 6 of the *Aboriginal Cultural Heritage Act* 2021.	Minimise	If impacts to any registered Aboriginal heritage site or any site associated with the Stage 4 of the Revised Proposal likely to be protected by the ACH Act are unavoidable, undertake an archaeological investigation with the ACH Act and provide the results of the excavation to the Registrar of Aboriginal Sites prior to commencing ground disturbing works.	• Archaeological investigation undertaken by suitably qualified person.	• Prior to commencing ground disturbing works.	• Archaeological investigation; and • Record of provision of results of the excavation to the Registrar of Aboriginal Sites.	• Impact to registered Aboriginal site or site associated with Stage 4 of the Revised Proposal likely to be protected by the ACH Act undertaken without archaeological investigation.	• Notification to DPLH; and • Incident will be recorded, and the cause investigated.	• Construction Contractor Environmental Management Representative; and • Main Roads Superintendent.

Management targets or indicators	Hierarchy	Management or response actions	Monitoring	Timing/Frequency	Reporting	Corrective action trigger	Corrective actions	Corrective action responsibility
	Minimise	Invite in writing two Traditional Owner representatives of either Yindjibarndi or Wintawari to be present for ground disturbing works on Land intersecting with a registered Aboriginal heritage site or any site likely to be protected by the ACH Act.	• Written records; and • Relevant Traditional Owner representatives present for ground disturbing activities.	• Prior to commencing ground disturbing works on the Land intersecting with a registered Aboriginal heritage site or any site associated likely to be protected by the ACH Act.	• Written record inviting either two Yindjibarndi or two Wintawari Traditional Owner representatives; and • Record of appropriate Traditional Owner representatives present daily.	• No record/evidence of written invitation to Traditional Owner representatives; and • Ground disturbing works on the Land intersecting with a registered Aboriginal heritage site or any site likely to be protected by the ACH Act prior to appropriate Traditional Owner representatives being present on site.		
Minimise construction or operational impacts to water flow or water quality of waterways identified as significant in Heritage site survey findings or recommendations,	Minimise	As identified in Table 5.3.1 management targets or indicators: • Road drainage designed to maintain surface water flows; and velocities; and • Prevent impacts to water quality during construction	• Site inspections.	• During design, construction and operations.	• Site inspection reports.	• Impacts to water flow or water quality of waterways identified as significant in Heritage site survey findings or recommendations.	• As identified in Table 5.3.1management targets or indicators: Road drainage designed to maintain surface water flows and velocities; and prevent impacts to water quality during construction.	• Construction Contractor Environmental Management Representative; and • Main Roads Superintendent.

Management targets or indicators	Hierarchy	Management or response actions	Monitoring	Timing/Frequency	Reporting	Corrective action trigger	Corrective actions	Corrective action responsibility
Minimise nuisance and health impacts from dust	Minimise	• Cleared and exposed areas will be rehabilitated or otherwise stabilised as early as practicable to minimise the potential for wind erosion; • Dust emissions will be controlled through appropriate measures where practicable including hydro mulch, water application through water carts and chemical dust suppressants. This applies to the entire construction site and includes, but is not limited to haul roads, cleared areas, batters and stockpiles; • All vehicles carrying dusty loads will be covered by tarpaulins etc. if travelling outside of the DE, where practicable; • If required and practicable, construction material shall be dampened by sprinkling water prior to transportation, especially during dry and windy weather conditions; and • The construction site will be kept clean to minimise dust accumulation within and surrounding the site.	• Visual inspection, pedestrian walkthrough; • Site inspection of dust controls; and • Opportunistic monitoring with emphasis on windy periods.	• During construction; and • Weekly.	• Weekly site inspection records.	• Excessive dust recorded; and • Complaint from receivers.	• Investigation of complaint. All complaints responded to within 24 hours or 48 hours if occurring over weekend; • Incident report if required; and • Implementation of contingency actions including watering, applying covers to dusty loads and moving stockpiles.	• Construction Contractor Environmental Management Representative.

Management targets or indicators	Hierarchy	Management or response actions	Monitoring	Timing/Frequency	Reporting	Corrective action trigger	Corrective actions	Corrective action responsibility
Minimise nuisance and health impacts to local community from noise during construction	Minimise	Construction works will be undertaken in accordance with Regulation 13 (Construction) in the *Environmental Protection (Noise) Regulations 1997 (Noise Regulations).* Construction activities (including materials transport) will be limited between 0700 and 1900 Monday to Saturday, excluding public holidays (standard work hours) where possible. Where construction activities are required outside of approved operating hours: • Prepare a Noise and Vibration Management Plan (NVMP); • Obtain approval for the NVMP from the Shire of Ashburton; • Ensure all nearby residents are notified prior to works, with details of time period of activity and summary of why the activity is required outside of usual hours; • Reduce noise emissions as much as practicable, e.g. croakers in place of reverse beepers; • Generators, compressors and other semi-fixed equipment that generate noise will be located as far as practicable from nearby residences; and • Maintenance schedules will be followed to ensure that all equipment is in good condition.	• Visual inspection, pedestrian walkthrough; • Site inspection of noise controls; and • Weekly check of machinery and equipment condition.	• During construction; and • Weekly.	• Weekly site inspection records.	• Excessive noise recorded; and • Complaint from receivers.	• Investigation of complaint. All complaints responded to within 24 hours or 48 hours if occurring over weekend; • Incident report if required; and • Implementation of contingency actions including locating noise or vibratory equipment further from receptors, amending working hours or swapping for less noisy equipment.	• Construction Contractor Environmental Management Representative.

5.4.6 Assessment of Impacts

Wherever practicable, impacts to Aboriginal heritage will be avoided, however some impacts to Aboriginal heritage sites due to Stage 4 of the Revised Proposal may be unavoidable. Consultation with Traditional Owners has been and will continue to be undertaken during the design of Stage 4 of the Revised Proposal in order to understand the values present and to minimise impacts where practicable. Where possible concerns raised during heritage site surveys, including potential impacts from reduced access to cultural heritage and loss of heritage values due to changes in surface water flow or quality will be address during design, construction or operational phases.

Should complete avoidance of Aboriginal sites not be achievable, consent to impact an Aboriginal site will be sought from the Minister via the preparation of a Aboriginal Cultural Heritage Management Plan in accordance with Division 6 of the ACH Act. Consent under the ACH Act will outline the extent of approved impact. Initial consultation has resulted in changes to the alignment to avoid areas of particular significance to the Traditional Owners.

Given the remote location of the Development Envelope, no significant impacts to amenity are anticipated. Stage 4 of the Revised Proposal has been developed to take into account requests from the owners of Hamersley Station to have the road deviate from the Rio Tinto Railway alignment in order to reduce impacts such as unwanted visitation once the road is opened to traffic. This will also reduce the risk of temporary impacts to amenity at the homestead through noise and dust during construction.

5.4.7 Predicted Outcome

5.4.7.1 Environmental Outcomes

Table 5-35 details of the predicted environmental outcomes of the current Approved Proposal and Revised Proposal for Social Surroundings.

It should be noted that the CER for the Approved Proposal was prepared in 2003 and the EPA finalised its decision report in 2005. Requirements in environmental impact assessment has progressed significantly in the early 2000's and the EPA has released a series of technical guidance with respect to the preparation of ERDs and the assessment of technical factors. Given this, direct comparison between the Approved Proposal and Revised Proposal is not possible in all cases.

Table 5-35 Environmental Outcomes for Revised Proposal – Social Surroundings

Element	Approved Proposal	Proposed Changes	Revised Proposal
Impacts to Millstream-Chichester National Park.	The construction of a sealed road will increase visitor pressures on the National Park and may result in DCLM providing camping or picnic areas at particular locations. Given the size and inaccessibility of most of the Park the opportunities for providing better access and viewing points along the existing railway/road	Change to – no change to the social values of the Millstream-Chichester National Park will occur.	No change to the social values of the Millstream-Chichester National Park will occur.

Element	Approved Proposal	Proposed Changes	Revised Proposal
	corridor are likely to outweigh the risks of increased visitor numbers.		
Amenity	There will be little potential visual impact to existing users of the area. Plant and equipment used on the works will comply with standard noise level requirements and negotiations regarding working out of standard hours will be undertaken when work is near the station homestead. Due to the low traffic levels predicted for the southern part of the Karratha to Tom Price road (60 vehicles per day) traffic noise levels are not considered an issue.	No material change given impacts to amenity during construction or operation of Stage 4 of the Revised Proposal are expected to be insignificant given the nearest residence is approximately 2 km from the Development Envelope and the nearest recreational or tourism areas are over 10 km away. Blasting and dust generation will be managed to avoid impacting any local resident or community members.	No significant impacts to amenity will occur.
Aboriginal heritage	Where avoidance of Aboriginal heritage sites is not possible Main Roads will seek a Section 18 clearance under the AH Act or ACH Act.	Change to - No unapproved disturbance in an Aboriginal heritage site will occur.	No unapproved disturbance in an Aboriginal heritage site will occur.
Historic heritage	No impacts identified in CER.	No impact predicted as There are no known historic heritage places listed on either the State Heritage List, National Heritage lists, or local Municipal heritage lists associated with Stage 4 of the Revised Proposal.	No impacts to historic heritage will occur.

5.4.7.2 Summary of Assessment of Significant Residual Impacts

While it is possible that the final Disturbance Footprint may impact on some Aboriginal heritage sites (subject to approval under the ACH Act and consultation with traditional owners), the Revised Proposal has been designed, will continue to be designed, and will be managed throughout the project lifecycle to avoid and minimise impacts on these sites.

Impact to amenity from the Revised Proposal is predicted to be low given the extent of baseline surveys and studies, management measures proposed, ongoing consultation with traditional owners, remoteness of the area, distance to tourism and recreational areas, presence of other infrastructure (such as the Rio Tinto Railway) and the short duration of construction activities.

Stage 4 of the Revised Proposal will bring local community benefits including improved road safety and reduced travel times for local residents, and improved access to tourism and recreations sites.

5.4.7.3 Assessment against EPA's Environmental Objective

The Proposed Changes are not expected to significantly alter the extent of magnitude of impacts currently considered in the Approved Proposal. No significant residual impacts to Social Surrounds have been identified.

Main Roads will implement the Revised Proposal so as to achieve the environmental outcomes outlined in Table 5-35. Doing so will ensure that the Revised Proposal avoids and minimises impacts to Social Surrounds as far as reasonably practicable. Approvals with respect to impacts to Aboriginal heritage sites from Stage 4 will be managed via an Aboriginal Cultural Heritage Management Plan in accordance with Division 6 of the ACH Act. This avoidance and minimisation of impacts will ensure that the Revised Proposal does not cause significant harm to social surroundings. As such the Revised Proposal is consistent with the EPA's environmental objective for Social Surroundings.

Assurance of achievement of the environmental outcomes is via:

- the proposed implementation conditions for the Revised Proposal detailed in Section 6 which are outcome-based conditions which mandate where an impact must be avoided, where a level of impact must not be exceeded or where a level of environmental protection must be met; or
- regulation by other DMAs permitting and licensing requirements (i.e. Division 6 approvals under the ACH Act).

Appendix F. Incoming Corres. from EPA RE MS 677 May16

02/782

Government of **Western Australia**
Office of the **Environmental Protection Authority**

RECEIVED
MAINROADS
- 1 JUN 2016
RECORDS
ACK

Mr Mark Hazebroek
Senior Project Director
Main Roads Western Australia
PO Box 6202
EAST PERTH WA 6892

Your Ref: *02/782*
Our Ref: *ACO9-2015-0030*
Enquiries: *Jennifer Fortune, 6145 0854*
Email: *jennifer.fortune@epa.wa.gov.au*

Dear Mr Hazebroek

NOTICE OF DESKTOP AUDIT OF STATEMENT 677

The Office of the Environmental Protection Authority (OEPA) has undertaken a desktop audit of Road from Karratha to Tom Price to verify Main Roads' compliance with the implementation conditions and proponent commitments of Statement 677. The Desktop Audit Report details the compliance status of each implementation condition and proponent commitment and is enclosed for your information.

At the time of the audit Main Roads was found to be compliant with the implementation conditions and proponent commitments.

No response is required in relation to this matter.

If you have any questions please contact Jennifer Fortune on 6145 0800.

Yours sincerely

Ian Munro
MANAGER, COMPLIANCE BRANCH

23 May 2016

Encl.

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Government of Western Australia
Office of the Environmental Protection Authority

OEPA Compliance Audit Report

Statement(s)	677
Proposal	Road from Karratha to Tom Price, Shires of Ashburton & Roebourne
Proponent	Main Roads Western Australia
Proponent Contact	Elizabeth Johnston – Senior Environment Officer, Infrastructure Delivery Directorate ph 9323 4945 - elizabeth.johnston@mainroads.wa.gov.au
Lead Auditor	Jennifer Fortune
Date of Audit	May 2016
OEPA File Number	AC09-2015-0030
Objectives	Assess/verify the proponent's compliance with Statement 677
Scope	Implementation conditions of Statement 677
Documents Reviewed	Statement 677 Bulletin 1159 Performance and Compliance Report dated May 2011 by GHD Pty Ltd (2013-0000076939). Weed Control and Revegetation Compliance – Post Construction Report dated October 2015 by GHD Pty Ltd (2015-1444718885475). 2014 Compliance Report by Main Roads (2015-1444718885475).
Attachments	Attachment One – Audit Table

Background

Main Roads Western Australia (MRWA) proposes to construct and maintain a new road from Northwest Coastal Highway (near Karratha), through the Millstream-Chichester National Park (NP), to the Nanutarra-Munjina Road intersection (north of Tom Price). The project is to be constructed in stages.

- Stage 2 is the section from North West Coastal Highway to Camp Curlewis. Camp Curlewis is located approximately 95 km south of Karratha at the intersection of the Roebourne Wittenoom Road and the Pilbara Rail Company railway. Construction of stage 2 began on 1 August 2006 and was completed in August 2008.

- Stage 3 is the section of the Roebourne Wittenoom Road between Camp Curlewis and Wallyinya Pool located approx 46 km south. This section was be constructed after 2006, the actual timing being subject to the availability of funding.

- Stage 4 is from Wallyinya Pool to the Nanutarra Munjina Road along the existing railway which is approximately 109km in length. This section was to be constructed after 2006, subject to the availability of funding.

The proposal was referred to the Environmental Protection Authority (EPA) in September 1998 by MRWA. The EPA determined that the likely environmental impacts were sufficient to warrant formal assessment of the proposal under the *Environmental Protection Act 1986*. Statement 677 was published on 4 January 2005.

To date only Stage 2 of the proposed Karratha to Tom Price Road, being a road length of approximately 90 km between the North West Coastal Highway south to the junction of the Roebourne– Wittenoom Road has been constructed.

A 46C minor change to condition was approved 13 June 2007 to increase the area of vegetation to be cleared within the National Park from 110 hectares to 145 hectares (2013-0000077712).

Audit Findings

The proponent has demonstrated an acceptable level of compliance with the conditions of Statement 677 audited.

Required Actions and Recommendations

No recommendations or further action required.

Report Prepared by: Jennifer Fortune – Environmental Officer	Date: 19 May 2016
Reviewed by: Paul Zahra – Principal Environmental Officer	Date: 20 May 2016
Endorsed by: Ian Munro – Manager Compliance Branch	Date: 23/5/16

Definitions

Phases

Pre-Construction - No ground disturbance has commenced. Plans may be in development or approvals are being sought prior to ground disturbance.

Construction – Ground disturbance may have commenced, no waste emission from operations has commenced, limited waste emissions may have occurred during 'commissioning' under a works approval issued under the Environmental Protection Act 1986 (EP Act); proposal has substantially commenced.

Operation – The following may have occurred or may be occurring: ground disturbance; operations are producing waste emissions; 'commissioning' under a licence issued under the EP Act; development of a site; remediation activity prior to development of site; mining activity; subdivision of site.

Decommissioning – The following may occur during this phase: ground disturbance for rehabilitation purposes; post-remediation; post-reclamation; development following remediation where the main objective of the proposal was remediation; decommissioning.

Overall – This phase is used where an audit element applies during multiple phases of the project.

Compliance Statuses

Compliant (C) – Implementation of the proposal has been carried out in accordance with the requirements of the audit element.

Completed (CLD) – A requirement with a finite period of application has been satisfactorily completed.

Not required at this stage (NR) – The requirements of the audit element were not triggered during the reporting period.

Potentially Non-compliant (PNC) – Possible or likely failure to meet the requirements of the audit element.

Non-compliant (NC) – Implementation of the proposal has not been carried out in accordance with the requirements of the audit element.

In process (IP) – Where an audit element requires a management or monitoring plan be submitted to the OEPA or another government agency for approval, that submission has been made and no further information or changes have been requested by the OEPA or the other government agency and assessment by the OEPA or other government agency for approval is still pending.

Abbreviations

CAR = Compliance Assessment Report

CEO = Chief Executive Officer of OEPA

DEC = Department of Environment and Conservation

DER = Department of Environment Regulation

DMP = Department of Mining and Petroleum

EPA = Environmental Protection Authority

OEPA = Office of the Environmental Protection Authority

Attachment One

AUDIT TABLE

PROPOSAL: Road from Karratha to Tom Price
STATEMENT: 677

Government of **Western Australia**
Office of the **Environmental Protection Authority**

Audit Code	Subject	Phase	Action	Plan Requirements	Notes	Status
677:M1.1	Implementation	Overall	Implement the proposal as documented in Schedule 1 of Statement 677, subject to the conditions of this statement	Length approximately 245 kilometers. Area of disturbance for road formation is approximately 474 hectares – of this approximately 137 hectares will be rehabilitated following construction. Area of disturbance for material sources is approximately 100 hectares. Fencing of road reserve approximately 200 kilometres of fence will be erected along the road reserve outside the Millstream-Chichester National Park.	The Proponent has submitted information showing compliance with Schedule 1 – Key Characteristics Table of this Statement for Stage 2 of the Karratha to Tom Price road. The 2011 Performance and Compliance Report (PCR 2011) states that the as built quantity of Stage 2 was approximately 88 kilometers. The 2014 Compliance Assessment Report (2014 CAR) states that a total of approximately 445 hectares of land was disturbed as a result of Stage 2, of which approximately 122.5 hectares occurred within the Millstream-Chichester National Park. Approximately 309 hectares was cleared due to the permanent alignment. The 136 hectares of temporarily disturbed land was available for rehabilitation (approximately 23.5 hectares within the Millstream- Chichester National Park). The proponent states that all areas of land disturbed during road construction and materials take and not part of the permanent road area were rehabilitated (2015-1444718885475). Fencing was not constructed by Main Roads Western Australia (MRWA). Fencing along the northern boundary was considered to be logistically difficult to achieve due to the terrain and large number of creek crossings. It was agreed by the Regional Manager of Department of Environment and Conservation (DEC), Pilbara and the Project Director of MRWA on 15 August 2008 that the western boundary was a higher priority as it contained several entry points for cattle into the park. MRWA agreed that a cash payment of $120,000 would be given to DEC for the fencing of the western boundary of Millstream Chichester National Park (2015-1448500610244).	C
677:M2.1	Proponent Commitments	Overall	Implement the environmental management commitments documented in Schedule 2 of Statement 677		The Proponent has submitted information showing compliance with the management commitments in Schedule 2 of this Statement.	C
677:M3.1	Nominated Proponent	Overall	The proponent nominated by the Minister for the Environment, under S38(6) or (7) of the Environmental Protection Act 1986 Act is responsible for the implementation of the proposal until the Minister has revoked this nomination and nominated another person in respect of the proposal under S38(7) of the EP Act		MRWA remains the proponent.	C
677:M3.2	Change in Proponent	Overall	Any request for a change in proponentship shall be accompanied by a copy of the Minister's statement endorsed with an undertaking by the proposed replacement proponent to carry out the proposal in accordance with the conditions and procedures set out in Statement 677. Contact details and appropriate documentation on the capability of the proposed replacement proponent to carry out the proposal shall also be provided.		No requests for a change in proponent have been received.	C
677:M3.3	Proponent	Overall	Notify the DoE of any change of proponent contact name and address		MRWA remains the proponent.	C
677:M4.1	Commencement	Overall	If the proposal has not been substantially commenced within five years of the date of this statement, the approval to implement the proposal as granted in Statement 677 shall lapse and be void		Stage 2 of the Proposal has been implemented. Construction commenced in June 2006 and the road was opened to the public on 3 August 2008.	CLD
677:M4.2	Commencement	Design	Make an application to the Minister for the Environment for any extension of approval for the substantial commencement of the proposal beyond five years from the date of Statement 677		Not required - see 677:M4.1	CLD
677:M5.1	Compliance Auditing	Overall	Prepare an audit programme and submit compliance reports to the DoE		The proponent states that six key performance indicator audits were undertaken by third party auditors, Shawmac from May 2006 until November 2007 for Stage 2 of the proposal. The OEPA has received the following copies: • Shawmac Performance Indicator Audit No. 2 dated July 2006 (2015-1445585203301). • Shawmac Performance Indicator Audit. Final Report, Performance Assessment No. 3 dated 16 November 2006 (2015-1445585183231).	C

AUDIT TABLE

PROPOSAL: Road from Karratha to Tom Price
STATEMENT: 677

Audit Code	Subject	Phase	Action	Plan Requirements	Notes	Status
					• Shawmac Performance Assessment No. 6 dated 29 November 2007 (2013-0000076939). PCR 2011 dated May 2011 by GHD Pty Ltd was received by the OEPA on the 24 August 2011 (2013-0000076939). The 2014 CAR was received by the OEPA on 9 October 2015 (2015-1444718885475). The report contained the Weed Control and Revegetation Compliance – Post Construction Report dated October 2015 by GHD Pty Ltd.	
677:M6.1:1	Weed control	Construction	In addition to commitment 4 (Vegetation Protection and Rehabilitation Management Plan) in schedule 2, to manage and control the spread of weeds, the proponent shall ensure that 1. earthmoving vehicles and construction equipment are free of soil and vegetative material prior to entering the construction area; 2. quarries and borrow pits are surveyed for Ruby Dock (Acetosa vesicaria) prior to utilising the material from these pits for road construction; 3. borrow pits and areas containing Ruby Dock (Acetosa vesicaria) are delineated in the field (by roping or a system of markers) to prevent access for construction crews and machinery; 4. soil and construction materials brought into the construction area from other areas are weed free		The Vegetation Protection and Rehabilitation Management Plan was approved by the DoE on 2 May 2006 (2015-1446795628456). Weed control and vegetation requirements were included within the plan. The proponent states in PCR 2011 that all earthmoving equipment arriving new to the project or moving from known Kapok or Ruby Dock infested areas on the Project were required to be cleaned down, inspected and deemed free from weeds and seeds prior to commencing ground engaging work. The PCR 2011 also states that monitoring of known weed infested areas and hand removal occurred throughout construction phase. A copy of the Ruby Dock inspection checklist details the inspections undertaken during construction (2013-0000076939). The proponent also states that a Project Land Clearing and Excavation Permit and associated procedure and register was implemented to control land disturbing activities, including identifying no go areas (weed infested areas, heritage sites etc), equipment clean down and weed control requirements. A template of the Clearing and Excavation Permit was provided in the PCR 2011 (2013-0000076939).	C
677:M6.1:2.1	Weed control	Design	Prepare a Weed Control and Monitoring Program in collaboration with the neighbouring railway operator(s) with the objective of controlling and eradicating existing weeds and future outbreaks of weeds along the road, particularly Ruby Dock (Acetosa vesicaria), both during and following construction		See 677:M6.1:1	C
677:M6.1:2.2	Weed control	Construction	Implement a Weed Control and Monitoring Program in collaboration with the neighbouring railway operator(s) with the objective of controlling and eradicating existing weeds and future outbreaks of weeds along the road, particularly Ruby Dock (Acetosa vesicaria), both during and following construction		See 677:M6.1:1	C
677:M6.1:2.3	Weed control	Post-construction	Implement a Weed Control and Monitoring Program in collaboration with the neighbouring railway operator(s) with the objective of controlling and eradicating existing weeds and future outbreaks of weeds along the road, particularly Ruby Dock (Acetosa vesicaria), both during and following construction		Weed Control and Revegetation Compliance – Post Construction Report by GHD Pty Ltd dated October 2015 was received by the OEPA on the 9 October 2015. The report provides details of weed control conducted post-construction (2015-1444718885475). It states that no ruby dock plants were recorded on the Karratha Tom Price Road during a 2014 survey. The report states that kapok plants however continue to spread along road verges in some areas despite efforts during the construction period to remove Kapok plants and seed in the existing infestations. Spraying and slashing have occurred annually but due to long flowering periods the plant has not been successfully controlled. The recent, further work indicates that kill rates were better in early 2015 (2015-1444718885475).	C
677:M7.1	Vegetation Protection	Construction	Limit the disturbance width of the road where it traverses the Themeda grassland threatened ecological community, near Hamersley Station, as shown in Figure 2 in schedule 1 in the Minister's statement 677, to not more than 20 metres		A letter from the DEC dated 2 May 2006 states that the Threatened Ecological Community (TEC) Protection and Management Plan is not relevant to Stage 2, and shall be required to be submitted and accepted prior to construction of Stage 4 of the project (2015-1446795628456). Not required at this stage.	NR
677:M7.2	Vegetation Protection	Construction	Limit the area of vegetation to be cleared within the Millstream-Chichester National Park to not more than 110 hectares		The area to be disturbed as specified in EPA Ministerial Statement 677, Condition 7-2 was amended under Section 46C from 110 hectares to 145 hectares within the Millstream-Chichester National Park on the 13th July 2007. The PCR 2011 states that approximately 445 hectares of land was disturbed as a result of Stage 2, of which approximately 122.5 hectares occurred within the Millstream-Chichester National Park, 20.6 hectares less than the approved amount (2013-0000076939).	C

Attachment One

AUDIT TABLE

PROPOSAL: Road from Karratha to Tom Price
STATEMENT: 677

Government of **Western Australia**
Office of the **Environmental Protection Authority**

Audit Code	Subject	Phase	Action	Plan Requirements	Notes	Status
677:M7.3:1	Rehabilitation	Construction	Rehabilitate 1. approximately 137 hectares of land disturbed for the construction of the road; and either 2. (a) approximately 205 hectares of redundant access tracks, including those tracks associated with the railway, and redundant material pits as an environmental offset activity, or 2(b) alternative offsets of equivalent cost/value, developed in liaison with the Department of Conservation and Land Management, and which deliver greater biodiversity outcomes. NOTE: For the purpose of this condition, the specific locations, and methods and procedures for rehabilitation shall be included in the Vegetation Protection and Rehabilitation Management Plan (see commitment 4).		The PCR 2011 states that all areas of land disturbed during road construction and materials take and not part of the permanent road area were rehabilitated. (2013-0000076939). In a letter to MRWA dated 20 September 2007 the Regional Manager of DEC Pilbara and the Project Director of MRWA agreed that MRWA in addition to 1) Rehabilitating 137 hectares disturbed by the construction of the road, would also choose option 2(b) an alternative offsets of equivalent cost/value which deliver greater biodiversity outcomes (2015-1448500610244). An offset amount of $2,500 per hectare of rehabilitation works was agreed to by DEC and MRWA. As Stage 2 comprised part of the overall road development, funds would be provided by MRWA to DEC for rehabilitation works equivalent to 100 hectares. Funding to rehabilitate the remaining 105 hectares will be provided when Stages 3 and 4 are being implemented, in accordance with the consumer price index. The DEC agreed to invoice MRWA for $250,000, comprising of the amount to rehabilitation 100 hectares for Stage 2 (2015-1448500610244).	C
677:M7.3:2	Rehabilitation	Post-construction	Rehabilitate 1. approximately 137 hectares of land disturbed for the construction of the road; and either 2. (a) approximately 205 hectares of redundant access tracks, including those tracks associated with the railway, and redundant material pits as an environmental offset activity, or 2(b) alternative offsets of equivalent cost/value, developed in liaison with the Department of Conservation and Land Management, and which deliver greater biodiversity outcomes. NOTE: For the purpose of this condition, the specific locations, and methods and procedures for rehabilitation shall be included in the Vegetation Protection and Rehabilitation Management Plan (see commitment 4).		See 677:M7.3:1	C
677:M7.4	Rehabilitation Completion Criteria	Design	Develop rehabilitation completion criteria to apply to the rehabilitation required by condition 7-3. The rehabilitation completion criteria shall have timeframes and shall be included in the Vegetation Protection and Rehabilitation Management Plan (see commitment 4 in schedule 2).		The Vegetation Protection and Rehabilitation Management Plan for stage 2 was approved by the DoE on 2 May 2006 (2015-1446795628456).	C
677:M7.5:1	Progress of rehabilitation	Construction	Monitor the progress of rehabilitation against the rehabilitation completion criteria referred to in condition 7-4 and implement contingency measures and supplementary rehabilitation works where the criteria are not being met		The PCR 2011 states that rehabilitation was successful and all areas required to be rehabilitated have been completed. No supplementary rehabilitation work was undertaken. Photographs showing the progress of rehabilitation were submitted within the PCR 2011 (2013-0000076939).	C
677:M7.5:2	Progress of rehabilitation	Post-construction	Monitor the progress of rehabilitation against the rehabilitation completion criteria referred to in condition 7-4 and implement contingency measures and supplementary rehabilitation works where the criteria are not being met		Weed control and revegetation compliance – Post Construction Report dated October 2015 was received by the OEPA on 13 October 2015 (2015-1444718885475). The report states that rehabilitation has been successful in the majority of areas including borrow pits, tracks, road side areas, and spoil dumps. Some borrow sites have small sections which have a hard base due to lack of available top soil and these are taking longer to establish vegetation. Ruby Dock has been monitored and controlled since the end of construction with no new infestations being found on the new road or adjacent areas since 2009. The report also states that kapok is primarily along the immediate road edge and has proven difficult to control. Spraying and slashing have occurred annually but due to long flowering periods the plant has not been successfully controlled. The 2014 CAR states that recent, further work indicates that weed kill rates were better in early 2015 (2015-1444718885475).	C
677:P1	Environmental Co-ordination	Overall	Employ a dedicated environmental co-ordinator		PCR 2011 states that a full time Project Environmental Coordinator and a part time Environmental Manager were employed for the duration of the Stage 2 project construction (2013-0000076939). The 2014 CAR states that ongoing input from a qualified and experienced ecologist (Anna Napier - the Environment Manager for the Millstream Link construction project) has been available for advice and monitoring for the entire 7-year post-construction period. Environmental and hydrological advice has also been obtained from GHD (2015-1444718885475).	C

Attachment One

AUDIT TABLE

PROPOSAL: Road from Karratha to Tom Price
STATEMENT: 677

Government of **Western Australia**
Office of the **Environmental Protection Authority**

Audit Code	Subject	Phase	Action	Plan Requirements	Notes	Status
677:P2	Surface Drainage Management Plan	Design	Prepare a Surface Drainage Management Plan		The Surface Drainage Plan was approved by the DoE on 2 May 2006 (2015-1446795628456).	C
677:P3.1:1	Surface Drainage Management Plan	Construction	Implement the Surface Drainage Management Plan		The PCR 2011 states that the implementation of the Surface Drainage Plan was audited by the third party auditor Shawmac. Six performance indicator audits were conducted by Shawmac from May 2006 until November 2007. The PCR 2011 provides details of the implementation of the plan and a copy of the November 2007 Shawmac Performance Indicator audit (2013-0000076939).	C
677:P3.1:2	Surface Drainage Management Plan	Post-construction	Implement the Surface Drainage Management Plan		The 2014 CAR states that bi-annual inspections to check the status of permanent or semipermanent pools has been occurring during the maintenance phase to ensure that they are not being adversely impacted by the downstream effects of the road. The 2014 CAR also details how damage of drains and scours caused by Cyclone Christine in early 2015 has been repaired (2015-1444718885475).	C
677:P4	Vegetation Protection and Rehabilitation	Design	Prepare a Vegetation Protection and Rehabilitation Management Plan.		The Vegetation Protection and Rehabilitation Management Plan was approved by the DoE on 2 May 2006 (2015-1446795628456).	C
677:P5.1:1	Vegetation Protection and Rehabilitation	Construction	Implement the Vegetation Protection and Rehabilitation Management Plan		The PCR 2011 states that the implementation of the Vegetation Protection and Rehabilitation Management Plan was audited by the third party auditor Shawmac. Six performance indicator audits were conducted by Shawmac from May 2006 until November 2007. The PCR 2011 provides details of the implementation of the plan and a copy of the November 2007 Shawmac Performance Indicator audit (2013-0000076939).	C
677:P5.1:2	Vegetation Protection and Rehabilitation	Post-construction	Implement the Vegetation Protection and Rehabilitation Management Plan		Weed control and Revegetation compliance – Post Construction Report dated October 2015 was received by the OEPA on 13 October 2015 (2015-1444718885475). The report provides details of rehabilitation and weed control conducted post-construction (2015-1444718885475). Photos showing rehabilitation were included in the report.	C
677:P6	Threatened Ecological Community (TEC) Protection and Management	Design	Prepare a TEC Protection and Management Plan		A letter from DEC dated 2 May 2006 states that the Threatened Ecological Community (TEC) Protection and Management Plan is not relevant to Stage 2, and shall be required to be submitted and accepted prior to construction of Stage 4 of the project (2015-1446795628456). Not required at this stage.	NR
677:P7.1	Threatened Ecological Community Protection and Management	Design	Implement the TEC Protection and Management Plan		See 677:P6	NR
677:P7.2	Threatened Ecological Community Protection and Management	Construction	Implement the TEC Protection and Management Plan		See 677:P6	NR
677:P7.3	Threatened Ecological Community Protection and Management	Post-construction	Implement the TEC Protection and Management Plan		See 677:P6	NR
677:P8.1	Rehabilitation Trials	Construction	Prepare a scientifically based rehabilitation trial for the treatment of redundant roads and tracks		The Rehabilitation Trial Monitoring report dated 30 August 2009 provides details on the rehabilitation trial which started in June 2008 (2013-0000076939).	C
677:P8.2	Rehabilitation Trials	Post-construction	Monitor and report outcomes of rehabilitation trials for the treatment of redundant roads and tracks.		The Rehabilitation Trial Monitoring report dated 30 August 2009 provides details on the rehabilitation trial which started in June 2008 (2013-0000076939).	C
677:P9.1:1	Rehabilitation trials	Construction	Rehabilitate redundant roads and tracks using results of the trials referred to in commitment 8.		The Weed Control and Revegetation Compliance – Post Construction Report dated October 2015 provides details of rehabilitation that was carried out along the entire road length, and on spoil heaps, borrow areas and some previously existing access tracks within the National Park (2015-1444718885475). Photographs showing the progress of rehabilitation were submitted within the PCR 2011 (2013-0000076939).	C
677:P9.1:2	Rehabilitation trials	Post-construction	Rehabilitate redundant roads and tracks using results of the trials referred to in commitment 8.		See 677:P9.1:1	C
677:P10	National Park Plan	Design	Prepare a National Park Plan which addresses impacts in the Millstream-Chichester National Park		The Millstream Chichester National Park Management Plan was approved by the DoE on 2 May 2006 (2015-1446795628456).	C
677:P11.1:1	National Park-Millstream-Chichester	Construction	Implement the National Park Plan		Stage 2 of the proposal has been implemented. The implementation of the Millstream Chichester National Park Management Plan was audited by the third party auditor Shawmac. Six performance indicator audits were conducted by Shawmac from May 2006 until November 2007. The PCR 2011 provides details of the implementation of the plan and a copy of the November 2007 Shawmac Performance Indicator audit (2013-0000076939).	C

Attachment One

AUDIT TABLE

PROPOSAL: Road from Karratha to Tom Price
STATEMENT: 677

Government of **Western Australia**
Office of the **Environmental Protection Authority**

Audit Code	Subject	Phase	Action	Plan Requirements	Notes	Status
677:P11.1:2	National Park-Millstream-Chichester	Post-construction	Implement the National Park Plan		The 2014 CAR states that monitoring has been on-going as part of implementing the requirements of the Maintenance Management Plan and as per rehabilitation and weed control reports (2015-1444718885475).	C
677:P12	Aboriginal Heritage	Design	Prepare an Aboriginal Heritage Management Plan (in compliance with the Aboriginal Heritage Act 1972).		The Aboriginal Heritage Management Plan was accepted by the Department of Indigenous Affairs on 12 December 2005 and approved by the DoE on 2 May 2006 (2015-1446795628456).	C
677:P13.1:1	Aboriginal Heritage	Design	Implement the Aboriginal Heritage Management Plan (in compliance with the Aboriginal Heritage Act 1972).		The PCR 2011 states that the implementation of the Aboriginal Heritage Management Plan was audited by the third party auditor Shawmac. Six performance indicator audits were conducted by Shawmac from May 2006 until November 2007. The PCR 2011 provides details of the implementation of the plan and a copy of the November 2007 Shawmac Performance Indicator audit (2013-0000076939).	C
677:P13.1:2	Aboriginal Heritage	Construction	Implement the Aboriginal Heritage Management Plan (in compliance with the Aboriginal Heritage Act 1972).		See 677:P13.1:1	C
677:P14	Construction Management Plan	Design	Prepare a Construction Management Plan		The Management Plan for Construction Activities was approved by the DoE on 2 May 2006 (2015-1446795628456).	C
677:P15	Construction Management	Construction	Implement the Construction Management Plan		The implementation of the Management Plan for Construction Activities was audited by the third party auditor Shawmac. Six performance indicator audits were conducted by Shawmac from May 2006 until November 2007. A copy of the November 2007 Shawmac Performance Indicator audit was submitted with the PCR 2011 (2013-0000076939).	C
677:P16.1:1	Fence construction at Millstream-Chichester National Park	Construction	Construct approximately 30 kilometres of fencing along the northern boundary of the Millstream-Chichester National Park where it is adjacent to Pyramid Station		Fencing was not constructed by MRWA. Fencing along the northern boundary was considered to be logistically difficult by DEC Pilbara to achieve, due to the terrain and large number of creek crossings. It was agreed by the Regional Manager of DEC, Pilbara and the Project Director of MRWA on 15 August 2008 that the western boundary was a higher priority as it contained several entry points for cattle into the park. MRWA agreed that an amount of $4,000 per kilometre would be provided to fence 30 kilometers. In a letter from DEC dated 20 September 2007 DEC agreed to invoice MRWA $120,000 for the fencing of the western boundary of Millstream Chichester National Park (2015-1448500610244).	C
677:P16.1:2	Fence construction at Millstream-Chichester National Park	Post-construction	Construct approximately 30 kilometres of fencing along the northern boundary of the Millstream-Chichester National Park where it is adjacent to Pyramid Station		See 677:P16.1:1	C
677:P17	Weed Control at Millstream-Chichester National Park	Overall	Contribute $25,000 per year, for five years, towards a weed control program for the Millstream-Chichester National Park		Letter from DEC dated 20 September 2007 to MRWA states that $25,000 was paid by MRWA for weed control in 2005/2006. DEC also stated that MRWA would be invoiced for $100,000 lump sum, comprising of the remaining four payments which would contribute to weed management works in Millstream Chichester National Park (2015-1448500610244).	C

Appendix G. D21#530943 PL05-CEMP-MRWA-KTP Rev 1.2 Construction Environmental Management Plan

Major Works Construction Environmental Management Plan

Karratha Tom Price Road Construction Phase 3a and 3b.

73/18

2019/20

MACA

D18#1057985
September 2019

Contents

1 PURPOSE 5
2 PROJECT CONTEXT 5
2.1 Contractor Information 5
2.2 Project Description 5
2.3 Potential Project Issues 8
2.4 Needs and Expectations of Interested Parties 8
2.4.1 Interested Parties 8
2.4.2 Relevant Needs and Expectations 9
3 LEADERSHIP 9
3.1 Leadership and Commitment 9
3.2 Environmental Policy 9
3.3 Environmental Management Commitment Statement 12
3.4 Contract Roles and Environmental Responsibilities 12
4 PLANNING 13
4.1 Project Development Planning 13
4.2 Construction Planning 13
5 ENVIRONMENTAL SUPPORT 18
5.1 Resources 18
5.2 Training and Competency 18
5.2.1 Site Induction Training 18
5.3 Consultation and Communication 19
5.3.1 Consultation 19
5.3.2 Internal Communication 19
5.3.3 External Communication 19
5.4 Documentation 19
5.4.1 General 20
5.4.2 Document and Data Control 20
6 OPERATION 20
6.1 Environmental Management Controls 20
6.2 Hold Points 20
6.3 Monitoring and Evaluation 38
6.4 Emergency Preparedness and Response 38
6.5 Environmental Incident Management 38
6.5.1 Environmental Incident Notification and Investigation 38
7 MEASUREMENT AND PERFORMANCE EVALUATION 39
7.1 Monitoring, Measurement, Analysis and Evaluation 39
7.1.1 General 39
7.1.2 Records and Records Management 40
7.1.3 Environmental Audit 40

7.1.4 Corrective and Preventative Action 40
8 CEMP REVIEW 40
9 IMPROVEMENT 40
10 REFERENCES AND RELATED DOCUMENTS 41
11 APPENDICES 41
Appendix 1: Health, Safety & Environment Commitment Statement 42
Appendix 2: MACA Reference Materials 43

Document Control

Owner	MACA
Custodian	MACA Project Manager – Shaun Elsdon
Document Number	PL05-CEMP-MRWA-KTP Construction Environmental Management Plan
Issue Date	25th September 2019
Review Frequency	6 Monthly

Amendments

Report Compilation & Review	Name and Position	Document Revision	Date
Template:	Luke Lovell Environment Officer	Draft v1	4/12/2018
Author:	Shaun Elsdon – MACA Project Manager Environmental Management Representative (EMR)	Rev 1.0	22/09/2019
Reviewer	Lisa Bow - MACA HSE Advisor Document Review and update.	Rev 1.1	3/10/19
Reviewers	Steve hardman – MACA Civil Operations Manager Damien O'Loughlin – MACA Construction Manager Greg Richards – MACA HSE Advisor Lisa Bow – MACA HSE Advisor Final Project Review	Rev 1.2	7/10/19

1 PURPOSE

This Construction Environmental Management Plan (CEMP) contains the Principal's minimum environmental and heritage requirements for establishing, implementing and managing Environmental compliance for the work under the Karratha Tom Price (KTP) Road Construction Phase 3a and 3b Contract.

MACA (the Contractor) has completed this CEMP with details of how the Principal's management requirements and additional risks they have identified, shall be managed throughout the construction phase.

It shall be used as a reference for MACA, those working on MACA's behalf, environmental regulators and other parties with an interest in understanding Main Roads approach to environmental management on the Karratha Rom Price Road Construction Phase 3a and 3b.

2 PROJECT CONTEXT

2.1 Contractor Information

MACA is one of the fastest growing international Mining, Civil Construction, Road Infrastructure and Mineral Processing contracting groups listed on the Australian Stock Exchange (ASX:MLD). Our experienced team of 1,200+ personnel provides market-leading services within Australia and Latin America. This plan is designed to satisfy the requirements of MACA's Standard Operating Procedures (SOP), Main Roads Specification's and AS/NZS ISO 14001 as applied and used on the project.

Services provided include contract mining, crushing and screening, civil construction and earthworks, road maintenance and asset management, and international mining services. Interquip was acquired by MACA (60%) in late 2016, thus adding minerals processing to our services.

MACA's hands-on approach has earned us a reputation for strong and reliable performance that consistently exceeds client objectives. Our vision to be number 1 as well as our "Can Do" attitude drives the way we work with each other, clients, suppliers and the greater community.

2.2 Project Description

Project Name: Karratha Rom Price Road Construction Phase 3a and 3b

Project Components:

The KTP project was initially proposed via a Consultative Environmental Review (CER) document in 2003. The CER included a total of 245 kilometres (km) of proposed new or upgraded road from the North West Coastal Highway to the Nanutarra - Munjina Road, in three stages (2, 3 and 4). The environmental approval of the project was given in April 2005 under Assessment 1244 (Bulletin 1159) and through Ministerial Statement 677.

Project Scope:
The project is expected to commence in late September 2019.

The scope of works includes, but is not limited to:

- The establishment of a camp, offices (MACA and MRWA), crib and ablutions.
- Two satellite crib and ablutions will also be set up along the alignment.
- Upgrade RTIO Rail Maintenance Track
- Establish construction water infrastructure at bore locations identified for the works.
- Establish on site laboratory to carry out material testing
- Clearing, grubbing and topsoil stripping will be undertaken with material windrowed or stockpiled along the alignment.

Cut to fill, load and haul, place and compact.
Borrow pits will be established and fill material pushed up. Borrow pits will be rehabilitated including ripping, shaping batters and re spreading of stripped topsoil.
Drainage upgrades will also progress with culvert repairs or replacement as identified in the culvert schedule
Subgrade mixing and compaction to be undertaken in instances of deep fill, basecourse material will be imported to site from quarries in Karratha region
Basecourse material will be mixed using a pavement stabilizer and where identified in floodway's the pavement will be stabilized with 0.75% cement.
Bitumen sealing, Bitumen followed by pavement sealing line-marking, signage and safety barriers will be installed

Project Location(s):

- Stage 3B: Millstream-Pannawonica Road junction and Karratha - Tom Price Road junction (SLK 108.1 – SLK 136.1 = 28 kilometres).
- Stage 3a of the KTP that occurs in or adjacent to the Millstream Chichester National Park, a distance of approximately 20 km.
- MGA reference: Zone 50 515,606mE 7626505m within the shire of Ashburton

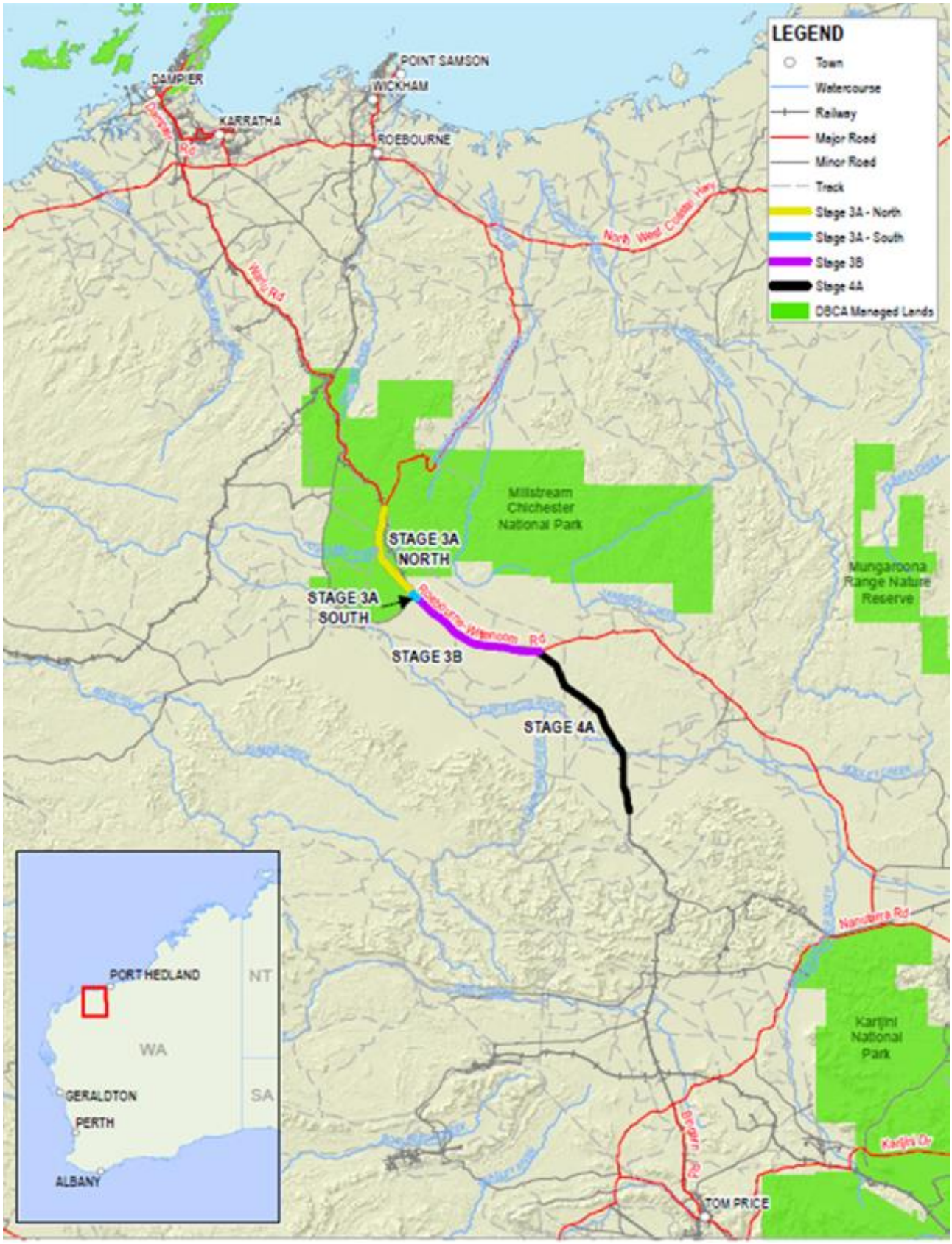

Figure 1: Project Location

2.3 Potential Project Issues

Table 1. Potential Issues that may prevent MACA's achievement of the intended outcomes of the EMP		
EMP OUTCOMES	**POTENTIAL ISSUES**	
	INTERNAL	**EXTERNAL**
Fulfilment of compliance obligations	• Lack of understanding of Project Obligations. • Non-compliance with Compliance Obligations. • Environmental incidents not being reported. •	• Extreme weather conditions, including the risk of fire and flooding. • Environmental incidents. • Illegal dumping. •
Continually enhance environmental performance	• Lack of resources, training, support • Lack of reviewing environmental performance • Lack of implementing continual improvement initiatives. •	• External stakeholders' processes (regulatory authorities and Local Government Authorities) •

2.4 Needs and Expectations of Interested Parties

2.4.1 Interested Parties

The following key internal and external stakeholders have an interest in the project. This list is not exhaustive. The outcome of this section should be the identification of those needs and expectations that are to be project compliance obligations.

Internal Stakeholders
Internal interested parties/stakeholders that are relevant to this CEMP include but are not limited to:

- Main Roads Environmental Department
- MACA
- Subcontractors

External Stakeholders
External interested parties/stakeholders that are relevant to this CEMP include but are not limited to:

- Yindjibarndi People
- DWER - *Dept of Water & Environmental Regulation*
- DAA - *Dept of Aboriginal Affairs*
- DPLH - *Dept of Planning Lands Heritage*
- DBCA - *Dept of Biodiversity, Conservation and Attractions*
- DPAW - *Dept of Parks and Wildlife*
- Water Corporation
- Shire of Ashburton
- Pilbara Railway
- Public

2.4.2 Relevant Needs and Expectations

The following list details what these interested parties need and expect from this CEMP:

- That all Construction Risks and Opportunities are identified and addressed;
- That all staff are aware of the Projects Environmental Risks and the actions required to address these risks;
- That stakeholders (internal and external) are provided regular and current information regarding corporate and legal obligations to be met
- Seeking input from interested stakeholder parties as required

3 LEADERSHIP

3.1 Leadership and Commitment

The Maca Project Manager or his Alternate, is the Representative for the Karratha to Tom Price Road Upgrade – Stage 3.

The Representative shall be responsible for:

- taking accountability for the effectiveness of the CEMP
- ensuring the integration of the CEMP into the project planning
- ensuring that the resources required for the implementation of the CEMP are available
- communicating the importance of effective environmental management and conforming to the CEMP requirements
- ensuring that the CEMP achieves its intended outcomes
- directing and supporting persons to contribute to the effectiveness of the CEMP
- promoting continual improvement in environmental management throughout the length of the Contract
- supporting other relevant management roles to demonstrate their leadership as it applies to their areas of responsibility

3.2 Environmental Policy

MACA Health, Safety & Environment Policy and the Main Roads' Environmental Policy outlines the commitment to environmental management principles and objectives that provide the overall intentions and direction of the organisation.

Main Roads' Environmental Policy is located under Environment on the Main Roads website http://www.mainroads.wa.gov.aun and Figure 2.

MACA Health, Safety & Environment Policy is located below in Figure 2.1

All Main Roads staff and personnel working on behalf of Main Roads, shall be aware of these Policies, their purpose, and their role in achieving the commitments, including how their work can affect the Main Roads ability to fulfil its compliance obligations.

MAIN ROADS WESTERN AUSTRALIA

MAY 2018

Environmental Policy

We are committed to protecting and enhancing the natural environmental and social values in all of our activities

Intent

All Main Roads staff and others working on Main Roads' behalf will:

- Recognise the importance of the natural environmental and social values and the broader benefits that these values provide to the community
- Foster strategic relationships with community and other stakeholders to contribute to the management of environmental values
- Facilitate environmental governance of our activities to deliver broad community benefit through the inclusion of environmental requirements in planning, programming, construction and maintenance processes
- Communicate this policy and our environmental performance publicly

Objectives

To ensure we achieve this policy our objectives are to:

- Deliver our services in full compliance with the obligations of environmental legislation and policy as a minimum standard
- Manage the environmental impacts of our activities through the hierarchy of 'avoid, minimise, rehabilitate and offset'
- Contribute to a sustainable transport system through the delivery of products and services that minimise environmental impacts, conserve natural resources and also achieve positive social and economic outcomes
- Implement, maintain and continually improve an effective environmental management system compliant with ISO 14001:2015 across Main Roads activities

Peter Woronzow
A/Managing Director of Main Roads
5/6/18

This policy forms part of the Integrated Management System (IMS) and is reviewed every two years or as required to ensure it complies and is relevant to legislative and business obligations.

mainroads WESTERN AUSTRALIA

Figure 2: Main Roads Environmental Policy

HEALTH, SAFETY & ENVIRONMENT POLICY

At MACA we are committed to providing a safe and healthy workplace for the prevention of work-related injury and/or ill health to our employees, contractors and visitors, and to plan our work responsibly in order to minimise impact to the environment. Our objective is to provide a "Zero Harm" workplace, through active leadership at all levels of the business, with informed decision-making based around our core values of People First, Exceeding Expectations, Continuous Improvement, Accountability and the Community. With this commitment realised, MACA will achieve its vision to **be number 1 in what we do.**

To achieve this, MACA will:

- Build a strong, supportive company safety culture based on visible leadership, with a commitment to consultation and engagement with all employees, contractors and worker's representatives.
- Expect total commitment by leadership personnel, employees and contractors to our objective of "Zero Harm", appropriate to the purpose, the size and the context of the organisation.
- Identify Catastrophic Risk and other workplace hazards. Verify Critical Controls are in place and functional prior to commencing an activity. Eliminate hazards where possible, and reduce the potential catastrophic risk to a level as low as reasonably practicable.
- Endorse relevant legislation, standards and best practice that impact on the operation and work environment, including duty of care required by employers and employees.
- Consider the lifecycle aspect to environmental decision-making to reduce MACA's environmental footprint. Be receptive to innovative ideas that will result in reducing emission discharges, wastes, energy usage and resource consumption.
- Identify items or areas of cultural heritage which may be impacted by our work activities, create an awareness of their significance, establish systems to protect and maintain its value.
- Implement and monitor safe work practices and continually review related procedures to ensure employees and contractors receive the approved and current information for safe and effective execution of tasks.
- Establish measurable objectives and targets to evaluate whether MACA is achieving the health, safety and environmental expectations, requirements and obligations of stakeholders.
- Actively support and recognise opportunities for continuous improvement relating to health, safety and the environment.

Reviewed and Approved

MACA Limited
Board of Directors
Next Review: June 2020

POL-LTD-002 Rev 5.0

Figure 2.1: MACA Health, Safety and Environment Policy

3.3 Environmental Management Commitment Statement

MACA has developed a Contract specific Health, Safety and Environment Commitment Statement based on the Main Roads and MACA's Environmental Policies. This Statement is relevant to the environmental impacts of the Contract activities.

The Environmental Management Commitment Statement is located in the MACA Management Systems.

Refer to Appendix 1 – *Health, Safety and Environmental Commitment Statement.*

3.4 Contract Roles and Environmental Responsibilities

A description of the roles and responsibilities for works under this Contract is provided in Table 2.

Table 2. Contract Roles and Environmental Responsibilities

ROLE	RESPONSIBILITY
MACA Environmental Management Representative (EMR) Project Manager / Alternate Manager	• Responsible for environmental management and control of all activities relating to the execution of the work under the Contract, including work under the Contract undertaken by subcontractors. • Communicating requirements of this CEMP to relevant supervisors, work crews and sub-contractors. • Reviewing, monitoring and inspecting works to ensure requirements of this CEMP are implemented. • Managing environmental Incident investigations and reporting requirements.
MACA Construction Manager	• Shall provide each subcontractor with all relevant Contract information and the parts of the approved CEMP that are relevant to the work to be undertaken by the subcontractor. •
MACA Superintendent, HSE Advisors & Supervisors	• Review Daily work scopes with crews to consider the potential impact of upcoming activities on the environment • Assess / implement mitigations, to avoid / minimise environmental risk where possible, in pre-start discussions, risk assessments and work method planning. • Conduct Site Inspections FO4674 – Supervisors Daily Work Area Inspection FO7115 – Workshop Shift Inspection FO7161 – Equipment Prestart Checklist FO4671 – Worksite Risk Control Assessment FO5055 – Weed Seed Dieback Inspection FO4252 – Monthly Facilities Management Inspection
MACA Employees, Sub-Contractors and Visitors	• Comply with the approved CEMP and Hygiene requirements of the Project • Manage all works to prevent unauthorised impact to vegetation • Comply with all Incident Reporting Procedures

Table 2. Contract Roles and Environmental Responsibilities	
ROLE	**RESPONSIBILITY**
	• Ensure all chemicals have been approved, are stored and disposed correctly. • Report immediately, any findings that may have Heritage or Cultural significance. •

4 PLANNING

4.1 Project Development Planning

In planning for this project, Main Roads established the following plans to address compliance and other obligations.

- Ministerial Statement No. 677 (MS 677) for Road from Karratha to Tom Price Shires of Ashburton & Roebourne.
- Bed and Banks Permit PMB202063(1)
- Construction Management Plan
- Vegetation Protection and Rehabilitation Management Plan
- Surface Drainage Management Plan
- Cultural Heritage Management Plan
- National Park Management Plan
- Weed Management Plan

The obligations were included in the Principal Environmental Management Requiements in Spec 204B.

Rio Tinto have allowed access and use of their rail access road during construction if required.

MACA shall detail how they intend managing these requirements in Table 4.

4.2 Construction Planning

The following items were used to identify the Risk and Opportunities related to this CEMP:

- Compliance obligations
- Principal Environmental Management Requirements
- Items identified in Section 2.2 and 2.3 of this CEMP
- Environmental Risks associated with construction activities
- Reference to Spec 204 (MRWA)

The Risks and Opportunities identified were assessed for the likelihood and consequence of events occurring during the Contract period in accordance with MACA's Risk Assessment process and are documented in Table 3.

If additional significant environmental aspects, compliance obligations and commitments are identified in the Risks and Opportunities Register, these Risk Treatment shall be added to Table 4 as an Operational Control.

Table 3. Construction Environmental Risks and Opportunities						
Construction Activity / Process / Product	**Risks and Opportunities**	**Rating**	**Risk Treatment Management Action**	**Residual Rating**	**Monitoring**	**Responsibility**
Earthworks and Construction	Contamination to groundwater / damage to environment from: • Deposits of chemicals in water supply. • Failure of waste water treatment plant. • Failure to clean up hydrocarbon spill • Rubbish not contained securely	M17	• Potentially contaminated runoff from refuelling will be contained and removed from site using a licensed contractor for disposal at a licensed facility. • Routine monitoring of drainage structures for erosion. • WWTP Inspections • Use of skip bins with lids • Remediation where required.	M20	**FO4674** Supervisor Daily Work Area Inspections **FO4671** Worksite Risk Control Assessment **FO7115** Workshop Shift Inspection Waste Water Treatment Plant Inspection *(Sub-Contractor – BBB-to provide for review)*	MACA Superintendent & Supervisors Camp Manager or delegate

Survey, Clearing, Earthworks & Construction Activities	• Incorrect survey. • Lack of demarcation. • Working outside exclusion zones resulting in fines / penalties, damage to reputation • Injury to fauna or flora	M17	• Heritage surveys. • Clearing permits required prior to clearing • Ground Disturbance Approval Permit • All areas of significance to be demarcated with correct colour flag/tape • All Project area ground disturbance will occur within designated areas. • In the event that an item of interest is identified during operations, ground disturbance activities will cease until approval given for the recommencement of ground disturbance activities. • Pre & Post Clearing meetings with personnel involved in clearing activities shall identify details of topsoil storage areas and area rehabilitation *(as per FO5054 Ground Disturbance Approval Permit)* • MACA will ensure that the site induction for employees and contractors includes information on awareness of the presence of significant sites, legal obligations and actions	M20	**FO4674** Supervisor Daily Work Area Inspections **FO5054** Ground Disturbance Approval Permit Permits Register;	MACA Superintendent & Supervisors

Material Sampling & Testing	• Onsite Testing Laboratory / Storage Area installed outside of minimum Specification • Material / calibration (NDM) does not meet the requirements of NATA and AS/NZS ISO 9001.	H13	• Transportable Material Testing Laboratory shall be set up on site in accordance with the requirements of the Australian Radiation Protection and Nuclear Safety Agency - Code of Practice and Safety Guide – Portable Density/Moisture Gauges Containing Radioactive Sources (*as per 6.6 of PL02-QMP-MRWA-KTP)* • Monitoring & Measurement will be in accordance with the ITP's (Inspection and Test Plans)	M17	**PL02-QMP-MRWA-KTP** Quality Management Plan (Section 6 Monitoring & Measurement Processes)	MACA Superintendent & Supervisors
Earthworks and Construction	• Equipment failure leading to fire. • Hot work leading to fire. • Lightning event causing fire. • Careless discarding of cigarette butts causing fire	E5	• Daily Plant & Vehicle Pre-Start Inspections. • Vehicle & Plant maintenance schedule. • Fire extinguishers on all vehicle/plant. • BOM monitored for Fire Restrictions • Hot work permit for 'hot work'. • Vehicles will be restricted from driving off access tracks, unless authorised by senior management. • Spark shields will be used where appropriate. • Fire restrictions, including smoking in designated areas only, will be implemented	M16	**FO4671** Worksite Risk Control Inspection; **FO7161** Equipment Prestart Checklist; **FO7115** Workshop Shift Inspection; **FO7103** Hot Work Permit **FO4252** Monthly Facilities Management Inspection	MACA Superintendent, HSE Advisors & Supervisors

Earthworks and Construction	• Spread of Weeds and Seeds • Environmental Damage • Asbestos Containing Material (ACM) identified during clearing/excavation activities	E5	• Vehicle Hygiene procedures followed • Reporting of any identified weed affected areas. • Daily Plant & Vehicle Pre-Start Inspections. • All works (within 100m) to cease immediately. • Area demarcated for restricted access. • Affected area to be documented on ACM finds register • Licenced contractor is contacted to conduct ACM removal process • All ACM will be removed and disposed by trained personnel	H12	**FO5055** Weed Seed Dieback Inspection; **FO4671** Worksite Risk Control Assessment	MACA Superintendent, HSE Advisors, Supervisors

Camp and Office	• Health / Illness from contaminated water	H13	• Prior to water being commissioned for use, testing will be conducted by MACA. *(bore locations and approval for use supplied by MRWA)*
			  • Test samples will be sent to Perth laboratory. Water will not be approved for use until compliance report has been received.
			  • Testing will also be conducted during the term of the Project
				M17	**FO4671** Worksite Risk Control Assessment
					
					FO4252 Monthly Facilities Management Inspection
						MACA Superintendent, HSE Advisors, Supervisors

5 ENVIRONMENTAL SUPPORT

5.1 Resources

The **Environmental Management Representative** (EMR) for this project will be the Project Manager or his alternate, and they will be responsible for the following:

- taking accountability for the effectiveness of the CEMP
- ensuring the integration of the CEMP into the project planning
- ensuring that the resources required for the implementation of the CEMP are available
- communicating the importance of effective environmental management and conforming to the CEMP requirements
- ensuring that the CEMP achieves its intended outcomes
- directing and supporting persons to contribute to the effectiveness of the CEMP
- promoting continual improvement in environmental management in throughout the length of the Contract
- supporting other relevant management roles to demonstrate their leadership as it applies to their areas of responsibility

MACA's nominated EMR shall have the authority to direct their responsibilities to an onsite delegate for short periods, which is to be agreed upon by both parties. This shall be undertaken only on a risk-based approach (i.e. if the activity has a high environmental risk, the EMR shall be on site at all times).

5.2 Training and Competency

MACA have ensured that all personnel (including subcontractors) carrying out works under its control, which affects its environmental performance and ability to fulfil its compliance obligations are competent (on the basis of education, training or experience) by:

- Ensuring all employees and sub-contractors complete the MACA Corporate Induction
- Ensuring all employees and sub-contractors complete the MACA Site Orientation

These Inductions provide relevant environmental awareness training to ensure personnel are competent to carry out works associated with the Contract.

MACA retains the appropriate documented information as evidence of competence at:

- MACA Data System

5.2.1 Site Induction Training

MACA has developed and detailed a Site Induction training program that includes as a minimum:

- Awareness of the importance of conformance with the environmental policy
- Awareness of importance of conformance with the Contract specific Environmental Commitment Statement
- Awareness of importance of conformance with the approved CEMP
- Roles and Responsibilities
- The significant environmental impacts, actual or potential, of work activities associated with the Contract
- The potential consequences of departure from specified operating procedures
- The environmental benefits of improved personal performance

The Site HSE Advisor or authorised delegate shall deliver the Site-specific Environmental induction training package for all personnel, the Superintendent and its agents, and all visitors not escorted on Site by inducted persons.

The Site HSE Advisor or authorised delegate shall evaluate all persons undertaking the Site induction training through a written test to ensure that inductees have an understanding of the Environmental requirements for the Contract.

The Site HSE Advisor or authorised delegate shall provide continual feedback to the EMR on all training conducted by:

- Updating MDS (MACA Data System) with training completed

5.3 Consultation and Communication

5.3.1 Consultation

Main Roads has identified the specific personnel that MACA is to consult and communicate to in Table 4. MACA shall detail how they intend to comply with these requirements in Table 4.

MACA has the following procedures for the identification, assessment, control and communication of hazards associated with the day-to-day work activities:

- Job Safety Analysis (JSA)
- Standard Operating Procedures (SOP)
- Daily Pre-Shift Meeting Minute
- Toolbox Meetings

5.3.2 Internal Communication

MACA has the following procedures for ensuring internal communication of environmental information to personnel:

- Daily Pre-Shift Meeting Minutes
- Toolbox Meetings

5.3.3 External Communication

All communication to external regulators shall be done through Main Roads.

All Complaints or enquiries received from the public will be referred to the Main Roads Superintendent.

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MACA has the following procedure for receiving, documenting relevant communication from external interested parties to Main Roads:

- Complaints will be actioned in reference with MACA's procedure, *SOP5011 Environmental Complaints Register and Response*
- Complaint received to be recorded using MACA's form, *FO1432 – Complaint Record Form*
- Complaints received are registered on the MDS Correspondence and Complaints Register located in MACA MDS System

5.4 Documentation

5.4.1 General

MACA's references and related documents (*procedures, processes, work practices and information required by the Contract*) to this CEMP are documented in Section 11.

The CEMP and associated referenced documents will be physically located at the MACA Site Office – KTP Project. The CEMP will be electronically available on MACA Management System - Sharepoint.

5.4.2 Document and Data Control

This plan shall be controlled under the MACA's Quality System for the duration of the Contract.

The controlled CEMP and associated contract environmental documentation is established, implemented and maintained on Site during construction.

If the CEMP or associated environmental documentation is required to be amended, it shall be sent via email to the Superintendent for approval. MACA shall review the CEMP and submit amendments to the Superintendent for approval within one (1) week if the following events occur:

- Detecting a non-conformance;
- MACA's practice is no longer reflecting the approved CEMP; or,
- A Serious Environmental incident occurs.

6 OPERATION

6.1 Environmental Management Controls

This Construction Environmental Management Plan (CEMP) has been developed to provide management strategy's to effectively manage the environmental risks for this project. The objective of this plan is to provide a framework to ensure that every measure, as far as reasonably practicable, is taken to minimise the exposure to the environment from the risks associated with this project.

This plan is structured in accordance with MACA (MACA) Standard Operating Procedures (SOP), the requirements of AS/NZS ISO 14001 and the requirements of MRWA.

All MACA personnel including subcontractors employed on this project shall perform their duties in accordance with the requirements of this plan. The Client's Management Systems and specifications underpin the MACA Environmental Management Plan and are the foundation block for all planning and executing activities.

MACA is required to establish, implement, control and maintain the processes needed to meet the Obligations identified by Main Roads and those additional Risks and Opportunities identified by MACA. These controls will be documented in the Environmental Management Control column in Table 4.

MACA shall also ensure these control measures are evaluated and amended as required.

6.2 Hold Points

MACA shall detail the information to be supplied to the Principal to release the Hold Point in Table 4.

Table 4. Construction Environmental Operational Controls				
Aspect	**Ref No.**	**Hold Points (Y/N)**	**Contractor Operational Control**	**Responsibility**

Aboriginal Heritage	204B.1	**Y**
		
		Y
			• MACA shall develop, implement and maintain procedures that protect Aboriginal heritage sites and review any Aboriginal heritage approvals / consents and implement processes that ensure compliance to the conditions, approvals and consents.
			• MACA shall undertake works in accordance with the processes that ensure compliance to the conditions, approvals and consents.
			• Personnel engaged on the Project are required to undergo an approved **(by MRWA Superintendent)** Cultural Heritage Awareness Induction which will include:
			  ○ Obligations and procedures that relate to the protection of Aboriginal Cultural Heritage, supported by processes and procedures to ensure that construction activities are constrained to areas where approvals have been obtained
			  ○ All persons undertaking work under the Contract made aware of care and handling of Aboriginal heritage sites and the requirement to protect them.
			  ○ The cultural importance of Aboriginal Sites and places as well as personal reporting obligations required by Main Roads and/or the Aboriginal Heritage Act 1972.
			  ○ Requirements to report any Aboriginal cultural material that may be discovered during preconstruction or construction works
			  ○ Requirements relating to the management of ground disturbance activities on the Project
			• The Superintendent shall be responsible for arranging the engagement of Aboriginal Heritage Monitors. The monitors shall be engaged for the following activities: Pegging of all Aboriginal Heritage Sites and Places. Any works adjacent to Aboriginal Sites and Places
			• MACA shall **notify MRWA a minimum of two weeks** prior of the dates of the pegging activities and when works are to commence adjacent to Aboriginal Heritage Sites and Places
			• MACA will establish collaborative relationships with the Yindjibarndi Native Title holders
			• MACA will target zero unauthorised impact occurrences to Registered Aboriginal Heritage Sites and Places *(or any other place assessed by a heritage professional with a likelihood of being defined as a Site under section 5 of the Aboriginal Heritage Act 1972)*
			• MACA shall ensure that any identified Aboriginal Heritage Sites and Places are not accessed by any personnel or machinery, or be impacted in any way, unless prior written authorisation has been provided by the Superintendent.
			• Comprehensive ground disturbance processes will be in place to ensure that construction activities are only undertaken in areas were Aboriginal Sites and places have been identified by the Yindjibarndi Native Title holders.
			• Additional mitigative measures also include a requirement for all Aboriginal Heritage Sites and Places within 100 metres of construction to be delineated with tape and, where deemed necessary by the Superintendent or the Aboriginal Heritage Monitors, the installation of additional delineation and/or barriers along the boundaries of approved land clearing permit areas that will generally be in those areas where Sites and Places are located very close to proposed construction activities. The delineation of approved land clearing permit areas is the responsibility of MACA
			• For areas where ground disturbance is proposed, it may be deemed necessary that additional delineation and/or barriers are installed where Aboriginal Sites and Places are found to be located very close to proposed construction areas.
			• The following process should be followed if any newly identified material which is suspected of having Aboriginal heritage value:
			  ○ Unless instructed by the Client, do not take photographs of any Aboriginal heritage site
			  ○ Do not disclose any information about any Aboriginal heritage site unless requested by DPLH *(Department of Planning Lands Heritage)*
			  ○ If the material identified is deemed likely to constitute an Aboriginal Site, work may not recommence in the area until formal advice has been provided by the Client
			• The following process should be followed if any material which is suspected to be skeletal in nature:
			  ○ Cease all work within 100 m of the area
			  ○ Unless instructed by MRWA, do not take photographs of any skeletal remains
			  ○ Do not disclose any information about any skeletal remains unless requested by the Principal Heritage Officer, DPLH or the West Australian Police
			  ○ Inform the immediate Supervisor who will in turn inform MRWA
			  ○ MRWA shall be responsible for informing the WA Police
			  ○ Exclusion area to be marked with tape or bunting
			  ○ MRWA Project Manager will ensure that AH Monitors are advised *(and If required, transported to the location to inspect)*
			  ○ MRWA PHO will advise MACA of any further action required following the cessation of work
			
			• MACA shall remove and dispose appropriately any demarcation, including bunting, flagging and/or fencing, once project works are completed
				MACA Project Manager

Table 4. Construction Environmental Operational Controls				
Aspect	**Ref No.**	**Hold Points (Y/N)**	**Contractor Operational Control**	**Responsibility**
Camps and Site Offices	204B.3	N	Where clearing of native vegetation is required, MACA will seek approval to clear from MRWA During construction and use of camp and offices MACA shall: • ensure all surfaces are shaped to avoid pooling or ponding • ensure that the ablutions are installed and maintained in accordance with the manufacturer's instructions • undertake regular monitoring of the sceptic and other tank alarms to ensure they are in good working order • ensure that spill kits are located and maintained on site and are sufficient to contain all spills that may occur • ensure vehicle movements do not disturb vegetation and heavy vehicle turnaround is limited to designated areas • chemicals and hazardous material storage areas are bunded, and the bund can contain the volume of fluids being stored (including sceptic tanks), and that they are managed in compliance with applicable Australian Standards • ensure that vehicle servicing and refuelling will be undertaken at designated areas • ensure no fuel storage or any other potentially hazardous land use be within 500m of a surface water body or major (named) waterway • ensure sewage treatment facilities / types will be agreed and the design approved by DCBA/ Water Corporation prior to construction / installation • ensure washdown and septic tank systems are regularly monitored for weed establishment and weeds controlled prior to seed set • use where feasible, non-septic systems which treat sewage to reusable water standards • submit details for site washdown facilities, to be approved by DWER/Water Corporation • ensure general waste storage will be in lidded containers and transported to an approved landfill • separate waste elements for recycling where facilities exist for its collection in the region. • ensure wastewater from the washdown facility is fully contained and evaporated on site and residue from the evaporation will be contained within secure skips pending disposal at an approved site in accordance with the requirements of WQPN 65 • ensure waste oil or other hydrocarbons are stored in a plastic lined, bunded pit or tank and transported to the nearest approved disposal facility and contaminated soil be contained within secure skips pending disposal at an approved site in accordance with the requirements of WQPN 65 • shall discourage construction staff, visitors and subcontractors from throwing cigarette butts on ground, and educated as to the risks of fire. Environment Management Representative to monitor compliance with approval and management requirements weekly. MACA shall ensure weekly internal reporting on any incidents or near-miss impacts and non-compliances. Upon completion of the contract, MACA shall ensure that all waste materials (including waste water, excess soil, cement, rubbish and any other deleterious matter) and equipment is removed and disposed of off-site at a suitable waste-disposal facility. No litter or waste materials will remain in the natural environment following completion of construction. No waste will be disposed of on site *MACA reference documents:* *SOP 5016 Clearing Controls, FO 5054 Ground Disturbance Approval Permit, SOP 5030 Equipment Servicing. SOP 5005 Waste Management.*	MACA Project Manager MACA Superintendent
Clearing	204B.4	N	MACA shall prepare, implement and maintain processes to ensure that: • Clearing of vegetation does not exceed the approved limits of clearing • Clearing of vegetation is undertaken in such a way that minimises impacts to native fauna • Vegetation is conserved when feasible, especially mature trees • Vegetation is not disturbed for temporary works such as side tracks, access tracks, temporary storage areas, spoil areas, site offices and camps • The movement of all vehicles, plant and machinery does not occur outside of the approved limits of clearing. This shall include all turnaround areas Whilst conducting clearing activities MACA shall: • minimise vegetation clearing and the area of disturbance by utilising existing cleared areas where possible • ensure that the Site has been pegged and flagged and the Hold Point has been released by MRWA in accordance with 204.B.19 - Pegging and Flagging Principal Environmental Management Requirements	MACA Project Manager MACA Superintendent MACA Supervisor

Table 4. Construction Environmental Operational Controls				
Aspect	**Ref No.**	**Hold Points (Y/N)**	**Contractor Operational Control**	**Responsibility**
			• identify suitable locations for the stockpiling of mulched material / traffic management is not located within areas identified for retention and / or protection as per the 204B.22.1 Demarcating and Protecting Special Environmental Areas Principal Environmental Management Requirements • report any damage to vegetation beyond the approved limit of clearing, as an Environment Incident • ensure that Mulch and Topsoil is managed in accordance with 204.B.17 Mulch and Topsoil Management Principal Environmental Management Requirements • ensure that clearing activities are completed in accordance with Main Roads Specifications: 204 (Environment), 301 (Clearing), 302 (Earthworks) • ensure that the movement of soil and vegetation is only undertaken in dry conditions unless otherwise approved by MRWA • ensure that the following is managed in accordance with 204.B.16 Machinery and Vehicle Management Principal Environmental Management Requirements; o All vehicles, plant and machinery are clean on entry, and o Movements are confined to the approved clearing limits during the works. MACA shall identify suitable locations for the storage and parking of vehicles, machinery and plant and ensure that it is not located within areas identified for retention and / or protection as per the 204B.22.1 Demarcating and Protecting Special Environmental Areas Principal Environmental Management Requirements or within 50 metres of a watercourse or wetland. Upon completion of the contract, MACA shall ensure that all vehicles, machinery and plant are clean on exit and the site is left clean of waste in accordance with 204.B.36 Waste Management Principal Environmental Management Requirements. MACA shall provide within 3 weeks of the clearing works being completed the following records; • Start and end date of clearing in a dd/mm/yyyy format, • The total area in hectares of vegetation cleared, and a shapefile of the area cleared in accordance with the Main Roads Environment and Heritage Data Management Standards (Refer to this link for templates https://www.mainroads.wa.gov.au/OurRoads/Environment/Pages/environmentlinks.aspx). Specific Management Actions - Clearing Limits of Clearing within the National Park is 15.4 ha Limits of Clearing for works outside the National Park is 49.1 ha The Limits of Clearing pegs/flagging to be left in place until the completion of construction in that zone Environmental Management Representative (EMR) to monitor Clearing Activities. MACA shall rehabilitate areas temporarily disturbed by the construction of the road All laydown, hardstand, site office and spoil/materials storage areas to be in existing cleared areas that are outside the National Park in existing cleared areas where possible, or as agreed with DBCA Areas cleared for materials storage, laydown or other requirements will be managed such that any stormwater runoff drains evenly off the site and does not create erosion or sedimentation to downslope areas. If necessary, temporary drainage channels will be constructed to direct water to creek lines or sump areas Access tracks for construction vehicles to be the minimum width required for safe vehicle usage No construction of side tracks within the National Park Existing tracks or other cleared zones will be used as access tracks to borrow pits Proposed limits of clearing will be checked by the EMR after being marked out, and before clearing of each section commences. Areas will be again checked within 3 days of clearing to measure actual clearing Native vegetation in the areas to be cleared will be stripped off using a bulldozer with rake blade (or similar) & stockpiled for re-use Larger shrubs & trees (rolled and broken) and all vegetation, will be stored in heaps or windrows, no greater than 1.5 m high, on the external edge of the cleared zone and no weed affected soil, mulch, fill or other material is brought into the cleared area Vegetation and soil which is removed through grading will be bladed out over the roadside so as not to provide a hazard or visual impact. Vegetation storage will not occur on areas containing high risk weeds such as Buffel grass, Ruby dock or Kapok, or in drainage lines Roadside batters with a 3:1 slope or flatter, are revegetated using locally native species in order to stabilise the batter and blend into the surrounding environment	

Table 4. Construction Environmental Operational Controls				
Aspect	**Ref No.**	**Hold Points (Y/N)**	**Contractor Operational Control**	**Responsibility**
			Any pits and new tracks to them will be designed (single access track only) and maintained to minimise disturbance to vegetation and will be placed such that there is no direct visual link from the new KTP For pits that will be developed to a size of >1 ha, the pit will be designed such that strips of native vegetation at least 10 m wide are retained between the 'cells' of the pit Vegetation will be stripped off the pit area and any access tracks and retained in a windrow not more than 1.5 m deep In pits Topsoil will be stripped to a depth of approximately 75 mm deep and stored in a windrow parallel to the stripped vegetation and not more than 1.5 m deep. Any pits that are required outside the original 1 km survey zone will be surveyed by a Botanist for the presence of conservation significant flora. If conservation significant flora is identified, a pit management plan will be developed in order to minimise the risk to, or loss of such species Borrow pits are designed and managed so as to minimise vegetation clearing and impacts on biodiversity and maximise their rehabilitation success Weekly clearing measurements taken and reported to MRWA. Weekly internal report on any incidents of direct or indirect damage to vegetation *MACA reference documents:* *SOP 5016 Clearing Controls, FO5054 Ground Disturbance Approval Permit, PL07-CMP-CIV-MRWA-KTP-3 – Construction Management Plan*,	
Dust	204B.8	N	MACA shall prepare, implement and maintain processes to ensure that; • Construction methods keep dust to a minimum. • Project activities are minimised or cease during periods of high wind or when excessive dust is generated. • Vegetation is only cleared when necessary and when weather conditions minimise dust emission. • Areas that requiring soil stabilisation are treated as soon as practicable. • The emission of dust is monitored during the works to ensure compliance with these processes. • Dust management complies with the Department of Water and Environment Regulation's *A guideline for managing the impacts of dust and associated contaminants, land development sites, contaminated sites remediation and other related activities*. • Dust does not pose a visual obstruction and safety issue to the construction work or travelling public. • Dust does not cause a nuisance to the local community or other sensitive receivers within close proximity to the works. • Dust does not cause the deterioration and/or death of adjacent native vegetation. • Complaints received by the public in relation to dust issues are recorded and responded to efficiently. All dust complaints to be addressed within 24 hours of receiving the Complaint • Water tankers are made available to dampen exposed surfaces within construction and laydown areas, particularly during ground disturbing activities • Loads are damped down and/or covered when being transported to or from the site where windblown material may cause nuisance or become a traffic hazard • Dust lift will be minimised through the use of watering and the use of gravel mulch if required MACA shall nominate for MRWA approval: • The source and location of water for dust supressing activities • Any additives to be used to aid in dust suppression *MACA reference documents:* *SOP 5003 Dust Management,*	MACA Superintendent MACA Supervisor
Erosion and Sedimentation	204B.10	N	MACA shall develop, implement and maintain processes and procedures to ensure they respond and address incidents of erosion and sedimentation within and adjacent to the work areas. Methods of soil stabilisation and sediment control that may be implemented include: • earth bunds to prevent sediment from moving to road surfaces and drainage systems • sediment fences installed at surface drain outlets into watercourses	MACA Project Manager MACA Superintendent MACA Supervisor

Table 4. Construction Environmental Operational Controls				
Aspect	**Ref No.**	**Hold Points (Y/N)**	**Contractor Operational Control**	**Responsibility**
			• hay bales and coir logs placed perpendicular to surface drains to slow down erosive runoff and to intercept eroded soil • coir and jute matting embedded into slopes using biodegradable corn starch pegs and with cuts to allow for plant into • plastic, cellular mesh stretched over and anchored at the top and bottom of steep slopes that allow subsequent placement and retention of soil and mulch for planting • silt curtains to contain materials that fall into or are placed in waterways as part of works; and • use of localised water treatments such as bio-retention basins and swales • surface roughening and benching of bare soil by creating furrows across slopes, terracing, or by surface roughing (tracking the soil surface) reduces erosion potential MACA shall develop, implement and maintain processes and procedures to: • Prevent water and wind soil erosion within and adjacent to the works areas. • Prevent the sedimentation and siltation of watercourses located within and adjacent to the works area. • Ensure that sedimentation and siltation of drainage lines due to the removal of riparian vegetation is avoided, minimised and mitigated. Ensure that loose surfaces and recently cleared areas are protected from wind and soil erosion, • Minimise exposed soil working surfaces or protect them from stormwater erosion • Ensure material such as gravel, crushed rock and excavated material is stockpiled away from drainage paths and covered to prevent erosion. • Ensure that water quality Monitoring is undertaken when turbidity and sedimentation is an issue. <u>Specific Management Actions – Erosion & Sedimentation</u> Maintain existing drainage patterns and to prevent soil erosion and sedimentation caused by construction activity or new waterways structures. Erosion and sediment controls installed during construction to manage erosion risk. No erosion rills greater than 50 cm in depth at completion of the construction maintenance phase Weekly inspection of site to ensure management actions are being implemented Pits will be designed and contoured, to minimise water ponding within them Upon completion of the contract, MACA shall continue to monitor water quality until the turbidity/sedimentation dissipates. MACA shall ensure that disturbed areas are stabilised as soon as is practicable after construction activities are completed.	
Fauna	204B.12	N	MACA shall ensure that fauna management requirements are communicated to the crew undertaking the clearing works during the induction and pre-start meeting. MACA shall conduct inspections of potential breeding trees, burrows, or dens. Where active nests, burrows or dens are identified, works shall not proceed until approval has been given by MRWA for the management of active nests, burrows or dens. MACA shall ensure that all onsite personnel undertake visual monitoring and are vigilant to the presence of fauna. Any sightings of fauna, including injury or fatality, shall be reported as an Environmental Incident MACA shall undertake the clearing in the following manner to allow fauna to move out of the clearing area; • Prior to the clearing activities commencing, use machinery to tap large trees with habitat hollows to encourage any animals evacuate • Undertake the clearing in one direction and towards areas of native vegetation to allow the animals to escape to adjacent habitat MACA shall ensure that: • No pets, traps or firearms are brought into the project area. • Fauna are not to be fed • Fauna are not to be intentionally harmed or killed • Fauna that venture into the work area are encouraged to leave in a manner that does not harm the animal or operator (loud noise, slowly approaching in a vehicle etc.) MACA shall ensure that if sick, injured or orphaned native wildlife are located on the project site, the WILDCARE Helpline (08) 9474 9055 will be contacted for assistance. MACA shall maintain records of any animal taken to a wildlife carer. MACA shall provide any records of fauna impact and calls to the WILDCARE Helpline and to MRWA.	MACA Project Manager MACA Superintendent MACA Supervisor

Table 4. Construction Environmental Operational Controls				
Aspect	**Ref No.**	**Hold Points (Y/N)**	**Contractor Operational Control**	**Responsibility**
Fencing	204B.13	N	MACA shall ensure that: • fence installation is located within the approved limits of clearing and in the manner specified in the 204B.4 Clearing Principal Environmental Management Requirements and 204.B.19 Pegging and Flagging Principal Environmental Management Requirements. • fence installation is not located within areas identified for retention and / or protection as per the 204B.22.1 Demarcating and Protecting Special Environmental Areas Principal Environmental Management Requirements MACA shall develop, implement and maintain procedures to ensure that the fence installation; • Does not impact on native vegetation outside the approved limits of clearing. • Does not impact upon any areas demarcated as special environmental areas. • Does not introduce or spread weeds, pest or disease. • Utilises previously cleared areas. • Ensures removal and clean-up of the works post construction in accordance with 204.B.36 Waste Principal Environmental Management Requirements	MACA Superintendent MACA Supervisor
Fire	204B.14	N	MACA shall: • communicate the risks and management requirements of fire to all site personnel during inductions and at pre-start meetings. • develop, implement and maintain a procedure to ensure the risks of fire are identified and managed • ensure that site personnel only smoke cigarettes within designated areas and dispose of butts in designated bins. Smoking shall not be allowed within vehicles / cabins. • ensure that no fires (including camp fires) are intentionally lit by any site personnel for any reason • regularly monitor if there are fire bans in place (DFES) or if there are vehicle movement bans (LGA) and take the necessary actions as advised by DFES and LGA. • ensure that all vehicles, plant and equipment to be fitted with fire extinguishers and restricted and to designated cleared areas • ensure that approved spark arrestors are fitted to vehicles and machinery • ensure that fire extinguishers are available and maintained in all vehicles / plant • ensure that a water tanker / cart will be on site at all times during project construction • ensure that site personnel are trained and competent in the use of emergency Fire suppressant equipment • ensure that hot works are only performed by those who are trained and competent and hold an approved Hot Work Permit • maintain a copy of the Fire Evacuation Plan on site at all times Construction personnel will extinguish, if safe to do so, and report fires occurring within the project area During hot work, a fire watch should be conducted to ensure that any fires are prevented, and any ignited fires are responded to. A check should occur at least once after the first 30 minutes. Higher risk areas or high value areas should be checked more frequently, every 30 minutes up to 3 hours after hot work has ceased. MACA will conform with the following agencies requirements for fire prevention; • Local Government Authority, • Department of Biodiversity, Conservation and Attractions (DBCA), and • Department of Fire and Emergency Services (DFES). *MACA reference documents:* *PL04-ERMP-MRWA-KTP Emergency Response Management Plan (Sections 7 / 8.4 / 8.5)*	MACA Superintendent MACA Supervisor MACA HSE Advisor
Hazardous Material	204B.15	N	For storage/transporting bulk fuel and hazardous material, MACA shall obtain a permit from Department of Mines, Industry Regulation and Safety. MACA shall: develop processes and procedures to prevent hydrocarbons, site erosion and sedimentation from the Site causing environmental pollution to surface and ground water sources. ensure that spill trays and spill response equipment is maintained and available near fuel storage or refuelling areas and are utilised to contain and clear up any spills	MACA Project Manager MACA Superintendent MACA Supervisor

Table 4. Construction Environmental Operational Controls				
Aspect	**Ref No.**	**Hold Points (Y/N)**	**Contractor Operational Control**	**Responsibility**
			• ensure that fuel storage, chemical storage, vehicle refuelling, servicing and maintenance activities must be undertaken in approved designated area/s. Designated areas must be demarcated and at least 500 m away from surface water body or major (named) waterways and bunded to contain any potential spills • ensure that all staff suitably qualified and competent to undertake works, especially refuelling activities • ensure that Safety Data Standards, for all hazardous materials, are maintained on site and that no storage of hydrocarbons or chemicals occurs within 500 m of a surface water body or major (named) waterway, wetland, public drinking water source area or wellhead protection zone • ensure that Generators located within 100 metres of a surface water body or major (named) waterways are bunded • ensure that the storage of bitumen, asphalt, concrete or aggregate will occur at designated depots or at controlled hardstands • ensure that vehicle servicing will be undertaken at designated areas and no on-site storage of fuel, oils and other contaminant materials will be permitted within 500 m of a surface water body or major (named) waterway, wetland, public drinking water source area or wellhead protection zone • ensure that all hazardous materials are stored in bunded areas and that those bunds, are sufficient in site to contain the full capacity of the storage facility • ensure that no storage of hydrocarbons or chemicals occurs within 500 m of a surface water body or major (named) waterway, wetland, public drinking water source area or wellhead protection zone • ensure that all hazardous material spills are reported as an Environmental Incident • ensure that Hazardous materials are disposed of at an approved and certified facility <u>Specific Management Actions – Hazardous Material</u> Bunds / containment areas be inspected regularly and after any substantial rainfall event. Monitoring and inspection reports shall be kept Weekly inspection of site to ensure management actions are being implemented. Bunds / containment areas be inspected regularly and after any substantial rainfall event. All relevant licences for fuel or dangerous goods transport, storage and use shall be obtained from the Department of Mines, Industry Regulation and Safety under the relevant acts and regulations Fuel and dangerous goods shall be managed as per the relevant licensing requirements Management of transport, storage and use of hazardous materials and hydrocarbons, through the Millstream water catchment area	
Machinery and Vehicles	204B.16	N	MACA shall; • ensure that all areas associated with the storage, parking, servicing, wash down and refuelling of all vehicles, plant and machinery is located within the approved limits of clearing and in the manner specified in the 204B.4 Clearing Principal Environmental Management Requirements and 204.B.19 Pegging and Flagging Principal Environmental Management Requirements and 204.B.22 Demarcating and Protecting Special Environment and Heritage Areas Principal Environmental Management Requirements • ensure that all areas associated with the storage, parking, servicing, wash down and refuelling of all vehicles, plant and machinery is not located within areas identified for retention and / or protection as per the 204B.22.1 Demarcating and Protecting Special Environmental Areas Principal Environmental Management Requirements and is not located in a dieback infested area • shall ensure that all vehicles, machinery and plant are clean on entry (i.e. free of all soil and vegetation material) and comply with the requirements of 204.B.32 Weed Management Principal Environmental Management Requirements MACA shall maintain records of checking all vehicles, machinery and plant are clean on entry and this shall include the following information: • Date of inspection • Time of inspection • Location of inspection • Owner and/or operator • Inspector/s • Plant type, make and model • Vehicle registration number • Odometer and/or hour metre reading • Cleanliness of cabin and external surrounds including; Cab vents, Control panels, Floor & mats, steps, pedals, door/s, window and bonnet seals, engine bay, undercarriage, tyres, rims, tracks, mudguards, trays /trailers, GET, overhead vents / grills / gutters, drums, toolboxes, hoses & implements.	MACA Project Manager MACA Superintendent MACA Workshop Supervisor

Table 4. Construction Environmental Operational Controls				
Aspect	**Ref No.**	**Hold Points (Y/N)**	**Contractor Operational Control**	**Responsibility**
			MACA shall ensure that all vehicles, machinery and plant are clean on exit and maintain inspection records detailing information as per the above inspection details. <u>Specific Management Actions – Machinery and Vehicles</u> Machinery will be kept in good mechanical condition to avoid unnecessary noise emissions Complaints register to be kept. Environmental Management Representative to monitor complaints Major plant and equipment which is moved into the National Park from other areas of the project shall be cleaned of soil and vegetative material prior to crossing into the Park All machinery and plant equipment moving from weed infested areas to areas free of weeds shall be cleaned down in order to minimise the spread or introduction of weeds All plant and equipment shall be maintained in a safe condition to minimise risks of sparking Underbody engine guards shall be regularly checked for build-up of vegetation and cleaned as necessary All vehicles and plant will arrive on site in a clean condition, i.e. without soil or vegetative material Machinery and plant are cleaned down in designated areas to prevent the introduction and spread of weeds	
Mulch and Topsoil	204B.17	N	MACA shall; • ensure that the movement of soil and vegetation is only undertaken in dry conditions unless otherwise approved and / or directed by MRWA • identify for the purpose of revegetation works, suitable and unsuitable topsoil and cleared vegetation / mulch material • conserve, mulch and stockpile the good quality vegetation, during clearing, for reuse revegetation works • stockpile good quality topsoil, during clearing, for reuse during revegetation works • ensure that weed infested vegetation and topsoil is disposed of appropriately at nominated locations • identify suitable locations for the storage and stockpiling of good quality and poor-quality topsoil and mulch • ensure that good quality topsoil and mulched vegetation does not contaminate the poor-quality topsoil and vegetation • identify, for MRWA's approval, suitable locations for the disposal of unsuitable topsoil, vegetation and spoil material. Non weed infested vegetation will be mulched and stockpiled in weed free areas within the limits clearing • ensure that all machinery used in the removal of weed-infested topsoil, shall be cleaned down before and between operations to prevent the introduction and spread of weeds • ensure the movement of large equipment over topsoil materials is avoided to minimise compaction • ensure that Dieback and weed infected topsoil and mulch vegetation shall be handled separately to minimise the risk of spreading dieback and weed species across the site and stockpiles • ensure that stockpiling operations shall occur in a manner to ensure that the properties of the topsoil are not degraded, and the topsoil made unsuitable for use in revegetation • ensure that all batter surface protection of stockpiles using erosion control matting; mulch; seeding or hydro-mulching shall be in accordance with Specification 204: Environmental Management • ensure that all stockpiled topsoil and mulched vegetation is stored and managed in accordance with 204.B.29 Stockpiles Principal Environmental Management Requirement's <u>Specific Management Actions – Mulch and Topsoil</u> Topsoil which is found to contain weed species will not be respread for rehabilitation purposes Topsoil from areas containing high risk weeds or high weed abundance will be buried to a depth of at least 400 mm in old pits outside the National Park, in embankments or fill sections to a depth of at least 400mm. All suitable topsoil will be removed to a depth of 75 mm and stored for re-use in rehabilitation and spread dry Topsoil will be stored in heaps or windrows adjacent to the edge of the cleared zones. Heaps will be no greater than 1.5 m high or 3 m in width Stored topsoil is to be kept dry where practicable Topsoil will not be stored on or near areas containing high risk weeds such as Buffel grass, Ruby dock or Kapok, or in drainage lines Topsoil spoil from the construction works will be stored on weed-free areas and will be reused as close as possible to its source Ongoing review and monitoring of topsoil stockpiles by Environmental Management Representative. Weekly reporting to Construction Manager and Construction Superintendent Weed contaminated topsoil stockpiles shall be quarantined from uncontaminated / clean topsoil stockpiles, clearly signed in the field and identified on a site plan	MACA Project Manager MACA Superintendent MACA Supervisor

Table 4. Construction Environmental Operational Controls				
Aspect	**Ref No.**	**Hold Points (Y/N)**	**Contractor Operational Control**	**Responsibility**
			MACA shall ensure that this site is left clean of waste in accordance with 204.B.36 Waste Management Principal Environmental Management Requirements.	
Noise	204B.18	N	Not Applicable to this Project.	
Pegging and Flagging	204B.19	N	MACA shall; • receive the limits of the approved clearing area from MRWA in shapefile and/or maps and /or in nominated drawings • confirm that the minimum area required to accommodate the earthworks has been accommodated by the approved clearing area • ensure that the designated area for clearing along the road alignment shall be the minimum required to accommodate the earthworks, as shown in the Drawings • unless otherwise shown on the Drawings, confirm the approved clearing area accommodates the areas required for the stockpiling of topsoil in windrows parallel to the road alignment, which shall not exceed two (2) metres beyond the limit of the earthworks • ensure that vegetation proposed to be cleared is demarcated by **PINK** flagging tape prior to the commencement of clearing and other project activities • ensure that any vegetation proposed to be retained is demarcated by **WHITE** flagging tape prior to the commencement of clearing and other project activities • confirm the protective measures required (that fence palings or other protective measures) for trees to be retained with MRWA prior to any clearing operations. MACA shall implement the protective measures required for all trees to be retained prior to clearing works commencing • ensure that the vegetation demarcated with **PINK** and **WHITE** flagging tape is consistent with the approved clearing areas • prior to the clearing works commencing, confirm the absence of significant fauna (cockatoos and possums) from trees and hollows. Where fauna is present, MACA shall obtain approval from MRWA for the management of such fauna, prior to clearing works commencing • record GPS locations of all the demarcated **PINK** and **WHITE** flagged area / locations and provide to MRWA for review and approval. The clearing works shall not commence without prior approval from MRWA • clearly communicate, either at the pre-start meeting or equivalent, to the crew undertaking the clearing works, through clear maps and other additional means, the areas to be cleared • take all precautions necessary to prevent damage to all existing services within the limits of clearing. Clearing within 3 metres of any service, or the distance nominated by the service provider, shall be carried out so that the service is not affected by the removal of the vegetation • take all precautions necessary to prevent damage to all vegetation within the limits of clearing that has been demarcated and/or tagged to be retained and protected • ensue that the clearing of temporary storage areas, campsites, water supply points, site offices and similar work areas is approved by MRWA prior to clearing commencing • ensure that the clearing of any other areas outside the Site is in accordance with Specification 100 GENERAL REQUIREMENTS (ENTRY TO LAND). • ensure that the clearing of temporary access tracks is accommodated by the approved clearing envelope and is carried out as necessary to provide a maximum cleared width as defined in Specification 202 TRAFFIC. Where necessary hand pruning of tree branches in accordance with AS 4373 shall be undertaken to obtain the required width • ensure that clearing for drains, levees and guide banks is accommodated by the approved clearing envelope and is to a distance of no more than one (1) metre beyond edge of earthworks • ensure that clearing for borrow pits, access tracks to borrow pits, pavement material pits and similar features is accommodated by the approved clearing envelope and is undertaken in accordance with Specification 303 PITS AND QUARRIES • identify and tag the vegetation required for transplanting as nominated in the Drawings or in Table 301A.2. • ensure that the lifting and temporary storage of the nominated vegetation shall be carried out in accordance with the Specification 304 REVEGETATION AND LANDSCAPING prior to the main clearing operations commencing • identify and tag and take all necessary precautions to protect all declared rare flora and nominated vegetation to be retained within the limits of clearing, as nominated in Table 301A.3 • ensure that vehicles and equipment shall are not driven or parked over vegetation located outside of the approved clearing area • ensure that no clearing or disturbance of topsoil shall occur outside of the approved clearing area	MACA Project Manager MACA Superintendent MACA Supervisor

Table 4. Construction Environmental Operational Controls				
Aspect	**Ref No.**	**Hold Points (Y/N)**	**Contractor Operational Control**	**Responsibility**
			Specific Management Actions – Pegging and Flagging Special Environmental Areas shall mean on site the mixed grassland PEC area and major creek lines All clearing areas to be surveyed out and pegged/flagged prior to clearing & pegs/flagging to be left in place until the completion of construction in that zone. Upon completion of the contract, MACA shall appropriately remove and dispose of any demarcation, pegging or flagging.	
Pre-Coating	204B.21	N	Refer to Precoating Principal Environmental Management Requirements (PEMR) for general management requirements. MACA shall; • ensure that pre-coating works are located within the approved limits of clearing and shall be managed in the manner specified in the 204B.4 Clearing Principal Environmental Management Requirements and 204.B.19 Pegging and Flagging Principal Environmental Management Requirements • ensure that pre-coating is not located within areas identified for retention and / or protection as per the 204B.22.1 Demarcating and Protecting Special Environmental Areas Principal Environmental Management Requirements • ensure that pre-coating works are located more than 100m from a watercourse, wetland, public drinking water source area of wellhead protection management zone • ensure that hazardous materials are stored in accordance with the 204.B.15 Hazardous Materials Principal Environmental Management Requirements MACA shall ensure the site is cleaned up in accordance with the 204.B.36 Waste Principal Environmental Management Requirements	MACA Project Manager

Protecting Special Environmental Areas on Site	204B.22	N	MACA shall;
			• refer to areas to be protected and avoided as Exclusion Area/s
			• ensure that all on-site personnel are aware of the requirement to protect the Site's special environment and heritage areas by ensuring all works are located within the approved limits of clearing
			• clearly communicate to the crew undertaking the clearing works, at the pre-start meeting (or equivalent), the approved limits of clearing and the Exclusion Area/s through maps and via a walkthrough of the site
			• develop, implement and maintain procedures that protect the Sites special environmental and heritage areas
			• demarcate any vegetation, threatened flora or trees to be retained and/or protected with pegging and flagging using **WHITE** tape
			• demarcate any heritage areas to be retained and/or protected with pegging and flagging using **PINK and BLACK** tape
			• protect the Site by demarcating any dieback infested areas with pegging and flagging using **ORANGE** tape and communicating that these dieback areas are exclusion zones and are not to be accessed under any circumstances. The knot of the tape shall be facing towards the dieback infestation. (NOTE: In Department of Biodiversity, Conservation and Attractions land, dieback infested areas will be marked using pink flagging with knot facing infested area)
			  • ensure that all works are undertaken in accordance with relevant procedures to prevent impacts to Exclusion area/s
			  • if they identify an additional special environment or heritage area within, immediately cease work at that location and notify MRWA
			  • report any beach of the Exclusion Area/s by plant, vehicle, machinery or personnel as an Environmental Incident to MRWA
			• ensure that all on-site personnel are aware and understand the following;
			  ○ White flagging tape shall be used demarcate threatened vegetation and trees to be retained
			  ○ Pink and black and flagging tape shall be used to demarcate heritage areas, and
			  ○ Orange flagging tape with the knot facing the infestation shall be used to demarcate dieback infested areas.
			  ○ Any flagged Exclusion Area/s and are not to be entered by anyone for any reason.
			  ○ the negative impacts of causing harm via unauthorised access to the Site's special environment and heritage areas by not observing the colour of the flagging tape and adhering to the approved limits of clearing
			
			Specific Management Actions – Protecting Special Environmental Areas on Site
			Special Environmental Areas shall mean the mixed grassland PEC area and major creek lines make sure not impacted outside the limits of clearing
			
			Upon completion of works MACA shall remove all demarcation, pegging and flagging of the Exclusion Area/s and dispose of the waste in accordance with the 204.B.36 Waste Principal Environmental Management Requirements
				MACA Project Manager
				MACA Superintendent
				MACA Supervisor

Table 4. Construction Environmental Operational Controls				
Aspect	**Ref No.**	**Hold Points (Y/N)**	**Contractor Operational Control**	**Responsibility**
Sealing, Priming and Sweeping	204B.25	N	MACA shall; • ensure that the works, machinery and associated storage / stockpiling is; • located within the approved limits of clearing and are managed in the manner specified in the 204B.4 Clearing Principal Environmental Management Requirements and 204.B.19 Pegging and Flagging Principal Environmental Management Requirements, and • Is not located within areas identified for retention and / or protection as per the 204B.22.1 Demarcating and Protecting Special Environmental Areas Principal Environmental Management Requirements. • ensure that the materials and water are sources for a location approved by MRWA • undertake regular monitoring of predicted weather forecasts with particular attention to predicted rainfall events, and shall not spray primer or seal within 8 hours of a predicted rainfall event • store all waste materials, such as bitumen paper, in bins with lids • ensure the movement of vehicles is undertaken in accordance with the 204.B.32 Traffic Management Principal Environmental Management Requirements • ensure the storage and handling of Hazardous Materials is undertaken in accordance with the 204.B.15 Hazardous Materials Principal Environmental Management Requirements • ensure the servicing and refuelling of machinery, plant and vehicles is undertaken in accordance with the 204.B.16 Machinery and Vehicle Principal Environmental Management Requirements MACA shall ensure the site is cleaned up in accordance with the 204.B.36 Waste Principal Environmental Management Requirements	MACA Project Manager
Side Track / Temporary Access Track	204B.26	N	MACA shall; • ensure that side tracks and access tracks are located within the approved limits of clearing and will be managed in the manner specified in the 204B.4 Clearing Principal Environmental Management Requirements and 204.B.19 Pegging and Flagging Principal Environmental Management Requirements • ensure that side tracks and access tracks are not located within areas identified for retention and / or protection as per the 204B.22.1 Demarcating and Protecting Special Environmental Areas Principal Environmental Management Requirements • ensure that the management of the side tracks and access tracks complies with the 204.B.8 Dust Management Principal Environmental Management Requirements • ensure that the clearing is managed in the manner specified in the 204B.4 Clearing Principal Environmental Management Requirements, 204.B.12 Fauna Management Principal Environmental Management Requirements and 204.B.37 Weed Management Principal Environmental Management Requirements • ensure that the movement of plant, equipment and machinery is undertaken in the manner specified in 204.B.32 Traffic Management Principal Environmental Management Requirements	MACA Superintendent MACA Supervisor
Spills	204B.27	N	MACA shall delegate someone to manage the appropriate notification/s and phone calls in the event of an Environmental Incident The delegate shall: ○ Call the MRWA Representative in the event of an Environmental Incident. ○ Call Emergency Services if the Environmental Incident poses a risk of loss of life, significant damage or injury. ○ Identify what was spilt and the source if it is safe to do so ○ Call 000 and inform Fire Services if they suspect the material is HAZMAT ○ Ensure the necessary PPE is available for potentially toxic or biohazard spills ○ Assess if it is safe to approach spill (e.g. sources of ignition, fumes, acids etc.) ○ Determine if there is appropriate equipment to deal with the spill (e.g. spill kit, sorbents, bags etc.) ○ Check if there is appropriate spill management equipment for the volume and the type of material available MACA shall; • maintain spill management equipment for the volume and the type of material that is known to be stored on site • ensure all personnel working with hazardous materials are trained and competent in spill response and reporting procedures • ensure the delegate chosen above, is trained and competent in spill response and management in accordance with MACA's Emergency Response Management Plan • nominate, for MRWA approval, the location for disposal of waste material	MACA Project Manager MACA Superintendent MACA Workshop Supervisor MACA Supervisor

Table 4. Construction Environmental Operational Controls				
Aspect	**Ref No.**	**Hold Points (Y/N)**	**Contractor Operational Control**	**Responsibility**

			• identify and obtain all required licensing for the transport, handling, storage and disposal material (e.g. sand, earth) that is required to contain the spill
			• respond to and clean up all spills in accordance with its operational controls as per:
			  ○ **Insignificant and Minor spills** shall be cleaned up and disposed of appropriately **within 24 hours** of the spill being identified.
			  ○ **Moderate and Major spills** shall be cleaned up and disposed of appropriately **within 2 weeks** of the spill being identified.
			  ○ **Catastrophic spills** shall be cleaned up under the **directions of DFES and MRWA**
			  ○ Where spills cannot be cleaned up immediately, ensure it is appropriately isolated and contained
			
			Any hydrocarbon or chemical spills which occur will be cleaned up as soon as possible with minimal disturbance to adjoining vegetation.
			
			MACA shall provide a report of all Environmental Incidents and any outstanding actions required for the remediation and clean up at MRWA's request
			
			MACA Reference docs:
			PL04-ERMP-MRWA-KTP (Covers major spills, incident responses/call outs),	

Spoil Management	204B.28	N	MACA shall; • ensure that spoil sites are located within the approved limits of clearing and will be managed in the manner specified in the 204B.4 Clearing Principal Environmental Management Requirements and 204.B.19 Pegging and Flagging Principal Environmental Management Requirements • ensure that spoil sites are not located within areas identified for retention and / or protection as per the 204B.22.1 Demarcating and Protecting Special Environmental Areas Principal Environmental Management Requirements • nominate for MRWA's approval, locations for the disposal and locations for the reuse of spoil material • nominate locations for the disposal of spoil that have the required licences or approvals to accept the material • dispose of oversize material in accordance with Specification 301 Clearing. If no such sites are identified, oversize material shall be disposed to an authorised waste disposal site • obtain landowner approval prior to access of land and disposal of spoil • ensure that spoil is managed in accordance with 204.B.17 Mulch and Topsoil Management Principal Environmental Management Requirements • ensure that spoil stockpiles are managed in accordance with the 204.B.29 Stockpile Principal Environmental Management Requirements • ensure that weed infested spoil is managed in accordance with the 204.B.37 Weed Management Principal Environmental Management Requirements • excavate and dispose of material that is unsuitable for use in Embankment Construction, Subgrade Preparation, or Embankment Foundation in accordance with Specification 301 Clearing • monitor and maintain records of the quantities of material reused and the quantities of materials disposed of <u>Specific Management Actions – Spoil Management</u> Spoil heaps will be monitored for weed growth and weed spraying will be carried out if required Weed infested spoil will not be used in rehabilitation works but will be disposed to a pit site outside the national park and covered with a minimum of 400mm of clean spoil	MACA Superintendent MACA Supervisor
Stockpiles	204B.29	N	MACA shall; • ensure that all stockpiles are located within the approved limits of clearing and are managed in the manner specified in the 204B.4 Clearing Principal Environmental Management Requirements and 204.B.19 Pegging and Flagging Principal Environmental Management Requirements • ensure that all stockpile locations are not located within areas identified for retention and / or protection as per the 204B.22.1 Demarcating and Protecting Special Environmental Areas Principal Environmental Management Requirements • nominate for MRWA's approval, locations for the stockpiling of gravel, concrete, cement, aggregate, rock, plant, culverts, dangerous goods, topsoil and mulch • ensure that stockpiles are located more than 100m from a watercourse, wetland, public drinking water source areas of wellhead protection management zone	MACA Project Manager MACA Superintendent MACA Supervisor

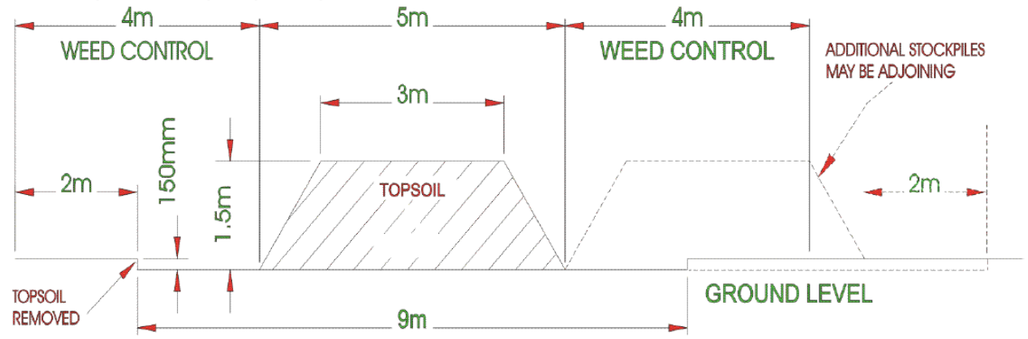
Table 4. Construction Environmental Operational Controls				
Aspect	**Ref No.**	**Hold Points (Y/N)**	**Contractor Operational Control**	**Responsibility**
			• ensure that stockpiles shall be positioned to allow for ease of transport of materials at any time, and to ensure that stockpiles do not impinge on driver's sight lines or affect road safety • maintain a 2-metre-wide corridor around all sides of the stockpiles to allow access in case of fires • protect and stabilise stockpiles by appropriate measures, to minimise erosion, sedimentation and the loss of materials, as approved by MRWA • ensure that stockpiling operations are managed in a manner to ensure that the properties of the topsoil are not degraded or made unsuitable for use in revegetation • manage and maintain the weed free topsoil and mulched vegetation stockpile sites to be weed free. Weed infestations shall be treated as many times as necessary to control the weed species to the satisfaction of MRWA • ensure that all batter surface protection of stockpiles using erosion control matting; mulch; seeding or hydro-mulching shall be in accordance with Specification 304 Revegetation and Landscaping • ensure that stockpile sites for topsoil are prepared and managed in accordance with Figure 204.B.29.23 Management Actions – Typical Cross Section for Topsoil stockpile (below)  *MACA Reference docs:*	
Surface Water / Drainage Management	204B.30	N	<u>Specific Management Actions – Surface Water / Drainage Management</u> Waterways structures and their resulting impact on natural waterways will be regularly monitored during the construction period Undertake inspections after any major storm event (e.g. cyclones, flooding) Reporting on compliance with the SDMP will be undertaken annually as part of Ministerial Statement 677 Compliance Assessment Report (CAR) No environmental harm to waterways or underground water due to erosion, vegetation loss or contamination Minimise the risk of erosion and sedimentation during the construction phase Weekly inspection of site to ensure management actions are being implemented All staff have been inducted to site and are aware of their obligations under the CEMP Minimise the impacts of construction on the natural functions, water quality and environmental values of existing waterways The location and site facilities within the PDWSA will be inspected by the Environmental Management Representative for compliance with DWER / Water Corporation requirements Weekly inspection of site to ensure management actions are being implemented. Bunds/ containment areas be inspected regularly and after any substantial rainfall event Bunds / containment areas be inspected regularly and after any substantial rainfall event Riverine vegetation which is at risk of loss from any threats as a result of the construction process will be considered for special protection. Such protection may include 'propping up' of bank areas supporting trees or shrubs through the use of rock or soil placement Remove silt and blockages from culverts and other drainage formations to ensure that water flows freely and does not unnecessarily damage natural drainage lines or Pools Periodically check the status of permanent or semipermanent pools to ensure that they are not being adversely impacted by the downstream effects of the road	MACA Project Manager MACA Superintendent MACA Supervisor

Table 4. Construction Environmental Operational Controls				
Aspect	**Ref No.**	**Hold Points (Y/N)**	**Contractor Operational Control**	**Responsibility**

Traffic Management	204B.32	N	MACA shall;
			• ensure that traffic management is located within the approved limits of clearing and in the manner specified in the 204B.4 Clearing Principal Environmental Management Requirements and 204.B.19 Pegging and Flagging Principal Environmental Management Requirements
			• ensure that traffic management is not located within areas identified for retention and / or protection as per the 204B.22.1 Demarcating and Protecting Special Environmental Areas Principal Environmental Management Requirements
			  • in accordance with items above, traffic management shall include the following:
			  • Traffic signs and other associated infrastructure
			  ○ The storage, laydown and parking of all vehicle, plant and machinery
			  ○ The movement of all vehicle, plant and machinery, including sufficient space of turnaround areas
			  • shall ensure that all bags used to stabilise signs comply with the requirements of 204.B.32 Weed Management Principal Environmental Management Requirements and does not contain weed or seed containing material
			• shall develop, implement and maintain procedures to ensure that the traffic management
			  ○ Does not impact on native vegetation outside the approved limits of clearing
			  ○ Does not impact upon any areas demarcated as special environmental areas
			  ○ Does not introduce or spread weeds, pest or disease
			  ○ Utilises previously cleared areas
			• shall operate in accordance with the approved Traffic Management Plan and the requirements set out above
			
			Upon completion of works MACA shall remove the traffic management infrastructure and clean up the site in accordance with 204.B.32 Traffic Management Principal Environmental Management Requirements and 204.B.36 Waste Principal Environmental Management Requirements
			
			MACA Reference docs: PLO1-TMP-MRWA-KTP
				MACA Project Manager

Water Abstraction and Storage	204B.34	N	MACA shall conduct the following; • Nominate water sources and locations for MRWA approval. • Obtain a licence and necessary approvals for the drawing of water from the nominated source / locations from the Department of Water and Environment and Regulation. • Obtain landowner agreement for the access to land and the use of the nominated source and location of water. • Ensure that the access and location of the water is within the approved limits of clearing and is managed in the manner specified in the 204B.4 Clearing Principal Environmental Management Requirements and 204.B.19 Pegging and Flagging Principal Environmental Management Requirements. • Ensure that the access and location of water is not located within areas identified for retention and / or protection as per the 204B.22.1 Demarcating and Protecting Special Environmental Areas Principal Environmental Management Requirements. • Where the water source access and location is outside of the approved limits of clearing, MACA shall ensure that the clearing of native vegetation and ground disturbing activities are not undertaken during water abstraction activities • Maintain records of water use including the dates, volume and location / sources of all water used during the works and any other details or requirements as directed by MRWA. • Ensure that the abstraction of water complies with the 204B.32 Traffic Management Principal Environmental Management Requirements. • Ensure that the abstraction of water complies with the 204B.37 Weed Management Principal Environmental Management Requirements. • Ensure that livestock have unhindered access to pre-existing water points for existing stock water points or station water supplies within the vicinity of the Works. <u>Specific Management Actions – Water Abstraction and Storage</u> Water quality will be at levels acceptable for the proposed use as indicated by the relevant Australian water quality guidelines MACA Construction Manager and Supervisors to monitor dust lift and impacts to workers and traffic MACA Construction Manager and Supervisors to monitor water quality for contamination or salinity of dust suppression water prior to first use from each bore used. Weekly internal reporting of non-compliances Upon completion of the contract, MACA shall report water usage as directed by MRWA.	MACA Project Manager

Table 4. Construction Environmental Operational Controls				
Aspect	**Ref No.**	**Hold Points (Y/N)**	**Contractor Operational Control**	**Responsibility**
Waste	204B.36	N	MACA shall conduct the following; • Ensure that waste management is located within the approved limits of clearing and in the manner specified in the 204B.4 Clearing Principal Environmental Management Requirements and 204.B.19 Pegging and Flagging Principal Environmental Management Requirements. • Ensure that waste management is not located within areas identified for retention and / or protection as per the 204B.22.1 Demarcating and Protecting Special Environmental Areas Principal Environmental Management Requirements. • Refer to waste as any material that contains; water, soil, cement, rubbish, deleterious matter and any other material that MRWA deems to be waste. • Develop, implement and maintain procedures for the removal and disposal of waste that has the potential to contain Asbestos Containing Material (ACM). • Ensure suitable Personal Protective Equipment is available for the removal and disposal of waste • Nominate waste stockpiles for MRWA's approval. • Ensure that stockpiles are located more than 500 meters from any surface water body or major (named) waterway, do not cause an amenity issue, do not require the clearing of native vegetation and are not located near any sensitive receivers. • Comply with the transportation of dangerous good legislative obligations and any local authority requirements for the transporting of waste. • Identify authorised waste disposal sites and ensure they meet the requirements of current WA state regulations and / or local government bylaws that will be used, prior to mobilisation to site. • Comply with the 204.B.15 Hazardous Materials Principal Environmental Management Requirements if disposing of hazardous materials. • Ensure that removal and disposal of waste complies with the 204.B.32 Traffic Management Principal Environmental Management Requirements. • Ensure that construction waste and other rubbish is covered or contained in bins with lids (where practicable) and removed regularly. • Ensure that ACM is managed and removed by appropriately qualified personnel in accordance with DWER and Department of Mines, Industry Regulation and Safety guidelines • Ensure that sceptic tank and effluent disposal systems have been installed and maintained in accordance with the requirements of the Health Regulations of the Local Government Authority <u>Specific Management Actions – Waste Management</u> All rubbish or construction equipment will be removed from pits following construction Pits may generally only be used for dumping of clean fill or rock waste Upon completion of the contract, MACA shall clean up the site and dispose of waste to the satisfaction of MRWA and in accordance with the requirements of the Local Government Authority, WA state regulations and local government bylaws.	MACA Project Manager MACA Superintendent MACA Workshop Supervisor MACA Supervisor
Weeds	204B.37	N	MACA shall; • Remove or kill any weeds growing in the project area that are likely to spread and result in environmental harm to adjacent areas of native vegetation that are in good or better condition. • Develop, implement and maintain procedures to identify and control declared and invasive weed species within the Contract areas, to the satisfaction of MRWA. • Prepare a weed control program, for nominated weed species for control and disposal, to the satisfaction of MRWA. • Undertake weed management in accordance with the 204.B.17 Topsoil and Mulch Principal Environmental Management Requirements. • Ensure all machinery and vehicles are clean on entry and clean on exit in accordance with the Machinery and Vehicle Management Principal Environmental Management Requirements to prevent the introduction and /or spread of weeds, pests and diseases. • Implement the weed control procedures and management plan and record and manage records of its' implementation. • Treat nominated weed infestations as many times as necessary to control and eradicate the weed species in accordance with the approved weed control program • Ensure that no weed, pest or diseased affected soil, mulch, fill or other material is brought into the Site.	MACA Project Manager MACA Superintendent MACA Supervisor

Table 4. Construction Environmental Operational Controls				
Aspect	**Ref No.**	**Hold Points (Y/N)**	**Contractor Operational Control**	**Responsibility**
			Specific Management Actions – Weed Management Staff carrying out construction works will be provided with a suitable induction (including photographs) of Ruby Dock and other weeds of concern in order to recognise relevant weeds and assist in reporting and control. Weeds will be discussed at Pre-Start and Toolbox meetings as required. Site induction and training will be undertaken to minimise the spread of weeds during construction Ground disturbing pre-construction activities will not be undertaken in areas known to support Ruby Dock Pits will not be developed in areas of weed infestation, particularly Ruby Dock Locations of Ruby Dock or Kapok will be monitored during construction within the Stage 3 alignment and will be removed by hand when found and any outbreak or spread of key weed infestations will be removed by hand (Ruby Dock) or sprayed with suitable herbicides as soon as they are identified Where weed infestation is close to a proposed pit area, detailed mapping of the infested area will be carried out prior to pit development, and access to the area will be restricted using temporary fencing and signage Prevent the introduction of new weed species into the project area and adjoining areas and ensure that existing weed infestations are not extended within the work area Documented and periodic inspections of haul roads & minor roads, water storage dams, wash down facilities, topsoil stockpiles, workshop, and refuelling areas, address the presence of weeds Ad hoc inspections of areas outside of the road construction zone are undertaken to check for any outbreaks of Ruby Dock or Kapok. Areas of infestation will be recorded Any new locations identified during construction will be recorded in the Weed Register Form (Appendix 1) and mapped. Areas of weed infestation will be mapped using a GPS and marked on the ground if applicable. All weed information will be mapped using GIS, and a copy of the data provided to DBCA at least annually, and at the end of the construction phase. The effectiveness of the weed control programme will be communicated to the Main Roads Environment Officer annually Known Ruby Dock infestations will be revisited following major rain periods to check for regrowth, control outbreaks and evaluate effectiveness of control Infestation of weeds, particularly *Aerva javanica* (Kapok) will not be managed through slashing, however will be managed through spraying of roadside vegetation and weeds Annual, seasonal (within 6 weeks of significant rainfall), monitoring of key weeds within the 60 m construction zone, in borrow pits and access roads will be completed until the completion criteria as stated in the Vegetation Protection and Rehabilitation Management Plan (GHD 2018)) have been achieved Remove or kill any weeds growing in project area that are likely to spread and result in environmental harm to adjacent areas of native vegetation If timing permits, infestations of Ruby Dock along the road corridor or adjacent tracks will be sprayed prior to construction commencement, otherwise specific locations or zones will be marked on the ground and/or on relevant plans and construction drawings, for avoidance, treatment or disposal of the soil / weed remains within the area Known areas of high priority weeds (such as Ruby Dock) will be quarantined and access prevented. Ground disturbing pre-construction activities, will not be undertaken in areas known to support Ruby Dock. Where necessary, areas will be demarcated with temporary fencing or other markers and entry restricted Any soil or materials imported onto the worksite will be from weed-free areas, source areas will be checked by the on-site Environmental Supervisor Where roadworks directly impact known areas of high priority weeds, topsoil will be removed separately, heaps delineated, and spoil disposed of as soon as possible through consultation with the MRWA Environmental Supervisor. It may be possible to use such soil within the fill areas beneath the road carriageway, but this option will be carefully considered for risk of accidental spread All new suspected weed locations shall be reported to the Environmental Management Representative Woody weed infestations will be cut to a stump and painted with herbicide. Cut material will be bagged and removed from site to an approved landfill or buried to a depth of at least 1 m Weed infestation that appear following topsoil respread, or other revegetation works will be targeted for herbicide or other control as applicable Pre-existing weed infestations are reduced wherever possible through active management No Ruby Dock is present within road corridor at completion of works/monitoring period Outbreak or spread of key weed infestations will be removed by hand (Ruby Dock) or sprayed with suitable herbicides as soon as they are identified. They will be mapped and revisited at regular intervals to ascertain the success of control treatments Vegetation growth will be sprayed with appropriate pesticide from the edge of the seal adjacent to the National Park.	

Table 4. Construction Environmental Operational Controls				
Aspect	**Ref No.**	**Hold Points (Y/N)**	**Contractor Operational Control**	**Responsibility**
			A small number of pits shall be nominated for dumping of weed infested topsoil or other weed infested material. This material will be buried to a depth of at least 400mm under clean fill All revegetated areas will be monitored, and spot sprayed for weeds at least annually, six to eight weeks after the completion of the wet season <u>Environmental Management Representative (EMR) will be accountable for:</u> • Ensuring the weed control program is implemented as planned • Ensuring the outcomes of the weed control program meet the satisfaction of DBCA. • Planning & implementation of the weed control program during the construction phase. • Providing adequate resources for weed control • Perform ongoing, weekly or as required, monitoring of construction equipment, topsoil heaps, spoil dumps and drainage areas for key weed presence. Inspection records to be kept • Planning activities to ensure the timely implementation of the weed control program.	
Other	204B.38	N	<u>Specific Management Actions – Other Requirements</u> A communication log shall be implemented capturing communication with stakeholders and the public Environmental Audits results shall be reported to the Environmental Management Representative. The EMR shall assign the required preventative corrective actions Induction – All personnel shall be advised of their responsibilities with regard to the Environmental Protection Act 1986, the Wildlife Conservation Act 1950, other relevant acts and regulations and of project approval and contractual requirements. A record of inductions will be kept by the Construction Manager Regular toolbox meetings will be used to reinforce messages on environmental protection, to relay new information and to encourage and celebrate positive outcomes MACA shall provide Source Protection awareness (relating to the PDWSA) as part of the Project Orientation Induction, to all workers, working within the Water Reserve Signs shall be placed around site and advertising material provided to inform workers that they are operating in a water reserve and the need for water quality protection. Signs are to include an emergency contact number MACA shall notify MRWA of any non-conformance to this plan, which shall detail the following information by investigating to determine: ○ Why the non-conformance occurred ○ What was the environmental harm or alteration of the environment that resulted from the non-conformance? ○ What changes to project activities and/or management plans is required? ○ Measures to prevent, control or abate the environmental harm that may have occurred Daily and weekly observations of the construction site will be conducted to ensure the objectives of this CEMP are implemented and that the required management actions are in place Weekly monitoring during construction by Environmental Management Representative to ensure management actions are appropriately implemented	MACA Project Manager

6.3 Monitoring and Evaluation

Hold Points are based from Specifications 204, 301, 303 and 304. The methodology for identifying, reaching and releasing Hold Points in the Contract shall be addressed in this section.

Certain requirements identified by the Principal in Table 4 have Hold Points. A Hold Point is defined as that stage in the process of delivering the work under the Contract, beyond which MACA must not proceed to the next activity without the written approval of the Superintendent.

The Superintendent will confirm that MACA has demonstrated compliance to the Specification by reviewing supplied supporting conformance records through the following methods:

- MACA – Hold Point Register
- MACA – Hold Point Release Form

The Superintendent is responsible for reviewing and releasing the Hold Points. They will advise the release of Hold Points to MACA and notify site staff.

6.4 Emergency Preparedness and Response

MACA's Emergency Response Plan and Emergency Procedures are within the MACA Management System – Sharepoint – *PL04-ERMP-MRWA-KTP*

The Emergency Response Plan has taken into account the following requirements:

- prepare to respond by planning actions to prevent or mitigate adverse environmental impacts from emergency situations
- respond to actual emergency situations
- take actions to prevent or mitigate the consequences of emergency situations, appropriate to the magnitude of the emergency and the potential environmental impact
- periodically test the planned response actions, where practicable
- periodically review and revise the process(es) and planned response actions, particularly after the occurrence of emergency situations or tests
- provide relevant information and training related to emergency preparedness and response, as appropriate, to relevant interested parties, including persons working under its control

The Emergency Response Plan also provides a list of the:

- nominated key personnel for the associated emergency situation with their contact details
- contact details of the emergency service providers
- relevant Main Roads Organisation personnel
- resources required to respond to environmental emergencies

The Site Induction Program addresses the identified issues in the Emergency Response Plan to ensure that all site personnel are aware of procedures in the event of an incident or emergency occurring.

6.5 Environmental Incident Management

6.5.1 Environmental Incident Notification and Investigation

MACA's Environmental Incident Management Procedure/s are detailed in Table 4.

MACA shall submit all environmental incidents in accordance with Main Roads Environment Incident Management Guideline and using Main Roads Environment Incident Report Form located on Main Roads' website, internet address: https://www.mainroads.wa.gov.au and under: Building Roads/ Contracting to Main Roads/ Contractor Reporting Forms.

MACA shall submit the completed Main Roads Environment Incident Notification Form to the Superintendent within 5 days of an insignificant or minor incident occurring and provide copies of all

reports and information associated with the incident to the Superintendent. For moderate, major and catastrophic incidents, this shall be completed within 24 hours of the incident becoming known to the incident reporter.

If the Superintendent advises that a Main Roads electronic reporting system is implemented and MACA is required to enter environmental incidents into the system, then MACA shall use that electronic incident reporting system for all environmental incident reporting.

For the duration of the Works the following roles will be responsible throughout the Environmental Incident Management Process:

- The person notifying the Superintendent of the incident via the Incident Notification Form or EQSafe shall be: MACA Site HSE Advisor or delegate
- Investigations led by MACA shall be conducted by: MACA Site HSE Advisor or delegate
- Role responsible for closing out the actions assigned to MACA by the Principal: MACA Site HSE Advisor or delegate
-

7 MEASUREMENT AND PERFORMANCE EVALUATION

7.1 Monitoring, Measurement, Analysis and Evaluation

7.1.1 General

MACA shall establish, implement and maintain detailed procedures, for the monitoring and measurement of environmental practices that can have a significant impact on the environment on a regular basis, which are detailed below.

MACA identified the following items that require monitoring and measuring:

- Amount of clearing, dates of clearing and a shapefile of the clearing area
- Material usage
- Operational controls
- Information to track performance
- Offset compliance
- Environmental incidents
- Audit results (measuring suitability of the CEMP, measuring compliance against CEMP)
- Customer complaints relating to the environment and other environmental approval requests

The following methods shall be used for monitoring, measuring, analysing and evaluating:

- Auditing Schedule
- Contractor's Inspection and Test Plans
- Material and Usage Report Form
- Environmental Incident Report Form
- Environmental Incidents Register
- Contractor Monthly Environmental Performance Report
- Quarterly Environmental Reviews (to review trends of audits, complaints and incidents)
- MACA Quarterly Health, Safety and Environmental Audit

The Criteria to be used to evaluate the project environmental performance shall be the:

- Number of environmental incidents
- Number of Non-Conformances and Improvement Actions
- Amount of customer complaints

MACA will conduct Civil Worksite Risk Control Assessments (FO4671) on a weekly basis.

This CEMP shall be evaluated on its environmental performance and effectiveness. MACA shall submit a completed Performance Report to the Superintendent within 5 days of the end of each month.

7.1.2 Records and Records Management

Table 4 contains the records required to be kept by MACA.

The control of records shall be in accordance with MACA's approved Plan for the Contract, which is titled PL02-QMP-MRWA-KTP-3

7.1.3 Environmental Audit

MACA shall develop, implement and maintain the Audit Schedule located within PL03-HSMP-MRWA-KTP. The Audit Schedule details the frequency, methods, responsibilities, planning requirements and reporting requirements.
MACA shall undertake an initial Environmental Audit before a quarter of the work under the Contract has commenced and subsequently conduct Environmental Audits at a frequency not less than once every three (3) months.
The audits shall be undertaken by MACA of the work under the Contract, including subcontractors, for the duration of the Contract.
For each audit conducted, a report shall be produced and shall detail the:

- scope of the audit
- audit question
- audit findings

7.1.4 Corrective and Preventative Action

If there is non-compliance, the corporate procedure shall be followed using the Non-Conformance Report (NCR) Form.

All evidence of compliance evaluation is located in MACA's Non-Conformance Report (NCR) Register, located on the local MACA drive.

8 CEMP REVIEW

MACA's EMR and others as appropriate, shall undertake a review of the CEMP for the Contract in accordance with the requirements of AS/NZS ISO 14001 if the contract period is:

- less than 6 months, at 50% completion of the project
- More than 6 months, every 6 months thereafter

The results of these reviews shall be submitted to the MACA Representative and Superintendent for endorsement to ensure its continuing suitability, adequacy and effectiveness.
If a non-conformance or incident occurs, MACA's shall undertake a review of the CEMP and submit suitable amendments to the Superintendent for approval within one week, or another timeframe directed by the Superintendent, whichever is the lesser.

The results of either of these reviews shall also be submitted to MACA's 'Top Management' for endorsement to ensure its continuing suitability, adequacy and effectiveness of the CEMP.

9 IMPROVEMENT

MACA shall determine the opportunities for improvement and capture these in their Continual Improvement Register located on the local MACA drive.

DEFINITIONS

Term	Definition
Environment	Surrounds in which an organisation operates, including air, water, land, natural resources, flora, fauna and their relationships.
Environmental Aspect	Element of an organisation's activities or products or services that interacts or can interact with the environment. An Environmental Aspect can cause an Environmental Impact. A significant environmental aspect is one that has or can have one or more significant environmental impact.
Environmental Impact	Change to the Environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
Project	Refers to only the construction activities associated with the Contract works
Risk	Effect of uncertainty Risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated likelihood (as defined in ISO Guide 73:2009, 3.6.1.1) of occurrence.
Risks and Opportunities	Potential adverse effects (threats) and potential beneficial effects (opportunities).
Top Management	A person or group of people who directs and controls the CEMP at the highest level.

10 REFERENCES AND RELATED DOCUMENTS

Document Number	Description
	International Standard ISO 14001 Environmental Management Systems – Requirements with Guidance for Use (2015)

11 APPENDICES

Appendix	Title
Appendix 1	MACA Health, Safety & Environment Commitment Statement
Appendix 2	MACA Reference Materials
Appendix 3	

Appendix 1: Health, Safety & Environment Commitment Statement

HEALTH, SAFETY & ENVIRONMMENT COMMITMENT STATEMENT

At MACA we are committed to providing a safe workplace for our employees, contractors and visitors; and to plan our work responsibly in order to minimise impact to the environment. Our objective is to provide a "Zero Harm" workplace, through active leadership at all levels of the business, with informed decision-making based around our core values of People First, Exceeding Expectations, Continuous Improvement and the Community. With this commitment realised, MACA will achieve its vision to be number 1 in what we do.

To achieve this, MACA will:

- Build a strong, supportive company culture based on visible leadership, consultation and engagement with all employees and contractors.
- Expect total commitment by leadership personnel, employees and contractors to our objective of "Zero Harm".
- Identify Catastrophic Risks and verify the Critical Controls are in place and functional prior to commencing an activity. Eliminate or reduce the potential catastrophic event risk to a level as low as reasonably practicable.
- Endorse relevant legislation, standards and best practice that impact on the operation and work environment, including duty of care required by employers and employees.
- Consider the lifecycle aspect to environmental decision-making to reduce MACA's environmental footprint. Be receptive to innovative ideas that will result in reducing emission discharges, wastes, energy usage and resource consumption.
- Identify items or areas of cultural heritage which may be impacted by our work activities, create an awareness of the significance, establish systems to protect and maintain its value.
- Implement and monitor safe work practices and continually review related procedures to ensure employees and contractors receive the approved and current information for safe and effective execution of tasks.
- Establish measurable objectives and targets to evaluate whether MACA is achieving the safety, health and environmental expectations, requirements and obligations of stakeholders.
- Actively support and recognise opportunities for continuous improvement relating to safety, health and the environment.

Reviewed and Approved

MACA Limited
Project Manager

MACA Limited
HSEQ Manager

Appendix 2: MACA Reference Materials

Copies of the following MACA documentation attached with this CEMP.

FO4674 – Supervisors Daily Work Area Inspection

FO7115 – Workshop Shift Inspection

FO7161 – Equipment Prestart Checklist

FO4671 – Worksite Risk Control Assessment

FO5055 – Weed Seed Dieback Inspection

FO4252 – Monthly Facilities Management Inspection

FO5054 – Ground Disturbance Approval Permit

FO7103 – Hot Work Permit

Other SOP's and reference material listed throughout CEMP, will be supplied with full suite of MACA Documentation.

Appendix H. D18#626232 Karratha Tom Price Road EPA Approved 6136933-REP_Water Management Plan_Rev025062018

Main Roads Western Australia

Karratha - Tom Price Road Stage 3 and 4a

Surface Drainage Management Plan

June 2018

Acronyms and Abbreviations

CAR	Compliance Assessment Report
CMP	Construction Management Plan
DBCA	Department of Biodiversity, Conservation and Attractions
DCLM/CALM	Department of Conservation and Land Management (superseded)
DEC	Department of Environment and Conservation (superseded)
DWER	Department of Water and Environmental Regulation
MP	Management Plan
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GHD	GHD Pty Ltd
Ha	hectare
km	Kilometre
KTP	Karratha Tom Price road
m	Metre
Main Roads	Main Road Western Australia
MS	Ministerial Statement
PaW	Parks and Wildlife Branch (of DBCA)
PDWSA	Public Drinking Water Source Area
SDMP	Surface Drainage Management Plan
VPRMP	Vegetation Protection and Rehabilitation Management Plan
WA	Western Australia

Table of contents

1. Context, scope and rationale 1
   - 1.1 Background 1
   - 1.2 Key environmental factors and impacts 4
   - 1.3 Condition requirements 4
   - 1.4 Rationale and approach 7
2. Management plan provisions 12
   - 2.1 Management systems and implementation 12
   - 2.2 Hydrological processes 13
3. Adaptive Management 20
   - 3.1 Environmental monitoring and corrective actions 20
   - 3.2 EMP Revision 20
   - 3.3 Audits 20
4. Stakeholder consultation 21
5. References 22

Table index

Table 1-1 Key environmental factors, values, and impacts relevant to the Proposal 4

Table 1-2 Requirements of MS 677 Commitment 2 of Schedule 2 4

Table 1-3 Studies and surveys relevant to the project area 7

Table 2-1 SDMP – Objectives and summary of key values and impacts 14

Table 2-2 SDMP – Management Actions and Targets 15

Figure index

Figure 1 Project location 3

Figure 2 Environmental aspects 6

Figure 3 Public Drinking Water Source Area 11

Appendices

Appendix A – Hydrological Study

1. Context, scope and rationale

This Surface Drainage Management Plan (SDMP) has been prepared for the construction and operation of Stages 3 and 4a of the Karratha Tom Price road (KTP). This section includes a summary of the proposal including its key features, information on the key environmental factors relating to construction of the road, the management approach that will be undertaken and the rationale for the approach.

1.1 Background

The KTP project was initially proposed via a Consultative Environmental Review (CER) document in 2003. The CER included a total of 245 kilometre (km) of proposed new or upgraded road from the North West Coastal Highway to the Nanutarra-Munjina Road, in three stages (2, 3 and 4). The environmental approval of the project was given in April 2005 under Assessment 1244 (Bulletin 1159) and through Ministerial Statement 677.

Construction of the 89 km of Stage 2 was commenced in 2006 by the Millstream Link Alliance and completed in 2008. This work was undertaken using a series of approved management plans as required under Statement 677. The management plans were approved by relevant authorities including the then (then) Department of Environment, Water and Rivers Commission and Department of Indigenous Affairs, with advice from Department of Conservation and Land Management (CALM). Adherence to the plans was audited internally, externally and by CALM/Department of Environment Conservation, particularly in relation to the section of Stage 2 which traversed the Millstream Chichester National Park.

The initial vegetation clearing approval was for 574 hectare (ha) (474 ha for the road formation and 100 ha for borrow pits), with 110 ha within the National Park. A Section 46C approval increased the amount of land approved for clearing within the National Park to 145 ha. Total clearing undertaken for Stage 2 was 445 ha, with 122 ha within the National Park.

1.1.1 Project area

This SDMP covers the road construction and associated drainage and borrow pits for Stages 3 and 4a of the KTP, a distance of approximately 93 km. These Stages start at the junction of the Pilbara Iron Railway line and the Roebourne Wittenoom Road and end approximately 7 km south of the Fortescue River crossing. Stage 3 of the road alignment (58 km) closely follows the Roebourne Wittenoom Road until the Pilbara Iron Railway deviates from this road towards Tom Price. Stage 4a of the project (35 km) runs south from the Roebourne Wittenoom Road adjacent to the existing railway access road (Figure 1). Approximately 14.6 km of the project area (Stage 3a) occurs within the Millstream Chichester National Park, primarily within a designated road reserve.

The road will consists of a 7 m wide two-lane seal with 1 m wide shoulders and associated cut or fill batters, table drains and offshoot drains. Stages 3 and 4a will incorporate approximately 42 floodways and 61 culverts. The approximate width of the road construction, within a flat area, will be 19m to 20 m, including table drains. Note that this will increase in areas of cut and fill.

Material for the formation will be sourced from a range of borrow pits within close proximity to the existing road, where possible.

1.1.2 Purpose and scope of this management plan

The main purpose of the SDMP is to ensure that the design and construction of the road will “maintain existing drainage patterns and prevent soil erosion and sedimentation caused by

construction activity or new waterways structures" (EPA Statement 677). The SDMP is required under Ministerial Statement 677 Proponent Environmental Management Commitment 2 (see Section 1.3).

This SDMP updates the previous plan developed for Stage 2 as follows and includes:

- Guidance using the most recent EPA guidelines for EMPs
- Updates on surface hydrology and the receiving environment
- Information on current hydrological design features
- Updates on best practice in environmental management
- New GIS mapping

The SDMP will be implemented during construction of the project works, along with four other management plans:

- Vegetation and Rehabilitation Management Plan
- Construction Management Plan
- National Park Management Plan (where applicable)'
- Cultural Heritage Management Plan.

1.1.3 Limitations

This report has been prepared by GHD for Main Road Western Australia (Main Roads) and may only be used and relied on by Main Roads for the purpose agreed between GHD and the Main Roads as set out in section 1.1.2 of this report.

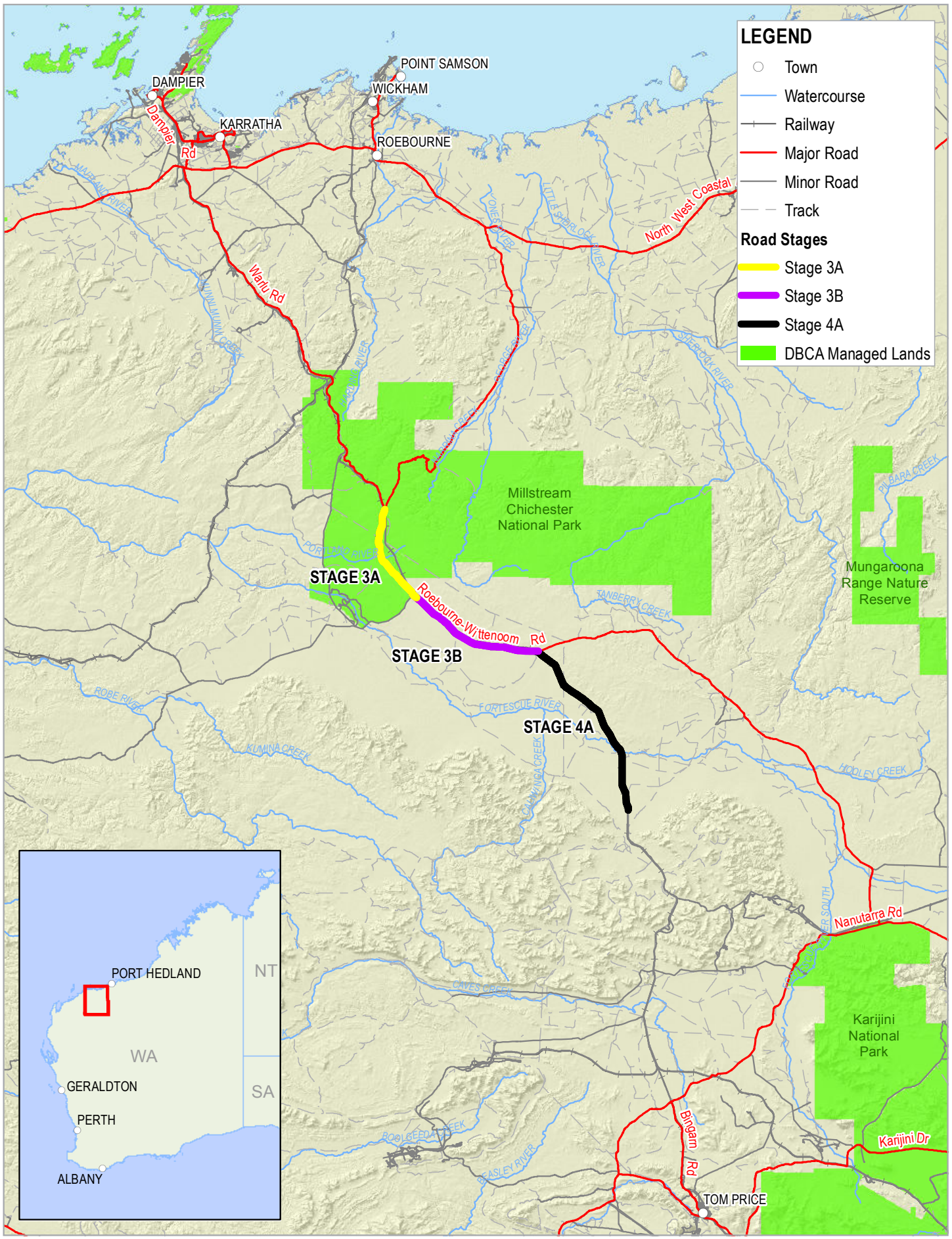
GHD otherwise disclaims responsibility to any person other than Main Roads arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Main Roads and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.



Paper Size ISO A4

0 10 20 30 40

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Main Roads Western Australia
Karratha - Tom Price Road Stages 3 and 4a

Location

Project No. **61-36933**
Revision No. **0**
Date **13/03/2018**

FIGURE 1

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Print date: 26 Mar 2018 - 17:40

Data source: GHD: Stage 3 and 4A Design Centerline - 20151202; Landgate: Water Line, Railways - 20151127, Roads - 20160502; DPaW - Managed Lands and Waters - 20141126; Geoscience Australia: GeoData Topo 250K Series 3 . Created by: afeeney

1.2 Key environmental factors and impacts

The key environmental factors identified as being relevant to this SDMP are outlined in Table 1-1. Table 1-1 summarises the project-specific environmental value, proposed impact activity and impact for the key factors. The key environmental factors are shown on Figure 2.

Table 1-1 Key environmental factors, values, and impacts relevant to the Proposal

EPA Factor	Key Values	Impact Activities	Key Potential Impacts
Hydrological Processes Inland Water Environmental Quality	Presence of Fortescue River and associated floodplain Dawson Creek, Kanjenjie Creek, Tunkewanna Creek, Balyeerinna Creek and Ti-Tree Creek as well as multiple minor gullies and drainage lines. Presence of Millstream Water Reserve	Construction of sealed road over creeks and floodway zones. Clearing of riparian vegetation. Hydrocarbon / chemical storage and use.	• Detention of floodwater, causing changed local ecological conditions upstream and downstream • Re-direction of floodwater, causing erosion and changed ecological conditions downstream • Contamination of Millstream Water Reserve

1.3 Condition requirements

The CER was assessed by officers of CALM during the public consultation period in 2004. As a result of the assessment and subsequent comments, a commitment to prepare a SDMP was given in EPA Bulletin 1159 of January 2005.

This SDMP has been prepared to meet Commitment 2 of Schedule 2 of Ministerial Statement 677, which required a SDMP to be prepared that includes the following elements:

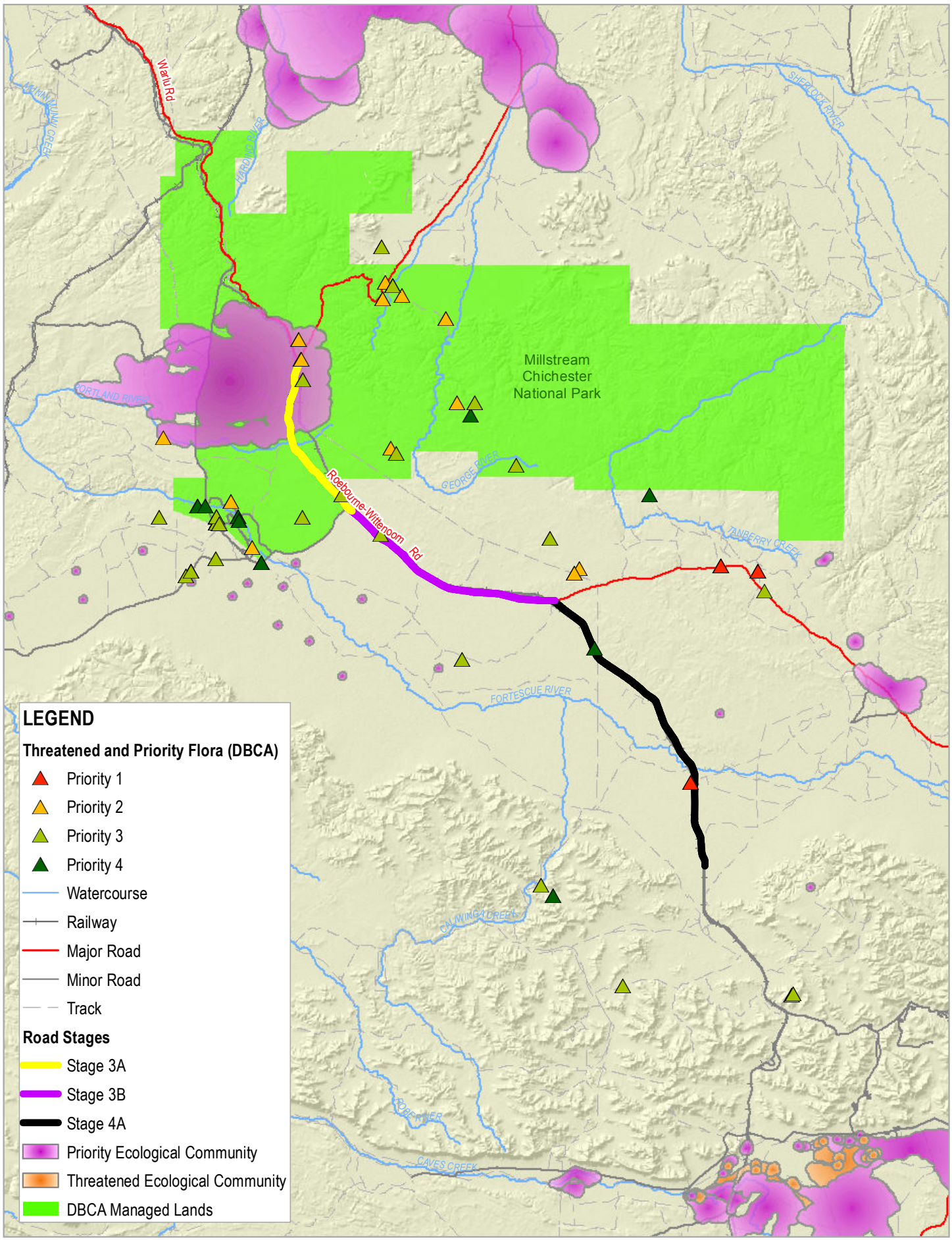
Table 1-2 Requirements of MS 677 Commitment 2 of Schedule 2

Element	Section of plan
1. Confirmation of design requirements (waterways report) for all major waterways	Apppendix A
2. Protection of embankments and waterway banks and beds	Table 2.2 – Erosion protection, design; Construction
3. Protection of riparian vegetation	Table 2.2 – Erosion protection, design; Construction
4. Strategies for maintaining sheet flows and avoiding drainage shadows (such as in Mulga groves)	Table 2.2 – Erosion protection, design; Construction
5. Management strategies for protecting water quality in the Harding Dam and Millstream water catchment areas	Table 2.2 - Construction
6. Emergency Response Planning for potential spills in the Harding and Millstream water catchment areas	Table 2.2 Construction

Element	Section of plan
7. Details for monitoring of waterway integrity and erosion risks during and following construction	Table 2.2 – Construction; Remediation
8. Management and remediation of any impacts found during monitoring	Table 2.2 - Remediation
9. Measurement and evaluation of environmental performance.	Table 2.2

The objective of the SDMP (as per ***Schedule 2 of Ministerial Statement 677***) is to: *To maintain existing drainage patterns and to prevent soil erosion and sedimentation caused by construction activity or new waterways structures*.

The SDMP is required prior to the commencement of construction and as per ***Management Commitment 3 of Ministerial Statement 677*** must be implemented prior to, during and post construction.



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Main Roads Western Australia
Karratha - Tom Price Road Stages 3 and 4a

Environmental Aspects

Project No. **61-36933**
Revision No. **0**
Date **13/03/2018**

FIGURE 2

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Print date: 28 Mar 2018 - 08:49

Data source: GHD: Stage 3 and 4A Design Centerline - 20151202; Landgate: Water Line, Railways - 20151127, Roads - 20160502; DPaW - Managed Lands and Waters - 20141126; Geoscience Australia: GeoData Topo 250K Series 3; DBCA: Threatened and Priority Flora - Provided by Main Roads - 20180328. Created by: afeeney

1.4 Rationale and approach

1.4.1 Survey and study findings

The following studies and surveys have been undertaken within, or are relevant to, the hydrology of the project area.

Table 1-3 Studies and surveys relevant to the project area

Studies	Consultant	Description
Surface water drainage assessment	GHD Pty Ltd	Desktop and field investigation of surface hydrology undertaken to characterise drainage and provide an initial risk assessment (August 2002, incorporated into the CER) (Main Roads 2003).
	BG&E	Hydrology investigation of the Concept Design on the KTP Stages 3 and 4a undertaken in 2017. This includes design flows for each catchment and assessment of the serviceability of floodways and hydraulic structures specified in the concept design.
Flora and vegetation	GHD Pty Ltd	Flora and vegetation survey of the proposed Karratha Tom Price Road (all sections), 2003. Provides baseline information on the vegetation of waterways. Incorporated in the CER

Hydrology

The CER provides a background on the general hydrology of the project area. Generally, south of the Portland River the catchments are broken into a series of small but defines watersheds in gently rolling hills. The Fortescue River plain is flat, with drainage lines tending to be small but defined. The railway service road is present at regular intervals within this section. Drainage is perpendicular to the road.

South of the Fortescue River crossing the proposed route continues close to the existing railway line. The main drainage here is northwards towards the Fortescue River (i.e. predominantly parallel to the railway).

The project requires the crossing of several watercourses and floodplains, including:

- Fortescue River and associated floodplain
- Dawsons Creek, Kanjenjie Creek, Tunkewanna Creek, Balyeerinna Creek and Ti-Tree Creek as well as multiple minor gullies and drainage lines

The project is located within the Millstream Water Reserve and within the P1 and P2 Public Drinking Water Source Areas (PDWSA)). The project starts to the south of the Harding Dam Catchment Area.

Each priority area is managed using a specific risk–based strategy to provide for effective water resource protection.

P1 areas are defined to ensure that there is *no degradation* of the water source induced by significant or high risk human activity. These areas are declared over land where the provision of a high quality drinking water source for public use is the prime beneficial land value. P1 areas typically cover land controlled by a state government agency. P1 areas are managed in accordance with the principle of risk avoidance and so most land development and human activity is normally opposed.

P2 areas are defined to ensure that there is *no increased risk of pollution* to the water source once a source protection plan has been published. These areas are declared over land where low intensity development (such as rural use) already exists. Protection of public water supply sources is a high priority in these areas. P2 areas are managed via the principle of *risk minimisation***,** and so the intensity of land development is restricted (with management conditions) and activities with a low contamination risk are accepted.

Roads are considered to be "Compatible with Conditions" within P1 and P2 areas in accordance with the Department of Water (2016) *Water Quality Protection Note No. 25 Land Use Compatibility Tables for Public Drinking Water Source Areas.*

The location of the main watercourses and PDWSA areas are shown in Figure 3.

Wetland / Waterway Vegetation

Two of the vegetation types mapped by GHD (2003) are considered to contain wetland dependent plant species:

- Drainage line vegetation of major and minor rivers, creeks and tributaries: River Gums and Paperbarks over Acacia species, sedge, grass and herb species
- Floodplain vegetation (*Acacia citrinoviridis* woodland and *A. xiphophylla* shrubland) around major and minor drainage lines.

1.4.2 Drainage design

Main Roads has undertaken concept design works for Stage 3 and 4a of KTP. This included a hydrology investigation of the concept design (BG&E 2017) provided in Appendix A, which involved calculation of design flows for each catchment and an assessment of the serviceability of the floodway's and hydraulic structures. The final drainage design will be a part of the detailed design phase and documented within the design report.

Hydraulic Analysis (BG&E 2017)

Floodways

There are 42 floodways proposed along the alignment. A dry serviceability of less than 2 years ARI and a wet serviceability of 50 + years ARI is characteristic for the majority of the floodway's. The final floodway design will be determined as part of the detailed design phase. This will include erosion and scour protection measures.

Culvert crossings

Culverts were assessed to ascertain the serviceability of the concept design. In many locations, levees will be required to contain the design flows from breaking out to the adjacent catchments. A dry serviceability of 10 + years ARI and wet serviceability of 100 years is characteristic for the majority of the culverts.

Fortescue River Crossing

The hydrology of the Fortescue River is unique. The Fortescue marshes upstream of the crossing can attenuate massive volumes of water. As such, relatively high storm waters may flow into the area and fill up this effective sump, with no outlet flow. It is Main Roads' preference to construct a floodway with no bridge. BG&E (2017) assessed two floodway options, and both options were designed to provide a 2 year ARI dry serviceability.

An assessment has also been made on the location of the floodway crossing of the Fortescue River. Further design and assessment will be undertaken in the detailed design phase. This will include measures such as rock armouring.

1.4.3 Key assumptions and uncertainties

BG&E (2017) has completed a hydrological analysis on each catchment in accordance with the 1987 edition of Australian Rainfall and Runoff (ARR 1987). Peak flows have been estimated using the Index Flood Method for the Pilbara Region. The 100 year flows have been estimated from logarithmic extrapolation. BG&E also provided the estimated flows from the Draft Version of the Regional Flood Frequency Estimation (RFFE) Model for the 2016 edition of Australian Rainfall and Runoff (ARR 2016). The RFFE Model typically provides higher flow estimates than the Index Flood Method for most catchments. However, for large catchments that experience a 50 year flow of 200m^3/s or more, the Index Flood Method tends to provide greater than 50 year ARI flow estimates than the RFFE Model. Additionally, the logarithmic extrapolation method utilised to estimate the 100 year flows from the Index Flood Method has resulted in significantly higher 100 year flows than the RFFE Model for these catchments.

1.4.4 Management approach

The management approach taken for this SDMP is based primarily on a risk-based assessment, relevant reference documents (Department of Water (2010) and Water Quality Protection Notes) and on the evidence of issues and outcomes from the construction of Stage 2 of the KTP.

The Stage 2 MP was reviewed and approved by CALM (now part of DBCA) and, due to construction within the National Park, was subject to careful scrutiny. Compliance with the previous SDMP was achieved.

Where necessary, current, improved processes or outcomes valid in the Pilbara region will be identified. A suite of existing information was used in developing the management approaches.

A hierarchical approach to manage the potential impacts from the project has been used:

- Avoidance: measures taken to avoid impact
- Minimisation: measures taken to reduce the duration, intensity and/or extent of impact
- Restoration: measures taken to restore previously existing conditions.

1.4.5 Rationale for choice of provisions

The outcome of the project is expected to remain fairly static over a number of years, with ongoing impacts including:

- Maintenance and/or replacement of the seal, road edges and road furniture
- Maintenance and repair of constructed drainage
- Little likely increase in traffic volumes
- Little likely changes to adjacent landuse.

Possible external effects of increases in rainfall intensity may occur as a result of climate change. These may cause increases in runoff and associated erosion or ponding.

Stage 2 of the project was completed in 2008. An SDMP for Stage 2 was prepared and approved by the then Department of Environment. This SDMP is consistent with the previous document, with updates based on the different contractual arrangement (construction only, rather than an alliance), different physical location and changes to legislation / practices. Lessons learnt from Stage 2 have been applied to this SDMP.

Outcome of Stage 2 SDMP

Ministerial Statement 677 - Compliance Assessment Report (CAR) (2018)

The CAR for 2018 reported that Stage 2 has achieved compliance with the SDMP. Monitoring and maintenance of surface drainage structures was ongoing throughout the maintenance phase. Reconstruction of the Harding River and Western Creek flood way crossings occurred during 2009 following extensive cyclone induced flood damage in early 2009.

Bi-annual inspections to check the status of permanent or semipermanent pools also occurred during the maintenance phase to ensure that they were not being adversely impacted by the downstream effects of the road.

Occasional events such as cyclones will continue to cause temporary scour and erosion downstream of drainage structures due to the design criteria for structures which is only required for a 1 in 100 year event. Cyclone Christine caused damage in early 2015 and repair of drains and scours has occurred.

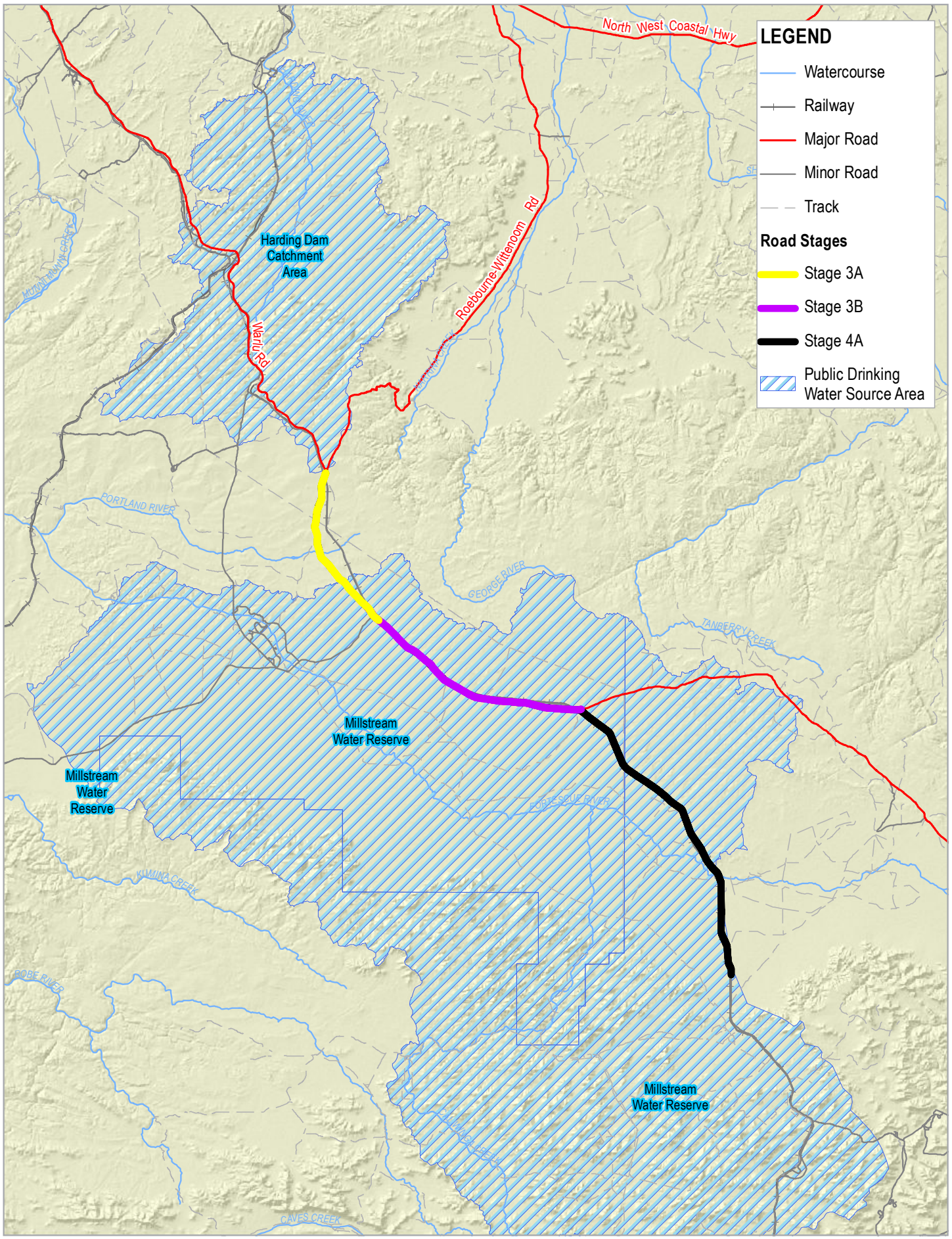
Rehabilitation Success – GHD 2015

GHD (2015) completed an assessment of rehabilitation success. Rehabilitation was successful with all rehabilitated landforms blended into the surrounding land (as much as possible). Soil in rehabilitated land was stable with no substantial ruts or rills.

Millstream Alliance – Position Paper 38

An assessment was carried out in early 2014 to assess the damage of Cyclone Christine on Stage 2. Most of the work required to bring the asset back to its original condition was due to the larger than designed flows which in some cases completely washed away grouted rock protection in culvert outlets as well as transporting an excessive volume of silt and debris into the culverts. Damage was also caused from high winds.

The flood levels were greater than the 20 year ARI design level. Repairs were made to areas damaged by the cyclone.



Paper Size ISO A4

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Main Roads Western Australia
Karratha - Tom Price Road Stages 3 and 4a

Public Drinking Water Source Areas

Project No. **61-36933**
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Date **13/03/2018**

FIGURE 3

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Data source: GHD: Stage 3 and 4A Design Centerline - 20151202; Landgate: Water Line, Railways - 20151127, Roads - 20160502; DoW: Public Drinking Water Source Area. . Created by: afeeney

2. Management plan provisions

2.1 Management systems and implementation

Main Roads has an integrated management system that incorporates an ISO 14001:2015 certified Environmental Management System.

2.1.1 Roles and responsibilities

Stages 3 and 4a of the KTP is likely to be constructed via a 'construct only' contract, whereby road design and construction supervision are undertaken by Main Roads and their consultants. Main Roads is responsible for all aspects relating to the road construction planning and design as well as for the ultimate compliance of the construction contractor. Key roles for the construction of the project are likely to be:

- Construction Superintendent – Main Roads
- Construction Manager– Construction contractor
- Environmental Supervisor – Main Roads or contractor.

2.1.2 Communication

Communication during the construction phase will occur on a daily, weekly or as-needed basis with relevant staff, project managers or external stakeholders. Project communication will be subject to the requirements of the construction contact, as determined by Main Roads but will, as a minimum, include the requirement for a communication log with external stakeholders and the public.

Key external stakeholders will include:

- DWER
- DBCA – primarily through Karratha PaW office
- Water Corporation
- Shire of Ashburton
- Pilbara Iron Railway
- Rio Tinto Iron Ore

2.1.3 Environmental awareness training and inductions

All construction personnel and sub-contractors will undergo an induction which includes information on the importance of all key elements within the management plans to ensuring that environmental outcomes are achieved. They will be advised of their responsibilities with regard to the *Environmental Protection Act, 1986, Rights in Water and Irrigation Act 1914* and other relevant acts and regulations and of project approval and contractual requirements. This SDMP will form part of the induction.

A record of inductions will be kept by the Construction Manager.

Regular toolbox meetings will be used to reinforce messages on environmental protection, to relay new information and to encourage and celebrate positive outcomes.

2.1.4 Monitoring

Daily and weekly observations of the construction site will be conducted to ensure the objectives of this SDMP are implemented and that the required management actions are in place.

Waterways structures and their resulting impact on natural waterways will be regularly monitored during the construction period and for 3 years post construction. Main Roads will undertake inspections after any major storm event (e.g. cyclones) as is currently the practice.

2.1.5 Environmental incidents / non-compliance

Environmental incidences and non-compliances will be identified and recorded as soon as possible by the relevant responsible persons. Incidents will be mitigated or rectified where possible within 48 hours of being identified. Non-conformances to this plan will be reported to the Main Roads Construction Superintendent within 48 hours of identification.

Any non-conformance to this plan is to be reported to DWER Compliance Branch and investigated to determine:

- Why the non-conformance occurred
- What was the environmental harm or alteration of the environment that resulted from the non-conformance
- What changes to project activities and/or management plans is required
- Measures to prevent, control or abate the environmental harm that may have occurred

2.1.6 Emergency response

Emergency response requirements will be determined by the Construction Manager and on the advice of the Shire of Ashburton and the Karratha PaW office. Response timing and preparedness will be in accordance with the Construction Management Plan (CMP).

2.1.7 Reporting

The environmental performance of the construction activities and the identification of auditing requirements will be assessed by Main Roads prior to and throughout the construction period. All documents pertaining to environmental management are required to be maintained though a system of document control, including the storage of hardcopy documents at site and archiving for handover to Main Roads upon contract completion.

Ministerial Condition 677 does not list specific reporting requirements, such as reporting of exceedance of threshold criteria. Reporting on compliance with the SDMP will be undertaken annually as part of Ministerial Statement 677 Compliance Assessment Report (CAR).

If a non-conformance with this plan occurs, Main Roads will notify DWER Compliance Branch through their email address at compliance@dwer.wa.gov.au within seven days of becoming aware of the non-conformance. A report on the investigation (as per 2.1.5 above) of the non-conformance will be provided within 60 days of reporting the non-conformance.

2.2 Hydrological processes

A summary of the relevant EPA objectives for water, the project SDMP objectives and key values and impacts is provided in Table 2-1. The management actions and targets are provided in Table 2-2.

Table 2-1 SDMP – Objectives and summary of key values and impacts

EPA Objective: Hydrological processes: *To maintain the hydrological regime of groundwater and surface water so that environmental values are protected.* Inland waters environmental quality: *To maintain the quality of groundwater and surface water so that environmental values are protected.*
Project SDMP Objective (Ministerial Statement 677*): To maintain existing drainage patterns and prevent soil erosion and sedimentation caused by construction activity or new waterways structures.*
Key environmental values: Watercourses and floodplains including • Fortescue River and associated floodplain • Dawson Creek, Kanjenjie Creek, Tunkewanna Creek, Balyeerinna Creek and Ti-Tree Creek as well as multiple minor gullies and drainage lines • Millstream Water Reserve (the project intersects the P1 and P2 Water Source Protection Areas). • Riparian vegetation
Key impacts and risks: • Detention of floodwater, causing changed local ecological conditions upstream and downstream • Re-direction of floodwater, causing erosion and changed ecological conditions downstream • Erosion and scour and thereby increasing water volume and sediment transfer into existing drainage lines/waterways • Increasing the risk of waterway embankment collapse through alterations in local hydrology and subsequent destabilisation • Increasing the risk of pollution of waterways through fuel and chemical spillage during construction

Table 2-2 SDMP – Management Actions and Targets

Management action or Environmental criteria	Management target / Response Action	Monitoring/Outcome	Documentation/Evidence
Commitment to Guidance			
• Main Roads will adhere to the relevant requirements of the following Water Quality Protection Notes: o WQPN 6: Vegetation buffers to sensitive water resources o WQPN 10: Contaminant spills – emergency response o WQPN 44: Roads near sensitive water resources o WQPN 60: Tanks for mobile fuel storage in PDWSAs o WQPN 65: Toxic and hazardous substances – storage and use o WQPN 83: Infrastructure corridors near sensitive water resources o WQPN 84: Rehabilitation of disturbed land in PDWSAs	No environmental harm to waterways or underground water due to erosion, vegetation loss or contamination		
Drainage Design			
Drainage will be designed to: • Minimise interruption of surface-flow patterns • Avoid ponding on the road and adjacent to the road formation • Minimise scour damage • Minimise the requirement for artificial drainage channels • Avoid water shadows and any other adverse impacts on the environment • Minimise damage resulting from events larger than the design flow • Minimise the need for maintenance such as scour repair and the removal of sediment deposits • Allow for the effects of and minimise the impact on adjacent drainage features, in particular those associated with the Pilbara Iron railway • Design the alignment to minimise the footprint and clearing of riparian vegetation (see Vegetation and Rehabilitation Management Plan for further details) • Avoid adverse impacts on infrastructure in the vicinity of the road,	Design of the alignment to minimise the 'footprint' and disturbance to watercourses where possible. Design of adequate protection to minimise risk of future environmental degradation and maximise longevity of existing waterways.	Road design drainage features will be reviewed to assess the ARI / serviceability levels of culverts, erosion and scour protection and maintenance of flow pathways.	Final design report will include drainage design.

Management action or Environmental criteria	Management target / Response Action	Monitoring/Outcome	Documentation/Evidence
such as station improvements and railway assets. The final culvert and floodway design will be undertaken in the detailed design phase.			
Erosion protection – design			
There is risk of erosion and scour at drainage points, design will include the following considerations: • Culverts usually result in outlet velocities that are higher than the natural stream velocities. These outlet velocities may require energy dissipation to prevent downstream erosion. The levels of rock protection placed at these structures are dependent upon the magnitude of the outlet velocity. • Sedimentation was identified in the Consultative Environmental Review report (MRWA, 2003) as not being a significant problem in most channels and culverts over the surveyed alignment, particularly in steep, hilly catchment areas where in most cases the channel beds are naturally armoured by rock deposits or basal rock • Other protection features include the use of table drains, levees, culvert linings, cut-off drains and offshoot drains to manage large peak flows, reduce flow velocities, and thereby reduce the possibility of scour and erosion • Drainage (floodway's, culverts, drains, rock protection etc) will be designed such that the resulting drainage patterns mimic natural flows as far as possible in order to reduce the impact of drainage shadows on vegetation. This is of particular relevance to floodways. • Sheet flows will be managed by the use of table drains / road embankment and offroad drainage levees and drains to direct flow to the nearest crossing point or normal stream flow. There are limited mulga groves in the area to be affected by drainage shadows. Most significant vegetation occurs along the larger natural stream flows and these will be maintained. • Typically, all culverts are located on natural stream flows in order	Design of adequate protection to minimise risk of future environmental degradation and maximise longevity of existing waterways. Design to incorporate scour protection (where necessary).	Road design will include erosion / scour protection.	Final design report will include drainage design and erosion / scour protection features.

Management action or Environmental criteria	Management target / Response Action	Monitoring/Outcome	Documentation/Evidence
to maximise the effectiveness of the culvert whilst reproducing the natural drainage flow / pattern.			
Construction phase			
General A number of actions and processes will be implemented during the construction phase in order to minimise the risks of detrimental impacts on waterways and drainage. The relevant management actions are: • Construction and installation of waterways structures will occur during the dry season (April to late November) where possible • Floodways and culverts will be constructed as designed, to ensure optimal transfer of water across the road and minimal impact on existing waterway capacities • Vegetation clearing will be minimised through careful marking and management • Site induction and training will be carried out to promote awareness of environmental risks to waterways • Litter will be regularly removed from site for temporary disposal in lidded bins and final disposal at a licensed rubbish disposal pit.	Minimise the impacts of construction on the natural functions, water quality and environmental values of existing waterways. Minimise the risk of erosion and sedimentation during the construction phase. All staff have been inducted to site and are aware of their obligations under the SDMP.	Weekly inspection of site to ensure management actions are being implemented	Environmental inspection reports / incidents / non-compliance / corrective actions.
Erosion / Scour Protection • Risks of erosion and sedimentation will be managed through various measures if required. These could include silt fences and sediment traps optimally placed to prevent soil export to waterways • The use of rock, soil or other materials to stabilise creek or river banks needs to account for the potential spread of weeds. Any material used in stabilising drainage channels must be free of weed propagules.	Erosion and sediment controls installed during construction to manage erosion risk. No erosion rills greater than 50 cm in depth at completion of the construction maintenance phase.	As above	Environmental inspection reports / incidents / non-compliance / corrective actions.
Public Drinking Water Source Area The location and controls of any construction facilities that are potentially polluting (fuel storage areas, depots, toilets) shall be discussed and agreed with DWER / Water Corporation for the facilities within the PDWSA. Management within the PDWSA will also	No degradation of PDWSA. No significant spills of fuel or chemicals with the PDWSA	The location and site facilities within the PDWSA will be inspected by the Environmental	Copies of correspondence with Water Corporation and DWER on works within the PDWSA shall be kept. Environmental inspection reports

Management action or Environmental criteria	Management target / Response Action	Monitoring/Outcome	Documentation/Evidence
include: • Chemical toilet facilities will be provided within the PDWSA and these will be regularly taken off site for disposal at a licensed premise. • Any fuel / chemical storage or refuelling areas will be in a containment compound with secondary bunding and emergency response equipment available and in accordance with WQPN 60 • Any conditions / requirements by DWER within the PDWSA are complied with, and evidence of compliance obtained • Any significant fuel or other chemical spill within the PDWSA shall be reported immediately to the Water Corporation and DWER.		Supervisor / Site Manager for compliance with DWER / Water Corporation requirements. Weekly inspection of site to ensure management actions are being implemented Bunds / containment areas be inspected regularly and after any substantial rainfall event.	/ incidents / non-compliance / corrective actions.
Site Depots / Site Infrastructure • The site office / depot and fuel / chemical storage areas will be placed as far as practical from ephemeral watercourses and preferably on gently-sloping, well-drained land • Site office, vehicle servicing areas, accommodation camp, waste and site storage areas to be located at least 500 m from surface waterbodies	To minimise the risks of chemical spillage and other polluting activities during the road construction phase No site facilities to be located within 500 m of surface waterbodies	Location of facilities approved by Environmental Supervisor.	Location of site office and other facilities to be provided in the Ministerial Statement CAR.
Chemical and Fuel The handling and storage of fuels is detailed within the CMP, and includes the following: • Storage areas should be established on stable ground in an area that is not subject to flooding • Raw materials/hazardous goods will be stored in an area not subject to flooding or erosion and not within 500 m of surface water bodies within the PDWSA • Potentially polluting materials will be managed so as to minimise	To minimise the risks of chemical spillage and other polluting activities during the road construction phase	Weekly inspection of site to ensure management actions are being implemented Bunds / containment areas be inspected regularly and after any substantial rainfall event.	Monitoring and inspection reports shall be kept. A summary and copies of relevant correspondence shall be provided in the Annual Ministerial Statement CAR.

Management action or Environmental criteria	Management target / Response Action	Monitoring/Outcome	Documentation/Evidence
the risk of contamination of the rivers and streams. This will include bunding of fuel storage, processes for fuel cartage, transfer and use • Spill response kits will be available wherever vehicles or equipment are refuelled • Inductions will emphasise the need to minimise risks of pollution within the catchment.			
Hydrocarbon / Chemical Spill The hydrocarbon / chemical spill response plan, this shall include the following items: • Isolate the spill area • Address the situation to stop the spill / leak if it is safe to do • Contain and clean up the spill using spill response equipment (and using appropriate PPE) • If the spill is within the PDWSA and is greater than 25L or has entered a waterway or pond, notify Water Corporation and DWER • Contaminated soil is to be contained within secure skips pending disposal at an approved site in accordance with the requirements of WQPN 65e • Document the incident, including remediation steps.	No significant environmental harm from hydrocarbon / fuel incidents All spills greater than 25L reported to Main Roads and spill response actions undertaken and documented.	As above	Copies of the environmental incident report shall be kept A summary and copies of relevant correspondence shall be provided in the Annual Ministerial Statement CAR.
Monitoring ad Remediation			
If any significant bed or bank damage on waterways is found to occur as a direct result of the waterways structures, the cause of the damage will be investigated by waterways engineers. Investigations may include re-modelling of waterways flows and consideration of the magnitude and frequency of the rain event. If the damage is found to be a result of the inability of the waterways structures to carry water for the designed rainfall event then further consideration of the design capacity of the structure will be undertaken. Minor scour and embankment erosion impacts, which can be attributed to the road construction works, will be remediated using rock protection or other methods deemed suitable on a case-by-case basis.	Design of adequate protection to minimise risk of future environmental degradation and maximise longevity of existing waterways.	Monitoring will occur during construction and for three years post-construction. This will include inspection of drainage.	Maintenance reports. A summary of any significant bed or bank damage / scour / erosion and the resulting management actions will be provided in the Ministerial Statement CAR.

3. Adaptive Management

The adaptive management approach aims to reduce impacts by embedding a cycle of monitoring, reporting and implementing change (where required). This document applies the principles of adaptive management through monitoring, corrective actions and implementing changes. Adaptive management has been embedded throughout this document, and the key adaptive management processes are described below.

3.1 Environmental monitoring and corrective actions

Internal monitoring of the environmental aspects of the road construction will occur throughout the project, through the Environmental Supervisor (or their delegate). Any non-conformances with the requirements of this CMP will be discussed with the Construction Manager/Construction Superintendent and rectified or mitigated as soon as possible to ensure minimal ongoing environmental harm. Relevant procedures will be amended/updated as necessary and inductions and other workforce communication will be undertaken in a timely manner to minimise the risk of re-occurrences.

3.2 EMP Revision

The SDMP is intended to be dynamic and will be updated to reflect changes in management practices and the social and natural environment with time. This will also allow flexibility to respond new environmental impacts and adopt new technologies / management measures.

Amendments to management actions will be completed on an as needs basis. This will include revision / amendment of management actions that are not achieving the desired outcomes, environmental monitoring identifying additional impacts and management actions, changes to relevant legislation or improvements to practices to achieve a greater environmental outcome.

Changes to the management actions or targets of this CMP will require the approval of the EPA Services prior to those changes being implemented.

Any changes will be reported through the Ministerial Statement CAR. Where significant changes to the SDMP, the document will be updated and distributed.

3.3 Audits

Internal and external audits will be undertaken as per the Main Roads contract schedule and the results reported back to the Environmental Site Officer where relevant, in order for them to undertake corrective actions.

4. Stakeholder consultation

Main Roads has not undertaken any water management specific stakeholder consultation (to date) for Stage 3 and 4a of the Karratha – Tom Price Road. Throughout Stage 2 of the project consultation was undertaken with relevant local and regulator parties.

As detailed design and construction planning progress, stakeholder consultation will commence, this is likely to include:

- DWER / Water Corporation - on fuel storage and other activities within the PDWSA and the requirements for permits under the *Rights in Water and Irrigation Act, 1914.*
- DBCA Pilbara PaW office.

5. References

BG&E (2017). Karratha Tom Price Road Stages 3 and 4a – Hydrological Study. Unpublished report prepared for Main Roads.

Department of Water (2010). Millstream Water Reserve. Drinking Water Source Protection Plan. West Pilbara Water Supply. Government of Western Australia. June 2010.

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Main Roads Western Australia 2003. Karratha - Tom Price Road, Karratha to Nanutarra-Munjina Road Section, Consultative Environmental Review. Assessment No. 1244. Main Roads, January 2003.

Millstream Link (2015). Position Paper 38 – Cyclone Christine Damage to Asset and Repair Work. Unpublished report prepared for Millstream Alliance.

Appendices

Appendix A – Hydrological Study

BG&E (2017) Karratha Tom Price Road Stages 3 and 4a. Hydrological Study

GHD

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Revision	Author	Reviewer		Approved for Issue		
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Appendix I. D18#626301 Karratha Tom Price Road EPA Approved Vegetation Protection and Rehabilitation Management Plan KTP Rev 1

Main Roads Western Australia

Karratha Tom Price Road Stages 3b and 4a Vegetation Protection and Rehabilitation Management Plan

July 2018

Acronyms and Abbreviations

BAM Act	*Biosecurity and Agriculture Management Act 2007*
CALM	Department of Conservation and Land Management (superseded)
CMP	Construction Management Plan
DBCA	Department of Biodiversity, Conservation and Attractions
DEC	Department of Environment and Conservation (superseded)
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GHD	GHD Pty Ltd
Ha	hectare
IBRA	Interim Biogeographic Regionalisation of Australia
km	Kilometre
KTP	Karratha Tom Price road
m	Metre
Main Roads	Main Road Western Australia
PaW	Parks and Wildlife Branch (of DBCA)
PEC	Priority Ecological Community
TEC	Threatened Ecological Community
VPRMP	Vegetation Protection and Rehabilitation Management Plan
WoNS	Weeds of National Significance

Table of contents

1. Context, scope and rationale 1
   - 1.1 Background 1
   - 1.2 Key environmental factors and impacts 4
   - 1.3 Condition requirements 4
   - 1.4 Rationale and approach 6
2. Management plan provisions 13
   - 2.1 Management systems and implementation 13
   - 2.2 Flora and vegetation management 15
   - 2.3 Rehabilitation 22
3. Adaptive management 29
   - 3.1 Environmental monitoring and corrective actions 29
   - 3.2 EMP Revision 29
   - 3.3 Audits 29
4. Stakeholder consultation 30
5. References 31

Table index

Table 1-1 Key environmental factors, values, and impacts relevant to the project 4

Table 1-2 Requirements of MS 677 Commitment 4 of Schedule 2 5

Table 1-3 Studies and surveys relevant to the project area 6

Table 1-4 Retention of Beard vegetation communities in the project area 7

Table 1-5 Conservation significant flora species within a 20 km buffer of the project area 8

Table 2-1-1 Vegetation and flora – Management actions and targets 15

Table 2-1-2 Rehabilitation– Management Actions and Targets 22

Table 2-3 Proposed completion criteria 27

Table 4-1 VPRMP stakeholder consultation record 30

Figure index

Figure 1 Project location 3

Figure 2 Environmental aspects 11

1. Context, scope and rationale

This Vegetation Protection and Rehabilitation Management Plan (VPRMP) has been prepared for the construction and operation of Stages 3b and 4a of the Karratha Tom Price road (KTP). It is one of five management plans developed for the project. This section includes a summary of the project including its key features, information on the key ecological factors relating to construction of the road, the management approach that will be undertaken and the rationale for the approach.

1.1 Background

The KTP project was initially proposed via a Consultative Environmental Review (CER) document in 2003. The CER included a total of 245 kilometre (km) of proposed new or upgraded road from the North West Coastal Highway to the Nanutarra-Munjina Road, in three stages (2, 3 and 4). The environmental approval of the project was given in April 2005 under Assessment 1244 (Bulletin 1159) and through Ministerial Statement 677.

Construction of the 89 km of Stage 2 was commenced in 2006 by the Millstream Link Alliance and completed in 2008. This work was undertaken using a series of approved management plans as required under Statement 677. The management plans were approved by relevant authorities including the then (then) Department of Environment, Water and Rivers Commission and Department of Indigenous Affairs, with advice from Department of Conservation and Land Management (CALM). Adherence to the plans was audited internally, externally and by CALM/Department of Environment Conservation, particularly in relation to the section of Stage 2 which traversed the Millstream Chichester National Park.

The initial vegetation clearing approval was for 574 hectare (ha) (474 ha for the road formation and 100 ha for borrow pits), with 110 ha within the National Park. A Section 46C approval increased the amount of land approved for clearing within the National Park to 145 ha. Total clearing undertaken for Stage 2 was 445 ha, with 122 ha within the National Park.

1.1.1 Project area

This VPRMP covers the road construction and associated drainage and borrow pits for Stages 3b and 4a of the KTP, a distance of approximately 93 km. These Stages start at the junction of the Pilbara Iron Railway line and the Roebourne Wittenoom Road and end approximately 7 km south of the Fortescue River crossing. Stage 3b of the road alignment (58 km) closely follows the Roebourne Wittenoom Road until the Pilbara Iron Railway deviates from this road towards Tom Price. Stage 4a of the project (35 km) runs south from the Roebourne Wittenoom Road adjacent to the existing railway access road (Figure 1).

The road will consists of a 7 m wide two-lane seal with 1 m wide shoulders and associated cut or fill batters, table drains and offshoot drains. Stages 3b and 4a will incorporate approximately 42 floodways and 61 culverts. The approximate width of the road construction, within a flat area, will be 19 m to 20 m, including table drains. Note that this will increase in areas of cut and fill.

Material for the formation will be sourced from a range of borrow pits in close proximity to the road, where possible.

1.1.2 Purpose and scope of this management plan

This VPRMP updates the previous plan developed for Stage 2 as follows and includes:

- Guidance using the most recent Environmental Protection Authority (EPA) guidelines for EMPs
- Updates on conservation significant flora and vegetation
- Updates on best practice in environmental management
- New GIS mapping.

The VPRMP will be implemented during construction of the project works along with four other management plans:

- Surface Drainage Management Plan
- Construction Management Plan
- National Park Management Plan (where applicable)
- Cultural Heritage Management Plan.

1.1.3 Limitations

This report has been prepared by GHD for Main Road Western Australia (Main Roads) and may only be used and relied on by Main Roads for the purpose agreed between GHD and the Main Roads as set out in section 1.1.2 of this report.

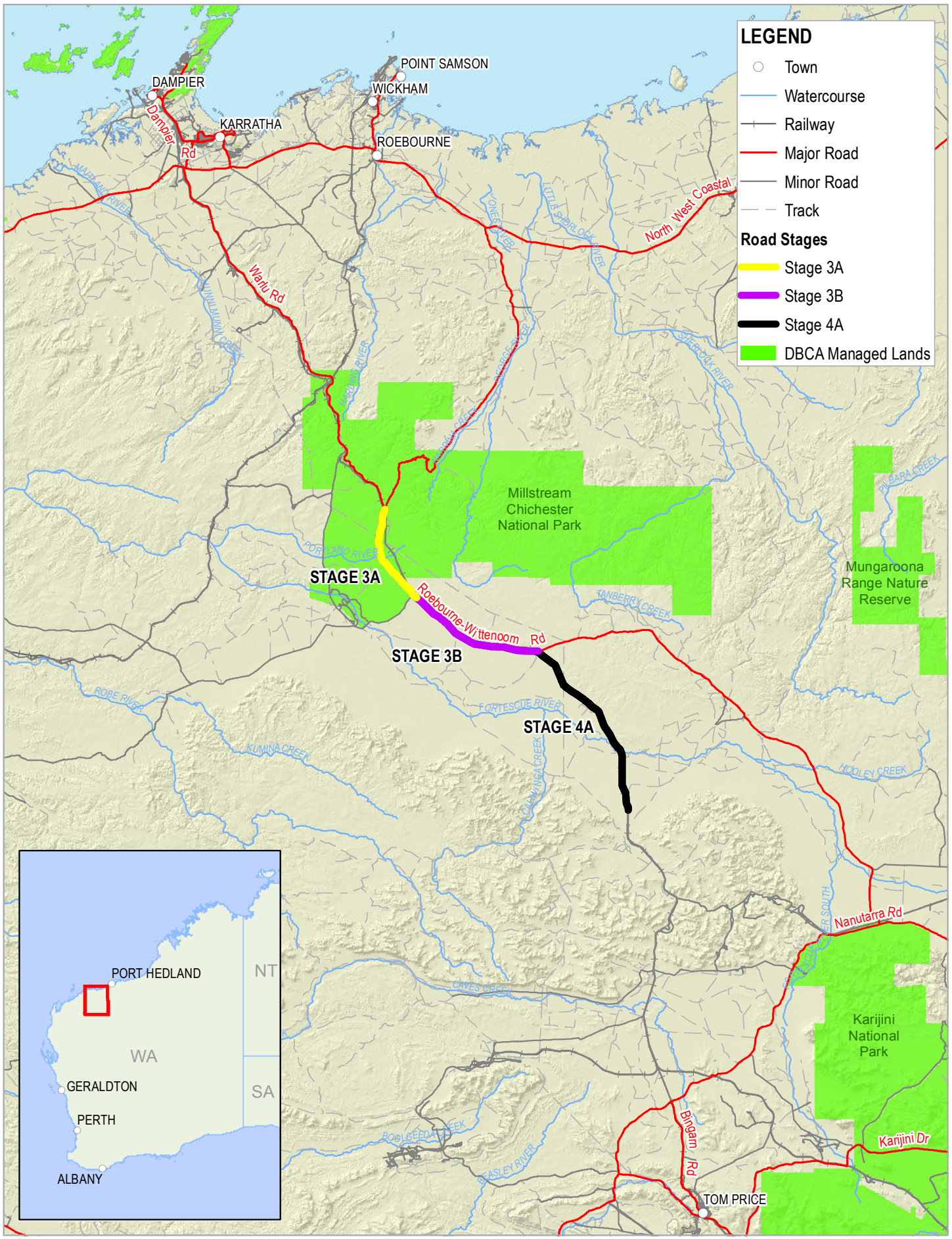
GHD otherwise disclaims responsibility to any person other than Main Roads arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Main Roads and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.



Paper Size ISO A4

0 10 20 30 40

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Main Roads Western Australia
Karratha - Tom Price Road Stages 3 and 4a

Location

Project No. **61-36933**
Revision No. **0**
Date **13/03/2018**

FIGURE 1

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Data source: GHD: Stage 3 and 4A Design Centerline - 20151202; Landgate: Water Line, Railways - 20151127, Roads - 20160502; DPaW - Managed Lands and Waters - 20141126; Geoscience Australia: GeoData Topo 250K Series 3 . Created by: afeeney

1.2 Key environmental factors and impacts

The key environmental factors identified as being relevant to this VPRMP are outlined in Table 1-1. The relevance of each environmental factor to the Stages 3b and 4a of the project is discussed in Section 1.4.1. Table 1-1 summarises the project-specific environmental value, proposed impact activity and impact for the key vegetation and habitat factors.

Table 1-1 Key environmental factors, values, and impacts relevant to the project

EPA Factor	Key Values	Impact Activities	Key Potential Impacts
Flora and vegetation	Native vegetation in a range of conditions. Priority 1 PEC.	Clearing of up to 130 ha of vegetation adjacent to the existing gravel road and in borrow pits and access tracks.	• Loss of patches of Priority 1 PEC of variable quality • Changes to local hydrology causing indirect vegetation damage through erosion • Introduction of new weed species or spread of existing weeds • No recorded conservation significant flora in or closely adjacent the impact areas.
Terrestrial Fauna*	A range of fauna habitats, including ephemeral rivers/creeks.	Clearing of up to 130 ha of habitat.	• Loss of habitat

***Note**: Due to the major issue for terrestrial fauna being habitat protection, specific fauna management is not discussed further in this plan. The potential issue of injury due to construction is dealt with in the Construction Management Plan for this project.

1.3 Condition requirements

The CER was assessed by officers of CALM during the public consultation period in 2004. As a result of the assessment and subsequent comments, a number of commitments regarding vegetation protection and rehabilitation were given in EPA Bulletin 1159 of January 2005. The commitments relevant to this VPRMP for Stage 3b and 4a of the KTP road are as follows:

Schedule 1 Table 1 - Area of disturbance:

- Road formation – approximately 474 ha
- Material pits – approximately 100 ha

(after Stage 2 remaining available clearing area is 130 ha) **See Table 2.1 – Road design and Road Construction**

Condition 7.2 - Area of disturbance in National Park

- During road construction the proponent shall limit the area of vegetation to be cleared to not more than 110 ha (increased to 145 ha)

(after Stage 2 remaining area is 23 ha) **See Table 2.1 – Road design and Road Construction**

Condition 7.3 – Rehabilitation

During the construction, the proponent shall rehabilitate:

1. Approximately 137 ha of land disturbed for the construction of the road; and either
2. a) approximately 205 ha of redundant access tracks, including those tracks associated with the railway, and redundant material pits as an environmental offset activity, or
   b) alternative offsets of equivalent cost/value, developed in liaison with the (then) CALM and which deliver greater biodiversity outcomes.

(after Stage 2, approximately 129 ha was rehabilitated; tracks were not rehabilitated as agreed with CALM and an alternative, monetary, offset for weed control and rehabilitation was paid).

For the purpose of this condition, the specific locations, and methods and procedures for rehabilitation shall be included in the VPRMP. **See Table 2.2.**

Condition 7.4 – Rehabilitation quality

To ensure that rehabilitation is undertaken to an acceptable standard, prior to the commencement of construction, the proponent shall develop rehabilitation completion criteria to apply to the rehabilitation required by condition 7.3, to the requirements of the Minister for the Environment on advice of the EPA and CALM.

The rehabilitation criteria shall have timeframes and shall be included in the VPRMP. **See Section 2.3.1.**

Condition 7.5 – Rehabilitation monitoring and contingency measures

The proponent shall monitor the progress of rehabilitation against the rehabilitation completion criteria referred to in condition 7.4 and shall implement contingency measures and supplementary rehabilitation works where the criteria are not being met, to the requirements of the Minister for the Environment on advice of the EPA and CALM. **See Table 2.2, Section 2.3.2 and Section 2.3.3.**

Commitment 4 of Statement 677 and additional requirements in 677

Prepare a Vegetation Protection and Rehabilitation Management Plan. Include the following elements

Table 1-2 Requirements of MS 677 Commitment 4 of Schedule 2

Elements of Commitment 4	Section of VPRMP
1. Design and construction strategies which minimise loss of native vegetation and fauna habitat	Table 2.1, Road design
2. Details of restrictions on clearing, and clearing boundaries	Table 2.1, Road construction
3. Protection of rare and significant flora	Table 2.1, Road construction
4. Treatment and protection of riparian zones	Table 2.1, Road construction
5. Treatment of material pits	Table 2.1, Borrow pit design and management
6. A detailed rehabilitation strategy which includes topsoil and weed management, brushing and seeding	Table 2.2, Rehabilitation
7. Monitoring measures for ensuring that vegetation is protected and replaced	Table 2.1, Weed control
8. Measurement and evaluation of environmental performance	Tables 2.1 and 2.2

9. Determination of timing of rehabilitation in relation to staging of the proposal	Table 2.2, Rehabilitation
10. In relation to the rehabilitation include the specific locations, methods and procedures for the work	Table 2.2, Rehabilitation
11. Develop rehabilitation completion criteria and timeframes to the requirements of Minister for the Environment, on advice of the Environmental Protection Authority and the (then) CALM	Section 2.3.1
12. Monitor the progress of rehabilitation against the rehabilitation completion criteria and implement contingency measure and supplementary rehabilitation works where the criteria are not being met.	Table 2.2, Section 2.3.2, Section 2.3.3

Commitment 677:P5.1:1 and 677:P.5 1:2).

Implement the Vegetation Protection and Rehabilitation Management Plan – to prevent loss of vegetation beyond the 'footprint' of the works, and minimise potential indirect effects on vegetation. To rehabilitate areas disturbed by construction of the road.

1.4 Rationale and approach

1.4.1 Survey and study findings

The following studies and surveys (Table 1-2) have been undertaken within, or are relevant to, the project area.

Table 1-3 Studies and surveys relevant to the project area

Studies	Consultant	Description
Flora and vegetation	GHD Pty Ltd	Flora and vegetation survey of the proposed Karratha Tom Price Road (2003). Desktop update of conservation significant flora and vegetation communities for Sections 3b and 4a (March 2018).
	Main Roads	Weed and broad vegetation survey, March 2018 (unpublished).
Fauna	GHD Pty Ltd (using Bamford Associates)	Fauna survey of the proposed Karratha Tom Price Road (all sections), including fish and freshwater vertebrates (2002).
	GHD Pty Ltd	Desktop update of conservation significant fauna potentially present in the project area (2016). Northern Quoll reconnaissance survey including the use of camera traps (2017).
Terrestrial environmental quality	GHD Pty Ltd Main Roads WA	Vegetation condition and fauna habitat quality was considered during vegetation and fauna surveys in 2003 and reviewed on site in March 2018 (unpublished).

Studies	Consultant	Description
Rehabilitation	Millstream Link (2006, 2015)	Rehabilitation and revegetation was undertaken during Stage 2 construction of KTP. Details of work carried out and the success of the work is available in management plans and compliance reporting.

Vegetation

Vegetation mapping of a 1 km wide corridor of Stages 3 and 4a of the project identified and recorded eight broad vegetation types (GHD 2003). These types were mostly also recorded along other Stages of the KTP and are generally widespread in the Pilbara bioregion. Eight broad scale vegetation communities have been previously mapped intersecting the project area (Beard 1975). All of these communities are widespread and well-retained within the Pilbara bioregion, and the Chichester and Fortescue IBRA sub-regions, with all remaining at over 99% of pre-European extent (Government of Western Australia 2018) (Table 1-4).

Table 1-4 Retention of Beard vegetation communities in the project area

Beard Vegetation Type / description	% remaining (Pilbara bioregion)	% in Chichester or Fortescue sub-region
175 Short bunch grassland - savanna/grass plain (Pilbara)	99.56	99.98
173 Hummock grasslands, shrub steppe; kanji over soft spinifex & *Triodia wiseana* on basalt	99.72	99.72
607 Hummock grasslands, low tree steppe; snappy gum & bloodwood over soft spinifex & *Triodia wiseana*	99.84	99.84
646 Hummock grasslands, shrub steppe; snakewood over *Triodia basedowii*	100.00	100
641 Medium woodland; coolabah & river gum	100.00	100
644 Hummock grasslands, open low tree steppe; mulga & snakewood over soft spinifex & *Triodia basedowii*	99.52	99.52
645 Hummock grasslands, shrub steppe; kanji & snakewood over soft spinifex & *Triodia wiseana*	99.99	99.99
82 Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	99.51	99.9

None of the vegetation types mapped by GHD (2003) are representative of a Threatened Ecological Community (TEC). The nearest TEC to the project area is the *Themeda* sp. Hamersley Station grassland, which is approximately 40 km to the south of the project area.

A Priority Ecological Community (PEC), has been broadly mapped (with buffers) by Parks and Wildlife (PaW) branch of the Department of Biodiversity Conservation and Attractions (DBCA) across the northern 8-9 km of the project area, within the Millstream Chichester National Park. It is listed as 'Four plant assemblages of the Wona Land System (previously 'Cracking clays of the Chichester and Mungaroona Range')' (Priority 1).

This community was patchily indicated in the 2002 survey in this location and was also recorded close by, in the Stage 2 area. It is likely present to the west and east of the road construction corridor as a mosaic with the vegetation type described by GHD (2003) (Figure 2). It is in relatively poor condition in the areas adjacent to the road, due to previous roadworks and impacts from the previously existing Camp Curlewis at Barowanna Hill.

Two of the vegetation types mapped by GHD are considered to contain wetland dependent plant species:

- Drainage line vegetation of major and minor rivers, creeks and tributaries: River Gums and Paperbarks over *Acacia* species, sedge, grass and herb species
- Floodplain vegetation (*Acacia citrinoviridis* woodland and *A. xiphophylla* shrubland) around major and minor drainage lines.

Flora

GHD (2003) recorded 282 plant species along the entire KTP length, with 103 additional species recorded in the northern part (Stage 2 and part of Stage 3a) of the road in 2004. The 2004 survey was undertaken in response to the dry conditions encountered in the northern part of the survey area in the initial Autumn 2002 field survey. No Threatened or Priority listed species were recorded in the survey area (1 km survey corridor) for Stages 3 and 4a at that time.

An assessment of the current conservation significant species was undertaken for the Chichester and Fortescue IBRA sub-regions using a PaW flora records search within a 20 km buffer of the Stage 3 and 4a road alignment. This assessment identified 21 previously recorded species within the 20 km buffer, but no existing records are within, or close to the proposed construction corridor. The 21 species occurring within 20 km are shown in Table 1-5.

Table 1-5 Conservation significant flora species within a 20 km buffer of the project area

Species	Closest known location	Description / Habitat
Acacia daweana (P3)	Recorded approximately 19.8 km west of the existing road.	Spreading shrub, 0.3-1.5 m high. Stony red loamy soils. Low rocky rises, along drainage lines.
Cladium procerum (P2)	Millstream Visitor Centre – approximately 12 km from Stage 3.	Densely tufted perennial, grass-like or herb (sedge), 2 m high. Perennial pools.
Dipteracanthus chichesterensis (P1)	17.6 km north east of Stage 4a.	Perennial, herb or shrub. No habitat information.
Eragrostis crateriformis (P3)	14.77 north east of start of Stage 3.	Annual grass to 0.4 m. Clayey loam or clay. Creek banks, depressions.
Euphorbia australis var. *glabra* (P2)	Approximately 5 km north of Stage 4a.	Low herb. No habitat information.
Fimbristylis sieberiana (P3)	Millstream Visitor Centre – approximately 12 km from Stage 3.	Grass-like or herb (sedge), 0.25-0.6 m high. Mud, skeletal soil pockets. Pool edges, sandstone cliffs.
Goodenia nuda (P4)	Approximately 125 m from edge of construction zone.	Annual herb to 0.3 m. Low-lying, seasonal water collecting sites.
Helichrysum oligochaetum (P1)	460 m west of Stage 4a.	Annual herb, to 0.25 m high. Yellow flowers. Red clay. Alluvial plains.
Ipomoea racemigera (P2)	18.24 km north-east of Stage 3.	Creeping annual, herb or climber. White flowers. No habitat information.
Livistona alfredii (P4)	On the Fortescue River at Millstream Visitor Centre.	Tall palm. Edges of permanent wetlands.
Oldenlandia sp. Hamersley Station (P3)	920 m east of northern end of Roebourne Wittenoom Road.	Annual herb to 0.1 m. Cracking clay, basalt. Gently undulating

Species	Closest known location	Description / Habitat
		plain with large surface rocks, flat crabholed plain.
Owenia acidula (P3)	Approximately 15.6 km west of Stage 3 near Millstream.	Tree, 3-8 m high. Flowers white-brown/cream. Clay.
Paspalidium retiglume (P2)	Approximately 1 km north of the northern railway crossing on Roebourne Wittenoom Road.	Grass to 1 m. Clay soils.
Pentalepis trichodesmoides subsp. *hispida* (P2)	Approximately 8.7 km north east of road.	No information.
Rhynchosia bungarensis (P4)	Approximately 18.6 km north east of Stage 3.	Compact, prostrate shrub, to 0.5 m high. Flowers yellow. Pebbly, shingly coarse sand amongst boulders.
Solanum albostellatum	Approximately 4.8 km west / southwest of road, and 8 km south of road.	No information.
Swainsona thomsoniana (P3)	Approximately 20 km west of Stage 3.	Cracking clay plains.
Teucrium pilbaranum (P2)	Approximately 10.2 km west of Stage 3.	Shrub, 0.2 m high. Flowers white. Clay. Crab hole plain in a river floodplain.
Themeda sp. Hamersley Station (P3)	Approximately 400 m east of proposed road. Close to Roebourne Wittenoom Road on Dawson Creek.	Clumped grass to 1.8 m high. Red clay. Clay pan, grass plain.
Trianthema sp. Python Pool (P2)	Approximately 12.8 km north east of start of Stage 3.	Low, spreading succulent. Rocky clay/loam soils.
Triodia basitricha (P3)	Approximately 370 m north-east of the existing road.	Spinifex grass. No habitat information.

Weeds

Construction of Stage 2 of the KTP required detailed assessment and management of high risk weeds, particularly within the Millstream Chichester National Park. This was requested by PaW as part of the approval of the required National Park Management Plan. Two key weeds were of concern; Ruby Dock (*Acetosa vesicaria*) and Kapok (*Aerva javanica*) and these were mapped and controlled, where possible. NatureMap (2017) indicates a small number of weeds recorded within a 10 km radius of the existing road. One of these *Vachellia farnesiana* (Mimosa Bush) is a tall shrub which proliferates in drainage lines and is a problem for stock. The most common weed present within the project area is likely to be *Cenchrus ciliaris* (Buffel Grass) which is often found in disturbed areas and along creeklines.

Fauna

A fauna survey was undertaken by Bamford (2002) of the whole proposed KTP. This survey included extensive field surveys and trapping over a period of 10 days. Studies focussed on the Fortescue Plain, due partly to the dry conditions at the time and the likely presence of more fauna in the vicinity of the Fortescue River.

The survey identified that:

- The vertebrate fauna of the overall study area (complete KTP area) is predicted to include seven species of freshwater fish, nine frog species, 96 reptile species, 139 bird species and 41 mammal species. With the exception of fish (confined to watercourses) and frogs,

the Fortescue plain has the highest species richness within each taxonomic group, although the Chichester Range and to some extent the southern plains support species with restricted distributions.

- There are species of fish, reptiles, birds and mammals that are of conservation significance, with most of these present or expected to be present in the rocky hills and/or the Fortescue plain. Major watercourses and associated fringing vegetation are also important.

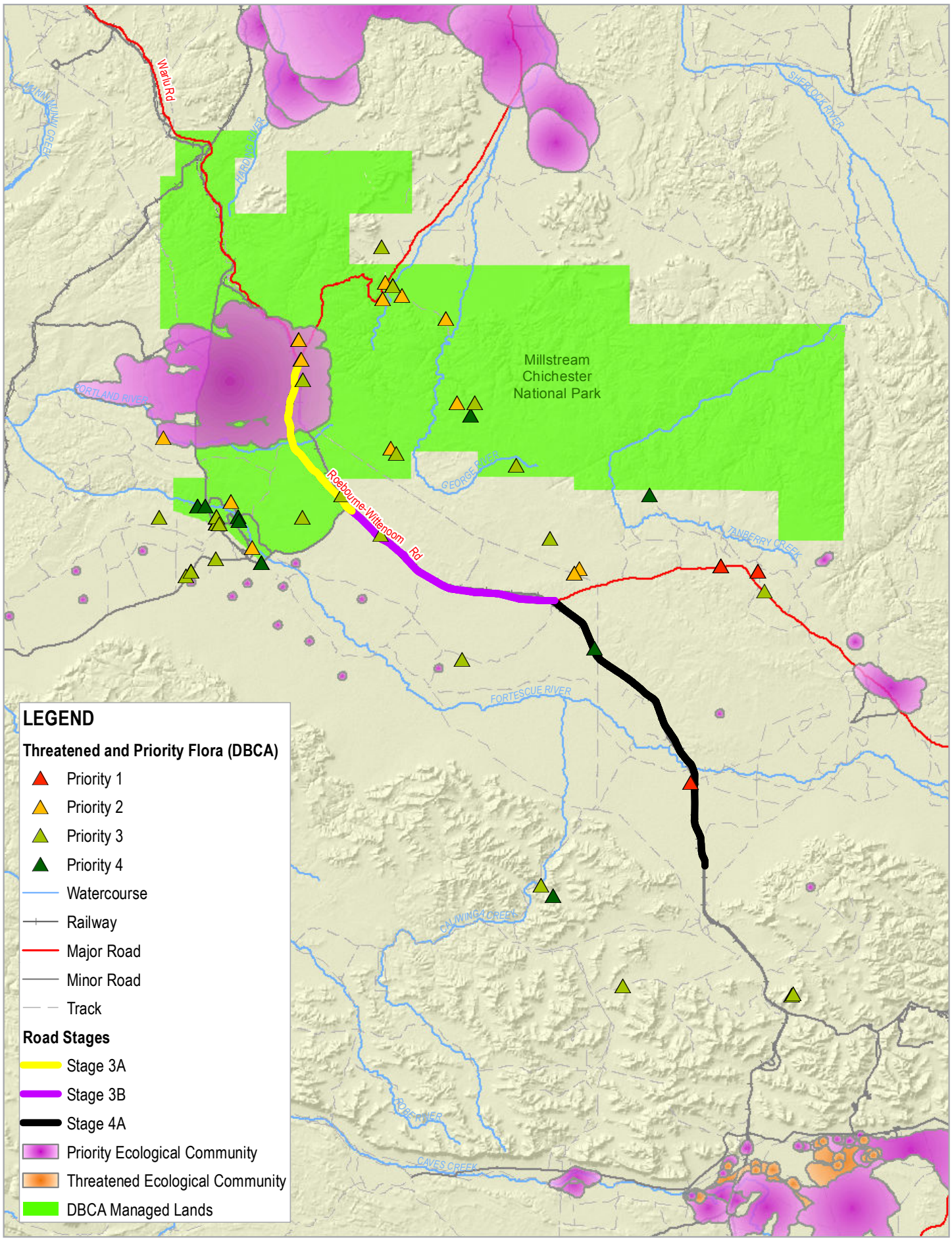
The Bamford (2002) report listed the presence or potential presence of 17 conservation significant species, based on the conservation listings at that time. A number of these have now been removed from State listings. An updated list of potentially occurring conservation significant species with a likelihood of occurrence of the species in the Stage 3 and 4a project area was established, based on DBCA records (sourced November 2017), habitat availability and knowledge from GHD's Principal Zoologist, Glen Gaikhorst (GHD 2016). This information identified 11 species of conservation significance were likely to occur or could possibly occur in the project area, as follows:

- ***Likely***: Lined Soil-crevice Skink, Short-tailed Mouse (Priority 4), Rainbow Bee-eater (Schedule 5), Peregrine Falcon (Schedule 7)
- ***Possible:*** Northern Quoll (Endangered), Pilbara Olive Python, Grey Falcon, Bilby (Vulnerable) Fortescue Grunter (Priority 4), Spectacles Hare Wallaby (Priority 3), Western Pebble-mound Mouse (Priority 4).

GHD undertook an assessment along Stages 3 and 4a in 2017 which specifically surveyed for the EPBC listed Northern Quoll (*Dasyurus hallucatus*). This survey did not record the species through physical evidence or the use of motion sensitive cameras and found only low level habitat, due to the lack of rock areas for denning sites (GHD 2017).

Rehabilitation

Rehabilitation of all roadside edges, cut off drain bunds, access tracks, side tracks, laydown areas and borrow pits was undertaken during, and immediately following, the construction of Stage 2 of the KTP. The rehabilitation areas were monitored during construction and for a period of 7 years following construction by a qualified botanist and rehabilitation specialist. The majority of revegetation of reshaped and ripped areas occurred through the respreading of topsoil and vegetative mulch, and was highly successful within a short period. Revegetation in early years was assisted by a good summer rainfall but all areas re-established well within 2-3 years of preparation. Some pit bases took longer to revegetate due to hard and impenetrable base soils and some seasonal waterlogging. Seed collected in areas to be cleared along the alignment was also used to assist revegetation in pits and on spoil dumps.



Paper Size ISO A4

0 5 10 15 20

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Main Roads Western Australia
Karratha - Tom Price Road Stages 3 and 4a

Environmental Aspects

Project No. **61-36933**
Revision No. **0**
Date **13/03/2018**

FIGURE 2

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Data source: GHD: Stage 3 and 4A Design Centerline - 20151202; Landgate: Water Line, Railways - 20151127, Roads - 20160502; DPaW - Managed Lands and Waters - 20141126; Geoscience Australia: GeoData Topo 250K Series 3; DBCA: Threatened and Priority Flora - Provided by Main Roads - 20180328. Created by: afeeney

1.4.2 Key assumptions and uncertainties

Flora and vegetation

The vegetation type and condition is considered to be similar to that found in the initial 2002 survey. As the area has had very limited development since 2002, and the KTP and rail access roads have small numbers of vehicles using them, the assumption that vegetation and weed presence is relatively unchanged is valid. Field assessments undertaken in March 2018 indicate that weed presence within Stages 3b and 4a has not changed significantly since the 2002 survey (GHD 2003).

Fauna

The comprehensive survey in 2002 by Bamford Consulting is still considered to be valid, due to the limited changes to land in the vicinity of the project area and to the extensive habitat available for most fauna species recorded.

1.4.3 Management approach

The management approach taken for this VPRMP is based primarily on a risk-based assessment, and on the evidence of issues and outcomes from the construction of Stage 2 of the KTP.

The Stage 2 Management Plan was reviewed and approved by CALM (now DBCA) and, due to construction within the National Park, was subject to careful scrutiny. Compliance on all but one of the actions (Kapok weed control) was achieved.

The management approach in this VPRMP is conservative, with the view of managing impacts during construction and ongoing usage of the road. The suite of existing information was used in developing the management approaches. Where necessary, current, improved processes or outcomes valid in the Pilbara region were identified and required.

A hierarchical approach to manage the potential impacts from the project has been used:

- Avoidance: measures taken to avoid impact
- Minimisation: measures taken to reduce the duration, intensity and/or extent of impact
- Restoration: measures taken to restore previously existing conditions.

1.4.4 Rationale for choice of provisions

The outcome of the project is expected to remain fairly static over a number of years, with ongoing impacts including:

- Maintenance and/or replacement of the seal, road edges and road furniture
- Maintenance and repair of constructed drainage
- Ongoing control of significant weeds, as required
- Little likely increase in traffic volumes
- Little likely change to adjacent landuse.

Possible external effects of increases in rainfall intensity may occur as a result of climate change. These may cause increases in runoff and associated erosion or ponding, however road design criteria include drainage design for a 1 in 50 year or 1 in 100 year flood event.

2. Management plan provisions

2.1 Management systems and implementation

Main Roads has an integrated management system that incorporates an ISO 14001:2015 certified Environmental Management System.

2.1.1 Roles and responsibilities

Stages 3b and 4a of the KTP is likely to be constructed via a 'construct only' contract, whereby road design and construction supervision are undertaken by Main Roads and their consultants. Main Roads is responsible for all aspects relating to the road construction planning and design as well as for the ultimate compliance of the construction contractor. Key roles for the construction of the project are likely to be:

- Construction Superintendent – Main Roads
- Construction Manager – Construction contractor
- Environmental Supervisor – Main Roads or contractor.

2.1.2 Communication

Communication during the construction phase will occur on a daily, weekly or as-needed basis with relevant staff, project managers or external stakeholders. Project communication will be subject to the requirements of the construction contact, as determined by Main Roads, but will, as a minimum, include the requirement for a communication log with external stakeholders and the public.

Key external stakeholders will include:

- Department of Water and Environmental Regulation
- DBCA – primarily through Karratha PaW office
- Shire of Ashburton
- Pilbara Iron Railway
- Rio Tinto Iron Ore.

2.1.3 Environmental awareness training and inductions

All construction personnel and sub-contractors will undergo an induction, which includes information on the importance of vegetation protection and rehabilitation and the requirements to enable environmental outcomes to be achieved. They will be advised of their responsibilities with regard to the *Environmental Protection Act 1986,* the *Wildlife Conservation Act 1950* and of project approval and contractual requirements. This VPRMP will form the basis of the induction.

A record of inductions will be kept by the Construction Manager.

Regular toolbox meetings will be used to reinforce messages on environmental protection, to relay new information and to encourage and celebrate positive outcomes.

2.1.4 Monitoring

Daily and weekly observations of the construction site will be conducted to ensure the objectives of this VPRMP are implemented and that the required management actions are in place.

2.1.5 Environmental incidents / non-compliances

Environmental incidences and non-compliances will be identified and recorded as soon as possible by the relevant responsible persons. Incidents will be mitigated or rectified where possible within 48 hours of being identified. Non-conformances to this plan will be reported to the Main Roads Construction Superintendent within 48 hours of identification.

Any non-conformance to this plan is to be reported to DWER Compliance Branch and investigated to determine:

- Why the non-conformance occurred
- What was the environmental harm or alteration of the environment that resulted from the non-conformance
- What changes to project activities and/or management plans is required
- Measures to prevent, control or abate the environmental harm that may have occurred

2.1.6 Emergency response

Emergency response requirements will be determined by the Construction Manager and on the advice of the Shire of Ashburton and the Karratha PaW office. Response timing and preparedness will in accordance with the Construction Management Plan (CMP).

2.1.7 Reporting

The environmental performance of the construction activities and the identification of auditing requirements will be assessed by Main Roads prior to and throughout the construction period. All documents pertaining to environmental management are required to be maintained though a system of document control, including the storage of hardcopy documents at site and archiving for handover to Main Roads upon contract completion.

Ministerial Condition 677 does not list specific reporting requirements, such as reporting of exceedance of threshold criteria. Reporting requirements specific to this VPRMP are outlined in Table 2.1 and Table 2.2. Reporting on compliance with the VPRMP will be undertaken annually as part of Ministerial Statement 677 Compliance Assessment Report (CAR).

If a non-conformance with this plan occurs, Main Roads will notify DWER Compliance Branch through their email address at compliance@dwer.wa.gov.au within seven days of becoming aware of the non-conformance. A report on the investigation (as per 2.1.5 above) of the non-conformance will be provided within 60 days of reporting the non-conformance.

2.2 Flora and vegetation management

Table 2-2 Vegetation and flora – Management actions and targets

EPA Objective: *To protect flora and vegetation so that biological diversity and ecological integrity are maintained*			
Outcome – No more than 130 ha of native vegetation is permanently removed as a result of the road construction (Ministerial Statement 677 Schedule 1, Schedule 2)			
Key environmental values: Native vegetation/fauna habitat			
Key impacts and risks: Clearing and excavation, indirect damage due to spoil storage, drainage realignment, weed spread			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/Evidence
Road Design			
Undertake design to minimise vegetation clearing and loss of fauna habitat, including: • Retain existing road alignment wherever possible while maintaining safety standards relevant to road design criteria • Minimise drainage clearing and structures where possible while maintaining design criteria for road safety and serviceability • Minimise clearing/earthworks to rocky outcrops and riverside habitat where possible to retain fauna habitat • Increase cut batter slopes where soils are suitable.	Less than 130 ha is cleared for the road formation and drainage. Less than 23 ha is cleared within the National Park	An environmental specialist will review relevant design elements at least once during the 85% design phase and discuss options to minimise the design footprint with design team if relevant.	Final Design Report will indicate steps/reviews taken to minimise clearing.
Road construction			
Undertake road construction planning and works to minimise vegetation clearing and damage as follows: • Road formation clearing and drainage will be retained within a 60 m (total width) zone around the existing Roebourne Wittenoom Road wherever possible (Stage 3b) and within a 60 m zone in Stage 4a • Minimise the need for a construction side-track, wherever possible • No construction side tracks will be allowed within the National Park unless agreed with DBCA/ Karratha PaW • All laydown, hardstand, site office and spoil/materials storage areas to be in existing cleared areas where possible	Less than 130 ha is cleared in total for roadworks and borrow pits Less than 23 ha is cleared within the National Park There is minimal detrimental indirect impact to adjacent vegetation. Any clearing outside the 60 m buffer zone within the National Park is to be	Ongoing monitoring by Site Supervisor. Proposed clearing areas will be checked by the Environmental Supervisor or Site Supervisor after being marked out and before clearing of each section commences. Areas will be again checked within 3 days of clearing to measure actual clearing.	Weekly clearing measurements/reporting to Construction Manager, Main Roads representative. Weekly internal report on any incidents of direct or indirect damage to vegetation.

EPA Objective: *To protect flora and vegetation so that biological diversity and ecological integrity are maintained*			
Outcome – No more than 130 ha of native vegetation is permanently removed as a result of the road construction (Ministerial Statement 677 Schedule 1, Schedule 2)			
Key environmental values: Native vegetation/fauna habitat			
Key impacts and risks: Clearing and excavation, indirect damage due to spoil storage, drainage realignment, weed spread			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/Evidence
• Access tracks for construction vehicles to be the minimum width required for safe vehicle usage • All clearing areas to be surveyed out and pegged/flagged prior to clearing and pegs/flagging to be left in place until the completion of construction in that zone • All clearing areas to be checked by the Environmental Supervisor or Construction Manager • Temporary fencing will be erected around vegetation to be retained in high value areas such as the mixed grassland PEC area and major creeklines • Any proposed areas of disturbance outside the surveyed area will be assessed by a qualified botanist and impacts on conservation significant plant species identified during the assessment (if any) within the National Park will be agreed with the Karratha PaW office • Areas cleared for materials storage, laydown or other requirements will be managed such that any stormwater runoff drains evenly off the site and does not create erosion or sedimentation to downslope areas. If necessary, temporary drainage channels will be constructed to direct water to creeklines or sump areas • Riverine vegetation which is at risk of loss from any threats as a result of the construction process will be considered for special protection. Such protection may include 'propping up' of bank areas supporting trees or shrubs through the use of rock or soil placement. • Dust lift will be minimised through the use of watering and the use of gravel mulch if required.	approved by the Karratha Parks and Wildlife office.		

EPA Objective: *To protect flora and vegetation so that biological diversity and ecological integrity are maintained*			
Outcome – No more than 130 ha of native vegetation is permanently removed as a result of the road construction (Ministerial Statement 677 Schedule 1, Schedule 2)			
Key environmental values: Native vegetation/fauna habitat			
Key impacts and risks: Clearing and excavation, indirect damage due to spoil storage, drainage realignment, weed spread			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/Evidence
Weed control			
Pre-construction • Undertake a survey for Ruby Dock, Kapok and other weeds listed under the *Biosecurity and Agriculture Management Act 2007* in the larger project area, including new and existing borrow pits and quarries to be used • The outcomes of the detailed assessment will be used as the basis for the development of a Weed Control and Monitoring Program. The Karratha PaW office will be consulted in regard to weed control within the National Park • If timing permits, infestations of Ruby Dock along the road corridor or adjacent tracks will be sprayed prior to construction commencement; otherwise, specific locations or zones will be marked on the ground and/or on relevant plans and construction drawings, for avoidance, treatment or disposal of the soil / weed remains within the area • Ground disturbing pre-construction activities will not be undertaken in areas known to support Ruby Dock. Where necessary, areas will be demarcated with temporary fencing or other markers and entry restricted • Staff carrying out pre-construction works will be provided with a suitable induction (including photographs) of Ruby Dock and other weeds of concern in order to avoid disturbing or spreading areas of infestation.	Locations of key weed species within the construction zones are known prior to construction commencement.	Pre-construction monitoring of weed presence by a qualified botanist.	Provision of a Weed Control and Monitoring Program to be prepared to the requirements of the Minister for Environment, on advice of EPA, CALM (DBCA) and Department of Agriculture (Department of Primary Industries and Regional Development) following a weed survey and prior to construction commencing.

EPA Objective: *To protect flora and vegetation so that biological diversity and ecological integrity are maintained*			
Outcome – No more than 130 ha of native vegetation is permanently removed as a result of the road construction (Ministerial Statement 677 Schedule 1, Schedule 2)			
Key environmental values: Native vegetation/fauna habitat			
Key impacts and risks: Clearing and excavation, indirect damage due to spoil storage, drainage realignment, weed spread			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/Evidence
Construction • Known areas of high priority weeds (such was Ruby Dock) will be quarantined and access prevented • Where roadworks directly impact known areas of high priority weeds, topsoil will be removed separately, heaps delineated and spoil disposed of as soon as possible through consultation with the Environmental Supervisor. It may be possible to use such soil within the fill areas beneath the road carriageway but this option will be carefully considered for risk of accidental spread • Any soil or materials imported onto the worksite will be from weed-free areas. Source areas will be checked by the on-site Environmental Supervisor • All vehicles and plant will arrive on site in a clean condition, i.e. without soil or vegetative material attached • Major plant and equipment which is moved into the National Park from other areas of the project will be cleaned of soil and vegetative material prior to crossing into the Park • All machinery and plant equipment moving from weed infested areas to areas free of weeds must always be cleaned down in order to minimise the spread or introduction of weeds • Topsoil spoil from the construction works will be stored on weed-free areas and will be reused as close as possible to its source where possible • Spoil heaps will be monitored for weed growth and weed spraying will be carried out if required	No new weed species are introduced into the project area and adjoining areas. Existing key weed species infestations are not extended within the works areas. Pre-existing weed infestations are reduced wherever possible through active management. No Ruby Dock is present within road corridor or borrow areas at completion of works/monitoring period	Annual, seasonal (within 6 weeks of significant rainfall), monitoring of key weeds within the 60 m construction zone, in borrow pits and access road and until completion criteria have been achieved. Environmental Supervisor to perform ongoing, weekly or as required, monitoring of construction equipment, topsoil heaps, spoil dumps and drainage areas for key weed presence.	

EPA Objective: *To protect flora and vegetation so that biological diversity and ecological integrity are maintained*			
Outcome – No more than 130 ha of native vegetation is permanently removed as a result of the road construction (Ministerial Statement 677 Schedule 1, Schedule 2)			
Key environmental values: Native vegetation/fauna habitat			
Key impacts and risks: Clearing and excavation, indirect damage due to spoil storage, drainage realignment, weed spread			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/Evidence
• Weed infested spoil will not be used in rehabilitation works but will be disposed to a pit site and covered with a minimum of 400 mm of clean spoil • Outbreak or spread of key weed infestations will be removed by hand (Ruby Dock) or sprayed with suitable herbicides as soon as they are identified • Woody weed infestations (*Acacia farnesiana, Parkinsonia*) will be cut to a stump and painted with herbicide. Cut material will be bagged and removed from site to an approved landfill or buried to a depth of at least 1 m.			
Fire control			
• All plant and equipment will be maintained in a safe condition to minimise risks of sparking • Underbody engine guards will be regularly checked for build-up of vegetation and cleaned as necessary • Water carts will be available on site at all times • Fire fighting equipment will be available at all times • No campfires will be permitted • Construction staff, visitors and contractors will be discouraged from throwing cigarette butts on the ground and educated as to the risks of fire.	No fires are caused by construction activities.	Weekly monitoring and vehicle checks.	Any fires caused as a result of the construction works will be reported to PaW and the Shire of Ashburton. This will include fire ignition source and management activities.
Borrow pit design and management			

EPA Objective: *To protect flora and vegetation so that biological diversity and ecological integrity are maintained*			
Outcome – No more than 130 ha of native vegetation is permanently removed as a result of the road construction (Ministerial Statement 677 Schedule 1, Schedule 2)			
Key environmental values: Native vegetation/fauna habitat			
Key impacts and risks: Clearing and excavation, indirect damage due to spoil storage, drainage realignment, weed spread			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/Evidence
• No borrow pits are to be established in the Millstream National Park under this plan. If borrow pits are required within the National Park, this plan will need to be amended following consultation and agreement with PaWAny pits that are required outside the original 1 km survey zone will be surveyed by a botanist for the presence of conservation significant flora • If conservation significant flora is identified, a pit management plan will be developed in order to minimise the risk to, or loss of such species • Where possible, existing tracks or other cleared zones will be used as access tracks to borrow pits • Any pits and new tracks to them will be designed to minimise disturbance to vegetation and will be placed such that there is no direct *visual* link from the new KTP • For pits that will be developed to a size of >1 ha, the pit will be designed such that strips of native vegetation at least 10 m wide are retained between the 'cells' of the pit • Pits will be designed and contoured, to minimise water ponding within them • Pits will not be developed in areas of weed infestation, particularly Ruby Dock. Where weed infestation is close to a proposed pit area, detailed mapping of the infested area will be carried out prior to pit development, and access to the area will be restricted using temporary fencing and signage	Borrow pits are designed and managed so as to minimise vegetation clearing and impacts on biodiversity. Borrow pits are designed and managed so as to maximise their rehabilitation success.	Weekly monitoring during pit operation by Environmental Supervisor to ensure management actions are appropriately implemented.	Weekly clearing measurements/reporting to Construction Manager and Construction Superintendent. Any new records of, or impacts to, conservation significant flora will be reported to PaW Karratha office and the Rare Flora Report Form.

EPA Objective: *To protect flora and vegetation so that biological diversity and ecological integrity are maintained*			
Outcome – No more than 130 ha of native vegetation is permanently removed as a result of the road construction (Ministerial Statement 677 Schedule 1, Schedule 2)			
Key environmental values: Native vegetation/fauna habitat			
Key impacts and risks: Clearing and excavation, indirect damage due to spoil storage, drainage realignment, weed spread			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/Evidence
• Vegetation will be stripped off the pit area and any access tracks and retained in a windrow not more than 1.5 m deep • Topsoil will be stripped to a depth of approximately 75 mm deep and stored in a windrow parallel to the stripped vegetation and not more than 1.5 m deep • Unusable material will be stored separately and retained for pit shaping during rehabilitation • Large rocks will be left *in situ*, broken down where possible, or retained for rehabilitation • A single access track will be maintained to each pit. • Pits may generally only be used for dumping of clean fill or rock waste • A small number of pits may be designated for dumping of weed infested topsoil or other weed infested material. This material will be buried to a depth of at least 400 mm under clean fill • All rubbish or construction equipment will be removed from pits following construction.			

2.3 Rehabilitation

Table 2-2 Rehabilitation– Management Actions and Targets

EPA Objective: To restore vegetation and habitat by rehabilitation of works areas			
Outcome – Re-establish pre-existing native vegetation on cleared areas not required for ongoing road usage			
Key environmental values: Native vegetation and fauna habitat in good or better condition			
Key impacts and risks: Failure of rehabilitation due to poor management or seasonal conditions; spread of key weed species through topsoil movement			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/Evidence
Rehabilitation planning			
• Rehabilitation works will be planned as part of initial clearing works in order to identify: – Requirements for suitable plant and equipment – Suitable topsoil for re-use – Suitable areas for soil and vegetation storage – The need for seed collection.	All areas cleared during construction and not required for the ongoing operation of the road will be revegetated. To provide replacement vegetation cover over disturbed areas, where revegetation is feasible. This vegetation cover will recreate the pre-existing vegetation, as closely as possible, in both form and function. Rehabilitation will be undertaken to attain success criteria (detailed in section 0).	Ongoing review and monitoring by Environmental Supervisor.	Weekly reporting to Construction Manager and Construction Superintendent.
Vegetation and topsoil stripping and storage			
• Native vegetation in the areas to be cleared will be stripped off using a bulldozer with rake blade (or similar) and stockpiled for re-use • Larger shrubs and trees will be rolled to break them up and all vegetation will be stored in heaps or windrows, no greater than 1.5 m high, on the external edge of the cleared zone	All suitable topsoil will be removed to the correct depth and stored for re-use in rehabilitation.	Ongoing review and monitoring by Environmental Supervisor.	Weekly reporting to Construction Manager and Construction Superintendent.

EPA Objective: To restore vegetation and habitat by rehabilitation of works areas			
Outcome – Re-establish pre-existing native vegetation on cleared areas not required for ongoing road usage			
Key environmental values: Native vegetation and fauna habitat in good or better condition			
Key impacts and risks: Failure of rehabilitation due to poor management or seasonal conditions; spread of key weed species through topsoil movement			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/Evidence
• Vegetation storage will not occur on areas containing high risk weeds such as Buffel grass, Ruby dock or Kapok, or in drainage lines • Topsoil will be stripped using a bulldozer to a depth of 75 mm and spread dry where possible • Topsoil from areas containing high risk weeds or high weed abundance will be buried to a depth of at least 400 mm in old pits or in embankments • Topsoil will be stored in heaps or windrows adjacent to the edge of the cleared zones. Heaps will be no greater than 1.5 m high or 3 m in width. Stored topsoil is to be kept dry where practicable • Topsoil will not be stored on or near areas containing high risk weeds such as Buffel grass, Ruby dock or Kapok, or in drainage lines.			
Ground preparation			
• Soil in cut zones and pits will be shaped to reduce steep slopes and to allow drainage to follow its natural course. Created landforms will mimic, where possible, the surrounding area • Where natural soils have been removed or compacted, the ground will be ripped along the contour to a depth of up to 400 mm, at 500 mm width intervals. This will promote water infiltration, reduce the risk of erosion, help retain respread topsoil and vegetation and create looser soil areas for plants to grow into	All land outside the road surface and drains impacted by construction works will be reshaped where possible to blend in with natural landforms	Ongoing review and monitoring by Environmental Supervisor.	Weekly reporting to Construction Manager and Construction Superintendent.

EPA Objective: To restore vegetation and habitat by rehabilitation of works areas			
Outcome – Re-establish pre-existing native vegetation on cleared areas not required for ongoing road usage			
Key environmental values: Native vegetation and fauna habitat in good or better condition			
Key impacts and risks: Failure of rehabilitation due to poor management or seasonal conditions; spread of key weed species through topsoil movement			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/Evidence
• In areas of shallow, rocky soils, compacted or hard exposed soils will be scarified or otherwise loosened to promote water retention and provide a base for vegetation establishment.			
Vegetation and topsoil respread			
• Topsoil will be applied to areas requiring rehabilitation as soon as reasonably practical, in order to ensure the best possible viability of seeds in the soil • Topsoil will be respread dry (where possible) over ripped and contoured cut and fill batters as well as areas cleared for access or working • Topsoil will be respread as evenly as practicable to an optimum depth of 50 mm • Vegetation will be respread over the topsoil as evenly as possible.	All stored topsoil and vegetation is re-used on areas planned for rehabilitation.	Ongoing review and monitoring by Environmental Supervisor.	Weekly reporting to Construction Manager and Construction Superintendent.
Seeding			
• Seeding will only be used as a supplementary process where suitable or sufficient topsoil is not available • Any seeds used in rehabilitation will be sourced from the local provenance (i.e. IBRA sub-region – not the general Pilbara region) • A seed collection agreement and schedule will be developed in consultation with PaW when required • Seed lists will be based on species previously recorded in the area and to the satisfaction of PaW • Soil preparation will be as for topsoiling and vegetation respread (i.e. shaping, ripping and scarifying as appropriate)	A suitable seed mix will be developed, procured and used to supplement possible lack of suitable topsoil in some areas.	Ongoing review and monitoring by Environmental Supervisor.	Weekly reporting to Construction Manager and Construction Superintendent.

EPA Objective: To restore vegetation and habitat by rehabilitation of works areas			
Outcome – Re-establish pre-existing native vegetation on cleared areas not required for ongoing road usage			
Key environmental values: Native vegetation and fauna habitat in good or better condition			
Key impacts and risks: Failure of rehabilitation due to poor management or seasonal conditions; spread of key weed species through topsoil movement			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/Evidence
• Seed will be spread at a rate of at least 3 kg per hectare and will be bulked up with smoked water vermiculite • The seed mix will contain at least 15 readily germinable species, with a mix of perennial and ephemeral species local to the particular area.			
Weed control			
• Stockpiles of spoil or topsoil which are found to contain weed species will not be respread for rehabilitation purposes. Such stockpiles will be buried under clean fill in borrow areas or fill sections to a depth of at least 400 mm • Weed infestation that appears following topsoil respread or other revegetation works will be targeted for herbicide or other control as applicable • Areas of weed infestation will be mapped using a GPS and marked on the ground if applicable • Any outbreaks of Ruby Dock will be treated as soon as possible, mapped, and revisited at regular intervals to ascertain the success of control treatments	No new weed species are introduced into the project area and adjoining areas. Existing key weed species infestations are not extended within the works areas. Pre-existing weed infestations are reduced wherever possible through active management.	Ongoing monitoring by Environmental Supervisor.	Weekly reporting to Construction Manager and Construction Superintendent. Outbreaks of Ruby Dock or other key weed species (*Vachellia farnesiana*) within or adjacent to borrow areas will be reported to PaW within 1 month of identification
• **Pit rehabilitation**			
• Pits will be designed and contoured to minimise water ponding within them. • The pit sides will be shaped and levelled to create batters no steeper than 1 in 4 and, where possible, 1 in 6 • The base and slopes of the pit will be deep ripped along the contour to a depth of at least 300 mm with the riplines at 500 mm intervals	All pit areas not required for ongoing maintenance and repair will be rehabilitated.	Ongoing review and monitoring by Environmental Supervisor.	Weekly reporting to Construction Manager and Construction Superintendent.

EPA Objective: To restore vegetation and habitat by rehabilitation of works areas			
Outcome – Re-establish pre-existing native vegetation on cleared areas not required for ongoing road usage			
Key environmental values: Native vegetation and fauna habitat in good or better condition			
Key impacts and risks: Failure of rehabilitation due to poor management or seasonal conditions; spread of key weed species through topsoil movement			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/Evidence
• Topsoil will be replaced to cover the pit as evenly as possible and to a maximum depth of 100 mm • Cleared vegetation will be respread evenly over the pit, along with any other vegetation which has been stored from other clearing areas in a similar vegetation type • If the pit will not be required in the future the access track will be ripped and respread with topsoil and cleared vegetation as above • Access to the completed pit will be restricted using fencing or large rocks where applicable.			
• **Reference site (for rehabilitation monitoring)**			
• For each material pit or other area to be rehabilitated a reference site is to be established for comparison against the rehabilitation. • This may either be a baseline survey of the pit vegetation prior to clearing, or a reference site within 100m of the clearing area. • Vegetation in the reference site must not be of lower quality than the site being disturbed	All rehabilitation areas are to have a reference site	See 2.3.2	Baseline survey or monitoring report of reference site

2.3.1 Suggested rehabilitation success criteria

The success of the rehabilitation program will be measured by a series of criteria. The time frames for measurement of the criteria may be dependent upon seasonal conditions. The success criteria are listed in Table 2-3.

Table 2-3 Success criteria

Item	Criteria
Landforms	No erosion gullies >500 mm deep within rehabilitation area No placed rocks >1 m in diameter exposed at the surface
Weeds	No Ruby Dock present No new weed species present (compared to reference site) Weed cover within rehabilitation area < weed cover at reference site
Vegetation cover	>50% native vegetation cover
Native species diversity	>60% species diversity of reference site

2.3.2 Rehabilitation monitoring

Monitoring of all rehabilitated areas will be undertaken as follows:

- At 6-monthly intervals for 1 year following completion of construction
- Annually after year 1 for 3 years or until completion criteria have been met.

Monitoring will be undertaken by a qualified and experienced botanist and will include the following:

- The use of a monitoring assessment pro-forma based on measuring the compliance criteria
- The use of fixed photographic points for a range of revegetated areas including borrow pits, roadside edges, drainage lines, creekline vegetation
- An assessment of weed species and densities where they are identified.
- An assessment of erosion, sedimentation or other ground disturbing impacts
- Mapped GPS points and polygons to indicate areas of weed infestation, rehabilitation failure or significant erosion.

2.3.3 Suggested contingency measures

In the event that rehabilitation monitoring indicates that completion criteria are unlikely to be met, due to lack of native vegetation growth within the first 1 or 2 years post-construction or that erosion or weed growth is significant, the following contingency measures will be implemented, where applicable:

Soil Erosion/Scour

- Erosion gullies of deeper than 500 mm should be filled with stable soil or rock material
- The source of the scour should be investigated and mitigated where possible through drainage amendments.

Weed Infestation

- The Weed Control and Monitoring Program should be amended to include more frequent weed control activities or changes in weed control techniques as relevant to the issue.

Lack of native plant germination/establishment

- Where areas > 20 m x 20 m show minimal signs of plant growth or establishment, options for re-spread of local topsoil or seeding with native plant species should be investigated and implemented
- Where vegetation in borrow pits does not establish as per the completion criteria consideration should be given to providing additional topsoil or overburden on the pit base or sides to provide a better plant substrate. Native plant seed and/or topsoil will also be added.

3. Adaptive management

The adaptive management approach aims to reduce impacts by embedding a cycle of monitoring, reporting and implementing change (where required). This document applies the principles of adaptive management through monitoring, corrective actions and implementing changes. Adaptive management has been considered throughout this document, and the key adaptive management processes are described below.

3.1 Environmental monitoring and corrective actions

Internal monitoring of the environmental aspects of the road construction will occur throughout the project, through the Environmental Supervisor (or their delegate). Any non-conformances with this VPRMP will be discussed with the Construction Manager/Construction Superintendent and rectified or mitigated as soon as possible to ensure minimal ongoing environmental harm. Where an exceedance of clearing has occurred in a local area, steps will be taken to ensure the overall clearing does not exceed the approved amount. Relevant procedures will be amended/updated as necessary and inductions and other workforce communication will be undertaken in a timely manner to minimise the risk of re-occurrences.

3.2 EMP Revision

The VPRMP is intended to be dynamic and may be updated to reflect changes in management practices and the natural environment with time. This will also allow flexibility to respond new environmental impacts and adopt new technologies / management measures.

Amendments to management actions will be completed on an as needs basis. This will include revision / amendment of management actions that are not achieving the desired outcomes, environmental monitoring identifying additional impacts and management actions, changes to relevant legislation or improvements to practices to achieve a greater environmental outcome.

Changes to the management actions or targets of this CMP will require the approval of the EPA Services prior to those changes being implemented.

Any changes will be reported through the Ministerial Statement CAR. Any key updates required to the VPRMP regarding aspects relating to ecological aspects within the National Park will be discussed with the Karratha PaW branch in the first instance in order to obtain the latest information available and discuss management expectations within the Park. Issues which may be amended over the course of the construction could relate to:

- Identification of Priority flora species within or immediately adjacent to the construction zone or borrow pits
- Identification of key weed species within or immediately adjacent to the construction zone or borrow pits
- Damage of vegetation in creeklines due to heavy seasonal rains
- Issues with rehabilitation due to seasonal constraints, lack of topsoil, lack of available seed.

3.3 Audits

Internal and external audits will be undertaken as per the Main Roads contract schedule and the results reported back to the Environmental Supervisor where relevant, in order for them to undertake corrective actions.

4. Stakeholder consultation

In preparing this VPRMP the following consultation specific to the preparation of the Management Plan has been undertaken. The consultation table below is an ongoing record of consultation undertaken and will be updated as consultation relating to environmental management occurs.

Table 4-1 VPRMP stakeholder consultation record

Stakholder/ contact person	Date	Type of consultation	Summary of communication	Comments received
PaW branch (Michelle Corbellini)	Nov 2015	Telephone	Discussion regarding weed information for Stage 3	Ensure an updated weed survey is undertaken.

5. References

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https://projects.ghd.com/oc/WesternAustralia1/stage4akarrathatompr/Delivery/Documents/6136933_REP_Vegetation Protection and Rehabilitation Management Plan KTP_Rev1.docx

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Appendix J. D20#630068 05 20200707 KTP CAR Report Appendix E Stage 3 and 4a Weed Control and Management Plan

Weed Control and Management Program

Karratha Tom Price Road Stage 3 and 4a

December 2018

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Contents

1 BACKGROUND 5
2 PROJECT LOCATION 5
3 OBJECTIVES AND KPIS 5
4 ACCOUNTABILITIES 6
5 TRAINING & AWARENESS 6
6 MAPPING & MONITORING OF WEED PRESENCE 6
6.1 Pre-Construction 6
6.2 Construction 8
6.3 Maintenance Phase 8
7 WEED CONTROL AND MANAGEMENT PRE-CONSTRUCTION, DURING AND POST CONSTRUCTION 9
8 MANAGEMENT PLAN PROVISIONS 16
8.1 Management systems and implementation 16
8.1.1 Monitoring 16
8.1.2 Environmental incidents / non-compliances 16
8.1.3 Reporting 16
9 ADAPTIVE MANAGEMENT 16
9.1 Environmental monitoring and corrective actions 16
9.2 WCMP Revision 17
9.3 Audits 17
10 STAKEHOLDER CONSULTATION 17
11 REFERENCES 18
12 APPENDIX 1 WEED REGISTER FORM 19
13 APPENDIX 2 WEED IDENTIFICATION PHOTOS 21
14 APPENDIX 3 WEED LOCATION MAPS 37

1 BACKGROUND

Main Roads Western Australia (Main Roads) is currently undertaking a staged upgrade of the Karratha-Tom Price Road (KTP project) which is located to the south of Karratha through to the existing Nanutarra-Munjina Road, north of Tom Price. The proposed road will generally follow close to the Pilbara Iron Railway and the existing Pilbara Iron Railway access road.

The KTP project was initially proposed via a Consultative Environmental Review (CER) document in 2003. The CER included a total of 245 kilometre (km) of proposed new or upgraded road from the North West Coastal Highway to the Nanutarra-Munjina Road, in three stages (2, 3 and 4). The environmental approval of the project was given in April 2005 under Assessment 1244 (Bulletin 1159) and through Ministerial Statement 677.

Construction of the 89 km of Stage 2 was commenced in 2006 by the Millstream Link Alliance and completed in 2008. This work was undertaken using a series of approved management plans as required under Statement 677. The management plans were approved by relevant authorities including the then Department of Environment, Water and Rivers Commission and Department of Indigenous Affairs, with advice from Department of Conservation and Land Management (CALM). Adherence to the plans was audited internally, externally and by CALM/Department of Environment Conservation, particularly in relation to the section of Stage 2 which traversed the Millstream Chichester National Park.

The initial vegetation clearing approval was for 574 hectare (ha) (474 ha for the road formation and 100 ha for borrow pits), with 110 ha within the National Park. A Section 46C approval increased the amount of land approved for clearing within the National Park to 145 ha (to a project total of 609 ha). Total clearing undertaken for Stage 2 was 445 ha, with 122 ha within the National Park.

This weed control and management plan is specific to Stage 3 and 4a of this road project and has been prepared in accordance with Condition 6-1(5) of Ministerial Statement 677.

2 PROJECT LOCATION

Stages 3 and 4a of the KTP cover a distance of approximately 93 km. These Stages start at the junction of the Pilbara Iron Railway line and the Roebourne Wittenoom Road and end approximately 7 km south of the Fortescue River crossing. Stage 3 of the road alignment (58 km) closely follows the Roebourne Wittenoom Road until the Pilbara Iron Railway deviates from this road towards Tom Price. Stage 4a of the project (35 km) runs south from the Roebourne Wittenoom Road adjacent to the existing railway access road. Approximately 14.6 km of the project area (Stage 3a) occurs within the Millstream Chichester National Park, primarily within a designated road reserve.

The road will consist of a 7 m wide two-lane seal with 1 m wide shoulders and associated cut or fill batters, table drains and offshoot drains. Stages 3 and 4a will incorporate approximately 42 floodways and 61 culverts. The approximate width of the road construction, within a flat area, will be 19 m to 20 m, including table drains. Note that this will increase in areas of cut and fill.

3 OBJECTIVES AND KPIS

The objectives of the weed control program are to:

1 Prevent the introduction of new weed species into the project area and adjoining areas.
2 Ensure that existing weed infestations are not extended within the work area.
3 Reduce weed infestations wherever possible through active management.
4 Minimise the risk of weed infestations developing in rehabilitated areas.

These objectives will be measured by the following Key Performance Indicators (KPIs):
1 Measurement of DBCAs satisfaction with Ruby Dock control during the construction period.
2 Measurement of Ruby Dock Control in the seven (7) year maintenance period.
1 Measurement of rehabilitation compliance in the seven (7) year maintenance period eg. percent native vegetation cover, number of species, weeds.

4 ACCOUNTABILITIES

Environmental Representative / Manager accountable for:

- Ensuring the weed control program is implemented as planned
- Ensuring the outcomes of the weed control program meet the satisfaction of DBCA.
- Planning & implementation of the weed control program during the construction phase.

Construction Superintendent accountable for:

- Providing adequate resources
- Planning activities to ensure the timely implementation of the weed control program.

5 TRAINING & AWARENESS

Staff carrying out construction works will be provided with a suitable induction (including photographs) of Ruby Dock and other weeds of concern in order to recognise relevant weeds and assist in reporting and control. Weeds will be discussed at Pre-Start and Toolbox meetings where appropriate.

6 MAPPING & MONITORING OF WEED PRESENCE

6.1 Pre-Construction

ecologia Environment (ecologia) was commissioned by Main Roads Western Australia (MRWA) to conduct a baseline weed survey of areas in July 2018 of proposed material pits and road widening associated with the upgrade of the Karratha-Tom Price Road and the Pannawonica-Millstream Road.

Twelve weed species were recorded within the stage 3 and 4a alignment. *Aerva javanica* was recorded only from the road verge in the northern section of the area (Figure 6.3 in appendix 2). *Bidens bipinnata* was recorded in low abundance from two locations in the south (Figure 6.13 in appendix 2). Extensive populations of *Cenchrus ciliaris* and *C. setiger* were present along road verges, particularly in the northern and southern sections of the proposed road (Figure 6.2-6.3 and Figure 6.14-6.15 in appendix 2), but both species were recorded sporadically along the entirety of the proposed road. *Echinochloa colona*, *Flaveria trinervia, Melochia pyramidata*, and *Sonchus oleraceus* were recorded in low abundance from a degraded creek (Figure 6.13), and more extensive populations of *Cynodon dactylon, Malvastrum americanum* and *Vachellia farnesiana* were primarily recorded from the same creek.

Aerva javanica was most abundant along the disturbed road verge of Roebourne-Wittenoom Road in the north-western section of the study area. It was also recorded in low abundance from an undisturbed rocky outcrop at site PM02 and from a single location adjacent to the Tom Price Railway Road. A total of 226 individuals were recorded within the study area from *25 point locations.*

Weeds were rarely recorded from undisturbed sites where vegetation condition was Excellent (primarily stony plains and low rocky hills) and undisturbed creeks and drainage lines.

Across the study area, weeds tended to be almost entirely restricted to disturbed roadsides, tracks, and existing pits, disturbed creeks and drainage lines, and floodplains and gilgai with cracking clay soils.

All species identified are listed as Permitted -s11 on the Western Australian Organism List (DPIRD 2018), and are not Weeds of National Significance. All species have a 'high' ecological impact rating and 'rapid' invasiveness rating in the Pilbara according to the Weed Prioritisation Process (DPaW 2013) (Table 1), except for *F. trinervia* and *M. pyramidata* which are not rated.

Distribution mapping for each species is shown in Appendix 3. Representative photographs of each species and significant populations are shown in Appendix 2.

Table 1: Weed species recorded within the stage 3 and 4a alignment

Species	Family	Habitat/s within the study area	Rating	Ecological impact	Invasiveness	Individuals recorded within study area (number of points)	Total area mapped (ha)
Aerva javanica (kapok bush)	*Amaranthaceae*	Disturbed roadsides, rocky outcrops	Permitted – s11	High	Rapid	226 (25)	–
Bidens bipinnata (bipinnate beggartick)	*Asteraceae*	Plains, clay soils	Permitted – s11	Unknown	Rapid	46 (3)	–
Cenchrus ciliaris (buffel grass)	*Poaceae*	Stony plains, cracking clays, creeks, drainage lines, disturbed roadsides	Permitted – s11	High	Rapid	464 (75)	29.17
Cenchrus setiger (Birdwood grass)	*Poaceae*	Stony plains, cracking clays, creeks, drainage lines, disturbed roadsides	Permitted – s11	High	Rapid	263 (46)	10.56
Cenchrus spp.	*Poaceae*	As above				6 (3)	260.77
Cynodon dactylon (couch grass)	*Poaceae*	Creeks	Permitted – s11	High	Rapid	–	11.08
Echinochloa colona (awnless barnyard grass)	*Poaceae*	Creeks	Permitted – s11	High	Rapid	6 (2)	–
Flaveria trinervia (speedy weed)	*Asteraceae*	Creeks	Permitted – s11	Unrated		1 (1)	–
Malvastrum americanum (spiked malvastrum)	*Malvaceae*	Cracking clays, gilgai, clay soils, creeks	Permitted – s11	High	Rapid	2 (2)	343.31
Melochia pyramidata (pyramid flower)	*Malvaceae*	Creeks	Permitted – s11	Unrated		34 (3)	–
Passiflora foetida var. *hispida* (stinking passion flower)	*Passifloraceae*	Creeks, drainage lines, disturbed areas	Permitted – s11	High	Rapid	5 (4)	–
Sonchus oleraceus (common sowthistle)	*Asteraceae*	Creek	Permitted – s11	Low	Rapid	1 (1)	–
Vachellia farnesiana (mimosa bush)	*Fabaceae*	Cracking clays, gilgai, clay soils, creeks	Permitted – s11	High	Rapid	150 (49)	425.33

6.2 Construction

On an ongoing basis any locations of Ruby Dock will be monitored within the stage 3 alignment and will be removed by hand when found.

Documented and periodic inspections of haul roads & minor roads, water storage dams, wash down facilities, topsoil stockpiles, workshop, and refuelling areas address the presence of weeds. *Ad hoc* inspections of areas outside of the road construction zone are undertaken to check for any outbreaks of Ruby Dock or Kapok. Areas of infestation will be recorded.

Any new locations identified during construction will be recorded in the Weed Register Form (Appendix 1) and mapped. Contractors are to report any declared plant species to the Main Roads Construction Superintendent within 48 hours. The Construction Superintendent is to report all Declared weeds to the Main Roads Environment Officer, who will report the weeds to the Department of Primary Industries and Regional Development as per s26 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act)[1].

Areas of weed infestation will be mapped using a GPS and marked on the ground if applicable. All weed information will be mapped using GIS, and a copy of the data provided to DBCA at least annually, and at the end of the construction phase. The effectiveness of the weed control programme will be communicated to the Main Roads Environment Officer annually.

Known Ruby Dock infestations will be revisited following major rain periods to check for regrowth, control outbreaks and evaluate effectiveness of control.

Infestation of weeds, particularly *Aerva javanica* (Kapok) will not be managed through slashing, however will be managed through spraying of roadside vegetation and weeds.

Annual, seasonal (within 6 weeks of significant rainfall), monitoring of key weeds within the 60 m construction zone, in borrow pits and access roads will be completed until the completion criteria (as stated in the Vegetation Protection and Rehabilitation Management Plan (GHD 2018)) have been achieved.

6.3 Maintenance Phase

The maintenance period continues for 7 years following construction completion. Monitoring and control for weed infestations will involve annual inspections and mapping of weed presence and spraying or hand removal as appropriate. All areas previously disturbed by the construction process will be inspected. All information on Ruby Dock infestations will be provided to DBCA annually or as requested by them.

[1] Refer to https://www.legislation.wa.gov.au/legislation/statutes.nsf/main_mrtitle_2736_homepage.html

7 WEED CONTROL AND MANAGEMENT PRE-CONSTRUCTION, DURING AND POST CONSTRUCTION

Table 2: Weed management actions pre, during and post construction

Management Action	Monitoring/Maintenance Program	Management Target / Response Action	Responsible Person	Completion Timeframe	Documentation/Evidence
Preconstruction					
Remove or kill any weeds growing in project area that are likely to spread and result in environmental harm to adjacent areas of native vegetation	Pre-construction	Locations of key weed species within the construction zones are known prior to construction commencement	Environmental Management Representative - Contractor	Prior to clearing commencing	Weed register form
Site induction and training will be undertaken to minimise the spread of weeds during construction	Pre-construction / Construction	Inductions and training	Environmental Management Representative - Contractor	Prior to clearing commencing	Inductions and training records
If timing permits, infestations of Ruby Dock along the road corridor or adjacent tracks will be sprayed prior to construction commencement	Pre-construction	Locations of key weed species within the construction zones are known prior to construction commencement	Environmental Management Representative - Contractor	Prior to clearing commencing	Weed register form
Known areas of high priority weeds (such was Ruby Dock) will be quarantined and access prevented	All Stages	Locations of weed species within the construction zones are known prior to construction commencement	Environmental Management Representative - Contractor	ongoing	Weed register form
All vehicles and plant will arrive on site and leave site in a clean condition, i.e. without soil or vegetative material attached.	Pre-construction	Inspections of vehicles and plant	Environmental Management Representative - Contractor	ongoing	Inspection records
Ground disturbing pre-construction activities will not be undertaken in areas known to support Ruby Dock. Where necessary, areas will be demarcated with temporary fencing or other markers and entry restricted	Pre-construction	Locations of weed species within the construction zones are known prior to construction commencement	Environmental Management Representative - Contractor	Prior to clearing commencing	Weed register form
Construction					
Any machinery used in the removal of weed-infested topsoil will be cleaned down before and between operations to prevent the introduction and spread of weeds outside weed infested areas	Construction	Inspections of vehicles and plant No new weed species are introduced into the project area and adjoining areas Existing key weed species infestations are not extended within the works areas	Environmental Management Representative - Contractor	Completion of construction	Inspection records

Spoil heaps will be monitored for weed growth and weed spraying will be carried out if required	All stages	Environmental Supervisor will monitor spoil heaps Weed spraying will be carried out if required	Environmental Management Representative - Contractor	ongoing	Weed register form
Weed infested spoil will not be used in rehabilitation works but will be disposed to a pit site outside the national park and covered with a minimum of 400 mm of clean spoil	All stages	No new weed species are introduced into the project area and adjoining areas No Ruby Dock is present within road corridor or existing borrow areas at completion of works/monitoring period	Environmental Management Representative - Contractor	ongoing	Weed register form
Any soil or materials imported onto the worksite will be from weed-free areas	All stages	Source areas will be checked by the on-site Environmental Supervisor Inspections of vehicles and plant No Ruby Dock is present within road corridor or existing borrow areas at completion of works/monitoring period	Environmental Management Representative - Contractor	ongoing	Inspection records
Machinery and plant are cleaned down in designated areas to prevent the introduction and spread of weeds	Post - Construction	Inspections of vehicles and plant	Environmental Management Representative - Contractor	ongoing	Inspection records
Where roadworks directly impact known areas of high priority weeds, topsoil will be removed separately, heaps delineated and spoil disposed of as soon as possible through consultation with the Environmental Supervisor. It may be possible to use such soil within the fill areas beneath the road carriageway but this option will be carefully considered for risk of accidental spread.	Construction	No new weed species are introduced into the project area and adjoining areas Existing key weed species infestations are not extended within the works areas No Ruby Dock is present within road corridor or existing borrow areas at completion of works/monitoring period Weed spraying will be carried out if required Pre-existing weed infestations are reduced wherever possible through active management	Environmental Management Representative - Contractor	Completion of construction	Weed register form
Weed contaminated topsoil stockpiles shall be quarantined from uncontaminated / clean topsoil stockpiles, clearly signed in the field and identified on a site plan	Construction and Post - Construction	Environmental Supervisor shall clearly sign in the field and identify on a site plan	Environmental Management Representative - Contractor	ongoing	Maps of site plan and signage

Report suspected new weed locations	All stages	Periodic inspections of haul roads & minor roads, water storage dams, wash down facilities, topsoil stockpiles, workshop, and refuelling areas address the presence of weeds Weed spraying will be carried out if required Pre-existing weed infestations are reduced wherever possible through active management No new weed species are introduced into the project area and adjoining areas Existing key weed species infestations are not extended within the works areas	Environmental Management Representative - Contractor	ongoing	Weed register form
Outbreak or spread of key weed infestations will be removed by hand (Ruby Dock) or sprayed with suitable herbicides as soon as they are identified	All stages	Periodic inspections of haul roads & minor roads, water storage dams, wash down facilities, topsoil stockpiles, workshop, and refuelling areas address the presence of weeds Weed spraying will be carried out if required	Environmental Management Representative - Contractor	ongoing	Weed register form
Any outbreaks of Ruby Dock will be treated as soon as possible, mapped, and revisited at regular intervals to ascertain the success of control treatments	All stages	No new weed species are introduced into the project area and adjoining areas No Ruby Dock is present within road corridor or existing borrow areas at completion of works/monitoring period Weed spraying will be carried out if required Pre-existing weed infestations are reduced wherever possible through active management	Environmental Management Representative - Contractor	ongoing	Weed register form
Ensure no weed affected soil, mulch, fill or other material is brought into the cleared area	Construction	Source areas will be checked by the on-site Environmental Supervisor	Environmental Management Representative - Contractor	Completion of construction	Inspection records

		Inspections of vehicles and plant Weed spraying will be carried out if required Pre-existing weed infestations are reduced wherever possible through active management			
Vegetation storage will not occur on areas containing high risk weeds such as Buffel grass, Ruby dock or Kapok, or in drainage lines	All stages	Environmental Supervisor will ensure vegetation storage areas will be checked prior to storing that they're not located near any mapped high risk weed areas Weed spraying will be carried out if required Pre-existing weed infestations are reduced wherever possible through active management	Environmental Management Representative - Contractor	ongoing	Inspection records
Woody weed infestations will be cut to a stump and painted with herbicide. Cut material will be bagged and removed from site to an approved landfill or buried to a depth of at least 1 m.		No new weed species are introduced into the project area and adjoining areas Existing key weed species infestations are not extended within the works areas Pre-existing weed infestations are reduced wherever possible through active management	Environmental Management Representative - Contractor	ongoing	Weed register form
Post Works					
Monitor compliance with the CEMP	Post - Construction	Environmental Supervisor to complete regular compliance inspections with CEMP	Environmental Management Representative - Contractor	ongoing	Compliance inspections
Weed infestation that appear following topsoil respread or other revegetation works will be targeted for herbicide or other control as applicable	Construction / Post - Construction	Monitoring will be undertaken by a qualified and experienced botanist to identify weeds during rehabilitation monitoring Outbreaks of Ruby Dock or other key weed species within or adjacent to borrow areas will be reported to	Environmental Management Representative - Contractor - Contractor	ongoing	Rehabilitation report and/or Weed register form

		PaW within 1 month of identification			
Weed monitoring and ongoing control of significant weeds, as required	Post - Construction	Annual, seasonal (within 6 weeks of significant rainfall), monitoring of key weeds within the 60 m construction zone, and access road and until completion criteria have been achieved for stage 3a A combination of slashing and spraying will be annually undertaken for stages 3b and 4a.	Environmental Management Representative - Contractor	ongoing	Weed register form
Disturbed areas are to be re-instated and stabilised	Post - Construction		Environmental Management Representative - Contractor	ongoing	Compliance inspections
Machinery and plant are cleaned down in designated areas to prevent the introduction and spread of weeds	Post - Construction	Inspections of vehicles and plant	Environmental Management Representative - Contractor	ongoing	Inspection records
Topsoil which are found to contain weed species will not be respread for rehabilitation purposes. Such stockpiles will be buried under clean fill in borrow areas or fill sections to a depth of at least 400 mm	Construction and Post - Construction	Environmental Supervisor to identify weed infested topsoil No new weed species are introduced into the project area and adjoining areas No Ruby Dock is present within road corridor or existing borrow areas at completion of works/monitoring period	Environmental Management Representative - Contractor	ongoing	Weed register form
Revegetation					
Stockpiles of spoil or topsoil which are found to contain weed species will not be respread for rehabilitation purposes. Such stockpiles will be buried under clean fill in borrow areas or fill sections to a depth of at least 400 mm	Post-construction	No new weed species are introduced into the project area and adjoining areas Pre-existing weed infestations are reduced wherever possible through active management	Environmental Management Representative - Contractor	ongoing	Weed register form
All revegetated areas will be monitored and spot sprayed for weeds at least annually, six to eight weeks after the completion of the wet season for stages 3a.	Post-construction	Annual, seasonal (within 6 weeks of significant rainfall), monitoring of key weeds within the 60 m construction zone, and access road and until completion criteria have been	Environmental Management Representative - Contractor	ongoing	Rehabilitation report and/or Weed register form

		achieved for stage 3a. A combination of slashing and spraying will be annually undertaken for stages 3b and 4a. Monitoring will be undertaken by a qualified and experienced botanist to identify weeds during rehabilitation monitoring			
Any outbreaks of Ruby Dock will be treated as soon as possible, mapped, and revisited at regular intervals to ascertain the success of control treatments.	Post-construction	Annual, seasonal (within 6 weeks of significant rainfall), monitoring of key weeds within the 60 m construction zone, and access road and until completion criteria have been achieved for stage 3a A combination of slashing and spraying will be annually undertaken for stages 3b and 4a.	Environmental Management Representative - Contractor	ongoing	Weed register form
Areas of weed infestation will be mapped using a GPS and marked on the ground if applicable	Post-construction	No new weed species are introduced into the project area and adjoining areas Pre-existing weed infestations are reduced wherever possible through active management	Environmental Management Representative - Contractor	ongoing	Weed register form
Monitoring					
Weed monitoring to be undertaken monthly during construction and annually post-construction	Construction / Post-construction	Annual, seasonal (within 6 weeks of significant rainfall), monitoring of key weeds within the 60 m construction zone, and access road and until completion criteria have been achieved for stage 3a A combination of slashing and spraying will be annually undertaken for stages 3b and 4a.	Environmental Management Representative - Contractor	ongoing	Weed register form
Where weed infestation is evident, herbicide application shall be undertaken to ensure no Ruby Dock present, no new weed species present (compared to	Construction / Post-construction	Revegetation monitoring for up to 4 years	Environmental Management Representative - Contractor	ongoing	Rehabilitation report and/or Weed register form

reference site) and weed cover within rehabilitation area < weed cover at reference site		Monitoring will be undertaken by a qualified and experienced botanist to identify weeds during rehabilitation monitoring			

8 MANAGEMENT PLAN PROVISIONS

8.1 Management systems and implementation

Main Roads has an integrated management system that incorporates an ISO 14001:2015 certified Environmental Management System.

8.1.1 Monitoring

Daily and weekly observations of the construction site will be conducted to ensure the objectives of this WCMP are implemented and that the required management actions are in place.

8.1.2 Environmental incidents / non-compliances

Environmental incidences and non-compliances will be identified and recorded as soon as possible by the relevant responsible persons. Incidents will be mitigated or rectified where possible within 48 hours of being identified. Non-conformances to this plan will be reported to the Main Roads Construction Superintendent within 48 hours of identification.
Any non-conformance to this plan is to be reported to DWER Compliance Branch and investigated to determine:

- Why the non-conformance occurred
- What was the environmental harm or alteration of the environment that resulted from the non-conformance
- What changes to project activities and/or management plans is required
- Measures to prevent, control or abate the environmental harm that may have occurred.

8.1.3 Reporting

The environmental performance of the construction activities and the identification of auditing requirements will be assessed by Main Roads prior to and throughout the construction period. All documents pertaining to environmental management are required to be maintained though a system of document control, including the storage of hardcopy documents at site and archiving for handover to Main Roads upon contract completion.

Ministerial Condition 677 does not list specific reporting requirements, such as reporting of exceedance of threshold criteria. Reporting requirements specific to this WCMP are outlined in Table 2-2-1 and Table 2-2-2 of the Vegetation Protection and Rehabilitation Management Plan (GHD 2018). Reporting on compliance with the WCMP will be undertaken annually as part of Ministerial Statement 677 Compliance Assessment Report (CAR).

If a non-conformance with this plan occurs, Main Roads will notify DWER Compliance Branch through their email address at compliance@dwer.wa.gov.au within seven days of becoming aware of the non-conformance. A report on the investigation (as per 8.1.2 above) of the non-conformance will be provided within 60 days of reporting the non-conformance.

9 ADAPTIVE MANAGEMENT

The adaptive management approach aims to reduce impacts by embedding a cycle of monitoring, reporting and implementing change (where required). This document applies the principles of adaptive management through monitoring, corrective actions and implementing changes. Adaptive management has been considered throughout this document, and the key adaptive management processes are described below.

9.1 Environmental monitoring and corrective actions

Internal monitoring of the environmental aspects of the road construction will occur throughout the project, through the Environmental Supervisor (or their delegate). Any non-conformances

with this WCMP will be discussed with the Construction Manager/Construction Superintendent and rectified or mitigated as soon as possible to ensure minimal ongoing environmental harm. Relevant procedures will be amended/updated as necessary and inductions and other workforce communication will be undertaken in a timely manner to minimise the risk of re-occurrences.

9.2 WCMP Revision

The WCMP is intended to be dynamic and may be updated to reflect changes in management practices and the natural environment with time. This will also allow flexibility to respond to new environmental impacts and adopt new technologies / management measures.

Amendments to management actions will be completed on an as needs basis. This will include revision / amendment of management actions that are not achieving the desired outcomes, environmental monitoring identifying additional impacts and management actions, changes to relevant legislation or improvements to practices to achieve a greater environmental outcome. Changes to the management actions or targets of this WCMP will require the approval of the EPA Services prior to those changes being implemented.

Any changes will be reported through the Ministerial Statement CAR. Issues which may be amended over the course of the construction / maintenance could relate to identification of key weed species within or immediately adjacent to the construction zone or borrow pits.

9.3 Audits

Internal and external audits will be undertaken as per the Main Roads contract schedule and the results reported back to the Environmental Supervisor where relevant, in order for them to undertake corrective actions.

10 STAKEHOLDER CONSULTATION

In preparing this WCMP the following consultation specific to the preparation of the Management Plan has been undertaken. The consultation table below is an ongoing record of consultation undertaken and will be updated as consultation relating to environmental management occurs. Consultation and collaboration with the neighboring railway operators in regard to eradicating weeds will be undertaken prior to construction.

Stakeholder/ contact person	Date	Type of communication	Comments recieved
Lara Martin (Department of Primary Industries and Regional Development)	21 November 2018	Email requesting a review of the Weed Control and Management Plan	Comments received on 22 November 2018.

11 REFERENCES

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Smith, N. M (2002). Weeds of the Wet / Dry Tropics of Australia, A Field Guide, Environmental Centre, Northern Territory.

Main Roads Western Australia Karratha-Tom Price Road and Pannawonica-Millstream Road Weed Survey (2018) Ecologia Environment, Osborne Park, Western Australia

12 APPENDIX 1 WEED REGISTER FORM

Year First Identified	MGA 50 Easting	MGA 50 Northing	Weed Name	Location Description	Area (m2) / No. of Plants	Stage and # of plants Seedling, Juvenile and or Adult's	Action Taken (pulled out / reported etc)	Disposal Location	Further Action Required

Year First Identified	MGA 50 Easting	MGA 50 Northing	Weed Name	Location Description	Area (m2) / No. of Plants	Stage and # of plants Seedling, Juvenile and or Adult's	Action Taken (pulled out / reported etc)	Disposal Location	Further Action Required

13 APPENDIX 2 WEED IDENTIFICATION PHOTOS

***Aerva javanica* (kapok bush)**

Location: Roebourne-Wittenoom Rd, disturbed road verge, 50K 515886.3 mE 7627606.9 mN, facing south.

Location: Site PM02, base of rocky outcrop, 50K 519056.6 mE 7607682.8 mN, facing south.

***Bidens bipinnata* (bipinnate beggartick)**

Location: Tom Price Railway Road, *Acacia* shrubland with clay soils, 50K 564468.8 mE 7582016.8 mN.

***Cenchrus ciliaris* (buffel grass)**

Location: Site PM04, cracking clay soils, 50K 504289.1 mE 7609097.9 mN.

Location: Site PM04, cracking clay soils, 50K 504289.1 mE 7609097.9 mN, facing north-west.

Location: Site PM03, cracking clay soils, 50K 509424.5 mE 7607978.6 mN, facing east.

Cenchrus setiger (Birdwood grass)

Location: Site PM02, cracking clay soils, 50K 517391.9 mE 7607619.0 mN.

Location: Site PM02, cracking clay soils, 50K 517391.9 mE 7607619.0 mN, facing south.

Cenchrus ciliaris + C. setiger

Location: Roebourne-Wittenoom Rd, disturbed road verge, 50K 521511.1239 mE 7615911.364 mN, facing south-east.

Location: Site BP139.6, disturbed area, 50K 549962.3415 mE 7601386.658 mN, facing north-east.

Location: Roebourne-Wittenoom Rd, disturbed road verge, 50K 516714.0 mE 7631516.0 mN, facing south-west.

***Cynodon dactylon* (couch)**

Location: Tom Price Railway Road, minor creek, 50K 564087.5 mE 7583096.2 mN, facing east.

Location: Site PM02, minor creek, 50K 519133.5 mE 7607597.4 mN.

Location: Site PM02, minor creek, 50K 519133.5 mE 7607597.4 mN, facing east.

***Echinochloa colona* (awnless barnyard grass)**

Location: Tom Price Railway Road, minor creek, 50K 564288.1 mE 7583031.0 mN.

Location: Site PM02, minor creek, 50K 519133.5 mE 7607597.4 mN, facing east.

Flaveria trinervia

Location: Tom Price Railway Road, adjacent to minor creek, 50K 564241.5 mE 7583168.0 mN, facing east.

***Malvastrum americanum* (spiked malvastrum)**

Location: Tom Price Railway Road, adjacent to minor creek, 50K 552454.5 mE 7597020.1 mN

Location: Site PM04, cracking clay soils, 50K 504424.0 mE 7609137.9 mN.

Location: Site PM04, cracking clay soils, 50K 504424.0 mE 7609137.9 mN, facing south.

***Melochia pyramidata* (pyramid flower)**

Location: Tom Price Railway Road, adjacent to minor creek, 50K 564165.4 mE 7583067.2 mN

Location: Tom Price Railway Road, adjacent to minor creek, 50K 564165.4 mE 7583067.2 mN

Location: Site PM02, minor creek, 50K 519042.7 mE 7607716.6 mN, facing south.

***Passiflora foetida* var*. hispida* (stinking passion flower)**

Location: Site PM06, drainage line, 50K 490287.3 mE 7597339.5 mN.

Location: Site PM02, cracking clay soils, 50K 515792.6 mE 7607837.0 mN, facing south-east.

Sonchus oleraceus (common sowthistle)

Location: Tom Price Railway Road, adjacent to minor creek, 50K 564288.1 mE 7583031.0 mN

Location: Tom Price Railway Road, adjacent to minor creek, 50K 564288.1 mE 7583031.0 mN

Vachellia farnesiana (mimosa bush)

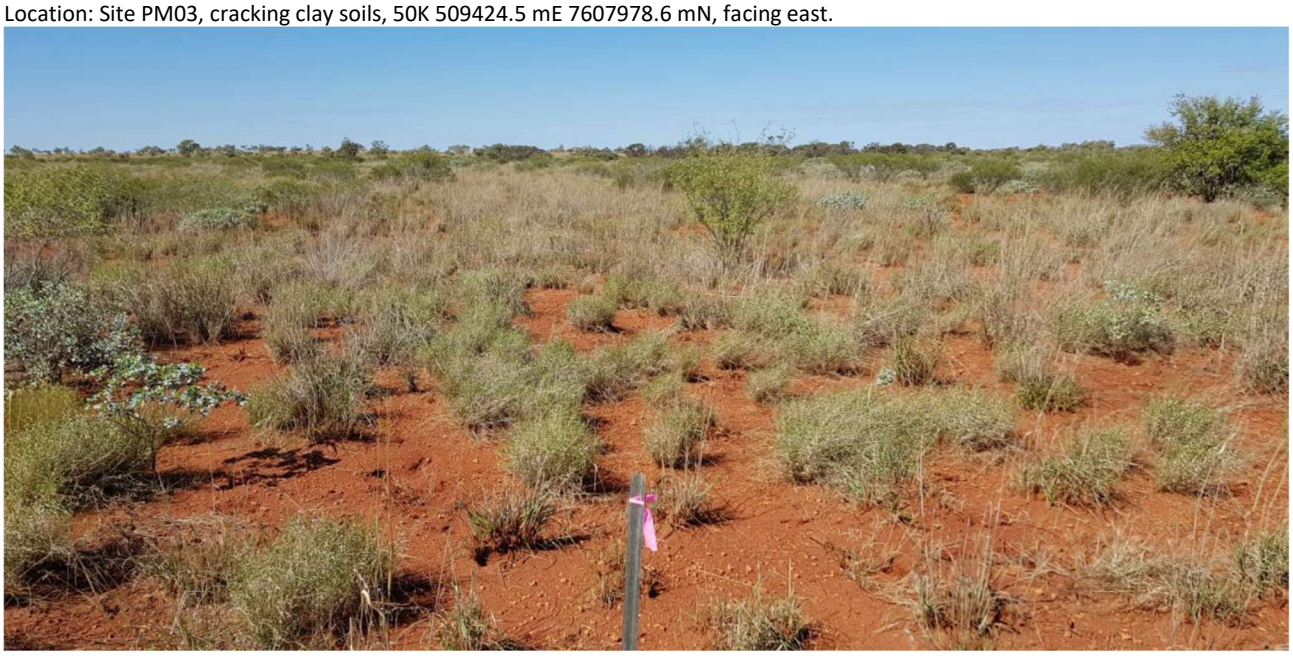
Location: Roebourne-Wittenoom Rd, disturbed road verge, 50K 516430.0 mE 7630724.3 mN.

Location: Roebourne-Wittenoom Rd, disturbed road verge, 50K 516430.0 mE 7630724.3 mN, facing south.

Location: Site PM04, cracking clay soils, 50K 504424.0 mE 7609137.9 mN, facing south.

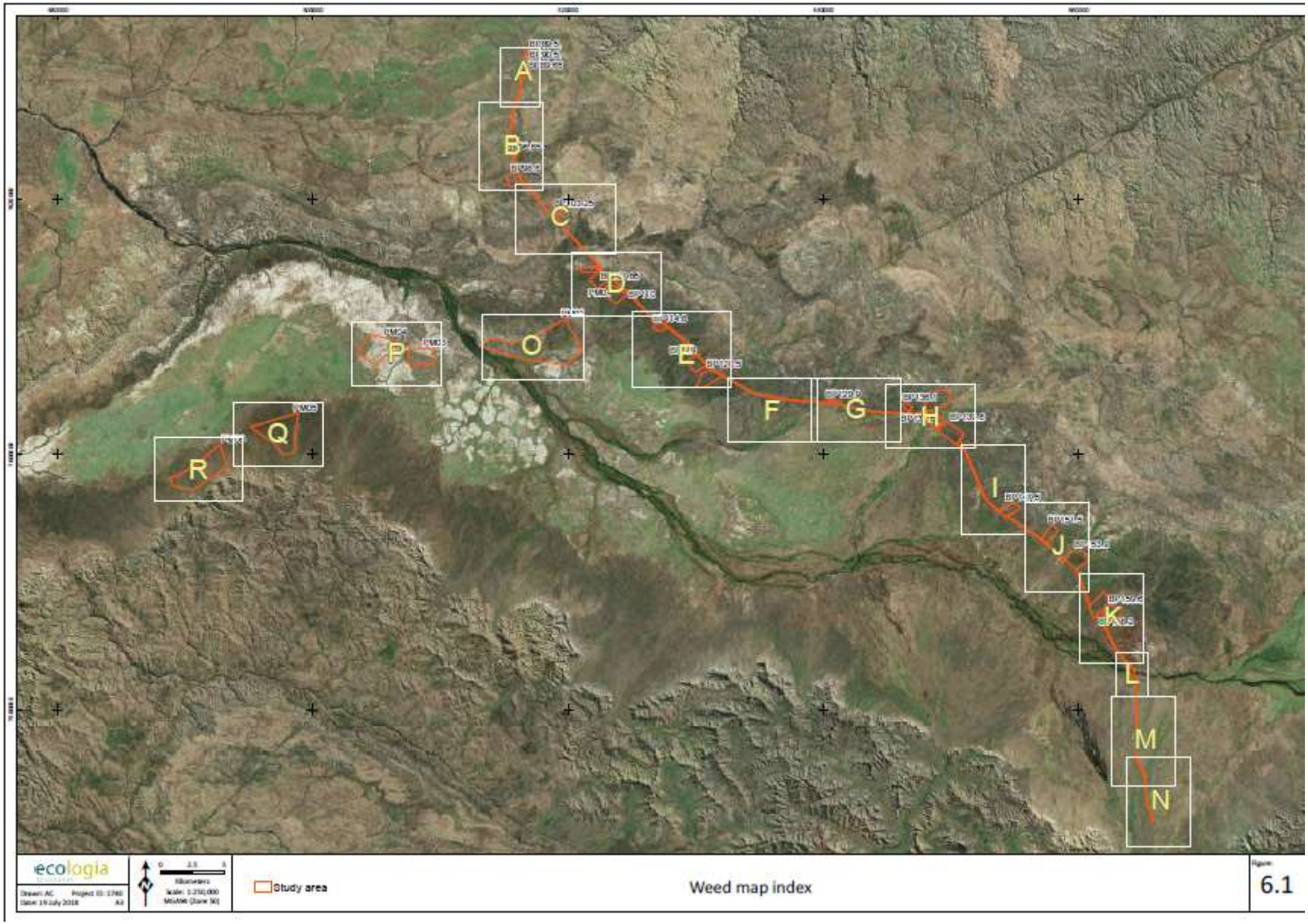
Vachellia farnesiana (mimosa bush)

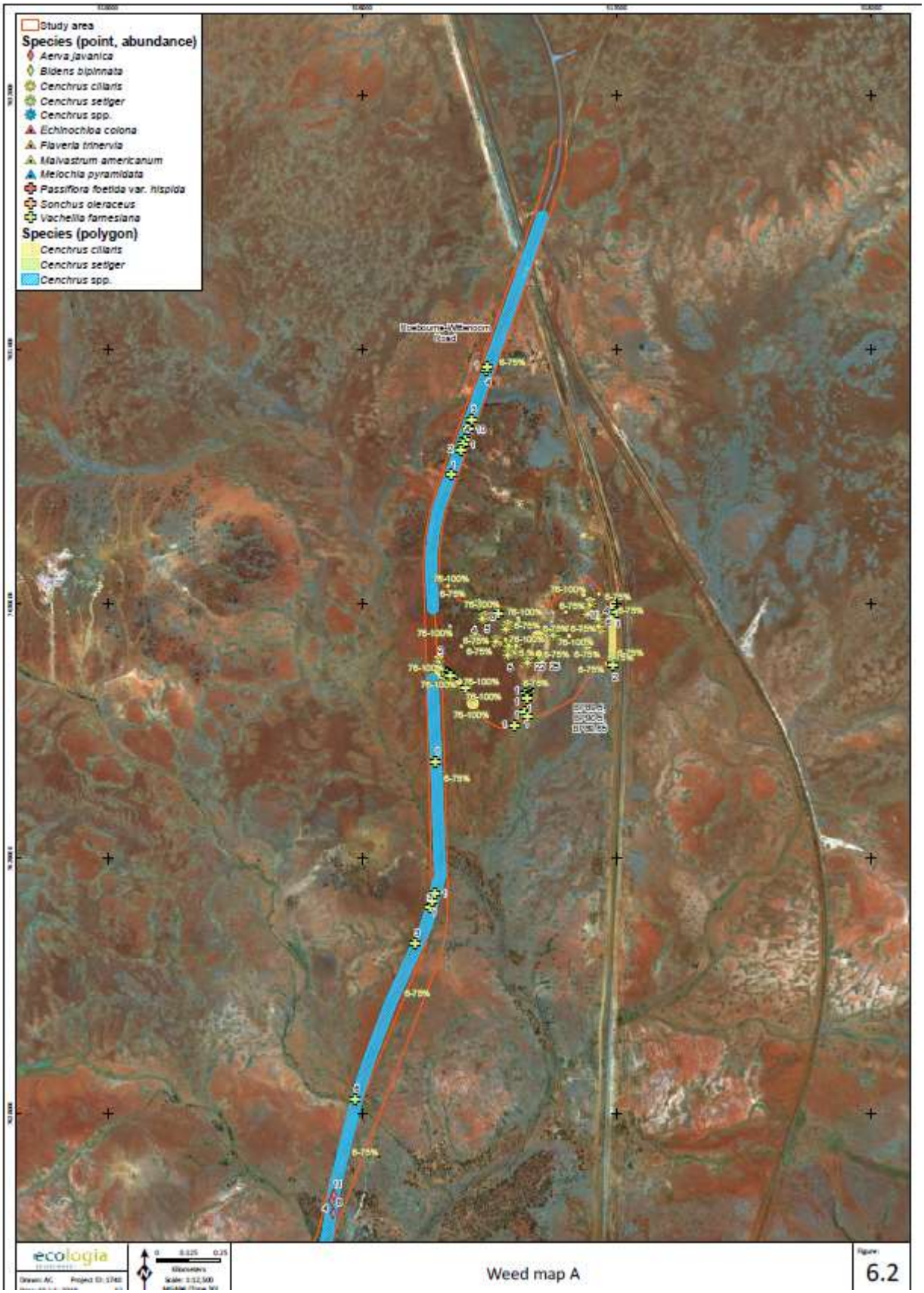
Location: Site PM03, cracking clay soils, 50K 509424.5 mE 7607978.6 mN, facing east.



Location: Site PM03 (Q19), cracking clay soils, 50K 519663.5 mE 7608384.9 mN, facing south-east.

14 APPENDIX 3 WEED LOCATION MAPS


A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
ecologia
Study area
Weed map index
6.1


Study area
Species (point, abundance)
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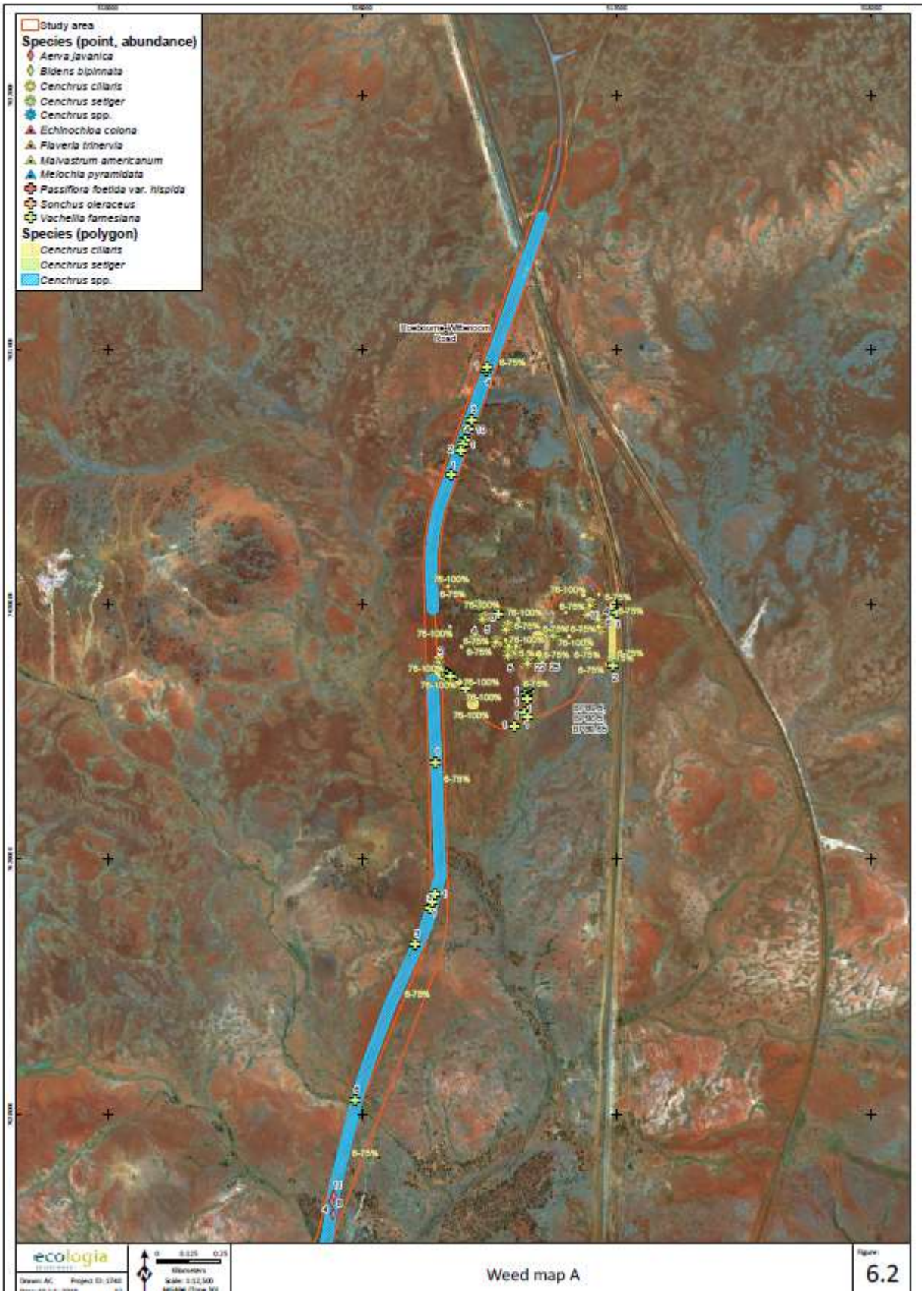
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Melochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Roebourne-Wittenoom Road
ecologia
Weed map A
6.2


Study area
Species (point, abundance)
Aerva javanica
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Melochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Weed map A
6.2


Study area
Species (point, abundance)
Aerva javanica
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Melochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus spp.
BP103 X5
Roebourne-Wittenoom Road
ecologia
Drawn: AC
Project ID: 1740
Date: 19 July 2018
A3
0 0.175 0.35
Kilometers
Scale: 1:20,000
MGA94 (Zone 50)
Weed map C
Figure:
6.4


Study area
Species (point, abundance)
Aerva javanica
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Melochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
BP107/85
PM01
BP110
PM02
BP114/3
Roebourne-Wittenoom Road
6-75%
ecologia
Drawn: AC
Date: 19 July 2018
Project ID: 1740
A3
0 0.175 0.35
Kilometers
Scale: 1:20,000
MGA94 (Zone 50)
Weed map D
Figure:
6.5


Study area
Species (point, abundance)
Aerva javanica
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Melochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus spp.
BP1148
6-75%
6-75%
Roebourne-Wittenoom Road
BP119
BP1205
ecologia
Drawn: AC Project ID: 1740
Date: 19 July 2018 A3
0 0.175 0.35
Kilometers
Scale: 1:20,000
MGA94 (Zone 50)
Weed map E
Figure:
6.6


534000
536000
538000
540000
BP120.5
Roebourne-Wittenoom Road
6
6-75%
6-75%
6-75%
6-75%
1
6-75%
6-75%
6-75%
Study area
Species (point, abundance)
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Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Melochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus setiger
ecologia
Drawn: AC
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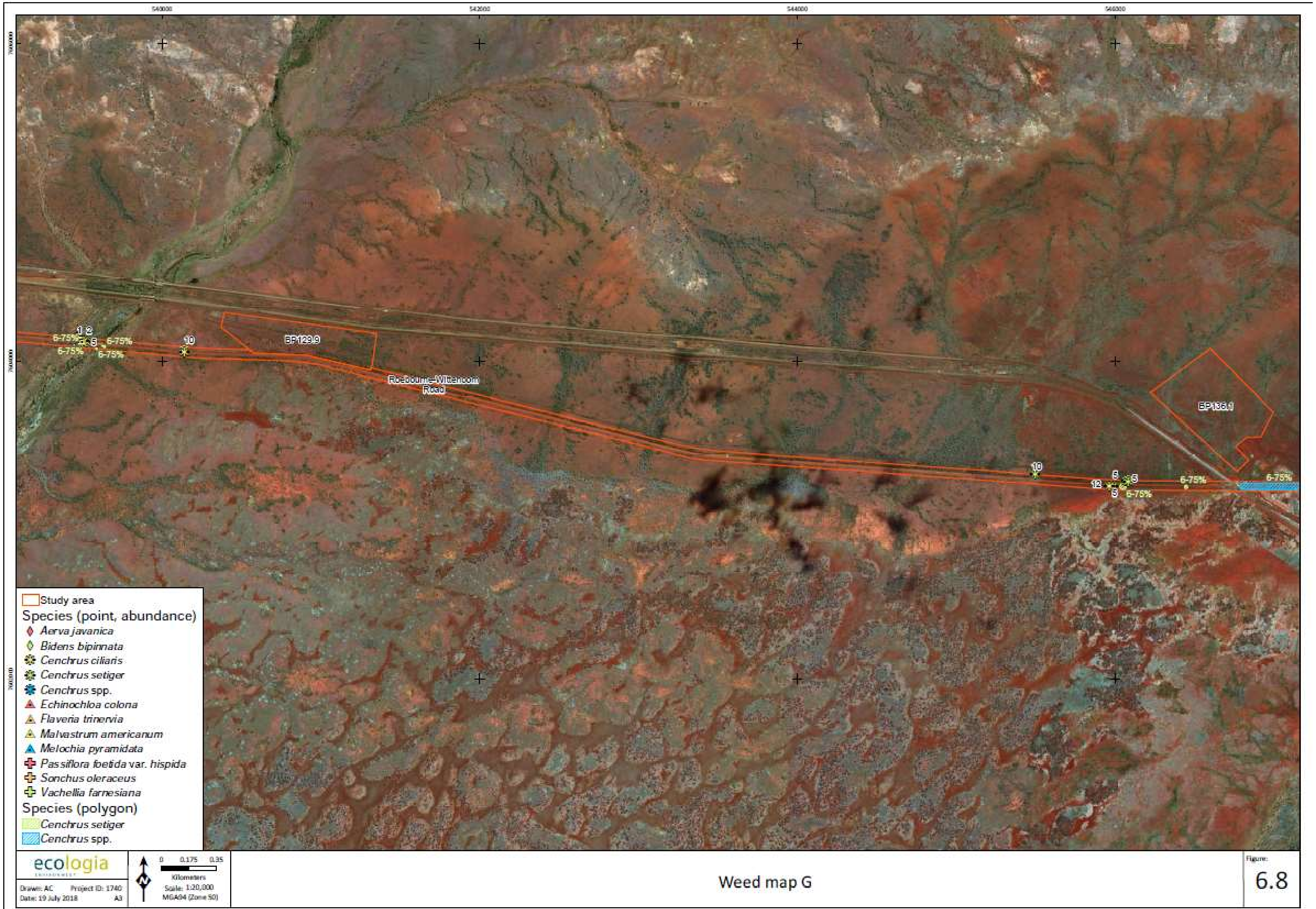
Scale: 1:20,000
MGA94 (Zone 50)
Weed map F
Figure:
6.7


EP129.9
Roebourne-Wittenoom Road
EP136.1
6-75%
Study area
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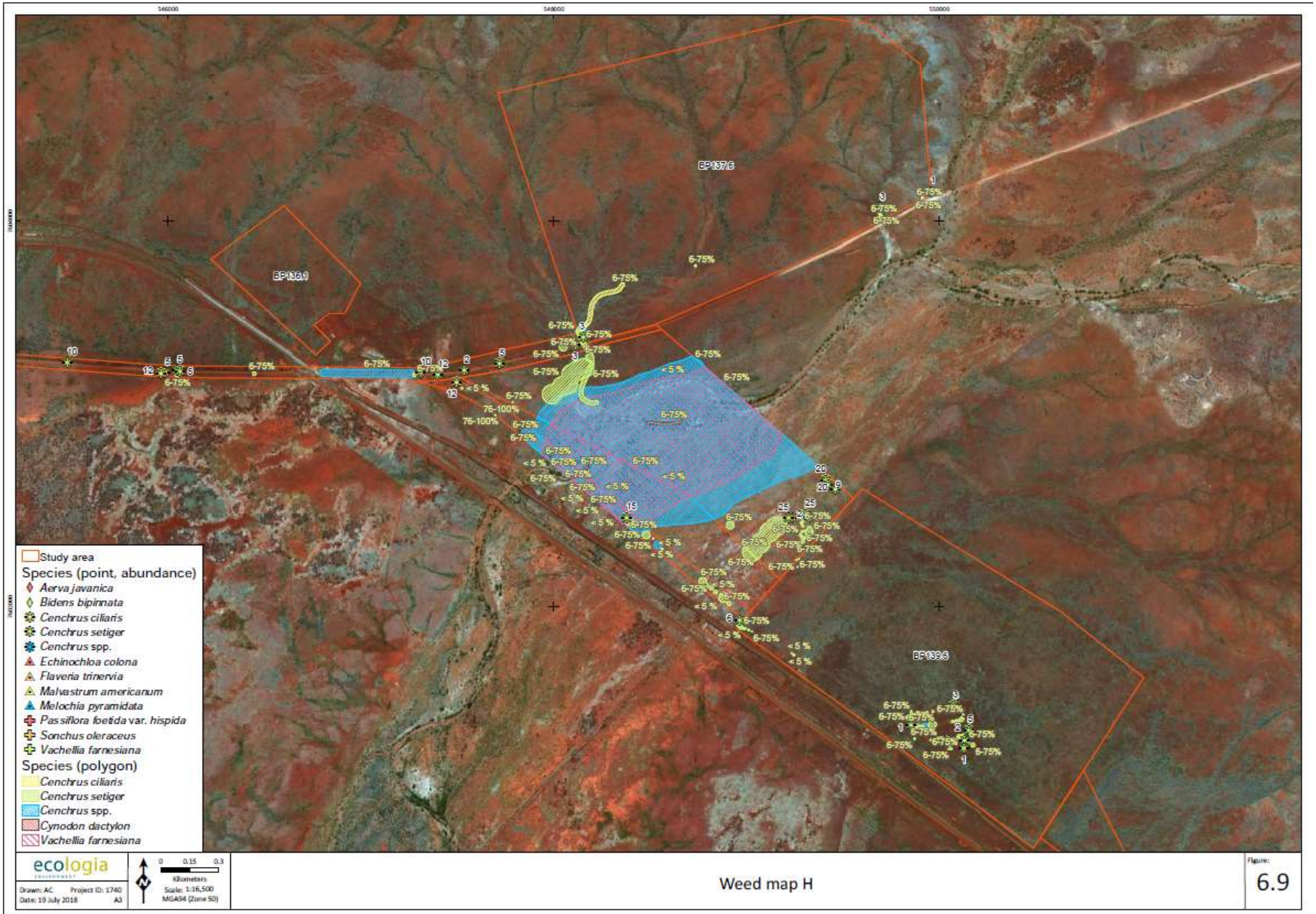
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Melochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus setiger
Cenchrus spp.
ecologia
Drawn: AC Project ID: 1740
Date: 19 July 2018 A3
Kilometers
Scale: 1:20,000
MGA94 (Zone 50)
Weed map G
Figure:
6.8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Cenchrus spp.
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Flaveria trinervia
Malvastrum americanum
Melochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Cynodon dactylon
Vachellia farnesiana
BP137.6
BP138.1
BP139.6
ecologia
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Kilometers
Scale: 1:16,500
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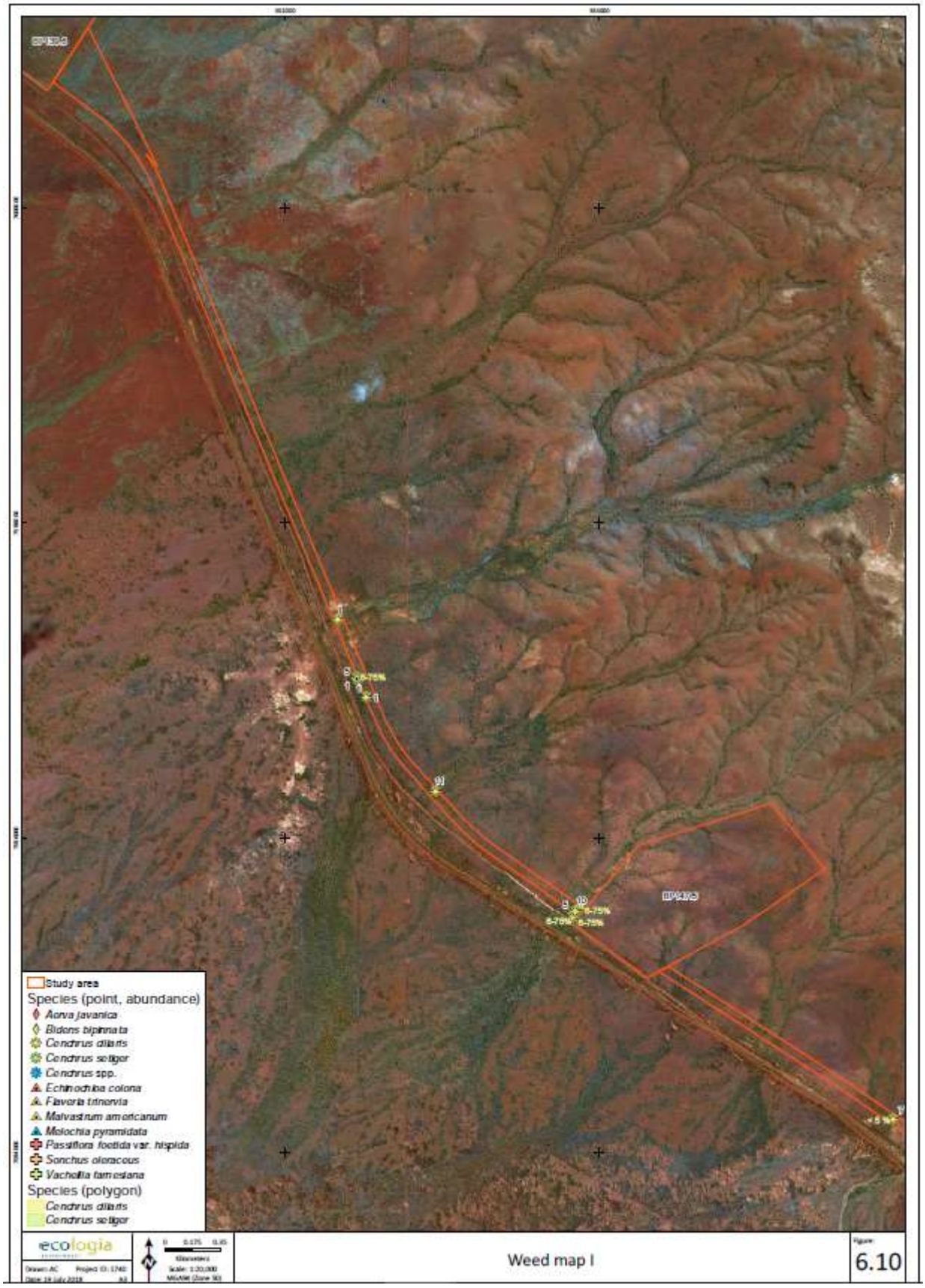
Study area
Species (point, abundance)
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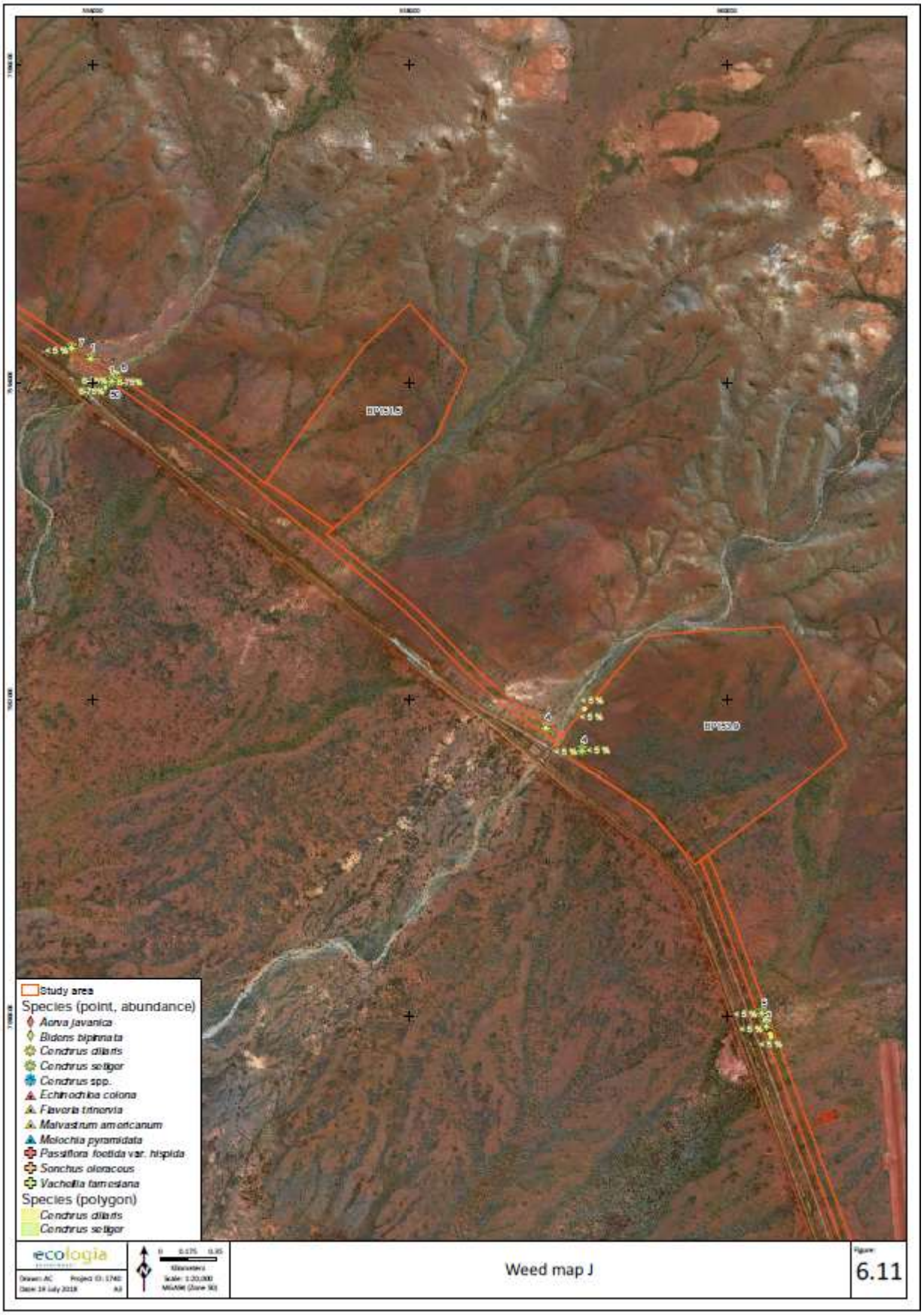
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setigor
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Melochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus ciliaris
Cenchrus setigor
ecologia
Weed map I
6.10


Study area
Species (point, abundance)
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Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
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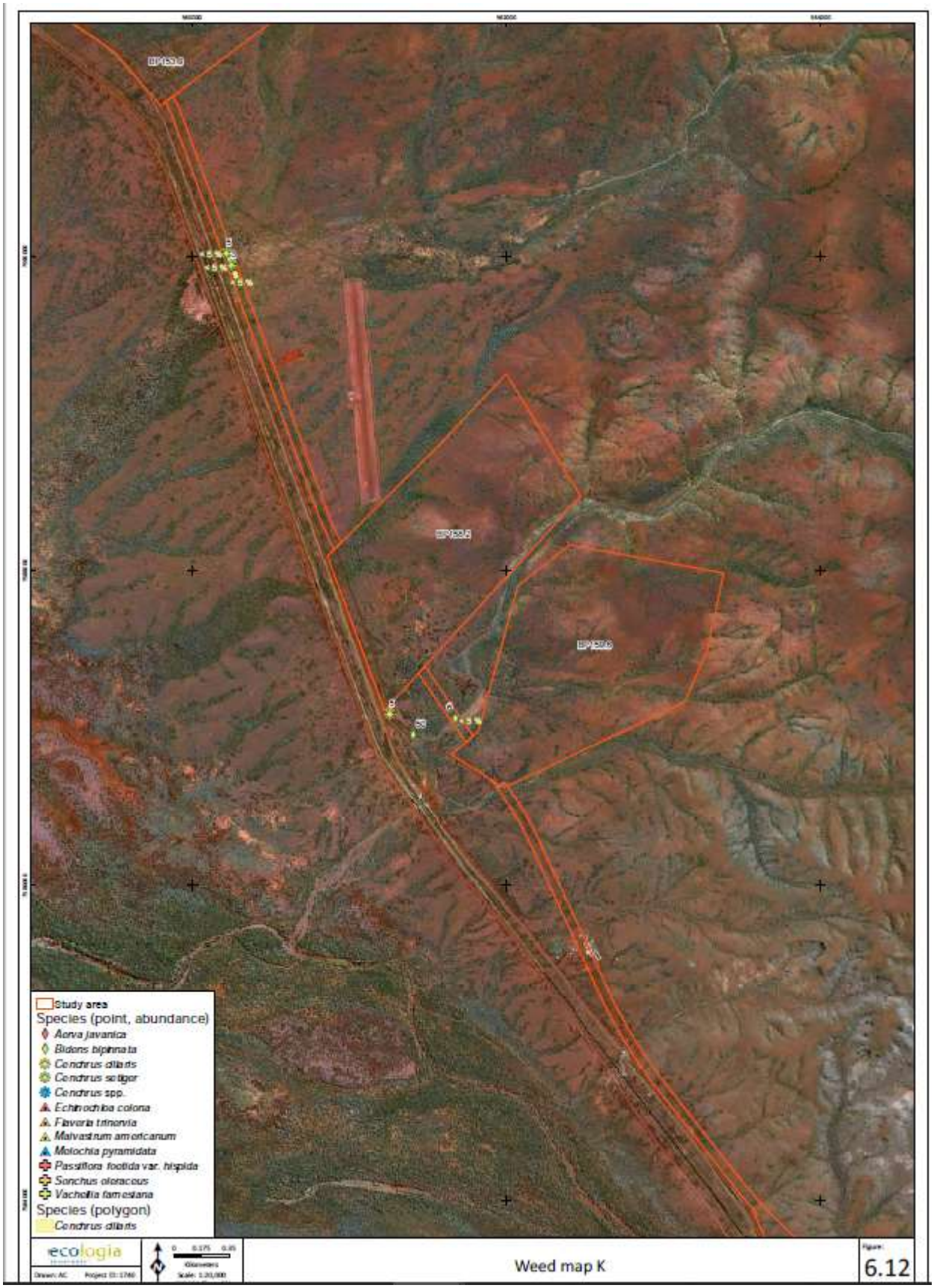
Flaveria trinervia
Malvastrum americanum
Malochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus ciliaris
Cenchrus setiger
ecologia
Weed map J
6.11


Study area
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Cenchrus setigor
Cenchrus spp.
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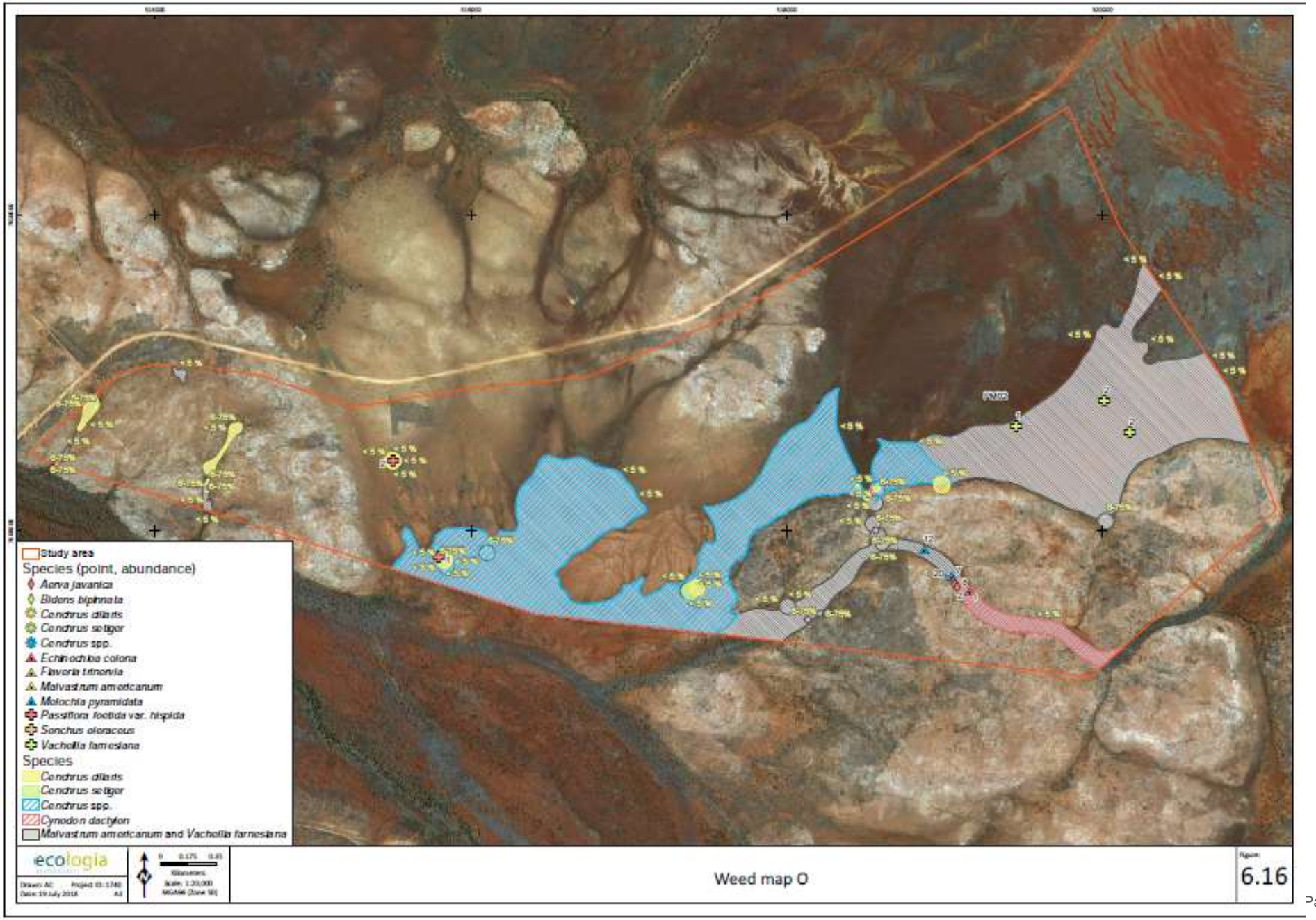
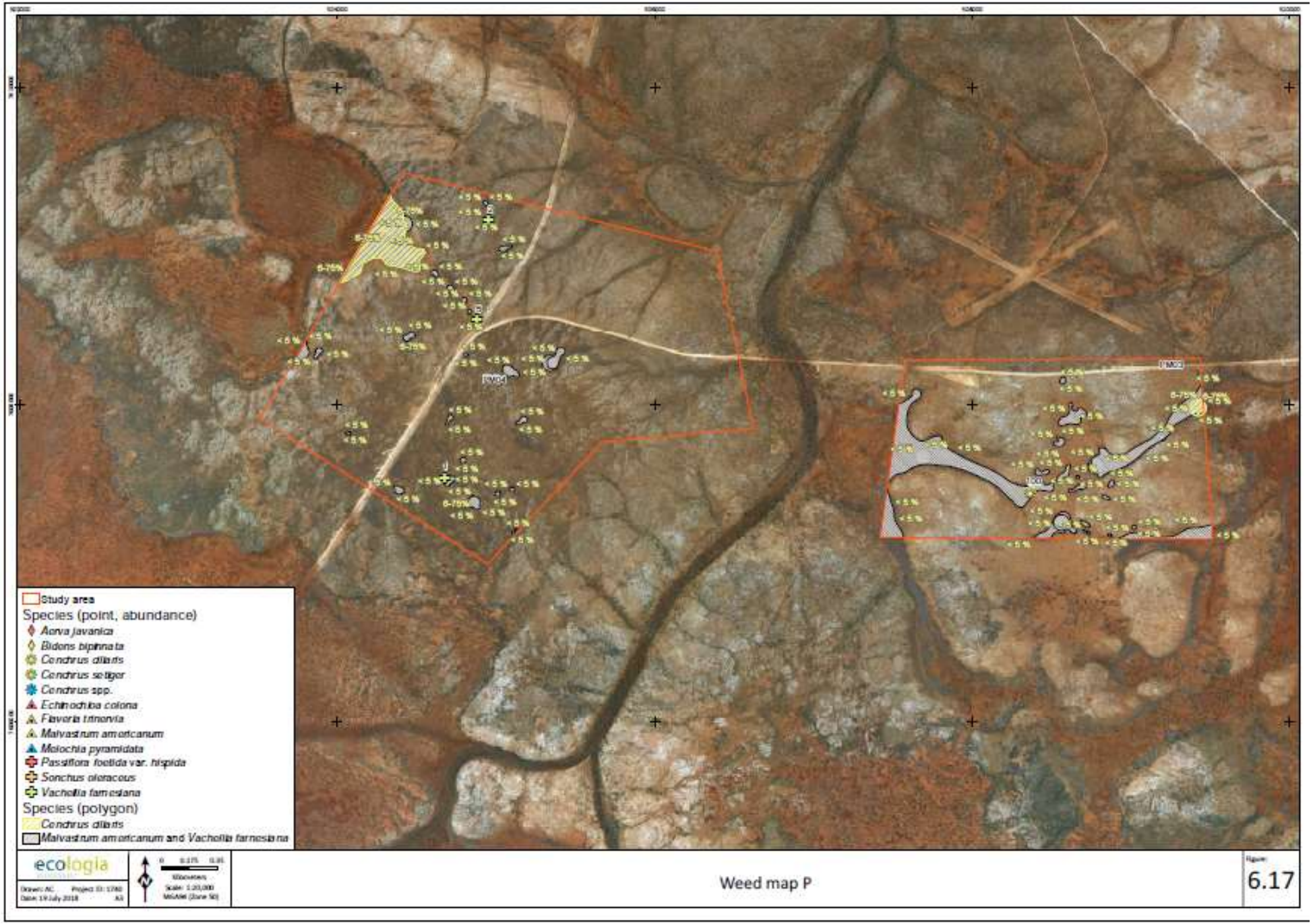
Flaveria trinervia
Malvastrum americanum
Malochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus ciliaris
ecologia
Weed map K
6.12


Study area
Species (point, abundance)
Aerva javanica
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Malochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus ciliaris
Cenchrus setiger
Cynodon dactylon
Malvastrum americanum
Vachellia farnesiana
ecologia
Weed map L
6.13


Study area
Species (point, abundance)
Aerva javanica
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setigor
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Molochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus ciliaris
Cenchrus setigor
ecologia
Weed map M
6.14


Study area
Species (point, abundance)
Aerva javanica
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setigor
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Melochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus ciliaris
Cenchrus setigor
ecologia
Weed map N
6.15


Study area
Species (point, abundance)
Aerva javanica
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setigor
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Malochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species
Cenchrus ciliaris
Cenchrus setigor
Cenchrus spp.
Cynodon dactylon
Malvastrum americanum and Vachellia farnesiana
ecologia
Weed map O
Figure:
6.16


Study area
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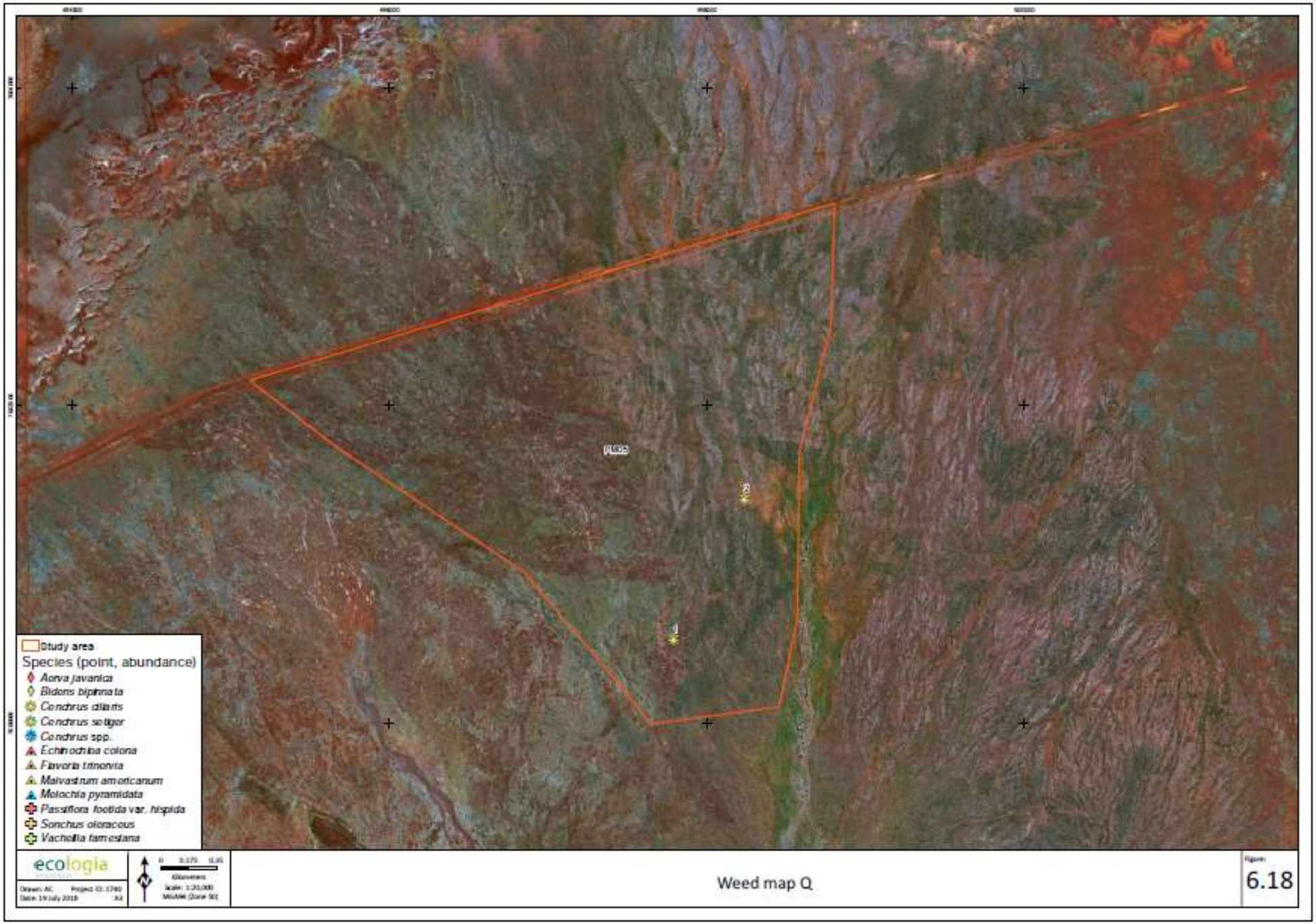
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Melochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus ciliaris
Malvastrum americanum and Vachellia farnesiana
ecologia
Weed map P
6.17


Study area
Species (point, abundance)
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Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
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Sonchus oleraceus
Vachellia farnesiana
ecologia
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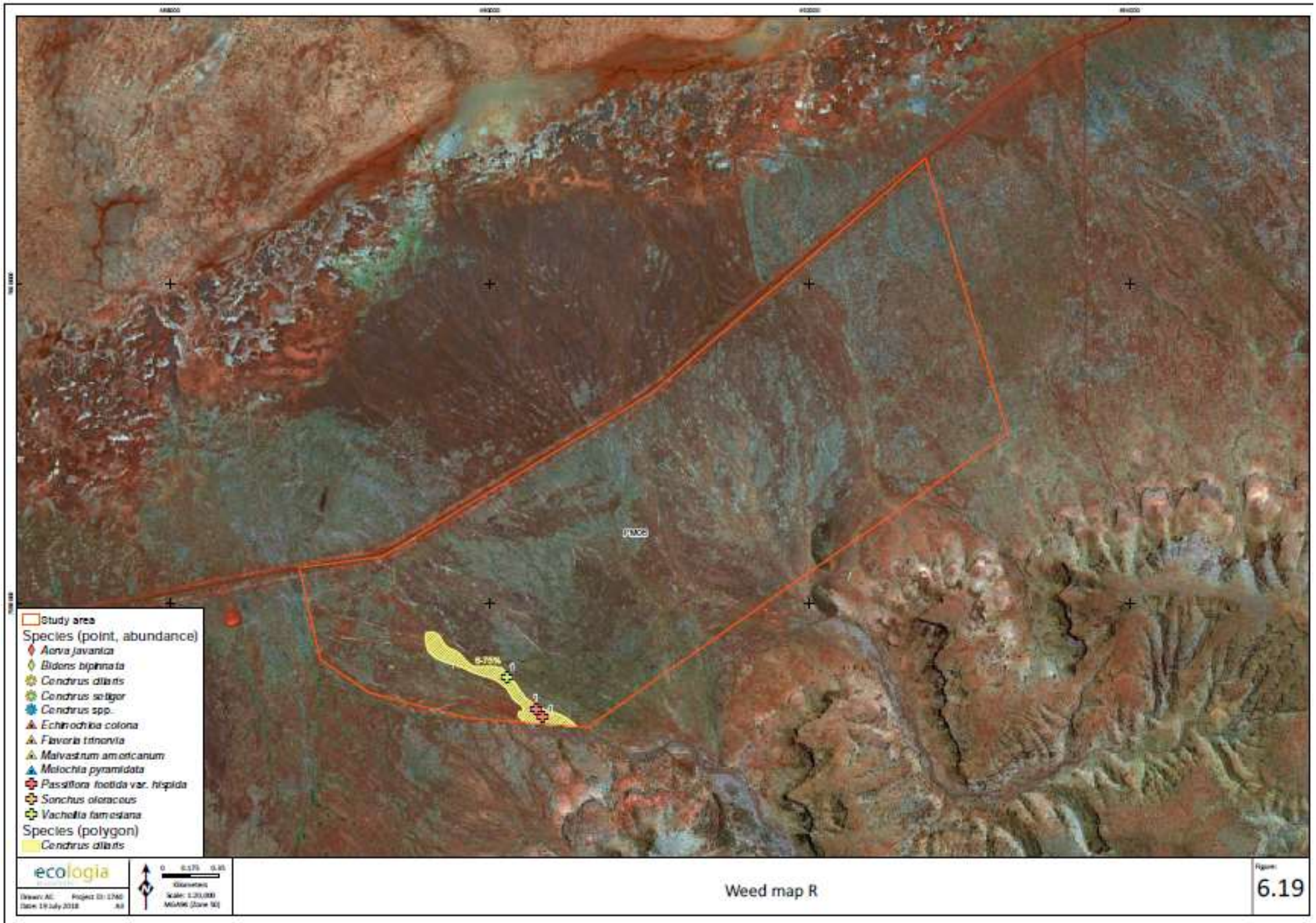
Study area
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Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Malochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus ciliaris
6-75%
PMOS
ecologia
Weed map R
6.19

Appendix L. D18#1115728 6137267_REP_National Park Management Plan KTP_Rev3 final approved 20 Dec 2018

Main Roads Western Australia

Karratha Tom Price Road Stage 3a North National Park Management Plan

December 2018

Acronyms and Abbreviations

CAR	Compliance Assessment Report
CALM	Department of Conservation and Land Management (superseded)
CER	Consultative Environmental Review
CHMP	Cultural Heritage Management Plan
DBCA	Department of Biodiversity, Conservation and Attractions
DEC	Department of Environment and Conservation (superseded)
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
MP	Management Plan
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
Ha	hectare
km	Kilometre
KTP	Karratha Tom Price road
m	Metre
Main Roads	Main Road Western Australia
NPMP	National Park Management Plan
PaW	Parks and Wildlife Branch (of DBCA)
PEC	Priority Ecological Community
SDMP	Surface Drainage Management Plan
VPRMP	Vegetation Protection and Rehabilitation Management Plan

Table of contents

1. Context, scope and rationale 1
   - 1.1 Background 1
   - 1.2 Key environmental factors and impacts 4
   - 1.3 Condition requirements 5
   - 1.4 Rationale and approach 6
2. Management Plan Provisions 15
   - 2.1 Management systems and implementation 15
   - 2.2 Flora and vegetation protection 17
   - 2.3 National Park protection and management 19
3. Adaptive management 22
   - 3.1 Environmental monitoring and corrective actions 22
   - 3.2 MP Revision 22
   - 3.3 Audits 22
4. Stakeholder consultation 23
5. References 24

Table index

Table 1-1 Key environmental factors, values, and impacts relevant to the project within Stage 3a North 4

Table 1-2 Requirements of MS 677 5

Table 1-3 Studies and surveys relevant to the project area 6

Table 2-1 Vegetation and flora – Management actions and targets for Stage 3a North 17

Table 2-2 National Park aspects – Management actions and targets for Stage 3a North 19

Table 4-1 NPMP stakeholder consultation record 23

Figure index

Figure 1 Project location 3

Figure 2 Environmental aspects 10

Figure 3 Public Drinking Water Source Area 11

Figure 4 Indicative Alignment 12

1. Context, scope and rationale

This National Park Management Plan (NPMP) has been prepared for the construction and operation of Stages 3a North of the Karratha Tom Price road (KTP). It is one of six management plans developed for the project, and takes precedence over the other plans where the works may affect the Millstream Chichester National Park. This section includes a summary of the project including its key features, information on the key environmental factors relating to construction of the road, the management approach that will be undertaken and the rationale for the approach.

1.1 Background

The KTP project was initially proposed via a Consultative Environmental Review (CER) document in 2003. The CER included a total of 245 kilometre (km) of proposed new or upgraded road from the North West Coastal Highway to the Nanutarra-Munjina Road, in three stages (2, 3 and 4). The environmental approval of the project was given in April 2005 under Assessment 1244 (Bulletin 1159) and through Ministerial Statement 677.

Construction of the 89 km of Stage 2 was commenced in 2006 by the Millstream Link Alliance and completed in 2008. This work was undertaken using a series of approved management plans as required under Statement 677. The management plans were approved by relevant authorities including the then (then) Department of Environment, Water and Rivers Commission and Department of Indigenous Affairs, with advice from Department of Conservation and Land Management (CALM). Adherence to the plans was audited internally, externally and by CALM/Department of Environment Conservation, particularly in relation to the section of Stage 2 which traversed the Millstream Chichester National Park.

The initial vegetation clearing approval was for 574 hectare (ha) (474 ha for the road formation and 100 ha for borrow pits), with 110 ha within the National Park. A Section 46C approval increased the amount of land approved for clearing within the National Park to 145 ha (to a project total of 609 ha). Total clearing undertaken for Stage 2 was 445 ha, with 122 ha within the National Park. Based on the extent of clearing to date for the KTP, the Ministerial Statement authorises an additional 164 ha of clearing, including 23 ha within the National Park.

1.1.1 Project area

This NPMP covers the road construction and associated drainage for Stage 3a North (the Stage within or adjacent to the National Park), a distance of approximately 20 km. This Stage starts north of the junction of the Pilbara Iron Railway line and the Roebourne Wittenoom Road and ends at Millstream Road. Stage 3a of the road alignment closely follows the Roebourne Wittenoom Road, primarily within a designated road reserve (Figure 1). This NPMP does not apply to the southern part of Stage 3a (Stage 3a South) that is not adjacent to the National Park.

The road will consists of a 7 m wide two-lane seal with 1 m wide shoulders and associated cut or fill batters, table drains and offshoot drains. It will incorporate approximately 10 floodways and a number of culverts. The standard width of the road construction, within a flat area, will be 19 m to 20 m, including table drains.

Based on the extent of approved clearing in Ministerial Statement 677, the total clearing that can be undertaken within the National Park is 23 ha.

Material for the formation will be sourced from a range of borrow pits outside the National Park.

1.1.2 Purpose and scope of this management plan

This NPMP updates the previous plan developed for Stage 2 as follows and includes:

- Guidance using the most recent Environmental Protection Authority (EPA) guidelines for EMPs
- Updates on conservation significant flora and vegetation
- Updates on best practice in environmental management
- New GIS mapping

The NPMP will be implemented during construction of the project works along with five other management plans:

- Surface Drainage Management Plan
- Vegetation Protection and Rehabilitation Management Plan Stage 3a North
- Vegetation Protection and Rehabilitation Management Plan Stage 3a South, 3b and 4a
- Construction Management Plan
- Cultural Heritage Management Plan.

Where these plans conflict with this NPMP, the NPMP will take precedence for all works affecting the Millstream Chichester National Park.

1.1.3 Limitations

This report has been prepared by GHD for Main Road Western Australia (Main Roads) and may only be used and relied on by Main Roads for the purpose agreed between GHD and the Main Roads as set out in section 1.1.2 of this report.

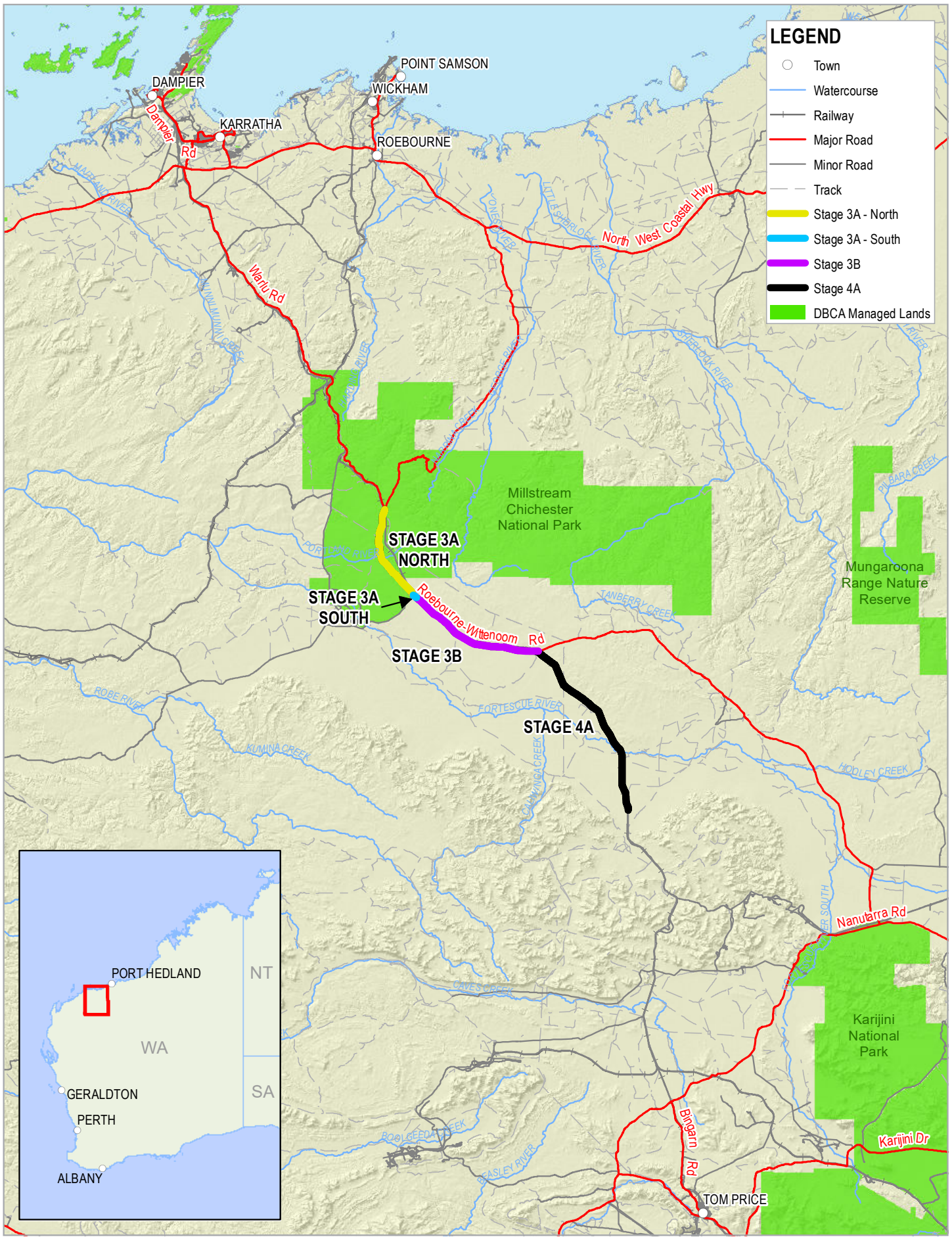
GHD otherwise disclaims responsibility to any person other than Main Roads arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Main Roads and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.



Paper Size ISO A4

0 10 20 30 40

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Main Roads Western Australia
Karratha - Tom Price Road Stages 3 and 4a

Location

Project No. **61-36933**
Revision No. **1**
Date **8/11/2018**

FIGURE 1

G:\61\36933\GIS\Maps\Working\61136933_001_Fig1Location_Rev1.mxd
Print date: 08 Nov 2018 - 13:23

Data source: GHD: Stage 3 and 4A Design Centerline - 20151202; Landgate: Water Line, Railways - 20151127, Roads - 20160502; DPaW - Managed Lands and Waters - 20141126; Geoscience Australia: GeoData Topo 250K Series 3 . Created by: afeeney

1.2 Key environmental factors and impacts

The key environmental factors identified as being relevant to this NPMP are outlined in Table 1-1. The relevance of each environmental factor to Stage 3a of the project is discussed in Section 1.4.1. Table 1-1 summarises the project-specific environmental value, proposed impact activity and impact for the key vegetation and habitat factors. Environmental constraints are identified in Figure 2 and Public Drinking Water Sources in Figure 3. The indicative project alignment is detailed in Figure 4.

Table 1-1 Key environmental factors, values, and impacts relevant to the project within Stage 3a North

EPA Factor	Key Values	Impact Activities	Key Potential Impacts
Flora and vegetation	Native vegetation in a range of conditions. Priority 1 PEC. Stage 3a within the Millstream-Chichester National Park.	Clearing of up to 23 ha in the National Park	• Loss of patches of Priority 1 PEC of variable quality • Changes to local hydrology causing indirect vegetation damage through erosion • Introduction of new weed species or spread of existing weeds • No recorded conservation significant flora in or closely adjacent the impact areas.
Terrestrial Fauna	A range of fauna habitats including ephemeral rivers/creeks.	Clearing of up to 23 ha of habitat in the National Park	• Loss of habitat
Terrestrial Environment Quality	Millstream-Chichester National Park.	Vegetation clearing and road construction along the existing gravel road through approximately 15 km of the National Park.	• Wind and water erosion of soil in proximity and downstream of cleared areas prior to revegetation /restoration.
Hydrological Processes	Dawson Creek as well as multiple minor gullies and drainage lines. Millstream Water Reserve.	Construction of sealed road over creeks and floodway zones.	• Detention of floodwater, causing changed local ecological conditions upstream and downstream • Re-direction of floodwater, causing erosion and changed ecological conditions downstream (see **Surface Drainage Management Plan** (SDMP)).
Landuse and social surroundings	Millstream National Park.	Re-construction /sealing of existing road causing greater usage of road.	• Additional access to section of the National Park which were not previously easily accessible, causing damage to vegetation, fauna or creeklines.

EPA Factor	Key Values	Impact Activities	Key Potential Impacts
Aboriginal heritage	Aboriginal ethnographic and archaeological sites present in the vicinity of the road alignment	Removal of or impact to, sites as follows as a result of road construction.	• Loss of Aboriginal heritage. (see **Cultural Heritage Management Plan** (CHMP)).

1.3 Condition requirements

The CER was assessed by officers of CALM during the public consultation period in 2004. As a result of the assessment and subsequent comments, a number of commitments regarding management within the National Park were given in EPA Bulletin 1159 of January 2005. The commitments relevant to this NPMP for Stage 3a of the KTP road are provided below with annotations in italics which provide outcomes from the Stage 2 construction within the National Park.

Table 1-2 Requirements of MS 677

Element	Section of plan
1. Limit the area of vegetation to be cleared within the Millstream-Chichester National Park to not more than 110 ha *(increased to 145 ha in total with 23 ha remaining to clear following Stage 2 construction)*. (***Condition M 7.2***)	Table 2-1
2. Prepare a National Park Plan which addresses impacts in the Millstream Chichester National Park. Include as elements of the plan the following: i. Design of interpretive signage and rest bays to promote understanding of Park values and protection of flora and fauna ii. Design to minimise the ecological and visual impact of the road through: a. minimising cut and fill through the park b. specifying the width of the construction corridor through the park c. best practice design of batters in cut and fill areas to provide stable landforms which blend in with the surrounding contours d. reducing vegetation clearing through forward planning and sensitive design iii. Long term management of the road reserve through the Park iv. Measurement and evaluation of environmental performance (***Commitment 677:P10***)	Table 2.2

The majority of these requirements were fulfilled in Stage 2 of the KTP, which included 50 km of new road within the National Park. Stage 3a runs through an area of low relief, on an existing

road and does not require significant cut and fill, as was required through the Chichester Range as part of Stage 2.

1.4 Rationale and approach

1.4.1 Survey and study findings

The following studies and surveys have been undertaken within, or are relevant to, the Stage 3a project area, which defines the area within the National Park. Information specific to the National Park area has been extracted, where relevant.

Table 1-3 Studies and surveys relevant to the project area

Studies	Consultant	Description
Flora and vegetation	GHD Pty Ltd	Flora and vegetation survey of the proposed Karratha Tom Price Road (all sections) (2003). Desktop update of conservation significant flora and vegetation communities for Sections 3 and 4a (2016 and 2018).
	Main Roads	Weed and broad vegetation survey, March 2018 (unpublished).
Fauna	GHD Pty Ltd (using Bamford Associates)	Fauna survey of the proposed Karratha Tom Price Road (all sections), including fish and freshwater vertebrates (2003, using Bamford 2002).
	GHD Pty Ltd	Desktop update of conservation significant fauna potentially present in the project area (2016). Northern Quoll reconnaissance survey including the use of camera traps (2017).
Terrestrial environmental quality	GHD Pty Ltd	Vegetation condition and fauna habitat quality was considered during vegetation and fauna surveys (2003).
	Main Roads	Vegetation condition and fauna habitat quality was reviewed March 2018 (unpublished).
Rehabilitation	Millstream Link (2006, 2015)	Rehabilitation and revegetation was undertaken during Stage 2 construction of KTP. Details of work carried out and the success of the work is available in management plans and compliance reporting.
Hydrological processes	GHD Pty Ltd	Desktop and field investigation of surface hydrology undertaken to characterise drainage and provide an initial risk assessment, provided within the CER (Main Roads 2003).
	BG&E	A full hydrologic and hydraulic analysis of the road project area to provide design input for floodways and culverts (2017).
Aboriginal heritage	Yuluwarlu Group Aboriginal Corporation Gavin Jackson, Cultural Resource Management	Archaeological and ethnographic surveys of Stages 3 and 4a in association with the Yinjibarndi Aboriginal Corporation (August 2017).

Vegetation and flora

Vegetation mapping of a 1 km wide corridor of Stage 3a (within the National Park) identified and recorded six broad vegetation types (GHD 2003). These types were also recorded along other Stages of the KTP and are generally widespread in the Pilbara bioregion, and the Chichester and Fortescue Interim Biogeographic Regionalisation of Australia sub-regions, with all representative vegetation associations (Beard 1975) remaining at over 99% of pre-European extent (Government of Western Australia 2018).

No Threatened Ecological Community are present within the project area. A Priority Ecological Community (PEC), has been broadly mapped (with buffers) by Parks and Wildlife (PaW) branch of the Department of Biodiversity Conservation and Attractions (DBCA) across the northern 8-9 km of the project area, within the National Park. It is listed as 'Four plant assemblages of the Wona Land System (previously 'Cracking clays of the Chichester and Mungaroona Range')' (Priority 1) (DBCA 2017).

This community was patchily indicated in the 2002 survey in this location and was also recorded close by, in the Stage 2 area. It is likely present to the west and east of the road construction corridor as a mosaic with the vegetation type described by GHD (2003) (Figure 2). It is in relatively poor condition in the areas adjacent to the road, due to previous roadworks and impacts from the previously existing Camp Curlewis at Barowanna Hill.

Two of the vegetation types mapped by GHD are considered to contain wetland/dampland dependent plant species:

- Drainage line vegetation of major and minor rivers, creeks and tributaries: River Gums and Paperbarks over Acacia species, sedge, grass and herb species
- Floodplain vegetation (*Acacia citrinoviridis* woodland and *A. xiphophylla* shrubland) around major and minor drainage lines.

No listed Threatened or Priority species have been recorded in, or within 400 m of the project area (60 m corridor) for Stage 3a (GHD 2003, 2004, DBCA records) (Figure 2). The nearest known records are:

- *Themeda* sp. Hamersley Station (P3) – 410 m east of the Stage 3a project area, east of the Pilbara Iron railway line
- *Paspalidum retiglume* (Priority 2) – approximately 620 m north of the northern most point of Stage 3a.

A number of Priority species occur in the vicinity of the Millstream Visitor Centre in semi-permanent wetland areas. These conditions are not present within the Stage 3a project area.

Weeds

Construction of Stage 2 of the KTP required detailed assessment and management of high risk weeds, particularly within the Millstream Chichester National Park. This was requested by PaW as part of the approval of the previous NPMP for Stage 2. Two key weeds were of concern; Ruby Dock (*Acetosa vesicaria*) and Kapok (*Aerva javanica*) and these were mapped and controlled, where possible. NatureMap (2017) indicates a small number of weeds recorded within a 10 km radius of the existing road. One of these *Vachellia farnesiana* (Mimosa Bush) is a tall shrub which proliferates in drainage lines and is a problem for stock. The most common weed present within the project area is likely to be *Cenchrus ciliaris* (Buffel Grass) which is often found in disturbed areas and along creeklines.

Fauna

An updated list of potentially occurring conservation significant species with a likelihood of occurrence of the species in the Stage 3 and 4a project area was established, based on DBCA records (sourced November 2017), habitat availability and knowledge from GHD's Principal Zoologist, Glen Gaikhorst (GHD 2016). This information identified that 11 species of conservation significance were likely to occur or could possibly occur in the project area, as follows:

- ***Likely***: Lined Soil-crevice Skink, Short-tailed Mouse (Priority 4), Rainbow Bee-eater (Schedule 5), Peregrine Falcon (Schedule 7)
- ***Possible:*** Northern Quoll (Endangered), Pilbara Olive Python, Grey Falcon, Bilby (Vulnerable) Fortescue Grunter (Priority 4), Spectacled Hare Wallaby (Priority 3), Western Pebble-mound Mouse (Priority 4).

GHD undertook an assessment along Stages 3 and 4a in 2017 which specifically surveyed for the EPBC listed Northern Quoll (*Dasyurus hallucatus*). This survey did not record the species through physical evidence or the use of motion sensitive cameras and found generally low level habitat, due to the lack of rock areas for denning sites (GHD 2017). The Bilby may also have been captured on motion sensitive cameras, but no records were made and no evidence of Bilbys (burrows, tracks) was found.

Rehabilitation

Rehabilitation of all roadside edges, cutoff drain bunds, access tracks, side tracks, laydown areas and borrow pits was undertaken during, and immediately following, the construction of Stage 2 of the KTP. The rehabilitation areas were monitored during construction and for a period of 7 years following construction by a qualified botanist and rehabilitation specialist. The majority of revegetation of reshaped and ripped areas occurred through the respreading of topsoil and vegetative mulch, and was highly successful within a short period. Revegetation in early years was assisted by a good summer rainfall but all areas re-established well within 2-3 years of preparation. Some pit bases took longer to revegetate due to hard and impenetrable base soils and some seasonal waterlogging. Seed collected in areas to be cleared along the alignment was also used to assist revegetation in pits and on spoil dumps.

Surface and groundwater hydrology

The CER provides a background on the general hydrology of the project area. Generally, south of the Portland River the catchments are broken into a series of small but defined watersheds in gently rolling hills.

Stage 3a of the project requires the crossing of several minor watercourses and floodplains, including Dawson Creek. All crossings will be constructed as concrete floodways or culverts, with 10 floodways planned for Stage 3a.

The project is located within the Millstream Water Reserve and within the P1 and P2 Public Drinking Water Source Areas. The project starts to the south of the Harding Dam Catchment Area (Figure 3).

Main Roads has undertaken concept design works for Stage 3 and 4a of KTP. This included a hydrology investigation of the concept design (BG&E 2017), which involved calculation of design flows for each catchment and an assessment of the serviceability of the floodway's and hydraulic structures. The final drainage design will be a part of the detailed design phase and documented within the design report.

Adjacent landuse

Stage 3a North (15 km) is within the Millstream Chichester National Park, and includes the junction of the road access to the Millstream Reserve and visitor centre. The visitor centre is approximately 11.5 km from the project area by direct line.

The Pilbara Iron Pty Ltd rail corridor is a maximum of 2.5 km to the east of the Stage 3 project area.

Aboriginal heritage

The most recent surveys have identified a number of Aboriginal sites and places within the proposed road construction area as follows:

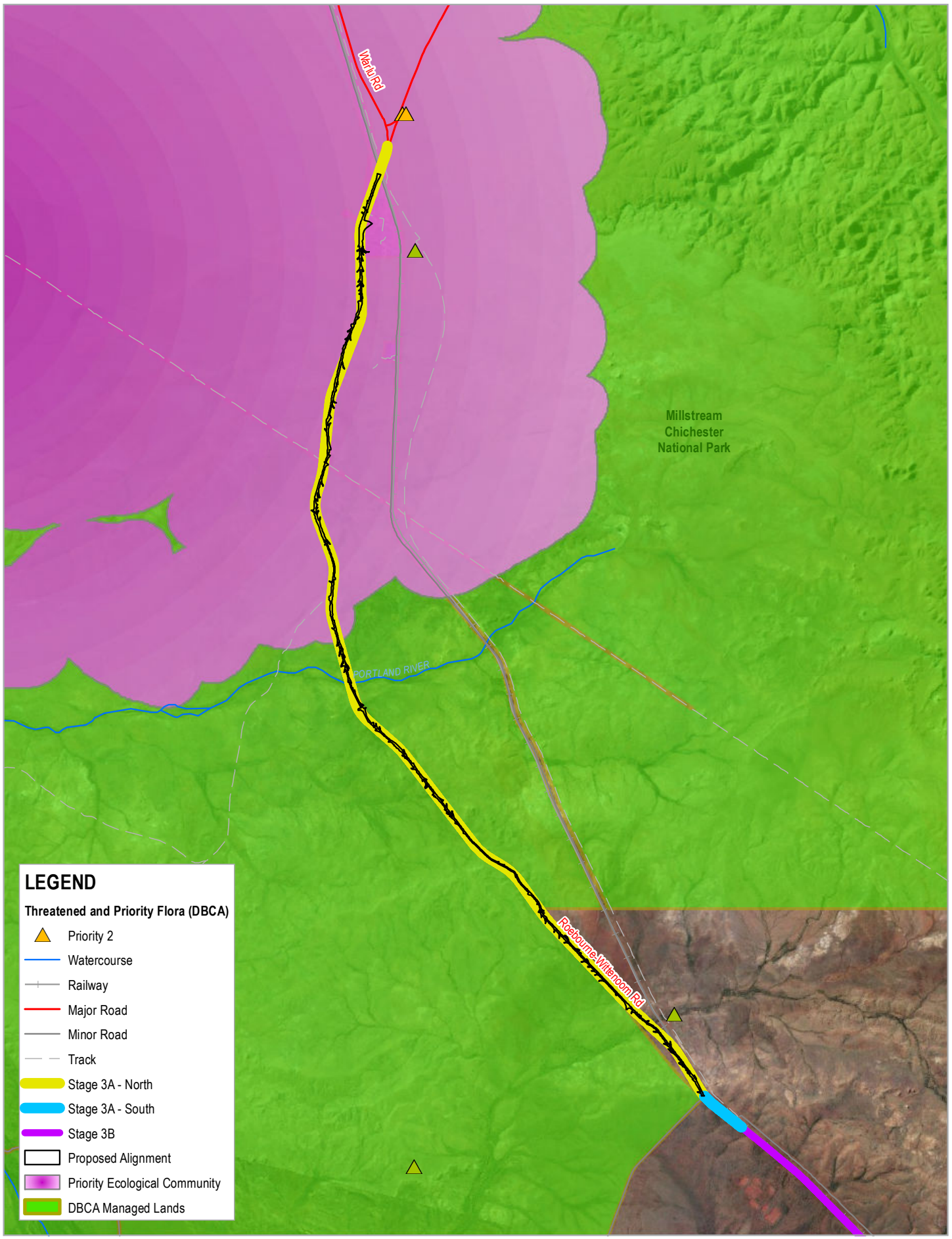
- Four recorded archaeological sites within the 60 m proposed construction zone
- Four sites within 100 m either side of the construction zone which could potentially be impacted.

As a result of the archaeological and ethnographic survey, the Yindjibarndi people have given their consent for Main Roads to construct the proposed road, access tracks, borrow pits and associated ground disturbance works and that includes consent to Main Roads to undertake the proposed works within the boundaries of the registered sites and newly identified archaeological material sites. If sites cannot be avoided the Yindjibarndi people request the opportunity to salvage the material and to be able to monitor construction within the relevant site areas.

Based on the likelihood of Aboriginal sites and places being impacted by project activities, if disturbance of sites is required by the project, Main Roads will investigate the need to make contact with the Department of Planning, Lands and Heritage (DPLH) and/or the Yindjibarndi people to seek advice upon required approvals prior to proceeding with any work that will affect the outlined Aboriginal sites or places to which the Aboriginal Heritage Act 1972 (AH Act) applies. This will ensure project activities are compliant with Ministerial Statement 677 and with the AH Act.

European heritage

Sections of the existing Roebourne Wittenoom road, which near the northern end of Stage 3, have been part of an important inland stock and transport route since the late 1800s. Information from CALM in 2003 indicated that stones, placed by cameleers, still line parts of this route.



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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Main Roads Western Australia
Karratha - Tom Price Road Stages 3 and 4a

Environmental Aspects

Project No.	**61-36933**
Revision No.	**1**
Date	**8/11/2018**

FIGURE 2

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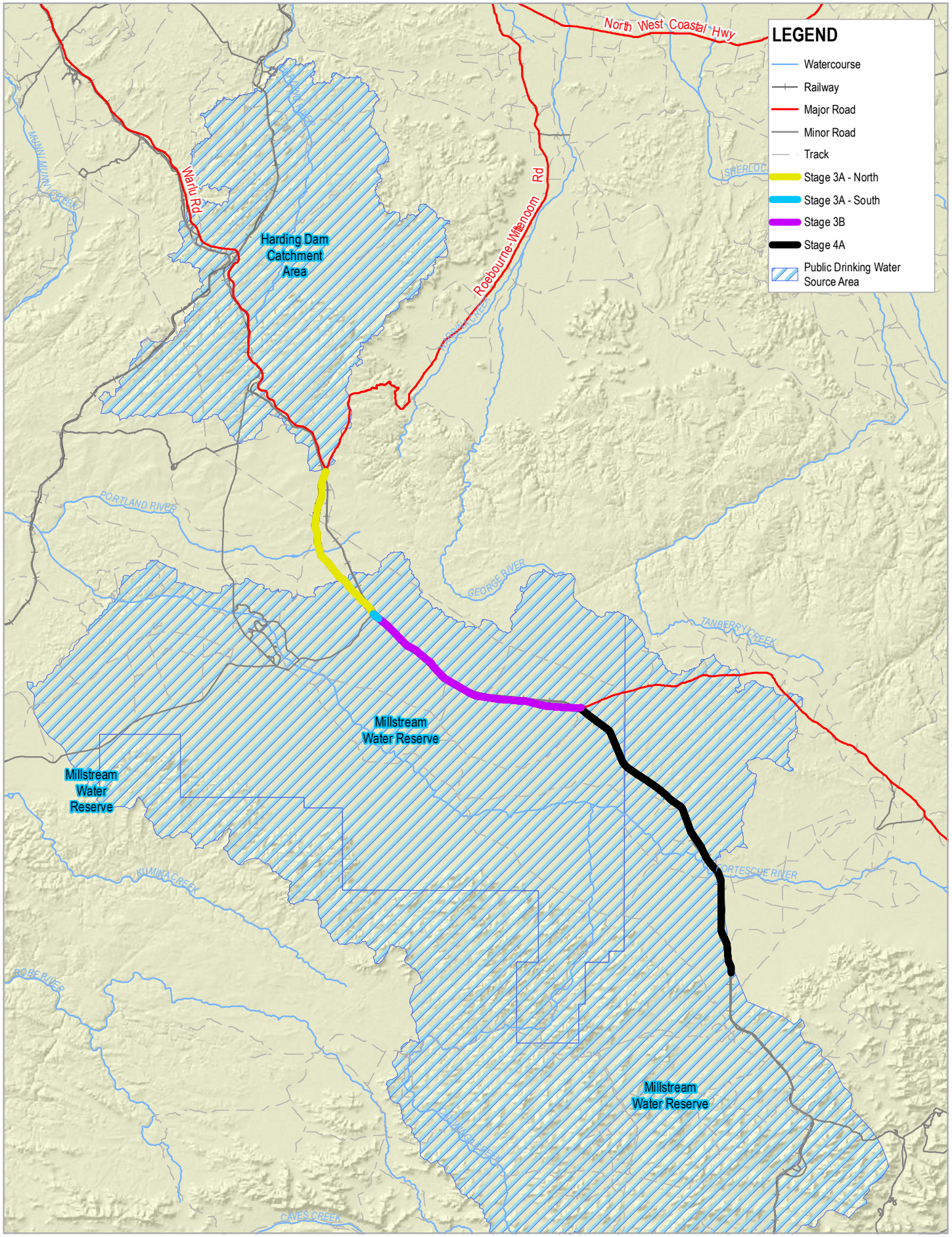

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Grid: GDA 1994 MGA Zone 50

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Main Roads Western Australia
Karratha - Tom Price Road Stages 3 and 4a

Public Drinking Water Source Areas

Project No. **61-36933**
Revision No. **1**
Date **8/11/2018**

FIGURE 3

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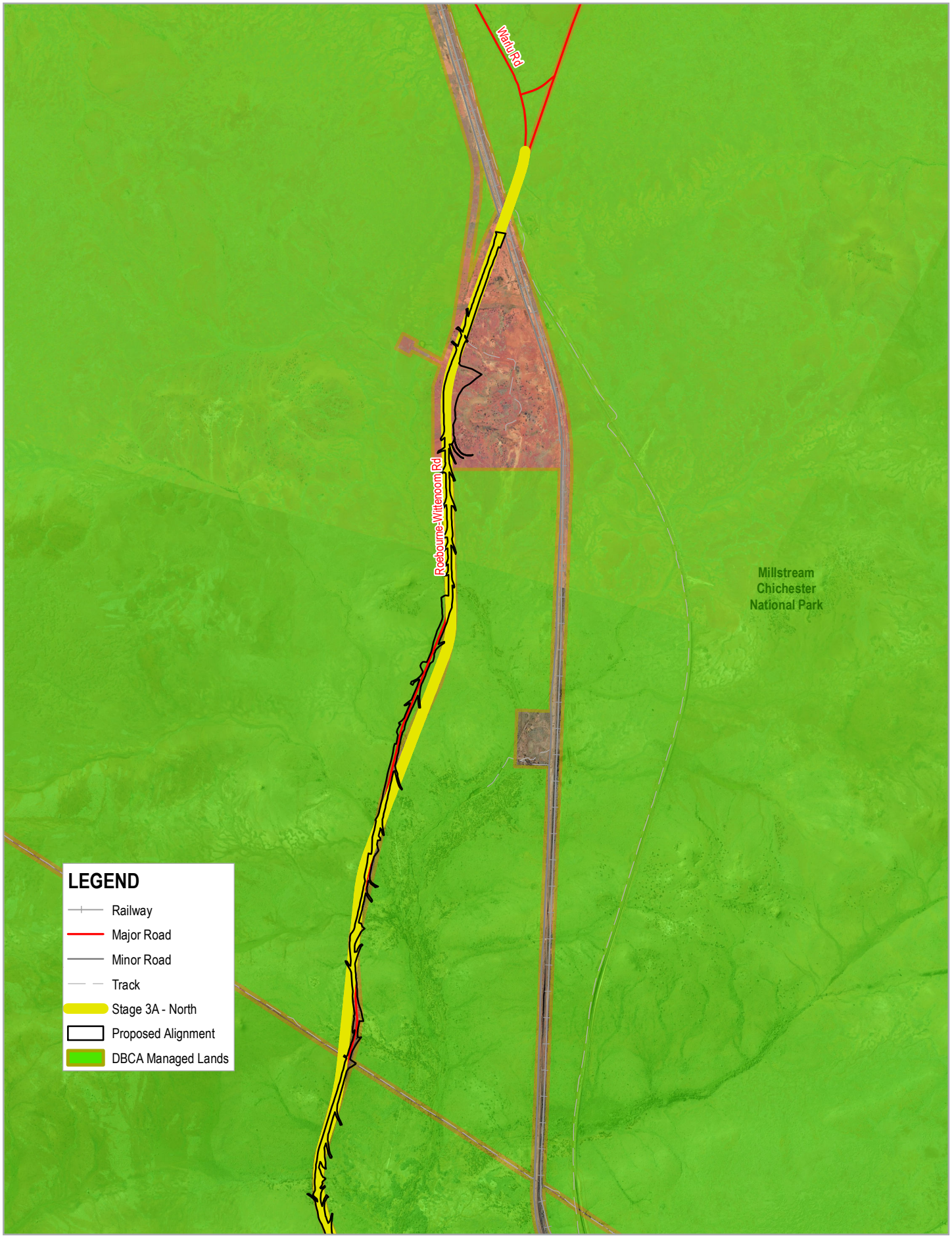

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GHD

Main Roads Western Australia
Karratha - Tom Price Road Stages 3 and 4a

Indicative alignment

Project No. **61-36933**
Revision No. **1**
Date **8/11/2018**

FIGURE 4

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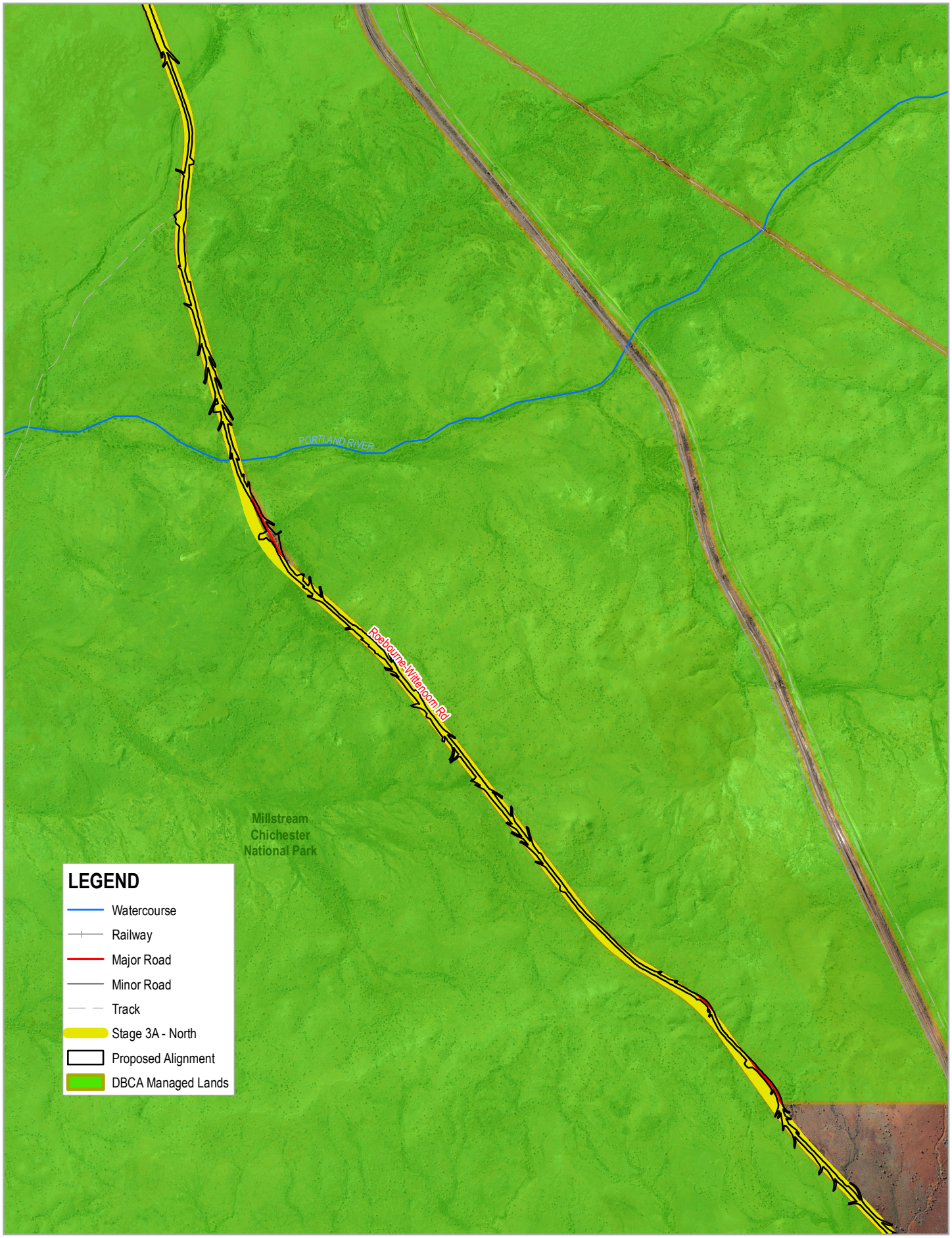

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Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 50

GHD

Main Roads Western Australia
Karratha - Tom Price Road Stages 3 and 4a

Indicative alignment

Project No. **61-36933**
Revision No. **1**
Date **8/11/2018**

FIGURE 4

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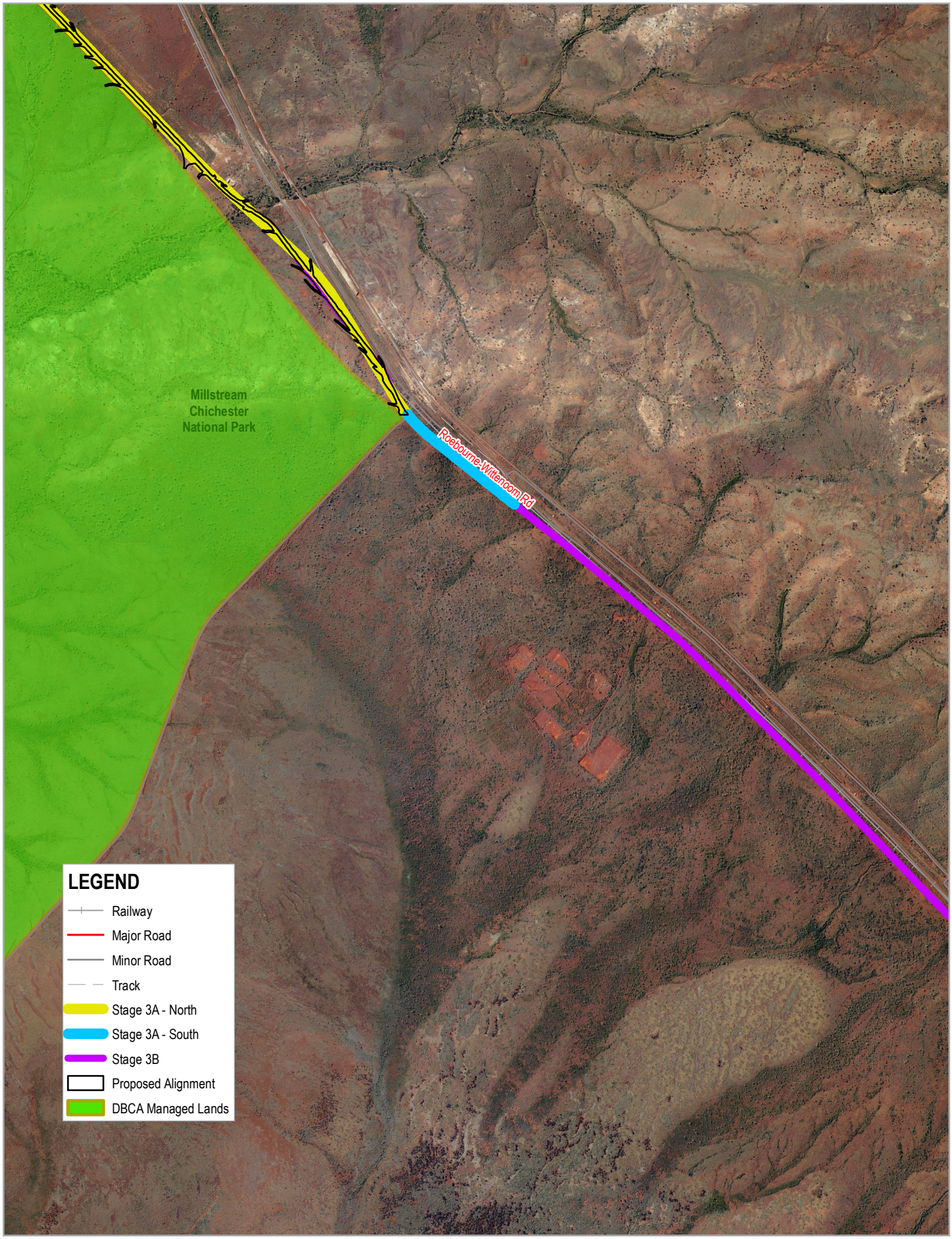

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Kilometres

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Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 50

GHD

Main Roads Western Australia
Karratha - Tom Price Road Stages 3 and 4a

Indicative alignment

Project No. **61-36933**
Revision No. **1**
Date **8/11/2018**

FIGURE 4

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1.4.2 Key assumptions and uncertainties

Flora and vegetation

The vegetation type and condition is considered to be similar to that found in the initial 2002 survey. As the area has had very limited development since 2002, and the KTP and rail access roads have small numbers of vehicles using them, the assumption that vegetation and weed presence is relatively unchanged is valid. Field assessments undertaken in March 2018 indicate that vegetation condition and weed presence within Stages 3a North has not changed significantly since the 2002 survey.

Fauna

The comprehensive survey in 2002 by Bamford Consulting is still considered to be valid, due to the limited changes to land in the vicinity of the project area and to the extensive habitat available for most fauna species recorded. An updated survey using camera trapping (GHD 2017) has provided assessment of the potential for the presence of some key threatened species.

1.4.3 Management approach

The management approach taken for this NPMP is based primarily on a risk-based assessment, and on the evidence of issues and outcomes from the construction of Stage 2 of the KTP.

The Stage 2 Management Plan was reviewed and approved by CALM (now DBCA) and, due to construction within the National Park, was subject to careful scrutiny. Compliance on all but one of the actions (Kapok weed control) was achieved.

The management approach in this NPMP is conservative, with the view of managing impacts during construction and ongoing usage of the road. The suite of existing information was used in developing the management approaches. Where necessary, current, improved processes or outcomes valid in the Pilbara region were identified and required.

A hierarchical approach to manage the potential impacts from the project has been used:

- Avoidance: measures taken to avoid impact
- Minimisation: measures taken to reduce the duration, intensity and/or extent of impact
- Restoration: measures taken to restore previously existing conditions.

1.4.4 Rationale for choice of provisions

The outcome of the project is expected to remain fairly static over a number of years, with ongoing impacts including:

- Maintenance and/or replacement of the seal, road edges and road furniture
- Maintenance and repair of constructed drainage
- Ongoing control of significant weeds, as required
- Little likely increase in traffic volumes
- Little likely change to adjacent landuse.

Possible external effects of increases in rainfall intensity may occur as a result of climate change. These may cause increases in runoff and associated erosion or ponding, however road design criteria include drainage design for a 1 in 50 year or 1 in 100 year flood event.

2. Management Plan Provisions

2.1 Management systems and implementation

Main Roads has an integrated management system that incorporates an ISO 14001:2018 certified Environmental Management System.

2.1.1 Roles and responsibilities

Stage 3a North is likely to be constructed via a 'construct only' contract, whereby road design and construction supervision are undertaken by Main Roads and their consultants. Main Roads is responsible for all aspects relating to the road construction planning and design as well as for the ultimate compliance of the construction contractor. Key roles for the construction of the project and contact details are as follows:

Position	Name	Telephone number
Construction Superintendent – Main Roads	Chamara Dias	(08) 9172 8896
Construction Manager – Construction contractor	TBA	
Environment Officer – Main Roads	Gaynor Owen	(08) 9323 6293

2.1.2 Communication

Communication during the construction phase will occur on a daily, weekly or as-needed basis with relevant staff, project managers or external stakeholders. Project communication will be subject to the requirements of the construction contact, as determined by Main Roads, but will, as a minimum, include the requirement for a communication log with external stakeholders and the public.

Key external stakeholders will include:

- DWER
- DBCA – primarily through Karratha PaW office
- Shire of Ashburton
- Pilbara Iron Railway
- Rio Tinto Iron Ore.

2.1.3 Environmental awareness training and inductions

All construction personnel and sub-contractors will undergo an induction, which includes information on the importance of vegetation protection and rehabilitation and the requirements to enable excellent environmental outcomes to be achieved. They will be advised of their responsibilities with regard to the *Environmental Protection Act 1986,* the *Wildlife Conservation Act 1950* and *Conservation and Land Management Act 1984*, including project approval and contractual requirements. This NPMP and other management plans will form the basis of the induction. Where the management plans differ, the NPMP will take precedence where impacts to the National Park are possible.

A record of inductions will be kept by the Site Manager.

Regular toolbox meetings will be used to reinforce messages on environmental protection, to relay new information and to encourage and celebrate positive outcomes.

2.1.4 Monitoring

Daily and weekly observations of the construction site will be conducted to ensure the objectives of this NPMP are implemented and that the required management actions are in place.

Waterways structures and their resulting impact on natural waterways will be regularly monitored during the construction period and the maintenance period (7 years). Main Roads will undertake inspections after any major storm event (e.g. cyclones) as is currently the practice.

2.1.5 Environmental incidents / non-compliances

Environmental incidences and non-compliances will be identified and recorded as soon as possible by the relevant responsible persons. Incidents will be mitigated or rectified where possible within 48 hours of being identified. Non-conformances to this plan will be reported to the Main Roads Construction Superintendent within 48 hours of identification.

Any non-conformance to this plan is to be reported to DWER Compliance Branch and investigated to determine:

- Why the non-conformance occurred
- What was the environmental harm or alteration of the environment that resulted from the non-conformance
- What changes to project activities and/or management plans is required
- Measures to prevent, control or abate the environmental harm that may have occurred

2.1.6 Emergency response

Emergency response requirements will be determined by the Construction Manager and on the advice of the Shire of Ashburton and the Karratha PaW office. Response timing and preparedness will be in accordance with the Construction Management Plan.

2.1.7 Reporting

The environmental performance of the construction activities and the identification of auditing requirements will be assessed by Main Roads prior to and throughout the construction period. All documents pertaining to environmental management are required to be maintained though a system of document control, including the storage of hardcopy documents at site and archiving for handover to Main Roads upon contract completion.

Ministerial Condition 677 does not list specific reporting requirements, such as reporting of exceedance of threshold criteria. Reporting requirements specific to this NPMP are outlined in Table 2-1 and Table 2-2. Reporting on compliance with the NPMP will be undertaken annually as part of Ministerial Statement 677 Compliance Assessment Report (CAR).

If a non-conformance with this plan occurs, Main Roads will notify DWER Compliance Branch through their email address at compliance@dwer.wa.gov.au within seven days of becoming aware of the non-conformance. A report on the investigation (as per 2.1.5 above) of the non-conformance will be provided within 60 days of reporting the non-conformance.

2.2 Flora and vegetation protection

Table 2-1 Vegetation and flora – Management actions and targets for Stage 3a North

EPA Objective: *To protect flora and vegetation so that biological diversity and ecological integrity are maintained*			
Outcome – No more than 23 ha of native vegetation within the National Park removed as a result of the road construction (Ministerial Statement 677 Schedule 1, Schedule 2)			
Key environmental values: Native vegetation/fauna habitat			
Key impacts and risks: Clearing and excavation, indirect damage due to spoil storage, drainage realignment, weed spread			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/Evidence
Road Design			
Undertake design to minimise vegetation clearing and damage, including: •Retain existing road alignment and grade (to reduce cut-and-fill) wherever possible while maintaining safety standards relevant to road design criteria •Minimise drainage clearing and structures where possible while maintaining design criteria for road safety and serviceability •Increase cut batter slopes where soils are suitable.	Less than 23 ha of vegetation in the National Park is cleared for road formation and drainage.	An environmental specialist will review relevant design elements at least once during the 85% design phase and discuss options to minimise the design footprint with design team if relevant.	Final Design Report will indicate steps/reviews taken to minimise clearing.
Road construction			
Undertake road construction planning and works to minimise vegetation clearing and damage as follows: • Road formation clearing and drainage will be retained within a 60 m (total width) zone around the existing Roebourne Wittenoom Road wherever possible. The road will be predominantly 9 m wide (7 m road and two 1 m wide shoulders) and up to 20 m including drainage structures. • Ensure roadside batters in cut-and-fill areas are revegetated using locally native species in order to stabilise the batter and blend into the surrounding environment. • No construction of side tracks within the National Park	Less than 23 ha of vegetation in the National Park is cleared. There is minimal detrimental indirect impact to adjacent vegetation.	Ongoing monitoring by Construction Manager. Proposed clearing areas will be checked by the Environmental Supervisor or Site Supervisor after being marked out and before clearing of each section commences. Areas will be again checked within 3 days of clearing to measure actual clearing.	Weekly clearing measurements/reporting to Site Manager and Construction Superintendent. Weekly internal report on any incidents of direct or indirect damage to vegetation.

EPA Objective: *To protect flora and vegetation so that biological diversity and ecological integrity are maintained*			
Outcome – No more than 23 ha of native vegetation within the National Park removed as a result of the road construction (Ministerial Statement 677 Schedule 1, Schedule 2)			
Key environmental values: Native vegetation/fauna habitat			
Key impacts and risks: Clearing and excavation, indirect damage due to spoil storage, drainage realignment, weed spread			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/Evidence
• All laydown, hardstand, site office and spoil/materials storage areas to be outside the National Park in existing cleared areas where possible, or as agreed with DBCA. • All clearing areas to be surveyed out and pegged/flagged prior to clearing and pegs/flagging to be left in place until the completion of construction in that zone • All clearing areas to be checked by the Environmental Supervisor or Site Manager prior to clearing • Temporary fencing will be erected around vegetation to be retained in high value areas such as the mixed grassland PEC area and major creeklines • Any areas of disturbance outside the previously surveyed area will be assessed by a qualified botanist and impacts on conservation significant species (if any) agreed with the Karratha PaW office. Surveys to be undertaken in accordance with EPA Technical Guidance. • Riverine vegetation which is at risk of loss from any threats as a result of the construction process will be considered for special protection. Such protection may include 'propping up' of bank areas supporting trees or shrubs through the use of rock or soil placement. • Any hydrocarbon or chemical spills which occur will be cleaned up as soon as possible with minimal disturbance to adjoining vegetation.			

2.3 National Park protection and management

Table 2-2 National Park aspects – Management actions and targets for Stage 3a North

EPA Objective: *To protect and enhance the National Park*			
Outcome – Minimise ongoing impacts in the National Park			
Key environmental values: Native vegetation/fauna habitat			
Key impacts and risks: Ongoing maintenance, erosion damage, weed spread			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/Evidence
Design of interpretive signage and rest bays			
• This aspect was discussed with CALM at the time of Stage 2 design and construction and agreement was made at that time that signage bays within Stage 2 did not need to be delivered. • Main Roads will discuss the requirement for signage or rest bays with DBCA during the design phase of Stage 3a North and implement as agreed.	Agreement with DBCA on requirements for interpretive signs and rest bays.	Environmental Coordinator	Design review
Rehabilitation			
• Rehabilitation actions will be managed as per the **Vegetation Protection and Rehabilitation Management Plan** (VPRMP) for Stage 3a North • Ensure roadside batters in cut-and-fill areas are revegetated using locally native species in order to stabilise the batter and blend into the surrounding environment • Discuss requirements for rehabilitation repair and further monitoring with Pilbara PaW and undertake works where agreed • Monitor rehabilitation and revegetation within the Park twice a year for the first year following construction	Completion criteria as detailed in the VPRMP. Contingency actions as per the VPRMP for Stage 3a North.	Bi-yearly monitoring	VPRMP

EPA Objective: *To protect and enhance the National Park*			
Outcome – Minimise ongoing impacts in the National Park			
Key environmental values: Native vegetation/fauna habitat			
Key impacts and risks: Ongoing maintenance, erosion damage, weed spread			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/Evidence
Minimise construction impacts			
See Table 2-1	Less than 23 ha of is cleared in total for roadworks. Visual impact is minimised	Ongoing monitoring by Construction Manager.	Weekly clearing measurements/reporting to Site Manager and Construction Superintendent. Weekly internal report on any incidents of direct or indirect damage to vegetation.
Long term management of the road reserve			
• Ensure that erosion impacts are repaired and mitigated as soon as possible following occurrence • Remove silt and blockages from culverts and other drainage formations to ensure that water flows freely and does not unnecessarily damage natural drainage lines or pools • Periodically check the status of permanent or semi-permanent pools to ensure that they are not being adversely impacted by the downstream effects of the road. • Vegetation and soil which is removed through grading will be bladed out over the roadside so as not to provide a hazard or visual impact • Liaise with PaW regarding the access tracks leading off the new road that are required to remain open • Block access to unused tracks leading off the new road where possible	Minimise and manage potential ongoing impacts of the road in the Park after construction Ensure rehabilitation is effective	Periodic (event based) and annual monitoring by Main Roads as part of standard annual network inspections	Annual maintenance reports for 3 years post-construction

EPA Objective: *To protect and enhance the National Park*			
Outcome – Minimise ongoing impacts in the National Park			
Key environmental values: Native vegetation/fauna habitat			
Key impacts and risks: Ongoing maintenance, erosion damage, weed spread			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/Evidence
Weed control			
• Control Ruby Dock and Kapok in consultation with PaW as per the **Weed Control and Management Program** (WCMP). • Monitor weed presence at a suitable time after heavy rainfall events for at least two years following construction, and beyond as agreed with PaW • Vegetation growth will be sprayed with appropriate pesticide from the edge of the seal adjacent to the National Park. • A communications protocol for construction and long-term road management (e.g. rehabilitation, weed management, closure of access points, etc.), within Millstream Chichester National Park to be developed and agreed with DBCA's Pilbara Regional office (i.e. Karratha) prior to work commencing within the National Park.	Compliance with WCMP	Monitor weed presence within 6 weeks after heavy rainfall events for at least two years following construction, and beyond as agreed with PaW until completion criteria are achieved for areas adjacent to the Millstream Chichester National Park.	WCMP

3. Adaptive management

The adaptive management approach aims to reduce impacts by embedding a cycle of monitoring, reporting and implementing change (where required). This document applies the principles of adaptive management through monitoring, corrective actions and implementing changes. Adaptive management has been considered throughout this document, and the key adaptive management processes are described below.

3.1 Environmental monitoring and corrective actions

Internal monitoring of the environmental aspects of the road construction will occur throughout the project, through the Environmental Supervisor (or their delegate). Any non-conformances with this NPMP will be discussed with the Construction Manager/Construction Superintendent and rectified or mitigated as soon as possible to ensure minimal ongoing environmental harm. Where an exceedence of clearing has occurred in a local area, steps will be taken to ensure the overall clearing does not exceed the approved amount.

3.2 MP Revision

This NPMP is intended to be dynamic and may be updated to reflect changes in management practices and the natural environment with time. This will also allow flexibility to respond to new environmental impacts and adopt new technologies / management measures.

Amendments to management actions will be completed on an as needs basis. This will include revision / amendment of management actions that are not achieving the desired outcomes, environmental monitoring identifying additional impacts and management actions, changes to relevant legislation or improvements to practices to achieve a greater environmental outcome.

Changes to the management actions or targets of this NPMP will require the approval of the EPA Services prior to those changes being implemented.

Any changes will be reported through the Ministerial Statement CAR. Any key updates required to the NPMP regarding aspects relating to ecological aspects will be discussed with the Karratha PaW branch in the first instance in order to obtain the latest information available and discuss management expectations. Issues which may be amended over the course of the construction could relate to:

- Identification of Priority flora species within or immediately adjacent to the construction zone
- Identification of key weed species within or immediately adjacent to the construction zone
- Issues relating to visitor access to the National Park.

3.3 Audits

Internal and external audits will be undertaken as per the Main Roads contract schedule and the results reported back to the Environmental Supervisor where relevant, in order for them to undertake corrective actions.

4. Stakeholder consultation

In preparing this NPMP limited consultation specific to the preparation of the Management Plan has been undertaken. As detailed design and construction planning progress, stakeholder consultation will commence. This is likely to include further discussions with DBCA Pilbara PaW office.

The consultation table below is an ongoing record of consultation undertaken and will be updated as consultation relating to environmental management occurs.

Table 4-1 NPMP stakeholder consultation record

Stakholder/ contact person	Date	Type of consultation	Summary of communication	Comments received
PaW branch (Michelle Corbellini)	Nov 2015	Telephone	Discussion regarding weed information for Stage 3	Ensure an updated weed survey is undertaken.
Murray Baker (DBCA)	May 2018	Meeting	Discussion regarding clearing and weed management within the National Park	Include measures within the National Park Management Plan and Vegetation Protection and Rehabilitation Management Plan to manage the impacts from clearing and weeds within the Park.

5. References

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https://projects.ghd.com/oc/WesternAustralia1/servicerequest33karr/Delivery/Documents/6137267_REP_National Park Management Plan KTP_Rev3.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
Rev 0	A Napier	D Farrar; J Braid		D Farrar		15/06/2018
Rev 1	R Lupton	D Farrar		D Farrar		6/11/2018
Rev 2	R Lupton	D Farrar		D Farrar		20/11/2018
Rev 3	R Lupton	D Farrar		D Farrar		17/12/2018

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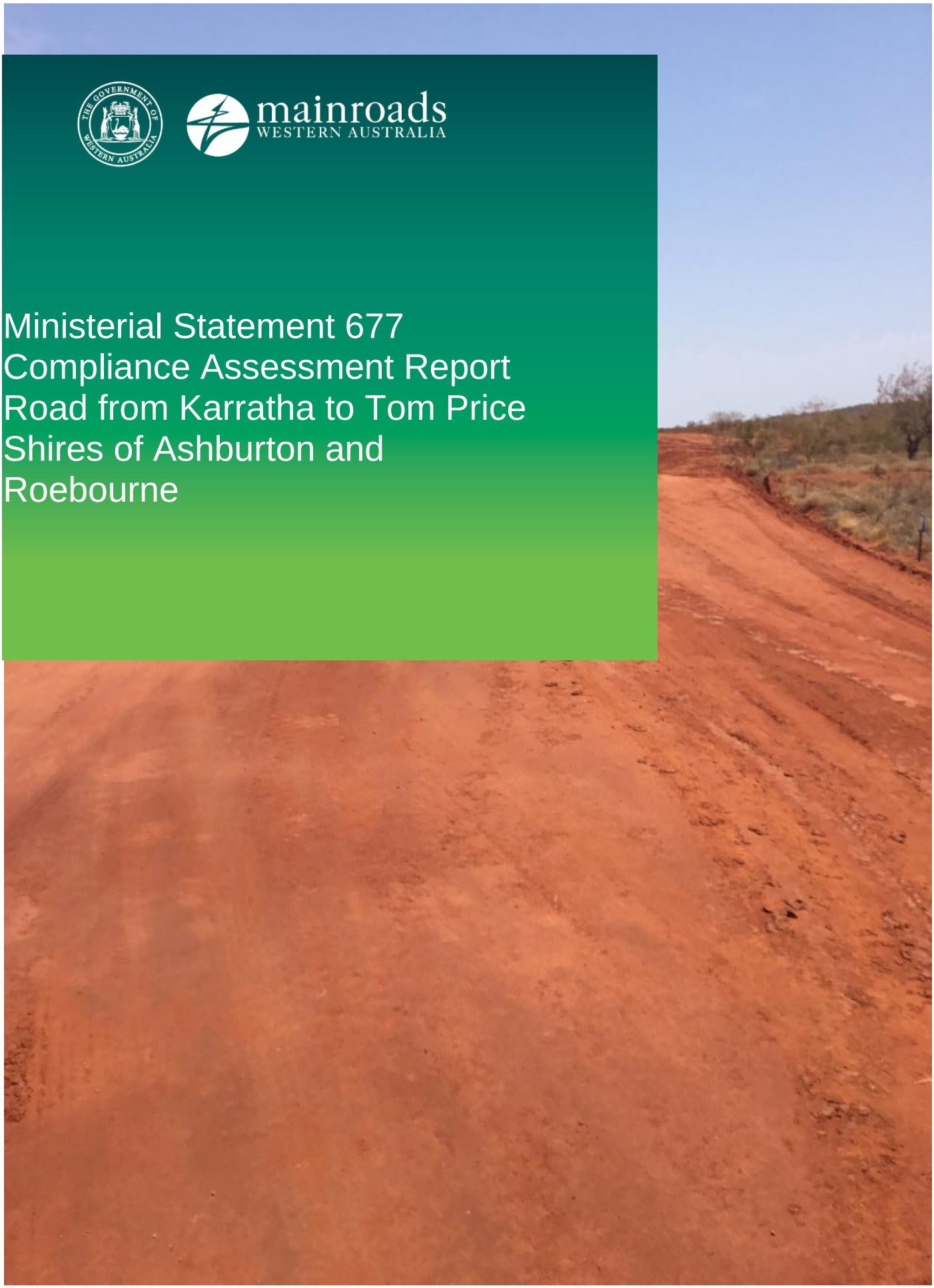
Appendix M. Ministerial Statement 677 Compliance Assessment Report October 2021



Ministerial Statement 677 Compliance Assessment Report Road from Karratha to Tom Price Shires of Ashburton and Roebourne

Contents

Introduction **1**
Background 1
Environmental Approvals 1
Purpose of this Report 1
Proposal Implementation Status **3**
Statement of Compliance **5**
Audit Tables **6**
Conclusion **18**
References **19**

Appendix A – Ministerial Statement 677 -46C Amendment
Appendix B - Main Roads Western Australia Pilbara Region Revegetation Monitoring Consultant Brief 2021 Program - Stage 3 KTP Rehabilitation Monitoring 2021, Photos & Maps
Appendix C – Letter to DBCA 23rd July 2019
Appendix D – Karratha Tom Price Road Stages 3 and 4a Construction Management Plan
Appendix E– Main Roads Karratha-Tom Price Road Stage 3 and 4a Weed Control and Management Program
Appendix F – Stage 3 Post Completion Monitoring & Weed Management Implementation
Appendix G– Offset Payment Receipt for stage 3

Introduction

Background

Main Roads Western Australia (Main Roads) has obtained approval to design and construct a connecting road between Karratha and Tom Price, in the west Pilbara (referred to as the "Project") (**Figure 1**).

The Project is being delivered in stages:

- Stage 2 – construction complete

  Included construction of approximately 90 km of new road connecting the North West Coastal Highway with the Roebourne Wittenoom Road. The Millstream Link Alliance (an alliance between Main Roads, GHD Pty Ltd, MacMahon Contractors and Coffey Geotechnical) undertook the design and construction of the Stage 2 for Main Roads between 2006 and August 2008.

- Stage 3 was completed on the 30/08/2020

  Includes the section of Roebourne Wittenoom Road between Camp Curlewis and Wallyinya Pool, and involves improvements and upgrades, including sealing of approximately 48 km of the existing Tom Price Karratha Road.

- Stage 4 – construction pending

  Involves construction of approximately 108 km of new sealed road, to the west of the Rio Tinto rail line.

Stage 3a & 3b commenced construction in October 2019 after asbestos remediation works along the unsealed Roebourne- Wittenoom Road were completed.

Most of the approved 574 ha disturbance footprint (as per MS677) will have been used in the construction of Stages 2 & 3.
Revised Proposal - Construction of Stage 4 is estimated to require up to an additional 1374 ha of ground disturbance: consisting of up to 800 ha of permanent clearing and 100 ha of temporary clearing.
Main Roads will submit a proposal to the EPA for assessment.

Environmental Approvals

Main Roads referred the Project to the Environmental Protection Authority (EPA) in September 1998. The EPA subsequently set a level of assessment for the Project as a Consultative Environmental Review (CER) (Assessment Number 1244).

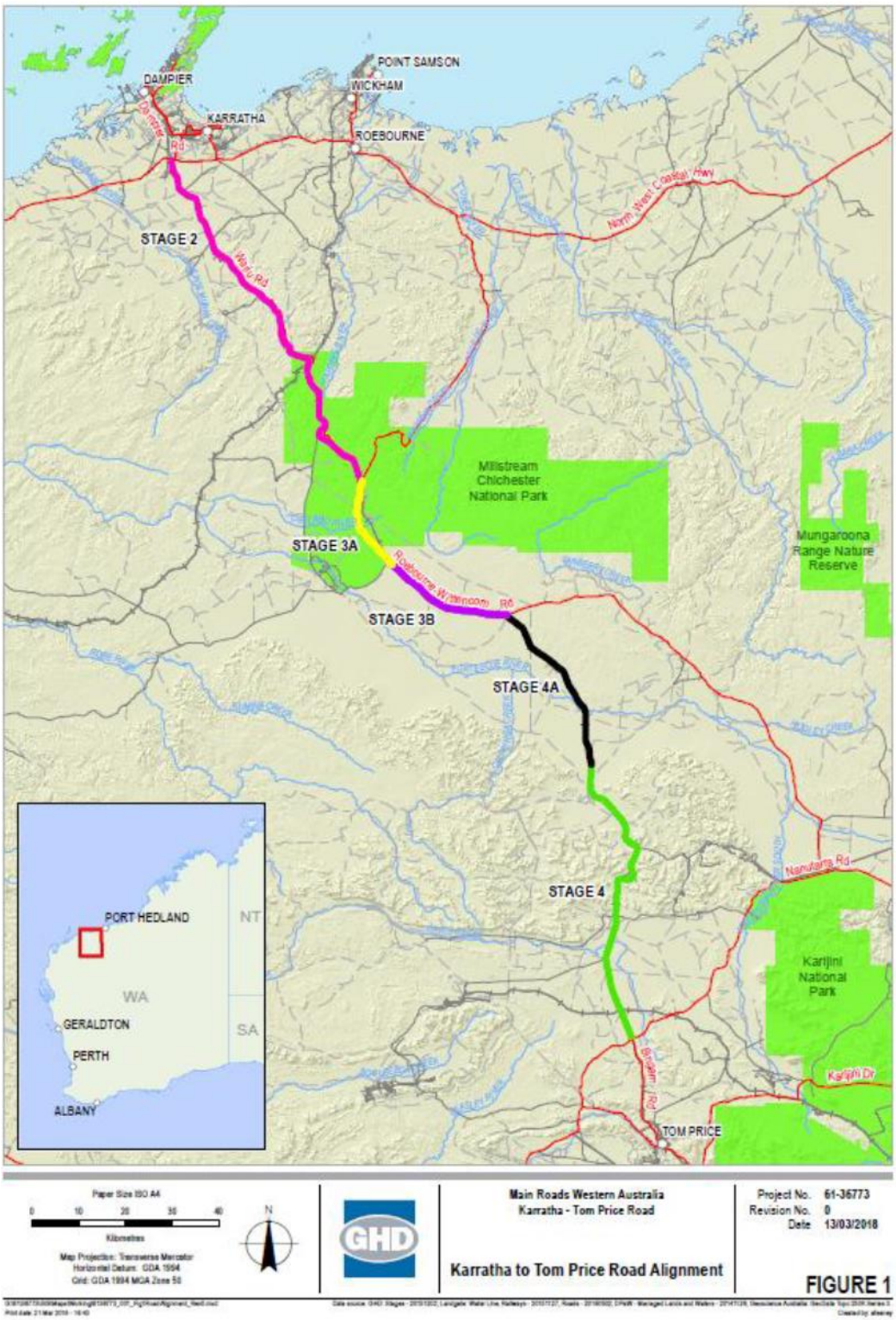
The Project was granted approval under the *Environmental Protection Act 1986* (EP Act) by the Minister for the Environment via Ministerial Statement 677 on 27 April 2005.

On the 4 May 2007 a minor change, to increase the area of vegetation to be cleared within the Millstream National Park from 110 to 145 ha, was requested. The amendment was approved on 13 July 2007.

Purpose of this Report

This Compliance Assessment Report (CAR) has been prepared to demonstrate compliance with the Conditions set out in Ministerial Statement 677.

Figure 1 Karratha to Tom Price Road Alignment



Proposal Implementation Status

Stage 2 – completed in August 2008.

Stage 2 was delivered as follows:

- pre-construction and construction – 2006 to 2008 via the Millstream Alliance
- monitoring and maintenance – undertaken by the Millstream Alliance for a period of 7 years following completion (from August 2008)
- environmental offsets were included in the Ministerial requirements. One of the offsets involved contributing $25,000 per year to the then Department of Environment and Conservation (DEC), for five years, towards a weed control program for areas within Millstream-Chichester National park. These payments have been completed.

Environmental Management Plans (EMPs) for Stage 2 of the overall Road from Karratha to Tom Price Project were submitted to, and accepted by, the then Department of the Environment (DoE) in May 2006. The following six EMPs addressed the requirements of commitments 2, 4, 10, 12 and 14 of Ministerial Statement 677:

1. Environmental Management Plan Preconstruction
2. Environmental Management Plan Construction
3. Aboriginal Heritage Management Plan
4. National Park Management Plan
5. Vegetation Protection and Rehabilitation Management Plan
6. Surface Drainage Management Plan

Stage 3a & Stage 3b – Construction commenced in October 2019 after asbestos remediation works along the unsealed Roebourne- Wittenoom Road, were completed. Stage 3 construction was completed on the 30/08/2020.

Environmental Management Plans (EMPs) for Stage 3a & Stage 3b of the overall Road from Karratha to Tom Price Project were submitted to, and accepted by, the EPA in 2018. The following six EMPs addressed the requirements of commitments 2, 4, 10, 12 and 14 of Ministerial Statement 677:

1. Environmental Management Plan Construction
2. Cultural Heritage Management Plan
3. National Park Management Plan
4. Vegetation Protection and Rehabilitation Management Plan
5. Weed control and management plan
6. Surface Drainage Management Plan

Discussions have continued with DBCA in regard to the design of appropriate interpretive signage and rest bays as per commitment 10.2.

Stage 4 – Currently in Planning Phase

Main Roads completed geotechnical investigation works for Stage 3 and 4a of the Project (Golder Associates 2017) and a Northern Quoll survey (GHD 2017). The geotechnical works included:

1. an assessment of the subsurface soil and groundwater conditions
2. pavement thickness and bituminous seal design
3. preliminary assessment of material quantity and quality

4. excavation of 146 test pits in September 2017.

The Northern Quoll investigation involved a desktop and field reconnaissance survey (July 2017), including camera trapping and habitat assessment. The survey did not record any Northern Quolls or their core habitat. Three small areas of supportive habitat were present; however, it was considered unlikely that the Northern Quoll would regularly utilise the area. They may opportunistically utilise area during times of dispersal.

Revised Stage 4 Proposal - Construction of Stage 4 is estimated to require up to an additional 1,374 ha of ground disturbance: consisting of up to 800 ha of permanent clearing and 100 ha of temporary clearing. Main Roads will submit a proposal to the EPA for assessment.

Statement of Compliance

Ministerial Statement 677 provided a list of compliance requirements, including pre-construction and post-construction actions. These actions were then developed into an Audit Table in consultation with the EPA Services Unit (now EPA Services) staff. For consistency with previous CARs (2011 and 2015), the agreed Audit Table has been used for this CAR.

The Ministerial Statement and EMPs have been complied with over the reporting period. Table 1 (audit table), Table 2 (proposal key characteristics compliance) and Table 3 (proponent environmental management commitments compliance) and their attachments provides all necessary details on compliance and performance.

The compliance documentation relates to Stage 3 and 4 of the Project. Tom Price Road Stage 2 was completed in August 2008, and all conditions and commitments are considered to be either compliant or complete. Please refer to previous CAR reports for information on Stage 2.

Audit Tables

The following audit tables (Table 1 – Table 3) include all of the commitments and conditions associated with Ministerial Statement 677 consistent with EPA's (2012) Post Assessment Guideline No. 3 - *Post Assessment Guideline for Preparing a Compliance Assessment Report*.

Table 1 Summary of Compliance with Environmental Approval Conditions (Ministerial Statement 677)

Audit Code / Subject	Condition / Action	Compliance Status	Further Information	Supporting Documentation
677: M1.1 Implementation	The proponent shall implement the proposal as documented in Schedule 1 of Statement 677 subject to the conditions of this statement.	Compliant	The area to be disturbed as specified in Statement 677, Condition 7-2 was amended under Section 46C of the EP Act from 110 hectares to 145 hectares on the 13th July 2007. Approximately 48 km of road is currently under construction within the agreed corridor connecting North West Coastal Highway with the Roebourne Wittenoom Road – referred to as Tom Price Road Stage 3 works. Stage 3 Completion Date 30/08/2020 Stage 4 is currently within the planning stage pending construction. The planned design is currently within the limits set out in Schedule 1.	Table 2 details key differences between Schedule 1 key proposal characteristics and design characteristics that form Stage 3 of the road from Karratha to Tom Price. Stage 4 is yet to be constructed- and currently being reviewed. Main Roads will submitted a proposal to the EPA on the 1st of December 2020.
677: M2.1 Proponent Commitments	The proponent shall Implement the environmental management commitments documented in Schedule 2 of Statement 677, to the requirements of the Minister for the Environment on advice of the EPA.	Compliant	Stage 3 – Six (6) Environmental Management Plans (EMPs) were submitted to and accepted by the then Department of Environment in November 2018. The EMPs were also sent to the then Department of Indigenous Affairs (DIA) and Department of Biodiversity Conservation and Attractions (DBCA). These EMPs addressed the requirements of Commitments 2, 4, 10, 12 and 14 of Ministerial Statement 677.	Stage 3 Letters of Acceptance were included as Appendices in the 2019 CAR report.
677: M3.1 Proponent nomination and contact details	The proponent for the time being nominated by the Minister for the Environment, under S38(6) or (7) of the EP Act is responsible for the implementation of the proposal until the Minister has revoked this nomination and nominated another person in respect of the proposal under S38(7) of the EP Act.	Compliant	Proponent – Main Roads Western Australia	
677: M3.2 Change in Proponent	Any request for a change in proponentship shall be accompanied by a copy of the Minister's statement endorsed with an undertaking by the proposed replacement proponent to carry out the proposal in accordance with the conditions and procedures set out in Statement 677. Contact details and appropriate documentation on the capability of the proposed replacement proponent to carry out the proposal shall	Compliant	No change to the proponent.	

Audit Code / Subject	Condition / Action	Compliance Status	Further Information	Supporting Documentation
	also be provided.			
677. M3.3 Proponent	Notify the DoE of any change of proponent contact name and address.	Compliant	No change – as above.	
677. M4.1 Commencement	If the proposal has not been substantially commenced within five years of the date of this statement, the approval to implement the proposal as granted in Statement 677 shall lapse and be void.	**Complete**	Construction of Stage 2 commenced in June 2006 and opened to the public on 3 August 2008. Construction of Stage 3 commenced in October 2019 and was completed on the 30th August 2020. Stage 4 Revised Proposal with the EPA for Consideration	.
677:M4.2 Commencement	Make an application to the Minister for the Environment for any extension of approval for the substantial commencement of the proposal beyond five years from the date of Statement 677.	**Complete**	See above	
677:M5.1 Compliance Auditing	Prepare an audit programme and submit compliance reports to the DoE	Compliant	This is the second CAR to be submitted to DWER since stage 3 commencement of construction October 2019. Stage 3 construction was completed on the 30/08/2020. CARs will continue to be submitted on an annual basis for ongoing monitoring and spraying associated with Stage 3 completion. Stage 4 is in the planning phase; construction commencement timeline is still to be determined.	
677:M6.1:1 Weed control - Construction	In addition to commitment 4 (Vegetation Protection and Rehabilitation Management Plan) in schedule 2, to manage and control the spread of weeds, the proponent shall ensure that (1.) earthmoving vehicles and construction equipment are free of soil and vegetative material prior to entering the construction area; (2.) quarries and borrow pits are surveyed for Ruby Dock (*Acetosa vesicaria*) prior to utilising the material from these pits for road construction; (3.) borrow pits and areas containing Ruby Dock (*Acetosa vesicaria*) are delineated in the field (by roping or a system of markers) to prevent access for construction crews and machinery; and (4.) soil and construction materials brought into the construction area from other areas are weed free.	Compliant – Stage 3	Stage 3 - Compliance in accordance with the Vegetation Protection and Rehabilitation Management Plan has been ongoing throughout the construction phase of Stage 3. Pre-clearing Weed Assessments were conducted in July 2018 by Ecologia Environmental and recorded a total of twelve weed species during the study. All species are listed as Permitted -s11 on the Western Australian Organism List and are not Weeds of National Significance. All species have a 'high' ecological impact rating and 'rapid' invasiveness rating in the Pilbara according to the Weed Prioritisation Process, except for *F. trinervia* and *M. pyramidata*, which are not rated. *Rumex vesicarius* (ruby dock) was not recorded during the survey. No Ruby Dock was identified in the Stage 3 project area during 2019 pre-construction weed surveys. Weed and seed inspections are being completed on imported machinery, equipment, and materials. Imported crushed aggregates contain a low weed	Main Roads Karratha-Tom Price Road and Pannawonica-Millstream Road Weed Survey included as Appendix B in the 2020 CAR report.

Audit Code / Subject	Condition / Action	Compliance Status	Further Information	Supporting Documentation
			risk due to being excavated from hard rock quarries with no soil content. All topsoil within the clearing boundary has been encapsulated in purpose built sealed containment cells and will be covered by the KTP road pavement upon the completion of works due to the presence of asbestos in the upper soil layer. Risk of weeds spreading once buried to this depth is greatly reduced. Construction of Stage 4 has not yet commenced. Pilbara Environmental – weed management contact setup after completion of Stage 3, contract to be renewed annually.	
677:M6.1:2.1 Weed control - Design	Prepare a Weed Control and Monitoring Program in collaboration with the neighbouring railway operator(s) with the objective of controlling and eradicating existing weeds and future outbreaks of weeds along the road, particularly Ruby Dock (*Acetosa vesicaria*), both during and following construction.	Compliant	Stage 3 – April/May 2018 Ecologia Environmental consultants completed a biological weed survey for Stage 3 on behalf of Main Roads. Stage 3 – Weed Control and Management Plan – Karratha Tom Price Road Stage 3 and 4a approved by DBCA in 2019. Stage 3 – Use of the neighbouring railway operator(s) access track for access throughout the project requires Main Roads to manage Weeds during construction. Stage 4 - Flora and Weed Surveys are in progress.	Appendix B- Main Roads Karratha-Tom Price Road and Pannawonica-Millstream Road Weed Survey included as Appendix B in the 2020 CAR report. Appendix E- Main Roads Karratha-Tom Price Road Stage 3 and 4a Weed Control and Management Program.
677:M6.1:2.2 Weed control - Construction	Implement a Weed Control and Monitoring Program in collaboration with the neighbouring railway operator(s) with the objective of controlling and eradicating existing weeds and future outbreaks of weeds along the road, particularly Ruby Dock (*Acetosa vesicaria*), both during and following construction.	Compliant	Stage 3 – The Weed control and Management Program commenced implementation for Stage 3 commenced implementation with construction in 2019. Stage 4 – not relevant at this time - only preliminary investigation works have been undertaken. Monitoring and weed management will be undertaken as part of construction.	Appendix E- Main Roads Karratha-Tom Price Road Stage 3 and 4a Weed Control and Management Program.
677:M6.1:2.3 Weed control – Post construction	Implement a Weed Control and Monitoring Program in collaboration with the neighbouring railway operator(s) with the objective of controlling and eradicating existing weeds and future outbreaks of weeds along the road, particularly Ruby Dock (*Acetosa vesicaria*), both during and following construction.	Compliant	Weed management has been implemented during construction of Stage 3 as prescribed in the weed management plan including weed hygiene checks of vehicles, post rainfall inspections of waterways and weekly site environmental inspections. Evidence of these can be provided upon request. Stage 3 – Ruby Dock has not been recorded during site construction nor was recorded during the 2018 Main Roads Weed Survey (Page iv). Pilbara Environmental – weed management contract setup after completion of stage 3, contract to be renewed annually. Pilbara Environmental, Managing Director Nick Tidmarsh. 'The primary weeds were Buffel Grass	Appendix E- Main Roads Karratha-Tom Price Road and Pannawonica-Millstream Road Weed Survey included as Appendix B in the 2020 CAR report. Pilbara Environmental 2021. Update – email from Nick Tidmarsh Managing Director - 26 July 2021 KTP Car Report Appendix E Pilbara Environmental KTP spot spraying within rehabilitated areas completed 1st July 2021.

Audit Code / Subject	Condition / Action	Compliance Status	Further Information	Supporting Documentation
			and Kapok. The rehab is generally looking quite good although ongoing vigilance/management of weeds will be crucial while the natives establish.' Stage 4 – not relevant at this time - only preliminary investigation works have been undertaken. Monitoring and weed management will be undertaken as part of the construction of this stage.	KTP Car Report Appendix E Allington Agri Roadside Herbicide Spraying Red Dog Hwy M065 SLK 0.00 – 76.71 Spraying 19 April 2021 Red Dog Hwy M065 SLK 0.00 – 15.00 Spraying 20 April 2021 Red Dog Hwy M065 SLK 76.71 – 136.32 Spraying 20 April 2021
677:M7.1 Vegetation Protection	Limit the disturbance width of the road where it traverses the Themeda grassland threatened ecological community, near Hamersley Station, as shown in Figure 2 in schedule 1 in the Minister's statement 677, to not more than 20 metres.	Compliant	Stage 3 – not applicable Stage 3 does not intersect the Themeda grassland. Stage 4 – not applicable as works have not yet commenced.	
677:M7.2 Vegetation Protection	Limit the area of vegetation to be cleared within the Millstream-Chichester National Park to not more than 110 hectares.	Compliant	Stage 3- Construction ongoing. 11 hectares of clearing within the National Park has occurred to date for these works. Stage 3 - The National Park Management Plan was approved by the EPA in December 2018. Stage 4 – Not applicable stage 4 does not intersect the National Park. The development envelope for Stage 4 does not intersect a National Park or any conservation reserve.	Stage 4 - Manuwarra Red Dog Highway - Revised Proposal. https://www.epa.wa.gov.au/proposals/manuwarra-red-dog-highway-%E2%80%93-revised-proposal
677:M7.3:1 Rehabilitation - Constriction	Rehabilitate (1) approximately 137 hectares of land disturbed for the construction of the road; and either (2)(a) approximately 205 hectares of redundant access tracks, including those tracks associated with the railway, and redundant material pits as an environmental offset activity, or (2)(b) alternative offsets of equivalent cost/value, developed in liaison with the Department of Conservation and Land Management, and which deliver greater biodiversity outcomes. NOTE: For the purpose of this condition, the specific locations, and methods and procedures for rehabilitation shall be included in the Vegetation Protection and Rehabilitation Management Plan (see commitment 4).	Compliant	Stage 3 and 4 – In a letter to Main Roads dated 20 September 2007 the Regional Manager of DEC Pilbara agreed that in addition to rehabilitating (1) 137 ha disturbed by the construction of the road, Main Roads would choose option (2)(b) – provision of an alternative offset for an equivalent cost. An offset amount of $2,500 per hectare of rehabilitation works was agreed to by DEC and Main Roads. Main Roads will request an invoice from DBCA for the offset for Stages 3 and 4 once the detailed design work for both stages has been completed. On the 28 May 2020 MRWA paid DBC $197669.87 for offsetting implementation of stages 3 KTP. Additional offsets will be required for the new Ministerial Statement for Stage 4 KTP.	Evidence of Payment for $50,000 offset -for stage 2 works was included as 'Appendix M' in the 2018 CAR Report. KTP Car Report Appendix F Stage 3 Offset Payment 30/07/2020

Audit Code / Subject	Condition / Action	Compliance Status	Further Information	Supporting Documentation
677:M7.3:2 Rehabilitation – Post construction	Rehabilitate (1) approximately 137 hectares of land disturbed for the construction of the road; and either (2)(a) approximately 205 hectares of redundant access tracks, including those tracks associated with the railway, and redundant material pits as an environmental offset activity, or (2)(b) alternative offsets of equivalent cost/value, developed in liaison with the Department of Conservation and Land Management, and which deliver greater biodiversity outcomes. NOTE: For the purpose of this condition, the specific locations, and methods and procedures for rehabilitation shall be included in the Vegetation Protection and Rehabilitation Management Plan (see commitment 4).	Compliant	Offset paid for Stage 3. Rehabilitation of disturbed land will commence for Stage 3 upon completion of construction activities. Pilbara Environmental - KTP Road Rehab – The site was ripped, and topsoil respread in 2020. Rehab site vegetation monitoring Feb 2021 – July 2021 Pilbara Environmental Rehabilitation Report to be provided within the Appendix of next year's CAR Report 2022	Appendix G– Offset Payment Receipt for stage 3 Appendix B Main Roads Western Australia Pilbara Region Revegetation Monitoring Consultant Pilbara Environmental 2021. KTP Monitoring Information – email from Nick Tidmarsh Managing Director - 19 July 2021 Brief 2021 Program - Stage 3 KTP Rehabilitation Monitoring 2021, Photos & Maps
677:M7.4 Rehabilitation	Develop rehabilitation completion criteria to apply to the rehabilitation required by condition 7-3. The rehabilitation completion criteria shall have timeframes and shall be included in the Vegetation Protection and Rehabilitation Management Plan (see commitment 4 in schedule 2).	Compliant	Stage 3 - Vegetation Protection and Rehabilitation Management Plan was approved by the EPA in November 2018 with similar completion criteria as stage 2 please refer to section 2.2.1 for full description. Stage 4 rehabilitation is not applicable, construction has not commenced.	Stage 3 Letters of Acceptance were attached as Appendix in 2018 CAR Report.
677:M7.5:1 Progress of rehabilitation - Construction	Monitor the progress of rehabilitation against the rehabilitation completion criteria referred to in condition 7-4 and implement contingency measures and supplementary rehabilitation works where the criteria are not being met	Compliant	Construction of Stage 3 commenced in October 2019 and was completed 30 August 2020. Stage 3 – Rehabilitation has been completed (rip and monitor) as per the management plan, The current reporting periods ongoing monitoring and weed control has been completed as per management plan. Pilbara Environmental - KTP Road Rehab – The site was ripped, and topsoil respread in 2020. Rehab site vegetation monitoring Feb 2021 – July 2021. Stage 4- Not applicable yet as construction has not commenced. Stage 4 currently revised proposal to the EPA.	Stage 4 - Manuwarra Red Dog Highway - Revised Proposal https://www.epa.wa.gov.au/proposals/manuwarra-red-dog-highway-%E2%80%93-revised-proposal
677:M7.5:2 Progress of rehabilitation – Post - Construction	Monitor the progress of rehabilitation against the rehabilitation completion criteria referred to in condition 7-4 and implement contingency measures and supplementary rehabilitation works where the criteria are not being met	Compliant	As above Pilbara Environmental, ongoing monitoring of rehabilitated areas is part of the weed management contract. Stage 4 – not relevant at this time - only preliminary investigation works have been undertaken. Monitoring and weed management will be undertaken as part of the construction of this stage.	

Table 2 Summary of Compliance with Schedule 1 – Proposal Key Characteristics

Element	Description	Compliance Status	Further Information	Supporting Documentation
Length	Approximately 245 km	Compliant	Approximately 88 km constructed as part of Stage 2. Approximately 48 km of road and associated drainage systems currently under construction as part of Stage 3.	
Connections to existing roads	North West Coastal Highway Roebourne–Wittenoom Road Millstream–Yaraloola Road Mt Bruce Road Nanutarra–Munjina Road	Compliant	Stage 2 – has constructed the North West Coastal Highway Roebourne–Wittenoom Road Stage 3- Currently under construction connecting Millstream–Yaraloola Road Mt Bruce	
Area of disturbance Road formation	Approximately 505 hectares – of this, approximately 149 hectares will be rehabilitated following construction.	Compliant	A total of approximately 490 hectares of land has been disturbed to date with ongoing construction of Stage 3, of which approximately 133.5 hectares occurred within the Millstream-Chichester National Park. Approximately 340 hectares was cleared due to the permanent alignment. The 148 hectares of temporarily disturbed land available for rehabilitation.	The area to be disturbed as specified in EPA Statement 677, Condition 7-2 was amended under Section 46C from 110 hectares to 145 hectares on the 13th July 2007.
Material sources	Approximately 100 hectares.	Compliant	Approximately 113 hectares has been cleared for material pits in Stages 2, 3a and 3b.	
Design Speed	110 kilometres per hour.	Compliant	110 kilometres per hour	
Formation width	Approximately 9 metres.	Compliant	Approximately 9 metres	
Waterways crossings	Culverts and low-level floodways will be used for all other waterway crossings.	Compliant	No bridges. Twenty-four (24) low-level floodways are currently being constructed as part of Stage 3 works.	
Railway crossings		Compliant	Zero (0) level crossings are included in Stage 3 scope.	
Fencing of road reserve	Approximately 200 kilometres of fence will be erected along the road reserve outside the Millstream-Chichester National Park.	Compliant - amended	Fencing of the road reserve occurred outside of the Millstream-Chichester National Park. It was agreed by the Regional Manager of DEC, Pilbara and the Project Director of Main Roads on 15 August 2008 that the western boundary was a higher priority as it contained several entry points for cattle into the park. Main Roads agreed that an amount of $4,000 per kilometre would be provided to fence 30	Evidence of Payment for $120,000 for fencing installation included as 'Appendix M' in the 2018 CAR Report.

Element	Description	Compliance Status	Further Information	Supporting Documentation
			km. In a letter from DEC dated 20 September 2007 DEC agreed to invoice Main Roads $120,000 for the fencing of the western boundary of Millstream Chichester National Park. Main Roads has confirmed payment to DEC for the $120, 000.	

Table 3 Summary of Compliance with Proponent Environmental Management Commitments

Audit Code	Commitment	Management Strategy	Phase	Compliance Status	Further Information	Supporting Documentation
677:P1	Employ a dedicated environmental co-ordinator	(1) To ensure that environmental co-ordination is effective. (2) To provide environmental advice and to supervise clearing and rehabilitation activities, particularly in the Millstream-Chichester National Park and the section of the road which traverses the threatened ecological community.	Overall – All Stages	Compliant	Main Roads has engaged a dedicated Environmental Co-ordinator for Stage 3 works construction planning, and implementation. Contractors responsible for construction have a dedicated environmental representative on site at all times responsible for daily site monitoring and management of compliance conditions on site.	
677:P2	Prepare a Surface Drainage Management Plan	To maintain existing drainage patterns and to prevent soil erosion and sedimentation caused by construction activity or new waterways structures	Design	Complete	Stage 3 – Surface drainage Management Plan was accepted by EPA in July 2018.	Stage 3 Letters of Acceptance were included as appendix in 2019 CAR report.
677:P3.1:1	Implement Surface Drainage Management Plan	To maintain existing drainage patterns and to prevent soil erosion and sedimentation caused by construction activity or new waterways structures	Construction / All Stages	Compliant	Stage 3 – Surface drainage Management Plan requirements have been integrated into project design and Construction Environmental Management Plan which commenced implementation with construction in 2019. Stage 4- Not applicable yet as construction has not commenced.	
677:P3.1:2	Implement Surface Drainage Management Plan		Post – construction	Compliant	Stage 3 and 4 - not applicable yet as construction has not been completed.	
677:P4	Prepare a Vegetation Protection and Rehabilitation Management Plan.	To prevent loss of vegetation beyond the ‘footprint’ of the works, and minimise potential indirect effects on vegetation. To rehabilitate areas disturbed by construction of the road	Design	Complete	Stage 3 - Vegetation Protection and Rehabilitation Management Plan was approved by the EPA in December 2018.	Stage 3 Letters of Acceptance were included as appendix in 2019 CAR report.
677:P5.1:1	Implement the Vegetation Protection and Rehabilitation Management Plan		Construction	Compliant	Stage 3 – Vegetation Protection and Rehabilitation Management Plan requirements integrated into project design and Construction Environmental Management Plan which commenced implementation with construction in 2019.	

Audit Code	Commitment	Management Strategy	Phase	Compliance Status	Further Information	Supporting Documentation
					Stage 4- Not applicable yet as construction has not commenced.	
677:P5.1:2	Implement the Vegetation Protection and Rehabilitation Management Plan	To rehabilitate areas disturbed by construction of the road	Post construction	Compliant	Stage 3 rehabilitation has been completed, commencement of ongoing roadside spraying, rehabilitation monitoring and spot spraying as per the management plan. The current reporting periods monitoring is complete however the Consultant's Rehabilitation Monitoring Report is outstanding and will be submitted within the next years CAR Report. The rehabilitation of Stage 4 is not applicable yet as construction has not been completed.	M065 Spray Records 19th & 20th April 2021, M065 Red Dog Hwy Spraying Craig Allington from Allington Agri. Revegetation Monitoring Scope Pilbara 2021 D21#218321
677:P6	Prepare a TEC Protection and Management Plan	To ensure that construction management in the TEC is of a similar standard to that employed in the National Park, and that this is to the satisfaction of CALM	Design	NA	Not applicable to Stage 2 or 3. A TEC management plan will be submitted prior to construction of Stage 4. Geotechnical works for Stage 3 and 4a were located north of the Themeda grassland TEC.	
677:P7.1	Implement the TEC Protection and Management Plan		Design	NA	See above.	
677:P7.2	Implement the TEC Protection and Management Plan		Construction	NA	See above.	
677:P7.3	Implement the TEC Protection and Management Plan		Post - construction	NA	See above	
677:P8.1	Prepare a scientifically based rehabilitation trial for the treatment of redundant roads and tracks	To rehabilitate redundant tracks and to provide information on best practice methodology for use by Main Roads and others in the Pilbara in the future	Construction	Compliant	Rehabilitation trial was completed during Stage 2 works.	Rehabilitation Trial for stage 2 was included as appendix in 2019 CAR report.
677:P8.2	Monitor and report outcomes of rehabilitation trials for the treatment of redundant roads and tracks.		Post - construction	Compliant	See above	

Audit Code	Commitment	Management Strategy	Phase	Compliance Status	Further Information	Supporting Documentation
677:P9.1:1	Rehabilitate redundant roads and tracks using results of the trials referred to in commitment 8.	To rehabilitate redundant tracks and to provide information on best practice methodology for use by Main Roads and others in the Pilbara in the future	Construction	Compliant	The majority of initially identified redundant tracks were not rehabilitated due to changed requirements from DEC Karratha Branch. A number of meetings were held between DEC and Millstream Link representatives, where a cash payment was agreed for DEC to undertake rehabilitation of redundant tracks and erect necessary fencing on behalf of Millstream Link. DEC requested amendments to Commitment 16 and Condition 7-3. During Stage 2 construction available small redundant areas were treated by ripping and where available cleared vegetation and topsoil was re-spread.	File note on meeting with DEC and changes to rehabilitation requirements was included in 2019 CAR report.
677:P9.1:2	Rehabilitate redundant roads and tracks using results of the trials referred to in commitment 8.		Post - construction	Compliant	Stage 3 rehabilitation has been completed, commencement of ongoing roadside spraying, rehabilitation monitoring and spot spraying as per the management plan. The current reporting periods monitoring is complete however the Consultant's Rehabilitation Monitoring Report is outstanding and will be submitted within the next years CAR Report. The rehabilitation of Stage 4 is not applicable yet as construction has not been completed.	M065 Spray Records 19th & 20th April 2021, M065 Red Dog Hwy Spraying Craig Allington from Allington Agri. Revegetation Monitoring Scope Pilbara 2021 D21#218321
677:P10	Prepare a National Park Plan which addresses impacts in the Millstream-Chichester National Park	To minimise the impacts of the road through the Millstream-Chichester National Park	Design	Complete	The National Park Management Plan and the Vegetation Protection and Rehabilitation Management Plan were accepted by CALM on the 6th of February 2006. Stage 3 - The National Park Management Plan was approved by the EPA in December 2018.	Stage 3 Letters of Acceptance was included as appendix in 2019 CAR report.
677:P10.1	Prepare a National Park Plan.	Design of appropriate interpretive signage and rest bays to promote understanding of Park values and protection of flora and fauna	Design	Compliant	Main Roads and DBCA had several meetings during 2019 in which rest bays and signage were discussed; negotiations are ongoing between the parties.	Main Roads and DBCA discussions regarding rest-bays are ongoing. Appendix C (Letter to DBCA)
677:P11.1:1	Implement the National Park Plan	To minimise the impacts of the road through the Millstream-Chichester National Park	Construction	Compliant	Stage 3 – National Park Plan requirements have been integrated into project design and Construction Environmental Management Plan which commenced implementation with construction in 2019. Stage 4- Not applicable yet as construction has not commenced	
677:P11.1:2	Implement the National Park Plan		Post construction	Compliant		
677:P12	Prepare an Aboriginal Heritage	To protect and preserve Aboriginal cultural heritage	Design	Complete	Stage 3 and 4 - The Cultural Heritage Management Plan was approved by the EPA on 21 June 2018.	Stage 3 Letters of Acceptance was included as

Audit Code	Commitment	Management Strategy	Phase	Compliance Status	Further Information	Supporting Documentation
	Management Plan (in compliance with the *Aboriginal Heritage Act 1972*).	within the area influenced by the roadworks				appendix in 2019 CAR report.
677:P13.1:1	Implement the Aboriginal Heritage Management Plan (in compliance with the *Aboriginal Heritage Act 1972*).		Design	Compliant	Stage 3 – Aboriginal Heritage Management Plan (in compliance with the Aboriginal Heritage Act 1972) requirements have been integrated into project design and Construction Environmental Management Plan which commenced implementation with construction in 2019. Stage 4- Not applicable yet as construction has not commenced	
677:P13.1:2	Implement the Aboriginal Heritage Management Plan (in compliance with the *Aboriginal Heritage Act 1972*).		Post Construction	Compliant	Stage 3 construction was completed on the 30/08/2020. Stage 4 is not applicable yet as construction has not commenced.	
677:P14	Prepare a Construction Management Plan	To ensure that environmentally and socially acceptable standards are established and maintained during construction works	Design	Complete	Stage 3 and 4 The Construction Management Plan was accepted by EPA in July 2018.	Stage 3 EMPs were included as appendix in 2019 CAR report.
677:P15	Implement the Construction Management Plan		Construction	Compliant	Stage 3 – Construction Management Plan requirements have been integrated into project design and Construction Environmental Management Plan which commenced implementation with construction in 2019. Stage 4- Not applicable yet as construction has not commenced	Construction Management Plan (Appendix D)
677:P16.1:1	Construct approximately 30 kilometres of fencing along the northern boundary of the Millstream-Chichester National Park where it is adjacent to Pyramid Station	To prevent stock access to the National Park	Construction	Compliant	Fencing not constructed by Millstream Link. DEC Karratha negotiated other offsets with Main Roads A number of meetings were held between DEC and Millstream Link representatives, where a cash payment was agreed for DEC to undertake rehabilitation of redundant tracks and erect necessary fencing on behalf of Millstream Link. details meeting minutes to this effect.	Evidence of Payment for $120,000 for fencing installation included as 'Appendix M' in the 2018 CAR Report
677:P16.1:2	Construct approximately 30 kilometres of		Post construction		Fencing was not constructed by Main Roads. Fencing along the northern boundary was considered to be logistically difficult by DEC Pilbara to achieve,	Evidence of Payment for $120,000 for

Audit Code	Commitment	Management Strategy	Phase	Compliance Status	Further Information	Supporting Documentation
	fencing along the northern boundary of the Millstream-Chichester National Park where it is adjacent to Pyramid Station				due to the terrain and large number of creek crossings. It was agreed by the Regional Manager of DEC, Pilbara and the Project Director of Main Roads on 15 August 2008 that the western boundary was a higher priority as it contained several entry points for cattle into the park. Main Roads agreed that an amount of $4,000 per kilometre would be provided to fence 30 kilometres. In a letter from DEC dated 20 September 2007 DEC agreed to invoice Main Roads $120,000 for the fencing of the western boundary of Millstream Chichester National Park	fencing installation included as 'Appendix M' in the 2018 CAR Report.
677:P17	Contribute $25,000 per year, for five years, towards a weed control program for the Millstream-Chichester National Park	To contribute to the overall weed control and management of the National Park, in particular the control of date and cotton palm, morning glory, khaki weed, Galland's curse, Indian water fern and Parkinsonia	Overall	Complete	Main Roads WA have completed payment to the former DEC.	Evidence of Payment for weed control included as 'Appendix M' in the 2018 CAR Report.

Conclusion

The audit tables have been prepared based on information available to Main Roads at this time. As outlined in Table 1 – Table 3 of this Compliance Assessment Report, Main Roads considers the status of the Conditions and Commitments under Ministerial Statement 677 to be compliant and/or complete for works undertaken to date.

Stage 2 of the KTP Road was completed in August 2008.

Construction of Stage 3 commenced in October 2019 and was completed 30 August 2020.

Stage 4 is still within the planning phase.

All conditions and commitments relating to Stage 2 are completed.

All conditions and commitments relating to Stage 3 are compliant.

References

Ecologia Environment 2018. Karratha - Tom Price Road and Pannawonica – Millstream Road Weed Survey. Unpublished report prepared for Main Roads – August 2018.

Main Roads 2018. Karratha - Tom Price Road Stage 3 and 4a – Weed Control and Management Program – December 2018.

GHD Pty Ltd 2018. Karratha Tom Price Road Stages 3 and 4a Construction Management Plan – June 2018

Main Roads 2021. KTP - Revegetation Monitoring Consultant Brief Pilbara Region 2021 Program – 26 February 2021

Allington Agri 2021. KTP - Daily Herbicide Spraying Record Form – 19 & 20 April 2021

Pilbara Environmental 2021. KTP Monitoring Information – email from Nick Tidmarsh Managing Director - 19 July 2021

Pilbara Environmental 2021. Update – email from Nick Tidmarsh Managing Director - 26 July 2021

https://www.epa.wa.gov.au/proposals/manuwarra-red-dog-highway-%E2%80%93-revised-proposal

Appendix A – Ministerial Statement 677 46C Amendment

Statement No.

MINISTER FOR THE ENVIRONMENT; SCIENCE 000677

STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED (PURSUANT TO THE PROVISIONS OF THE ENVIRONMENTAL PROTECTION ACT 1986)

ROAD FROM KARRATHA TO TOM PRICE
SHIRES OF ASHBURTON & ROEBOURNE

Proposal: The proposal is to construct and maintain a new road from the North West Coastal Highway, near Karratha to the Nanutarra-Munjina Road, north of Tom Price, as documented in schedule 1 of this statement.

The road which is approximately 245 kilometres in length traverses the Millstream-Chichester National Park.

Proponent: Main Roads Western Australia

Proponent Address: PO Box 6202
EAST PERTH WA 6004

Assessment Number: 1244

Report of the Environmental Protection Authority: Bulletin 1159

The proposal referred to above may be implemented by the proponent subject to the following conditions and procedures:

1 Implementation

1-1 The proponent shall implement the proposal as documented in schedule 1 of this statement subject to the conditions of this statement.

2 Proponent Commitments

2-1 The proponent shall implement the environmental management commitments documented in schedule 2 of this statement, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority

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27 APR 2005

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E-MAIL: judy-edwards@epc.wa.gov.au

3 Proponent Nomination and Contact Details

3-1 The proponent for the time being nominated by the Minister for the Environment under section 38(6) or (7) of the *Environmental Protection Act 1986* is responsible for the implementation of the proposal until such time as the Minister for the Environment has exercised the Minister's power under section 38(7) of the Act to revoke the nomination of that proponent and nominate another person as the proponent for the proposal.

3-2 If the proponent wishes to relinquish the nomination, the proponent shall apply for the transfer of proponent and provide a letter with a copy of this statement endorsed by the proposed replacement proponent that the proposal will be carried out in accordance with this statement. Contact details and appropriate documentation on the capability of the proposed replacement proponent to carry out the proposal shall also be provided.

3-3 The nominated proponent shall notify the Department of Environment of any change of contact name and address within 60 days of such change.

4 Commencement and Time Limit of Approval

4-1 The proponent shall substantially commence the proposal within five years of the date of this statement or the approval granted in this statement shall lapse and be void.

Note: The Minister for the Environment will determine any dispute as to whether the proposal has been substantially commenced.

4-2 The proponent shall make application for any extension of approval for the substantial commencement of the proposal beyond five years from the date of this statement to the Minister for the Environment, prior to the expiration of the five-year period referred to in condition 4-1.

The application shall demonstrate that:

1. the environmental factors of the proposal have not changed significantly,
2. new, significant, environmental issues have not arisen; and
3. all relevant government authorities have been consulted.

Note: The Minister for the Environment may consider the grant of an extension of the time limit of approval not exceeding five years for the substantial commencement of the proposal.

5 Compliance Audit and Performance Review

5-1 The proponent shall prepare an audit program and submit compliance reports to the Department of Environment which address:

3 Proponent Nomination and Contact Details

3-1 The proponent for the time being nominated by the Minister for the Environment under section 38(6) or (7) of the *Environmental Protection Act 1986* is responsible for the implementation of the proposal until such time as the Minister for the Environment has exercised the Minister's power under section 38(7) of the Act to revoke the nomination of that proponent and nominate another person as the proponent for the proposal.

3-2 If the proponent wishes to relinquish the nomination, the proponent shall apply for the transfer of proponent and provide a letter with a copy of this statement endorsed by the proposed replacement proponent that the proposal will be carried out in accordance with this statement. Contact details and appropriate documentation on the capability of the proposed replacement proponent to carry out the proposal shall also be provided.

3-3 The nominated proponent shall notify the Department of Environment of any change of contact name and address within 60 days of such change.

4 Commencement and Time Limit of Approval

4-1 The proponent shall substantially commence the proposal within five years of the date of this statement or the approval granted in this statement shall lapse and be void.

Note: The Minister for the Environment will determine any dispute as to whether the proposal has been substantially commenced.

4-2 The proponent shall make application for any extension of approval for the substantial commencement of the proposal beyond five years from the date of this statement to the Minister for the Environment, prior to the expiration of the five-year period referred to in condition 4-1.

The application shall demonstrate that:

1. the environmental factors of the proposal have not changed significantly,
2. new, significant, environmental issues have not arisen; and
3. all relevant government authorities have been consulted.

Note: The Minister for the Environment may consider the grant of an extension of the time limit of approval not exceeding five years for the substantial commencement of the proposal.

5 Compliance Audit and Performance Review

5-1 The proponent shall prepare an audit program and submit compliance reports to the Department of Environment which address:

1. the status of implementation of the proposal as defined in schedule 1 of this statement;

2. evidence of compliance with the conditions and commitments; and

3. the performance of the environmental management plans and programs.

Note: Under sections 48(1) and 47(2) of the *Environmental Protection Act 1986*, the Chief Executive Officer of the Department of Environment is empowered to monitor the compliance of the proponent with the statement and should directly receive the compliance documentation, including environmental management plans, related to the conditions, procedures and commitments contained in this statement.

6 Weed Control

6-1 In addition to commitment 4 (Vegetation Protection and Rehabilitation Management Plan) in schedule 2, to manage and control the spread of weeds, the proponent shall ensure that:

1. earthmoving vehicles and construction equipment are free of soil and vegetative material prior to entering the construction area;

2. quarries and borrow pits are surveyed for Ruby Dock (*Acetosa vesicaria*) prior to utilising the material from these pits for road construction;

3. borrow pits and areas containing Ruby Dock (*Acetosa vesicaria*) are delineated in the field (by roping or a system of markers) to prevent access for construction crews and machinery;

4. soil and construction materials brought into the construction area from other areas are weed free; and

5. a Weed Control and Monitoring Program is prepared and implemented in collaboration with the neighbouring railway operator(s) with the objective of controlling and eradicating existing weeds and future outbreaks of weeds along the road, particularly Ruby Dock (*Acetosa vesicaria*), both during and following construction,

to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority, the Department of Conservation and Land Management and the Department of Agriculture.

7 Vegetation Protection and Rehabilitation

7-1 During road construction, the proponent shall limit the disturbance width of the road where it traverses the *Themeda* grassland threatened ecological community, near Hamersley Station, as shown in Figure 2 in schedule 1, to not more than 20 metres.

7-2 During road construction, the proponent shall limit the area of vegetation to be cleared within the Millstream-Chichester National Park to not more than 110 hectares.

7-3 During and following construction, the proponent shall rehabilitate:

1 approximately 137 hectares of land disturbed for the construction of the road; and *either*

2(a) approximately 205 hectares of redundant access tracks, including those tracks associated with the railway, and redundant material pits as an environmental offset activity, *or*

2(b) alternative offsets of equivalent cost/value, developed in liaison with the Department of Conservation and Land Management, and which deliver greater biodiversity outcomes,

to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority and the Department of Conservation and Land Management.

For the purpose of this condition, the specific locations, and methods and procedures for rehabilitation shall be included in the Vegetation Protection and Rehabilitation Management Plan (see commitment 4).

7-4 To ensure that rehabilitation is undertaken to an acceptable standard, prior to the commencement of construction, the proponent shall develop rehabilitation completion criteria to apply to the rehabilitation required by condition 7-3, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority and the Department of Conservation and Land Management.

The rehabilitation completion criteria shall have timeframes and shall be included in the Vegetation Protection and Rehabilitation Management Plan (see commitment 4 in schedule 2).

7-5 The proponent shall monitor the progress of rehabilitation against the rehabilitation completion criteria referred to in condition 7-4 and shall implement contingency measures and supplementary rehabilitation works where the criteria are not being met, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority and the Department of Conservation and Land Management.

Procedures

1 Where a condition states "to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority", the Environmental Protection Authority will provide that advice to the Department of Environment for the preparation of written notice to the proponent.

2 The Environmental Protection Authority may seek advice from other agencies or organisations, as required, in order to provide its advice to the Department of Environment.

3 Where a condition lists advisory bodies, it is expected that the proponent will obtain the advice of those listed as part of its compliance reporting to the Department of Environment.

Notes

1 The Minister for the Environment will determine any dispute between the proponent and the Environmental Protection Authority or the Department of Environment over the fulfilment of the requirements of the conditions.

Dr Judy Edwards MLA
MINISTER FOR THE ENVIRONMENT; SCIENCE

Schedule 1

The Proposal (Assessment No. 1244)

The proposal is to construct and maintain a sealed new road from the North West Coastal Highway, near Karratha to the Nanutarra-Munjina Road, north of Tom Price.

The road traverses the Millstream-Chichester National Park.

The location and alignment of the road are shown in Figures 1 and 2.

The Key Proposal Characteristics are shown in Table 1 below.

Table 1 - Key Proposal Characteristics

Element	Quantities/Description
Length	Approximately 245 kilometres.
Connections to existing roads	North West Coastal Highway Roebourne-Wittenoom Road Millstream-Yaraloola Road Mt Bruce Road Nanutarra-Munjina Road
Area of disturbance • Road formation	Approximately 474 hectares – of this, approximately 137 hectares will be rehabilitated following construction.
• Material sources	Approximately 100 hectares.
Design speed	110 kilometres per hour
Formation width	Approximately 9 metres.
Waterway crossings	Up to 9 bridges across major watercourses and railway lines. Culverts and low-level floodways will be used for all other waterway crossings.
Railway crossings	One road-over-rail bridge Four new level crossings.
Fencing of road reserve	Approximately 200 kilometres of fence will be erected along the road reserve outside the Millstream-Chichester National Park.

Figures (attached)

Figure 1 - Location of the proposal and location of road alignment.
Figure 2 - Location of road alignment.

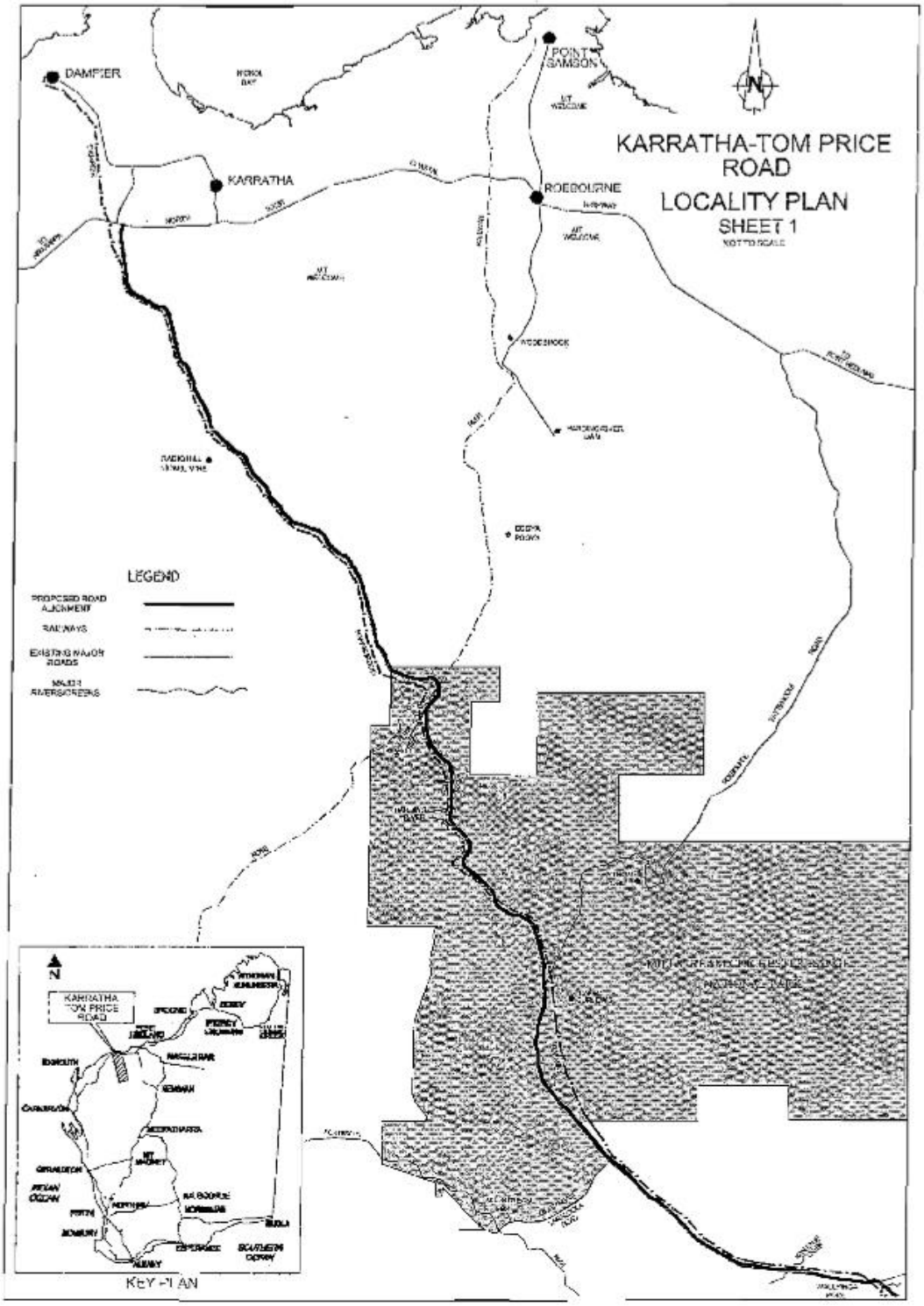


Figure 1: Location of the proposal and location of road alignment.

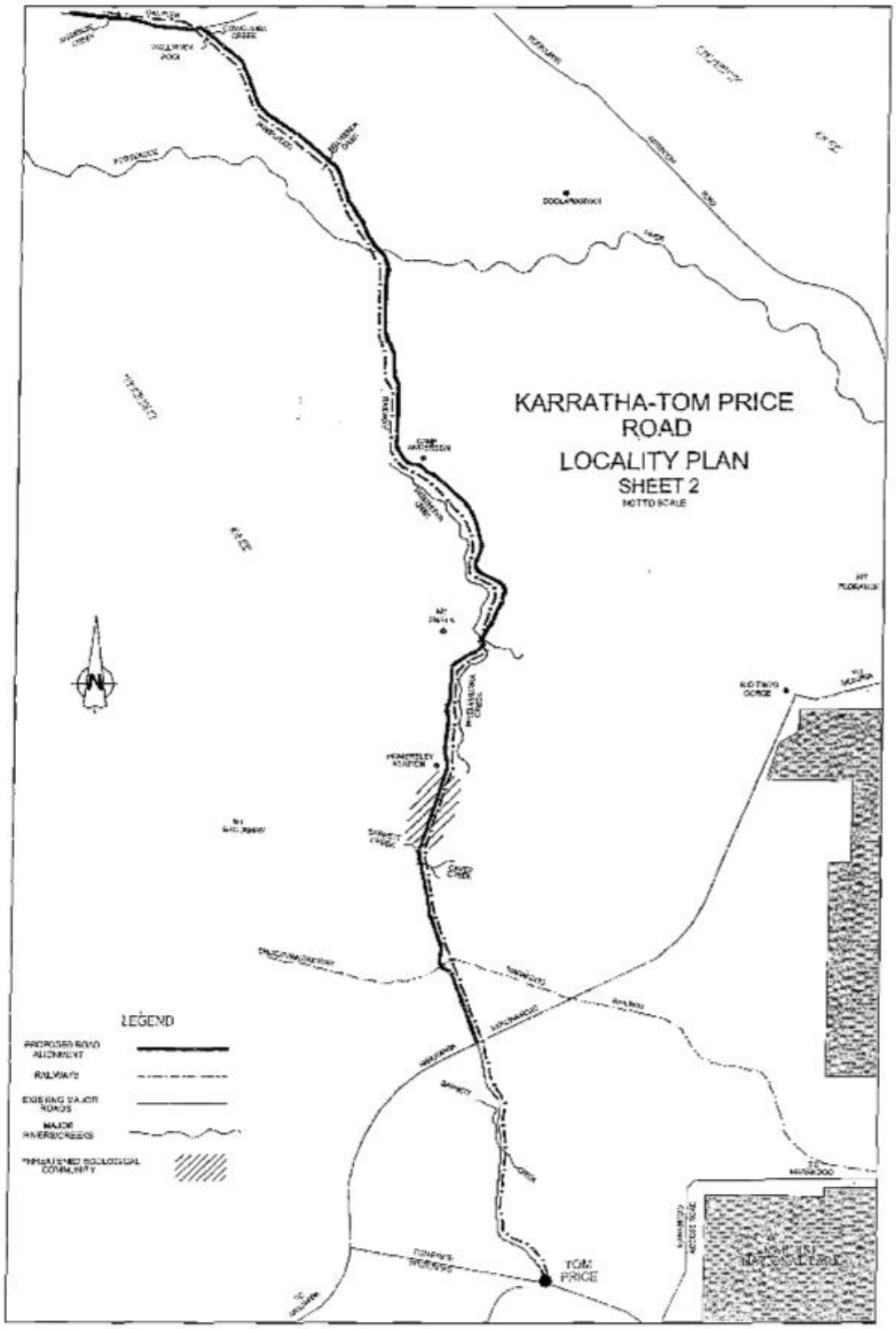


Figure 2: Location of road alignment

Schedule 2

Proponent's Environmental Management Commitments

February 2005

ROAD FROM KARRATHA TO TOM PRICE
SHIRES OF ASHBURTON & ROEBOURNE

(Assessment No. 1244)

Main Roads Western Australia

Schedule 2

Road from Karratha to Tom Price (Assessment 1244)
PROPONENT'S ENVIRONMENTAL MANAGEMENT COMMITMENTS – February 2005

Note: The term "commitment" as used in this schedule includes the entire row of the table and its six separate parts as follows:

- a commitment number;
- a commitment topic;
- the 'action' to be undertaken by the proponent;
- the objective of the commitment;
- the timing requirements of the commitment; and
- the body/agency to provide technical advice to the Department of Environment.

No.	Topic	Action	Objective	Timing	Advice
1.	Environmental Co-ordination	Employ a dedicated environmental co-ordinator.	To ensure that environmental co-ordination is effective. To provide environmental advice and to supervise clearing and rehabilitation activities, particularly in the Millstream-Chichester National Park and the section of the road which traverses the threatened ecological community.	During construction	CALM

No.	Topic	Action	Objective	Timing	Advice
2.	Surface Drainage Management	Prepare a Surface Drainage Management Plan which includes the following elements: 1. Confirmation of design requirements (waterways report) for all major waterways; 2. Protection of embankments and waterway banks and beds; 3. Protection of riparian vegetation; 4. Strategies for maintaining sheet flows and avoiding drainage shadows (for example in Mulga groves); 5. Management strategies for protecting water quality in the Harding Dam and Millstream water catchment areas; 6. Emergency Response Planning for potential spills in the Harding and Millstream water catchment areas; 7. Details for monitoring of waterway integrity and erosion risks during and following construction; 8. Management and remediation of any impacts found during monitoring; and 9. Measurement and evaluation of environmental performance.	To maintain existing drainage patterns and to prevent soil erosion and sedimentation caused by construction activity or new waterways structures.	Prior to commencement of construction.	CALM
3.	Surface Drainage Management	Implement the Surface Drainage Management Plan.	To maintain existing drainage patterns and to prevent soil erosion and sedimentation caused by construction activity or new waterways structures.	Prior to, during and post-construction.	CALM

No.	Topic	Action	Objective	Timing	Advice
4.	Vegetation Protection and Rehabilitation	Prepare a Vegetation Protection and Rehabilitation Management Plan to include the following elements: 1. Design and construction strategies which minimise loss of native vegetation and fauna habitat; 2. Details of restrictions on clearing, and clearing boundaries; 3. Protection of rare and significant flora; 4. Treatment and protection of riparian zones; 5. Treatment of material pits; 6. A detailed rehabilitation strategy which includes topsoil and weed management, brushing and seeding; 7. Monitoring measures for ensuring that vegetation is protected and replaced; 8. Measurement and evaluation of environmental performance; and 9. Determination of timing of rehabilitation in relation to staging of the proposal (see conditions 7-3 and 7-4).	To prevent loss of vegetation beyond the 'footprint' of the works, and minimise potential indirect effects on vegetation. To rehabilitate areas disturbed by construction of the road.	Prior to commencement of construction.	CALM
5.	Vegetation Protection and Rehabilitation	Implement the Vegetation Protection and Rehabilitation Management Plan.	To prevent loss of vegetation beyond the 'footprint' of the works, and minimise potential indirect effects on vegetation. To rehabilitate areas disturbed by construction of the road.	During and post-construction.	CALM
6.	Threatened Ecological Community (TEC) Protection and Management	Prepare a TEC Protection and Management Plan which includes: 1. Fencing of the road reserve to provide a minimum 200-metre wide reserve; 2. Limits on clearing and construction activities; and 3. Barring of material pits.	To ensure that construction management in the TEC is of a similar standard to that employed in the National Park, and that this is to the satisfaction of CALM.	Prior to commencement of construction	CALM

No.	Topic	Action	Objective	Timing	Advice
7.	Threatened Ecological Community Protection and Management	Implement the TEC Protection and Management Plan.	To ensure that construction management in the Threatened Ecological Community is of a similar standard to that employed in the National Park, and that this is to the satisfaction of CALM.	Prior to, during and post-construction	CALM
8.	Rehabilitation Trials	1. Prepare a scientifically based rehabilitation trial for the treatment of redundant roads and tracks. 2. Monitor and report the outcome of these trials.	To rehabilitate redundant tracks and to provide information on best practice methodology for use by Main Roads and others in the Pilbara in the future.	During and post-construction	CALM
9.	Rehabilitation Trials	Rehabilitate redundant roads and tracks using results of the trials referred to in commitment 8.	To rehabilitate redundant tracks and to provide information on best practice methodology for use by Main Roads and others in the Pilbara in the future.	During and post-construction	CALM

No.	Topic	Action	Objective	Timing	Advice
10.	National Park Plan	Prepare a National Park Plan which addresses impacts in the Millstream-Chichester National Park and which includes as elements: 1. Design of appropriate interpretive signage and rest bays to promote understanding of Park values and protection of flora and fauna; 2. Design to minimise the ecological and visual impact of the road through: a. Minimising cut-and-fill through the Park; b. Specifying the width of the construction corridor through the Park; c. Best practice design of batters in cut-and-fill areas to provide stable landforms which blend in with the surrounding contours; and d. Reducing vegetation clearing through forward planning and sensitive design. 3. Long-term management of the road reserve through the Park; and 4. Measurement and evaluation of environmental performance.	To minimise the impacts of the road through the Millstream-Chichester National Park.	Prior to commencement of construction	CALM
11.	National Park Plan	Implement the National Park Plan.	To minimise the impacts of the road through the Millstream-Chichester National Park.	Prior to, during and post-construction	CALM
12.	Aboriginal Heritage	Prepare an Aboriginal Heritage Management Plan which incorporates the following elements (in compliance with the *Aboriginal Heritage Act 1972*): 1. A strategy for further Aboriginal heritage assessment and consultation during the final design of the road; 2. Details of commitments and conditions for design and construction activities to avoid impacts on significant sites.	To protect and preserve Aboriginal cultural heritage within the area influenced by the roadworks.	Prior to commencement of construction.	DIA

No.	Topic	Action	Objective	Timing	Advice
13.	Aboriginal Heritage	Implement the Aboriginal Heritage Management Plan.	To protect and preserve Aboriginal cultural heritage within the area influenced by the roadworks.	Prior to and during construction.	DIA
14.	Construction Management	Prepare a Construction Management Plan to address: 1. Management of construction camps, including waste management; 2. Noise, dust and other construction nuisance; 3. Management of transport, storage and use of hazardous materials and hydrocarbons, particularly through the Harding and Millstream water catchment areas.	To ensure that environmentally and socially acceptable standards are established and maintained during construction works.	Prior to commencement of construction	CALM Local Authorities
15.	Construction Management	Implement the Construction Management Plan.	To ensure that environmentally and socially acceptable standards are established and maintained during construction works.	During construction	CALM Local Authorities
16.	Fence construction at Millstream-Chichester National Park	Construct approximately 30 kilometres of fencing along the northern boundary of the Millstream-Chichester National Park where it is adjacent to Pyramid Station.	To prevent stock access to the National Park.	During construction, and, if necessary, post-construction on advice of CALM.	CALM
17.	Weed control at Millstream-Chichester National Park	Contribute $25,000 per year, for five years, towards a weed control program for the Millstream-Chichester National Park.	To contribute to the overall weed control and management of the National Park, in particular the control of date and cotton palm, morning glory, khaki weed, Galland's curse, Indian water fern and Parkinsonia.	During and post-construction	CALM

Abbreviations
CALM - Department of Conservation and Land Management DIA - Department of Indigenous Affairs

Attachment to Statement 677

Change to implementation condition under section 46C

Proposal: Road from Karratha to Tom Price, Shires of Ashburton and Roebourne

Proponent: Main Roads Western Australia

Amendment to implementation condition 7-2:

From: During road construction, the proponent shall limit the area of vegetation to be cleared within the Millstream-Chichester National Park to not more than 110 hectares.

To: During road construction, the proponent shall limit the area of vegetation to be cleared within the Millstream-Chichester National Park to not more than 145 hectares.

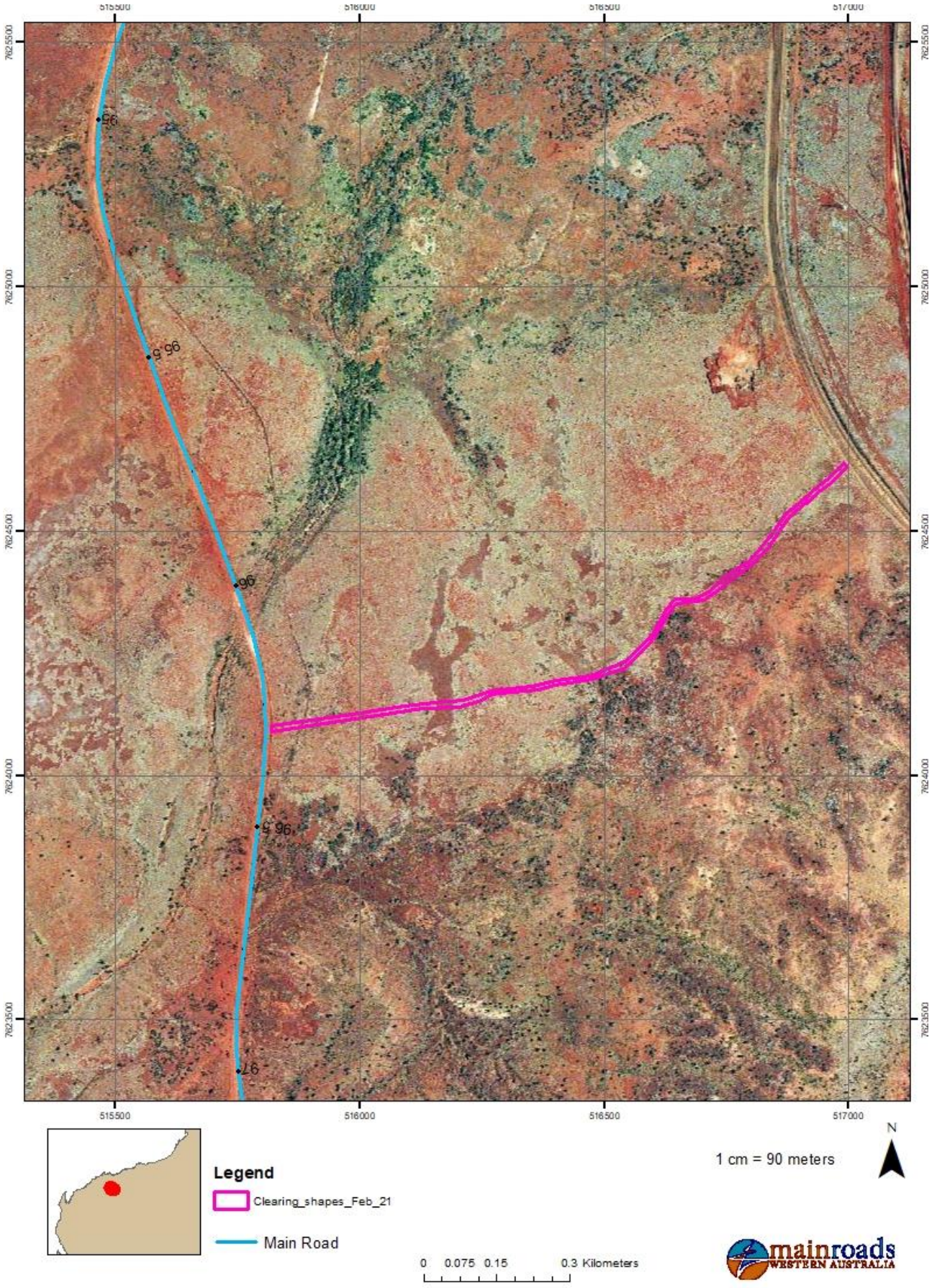
Appendix B : Main Roads Western Australia Pilbara Region Revegetation Monitoring Consultant Brief 2021 Program - Stage 3 KTP Rehabilitation Monitoring 2021, Photos & Maps

Photos & Maps of Rehabilitation February 2021 - Pilbara Environmental – Revegetation Monitoring Scope Pilbara 2021

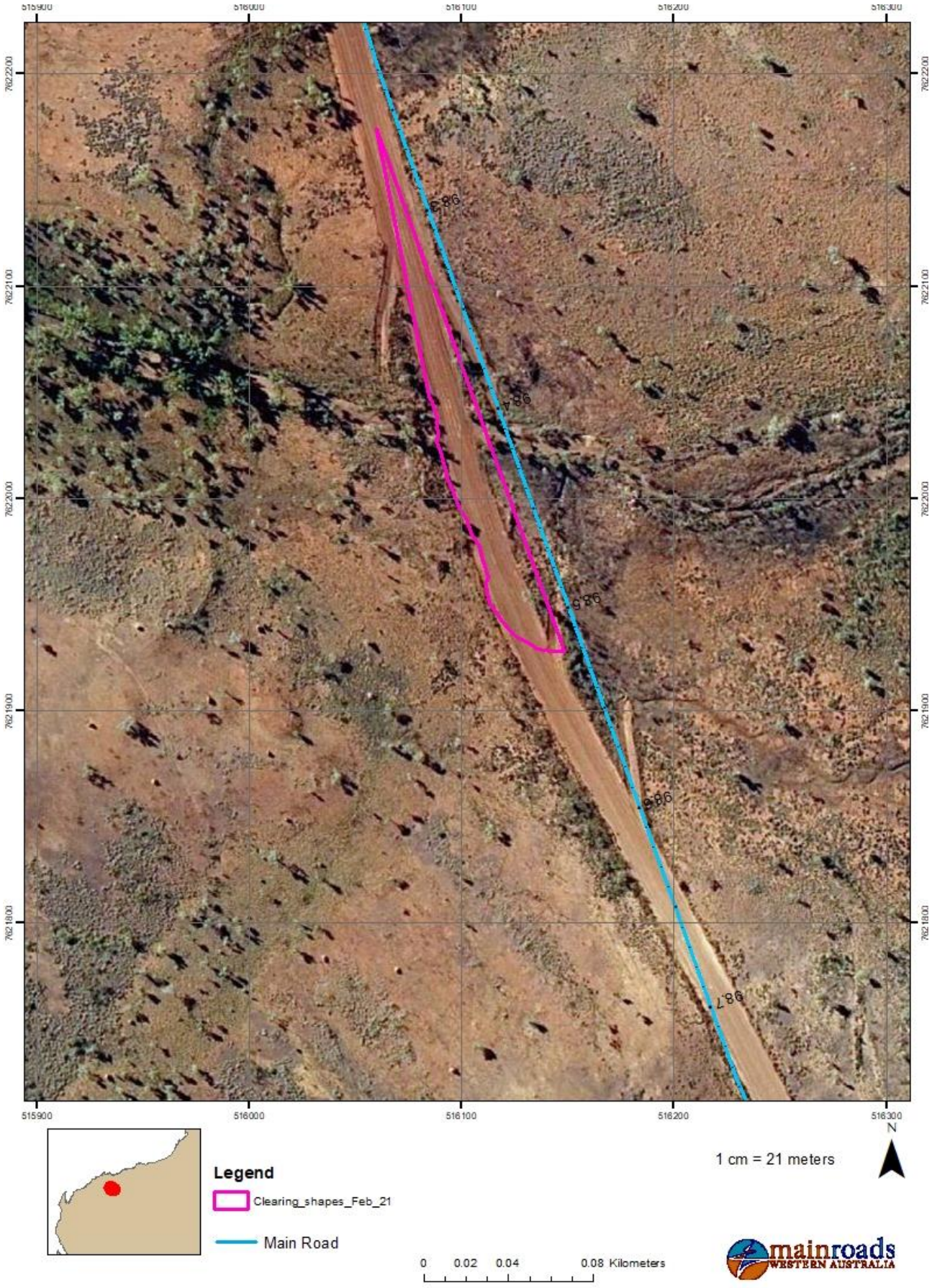
Photo (1) Karratha - Tom Price Road Stage 3 Rehabilitation 2021

Photo (2) Karratha - Tom Price Road Stage 3 Rehabilitation 2021

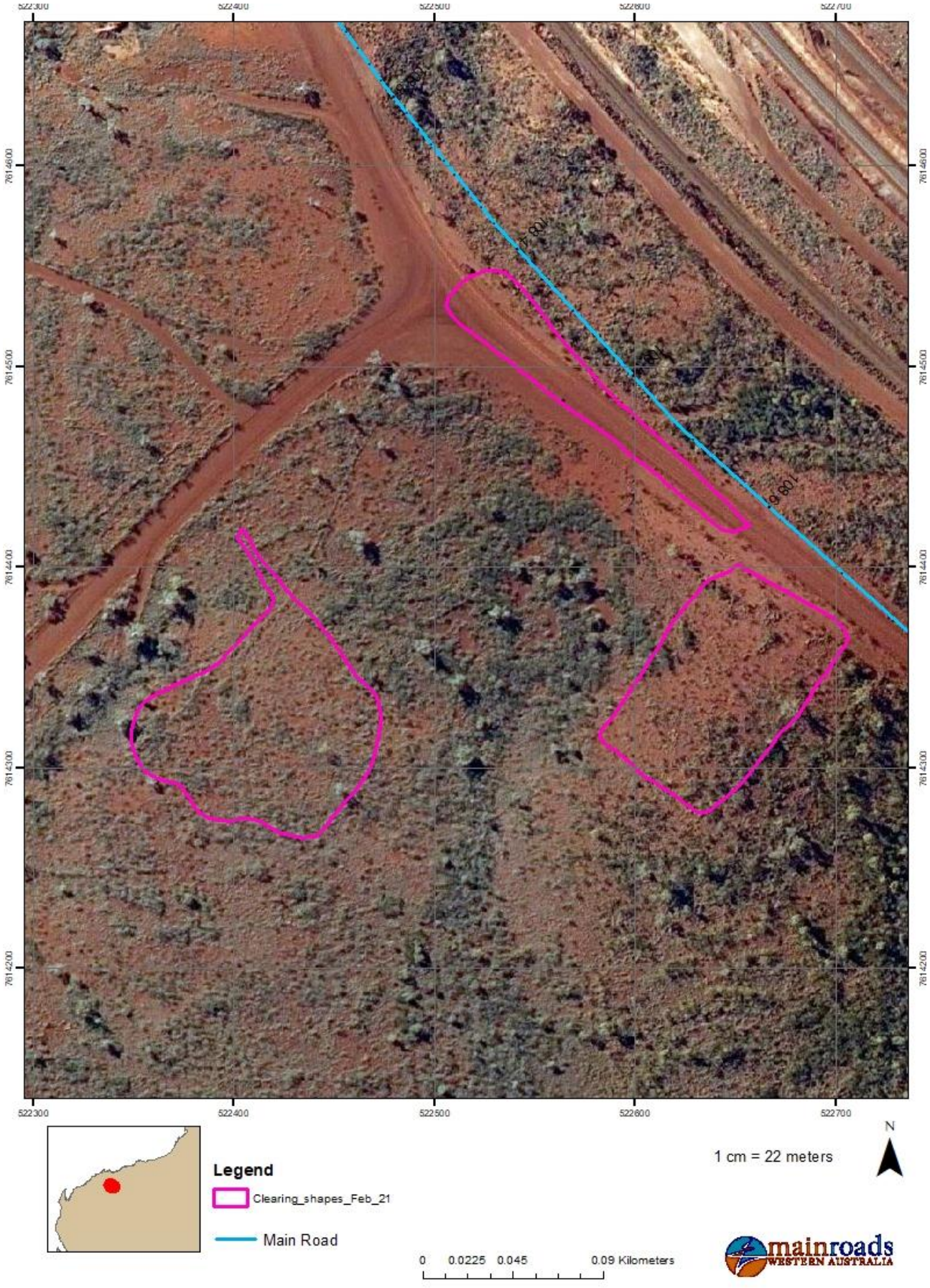
Photo (3) Karratha - Tom Price Road Stage 3 Rehabilitation 2021



Map (1) Karratha - Tom Price Road Stage 3 Rehabilitation 2021



Map (2) Karratha - Tom Price Road Stage 3 Rehabilitation 2021



Map (3) Karratha - Tom Price Road Stage 3 Rehabilitation 2021

Map (4) Karratha - Tom Price Road Stage 3 Rehabilitation 2021

Appendix C – Letter to DBCA23rd July 2019

mainroads
WESTERN AUSTRALIA

Enquiries: Luke Lovell
Our Ref: Karratha Tom Price Road (D19#542129)

23 July 2019

Allisdair MacDonald
Department of Biodiversity Conservation and Attractions
PO Box 835
Karratha Western Australia 6714

Dear Mr MacDonald

Karratha Tom Price Road Compliance

I am writing in response to your letter dated 1 July 2019 regarding Ministerial Statement 677 (MS677) and the associated management plans relating to Stages 2, 3 and 4 of the Karratha Tom Price Road Project, and the meeting between the Department of Biodiversity, Conservation and Attractions (DBCA) and Main Roads on 7 June 2019.

The discussions between our organisations on this road project related to:

- Ongoing weed management of the Completed Stage 2 Karratha Tom Price Project (Condition 6 MS677).
- Rest bay design (Commitment 10 MS677).
- Offset payment (Condition 7-3 MS677).

The following advice clarifies Main Roads' position on these three areas.

1. **Ongoing weed management (Condition 6 MS677)**

As discussed in your letter dated 1 July 2019, DBCA have advised that it considered the Tom Price Road Stage 2 Millstream Chichester National Park Management Plan (2005) has no set expiry on several conditions inclusive of weed monitoring and control of kapok and ruby dock. However, Condition 7-4 states that timeframes for the completion criteria shall be included in the Tom Price Road Stage 2 Millstream Chichester Vegetation Protection and Rehabilitation Management Plan (2005). Completion criteria of seven years is specified on page seven of the Tom Price Road Stage 2 Millstream Chichester Vegetation Protection and Rehabilitation Management Plan (2005). Both plans were approved by Main Roads and DBCA.

A final monitoring survey and report was completed in October 2015 these documents were submitted to the EPA as part of the 2018 Compliance Assessment Report. The monitoring survey found Weed levels to be at less than 5% cover (of the overall vegetation cover) within the Project area. Main Roads are happy to provide a copy of the final monitoring survey on request.

Main Roads Western Australia
Pilbara, Maxine McGillivray Centre, South Hedland WA 6722
PO Box 2258, South Hedland WA 6722

mainroads.wa.gov.au
enquiries@mainroads.wa.gov.au
138 138

Main Roads considers the requirements relating to weed monitoring and weed eradication of the completed Stage 2 Karratha Tom Price Road Project have met the requirements of MS677 and the Tom Price Road Stage 2 Millstream Chichester Vegetation Protection and Rehabilitation Management Plan (2005) and is therefore complete.

2. **Rest bay design (Commitment 10 MS677)**

Main Roads has a strong preference that no parking bays are located within the Stage 3 area due to the high occurrence of asbestos and the subsequent potential risk to users of the rest areas, as well as the risks associated with the ongoing management of the rest areas. This view is strongly supported by the Department of Health and a number of other departments that have been working with Main Roads on the asbestos issues on this new road.

The Karratha Tom Price Road Stage 3a National Park Management Plan (condition 10.1 MS677) management actions stipulates *"Main Roads will discuss the requirement for signage or rest bays with DBCA"*. Given our position that the location of such infrastructure is not appropriate, it is considered that this action is now complete.

3. **Offset payment (Condition 7-3 MS677)**

In accordance with the signed agreement between our organisations dated 20 September 2007, Main Roads has now processed the DBCA Invoice for the offset payment for Stages 3 and 4. Main Roads will request an invoice from DBCA for the offset payment for Stages 3 and 4 at your earliest convenience.

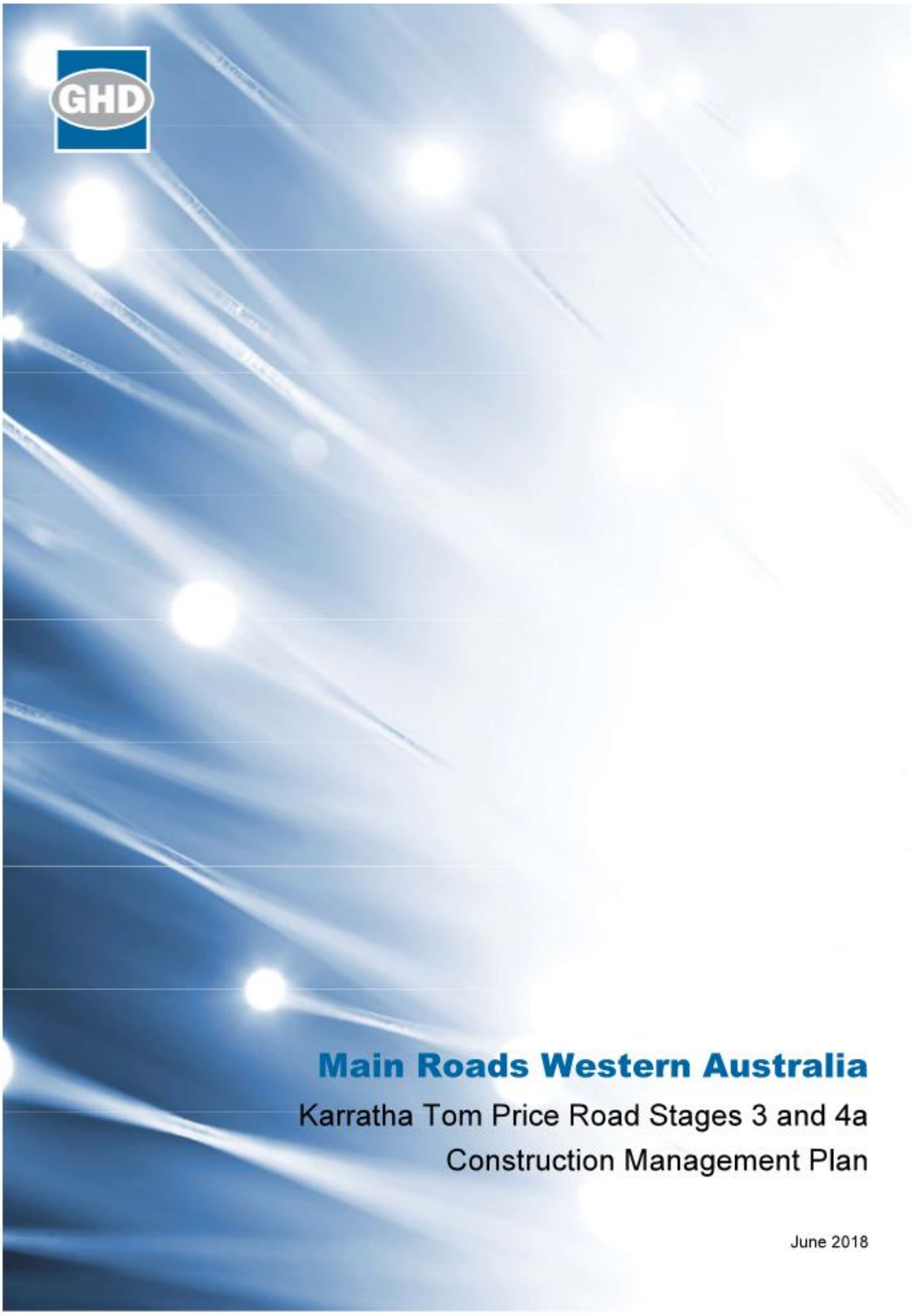
I look forward to working with DBCA as progress this important project and I look forward to receiving the locations for the alternative rest bays.

For further information, please contact Luke Lovell 9323 4765.

Yours sincerely

Andrew Pyke
Regional Manager
Central and Northern Regions / Pilbara Region
m: +61 417 091 103 | p: +61 9172 8810

Appendix D – Karratha Tom Price Road Stages 3 and 4a Construction Management Plan


GHD
Main Roads Western Australia
Karratha Tom Price Road Stages 3 and 4a
Construction Management Plan
June 2018
WATER | ENERGY & RESOURCES | ENVIRONMENT | PROPERTY & BUILDINGS | TRANSPORTATION

Acronyms and Abbreviations

CALM	Department of Conservation and Land Management (superseded)
CER	Consultative Environmental Review
CMP	Construction Management Plan
DBCA	Department of Biodiversity, Conservation and Attractions
MP	Management Plan
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
Ha	hectare
km	Kilometre
KTP	Karratha Tom Price road
m	Metre
Main Roads	Main Road Western Australia
PaW	Parks and Wildlife Branch (of DBCA)
PDWSA	Public Drinking Water Source Area
PEC	Priority Ecological Community
TEC	Threatened Ecological Community

Table of contents

1. Context, scope and rationale 1
   1.1 Background 1
   1.2 Key environmental factors and impacts 4
   1.3 Condition requirements 4
   1.4 Rationale and approach 5
2. Management plan provisions 10
   2.1 Management systems and implementation 10
   2.2 Waste and dangerous goods management 12
   2.3 Noise and dust 15
3. Adaptive management 16
   3.1 Environmental monitoring and corrective actions 16
   3.2 EMP Revision 16
   3.3 Audits 16
4. Stakeholder consultation 17
5. References 18

Table index

Table 1-1 Key environmental factors, values, and impacts relevant to the project 4
Table 1-2 Statement 677 proponent environmental commitments 4
Table 1-3 Studies and surveys relevant to the project area 5
Table 2-1 Waste and dangerous goods – Management actions and targets 12
Table 2-2 Noise and dust - actions and targets 15

Figure index

Figure 1 Project location 3
Figure 2 Environmental aspects 7
Figure 3 Public Drinking Water Source Area 8

1. Context, scope and rationale

This Construction Management Plan (CMP) has been prepared for the construction and operation of Stages 3 and 4a of the Karratha Tom Price road (KTP). It is one of five management plans developed for the project. This section includes a summary of the project including its key features, information on the key environmental factors relating to construction of the road, the management approach that will be undertaken and the rationale for the approach.

1.1 Background

The KTP project was initially proposed via a Consultative Environmental Review (CER) document in 2003. The CER included a total of 245 kilometre (km) of proposed new or upgraded road from the North West Coastal Highway to the Nanutarra-Munjina Road, in three stages (2, 3 and 4). The environmental approval of the project was given in April 2005 under Assessment 1244 (Bulletin 1159) and through Ministerial Statement 677.

Construction of the 89 km of Stage 2 was commenced in 2006 by the Millstream Link Alliance and completed in 2008. This work was undertaken using a series of approved management plans as required under Statement 677. The management plans were approved by relevant authorities including the then (then) Department of Environment, Water and Rivers Commission and Department of Indigenous Affairs, with advice from Department of Conservation and Land Management (CALM). Adherence to the plans was audited internally, externally and by CALM/Department of Environment Conservation, particularly in relation to the section of Stage 2 which traversed the Millstream Chichester National Park.

The initial vegetation clearing approval was for 574 hectare (ha) (474 ha for the road formation and 100 ha for borrow pits), with 110 ha within the National Park. A Section 46C approval increased the amount of land approved for clearing within the National Park to 145 ha. Total clearing undertaken for Stage 2 was 445 ha, with 122 ha within the National Park.

1.1.1 Project area

This CMP covers the road construction and associated drainage and borrow pits for Stages 3 and 4a of the KTP, a distance of approximately 93 km. These Stages start at the junction of the Pilbara Iron Railway line and the Roebourne Wittenoom Road and end approximately 7 km south of the Fortescue River crossing. Stage 3 of the road alignment (58 km) closely follows the Roebourne Wittenoom Road until the Pilbara Iron Railway deviates from this road towards Tom Price. Stage 4a of the project (35 km) runs south from the Roebourne Wittenoom Road adjacent to the existing railway access road (Figure 1). Approximately 14.6 km of the project area (Stage 3a) occurs within the Millstream Chichester National Park, primarily within a designated road reserve.

The road will consists of a 7 m wide two-lane seal with 1 m wide shoulders and associated cut or fill batters, table drains and offshoot drains. Stages 3 and 4a will incorporate approximately 42 floodways and 61 culverts. The approximate width of the road construction, within a flat area, will be 19m to 20 m, including table drains. Note that this will increase in areas of cut and fill.

Material for the formation will be sourced from a range of borrow pits within close proximity of the existing road, where possible.

1.1.2 Purpose and scope of this management plan

This CMP is one of a series of management plans required for the construction of Stages 3 and 4a of the KTP, and includes factors and management measures for aspects not dealt with in the other plans. It should be read in conjunction with the other management plans.

This plan updates the previous CMP developed for Stage 2 as follows and includes:

- Guidance using the most recent Environmental Protection Authority (EPA) guidelines for EMPs
- Updates on key environmental factors (e.g. fauna protection)
- Updates on required licensing and best practice in environmental management
- GIS mapping with the most recent, relevant information available.

The CMP will be implemented during construction of the project works along with four other management plans:

- Surface Drainage Management Plan
- Vegetation Protection and Rehabilitation Management Plan
- National Park Management Plan (where applicable)
- Cultural Heritage Management Plan.

1.1.3 Limitations

This report has been prepared by GHD for Main Road Western Australia (Main Roads) and may only be used and relied on by Main Roads for the purpose agreed between GHD and the Main Roads as set out in section 1.1.2 of this report.

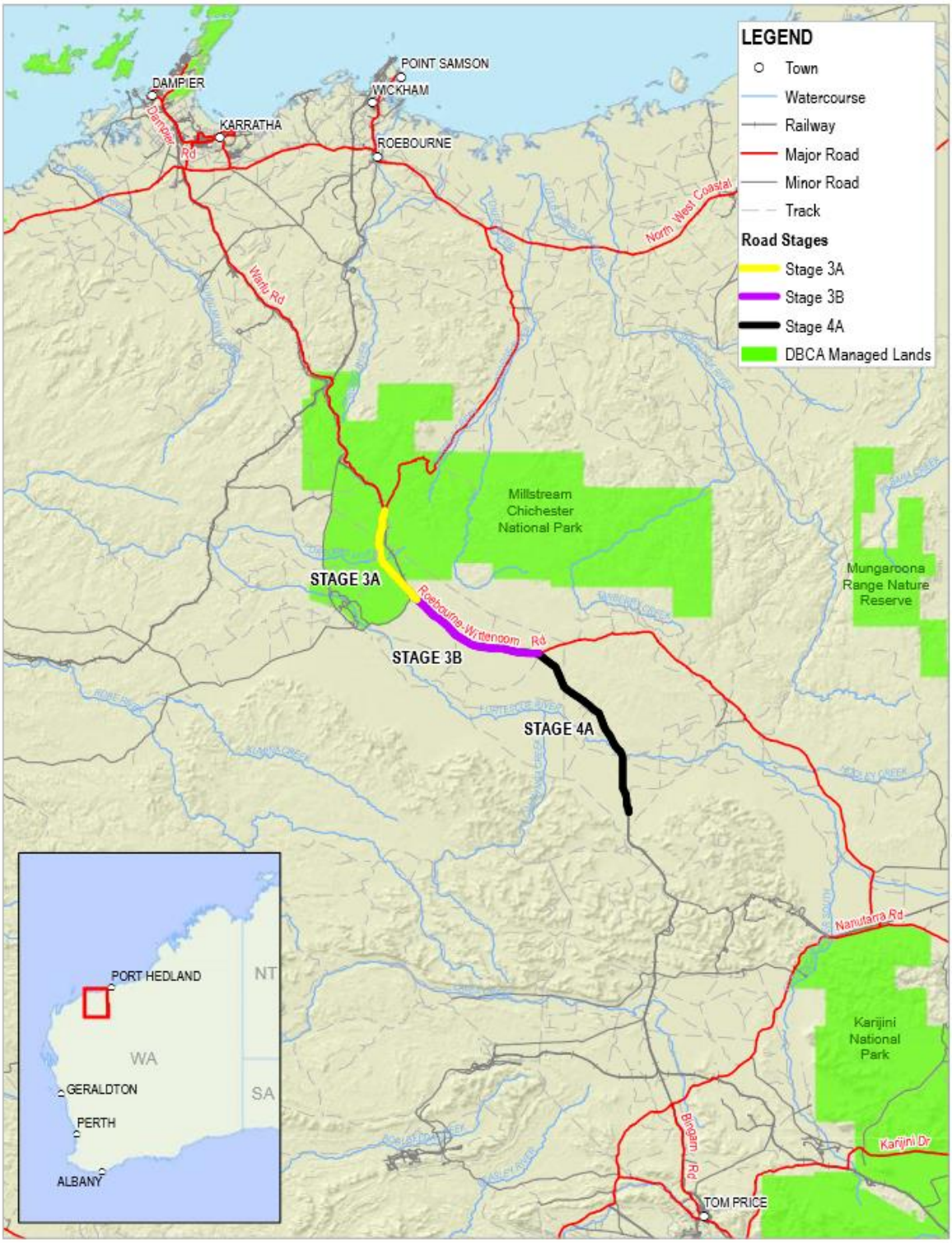
GHD otherwise disclaims responsibility to any person other than Main Roads arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Main Roads and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.


LEGEND
Town
Watercourse
Railway
Major Road
Minor Road
Track
Road Stages
Stage 3A
Stage 3B
Stage 4A
DBCA Managed Lands
POINT SAMSON
WICKHAM
DAMPIER
KARRATHA
ROEBOURNE
Dampier Rd
North West Coastal
Wardu Rd
Millstream Chichester National Park
Mungaroona Range Nature Reserve
STAGE 3A
Roebourne-Wittenoom Rd
STAGE 3B
STAGE 4A
Nanutarra Rd
Karijini National Park
Karijini Dr
Bingam Rd
TOM PRICE
PORT HEDLAND
NT
WA
SA
GERALDTON
PERTH
ALBANY
Paper Size ISO A4
0 10 20 30 40
Kilometres
N
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50
GHD
Main Roads Western Australia
Karratha - Tom Price Road Stages 3 and 4a
Location
Project No. 61-36933
Revision No. 0
Date 13/03/2018
FIGURE 1

1.2 Key environmental factors and impacts

The key environmental factors identified as being relevant to this CMP are outlined in Table 1-1. The relevance of each environmental factor to the Stages 3 and 4a of the project is discussed in Section 1.4.1. Table 1-1 summarises the project-specific environmental value, proposed impact activity and impact for the key factors.

Table 1-1 Key environmental factors, values, and impacts relevant to the project

EPA Factor	Key Values	Impact Activities	Key Potential Impacts
Terrestrial Environmental Quality	Millstream-Chichester National Park Millstream Water Reserve.	Management of construction camps Transport storage and use of hazardous substances and hydrocarbons	• Contamination from hydrocarbon spills, site offices, waste management.
Social Surroundings	Adjacent noise and dust sensitive receivers	Dust and noise during construction causing nuisance impacts	• Dust impacts on traffic, office and accommodation facilities

1.3 Condition requirements

The CER was assessed by officers of CALM during the public consultation period in 2004. As a result of the assessment and subsequent comments, a number of commitments regarding construction management were given in EPA Bulletin 1159 of January 2005. The Proponent commitments relevant to this CMP for Stage 3 and 4a of the KTP road are as follows:

Table 1-2 Statement 677 proponent environmental commitments

No.	Topic	Action	Objective
14	Construction management	Prepare a Construction Management Plan that addresses: 1. Management of construction camps, including waste management (Table 2-1) 2. Noise, dust and other construction nuisance (Table 2-2) 3. Management of transport, storage and use of hazardous materials and hydrocarbons, particularly through the Millstream water catchment area (Table 2-1)	To ensure that environmentally and socially acceptable standards are established and maintained during construction works.
15	Construction Management	Implement the Construction Management Plan – to ensure that	To ensure that environmentally and socially

		environmentally and socially acceptable standards are established and maintained during construction works.	acceptable standards are established and maintained during construction works.

1.4 Rationale and approach

1.4.1 Survey and study findings

The following studies and surveys have been undertaken within, or are relevant to, the project area. Environmental aspects,main watercourses and Public Drinking Water Source Areas (PDWSA) are shown in Figure 2 and Figure 3, respectively.

Table 1-3 Studies and surveys relevant to the project area

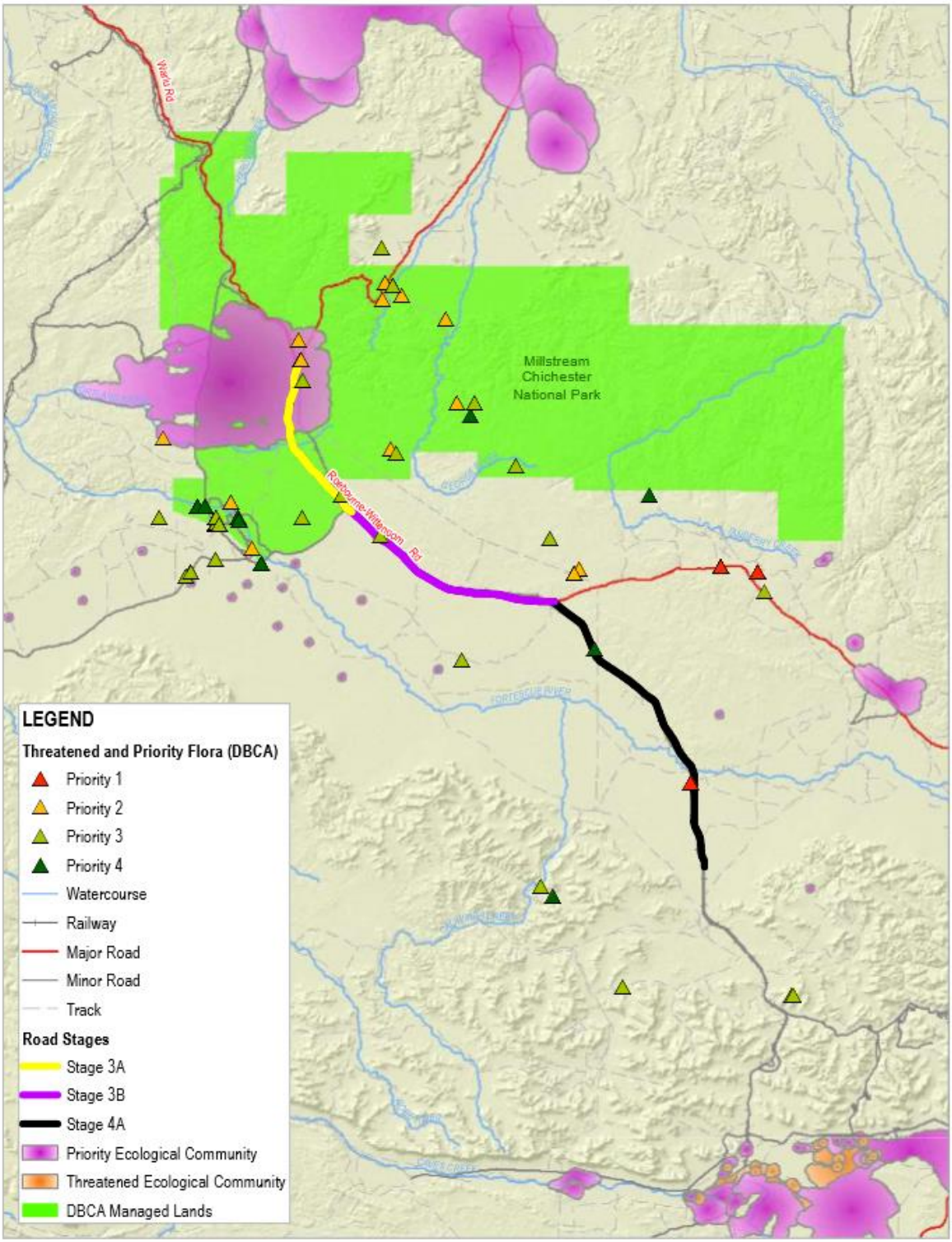
Studies	Consultant	Description
Flora and vegetation	GHD Pty Ltd	Flora and vegetation survey of the proposed Karratha Tom Price Road (all sections) (2003). Desktop update of conservation significant flora and vegetation communities for Sections 3 and 4a (2016 and 2018).
	Main Roads	Weed and broad vegetation survey, March 2018 (unpublished).
Fauna	GHD Pty Ltd (using Bamford Associates)	Fauna survey of the proposed Karratha Tom Price Road (all sections), including fish and freshwater vertebrates (2003, using Bamford 2002).
	GHD Pty Ltd	Desktop update of conservation significant fauna potentially present in the project area (2016). Northern Quoll reconnaissance survey including the use of camera traps (2017).
Terrestrial environmental quality	GHD Pty Ltd	Vegetation condition and fauna habitat quality was considered during vegetation and fauna surveys (2003).
	Main Roads	Vegetation condition and fauna habitat quality was reviewed March 2018 (unpublished)
Rehabilitation	Millstream Link (2006, 2015)	Rehabilitation and revegetation was undertaken during Stage 2 construction of KTP. Details of work carried out and the success of the work is available in management plans and compliance reporting.
Hydrological processes	GHD Pty Ltd	Desktop and field investigation of surface hydrology undertaken to characterise drainage and provide an initial risk assessment, provided within the CER (Main Roads 2003).
	BG&E	A full hydrologic and hydraulic analysis of the road project area to provide design input for floodways and culverts (2017).
Aboriginal heritage	Yuluwarlu Group Aboriginal Corporation Gavin Jackson, Cultural Resource	Archaeological and ethnographic surveys of Stages 3 and 4a in association with the Yinjibarndi Aboriginal Corporation (August 2017).

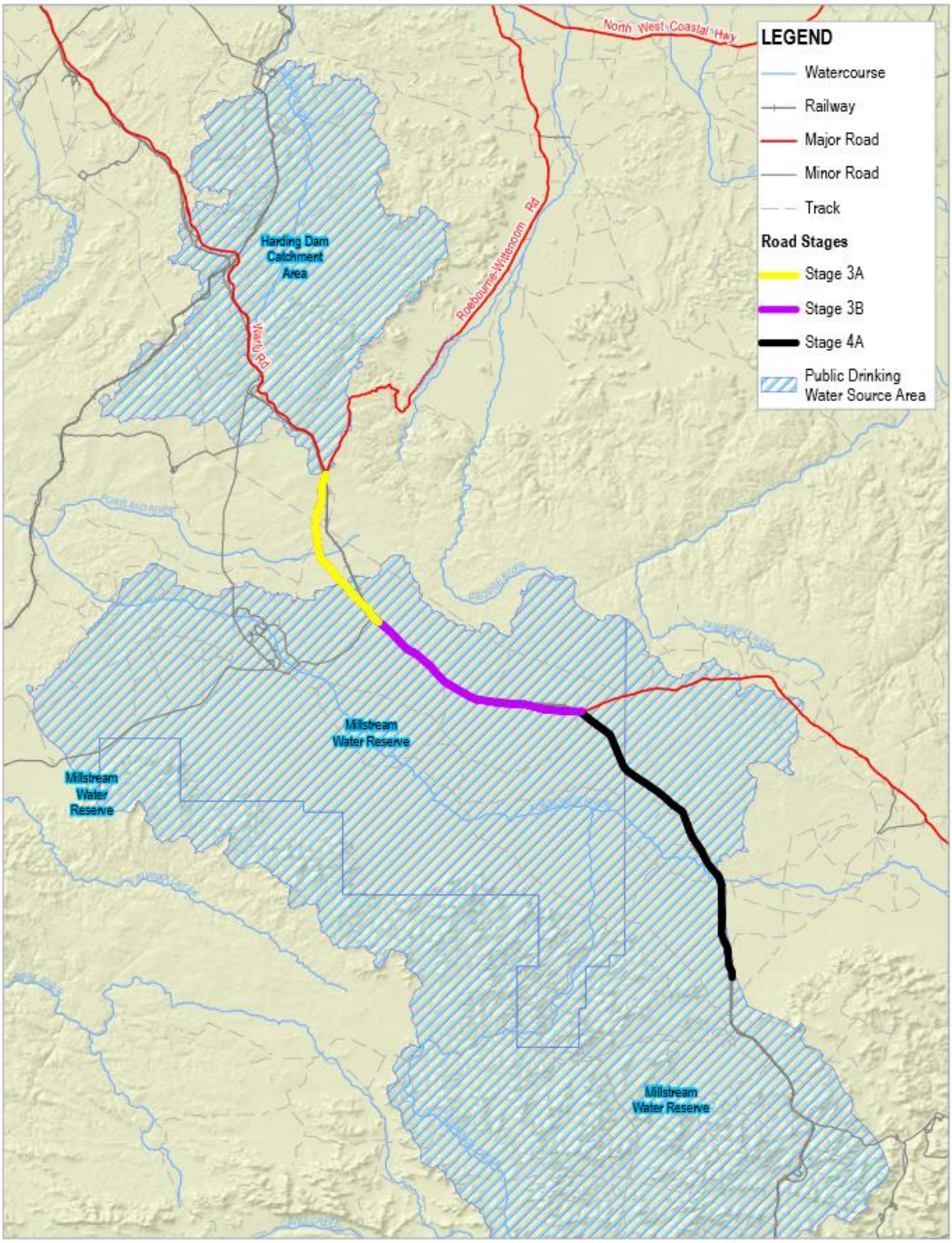
Studies	Consultant	Description
	Management	

Adjacent landuse

The landuse adjacent to the project area primarily includes pastoral leaseholds with some presence of cattle and associated water sources and fencing. No station homesteads are present within 20 km of the project construction area. The northern 14.6 km of the project area is within the Millstream Chichester National Park, and includes the junction of the road access to the Millstream Reserve and visitor centre. The visitor centre is approximately 11.5 km from the project area by direct line.

The Pilbara Iron Pty Ltd rail corridor or rail access road is closely adjacent to the project area for its entire length.


Millstream
Chichester
National Park
Roebourne-Wittenoom Rd
LEGEND
Threatened and Priority Flora (DBCA)
Priority 1
Priority 2
Priority 3
Priority 4
Watercourse
Railway
Major Road
Minor Road
Track
Road Stages
Stage 3A
Stage 3B
Stage 4A
Priority Ecological Community
Threatened Ecological Community
DBCA Managed Lands
Paper Size ISO A4
0 5 10 15 20
Kilometres
N
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50
GHD
Main Roads Western Australia
Karratha - Tom Price Road Stages 3 and 4a
Environmental Aspects
Project No. 61-36933
Revision No. 0
Date 13/03/2018
FIGURE 2


North West Coastal Hwy
LEGEND
Watercourse
Railway
Major Road
Minor Road
Track
Road Stages
Stage 3A
Stage 3B
Stage 4A
Public Drinking Water Source Area
Harding Dam Catchment Area
Roebourne-Wittenoom Rd
Millstream Water Reserve
Millstream Water Reserve
Millstream Water Reserve
Paper Size ISO A4
0 5 10 15 20
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50
N
GHD
Main Roads Western Australia
Karratha - Tom Price Road Stages 3 and 4a
Public Drinking Water Source Areas
Project No. 61-36933
Revision No. 0
Date 13/03/2018
FIGURE 3

1.4.2 Key assumptions and uncertainties

Based on site visits in 2017 by GHD and 2018 by Main Roads it is assumed that no additional sensitive receptors are present.

1.4.3 Management approach

The management approach taken for this CMP is based primarily on a risk-based assessment, relevant reference documents (Department of Water (2010) and Water Quality Protection Notes), and on the evidence of issues and outcomes from the construction of Stage 2 of the KTP.

The Stage 2 CMP was reviewed and approved by the Department of the Environment (now DBCA) and, due to construction within the National Park, was subject to careful scrutiny. Where necessary, current, improved processes or outcomes valid in the Pilbara region were identified and required.

The management approach in this CMP is conservative, with the view of managing impacts during construction of the road. The suite of existing information was used in developing the management approaches.

A hierarchical approach to manage the potential impacts from the project has been used:

- Avoidance: measures taken to avoid impact
- Minimisation: measures taken to reduce the duration, intensity and/or extent of impact
- Restoration: measures taken to restore previously existing conditions.

1.4.4 Rationale for choice of provisions

The outcome of the project is expected to remain fairly static over a number of years, with ongoing impacts including:

- Maintenance and/or replacement of the seal, road edges and road furniture
- Maintenance and repair of constructed drainage
- Little likely increase in traffic volumes
- Little likely change to adjacent landuse.

2. Management plan provisions

2.1 Management systems and implementation

Main Roads has an integrated management system that incorporates an ISO 14001:2015 certified Environmental Management System.

2.1.1 Roles and responsibilities

Stages 3 and 4a of the KTP is likely to be constructed via a 'construct only' contract, whereby road design and construction supervision are undertaken by Main Roads and their consultants. Main Roads is responsible for all aspects relating to the road construction planning and design as well as for the ultimate compliance of the construction contractor. Key roles for the construction of the project are likely to be:

- Construction Superintendent – Main Roads
- Construction Manager– Construction contractor
- Environmental Supervisor – Main Roads or contractor.

2.1.2 Communication

Communication during the construction phase will occur on a daily, weekly or as-needed basis with relevant staff, project managers or external stakeholders. Project communication will be subject to the requirements of the construction contact, as determined by Main Roads, but will, as a minimum, include the requirement for a communication log with external stakeholders and the public.

External stakeholders will include:

- DWER
- Water Corporation
- DBCA – primarily through Karratha PaW office
- Shire of Ashburton
- Pilbara Iron Railway
- Rio Tinto Iron Ore.

2.1.3 Environmental awareness training and inductions

All construction personnel and sub-contractors will undergo an induction, which includes information on the importance of key factors within the management plans to enable excellent environmental outcomes to be achieved. They will be advised of their responsibilities with regard to the *Environmental Protection Act 1986,* the *Wildlife Conservation Act 1950,* other relevant acts and regulations and of project approval and contractual requirements. This CMP will form part of the induction.

The primary contractor will also be responsible for providing a Source Protection presentation (relating to the PDWSA) to all workers, working within the Water Reserve.

Signs are to be placed around site and advertising material provided to inform workers that they are operating in a water reserve and the need for water quality protection. Signs are to include an emergency contact number.

A record of inductions will be kept by the Construction Manager.

Regular toolbox meetings will be used to reinforce messages on environmental protection, to relay new information and to encourage and celebrate positive outcomes.

2.1.4 Monitoring

Daily and weekly observations of the construction site will be conducted to ensure the objectives of this CMP are implemented and that the required management actions are in place.

Waterways structures and their resulting impact on natural waterways will be regularly monitored during the construction period and for 3 years post construction. Main Roads will undertake inspections after any major storm event (e.g. cyclones) as is currently the practice.

2.1.5 Environmental incidents / non-compliance

Environmental incidences and non-compliances will be identified and recorded as soon as possible by the relevant responsible persons. Incidents will be mitigated or rectified where possible within 48 hours of being identified. Non-conformances to this plan will be reported to the Main Roads Construction Superintendent within 48 hours of identification.

Any non-conformance to this plan is to be reported to DWER Compliance Branch and investigated to determine:

- Why the non-conformance occurred
- What was the environmental harm or alteration of the environment that resulted from the non-conformance
- What changes to project activities and/or management plans is required
- Measures to prevent, control or abate the environmental harm that may have occurred.

2.1.6 Emergency response

Emergency response requirements will be determined by the Construction Manager and the requirements of the Shire of Ashburton and the Karratha PaW office.

2.1.7 Reporting

The environmental performance of the construction activities and the identification of auditing requirements will be assessed by Main Roads prior to and throughout the construction period. All documents pertaining to environmental management are required to be maintained though a system of document control, including the storage of hardcopy documents at site and archiving for handover to Main Roads upon contract completion.

Ministerial Condition 677 does not list specific reporting requirements, such as reporting of exceedance of threshold criteria. Reporting requirements specific to this CMP are outlined in Table 2-1. Reporting on compliance with the CMP will be undertaken annually as part of Ministerial Statement 677 Compliance Assessment Report (CAR).

If a non-conformance with this plan occurs, Main Roads will notify DWER Compliance Branch through their email address at compliance@dwer.wa.gov.au within seven days of becoming aware of the non-conformance. A report on the investigation (as per 2.1.5 above) of the non-conformance will be provided within 60 days of reporting the non-conformance.

2.2 Waste and dangerous goods management

Table 2-1 Waste and dangerous goods – Management actions and targets

EPA Objective: Terrestrial Environmental Quality - *To maintain the quality of land and soils so that environmental values are protected.*			
Outcome – Minimal risks of fauna injury, land or surface water pollution or detrimental visual impact from road construction activities			
Key environmental values: Presence of ephemeral creeks and rivers, a water reserve, a National Park and high quality bushland views			
Key impacts and risks: Pollution of water bodies; visual pollution of viewscapes			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/evidence
Licences			
• All relevant licences for fuel or dangerous goods transport, storage and use will be obtained from the Department of Mines, Industry Regulation and Safety under the relevant acts and regulations • Fuel and dangerous goods will be managed as per the relevant licensing requirements.	No environmental harm due to spillage, misuse of fuel or dangerous goods.	Environment Supervisor to monitor compliance daily.	Planning and completion reports. Weekly internal reporting on any incidents or near-miss impacts and non-compliances.
Commitment to Guidance			
• Main Roads will adhere to the relevant requirements of the following Water Quality Protection Notes: ○ WQPN 10: Contaminant spills – emergency response ○ WQPN 44: Roads near sensitive water resources ○ WQPN 60: Tanks for mobile fuel storage in PDWSAs ○ WQPN 65: Toxic and hazardous substances – storage and use ○ WQPN 83: Infrastructure corridors near sensitive water resources ○ WQPN 84: Rehabilitation of disturbed land in PDWSAs	No environmental harm due to spillage, misuse of fuel or dangerous goods	Environment Supervisor to monitor compliance daily.	Planning and completion reports. Weekly internal reporting on any incidents or near-miss impacts and non-compliances.

EPA Objective: Terrestrial Environmental Quality - *To maintain the quality of land and soils so that environmental values are protected.*			
Outcome – Minimal risks of fauna injury, land or surface water pollution or detrimental visual impact from road construction activities			
Key environmental values: Presence of ephemeral creeks and rivers, a water reserve, a National Park and high quality bushland views			
Key impacts and risks: Pollution of water bodies; visual pollution of viewscapes			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/evidence
Location and type of facilities			
• No new camps/temporary accommodation, fuel storage or any other potentially hazardous land use be within 500 m of a surface water body or major (named) waterway • No new camps/temporary accommodation, fuel storage or any other potentially hazardous land use to be within 500 m of a production bore and should be located away from areas overlying the Millstream Dolomite[1] • New ablution facilities within the water reserve should be sited away from the Millstream Dolomite[1] • Local Government permits will be obtained from the Shire of Ashburton for septic systems (if proposed) • Sewage treatment facilities/types will be agreed and the design approved by DCBA/ Water Corporation prior to construction/installation • Non-septic systems which treat sewage to re-useable water standards will be used where feasible • Site washdown facilities will be approved by DWER/Water Corporation	No litter or waste materials will remain in the natural environment following completion of construction.	Environment Supervisor to monitor compliance.	Planning and completion reports. Weekly internal reporting on any incidents or near-miss impacts and non-compliances.

[1] Refer to the Department of Water 2010 *Millstream Water Reserve – Drinking water source protection plan – West Pilbara water supply* Water resource protection series Report No. 116 and Haig, T 2009 *The Pilbara coast water study*, Hydrological record series, Report HG34, for information on the Millstream Dolomite

EPA Objective: Terrestrial Environmental Quality - *To maintain the quality of land and soils so that environmental values are protected.*			
Outcome – Minimal risks of fauna injury, land or surface water pollution or detrimental visual impact from road construction activities			
Key environmental values: Presence of ephemeral creeks and rivers, a water reserve, a National Park and high quality bushland views			
Key impacts and risks: Pollution of water bodies; visual pollution of viewscapes			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/evidence
• No waste will be disposed of on site.			
Management of waste facilities			
• General waste storage will be in lidded containers and transported to an approved landfill • Waste elements will be separated for recycling where facilities exist for its collection in the region • Wastewater from the washdown facility will be fully contained and evaporated on site • Residue from the evaporation will be contained within secure skips pending disposal at an approved site in accordance with the requirements of WQPN 65 • Washdown and septic tank systems will be regularly monitored for weed establishment and weeds controlled prior to seed set • Waste oil or other hydrocarbons will be stored in a plastic lined, bunded pit or tank and transported to the nearest approved disposal facility. • Contaminated soil is to be contained within secure skips pending disposal at an approved site in accordance with the requirements of WQPN 65.	No litter or waste materials will remain in the natural environment following completion of construction.	Environment Supervisor to monitor compliance with approval and management requirements weekly.	Weekly internal reporting on any incidents or near-miss impacts and non-compliances.

2.3 Noise and dust

Table 2-2 Noise and dust - actions and targets

EPA Objective: Social Surroundings –*To protect social surroundings from significant harm*			
Outcome – Minimise impacts of nuisance emissions			
Key environmental values:			
Key impacts and risks: Dust impacts on traffic, office and accommodation facilities			
Management action or Environmental criteria	Management target / Response Action	Monitoring	Documentation/evidence
Dust minimisation			
• Water trucks will be used as required, to reduce dust on access tracks, laydown areas and the road carriageway • Water will predominantly be acquired from existing bores and relevant licences will be gained • Water quality will be checked prior to use • Complaints register to be kept	Dust will not create health or traffic risks. Water quality will be at levels acceptable for the proposed use as indicated by the relevant Australian water quality guidelines. All dust complaints to be addressed within 24 hours of receiving the complaint	Construction Manager, Environmental Supervisor to monitor dust lift and impacts to workers and traffic. Construction Manager, Environmental Supervisor to monitor water quality for contamination or salinity of dust suppression water prior to first use from each bore used,	Weekly internal reporting of non-compliances.
Noise emissions			
• Machinery will be kept in good mechanical condition to avoid unnecessary noise emissions • Complaints register to be kept	Noise will not create a nuisance	Construction Manager, Environmental Supervisor to monitor	

3. Adaptive management

The adaptive management approach aims to reduce impacts by embedding a cycle of monitoring, reporting and implementing change (where required). This document applies the principles of adaptive management through monitoring, corrective actions and implementing changes. Adaptive management has been considered throughout this document, and the key adaptive management processes are described below.

3.1 Environmental monitoring and corrective actions

Internal monitoring of the environmental aspects of the road construction will occur throughout the project, through the Environmental Supervisor (or their delegate). Any non-conformances with the requirements of this CMP will be discussed with the Construction Manager/Construction Superintendent and rectified or mitigated as soon as possible to ensure minimal ongoing environmental harm. Relevant procedures will be amended/updated as necessary and inductions and other workforce communication will be undertaken in a timely manner to minimise the risk of re-occurrences.

3.2 EMP Revision

The CMP is intended to be dynamic and may be updated to reflect changes in management practices and the natural environment with time. This will also allow flexibility to respond new environmental impacts and adopt new technologies / management measures.

Amendments to management actions will be completed on an as needs basis. This will include revision / amendment of management actions that are not achieving the desired outcomes, environmental monitoring identifying additional impacts and management actions, changes to relevant legislation or improvements to practices to achieve a greater environmental outcome.

Changes to the management actions or targets of this CMP will require the approval of the EPA Services prior to those changes being implemented.

Any changes will be reported through the Ministerial Statement CAR. Where significant changes to the CMP are required, the document will be updated and distributed. Issues which may be amended over the course of the construction could relate to:

- The presence of new surface water pools in creeklines adjacent to the road construction area
- Changes to the requirements for site accommodation or fuel storage.

3.3 Audits

Internal and external audits will be undertaken as per the Main Roads contract schedule and the results reported back to the Environmental Supervisor where relevant, in order for them to undertake corrective actions.

4. Stakeholder consultation

Main Roads has not undertaken any construction specific stakeholder consultation (to date) for Stage 3 and 4a of the Karratha – Tom Price Road. Throughout Stage 2 of the project consultation was undertaken with relevant local and regulator parties.

As detailed design and construction planning progress, stakeholder consultation will commence; this is likely to include:

- DWER / Water Corporation - on fuel storage and other activities within the PDWSA and the requirements for permits under the *Rights in Water and Irrigation Act, 1914.*
- DBCA Pilbara PaW office.

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Appendix E – Karratha Tom Price Road Stage 3 and 4a Weed Control and Management Plan

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August 2018

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Report Compilation & Review	Name and Position	Document Revision	Date
Author:	Luke Lovell Environment Officer	Draft v1	07 August 2018
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Contents

1 BACKGROUND 5
2 PROJECT LOCATION 5
3 OBJECTIVES AND KPIS 5
4 ACCOUNTABILITIES 6
5 TRAINING & AWARENESS 6
6 MAPPING & MONITORING OF WEED PRESENCE 6
6.1 Pre-Construction 6
6.2 Construction 8
6.3 Maintenance Phase 8
7 WEED CONTROL AND MANAGEMENT PRE-CONSTRUCTION, DURING AND POST CONSTRUCTION 9
8 MANAGEMENT PLAN PROVISIONS 16
8.1 Management systems and implementation 16
8.1.1 Monitoring 16
8.1.2 Environmental incidents / non-compliances 16
8.1.3 Reporting 16
9 ADAPTIVE MANAGEMENT 16
9.1 Environmental monitoring and corrective actions 16
9.2 WCMP Revision 17
9.3 Audits 17
10 STAKEHOLDER CONSULTATION 17
11 REFERENCES 18
12 APPENDIX 1 WEED REGISTER FORM 19
13 APPENDIX 2 WEED IDENTIFICATION PHOTOS 21
14 APPENDIX 3 WEED LOCATION MAPS 37

1 BACKGROUND

Main Roads Western Australia (Main Roads) is currently undertaking a staged upgrade of the Karratha-Tom Price Road (KTP project) which is located to the south of Karratha through to the existing Nanutarra-Munjina Road, north of Tom Price. The proposed road will generally follow close to the Pilbara Iron Railway and the existing Pilbara Iron Railway access road.

The KTP project was initially proposed via a Consultative Environmental Review (CER) document in 2003. The CER included a total of 245 kilometre (km) of proposed new or upgraded road from the North West Coastal Highway to the Nanutarra-Munjina Road, in three stages (2, 3 and 4). The environmental approval of the project was given in April 2005 under Assessment 1244 (Bulletin 1159) and through Ministerial Statement 677.

Construction of the 89 km of Stage 2 was commenced in 2006 by the Millstream Link Alliance and completed in 2008. This work was undertaken using a series of approved management plans as required under Statement 677. The management plans were approved by relevant authorities including the then Department of Environment, Water and Rivers Commission and Department of Indigenous Affairs, with advice from Department of Conservation and Land Management (CALM). Adherence to the plans was audited internally, externally and by CALM/Department of Environment Conservation, particularly in relation to the section of Stage 2 which traversed the Millstream Chichester National Park.

The initial vegetation clearing approval was for 574 hectare (ha) (474 ha for the road formation and 100 ha for borrow pits), with 110 ha within the National Park. A Section 46C approval increased the amount of land approved for clearing within the National Park to 145 ha (to a project total of 609 ha). Total clearing undertaken for Stage 2 was 445 ha, with 122 ha within the National Park.

This weed control and management plan is specific to Stage 3 and 4a of this road project and has been prepared in accordance with Condition 6-1(5) of Ministerial Statement 677.

2 PROJECT LOCATION

Stages 3 and 4a of the KTP cover a distance of approximately 93 km. These Stages start at the junction of the Pilbara Iron Railway line and the Roebourne Wittenoom Road and end approximately 7 km south of the Fortescue River crossing. Stage 3 of the road alignment (58 km) closely follows the Roebourne Wittenoom Road until the Pilbara Iron Railway deviates from this road towards Tom Price. Stage 4a of the project (35 km) runs south from the Roebourne Wittenoom Road adjacent to the existing railway access road. Approximately 14.6 km of the project area (Stage 3a) occurs within the Millstream Chichester National Park, primarily within a designated road reserve.

The road will consist of a 7 m wide two-lane seal with 1 m wide shoulders and associated cut or fill batters, table drains and offshoot drains. Stages 3 and 4a will incorporate approximately 42 floodways and 61 culverts. The approximate width of the road construction, within a flat area, will be 19 m to 20 m, including table drains. Note that this will increase in areas of cut and fill.

3 OBJECTIVES AND KPIS

The objectives of the weed control program are to:

1 Prevent the introduction of new weed species into the project area and adjoining areas.
2 Ensure that existing weed infestations are not extended within the work area.
3 Reduce weed infestations wherever possible through active management.
4 Minimise the risk of weed infestations developing in rehabilitated areas.

These objectives will be measured by the following Key Performance Indicators (KPIs):
1 Measurement of DBCAs satisfaction with Ruby Dock control during the construction period.
2 Measurement of Ruby Dock Control in the seven (7) year maintenance period.
1 Measurement of rehabilitation compliance in the seven (7) year maintenance period eg. percent native vegetation cover, number of species, weeds.

4 ACCOUNTABILITIES

Environmental Representative / Manager accountable for:

- Ensuring the weed control program is implemented as planned
- Ensuring the outcomes of the weed control program meet the satisfaction of DBCA.
- Planning & implementation of the weed control program during the construction phase.

Construction Superintendent accountable for:

- Providing adequate resources
- Planning activities to ensure the timely implementation of the weed control program.

5 TRAINING & AWARENESS

Staff carrying out construction works will be provided with a suitable induction (including photographs) of Ruby Dock and other weeds of concern in order to recognise relevant weeds and assist in reporting and control. Weeds will be discussed at Pre-Start and Toolbox meetings where appropriate.

6 MAPPING & MONITORING OF WEED PRESENCE

6.1 Pre-Construction

ecologia Environment (ecologia) was commissioned by Main Roads Western Australia (MRWA) to conduct a baseline weed survey of areas in July 2018 of proposed material pits and road widening associated with the upgrade of the Karratha-Tom Price Road and the Pannawonica-Millstream Road.

Twelve weed species were recorded within the stage 3 and 4a alignment. *Aerva javanica* was recorded only from the road verge in the northern section of the area (Figure 6.3 in appendix 2). *Bidens bipinnata* was recorded in low abundance from two locations in the south (Figure 6.13 in appendix 2). Extensive populations of *Cenchrus ciliaris* and *C. setiger* were present along road verges, particularly in the northern and southern sections of the proposed road (Figure 6.2-6.3 and Figure 6.14-6.15 in appendix 2), but both species were recorded sporadically along the entirety of the proposed road. *Echinochloa colona*, *Flaveria trinervia, Melochia pyramidata*, and *Sonchus oleraceus* were recorded in low abundance from a degraded creek (Figure 6.13), and more extensive populations of *Cynodon dactylon, Malvastrum americanum* and *Vachellia farnesiana* were primarily recorded from the same creek.

Aerva javanica was most abundant along the disturbed road verge of Roebourne-Wittenoom Road in the north-western section of the study area. It was also recorded in low abundance from an undisturbed rocky outcrop at site PM02 and from a single location adjacent to the Tom Price Railway Road. A total of 226 individuals were recorded within the study area from *25 point locations.*

Weeds were rarely recorded from undisturbed sites where vegetation condition was Excellent (primarily stony plains and low rocky hills) and undisturbed creeks and drainage lines.

Across the study area, weeds tended to be almost entirely restricted to disturbed roadsides, tracks, and existing pits, disturbed creeks and drainage lines, and floodplains and gilgai with cracking clay soils.

All species identified are listed as Permitted -s11 on the Western Australian Organism List (DPIRD 2018), and are not Weeds of National Significance. All species have a 'high' ecological impact rating and 'rapid' invasiveness rating in the Pilbara according to the Weed Prioritisation Process (DPaW 2013) (Table 1), except for *F. trinervia* and *M. pyramidata* which are not rated.

Distribution mapping for each species is shown in Appendix 3. Representative photographs of each species and significant populations are shown in Appendix 2.

Table 1: Weed species recorded within the stage 3 and 4a alignment

Species	Family	Habitat/s within the study area	Rating	Ecological impact	Invasiveness	Individuals recorded within study area (number of points)	Total area mapped (ha)
Aerva javanica (kapok bush)	*Amaranthaceae*	Disturbed roadsides, rocky outcrops	Permitted – s11	High	Rapid	226 (25)	–
Bidens bipinnata (bipinnate beggartick)	*Asteraceae*	Plains, clay soils	Permitted – s11	Unknown	Rapid	46 (3)	–
Cenchrus ciliaris (buffel grass)	*Poaceae*	Stony plains, cracking clays, creeks, drainage lines, disturbed roadsides	Permitted – s11	High	Rapid	464 (75)	29.17
Cenchrus setiger (Birdwood grass)	*Poaceae*	Stony plains, cracking clays, creeks, drainage lines, disturbed roadsides	Permitted – s11	High	Rapid	263 (46)	10.56
Cenchrus spp.	*Poaceae*	As above				6 (3)	260.77
Cynodon dactylon (couch grass)	*Poaceae*	Creeks	Permitted – s11	High	Rapid	–	11.08
Echinochloa colona (awnless barnyard grass)	*Poaceae*	Creeks	Permitted – s11	High	Rapid	6 (2)	–
Flaveria trinervia (speedy weed)	*Asteraceae*	Creeks	Permitted – s11	Unrated		1 (1)	–
Malvastrum americanum (spiked malvastrum)	*Malvaceae*	Cracking clays, gilgai, clay soils, creeks	Permitted – s11	High	Rapid	2 (2)	343.31
Melochia pyramidata (pyramid flower)	*Malvaceae*	Creeks	Permitted – s11	Unrated		34 (3)	–
Passiflora foetida var. *hispida* (stinking passion flower)	*Passifloraceae*	Creeks, drainage lines, disturbed areas	Permitted – s11	High	Rapid	5 (4)	–
Sonchus oleraceus (common sowthistle)	*Asteraceae*	Creek	Permitted – s11	Low	Rapid	1 (1)	–
Vachellia farnesiana (mimosa bush)	*Fabaceae*	Cracking clays, gilgai, clay soils, creeks	Permitted – s11	High	Rapid	150 (49)	425.33

6.2 Construction

On an ongoing basis any locations of Ruby Dock will be monitored within the stage 3 alignment and will be removed by hand when found.

Documented and periodic inspections of haul roads & minor roads, water storage dams, wash down facilities, topsoil stockpiles, workshop, and refuelling areas address the presence of weeds. *Ad hoc* inspections of areas outside of the road construction zone are undertaken to check for any outbreaks of Ruby Dock or Kapok. Areas of infestation will be recorded.

Any new locations identified during construction will be recorded in the Weed Register Form (Appendix 1) and mapped. Contractors are to report any declared plant species to the Main Roads Construction Superintendent within 48 hours. The Construction Superintendent is to report all Declared weeds to the Main Roads Environment Officer, who will report the weeds to the Department of Primary Industries and Regional Development as per s26 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act)[1].

Areas of weed infestation will be mapped using a GPS and marked on the ground if applicable. All weed information will be mapped using GIS, and a copy of the data provided to DBCA at least annually, and at the end of the construction phase. The effectiveness of the weed control programme will be communicated to the Main Roads Environment Officer annually.

Known Ruby Dock infestations will be revisited following major rain periods to check for regrowth, control outbreaks and evaluate effectiveness of control.

Infestation of weeds, particularly *Aerva javanica* (Kapok) will not be managed through slashing, however will be managed through spraying of roadside vegetation and weeds.

Annual, seasonal (within 6 weeks of significant rainfall), monitoring of key weeds within the 60 m construction zone, in borrow pits and access roads will be completed until the completion criteria (as stated in the Vegetation Protection and Rehabilitation Management Plan (GHD 2018)) have been achieved.

6.3 Maintenance Phase

The maintenance period continues for 7 years following construction completion. Monitoring and control for weed infestations will involve annual inspections and mapping of weed presence and spraying or hand removal as appropriate. All areas previously disturbed by the construction process will be inspected. All information on Ruby Dock infestations will be provided to DBCA annually or as requested by them.

[1] Refer to https://www.legislation.wa.gov.au/legislation/statutes.nsf/main_mrtitle_2736_homepage.html

7 WEED CONTROL AND MANAGEMENT PRE-CONSTRUCTION, DURING AND POST CONSTRUCTION

Table 2: Weed management actions pre, during and post construction

Management Action	Monitoring/Maintenance Program	Management Target / Response Action	Responsible Person	Completion Timeframe	Documentation/Evidence
Preconstruction					
Remove or kill any weeds growing in project area that are likely to spread and result in environmental harm to adjacent areas of native vegetation	Pre-construction	Locations of key weed species within the construction zones are known prior to construction commencement	Environmental Management Representative - Contractor	Prior to clearing commencing	Weed register form
Site induction and training will be undertaken to minimise the spread of weeds during construction	Pre-construction / Construction	Inductions and training	Environmental Management Representative - Contractor	Prior to clearing commencing	Inductions and training records
If timing permits, infestations of Ruby Dock along the road corridor or adjacent tracks will be sprayed prior to construction commencement	Pre-construction	Locations of key weed species within the construction zones are known prior to construction commencement	Environmental Management Representative - Contractor	Prior to clearing commencing	Weed register form
Known areas of high priority weeds (such was Ruby Dock) will be quarantined and access prevented	All Stages	Locations of weed species within the construction zones are known prior to construction commencement	Environmental Management Representative - Contractor	ongoing	Weed register form
All vehicles and plant will arrive on site and leave site in a clean condition, i.e. without soil or vegetative material attached.	Pre-construction	Inspections of vehicles and plant	Environmental Management Representative - Contractor	ongoing	Inspection records
Ground disturbing pre-construction activities will not be undertaken in areas known to support Ruby Dock. Where necessary, areas will be demarcated with temporary fencing or other markers and entry restricted	Pre-construction	Locations of weed species within the construction zones are known prior to construction commencement	Environmental Management Representative - Contractor	Prior to clearing commencing	Weed register form
Construction					
Any machinery used in the removal of weed-infested topsoil will be cleaned down before and between operations to prevent the introduction and spread of weeds outside weed infested areas	Construction	Inspections of vehicles and plant No new weed species are introduced into the project area and adjoining areas Existing key weed species infestations are not extended within the works areas	Environmental Management Representative - Contractor	Completion of construction	Inspection records

Spoil heaps will be monitored for weed growth and weed spraying will be carried out if required	All stages	Environmental Supervisor will monitor spoil heaps Weed spraying will be carried out if required	Environmental Management Representative - Contractor	ongoing	Weed register form
Weed infested spoil will not be used in rehabilitation works but will be disposed to a pit site outside the national park and covered with a minimum of 400 mm of clean spoil	All stages	No new weed species are introduced into the project area and adjoining areas No Ruby Dock is present within road corridor or existing borrow areas at completion of works/monitoring period	Environmental Management Representative - Contractor	ongoing	Weed register form
Any soil or materials imported onto the worksite will be from weed-free areas	All stages	Source areas will be checked by the on-site Environmental Supervisor Inspections of vehicles and plant No Ruby Dock is present within road corridor or existing borrow areas at completion of works/monitoring period	Environmental Management Representative - Contractor	ongoing	Inspection records
Machinery and plant are cleaned down in designated areas to prevent the introduction and spread of weeds	Post - Construction	Inspections of vehicles and plant	Environmental Management Representative - Contractor	ongoing	Inspection records
Where roadworks directly impact known areas of high priority weeds, topsoil will be removed separately, heaps delineated and spoil disposed of as soon as possible through consultation with the Environmental Supervisor. It may be possible to use such soil within the fill areas beneath the road carriageway but this option will be carefully considered for risk of accidental spread.	Construction	No new weed species are introduced into the project area and adjoining areas Existing key weed species infestations are not extended within the works areas No Ruby Dock is present within road corridor or existing borrow areas at completion of works/monitoring period Weed spraying will be carried out if required Pre-existing weed infestations are reduced wherever possible through active management	Environmental Management Representative - Contractor	Completion of construction	Weed register form
Weed contaminated topsoil stockpiles shall be quarantined from uncontaminated / clean topsoil stockpiles, clearly signed in the field and identified on a site plan	Construction and Post - Construction	Environmental Supervisor shall clearly sign in the field and identify on a site plan	Environmental Management Representative - Contractor	ongoing	Maps of site plan and signage

Report suspected new weed locations	All stages	Periodic inspections of haul roads & minor roads, water storage dams, wash down facilities, topsoil stockpiles, workshop, and refuelling areas address the presence of weeds Weed spraying will be carried out if required Pre-existing weed infestations are reduced wherever possible through active management No new weed species are introduced into the project area and adjoining areas Existing key weed species infestations are not extended within the works areas	Environmental Management Representative - Contractor	ongoing	Weed register form
Outbreak or spread of key weed infestations will be removed by hand (Ruby Dock) or sprayed with suitable herbicides as soon as they are identified	All stages	Periodic inspections of haul roads & minor roads, water storage dams, wash down facilities, topsoil stockpiles, workshop, and refuelling areas address the presence of weeds Weed spraying will be carried out if required	Environmental Management Representative - Contractor	ongoing	Weed register form
Any outbreaks of Ruby Dock will be treated as soon as possible, mapped, and revisited at regular intervals to ascertain the success of control treatments	All stages	No new weed species are introduced into the project area and adjoining areas No Ruby Dock is present within road corridor or existing borrow areas at completion of works/monitoring period Weed spraying will be carried out if required Pre-existing weed infestations are reduced wherever possible through active management	Environmental Management Representative - Contractor	ongoing	Weed register form
Ensure no weed affected soil, mulch, fill or other material is brought into the cleared area	Construction	Source areas will be checked by the on-site Environmental Supervisor	Environmental Management Representative - Contractor	Completion of construction	Inspection records

		Inspections of vehicles and plant Weed spraying will be carried out if required Pre-existing weed infestations are reduced wherever possible through active management			
Vegetation storage will not occur on areas containing high risk weeds such as Buffel grass, Ruby dock or Kapok, or in drainage lines	All stages	Environmental Supervisor will ensure vegetation storage areas will be checked prior to storing that they're not located near any mapped high risk weed areas Weed spraying will be carried out if required Pre-existing weed infestations are reduced wherever possible through active management	Environmental Management Representative - Contractor	ongoing	Inspection records
Woody weed infestations will be cut to a stump and painted with herbicide. Cut material will be bagged and removed from site to an approved landfill or buried to a depth of at least 1 m.		No new weed species are introduced into the project area and adjoining areas Existing key weed species infestations are not extended within the works areas Pre-existing weed infestations are reduced wherever possible through active management	Environmental Management Representative - Contractor	ongoing	Weed register form
Post Works					
Monitor compliance with the CEMP	Post - Construction	Environmental Supervisor to complete regular compliance inspections with CEMP	Environmental Management Representative - Contractor	ongoing	Compliance inspections
Weed infestation that appear following topsoil respread or other revegetation works will be targeted for herbicide or other control as applicable	Construction / Post - Construction	Monitoring will be undertaken by a qualified and experienced botanist to identify weeds during rehabilitation monitoring Outbreaks of Ruby Dock or other key weed species within or adjacent to borrow areas will be reported to	Environmental Management Representative - Contractor - Contractor	ongoing	Rehabilitation report and/or Weed register form

		PaW within 1 month of identification			
Weed monitoring and ongoing control of significant weeds, as required	Post - Construction	Annual, seasonal (within 6 weeks of significant rainfall), monitoring of key weeds within the 60 m construction zone, and access road and until completion criteria have been achieved for stage 3a A combination of slashing and spraying will be annually undertaken for stages 3b and 4a.	Environmental Management Representative - Contractor	ongoing	Weed register form
Disturbed areas are to be re-instated and stabilised	Post - Construction		Environmental Management Representative - Contractor	ongoing	Compliance inspections
Machinery and plant are cleaned down in designated areas to prevent the introduction and spread of weeds	Post - Construction	Inspections of vehicles and plant	Environmental Management Representative - Contractor	ongoing	Inspection records
Topsoil which are found to contain weed species will not be respread for rehabilitation purposes. Such stockpiles will be buried under clean fill in borrow areas or fill sections to a depth of at least 400 mm	Construction and Post - Construction	Environmental Supervisor to identify weed infested topsoil No new weed species are introduced into the project area and adjoining areas No Ruby Dock is present within road corridor or existing borrow areas at completion of works/monitoring period	Environmental Management Representative - Contractor	ongoing	Weed register form
Revegetation					
Stockpiles of spoil or topsoil which are found to contain weed species will not be respread for rehabilitation purposes. Such stockpiles will be buried under clean fill in borrow areas or fill sections to a depth of at least 400 mm	Post-construction	No new weed species are introduced into the project area and adjoining areas Pre-existing weed infestations are reduced wherever possible through active management	Environmental Management Representative - Contractor	ongoing	Weed register form
All revegetated areas will be monitored and spot sprayed for weeds at least annually, six to eight weeks after the completion of the wet season for stages 3a.	Post-construction	Annual, seasonal (within 6 weeks of significant rainfall), monitoring of key weeds within the 60 m construction zone, and access road and until completion criteria have been	Environmental Management Representative - Contractor	ongoing	Rehabilitation report and/or Weed register form

		achieved for stage 3a. A combination of slashing and spraying will be annually undertaken for stages 3b and 4a. Monitoring will be undertaken by a qualified and experienced botanist to identify weeds during rehabilitation monitoring			
Any outbreaks of Ruby Dock will be treated as soon as possible, mapped, and revisited at regular intervals to ascertain the success of control treatments.	Post-construction	Annual, seasonal (within 6 weeks of significant rainfall), monitoring of key weeds within the 60 m construction zone, and access road and until completion criteria have been achieved for stage 3a A combination of slashing and spraying will be annually undertaken for stages 3b and 4a.	Environmental Management Representative - Contractor	ongoing	Weed register form
Areas of weed infestation will be mapped using a GPS and marked on the ground if applicable	Post-construction	No new weed species are introduced into the project area and adjoining areas Pre-existing weed infestations are reduced wherever possible through active management	Environmental Management Representative - Contractor	ongoing	Weed register form
Monitoring					
Weed monitoring to be undertaken monthly during construction and annually post-construction	Construction / Post-construction	Annual, seasonal (within 6 weeks of significant rainfall), monitoring of key weeds within the 60 m construction zone, and access road and until completion criteria have been achieved for stage 3a A combination of slashing and spraying will be annually undertaken for stages 3b and 4a.	Environmental Management Representative - Contractor	ongoing	Weed register form
Where weed infestation is evident, herbicide application shall be undertaken to ensure no Ruby Dock present, no new weed species present (compared to	Construction / Post-construction	Revegetation monitoring for up to 4 years	Environmental Management Representative - Contractor	ongoing	Rehabilitation report and/or Weed register form

reference site) and weed cover within rehabilitation area < weed cover at reference site		Monitoring will be undertaken by a qualified and experienced botanist to identify weeds during rehabilitation monitoring			

8 MANAGEMENT PLAN PROVISIONS

8.1 Management systems and implementation

Main Roads has an integrated management system that incorporates an ISO 14001:2015 certified Environmental Management System.

8.1.1 Monitoring

Daily and weekly observations of the construction site will be conducted to ensure the objectives of this WCMP are implemented and that the required management actions are in place.

8.1.2 Environmental incidents / non-compliances

Environmental incidences and non-compliances will be identified and recorded as soon as possible by the relevant responsible persons. Incidents will be mitigated or rectified where possible within 48 hours of being identified. Non-conformances to this plan will be reported to the Main Roads Construction Superintendent within 48 hours of identification.
Any non-conformance to this plan is to be reported to DWER Compliance Branch and investigated to determine:

- Why the non-conformance occurred
- What was the environmental harm or alteration of the environment that resulted from the non-conformance
- What changes to project activities and/or management plans is required
- Measures to prevent, control or abate the environmental harm that may have occurred.

8.1.3 Reporting

The environmental performance of the construction activities and the identification of auditing requirements will be assessed by Main Roads prior to and throughout the construction period. All documents pertaining to environmental management are required to be maintained though a system of document control, including the storage of hardcopy documents at site and archiving for handover to Main Roads upon contract completion.

Ministerial Condition 677 does not list specific reporting requirements, such as reporting of exceedance of threshold criteria. Reporting requirements specific to this WCMP are outlined in Table 2-2-1 and Table 2-2-2 of the Vegetation Protection and Rehabilitation Management Plan (GHD 2018). Reporting on compliance with the WCMP will be undertaken annually as part of Ministerial Statement 677 Compliance Assessment Report (CAR).

If a non-conformance with this plan occurs, Main Roads will notify DWER Compliance Branch through their email address at compliance@dwer.wa.gov.au within seven days of becoming aware of the non-conformance. A report on the investigation (as per 8.1.2 above) of the non-conformance will be provided within 60 days of reporting the non-conformance.

9 ADAPTIVE MANAGEMENT

The adaptive management approach aims to reduce impacts by embedding a cycle of monitoring, reporting and implementing change (where required). This document applies the principles of adaptive management through monitoring, corrective actions and implementing changes. Adaptive management has been considered throughout this document, and the key adaptive management processes are described below.

9.1 Environmental monitoring and corrective actions

Internal monitoring of the environmental aspects of the road construction will occur throughout the project, through the Environmental Supervisor (or their delegate). Any non-conformances

with this WCMP will be discussed with the Construction Manager/Construction Superintendent and rectified or mitigated as soon as possible to ensure minimal ongoing environmental harm. Relevant procedures will be amended/updated as necessary and inductions and other workforce communication will be undertaken in a timely manner to minimise the risk of re-occurrences.

9.2 WCMP Revision

The WCMP is intended to be dynamic and may be updated to reflect changes in management practices and the natural environment with time. This will also allow flexibility to respond to new environmental impacts and adopt new technologies / management measures.

Amendments to management actions will be completed on an as needs basis. This will include revision / amendment of management actions that are not achieving the desired outcomes, environmental monitoring identifying additional impacts and management actions, changes to relevant legislation or improvements to practices to achieve a greater environmental outcome. Changes to the management actions or targets of this WCMP will require the approval of the EPA Services prior to those changes being implemented.

Any changes will be reported through the Ministerial Statement CAR. Issues which may be amended over the course of the construction / maintenance could relate to identification of key weed species within or immediately adjacent to the construction zone or borrow pits.

9.3 Audits

Internal and external audits will be undertaken as per the Main Roads contract schedule and the results reported back to the Environmental Supervisor where relevant, in order for them to undertake corrective actions.

10 STAKEHOLDER CONSULTATION

In preparing this WCMP the following consultation specific to the preparation of the Management Plan has been undertaken. The consultation table below is an ongoing record of consultation undertaken and will be updated as consultation relating to environmental management occurs. Consultation and collaboration with the neighboring railway operators in regard to eradicating weeds will be undertaken prior to construction.

Stakeholder/ contact person	Date	Type of communication	Comments recieved
Lara Martin (Department of Primary Industries and Regional Development)	21 November 2018	Email requesting a review of the Weed Control and Management Plan	Comments received on 22 November 2018.

11 REFERENCES

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Department of Parks and Wildlife (DPaW) (2013). Invasive Plant Prioritisation Process for DPaW. Available at: http://dec.wa.gov.au/management-and-protection/plants/invasive-plants/invasive-plantprioritisation- process.html. Department of Parks and Wildlife. Government of Western Australia.

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Keighery, B.J. (1994) Bushland Plant Survey - A Guide to Plant Community Survey for the Community Wildflower Society of WA (inc) Nedlands WA.

Smith, N. M (2002). Weeds of the Wet / Dry Tropics of Australia, A Field Guide, Environmental Centre, Northern Territory.

Main Roads Western Australia Karratha-Tom Price Road and Pannawonica-Millstream Road Weed Survey (2018) Ecologia Environment, Osborne Park, Western Australia

12 APPENDIX 1 WEED REGISTER FORM

Year First Identified	MGA 50 Easting	MGA 50 Northing	Weed Name	Location Description	Area (m2) / No. of Plants	Stage and # of plants Seedling, Juvenile and or Adult's	Action Taken (pulled out / reported etc)	Disposal Location	Further Action Required

Year First Identified	MGA 50 Easting	MGA 50 Northing	Weed Name	Location Description	Area (m2) / No. of Plants	Stage and # of plants Seedling, Juvenile and or Adult's	Action Taken (pulled out / reported etc)	Disposal Location	Further Action Required

13 APPENDIX 2 WEED IDENTIFICATION PHOTOS

***Aerva javanica* (kapok bush)**

Location: Roebourne-Wittenoom Rd, disturbed road verge, 50K 515886.3 mE 7627606.9 mN, facing south.

Location: Site PM02, base of rocky outcrop, 50K 519056.6 mE 7607682.8 mN, facing south.

***Bidens bipinnata* (bipinnate beggartick)**

Location: Tom Price Railway Road, *Acacia* shrubland with clay soils, 50K 564468.8 mE 7582016.8 mN.

***Cenchrus ciliaris* (buffel grass)**

Location: Site PM04, cracking clay soils, 50K 504289.1 mE 7609097.9 mN.

Location: Site PM04, cracking clay soils, 50K 504289.1 mE 7609097.9 mN, facing north-west.

Location: Site PM03, cracking clay soils, 50K 509424.5 mE 7607978.6 mN, facing east.

***Cenchrus setiger* (Birdwood grass)**

Location: Site PM02, cracking clay soils, 50K 517391.9 mE 7607619.0 mN.

Location: Site PM02, cracking clay soils, 50K 517391.9 mE 7607619.0 mN, facing south.

Cenchrus ciliaris + C. setiger

Location: Roebourne-Wittenoom Rd, disturbed road verge, 50K 521511.1239 mE 7615911.364 mN, facing south-east.

Location: Site BP139.6, disturbed area, 50K 549962.3415 mE 7601386.658 mN, facing north-east.

Location: Roebourne-Wittenoom Rd, disturbed road verge, 50K 516714.0 mE 7631516.0 mN, facing south-west.

***Cynodon dactylon* (couch)**

Location: Tom Price Railway Road, minor creek, 50K 564087.5 mE 7583096.2 mN, facing east.

Location: Site PM02, minor creek, 50K 519133.5 mE 7607597.4 mN.

Location: Site PM02, minor creek, 50K 519133.5 mE 7607597.4 mN, facing east.

***Echinochloa colona* (awnless barnyard grass)**

Location: Tom Price Railway Road, minor creek, 50K 564288.1 mE 7583031.0 mN.

Location: Site PM02, minor creek, 50K 519133.5 mE 7607597.4 mN, facing east.

Flaveria trinervia

Location: Tom Price Railway Road, adjacent to minor creek, 50K 564241.5 mE 7583168.0 mN, facing east.

***Malvastrum americanum* (spiked malvastrum)**

Location: Tom Price Railway Road, adjacent to minor creek, 50K 552454.5 mE 7597020.1 mN

Location: Site PM04, cracking clay soils, 50K 504424.0 mE 7609137.9 mN.

Location: Site PM04, cracking clay soils, 50K 504424.0 mE 7609137.9 mN, facing south.

***Melochia pyramidata* (pyramid flower)**

Location: Tom Price Railway Road, adjacent to minor creek, 50K 564165.4 mE 7583067.2 mN

Location: Tom Price Railway Road, adjacent to minor creek, 50K 564165.4 mE 7583067.2 mN

Location: Site PM02, minor creek, 50K 519042.7 mE 7607716.6 mN, facing south.

***Passiflora foetida* var. *hispida* (stinking passion flower)**

Location: Site PM06, drainage line, 50K 490287.3 mE 7597339.5 mN.

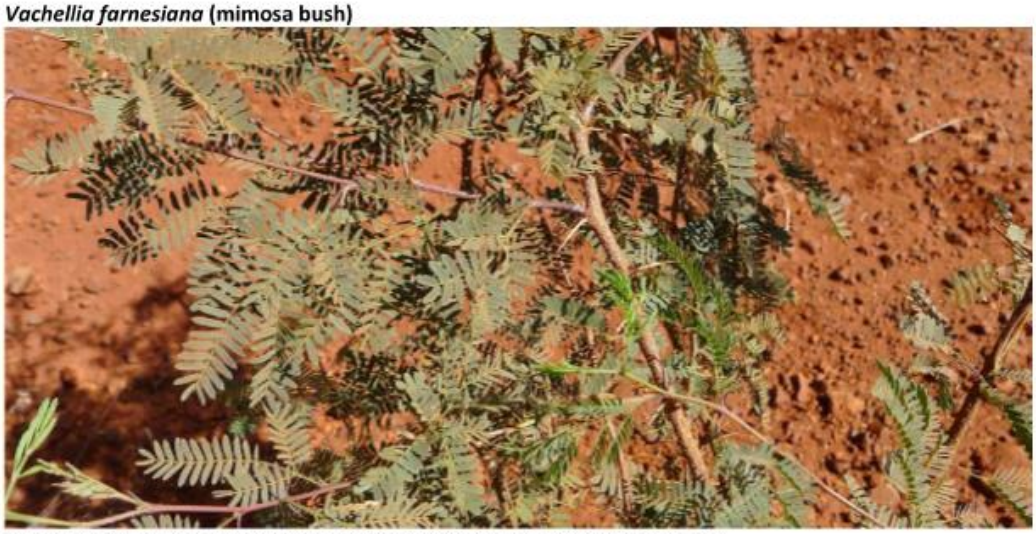
Location: Site PM02, cracking clay soils, 50K 515792.6 mE 7607837.0 mN, facing south-east.

***Sonchus oleraceus* (common sowthistle)**

Location: Tom Price Railway Road, adjacent to minor creek, 50K 564288.1 mE 7583031.0 mN

Location: Tom Price Railway Road, adjacent to minor creek, 50K 564288.1 mE 7583031.0 mN

***Vachellia farnesiana* (mimosa bush)**



Location: Roebourne-Wittenoom Rd, disturbed road verge, 50K 516430.0 mE 7630724.3 mN.

Location: Roebourne-Wittenoom Rd, disturbed road verge, 50K 516430.0 mE 7630724.3 mN, facing south.

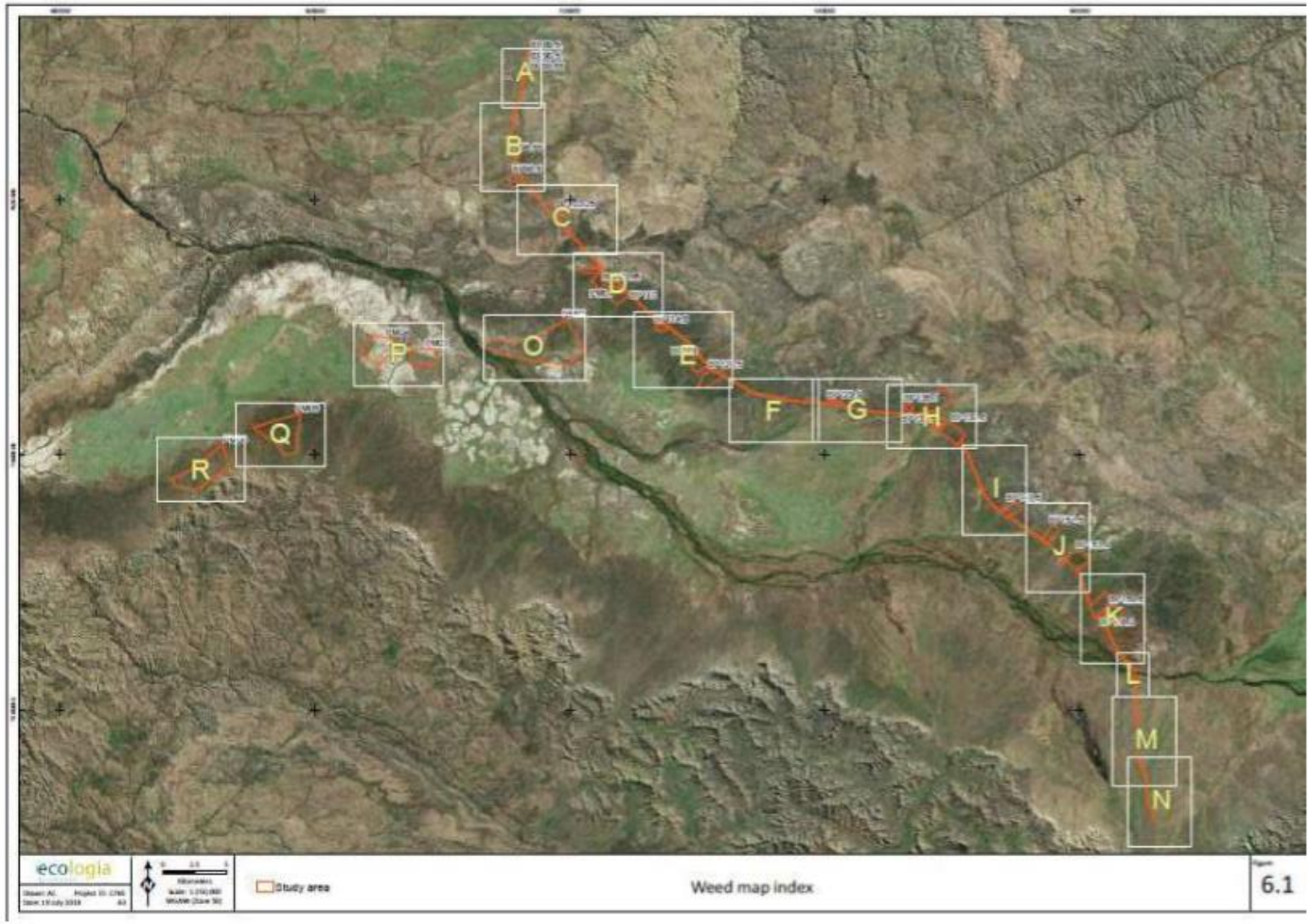
Location: Site PM04, cracking clay soils, 50K 504424.0 mE 7609137.9 mN, facing south.

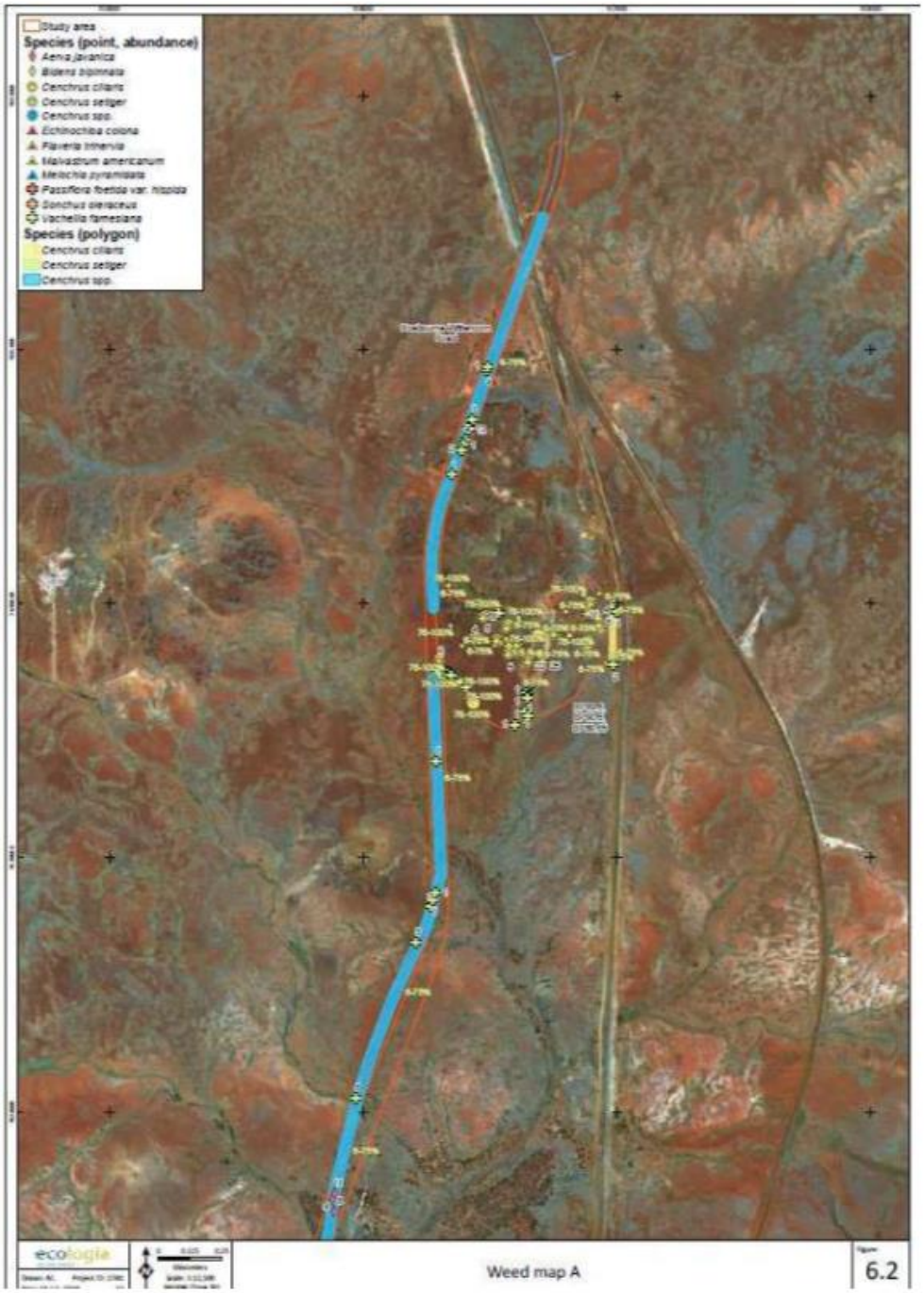
***Vachellia farnesiana* (mimosa bush)**

Location: Site PM03, cracking clay soils, 50K 509424.5 mE 7607978.6 mN, facing east.

Location: Site PM03 (Q19), cracking clay soils, 50K 519663.5 mE 7608384.9 mN, facing south-east.

14 APPENDIX 3 WEED LOCATION MAPS


A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
ecologia
Study area
Weed map index
6.1


Study area
Species (point, abundance)
Aerva javanica
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Melochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
ecologia
Weed map A
6.2

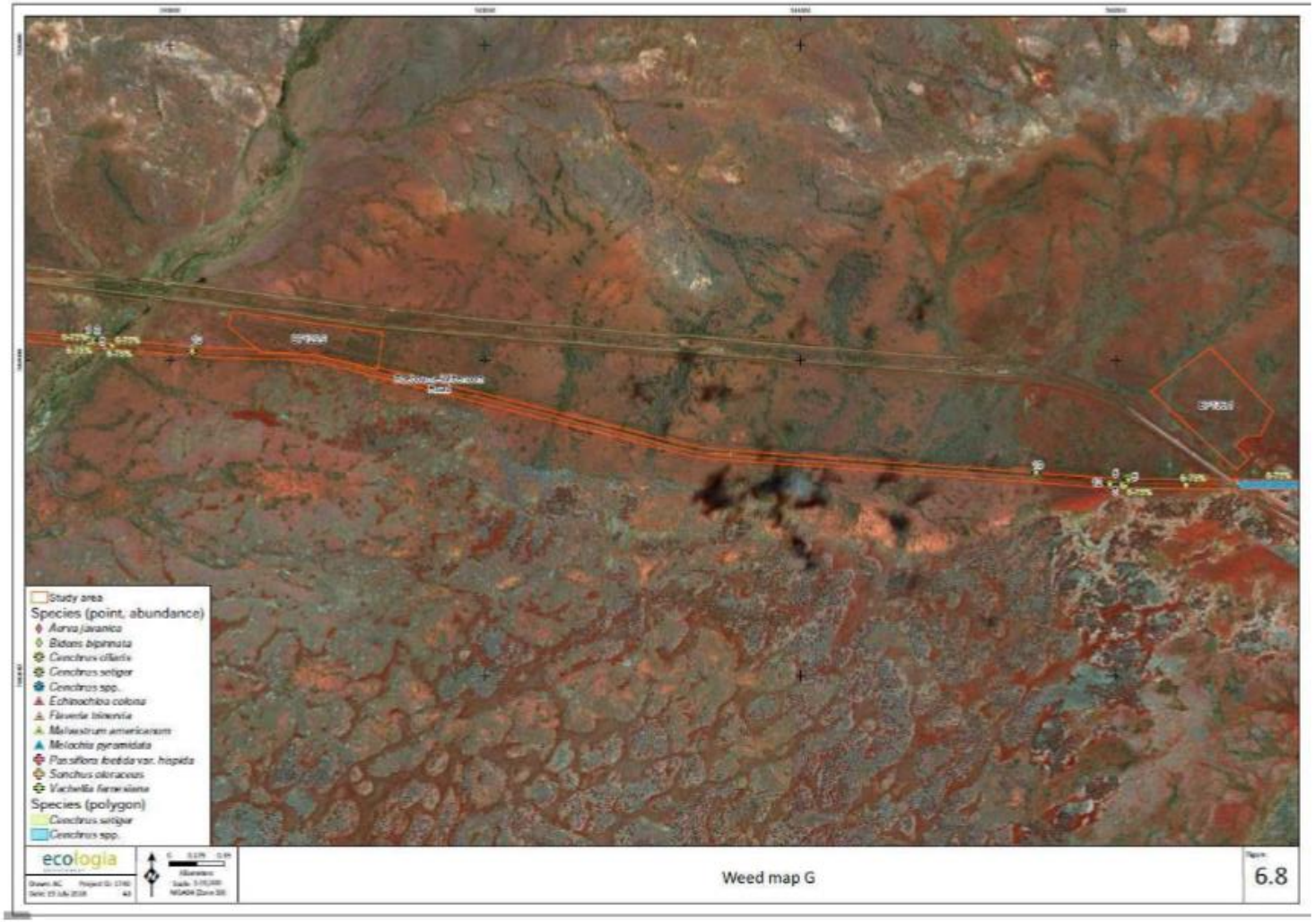

Study area
Species (point, abundance)
Aerva javanica
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Melochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
ecologia
Weed map A
6.2


Study area
Species (point, abundance)
Aerva javanica
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Melochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus spp.
ecologia
Weed map C
6.4


Study area
Species (point, abundance)
Aerva javanica
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria sinuata
Malvastrum americanum
Melochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
ecologia
Weed map D
6.5


Study area
Species (point, abundance)
Aerva javanica
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Mahestrum americanum
Malachia pyramidata
Parvillora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus spp.
6-70%
6-70%
ecologia
Weed map E
6.6


Study area
Species (point, abundance)
Aerva javanica
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Melochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus setiger
ecologia
Weed map F
6.7


Study area
Species (point, abundance)
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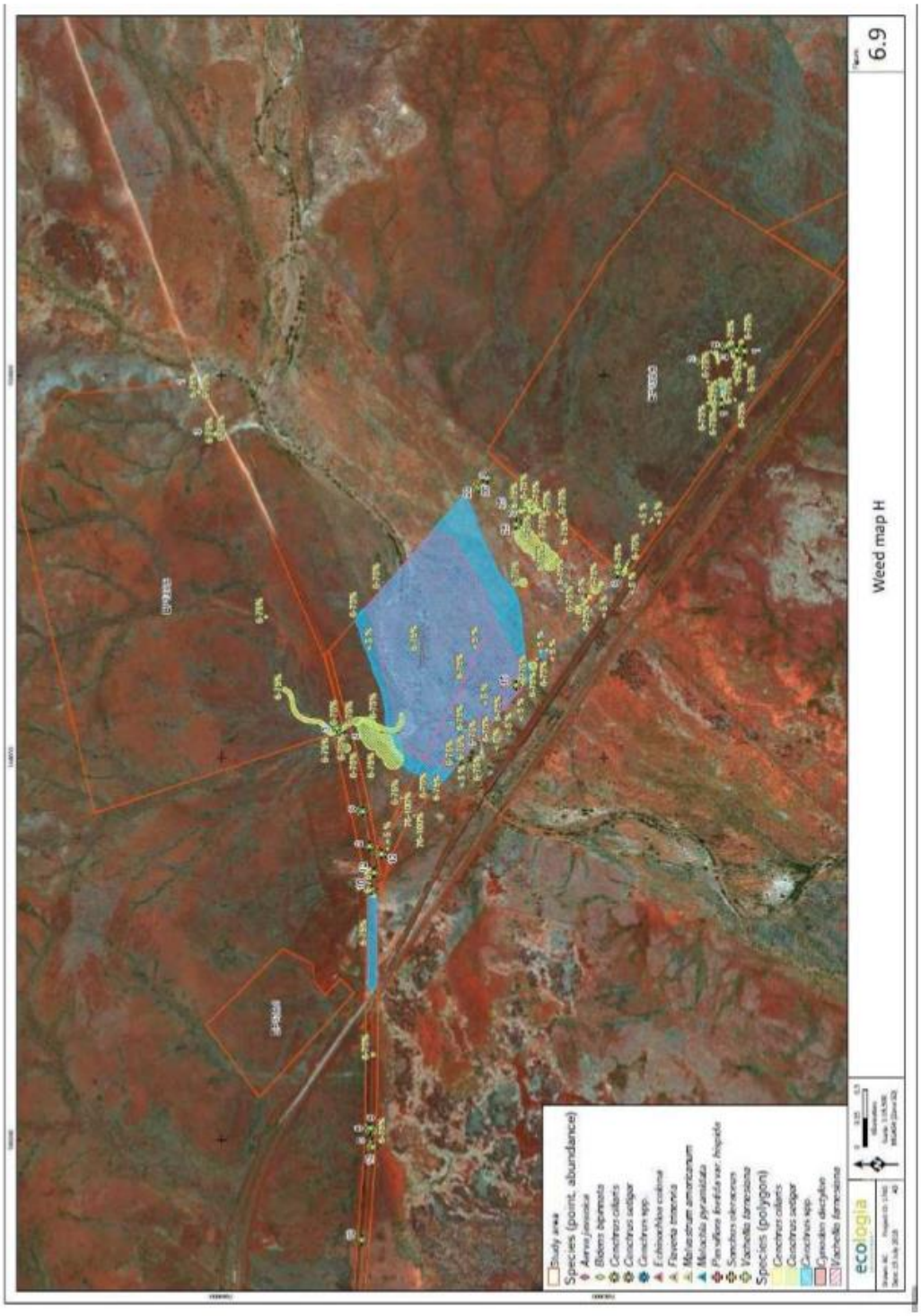
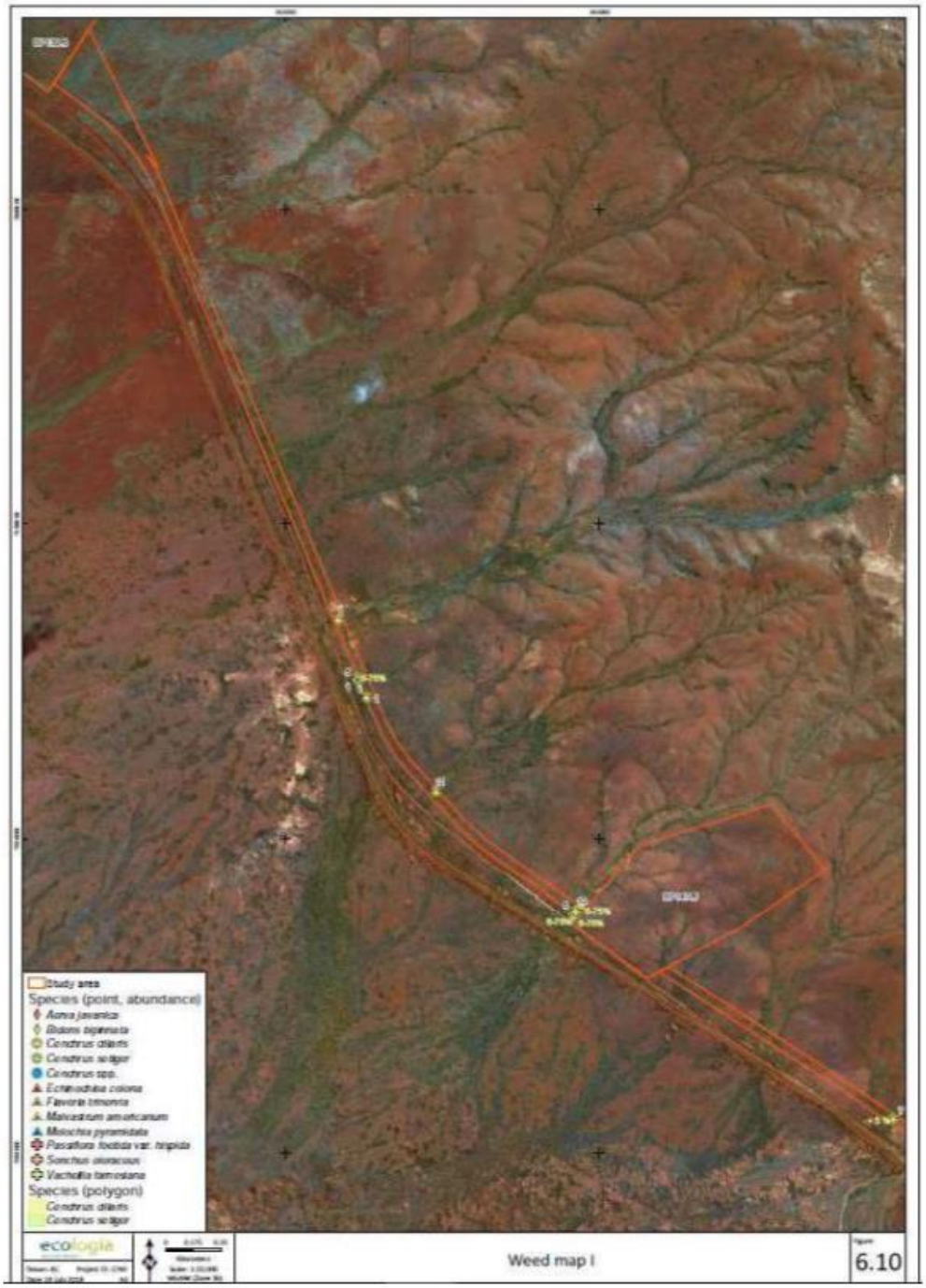
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria bidentis
Malvastrum americanum
Melochia pyramidata
Pandiaka heudelotii var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus setiger
Cenchrus spp.
ecologia
Weed map G
6.8

Weed Control and Management Plan – Karratha Tom Price Road Stage 3 and 4a

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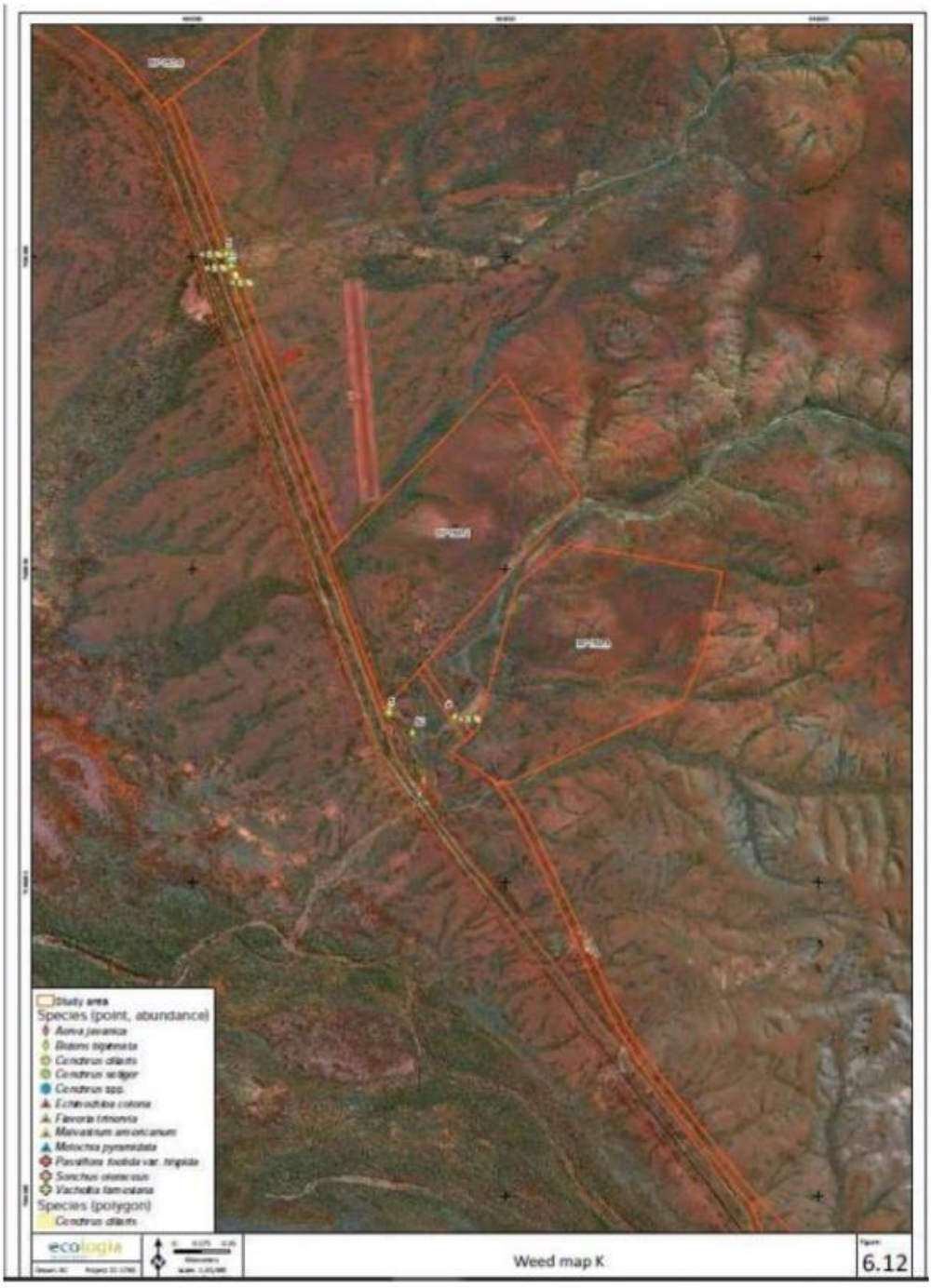
Species (point, abundance)
Aerva javanica
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Melochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus ciliaris
Cenchrus setiger
ecologia
Weed map I
6.10


Study area
Species (point, abundance)
Species (polygon)
Weed map J
6.11


Species (point, abundance)
Species (polygon)
ecologia
Weed map K
6.12


Study area
Species (point, abundance)
Aerva javanica
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Malochia pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
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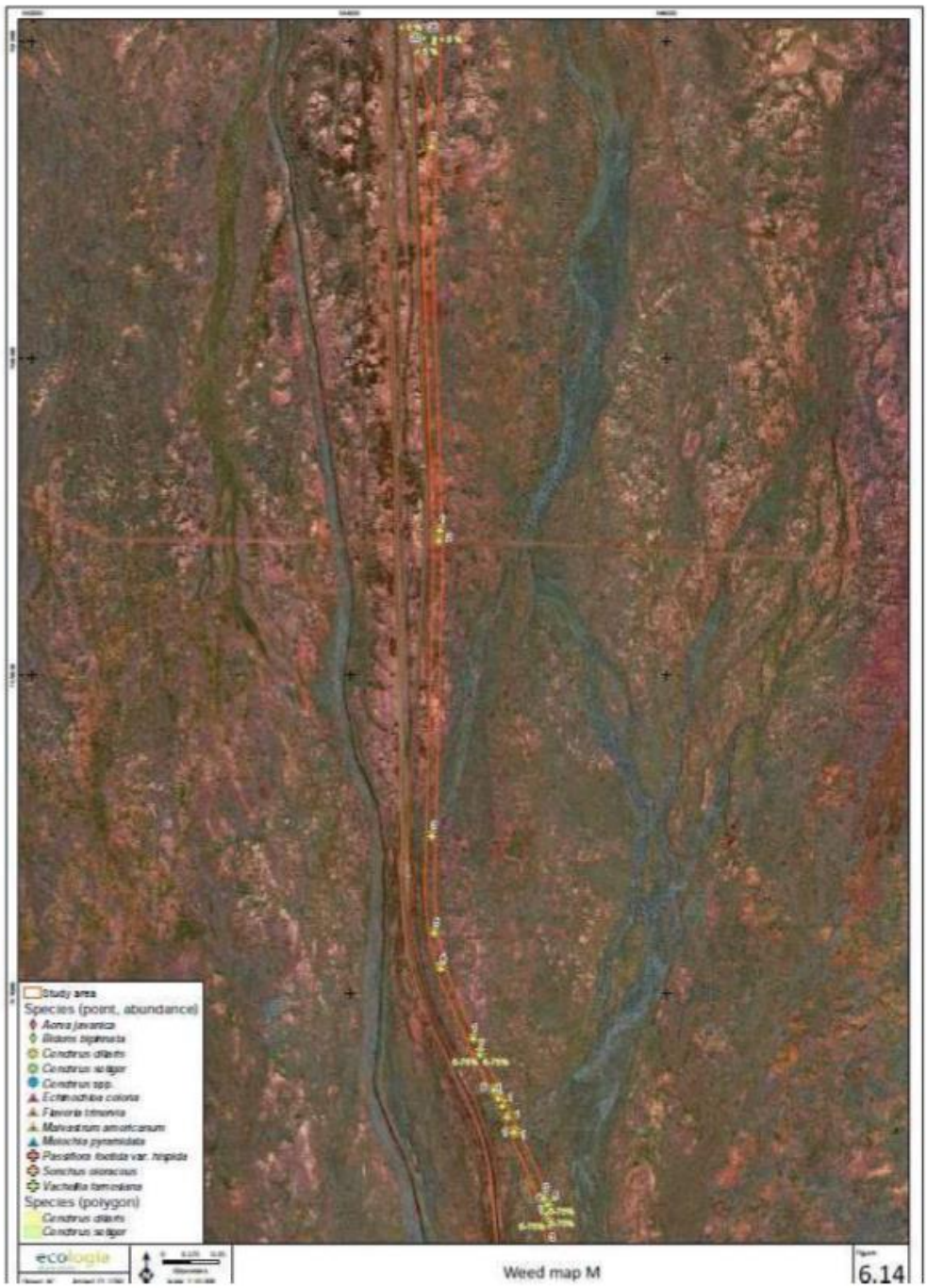
Cenchrus setiger
Cynodon dactylon
Malvastrum americanum
Vachellia farnesiana
ecologia
Weed map L
6.13



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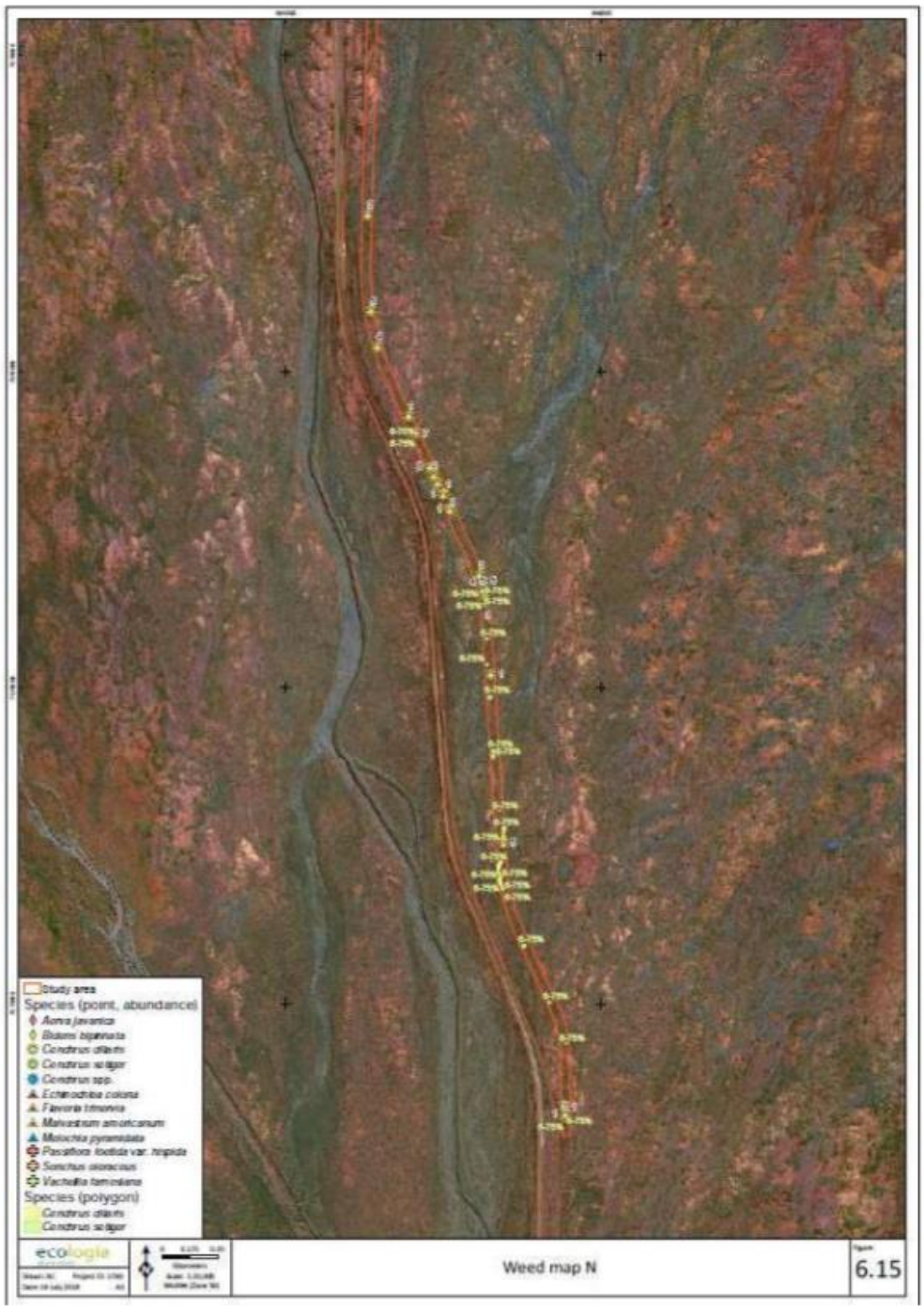
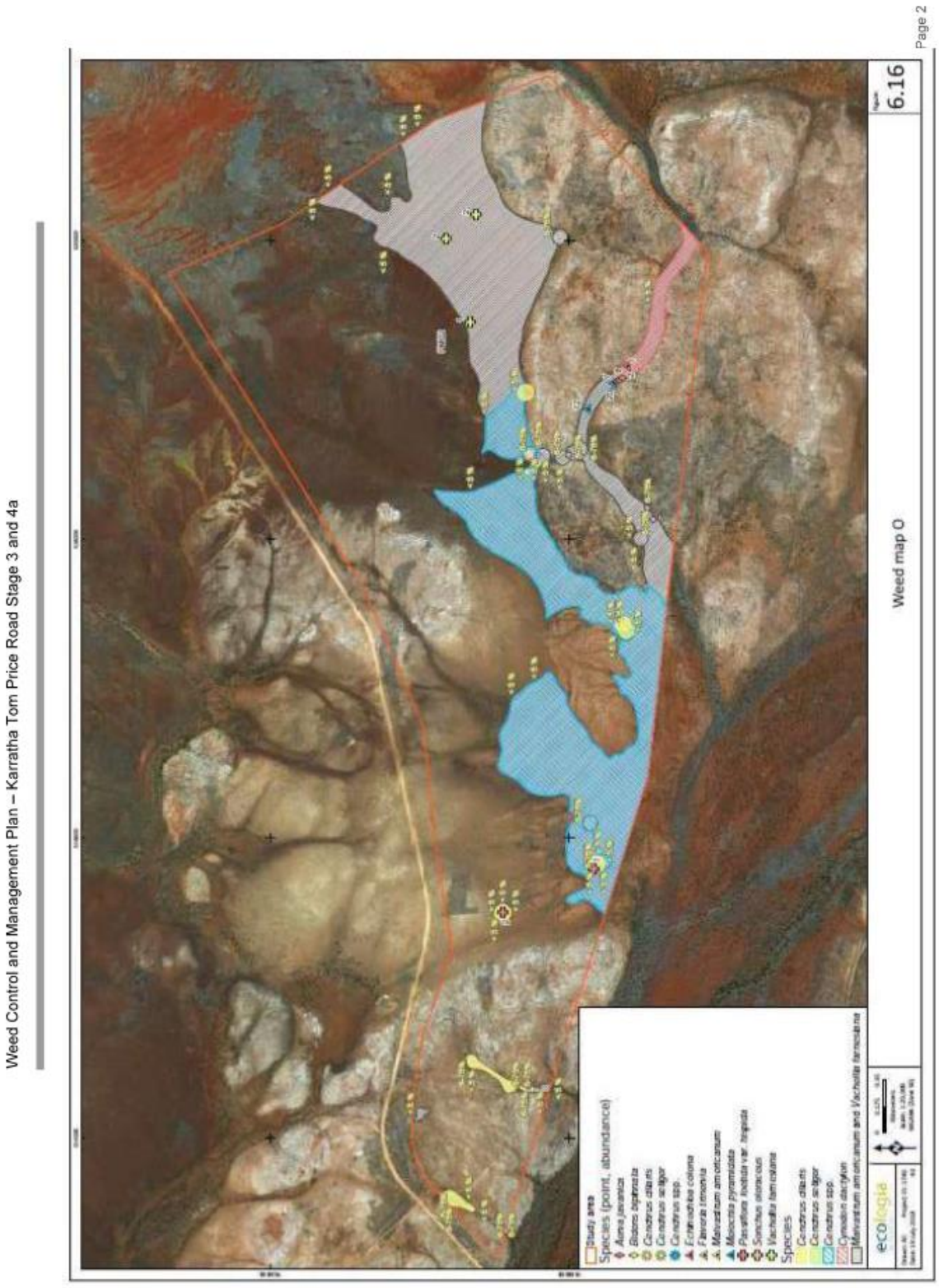
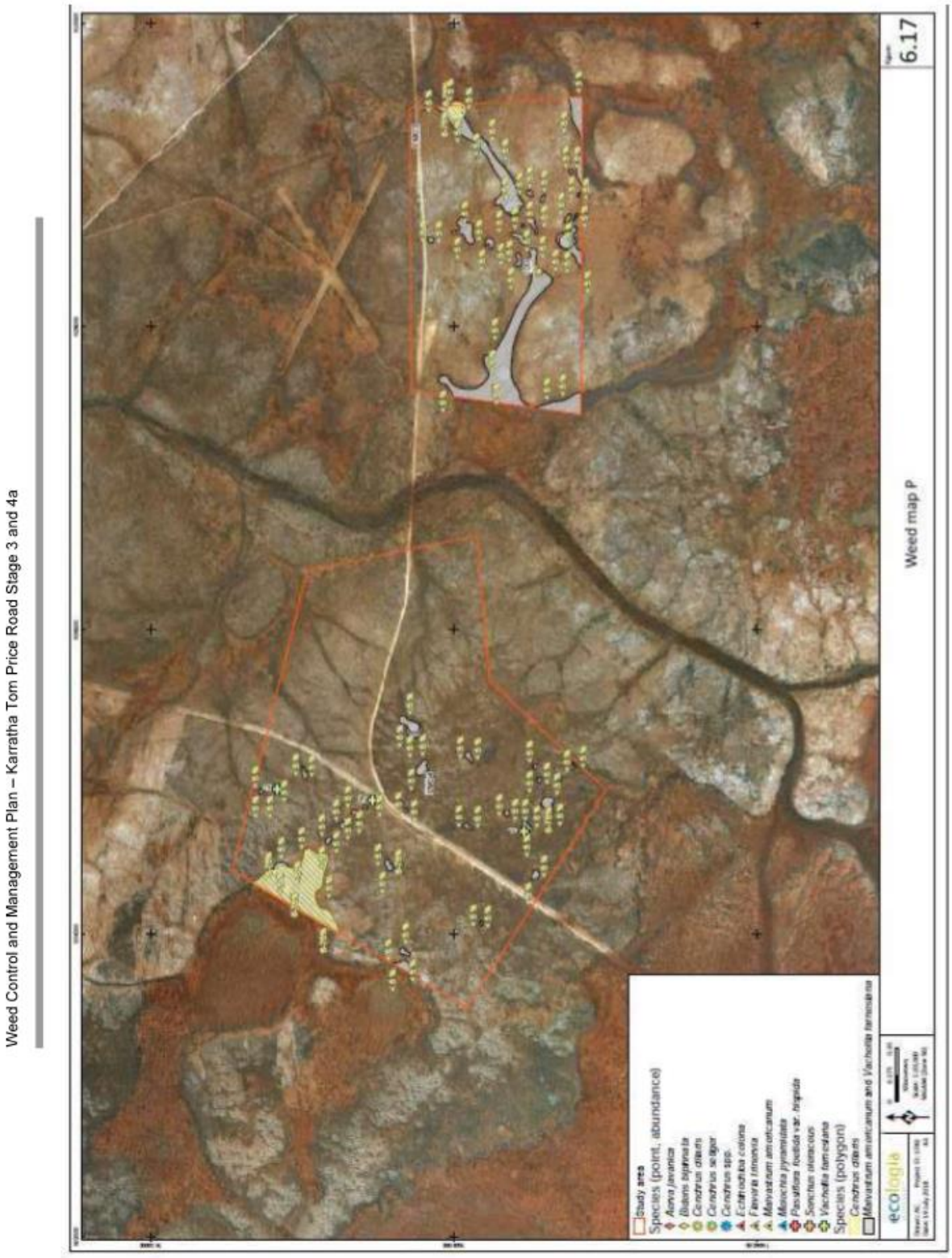

Study area
Species (point, abundance)
Aerva javanica
Bidens bipinnata
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Echinochloa colona
Flaveria trinervia
Malvastrum americanum
Malvastrum pyramidata
Passiflora foetida var. hispida
Sonchus oleraceus
Vachellia farnesiana
Species (polygon)
Cenchrus ciliaris
Cenchrus setiger
ecologia
Weed map N
6.15


Weed Control and Management Plan – Karratha Tom Price Road Stage 3 and 4a
Page 2
6.16
Weed map O
ecologia
Study area
Species (point, abundance)
Species
Cenchrus ciliaris
Cenchrus setiger
Cenchrus spp.
Cynodon dactylon
Malvastrum americanum and Vachellia farnesiana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Weed map P
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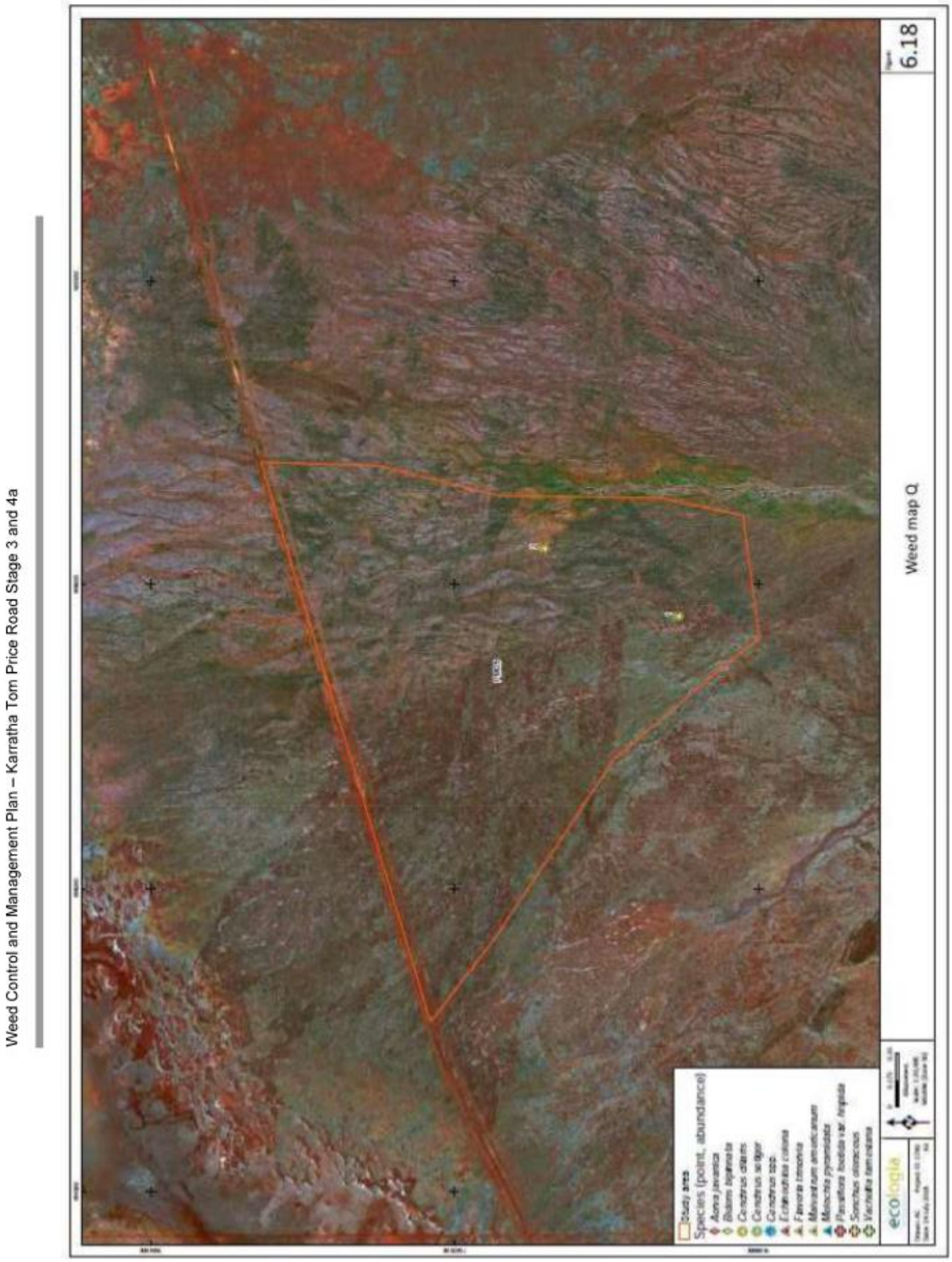
ecologia
Study area
Species (point, abundance)
Species (polygon)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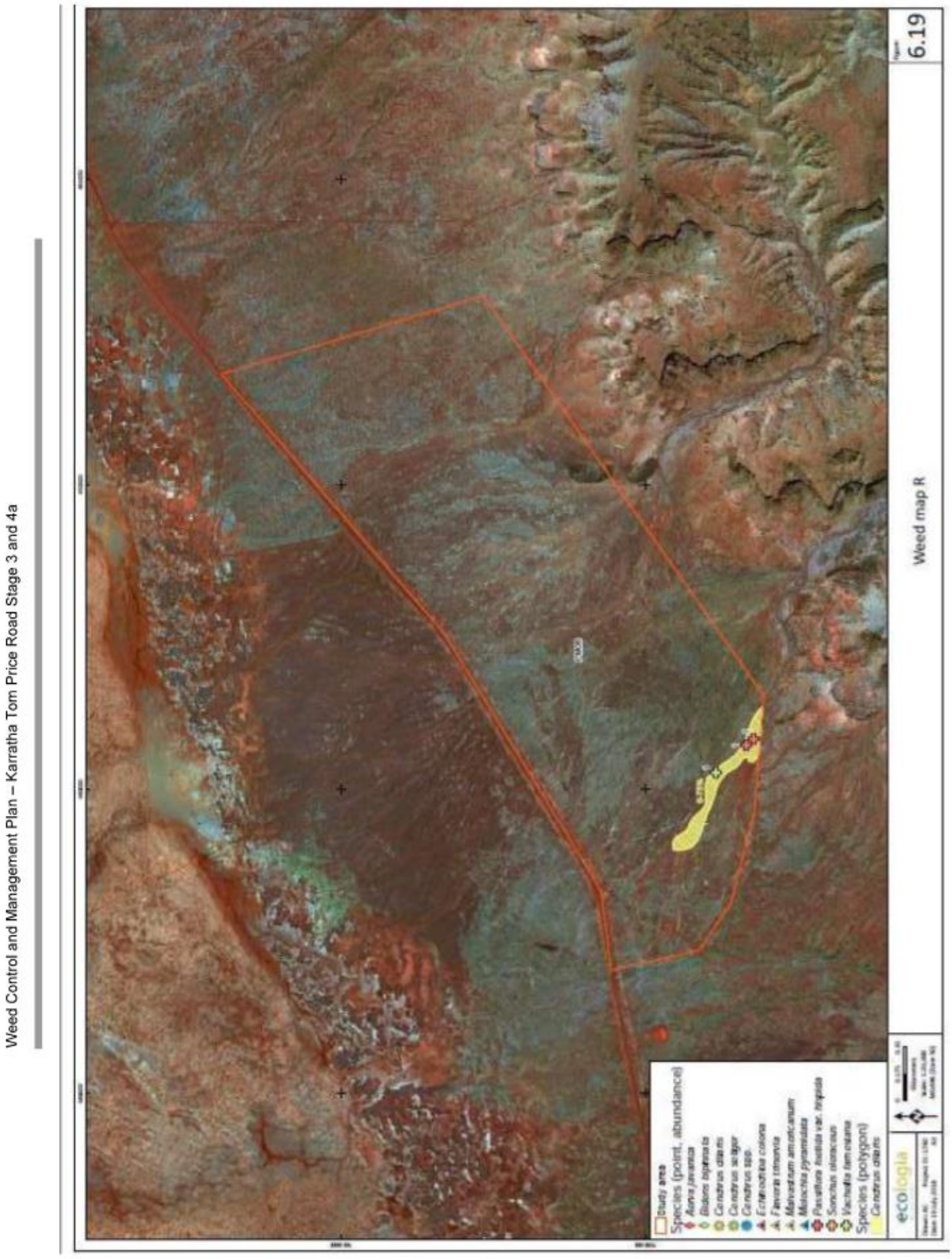
6.18
ecologia


Weed Control and Management Plan – Karratha Tom Price Road Stage 3 and 4a
Weed map R
6.19
Study area
Species (point, abundance)
Species (polygon)
Cenchrus ciliaris
ecologia

Appendix F – Stage 3 Post Completion Weed Management Implementation

Pilbara Environmental - notification completion of revegetation monitoring and spot spraying.

FW: Update

LOVELL Luke (Con)
To FARDIG Mark (Con)

Reply | Reply All | Forward | ...
Mon 26/07/2021 3:56 PM

Luke Lovell
Environmental Officer (Pilbara)
Planning and Technical Services Directorate
p: +61 9323 4765
w: www.mainroads.wa.gov.au

From: Nick Tidmarsh <nick@pilbaraenvironmental.com.au>
Sent: Friday, 2 July 2021 7:05 AM
To: LOVELL Luke (Con) <Luke.Lovell@mainroads.wa.gov.au>
Subject: Update

Hi Luke,

Quick update on MR projects. I will finish the field monitoring today for the revegetation sites. Weed management has been completed at NWCH (all polygons), Onslow (one polygon) and KTP (one polygon) sites. The primary weeds were Buffel Grass and Kapok. The rehab is generally looking quite good although ongoing vigilance/management of weeds will be crucial while the natives establish.

The Marble Bar report has had its internal review. I will make some minor changes and send though the draft on Monday. Karijini Drive report is still I process but I will endeavour to get it through as quick as I can.

If there is anything you need as a priority though let me know and I will expedite it.

Cheers
Nick

Pilbara Environmental
Nick Tidmarsh
Managing Director, Pilbara Environmental
0401 7272 88 | nick@pilbaraenvironmental.com.au

Email to Luke Lovell, Main Roads Environmental Officer, Pilbara Planning and Technical Services Directorate from Nick Tidmarsh, Managing Director, Pilbara Environmental.

'All the spraying and monitoring for KTP was completed on the 1st July. Onslow and NWCH sites were completed prior to that.' Nick Tidmarsh Managing Director, Pilbara Environmental.

mainroads WESTERN AUSTRALIA

DAILY HERBICIDE SPRAYING RECORD FORM

Application Date:	19/04/2021	Application Method:	Boom		Name	Amount	(L/kg/g) Unit
Region:	Pilbara	Nozzle Type:	side cast and Flat Fan	Herbicide(s)	Glyphosate	80.0	Litres
Operator Name(s):	Craig Allington	Pressure (kPa):			Metsulfuron	750.0	Grams
		or Pressure (bar):	3 - 3 bar		Triclopyr	38.0	Litres
Operator License Number(s):	6272	Output (L/Min):					
		Vehicle Speed:	10 to 25km/hr				
Company Name:	Allington Agri	Tank Capacity (full):	2,700 L	Adjuvant(s)	Choice Weathermaster	35.0	Litres
MEMP/PEMR Ref:		Tank Filled to:	2,700 L				
Defect Code:		No. of Tanks Used	3	Surfactant(s)	Spraywet	15.0	Litres
Spraying Zone:	Maintenance Zone			Dye	NIL		

Road Name / Bridge No.	Road No.	Start SLK	End SLK	Distance (km)	Side of Road			Average Width (m)	Area (ha)	Spray Hours	Rate (L/ha)	Quantity Used (L)
					Left	Median	Right					
				0.00 km					0.00 ha			0 L
KARRATHA TOM PRICE ROAD	M065	0.00	76.71	152.00 km	•		•	5.0 m	75.00 ha	10.00 hrs	100.0 L/ha	7,500 L
				0.00 km					0.00 ha			0 L
				0.00 km					0.00 ha			0 L
				0.00 km					0.00 ha			0 L
			Totals:	152.00 km					75.00 ha	10.00 hrs		7,500 L

Spraying Scope, Weeds Targeted & Observed	Factors Affecting Performance - Comments
Woody Weeds & grasses within maintenance zone	Started at 6.45am (first light) at intersection with NWCH and M065, had to narrow the spray width due to the veg being to big to drive on the shoulder in places without breaking off the nozzles. Did break off 2 nozzles in first 15km - will respray tomorrow. Missed a section of approx 2km of dam catchment area approx 64slk both sides - Water Authority signage is in place. Additional Weather Observation: 1.45pm, Delta T 7.8, Humidity 56.6, Temp 32, Wind 3km/hr esterly.

Weather Observations

6.45am		9.30am		11.00am	
Delta T:	1.1	Delta T:	4.5	Delta T:	5.5
Clear ☑	Humidity: 87	Clear ☑	Humidity: 73	Clear ☑	Humidity: 63
Cloudy ☐	Temperature: 24	Cloudy ☐	Temperature: 29	Cloudy ☐	Temperature: 29
Overcast ☐	Wind Speed: 2.1km/hr	Overcast ☐	Wind Speed: 0.2	Overcast ☐	Wind Speed: 5.5km/hr
Raining ☐	Wind Direction: ESE	Raining ☐	Wind Direction: EAST	Raining ☐	Wind Direction: EASTERLY

Copy of M065 RED DOG HWY SPRAYING 19TH APRIL 2021 0.00-76.71 SLK Herbicide Spraying Record 1

19th April 2021 Roadside Spraying Red Dog Hwy M065 SLK 0.00 - 76.71

mainroads WESTERN AUSTRALIA

DAILY HERBICIDE SPRAYING RECORD FORM

Application Date:	20/04/2021	Application Method:	Boom		Name	Amount	(L/kg/g) Unit
Region:	Pilbara	Nozzle Type:	side cast and Flat Fan	Herbicide(s)	Glyphosate	7.0	Litres
Operator Name(s):	Craig Allington	Pressure (kPa):			Metsulfuron	70.0	Grams
		or Pressure (bar):	3 - 3 bar		Triclopyr	4.0	Litres
Operator License Number(s):	6272	Output (L/Min):					
		Vehicle Speed:	10 to 25km/hr				
Company Name:	Allington Agri	Tank Capacity (full):	2,700 L	Adjuvant(s)	Choice Weathermaster	4.0	Litres
MEMP/PEMR Ref:		Tank Filled to:	2,700 L				
Defect Code:		No. of Tanks Used	1	Surfactant(s)	Spraywet	1.0	Litres
Spraying Zone:	Maintenance Zone			Dye	NIL		

Road Name / Bridge No.	Road No.	Start SLK	End SLK	Distance (km)	Side of Road			Average Width (m)	Area (ha)	Spray Hours	Rate (L/ha)	Quantity Used (L)
					Left	Median	Right					
				0.00 km					0.00 ha			0 L
KARRATHA TOM PRICE ROAD	M065	0.00	15.00	15.00 km	•			5.0 m	7.00 ha	1.00 hrs	100.0 L/ha	1,500 L
				0.00 km					0.00 ha			0 L
				0.00 km					0.00 ha			0 L
				0.00 km					0.00 ha			0 L
			Totals:	15.00 km					7.00 ha	1.00 hrs		1,500 L

Spraying Scope, Weeds Targeted & Observed	Factors Affecting Performance - Comments
Woody Weeds and grasses within maintenance zone	Respray of first 15km as yesterday I broke off 2 nozzles (at separate times) when they got caught up in branches of the larger plants as I tried to drive over them to maintain 6m spray width. After the first 15 km, yesterday on the 19th, I then drove further onto the road to avoid the vegetation.

Weather Observations

3.00pm											
Clear	☑	Delta T:	8	Clear	☐	Delta T:		Clear	☐	Delta T:	
Cloudy	☐	Humidity:	52	Cloudy	☐	Humidity:		Cloudy	☐	Humidity:	
Overcast	☐	Temperature:	33	Overcast	☐	Temperature:		Overcast	☐	Temperature:	
Raining	☐	Wind Speed:	5km/hr	Raining	☐	Wind Speed:		Raining	☐	Wind Speed:	
		Wind Direction:	ESE			Wind Direction:				Wind Direction:	

Copy of M065 RED DOG HWY SPRAYING 20TH APRIL 2021 0.00-15.00 SLK (LHS only) Herbicide Spraying Record 1

20th April 2021 Roadside Spraying Red Dog Hwy M065 SLK 0.00 – 15.00 LHS only

mainroads WESTERN AUSTRALIA

DAILY HERBICIDE SPRAYING RECORD FORM

Application Date:	20/04/2021	Application Method:	Boom		Name	Amount	(L/kg/g) Unit
Region:	Pilbara	Nozzle Type:	side cast and Flat Fan	Herbicide(s)	Glyphosate	70.0	Litres
Operator Name(s):	Craig Allington	Pressure (kPa):			Metsulfuron	700.0	Grams
		or Pressure (bar):	3 - 3 bar		Triclopyr	35.0	Litres
Operator License Number(s):	6272	Output (L/Min):					
		Vehicle Speed:	10 to 25km/hr				
Company Name:	Allington Agri	Tank Capacity (full):	2,700 L	Adjuvant(s)	Choice Weathermaster	35.0	Litres
MEMP/PEMR Ref:		Tank Filled to:	2,700 L				
Defect Code:	741.02 - Spraying SH&Dr	No. of Tanks Used	3	Surfactant(s)	Spraywet	15.0	Litres
Spraying Zone:	Maintenance Zone			Dye	NIL		

Road Name / Bridge No.	Road No.	Start SLK	End SLK	Distance (km)	Side of Road			Average Width (m)	Area (ha)	Spray Hours	Rate (L/ha)	Quantity Used (L)
					Left	Median	Right					
				0.00 km					0.00 ha			0 L
KARRATHA TOM PRICE ROAD	M065	76.71	136.32	120.00 km	•		•	5.0 m	70.00 ha	9.00 hrs	100.0 L/ha	7,000 L
				0.00 km					0.00 ha			0 L
				0.00 km					0.00 ha			0 L
				0.00 km					0.00 ha			0 L
			Totals:	120.00 km					70.00 ha	9.00 hrs		7,000 L

Spraying Scope, Weeds Targeted & Observed	Factors Affecting Performance - Comments
Woody Weeds and grasses within maintenance zone	Start at 7am spray to the southern end of the works, turned around and sprayed back. A lot smaller vegetation on the new section and getting the 6m spray width was easier because the vehicles could travel further onto the road shoulder without the larger veg there.

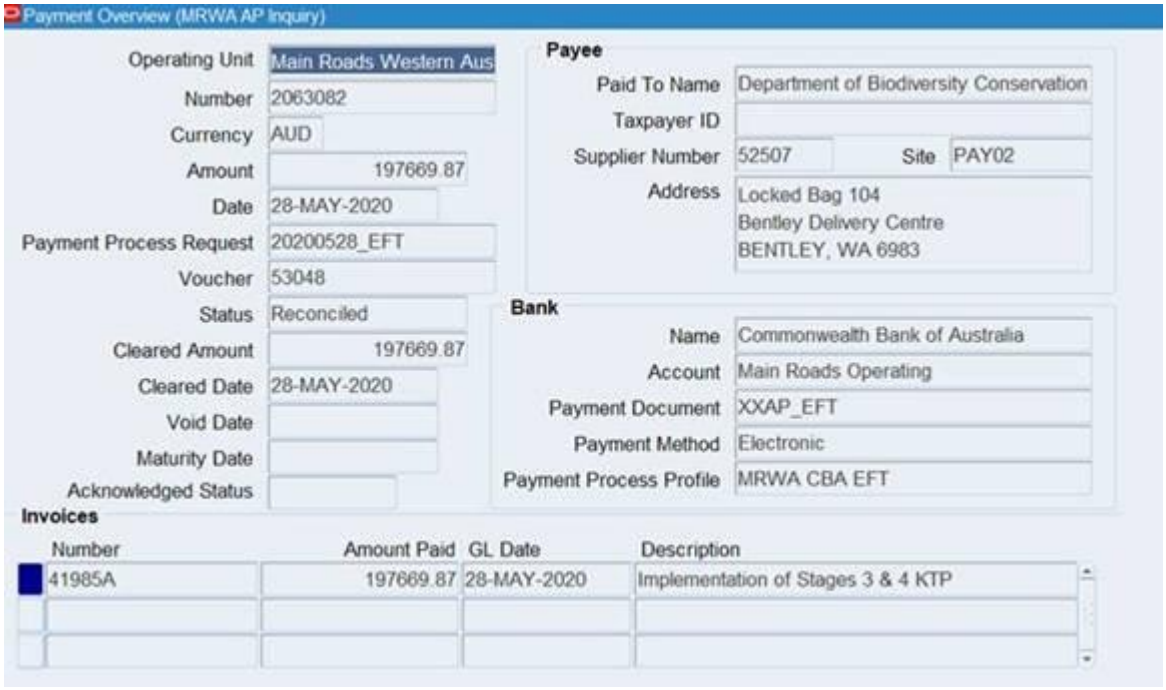
Weather Observations

7.00am		9.30am		1.00pm	
Delta T:	2.9	Delta T:	5.5	Delta T:	7.5
Clear ☑	Humidity: 76	Clear ☑	Humidity: 66	Clear ☑	Humidity: 54.8
Cloudy ☐	Temperature: 22	Cloudy ☐	Temperature: 28.9	Cloudy ☐	Temperature: 31
Overcast ☐	Wind Speed: 3km/hr	Overcast ☐	Wind Speed: 5km/hr	Overcast ☐	Wind Speed: 2km/hr
Raining ☐	Wind Direction: ESE	Raining ☐	Wind Direction: EAST	Raining ☐	Wind Direction: EASTERLY-ENE

Copy of M065 RED DOG HWY SPRAYING 20TH APRIL 2021 76.71-136.32 SLK Herbicide Spraying Record 1

20th April 2021 Roadside Spraying Red Dog Hwy M065 SLK 76.71 – 136.32

Appendix G – Stage 3 Offset Payment 2020



Payment Overview (MRWA AP Inquiry)

Operating Unit	Main Roads Western Aus
Number	2063082
Currency	AUD
Amount	197669.87
Date	28-MAY-2020
Payment Process Request	20200528_EFT
Voucher	53048
Status	Reconciled
Cleared Amount	197669.87
Cleared Date	28-MAY-2020
Void Date	
Maturity Date	
Acknowledged Status	

Payee

Paid To Name	Department of Biodiversity Conservation
Taxpayer ID	
Supplier Number	52507
Site	PAY02
Address	Locked Bag 104 Bentley Delivery Centre BENTLEY, WA 6983

Bank

Name	Commonwealth Bank of Australia
Account	Main Roads Operating
Payment Document	XXAP_EFT
Payment Method	Electronic
Payment Process Profile	MRWA CBA EFT

Invoices

Number	Amount Paid	GL Date	Description
41985A	197669.87	28-MAY-2020	Implementation of Stages 3 & 4 KTP

Appendix N. Ministerial Statement 677 Compliance Assessment Report Sept 19

Ministerial Statement 677 Compliance Assessment Report Road from Karratha to Tom Price Shires of Ashburton and Roebourne

Contents

Introduction 1
Background 1
Environmental Approvals 1
Purpose of this Report 1
Summary of Proposals Implementation Status 3
Statement of Compliance 5
Audit Tables 6
Conclusion 21
References 22

Appendix A – Ministerial Statement 677 46C Amendment
Appendix B – Letter of acceptance – EMPs Stage 3
Appendix C – Confirmation of environmental offset
Appendix D - Rehabilitation Trial
Appendix E – Stage 3 Rest Bays Meeting Minutes e-mail

Introduction

Background

Main Roads Western Australia (Main Roads) has obtained approval to design and construct a connecting road between Karratha and Tom Price, in the west Pilbara (referred to as the "Project") (**Figure 1**).

The Project is being delivered in stages:

- Stage 2 - completed
  Included construction of approximately 90 km of new road connecting the North West Coastal Highway with the Roebourne Wittenoom Road was completed in 2008.
- Stage 3 –pending
  Includes the section of Roebourne Wittenoom Road between Camp Curlewis and Wallyinya Pool, and involves improvements and upgrades, including sealing of approximately 48 km of the existing Tom Price Karratha Road.
- Stage 4 –pending
  Extends from Wallyinya Pool to the Nanutarra Munjina Road along the existing railway, which is approximately 109 km in length.

Stage 3 is scheduled to commence construction later in 2019, once asbestos remediation works along the unsealed Roebourne- Wittenoom Road is completed.

Stage 4a has undergone initial geotechnical investigations and a Northern Quoll survey in 2017. Further works will continue to progress as federal funding has been secured for the project and is currently in the planning stage.

Environmental Approvals

Main Roads referred the Project to the Environmental Protection Authority (EPA) in September 1998. The EPA subsequently set a level of assessment for the Project as a Consultative Environmental Review (CER) (Assessment Number 1244).

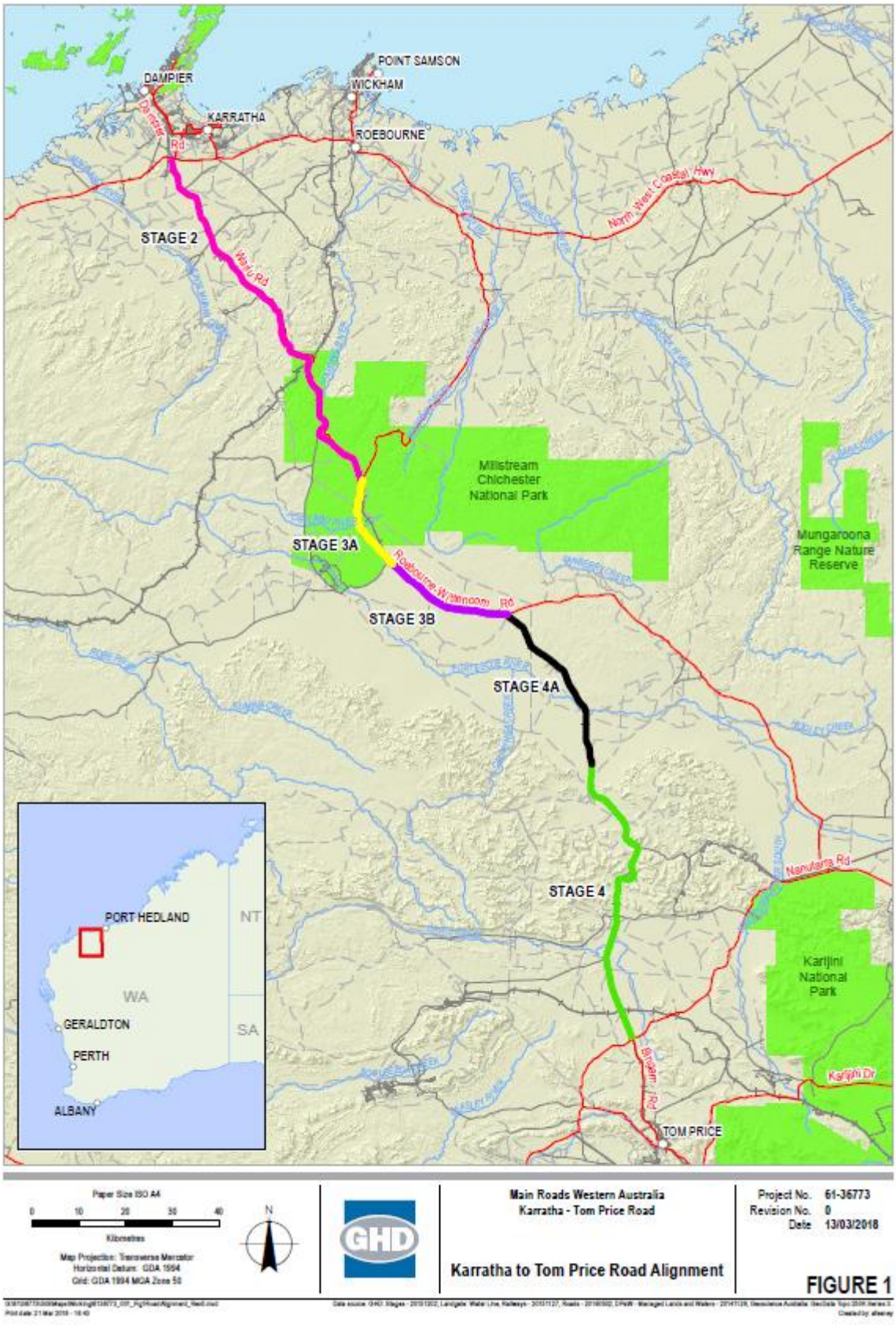
The Project was granted approval under the *Environmental Protection Act 1986* (EP Act) by the Minister for the Environment via Ministerial Statement 677 on 27 April 2005.

On the 4 May 2007 a minor change, to increase the area of vegetation to be cleared within the Millstream National Park from 110 to 145 ha, was requested. The amendment was approved on 13 July 2007.

Purpose of this Report

This Compliance Assessment Report (CAR) has been prepared to demonstrate compliance with the Conditions set out in Ministerial Statement 677.

Figure 1 Karratha to Tom Price Road Alignment



Summary of Proposals Implementation Status

Stage 2 – completed in August 2008.
Stage 2 was delivered as follows:

- pre-construction and construction – 2006 to 2008 via the Millstream Alliance
- monitoring and maintenance – undertaken by the Millstream Alliance for a period of 7 years following completion (from August 2008)
- environmental offsets were included in the Ministerial requirements. One of the offsets involved contributing $25,000 per year for 5 years to the then Department of Environment and Conservation (DEC), towards a weed control program for areas within Millstream-Chichester National Park. These payments have been completed.

Environmental Management Plans (EMPs) for Stage 2 of the project were submitted to, and accepted by, the then Department of the Environment (DoE) in May 2006. The following six EMPs addressed the requirements of commitments 2, 4, 10, 12 and 14 of Ministerial Statement 677:

1. Environmental Management Plan Preconstruction
2. Environmental Management Plan Construction
3. Aboriginal Heritage Management Plan
4. National Park Management Plan
5. Vegetation Protection and Rehabilitation Management Plan
6. Surface Drainage Management Plan

Stage 3 - Preconstruction

Stage 3 is scheduled to start construction during the later months of 2019 after asbestos remediation works along the unsealed Roebourne- Wittenoom Road, are complete.

Environmental Management Plans (EMPs) for Stage 3 of the overall Road from Karratha to Tom Price Project were submitted to, and accepted by, the EPA in 2018. The following six EMPs addressed the requirements of commitments 2, 4, 10, 12 and 14 of Ministerial Statement 677:

1. Environmental Management Plan Construction
2. Cultural Heritage Management Plan
3. National Park Management Plan
4. Vegetation Protection and Rehabilitation Management Plan
5. Weed control and management Plan
6. Surface Drainage Management Plan

Discussions have commenced with DBCA in regards to design of appropriate interpretive signage and rest bays as per commitment 10.2.

Stage 4a – Currently in Planning Phase

Main Roads completed geotechnical investigation works for Stage 3 and 4a of the project (Golder Associates 2017) and a Northern Quoll survey (GHD 2017). The geotechnical works included:

- an assessment of the subsurface soil and groundwater conditions
- pavement thickness and bituminous seal design
- preliminary assessment of material quantity and quality
- excavation of 146 test pits in September 2017.

The Northern Quoll investigation involved a desktop and field reconnaissance survey (July 2017), including camera trapping and habitat assessment. The survey did not record any Northern Quolls or

their core habitat. Three small areas of supportive habitat were present, however it was considered unlikely that the Northern Quoll would regularly utilise the area. They may opportunistically utilise area during times of dispersal.

Further works will continue to progress as federal funding has been secured for the project and as a result this stage is currently in the planning stage.

Statement of Compliance

Ministerial Statement 677 provided a list of compliance requirements, including pre-construction and post-construction actions. These actions were then developed into an Audit Table in consultation with the EPA Services Unit (now EPA Services). For consistency with previous CARs (2011 and 2015), the agreed Audit Table has been used for this CAR.

The Ministerial Statement and EMPs have been complied with over the reporting period. Table 1 (audit table), Table 2 (proposal key characteristics compliance) and Table 3 (proponent environmental management commitments compliance) and their attachments provides all necessary details on compliance and performance.

The compliance documentation relates to Stages 3 and 4 of the Project, with stage 2 of the Project being completed in August 2008, and all conditions and commitments are considered to be either compliant or complete. Please refer to previous CAR reports for information on Stage 2.

A completed OEPA's *Post Assessment Form for a Statement of Compliance* is attached in Appendix E.

Audit Tables

The following audit tables (Table 1 – Table 3) include all of the commitments and conditions associated with Ministerial Statement 677 consistent with EPA's (2012) Post Assessment Guideline No. 3 - *Post Assessment Guideline for Preparing a Compliance Assessment Report*.

Table 1 Summary of Compliance with Environmental Approval Conditions (Ministerial Statement 677)

Audit Code / Subject	Condition / Requirement	Compliance Status	Further Information / How	Supporting Documentation / Evidence
677: M1.1 Implementation	The proponent shall implement the proposal as documented in Schedule 1 of Statement 677 subject to the conditions of this statement.	Compliant	The area to be disturbed as specified in Statement 677, Condition 7-2 was amended under Section 46C of the EP Act from 110 hectares to 145 hectares on the 13th July 2007. Approximately 90 km of road has been constructed within the agreed corridor connecting North West Coastal Highway with the Roebourne Wittenoom Road – referred to as Karratha Tom Price Road Stage 2. Stage 3 is pending construction the planned design is currently within the limits set out in Schedule 1. Geotechnical works have been undertaken within 4a in 2017 and is currently within the planning stage.	Table 2 details key differences between Schedule 1 key proposal characteristics and as built characteristics that formed Stage 2 of the road from Karratha to Tom Price. Stage 3 is yet to be constructed
677: M2.1 Proponent Commitments	The proponent shall Implement the environmental management commitments documented in Schedule 2 of Statement 677, to the requirements of the Minister for the Environment on advice of the EPA.	Compliant	Stage 3 – Six (6) Environmental Management Plans (EMPs) were submitted to and accepted by the then Department of Environment in November 2018 . The EMPs were also sent to the then Department of Indigenous Affairs (DIA) and Department of Biodiversity Conservation and Attractions (DBCA). These EMPs addressed the requirements of Commitments 2, 4, 10, 12 and 14	Appendix A – Letters of acceptance

Audit Code / Subject	Condition / Requirement	Compliance Status	Further Information / How	Supporting Documentation / Evidence
			of Ministerial Statement 677.	
677: M3.1 Proponent nomination and contact details	The proponent for the time being nominated by the Minister for the Environment, under S38(6) or (7) of the EP Act is responsible for the implementation of the proposal until the Minister has revoked this nomination and nominated another person in respect of the proposal under S38(7) of the EP Act.	Compliant	Proponent – Main Roads Western Australia	
677: M3.2 Change in Proponent	Any request for a change in proponentship shall be accompanied by a copy of the Minister's statement endorsed with an undertaking by the proposed replacement proponent to carry out the proposal in accordance with the conditions and procedures set out in Statement 677. Contact details and appropriate documentation on the capability of the proposed replacement proponent to carry out the proposal shall also be provided.	Compliant	No change to the proponent.	
677. M3.3 Proponent	Notify the DoE of any change of proponent contact name and address.	Compliant	No change – as above.	
677. M4.1 Commencement	If the proposal has not been substantially commenced within five years of the date of this statement, the approval to implement the proposal as granted in Statement 677 shall lapse and be void.	**Complete (CLD)**	Construction of Stage 2 commenced in June 2006 and opened to the public on 3 August 2008.	.

Audit Code / Subject	Condition / Requirement	Compliance Status	Further Information / How	Supporting Documentation / Evidence
677:M4.2 Commencement	Make an application to the Minister for the Environment for any extension of approval for the substantial commencement of the proposal beyond five years from the date of Statement 677.	**Complete**	See above	
677:M5.1 Compliance Auditing	Prepare an audit programme and submit compliance reports to the DoE	Compliant	CARs will be submitted for works on future stages (3 and 4) when substantially commenced.	
677:M6.1:1 Weed control - Construction	In addition to commitment 4 (Vegetation Protection and Rehabilitation Management Plan) in schedule 2, to manage and control the spread of weeds, the proponent shall ensure that (1.) earthmoving vehicles and construction equipment are free of soil and vegetative material prior to entering the construction area; (2.) quarries and borrow pits are surveyed for Ruby Dock (*Acetosa vesicaria*) prior to utilising the material from these pits for road construction; (3.) borrow pits and areas containing Ruby Dock (*Acetosa vesicaria*) are delineated in the field (by roping or a system of markers) to prevent access for construction crews and machinery; and (4.) soil and construction materials brought into the construction area from other areas are weed free.	Compliant	Stage 3 - Compliance in accordance with the Vegetation Protection and Rehabilitation Management Plan will be initiated as part of construction for Stage 3. Stage 4 – pending.	
677:M6.1:2.1 Weed control - Design	Prepare a Weed Control and Monitoring Program in collaboration with the neighbouring railway operator(s) with the objective of controlling and eradicating existing weeds and future outbreaks of	Compliant	Stage 3 – comments received from DBCA and necessary to Weed control management plan 22 November 2018	

Audit Code / Subject	Condition / Requirement	Compliance Status	Further Information / How	Supporting Documentation / Evidence
	weeds along the road, particularly Ruby Dock (*Acetosa vesicaria*), both during and following construction.			
677:M6.1:2.2 Weed control - Construction	Implement a Weed Control and Monitoring Program in collaboration with the neighbouring railway operator(s) with the objective of controlling and eradicating existing weeds and future outbreaks of weeds along the road, particularly Ruby Dock (*Acetosa vesicaria*), both during and following construction.	Compliant	Stage 3 – Weed control and Management Program Stage 3 will be implemented upon construction. Stage 4 – not relevant at this time - only preliminary investigation works have been undertaken. Monitoring and weed management will be undertaken as part of the construction of this stage.	
677:M6.1:2.3 Weed control – Post construction	Implement a Weed Control and Monitoring Program in collaboration with the neighbouring railway operator(s) with the objective of controlling and eradicating existing weeds and future outbreaks of weeds along the road, particularly Ruby Dock (*Acetosa vesicaria*), both during and following construction.	Compliant	Stage 3 and 4: Works have not commenced – not relevant at this time.	
677:M7.1 Vegetation Protection	Limit the disturbance width of the road where it traverses the Themeda grassland threatened ecological community, near Hamersley Station, as shown in Figure 2 in schedule 1 in the Minister's statement 677, to not more than 20 metres.	Compliant	Not Applicable	Only Applicable to Stage 4

Audit Code / Subject	Condition / Requirement	Compliance Status	Further Information / How	Supporting Documentation / Evidence
677:M7.2 Vegetation Protection	Limit the area of vegetation to be cleared within the Millstream-Chichester National Park to not more than 110 hectares.	Compliant	Stage 3 has not been constructed however the design consists of approximately 14ha of clearing within the National Park. Stage 4 – Not applicable stage 4 does not intersect the National Park.	
677:M7.3:1 Rehabilitation - Constriction	Rehabilitate (1) approximately 137 hectares of land disturbed for the construction of the road; and either (2)(a) approximately 205 hectares of redundant access tracks, including those tracks associated with the railway, and redundant material pits as an environmental offset activity, or (2)(b) alternative offsets of equivalent cost/value, developed in liaison with the Department of Conservation and Land Management, and which deliver greater biodiversity outcomes. NOTE: For the purpose of this condition, the specific locations, and methods and procedures for rehabilitation shall be included in the Vegetation Protection and Rehabilitation Management Plan (see commitment 4).	Compliant	Stage 3 and 4 – In a letter to Main Roads dated 20 September 2007 the Regional Manager of DEC Pilbara agreed that in addition to rehabilitating (1) 137 ha disturbed by the construction of the road, Main Roads would choose option (2)(b) – provision of an alternative offset for an equivalent cost. An offset amount of $2,500 per hectare of rehabilitation works was agreed to by DEC and Main Roads. Main Roads will request an invoice from DBCA for the offset for Stages 3 and 4 once the detailed design work for both stages has been completed.	Appendix B – Confirmation of environmental offset payment
677:M7.3:2 Rehabilitation – Post construction	Rehabilitate (1) approximately 137 hectares of land disturbed for the construction of the road; and either (2)(a) approximately 205 hectares of redundant access tracks, including those tracks associated with the railway, and redundant material pits as an environmental offset activity, or (2)(b) alternative offsets of equivalent	Compliant	See above.	

Audit Code / Subject	Condition / Requirement	Compliance Status	Further Information / How	Supporting Documentation / Evidence
	cost/value, developed in liaison with the Department of Conservation and Land Management, and which deliver greater biodiversity outcomes. NOTE: For the purpose of this condition, the specific locations, and methods and procedures for rehabilitation shall be included in the Vegetation Protection and Rehabilitation Management Plan (see commitment 4).			
677:M7.4 Rehabilitation	Develop rehabilitation completion criteria to apply to the rehabilitation required by condition 7-3. The rehabilitation completion criteria shall have timeframes and shall be included in the Vegetation Protection and Rehabilitation Management Plan (see commitment 4 in schedule 2).	**Complete – Stage 2** Compliant Stages 3 and 4	Stage 3 - Vegetation Protection and Rehabilitation Management Plan was approved by the EPA in November 2018 with similar completion criteria as Stage 2.	Stage 3 Appendix A – Stage 3 Letters of Acceptance
677:M7.5:1 Progress of rehabilitation - Construction	Monitor the progress of rehabilitation against the rehabilitation completion criteria referred to in condition 7-4 and implement contingency measures and supplementary rehabilitation works where the criteria are not being met	Compliant	Stage 3 and 4 – not applicable at this time as construction has not commenced.	
677:M7.5:2 Progress of rehabilitation – Post - Construction	Monitor the progress of rehabilitation against the rehabilitation completion criteria referred to in condition 7-4 and implement contingency measures and supplementary rehabilitation works where the criteria are not being met	Compliant	Stage 3 and 4 – not applicable at this time as construction has not commenced.	

Table 2 Summary of Compliance with Schedule 1 – Proposal Key Characteristics

Element	Description	Compliance Status	Further Information / How	Supporting Documentation / Evidence
Length	Approximately 245 km	Compliant	Approximately 88 km constructed as part of Stage 2.	
Connections to existing roads	North West Coastal Highway Roebourne–Wittenoom Road Millstream–Yaraloola Road Mt Bruce Road Nanutarra–Munjina Road	Compliant	Stage 2 – has constructed the North West Coastal Highway connection. Roebourne–Wittenoom Road connection.	
Area of disturbance Road formation	Approximately 474 hectares – of this, approximately 137 hectares will be rehabilitated following construction.	Compliant	Approximately 445 hectares of land was disturbed as a result of Stage 2, of which approximately 122.5 hectares occurred within the Millstream-Chichester National Park. Approximately 309 hectares was cleared due to the permanent alignment. The 136 hectares of temporarily disturbed land available for rehabilitation (approximately 23.5 hectares within the Millstream-Chichester National Park). Areas of land disturbed during road construction that were not part of the permanent road area, were rehabilitated.	The area to be disturbed as specified in EPA Statement 677, Condition 7-2 was amended under Section 46C from 110 hectares to 145 hectares on the 13th July 2007. Realignment of the road, south of Western Creek and in the Millstream-Chichester National Park to avoid an aboriginal heritage site (Figure 1 – location of the as-built Stage 2 alignment)
Material sources	Approximately 100 hectares.	Compliant	Approximately 103 hectares	
Design Speed	110 kilometres per hour.	Compliant	110 kilometres per hour	
Formation width	Approximately 9 metres.	Compliant	Approximately 9 metres	

Element	Description	Compliance Status	Further Information / How	Supporting Documentation / Evidence
Waterways crossings	Up to 9 bridges across major water courses and railway lines Culverts and low-level floodways will be used for all other waterway crossings.	Compliant	No bridges. Two (2) low-level floodways constructed over Western Creek and Harding River. Floodway over Harding River substituted for original bridge design.	
Railway crossings	One road-over-rail bridge Four new level crossings	Compliant	No bridges One (1) new level crossing at Western Creek.	
Fencing of road reserve	Approximately 200 kilometres of fence will be erected along the road reserve outside the Millstream-Chichester National Park.	Compliant - amended	Fencing of the road reserve occurred outside of the Millstream-Chichester National Park. It was agreed by the Regional Manager of DEC, Pilbara and the Project Director of Main Roads on 15 August 2008 that the western boundary was a higher priority as it contained several entry points for cattle into the park. Main Roads agreed that an amount of $4,000 per kilometre would be provided to fence 30 km. In a letter from DEC dated 20 September 2007 DEC agreed to invoice Main Roads $120,000 for the fencing of the western boundary of Millstream Chichester National Park. Main Roads has confirmed payment to DEC for the $120, 000 (Appendix B).	Appendix B – provides a copy of the correspondence and evidence of payment by Main Roads.

Table 3 Summary of Compliance with Proponent Environmental Management Commitments

Audit Code	Commitment/ Subject	Management Strategy / Requirementr	Phase	Compliance Status	Further Information / How	Supporting Documentation / Evidence
677:P1	Employ a dedicated environmental co-ordinator	(1) To ensure that environmental co-ordination is effective. (2) To provide environmental advice and to supervise clearing and rehabilitation activities, particularly in the Millstream-Chichester National Park and the section of the road which traverses the threatened ecological community.	Overall – All Stages	Compliant	Stage 3 and 4 / ongoing - Ongoing environmental management will be undertaken by Main Roads as part of their maintenance program. Any future works will be managed by Main Roads and be subject to Main Roads internal environmental requirements. Environmental staff will be employed for the construction of future stages.	
677:P2	Prepare a Surface Drainage Management Plan	To maintain existing drainage patterns and to prevent soil erosion and sedimentation caused by construction activity or new waterways structures	Design	**Complete – Stage 2 and 3** Compliant – Stage 4	Stage 3 – Surface drainage Management Plan was accepted by EPA in July 2018.	Appendix D – Stage 3 Letters of Acceptance
677:P3.1:1	Implement Surface Drainage Management Plan	To maintain existing drainage patterns and to prevent soil erosion and	Construction / All Stages	Compliant	Stage 3 and 4 – not applicable at this time.	

Audit Code	Commitment/ Subject	Management Strategy / Requirementr	Phase	Compliance Status	Further Information / How	Supporting Documentation / Evidence
677:P3.1:2	Implement Surface Drainage Management Plan	sedimentation caused by construction activity or new waterways structures	Post – construction	Compliant	See above	
677:P4	Prepare a Vegetation Protection and Rehabilitation Management Plan.	To prevent loss of vegetation beyond the 'footprint' of the works, and minimise potential indirect effects on vegetation. To rehabilitate areas disturbed by construction of the road	Design	**Complete** Compliant – Stage 4	Stage 3 - Vegetation Protection and Rehabilitation Management Plan was approved by the EPA in December 2018.	Stage 3 Appendix D – Stage 3 Letters of Acceptance
677:P5.1:1	Implement the Vegetation Protection and Rehabilitation Management Plan		Construction	Compliant	Stage 3 and 4 – not applicable yet as construction has not commenced	
677:P5.1:2	Implement the Vegetation Protection and Rehabilitation Management Plan	To rehabilitate areas disturbed by construction of the road	Post construction	Compliant	Stage 3 and 4 - not applicable yet as construction has not commenced	.
677:P6	Prepare a TEC Protection and Management Plan	To ensure that construction management in the TEC is of a similar standard to that employed in the National Park, and	Design	NA	Not applicable to Stage 2, 3 or 4a. A TEC management plan will be submitted prior to construction of Stage 4. Geotechnical works for Stage 3 and 4a were located north of the Themeda grassland TEC.	

Audit Code	Commitment/ Subject	Management Strategy / Requirementr	Phase	Compliance Status	Further Information / How	Supporting Documentation / Evidence
677:P7.1	Implement the TEC Protection and Management Plan	that this is to the satisfaction of CALM	Design	NA	See above.	
677:P7.2	Implement the TEC Protection and Management Plan		Construction	NA	See above.	
677:P7.3	Implement the TEC Protection and Management Plan		Post - construction	NA	See above	
677:P8.1	Prepare a scientifically based rehabilitation trial for the treatment of redundant roads and tracks	To rehabilitate redundant tracks and to provide information on best practice methodology for use by Main Roads and others in the Pilbara in the future	Construction	**Complete**	A rehabilitation trial was established in the former Main Roads Borrow Pit to the east of SLK 0 to SLK 0.8, at the start of the road and adjacent to the North West Coastal highway (NWCH). The results of the trial are summarised in the NWCH Borrow Pit Rehabilitation Trial Monitoring Report (Appendix C).	Appendix C – Rehabilitation Trial
677:P8.2	Monitor and report outcomes of rehabilitation trials for the treatment of redundant roads and tracks.		Post - construction	Compliant	See above	
677:P9.1:1	Rehabilitate redundant roads and tracks using	To rehabilitate redundant tracks and to provide	Construction	Compliant	The majority of initially identified redundant tracks were not rehabilitated due to changed requirements from DEC Karratha Branch. A number of meetings	Appendix B - File note on meeting with DEC and

Audit Code	Commitment/ Subject	Management Strategy / Requirementr	Phase	Compliance Status	Further Information / How	Supporting Documentation / Evidence
	results of the trials referred to in commitment 8.	information on best practice methodology for use by Main Roads and others in the Pilbara in the future			were held between DEC and Millstream Link representatives, where a cash payment was agreed for DEC to undertake rehabilitation of redundant tracks and erect necessary fencing on behalf of Millstream Link. DEC requested amendments to Commitment 16 and Condition 7-3. During Stage 2 construction available small redundant areas were treated by ripping and where available cleared vegetation and topsoil was re-spread.	changes to rehabilitation requirements.
677:P9.1:2	Rehabilitate redundant roads and tracks using results of the trials referred to in commitment 8.		Post - construction	NA	Stage 3 and 4 – Not applicable as construction has not commenced.	
677:P10	Prepare a National Park Plan which addresses impacts in the Millstream-Chichester National Park	To minimise the impacts of the road through the Millstream-Chichester National Park	Design	**Complete**	The National Park Management Plan and the Vegetation Protection and Rehabilitation Management Plan were accepted by CALM on the 6th of February 2006. Stage 3 - The National Park Management Plan was approved by the EPA in December 2018 (Appendix D)	Stage 3 Appendix D – Stage 3 Letters of Acceptance
677:P10.1	Prepare a National Park Plan.	Design of appropriate interpretive signage and rest bays to promote understanding of Park values and protection of flora	Design	Compliant	Main Roads and DBCA had a meeting on 7 June 2019 in which rest bays and signage were discussed; negotiations are ongoing between the parties (Appendix D).	Appendix R – meeting minutes between Main Roads and DBCA

Audit Code	Commitment/ Subject	Management Strategy / Requirementr	Phase	Compliance Status	Further Information / How	Supporting Documentation / Evidence
		and fauna				
677:P11.1:1	Implement the National Park Plan	To minimise the impacts of the road through the Millstream-Chichester National Park	Construction	Compliant	Stage 3 and 4 – not relevant at this time.	
677:P11.1:2	Implement the National Park Plan		Post construction	NA		
677:P12	Prepare an Aboriginal Heritage Management Plan (in compliance with the *Aboriginal Heritage Act 1972*).	To protect and preserve Aboriginal cultural heritage within the area influenced by the roadworks	Design	**Complete**	.Stage 3 and 4a - The Cultural Heritage Management Plan was approved by the EPA on 21 June 2018.	Appendix D – Stage 3 Letters of Acceptance
677:P13.1:1	Implement the Aboriginal Heritage Management Plan (in compliance with the *Aboriginal Heritage Act 1972*).		Design	NA	Stage 3 and 4 – not relevant yet as construction has not commenced.	
677:P13.1:2	Implement the Aboriginal Heritage Management Plan (in compliance		Design	Compliant	Heritage surveys were complete for Stage 3 and 4a in 2018.	

Audit Code	Commitment/ Subject	Management Strategy / Requirementr	Phase	Compliance Status	Further Information / How	Supporting Documentation / Evidence
	with the *Aboriginal Heritage Act 1972*).				No relevant for stages 3 and 4 at this point in time	
677:P14	Prepare a Construction Management Plan	To ensure that environmentally and socially acceptable standards are established and maintained during construction works	Design	Complete	Stage 3 and 4 The Construction Management Plan was accepted by EPA in July 2018.	Appendix F – Stage 3 EMPs
677:P15	Implement the Construction Management Plan		Construction	NA	Not relevant for Stages 3 and 4 as construction has not commenced	
677:P16.1:1	Construct approximately 30 kilometres of fencing along the northern boundary of the Millstream-Chichester National Park where it is adjacent to Pyramid Station	To prevent stock access to the National Park	Construction	Compliant	Fencing not constructed by Millstream Link. DEC Karratha negotiated other offsets with Main Roads. A number of meetings were held between DEC and Millstream Link representatives, where a cash payment was agreed for DEC to undertake rehabilitation of redundant tracks and erect necessary fencing on behalf of Millstream Link. details meeting minutes to this effect.	Appendix B - provides a copy of the invoice and file note on correspondence with DEC regarding offsets.
677:P16.1:2	Construct approximately 30 kilometres of fencing along the northern boundary of the Millstream-		Post construction	**Complete**	Fencing was not constructed by Main Roads. Fencing along the northern boundary was considered to be logistically difficult by DEC Pilbara to achieve, due to the terrain and large number of creek crossings. It was agreed by the Regional Manager of DEC, Pilbara and the Project Director of Main Roads	Appendix B – provides a copy of the invoice and file note on correspondence with DEC regarding

Audit Code	Commitment/ Subject	Management Strategy / Requirementr	Phase	Compliance Status	Further Information / How	Supporting Documentation / Evidence
	Chichester National Park where it is adjacent to Pyramid Station				on 15 August 2008 that the western boundary was a higher priority as it contained several entry points for cattle into the park. Main Roads agreed that an amount of $4,000 per kilometre would be provided to fence 30 kilometers. In a letter from DEC dated 20 September 2007 DEC agreed to invoice Main Roads $120,000 for the fencing of the western boundary of Millstream Chichester National Park	offsets.
677:P17	Contribute $25,000 per year, for five years, towards a weed control program for the Millstream-Chichester National Park	To contribute to the overall weed control and management of the National Park, in particular the control of date and cotton palm, morning glory, khaki weed, Galland's curse, Indian water fern and Parkinsonia	Overall	**Complete**	Main Roads WA has completed payment to the former DEC.	Appendix B – provides a copy of payments for offsets.

Conclusion

The audit tables have been prepared based on information available to Main Roads at this time. As outlined in Table 1 – Table 3 of this Compliance Assessment Report, Main Roads considers the status of the Conditions and Commitments under Ministerial Statement 677 to be compliant and/or complete for works undertaken to date.

As Stage 2 of the Karratha – Tom Price Road was completed in August 2008, and all conditions and commitments are considered to be either compliant or complete and have not been included herewith unless actions during Stage 2 are relevant to Stage 3 and 4 actions.

References

GHD Pty Ltd 2017. Karratha Tom Price Road (K-TP3 and K-TP4a to Rio Access) – Northern Quoll Reconnaissance Survey. Unpublished report prepared for Main Roads – September 2017.

Golder Associates Pty Ltd 2017. Geotechnical and Pavement Investigation – Karratha to Tom Price Road, Stage 3 and 4a. Unpublished report prepared for Main Roads – December 2017.

Appendix A – Letters of acceptance – EMPs Stage 3

Government of **Western Australia**
Department of **Water and Environmental Regulation**

Our ref: DWERA-000960
Enquiries: Peta Hayward, Ph 6364 6463

Ms Martine Scheltema
Manager Environment
Main Roads Western Australia
PO Box 6202
EAST PERTH WA 6892

ATTENTION: Gaynor Owen

Dear Ms Scheltema

ROAD FROM KARRATHA TO TOM PRICE STAGES 3 AND 4A – MINISTERIAL STATEMENT 677 – MULTIPLE MANAGEMENT PLANS – APPROVED

Thank you for your letters of 23 November 2018 and 18 December 2018, submitting the following plans to the Department of Water and Environmental Regulation (DWER) for review:

- Karratha Tom Price Stage 3a South, 3b and 4a Vegetation Protection and Rehabilitation Management Plan (Rev 2, December 2018).
- Karratha Tom Price Stage 3a North Vegetation Protection and Rehabilitation Management Plan (Rev 3, December 2018).
- Karratha Tom Price Stage 3a North National Park Management Plan (Rev 3, December 2018).
- Weed Control and Management Program Karratha Tom Price Stage 3 and 4a (Rev 1, December 2018).

I note the above plans have been prepared to satisfy conditions 2, 6 and 7 and the proponent environmental management commitments No. 4 and 10 of Ministerial Statement 677 (MS 677).

I am satisfied with the preparation of the plans above, and consider the requirements of conditions 2, 6 and 7 and the proponent environmental management commitments No. 4 and 10 of MS 677 have been met.

It is noted that the Karratha Tom Price Stage 3a South, 3b and 4a Vegetation Protection and Rehabilitation Management Plan (VPRMP) (Rev 2, December 2018) replaces the previously approved VPRMP (Rev 1 – 12 July 2018).

168 St Georges Terrace Western Australia 6000
Locked Bag 33 Cloisters Square Perth WA 6850
Telephone: 08 6364 7000 Facsimile: 08 6364 7001
www.dwer.wa.gov.au

Please be advised separate Management Plans are required prior to the construction of Stage 4b.

Please note any changes to the management actions or targets of the above plans would require the approval of DWER.

Yours sincerely

Anthony Sutton
Executive Director
EPA SERVICES
for the Chief Executive Officer under Notice of Delegation dated 3 July 2017

11 December 2018

Government of Western Australia
Department of Water and Environmental Regulation

Our ref: DWERA-000961/DWERA-000959
Enquiries: Peta Hayward Ph 6364 6463
Email: peta.hayward@dwer.wa.gov.au

Ms Martine Scheltema
Manager Environment
Main Roads Western Australia
PO Box 6202
EAST PERTH WA 6892

ATTENTION: Ms Gaynor Owen

Dear Ms Scheltema

KARRATHA TOM PRICE ROAD STAGES 3 AND 4A – MINISTERIAL STATEMENT 677 – CONSTRUCTION AND SURFACE DRAINAGE MANAGEMENT PLANS FOR THE PROPOSED STAGES 3 AND 4A UPGRADE OF THE KARRATHA TOM PRICE ROAD IN THE PILBARA REGION OF WA

Thank you for your letter of 2 July 2018 submitting the revised Construction Management Plan – 25 June 2018 and the Surface Drainage Management Plan – 25 June 2018 to the Department of Water and Environmental Regulation (DWER), EPA Services directorate.

I note that the Plans have been prepared to satisfy condition 2 and proponent environmental management commitments No. 2 and14 of Ministerial Statement 677.

Main Roads WA is advised that the revised versions of the Plans are considered acceptable and meet the requirements of condition 2 and the proponent environmental management commitments No. 2 and 14 for Stages 3 and 4A. A separate Management Plan will be required prior to the construction of Stage 4B.

Please note any changes to the management actions or targets of the Construction Management Plan – 25 June 2018 and/or the Surface Drainage Management Plan – 25 June 2018 would require the approval of the DWER.

Should you have any questions concerning this correspondence please contact Peta Hayward on 6364 6463 or email peta.hayward@dwer.wa.gov.au.

Yours sincerely

Hans Jacob
A/Executive Director
EPA SERVICES
6 July 2018

168 St Georges Terrace Western Australia 6000
Locked Bag 33 Cloisters Square Perth WA 6850
Telephone: 08 6364 7000 Facsimile: 08 6364 7001
www.dwer.wa.gov.au

Our ref: DWERA-000962
Enquiries: Peta Hayward Ph 6364 6463
Email: peta.hayward@dwer.wa.gov.au

Ms Martine Scheltema
Manager Environment
Main Roads Western Australia
PO Box 6202
EAST PERTH WA 6892

ATTENTION: Ms Gaynor Owen

Dear Ms Scheltema

KARRATHA TOM PRICE ROAD STAGES 3 AND 4A – MINISTERIAL STATEMENT 677 – CULTURAL HERITAGE MANAGEMENT PLAN FOR THE PROPOSED STAGES 3 AND 4A UPGRADE OF THE KARRATHA TOM PRICE ROAD IN THE PILBARA REGION OF WA

Thank you for your letter of 18 June 2018 submitting the revised Cultural Heritage Management Plan - June 2018 (the Plan) to the Department of Water and Environmental Regulation (DWER), EPA Services Directorate.

I note that the Plan has been prepared to satisfy condition 2 and proponent environmental management commitments No. 12 of Ministerial Statement 677.

Main Roads WA is advised that the revised version of the Plan is considered acceptable and meets the requirements of condition 2 and the proponent environmental management commitments No. 12 for Stages 3 and 4A. A separate Management Plan will be required prior to the construction of Stage 4B.

Please note any changes to the management actions or targets of the Cultural Heritage Management Plan - June 2018 would require the approval of the DWER.

Should you have any questions concerning this correspondence please contact Peta Hayward on 6364 6463 or email peta.hayward@dwer.wa.gov.au.

Yours sincerely

Anthony Sutton
Executive Director
EPA SERVICES
21 June 2018

168 St Georges Terrace Western Australia 6000
Locked Bag 33 Cloisters Square Perth WA 6850
Telephone: 08 6364 7000 Facsimile: 08 6364 7001
www.dwer.wa.gov.au

Appendix B – Confirmation of environmental offset

Department of **Environment** and **Conservation**

File No: 05/5600
Document No: 207 # 154822
Date Due: ../../..
Action Officer: .....

Your Reference:
Our Reference:
Enquiry: Ian Walker

Phone: 08 9182 2000
Fax: 08 9144 1118
Email: ian.walker@dec.wa.gov.au

Mr Mark Hazebroek
Project Director
Main Roads WA
PO Box 6202
EAST PERTH WA 6892

Dear Mark

LETTER OF AGREEMENT: OFFSETS FOR THE KARRATHA TO TOM PRICE ROAD DEVELOPMENT, STAGE 2

Thank you for meeting with the Department of Environment and Conservation Pilbara Region (DEC) staff on 13 September 2007 to discuss offsets for the development of Stage 2 of Karratha to Tom Price Road.

I can confirm the following items were agreed to by DEC and Main Roads (MRWA) at the meeting. These items are in accordance with requirements under Ministerial Statement 1159, and relate to offsets associated with vegetation clearing and disturbance within Millstream-Chichester National Park (MCNP).

1. **Commitment No. 17 – Weed control in MCNP**

Issue	Action	Objective	Phase
Weed control at Millstream-Chichester National Park	Contribute $25,000 per year, for five years, towards a weed control program for the Millstream-Chichester National Park.	To contribute to the overall weed control and management of the National Park, in particular the control of date and cotton palm, morning glory, khaki weed, Galland's curse, Indian water fern and Parkinsonia	During construction and post construction

It is acknowledged that $25,000 was paid by MRWA for weed control in MCNP in 2005/2006. Four further annual payments remain outstanding in order for this commitment to be met. It is agreed that MRWA would pay DEC the remaining four payments of $25,000 in a lump sum, which will contribute to weed management works in MCNP.

Action: DEC to invoice MRWA for $100,000, comprising the four remaining payments of $25,000, towards weed management works in Millstream-Chichester National Park.

2. **Commitment No. 16 – Fence construction at MCNP**

Issue	Action	Objective	Phase
Fence construction at Millstream-Chichester National Park	Construct approximately 30 kilometres of fencing along the northern boundary of the Millstream-Chichester National Park where it is occurs adjacent to Pyramid Station.	To prevent stock access into the National Park.	During construction and post construction

PILBARA REGION: Mardie Rd, Karratha Industrial Estate, Karratha
Postal address: PO Box 835, Karratha, Western Australia 6714
Phone: (08) 9143 1488 Fax: (08) 9144 1118 Website: www.naturebase.net

It is acknowledged that fencing works have not yet commenced. Fencing along the northern boundary of MCNP will be logistically difficult to achieve, due to the terrain and large number of creek crossings. This is an ongoing management issue that DEC will need to address. An alternative boundary of high priority for fencing is the western boundary adjoining the water reserve, which contains several entry points for cattle into the park. It is agreed by DEC and MRWA that it is more feasible and practicable for MRWA to contribute towards fencing along this boundary. An amount of $4,000 per kilometre for fencing (comprising materials and labour) was agreed to by DEC and MRWA.

Action: DEC to invoice MRWA for $120,000, comprising the amount to fence 30 kilometres (at $4,000 per kilometre) along the western boundary of Millstream-Chichester National Park.

3. **Condition 7-3 (2) Rehabilitation**

7-3 During and following construction, the proponent shall rehabilitate:

1) *approximately 137 hectares of land disturbed for the construction of the road. This includes all land disturbed from road construction which do not form part of the carriageway; and*
2) *approximately 205 hectares of redundant access tracks, including those tracks associated with the existing railway and redundant material pits as an environmental offset activity,*

to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority and the Department of Conservation and Land Management.

It is agreed that subsection (1) of Condition 7-3 refers to rehabilitation associated with disturbance caused by road construction, and therefore constitutes a management requirement, not an offset. Subsection (2) of Condition 7-3 refers to additional rehabilitation work involving already disturbed areas, and therefore does constitute an offset. The offset requirement therefore relates to the rehabilitation of approximately 205 hectares of disturbed land not associated with road construction activities.

It is agreed by DEC and MRWA that rehabilitation works should be for broad conservation management works associated with protecting the biodiversity and cultural values of Millstream-Chichester National Park. An amount of $2,500 per hectare of rehabilitation works was agreed to by DEC and MRWA. Given Stage 2 comprises part of the overall road development, it is agreed that funds will be provided by MRWA for rehabilitation works equivalent to 100 hectares. Funding to rehabilitate the remaining 105 hectares will be provided when Stages 3 and 4 are being implemented, in accordance with the Consumer Price Index (CPI).

Action: DEC to invoice MRWA for $250,000, comprising the amount to rehabilitate 100 hectares (at $2,500 per hectare) for Stage 2. Funds to rehabilitate the remaining 105 hectares will be provided by MRWA during the implementation of Stages 3 and 4, at the cost of $2,500 per hectare adjusted to CPI increases/decreases from September 2007 quarter.

DEC will establish a trust account to manage the above offset funding related to the Karratha to Tom Price Road development.

I trust that the above items reflect MRWA's understandings of the discussions and verbal agreements reached during our meeting on 13 September 2007. In order to formalize the agreement between DEC and MRWA, I ask that you sign this letter on the next page, and return the letter to me (and keep a copy for yourself). I will then arrange for the relevant invoices to be prepared and sent to your Department.

If you wish to further discuss the agreement, or have any changes to the above action items, please do not hesitate to contact me on 9182 2000.

Yours sincerely

Ian Walker
REGIONAL MANAGER – PILBARA

20 September 2007

I agree to MRWA's obligations as stated in this letter of agreement:
SIGNED by **MRWA** in the presence of:

Mark Hazebroek
PROJECT DIRECTOR
MAIN ROADS WESTERN AUUSTRALIA
15/8/08
Date

Witness

Name SIMON LOXLEY

Witness Address:
MAIN ROADS
DON AITKEN CENTRE
EAST PERTH WA 6000

I agree to DEC's obligations as stated in this letter of agreement:
SIGNED by **DEC** in the presence of:

Ian Walker
REGIONAL MANAGER
DEPARTMENT OF ENVIRONMENT AND CONSERVATION - PILBARA

Date 20/9/07

Witness

Name

Witness Address:
PO Box 835
Karratha WA 6714

Appendix C - Rehabilitation Trial

NWCH Borrow Pit Rehabilitation Monitoring Report

Karratha – Tom Price Stage 2

Revision Date: 30-Aug-09

MILLSTREAM LINK

KARRATHA - TOM PRICE ROAD STAGE 2

Contents

1 BACKGROUND 3

2 TIMING 3

3 DESIGN OF REHABILITATION TRIAL PLOTS 3

4 MONITORING REQUIREMENTS 6

4.1 Photo Monitoring Results 7

4.1.1 Trial 1 – Vegetation Respread & Ripping 7

4.1.2 Trial 2 – Vegetation & Topsoil Respread & Ripping 7

4.1.3 Trial 3 – Control with no treatment 7

4.1.4 Trial 4 – Topsoil Respread & Ripping 7

5 SUMMARY 8

APPENDIX 9

Appendix 1 – Photos Trial 1 – Vegetation Respread & Ripping 9

Appendix 2 – Photo Trial 2 – Vegetation & Topsoil Respread & Ripping 10

Appendix 3 – Photo Trial 3 – Control with no treatment 11

Appendix 4 – Photo Trial 4 – Topsoil Respread & Ripping 12

MILLSTREAM LINK

KARRATHA - TOM PRICE ROAD STAGE 2

Rehabilitation Trial Monitoring Report

For

Karratha – Tom Price Stage 2

Client: Millstream Link Alliance

Macmahon Project No.: C421

Business Unit: Construction
Division: WA Construction

NWCH Borrow Pit Rehabilitation Monitoring Report

Karratha – Tom Price Stage 2

Revision Date: 30-Aug-09

MILLSTREAM LINK

KARRATHA - TOM PRICE ROAD STAGE 2

1 BACKGROUND

A rehabilitation trial was established in the former MRWA Borrow Pit to the east of SLK 0 to SLK 0.8, at the start of the Road and adjacent to the North West Coastal highway (NWCH). The rehabilitation trial was established to address the Vegetation Protection and Rehabilitation Management Plan (VPRMP) commitments which formed part of the EPA Statement 677 approval for the Karratha Tom Price Road.

The purpose of the rehabilitation trials is to identify rehabilitation methods that result in rehabilitation success which may be applied to similar linear projects in the Pilbara region. Most rehabilitation trial and implementation work in the Pilbara has been carried out following mining activities and there has been little applied to broad scale linear projects such as roads.

2 TIMING

The rehabilitation trials were to be implemented in the winter of 2006. Due to equipment availability the rehabilitation trial was not established until June 2008 when construction of the road was almost complete.

3 DESIGN OF REHABILITATION TRIAL PLOTS

The rehabilitation trials were to involve a range of soil, topsoil and cleared vegetation treatments.

A proposed trial layout was established as shown in **Figure 1** and included Five (5) trial plots of varying size as follows:

1. Trial 1 - Rip only
2. Trial 2 - Flatten out mound, ripping, topsoil and re-spread.
3. Trial 3 - Nothing Peg only: CONTROL
4. Trial 4 - Topsoil only, no ripping
5. Trial 5 - Ripping, topsoil and re-spread

NWCH Borrow Pit Rehabilitation Monitoring Report
Karratha – Tom Price Stage 2
Revision Date: 30-Aug-09

MILLSTREAM LINK
KARRATHA - TOM PRICE ROAD STAGE 2

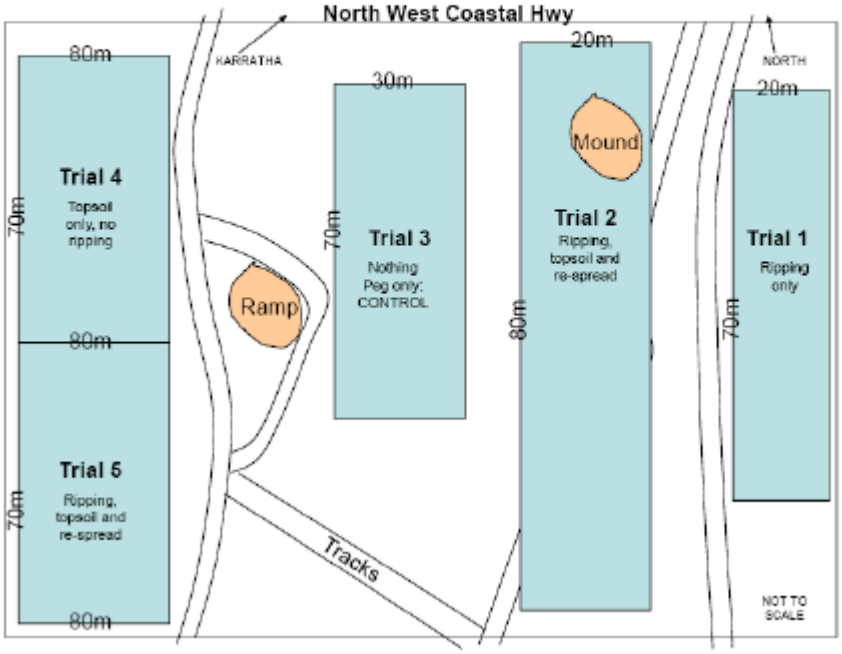


Figure 1 – Proposed rehabilitation trial layout

These areas were marked with star pickets and signposted (**Picture 1**), however during rehabilitation works four (4) trial plots of varying size were established in the NWCH Borrow Pit as shown in **Figure 2.**

Picture 1 – Signposting of Rehabilitation trial plots

The rehabilitation treatments applied to these areas were as follows;

1. Trial 1 – Vegetation Respread & Ripping;
2. Trial 2 – Vegetation & Topsoil Respread & Ripping;
3. Trial 3 – Control with no treatment
4. Trial 4 – Topsoil Respread & Ripping

Ripping was completed using a D8 Bulldozer. Generally rip lines were spaced approximately 1.2m apart.

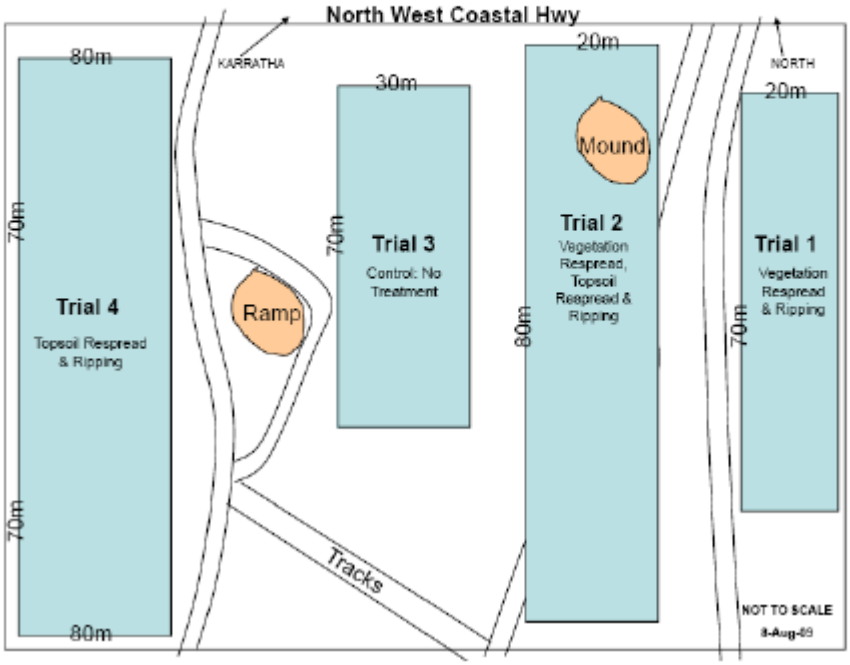


Figure 2 – Constructed rehabilitation trial layout

4 MONITORING REQUIREMENTS

The VPRMP detailed the following monitoring requirements for rehabilitation trials:

- Documentation of methods, results, and outcomes of rehabilitation processes will be undertaken, with rigorous, repeatable monitoring performed.
- The trial sections will be monitored quarterly, or 3 weeks after substantial rainfall. Monitoring will assess:
  - Erosion/soil loss.
  - Weed invasion. This will be measured through the use of random quadrats where the diversity and density of weed species is recorded.
  - Germination and establishment of native plant species. This will be measured through the use of random quadrats. Density and diversity will be recorded.
- Monitoring will be based on a combination of photographic record and quantitative measurements.
- Permanent monitoring point(s) will be established and photos taken from the same point(s) each time.
- The success of the trials will be discussed regularly with CALM and other advisors.

Following discussions between Ms Anna Napier (Millstream Link Alliance Environmental Manager) and representatives from the Karratha Regional Office of the DEC it was agreed the monitoring program detailed in the VPRMP was unnecessarily detailed. As a result, the following monitoring program has been implemented at the NWCH borrow pit:

- Annual monitoring of the rehabilitation trial assessing vegetation coverage and erosion
- Monitoring is based on photographic records taken at the established photo monitoring points as shown in Figure 2.

4.1 Photo Monitoring Results

On the 9th of June 2009, annual photo monitoring was undertaken at the NWCH Borrow Pit Rehabilitation Trial Plots by Ms Anna Napier (MSL Alliance Environmental Manager) and Eve Lancaster (Macmahon Quality and Environment Coordinator). Photos were taken from locations shown in **Figure 3**.

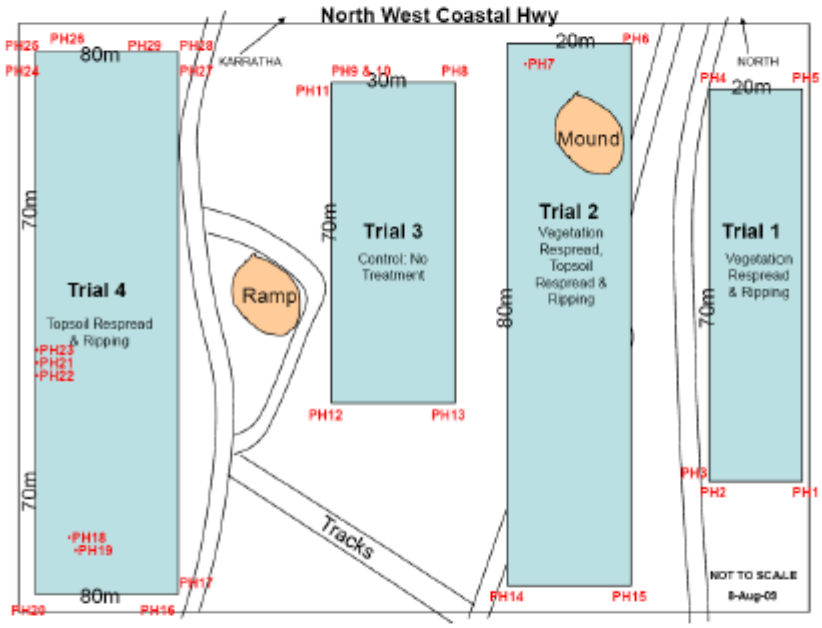


Figure 3 – Constructed rehabilitation trial layout showing photo monitoring locations

4.1.1 Trial 1 – Vegetation Respread & Ripping

Appendix 1 includes photos from the monitoring undertaken on the 9th of June 2009.

4.1.2 Trial 2 – Vegetation & Topsoil Respread & Ripping

Appendix 2 includes photos from the monitoring undertaken on the 9th of June 2009.

4.1.3 Trial 3 – Control with no treatment

Appendix 3 includes photos from the monitoring undertaken on the 9th of June 2009.

4.1.4 Trial 4 – Topsoil Respread & Ripping

Appendix 4 includes photos from the monitoring undertaken on the 9th of June 2009.

5 SUMMARY

- In Trial 1 (vegetation respread and ripping), the respread of vegetation alone does not appear to have significantly assisted in vegetation re-establishment.
- In Trial 2 (vegetation and topsoil respread and ripping), the combination of topsoil and vegetation respreading has resulted a higher coverage of vegetation than Trial 1, however poor drainage and a higher visual content of calcrete in the ripped rocky substrate appears to have had a negative impact on vegetation re-establishment (see photo monitoring point PH15). Where topsoil is thickest, the vegetation coverage appears higher.
- In Trial 3 (control) has the lowest coverage of vegetation. Ripping occurred in a section of the control site and where this has occurred vegetation establishment is higher than where ripping has not occurred.
- In Trial 4 (topsoil respread and ripping) where topsoil has been respread, vegetation re-establishment and diversity has been most prominent in comparison to the other trials. Grasses also appear in the greatest abundance. In comparison with the other trials.
- Where topsoil has been re-spread and ripped regrowth of vegetation and diversity of vegetation has been visually more successful. This is most evident in areas with greater percentages of soil substrate, rather than rocky calcrete areas.
- The respreading of vegetation does not appear to assist greatly in vegetation re-establishment.
- The presence of calcrete substrate material and the ponding of water appear to hinder the re-establishment of vegetation.

Appendix D – Stage 3 Rest Bays Meeting Minutes e-mail

Reply Reply All Forward IM

Kirsten Marmion <kirsten.marmion@dbca.wa.gov.au> LOVELL Luke (Con); PYKE Andrew (RM); HOLLYOCK Ben (PEO); + 2 7/06/2

KTP Stage 3 Meeting

Follow up. Start by Monday, 10 June 2019. Due by Monday, 10 June 2019.
You replied to this message on 10/06/2019 3:37 PM.

Hi Luke, Jarryd, Ben (and Andrew),

Thanks again for travelling down/up to Karratha to discuss the commencement of Stage 3 of the Karratha to Tom Price Road.

The main outcomes of the meeting are noted as follows:

Interpretive signage and information bays

- MRWA preference is that there are no bays located within stage 3 due to the high occurrence of asbestos and potential risk to users.
- MRWA would prefer to transfer all future liability associated with potential asbestos contamination surrounding an information bay located in stage 3 to DBCA.
- DBCA preference is for an information bay rather than just road side signage due to improved effectiveness of sharing information on MCNP.
- DBCA open to enabling MRWA to clear vegetation within MCNP beyond the current NVCP quota (through CALM Act mechanisms).
- There is some flexibility to the location of an information bay outside of stage 3 (e.g. KTP at the Python Pool turn-off or Pannawonica Road).

Actions:

- DBCA to provide MRWA a letter outlining the preference for an information bay, requirements for an information bay, preferred location/s.

MS 677 offset payment

- Invoice for final offset payment provided by DBCA to MRWA as per the 2007 agreement between MRWA and DBCA.
- MRWA has changed the alignment of the road and area of impact within MCNP since the MS was issued.

Actions:

- MRWA to acknowledge receipt of invoice via letter.
- MRWA to seek clarification from OEPA on the requirement and scope of final offset payment (and advise DBCA of outcome).

Weed management on stage 2

- DBCA requires clarification on the management program MRWA are implementing on stage 2 (e.g. Stage 2 Vegetation Protection and Rehabilitation Management Plan) and further information on whether this has been successful.
- All key stakeholders are currently implementing weed control programs throughout MCNP (i.e. Water Corporation, RTIO and DBCA) and stage 2 has been identified as ongoing weed risk to control efforts.

Actions:

- MRWA to advise DBCA on what weed management program is currently being implemented for stage 2.

Prescribed burn program

- DBCA is implementing an aerial and ground burn program in MCNP between May and July.
- Email notifications have already been provided to MRWA.

Actions:

- None.

If there is anything else you would like noted then please let me know.

Regards

Kirsten

Appendix E – Post Assessment Form for a Statement of Compliance

Statement of Compliance

Proposal and Proponent Details

Proposal Title	Road From Karratha to Tom Price Shires of Ashburton and Roebourne
Statement Number	677
Proponent Name	Main Roads Western Australia
Proponent's Australian Company Number *(where relevant)*	NA

Statement of Compliance Details

Reporting Period	2018 *to* 2019

Implementation phase(s) during reporting period (please tick ✓ relevant phase(s))							
Pre-construction	X	Construction		Operation		Decommissioning	

Audit Table for Statement addressed in this Statement of Compliance is provided at Attachment:	See Audit tables 1,2,and 3 in CAR
An audit table for the Statement addressed in this Statement of Compliance must be provided as Attachment 2 to this Statement of Compliance. The audit table must be prepared and maintained in accordance with the Department of Water and Environmental Regulation (DWER) *Post Assessment Guideline for Preparing an Audit Table*, as amended from time to time. The 'Status Column' of the audit table must accurately describe the compliance status of each implementation condition and/or procedure for the reporting period of this Statement of Compliance. The terms that may be used by the proponent in the 'Status Column' of the audit table are limited to the Compliance Status Terms listed and defined in Table 1 of Attachment 1.	

Were all implementation conditions and/or procedures of the Statement complied with within the reporting period? (please tick ✓ the appropriate box)			
No (please proceed to Section 3)		Yes (please proceed to Section 4)	X

Each page (including Attachment 2) must be initialed by the person who signs Section 4 of this Statement of Compliance.
INITIALS: _____

Details of Non-compliance(s) and/or Potential Non-compliance(s)

The information required Section 3 must be provided for each non-compliance or potential non-compliance identified during the reporting period covered by this Statement of Compliance.

Non-compliance/potential non-compliance 0-1

Which implementation condition or procedure was non-compliant or potentially non-compliant?
Was the implementation condition or procedure non-compliant or potentially non-compliant?
On what date(s) did the non-compliance or potential non-compliance occur (if applicable)?

Was this non-compliance or potential non-compliance reported to the Chief Executive Officer, DWER?	
☐ Yes ☐ Reported to DWER verbally Date _____ ☐ Reported to DWER in writing Date _____	☐ No

What are the details of the non-compliance or potential non-compliance and where relevant, the extent of and impacts associated with the non-compliance or potential non-compliance?
What is the precise location where the non-compliance or potential non-compliance occurred (if applicable)? (please provide this information as a map or GIS co-ordinates)
What was the cause(s) of the non-compliance or potential non-compliance?
What remedial and/or corrective action(s), if any, were taken or are proposed to be taken in response to the non-compliance or potential non-compliance?
What measures, if any, were in place to prevent the non-compliance or potential non-compliance before it occurred? What, if any, amendments have been made to those measures to prevent re-occurrence?
Please provide information/documentation collected and recorded in relation to this implementation condition or procedure: • in the reporting period addressed in this Statement of Compliance; and • as outlined in the approved Compliance Assessment Plan for the Statement addressed in this Statement of Compliance. (the above information may be provided as an attachment to this Statement of Compliance)

For additional non-compliance or potential non-compliance, please duplicate this page as required.

Proponent Declaration

I,Ben Hollyock, Principal Environment Officer …., *(full name and position title)*

declare that I am authorised on behalf of ……Main Roads Western Australia……..

(being the person responsible for the proposal) to submit this form and that the information contained in this form is true and not misleading.

Signature:.... ..... Date:.03/09/2019.....

Please note that:

- it is an offence under section 112 of the *Environmental Protection Act 1986* for a person to give or cause to be given information that to his knowledge is false or misleading in a material particular; and
- the Chief Executive Officer of the DWER has powers under section 47(2) of the *Environmental Protection Act 1986* to require reports and information about implementation of the proposal to which the statement relates and compliance with the implementation conditions.

Submission of Statement of Compliance

One hard copy and one electronic copy (preferably PDF on CD or thumb drive) of the Statement of Compliance are required to be submitted to the Chief Executive Officer, DWER, marked to the attention of Manager, Compliance (Ministerial Statements).

Please note, the DWER has adopted a procedure of providing written acknowledgment of receipt of all Statements of Compliance submitted by the proponent, however, the DWER does not approve Statements of Compliance.

Contact Information

Queries regarding Statements of Compliance, or other issues of compliance relevant to a Statement may be directed to Compliance (Ministerial Statements), DWER:

Manager, Compliance (Ministerial Statements)

Department of Water and Environmental Regulation

Postal Address: Locked Bag 33
Cloisters Square
PERTH WA 6850

Phone: (08) 6364 7000

Email: compliance@dwer.wa.gov.au

Post Assessment Guidelines and Forms

Post assessment documents can be found at www.epa.wa.gov.au

Appendix O. Impact Reconciliation Procedure (IRP) for Stage 4 of the Revised proposal

Manuwarra Red Dog Highway

Impact Reconciliation Plan

EPA Assessment Number 2273

Revision | 0

03 November 2022

Main Roads Western Australia

Manuwarra Red Dog Highway

Project No:	IW218110
Document Title:	Impact Reconciliation Procedure
Revision:	0
Document Status:	Final
Date:	03 November 2023
Client Name:	Main Roads Western Australia
Project Manager:	Arne de Vos
Author:	Jessica Tacey
File Name:	MRDH Impact Reconciliation Plan_Rev B

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Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved	Signature
A	20/10/2022	Draft for Client Review	Jessica Tacey	Arne de Vos	Arne de Vos	Arne de Vos	
B	03/11/2022	Draft for Client Review	Jessica Tacey	Arne de Vos	Arne de Vos	Arne de Vos	
0	03/11/2022	Draft for Client Review	Jessica Tacey	Arne de Vos	Arne de Vos	Arne de Vos	

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Contents

1 Introduction 3
1.1 Assessment Process 3
1.2 Document Purpose 3
2 The Proposal and Condition Requirements 4
2.1 The Revised Proposal 4
2.2 Ministerial Statement Condition Requirements 6
3 Impact Reconciliation Procedure 7
3.1 Identification of Environmental Values Requiring Offsets 7
3.2 Ground Disturbance Permits 10
3.3 Determining the Extent of Clearing 10
4 Reporting 11
4.1 Frequency and Timing 11
4.2 Content of the IRR 12
5 Review and Implementation 13
6 References 14
7 Figures 15

Tables

Table 2-1 Summary of Revised Proposal 4
Table 2-2 Key Characteristics of the Revised Proposal 4
Table 3-1 Environmental values for MRDH (Stage 4) with significant residual impacts requiring an offset 8
Table 4-1. Timeframes and frequency of impact reconciliation activities under this IRP. 11

Figures

Figure 1. Manuwarra Red Dog Highway Project Overview 16
Figure 2. Vegetation Condition 16
Figure 3. Conservation Significant Vegetation 16
Figure 4. Ghost Bat Habitat 16
Figure 5. Northern Quoll Habitat 16
Figure 6. Temporary Clearing Areas 16

Glossary

Acronym	Definition
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
IRP	Impact Reconciliation Plan
IRR	Impact Reconciliation Report
PEC	Priority Ecological Community
TEC	Threatened Ecological Community

1 Introduction

Main Roads Western Australia (Main Roads) referred the Manuwarra Red Dog Highway (then known as the Karratha – Tom Price Road) to the WA Environmental Protection Authority (EPA), under section 38 of the Environmental Protection Act 1986 (EP Act), in September 1998. The Proposal was granted conditional Ministerial approval via Ministerial Statement (MS) 677 in April 2005.

Main Roads is now proposing changes to Stage 4 of the Manuwarra Red Dog Highway (MRDH) to provide for the additional disturbance required to incorporate changes to road design standards and community expectations regarding safety of regional roads. Following initial discussions with the EPA, it was determined that the changes and additional disturbance should be referred under section 38 of the EP Act as a Revised Proposal, as the changes have the potential to result in significant additional environmental impacts to flora and vegetation, terrestrial fauna, inland waters, social surroundings and air quality.

1.1 Assessment Process

The Revised Proposal is undergoing assessment by the Western Australian Environmental Protection Authority (EPA) under the Western Australian *Environmental Protection Act* 1986 (EP Act). Separately, Stage 4 of MRDH is being assessed by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act; EPBC 2021/8897).

1.2 Document Purpose

The purpose of this Impact Reconciliation Procedure (IRP) is to outline the method the Proponent intends to use to calculate the area of vegetation and other environmental values that are likely to be impacted within the Development Envelope for Stage 4 of the Revised Proposal. This IRP has been prepared in accordance with the EPA's Instructions for preparing Impact Reconciliation Procedures and Impact Reconciliation Reports (EPA 2021).

2 The Proposal and Condition Requirements

2.1 The Revised Proposal

The Revised Proposal is to construct and maintain a new sealed road from the North West Coastal Highway, near Karratha, to the Nanutarra-Munjina Road, north of Tom Price. The Revised Proposal is comprised of three key stages that are outlined in Table 2-1 and Table 2-2 (noting that Stage 1 of the Manuwarra Red Dog Highway was completed in 2003 and is not included in this Proposal):

Table 2-1 Summary of Revised Proposal

Proposal Title	Manuwarra Red Dog Highway
Proponent Name	Main Roads Western Australia
Short Description	The Revised Proposal is to construct and maintain a new sealed road from the North West Coastal Highway, near Karratha, to the Nanutarra-Munjina Road, north of Tom Price (Figure 1). The Revised Proposal is comprised of three stages: • a new 93 km section from the North West Coastal Highway near Karratha to about 20km north of the Millstream turn-off on the existing Roebourne – Wittenoom Road (Stage 2); • a 46 km section in common with the existing Roebourne – Wittenoom Road (Stage 3); and • a 112 km section from Wallyinya Pool (on the existing Roebourne – Wittenoom Road) to the Nanutarra – Munjina Road (Stage 4) adjacent to the existing Pilbara Rail Company railway. Note that Stage 1 of the Manuwarra Red Dog Highway, completed in 2003, was not included in the Approved Proposal. The Revised Proposal has a greater area of vegetation clearing than the original, Approved Proposal.

Table 2-2 Key Characteristics of the Revised Proposal

Proposed element	Location / description	Existing Proposal extent (MS 677 Current Authorised Extent)[1]	Proposed amendment	Combined extent, capacity or range
Physical elements				
Length	North West Coastal Highway, near Karratha, to the Nanutarra-Munjina Road, north of Tom Price.	Approximately 245 km.	Increase in length by approximately 6 km.	Approximately 251 km.
Connections to existing roads		North West Coastal Highway; Roebourne-	Removed[2]	

[1] Since approval of the Original Proposal in April 2005, two minor changes to the Proposal Key Characteristics have been approved via the Section 45C process being creation of a total area of disturbance of 574 ha by combining the two areas of disturbance described in the Original Proposal; and removal of elements that were no longer considered key characteristics for the purposes of environmental approval (i.e. design speed and railway crossings). Note the previous Section 45C process did not remove formation width and connections to existing roads.

[2] Road connections are no longer considered a key characteristic for the purposes of environmental approval as this area is accounted for in the Proposal Element "Area of disturbance"

Proposed element	Location / description	Existing Proposal extent (MS 677 Current Authorised Extent)1	Proposed amendment	Combined extent, capacity or range
		Wittenoon Road; Millstream-Yaraloola Road; Mt Bruce Road; and Nanutarra-Munjina Road.		
Area of Disturbance		Clearing and disturbance of no more than 574 ha – of this no less than 137 ha will be rehabilitated following construction of the road formation.[3]	Additional clearing and disturbance of no more than 665 ha within a Development Envelope of 7,142 ha located within the Stage 4 Section, of which no less than 100 ha will be rehabilitated following construction of the road formation.	Clearing and disturbance of no more than 1,239 ha of which no less than 237 ha will be rehabilitated following construction of the road formation. All clearing and disturbance for Stage 4 of the Proposal is to occur within a Development Envelope of 7,142 ha.
Formation width		Approximately 9 m.	Removed[4]	
Waterway crossings		Up to nine bridges across major watercourses and railway lines. Culverts and low-level floodways will be used for all other waterway crossings.	No change	Up to nine bridges across major watercourses and railway lines. Culverts and low-level floodways will be used for all other waterway crossings.

Up to 550 ha of permanent clearing of native vegetation in Good to Excellent condition and 100 ha of temporary clearing of native vegetation in Good to Excellent condition will be cleared as part of Stage 4 of the Revised Proposal. This temporary clearing will be revegetated once construction is complete and will avoid areas that contain significant flora or vegetation. The EPA considers clearing of Good or better condition vegetation to be a significant impact that requires offsetting (EPA, 2021). Impacts associated with the completed Stage 2 and 3 have been offset in accordance with the implementation conditions of the previous Proposal.

[3] No Development Envelope is defined in the Approved Proposal

[4] Formation width is no longer considered a key characteristic for the purposes of environmental approval as this area is accounted for in the Proposal Element "Area of disturbance"

2.2 Ministerial Statement Condition Requirements

The condition requirements of the Approved Proposal are described in MS 677. It is expected that a either a revised MS 677 or a new ministerial statement will be issued for the Revised Proposal once approved. Loss of flora and vegetation in Good to Excellent condition, threatened and priority ecological communities and critical and important habitats for Northern Quoll and Ghost Bats are anticipated to be required to be offset as a condition of implementation of the Revised Proposal.

3 Impact Reconciliation Procedure

3.1 Identification of Environmental Values Requiring Offsets

The significant residual impacts of Stage 4 of the Revised Proposal, with reference to the Pilbara Environmental Offsets Fund, include:

- permanent clearing of up to 550 ha of vegetation in 'Good to Excellent' condition within the Development Envelope (Figure 2);
- temporary clearing of up to 100 ha of Good to Excellent condition vegetation which will be rehabilitated for Stage 4 of the Revised Proposal (Figure 6);
- clearing of no more than 15 ha of the Themeda grasslands TEC (Figure 3);
- clearing of no more than 12 ha of the Brockman Iron cracking clay communities of the Hamersley Range PEC (Figure 3);
- clearing of up to 4.0 ha of potential Northern Quoll denning and dispersal habitat that is identified as habitat critical to the survival of the Northern Quoll (Figure 5);
- clearing of up to 42.3 ha of important foraging and dispersal habitat for the Northern Quoll (defined as Northern Quoll habitat within 1 km of habitat critical to the survival of the Northern Quoll) (Figure 5); and
- clearing of up to 18.7 ha of Ghost Bat foraging habitat within 5 km of the possible maternity roost identified by Biota (2021) (Figure 4).

Other potential direct and indirect impacts to flora and vegetation associated with the Revised Proposal will not be significant at the local or regional scale, as the vegetation associations are well represented in the region. Given the small extent of the proposed clearing of vegetation identified as being locally significant, this clearing will not result in a significant residual impact. Clearing of Priority flora species are also not considered to be significant at the local or regional scale, given the small extent of clearing of these species and the wide distribution and number of known records of these species.

A monetary contribution to the Pilbara Environmental Offset Fund (PEOF) will be required at an agreed rate per hectare of clearing to the PEOF for native vegetation in 'Good to Excellent' condition, TEC, PEC and Northern Quoll critical habitat. Environmental values for MRDH (Stage 4) that require offsets, as well as the offset rate within the Pilbara sub-regions, are included in Table 3-1below. The offset rate per hectare for all IBRA subregions was sourced from the PEOF webpage on the Department of the Water Environmental and Regulation (DWER) website and was subject to the Consumer Price Index (CPI) (DWER 2022).

The base rate will apply for "impacts to native vegetation in Good to Excellent condition, which may include impacts to fauna habitat (including threatened fauna)". It is noted that different rates will apply dependent on the IBRA subregion (Hamersley, Fortescue or Chichester), all of which intersect Stage 4 of the Revised Proposal (DWER, 2022). The Indicative Disturbance Footprint and Indicative Temporary Clearing Area comprises:

- Fortescue IBRA subregion – 108 ha;
- Hamersley IBRA subregion – 388 ha; and
- Chichester IBRA subregion – 158 ha.

However, in addition to this, it is expected that the higher rate will apply for the Revised Proposal's impact on 15 ha of the *Themeda* grasslands TEC, 12 ha of the Brockman Iron PEC, 4 ha of Northern Quoll critical habitat, 48.4 ha of habitat comprising important foraging and dispersal habitat for Northern Quolls and/or Ghost Bats, noting that a portion of the Northern Quoll foraging and dispersal habitat and Ghost Bat foraging habitat overlap and will only be offset once (DWER, 2022). The important foraging and dispersal habitat for Northern Quolls and/or Ghost Bats comprises:

- 12.6 ha of habitat that represents supporting habitat for both Northern Quoll (foraging and dispersal) and Ghost Bat (foraging).
- 29.7 ha of habitat that represents supporting habitat for Northern Quoll (foraging and dispersal) only.
- 6.1 ha of habitat that represents supporting habitat for Ghost Bat (foraging) only.

All areas to be cleared which are part of the *Themeda* grasslands TEC, the Brockman Iron PEC, the Northern Quoll critical habitat and important foraging and dispersal habitat and Ghost Bat foraging habitat are in Good to Excellent condition; to avoid offsetting these twice, the areas will be removed from the base rate calculation of Good to Excellent condition vegetation and only offset at the higher rate.

The areas to be cleared of *Themeda* grasslands TEC, the Brockman Iron PEC, the Northern Quoll critical habitat and the important foraging and dispersal habitat for Northern Quolls and/or Ghost Bats are all within the Hamersley region. As none of these environmental values overlap, a total of 79.4 ha is to be offset at the higher offset calculation rate.

The total area of Good to Excellent condition vegetation to be cleared in the Hamersley region is 388 ha. Removing the 79.4 ha which is already calculated at a higher rate from this leaves a total of 308.6 ha to be offset at the base rate. This is summarised in Table 3-1.

The estimated financial contribution is based on the 2021/2022 rates, and anticipated hectares to be directly impacted (i.e. cleared) for each IBRA sub-region. However, the financial contribution will be based on actual clearing, and this can only be calculated after clearing has been conducted.

It is anticipated that the value of expenditure per hectare of clearing that is expected to have a significant residual impact will be annually adjusted in accordance with the Perth Consumer Price Index (CPI) fluctuations from 1 July 2023. The Australian Bureau of Statistics (ABS) publish the annual CPI for Australian cities in September of each year and will be referenced when calculating the annual adjustments.

Table 3-1 Environmental values for MRDH (Stage 4) with significant residual impacts requiring an offset

Environmental Feature	Clearing	Contribution	IBRA Subregion	Offset rate (2021/22)	Area (ha)	Total
Themeda grasslands TEC	Up to 15 ha	Based on DWER (2022), it is expected that a higher rate per hectare of clearing should be contributed	Hamersley	$1,780/ha	15	$26,700

		to the fund for the 15 ha of TEC.				
Brockman Iron PEC	Up to 12 ha	Based on DWER (2022), it is expected that a higher rate per hectare of clearing should be contributed to the fund for the 12 ha of PEC.	Hamersley	$1,780/ha	12	$21,360
Habitat critical to the survival of the Northern Quoll	Up to 4 ha	Based on DWER (2022), it is expected that a higher rate per hectare of clearing should be contributed to the fund for the up to 4 ha of Northern Quoll critical habitat.	Hamersley	$1,780/ha	4	$7,120
Important foraging and dispersal habitat for Northern Quolls and/or Ghost Bats	Up to 48.4 ha	Based on DWER (2022), it is expected that a higher rate per hectare of clearing should be contributed to the fund for the up to 48.4 ha Important foraging and dispersal habitat for Northern Quolls and/or Ghost Bats.	Hamersley	$1,780/ha	48.4	$86,152
Native vegetation in Good to Excellent condition	Up to 574.6 ha	Based on DWER (2022), a rate per hectare of clearing should be contributed to the fund for the 511 ha of native vegetation in Good to Excellent condition. This rate is expected to be the base rate.	Fortescue	$1,780/ha	108	$192,240
			Hamersley	$890/ha	308.6	$274,654
			Chichester	$841/ha	158	$132,878

	TOTAL	$741,104

3.2 Ground Disturbance Permits

A ground disturbance permit process will be developed by the contractor and signed off by the Main Roads Superintendent. The process will include a review of the disturbance area against the approval boundary. All clearing areas will be demarcated and approved by the Main Roads Superintendent prior to clearing commencing and all clearing areas will be checked and confirmed post-clearing (as per Main Roads Specification 301 – Vegetation Clearing and Demolition).

3.3 Determining the Extent of Clearing

On an annual basis a spatial assessment will be undertaken to confirm the extent of vegetation (and associated fauna habitat type) that was cleared. A spatial analysis will be used to compare the state of the vegetation and habitat at the end of each financial year with the 'baseline' state of vegetation and habitat which existed prior to Stage 4 of the Revised Proposal's clearing activities occurring. The spatial assessment will be ground truthed by the digital ground survey data that will collected by the Superintendent after completion of vegetation clearing via a digital ground survey in accordance with Main Roads Digital Ground Survey Standard 67-08-43 to capture the As Constructed Vegetation Clearing Area data.

4 Reporting

The Proponent will prepare one or more Impact Reconciliation Reports (IRRs) to document the clearing undertaken. The IRRs will be provided to DWER to enable DWER to determine the contributions payable.

4.1 Frequency and Timing

IRRs will be submitted biennially (from the time of approval of the Proposal). The first reporting period will commence on the day clearing for Stage 4 commences, ending on the second 30 June following. Successive reporting periods run from 1 July to the second 30 June following. The IRR will advise DWER on the amount of clearing that has been undertaken within each year of the biennial reporting period. This clearing is then used to define the amount to be contributed to the fund for areas cleared during the reporting period, with the rate/ha determined in accordance with the fund's implementation plan.

Table 4-1. Timeframes and frequency of impact reconciliation activities under this IRP.

Biennial Reporting Period	Action	Timing [5]
N/A	Ministerial Statement issued	
	Commencement of clearing action	
Period 1	First biennial reporting period	30 June 2023 to 30 June 2025
	Survey pick-up	30 June 2024 30 June 2025
	IRR submitted to DWER	30 September 2025
	Evidence of payment submitted to DWER	Within 10 business days of the date of the payment
Period 2	First biennial reporting period	1 July 2025 to 30 June 2027
	Survey pick-up	30 June 2026 30 June 2027
	IRR submitted to DWER	30 September 2027

[5] Timing is based on the assumption that works will commence in the 2023/24 financial year.

	Evidence of payment submitted to DWER	Within 10 business days of the date of the payment
On completion of clearing	IRR submitted to DWER	On completion of clearing required for the proposal

No clearing is expected after the end of the last reporting period. However, the Proponent will continue to prepare and submit IRRs according to the reporting frequency established by Table 2 until DWER advises in writing that the Proponent is no longer required to implement this IRP.

4.2 Content of the IRR

Each IRR will be structured in the manner prescribed in the EPA's 'Instructions on How to Prepare EP Act Part IV IRPs and IRRs, 2022'.

Each IRR will include the following information:

- Identification of the relevant Ministerial Statement, applicable conditions, the Proposal and the reporting period.
- Quantification of clearing undertaken during the reporting period, broken down into the environmental values identified in Table 3-1 of this IRP.
- Information from surveys supporting the quantification of clearing undertaken, including spatial data representing areas of ground disturbance (if deemed relevant) and supporting reports.
- A quantitative estimate of clearing expected in the future.

5 Review and Implementation

While no scheduled review of this IRP is required, DWER may direct the Proponent to revise an IRP at its discretion. Irrespective of the schedule set out in Table 2, the Proponent will continue to implement this IRP until any of the following occurs:

- The Proponent identifies additional protected species habitat during operations that need to be included into this IRP.
- DWER approves a revised version of this IRP, at which time the revised IRP will be implemented instead.
- DWER advises in writing that this IRP no longer needs to be implemented.

6 References

Department of Water and Environmental Regulation (DWER), 2022. Program: Pilbara Environmental Offsets Fund. DWER, Joondalup, WA.

Environmental Protection Authority (EPA), 2016. Environmental Factor Guideline. Flora and Vegetation. Environmental Protection Authority, Joondalup, WA.

EPA, 2021. Instructions on how to prepare *Environmental Protection Act 1986* Part IV Impact Reconciliation Procedures and Impact Reconciliation Reports. Environmental Protection Authority, Joondalup, WA.

Main Roads Western Australia , 2019. Specification 301 – Vegetation Clearing and Demolition. Main Roads, East Perth, WA.

7 Figures

500000
600000
7700000
7600000
7500000

DAMPIER
KARRATHA
ROEBOURNE
Harding River
STAGE 2
COMPLETED
90km
Millstream Chichester National Park
STAGE 3
COMPLETED
48km
Sherlock River
STAGE 4
PROPOSED
112km
Fortescue River
Robe River
Weelumurra Creek
Caves Creek
Serpentine Creek
Duck Creek
Barnett Creek
STAGE 1
COMPLETED
25km
Hardey River
TOM PRICE
Karijini National Park

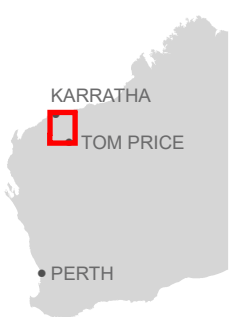
Figure 1 Manuwarra Red Dog Highway Project Overview

Legend

- Major Roads
- Rivers and Creeks
- DBCA Legislated Lands and Waters (National Parks)

0 7.5 15 30
Kilometres

N



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541800 546000 550200

7606200 7602000 7597800

Hammersley Iron Railway

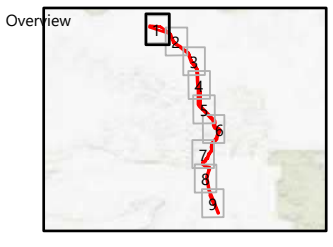
Roebourne-Wittenoom Rd

Tom Price Railway Rd

Vegetation Condition
- Excellent
- Very Good
- Good
- Poor
- Cleared

Figure 2 Vegetation Condition

Legend
- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Rivers and Creeks



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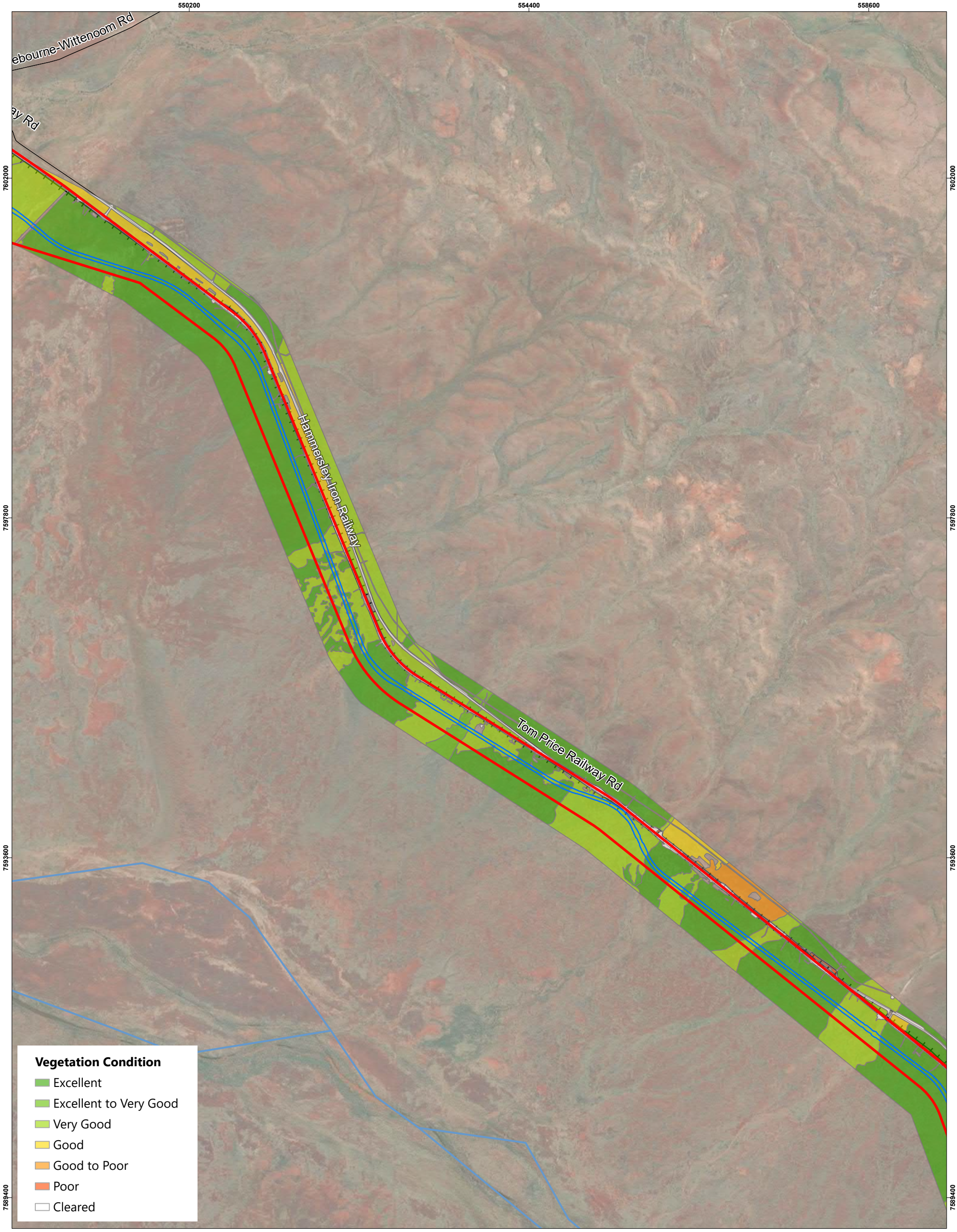
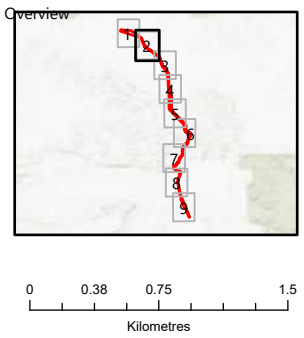


Figure 2 Vegetation Condition

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Rivers and Creeks



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558600
562800
567000
7593600
7589400
7585200
7581000

Hammersley Iron Railway

Tom Price Railway Rd

Tom Pric

Vegetation Condition
- Excellent
- Very Good
- Good
- Good to Poor
- Poor
- Cleared

Figure 2 Vegetation Condition

Legend
- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Rivers and Creeks

Overview

0 0.38 0.75 1.5
Kilometres

N

KARRATHA
TOM PRICE
PERTH

Jacobs

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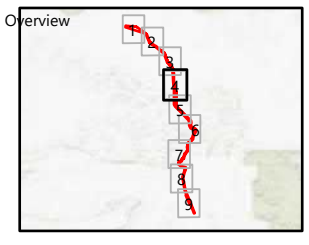
562800
567000
7581000
7576800
7572600
7568400
Tom Price Railway Rd
Hammersley Iron Railway
Vegetation Condition
Excellent
Very Good
Good
Cleared

Figure 2 Vegetation Condition

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Rivers and Creeks



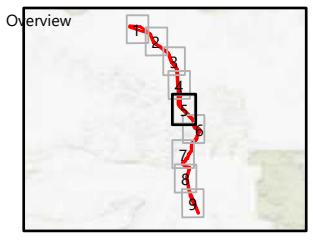
Jacobs

JACOBS, 263 Adelaide Terrace, Perth WA 6000
Tel: +61 8 9469 4400 Fax: +61 8 9469 4488

562800
567000
571200
7568400
7564200
7560000
7555800
Tom Price Railway Rd
Hammersley Iron Railway
Vegetation Condition
- Excellent
- Excellent to Very Good
- Very Good
- Very Good to Good
- Good
- Poor
- Cleared

Figure 2 Vegetation Condition

Legend
- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Rivers and Creeks



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Tel: +61 8 9469 4400 Fax: +61 8 9469 4488

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7547400

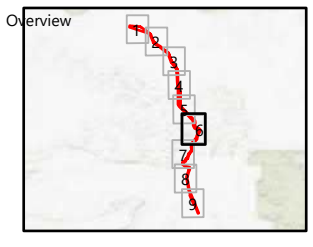
Tom Price Railway Rd

Hammersley Iron Railway

Vegetation Condition
- Excellent
- Excellent to Very Good
- Very Good
- Very Good to Good
- Good
- Good to Poor
- Poor
- Cleared

Figure 2 Vegetation Condition

Legend
- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Rivers and Creeks



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Tel: +61 8 9469 4400 Fax: +61 8 9469 4488

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7534800
Tom Price Railway Rd
Hammersley Rd
Hammersley Iron Railway
Vegetation Condition
- Excellent
- Very Good
- Very Good to Good
- Good
- Good to Poor
- Cleared

Figure 2 Vegetation Condition

Legend
- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Rivers and Creeks

Overview

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Kilometres

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KARRATHA
TOM PRICE
PERTH

Jacobs

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Tel: +61 8 9469 4400 Fax: +61 8 9469 4488

562800
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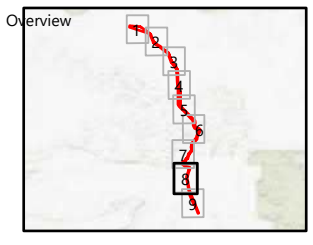
571200
7534800
7530600
7526400
7522200
Hammersley Rd
Hammersley Iron Railway
Tom Price Railway Rd
Vegetation Condition
- Excellent
- Excellent to Very Good
- Very Good
- Very Good to Good
- Good
- Good to Poor
- Cleared

Figure 2 Vegetation Condition

Legend
- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Rivers and Creeks



Jacobs

JACOBS, 263 Adelaide Terrace, Perth WA 6000
Tel: +61 8 9469 4400 Fax: +61 8 9469 4488

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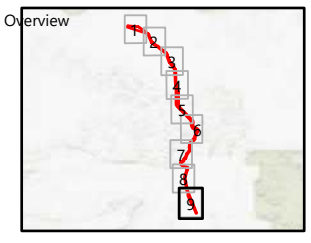
Hammersley Iron Railway
Hammersley Iron Railway
Hammersley Iron Railway
Tom Price Railway Rd
Nanutarra Rd

Vegetation Condition
- Excellent to Very Good
- Very Good
- Good
- Cleared

Figure 2 Vegetation Condition

Legend
- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Rivers and Creeks



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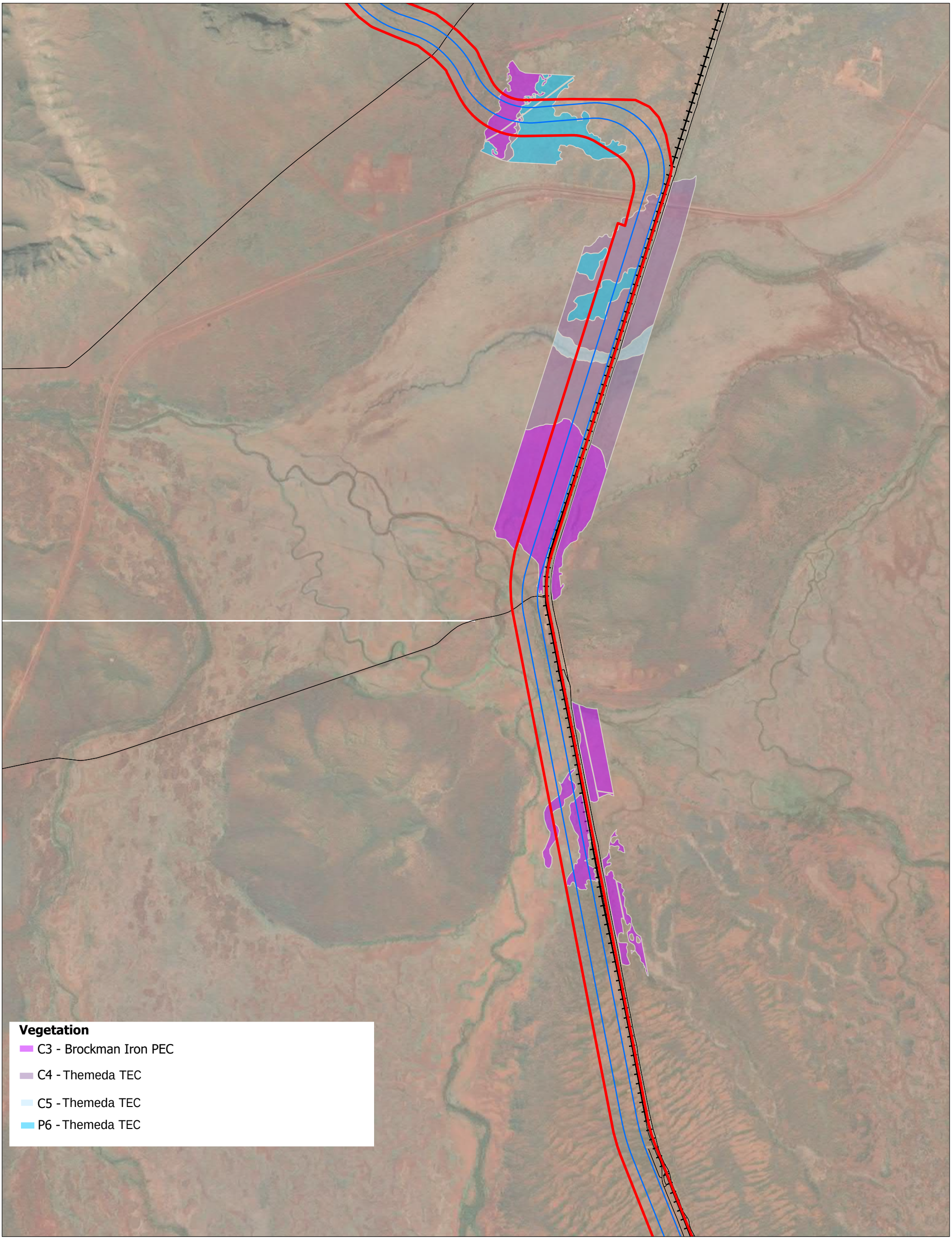
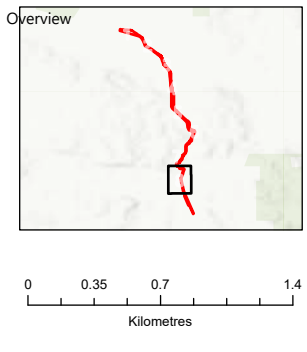


Figure 3 Conservation Significant Vegetation

Legend

- Disturbance Footprint
- Development Envelope
- Railways
- Roads



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Tom Price Railway Rd
Hammersley Rd
Hammersley Iron Railway
Macroderma gigas
(Cave with scats)
Macroderma gigas
(Cave with scats, potential maternity cave)

Ghost Bat Habitat

- CP - Floodplain - Other Suitable Habitat
- HS - Mesas, caves, cliffs and free faces - Important Habitat
- MDE - Eucalyptus fringed major drainage lines and associated tributaries - Important Habitat
- RHS - Rocky hills and slopes with low open spinifex and scattered trees - Important Habitat

Fauna Observation

- *Macroderma gigas*, VU

Figure 4 Ghost Bat Habitat

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary

Overview

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Kilometres

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562800 567000 571200

7534800 7530600 7526400 7522200

Macroderma gigas

Hammersley Rd

Hammersley Iron Railway

Tom Price Railway Rd

Ghost Bat Habitat

- HS - Mesas, caves, cliffs and free faces - Important Habitat
- MDE - Eucalyptus fringed major drainage lines and associated tributaries - Important Habitat
- MMW - Man made water bodies
- RHS - Rocky hills and slopes with low open spinifex and scattered trees - Important Habitat

Fauna Observation

- *Macroderma gigas*, VU

Figure 4 Ghost Bat Habitat

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary

Overview

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Kilometres

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541800 546000 550200

7606200 7602000 7597800

Hammersley Iron Railway

Roebourne-Wittenoom Rd

Tom Price Railway Rd

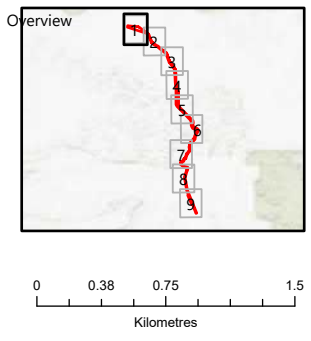
Supporting Northern Quoll Habitat

MDE - Eucalyptus fringed major drainage lines and associated tributaries

Figure 5 Northern Quoll Habitat

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary



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ay Rd
Hammersley Iron Railway
Tom Price Railway Rd

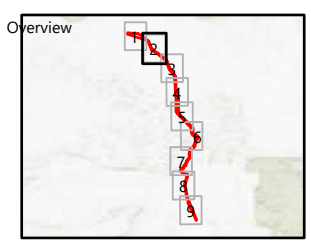
Supporting Northern Quoll Habitat

MDE - Eucalyptus fringed major drainage lines and associated tributaries

Figure 5 Northern Quoll Habitat

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary



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Tel: +61 8 9469 4400 Fax: +61 8 9469 4488

558600 562800 567000

7593600 7589400 7585200 7581000

Hammersley Iron Railway

Tom Price Railway Rd

Tom Price

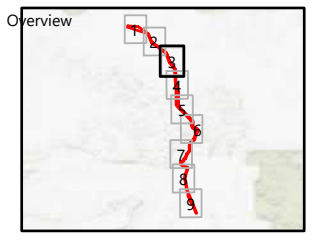
Supporting Northern Quoll Habitat

MDE - Eucalyptus fringed major drainage lines and associated tributaries

Figure 5 Northern Quoll Habitat

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary



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Tom Price Railway Rd

Hammersley Iron Railway

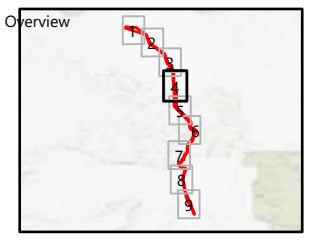
Supporting Northern Quoll Habitat

MDE - Eucalyptus fringed major drainage lines and associated tributaries

Figure 5 Northern Quoll Habitat

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary



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562800 567000 571200

7568400 7564200 7560000 7555800

Tom Price Railway Rd

Hammersley Iron Railway

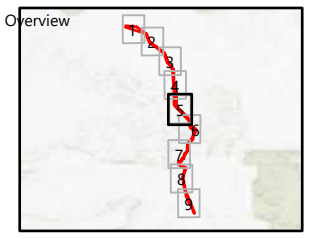
Supporting Northern Quoll Habitat

- MDE - Eucalyptus fringed major drainage lines and associated tributaries
- MDM - Melaleuca forest/major drainage lines
- RHS - Rocky hills and slopes with low open spinifex and scattered trees

Figure 5 Northern Quoll Habitat

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary



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Kilometres

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Tel: +61 8 9469 4400 Fax: +61 8 9469 4488

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7547400

Tom Price Railway Rd

Hammersley Iron Railway

Habitat Critical to the Survival of the Species

- HS - Mesas, caves, cliffs and free faces
- RG - Rocky gullies

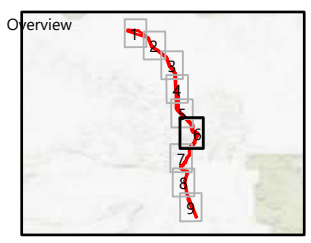
Supporting Northern Quoll Habitat

- MDE - Eucalyptus fringed major drainage lines and associated tributaries
- MDM - Melaleuca forest/major drainage lines
- RHS - Rocky hills and slopes with low open spinifex and scattered trees

Figure 5 Northern Quoll Habitat

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary



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562800
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Tom Price Railway Rd
Hammersley Rd
Hammersley Iron Railway

Habitat Critical to the Survival of the Species

HS - Mesas, caves, cliffs and free faces

Supporting Northern Quoll Habitat

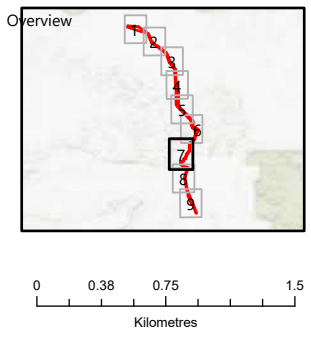
MDE - Eucalyptus fringed major drainage lines and associated tributaries

RHS - Rocky hills and slopes with low open spinifex and scattered trees

Figure 5 Northern Quoll Habitat

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary



Jacobs

JACOBS, 263 Adelaide Terrace, Perth WA 6000
Tel: +61 8 9469 4400 Fax: +61 8 9469 4488

562800 567000 571200

7534800 7530600 7526400 7522200

Hammersley Rd

Hammersley Iron Railway

Tom Price Railway Rd

Habitat Critical to the Survival of the Species

HS - Mesas, caves, cliffs and free faces

Supporting Northern Quoll Habitat

MDE - Eucalyptus fringed major drainage lines and associated tributaries

RHS - Rocky hills and slopes with low open spinifex and scattered trees

Figure 5 Northern Quoll Habitat

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary

Overview

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Kilometres

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Jacobs

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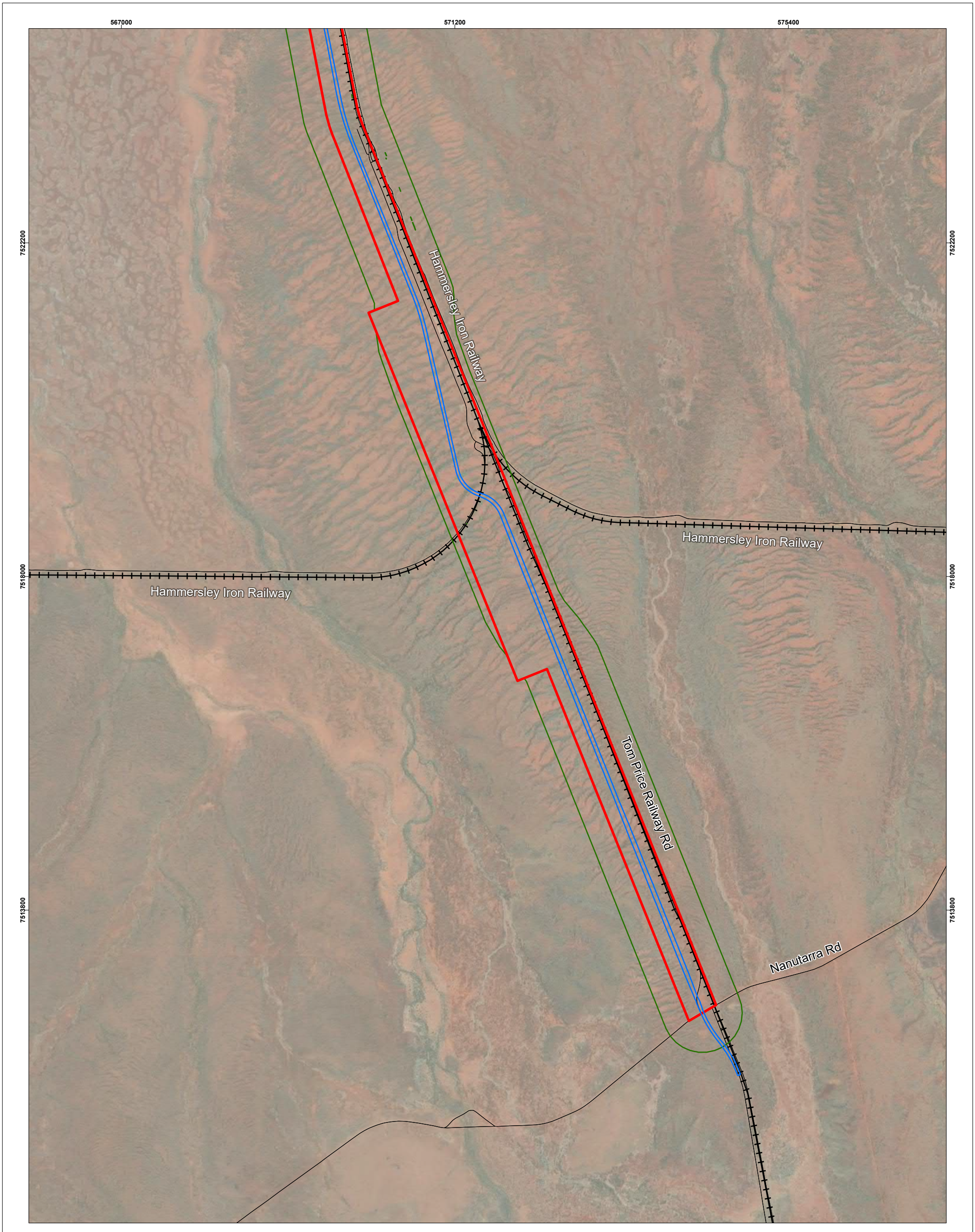
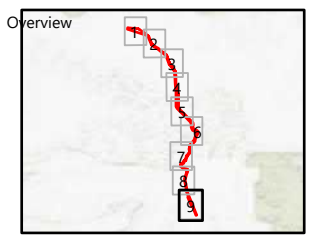


Figure 5 Northern Quoll Habitat

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary



Jacobs

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Tel: +61 8 9469 4400 Fax: +61 8 9469 4488

541800
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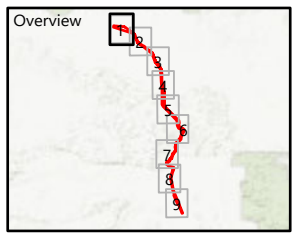
Hammersley Iron Railway
Roebourne-Wittenoom Rd
Tom Price Railway Rd
Temporary Clearing Areas
Northern Quoll Habitat
MDE - Eucalyptus fringed major drainage lines and associated tributaries
Ghost Bat Habitat
MDE - Eucalyptus fringed major drainage lines and associated tributaries
Existing Heritage Places (DPLH)
Lodged
Registered Site
Stored Data / Not a Site

Figure 6 Temporary Clearing Areas

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary



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Tel: +61 8 9469 4400 Fax: +61 8 9469 4488

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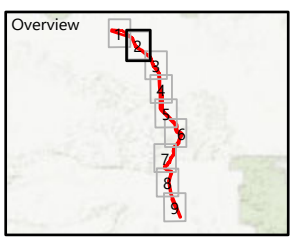
ay Rd
Hammersley Iron Railway
Tom Price Railway Rd
Temporary Clearing Areas
Northern Quoll Habitat
MDE - Eucalyptus fringed major drainage lines and associated tributaries
Ghost Bat Habitat
CP - Floodplain
MDE - Eucalyptus fringed major drainage lines and associated tributaries
Existing Heritage Places (DPLH)
Lodged
Registered Site

Figure 6 Temporary Clearing Areas

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary



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JACOBS, 263 Adelaide Terrace, Perth WA 6000
Tel: +61 8 9469 4400 Fax: +61 8 9469 4488

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Hammersley Iron Railway

Tom Price Railway Rd

Tom Price

Temporary Clearing Areas

Northern Quoll Habitat

MDE - Eucalyptus fringed major drainage lines and associated tributaries

Ghost Bat Habitat

CP - Floodplain

MDE - Eucalyptus fringed major drainage lines and associated tributaries

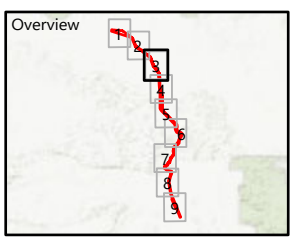
Existing Heritage Places (DPLH)

Lodged

Figure 6 Temporary Clearing Areas

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary



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7568400

Tom Price Railway Rd

Hammersley Iron Railway

Temporary Clearing Areas

Northern Quoll Habitat

MDE - Eucalyptus fringed major drainage lines and associated tributaries

Ghost Bat Habitat

CP - Floodplain

MDE - Eucalyptus fringed major drainage lines and associated tributaries

MMW - Man made water bodies

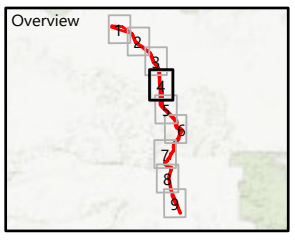
Existing Heritage Places (DPLH)

Stored Data / Not a Site

Figure 6 Temporary Clearing Areas

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary



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Kilometres

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Jacobs

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Tel: +61 8 9469 4400 Fax: +61 8 9469 4488

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7568400 7564200 7560000 7555800

Tom Price Railway Rd

Hammersley Iron Railway

Temporary Clearing Areas

Northern Quoll Habitat

- RHS - Rocky hills and slopes with low open spinifex and scattered trees
- MDE - Eucalyptus fringed major drainage lines and associated tributaries
- MDM - Melaleuca forest/major drainage lines

Ghost Bat Habitat

- CP - Floodplain
- RHS - Rocky hills and slopes with low open spinifex and scattered trees - Important Habitat
- MDE - Eucalyptus fringed major drainage lines and associated tributaries
- MDM - Melaleuca forest/major drainage lines
- MMW - Man made water bodies

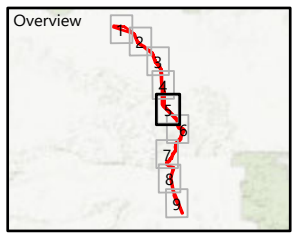
Existing Heritage Places (DPLH)

- Lodged
- Registered Site
- Stored Data / Not a Site

Figure 6 Temporary Clearing Areas

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary



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567000 571200 575400

7560000 7555800 7551600 7547400

Tom Price Railway Rd

Hammersley Iron Railway

- Temporary Clearing Areas

Critical to Survival of Species

- HS - Mesas, caves, cliffs and free faces
- RG - Rocky gullies

Supporting Habitat

- RHS - Rocky hills and slopes with low open spinifex and scattered trees
- MDE - Eucalyptus fringed major drainage lines and associated tributaries
- MDM - Melaleuca forest/major drainage lines

Ghost Bat Habitat

- CP - Floodplain
- HS - Mesas, caves, cliffs and free faces - Important Habitat
- RHS - Rocky hills and slopes with low open spinifex and scattered trees - Important Habitat
- RG - Rocky gullies - Important Habitat
- MDE - Eucalyptus fringed major drainage lines and associated tributaries
- MDM - Melaleuca forest/major drainage lines

Existing Heritage Places (DPLH)

- Lodged
- Registered Site
- Stored Data / Not a Site

Figure 6 Temporary Clearing Areas

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary

Overview

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Kilometres

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PERTH

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562800 567000 571200

7547400 7543200 7539000 7534800

Tom Price Railway Rd

Hammersley Rd

Hammersley Iron Railway

Temporary Clearing Areas

Northern Quoll Critical Habitat

HS - Mesas, caves, cliffs and free faces

Northern Quoll Habitat

RHS - Rocky hills and slopes with low open spinifex and scattered trees

MDE - Eucalyptus fringed major drainage lines and associated tributaries

Ghost Bat Habitat

CP - Floodplain

HS - Mesas, caves, cliffs and free faces - Important Habitat

RHS - Rocky hills and slopes with low open spinifex and scattered trees - Important Habitat

MDE - Eucalyptus fringed major drainage lines and associated tributaries

Existing Heritage Places (DPLH)

Lodged

Registered Site

Stored Data / Not a Site

Vegetation TEC & PEC

Themeda grasslands on cracking clays (Hamersley Station, Pilbara)

Brockman Iron cracking clay communities of the Hamersley Range

Figure 6 Temporary Clearing Areas

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary

Overview

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Kilometres

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Hammersley Rd

Hammersley Iron Railway

Tom Price Railway Rd

Temporary Clearing Areas

Northern Quoll Critical Habitat

HS - Mesas, caves, cliffs and free faces

Northern Quoll Habitat

RHS - Rocky hills and slopes with low open spinifex and scattered trees

MDE - Eucalyptus fringed major drainage lines and associated tributaries

Ghost Bat Habitat

HS - Mesas, caves, cliffs and free faces - Important Habitat

RHS - Rocky hills and slopes with low open spinifex and scattered trees - Important Habitat

MDE - Eucalyptus fringed major drainage lines and associated tributaries

MMW - Man made water bodies

Existing Heritage Places (DPLH)

Lodged

Registered Site

Vegetation TEC & PEC

Themeda grasslands on cracking clays (Hamersley Station, Pilbara)

Brockman Iron cracking clay communities of the Hamersley Range

Figure 6 Temporary Clearing Areas

Legend

- Roads
- Railways
- Disturbance Footprint
- Development Envelope
- Fauna Habitat Survey Boundary

Overview

0 0.38 0.75 1.5

Kilometres

N

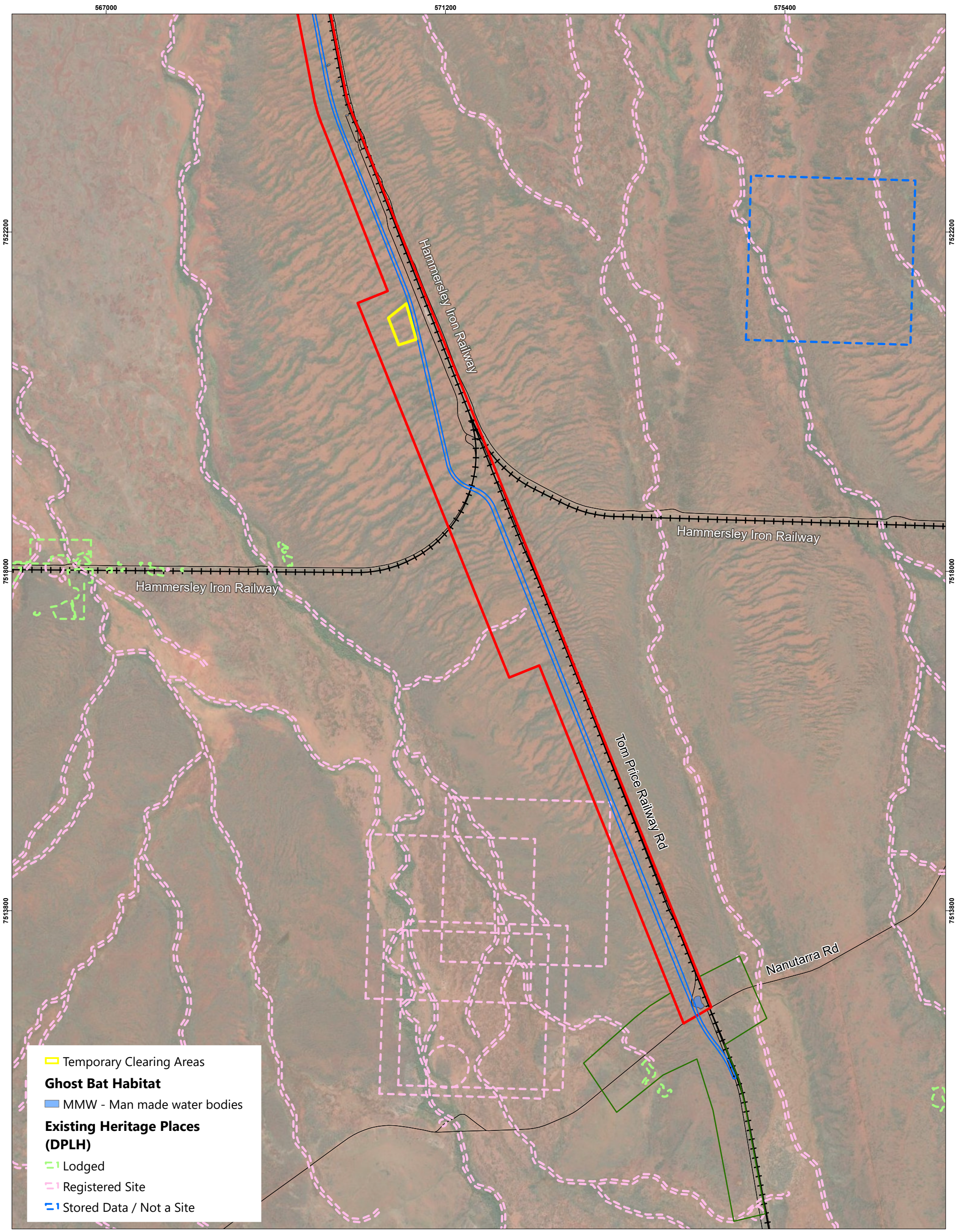
KARRATHA

TOM PRICE

PERTH

Jacobs

JACOBS, 263 Adelaide Terrace, Perth WA 6000
Tel: +61 8 9469 4400 Fax: +61 8 9469 4488



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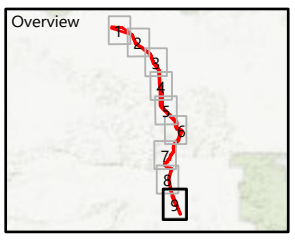

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