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Memo

To	Fabian Goddard	Company	CZR Resources
From	Natalie Horsfield	Job No.	385F
Date	15/06/2022	Doc No.	016a
Subject	Robe Mesa Study – Haul Road Surface Water Assessment		

Fabian,

We are pleased to provide you with the following memo detailing the results of the surface water assessment completed for the Robe Mesa haul road.

1. INTRODUCTION

The Robe Mesa Iron Ore Project is located near to Yarraloola, approximately 140 km southwest of Karratha, between the Rio Tinto owned Mesa-A and Mesa-J iron ore mines. It is also close to the Rio Tinto township of Pannawonica. CZR's Yarraloola tenements cover two identified project areas; the Robe Mesa Deposit and the Ashburton Magnetite System. The Robe Mesa Deposit is hosted by two flat sheets of pisolitic ironstone that overlie each other, with the upper sheet containing approximately 24Mt of higher-grade ore. Mining was originally focused on the upper sheet alone, but will now also include the lower sheet.

The processed iron ore is planned to be transported from Robe Mesa by means of a new haul road (tenement L08 295), which will be constructed from south of the deposit and run approximately 30 km to the west, to link up with the North West Coastal Highway. The new haul road route crosses several ephemeral surface water creek systems, which can flow strongly following large rainfall runoff events. CZR wish to understand the likely magnitude of the surface water flows where they cross the haul road route, to aid with culvert and road design.

This brief report delineates the surface water catchments feeding the new haul road creek crossings and gives estimated surface water flows at those points for a variety of rainfall return periods.

2. HAUL ROAD CATCHMENTS

Figure 3.1 presents the surface water catchments draining to the proposed haul road alignment and their associated crossing locations and main drainage lines. These have been defined using SRTM topographical data and publicly available satellite imagery (Google Satellite and Bing Aerial). The inherent limitations with the accuracy of SRTM data and its lack of fine detail (30 m x 30 m spatial sampling with <=16 m absolute vertical height accuracy, <= 10 m relative vertical height accuracy and <=20 m absolute horizontal circular accuracy (NASA, 2000)) introduce uncertainty into this catchment delineation and the location of crossing

points should be confirmed using more detailed topographical data. Figure 3.2 is zoomed in to show some of the smaller crossing catchments.

Characteristics of the crossing catchments are presented in Figure 3.2. Catchment 6 contains a watercourse that splits immediately upstream of the haul road and therefore has two crossing locations (6 and 6a) identified on Figure 3.2.

3. REGIONAL PEAK FLOW ESTIMATION

Peak flows for each of the catchments have been estimated for a range of Annual Exceedance Probability (AEP) events using the two methods listed below and are presented in Table 3.1.

3.1 Regional Flood Frequency Procedure (RFFP2000)

The Regional Flood Frequency Procedure (RFFP2000) was developed by Flavell (2012) for the Pilbara, Kimberley, Wheatbelt and Goldfields regions using regression analysis of flood records from gauging stations along with the catchment location and characteristics.

3.2 Regional Flood Frequency Estimation (RFFE) technique

The Regional Flood Frequency Estimation (RFFE) technique was developed as a part of ARR 2016 (Ball et al., 2016) and is based on data from several gauged catchments around Australia. The analysis is completed on-line at https://rffe.arr-software.org/.

3.3 Comparison

The peak flows presented in Figure 3.2 indicate a significant difference in the values estimated using the RFFP2000 and RFFE for most catchments, with the latter producing significantly higher values. Both methods are known to vary in their accuracy depending on the relationship between the characteristics of the catchment that estimates are being made for and those for which the method was derived.

A flood study completed for the Cane River catchment (BG&E, 2021), immediately to the west of those assessed here, found RFFE estimates to be closer to those obtained through a Flood Frequency Analysis and RORB model calibration against recorded data. In line with this study, adopting the RFFE values for the haul road will also provide more conservative peak flow estimates for the design of management structures.

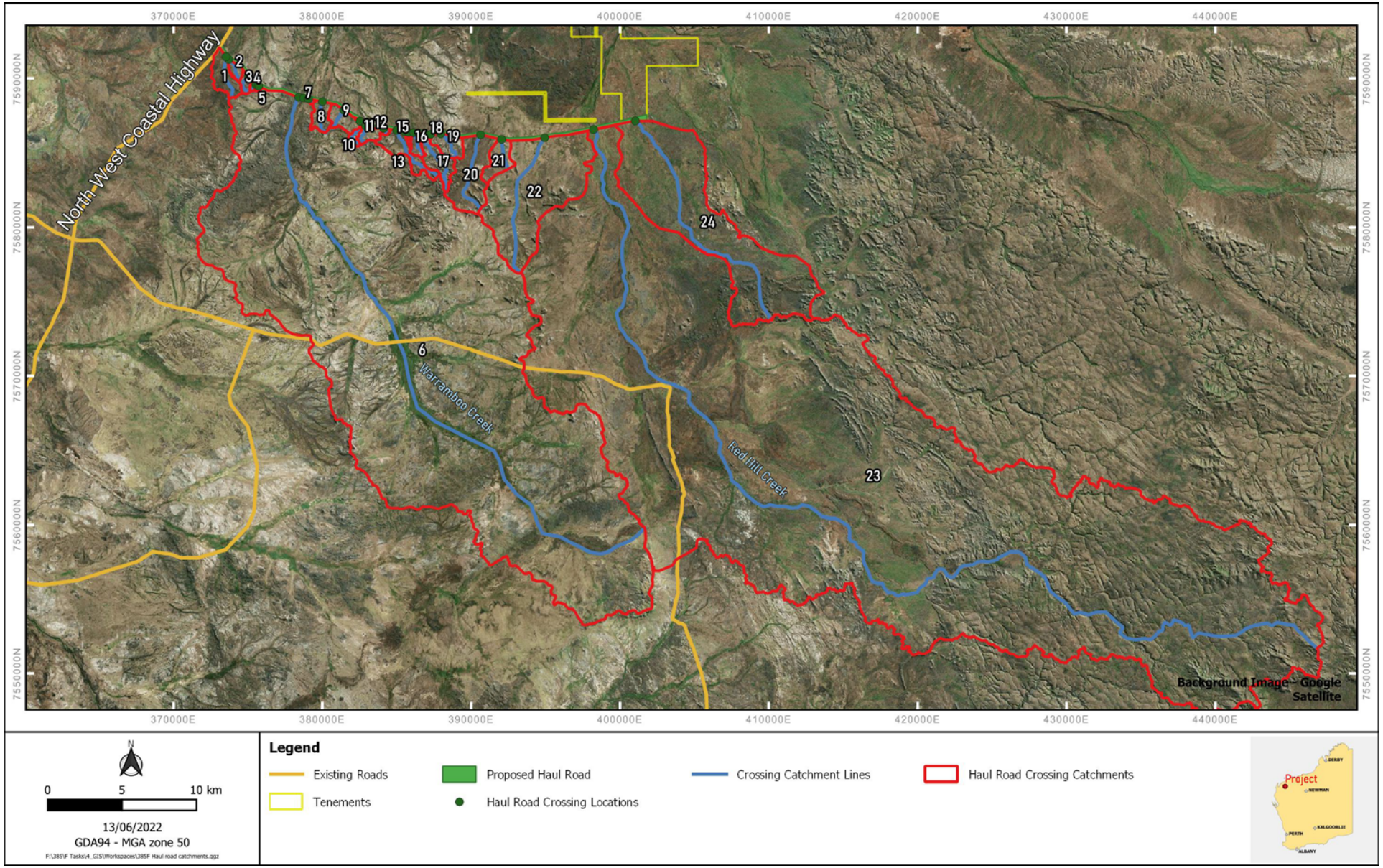

Figure 3.1 Haul Road Crossing Catchments

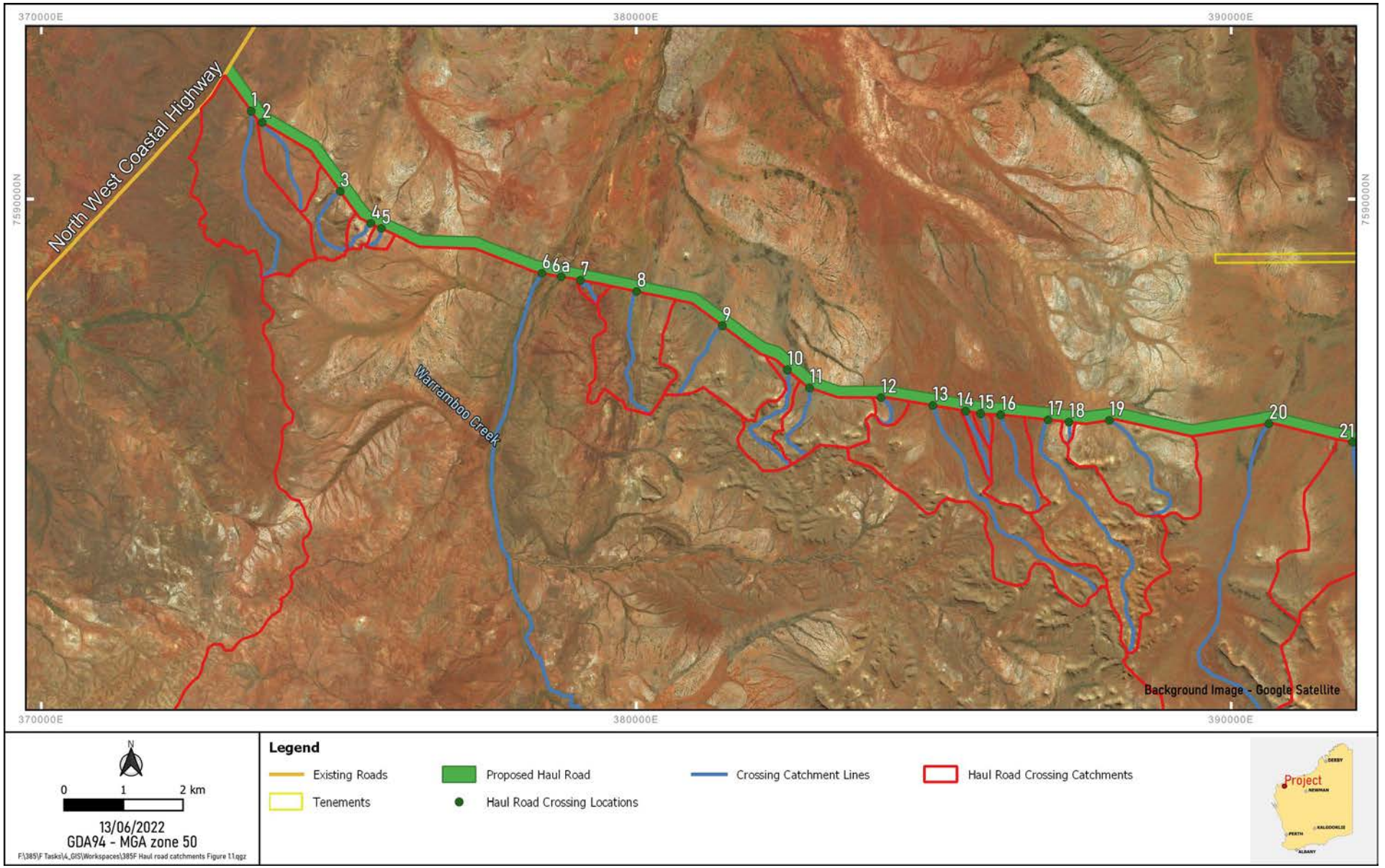

Figure 3.2 Haul Road Crossing Catchments

Table 3.1 Haul Road Crossings - Catchment Characteristics and Peak Flow Estimates

Catchment Characteristics				RFFP2000 Peak Flow (m^3/s)				RFFE Peak Flow (m^3/s)			
Catchment	Area (km^2)	Length (km)	Slope (m/km)	AEP				AEP			
				10%	5%	2%	1%	10%	5%	2%	1%
1	3.67	3.15	6.94	7	11	19	29	27	39	57	71
2	0.87	1.72	6.65	2	4	6	9	12	18	26	32
3	0.81	1.42	15.60	3	5	8	12	12	17	25	31
4	0.19	0.61	27.85	1	2	3	5	5	8	11	14
5	0.12	0.44	24.46	1	1	2	3	4	6	9	11
6	489.47	45.36	1.53	152	266	457	688	477	694	1010	1260
7	0.12	0.55	40.62	1	1	3	4	4	6	9	11
8	2.25	2.34	9.54	5	8	15	22	21	31	45	56
9	2.35	1.41	14.02	10	15	26	40	22	32	47	58
10	0.82	2.33	12.61	2	4	7	11	12	18	26	33
11	1.39	1.44	6.24	4	6	10	15	17	24	35	44
12	0.21	0.75	19.76	1	2	3	4	6	8	12	15
13	4.31	4.46	8.30	7	13	23	35	32	47	68	85
14	0.20	1.32	13.43	1	1	2	4	6	9	13	16
15	0.12	0.64	27.01	1	1	2	3	4	6	9	12
16	1.10	1.85	7.13	2	4	7	11	15	23	33	41
17	4.01	4.71	8.19	6	13	22	33	32	46	67	83
18	0.07	0.39	18.21	0	1	1	2	3	5	7	9
19	2.64	2.30	14.41	8	12	21	32	25	37	53	66
20	11.11	5.85	4.50	13	22	38	57	56	81	118	147
21	3.51	2.05	2.62	6	10	16	25	30	44	64	79
22	39.83	10.03	2.93	34	54	93	140	119	173	252	314
23	789.18	80.56	3.37	241	529	909	1370	636	925	1340	1680
24	69.84	17.98	3.22	45	83	144	216	170	248	361	450

4. REFERENCES

Ball J, Babister M, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), 2016, Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia.

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Flavell, D. (2012). Design flood estimation in Western Australia. Australian Journal of Water Resources. 16. 10.7158/W11-865.2012.16.1.

NASA (2000) Shuttle Radar Topography Mission Statistics. [https://www2.jpl.nasa.gov/srtm/statistics.html]. Updated 14th March 2000. Accessed 13th June 2022.

We trust that this memo meets your requirements. Please contact us if you have any further questions regarding this assessment.

Regards,

Natalie *Brieland*

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