HYDROLOGY AND HYDROGEOLOGY ASSESSMENT

Yindjibarndi Energy Corporation (YEC)

Renewable Energy Project

PW029423

2/4/2025

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EXECUTIVE SUMMARY

The Yindjibarndi Energy Corporation (YEC) is a partnership between the Yindjibarndi Aboriginal Corporation (YAC) and renewable energy company ACEN Corporation. YEC plans to develop up to 3GW of wind, solar and battery storage on Yindjibarndi Ngurra (country) in Western Australia's Pilbara region.

This includes proposed wind farms and solar farms, located approximately 55km south of Karratha along the western edge of the Millstream Chichester National Park, within an area of Exclusive Native Title within the Yindjibarndi Native Title Determination Areas.

The project area lies on the edges of the Fortescue River, Maitland River and Harding River catchments. Importantly this includes the top of the Harding Dam Catchment Area; a Priority P1 Water Protection Area. Development inside the Catchment Area will be placed under greater scrutiny and will require more rigorous risk assessment and mitigation to ensure there is now potential contamination of drinking water from the development.

Surface water management measures will need to be put in place to ensure that disturbed surfaces remain stable and non-eroding, and downstream surface water regimes and ecosystems are protected. As such, cleared areas should be bunded off to prevent sediment laden runoff, and sediment basins and other sediment mitigation measures used as required. Effort should be made to prevent reducing flows to the downstream environment by locating infrastructure outside of major creeks and installing floodways/culverts through access roads.

The site is situated on the northern edge of the Hammersley Basin in an area that features a largely basalt geology. Basalt rocks typically do not form very good aquifers, but as the project is anticipated to require a relatively small water supply of around 410,000 kL/year for a two-year construction period, this does not pose a significant risk to the project. Water exploration in these sorts of aquifers will require an extensive drilling program that will have many unsuccessful bores, but the bores will not be deep, and exploration does not need to be cost-intensive.

Local groundwater is anticipated to be fresh (<1,000 mg/L total dissolved solids) and should be suitable for concrete batching and dust suppression (and camp water supply).

As the water demand is very low, groundwater drawdown in the local aquifers should not be high, and there is little to no risk to ground dependent ecosystems, stygofauna, or other users (including the Harding Dam Catchment Area).

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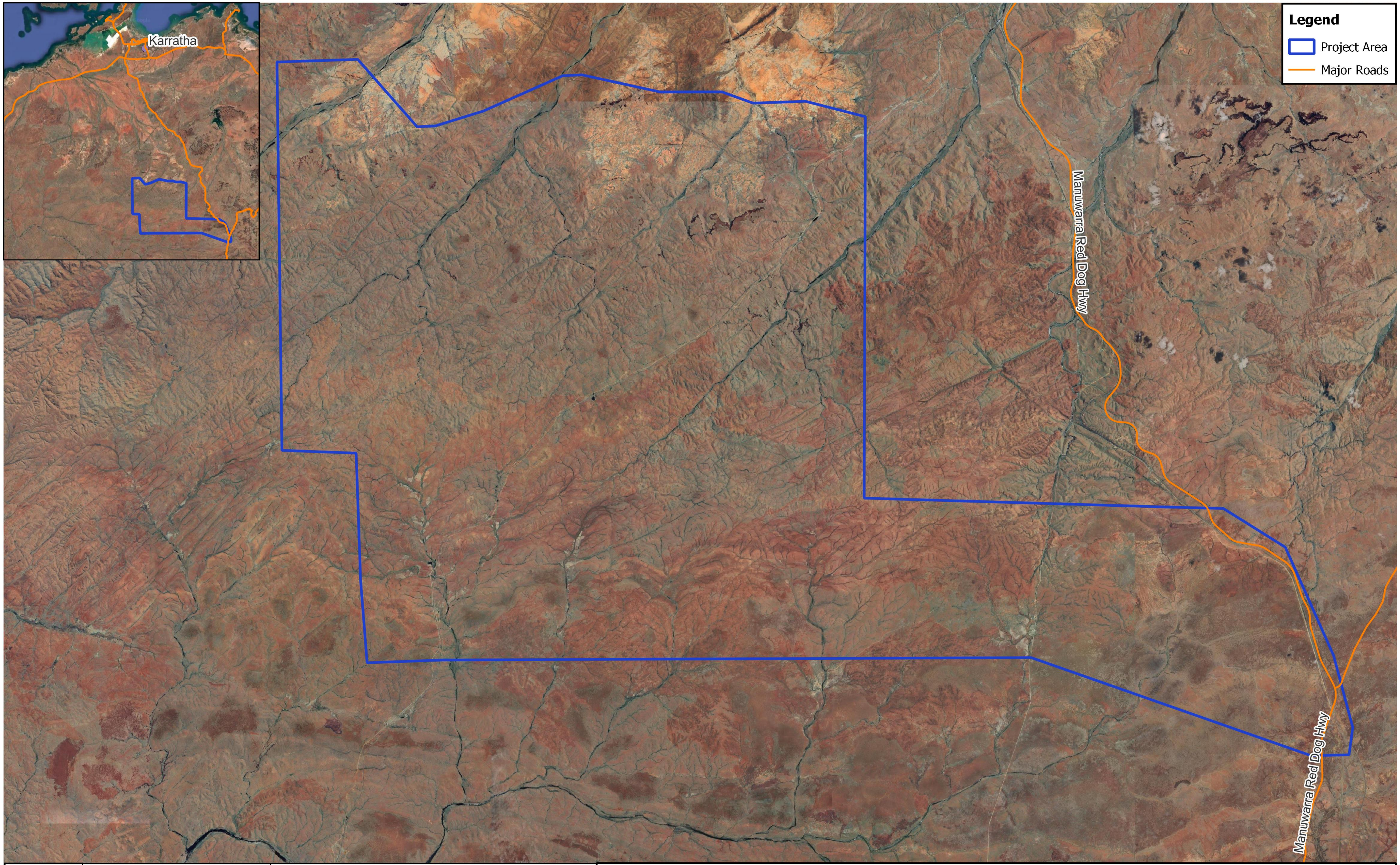
1. Introduction

1.1. General

The Yindjibarndi Energy Corporation (YEC) is a partnership between the Yindjibarndi Aboriginal Corporation (YAC) and renewable energy company ACEN Corporation. YEC plans to develop up to 3GW of wind, solar and battery storage on Yindjibarndi Ngurra (country) in Western Australia's Pilbara region. This includes proposed wind farms and solar farms within the Yindjibarndi Native Title Determination Areas, about 55km south of Karratha (refer Figure A).

1.2. Scope of Work

- Desktop Study – including assessment of the existing surface water environment (climate, catchments, existing drainage conditions and flow directions), soil characteristics, rainfall run-off characteristics and IFD (rainfall intensity-frequency-duration) data
- Hydrologic and Hydraulic Modelling – estimation of peak flood flows and 2D pre-development hydraulic modelling for the 5% and 1% AEP storm events that may externally impact the site and access roads
- Desktop Hydrogeology study
- Surface Water Management – including assessment of the potential hydrological impacts on surface water systems (including water quality) resulting from the development of the project, consideration of surface water impacts on the project and potential mitigation measures



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Sources: YEC, Google Satellite

Figure A

Site Location Plan

2. Climate and Topography

2.1. Climate

2.1.1. General

The project area is located along the western edge of the Millstream Chichester National Park. The Manuwarra Red Dog Highway (Karratha to Tom Price) passes to the east of the area.

The area has an arid to semi-arid climate with hot, humid summers and warm dry winters. The average annual rainfall in the area is about 300mm and is highly variable year on year. The closest BoM (Bureau of Meteorology) weather station is located closer to the coast at Karratha Aero (BoM site 004083), approximately 55km north of the site. The annual rainfall at this station is 288mm (1972–2024).

Most rainfall is summer rain (57% falls January to March on average) as a result of scattered thunderstorms, producing heavy localised and unpredictable falls over short periods; as well as tropical storms and cyclones. Tropical lows usually originate off the Pilbara coast and can bring widespread rain to the region.

Temperatures vary from minimum / maximum averages of 14°–28°C in winter, and 26°–36°C in summer. The average annual pan evaporation is ~3,400mm.

2.1.2. Climate change

The climate change projections for the Northern Australian Rangelands (which includes the Pilbara region) are based on 54 Natural Resource Management clusters which largely correspond to the broad-scale climate and biophysical region (Australian Rainfall & Runoff / ARR, 2019). Climate projections from climate models predict that temperatures will continue to rise. The annual rainfall in the Pilbara is projected to remain largely unchanged to 2090, however, the intensity of heavy rainfall events is projected to increase. Natural variability is the primary driver for the volume of rainfall in the region, and there is high confidence that natural rainfall variability will remain the driver of rainfall in the intermediate future.

Rainfall characteristics can be adjusted for future climates: "Given the uncertainty in rainfall projections and their considerable regional variability, an increase in rainfall (intensity or depth) of 5% per °C of local warming is recommended", relative to a 20 year, 1986–2005 baseline (ARR, 2019).

Different possible climate futures have been described based on a greenhouse gas concentration trajectory adopted by the IPCC (IPCC, 2019), also referred to as Representative Concentration Pathways (RCPs), of which an overview is presented in Table 1.

Table 1: Global warming increase (°C) projections (IPCC, 2019)

Representative Concentration Pathway	Year 2031 – 2050 Mean and range (°C)	Year 2081 – 2100 Mean and range (°C)
RCP 2.6	1.6 (1.1 to 2.0)	1.6 (0.9 to 2.4)
RCP 4.5	1.7 (1.3 to 2.2)	2.5 (1.7 to 3.3)
RCP 6	1.6 (1.2 to 2.0)	2.9 (2.0 to 3.8)
RCP 8.5	2.0 (1.5 to 2.4)	4.3 (3.2 to 5.4)

The wind/solar farm is likely to have a long service life. For a RCP4.5 scenario and a 50+ year life, assuming a 2.5–3°C increase in temperature would be appropriate, then a 10–15% increase over the standard BoM / ARR Book 2 rainfall intensities is required. In order to incorporate climate change risks into decisions involving flood estimation, a six-step process using a decision tree approach is recommended (refer ARR, 2019). However, based on the relatively low flood related design requirements, minimal consequence of failure (such as risks to life, property and the environment) and low cost of flood repair / retrofit, the standard ARR Book 2 rainfall and temporal patterns are considered to be appropriate.

2.2. Rainfall Intensity-Frequency-Depth

The BoM website provides probabilistic or statistically based Intensity Frequency Duration (IFD) rainfall characteristics, which are required to characterise storm rainfall intensities. IFD rainfall depths represent design rainfalls for events of frequent and infrequent occurrence for various annual exceedance probabilities (AEP). Selected IFD data for the site are shown in Table 2. Temporal rainfall distributions available in the ARR Hub describe how rainfall falls over time as a design input.

Table 2: Intensity—Frequency—Duration (mm)

Duration (hrs)	63% AEP	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1%AEP
1	26	30	42	51	59	69	77
2	32	37	53	63	74	88	98
6	50	75	93	111	136	155	42
12	51	61	96	121	147	184	213
24	61	75	121	155	190	241	282
36	68	83	135	174	214	272	319
72	79	97	156	200	244	308	360

2.3. Topography

The total project area covers an area of ~500km^2 (85km north–south and 150 km east west) which includes the proposed wind/solar farms and access roads. Elevations around the site vary from RL128m to RL350m. The site consists of steep terrain with ridges and gorges, as well as wide flat creek beds. The southern area of the site is flatter, running along the top of hills.

2.4. Soils

No specific soil/geotechnical information is available for the project area. However, Pilbara soils and near-surface materials are typically sandy to clayey loams, with significant iron content, low organic matter and are loose and easily erodible. Hard duricrust or lateritic layers just below the surface act as a natural cap, contributing to low permeability and influencing water drainage.

3. Hydrology/Flood Modelling

3.1. Catchment Definition

The southern part of the site is in the Fortescue River catchment, the northern and eastern parts drain into the Maitland River and Harding River respectively. The site consists of ephemeral creeks with some semi-permanent pools. The site and most of the catchments upstream of the site are covered by topographical survey data (Lidar) however, there are small sections of upstream catchment that lie outside the Lidar extents. Figure B and Figure C show the regional and local catchment boundaries respectively.

3.2. Harding Dam Water Reserve

Much of the Project area lies within the Harding Dam Catchment Area, a Priority 1 Water Protection Area (Water and Rivers Commission, 1999; Figure B). These areas are managed to ensure that there is no degradation of the water source and land development is generally not permitted. According to the land use compatibility criteria in the Harding Dam Water Source Protection Plan (Water and Rivers Commission 1999), many activities are deemed 'incompatible', including 'Power Stations'. However, 'Power Stations' are not well-defined in this list, and probably refers to large fossil fuel or nuclear sites.

Any development within the reserve would need to be assessed by the Department of Water and Environmental Regulation. Early engagement and discussions with the Department about the Project would be advisable, so the Department has all the relevant context before making their assessment.

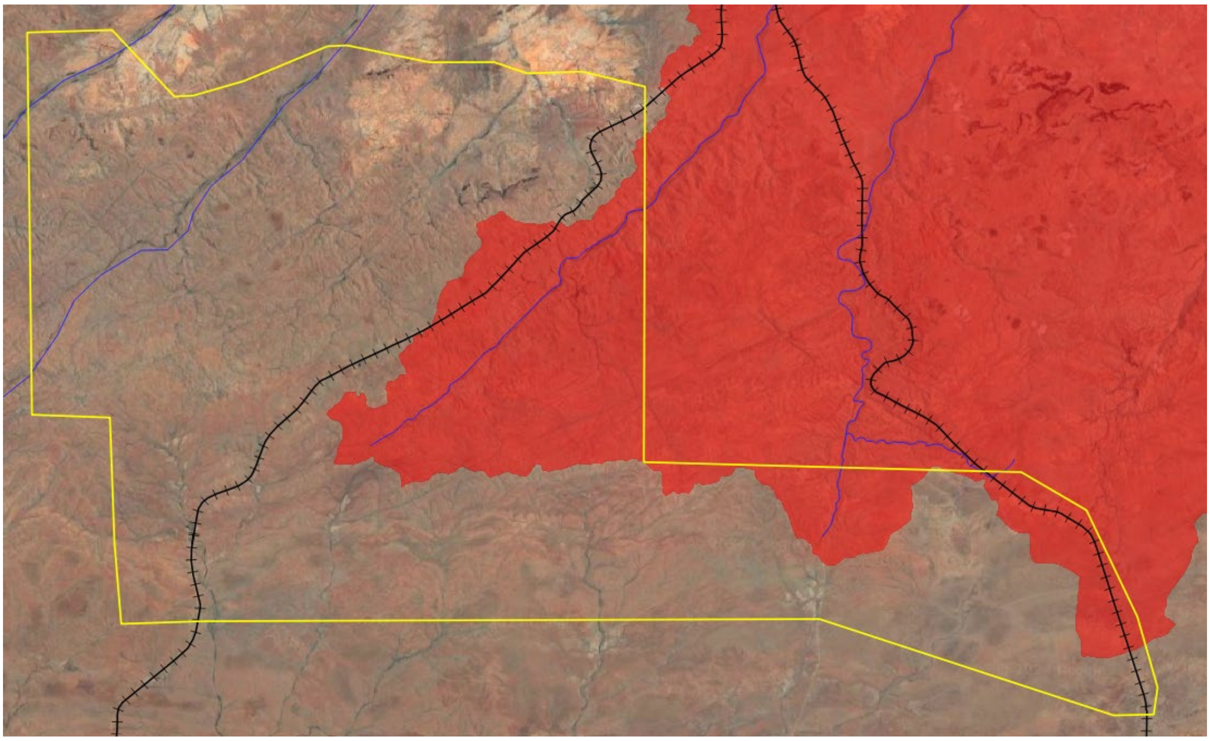


Figure B Harding Dam Catchment Area

3.3. Flood Flow Estimates

1% and 5% AEP flood flow hydrographs were calculated for several external catchments using RORB and the critical duration determined (24hrs). Initial and proportional losses were calculated based on the SCS method.

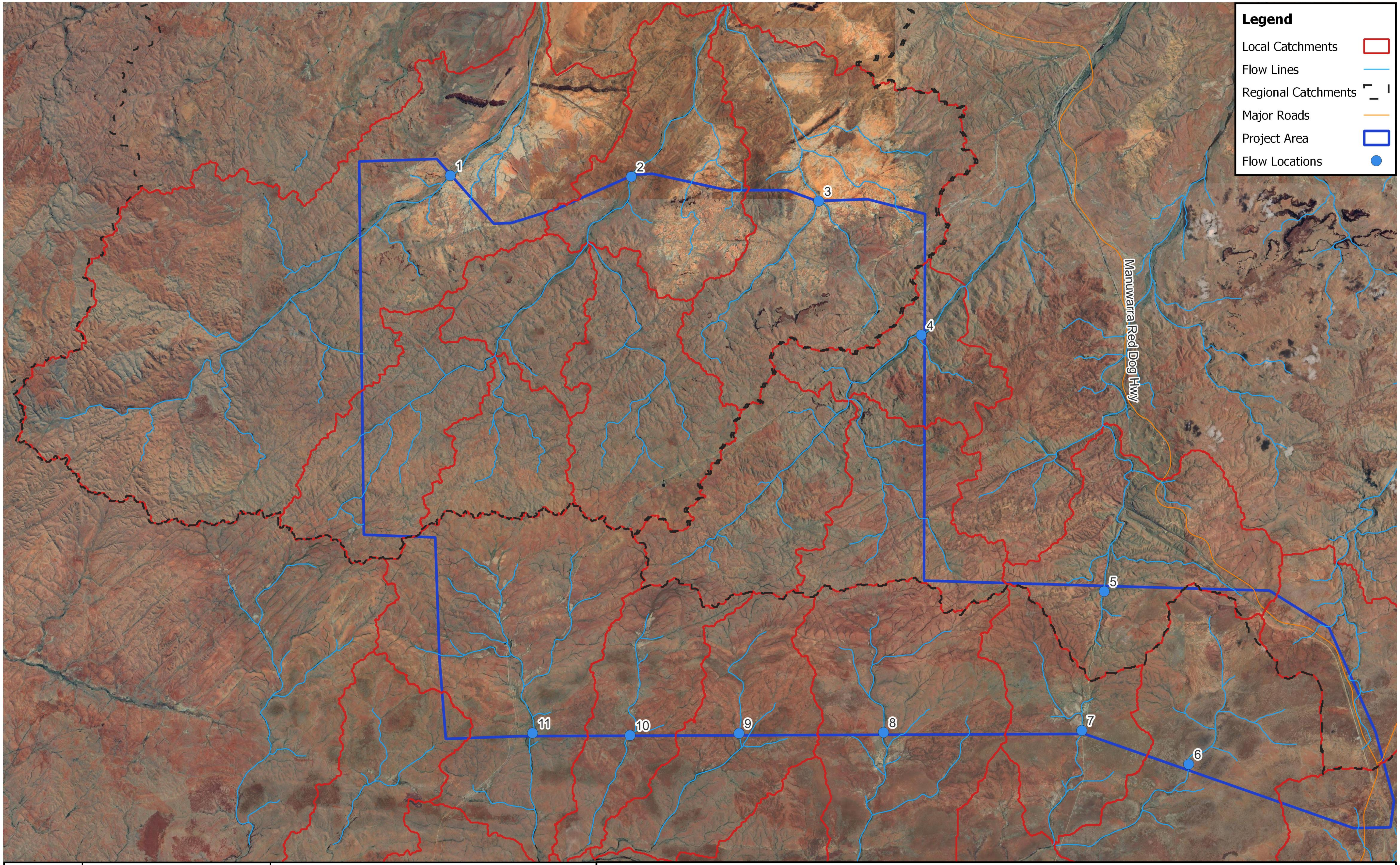
In addition, 2D flood modelling was undertaken using HEC-RAS. The model simulates hydraulic flow behaviour within a 2D grid domain based on the topography (i.e. based on a digital terrain model). A rain on grid (RoG) model was run over the provided Lidar, and FABDEM (global terrain) data where Lidar was not available. A grid spacing of 60mx60m was used. The Rio Tinto Robe River–Dampier rail line runs through the middle of the site and a 10mx10m refinement region was placed over the rail line and culverts added, with size estimated based on Google imagery.

The HEC-RAS RoG hydraulic model and RORB hydrologic model showed similar peak flow results, and the HEC-RAS model/flows were adopted.

The peak flows for the 5% AEP and 1% AEP in the larger creeks (locations shown in Figure C) are provided below.

Table 3: Peak Flows (m^3/s)

Location	Catchment Area (km^2)	Peak Flow (m^3/s)	
		5% AEP	1% AEP
1	149	462	910
2	135	449	840
3	36	124	247
4	94	327	635
5	12	43	75
6	35	98	194
7	19	60	106
8	25	87	169
9	12	45	87
10	18	66	126
11	58	182	363



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Sources: YEC, Google

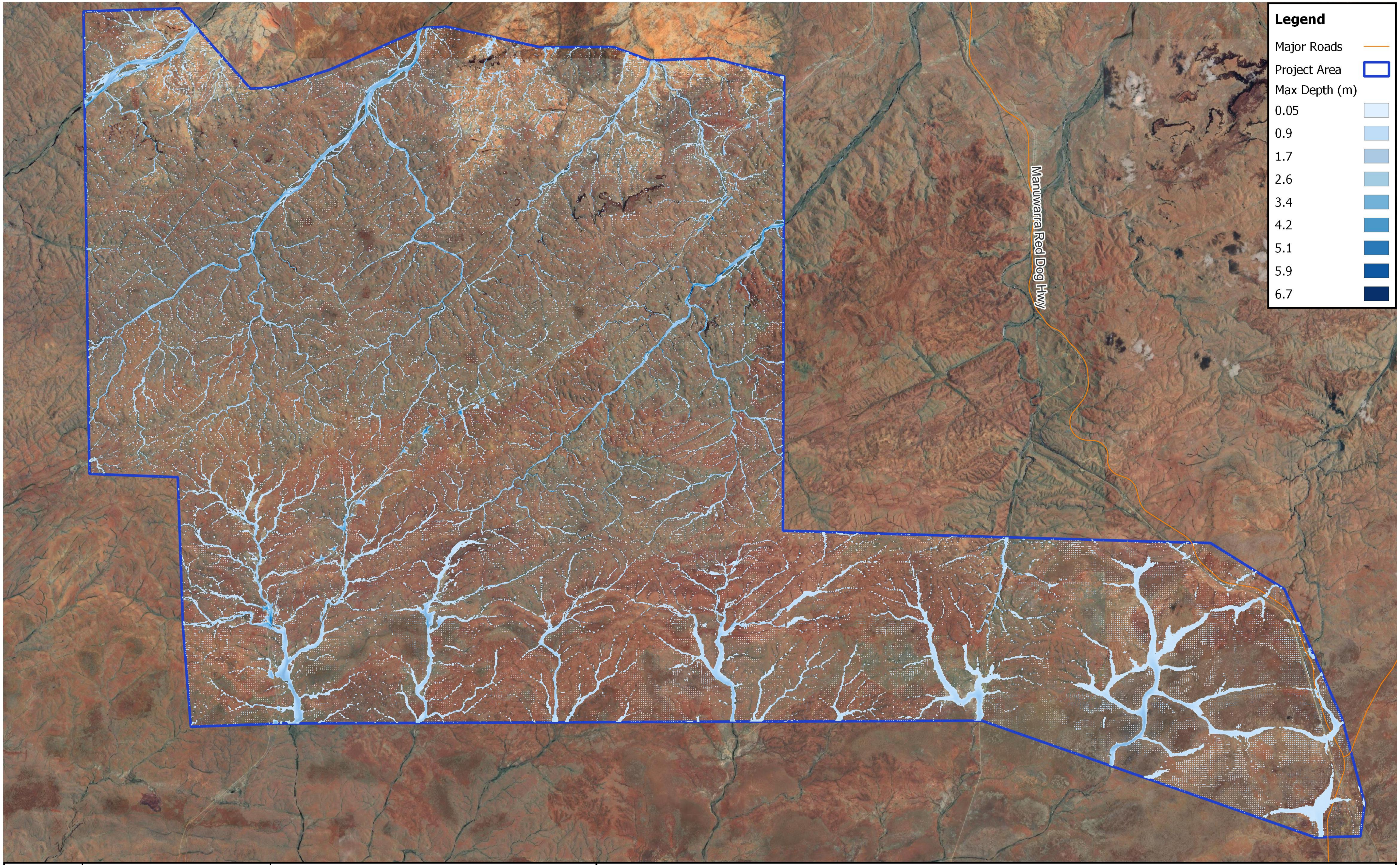
Figure C

Local Catchment Boundaries

3.4. Pre-development flood modelling

The 5% AEP (20-year ARI) and 1% AEP (100-year ARI) maximum flood depth and velocities are shown in Figures D and E; and Figures F and G below respectively. The maximum flood depths are several metres in the larger creeks, and less in the smaller tributaries draining the hilly terrain and feeding into those larger creeks.

Similarly, velocities in the larger creeks are generally low (<2m/s), with occasional localised areas of higher velocity. The maximum velocities in the steeper (rocky) feeder gulleys tend to be much higher.



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Sources: YEC, Google

0 2 4 6 8 km

Figure D

5% AEP Pre-Development Flood Depths

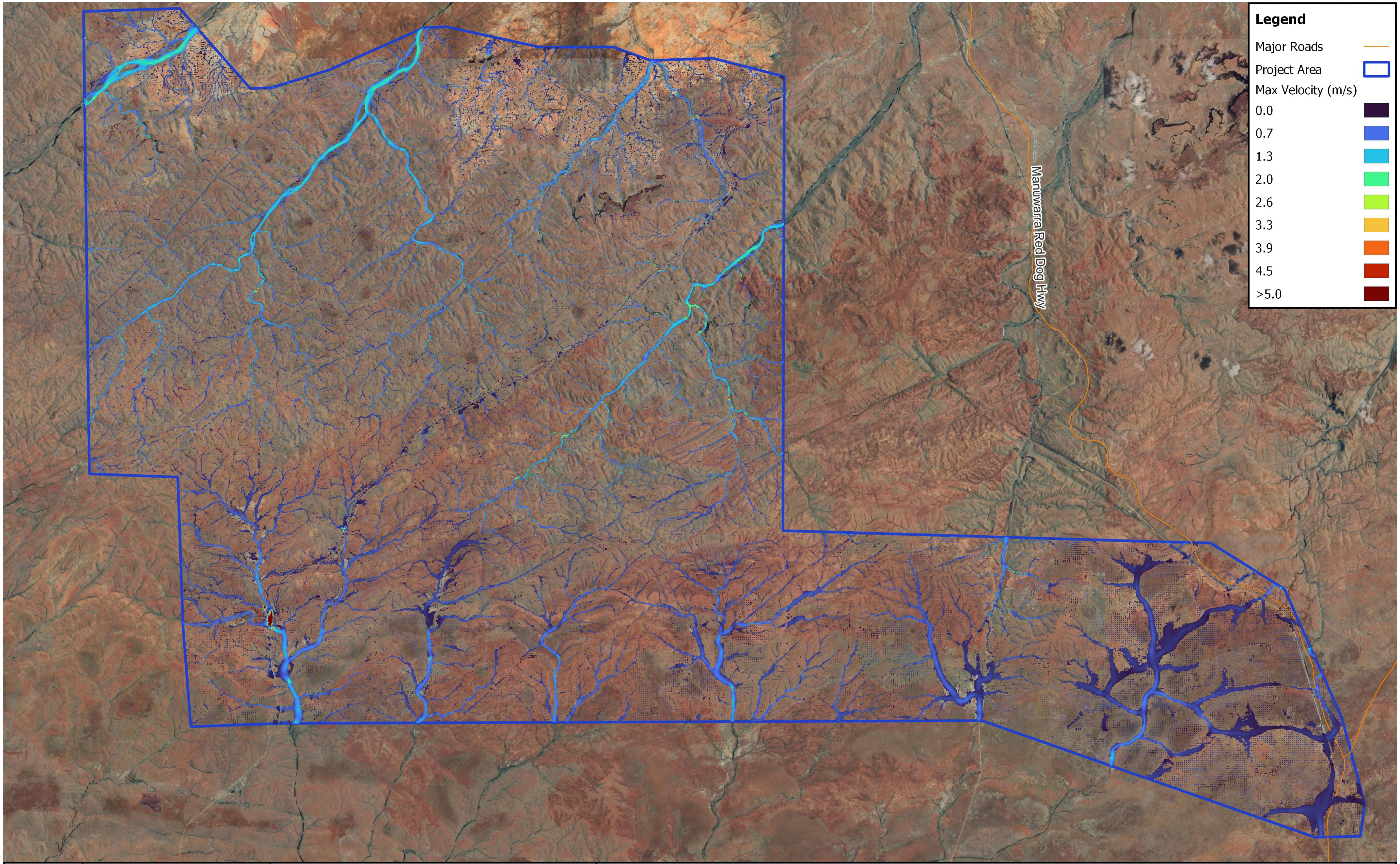

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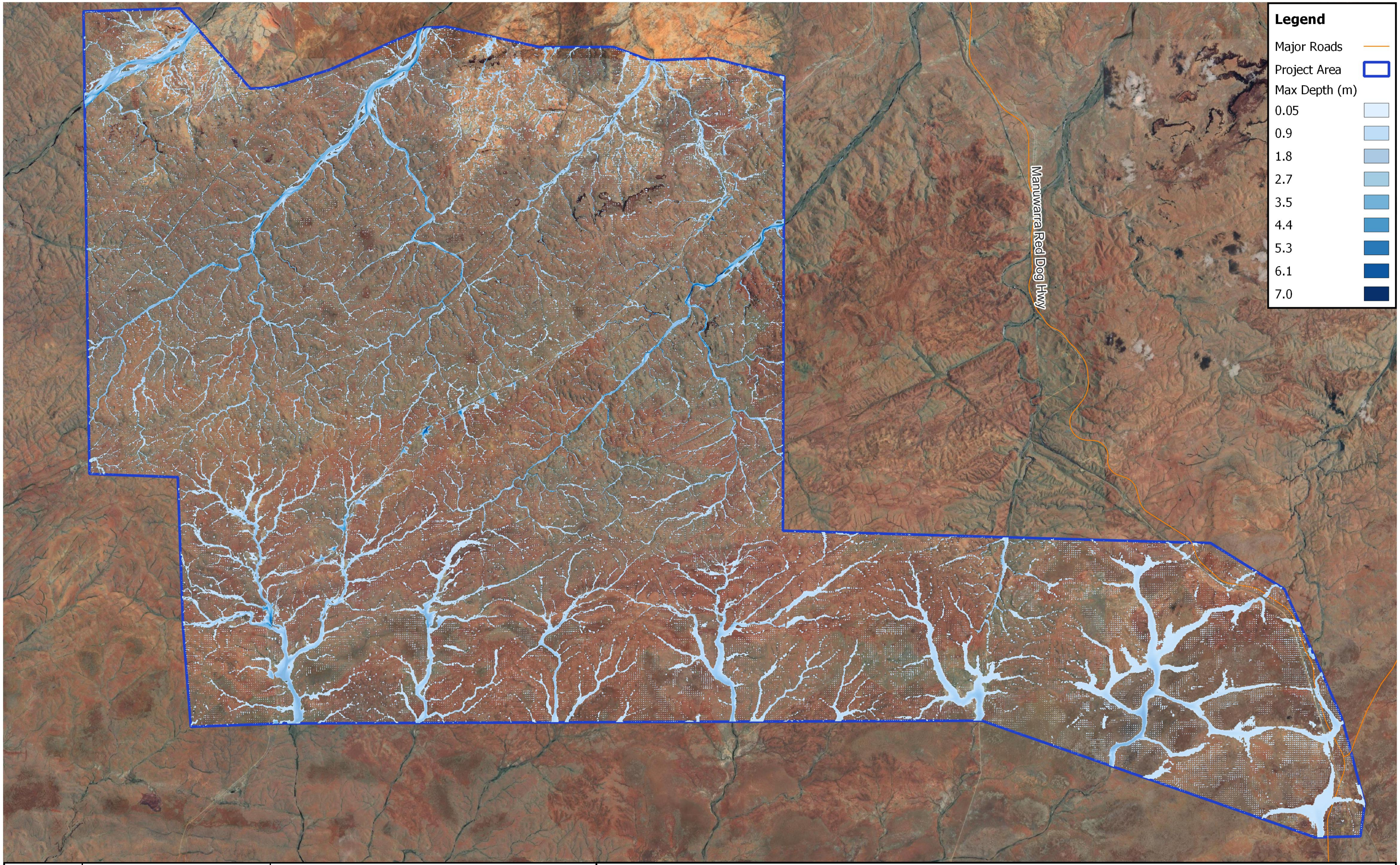
Figure E

5% AEP Pre-Development Velocities



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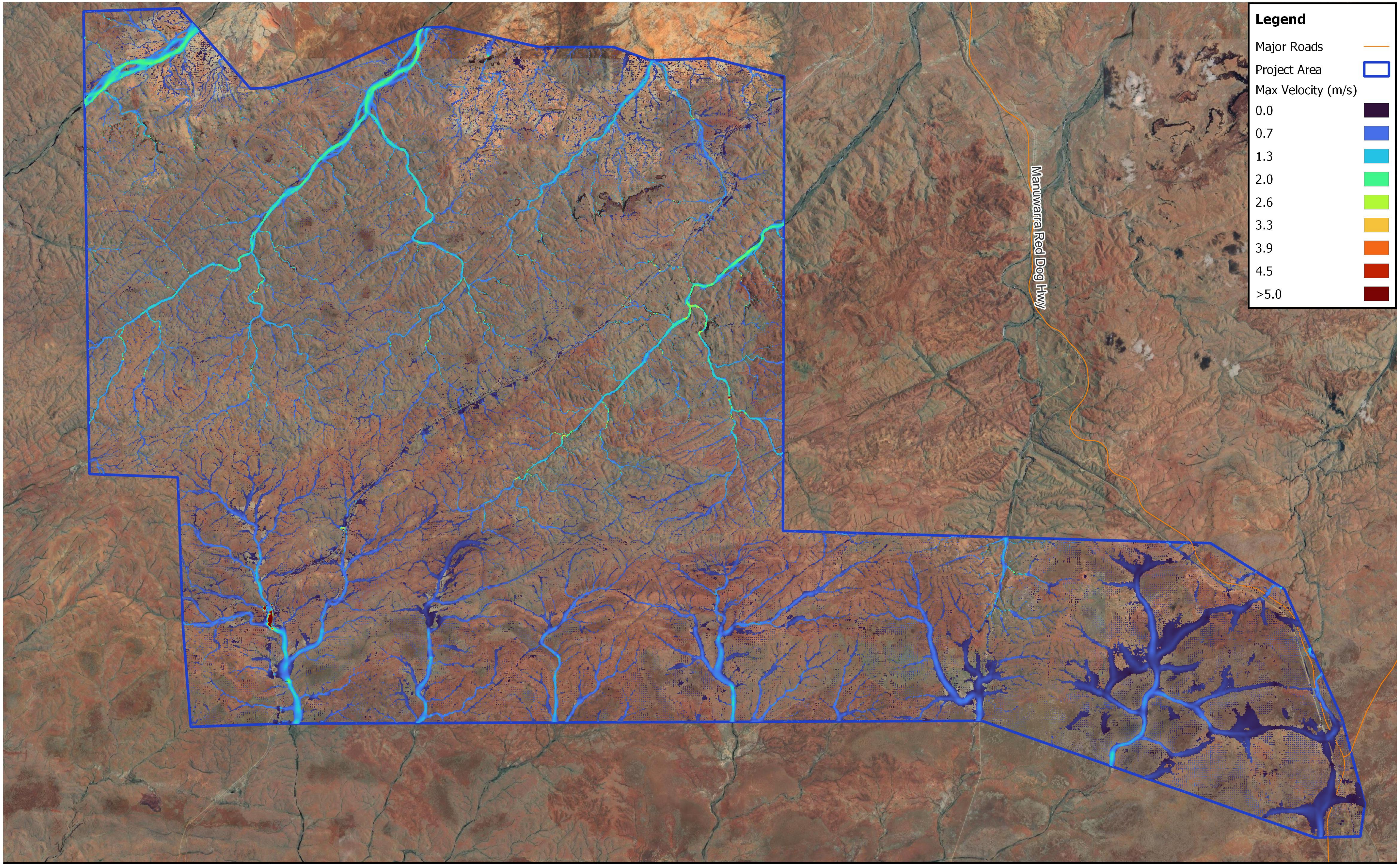
Sources: YEC, Google

Figure F

1% AEP Pre-Development Flood Depths



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Sources: YEC, Google

0 2 4 6 8 km

Figure G

1% AEP Pre-Development Velocities

4. Hydrogeology

The hydrogeology of the project area / site is dictated by the local geology. In a broad sense, the area contains no aquifers of note, and the local geology is almost entirely igneous rock. A brief geological summary is provided below, with more detail provided on the local hydrogeology and areas of potential water supply.

4.1. Geology

The site is situated on the northern edge of the Hammersley Basin with rocks of the East Pilbara Granite-Greenstone Terrane on the northern side of the site. The geology of the site is well-described in the Pinderi Hills 1:100000 Geological Map Sheet (Hickman, 1997), and is dominated by basaltic rock of the Maddina, Tumbiana, and Kylena Formations. A summary of the key geological formations is provided below:

4.1.1. Brill Monzogranite

Foliated and locally gneissic monzogranite and granodiorite of the Maitland River Supersuite (Van Kranendonk, 2006).

4.1.2. Munni Supersite Intrusion

Metamorphosed layered intrusion comprising gabbro, leucogabbro, peridotite and dunite.

4.1.3. Maddina Formation

Massive, amygdaloidal, or vesicular basalt and basaltic andesite.

4.1.4. Tumbiana Formation

Although mostly sandstone, siltstone and tuffs around the Pilbara, in the project area the Tumbiana Formation largely comprises basaltic rock.

4.1.5. Kylena Formation

Almost entirely massive and amygdaloidal basalt in the project area.

4.1.6. Cenozoic Material

Weathering of the fresh rock during the Cenozoic, commonly formed a deep weathered profile in Western Australia. However, in the project area, this weathered profile has been eroded away and, in most places, fresh (or near-fresh) rock is now exposed at the surface.

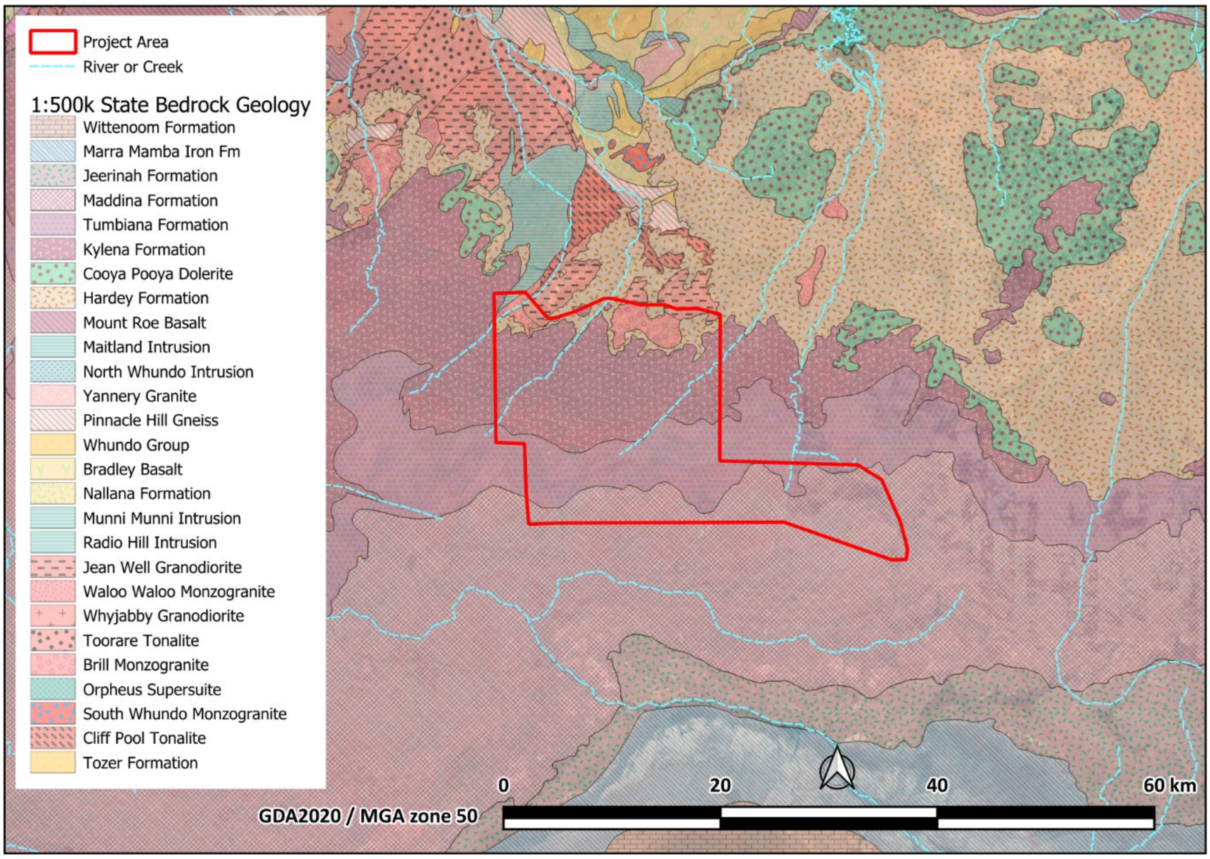

Figure I Local Geology near the Project Area

4.2. Hydrogeology

In the Pilbara, two aquifer types are most common, (a) 'Fractured Rock Aquifer' and (b) 'Alluvial Aquifer'.

4.2.1. Fractured Rock Aquifer

Fractured rock aquifers are not anticipated to be extensive; the igneous and metamorphic rocks have negligible primary porosity, and the fresh rock is typically a very poor aquifer (McFarlane DJ (ed.), 2015). Weathering of this rock, where present, will have developed secondary porosity due to the break-up of the rock fabric and the development of small open fractures that can act as a conduit for water flow.

4.2.2. Alluvial Aquifer

Although common throughout the Pilbara, the project area lies in a dissected plateau of the Chichester Ranges, and there is limited development of alluvium. To create a useful thickness of alluvium, the local rivers would need to slow sufficiently to drop their suspended load. In this area, it appears that river flow is sufficiently fast to keep alluvial sediment thicknesses low.

4.2.3. Local Hydrogeology

The hydrogeology of the Pilbara is typically a direct expression of the underlying geology, and in the project area the geology is largely fresh, impermeable rock. The aquifer development in the area is therefore limited to porosity developed in fresh rock via the weathering process i.e. the Fractured Rock Aquifer.

4.2.4. Water quality

There are no publicly available water quality data from water bores within 5km of the project area. Experience in the local area suggests the water is low salinity (fresh to brackish) with few dissolved metals. DWER (Department of Water and Environmental) State-wide salinity mapping indicates the salinity (as Total Dissolved Solids) of groundwater in the area ranges from 500-1000mg/L, which is classed as Fresh Water (Figure I).

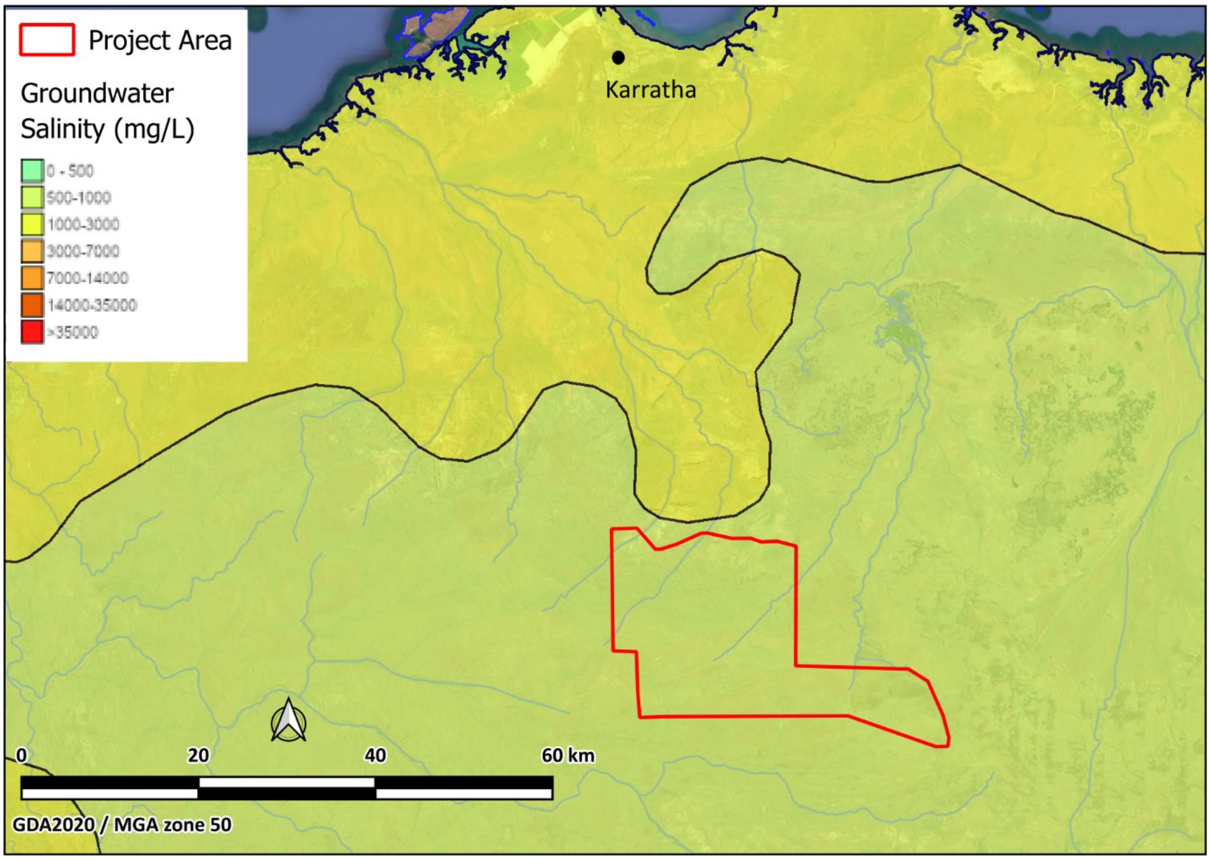

Figure J Likely Groundwater Salinity

4.2.5. Depth to Groundwater

There are no recorded, publicly available data on the depth to water in the project area.

Drilled depth of water bores in the region tends to be less than 30m (DWER Winsites, 2024), likely reflecting the depth of water and the depth of fracturing that has usable quantities of water.

4.2.6. Other Groundwater Users

The Pilbara Iron Company (Services) Pty Ltd is the single water licence holder in the project area; GWL169174, with an allocation of 150,000kL/year (5L/s) (refer DWER Water Register, 2024). Pilbara Iron is wholly owned by Rio Tinto, and from the location of the bores, it appears that the bores were originally a water supply for rail construction and are now likely used for rail maintenance.

The DWER Winsites website shows five water bores drilled in the project area; and a further twelve just outside (Figure J). These bores are all shallow, with a maximum depth in the order of 30m.

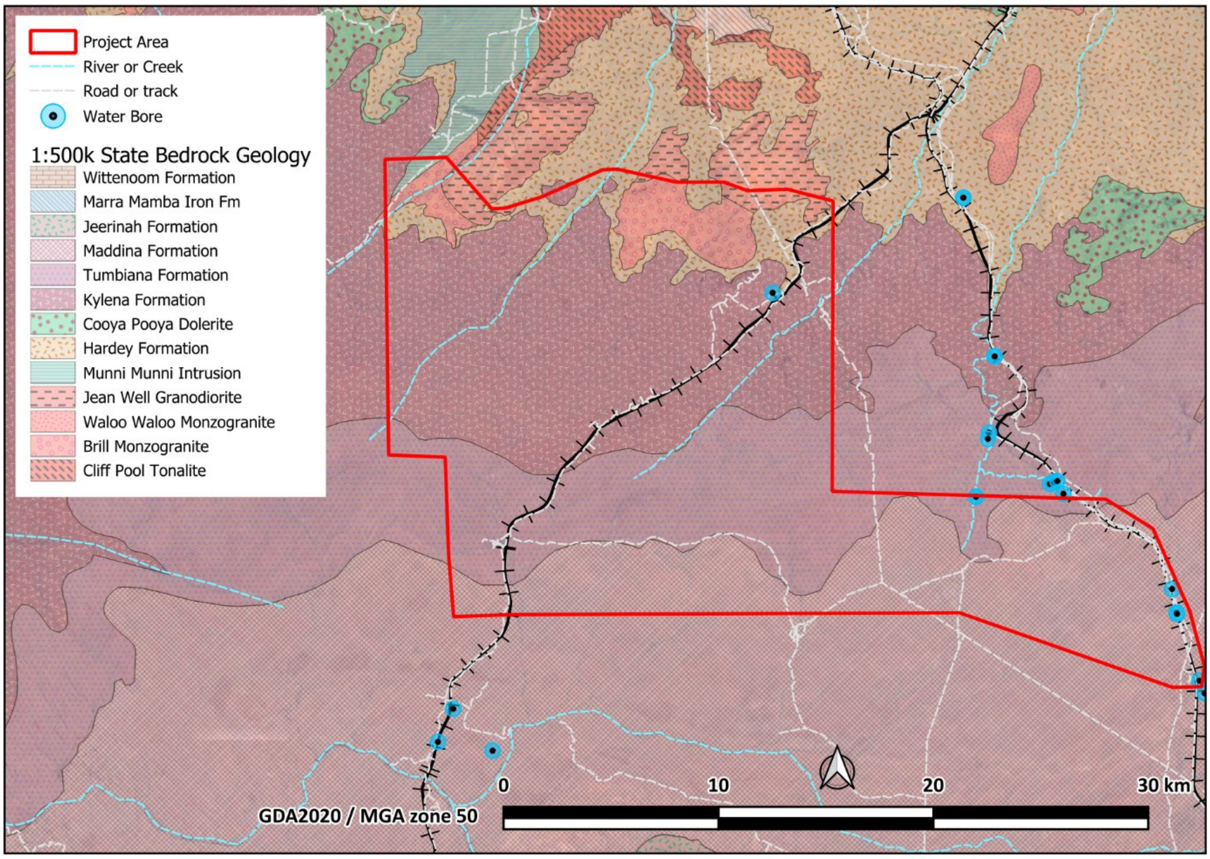

Figure K Registered Water Bores near the Project Area (DWER, 2024)

4.3. Aquifer Potential

The igneous and metamorphic rocks of the area have negligible primary porosity, and the fresh rock is typically a very poor aquifer. Where there is a deeper weathering profile, the 'fractured rock' aquifers can form, which are often associated with greenstone rocks and occasional quartz veining (McFarlane DJ (ed.), 2015). The weathering will break up the rock fabric and encourage the development of small open fractures that can act as a conduit for water flow.

No aquifer parameters are known for the site but can be estimated using data sourced from bores constructed in the fractured rock aquifer elsewhere in the Pilbara. Recent work by Rojas et al. (2018) provides a mean hydraulic conductivity for the aquifer as about 2.3 m/d, and median hydraulic conductivity of about 6 m/d, with a mean specific yield of 0.013 (quite low, indicating that the aquifer is not highly productive). Potential yields from these bores are likely to be less than 100 kL/day or 1 L/s (Wright, 1997).

Drilling water bores in this kind of aquifer can be difficult, and the success rate (successful completion of a water bore with a yield of >1 L/s) can be around 25% i.e. for every four water bores started, three will likely not yield sufficient water to complete the bore.

By looking at the geology, topography, vegetation density and likely fracture/fault zones, it can be possible to pick areas that are more prospective for water. Figure K shows the interpretation completed by Pentium Water. Blue areas have geological or structural features that appear to dictate stream flow and are likely to feature some groundwater control as well. The areas are quite narrow, largely restricted to small valleys, and may be difficult to access.

Although these areas are highlighted as having potential, the probability of successful completion of a water bore remains low.

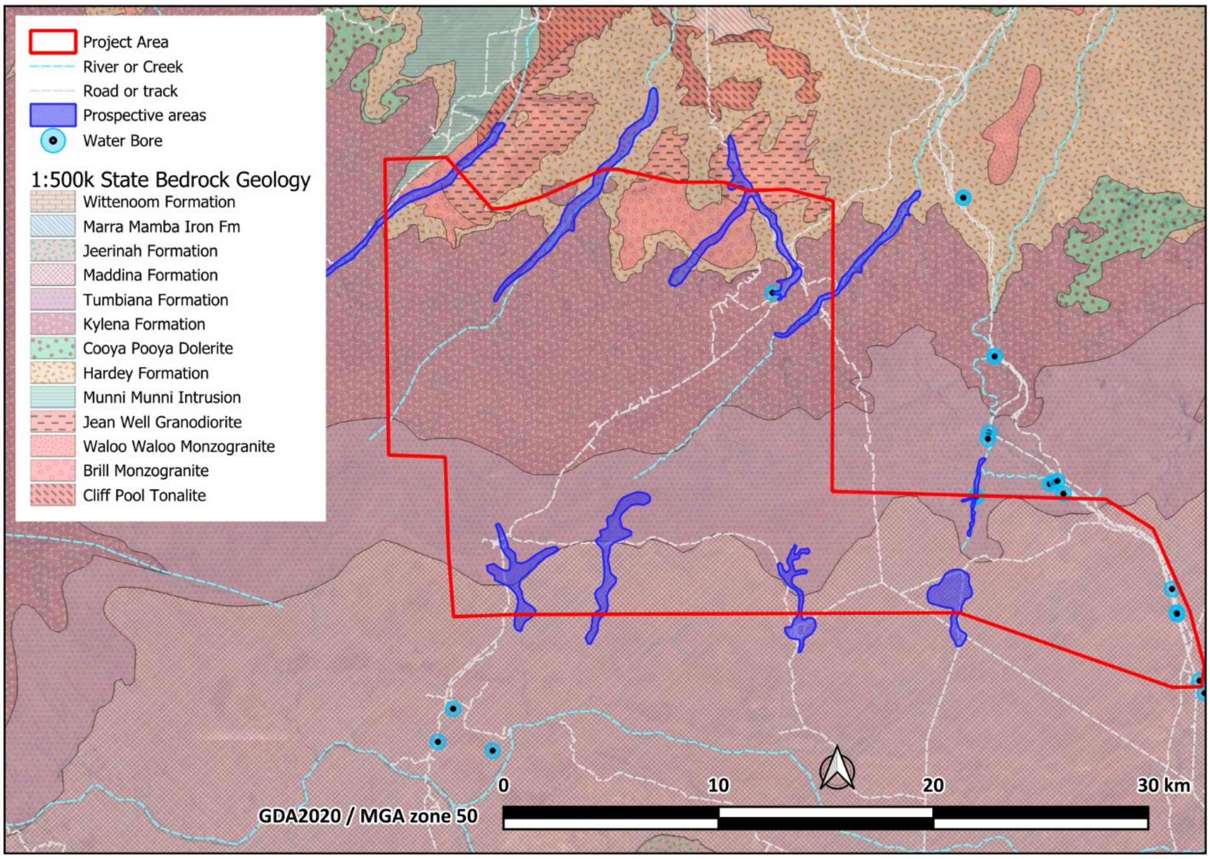

Figure L Areas Interpreted to be Prospective for Groundwater

5. Hydrogeological Risk Assessment

5.1. General

As there is likely to be little interaction between construction activities and the groundwater, it is likely that the wind/solar proposals do not pose any risk to the groundwater. However, there is a likelihood a water supply would be required for construction purposes. Although there is not yet a complete understanding of the volumes of water required, it is likely to be about 410,000 kL per year (pers com, 2024) for a one-to-two-year period. This volume of water is small and over a short time-period, so again the risks to groundwater are very low.

However, there may be some specific areas that are more sensitive than others. This risk assessment focuses on both the risks to the environment and risks to other users, as well as possible risks to the project.

5.2. Groundwater Dependent Ecosystems

A portion of the project area is defined as having 'Moderate Potential' for Terrestrial GDE (i.e. vegetation dependent on groundwater), largely within the Tumbiana Formation (Figure L; BoM, 2024). Inspection of satellite imagery shows that this area is no more vegetated than other areas, so this may be simply a function of how shallow the groundwater is. The BoM database uses the depth to water as the basis for their assessment. As such, the study area likely has low probability of GDEs outside the immediate creek lines.

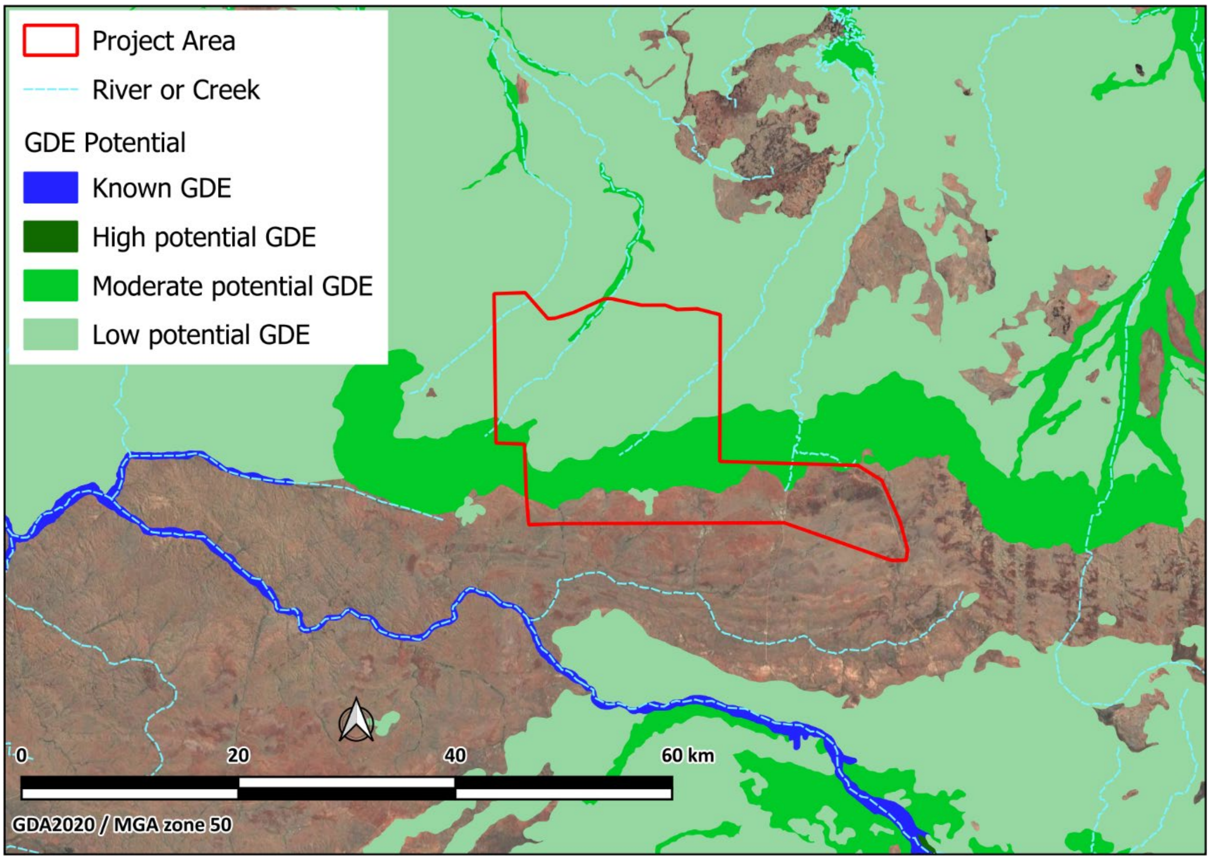

Figure M Potential for Terrestrial Groundwater Dependent Ecosystems (based on BoM, 2024)

5.2.1. Stygofauna

The prevalence of stygofauna in the local area is largely unknown, but as the regional water quality is likely very similar, the species encountered are likely to be similar everywhere. Risks are only associated with stygofauna where there is the possibility of encountering new and/or unique species. Stygofauna species habitat is typically related to the local water quality, and it is likely to be very similar across the project, the risk of encountering unusual species within the development envelope is low.

As the indicated water demand is very low, the likelihood of water abstraction leading to stygofauna extinction is vanishingly small. Extinction would only occur where stygofauna are not widely distributed and aquifers are depleted so much, that no habitat remains.

As any water supply development for any wind/solar projects on site will likely be for only small volumes and will probably not need to be assessed for Stygofauna.

5.3. Groundwater Volume

Although there is a groundwater licence over the project area for 150,000 kL/year, most of the water bores associated with this licence lie outside the project area. The sustainable volume available from within the project area is unknown and will be difficult to estimate even with multiple exploration bores.

However, a water supply of less than 410,000 kL per year (13 L/s) for construction purposes should be feasible but will require an extensive drilling exploration program that is likely to have many unsuccessful bores.

5.4. Groundwater Quality

The water quality in the area is very good, with the TDS (or salinity) currently mapped as less than 1,000mg/L. Although it is common for water salinity to increase with pumping, salinity is unlikely to increase significantly due to the very limited depth of water – the noted increase in salinity in other bores is due to the accumulation of salts towards the base of an aquifer.

5.5. Potential Impacts Due to Groundwater Abstraction

The current water demand for the project is very low, and there is little risk of impact to Groundwater Dependent Ecosystems, Stygofauna or other users from this small abstraction from the local fractured rock aquifer.

6. Surface Water Management

6.1. Surface water guidelines

Objectives for water quality are outlined in "Water Quality Protection Guidelines", DWER, 2000, a series for water quality management in mining and mineral processing. Of the eleven guidelines, those relating to water, water quality monitoring, stormwater, mechanical servicing and workshop facilities, laboratory waste, fuelling chemical storage are relevant. Various other guidelines and standards may be applicable, including for example DWER 'Guidelines and ANZECC Guidelines for Fresh and Marine Water Quality'.

Environmental approvals involving land disturbance typically require adherence to the maintenance of surface water regimes and the protection of downstream ecosystems. As such, the design of the facilities needs to specifically include design for the management of stormwater run-off both within the site, and out of the site.

Environmental management should be proactive rather than reactive; with risk assessment undertaken, "best management practices" used, and progressive erosion and sediment control / mitigation undertaken in each potential run-off/drainage area.

A 'Soil and Water (or Surface Water) Management Plan' (SWMP) can identify, plan, manage and implement the required strategies, detail roles /responsibilities, and outline an effective monitoring, auditing and reporting framework. Controls should be monitored to ensure their effectiveness, and changes made if they are not achieving their objectives. The SWMP should be a practical guide for use during the construction and operational phases and interrelates with other environmental management plans.

6.2. Surface water management measures

6.2.1. Harding Dam Water Catchment Area

The presence of the Harding Dam Water Catchment Area means there will need to be clear communication with Department of Water and Environmental Regulation to ensure there is no impact to the water quality in the catchment. Each potential risk will need to be assessed, and mitigation strategy developed; at this early stage, that would appear to largely revolve around reducing the potential for turbidity and the potential for chemical or fuel spills.

An alternate management strategy would be to ensure all fuel, chemical, camp, and storage areas are outside the catchment area. This would limit the potential risks to the catchment area.

More detailed assessment of the potential impacts will be needed as the project becomes better defined.

6.2.2. Surface Water Quality

Flow in Pilbara creeks is typically short-lived, occurring only after substantial rainfall. These intermittent flows often carry organic material, debris, and sediment. As such, surface water quality can vary significantly depending on recent weather patterns, local geology, and land cover. After rainfall, especially following dry periods, creek water often has high sediment loads due to the loose, dry soil and sparse vegetation, leading to turbidity (cloudiness) in the water.

Surface water in the Pilbara following rainfall tends to have high sediment loads, moderate salinity, and neutral to slightly alkaline pH. Water is often turbid with suspended sediments, and as flow reduces, the water in pools can become more saline and stagnant. These characteristics reflect the region's arid climate and sparse vegetation, as well as the mineral-rich geology of the Pilbara.

6.2.3. Wind Farm Areas

The wind turbine foundations are generally located at high points on the site and make up a very small percentage of the overall catchment areas. During construction, larger laydown areas may be required at each turbine location, which could then be reduced for the operational phase.

In addition, high voltage reticulation power lines are required to connect groups of turbines to each substation, typically buried but in hilly/rocky terrain may be overhead lines. Any high-voltage transmission lines required are likely to be supported on large towers to connect the individual substations to the external grid.

All infrastructure should be located outside the 1% AEP creek flood areas.

The main risk to the environment is water quality degradation, with the potential for dirty (sediment laden) water running off disturbed ground and into the downstream environment. All turbine pads / laydowns should be graded to a low point (away from the access road) and bunded off to trap dirty water at one end, where it can then infiltrate and evaporate.

6.2.4. Solar Farm Areas

The selection of a site must place significance on topography, existing site conditions and constraints such as nearby watercourses and soil types. These factors influence the volume and flow rate of runoff that, if not properly managed, can result in negative impacts downstream.

Typically, a solar site is minimally cleared of native vegetation and only graded; bulk earthworks are not carried out and solar panels are installed along the existing topography. Although the site is not 'bare', cleared areas can lead to dust generation and be affected by surface water erosion. Soils experience significant compaction due to construction activity, with resulting increase in compaction of soil / increase of runoff and sediment transport.

Under pre-development conditions, the solar land area areas may include small pockets / depressions that would capture runoff, reduce flow velocities, and provide opportunity for infiltration and/or ensure that not all run-off left the site. Post-development, the land may have generally similar characteristics, but as a function of the work environment and grading activities, relatively long distances (or reaches) of solar developments may be smoothed out to permit the piles/panels to be installed and to promote effective transportation networks. The combination of long reaches and smooth surfaces may result in the formation of shallow concentrated flow which can extend much further downstream and give rise to rills and gullies possibly leading to erosion due to increased runoff velocity and volumes.

The stormwater management component of the design (construction and operations) needs to delineate site watersheds, identify internal drainage areas, and carry out flood / flow calculations to confirm whether stormwater management is or is not required for the site. There is potential that permanent measures may be required to control water and sediment transport after full build-out of the solar project. The goal is to lower total suspended solids (TSS) where water flows off-site.

6.2.5. Access Roads

A heavy vehicle (HV) access road, suitable for heavy vehicles and designed to transport wind turbine blades, is required to each turbine location, as well as for ongoing maintenance. This road will cut across creeks and minor flow lines, typically as floodways at bed level, but some creek crossings require raised vertical road geometry across the waterway in order to transport the turbine blades. In this case, minor culverts will be required.

Other light vehicle access roads are usually designed to be simple and low-maintenance roads, often constructed with a gravel surface. These roads are typically built with minimal elevation and follow the natural topography to reduce construction costs and environmental impacts.

A combination of floodways and culverts should be considered as required to ensure water does not get trapped behind roads and there is continued flow downstream.

6.2.6. Floodways and culverts

The type of structure at water way crossings is determined by the level of immunity from flooding that is required, and the time of closure acceptable during flooding. Low level floodway crossings (grading the road surface through the water course and gravelling the surface as required) allow water to flow across the roads at natural flow paths. For cars and trucks, road closure is normally assumed when the flow depth exceeds ~ 0.25m and 0.5m respectively. Such floodways tend to require regular maintenance.

An elevated road formation creates a weir effect, increases the downstream velocity, and chances of scouring (requiring rock armour, for example). A relieving culvert can be installed though the elevated profile to prevent water ponding upstream, and also at incised creeks. The road elevation above the culverts can be higher, with lower flood overflow sections each side (so that flow preferentially crosses the road away from the culverts. The desirable minimum size for drainage is DN600 (absolute minimum DN450).

The road pavement can be designed and protected to withstand submersion if desired.

6.2.7. Sedimentation Basins

Erosion and sediment control is typically required downstream of cleared / disturbed areas to capture and treat dirty water run-off prior to release downstream. As such, sufficient bunding is required (internally or on the site boundary) to capture internal dirty water and stop it running off the site.

For sedimentation basin design, the target particle size is typically silts (2–63 μm) and fine sands (63–200 μm), as these contribute significantly to turbidity and are common in runoff from arid regions. Fine clays (<2 μm) are more difficult to settle but may also be targeted with longer detention times or through additional features like baffles or coagulants, depending on water quality goals. The end goal is a manageable pond size.

Flood flows pass over a spillway, set within the allowed freeboard. A basin may be configured as a wet or dry (preferred) basin. A dry basin drains through a 'control' outlet (e.g. overflow pit / pipe system) over a day or so, and the basin is therefore normally dry. A wet basin has no 'control' outlet, hence any water trapped in the basin slowly infiltrates and evaporates.

Even on very flat sites with minimal slopes (<0.3%), a sedimentation basin might still be advisable, particularly if the site has been cleared and not revegetated. While flow velocities may be low, heavy sporadic rainfall events can still cause localised erosion and mobilise sediment even on flat land particularly in areas of concentrated flow. When vegetation is absent, there is little to hold the soil in place, which can lead to sediment-laden runoff.

At the time of project closure, decommissioning of the site and rehabilitation of disturbed areas is required. Sedimentation basins are retained in place until revegetation of surfaces and surface stability has been achieved. The basin and bunds are then removed.

7. Summary

The Yindjibarndi Energy Corporation (YEC) is a partnership between the Yindjibarndi Aboriginal Corporation (YAC) and renewable energy company ACEN Corporation. YEC plans to develop up to 3GW of wind, solar and battery storage on Yindjibarndi Ngurra (country) in Western Australia's Pilbara region.

This includes proposed wind farms and solar farms, located approximately 55km south of Karratha along the western edge of the Millstream Chichester National Park, within an area of Exclusive Native Title in the Yindjibarndi Native Title Determination Areas.

This area has an arid to semi-arid climate with hot, humid summers and warm dry winters.

The site consists of steep terrain with ridges and gorges as well as some wide flat creek beds. Creeks are ephemeral with some semi-permanent pools. The southern area of the site is flatter, running along the top of hills. Elevations around the site vary from RL128m to RL350m. Velocities in the larger creeks are generally low (<2m/s), with occasional localised areas of higher velocity. Velocities in the smaller water course channels that feed into the larger creeks is higher.

The project area lies on the edges of the Fortescue River, Maitland River and Harding River catchments. Importantly this includes the top of the Harding Dam Catchment Area; a Priority P1 Water Protection Area. Development inside the Catchment Area will be placed under greater scrutiny and will require more rigorous risk assessment and mitigation to ensure there is now potential contamination of drinking water from the development.

Surface water management measures need to be put in place to ensure that disturbed surfaces remain stable and non-eroding, and downstream surface water regimes and ecosystems are protected. As such, cleared areas should be bunded off to prevent sediment laden runoff, and revegetation, sediment basins and other sediment mitigation measures used as required. Effort should be made to prevent reducing flows to the downstream environment by locating infrastructure outside of major creeks and installing floodways/culverts through access roads.

The site is situated on the northern edge of the Hammersley Basin. Bore groundwater quality is anticipated to be fresh. Construction activity is unlikely to impact groundwater. Ground dependent ecosystems tend not to exist outside the immediate creek lines, and it is similarly unlikely that a project would need to be assessed for stygofauna. A water supply of less than 410,000 kL/year (13 L/s) for construction purposes should be feasible but may require an extensive drilling program that will have many unsuccessful bores i.e. the probability of successful completion of a water bore remains low.

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