EA APPLICATION SUPPORTING REPORT

SAVANNAH GOLDFIELDS LTD

Appendix 12 Flood Impact Assessment (ATC Williams, 2022)

REPORT

WULGURU TECHNICAL SERVICES PTY LTD
ABN: 79 644 301 655

Agate Creek Gold Mine

Flood Impact Assessment

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1 INTRODUCTION

1.1 Background

Agate Creek Gold Mine (ACGM), owned and operated by Laneway Resources (LWR), is proposed to expand its current mining operation from 45,000 tpa to 250,000 tpa as part of the mine's Stage 2 expansion phase. Laneway was granted mining lease (ML) 100030 on February 2019 and currently operates within Environmental Authority (EA) EPSL03068015 (dated 6 September 2021). Due to the proposed increase to mining operations, an approval and EA amendment is required to mine in excess of 240,000 tpa.

1.1.1 Current Operations

Agate Creek activities currently encompass the extraction of gold ore and waste rock from the Sherwood open Cut Pit situated at approximately the midpoint of ML100030. Ore is transported to the ROM pad where it is temporarily stockpiled. Waste rock is transported to the Sherwood Waste Rock Dump WRD on-site. LWR currently extract up to 45,000 tpa.

1.1.2 General Arrangement of the Proposed Expansion

LWR are proposing to expand current operations across the Sherwood and Sherwood West resource areas under ML100030, extracting up to 250,000 tpa across 6 individual open cut pits. The expansion of operations will include the following mine domains:

- Six open cut pits;
- Four waste rock dumps (WRDs);
- Topsoil stockpile areas;
- Expanded administrative buildings and other mining infrastructure (roads, camp etc.);
- 0.4 Ha expanded Run of Mine (ROM) pad;
- Magazine;
- Water storages; and
- Sediment ponds.

Refer to Figure 002 in **Appendix A** for the key site details.

Ore is to be transported off site to Georgetown for processing. Access to Agate Creek is to remain as Rungulla Road/Agate Creek Road /Cobb Road and onto Georgetown via Forsayth Road.

1.2 Scope of Works

ATC Williams (ATCW) Pty Ltd have been engaged by Wulguru Technical Services (WTS) Pty Ltd to assist with site investigations and the documentation required for the major EA amendment and in support of the Progressive Rehabilitation and Closure Plan (PRCP) of Agate Creek mine site. The site investigations required by WTS include the following:

- Water Management Plan (WMP);
- Flood Impact Assessment (FIA);
- Waste Rock Dump (WRD) Concept Design and Management Plan.

This report outlines a Flood Impact Assessment (FIA) for the Agate Creek Gold Mine site. In accordance with the DES guideline for PRC plans (PRCP) **[8]**, pit voids should be outside the 0.1% (1 in 1000 year event) floodplain as they are classified as Non-use Management Areas (NUMAs). Floodplain modelling for the significant watercourse (Agate Creek) through the mine lease was therefore required to estimate the extents of the 0.1% floodplain.

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1.3 Legal and Regulatory Requirements

The mining lease (ML) ML100030 and current operation is under an active Environmental Authority EPSL03068015 (the EA), granted 6 September 2021. The mine is part of the larger Agate Creek Gold Project, which also includes a mineral development licence (MDL402), and exploration permits for areas north of the mine (EPM17788 and EPM26460). However, this project focuses only on the mine area within ML100030 and an EA Amendment to expand the site operations.

Legislation and regulatory requirements therefore apply to the site and operations due to the environmental risks associated with the proposed mining activities. The following legal and regulatory guidelines have been used as a reference when developing this report:

- Australian Rainfall and Runoff (ARR) 2019 **[3]**
- Progressive rehabilitation and closure plans (PRC plans) 2021 **[8]**

1.4 Report Summary and Structure

The Flood Impact Assessment has been prepared using the available data, in accordance with the relevant guidelines. A RORB hydrological model and TUFLOW 2D hydraulic model was developed to estimate the 0.1% AEP (1 in 1000 year event) floodplain extents for Agate Creek that runs through the mine lease (ML100030). The 0.1% AEP floodplain of Agate Creek is clear of all proposed voids and no changes to the site layout are proposed due to the floodplain extents. It is noted that should a crossing over Agate Creek be required as part of future stages, a revised flood model should be developed to estimate any upstream impacts due to a culvert/structure over the creek. It is also recommended that the flood model be revised as part of the detailed design phase when detailed elevation data and images of the Agate Creek floodplain are available.

This report is structured in the following sections:

Section 2: Provides a brief description of the project site and the regional climate.

Section 3: Presents an overview of the hydrology and hydraulic modelling methodology.

Section 4: Presents the 1D hydrological results and flood frequency analysis.

Section 5: Presents the 2D hydraulic model parameters adopted.

Section 6: Discusses the results from the hydraulic model.

Section 7: States the conclusions and recommendations.

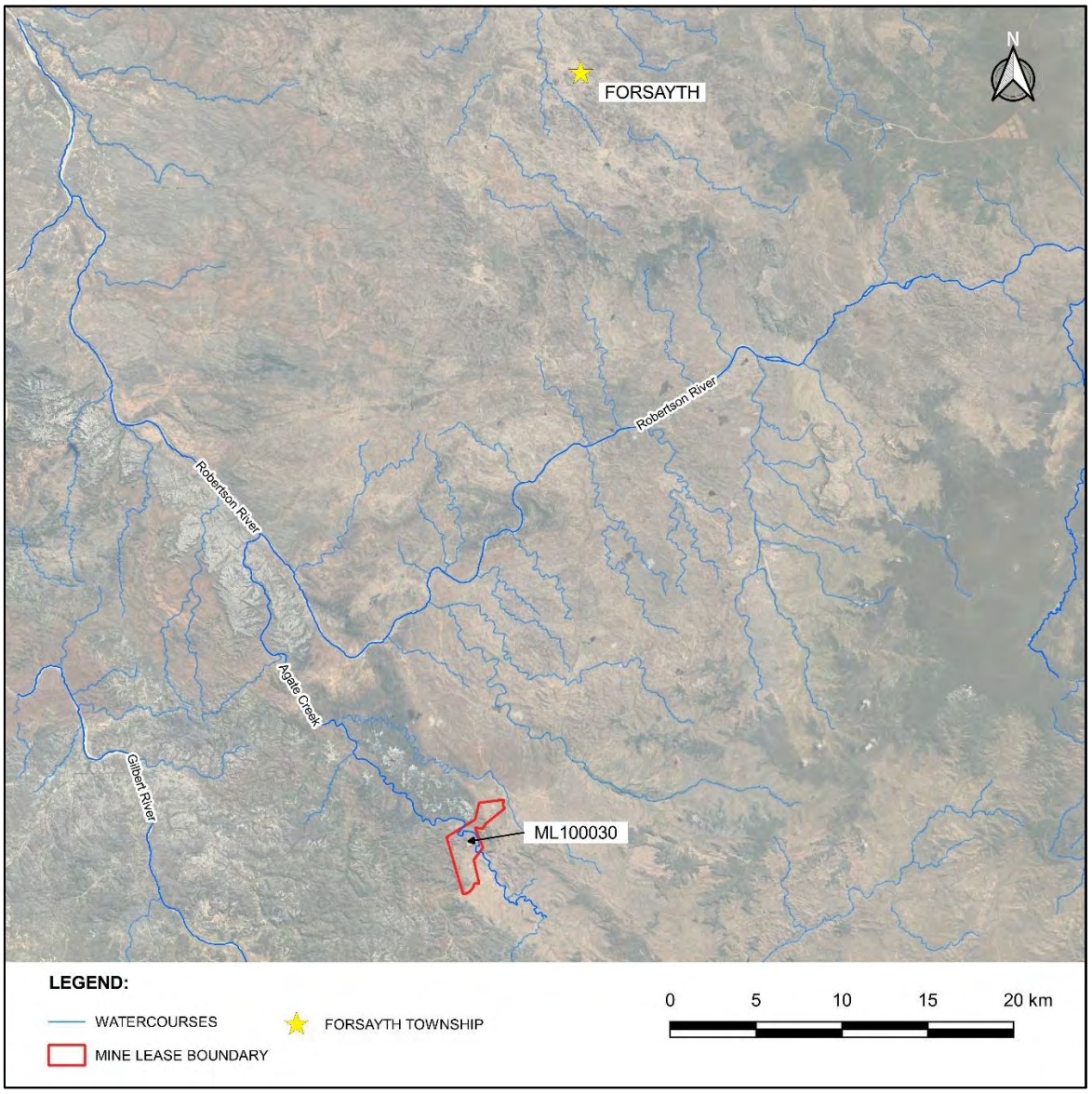
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2 SITE DESCRIPTION

2.1 Site Location

Agate Creek Gold Mine site is located approximately 40 km south-west (Rungulla Road) of Forsayth, Far North Queensland. The mine is part of the larger Agate Creek Gold Project, which also includes a mineral development licence MDL402, and exploration permits for areas north of the mine (EPM17788 and EPM26460). However, this project focuses only on the mine area within ML100030, as shown on **Diagram 1.** Typical site conditions are shown in **Photo 1.**

DIAGRAM 1: SITE LOCALITY MAP



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PHOTO 1: TYPICAL SITE CONDITIONS

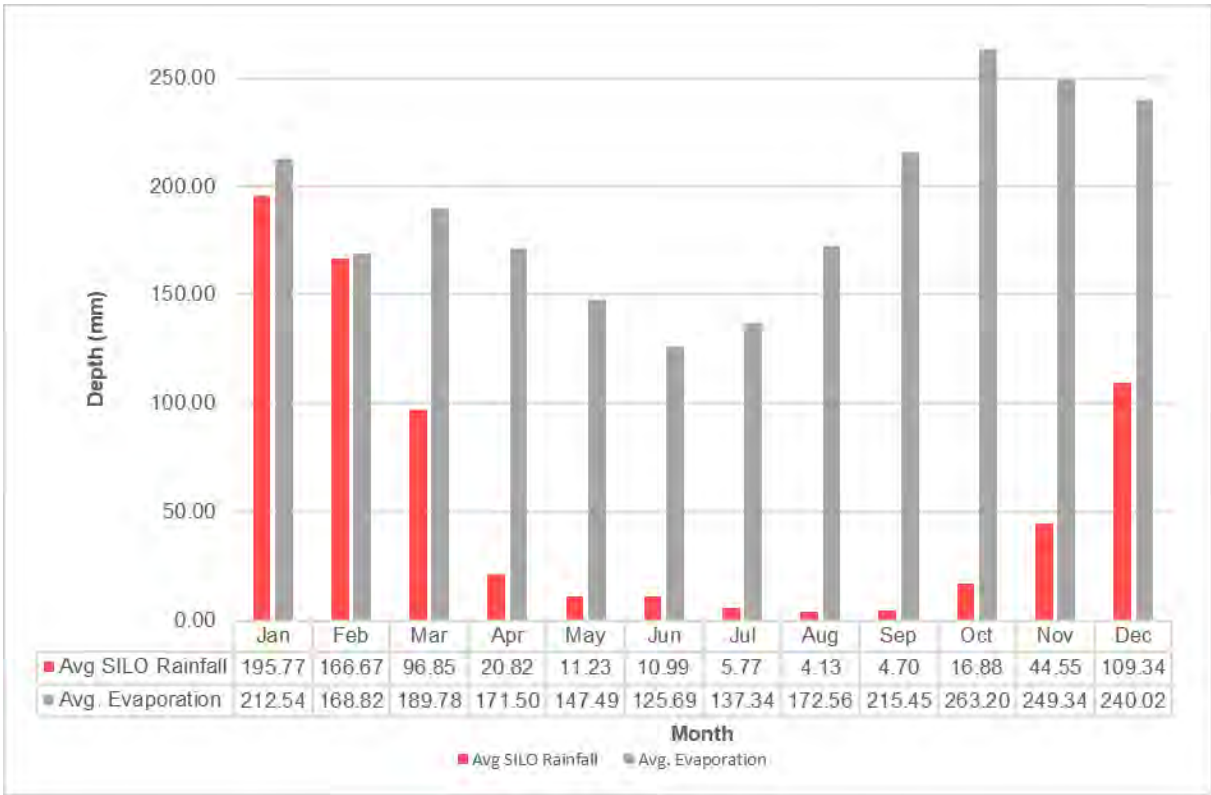


2.2 Climate

The ACGM site is located in the Far North Queensland region which has a tropical climate characterised by a distinct wet season (December – March) and dry season (April – November). Annual average rainfall is approximately 1085 mm, with most falling during the wet season. The nearest meteorological weather station to the site is the Bureau of Meteorology's (BoM) Robinhood Station located some 24.4 km to the northeast of the site. The Robinhood weather station does not have long-term evaporation data, which is a key factor in the assessment of surface water management. Therefore, for the purposes of this assessment evaporation data has been sourced from the SILO Data Drill program **[13]** specific to the site location.

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GRAPH 1: RAINFALL AND EVAPORATION MONTHLY AVERAGES



Rainfall data can significantly vary when affected by broader weather patterns, such as 'El Niño Southern Oscillation', and additional tropical cyclones that occur among November and April **[5]**. For instance, Agate Creek has experienced as much as 235 mm in a single January day and as much as 813 mm in a single month (February) **[5]**.

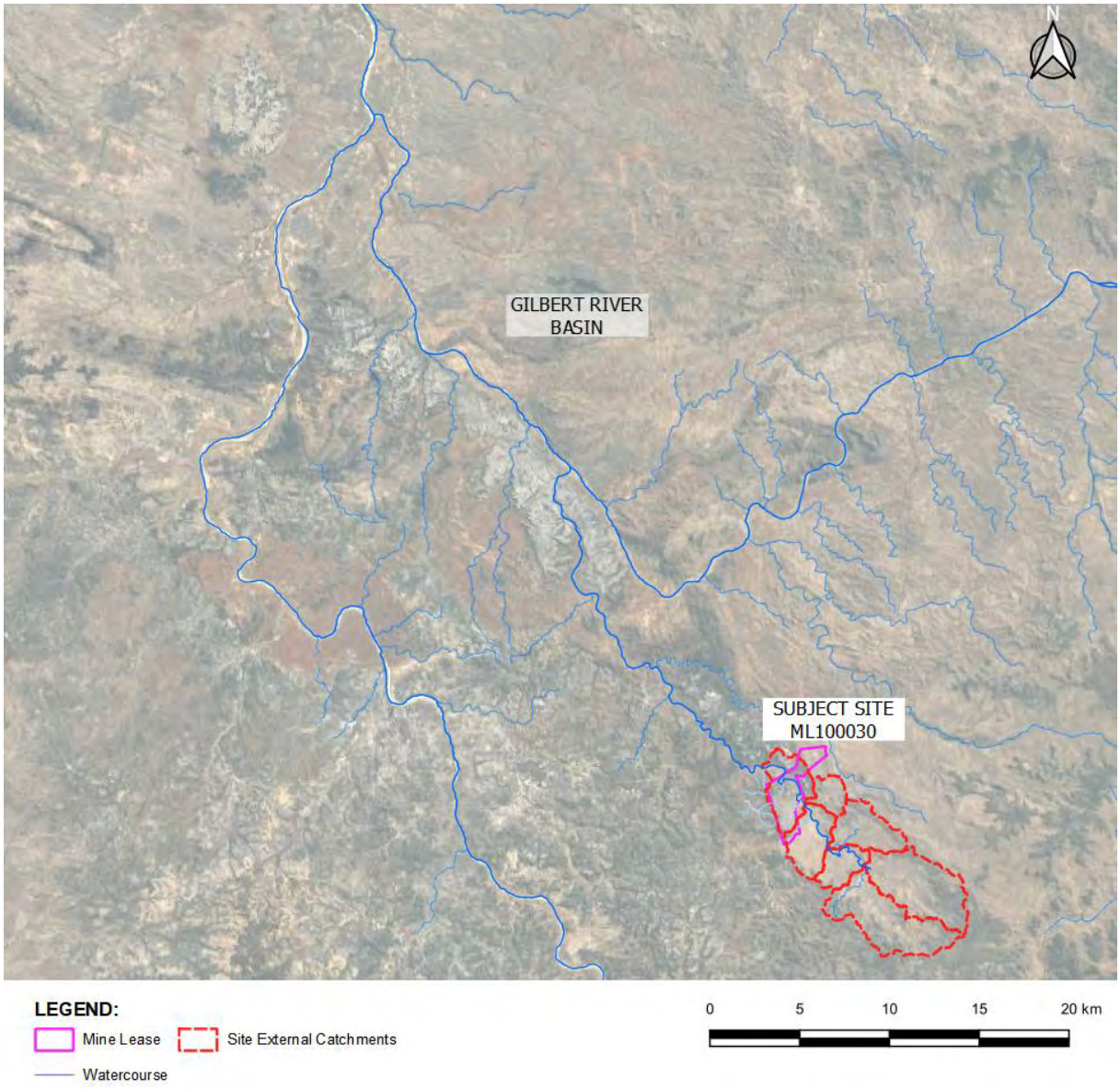
2.3 Hydrological Characteristics and Topography

2.3.1 Regional Context

The ACGM site forms part of the Gilbert River catchment located within the wider regional Gilbert basin in Far North Queensland. The site has few ephemeral waterways directly discharging to Agate Creek which is the immediate receiving watercourse for the site, located centrally within the mine lease running from east to northwest. Agate Creek subsequently discharges northwest until it intersects Robertsons River, approximately 23 km northwest of the site. The Robertsons River then joins the Gilbert River, located approximately 26 km downstream from the point of confluence of Agate Creek and Robertsons River. The Gilbert River travels further downstream by approximately 361 km until it reaches the Gulf of Carpentaria which is the final discharge point for the Gilbert basin. The regional watercourses are depicted on **Diagram 2**, noting that the mine lease has a large upstream catchment of approximately (64.8 km^2) that discharges through the site as Agate Creek.

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DIAGRAM 2: REGIONAL DRAINAGE



2.3.2 Site Context

The subject site is located on a valley within Agate Creek. The site is bordered to the east and west by an existing ridge and to the south by the Rungulla Road. The majority of the site drains centrally to Agate Creek that has a large upstream catchment as described in **Section 2.3.1**. Elevation data over the lease ranges between approximately RL 422 m to RL 529 m. Local drainage lines at the site are depicted in **Diagram 3.**

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DIAGRAM 3: LOCAL DRAINAGE



2.4 Site Features

Key elements of the proposed project site associated with the water management system are as follows:

- Open cut Pits;
- Waste Rock Dumps (WRD);
- Haul roads;
- ROM Pad;
- Sediment Dams
- Water Storage Dam;

These elements are depicted on **Figure 001** attached in **Appendix A**.

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2.5 Available Data

Data for use in this project was obtained from a variety of sources, these included:

- Elevation Data as a 5 m gridded data set provided by Wulguru Technical Services **[16]**
- ELVIS Digital Terrain Data (DTM). Shuttle Radar Topography Mission (SRTM)-derived 1 Second data was available for the site. This is approximately 30 m gridded data **[10]**;
- Google Imagery **[9]**;
- Australian Rainfall and Runoff (ARR) Data Hub data **[3]**;
- Bureau of Meteorology (BOM) IFD data **[5]**;
- Water Monitoring Information Portal gauge data **[15]**;

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3 METHODOLOGY

3.1 Review of Existing Data

A review of the available data listed in **Section 2.5** was conducted for the site and proposed mine development. The review of background data included importing the data such as topography and imagery, converting to suitable formats (if required), and highlighting any knowledge gaps or errors within the datasets. It is noted that the adopted elevation data and aerial imagery are both coarse satellite datasets, as no detailed site specific information was made available for the development of this report.

3.2 Catchment Modelling

3.2.1 1D Hydrological Modelling

A hydrological model for Agate Creek through the ACGM was developed with the model outlet set downstream of the mine site / mine lease. The model was developed in RORB software, which is a runoff and streamflow routing program used to calculate flood hydrographs from rainfall and other channel inputs **[12]**.

Specific hydrological modelling details are provided in **Section 4**.

3.2.2 2D Hydraulic Modelling

A 2D TUFLOW **[4]** model was then developed to map flood behaviour through the site. An inflow hydrograph and a direct rainfall approach was adopted to model Agate Creek flows as well as localised overland flow paths across the site. This hydraulic model was used to produce flood mapping outputs.

Specific hydraulic modelling details are provided in **Section 5**.

3.3 Sensitivity Testing

Sensitivity testing was conducted to assess how the model behaved due to changes in the major model parameters and hydrological inflows. The sensitivity scenarios that were modelled included:

- Manning's 'n' (+ 50%);
- Increase to the inflow hydrograph (+ 30%);
- Grid sizes to optimise run time versus peak flow and mapping accuracy.

It should be noted that limited data was available at the time of this study, and further information regarding the existing creek conditions along with a detailed site survey should be obtained as part of the detailed design phase for the project. This may require revision to this report if there are changes to the key input parameters.

3.4 Flood Map Outputs

Several flood mapping outputs were produced following the TUFLOW modelling and are presented in **Appendix B**. The mapping outputs include:

0.1% AEP Flood Event:

a. Maximum Flood Depth;
b. Maximum Water Surface Elevations;
c. Maximum Velocities;

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4 1D HYDROLOGICAL MODEL

4.1 Background

A 1D hydrological model was developed in RORB version 6.45 **[12]** to analyse the peak flow at the critical locations by selecting the critical duration and associated ARR temporal pattern. The hydrograph was then used for the 2D hydraulic modelling. The peak flow estimates were also compared to ARR's Regional Flood Frequency Estimation Tool (RFFE) to validate the model.

4.2 Model Development

The Agate Creek catchment boundaries were estimated from the available ELVIS Shuttle Radar Topography Mission (SRTM) **[10]** elevation data. Recommended ARR and RORB parameters were adopted in the model development for Queensland sites. The RORB lag parameter followed ARR's recommended formula based on catchment area **[3]**; as the RORB lag parameter was developed from a series of calibrated models for several QLD gauges.

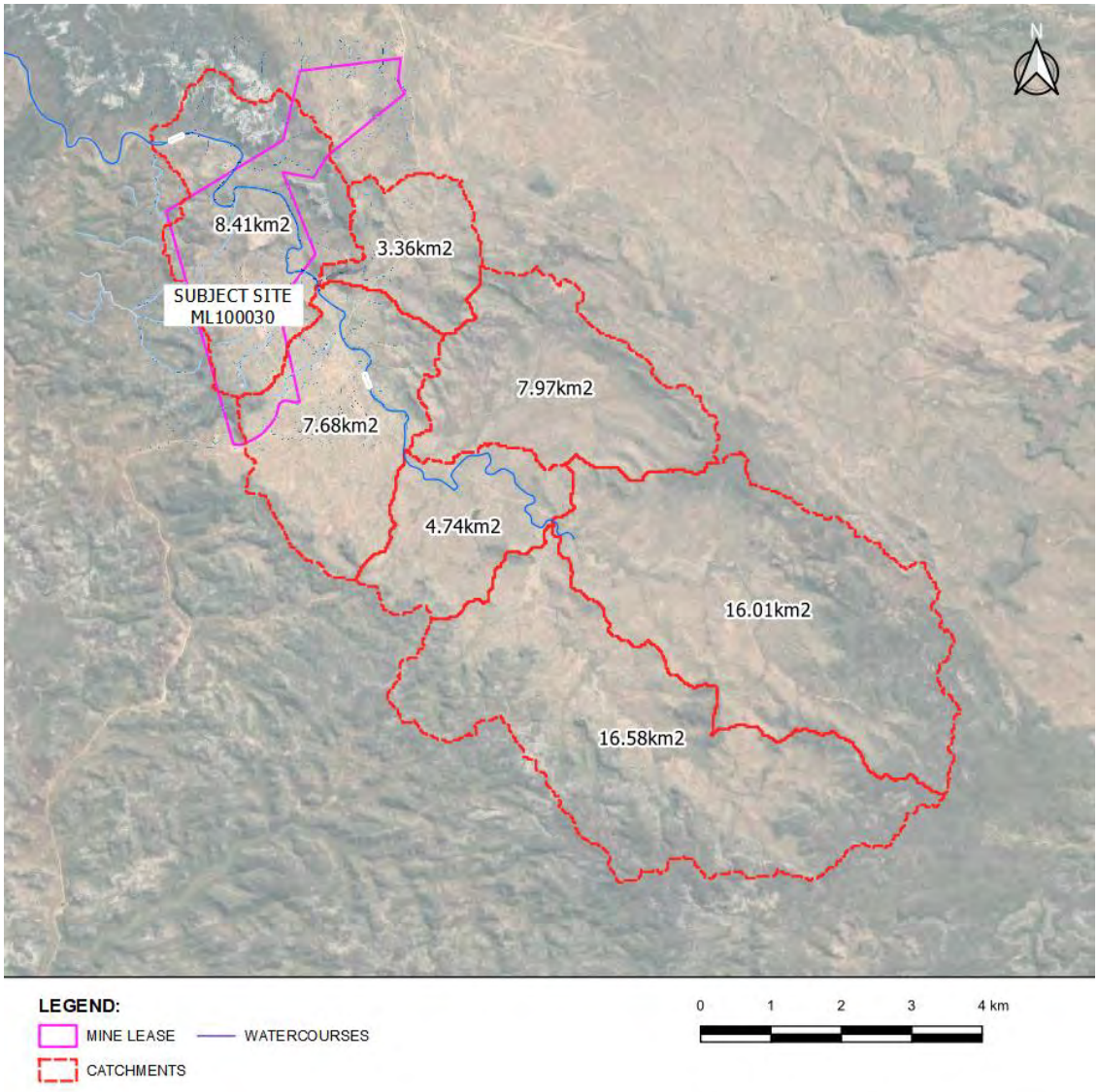
Table 1 summarises the key model inputs adopted in the model.

TABLE 1: RORB MODEL INPUTS

Parameter	Value
	Agate Creek (D/S of Mine Site)
Total Area (ha)	64.8 km^2
Catchment Type	Natural
K_c (lag parameter)	8.02 (as per Eqn 7.6.8 in ARR **[3]**)
Non-linearity 'm' value	0.80
Initial Loss Continuing Loss	24 mm 6.3 mm/hr
Pre-burst Applied	No (given the low pre-burst values under the median condition)
Areal Reduction Factors	Yes

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DIAGRAM 4: MODELLED CATCHMENTS



4.3 Results

The RORB model results are presented in **Table 2** using the methodology described in the preceding sections and compared to the RFFE tool outputs **[2]**. The critical duration event was selected based on the median peak flow for the catchment outlet location.

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TABLE 2: RFFE COMPARISON AT AGATE CREEK

Annual Exceedance Probability % (AEP)	RFFE Tool Peak Flow (m^3/s)			RORB Peak Flow (m^3/s)
	Lower Confidence Limit (5%)	Discharge	Higher Confidence Limit (5%)	Median Event
50	22	54	131	45
20	45	103	243	102
10	59	145	357	126
5	73	190	500	160
2	90	260	748	208
1	105	319	988	271

The RFFE results demonstrate that the RORB model produces reasonable estimates and are well within the confidence limits of the RFFE tool for the peak flows. No further refinement of the RORB model was conducted due to the conceptual assessment of this report and conservative approach taken in estimating the floodplain extents (refer to **Section 6.4**). The RORB model is therefore considered appropriate for use to estimate the 0.1% AEP hydrograph, noting that no losses were applied to the 0.1% AEP event in RORB. The model results have also been sensitivity tested to consider the impacts of higher peak flows through Agate Creek, refer to **Section 6.3**.

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5 2D HYDRAULIC MODEL

5.1 Background

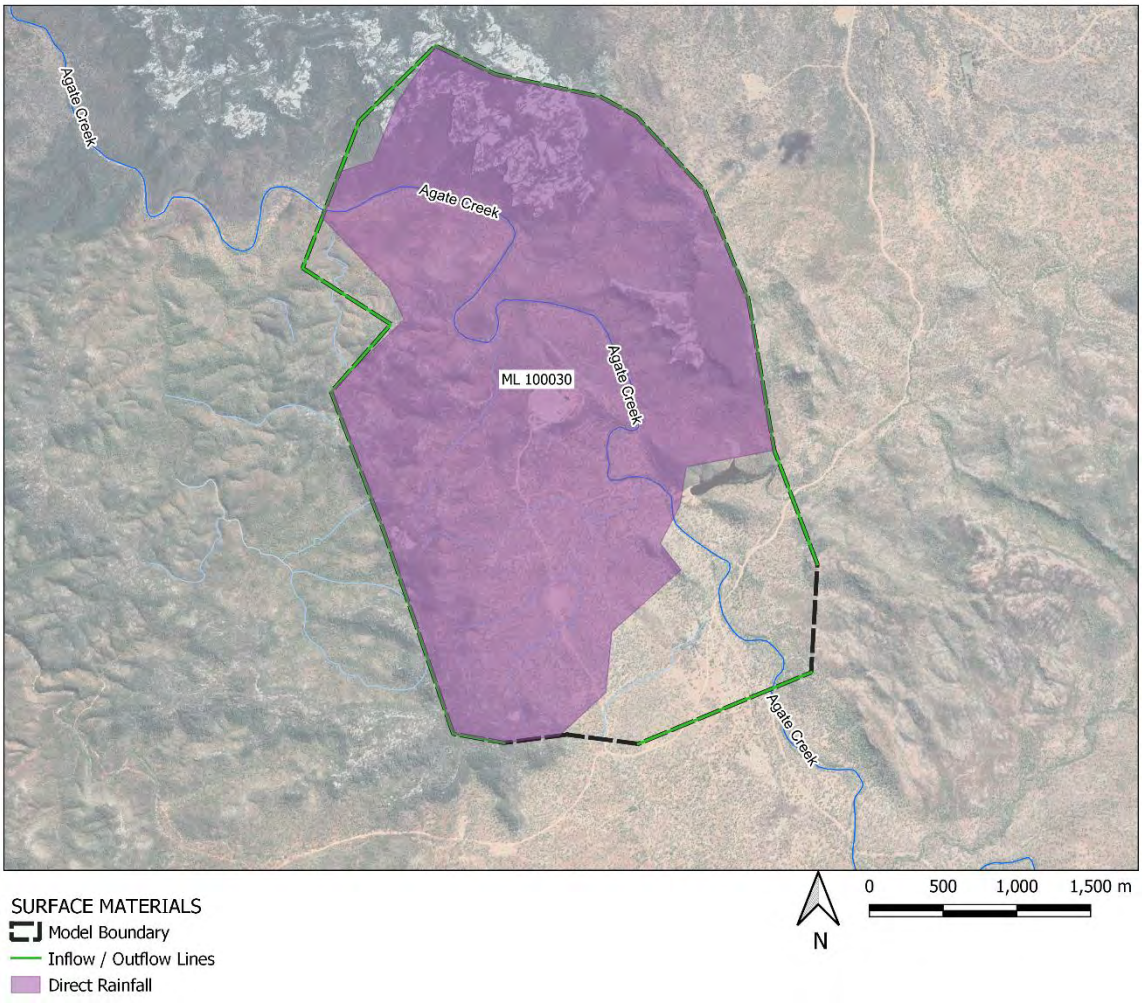
To investigate the potential flooding through the site a flood assessment was conducted using a 2D hydraulic model. TUFLOW software was used for the hydraulic model as it is an advanced 1D/2D/3D computer simulation software that is internationally recognised for hydraulic modelling accuracy, speed and workflow efficiency **[4]**. The software is frequently adopted for regional flooding investigations and urban drainage assessments.

5.2 Model Parameters

5.2.1 Model Extent

The modelled extent is depicted in **Diagram 5.**

DIAGRAM 5: TUFLOW MODEL EXTENTS



5.2.2 Direct Rainfall and Inflow Hydrographs

Direct rainfall was adopted over the mine site area, whist an inflow hydrograph was used at the upstream end of the model extents to represent flow within Agate Creek. The rainfall and hydrograph adopted represented the critical duration based on the RORB outputs for the median peak flow of the 0.1% AEP event with no losses. The inputs are presented in **Table 3** and **Graph 1**.

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GRAPH 2: 0.1% AEP AGATE CREEK INFLOW HYDROGRAPH

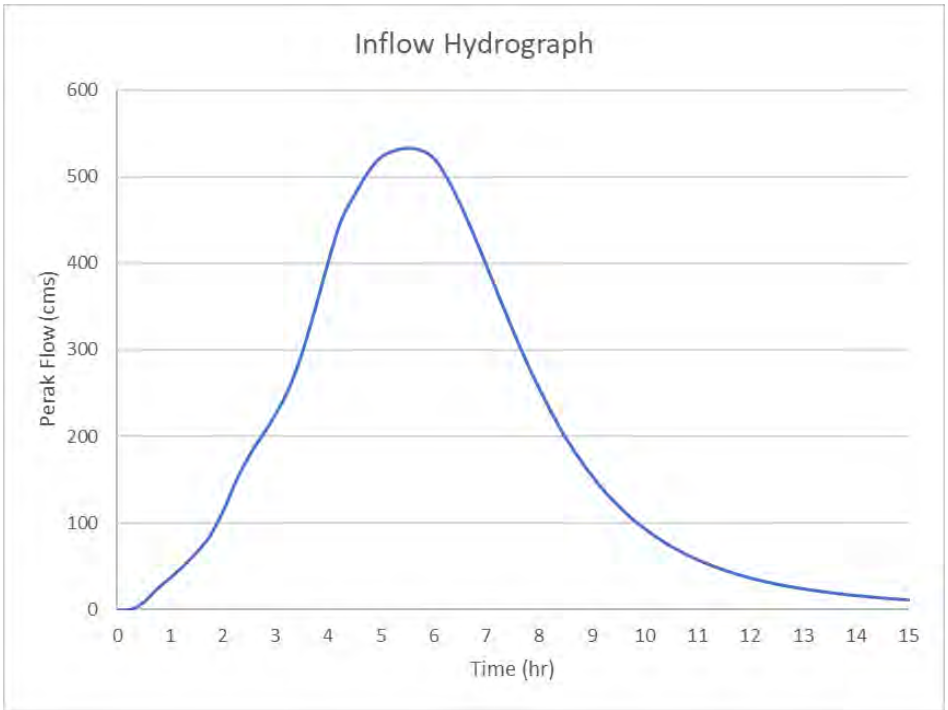


TABLE 3: TEMPORAL TEMPLATES ADOPTED

AEP (%)	Duration_Temporal Pattern
0.1	6 hour_10

5.2.3 Stormwater Infrastructure

No relevant or known stormwater infrastructure exists within the extents of the model domain. **It should be noted that at the time of this flood study, no information regarding a culvert/crossing over Agate Creek to connect the eastern and western areas of the mine site was available, and as such no infrastructure was included in the model**. Any future culvert/crossing over Agate Creek has the potential to worsen the upstream flood extents depending on the drainage design. A revised flood model should therefore be undertaken when design details are known (i.e size of culvert/crossing, road heights, inlet/outlet infrastructure) to check the flood extents against the outcomes of this report.

5.2.4 Model Boundary Conditions

Outflow boundary conditions were placed as illustrated on **Diagram 5**. The outflow boundary conditions were modelled as free-draining outlets with slopes approximated from the elevation data (0.5% was adopted to Agate Creek). It was assumed that Agate Creek is not impacted by backwater or tailwater levels at this location.

5.2.5 Surface Roughness and Losses

The default surface roughness was modelled as a depth-varying Manning's 'n' value, and aerial imagery indicates similar vegetation conditions over the undisturbed site areas and the external catchments. **Diagram 6** illustrates the surface materials adopted in the modelling.

A depth-varying Manning's 'n' value was adopted for the natural grasses due to the relatively high natural grassland over the catchment surfaces and sheet flow conditions being dominant within the flatter areas of the catchment. The parameters adopted for all surfaces are illustrated in **Table 4**.

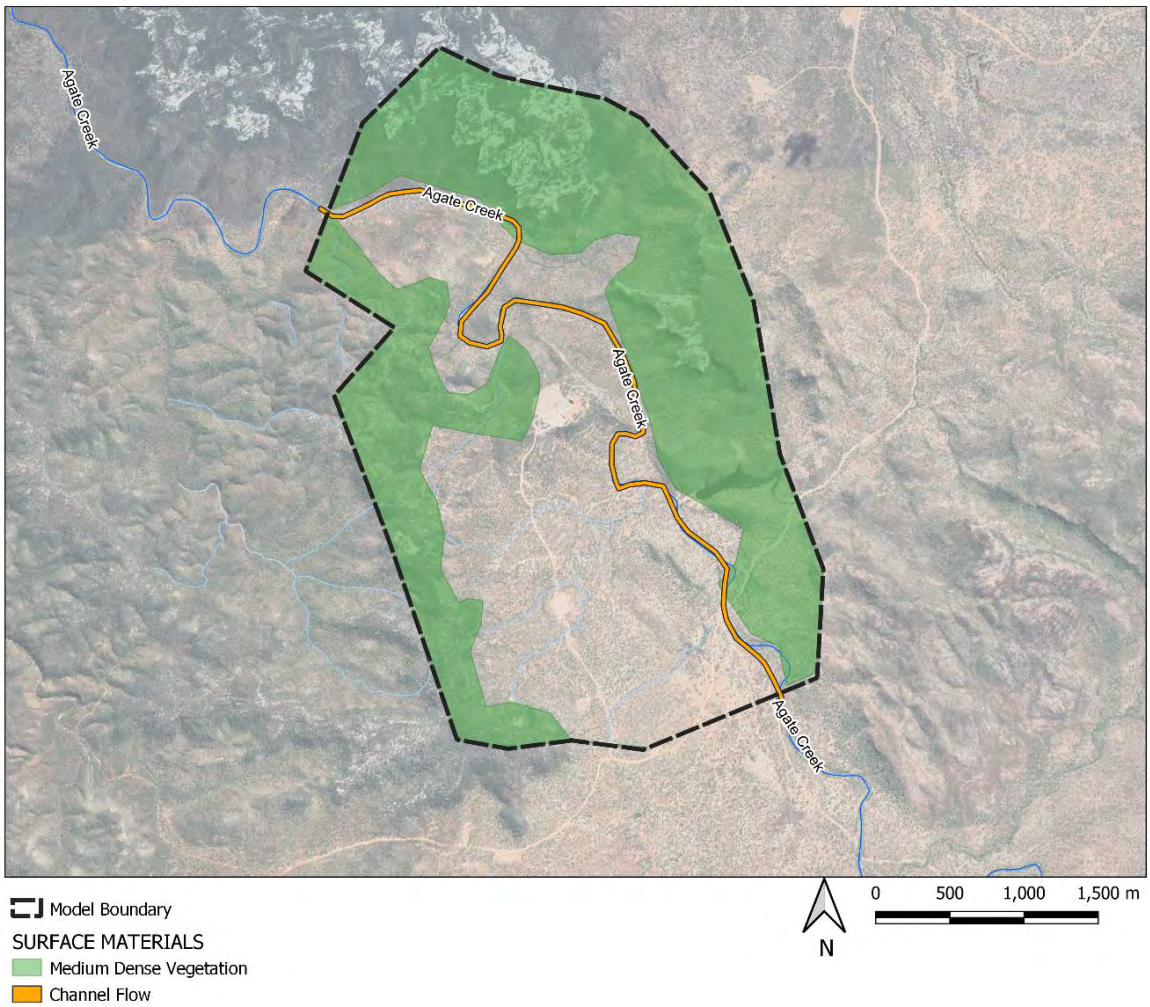
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TABLE 4: MANNING'S SURFACE ROUGHNESS PARAMETERS

Description	Manning's 'n'	Infiltration (IL, CL) (mm)	Losses Direct Rainfall Depth (IL, CL) (mm)
Floodplain (default where not overlayed by a material below)	Depth varying: Depth = 0 m to < 0.3 m, n = 0.2 Depth ≥ 0.3 m, n = 0.050	0, 0	0, 6.3
Medium Density Trees	0.075	0, 0	0, 6.3
Channel Flow	0.030	0, 0	

The above values are assumed using Innovyze's recommended 2D Manning's 'n' values **[11]** as well as Brisbane City Council's Manning's Roughness document **[7]**.

DIAGRAM 6: SURFACE MATERIALS ADOPTED



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5.2.6 Model Time Step and Grid Size

The model was initially run with a 30 m grid size to assess the model performance. This grid size was iteratively reduced to 5 m to optimise the run times whilst providing accurate results. The model also adopted TUFLOW's SGS (Sub-Grid Sampling) capability to enable accurate modelling outputs and practical run times. An adaptive time step was adopted, with 1 second being the minimum set value.

5.3 Model Scenarios

The following scenario was modelled:

- 0.1% AEP (existing conditions to determine Agate Creek floodplain)

The results are discussed in **Section 6**.

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6 RESULTS

6.1 Flood Depths and Elevations

The mapped results of the hydraulic modelling are provided in **Appendix B**. The results indicate that flooding of Agate Creek overtops the creek's banks and generally follows the watercourse alignment. The 0.1% event maximum flood depths vary from shallow depths on the outer banks to approximately 6-8 m in deeper areas of the creek. Flow predominately runs along the eastern extents of the proposed mine development area and flows to the northwest.

Pit 5 within the southern portion of the mine development area was found to have the least freeboard to the estimated flood levels at approximately 6 m. All remaining pit voids were well clear of the of the floodplain.

6.2 Velocities

The flood event velocities are of high magnitude within the creek due to the relatively narrow channel and high peak flows. In the 0.1 % AEP event, velocity over the inundated Agate Creek floodplain vary between 0.5 - 5 m/s. Overland flow velocities from local gullies within the site were of less magnitude at only 0.5 m/s to 1.5 m/s. However, noting that localised velocities within the mine development area should be assessed as part of a site specific detailed design of diversion bunds and drains for the site features.

6.3 Sensitivity Testing

The results of the sensitivity testing demonstrated that the model was not significantly sensitive to a change in Manning's 'n' in the surrounding vegetated areas. A 50% increase in all of the Manning's 'n' values resulted in the average maximum water elevations raising by approximately 0.3 m in Agate Creek. A 30% increase in peak flows resulted in an average increase of approximately 0.25 m to the water surface elevations within Agate Creek. Both sensitivity testing scenarios did not result in any of the voids being inundated by the 0.1% AEP event floodplain.

The selected grid size was found to produce accurate results with minimal mass balance errors, and reducing the grid size further did not result in significantly different results to those presented in this FIA.

6.4 Development Implications

The key mine development area, in addition to the existing and proposed voids are all clear of the 0.1% floodplain extents in accordance with the PRCP Guidelines **[8]**. **Appendix B** illustrates a conservative floodplain extent approximated from the maximum flood depths and elevations outputs. Pit 5 was found to have the least freeboard to the 0.1% floodplain water surface elevation at approximately 6 m above the adjacent maximum water surface elevations. The sensitive testing confirmed the importance of accurate input data, and the model should be revised in the detailed design phase when more accurate elevation data and photos of the Agate Creek floodplain are made available. Furthermore, any future infrastructure proposed over Agate Creek may have the potential to change the outcomes of this report, and the flood model should therefore be revised as part of future detailed drainage designs. This is important as any changes to the natural flow path may result in increased flood levels due to the varying terrain and flood widths of Agate Creek. These aspects must be considered for the detailed design phase to confirm there are no voids proposed within the floodplain.

7 SUMMARY AND CONCLUSION

This Flood Impact Assessment (FIA) report was developed to assist with the EA Amendment and Progressive Rehabilitation and Closure Plan (PRCP) for the Agate Creek Gold Mine. The results indicate that Agate Creek floodplain traverses through the subject mine lease (ML100030), with the major mine development features outside of the floodplain extents. Specifically, it was found that the proposed open cut pits (voids) are not impacted by the 0.1% AEP flood event. This is in accordance with Non-use Mining Areas (NUMA) as per the DES PRCP guidelines.

It should be noted that a key input to the flood model was the underlying elevation file adopted for the site. The elevation file provided was a relatively coarse satellite dataset, and the flood model should therefore be checked when detailed site survey is made available. Furthermore, no crossing/culvert over Agate Creek was proposed as part of this assessment for the initial mining operational period. Any future crossings/culverts proposed over the creek should therefore be reassessed to determine any potential upstream or downstream flood impacts to mine development areas.

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8 REFERENCES

[1] Australian Rainfall and Runoff (2022), 'ARR Data Hub', available from: https://data.arr-software.org/

[2] Australian Rainfall and Runoff (2022), 'Regional Flood Frequency Estimation Tool (RFFE)', available from: https://rffe.arr-software.org/limits.html

[3] Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), 2019, Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia

[4] BMT (2018) 'TUFLOW Classic/HPC User Manual'

[5] Bureau of Meteorology (BOM) 'Design Rainfall Data System (2016)', available from: http://www.bom.gov.au/water/designRainfalls/revised-ifd/

[6] Bronze Digital Atlas of Australia, "Weather of Agate Creek, QLD," [Online]. Available: http://www.bonzle.com/c/a?a=p&p=241233&cmd=sp&d=w&c=1&x=143%2E50505&y=%2D18%2E933525&w=28640&mpsec=0

[7] Brisbane City Council (2003) 'Natural Channel Design Guidelines' Brisbane City Council, Brisbane, Australia

[8] Department of environment and Science (DES) (2021), 'Progressive rehabilitation and closure plans (PRC plans)'

[9] Google Earth, accessed 2022, available from: https://earth.google.com/

[10] Intergovernmental Committee on Surveying and Mapping (2022), 'Elevation and Depth - Foundation Spatial Data', available from: https://elevation.fsdf.org.au

[11] Innovyze (2021) 'Recommended Manning's 'n' values - Open Channel', Innovyze Help Centre

[12] Laurenson, E.M. et al. (2010), 'Rorb Version 6 User Manual', Monash University Department of Civil Engineering in conjunction with HARC and Melbourne Water Corporation

[13] Queensland Government, "SILO - Australian climate data from 1889 to yesterday," 2022. [Online]. Available: https://www.longpaddock.qld.gov.au/silo/point-data/

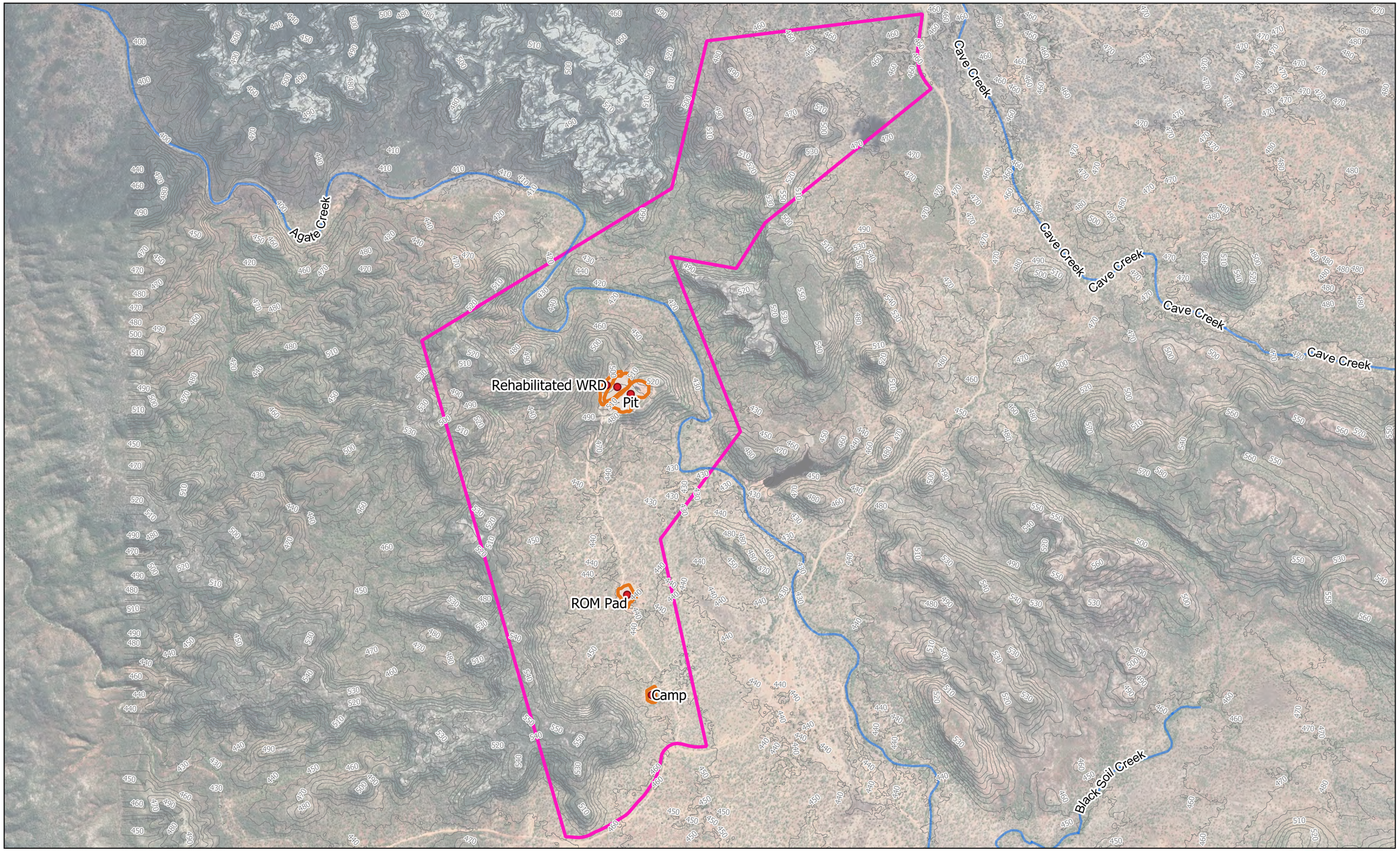
[14] Queensland Government, "Northern Queensland fossicking," 2022. [Online]. Available: https://www.qld.gov.au/recreation/activities/areas-facilities/fossicking/north-qld/agate-creek.

[15] Queensland Government, "Water Monitoring Information Portal," 2022, available from: https://water-monitoring.information.qld.gov.au/

[16] World DEM (2022) ' WorldDEM Neo' available from: https://www.intelligence-airbusds.com/imagery/reference-layers/worlddem/

APPENDICES

APPENDIX A – ATCW CONCEPT FIGURES



- LABLES
- MINE LEASE
- EXISTING FEATURES
- EXISTING CONTOURS 10m
- MAJOR WATERCOURSES

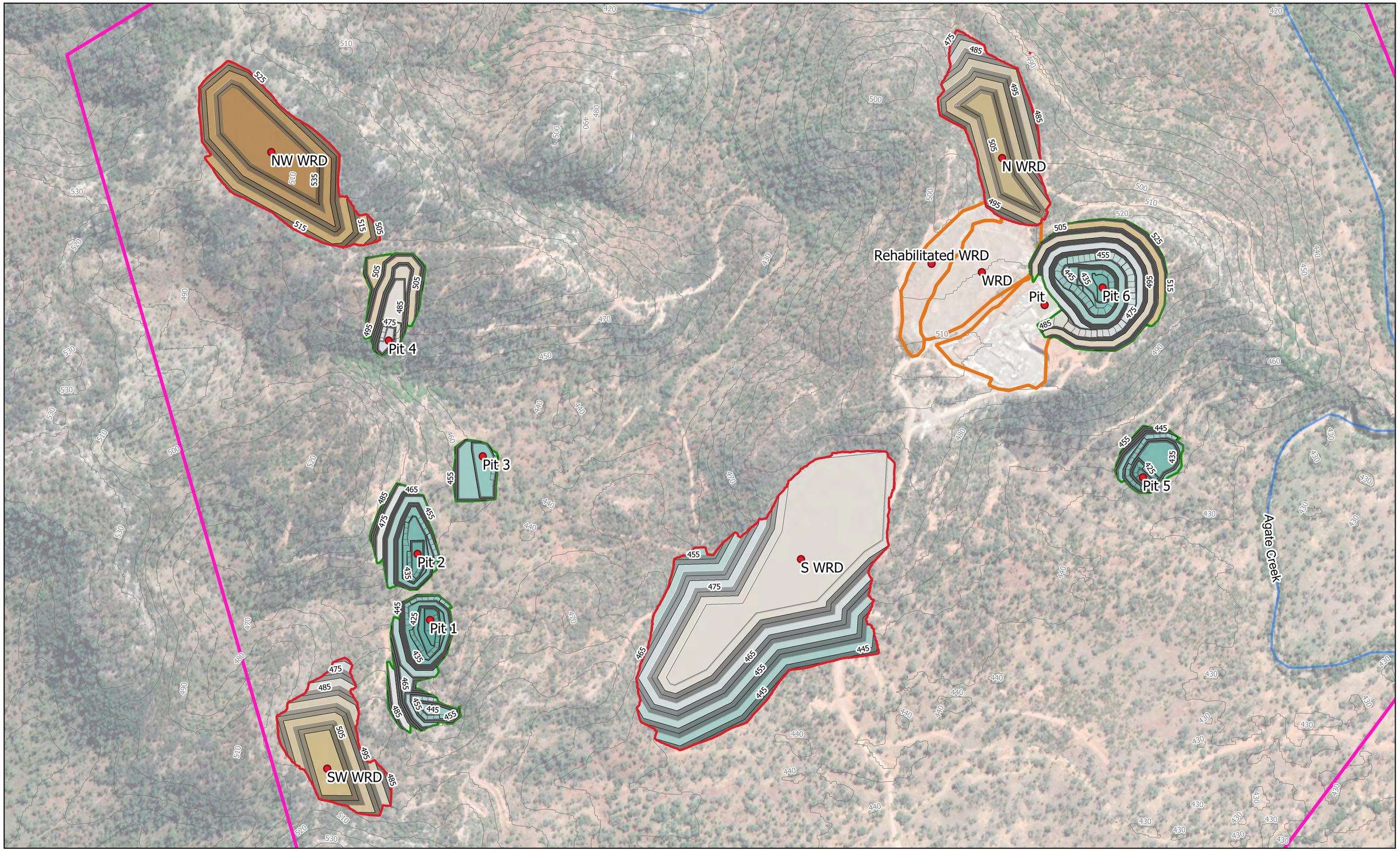
FIGURE 001
EXISTING FEATURES
AGATE CREEK GOLD MINE

N

0 500 1,000 1,500 m

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- LABLES
- MINE LEASE
- EXISTING FEATURES
- WRD FOOTPRINTS
- PIT FOOTPRINTS
- EXISTING CONTOURS 10m
- AGATE CREEK

WRD & PIT DESIGN

- 400.00
- 437.50
- 475.00
- 512.50
- 550.00

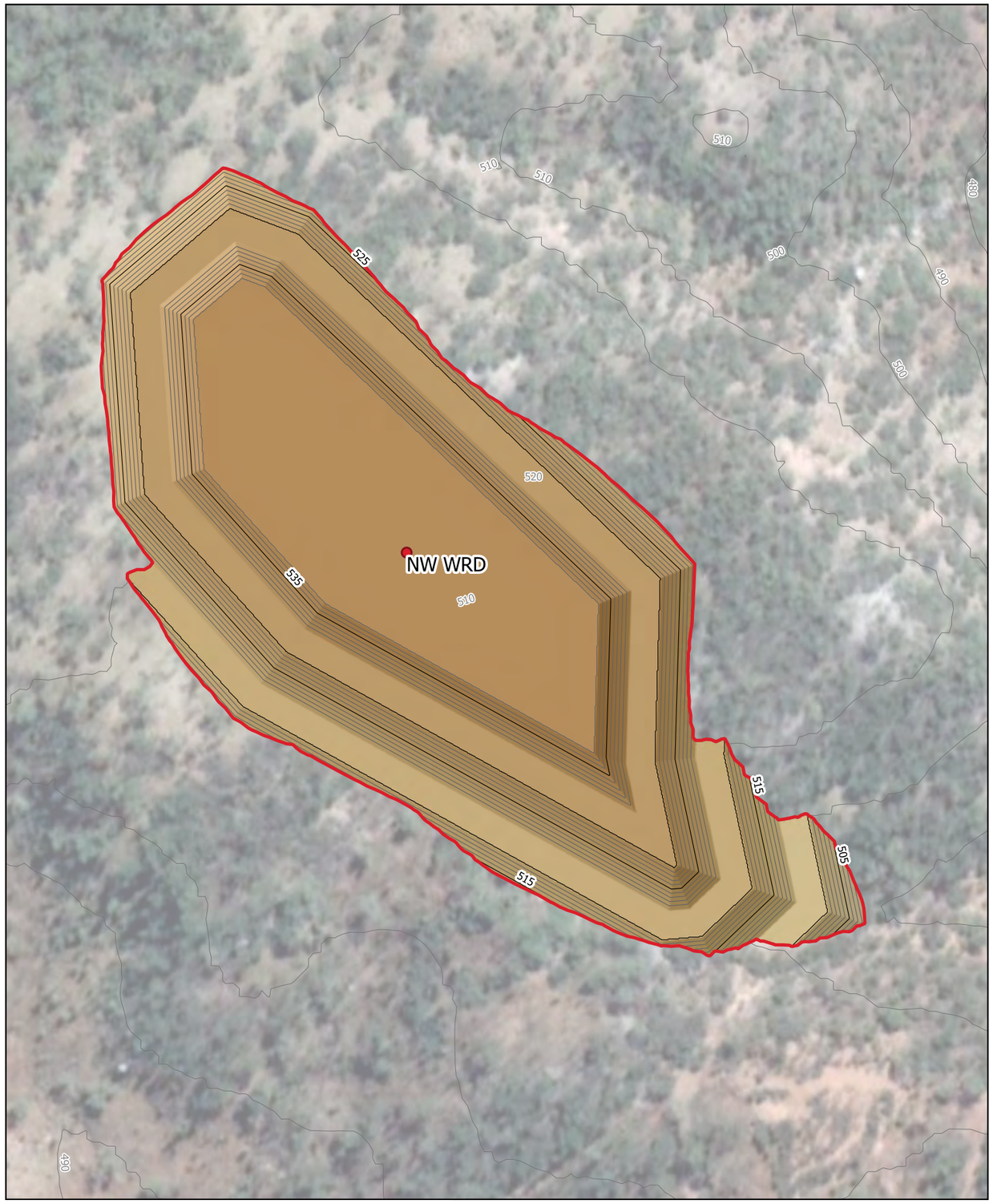
FIGURE 002
PROPOSED LAYOUT
AGATE CREEK GOLD MINE

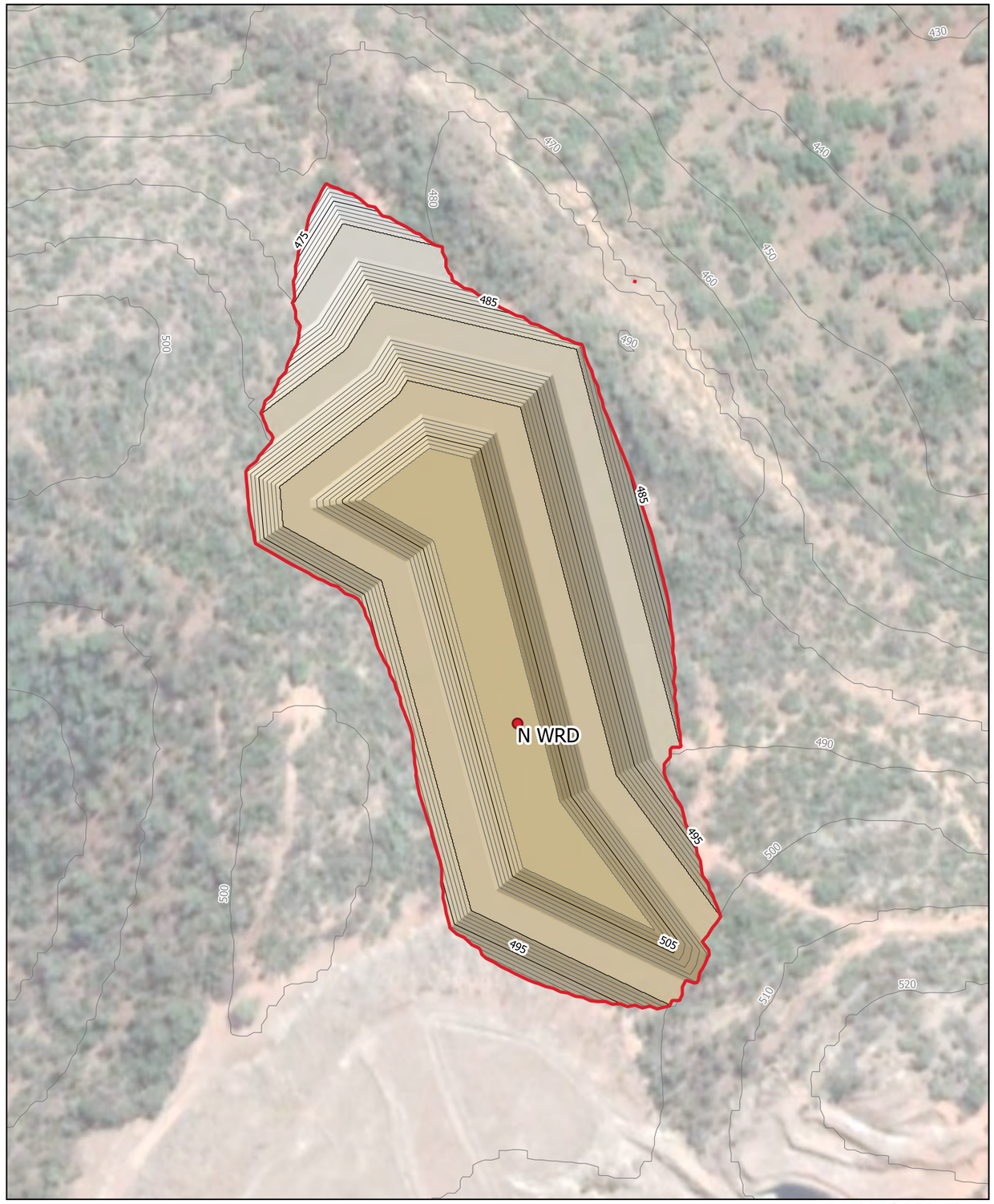
N

0 100 200 300 m

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LABLES
MINE LEASE
WRD FOOTPRINTS
EXISTING CONTOURS 10m

WRD DESIGN
400.00
437.50
475.00
512.50
550.00

FIGURE 003
PROPOSED NORTH-WEST & NORTH WASTE ROCK DUMP
AGATE CREEK GOLD MINE

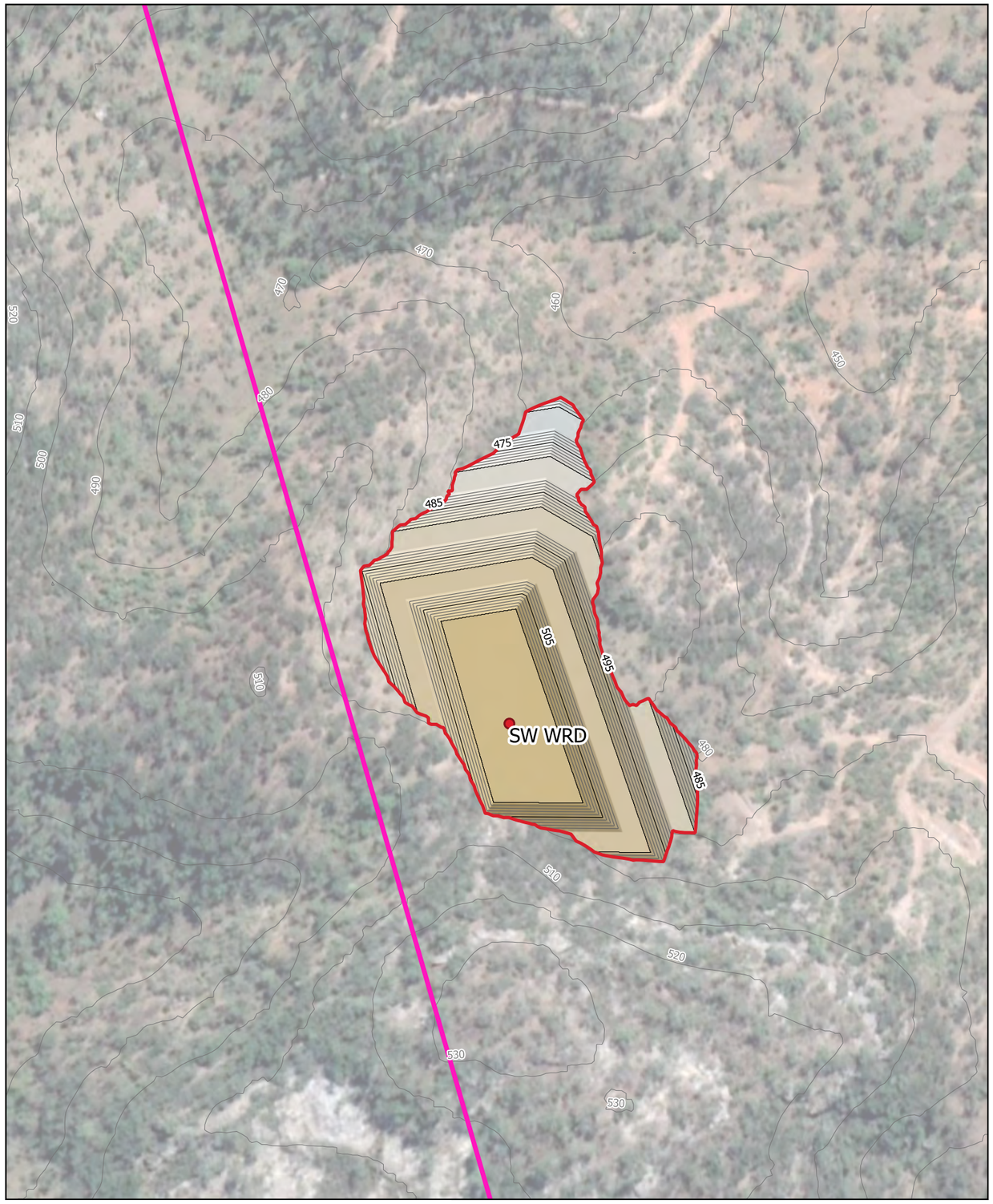
N

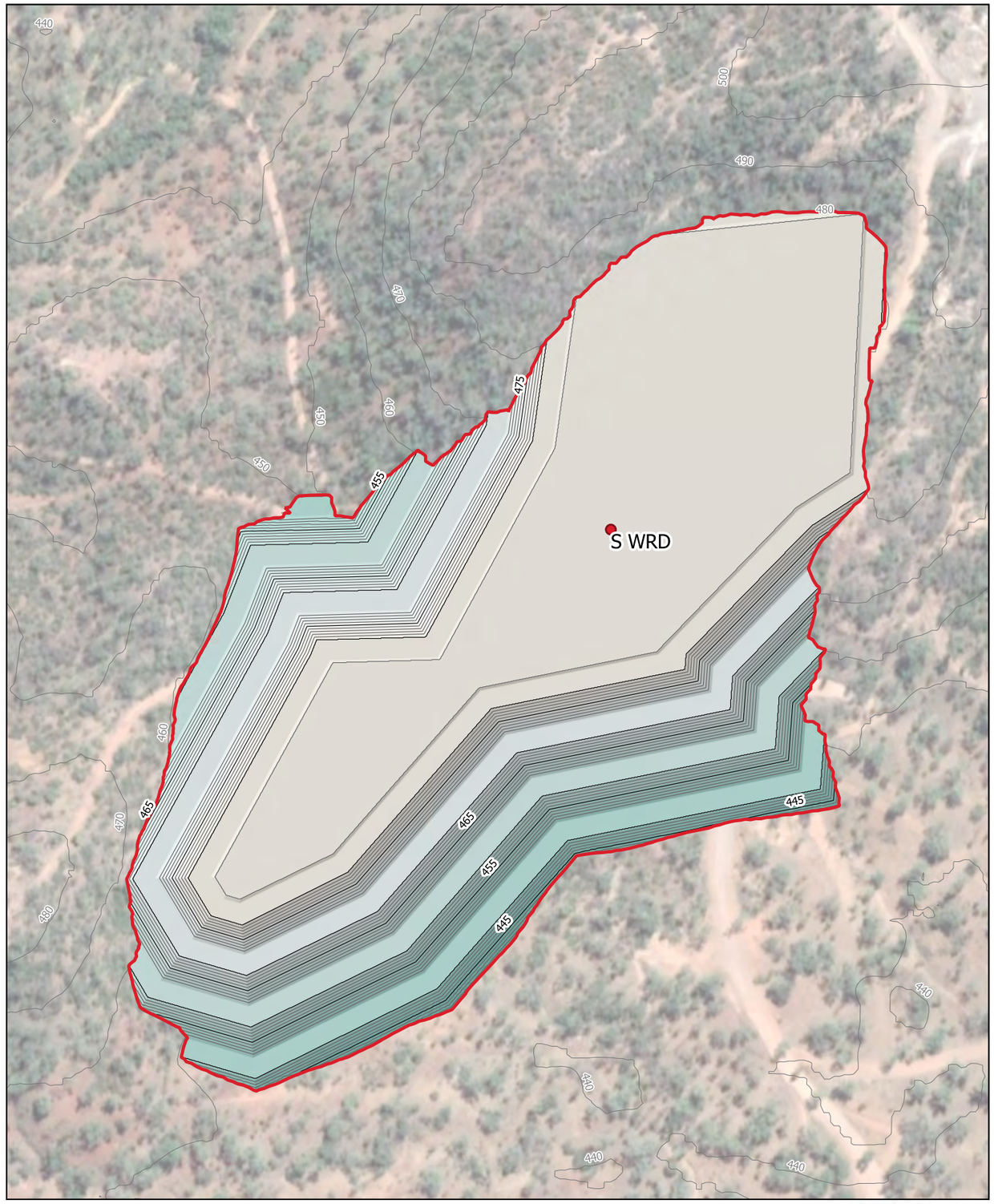
0 50 100 150 m

ATC WILLIAMS

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- LABLES
- MINE LEASE
- WRD FOOTPRINTS
- EXISTING CONTOURS 10m

WRD DESIGN
- 400.00
- 437.50
- 475.00
- 512.50
- 550.00

FIGURE 004
PROPOSED SOUTH-WEST & SOUTH WASTE ROCK DUMP
AGATE CREEK GOLD MINE

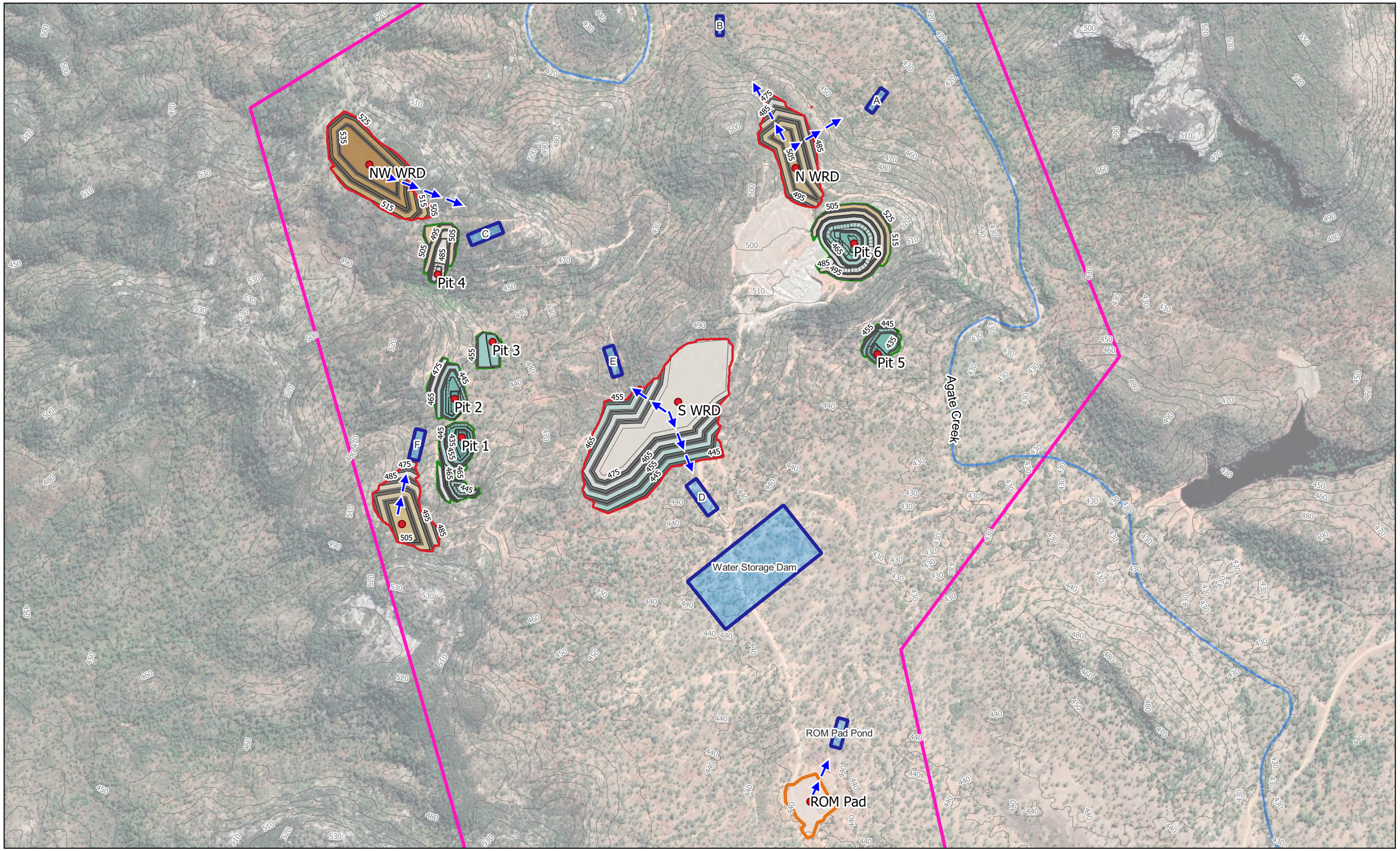
N

0 50 100 150 m

ATC WILLIAMS

REF: 116091.17 DATE: 2022-07-27

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- LABLES
- MINE LEASE
- EXISTING FEATURES
- WRD FOOTPRINTS
- PIT FOOTPRINTS
- EXISTING CONTOURS 10m
- AGATE CREEK
- FLOW PATH
- SEDIMENT PONDS / WATER SRORAGE

WRD & PIT DESIGN

- 400.00
- 437.50
- 475.00
- 512.50
- 550.00

FIGURE 005
PROPOSED WATER MANAGEMENT PLAN
AGATE CREEK GOLD MINE

N

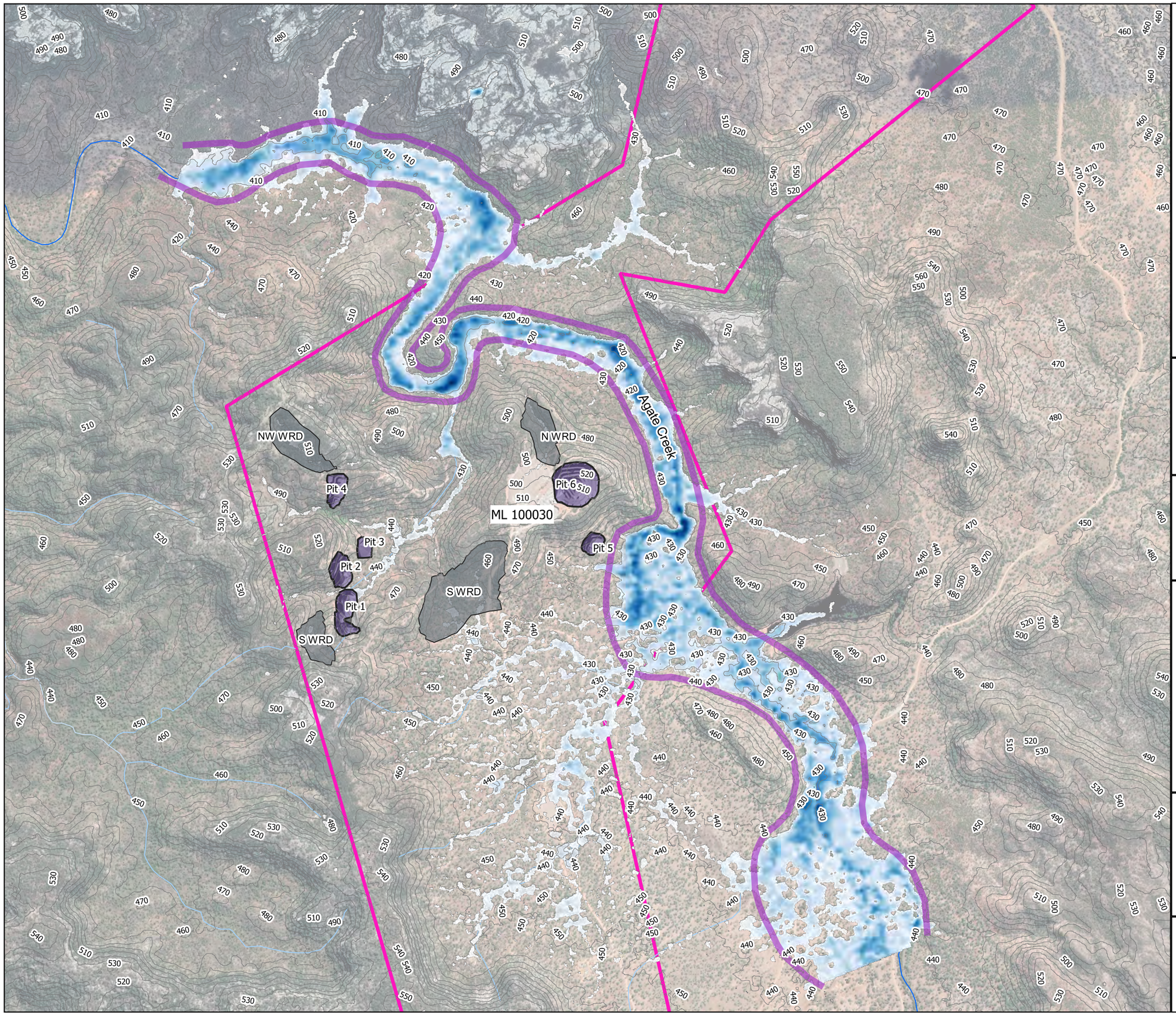
0 200 400 600 m

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APPENDIX B – FLOOD MAPPING OUTPUTS

TAILINGS.WATER.WASTE.



LEGEND

- MINE LEASE
- EXISTING SITE CONTOURS 10m
- ASSUMED FLOODPLAIN EXTENTS

MAXIMUM WATER DEPTH (m)

- < = 0.1
- 0.1 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8

FIGURE 001

0.1% AEP Maximum Water Depth

AGATE CREEK GOLD MINE

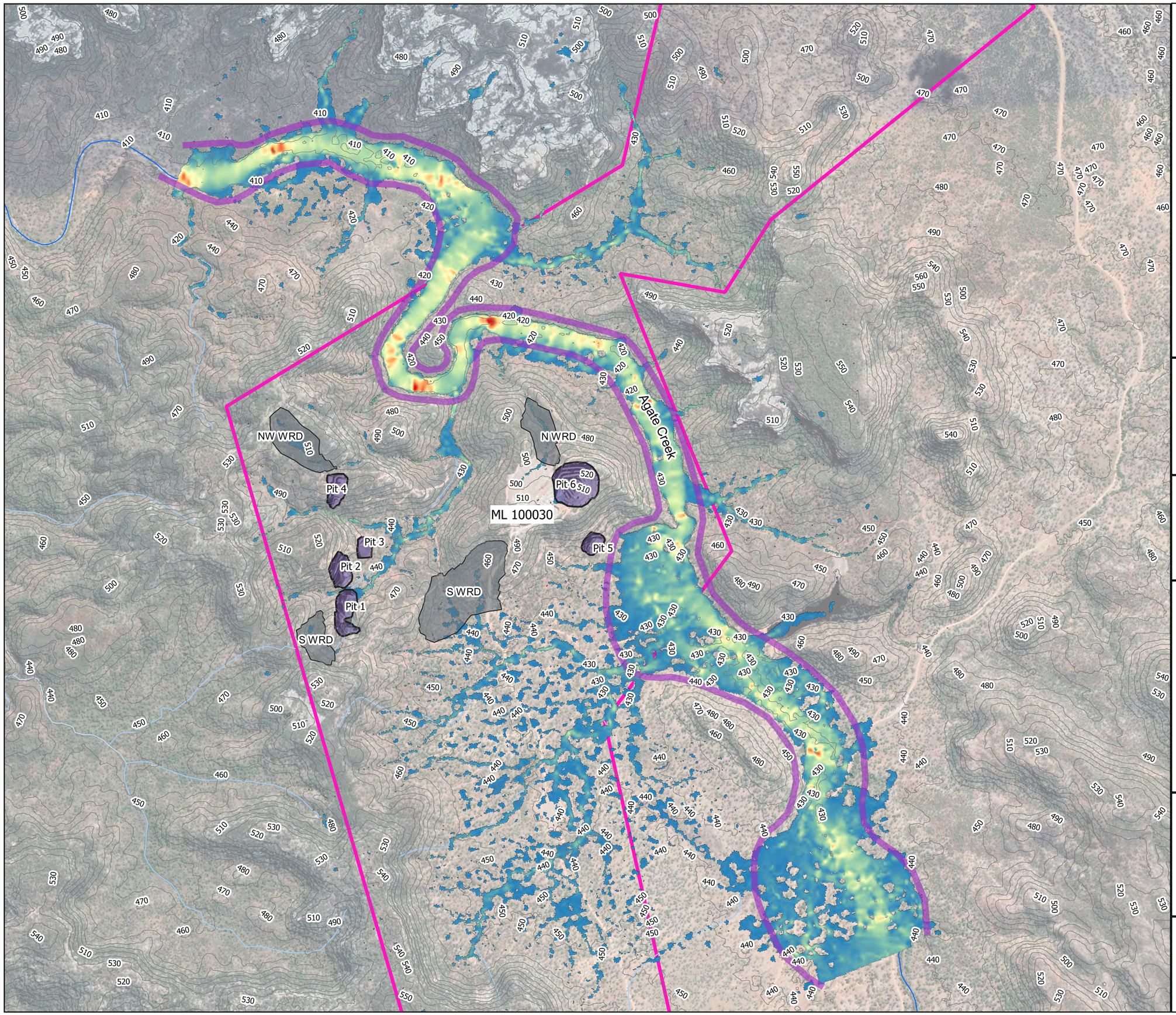
N

0 300 600 900 m

ATC WILLIAMS

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LEGEND

- MINE LEASE
- EXISTING SITE CONTOURS 10m
- ASSUMED FLOODPLAIN EXTENTS

MAXIMUM VELOCITY (m/s)

- 0.0
- 1.0
- 2.0
- 3.0
- 4.0
- 5.0
- 6.0

FIGURE 002

0.1% AEP Maximum Velocity

AGATE CREEK GOLD MINE

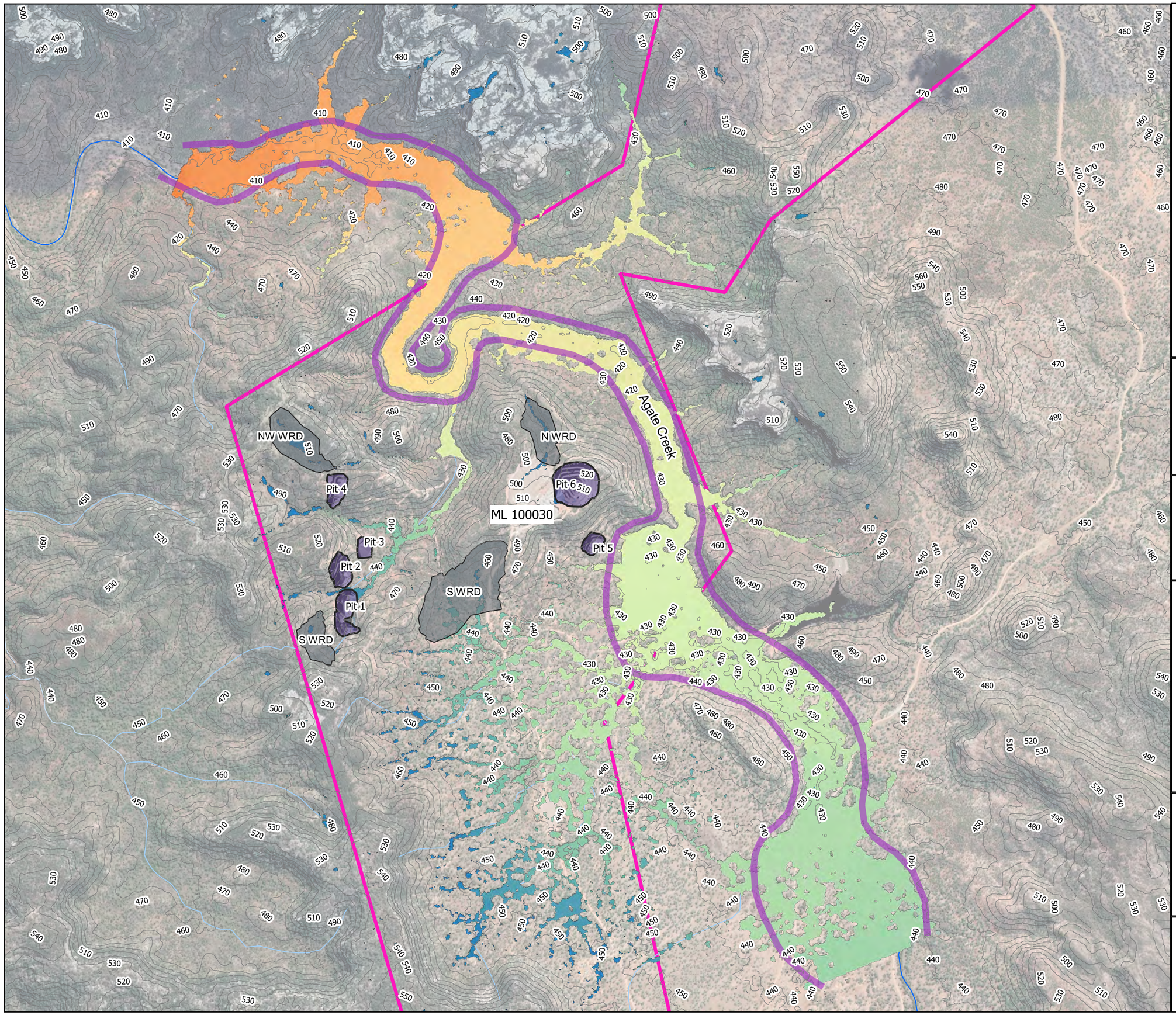
N

0 300 600 900 m

ATC WILLIAMS

REF: 116091.17 DATE: 2022-07-27

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LEGEND

- MINE LEASE
- EXISTING SITE CONTOURS 10m
- ASSUMED FLOODPLAIN EXTENTS

MAXIMUM WATER ELEVATION (RL m)

- 400
- 410
- 420
- 430
- 440
- 450

FIGURE 003

0.1% AEP Maximum Water Elevation

AGATE CREEK GOLD MINE

N

0 300 600 900 m

ATC WILLIAMS

REF: 116091.17 DATE: 2022-07-27

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