MEMORANDUM

Project:	Calliope PRCP	Date:	27 June 2025
To:	Epic Environmental	From:	Engeny
ATT:	Shaille Hill	CC:	Romin Nejad
Subject:	Calliope Limestone Quarry PRCP – Final Landform Flood Assessment		

FINAL LANDFORM FLOOD ASSESSMENT

Engeny have been engaged by Epic Environmental (Epic) to undertake the flood assessment of the proposed final landform for the closure of the Calliope Limestone Quarry. Epic have supplied Engeny with the final landform surface which is proposed to be constructed by end of life in the year 2100. Engeny have undertaken flood modelling of the key waterways and final landform surface to assess susceptibility and influence across the Site to inform rehabilitation and final landform planning regarding flood runoff. It is noted that the Site is bounded by Awoonga Lake on the eastern side and a tributary of the Boyne River on the western side. The flood assessment was completed to comply with Section 3.6.1 of the *Progressive Rehabilitation and Closure Plans Guideline (DES, March 2021).*

Hydrology

Development of a hydrologic model of the catchment was undertaken to determine runoff hydrographs for a range of storm Annual Exceedance Probabilities (AEPs) and durations. The 1% AEP, 0.1% AEP, 0.01% AEP and Probable Maximum Flood (PMF) design storms were applied to key overland flow paths with consideration of future mine domains and landforms to determine potential flood risks to the ongoing stability of the final landform.

PMF rainfall depths were developed in accordance with *The Estimation of Probably Maximum Precipitation in Australia: Generalised Short-Duration Method (BoM, 2003).* Only the burst of the PMF was modelled and therefore it is assumed that sufficient pre-burst rainfall has occurred such that the soil conditions are saturated, therefore an initial/continuing loss regime of 0 mm & 1 mm/h was adopted. The full ensemble of the ten rarest temporal patterns were modelled as well as the BoM Average Variability Method (AVM) temporal pattern to determine the median catchment response.

0.01% AEP rainfall depths were determined by interpolating between the 0.1% AEP and PMF storm depths. Losses for events exceeding the 1% AEP storm were interpolated between the 1% AEP and PMF.

The temporal patterns for the 1% AEP match the 10 ensemble patterns recommended in ARR 2019, events rarer than the 1% AEP adopted the same temporal patterns as the PMF.

Hydraulics

Development of a hydraulic model of the mine area and tributary waterway downstream was undertaken to determine the flood risk profile in the final landform scenario. Modelling of the design storms included the effects of the tributary waterway to represent any potential alteration of flows upstream and downstream of the Site. The effects of Awoonga Lake was considered by applying the tailwater level consistent with the design of the outlet weir control structure as extracted from the 1m LiDAR dataset. Model inflows and domains were applied to appropriately represent key overland flow paths and potential flood levels or ponded areas to determine the extent of flooding in the final landform scenario.

A summary of the key model inputs for hydrology and hydraulics are provided below in Table 1.

The final landform surface as modelled in TUFLOW is shown below in Figure 1 and the catchment breakdown is provided in Figure 2.

TABLE 1: FINAL LANDFORM MODEL ASSUMPTIONS

Model Item	Data Used	Source
Catchments	Gladstone 2009 1m LiDAR Final Landform Surface	Elevation and Depth Foundation Spatial Data (ELVIS) Epic Environmental
Rainfall	**1% & 0.1% AEP** BOM IFD's **0.01% AEP** Interpolated between 0.1% AEP and PMF **PMF** *The Estimation of Probably Maximum Precipitation in Australia: Generalised Short-Duration Method*	Bureau of Meteorology
Temporal patterns	**1% AEP** ARR ensemble patterns **Events rarer than the 1% AEP** 10 rarest temporal patterns BoM AVM	Australian Rainfall and Runoff (ARR) 2019 Bureau of Meteorology
Catchment hydrographs	WBNM hydrologic software package	
DEM	Gladstone 2009 1m LiDAR Final Landform Surface (dxf dated 250528)	Elevation and Depth Foundation Spatial Data (ELVIS) Epic Environmental
Hydraulic roughness	Final Landform Land Use	Epic Environmental
Tailwater	Gladstone 2009 1m LiDAR	Elevation and Depth Foundation Spatial Data (ELVIS)
Flood Extents	TUFLOW hydraulic software package	

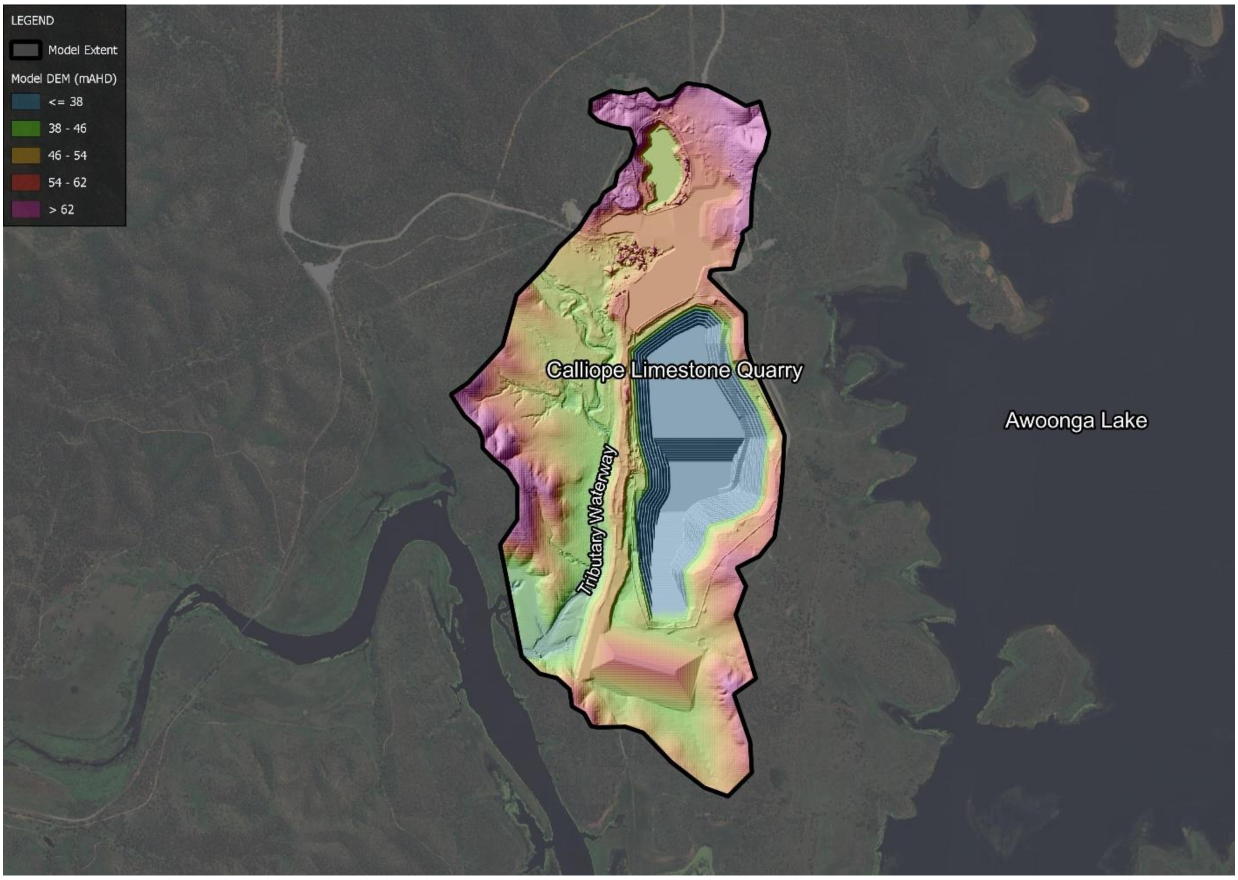


Figure 1: Final Landform DEM

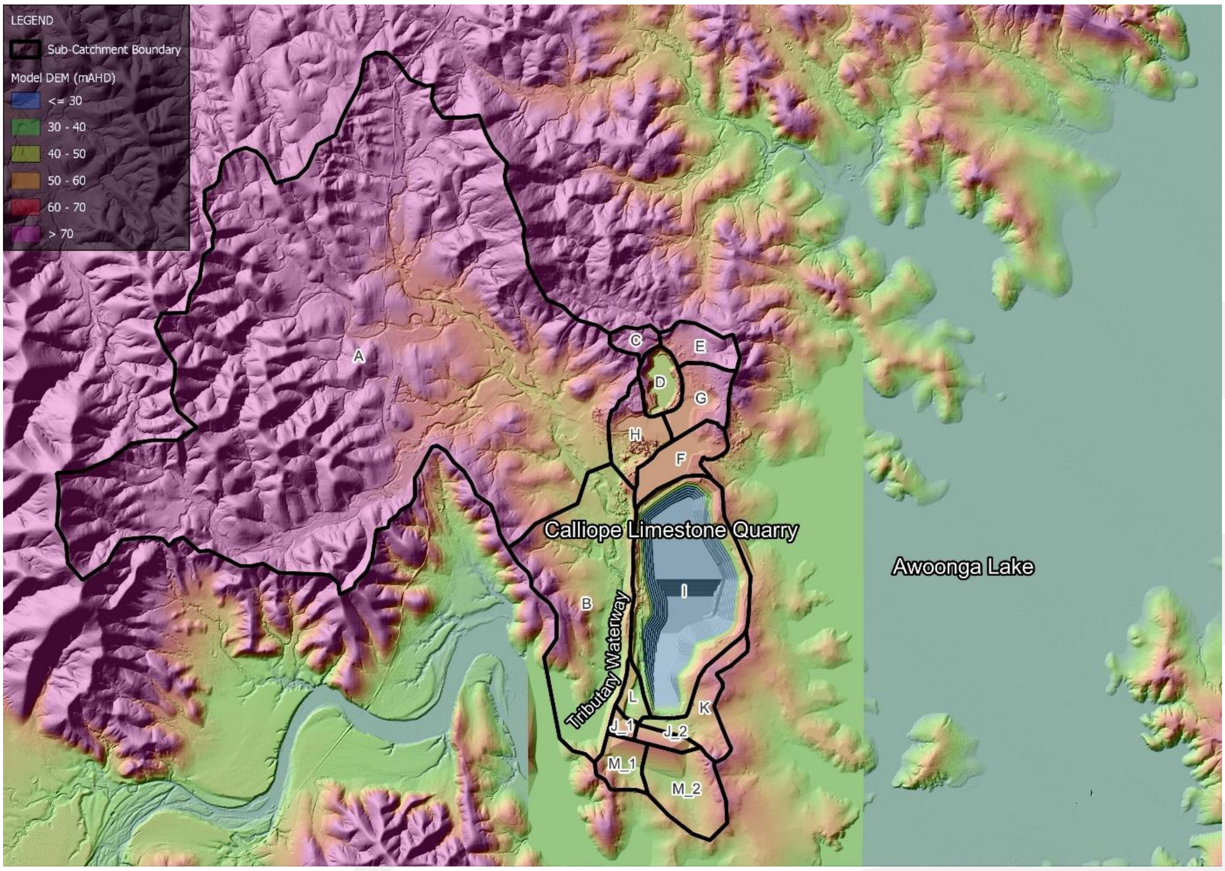


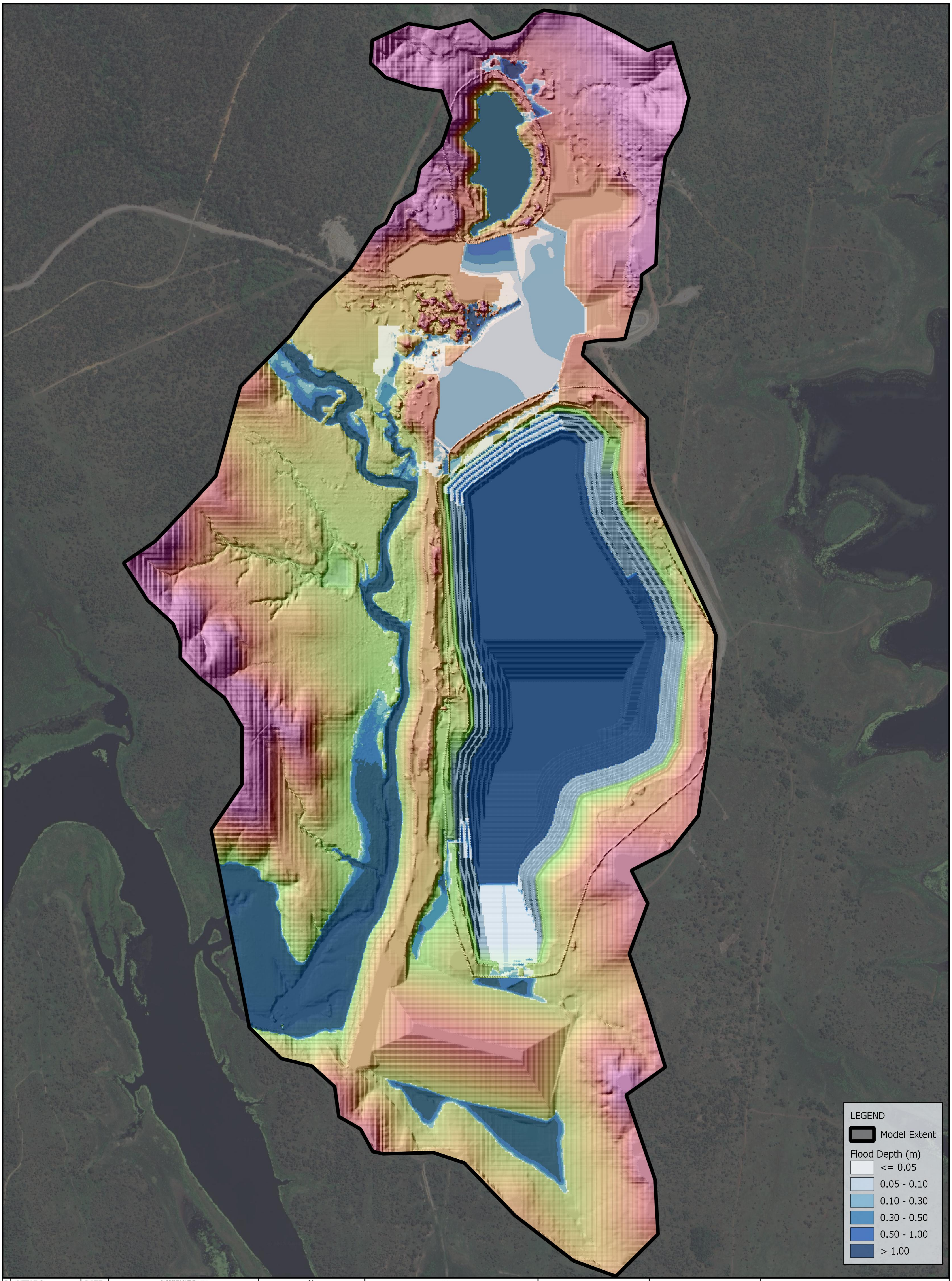
Figure 2: Catchment Breakdown

Final Landform Flood Risk Profile

The flood depth and velocity mapping of the final landform scenario is shown below in Figure 3 to Figure 10. The flood depth maps demonstrate that ponding is anticipated to occur across the Site following all simulated flood events, with standing water expected both within and external to the voids.

It is noted that there are 4 locations at Pit 3-4, and 1 location at Pit 2, where inflow to the voids is observed by overtopping of the pit protection structures. Overtopping of the pit protection structures is predicted to occur in all simulated design events. However, these void inflows are caused by local catchment runoff only and it is not anticipated that the flooding within the tributary of the Boyne River on the western side would generate any inflows to the voids based on the flood results and ground levels.

Velocities at the pit inflow locations are in excess of 1.5 m/s based on the velocity mapping. It is therefore recommended that these locations are suitably protected (i.e. with rock, or some alternative form of armouring), to minimise scour potential and ensure the longevity of the final landform. Velocities across the remainder of the landform are generally less than 1.5 m/s and can therefore be protected from erosion through application of revegetation outcomes. There is a location adjacent Pit 2 (east) and a single location south of the waste rock dump where velocities exceed 1.5 m/s, these areas should be considered for additional rock armouring controls for long term landform stability.



R	DETAILS	DATE
1	Final Issue	27-06-2025

DRAWN	ZL	CHECKED	JH
APPROVED	SB	DATE	27-06-2025

NOTES:

N

0 0.1 0.2 km

SCALE @ A3 - 1:10,000
GDA94 / MGA zone 56

DISCLAIMER
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DATA SOURCE
QLD Government Open Data Source

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Figure 3 - 100 Year Flood Depth

Epic Environmental
Calliope PRCP
Final Landform Flood Assessment

Drg Ref.

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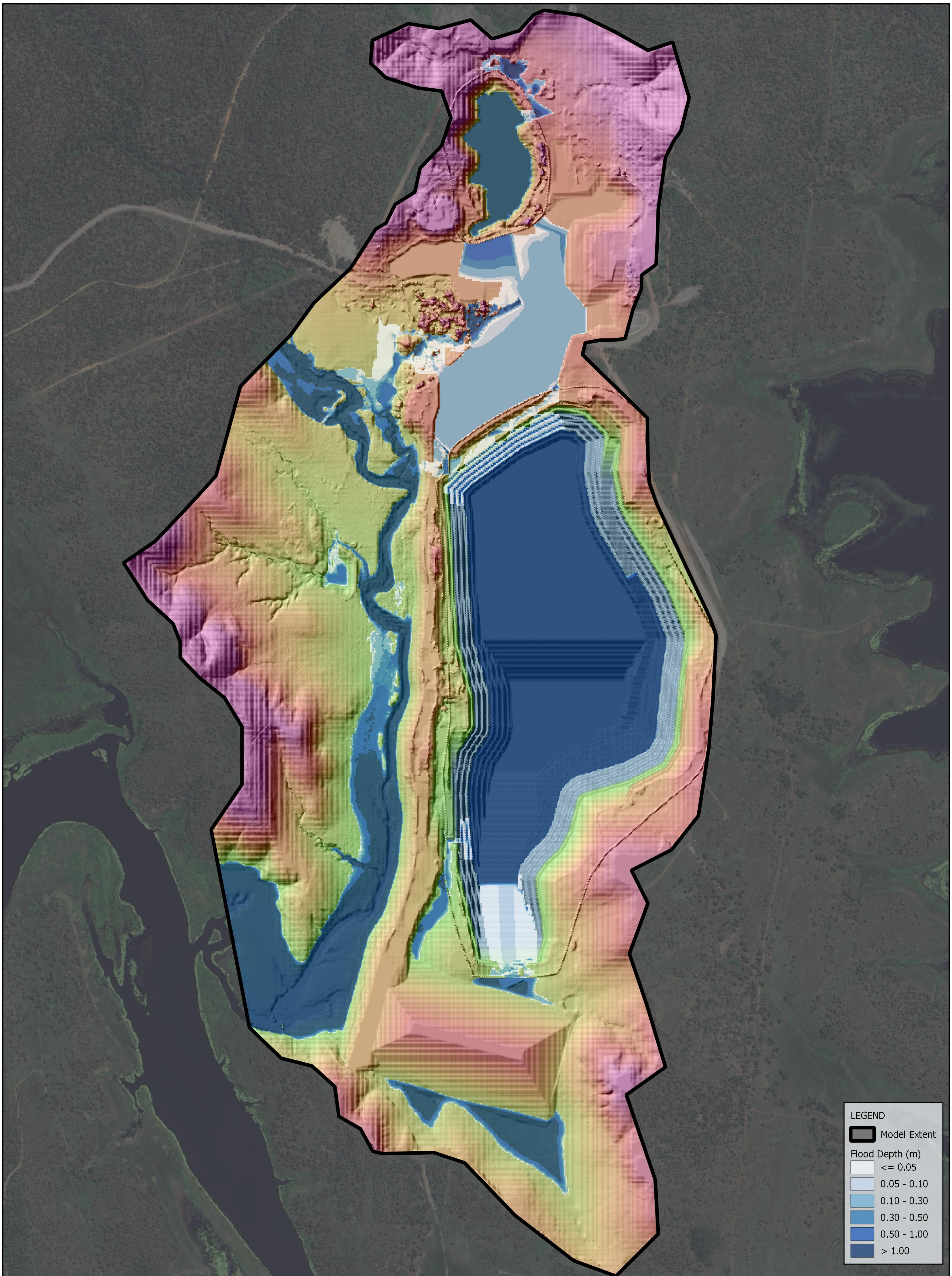

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Figure 4 - 1000 Year Flood Depth

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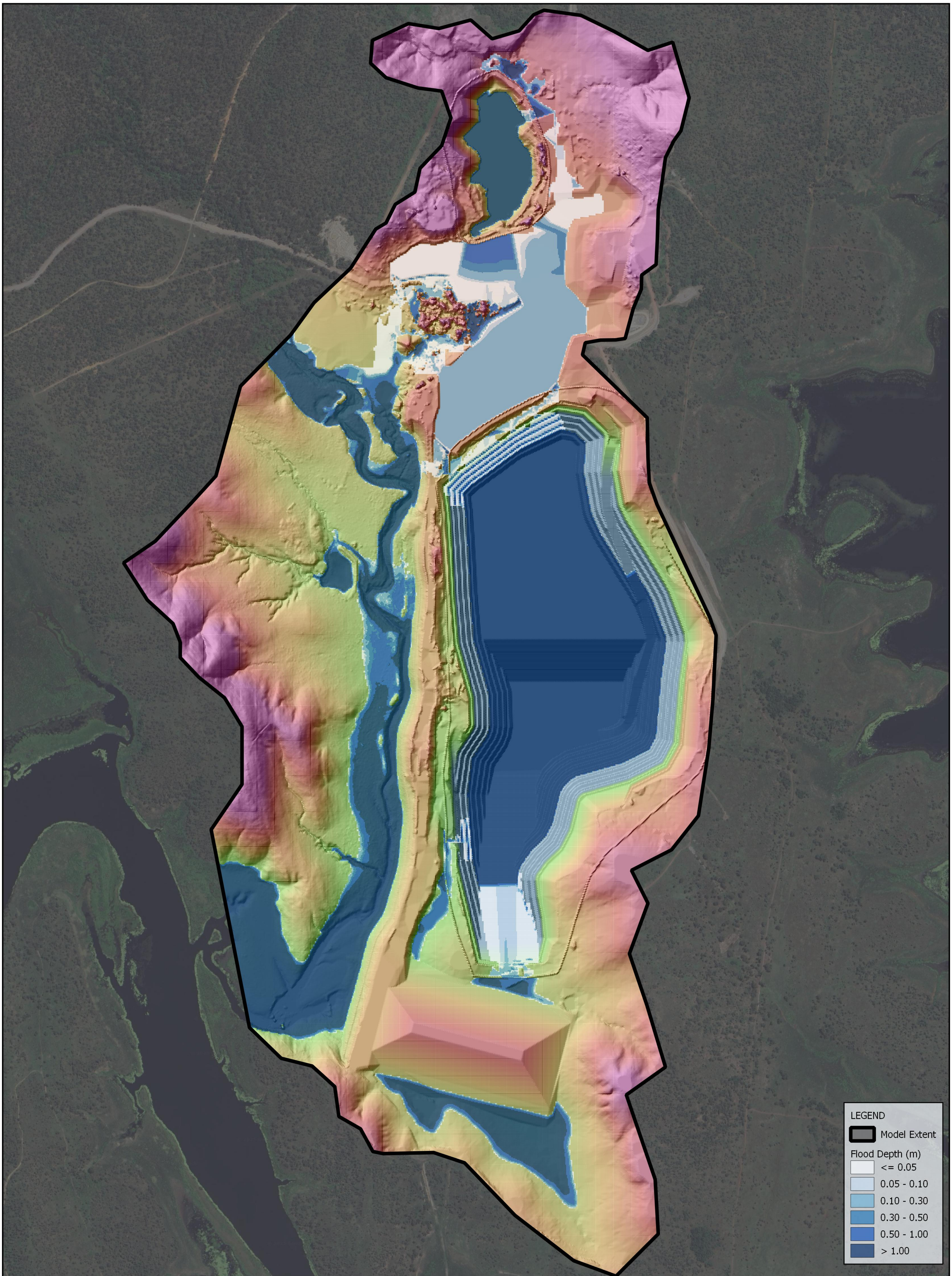

Figure 5 - 10000 Year Flood Depth

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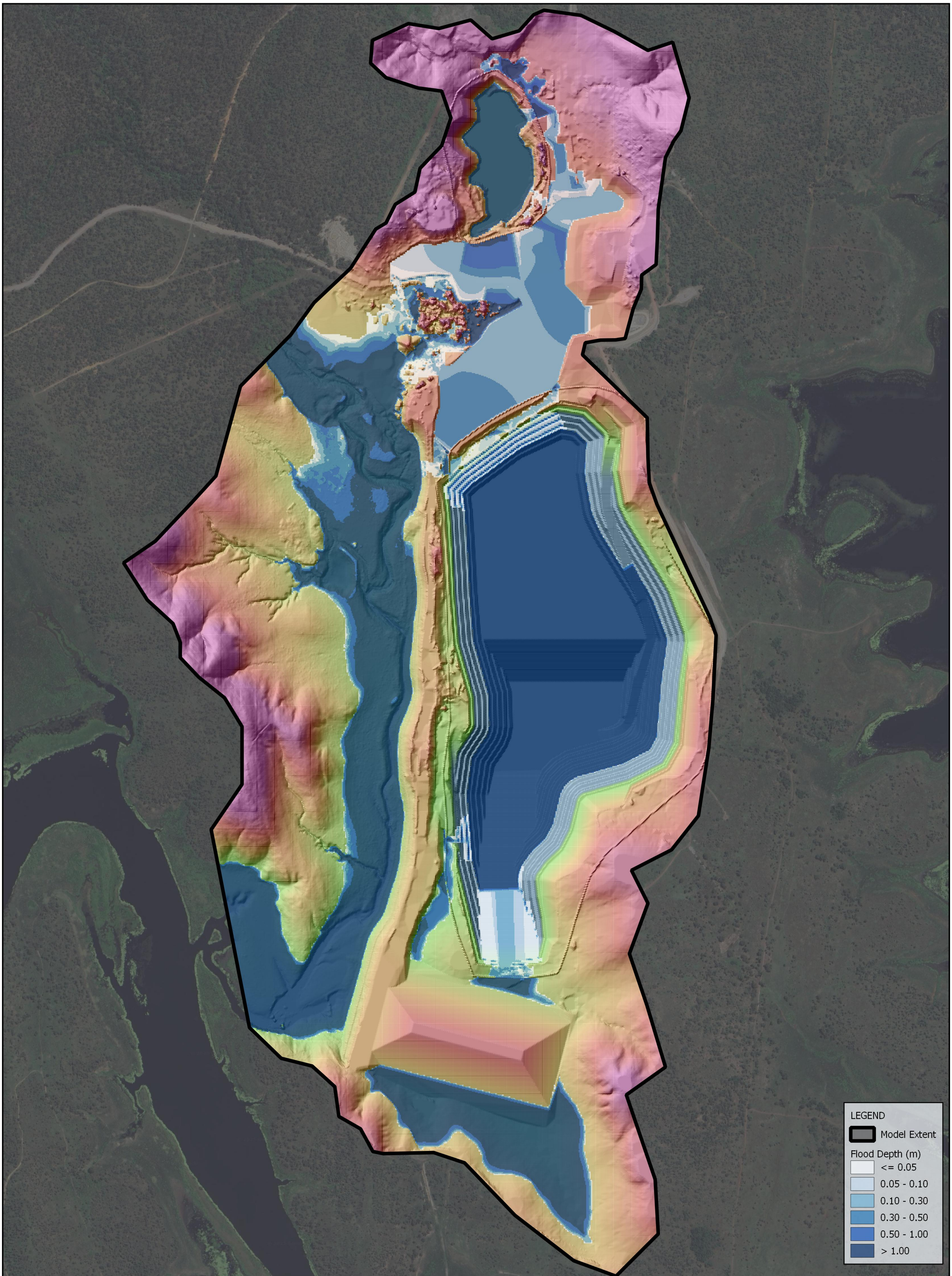

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Figure 6 - PMP Flood Depth

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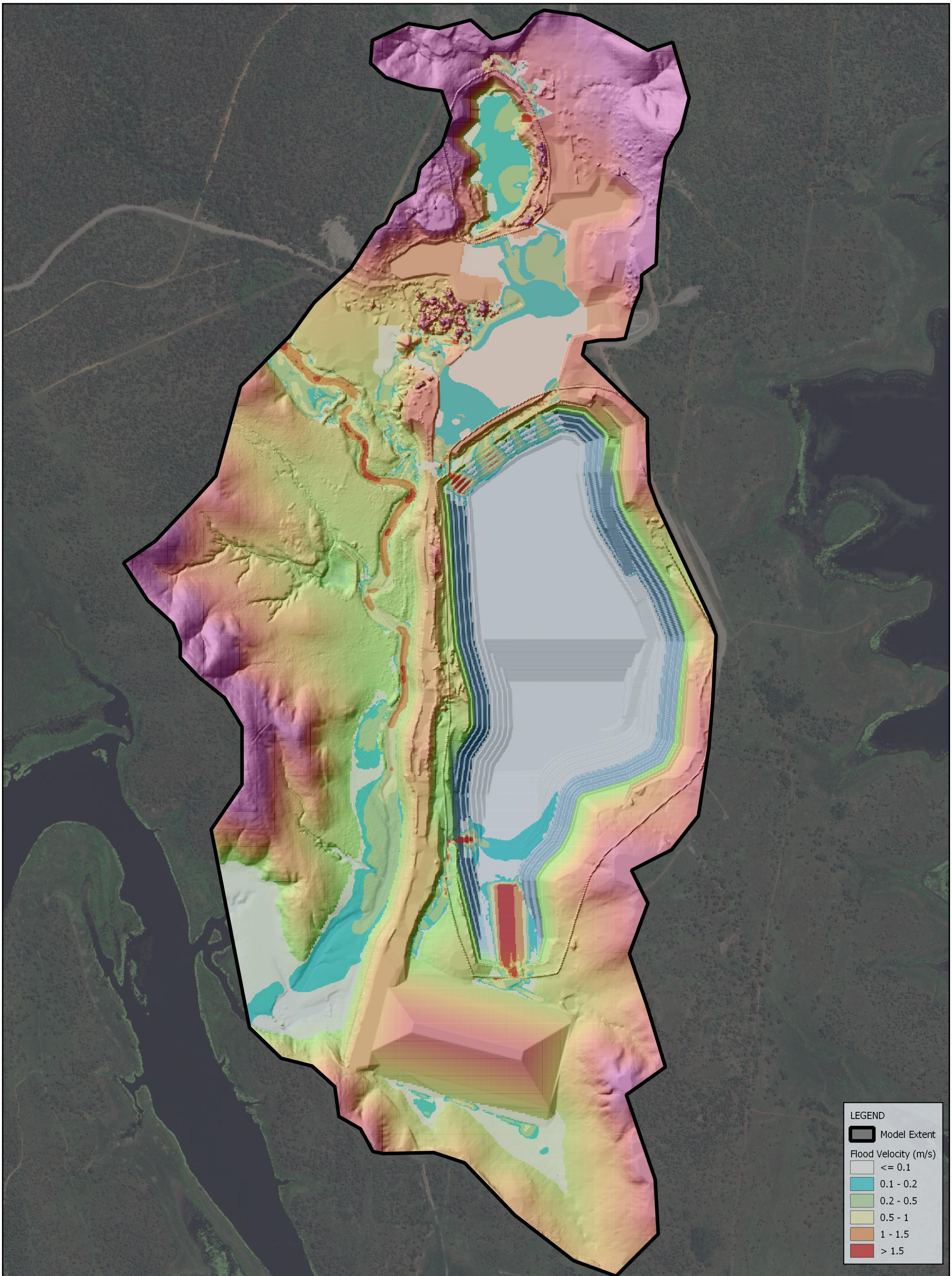

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Figure 7 - 100 Year Flood Velocity

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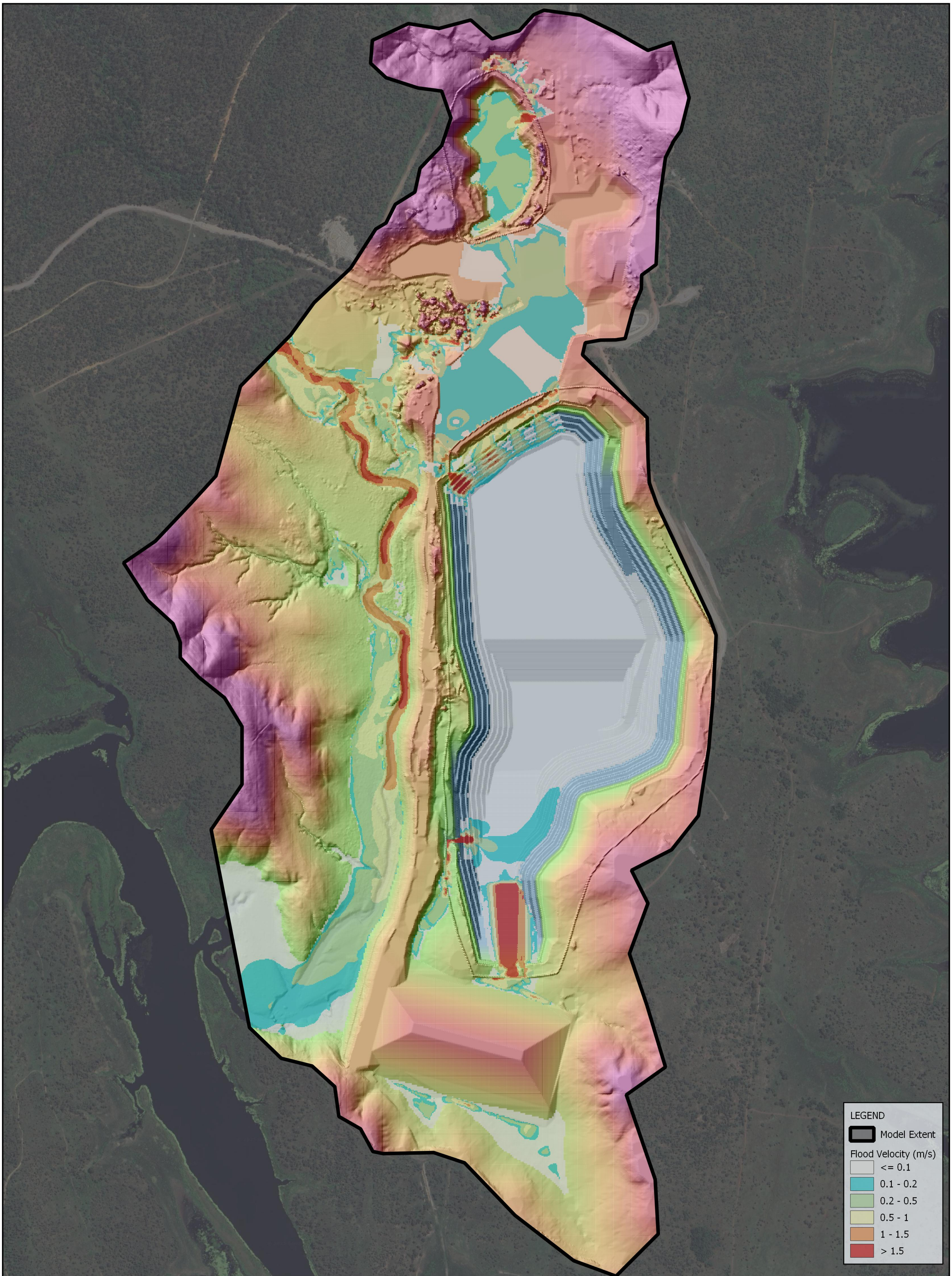

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Figure 8 - 1000 Year Flood Velocity

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Figure 9 - 10000 Year Flood Velocity

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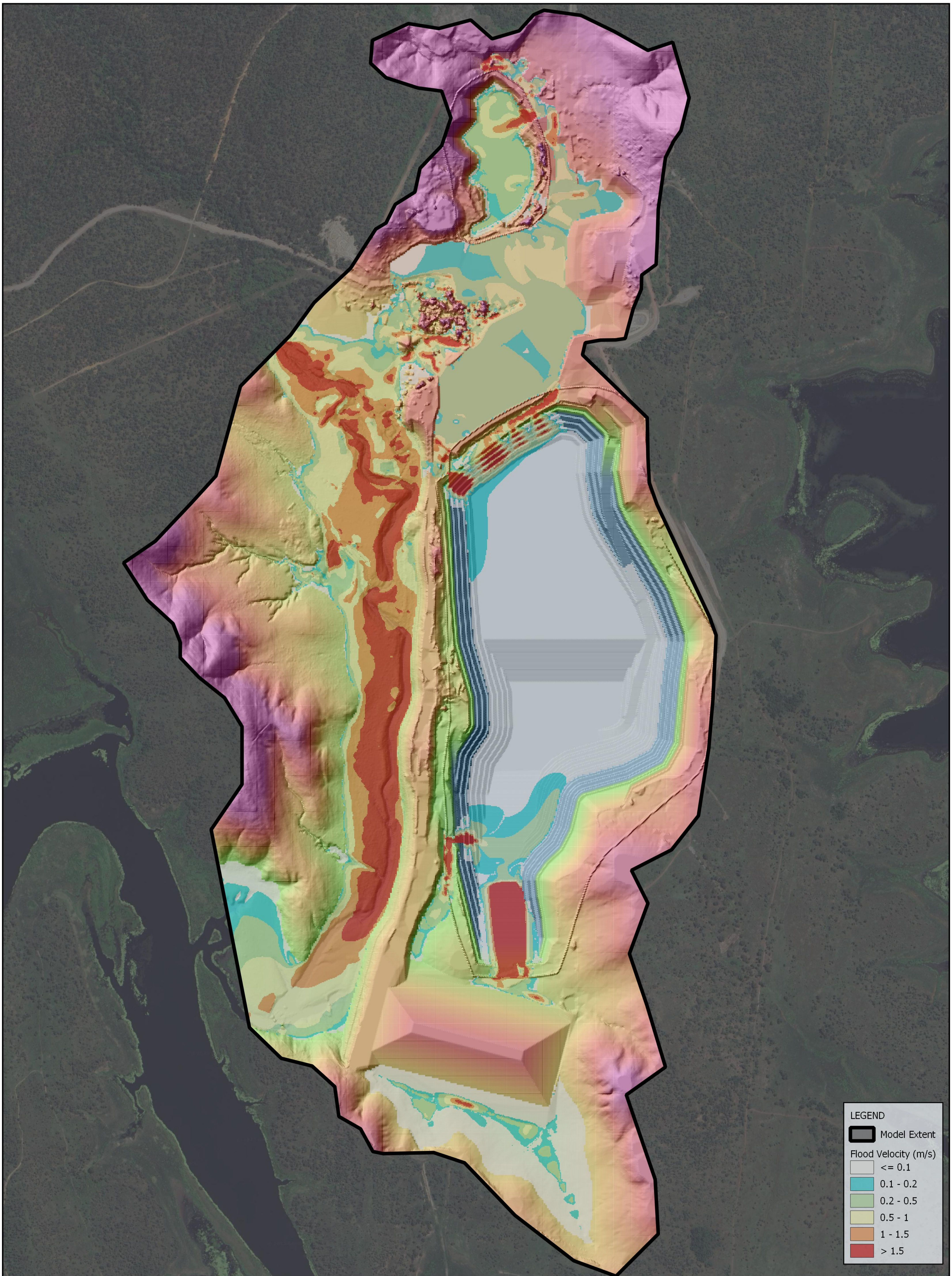

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Figure 10 - PMP Flood Velocity

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