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Design Modelling Report

Edenhope Flood Investigation

West Wimmera Shire Council

4 June 2026

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ACKNOWLEDGEMENT OF COUNTRY

The Board and employees of Water Technology acknowledge and respect the Aboriginal and Torres Strait Islander Peoples as the Traditional Custodians of Country throughout Australia. We specifically acknowledge the Traditional Custodians of the land on which our offices reside and where we undertake our work.

We respect the knowledge, skills and lived experiences of Aboriginal and Torres Strait Islander Peoples, who we continue to learn from and collaborate with. We also extend our respect to all First Nations Peoples, their cultures and to their Elders, past and present.

Artwork by Maurice Goolagong 2023. This piece was commissioned by Water Technology and visualises the important connections we have to water, and the cultural significance of journeys taken by traditional custodians of our land to meeting places, where communities connect with each other around waterways.

The symbolism in the artwork includes:

- *Seven circles representing each of the States and Territories in Australia where we do our work*
- *Blue dots between each circle representing the waterways that connect us*
- *The animals that rely on healthy waterways for their home*
- *Black and white dots representing all the different communities that we visit in our work*
- *Hands that are for the people we help on our journey*

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4 June 2026

Edwin Irvine
Senior Planning Officer
West Wimmera Shire Council
49 Elizabeth St, Edenhope VIC 3318

Via email: EdwinIrvine@westwimmera.vic.gov.au

Dear Edwin

Edenhope Flood Investigation

Please see the attached Design Modelling Report for the Edenhope Flood Investigation. This report is one of a series and documents the following:

- Draft flood mapping for 10% and 1% AEP flood events.
- Model sensitivity testing.

Upon approval of the draft modelling, the remaining design modelling will be undertaken.

Yours sincerely

Vitaly Leschen
Project Engineer
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WATER TECHNOLOGY PTY LTD

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GLOSSARY

Annual Exceedance Probability (AEP)	Refers to the probability or risk of a flood of a given size occurring or being exceeded in any given year. A 90% AEP flood has a high probability of occurring or being exceeded; it would occur quite often and would be relatively small. A 1% AEP flood has a low probability of occurrence or being exceeded; it would be fairly rare but it would be of extreme magnitude.
Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to mean sea level. Introduced in 1971 to eventually supersede all earlier datums.
Average Recurrence Interval (ARI)	Refers to the average time interval between a given flood magnitude occurring or being exceeded. A 10 year ARI flood is expected to be exceeded on average once every 10 years. A 100 year ARI flood is expected to be exceeded on average once every 100 years. The AEP is the ARI expressed as a percentage.
Cadastre, cadastral base	Information in map or digital form showing the extent and usage of land, including streets, lot boundaries, water courses etc.
Catchment	The area draining to a site. It always relates to a particular location and may include the catchments of tributary streams as well as the main stream.
Design flood	A design flood is a probabilistic or statistical estimate, being generally based on some form of probability analysis of flood or rainfall data. An average recurrence interval or exceedance probability is attributed to the estimate.
Discharge	The rate of flow of water measured in terms of volume over time. It is to be distinguished from the speed or velocity of flow, which is a measure of how fast the water is moving rather than how much is moving.
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or overland runoff before entering a watercourse and/or coastal inundation resulting from elevated sea levels and/or waves overtopping coastline defences.
Flood frequency analysis	A statistical analysis of observed flood magnitudes to determine the probability of a given flood magnitude.
Flood hazard	Potential risk to life and limb caused by flooding. Flood hazard combines the flood depth and velocity.
Floodplain	Area of land which is subject to inundation by floods up to the probable maximum flood event, i.e. flood prone land.
Flood storages	Those parts of the floodplain that are important for the temporary storage, of floodwaters during the passage of a flood.

Geographical information systems (GIS)	A system of software and procedures designed to support the management, manipulation, analysis and display of spatially referenced data.
Hydraulics	The term given to the study of water flow in a river, channel or pipe, in particular, the evaluation of flow parameters such as stage and velocity.
Hydrograph	A graph that shows how the discharge changes with time at any particular location.
Hydrology	The term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.
Intensity frequency duration (IFD) analysis	Statistical analysis of rainfall, describing the rainfall intensity (mm/hr), frequency (probability measured by the AEP), duration (hrs). This analysis is used to generate design rainfall estimates.
LiDAR	Spot land surface heights collected via aerial light detection and ranging (LiDAR) survey. The spot heights are converted to a gridded digital elevation model dataset for use in modelling and mapping.
Peak flow	The maximum discharge occurring during a flood event.
Probability	A statistical measure of the expected frequency or occurrence of flooding. For a fuller explanation see Average Recurrence Interval.
Probable Maximum Flood	The flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in a particular drainage area.
RORB	A hydrological modelling tool used in this study to calculate the runoff generated from historic and design rainfall events.
Runoff	The amount of rainfall that actually ends up as stream or pipe flow, also known as rainfall excess.
Stage	Equivalent to 'water level'. Both are measured with reference to a specified datum.
Stage hydrograph	A graph that shows how the water level changes with time. It must be referenced to a particular location and datum.
Topography	A surface which defines the ground level of a chosen area.

1 INTRODUCTION

Water Technology was commissioned by West Wimmera Shire Council (WWSC) to undertake the Edenhope and Apsley Flood Investigation. This report is specific to Edenhope, with the reporting separated for each township. Edenhope is within West Wimmera Shire Council, located in Victoria's Wimmera region approximately 100 km southwest of Horsham. Edenhope is also within the Wimmera Catchment Management Authority (CMA) management area and the Millicent Coast hydrologic basin. The township has a population of around 1,000 residents, located on the banks of Lake Wallace.

Edenhope is known to be prone to stormwater flooding, with events recorded in 1971, 1973, 1975, 1981, 1991, 1993, 2011, 2016 and 2022. Edenhope is at risk from overland flow from a series of local undefined waterways and wetlands located to the southeast.

There is no current flood study for Edenhope, and current flood risk information is based on observations from Council, VICSES and the Wimmera Wetlands Hydrology Investigation completed by Water Technology in 2019.

This study will use existing flood observations and design hydrologic parameters produce reliable flood intelligence for use in emergency management situations, assess the current flood impact/exposure in terms of annual average damages caused by flooding in Edenhope and investigate structural and non-structural mitigation options. It will also produce planning scheme overlays for inclusion in the West Wimmera Shire Council planning scheme.

This report is one of a series documenting the outcomes of the Edenhope Flood Investigation. This report documents the core technical work. Each reporting stage is shown below:

- R01 – Data Collation, Model Development and Calibration Report.
- **R02A – Design Modelling Report – This report.**
- R03A – Flood Intelligence Report & Municipal Flood Emergency Plan (MFEP) Documentation.
- R04A – Final Summary Report.

Note: Version A indicates Edenhope and version B indicates Apsley.

1.1 Study Area

Edenhope is located within western Victoria. Its location with respect to western Victoria is shown in Figure 1-1, with the study area for Edenhope in Figure 1-2.

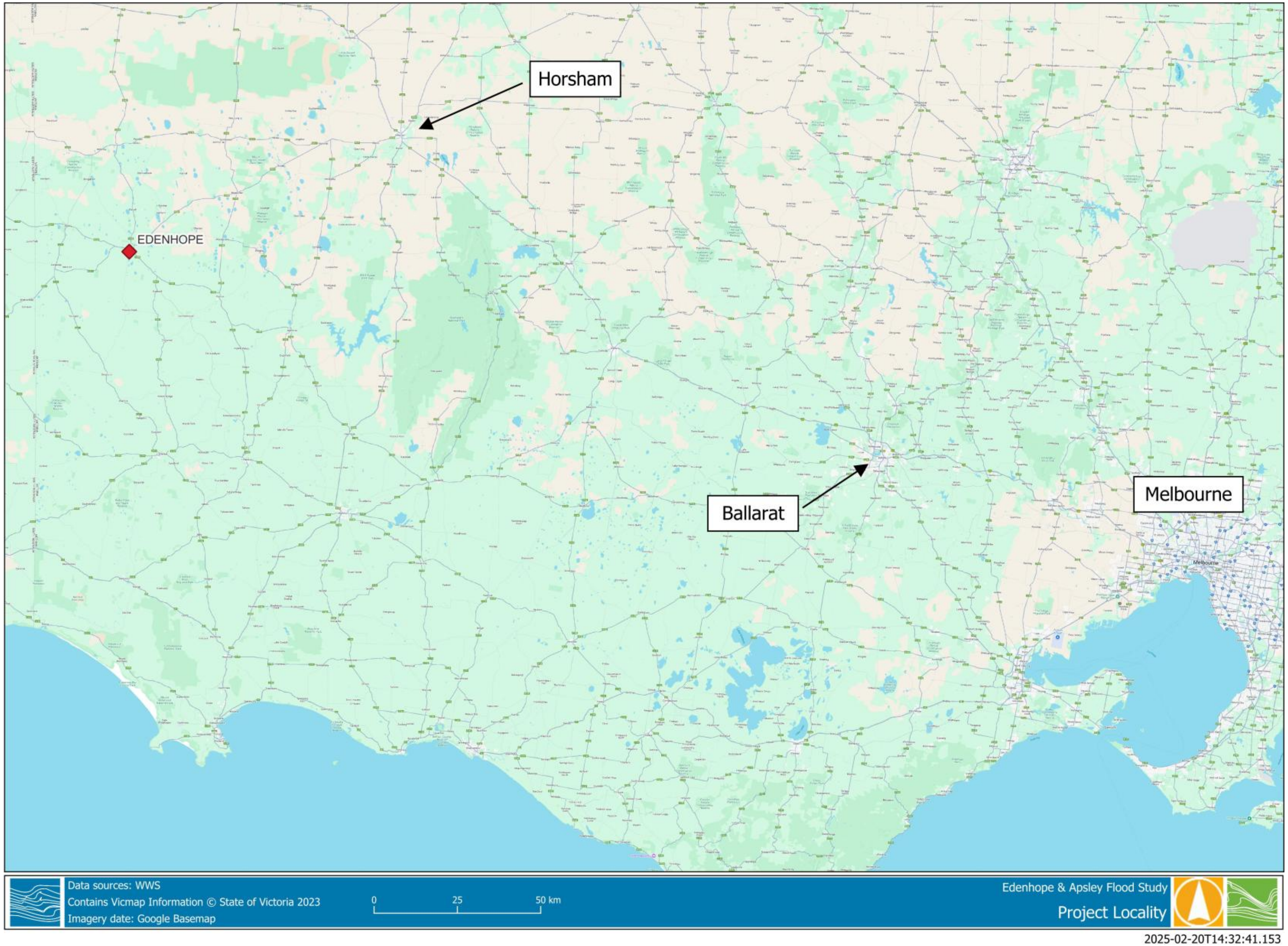

Figure 1-1 Edenhope with respect to western Victoria

Figure 1-2 Edenhope Study Area

2 HYDRAULIC DESIGN MODELLING

2.1 Model Extent and Structure

A 1D/2D TUFLOW model was developed for the Edenhope study area, encompassing the upstream catchment. The model extent was determined based on the topography, ensuring the entire upstream catchment was included.

The models were developed in the TUFLOW HPC hydraulic modelling software. The model topography was represented with a varying resolution (using Quadtree), with a cell size of 12 m outside of the township and 3 m within the township and across the local catchment. The ability for the resultant model grid to capture finer details was supported by Sub-Grid-Sampling (SGS) of the underlying topography datasets, which was based on detailed 2 m LiDAR.

The model adopted a Rain-on-Grid (RoG) approach directly applied rainfall to the Edenhope catchment area. This modelling approach provided a better understanding of overland flow and drainage paths through the township and within the upstream catchment. RoG was considered more appropriate than a standard runoff routing model due to the complex natural upstream storages. As this investigation covered both stormwater and riverine flooding, rainfall was applied in two areas varying the Areal Reduction Factor (ARF). The applied rainfall is further discussed in Section 2.6.

The model adopted an outflow boundary downstream of Lake Wallace. The outflow boundary adopted a water level vs flow (stage-discharge) curve calculated from the topography. The influence of these boundaries was controlled by the two upstream lakes, which both act as natural controls to upstream flooding.

A model schematic is presented in Figure 2-1.

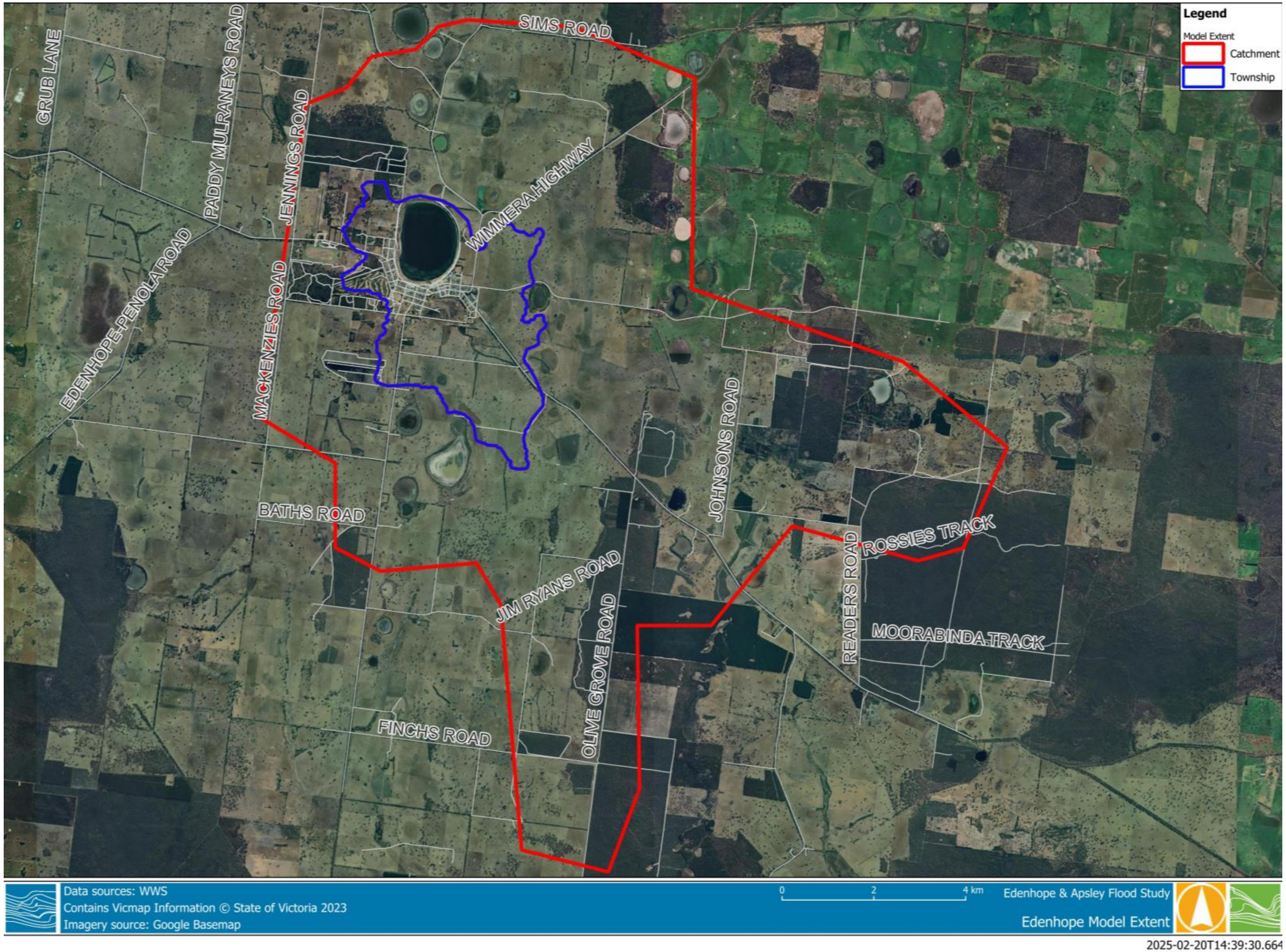

Figure 2-1 Edenhope Model Schematic

2.2 Model Topography

The model was primarily based upon the Wimmera CMA topographic Light Detection (LiDAR) dataset (2006). The Wimmera CMA LiDAR covered the entirety of the township and most of the respective catchment. Areas not covered by the Wimmera CMA LiDAR adopted the VicMap 10m DEM. While the LiDAR was the primary source of topographic information, the model topography was further refined where more accurate or appropriate data was available. The main adjustment made to the LiDAR were the removal of water from storages or works known to have been undertaken (road works etc). Figure 2-2 provides an overview of the model topography development.

The topography of the catchments was previously shown in Figure 2-3.

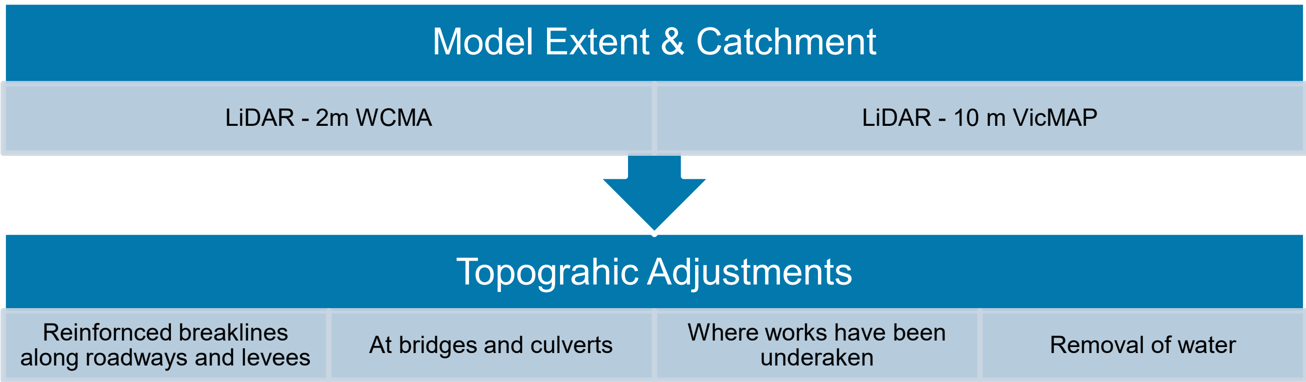

Figure 2-2 Model topography development methodology

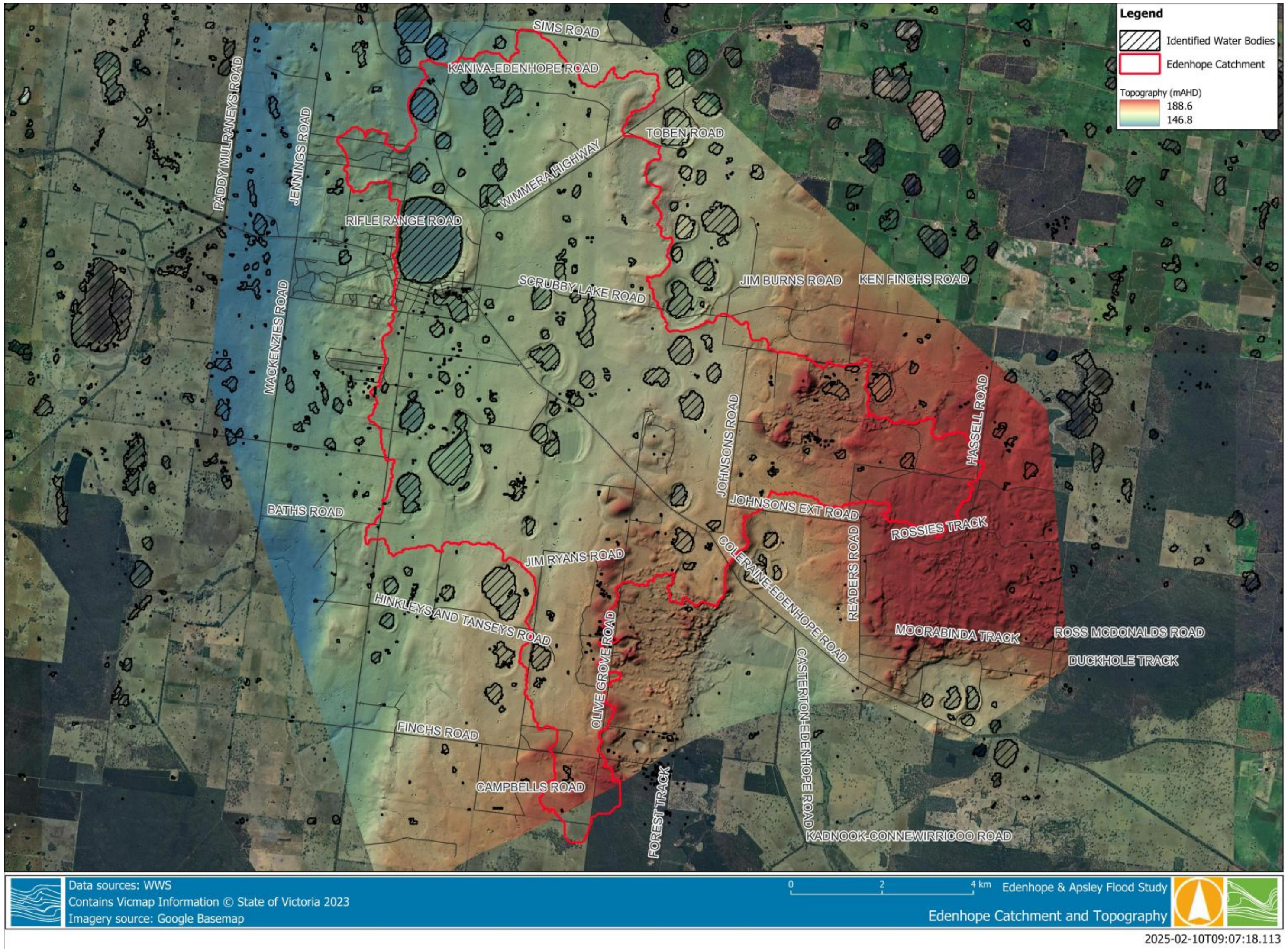

Figure 2-3 Edenhope catchment and topography

2.3 Model Roughness

A key component of a hydraulic model is the hydraulic roughness of the different land use types, represented with a 2D materials layer. The range of land uses re represented by a Mannings '*n*' roughness value (surface resistance). The roughness values vary between land uses. In general terms, a lower Manning's 'n' value represents a more efficient flow surface (e.g. a roadway), while a higher Manning's 'n' value represents a rougher and slower surface (e.g. dense vegetation). For this investigation, a roughness map was developed based on aerial imagery, several site visits and during model verification. The adopted Manning's 'n' values are presented in Table 2-1 and shown spatially in Figure 2-4.

Table 2-1 Land Use Manning's 'n' Roughness values

Material	Manning's 'n' value
Rural Residential	0.1
Pasture	0.04
Dense Vegetation	0.095
Waterway Channel	0.03
Roadway (Paved)	0.025
Roadway (Unpaved)	0.035
Lake / Swamp / Wetland	0.05

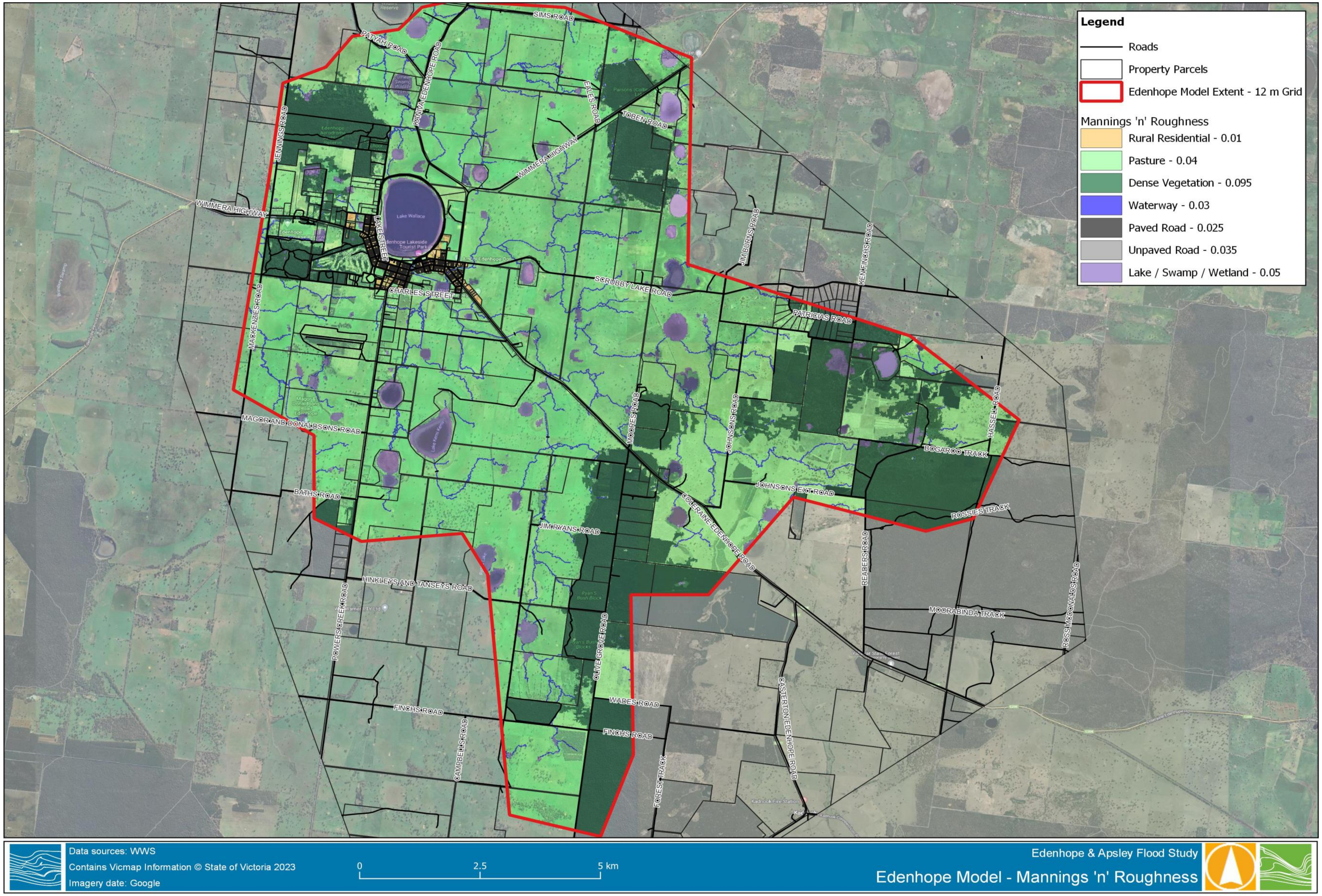

Figure 2-4 Edenhope – Model Roughness

2.4 Model Structures

The drainage infrastructure in Edenhope largely consists of open drains, pipes, pits and bridges. The major drainage network (pits and pipes) was provided by WWSC, with the invert levels estimated based on the topography, incorporating a standard cover based on pipe size. Additional bridge and culvert measurements were obtained during the site visit. In total, the Edenhope model incorporated 211 pipes, 150 pits and 5 bridges. Upstream of the township where flow paths intercepted roadways crossings were artificially removed to ensure connectivity, unless other information was known. The modelled (township) infrastructure is shown in Figure 2-5.

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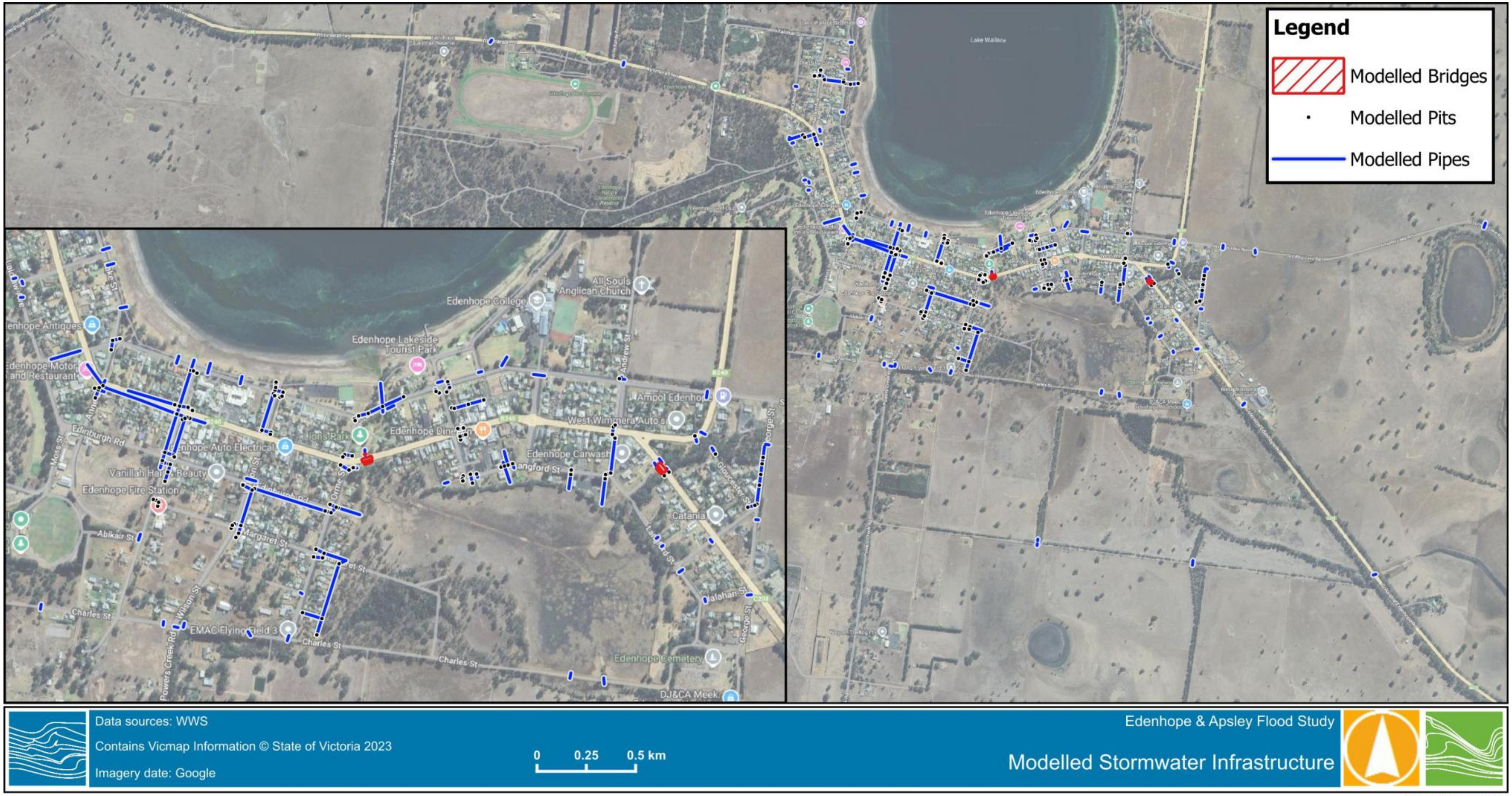

Figure 2-5 Edenhope Modelled Structure

2.5 Initial Water Level

The Edenhope catchment contains multiple depressions creating a series of swamps, wetlands and lakes all which provide significant catchment storage. Many of these depressions are ephemeral, only experiencing pooling water in periods of prolonged rainfall. The complex connectivity of these wetlands influences flood behaviour within the township.

The variation in available catchment storage, vegetation cover and soil moisture, has implications on flooding within the township, and while flooding has historically occurred during antecedent wet conditions, there is always the potential for a rainfall event to occur during a dry period. Satellite imagery was used to provide an understanding of potential antecedent catchment conditions. The datasets used for the sensitivity analysis included:

- Digital Earth Australia (DEA) Water Observation Multi Year[1] – this dataset provided the frequency at which satellite imagery captured water within the various depressions. It was used to assess extreme conditions, adopting water where observations have occurred less than 1% of the time, Figure 2-6.
- DEA Wetness Percentiles[2] – this dataset provided 10th, 50th and 90th percentiles of "wetness" within the area. It was used as the basis of sensitivity analysis, with the three used to identify starting conditions within the depressions. The 90th percentile output is provided in Figure 2-7, noting that this output was filtered to water bodies only when tested.
  - Note, the DEA Water Observation dataset, could also be varied to capture initial conditions for a range of conditions. A comparison of the two datasets is provided in Figure 2-8. It demonstrates that the datasets reasonably align with one another.

The initial water level conditions within the Edenhope catchment impact the flood levels in the township and impact the mapping outputs for the study. To account for this uncertainty sensitivity analysis was undertaken and is further discussed in Section 3.2.

[1] https://knowledge.dea.ga.gov.au/data/product/dea-water-observations-statistics-landsat/?tab=overview
[2] https://maps.dea.ga.gov.au/#share=s-mYmYKh57NcZV7nUN8vaV52ZNO5S

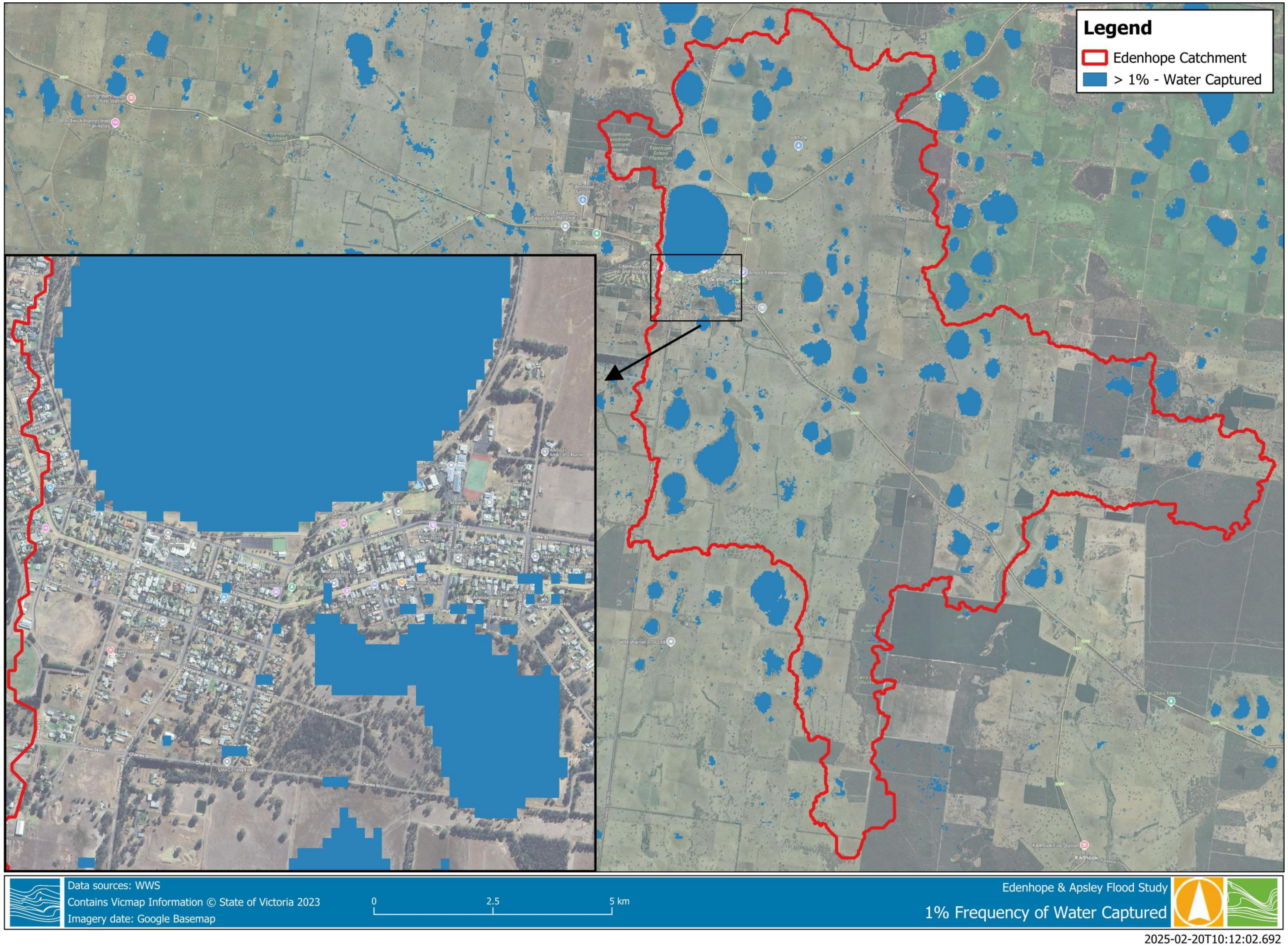

Figure 2-6 DEA Water Observation – 1% Return Frequency

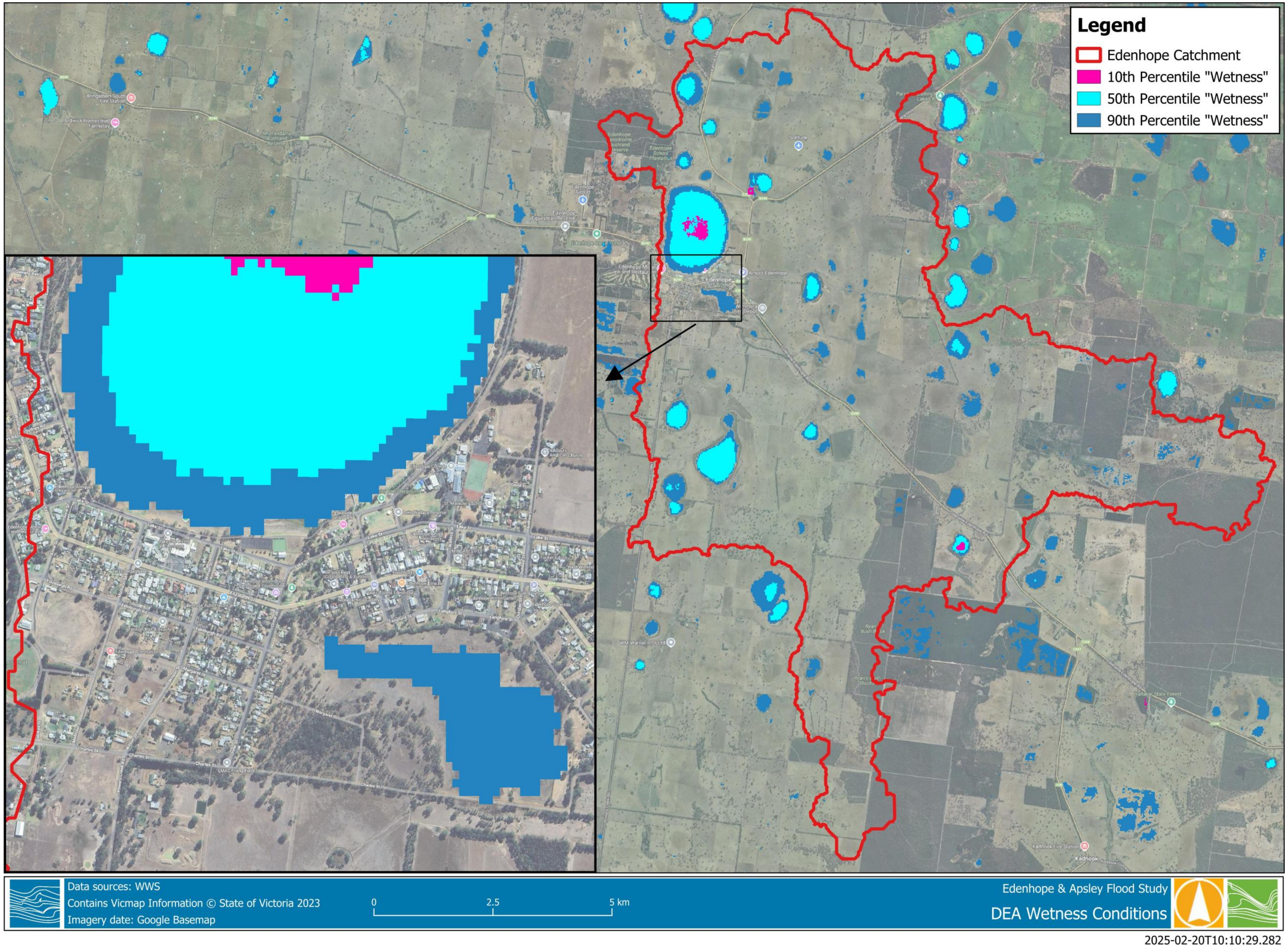

Figure 2-7 DEA Wetness Percentile – 10th, 50th and 90th for Water Bodies

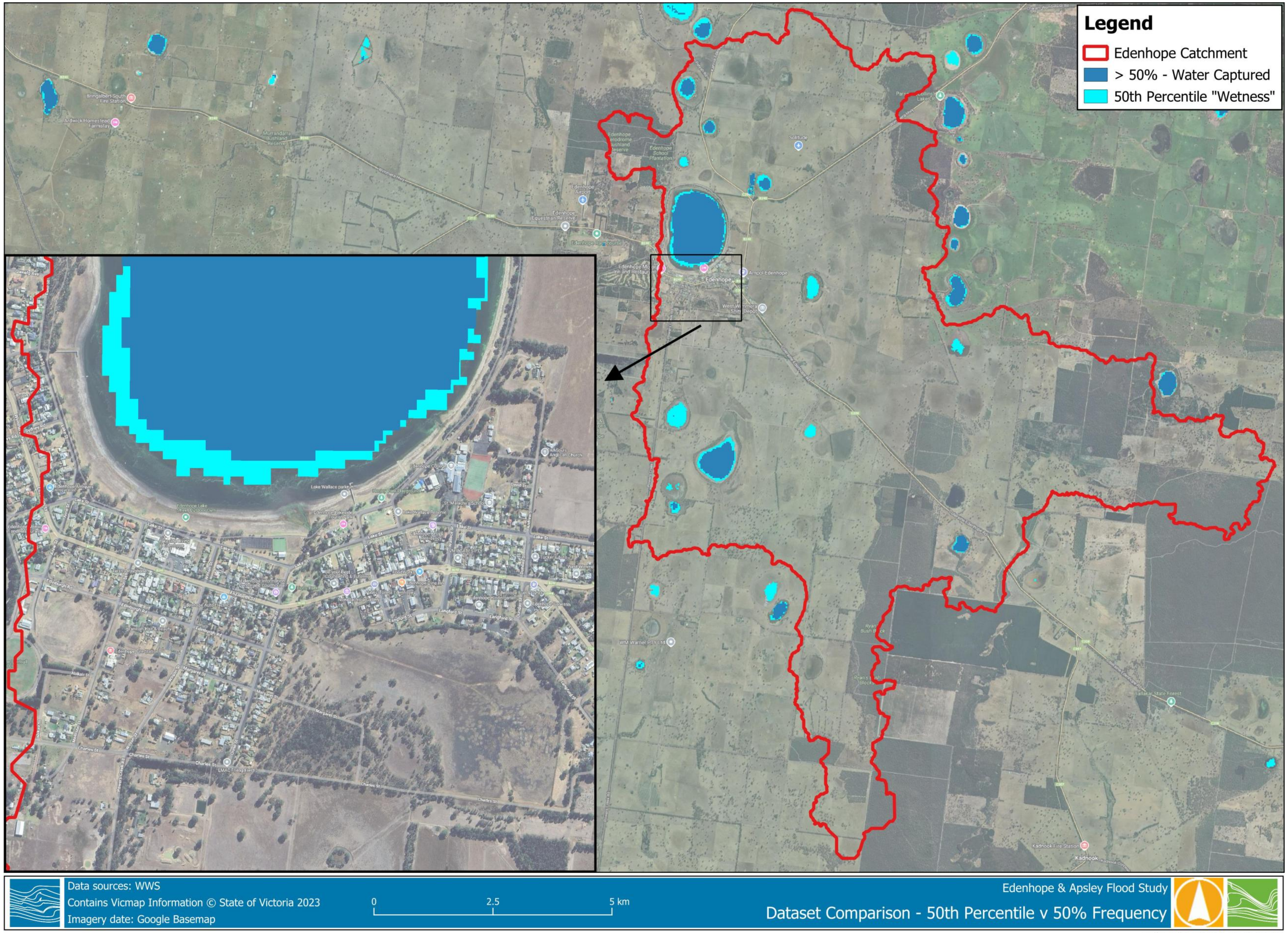

Figure 2-8 Comparison of Datasets

2.6 Design Rainfall and Losses

2.6.1 IFD design rainfall depths

The design rainfall depths were downloaded from the Bureau of Meteorology (BoM) website using the centroid of each rainfall area (township & riverine). Table 2-2 and Table 2-3 show the design rainfall depths for each AEP and event duration. Table 2-3 shows values which have been adjusted based on ARF calculated from the riverine catchment area of 146.6 km^2.

Table 2-2 IFD design rainfall depth (mm) – Township Catchment (No ARF)

Duration	20%	10%	5%	2%	1%	0.5%	0.2%	0.05%
1 hr	19.6	23.9	28.4	35	40.5	47.2	56.9	65.3
1.5 hr	22.4	27.2	32.4	39.9	46.1	53.6	64.6	74.1
2 hr	24.6	29.8	35.4	43.6	50.3	58.6	70.6	81
3 hr	27.9	33.8	40.1	49.3	57	66.4	80.2	92
4.5 hr	31.7	38.3	45.4	55.8	64.6	75.5	91.2	105
6 hr	34.6	41.9	49.6	61	70.7	82.6	99.9	115
9 hr	39.2	47.4	56	69	80.2	93.9	114	131
12 hr	42.8	56.1	61.1	75.3	87.7	103	124	143
18 hr	48.2	58.1	68.7	84.8	98.9	116	140	161
24 hr	52.2	63	74.4	91.9	107	125	151	173

Table 2-3 IFD design rainfall depth (mm) – Riverine Catchment (with ARF)

Duration	20%	10%	5%	2%	1%	0.5%	0.2%	0.05%
1 hr	16	19.3	22.6	27.4	31.3	36	42.6	48.2
1.5 hr	16	19.3	22.6	27.4	31.3	36	42.6	48.2
2 hr	18.8	22.6	26.5	32	36.4	41.7	49.2	55.6
3 hr	21.1	25.1	29.4	35.4	40.1	46	54.1	61
4.5 hr	24.4	29.1	33.9	40.7	46.2	52.8	62.2	70
6 hr	28.4	33.8	39.5	47.7	54.4	62.6	74.1	84
9 hr	31.6	37.9	44.5	54.1	62.1	71.9	85.9	98
12 hr	36.4	43.9	51.6	63.1	73	85.1	102.7	117.4
18 hr	40.1	48.1	56.7	69.5	80.6	94.2	112.6	129.3
24 hr	50.1	60.3	71	87.4	101.5	118.2	142.3	162.6

2.6.2 Temporal patterns

Temporal patterns were obtained via the ARR Data Hub using the catchment centroid. Temporal patterns were selected from the "Murray Basin region". Given the limited size of each catchment, and in line with the recommendations of ARR2019, point temporal patterns were adopted.

To reduce computational time and model runs to identify the township critical duration/s, only three temporal patterns per duration were assessed: a front loaded, steady and rear loaded. The front-loaded pattern had most of the rainfall occurring within the first third of the storm and the back loaded in the last third, while the steady had relatively constant rainfall bursts. The patterns modelled are listed in Table 2-4.

Once the critical storm duration/s were determined (Section 3.5), all ten temporal patterns were run for these durations and adopted for the design mapping.

Table 2-4 1% AEP analysed durations and temporal patterns

<table>
<tr><th>Duration</th><th>Front loaded</th><th>Steady</th><th>Rear loaded</th></tr>
<tr><td>1 hr</td><td rowspan="2">TP04</td><td>TP03</td><td rowspan="2">TP09</td></tr>
<tr><td>1.5 hr</td><td rowspan="2">TP01</td></tr>
<tr><td>2 hr</td><td>TP02</td><td>TP10</td></tr>
<tr><td>3 hr</td><td>TP04</td><td>TP06</td><td rowspan="2">TP02</td></tr>
<tr><td>4.5 hr</td><td>TP05</td><td rowspan="3">TP07</td></tr>
<tr><td>6 hr</td><td>TP04</td><td>TP10</td></tr>
<tr><td>9 hr</td><td>TP05</td><td>TP01</td></tr>
<tr><td>12 hr</td><td rowspan="2">TP03</td><td>TP09</td><td>TP04</td></tr>
<tr><td>18 hr</td><td>TP07</td><td>TP02</td></tr>
<tr><td>24 hr</td><td>TP09</td><td>TP02</td><td>TP01</td></tr>
</table>

3 SENSITIVITY ANALYSIS

3.1 Overview

Flood model sensitivity testing consists of altering an individual input or parameter and comparing results to the base case to understand the parameter's influence on flood behaviour. Sensitivity testing of the model was undertaken for a range of parameters and inputs. Sensitivity testing of the model was completed for the Edenhope model for the 10% and 1% AEP events.

3.2 Initial Water Level

A sensitivity test was undertaken to determine how varying initial water level could impact the 10% and 1% AEP flood levels and extents. The following scenarios were tested for 1.5 hours and 9 hours storm durations for 10% AEP, and 2 hours and 12 hours storm durations for 1% AEP event:

- "Base" Case – Adopting the 90th percentile of observed "wetness"
- "Dry" Case – Adopting the 50th percentile of observed "wetness"
- "Wet" Case – Adopting the 99th percentile of observed water.

The water surface elevations for the dry and wet case scenarios were compared to the base case, as presented in Figure 3-1 to Figure 3-2 and Figure 3-3 to Figure 3-4, for the two AEP modelled respectively. The results demonstrate that the initial water level has the following influence:

- Increased water levels within the storages, increasing with wetter catchment conditions.
- Minimal (less than 5 mm) change along flow paths connecting the storages or within the township.

The impact of initial water levels demonstrates that the storages has controlled spill locations and significant volume to attenuate flows. Therefore, the impact on flooding along flow paths within Edenhope is similar. The areas impacted are localised to the storages and are more dependent upon long term rainfall than individual rainfall events. This indicates that the catchment is not overly sensitive to the initial water levels. Based on these findings, the adoption of the base case initial water level (90th percentile) is considered a conservative but suitable outcome.

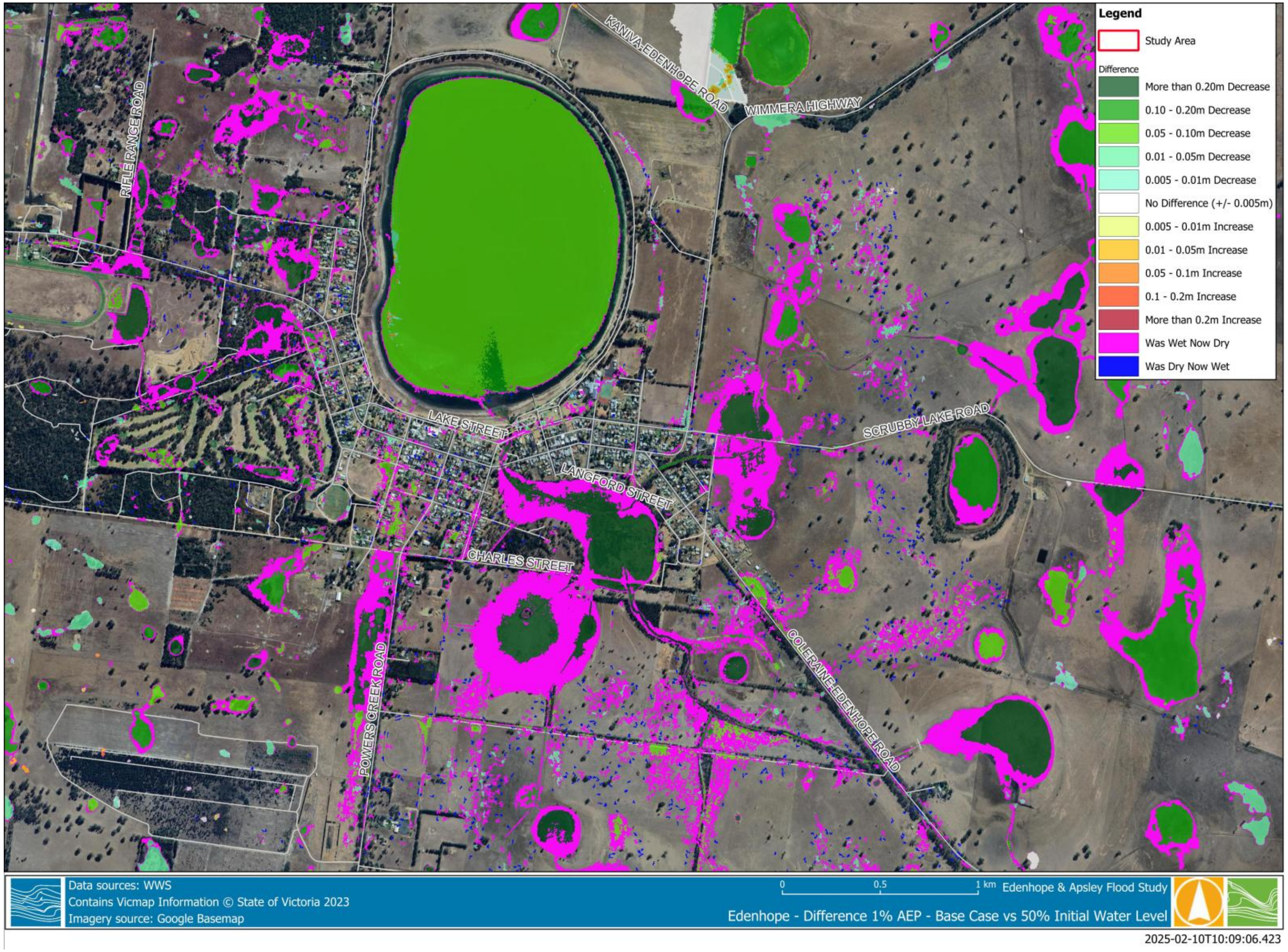

Figure 3-1 Difference Plot for 1% AEP – Base Case vs 50% Initial Water Level

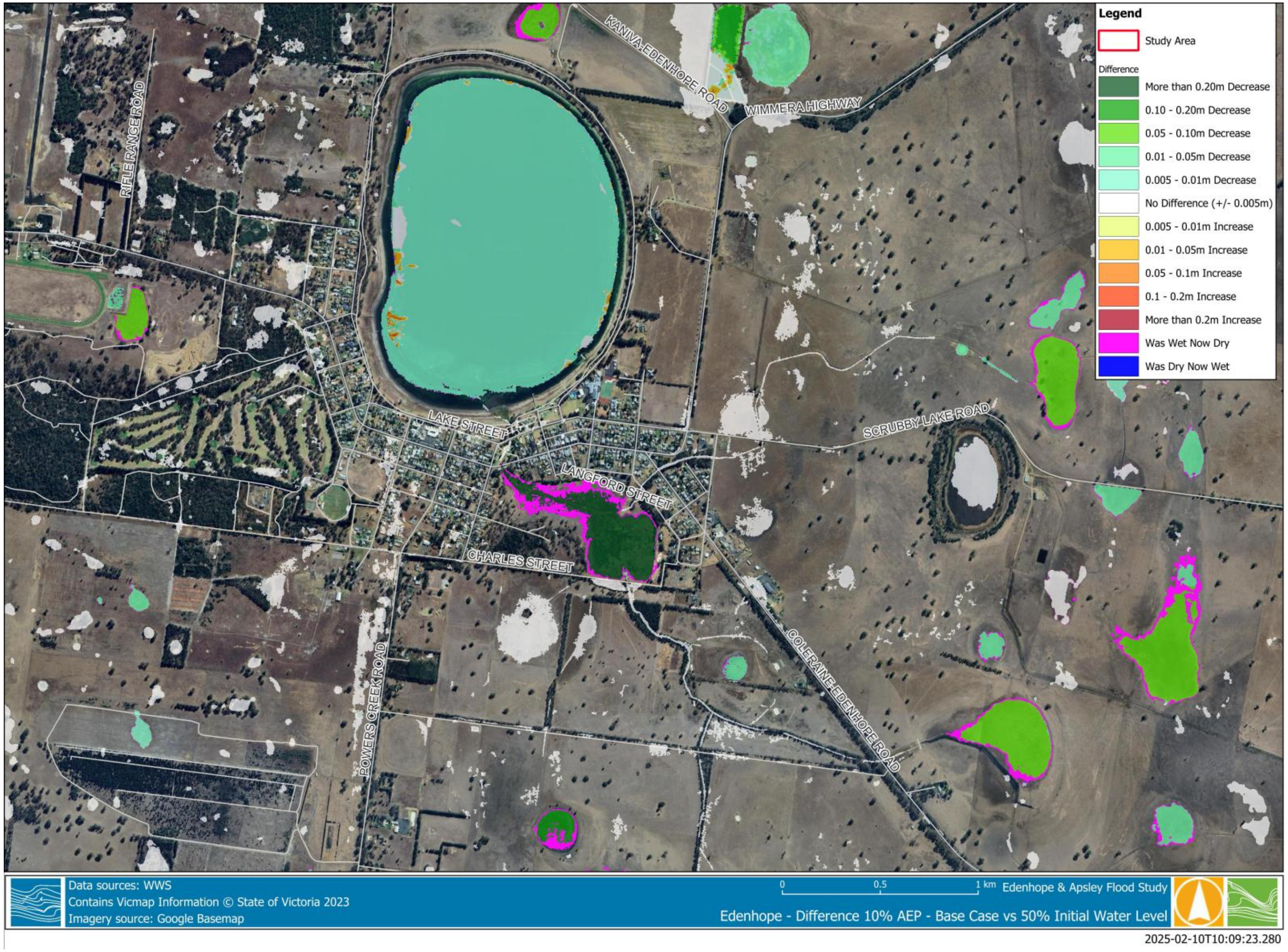

Figure 3-2 Difference Plot for 10% AEP - Base Case vs 50% Initial Water Level

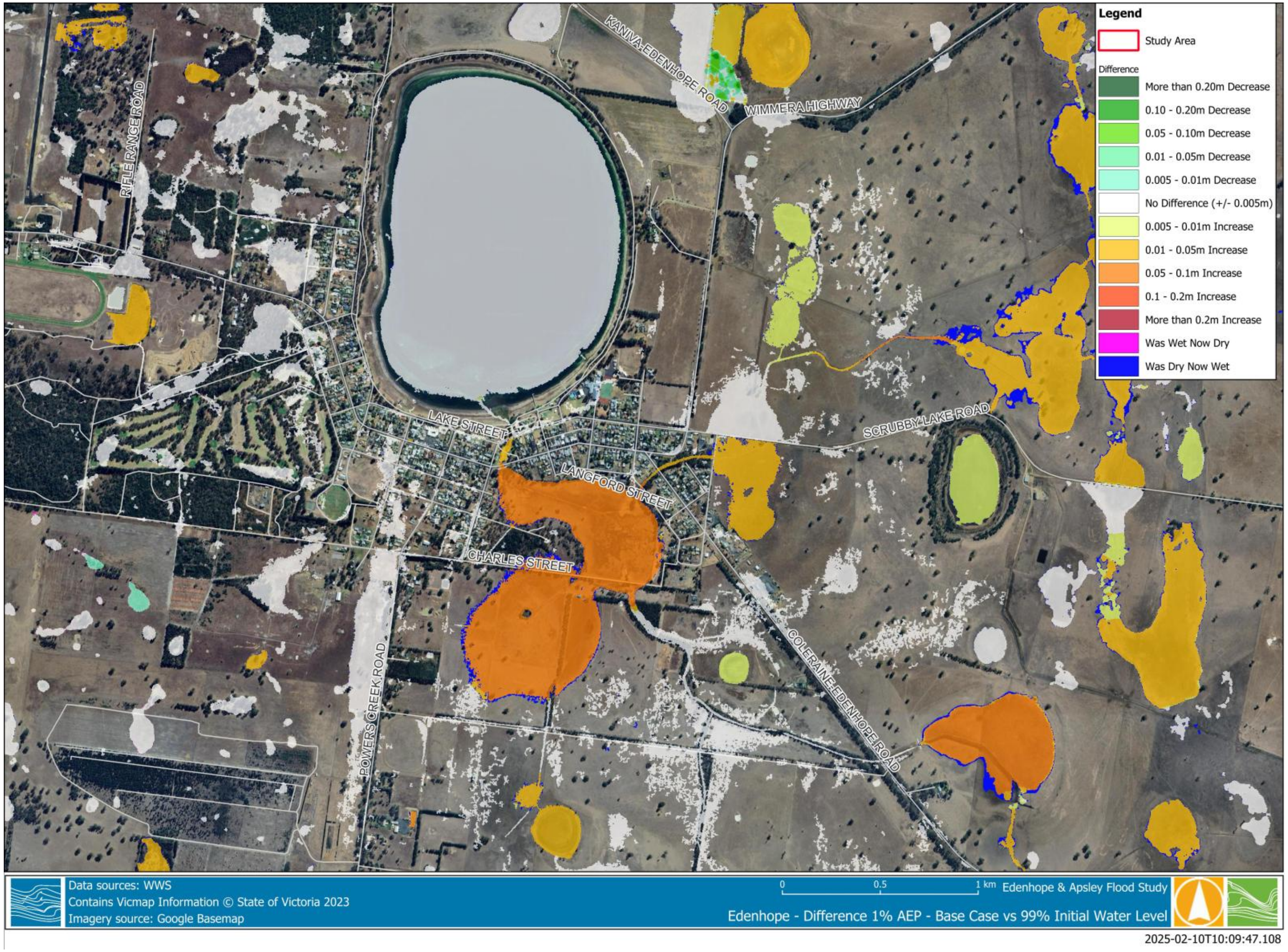

Figure 3-3 Difference Plot for 1% AEP - Base Case vs 99% Initial Water Level

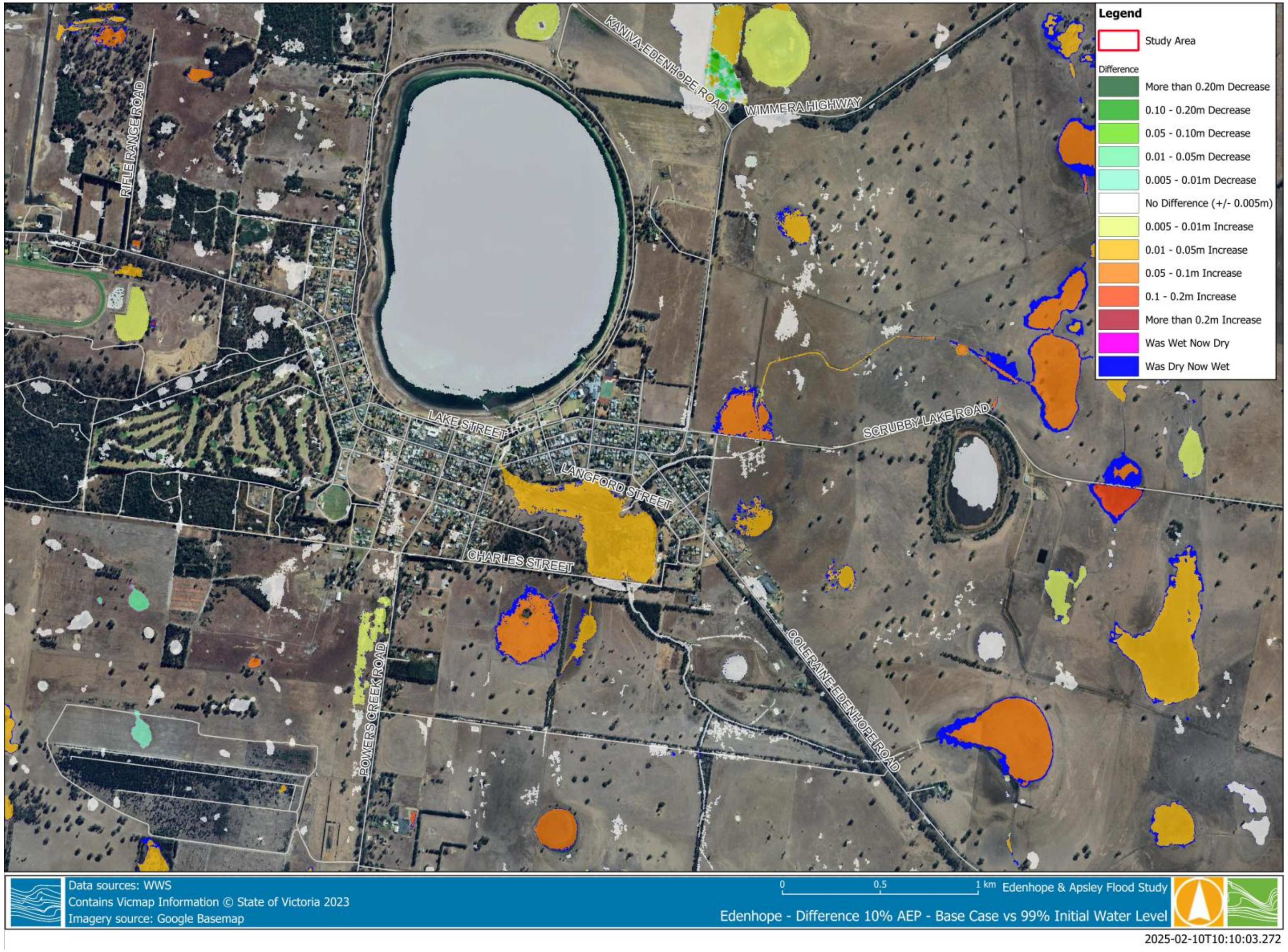

Figure 3-4 Difference Plot for 10% AEP - Base Case vs 99% Initial Water Level

3.3 Rainfall Losses and Pre-burst

The ARR Data Hub Victorian Specific Data suggests that applying pre-burst rainfall has an effect on rainfall losses[3]. This is due to the vast area availability at the upstream depression storages which consequently impacts the amount of transmission losses and in turn flood level.

The sensitivity to pre-burst rainfall was undertaken to reduce rainfall loss by the 10%, 50%, and 75% pre-burst ratios. The following scenarios were tested for the 1.5 hours and 9 hours storm durations for 10% AEP, and 2 hours and 12 hours storm durations for 1% AEP event:

- Base Case – Adopting the 75th percentile for the pre-burst ratio.
- No Pre-burst" Case – Adopting the 10th percentile for the pre-burst ratio.
- Lower Pre-burst Case – Adopting the 50th percentile for the pre-burst ratio.

The water surface elevations for the two lower percentile pre-bursts were comparted to the 75th percentile pre-burst depths. The resultant difference plots for the comparing the 10th percentile against the 75th and the 50th percentile against the 75th for the two modelled AEP events are presented in Figure 3-5 to Figure 3-6 and Figure 3-7 to Figure 3-8, respectively.

The result shows that the maximum water level decrease is 0.2 m for the 1% AEP and 0.12 m for the 10% AEP flood events, when compared to the base case. This demonstrates some sensitivity to rainfall losses influenced by pre-burst, which is primarily driven by an increase or decrease in the volume of water spilling from the upstream storages. Based on the ARR Data Hub guideline, the adopted pre-burst ratio for the design storm event was the 75th percentile. This provides conservative flood mapping for Edenhope's design rainfall events but was considered to give a sound representation of the likely design inundation.

[3] https://data.arr-software.org/vic_specific

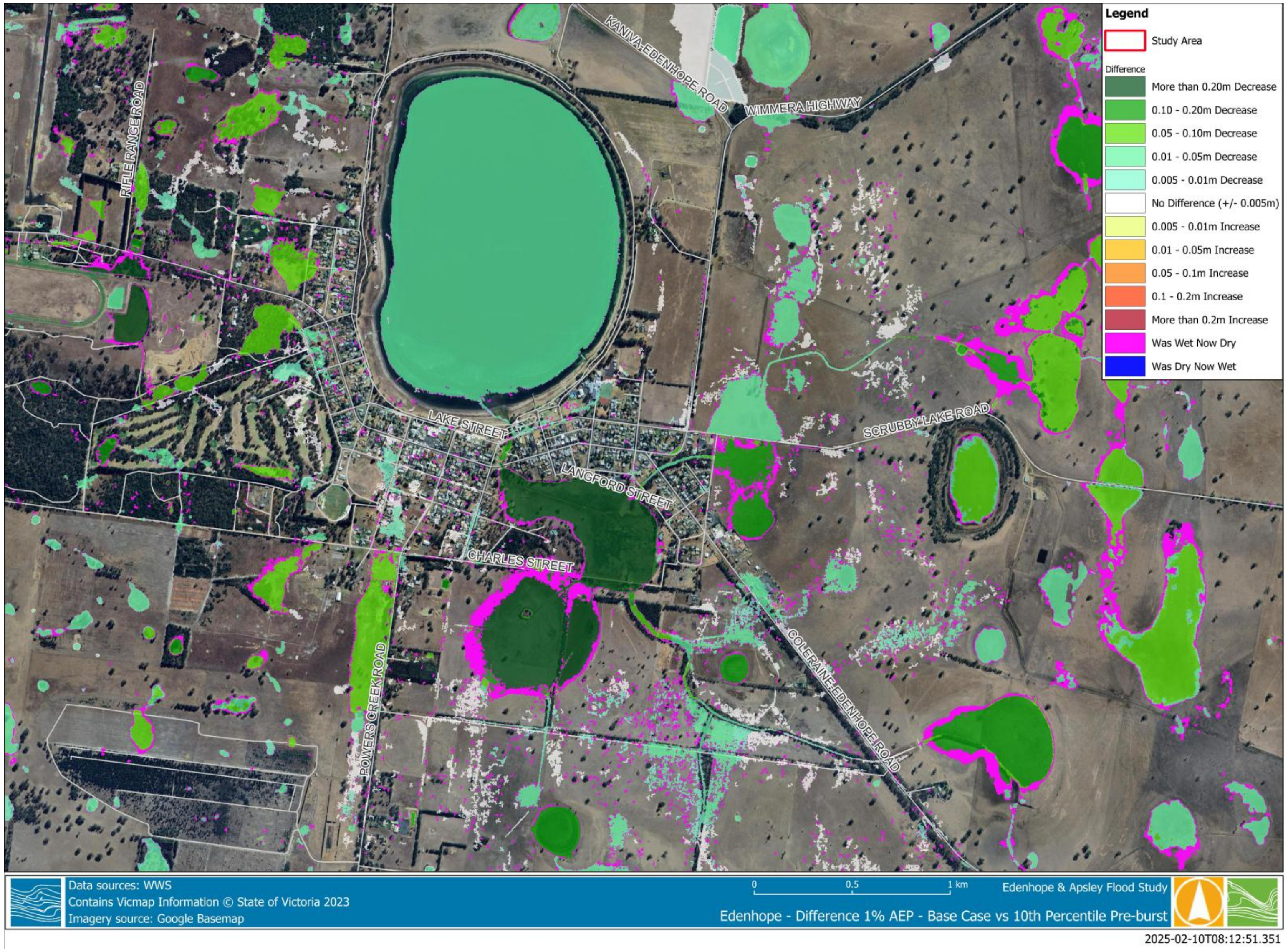

Figure 3-5 Difference Plot for 1% AEP – Base Case vs 10th Percentile Pre-burst

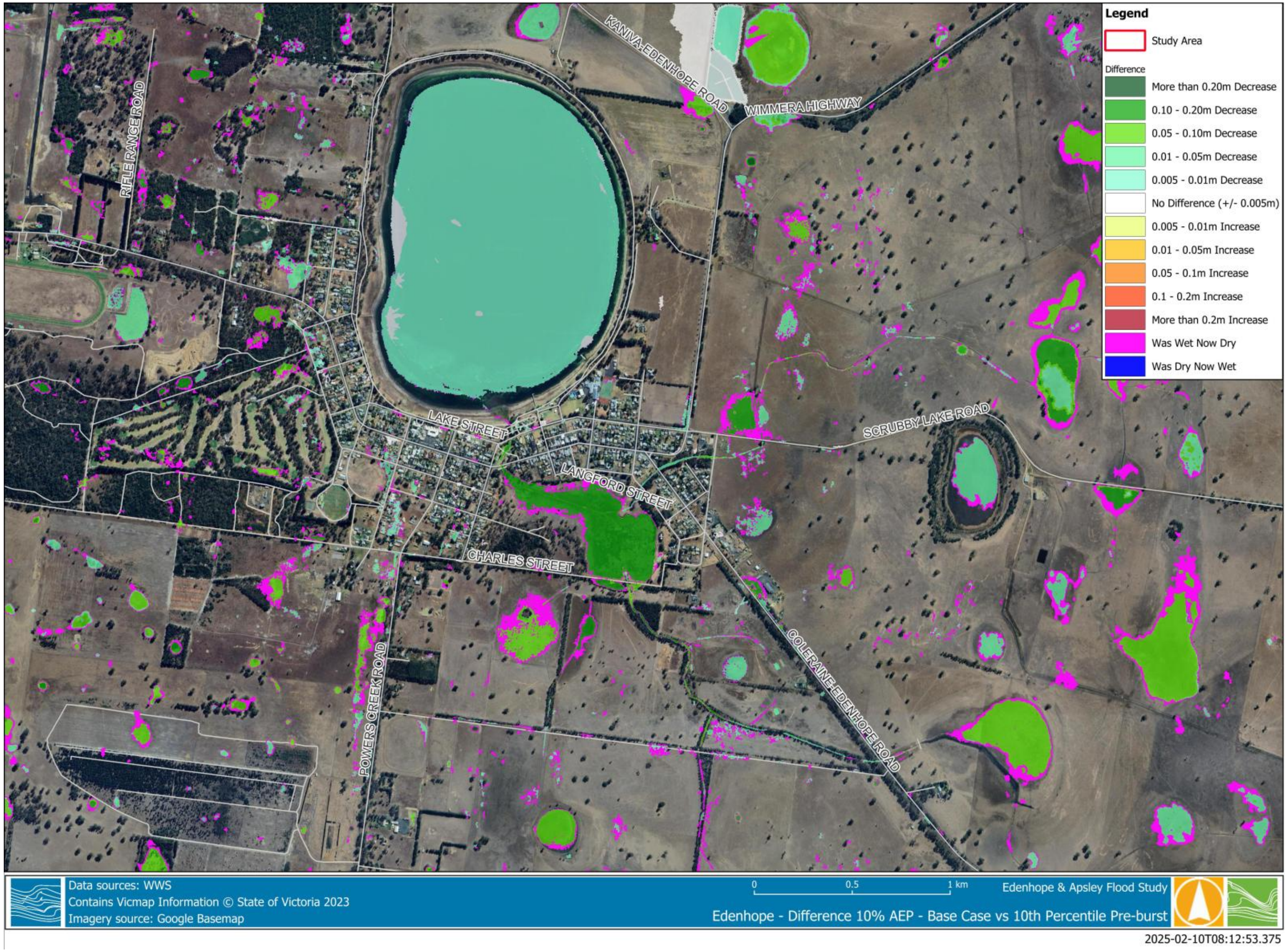

Figure 3-6 Difference Plot for 10% AEP - Base Case vs 10th Percentile Pre-burst

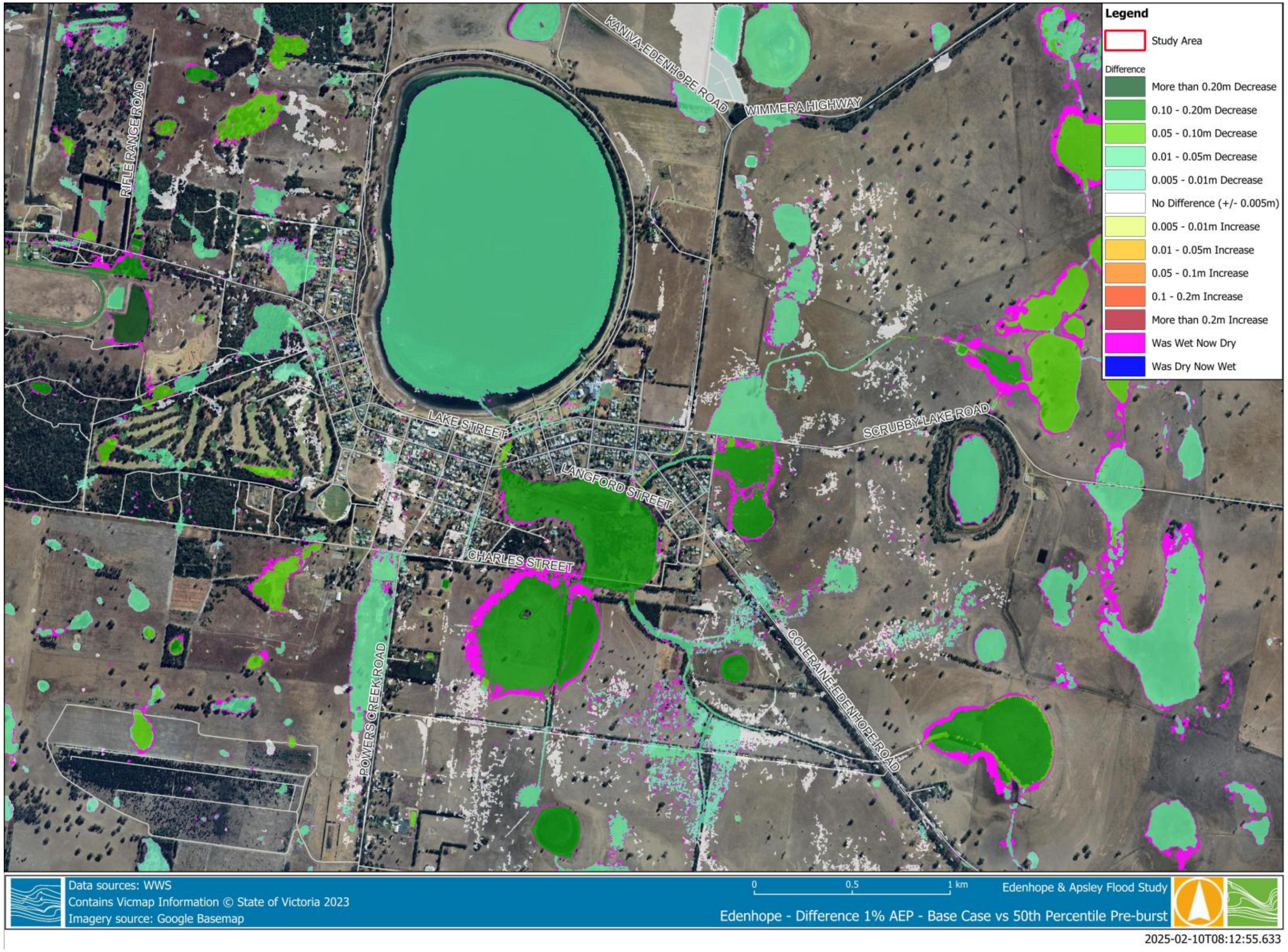

Figure 3-7 Difference Plot for 1% AEP - Base Case vs 50th Percentile Pre-burst

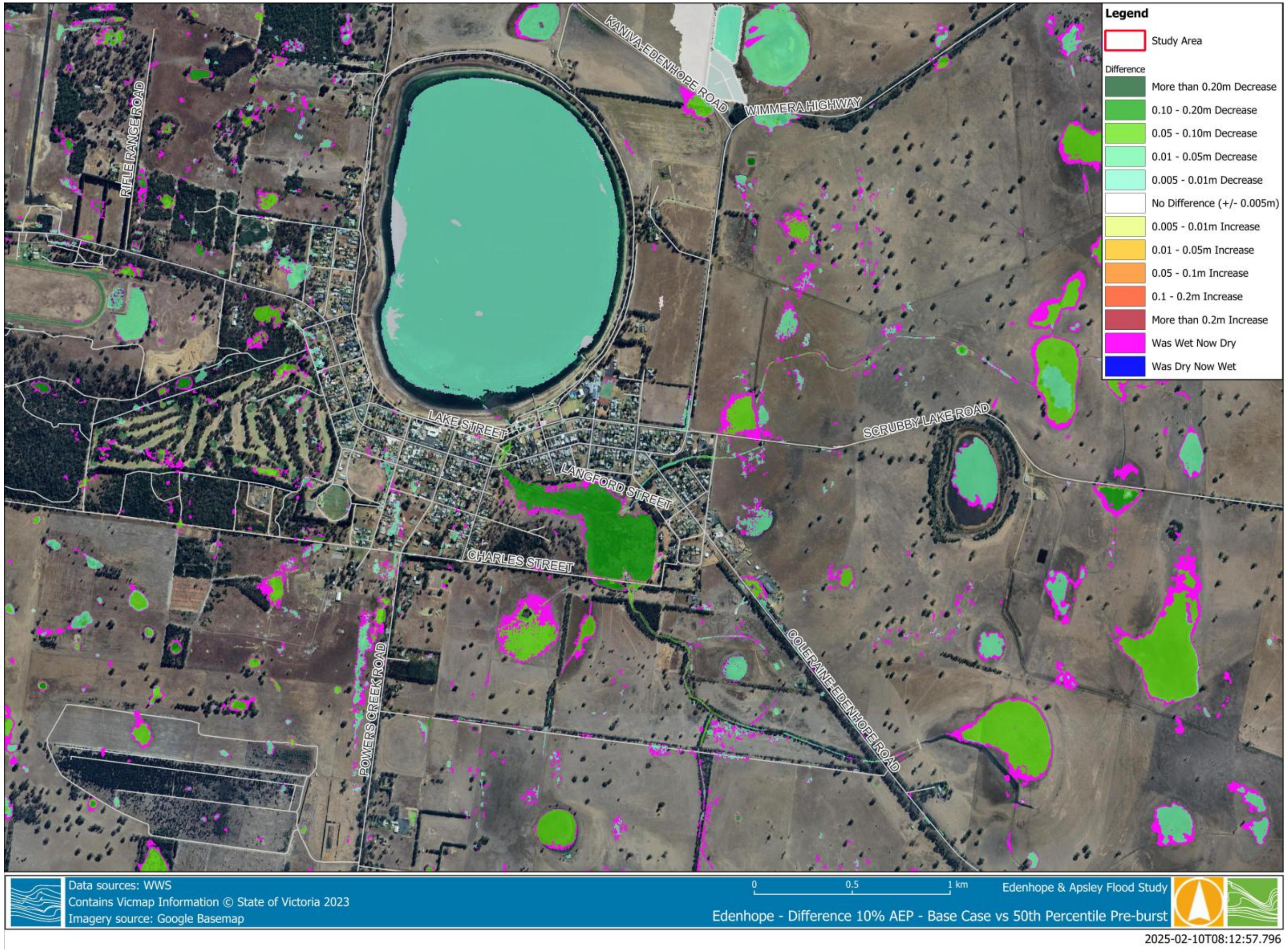

Figure 3-8 Difference Plot for 10% AEP - Base Case vs 50th Percentile Pre-burst

3.4 Roughness coefficients

Hydraulic roughness sensitivity within the hydraulic model was tested by lowering and raising the Manning's 'n', to assess the impact on the flood behaviour. The roughness values in the model, as listed in Table 2-1, were multiplied by a factor of 0.8 and 1.2 for the low and high roughness values respectively.

The water surface elevations for the lowered and increased roughness were compared against the baseline values. The difference in water surface elevation for the lowered scenario and increased scenario for the two AEP events is presented in Figure 3-9 to Figure 3-10, and Figure 3-11 to Figure 3-12 respectively.

The results shows that the change in roughness coefficient value has little influence in the change in water level differences for both 10% and 1% AEP flood events. The 1% AEP flood event has a difference up to +/- 0.02 m, whereas 10% AEP has a difference up to +/- 0.007 m. The comparison of lowered and increased roughness with the baseline has shown no significant impact on flood extent.

The adopted roughness values are selected based on the previously calibrated flood event. The sensitivity testing of lowered and increased roughness values has minimal flooding impact along flow paths within Edenhope, and results in a minimal consequence with the change in roughness values. The adopted roughness values were considered suitable.

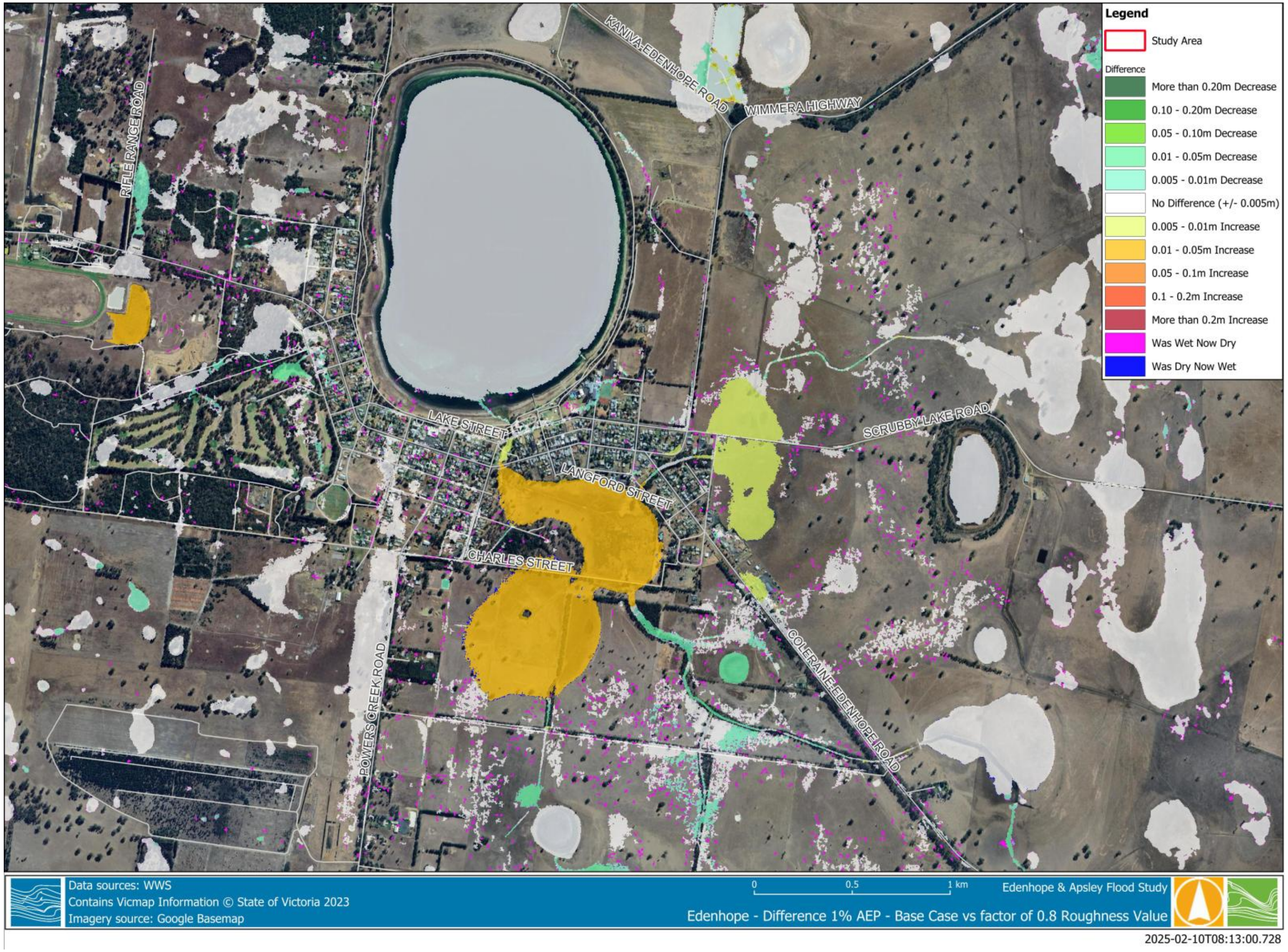

Figure 3-9 Difference Plot for 1% AEP - Base Case vs factor of 0.8 Roughness Value

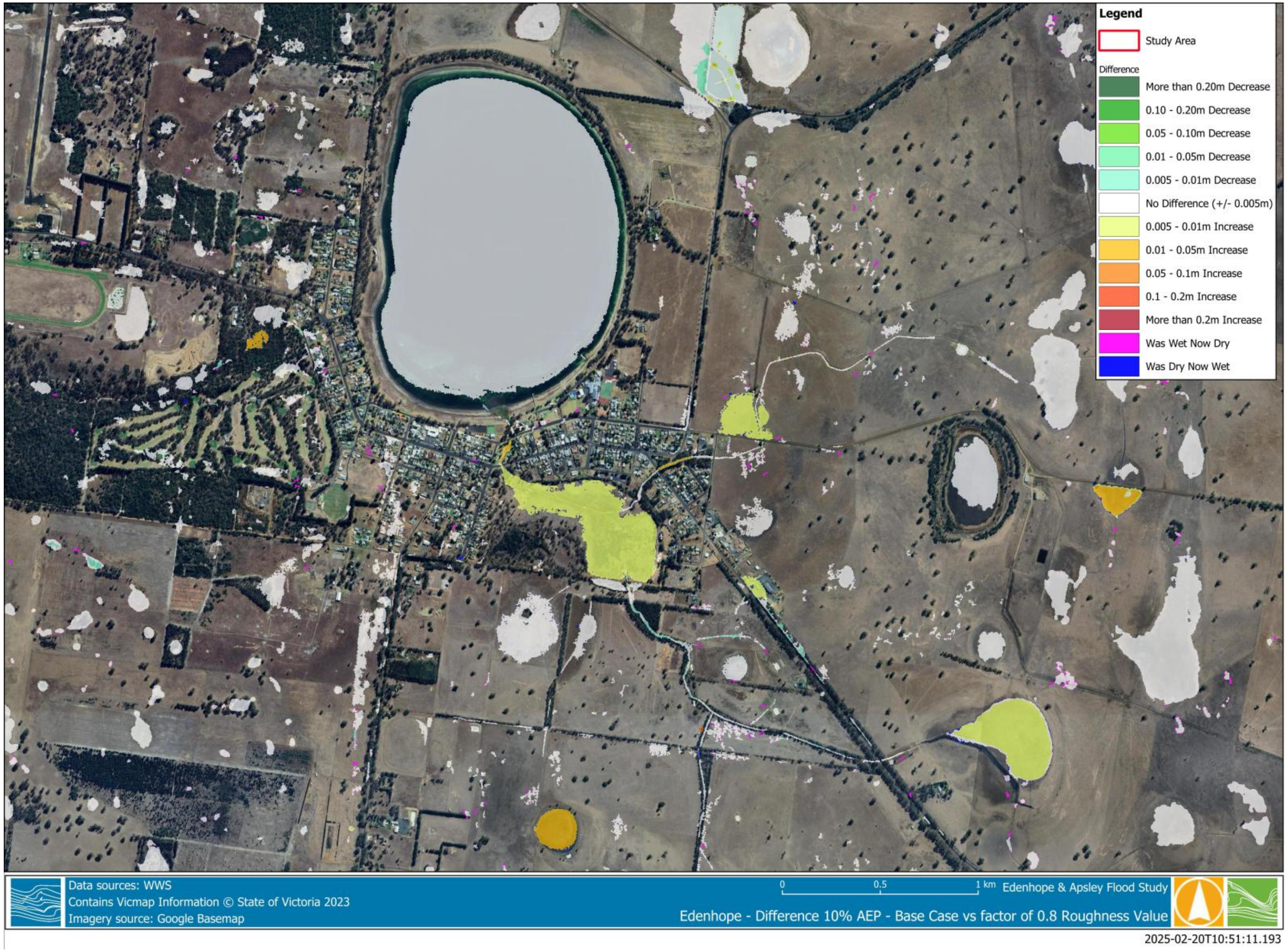

Figure 3-10 Difference Plot for 10% AEP - Baselines vs factor of 0.8 Roughness Value

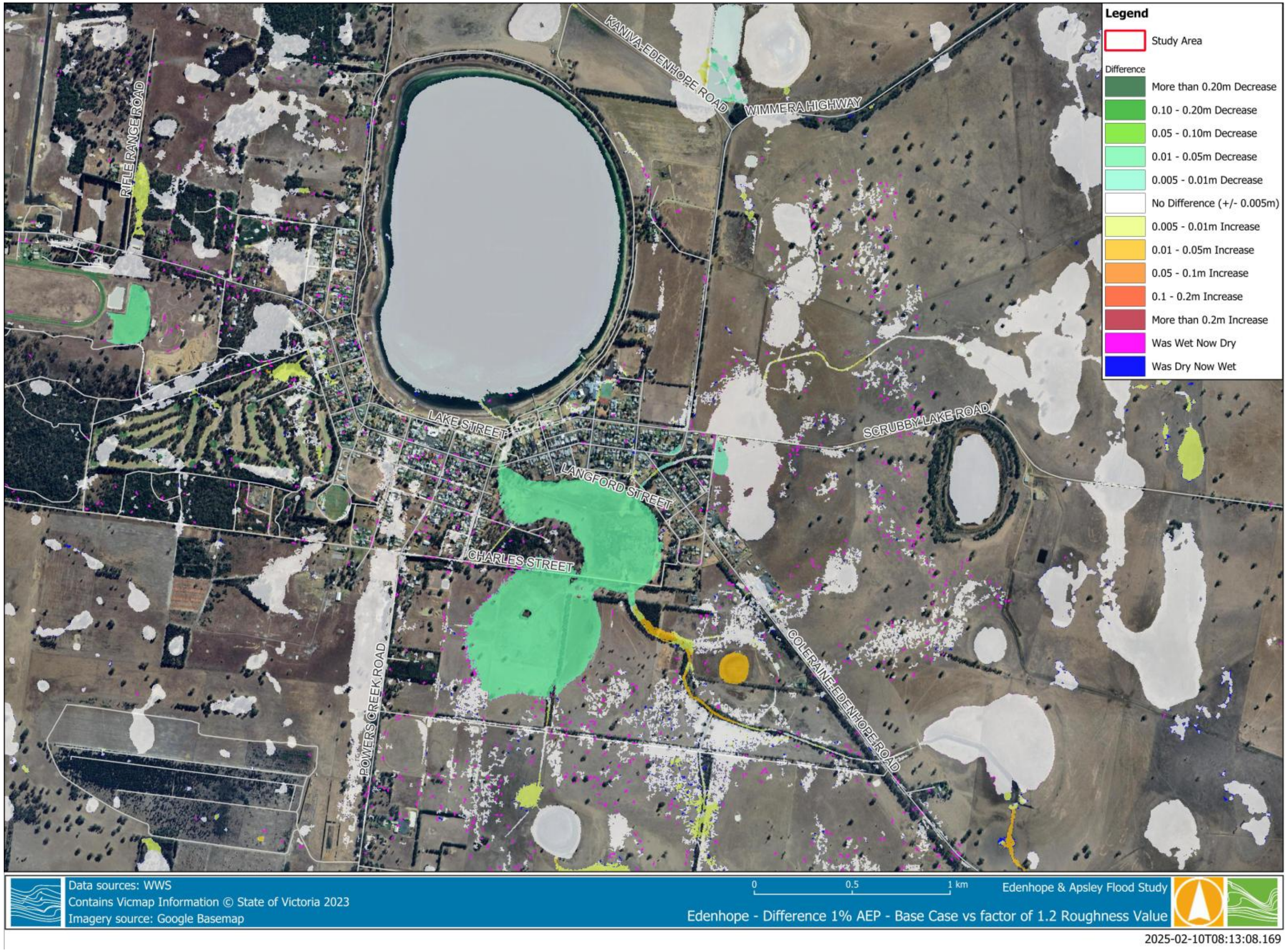

Figure 3-11 Difference Plot for 1% AEP - Base Case vs factor of 1.2 Roughness Value

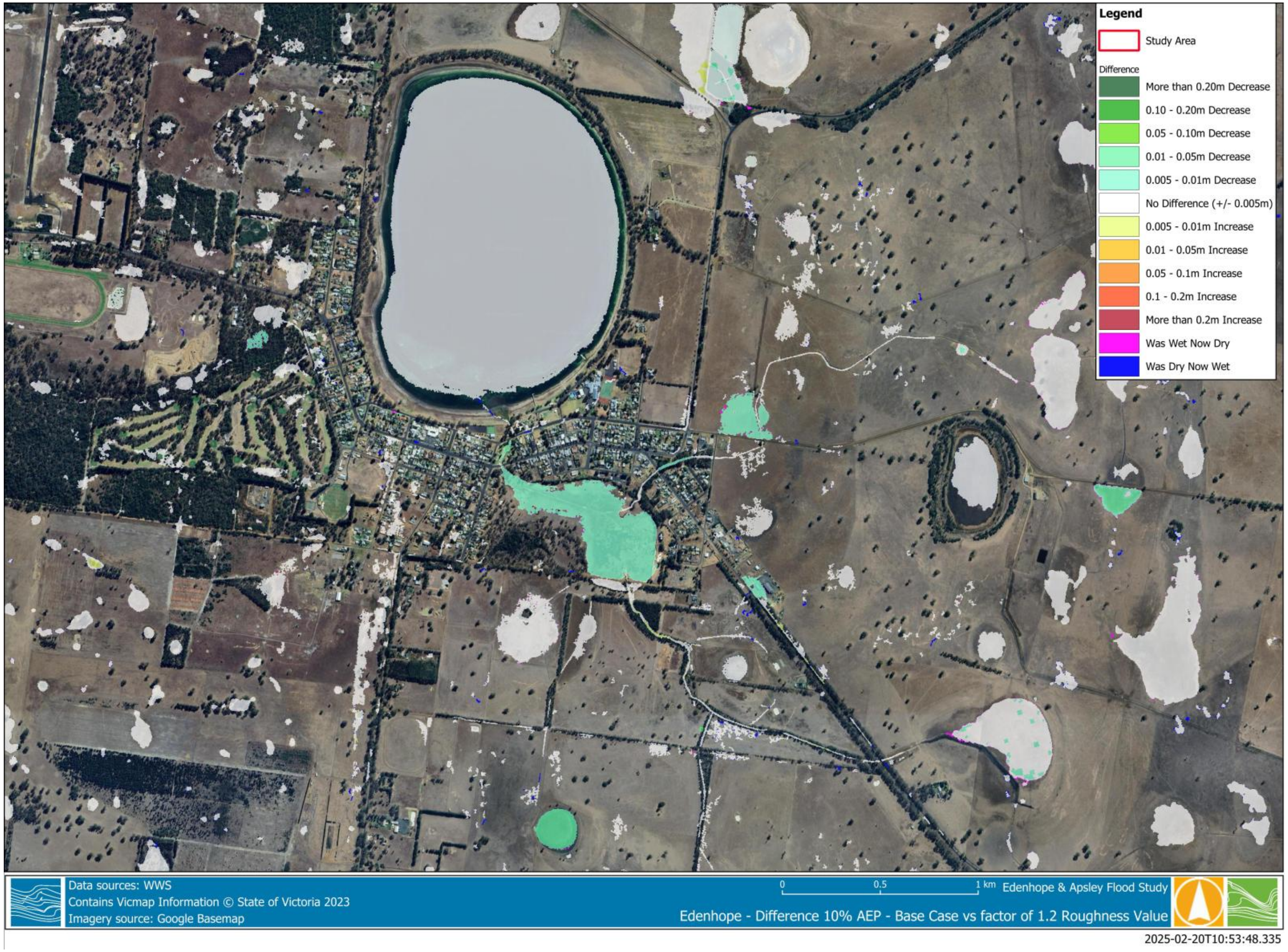

Figure 3-12 Difference Plot for 10% AEP – Base Case vs factor of 1.2 Roughness Value

3.5 Critical Storm Duration

A range of durations were modelled to determine the critical event durations across each model extent. To determine the critical duration, the following steps were undertaken:

- Three temporal patterns (i.e., front-, steady-, and rear-loaded) were modelled for each duration between 1 hour to 24 hours. The analysed storm durations and temporal patterns for the 10% and 1% AEP events are listed in Table 2-4.
- For individual storm durations the results (flood depth) from the 3 temporal patterns were maximised. This allowed to capture sensitivity within the catchment to temporal pattern loaded.
- The median value across all maxed storm durations was extracted to identify the critical duration/s. Three critical durations were identified within the model extent for each AEP event (i.e., short, mid, long), which are listed in Table 3-1.
- The selected durations were then rerun with all ten temporal patterns and the median peak flow value were taken. The resulted median depth grid would consist of a combination of several temporal patterns based on the key catchment locations (i.e., Edenhope township and upstream flow path).
- Lastly, the median depth results were then maximised to obtain the final maximised depth results with a combination of critical durations. The selected critical durations and key catchment locations are listed in Table 3-2.

For this assessment, the base parameters determined in the previous sensitivity test section were used to determine the critical durations and temporal pattern as the design storm event.

Table 3-1 Selected short, mid, long critical durations

Critical Duration	1% AEP	10% AEP
Short	1 hours	1.5 hours
Mid	12 hours	
Long	24 hours	

Table 3-2 Finalised critical durations at key catchment locations

	AEP	Critical Duration
Edenhope township	1%	1 hours
	10%	1.5 hours
Upstream flow path	1%	12 hours
	10%	9 hours

3.6 Adopted Parameters for Design Modelling

The sensitivity testing showed varying impact on the flood behaviour in the Edenhope catchment. The adopted design parameters closely aligned with those determined during the January 2011 model calibration. The adopted parameter values were as follows:

- Antecedent conditions – 90th percentile initial water level;
- Rainfall losses and pre-burst – 75th percentile pre-burst rainfall;
- Roughness coefficient – see Table 2-1;
- Critical durations – see Table 3-2.

4 DRAFT FLOOD MODELLING

4.1 Existing Conditions

Design flood modelling for the 10% and 1% AEP events was completed using the validated hydraulic models. Flood modelling outputs will be applied for flood emergency response improvement and planning, and flood maps will be used as guidance for future land use development.

The final flood maps for each event were created by the maximum of all the runs for each AEP event. The maximum flood extents for the 10% and 1% AEP events for the zoomed in Edenhope township and zoomed out extent are shown in Figure 4-3 and Figure 4-3 respectively, and the maximum depths of both events are shown in Figure 4-4 to Figure 4-11. All gridded results were filtered to only include areas where the flood depth is >0.05 m and puddles >200m^2.

Flood hazard mapping was prepared in line with ARR2019 and the Australian Disaster Resilience Guideline 7-3 Flood Hazard[4]. The hazard classifications are based on the peak depth, velocity and product of depth and velocity. The classifications are shown Figure 4-1.

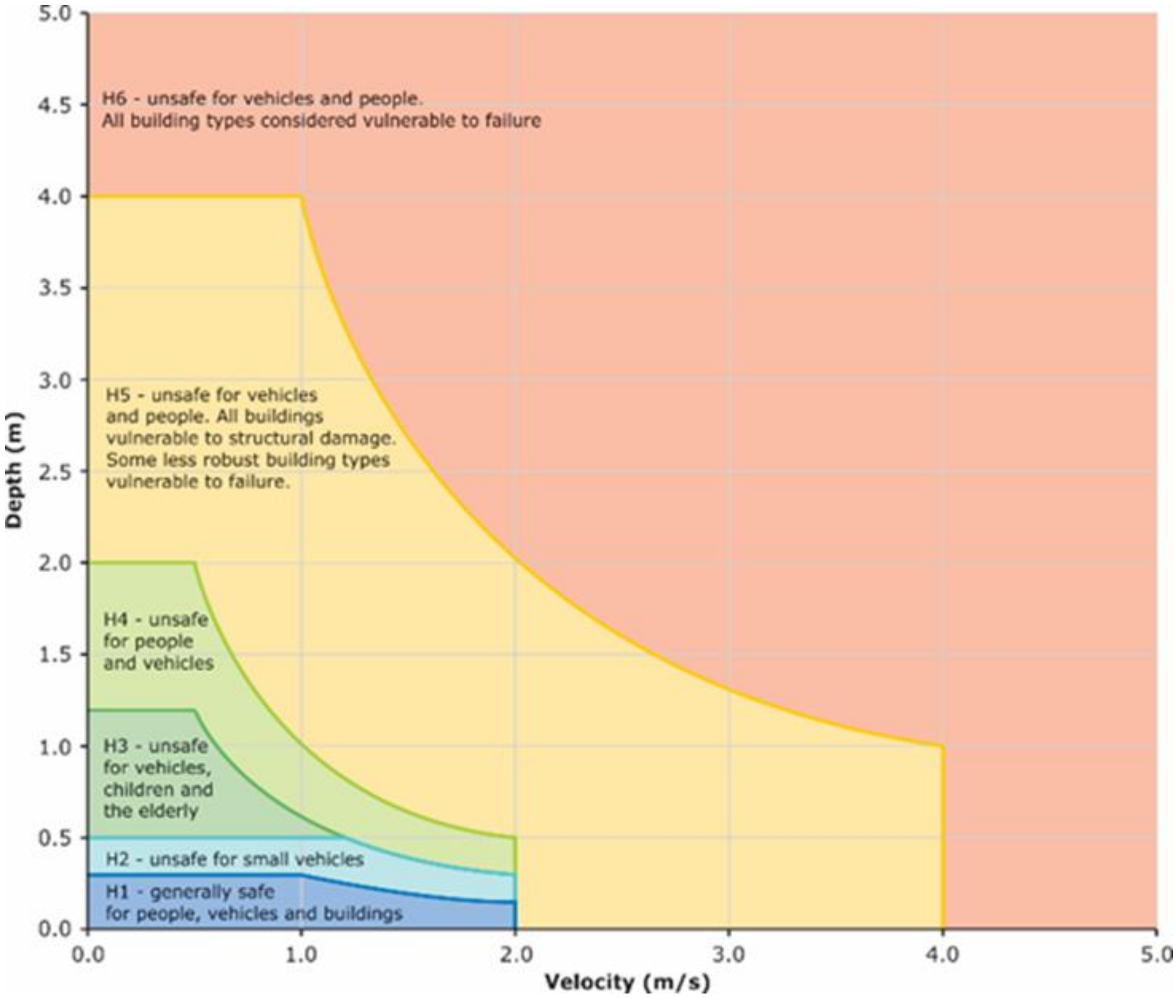

Figure 4-1 Flood hazard classifications

[4]Australian Disaster Resilience Guideline 7-3 Flood Hazard, 2017, Australian Institute Disaster Resilience

Figure 4-2 Zoomed into Edenhope - 10% and 1% AEP flood events

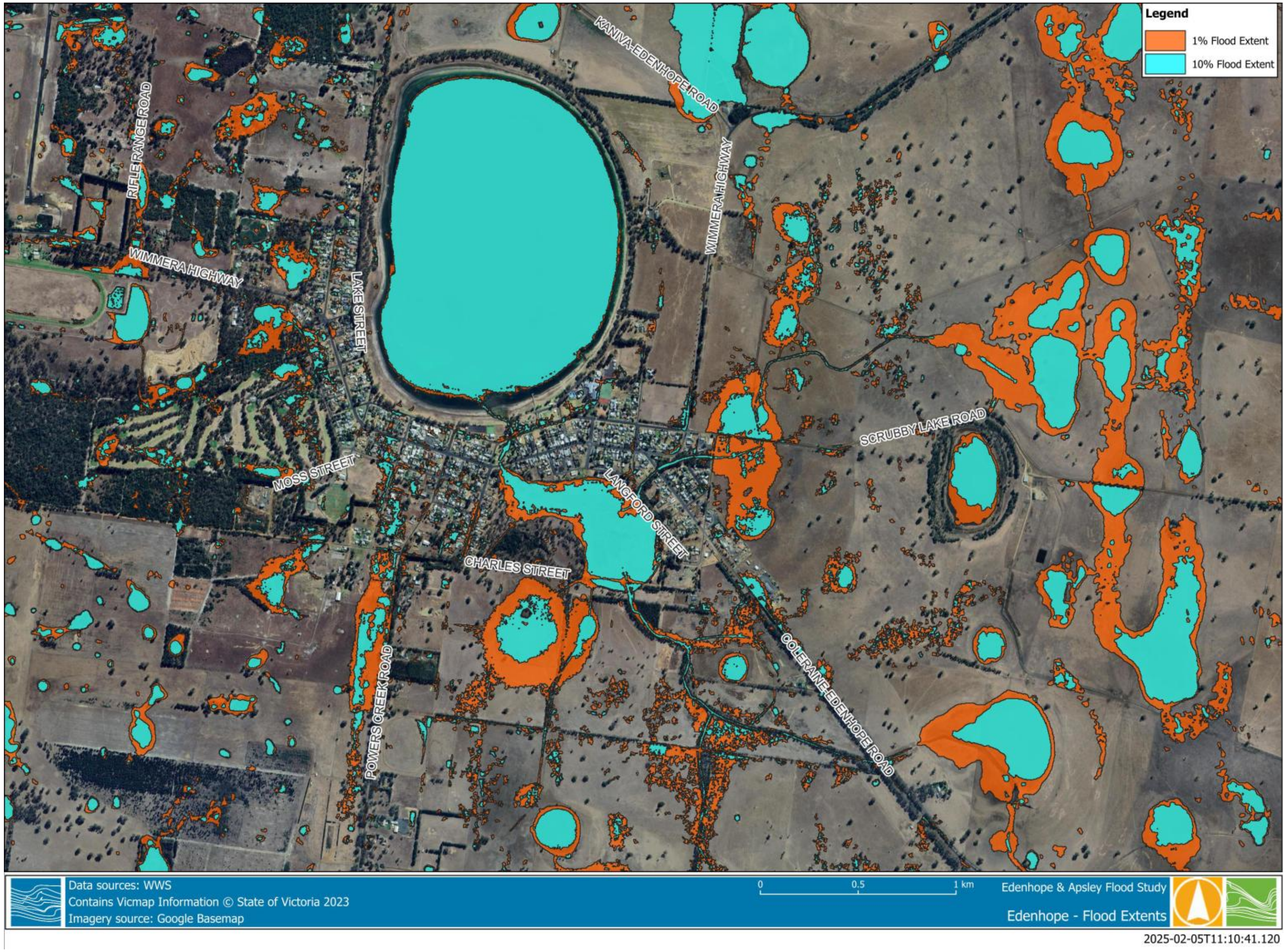

Figure 4-3 Broad extent - 10% and 1% AEP flood event extents

Figure 4-4 Zoomed into Edenhope - 1% AEP flood depth with water surface elevation contours

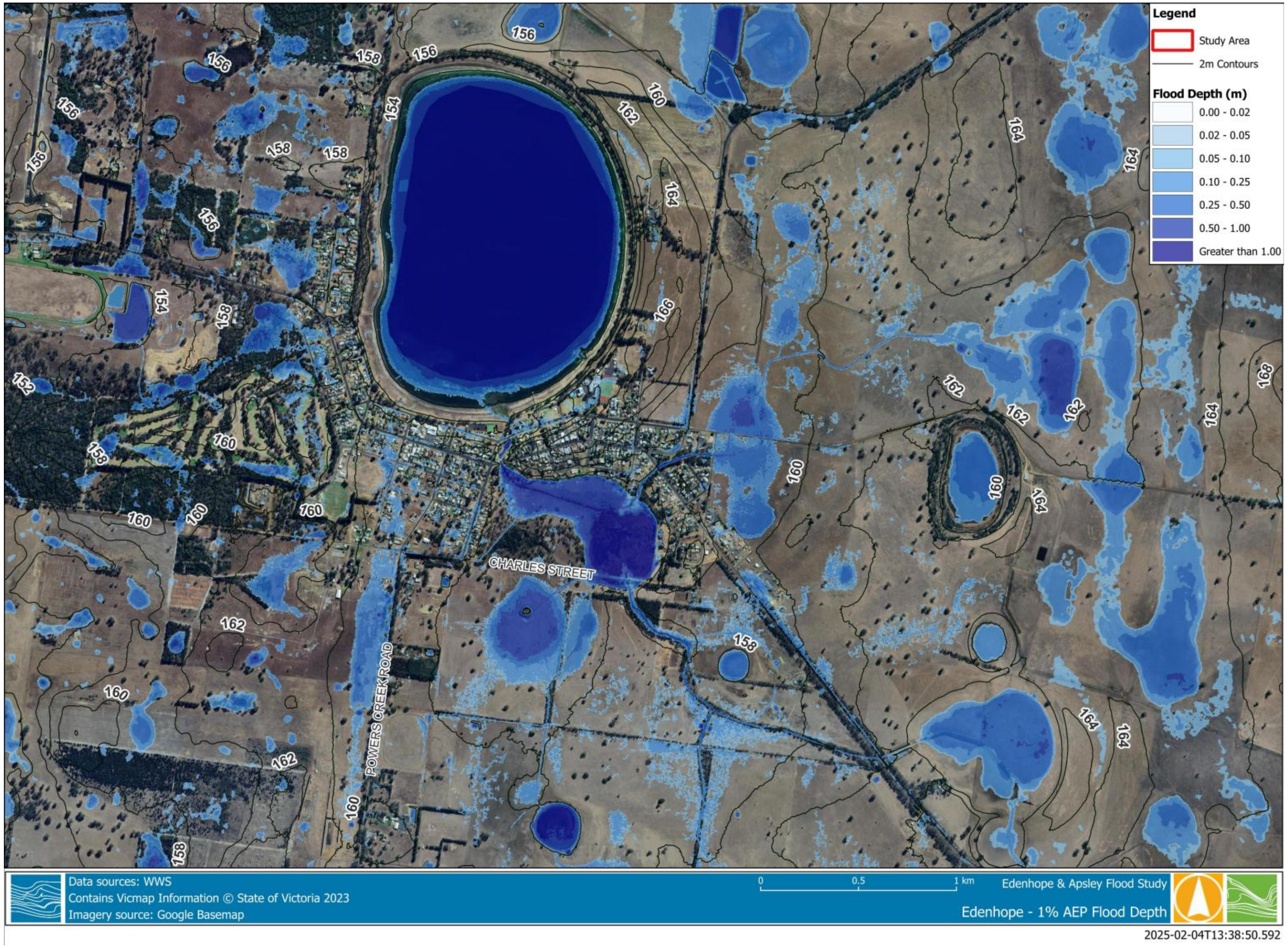

Figure 4-5 Broad extent - 1% AEP flood depth with water surface elevation contours

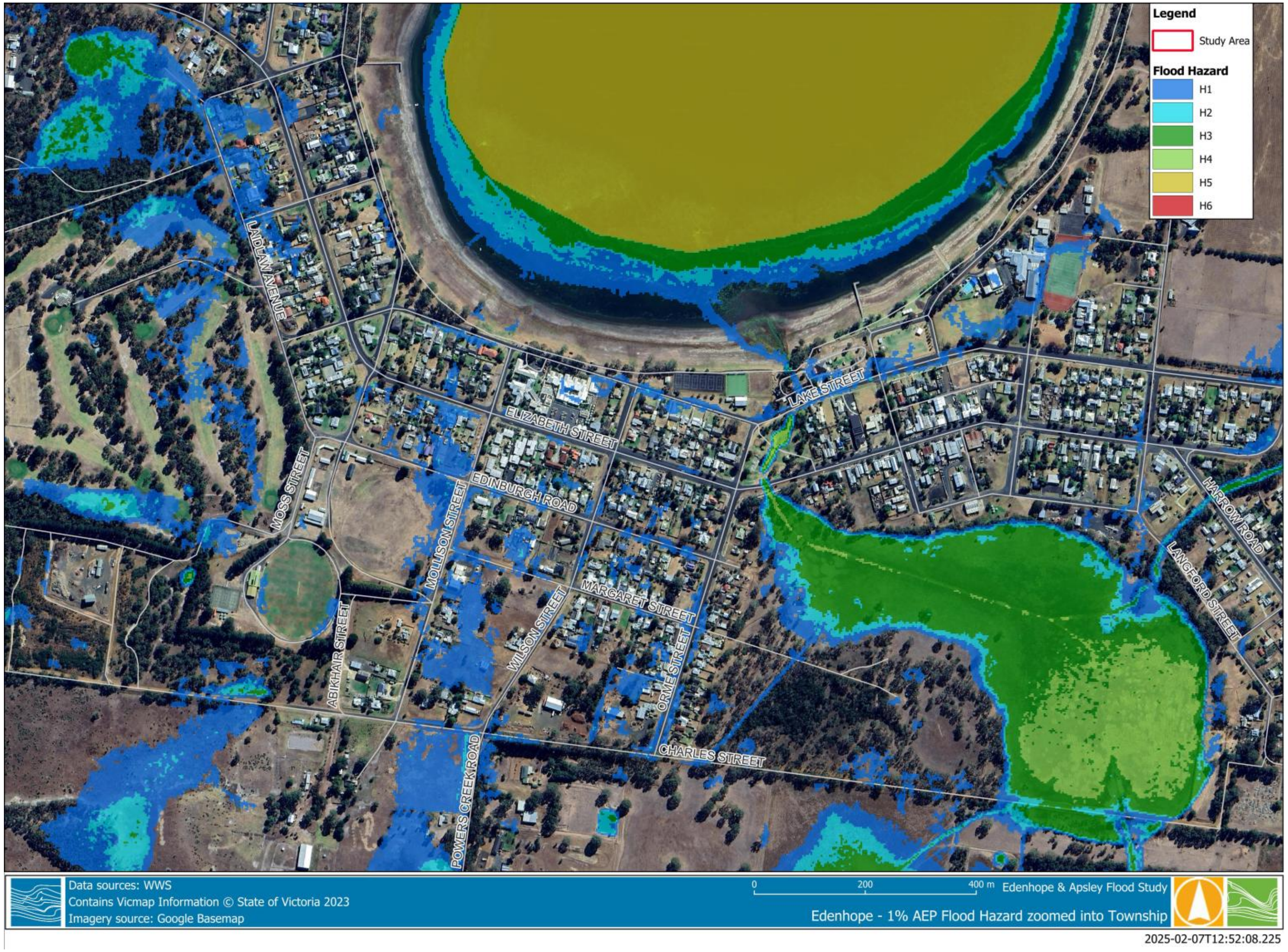

Figure 4-6 Zoomed to Edenhope - 1% AEP Flood Hazard

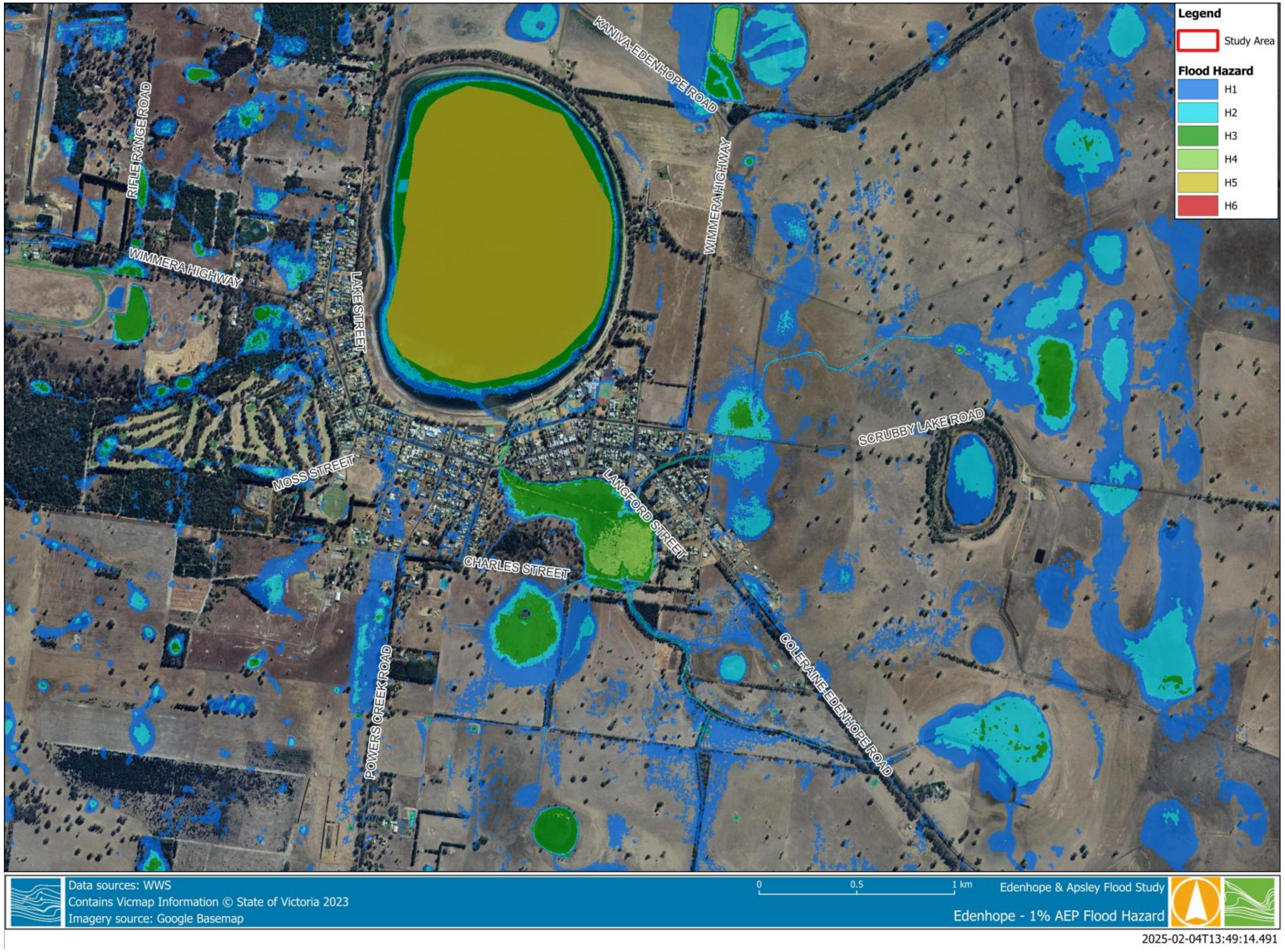

Figure 4-7 Broad extent - 1% AEP Flood Hazard

Figure 4-8 Zoomed into Edenhope - 10% AEP flood depth with 1m water surface elevation contours

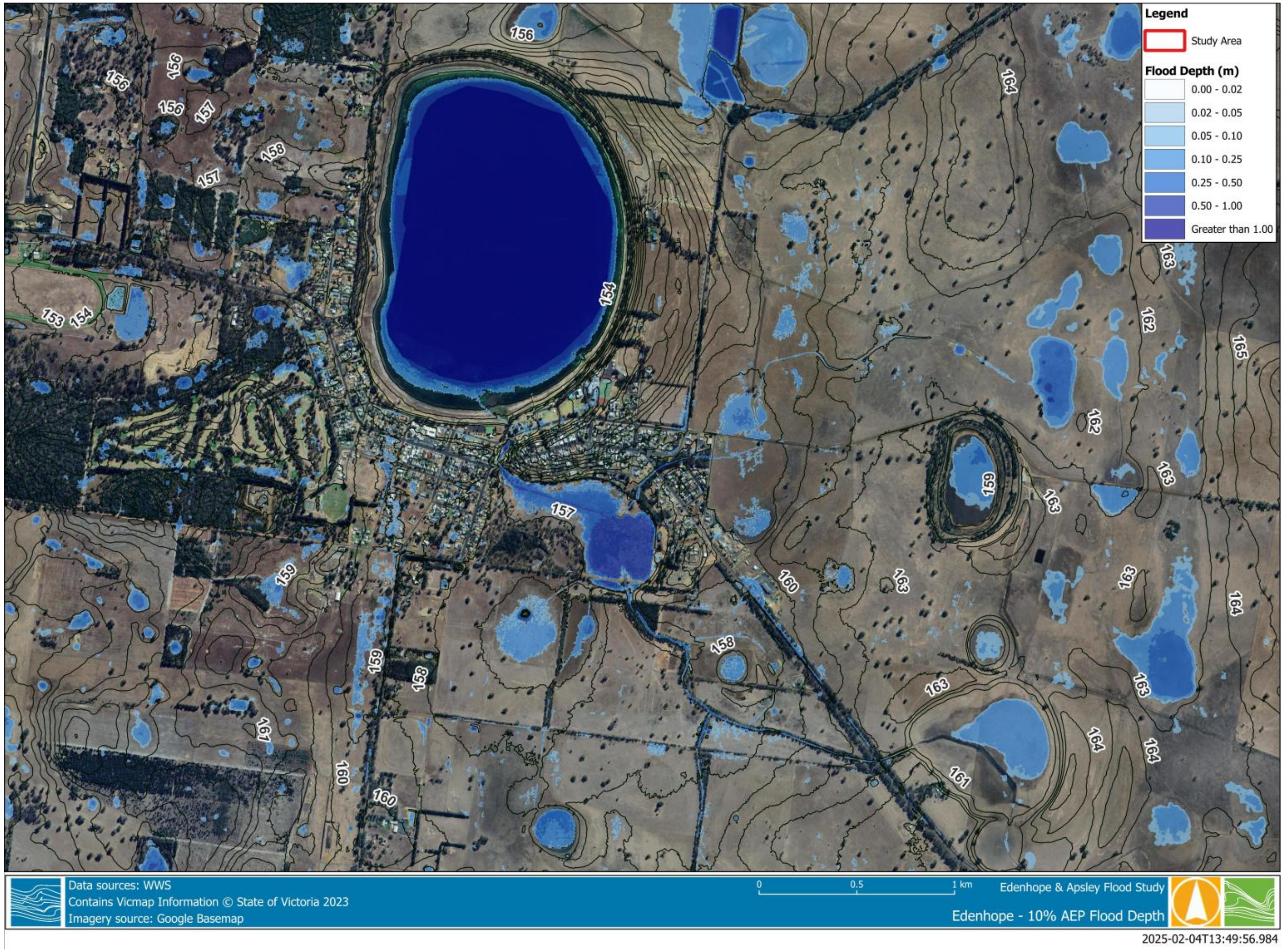

Figure 4-9 Broad extent - 10% AEP flood depth with water surface elevation contours

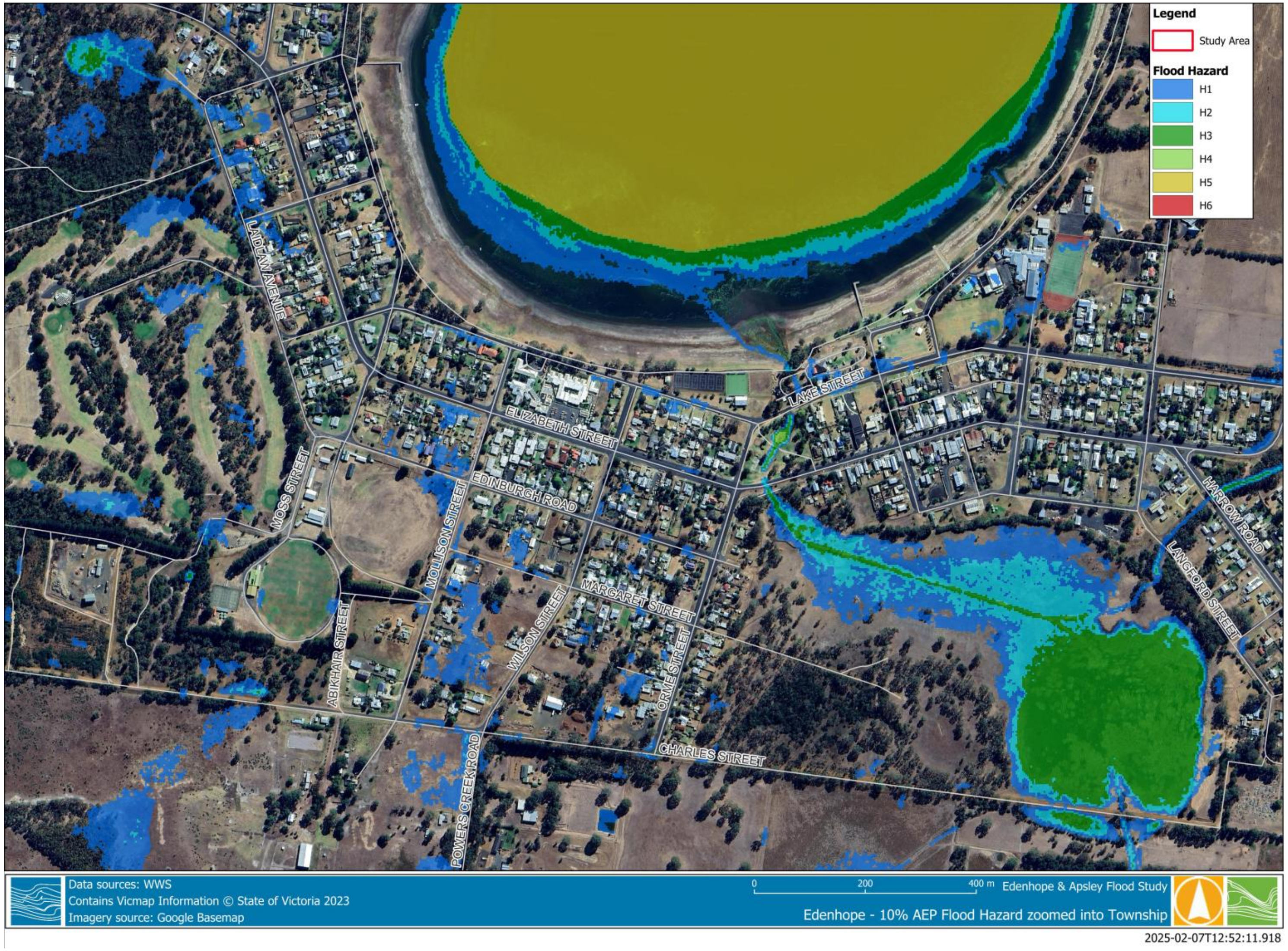

Figure 4-10 Zoomed into Edenhope - 10% AEP Flood Hazard

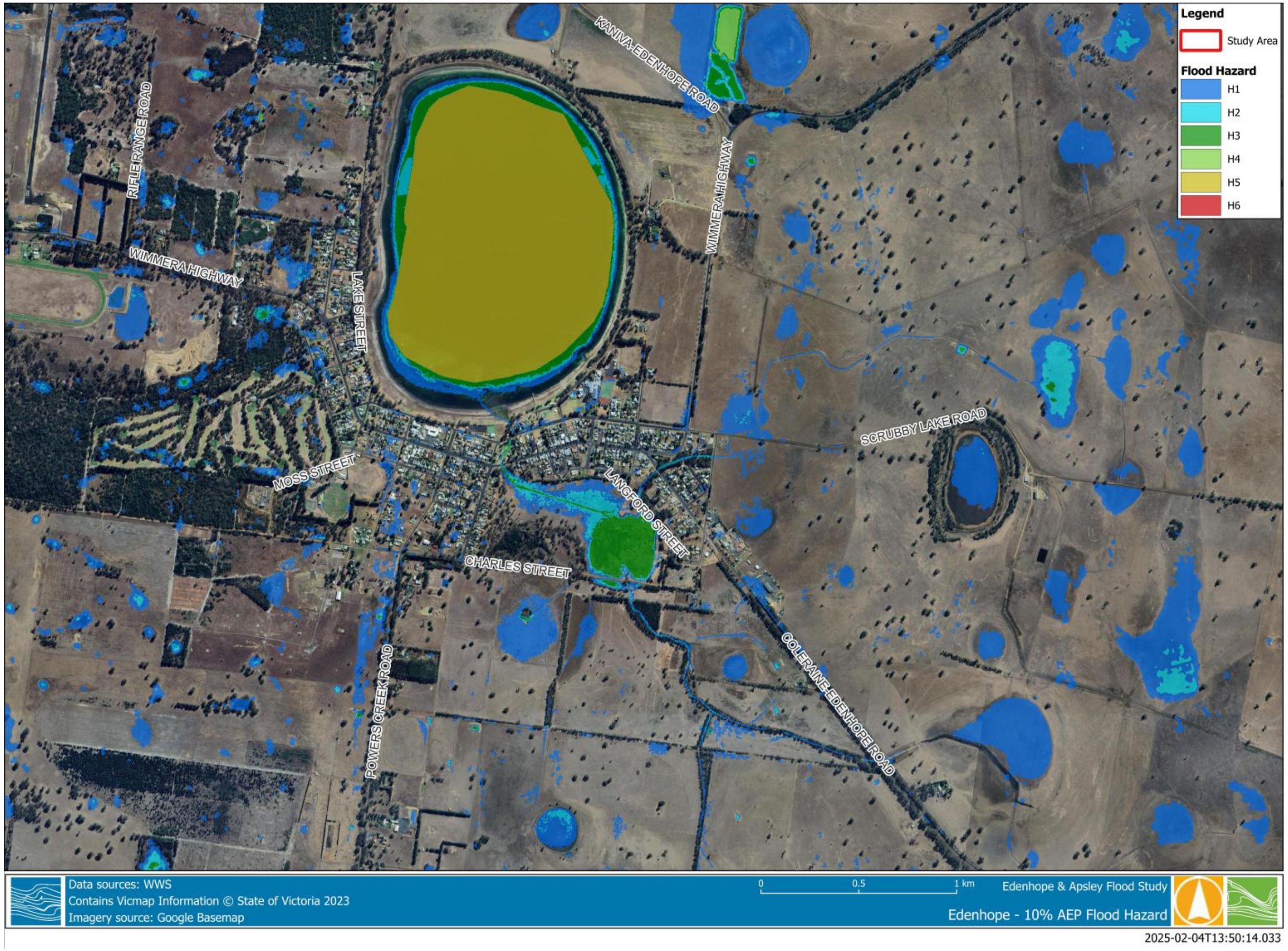

Figure 4-11 Broad extent - 10% AEP Flood Hazard

5 SUMMARY AND DISCUSSION

Design modelling and sensitivity testing of the hydraulic models built for Edenhope as part of the Edenhope and Apsley Flood Investigation have been completed and detailed in this report. Once the draft flood mapping has been approved for 10% and 1% AEP events, the design modelling will be undertaken for the other events, including 20%, 5%, 2%, 0.5% and the 1% AEP events with projected climate change increased rainfall intensity under RCP4.5 and RCP8.5 for the year 2100.

The modelling shows limited sensitivity to antecedent conditions, rainfall losses and pre-burst, roughness coefficient, and critical storm duration. For the 10% and 1% AEP events, the initial water level was not shown to be influential on results in the township and upstream flow path. On the other hand, both the rainfall losses and pre-burst, and the roughness coefficient have some impacts on the overall flood level results. Therefore, pre-burst values that enable a conservative flood mapping approach and roughness values calibrated to the recent flood event are adopted as the parameter values for the design modelling.

The draft flood mapping was produced in line with industry standards and the current Australian Rainfall and Runoff guidelines. The mapping is fit for the purposes of informing land use planning in Edenhope through the development of draft overlays for a future planning scheme amendment. As part of this study, model outputs will be used to assess average annual flood damages for the township and the models will be utilised to assess potential structural mitigation options. Flood intelligence products will be developed to inform emergency management planning and response, including updated content for the Municipal Flood Emergency Management Plan.

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