Flood Risk Report – Dargo Valley

Rapid Estimation of Flood Risk in Upland Floodplain Areas

East Gippsland Catchment Management Authority

August 2017

Document Status

Version	Doc type	Reviewed by	Approved by	Date issued
v01	Draft			25/01/2017
v02	Final Draft			10/02/2017
v03	Final			08/08/2017

Project Details

Project Name	Rapid Estimation of Flood Risk in Upland Floodplain Areas
Client	East Gippsland Catchment Management Authority
Client Project Manager	
Water Technology Project Manager	
Water Technology Project Director	
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Document Number	R02v03_4866-01_FloodRisk_Dargo_Valley_FINAL.docx

08 August 2017

East Gippsland Catchment Management Authority

Dear

Flood Risk Report –Dargo Valley

This report documents the flood risk assessment of Dargo Valley for Phase 2 of the Rapid Estimation of Flood Risk in Upland Areas project (EGCMA Contract 130). The report details the technical methodology adopted for the site, describes the modelled flood behaviour of the site, summarises key flood intelligence and presents flood risk metrics consistent with the East Gippsland CMA Regional Flood Risk Assessment (Aither, 2016).

This report is supported by the earlier Project Plan and Data Review report (R01), which documents the hydrology and hydraulic method for all 8 sites assessed in this project. The report is issued along with all relevant digital GIS datasets and flood modelling outputs in Victorian Flood Database format.

Yours sincerely

WATER TECHNOLOGY PTY LTD

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1 INTRODUCTION

Water Technology was commissioned by East Gippsland CMA to undertake a rapid flood risk assessment for eight upland floodplains in the East Gippsland region. These eight floodplains are areas where East Gippsland CMA currently have very limited to no flood risk information available. These areas were defined as areas with a flood risk within the East Gippsland Regional Flood Risk Assessment (Aither, 2016), but had no flood risk information. The rapid flood risk assessments will therefore deliver critical flood risk information for the region.

These eight rapid flood risk assessments are to serve as a pilot study on how to undertake future assessments. It is acknowledged that some floodplains will not have funding and will not have a high enough level of flood risk to warrant a detailed flood risk assessment. The objective for these rapid flood risk assessments is therefore to develop a rapid, cost effective methodology, that is fit for purpose and defendable.

The report details the technical methodology adopted for the site, describes the modelled flood behaviour of the site, summarises key flood intelligence and presents flood risk metrics consistent with the East Gippsland CMA Regional Flood Risk Assessment (Aither, 2016).

This report documents the flood risk assessment of Dargo Valley for Phase 2 of the project.

This report is supported by the earlier Project Plan and Data Review report (R01), which documents the hydrology and hydraulic method for all 8 sites assessed in this project. The report is issued along with all relevant digital GIS datasets and flood modelling outputs in Victorian Flood Database (VFD) format.

The outcomes of the study will be reviewed and a recommended approach for conducting future rapid flood risk assessments will be documented.

2 BACKGROUND

The Dargo Valley site catchment extends from Dargo, north to Mount Hotham, the catchment is 684 square kilometres in size. Its shape is long and narrow in the South to North direction, ranging from 12-15 kilometres wide and over 60 kilometres long. There are relatively flat areas of pasture around the Dargo Township, the slopes get steeper and vegetated with bushland as the catchment heads north. The study area is shown in Figure 2-1, while the catchment area is displayed in the image inset.

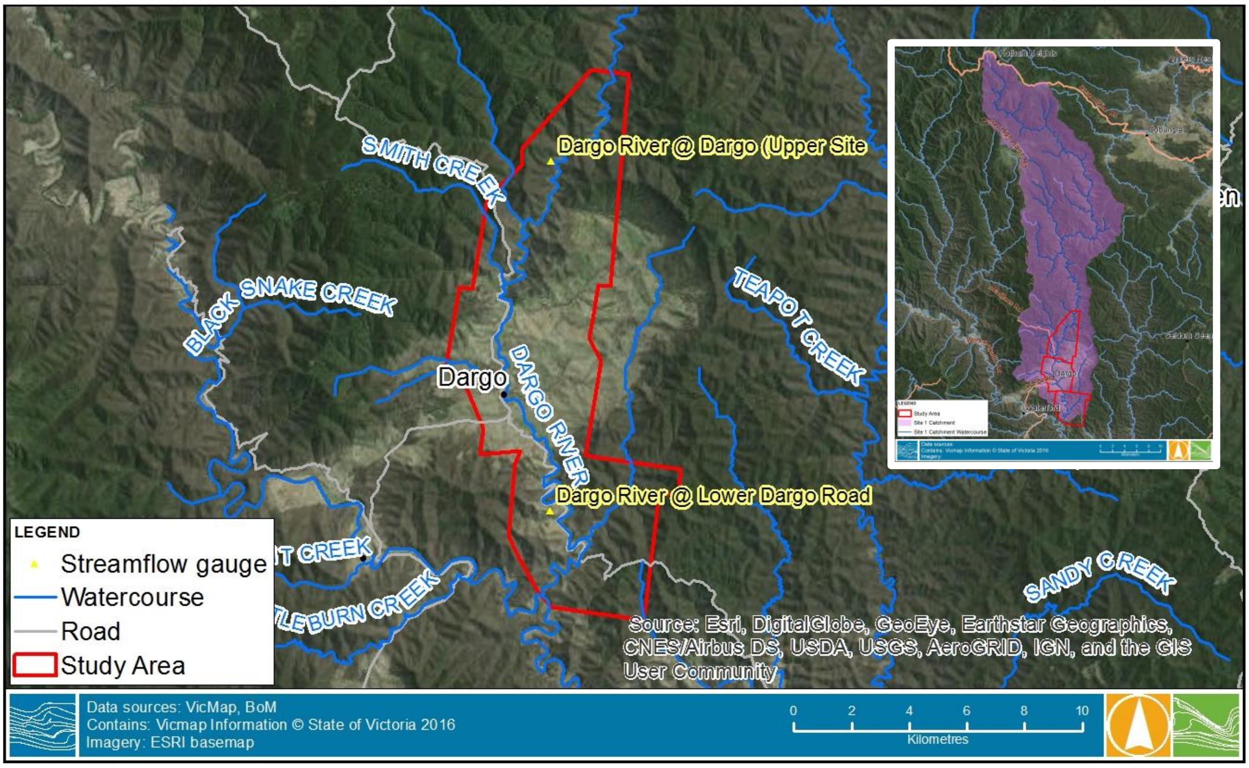

Figure 2-1 Study Area – Dargo Valley

3 FLOOD RISK MODELLING

The methodology adopted in this study was developed to deliver a rapid flood risk assessment. It used the best available topographic data, available streamflow gauging and simplified hydrologic methods for each site, using a combination of flood frequency analysis, adjustment of peak flow by catchment scaling and regional peak flow approximations. The hydraulic modelling utilised TUFLOW Graphical Processing Unit (GPU) software to ensure fast run times.

3.1 Topography

The Dargo Valley site has Rivers LiDAR along the Dargo Valley, with the VICMAP derived Digital Elevation Model (DEM) higher up on the valley slopes, Figure 3-1. The Rivers LiDAR is highly accurate, with the VICMAP derived DEM being far less accurate and was only used as a last resort. The flood mapping depths will be less accurate in the area where the VICMAP derived DEM was used. The mapping results showed that the flooding was contained within the higher resolution Rivers LiDAR domain. The VICMAP DEM to the east of Dargo was adjusted by 5.8 m to match with the Rivers LiDAR as close as possible. A difference of the Rivers LiDAR and the VICMAP derived DEM at the required location is provided in Figure 3-2.

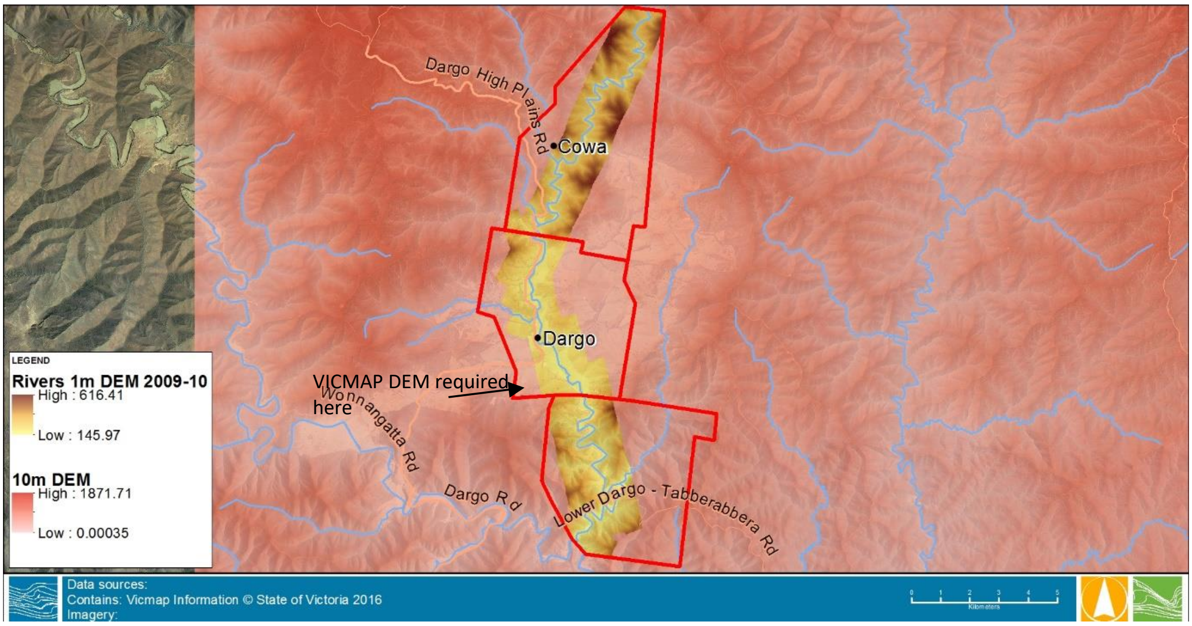

Figure 3-1 Dargo Valley Topography Data

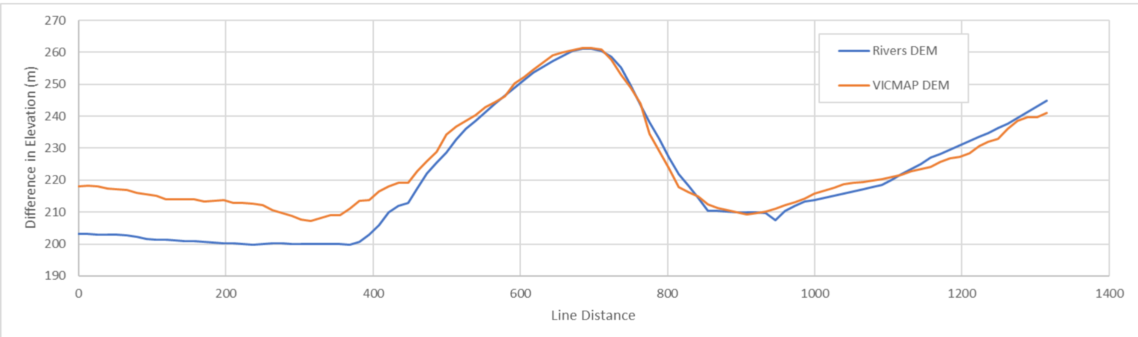

Figure 3-2 Dargo Valley Comparison of Rivers LiDAR and VICMAP Derived DEM

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3.2 Hydrology

The hydrology analysis for Dargo Valley is described below.

AVAILABLE GAUGES:

- **Dargo River @ Lower Dargo Road (224213) – Primary Gauge**
- Dargo River @ Dargo River Upper (224205)
- Dargo River @ Dargo River Lower (224202) – daily values only

PRIMARY GAUGE LOCATION

- 4.5 km downstream of the bridge at Dargo

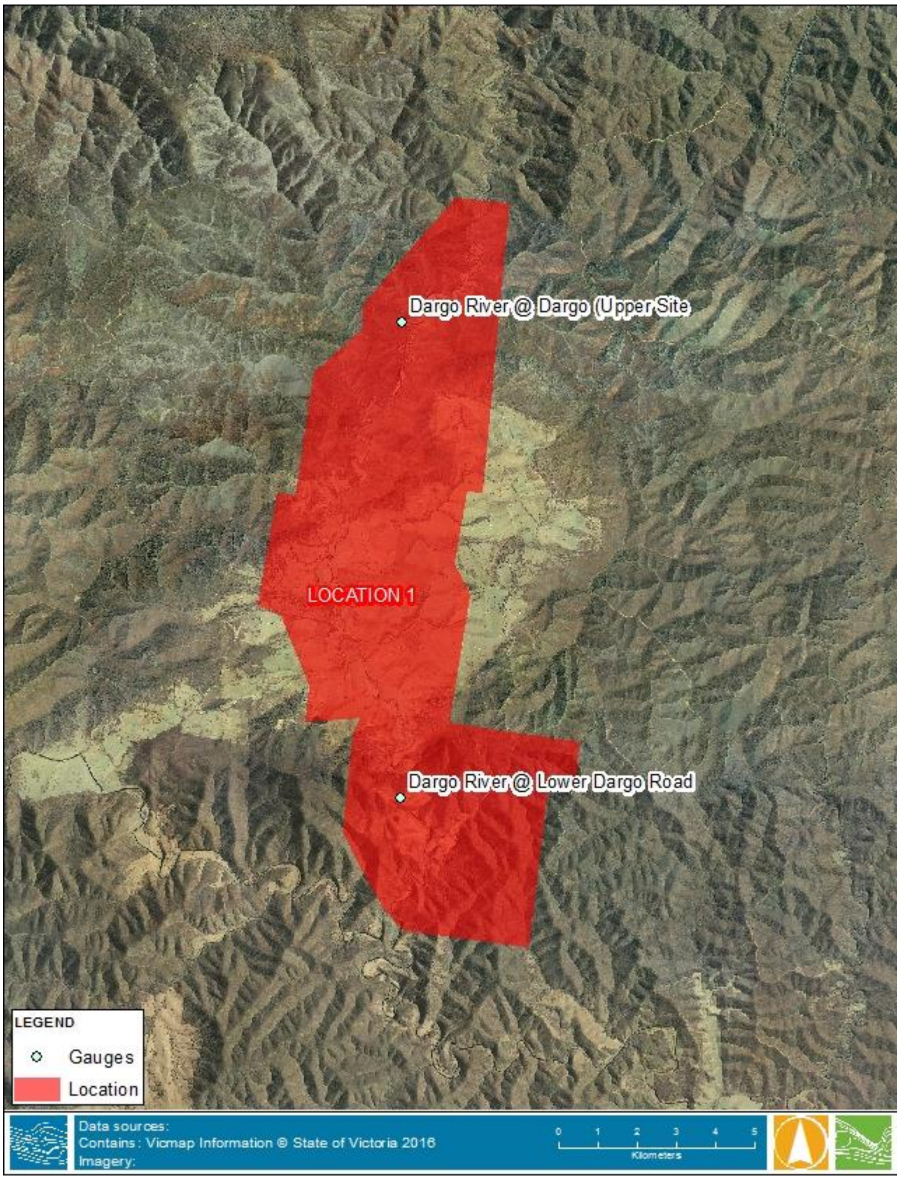

Figure 3-3 Location of gauges relative to designated study area

Primary Gauge	
Catchment area	676 km^2
Period of record	43 years
Gauge Zero	172.824 m AHD
Highest Gauged Flow	10,450 ML/d
Highest Gauged Level	4.005 m
Highest Gauged Date	25/10/1985
Highest Recorded Level	4.88 m
Highest Recorded Flow	18,618 ML/d
Rating Curve Extrapolated Beyond	4.01 m
Rating Curve Unreliable Beyond	10,500 ML/d

RAPID RATING CURVE REVIEW

- There are relatively few high flow gaugings, with the highest recorded flow well beyond the reliable section of the rating curve, indicating uncertainty at high flows.
- Data fits well along the rating curve, with very little scatter across the flow regime.
- Previous work by East & West Gippsland CMA's document FFA for several gauges across the region. The previously estimated 1% AEP flow is well beyond the highest gauged flow extent, which means there is likely to be uncertainty in the design flows.

LARGEST EVENTS

The table below summarises the largest flow events recorded at this gauge. All events are extrapolated at the peak as the values are all beyond the extent of gauged values on the rating curve.

Table 3-1 Largest flow events recorded at gauge 224213

Year	Max Discharge (ML/d)	QA at Peak
2012	18618	150
2007	17042	150
1998	16579	150
1990	16444	150
1993	14560	150

ADOPTED HYDROLOGY APPROACH

The hydrology method adopted for the rapid flood risk assessment had to be rapid and cost effective for all sites. The methods adopted all estimated peak flow only (except for Site 5 Cann River which had a previously developed RORB model). The hydrology adopted for all sites used a generic hydrograph shape on all tributaries. The hydrograph rose over 12 hours, held steady at the peak flow for 12 hours in upland floodplains or 24 hours in lowland floodplains, and then receded over 24 hours. These rates of rise and fall were based on a selected number of gauges spread across the region over a range of catchment sizes. It is understood that real events will all differ in the rates of rise and fall, but for the purposes of this rapid assessment a generic approach was adopted for rapid modelling. This approach provides a dynamic hydrograph so flood behaviour and intelligence can consider areas first impacted and it allows for a long enough peak so that steady state flood levels are achieved for mapping purposes.

For Dargo Valley there was a sufficient gauge record to undertake a flood frequency analysis (FFA) to estimate peak flow, however caution must be exercised as the peaks of the major floods are all extrapolated, compromising the accuracy of the historic flood record and thus the FFA. For the purposes of this rapid assessment, the gauge rating curve was accepted, however it must be stressed that there is significant uncertainty in this assumption.

The design flows from the gauge location were adjusted by catchment area and distributed across the main river and tributaries appropriately. For tributaries downstream of the gauge location a regional approximation of peak flow was adopted. See Figure 3-4.

The flood frequency analysis was completed for 42 years of recorded data using Flike with a Log Pearson III distribution. Censoring was completed using the Grubbs Beck test which found no outliers. The fitted distribution curve is shown in Figure 3-5 whilst the FFA design flows are outlined in Table 3-2.

To determine inflows at the upstream boundary from the Flood Frequency Analysis at the gauge, the following formula was used from Hydrological Recipes (CRC for Catchment Hydrology, 2004).

$$F = \frac{A_C}{A_G}^{0.7}$$

Where:

- A_c = The area upstream of the inflow
- A_G = The gauged catchment area

Flows at Inflow 1 were determined by multiplying design flows determined through the FFA at the gauge location by the multiplier F (0.697). The remaining flow was distributed across the six tributary inflow points located upstream of the gauge to ensure the design flows were being represented accurately at the gauge location. This ensured that when all tributary inflows were modelled together, the peak flow at the gauge location was equal to that from the FFA.

As Inflow 5 is located downstream of the gauge, discharge was calculated using regional estimates. All inflow points underwent verification through comparison with Rational Method estimates and the new AR&R Regional Flood Frequency Estimate tool. The Rational Method flows were adopted as when the two methods were applied to several gauge locations in the region and compared to FFA results, the Rational Method results were generally closer to the FFA. This is similar to findings from past Water Technology studies around Victoria. This may not be the case in all regions. The ARR RFFE method is based on detailed FFA at several gauges in the region of interest and developing prediction equations fitted to the FFA results and catchment descriptors. Where the FFA used in the analysis is highly uncertain, the prediction equation will also be highly uncertain. Unfortunately, in this region the rating curves at most gauges used to form the prediction equations are extrapolated from low flows within channel. It is likely that the historic record is inaccurate, leading to poor regional estimates from the ARR RFFE method.

Final flows are show in Table 3-3.

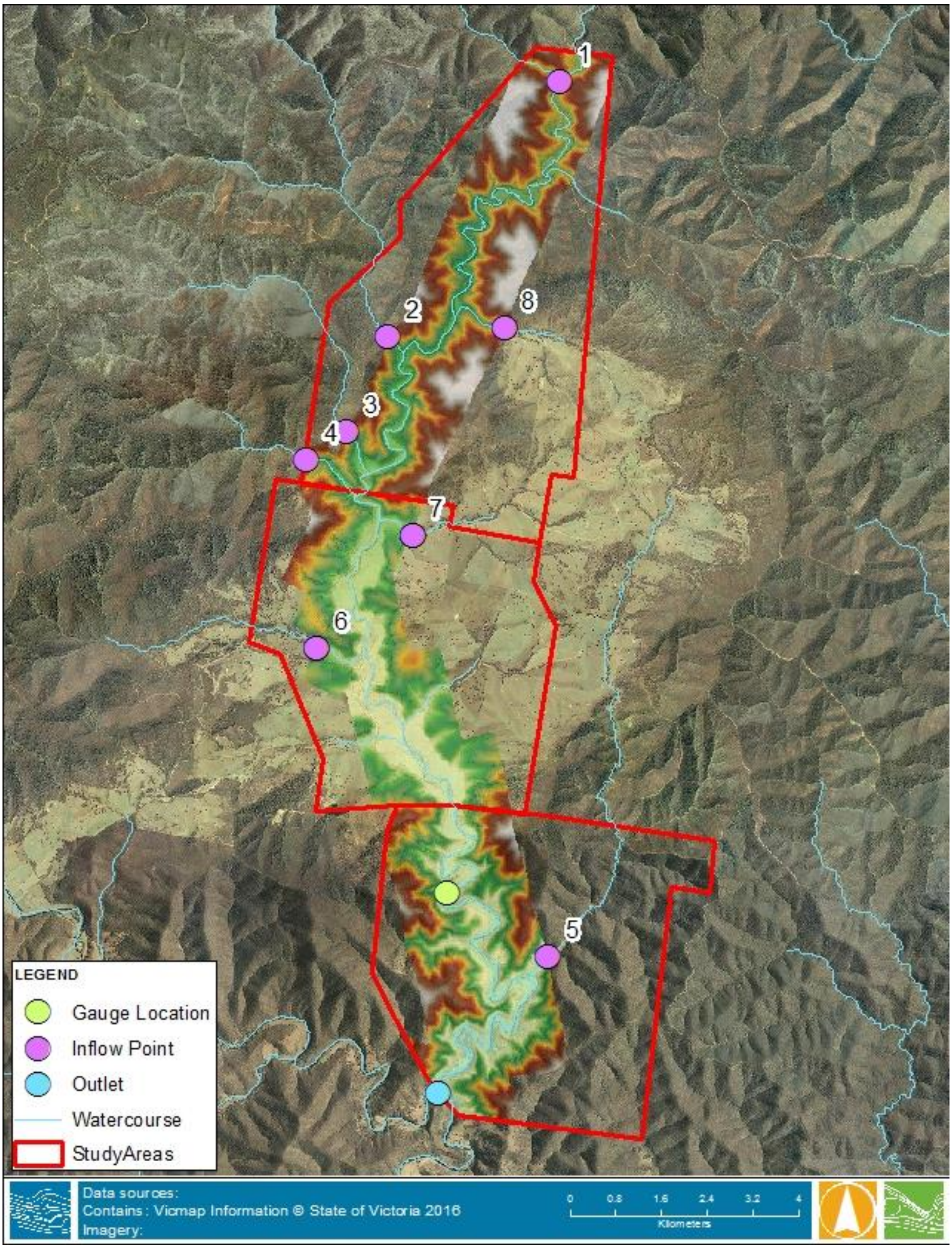

Figure 3-4 **Location of inflow points, gauge and outlet in model**

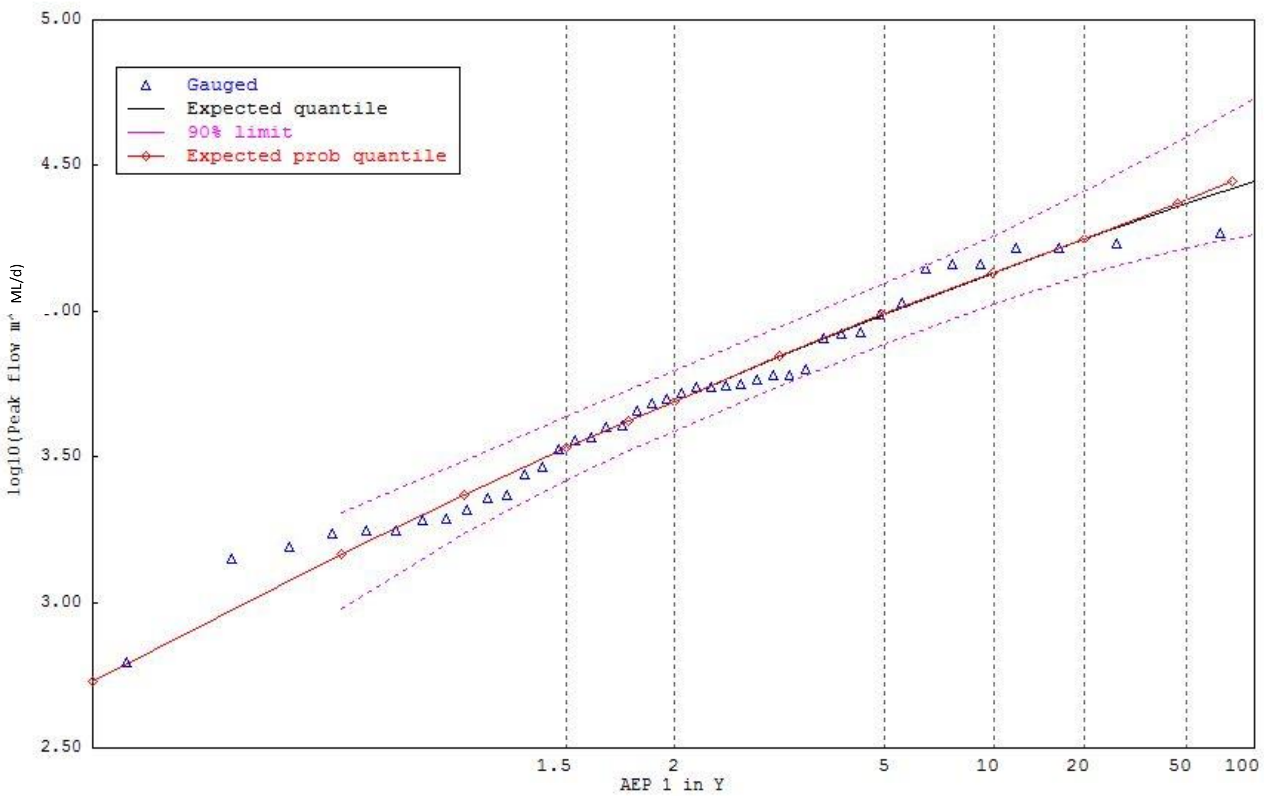

Figure 3-5 Log Pearson III curve for FFA at Dargo River at Lower Dargo Road

Table 3-2 Design Flows at Dargo River at Lower Dargo Road Gauge

AEP (%)	Discharge (ML/d)	5% Confidence Limit (ML/d)	95% Confidence Limit (ML/d)
50	4,90	3,900	6,200
20	9,70	7,700	12,400
10	13,500	10,600	18,100
5	17,600	13,400	25,700
2	23,400	16,500	39,600
1	28,000	18,400	53,500
0.5	32,900	19,900	71,300
0.2	39,700	21,500	102,300

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Table 3-3 Modelled Design Flows and Method of Determination

	1% AEP Discharge (ML/d)	10% AEP Discharge (ML/d)	Method
Inflow1	19,500	9,400	Catchment scaling based on FFA
Inflow2	1,200	700	Distribution of remaining flow from FFA
Inflow3	1,200	700	
Inflow4	1,200	700	
Inflow5	2,800	1,300	Rational (Adams method)
Inflow6	1,200	700	Distribution of remaining flow from FFA
Inflow7	1,200	700	
Inflow8	1,200	700	

VERIFICATION OF DESIGN FLOWS

The FFA results for the 1% AEP and 10% AEP were compared to previous, unpublished, FFA results developed by West Gippsland CMA and East Gippsland CMA for several gauges across the region. The design flows were generally within plus or minus 8%, which is deemed acceptable.

Hydrology used in this study was reviewed by an independent technical reviewer from the DELWP panel, and was approved by DEWLP and the East Gippsland CMA.

3.3 Hydraulics

All sites were modelled using TUFLOW GPU (version 2016-03-AD-w64). The choice of the GPU software ensures fast run times fitting with a rapid flood risk assessment. The models were all initially built by a single engineer to ensure consistency. These base models were then updated with site specific information around critical road crossings, with adjustments made to ensure model stability and quality of outputs. The following section describes the key inputs to the model development and simulation.

Throughout the report there are several references to modelling terms which the reader may not be familiar with. Table 3-4 provides a brief description of some of these terms

Table 3-4 Hydraulic Modelling Terminology

Terminology	Explanation
Z shapes	This is a tool used to adjust the elevation of the topography. In this case, it is used to raise or lower a less reliable LiDAR data set to match a reliable one and better represent the topography and channel.
SA boundary	This is a polygon used within the hydraulic model to release the inflows into the 2D model over the grid cells within the polygon.
BC Boundary (HQ)	This is a line placed at the downstream end of a model to allow the water to flow out of the model. An HQ boundary calculates the outflow based on the slope of the river near the downstream boundary and the modelled water level.

TOPOGRAPHY

The TUFLOW models were all built using the best available terrain data as discussed in Section 3.1. A grid size of 5 m was adopted. At this grid resolution, the major waterways are all represented reasonably well by the 2D grid, with waterways ranging from 20 to 60 m wide.

A z shape was included in the model to lower the VICMAP Derived DEM by 5.8 m, however, water levels in the 1% AEP event did not reach this area of the model and so further work to smooth the two LiDAR sets was not taken.

After an initial run, the code boundary was brought closer to the Rivers LiDAR boundary. A secondary run indicated that this could be further reduced, but as results were deemed to be acceptable and unimpacted by a change, further action was not taken.

STRUCTURES

Three road bridges over the Dargo River were identified from aerial imagery as being located within the study area; Jones Road, Omeo Road and Lower Dargo-Tabberabbera Road. Two waterway crossings exist at Dargo High Plains Road crossing Grady Creek, Smith Creek and Two Mile Creek. The elevation of the approaches for each of these roads from the LiDAR was compared to water levels in the initial run to determine if the bridge was likely to be overtopped in a 1% AEP event. It was determined that Jones Road, along with the minor crossings, were likely to be overtopped in a 1% AEP event. Head loss across the structures is outlined for both modelled scenarios in Table 3-5.There is a large head loss at Grady Creek at Dargo High Plains Road. This is likely due to the crossing being picked up in the LiDAR with no water flowing under the bridge deck. The impacts on flood levels are localised and have no real impact on the outcomes of this rapid mapping project. The crossing is minor; however, it is recommended that this and all other structures located within the study area are surveyed in future detailed studies and included in the model.

Bridge decks that are a long way above, or below the flood levels are unlikely to have an impact on the flows or flood levels across the site. In the case of the flood level being at the height of the bridge deck, localised impacts may occur. In the context of this study, due to the rapid modelling approach and therefore the lack of information surrounding structures, no structures were included in the model in detail.

Table 3-5 Head Loss across structures

Structure	Watercourse	Head Drop – 10% AEP	Head Drop – 1% AEP
Jones Road	Dargo River	0.202	0.092
Upper Dargo Road	Two Mile Creek	0.375	0.384
Dargo High Plains Road	Smith Creek	0.303	0.304
Dargo High Plains Road	Grady Creek	0.497	0.503
Omeo Road	Dargo River	0.06	0.085
Lower Dargo-Tabberabbera Road.	Dargo River	-0.001	-0.003

HYDRAULIC ROUGHNESS

A roughness map was developed across the model area by using aerial imagery and VICMAP planning and roads layers. The roughness types mapped are shown in Figure 3-6. The roughness values adopted were consistent across all sites and are in line with accepted industry values.

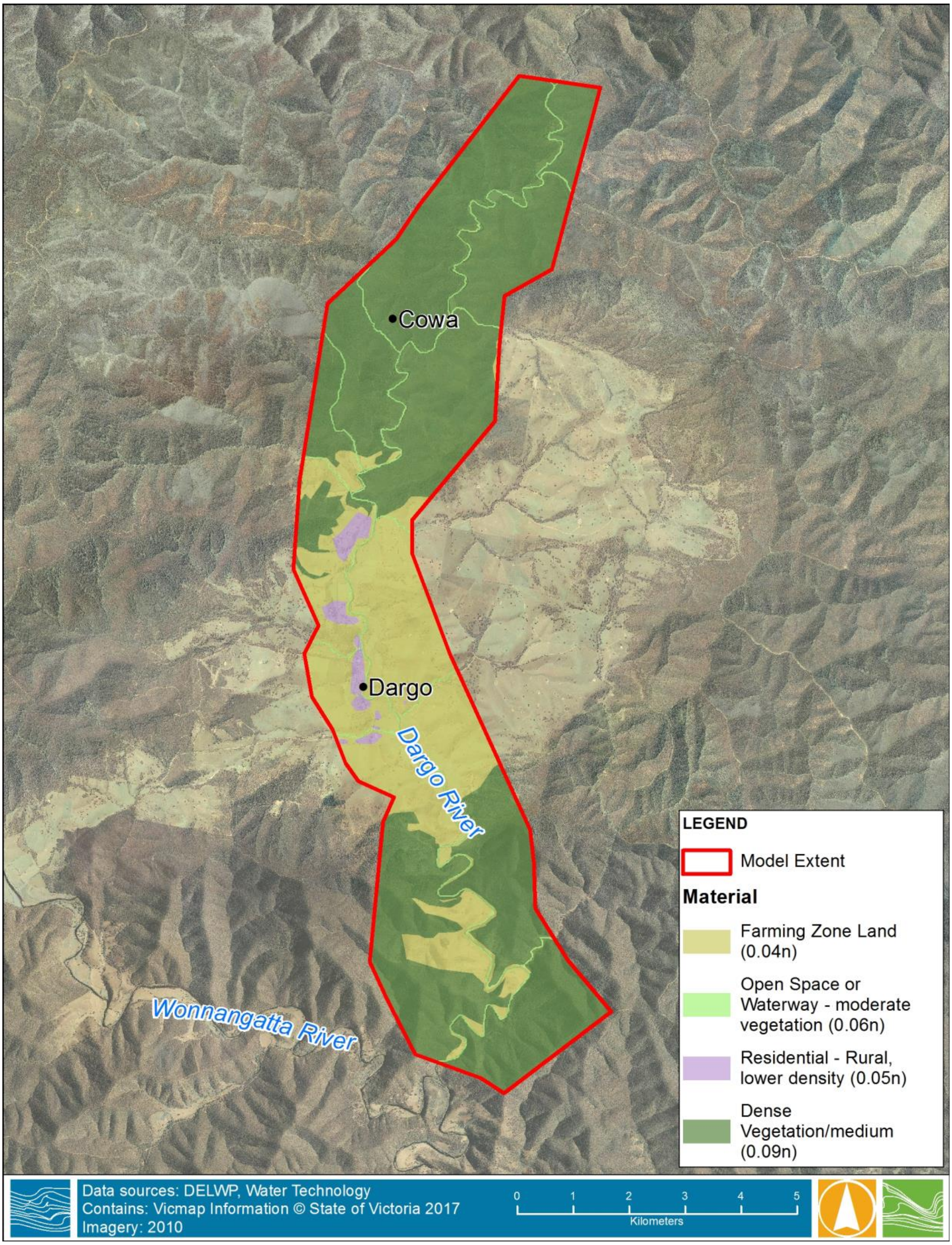

Figure 3-6 **Roughness Map and Roughness Values**

BOUNDARIES

All tributary inflows identified in Section 3.2 were input to TUFLOW as "sa" inflows, which allow the flow to spread across the area defined by the "sa" polygon. The "sa" polygons were defined to spread the flow across the waterway and floodway at each inflow point.

The downstream boundary used a "HQ" boundary which was based upon the slope of the river over a 1.5 km reach upstream from the downstream boundary.

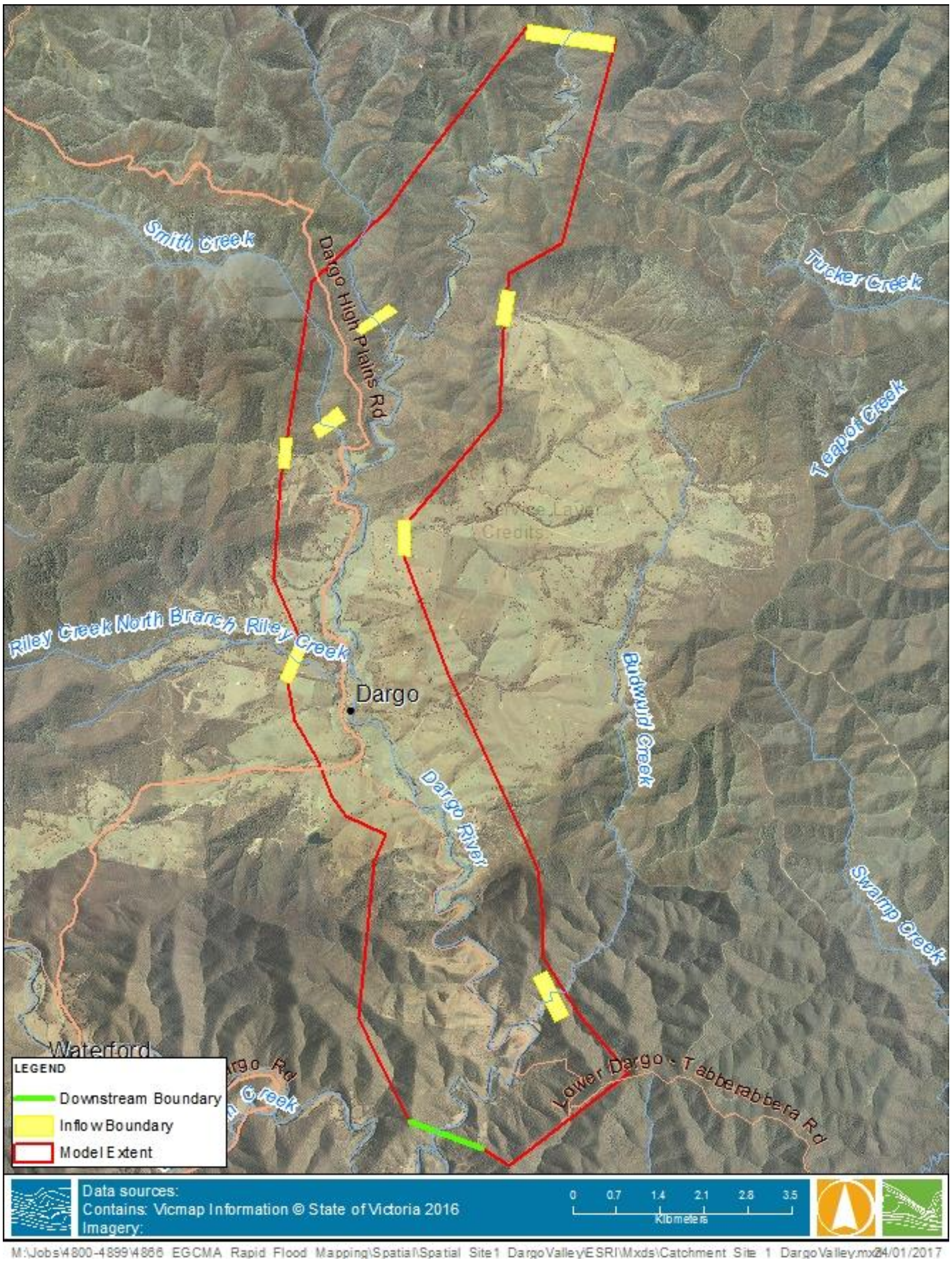

Figure 3-7 Model Boundaries

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MODEL SIMULATIONS

The following model simulations were run for the Dargo Valley model.

- 10% AEP inflows with a HQ downstream boundary
- 1% AEP inflows with a HQ downstream boundary

Table 3-6 Model simulation statistics

Item	10% AEP Model	1% AEP Model
Timestep (seconds)	0.55 - 2.6	0.57 – 1.9
Grid size (meters)	5	5
Runtime	1 hour 20 min	49 min
Nc/Nu QA Check*	Pass (Nc Limited)	Pass (Nc Limited)
Hydrograph duration (hours)	48	42**
Map output interval (seconds)	1800	1800
Time series output interval (seconds)	60 s	60 s

* Nc/Nu limited is a modelling output related to model stability. Nc results approach 1.6 whilst Nu results approach 1. A stable model will reach one of these limits, either the Nc or the Nu. As long as neither of these exceed their limit, the model is considered to be stable.

** Hydrograph reduced to reduce model time whilst ensuring the model still reached steady state. This made a minor difference to run times, and was therefore not completed for the 10% AEP event.

MODEL OUTPUTS

The TUFLOW tool TUFLOW_to_GIS was used to extract the maximum values of water surface, depth, velocity, and velocity times depth as grids at half the model resolution (i.e. 2.5 m). Water Level, Depth, Velocity and Hazard grids.

RESULTS VERIFICATION

Historic data was available for the Dargo Valley study area in the form of historic flood heights that were measured during the 2007 and 2012 floods and all had a high reliability rating indicating they were levels surveyed by an experienced surveyor using appropriate techniques resulting in a high vertical accuracy. Peak flows from these historic events are available through the gauge record at the Dargo River at Lower Dargo Road gauge. These were compared to the peak flows of design floods from the FFA to determine the AEP of each historic flood. It was found that the historic peak flows were similar to the 5% AEP peak flow, and are shown relative to the FFA results in Table 3-7. The modelled 1% AEP and 10% AEP results were then compared to these historic points to provide a verification of the modelling results. It is important to note that the historic flood peaks for 2012 and 2007 are both far beyond the gauged portion of the rating curve, are extrapolated and must be treated with caution.

Comparison showed that the modelled 1% AEP flood levels were well above the level of the surveyed historic events as shown in Figure 3-8. The historic heights were much closer to the 10 % AEP levels, with most modelled levels above the historic surveyed points but several points falling below the historic surveyed levels. On average across all points, the modelled 10% AEP levels were 0.23 m above the historic surveyed heights for 2012 and 0.8 m above in the 2007 event, shown in Figure 3-8.

These results indicate that if the recorded flow is correct and the surveyed heights are accurate, the modelled flood levels may be too high. Given the rapid hydrology and extrapolated rating curves at the gauge, there is significant uncertainty in the historical flows, and not much can be drawn from the verification. It is comforting that the historic levels match closer to the 10% AEP than they do to the 1% AEP design modelling results. Further analysis into historical (2007 and 2012) and design hydrology would help understand the significance of the observed results.

Table 3-7 FFA results for Lower Dargo Road and the 2007 and 2012 recorded peaks

AEP (%)	Discharge (ML/d)	2007 Peak (ML/d)	2012 Peak (Ml/d)
50	4,90		
20	9,70		
10	13,500		
5	17,600	17,042	18,618
2	23,400		
1	28,000		
0.5	32,900		
0.2	39,700		

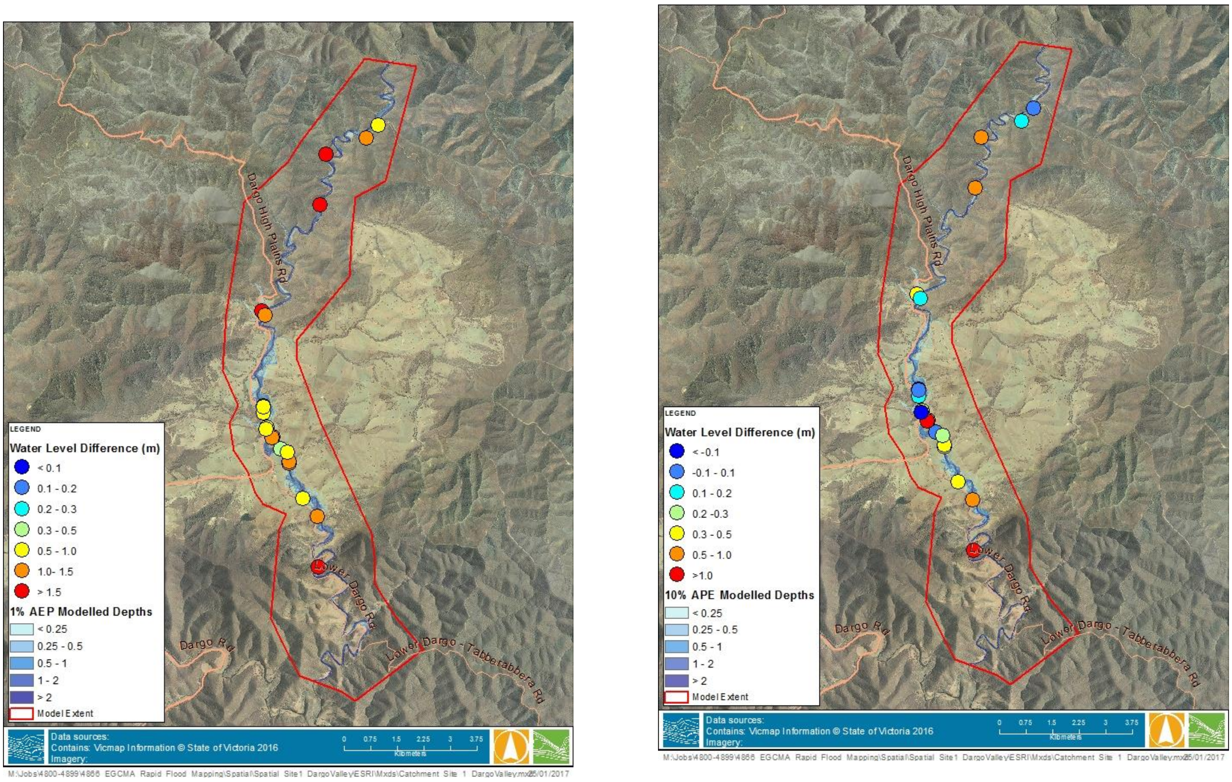

Figure 3-8 Difference in modelled 1% AEP (left) and 10% AEP (right) flood levels and combined historic 2012 and 2007 surveyed levels

4 FLOOD BEHAVIOUR

This section describes the flood behaviour through the study area for the 10% and 1% AEP flood events based on the hydraulic modelling results. Information includes potential impacts to roads, properties and houses due to the modelled flooding.

10% AEP Flood Event

The 10 % AEP flood extent remains relatively confined to the river channel upstream and downstream of Dargo as the river channel is very steep and confined. Floodwaters break out as the topography flattens around the Dargo township, to around 200 m at the widest point.

In the confined reaches, the modelling indicates that velocities of up to 3.4 m/s can occur. Velocities decrease across the floodplains, and overland flows through town are generally below 0.5 m/s.

Potentially hazardous velocities occur downstream of Omeo Road Bridge.

AREAS OF SIGNIFICANT IMPACT

Over bank flows (inundation of the floodplain) occur across the following roads:

- Lind Avenue at Riley Creek
- Kings Road at Riley Creek
- Omeo Road at Riley Creek

When assessing the flood risk, Water Technology have used the following definitions. When we refer to 'properties inundated', they are properties with buildings on them, but the buildings may not be inundated. If the building is inundated, we refer to 'buildings' not properties.

There are 22 developed properties impacted by the flood extent within Dargo, along Lind Avenue, between the confluence of Riley Creek and the Dargo River and Dargo Road. These properties are inundated but the buildings may not be. Depths are up to 300 mm on these properties located upstream of the Omeo Road Bridge. Properties downstream of the bridge are inundated to depths ranging between 300 mm and 1.5 m. Of these 22 properties, there are 7 buildings which are inundated and may be subject to above floor flooding, however without floor level survey this cannot be confirmed.

There are an additional 4 properties downstream of Dargo Road, located on Lower Dargo Road, that are at risk of flooding within the parcel boundary. There are another 9 properties inundated along Dargo High Plains Road, north of the Riley Creek confluence. There are no properties impacted north of Upper Dargo Road. There is 1 property located on Jims Track is also inundated. Impacted buildings and roads are shown in Figure 4-1.

1% AEP Flood Event

The 1% AEP flood event is for the most part, confined within the river banks in the upper and lower reaches of the study area. There are an increased number of over bank flows (inundation of the floodplain) through the steep narrow valley, spilling onto the floodplain. Depths are around 1 to 2 m greater than the 10% AEP event in these confined reaches.

There are over bank flows (inundation of the floodplain) through the flat floodplains surrounding Dargo, with the floodwaters extending further on to rural land bounded by Dargo High Plains Road and Dalmore Road. Depths increase from the 10% AEP event in this area by around 300 mm to 1 m. The 1% AEP modelled flood depths are shown in the Outputs Section in Figure 6-1, whilst the 10% AEP and 1% AEP extents are shown in Figure 6-3.

Velocities of up to 3.9 m/s can occur throughout the modelled area. These increase along the confined channels and slow down across the floodplains. Flood flows through town are generally below 0.5 m/s.

Some locations with potentially hazardous velocities include:

- Downstream of Omeo Road Bridge
- Dargo River, downstream of the confluence with Riley Creek

AREAS OF SIGNIFICANT IMPACT

Over bank flows (inundation of the floodplain) occur across the following roads:

- Upper Dargo Road at Dargo River
- Dargo High Plains Road between Smiths Creek and Grady Creek, from the Dargo River
- Lind Avenue from Riley Creek and Dargo River
- Further over bank flows (inundation of the floodplain) occur across Kings Road from Riley Creek and offshoot.
- Dalmore Road at Dargo River
- Cartner Road downstream of Lower Dargo-Tabberabbera Road Bridge
- Jones Road Bridge likely overtopped

During a flood the Omeo Road Bridge and Lower Dargo Tabberabbera Road Bridge should be monitored.

Compared to the 10% AEP event, a further 12 properties are inundated within Dargo. Another 2 properties north of the confluence with Riley Creek are inundated. There is a total of 25 buildings located within the flood extent which are potentially at risk of above floor flooding. Impacted buildings and roads are shown in Figure 4-1.

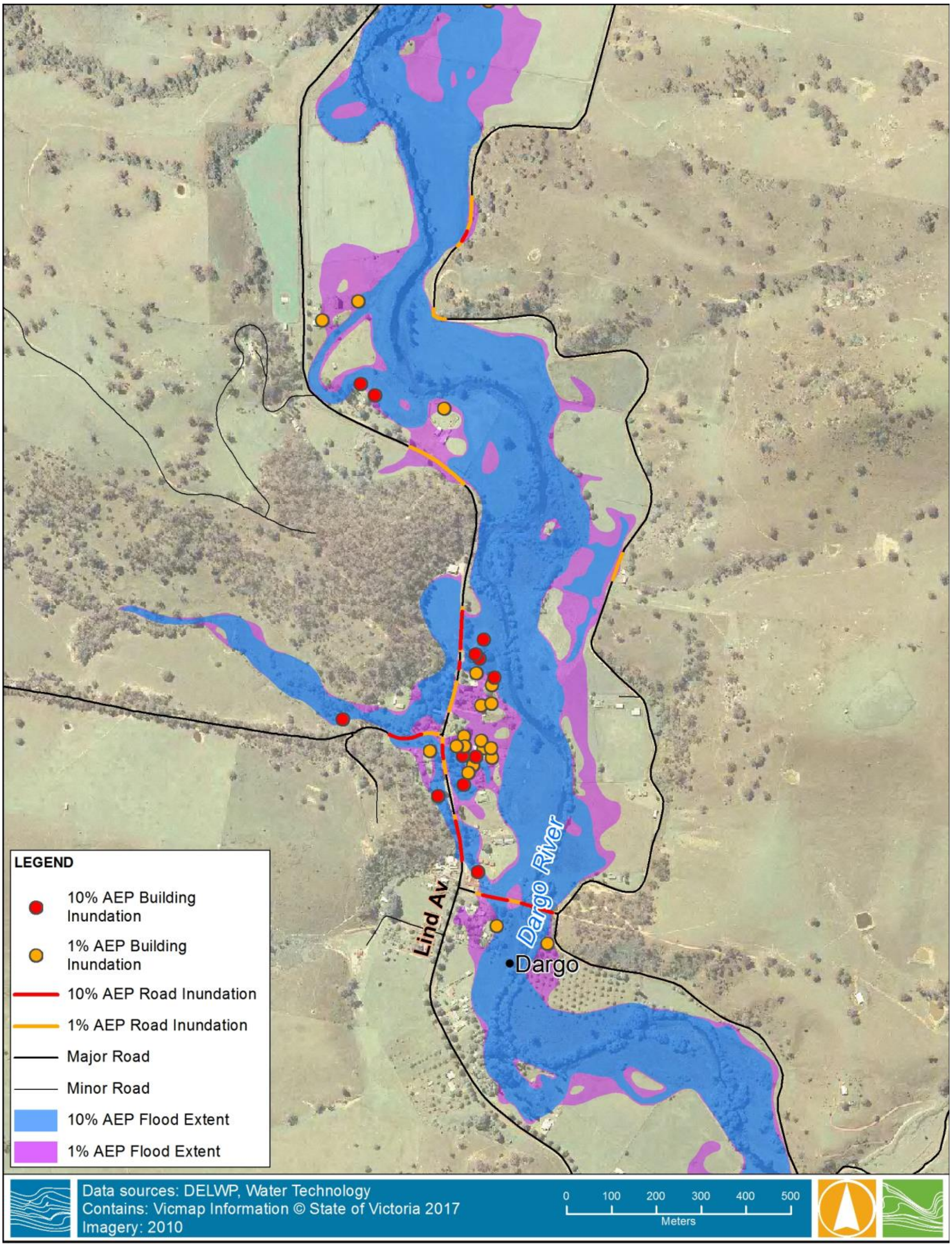

Figure 4-1 **Inundated buildings and roads during the 10% AEP and 1% AEP flood events - Dargo**

5 FLOOD RISK METRICS

Water Technology used the revised 10% and 1% AEP flood mapping extents to recalculate the inputs to the Regional Flood Risk Assessments completed by Aither in their study titled “East Gippsland CMA Regional Flood Risk Assessment” from May 2016. Aither used these revised inputs to update the flood risk metrics.

Risk analysis was based on GIS datasets and flood impact assumptions. Using a process that cross referenced flood mapping (1% AEP flood extent and the “floodway” described as the 10% AEP flood extent) with typical GIS datasets from VICMAP, each area (or management unit) was assessed for flood risk. This process effectively involved monetarising flood impacts from various types of damages (Direct, Indirect and Intangible). Areas were characterized into two types urban or rural, with each of these locations ultimately having the following flood risk results calculated:

- Density of flood damages;
  - the average annual damage (AAD) divided by the area of inundation for the 1% AEP flood extent
- Absolute AAD;
  - the absolute size of the AAD per management unit (area);
- Proportion of town population affected
  - average annual population affected (AAPA) divided per thousand population.

Flood risk results (flood metrics) were presented on a scale from 1.0 to 6.0; where 6.0 was considered extreme and 1.0 was low. Locations reported with 0 had no available data. Decimal places were used to demonstrate the severity of damage within each scoring bounds (Aither 2016).

Table 5-1 identifies the management units from the Aither (2016) assessment which are located within the Dargo Valley model area.

Table 5-1 Flood Risk Metric management units within the Dargo Valley study area

ID	Management Unit (name)	Type
55	Dargo River Upper	Rural
54	Dargo River Central	Urban
53	Dargo River Lower	Rural

The results of the risk assessment using the new rapid flood mapping are shown in Table 5-2, with a comparison to the earlier results from the Aither (2016) study which in this area was based on very limited to no flood risk information.

Table 5-2 Results of the risk assessment for each management unit for each risk metric

ID	Management Unit	Density of flood damages		Absolute AAD		Prop. of town		Overall	
		2016	2017	2016	2017	2016	2017	2016	2017
55	Dargo River Upper	1.1	1.1	1.1	1.0	0.0	0.0	1	1
54	Dargo River Central	1.6	3.4	2.5	2.9	4.6	5.3	3	4
53	Dargo River Lower	1.1	1.1	1.1	1.0	0.0	0.0	1	1

Note: 2016 refers to the previous risk assessment by Aither (2016), 2017 refers to the revised risk assessment using the modelled flood results from this rapid flood investigation.

6 OUTPUTS

The rapid flood mapping produced several model files and GIS files used to construct the hydrological and hydraulic models, as well as result output files. A summary of the outputs delivered to the EGCMA is provided in Table 6-1.

Table 6-1 Summary of Outputs

Stage	Outputs
Hydrologic Modelling	• Flike model files (fld) • Flike output files
Hydraulic Model Inputs	Full Hydraulic model file suite.
Victorian Flood Database Format Raster Information	Grid files in ASCII format for the two modelled design events. • Water Surface Elevation; • Depth • Velocity • Depth x Velocity • DTM
Victorian Flood Database Format Vector Information	• Extents for all design events (e.g. extent_100y_ari) • Flood contours (200mm increment) (e.g. contour_100y_ari) • Floodway • Study area extent • GIS files for flow vectors/directions • GIS files for flow output locations

Flood mapping outputs for flood depth and extent are shown in Figure 6-1 to Figure 6-4 below.

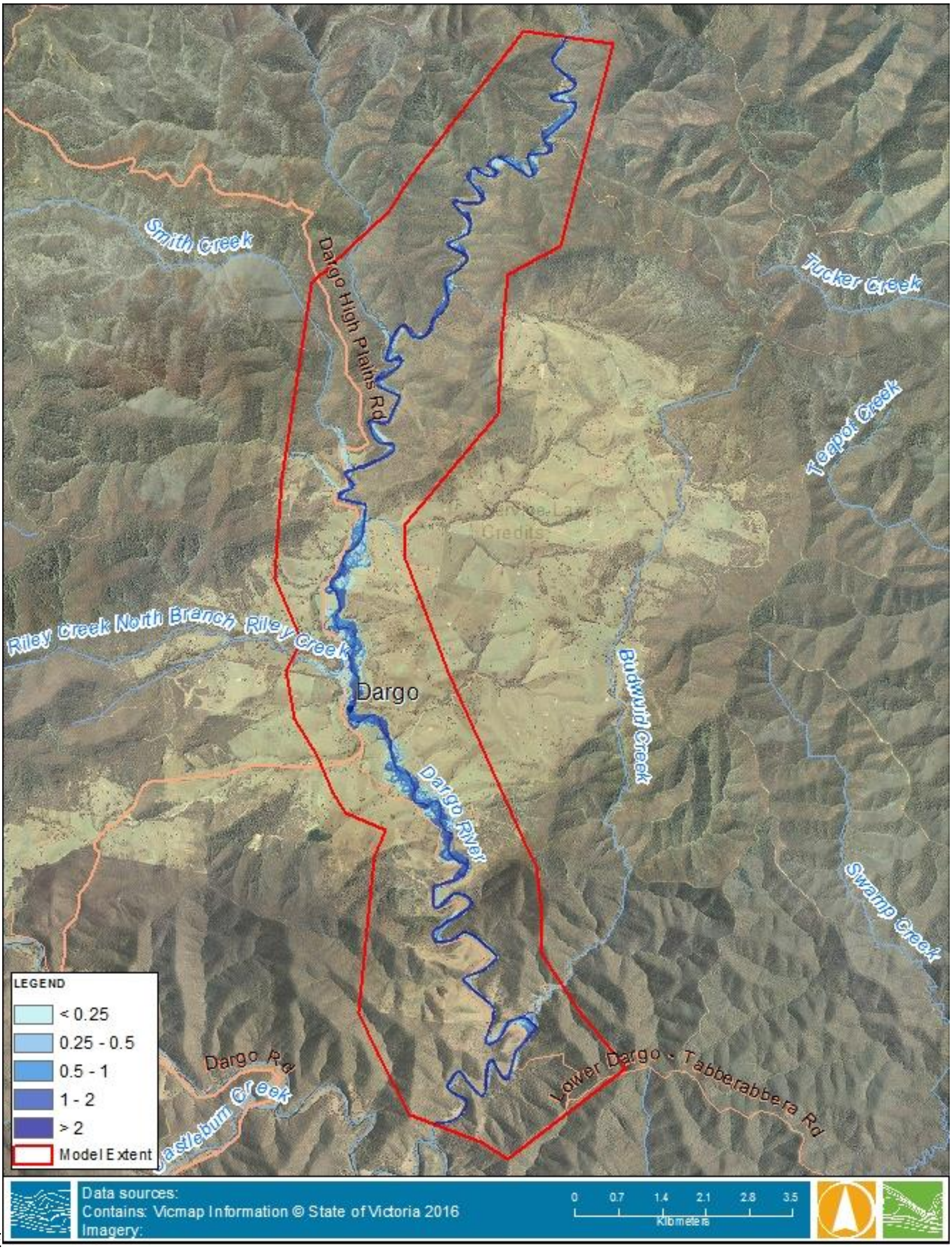

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Figure 6-1 Modelled 1% AEP flood depths along the Dargo River

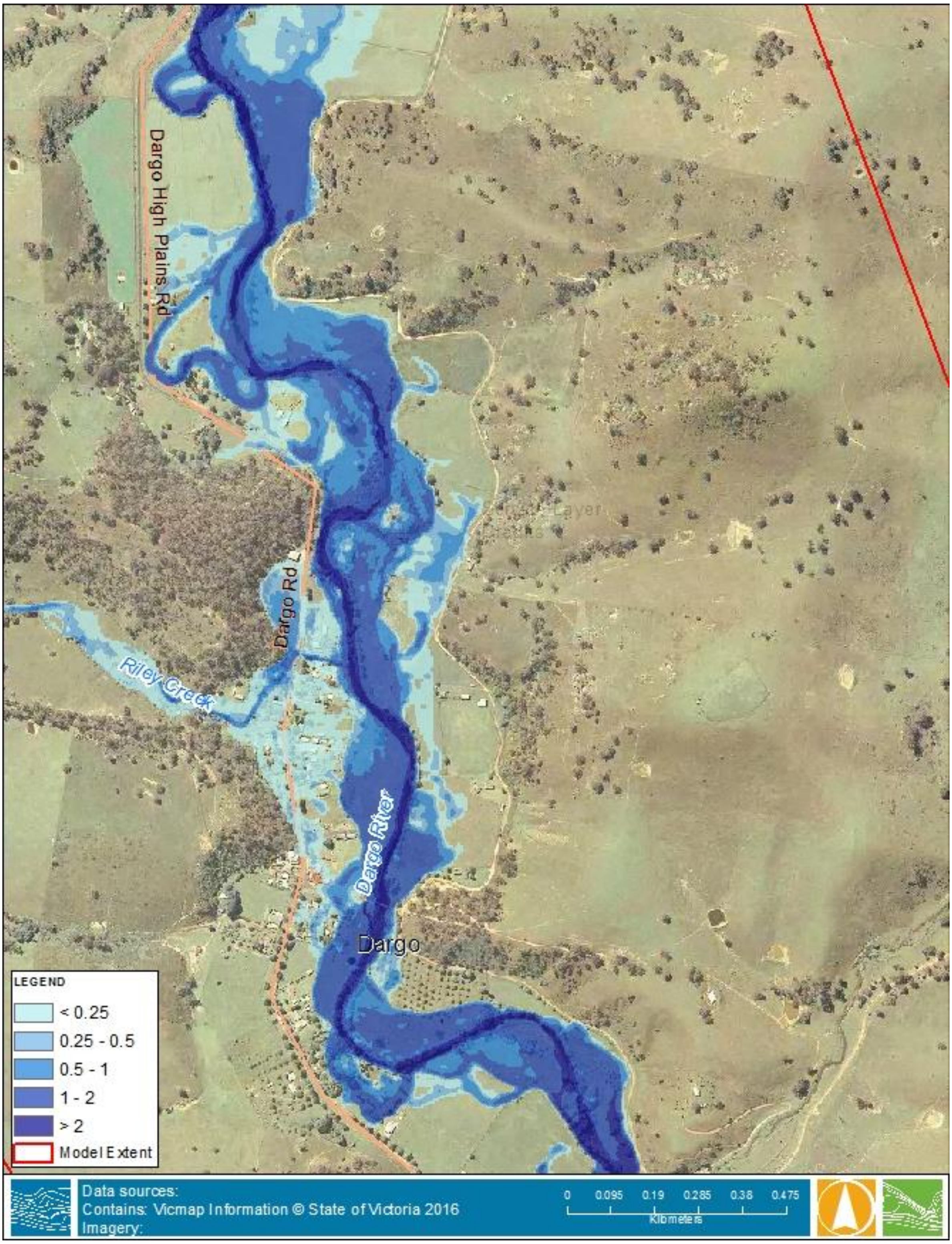

Figure 6-2 Modelled 1% AEP flood depths at Dargo – Zoom

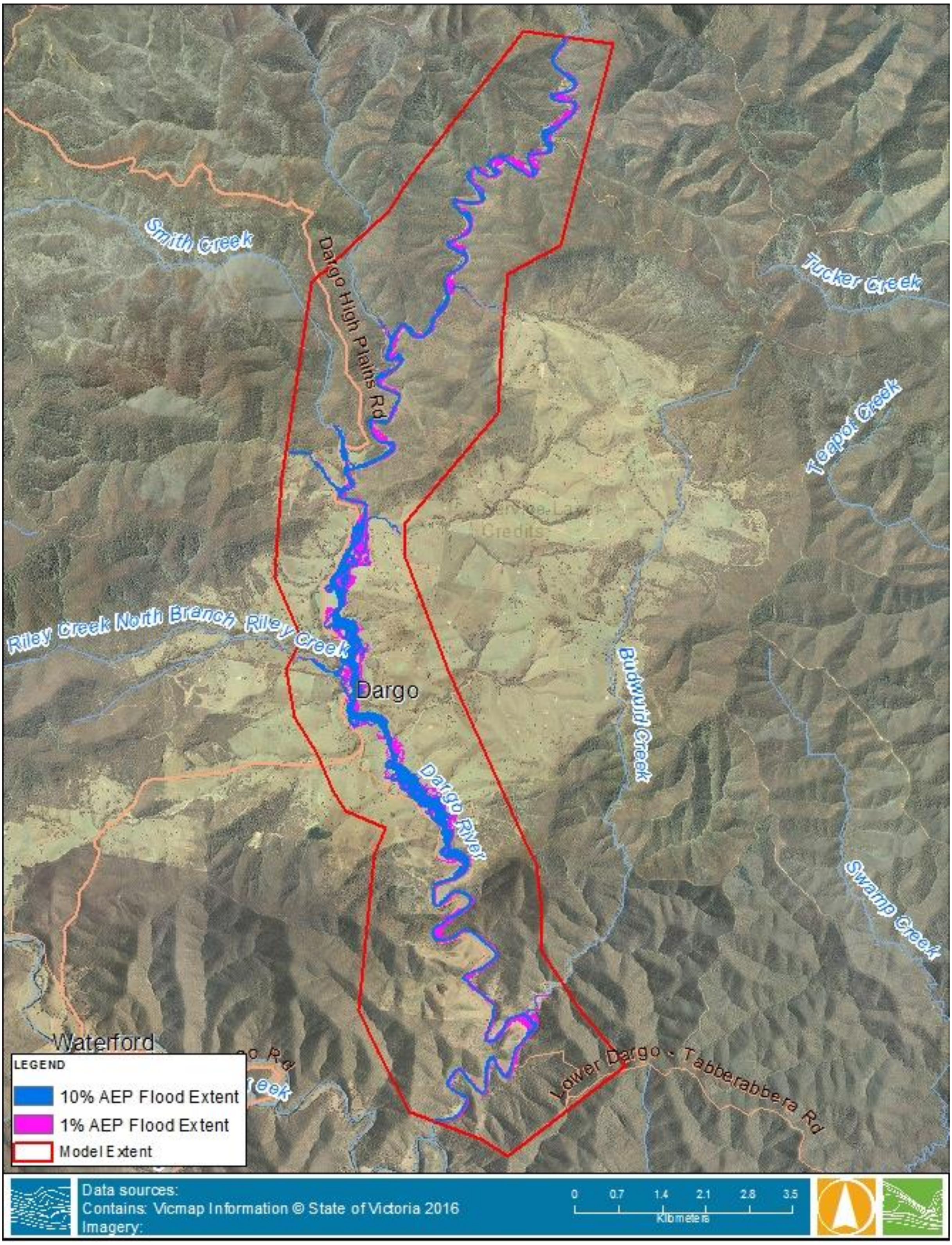

Figure 6-3 Modelled 1% AEP and 10% AEP flood extents along the Dargo River

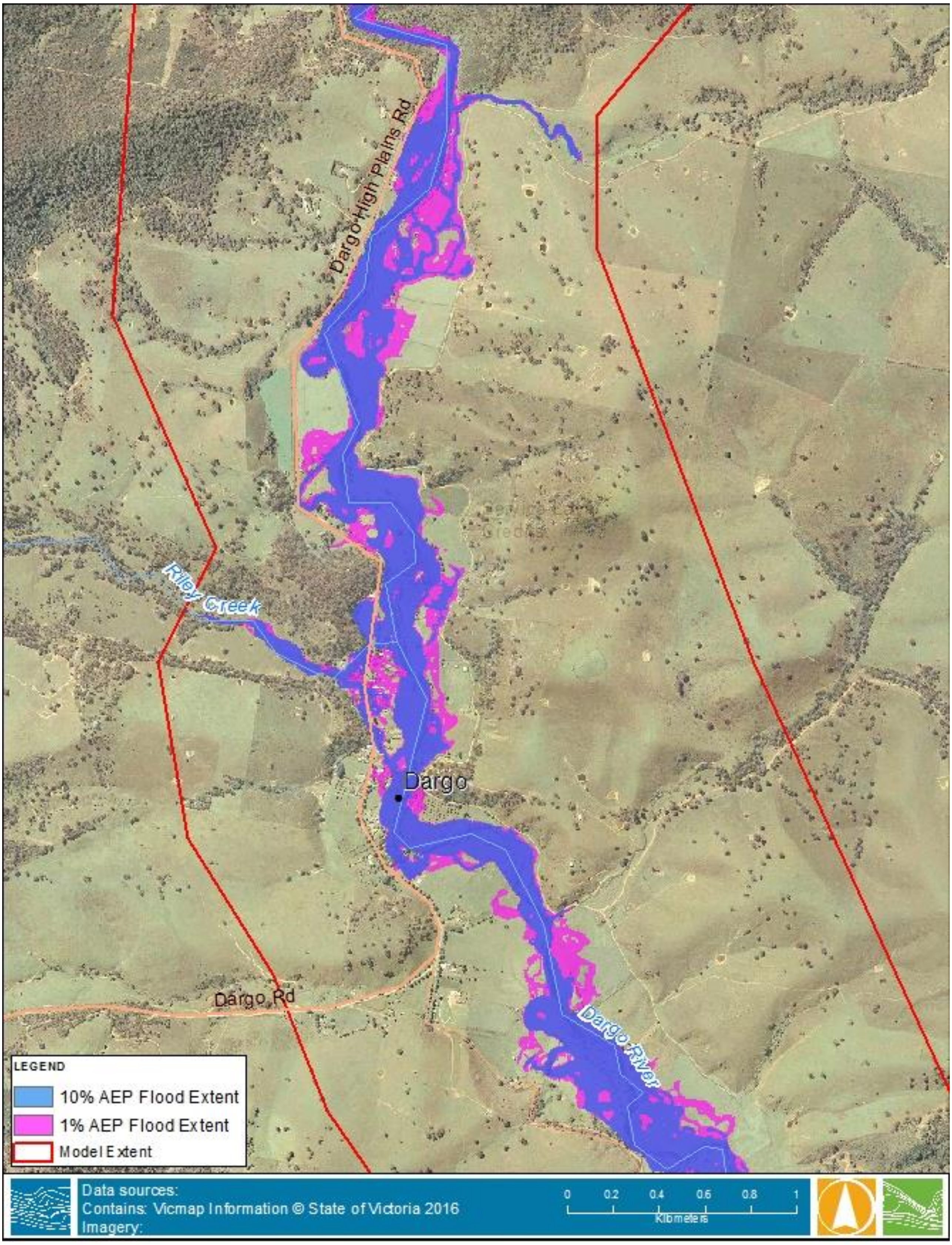

Figure 6-4 Modelled 1% AEP and 10% AEP flood extents at Dargo - Zoom

R02v03_4866-01_FloodRisk_Dargo_Valley_FINAL.docx

7 REFERENCES

Aither 2016, East Gippsland CMA Regional Flood Risk Assessment

Grayson R.B, Argent R.M, Nathan R.J, McMahon T.A, Mein R.G (2004), *Hydrological Recipes; Estimation Techniques in Australian Hydrology',* Catchment Research Centre for Catchment Hydrology

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