Penrith Overland Flow Flood "Overview Study"

Flood Analysis for Central Urban (Zone 1), Northern Rural (Zone 2), Southern Rural (Zone 3)

Report Prepared For

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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 each year; it would occur quite often and would be relatively small. A 1%AEP flood has a low probability of occurrence or being exceeded each year; it would be fairly rare but it would be relatively large.
Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to mean sea level.
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.
Creek Rehabilitation	Rehabilitating the natural 'biophysical' (i.e. geomorphic and ecological) functions of the creek.
Design Flood	A significant event to be considered in the design process; various works within the floodplain may have different design events.
Development	The erection of a building or the carrying out of work; or the use of land or of a building or work; or the subdivision of land.
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 super elevated sea levels and/or waves overtopping coastline defences.
Flood Fringe	The remaining area of flood-prone land after floodway and flood storage areas have been defined.
Flood Hazard	Potential risk to life and limb caused by flooding.
Flood-Prone Land	Land susceptible to flooding by the PMF event. Flood prone land is synonymous with flood liable land
Floodplain	Area of land which is subject to inundation by floods up to the probable maximum flood event, i.e. flood prone land.
Floodplain Management Measures	The full range of techniques available to floodplain managers.

Floodplain Management Options	The measures which might be feasible for the management of a particular area.
Flood Planning Area	The area of land below the flood planning level and thus subject to flood related development controls.
Flood Planning Levels (FPL's)	Flood levels selected for planning purposes, as determined in floodplain risk management studies and incorporated in floodplain risk management plans. Selection should be based on an understanding of the full range of flood behaviour and the associated flood risk. It should also take into account the social, economic and ecological consequences associated with floods of different severities. Different FPLs may be appropriate for different categories of land use and for different parts of the floodplain. As FPLs do not necessarily extend to the limits of flood prone land (as defined by the probable maximum flood), floodplain risk management plans may apply to flood prone land beyond the defined FPLs.
Flood Storages	Those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood.
Floodway Areas	Those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels.
Geographical Information Systems (GIS)	A system of software and procedures designed to support the management, manipulation, analysis and display of spatially referenced data.
High Hazard	Flood conditions that pose a possible danger to personal safety; evacuation by trucks difficult; able-bodied adults would have difficulty wading to safety; potential for significant structural damage to buildings.
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.
Integrated Survey Grid (ISG)	ISG is a global co-ordinate system based on a Transverse Mercator Projection. The globe is divided into a number of zones, with the true origin at the intersection of the Central Meridian and the Equator.
Low Hazard	Flood conditions such that should it be necessary, people and their possessions could be evacuated by trucks; able-bodied adults would have little difficulty wading to safety.

Mainstream Flooding	Inundation of normally dry land occurring when water overflows the natural or artificial banks of the principal watercourses in a catchment. Mainstream flooding generally excludes watercourses constructed with pipes or artificial channels considered as stormwater channels.
Management Plan	A document including, as appropriate, both written and diagrammatic information describing how a particular area of land is to be used and managed to achieve defined objectives. It may also include description and discussion of various issues, special features and values of the area, the specific management measures which are to apply and the means and timing by which the plan will be implemented.
Mathematical/Computer Models	The mathematical representation of the physical processes involved in runoff and stream flow. These models are often run on computers due to the complexity of the mathematical relationships. In this report, the models referred to are mainly involved with rainfall, runoff, pipe and overland stream flow.
NPER	National Professional Engineers Register. Maintained by the Institution of Engineers, Australia.
Peak Discharge	The maximum discharge occurring during a flood event.
Probable Maximum Flood	The flood calculated to be the maximum that is likely to occur.
Probability	A statistical measure of the expected frequency or occurrence of flooding. For a fuller explanation see Annual Exceedance Probability.
Risk	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. For this study, it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
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.
Stormwater Flooding	Inundation by local runoff. Stormwater flooding can be caused by local runoff exceeding the capacity of an urban stormwater drainage system or by the backwater effects of mainstream flooding causing the urban stormwater drainage system to overflow.
Topography	A surface which defines the ground level of a chosen area.

* A number of terms in this Glossary have been derived or adapted from the NSW Government *Floodplain Development Manual*, 2005.

1. INTRODUCTION

Penrith City Council is responsible for the preparation of a comprehensive Floodplain Risk Management Plan for the Penrith Local Government Area (LGA) in accordance with the NSW Government's *Floodplain Development Manual* (2005). As part of the preparation and implementation of the Floodplain Risk Management Plan for the various catchments, Council has resolved to undertake "Penrith overland flow flood – overview study" to define the nature and extent of flood behaviour for the LGA.

The objective of this study is to generate sufficient information to define flood risk and prioritise flood risk management across the LGA. The results from this study will provide Council with a sound basis upon which to undertake a program of more detailed overland flood studies. This will ultimately lead to a complete Floodplain Risk Management Plan for the LGA.

The study area covers the LGA and has been divided into the following three zones for the purpose of this study:

- Zone 1 – 'Central Urban'
- Zone 2 – 'Northern Rural'
- Zone 3 – 'Southern Rural'.

The majority of the population resides within Zone 1, which also includes the Penrith CBD. A layout of the study area showing the zone boundaries is shown in Figure 1.1. The major rivers and creeks are shown in Figures 1.2 A, B & C.

A number of areas in the LGA have been subjected to detailed flood studies and therefore were excluded from the current study. These areas are:

- The Penrith Lakes Scheme
- Australian Defence Industries Sites at St. Marys
- Glenmore Park Extension
- Erskine Park Employment Zone, and
- Rivers and floodplains being assessed as part of the *Nepean River Flood Study* (in progress) and *South Creek Flood Study* (in progress).

An innovative methodology was adopted for this study that generated the necessary information to fulfil the objectives of the study. In addition, the adopted methodology provides a robust preliminary assessment of the flood behaviour in the LGA.

The study was overseen by a Technical Working Group (TWG) convened by Council. Representatives from Council, the Department of Natural Resources (DNR) and the State Emergency Service (SES) were included in the TWG.

2. STUDY OBJECTIVES

Council's floodplain management process envisages the definition of mainstream, tributary and overland flow flood behaviour throughout the LGA for the full range of potential flood events up to and including the Probable Maximum Flood (PMF). The definition of mainstream and tributary flood behaviour is already under way through a series of flood studies (including the *Nepean River Flood Study* and the *South Creek Flood Study*). In the next stage, overland flow behaviour for various sub-catchments within the LGA would be defined by undertaking detailed flood studies.

Council has undertaken this 'overview study' as a precursor to defining the overland flow behaviour through detailed flood studies. As there are a large number of sub-catchments, prioritisation is required to allocate resources to the sub-catchments that are most affected by high flood risk.

The primary objectives of this study are to:

- Identify, validate and map all major overland flow paths within the Study Area
- Identify and map sub catchments for all catchments within the Study Area
- Identify properties at risk of major overland flooding
- Define local flood behaviour in the Study Area by producing information on flows, flood levels, depth of flows and velocities for the 20 year, 100 year ARI and the PMF events under existing catchment conditions,
- Assess provisional flood hazard for properties at risk from flooding for the 20 year and 100 year ARI events and the PMF, and
- Rank the nominated sub-catchment areas in terms of severity of flooding for further investigations. Council may also consider landuse, known flood affected areas and cost of potential mitigation works when prioritising the sub-catchments.

The above objectives were achieved through detailed hydrological/hydraulic modelling of the entire LGA described in the subsequent sections of this report. It is to be noted that ranking of the sub-catchments for further investigation was the main objective of this study and the majority of the other objectives were achieved through the process of establishing the sub-catchment rankings.

The areas within the 100 year ARI flood extent for both the Nepean River and South Creek were excluded from the current study.

3. STUDY DATA

Penrith City Council provided the majority of the data required for the study. The data was compiled and processed for use in the study. Cardno Lawson Treloar also acquired further data through a number of site visits.

3.1 Available Data

The data available for this study is summarised below.

3.1.1 Topographic Survey

Airborne Laser Scanning (ALS) raw survey data along with an accurate digital ortho-rectified colour aerial images and contours of the entire Penrith LGA were supplied by Council. The DTM was constructed from Airborne Laser Scanning (ALS) survey undertaken on 7-9 November 2002. The supplied data had non-topographic features, such as buildings and vegetation cover, removed from the DTM to provide a better definition of overland flowpaths in the LGA. In addition, the data had representation of some structures (major bridges and culverts) also removed from the DTM.

3.1.2 Culvert/Bridge Data

Not all of the significant structures were removed from the DTM and were instead represented as ”obstructions” across the watercourse i.e. the ground levels in DTM represent the road across the creek rather than the creek section. The representation of these structures was in the form of street/road surface on top of the bridge/culvert. After discussion with the Technical Working Group (TWG), it was decided that significant structures on local creeks would be taken into account in the flooding analysis. This required that either a culvert or bridge be incorporated at the creek crossing location as represented in the DTM. All culverts that have been included in the analysis are considered to be fully open i.e. no blockages are taken into account in this study.

Council has previously undertaken asset surveys and collected data on a number of structures within the LGA (dated 2004). A data sheet was prepared for each structure, containing a photograph and a few relevant dimensions. These data sheets were provided to Cardno Lawson Treloar for use in the study. However, the data supplied did not include all the necessary dimensions of these structures. Consequently, the required dimensions (size of flow area) were scaled from the photograph and other dimensions available on the data sheet for the structures. The model therefore contains an approximate representation of these structures. The data sheets for structures are provided in Appendix A.

The data provided by Council did not include all significant structures in the study area. A number of site visits were undertaken in December 2005 and January 2006 to measure the size of significant culverts/bridges in various sub-catchments. Culvert/bridge inverts that were used in the hydraulic model were obtained from the fine model grid, which defines the average ground level within a 3 m by 3m grid cell at the culvert/bridge inlet/outlet. Figure 3.1A -C shows the location of the bridges/culverts used in this study.

It is to be noted that a significant effort was made to identify all the major culverts/bridges in the study area. Following preliminary modelling, a detailed review of flooding was undertaken with Council to identify areas where flood behaviour was substantially different to Council’s past experience in the area. This exercise also identified a number of major structures that were missing in the model. Details of these structures were later obtained and included in the model.

Despite the substantial review, a number of such structures may still be unaccounted for in this study. These structures are likely to be relatively small and only have a localised impact on the flood behaviour.

After review of the final draft report, Council requested a model check for culverts under the M4 in the vicinity of Ropes Creek and under the railway line in the vicinity of Werrington Creek. The check

revealed that these culverts were not included in the model. Therefore, the flood extents shown in the vicinity of these structures should be interpreted with caution.

It is important to note that the above qualification also applies equally to those areas where such culverts have been accounted for. This is due to the fact that the current study is broad-scale in nature and all the important hydraulic features other than culverts/bridges may not have been included in the model. More accurate flood behaviour in any area can only be established by undertaking a detailed flood study.

Appendix A provides details of all the structures used in the study – both those available in Council's asset survey and those inspected for this study.

It is important to note that the structure data provided in Appendix A is approximate and should not be used for the detailed analysis of flood behaviour in the catchments. A detailed survey for these structures would be required when a comprehensive flood study is carried out.

No stormwater pit and pipe networks were modelled in this study.

3.1.3 Data from Previous Flood Studies - Based on Published Data

The areas lying within the 100 year ARI flood extents of the Nepean River and South Creek were excluded from the study. These flood extents were developed from the flood data collated as part of this study**.** For the Nepean River, flood data for various design events was obtained from DNR and Council (Upper Nepean Flood Study, DLWC 1995; Nepean River at Penrith Flood Study L&T 1995; Hawkesbury Flood and Hazard Mapping Webb, McKeown 1999) which was then used to develop a map of the 100 year ARI flood extent. For South Creek, flood extents were obtained from a previous flood study (Willing, 1991). The extents were digitised from a hard copy into a GIS. Both these extents are approximate and are expected to be modified following the completion of flood studies, which are currently underway, but incomplete at the time of this study.

3.2 Other Data

In addition to the data described above, the following data was sourced from the Council:

- GIS data
- Cadastre boundaries
- Street names
- Location of major bridges in asset register (Appendix A)
- Location of buildings of special interest including
  - Ambulance
  - Child care centres
  - Church
  - Entertainment
  - Fire Stations
  - Hospitals
  - Hotels
  - Nursing homes
  - Police stations
  - Retirement villages
  - Schools
  - State Emergency Services
  - Shopping centres
  - Universities/TAFES
- Reports
  - Department of Land & Water Conservation, September 1995 (Report No NSWPW 95052), Upper Nepean River Flood Study, Prepared for Wollondilly Shire Council, Campbelltown City Council, The Council of Camden, Liverpool City Council & Penrith City Council.

- Lawson & Treloar, December 1995, (Report HO/43/95), Nepean River at Penrith Flood Study.
- Lawson Treloar, May 2003 (J2057/R2025)) Hawkesbury- Nepean Floodplain Management Strategy, Road Evacuation Route Upgrade Strategy, Local Hydraulic Specification Study, Berkshire Park, Prepared for Bewsher Consulting & Department of Sustainable Natural Resources.
- Webb, McKeown & Associates Pty Ltd, March 2002, Road Evacuation Route Upgrade Strategy Local Hydraulics Specification Study Emu Plains, Prepared for Department of Land and Water Conservation.
- Willing & Partners, February 1991, South Creek Floodplain Management Study, Volumes 1 and 2, Prepared for Department of Water Resources.

- Aerial photographs
  - High resolution aerial photographs
  - Low resolution aerial photographs.
- Major works that were carried out after the ALS survey and aerial photography have not been included in the study. These works include
  - St Marys Levee (including Byrnes Creek works)
  - Londonderry Road Upgrade
  - Wilshire Road Upgrade.

4. PENRITH LOCAL GOVERNMENT AREA

The Penrith Local Government Area (LGA) lies to the west of the Sydney Metropolitan Area at the foot of the Blue Mountains. The LGA covers an area of 407 square kilometres and comprises 34 suburbs. The LGA is bounded by the Nepean River in the south-west, Emu Plains, Emu Heights and Leonay in the west, Springwood Road, The Driftway (south of Agnes Bank) and Richmond Road in the north, South Creek and Ropes Creek in the east and Elizabeth Drive including Luddenham Village and Wallacia in the south. Penrith is approximately 54 kilometres from Sydney. The Great Western Highway, the M4 Freeway, the Western Railway line and the Sydney Water pipeline all cross the area from east to west. The location of the LGA in relation to Sydney is shown in Figure 4.1.

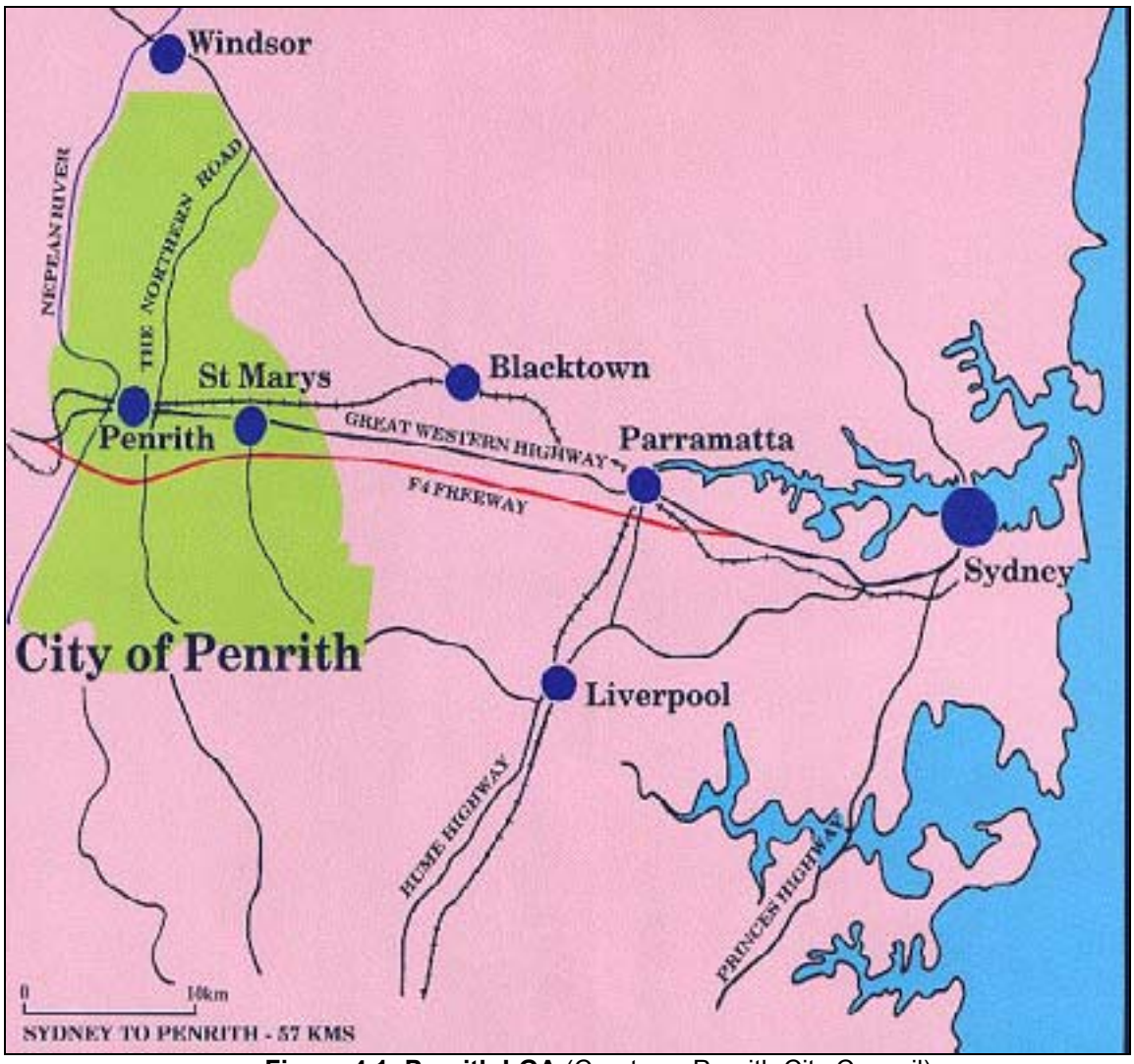

Figure 4.1: Penrith LGA (Courtesy: Penrith City Council)

Penrith is one of the three largest local government areas in Western Sydney and has the sixth largest population of any local government area in New South Wales. The estimated population for the LGA as at June 2004 was 177,554. The population resides primarily in residential estates spreading north and south from the Great Western Highway, the M4 Freeway and the railway. Approximately 90% of Penrith's population reside in urban areas of the LGA.

4.1 Land use

The land use within the Penrith LGA includes open space, rural, rural residential, residential, commercial and industrial uses. The area also supports major agricultural and industrial activity. The

agricultural land lies to the north and south of the residential areas. There are two Central Business Districts at Penrith and St. Marys to cater for the demands of the urban population.

4.2 Topography

The topography varies from a peak elevation of 240 mAHD in the south to a low of 0.5 mAHD in the north. The northern areas generally have flatter slopes (up to 5%), whereas the southern areas are more undulating (slopes varying from 2-20%). The major creeks and tributaries generally flow from south to north.

4.3 Flood Mechanisms

Large areas of the Penrith LGA are subject to mainstream flooding from the Nepean River and South Creek. In a 100 year ARI event, approximately 29 square kilometres of Nepean River floodplain and 23 square kilometres of South Creek floodplain would be inundated. However, there are numerous tributaries of the Nepean River and South Creek that have significant floodplain areas within the LGA as a result of local catchment flooding. In addition, there are a number of major overland flowpaths through developed areas that, when activated, can result in property flooding.

This study provides preliminary information on both tributary and major overland flowpath flooding in the LGA.

As outlined in Section 1, a number of localised flood studies have been carried out previously in the LGA including studies for the:

- Penrith Lakes Scheme
- Australian Defence Industries site at St Marys
- Glenmore Park Extensions and Erskine Park Employment Zone

These areas have been excluded from the study area for the current study.

5. STUDY METHODOLOGY

Analysis of overland flow is a complex task in an urban environment such as that found in Zone 1 of the study area (Figure 1.1). In many developed areas, the natural creek systems have been replaced with underground pipe drainage, which has a limited capacity. The overland flow resulting from a major flood event may affect areas that are different to those that would have otherwise been affected if the system were in its natural state. This is due to the complexity of overland flowpaths that are created as a result of the development of the area. A reasonably accurate assessment of flooding in such areas requires a two-dimensional approach in modelling the flood behaviour.

5.1 Overview

The main objective of this study was to establish priorities for detailed overland flow studies. The prioritisation process required a flood risk assessment for various sub-catchments within the Penrith LGA. As such, a robust and innovative methodology was adopted for the flood risk assessment that provided a high degree of confidence in ranking sub-catchments on the basis of the severity of flooding. The methodology is described in the following sections.

5.2 Two-Dimensional Hydraulic Modelling

Two-dimensional (2D) hydraulic modelling was carried out to determine the flood behaviour for the entire LGA. The input to the hydraulic modelling was not based on traditional methods of hydrological analysis. Rather, design rainfall time-series were applied directly on the model grid as input, which resulted in the generation of overland flow. Appropriate rainfall losses were subtracted from the design rainfall to derive excess hyetographs. This is described further in Section 5.2.2.

A fine grid size was deemed necessary to define the overland flowpaths through the developed areas of the LGA. However, due to current computer limitations (speed and memory), it was not possible to establish a detailed grid for the entire study area. To overcome this limitation, a coarse/fine grid combination was used where a coarse 45 m grid was established for the entire LGA and finer, detailed grids were then nested within the coarser grid. The design rainfall input to the model resulted in overland flow, which was then routed on the coarse 45 m grid before arriving at the location of each finer grid where flowpaths were modelled in higher detail. Figure 5.1 provides a schematic of the coarse/fine grid combination used in the study. It is to be noted that each fine grid had design rainfall applied as input along with flows from the coarse grid. Approximately 24 million grid cells of fine grids were required to model the entire LGA.

Significant culverts/bridges in the study area were included as one-dimensional (1D) components within the fine grid. However, a few structures were also included in the coarse grid at critical locations as identified by Council.

Modelling results included flood level, velocity and discharge data throughout the LGA. Model results were used to define the provisional flood hazard based on the depth - velocity criteria as defined in the *Floodplain Development Manual* (NSW Government, 2005). All study results were provided in GIS for easy transfer to Council's GIS.

Hydraulic modelling was carried out for the PMF, 100 year and 20 year ARI events. The details of the modelling are provided below.

5.2.1 Modelling System

The SOBEK 1D/2D modelling package was used for the study. SOBEK 1D/2D is a purpose-built flood model developed by WL|Delft Hydraulics. The model has been exclusively developed for flooding investigations of floodplains in urban environments. The model offers a number of state-of-the-art features including sub and supercritical flow, wetting and drying in overland flow and an advanced and robust numerical scheme. Cardno Lawson Treloar has used SOBEK in a number of studies of this nature in the past.

5.2.2 Rainfall

Design rainfall for the Penrith area was derived from AR&R (1999). The Council also provided the design rainfall data that has been prepared by the Bureau of Meteorology specifically for the Penrith area. Table 5.0 lists the rainfall intensities for various design events as provided in the Council data.

Table 5.0a: Rainfall Intensity Coefficients

BUREAU OF METEOROLOGY INTENSITY COEFFICIENTS FOR PENRITH							
Period	**A**	**B**	**C**	**D**	**E**	**F**	**G**
1	3.1235	-0.5793	-0.0202	0.00945	-0.001209	-0.0004600	0.0000687
2	3.3820	-0.5790	-0.0208	0.00914	-0.001066	-0.0004188	0.0000614
5	3.6470	-0.5792	-0.0236	0.00780	-0.000288	-0.0002227	0.0000085
10	3.7766	-0.5793	-0.0252	0.00707	0.000155	-0.0001137	-0.0000215
20	3.9242	-0.5799	-0.0260	0.00683	0.000358	-0.0000630	-0.0000344
50	4.0911	-0.5795	-0.0274	0.00590	0.000772	0.0000646	-0.0000663
100	4.2024	-0.5800	-0.0280	0.00570	0.000942	0.0001046	-0.0000765

Design rainfall intensities as listed in Table 5.0b were calculated using the following equation (Guidelines for Engineering Works, Penrith Council 2006).

$\ln(i) = a + b(\ln T) + c(\ln T)2 + d(\ln T)3 + e(\ln T)4 + f(\ln T)5 + g(\ln T)6$
Where
ln = natural logarithm
i = intensity in mm/hr
T = time in hours
a, b, c, d, e, f and g are coefficients

Table 5.0b: Design Rainfall Intensities (mm/hr)*

Time	**RETURN PERIOD (YEARS)**						
hr min	**1**	**2**	**5**	**10**	**20**	**50**	**100**
0 6	69.5	90.0	117.7	134.2	155.6	184.2	206.1
0 7	65.6	84.9	111.1	126.6	146.9	173.8	194.5
0 8	62.3	80.6	105.4	120.1	139.3	164.9	184.5
0 9	59.4	76.9	100.5	114.5	132.8	157.1	175.8
0 10	56.9	73.6	96.1	109.5	127.0	150.2	168.0
0 11	54.6	70.7	92.3	105.1	121.9	144.1	161.2
0 12	52.6	68.1	88.8	101.1	117.2	138.6	155.0
0 13	50.7	65.7	85.6	97.5	113.1	133.6	149.4
0 14	49.1	63.5	82.8	94.2	109.3	129.1	144.4
0 15	47.5	61.5	80.2	91.2	105.8	125.0	139.7
0 16	46.1	59.7	77.7	88.5	102.6	121.2	135.5
0 17	44.8	58.0	75.5	85.9	99.6	117.7	131.6
0 18	43.6	56.4	73.4	83.6	96.9	114.4	128.0

Time	RETURN PERIOD (YEARS)						
hr min	1	2	5	10	20	50	100
0 19	42.4	54.9	71.5	81.4	94.3	111.4	124.6
0 20	41.4	53.5	69.7	79.3	92.0	108.6	121.4
0 22	39.4	51.0	66.4	75.6	87.6	103.5	115.7
0 24	37.7	48.8	63.6	72.3	83.8	99.0	110.7
0 26	36.2	46.8	61.0	69.4	80.4	95.0	106.2
0 28	34.8	45.0	58.6	66.7	77.3	91.3	102.1
0 30	33.5	43.4	56.5	64.3	74.6	88.0	98.4
0 35	30.8	39.9	52.0	59.2	68.6	81.0	90.6
0 40	28.6	37.1	48.3	55.0	63.7	75.3	94.2
0 45	26.8	34.7	45.2	51.5	59.7	70.5	78.8
0 50	25.2	32.7	42.6	48.5	56.2	66.4	74.2
0 55	23.9	30.9	40.3	45.9	53.2	62.9	70.3
1 00	22.7	29.4	38.4	43.7	50.6	59.8	66.8
1 30	17.9	23.2	30.2	34.4	39.9	47.1	52.6
2 00	15.1	19.6	25.4	28.9	33.5	39.6	44.2
2 30	13.2	17.1	22.2	25.3	29.3	34.5	38.6
3 00	11.9	15.3	19.9	22.6	26.2	30.9	34.5
3 30	10.8	14.0	18.1	20.6	23.8	28.1	31.4
4 00	10.0	12.9	16.7	19.0	22.0	25.9	28.9
4 30	9.3	12.0	15.6	17.7	20.4	24.1	26.9
5 00	8.7	11.3	14.6	16.6	19.2	22.6	25.2
5 30	8.2	10.7	13.8	15.6	18.1	21.3	23.8
6 00	7.8	10.1	13.1	14.8	17.2	20.2	22.5
8 00	6.6	8.5	10.9	12.3	14.1	16.5	18.3
9 00 [+]	6.4	8.2	10.3	11.5	13.2	16.3	16.9
10 00	5.7	7.4	9.5	10.7	12.3	14.4	15.9
12 00	5.1	6.6	8.5	9.5	11.0	12.8	14.2
18 00	3.9	5.1	6.6	7.5	8.6	10.2	11.4
24 00	3.2	4.2	5.5	6.3	7.3	8.6	9.6
36 00	2.4	3.2	4.2	4.9	5.7	6.8	7.6
48 00	2.0	2.6	3.5	4.0	4.7	5.7	6.4
60 00	1.7	2.2	3.0	3.4	4.1	4.9	5.5
72 00	1.4	1.9	2.6	3.0	3.6	4.3	4.9

[*] Data supplied by Penrith City Council
[+] Values derived from AR&R IFD calculations

The design rainfall losses applied varied between Zone 1 and Zones 2 & 3. This is primarily due to the land use in these areas (Section 4.1). Zone 1 is primarily urban, while Zones 2 and 3 are primarily rural or forested. The assumed rainfall losses are shown in Table 5.1.

Table 5.1 Adopted Rainfall Losses

Area	Initial Loss (mm)*	Continuing Loss (mm/hr)
Zone 1	5	1
Zones 2 & 3	10	2.5

* Urban areas are approximately 50% impervious, as such the rainfall losses are approximately half that of the rural areas

A sample excess hyetograph (rainfall – losses) for the 100 year ARI design rainfall is shown in Figure 5.2.

For the PMF event, the maximum intensity rainfall as provided in *The Estimation of Probable Maximum Precipitation in Australia – Generalised Short-Duration Method* (Bureau of Meteorology, June 2003) was adopted as the rainfall input for the entire study area, assuming a uniform spatial distribution. This is a conservative approach and was adopted after discussion with the TWG. However, this approach is a reasonable estimate of the PMF for the small-scale individual sub-catchments adopted for this study.

No rainfall losses were assumed in Zones 1, 2 and 3 for the PMF as per the guidelines of AR&R (1999).

5.2.3 Grid Generation and Model Setup

A coarse 45 m grid was used to define the entire LGA. Smaller, fine-scale grids were then used to model the overland flow behaviour in detail. For Zone 1, 3 m grids were used, while for Zones 2 and 3, 9 m grids were used. Figure 5.3 shows the layout of these grids. A single model setup consisted of a fine scale grid nested within the 45 m grid.

In order to minimise boundary effects at the interface of a fine grid and the 45 m grid, the fine grid extents were overlapped by 90 m. This overlap provided a reasonable buffer for the integration of flood extents between adjacent grids.

The ALS survey data received from the Council (Section 3.1.1) was used to generate the grids for the model. Due to the high density of survey points (approximately 6 to 8 in each 3 m grid cell), the grid cell level was established by taking the average of the survey data points within that cell. This provided a reasonable estimate of the 3m grid cell.

To avoid long computational model run times, the finer grids were generally kept under 500,000 points. This equates to an approximate area of 450 hectares. In total, there were approximately 12.7 million 3 m grid cells defining Zone 1 and 3.7 million 9 m grid cells defining Zone 2 &3.

Figure 5.4 shows the 45 m grid used in the modelling. The figure also provides the general topography of the study area.

5.2.4 Buildings

Buildings within the floodplain in Zone 1 (Figure 1.1) were assumed to completely block overland flow, and were modelled as raised blocks in the topographic grids. Due to the open nature of the rural areas in Zones 2 and 3, buildings were not deemed critical to overland flow behaviour and were not raised within the topographic grid.

Initial design model runs were undertaken using the 45 m grid. These runs were used to define a preliminary PMF design extent with an assumption that every model cell with a 5cm depth or greater was part of the flood extent (a 5 cm depth was used for the preliminary extents to ensure that all houses within the floodplain were picked up). Buildings were then mapped in Zone 1 within this preliminary PMF extent. It was assumed that buildings external to this extent were not critical to the passage of overland flow. In total, approximately 29,000 buildings were mapped from ortho-rectified aerial photography dated 2002.

5.2.5 Hydraulic Roughness Map

Two-dimensional hydraulic modelling requires the preparation of a hydraulic roughness map that characterises the surface roughness for various land uses. This roughness map was generated based on the aerial photography supplied by Council and site inspections carried out during the study.

There is no standard reference that provides guidelines on estimating the hydraulic roughness for overland flow in 2D models. Standard references such as Chow (1973), that provide roughness values for channels can provide an approximate estimate of 2D roughness. However, a better guide for 2D roughness is the past experience in 2D model calibration. As such, roughness values used in the 2D model have been based on past experience in model calibration in catchments of similar land use and topography.

Table 5.2 shows the adopted Manning's 'n' roughness values used for the modelling.

Table 5.2 Adopted Manning's 'n' Values

Classification	Manning's 'n'
Grass	0.030
Roads	0.015
Residential/ Urban areas	0.100
Forest/ Bushland	0.100
Creeks/Waterways	0.030
Open Bushland/ Shrubs	0.050

The roughness maps for the three zones are presented in Figures 5.5A-C.

5.2.6 Estimation of Critical Duration

Model runs were carried out for critical durations only. The critical duration for each model setup (combination of the coarse 45 m grid and a single fine grid) was determined from preliminary modelling undertaken using the 45 m grid. The PMF, 100 year and 20 year ARI design events were run for the standard durations of 15, 30 and 45 minutes, 1, 1.5, 2, 3, 6, 9, 12, 18, 24, 36 and 72 hours. The 15 minutes duration for the 100 year and 20 year ARI events was selected as the minimum duration as it represents the time of concentration for a small-scale catchment. For PMF, the BOM methodology for PMP estimation provides 15 minutes as the minimum duration. The results of this modelling were then used to establish the critical duration, which resulted in the peak water for the given design event.

The critical duration for any location in a catchment is dependent on the catchment area upstream of that location. As such, multiple critical durations were observed for most fine grids. For such grids, either an "average" representative critical duration was taken, or two representative critical durations were taken where the difference in the critical duration was large. Table 5.3 provides the critical durations adopted for various model areas in the LGA.

Table 5.3: Critical Durations Adopted for Various Model Areas in the LGA

Grid*	100yr ARI	20yr ARI	PMF
A3	2hr	2hr	30m
A4	2hr	2hr	30m
A5	2hr	2hr	30m
B1	90m	45 m	60m
B3	2hr	2hr	30m
B4	2hr	60m/2hr	15m
B5	2hr	60m	15m/45m
C1	90m	90m	45m

Grid*	100yr ARI	20yr ARI	PMF
C2	2hr	2hr	90m
C3	2hr	2hr	4hr
C4	2hr	90m/2hr	30m/4hr
C5	2hr	90m	45m/60m
C6	2hr	2hr	15m/4hr
C7	2hr	2hr	3hr
D1	90m	90m	45m
D2	9hr	12hr	2hr
D3	2hr	90m	90m
D4	2hr	60m	15m
D5	2hr	90m	15m
D6	2hr	90m	15m/3hr
D7	2hr/9hr	36hr	30m/3hr
D8	9hr	2hr	2hr
E1	90m	90m	45m
E2	9hr	9hr	45m/90m
E3	2hr	90m	90m
E4	60m	60m	15m
E5	2hr	1hr	30m
E6	2hr	1hr	15m/90m/3hr
E7	2hr	2hr	15m/3hr
E8	2hr/36hr+	9hr	45m/2hr
F1	3hr/9hr	1hr/9hr	2hr
F2	2hr/6hr	2hr/9hr	30m
F3	2hr/9hr	60m/9hr	45m
F4	2hr	90m	15m
F5	2hr	90m	30m
F6	2hr	60m	15m
F7	2hr	90m	15m/60m
F8	2hr	90m	15m
F9	2hr	2hr	30m/90m
G2	9hr	9hr	60m
G3	2hr	60m	15m
G7	2hr	90m	45m
G8	2hr	60m	15m
G9	2hr	2hr	15m/90m
Z2a	1hr/2hr	1hr/2hr	30m/90m
Z2b	2hr/36hr	2hr/36hr	90m/4hr
Z2c	2hr/6hr	2hr/6hr	45m/2hr/4hr
Z2d	2hr/9hr	2hr/9hr	15m/90m/2hr
Z3a	2hr/9hr	2hr/6hr	15m/45m/6hr
Z3b	2hr/9hr	2hr/9hr	15m/90m/2hr
Z3b2	3hr	1hr	15m/2hr
Z3c	2hr	1hr/2hr	15m/45m
Z3c2	2hr	90m/6hr	15m/90m
Z3d	2hr	1hr/2hr	15m/45m
Z3e	2hr	1hr/2hr	15m/45m
Z3f	2hr	1hr	15m/30m

* See Figure 5.3 for grid locations

+ longer duration storms were critical in some areas due to mainstream flooding modelled in the 45m grid model being outside the 100 year mainstream extent as obtained from previous reports.

5.2.7 Design Flood Estimation

A single model set-up consisted of a fine 3m grid for Zone 1 and a 9m grid for Zones 2 & 3 nested within the coarse 45 m grid. Separate models were set-up for each of the fine grids. Design flood modelling was undertaken for the PMF, the 100 year and 20 year ARI design events for the critical durations established for each model area. The downstream boundaries for the coarse 45 m model were taken as the 5 year ARI peak water level at the Nepean River, Rickabys Creek and South Creek. The 5 year ARI water levels were adopted from the RUBICON model used in the Hawkesbury Flood & Hazard Mapping Study by Webb, McKeown & Associates (1999) and are provided in Table 5.4. Less frequent design flood levels were not considered as boundaries for this study, as all the areas within the 100 year ARI mainstream flood extents are to be excluded.

A model sensitivity run was carried out where the downstream boundary was set to the 20 year ARI levels, adopted from the above flood studies. The results (Figure 5.7) show that there is no difference to peak water levels, outside of the areas which are excluded from the mapping (i.e. the 100 year ARI mainstream flood extent).

Table 5.4: Downstream Boundary Water Levels

River/Creek	5 year ARI Water Level (mAHD)
Nepean River	12.93
Rickabys Creek	11.08
South Creek	10.82

At the upstream boundary, no inflow was assumed for the Nepean River, South Creek and Ropes Creek as mainstream flooding was to be excluded in this study.

A local hydraulic specification study has been previously carried out for Emu Plains (Webb, McKeown & Associates, 2002). The RAFTS model developed for the study was provided by Webb, McKeown and Associates on behalf of Council. This model was used to generate inflow hydrographs that were used as a model boundary at Emu Plains.

5.2.8 Further Assumptions

As part of this study the existing sub-surface stormwater drainage infrastructure was assumed ineffective (i.e. all flows were assumed to pass overland). This was in recognition of the fact that some areas where overland flooding occurs generally have pits and pipes of limited capacity, which also have a high tendency to block with local debris. It must also be noted that some areas have substantial pit and pipe networks (up to 100 year capacity). However, if on average the established pipe networks are designed to carry the 5 year ARI flows then approximately half of the 100 year ARI flows will be carried within the pipe network, assuming no blockages. As the pipe networks have not been considered, the overland flow extents within these areas can be considered conservative.

It should be also noted that some areas have no pit and pipe network and as such street drainage assumptions are not relevant.

5.3 Major Overland Flowpaths

Major overland flowpath definition was based on the coarse grid modelling undertaken to determine the critical duration (see Section 5.2.6). PMF model results from the 45 metre grid were used to define the preliminary flood extents that included all grid cells with a flow depth greater than 5 cm (For the final flood extent a 15 cm depth was used. However, a 5 cm depth was used for the preliminary extents to ensure that all flowpaths were identified). This process generated an approximate location of all major flowpaths within the LGA.

The flow paths were labelled using a naming convention based on the order of the tributary starting from a main creek. Figure 5.6 provides an example of this naming convention for an assumed South Creek tributary.

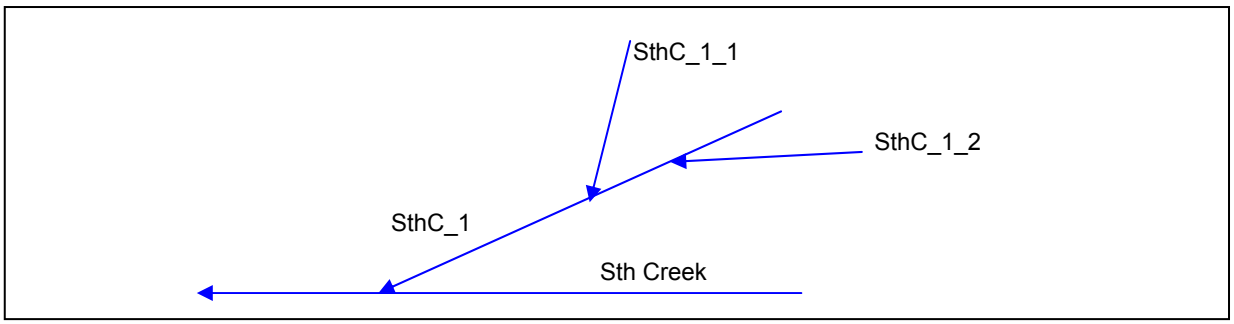

Figure 5.6 Flow Path Naming Convention

5.4 Discharge Measurement Stations

Before undertaking the fine grid modelling, it was necessary to define the location of discharge measuring stations as part of the model set-up. The preliminary definition of flowpaths derived from the coarse grid results was used to establish the location of these stations. Discharge measuring stations consist of a line segment extending across the preliminary PMF extent and measure the discharge through the grid cells underlying the line segment.

Discharge measurement stations were spaced at approximately 100m in Zone 1 and 200m in Zone 2 & 3. These stations were labelled with the name of the flowpath and a chainage starting from the downstream end. An example is shown in Figure 5.7:

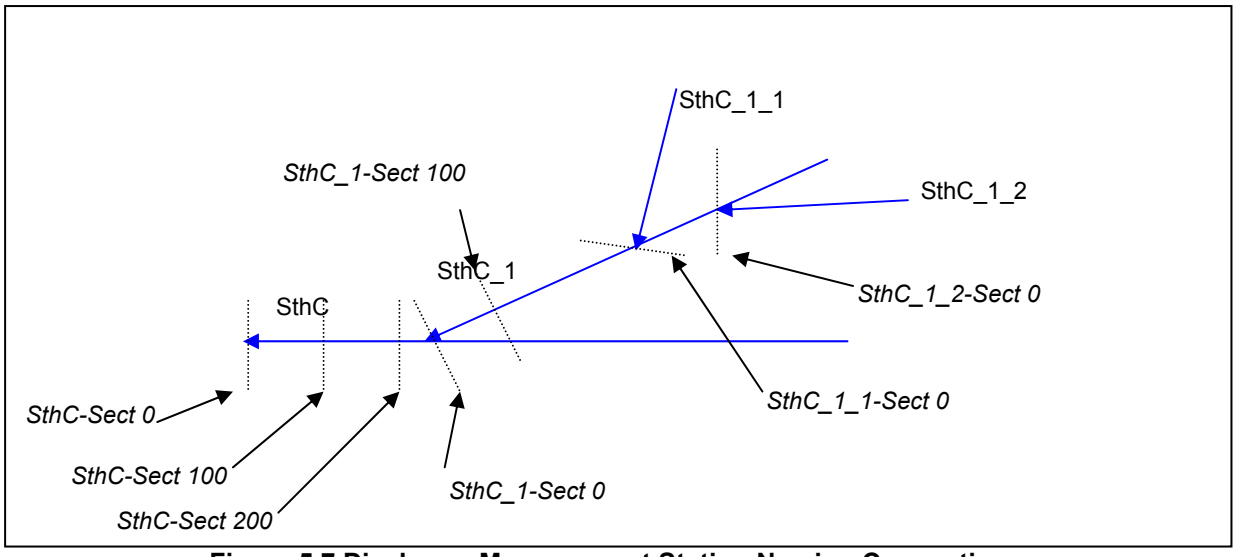

Figure 5.7 Discharge Measurement Station Naming Convention

5.5 Sub-catchment Delineation

As outlined in Section 2, the primary objective of the study was to prioritise the sub-catchments within the Penrith LGA for future detailed flood studies. After discussions with the TWG, it was decided that the entire LGA be subdivided into sub-catchments with an approximate area of 100 hectares. A preliminary subdivision of the catchments was obtained using the 'CatchmentSim' software (CRC for Catchment Hydrology, 2005). This software generates sub-catchments based on DTM data for a given area. Due to software limitations, the 45m grid (generated from the ALS raw data) was used in CatchmentSim. Based on the single input for the number of sub-catchments the software then

generated the desired number of sub-catchments. The preliminary sub-catchments that were generated were then manually modified to rectify anomalies.

Finally, the sub-catchment boundaries were further modified based on the results of detailed flood modelling of the overland flow. Figures 5.8A-C provide the final layout of the sub-catchments. The naming convention of the sub-catchments has been based on the convention used for the overland flow paths (Section 5.3). The sub-catchment names are not necessarily sequential as they are based on the flowpaths that lie closest to the centre of the catchment. The sub-catchment names and areas are provided in Appendix B. A total of 249 sub-catchments were delineated. Council has provided a list of 40 major catchments within the LGA and has related these major catchments to the sub-catchments delineated in the current study. Table 5.5 lists the major catchments along with the associated sub-catchments.

Table 5.5 – Sub-catchments within Major Catchments in Penrith LGA

No.	Creek Name	Catchment No.	Zone No.	CLT Sub-Catchments
1	Alston Creek (Surveyors Creek tributary)	BP500	1	SurC_4_2, SurC_4, SurC_4_3a, SurC_4_4, SurC_4_7, SurC_4_3, SurC_4_1
2	Badgerys Creek	BS400	3	BadC_1, BadC
3	Blackwell Creek	BS500	1	SthC_25_2, SthC_24, SthC_24_1, SthC_25, SthC_25_7
4	Blaxland Creek	BS400	3	BlxC_21_2, BlxC_20_3, BlxC_19, SthC, BlxC_7_1, BlxC_18_4, BlxC_10
5	Blind Kemps Creek	BS500	3	SthC_32_3_1, SthC_32_5_2
6	Boundary Creek	BP100	1	BouC_6_1, BouC_3, BouC, BouC_4, BouC_4_4
7	Byrnes Creek North	BM500	1	ByrC_6, ByrC_3, ByrC_2, ByrC_9, ByrC_5
8	Cambridge Park	BK100	1	SthC_10_5, SthC_10, SthC_10_5_7, SthC_10_5_8, SthC_10_7, SthC_10_10, SthC_10_5_1, SthC_10_5_3, SthC_10_3_1, SthC_10_5_4
9	Clairmont Creek	BS400	1	ClaC, ClaC_5, ClaC_10, ClaC_9, ClaC_8_3, ClaC_3, ClaC_1, SthC_18, ClaC_2, SthC_17
10	College Creek	BK400	1	WC_10, WC_11, WC_9
11	Corporation Drain	BP200	1	PTC_1_2, PTC_1
12	Cosgroves Creek	BK400	1	CC_12, CC_9
13	Cranebrook Creek	BN300	2	BouC_6_5, BouC_6_2
14	Farm Creek	BE100	1	NepR_13_3

No.	Creek Name	Catchment No.	Zone No.	CLT Sub-Catchments
15	Farrels Creek	BN300	1,2	BouC_6_3, BouC_6_6, CbkC_2_7_1, CbkC_2_6, BouC_6_2_2_1, BouC_6_2_4, BouC_6_7_1, BouC_6_7_2, BouC_6_1_2, BouC_6_1_1_1, BouC_6_4_3, BouC_6_4_1_3
16	Jerrys Creek	BS300	3	JryC_7, JryC_3_7_1
17	Kemps Creek	BS500	3	KC_17, KC_10, KC_14_3_3
18	Knapsack Creek	BE200	1	NepR_15_1_2_1, NepR_15_1_3_1, NepR_13_12, NepR_15
19	Lapstone Creek	BE100	1	NepR_11_8_2_3, NepR_11, NepR_11_12_1a, NepR_13_10_1, NepR_11_12_1, NepR_11_4, NepR_11_1_1_1
20	Little Creek	BM300	1	SthC_16, SthC_16_8, SthC_16_4, SthC_16_5, SthC_16_9, SthC_16_11_1
21	Littlefields Creek	BS200	3	LfC
22	Llandilo Creek	BN400	2	SthC_9_2
23	Maxwell Creek	BP500	1	SurC_2_1, SurC_2_3, SurC_2_2
24	McCarthys Creek	BN300	2	BouC_6_5, BouC_6_2
25	Mulgoa Creek	BS200	3	MgC_54, MgC_55_6_2, MgC_13_11_3, MgC_13_17, MgC_55_7, MgC_1, MgC_3, MgC_4_3, MgC, MgC_29, MgC_14_2, MgC_13_7_5, MgC_32_3, MgC_31_9, MgC_30_8, MgC_43_5
26	Nepean River		1,2,3	NepR_13_1, NepR_16, NepR_4, NepR_7, NepR_36, NepR_23, NepR, MgC_31_14_1, NepR_1_1_1_1, NepR_15_1a
27	Orth Creek	BK400	1	WC_8_4_3
28	Peachtree Creek	BP600	1	PTC_3, PTC, PTC_2
29	Racecourse Creek	BP400	1	PTC_2_1, PTC_2_1a, PTC_2_4, PTC_2_2, PTC_2_3_1
30	Rickabys Creek	BN200	2	RkbC_17_10_10_1, RkbC_5_2, RkbC_13, RkbC_9_3, RkbC_7_1, RkbC_24, RkbC_23_6_1_1, RkbC_1, RkbC_5, RkbC_4, RkbC_8, RkbC_30, RkbC_30_1, RkbC_30_3, RkbC_26, RkbC_29_1, RkbC_29_5, SthC_1_3_7_7, RkbC
31	Ropes Creek	BM200, BS600	1,3	RpC_18_2, RpC, RpC_16_1, RpC_14, RpC_27, RpC_11, RpC_13, RpC_13_1a, RpC_13_1, RpC_9, RpC_5, RpC_1, RpC_4, RpC_10a, RpC_19, RpC_19_2, RpC_16,

No.	Creek Name	Catchment No.	Zone No.	CLT Sub-Catchments
				RpC_15, RpC_8_3, RpC_10, RpC_30_1, RpC_29, RpC_29_1
32	School House Creek	BS100	1	ScHC_12_2, ScHC_10, ScHC_11, ScHC_6, ScHC_1, ScHC_6_1, ScHC_12_3_3, ScHC_12_4
33	Scope Creek	BN300	1	RkbC_29_5a
34	Showground Channel	BP300	1	PTC_1_1, PTC_1_1_1
35	South Creek		1,2,3	SthC_6_1, SthC_15, SthC_11_1, SthC_13, SthC_29_2, SthC_29_16, SthC_37, SthC_25_1, SthC_1_3_7_2_3_2_3, SthC_14, SthC_14_1, SthC_21_1, SthC_21, SthC_31, SthC_28_2, SthC_28_2a, SthC_13a, SthC_10_1, SthC_11, SthC_12, SthC_19, SthC_14_4, SthC_20_1, SthC_18_1, SthC_1_5, SthC_1_1, CC_1_1, BadC_5
36	St Clair Creek	BM500	1	ByrC_14, SthC_23_1, ByrC,
37	Surveyors Creek	BP500	1	SurC_2, PTC_3_1_1, SurC_1a, SurC_1, SurC_5, SurC_6_1, SurC_6_2, SurC_8_1, SurC_8_3, SurC_3, SurC
38	Torkington Creek	BN200	2	RkbC_17_10_3, RkbC_17, RkbC_17_10_2_3_1, RkbC_17_6, RkbC_17_9_5_1
39	Werrington Creek	BK300,BK400	1	WC, WC_4_1, WC_8, WC_8_8, WC_8_2, WC_8_1, WC_6, WC_4, WC_1, WC_2
40	Wilshire Creek	BN200	2	RkbC_12_1_2

The above table provides approximate relationship for some of the sub-catchments with the major catchments, since in low relief areas with pipe networks, some of these sub-catchments would actually be part of another major catchment than indicated in this table.

5.6 Sensitivity Analysis

Model results for the 100 year ARI event were tested for sensitivity to the following model parameters:

- Downstream Boundary
- Hydraulic Roughness
- Flow Discharge.

The downstream boundary of the 45 m grid model was tested for sensitivity by changing the boundary level from the 5 year ARI to the 20 year ARI peak water levels as obtained from the RUBICON model results provided by DNR (Table 5.6).

Table 5.6: Downstream Boundary Water Levels used in Sensitivity Analysis

Location	Rubicon Cross Section used	Design Boundary (5 year ARI level, mAHD)	Boundary 'up' (20 year ARI level, mAHD)
Nepean River	Anges1	12.93	14.63
Rickabys Creek	BlacktownRd	11.08	13.75
South Creek	Richwalk	10.82	13.67

The downstream boundary sensitivity was carried out using the coarse 45 m grid as this covers the entire study area. The difference in peak water levels for the two downstream boundaries is shown in Figure 5.9. The result of the boundary sensitivity indicates that the impact is mostly contained within Zone 2. These increases are contained within the areas that are excluded from the study and as such have no affect on the ranking criteria (Section 7).

Sensitivity to hydraulic roughness was tested for two different areas within the LGA. Roughness for a representative model area from Zone 1 (model E4, Figure 5.3) and Zones 2 & 3 (model Z3c, Figure 5.3) was modified by +/- 20% and model runs were carried out. The difference in peak water levels is shown in Figures 5.10 and 5.11 for Zone 1 and Figures 5.12 and 5.13 for Zones 2 & 3.

Sensitivity to discharge was modelled by varying the rainfall by +/- 20%. The difference in peak water levels is shown in Figures 5.14 and 5.15 for Zone 1 and Figures 5.16 and 5.17 for Zones 2 & 3.

The results indicate that the model is not very sensitive to a 20% change in hydraulic roughness or discharge. The extents were not remapped for the sensitivity runs however a difference in peak depth was considered, with 95% of results being within 2 cm it is not likely that there would be many additional properties affected by flood levels. Further assessment was carried out by plotting the change in peak water levels against the total number of grid cells in the modelled area. Figures 5.18 and 5.19 below present this assessment.

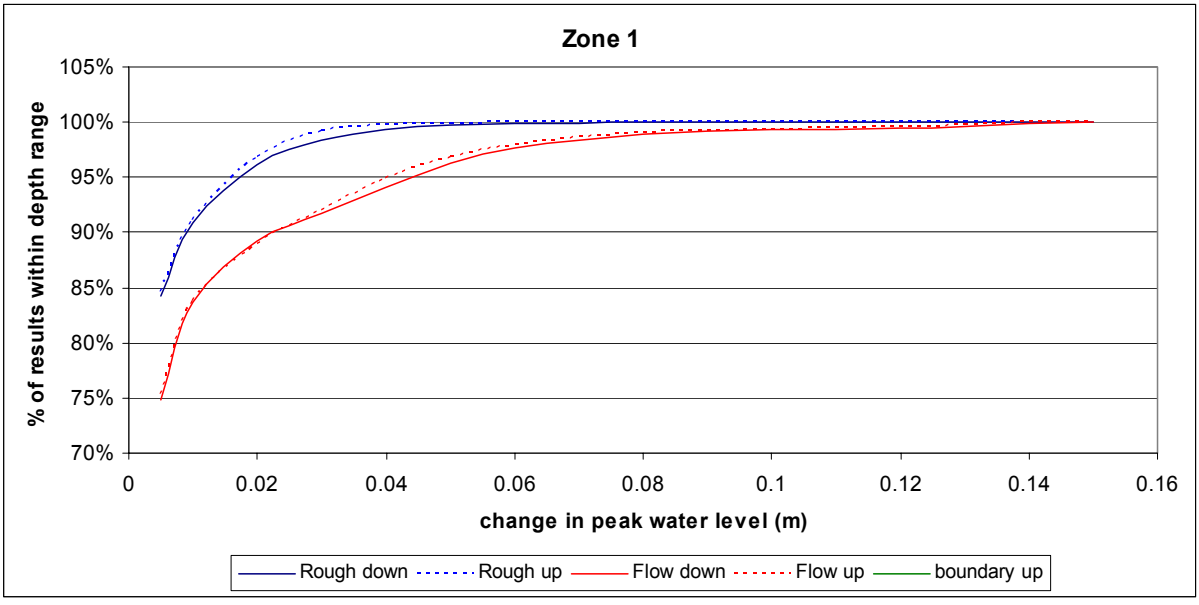

Figure 5.18: Sensitivity of Model Results – Zone 1

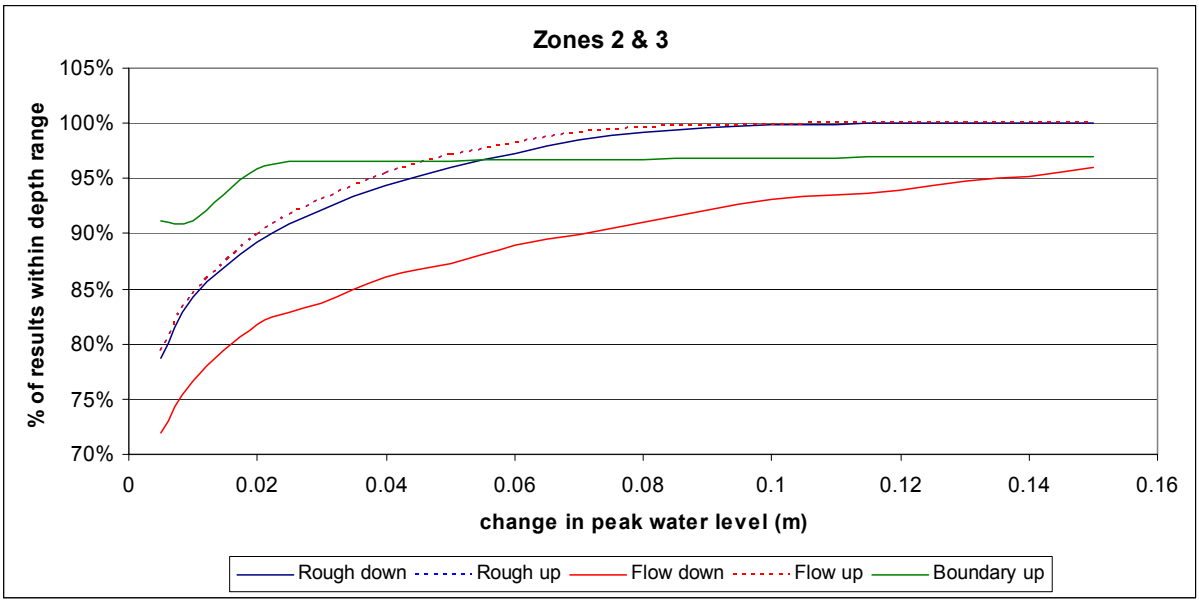

Figure 5.19: Sensitivity of Model Results – Zone 2 & 3

It can be seen from Figures 5.18 and 5.19 that in the majority of cases, 100% of the peak water levels are within 0.1 m of the 100 year ARI design flood levels. The changes of greater than 0.1 m occur within the major creek lines and as such do not directly affect properties in the study area.

The edges of the fine grids were overlapped by 90 metres to provide a smooth transition of extents at the border between the fine and coarse grids. In general the extents matched well at the interface between the two models. If the extents were significantly different then the model was rerun with the transition area modified to fix the anomaly.

6. RESULTS

The 2D hydraulic modelling of the entire Penrith LGA provided a large set of results including flood level, flood depth, velocity and discharge. This data was extracted from the model output and processed in a GIS (MapInfo) software for further assessment.

Due to the large data set, some of the results are only provided in electronic format on the CD accompanying this report. These results can be used more effectively in Council's GIS environment rather than in a hard copy format.

The following result data was extracted for the purpose of prioritisation of sub-catchments and for presentation purposes.

6.1 Flood Extents

Since rainfall was used as an input to the hydraulic model, flow was generated in the entire modelled grid area. However, only those areas with a flow depth greater than 0.15 m were considered to be 'flood affected'. Such areas were delineated using a GIS data analysis tool (MapInfo query) to produce the preliminary flood extents. Further refinement of the preliminary flood extents was carried out manually to remove anomalies. Final flood extents generated from all of the fine-scale grids were combined into a single GIS layer. These final flood extents for the entire LGA are provided in Figures 6.1 A-K. Figure 6.0 provides the key to the various figures.

Flood extents from the various fine grid models were combined at the interface by comparing extents from the adjacent grids. The 90 m overlap assumed in the modelling of the fine grids (Section 5.2.3) provided the necessary buffer for integration of the flood extent for the adjacent grids.

The flood extents generated from the fine grid modelling provided a more accurate definition of overland flowpaths as compared to that achieved using coarse grid modelling (see Section 5.2.8). It is therefore recommended that the flowpath definition provided by the fine grid flood extents be used in any further assessment.

Table 6.1 shows the total number of allotments affected in various design flood events.

Table 6.1 Properties Affected in Various Design Flood Events

Design Event	**Number of properties affected by overland flooding outside of mainstream flooding and excluded areas**		**Number of properties affected by mainstream 100 year ARI flooding only**
	Residential	*Other*	*Properties*
PMF	27,424	668	-[+]
100 Year ARI	11,732	420	2,296*
20 Year ARI	8,960	346	-

* This is an indicative value only as it includes all cadastral blocks within the mainstream flood extent (as determined from previous studies) It is important to note that the 100 year ARI extents from previous studies had to be digitised into GIS and as such may not be 100% accurate. It also needs to be noted that the 100 year ARI mainstream flooding extents do not consider the Hawkesbury River backwater levels in Rickaby's creek. Further to this the South Creek Flood Study is in the process of being reviewed and it is expected that the flood extent will be modified.

[+] only 100 year ARI mainstream flood extent available.

It is important to note that the PMF levels for areas located within the mainstream PMF extent may be underestimated.

6.2 Provisional Flood Hazard

Provisional flood hazard was defined as per the definition provided in the *Floodplain Development Manual - Figure L2* provided as Figure 6.21 (NSW Government, 2005). The hazards are provisional because they only consider the hydraulic aspects of hazard and are calculated from the peak velocity and the peak depth results generated in each model. It is likely that peak velocity and peak depth may occur at different times during the flood simulation and therefore the adopted approach provides a conservative estimate of the provisional hazard.

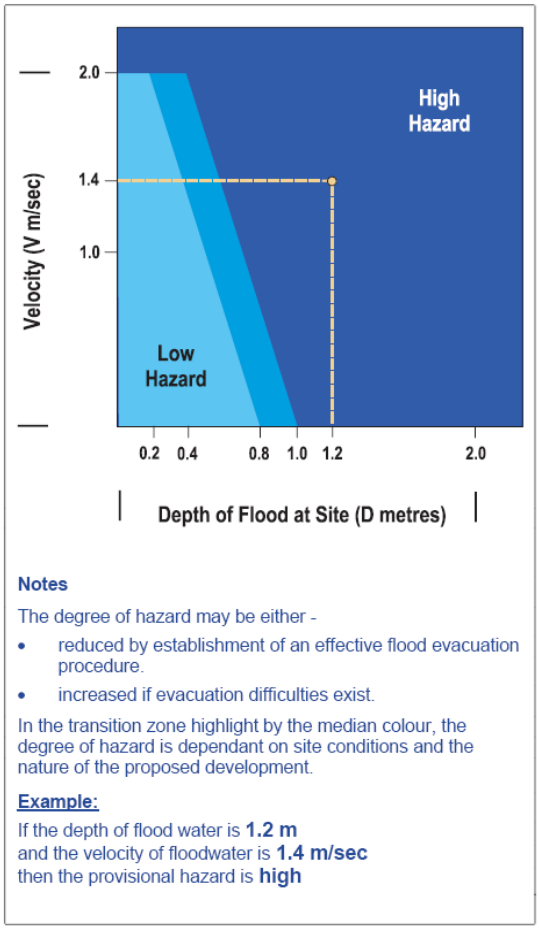

FIGURE L2 - Provisional Hydraulic Hazard Categories

Figure 6.21: Provisional Hydraulic Hazard Categories – Floodplain Development Manual 2005

The Floodplain development manual (2005) requires that other factors be considered in determining true hazard such as size of flood, effective warning time, flood readiness, rate of rise of floodwaters, depth and velocity of flood waters, duration of flooding, evacuation problems, effective flood access, type of development within the floodplain, complexity of the stream network and inter-relationship between flows.

High and low hazard areas were delineated for the entire LGA. It is important to note that high provisional hazard areas may lie outside the flood extents as areas that have a depth less then 0.15 m but a velocity greater than 2 m/s would be classified with high provisional hazard. High provisional hazard defined for the entire LGA is provided in Figures 6.2 A-K. Figure 6.0 provides the key to the various figures.

6.3 Discharge

Peak discharge data was obtained at the discharge measurement stations placed along the overland flowpaths, which were defined based on coarse grid modelling (Section 5.2.3). Since the location of overland flowpaths was refined during the fine grid modelling, the discharge measurement stations may not capture the entire flow for a given flowpath but are reliable with respect to reporting the appropriate order of magnitude of flow.

Since a very large number of discharge measurement sections were established (approximately 13,700), it was deemed more appropriate to provide the discharge data in electronic format rather in a hard copy format. The data is provided on the CD accompanying this report. The data can be directly transferred to the Council GIS and can be used easily with other geo-referenced data such as aerial photographs and the cadastral data.

6.4 Flood Level, Velocity and Depth Data

Model results for the peak flood level, velocity and depth were processed within the flood extents and are provided on the CD accompanying this report. It needs to be noted that the model results only provide preliminary flood extents as only limited events were considered, the creeks and rivers were only modelled in the 2D domain and pit and pipe networks were not included.

6.5 Ground Truthing and Validation of Results

A number of site visits were undertaken to identify and obtain measurements of significant culverts/bridges in the study area. After preliminary modelling, flood extents were reviewed during two separate meetings with Council. Suggested changes were made in the model and further model runs were undertaken to rectify anomalies in the flood extent. Past experience of the Council representatives and the availability of previous flood studies in the study area provided the opportunity to validate the flood extents.

6.6 Stormwater Drainage

The local stormwater drainage including pits and pipe networks were not included in modelling. The design flood levels are therefore likely to be overestimated. However, given the dynamic nature of flooding, it is possible in a catchment with a pipe network that the peak flood arrival time of both overland and pipe flow at a certain location coincides in such a manner that the resulting flood level is higher than that estimated with the assumption of no pipe network.

7. SUB-CATCHMENT PRIORITISATION

The main objective of the study is to rank each sub-catchment for establishing priorities for the undertaking of detailed flood studies in the future. The ranking process is based on estimating the flood risk associated with various design flood events. The flood risk is defined as potential danger to personal safety and potential damage to property resulting from flooding (NSW Government, 2005). The risk to personal safety is generally established by estimating the provisional flood hazard, which relates the depth of flooding with the velocity of floodwaters. The risk to property can be described by both provisional hazard and the Annual Average Damage (AAD) for the area of interest. However, it should be noted that AAD is only a useful comparative measure. The impact from a single event is often what matters to individual owners and occupiers. The AAD values can be used to compare the relative worth of damage between separate sub-catchments and does not reflect the damage likely to occur in any one event. Both of these parameters have been used in the assessment of flood risk for the sub-catchments in the Penrith LGA.

7.1 Methodology

Risk is defined as the likelihood of consequences arising from the flood event. In mathematical form the risk is given by:

Risk = Consequences x Likelihood

The flood risks considered in the sub-catchment ranking are:

- Hazard risk
- Economic risk.

The above risks were estimated from the model results for the design flood events (Section 6). The data extracted from the results included:

- The number of properties flooded
- The depth of flooding affecting each property
- The number of properties affected by provisional “high” hazard, and
- The property type ie. house, school, church.

The number of properties flooded or subjected to provisional high hazard was determined by counting the cadastral blocks that both lie within, or are partially affected by the flood extent (depth of flow greater than 0.15m) or the high hazard extent.

The two risk factors are then defined as:

- Hazard Risk = Number of properties affected x probability of flood event
- Economic Risk = Damage x probability of flood event.

Whilst these two types of risks are quantified, it can be useful to consider both the combined risks and the single risks when assessing sub-catchment prioritisation.

The risks from each design event have been added together to derive a single risk “value” for the sub-catchment. This process was undertaken for both risk factors separately.

Since sub-catchment sizes vary throughout the LGA, the two risk factors are divided by the sub-catchment area to give equal weighting to each sub-catchment.

It is important to note that as the pipe network has not been included in the hydraulic models the results from Zone 1 represent a more conservative approach then the results from Zones 2 and 3 which do not have established pipe networks. It may be considered that on average the stormwater pipe network is designed to carry a 5 year ARI flow. A 5 year ARI flow represents approximately 50% of a 100 year ARI flow (Penrith Council), resulting in 50% of the flow being conveyed in pipes and 50%

being conveyed overland. If pipe blockages and pit inlet losses were taken into account then the amount being conveyed overland would be most likely be greater then 50% of the 100 year ARI. The 20 year ARI flows are approximately 60% of a 100 year flow (estimated in the current study), as such the 20 year ARI overland flow results may be a more realistic representation of the 100 year ARI overland flows in developed areas that have a 5 year capacity pipe network. It is therefore possible to devise another method of catchment ranking that accounts for the pipe network in the catchment. In this method, the 20 year ARI model results can be used to establish ranking criteria for catchments with pipe network and 100 year ARI results for catchments without pipe networks. Such a method would affect the Zone 1 catchment ranking, where large areas are urbanised and have existing pipe networks. Catchment ranking for Zone 2 and 3, which are mostly rural in nature, is not likely to change. This method has not been used in this report, however, if desired Council can undertake this exercise at a later stage.

7.1.1 Special Buildings

Some of the sub-catchments include special buildings such as schools, hospitals, churches etc. The risk to such buildings is generally higher than residential buildings. Since the majority of the buildings within the LGA are residential in nature, the “special” buildings were given an equivalent residential weighting based on the equivalent number of residential buildings. The weighting for different buildings is provided in Table 7.1:

Table 7.1 – Special Buildings

Building type	Equivalent number of residential buildings used in risk assessment
Ambulance	20
Child Care Centre	1
Church	1
Entertainment	1
Fire Stations	20
Hospital	1
Hotel	1
Nursing Home	1
Police Stations	20
Retirement Village	1
School	1
State Emergency Services	20
Shopping Centre	1
TAFE	1
University	1

The weighting factors provided in Table 7.1 have been assumed based on the likely impact of flooding. These weighting factors were presented and approved in a Technical Working Group meeting.

7.1.2 Hazard Risk

The number of properties subject to provisional high flood hazard in a particular sub-catchment are counted for each design flood event and the hazard risk calculated as the product of the number of properties and the probability of each design flood event evaluated. A sample calculation for a single sub-catchment is provided in Table 7.

Table 7.2 – Hazard Risk Assessment

Design event	Number of residential properties affected by high hazard	Number of Schools affected by high hazard	Total Number of properties affected by high hazard)	Average Recurrence interval (years)	Calculation	Risk
PMF	100	2	100+2x20=140	10,000	= 140 / 10,000	0.014
100 year ARI	90	-	90	100	= 90 / 100	0.900
20 year ARI	80	-	80	20	= 80 / 20	4.000

The total risk for the sub-catchment in Table 7.2 is 4.914. This risk was calculated for each sub-catchment in the LGA and then divided by their respective areas to establish the value "risk per unit area". This risk value was then used to rank the sub-catchment.

It is to be noted that the average recurrence interval for the PMF has been assumed to be 10,000 years, which equates to a probability of 0.0001(1/10,000). It is noted that a PMF on Hawkesbury Nepean system equates to 100,000 year event. However, assuming a rarer probability for the PMF does not have a significant impact on the overall risk value.

7.1.3 Economic Risk

The economic damage associated with flooding is related to the depth of flooding at a particular location and the relationship is generally presented in the form of a 'damage curve'. The Draft Residential DNR damage curves (*Floodplain Management Guideline No.4 – Residential Flood Damage Calculation*, Draft, February 2004) were used to assign a 'damage value' based on the depth of flooding for each property. These curves provide a total flood damage (structure and contents) value for the depth of flooding on a residential property, including both yard and above-floor flooding. In the absence of detailed property survey data, the Technical Working Group decided that floor levels could be assumed to be 0.2m above the natural ground level for all properties.

The flooding analysis carried out for this study is of a broad scale nature and as such the flood depths for properties can not be relied on as an accurate estimate of the monetary value of damage using the damage curves. In addition, the property details available for this study are also insufficient to calculate an accurate estimate of the damage. However, damage curves do provide a basis for quantifying the impact of flooding depth and therefore were normalised on a scale of 0-100 to estimate the economic risk. The normalised curve is shown in Figure 7.1.

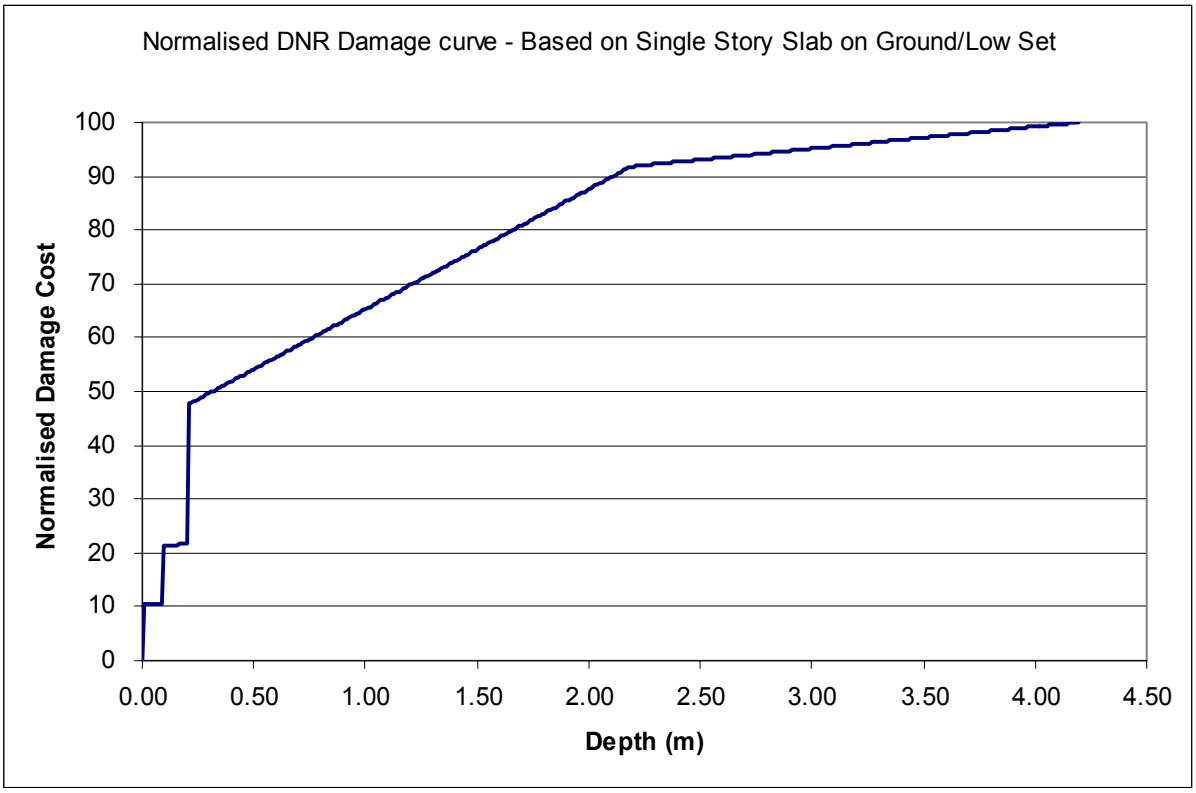

Figure 7.1: Normalised Damage Curve

The flood 'damage' for each property was estimated from the normalised damage curve in Figure 7.1. The total 'damage' for a sub-catchment was obtained by adding the 'damages' to individual properties and the risk associated with a particular design event was estimated by multiplying the probability of the design event with the total ' damages'. The total risk for the sub-catchment was calculated by adding the risk associated with each design event.

7.2 Final Ranking

All sub-catchments within the Penrith LGA have been ranked based on the Hazard and Economic Risk criteria. The 249 sub-catchments that were assessed were split into 10 percentile bands, with the 10% band representing the highest 10% of the flood affected sub-catchments. Appendix B shows the ranking based on both hazard and economic criteria. Figure 7.2 provides a schematic plan showing ranking of the sub-catchments in the LGA.

Table 7.3 provides alphabetical listing of the top 10% of flood affected sub-catchments based on the combined criteria of hazard and economic damage. The list accounts for 25 of the total 249 sub-catchments in the LGA. Table B1 in Appendix B shows the complete ranking summary table and Table B2 shows the details that were used in the ranking calculations.

Table 7.3 Top 10% Ranked Sub-Catchments - Based on Combined Criteria

Tributary	Sub-Catchment ID
Byrnes Creek - St Marys (South of Great Western Highway & north of M4)	ByrC_2
	ByrC_3
	ByrC_5
Cranebrook Creek – Castlereagh – Area surrounding the Penrith Lakes Scheme	BouC_6_5
Emu Heights – North of Old Bathurst Road	NepR_11_1_1_1
Emu Plains – South of Western Railway Line	NepR_11_12_1
	NepR_13_10_1
Little Creek – St Marys – South of the Western Railway line	SthC_16
Peach Tree Creek – Penrith (South of Western Railway & north of Jamison Rd)	PTC_1
	PTC_1_1
	PTC_1_1_1
Peach Tree Creek – Jamisontown – West of Mulgoa Road	PTC_2
Peach Tree Creek – Jamisontown – East of Mulgoa Road	PTC_2_1
Peach Tree Creek – Jamisontown – South of Jamison Road	PTC_3
Ropes Creek – St Marys – North of Christie Street	RpC_5
School House Creek – Regentville - South of Mulgoa Road	ScHC_6_1
South Creek Tributary – Cambridge Gardens – East of the Northern Road	SthC_10_5_7
South Creek Tributary - St Marys– North of Western Railway	SthC_14
South Creek – St Marys – South of the Western Railway line	SthC_18_1
South Creek – Claremont Meadows – South of Great Western Highway	SthC_20_1
Surveyors Creek – Jamisontown – East of Mulgoa Road	SurC_1a
	SurC_2
Werrington Creek – Kingswood	WC_8
	WC_8_2

7.3 Discussion

It is important to note that the pipe network has not been included in the modelling and therefore the results from Zone 1 represent a more conservative approach than the results from Zones 2 and 3 which do not have established pipe networks. Thus, there is a bias in prioritisation towards the Zone 1 catchments. A methodology is suggested below that accounts for the pipe network in the catchment prioritisation process.

It may be considered that on average the stormwater pipe network is designed to carry a 5 year ARI flow. A 5 year ARI flow represents approximately 50% of a 100 year ARI flow (Penrith Council), resulting in 50% of the flow being conveyed in pipes and 50% being conveyed overland. If pipe blockages and pit inlet losses were taken into account then the amount being conveyed overland would most likely be greater then 50% of the 100 year ARI. The 20 year ARI flows are approximately 60% of a 100 year flow (estimated in the current study), as such the 20 year ARI overland flow results may be a more realistic representation of the 100 year ARI overland flows in developed areas that have a 5 year capacity pipe network. It is therefore possible to devise another method of catchment ranking that accounts for the pipe network in the catchment. In this method, the 20 year ARI model results can be used to establish ranking criteria for catchments with pipe network and 100 year ARI results for catchments without pipe networks. Such a method would affect the Zone 1 catchment ranking, where large areas are urbanised and have existing pipe networks. Catchment ranking for Zone 2 and 3, which are mostly rural in nature, is not likely to change. This method has not been used in this report, however, if desired Council can undertake this exercise at a later stage.

8. QUALIFICATIONS

This report has been prepared for Penrith City Council to define the nature and extent of broad-scale overland flow flooding for the Penrith LGA. The report provides a robust methodology to prioritise sub-catchments in the LGA for detailed flood studies.

The modelling procedures adopted for this study follow current standard practice and considerable care has been applied to the preparation of the results. However, model set-up depends on the quality of data available and there will always be some uncertainties. The flow regime and the flow control structures are very complicated and can only be represented by schematised model layouts.

Hence, there will be an unknown level of uncertainty in the results and this should be borne in mind in their application.

The results of the study are based on the following assumptions/conditions:

- Stormwater pit and pipe network were not included in modelling. The modelling results are likely to be conservative.
- The flood extents, flood levels, discharge and velocity data generated as part of this study are approximate and should not be used to estimate localised flood behaviour in the floodplain. The data, however, provides a useful guideline to the likely flood behaviour in the Penrith LGA.
- The adopted modelling approach whereby design rainfall is applied directly on to the 2D model grid results in overland flow routing that is inherently different to hydrological modelling approaches. The discharge data provided in this report is therefore likely to be different to what may be obtained using hydrological models. However, the approach used in this report is suitable for a broad-scale overland flow study.
- The overland flow PMF levels within the mainstream Nepean River and South Creek PMF extents may be underestimated as mainstream flooding PMF level could be higher than the level achieved from overland flooding.
- Since only a limited number of bridges and culverts are included in the modelling, the resulting flood behaviour may vary significantly if detailed flood modelling were to be undertaken.
- Following the issuing of the final draft report it was discovered that some culverts under the M4 in the vicinity of Ropes Creek and under the railway line in the vicinity of Werrington Creek were not included in the modelling. Also the culverts under Bluehills Drive road in Glenmore Park were modelled as three culverts instead of five. Therefore, the flood extents shown in the vicinity of these structures should be interpreted with caution.
- Major works such as the Londonderry Road upgrade and the Wilshire Road upgrade, that were carried out after the ALS survey and aerial photographs, have not been included in this study.
- The study results should only be used as per the objectives of this study.

9. ACKNOWLEDGEMENTS

The assistance of the Penrith City Council, the Department of Natural Resources and the State Emergency Service is gratefully acknowledged.

This study was funded under the State Government's Floodplain Management Program through the Department of Natural Resources.

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APPENDIX A

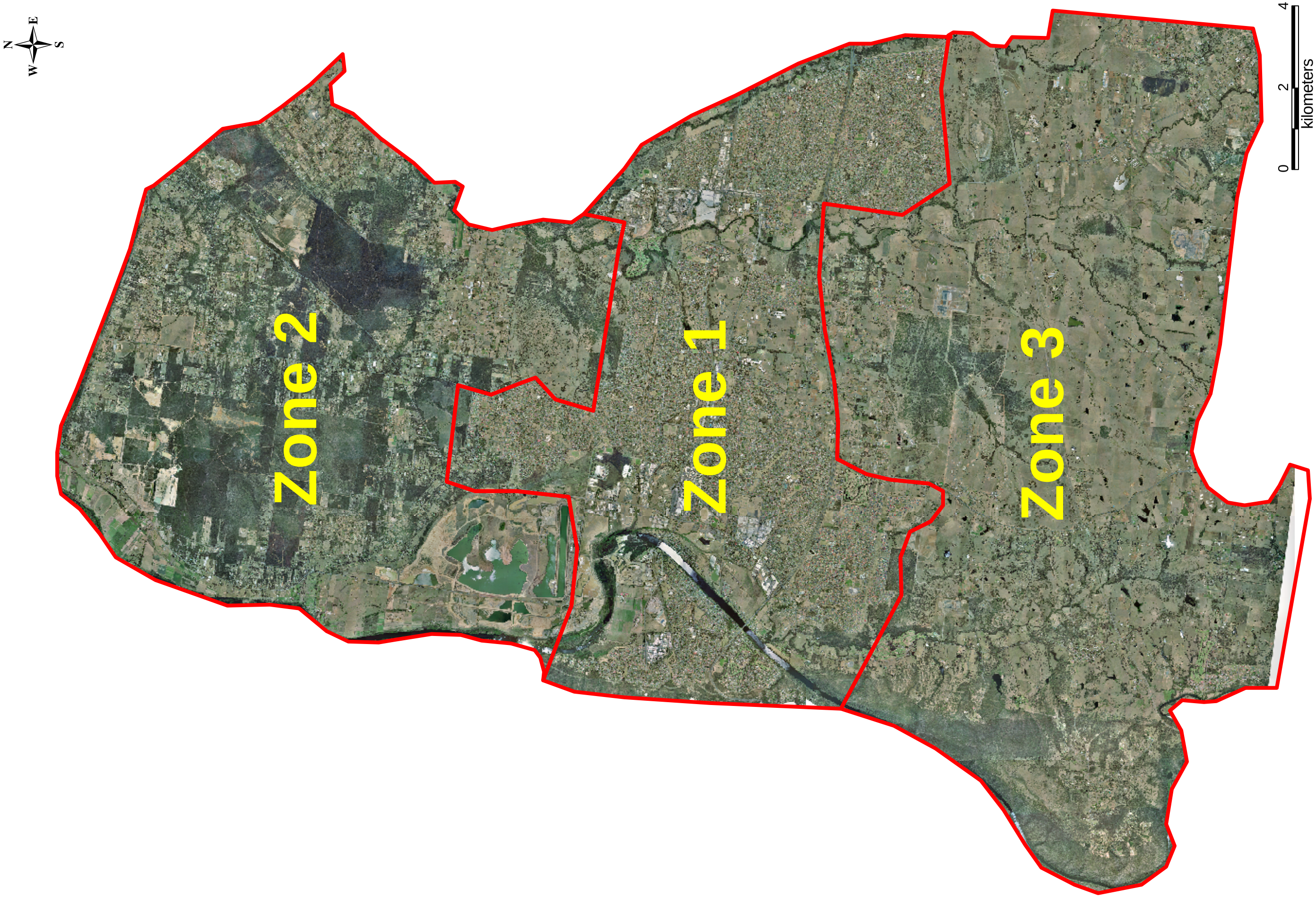
Surveyed Culvert Photographs with Approximate Dimensions

Note

Every attempt was made to locate all the major culverts within the Penrith LGA. However, it must not be assumed that the culverts shown here are all the culverts in the LGA. If further flood studies are carried out then accurately located and surveyed culverts will need to be acquired.

APPENDIX B:

Sub-catchment Ranking

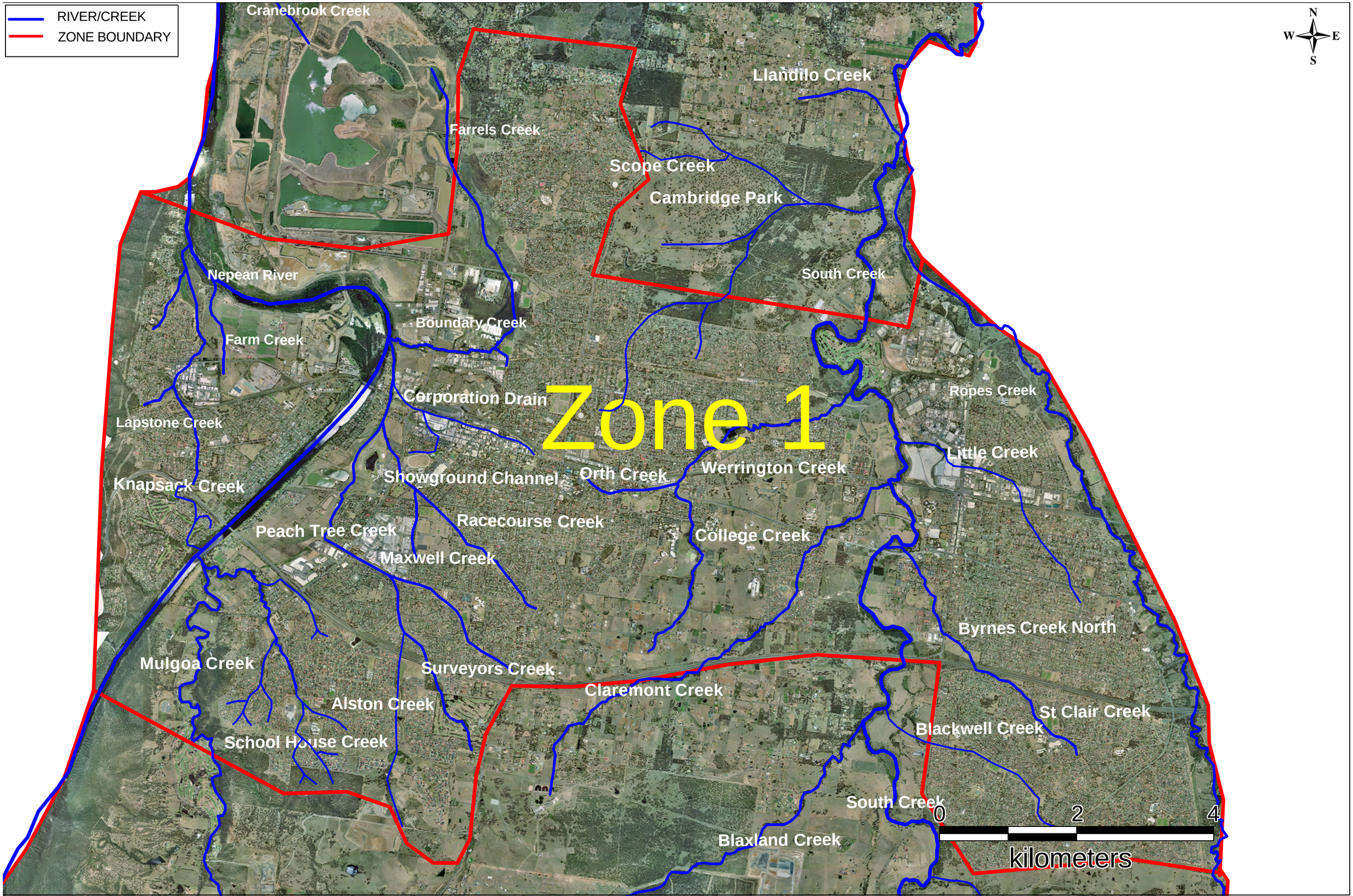


Cardno Lawson Treloar

J2453/R2251/V4
August 2006

Penrith Overland Flow Study

FIGURE 1.1
STUDY AREA WITH ZONE BOUNDARIES
J2453\Figures\Figures-V4\Figure 1.1 - Study Area with Zone Boundaries-V4.Wor



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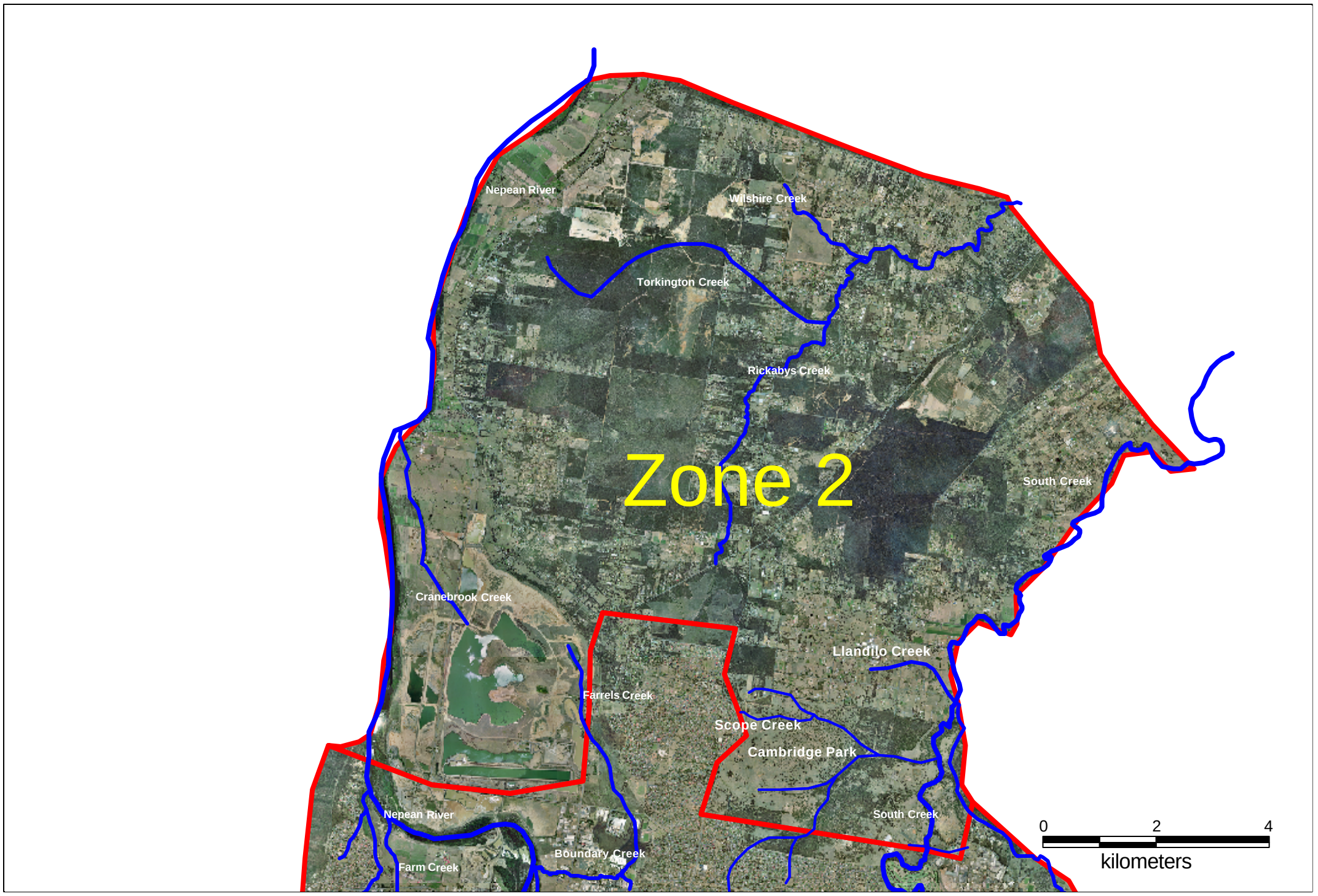
Penrith Overland Flow Study

FIGURE 1.2.A
LOCATION OF MAJOR RIVERS/CREEKS: ZONE 1
J2453 - Penrith Overland Flow Study\Figures\first and second order creeks A.WOR


Nepean River
Wilshire Creek
Torkington Creek
Rickabys Creek
Zone 2
South Creek
Cranebrook Creek
Llandilo Creek
Farrels Creek
Scope Creek
Cambridge Park
Nepean River
South Creek
Boundary Creek
Farm Creek
0
2
4
kilometers

RIVER/CREEK
ZONE BOUNDARY

N
W E
S

Knapsack Creek
Showground Channel
Orth Creek
Werrington Creek
Little Creek
Peach Tree Creek
Racecourse Creek
College Creek
Maxwell Creek
Byrnes Creek North
Mulgoa Creek
Surveyors Creek
Claremont Creek
Alston Creek
St Clair Creek
School House Creek
Blackwell Creek
South Creek
Blaxland Creek
Blind Kemps Creek
Nepean River
Littlefields Creek
Zone 3
Ropes Creek
Jerrys Creek
Cosgrove Creek
Badgerys Creek
Kemps Creek
South Creek

0 2 4
kilometers

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August 2006

Penrith Overland Flow Study

FIGURE 1.2.C
LOCATION OF MAJOR RIVERS/CREEKS: ZONE 3
J2453 - Penrith Overland Flow Study\Figures\first and second order creeks C.WOR

BRIDGE AND OR CULVERT LOCATION

411 REFERENCE NUMBER: CLT 411

ZONE BOUNDARY

M4 MOTORWAY MAJOR ROADS

N W E S

Zone 1

CASTLEREAGH ROAD

CRANEBROOK ROAD

THE NORTHERN ROAD

JAMISON ROAD

GREAT WESTERN HIGHWAY

MULGOA ROAD

M4 MOTORWAY

MOORE ROAD

LODDEN HAM ROAD

0 2 4

kilometres

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J2453/R2251/V4
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FIGURE 3.1A
LOCATION OF BRIDGES AND CULVERTS : ZONE 1
J2453\Figures\Figure-V4\Figure 3.1A - Location of Bridges & Culverts Zone 1-V4.WOR

BRIDGE AND OR CULVERT LOCATION

411 REFERENCE NUMBER: CLT 411

ZONE BOUNDARY

M4 MOTORWAY MAJOR ROADS

N W E S

Zone 2

600 601 602 603 546 32 607 608 609 58 65 31 610 194 63 60 191 195 190 196 431 430 605 57 411 412 49 641 33 35 34 548 547 545 421 546 187 550 542 544 551 538 172 38 171 433 432 452

CASTLEREAGH ROAD
THE DRIFTWAY
CARRINGTON ROAD
LONDONDERRY ROAD
SCHWOND ROAD
THE NORTHERN ROAD
LANDILO ROAD
CRANEBROOK ROAD
EAGH ROAD

0 2 4
kilometres

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FIGURE 3.1B
LOCATION OF BRIDGES AND CULVERTS : ZONE 2
J2453\Figures\Figure-V4\Figure 3.1B - Location of Bridges & Culverts Zone 2-V4.WOR

BRIDGE AND OR CULVERT LOCATION

411 REFERENCE NUMBER: CLT 411

ZONE BOUNDARY

M4 MOTORWAY MAJOR ROADS

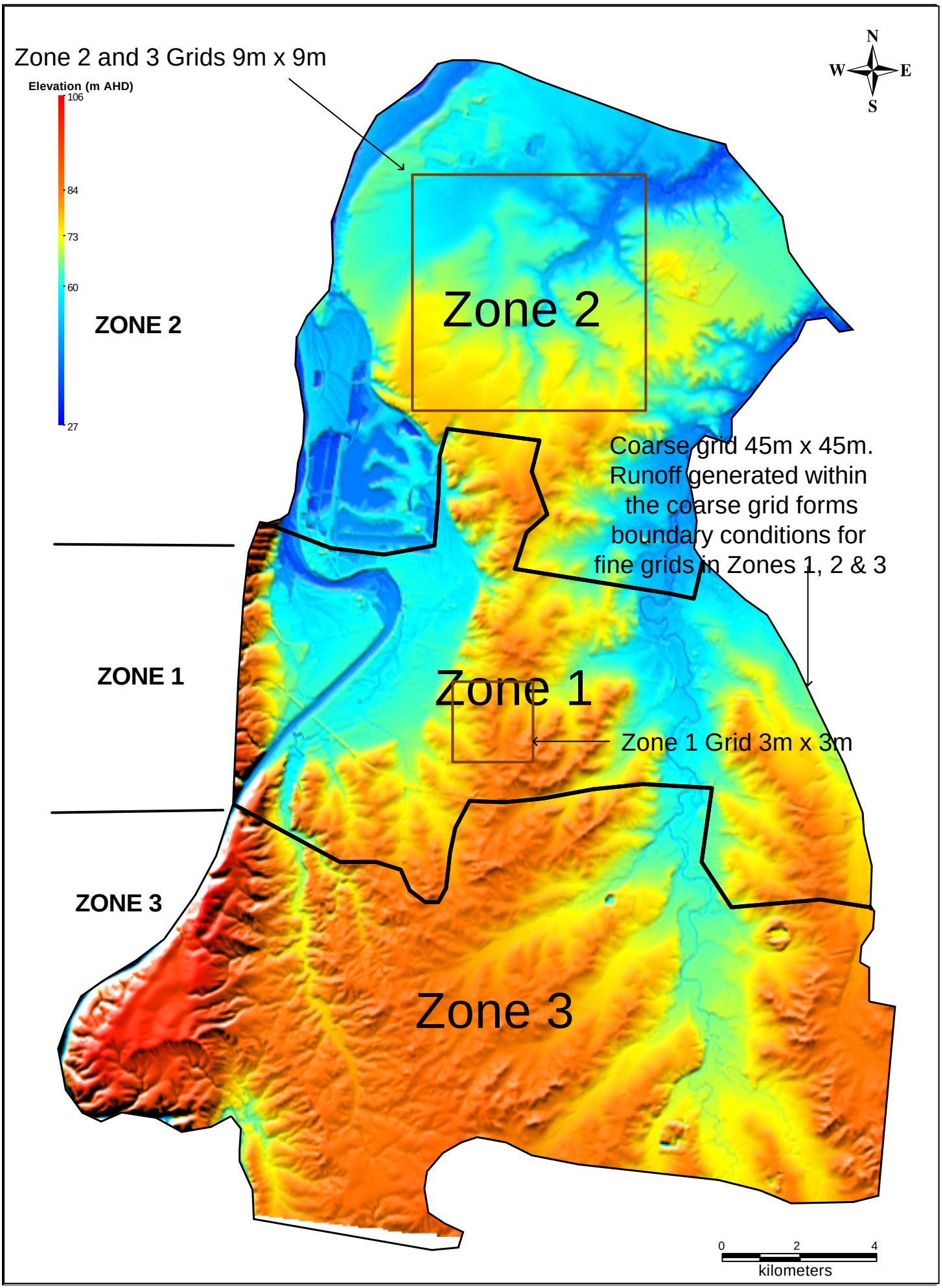
Zone 3

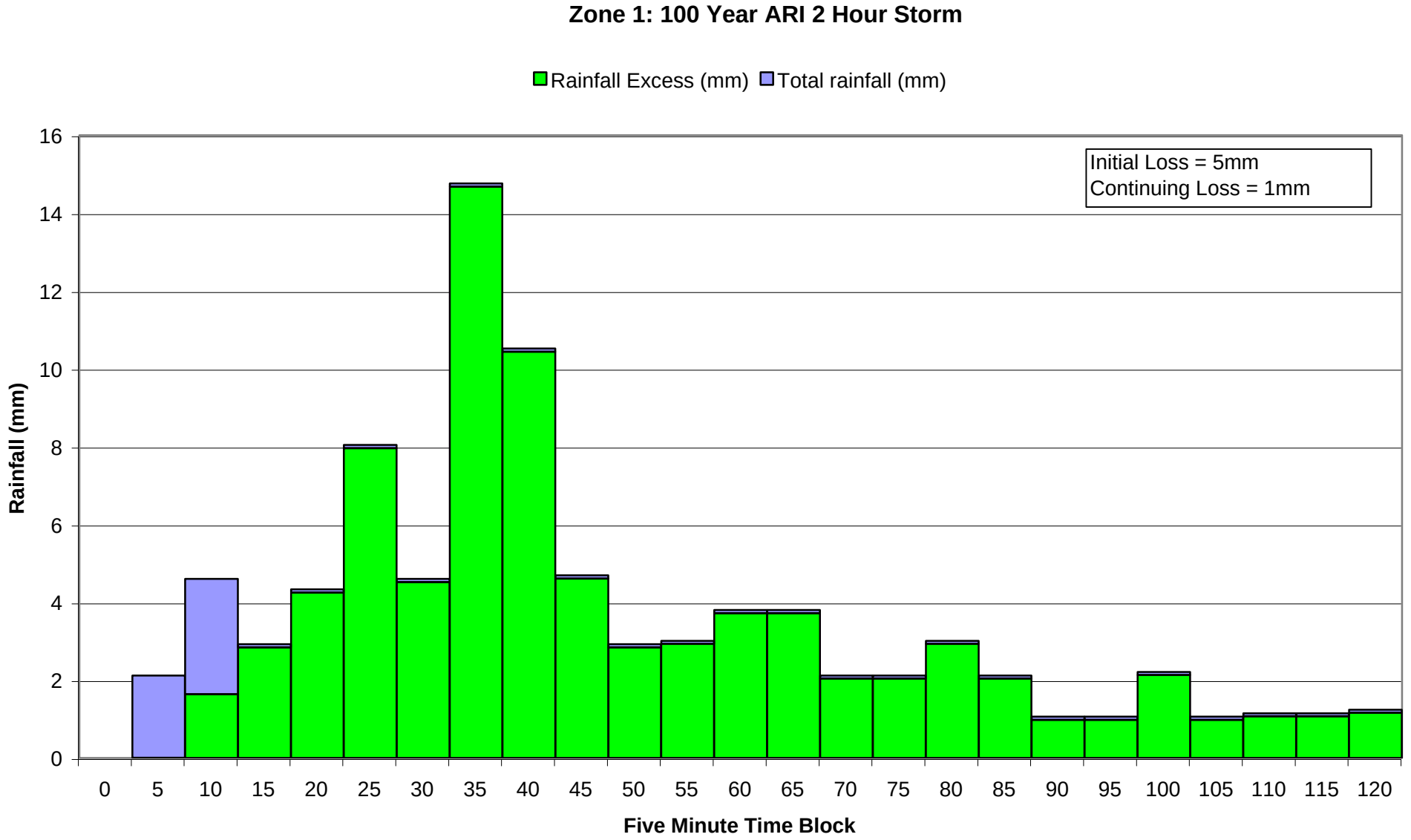
N W E S

0 2 4

kilometres

FIGURE 3.1C
LOCATION OF BRIDGES AND CULVERTS : ZONE 3
J2453\Figures\Figure-V4\Figure 3.1C - Location of Bridges & Culverts Zone 3-V4.WOR


Zone 2 and 3 Grids 9m x 9m
Elevation (m AHD)
106
84
73
60
27
N
W
E
S
ZONE 2
Zone 2
Coarse grid 45m x 45m. Runoff generated within the coarse grid forms boundary conditions for fine grids in Zones 1, 2 & 3
ZONE 1
Zone 1
Zone 1 Grid 3m x 3m
ZONE 3
Zone 3
0
2
4
kilometers


Zone 1: 100 Year ARI 2 Hour Storm
Rainfall Excess (mm)
Total rainfall (mm)
Initial Loss = 5mm
Continuing Loss = 1mm
Rainfall (mm)
0
2
4
6
8
10
12
14
16
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120
Five Minute Time Block

N
W E
S

ZONE 2
[9m x 9m grid]

Zone 2

Z2a Z2b Z2c Z2d Z2e

A3 A4 A5

B1 B3 B4 B5

C1 C2 C3 C4 C5 C6 C7

D1 D2 D3 D4 D5 D6 D7 D8

ZONE 1
[3m x 3m grid]

Zone 1

E1 E2 E3 E4 E5 E6 E7 E8

F1 F2 F3 F4 F5 F6 F7 F8 F9

Z3b2 G2 G3 Z3c2 G7 G8 G9

ZONE 3
[9m x 9m grid]

Z3a

Z3b

Zone 3

Z3c Z3d

Z3e Z3f

Legend
- 3m x 3m grid
- 9m x 9m grid
- Zone boundary

0 2.5 5
kilometres

FIGURE 5.3
LAYOUT OF MODEL GRIDS FOR ZONE 1, 2 AND 3

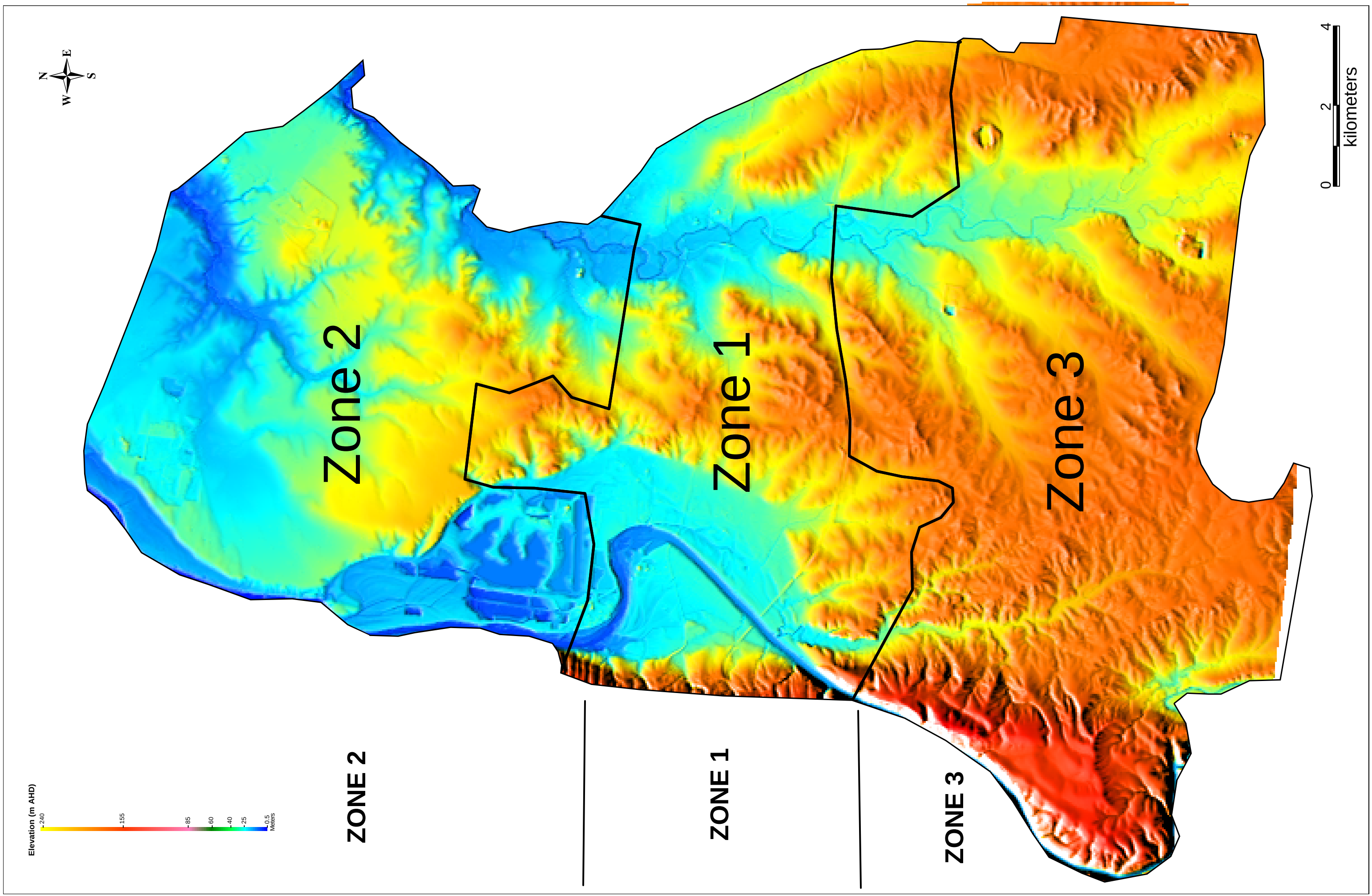


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FIGURE 5.4
45m GRID TOPOGRAPHY
J2453\Figures\Figures-V4\Figure 5.4 - 45 Grid Topography-V4.Wor

ROUGHNESS LEGEND

- Residential/Urban Areas (n = 0.1)
- Roads (n = 0.015)
- Grass (n = 0.03)
- Open Bushlands/Shrubs (n = 0.05)
- Forest/Bushland (n = 0.1)
- Waterways (n = 0.03)

N
W E
S

ZONE 1

ZONE 3

Zone 1

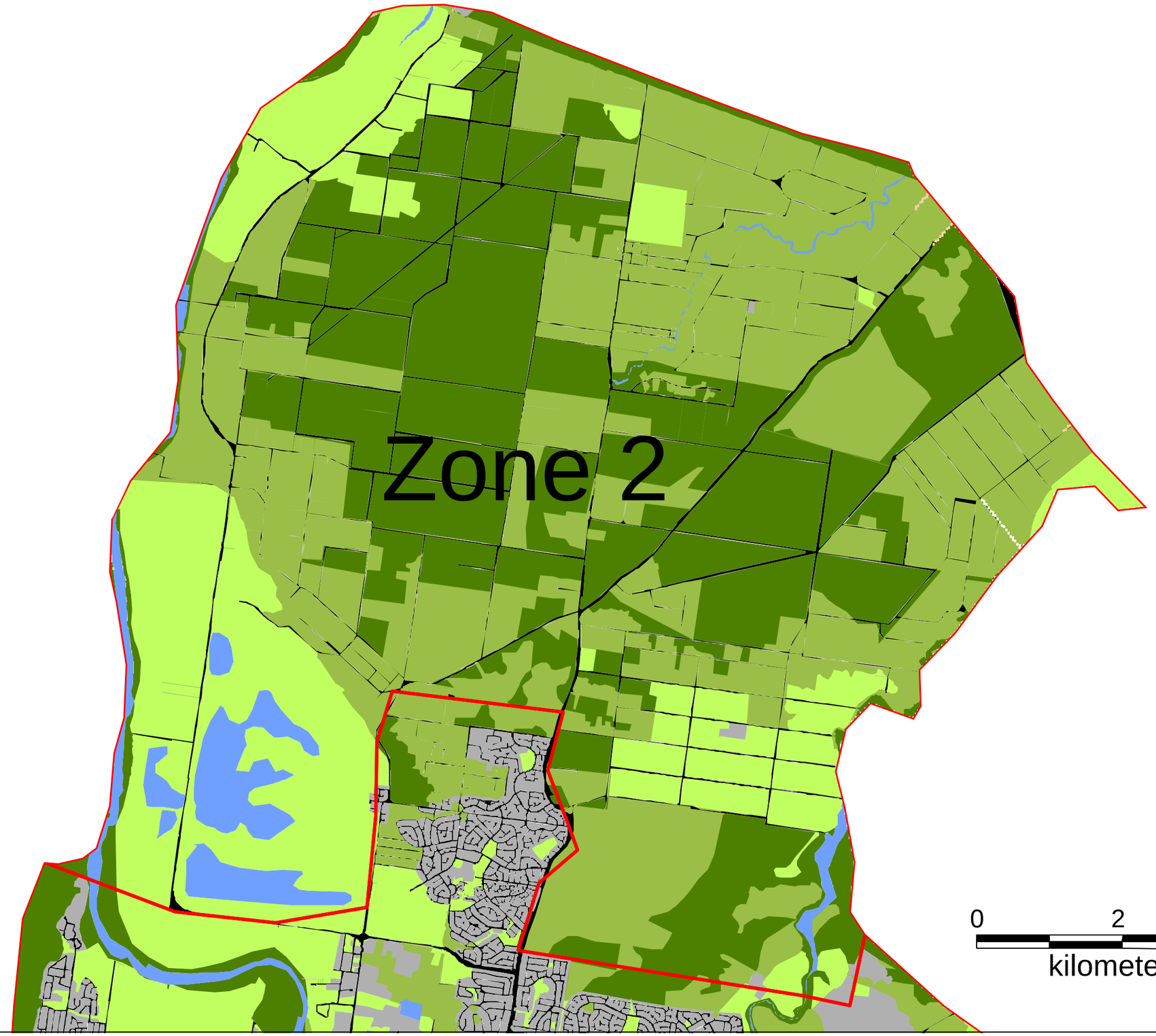
0 2 4
kilometers

FIGURE 5.5A
ROUGHNESS MAP : ZONE 1
J2453\Figures\Figures-V4\Figure 5.5A Roughness Map Zone 1-V4.Wor

ROUGHNESS LEGEND

- Residential/Urban Areas (n = 0.1)
- Roads (n = 0.015)
- Grass (n = 0.03)
- Open Bushlands/Shrubs (n= 0.05)
- Forest/Bushland (n = 0.1)
- Waterways (n = 0.03)

N
W E
S



ZONE 2

0 2 4
kilometers

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FIGURE 5.5B
ROUGHNESS MAP : ZONE 2
J2453\Figures\Figures-V4\Figure 5.5B Roughness Map: Zone 2-V4.Wor

ROUGHNESS LEGEND

- Residential/Urban Areas (n = 0.1)
- Roads (n = 0.015)
- Grass (n = 0.03)
- Open Bushlands/Shrubs (n = 0.05)
- Forest/Bushland (n = 0.1)
- Waterways (n = 0.03)

Zone 1

Zone 3

ZONE 3

N
W E
S

0 2 4
kilometers

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August 2006

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FIGURE 5.5C
ROUGHNESS MAP : ZONE 3
J2453\Figures\Figures-V4\Figure 5.5C Roughness Map: Zone 3-V4.Wor

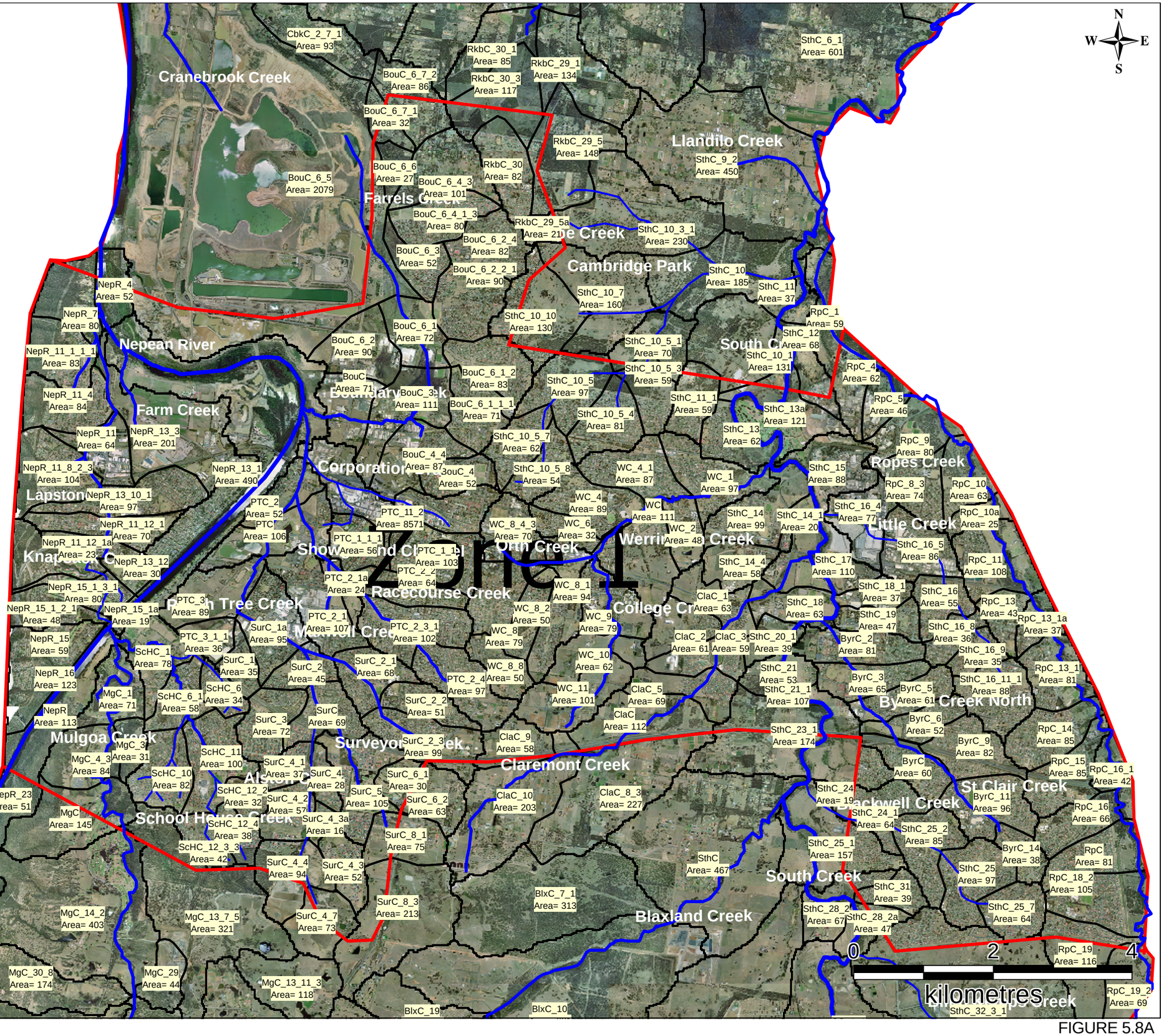
Zone Boundary

Sub-Catchment Boundary
Areas are in hectares

Major Tributaries

For All Zones		Tributary Abbreviation
Badgerys Creek	=	BadC_1
Blaxland Creek	=	BlxC_1
Boundary Creek	=	BouC_1
Byrnes Creek	=	ByrC_1
Claremont Creek	=	ClaC_1
Cosgroves Creek	=	CC_1
Cranebrook Creek	=	CbkC_1
Jerrys Creek	=	JryC_1
Kemps Creek	=	KC_1
Littlefields Creek	=	LfC_1
Mulgoa Creek	=	MgC_1
Nepean River	=	NepR_1
Oaky Creek	=	Oaky Creek
Peach Tree Creek	=	PTC_1
Ropes Creek	=	RpC_1
School House Creek	=	ScHC_1
South Creek	=	SthC_1
Surveyors Creek	=	SurC_1
Werrington Creek	=	WC_1

Note: For further subcatchment name clarification see table 5.5



Zone Boundary

Sub-Catchment Boundary
Areas are in hectares

Major Tributaries

For All Zones		Tributary Abbreviation
Badgerys Creek	=	BadC_1
Blaxland Creek	=	BlxC_1
Boundary Creek	=	BouC_1
Byrnes Creek	=	ByrC_1
Claremont Creek	=	ClaC_1
Cosgroves Creek	=	CC_1
Cranebrook Creek	=	CbkC_1
Jerrys Creek	=	JryC_1
Kemps Creek	=	KC_1
Littlefields Creek	=	LfC_1
Mulgoa Creek	=	MgC_1
Nepean River	=	NepR_1
Oaky Creek	=	Oaky Creek
Peach Tree Creek	=	PTC_1
Ropes Creek	=	RpC_1
School House Creek	=	ScHC_1
South Creek	=	SthC_1
Surveyors Creek	=	SurC_1
Werrington Creek	=	WC_1

Note: For further subcatchment name clarification, see table 5.5

N
W E
S

Zone 2

Nepean River
Wilshire Creek
Torkington Creek
Rickabys Creek
South Creek
Cranebrook Creek
Llandilo Creek
Farrels Creek
Cambridge Park
Nepean River
Farm Creek

RkbC_12_1_2 Area= 694
RkbC_17_9_5_1 Area= 279
NepR_1_1_1_1 Area= 652
RkbC_17 Area= 360
RkbC_9_3 Area= 122
RkbC_1 Area= 214
RkbC_5 Area= 81
RkbC_8 Area= 148
RkbC_17_6 Area= 613
RkbC_13 Area= 128
RkbC_7_1 Area= 100
RkbC_4 Area= 75
RkbC_17_10_2_3_1 Area= 716
RkbC_5_2 Area= 93
SthC_1_3_7_2_3_2_3 Area= 180
RkbC Area= 347
SthC_1_5 Area= 454
RkbC_17_10_3 Area= 866
SthC_1_3_7_7 Area= 505
RkbC_24 Area= 88
CbkC_2_6 Area= 72
RkbC_26 Area= 134
RkbC_23_6_1_1 Area= 531
SthC_1_1 Area= 531
RkbC_17_10_10_1 Area= 217
CbkC_2_7_1 Area= 93
SthC_6_1 Area= 601
RkbC_30_1 Area= 85
RkbC_29_1 Area= 134
BouC_6_7_2 Area= 86
RkbC_30_3 Area= 117
BouC_6_7_1 Area= 32
RkbC_29_5 Area= 148
SthC_9_2 Area= 450
BouC_6_6 Area= 27
RkbC_30 Area= 82
BouC_6_5 Area= 2079
BouC_6_4_3 Area= 101
BouC_6_4_1_3 Area= 80
RkbC_29_5a Area= 21
SthC_10_3_1 Area= 230
BouC_6_2_4 Area= 82
BouC_6_3 Area= 52
BouC_6_2_2_1 Area= 90
SthC_10 Area= 185
SthC_11 Area= 37
NepR_4 Area= 52
SthC_10_7 Area= 160
NepR_7 Area= 80
SthC_10_10 Area= 130
RpC_1 Area= 59
BouC_6_1 Area= 72
SthC_12 Area= 68
BouC_6_2 Area= 90
SthC_10_5_1 Area= 70
SthC_10_1 Area= 131
NepR_11_1_1_1 Area= 83
SthC_10_5_3 Area= 59
RpC_4 Area= 62
BouC_6_1_2 Area= 83
BouC Area= 71
BouC_3 Area= 111
SthC_11_1 Area= 59
RpC_5 Area= 46
NepR_11_4 Area= 84
BouC_6_1_1_1 Area= 71
SthC_10_5 Area= 970_5_4
SthC_13a Area= 121

0 2 4
kilometres

Zone Boundary

Sub-Catchment Boundary
Areas are in hectares

Major Tributaries

For All Zones		Tributary Abbreviation
Badgerys Creek	=	BadC_1
Blaxland Creek	=	BlxC_1
Boundary Creek	=	BouC_1
Byrnes Creek	=	ByrC_1
Claremont Creek	=	ClaC_1
Cosgroves Creek	=	CC_1
Cranebrook Creek	=	CbkC_1
Jerrys Creek	=	JryC_1
Kemps Creek	=	KC_1
Littlefields Creek	=	LfC_1
Mulgoa Creek	=	MgC_1
Nepean River	=	NepR_1
Oaky Creek	=	Oaky Creek
Peach Tree Creek	=	PTC_1
Ropes Creek	=	RpC_1
School House Creek	=	ScHC_1
South Creek	=	SthC_1
Surveyors Creek	=	SurC_1
Werrington Creek	=	WC_1

Note: for further subcatchment name clarification, see table 5.5

Zone 1

Zone 3

Nepean River

Littlefields Creek

Jerrys Creek

Cosgrove Creek

Badgerys Creek

South Creek

Kemps Creek

Ropes Creek

Blaxland Creek

Claremont Creek

Byrnes Creek North

St Clair Creek

Blind Kemps Creek

College Creek

Werrington Creek

Surveyors Creek

School House Creek

Mulgoa Creek

Peach Tree Creek

Knapsack Creek

N
W E
S

0 2 4
kilometres

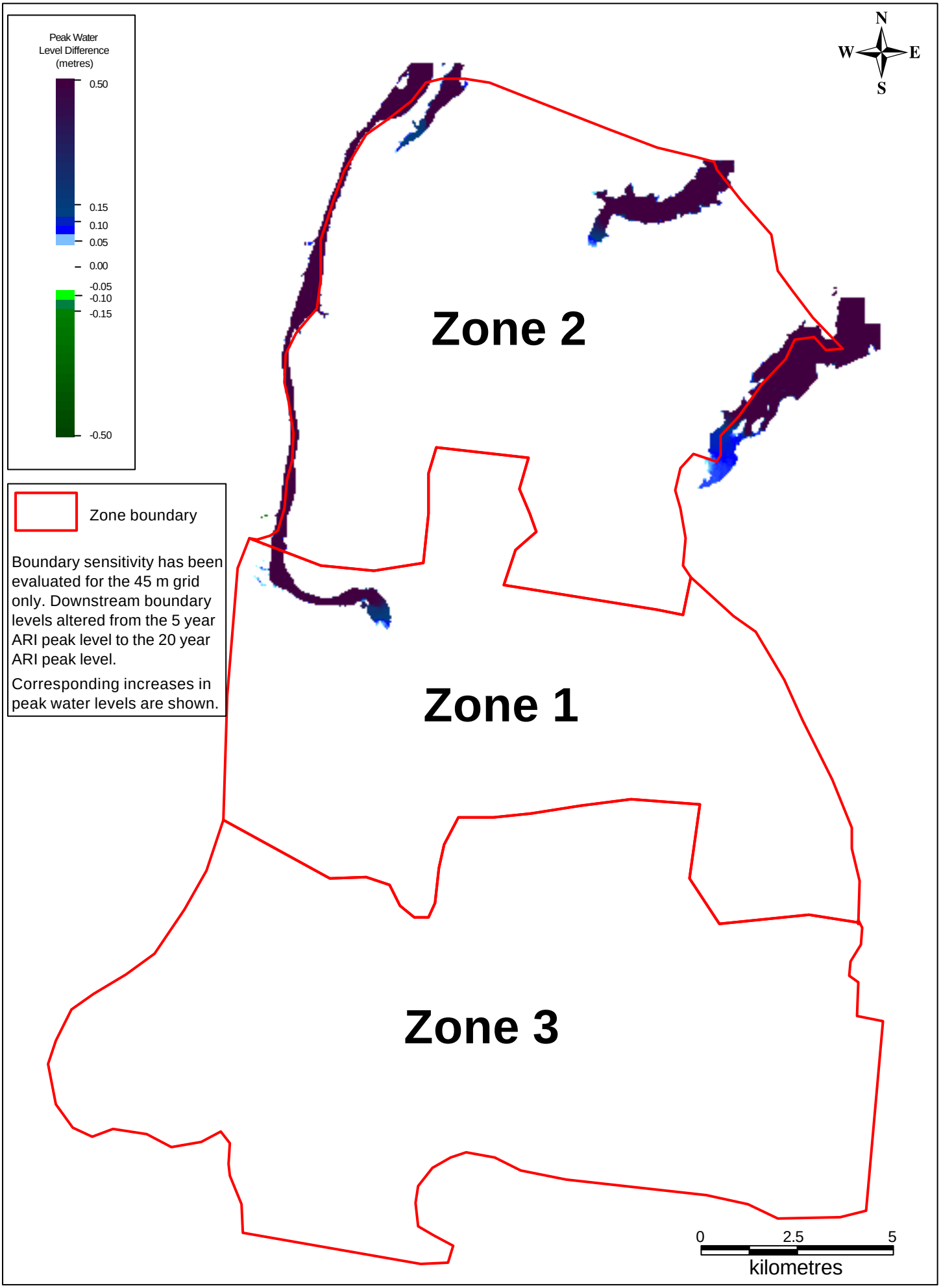


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FIGURE 5.9

SENSITIVITY RESULTS - DOWNSTREAM BOUNDARY

J2453/R2251/V4

August 2006

J:\WR\J2453 - Penrith Overland Flow Study\Figures\Figures-V4\Figure 5.9 Sensitivity Results - Downstream Boundary-V4.Wor

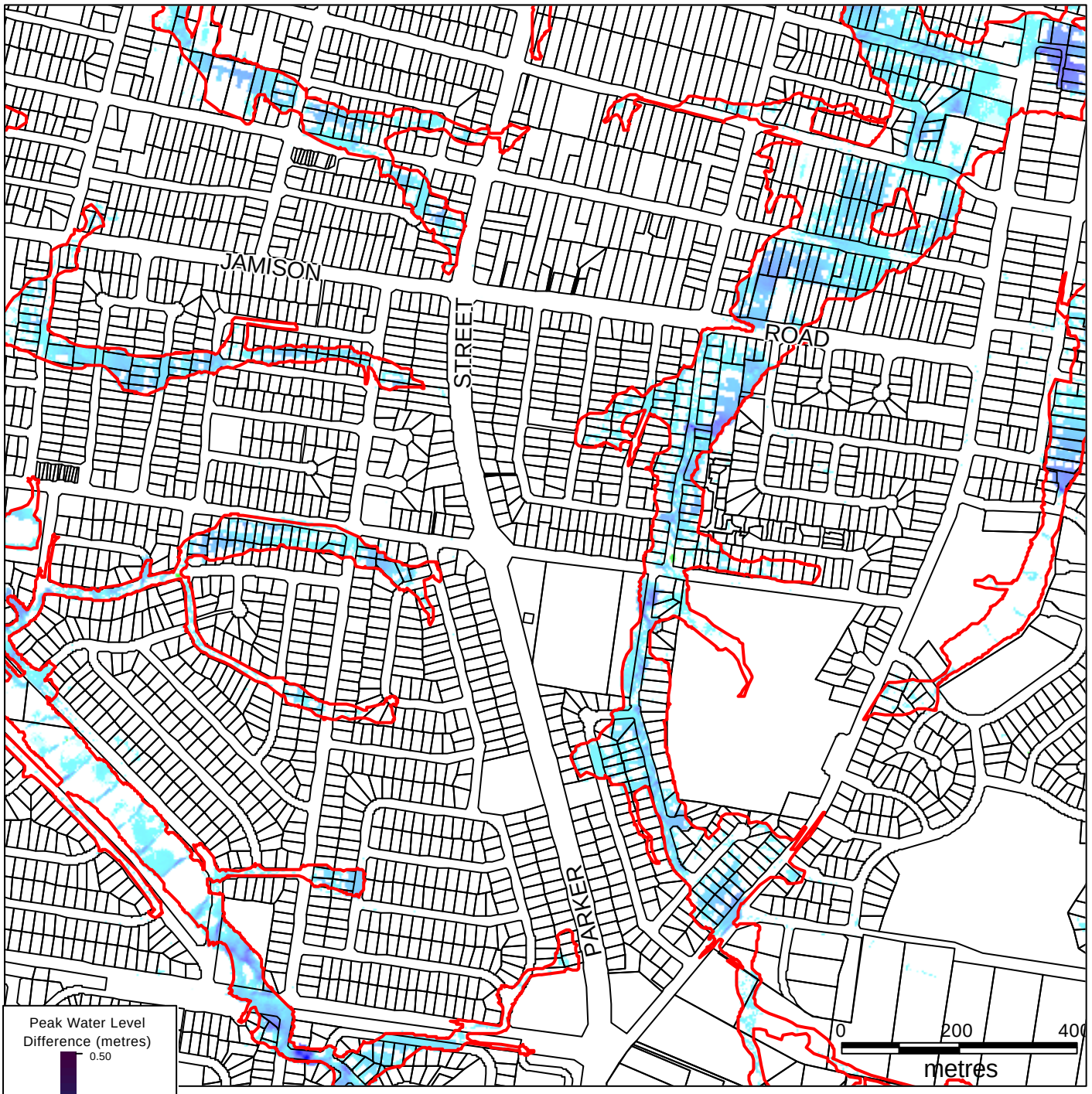

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FIGURE 5.10

ZONE 1 SENSITIVITY RESULTS - ROUGHNESS UP 20%

J2453/R2251/V4

August 2006

J:\WR\J2453 - Penrith Overland Flow Study\Figures\Figures-V4\Figure 5.10-Sensitivity Results-Roughness up 20% Zone1-V4.WOR

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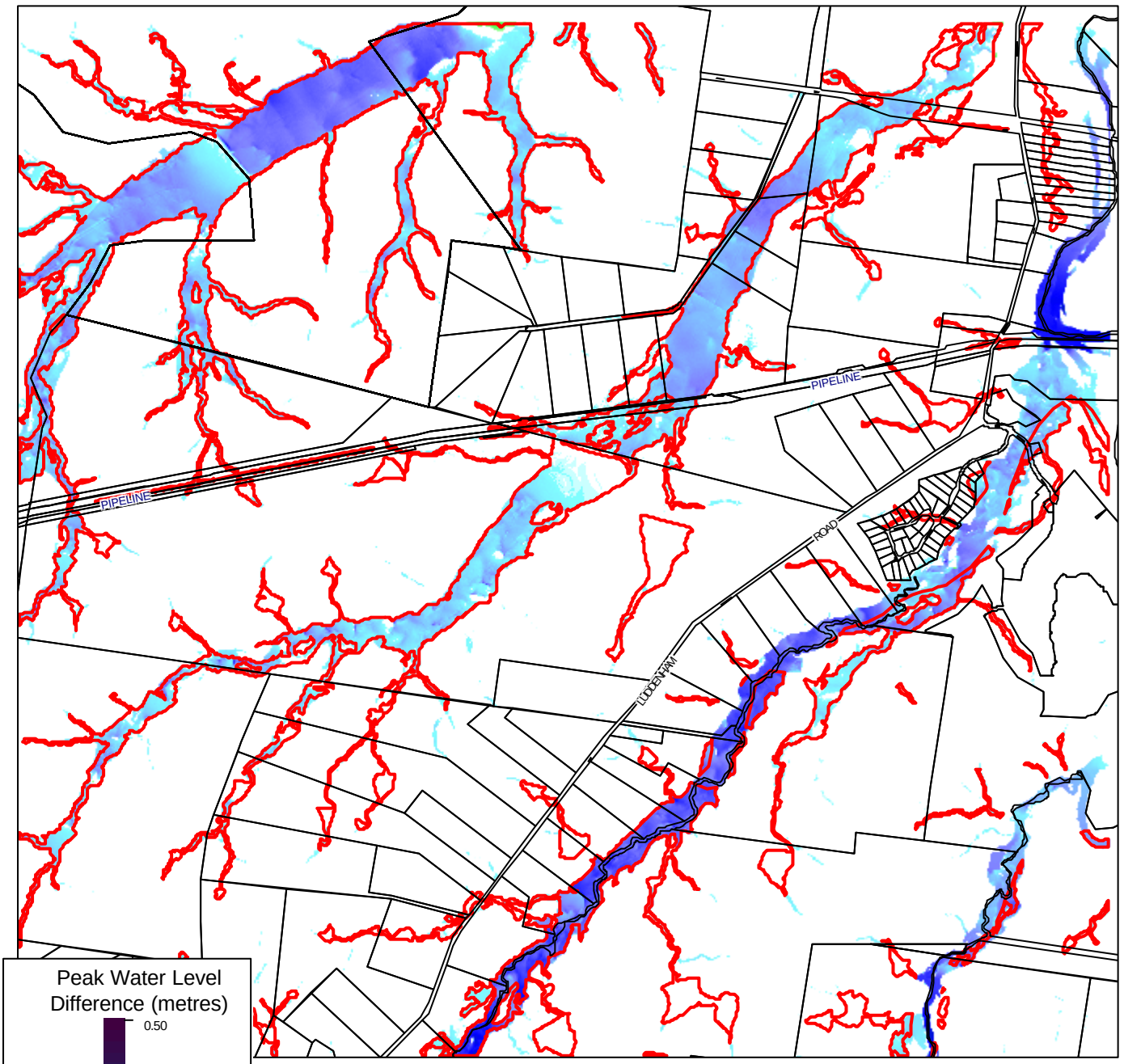
FIGURE 5.11

ZONE 1 SENSITIVITY RESULTS - ROUGHNESS DOWN 20%

J2453/R2251/V4

August 2006

J:\WR\J2453 - Penrith Overland Flow Study\Figures\Figures-V4\Figure 5.11-Sensitivity Results-Roughness down 20% Zone1-V4.WOR



Peak Water Level Difference (metres)

0.50
0.15
0.10
0.05
0.01
-0.01
-0.05
-0.10
-0.15
-0.50

LEGEND

100yr 2hr flood extent

Sensitivity results have been run for one grid only.

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Penrith Overland Flow Study

FIGURE 5.12

ZONE 2 SENSITIVITY RESULTS - ROUGHNESS UP 20%

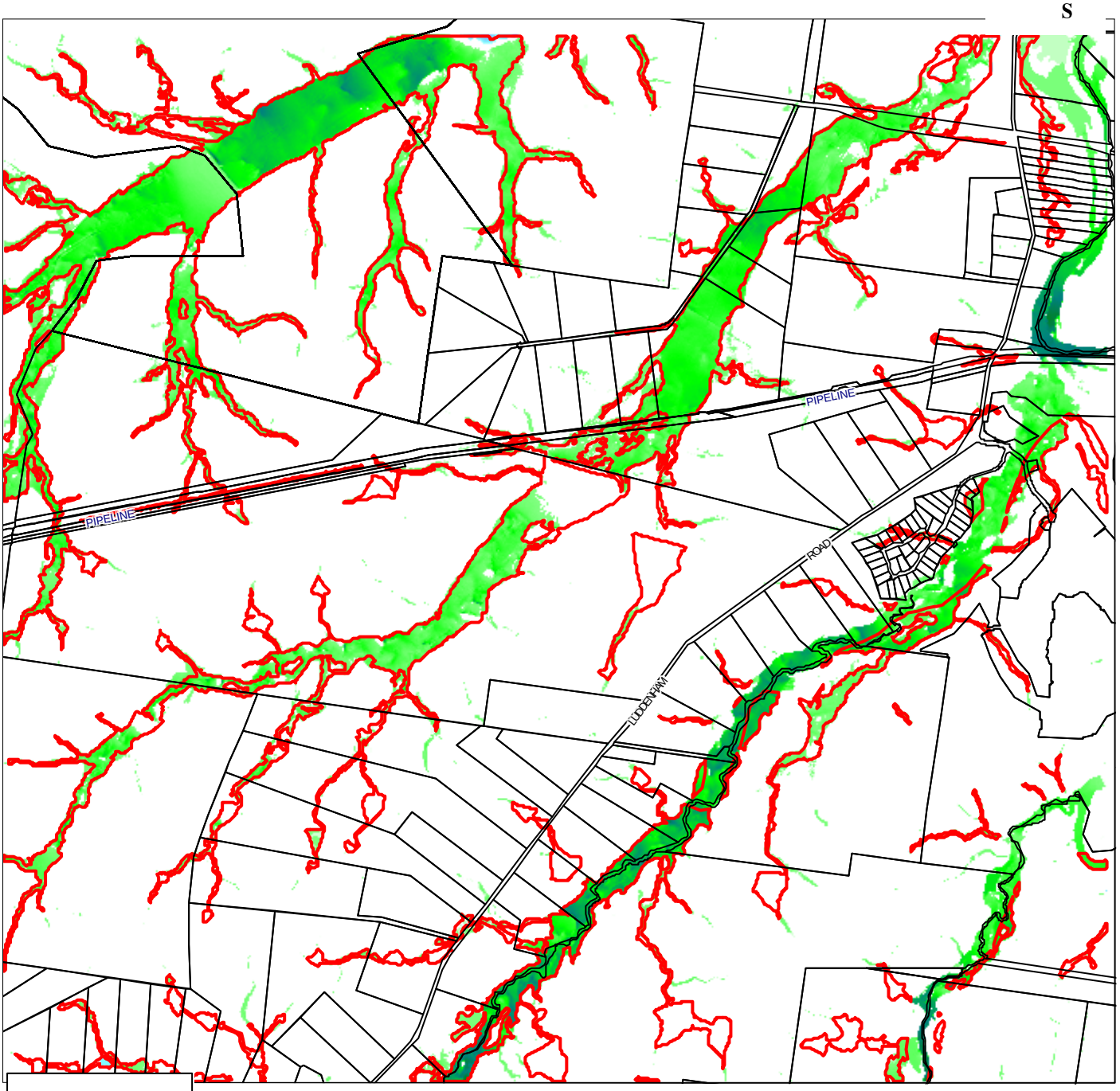

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FIGURE 5.13

ZONE 2 SENSITIVITY RESULTS - ROUGHNESS DOWN 20%

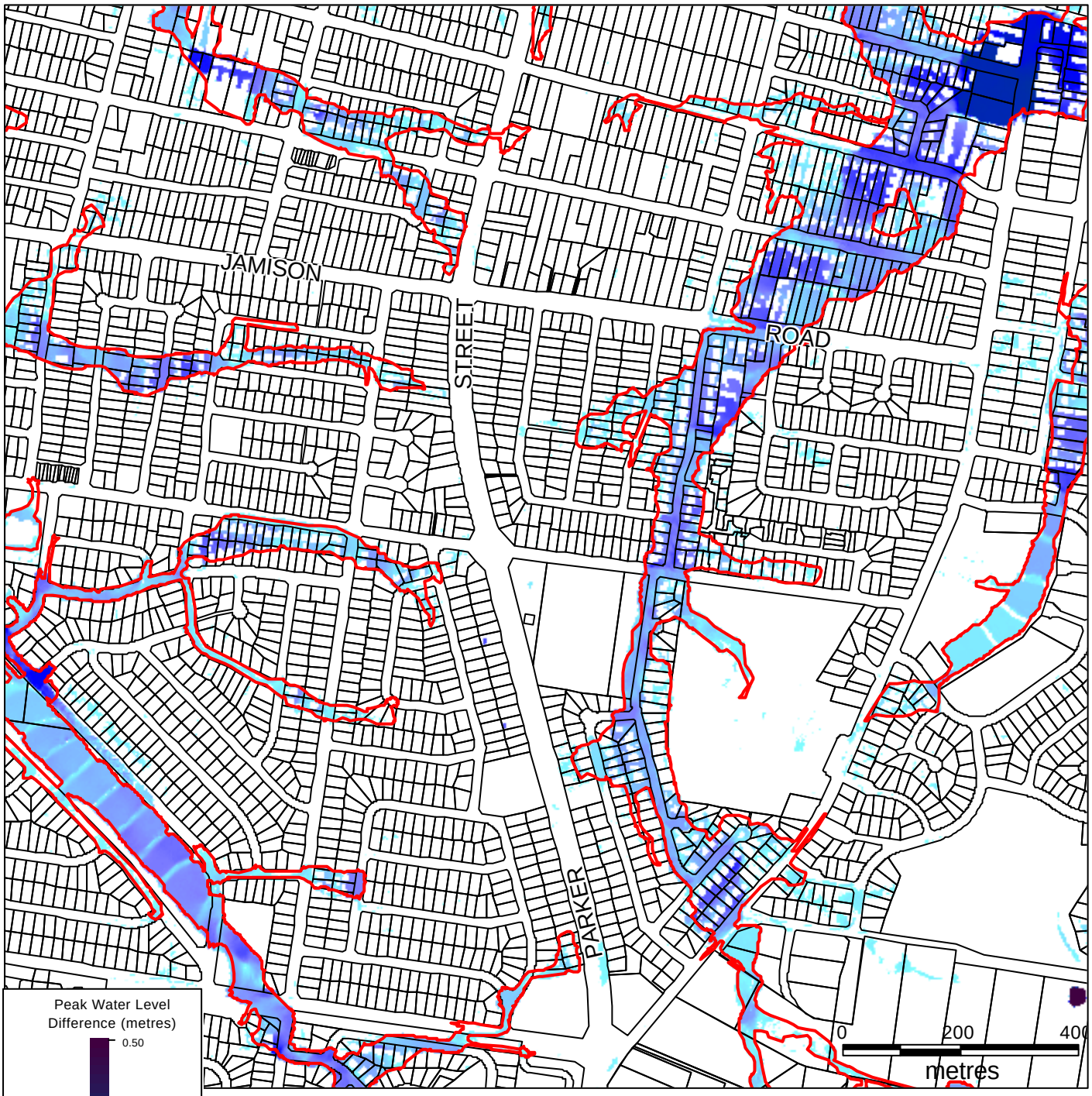

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FIGURE 5.14
ZONE 1 SENSITIVITY RESULTS - FLOW UP 20%

J2453\R2251\V4
August 2006

J:\WR\J2453 - Penrith Overland Flow Study\Figures\Figures-V4\Figure 5.14-Sensitivity Results-Flow up 20%-V4.WOR

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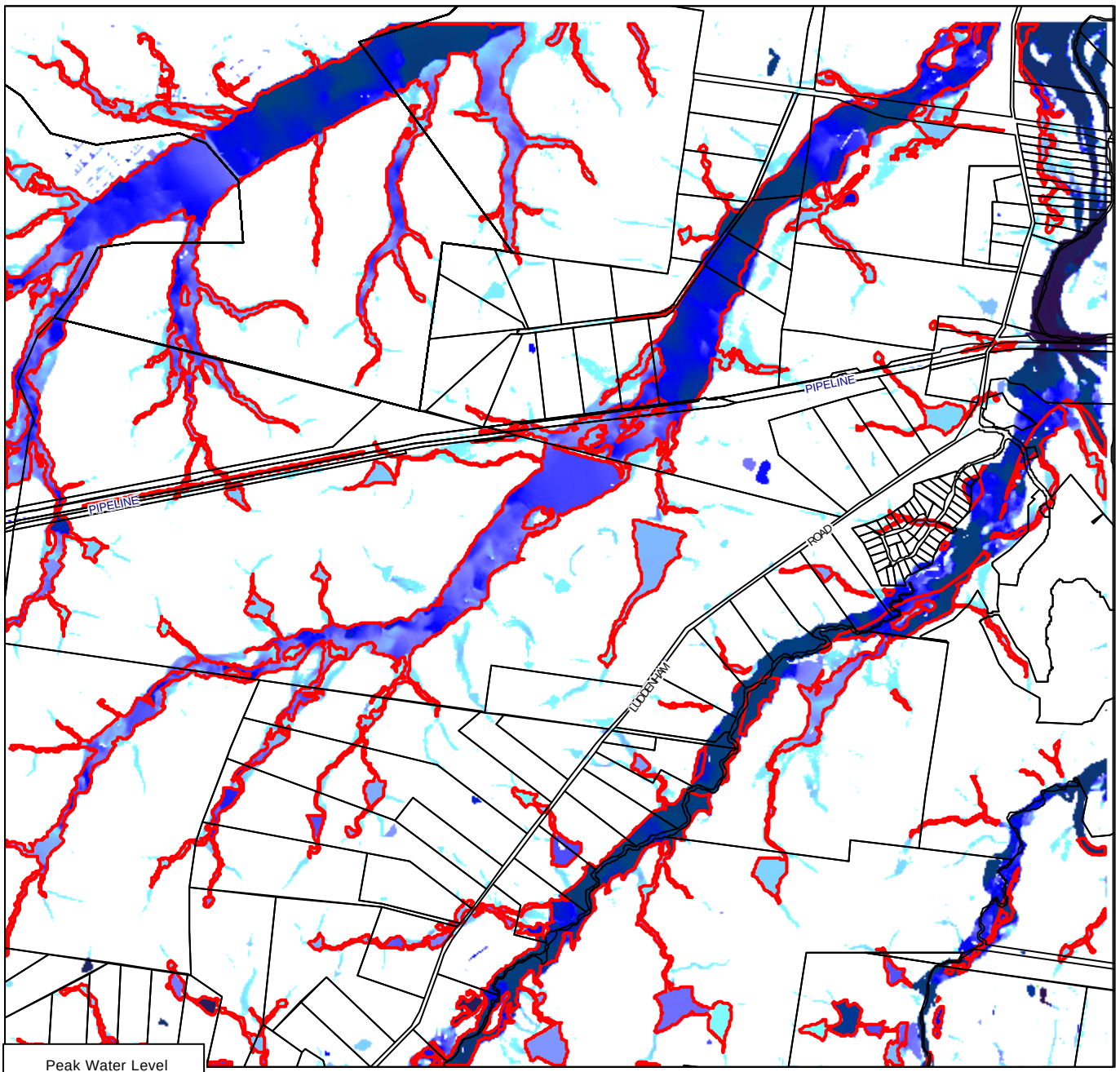
FIGURE 5.15

ZONE 1 SENSITIVITY RESULTS - FLOW DOWN 20%



Peak Water Level Difference (metres)

0.50
0.15
0.10
0.05
0.01
-0.01
-0.05
-0.10
-0.15
-0.50

LEGEND

100yr 2hr flood extent

Sensitivity results have been run for one grid only.

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FIGURE 5.16

ZONE 2 SENSITIVITY RESULTS - FLOW UP 20%

J2453/R2251/V4
August 2006

J:\WR\J2453 - Penrith Overland Flow Study\Figures\Figures-V4\Figure 5.16-Sensitivity Results-Flow up 20% zone 2-V4.Wor

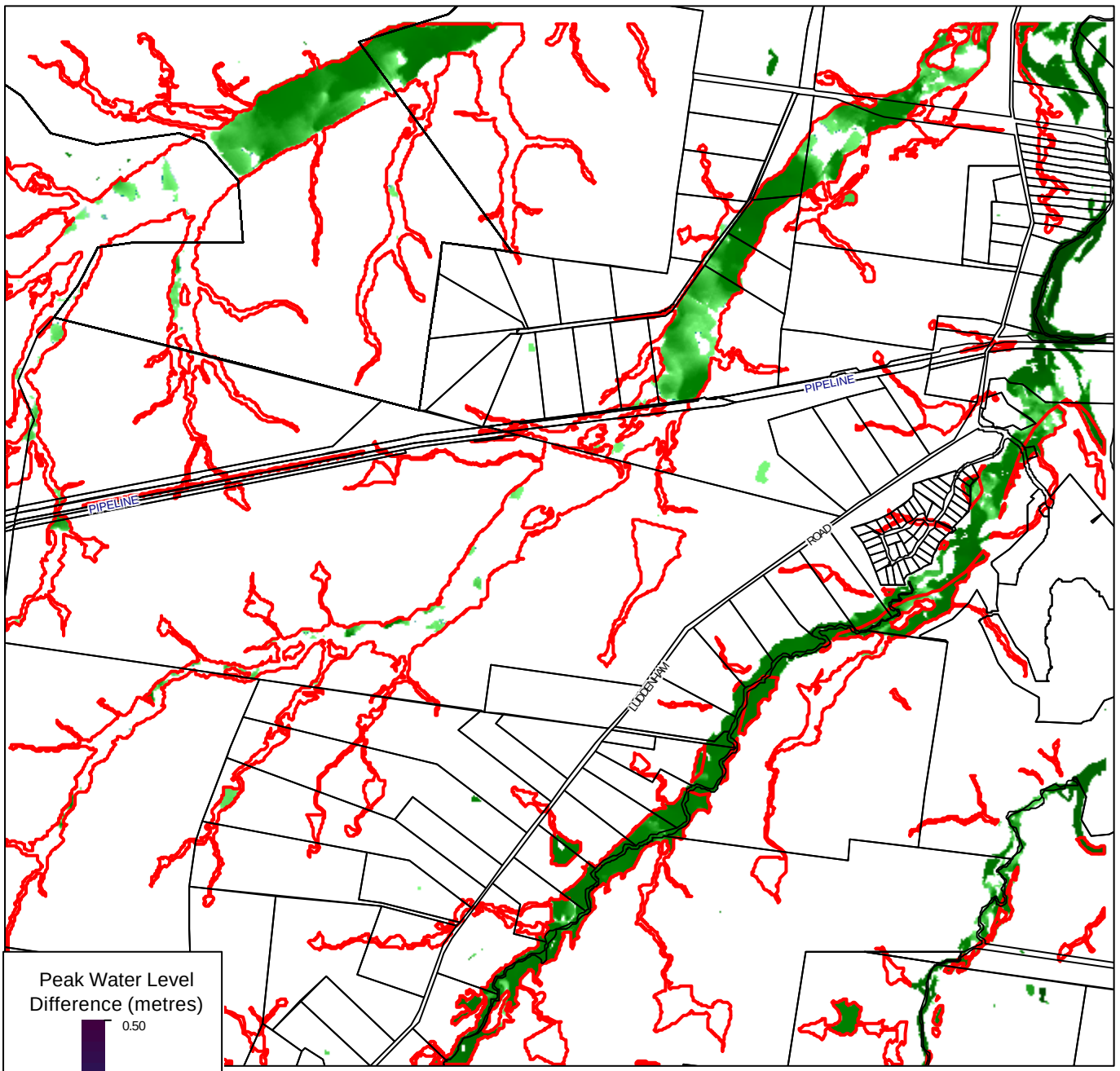

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FIGURE 5.17

ZONE 2 SENSITIVITY RESULTS - FLOW DOWN 20%

J2453/R2251/V4
August 2006

J:\WR\J2453 - Penrith Overland Flow Study\Figures\Figures-V4\Figure 5.17- Sensitivity Results-Flow down 20% zone 2-V4.Wor

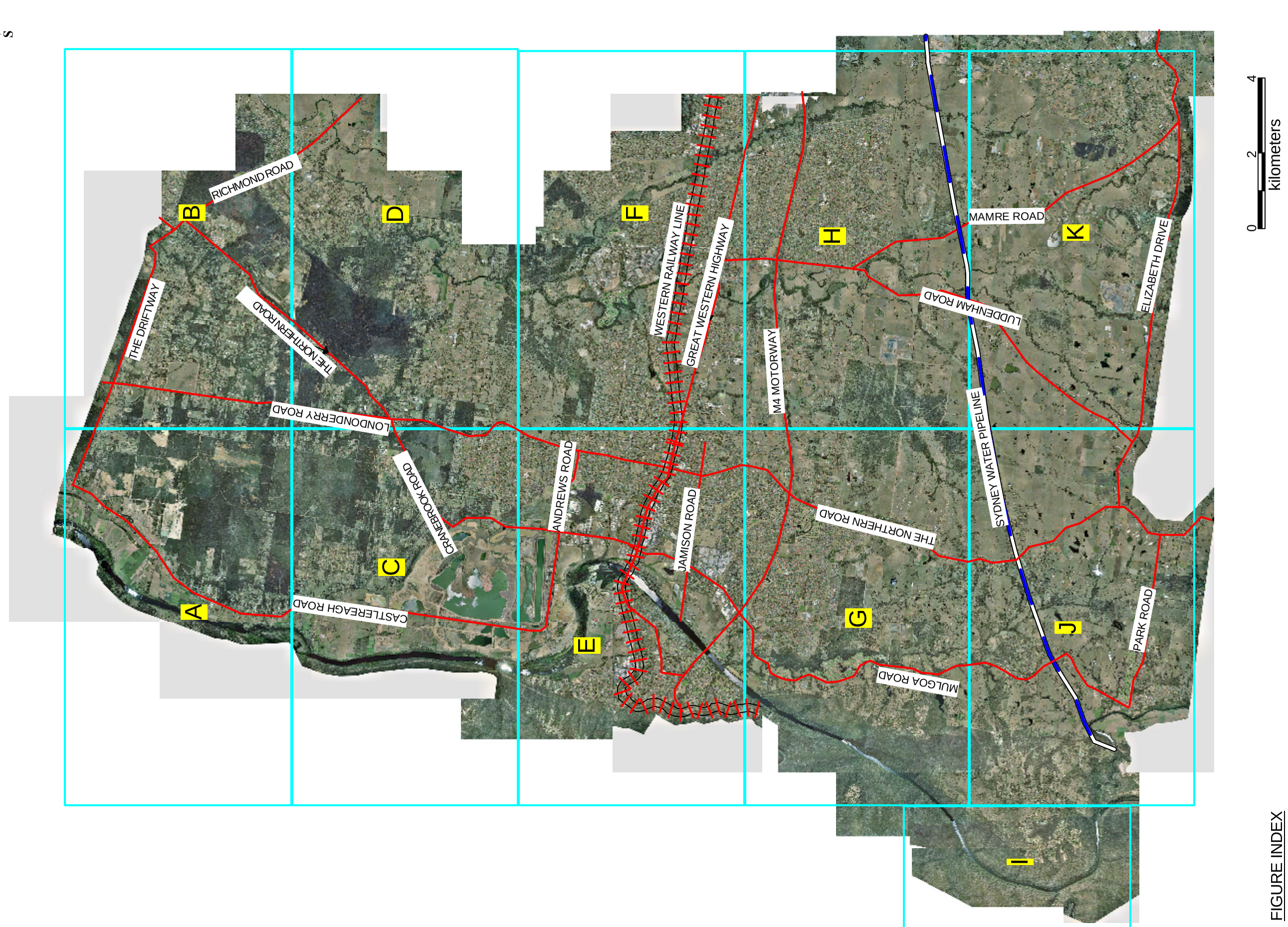

FIGURE INDEX

FIGURE 6.1 A-K: FLOOD EXTENT MAPS FOR PMF, 100 YEAR AND 20 YEAR ARI EVENTS

FIGURES 6.2 A-K: PROVISIONAL FLOOD HAZARD MAPS FOR PMF, 100 YEAR AND 20 YEAR ARI EVENTS

PMF Extent

100 Year ARI Flood Extent

20 Year ARI Flood Extent

Excluded Areas
Including 100 Year ARI Flood Extent
for Nepean River and South Creek

N
W E
S

CASTLEREAGH ROAD

0 1 2
kilometres

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FIGURE 6.1 A
PMF, 100 YEAR AND 20 YEAR ARI FLOOD EXTENT
J2453\Figures\Figures-V4\Figure 6.1 A Flood Extent-V4.Wor

PMF Extent

100 Year ARI Flood Extent

20 Year ARI Flood Extent

Excluded Areas
Including 100 Year ARI Flood Extent
for Nepean River and South Creek

N
W E
S

0 1 2
kilometres

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FIGURE 6.1 B
PMF, 100 YEAR AND 20 YEAR ARI FLOOD EXTENT
J2453\Figures\Figures-V4\Figure 6.1 B Flood Extent-V4.Wor

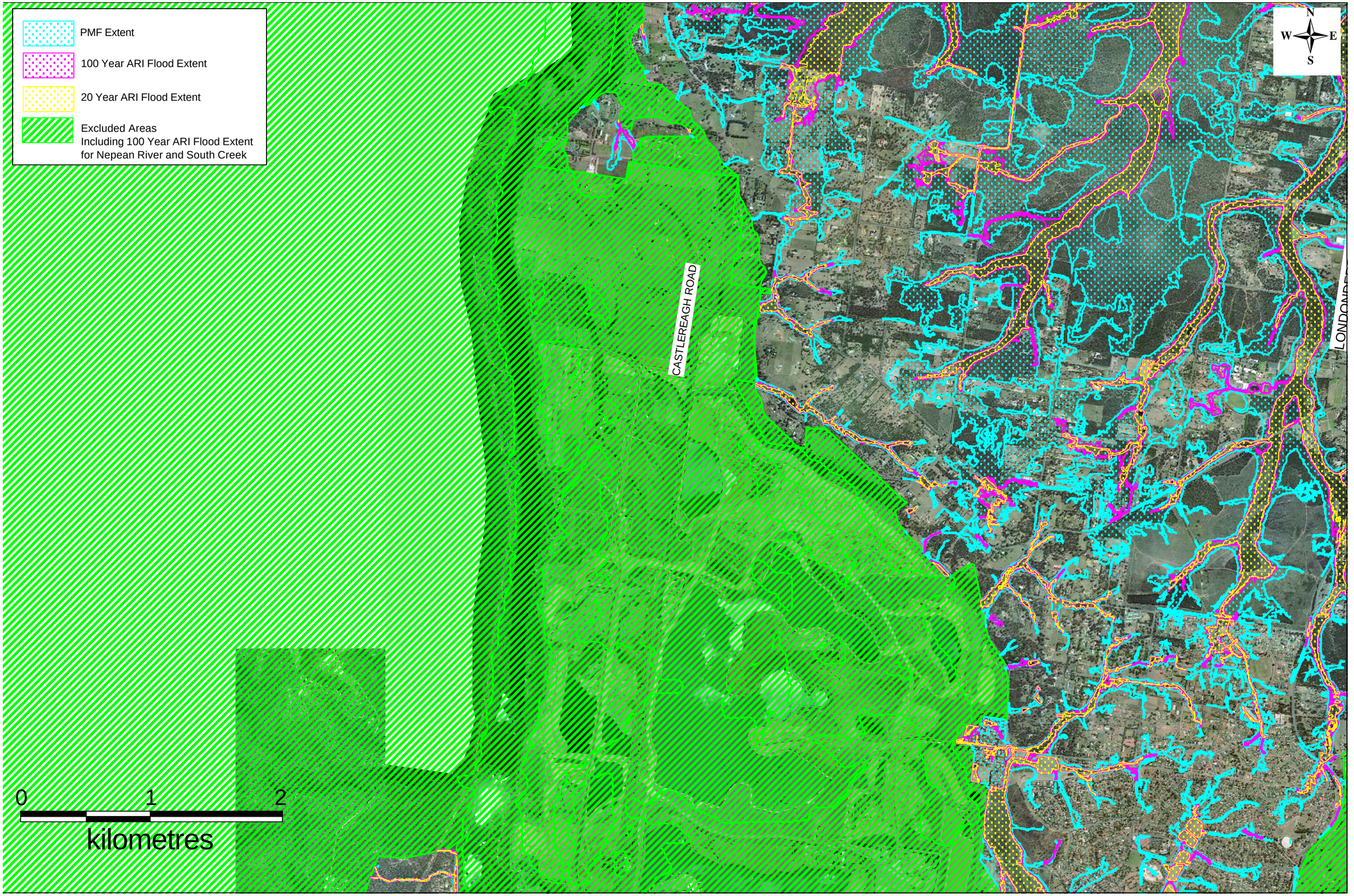

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FIGURE 6.1 C
PMF, 100 YEAR AND 20 YEAR ARI FLOOD EXTENT

J2453\Figures\Figures-V4\Figure 6.1 C Flood Extent-V4 Wor

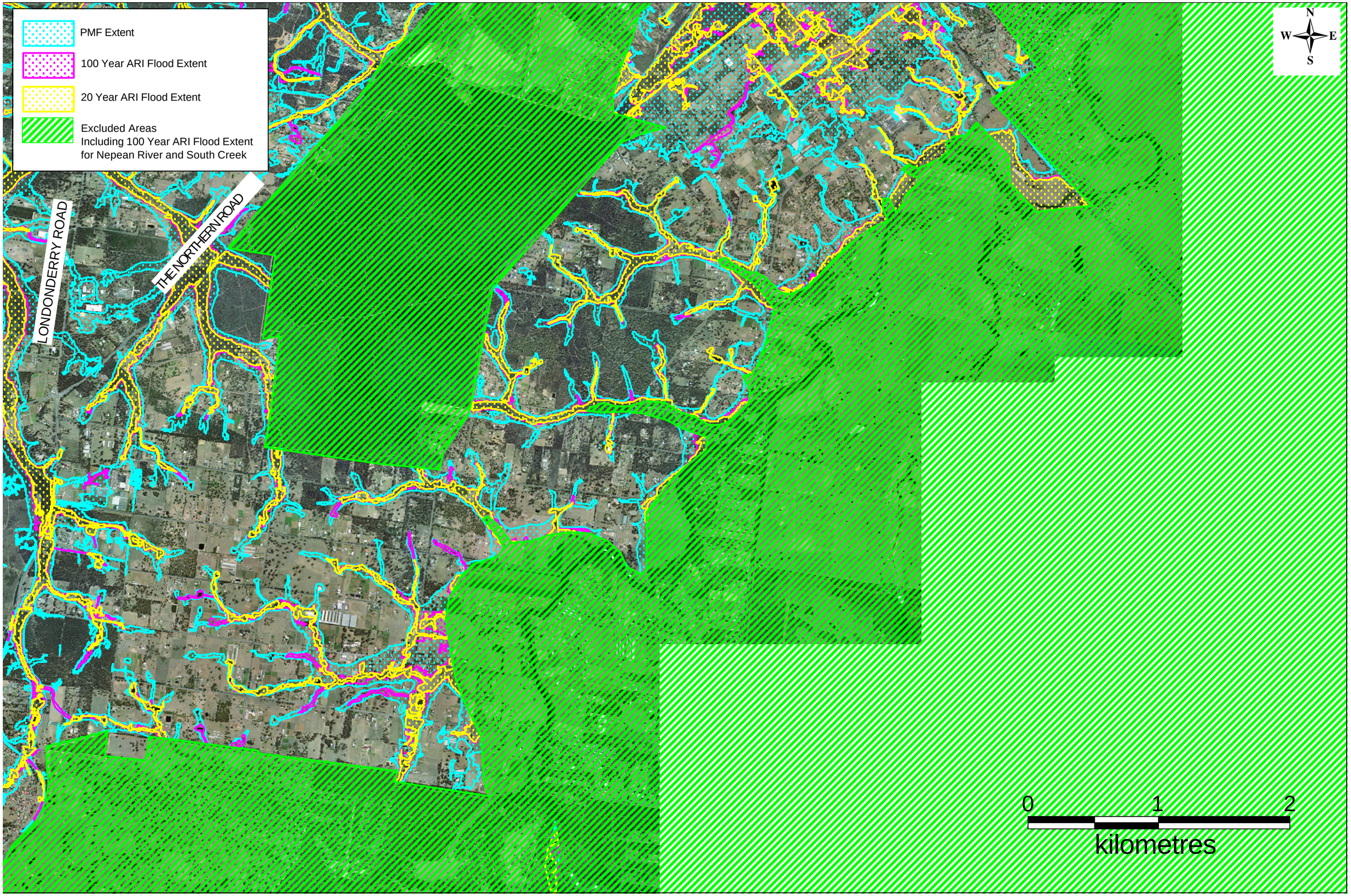

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FIGURE 6.1 D
PMF, 100 YEAR AND 20 YEAR ARI FLOOD EXTENT
J2453\Figures\Figures-V4\Figure 6.1 D Flood Extent-V4.Wor

PMF Extent

100 Year ARI Flood Extent

20 Year ARI Flood Extent

Excluded Areas
Including 100 Year ARI Flood Extent
for Nepean River and South Creek

N
W E
S

CASTLEREAGH ROAD

THE NORTHERN ROAD

CASTLEREAGH ROAD

JAMISON ROAD

MULGOA ROAD

0 1 2
kilometres

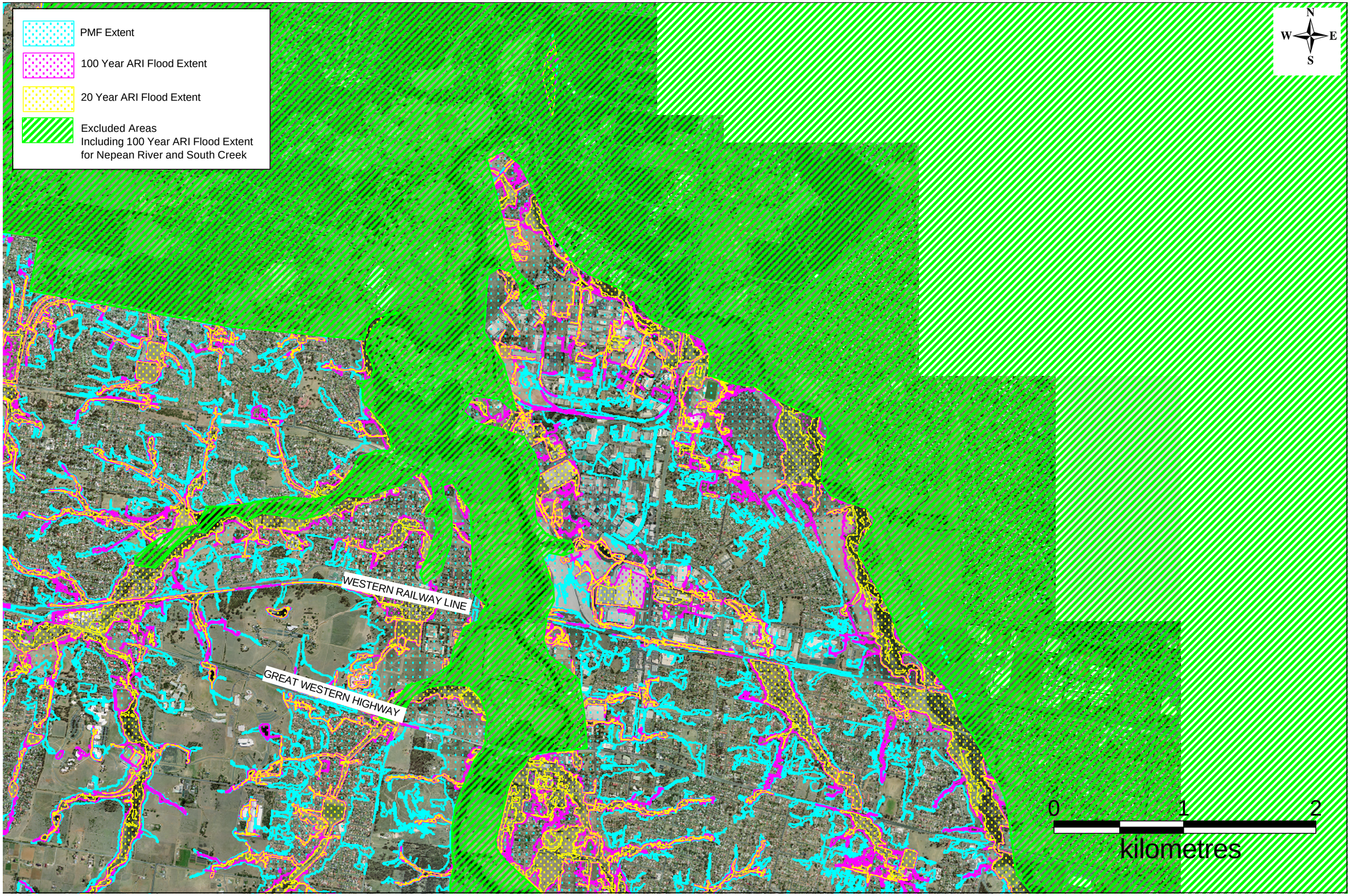
Cardno Lawson Treloar

J2453/R2251/V4
August 2006

Penrith Overland Flow Study

FIGURE 6.1 E
PMF, 100 YEAR AND 20 YEAR ARI FLOOD EXTENT

J2453\Figures\Figures-V4\Figure 6.1 E Flood Extent-V4.Wor



Cardno Lawson Treloar

J2453/R2251/V4
August 2006

Penrith Overland Flow Study

FIGURE 6.1 F
PMF, 100 YEAR AND 20 YEAR ARI FLOOD EXTENT

J2453\Figures\Figures-V4\Figure 6.1 F Flood Extent-V4.Wor

PMF Extent

100 Year ARI Flood Extent

20 Year ARI Flood Extent

Excluded Areas
Including 100 Year ARI Flood Extent
for Nepean River and South Creek

N
W E
S

MULGOA ROAD

M4

MULGOA ROAD

THE NORTHERN ROAD

0 1 2
kilometres

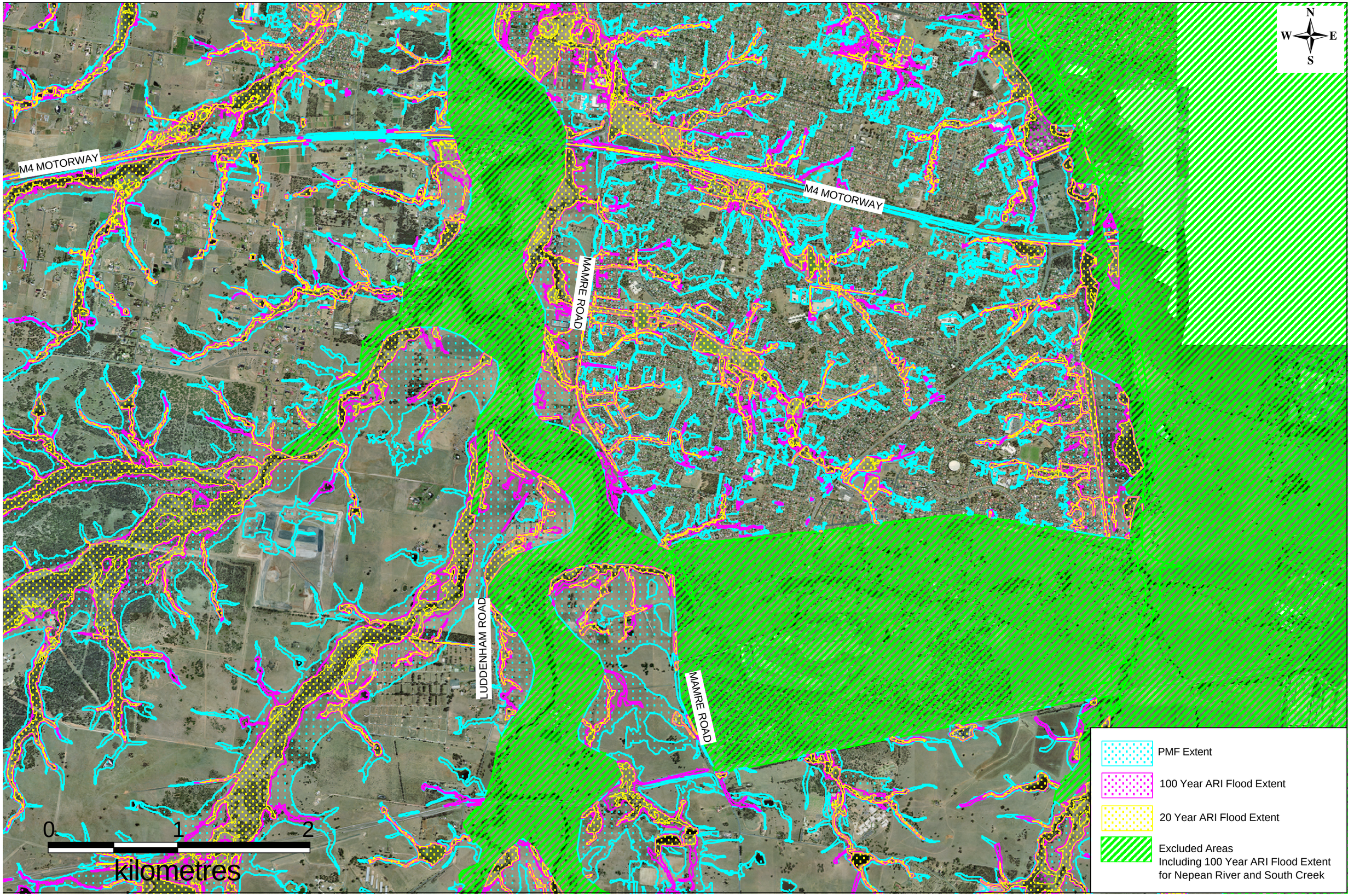
Cardno
Lawson
Treloar

J2453/R2251/V4
August 2006

Penrith Overland Flow Study

FIGURE 6.1 G
PMF, 100 YEAR AND 20 YEAR ARI FLOOD EXTENT

J2453\Figures\Figures-V4\Figure 6.1 G Flood Extent-V4.Wor



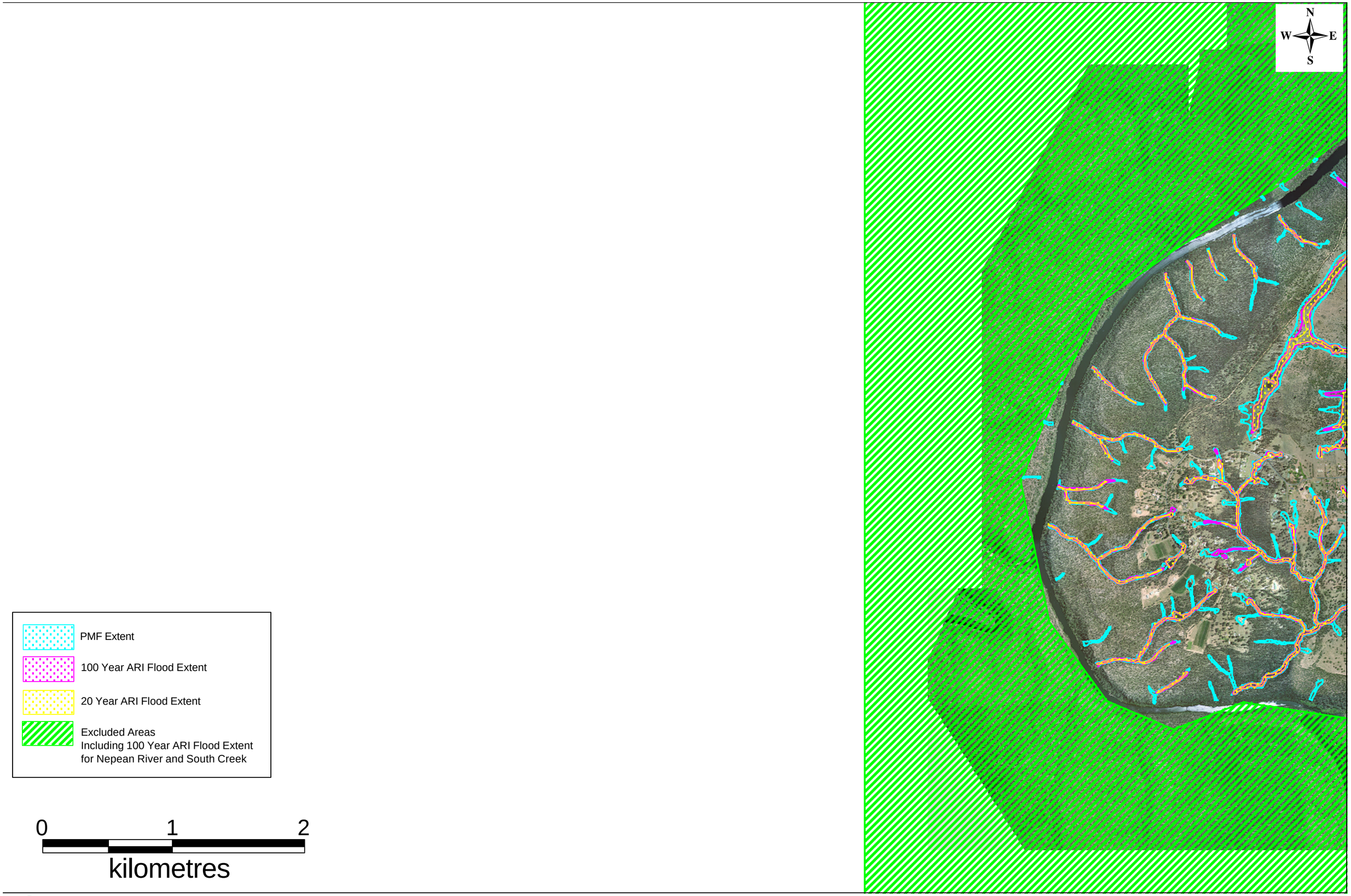
Cardno Lawson Treloar

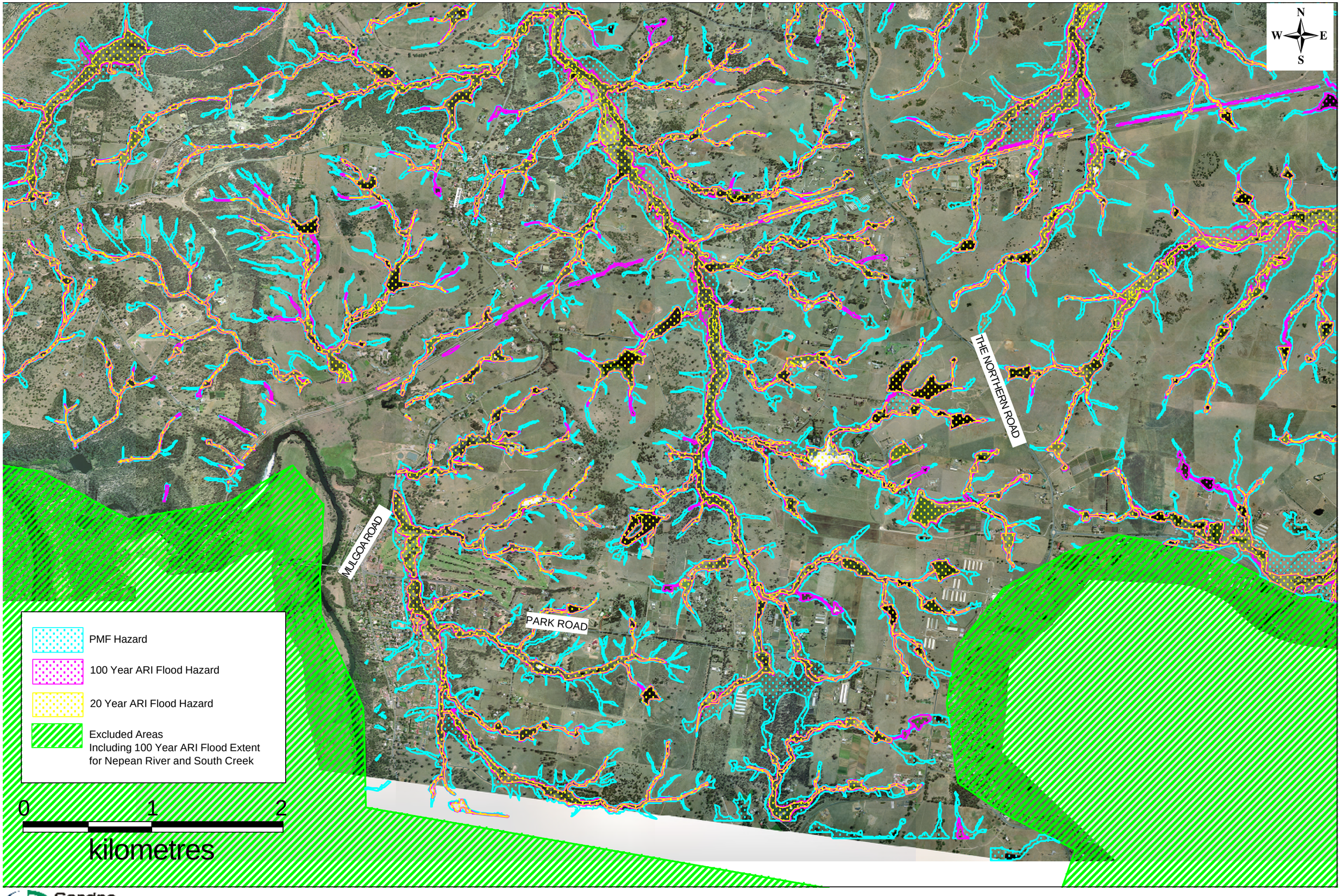
J2453/R2251/V4
August 2006

Penrith Overland Flow Study

FIGURE 6.1 H
PMF, 100 YEAR AND 20 YEAR ARI FLOOD EXTENT

J2453\Figures\Figures-V4\Figure 6.1 H Flood Extent-V4.wor


N
W
E
S
PMF Extent
100 Year ARI Flood Extent
20 Year ARI Flood Extent
Excluded Areas
Including 100 Year ARI Flood Extent
for Nepean River and South Creek
0
1
2
kilometres



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August 2006

Penrith Overland Flow Study

FIGURE 6.1 J
PMF, 100 YEAR AND 20 YEAR ARI PROVISIONAL FLOOD EXTENT

J2453\Figures\Figures-V4\Figure 6.1 J Flood Extent-V4 Wor

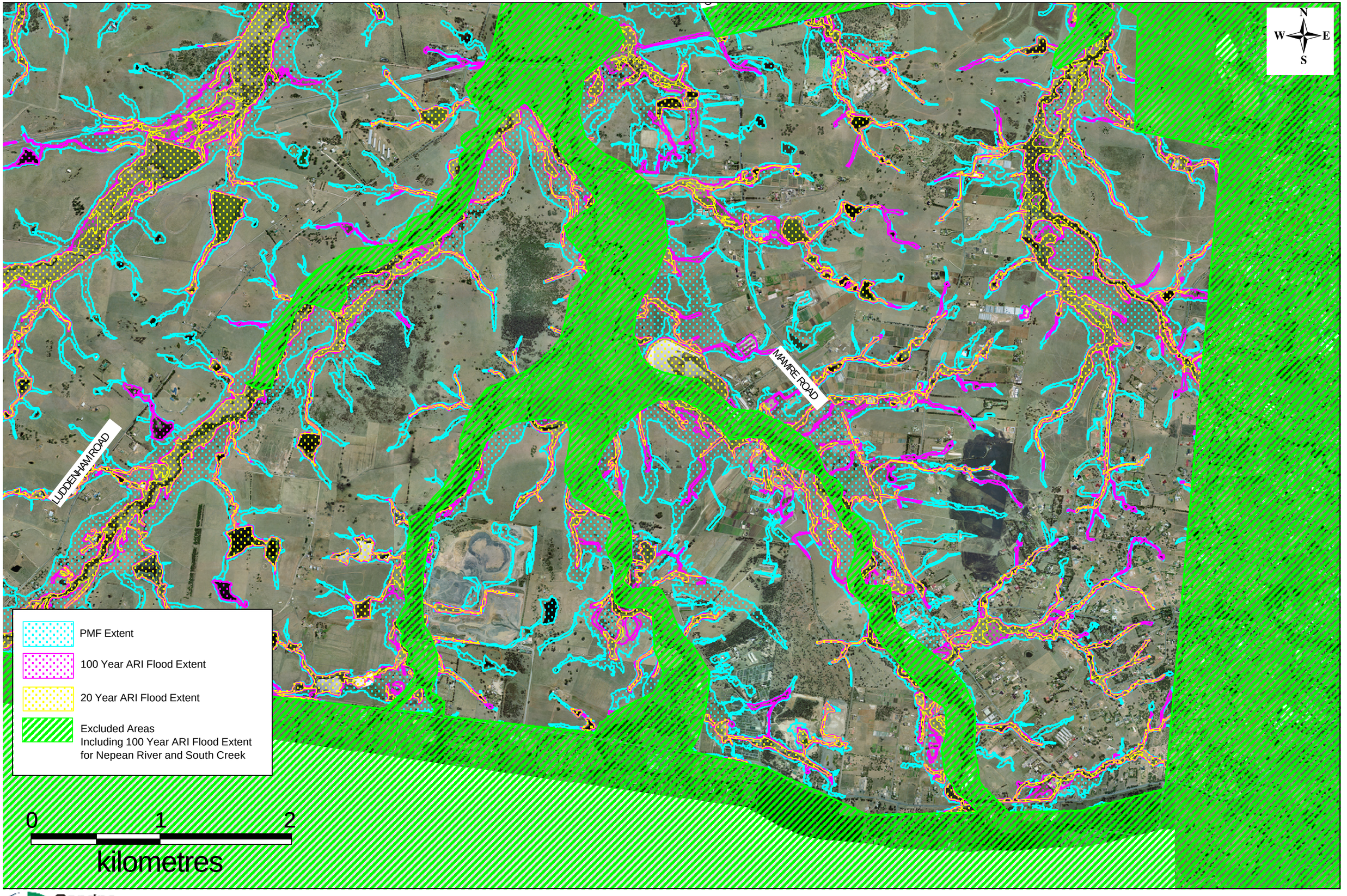

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FIGURE 6.1 K
PMF, 100 YEAR AND 20 YEAR ARI FLOOD EXTENT

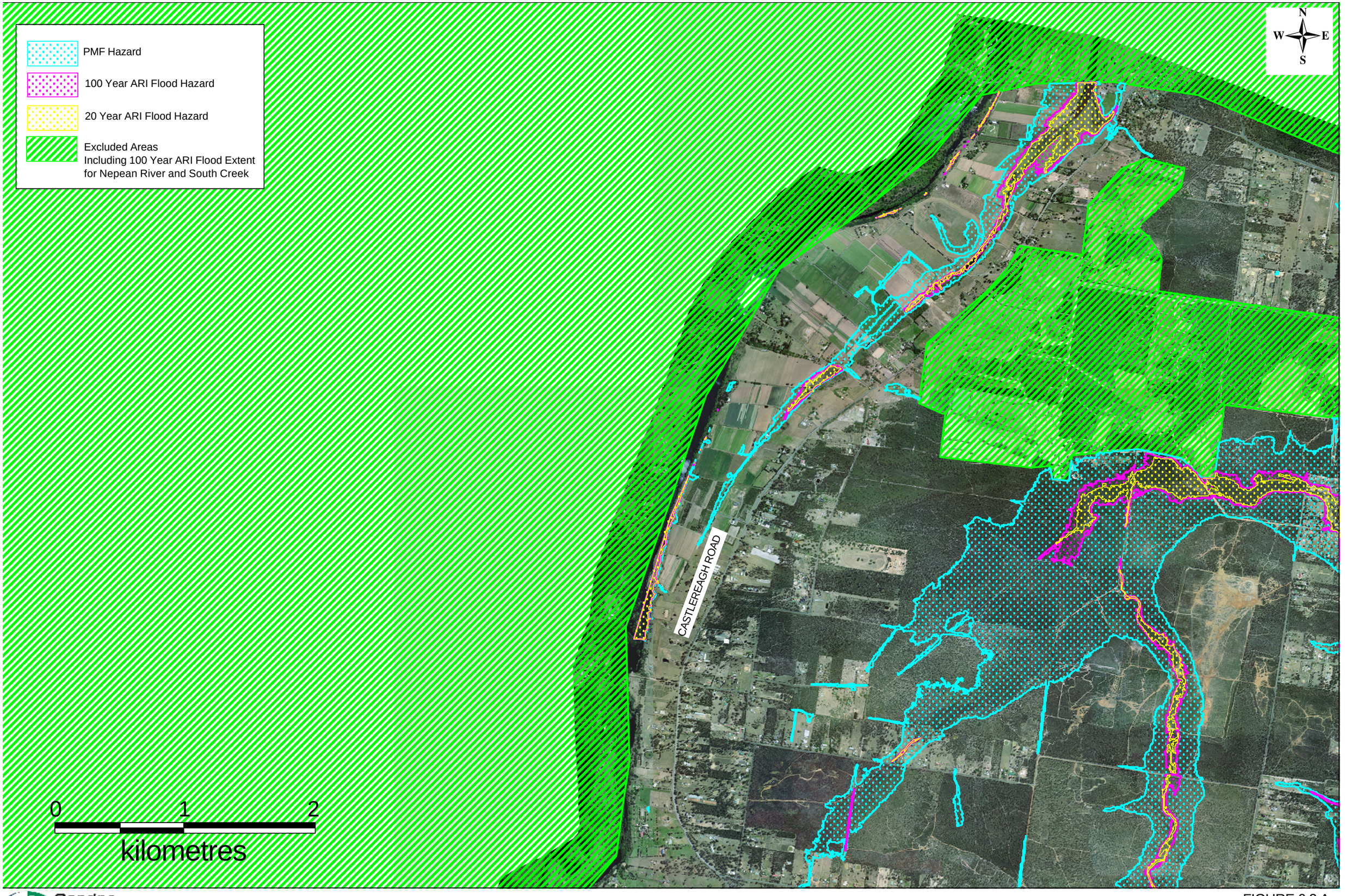

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FIGURE 6.2 A
PMF, 100 YEAR AND 20 YEAR ARI PROVISIONAL FLOOD HAZARD

J2453\Mapinfo\Figures\Figures-V4\Figure 6.2 A Flood Hazard-V4.Wor

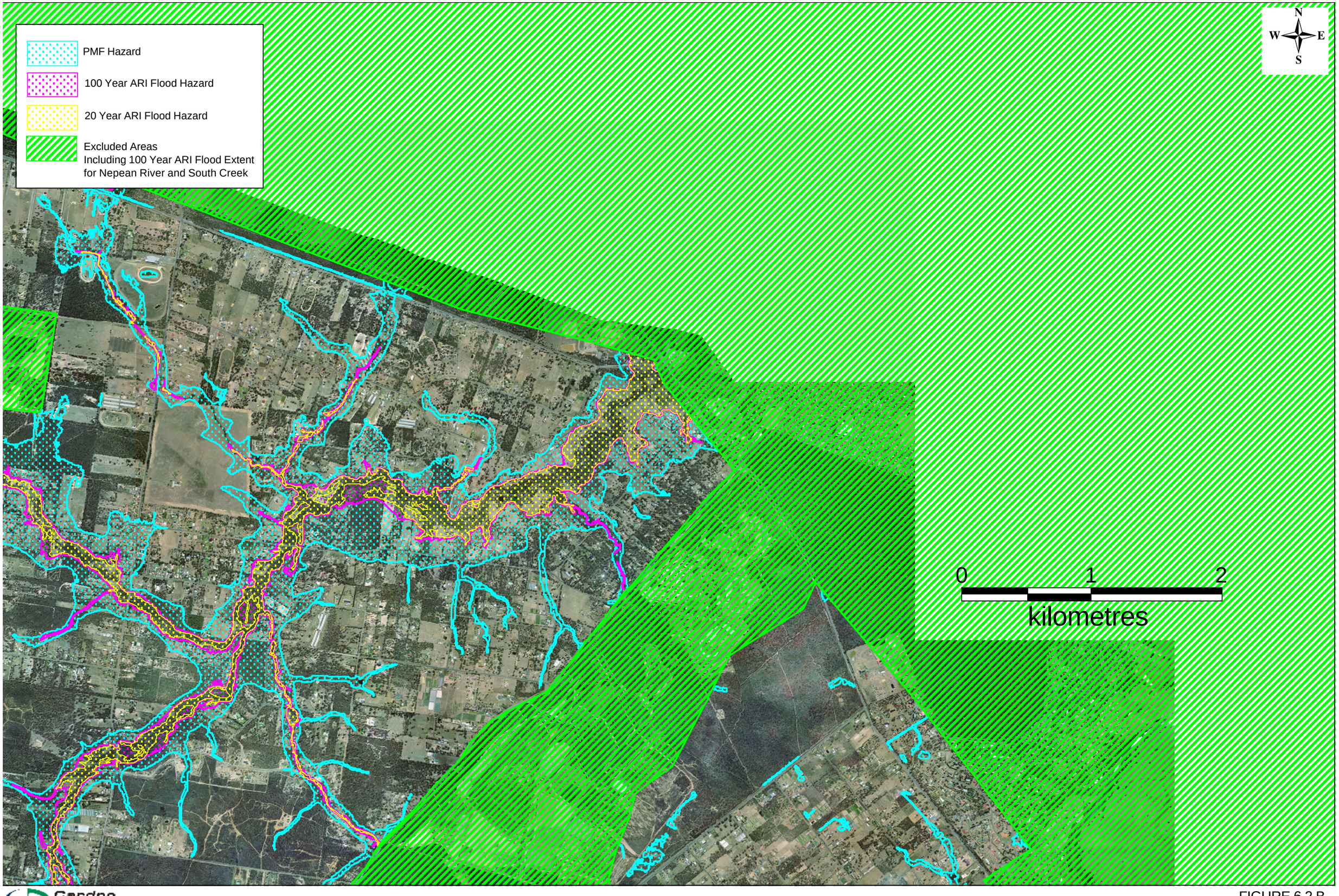

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FIGURE 6.2 B
PMF, 100 YEAR AND 20 YEAR ARI PROVISIONAL FLOOD HAZARD

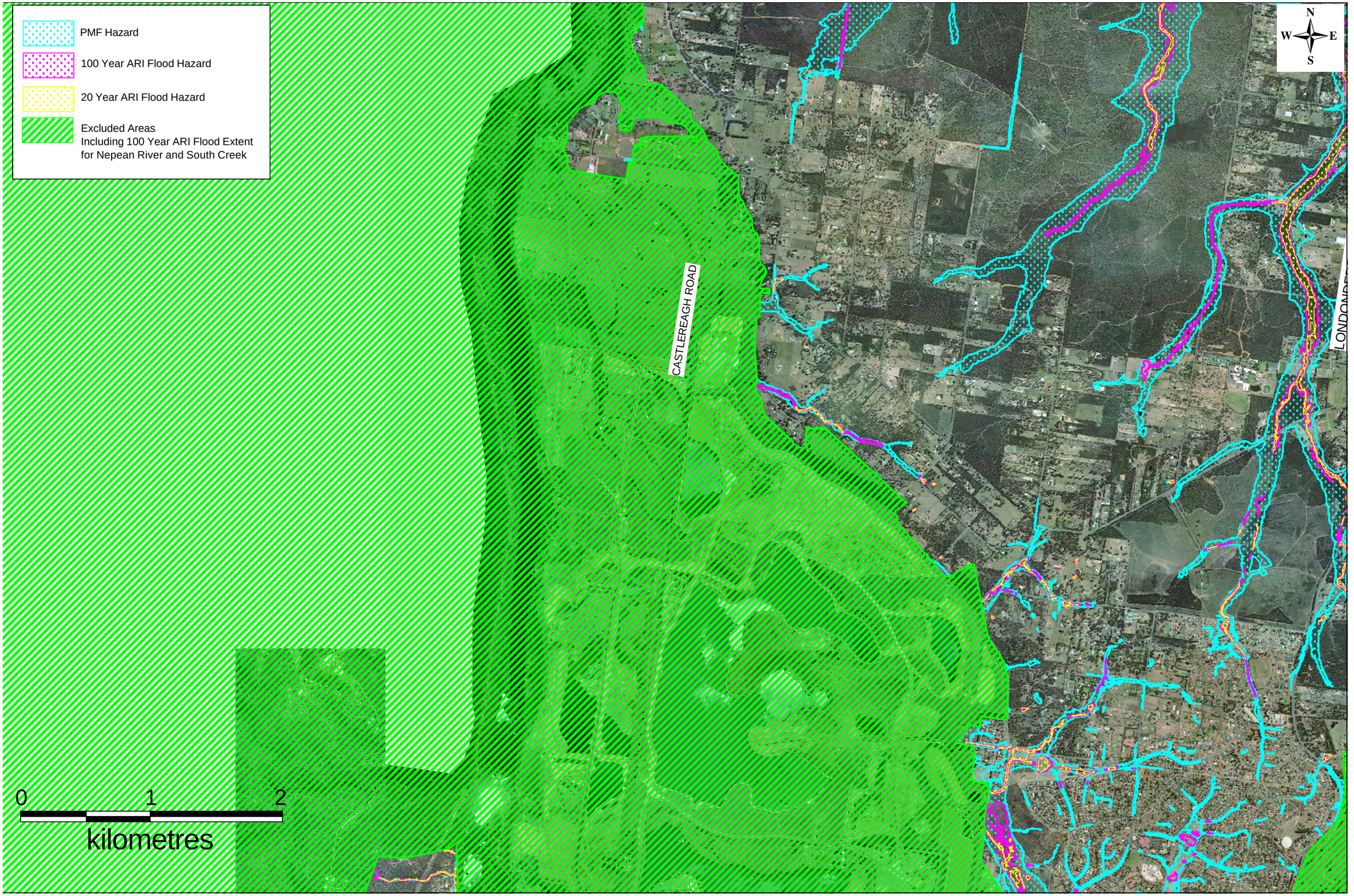

FIGURE 6.2 C
PMF, 100 YEAR AND 20 YEAR ARI PROVISIONAL FLOOD HAZARD

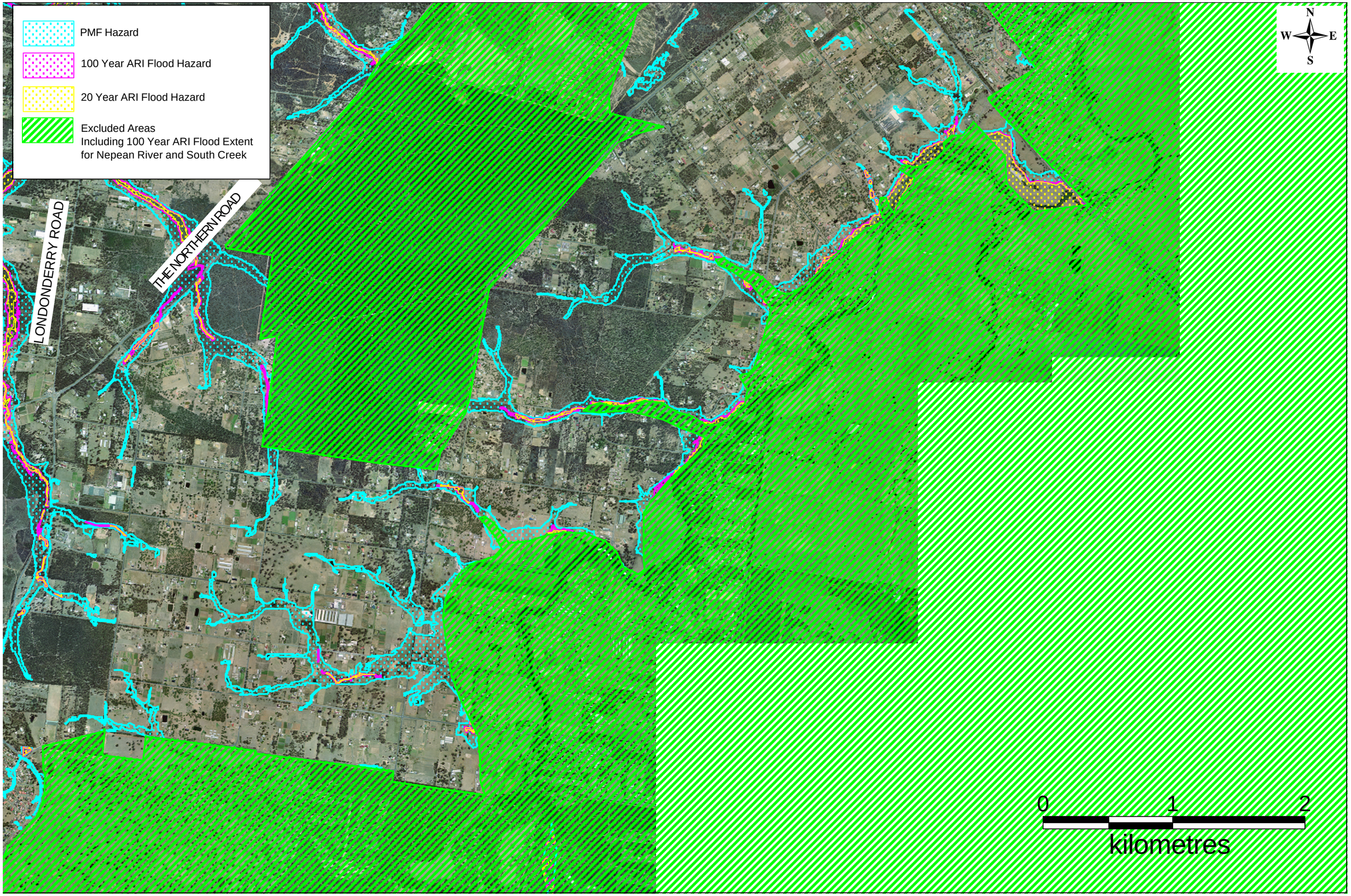

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FIGURE 6.2 D
PMF, 100 YEAR AND 20 YEAR ARI PROVISIONAL FLOOD HAZARD

PMF Hazard

100 Year ARI Flood Hazard

20 Year ARI Flood Hazard

Excluded Areas
Including 100 Year ARI Flood Extent
for Nepean River and South Creek

N
W E
S

CASTLEREAGH ROAD

CASTLEREAGH ROAD

THE NORTHERN ROAD

JAMISON ROAD

MULGOA ROAD

0 1 2
kilometres

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FIGURE 6.2 E
PMF, 100 YEAR AND 20 YEAR ARI PROVISIONAL FLOOD HAZARD

J2453\Figures\Figures-V4\Figure 6.2 E Flood Hazard-V4.Wor

PMF Hazard

100 Year ARI Flood Hazard

20 Year ARI Flood Hazard

Excluded Areas
Including 100 Year ARI Flood Extent
for Nepean River and South Creek

0 1 2
kilometres

N
W E
S

WESTERN RAILWAY LINE

GREAT WESTERN HIGHWAY

Cardno
Lawson
Treloar

FIGURE 6.2 F
PMF, 100 YEAR AND 20 YEAR ARI PROVISIONAL FLOOD HAZARD

PMF Hazard

100 Year ARI Flood Hazard

20 Year ARI Flood Hazard

Excluded Areas
Including 100 Year ARI Flood Extent
for Nepean River and South Creek

N
W E
S

MULGOA ROAD

M4

THE NORTHERN ROAD

MULGOA ROAD

0 1 2
kilometres

Cardno
Lawson
Treloar

J2453/R2251/V4
August 2006

Penrith Overland Flow Study

FIGURE 6.2 G
PMF, 100 YEAR AND 20 YEAR ARI PROVISIONAL FLOOD HAZARD

J2453\Figures\Figures-V4\Figure 6.2 G Flood Hazard-V4.Wor

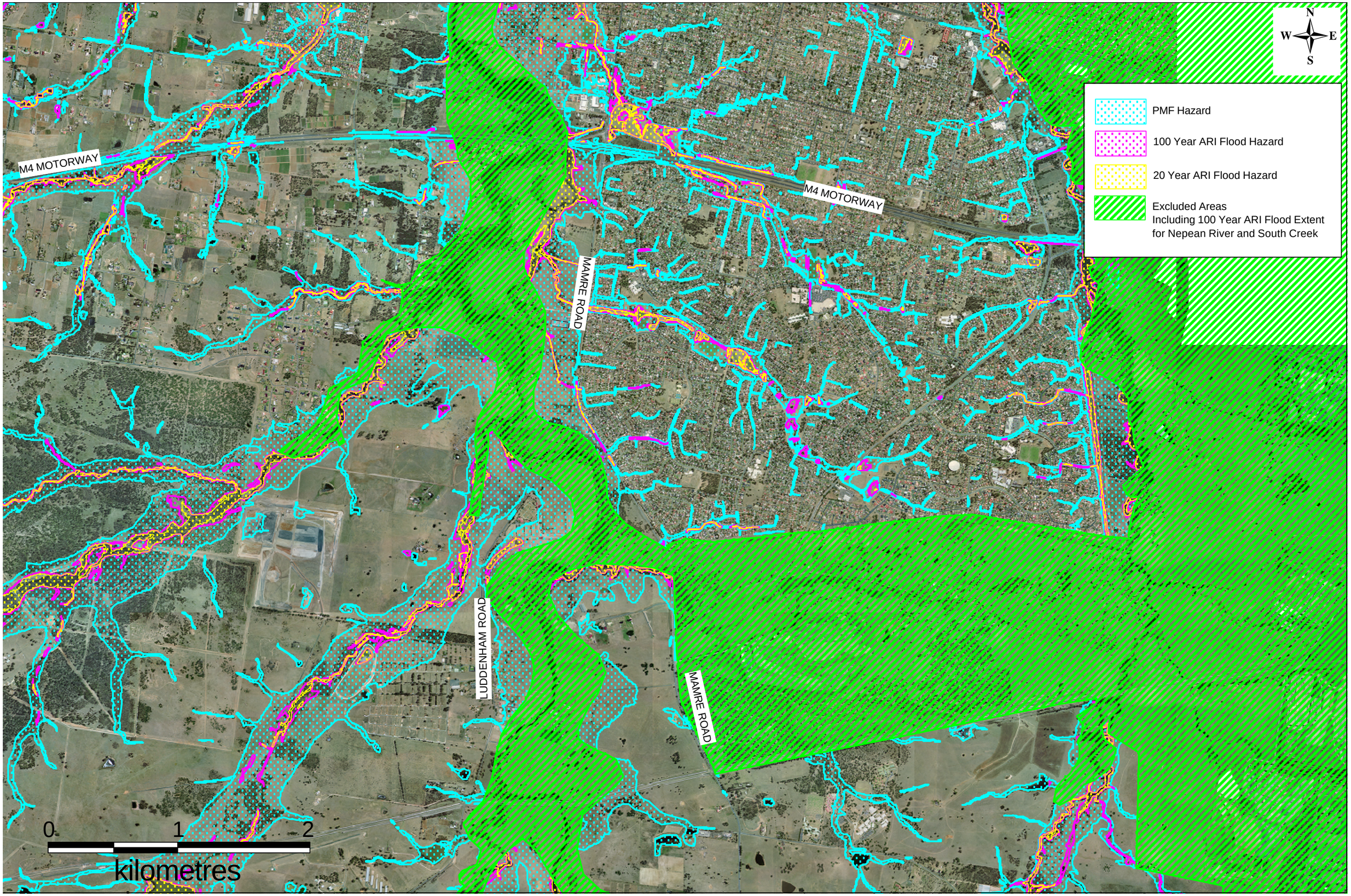

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FIGURE 6.2 H
PMF, 100 YEAR AND 20 YEAR ARI PROVISIONAL FLOOD HAZARD

J2453\Figures\Figures-V4\Figure 6.2 H Flood Extent-V4.Wor

PMF Hazard

100 Year ARI Flood Hazard

20 Year ARI Flood Hazard

Excluded Areas
Including 100 Year ARI Flood Extent
for Nepean River and South Creek

0 1 2

kilometres

FIGURE 6.2 I
PMF, 100 YEAR AND 20 YEAR ARI PROVISIONAL FLOOD HAZARD

J2453\Figures\Figures-V4\Figure 6.1 I Flood Hazard-V4.Wor

N
W E
S

THE NORTHERN ROAD

MULGOA ROAD

PARK ROAD

PMF Hazard

100 Year ARI Flood Hazard

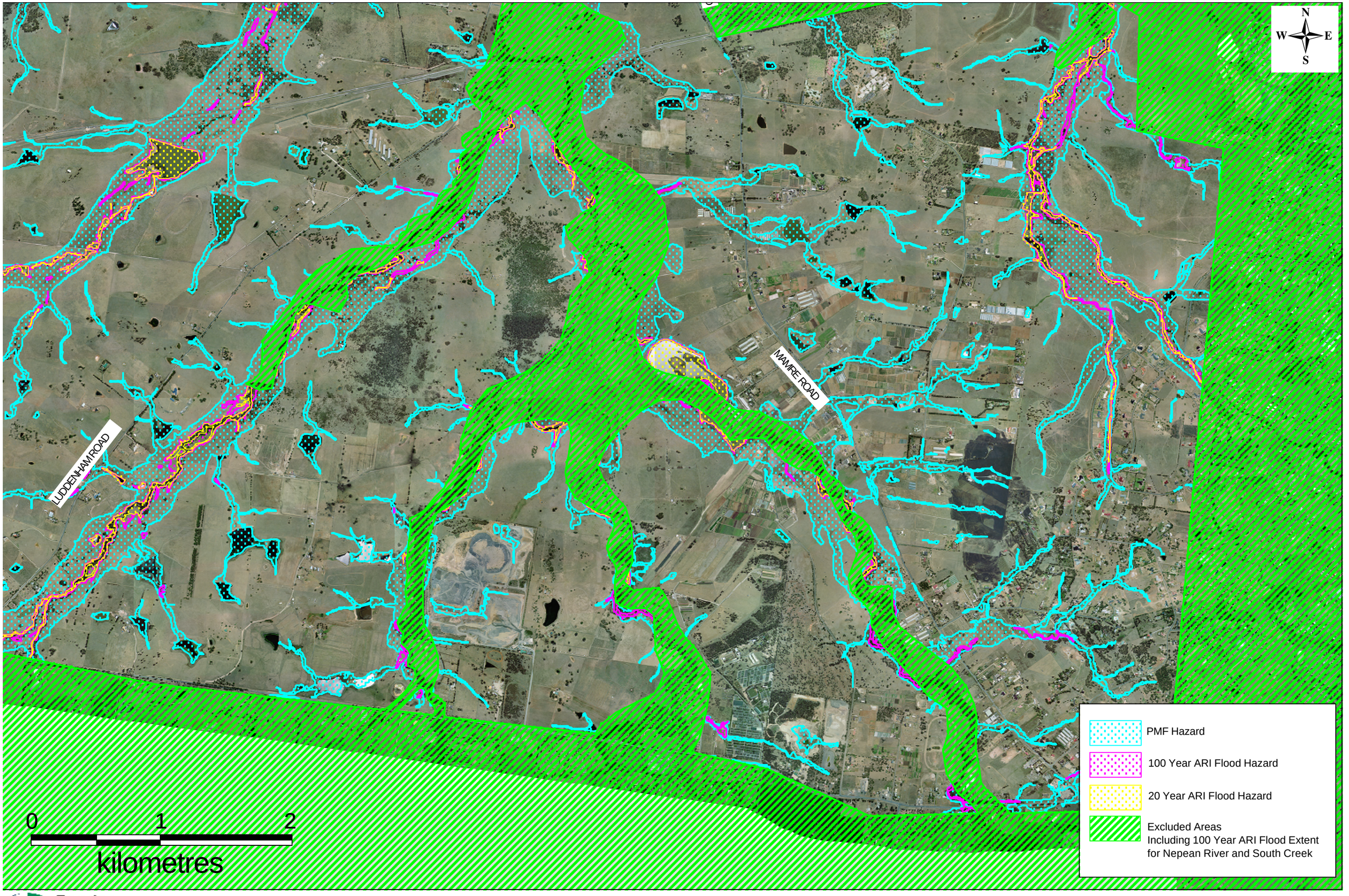
20 Year ARI Flood Hazard

Excluded Areas
Including 100 Year ARI Flood Extent
for Nepean River and South Creek

0 1 2
kilometres

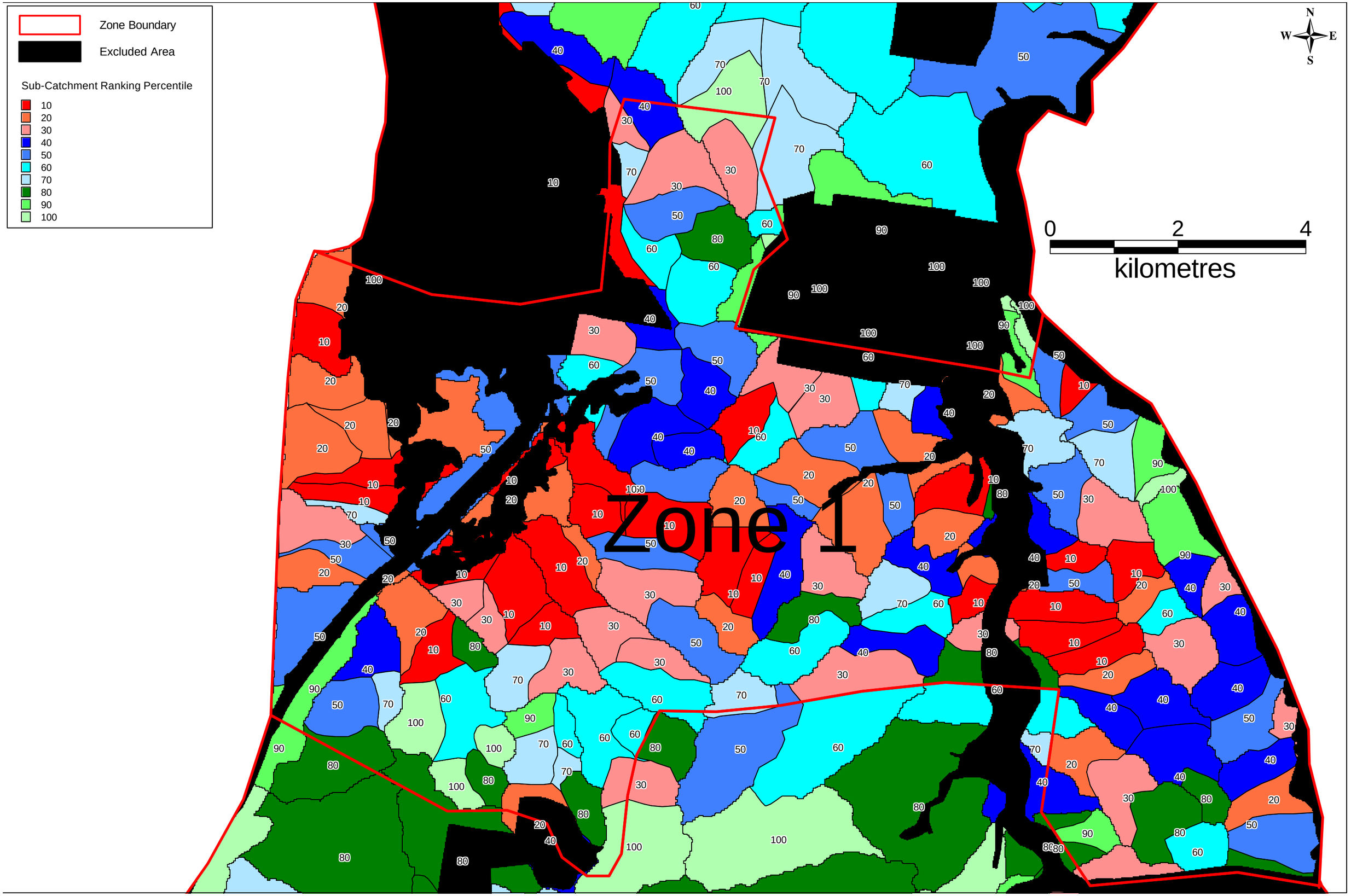
Cardno
Lawson
Treloar

FIGURE 6.2 J
PMF, 100 YEAR AND 20 YEAR ARI PROVISIONAL FLOOD HAZARD



Cardno Lawson Treloar

FIGURE 6.2 K
PMF, 100 YEAR AND 20 YEAR ARI PROVISIONAL FLOOD HAZARD



Cardno Lawson Treloar

J2453/R2251/V4
August 2006

Penrith Overland Flow Study

FIGURE 7.2A
SUB-CATCHMENT RANK: ZONE 1

J2453\Figures\Figures-V4\Figure 7.2A Subcatchment Rank Zone 1-V4.Wor

Zone Boundary

Excluded Area

Sub-Catchment Ranking Percentile

10
20
30
40
50
60
70
80
90
100

N
W E
S

Zone 2

0 2 4
kilometres

FIGURE 7.2B
SUB-CATCHMENT RANK: ZONE 2

Zone Boundary

Excluded Area

Sub-Catchment Ranking Percentile

10
20
30
40
50
60
70
80
90

Zone 1

Zone 3

N
W E
S

0 2 4
kilometres

FIGURE 7.2C
SUB-CATCHMENT RANK: ZONE 3

APPENDIX A

Surveyed Culvert Photographs with Approximate Dimensions

Note

Every attempt was made to locate all the major culverts within the Penrith LGA. However, it must not be assumed that the culverts shown here are all the culverts in the LGA. If further flood studies are carried out then accurately located and surveyed culverts will need to be acquired.

Origin of Culvert Details		
CLT ID	**Origin of data**	**Location details (Council data only)**
1	Council Data	Wedmore Road from Palomino to Litton St, Emu Heights
2	Council Data	Kite Street from Russell St to End of road, Emu Plains
3	Council Data	Macquarie Avenue from The Crescent to Henry Street, Lemongrove
5	CLT Field Data	Littlefields Road from Farm to Tilba, Mulgoa
6	Filtered from topo*	Durham Street from Ropes Creek to Melbourne, Oxley Park
8	Council Data	The Kingsway from Tennant Road to Charles Hackett, St Marys
9	CLT Field Data	Gadara Drive from Moolana to Narooma, Sth Penrith
10	Council Data	Ikin Street from York Road to Drake Street, Sth Penrith
11	Council Data	Banks Drive from Heron Drv to Timesweep Drv, St. Clair
12	Council Data	Banks Drive from Shakespeare St to Timesweep Dr, St. Clair
13	Council Data	Bennett Road from Banks Drive to Belledale Cl, St. Clair
14	Council Data	Burton Street from Heavey to Charles Sturt, Werrington
15	Council Data	Sunflower Drive from Vivaldi Cr to Sandpiper Cr, Claremont Meadows
16	Council Data	Sunflower Drive from Primrose Ct to Killeroo Cr, Claremont Meadows
17	Council Data	Sunflower Drive from Prairie Glen. to Wonnai Place, Claremont Meadows
18	Council Data	Sunflower Drive from Killeroo Cr to Myrtle Rd, Claremont Meadows
19	CLT Field Data	Greenhaven Drive from Litton St. to Parkwood Grove, Emu Heights
20	CLT Field Data	Palomino Rd from Wedmore Rd to Annie Close, Emu Heights
21	Council Data	Gardenia Ave. from Hatigan to Mcauley, Emu Plains
22	CLT Field Data	Nepean Street from Beach to Tattersall, Emu Plains
23	Filtered from topo	River Road from Nepean to Hunter, Emu Plains
24	Emu Plains Study	Russell St from Kite St to Ithaca St, Emu Plains
25	CLT Field Data	Floribunda Ave from Acacia to Lady Jamison, Glenmore Park
26	Council Data	Dent Street from Jamison Road to Preston St, Jamison Town
27	Council Data	Jamison Park Access from Jamison Road to Jamison Park, Jamison Town
29	Council Data	Hickeys Lane from Coombes Dr. to Dead End, Kingswood
30	CLT Field Data	Victoria Street from Park to Shaw, Kingswood
31	CLT Field Data	Bowman Rd from Purcell Rd to Mills Rd, Londonderry
32	CLT Field Data	Carrington Road from Milford Road to Bowman Road, Londonderry
33	Council Data	Borrowdale Way from Callisto to Sherringham, Mt. Pleasant
34	Council Data	Greygums Road from Mc Henry St to Antonio St, Mt. Pleasant
35	CLT Field Data	Nepean Street from Cranebrook to Camelot, Mt. Pleasant
36	CLT Field Data	Bowood Way from Capitol Hill to Capitol Hill, Mt. Vernon
37	CLT Field Data	Capitol Hill Drive from Appin to Centennial, Mt. Vernon
39	CLT Field Data	Forrestor Road from Harris to Glossop, Nth. St Marys
40	Council Data	Caddens Road from Ulm Road to Kent Road, Orchard Hills
41	Council Data	Castle Road from Ulm to End of road, Orchard Hills
42	CLT Field Data	York Road from Jamison Road to Preston St, Sth Penrith
43	Council Data	Blackwell Ave. from Banks Drv to Bradman Ave., St. Clair
44	Council Data	Cook Parade from Banks Dr to Solander Dr, St. Clair
45	CLT Field Data	John Oxley Drive from Lethbridge to Prince, Werrington
46	Council Data	Laguna Drive from Surveyors Creek Road to Musselburgh Cl, Glenmore Park
47	Council Data	Glenmore Parkway from Blue Hills Drive to Surveyors Creek Road, Glenmore Park
48	Council Data	Coonawarra Drive from Bennett to Ibis, St. Clair
49	Council Data	Eighth Ave. from South Creek to Second, Llandilo
50	Council Data	Luddenham Road from Patons to Mamre, Luddenham
51	Filtered from topo	Forrester Road from Dunheved to Elsworth, Nth St. Marys
52	Filtered from topo	Debrincat Ave. from Boronia Road to Boundary, Nth. St Marys
53	Filtered from topo	Silverdale Road from Nepean River to Mulgoa, Wallacia
54	Filtered from topo	Christie Road from Werrington to Christie, Werrington
55	Filtered from topo	Dunheved Road from John Batman to Werrington, Werrington County
56	Filtered from topo	Christie Road from Werrington to Christie, Werrington
57	CLT Field Data	St. Marys Road from Sirius Place to Council Boundary, Berkshire Park
58	Filtered from topo	Londonderry Road from 100 m South Kenmare Rd to , Londonderry
60	CLT Field Data	Londonderry Road from At Londonderry Rd to Cherrybrook Chase, Londonderry
61	CLT Field Data	Glossop Street from Debrincat to Kurrajong, Nth St Marys
62	CLT Field Data	Werrington Road from Parkes Ave. to The Kingsway, Werrington
63	Filtered from topo	Londonderry Road from 100 m North CherryBrook Chase to , Londonderry
65	Filtered from topo	Londonderry Road from 200 m South Kenmare Rd to , Londonderry
66	Council Data	Parker Street from Cox to Great West. Highway, Penrith
68	CLT Field Data	Shaw Park from Herbert st behind basketball stadium to , Cambridge Park
70	CLT Field Data	111m Sth Gardenia Av from Emu Park to , Emu Plains
71	CLT Field Data	183m Sth Gardenia Av. from In Emu Park to , Emu Plains
72	CLT Field Data	
73	Council Data	Mulgoa Road from Batt St to Blaikie, Jamison Town
74	Council Data	104 York Road from To Reserve to (in reserve), Jamisontown
75	Council Data	124 York Road from 124 York Road to (in reserve), Jamisontown
76	Council Data	Mulgoa Road from Blakie Rd to Batt St, Penrith

Origin of Culvert Details		
CLT ID	**Origin of data**	**Location details (Council data only)**
77	CLT Field Data	Madison Circuit from Madison Ct to Banks Primary, St.Clair
78	CLT Field Data	100m west of Burton St from to (in reserve), Werrington
79	Council Data	Claremont Me. Reserve from Myrtle Rd to Mullaga Cl, Claremont Meadows
80	CLT Field Data	Off Glenmore Parkway from Glenmore Park to Floribunda Ave., Glenmore Park
81	Council Data	Jamison Road Access from Jamison Road to Regentville Road, Jamison Town
82	Filtered from topo	Glossop Street from Hobart to Harris, St. Marys
83	Filtered from topo	Werrington Road from Parkes Ave. to Rance Rd, Werrington
85	CLT Field Data	Park Ave from Heath St to Park Ave, Werrington
88	Filtered from topo	Castlereagh Rd from Cranebrook to Jackson, Castlereagh
89	Filtered from topo	Castlereagh Road from 100m east Readymix Entrance to , Castlereagh
90	Filtered from topo	Bennett from Over M4 to , Colyton
91	Filtered from topo	Carlisle Ave. from Sth Creek to Erskine Park Road, Colyton
92	Filtered from topo	Great Western H'way from Roper Road to Boundary, Colyton
94	Council Data	Roper Rd from Over M4 to , Colyton
95	Council Data	Russell St from M4 Motorway to , Emu Plains
97	Filtered from topo	Elizabeth from Martin to Western, Kemps Creek
98	Filtered from topo	Elizabeth Drive from Saisbury Road to Mamre Road, Kemps Creek
99	Filtered from topo	Elizabeth Drive from Badgery Rd to Lawson, Kemps Creek
100	Filtered from topo	M4 from Over Nepean River to , Leonay
102	Council Data	Kent Road from Over M4 to Caddens, Orchard Hills
104	Council Data	Northern Rd over M4 from Frogmore Rd to Homestead Rd, Orchard Hills
105	Filtered from topo	Great Western H'way from Over Nepean River to , Penrith
108	Council Data	Mulgoa Road from Batt St to Blaikie Rd, Penrith
109	Filtered from topo	M4 over Mulgoa Rd from South Side to , Regentville
110	CLT Field Data	Mulgoa Road from Spencer to Glenmore Parkway, Regentville
111	Filtered from topo	Great Western H'way from Bridge to Neale, St Marys
112	CLT Field Data	Mamre Road from Solander to Luddenham, St. Clair
113	Filtered from topo	Great Western H'way from Bridge to Neale, St. Marys
114	Filtered from topo	M4 over South Creek from to , St. Marys
115	CLT Field Data	Mulgoa Road from Water Street to , Wallacia
116	CLT Field Data	Park Road from Vincent to Water, Wallacia
118	Filtered from topo	
119	Filtered from topo	
120	Filtered from topo	
121	Filtered from topo	
122	Filtered from topo	
123	Filtered from topo	
124	Filtered from topo	
125	Filtered from topo	
126	CLT Field Data	
127	CLT Field Data	
128	Filtered from topo	
129	Filtered from topo	
130	No Access	
131	CLT Field Data	
132	Filtered from topo	
133	Filtered from topo	
136	CLT Field Data	
137	Filtered from topo	
138	Filtered from topo	
139	Filtered from topo	
152	Filtered from topo	
153	Filtered from topo	
154	CLT Field Data	
157	Filtered from topo	
158	Filtered from topo	
159	Filtered from topo	
160	Filtered from topo	
161	Filtered from topo	
162	Filtered from topo	
163	Filtered from topo	
164	Filtered from topo	
166	Filtered from topo	
167	Filtered from topo	
169	CLT Field Data	
170	CLT Field Data	
171	Filtered from topo	
172	Filtered from topo	

Origin of Culvert Details		
CLT ID	**Origin of data**	**Location details (Council data only)**
179	Filtered from topo	
180	Filtered from topo	
182	Filtered from topo	
183	Filtered from topo	
185	Filtered from topo	
186	Filtered from topo	
187	Filtered from topo	
190	CLT Field Data	
191	No Access	
194	CLT Field Data	
195	CLT Field Data	
196	CLT Field Data	
199	CLT Field Data	
200	CLT Field Data	
201	Filtered from topo	
205	CLT Field Data	
206	No Access	
207	CLT Field Data	
209	No Access	
210	CLT Field Data	
211	CLT Field Data	
212	CLT Field Data	
213	CLT Field Data	
214	CLT Field Data	
216	CLT Field Data	
217	CLT Field Data	
218	CLT Field Data	
219	CLT Field Data	
220	CLT Field Data	
221	CLT Field Data	
222	Filtered from topo	
223	Filtered from topo	
400	CLT Field Data	
402	CLT Field Data	
403	CLT Field Data	
404	CLT Field Data	
405	CLT Field Data	
406	CLT Field Data	
407	CLT Field Data	
408	CLT Field Data	
409	CLT Field Data	
410	CLT Field Data	
411	CLT Field Data	
412	CLT Field Data	
416	CLT Field Data	
419	No Access	
421	Filtered from topo	
430	CLT Field Data	
431	CLT Field Data	
432	CLT Field Data	
433	CLT Field Data	
434	CLT Field Data	
435	CLT Field Data	
436	CLT Field Data	
438	CLT Field Data	
440	CLT Field Data	
440	CLT Field Data	
441	CLT Field Data	
442	CLT Field Data	
443	Filtered from topo	
444	CLT Field Data	
445	CLT Field Data	
446	CLT Field Data	
447	CLT Field Data	
448	CLT Field Data	
449	CLT Field Data	
450	CLT Field Data	
451	CLT Field Data	

Origin of Culvert Details		
CLT ID	**Origin of data**	**Location details (Council data only)**
452	CLT Field Data	
452	Emu Plains Study	
500	CLT Field Data	
501	CLT Field Data	
502	CLT Field Data	
503	CLT Field Data	
504	CLT Field Data	
505	CLT Field Data	
506	CLT Field Data	
507	CLT Field Data	
508	CLT Field Data	
509	CLT Field Data	
510	CLT Field Data	
511	CLT Field Data	
513	CLT Field Data	
514	CLT Field Data	
515	CLT Field Data	
516	CLT Field Data	
517	No Access	
518	CLT Field Data	
519	CLT Field Data	
520	CLT Field Data	
521	Filtered from topo	
522	No Access	
523	CLT Field Data	
524	CLT Field Data	
526	No Access	
527	No Access	
528	No Access	
529	No Access	
530	No Access	
531	CLT Field Data	
532	No Access	
533	No Access	
534	Emu Plains Study	
535	CLT Field Data	
536	CLT Field Data	
537	CLT Field Data	
538	No Access	
539	CLT Field Data	
540	CLT Field Data	
541	No Access	
542	No Access	
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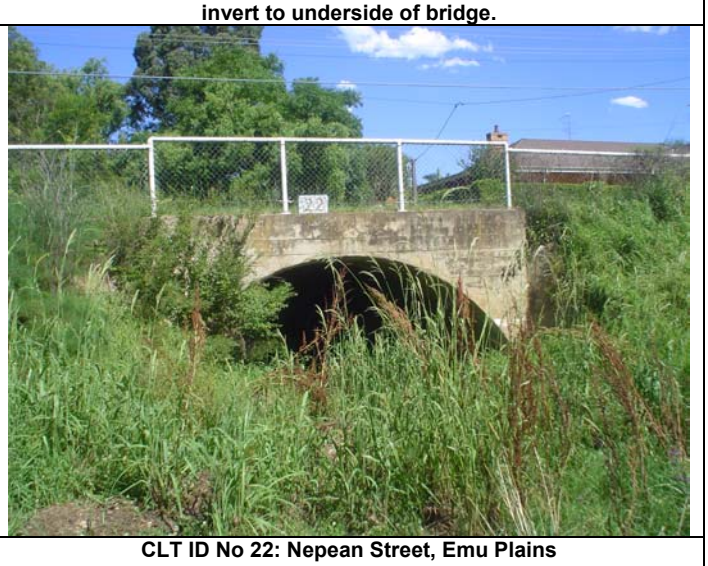
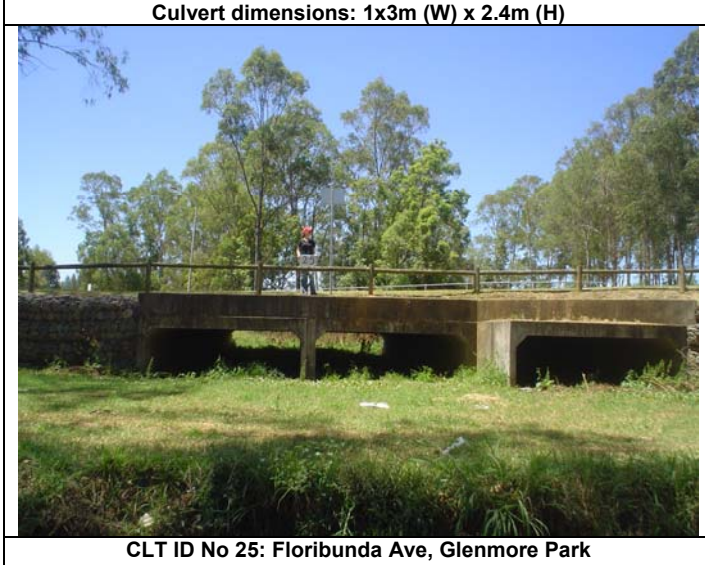
560	No Access	
561	No Access	
562	No Access	
563	No Access	
564	No Access	
565	CLT Field Data	
566	CLT Field Data	
567	CLT Field Data	
568	No Access	
570	CLT Field Data	

Origin of Culvert Details		
CLT ID	**Origin of data**	**Location details (Council data only)**
571	CLT Field Data	
572	CLT Field Data	
573	No Access	
574	CLT Field Data	
575	CLT Field Data	
576	CLT Field Data	
577	CLT Field Data	
578	CLT Field Data	
579	CLT Field Data	
580	CLT Field Data	
581	CLT Field Data	
582	CLT Field Data	
584	Filtered from topo	
585	Filtered from topo	
587	CLT Field Data	
588	CLT Field Data	
589	No Access	
590	CLT Field Data	
591	CLT Field Data	
592	CLT Field Data	
595	CLT Field Data	
597	Filtered from topo	
598	Council Data	
600	Filtered from topo	
601	Filtered from topo	
602	Filtered from topo	
603	Filtered from topo	
605	CLT Field Data	
607	CLT Field Data	
608	Filtered from topo	
609	No Access	
610	CLT Field Data	
611	Emu Plains Study	
612	Filtered from topo	
613	CLT Field Data	
616	CLT Field Data	
619	No Access	
620	CLT Field Data	
621	No Access	
624	CLT Field Data	
625	CLT Field Data	
626	CLT Field Data	
627	CLT Field Data	
628	CLT Field Data	
629	No Access	
630	CLT Field Data	
631	CLT Field Data	
632	CLT Field Data	
633	No Access	
634	CLT Field Data	
635	CLT Field Data	
636	CLT Field Data	
637	CLT Field Data	
638	CLT Field Data	
640	Emu Plains Study	
641	CLT Field Data	
642	CLT Field Data	
643	CLT Field Data	
644	Filtered from topo	
645	Filtered from topo	
646	Filtered from topo	

* - Filtered from topo - the ALS survey had excluded the bridge deck levels and interpolated natural ground levels.
As such no structure was required in the model

	
CLT ID No 5: Littlefields Road, Mulgoa	**CLT ID No 9: Gadara Drive, South Penrith**
Bridge Dimensions: 13.5m wide and 3.5m high	**Trapezoidal channel, 10m at top, 3m at base, 2m high from channel invert to underside of bridge.**
	
CLT ID No 19: Greenhaven Drive, Emu Heights	**CLT ID No 22: Nepean Street, Emu Plains**
Culvert dimensions: 1x3m (W) x 2.4m (H)	**Culvert dimensions: 4m at base**
	
CLT ID No 25: Floribunda Ave, Glenmore Park	**CLT ID No 25T: Floribunda Ave, Glenmore Park**
Culvert dimensions: 3x3.5 (W) x1.5 (H)	**Sediment Trap upstream of culverts**

CLT ID No 30: Victoria Street, Kingswood

Culvert dimensions: 5x3.2 (W) x2 (H)

CLT ID No 31: Bowman Rd, Londonderry

Culvert dimensions : 3 X 1.6m diameter culverts

CLT ID No 32: Carrington Road, Londonderry

Culvert dimensions: 4 x 3.0m (W) x 3.8m (H)

CLT ID No 35: Nepean Street, Mt. Pleasant

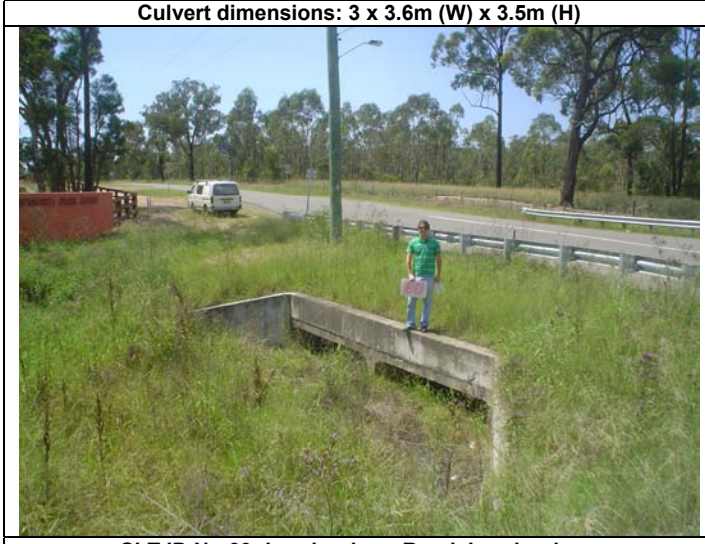
Culvert dimensions: 4 x 2.5m (W) x ~1m (H)

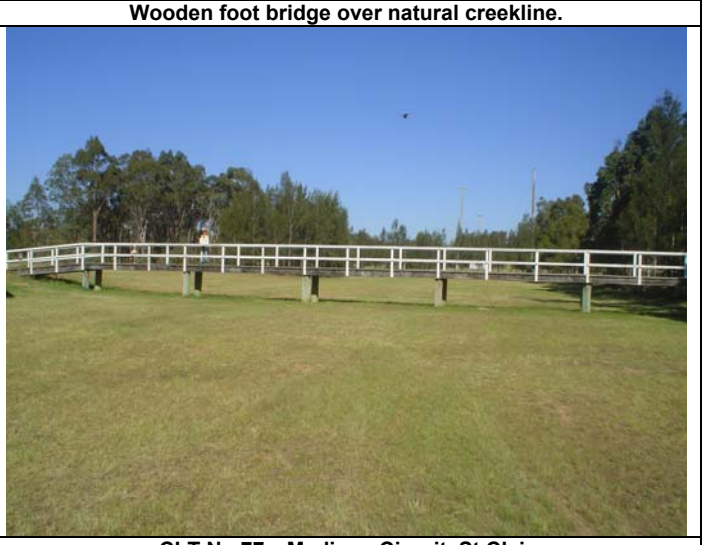
CLT ID No 36: Bowood Way, Mt. Vernon

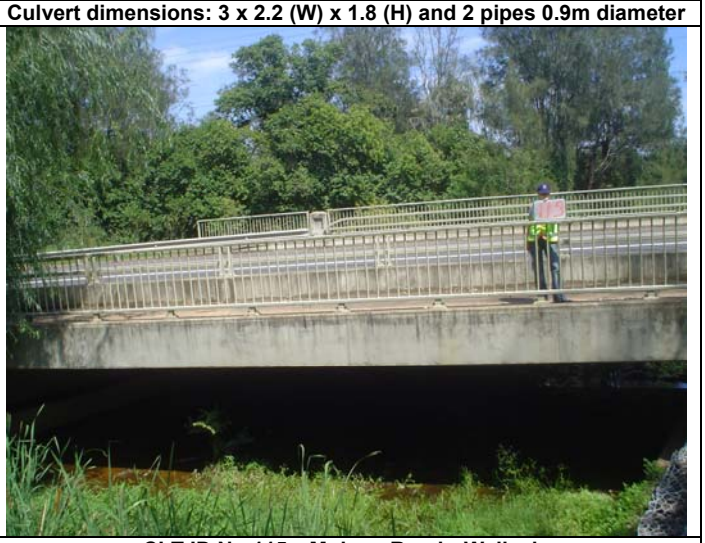
Upstream side. Culvert dimensions: 4 x 1.1m (diameter)

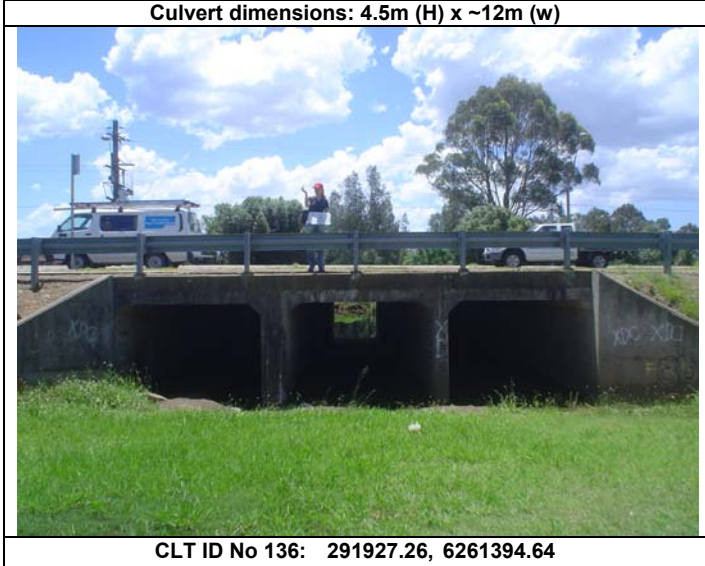
CLT ID No 37: Capitol Hill Drive, Mt. Vernon

Culvert Dimensions: 3 X 4.5m (W) X 1.6m (H)

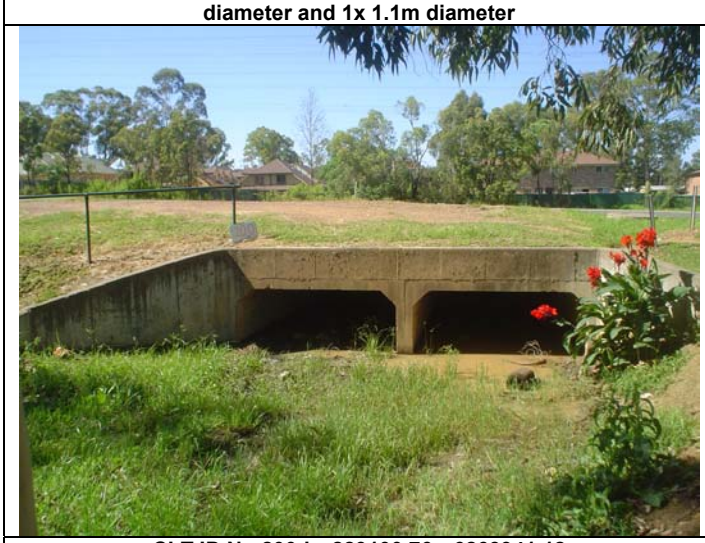
	
CLT ID No 39: Forrestor Road, Nth. St Marys	**CLT ID No 42: York Road, Sth Penrith**
Culvert dimensions: 3 x3.5m(W) x 0.75m(H) and 3x1.4(W)x0.55(H)	**Culvert dimensions: 2 x 3m (W) x 2.2m (H)**
	
CLT ID No 45: John Oxley Drive, Werrington	**CLT ID No 57: St. Marys Road, Berkshire Park**
Culvert dimensions: 3 x 3.6m (W) x 3.5m (H)	**Culvert dimensions: 4 x 1.7m (diameter)**
	
CLT ID No 60: Londonderry Road, Londonderry	**CLT ID No 61: Glossop Street, Nth St Marys**
Culvert dimensions: 2 x 2.9m (W) x 0.6m (H)	**Upstream side. Culvert dimensions: 5 x 1.5m (W) x 1m (H)**

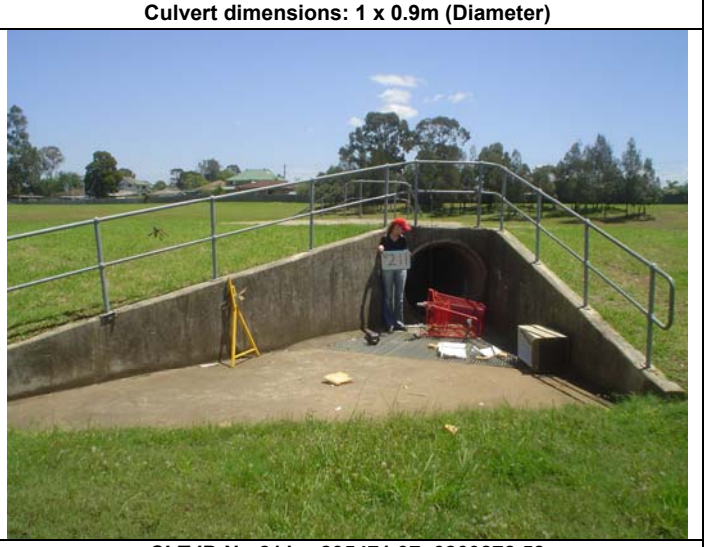
	
CLT ID No 61D: Glossop Street, Nth St Marys	**CLT ID No 62 Werrington Road, Werrington**
Downstream side.	**Culvert dimensions: 3 x 2m(W) x 1.8m(H)**
	
CLT ID No 68: Shaw Park, Cambridge Park	**CLT ID No 70: 111m Sth Gardenia Av, Emu Plains**
2 x 0.9m diameter pies and 1 x 0.6m diameter pipe	**Wooden foot bridge over natural creekline.**
	
CLT ID No 72: Emu Plains Park, Emu Plains	**CLT No 77: Madison Circuit, St.Clair**
0.9m diameter pipe.	**1.3m to underside of bridge.**

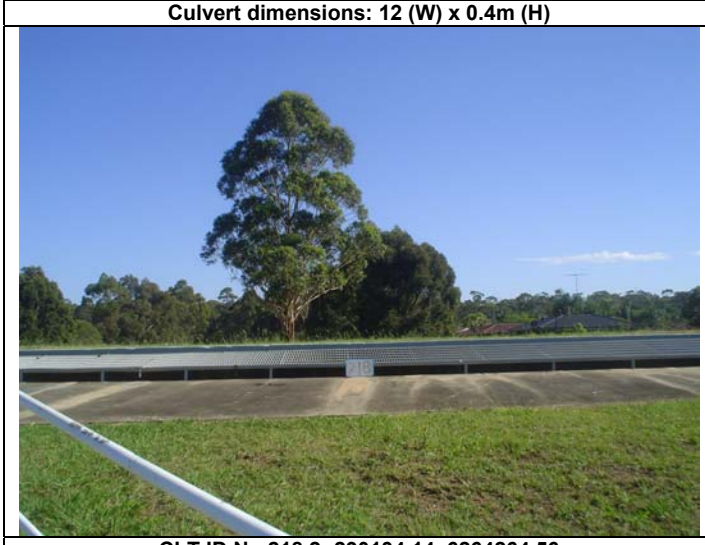
	
CLT No 78: 100m west of Burton St, Werrington	**CLT No 80: Off Glenmore Parkway, Glenmore Park**
Footbridge over creek.	**Footbridge over channel - 7m wide x 2m height**
	
CLT ID No 85: Park Ave, Werrington	**CLT No 110: Mulgoa Road, Regentville**
4 x 2.2m diameter pipes under railway.	**Culvert dimensions: 3 x 2.2 (W) x 1.8 (H) and 2 pipes 0.9m diameter**
	
CLT ID No 112: Mamre Road, St. Clair	**CLT ID No 115: Mulgoa Road, Wallacia**
Culvert dimensions: 6 x 0.9m diameter pipes	**Bridge dimensions: 18m (W) x 2.5m(H)**

Not possible to take photo as too overgrown.	
CLT ID No 116: Park Road, Wallacia	**CLT ID No 126: 283372.21, 6263363.1 (Coordinates -MGA 94, Zone 56)**
Culvert dimensions: 3 x 3.2m (W) x 3m (H)	**Culvert dimensions: 4 X 2m (W) x 2.5m (H) box culverts under rail line in trapezoidal channel**
	
CLT ID No 127: 282701.23, 6263277.23 (Coordinates -MGA 94, Zone 56)	**CLT ID No 131: 281853.93, 6262910.11 (Coordinates -MGA 94, Zone 56)**
Culvert dimensions: 4.5m (H) x ~12m (w)	**No dimensions noted**
	
CLT ID No 136: 291927.26, 6261394.64 (Coordinates -MGA 94, Zone 56)	**CLT ID No 154: 282664.36, 6262011.93 (Coordinates -MGA 94, Zone 56)**
Culvert dimensions: 3 x 2.6 (W) x 2(H)	**Culvert dimensions: 9 x 2.5 (W) x 1.5(H)**

	
CLT ID No 170-2: 284920.66, 6262039.24 (Coordinates - MGA 94, Zone 56)	**CLT ID No 170: 284920.66, 6262039.24 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 6x 3.5 (W) x 2 (H)	**Culvert dimensions: 6x 3.5 (W) x 2 (H)**
	
CLT ID No 190: 297192.01,6271448.64 (Coordinates - MGA 94, Zone 56)	**CLT ID No 194: 289670.96, 6273064.75 (Coordinates - MGA 94, Zone 56)**
Bridge over South Creek	**Bridge dimensions: 9m (W) x 3m (H)**
	
CLT ID No 195: 289370.38, 6272141.29 (Coordinates - MGA 94, Zone 56)	**CLT ID No 196: 289072.96, 6270695.34 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 1 x 2.8 (W) x 1.5 (H)	**Culvert dimensions: 3 x 0.7m diameter**

	
CLT ID No 199d: 289182.32, 6264383.4 (Coordinates - MGA 94, Zone 56)	**CLT ID No 199u:289182.32, 6264383.4 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: Single Culvert 3.5m (W) x 1.5m (H), 2 x 1.6m diameter and 1x 1.1m diameter	**Upstream side, Single Culvert 3.5 (W) x 1.5 (H)**
	
CLT ID No 200d: 289100.76, 6263941.12 (Coordinates - MGA 94, Zone 56)	**CLT ID No 200u: 289100.76, 6263941.12 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 2 x 2.4m (W) 1m (H)- Downstream End	**Culvert dimensions: 2 x 2.4m (W) 1m (H)- Upstream End**
	
CLT ID No 205L: 283090.11, 6260170.53 (Coordinates - MGA 94, Zone 56)	**ID No 205: 283090.11, 6260170.53 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 1 x 0.8m (Diameter)	**Bridge – 3.8m High**

	
CLT ID No 207: 283096.55, 6260348.64 (Coordinates - MGA 94, Zone 56)	**CLT ID No 210: 296357.59, 6253706.43 (Coordinates - MGA 94, Zone 56)**
Dimensions: 7.5m high	**Culvert dimensions: 1 x 0.9m (Diameter)**
	
CLT ID No 211: 295471.97, 6260878.58 (Coordinates - MGA 94, Zone 56)	**CLT ID No 211u: 295471.97, 6260878.58 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 1 x 1.9m (Diameter)	**Culvert dimensions: 1 x 1.9m (Diameter)**
	
CLT ID No 212: 295551.27, 6260699.14 (Coordinates - MGA 94, Zone 56)	**CLT ID No 213u: 295558.59, 6260642.9 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 3 x 1.6m (Diameter)	**Culvert dimensions: Pipes inside 2m (W) x 0.35m (H)**

	
CLT ID No 214: 293375.58, 6260814.72 (Coordinates - MGA 94, Zone 56)	**CLT ID No 216: 293575.22, 6260297.13 (Coordinates - MGA 94, Zone 56)**
Dimensions: 2 x 1.6m diameter pipes – downstream outlet	**Culvert dimensions: 2 x 0.9m (Diameter)**
	
CLT ID No 217: 290133.28, 6264303.1 (Coordinates - MGA 94, Zone 56)	**CLT ID No 218: 290134.14, 6264264.56 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 12 (W) x 0.4m (H)	**Culvert dimensions: 1 x 1.1m (Diameter)**
	
CLT ID No 218 2: 290134.14, 6264264.56 (Coordinates - MGA 94, Zone 56)	**CLT ID No 220: 290109.68, 6264108.9 (Coordinates - MGA 94, Zone 56)**
Dimensions: 13 (W) x 0.2m (H)	**Trap wall with pit and grate. Dimensions: Trap 2 m (W) x 0.6m (H) and 1 x 0.9m (Diameter) culvert**

	
CLT ID No 221: 290114.48, 6264505.37 (Coordinates - MGA 94, Zone 56)	**CLT ID No 221 1: 290114.48, 6264505.37 (Coordinates - MGA 94, Zone 56)**
Culvert Dimensions: 2 x 1.2m (W) X 1m (H) Entry inlet 2.4m (W) x 0.8m (H)	**Pipes leading into CLT ID No 221 – Right Side**
	
CLT ID No 221 2: 290114.48, 6264505.37 (Coordinates - MGA 94, Zone 56)	**CLT ID No 400d: 288991.85, 6263920.57 (Coordinates - MGA 94, Zone 56)**
Pipes leading into CLT ID No 221 - Left Side	**Culvert dimensions: 2 x 1.2m (Diameter)**
	
CLT ID No 402: Parkes Street 292488.81, 6262818.26 (Coordinates - MGA 94, Zone 56)	**CLT ID No 410: 294108.94, 6264067.97 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 1 x 2m (W) 0.5m (H)	**Culvert dimensions: 3 x 0.9m (Diameter)**

	
CLT ID No 411: 288443.49, 6268228.25 (Coordinates - MGA 94, Zone 56)	**CLT ID No 412: Bellatrix Street - 288484.59, 6268053.73 (Coordinates - MGA 94, Zone 56)**
Dimensions: 3 x 1.6m (W)	**Culvert dimensions: 2 x 3m (W) 0.95m (H)**
	
CLT ID No 416: 287224.08, 6259524.86 (Coordinates - MGA 94, Zone 56)	**CLT ID No 432: 286957.45, 6265282.35 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 2 x 0.9m (Diameter)	**Culvert dimensions: 7 x 0.9m (Diameter)**
	
CLT ID No 433: 286938.81, 6265308.98 (Coordinates - MGA 94, Zone 56)	**CLT ID No 434: 286231.89, 6264123.36 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 1 x 0.9m (Diameter) and 1 x 4m (w) x 1.2m (H)	**Culvert dimensions: 1 x2.5m (w) x 2.5m (H) and 1 x 2.5m (w) x 3m (H)**

	
CLT ID No 435: Great Western H'way 285542.94, 6263234.0892 (Coordinates - MGA 94, Zone 56)	**CLT ID No 436: 285767.55, 6262566.97 (Coordinates - MGA 94, Zone 56)**
Bridge dimensions: 4 (W) x 12.5 (H)	**Culvert dimensions: 2x 2 (W) x 1.7 (H)**
	
CLT ID No 438: 285252.82, 6262037.36 (Coordinates - MGA 94, Zone 56)	**CLT ID No 440: 283887.5, 6259960.76 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 2 x 2.6m (W) x 3 (H)	**Downstream end - dimensions: 2 x 2.2m (Diameter)**
	
CLT ID No 440u: 283927.82, 6259886.03 (Coordinates - MGA 94, Zone 56)	**CLT ID No 442: 282887.22, 6256752.72 (Coordinates - MGA 94, Zone 56)**
Upstream box weir with trash rack.	**Inaccessible**

	
CLT ID No 444: 286689.9, 6259819.45 (Coordinates - MGA 94, Zone 56)	**CLT ID No 445: Ridgetop Drive 285530.854, 6257909.6159 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 2 x 1.8m diameter	**Culvert dimensions: 2 x 3.7m (W) x 0.9 m (H), 1 x 1.2m (W) x 0.9m (H), 2 x 3.2m (W) x 2 (H), 5 x 4.2m (W) x 0.9m (H)**
	
CLT ID No 446: 288521.77, 6258802.63 (Coordinates - MGA 94, Zone 56)	**CLT ID No 447: 288973.09, 6259031.96 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 2 x 1.4m diameter	**Culvert dimensions: 3 x 1.4m diameter**
	
CLT ID No 448: Mamre Road -293688.21, 6260063.18 (Coordinates - MGA 94, Zone 56)	**ID No 449: 293515.1, 6258629.6 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 5 x 3.3m (W) x 1.5 m (H)	**Culvert dimensions: 5 x 0.9m diameter with grate over ground**

CLT ID No 450: 293478.29, 6258331.09
(Coordinates - MGA 94, Zone 56)
Culvert dimensions: 5 x 2.2m (W) x 0.9 m (H)

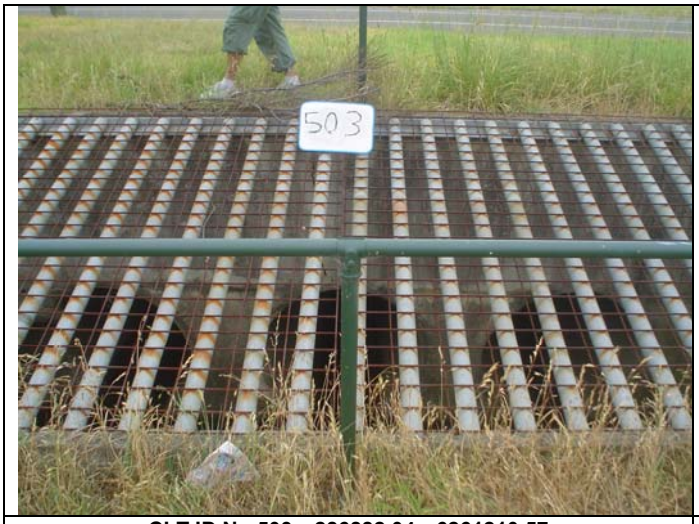
CLT ID No 451: 294136.92, 6256264.21
(Coordinates - MGA 94, Zone 56)
Culvert dimensions: 4 x 3.2m (W) x 1.5 m (H)

CLT ID No 452: Erskine Park 294363.216, 6255968.6288
(Coordinates - MGA 94, Zone 56)
Culvert dimensions: 8 x 3.8m (W) x 0.7 m (H)

CLT ID No 500: 285827.11, 6260693.28
(Coordinates - MGA 94, Zone 56)
Culvert dimensions: 2 x 1.8m diameter

CLT ID No 501: 286587.51, 6261394.43
(Coordinates - MGA 94, Zone 56)
Culvert dimensions: 3 x 1.1 m with Trash Grate on Top

ID No 502: 286500.91, 6261546.84
(Coordinates - MGA 94, Zone 56)
Culvert dimensions: 2 x 1.4 diameter



CLT ID No 503: 286882.04, 6261210.57
(Coordinates - MGA 94, Zone 56)

Upstream Side - Dimensions: 3 x 1.2m diameter pipes

CLT ID No 503d: 286882.04, 6261210.57
(Coordinates - MGA 94, Zone 56)

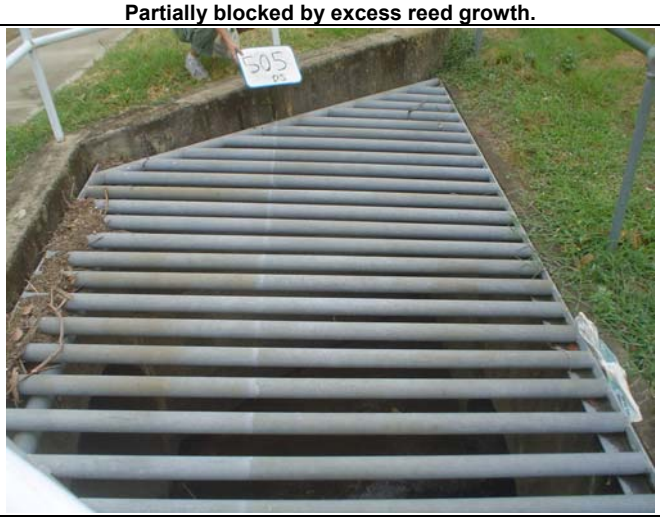
Downstream Side – Dimensions: 1 x 1.4m diameter pipes

CLT ID No 504: 286355.16, 6263880.62
(Coordinates - MGA 94, Zone 56)

Culvert dimensions: 4 x 0.9m (Diameter)
Partially blocked by excess reed growth.

CLT ID No 505: 286442.08, 6260401.64
(Coordinates - MGA 94, Zone 56)

Culvert dimensions: 1 x 1.8m (Diameter)



CLT ID No 505: 286442.08, 6260401.64
(Coordinates - MGA 94, Zone 56)

Culvert dimensions: 1 x 1.8m (Diameter)
Drain inlets are 2.7m wide, 0.2m high

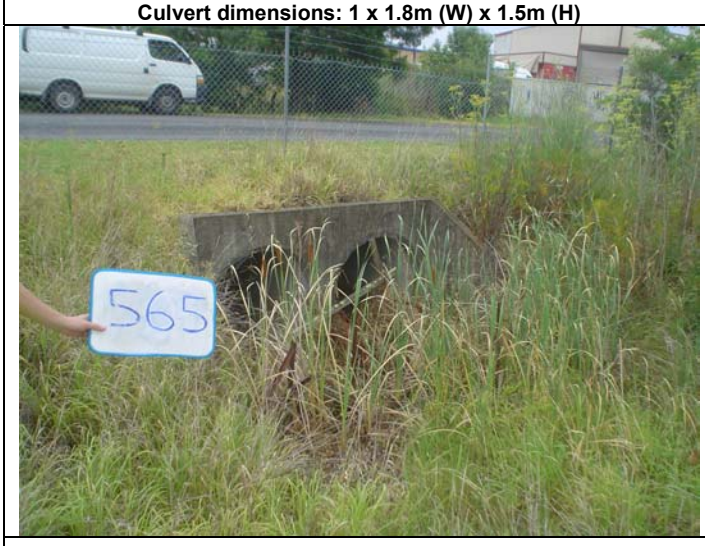
CLT ID No 506: 285648.11, 6262619.68
(Coordinates - MGA 94, Zone 56)

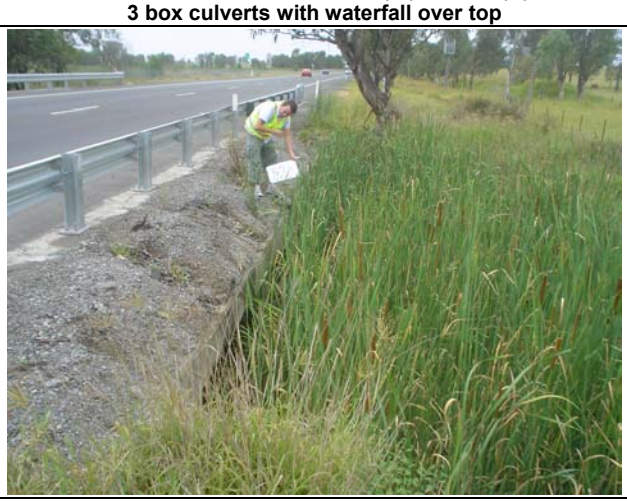
Culvert dimensions: 2 x 3.6m (w) x 1.5m (H)

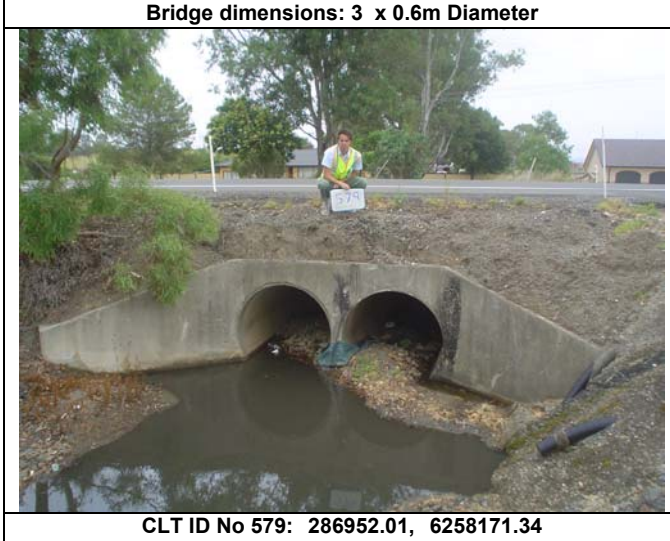
	
CLT ID No 507: 285666.6, 6258280.23 (Coordinates - MGA 94, Zone 56)	**CLT ID No 508: 285715.46, 6259568.72 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 3 x 1.2m (W) 0.6m (H)	**Culvert dimensions: 2 x 2.4m (W) 1.8m (H)**
	
CLT ID No 509: 285702.91, 6259632.32 & CLT ID No 510: 285714.07, 6259722.49 (Coordinates - MGA 94, Zone 56)	**CLT ID No 511: 286130.98, 6259563.63 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 3 x 1.6m (W) x 2.6m (H) No 509 – U/S end under M4, No 510 – D/S end under M4	**Culvert dimensions: 4 x 1.9m (W) x 1.9m (H) No 511 – D/S end under M4**
	
CLT ID No 512: 286130.98, 6259563.63 (Coordinates - MGA 94, Zone 56)	**CLT ID No 513: 286314.78, 6259099.27 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 4 x 1.9m (W) x 1.9m (H) No 512 – U/S end under M4	**Culvert dimensions: 9 x 3.8m (w) x 1.6m (H)**

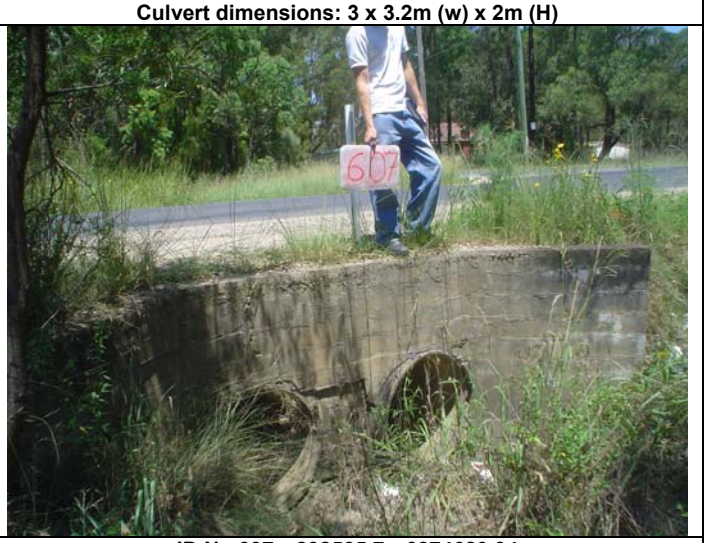
	
CLT ID No 514: 286731.89, 6258364.71 (Coordinates - MGA 94, Zone 56)	**CLT ID No 515: 287450.9, 6259367.44 (Coordinates - MGA 94, Zone 56)**
Dimensions: 4 x 2.6m (W) x 1.3m (H)	**Culvert dimensions: 2 x 1.1m diameter**
	
CLT ID No 516: 288078.92, 6260020.24 (Coordinates - MGA 94, Zone 56)	**CLT ID No 518: 281990, 6263285 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 3 x 1.6m (Diameter)	**Culvert dimensions: 3 x 3m (W) x 1.8m (H)**
	
CLT ID No 519: 283073, 6263922 (Coordinates - MGA 94, Zone 56)	**CLT ID No 520: 281425, 6262290 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 3 x 3m (W) x 1.6m (H)	**Culvert dimensions: 1 x 0.5m (W) x 0.5m (H)**

	
CLT ID No 523: 281684, 6262161 (Coordinates - MGA 94, Zone 56)	**CLT ID No 524: 283220, 6263439 (Coordinates - MGA 94, Zone 56)**
Dimensions: 1 x 3m (W) x 2.4m (H)	**Bridge over trapezoidal channel**
	
CLT ID No 531: 281393, 6260652 (Coordinates - MGA 94, Zone 56)	**CLT ID No 534: 282540, 6261950 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 1 x 0.9m (Diameter)	**Culvert dimensions: 4 x 2m (W) x 1.5m (H)**
	
CLT ID No 535: 287106.43, 6258814.29 (Coordinates - MGA 94, Zone 56)	**CLT ID No 536: 287723.85, 6259214.05 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 3 x 1.1m diameter	**Culvert dimensions: 1 x 0.6m diameter**

	
CLT ID No 537: 292908.16, 6264606.61 (Coordinates - MGA 94, Zone 56)	**CLT ID No 539: 294073.47, 6264125.03 (Coordinates - MGA 94, Zone 56)**
Dimensions: 2 x 0.9m pipe culvert	**Culvert dimensions: 1 x 1.2m (W) x 1.5m (H)**
	
CLT ID No 540: 288078.92, 6260020.24 (Coordinates - MGA 94, Zone 56)	**CLT ID No 552**
Culvert dimensions: 1 x 1.8m (W) x 1.5m (H)	**Culvert dimensions: no access ~ 1200-1600mm**
	
CLT ID No 565: 286588.17, 6263729 (Coordinates - MGA 94, Zone 56)	**CLT ID No 566: 285131.68, 6259902.38 & CLT ID No 567: 285208.316259966.48 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 2 x 1.2m diameter	**Culvert dimensions: 3 x 1.2m diameter**

	
CLT ID No 570: 285677.92, 6258087.59 (Coordinates - MGA 94, Zone 56)	**CLT ID No 571: 285955.68, 6258022.22 (Coordinates - MGA 94, Zone 56)**
Bridge Dimensions: 24.5m (W) x 2m (H) with sandstone base	**Culvert dimensions: 3 x 3m (W) x 0.8m (H) 3 box culverts with waterfall over top**
	
CLT ID No 572: 286045.04, 6257941.76 (Coordinates - MGA 94, Zone 56)	**CLT ID No 574: 286891.47, 6257729.77 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 2 x 3.4m (W) x 0.9m (H)	**Culvert dimensions: 3 x 3m (W) x 1.1m (H)**
	
CLT ID No 575: 286858.98, 6257845.04 (Coordinates - MGA 94, Zone 56)	**CLT ID No 576: 286867.68, 6258021.64 (Coordinates - MGA 94, Zone 56)**
Bridge dimensions: 6m (W) x 1.7m (H)	**Culvert dimensions: 2 x 0.9m diameter to left and 24 x 0.6m diameter pipes to right**

	
CLT ID No 577: 286857.81, 6258082.76 (Coordinates - MGA 94, Zone 56)	**CLT ID No 578: 286820.1, 6262566.97 (Coordinates - MGA 94, Zone 56)**
Bridge dimensions: 3 x 0.6m Diameter	**Culvert dimensions: 4 x 0.9m Diameter**
	
CLT ID No 579: 286952.01, 6258171.34 (Coordinates - MGA 94, Zone 56)	**CLT ID No 580: 282532.62, 6258589.85 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 2 x 1.1m diameter	**Downstream end - dimensions: 2 x 1.6m (W) x 0.7m (H)**
	
CLT ID No 581: 282542.26, 6258861.32 (Coordinates - MGA 94, Zone 56)	**CLT ID No 582: 282429.81, 6259154.47 (Coordinates - MGA 94, Zone 56)**
Dimensions: 1 x 0.47 (W) x 1.2m (H)	**Dimensions: 2 x 0.7m Diameter**

	
CLT ID No 587: 294134.97, 6264062.65 (Coordinates - MGA 94, Zone 56)	**CLT ID No 588: 283398.61, 6263935.36 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 2 x 1.2m diameter	**Culvert dimensions: 2 x 1m (W) x 0.5 m (H)**
	
CLT ID No 590: 292906.01, 6263797.63 (Coordinates - MGA 94, Zone 56)	**CLT ID No 592: 283263.19, 6263930.4 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 2 x 1.3m diameter	**Culvert dimensions: 3 x 3.2m (w) x 2m (H)**
	
CLT ID No 605: 289041.02, 6269791.25 (Coordinates - MGA 94, Zone 56)	**ID No 607: 292535.7, 6274629.34 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 2 x 2.4m (W) x 0.8 m (H)	**Culvert dimensions: 2 x 0.9m diameter**

CLT ID No 610: 293113.96, 6273690.18
(Coordinates - MGA 94, Zone 56)

Culvert dimensions: 2 x 0.7 m Diameter

CLT ID No 613: 285542.6, 6261945.3
(Coordinates - MGA 94, Zone 56)

Culvert dimensions: 2 x 3m (W) x 1.6 m (H)

CLT ID No 620: 294170.39, 6259455.57
(Coordinates - MGA 94, Zone 56)

Culvert dimensions: 3 x 3m (W) x 1.6 m (H)

CLT ID No 624: 282616.53, 6255333.62
(Coordinates - MGA 94, Zone 56)

Culvert dimensions: 2 x 3.2m (W) x 3.2 m (H)

CLT ID No 627: 283038.3, 6253423.02
(Coordinates - MGA 94, Zone 56)

Culvert dimensions: 1 x 2m (W) x 0.8m (H)

ID No 628: 283331.81, 6252570.84
(Coordinates - MGA 94, Zone 56)

Culvert dimensions: 1 x 0.6m diameter

	
CLT ID No 630: 283636.03, 6255368.22 (Coordinates - MGA 94, Zone 56)	**CLT ID No 631: 282797.16, 6256287.01 (Coordinates - MGA 94, Zone 56)**
Dimensions: 1 x 0.7m Diameter	**Culvert Dimensions: 3 x 1.8m (W) x 1.2m (H)**
	
CLT ID No 632: 284035.82, 6253408.08 (Coordinates - MGA 94, Zone 56)	**CLT ID No 634: 294549.21, 6255705.1 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 1 x 0.9m (Diameter)	**Bridge dimensions: no measurements.**
	
CLT ID No 636: 283082.42 , 6249839.66 (Coordinates - MGA 94, Zone 56)	**CLT ID No 637: 289196.39, 6249979.67 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 1 x 1.2m (Diameter)	**Culvert dimensions: 2 x 3.2m (w) x 2m (H)**

	
CLT ID No 638: 282374.27, 6248757.24 (Coordinates - MGA 94, Zone 56)	**CLT ID No 641: 289162.35, 6267133.5 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 3 x 3m (W) 1.2m (H)	**Culvert dimensions: 1 x 1.8m (W) 0.6m (H)**
	
CLT ID No 642: 289804.19, 6263842.34 (Coordinates - MGA 94, Zone 56)	**CLT ID No 643: 289566.64, 6262080.23 (Coordinates - MGA 94, Zone 56)**
Culvert dimensions: 1 x 1.2m Diameter	**Culvert dimensions: 3 x 2.6m (W) x 1.5m (H)**

APPENDIX B:

Sub-catchment Ranking

Table B - Subcatchment Naming Convention	
Tributary Name	**Tributary abbreviation**
Badgerys Creek	BadC_1
Blaxland Creek	BlxC_1
Boundary Creek	BouC_1
Byrnes Creek	ByrC_1
Claremont Creek	ClaC_1
Cosgroves Creek	CC_1
Cranebrook Creek	CbkC_1
Jerrys Creek	JryC_1
Kemps Creek	KC_1
Littlefields Creek	LfC_1
Mulgoa Creek	MgC_1
Nepean River	NepR_1
Oaky Creek	Oaky Creek
Peach Tree Creek	PTC_1
Ropes Creek	RpC_1
School House Creek	ScHC_1
South Creek	SthC_1
Surveyors Creek	SurC_1
Werrington Creek	WC_1

Table B1 - Ranking Summary Table

Ranking based on Hazard Criteria			Ranking based on Depth Criteria			Ranking based on Combined Criteria		
Subcatchment *	**Zone**	**Band**	**Subcatchment**	**Zone**	**Band**	**Subcatchment**	**Zone**	**Band**
Subcatchments Ranked top 10%								
SthC_16	Zone 1	**10%**	PTC_1_1_1	Zone 1	**10%**	NepR_13_10_1	Zone 1	**10%**
NepR_13_10_1	Zone 1	**10%**	NepR_13_10_1	Zone 1	**10%**	SthC_16	Zone 1	**10%**
SurC_2	Zone 1	**10%**	SthC_16	Zone 1	**10%**	PTC_2	Zone 1	**10%**
PTC_2	Zone 1	**10%**	WC_8	Zone 1	**10%**	PTC_1_1_1	Zone 1	**10%**
BouC_6_5	Zone 2	**10%**	PTC_2	Zone 1	**10%**	SurC_2	Zone 1	**10%**
SthC_20_1	Zone 1	**10%**	ByrC_2	Zone 1	**10%**	WC_8	Zone 1	**10%**
SthC_18_1	Zone 1	**10%**	SurC_1a	Zone 1	**10%**	ByrC_2	Zone 1	**10%**
PTC_1	Zone 1	**10%**	PTC_1_1	Zone 1	**10%**	PTC_1	Zone 1	**10%**
PTC_1_1_1	Zone 1	**10%**	PTC_1	Zone 1	**10%**	BouC_6_5	Zone 2	**10%**
NepR_7	Zone 1	**10%**	SurC_2	Zone 1	**10%**	PTC_1_1	Zone 1	**10%**
ByrC_2	Zone 1	**10%**	PTC_2_1	Zone 1	**10%**	SurC_1a	Zone 1	**10%**
WC_8	Zone 1	**10%**	ByrC_5	Zone 1	**10%**	SthC_18_1	Zone 1	**10%**
NepR_11_1_1_1	Zone 1	**10%**	BouC_6_1_1_1	Zone 1	**10%**	SthC_20_1	Zone 1	**10%**
NepR_11_12_1	Zone 1	**10%**	ByrC_6	Zone 1	**10%**	NepR_11_12_1	Zone 1	**10%**
PTC_1_1	Zone 1	**10%**	PTC_2_2	Zone 1	**10%**	ByrC_3	Zone 1	**10%**
NepR_15	Zone 1	**10%**	WC_6	Zone 1	**10%**	SthC_10_5_7	Zone 1	**10%**
SthC_14_4	Zone 1	**10%**	BouC_6_5	Zone 2	**10%**	SthC_14	Zone 1	**10%**
SurC_1a	Zone 1	**10%**	NepR_11_12_1	Zone 1	**10%**	RpC_5	Zone 1	**10%**
ScHC_6_1	Zone 1	**10%**	ByrC_3	Zone 1	**10%**	PTC_2_1	Zone 1	**10%**
ScHC_1	Zone 1	**10%**	NepR_15_1_2_1	Zone 1	**10%**	ScHC_6_1	Zone 1	**10%**
RkbC_4	Zone 2	**10%**	SthC_10_5_7	Zone 1	**10%**	NepR_11_1_1_1	Zone 1	**10%**
WC	Zone 1	**10%**	SthC_18_1	Zone 1	**10%**	ByrC_5	Zone 1	**10%**
RpC_5	Zone 1	**10%**	SthC_10_5_3	Zone 1	**10%**	PTC_3	Zone 1	**10%**
ByrC_3	Zone 1	**10%**	SthC_14	Zone 1	**10%**	WC_8_2	Zone 1	**10%**
Subcatchments Ranked top 10% to 20%								
NepR_15_1a	Zone 1	**20%**	SthC_20_1	Zone 1	**20%**	NepR_7	Zone 1	**20%**
PTC_3	Zone 1	**20%**	SthC_16_8	Zone 1	**20%**	NepR_15	Zone 1	**20%**
SthC_18	Zone 1	**20%**	RkbC_29_5a	Zone 1	**20%**	WC	Zone 1	**20%**
SthC_14	Zone 1	**20%**	SthC_10_5_8	Zone 1	**20%**	SthC_14_4	Zone 1	**20%**
SurC_4_4	Zone 3	**20%**	PTC_1_2	Zone 1	**20%**	RpC	Zone 1	**20%**
SthC_10_5_7	Zone 1	**20%**	RpC_5	Zone 1	**20%**	ScHC_1	Zone 1	**20%**
SurC_8_1	Zone 3	**20%**	WC_8_8	Zone 1	**20%**	NepR_11_8_2_3	Zone 1	**20%**
NepR_11_8_2_3	Zone 1	**20%**	SurC_2_2	Zone 1	**20%**	WC_8_4_3	Zone 1	**20%**
WC_8_2	Zone 1	**20%**	BouC_4_4	Zone 1	**20%**	PTC	Zone 1	**20%**
RkbC_13	Zone 2	**20%**	WC_8_2	Zone 1	**20%**	SurC_4_4	Zone 3	**20%**
RpC_16_1	Zone 1	**20%**	RpC_13	Zone 1	**20%**	NepR_11	Zone 1	**20%**
NepR_11_4	Zone 1	**20%**	PTC_3	Zone 1	**20%**	SthC_16_8	Zone 1	**20%**
WC_1	Zone 1	**20%**	RpC_14	Zone 1	**20%**	WC_8_8	Zone 1	**20%**
SthC_13a	Zone 1	**20%**	NepR_11	Zone 1	**20%**	WC_4	Zone 1	**20%**
RpC_13_1a	Zone 1	**20%**	ScHC_6_1	Zone 1	**20%**	ByrC_6	Zone 1	**20%**
WC_8_4_3	Zone 1	**20%**	SurC_1	Zone 1	**20%**	NepR_11_4	Zone 1	**20%**
SthC_32_3_1	Zone 3	**20%**	RpC	Zone 1	**20%**	NepR_13_3	Zone 1	**20%**
RpC	Zone 1	**20%**	NepR_13_3	Zone 1	**20%**	SthC_24_1	Zone 1	**20%**
RkbC_1	Zone 2	**20%**	SthC_16_11_1	Zone 1	**20%**	NepR_15_1a	Zone 1	**20%**
RkbC_24	Zone 2	**20%**	SthC_25_2	Zone 1	**20%**	RkbC_4	Zone 2	**20%**
PTC_2_1	Zone 1	**20%**	PTC	Zone 1	**20%**	WC_1	Zone 1	**20%**
PTC	Zone 1	**20%**	SthC_10_5	Zone 1	**20%**	SthC_13a	Zone 1	**20%**
PTC_3_1_1	Zone 1	**20%**	NepR_11_1_1_1	Zone 1	**20%**	SthC_18	Zone 1	**20%**
SurC_4_7	Zone 3	**20%**	WC_4_1	Zone 1	**20%**	RkbC_1	Zone 2	**20%**
ByrC_5	Zone 1	**20%**	ByrC	Zone 1	**20%**	PTC_2_1a	Zone 1	**20%**

Ranking based on Hazard Criteria			Ranking based on Depth Criteria			Ranking based on Combined Criteria		
Subcatchment *	**Zone**	**Band**	**Subcatchment**	**Zone**	**Band**	**Subcatchment**	**Zone**	**Band**
Subcatchments Ranked top 20% to 30%								
WC_9	Zone 1	**30%**	WC_8_4_3	Zone 1	**30%**	RkbC_13	Zone 2	**30%**
RkbC_8	Zone 2	**30%**	WC_4	Zone 1	**30%**	SurC	Zone 1	**30%**
WC_4	Zone 1	**30%**	NepR_13_1	Zone 1	**30%**	PTC_3_1_1	Zone 1	**30%**
SthC_24_1	Zone 1	**30%**	SthC_24_1	Zone 1	**30%**	SthC_21	Zone 1	**30%**
SthC_21	Zone 1	**30%**	RpC_18_2	Zone 1	**30%**	PTC_2_3_1	Zone 1	**30%**
SurC_2_1	Zone 1	**30%**	NepR_15	Zone 1	**30%**	SthC_32_3_1	Zone 3	**30%**
BouC_6_1	Zone 1	**30%**	WC	Zone 1	**30%**	SurC_8_1	Zone 3	**30%**
RpC_13_1	Zone 1	**30%**	NepR_11_8_2_3	Zone 1	**30%**	WC_9	Zone 1	**30%**
NepR_11	Zone 1	**30%**	NepR_7	Zone 1	**30%**	BouC_6_7_1	Zone 1	**30%**
MgC_1	Zone 1	**30%**	PTC_2_1a	Zone 1	**30%**	RpC_16_1	Zone 1	**30%**
NepR_15_1_3_1	Zone 1	**30%**	BouC	Zone 1	**30%**	SthC_10_5_4	Zone 1	**30%**
CbkC_2_7_1	Zone 2	**30%**	PTC_2_3_1	Zone 1	**30%**	SthC_16_5	Zone 1	**30%**
SurC	Zone 1	**30%**	SthC_14_4	Zone 1	**30%**	SurC_2_1	Zone 1	**30%**
NepR_13_3	Zone 1	**30%**	SurC_4_4	Zone 3	**30%**	SurC_2_2	Zone 1	**30%**
BouC_6_7_1	Zone 1	**30%**	SthC_13	Zone 1	**30%**	RpC_13_1a	Zone 1	**30%**
SthC_16_5	Zone 1	**30%**	BouC_6_2	Zone 1	**30%**	BouC_6_2	Zone 1	**30%**
BouC_6_7_2	Zone 1	**30%**	ScHC_1	Zone 1	**30%**	SthC_10_5	Zone 1	**30%**
PTC_2_1a	Zone 1	**30%**	RpC_8_3	Zone 1	**30%**	SurC_1	Zone 1	**30%**
ClaC	Zone 1	**30%**	PTC_2_4	Zone 1	**30%**	RkbC_30	Zone 1	**30%**
RkbC	Zone 2	**30%**	NepR_11_4	Zone 1	**30%**	BouC_6_4_3	Zone 1	**30%**
WC_8_8	Zone 1	**30%**	ClaC_1	Zone 1	**30%**	ClaC	Zone 1	**30%**
MgC_4_3	Zone 1	**30%**	SurC	Zone 1	**30%**	RkbC_24	Zone 2	**30%**
ClaC_5	Zone 1	**30%**	SthC_10_5_4	Zone 1	**30%**	SthC_25_2	Zone 1	**30%**
WC_8_1	Zone 1	**30%**	RkbC_30	Zone 1	**30%**	NepR_15_1_3_1	Zone 1	**30%**
KC_17	Zone 3	**30%**	WC_1	Zone 1	**30%**	RkbC_8	Zone 2	**30%**
						SthC_16_11_1	Zone 1	**30%**
Subcatchments Ranked top 30% to 40%								
SthC_16_8	Zone 1	**40%**	BouC_6_4_3	Zone 1	**40%**	RpC_13	Zone 1	**40%**
SthC_17	Zone 1	**40%**	SthC_13a	Zone 1	**40%**	BouC_4	Zone 1	**40%**
PTC_2_3_1	Zone 1	**40%**	SthC_16_9	Zone 1	**40%**	RpC_13_1	Zone 1	**40%**
SthC_10_5_4	Zone 1	**40%**	BouC_6_1_2	Zone 1	**40%**	WC_8_1	Zone 1	**40%**
SthC_16_4	Zone 1	**40%**	RkbC_1	Zone 2	**40%**	KC_17	Zone 3	**40%**
SthC_25_1	Zone 3	**40%**	BouC_4	Zone 1	**40%**	ByrC	Zone 1	**40%**
NepR_16	Zone 1	**40%**	BouC_6_7_1	Zone 1	**40%**	ByrC_9	Zone 1	**40%**
RkbC_17_6	Zone 2	**40%**	SthC_21	Zone 1	**40%**	ClaC_5	Zone 1	**40%**
ClaC_10	Zone 3	**40%**	ByrC_11	Zone 1	**40%**	ByrC_11	Zone 1	**40%**
NepR_13_12	Zone 1	**40%**	NepR_15_1a	Zone 1	**40%**	SthC_25_1	Zone 3	**40%**
SurC_6_1	Zone 1	**40%**	SthC_16_5	Zone 1	**40%**	SurC_4_7	Zone 3	**40%**
BouC_6_4_3	Zone 1	**40%**	NepR_11_12_1a	Zone 1	**40%**	BouC_6_1_1_1	Zone 1	**40%**
RkbC_30	Zone 1	**40%**	PTC_3_1_1	Zone 1	**40%**	BouC_6_7_2	Zone 1	**40%**
RkbC_5	Zone 2	**40%**	ByrC_9	Zone 1	**40%**	SthC_13	Zone 1	**40%**
BouC_6_2	Zone 1	**40%**	RkbC_4	Zone 2	**40%**	MgC_1	Zone 1	**40%**
ByrC_6	Zone 1	**40%**	SthC_18	Zone 1	**40%**	RkbC_5	Zone 2	**40%**
ByrC_9	Zone 1	**40%**	SthC_11_1	Zone 1	**40%**	RpC_14	Zone 1	**40%**
BouC_4	Zone 1	**40%**	WC_2	Zone 1	**40%**	BouC_6_1	Zone 1	**40%**
RkbC_26	Zone 2	**40%**	ClaC	Zone 1	**40%**	SthC_17	Zone 1	**40%**
SthC_6_1	Zone 2	**40%**	WC_9	Zone 1	**40%**	BouC_4_4	Zone 1	**40%**
RpC_16	Zone 1	**40%**	SurC_2_1	Zone 1	**40%**	CbkC_2_7_1	Zone 2	**40%**
MgC_13_17	Zone 3	**40%**	RpC_4	Zone 1	**40%**	RkbC	Zone 2	**40%**
BouC_6_4_1_3	Zone 1	**40%**	SthC_32_3_1	Zone 3	**40%**	RpC_16	Zone 1	**40%**
ByrC_11	Zone 1	**40%**	RkbC_13	Zone 2	**40%**	ClaC_1	Zone 1	**40%**
ScHC_11	Zone 1	**40%**	RpC_19	Zone 3	**40%**			

Ranking based on Hazard Criteria			Ranking based on Depth Criteria			Ranking based on Combined Criteria		
Subcatchment *	**Zone**	**Band**	**Subcatchment**	**Zone**	**Band**	**Subcatchment**	**Zone**	**Band**
Subcatchments Ranked top 40% to 50%								
BouC_3	Zone 1	**50%**	SthC_19	Zone 1	**50%**	WC_2	Zone 1	**50%**
WC_11	Zone 1	**50%**	WC_8_1	Zone 1	**50%**	NepR_15_1_2_1	Zone 1	**50%**
RpC_9	Zone 1	**50%**	KC_17	Zone 3	**50%**	WC_4_1	Zone 1	**50%**
SurC_5	Zone 1	**50%**	SthC_25_1	Zone 3	**50%**	NepR_13_12	Zone 1	**50%**
MgC_43_5	Zone 3	**50%**	RkbC_5	Zone 2	**50%**	PTC_2_2	Zone 1	**50%**
SthC_1_3_7_7	Zone 2	**50%**	RpC_16	Zone 1	**50%**	BouC_6_1_2	Zone 1	**50%**
RpC_15	Zone 1	**50%**	NepR_15_1_3_1	Zone 1	**50%**	MgC_4_3	Zone 1	**50%**
SurC_4	Zone 1	**50%**	ClaC_5	Zone 1	**50%**	RpC_15	Zone 1	**50%**
RkbC_23_6_1_1	Zone 2	**50%**	SurC_8_1	Zone 3	**50%**	PTC_2_4	Zone 1	**50%**
RkbC_17_10_10_1	Zone 2	**50%**	RpC_15	Zone 1	**50%**	RpC_4	Zone 1	**50%**
SthC_10_5	Zone 1	**50%**	BouC_6_2_2_1	Zone 1	**50%**	BouC_3	Zone 1	**50%**
WC_2	Zone 1	**50%**	SthC_15	Zone 1	**50%**	ClaC_10	Zone 3	**50%**
RpC_29	Zone 3	**50%**	RpC_16_1	Zone 1	**50%**	RpC_9	Zone 1	**50%**
LfC	Zone 3	**50%**	RkbC_7_1	Zone 2	**50%**	RpC_18_2	Zone 1	**50%**
MgC_3	Zone 1	**50%**	RpC_13_1a	Zone 1	**50%**	NepR_13_1	Zone 1	**50%**
SurC_4_3a	Zone 1	**50%**	RkbC_8	Zone 2	**50%**	SthC_16_4	Zone 1	**50%**
MgC_13_11_3	Zone 3	**50%**	SthC_14_1	Zone 1	**50%**	SthC_6_1	Zone 2	**50%**
SurC_2_3	Zone 1	**50%**	RpC_13_1	Zone 1	**50%**	RkbC_17_6	Zone 2	**50%**
SurC_2_2	Zone 1	**50%**	RkbC_24	Zone 2	**50%**	SthC_1_3_7_7	Zone 2	**50%**
SurC_1	Zone 1	**50%**	SthC_17	Zone 1	**50%**	MgC_13_17	Zone 3	**50%**
SthC_25_2	Zone 1	**50%**	SthC_9_2	Zone 2	**50%**	MgC_43_5	Zone 3	**50%**
SthC_24	Zone 3	**50%**	ClaC_3	Zone 1	**50%**	WC_6	Zone 1	**50%**
NepR_1_1_1_1	Zone 2	**50%**	RpC_9	Zone 1	**50%**	SthC_19	Zone 1	**50%**
SthC_16_11_1	Zone 1	**50%**	BouC_6_7_2	Zone 1	**50%**	NepR_16	Zone 1	**50%**
RpC_4	Zone 1	**50%**	BouC_3	Zone 1	**50%**	BouC_6_4_1_3	Zone 1	**50%**
						PTC_1_2	Zone 1	**50%**
Subcatchments Ranked top 50% to 60%								
MgC_30_8	Zone 3	**60%**	BouC_6_3	Zone 1	**60%**	SurC_6_1	Zone 1	**60%**
SthC_13	Zone 1	**60%**	SthC_1_3_7_7	Zone 2	**60%**	RkbC_29_5a	Zone 1	**60%**
JryC_7	Zone 3	**60%**	NepR_13_12	Zone 1	**60%**	SthC_10_5_3	Zone 1	**60%**
BlxC_10	Zone 3	**60%**	MgC_43_5	Zone 3	**60%**	SthC_10_5_8	Zone 1	**60%**
RpC_29_1	Zone 3	**60%**	SthC_21_1	Zone 1	**60%**	SthC_16_9	Zone 1	**60%**
ByrC	Zone 1	**60%**	SthC_23_1	Zone 3	**60%**	WC_11	Zone 1	**60%**
ClaC_9	Zone 1	**60%**	RkbC	Zone 2	**60%**	BouC_6_2_2_1	Zone 1	**60%**
ClaC_1	Zone 1	**60%**	MgC_1	Zone 1	**60%**	RkbC_26	Zone 2	**60%**
SthC_1_1	Zone 2	**60%**	SurC_4_2	Zone 1	**60%**	RkbC_23_6_1_1	Zone 2	**60%**
ClaC_2	Zone 1	**60%**	SthC_6_1	Zone 2	**60%**	SurC_2_3	Zone 1	**60%**
SthC_25_7	Zone 1	**60%**	SurC_4_7	Zone 3	**60%**	ScHC_11	Zone 1	**60%**
RpC_13	Zone 1	**60%**	MgC_13_17	Zone 3	**60%**	RkbC_17_10_10_1	Zone 2	**60%**
BouC_6_1_2	Zone 1	**60%**	CbkC_2_7_1	Zone 2	**60%**	SthC_9_2	Zone 2	**60%**
BouC_6_2_4	Zone 1	**60%**	ClaC_8_3	Zone 3	**60%**	SthC_23_1	Zone 3	**60%**
SthC_19	Zone 1	**60%**	BouC_6_1	Zone 1	**60%**	SthC_1_1	Zone 2	**60%**
ClaC_8_3	Zone 3	**60%**	KC_14_3_3	Zone 3	**60%**	ClaC_8_3	Zone 3	**60%**
WC_10	Zone 1	**60%**	ClaC_10	Zone 3	**60%**	BouC_6_3	Zone 1	**60%**
RkbC_12_1_2	Zone 2	**60%**	CbkC_2_6	Zone 2	**60%**	SurC_5	Zone 1	**60%**
RkbC_30_1	Zone 2	**60%**	SthC_1_1	Zone 2	**60%**	SurC_4	Zone 1	**60%**
SthC_23_1	Zone 3	**60%**	MgC_4_3	Zone 1	**60%**	ClaC_3	Zone 1	**60%**
KC_14_3_3	Zone 3	**60%**	RkbC_9_3	Zone 2	**60%**	KC_14_3_3	Zone 3	**60%**
RkbC_17_9_5_1	Zone 2	**60%**	SthC_1_5	Zone 2	**60%**	RpC_29	Zone 3	**60%**
MgC_29	Zone 3	**60%**	RkbC_17_6	Zone 2	**60%**	SthC_25_7	Zone 1	**60%**
BouC_6_2_2_1	Zone 1	**60%**	SthC_16_4	Zone 1	**60%**	BouC	Zone 1	**60%**
RkbC_29_1	Zone 2	**60%**	ScHC_6	Zone 1	**60%**			

Ranking based on Hazard Criteria			Ranking based on Depth Criteria			Ranking based on Combined Criteria		
Subcatchment *	**Zone**	**Band**	**Subcatchment**	**Zone**	**Band**	**Subcatchment**	**Zone**	**Band**
Subcatchments Ranked top 60% to 70%								
SthC_28_2a	Zone 3	**70%**	SthC_25_7	Zone 1	**70%**	SthC_15	Zone 1	**70%**
PTC_2_4	Zone 1	**70%**	SthC_10_10	Zone 2	**70%**	RkbC_7_1	Zone 2	**70%**
SurC_3	Zone 1	**70%**	SurC_2_3	Zone 1	**70%**	NepR_1_1_1_1	Zone 2	**70%**
SthC_9_2	Zone 2	**70%**	BouC_6_4_1_3	Zone 1	**70%**	SurC_4_2	Zone 1	**70%**
JryC_3_7_1	Zone 3	**70%**	RkbC_29_5	Zone 2	**70%**	MgC_13_11_3	Zone 3	**70%**
BouC_6_3	Zone 1	**70%**	ScHC_12_4	Zone 1	**70%**	MgC_3	Zone 1	**70%**
RpC_14	Zone 1	**70%**	WC_11	Zone 1	**70%**	LfC	Zone 3	**70%**
MgC_14_2	Zone 3	**70%**	RkbC_12_1_2	Zone 2	**70%**	RkbC_12_1_2	Zone 2	**70%**
SurC_4_3	Zone 1	**70%**	BouC_6_6	Zone 1	**70%**	RpC_8_3	Zone 1	**70%**
BouC_6_6	Zone 1	**70%**	SthC_12	Zone 2	**70%**	SurC_4_3a	Zone 1	**70%**
SurC_4_2	Zone 1	**70%**	RkbC_23_6_1_1	Zone 2	**70%**	ClaC_9	Zone 1	**70%**
WC_4_1	Zone 1	**70%**	SurC_3	Zone 1	**70%**	SthC_24	Zone 3	**70%**
ClaC_3	Zone 1	**70%**	SurC_6_2	Zone 3	**70%**	RkbC_17_9_5_1	Zone 2	**70%**
MgC_55_6_2	Zone 3	**70%**	RkbC_5_2	Zone 2	**70%**	RkbC_30_1	Zone 2	**70%**
BouC_4_4	Zone 1	**70%**	RkbC_17_10_10_1	Zone 2	**70%**	SurC_3	Zone 1	**70%**
MgC_13_7_5	Zone 3	**70%**	NepR_16	Zone 1	**70%**	RkbC_9_3	Zone 2	**70%**
MgC_32_3	Zone 3	**70%**	SurC_6_1	Zone 1	**70%**	BouC_6_6	Zone 1	**70%**
RkbC_29_5	Zone 2	**70%**	RkbC_17_9_5_1	Zone 2	**70%**	JryC_7	Zone 3	**70%**
CC_9	Zone 3	**70%**	RkbC_26	Zone 2	**70%**	MgC_30_8	Zone 3	**70%**
MgC	Zone 3	**70%**	NepR_1_1_1_1	Zone 2	**70%**	NepR_11_12_1a	Zone 1	**70%**
MgC_54	Zone 3	**70%**	RkbC_30_1	Zone 2	**70%**	RkbC_29_5	Zone 2	**70%**
RkbC_9_3	Zone 2	**70%**	ScHC_11	Zone 1	**70%**	SthC_11_1	Zone 1	**70%**
RpC_18_2	Zone 1	**70%**	SurC_4_3	Zone 1	**70%**	ClaC_2	Zone 1	**70%**
BlxC_18_4	Zone 3	**70%**	RpC_29	Zone 3	**70%**	RkbC_29_1	Zone 2	**70%**
SthC_25	Zone 1	**70%**	RkbC_29_1	Zone 2	**70%**	CbkC_2_6	Zone 2	**70%**
Subcatchments Ranked top 70% to 80%								
NepR_13_1	Zone 1	**80%**	SurC_4	Zone 1	**80%**	RpC_19	Zone 3	**80%**
BouC_6_1_1_1	Zone 1	**80%**	SthC_28_2	Zone 3	**80%**	ScHC_6	Zone 1	**80%**
RkbC_7_1	Zone 2	**80%**	ClaC_9	Zone 1	**80%**	SthC_21_1	Zone 1	**80%**
SthC_15	Zone 1	**80%**	SurC_5	Zone 1	**80%**	SurC_4_3	Zone 1	**80%**
ScHC_6	Zone 1	**80%**	SthC	Zone 3	**80%**	SthC_14_1	Zone 1	**80%**
SthC_16_9	Zone 1	**80%**	ByrC_14	Zone 1	**80%**	BlxC_10	Zone 3	**80%**
RpC_27	Zone 3	**80%**	MgC_13_11_3	Zone 3	**80%**	BouC_6_2_4	Zone 1	**80%**
RpC_30_1	Zone 3	**80%**	SthC_10_3_1	Zone 2	**80%**	MgC_29	Zone 3	**80%**
CbkC_2_6	Zone 2	**80%**	MgC_3	Zone 1	**80%**	RpC_29_1	Zone 3	**80%**
ScHC_12_4	Zone 1	**80%**	SurC_4_3a	Zone 1	**80%**	ScHC_12_4	Zone 1	**80%**
KC_10	Zone 3	**80%**	LfC	Zone 3	**80%**	SthC_28_2a	Zone 3	**80%**
ByrC_14	Zone 1	**80%**	CC_1_1	Zone 3	**80%**	JryC_3_7_1	Zone 3	**80%**
NepR_23	Zone 3	**80%**	MgC_29	Zone 3	**80%**	WC_10	Zone 1	**80%**
NepR_15_1_2_1	Zone 1	**80%**	ClaC_2	Zone 1	**80%**	SurC_6_2	Zone 3	**80%**
CC_12	Zone 3	**80%**	RpC_10	Zone 1	**80%**	MgC_14_2	Zone 3	**80%**
MgC_55_7	Zone 3	**80%**	JryC_7	Zone 3	**80%**	ByrC_14	Zone 1	**80%**
RpC_11	Zone 1	**80%**	SthC_24	Zone 3	**80%**	MgC	Zone 3	**80%**
NepR_36	Zone 3	**80%**	RpC_11	Zone 1	**80%**	MgC_32_3	Zone 3	**80%**
SthC_28_2	Zone 3	**80%**	SthC_28_2a	Zone 3	**80%**	SthC_28_2	Zone 3	**80%**
MgC_31_9	Zone 3	**80%**	RkbC_17_10_2_3_1	Zone 2	**80%**	SthC_25	Zone 1	**80%**
SthC	Zone 3	**80%**	MgC_30_8	Zone 3	**80%**	SthC	Zone 3	**80%**
RpC_10	Zone 1	**80%**	BouC_6_2_4	Zone 1	**80%**	CC_9	Zone 3	**80%**
PTC_2_2	Zone 1	**80%**	MgC	Zone 3	**80%**	MgC_55_6_2	Zone 3	**80%**
BlxC_21_2	Zone 3	**80%**	SthC_31	Zone 1	**80%**	MgC_54	Zone 3	**80%**
SthC_29_2	Zone 3	**80%**	SthC_25	Zone 1	**80%**	MgC_13_7_5	Zone 3	**80%**

Ranking based on Hazard Criteria			Ranking based on Depth Criteria			Ranking based on Combined Criteria		
Subcatchment *	**Zone**	**Band**	**Subcatchment**	**Zone**	**Band**	**Subcatchment**	**Zone**	**Band**
Subcatchments Ranked top 80% to 90%								
SthC_21_1	Zone 1	**90%**	KC_10	Zone 3	**90%**	RpC_11	Zone 1	**90%**
BadC	Zone 3	**90%**	JryC_3_7_1	Zone 3	**90%**	SthC_1_5	Zone 2	**90%**
SurC_6_2	Zone 3	**90%**	NepR	Zone 1	**90%**	KC_10	Zone 3	**90%**
BadC_5	Zone 3	**90%**	MgC_32_3	Zone 3	**90%**	RpC_10	Zone 1	**90%**
NepR	Zone 1	**90%**	BlxC_10	Zone 3	**90%**	SthC_12	Zone 2	**90%**
RkbC_17_10_3	Zone 2	**90%**	RpC_29_1	Zone 3	**90%**	SthC_10_10	Zone 2	**90%**
ScHC_10	Zone 1	**90%**	NepR_36	Zone 3	**90%**	CC_1_1	Zone 3	**90%**
CC_1_1	Zone 3	**90%**	SurC_4_1	Zone 1	**90%**	RpC_30_1	Zone 3	**90%**
RkbC_17_10_2_3_1	Zone 2	**90%**	MgC_14_2	Zone 3	**90%**	RkbC_5_2	Zone 2	**90%**
SthC_29_16	Zone 3	**90%**	BadC_5	Zone 3	**90%**	NepR_36	Zone 3	**90%**
MgC_31_14_1	Zone 3	**90%**	CC_9	Zone 3	**90%**	BlxC_18_4	Zone 3	**90%**
RkbC_30_3	Zone 2	**90%**	MgC_54	Zone 3	**90%**	RkbC_17_10_2_3_1	Zone 2	**90%**
BadC_1	Zone 3	**90%**	RpC_30_1	Zone 3	**90%**	RpC_27	Zone 3	**90%**
BlxC_7_1	Zone 3	**90%**	RpC_1	Zone 2	**90%**	NepR	Zone 1	**90%**
SthC_37	Zone 3	**90%**	MgC_31_9	Zone 3	**90%**	MgC_31_9	Zone 3	**90%**
SthC_14_1	Zone 1	**90%**	MgC_55_6_2	Zone 3	**90%**	CC_12	Zone 3	**90%**
SurC_8_3	Zone 3	**90%**	SthC_37	Zone 3	**90%**	BadC_5	Zone 3	**90%**
BlxC_20_3	Zone 3	**90%**	MgC_13_7_5	Zone 3	**90%**	MgC_55_7	Zone 3	**90%**
RkbC_17	Zone 2	**90%**	RkbC_17	Zone 2	**90%**	NepR_23	Zone 3	**90%**
WC_6	Zone 1	**90%**	ScHC_12_3_3	Zone 1	**90%**	SthC_10_3_1	Zone 2	**90%**
SurC_4_1	Zone 1	**90%**	WC_10	Zone 1	**90%**	SthC_31	Zone 1	**90%**
PTC_1_2	Zone 1	**90%**	RkbC_17_10_3	Zone 2	**90%**	BlxC_21_2	Zone 3	**90%**
SthC_31	Zone 1	**90%**	CC_12	Zone 3	**90%**	BadC	Zone 3	**90%**
ScHC_12_2	Zone 1	**90%**	RpC_27	Zone 3	**90%**	RkbC_17_10_3	Zone 2	**90%**
ScHC_12_3_3	Zone 1	**90%**	BadC	Zone 3	**90%**	SurC_4_1	Zone 1	**90%**
Subcatchments Ranked top 90% to 100%								
RkbC_29_5a	Zone 1	**100%**	MgC_55_7	Zone 3	**100%**	SthC_29_2	Zone 3	**100%**
BouC	Zone 1	**100%**	BlxC_21_2	Zone 3	**100%**	SthC_37	Zone 3	**100%**
SthC_10_5_8	Zone 1	**100%**	BlxC_18_4	Zone 3	**100%**	ScHC_10	Zone 1	**100%**
RpC_19	Zone 3	**100%**	ScHC_10	Zone 1	**100%**	RkbC_17	Zone 2	**100%**
SthC_12	Zone 2	**100%**	NepR_23	Zone 3	**100%**	ScHC_12_3_3	Zone 1	**100%**
SthC_11_1	Zone 1	**100%**	SthC_32_5_2	Zone 3	**100%**	MgC_31_14_1	Zone 3	**100%**
SthC_10_5_3	Zone 1	**100%**	SthC_29_2	Zone 3	**100%**	SthC_29_16	Zone 3	**100%**
RpC_8_3	Zone 1	**100%**	SthC_1_3_7_2_3_2	Zone 2	**100%**	BlxC_7_1	Zone 3	**100%**
RkbC_5_2	Zone 2	**100%**	SurC_8_3	Zone 3	**100%**	RkbC_30_3	Zone 2	**100%**
SthC_10_3_1	Zone 2	**100%**	MgC_31_14_1	Zone 3	**100%**	RpC_1	Zone 2	**100%**
NepR_11_12_1a	Zone 1	**100%**	BlxC_7_1	Zone 3	**100%**	SurC_8_3	Zone 3	**100%**
RpC_1	Zone 2	**100%**	ScHC_12_2	Zone 1	**100%**	BadC_1	Zone 3	**100%**
RpC_10a	Zone 1	**100%**	SthC_29_16	Zone 3	**100%**	BlxC_20_3	Zone 3	**100%**
SthC_1_5	Zone 2	**100%**	RkbC_30_3	Zone 2	**100%**	ScHC_12_2	Zone 1	**100%**
SthC_10_10	Zone 2	**100%**	BadC_1	Zone 3	**100%**	SthC_32_5_2	Zone 3	**100%**
SthC_32_5_2	Zone 3	**100%**	BlxC_20_3	Zone 3	**100%**	SthC_1_3_7_2_3_2	Zone 2	**100%**
SthC_1_3_7_2_3_2_3	Zone 2	**100%**	RpC_10a	Zone 1	**100%**	RpC_10a	Zone 1	**100%**
BlxC_19	Zone 3	**100%**	BlxC_19	Zone 3	**100%**	BlxC_19	Zone 3	**100%**
NepR_4	Zone 1	**100%**	NepR_4	Zone 1	**100%**	NepR_4	Zone 1	**100%**
RpC_19_2	Zone 3	**100%**	RpC_19_2	Zone 3	**100%**	RpC_19_2	Zone 3	**100%**
SthC_10	Zone 2	**100%**	SthC_10	Zone 2	**100%**	SthC_10	Zone 2	**100%**
SthC_10_1	Zone 2	**100%**	SthC_10_1	Zone 2	**100%**	SthC_10_1	Zone 2	**100%**
SthC_10_5_1	Zone 2	**100%**	SthC_10_5_1	Zone 2	**100%**	SthC_10_5_1	Zone 2	**100%**
SthC_10_7	Zone 2	**100%**	SthC_10_7	Zone 2	**100%**	SthC_10_7	Zone 2	**100%**
SthC_11	Zone 2	**100%**	SthC_11	Zone 2	**100%**	SthC_11	Zone 2	**100%**

* Sub-Catchments are not ranked alphabetically within each ranking band

Table B2 - Sub-Catchment Ranking Calculation Table

				Properties affected by FLOOD EXTENT			Properties affected by FLOOD HAZARD								Damage analysis for properties affected by FLOOD EXTENT							Final Ranking		
subcatchment	Zone	Sub-catchment area (ha)	area without areas to be excluded (ha)	properties affected by PMF extent	properties affected by 100yr extent	properties affected by 20 yr extent	properties affected by PMF Hazard	properties affected by 100yr Hazard	properties affected by 20 year Hazard	Hazard weighted PMF	Hazard weighted 100yr	Hazard weighted 20 yr	Total Hazard ARI Weighted	Hazard weighted per hectare	rank	PMF damages (normalised)	100yr damages (normalised)	20yr damages (normalised)	Damages weighted PMF	Damages weighted 100yr	Damages weighted 20yr	Total Damages ARI Weighted	Total Damages weighted per ha	rank	Add hazard and depth rank	Re-Ranked based on hazard and depth	Ranking band
BadC	Zone 3	271	246	10	9	9	9	4	4	0.00	0.04	0.2	0.2	0.00	**201**	829	686	664	0	7	33	40	0.16	**224**	**425**	**222**	**90%**
BadC_1	Zone 3	215	144	1	1	1	1	1	1	0.00	0.01	0.1	0.1	0.00	**212**	100	100	100	0	1	5	6	0.04	**239**	**451**	**236**	**100%**
BadC_5	Zone 3	510	410	31	26	25	21	6	6	0.00	0.06	0.3	0.4	0.00	**203**	2,331	1,804	1,689	0	18	84	103	0.25	**209**	**412**	**216**	**90%**
BlxC_10	Zone 3	621	621	38	36	36	36	35	35	0.00	0.35	1.8	2.1	0.00	**128**	3,604	3,150	3,046	0	32	152	184	0.30	**204**	**332**	**180**	**80%**
BlxC_18_4	Zone 3	191	191	6	6	6	6	6	6	0.00	0.06	0.3	0.4	0.00	**173**	555	468	423	0	5	21	26	0.14	**227**	**400**	**210**	**90%**
BlxC_19	Zone 3	105	105	-	-	-	-	-	-	-	-	-	-	-	**242**	-	-	-	-	-	-	-	-	**242**	**484**	**242**	**100%**
BlxC_20_3	Zone 3	229	229	2	1	1	1	1	1	0.00	0.01	0.1	0.1	0.00	**217**	190	92	92	0	1	5	6	0.02	**240**	**457**	**237**	**100%**
BlxC_21_2	Zone 3	394	394	20	16	16	16	7	7	0.00	0.07	0.4	0.4	0.00	**198**	1,422	1,046	995	0	10	50	60	0.15	**226**	**424**	**221**	**90%**
BlxC_7_1	Zone 3	313	313	5	4	4	3	2	2	0.00	0.02	0.1	0.1	0.00	**213**	373	305	301	0	3	15	18	0.06	**235**	**448**	**232**	**100%**
BouC	Zone 1	71	47	59	41	36	35	-	-	0.00	-	-	0.0	0.00	**226**	4,000	2,086	1,796	0	21	90	111	2.36	**60**	**286**	**149**	**60%**
BouC_3	Zone 1	111	87	30	24	23	28	7	7	0.00	0.07	0.4	0.4	0.00	**100**	2,348	1,467	1,324	0	15	66	81	0.93	**124**	**224**	**110**	**50%**
BouC_4	Zone 1	52	52	95	32	27	42	5	5	0.00	0.05	0.3	0.3	0.01	**92**	5,360	1,716	1,250	1	17	62	80	1.54	**80**	**172**	**77**	**40%**
BouC_4_4	Zone 1	87	85	139	105	94	55	3	3	0.01	0.03	0.2	0.2	0.00	**164**	8,188	5,246	4,451	1	52	223	276	3.25	**33**	**197**	**95**	**40%**
BouC_6_1	Zone 1	72	34	6	6	6	6	5	5	0.00	0.05	0.3	0.3	0.01	**56**	552	457	439	0	5	22	27	0.78	**139**	**195**	**93**	**40%**
BouC_6_1_1_1	Zone 1	71	71	264	134	125	103	2	2	0.01	0.02	0.1	0.1	0.00	**176**	14,776	6,828	5,820	1	68	291	361	5.08	**13**	**189**	**87**	**40%**
BouC_6_1_2	Zone 1	83	83	188	82	54	98	4	4	0.01	0.04	0.2	0.2	0.00	**137**	10,277	3,384	1,916	1	34	96	131	1.57	**78**	**215**	**105**	**50%**
BouC_6_2	Zone 1	90	61	73	46	37	28	6	6	0.00	0.06	0.3	0.4	0.01	**89**	4,400	2,602	1,938	0	26	97	123	2.02	**65**	**154**	**65**	**30%**
BouC_6_2_2_1	Zone 1	90	90	176	43	35	52	4	4	0.01	0.04	0.2	0.2	0.00	**148**	8,490	2,026	1,647	1	20	82	103	1.15	**110**	**258**	**132**	**60%**
BouC_6_2_4	Zone 1	82	82	162	18	5	32	4	4	0.00	0.04	0.2	0.2	0.00	**138**	7,686	877	327	1	9	16	26	0.32	**196**	**334**	**181**	**80%**
BouC_6_3	Zone 1	52	52	131	35	14	62	2	2	0.01	0.02	0.1	0.1	0.00	**155**	6,249	1,581	618	1	16	31	47	0.91	**125**	**280**	**142**	**60%**
BouC_6_4_1_3	Zone 1	80	80	178	19	15	39	7	7	0.00	0.07	0.4	0.4	0.01	**97**	9,107	1,005	832	1	10	42	53	0.66	**153**	**250**	**124**	**50%**
BouC_6_4_3	Zone 1	101	101	97	58	49	47	10	10	0.00	0.10	0.5	0.6	0.01	**86**	5,882	3,157	2,614	1	32	131	163	1.61	**75**	**161**	**69**	**30%**
BouC_6_5	Zone 2	2079	163	327	233	214	230	132	132	0.02	1.32	6.6	7.9	0.05	**5**	23,178	14,139	12,757	2	141	638	782	4.79	**17**	**22**	**9**	**10%**
BouC_6_6	Zone 1	27	26	9	6	4	5	1	1	0.00	0.01	0.1	0.1	0.00	**159**	582	383	253	0	4	13	17	0.64	**158**	**317**	**166**	**70%**
BouC_6_7_1	Zone 1	32	31	15	15	12	9	4	4	0.00	0.04	0.2	0.2	0.01	**64**	1,116	985	751	0	10	38	48	1.53	**81**	**145**	**58**	**30%**
BouC_6_7_2	Zone 1	86	86	45	27	22	15	11	11	0.00	0.11	0.6	0.7	0.01	**66**	2,881	1,539	1,324	0	15	66	82	0.95	**123**	**189**	**87**	**40%**
ByrC	Zone 1	60	60	232	76	60	90	3	3	0.01	0.03	0.2	0.2	0.00	**130**	12,567	3,610	2,729	1	36	136	174	2.90	**49**	**179**	**81**	**40%**
ByrC_11	Zone 1	96	96	281	65	47	56	8	8	0.01	0.08	0.4	0.5	0.01	**98**	13,783	3,027	2,286	1	30	114	146	1.52	**83**	**181**	**84**	**40%**
ByrC_14	Zone 1	38	38	58	10	3	8	1	1	0.00	0.01	0.1	0.1	0.00	**186**	2,923	494	197	0	5	10	15	0.40	**180**	**366**	**190**	**80%**
ByrC_2	Zone 1	81	73	271	190	153	206	37	37	0.02	0.37	1.9	2.2	0.03	**11**	20,846	10,897	8,691	2	109	435	546	7.47	**6**	**17**	**7**	**10%**
ByrC_3	Zone 1	65	65	230	109	92	146	17	17	0.01	0.17	0.9	1.0	0.02	**24**	15,548	5,817	4,827	2	58	241	301	4.63	**19**	**43**	**15**	**10%**
ByrC_5	Zone 1	61	61	269	129	106	108	10	10	0.01	0.10	0.5	0.6	0.01	**49**	14,823	6,515	4,906	1	65	245	312	5.11	**12**	**61**	**22**	**10%**
ByrC_6	Zone 1	52	52	227	115	90	75	5	5	0.01	0.05	0.3	0.3	0.01	**90**	12,064	5,332	4,020	1	53	201	256	4.91	**14**	**104**	**39**	**20%**
ByrC_9	Zone 1	82	82	255	82	37	39	8	8	0.00	0.08	0.4	0.5	0.01	**91**	13,334	3,788	1,642	1	38	82	121	1.48	**88**	**179**	**81**	**40%**
CbkC_2_6	Zone 2	72	72	25	15	15	15	2	2	0.00	0.02	0.1	0.1	0.00	**183**	1,555	964	908	0	10	45	55	0.77	**142**	**325**	**174**	**70%**
CbkC_2_7_1	Zone 2	93	88	27	20	18	17	12	12	0.00	0.12	0.6	0.7	0.01	**61**	1,855	1,261	1,161	0	13	58	71	0.80	**137**	**198**	**96**	**40%**
CC_1_1	Zone 3	307	172	31	22	20	30	2	2	0.00	0.02	0.1	0.1	0.00	**207**	2,393	1,255	1,003	0	13	50	63	0.37	**186**	**393**	**206**	**90%**
CC_12	Zone 3	607	607	25	22	22	26	15	15	0.00	0.15	0.8	0.9	0.00	**189**	2,193	1,829	1,771	0	18	89	107	0.18	**222**	**411**	**215**	**90%**
CC_9	Zone 3	556	493	59	39	33	55	17	17	0.01	0.17	0.9	1.0	0.00	**168**	4,384	2,425	1,934	0	24	97	121	0.25	**210**	**378**	**196**	**80%**
ClaC	Zone 1	112	112	28	23	21	47	14	14	0.00	0.14	0.7	0.8	0.01	**68**	3,321	2,749	2,590	0	27	129	157	1.40	**93**	**161**	**69**	**30%**
ClaC_1	Zone 1	63	62	198	45	36	134	3	3	0.01	0.03	0.2	0.2	0.00	**132**	13,367	2,192	1,781	1	22	89	112	1.81	**70**	**202**	**99**	**40%**
ClaC_10	Zone 3	203	203	61	47	37	53	21	21	0.01	0.21	1.1	1.3	0.01	**83**	4,282	3,108	2,510	0	31	125	157	0.77	**141**	**224**	**110**	**50%**
ClaC_2	Zone 1	61	61	132	8	6	64	3	3	0.01	0.03	0.2	0.2	0.00	**134**	7,653	419	345	1	4	17	22	0.36	**188**	**322**	**172**	**70%**
ClaC_3	Zone 1	59	59	238	17	17	109	2	2	0.01	0.02	0.1	0.1	0.00	**162**	14,702	974	933	1	10	47	58	0.98	**121**	**283**	**145**	**60%**
ClaC_5	Zone 1	69	69	175	40	25	133	8	8	0.01	0.08	0.4	0.5	0.01	**72**	11,503	1,853	1,223	1	19	61	81	1.17	**107**	**179**	**81**	**40%**
ClaC_8_3	Zone 3	227	227	64	48	44	47	11	11	0.00	0.11	0.6	0.7	0.00	**140**	4,408	3,219	2,936	0	32	147	179	0.79	**138**	**278**	**141**	**60%**
ClaC_9	Zone 1	58	58	18	8	6	14	3	3	0.00	0.03	0.2	0.2	0.00	**131**	1,164	492	371	0	5	19	24	0.41	**177**	**308**	**160**	**70%**
JryC_3_7_1	Zone 3	860	756	74	64	56	61	31	31	0.01	0.31	1.6	1.9	0.00	**154**	5,502	4,178	3,744	1	42	187	230	0.30	**201**	**355**	**186**	**80%**
JryC_7	Zone 3	598	568	135	57	51	85	32	32	0.01	0.32	1.6	1.9	0.00	**127**	8,565	3,710	3,275	1	37	164	202	0.36	**190**	**317**	**166**	**70%**
KC_10	Zone 3	567	484	43	41	35	41	13	13	0.00	0.13	0.7	0.8	0.00	**185**	3,668	2,841	2,393	0	28	120	148	0.31	**200**	**385**	**202**	**90%**
KC_14_3_3	Zone 3	546	495	150	118	109	111	23	23	0.01	0.23	1.2	1.4	0.00	**145**	10,144	6,862	6,288	1	69	314	384	0.78	**140**	**285**	**146**	**60%**
KC_17	Zone 3	62	61	21	19	17	19	7	7	0.00	0.07	0.4	0.4	0.01	**74**	1,627	1,379	1,244	0	14	62	76	1.25	**102**	**176**	**80**	**40%**
LfC	Zone 3	310	310	40	30	26	25	20	20	0.00	0.20	1.0	1.2	0.00	**113**	2,935	2,143	1,914	0	21	96	117	0.38	**185**	**298**	**156**	**70%**
MgC	Zone 3	145	145	9	9	9	9	5	5	0.00	0.05	0.3	0.3	0.00	**169**	822	758	755	0	8	38	45	0.31	**197**	**366**	**190**	**80%**
MgC_1	Zone 1	71	71	17	12	12	16	10	10	0.00	0.10	0.5	0.6	0.01	**59**	1,545	1,057	1,014	0	11	51	61	0.87	**132**	**191**	**90**	**40%**
MgC_13_11_3	Zone 3	118	115	16	14	12	12	7	7	0.00	0.07	0.4	0.4	0.00	**116**	1,114	863	733	0	9	37	45	0.39	**181**	**297**	**154**	**70%**
MgC_13_17	Zone 3	245	241	69	58	51	47	22	22	0.00	0.22	1.1	1.3	0.01	**96**	4,678	3,616	3,169	0	36	158	195	0.81	**136**	**232**	**119**	**50%**
MgC_13_7_5	Zone 3	321	226	10	9	9	9	8	8	0.00	0.08	0.4	0.5	0.00	**165**	955	827	790	0	8	39	48	0.21	**217**	**382**	**199**	**80%**
MgC_14_2	Zone 3	403	403	22	21	19	22	16	16	0.00	0.16	0.8	1.0	0.00	**157**	2,150	1,868	1,745	0	19	87	106	0.26	**208**	**365**	**189**	**80%**
MgC_29	Zone 3	44	44	3	3	3	3	2	2	0.00	0.02	0.1	0.1	0.00	**147**	285	271	267	0	3	13	16	0.37	**187**	**334**	**181**	**80%**
MgC_3	Zone 1	31	31	2	2	2	2	2	2	0.00	0.02	0.1	0.1	0.00	**114**	200	200	200	0	2	10	12	0.39	**183**	**297**	**154**	**70%**
MgC_30_8	Zone 3	174	174	12	12	11	11	10	10	0.00	0.10	0.5	0.6	0.00	**125**	1,095	963	916	0	10	46	56	0.32	**195**	**320**	**168**	**70%**
MgC_31_14_1	Zone 3	548	498	7	7	7	7	5	5	0.00	0.05	0.3	0.3	0.00	**210**	597	542	532	0	5	27	32	0.06	**234**	**444**	**230**	**100%**
MgC_31_9	Zone 3	413	413	25	21	21	15	9	9	0.00	0.09	0.5	0.5	0.00	**194**	2,052	1,530	1,473	0	15	74	89	0.22	**214**	**408**	**214**	**90%**
MgC_32_3	Zone 3	198	198	13	13	12	13	7	7	0.00	0.07	0.4	0.4	0.00	**166**	1,128	1,003	975	0	10	49	59	0.30	**203**	**369**	**192**	**80%**
MgC_4_3	Zone 1	84	84	12	12	11	12	10	10	0.00	0.10	0.5	0.6	0.01	**71**	1,178	1,133	1,028	0	11	51	63	0.75	**144**	**215**	**105**	**50%**
MgC_43_5	Zone 3	868	868	321	230	216	250	66	66	0.03	0.66	3.3	4.0	0.00	**104**	20,936	13,855	12,672	2	139	634	774	0.89	**128**	**232**	**119**	**50%**

Table B2 - Sub-Catchment Ranking Calculation Table

				Properties affected by FLOOD EXTENT			Properties affected by FLOOD HAZARD								Damage analysis for properties affected by FLOOD EXTENT							Final Ranking		
subcatchment	Zone	Sub-catchment area (ha)	area without areas to be excluded (ha)	properties affected by PMF extent	properties affected by 100yr extent	properties affected by 20 yr extent	properties affected by PMF Hazard	properties affected by 100yr Hazard	properties affected by 20 year Hazard	Hazard weighted PMF	Hazard weighted 100yr	Hazard weighted 20 yr	Total Hazard ARI Weighted	Hazard weighted per hectare	rank	PMF damages (normalised)	100yr damages (normalised)	20yr damages (normalised)	Damages weighted PMF	Damages weighted 100yr	Damages weighted 20yr	Total Damages ARI Weighted	Total Damages weighted per ha	rank	Add hazard and depth rank	Re-Ranked based on hazard and depth	Ranking band
MgC_54	Zone 3	291	291	17	17	17	16	10	10	0.00	0.10	0.5	0.6	0.00	**170**	1,391	1,210	1,173	0	12	59	71	0.24	**211**	**381**	**198**	**80%**
MgC_55_6_2	Zone 3	407	407	28	24	24	23	15	15	0.00	0.15	0.8	0.9	0.00	**163**	1,964	1,533	1,442	0	15	72	88	0.22	**215**	**378**	**196**	**80%**
MgC_55_7	Zone 3	207	205	14	8	7	11	5	5	0.00	0.05	0.3	0.3	0.00	**190**	995	611	527	0	6	26	33	0.16	**225**	**415**	**217**	**90%**
NepR	Zone 1	113	70	6	5	5	6	1	1	0.00	0.01	0.1	0.1	0.00	**204**	515	352	348	0	4	17	21	0.30	**202**	**406**	**213**	**90%**
NepR_1_1_1_1	Zone 2	652	546	114	72	67	51	32	32	0.01	0.32	1.6	1.9	0.00	**122**	7,625	4,910	4,566	1	49	228	278	0.51	**169**	**291**	**152**	**70%**
NepR_11	Zone 1	64	62	149	71	60	39	9	9	0.00	0.09	0.5	0.5	0.01	**58**	8,717	3,833	3,093	1	38	155	194	3.13	**38**	**96**	**35**	**20%**
NepR_11_1_1_1	Zone 1	83	72	108	65	49	68	31	31	0.01	0.31	1.6	1.9	0.03	**13**	6,961	4,210	3,382	1	42	169	212	2.94	**47**	**60**	**21**	**10%**
NepR_11_12_1	Zone 1	70	55	241	97	81	91	23	23	0.01	0.23	1.2	1.4	0.03	**14**	13,497	4,999	4,158	1	50	208	259	4.71	**18**	**32**	**14**	**10%**
NepR_11_12_1a	Zone 1	23	22	81	14	13	2	-	-	0.00	-	-	0.0	0.00	**235**	3,859	587	534	0	6	27	33	1.50	**86**	**321**	**169**	**70%**
NepR_11_4	Zone 1	84	78	217	68	43	56	16	16	0.01	0.16	0.8	1.0	0.01	**36**	11,497	3,451	2,117	1	35	106	142	1.81	**69**	**105**	**40**	**20%**
NepR_11_8_2_3	Zone 1	104	104	175	96	78	136	23	23	0.01	0.23	1.2	1.4	0.01	**32**	11,316	5,297	4,216	1	53	211	265	2.55	**57**	**89**	**31**	**20%**
NepR_13_1	Zone 1	490	131	308	163	127	32	4	4	0.00	0.04	0.2	0.2	0.00	**175**	16,100	7,286	5,811	2	73	291	365	2.79	**52**	**227**	**114**	**50%**
NepR_13_10_1	Zone 1	97	51	293	154	140	187	80	80	0.02	0.80	4.0	4.8	0.09	**2**	20,749	9,436	8,070	2	94	403	500	9.80	**2**	**4**	**1**	**10%**
NepR_13_12	Zone 1	30	10	22	7	1	9	1	1	0.00	0.01	0.1	0.1	0.01	**84**	1,328	410	95	0	4	5	9	0.90	**127**	**211**	**103**	**50%**
NepR_13_3	Zone 1	201	105	177	106	98	28	14	14	0.00	0.14	0.7	0.8	0.01	**63**	10,223	5,762	5,231	1	58	262	320	3.05	**42**	**105**	**40**	**20%**
NepR_15	Zone 1	59	59	72	53	48	62	24	24	0.01	0.24	1.2	1.4	0.02	**16**	4,700	2,821	2,527	0	28	126	155	2.63	**55**	**71**	**26**	**20%**
NepR_15_1_2_1	Zone 1	48	48	175	85	62	114	1	1	0.01	0.01	0.1	0.1	0.00	**188**	11,551	4,415	3,173	1	44	159	204	4.25	**20**	**208**	**101**	**50%**
NepR_15_1_3_1	Zone 1	80	80	50	28	25	35	11	11	0.00	0.11	0.6	0.7	0.01	**60**	3,504	1,793	1,516	0	18	76	94	1.18	**106**	**166**	**73**	**30%**
NepR_15_1a	Zone 1	19	4	28	1	1	24	1	1	0.00	0.01	0.1	0.1	0.02	**25**	1,572	100	98	0	1	5	6	1.52	**84**	**109**	**43**	**20%**
NepR_16	Zone 1	123	113	32	23	13	43	12	12	0.00	0.12	0.6	0.7	0.01	**81**	2,006	1,396	906	0	14	45	59	0.53	**165**	**246**	**123**	**50%**
NepR_23	Zone 3	51	40	1	1	1	1	1	1	0.00	0.01	0.1	0.1	0.00	**187**	85	74	73	0	1	4	4	0.11	**229**	**416**	**218**	**90%**
NepR_36	Zone 3	512	478	45	35	32	26	11	11	0.00	0.11	0.6	0.7	0.00	**192**	3,403	2,397	2,166	0	24	108	133	0.28	**206**	**398**	**209**	**90%**
NepR_4	Zone 1	52	0	-	-	-	-	-	-	-	-	-	-	-	**242**	-	-	-	-	-	-	-	-	**242**	**484**	**242**	**100%**
NepR_7	Zone 1	80	62	61	37	33	40	33	33	0.00	0.33	1.7	2.0	0.03	**10**	4,221	2,718	2,526	0	27	126	154	2.48	**58**	**68**	**25**	**20%**
PTC	Zone 1	106	64	87	62	53	81	11	11	0.01	0.11	0.6	0.7	0.01	**46**	6,332	3,716	3,034	1	37	152	189	2.96	**45**	**91**	**33**	**20%**
PTC_1	Zone 1	85	72	264	200	154	199	44	44	0.02	0.44	2.2	2.7	0.04	**8**	16,969	9,963	7,674	2	100	384	485	6.74	**9**	**17**	**7**	**10%**
PTC_1_1	Zone 1	103	103	427	274	216	198	42	42	0.02	0.42	2.1	2.5	0.02	**15**	25,633	14,234	11,220	3	142	561	706	6.85	**8**	**23**	**10**	**10%**
PTC_1_1_1	Zone 1	56	56	315	252	224	265	31	31	0.03	0.31	1.6	1.9	0.03	**9**	21,999	13,395	11,563	2	134	578	714	12.76	**1**	**10**	**4**	**10%**
PTC_1_2	Zone 1	71	71	188	110	90	83	-	-	0.01	-	-	0.0	0.00	**221**	11,250	5,445	4,083	1	54	204	260	3.66	**29**	**250**	**124**	**50%**
PTC_2	Zone 1	52	20	113	64	46	135	17	17	0.01	0.17	0.9	1.0	0.05	**4**	11,138	3,543	2,532	1	35	127	163	8.16	**5**	**9**	**3**	**10%**
PTC_2_1	Zone 1	107	104	341	225	182	301	18	18	0.03	0.18	0.9	1.1	0.01	**45**	24,375	11,532	9,219	2	115	461	579	5.56	**11**	**56**	**19**	**10%**
PTC_2_1a	Zone 1	24	24	16	16	16	16	3	3	0.00	0.03	0.2	0.2	0.01	**67**	1,312	1,005	964	0	10	48	58	2.43	**59**	**126**	**49**	**20%**
PTC_2_2	Zone 1	64	64	237	145	106	93	1	1	0.01	0.01	0.1	0.1	0.00	**197**	13,188	6,562	4,882	1	66	244	311	4.86	**15**	**212**	**104**	**50%**
PTC_2_3_1	Zone 1	102	102	291	123	80	129	11	11	0.01	0.11	0.6	0.7	0.01	**77**	15,778	5,505	3,654	2	55	183	239	2.35	**61**	**138**	**54**	**30%**
PTC_2_4	Zone 1	97	97	176	75	64	95	4	4	0.01	0.04	0.2	0.2	0.00	**151**	9,685	3,432	2,860	1	34	143	178	1.84	**68**	**219**	**108**	**50%**
PTC_3	Zone 1	89	28	39	28	24	39	7	7	0.00	0.07	0.4	0.4	0.02	**26**	3,077	1,680	1,425	0	17	71	88	3.16	**36**	**62**	**23**	**10%**
PTC_3_1_1	Zone 1	36	36	18	13	13	17	6	6	0.00	0.06	0.3	0.4	0.01	**47**	1,452	915	884	0	9	44	53	1.49	**87**	**134**	**52**	**30%**
RkbC	Zone 2	347	346	106	84	68	81	43	43	0.01	0.43	2.2	2.6	0.01	**69**	8,710	5,811	4,933	1	58	247	306	0.88	**131**	**200**	**97**	**40%**
RkbC_1	Zone 2	214	154	74	54	54	52	28	28	0.01	0.28	1.4	1.7	0.01	**43**	6,017	4,047	3,939	1	40	197	238	1.55	**79**	**122**	**48**	**20%**
RkbC_12_1_2	Zone 2	694	653	185	138	117	75	31	31	0.01	0.31	1.6	1.9	0.00	**142**	12,467	7,888	6,742	1	79	337	417	0.64	**157**	**299**	**157**	**70%**
RkbC_13	Zone 2	128	128	51	36	33	46	28	28	0.00	0.28	1.4	1.7	0.01	**34**	4,565	3,073	2,843	0	31	142	173	1.35	**98**	**132**	**50**	**30%**
RkbC_17	Zone 2	360	326	64	25	21	7	1	1	0.00	0.01	0.1	0.1	0.00	**218**	3,658	1,298	1,079	0	13	54	67	0.21	**218**	**436**	**228**	**100%**
RkbC_17_10_10_1	Zone 2	217	217	52	36	30	28	15	15	0.00	0.15	0.8	0.9	0.00	**109**	3,706	2,199	1,908	0	22	95	118	0.54	**164**	**273**	**137**	**60%**
RkbC_17_10_2_3	Zone 2	716	716	148	81	72	44	8	8	0.00	0.08	0.4	0.5	0.00	**208**	8,811	4,444	3,812	1	44	191	236	0.33	**194**	**402**	**211**	**90%**
RkbC_17_10_3	Zone 2	866	863	108	54	43	37	12	12	0.00	0.12	0.6	0.7	0.00	**205**	6,868	3,177	2,622	1	32	131	164	0.19	**221**	**426**	**223**	**90%**
RkbC_17_6	Zone 2	613	521	217	112	98	148	55	55	0.01	0.55	2.8	3.3	0.01	**82**	16,234	7,015	6,110	2	70	305	377	0.72	**147**	**229**	**117**	**50%**
RkbC_17_9_5_1	Zone 2	279	43	6	6	6	5	2	2	0.00	0.02	0.1	0.1	0.00	**146**	467	388	372	0	4	19	23	0.52	**167**	**313**	**162**	**70%**
RkbC_23_6_1_1	Zone 2	531	449	115	78	73	78	32	32	0.01	0.32	1.6	1.9	0.00	**108**	7,910	4,868	4,501	1	49	225	275	0.61	**160**	**268**	**134**	**60%**
RkbC_24	Zone 2	88	88	27	18	18	17	16	16	0.00	0.16	0.8	1.0	0.01	**44**	2,174	1,547	1,505	0	15	75	91	1.03	**118**	**162**	**71**	**30%**
RkbC_26	Zone 2	134	134	27	17	15	17	13	13	0.00	0.13	0.7	0.8	0.01	**93**	2,177	1,296	1,115	0	13	56	69	0.51	**168**	**261**	**133**	**60%**
RkbC_29_1	Zone 2	134	134	27	18	15	12	6	6	0.00	0.06	0.3	0.4	0.00	**149**	1,838	1,143	960	0	11	48	60	0.44	**174**	**323**	**173**	**70%**
RkbC_29_5	Zone 2	148	145	35	26	24	17	5	5	0.00	0.05	0.3	0.3	0.00	**167**	2,390	1,662	1,550	0	17	77	94	0.65	**154**	**321**	**169**	**70%**
RkbC_29_5a	Zone 1	21	20	90	30	25	15	-	-	0.00	-	-	0.0	0.00	**225**	4,584	1,485	1,211	0	15	61	76	3.79	**27**	**252**	**127**	**60%**
RkbC_30	Zone 1	82	82	319	68	45	86	8	8	0.01	0.08	0.4	0.5	0.01	**87**	16,425	2,861	2,099	2	29	105	135	1.65	**73**	**160**	**68**	**30%**
RkbC_30_1	Zone 2	85	85	19	13	10	11	4	4	0.00	0.04	0.2	0.2	0.00	**143**	1,326	848	657	0	8	33	41	0.49	**170**	**313**	**162**	**70%**
RkbC_30_3	Zone 2	117	117	6	1	1	1	1	1	0.00	0.01	0.1	0.1	0.00	**211**	350	90	86	0	1	4	5	0.04	**238**	**449**	**233**	**100%**
RkbC_4	Zone 2	75	35	18	13	13	15	11	11	0.00	0.11	0.6	0.7	0.02	**21**	1,514	865	825	0	9	41	50	1.43	**89**	**110**	**44**	**20%**
RkbC_5	Zone 2	81	81	25	22	21	22	8	8	0.00	0.08	0.4	0.5	0.01	**88**	2,167	1,730	1,647	0	17	82	100	1.23	**104**	**192**	**91**	**40%**
RkbC_5_2	Zone 2	93	16	3	3	3	3	-	-	0.00	-	-	0.0	0.00	**233**	203	158	150	0	2	7	9	0.57	**163**	**396**	**208**	**90%**
RkbC_7_1	Zone 2	100	100	39	28	28	26	3	3	0.00	0.03	0.2	0.2	0.00	**177**	2,755	1,886	1,859	0	19	93	112	1.12	**113**	**290**	**151**	**70%**
RkbC_8	Zone 2	148	148	51	32	31	43	24	24	0.00	0.24	1.2	1.4	0.01	**51**	4,513	2,754	2,650	0	28	133	161	1.08	**115**	**166**	**73**	**30%**
RkbC_9_3	Zone 2	122	122	50	28	27	16	4	4	0.00	0.04	0.2	0.2	0.00	**171**	3,177	1,654	1,483	0	17	74	91	0.75	**145**	**316**	**165**	**70%**
RpC	Zone 1	81	61	283	97	67	97	11	11	0.01	0.11	0.6	0.7	0.01	**42**	14,963	4,217	2,862	1	42	143	187	3.06	**41**	**83**	**29**	**20%**
RpC_1	Zone 2	59	15	1	1	1	1	-	-	0.00	-	-	0.0	0.00	**236**	100	59	58	0	1	3	4	0.23	**213**	**449**	**233**	**100%**
RpC_10	Zone 1	63	50	101	18	3	12	1	1	0.00	0.01	0.1	0.1	0.00	**196**	4,909	755	198	0	8	10	18	0.36	**189**	**385**	**202**	**90%**
RpC_10a	Zone 1	25	20	26	-	-	1	-	-	0.00	-	-	0.0	0.00	**237**	1,304	-	-	0	-	-	0	0.01	**241**	**478**	**241**	**100%**
RpC_11	Zone 1	108	84	88	13	11	7	2	2	0.00	0.02	0.1	0.1	0.00	**191**	3,859	598	463	0	6	23	30	0.35	**192**	**383**	**200**	**90%**

Table B2 - Sub-Catchment Ranking Calculation Table

				Properties affected by FLOOD EXTENT			Properties affected by FLOOD HAZARD								Damage analysis for properties affected by FLOOD EXTENT							Final Ranking		
subcatchment	Zone	Sub-catchment area (ha)	area without areas to be excluded (ha)	properties affected by PMF extent	properties affected by 100yr extent	properties affected by 20 yr extent	properties affected by PMF Hazard	properties affected by 100yr Hazard	properties affected by 20 year Hazard	Hazard weighted PMF	Hazard weighted 100yr	Hazard weighted 20 yr	Total Hazard ARI Weighted	Hazard weighted per hectare	rank	PMF damages (normalised)	100yr damages (normalised)	20yr damages (normalised)	Damages weighted PMF	Damages weighted 100yr	Damages weighted 20yr	Total Damages ARI Weighted	Total Damages weighted per ha	rank	Add hazard and depth rank	Re-Ranked based on hazard and depth	Ranking band
RpC_13	Zone 1	43	43	209	67	41	103	2	2	0.01	0.02	0.1	0.1	0.00	**136**	13,820	3,329	2,040	1	33	102	137	3.18	**35**	**171**	**76**	**40%**
RpC_13_1	Zone 1	81	68	91	36	10	12	10	10	0.00	0.10	0.5	0.6	0.01	**56**	4,795	2,085	989	0	21	49	71	1.04	**117**	**173**	**78**	**40%**
RpC_13_1a	Zone 1	37	32	75	6	6	25	6	6	0.00	0.06	0.3	0.4	0.01	**39**	4,385	583	577	0	6	29	35	1.10	**114**	**153**	**64**	**30%**
RpC_14	Zone 1	85	79	290	102	76	89	3	3	0.01	0.03	0.2	0.2	0.00	**156**	15,510	5,061	3,933	2	51	197	249	3.15	**37**	**193**	**92**	**40%**
RpC_15	Zone 1	85	82	289	52	25	28	6	6	0.00	0.06	0.3	0.4	0.00	**106**	13,214	2,323	1,407	1	23	70	95	1.16	**109**	**215**	**105**	**50%**
RpC_16	Zone 1	66	66	182	37	27	43	6	6	0.00	0.06	0.3	0.4	0.01	**95**	8,925	1,604	1,251	1	16	63	80	1.20	**105**	**200**	**97**	**40%**
RpC_16_1	Zone 1	42	24	6	5	5	6	5	5	0.00	0.05	0.3	0.3	0.01	**35**	574	470	446	0	5	22	27	1.13	**112**	**147**	**59**	**30%**
RpC_18_2	Zone 1	105	97	375	136	96	98	3	3	0.01	0.03	0.2	0.2	0.00	**172**	20,111	5,849	4,030	2	58	201	262	2.70	**54**	**226**	**113**	**50%**
RpC_19	Zone 3	116	24	71	15	12	13	-	-	0.00	-	-	0.0	0.00	**228**	3,555	636	500	0	6	25	32	1.32	**99**	**327**	**175**	**80%**
RpC_19_2	Zone 3	69	0	-	-	-	-	-	-	-	-	-	-	-	**242**	-	-	-	-	-	-	-	-	**242**	**484**	**242**	**100%**
RpC_27	Zone 3	357	339	13	13	13	13	10	10	0.00	0.10	0.5	0.6	0.00	**181**	1,139	1,017	971	0	10	49	59	0.17	**223**	**404**	**212**	**90%**
RpC_29	Zone 3	178	178	55	34	23	27	12	12	0.00	0.12	0.6	0.7	0.00	**112**	3,072	1,747	1,239	0	17	62	80	0.45	**173**	**285**	**146**	**60%**
RpC_29_1	Zone 3	108	108	22	12	6	18	6	6	0.00	0.06	0.3	0.4	0.00	**129**	1,272	761	474	0	8	24	31	0.29	**205**	**334**	**181**	**80%**
RpC_30_1	Zone 3	35	35	11	11	2	9	1	1	0.00	0.01	0.1	0.1	0.00	**182**	633	401	84	0	4	4	8	0.24	**212**	**394**	**207**	**90%**
RpC_4	Zone 1	62	35	38	21	14	12	2	2	0.00	0.02	0.1	0.1	0.00	**124**	2,377	1,014	754	0	10	38	48	1.37	**96**	**220**	**109**	**50%**
RpC_5	Zone 1	46	25	32	26	21	22	7	7	0.00	0.07	0.4	0.4	0.02	**23**	2,533	1,645	1,373	0	16	69	85	3.41	**30**	**53**	**18**	**10%**
RpC_8_3	Zone 1	74	74	331	109	38	16	-	-	0.00	-	-	0.0	0.00	**232**	17,126	4,795	1,885	2	48	94	144	1.94	**67**	**299**	**157**	**70%**
RpC_9	Zone 1	80	52	23	15	14	10	4	4	0.00	0.04	0.2	0.2	0.00	**102**	1,583	958	804	0	10	40	50	0.96	**122**	**224**	**110**	**50%**
ScHC_1	Zone 1	78	78	82	36	34	46	25	25	0.00	0.25	1.3	1.5	0.02	**20**	5,892	2,746	2,586	1	27	129	157	2.02	**66**	**86**	**30**	**20%**
ScHC_10	Zone 1	82	82	240	5	2	70	1	1	0.01	0.01	0.1	0.1	0.00	**206**	11,805	239	139	1	2	7	11	0.13	**228**	**434**	**227**	**100%**
ScHC_11	Zone 1	100	100	188	15	10	80	8	8	0.01	0.08	0.4	0.5	0.00	**99**	9,858	934	764	1	9	38	49	0.49	**171**	**270**	**136**	**60%**
ScHC_12_2	Zone 1	32	32	111	4	-	26	-	-	0.00	-	-	0.0	0.00	**223**	5,210	129	-	1	1	-	2	0.06	**236**	**459**	**238**	**100%**
ScHC_12_3_3	Zone 1	42	42	94	8	3	33	-	-	0.00	-	-	0.0	0.00	**224**	4,575	341	92	0	3	5	8	0.20	**219**	**443**	**229**	**100%**
ScHC_12_4	Zone 1	38	38	82	9	8	27	1	1	0.00	0.01	0.1	0.1	0.00	**184**	4,091	444	390	0	4	19	24	0.64	**155**	**339**	**184**	**80%**
ScHC_6	Zone 1	34	34	76	8	7	15	1	1	0.00	0.01	0.1	0.1	0.00	**179**	3,755	409	381	0	4	19	24	0.69	**149**	**328**	**176**	**80%**
ScHC_6_1	Zone 1	58	58	149	60	45	84	19	19	0.01	0.19	1.0	1.1	0.02	**19**	9,905	3,702	2,859	1	37	143	181	3.12	**39**	**58**	**20**	**10%**
SthC	Zone 3	467	423	106	55	48	74	9	9	0.01	0.09	0.5	0.5	0.00	**195**	6,547	3,169	2,740	1	32	137	169	0.40	**179**	**374**	**195**	**80%**
SthC_1_1	Zone 2	531	430	151	90	87	78	22	22	0.01	0.22	1.1	1.3	0.00	**133**	10,429	5,791	5,406	1	58	270	329	0.77	**143**	**276**	**140**	**60%**
SthC_1_3_7_2_3_2	Zone 2	180	41	1	1	1	1	-	-	0.00	-	-	0.0	0.00	**241**	70	64	64	0	1	3	4	0.09	**232**	**473**	**240**	**100%**
SthC_1_3_7_7	Zone 2	505	253	85	71	60	60	19	19	0.01	0.19	1.0	1.1	0.00	**105**	6,110	4,450	3,666	1	44	183	228	0.90	**126**	**231**	**118**	**50%**
SthC_1_5	Zone 2	454	358	124	89	77	16	-	-	0.00	-	-	0.0	0.00	**238**	7,752	4,987	4,252	1	50	213	263	0.74	**146**	**384**	**201**	**90%**
SthC_10	Zone 2	185	0	1	1	1	1	1	1	0.00	0.01	0.1	0.1	-	**242**	100	78	76	0	1	4	5	-	**242**	**484**	**242**	**100%**
SthC_10_1	Zone 2	131	0	-	-	-	-	-	-	-	-	-	-	-	**242**	-	-	-	-	-	-	-	-	**242**	**484**	**242**	**100%**
SthC_10_10	Zone 2	130	49	87	27	13	2	-	-	0.00	-	-	0.0	0.00	**239**	4,161	953	466	0	10	23	33	0.68	**151**	**390**	**205**	**90%**
SthC_10_3_1	Zone 2	230	82	23	12	8	9	-	-	0.00	-	-	0.0	0.00	**234**	1,417	738	496	0	7	25	32	0.39	**182**	**416**	**218**	**90%**
SthC_10_5	Zone 1	97	60	252	93	62	80	4	4	0.01	0.04	0.2	0.2	0.00	**110**	13,371	4,009	2,711	1	40	136	177	2.95	**46**	**156**	**66**	**30%**
SthC_10_5_1	Zone 2	70	0	-	-	-	-	-	-	-	-	-	-	-	**242**	-	-	-	-	-	-	-	-	**242**	**484**	**242**	**100%**
SthC_10_5_3	Zone 1	59	21	99	38	28	7	-	-	0.00	-	-	0.0	0.00	**231**	5,013	1,754	1,346	1	18	67	85	4.06	**23**	**254**	**128**	**60%**
SthC_10_5_4	Zone 1	81	74	213	59	46	56	8	8	0.01	0.08	0.4	0.5	0.01	**78**	11,312	2,657	1,897	1	27	95	123	1.66	**72**	**150**	**60**	**30%**
SthC_10_5_7	Zone 1	62	62	298	169	79	130	14	14	0.01	0.14	0.7	0.9	0.01	**30**	17,333	7,983	3,605	2	80	180	262	4.22	**21**	**51**	**16**	**10%**
SthC_10_5_8	Zone 1	54	54	190	92	68	40	-	-	0.00	-	-	0.0	0.00	**227**	10,010	4,223	3,099	1	42	155	198	3.67	**28**	**255**	**129**	**60%**
SthC_10_7	Zone 2	160	4	-	-	-	-	-	-	-	-	-	-	-	**242**	-	-	-	-	-	-	-	-	**242**	**484**	**242**	**100%**
SthC_11	Zone 2	37	4	-	-	-	-	-	-	-	-	-	-	-	**242**	-	-	-	-	-	-	-	-	**242**	**484**	**242**	**100%**
SthC_11_1	Zone 1	59	26	67	17	16	11	-	-	0.00	-	-	0.0	0.00	**230**	3,110	662	598	0	7	30	37	1.42	**91**	**321**	**169**	**70%**
SthC_12	Zone 2	68	34	20	11	8	16	-	-	0.00	-	-	0.0	0.00	**229**	1,550	477	327	0	5	16	21	0.63	**159**	**388**	**204**	**90%**
SthC_13	Zone 1	62	36	53	27	22	23	2	2	0.00	0.02	0.1	0.1	0.00	**126**	2,837	1,431	1,177	0	14	59	73	2.04	**64**	**190**	**89**	**40%**
SthC_13a	Zone 1	121	30	19	15	10	10	6	6	0.00	0.06	0.3	0.4	0.01	**38**	1,432	987	762	0	10	38	48	1.60	**76**	**114**	**46**	**20%**
SthC_14	Zone 1	99	66	383	106	83	326	16	16	0.03	0.16	0.8	1.0	0.02	**28**	32,582	5,562	4,028	3	56	201	260	3.94	**24**	**52**	**17**	**10%**
SthC_14_1	Zone 1	20	6	21	2	2	18	-	-	0.00	-	-	0.0	0.00	**215**	1,867	109	101	0	1	5	6	1.05	**116**	**331**	**179**	**80%**
SthC_14_4	Zone 1	58	58	53	39	32	53	23	23	0.01	0.23	1.2	1.4	0.02	**17**	4,616	2,447	2,052	0	24	103	128	2.20	**62**	**79**	**28**	**20%**
SthC_15	Zone 1	88	68	68	25	21	37	2	2	0.00	0.02	0.1	0.1	0.00	**178**	5,023	1,537	1,221	1	15	61	77	1.13	**111**	**289**	**150**	**70%**
SthC_16	Zone 1	55	55	282	151	116	164	103	103	0.02	1.03	5.2	6.2	0.11	**1**	19,764	11,085	8,416	2	111	421	534	9.70	**3**	**4**	**1**	**10%**
SthC_16_11_1	Zone 1	88	88	540	180	73	67	5	5	0.01	0.05	0.3	0.3	0.00	**123**	28,118	8,335	3,587	3	83	179	266	3.02	**43**	**166**	**73**	**30%**
SthC_16_4	Zone 1	77	74	83	18	11	35	8	8	0.00	0.08	0.4	0.5	0.01	**79**	5,326	1,125	834	1	11	42	53	0.72	**148**	**227**	**114**	**50%**
SthC_16_5	Zone 1	86	86	187	51	34	82	11	11	0.01	0.11	0.6	0.7	0.01	**65**	11,572	2,895	1,977	1	29	99	129	1.50	**85**	**150**	**60**	**30%**
SthC_16_8	Zone 1	36	36	169	66	42	49	4	4	0.00	0.04	0.2	0.2	0.01	**75**	9,202	3,198	2,164	1	32	108	141	3.92	**26**	**101**	**36**	**20%**
SthC_16_9	Zone 1	35	35	105	22	15	21	1	1	0.00	0.01	0.1	0.1	0.00	**180**	4,918	1,188	861	0	12	43	55	1.58	**77**	**257**	**130**	**60%**
SthC_17	Zone 1	110	46	85	12	11	35	5	5	0.00	0.05	0.3	0.3	0.01	**76**	5,385	817	758	1	8	38	47	1.01	**119**	**195**	**93**	**40%**
SthC_18	Zone 1	63	28	33	10	10	33	7	7	0.00	0.07	0.4	0.4	0.02	**27**	2,814	692	654	0	7	33	40	1.42	**90**	**117**	**47**	**20%**
SthC_18_1	Zone 1	37	34	131	41	37	63	21	21	0.01	0.21	1.1	1.3	0.04	**7**	7,424	2,587	2,249	1	26	112	139	4.09	**22**	**29**	**12**	**10%**
SthC_19	Zone 1	47	42	107	23	17	39	2	2	0.00	0.02	0.1	0.1	0.00	**139**	6,123	1,186	846	1	12	42	55	1.30	**100**	**239**	**122**	**50%**
SthC_20_1	Zone 1	39	32	15	5	5	31	21	21	0.00	0.21	1.1	1.3	0.04	**6**	3,128	2,164	2,077	0	22	104	126	3.93	**25**	**31**	**13**	**10%**
SthC_21	Zone 1	53	32	60	23	13	59	5	5	0.01	0.05	0.3	0.3	0.01	**54**	5,697	1,190	730	1	12	36	49	1.53	**82**	**136**	**53**	**30%**
SthC_21_1	Zone 1	107	60	34	19	15	26	1	1	0.00	0.01	0.1	0.1	0.00	**200**	2,496	1,124	841	0	11	42	54	0.89	**129**	**329**	**177**	**80%**
SthC_23_1	Zone 3	174	129	137	42	31	45	6	6	0.00	0.06	0.3	0.4	0.00	**144**	7,412	2,301	1,806	1	23	90	114	0.88	**130**	**274**	**139**	**60%**
SthC_24	Zone 3	19	17	1	1	1	1	1	1	0.00	0.01	0.1	0.1	0.00	**121**	100	100	100	0	1	5	6	0.35	**191**	**312**	**161**	**70%**
SthC_24_1	Zone 1	64	64	351	91	58	123	10	10	0.01	0.10	0.5	0.6	0.01	**53**	18,918	4,125	2,684	2	41	134	177	2.77	**53**	**106**	**42**	**20%**

Table B2 - Sub-Catchment Ranking Calculation Table

				Properties affected by FLOOD EXTENT			Properties affected by FLOOD HAZARD								Damage analysis for properties affected by FLOOD EXTENT							Final Ranking		
subcatchment	Zone	Sub-catchment area (ha)	area without areas to be excluded (ha)	properties affected by PMF extent	properties affected by 100yr extent	properties affected by 20 yr extent	properties affected by PMF Hazard	properties affected by 100yr Hazard	properties affected by 20 year Hazard	Hazard weighted PMF	Hazard weighted 100yr	Hazard weighted 20 yr	Total Hazard ARI Weighted	Hazard weighted per hectare	rank	PMF damages (normalised)	100yr damages (normalised)	20yr damages (normalised)	Damages weighted PMF	Damages weighted 100yr	Damages weighted 20yr	Total Damages ARI Weighted	Total Damages weighted per ha	rank	Add hazard and depth rank	Re-Ranked based on hazard and depth	Ranking band
SthC_25	Zone 1	97	97	254	21	7	18	3	3	0.00	0.03	0.2	0.2	0.00	**174**	12,198	878	395	1	9	20	30	0.31	**199**	**373**	**194**	**80%**
SthC_25_1	Zone 3	157	84	228	63	39	32	9	9	0.00	0.09	0.5	0.5	0.01	**80**	10,540	2,523	1,567	1	25	78	105	1.25	**103**	**183**	**85**	**40%**
SthC_25_2	Zone 1	85	85	363	140	101	56	5	5	0.01	0.05	0.3	0.3	0.00	**120**	17,273	5,570	3,946	2	56	197	255	3.00	**44**	**164**	**72**	**30%**
SthC_25_7	Zone 1	64	60	116	24	14	20	3	3	0.00	0.03	0.2	0.2	0.00	**135**	5,800	1,112	587	1	11	29	41	0.68	**150**	**285**	**146**	**60%**
SthC_28_2	Zone 3	67	46	76	14	7	11	1	1	0.00	0.01	0.1	0.1	0.00	**193**	3,418	453	284	0	5	14	19	0.41	**176**	**369**	**192**	**80%**
SthC_28_2a	Zone 3	47	23	39	5	1	10	1	1	0.00	0.01	0.1	0.1	0.00	**150**	1,453	270	100	0	3	5	8	0.34	**193**	**343**	**185**	**80%**
SthC_29_16	Zone 3	555	555	7	7	7	7	6	6	0.00	0.06	0.3	0.4	0.00	**209**	608	530	510	0	5	26	31	0.06	**237**	**446**	**231**	**100%**
SthC_29_2	Zone 3	745	740	30	22	19	25	13	13	0.00	0.13	0.7	0.8	0.00	**199**	2,283	1,468	1,276	0	15	64	79	0.11	**231**	**430**	**225**	**100%**
SthC_31	Zone 1	39	38	157	25	6	39	-	-	0.00	-	-	0.0	0.00	**222**	7,174	674	85	1	7	4	12	0.31	**198**	**420**	**220**	**90%**
SthC_32_3_1	Zone 3	407	98	228	84	38	85	18	18	0.01	0.18	0.9	1.1	0.01	**41**	11,383	3,509	1,958	1	35	98	134	1.37	**97**	**138**	**54**	**30%**
SthC_32_5_2	Zone 3	218	163	7	5	5	5	-	-	0.00	-	-	0.0	0.00	**240**	438	293	289	0	3	14	17	0.11	**230**	**470**	**239**	**100%**
SthC_37	Zone 3	394	344	26	24	18	26	2	2	0.00	0.02	0.1	0.1	0.00	**214**	1,996	1,496	1,161	0	15	58	73	0.21	**216**	**430**	**225**	**100%**
SthC_6_1	Zone 2	601	342	114	83	74	85	32	32	0.01	0.32	1.6	1.9	0.01	**94**	8,349	5,431	4,637	1	54	232	287	0.84	**134**	**228**	**116**	**50%**
SthC_9_2	Zone 2	450	339	162	113	93	118	14	14	0.01	0.14	0.7	0.9	0.00	**153**	10,540	6,596	5,410	1	66	271	338	1.00	**120**	**273**	**137**	**60%**
SurC	Zone 1	69	69	308	79	31	182	9	9	0.02	0.09	0.5	0.6	0.01	**62**	20,301	3,729	1,527	2	37	76	116	1.68	**71**	**133**	**51**	**30%**
SurC_1	Zone 1	35	35	126	38	33	62	2	2	0.01	0.02	0.1	0.1	0.00	**119**	7,660	2,055	1,731	1	21	87	108	3.08	**40**	**159**	**67**	**30%**
SurC_1a	Zone 1	95	95	514	311	210	461	36	36	0.05	0.36	1.8	2.2	0.02	**18**	37,353	16,184	10,238	4	162	512	677	7.13	**7**	**25**	**11**	**10%**
SurC_2	Zone 1	45	45	217	120	81	198	39	39	0.02	0.39	2.0	2.4	0.05	**3**	17,223	6,108	3,942	2	61	197	260	5.78	**10**	**13**	**5**	**10%**
SurC_2_1	Zone 1	68	68	144	46	27	63	10	10	0.01	0.10	0.5	0.6	0.01	**55**	8,519	2,251	1,404	1	23	70	94	1.38	**95**	**150**	**60**	**30%**
SurC_2_2	Zone 1	51	51	171	78	51	50	3	3	0.01	0.03	0.2	0.2	0.00	**118**	9,073	3,696	2,565	1	37	128	166	3.26	**32**	**150**	**60**	**30%**
SurC_2_3	Zone 1	99	99	195	38	18	15	6	6	0.00	0.06	0.3	0.4	0.00	**117**	9,582	1,738	952	1	17	48	66	0.67	**152**	**269**	**135**	**60%**
SurC_3	Zone 1	72	72	247	21	12	31	3	3	0.00	0.03	0.2	0.2	0.00	**152**	12,118	953	648	1	10	32	43	0.60	**161**	**313**	**162**	**70%**
SurC_4	Zone 1	28	28	49	2	2	16	2	2	0.00	0.02	0.1	0.1	0.00	**107**	2,483	195	192	0	2	10	12	0.42	**175**	**282**	**144**	**60%**
SurC_4_1	Zone 1	37	37	173	17	3	52	-	-	0.01	-	-	0.0	0.00	**220**	8,365	613	65	1	6	3	10	0.28	**207**	**427**	**224**	**90%**
SurC_4_2	Zone 1	57	57	224	29	19	120	2	2	0.01	0.02	0.1	0.1	0.00	**160**	12,797	1,163	707	1	12	35	48	0.85	**133**	**293**	**153**	**70%**
SurC_4_3	Zone 1	52	51	165	13	8	12	2	2	0.00	0.02	0.1	0.1	0.00	**158**	8,201	685	307	1	7	15	23	0.45	**172**	**330**	**178**	**80%**
SurC_4_3a	Zone 1	16	16	21	2	1	2	1	1	0.00	0.01	0.1	0.1	0.00	**115**	1,018	144	90	0	1	5	6	0.38	**184**	**299**	**157**	**70%**
SurC_4_4	Zone 3	94	35	51	24	20	36	8	8	0.00	0.08	0.4	0.5	0.01	**29**	3,061	1,485	1,223	0	15	61	76	2.18	**63**	**92**	**34**	**20%**
SurC_4_7	Zone 3	73	6	1	1	1	1	1	1	0.00	0.01	0.1	0.1	0.01	**48**	93	87	82	0	1	4	5	0.83	**135**	**183**	**85**	**40%**
SurC_5	Zone 1	105	105	156	13	9	55	8	8	0.01	0.08	0.4	0.5	0.00	**103**	8,839	830	664	1	8	33	42	0.40	**178**	**281**	**143**	**60%**
SurC_6_1	Zone 1	30	30	6	4	4	5	3	3	0.00	0.03	0.2	0.2	0.01	**85**	440	268	261	0	3	13	16	0.53	**166**	**251**	**126**	**60%**
SurC_6_2	Zone 3	63	63	24	14	10	16	1	1	0.00	0.01	0.1	0.1	0.00	**202**	1,484	825	587	0	8	29	38	0.60	**162**	**364**	**188**	**80%**
SurC_8_1	Zone 3	75	75	29	23	22	26	17	17	0.00	0.17	0.9	1.0	0.01	**31**	2,089	1,573	1,418	0	16	71	87	1.16	**108**	**139**	**56**	**30%**
SurC_8_3	Zone 3	213	212	10	4	4	8	1	1	0.00	0.01	0.1	0.1	0.00	**216**	610	247	242	0	2	12	15	0.07	**233**	**449**	**233**	**100%**
WC	Zone 1	111	111	177	105	71	112	32	32	0.01	0.32	1.6	1.9	0.02	**22**	12,013	6,495	4,477	1	65	224	290	2.61	**56**	**78**	**27**	**20%**
WC_1	Zone 1	97	74	296	71	31	150	15	15	0.02	0.15	0.8	0.9	0.01	**37**	17,565	3,239	1,744	2	32	87	121	1.64	**74**	**111**	**45**	**20%**
WC_10	Zone 1	62	62	5	4	3	7	3	3	0.00	0.03	0.2	0.2	0.00	**141**	367	276	183	0	3	9	12	0.19	**220**	**361**	**187**	**80%**
WC_11	Zone 1	101	101	22	19	16	19	8	8	0.00	0.08	0.4	0.5	0.00	**101**	1,629	1,237	1,043	0	12	52	65	0.64	**156**	**257**	**130**	**60%**
WC_2	Zone 1	48	45	102	29	20	40	3	3	0.00	0.03	0.2	0.2	0.00	**111**	5,719	1,403	981	1	14	49	64	1.41	**92**	**203**	**100**	**50%**
WC_4	Zone 1	89	82	240	116	68	102	13	13	0.01	0.13	0.7	0.8	0.01	**52**	13,822	5,793	3,406	1	58	170	230	2.80	**51**	**103**	**38**	**20%**
WC_4_1	Zone 1	87	82	303	98	80	97	3	3	0.01	0.03	0.2	0.2	0.00	**161**	15,680	4,753	3,821	2	48	191	240	2.93	**48**	**209**	**102**	**50%**
WC_6	Zone 1	32	32	118	66	48	54	-	-	0.01	-	-	0.0	0.00	**219**	6,540	3,295	2,411	1	33	121	154	4.82	**16**	**235**	**121**	**50%**
WC_8	Zone 1	79	79	364	266	227	190	39	39	0.02	0.39	2.0	2.4	0.03	**12**	21,542	12,875	10,976	2	129	549	680	8.60	**4**	**16**	**6**	**10%**
WC_8_1	Zone 1	94	94	190	61	36	98	11	11	0.01	0.11	0.6	0.7	0.01	**73**	10,722	2,819	1,820	1	28	91	120	1.28	**101**	**174**	**79**	**40%**
WC_8_2	Zone 1	50	50	142	68	54	70	11	11	0.01	0.11	0.6	0.7	0.01	**33**	7,937	3,251	2,579	1	33	129	162	3.25	**34**	**67**	**24**	**10%**
WC_8_4_3	Zone 1	70	70	164	88	63	59	13	13	0.01	0.13	0.7	0.8	0.01	**40**	9,258	4,544	3,097	1	45	155	201	2.87	**50**	**90**	**32**	**20%**
WC_8_8	Zone 1	50	50	152	105	53	84	6	6	0.01	0.06	0.3	0.4	0.01	**70**	8,531	4,610	2,405	1	46	120	167	3.34	**31**	**101**	**36**	**20%**
WC_9	Zone 1	79	79	111	41	29	65	13	13	0.01	0.13	0.7	0.8	0.01	**50**	7,274	2,382	1,693	1	24	85	109	1.38	**94**	**144**	**57**	**30%**

Table B2 - Sub-Catchment Ranking Calculation Table

				Properties affected by FLOOD EXTENT			Properties affected by FLOOD HAZARD								Damage analysis for properties affected by FLOOD EXTENT							Final Ranking		
subcatchment	Zone	Sub-catchment area (ha)	area without areas to be excluded (ha)	properties affected by PMF extent	properties affected by 100yr extent	properties affected by 20 yr extent	properties affected by PMF Hazard	properties affected by 100yr Hazard	properties affected by 20 year Hazard	Hazard weighted PMF	Hazard weighted 100yr	Hazard weighted 20 yr	Total Hazard ARI Weighted	Hazard weighted per hectare	rank	PMF damages (normalised)	100yr damages (normalised)	20yr damages (normalised)	Damages weighted PMF	Damages weighted 100yr	Damages weighted 20yr	Total Damages ARI Weighted	Total Damages weighted per ha	rank	Add hazard and depth rank	Re-Ranked based on hazard and depth	Ranking band
BadC	Zone 3	271	246	10	9	9	9	4	4	0.00	0.04	0.2	0.2	0.00	**201**	829	686	664	0	7	33	40	0.16	**224**	**425**	**222**	**90%**
BadC_1	Zone 3	215	144	1	1	1	1	1	1	0.00	0.01	0.1	0.1	0.00	**212**	100	100	100	0	1	5	6	0.04	**239**	**451**	**236**	**100%**
BadC_5	Zone 3	510	410	31	26	25	21	6	6	0.00	0.06	0.3	0.4	0.00	**203**	2,331	1,804	1,689	0	18	84	103	0.25	**209**	**412**	**216**	**90%**
BlxC_10	Zone 3	621	621	38	36	36	36	35	35	0.00	0.35	1.8	2.1	0.00	**128**	3,604	3,150	3,046	0	32	152	184	0.30	**204**	**332**	**180**	**80%**
BlxC_18_4	Zone 3	191	191	6	6	6	6	6	6	0.00	0.06	0.3	0.4	0.00	**173**	555	468	423	0	5	21	26	0.14	**227**	**400**	**210**	**90%**
BlxC_19	Zone 3	105	105	-	-	-	-	-	-	-	-	-	-	-	**242**	-	-	-	-	-	-	-	-	**242**	**484**	**242**	**100%**
BlxC_20_3	Zone 3	229	229	2	1	1	1	1	1	0.00	0.01	0.1	0.1	0.00	**217**	190	92	92	0	1	5	6	0.02	**240**	**457**	**237**	**100%**
BlxC_21_2	Zone 3	394	394	20	16	16	16	7	7	0.00	0.07	0.4	0.4	0.00	**198**	1,422	1,046	995	0	10	50	60	0.15	**226**	**424**	**221**	**90%**
BlxC_7_1	Zone 3	313	313	5	4	4	3	2	2	0.00	0.02	0.1	0.1	0.00	**213**	373	305	301	0	3	15	18	0.06	**235**	**448**	**232**	**100%**
BouC	Zone 1	71	47	59	41	36	35	-	-	0.00	-	-	0.0	0.00	**226**	4,000	2,086	1,796	0	21	90	111	2.36	**60**	**286**	**149**	**60%**
BouC_3	Zone 1	111	87	30	24	23	28	7	7	0.00	0.07	0.4	0.4	0.00	**100**	2,348	1,467	1,324	0	15	66	81	0.93	**124**	**224**	**110**	**50%**
BouC_4	Zone 1	52	52	95	32	27	42	5	5	0.00	0.05	0.3	0.3	0.01	**92**	5,360	1,716	1,250	1	17	62	80	1.54	**80**	**172**	**77**	**40%**
BouC_4_4	Zone 1	87	85	139	105	94	55	3	3	0.01	0.03	0.2	0.2	0.00	**164**	8,188	5,246	4,451	1	52	223	276	3.25	**33**	**197**	**95**	**40%**
BouC_6_1	Zone 1	72	34	6	6	6	6	5	5	0.00	0.05	0.3	0.3	0.01	**56**	552	457	439	0	5	22	27	0.78	**139**	**195**	**93**	**40%**
BouC_6_1_1_1	Zone 1	71	71	264	134	125	103	2	2	0.01	0.02	0.1	0.1	0.00	**176**	14,776	6,828	5,820	1	68	291	361	5.08	**13**	**189**	**87**	**40%**
BouC_6_1_2	Zone 1	83	83	188	82	54	98	4	4	0.01	0.04	0.2	0.2	0.00	**137**	10,277	3,384	1,916	1	34	96	131	1.57	**78**	**215**	**105**	**50%**
BouC_6_2	Zone 1	90	61	73	46	37	28	6	6	0.00	0.06	0.3	0.4	0.01	**89**	4,400	2,602	1,938	0	26	97	123	2.02	**65**	**154**	**65**	**30%**
BouC_6_2_2_1	Zone 1	90	90	176	43	35	52	4	4	0.01	0.04	0.2	0.2	0.00	**148**	8,490	2,026	1,647	1	20	82	103	1.15	**110**	**258**	**132**	**60%**
BouC_6_2_4	Zone 1	82	82	162	18	5	32	4	4	0.00	0.04	0.2	0.2	0.00	**138**	7,686	877	327	1	9	16	26	0.32	**196**	**334**	**181**	**80%**
BouC_6_3	Zone 1	52	52	131	35	14	62	2	2	0.01	0.02	0.1	0.1	0.00	**155**	6,249	1,581	618	1	16	31	47	0.91	**125**	**280**	**142**	**60%**
BouC_6_4_1_3	Zone 1	80	80	178	19	15	39	7	7	0.00	0.07	0.4	0.4	0.01	**97**	9,107	1,005	832	1	10	42	53	0.66	**153**	**250**	**124**	**50%**
BouC_6_4_3	Zone 1	101	101	97	58	49	47	10	10	0.00	0.10	0.5	0.6	0.01	**86**	5,882	3,157	2,614	1	32	131	163	1.61	**75**	**161**	**69**	**30%**
BouC_6_5	Zone 2	2079	163	327	233	214	230	132	132	0.02	1.32	6.6	7.9	0.05	**5**	23,178	14,139	12,757	2	141	638	782	4.79	**17**	**22**	**9**	**10%**
BouC_6_6	Zone 1	27	26	9	6	4	5	1	1	0.00	0.01	0.1	0.1	0.00	**159**	582	383	253	0	4	13	17	0.64	**158**	**317**	**166**	**70%**
BouC_6_7_1	Zone 1	32	31	15	15	12	9	4	4	0.00	0.04	0.2	0.2	0.01	**64**	1,116	985	751	0	10	38	48	1.53	**81**	**145**	**58**	**30%**
BouC_6_7_2	Zone 1	86	86	45	27	22	15	11	11	0.00	0.11	0.6	0.7	0.01	**66**	2,881	1,539	1,324	0	15	66	82	0.95	**123**	**189**	**87**	**40%**
ByrC	Zone 1	60	60	232	76	60	90	3	3	0.01	0.03	0.2	0.2	0.00	**130**	12,567	3,610	2,729	1	36	136	174	2.90	**49**	**179**	**81**	**40%**
ByrC_11	Zone 1	96	96	281	65	47	56	8	8	0.01	0.08	0.4	0.5	0.01	**98**	13,783	3,027	2,286	1	30	114	146	1.52	**83**	**181**	**84**	**40%**
ByrC_14	Zone 1	38	38	58	10	3	8	1	1	0.00	0.01	0.1	0.1	0.00	**186**	2,923	494	197	0	5	10	15	0.40	**180**	**366**	**190**	**80%**
ByrC_2	Zone 1	81	73	271	190	153	206	37	37	0.02	0.37	1.9	2.2	0.03	**11**	20,846	10,897	8,691	2	109	435	546	7.47	**6**	**17**	**7**	**10%**
ByrC_3	Zone 1	65	65	230	109	92	146	17	17	0.01	0.17	0.9	1.0	0.02	**24**	15,548	5,817	4,827	2	58	241	301	4.63	**19**	**43**	**15**	**10%**
ByrC_5	Zone 1	61	61	269	129	106	108	10	10	0.01	0.10	0.5	0.6	0.01	**49**	14,823	6,515	4,906	1	65	245	312	5.11	**12**	**61**	**22**	**10%**
ByrC_6	Zone 1	52	52	227	115	90	75	5	5	0.01	0.05	0.3	0.3	0.01	**90**	12,064	5,332	4,020	1	53	201	256	4.91	**14**	**104**	**39**	**20%**
ByrC_9	Zone 1	82	82	255	82	37	39	8	8	0.00	0.08	0.4	0.5	0.01	**91**	13,334	3,788	1,642	1	38	82	121	1.48	**88**	**179**	**81**	**40%**
CbkC_2_6	Zone 2	72	72	25	15	15	15	2	2	0.00	0.02	0.1	0.1	0.00	**183**	1,555	964	908	0	10	45	55	0.77	**142**	**325**	**174**	**70%**
CbkC_2_7_1	Zone 2	93	88	27	20	18	17	12	12	0.00	0.12	0.6	0.7	0.01	**61**	1,855	1,261	1,161	0	13	58	71	0.80	**137**	**198**	**96**	**40%**
CC_1_1	Zone 3	307	172	31	22	20	30	2	2	0.00	0.02	0.1	0.1	0.00	**207**	2,393	1,255	1,003	0	13	50	63	0.37	**186**	**393**	**206**	**90%**
CC_12	Zone 3	607	607	25	22	22	26	15	15	0.00	0.15	0.8	0.9	0.00	**189**	2,193	1,829	1,771	0	18	89	107	0.18	**222**	**411**	**215**	**90%**
CC_9	Zone 3	556	493	59	39	33	55	17	17	0.01	0.17	0.9	1.0	0.00	**168**	4,384	2,425	1,934	0	24	97	121	0.25	**210**	**378**	**196**	**80%**
ClaC	Zone 1	112	112	28	23	21	47	14	14	0.00	0.14	0.7	0.8	0.01	**68**	3,321	2,749	2,590	0	27	129	157	1.40	**93**	**161**	**69**	**30%**
ClaC_1	Zone 1	63	62	198	45	36	134	3	3	0.01	0.03	0.2	0.2	0.00	**132**	13,367	2,192	1,781	1	22	89	112	1.81	**70**	**202**	**99**	**40%**
ClaC_10	Zone 3	203	203	61	47	37	53	21	21	0.01	0.21	1.1	1.3	0.01	**83**	4,282	3,108	2,510	0	31	125	157	0.77	**141**	**224**	**110**	**50%**
ClaC_2	Zone 1	61	61	132	8	6	64	3	3	0.01	0.03	0.2	0.2	0.00	**134**	7,653	419	345	1	4	17	22	0.36	**188**	**322**	**172**	**70%**
ClaC_3	Zone 1	59	59	238	17	17	109	2	2	0.01	0.02	0.1	0.1	0.00	**162**	14,702	974	933	1	10	47	58	0.98	**121**	**283**	**145**	**60%**
ClaC_5	Zone 1	69	69	175	40	25	133	8	8	0.01	0.08	0.4	0.5	0.01	**72**	11,503	1,853	1,223	1	19	61	81	1.17	**107**	**179**	**81**	**40%**
ClaC_8_3	Zone 3	227	227	64	48	44	47	11	11	0.00	0.11	0.6	0.7	0.00	**140**	4,408	3,219	2,936	0	32	147	179	0.79	**138**	**278**	**141**	**60%**
ClaC_9	Zone 1	58	58	18	8	6	14	3	3	0.00	0.03	0.2	0.2	0.00	**131**	1,164	492	371	0	5	19	24	0.41	**177**	**308**	**160**	**70%**
JryC_3_7_1	Zone 3	860	756	74	64	56	61	31	31	0.01	0.31	1.6	1.9	0.00	**154**	5,502	4,178	3,744	1	42	187	230	0.30	**201**	**355**	**186**	**80%**
JryC_7	Zone 3	598	568	135	57	51	85	32	32	0.01	0.32	1.6	1.9	0.00	**127**	8,565	3,710	3,275	1	37	164	202	0.36	**190**	**317**	**166**	**70%**
KC_10	Zone 3	567	484	43	41	35	41	13	13	0.00	0.13	0.7	0.8	0.00	**185**	3,668	2,841	2,393	0	28	120	148	0.31	**200**	**385**	**202**	**90%**
KC_14_3_3	Zone 3	546	495	150	118	109	111	23	23	0.01	0.23	1.2	1.4	0.00	**145**	10,144	6,862	6,288	1	69	314	384	0.78	**140**	**285**	**146**	**60%**
KC_17	Zone 3	62	61	21	19	17	19	7	7	0.00	0.07	0.4	0.4	0.01	**74**	1,627	1,379	1,244	0	14	62	76	1.25	**102**	**176**	**80**	**40%**
LfC	Zone 3	310	310	40	30	26	25	20	20	0.00	0.20	1.0	1.2	0.00	**113**	2,935	2,143	1,914	0	21	96	117	0.38	**185**	**298**	**156**	**70%**
MgC	Zone 3	145	145	9	9	9	9	5	5	0.00	0.05	0.3	0.3	0.00	**169**	822	758	755	0	8	38	45	0.31	**197**	**366**	**190**	**80%**
MgC_1	Zone 1	71	71	17	12	12	16	10	10	0.00	0.10	0.5	0.6	0.01	**59**	1,545	1,057	1,014	0	11	51	61	0.87	**132**	**191**	**90**	**40%**
MgC_13_11_3	Zone 3	118	115	16	14	12	12	7	7	0.00	0.07	0.4	0.4	0.00	**116**	1,114	863	733	0	9	37	45	0.39	**181**	**297**	**154**	**70%**
MgC_13_17	Zone 3	245	241	69	58	51	47	22	22	0.00	0.22	1.1	1.3	0.01	**96**	4,678	3,616	3,169	0	36	158	195	0.81	**136**	**232**	**119**	**50%**
MgC_13_7_5	Zone 3	321	226	10	9	9	9	8	8	0.00	0.08	0.4	0.5	0.00	**165**	955	827	790	0	8	39	48	0.21	**217**	**382**	**199**	**80%**
MgC_14_2	Zone 3	403	403	22	21	19	22	16	16	0.00	0.16	0.8	1.0	0.00	**157**	2,150	1,868	1,745	0	19	87	106	0.26	**208**	**365**	**189**	**80%**
MgC_29	Zone 3	44	44	3	3	3	3	2	2	0.00	0.02	0.1	0.1	0.00	**147**	285	271	267	0	3	13	16	0.37	**187**	**334**	**181**	**80%**
MgC_3	Zone 1	31	31	2	2	2	2	2	2	0.00	0.02	0.1	0.1	0.00	**114**	200	200	200	0	2	10	12	0.39	**183**	**297**	**154**	**70%**
MgC_30_8	Zone 3	174	174	12	12	11	11	10	10	0.00	0.10	0.5	0.6	0.00	**125**	1,095	963	916	0	10	46	56	0.32	**195**	**320**	**168**	**70%**
MgC_31_14_1	Zone 3	548	498	7	7	7	7	5	5	0.00	0.05	0.3	0.3	0.00	**210**	597	542	532	0	5	27	32	0.06	**234**	**444**	**230**	**100%**
MgC_31_9	Zone 3	413	413	25	21	21	15	9	9	0.00	0.09	0.5	0.5	0.00	**194**	2,052	1,530	1,473	0	15	74	89	0.22	**214**	**408**	**214**	**90%**
MgC_32_3	Zone 3	198	198	13	13	12	13	7	7	0.00	0.07	0.4	0.4	0.00	**166**	1,128	1,003	975	0	10	49	59	0.30	**203**	**369**	**192**	**80%**
MgC_4_3	Zone 1	84	84	12	12	11	12	10	10	0.00	0.10	0.5	0.6	0.01	**71**	1,178	1,133	1,028	0	11	51	63	0.75	**144**	**215**	**105**	**50%**
MgC_43_5	Zone 3	868	868	321	230	216	250	66	66	0.03	0.66	3.3	4.0	0.00	**104**	20,936	13,855	12,672	2	139	634	774	0.89	**128**	**232**	**119**	**50%**

Table B2 - Sub-Catchment Ranking Calculation Table

				Properties affected by FLOOD EXTENT			Properties affected by FLOOD HAZARD								Damage analysis for properties affected by FLOOD EXTENT							Final Ranking		
subcatchment	Zone	Sub-catchment area (ha)	area without areas to be excluded (ha)	properties affected by PMF extent	properties affected by 100yr extent	properties affected by 20 yr extent	properties affected by PMF Hazard	properties affected by 100yr Hazard	properties affected by 20 year Hazard	Hazard weighted PMF	Hazard weighted 100yr	Hazard weighted 20 yr	Total Hazard ARI Weighted	Hazard weighted per hectare	rank	PMF damages (normalised)	100yr damages (normalised)	20yr damages (normalised)	Damages weighted PMF	Damages weighted 100yr	Damages weighted 20yr	Total Damages ARI Weighted	Total Damages weighted per ha	rank	Add hazard and depth rank	Re-Ranked based on hazard and depth	Ranking band
MgC_54	Zone 3	291	291	17	17	17	16	10	10	0.00	0.10	0.5	0.6	0.00	**170**	1,391	1,210	1,173	0	12	59	71	0.24	**211**	**381**	**198**	**80%**
MgC_55_6_2	Zone 3	407	407	28	24	24	23	15	15	0.00	0.15	0.8	0.9	0.00	**163**	1,964	1,533	1,442	0	15	72	88	0.22	**215**	**378**	**196**	**80%**
MgC_55_7	Zone 3	207	205	14	8	7	11	5	5	0.00	0.05	0.3	0.3	0.00	**190**	995	611	527	0	6	26	33	0.16	**225**	**415**	**217**	**90%**
NepR	Zone 1	113	70	6	5	5	6	1	1	0.00	0.01	0.1	0.1	0.00	**204**	515	352	348	0	4	17	21	0.30	**202**	**406**	**213**	**90%**
NepR_1_1_1_1	Zone 2	652	546	114	72	67	51	32	32	0.01	0.32	1.6	1.9	0.00	**122**	7,625	4,910	4,566	1	49	228	278	0.51	**169**	**291**	**152**	**70%**
NepR_11	Zone 1	64	62	149	71	60	39	9	9	0.00	0.09	0.5	0.5	0.01	**58**	8,717	3,833	3,093	1	38	155	194	3.13	**38**	**96**	**35**	**20%**
NepR_11_1_1_1	Zone 1	83	72	108	65	49	68	31	31	0.01	0.31	1.6	1.9	0.03	**13**	6,961	4,210	3,382	1	42	169	212	2.94	**47**	**60**	**21**	**10%**
NepR_11_12_1	Zone 1	70	55	241	97	81	91	23	23	0.01	0.23	1.2	1.4	0.03	**14**	13,497	4,999	4,158	1	50	208	259	4.71	**18**	**32**	**14**	**10%**
NepR_11_12_1a	Zone 1	23	22	81	14	13	2	-	-	0.00	-	-	0.0	0.00	**235**	3,859	587	534	0	6	27	33	1.50	**86**	**321**	**169**	**70%**
NepR_11_4	Zone 1	84	78	217	68	43	56	16	16	0.01	0.16	0.8	1.0	0.01	**36**	11,497	3,451	2,117	1	35	106	142	1.81	**69**	**105**	**40**	**20%**
NepR_11_8_2_3	Zone 1	104	104	175	96	78	136	23	23	0.01	0.23	1.2	1.4	0.01	**32**	11,316	5,297	4,216	1	53	211	265	2.55	**57**	**89**	**31**	**20%**
NepR_13_1	Zone 1	490	131	308	163	127	32	4	4	0.00	0.04	0.2	0.2	0.00	**175**	16,100	7,286	5,811	2	73	291	365	2.79	**52**	**227**	**114**	**50%**
NepR_13_10_1	Zone 1	97	51	293	154	140	187	80	80	0.02	0.80	4.0	4.8	0.09	**2**	20,749	9,436	8,070	2	94	403	500	9.80	**2**	**4**	**1**	**10%**
NepR_13_12	Zone 1	30	10	22	7	1	9	1	1	0.00	0.01	0.1	0.1	0.01	**84**	1,328	410	95	0	4	5	9	0.90	**127**	**211**	**103**	**50%**
NepR_13_3	Zone 1	201	105	177	106	98	28	14	14	0.00	0.14	0.7	0.8	0.01	**63**	10,223	5,762	5,231	1	58	262	320	3.05	**42**	**105**	**40**	**20%**
NepR_15	Zone 1	59	59	72	53	48	62	24	24	0.01	0.24	1.2	1.4	0.02	**16**	4,700	2,821	2,527	0	28	126	155	2.63	**55**	**71**	**26**	**20%**
NepR_15_1_2_1	Zone 1	48	48	175	85	62	114	1	1	0.01	0.01	0.1	0.1	0.00	**188**	11,551	4,415	3,173	1	44	159	204	4.25	**20**	**208**	**101**	**50%**
NepR_15_1_3_1	Zone 1	80	80	50	28	25	35	11	11	0.00	0.11	0.6	0.7	0.01	**60**	3,504	1,793	1,516	0	18	76	94	1.18	**106**	**166**	**73**	**30%**
NepR_15_1a	Zone 1	19	4	28	1	1	24	1	1	0.00	0.01	0.1	0.1	0.02	**25**	1,572	100	98	0	1	5	6	1.52	**84**	**109**	**43**	**20%**
NepR_16	Zone 1	123	113	32	23	13	43	12	12	0.00	0.12	0.6	0.7	0.01	**81**	2,006	1,396	906	0	14	45	59	0.53	**165**	**246**	**123**	**50%**
NepR_23	Zone 3	51	40	1	1	1	1	1	1	0.00	0.01	0.1	0.1	0.00	**187**	85	74	73	0	1	4	4	0.11	**229**	**416**	**218**	**90%**
NepR_36	Zone 3	512	478	45	35	32	26	11	11	0.00	0.11	0.6	0.7	0.00	**192**	3,403	2,397	2,166	0	24	108	133	0.28	**206**	**398**	**209**	**90%**
NepR_4	Zone 1	52	0	-	-	-	-	-	-	-	-	-	-	-	**242**	-	-	-	-	-	-	-	-	**242**	**484**	**242**	**100%**
NepR_7	Zone 1	80	62	61	37	33	40	33	33	0.00	0.33	1.7	2.0	0.03	**10**	4,221	2,718	2,526	0	27	126	154	2.48	**58**	**68**	**25**	**20%**
PTC	Zone 1	106	64	87	62	53	81	11	11	0.01	0.11	0.6	0.7	0.01	**46**	6,332	3,716	3,034	1	37	152	189	2.96	**45**	**91**	**33**	**20%**
PTC_1	Zone 1	85	72	264	200	154	199	44	44	0.02	0.44	2.2	2.7	0.04	**8**	16,969	9,963	7,674	2	100	384	485	6.74	**9**	**17**	**7**	**10%**
PTC_1_1	Zone 1	103	103	427	274	216	198	42	42	0.02	0.42	2.1	2.5	0.02	**15**	25,633	14,234	11,220	3	142	561	706	6.85	**8**	**23**	**10**	**10%**
PTC_1_1_1	Zone 1	56	56	315	252	224	265	31	31	0.03	0.31	1.6	1.9	0.03	**9**	21,999	13,395	11,563	2	134	578	714	12.76	**1**	**10**	**4**	**10%**
PTC_1_2	Zone 1	71	71	188	110	90	83	-	-	0.01	-	-	0.0	0.00	**221**	11,250	5,445	4,083	1	54	204	260	3.66	**29**	**250**	**124**	**50%**
PTC_2	Zone 1	52	20	113	64	46	135	17	17	0.01	0.17	0.9	1.0	0.05	**4**	11,138	3,543	2,532	1	35	127	163	8.16	**5**	**9**	**3**	**10%**
PTC_2_1	Zone 1	107	104	341	225	182	301	18	18	0.03	0.18	0.9	1.1	0.01	**45**	24,375	11,532	9,219	2	115	461	579	5.56	**11**	**56**	**19**	**10%**
PTC_2_1a	Zone 1	24	24	16	16	16	16	3	3	0.00	0.03	0.2	0.2	0.01	**67**	1,312	1,005	964	0	10	48	58	2.43	**59**	**126**	**49**	**20%**
PTC_2_2	Zone 1	64	64	237	145	106	93	1	1	0.01	0.01	0.1	0.1	0.00	**197**	13,188	6,562	4,882	1	66	244	311	4.86	**15**	**212**	**104**	**50%**
PTC_2_3_1	Zone 1	102	102	291	123	80	129	11	11	0.01	0.11	0.6	0.7	0.01	**77**	15,778	5,505	3,654	2	55	183	239	2.35	**61**	**138**	**54**	**30%**
PTC_2_4	Zone 1	97	97	176	75	64	95	4	4	0.01	0.04	0.2	0.2	0.00	**151**	9,685	3,432	2,860	1	34	143	178	1.84	**68**	**219**	**108**	**50%**
PTC_3	Zone 1	89	28	39	28	24	39	7	7	0.00	0.07	0.4	0.4	0.02	**26**	3,077	1,680	1,425	0	17	71	88	3.16	**36**	**62**	**23**	**10%**
PTC_3_1_1	Zone 1	36	36	18	13	13	17	6	6	0.00	0.06	0.3	0.4	0.01	**47**	1,452	915	884	0	9	44	53	1.49	**87**	**134**	**52**	**30%**
RkbC	Zone 2	347	346	106	84	68	81	43	43	0.01	0.43	2.2	2.6	0.01	**69**	8,710	5,811	4,933	1	58	247	306	0.88	**131**	**200**	**97**	**40%**
RkbC_1	Zone 2	214	154	74	54	54	52	28	28	0.01	0.28	1.4	1.7	0.01	**43**	6,017	4,047	3,939	1	40	197	238	1.55	**79**	**122**	**48**	**20%**
RkbC_12_1_2	Zone 2	694	653	185	138	117	75	31	31	0.01	0.31	1.6	1.9	0.00	**142**	12,467	7,888	6,742	1	79	337	417	0.64	**157**	**299**	**157**	**70%**
RkbC_13	Zone 2	128	128	51	36	33	46	28	28	0.00	0.28	1.4	1.7	0.01	**34**	4,565	3,073	2,843	0	31	142	173	1.35	**98**	**132**	**50**	**30%**
RkbC_17	Zone 2	360	326	64	25	21	7	1	1	0.00	0.01	0.1	0.1	0.00	**218**	3,658	1,298	1,079	0	13	54	67	0.21	**218**	**436**	**228**	**100%**
RkbC_17_10_10_1	Zone 2	217	217	52	36	30	28	15	15	0.00	0.15	0.8	0.9	0.00	**109**	3,706	2,199	1,908	0	22	95	118	0.54	**164**	**273**	**137**	**60%**
RkbC_17_10_2_3	Zone 2	716	716	148	81	72	44	8	8	0.00	0.08	0.4	0.5	0.00	**208**	8,811	4,444	3,812	1	44	191	236	0.33	**194**	**402**	**211**	**90%**
RkbC_17_10_3	Zone 2	866	863	108	54	43	37	12	12	0.00	0.12	0.6	0.7	0.00	**205**	6,868	3,177	2,622	1	32	131	164	0.19	**221**	**426**	**223**	**90%**
RkbC_17_6	Zone 2	613	521	217	112	98	148	55	55	0.01	0.55	2.8	3.3	0.01	**82**	16,234	7,015	6,110	2	70	305	377	0.72	**147**	**229**	**117**	**50%**
RkbC_17_9_5_1	Zone 2	279	43	6	6	6	5	2	2	0.00	0.02	0.1	0.1	0.00	**146**	467	388	372	0	4	19	23	0.52	**167**	**313**	**162**	**70%**
RkbC_23_6_1_1	Zone 2	531	449	115	78	73	78	32	32	0.01	0.32	1.6	1.9	0.00	**108**	7,910	4,868	4,501	1	49	225	275	0.61	**160**	**268**	**134**	**60%**
RkbC_24	Zone 2	88	88	27	18	18	17	16	16	0.00	0.16	0.8	1.0	0.01	**44**	2,174	1,547	1,505	0	15	75	91	1.03	**118**	**162**	**71**	**30%**
RkbC_26	Zone 2	134	134	27	17	15	17	13	13	0.00	0.13	0.7	0.8	0.01	**93**	2,177	1,296	1,115	0	13	56	69	0.51	**168**	**261**	**133**	**60%**
RkbC_29_1	Zone 2	134	134	27	18	15	12	6	6	0.00	0.06	0.3	0.4	0.00	**149**	1,838	1,143	960	0	11	48	60	0.44	**174**	**323**	**173**	**70%**
RkbC_29_5	Zone 2	148	145	35	26	24	17	5	5	0.00	0.05	0.3	0.3	0.00	**167**	2,390	1,662	1,550	0	17	77	94	0.65	**154**	**321**	**169**	**70%**
RkbC_29_5a	Zone 1	21	20	90	30	25	15	-	-	0.00	-	-	0.0	0.00	**225**	4,584	1,485	1,211	0	15	61	76	3.79	**27**	**252**	**127**	**60%**
RkbC_30	Zone 1	82	82	319	68	45	86	8	8	0.01	0.08	0.4	0.5	0.01	**87**	16,425	2,861	2,099	2	29	105	135	1.65	**73**	**160**	**68**	**30%**
RkbC_30_1	Zone 2	85	85	19	13	10	11	4	4	0.00	0.04	0.2	0.2	0.00	**143**	1,326	848	657	0	8	33	41	0.49	**170**	**313**	**162**	**70%**
RkbC_30_3	Zone 2	117	117	6	1	1	1	1	1	0.00	0.01	0.1	0.1	0.00	**211**	350	90	86	0	1	4	5	0.04	**238**	**449**	**233**	**100%**
RkbC_4	Zone 2	75	35	18	13	13	15	11	11	0.00	0.11	0.6	0.7	0.02	**21**	1,514	865	825	0	9	41	50	1.43	**89**	**110**	**44**	**20%**
RkbC_5	Zone 2	81	81	25	22	21	22	8	8	0.00	0.08	0.4	0.5	0.01	**88**	2,167	1,730	1,647	0	17	82	100	1.23	**104**	**192**	**91**	**40%**
RkbC_5_2	Zone 2	93	16	3	3	3	3	-	-	0.00	-	-	0.0	0.00	**233**	203	158	150	0	2	7	9	0.57	**163**	**396**	**208**	**90%**
RkbC_7_1	Zone 2	100	100	39	28	28	26	3	3	0.00	0.03	0.2	0.2	0.00	**177**	2,755	1,886	1,859	0	19	93	112	1.12	**113**	**290**	**151**	**70%**
RkbC_8	Zone 2	148	148	51	32	31	43	24	24	0.00	0.24	1.2	1.4	0.01	**51**	4,513	2,754	2,650	0	28	133	161	1.08	**115**	**166**	**73**	**30%**
RkbC_9_3	Zone 2	122	122	50	28	27	16	4	4	0.00	0.04	0.2	0.2	0.00	**171**	3,177	1,654	1,483	0	17	74	91	0.75	**145**	**316**	**165**	**70%**
RpC	Zone 1	81	61	283	97	67	97	11	11	0.01	0.11	0.6	0.7	0.01	**42**	14,963	4,217	2,862	1	42	143	187	3.06	**41**	**83**	**29**	**20%**
RpC_1	Zone 2	59	15	1	1	1	1	-	-	0.00	-	-	0.0	0.00	**236**	100	59	58	0	1	3	4	0.23	**213**	**449**	**233**	**100%**
RpC_10	Zone 1	63	50	101	18	3	12	1	1	0.00	0.01	0.1	0.1	0.00	**196**	4,909	755	198	0	8	10	18	0.36	**189**	**385**	**202**	**90%**
RpC_10a	Zone 1	25	20	26	-	-	1	-	-	0.00	-	-	0.0	0.00	**237**	1,304	-	-	0	-	-	0	0.01	**241**	**478**	**241**	**100%**
RpC_11	Zone 1	108	84	88	13	11	7	2	2	0.00	0.02	0.1	0.1	0.00	**191**	3,859	598	463	0	6	23	30	0.35	**192**	**383**	**200**	**90%**

Table B2 - Sub-Catchment Ranking Calculation Table

				Properties affected by FLOOD EXTENT			Properties affected by FLOOD HAZARD								Damage analysis for properties affected by FLOOD EXTENT							Final Ranking		
subcatchment	Zone	Sub-catchment area (ha)	area without areas to be excluded (ha)	properties affected by PMF extent	properties affected by 100yr extent	properties affected by 20 yr extent	properties affected by PMF Hazard	properties affected by 100yr Hazard	properties affected by 20 year Hazard	Hazard weighted PMF	Hazard weighted 100yr	Hazard weighted 20 yr	Total Hazard ARI Weighted	Hazard weighted per hectare	rank	PMF damages (normalised)	100yr damages (normalised)	20yr damages (normalised)	Damages weighted PMF	Damages weighted 100yr	Damages weighted 20yr	Total Damages ARI Weighted	Total Damages weighted per ha	rank	Add hazard and depth rank	Re-Ranked based on hazard and depth	Ranking band
RpC_13	Zone 1	43	43	209	67	41	103	2	2	0.01	0.02	0.1	0.1	0.00	**136**	13,820	3,329	2,040	1	33	102	137	3.18	**35**	**171**	**76**	**40%**
RpC_13_1	Zone 1	81	68	91	36	10	12	10	10	0.00	0.10	0.5	0.6	0.01	**56**	4,795	2,085	989	0	21	49	71	1.04	**117**	**173**	**78**	**40%**
RpC_13_1a	Zone 1	37	32	75	6	6	25	6	6	0.00	0.06	0.3	0.4	0.01	**39**	4,385	583	577	0	6	29	35	1.10	**114**	**153**	**64**	**30%**
RpC_14	Zone 1	85	79	290	102	76	89	3	3	0.01	0.03	0.2	0.2	0.00	**156**	15,510	5,061	3,933	2	51	197	249	3.15	**37**	**193**	**92**	**40%**
RpC_15	Zone 1	85	82	289	52	25	28	6	6	0.00	0.06	0.3	0.4	0.00	**106**	13,214	2,323	1,407	1	23	70	95	1.16	**109**	**215**	**105**	**50%**
RpC_16	Zone 1	66	66	182	37	27	43	6	6	0.00	0.06	0.3	0.4	0.01	**95**	8,925	1,604	1,251	1	16	63	80	1.20	**105**	**200**	**97**	**40%**
RpC_16_1	Zone 1	42	24	6	5	5	6	5	5	0.00	0.05	0.3	0.3	0.01	**35**	574	470	446	0	5	22	27	1.13	**112**	**147**	**59**	**30%**
RpC_18_2	Zone 1	105	97	375	136	96	98	3	3	0.01	0.03	0.2	0.2	0.00	**172**	20,111	5,849	4,030	2	58	201	262	2.70	**54**	**226**	**113**	**50%**
RpC_19	Zone 3	116	24	71	15	12	13	-	-	0.00	-	-	0.0	0.00	**228**	3,555	636	500	0	6	25	32	1.32	**99**	**327**	**175**	**80%**
RpC_19_2	Zone 3	69	0	-	-	-	-	-	-	-	-	-	-	-	**242**	-	-	-	-	-	-	-	-	**242**	**484**	**242**	**100%**
RpC_27	Zone 3	357	339	13	13	13	13	10	10	0.00	0.10	0.5	0.6	0.00	**181**	1,139	1,017	971	0	10	49	59	0.17	**223**	**404**	**212**	**90%**
RpC_29	Zone 3	178	178	55	34	23	27	12	12	0.00	0.12	0.6	0.7	0.00	**112**	3,072	1,747	1,239	0	17	62	80	0.45	**173**	**285**	**146**	**60%**
RpC_29_1	Zone 3	108	108	22	12	6	18	6	6	0.00	0.06	0.3	0.4	0.00	**129**	1,272	761	474	0	8	24	31	0.29	**205**	**334**	**181**	**80%**
RpC_30_1	Zone 3	35	35	11	11	2	9	1	1	0.00	0.01	0.1	0.1	0.00	**182**	633	401	84	0	4	4	8	0.24	**212**	**394**	**207**	**90%**
RpC_4	Zone 1	62	35	38	21	14	12	2	2	0.00	0.02	0.1	0.1	0.00	**124**	2,377	1,014	754	0	10	38	48	1.37	**96**	**220**	**109**	**50%**
RpC_5	Zone 1	46	25	32	26	21	22	7	7	0.00	0.07	0.4	0.4	0.02	**23**	2,533	1,645	1,373	0	16	69	85	3.41	**30**	**53**	**18**	**10%**
RpC_8_3	Zone 1	74	74	331	109	38	16	-	-	0.00	-	-	0.0	0.00	**232**	17,126	4,795	1,885	2	48	94	144	1.94	**67**	**299**	**157**	**70%**
RpC_9	Zone 1	80	52	23	15	14	10	4	4	0.00	0.04	0.2	0.2	0.00	**102**	1,583	958	804	0	10	40	50	0.96	**122**	**224**	**110**	**50%**
ScHC_1	Zone 1	78	78	82	36	34	46	25	25	0.00	0.25	1.3	1.5	0.02	**20**	5,892	2,746	2,586	1	27	129	157	2.02	**66**	**86**	**30**	**20%**
ScHC_10	Zone 1	82	82	240	5	2	70	1	1	0.01	0.01	0.1	0.1	0.00	**206**	11,805	239	139	1	2	7	11	0.13	**228**	**434**	**227**	**100%**
ScHC_11	Zone 1	100	100	188	15	10	80	8	8	0.01	0.08	0.4	0.5	0.00	**99**	9,858	934	764	1	9	38	49	0.49	**171**	**270**	**136**	**60%**
ScHC_12_2	Zone 1	32	32	111	4	-	26	-	-	0.00	-	-	0.0	0.00	**223**	5,210	129	-	1	1	-	2	0.06	**236**	**459**	**238**	**100%**
ScHC_12_3_3	Zone 1	42	42	94	8	3	33	-	-	0.00	-	-	0.0	0.00	**224**	4,575	341	92	0	3	5	8	0.20	**219**	**443**	**229**	**100%**
ScHC_12_4	Zone 1	38	38	82	9	8	27	1	1	0.00	0.01	0.1	0.1	0.00	**184**	4,091	444	390	0	4	19	24	0.64	**155**	**339**	**184**	**80%**
ScHC_6	Zone 1	34	34	76	8	7	15	1	1	0.00	0.01	0.1	0.1	0.00	**179**	3,755	409	381	0	4	19	24	0.69	**149**	**328**	**176**	**80%**
ScHC_6_1	Zone 1	58	58	149	60	45	84	19	19	0.01	0.19	1.0	1.1	0.02	**19**	9,905	3,702	2,859	1	37	143	181	3.12	**39**	**58**	**20**	**10%**
StHC	Zone 3	467	423	106	55	48	74	9	9	0.01	0.09	0.5	0.5	0.00	**195**	6,547	3,169	2,740	1	32	137	169	0.40	**179**	**374**	**195**	**80%**
StHC_1_1	Zone 2	531	430	151	90	87	78	22	22	0.01	0.22	1.1	1.3	0.00	**133**	10,429	5,791	5,406	1	58	270	329	0.77	**143**	**276**	**140**	**60%**
StHC_1_3_7_2_3_2	Zone 2	180	41	1	1	1	1	-	-	0.00	-	-	0.0	0.00	**241**	70	64	64	0	1	3	4	0.09	**232**	**473**	**240**	**100%**
StHC_1_3_7_7	Zone 2	505	253	85	71	60	60	19	19	0.01	0.19	1.0	1.1	0.00	**105**	6,110	4,450	3,666	1	44	183	228	0.90	**126**	**231**	**118**	**50%**
StHC_1_5	Zone 2	454	358	124	89	77	16	-	-	0.00	-	-	0.0	0.00	**238**	7,752	4,987	4,252	1	50	213	263	0.74	**146**	**384**	**201**	**90%**
StHC_10	Zone 2	185	0	1	1	1	1	1	1	0.00	0.01	0.1	0.1	-	**242**	100	78	76	0	1	4	5	-	**242**	**484**	**242**	**100%**
StHC_10_1	Zone 2	131	0	-	-	-	-	-	-	-	-	-	-	-	**242**	-	-	-	-	-	-	-	-	**242**	**484**	**242**	**100%**
StHC_10_10	Zone 2	130	49	87	27	13	2	-	-	0.00	-	-	0.0	0.00	**239**	4,161	953	466	0	10	23	33	0.68	**151**	**390**	**205**	**90%**
StHC_10_3_1	Zone 2	230	82	23	12	8	9	-	-	0.00	-	-	0.0	0.00	**234**	1,417	738	496	0	7	25	32	0.39	**182**	**416**	**218**	**90%**
StHC_10_5	Zone 1	97	60	252	93	62	80	4	4	0.01	0.04	0.2	0.2	0.00	**110**	13,371	4,009	2,711	1	40	136	177	2.95	**46**	**156**	**66**	**30%**
StHC_10_5_1	Zone 2	70	0	-	-	-	-	-	-	-	-	-	-	-	**242**	-	-	-	-	-	-	-	-	**242**	**484**	**242**	**100%**
StHC_10_5_3	Zone 1	59	21	99	38	28	7	-	-	0.00	-	-	0.0	0.00	**231**	5,013	1,754	1,346	1	18	67	85	4.06	**23**	**254**	**128**	**60%**
StHC_10_5_4	Zone 1	81	74	213	59	46	56	8	8	0.01	0.08	0.4	0.5	0.01	**78**	11,312	2,657	1,897	1	27	95	123	1.66	**72**	**150**	**60**	**30%**
StHC_10_5_7	Zone 1	62	62	298	169	79	130	14	14	0.01	0.14	0.7	0.9	0.01	**30**	17,333	7,983	3,605	2	80	180	262	4.22	**21**	**51**	**16**	**10%**
StHC_10_5_8	Zone 1	54	54	190	92	68	40	-	-	0.00	-	-	0.0	0.00	**227**	10,010	4,223	3,099	1	42	155	198	3.67	**28**	**255**	**129**	**60%**
StHC_10_7	Zone 2	160	4	-	-	-	-	-	-	-	-	-	-	-	**242**	-	-	-	-	-	-	-	-	**242**	**484**	**242**	**100%**
StHC_11	Zone 2	37	4	-	-	-	-	-	-	-	-	-	-	-	**242**	-	-	-	-	-	-	-	-	**242**	**484**	**242**	**100%**
StHC_11_1	Zone 1	59	26	67	17	16	11	-	-	0.00	-	-	0.0	0.00	**230**	3,110	662	598	0	7	30	37	1.42	**91**	**321**	**169**	**70%**
StHC_12	Zone 2	68	34	20	11	8	16	-	-	0.00	-	-	0.0	0.00	**229**	1,550	477	327	0	5	16	21	0.63	**159**	**388**	**204**	**90%**
StHC_13	Zone 1	62	36	53	27	22	23	2	2	0.00	0.02	0.1	0.1	0.00	**126**	2,837	1,431	1,177	0	14	59	73	2.04	**64**	**190**	**89**	**40%**
StHC_13a	Zone 1	121	30	19	15	10	10	6	6	0.00	0.06	0.3	0.4	0.01	**38**	1,432	987	762	0	10	38	48	1.60	**76**	**114**	**46**	**20%**
StHC_14	Zone 1	99	66	383	106	83	326	16	16	0.03	0.16	0.8	1.0	0.02	**28**	32,582	5,562	4,028	3	56	201	260	3.94	**24**	**52**	**17**	**10%**
StHC_14_1	Zone 1	20	6	21	2	2	18	-	-	0.00	-	-	0.0	0.00	**215**	1,867	109	101	0	1	5	6	1.05	**116**	**331**	**179**	**80%**
StHC_14_4	Zone 1	58	58	53	39	32	53	23	23	0.01	0.23	1.2	1.4	0.02	**17**	4,616	2,447	2,052	0	24	103	128	2.20	**62**	**79**	**28**	**20%**
StHC_15	Zone 1	88	68	68	25	21	37	2	2	0.00	0.02	0.1	0.1	0.00	**178**	5,023	1,537	1,221	1	15	61	77	1.13	**111**	**289**	**150**	**70%**
StHC_16	Zone 1	55	55	282	151	116	164	103	103	0.02	1.03	5.2	6.2	0.11	**1**	19,764	11,085	8,416	2	111	421	534	9.70	**3**	**4**	**1**	**10%**
StHC_16_11_1	Zone 1	88	88	540	180	73	67	5	5	0.01	0.05	0.3	0.3	0.00	**123**	28,118	8,335	3,587	3	83	179	266	3.02	**43**	**166**	**73**	**30%**
StHC_16_4	Zone 1	77	74	83	18	11	35	8	8	0.00	0.08	0.4	0.5	0.01	**79**	5,326	1,125	834	1	11	42	53	0.72	**148**	**227**	**114**	**50%**
StHC_16_5	Zone 1	86	86	187	51	34	82	11	11	0.01	0.11	0.6	0.7	0.01	**65**	11,572	2,895	1,977	1	29	99	129	1.50	**85**	**150**	**60**	**30%**
StHC_16_8	Zone 1	36	36	169	66	42	49	4	4	0.00	0.04	0.2	0.2	0.01	**75**	9,202	3,198	2,164	1	32	108	141	3.92	**26**	**101**	**36**	**20%**
StHC_16_9	Zone 1	35	35	105	22	15	21	1	1	0.00	0.01	0.1	0.1	0.00	**180**	4,918	1,188	861	0	12	43	55	1.58	**77**	**257**	**130**	**60%**
StHC_17	Zone 1	110	46	85	12	11	35	5	5	0.00	0.05	0.3	0.3	0.01	**76**	5,385	817	758	1	8	38	47	1.01	**119**	**195**	**93**	**40%**
StHC_18	Zone 1	63	28	33	10	10	33	7	7	0.00	0.07	0.4	0.4	0.02	**27**	2,814	692	654	0	7	33	40	1.42	**90**	**117**	**47**	**20%**
StHC_18_1	Zone 1	37	34	131	41	37	63	21	21	0.01	0.21	1.1	1.3	0.04	**7**	7,424	2,587	2,249	1	26	112	139	4.09	**22**	**29**	**12**	**10%**
StHC_19	Zone 1	47	42	107	23	17	39	2	2	0.00	0.02	0.1	0.1	0.00	**139**	6,123	1,186	846	1	12	42	55	1.30	**100**	**239**	**122**	**50%**
StHC_20_1	Zone 1	39	32	15	5	5	31	21	21	0.00	0.21	1.1	1.3	0.04	**6**	3,128	2,164	2,077	0	22	104	126	3.93	**25**	**31**	**13**	**10%**
StHC_21	Zone 1	53	32	60	23	13	59	5	5	0.01	0.05	0.3	0.3	0.01	**54**	5,697	1,190	730	1	12	36	49	1.53	**82**	**136**	**53**	**30%**
StHC_21_1	Zone 1	107	60	34	19	15	26	1	1	0.00	0.01	0.1	0.1	0.00	**200**	2,496	1,124	841	0	11	42	54	0.89	**129**	**329**	**177**	**80%**
StHC_23_1	Zone 3	174	129	137	42	31	45	6	6	0.00	0.06	0.3	0.4	0.00	**144**	7,412	2,301	1,806	1	23	90	114	0.88	**130**	**274**	**139**	**60%**
StHC_24	Zone 3	19	17	1	1	1	1	1	1	0.00	0.01	0.1	0.1	0.00	**121**	100	100	100	0	1	5	6	0.35	**191**	**312**	**161**	**70%**
StHC_24_1	Zone 1	64	64	351	91	58	123	10	10	0.01	0.10	0.5	0.6	0.01	**53**	18,918	4,125	2,684	2	41	134	177	2.77	**53**	**106**	**42**	**20%**

Table B2 - Sub-Catchment Ranking Calculation Table

				Properties affected by FLOOD EXTENT			Properties affected by FLOOD HAZARD								Damage analysis for properties affected by FLOOD EXTENT							Final Ranking		
subcatchment	Zone	Sub-catchment area (ha)	area without areas to be excluded (ha)	properties affected by PMF extent	properties affected by 100yr extent	properties affected by 20 yr extent	properties affected by PMF Hazard	properties affected by 100yr Hazard	properties affected by 20 year Hazard	Hazard weighted PMF	Hazard weighted 100yr	Hazard weighted 20 yr	Total Hazard ARI Weighted	Hazard weighted per hectare	rank	PMF damages (normalised)	100yr damages (normalised)	20yr damages (normalised)	Damages weighted PMF	Damages weighted 100yr	Damages weighted 20yr	Total Damages ARI Weighted	Total Damages weighted per ha	rank	Add hazard and depth rank	Re-Ranked based on hazard and depth	Ranking band
SthC_25	Zone 1	97	97	254	21	7	18	3	3	0.00	0.03	0.2	0.2	0.00	**174**	12,198	878	395	1	9	20	30	0.31	**199**	**373**	**194**	**80%**
SthC_25_1	Zone 3	157	84	228	63	39	32	9	9	0.00	0.09	0.5	0.5	0.01	**80**	10,540	2,523	1,567	1	25	78	105	1.25	**103**	**183**	**85**	**40%**
SthC_25_2	Zone 1	85	85	363	140	101	56	5	5	0.01	0.05	0.3	0.3	0.00	**120**	17,273	5,570	3,946	2	56	197	255	3.00	**44**	**164**	**72**	**30%**
SthC_25_7	Zone 1	64	60	116	24	14	20	3	3	0.00	0.03	0.2	0.2	0.00	**135**	5,800	1,112	587	1	11	29	41	0.68	**150**	**285**	**146**	**60%**
SthC_28_2	Zone 3	67	46	76	14	7	11	1	1	0.00	0.01	0.1	0.1	0.00	**193**	3,418	453	284	0	5	14	19	0.41	**176**	**369**	**192**	**80%**
SthC_28_2a	Zone 3	47	23	39	5	1	10	1	1	0.00	0.01	0.1	0.1	0.00	**150**	1,453	270	100	0	3	5	8	0.34	**193**	**343**	**185**	**80%**
SthC_29_16	Zone 3	555	555	7	7	7	7	6	6	0.00	0.06	0.3	0.4	0.00	**209**	608	530	510	0	5	26	31	0.06	**237**	**446**	**231**	**100%**
SthC_29_2	Zone 3	745	740	30	22	19	25	13	13	0.00	0.13	0.7	0.8	0.00	**199**	2,283	1,468	1,276	0	15	64	79	0.11	**231**	**430**	**225**	**100%**
SthC_31	Zone 1	39	38	157	25	6	39	-	-	0.00	-	-	0.0	0.00	**222**	7,174	674	85	1	7	4	12	0.31	**198**	**420**	**220**	**90%**
SthC_32_3_1	Zone 3	407	98	228	84	38	85	18	18	0.01	0.18	0.9	1.1	0.01	**41**	11,383	3,509	1,958	1	35	98	134	1.37	**97**	**138**	**54**	**30%**
SthC_32_5_2	Zone 3	218	163	7	5	5	5	-	-	0.00	-	-	0.0	0.00	**240**	438	293	289	0	3	14	17	0.11	**230**	**470**	**239**	**100%**
SthC_37	Zone 3	394	344	26	24	18	26	2	2	0.00	0.02	0.1	0.1	0.00	**214**	1,996	1,496	1,161	0	15	58	73	0.21	**216**	**430**	**225**	**100%**
SthC_6_1	Zone 2	601	342	114	83	74	85	32	32	0.01	0.32	1.6	1.9	0.01	**94**	8,349	5,431	4,637	1	54	232	287	0.84	**134**	**228**	**116**	**50%**
SthC_9_2	Zone 2	450	339	162	113	93	118	14	14	0.01	0.14	0.7	0.9	0.00	**153**	10,540	6,596	5,410	1	66	271	338	1.00	**120**	**273**	**137**	**60%**
SurC	Zone 1	69	69	308	79	31	182	9	9	0.02	0.09	0.5	0.6	0.01	**62**	20,301	3,729	1,527	2	37	76	116	1.68	**71**	**133**	**51**	**30%**
SurC_1	Zone 1	35	35	126	38	33	62	2	2	0.01	0.02	0.1	0.1	0.00	**119**	7,660	2,055	1,731	1	21	87	108	3.08	**40**	**159**	**67**	**30%**
SurC_1a	Zone 1	95	95	514	311	210	461	36	36	0.05	0.36	1.8	2.2	0.02	**18**	37,353	16,184	10,238	4	162	512	677	7.13	**7**	**25**	**11**	**10%**
SurC_2	Zone 1	45	45	217	120	81	198	39	39	0.02	0.39	2.0	2.4	0.05	**3**	17,223	6,108	3,942	2	61	197	260	5.78	**10**	**13**	**5**	**10%**
SurC_2_1	Zone 1	68	68	144	46	27	63	10	10	0.01	0.10	0.5	0.6	0.01	**55**	8,519	2,251	1,404	1	23	70	94	1.38	**95**	**150**	**60**	**30%**
SurC_2_2	Zone 1	51	51	171	78	51	50	3	3	0.01	0.03	0.2	0.2	0.00	**118**	9,073	3,696	2,565	1	37	128	166	3.26	**32**	**150**	**60**	**30%**
SurC_2_3	Zone 1	99	99	195	38	18	15	6	6	0.00	0.06	0.3	0.4	0.00	**117**	9,582	1,738	952	1	17	48	66	0.67	**152**	**269**	**135**	**60%**
SurC_3	Zone 1	72	72	247	21	12	31	3	3	0.00	0.03	0.2	0.2	0.00	**152**	12,118	953	648	1	10	32	43	0.60	**161**	**313**	**162**	**70%**
SurC_4	Zone 1	28	28	49	2	2	16	2	2	0.00	0.02	0.1	0.1	0.00	**107**	2,483	195	192	0	2	10	12	0.42	**175**	**282**	**144**	**60%**
SurC_4_1	Zone 1	37	37	173	17	3	52	-	-	0.01	-	-	0.0	0.00	**220**	8,365	613	65	1	6	3	10	0.28	**207**	**427**	**224**	**90%**
SurC_4_2	Zone 1	57	57	224	29	19	120	2	2	0.01	0.02	0.1	0.1	0.00	**160**	12,797	1,163	707	1	12	35	48	0.85	**133**	**293**	**153**	**70%**
SurC_4_3	Zone 1	52	51	165	13	8	12	2	2	0.00	0.02	0.1	0.1	0.00	**158**	8,201	685	307	1	7	15	23	0.45	**172**	**330**	**178**	**80%**
SurC_4_3a	Zone 1	16	16	21	2	1	2	1	1	0.00	0.01	0.1	0.1	0.00	**115**	1,018	144	90	0	1	5	6	0.38	**184**	**299**	**157**	**70%**
SurC_4_4	Zone 3	94	35	51	24	20	36	8	8	0.00	0.08	0.4	0.5	0.01	**29**	3,061	1,485	1,223	0	15	61	76	2.18	**63**	**92**	**34**	**20%**
SurC_4_7	Zone 3	73	6	1	1	1	1	1	1	0.00	0.01	0.1	0.1	0.01	**48**	93	87	82	0	1	4	5	0.83	**135**	**183**	**85**	**40%**
SurC_5	Zone 1	105	105	156	13	9	55	8	8	0.01	0.08	0.4	0.5	0.00	**103**	8,839	830	664	1	8	33	42	0.40	**178**	**281**	**143**	**60%**
SurC_6_1	Zone 1	30	30	6	4	4	5	3	3	0.00	0.03	0.2	0.2	0.01	**85**	440	268	261	0	3	13	16	0.53	**166**	**251**	**126**	**60%**
SurC_6_2	Zone 3	63	63	24	14	10	16	1	1	0.00	0.01	0.1	0.1	0.00	**202**	1,484	825	587	0	8	29	38	0.60	**162**	**364**	**188**	**80%**
SurC_8_1	Zone 3	75	75	29	23	22	26	17	17	0.00	0.17	0.9	1.0	0.01	**31**	2,089	1,573	1,418	0	16	71	87	1.16	**108**	**139**	**56**	**30%**
SurC_8_3	Zone 3	213	212	10	4	4	8	1	1	0.00	0.01	0.1	0.1	0.00	**216**	610	247	242	0	2	12	15	0.07	**233**	**449**	**233**	**100%**
WC	Zone 1	111	111	177	105	71	112	32	32	0.01	0.32	1.6	1.9	0.02	**22**	12,013	6,495	4,477	1	65	224	290	2.61	**56**	**78**	**27**	**20%**
WC_1	Zone 1	97	74	296	71	31	150	15	15	0.02	0.15	0.8	0.9	0.01	**37**	17,565	3,239	1,744	2	32	87	121	1.64	**74**	**111**	**45**	**20%**
WC_10	Zone 1	62	62	5	4	3	7	3	3	0.00	0.03	0.2	0.2	0.00	**141**	367	276	183	0	3	9	12	0.19	**220**	**361**	**187**	**80%**
WC_11	Zone 1	101	101	22	19	16	19	8	8	0.00	0.08	0.4	0.5	0.00	**101**	1,629	1,237	1,043	0	12	52	65	0.64	**156**	**257**	**130**	**60%**
WC_2	Zone 1	48	45	102	29	20	40	3	3	0.00	0.03	0.2	0.2	0.00	**111**	5,719	1,403	981	1	14	49	64	1.41	**92**	**203**	**100**	**50%**
WC_4	Zone 1	89	82	240	116	68	102	13	13	0.01	0.13	0.7	0.8	0.01	**52**	13,822	5,793	3,406	1	58	170	230	2.80	**51**	**103**	**38**	**20%**
WC_4_1	Zone 1	87	82	303	98	80	97	3	3	0.01	0.03	0.2	0.2	0.00	**161**	15,680	4,753	3,821	2	48	191	240	2.93	**48**	**209**	**102**	**50%**
WC_6	Zone 1	32	32	118	66	48	54	-	-	0.01	-	-	0.0	0.00	**219**	6,540	3,295	2,411	1	33	121	154	4.82	**16**	**235**	**121**	**50%**
WC_8	Zone 1	79	79	364	266	227	190	39	39	0.02	0.39	2.0	2.4	0.03	**12**	21,542	12,875	10,976	2	129	549	680	8.60	**4**	**16**	**6**	**10%**
WC_8_1	Zone 1	94	94	190	61	36	98	11	11	0.01	0.11	0.6	0.7	0.01	**73**	10,722	2,819	1,820	1	28	91	120	1.28	**101**	**174**	**79**	**40%**
WC_8_2	Zone 1	50	50	142	68	54	70	11	11	0.01	0.11	0.6	0.7	0.01	**33**	7,937	3,251	2,579	1	33	129	162	3.25	**34**	**67**	**24**	**10%**
WC_8_4_3	Zone 1	70	70	164	88	63	59	13	13	0.01	0.13	0.7	0.8	0.01	**40**	9,258	4,544	3,097	1	45	155	201	2.87	**50**	**90**	**32**	**20%**
WC_8_8	Zone 1	50	50	152	105	53	84	6	6	0.01	0.06	0.3	0.4	0.01	**70**	8,531	4,610	2,405	1	46	120	167	3.34	**31**	**101**	**36**	**20%**
WC_9	Zone 1	79	79	111	41	29	65	13	13	0.01	0.13	0.7	0.8	0.01	**50**	7,274	2,382	1,693	1	24	85	109	1.38	**94**	**144**	**57**	**30%**