Breakfast Creek Flood Study
Volume 1 of 2

BRISBANE CITY

Dedicated to a better Brisbane

Breakfast Creek Flood Study

Volume 1 of 2

Prepared by Brisbane City Council's, City Projects Office

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Breakfast Creek
Flood Study

Executive Summary

BREAKFAST CREEK FLOOD STUDY – EXECUTIVE SUMMARY

CONTENTS

Glossary of Terms

Term	**Definition**
AHD	Australian Height Datum (AHD) is the reference level for defining reduced levels adopted by the National Mapping Council of Australia. The level of 0.0 m AHD is approximately mean sea level.
AMTD	Adopted Middle Thread Distance.
ARI	The Average Recurrence Interval (ARI) is a statistical estimate of the average period in years between the occurrences of a flood of a given size at a specific location. For example, a 100-year ARI could also be expressed as having a 1 in 100 chance or a 1 per cent chance of occurring in any given year.
AEP	The Annual Exceedance Probability that a given rainfall total or flood flow will be exceeded in any one year. For example, a 100-year ARI could also be expressed as having a 1 in 100 chance or a 1 per cent chance of occurring in any given year.
DEM	Digital Elevation Model (DEM) A three-dimensional model of the ground surface elevation.
Design Event, Design Storm	A mathematical storm representing a precipitation event.
DIS storm	Duration Independent Storm, a Synthetic design storm pattern developed by BCC intended to simulate design events
ESTRY	1-dimensional flood modelling component of TUFLOW software.
PMF	Probable Maximum Flood. The maximum flood that is reasonably estimated to not be exceeded. Derived from a PMP.
PMP	The PMP is the greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location at a particular time of the year.

List of Abbreviations

Abbreviation	**Definition**
AMTD	Adopted Middle Thread Distance
ALS	Airborne Laser Scanning
AR&R	Australian Rainfall and Runoff (1999)
BCC	Brisbane City Council
CBD	Central Business District
IFD	Intensity Frequency Duration
MHG	Maximum Height Gauge
MRC	Minimum Riparian Corridor
MSQ	Maritime Safety Queensland
QUDM	Queensland Urban Drainage Manual (2013)
WC	Waterway Corridor

1 INTRODUCTION

The Breakfast Creek catchment is located in the north-western suburbs of Brisbane. The catchment is wholly contained within the city boundaries, covering the wards of Hamilton, Central, Grange, Enoggera, The Gap and Toowong. The Breakfast/Enoggera Creek catchment commences in Brisbane State Forest in the D'Aguilar Range and falls generally eastward to the mouth of the creek at the Brisbane River at Newstead. Ground levels in the catchment range from 550 metres in Brisbane Forest Park to tidal levels at the junction with the Brisbane River.

The catchment contains four major creeks – Enoggera Creek, Breakfast Creek, Ithaca Creek and Fish Creek.

- Enoggera Creek drains the western end of the catchment and includes Enoggera Dam. Enoggera Creek begins in steep forest before flowing into the Enoggera Reservoir. Downstream of the Reservoir, Enoggera Creek winds through a well-defined, predominantly natural channel, bordered by established residential development. The Enoggera Creek catchment covers an area of approximately 32 km^2 upstream of the dam, and an additional 18 km^2 downstream of the dam, therefore covering more than 65% of the total Breakfast-Enoggera catchment.

- Fish Creek is a tributary of Enoggera Creek and drains approximately 5 km^2 of the catchment to the north of the Enoggera Creek catchment. Fish Creek is fed by residential stormwater drainage from the suburb of The Gap. The watercourse joins Enoggera Creek just downstream of Walton Bridge on Waterworks Road.

- Ithaca Creek is located to the south of Enoggera Creek and drains an area of approximately 11 km^2. The catchment of Ithaca Creek begins on the forested watershed of Mt Coot-tha and traverses the residential communities of Bardon, Ashgrove, Jubilee and Ithaca. Enoggera Creek and Ithaca Creek join approximately 700 metres upstream of the Kelvin Grove Road bridge.

- Breakfast Creek is characterised by a low-gradient meandering main channel which is tidal up to the stream flow weir adjacent to Bancroft Park. The existing creekside development of Breakfast Creek is comprised predominantly of recreational parkland in the upper reaches and dense commercial development in the lower reaches. Breakfast Creek discharges into the Brisbane River at Newstead. The Breakfast Creek catchment covers an area of approximately 13 km^2.

The total area of the Breakfast-Enoggera Creek catchment is approximately 80 km^2. A summary of the catchments is presented in **Table 1.1** – Catchments Areas.

Table 1.1 Catchments Areas

Catchment	Area (km^2)	Length (km)
Enoggera Creek upstream of Enoggera Dam	32.3	18*
Enoggera Creek from Dam to Ithaca confluence	17.7	14
Fish Creek	4.8	3
Ithaca Creek	11.1	8
Breakfast Creek	13.4	7
Total	**79.3**	**32**

Note: * Not part of hydraulic model

A number of flood studies of Breakfast/Enoggera Creek were conducted previously by Brisbane City Council to determine flood levels throughout the catchment and establish flood regulation lines. But due to continuing urbanization and infrastructure development none of them has been finalized and adopted. As this current flood study has been prepared by utilizing most recent and up to date information with the most advanced flood modelling tool, it is expected that this flood study will serve various purposes.

An objective of this study is to develop a two dimensional (2D) model of Breakfast-Enoggera Creek System by utilizing 2D hydraulic modelling software with up to date information and to finalize the draft flood study with the outcome of this 2 dimensional hydraulic study. The 2D hydraulic modelling software used in this study is TUFLOW. River channels and structures located upstream of the Kelvin Grove Road bridge were represented in 1D through TUFLOW's 1D modelling system, ESTRY. The 1D and 2D elements were linked to enable real-time flow transitions between the 1D and 2D domains.

Up until now, Council's primary tool for analysing flood behaviour in the Breakfast Creek catchment is a one dimensional (1D) hydraulic model of Breakfast Creek and its main tributaries. This hydraulic model was developed using the MIKE11 modelling software. 1D hydraulic models simulate flow in one dimension, i.e. up or down river. They are therefore limited in their ability to represent complex flow paths across floodplains. This is of particular concern in urban areas (due to the complexity of flood behaviour through an urban setting) and/or where model accuracy is important.

In recent years, with the advent of more powerful computers, two dimensional (2D) hydraulic modelling has become a standard industry approach to address the flooding behaviour within the floodplain. 2D models are generally depth-averaged, simulating flow in the horizontal plane. Given the degree of urbanisation in the Enoggera-Breakfast Creek catchment and increased flood sensitivity, a 2D hydraulic modelling approach will enhance Council's understanding of flood behaviour within the channel and adjacent floodplains. In addition, as all new major infrastructure works associated with the CLEM7 Cross River Tunnel, Airport Link M7 Tunnel and Northern Busway Project have utilized more advanced 2 Dimensional modelling techniques to assess the impact of these infrastructures, it will be beneficial to Council to develop a tool which is compatible to these models and to cater any future needs.

Updating the model to include more recent development and calibrating the model to recent flood events (May 2009 and January 2013) is also included within the scope of this study.

The 2 Dimensional TUFLOW model built and developed for this study, utilized information from both the 1 Dimensional MIKE11 model and the 2 Dimensional TUFLOW model of Airport Link. In some cases some technical adjustments to these model parameters were carried out to make them suitable to incorporate in the developed model.

In summary, expected major outcomes of the Breakfast-Enoggera Creek flood study are:

- Design flood levels and Flood inundation mapping
- Flood regulation line/ Waterway Corridor and minimum riparian corridor analysis
- Analysis of extreme events and Climate Change effects, and
- Hydraulic and hydrologic models which can be adapted to analyse alternate scenarios (such as various development scenarios and structures).

These outcomes were achieved through the use of calibrated hydrologic and hydraulic models of the catchment. The hydrologic model used was WBNM version 2.1, whilst TUFLOW 64-bit version of 2012-05-AA build was employed for the hydraulic model.

2 PROJECT ELEMENTS

The Breakfast and Enoggera Creek Flood Study was conducted in two separate stages. Each stage is documented in a separate report contained within this document:

- Report A: Model Calibration
- Report B: Design Event Modelling

2.1 Report A: Model Calibration

The calibration report presents the details associated with development and calibration of the WBNM and TUFLOW models.

The WBNM hydrologic model simulates the catchment rainfall-runoff and, in a highly simplified approach, the movement of flood waters down the creeks. The TUFLOW 2 Dimensional hydraulic model simulates the movement of flood waters using advanced mathematics, thereby giving a more accurate representation of flood behaviour, particularly where downstream effects and hydraulic structures are influential.

Calibration of the WBNM and TUFLOW models against a number of historical events was undertaken. Calibration is the process by which flood levels generated from the model using recorded rainfall are compared with recorded flood level data for the event in question. When sufficient points are in agreement, the model is considered 'calibrated' to that event. By calibrating to a range of historical flood events, the model can be used more confidently to represent the action of the catchment and to develop design event flood levels.

The WBNM model was calibrated for the January 1974, April 1989, May 1996, May 2009 and January 2013 flood events. TUFLOW model was calibrated for the April 1989, May 2009 and January 2013 flood events and verified against May 1996 flood event.

In summary, good calibration was achieved for the hydrologic and hydraulic models across a range of historical events.

2.2 Report B: Design and Extreme Event Modelling

Following on from the calibration report, the design event report provides details on the results of the design event model simulations obtained using the calibrated hydrologic and hydraulic models. Peak water surface levels and discharges were calculated for the 100%, 50%, 20%, 10%, 5%, 2%, 1%, 0.5%, 0.2%, 0.05% AEP and PMF events. 1%, 0.5% and 0.2% AEP events were further calculated to assess the impacts from climate change scenarios at the year 2050 and 2100. Note, 0.05% AEP and PMF events were analysed only with existing case scenario.

Design event hydrology was based on the Duration Independent Storm (DIS) temporal patterns. Rare and extreme events hydrologic calculations were conducted with the methodology developed by CPO as used in other recent flood studies.

Anticipated water levels and flows at different cross section locations extracted from the design analysis outputs and relevant mappings are included in **Appendix E** and **Appendix J** of the report respectively. Also **Appendix I** contains the mappings showing scenario with existing waterway conditions with ultimate catchment hydrology.

Breakfast Creek
Flood Study

Report A - Model Calibration

REPORT A – MODEL CALIBRATION

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1 INTRODUCTION

City Projects Office, Brisbane City Council was commissioned to undertake a flood study of the Breakfast-Enoggera creek catchment.

This flood study report relates to the flooding of the major waterways of the Breakfast-Enoggera Creek catchment. The Breakfast-Enoggera Creek catchment is located entirely within the boundaries of Brisbane City, and spans the suburbs of The Gap, Ashgrove, Bardon, Kelvin Grove and Bowen Hills. The location of the catchment is shown on **Figure 1.1**.

Hydrologic and hydraulic models have been developed for the catchment and calibrated and verified against a range of flood events for which recorded information is available.

This report describes the catchment, its history in relation to flooding and flood mitigation, and the development and calibration of hydrologic and hydraulic models for the catchment. Also presents model results for a range of storm events and a number of scenarios.

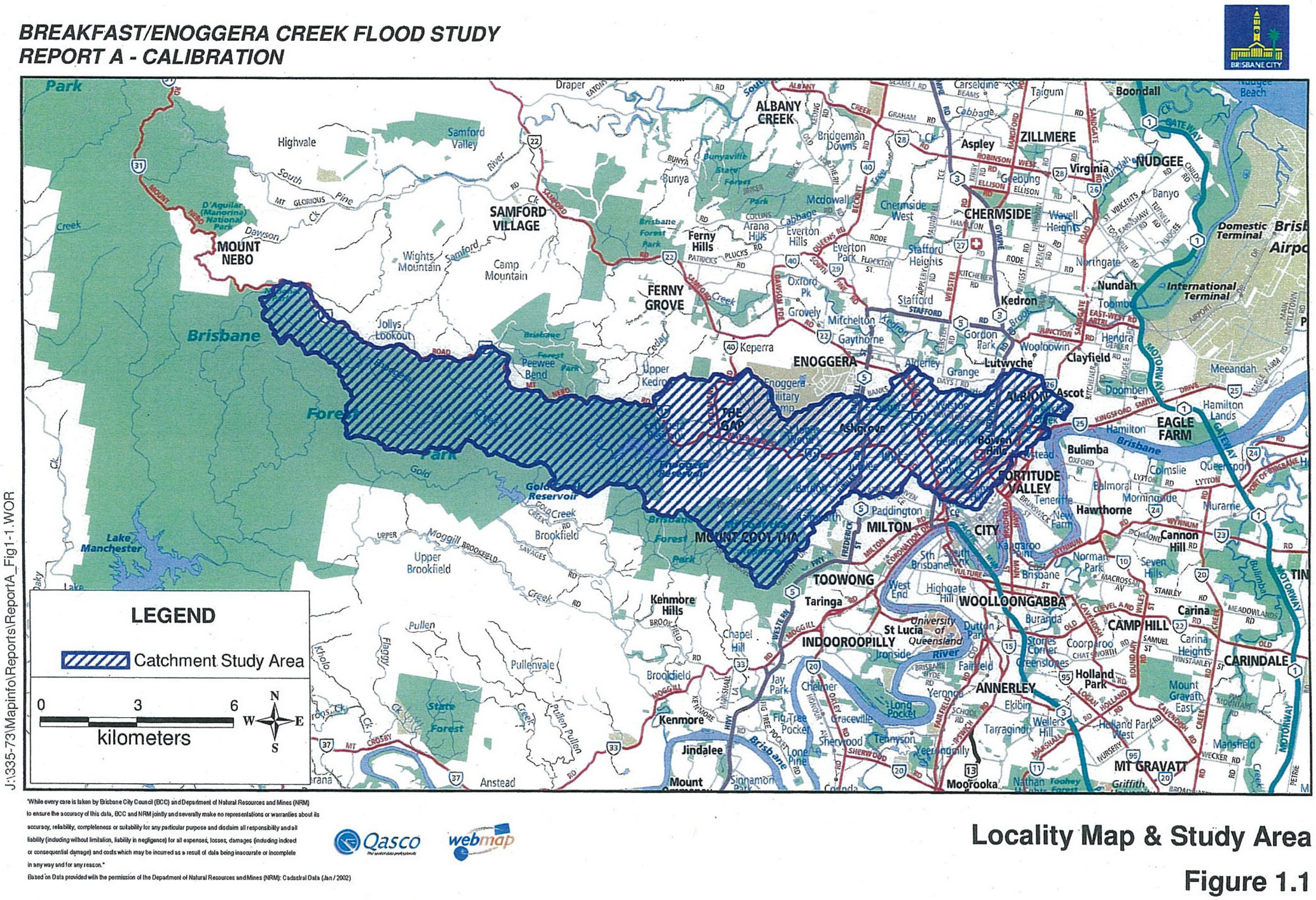


Figure 1.1 **Locality Map & Study Area**

2 CATCHMENT DESCRIPTION

The Breakfast-Enoggera Creek catchment commences in Brisbane State Forest in the D'Aguilar Range and falls generally eastward to the mouth of the creek at the Brisbane River at Newstead. Ground levels in the catchment range from 550 metres in Brisbane Forest Park to tidal levels at the junction with the Brisbane River.

The catchment contains four major creeks – Enoggera Creek, Breakfast Creek, Ithaca Creek and Fish Creek.

- Enoggera Creek drains the western end of the catchment and includes Enoggera Dam. Enoggera Creek begins in steep forest before flowing into the Enoggera Reservoir. The heavily wooded upper catchment upstream of the Reservoir comprises more than one third of the total catchment area. The reservoir was initially constructed in 1866. Downstream of the Reservoir, Enoggera Creek winds through a well-defined, predominantly natural channel, bordered by established residential development. The Enoggera Creek catchment covers an area of approximately 32 km^2 upstream of the dam, and an additional 18 km^2 downstream of the dam, therefore covering more than 65% of the total Breakfast-Enoggera catchment.

- Fish Creek is a tributary of Enoggera Creek and drains approximately 5 km^2 of the catchment to the north of the Enoggera Creek catchment. Fish Creek is fed by residential stormwater drainage from the suburb of The Gap. The watercourse joins Enoggera Creek just downstream of Walton Bridge on Waterworks Road.

- Ithaca Creek is located to the south of Enoggera Creek and drains an area of approximately 11 km^2. The catchment of Ithaca Creek begins on the forested watershed of Mt Coot-tha and traverses the residential communities of Bardon, Ashgrove, Jubilee and Ithaca. Enoggera Creek and Ithaca Creek join to form Breakfast Creek approximately 700 metres upstream of the Kelvin Grove Road bridge.

- Breakfast Creek is characterised by a low-gradient meandering main channel which is tidal up to the stream flow weir adjacent to Bancroft Park. The existing creek-side development of Breakfast Creek is comprised predominantly of recreational parkland in the upper reaches and dense commercial development in the lower reaches. Breakfast Creek discharges into the Brisbane River at Newstead. The Breakfast Creek catchment covers an area of approximately 13 km^2.

The total area of the Breakfast-Enoggera Creek catchment is approximately 80 km^2. **Figure 2.1** illustrates the Breakfast-Enoggera Creek catchment.

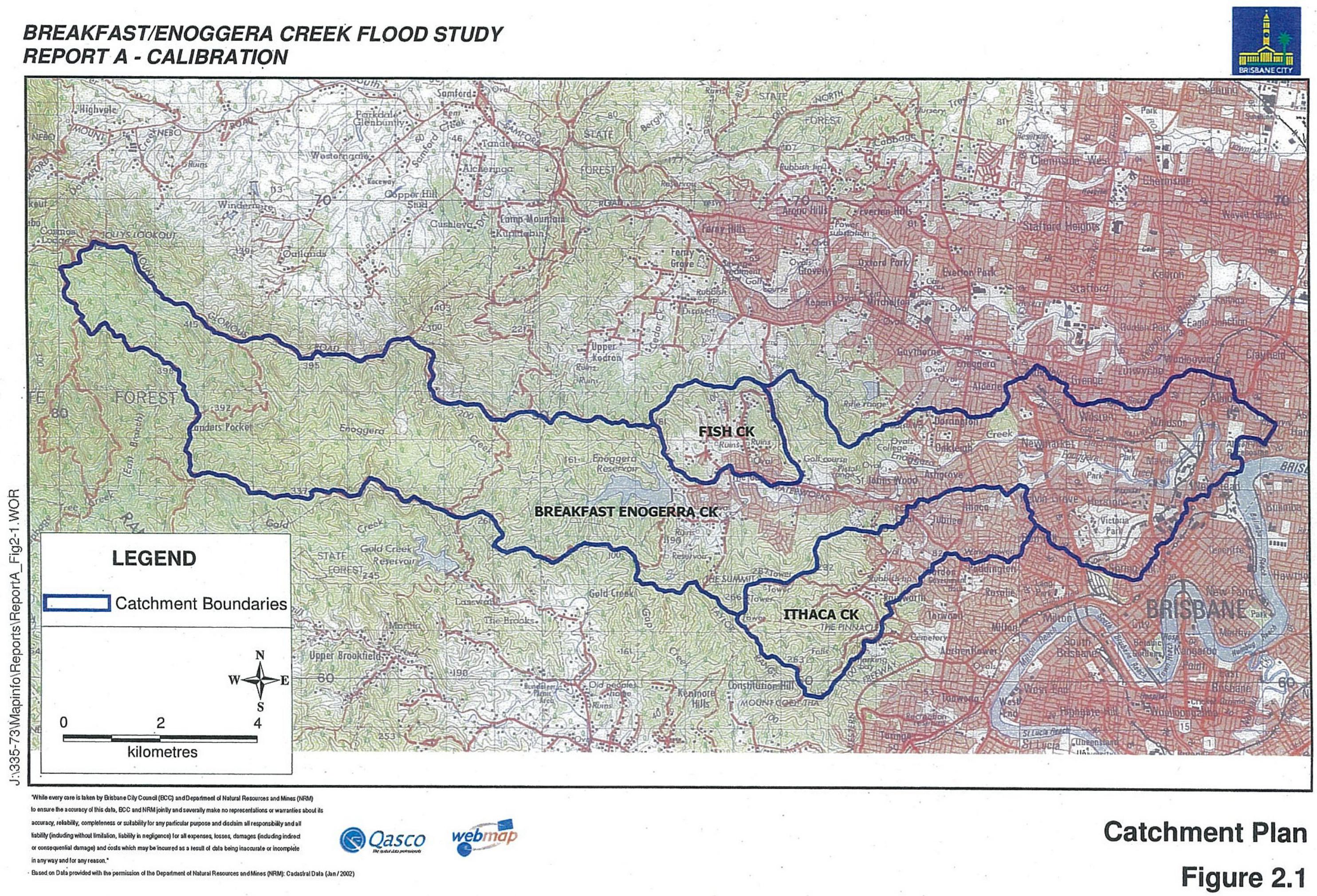


Figure 2.1 Catchment Plan

3 CATCHMENT HISTORY

3.1 Flooding History

The Breakfast-Enoggera Creek catchment has a history of significant flooding events. These flooding events have typically been followed by flooding investigations and proposals for major mitigation strategies.

The early history of the catchment is best described in the following excerpt from a major study of the Breakfast and Enoggera Creeks carried out in 1973 by Cameron McNamara & Partners for the Coordinator General's Department:

> *Early settlement in Australia set the pattern for the network of urban areas and their layout as they exist at the present time. That so many communities suffer regular and significant damages from flooding is therefore readily understood when it is remembered that at the time of initial settlement, proximity to a waterway was highly desirable on many counts and indeed necessary for transport and water supply facilities. Early settlers came almost exclusively from Europe where the intense rainfalls and large variations in stage height of streams common in Australia are not generally experienced.*
>
> *Perhaps the most striking feature of the development of the catchment at this time as shown on survey office maps of the day was the total lack of development in the lower flood plain areas although development and land subdivision was beginning to surround these areas. The Mayne Railway Yards; the area bounded by Lutwyche Road, Cartwright Street and Enoggera Creek; the area bounded by Newmarket Road, Finsbury Street, Enoggera Creek and Green Terrace; and the flood plain area between Clyde Road and Bowen Bridge Road were conspicuously undeveloped. It is reasonable to say that all of these flood plain lands were under rural usage.*
>
> *By 1930 however, substantial development had taken place in all of these areas. This was presumably so because memories of the late nineteenth century floods had faded, expansion of the city's population to some 280,000 people had created economic pressures, and the presence of Enoggera Reservoir may have had an understandably reassuring effect on the developers in these areas.*
>
> *The area around Mayne Railway Siding was being developed as a railway marshalling yard, but it is unlikely that any major increases in the general ground level had been made. Urban development in the catchment now extended westward to include Ashgrove, but most of the urbanised areas still contained about 30% of vacant allotments.*

While work in the road, street and drainage fields was progressing it must be remembered that even as late as 1930 few of the residential roads were sealed, only slightly more were provided with kerb and channel, and underground stormwater drainage generally consisted of culverts at intersections to assist the run-off into the nearest natural drainage line.

By 1950 the flood plain was intensely developed and land usage patterns in the lower flood plains were becoming predominantly industrial. Urban development had extended to include St. Johns Wood area and most of the vacant allotments evident in the 1920 - 1930 period were developed.

The post-war economy had stabilised by 1950 and development steadily progressed. As new areas were opened to urban development the roads were sealed and provided with kerb and channelling and with adequate underground stormwater drainage. The backlog of such facilities in the areas already developed was attacked by the Brisbane City Council culminating with very large efforts in this direction in the 1960's.

Major flooding of the same order as that of February 1931 occurred in June 1967. Damages sustained by properties were understandably higher as a result of more intense development and the existence of more sophisticated and expensive industrial machinery within the zones of inundation.

By 1970 urban development was well established over a large proportion of the catchment between Ashgrove and the Enoggera Reservoir and the pattern of future development had clearly emerged. Since 1949 the stormwater drainage requirements set down by the Brisbane City Council have provided for run-off from storms of once in ten year return periods to be carried in the pipe system. Accordingly the modern roads and drainage were affording very little attenuation of run-off and the annual increase in total impervious area within the catchment was larger than at any previous time.

These conditions assisted the two major floods in February and April of 1972 to reach the proportions they did....It is of interest to note that had the February flood not cleared the channel and left it in a state of reduced effective roughness, the stage heights of the April flood would have exceeded those of the June 1967 flood.

This history demonstrates that the frequency and severity of flooding in Breakfast-Enoggera Creek is such that there is a reasonable degree of knowledge of flooding in the catchment.

An extract from the 1931 inquiry into the cause of flooding in the Breakfast Creek area (carried out subsequent to severe flooding in 1931), refers to a submission for the canalisation of the creek from Normanby Bridge to just above Breakfast Creek Road Bridge and the conversion of the low-lying land into a park of 300 acres. This submission was presented in 1913-14. Even at this early date, the flooding potential of this area was known. However, as stated in the 1931 enquiry:

> *This scheme, while perhaps feasible then, is impracticable today, but it should be noted that it is a well established principle to avoid flood damage by simply refraining from occupying land that is sure to be periodically flooded and utilising such land for parks, playing fields, or pasturage.*

The scheme is even more impracticable today. However, since development involving unregulated filling and encroachment into the floodplain over the past 100 years has robbed the creek system of its natural conveyance and storage areas, either some degree of flooding, or some form of flood mitigation must be accepted in this catchment, particularly in the lower reaches.

3.2 Mitigation History

Enoggera Dam was constructed in 1866. In 1973 the spillway was lowered due to fears that the dam wall may not be able to withstand overtopping.

In 1976, following the January 1974 flood event and a report by Cameron McNamara & Partners, the dam wall and spillway were raised, making the dam a multi-purpose structure for both water supply and flood mitigation. At this time two rectangular sluice openings were built into the spillway structure with their inverts at the old spillway crest level of 74.37m AHD.

After the flooding event of 1931 and a subsequent report by a selected technical committee, channel improvements in the lower reaches of Breakfast Creek were undertaken. This resulted in the straightening of two sections of Breakfast Creek adjacent to the Mayne railway yards, and straightening between Normanby Bridge (Kelvin Grove Road) and Bishop Street.

After the Cameron McNamara & Partners flooding investigation of 1973, including its revision accounting for the event of January 1974, major channel dredging works were undertaken from Normanby Bridge to the channel mouth. This work was carried out between 1976 and 1979, and involved significant destruction of the creek side mangrove habitat and long-term disruption to the general community due to increased noise, dust and traffic.

Over the next six years siltation levels were observed to be increasing and an investigation by Riedel and Byrne was commissioned to determine the effects of the siltation on the designed flood profiles resulting from the 1976 to 1979 dredging. The investigation concluded that by 1985 up to one third of the improvement gained by the dredging had been lost.

In 1988 some minor dredging work was undertaken in the lower reach of Breakfast Creek to improve the creek's trafficability to the moorings.

Under the City of Brisbane (Flood Mitigation, etc) Act Amendment Act 1974, No.38 (now repealed) the Brisbane City Council had an obligation to maintain the efficiency of the flood mitigation works and hence the continued dredging of Breakfast Creek was considered to be required. However the considerable public and ecological disruption which resulted from the original dredging led the Council to commission Sinclair Knight Consulting Engineers to undertake an *Impact Assessment Study of the Dredging for Maintenance of Flood Mitigation in 1993*. This report was supported by creek bed survey carried out in 1992.

The Sinclair Knight report recommended limited dredging in selected areas and also the removal of a natural rock bar identified downstream of the Breakfast Creek Road Bridge, at the confluence with the Brisbane River.

In late 1995 GHD delivered a *Supplementary Impact Assessment Report (SIAR)* based upon the recommendations of the 1993 Sinclair Knight report. This SIAR provided a more focussed analysis of the recommended maintenance works in terms of ecological, social and economic impacts associated with each option. The report quantifies estimated siltation rates and states that siltation in the upstream reaches is dominated by fluvial deposits whilst the downstream reaches are demonstrating much lower accretion and are likely to be reaching an equilibrium.

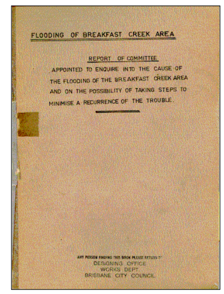
In view of pursuing the findings of the SIAR, GHD went on to submit two Environmental Management Plans for the *Dredging of Breakfast Creek* and *Removal of the rock bar*. The rock bar was removed in conjunction with the construction of the Inner City Bypass in 2003.

Maintenance dredging of the reach of creek between Bowen Bridge Road and Kelvin Grove Road began in 2011. The first stage of a multi-million dollar program was completed in the region immediately upstream of Bowen Bridge Road. The work in this section focused on the removal of accumulated sediment and the selective removal of mangroves which had colonised these zones. An added improvement to the northern side of the creek was the creation of a clear flowpath for flood waters which had entered onto the floodplain to return to the creek channel. Additional stages of dredging will be undertaken in the future as funding permits.

3.3 Reporting History

As previously noted, a number of studies have been carried out on Breakfast-Enoggera Creek. These reports provide a valuable insight into the historical flooding, technical investigations and mitigation works within the creek systems. A summary of each report appears below.

3.3.1 Flooding of Breakfast Creek Area



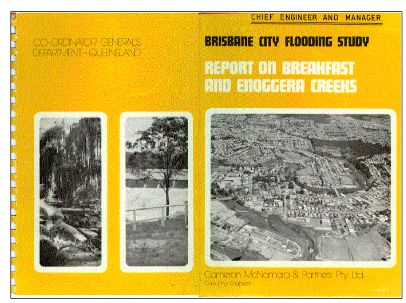
Committee of Representatives, 1931

This study was carried out by an appointed committee of representatives from BCC, Department of Harbours and Marine and the Railways Department. The study was carried out subsequent to significant flooding of the creek during February 1931.

In this study, the discharge at the mouth of Breakfast Creek for the February 1931 event was computed to be 20,000 cusecs (approximately 570 m^3/s). Flow from Enoggera Reservoir accounted for approximately 8,200 cusecs (235 m^3/s) of this flow.

Suggested possible mitigation options included dredging, canalisation of the lower portion of the creek, construction of levees, the raising of low lying areas and the construction of a flood mitigation dam downstream of the Enoggera Reservoir. Construction of the regulating dam was considered the most favourable recommendation. However, it was the canalisation (straightening) of the lower portion of Breakfast Creek which was eventually undertaken.

3.3.2 Report on Breakfast and Enoggera Creeks



Cameron, McNamara & Partners Pty Ltd, 1973

The Co-ordinator General's Department commissioned this report after flooding in 1967 caused major damage. In this report, the June 1967 event is estimated to have a return period of the order of 30 years.

The report investigates the flooding of Breakfast, Enoggera, Fish and Ithaca Creeks, with a variety of flood mitigation options investigated and associated flood profiles and cost benefit analysis presented. The report also provides a valuable summary of flooding in the area and insight into the history of development within the catchment.

A number of flood mitigation options were considered in detail, with a large proportion of the report consumed with the detailed economic analysis of each of the mitigation options. The recommended flood mitigation option included the raising of the Enoggera Reservoir embankment to provide additional flood storage during significant events, and the dredging of the main channel from Normanby Bridge (Kelvin Grove Road) to the confluence with the Brisbane River.

The study made use both of physical and mathematical models. Results from the University of Queensland physical model and report on the flooding in the lower reaches of Breakfast Creek were referenced, while the early mathematical hydrologic and hydraulic computer programs of HYDIN, RIVOS, RETIN and WASUF were employed. These computer programs performed unit hydrograph calculations and steady state backwater analysis with supplementary information on the effects of retention basins and channel routing being incorporated for the differing scenarios. Calculated flood profiles were presented for 1 in 10 year and 1 in 100 year return periods.

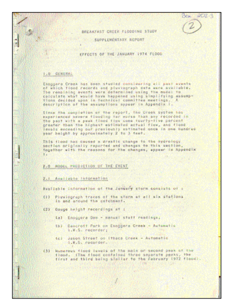
The report also included an interesting discussion on Town Planning issues relating to the use of flood plain land. This was followed by a detailed summary of the Town Planning issues particularly relevant to various reaches of the Breakfast Creek flood plain.

A brief discussion and the presentation of calculations on the effect of varying the Brisbane River tail water level on anticipated flood flows indicated that little or no effect was translated beyond Normanby Bridge, regardless of the tidal component.

Relevant final recommendations of this report were that:

- the raising of the Enoggera Reservoir embankment be conducted as a matter of high priority;
- channel dredging be carried out in the lower reaches;
- the State Forest area upstream of the Enoggera Reservoir, and Mount Coot-tha Park Reserve be retained as forested open space in perpetuity.

3.3.3 Supplementary Report Effects of the January 1974 Flood



Box 202-3

(2)

BREAKFAST CREEK FLOODING STUDY

SUPPLEMENTARY REPORT

EFFECTS OF THE JANUARY 1974 FLOOD

1.0 GENERAL

Enoggera Creek has been studied considering all past events of which flood records and pluviograph data were available. The remaining events were determined using the model to calculate what would have happened using simplifying assumptions decided upon in technical committee meetings. A description of the assumptions appear in Appendix I.

Since the completion of the report, the Creek system has experienced severe flooding far worse than any recorded in the past with a peak flood flow some fourty-five percent greater than the highest estimated actual flow, and flood levels exceeding our previously estimated once in one hundred year height by approximately 2 to 3 feet.

This flood has caused a drastic change to the hydrology section originally reported and changes to this section, together with the reasons for the changes, appear in Appendix I.

2.0 MODEL PREDICTION OF THE EVENT

2.1 Available Information

Available information of the January storm consists of :

(1) Pluviograph traces of the storm at all six stations in and around the catchment.

(2) Gauge height recordings at :

(a) Enoggera Dam - manual staff readings;

(b) Bancroft Park on Enoggera Creek - Automatic I.W.S. recorder;

(c) Jason Street on Ithaca Creek - Automatic I.W.S. recorder.

(3) Numerous flood levels of the main or second peak of the flood. (The flood contained three separate peaks, the first and third being similar to the February 1972 flood).

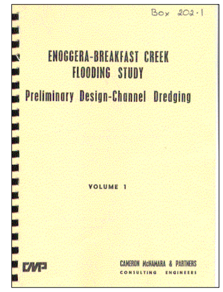
Cameron, McNamara & Partners Pty Ltd, 1974

Subsequent to the Cameron McNamara & Partners study of the area, major flooding occurred throughout Brisbane in January 1974. A supplementary study was therefore commissioned to update the study as a result of additional information provided by the January 1974 event.

The study included a review of the 1973 model hydrology and subsequent hydraulic results based upon the January 1974 event. The January 1974 event was estimated to have a return period of 100 years based upon the Enoggera Reservoir level of 1973. As a result, the anticipated 1 in 100 year flow at Bowen Bridge was upgraded from 19500 cusecs (approximately 560 m^3/s) to 25000 cusecs (approximately 715 m^3/s). Revised return periods for April 1972, February 1972 and June 1967 were also presented.

A review of the flood frequency at Bowen Bridge Road revealed a poor correlation between historical events recorded at the Brisbane Regional Office and observed discharges at Enoggera Dam. Detailed discussion of variations in the standard deviation and skewness of statistical data was presented. Revised stage and discharge frequency data were also presented for Bowen Bridge Road. It is evident from this report that the Enoggera Dam spillway was lowered in 1973 to ensure the dam wall would not be over topped by a very large flood.

3.3.4 Preliminary Design-Channel Dredging Volumes 1, 2 & 3



Cameron, McNamara & Partners Pty Ltd, 1974

Volume 1

This volume discussed the design criteria for the dredging of the lower reaches of the creek, below Normanby Bridge.

The effects of flood regulation lines at some selected locations along Breakfast Creek were discussed, along with the resumption of properties required to undertake the proposed dredging.

The report contained a copy of the 'Supplementary Report – Effects of January 1974 Flood' as an appendix. This report included flood frequency curves at Enoggera Dam and Bowen Bridge Road.

Volume 2

Volume 2 consisted of plans for the proposed dredging, along with Q50 and Q100 flood profiles for the three options:

- No works
- Dam Works
- Dam Works and Channel Dredging

Hydrographs for Enoggera Reservoir and Bowen Bridge Road were also presented for the Q100 and Q50 for the options:

- No works
- Dam Works and Channel Dredging

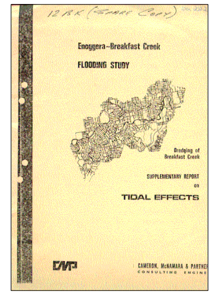
In this study, the January 1974 event was considered to be a 1 in 100 year event.

Minimum floor level plans were also presented.

Volume 3

This volume consisted of plans for channel dredging and land resumptions.

3.3.5 Dredging of Breakfast Creek Supplementary Report on Tidal Effects

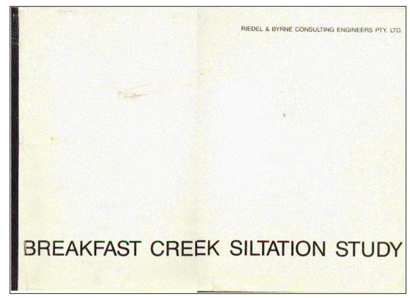


Cameron, McNamara & Partners Pty Ltd, 1974

The report concluded that:

> *The dredging of Breakfast Creek will not have any undue influence on the regime of the creek although there will be a tendency for the creek to return to its natural state and thus continuous dredging maintenance will be required.*

3.3.6 Breakfast Creek Siltation Study



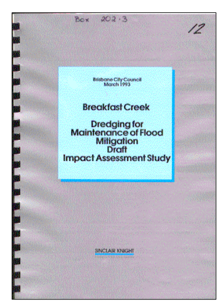
Reidel and Byrne Consulting Engineers, 1986

This study investigated the effect of siltation on the flood characteristics of Breakfast Creek. Inflow hydrographs and flood levels were extracted from previous studies.

The report stated that the source of sediment in the creek could not be reliably determined, although the Brisbane River appeared to be the main source. It also confirmed that major dredging works of Breakfast Creek were undertaken between 1976 and 1979.

Design flow hydrographs for Bancroft Park were presented for Q100 and Q50 flows. A System-11 DHI model (the predecessor to MIKE 11) was calibrated to the January 1974 event to assess the impact of the siltation. The investigation stated that by 1986 approximately 30% of the improvement gained by dredging (undertaken between 1976 and 1979) had been lost due to siltation.

3.3.7 Dredging for Maintenance of Flood Mitigation Draft Impact Assessment Study



Sinclair Knight & Partners Pty Ltd, 1993

This investigation was commissioned by the Brisbane City Council as a result of continued siltation within the dredged reaches of Breakfast Creek since the 1976 to 1979 major dredging works were undertaken. The investigation was carried out to determine the extent of dredging required to achieve the original designed flood mitigation levels with minimal adverse impact on physical, social and environmental elements.

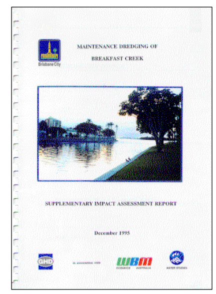
The report recommended limited dredging and the removal of a rock bar at the mouth of the creek. The study showed that these measures were required to achieve the flood mitigation potential of the original 1976 to 1979 major dredging.

A hydraulic model of the creek was developed to determine levels in the creek. This model employed survey of the creek bed profile carried out in 1992. The hydraulic model was not detailed in the report. No reference was found in the report as to which hydraulic model was used.

The effect of siltation on predicted flood profiles was summarised for the anticipated 100 year event. The results presented were for relative increases only - detailed anticipated flood levels are not tabulated. However, profiles for a range of ARIs were presented for two mitigation (maintenance) options. The two flood mitigation options presented were:

- The removal of approximately 120,000 m^3 of material from along the whole length of Breakfast Creek.
- The removal of a natural rock obstruction at the mouth of Breakfast Creek and a reduced quantity of dredging of approximately 80,000 m^3.

3.3.8 Maintenance Dredging of Breakfast Creek. Supplementary Impact Assessment Report



GHD in association with WBM and Water Studies,1995.

This report was an extension of the 1993 Sinclair Knight Report and focused more closely upon the quantitative impacts of the main channel siltation and any subsequent maintenance dredging or modification to the creek channel.

The investigation revealed that a comparison of the 1992 and 1979 bed profiles showed an estimated 25% of the original dredged volume had been lost to sedimentation.

The report quantified estimated siltation rates and stated that siltation in the upstream reaches was dominated by fluvial deposits whilst the downstream reaches were likely to be demonstrating much lower accretion and may be reaching an equilibrium state.

The report discussed in detail a variety of mitigation options including those presented by Sinclair Knight in their 1993 study (refer Section 3.3.7). Other options included more specific economic analysis of the feasibility of purchasing properties identified as being flood prone, and the possibility of raising dwellings identified as being potentially inundated. In addition the feasibility of upgrading major road and rail bridges was undertaken, confirming that this was not a feasible option.

Mitigation options were assessed for the effect on flood levels using a HEC-RAS steady state one-dimensional model, with a tail water level of MHWS (1.0 m AHD).

The report stated that the impact of removing the rock bar from the mouth of Breakfast Creek has the effect of lowering the Q100 profile to below the soffit of the Abbotsford Road bridge. This lowering would result in a significant reduction in the head loss through this structure, and hence a significant reduction in water levels upstream of Abbotsford Road. The reduction in water level was expected to occur as far upstream as the Bancroft Park weir. These statements were based on the results of HEC-RAS modelling of the creek.

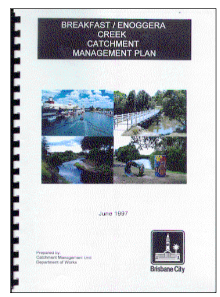
Tabulated Q100 and Q50 anticipated flood levels for the ‘existing’ and ‘rock bar removed’ scenarios were presented.

In summary, the final recommendations of the report were:

- remove the rock bar at the mouth of Breakfast Creek;
- prepare a strategy to control the inflow of fluvial deposits in the upper reaches;
- undertake a monitoring program to confirm the erosion/accretion rates assumed in the study;
- undertake a detailed flood damage survey; and
- amend Council flood maps to take into account the likely build up of sediments (and therefore increase in flood levels) between maintenance cycles.

Whilst the report discussed in some detail the difficulty of maintaining a post mitigation flood profile through continuous dredging it does not clearly conclude if dredging (albeit over a set period of time) should continue in addition to the proposed removal of the rock bar.

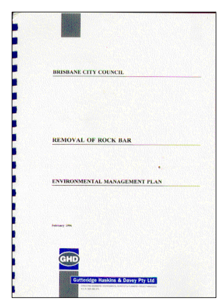
3.3.9 Dredging of Breakfast Creek Environmental Management Plan



GHD, 1996

This Environment Management Plan followed on from information presented in the Supplementary Impact Assessment Study (SIAS) of 1995. Whilst the SIAS final recommendations did not include maintenance dredging it did however, refer to the need for a strategy for the management of fluvial deposits in the upper reaches of Breakfast Creek. The report also alluded to the need to continue dredging should the strategy initiatives prove to be less effective than anticipated.

3.3.10 Removal of Rock Bar Environmental Management Plan

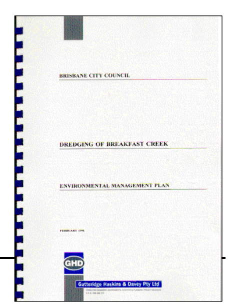


GHD, 1996

This Environment Management Plan also followed on from information presented in the Supplementary Impact Assessment Study (SIAS) of 1995, and provided details for the undertaking of the rock bar removal.

No new information in relation to the hydrology or hydraulics of the creek was presented.

3.3.11 Breakfast-Enoggera Creek Catchment Management Plan



BCC Catchment Management Unit Department of Works, 1997

This Plan provided an environmental assessment of the catchment and its waterways. The plan contained references to key vegetation, erosion and sedimentation issues, which had been identified throughout the catchment. Discussion of catchment water quality and rehabilitation of vegetation and weed control were also presented.

Whilst this report provides useful background information for undertaking the strategic components of the Waterway Management section of the Breakfast-Enoggera Creek Flood Study, it does not contain quantitative details associated with the flooding characteristics of the creek systems.

3.3.12 Breakfast-Enoggera Creek Waterway Management Plan

Brisbane City Council, 2004

The Breakfast-Enoggera Creek Waterway Management Plan was prepared in 2004. The plan provides an overview of the current state of the catchment and considers water quantity, water quality, land use and other social requirements in determining recommendations for specific actions and strategies for the management of waterway corridors.

As part of the Waterway Management Plan, a Water Quantity Assessment (WQA) was prepared. The WQA used hydrologic and hydraulic models of the catchment to determine flood sensitive areas and anticipated inundation.

3.3.13 Draft Breakfast-Enoggera Creek Flood Study

Cardno and City Design - Brisbane City Council, 2008

This detailed and near-complete flood study was concluded in December 2008. This study contains both hydrologic and hydrodynamic components. The hydrologic analysis was commenced in 1998/1999 and utilized the WBNM software package. The hydraulic analysis was commenced in 2005 and conducted using the 1-dimensional MIKE11 software package. At the time of completion of this study a number of major infrastructure projects (CLEM7 Tunnel, Airport Link Tunnel, Northern Busway) around the area between Bowen Bridge Road Bridge and Railway Loop Bridge were initiated and significantly changed the hydraulic characteristics of the upper and middle reaches of Breakfast Creek. In addition, these proposed changes were investigated through a more advanced 2-dimensional modelling exercise under a different detailed hydraulic analysis. As a result, the outcomes of this flood study became obsolete and an upgrade to the study was deemed necessary.

4 AVAILABLE DATA

4.1 Topographic Data

4.1.1 Cross sections and contours

Detailed survey of Breakfast-Enoggera Creek (including Ithaca and Fish Creeks) was undertaken by Brisbane City Council during 1997/1998. A total of 397 cross sections were surveyed for the flood study.

Cross sections were surveyed from left to right looking downstream, and numbered in ascending order from downstream to upstream. Wherever possible, previous survey carried out in 1992 was used to develop the model cross sections, with the 1997/1998 survey supplementing this data. The 1992 survey consisted of top of bank to top of bank survey downstream of Kelvin Grove Road. Survey carried out in 1997/1998 in this area consisted of overbank survey only.

Additional survey was conducted in 2003/4 to facilitate a sedimentation study of Breakfast Creek. This survey consisted of hydrographic and land based survey downstream of Kelvin Grove Road. This information has been used in this flood study for analysis of ultimate scenario, but not for analysis of calibration events as the earlier survey was considered to be more representative of the creek at the time of the calibration events.

Airborne Laser Scanning (ALS) of the Brisbane City area was conducted in 2002 and again in 2009, providing the basis for updated ground level details. This information has been used in the hydraulic model to define the underlying topography. With the exception of the areas confined within the Airport Link Model (APL), all 2-dimensional parts of the model have been built utilizing the 2009 ALS data.

All the topographical information for the areas confined within the APL model were sourced from the APL hydraulic models depending on the analysed scenario.

4.1.2 Aerial Photography

Hydrologic modelling for the catchment commenced in 1998/1999. Aerial photography available at that time was flown in September 1997. This photography was used to define the extent and characteristics of the development existing within the catchment at that time.

The most recently acquired aerial photography was flown for the whole of the Brisbane City area in 2011. In addition to providing input parameters to the hydrology model, aerial photography, in conjunction with site inspection and ground level photography also assisted in the determination of hydraulic roughness (Mannings 'n') values for use in the hydraulic model.

4.1.3 Hydraulic Structures

In total, one hundred (100) crossings are located throughout the catchment. These crossings consist of:

- 17 major public road bridges/culverts
- 3 rail bridges
- 16 minor public road bridges/culverts
- 35 footbridges
- 4 low level crossing structure (constructed post 1998)
- 2 gauging weirs
- 9 pipe crossings
- 6 new road bridges associated with the CLEM7 Tunnel Infrastructure Project
- 2 new road bridges associated with the Northern Busway Infrastructure Project
- 6 new road bridges associated with the Airport Link Infrastructure Project

Of these, detailed description is available for 80 of the crossing structures from the survey conducted in 1998. Since the original survey of structures was conducted, a significant number of additional structures have been built and/or upgraded. These are:

- Waterworks Road, Enoggera Creek (duplicated);
- Waterworks Road, Ithaca Creek (duplicated);
- Inner City Bypass (Horace Street off ramp) crossing approximately 250 metres downstream of Bowen Bridge Road;
- Inner City Bypass and Allison Street crossing approximately 600 metres upstream of Breakfast Creek Road;
- 2 low level crossings on Enoggera Creek approximately 750 metres upstream of Ashgrove Avenue;
- 1 new low level bikeway crossing on Enoggera Creek approximately 550 metres upstream of Gresham Street;
- 1 new low level bikeway crossing on Ithaca Creek immediately upstream of Jubilee Tce road bridge;
- Replacement of the footbridge structure at Bowman Parade;

- 6 new road bridges and widening of 2 existing road bridges associated with the CLEM7 Tunnel Infrastructure Project;
- 2 new road bridges associated with the Northern Busway Infrastructure Project;
- 6 new road bridges, widening and extension of 3 CLEM7 tunnel infrastructures as part of the Airport Link Infrastructure Project.

As-constructed drawings or relevant hydraulic models containing detailed structural information are available for these structures.

After development of the MIKE11 model for the 2008 study, several new major infrastructure projects were commissioned. Detailed flood studies were conducted as part of these infrastructure projects with the development of more detailed hydraulic models. Among them the most detailed and established flood study is the one prepared as part of the Airport Link project by Parsons Brinckerhoff Arup Joint Venture (PBAJV) on behalf of BrisConnections. This study has incorporated details about all the new structures and any additions/alterations to the existing. Hence, this has been considered as the best source of the up to date information about all new infrastructures.

Out of the total one hundred (100) structures, in total eighty (80) of the crossing structures are included in the hydrodynamic models.

Details of the structures included in the hydraulic models were mainly sourced from:

- Detailed structure survey conducted in 1998
- As constructed drawings
- Hydraulic Structure Reference Sheets of previously conducted draft studies
- Airport Link hydraulic model

As additions/up gradations of the structures happened at different stages of the timeline adopted for this study (1989 to 2013), it was required to setup three (3) separate models to accurately represent the specific catchment condition during the calibration events.

Further details about the model setup based on the structure existence scenario are provided within following section 5.2.27.

4.2 Hydrographic Data

4.2.1 Rainfall

There are a number of pluviograph and daily rainfall stations located both within and adjacent to the Breakfast-Enoggera Creek catchment (refer Figure 4.1). Data from all available stations was collected for all events considered for this study. Pluviograph stations used in the study, along with their periods of operation and ownership are detailed in **Table 4.1.**

Table 4.1 Pluviograph Station Information

Station Name	Station Number	Owner	Period of Operation	Latitude	Longitude
Mt Coot-tha	40533 I_R512	BoM BCC	1971 – 1994 1994 – Present	27°27'53"	152°56'43"
Deagon	40531 C_R560	BoM BCC	1971 – 1987 1994 – Present	27°20'09"	153°03'27"
Enoggera Dam	40225E_R533	BCC (QUU) BCC SEQWater	1961 – 1995 1994 – 2009 2010 - Present	27°26'49"	152°55'35"
3 Ways	40528 E_R507	BCC (QUU) BCC	1970 – 1995 1994 – Present	27°26'43"	152°49'33"
Gold Creek Reservoir	40230 G_R718	BCC (QUU) BCC SEQWater	1967 – 1995 1994 – 2009 2010 - Present	27°28'00"	152°52'59"
Lake Manchester	40115 MAR730	BCC QUU) BCC SEQWater	1967 – 1996 1995 – 2009 2010 – Present	27°29'00"	152°45'00"
Mt. Nebo	40526	BCC (QUU)	1967 – 1995	27°23'00"	152°46'00"
Ferny Grove	40461 K_R545	BoM BCC	1971 – Present 1994 – 2009	27°23'45"	152°55'45"
Kalinga Bowls Club	40222	BoM	1971 – Present	27°24'00"	153°02'00"
Brisbane	40214 BCR015	BoM BCC	1908 – 1991 1990 – 2009	27°27'59"	153°01'18"

Note: All City Projects Office gauges are part of the telemetry system
BCC – Brisbane City Council, City Projects Office
BCC (QUU) – Brisbane City Council, Queensland Urban utilities
BoM – Commonwealth Bureau of Meteorology
SEQWater – South-East Queensland Water, Queensland Government

4.2.2 Maximum Height Gauges

Maximum height gauges (MHGs) record the maximum flood level which occurred during an event. The gauge consists of a hollow pipe with a hole near the base, and small cups attached to the inside of the pipe. As the water level in the creek rises, the cups fill with water. When the water level recedes, the water remains in the cups. Officers then visit the site to determine the maximum level reached.

In total forty maximum height gauges have been installed on Breakfast-Enoggera Creek. These gauges have been installed progressively since 1975. Out of these, recorded data from thirty five maximum height gauges have been considered in the calibration. The locations of all maximum height gauges in the catchment are shown on **Figure 4.1**. Levels are not recorded at all maximum height gauges for all events due in part to damage to the gauges during the event. Levels recorded by the maximum height gauges for those events considered in the calibration are detailed in **Table 4.2.**

Table 4.2 Maximum Height Gauge Information

Location	MHG No	Maximum Height Gauge Recorded Level (mAHD)			
		25-Apr-89	3-May-96	20-May-09	27-Jan-13
Breakfast Creek					
Sedgely Park	-	–	–	–	–
Bishop Street D/S	B150	–	–	–	–
Mark Street	B140	3.77	3.58	5.47	4.97
Noble Street	B130	2.99	Under	3.96	3.66
Lutwyche Road U/S	B120	2.73	2.41	3.24	3.12
Lutwyche Road D/S	B110	2.61	2.32	3.21	2.87
Railways	B100	2.47	Under	3.01	2.62
Enoggera Creek					
Ashgrove Avenue	E100	Under	8.8	9.57	9.38
Frasers Road	E120	Under	Under	15.7	14.04
Mirrabooka Road	E130	Under	Under	16.24	15.8
Royal Parade	E150	Under	Under	24.24	Under
Bennett Road	E170	28.88	29.07	29.82	29.76
Illowra Street	E200	Under	Under	40.7	40.61
Quandong St	E110	10.32	10.47	–	10.52
Glenlyon Drive	E140	–	16.89	18.38	17.79
Royal Parade	E160	–	–	25.39	24.41
Glen Affric Street	E180	–	–	33.26	Under
Blucher Av	E190	35.98	36.11	36.92	36.63
Payne Rd	E210	45.36	45.43	46.22	45.64
Yoorala Street	E220	47.45	47.54	48.14	47.86
Fish Creek					
Alutha Road	F150	–	49.9	50.65	Under
Settlement Road U/S	F140	–	–	43	42.55
Settlement Road D/S	F130	–	–	39.75	39.27
Glenella Street U/S	F120	–	–	36.72	35.86
Glenella Street D/S	F110	34.97	35.18	36.69	35.59
Waterworks Road	F100	–	–	32.54	32.17
Ithaca Creek					
Eager Street	I100	–	–	7.58	6.98
Beatrice Street	I140	–	–	22.73	22.17
Bowman Parade	I160	33.71	–	34.2	33.71
Carwoola Street	I170	56.46*	–	Over	56.03
Waterworks Road	I120	–	7.45	9.07	8.45
Jubilee Terrace	I130	16.45	–	15.9	15.42
Coopers Camp Road	I150	25.18	–	26.34	25.47

Note: Under Data not recorded - generally means water level below limit of MHG
– No reading, site not visited
* Debris level (level below minimum recordable level of gauge)

4.2.3 Stream Gauges

Five continuous stream gauges have been installed in the Breakfast-Enoggera Creek catchment. These gauges, along with their period of operation and ownership are detailed in **Table 4.3**. The gauge locations are shown on **Figure 4.1**.

Table 4.3 Stream Gauge Details

Gauge name	Gauge Location	Latitude	Longitude	Owner	Period of Operation
E_E532	Enoggera Dam spillway	27°26'49" 27°26'49" 27°26'49"	152°55'35" 152°55'35" 152°55'35	SEQWater BCC BW	2010-Present 6/1994-2009 1866-6/1994
E_A531	Bancroft Park, Enoggera Creek (just u/s of Kelvin Grove Road)	27°26'46" 27°26'13" 27°26'13"	153°00'14" 153°00'16" 153°00'16"	BCC BCC DERM/BOM	5/1997-Present 3/1994-1/1997 11/1971-1/1994
I_E535	Jason Street, Ithaca Creek	27°26'46" 27°26'13"	152°59'32" 152°59'32"	BCC DERM	3/1994-Present 9/1972-3/1994
B_A525	Opposite Mann Park, Breakfast Creek (d/s of Bowen Bridge Road)	27°26'37"	153°01'58"	BCC	2/1994-Present
B_A594	Newstead House, Breakfast Creek (mouth of creek)	27°26'35"	153°02'46"	BCC	2/1998-Present

Note: All City Projects Office gauges are part of the telemetry system
BCC – Brisbane City Council, City Projects Office
BCC (QUU) – Brisbane City Council, Queensland Urban utilities
BoM – Commonwealth Bureau of Meteorology
DERM – Department of Environment and Resource Management, Queensland Government
SEQWater – South-East Queensland Water, Queensland Government

Details concerning each of the gauging locations are provided in the following sections.

4.2.3.1 Enoggera Dam Spillway

Enoggera Dam was constructed in 1866. In 1973 the spillway was lowered due to fears that the dam wall may not be able to withstand overtopping.

In 1976, following the January 1974 flood event and the report by Cameron McNamara & Partners, the dam wall was raised by 6.25 metres and the spillway raised by 7.25 metres, making the dam a multi-purpose structure for both water supply and flood mitigation. At this time two rectangular sluice openings (3.0m x 1.85m) were built into the spillway structure with their inverts at the old spillway crest level of 74.37m AHD.

Relevant spillway details for determination of flows over the spillway are:

- Post 1976 invert level of new spillway 80.47m AHD

- Post 1976 embankment level 84.25m AHD;
- Spillway width 84.0m

Stage-storage curves and rating curves for Enoggera Dam sourced from Brisbane City Council Department of Works plan no.W5401/52 are shown on **Figure 4.2** and **Figure 4.3,** respectively.

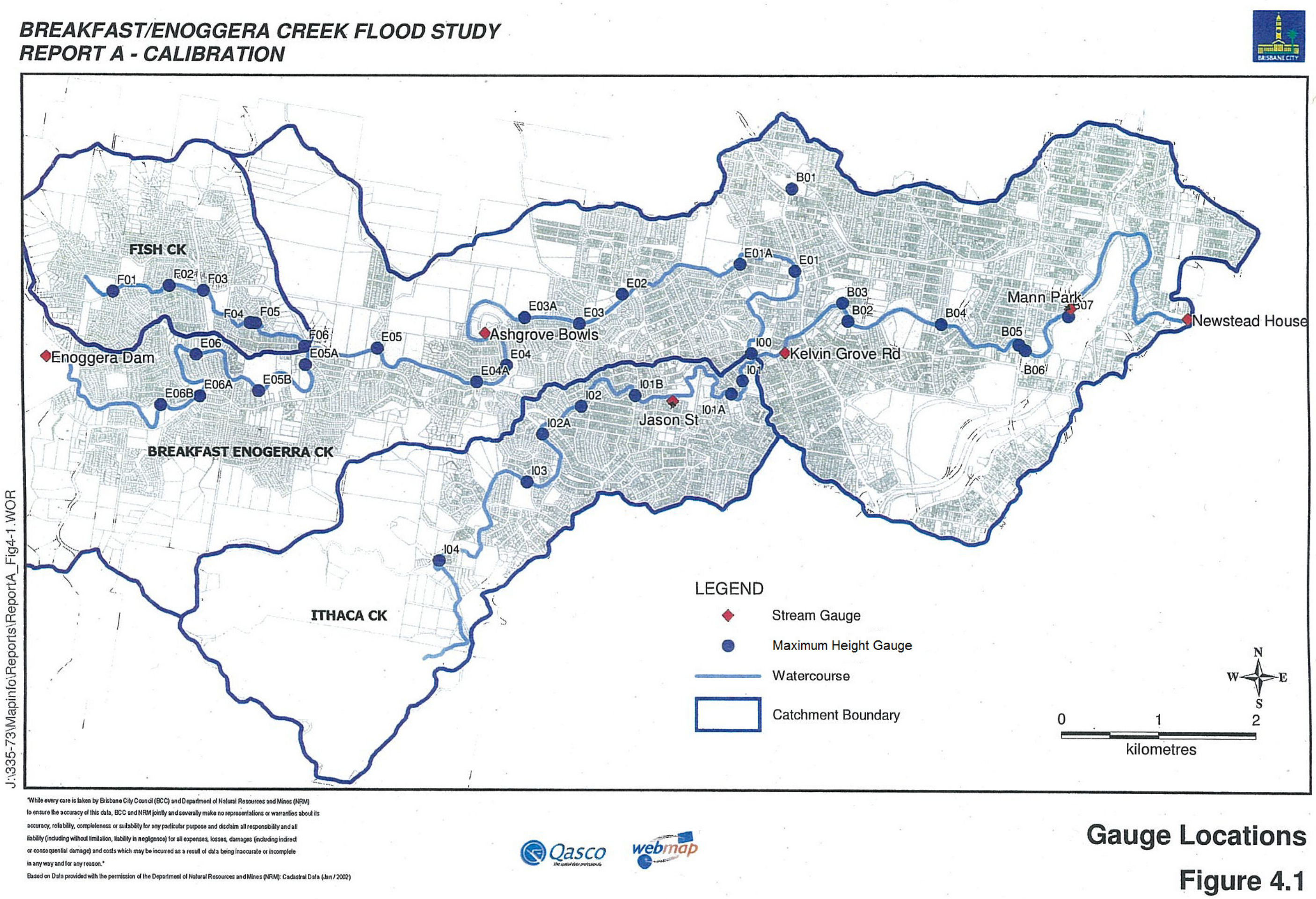


Figure 4.1 Gauge Locations

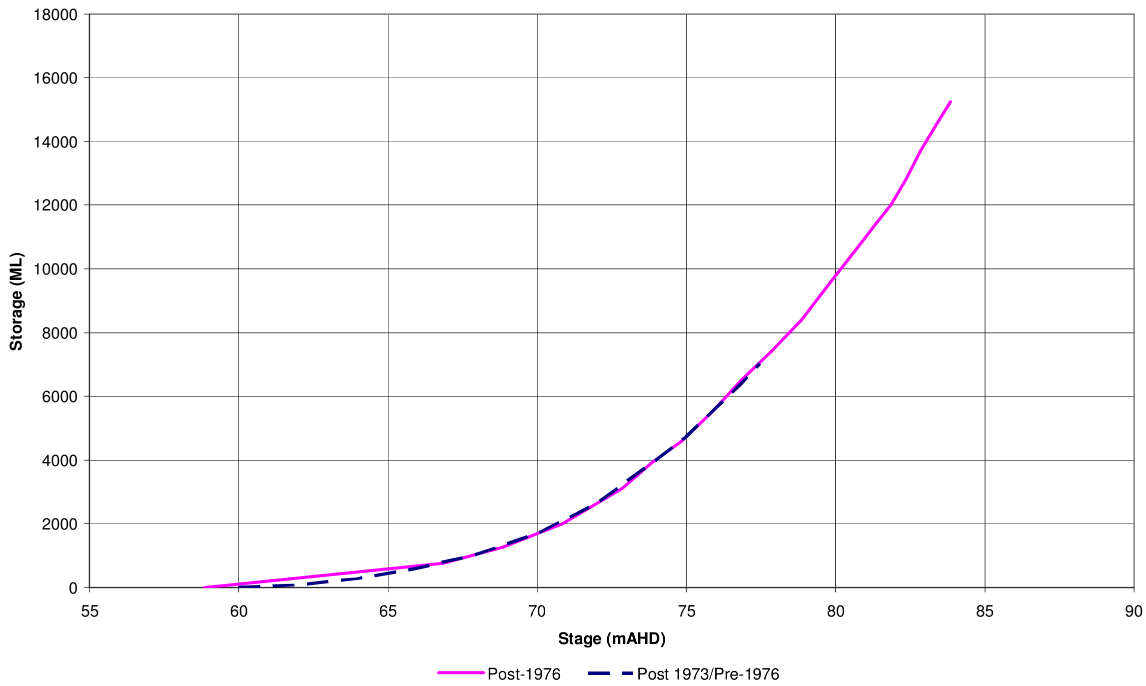


Figure 4.2 Stage-Storage Curves, Enoggera Dam

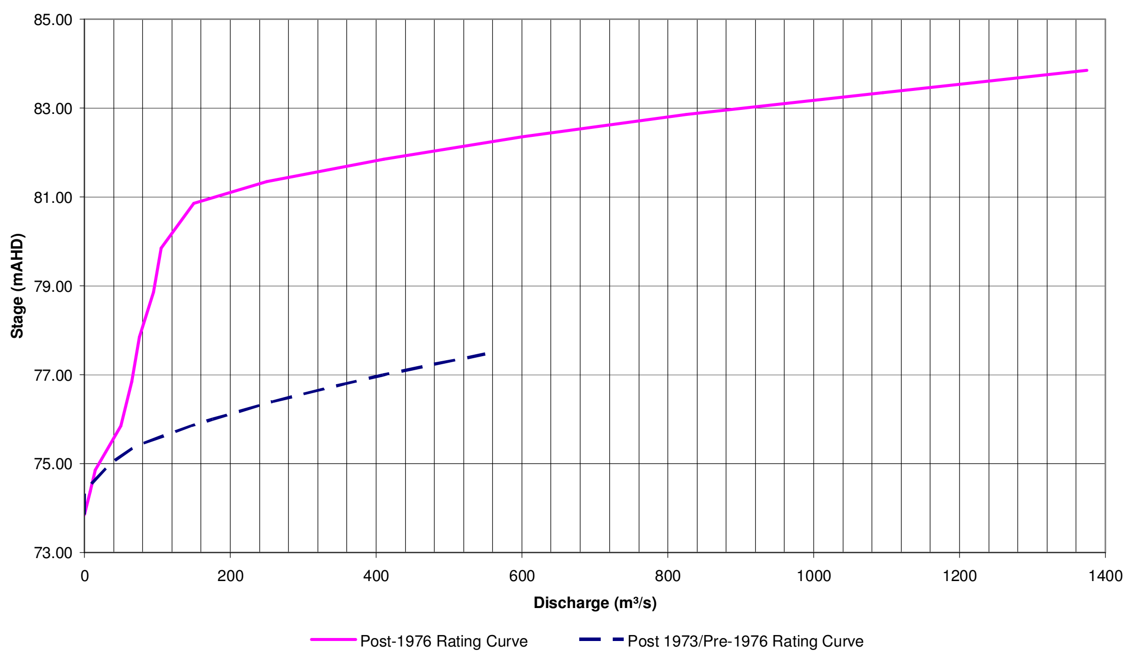


Figure 4.3 Spillway Rating Curves, Enoggera Dam

4.2.3.2 Bancroft Park

This float/well gauge was installed in November 1971 by the Department of Natural Resources (DNR) and includes a flow control weir, which constitutes the tidal limit in Breakfast Creek. This gauge was under the control of DNR until early 1996 when BCC took charge of the site and installed Council monitoring equipment. At that time the existing gauge boards were resurveyed and a small discrepancy corrected.

The flood event of May 1996 caused significant erosion in the vicinity of the gauge, which prompted the relocation of the gauge to a more stable position, approximately 70 metres upstream of the weir.

During the May 2009 event the gauge at this new location was operational and provided good records.

A photograph of the Bancroft Park site is contained in **Figure 4.4**.

Figure 4.4 Bancroft Park Rating Weir

4.2.3.3 Jason Street

This float/well gauge was installed by the Department of Natural Resources (DNR) in September 1972. In the late 1980's (prior to the April 1989 event) DNR installed a small weir at the site.

The gauge has been shared by Brisbane City Council since early 1994.

A photograph of the Jason Street site is contained in **Figure 4.5.**

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Figure 4.5 Jason Street Rating Weir

4.2.3.4 Opposite Mann Park

This gauge was installed early in 1994. It is a continuous stream gauge located well within the tidal range of Breakfast Creek. The significant storm events which have occurred since installation of this gauge are the May 1996 and May 2009 events.

4.2.3.5 Opposite Newstead House

This telemetry gauge was installed in 1998. The station provides useful receiving water levels for the calibration of the historical flooding events giving an understanding of the influence of tide and storm surge on flood levels in the lower reaches of the Breakfast-Enoggera Creek system. As the gauge was not present for the 1996 flood event, recorded information for the Port Office and Brisbane Bar gauges (both operated by the State Government) was employed to determine levels at the mouth of Breakfast Creek during the model calibration process.

A photograph of the Newstead House site is contained in **Figure 4.6**.

Figure 4.6 Newstead House Rating Site

5 MODEL SETUP

5.1 Hydrology Model (WBNM)

5.1.1 General

WBNM Version 2.1 (1995), the watershed bounded network model, was chosen for the hydrologic modelling of the Breakfast-Enoggera Creek catchment. WBNM was developed by Wollongong University. It is an event-based model, which is well suited for flood studies of natural and/or urban catchments.

WBNM calculates flood hydrographs from rainfall using runoff routing procedures. The catchment is divided into sub-catchments based on the stream network and surface topography. Each sub-catchment is represented by a non-linear concentrated storage reservoir with lag characteristics determined by the size of the sub catchment.

Storage reservoirs such as dams and detention basins can be modelled using stage, storage, discharge relationships.

Channel routing can be undertaken using either non-linear routing, hydrograph delay or Muskingum-Cunge routing.

Separate runoff hydrographs are calculated for pervious and impervious surfaces of each sub-catchment and added at the sub-catchment outlet. The runoff hydrograph from the pervious surfaces is calculated using non-linear routing whilst the impervious surfaces use linear routing. Impervious surface routing is automatically reduced by a parameter to allow for the reduced travel times on the impervious surfaces.

5.1.2 Hydrology Model Setup

The Breakfast-Enoggera Creek catchment was divided into 86 sub-catchment areas, as shown on Figure 5.1. Sub-catchment boundaries were defined by taking into account topography and stormwater drainage. While delineating catchment boundaries, all major creek crossings were also considered. Catchment areas, impervious percentages and other relevant information related to the WBNM model are listed in **Appendix C**.

A summary of catchment areas to major road crossings is also presented in **Table-5.1.**

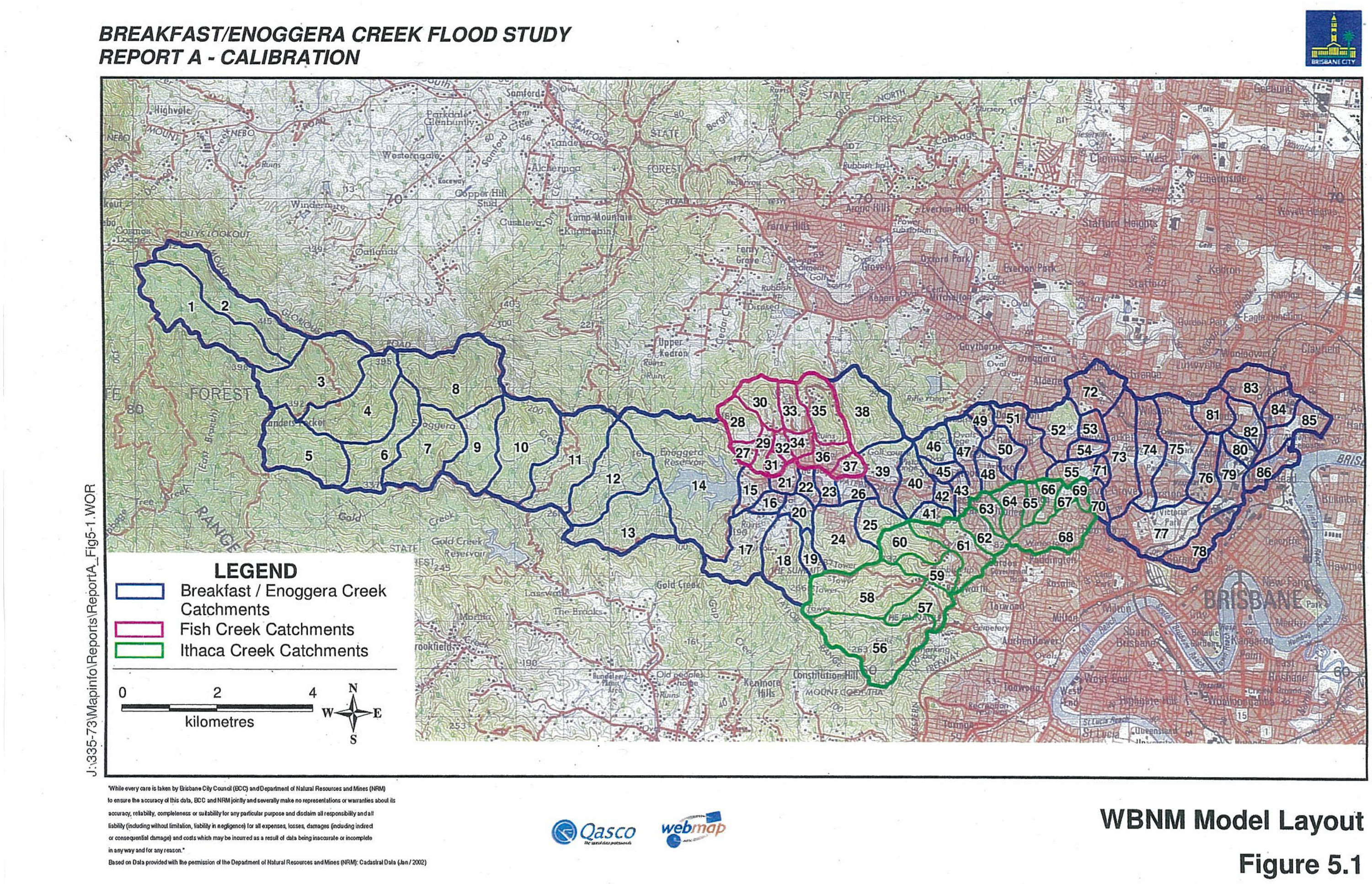

Figure 5.1 WBNM Model Layout

Table 5.1 Catchment Area Summary

Location	**Area (km^2)**
Enoggera Creek	
Enoggera Dam	32.3
School Road	36.5
Waterworks Road#	39.9
Gresham Street	48.7
Stewart Avenue	51.9
Ashgrove Avenue	54.1
Enoggera Creek Total*	54.8
Fish Creek	
Settlement Road	3.0
Fish Creek Total	4.8
Ithaca Creek	
Simpsons Road	5.7
Bowman Parade	7.5
Coopers Camp Road	8.0
Ithaca Creek Total	11.1
Breakfast Creek	
Kelvin Grove Road	66.4
Bowen Bridge Road	72.4
Hudson Road	77.6
Breakfast Creek Catchment Total	**79.3**

Note: # Fish Creek joins Enoggera Creek just downstream of Waterworks Road
* Includes Fish Creek catchment

5.2 Hydrodynamic Model (TUFLOW)

5.2.1 General

In order to model the hydraulic behaviour of Breakfast-Enoggera Creek, a hydrodynamic model of the creek system was established. One of the most advanced, industry-preferred, flood modelling tools, TUFLOW, developed and maintained by BMT-WBM, was adopted for use in the flood study.

The current 1-dimensional MIKE11 model developed and finalized in 2008 was used as the base model for this upgraded hydraulic analysis. This 1-dimensional hydrodynamic model was initially developed in 1998/1999 using MIKE 11 Version 4.10. This model was subsequently upgraded in 2001 as part of the Water Quantity Assessment for the Breakfast Creek catchment. At that time, the model was upgraded to Version 2001b, with structures calculated using the Version 1999b methodology. The model was later upgraded to Version 2004. Also, parts of the model covering the lower reaches (downstream of Kelvin Grove Road to the confluence of Brisbane River) have been built based on the data obtained from the Airport Link Alliance through the TUFLOW model developed as part of the hydraulic investigation carried out to determine the impacts resulting from the major infrastructure projects within this area.

5.2.2 Hydrodynamic Model Setup

5.2.2.1 General

The TUFLOW model developed for this flood study is comprised of multiple domains. A domain is a term used to describe separate sections of the model which allows different cell size and orientation to be utilized within a single model and if required, these domains can run independently with relevant boundary conditions. As multiple domain setup allows any number of sections of different cell size and orientation can be built into a single model, in order to reduce the model runtime by utilizing different grid sizes in upper and lower reaches and to provide flexibility in the model uses the multiple domain setup has been selected for this model.

The upper domain extends from the most upstream sections of all the tributaries (Enoggera, Fish and Ithaca Creeks) to the upstream end of Kelvin Grove Road bridge. The lower domain extends from the downstream end of the Kelvin Grove Road bridge to the confluence of Brisbane River. The upper domain was developed with the 1D-2D approach (1D River Channel and 2D Floodplain) and lower domain was with 2D approach (2D River Channel and 2D Floodplain). The reasons for selecting this approach are:

- the creek network located within the upper domain comprises well-defined, deep channels and limited floodplains.
- the creek network located within the lower domain comprises wide channels and wide floodplains

- a significant number of crossing structures over the creek exist within the upper domain. Most of them are narrow and small in configuration.
- the base model of the lower domain - the Airport Link Model - is developed with a 2-dimensional approach.

The upper domain has been developed with a 10m grid resolution and the lower domain with a grid resolution of 5m. Initially a 5m grid resolution was considered for both domains, but in order to reduce the model runtime and as there is limited floodplain in the upper domain the coarser grid resolution in the upper domain was adopted.

Figure 5.2 represents the layout of the model schematisation.

5.2.2.2 Model Extent and Network

The extent of the Breakfast Creek TUFLOW model is shown on Figure 5.2**.** The main features of the model are as follows:

- 257 cross sections (7 on Breakfast Creek, 128 on Enoggera Creek, 35 on Fish Creek and 87 on Ithaca Creek);
- 3 branches;
- 80 crossing structures to describe road/pedestrian bridges and culverts, causeways and weirs within the model;
- In total 3 inflows to the upstream ends of each branch; and
- 64 local inflows to points within the model.

Note that the number of cross sections in the model differs from the number of cross sections surveyed for two reasons:

- weir profiles were surveyed, but are not used as cross sections in the model.
- at smaller structures, only the upstream or downstream cross section was surveyed. In these cases, the surveyed cross section was duplicated in the model

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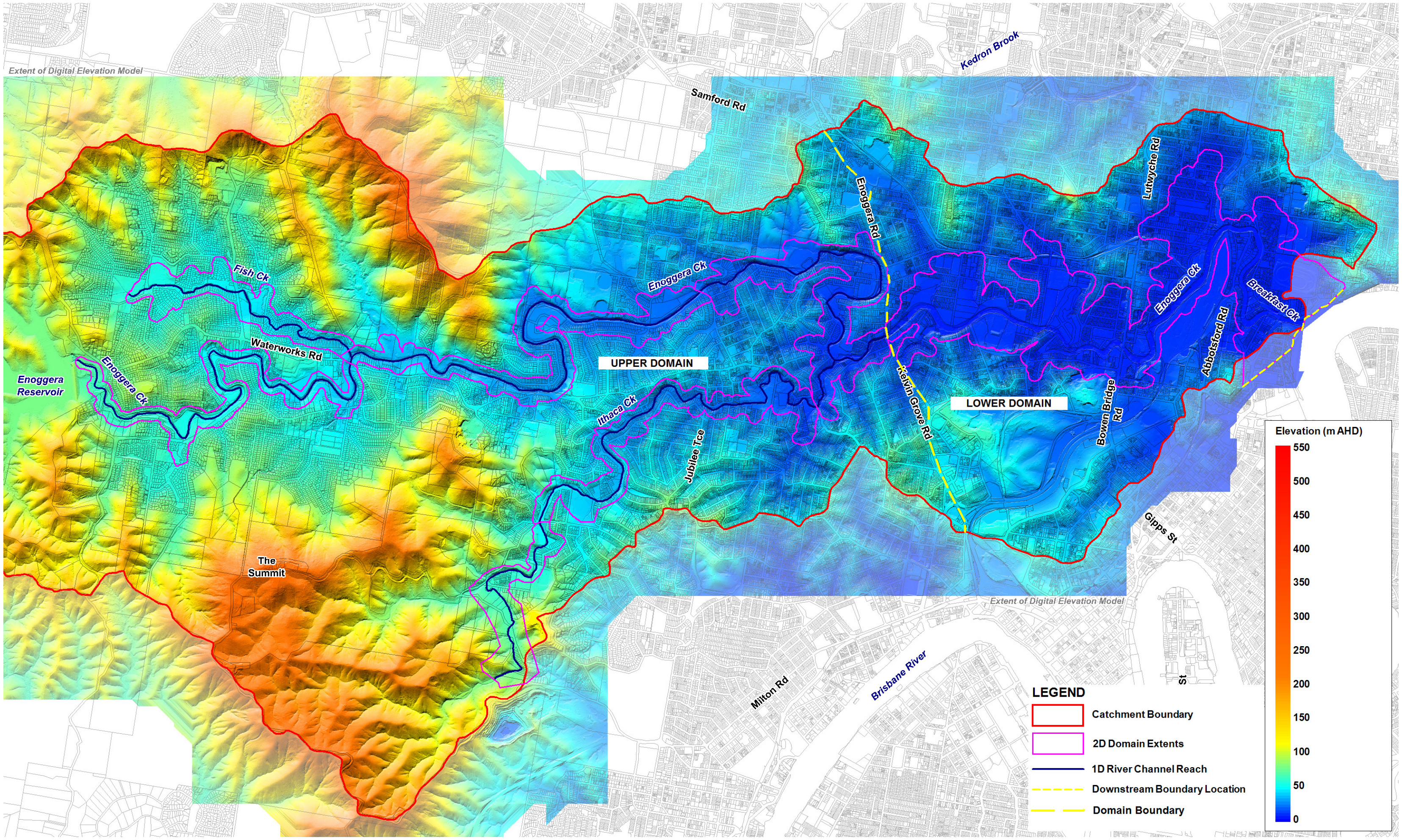


Figure 5.2 TUFLOW Model Schematisation

5.2.2.3 Digital Elevation Model (DEM)

In order to define the topography in the 2D model, two DEMs were developed. One DEM was used to run the calibration and verification events prior to 2009 and also used for the Ultimate Scenario runs. The other DEM has been used to calibrate the model against May 2009 event. To verify the January 2013 event, the ultimate scenario DEM was used. The resolution of both DEMs is 1m. Both DEMs are based on the following data sources:

- 2009 LiDAR data used as the base layer of the DEM.
- Downstream of Kelvin Grove Road Bridge, in reaches where the river channel has been modelled in 2D, a DEM of the river channel was created using the 1997/1998 cross-section survey data. This river channel DEM spanned from top of bank to top of bank and follows the alignment of the river channel. The river channel DEM was subsequently ‘stamped’ onto the DEM prepared from LiDAR data.
- Downstream of Bowen Bridge Road bridge the cross section survey data from 2003/2004 was used to develop a DEM of the river channel; similar to the description in the previous point. Again, this was also ‘stamped’ onto the LiDAR data.
- The bathymetric survey data covering the river channel between Kelvin Grove Road Bridge and the confluence with Brisbane River has also been ‘stamped’ onto the LiDAR data.

Discrepancies in ground levels caused by the edge effects between the DEM derived from the channel cross-sections and the DEM derived from the LiDAR were also smoothed out. The sections of the DEMs falling within the Airport Link (APL) hydraulic model were substituted with the topographical information obtained from the APL model.

5.2.2.4 Land-use Mapping and Hydraulic Roughness

In TUFLOW, Manning’s n values in the 2D domains are specified using a GIS layer delineating different land-use types. This GIS layer was developed using the following data sources:

- Cadastre data was used to define the location of roads and urban blocks.
- City Plan was used to define land-uses other than road.
- Aerial photography was used to determine areas of high, medium and low density vegetation.

Initial Manning’s ‘n’ roughness values within the active channel (1D) initially were based on those used in the MIKE11 model. These values were later adjusted as a result of the calibration exercise.

The sections of the model falling within the Airport Link (APL) hydraulic model were later substituted with the hydraulic roughness information obtained from the APL model.

5.2.2.5 Channel Representation

1D Channel Representation

In-bank flow is generally well represented in 1D. Where the 2D model resolution is coarse relative to the in-bank channel geometry, it is better practice to model the river channel in 1D and link the 1D channel to the 2D floodplain. Also, according to industry best practice, the main channel should not be modelled in 2D where narrower than four grid cells wide. Along Enoggera, Fish and Ithaca Creeks the river channel is generally wider than 10m (i.e. two times the 2D grid cells size), however there are a few short narrower sections (approximately 10m). Hence these creeks are modelled in 1D-2D combination (main channel in 1D and floodplain in 2D) to upstream of the Kelvin Grove Road bridge for best representation of the hydraulic regime of these reaches. This part of the model (1D-2D) composes the upper domain of the model.

Downstream of Kelvin Grove Road Bridge the channel width is approximately 35m and therefore adequate for modelling in 2D.

The ESTRY cross-section data (1d_tab layer with XZ tables) was created by using the MIKE11 cross-section data. Cross sections were trimmed to top of bank i.e. up to the 1D-2D link and Manning's n values which vary across the width of the channel were also defined according to the MIKE11 cross sections. ESTRY channels (1d_nwk layer) were then digitised between cross-sections (i.e. end cross-section technique). Using this setup, ESTRY interpolates the channel hydraulic properties based on the upstream and downstream cross section details. The 1D river channels were linked to the 2D domains using the external head transfer technique (HX link).

2D Channel Representation

It is generally preferred to represent the river channel in 2D where the channel geometry can be sufficiently captured by the grid resolution. The minimum grid resolution for modelling the river channel in 2D is where at least four grid cells span the width of the river channel.

As the river channel of Breakfast Creek is over 35m wide downstream of the confluence of Enoggera and Ithaca Creek, and widens further downstream of Kelvin Grove road Bridge to over 50m. Using a grid cell size of 5m, the river channel downstream of Kelvin Grove Road Bridge has been selected to be represented in 2D. This part of the model (2D) composes the lower domain of the model. This lower domain of the model also contains the relevant model inputs from the APL model, which supersedes any other model inputs for the areas falling within the APL model.

5.2.2.6 Floodplain Representation

As mentioned previously, the developed model consists of two domains, upper and lower. The domains meet at Kelvin Grove Road bridge where flooding is constrained. The floodplain within both domains has been modelled in 2D. The upper domain has been developed with a 10m grid resolution and the lower domain with a grid resolution of 5m.

5.2.2.7 Structures

As mentioned earlier, out of the total one hundred (100) structures, in total eighty (80) of the crossing structures are included in the hydrodynamic model.

These structures included major bridges, culverts, footbridges and weirs. The structures modelled in each of the main branches and the types of structures involved are detailed in **Table 5.2**. Further details of these structures are provided in the Hydraulic Structure Reference Sheets.

Out of the six (6) low level crossing structures located within the Ashgrove Golf Course, only one has been included in the model, being represented as a weir structure. The remaining structures were not considered for explicit modelling as they are quite minor in nature and unlikely to cause any significant effect on water levels.

The recently constructed three low level crossing structures over Enoggera Creek and one over Ithaca Creek were not included in the model as the 1 year ARI flood level is well above these waterway crossings and their impact on larger events is negligible. This approach is consistent with other smaller waterway crossings throughout the catchment.

The duplicated waterway crossings at Waterworks Road on Enoggera Creek and Ithaca Creek were modelled as a single structure by adopting the dimensions which will exert the maximum influence on the flood flow. This principle was also applied to model Mirrabooka Road road and pedestrian bridges on Enoggera Creek.

No pipe crossing structure have been modelled due to their negligible impact on most of the ultimate scenario events (very low lying), as well as some of the low level crossing structures to avoid major model instability.

Table 5.2 TUFLOW Model Structures

Structure name	Structure Type	Structure Details
Breakfast Creek		
Breakfast Creek Road	Bridge/weir	3 spans (total width = 61m)
Inner City Bypass/Allison Street off ramp*	Bridge	11 spans (total width = 290m)/ 3 spans (total width = 86m)
Abbotsford Road	Bridge/weir	3 spans (total width = 46m)
Hudson Road	Bridge/weir	5 spans (total width = 250m)
North Coast Railway	Bridge	3 spans (total width = 64m)
Ferny Grove Railway	Bridge	7 spans (total width = 105m)
Railway Loop	Bridge	5 spans (total width = 73m)
NSBT/CLEM7 – BRMCN1	Bridge	Multiple spans
NSBT/CLEM7 – BRMCK2	Bridge	Multiple spans
NSBT/CLEM7 – BRMCK1 (2^{nd} loop)	Bridge	Multiple spans
Airport Link – BR104	Bridge	Multiple spans
Airport Link – BR110	Bridge	Multiple spans
NSBT/CLEM7 – BRMC41	Bridge	Multiple spans
Airport Link – BR1102	Bridge	Multiple spans

Structure name	Structure Type	Structure Details
Inner City Bypass off ramp (Horace Street)*	Bridge	5 spans (total width = 100m)
NSBT/CLEM7 – BRMCK1(1st loop)	Bridge	Multiple spans
Airport Link – BR111	Bridge	Multiple spans
NSBT/CLEM7 – BR11A	Bridge	Multiple spans
Bowen Bridge Road	Bridge/weir	4 spans (total width = 56m)
Airport Link – BR106	Bridge	Multiple spans
Airport Link – BR113	Bridge	Multiple spans
Northern Busway Alliance - BR501	Bridge	Multiple spans
Downey Park Footbridge	Bridge/weir	1 span (total width = 57m)
Noble Street Footbridge	Bridge/weir	5 spans (total width = 71m)
Bishop Street Footbridge	Bridge/weir	5 spans (total width = 43m)
Kelvin Grove Road	Bridge/weir	5 spans (total width = 49m)
Bancroft Park gauging weir	Weir	Min level = 1.82 m AHD
Murray Street Footbridge	Bridge/weir	2 spans (total width = 27m)
Enoggera Creek		
Park Avenue Footbridge	Bridge/weir	4 spans (total width = 28m)
Corbie Street Footbridge	Bridge/weir	1 spans (total width = 19m)
Ashgrove Avenue	Bridge/weir	5 spans (total width = 44m)
Steege Street Footbridge	Bridge/weir	4 spans (total width = 30m)
Stewart Avenue	Bridge/weir	3 spans (total width = 47m)
Mirrabooka Road[1]	Bridge/weir	3 spans (total width = 29m)
Mirrabooka Road Footbridge[1]	Bridge/weir	3 spans (total width = 32m)
Glenlyon Drive Footbridge	Bridge/weir	2 spans (total width = 20m)
Royal Parade Footbridge	Bridge/weir	3 spans (total width = 16m)
Gresham Street	Bridge/weir	4 spans (total width = 35m)
Bennett Road	Culvert/weir	2 / 3.6 x 2.1m RCBC
Ashgrove Golf Course Causeway	Weir	Min Level = 27.35 mAHD
Waterworks Road[2]	Bridge/weir	2 spans (total width = 28m)
Walton Reserve Causeway	Culvert/weir	4 / 1.86m dia CIP
Shopping Centre Footbridge	Bridge/weir	2 spans (total width = 39m)
Tandara Street Footbridge	Culvert/weir	2 / 1.2 x 0.6m RCBC
Illowra Street	Bridge/weir	3 spans (total width = 28m)
Riaweena Street Footbridge	Bridge/weir	2 spans (total width = 29m)
School Road	Bridge/weir	1 span (total width = 21m)
Dam Causeway	Culvert/weir	3 / 1.2 x 0.9m RCBC
Ithaca Creek		
Glenrosa Road	Culvert/weir	3 / 3.0 x 3.0m RCBC
Waterworks Road[2]	Bridge/weir	1 span (total width = 11m)
Kenwyn Road	Culvert/weir	2 / 2.1 x 1.3 m RCBC, 2 /1.8 x 1.3 m RCBC
Fulcher Road	Bridge/weir	2 spans (total width = 23m)
Nathan Avenue Footbridge	Bridge/weir	1 span (total width = 22m)
Dean Street Footbridge	Bridge/weir	1 span (total width = 17m)

Structure name	Structure Type	Structure Details
Jason Street Gauging Weir (v-notch)	Weir	Min Level = 11.74 mAHD
Lugg Street Footbridge	Bridge/weir	1 span (total width = 20m)
Jubilee Terrace	Bridge/weir	2 spans (total width = 30m)
Devonshire Street Footbridge	Bridge/weir	1 span (total width = 16m)
Glen Parade Footbridge	Bridge/weir	2 spans (total width = 18m)
Coopers Camp Road	Bridge/weir	2 spans (total width = 28m)
Coolibah Street Footbridge	Bridge/weir	1 span (total width = 15m)
Bowman Parade Footbridge[3]	Bridge/weir	3 spans (total width = 19.6m)
Bowman Parade	Culvert/weir	3 / 0.75m dia RCP
Lilley Avenue Footbridge	Bridge/weir	3 spans (total width = 30m)
Simpsons Road	Bridge/weir	1 span (total width = 21m)
Carwoola Street	Culvert/weir	3 / 2.1 x 2.1m RCBC, 2 / 2.4 x 1.9m RCBC
Sir Samuel Griffiths Drive	Culvert/weir	5 / 1.8m dia RCP
JC Slaughter Falls Road cross No 1	Culvert/weir	3 / 1.2m dia RCP
JC Slaughter Falls Road cross No 2	Culvert/weir	3 / 1.2m dia RCP
JC Slaughter Falls Road cross No 3	Culvert/weir	3 / 1.2m dia RCP
Fish Creek		
Lochinvar Lane Footbridge	Bridge/weir	1 span (total width = 17m)
Romea Street	Culvert/weir	2 / 3.6 x 1.2m RCBC
Quirk Street	Bridge/weir	2 spans (total width = 15m)
Pangela Street Footbridge	Bridge/weir	1 span (total width = 18m)
Settlement Road	Culvert/weir	6 / 1.8m dia RCP
Hilder Road	Culvert/weir	2 / 2.5 x 2.2m RCBC
Wittonga Park Footpath	Culvert/weir	2 / 1.5m dia RCP
Wittonga Park Footbridge	Bridge/weir	1 span (total width = 15m)

Note: RCBC - reinforced concrete box culvert
CIP - corrugated iron pipes
RCP - reinforced concrete pipes

[1] These two structures are modelled as a single structure by adopting the dimensions which will exert the maximum influence on the flood flow.

[2] Comprise of two parallel structures. These structures are modelled as a single structure by adopting the dimensions which will exert the maximum influence on the flood flow.

[3] This structure was replaced in the year 2010 by a structure of similar configuration. As constructed information were used in all models.

These listed structures are modelled either as 1D, 1D-2D or 2D approaches. The 1D approach is preferred where the total structure width is smaller than one or two 2D grid cells. Within the 2D domain the structures can be modelled as either 1D or 2D or in combination. Within the 1D domain the structures should be modelled as 1D. Hence within the upper domain, where the main channel of the river is modelled as 1D (ESTRY), the structures located within the river channel were also modelled as 1D with 1D weir component.

Of those located within the Lower Domain, minor structures were modelled as 2D with a 1D weir component and major structures were modelled as 2D with the flow constriction approach. Details of all new infrastructures within this domain have been sourced from the APL model. Typically these structures were represented by applying flow constrictions to the grid cells along the alignment of the bridge.

Values for the bridge loss parameters were determined from the outcome of the calibration process. A similar approach was adopted for selecting other loss factors (i.e form loss factor for bridge piers) associated with the structures.

For all events analysed in this study, handrails were assumed to be completely blocked with debris.

As the Kelvin Grove Road bridge has been utilized as the link between the two domains of the model, this structure was required to be modelled with 1D approach though other approaches (1D/2D or 2D) could be adopted.

The selected calibration and verification events (April 1989, May 1996, May 2009 and January 2013) span over approximately twenty four years of timeline. During this period a significant number of new waterway crossings have been constructed and/or upgraded. As a consequence a series of calibration models needed to be developed to represent the structure details over time. Hence, it was required to setup three (3) separate hydraulic models to accurately represent that specific period. These models are:

A. Calibration/Verification Model 1 to calibrate and verify 1989 and 1996 events respectively;

B. Calibration Model 2 to calibrate 2009 event; and

C. Calibration Model 3 to calibrate 2013 event.

The Model 3 is also utilized in ultimate scenario and extreme events analysis.

A. Calibration Model 1

The hydraulic Model 1 which was utilized for calibration and verification with the April 1989 and May 1996 events contains the details for structures constructed and upgraded up to 1998. This includes all structures tabulated in **Table 5.2** except those added in Model 2 and Model 3.

B. Calibration Model 2

After May 1996, a number of new waterway crossings were constructed. New waterway crossings within the catchment which are added after May 1996 historical events are:

- Inner City Bypass (Horace Street off ramp) crossing approximately 250 metres downstream of Bowen Bridge Road;
- Inner City Bypass and Allison Street crossing approximately 600 metres upstream of Breakfast Creek Road;
- 2 low level bikeway crossings on Enoggera Creek approximately 750 metres upstream of Ashgrove Avenue;
- 1 low level bikeway crossing on Ithaca Creek immediately upstream of Jubilee Tce road bridge; and

- 6 new road bridges and widening of 2 existing road bridges associated with the CLEM7 Tunnel Infrastructure Project.

Waterway crossings which have been upgraded (in this case, duplicated) are:

- Waterworks Road, Enoggera Creek; and
- Waterworks Road, Ithaca Creek.

The hydraulic Model 2 which was utilized for calibration with the May 2009 event contains all the structures considered in Model 1 with inclusion of all the additional/altered structures listed above (except 3 low level bikeway crossings). This model also contains the as-is details of the completed and under construction structures of the Airport Link and Northern Busway infrastructure projects and all the changed topographic information. Note, May 2009 happened during the construction of the Airport Link Tunnel and Northern Busway projects.

C. Calibration Model 3

After the May 2009 historical event, more additional new waterway crossings within the catchment added or altered. Those are:

- 2 new road bridges associated with the Northern Busway Infrastructure Project;
- 6 new road bridges, widening and extension of 3 CLEM7 tunnel infrastructure as part of the Airport Link Infrastructure Project;
- 1 low level bikeway crossing on Enoggera Creek approximately 550 metres upstream of Gresham Street; and
- Replacement of the footbridge structure at Bowman Parade.

The hydraulic Model 3 which was utilized for calibration with the January 2013 storm event has incorporated all these additional/altered structures in addition to what been considered in Model 1 and Model 2. This model also contains all the as constructed information (structural and topographical).

Most of these new structures span over both creek and floodplain. The presence of such structures has the potential to influence flood levels however some of them are elevated and have very little impact on the flooding characteristics, particularly from the superstructure components.

Most of the details of the structures which are included in Model 1 were sourced from the detailed structural survey conducted in 1998.

Detailed design drawings are available for the structures included in Model 2, but except for two Waterworks Road bridges, all detailed information were sourced from the Airport Link hydraulic model developed to analyse the impacts from the infrastructure works. Details of the Waterworks Road bridges were sourced from the design drawings.

For establishing Model 3, all details of the newly constructed structures except those for the Bowman Parade footbridge were sourced from the Airport Link hydraulic model.

All data associated with the new structures and other infrastructures constructed as part of the Major Infrastructure projects together with the underlying topographical and roughness information were incorporated in the model from the hydraulic model developed as part of the Airport Link project. This project is the latest of the series of infrastructure projects and any data adopted from this were considered as most up to date.

5.2.2.8 Model Boundaries

Inflow Boundary

There are three inflows into the upstream boundaries and 64 local inflows into the model. These inflows have been applied to the model through SA (Source Area) Polygons resembling the corresponding sub-catchments of the WBNM hydrology model.

Downstream Boundary

Breakfast Creek flows into the Brisbane River near the Albion Park Paceway. The model extent was aligned with the left bank of the Brisbane River and extended to higher ground on the left and right bank of Breakfast Creek. A stage hydrograph was applied at the downstream extent of the model. For 1989 and 1996 calibration event simulations, recorded information for the Port Office and Brisbane Bar gauges (both operated by the Department of Transport) was employed to determine levels at the mouth of Breakfast Creek during calibration events. For May 2009 and January 2013 events recorded height data from the stream gauge located at the mouth of the Breakfast Creek (Newstead House) was employed. A summary of the levels employed for each event are detailed in **Table 5.3**.

Table 5.3 Summary of Adopted Tailwater Conditions – Calibration Events

Event	Source of Data	Max Level (m AHD)
April 1989	Interpolation between Brisbane Bar & Port Office gauges	1.66
May 1996	Interpolation between Brisbane Bar & Port Office gauges	2.01
May 2009	Recorded level data from the stream gauge located at mouth	1.46
January 2013	Recorded level data from the stream gauge located at mouth	2.08

5.2.2.9 Other Model Parameters

Time Series Outputs

Plot output (PO) lines and points were placed at stream gauge locations and Maximum Height Gauge locations and also at upstream of structure locations to extract time series results.

Simulation Time

The simulation times considered for calibration and verification events are according to the recorded duration.

Timestep

For calibration and verification event runs the adopted timestep for the 1D component is 0.5 seconds, whereas for 2D components it is 1 second and 3 seconds for lower and upper domain, respectively.

Software Version

The 64-bit version of 2012-05-AA build has been utilized for all the model simulations.

5.3 Structure Head Loss Verification

5.3.1 General

In addition to the TUFLOW model, each of the structures was also analysed using HEC-RAS Version 3.1.3. This allowed for greater confidence in the head losses predicted at each of the structures. The HEC-RAS models can also be used for preliminary analyses of structures such as occurs with road upgrade and other creek works, without the need for the TUFLOW model.

HEC-RAS was developed by the US Army Corps of Engineers Hydrologic Engineering Centre to perform one-dimensional water surface profile calculations for steady gradually varied flow in natural or constructed channels (US Army Corps of Engineers 1995, p.2-2). The program uses the standard step method to determine water levels for subcritical, supercritical, or mixed flow regimes.

5.3.2 Hydraulic Model Setup

Each of the structures listed in Section 5.2.2 was modelled using HEC-RAS to verify the results obtained using the TUFLOW model. A separate model was created for each structure. Cross sections used in the draft MIKE 11 model which is the base model of the TUFLOW 1D component (ESTRY) were duplicated for use in the HEC-RAS model. Note, no HECRAS analysis was conducted for the structures contained within the Airport Link Model as it is expected that these structures were verified in the earlier analysis. These comparisons were conducted for a minor event (10 Year ARI event) and a major event (100 Year ARI event).

The HEC-RAS models typically consisted of four cross sections – two each upstream and downstream of the structure itself. The flow rate and the downstream water level for the HEC-RAS models were obtained from the TUFLOW model results. Mannings ‘n’ roughness values used in the HEC-RAS models were taken directly from the TUFLOW model. The levels obtained from the HEC-RAS models for the upstream cross section were then compared with the results obtained using the TUFLOW model.

Results obtained for each structure using both the TUFLOW and HEC-RAS models are listed in **Appendix D**. Typically, results obtained using the HEC-RAS models were within 0 to 300mm of those obtained using the TUFLOW model. The TUFLOW structure setups were therefore considered to be adequate.

6 CALIBRATION ANALYSIS

6.1 Selection of Events

In order to provide the best possible calibration of both the hydrologic and hydrodynamic model, the widest range of events covering the highest recorded floods, were sought. Calibration of the models was then achieved by adjusting model parameters until the model reproduced the behaviour observed in the catchment. Although this process was carried out for a number of recorded events, one set of parameters, with the exception of rainfall losses, was adopted to represent all storm events.

Selection of likely events involved perusal of all available data related to flooding. Main data sources (as detailed in Section 4) were:

- Historic flood levels;
- Maximum Height Gauge (MHG) readings;
- Recorded pluviograph data (continuous rainfall records); and
- Recorded stage (water level) hydrographs

The hydrologic and hydraulic models are best calibrated with the aid of a recorded hydrograph (of level or flow) throughout a flood event. The preliminary event selection therefore began with a determination of the range of events with recorded stage hydrographs. Supporting information (rainfall pluviographs, MHG records and surveyed debris marks) was then sought for those events for which stream gauge information was available.

Events were chosen to include both the largest events recorded and those with the greatest degree of information available. The following events were chosen for calibration of the hydrologic model:

- January 1974
- April 1989
- May 1996
- May 2009 and
- January 2013.

For calibration of the hydrodynamic model, three events were selected and further one event for verification purposes. These events are:

for calibration purposes:

- April 1989
- May 2009 and
- January 2013.

and for verification purposes:

- May 1996

Although the largest event on record, the 1974 event was not considered for calibration purposes due to the significant changes to have occurred in the lower reaches of the Breakfast-Enoggera Creek system since then.

Each of these events will be discussed in greater detail later in this section. Detailed information regarding pluviograph and recorded flood level data for these events is contained in **Appendix A**.

Table 6.1 indicates the availability of stream gauge information for each of the chosen events.

Table 6.1 Stream Gauge Availability

Gauge Location	**April 1989**	**May 1996**	**May 2009**	**January 2013**
Enoggera Dam Spillway	✓	✓	✓	✓
Bancroft Park	✓	✓	✓	✓
Jason Street	✓	✓	✓	✓
Opp Mann Park	–	✓	–	✓
Newstead House	–	–	✓	✓

6.2 Calibration and Verification of Hydrology Model

6.2.1 General

Recorded rainfall patterns for the historical storm event selected for calibration and verification were extracted and formatted for WBNM. The selected calibration events each had a number of recorded pluviographs, which provided a distribution of the temporal pattern for each event, over the full length of the catchment. Using mass rainfall curves, data anomalies and isolated rainfall cells were identified and the appropriate distributions made between the rainfall data and each of the sub-catchments. Schematic plots of the adopted rainfall distributions for each calibration event are presented in **Appendix A**. Mass rainfall curves and rainfall hyetographs are also presented in **Appendix A**.

All other hydrologic model configuration and parameters with the exception of rainfall losses were maintained across all the calibration and verification events.

A brief description of each calibration and verification event and the associated model calibration is provided below.

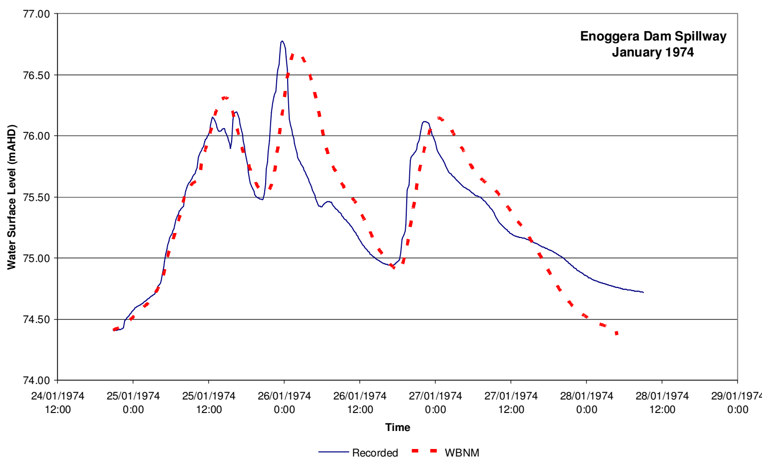
6.2.2 January 1974

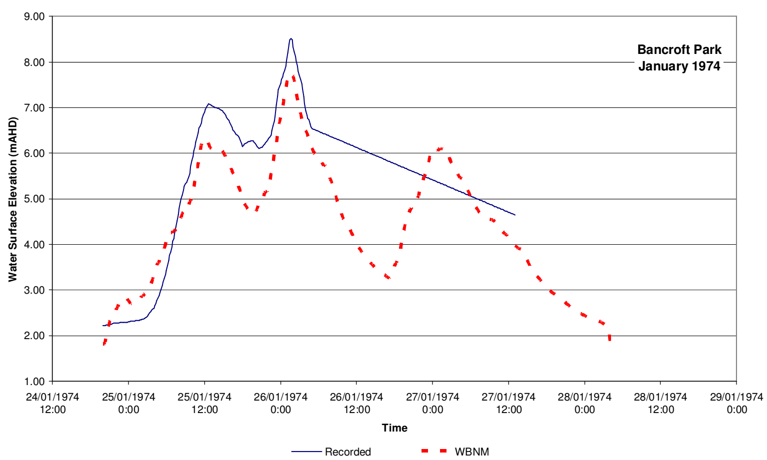
This is the largest of the calibration events selected and occurred between 24th and 27th January 1974. The event temporal pattern indicates a multiple burst storm with total rainfall volumes ranging from

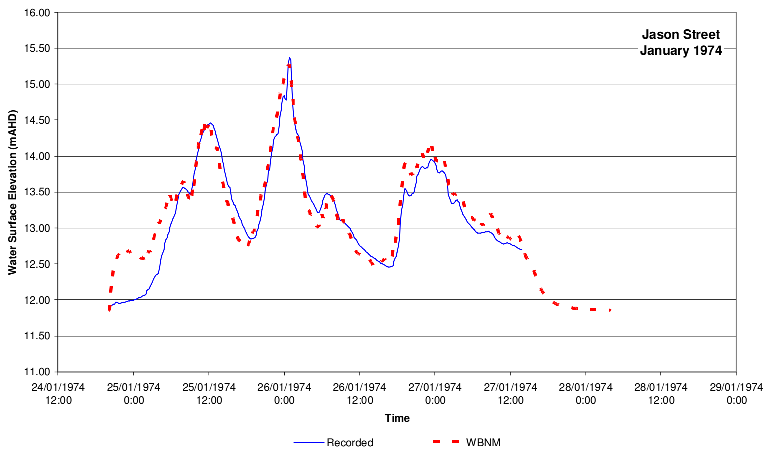
650 mm to 970 mm. Highest rainfall readings were taken in the middle and upper reaches of the catchment above Enoggera Dam.

Enoggera Dam was at full capacity with the post 1973 spillway configuration. No significant discharge was recorded at the commencement of the storm. This event also provided the largest stream depth records for the Jason Street and Bancroft Park gauges.

Figure 6.1 Hydrologic Calibration, January 1974







Calibration results for this event, as shown on **Figure 6.1**, indicate a good match to the recorded hydrographs at Enoggera Dam and an excellent match to the Jason Street gauge recorded hydrograph. All the calibration hydrographs show excellent matches to the trends of the rising and falling limbs of the recorded hydrographs. The match of the hydrographs at Bancroft Park was not as close as achieved for the other locations. This is due to the mitigation works that were carried out downstream of Kelvin Grove Road. The recorded hydrograph is based on flows from the pre-mitigated watercourse condition. The unmitigated channel downstream of Kelvin Grove Road influenced recorded tailwater levels of Bancroft Park. Considering this the observed differences are not unexpected.

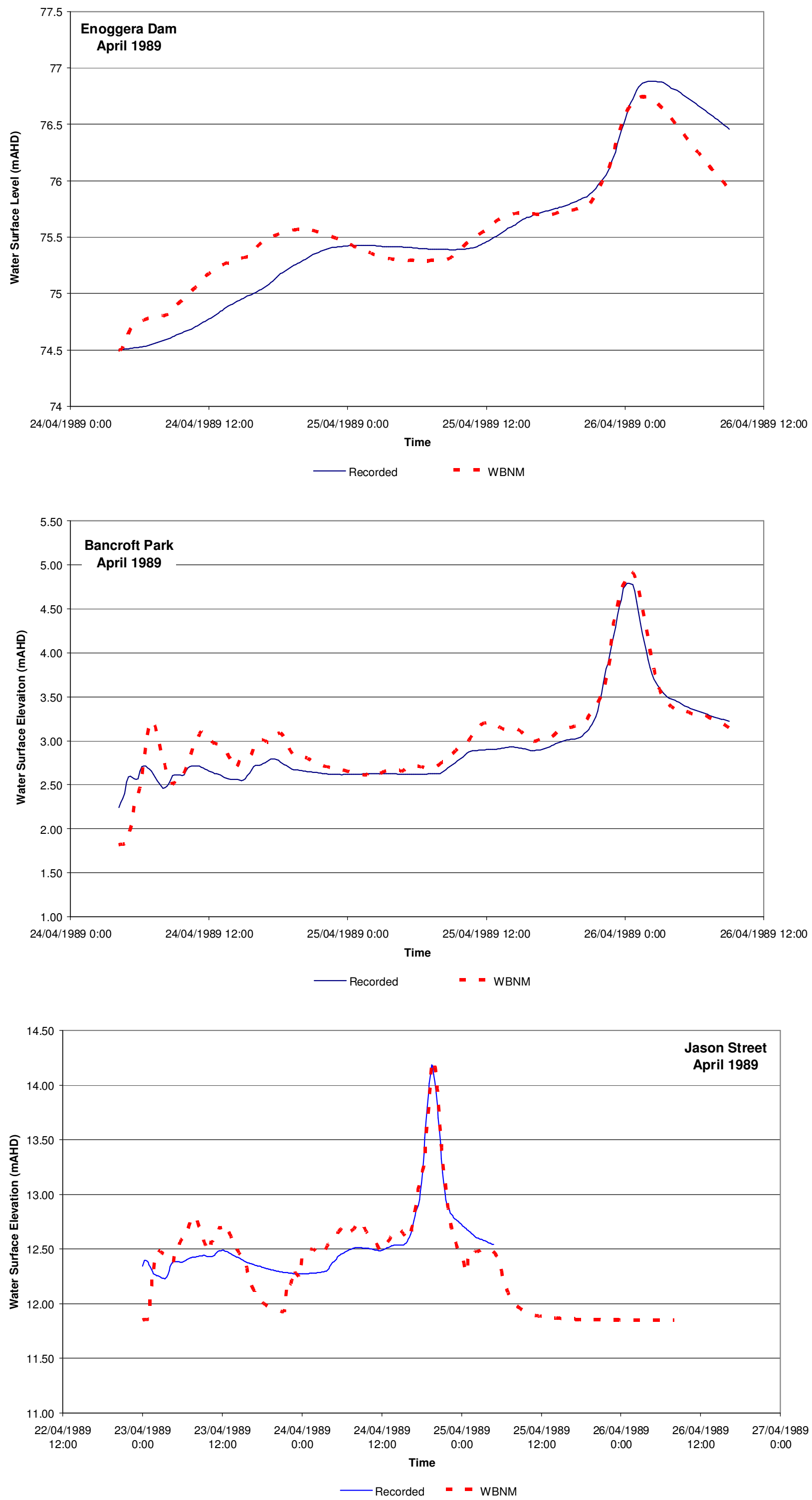
6.2.3 April 1989

This model calibration event occurred between 23rd and 26th April 1989. The mass rainfall curves and temporal patterns indicated light steady rainfall for the first 72 hours followed by a single heavy burst distributed evenly across the catchment.

This event was the first of the events analysed in this study to incorporate the raised spillway of Enoggera Dam. No significant discharge was recorded at the commencement of the storm.

Calibration results for this event, as shown on **Figure 6.2** and **Table 6.3**, **Table 6.4** and **Table 6.5**, indicate excellent matches for timing, peaks and hydrograph characteristics at the three recorded hydrograph locations.

Figure 6.2 Hydrologic Calibration, April 1989



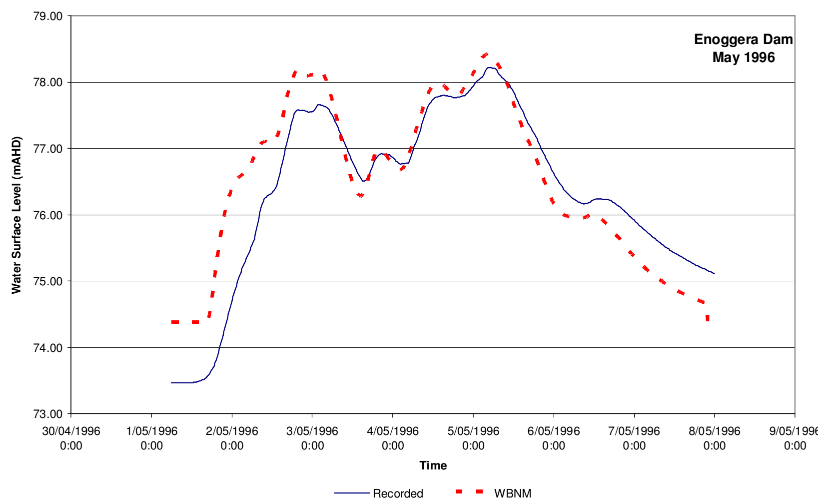
6.2.4 May 1996

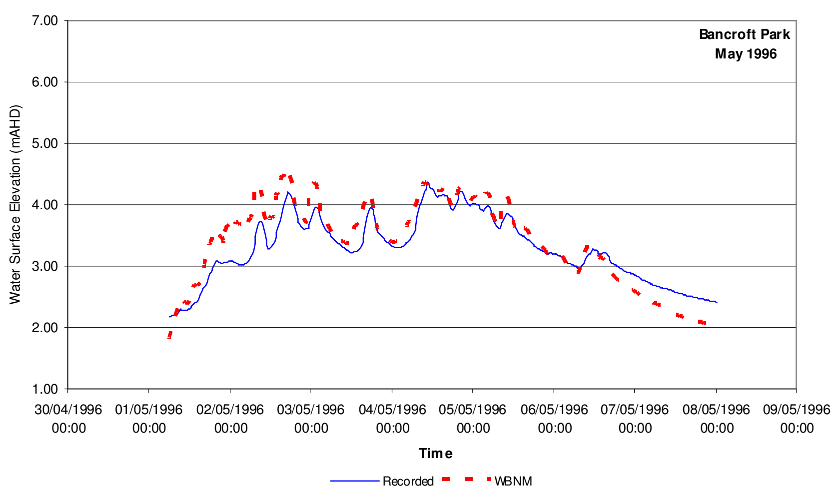
This model verification event occurred between 30th of April and 6th May 1996. This event is characterised by a long duration of heavy rainfall with multiple small peaks throughout. It is the smallest event peak for calibration at both Bancroft Park and Jason Street gauges, however its total volume is comparable to the January 1974 event.

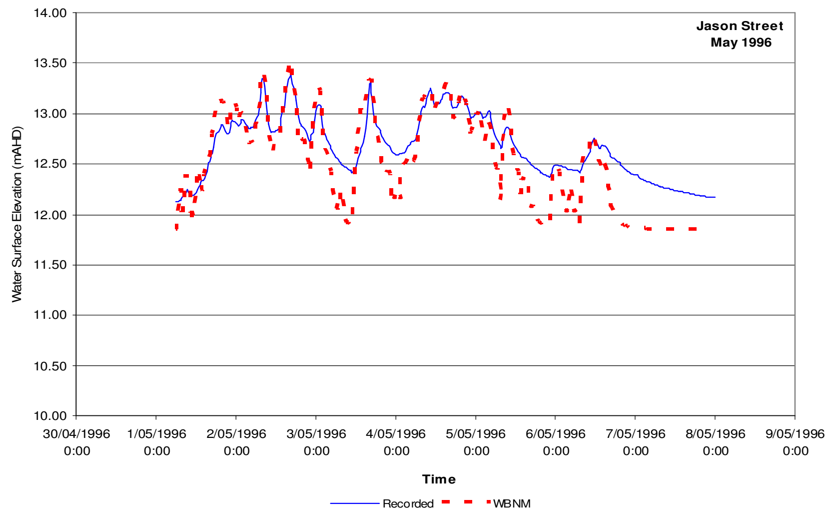
Water levels in Enoggera Dam were initially well below the spillway, but the steady rainfall filled the available storage and the Dam overtopped the spillway, reaching the highest peak at the spillway of the selected calibration events.

Calibration results for this event, as shown on **Figure 6.3** and **Table 6.3**, **Table 6.4** and **Table 6.5**, indicate excellent results in matching the hydrograph characteristics and peak levels at Enoggera Dam, Jason Street and Bancroft Park.

Figure 6.3 Hydrologic Calibration, May 1996







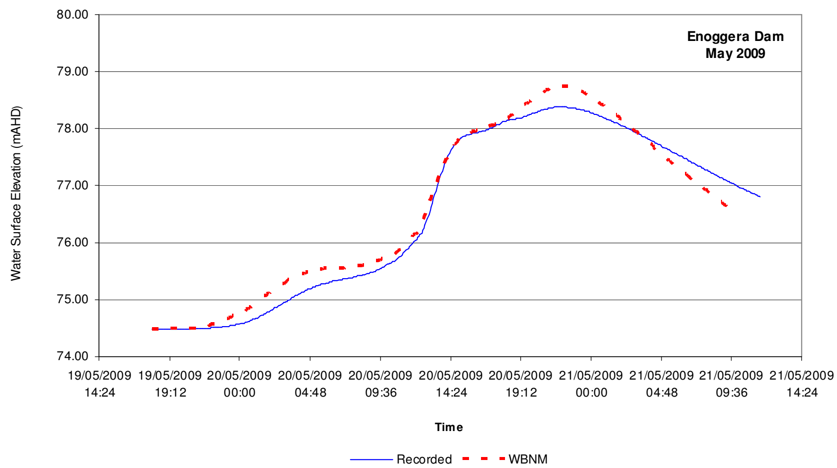
6.2.5 May 2009

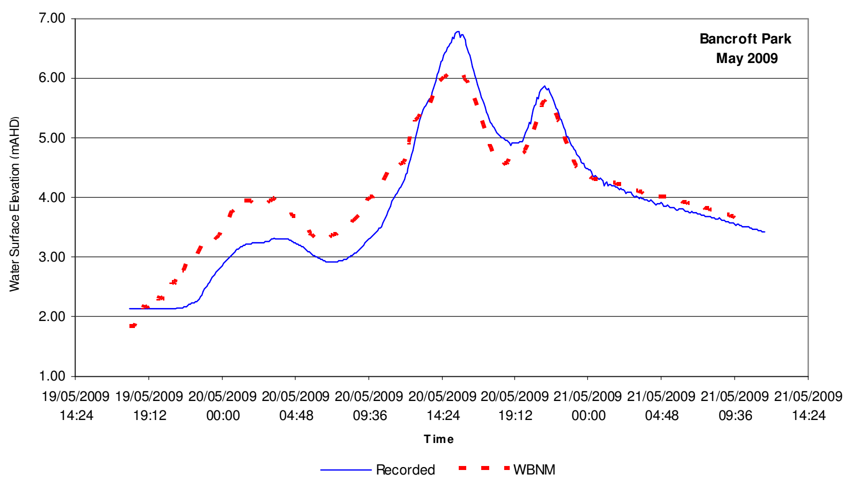
This model calibration event occurred between 19th of May and 21st of May 2009. This event is characterised by a short duration of heavy rainfall with multiple small peaks throughout. Particularly, on 20 May 2009, widespread, prolonged rainfall occurred across Brisbane. Rainfall totals for the day were typically in the order of 100 to 300 mm. Heaviest rainfalls for the 20th May event typically occurred over a 5 hour period between 10am and 3pm. Heavy rainfall bursts were also recorded between 5 and 8pm at some locations. Other periods recorded only minor rainfalls.

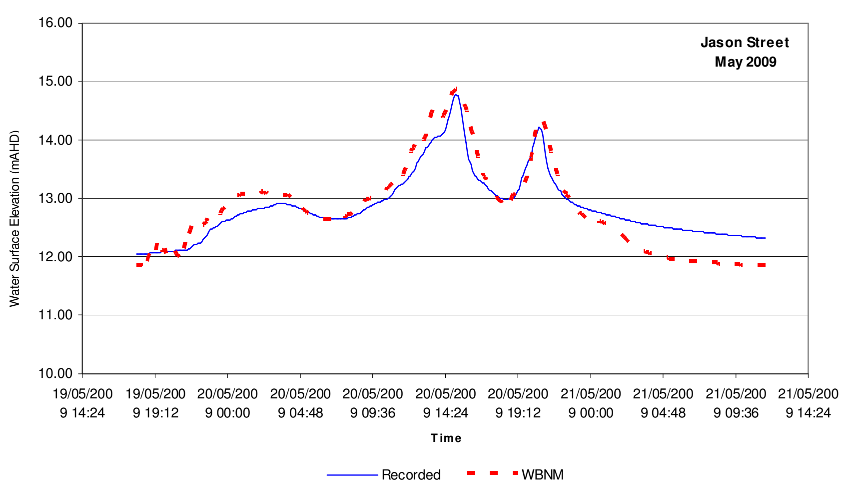
Water levels in Enoggera Dam were initially well below the spillway, but the steady rainfall filled the available storage and the Dam overflowed via the sluice spillway.

Calibration results for this event, as shown on **Figure 6.4** and **Table 6.3**, **Table 6.4** and **Table 6.5**, indicate excellent results in matching the hydrograph characteristics and peak levels at Enoggera Dam and Jason Street but failed to achieve a good calibration at Bancroft Park. The potential reason could be blockage from the structures/fences and/or significant changes in the channel bathymetry due to siltation. Also due to the malfunctioning of the Mann Park gauge calibration of the model downstream of Bowen Bridge Road was not able to be verified.

Figure 6.4 Hydrologic Calibration, May 2009







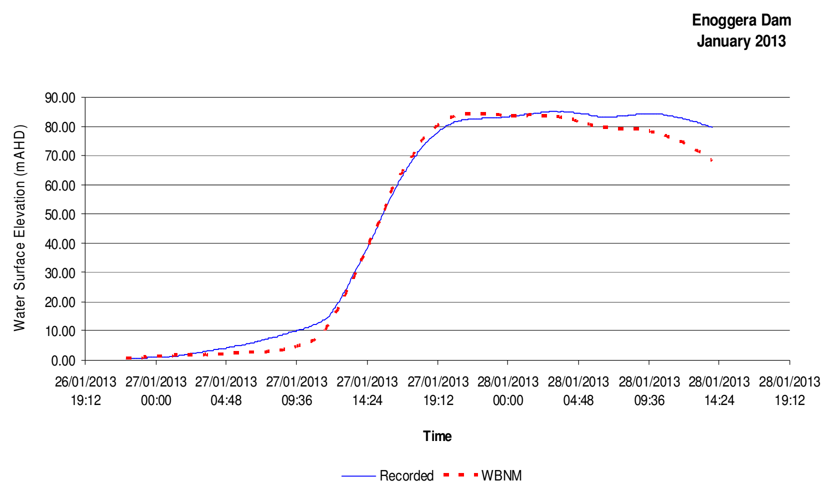
6.2.6 January 2013

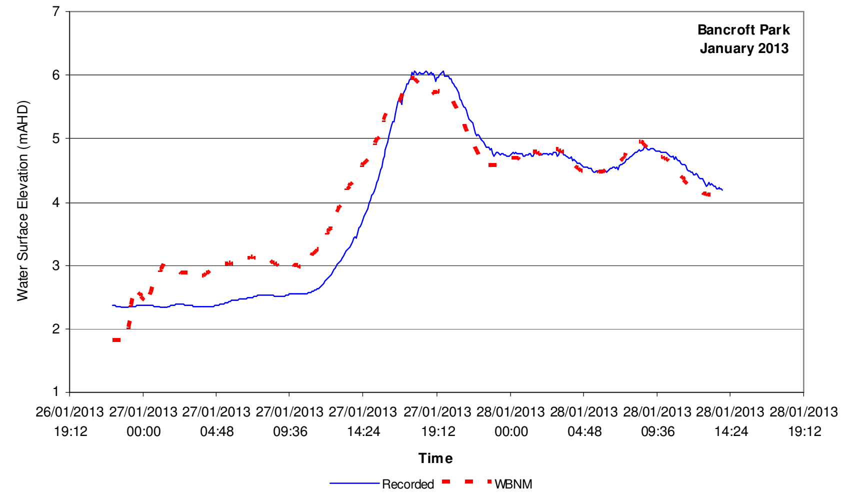
This model calibration event occurred between Saturday 26th and Monday 28th January 2013. This event is characterised by a moderate to heavy rainfall, particularly on 27th January. Particularly, on 27th January, widespread, prolonged rainfall occurred across Brisbane. The recorded 24 hour total rainfall ranged from 324mm at Enoggera Creek in Brisbane Forest Park to 152mm at Breakfast Creek in Bowen Hills. As a result of the significant rainfall and in combination with the storm surge, several areas within the catchment were subject to flash flooding. Other periods recorded only minor rainfalls.

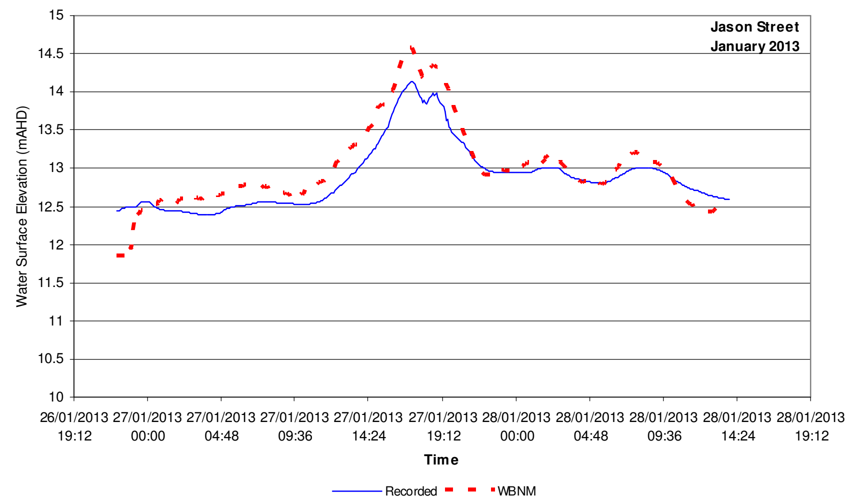
Water levels in Enoggera Dam were initially well below the spillway, but the steady rainfall filled the available storage and the Dam overflowed via the sluice spillway.

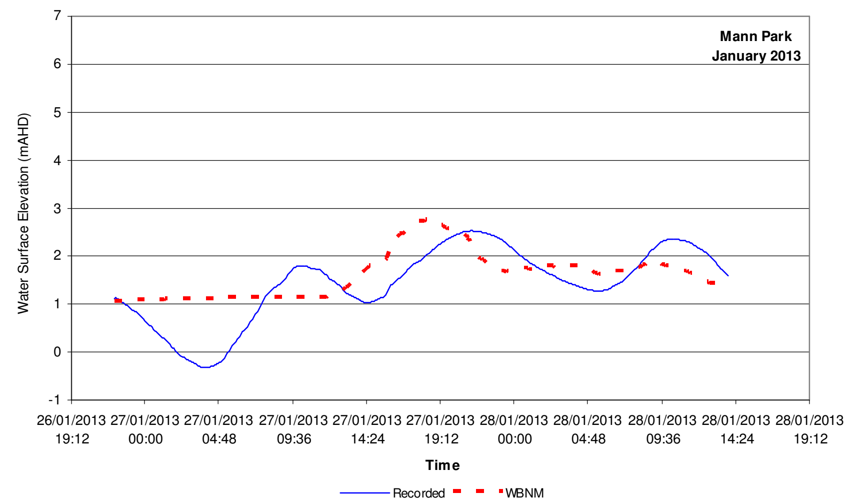
Calibration results for this event, as shown on **Figure 6.5** and **Table 6.3**, **Table 6.4** and **Table 6.5**, indicate excellent results in matching the hydrograph characteristics and peak levels at Enoggera Dam and Bancroft Park but failed to achieve good calibration in Jason Street. Mann Park gauge demonstrated relatively good calibration in terms of timing of the peak and hydrograph shape but only fair in terms of peak height prediction.

Figure 6.5 Hydrologic Calibration, January 2013




Bancroft Park
January 2013
Water Surface Elevation (mAHD)
7
6
5
4
3
2
1
26/01/2013 19:12
27/01/2013 00:00
27/01/2013 04:48
27/01/2013 09:36
27/01/2013 14:24
27/01/2013 19:12
28/01/2013 00:00
28/01/2013 04:48
28/01/2013 09:36
28/01/2013 14:24
28/01/2013 19:12
Time
Recorded
WBNM


Jason Street
January 2013
Water Surface Elevation (mAHD)
15
14.5
14
13.5
13
12.5
12
11.5
11
10.5
10
26/01/2013 19:12
27/01/2013 00:00
27/01/2013 04:48
27/01/2013 09:36
27/01/2013 14:24
27/01/2013 19:12
28/01/2013 00:00
28/01/2013 04:48
28/01/2013 09:36
28/01/2013 14:24
28/01/2013 19:12
Time
Recorded
WBNM


Mann Park
January 2013
Water Surface Elevation (mAHD)
7
6
5
4
3
2
1
0
-1
26/01/2013 19:12
27/01/2013 00:00
27/01/2013 04:48
27/01/2013 09:36
27/01/2013 14:24
27/01/2013 19:12
28/01/2013 00:00
28/01/2013 04:48
28/01/2013 09:36
28/01/2013 14:24
28/01/2013 19:12
Time
Recorded
WBNM

6.2.7 Initial and Continuing Losses

Initial and continuing losses were adopted for each calibration event. These losses are summarised in **Table 6.2**.

Initially, a consistent continuing loss was assumed across all events and only initial losses varied to suit the rising limbs of each recorded hydrograph. The losses were not varied for each of the separate creek catchments i.e Fish, Ithaca, Enoggera and Breakfast.

For May 2009 event, a range of loss factors were considered. Out of them IL = 20mm/hr and CL = 3mm/hr were found relatively appropriate in terms of the calibration.

For January 2013 event, a range of loss factors were considered. Out of them IL = 40mm/hr and CL = 3mm/hr were found relatively appropriate in terms of the calibration.

Table 6.2 Initial and Continuing Losses

Calibration Event	Initial Loss (mm)	Continuing Loss (mm/hr)
January 1974	0	0
April 1989	0	0
May 1996*	40	3
May 2009	20	3
January 2013	40	3

* Due to limitations of the hydrologic model, an initial loss (IL) value of '0' has been adopted for sub-catchments 56, 57 and 58 and continuing loss (CL) value of '0' has been adopted for sub-catchments 1-14.

6.2.8 Summary of Hydrology Calibration Results

Results at each gauge for each event are summarised in **Table 6.3**, **Table 6.4** and **Table 6.5**.

Table 6.3 Summary of Hydrology Calibration Results, Bancroft Park Gauge

Event	Peak flood Level			Peak Flow Rate			Time of Peak	
	Rec. (m AHD)	Calc. (m AHD)	Diff (m)	Rec. (m^3/s)	Calc. (m^3/s)	Diff (%)	Rec.	Calc.
January 1974	8.51	7.16	-1.35	851*	691	19*	26/01/74 1:40am	26/01/74 1:30am
April 1989	4.79	4.93	+0.14	196	215	10	26/04/89 12:20am	26/04/89 12:30am
May 1996	4.36	4.37	+0.01	149	158	9	04/05/96 11:00am**	04/05/96 10:00am**
May 2009	6.79	6.11	-0.68	330	352	22	20/05/09 04:30am**	20/05/09 03:25am**
January 2013	6.06	5.95	-0.11	292	323	31	27/01/13 05:45pm	27/01/13 05:35pm

* This value was derived using the Bancroft Park rating curve for post mitigation conditions and hence DOES NOT relate to actual recorded peak flow.

** Multiple Peak storm

Table 6.4 Summary of Hydrology Calibration Results, Jason Street Gauge

Event	Peak flood Level			Peak Flow Rate			Time of Peak	
	Rec. (m AHD)	Calc. (m AHD)	Diff (m)	Rec. (m^3/s)	Calc. (m^3/s)	Diff (%)	Rec.	Calc.
January 1974	15.37	15.27	-0.10	174	156	10	26/01/74 12:50am	26/01/74 12:50am
April 1989	14.19	14.22	+0.03	65	67	3	26/04/89 11:40am	26/04/89 11:50am
May 1996	13.38	13.55	+0.17	27	34	26	02/05/96 4:20pm**	02/05/96 4:20pm**
May 2009	14.87	14.78	-0.09	100	107	7	20/05/09 3:05pm**	20/05/09 3:05pm**
January 2013	14.14	14.67	+0.53	62	92	30	27/01/13 05:00pm	27/01/13 05:15pm

** Multiple Peak storm

Table 6.5 Summary of Hydrology Calibration Results, Enoggera Dam Gauge

Event	Peak flood Level			Peak Flow Rate			Time of Peak	
	Rec. (m AHD)	Calc. (m AHD)	Diff (m)	Rec. (m^3/s)	Calc. (m^3/s)	Diff (%)	Rec.	Calc.
January 1974	76.78	76.69	-0.09	352	330	6	25/01/74 11:40pm	26/01/74 1:40am
April 1989	76.88	76.75	-0.13	60	54	10	26/04/89 2:20am	26/04/89 2:00am
May 1996	78.22	78.43	+0.21	77	67	13	05/05/96 5.00pm	02/05/96 5:00pm
May 2009	78.38	78.75	+0.04	79	83	4	20/05/09 9:40pm	20/05/09 9:45pm
January 2013	78.91	78.84	-0.07	85	84	1	28/01/13 3:40am	27/01/13 9:40pm

In summary, good calibration was achieved for the hydrologic model across a range of historical events. The WBNM model has successfully interpreted and incorporated the many specific elements of rainfall and runoff derivation peculiar to this catchment and the calibration events chosen.

6.3 Calibration of Hydrodynamic Model

6.3.1 General

Initial calibration of the TUFLOW model took the form of adjusting Mannings 'n' values (initially selected from MIKE11 model and aerial photography) within reasonable limits until calculated levels agreed with those recorded. Later losses through hydraulic structures were adjusted to calibrate against the recorded data. The structural losses were also verified against the purpose built HECRAS models.

It is generally considered that a good calibration is achieved when calculated peak flood levels are within:

- 150 mm of continuous flood records (ie. stream gauge record),
- 300 mm of maximum height gauge (MHG) records, and
- 400 mm of other recorded levels.

A review of flood levels recorded in the catchment indicated that a number were dubious - typically because another nearby level was vastly different to that level. These flood levels were not considered for the calibration. Data available for each of the events is summarised in the following sections.

Inflows were obtained from the calibrated hydrologic model and input to the MIKE 11 model. Mannings 'n' values were then adjusted to obtain the best possible calibration over all events.

6.3.2 Event Summary

6.3.2.1 April 1989

This event was one of the largest of the modern events (post creek mitigation), second to the May 2009 event in some locations. Mitigation had occurred in Breakfast Creek prior to this event and an adequate calibration could therefore be achieved in Breakfast Creek.

6.3.2.2 May 2009

As a result of this event minor to moderate flooding was recorded in Ithaca and Breakfast-Enoggera Creek Catchments.

a. Ithaca Creek

The top end of Ithaca Creek recorded an approximately 20 year ARI (Average Recurrence Interval) rainfall intensity (for a 2 hour duration) which resulted in significant flows in the watercourse. The stream gauge at Jason Street recorded a water level of 14.8m AHD representing a 2.8 m rise above standing water levels. This level is lower than expected for this event. Reasons for this may be the influence of the 20 November 2008 flood event which is likely to have removed much debris and vegetation from the creek leaving it more hydraulically efficient.

b. Breakfast / Enoggera Creek

The catchment in general experienced a 10 year ARI rainfall event. Enoggera Dam filled to above the level of the sluice spillway with significant flows then entering Enoggera Creek, however Ithaca Creek flood flows combined with flows in Enoggera Creek to cause significant water level rises in Enoggera Creek from Bancroft Park upstream of Kelvin Grove Road to Bowen Bridge Road. The stream gauge at Bancroft Park recorded a 4.6m rise in water level with the final 2.3 m occurring in 3 hours. Flood waters entered properties abutting the park during the event and damaged park infrastructure. Flood damage was also experienced by low lying properties in the Windsor area.

6.3.2.3 May 1996

This event was a long duration event which resulted in prolonged minor flooding throughout Brisbane. The event consisted of a number of peaks. As the event was a long duration event, levels at the Breakfast Creek mouth (Brisbane River) were high, resulting in backwater flooding in the lower reaches.

6.3.2.4 January 2013

During the Saturday 26th and Sunday 27th January rainfall event, areas located within the Enoggera, Breakfast, Ithaca and Fish Creek catchment received moderate to heavy rainfall, particularly on 27th January. The recorded 24 hour total rainfall ranged from 324mm at Enoggera Creek in Brisbane Forest Park to 152mm at Breakfast Creek in Bowen Hills. As a result of the significant rainfall and in combination with the storm surge, several areas within the catchment were subject to flash flooding. Several creek crossings also experienced varying degrees of damage.

Recorded peak flood levels and debris survey indicate that the most upper parts of the Enoggera-Breakfast Creek catchment experienced flooding corresponding to a 1 in 20 year ARI flood event. The rest of the upper and middle areas experienced flood levels ranking between a 1 in 2 year and 1 in 5 year ARI event except areas adjacent to Bancroft Park where recorded levels indicated similar to a 1 in 20 year ARI flood. The lower catchment (from Bowen Bridge Road to downstream) experienced a flood event between 1 in 2 year ARI to 1 in 5 year ARI with the exception of areas adjacent to the creek mouth where recorded levels indicated similar to a 1 in 20 year ARI flood event. This is likely due to the coincident high tide and storm surge from Moreton Bay.

The most upper parts of the Ithaca Creek catchment experienced flooding corresponding to a 1 in 20 year ARI flood event. The rest of the upper and middle areas of Ithaca Creek catchment experienced a flood event between a 1 in 2 year ARI and 1 in 5 year ARI flood event. The lower part of the catchment (particularly at the confluence with Enoggera Creek) experienced flooding corresponding to a 1 in 10 year ARI flood event. The Fish Creek catchment experienced flooding corresponding to a 1 in 2 year ARI flood event.

6.3.3 Summary of Hydrodynamic Calibration Results

The results of the hydrodynamic calibration for each of the gauges are summarised in **Table 6.6** and **Table 6.7.**

Table 6.6 Summary of Hydrodynamic Calibration Results, Bancroft Park Gauge

Event	Peak flood Level			Peak Flow Rate			
	Rec. (m AHD)	Calc. (m AHD)	Diff (m)	Rec. (m^3/s)	Calc. (m^3/s)	Diff (m^3/s)	Diff (%)
April 1989	4.79	5.08	+0.29	196	228	+32	16
May 1996**	4.36	4.06	-0.30	149	152	+3	2
May 2009**	6.79	6.46	-0.33	330	358	+28	8
January 2013	6.06	5.88	-0.18	292	295	+3	1

** Multiple Peak storm

Table 6.7 Summary of Hydrodynamic Calibration Results, Jason Street Gauge

Event	Peak flood Level			Peak Flow Rate			
	Rec. (m AHD)	Calc. (m AHD)	Diff (m)	Rec. (m^3/s)	Calc. (m^3/s)	Diff (m^3/s)	Diff (%)
April 1989	14.19	14.22	+0.03	65	70	+5	9
May 1996**	13.38	13.73	+0.35	27	50	+23	51
May 2009**	14.87	14.81	-0.06	100	106	+6	6
January 2013	14.14	14.54	+0.4	62	84	+22	35

** Multiple Peak storm

The agreement between calculated values and those recorded at maximum height gauges for each of the other events is presented in **Table 6.8**.

Comparison plot of hydrographs (recorded and calculated from hydrologic and hydraulic analysis) at stream gauge locations for calibration events (1989, 2009 and 2013) and verification events (1996) are provided in **Appendix A**.

Table 6.8 Summary of Hydrodynamic Calibration Results, Maximum Height Gauges

MHG No	Previous MHG ID	MHG Location	BCC XSect ID	AMTD (m)	Recordable Range		Apr-89			May-96			May-09			Jan-13		
					Max	Min	Water Level (m AHD)		Diff (m)	Water Level (m AHD)		Diff (m)	Water Level (m AHD)		Diff (m)	Water Level (m AHD)		Diff (m)
					(m AHD)	(m AHD)	Meas.	Calc.		Meas.	Calc.		Meas.	Calc.		Meas.	Calc.	
Gauges																		
		Bancroft Park	B647	6666			4.79	4.72	-0.07	4.36	4.495	0.135	6.79	6.46	**-0.33**	6.06	6.07	0.01
		Jason Street	I151	26929			14.19	14.15	-0.04	13.38	13.74	0.36	14.87	14.84	-0.03	14.14	14.4	**0.26**
Breakfast																		
B150		d/s Bishop Street	B540	5879	2.85	0.75												
B140	**B03**	Mark Street	B570	6036	4.89	2.79	3.77	4.17	**0.4**	3.58	3.8	**0.22**	5.47	5.14	**-0.33**	4.97	4.59	**-0.38**
B130	**B04**	Noble Street	B441	4754	4.74	2.64	2.99	3.33	**0.34**	< 2.64	3.03	> 0.39	3.96	3.93	-0.03	3.66	3.66	0
B120	**B05**	Lutwyche Road u/s	B340	3785	4.14	2.04	2.73	2.79	0.06	2.41	2.47	**0.06**	3.24	3.43	0.19	3.12	3.22	0.1
B110	**B06**	Lutwyche Road d/s	B329	3739	4.18	2.08	2.61	2.68	**0.07**	2.32	2.44	**0.12**	3.21	3.31	0.1	2.87	3.06	0.19
B100	**B07**	Railways	B290	2905	4.43	2.33	2.47	2.45	-0.02	< 2.33	2.34	> 0.01	3.01	3	-0.01	2.62	2.84	0.22
Enoggera																		
E100	**E01**	Ashgrove Avenue	E71	8586	10.41	8.31	< 8.31	8.65	> 0.34	8.8	8.46	-0.34	9.57	9.59	**0.02**	9.38	9	-0.38
E110	**E01A**	Quandong Street	E105	9455	12.13	10.03	10.32	10.16	-0.16	10.47	9.93	**-0.54**	n/a	10.92	n/a	10.52	10.42	-0.1
E120	**E02**	Frasers Road	E200	10818	16.28	14.18	< 14.18	14.23	> 0.05	< 14.18	13.89	< -0.29	15.7	15.06	**-0.64**	14.04	14.48	**0.44**
E130	**E03**	Mirrabooka Road	E235	11423	18.34	16.24	< 16.24	15.8	< -0.44	< 16.24	15.56	< -0.68	16.24	16.57	0.33	15.8	16.11	0.31
E140	**E03A**	Glen Lyon Drive	E300	11977	18.79	16.69	< 16.69	17.52	> 0.83	16.89	16.96	0.07	18.38	18.41	0.03	17.79	17.91	0.12
E150	**E04**	Royal Parade	E395	13555	26.1	24	< 24.00	22.95	< -1.05	< 24.00	22.62	< -1.38	24.24	24.09	**-0.15**	<24.00	23.47	< -0.53
E160	**E04A**	Royal Parade	E440	13973	26.04	23.94	< 23.94	24.28	> 0.34	< 23.94	23.8	< -0.14	25.39	25.21	-0.18	24.41	24.67	0.26
E170	**E05**	Bennett Road	E540	15156	30.89	28.79	28.88	29.76	**0.88**	28.6	29.61	**1.01**	29.82	30.11	0.29	29.76	29.87	0.11
E180	**E05A**	Glen Affric Street	E629	16087	34.01	31.91	< 31.91	32.24	> 0.33	< 31.91	32.14	> 0.23	33.26	32.87	**-0.39**	<31.91	32.52	> 0.61
E190	**E05B**	Blucher Avenue	E693	17137	37.5	35.4	35.98	35.84	-0.14	36.11	35.96	-0.15	36.92	36.48	**-0.44**	36.63	36.21	**-0.42**
E200	**E06**	Illowra Street	E740	17865	44.1	42	< 42.00	40.15	< -1.85	< 42.00	40.47	< -1.53	40.7	40.84	0.14	40.61	40.58	-0.03
E210	**E06A**	Payne Road	E830	18972	47.18	45.08	45.36	44.95	**-0.41**	45.43	45.14	-0.29	46.22	45.58	**-0.64**	45.64	45.34	-0.3
E220	**E06B**	Yoorala Street	E869	19460	49.28	47.18	47.45	47.23	-0.22	47.54	47.26	-0.28	48.14	47.97	-0.17	47.86	47.7	-0.16
Ithaca																		
I100	**I01**	Eagar Street	I35	25352	10.18	7.2	< 7.20	6.61	< -0.59	< 8.08	6.2	< -1.88	7.58	7.27	-0.31	6.98	7.03	0.05
I120	**I01A**	Waterworks Road	I59	25648	9.3	8.08	< 8.08	8.1	< -0.02	7.45	7.64	0.19	9.07	8.85	-0.22	8.45	8.55	0.1
I130	**I01B**	Jubilee Terrace	I171	27395	18.25	16.15	16.45	15.57	**-0.88**	< 16.15	15.18	< -0.97	15.9	16.26	0.36	15.42	15.84	**0.42**
I140	**I02**	Beatrice Street	I224	28285	25.44	23.34	< 23.34	21.87	< -1.47	< 23.34	21.59	< -1.75	22.73	22.42	**-0.31**	22.17	22.12	-0.05
I150	**I02A**	Coopers Camp Road	I252	28824	27.03	24.93	25.18	25.09	-0.09	< 24.93	24.85	< -0.08	26.34	25.78	**-0.56**	25.47	25.33	-0.14
I160	**I03**	Bowman Parade	I300	29652	35.34	33.24	33.71	33.42	-0.29	< 33.24	33.28	> 0.04	34.2	33.8	**-0.4**	33.71	33.56	-0.15
I170	**I04**	Carwoola Street	I430	31500	58.65	56.55	56.46	56.32	-0.14	< 56.55	54.4	< -2.15	> 56.55	56.67	< -0.12	56.03	56.35	**0.32**
Fish																		
F150	**F01**	Alutha Road	F183	32559	52.76	50.66	< 50.66	49.56	< -1.1	49.9	48.97	**-0.93**	50.65	51.2	**0.55**	< 50.66	49.99	< -0.67
F140	**F02**	Settlement Road u/s	F150	32000	42.1	40	< 40.00	41.55	> 1.55	< 40.00	41.25	> 1.25	43	42.44	**-0.56**	42.55	41.75	**-0.8**
F130	**F03**	Settlement Road d/s	F108	31557	41.07	38.97	< 38.97	38.59	< -0.38	< 38.97	38.25	< -0.72	39.75	39.59	-0.16	39.27	38.83	**-0.44**
F120	**F04**	Glenella Street u/s	F55	30845	37.86	35.76	< 35.76	36.2	> 0.44	< 35.76	35.98	> 0.22	36.72	36.7	-0.02	35.86	36.36	**0.5**
F110	**F05**	Glenella Street d/s	F48	30770	36.84	34.74	34.97	35.8	**0.83**	35.18	35.76	**0.58**	36.69	35.91	**-0.78**	35.59	35.84	0.25
F100	**F06**	Waterworks Road	F10	30071	35.31	33.21	< 33.21	31.78	< -1.43	< 33.21	31.66	< -1.55	32.54	32.26	-0.28	32.17	32.03	-0.14

As shown by the results in the above tables, a reasonable calibration was achieved. The following comments are relevant in relation to the calibration:

- Although for some gauges, the calibration is not within the expected accuracy, calibration at all MHG's (except Bennett Road) is considered acceptable as the difference between calculated and recorded levels varies between positive and negative values – that is, for all gauges other than Bennett Road, the model sometimes over predicts and sometimes under predicts the level. Further variation in flow rate or Manning's value would not improve the calibration.
- Results for the Bennett Road maximum height gauge for all events are above those calculated using the calibrated model. Further investigation was conducted to determine the reason for the difference. An examination of a structure, located directly upstream of the gauge, indicated that less than 40 mm of the difference in water level could be attributed to differences in the modelled structure and the actual structure. The remainder of the difference can be explained by the limitations of the MHGs in capturing the accurate level of water surface due to different site specific anomalies.
- Calibration of the model against the recorded stream gauge data obtained from the gauge located at Bancroft Park demonstrated to be within the acceptable range for 1989, 1996 and 2013 events, but 2009 event raised some concerns. The potential reason for the discrepancy in 2009 event could be some site specific reasons (e.g. blockage, changes in bed profile, dense vegetation etc.) or the gauge might have been over-estimating. Note, according to the maintenance records, this gauge had been replaced after 1996 storm event.
- Calibration of the model against the recorded stream gauge data obtained from the gauge located at Jason Street demonstrated to be within the acceptable range in terms of peak height prediction, timing of the peak and hydrograph shape for all events except for the 2013 event. Verification with 1996 event also raised concern about the peak flow prediction. The potential reason behind these discrepancies could be mal-functioning gauge or more works need to be done to the hydrologic analysis.
- Areas located downstream of Kelvin Grove Road were not calibrated well against both 1989 and 1996 calibration events (Pre Infrastructure Projects), but well calibrated against May 2009 and January 2013 events. The possible reason could be the inflow data obtained from the hydrologic models which were jointly calibrated against the hydraulic model developed with different topographical setup (cross section – Pre 2002), and the current hydraulic model is developed with more detailed and up to date topographical data (2002 and 2009 ALS data). Given that a good calibration was achieved for both the May 2009 and January 2013 calibration events, the calibrations for other events should be considered acceptable.

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Breakfast Creek
Flood Study

Report B Design and Extreme
Event Modelling

REPORT B – DESIGN AND EXTREME EVENT MODELLING

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1 INTRODUCTION

The calibrated hydrologic and hydraulic models discussed in the Breakfast Creek Calibration Report were used to determine design flood levels, discharges and velocities for Breakfast Creek, Enoggera Creek, Fish Creek and Ithaca Creek. This Design Event Report follows on from the Breakfast and Enoggera Calibration report and presents the methodology and results of the design event analysis. .

Results were determined for design storm events for the 1, 2, 5, 10, 20, 50, 100, 200, 500, 2000 year ARI and PMF events. The 100, 200 and 500 year ARI events were further analysed to assess the impacts from climate change scenarios at the year 2050 and 2100.

2 MODEL DATA

2.1 Design Rainfall

The calibrated hydrologic and hydraulic models were used to analyse the following design flood events for the Enoggera-Fish-Ithaca-Breakfast Creek catchment:

- 1 year ARI
- 2 year ARI
- 5 year ARI
- 10 year ARI
- 20 year ARI
- 50 year ARI
- 100 year ARI
- 200 year ARI
- 500 year ARI
- 2000 year ARI
- Probable Maximum Flood (PMF)

In order to derive design storm events (1 to 100 year ARI design flood events) for the Breakfast/Enoggera Creek catchment, the duration independent synthetic event was employed. This method of analysis was developed by Morris (1996) and involves the use of a single temporal pattern for all durations. The duration independent storms (DIS) are constructed for a given recurrence interval using the intensity-frequency-duration curve for the relevant area. The synthetic event contains the maximum likely rainfall for any given storm duration (up to 24 hours). Generally, it is necessary to apply a reduction factor to the DIS rainfall. This is required in order to create synthetic design event temporal patterns that produce design runoff which is appropriate for the catchment in compliance with the historical records.

For further information on the duration independent synthetic event, including the method of construction of the temporal pattern, refer to **Appendix B**.

For the 200 and 500 year ARI events, the rainfall intensities were determined in accordance with the CRC-FORGE methodology. The 2000 year ARI and PMF events have been modelled using a log-log interpolation of rainfall depths (as recommended by AR&R) and a single temporal pattern for all of Brisbane. Section 3.3 contains further details about the methodologies adopted to analyse the selected extreme events.

2.2 Tailwater Conditions

Several constant downstream tidal boundary conditions were adopted for the design event modelling considered in this report. Tidal tables indicate that the Mean High Water Springs (MHWS) level at the mouth of Breakfast Creek is 1.05 mAHD. This level was adopted as the boundary condition for design event analysis of Breakfast and Enoggera Creek with the exception of climate change scenarios and extreme events. **Table 2.1** reports the adopted tailwater conditions for the different design cases.

Table 2.1 Adopted Tailwater Conditions

Design Event Case	Tailwater Source	Tailwater Level (mAHD)
1 year ARI - 500 year ARI	MHWS	1.05
Climate Change Scenario Year 2050	MHWS + 0.3m	1.35
Climate Change Scenario Year 2100	MHWS + 0.8m	1.85
2000 year ARI	HAT	1.65
PMF	HAT	1.65

2.3 Topographic Data and Hydraulic Structures

The calibrated and verified hydraulic model was used to analyse the design case conditions. Changes made to that model were limited to the inclusion of the appropriate design case hydrology.

As discussed in the Calibration Report, land and hydrographic survey was conducted of Breakfast and Enoggera Creek and this information was used in developing the TUFLOW hydraulic model used for the study.

The details of the hydraulic structures located within the catchment have been sourced from:

a. Field Survey Books,

b. As Constructed Design Drawings, and

c. Airport Link hydraulic model.

All new crossings and other infrastructure associated with the CLEM7, Northern Busway and Airport Link projects together with the underlying topographical and roughness information were incorporated in the model with the data obtained from the hydraulic model developed as part of the Airport Link project.

3 HYDROLOGIC MODEL

3.1 Design Event Model Setup

Design event modelling assumes ultimate development conditions within the catchment. Therefore, the WBNM calibration model was modified to reflect these conditions. Changes to the extent and degree of development within a catchment are quantified using the percentage of impervious surface area associated with each sub-catchment. Ultimate development conditions were determined based on land use planning and zoning maps for the study area.

Appendix C lists the adopted percentage imperviousness for each sub catchment.

3.2 Design Rainfall Factor Assessment

3.2.1 Overview

As outlined previously, when using the DIS methodology it is generally necessary to determine the factor that is needed to ensure the design runoff matches historic records within a catchment. A lengthy procedure was employed to determine the factors for design rainfall within the Breakfast and Enoggera Creek catchments. The methodology is discussed in further detail in the following sections of this report and is summarised as follows:

- A flood frequency analysis for discharges from Enoggera Dam based on historic rainfall for a period of 86 years was conducted. These discharges were determined using the current spillway configuration established in 1976.
- The assessment of appropriate rainfall factors for the DIS storms applied upstream of the Enoggera Dam to achieve a match between the design discharge at the dam spillway and those calculated from the flood frequency analysis.
- Calculation of appropriate rainfall factors for the DIS storms applied downstream of the Enoggera Dam in order to achieve a match between the DIS design discharge and the previous estimates of design discharge. This comparison was conducted at Bancroft Park and Bowen Bridge Road.
- The adoption of rainfall factors and design discharges for the DIS storm event throughout the model.

3.2.2 Flood Frequency Analysis – Enoggera Dam

In order to determine peak discharges for the design events from the catchment upstream of Enoggera Dam a flood frequency analysis based on Weibull plotting positions was carried out using flows derived from historic rainfall records. From this analysis estimates were made of the expected discharges for each design event which were then used as the basis to determine the appropriate DIS factor for sub-catchments upstream of Enoggera Dam.

The stage-discharge relationship for Enoggera Dam was modified in 1976 following an upgrade of the Dam. The flood frequency analysis presented here was based on the current spillway configuration as shown in **Figure 3.1**.

Historic rainfall data was available for a period of 86 years from 1911 to 1996. This rainfall was recorded at the Bureau of Meteorology station in the Brisbane CBD. The worst 3 hour rainfall burst was extracted from each year of record and was applied to the WBNM model in order to determine the discharge from Enoggera Dam for that rainfall event. The discharge from the dam was extracted for each year giving an annual series on which the flood frequency analysis was carried out. **Table 3.1** reports the design discharges at Enoggera Dam based on the flood frequency analysis and the peak discharges based on the duration independent storms. It is clear from this table that the comparison between the flood frequency analysis and design case discharges is close. This comparison can be seen graphically on **Figure 3.2**.

Table 3.1 Enoggera Dam Flood Frequency Results

Design Event ARI	Flood Frequency Analysis Peak Discharge (m^3/s)	DIS Peak Discharge (m^3/s)
100 year	119	103
50 year	106	99
20 year	88	87
10 year	75	75
5 year	61	69
2 year	43	58

Prior use of the DIS methodology has determined that in order to match a flood frequency analysis based on flows generated by historical rainfall, generally, a factor of 1 is applied to the 100 year event and factors less than 1 are applied to design events with an average recurrence interval less than 100 years. Contrary to this norm, for Enoggera Creek the best calibration of DIS storms against historic discharges was achieved using a factor of 1 for all ARI events. The best explanation for this finding is as follows.

In DIS methodology, the temporal pattern concentrates a substantial volume of rainfall into a short duration. It is this feature which normally requires the introduction of a factor to attenuate the peak to a more reasonable value. However, in the case of Enoggera Dam, peak flows from the upstream catchments are attenuated quite significantly by the dam which is evident when comparisons are made between the dam inflow and outflow hydrographs (refer **Figure 3.3**). Therefore, to achieve a satisfactory match to flows derived from the FFA it was not necessary to reduce the design flows derived through application of the DIS rainfall pattern for the catchments upstream of the dam and a factor of 1 was used for all design events.

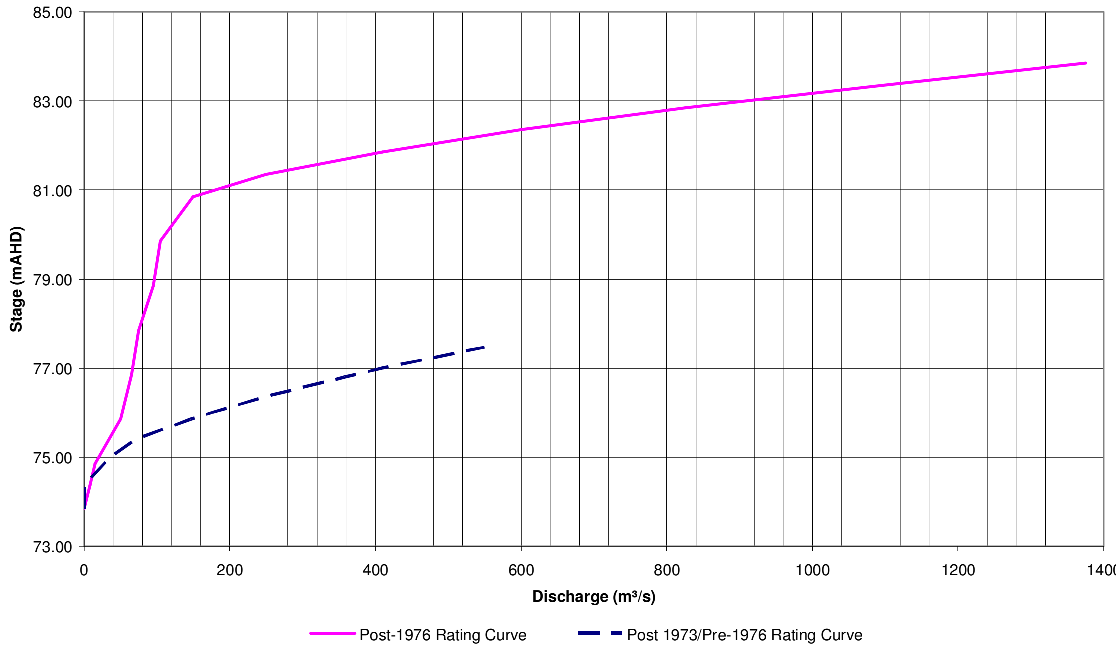

Figure 3.1 Enoggera Dam Current Spillway Rating Curve

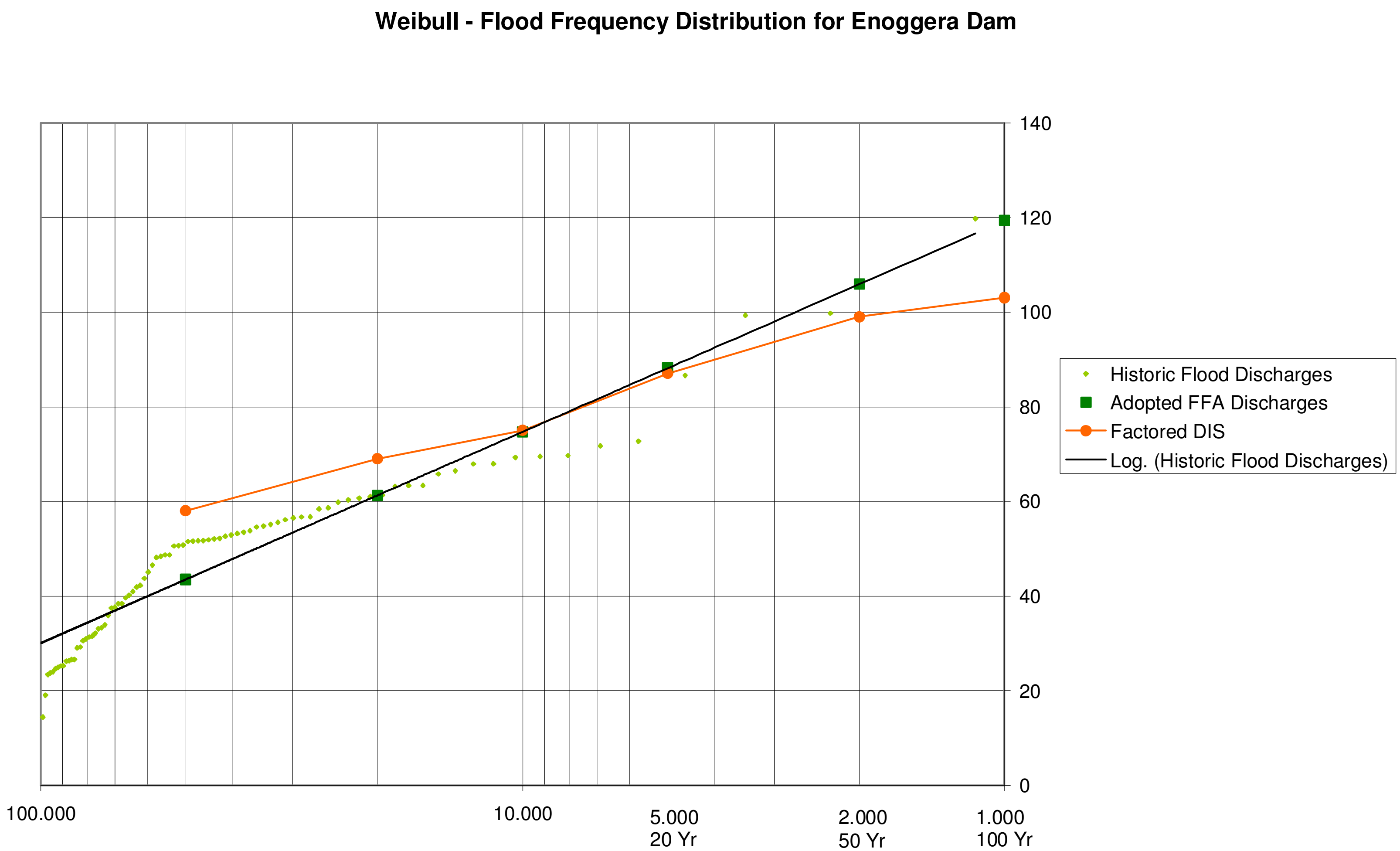

Figure 3.2 Enoggera Dam Flood Frequency Analysis and Duration Independent Storm Results

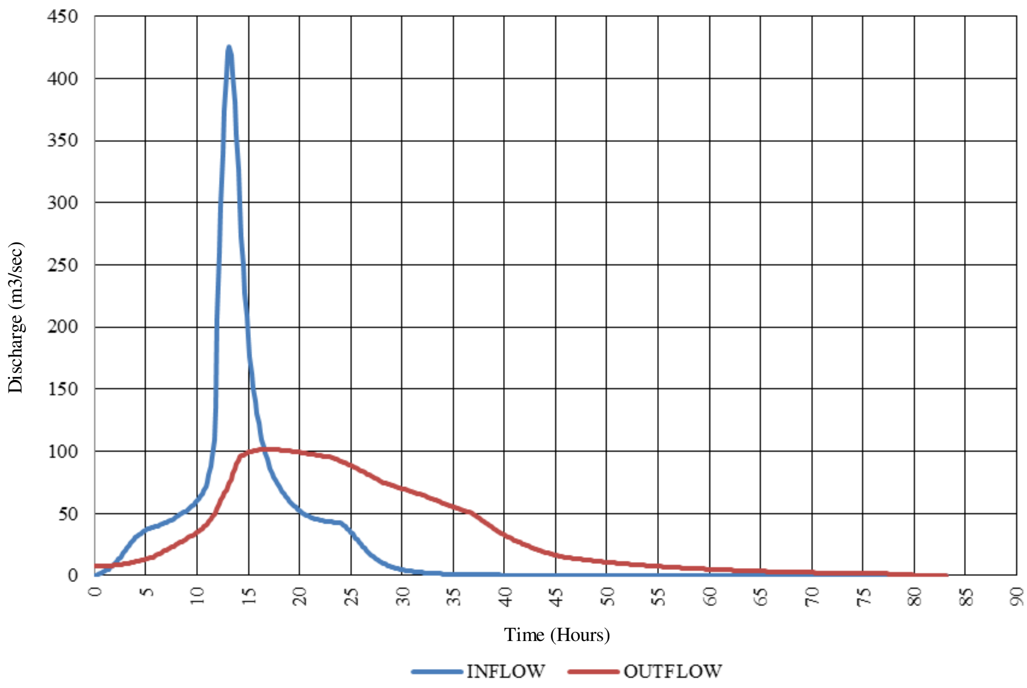

Figure 3.3 Enoggera Dam Inflow Outflow Comparisons

3.2.3 Previous Estimates of Design Flows

Design flows for the remainder of the system downstream of the Enoggera Dam were based on flows from the GHD, WBM and Water Studies report *"Maintenance Dredging of Breakfast Creek - Supplementary Impact Assessment Report"* (1995), at two key locations. The assessment points selected were located towards the downstream end of Breakfast Creek at Bancroft Park and Bowen Bridge Road. The analysis conducted at the time of the 1995 study was rigorous and the results and outcomes presented are considered to be accurate for the current conditions within the floodplain. Therefore, rather than reproducing these flows through a full analysis it was decided to match the model to the flows previously calculated.

These flows are documented in **Table 3.2** and were adopted in order to provide a level of consistency with previous studies. The 2 year ARI event was not assessed in the 1995 study therefore a flow for this event was not available.

Table 3.2 GHD, WBM & Water Studies Dredging Study (1995) Design Flows

ARI (yr)	Peak Flow Rate (m^3/s)	
	Bancroft Park	**Bowen Bridge Road**
100	580	509
50	494	431
20	421	367
10	368	321
5	314	274
2	-	-
1	-	-

Initially, the duration independent synthetic event was analysed in the WBNM model using a factor of 1, and flows were extracted and applied to the MIKE11 model. It was found from this analysis that at all locations downstream of the Enoggera Dam spillway, the flow produced by the synthetic event was higher than the flow documented in the 1995 dredging study. The duration independent synthetic event was then factored until the dredging study flows were matched at the assessment locations. Note the TUFLOW model adopted the same inflow values from the MIKE11 analysis which were verified and adjusted during the previous study with MIKE11.

3.2.4 Design Rainfall Factors

The factors adopted for each average recurrence interval and the resultant peak flow rates are listed in **Table 3.3**. As shown by a comparison of the results in **Tables 3.2 and 3.3**, a good agreement was obtained between the synthetic event flows and the 1995 dredging study flows at Bancroft Park and Bowen Bridge Road. As noted previously, the 2 and 1 year ARI flow were not determined in the 1995 dredging study but were required for this current flood study. Given that the DIS Factor adopted for both the 10 year and 5 year event was 0.91, this same factor was applied to the 2 year ARI and 1 year ARI synthetic rainfall to calculate the design flows.

Flows from the Enoggera Dam were assessed based on a flood frequency analysis of flows produced from historic rainfall (refer to Section 3.2.2 for further information). This analysis indicated that the closest match of flows was achieved by adopting a factor of 1 for the synthetic rainfall for all catchments upstream of the Enoggera Dam.

Table 3.3 Design Event Flows and DIS Factors

ARI (yr)	DIS Factor*	Peak Flow Rate (m^3/s)		
		Enoggera Dam	**Bancroft Park**	**Bowen Bridge Road**
100	0.92	103	581	510
50	0.87	99	490	439
20	0.87	87	402	367
10	0.91	75	355	327
5	0.91	69	209	281
2	0.91	58	231	212
1	0.91	58	231	212

* This DIS Factor applied only to sub-catchments downstream of Enoggera Dam. A DIS Factor of 1 was applied to sub-catchments upstream of Enoggera Dam.

3.3 Extreme Event Hydrology

3.3.1 General

This section details the derivation of the design flood hydrology for the following extreme events:

- 200 year and 500 year ARI events
- 2000 year ARI event, and
- Probable Maximum Precipitation (PMP)

3.3.2 200 year and 500 year ARI Events

The IFD rainfall data for the 200 year and 500 year ARI events was obtained using the CRC Forge method. During this process it was found that the 200 year ARI CRC-Forge rainfall intensities were lower than the 100 year ARI AR&R rainfall intensities. Therefore, adjustments were made to the 200 year ARI rainfall intensity as follows:

200 yearr ARI intensity (I) = $(500\text{-yr } I_{\text{CRC-Forge}} - 100\text{-yr } I_{\text{AR\&R}}) \times \{(200\text{-yr } I_{\text{CRC-Forge}} - 100\text{-yr } I_{\text{CRC-Forge}}) / (500\text{-yr } I_{\text{CRC-Forge}} - 100\text{-yr } I_{\text{CRC-Forge}})\} + 100\text{-yr } I_{\text{AR\&R}}$

Table 3.4 indicates the adopted 200 year and 500 year ARI design rainfall intensities with comparison to the adopted 100 year ARI.

Table 3.4 Adopted IFD (200 year and 500 year ARI)

Duration (hr)	Rainfall Intensity (mm/hr)		
	100 year ARI	**200 year ARI**	**500 year ARI**
0.5	159	169	183
1	113	119	127
1.5	86	103.5	111
2	71	88	95
3	53	57	63
4.5	40.4	46.5	51.5
6	33.1	36	40

The AR&R 100 year ARI design temporal pattern was adopted for both these events.

3.3.3 2000 year ARI Event

The 2000 year ARI rainfall IFD was determined using the CRC-Forge method. To avoid the need to simulate all of the different storm durations, a simplified super-storm method was used. This same methodology has also been used on other BCC flood studies currently being undertaken.

The rationale for adopting this approach is that world-wide research indicates that as storm rainfall depths increase during short duration storms, the rainfall intensity becomes more uniform. For this reason, the multi-peaked AR&R temporal pattern (as used for the 200 year and 500 year ARI) was not considered suitable for the analysis of this more extreme event.

A 6-hour super-storm was developed to represent all storm durations up to 6 hours. The super-storm was developed in 30 minute blocks and incorporates the 30 minute, 1 hour, 1.5 hours, 2 hours, and 3 hours storm bursts. Durations less than 30 minutes were not considered. The total rainfall depth of the super-storm was set equal to the 6 hour 2000 year ARI CRC Forge rainfall depth, which was determined as 340 mm.

3.3.4 PMP

For the PMP scenario, the 6 hour super-storm approach was also undertaken using the same temporal pattern as the 2000 year ARI.

The total PMP depth was derived from the 6 hour storm duration using the Generalised Short Duration Method (GSDM). For the tropical and sub-tropical coastal areas it is recommended that this method is to be used to estimate the PMP over areas up to 520 km2 and for durations up to 6 hours. To apply a consistent methodology across the majority of BCC an average catchment size of 60 km2 and moisture adjustment factor of 0.85 were adopted.

The total rainfall depth of the super-storm was set equal to the 6 hour GSDM PMP rainfall depth, which was determined as 816 mm.

Table 3.5 indicates the adopted super-storm temporal pattern and hyetographs for the 2000 year ARI and the PMP.

Table 3.5 Adopted Super-storm Hyetographs

Time (hr)	Rainfall (%)	Rainfall (mm)	
		2000 year	PMP
0.00	0	0.00	0.00
0.17	1	4.33	9.92
0.33	3	4.33	9.92
0.50	4	4.33	9.92
0.67	5	4.33	9.92
0.83	6	4.33	9.92
1.00	8	4.33	9.92
1.17	9	4.33	13.46
1.33	10	4.33	13.46
1.50	11	4.33	13.46
1.67	14	7.58	18.42
1.83	16	7.58	18.42
2.00	18	7.58	18.42
2.17	20	7.58	27.63
2.33	23	7.58	27.63
2.50	25	7.58	27.63
2.67	30	16.00	38.25
2.83	34	16.00	38.25
3.00	46	41.00	75.08
3.17	58	41.00	75.08
3.33	70	41.00	75.08
3.50	75	16.00	38.25
3.67	77	7.58	27.63
3.83	80	7.58	27.63
4.00	82	7.58	27.63
4.17	84	7.58	18.42
4.33	86	7.58	18.42
4.50	89	7.58	18.42
4.67	90	4.33	13.46
4.83	91	4.33	13.46
5.00	92	4.33	13.46
5.17	94	4.33	9.92
5.33	95	4.33	9.92
5.50	96	4.33	9.92
5.67	97	4.33	9.92
5.83	99	4.33	9.92
6.00	100	4.33	9.92

4 HYDRAULIC MODELLING

4.1 Design Event Model Setup

4.1.1 Overview

The calibrated and verified TUFLOW model was used to simulate the standard Design rainfall Events, Large and Extreme Events and Climate Change scenarios with relevant boundary conditions. Additionally, model data were altered to:

- Limit the effective flow widths to the Waterway Corridor (WC) limits, and
- Represent minimum (vegetated) riparian corridor widths.

All inflow locations are identical to those in the calibrated model. For analysis with the Large and Extreme Events, additional linkage between the upper and lower domain has been incorporated.

4.1.2 Modelling Ultimate Waterway Conditions

4.1.2.1 Waterway Corridors

Waterway Corridors (WC) are an integral part of the Council's Planning Scheme for Brisbane. City Plan describes Waterway Corridors as:

"The corridors along a waterway indicated on the planning scheme maps. These corridors are defined by:

- A flood regulation line (FRL)
- A local plan environmental corridor or waterway corridor
- A waterway corridor defined in a stormwater management plan
- A waterway corridor defined in a waterway management plan

If more than one of these measures is available for a particular waterway, the largest applies.

If there is no FRL, local plan, SMP or WMP a 30 m distance measured on each side from the centreline of the waterway."

These corridors identify zones where the water flow, water quality, ecology and open space, and recreation and amenity values are to be preserved and/or managed in an ecologically sustainable manner.

4.1.2.2 Proposed Waterway Corridors

The FRLs and WCs have been identified within the Breakfast Creek catchment. With the exception of Ithaca Creek, the FRLs and WCs are the same across the creek network. For the purposes of this flood study, the WC was selected as the ultimate development control for Ithaca Creek within the model. In Breakfast Creek catchment, due to the recent major infrastructure works carried out as part of the CLEM7, Airport Link and Northern Busway projects, a significant portion of the land outside the current FRL/WC has been nominated as a flood mitigation zone. Moreover, a significant number of private properties have been moved into public ownership adjacent to the project area for project purposes. In addition, within the reaches from Kelvin Grove Road to Bowen Bridge Road, a significant number of open spaces area are located outside the current FRL/WC and also in other reaches of the entire network. Hence, for the purpose of this study the current FRL/WC has been altered to incorporate the majority of public lands adjacent the creek (excluding public facilities such as Emergency Services Establishments, Energex Substations, Hospitals and Schools), constructed flood mitigation zones and other areas subject of re-profiling as shown in the attached **Figure 4.1** and **Figure 4.2.**

It should be noted that the FRL/WC model scenario is conservative in that it assumes that all areas outside of the WC are developed. This is not likely to occur in all cases. For example, the 100 year ARI flood inundation area extends approximately 500 metres into the Windsor area (just upstream of Bowen Bridge Road). It is unlikely that all of the allotments in this area will be filled to a level above the 100 year ARI flood level. However the latest modelling has reflected the location of a proposed FRL/WC which still excludes a significant number of storage areas within this reach.

Figure 4.1 Proposed and Modelled Adjustment of the FRL/WC within the APL Zone

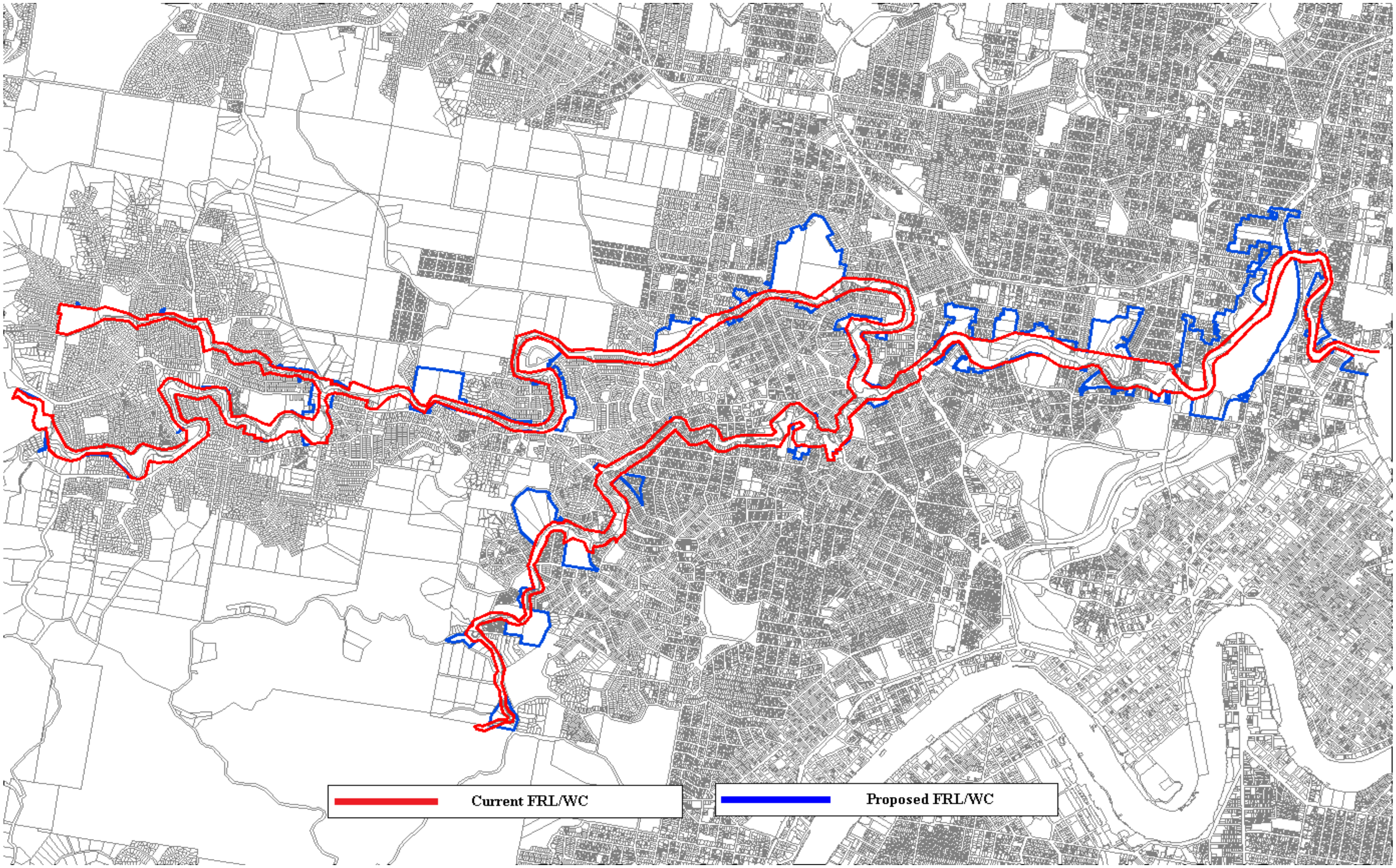

Figure 4.2 Proposed and Modelled Adjustment of the FRL/WC

4.1.2.3 Filling Beyond Waterway Corridor

Usually, the presence of a WC is incorporated in the TUFLOW model by superimposing the Corridor extents over the model topography and incorporating a vertical wall (walling off) to exclude the conveyance and storage characteristics of the watercourse beyond the limits of the WC. Essentially this practice assumes that filling and development will ultimately occur beyond the boundary of the WC, as shown in **Figure 4.3**.

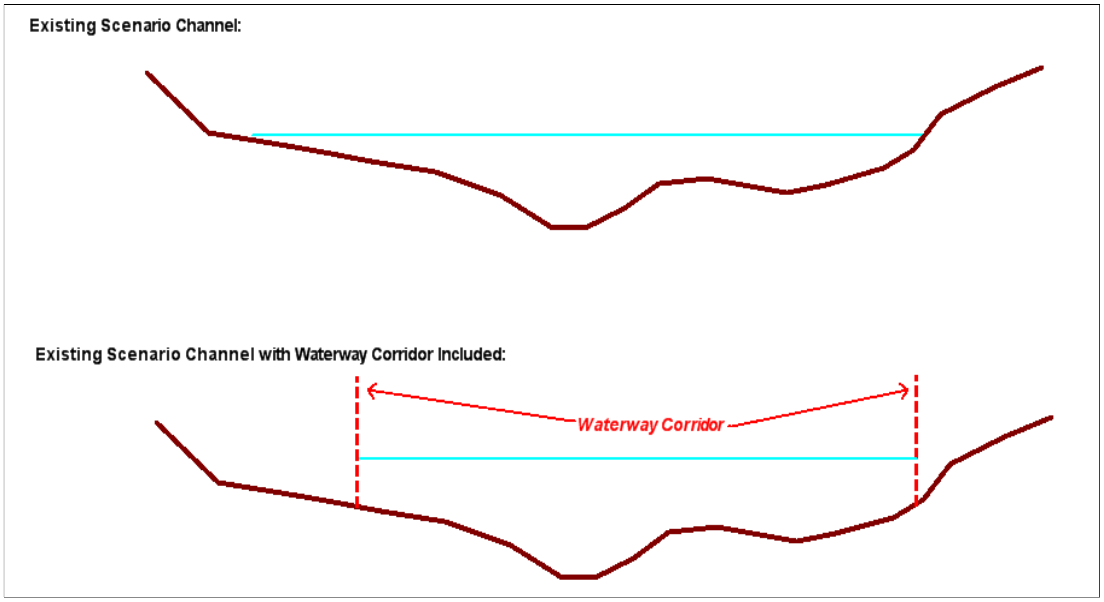

Figure 4.3 Implementation of Waterway Corridor using 'Walling Off' Method

This methodology has proved satisfactory when simulating 1 to 100 year ARI design flood events. However, when simulating larger flows such as 200 and 500 year ARI design events, prior experience has shown that the Waterway Corridor 'walls' resulted in conservatively high water levels and stability issues in some hydraulic modelling software packages.

For this flood study, the following alternative method for simulating the Waterway Corridor was adopted:

1. Implement Waterway Corridor using the 'walling off' methodology and include Minimum Riparian Corridor assumptions.

2. Simulate the 100 year ARI Duration Independent Storm flood event.

3. Take the resulting Ultimate Case 100 year ARI Duration Independent Storm flood levels and add 300mm development freeboard.

4. In areas outside the Waterway Corridor raise the terrain model to this height until the natural surface level is intersected, as shown in **Figure 4.4**.

This alternative method of simulating Waterway Corridors allows for more accurate and more stable modelling of larger flow events, particular when utilising two-dimensional hydraulic modelling packages.

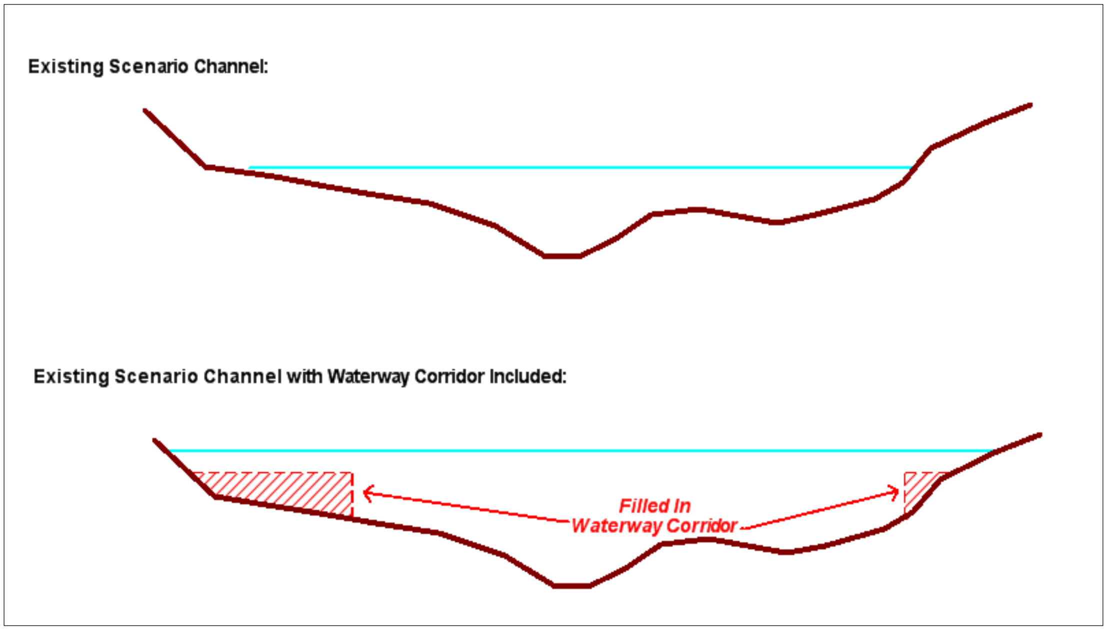

Figure 4.4 Implementation of Waterway Corridor using 'Filling' Method

4.1.2.4 Minimum Riparian Corridor

The vegetation along a waterway is called riparian vegetation. It is a key contributor to waterway health, acting as a buffer between the waterway and adjacent lands. A well-vegetated riparian zone can improve water quality by filtering overland flow and reducing erosion along creek banks. Shady trees protect vulnerable organisms from extremes of temperature; root systems and woody debris become habitat for fauna; and organic matter sustains aquatic food webs. Vegetation also provides habitat and forage for fauna and adds to a waterway's recreational value.

This study calculates anticipated flood levels assuming a minimum vegetated riparian corridor width along the entire creek system where possible. This hydraulic investigation does not in any way imply that Council is planning to establish a minimum riparian vegetated corridor width in the creek catchment. The minimum vegetated riparian corridor is modelled solely in recognition that at some unspecified time in the future, revegetation may occur, either through natural regeneration or as a result of scheduled planting programs. The results of this modelling are intended to ensure that the habitable floor levels of developments within the floodplain take account of possible future revegetation.

Minimum vegetated riparian corridors have been applied to the main channels of all the reaches (where possible) modelled in the hydraulic models. The minimum vegetated riparian corridors were simulated as dense vegetation (i.e. Manning's n value of 0.15) extending from the top of the low flow channel for a minimum width of 15 m on both sides of the creek. Where there is no obvious low flow channel, the vegetation was applied at the anticipated two year Average Recurrence Interval (2 year ARI) flood level on the basis that this size event is generally contained within the bed and banks of the low flow channel. The riparian corridor with a Manning's n value of 0.15 was added to all creek cross-sections in the 1D (ESTRY) part of the model. Where the existing Manning's n value of the cross-section in that region is higher than 0.15, the existing value has not been altered. Within the 2D part, a layer with Manning's n value of 0.15 representing the potential riparian corridor has been added.

4.1.3 Large and Extreme Event Modelling

In order to simulate large and extreme flood events, alterations were required for practicality and model stability. The following sections describe the alterations made to the large and extreme event model.

4.1.3.1 Adjustments to the TUFLOW Model

The modelling of large and extreme flood events involves the simulation of very large flows in the hydraulic model. As these large flows typically result in faster velocities and deeper flooding, it can introduce instabilities and inaccuracies into a detailed hydraulic model.

To reduce the risk of potential instability in large and extreme event simulation, an additional high level link between the two domains (upper and lower) has been incorporated in the model over Enoggera Road near Ashgrove Road bridge where the potential breach of bank might happen during a large event.

In addition, model simulation timesteps have also been adjusted according to the circumstances.

4.1.3.2 Cross-section Extension

Due to 1D-2D setup of the model, no adjustments to the cross sections were required.

4.1.3.3 Alteration of Structures

When modelling very large flows, some hydraulic structures may need to be altered to maintain model accuracy and stability. This can include the addition of weir sections (if previously not used), increased width of weir sections, or removal of structures which do not incur head loss. However, no adjustment to any of the structures was required.

4.1.3.4 Alteration of Floodplain Roughness

When modelling very large flows, roughness of the flood plains changes. To represent the changes, a slightly reduced (by around 15%) roughness values have been adopted at the areas located downstream of Kelvin Grove Road to the confluence with Brisbane River.

4.1.4 Climate Change Sensitivity Analysis

A sensitivity analysis was carried out, examining the impact of the following factors on flood levels along the Enoggera, Fish, Ithaca, Breakfast Creek system:

- Rainfall intensity changes; and
- Sea level rise.

The Department of Environment and Resource Management (DERM) proposed a new State Planning Policy 3/11 effective from 3 February 2012. Among other policies, it outlined a requirement for the allowance of sea-level rise and increase in rainfall intensity as a result from Climate Change.

The SSP 3/11 outlines the following factors to be used by local government to determine planning levels for appropriate planning horizons (2050, 2070 and 2100):

- A sea-level rise factor of 0.8 metres;
- An increase in the maximum cyclone intensity by 10 per cent; and
- Where a relevant storm-tide inundation assessment has not been completed in relation to a proposed development, the coastal hazard area is taken to be all land between high water mark and a minimum default 100-year Design Storm Tide Event level of 1.5 metres above the level of Highest Astronomical Tide for all developments in SEQ.

The Inland Flooding Study (DERM, 2010) outlines the rationale for adopting an interim methodology for assessing flooding risk in Queensland:

1. The proposed methodology is to factor a 5 per cent increase in rainfall intensity at Annual Exceedance Probabilities (AEP) of 1% (100 yr ARI), 0.5% (200 yr ARI) and 0.2% (500 yr ARI) per degree of global temperature increase for all rainfall events recommended in SPP 1/03 for the location and design of new development.
2. The following temperatures and timeframes should be used for the purposes of applying the climate change factor in Recommendation 1:

a) 2°C by 2050

b) 3°C by 2070

c) 4°C by 2100

For this study, the timeframes of 2050 and 2100 were selected for sensitivity modelling based on the methodology outlined above, an appropriate increase in rainfall intensity to use for 2050 is 10% and for 2100 is 20% with coincident tailwater increases of 0.3m and 0.8m respectively. The modelled Climate Change and Sea Level Rise sensitivity events are outlined in **Table 4.1** below:

Table 4.1 Modelled Climate Change and Sea Level Rise Events

Timeframe	Catchment Conditions	Design Event	Rainfall Intensity Increase	Tailwater Boundary
2050	Ultimate Conditions	100 Yr ARI	10% Increase	MHWS + 0.3m
	Ultimate Conditions	200 Yr ARI	10% Increase	MHWS + 0.3m
2100	Ultimate Conditions	100 Yr ARI	20% Increase	MHWS + 0.8m
	Ultimate Conditions	200 Yr ARI	20% Increase	MHWS + 0.8m
	Ultimate Conditions	500 Yr ARI	20% Increase	MHWS + 0.8m

Tabulated results of these modelling events are given in **Appendix E**, and mapping outputs are presented in **Appendix G** of this report.

4.2 Results

4.2.1 Flood Levels and Discharges

The TUFLOW model was run for each storm event to determine the design flood levels and discharges in Breakfast Creek, Enoggera Creek, Ithaca Creek and Fish Creek. Water surface level and flow data extracted at BCC cross section locations are tabulated in **Appendix E** for all design events (100 year ARI event to 1 year ARI event).

Appendix E also contains the predicted flood levels for the 200 year ARI event (ultimate case), 500 year ARI event (ultimate case), 2000 year ARI Event (existing case), PMF event (existing case), 100 year and 200 year ARI event with climate change scenario (year 2050 and 2100) and 500 year ARI event with climate change scenario (year 2100 only).

4.2.2 Flood Mapping

Ultimate scenario planning level surfaces were required to be generated and mapped. Within the flood modelling context, the ultimate scenario involves modifying the flood model topography to represent a fully developed floodplain in accordance with CityPlan and in most instances applying an allowance for a riparian corridor. This process generally results in design flood levels being increased. Council requires these increased levels to then be mapped against the current floodplain topography thus providing a flood extent that is conservative, extends beyond the “existing” flood extent and ‘flags’ the additional properties that could potentially be at flood risk in the future and should have development controls (planning levels) applied.

With the move to ‘two-dimensional’ flood models, the production of flood levels, extents and depth-velocity products is inherent in simulating a model, i.e. a flood map is a direct output from a model simulation removing the requirement to apply a separate process. For the “existing” case simulations, the model is run and the direct output is able to be mapped or referenced in a GIS environment. In order to simulate the “ultimate” scenario, the model topography must be modified to represent filling associated with development. This in turn affects the resulting flood mapping with the flood extent limited to the edge of the filled floodplain. Post processing of the model output is required to represent the modelled flood levels against the current floodplain conditions.

The WaterRide stretching tool was selected for the purpose of processing the “ultimate” case results and producing the planning flood levels and surfaces. The stretching calculation starts at the north easterly corner where it identifies each “dry cell” which is located immediately adjacent to the “wet cells”. It then calculates a water level for the dry cell by interpolating the neighbouring flood levels. If the assigned flood level is higher than the ground level for that cell, then the cell will be identified as wet. If this condition is not met (i.e. water level is less than ground level) then this cell will be identified as dry. This is an iterative process and continues counter clockwise until there is no wet cell left in a single revolution.

From experience to date, it is known that the WaterRide stretching tool alone cannot provide robust surface and level information in all conditions. Therefore, a thorough review of each surface produced by the tool was undertaken and manual intervention applied to the process to ensure suitable outcomes. To help with the initial review process, a comparison of the stretched extent with calculated flood extents including existing scenarios and larger events was undertaken. To modify the stretched surface, break lines were used to limit the expansion of the surface and to stop the “leakage” (upstream higher water level projecting to the downstream lower area) of the surface in problematic areas. Applying break lines at the right place enhances the produced flood levels and surfaces and minimises the anomalies across the flood extent.

In general, the modified areas are mostly observed around tight bends, at structures with high head losses, steep areas where the water can leak, stream junctions where cross-flow is likely, parallel channels, secondary paths and breakout areas. Specific applications and implications of the breaklines for this flood study are outlined in **Table G.1** and shown in **Figure G.1** in **Appendix G**.

Despite the review of the stretched surfaces and the inclusion of break lines to manipulate the stretching process, the process and outputs are still subject to limitations as follows:

- The application of break lines will result in significant steps in the generated surface in some locations
- The application of break lines is highly subjective in some locations
- The application of break lines will not necessarily be consistent across all design events (i.e. they will change in number and location depending on the magnitude of the design event considered)

- The stretching process may not be readily repeatable (i.e. the output has not come directly from a model simulation and if model outputs change, it cannot be guaranteed that the process will not need further refinement to produce acceptable results)

Flood level contour and depth mapping of flood surfaces using the above methodology are contained in **Appendix J**. Mapping is given for Design Events and some selected Large and Extreme Events scenarios. Also **Appendix I** contains the mappings showing scenario with existing waterway conditions with ultimate catchment hydrology.

5 CONCLUSION

This report details the calibration and verification event, design event, extreme event and climate change modelling for the Enoggera, Fish, Ithaca, Breakfast Creek system. Hydraulic models of the creek system have been developed using the TUFLOW modelling software, whilst hydrologic analysis of the catchment were undertaken using the WBNM software package. The WBNM model covers the entire catchment of the Enoggera, Fish, Ithaca, Breakfast Creek system while the TUFLOW model covers the majority of the open channel flow downstream of the Enoggera Dam to the confluence with the Brisbane River (i.e. the entire Enoggera and Breakfast Creeks). The majority of the open channel areas of Fish and Ithaca Creeks are also included in the hydraulic model.

The calibrated WBNM model from the Draft Breakfast/Enoggera Creek Flood Study (2008) was adopted for use without any modification in this study. This model was also used for generating inflows (hydrologic analysis) for historical events of 20th May 2009 and 27th January 2013. Calibration of the TUFLOW model was undertaken utilising three historical storms; namely 24th April 1989, 20th May 2009 and 27th January 2013. Verification of the TUFLOW model was also undertaken utilising one historical storm; namely May 1996.

Hydrometric data for the four historical events was sourced and included the following:

- Rainfall station data;
- Stream gauge data;
- Maximum Height Gauge data; and
- Recorded Debris Height data (January 2013 event only)

During the calibration process the hydraulic parameters were adjusted to achieve a good agreement with the historical data. The hydraulic parameters which were adjusted were generally Manning's 'n' roughness values, the hydraulic structure representation and loss parameters of the hydraulic structures. Cross-checks of the TUFLOW structure head-losses were undertaken at the major bridge structures using the HEC-RAS software, from which is was confirmed that the model was representing the structures adequately.

The hydraulic model was able to adequately replicate the historical calibration results for the April 1989, May 2009 and January 2013 events, including the replication of the rising and falling limbs of the hydrograph(s). Modelled peak levels at the MHG and Stream Gauges were generally within a range of +/- 300 mm to recorded levels.

Utilising the adopted parameters from the calibration process, verification modelling was undertaken. Similar to the calibration results, the verification achieved a good agreement between the simulated and historical records for the May 1996 event. However, the peak flow data at Jason Street gauge did not match the recorded values well. The high spatial variability of the rainfall during this event as well as the limitations of the hydrologic model, as discussed in this report, is a plausible justification for this difference.

Given the results of the calibration and verification process were quite reasonable, the WBNM and TUFLOW models were considered acceptable for use in the estimation of design flood levels.

Design and extreme flood magnitudes were estimated for the full range of events from 1 year ARI to PMF. These analyses assumed ultimate catchment development conditions in accordance with the current version of BCC City Plan.

Three waterway scenarios were considered. Scenario 1 is based on the proposed waterway conditions, as discussed earlier in this report. No further modifications were made to the TUFLOW model developed as part of the calibration / verification phase. Scenario 2 includes an allowance for a riparian corridor along the edge of the channel. Scenario 3 includes an allowance for the riparian corridor (as per Scenario 2) and also assumes filling to the WC boundary to simulate potential development outside the WC.

The TUFLOW modelling results provided peak flood discharges and peak flood levels, which were used to produce peak flood extent, peak flood depth and peak flood depth-velocity mapping.

A climate change analysis was then undertaken to determine the impacts for two planning horizons; namely 2050 and 2100. This included making allowances for increased rainfall intensity and increased mean sea level rise. This analysis was undertaken for the 100yr, 200yr and 500yr ARI events.

Hydraulic Structure Reference Sheets (HSRS) for all major crossings within the TUFLOW model area (except those constructed as part of the CLEM7, Northern Busway Alliance and Airport Link projects) were also prepared. The HSRS provide data for each hydraulic structure and includes data relating to the structure description, location, hydraulic performance and history, where available.

Flood level contour and depth mapping of flood surfaces with ultimate waterway conditions for Design Events (2 year ARI to 100 year ARI) and some selected Large and Extreme Events (200 year AR and 500 year ARI) scenarios have been developed. Flood extent mapping for existing waterway conditions for design events (2 year ARI to 100 year ARI) and some selected Large and Extreme Events (200 year ARI, 500 year ARI and 2000 Year ARI) have also been developed.

6 LIMITATIONS

In utilising the study output it is important to be aware of the limitations which can be summarised as follows:

- The models have been calibrated / verified only at locations where records exist. This should be taken into account when considering the accuracy of results outside the influence of these locations. Also, the highest magnitude event used in the calibration/verification process is similar to the 20 year ARI design event which is much smaller than the design flood event (100 year ARI). Hence the accuracy of the model performances for larger events cannot be guaranteed.

- The calibrated WBNM hydrologic model sourced from the Draft Breakfast/Enoggera Creek Flood Study (2008) was adopted for use without any modification in this study. Detailed checks have not been undertaken on the accuracy of the model input parameters and analysis output and it is assumed that these data are representative and "fit for purpose."

- Topographical cross sectional information utilised within the TUFLOW hydraulic model have been sourced from ground survey conducted in 1998 and no detailed checks have been undertaken on the accuracy of these data, it is assumed that the data is representative of the topography and "fit for purpose."

- BCC 2009 ALS data has been used as the basis for the TUFLOW model topography (other than the data sourced from Airport Link TUFLOW model), with some minor modifications undertaken in places. Detailed checks have not been undertaken on the accuracy of the ALS data, and it is assumed that the data is representative of the topography and "fit for purpose."

- No detailed checks have been carried out to verify the accuracy of the data sourced from Airport Link TUFLOW hydraulic model. It is assumed that the data is representative and "fit for purpose."

- The models prepared for this study are catchment scale and have been developed to simulate the flooding characteristics at a broad scale. As a result, smaller more localised flooding characteristics may not be apparent in the results.

- Future/ongoing changes to the catchment conditions that are not reflected in the modelling may impact the validity of the study.

- The accuracy of the model results is directly linked to the following:

  - The accuracy limits of the data used to develop the model (e.g. ALS, survey information, structure data, etc.).

  - The accuracy and quality of the hydrometric data used to verify the models.

  - The number of historical stream gauge / MHG / Debris Survey Marking locations throughout the catchment.

  - The purpose of the study (i.e. catchment / broad-scale or detailed).

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LIST OF APPENDICES

APPENDIX A: AVAILABLE DATA

This appendix provides details of data available and utilized within the calibration and verification of the hydrologic and hydraulic model. The later section (Figure A.16) also includes the comparison plots of recorded, hydrologic and hydraulic analysis outputs at selected stream gauge locations.

List of Figures

List of Tables

Figure A.1 Typical Rainfall Distribution and Mass Rainfall Curves, January 1974 Event

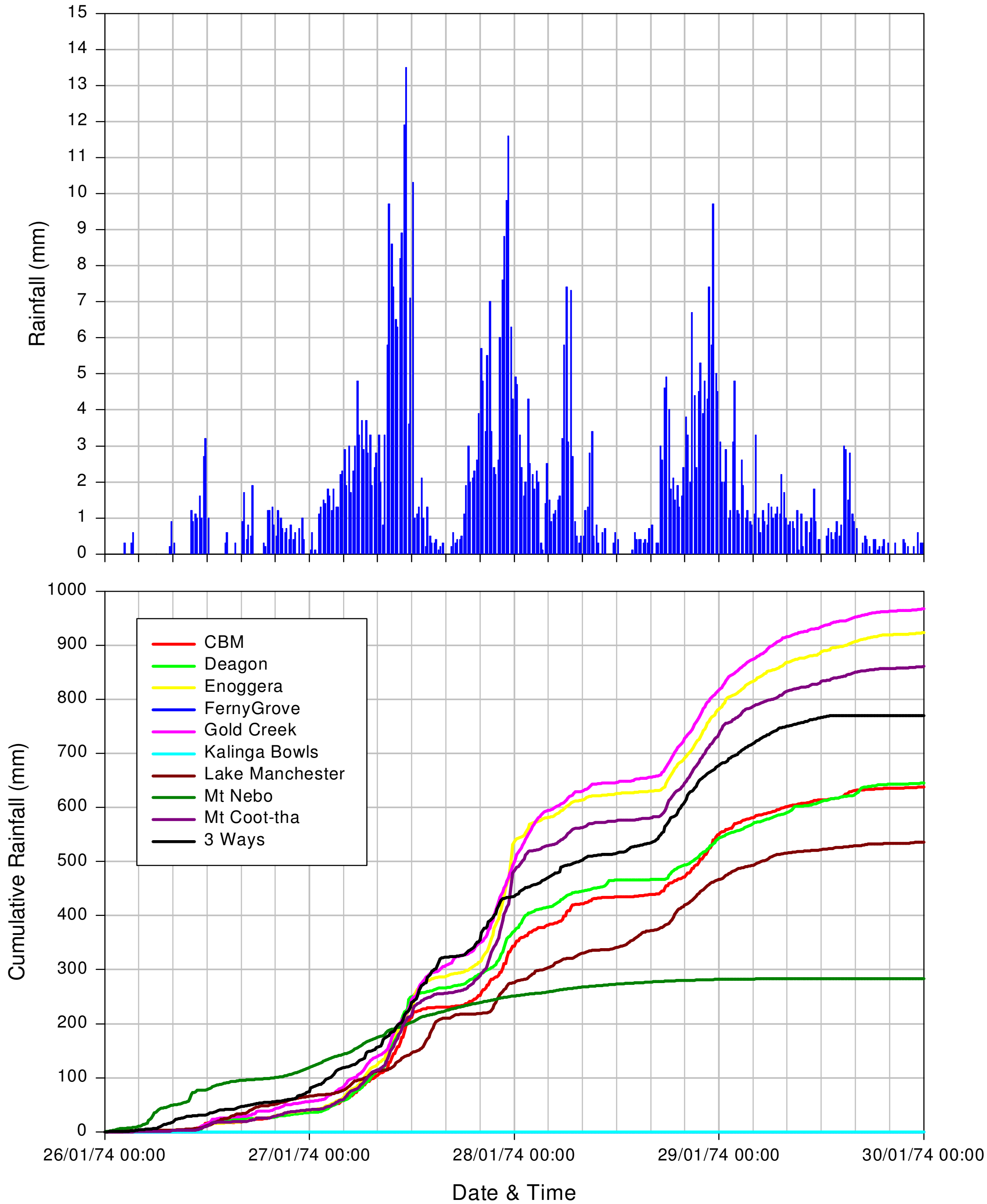


Figure A.2 Typical Rainfall Distribution and Mass Rainfall Curves, April 1989 Event

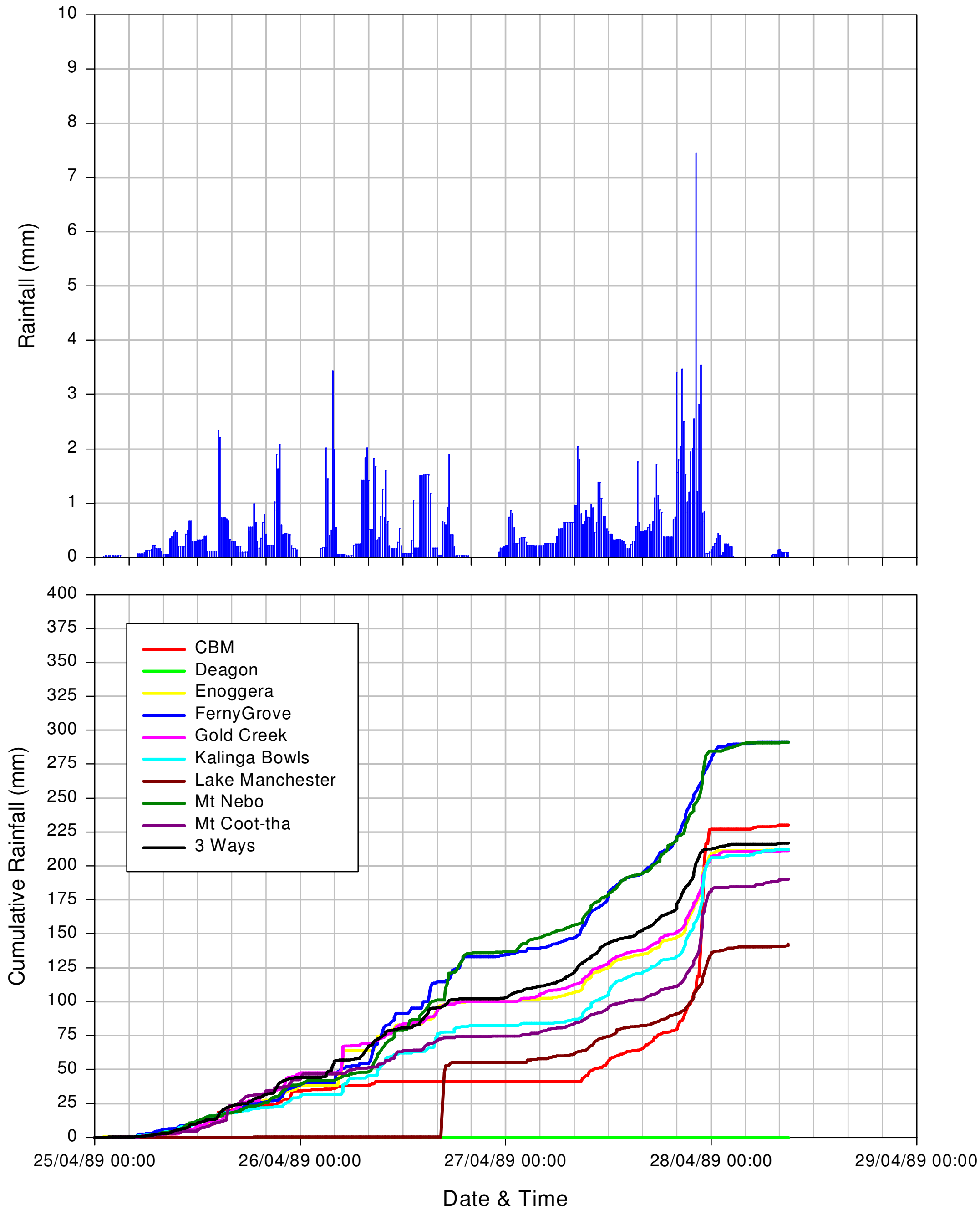


Figure A.3 Typical Rainfall Distribution and Mass Rainfall Curves, May 1996 Event

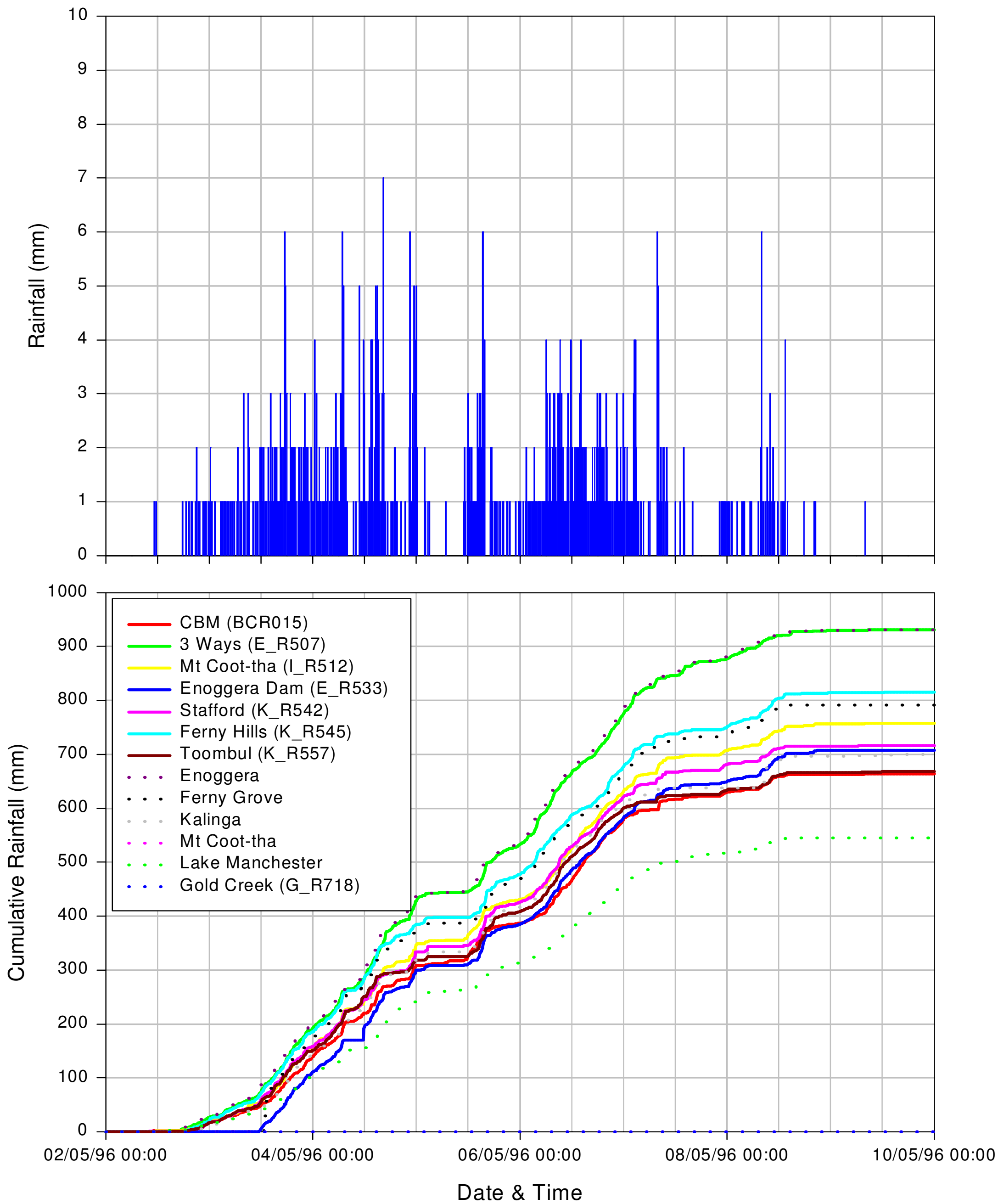
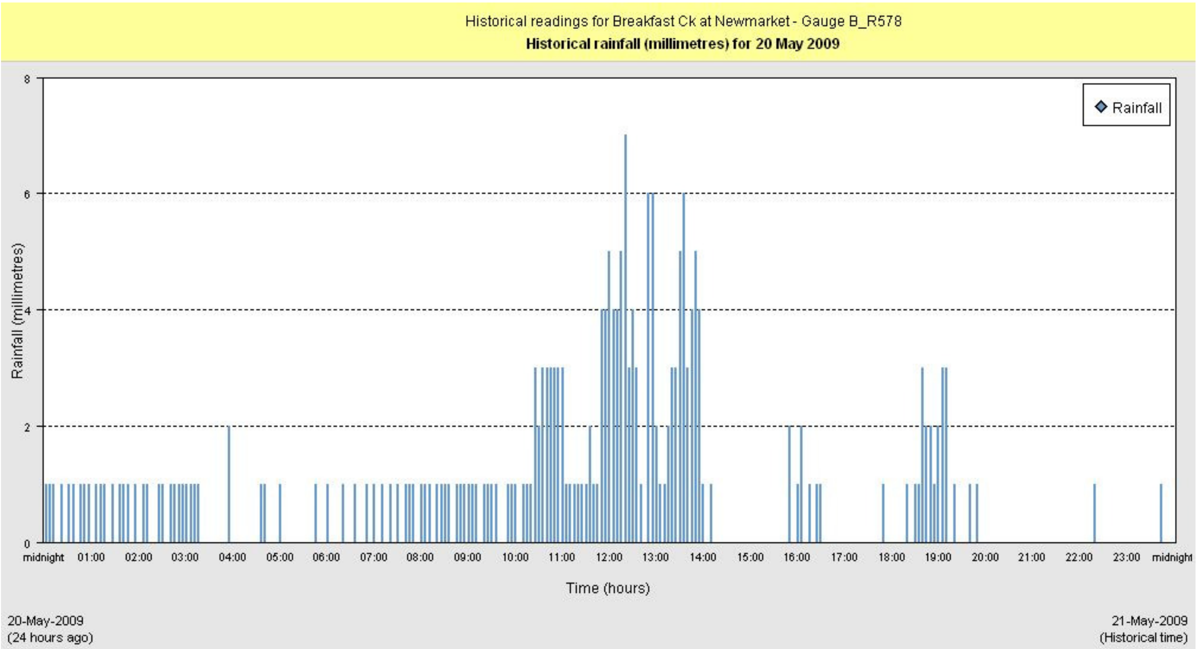
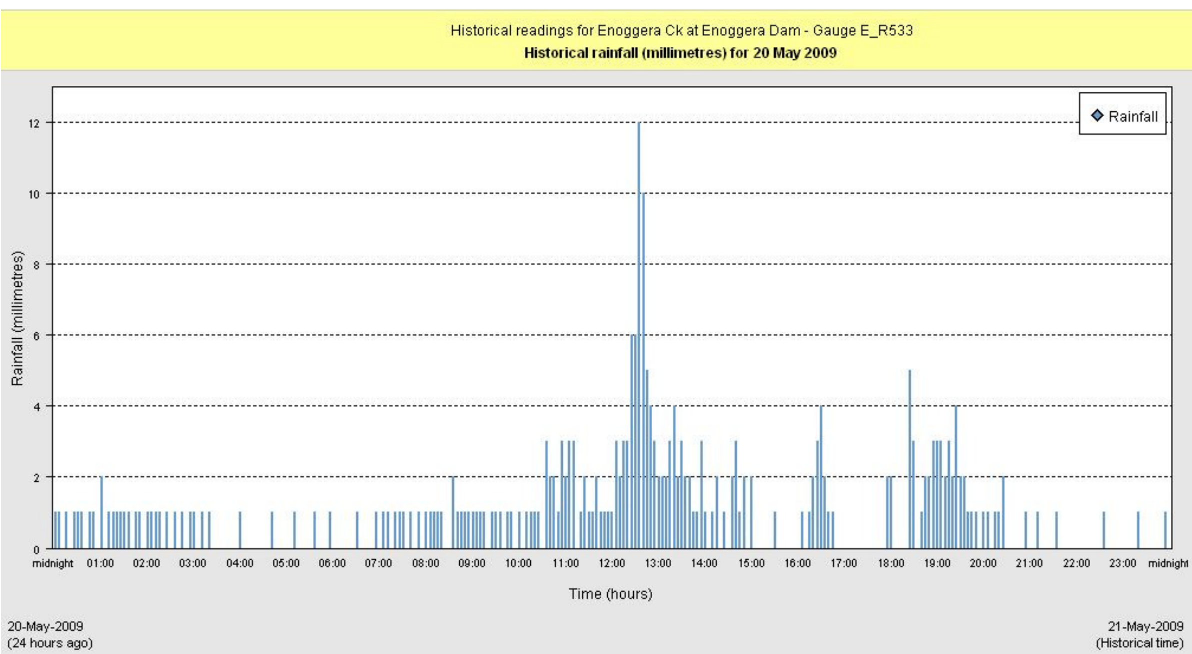


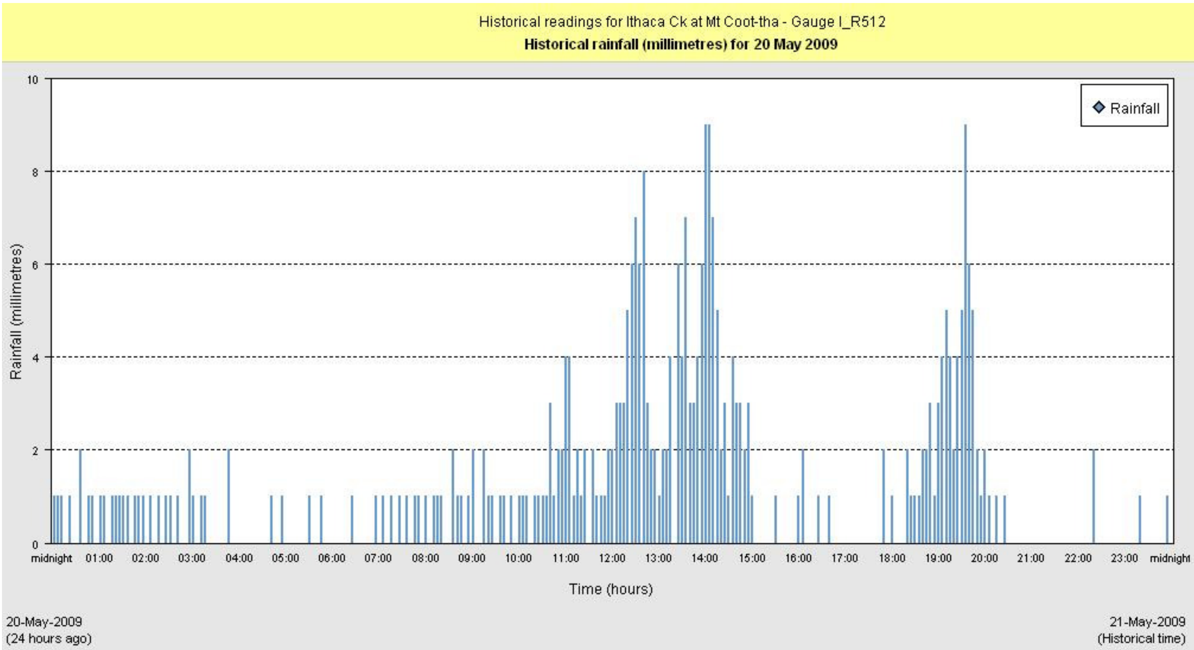
Figure A.4 Typical Rainfall Distribution, May 2009 Event



Breakfast Creek at Newmarket – Rainfall Gauge B_R578

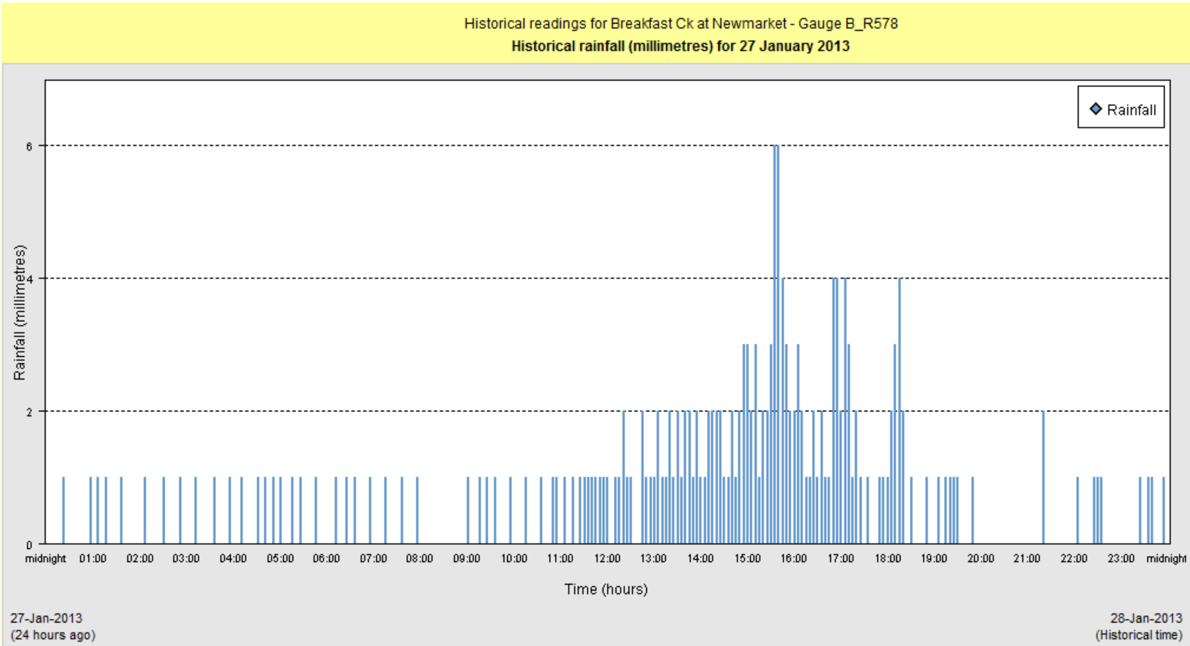


Enoggera Dam – Rainfall Gauge E_R533

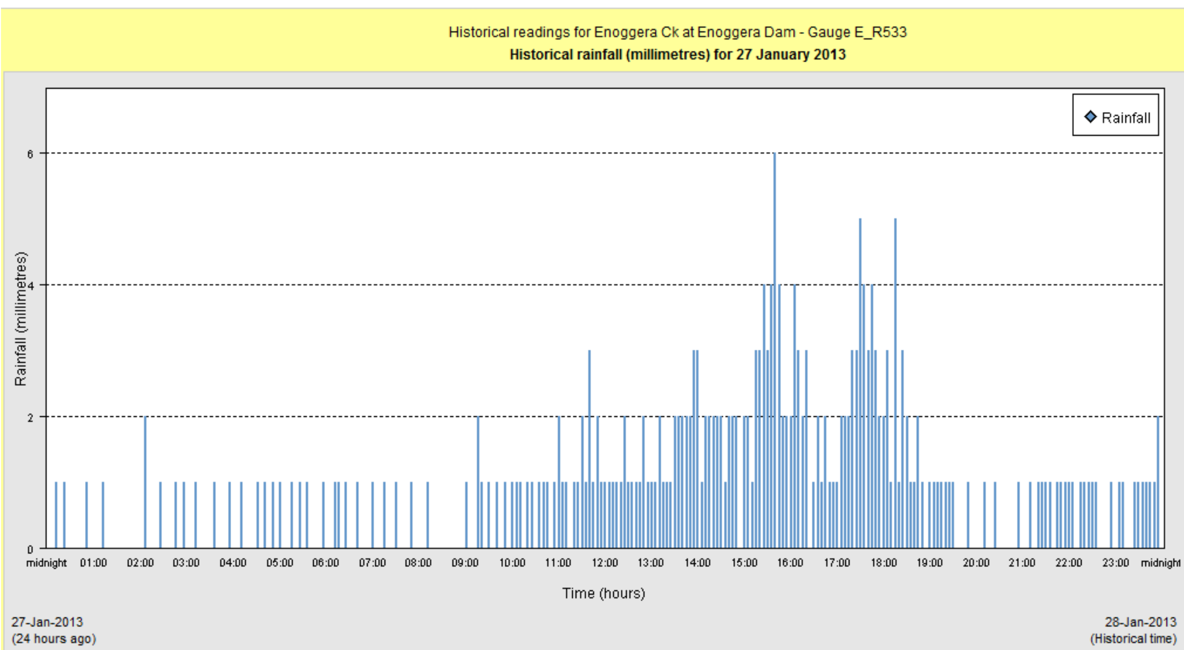


Ithaca Creek at Mt Coot-tha – Rainfall Gauge I_R512

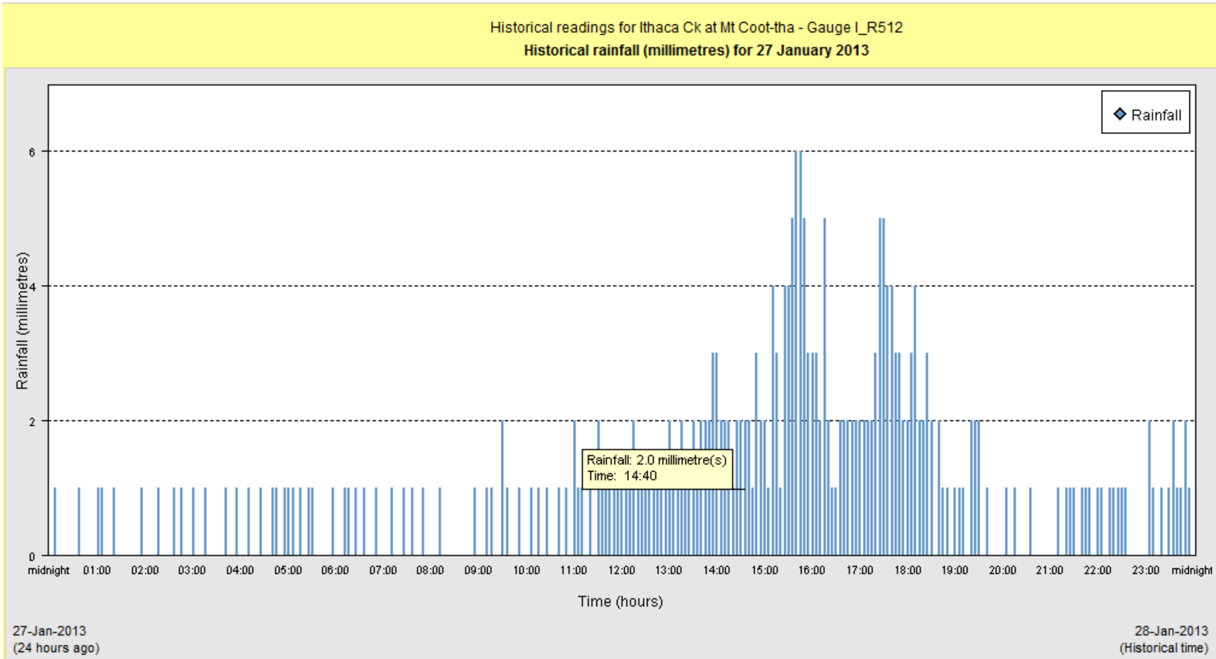
Figure A.5 Typical Rainfall Distribution, January 2013 Event



Breakfast Creek at Newmarket – Rainfall Gauge B_R578



Enoggera Dam – Rainfall Gauge E_R533



Ithaca Creek at Mt Coot-tha – Rainfall Gauge I_R512

Figure A.6 Intensity-Frequency-Duration Curves, Enoggera Dam January 1974 Event

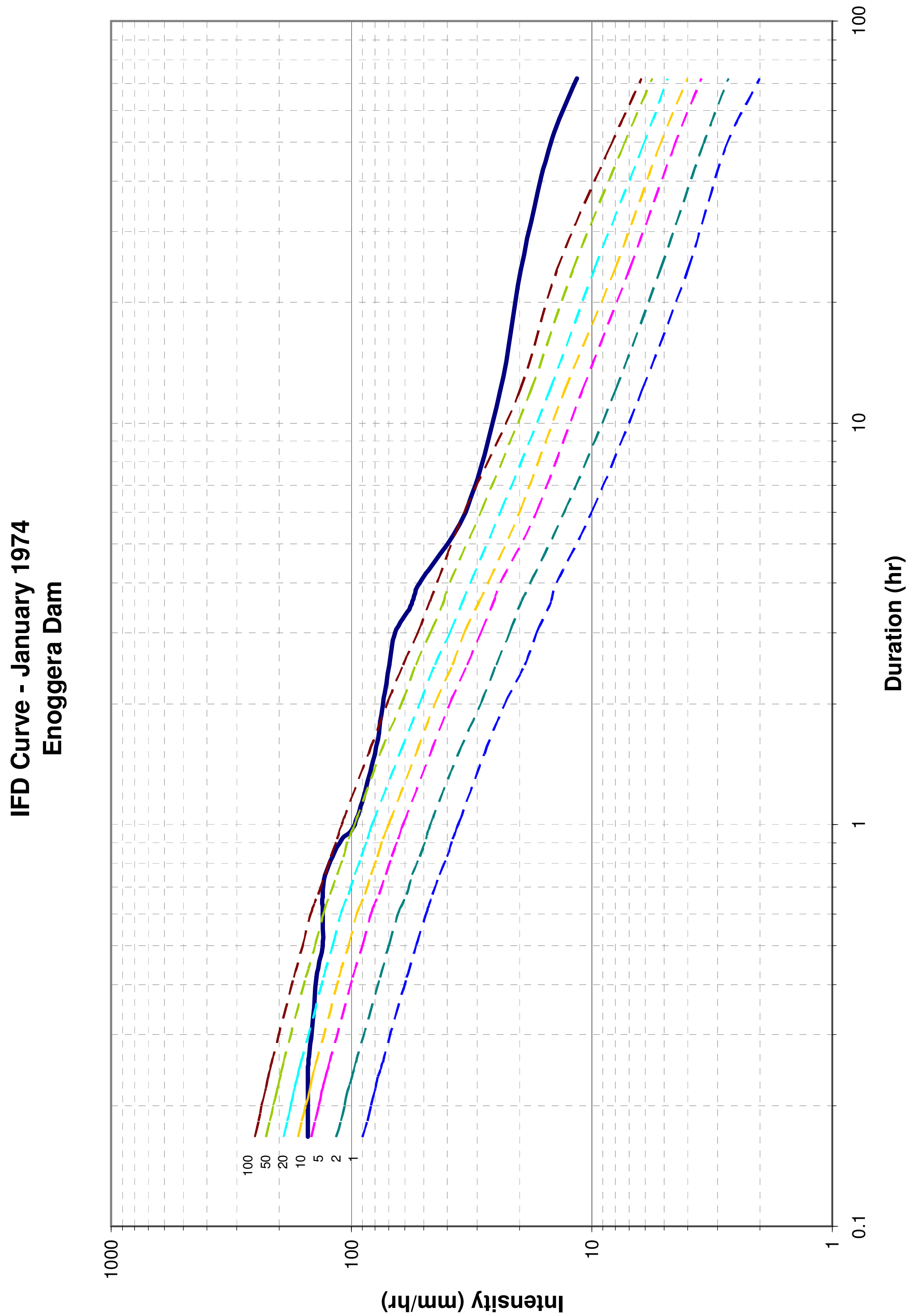


Figure A.7 Intensity-Frequency-Duration Curves, April 1989 Event

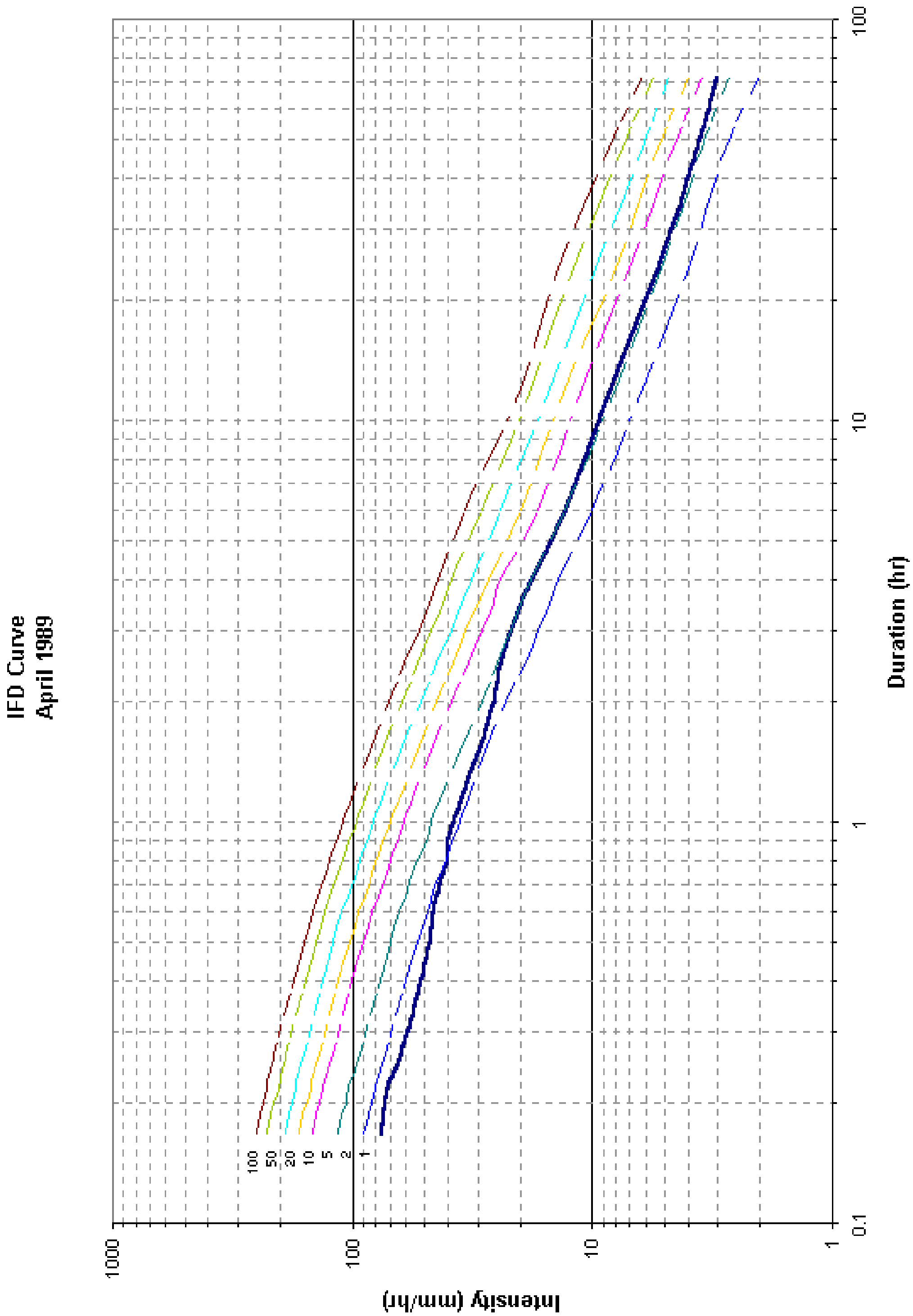


Figure A.8 Intensity-Frequency-Duration Curves, May 1996 Event

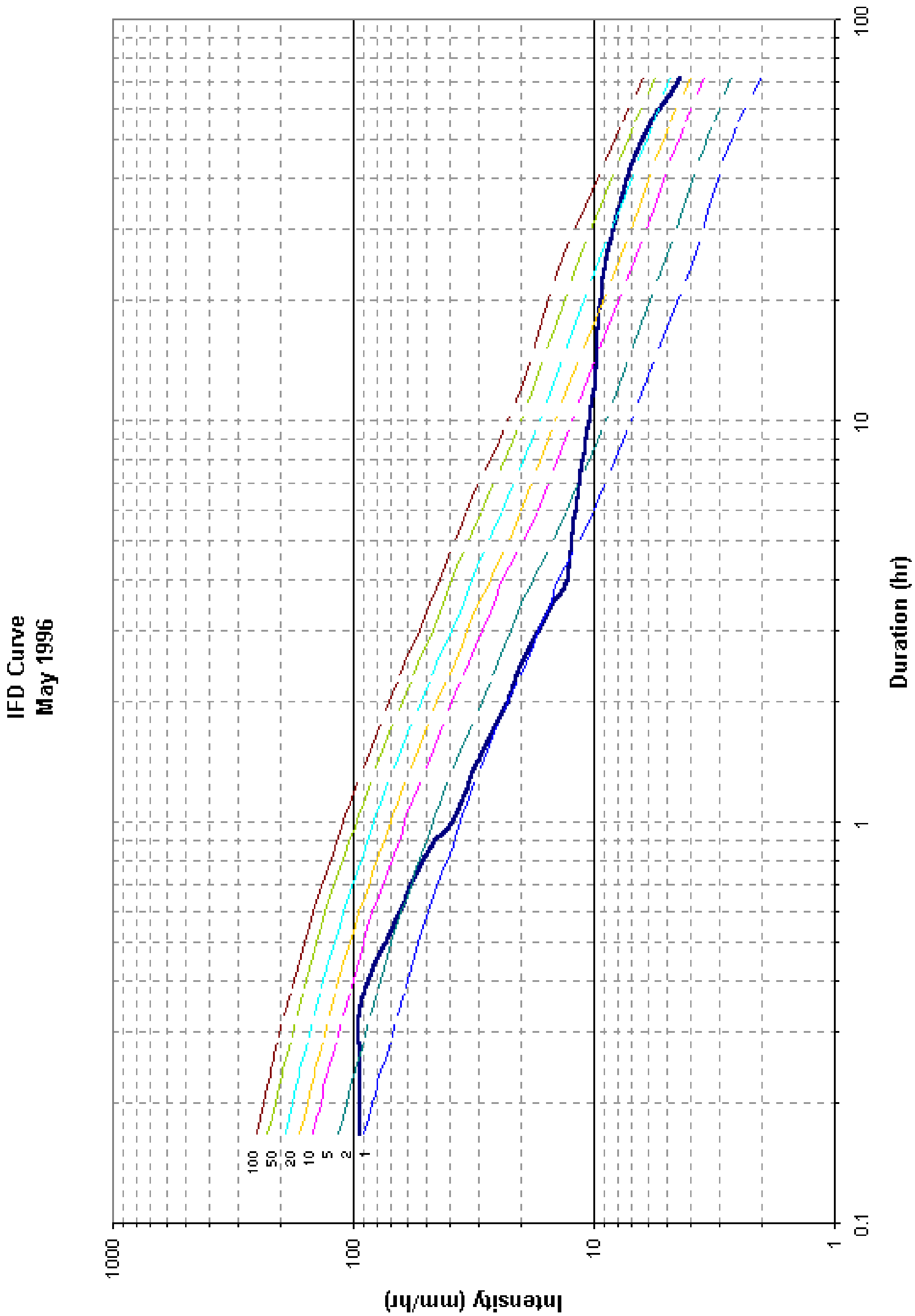


Figure A.9 Intensity-Frequency-Duration Curves, May 2009 Event

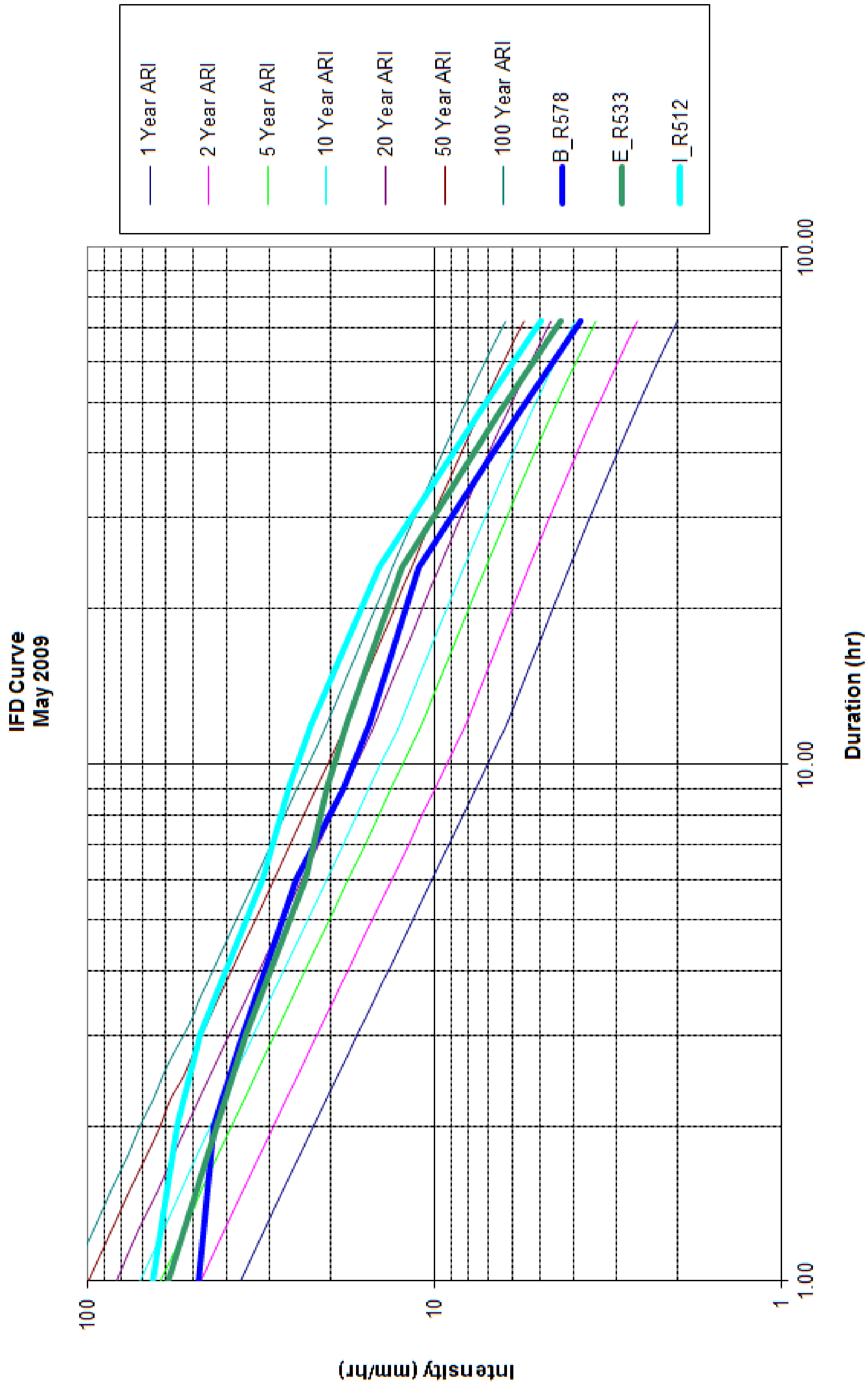


Figure A.10 Intensity-Frequency-Duration Curves, January 2013 Event

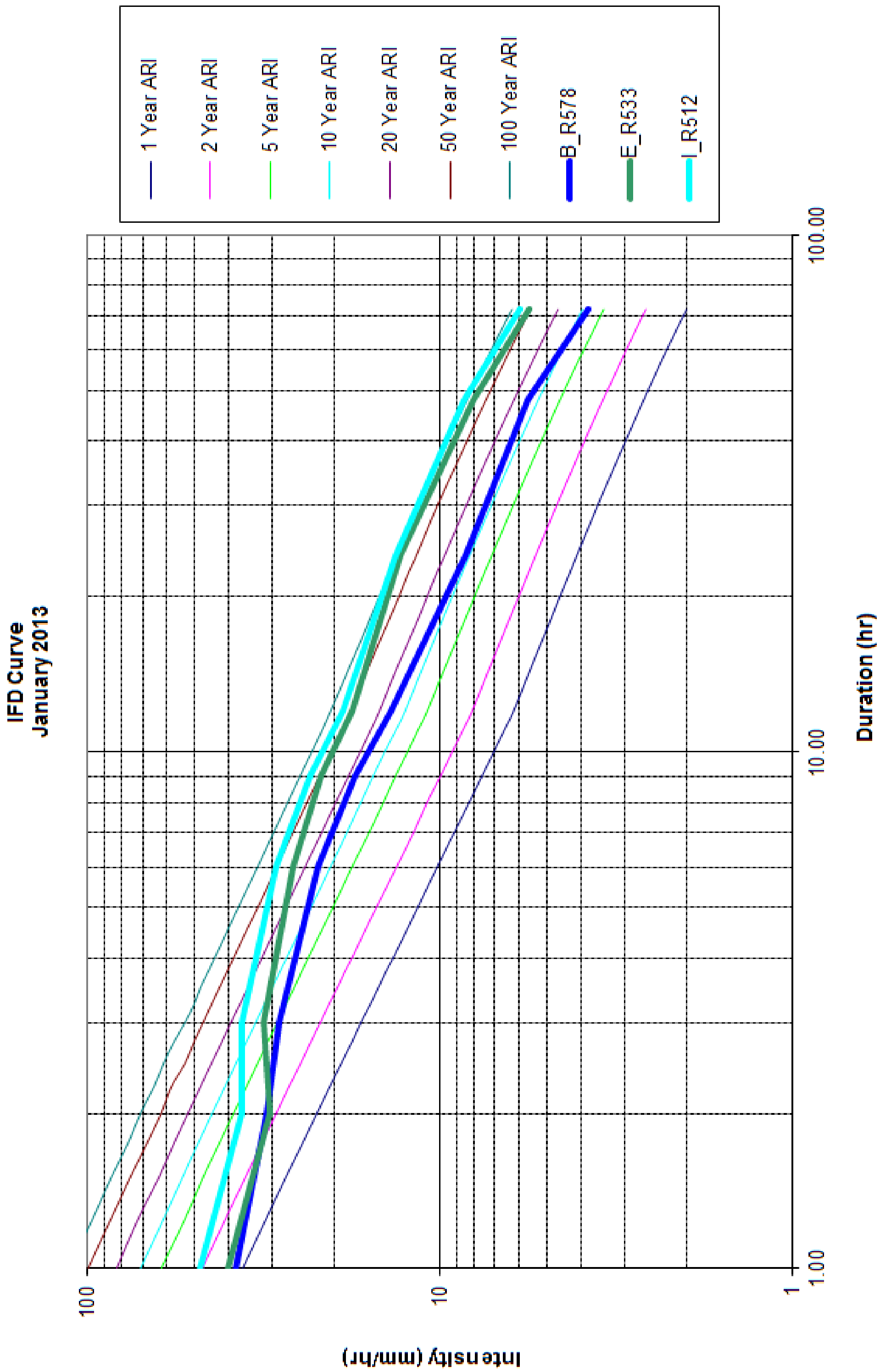


Table A.1 Enoggera Reservoir Gauge Rating

Post 1973/Pre 1976	
Flow (m^3/s)	**Level (m AHD)**
0	74.37
36	75.00
71	75.40
146	75.85
176	76.00
258	76.40
358	76.80
409	77.00
550	77.47

Post 1976	
Flow (m^3/s)	**Level (m AHD)**
0	73.85
8	74.37
15	74.85
50	75.85
65	76.85
75	77.85
95	78.85
105	79.85
150	80.85
250	81.35
410	81.85
600	82.35
825	82.85
1095	83.35
1375	83.85

Figure A.11 Bancroft Park Gauge Rating Weir

Figure A.12 Bancroft Park Gauge Rating (up to 1996)

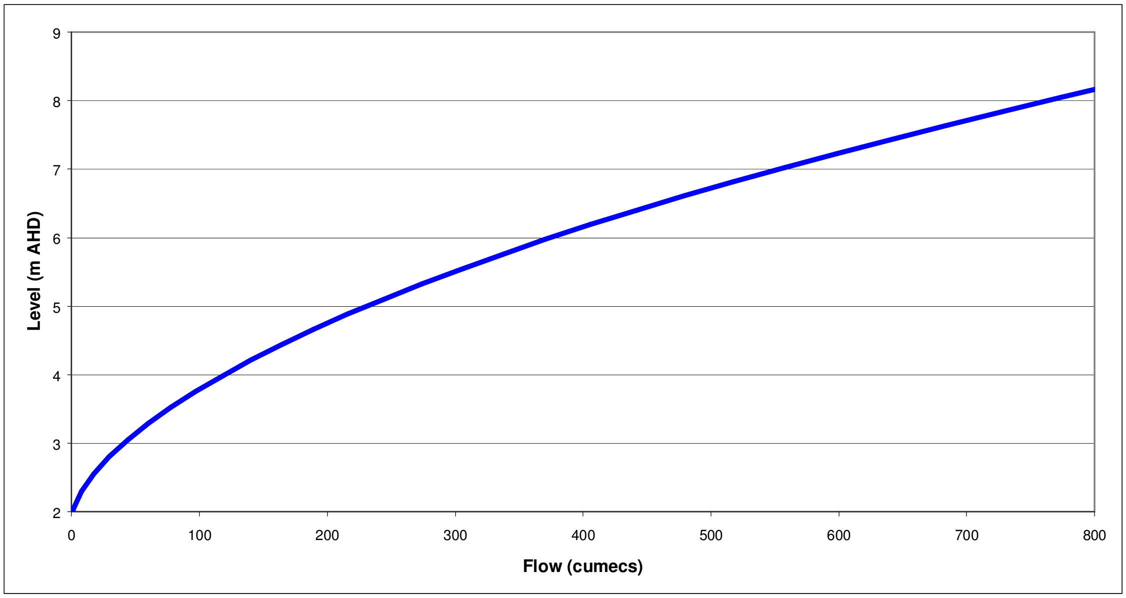


Figure A.13 Bancroft Park Gauge Rating (post 1996)

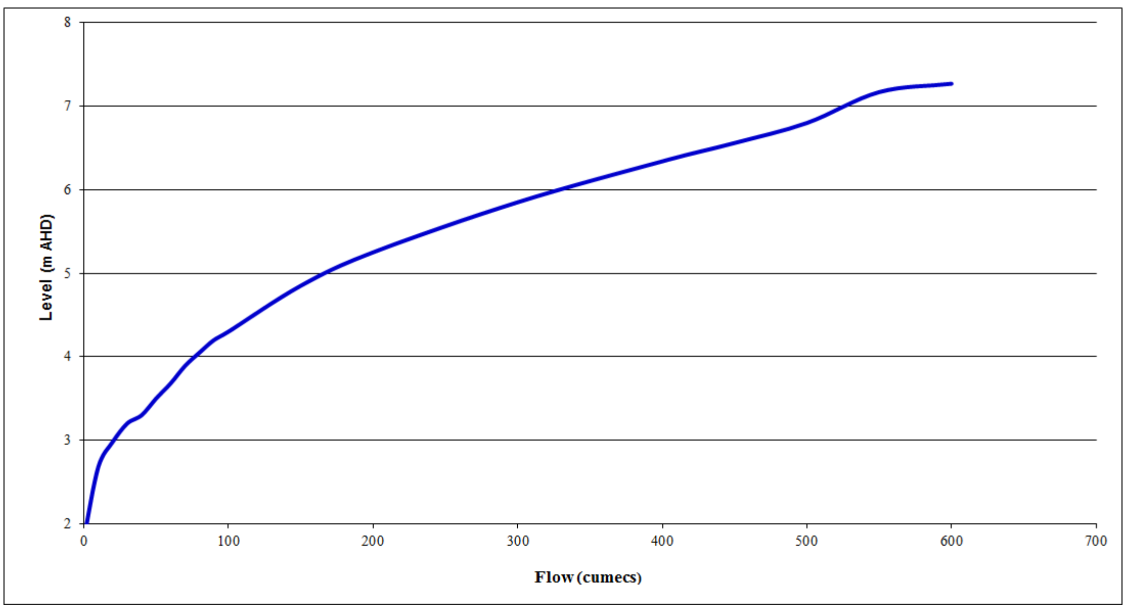


Table A.2 Bancroft Park Gauge Rating (up to 1996)

Flow (m^3/s)	Level (m AHD)
0	1.82
10	2.35
20	2.60
30	2.80
40	2.95
50	3.15
60	3.28
70	3.40
80	3.55
90	3.68
100	3.80
150	4.30
200	4.75
300	5.50
400	6.15
450	6.45
500	6.72
550	7.00
600	7.25
650	7.48
700	7.70
750	7.95
800	8.15

Table A.3 Bancroft Park Gauge Rating (post 1996)

Flow (m^3/s)	Level (m AHD)
0	1.82
10	2.70
20	2.98
30	3.22
40	3.28
50	3.50
60	3.68
70	3.89
80	4.05
90	4.20
100	4.30
150	4.85
200	5.25
300	5.85
400	6.34
450	6.56
500	6.80
550	7.20
600	7.27

Figure A.14 Jason Street Gauge Rating Weir

Figure A.15 Jason Street Gauge Rating

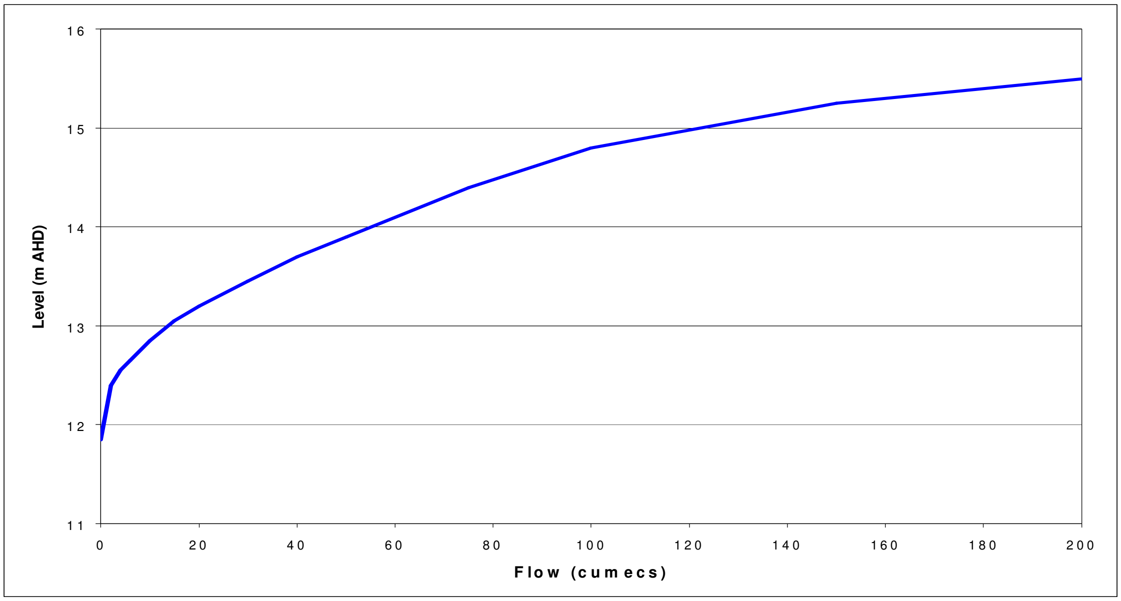


Table A.4 Jason Street Gauge Rating

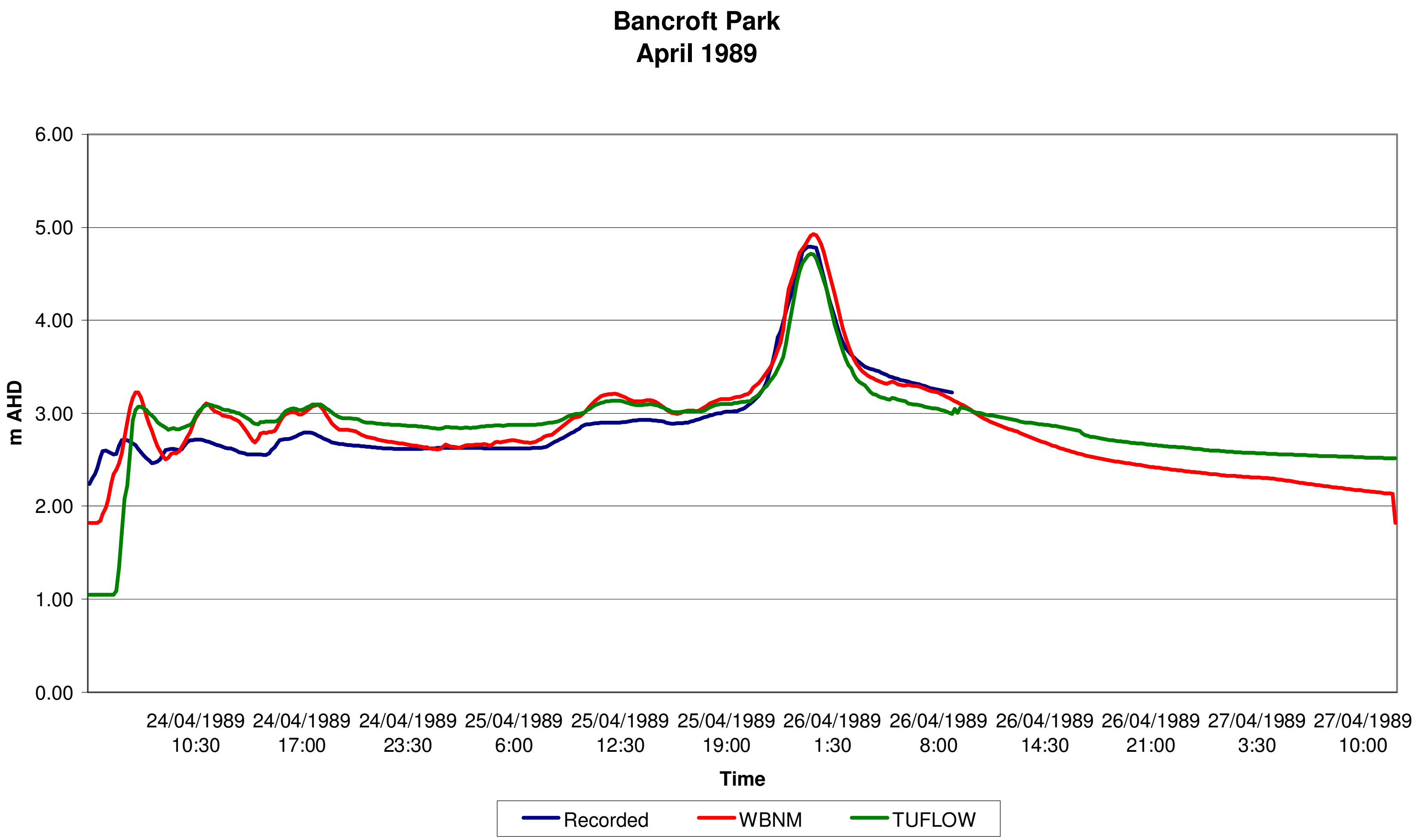
Flow (m^3/s)	Level (m AHD)
0	11.85
2	12.40
4	12.55
6	12.65
10	12.85
15	13.05
20	13.20
30	13.45
40	13.70
50	13.90
75	14.40
100	14.80
150	15.25
200	15.50

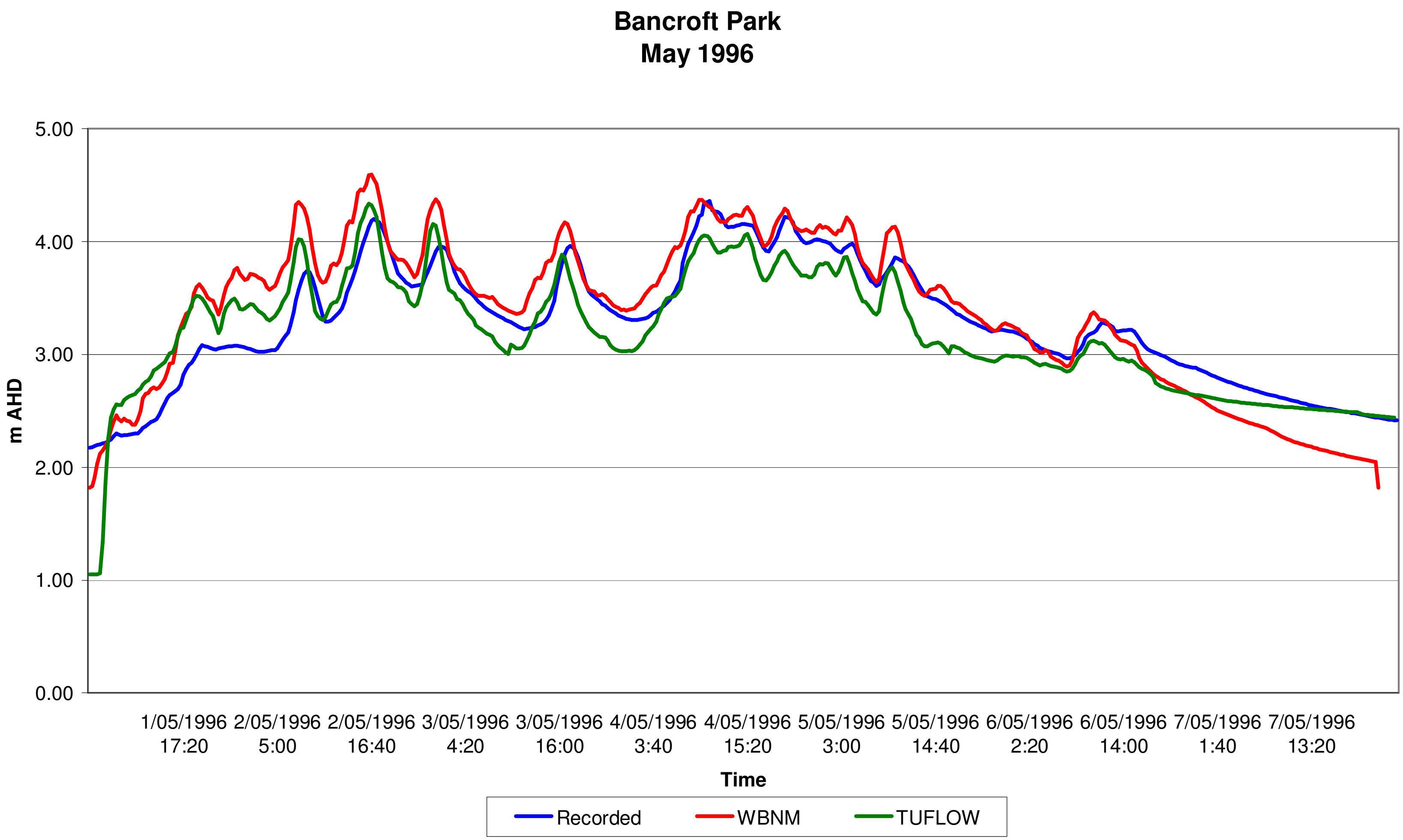
Figure A.16 Comparison Plots of Recorded, Hydrologic and Hydraulic Analysis Output at Stream Gauge Locations

A. Bancroft Park

B. Jason Street

C. Mann Park


Bancroft Park
April 1989
6.00
5.00
4.00
3.00
2.00
1.00
0.00
m AHD
24/04/1989 10:30
24/04/1989 17:00
24/04/1989 23:30
25/04/1989 6:00
25/04/1989 12:30
25/04/1989 19:00
26/04/1989 1:30
26/04/1989 8:00
26/04/1989 14:30
26/04/1989 21:00
27/04/1989 3:30
27/04/1989 10:00
Time
Recorded
WBNM
TUFLOW


Bancroft Park
May 1996
5.00
4.00
3.00
2.00
1.00
0.00
m AHD
1/05/1996 17:20
2/05/1996 5:00
2/05/1996 16:40
3/05/1996 4:20
3/05/1996 16:00
4/05/1996 3:40
4/05/1996 15:20
5/05/1996 3:00
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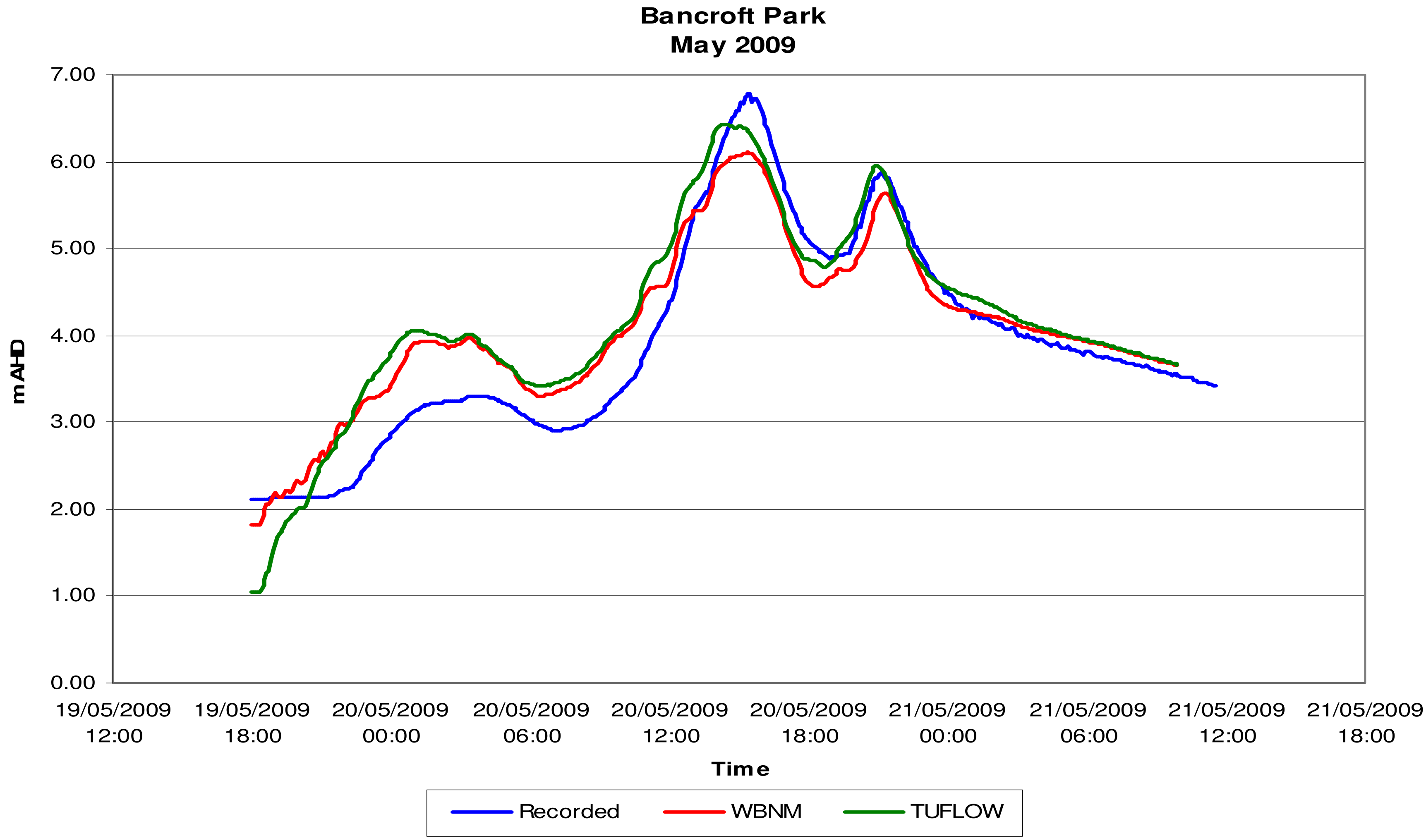
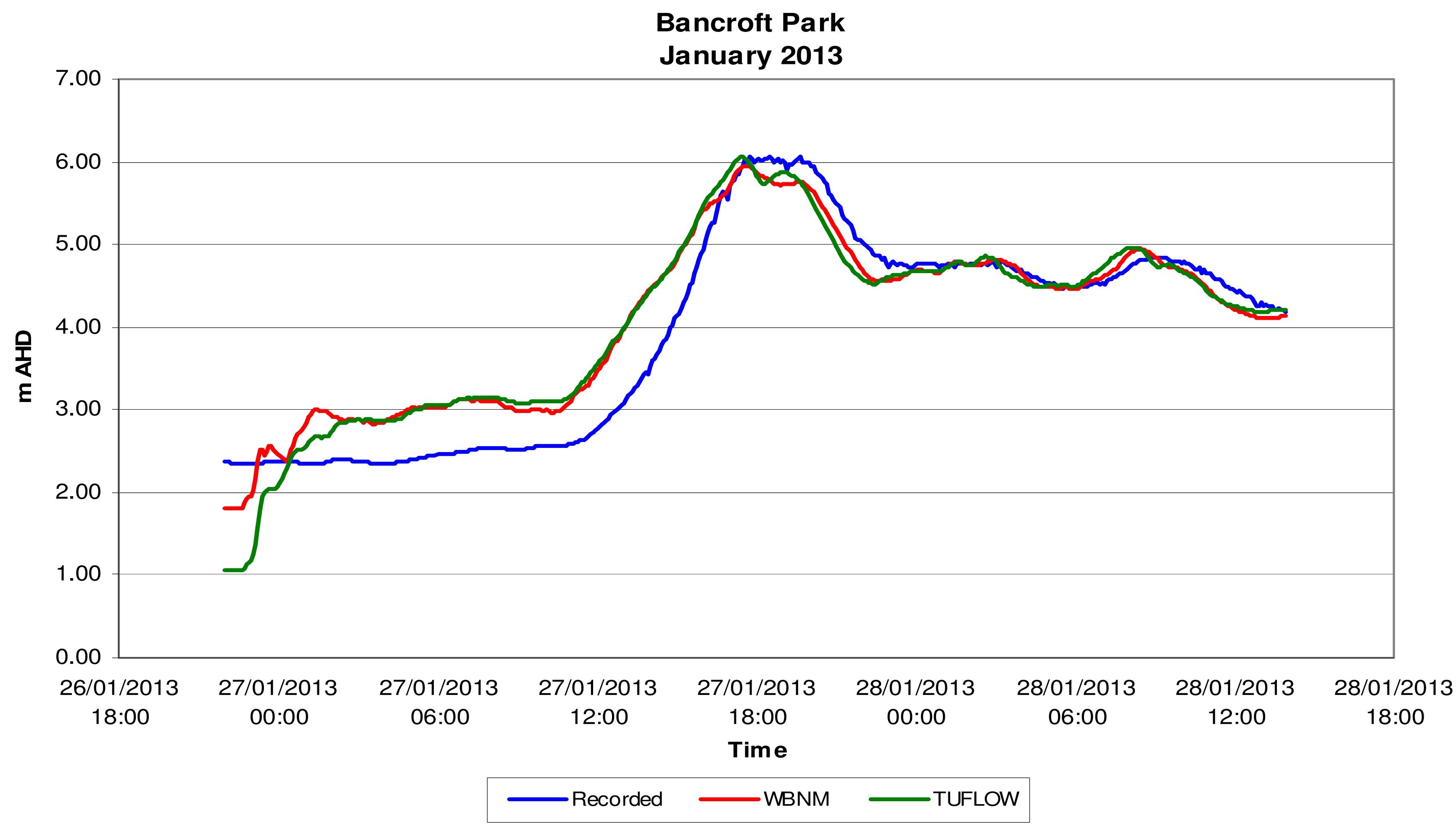
7/05/1996 13:20
Time
Recorded
WBNM
TUFLOW


Bancroft Park
May 2009
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
mAHD
19/05/2009 12:00
19/05/2009 18:00
20/05/2009 00:00
20/05/2009 06:00
20/05/2009 12:00
20/05/2009 18:00
21/05/2009 00:00
21/05/2009 06:00
21/05/2009 12:00
21/05/2009 18:00
Time
Recorded
WBNM
TUFLOW


Bancroft Park
January 2013
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
m AHD
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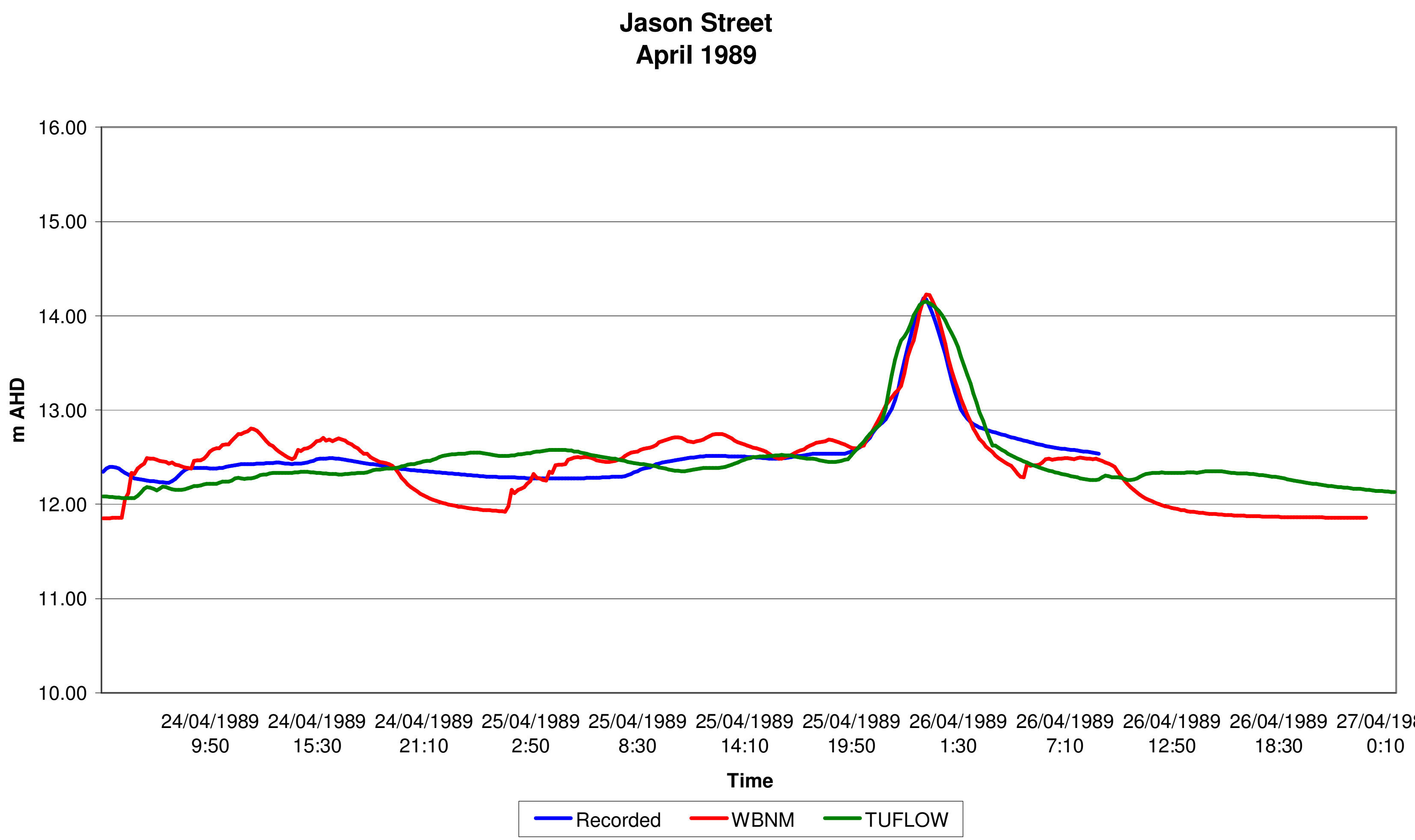
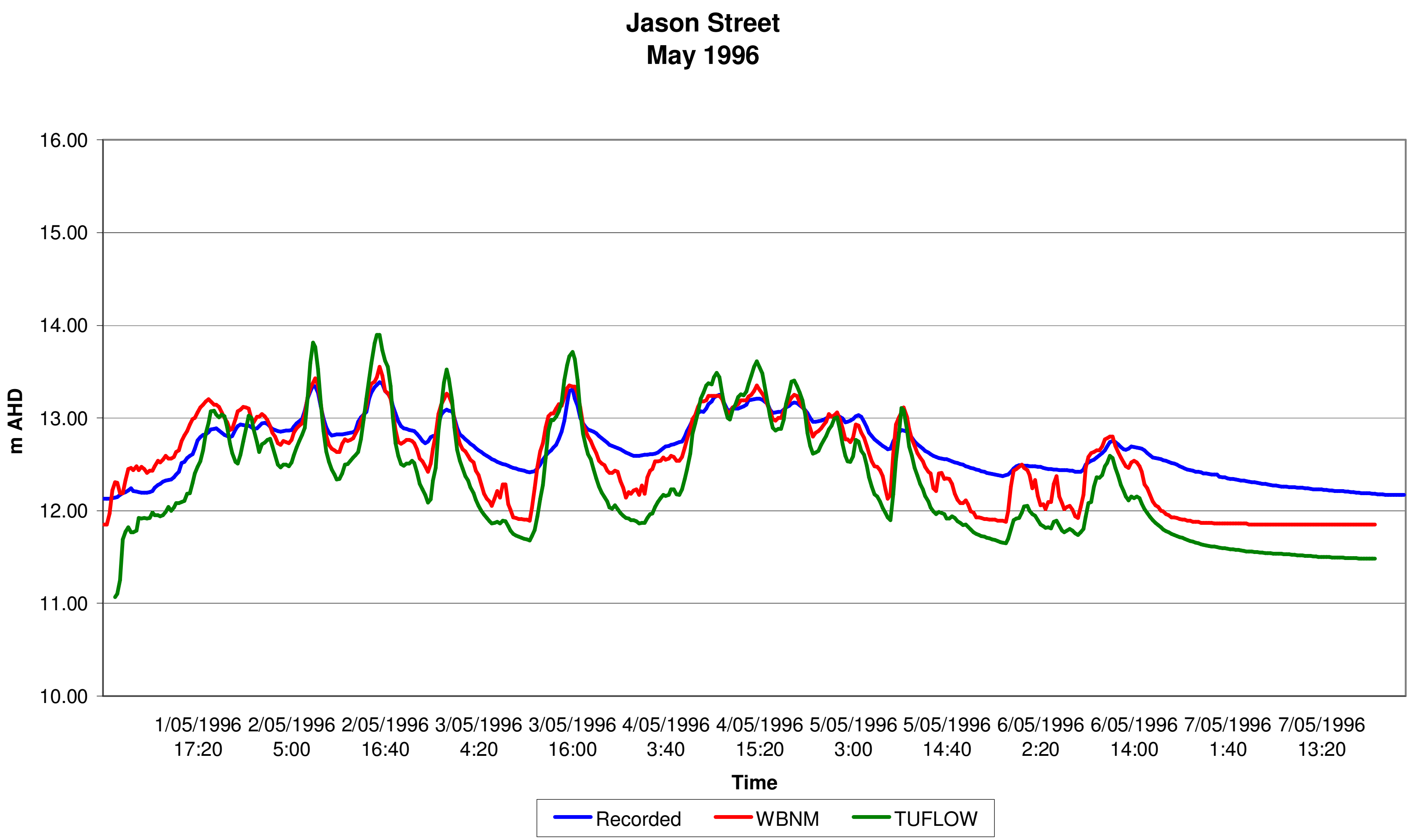
27/01/2013 00:00
27/01/2013 06:00
27/01/2013 12:00
27/01/2013 18:00
28/01/2013 00:00
28/01/2013 06:00
28/01/2013 12:00
28/01/2013 18:00
Time
Recorded
WBNM
TUFLOW


Jason Street
April 1989
16.00
15.00
14.00
13.00
12.00
11.00
10.00
m AHD
24/04/1989 9:50
24/04/1989 15:30
24/04/1989 21:10
25/04/1989 2:50
25/04/1989 8:30
25/04/1989 14:10
25/04/1989 19:50
26/04/1989 1:30
26/04/1989 7:10
26/04/1989 12:50
26/04/1989 18:30
27/04/198 0:10
Time
Recorded
WBNM
TUFLOW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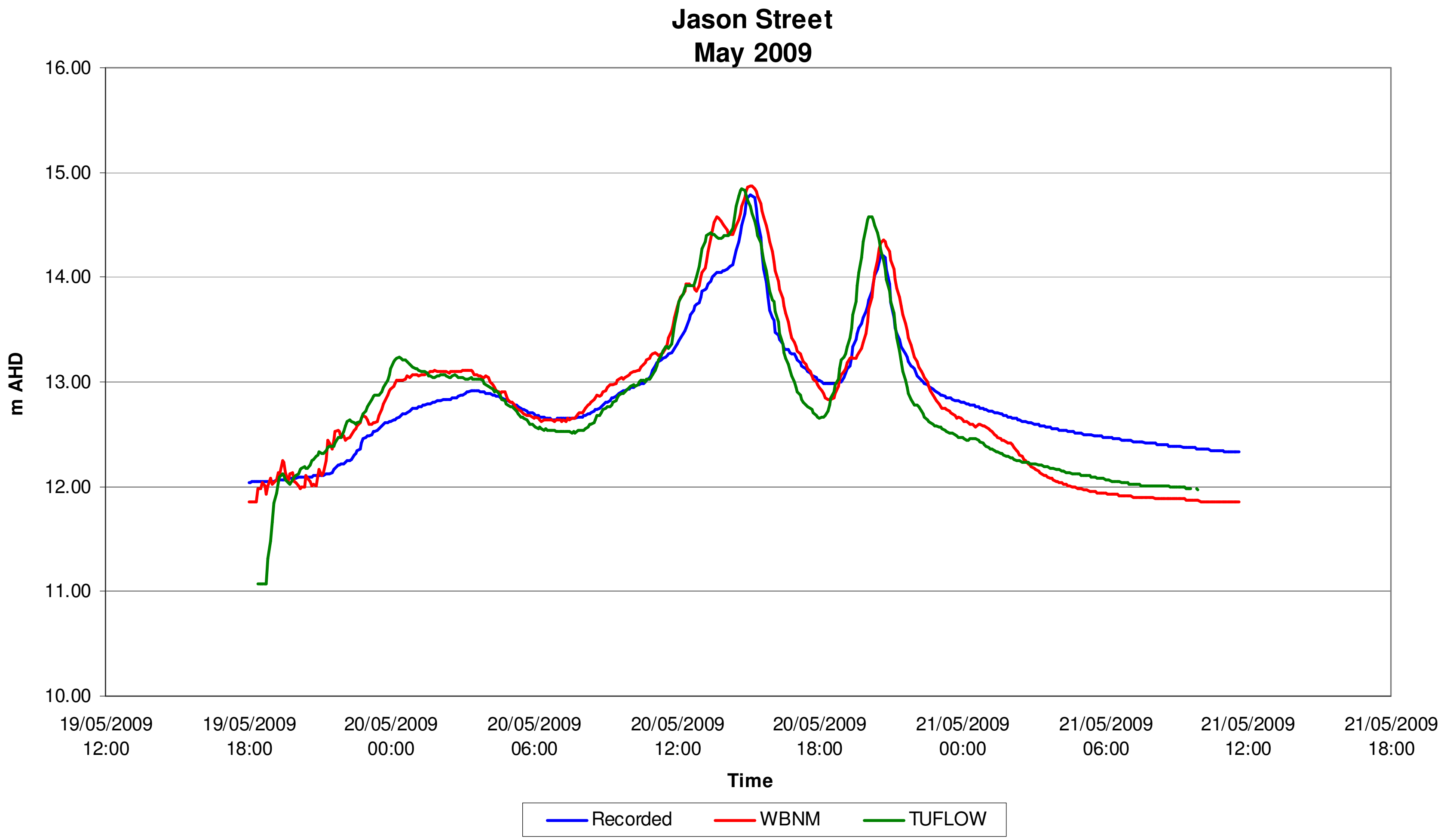
May 1996
16.00
15.00
14.00
13.00
12.00
11.00
10.00
m AHD
1/05/1996 17:20
2/05/1996 5:00
2/05/1996 16:40
3/05/1996 4:20
3/05/1996 16:00
4/05/1996 3:40
4/05/1996 15:20
5/05/1996 3:00
5/05/1996 14:40
6/05/1996 2:20
6/05/1996 14:00
7/05/1996 1:40
7/05/1996 13:20
Time
Recorded
WBNM
TUFLOW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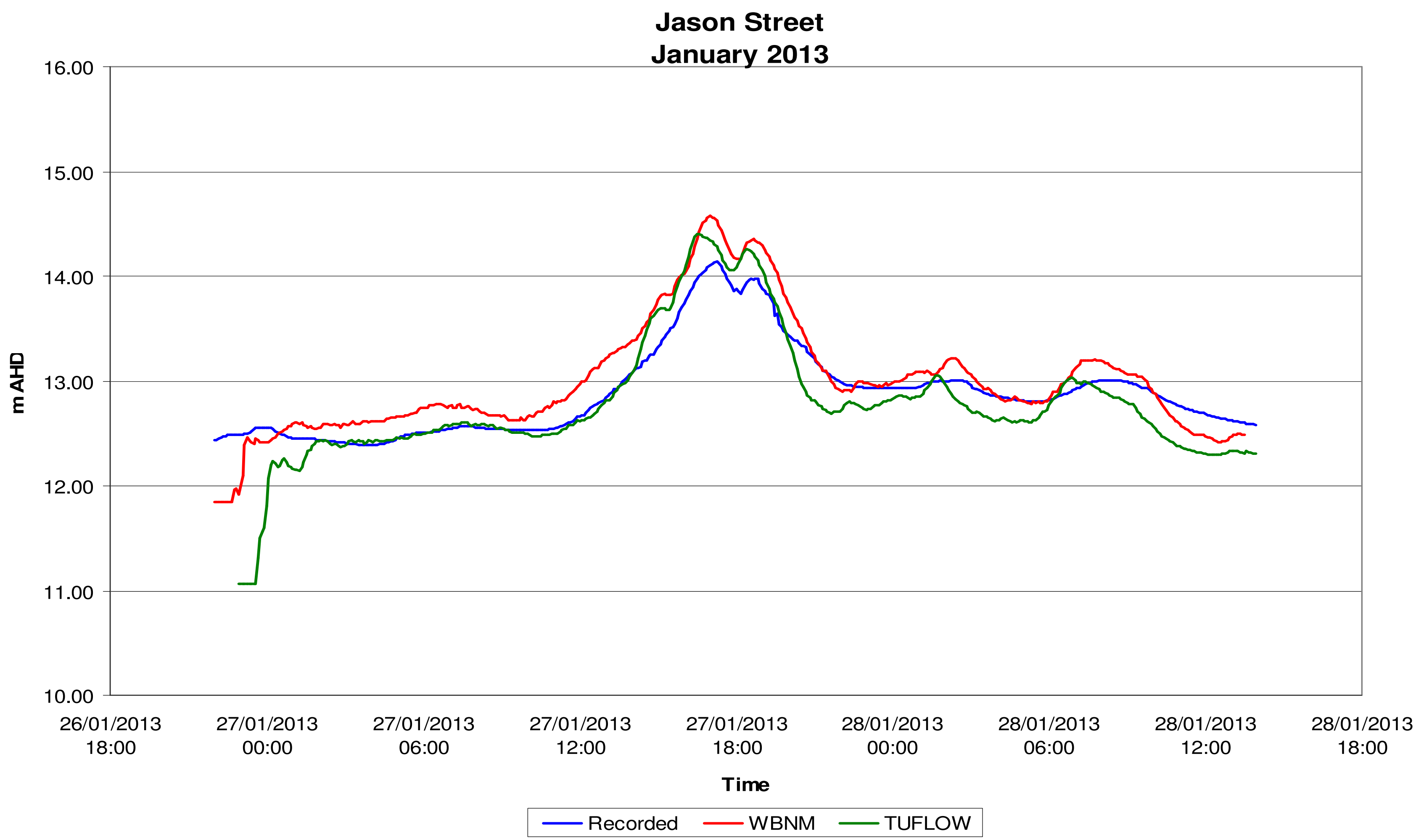
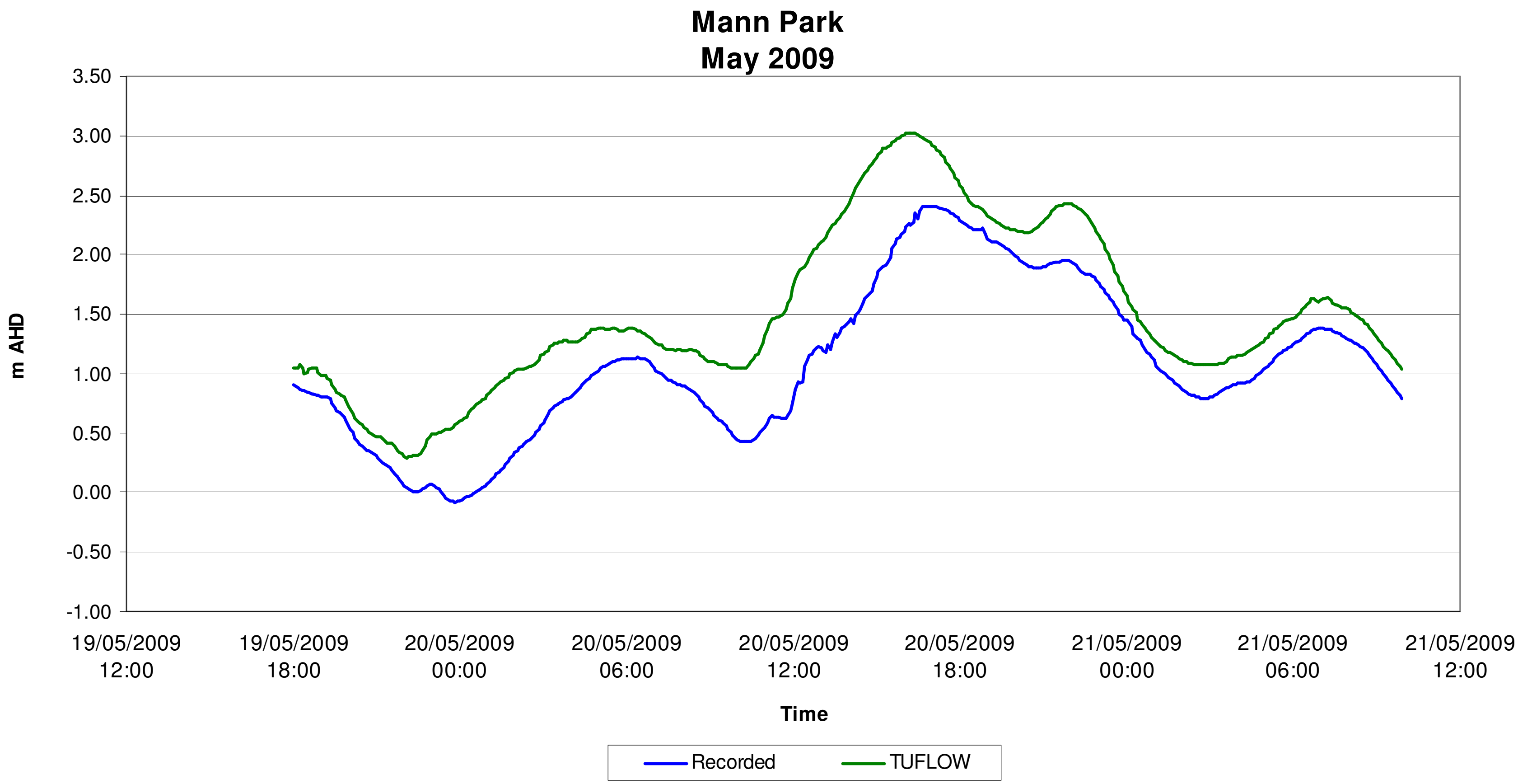
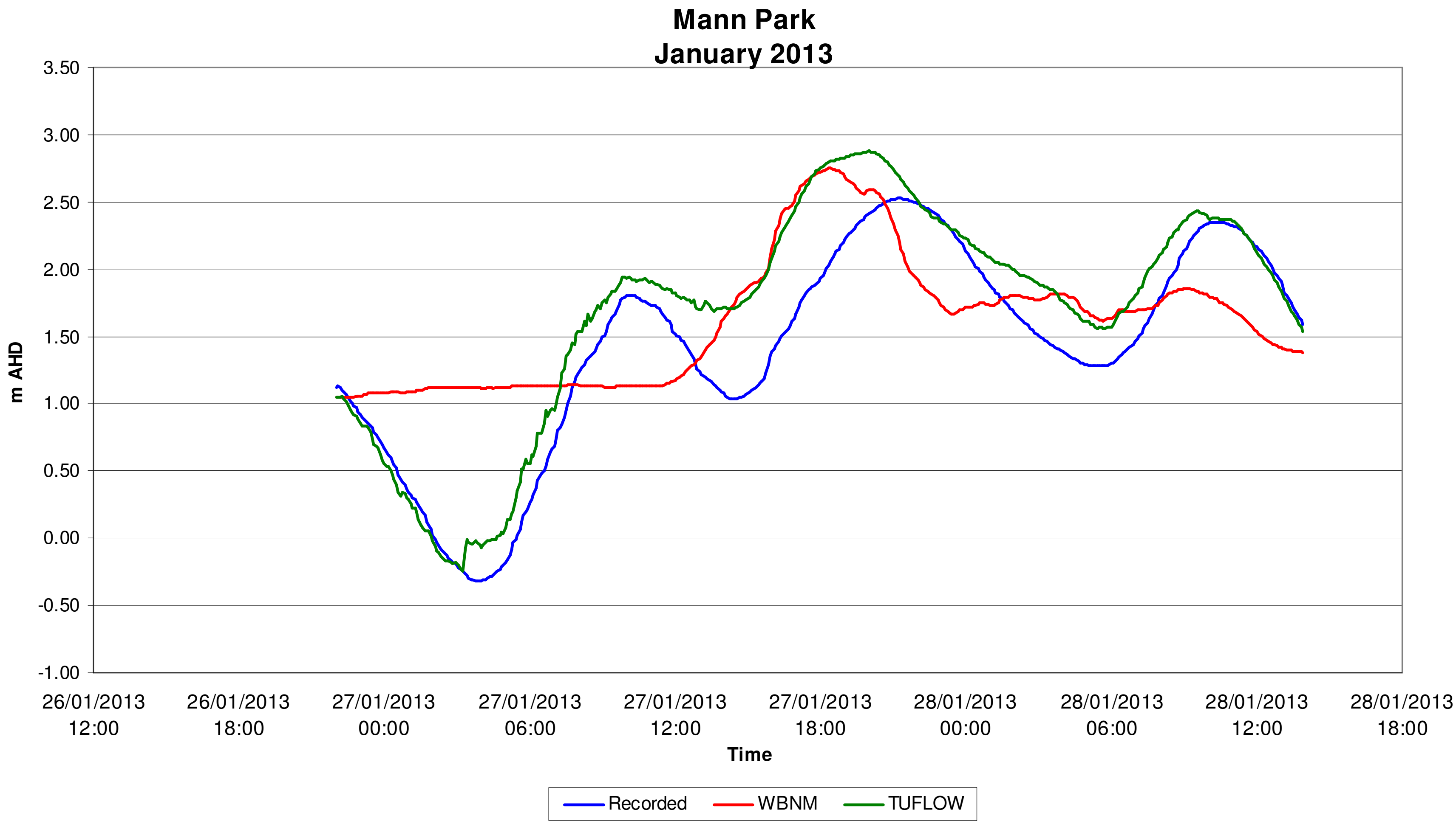
May 2009
16.00
15.00
14.00
13.00
12.00
11.00
10.00
m AHD
19/05/2009 12:00
19/05/2009 18:00
20/05/2009 00:00
20/05/2009 06:00
20/05/2009 12:00
20/05/2009 18:00
21/05/2009 00:00
21/05/2009 06:00
21/05/2009 12:00
21/05/2009 18:00
Time
Recorded
WBNM
TUFLOW


Jason Street
January 2013
16.00
15.00
14.00
13.00
12.00
11.00
10.00
m AHD
26/01/2013 18:00
27/01/2013 00:00
27/01/2013 06:00
27/01/2013 12:00
27/01/2013 18:00
28/01/2013 00:00
28/01/2013 06:00
28/01/2013 12:00
28/01/2013 18:00
Time
Recorded
WBNM
TUFLOW


Mann Park
May 2009
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
m AHD
19/05/2009 12:00
19/05/2009 18:00
20/05/2009 00:00
20/05/2009 06:00
20/05/2009 12:00
20/05/2009 18:00
21/05/2009 00:00
21/05/2009 06:00
21/05/2009 12:00
Time
Recorded
TUFLOW


Mann Park
January 2013
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
m AHD
26/01/2013 12:00
26/01/2013 18:00
27/01/2013 00:00
27/01/2013 06:00
27/01/2013 12:00
27/01/2013 18:00
28/01/2013 00:00
28/01/2013 06:00
28/01/2013 12:00
28/01/2013 18:00
Time
Recorded
WBNM
TUFLOW

APPENDIX B: DURATION INDEPENDENT SYNTHETIC STORM

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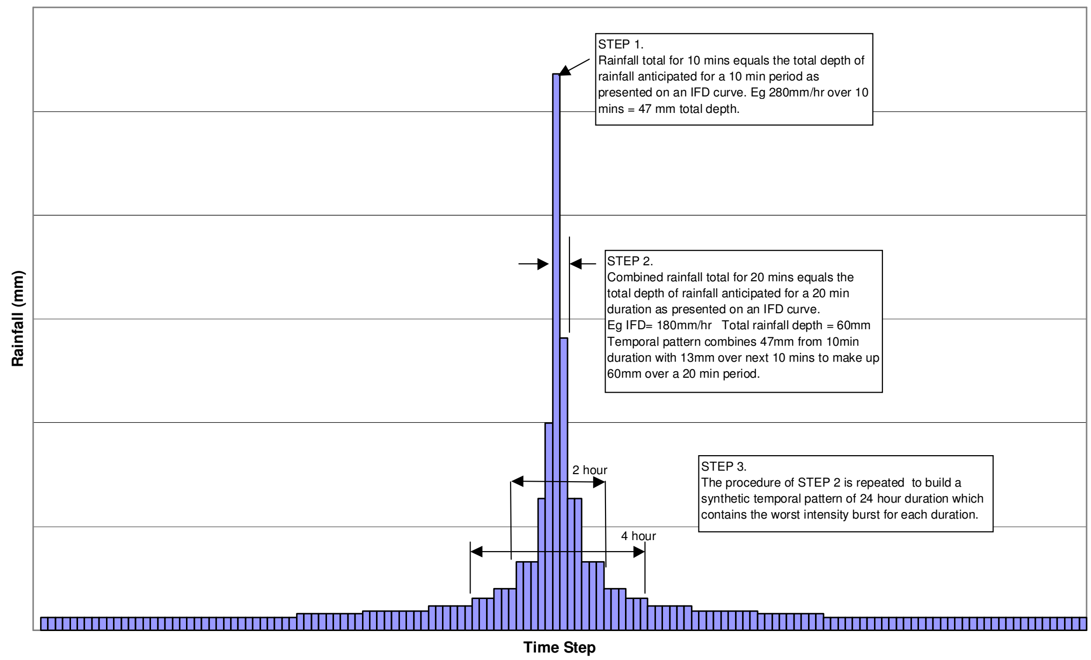
B.1. DESIGN EVENTS – DEVELOPMENT OF DURATION INDEPENDENT SYNTHETIC EVENT

Duration Independent Synthetic temporal patterns were derived from IFD curves presented for Brisbane in the Brisbane City Council QUDM supplement (July 1994).

For each ARI a single storm temporal pattern was built by combining the worst burst of rainfall extracted from points which follow the curves of each ARI on the IFD chart. The resulting synthetic temporal patterns each contain the anticipated worst bursts of design rainfall from 10 minutes to 24 hours, as demonstrated in **Figure B-1**.

Figure B-1 Development of Duration Independent Synthetic Temporal Pattern



Each derived ARI synthetic temporal pattern is then applied over the existing catchment condition as per the recorded historical BoM data.

Factors were then applied at each location to each of the peak ARI discharges to align it with BoM flood frequency data.

These factors were then averaged across the entire study area and applied to the synthetic rainfall patterns to produce a set of design event synthetic temporal patterns.

Each design event synthetic temporal pattern was then run through the WBNM hydrologic model for both existing and ultimate catchment development scenarios to provide design event inflow hydrographs for TUFLOW model.

APPENDIX C: MODEL DATA

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C.1. HYDROLOGIC MODEL PARAMETERS

Table C-1 Catchment Details

Sub-Catchment No	Sub-Catchment Type	Contributing Sub-Catchments			Sub-Catchment Area (ha)	Impervious		Sub-Catchment Coordinates				WBNM Routing Type	Non linear Routing WCFACT	Muskingum K	Muskingum X
						Existing (%)	Ultimate (%)	Centre		Outlet					
		No	No	No				Easting	Northing	Easting	Northing				
1	OL	0	0	0	265.79	0	0	481398	6967548	483181	6966547				
2	OL	0	0	0	204.68	0	0	482079	6967851	483477	6966756				
3	WC	1	2	0	261.21	0	0	483794	6966267	484540	6965838	R	0.4		
4	WC	3	0	0	226.87	0	0	484756	6965618	485365	6965069	R	0.4		
5	OL	0	0	0	190.26	0	0	483518	6964669	484482	6964343				
6	WC	5	4	0	161.20	0	0	485211	6964817	485909	6965118	R	0.4		
7	WC	6	0	0	184.00	0	0	486130	6964667	486940	6964706	R	0.4		
8	OL	0	0	0	261.67	0	0	486755	6966243	487085	6965468				
9	WC	8	7	0	145.44	0	0	487217	6964697	487643	6964696	R	0.4		
10	WC	9	0	0	237.87	0	0	488178	6964756	488869	6964557	R	0.4		
11	WC	10	0	0	219.90	0	0	489178	6964481	489629	6964159	R	0.4		
12	WC	11	0	0	205.78	0	0	490042	6964089	490820	6963886	R	0.4		
13	OL	0	0	0	187.47	0	0	490397	6963150	491128	6963720				
14	S1	12	13	0	474.67	0	0	491769	6964138	492744	6964095				
15	WC	14	0	0	46.10	40	55	493008	6963838	493158	6963579	M		7	0.47

Table C-1 Catchment Details cont.

Sub-Catchment No	Sub-Catchment Type	Contributing Sub-Catchments			Sub-Catchment Area (ha)	Impervious		Sub-Catchment Coordinates				WBNM Routing Type	Non linear Routing WCFACT	Muskingum K	Muskingum X
						Existing (%)	Ultimate (%)	Centre		Outlet					
		No	No	No				Easting	Northing	Easting	Northing				
16	WC	15	0	0	26.59	70	75	493394	6963532	493687	6963477	M		5	0.47
17	OL	0	0	0	130.09	0	0	492833	6962578	493478	6963081				
18	OL	17	0	0	136.44	0	10	493749	6962316	493813	6963320				
19	OL	0	0	0	31.87	0	0	494273	6962406	494199	6962996				
20	WC	16	18	19	38.49	80	80	494028	6963371	494228	6963618	M		7	0.47
21	OL	0	0	0	28.80	80	80	493764	6964018	494056	6964118				
22	WC	20	21	0	27.26	80	80	494233	6963894	494350	6964100	M		11	0.47
23	WC	22	0	0	30.98	80	80	494613	6963864	494865	6963761	M		8	0.47
24	OL	0	0	0	151.13	40	50	494928	6962777	495391	6963613				
25	OL	0	0	0	64.85	40	50	495669	6963150	495391	6963613				
26	WC	23	24	25	36.86	40	60	495208	6963820	495431	6964102	M		10	0.47
27	OL	0	0	0	21.03	70	80	492886	6964630	493122	6964702				
28	OL	0	0	0	61.05	40	40	492792	6965275	493130	6964884				
29	WC	27	28	0	28.98	70	70	493274	6964657	493478	6964770	M		5	0.40
30	OL	0	0	0	72.74	30	50	493274	6965709	493537	6965052				
31	OL	0	0	0	17.77	80	80	493514	6964349	493602	6964570				
32	WC	29	31	30	21.03	70	70	493695	6964716	493812	6964724	M		4	0.40
33	OL	0	0	0	53.75	30	60	493912	6965526	494136	6965027				
34	WC	32	33	0	26.98	80	80	494068	6964812	494343	6964739	M		6	0.40
35	OL	0	0	0	102.65	30	70	494547	6965519	494608	6964779				

Table C-1 **Catchment Details** cont.

Sub-Catchment No	Sub-Catchment Type	Contributing Sub-Catchments			Sub-Catchment Area (ha)	Impervious		Sub-Catchment Coordinates				WBNM Routing Type	Non linear Routing WCFACT	Muskingum K	Muskingum X
						Existing (%)	Ultimate (%)	Centre		Outlet					
		No	No	No				Easting	Northing	Easting	Northing				
36	WC	35	34	0	48.31	80	80	494585	6964539	494876	6964421	M		11	0.40
37	WC	36	0	0	27.95	60	70	495120	6964285	495431	6964102	M		12	0.40
38	OL	0	0	0	166.53	0	20	495453	6965498	495533	6964742				
39	WC	38	37	26	98.13	20	50	495872	6964236	496197	6964033	M		5	0.32
40	WC	39	0	0	79.76	20	40	496463	6963937	496903	6963878	M		5	0.32
41	OL	0	0	0	30.80	30	60	496857	6963301	497018	6963474				
42	WC	41	40	0	23.14	60	80	497110	6963711	497322	6963782	M		5	0.25
43	WC	42	0	0	28.14	60	80	497464	6963726	497457	6964185	M		7	0.25
44	OL	0	0	0	0.00	0	0	497464	6963726	497457	6964185				
45	WC	43	0	0	27.71	50	70	497064	6964244	497082	6964371	M		7	0.25
46	WC	45	0	0	51.03	0	0	496948	6964755	497339	6964621	M		4	0.25
47	WC	46	0	0	75.56	40	40	497597	6964656	497762	6964471	M		5	0.25
48	WC	47	0	0	43.82	70	70	498102	6964173	498302	6964416	M		5	0.25
49	OL	0	0	0	27.48	30	30	497952	6965316	498025	6964930				
50	WC	49	48	0	57.77	70	70	498386	6964655	498800	6964755	M		9	0.25
51	WC	50	0	0	104.46	80	80	498833	6964809	499228	6964978	M		7	0.25
52	WC	51	0	0	91.22	60	60	499515	6965128	499966	6965129	M		13	0.25
53	WC	52	0	0	31.16	70	70	500262	6965153	500528	6964846	M		11	0.25
54	WC	53	0	0	29.34	70	70	500139	6964689	500112	6964486	M		3	0.25
55	WC	54	0	0	43.94	70	70	499827	6964233	500324	6964088	M		4	0.25

Table C-1 Catchment Details cont.

Sub-Catchment No	Sub-Catchment Type	Contributing Sub-Catchments			Sub-Catchment Area (ha)	Impervious		Sub-Catchment Coordinates				WBNM Routing Type	Non linear Routing WCFACT	Muskingum K	Muskingum X
						Existing (%)	Ultimate (%)	Centre		Outlet					
		No	No	No				Easting	Northing	Easting	Northing				
56	OL	0	0	0	224.12	0	0	495640	6960611	496889	6961056				
57	WC	56	0	0	73.77	0	20	496649	6961365	496731	6961937	M		12	0.45
58	OL	0	0	0	208.62	0	0	495374	6961677	496731	6961937				
59	WC	57	58	0	65.12	10	50	496893	6962140	497241	6962536	M		11	0.45
60	OL	0	0	0	75.18	5	30	496370	6962628	497241	6962536				
61	WC	60	59	0	102.73	20	50	497384	6962556	497762	6962742	M		7	0.45
62	WC	61	0	0	52.15	70	75	497939	6962914	497852	6963345	M		12	0.41
63	WC	62	0	0	33.04	70	75	498074	6963367	498253	6963572	M		13	0.41
64	WC	63	0	0	55.43	70	80	498542	6963443	498849	6963635	M		13	0.41
65	WC	64	0	0	27.53	70	80	498975	6963528	499231	6963667	M		6	0.41
66	WC	65	0	0	31.06	70	80	499304	6963605	499582	6963883	M		10	0.41
67	WC	66	0	0	15.99	65	70	499663	6963671	499920	6963634	M		8	0.41
68	OL	0	0	0	118.73	80	80	499480	6962936	499920	6963634				
69	WC	67	68	0	19.59	70	80	500048	6963744	500324	6964088	M		7	0.41
70	OL	0	0	0	27.87	80	80	500367	6963606	500324	6964088				
71	WC	70	69	55	15.06	70	70	500466	6964244	500595	6964330	M		5	0.01
72	OL	0	0	0	92.30	70	70	500332	6965949	500728	6965624				
73	WC	71	72	0	153.73	70	75	500869	6964559	501162	6964380	M		10	0.01
74	WC	73	0	0	108.67	70	70	501429	6964649	501773	6964482	M		9	0.01
75	WC	74	0	0	175.12	65	65	502033	6964669	502392	6964178	M		10	0.01

Table C-1 Catchment Details cont.

Sub-Catchment No	Sub-Catchment Type	Contributing Sub-Catchments			Sub-Catchment Area (ha)	Impervious		Sub-Catchment Coordinates				WBNM Routing Type	Non linear Routing WCFACT	Muskingum K	Muskingum X
						Existing (%)	Ultimate (%)	Centre		Outlet					
		No	No	No				Easting	Northing	Easting	Northing				
76	WC	75	0	0	69.90	70	70	502657	6964218	502870	6964199	M		7	0.01
77	OL	0	0	0	164.81	40	40	501644	6963039	502682	6963504				
78	OL	0	0	0	74.23	80	80	502530	6962738	503156	6963443				
79	WC	77	78	76	73.88	70	80	503078	6963946	503284	6964509	M		11	0.10
80	WC	79	0	0	33.28	75	80	503369	6964714	503600	6964841	M		6	0.10
81	OL	0	0	0	60.04	80	80	502833	6965467	503263	6965425				
82	WC	81	80	0	53.75	70	70	503529	6965252	503820	6965350	M		8	0.10
83	OL	0	0	0	83.63	80	80	503694	6966033	503820	6965350				
84	WC	83	82	0	44.84	80	80	504222	6965555	504175	6965201	M		6	0.10
85	WC	84	0	0	76.41	70	70	504488	6965106	504017	6964532	M		10	0.10
86	WC	85	0	0	47.25	70	70	503972	6964300	504556	6964443	M		9	0.10

C.2. HYDRAULIC MODEL PARAMETERS

Table C-2 Inflow Locations to TUFLOW Model

Name of Inflow	Description	Inflow	
		Branch	Inflow ID
Breakfast Creek (Enoggera Creek junction to Brisbane River)			
70	Flow from sub-catchment 70	BREAKFAST	70
71	Flow from sub-catchment 71	BREAKFAST	71
73	Flow from sub-catchment 72 and 73	BREAKFAST	73
74	Flow from sub-catchment 74	BREAKFAST	74
75	Flow from sub-catchment 75	BREAKFAST	75
76	Flow from sub-catchment 76	BREAKFAST	76
77	Flow from sub-catchment 77	BREAKFAST	77
78	Flow from sub-catchment 78	BREAKFAST	78
79	Flow from sub-catchment 79	BREAKFAST	79
80	Flow from sub-catchment 80	BREAKFAST	80
81	Flow from sub-catchment 81	BREAKFAST	81
82	Flow from sub-catchment 82	BREAKFAST	82
83	Flow from sub-catchment 83	BREAKFAST	83
84	Flow from sub-catchment 84	BREAKFAST	84
85	Flow from sub-catchment 85	BREAKFAST	85
86	Flow from sub-catchment 86	BREAKFAST	86
Enoggera Creek (Enoggera Dam to junction with Breakfast Creek)			
14	Flow from Enoggera Dam (sub-catchments 1 to 14)	ENOGGERA	14
15	Flow from sub-catchment 15	ENOGGERA	15
16	Flow from sub-catchment 16	ENOGGERA	16
18	Flow from sub-catchments 17 and 18	ENOGGERA	18
20	Flow from sub-catchments 19 and 20	ENOGGERA	20
22	Flow from sub-catchments 21 and 22	ENOGGERA	22
23	Flow from sub-catchment 23	ENOGGERA	23
24	Flow from sub-catchment 24	ENOGGERA	24
25	Flow from sub-catchment 25	ENOGGERA	25
26	Flow from sub-catchment 26	ENOGGERA	26
38	Flow from sub-catchment 38	ENOGGERA	38
39	Flow from sub-catchment 39	ENOGGERA	39
40	Flow from sub-catchment 40	ENOGGERA	40
41	Flow from sub-catchment 41	ENOGGERA	41

Table C-5 Inflow Locations to TUFLOW Model cont.

Name of Inflow	Description	Inflow	
		Branch	**Inflow ID**
42	Flow from sub-catchment 42	ENOGGERA	42
43	Flow from sub-catchment 43	ENOGGERA	43
45	Flow from sub-catchment 45	ENOGGERA	45
46	Flow from sub-catchment 46	ENOGGERA	46
47	Flow from sub-catchment 47	ENOGGERA	47
48	Flow from sub-catchment 48	ENOGGERA	48
49	Flow from sub-catchment 49	ENOGGERA	49
50	Flow from sub-catchment 50	ENOGGERA	50
51	Flow from sub-catchment 51	ENOGGERA	51
52	Flow from sub-catchment 52	ENOGGERA	52
53	Flow from sub-catchment 53	ENOGGERA	53
54	Flow from sub-catchment 54	ENOGGERA	54
55	Flow from sub-catchment 55	ENOGGERA	55
Ithaca Creek (JC Slaughter Falls to junction with Enoggera Creek)			
56	Flow from sub-catchment 56	ITHACA	56
57	Flow from sub-catchment 57	ITHACA	57
58	Flow from sub-catchment 58	ITHACA	58
59	Flow from sub-catchment 59	ITHACA	59
60	Flow from sub-catchment 60	ITHACA	60
61	Flow from sub-catchment 61	ITHACA	61
62	Flow from sub-catchment 62	ITHACA	62
63	Flow from sub-catchment 63	ITHACA	63
64	Flow from sub-catchment 64	ITHACA	64
65	Flow from sub-catchment 65	ITHACA	65
66	Flow from sub-catchment 66	ITHACA	66
67	Flow from sub-catchment 67	ITHACA	67
68	Flow from sub-catchment 68	ITHACA	68
69	Flow from sub-catchment 69	ITHACA	69
Fish Creek (Wittonga Park to junction with Enoggera Creek)			
28	Flow from sub-catchment	FISH	10000
27	Flow from sub-catchment	FISH	10149
29	Flow from sub-catchment	FISH	10423
31	Flow from sub-catchment	FISH	10534

Table C-5 Inflow Locations to TUFLOW Model cont.

Name of Inflow	**Description**	**Inflow**	
		Branch	**Inflow ID**
30	Flow from sub-catchment	FISH	30
32	Flow from sub-catchment	FISH	32
34	Flow from sub-catchment	FISH	34
35	Flow from sub-catchment	FISH	35
36	Flow from sub-catchment	FISH	36
37	Flow from sub-catchment	FISH	37

Note: There is no sub-catchment number 44. The inflow locations are similar to MIKE11 Inflow Points.

APPENDIX D: WATER SURFACE LEVEL COMPARISON AT STRUCTURES

This appendix provides comparison of HECRAS analysis results with TUFLOW analysis results at different structure locations and calculated affluxes.

Comparison of Upstream Water Surface Level at Structures

	10 YEAR ARI Event					100 Year ARI Event				
Structure Name	**HECRAS u/s (mAHD)**	**TUFLOW u/s (mAHD)**	**Difference (m)**	**TUFLOW d/s (mAHD)**	**Afflux (m)**	**HECRAS u/s (mAHD)**	**TUFLOW u/s (mAHD)**	**Difference (m)**	**TUFLOW d/s (mAHD)**	**Afflux (m)**
BRIDGES										
Breakfast Creek										
Bishop Street Footbridge	4.96	5.03	0.07	4.79	0.24	6.18	6.14	-0.04	5.77	0.37
Kelvin Grove Road (inbound)	5.38	5.56	0.18	5.22	0.34	6.78	6.85	0.07	6.16	0.69
Murray Street Footbridge	6.63	6.5	-0.13	6.45	0.05	7.84	7.65	-0.19	7.57	0.08
Enoggera Creek										
Park Avenue Footbridge	7.62	7.68	0.06	7.43	0.25	8.51	8.56	0.05	8.34	0.22
Corbie Street Footbridge	8.52	8.81	0.29	8.03	0.78	9.4	9.71	0.31	8.85	0.86
Ashgrove Avenue	10.1	9.93	-0.17	9.54	0.39	11.11	10.78	-0.33	10.38	0.40
Steege Street Footbridge	13.18	12.93	-0.25	12.90	0.03	13.96	13.83	-0.13	13.79	0.04
Stewart Avenue	15.15	15.35	0.2	14.69	0.66	16.51	16.3	-0.21	15.55	0.75
Mirrabooka Road	17.15	16.78	-0.37	16.46	0.32	17.79	17.43	-0.36	17.25	0.18
Glenlyon Drive Footbridge	18.81	18.71	-0.1	18.12	0.59	19.35	19.33	-0.02	18.74	0.59
Royal Parade Footbridge	22.96	23.06	0.1	22.21	0.85	23.61	23.74	0.13	23.21	0.53
Gresham Street	25.42	25.49	0.07	24.56	0.93	25.92	26.12	0.2	25.35	0.77
Waterworks Road	32.95	33.1	0.15	32.77	0.33	33.81	34.1	0.29	33.58	0.52
Shopping Centre Footbridge	35.25	35.41	0.16	34.99	0.42	36.04	36.3	0.26	35.83	0.47
Illowra Street	41.1	41.01	-0.09	40.23	0.78	41.77	42	0.23	40.94	1.06
Riawena Street Footbridge	44.49	44.57	0.08	43.89	0.68	45.44	45.5	0.06	44.62	0.88
School Road	46.36	46.86	0.5	45.90	0.96	47.79	47.79	0	46.67	1.12

Comparison of Upstream Water Surface Level at Structures

	10 YEAR ARI Event					100 Year ARI Event				
Structure Name	**HECRAS u/s (mAHD)**	**TUFLOW u/s (mAHD)**	**Difference (m)**	**TUFLOW d/s (mAHD)**	**Afflux (m)**	**HECRAS u/s (mAHD)**	**TUFLOW u/s (mAHD)**	**Difference (m)**	**TUFLOW d/s (mAHD)**	**Afflux (m)**
BRIDGES										
Ithaca Creek										
Waterworks Road	8.75	9.06	0.31	7.84	1.22	10.61	10.51	-0.1	8.51	2.00
Fulcher Road	12.03	11.9	-0.13	10.98	0.92	12.98	12.85	-0.13	11.52	1.33
Nathan Avenue Footbridge	14.11	13.69	-0.42	13.28	0.41	14.61	14.29	-0.32	14.07	0.22
Dean Street Footbridge	14.63	14.82	0.19	14.38	0.44	15.42	15.58	0.16	15.08	0.50
Lugg Street Footbridge	15.85	15.92	0.07	15.72	0.20	16.69	16.77	0.08	16.43	0.34
Jubilee Terrace	17.18	17.19	0.01	16.69	0.50	18.53	18.24	-0.29	17.54	0.70
Devonshire Street Footbridge	20.32	20.26	-0.06	19.84	0.42	21.04	20.72	-0.32	20.45	0.27
Glen Parade Footbridge	22.95	22.76	-0.19	22.05	0.71	23.47	23.35	-0.12	22.63	0.72
Coopers Camp Road	25.41	25.62	0.21	25.26	0.37	26.18	26.44	0.26	25.91	0.53
Coolibah Street Footbridge	31.21	31.27	0.06	30.17	1.10	31.53	31.61	0.08	30.50	1.11
Bowman Parade Footbridge	33.54	33.58	0.04	33.57	0.01	33.77	33.9	0.13	33.89	0.01
Lilley Avenue	38.31	38.34	0.03	38.11	0.23	39.12	38.79	-0.33	38.57	0.22
Simpsons Road	42.94	43.09	0.15	42.27	0.83	44.13	44.09	-0.04	42.91	1.19
Fish Creek										
Lochinvar Lane Footbridge	33.93	33.9	-0.03	32.89	1.01	34.44	34.71	0.27	33.68	1.03
Quirk Street	37.2	36.89	-0.31	35.88	1.01	37.63	37.32	-0.31	36.42	0.90
Pangela Street Footbridge	38.31	38.64	0.33	37.70	0.94	39.14	39.3	0.16	38.30	1.00
Wittonga Park Footbridge	51.86	52.11	0.25	51.37	0.74	52.34	52.48	0.14	51.82	0.66

Comparison of Upstream Water Surface Level at Structures										
	10 YEAR ARI Event					**100 Year ARI Event**				
Structure Name	**HECRAS u/s (mAHD)**	**TUFLOW u/s (mAHD)**	**Difference (m)**	**TUFLOW d/s (mAHD)**	**Afflux (m)**	**HECRAS u/s (mAHD)**	**TUFLOW u/s (mAHD)**	**Difference (m)**	**TUFLOW d/s (mAHD)**	**Afflux (m)**
CULVERT										
Enoggera Creek										
Dam Causeway	60.14	60.46	0.32	59.91	0.55	60.31	60.73	0.42	60.30	0.43
Tandara Street	37.82	37.79	-0.03	37.19	0.60	38.32	38.32	0	37.87	0.45
Walton Bridge Causeway	34.8	34.87	0.07	34.72	0.15	35.54	35.51	-0.03	35.51	0.20
Ithaca Creek										
JCS3	75.95	76.07	0.12	73.88	2.19	76.53	77.14	0.61	74.39	2.75
JCS2	71.3	71.45	0.15	69.65	1.80	71.62	71.9	0.28	70.23	1.67
JCS1	69.36	69.19	-0.17	66.44	2.75	69.7	69.81	0.11	66.80	3.01
Samuel Griffith Drive	63.1	63.66	0.56	61.66	2.00	64.16	64.11	-0.05	62.09	2.02
Carwoola St	56.69	57.03	0.34	55.57	1.46	57.52	57.44	-0.08	56.10	1.34
Kenwyn Rd	9.65	9.56	-0.09	9.46	0.11	10.62	10.63	0.01	10.61	0.03
Glenrosa Rd	7.23	7.03	-0.2	6.89	0.14	8.18	8.05	-0.13	7.97	0.09
Fish Creek										
Wittonga Park Footpath	50.83	51	0.17	48.48	2.52	51.12	51.27	0.15	48.90	2.37
Settlement Road	41.11	41.32	0.21	39.80	1.53	41.44	41.67	0.23	40.36	1.32

APPENDIX E: DESIGN RESULTS

List of Tables

NB: Shaded cells in **Table E-1** indicate cross sections where the design flood level is lower than the storm surge level. At these locations the storm surge level would govern development levels.

Storm surge levels for the Brisbane River are:

- 100 year storm surge level = 2.5 mAHD
- 50 year storm surge level = 2.2 mAHD
- 20 year storm surge level = 2.1 mAHD
- 10 year storm surge level = 1.9 mAHD
- 5 year storm surge level = 1.9 mAHD
- 2 year storm surge level = 1.8 mAHD

Design event results include the effect of waterway corridors and riparian vegetation within the watercourse. It should be noted that the PMF event in the Brisbane River has not been considered and could be higher than the values reported in **Table E-3**.

Table E-1 Design Event Results – Anticipated Water Levels

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			100yr (m AHD)	50yr (m AHD)	20yr (m AHD)	10yr (m AHD)	5yr (m AHD)	2yr (m AHD)	1yr (m AHD)
Enoggera Creek									
E980	21313	59.42	62.16	62.12	61.99	61.85	61.79	61.67	61.61
E960	21203	59.75	61.25	61.21	61.05	60.87	60.79	60.62	60.54
E950	21029	56.88	60.85	60.81	60.69	60.55	60.48	60.36	60.30
E941	20978	57.22	60.42	60.37	60.22	60.06	59.98	59.82	59.75
Dam Causeway									
E940	20918	57.68	60.19	60.13	59.96	59.77	59.68	59.49	59.40
E930	20689	55.97	58.96	58.91	58.75	58.58	58.48	58.30	58.20
E920	20503	54.70	57.52	57.48	57.36	57.22	57.15	57.00	56.93
E910	20344	54.04	56.09	56.06	55.96	55.84	55.79	55.68	55.62
E900	20123	50.41	52.68	52.64	52.52	52.39	52.32	52.19	52.13
E892	20073	49.62	51.78	51.74	51.61	51.47	51.40	51.27	51.20
E890	19951	47.85	50.83	50.78	50.62	50.44	50.35	50.17	50.09
E880	19692	46.37	49.90	49.79	49.60	49.44	49.25	48.92	48.82
E870	19507	44.80	48.64	48.46	48.19	47.97	47.74	47.35	47.25
E869	19460	44.83	48.48	48.27	47.94	47.69	47.42	46.97	46.84
Gap Pony Club Pipe									
E860	19340	43.34	48.20	47.96	47.60	47.32	47.02	46.50	46.30
E841	19087	42.94	47.77	47.50	47.12	46.83	46.52	45.97	45.67
School Road									
E839	19062	42.94	46.73	46.52	46.19	45.96	45.70	45.24	45.00
E830	18972	41.92	46.31	46.09	45.75	45.51	45.25	44.76	44.51
E820	18865	41.20	45.97	45.74	45.38	45.12	44.84	44.35	44.09
E810	18673	40.46	44.65	44.45	44.14	43.92	43.67	43.23	42.99
Riaweena Street Footbridge									
E800	18456	38.69	43.49	43.30	43.01	42.83	42.63	42.25	42.02
E790	18245	39.03	42.78	42.56	42.21	41.96	41.70	41.27	41.04
E780	18122	37.78	42.36	42.10	41.71	41.42	41.11	40.55	40.20
E770	18047	36.77	42.18	41.92	41.51	41.21	40.88	40.28	39.90
E760	18003	36.48	42.08	41.81	41.40	41.10	40.77	40.16	39.77
E751	17967	36.33	41.96	41.69	41.28	40.98	40.65	40.06	39.67
Illowra Street									
E749	17944	36.60	41.00	40.80	40.49	40.26	40.00	39.52	39.22
E740	17865	36.40	40.47	40.27	39.97	39.75	39.51	39.04	38.75
E730	17682	35.03	39.81	39.62	39.33	39.12	38.89	38.44	38.14
E720	17550	34.85	39.38	39.19	38.92	38.73	38.52	38.10	37.82
E710	17316	34.36	38.44	38.23	37.95	37.79	37.63	37.35	37.18

Table E-1 Design Event Results – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			100yr (m AHD)	50yr (m AHD)	20yr (m AHD)	10yr (m AHD)	5yr (m AHD)	2yr (m AHD)	1yr (m AHD)
Tandara Street Footbridge									
E705	17282	33.88	38.02	37.80	37.47	37.24	36.98	36.55	36.27
E700	17225	33.27	37.87	37.64	37.30	37.04	36.76	36.26	35.95
E690	17137	32.64	37.55	37.30	36.94	36.67	36.39	35.86	35.53
E680	16939	31.74	36.97	36.69	36.31	36.04	35.75	35.22	34.90
E670	16775	31.63	36.67	36.37	35.97	35.69	35.38	34.83	34.48
E668	16721	31.00	36.45	36.14	35.74	35.45	35.14	34.57	34.21
Shopping Centre Footbridge									
E659	16658	30.50	36.06	35.74	35.34	35.06	34.75	34.20	33.81
Walton Bridge Reserve Causeway									
E650	16410	29.71	35.34	34.99	34.53	34.23	33.90	33.33	32.99
E640	16242	28.88	35.01	34.63	34.12	33.79	33.43	32.79	32.40
E630	16118	28.56	34.86	34.44	33.91	33.57	33.19	32.53	32.14
E629	16087	28.99	34.84	34.41	33.88	33.53	33.15	32.49	32.09
E621	16059	28.68	34.81	34.38	33.84	33.49	33.11	32.44	32.04
Waterworks Road									
E619	16030	28.43	34.47	34.06	33.56	33.25	32.90	32.29	31.91
E610	15985	28.24	34.42	34.01	33.50	33.19	32.83	32.22	31.84
E600	15926	27.45	34.36	33.94	33.43	33.10	32.74	32.11	31.70
E590	15886	27.25	34.30	33.88	33.36	33.03	32.66	32.01	31.59
E580	15715	26.68	34.16	33.72	33.19	32.86	32.47	31.79	31.34
E575	15648	26.74	34.09	33.64	33.11	32.77	32.38	31.70	31.24
E571	15574	26.19	33.89	33.43	32.88	32.54	32.14	31.46	31.01
E560	15454	25.86	33.85	33.39	32.83	32.48	32.07	31.37	30.90
E556	15420	25.93	33.84	33.38	32.81	32.46	32.06	31.34	30.87
E551	15249	24.86	33.74	33.28	32.71	32.36	31.95	31.23	30.75
E540	15176	26.30	33.61	33.15	32.59	32.24	31.83	31.12	30.64
Bennett Road									
E536	15063	23.78	29.98	29.66	29.26	28.97	28.64	28.05	27.66
E530	14987	23.90	29.71	29.37	28.96	28.67	28.32	27.69	27.26
E531	14958	23.70	29.59	29.26	28.85	28.55	28.20	27.55	27.10
E520	14864	22.76	29.15	28.80	28.37	28.06	27.69	27.03	26.57
E510	14697	22.26	28.79	28.44	28.00	27.68	27.31	26.59	26.09
E500	14540	20.95	28.22	27.89	27.47	27.17	26.81	26.10	25.58
E480	14296	20.71	27.33	27.03	26.65	26.38	26.05	25.35	24.79
E470	14185	20.53	27.07	26.77	26.39	26.12	25.78	25.06	24.45
E450	14064	19.88	26.89	26.59	26.21	25.94	25.60	24.87	24.21
E440	13973	20.03	26.74	26.45	26.08	25.81	25.47	24.72	24.03
E413	13853	19.95	26.49	26.22	25.86	25.60	25.27	24.51	23.82

Table E-1 Design Event Results – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			100yr (m AHD)	50yr (m AHD)	20yr (m AHD)	10yr (m AHD)	5yr (m AHD)	2yr (m AHD)	1yr (m AHD)
Gresham Street									
E411	13841	19.48	25.61	25.35	25.02	24.76	24.44	23.82	23.38
E409	13728	18.64	25.29	25.02	24.70	24.43	24.11	23.51	23.08
E400	13632	18.68	25.03	24.76	24.43	24.19	23.88	23.29	22.86
E395	13555	17.86	24.80	24.53	24.21	23.98	23.70	23.12	22.71
E390	13517	17.39	24.67	24.41	24.09	23.87	23.59	23.04	22.64
E380	13403	17.33	24.18	23.93	23.65	23.46	23.23	22.76	22.41
E362	13217	16.90	23.78	23.52	23.24	23.07	22.85	22.43	22.11
Royal Parade Footbridge									
E360	13206	16.82	23.33	23.02	22.61	22.34	21.99	21.38	20.94
E350	13041	16.37	22.83	22.51	22.08	21.80	21.40	20.74	20.28
E340	12820	14.97	22.38	22.04	21.62	21.32	20.90	20.17	19.69
E330	12538	14.70	21.49	21.14	20.72	20.41	19.99	19.18	18.65
E320	12291	13.82	20.82	20.51	20.11	19.82	19.43	18.61	18.04
E310	12152	13.51	20.64	20.35	19.95	19.68	19.28	18.46	17.88
E300	12038	12.79	20.18	19.90	19.56	19.31	18.94	18.12	17.51
E290	11977	12.97	19.82	19.58	19.27	19.04	18.69	17.87	17.21
E281	11902	12.41	19.61	19.37	19.08	18.86	18.52	17.69	17.02
Glenlyon Drive Footbridge									
E279	11890	12.56	19.00	18.77	18.47	18.25	17.94	17.25	16.70
E270	11821	11.83	18.84	18.61	18.31	18.08	17.76	17.05	16.51
E260	11709	11.57	18.59	18.34	18.02	17.79	17.46	16.72	16.17
E250	11609	11.39	18.38	18.13	17.81	17.57	17.22	16.49	15.95
E240	11473	11.08	18.02	17.77	17.45	17.22	16.87	16.15	15.69
E235	11423	11.12	17.89	17.64	17.33	17.10	16.76	16.03	15.61
E233	11373	10.83	17.78	17.53	17.23	17.00	16.65	15.92	15.51
Mirrabooka Road Footbridge									
E231	11365	11.00	17.68	17.43	17.12	16.89	16.54	15.83	15.42
Mirrabooka Road									
E229	11349	11.16	17.38	17.13	16.80	16.56	16.19	15.56	15.13
E220	11215	10.11	17.16	16.90	16.58	16.34	15.97	15.33	14.89
E210	11028	10.54	16.83	16.52	16.15	15.91	15.55	14.90	14.48
E200	10818	9.47	16.56	16.22	15.78	15.48	15.05	14.37	13.95
E191	10776	9.92	16.48	16.14	15.70	15.39	14.96	14.27	13.85
Stewart Road									
E189	10742	9.58	15.67	15.38	14.99	14.74	14.42	13.88	13.53
E180	10567	8.63	15.01	14.72	14.31	14.07	13.76	13.24	12.90
E170	10404	8.51	14.29	13.99	13.62	13.37	13.04	12.50	12.25
E160	10268	8.04	13.84	13.55	13.18	12.93	12.60	12.04	11.94

Table E-1 Design Event Results – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			100yr (m AHD)	50yr (m AHD)	20yr (m AHD)	10yr (m AHD)	5yr (m AHD)	2yr (m AHD)	1yr (m AHD)
Steege Street Footbridge									
E158	10258	7.82	13.81	13.51	13.15	12.91	12.58	12.02	11.89
E150	10203	7.90	13.71	13.42	13.06	12.82	12.49	11.93	11.59
E140	9990	7.54	13.27	12.97	12.62	12.37	12.05	11.50	11.17
E130	9878	7.30	12.89	12.59	12.23	11.99	11.67	11.14	10.83
E120	9694	7.04	12.60	12.28	11.90	11.64	11.31	10.79	10.48
E110	9591	6.66	12.41	12.08	11.69	11.43	11.10	10.57	10.26
E105	9455	6.63	12.23	11.89	11.49	11.22	10.88	10.33	10.00
E100	9264	6.32	12.01	11.65	11.22	10.94	10.58	10.01	9.68
E90	8843	5.46	11.53	11.11	10.64	10.31	9.89	9.22	8.80
E80	8656	3.75	11.39	10.97	10.48	10.14	9.71	8.99	8.53
E71	8586	4.50	11.27	10.85	10.37	10.04	9.61	8.90	8.44
Ashgrove Avenue									
E69	8566	4.76	10.68	10.35	9.94	9.66	9.29	8.66	8.23
E60	8301	3.49	10.11	9.76	9.39	9.13	8.81	8.21	7.79
E51	8038	3.07	9.84	9.46	9.08	8.82	8.51	7.92	7.48
Corbie Street Footbridge									
E40	7761	2.72	9.00	8.54	8.12	7.90	7.60	7.14	6.82
E35	7706	1.65	8.90	8.44	8.01	7.79	7.50	7.04	6.72
Park Avenue Footbridge									
E30	7630	2.36	8.65	8.17	7.69	7.48	7.19	6.73	6.43
E20	7330	1.43	8.48	7.96	7.40	7.19	6.89	6.36	6.06
E10	7201	1.04	8.43	7.90	7.30	7.09	6.77	6.21	5.89
Breakfast Creek									
B661	6946	0.18	8.27	7.73	7.04	6.83	6.53	5.93	5.57
Murray Street Footbridge									
B650	6737	0.56	8.08	7.56	6.85	6.61	6.34	5.74	5.39
B647	6670	-0.12	7.86	7.35	6.57	6.33	6.07	5.40	5.01
Bancroft Park Gauging Weir									
B641	6551	0.41	7.74	7.25	6.43	6.18	5.91	5.21	4.78
Kelvin Grove Road									
B629	6503	-0.14	7.07	6.76	6.07	5.91	5.71	5.07	4.67
B620	6487	-0.58	7.05	6.74	6.16	5.92	5.69	5.04	4.65
B610	6409	-0.43	7.06	6.80	6.31	6.10	5.71	5.06	4.67
B600	6317	0.00	7.14	6.73	6.31	6.01	5.64	5.00	4.61
B590	6217	-0.05	7.11	6.62	6.24	5.94	5.57	4.93	4.55
B580	6124	-0.38	7.04	6.52	6.15	5.86	5.48	4.84	4.45
B570	6036	-1.09	6.93	6.42	6.05	5.76	5.38	4.73	4.33
B561	5992	-0.10	6.92	6.40	6.02	5.72	5.35	4.69	4.30

Table E-1 Design Event Results – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			100yr (m AHD)	50yr (m AHD)	20yr (m AHD)	10yr (m AHD)	5yr (m AHD)	2yr (m AHD)	1yr (m AHD)
Bishop Street Footbridge									
B559	5983	-0.14	6.68	6.20	5.83	5.55	5.19	4.57	4.19
B550	5959	-0.89	6.67	6.19	5.81	5.54	5.18	4.56	4.18
B540	5879	-0.76	6.64	6.15	5.76	5.48	5.12	4.49	4.12
B530	5796	-0.67	6.62	6.13	5.74	5.46	5.09	4.46	4.09
B520	5616	-1.16	6.57	6.07	5.67	5.39	5.01	4.39	4.01
B510	5518	-0.59	6.52	6.03	5.63	5.35	4.98	4.35	3.98
B500	5423	-0.73	6.49	6.00	5.60	5.32	4.95	4.31	3.94
B490	5240	-0.96	6.38	5.88	5.48	5.19	4.81	4.20	3.84
B480	5150	-1.30	6.25	5.75	5.31	5.00	4.65	4.07	3.73
B470	5050	-1.33	6.09	5.59	5.14	4.85	4.51	3.96	3.64
B460	4957	-1.22	6.05	5.55	5.09	4.79	4.45	3.90	3.59
B450	4853	-1.64	5.95	5.45	4.97	4.65	4.29	3.74	3.45
B441	4754	-0.94	5.85	5.36	4.87	4.55	4.18	3.61	3.34
Noble Street Footbridge									
B439	4740	-1.25	5.79	5.31	4.83	4.52	4.15	3.58	3.31
B430	4657	-1.28	5.71	5.24	4.76	4.43	4.06	3.49	3.24
B420	4568	-1.73	5.70	5.23	4.74	4.41	4.03	3.44	3.17
B410	4478	-1.46	5.69	5.22	4.73	4.41	4.02	3.44	3.17
B400	4414	-1.35	5.69	5.22	4.73	4.41	4.02	3.43	3.16
B391	4372	-1.50	5.69	5.22	4.73	4.40	4.02	3.43	3.15
Downey Park Footbridge									
B389	4362	-1.81	5.69	5.22	4.73	4.40	4.02	3.43	3.15
B380	4313	-1.90	5.69	5.22	4.73	4.40	4.01	3.42	3.13
B370	4195	-1.67	5.68	5.20	4.71	4.38	3.98	3.36	3.05
B360	4071	-2.02	5.64	5.17	4.67	4.33	3.93	3.27	2.94
B350	3961	-2.20	5.63	5.16	4.66	4.32	3.91	3.24	2.90
B340	3866	-2.76	5.62	5.14	4.64	4.29	3.89	3.21	2.87
B331	3785	-2.16	5.55	5.07	4.54	4.19	3.79	3.13	2.80
Bowen Bridge Road									
B329	3739	-1.99	5.36	4.87	4.30	3.97	3.61	3.00	2.70
B320	3573	-2.04	5.29	4.79	4.21	3.89	3.53	2.92	2.62
B310	3402	-2.04	5.24	4.73	4.15	3.83	3.46	2.84	2.54
B300	3161	-2.42	5.08	4.58	4.01	3.68	3.32	2.71	2.42
B290	2905	-2.02	4.98	4.48	3.91	3.57	3.22	2.61	2.32
B280	2822	-2.08	4.95	4.44	3.87	3.53	3.18	2.56	2.28
B272	2731	-2.34	4.85	4.31	3.73	3.39	3.06	2.48	2.22
Railway loop									
B270	2705	-2.41	4.77	4.26	3.69	3.36	3.04	2.47	2.20
B261	2521	-2.14	4.58	4.06	3.51	3.17	2.86	2.32	2.08

Table E-1 Design Event Results – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			100yr (m AHD)	50yr (m AHD)	20yr (m AHD)	10yr (m AHD)	5yr (m AHD)	2yr (m AHD)	1yr (m AHD)
Ferny Grove Railway									
B259	2436	-2.27	4.53	4.01	3.47	3.13	2.82	2.28	2.05
B250	2393	-3.01	4.41	3.87	3.33	3.01	2.70	2.19	1.96
B240	2308	-2.49	4.25	3.70	3.18	2.87	2.59	2.10	1.89
B230	2166	-2.36	4.12	3.54	3.03	2.72	2.45	1.99	1.80
B220	2069	-2.85	4.10	3.53	3.01	2.70	2.43	1.98	1.79
B201	1938	-2.63	3.95	3.36	2.87	2.57	2.31	1.89	1.72
North Coast Railway									
B199	1886	-3.23	3.66	3.27	2.77	2.46	2.21	1.76	1.59
B191	1825	-3.79	3.47	3.10	2.63	2.34	2.10	1.70	1.54
Hudson Road									
B180	1781	-3.98	3.40	3.04	2.57	2.31	2.07	1.68	1.52
B171	1653	-3.24	3.28	2.93	2.48	2.23	2.00	1.63	1.49
Abbotsford Road									
B169	1615	-2.95	3.22	2.88	2.43	2.19	1.96	1.61	1.47
B160	1488	-3.74	2.88	2.60	2.21	2.00	1.80	1.51	1.39
B150	1391	-3.40	2.77	2.48	2.09	1.89	1.72	1.45	1.35
B140	1288	-3.30	2.70	2.44	2.06	1.87	1.70	1.43	1.34
B130	1186	-2.87	2.73	2.45	2.06	1.86	1.69	1.43	1.33
B120	1025	-3.04	2.73	2.46	2.06	1.86	1.69	1.43	1.33
B110	917	-3.40	2.56	2.31	1.95	1.77	1.61	1.38	1.29
B100	850	-3.31	2.46	2.21	1.85	1.68	1.54	1.34	1.25
B90	667	-4.09	2.34	2.09	1.76	1.61	1.48	1.30	1.23
B80	590	-4.39	1.96	1.74	1.49	1.38	1.30	1.19	1.15
B70	478	-4.15	1.66	1.48	1.30	1.23	1.18	1.11	1.10
B60	356	-4.64	1.50	1.35	1.20	1.15	1.12	1.08	1.07
B50	252	-3.32	1.49	1.33	1.18	1.14	1.11	1.08	1.07
B40	205	-3.49	1.48	1.32	1.17	1.13	1.11	1.08	1.07
Breakfast Creek Road									
B39	168	-4.20	1.41	1.26	1.13	1.10	1.08	1.06	1.06
B30	109	-4.24	1.05	1.05	1.05	1.05	1.05	1.05	1.05
B20	37	-3.75	1.05	1.05	1.05	1.05	1.05	1.05	1.05
B10	0	-4.23	1.05	1.05	1.05	1.05	1.05	1.05	1.05
Ithaca Creek									
I526	32871	72.36	77.28	76.80	76.39	76.14	75.86	75.36	75.03
JC Slaughter Falls Crossing No 3									
I520	32849	71.69	75.04	74.77	74.53	74.39	74.22	73.93	73.73
I513	32652	68.64	71.86	71.67	71.50	71.40	71.27	71.04	70.85
JC Slaughter Falls Crossing No 2									
I511	32634	67.95	70.38	70.14	69.93	69.80	69.65	69.36	69.22
I510	32577	67.10	69.94	69.68	69.46	69.31	69.14	68.80	68.47
I503	32504	65.50	69.73	69.48	69.26	69.12	68.96	68.62	68.28

Table E-1 Design Event Results – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			100yr (m AHD)	50yr (m AHD)	20yr (m AHD)	10yr (m AHD)	5yr (m AHD)	2yr (m AHD)	1yr (m AHD)
JC Slaughter Falls Crossing No 1									
I501	32477	64.63	66.90	66.77	66.63	66.55	66.45	66.20	66.02
I500	32352	63.22	65.01	64.84	64.69	64.59	64.53	64.41	64.29
I490	32221	61.07	64.27	64.12	63.96	63.83	63.64	62.91	62.57
I481	32133	60.63	64.01	63.87	63.72	63.59	63.41	62.65	62.28
Sir Samuel Griffiths Drive									
I479	32120	59.64	62.22	62.06	61.89	61.77	61.62	61.34	61.13
I470	31957	57.96	61.15	61.02	60.81	60.72	60.60	60.34	60.23
I460	31758	56.73	58.52	58.32	58.17	58.04	57.91	57.72	57.45
I450	31561	54.00	58.10	57.80	57.56	57.34	57.09	56.75	56.23
Carwoola Street									
I430	31526	53.90	56.46	56.18	55.91	55.76	55.58	55.27	55.05
I420	31300	51.30	54.61	54.39	54.13	54.00	53.83	53.55	53.36
I410	31134	50.15	52.65	52.36	52.13	52.02	51.89	51.68	51.54
I400	30988	47.07	50.52	50.23	49.90	49.73	49.53	49.19	48.97
I390	30889	45.55	48.91	48.66	48.40	48.27	48.12	47.80	47.59
I380	30767	43.94	47.16	46.94	46.72	46.62	46.50	46.31	46.16
I362	30431	40.24	44.23	43.82	43.38	43.16	42.90	42.47	42.19
Simpsons Road									
I360	30408	40.04	43.09	42.82	42.52	42.37	42.19	41.87	41.66
I350	30293	38.13	41.13	40.95	40.75	40.65	40.55	40.39	40.22
I340	30129	36.41	39.56	39.32	39.07	38.95	38.81	38.55	38.40
I330	30002	35.28	39.26	39.02	38.76	38.62	38.47	38.16	37.92
I329	29976	35.52	39.14	38.91	38.64	38.51	38.36	38.05	37.82
Lilley Avenue Footbridge									
I320	29877	33.90	37.02	36.82	36.64	36.55	36.45	36.26	36.14
I310	29747	31.89	35.04	34.88	34.68	34.58	34.46	34.22	34.07
I300	29652	30.67	34.26	34.10	33.94	33.85	33.73	33.52	33.33
Bowman Parade									
I293	29635	30.72	34.09	33.92	33.76	33.65	33.53	33.30	33.12
Bowman Parade Footbridge									
I289	29619	30.84	34.05	33.88	33.71	33.61	33.49	33.26	33.08
I280	29498	29.20	32.89	32.69	32.46	32.31	32.14	31.78	31.54
I275	29405	27.87	32.14	31.92	31.72	31.59	31.45	31.14	30.90
Coolibah Street Footbridge									
I273	29388	27.43	30.80	30.59	30.42	30.31	30.19	29.94	29.79
I270	29287	26.76	29.98	29.72	29.47	29.32	29.16	28.87	28.65
I265	29115	24.58	28.68	28.37	28.08	27.91	27.73	27.41	27.17
I260	28953	23.52	27.13	26.78	26.46	26.27	26.06	25.71	25.47
I259	28892	23.50	26.85	26.50	26.17	25.98	25.76	25.40	25.15

Table E-1 Design Event Results – Anticipated Water Levels cont

BCC Cross Section ID)	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			100yr (m AHD)	50yr (m AHD)	20yr (m AHD)	10yr (m AHD)	5yr (m AHD)	2yr (m AHD)	1yr (m AHD)
Kamber Street Pipe									
I257	28866	23.07	26.78	26.43	26.10	25.90	25.69	25.32	25.07
I252	28824	22.60	26.70	26.34	26.01	25.82	25.61	25.24	24.98
I251	28790	22.95	26.53	26.17	25.83	25.63	25.42	25.05	24.80
Coopers Camp Road									
I249	28771	22.45	26.03	25.74	25.47	25.30	25.11	24.79	24.58
I240	28595	20.77	24.93	24.68	24.45	24.29	24.06	23.66	23.38
I230	28366	19.20	23.90	23.64	23.38	23.20	22.95	22.47	22.13
I226	28289	18.63	23.53	23.29	23.04	22.87	22.62	22.13	21.76
Glen Parade Footbridge									
I224	28285	18.71	23.00	22.76	22.51	22.33	22.11	21.71	21.42
I220	28135	17.55	21.77	21.50	21.23	21.06	20.88	20.53	20.28
I210	28043	17.23	21.20	20.97	20.73	20.59	20.43	20.13	19.90
I203	27932	16.65	20.89	20.66	20.44	20.30	20.15	19.84	19.60
Devonshire Street Footbridge									
I201	27923	16.67	20.62	20.37	20.10	19.93	19.73	19.36	19.11
I200	27819	15.86	20.33	20.04	19.71	19.51	19.27	18.83	18.55
I190	27637	15.14	19.28	18.94	18.63	18.44	18.24	17.90	17.66
I180	27544	14.23	18.78	18.36	17.98	17.76	17.50	17.04	16.77
I171	27395	13.36	18.47	18.00	17.54	17.26	16.95	16.40	16.06
Jubilee Terrace									
I169	27347	13.36	17.82	17.44	17.05	16.81	16.53	16.05	15.76
I160	27182	12.33	17.30	16.95	16.56	16.32	16.04	15.56	15.25
I154	27097	12.06	17.13	16.77	16.38	16.12	15.82	15.31	14.99
Lugg Street Footbridge									
I151	26929	11.50	16.18	15.88	15.55	15.34	15.07	14.57	14.26
Jason Street V Weir									
I149	26924	11.07	16.03	15.74	15.42	15.20	14.93	14.41	14.10
I141	26826	10.61	15.35	15.06	14.76	14.57	14.32	13.82	13.49
Dean Street Footbridge									
I140	26766	10.02	15.14	14.85	14.55	14.37	14.13	13.62	13.30
I131	26589	9.40	14.64	14.39	14.13	13.96	13.73	13.22	12.88
Nathan Avenue Footbridge									
I120	26327	8.04	13.18	12.84	12.45	12.22	11.96	11.51	11.20
I111	26237	7.85	13.03	12.65	12.23	11.99	11.70	11.23	10.92
Fulcher Road									
I109	26221	7.77	11.95	11.67	11.40	11.25	11.06	10.75	10.52
I100	26080	7.07	11.20	10.81	10.55	10.43	10.30	10.05	9.88
I90	25982	6.04	11.03	10.56	10.24	10.12	9.98	9.76	9.61
I81	25866	6.36	10.95	10.38	9.95	9.78	9.62	9.42	9.28

Table E-1 Design Event Results – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			100yr (m AHD)	50yr (m AHD)	20yr (m AHD)	10yr (m AHD)	5yr (m AHD)	2yr (m AHD)	1yr (m AHD)
Kenwyn Road									
I79	25849	6.27	10.88	10.28	9.80	9.58	9.36	9.07	8.85
I70	25803	5.94	10.85	10.23	9.71	9.46	9.20	8.88	8.64
I60	25701	5.00	10.80	10.14	9.55	9.23	8.90	8.41	8.13
I59	25648	4.87	10.79	10.12	9.51	9.17	8.81	8.23	7.90
I51	25577	4.38	10.71	10.05	9.44	9.11	8.74	8.13	7.79
Waterworks Road									
I49	25536	4.02	8.93	8.48	8.17	8.00	7.81	7.47	7.27
I40	25395	3.62	8.74	8.21	7.90	7.70	7.48	7.05	6.76
I35	25352	3.33	8.66	8.12	7.74	7.52	7.29	6.82	6.51
I30	25314	3.50	8.61	8.07	7.62	7.41	7.14	6.66	6.33
I21	25189	2.74	8.54	8.00	7.49	7.29	6.97	6.45	6.09
Glenrosa Road									
I19	25166	2.69	8.46	7.93	7.36	7.16	6.83	6.28	5.96
I10	25063	1.70	8.42	7.89	7.28	7.07	6.75	6.18	5.84
Fish Creek									
F212	32982	52.86	54.74	54.58	54.42	54.33	54.23	54.05	53.90
F200	32833	51.47	53.28	53.19	53.11	53.04	52.94	52.78	52.62
F192	32763	49.58	52.52	52.35	52.14	52.01	51.83	51.52	51.24
Wittonga Park Footbridge									
F190	32585	47.51	51.39	51.28	51.15	51.08	50.98	50.73	50.22
F183	32559	47.46	51.27	51.15	51.01	50.94	50.84	50.59	50.09
Wittonga Park Footpath									
F181	32538	46.24	49.28	49.16	48.81	48.71	48.56	48.24	47.97
Hilder Road									
F179	32508	45.84	48.48	48.28	48.08	47.97	47.83	47.55	47.35
F170	32448	44.88	47.99	47.76	47.53	47.39	47.22	46.87	46.66
F160	32274	42.60	46.59	46.37	46.15	46.03	45.87	45.53	45.28
F150	32000	41.00	43.95	43.69	43.44	43.30	43.11	42.78	42.58
F140	31898	39.26	43.16	42.87	42.57	42.40	42.18	41.69	41.33
F130	31802	37.95	42.63	42.35	42.08	41.92	41.71	41.16	40.53
F111	31608	36.42	42.03	41.84	41.64	41.52	41.35	40.83	40.04
Settlement Road									
F109	31586	36.27	40.78	40.55	40.30	40.15	39.94	39.51	39.15
F108	31557	36.07	40.46	40.22	39.96	39.79	39.58	39.17	38.91
F106	31525	36.06	40.37	40.12	39.85	39.68	39.46	39.03	38.78
F100	31401	35.79	39.91	39.65	39.35	39.16	38.91	38.40	38.07
F90	31258	34.53	39.72	39.44	39.12	38.93	38.66	38.11	37.77
F81	31166	34.10	39.53	39.26	38.95	38.75	38.49	37.90	37.57

Table E-1 Design Event Results – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			100yr (m AHD)	50yr (m AHD)	20yr (m AHD)	10yr (m AHD)	5yr (m AHD)	2yr (m AHD)	1yr (m AHD)
Pangela Street Footbridge									
F79	31150	33.95	38.52	38.26	38.02	37.86	37.68	37.36	37.11
F70	31023	33.17	38.12	37.88	37.66	37.52	37.36	37.08	36.87
F60	30875	32.78	37.86	37.64	37.43	37.30	37.15	36.92	36.73
F55	30845	32.60	37.80	37.59	37.39	37.26	37.11	36.88	36.70
F51	30802	32.27	37.64	37.42	37.22	37.09	36.95	36.72	36.53
Quirk Street									
F49	30789	32.33	36.48	36.19	35.95	35.83	35.70	35.42	35.20
F48	30770	32.35	36.45	36.15	35.91	35.79	35.65	35.37	35.15
F40	30605	31.66	36.22	35.83	35.49	35.31	35.10	34.75	34.49
F30	30389	30.76	36.05	35.59	35.12	34.86	34.52	33.90	33.55
F20	30224	29.84	35.94	35.46	34.97	34.68	34.31	33.50	32.98
F13	30157	29.24	35.12	34.77	34.38	34.14	33.83	33.08	32.59
Romea Street Culvert									
F12	30117	28.89	34.86	34.53	34.15	33.91	33.61	32.89	32.41
Lochinvar Lane Footbridge									
F10	30071	28.45	34.43	34.02	33.52	33.21	32.87	32.27	31.89

Table E-2 Design Event Results – Anticipated Flows

BCC Cross Section ID	Peak Flow Rate (m^3/s) 100 yr	50 yr	20 yr	10 yr	5 yr	2 yr	1 yr
Enoggera Creek							
E980	103.2	99.2	87.4	74.7	68.9	58.4	53.7
E960	103.2	99.2	87.4	74.7	68.9	58.3	53.7
E950	99.7	95.9	84.8	72.3	67.0	57.2	52.9
E941	103.5	99.6	90.6	79.7	73.3	61.4	55.6
E940	122.9	117.2	101.1	84.9	77.5	63.8	57.7
E930	102.3	98.3	86.8	74.7	69.1	58.6	53.7
E920	100.5	96.6	85.3	74.0	68.6	58.4	53.6
E910	106.0	101.7	89.4	76.7	70.8	59.5	54.3
E900	104.6	100.5	87.9	75.8	70.1	59.2	54.2
E892	95.6	91.9	81.4	70.8	65.8	56.1	51.6
E890	104.4	100.2	88.3	76.3	70.5	59.6	54.5
E880	162.9	144.0	118.9	102.6	87.3	63.2	57.4
E870	159.3	141.4	117.9	102.1	86.9	63.0	57.4
E869	169.3	146.6	117.8	101.8	86.6	62.8	57.4
E860	148.9	135.7	116.2	101.4	86.2	62.4	57.4
E841	173.6	156.4	131.9	115.2	98.2	71.3	58.1
E839	178.4	157.4	131.5	115.0	98.1	71.1	58.1
E830	171.8	155.2	130.9	114.4	97.6	70.8	58.1
E820	169.5	154.3	130.2	113.8	97.0	70.4	58.1
E810	170.3	153.9	129.9	113.5	96.7	70.2	58.1
E800	175.3	157.6	132.3	115.0	97.5	70.0	58.1
E790	212.8	191.6	156.0	132.5	109.4	75.1	58.7
E780	188.9	169.6	141.0	122.0	103.0	73.7	58.6
E770	178.9	161.4	136.2	119.1	101.6	73.6	58.5
E760	178.6	161.2	136.1	119.1	101.6	73.5	58.5
E751	179.1	161.5	136.2	119.3	101.7	73.6	58.5
E749	175.1	158.7	134.8	118.5	101.4	73.5	58.5
E740	179.9	162.6	136.7	119.0	101.2	73.3	58.5
E730	178.0	160.6	135.6	118.6	101.1	73.0	58.5
E720	183.1	164.9	139.2	121.8	103.9	75.0	59.4
E710	185.0	166.7	141.2	123.6	105.6	76.4	60.5
E705	182.5	160.1	133.1	117.3	101.0	74.9	59.3
E700	180.5	164.2	137.5	120.1	102.4	74.8	59.2
E690	196.2	173.5	141.6	122.9	103.9	74.6	59.1
E680	179.2	163.0	137.8	120.5	102.7	74.2	58.9
E670	180.8	162.7	137.6	120.2	102.6	74.1	58.8
E668	150.8	139.2	123.3	109.2	96.0	69.8	58.9
E659	236.1	207.4	172.0	149.1	123.9	87.9	68.1
E650	238.8	208.0	172.6	149.0	126.6	89.4	71.7
E640	208.9	193.4	165.1	144.9	123.6	89.6	72.0
E630	223.1	196.8	167.3	148.1	126.9	92.0	74.1
E629	230.9	202.3	169.7	148.9	127.0	92.1	74.2
E621	229.9	202.2	169.7	148.9	127.0	92.2	74.3

Table E-2 Design Event Results – Anticipated Flows cont

BCC Cross Section ID	Peak Flow Rate (m^3/s)						
	100 yr	50 yr	20 yr	10 yr	5 yr	2 yr	1 yr
E619	224.8	200.4	169.1	148.9	127.1	92.4	74.4
E610	324.4	288.0	241.8	212.8	189.0	141.7	116.0
E600	376.4	330.2	275.5	244.7	210.2	153.1	123.5
E590	366.4	324.2	273.1	241.6	207.4	150.9	121.4
E580	363.6	320.2	268.8	238.4	204.7	151.3	121.2
E575	371.6	325.8	271.7	239.8	205.6	150.4	121.1
E571	384.3	332.5	276.1	243.7	209.1	154.8	125.9
E560	382.4	334.8	280.2	248.7	214.8	160.2	129.4
E556	380.2	333.7	280.7	249.2	215.3	161.3	130.4
E551	396.3	346.1	289.1	255.8	219.9	163.3	132.6
E540	296.2	262.6	223.9	200.7	175.3	134.3	110.5
E536	447.9	392.3	328.2	286.8	243.4	175.2	135.1
E530	407.5	358.8	303.5	269.3	230.3	168.4	132.2
E531	435.6	381.0	319.7	282.6	241.4	175.0	134.9
E520	440.6	385.4	323.8	283.6	240.9	174.5	134.5
E510	453.8	395.8	328.8	283.1	240.4	173.9	134.1
E500	432.5	381.5	322.0	282.8	240.1	173.5	133.9
E480	448.7	391.9	329.3	288.7	245.8	177.2	137.3
E470	449.1	393.2	330.2	289.5	245.4	176.3	136.7
E450	450.9	394.1	329.4	288.6	245.5	176.8	137.3
E440	428.2	376.3	317.3	280.2	240.1	176.8	137.5
E413	458.2	401.3	337.6	295.5	249.7	176.6	137.3
E411	458.7	413.9	349.0	303.8	253.1	169.8	135.7
E409	460.4	406.4	350.3	295.4	247.6	174.6	130.0
E400	457.3	402.0	338.4	297.2	250.9	176.3	135.2
E395	463.9	404.7	336.8	294.3	249.1	178.9	138.5
E390	512.9	449.2	372.6	321.6	273.7	192.9	148.5
E380	429.5	378.5	319.9	283.1	242.7	177.6	138.2
E362	577.8	419.3	354.1	311.7	260.9	184.2	140.9
E360	708.3	604.1	491.6	421.4	338.1	221.5	159.0
E350	445.4	393.7	323.8	284.0	239.1	174.3	137.0
E340	455.3	405.1	339.7	297.8	250.1	175.2	136.6
E330	495.9	421.6	352.5	311.0	258.0	181.6	140.8
E320	454.7	389.9	324.4	291.8	250.3	176.2	138.4
E310	489.7	430.7	357.0	311.9	252.0	177.2	138.2
E300	514.9	448.7	372.7	324.1	265.5	184.6	143.5
E290	440.8	387.6	328.7	291.6	246.5	178.7	140.7
E281	480.5	417.3	349.7	305.9	252.4	178.2	140.7
E279	499.7	437.6	368.6	325.1	268.5	181.0	140.6
E270	491.0	427.0	353.9	308.5	255.7	178.5	140.5
E260	474.3	414.5	347.7	305.6	253.6	177.4	140.4
E250	492.5	425.1	350.7	304.5	249.5	177.2	141.0
E240	471.3	410.2	341.7	298.6	246.6	177.0	156.3
E235	458.1	398.2	331.0	289.3	240.6	177.4	159.5
E233	487.8	427.4	357.8	311.0	252.5	202.5	199.3

Table E-2 Design Event Results – Anticipated Flows cont

BCC Cross Section ID	Peak Flow Rate (m^3/s)						
	100 yr	**50 yr**	**20 yr**	**10 yr**	**5 yr**	**2 yr**	**1 yr**
E231	487.5	427.2	357.6	310.9	252.4	202.5	199.1
E229	567.6	497.7	412.4	353.4	275.6	178.5	149.9
E220	462.1	414.9	354.1	308.3	253.2	178.7	142.0
E210	437.3	365.1	299.4	270.6	237.6	176.3	143.3
E200	463.9	407.2	342.4	298.9	245.3	178.5	142.4
E191	547.0	409.6	341.8	300.2	250.4	179.9	142.9
E189	428.4	362.2	297.5	261.7	225.1	170.6	139.4
E180	460.7	396.6	314.8	276.2	231.9	167.6	132.0
E170	455.1	395.0	329.7	290.0	243.2	176.3	157.4
E160	465.9	407.2	380.2	363.8	343.3	323.4	322.3
E158	516.1	444.7	366.2	318.1	259.5	205.0	177.4
E150	469.2	408.4	341.5	300.5	250.7	180.1	150.6
E140	463.9	405.6	340.5	300.0	250.7	180.3	144.0
E130	417.5	371.5	320.6	287.5	242.9	177.2	142.3
E120	503.1	443.1	372.4	325.7	269.1	189.0	148.9
E110	453.8	394.7	331.2	292.8	245.5	177.8	142.8
E105	482.7	423.4	355.7	313.9	263.4	189.5	150.8
E100	475.8	410.3	341.0	300.1	250.5	180.5	144.7
E90	446.2	392.5	330.3	291.7	246.1	178.5	143.5
E80	483.6	421.4	349.4	305.2	253.1	181.8	145.1
E71	466.8	406.6	338.1	296.3	246.6	178.4	143.4
E69	484.8	48.4	337.9	296.1	246.4	178.3	143.3
E60	470.9	405.5	336.7	296.1	245.8	177.9	142.7
E51	470.1	408.7	335.8	297.7	244.4	177.3	141.7
E40	459.7	407.4	338.1	295.5	243.9	174.7	140.8
E35	467.0	408.1	335.2	294.5	245.3	177.5	141.8
E30	453.0	396.8	326.9	286.6	235.4	170.8	137.1
E20	427.7	387.6	328.2	294.5	241.5	176.8	141.9
E10	394.0	365.0	318.4	289.1	239.8	177.3	142.1

Table E-2 Design Event Results – Anticipated Flows cont

BCC Cross Section ID	Peak Flow Rate (m^3/s)						
	100 yr	50 yr	20 yr	10 yr	5 yr	2 yr	1 yr
Breakfast Creek							
B661	608.5	538.3	436.8	400.4	316.7	234.2	189.5
B650	460.9	418.9	340.4	321.6	245.6	193.9	165.6
B647	662.3	570.9	469.5	417.2	341.4	247.1	196.8
B641	627.2	562.6	452.3	431.6	323.4	237.9	191.9
B629	650.1	557.0	451.4	433.5	322.8	237.4	191.6
B620	621.2	564.8	471.9	451.9	322.7	237.4	191.6
B610	618.8	588.4	496.4	472.9	322.3	236.9	191.3
B600	634.0	593.5	492.7	470.5	322.1	237.2	192.0
B590	615.6	583.5	477.5	457.5	320.8	235.6	190.4
B580	614.4	588.9	469.9	452.4	319.4	234.5	189.5
B570	607.0	558.4	437.2	413.4	314.8	231.6	187.8
B561	486.4	415.9	349.7	311.7	255.6	191.1	158.8
B559	428.8	363.8	309.3	275.6	228.9	173.8	146.5
B550	608.0	521.3	435.0	390.2	313.5	229.2	185.9
B540	611.4	525.4	437.4	393.3	315.0	230.2	187.1
B530	615.3	525.4	439.3	386.7	316.2	231.0	188.3
B520	626.2	530.3	449.3	392.9	326.6	238.6	194.6
B510	610.6	511.2	433.1	375.8	311.6	227.5	186.1
B500	616.7	512.2	433.9	374.8	310.2	225.9	185.1
B490	597.2	486.9	418.1	364.9	302.9	221.4	182.2
B480	597.2	486.6	416.7	362.0	303.3	221.2	182.0
B470	599.1	488.5	417.5	363.3	304.7	222.5	183.3
B460	596.8	486.4	415.8	362.3	304.1	221.9	183.0
B450	593.4	483.3	412.5	360.5	302.8	221.3	182.6
B441	572.2	481.0	409.5	358.4	301.3	220.8	182.2
B439	567.7	480.5	409.0	358.0	301.0	220.7	182.1
B430	593.8	481.4	405.0	355.6	299.5	220.2	182.4
B420	574.6	466.9	387.9	342.0	288.9	213.8	177.6
B410	546.2	445.0	370.4	327.9	279.0	209.6	175.1
B400	349.1	301.7	266.1	245.6	223.2	192.6	168.2
B391	147.2	143.3	141.9	141.2	137.3	129.0	124.1
B389	184.6	172.1	165.6	161.2	154.8	143.4	134.7
B380	179.6	168.0	161.9	157.8	152.3	142.1	134.1
B370	557.8	451.0	373.9	328.3	278.0	207.0	172.6
B360	198.5	175.8	158.8	152.2	147.1	143.6	140.3
B350	485.1	396.8	333.4	295.6	255.3	199.4	169.0
B340	551.2	444.8	369.0	322.4	273.8	204.3	170.0
B331	538.9	442.5	367.2	321.5	272.7	203.8	169.6
B329	534.8	442.3	366.7	321.1	272.6	203.8	169.6
B320	388.7	366.6	335.9	308.3	274.5	206.6	172.8
B310	382.5	361.9	333.5	306.0	273.0	205.7	172.1
B300	536.8	438.6	365.4	321.4	272.8	204.2	171.3
B290	528.0	437.1	364.2	320.9	272.3	204.1	171.9
B280	529.3	438.8	364.8	321.5	272.8	204.1	171.8

Table E-2 Design Event Results – Anticipated Flows cont

BCC Cross Section ID	Peak Flow Rate (m^3/s)						
	100 yr	50 yr	20 yr	10 yr	5 yr	2 yr	1 yr
B272	511.9	430.9	360.2	319.5	271.1	203.2	171.6
B270	510.3	430.5	360.1	319.4	271.0	203.2	171.6
B261	496.1	428.7	358.8	319.5	271.1	203.4	171.9
B259	491.8	427.9	357.6	319.4	271.0	203.4	171.9
B250	489.1	427.2	356.7	319.3	270.9	203.4	172.0
B240	483.8	426.8	355.8	319.2	270.8	203.3	171.9
B230	478.3	425.5	352.2	318.2	270.5	203.2	171.9
B220	476.3	426.0	352.8	311.0	271.1	203.8	172.6
B201	480.9	429.0	355.4	313.2	273.1	205.3	174.4
B199	481.3	429.1	355.4	313.5	273.2	205.4	174.4
B191	480.2	429.0	355.3	313.2	273.1	205.3	174.3
B180	479.7	428.9	355.2	313.3	273.2	205.3	174.3
B171	478.6	428.7	355.1	313.2	273.1	205.4	174.3
B169	478.1	428.7	355.1	313.1	273.2	205.8	174.4
B160	478.3	428.6	355.0	313.2	273.2	205.4	174.4
B150	479.6	429.5	355.8	314.1	273.8	205.8	174.9
B140	480.3	430.3	356.4	314.9	274.5	206.0	175.2
B130	479.0	429.3	355.7	313.8	273.8	205.8	175.3
B120	478.2	429.1	355.5	313.7	273.8	205.7	175.0
B110	477.8	429.0	355.4	313.6	273.8	205.7	175.0
B100	476.5	428.9	355.5	313.6	273.8	205.8	175.0
B90	478.7	431.0	358.3	315.0	275.0	206.7	175.9
B80	478.6	431.3	357.9	315.1	275.0	206.8	176.2
B70	478.5	431.0	357.1	315.0	275.0	206.6	176.1
B60	478.5	430.9	357.0	315.0	275.0	206.6	176.1
B50	479.8	431.9	357.8	315.7	275.6	207.0	176.5
B40	479.9	432.0	357.9	315.8	275.7	207.1	176.5
B39	480.3	432.1	357.9	315.8	275.7	207.2	176.5
B30	481.3	432.1	358.0	315.8	275.7	207.2	176.5
B20	480.7	432.2	358.0	315.8	275.7	207.1	176.5
B10	481.2	433.0	358.8	316.5	276.1	207.3	176.7

Table E-2 Design Event Results – Anticipated Flows cont

BCC Cross Section ID	Peak Flow Rate (m^3/s)						
	100 yr	**50 yr**	**20 yr**	**10 yr**	**5 yr**	**2 yr**	**1 yr**
Ithaca Creek							
I526	55.1	45.0	36.8	32.4	27.7	20.4	15.6
I520	55.0	44.9	36.7	32.3	27.6	20.2	15.6
I513	54.7	44.6	36.4	32.1	27.4	20.1	15.5
I511	64.5	53.1	43.5	37.7	31.9	22.2	17.2
I510	54.6	43.4	38.4	38.8	38.0	34.9	31.2
I503	54.2	44.1	36.1	31.8	27.1	19.8	14.7
I501	68.7	54.9	43.3	37.2	30.6	20.7	15.2
I500	46.0	39.0	33.5	33.4	28.5	19.8	15.2
I490	51.1	42.5	34.6	30.3	26.0	19.3	15.2
I481	50.1	38.9	34.4	30.3	26.1	19.3	15.2
I479	63.8	53.3	42.6	36.1	29.4	19.3	15.2
I470	54.6	43.9	34.3	30.0	25.7	19.1	15.1
I460	65.8	55.1	45.1	45.0	38.5	29.8	22.4
I450	113.0	97.2	75.9	67.7	58.8	47.1	35.0
I430	157.9	125.7	100.1	85.7	70.9	48.1	34.9
I420	144.0	118.7	92.8	81.3	68.8	50.7	40.4
I410	150.0	114.5	90.5	79.8	68.1	50.7	40.4
I400	136.5	114.2	90.4	79.8	68.1	50.7	40.4
I390	114.3	94.8	75.6	66.9	57.4	43.6	35.5
I380	131.1	108.2	85.7	75.8	64.9	47.6	38.6
I370	136.6	111.4	89.4	79.4	67.7	50.4	40.2
I362	136.6	112.5	89.9	79.3	67.8	50.4	40.2
I360	156.9	129.5	103.3	91.2	78.5	57.9	46.2
I350	155.9	129.5	103.4	91.3	78.6	58.1	46.2
I340	155.5	128.8	103.1	91.2	78.4	57.5	46.1
I330	145.1	121.6	99.1	88.1	76.3	56.6	46.1
I329	155.4	128.6	102.1	91.1	78.4	57.2	46.1
I320	109.9	91.0	73.6	62.6	54.7	40.8	33.3
I310	100.4	87.9	74.4	67.8	60.4	46.9	39.2
I300	191.2	156.7	127.8	112.8	96.0	70.8	56.2
I293	189.5	154.4	125.1	109.8	93.2	68.7	59.7
I289	241.9	197.4	159.6	138.5	115.4	80.4	61.3
I280	180.5	149.7	123.6	109.2	93.3	67.8	53.9
I275	135.1	112.5	93.5	82.8	72.5	55.3	46.7
I273	213.8	176.2	146.8	129.4	111.3	78.6	59.5
I270	239.7	194.5	158.4	137.5	117.7	85.7	65.3
I265	178.6	146.6	119.3	105.3	90.9	68.2	54.0
I260	177.5	146.0	119.2	105.2	90.8	68.1	54.0
I259	177.7	146.0	119.2	105.2	90.7	68.0	54.0
I257	177.7	146.1	119.1	105.1	90.7	68.0	54.0
I252	173.0	143.6	118.7	105.1	90.7	68.0	54.0
I251	188.7	154.4	126.1	111.3	96.0	71.9	57.4

Table E-2 Design Event Results – Anticipated Flows cont

BCC Cross Section ID	Peak Flow Rate (m^3/s)						
	100 yr	**50 yr**	**20 yr**	**10 yr**	**5 yr**	**2 yr**	**1 yr**
I249	186.1	153.9	126.1	111.3	96.0	71.9	57.4
I240	186.7	153.9	125.9	110.9	95.6	71.6	57.3
I230	206.5	166.9	135.8	117.6	99.8	73.5	59.3
I226	195.4	160.4	130.1	113.8	98.1	73.2	59.3
I224	269.6	222.4	176.4	149.0	119.6	77.5	59.7
I220	240.3	193.3	152.8	129.9	107.9	75.1	59.1
I210	187.9	152.5	125.6	109.7	94.0	69.3	57.7
I203	186.9	156.4	128.4	112.9	97.8	72.7	58.2
I201	235.0	194.6	159.1	138.0	115.4	79.8	60.7
I200	239.0	196.1	153.0	129.2	106.0	73.1	58.0
I190	195.1	161.8	131.4	114.2	96.9	71.6	57.5
I180	212.1	171.5	142.2	125.5	106.3	74.9	60.7
I171	204.6	169.9	139.4	122.8	104.7	75.3	60.7
I169	199.9	166.2	136.1	119.6	102.3	74.9	60.4
I160	198.3	162.3	134.3	117.5	101.1	74.2	60.1
I157	201.3	165.8	135.6	118.8	101.7	74.5	60.1
I154	263.2	207.8	162.2	138.4	115.0	80.1	62.8
I151	172.6	143.0	117.8	105.9	91.0	69.3	57.2
I149	211.3	175.5	144.5	127.1	108.3	77.4	61.7
I141	263.9	215.4	168.6	119.4	113.0	75.7	60.5
I140	240.4	193.2	153.5	133.3	113.8	82.9	66.1
I131	215.5	176.9	141.4	122.7	103.3	76.6	61.3
I120	258.7	208.6	160.8	137.0	112.7	77.2	60.7
I111	206.2	169.4	137.9	121.3	104.0	77.4	62.1
I109	163.4	135.5	113.4	102.6	89.6	71.7	59.0
I100	220.2	179.6	146.4	128.3	109.1	79.5	62.7
I90	162.0	131.4	104.8	92.1	80.2	62.1	52.4
I81	215.9	181.1	148.1	130.3	110.8	82.2	65.4
I79	255.2	218.0	182.1	163.7	143.7	110.6	89.9
I70	199.3	165.5	134.6	118.2	103.4	82.7	65.6
I60	213.9	180.0	148.6	130.6	111.2	78.7	63.0
I59	210.7	174.8	144.6	127.0	107.1	77.6	61.3
I51	205.9	171.9	141.6	125.1	107.5	80.1	64.5
I49	156.2	134.4	113.8	103.2	90.2	71.1	59.5
I40	209.4	173.5	143.3	125.3	106.9	79.4	64.2
I35	198.4	162.2	133.5	118.2	101.8	78.6	64.2
I30	193.3	159.7	132.4	118.2	103.0	77.7	63.2
I21	199.4	166.3	137.3	121.6	105.6	80.1	64.2
I19	233.9	190.3	155.7	135.8	115.1	80.4	62.3
I10	218.0	186.1	154.2	135.7	115.4	84.9	66.8

Table E-2 Design Event Results – Anticipated Flows cont

BCC Cross Section ID	Peak Flow Rate (m^3/s)						
	100 yr	**50 yr**	**20 yr**	**10 yr**	**5 yr**	**2 yr**	**1 yr**
Fish Creek							
F212	27.4	22.8	19.1	17.2	14.9	11.5	8.8
F200	34.9	31.1	28.0	25.3	22.0	17.0	13.1
F192	43.2	35.1	28.2	25.1	21.8	16.2	12.9
F190	48.7	42.0	35.5	32.2	28.1	20.7	16.4
F183	54.9	46.6	38.7	34.7	29.8	21.5	16.1
F181	54.8	46.6	38.6	34.6	29.7	21.2	15.7
F179	93.5	78.6	64.7	57.7	49.0	34.5	25.9
F170	99.5	82.9	67.9	60.4	51.5	36.9	29.4
F160	105.3	88.5	73.6	65.8	56.3	40.8	32.3
F150	104.3	87.6	72.8	65.1	55.8	40.8	32.2
F140	104.2	87.3	72.4	64.7	55.3	40.3	32.0
F130	129.8	109.0	90.8	81.2	69.6	51.2	42.3
F111	123.4	104.6	88.2	79.1	68.3	51.4	41.3
F109	149.2	123.6	102.6	90.1	75.4	52.2	41.2
F108	137.7	116.7	99.3	86.8	74.0	51.9	41.2
F106	148.2	125.1	104.2	90.0	75.9	51.7	41.2
F100	126.1	102.9	86.3	78.4	69.5	51.2	41.0
F90	158.4	130.1	107.8	97.3	84.6	64.8	52.9
F81	174.1	142.0	116.6	103.2	88.7	66.1	52.9
F79	228.9	180.9	139.8	117.1	95.0	65.3	52.8
F70	171.8	141.1	117.6	105.1	91.7	69.4	55.7
F60	187.1	152.2	124.9	110.6	96.1	72.6	58.1
F55	170.1	138.9	115.1	103.0	90.6	69.2	56.2
F51	187.2	152.1	124.8	110.9	96.2	72.5	58.0
F49	217.3	174.7	143.4	125.5	107.4	79.2	62.3
F48	180.4	148.7	122.7	109.0	95.4	72.4	57.9
F40	184.3	150.0	122.8	109.8	94.9	72.0	57.5
F30	164.6	137.4	114.1	103.4	90.5	70.6	56.7
F20	173.6	144.2	118.8	105.9	90.2	68.2	55.7
F13	149.4	127.1	108.0	98.3	86.0	67.5	55.5
F12	185.3	153.5	123.9	108.4	90.2	67.4	55.4
F10	162.2	135.5	112.8	101.2	87.9	69.4	57.3

Table E-3 Extreme Event and Climate Change Analysis Results – Anticipated Water Levels

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			200yr Design (m AHD)	200yr 2050 (m AHD)	200yr 2100 (m AHD)	500yr Design (m AHD)	500yr 2100 (m AHD)	2000yr (m AHD)	PMF (m AHD)
Enoggera Creek									
E980	21313	59.42	62.52	62.95	63.40	63.24	64.34	63.73	68.53
E960	21203	59.75	61.72	62.24	62.74	62.57	63.72	63.09	67.98
E950	21029	56.88	61.24	61.70	62.11	61.96	62.83	62.37	65.56
E941	20978	57.22	60.86	61.33	61.74	61.60	62.47	62.02	65.15
Dam Causeway									
E940	20918	57.68	60.67	61.17	61.59	61.44	62.33	61.87	64.99
E930	20689	55.97	59.37	59.73	60.02	59.93	60.49	60.07	62.55
E920	20503	54.70	57.85	58.12	58.36	58.27	58.97	58.45	61.52
E910	20344	54.04	56.37	56.72	57.03	56.93	57.70	57.23	60.90
E900	20123	50.41	53.02	53.35	53.69	53.57	54.40	53.84	57.40
E892	20073	49.62	52.16	52.56	52.89	52.78	53.58	53.00	56.53
E890	19951	47.85	51.26	51.70	52.06	51.95	52.60	52.20	54.50
E880	19692	46.37	50.12	50.21	50.32	50.27	50.82	50.51	53.85
E870	19507	44.80	49.12	49.33	49.73	49.56	50.63	49.94	53.96
E869	19460	44.83	49.04	49.27	49.67	49.49	50.56	49.87	53.84
Gap Pony Club Pipe									
E860	19340	43.34	48.82	49.07	49.44	49.26	50.35	49.64	53.68
E841	19087	42.94	48.46	48.73	49.04	48.86	49.90	49.22	53.04
School Road									
E839	19062	42.94	47.19	47.39	47.75	47.55	48.71	48.02	51.97
E830	18972	41.92	46.78	46.98	47.35	47.14	48.31	47.61	51.69
E820	18865	41.20	46.46	46.67	47.05	46.84	48.16	47.32	51.64
E810	18673	40.46	45.10	45.27	45.56	45.39	46.55	45.77	49.67
Riaweena Street Footbridge									
E800	18456	38.69	43.93	44.13	44.45	44.25	45.47	44.69	48.47
E790	18245	39.03	43.27	43.48	43.76	43.61	44.77	43.95	47.82
E780	18122	37.78	42.90	43.12	43.43	43.26	44.51	43.63	47.49
E770	18047	36.77	42.74	42.96	43.28	43.11	44.37	43.48	47.19
E760	18003	36.48	42.64	42.87	43.19	43.02	44.29	43.38	47.04
E751	17967	36.33	42.52	42.74	43.06	42.89	44.15	43.25	46.86
Illowra Street									
E749	17944	36.60	41.40	41.56	41.79	41.67	42.76	41.99	45.72
E740	17865	36.40	40.88	41.05	41.28	41.17	42.31	41.52	45.51
E730	17682	35.03	40.24	40.42	40.65	40.54	41.65	40.88	44.92
E720	17550	34.85	39.80	39.97	40.17	40.09	41.13	40.38	44.05
E710	17316	34.36	38.87	39.05	39.22	39.16	39.99	39.32	42.82

Table E-3 Extreme Event and Climate Change Analysis Results – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			200yr Design (m AHD)	200yr 2050 (m AHD)	200yr 2100 (m AHD)	500yr Design (m AHD)	500yr 2100 (m AHD)	2000yr (m AHD)	PMF (m AHD)
Tandara Street Footbridge									
E705	17282	33.88	38.47	38.64	38.79	38.74	39.45	38.87	41.90
E700	17225	33.27	38.33	38.50	38.65	38.60	39.25	38.74	41.65
E690	17137	32.64	38.03	38.21	38.37	38.31	38.99	38.50	41.52
E680	16939	31.74	37.42	37.58	37.74	37.69	38.40	37.77	41.34
E670	16775	31.63	37.12	37.29	37.44	37.39	38.02	37.38	40.91
E668	16721	31.00	36.89	37.05	37.21	37.15	37.72	37.03	40.75
Shopping Centre Footbridge									
E659	16658	30.50	36.48	36.66	36.83	36.77	37.25	36.56	40.56
Walton Bridge Reserve Causeway									
E650	16410	29.71	35.76	35.97	36.18	36.10	36.58	35.98	40.49
E640	16242	28.88	35.47	35.74	36.00	35.90	36.45	35.65	40.47
E630	16118	28.56	35.34	35.63	35.89	35.80	36.36	35.49	40.18
E629	16087	28.99	35.32	35.62	35.88	35.78	36.35	35.48	40.15
E621	16059	28.68	35.28	35.58	35.84	35.74	36.30	35.41	40.01
Waterworks Road									
E619	16030	28.43	34.82	35.08	35.30	35.22	35.67	34.61	37.71
E610	15985	28.24	34.76	35.02	35.24	35.16	35.60	34.49	37.50
E600	15926	27.45	34.68	34.95	35.17	35.09	35.53	34.32	37.36
E590	15886	27.25	34.61	34.88	35.10	35.02	35.46	34.15	37.15
E580	15715	26.68	34.42	34.70	34.91	34.84	35.25	33.64	36.42
E575	15648	26.74	34.32	34.61	34.82	34.74	35.15	33.43	36.22
E571	15574	26.19	34.08	34.38	34.59	34.52	34.91	33.21	36.35
E560	15454	25.86	34.02	34.33	34.54	34.46	34.86	33.01	36.24
E556	15420	25.93	34.00	34.31	34.52	34.45	34.84	32.94	36.20
E551	15249	24.86	33.86	34.18	34.38	34.31	34.69	32.47	35.82
E540	15176	26.30	33.73	34.04	34.24	34.17	34.55	32.27	35.68
Bennett Road									
E536	15063	23.78	30.62	30.78	31.00	30.92	31.41	31.28	34.50
E530	14987	23.90	30.35	30.50	30.72	30.64	31.12	30.99	34.24
E531	14958	23.70	30.23	30.38	30.61	30.53	31.01	30.89	34.13
E520	14864	22.76	29.82	29.97	30.21	30.12	30.61	30.47	33.75
E510	14697	22.26	29.44	29.59	29.83	29.74	30.21	30.04	33.14
E500	14540	20.95	28.80	28.95	29.16	29.08	29.51	29.27	32.09
E480	14296	20.71	27.80	27.93	28.11	28.05	28.45	28.09	30.77
E470	14185	20.53	27.50	27.63	27.80	27.74	28.11	27.68	30.25
E450	14064	19.88	27.29	27.41	27.58	27.52	27.88	27.37	29.89
E440	13973	20.03	27.12	27.24	27.40	27.34	27.69	27.14	29.64
E413	13853	19.95	26.83	26.94	27.09	27.04	27.37	26.83	29.29

Table E-3 Extreme Event and Climate Change Analysis Results – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			200yr Design (m AHD)	200yr 2050 (m AHD)	200yr 2100 (m AHD)	500yr Design (m AHD)	500yr 2100 (m AHD)	2000yr (m AHD)	PMF (m AHD)
Gresham Street									
E411	13841	19.48	26.10	26.22	26.39	26.33	26.71	26.35	28.93
E409	13728	18.64	25.81	25.93	26.11	26.04	26.46	26.21	28.89
E400	13632	18.68	25.53	25.66	25.83	25.77	26.17	25.94	28.61
E395	13555	17.86	25.31	25.44	25.61	25.54	25.95	25.70	28.29
E390	13517	17.39	25.18	25.31	25.48	25.41	25.81	25.57	28.08
E380	13403	17.33	24.66	24.78	24.95	24.89	25.26	25.04	27.40
E362	13217	16.90	24.26	24.39	24.56	24.50	24.87	24.72	27.15
Royal Parade Footbridge									
E360	13206	16.82	23.85	23.99	24.16	24.09	24.47	24.33	26.65
E350	13041	16.37	23.33	23.45	23.60	23.54	23.87	23.73	25.75
E340	12820	14.97	22.88	23.02	23.18	23.12	23.49	23.31	25.61
E330	12538	14.70	22.07	22.21	22.39	22.32	22.71	22.49	24.71
E320	12291	13.82	21.34	21.48	21.65	21.59	22.00	21.52	24.02
E310	12152	13.51	21.12	21.25	21.40	21.34	21.72	21.18	23.59
E300	12038	12.79	20.61	20.73	20.88	20.82	21.19	20.68	22.79
E290	11977	12.97	20.23	20.35	20.49	20.44	20.78	20.23	22.14
E281	11902	12.41	20.00	20.11	20.25	20.20	20.53	19.97	21.87
Glenlyon Drive Footbridge									
E279	11890	12.56	19.41	19.52	19.67	19.61	19.95	19.48	21.45
E270	11821	11.83	19.26	19.37	19.52	19.46	19.80	19.36	21.35
E260	11709	11.57	19.03	19.14	19.28	19.23	19.57	19.09	21.14
E250	11609	11.39	18.84	18.95	19.09	19.04	19.38	18.85	20.99
E240	11473	11.08	18.47	18.58	18.73	18.68	19.03	18.44	20.65
E235	11423	11.12	18.34	18.45	18.60	18.54	18.91	18.31	20.49
E233	11373	10.83	18.23	18.34	18.50	18.44	18.81	18.22	20.40
Mirrabooka Road Footbridge									
E231	11365	11.00	18.13	18.25	18.41	18.35	18.73	18.19	20.41
Mirrabooka Road									
E229	11349	11.16	17.85	17.99	18.16	18.09	18.49	18.12	20.47
E220	11215	10.11	17.63	17.78	17.96	17.89	18.32	17.97	20.38
E210	11028	10.54	17.36	17.52	17.72	17.64	18.10	17.70	20.09
E200	10818	9.47	17.12	17.30	17.50	17.42	17.88	17.48	19.97
E191	10776	9.92	17.03	17.20	17.41	17.33	17.78	17.38	19.84
Stewart Road									
E189	10742	9.58	16.19	16.32	16.46	16.41	16.74	16.49	18.84
E180	10567	8.63	15.55	15.70	15.87	15.80	16.19	16.00	18.59
E170	10404	8.51	14.86	15.02	15.20	15.13	15.55	15.39	18.07
E160	10268	8.04	14.40	14.56	14.74	14.67	15.10	14.92	17.72

Table E-3 Extreme Event and Climate Change Analysis Results – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			200yr Design (m AHD)	200yr 2050 (m AHD)	200yr 2100 (m AHD)	500yr Design (m AHD)	500yr 2100 (m AHD)	2000yr (m AHD)	PMF (m AHD)
Steege Street Footbridge									
E158	10258	7.82	14.36	14.51	14.70	14.63	15.04	14.87	17.56
E150	10203	7.90	14.26	14.42	14.60	14.53	14.94	14.77	17.45
E140	9990	7.54	13.81	13.97	14.14	14.08	14.47	14.22	16.88
E130	9878	7.30	13.45	13.60	13.78	13.72	14.12	13.86	16.57
E120	9694	7.04	13.18	13.34	13.52	13.45	13.85	13.53	16.25
E110	9591	6.66	13.00	13.16	13.34	13.27	13.67	13.28	15.99
E105	9455	6.63	12.83	12.99	13.17	13.10	13.49	13.03	15.65
E100	9264	6.32	12.63	12.79	12.96	12.90	13.27	12.70	15.29
E90	8843	5.46	12.18	12.34	12.50	12.44	12.78	11.88	14.60
E80	8656	3.75	12.05	12.21	12.38	12.31	12.66	11.76	14.55
E71	8586	4.50	11.92	12.09	12.26	12.20	12.56	11.69	14.53
Ashgrove Avenue									
E69	8566	4.76	11.22	11.39	11.59	11.51	11.95	11.40	14.46
E60	8301	3.49	10.66	10.88	11.12	11.03	11.57	11.13	14.36
E51	8038	3.07	10.40	10.64	10.91	10.80	11.39	10.89	14.17
Corbie Street Footbridge									
E40	7761	2.72	9.66	9.94	10.23	10.12	10.72	9.94	13.30
E35	7706	1.65	9.57	9.86	10.14	10.03	10.63	9.85	13.19
Park Avenue Footbridge									
E30	7630	2.36	9.36	9.66	9.96	9.85	10.45	9.66	13.05
E20	7330	1.43	9.21	9.53	9.84	9.72	10.34	9.50	13.00
E10	7201	1.04	9.18	9.50	9.81	9.69	10.32	9.45	12.98
Breakfast Creek									
B661	6946	0.18	9.04	9.37	9.69	9.57	10.19	9.19	12.82
Murray Street Footbridge									
B650	6737	0.56	8.86	9.19	9.51	9.39	9.98	8.69	12.44
B647	6670	-0.12	8.67	9.02	9.34	9.22	9.81	8.37	12.21
Bancroft Park Gauging Weir									
B641	6551	0.41	8.57	8.93	9.25	9.13	9.72	8.18	12.09
Kelvin Grove Road									
B629	6503	-0.14	7.61	7.88	8.13	8.03	8.50	6.20	10.28
B620	6487	-0.58	7.55	7.80	8.05	7.95	8.42	6.89	10.10
B610	6409	-0.43	7.57	7.81	8.03	7.94	8.39	6.80	9.99
B600	6317	0.00	7.48	7.70	7.90	7.82	8.23	7.13	9.72
B590	6217	-0.05	7.43	7.65	7.85	7.76	8.18	7.24	9.79
B580	6124	-0.38	7.36	7.58	7.78	7.70	8.11	7.22	9.76
B570	6036	-1.09	7.26	7.46	7.65	7.58	7.97	6.98	9.53
B561	5992	-0.10	7.25	7.47	7.66	7.58	7.99	7.09	9.52

Table E-3 Extreme Event and Climate Change Analysis Results – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			200yr Design (m AHD)	200yr 2050 (m AHD)	200yr 2100 (m AHD)	500yr Design (m AHD)	500yr 2100 (m AHD)	2000yr (m AHD)	PMF (m AHD)
Bishop Street Footbridge									
B559	5983	-0.14	6.99	7.18	7.36	7.28	7.68	6.63	9.42
B550	5959	-0.89	6.98	7.17	7.35	7.27	7.67	6.74	9.45
B540	5879	-0.76	6.95	7.14	7.32	7.24	7.64	6.76	9.44
B530	5796	-0.67	6.94	7.13	7.31	7.23	7.63	6.76	9.44
B520	5616	-1.16	6.89	7.08	7.25	7.18	7.58	6.71	9.43
B510	5518	-0.59	6.85	7.04	7.21	7.14	7.53	6.61	9.40
B500	5423	-0.73	6.82	7.00	7.17	7.10	7.49	6.54	9.38
B490	5240	-0.96	6.71	6.89	7.06	6.99	7.38	6.47	9.23
B480	5150	-1.30	6.60	6.77	6.95	6.87	7.26	6.37	9.13
B470	5050	-1.33	6.44	6.62	6.80	6.72	7.12	6.28	9.03
B460	4957	-1.22	6.41	6.59	6.77	6.69	7.08	6.27	9.03
B450	4853	-1.64	6.34	6.52	6.70	6.62	7.01	6.23	8.95
B441	4754	-0.94	6.25	6.43	6.61	6.53	6.91	6.16	8.82
Noble Street Footbridge									
B439	4740	-1.25	6.18	6.36	6.54	6.46	6.83	6.10	8.67
B430	4657	-1.28	6.12	6.30	6.47	6.39	6.75	6.09	8.69
B420	4568	-1.73	6.10	6.28	6.46	6.38	6.73	6.07	8.65
B410	4478	-1.46	6.10	6.28	6.45	6.37	6.73	6.07	8.64
B400	4414	-1.35	6.10	6.28	6.45	6.37	6.73	6.07	8.64
B391	4372	-1.50	6.10	6.28	6.46	6.37	6.73	6.07	8.64
Downey Park Footbridge									
B389	4362	-1.81	6.10	6.28	6.45	6.37	6.73	6.07	8.64
B380	4313	-1.90	6.10	6.28	6.45	6.37	6.73	6.07	8.64
B370	4195	-1.67	6.09	6.27	6.45	6.37	6.72	6.08	8.65
B360	4071	-2.02	6.06	6.24	6.41	6.33	6.69	6.07	8.65
B350	3961	-2.20	6.06	6.24	6.41	6.33	6.69	6.07	8.69
B340	3866	-2.76	6.05	6.23	6.41	6.34	6.68	6.06	8.68
B331	3785	-2.16	6.01	6.20	6.38	6.30	6.65	6.02	8.65
Bowen Bridge Road									
B329	3739	-1.99	5.87	6.08	6.26	6.18	6.53	5.86	8.40
B320	3573	-2.04	5.83	6.03	6.22	6.14	6.49	5.84	8.38
B310	3402	-2.04	5.76	5.94	6.11	6.04	6.35	5.75	8.04
B300	3161	-2.42	5.59	5.77	5.92	5.86	6.13	5.54	7.59
B290	2905	-2.02	5.49	5.66	5.80	5.74	6.00	5.47	7.47
B280	2822	-2.08	5.47	5.63	5.77	5.71	5.97	5.49	7.49
B272	2731	-2.34	5.40	5.57	5.71	5.65	5.92	5.39	7.47
Railway loop									
B270	2705	-2.41	5.30	5.47	5.61	5.55	5.84	5.20	7.38
B261	2521	-2.14	5.15	5.30	5.44	5.38	5.69	5.06	7.30

Table E-3 Extreme Event and Climate Change Analysis Results – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			200yr Design (m AHD)	200yr 2050 (m AHD)	200yr 2100 (m AHD)	500yr Design (m AHD)	500yr 2100 (m AHD)	2000yr (m AHD)	PMF (m AHD)
Ferny Grove Railway									
B259	2436	-2.27	5.13	5.29	5.43	5.37	5.68	5.10	7.20
B250	2393	-3.01	5.07	5.25	5.40	5.33	5.66	5.04	7.13
B240	2308	-2.49	4.96	5.16	5.31	5.25	5.60	4.98	7.12
B230	2166	-2.36	4.87	5.07	5.24	5.16	5.55	4.97	7.12
B220	2069	-2.85	4.83	5.03	5.19	5.11	5.50	4.95	7.10
B201	1938	-2.63	4.63	4.84	5.01	4.93	5.35	4.77	7.04
North Coast Railway									
B199	1886	-3.23	4.17	4.34	4.51	4.41	4.86	4.20	6.81
B191	1825	-3.79	3.98	4.14	4.29	4.20	4.60	4.08	6.54
Hudson Road									
B180	1781	-3.98	3.90	4.05	4.21	4.11	4.52	4.05	6.43
B171	1653	-3.24	3.78	3.94	4.10	3.99	4.42	4.01	6.40
Abbotsford Road									
B169	1615	-2.95	3.65	3.80	3.98	3.87	4.31	3.88	6.34
B160	1488	-3.74	3.40	3.56	3.78	3.68	4.11	3.74	6.22
B150	1391	-3.40	3.41	3.57	3.79	3.69	4.14	3.77	6.21
B140	1288	-3.30	3.31	3.48	3.71	3.60	4.07	3.72	6.19
B130	1186	-2.87	3.29	3.46	3.69	3.59	4.05	3.72	6.18
B120	1025	-3.04	3.30	3.46	3.68	3.58	4.01	3.65	5.85
B110	917	-3.40	3.10	3.27	3.50	3.39	3.85	3.54	5.81
B100	850	-3.31	3.03	3.19	3.42	3.32	3.77	3.47	5.74
B90	667	-4.09	2.90	3.08	3.33	3.21	3.69	3.44	5.67
B80	590	-4.39	2.51	2.71	3.00	2.87	3.39	3.21	5.53
B70	478	-4.15	2.19	2.36	2.67	2.54	3.10	3.04	5.38
B60	356	-4.64	1.95	2.10	2.38	2.29	2.74	2.50	5.11
B50	252	-3.32	1.95	2.05	2.29	2.21	2.65	2.40	4.83
B40	205	-3.49	3.65	3.80	3.98	3.87	4.31	3.88	6.34
Breakfast Creek Road									
B39	168	-4.20	1.81	1.89	2.18	2.04	2.48	2.23	4.50
B30	109	-4.24	1.05	1.58	2.40	1.05	2.40	1.28	4.21
B20	37	-3.75	1.05	1.60	2.40	1.05	2.41	1.05	2.65
B10	0	-4.23	1.06	1.57	2.36	1.07	2.36	1.15	2.32
Ithaca Creek									
I526	32871	72.36	77.76	77.96	78.12	78.06	78.41	78.31	79.92
JC Slaughter Falls Crossing No 3									
I520	32849	71.69	75.33	75.48	75.61	75.56	75.85	75.81	77.16
I513	32652	68.64	72.12	72.24	72.35	72.31	72.52	72.50	73.46
JC Slaughter Falls Crossing No 2									
I511	32634	67.95	70.64	70.78	70.92	70.87	71.14	71.12	72.26
I510	32577	67.10	70.22	70.37	70.51	70.46	70.74	70.72	71.88
I503	32504	65.50	70.00	70.15	70.30	70.25	70.52	70.50	71.64

Table E-3 Extreme Event and Climate Change Analysis Results – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			200yr Design (m AHD)	200yr 2050 (m AHD)	200yr 2100 (m AHD)	500yr Design (m AHD)	500yr 2100 (m AHD)	2000yr (m AHD)	PMF (m AHD)
JC Slaughter Falls Crossing No 1									
I501	32477	64.63	67.11	67.22	67.33	67.29	67.53	67.52	68.44
I500	32352	63.22	65.19	65.32	65.41	65.37	65.57	65.52	66.36
I490	32221	61.07	64.42	64.50	64.61	64.57	64.79	64.70	65.59
I481	32133	60.63	64.15	64.23	64.32	64.29	64.49	64.42	65.23
Sir Samuel Griffiths Drive									
I479	32120	59.64	62.39	62.48	62.57	62.54	62.75	62.62	63.28
I470	31957	57.96	61.37	61.47	61.42	61.48	61.61	61.49	61.87
I460	31758	56.73	58.64	58.76	58.88	58.84	59.05	58.35	58.79
I450	31561	54.00	57.94	58.08	58.20	58.16	58.43	57.89	58.72
Carwoola Street									
I430	31526	53.90	56.60	56.77	56.92	56.85	57.17	56.86	58.01
I420	31300	51.30	54.88	55.05	55.21	55.15	55.49	55.46	56.82
I410	31134	50.15	53.04	53.27	53.42	53.37	53.68	53.66	55.04
I400	30988	47.07	50.86	51.06	51.23	51.17	51.56	51.44	52.91
I390	30889	45.55	49.08	49.24	49.37	49.33	49.62	49.54	50.57
I380	30767	43.94	47.38	47.45	47.52	47.49	47.64	47.31	48.42
I362	30431	40.24	44.72	44.98	45.19	45.11	45.67	45.34	46.63
Simpsons Road									
I360	30408	40.04	43.40	43.57	43.71	43.66	43.98	43.72	44.69
I350	30293	38.13	41.31	41.43	41.53	41.50	41.76	41.75	42.87
I340	30129	36.41	39.84	40.00	40.14	40.09	40.40	40.12	41.25
I330	30002	35.28	39.55	39.71	39.85	39.80	40.10	39.68	40.74
I329	29976	35.52	39.42	39.59	39.72	39.68	39.98	39.55	40.58
Lilley Avenue Footbridge									
I320	29877	33.90	37.22	37.33	37.43	37.40	37.64	37.27	38.11
I310	29747	31.89	35.24	35.34	35.43	35.40	35.61	35.27	36.07
I300	29652	30.67	34.44	34.53	34.61	34.58	34.77	34.51	35.26
Bowman Parade									
I293	29635	30.72	34.27	34.35	34.44	34.41	34.60	34.38	35.11
Bowman Parade Footbridge									
I289	29619	30.84	34.23	34.31	34.40	34.37	34.56	34.34	35.07
I280	29498	29.20	33.09	33.20	33.30	33.27	33.51	33.07	33.96
I275	29405	27.87	32.36	32.47	32.59	32.53	32.79	32.08	33.17
Coolibah Street Footbridge									
I273	29388	27.43	31.02	31.13	31.26	31.22	31.47	31.23	32.51
I270	29287	26.76	30.26	30.40	30.56	30.51	30.83	30.80	32.34
I265	29115	24.58	29.00	29.15	29.28	29.23	29.52	29.42	30.68
I260	28953	23.52	27.51	27.68	27.86	27.79	28.15	28.07	29.30
I259	28892	23.50	27.23	27.41	27.57	27.51	27.85	27.76	28.87

Table E-3 Extreme Event and Climate Change Analysis Results – Anticipated Water Levels cont

BCC Cross Section ID)	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			200yr Design (m AHD)	200yr 2050 (m AHD)	200yr 2100 (m AHD)	500yr Design (m AHD)	500yr 2100 (m AHD)	2000yr (m AHD)	PMF (m AHD)
Kamber Street Pipe									
I257	28866	23.07	27.17	27.34	27.50	27.44	27.78	27.68	28.76
I252	28824	22.60	27.09	27.27	27.44	27.37	27.71	27.62	28.69
I251	28790	22.95	26.94	27.13	27.30	27.23	27.58	27.49	28.59
Coopers Camp Road									
I249	28771	22.45	26.28	26.39	26.51	26.47	26.72	26.68	27.75
I240	28595	20.77	25.20	25.34	25.48	25.43	25.76	25.67	27.03
I230	28366	19.20	24.17	24.30	24.44	24.38	24.70	24.40	25.74
I226	28289	18.63	23.77	23.89	24.02	23.96	24.25	23.93	25.16
Glen Parade Footbridge									
I224	28285	18.71	23.25	23.36	23.49	23.44	23.73	23.51	24.72
I220	28135	17.55	22.06	22.19	22.34	22.29	22.65	22.39	23.95
I210	28043	17.23	21.48	21.61	21.77	21.71	22.07	21.79	23.28
I203	27932	16.65	21.16	21.30	21.46	21.40	21.77	21.51	23.09
Devonshire Street Footbridge									
I201	27923	16.67	20.91	21.06	21.24	21.17	21.56	21.37	23.01
I200	27819	15.86	20.65	20.82	21.03	20.96	21.40	21.19	22.89
I190	27637	15.14	19.68	19.92	20.18	20.08	20.62	20.29	22.02
I180	27544	14.23	19.25	19.53	19.82	19.72	20.31	20.02	21.76
I171	27395	13.36	19.00	19.32	19.63	19.52	20.14	19.86	21.62
Jubilee Terrace									
I169	27347	13.36	18.20	18.39	18.57	18.50	18.91	18.66	20.43
I160	27182	12.33	17.65	17.81	17.97	17.91	18.27	17.90	19.54
I154	27097	12.06	17.09	17.24	17.40	17.34	17.70	17.38	18.96
Lugg Street Footbridge									
I151	26929	11.50	16.49	16.64	16.78	16.72	17.04	16.72	18.10
Jason Street V Weir									
I149	26924	11.07	16.33	16.46	16.60	16.55	16.85	16.54	17.80
I141	26826	10.61	15.63	15.77	15.90	15.85	16.15	15.94	17.08
Dean Street Footbridge									
I140	26766	10.02	15.43	15.57	15.71	15.66	15.98	15.75	16.96
I131	26589	9.40	14.88	15.00	15.12	15.07	15.37	15.01	16.09
Nathan Avenue Footbridge									
I120	26327	8.04	13.47	13.61	13.78	13.72	14.08	13.88	15.11
I111	26237	7.85	13.35	13.49	13.68	13.61	14.01	13.80	15.10
Fulcher Road									
I109	26221	7.77	12.27	12.44	12.62	12.55	12.92	12.60	14.08
I100	26080	7.07	11.72	11.98	12.24	12.14	12.64	12.52	14.17
I90	25982	6.04	11.62	11.90	12.18	12.08	12.58	12.40	14.04
I81	25866	6.36	11.56	11.85	12.14	12.03	12.53	12.37	13.98

Table E-3 Extreme Event and Climate Change Analysis Results – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			200yr Design (m AHD)	200yr 2050 (m AHD)	200yr 2100 (m AHD)	500yr Design (m AHD)	500yr 2100 (m AHD)	2000yr (m AHD)	PMF (m AHD)
Kenwyn Road									
I79	25849	6.27	11.51	11.81	12.09	11.99	12.49	12.37	14.00
I70	25803	5.94	11.48	11.78	12.07	11.97	12.47	12.36	13.97
I60	25701	5.00	11.45	11.76	12.05	11.94	12.45	12.34	13.93
I59	25648	4.87	11.44	11.74	12.04	11.93	12.43	12.33	13.93
I51	25577	4.38	11.37	11.67	11.97	11.86	12.37	12.24	13.90
Waterworks Road									
I49	25536	4.02	9.54	9.84	10.14	10.03	10.63	9.88	13.14
I40	25395	3.62	9.40	9.71	10.02	9.90	10.51	9.71	13.10
I35	25352	3.33	9.36	9.67	9.98	9.86	10.48	9.66	13.07
I30	25314	3.50	9.32	9.64	9.95	9.83	10.45	9.62	13.05
I21	25189	2.74	9.27	9.59	9.90	9.78	10.40	9.56	13.03
Glenrosa Road									
I19	25166	2.69	9.20	9.52	9.83	9.71	10.33	9.48	12.98
I10	25063	1.70	9.17	9.50	9.81	9.69	10.31	9.44	12.97
Fish Creek									
F212	32982	52.86	54.88	54.97	55.06	55.03	55.20	55.07	55.57
F200	32833	51.47	53.38	53.44	53.50	53.47	53.61	53.30	53.61
F192	32763	49.58	52.65	52.72	52.80	52.77	52.92	52.57	52.99
Wittonga Park Footbridge									
F190	32585	47.51	51.50	51.57	51.64	51.61	51.76	51.45	51.90
F183	32559	47.46	51.38	51.46	51.53	51.50	51.68	51.33	51.83
Wittonga Park Footpath									
F181	32538	46.24	49.58	49.81	50.04	49.94	50.54	49.45	51.01
Hilder Road									
F179	32508	45.84	48.70	48.83	48.96	48.91	49.19	48.93	49.82
F170	32448	44.88	48.22	48.36	48.49	48.43	48.72	48.47	49.39
F160	32274	42.60	46.83	46.98	47.11	47.06	47.37	47.07	47.93
F150	32000	41.00	44.20	44.36	44.52	44.45	44.81	44.41	45.49
F140	31898	39.26	43.37	43.54	43.72	43.63	44.01	43.50	44.62
F130	31802	37.95	42.72	42.85	43.02	42.93	43.24	42.63	43.49
F111	31608	36.42	42.15	42.22	42.32	42.29	42.48	41.86	42.26
Settlement Road									
F109	31586	36.27	40.98	41.09	41.21	41.17	41.40	40.97	41.64
F108	31557	36.07	40.68	40.80	40.92	40.88	41.12	40.73	41.48
F106	31525	36.06	40.60	40.72	40.84	40.80	41.04	40.67	41.46
F100	31401	35.79	40.14	40.28	40.39	40.35	40.58	40.07	40.93
F90	31258	34.53	39.94	40.09	40.20	40.16	40.39	39.85	40.73
F81	31166	34.10	39.74	39.89	39.99	39.95	40.17	39.66	40.54

Table E-3 Extreme Event and Climate Change Analysis Results – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)						
			200yr Design (m AHD)	200yr 2050 (m AHD)	200yr 2100 (m AHD)	500yr Design (m AHD)	500yr 2100 (m AHD)	2000yr (m AHD)	PMF (m AHD)
Pangela Street Footbridge									
F79	31150	33.95	38.81	38.94	39.07	39.02	39.30	38.87	39.89
F70	31023	33.17	38.38	38.50	38.61	38.57	38.82	38.34	39.27
F60	30875	32.78	38.09	38.21	38.31	38.28	38.50	37.93	38.81
F55	30845	32.60	38.03	38.14	38.24	38.20	38.42	37.82	38.68
F51	30802	32.27	37.87	37.98	38.08	38.05	38.27	37.67	38.54
Quirk Street									
F49	30789	32.33	36.79	36.97	37.13	37.07	37.42	37.05	38.32
F48	30770	32.35	36.77	36.94	37.11	37.05	37.40	37.02	38.31
F40	30605	31.66	36.57	36.77	36.96	36.89	37.27	36.77	38.15
F30	30389	30.76	36.38	36.60	36.79	36.72	37.10	36.53	37.93
F20	30224	29.84	36.23	36.47	36.66	36.59	36.97	36.34	37.75
F13	30157	29.24	35.49	35.68	35.89	35.81	36.21	35.58	37.56
Romea Street Culvert									
F12	30117	28.89	35.25	35.44	35.65	35.58	35.99	35.30	37.53
Lochinvar Lane Footbridge									
F10	30071	28.45	34.78	35.03	35.26	35.18	35.62	34.54	37.50

Table E-4 Comparison of Different 100 Year ARI Event Scenarios – Anticipated Water Levels

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)			
			100yr Design (m AHD)	100yr 2050 (m AHD)	100yr 2100 (m AHD)	100yr MRC (m AHD)
Enoggera Creek						
E980	21313	59.42	62.16	62.40	62.58	62.16
E960	21203	59.75	61.25	61.56	61.79	61.25
E950	21029	56.88	60.85	61.10	61.30	60.84
E941	20978	57.22	60.42	60.71	60.92	60.42
Dam Causeway						
E940	20918	57.68	60.19	60.51	60.74	60.19
E930	20689	55.97	58.96	59.25	59.43	58.96
E920	20503	54.70	57.52	57.75	57.89	57.52
E910	20344	54.04	56.09	56.28	56.42	56.09
E900	20123	50.41	52.68	52.91	53.06	52.68
E892	20073	49.62	51.78	52.03	52.21	51.78
E890	19951	47.85	50.83	51.12	51.32	50.83
E880	19692	46.37	49.90	50.08	50.16	49.89
E870	19507	44.80	48.64	49.02	49.21	48.63
E869	19460	44.83	48.48	48.93	49.14	48.47
Gap Pony Club Pipe						
E860	19340	43.34	48.20	48.70	48.92	48.18
E841	19087	42.94	47.77	48.32	48.57	47.75
School Road						
E839	19062	42.94	46.73	47.11	47.28	46.72
E830	18972	41.92	46.31	46.69	46.87	46.30
E820	18865	41.20	45.97	46.37	46.56	45.96
E810	18673	40.46	44.65	45.01	45.17	44.64
Riaweena Street Footbridge						
E800	18456	38.69	43.49	43.85	44.01	43.48
E790	18245	39.03	42.78	43.18	43.35	42.76
E780	18122	37.78	42.36	42.80	42.99	42.34
E770	18047	36.77	42.18	42.64	42.83	42.16
E760	18003	36.48	42.08	42.54	42.74	42.06
E751	17967	36.33	41.96	42.42	42.61	41.94
Illowra Street						
E749	17944	36.60	41.00	41.32	41.46	40.99
E740	17865	36.40	40.47	40.80	40.95	40.45
E730	17682	35.03	39.81	40.16	40.32	39.80
E720	17550	34.85	39.38	39.71	39.87	39.37
E710	17316	34.36	38.44	38.78	38.94	38.41

Table E-4 Comparison of Different 100 Year ARI Event Scenarios – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)			
			100yr Design (m AHD)	100yr 2050 (m AHD)	100yr 2100 (m AHD)	100yr MRC (m AHD)
Tandara Street Footbridge						
E705	17282	33.88	38.02	38.38	38.54	37.99
E700	17225	33.27	37.87	38.23	38.40	37.84
E690	17137	32.64	37.55	37.93	38.10	37.51
E680	16939	31.74	36.97	37.34	37.48	36.89
E670	16775	31.63	36.67	37.03	37.19	36.56
E668	16721	31.00	36.45	36.80	36.95	36.31
Shopping Centre Footbridge						
E659	16658	30.50	36.06	36.39	36.55	35.88
Walton Bridge Reserve Causeway						
E650	16410	29.71	35.34	35.66	35.84	35.02
E640	16242	28.88	35.01	35.34	35.57	34.56
E630	16118	28.56	34.86	35.19	35.45	34.30
E629	16087	28.99	34.84	35.17	35.43	34.26
E621	16059	28.68	34.81	35.13	35.39	34.21
Waterworks Road						
E619	16030	28.43	34.47	34.69	34.92	33.77
E610	15985	28.24	34.42	34.62	34.86	33.68
E600	15926	27.45	34.36	34.54	34.79	33.54
E590	15886	27.25	34.30	34.47	34.72	33.40
E580	15715	26.68	34.16	34.28	34.53	33.06
E575	15648	26.74	34.09	34.18	34.43	32.88
E571	15574	26.19	33.89	33.93	34.18	32.41
E560	15454	25.86	33.85	33.87	34.13	32.23
E556	15420	25.93	33.84	33.85	34.11	32.18
E551	15249	24.86	33.74	33.71	33.97	31.85
E540	15176	26.30	33.61	33.58	33.84	31.68
Bennett Road						
E536	15063	23.78	29.98	30.50	30.70	29.92
E530	14987	23.90	29.71	30.22	30.42	29.63
E531	14958	23.70	29.59	30.11	30.31	29.52
E520	14864	22.76	29.15	29.69	29.90	29.06
E510	14697	22.26	28.79	29.31	29.52	28.68
E500	14540	20.95	28.22	28.68	28.88	28.07
E480	14296	20.71	27.33	27.67	27.87	27.10
E470	14185	20.53	27.07	27.37	27.57	26.78
E450	14064	19.88	26.89	27.14	27.35	26.55
E440	13973	20.03	26.74	26.97	27.18	26.38
E413	13853	19.95	26.49	26.69	26.88	26.14

Table E-4 Comparison of Different 100 Year ARI Event Scenarios – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)			
			100yr Design (m AHD)	100yr 2050 (m AHD)	100yr 2100 (m AHD)	100yr MRC (m AHD)
Gresham Street						
E411	13841	19.48	25.61	26.00	26.14	25.49
E409	13728	18.64	25.29	25.72	25.86	25.23
E400	13632	18.68	25.03	25.45	25.58	24.97
E395	13555	17.86	24.80	25.22	25.36	24.75
E390	13517	17.39	24.67	25.09	25.23	24.62
E380	13403	17.33	24.18	24.57	24.71	24.13
E362	13217	16.90	23.78	24.18	24.32	23.72
Royal Parade Footbridge						
E360	13206	16.82	23.33	23.76	23.91	23.25
E350	13041	16.37	22.83	23.24	23.38	22.73
E340	12820	14.97	22.38	22.79	22.94	22.25
E330	12538	14.70	21.49	21.97	22.13	21.36
E320	12291	13.82	20.82	21.25	21.40	20.64
E310	12152	13.51	20.64	21.04	21.17	20.43
E300	12038	12.79	20.18	20.52	20.65	20.01
E290	11977	12.97	19.82	20.15	20.28	19.69
E281	11902	12.41	19.61	19.93	20.05	19.48
Glenlyon Drive Footbridge						
E279	11890	12.56	19.00	19.33	19.45	18.84
E270	11821	11.83	18.84	19.18	19.30	18.66
E260	11709	11.57	18.59	18.94	19.07	18.38
E250	11609	11.39	18.38	18.75	18.87	18.17
E240	11473	11.08	18.02	18.38	18.51	17.81
E235	11423	11.12	17.89	18.25	18.37	17.71
E233	11373	10.83	17.78	18.14	18.26	17.62
Mirrabooka Road Footbridge						
E231	11365	11.00	17.68	18.04	18.17	17.53
Mirrabooka Road						
E229	11349	11.16	17.38	17.75	17.89	17.26
E220	11215	10.11	17.16	17.53	17.67	17.02
E210	11028	10.54	16.83	17.25	17.41	16.61
E200	10818	9.47	16.56	17.00	17.18	16.28
E191	10776	9.92	16.48	16.91	17.08	16.20
Stewart Road						
E189	10742	9.58	15.67	16.08	16.23	15.52
E180	10567	8.63	15.01	15.43	15.60	14.86
E170	10404	8.51	14.29	14.74	14.91	14.20
E160	10268	8.04	13.84	14.27	14.45	13.73

Table E-4 Comparison of Different 100 Year ARI Event Scenarios – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)			
			100yr Design (m AHD)	100yr 2050 (m AHD)	100yr 2100 (m AHD)	100yr MRC (m AHD)
Steege Street Footbridge						
E158	10258	7.82	13.81	14.23	14.40	13.70
E150	10203	7.90	13.71	14.14	14.31	13.60
E140	9990	7.54	13.27	13.69	13.86	13.12
E130	9878	7.30	12.89	13.32	13.49	12.74
E120	9694	7.04	12.60	13.05	13.22	12.40
E110	9591	6.66	12.41	12.87	13.05	12.17
E105	9455	6.63	12.23	12.70	12.88	11.94
E100	9264	6.32	12.01	12.50	12.68	11.64
E90	8843	5.46	11.53	12.05	12.22	10.93
E80	8656	3.75	11.39	11.91	12.09	10.78
E71	8586	4.50	11.27	11.78	11.97	10.70
Ashgrove Avenue						
E69	8566	4.76	10.68	11.08	11.26	10.35
E60	8301	3.49	10.11	10.46	10.70	9.94
E51	8038	3.07	9.84	10.17	10.44	9.66
Corbie Street Footbridge						
E40	7761	2.72	9.00	9.32	9.67	8.81
E35	7706	1.65	8.90	9.22	9.58	8.72
Park Avenue Footbridge						
E30	7630	2.36	8.65	8.98	9.35	8.49
E20	7330	1.43	8.48	8.82	9.19	8.30
E10	7201	1.04	8.43	8.78	9.15	8.25
Breakfast Creek						
B661	6946	0.18	8.27	8.64	9.00	8.07
Murray Street Footbridge						
B650	6737	0.56	8.08	8.46	8.79	7.86
B647	6670	-0.12	7.86	8.28	8.58	7.64
Bancroft Park Gauging Weir						
B641	6551	0.41	7.74	8.18	8.51	7.51
Kelvin Grove Road						
B629	6503	-0.14	7.07	8.32	8.44	6.84
B620	6487	-0.58	7.05	8.24	8.37	6.82
B610	6409	-0.43	7.06	7.85	7.95	6.90
B600	6317	0.00	7.14	7.94	7.86	6.90
B590	6217	-0.05	7.11	7.85	7.78	6.83
B580	6124	-0.38	7.04	7.69	7.68	6.73
B570	6036	-1.09	6.93	7.52	7.56	6.60
B561	5992	-0.10	6.92	7.52	7.56	6.59

Table E-4 Comparison of Different 100 Year ARI Event Scenarios – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)			
			100yr Design (m AHD)	100yr 2050 (m AHD)	100yr 2100 (m AHD)	100yr MRC (m AHD)
Bishop Street Footbridge						
B559	5983	-0.14	6.68	7.22	7.28	6.33
B550	5959	-0.89	6.67	7.19	7.26	6.31
B540	5879	-0.76	6.64	7.09	7.22	6.24
B530	5796	-0.67	6.62	7.06	7.19	6.21
B520	5616	-1.16	6.57	7.03	7.15	6.12
B510	5518	-0.59	6.52	6.97	7.10	6.06
B500	5423	-0.73	6.49	6.92	7.07	6.01
B490	5240	-0.96	6.38	6.78	6.95	5.87
B480	5150	-1.30	6.25	6.65	6.84	5.70
B470	5050	-1.33	6.09	6.49	6.68	5.48
B460	4957	-1.22	6.05	6.45	6.64	5.43
B450	4853	-1.64	5.95	6.38	6.57	5.33
B441	4754	-0.94	5.85	6.28	6.47	5.21
Noble Street Footbridge						
B439	4740	-1.25	5.79	6.22	6.40	5.16
B430	4657	-1.28	5.71	6.15	6.32	5.09
B420	4568	-1.73	5.70	6.13	6.31	5.08
B410	4478	-1.46	5.69	6.13	6.31	5.08
B400	4414	-1.35	5.69	6.13	6.31	5.07
B391	4372	-1.50	5.69	6.13	6.31	5.07
Downey Park Footbridge						
B389	4362	-1.81	5.69	6.13	6.30	5.07
B380	4313	-1.90	5.69	6.13	6.30	5.07
B370	4195	-1.67	5.68	6.12	6.29	5.06
B360	4071	-2.02	5.64	6.08	6.25	5.04
B350	3961	-2.20	5.63	6.07	6.25	5.03
B340	3866	-2.76	5.62	6.06	6.24	5.01
B331	3785	-2.16	5.55	6.03	6.21	4.94
Bowen Bridge Road						
B329	3739	-1.99	5.36	5.90	6.09	4.77
B320	3573	-2.04	5.29	5.86	6.05	4.70
B310	3402	-2.04	5.24	5.79	5.97	4.61
B300	3161	-2.42	5.08	5.63	5.80	4.43
B290	2905	-2.02	4.98	5.52	5.68	4.31
B280	2822	-2.08	4.95	5.49	5.66	4.26
B272	2731	-2.34	4.85	5.43	5.60	4.08
Railway loop						
B270	2705	-2.41	4.77	5.33	5.50	4.03
B261	2521	-2.14	4.58	5.17	5.32	3.78

Table E-4 Comparison of Different 100 Year ARI Event Scenarios – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)			
			100yr Design (m AHD)	100yr 2050 (m AHD)	100yr 2100 (m AHD)	100yr MRC (m AHD)
Ferny Grove Railway						
B259	2436	-2.27	4.53	5.14	5.31	3.78
B250	2393	-3.01	4.41	5.08	5.27	3.70
B240	2308	-2.49	4.25	4.97	5.18	3.57
B230	2166	-2.36	4.12	4.87	5.08	3.47
B220	2069	-2.85	4.10	4.82	5.03	3.40
B201	1938	-2.63	3.95	4.62	4.85	3.19
North Coast Railway						
B199	1886	-3.23	3.66	4.16	4.35	3.07
B191	1825	-3.79	3.47	3.97	4.16	2.90
Hudson Road						
B180	1781	-3.98	3.40	3.88	4.07	2.83
B171	1653	-3.24	3.28	3.76	3.95	2.72
Abbotsford Road						
B169	1615	-2.95	3.22	3.63	3.82	2.66
B160	1488	-3.74	2.88	3.37	3.57	2.50
B150	1391	-3.40	2.77	3.37	3.58	2.46
B140	1288	-3.30	2.70	3.26	3.49	2.38
B130	1186	-2.87	2.73	3.24	3.47	2.35
B120	1025	-3.04	2.73	3.25	3.46	2.35
B110	917	-3.40	2.56	3.05	3.28	2.22
B100	850	-3.31	2.46	2.96	3.20	2.11
B90	667	-4.09	2.34	2.82	3.08	1.99
B80	590	-4.39	1.96	2.42	2.74	1.66
B70	478	-4.15	1.66	2.06	2.43	1.39
B60	356	-4.64	1.50	1.85	2.21	1.26
B50	252	-3.32	1.49	1.84	2.22	1.25
B40	205	-3.49	3.22	3.63	3.82	2.66
Breakfast Creek Road						
B39	168	-4.20	1.41	1.70	2.15	1.16
B30	109	-4.24	1.05	1.57	2.39	1.05
B20	37	-3.75	1.05	1.60	2.43	1.05
B10	0	-4.23	1.05	1.56	2.37	1.05
Ithaca Creek						
I526	32871	72.36	77.28	77.67	77.87	77.14
JC Slaughter Falls Crossing No 3						
I520	32849	71.69	75.04	75.26	75.40	74.99
I513	32652	68.64	71.86	72.06	72.18	71.83
JC Slaughter Falls Crossing No 2						
I511	32634	67.95	70.38	70.58	70.70	70.34
I510	32577	67.10	69.94	70.15	70.28	69.90
I503	32504	65.50	69.73	69.94	70.07	69.69

Table E-4 Comparison of Different 100 Year ARI Event Scenarios – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)			
			100yr Design (m AHD)	100yr 2050 (m AHD)	100yr 2100 (m AHD)	100yr MRC (m AHD)
JC Slaughter Falls Crossing No 1						
I501	32477	64.63	66.90	67.06	67.16	66.90
I500	32352	63.22	65.01	65.14	65.25	64.95
I490	32221	61.07	64.27	64.37	64.46	64.19
I481	32133	60.63	64.01	64.11	64.19	63.94
Sir Samuel Griffiths Drive						
I479	32120	59.64	62.22	62.34	62.44	62.18
I470	31957	57.96	61.15	61.27	61.32	61.16
I460	31758	56.73	58.52	58.58	58.68	58.23
I450	31561	54.00	58.10	57.89	57.99	57.51
Carwoola Street						
I430	31526	53.90	56.46	56.53	56.68	56.16
I420	31300	51.30	54.61	54.81	54.94	54.56
I410	31134	50.15	52.65	52.95	53.12	52.59
I400	30988	47.07	50.52	50.78	50.94	50.46
I390	30889	45.55	48.91	48.99	49.15	48.76
I380	30767	43.94	47.16	47.20	47.41	46.82
I362	30431	40.24	44.23	44.59	44.84	44.11
Simpsons Road						
I360	30408	40.04	43.09	43.33	43.46	43.00
I350	30293	38.13	41.13	41.27	41.35	41.07
I340	30129	36.41	39.56	39.78	39.90	39.48
I330	30002	35.28	39.26	39.48	39.61	39.19
I329	29976	35.52	39.14	39.36	39.49	39.06
Lilley Avenue Footbridge						
I320	29877	33.90	37.02	37.18	37.26	36.97
I310	29747	31.89	35.04	35.19	35.28	34.99
I300	29652	30.67	34.26	34.40	34.48	34.16
Bowman Parade						
I293	29635	30.72	34.09	34.23	34.30	33.96
Bowman Parade Footbridge						
I289	29619	30.84	34.05	34.19	34.26	33.92
I280	29498	29.20	32.89	33.04	33.14	32.66
I275	29405	27.87	32.14	32.31	32.41	31.91
Coolibah Street Footbridge						
I273	29388	27.43	30.80	30.98	31.07	30.62
I270	29287	26.76	29.98	30.20	30.32	29.90
I265	29115	24.58	28.68	28.93	29.07	28.58
I260	28953	23.52	27.13	27.43	27.59	27.02
I259	28892	23.50	26.85	27.15	27.31	26.74

Table E-4 Comparison of Different 100 Year ARI Event Scenarios – Anticipated Water Levels cont

BCC Cross Section ID)	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)			
			100yr Design (m AHD)	100yr 2050 (m AHD)	100yr 2100 (m AHD)	100yr MRC (m AHD)
Kamber Street Pipe						
I257	28866	23.07	26.78	27.08	27.25	26.67
I252	28824	22.60	26.70	27.01	27.18	26.58
I251	28790	22.95	26.53	26.85	27.03	26.41
Coopers Camp Road						
I249	28771	22.45	26.03	26.23	26.33	25.94
I240	28595	20.77	24.93	25.14	25.26	24.85
I230	28366	19.20	23.90	24.11	24.23	23.82
I226	28289	18.63	23.53	23.72	23.82	23.46
Glen Parade Footbridge						
I224	28285	18.71	23.00	23.19	23.30	22.93
I220	28135	17.55	21.77	22.00	22.12	21.67
I210	28043	17.23	21.20	21.41	21.54	21.11
I203	27932	16.65	20.89	21.09	21.22	20.80
Devonshire Street Footbridge						
I201	27923	16.67	20.62	20.83	20.97	20.53
I200	27819	15.86	20.33	20.57	20.72	20.24
I190	27637	15.14	19.28	19.59	19.77	19.18
I180	27544	14.23	18.78	19.13	19.36	18.65
I171	27395	13.36	18.47	18.87	19.13	18.33
Jubilee Terrace						
I169	27347	13.36	17.82	18.12	18.28	17.71
I160	27182	12.33	17.30	17.57	17.72	17.19
I154	27097	12.06	17.13	17.01	17.15	16.65
Lugg Street Footbridge						
I151	26929	11.50	16.18	16.42	16.55	16.07
Jason Street V Weir						
I149	26924	11.07	16.03	16.26	16.38	15.92
I141	26826	10.61	15.35	15.58	15.69	15.26
Dean Street Footbridge						
I140	26766	10.02	15.14	15.37	15.49	15.05
I131	26589	9.40	14.64	14.83	14.92	14.56
Nathan Avenue Footbridge						
I120	26327	8.04	13.18	13.42	13.53	13.08
I111	26237	7.85	13.03	13.28	13.40	12.92
Fulcher Road						
I109	26221	7.77	11.95	12.20	12.33	11.86
I100	26080	7.07	11.20	11.59	11.81	11.04
I90	25982	6.04	11.03	11.48	11.71	10.84
I81	25866	6.36	10.95	11.42	11.65	10.73

Table E-4 Comparison of Different 100 Year ARI Event Scenarios – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)			
			100yr Design (m AHD)	100yr 2050 (m AHD)	100yr 2100 (m AHD)	100yr MRC (m AHD)
Kenwyn Road						
I79	25849	6.27	10.88	11.36	11.60	10.65
I70	25803	5.94	10.85	11.33	11.57	10.61
I60	25701	5.00	10.80	11.30	11.54	10.56
I59	25648	4.87	10.79	11.28	11.53	10.54
I51	25577	4.38	10.71	11.21	11.45	10.47
Waterworks Road						
I49	25536	4.02	8.93	9.35	9.57	8.81
I40	25395	3.62	8.74	9.15	9.41	8.62
I35	25352	3.33	8.66	9.07	9.36	8.54
I30	25314	3.50	8.61	9.01	9.32	8.47
I21	25189	2.74	8.54	8.89	9.26	8.39
Glenrosa Road						
I19	25166	2.69	8.46	8.80	9.17	8.30
I10	25063	1.70	8.42	8.77	9.15	8.25
Fish Creek						
F212	32982	52.86	54.74	54.90	54.98	54.74
F200	32833	51.47	53.28	53.39	53.45	53.28
F192	32763	49.58	52.52	52.66	52.73	52.52
Wittonga Park Footbridge						
F190	32585	47.51	51.39	51.51	51.57	51.38
F183	32559	47.46	51.27	51.39	51.46	51.25
Wittonga Park Footpath						
F181	32538	46.24	49.28	49.61	49.82	49.23
Hilder Road						
F179	32508	45.84	48.48	48.71	48.83	48.48
F170	32448	44.88	47.99	48.23	48.36	47.98
F160	32274	42.60	46.59	46.84	46.98	46.60
F150	32000	41.00	43.95	44.21	44.35	43.92
F140	31898	39.26	43.16	43.38	43.53	43.07
F130	31802	37.95	42.63	42.72	42.84	42.45
F111	31608	36.42	42.03	42.15	42.22	41.94
Settlement Road						
F109	31586	36.27	40.78	40.97	41.08	40.72
F108	31557	36.07	40.46	40.67	40.78	40.41
F106	31525	36.06	40.37	40.59	40.70	40.31
F100	31401	35.79	39.91	40.12	40.25	39.82
F90	31258	34.53	39.72	39.92	40.07	39.60
F81	31166	34.10	39.53	39.72	39.86	39.42

Table E-4 Comparison of Different 100 Year ARI Event Scenarios – Anticipated Water Levels cont

BCC Cross Section ID	AMTD (m)	Bed Level (m AHD)	Anticipated Water Level (m AHD)			
			100yr Design (m AHD)	100yr 2050 (m AHD)	100yr 2100 (m AHD)	100yr MRC (m AHD)
Pangela Street Footbridge						
F79	31150	33.95	38.52	38.78	38.90	38.47
F70	31023	33.17	38.12	38.35	38.46	38.07
F60	30875	32.78	37.86	38.07	38.17	37.80
F55	30845	32.60	37.80	38.00	38.10	37.75
F51	30802	32.27	37.64	37.84	37.94	37.58
Quirk Street						
F49	30789	32.33	36.48	36.74	36.90	36.35
F48	30770	32.35	36.45	36.71	36.87	36.32
F40	30605	31.66	36.22	36.50	36.69	35.98
F30	30389	30.76	36.05	36.30	36.51	35.67
F20	30224	29.84	35.94	36.16	36.37	35.49
F13	30157	29.24	35.12	35.42	35.57	34.86
Romea Street Culvert						
F12	30117	28.89	34.86	35.17	35.32	34.59
Lochinvar Lane Footbridge						
F10	30071	28.45	34.43	34.64	34.88	33.72

APPENDIX F: HYDRAULIC STRUCTURE REFERENCE SHEETS

The hydraulic structure reference sheets for all structures within the modelled area are presented in the following tables for the ultimate case.

Table F.1 Breakfast Creek Road

CREEK	**BREAKFAST CREEK**
LOCATION	**BREAKFAST CREEK ROAD**

IMMUNITY RATING:	**> 100 yr**

DATE OF SURVEY:	**APRIL 1998**	UBD REF	**140 F19**
AERIAL PHOTO No:	**SPH 11/1, Sheet 3.1**	STRUCTURE ID	**B31090**
BCC CROSS SECTION No:	**B40**	AMTD (m):	**205**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**3 spans (L-R) 18.8, 23.5, 18.7** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**-2.81**	UPSTREAM OBVERT LEVEL:	**Centre 4.46**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**-2.81**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**Centre 4.46**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes B40**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**24.37**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**5.65**
PIER WIDTH (m):	**1.0**		
HEIGHT OF GUARDRAILS (m AHD):			**Centre @ 7.21m AHD**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.05m high metal railings**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 42**

CREEK	**BREAKFAST CREEK**
LOCATION	**BREAKFAST CREEK ROAD**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	479.9	1.48	1.41	70
50	432.0	1.32	1.26	60
20	357.9	1.17	1.13	40
10	315.8	1.13	1.10	30
5	275.7	1.11	1.08	30
2	207.1	1.08	1.06	20
1	176.5	1.07	1.06	10

NB: Results are based on ultimate case modelling.

Breakfast Creek Road, looking downstream

Table F.2 Inner City Bypass

CREEK	**BREAKFAST CREEK**
LOCATION	**INNER CITY BYPASS/ALLISON STREET**

IMMUNITY RATING:	**> 100 yr**

DATE OF SURVEY:		UBD REF	**140 F19**
AERIAL PHOTO No:	**SPH 11/1, Sheet 3.1**	STRUCTURE ID	**B30455**
BCC CROSS SECTION No:		AMTD (m):	**820**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**3 spans, L-R 26, 34, 26 m** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:		UPSTREAM OBVERT LEVEL:	4.5
DOWNSTREAM INVERT LEVEL: For culverts give floor level.		DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**As above**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**No**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**38**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**R4.63, C7.12**
PIER WIDTH (m):	**1.5**		
HEIGHT OF GUARDRAILS (m AHD): DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			**2001**
PLAN NUMBER:			**Q672/30/ST/BR/01200/AC**
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**Inner City Bypass bridge significantly larger than Allison Street bridge**

CREEK	**BREAKFAST CREEK**
LOCATION	**INNER CITY BYPASS/ALLISON STREET**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	428.9	2.46	2.20	260
50	432.0	2.21	1.96	250
20	355.5	1.85	1.65	200
10	313.6	1.68	1.51	170
5	273.8	1.54	1.4	140
2	205.8	1.34	1.26	80
1	175.0	1.25	1.19	60

NB: Results are based on ultimate case modelling.

Inner City Bypass, looking upstream (Allison Street in foreground)

Table F.3 Abbotsford Road

CREEK	**BREAKFAST CREEK**
LOCATION	**ABBOTSFORD ROAD**

IMMUNITY RATING: **> 100 yr**

DATE OF SURVEY:	**APRIL 1998**	UBD REF	**140 E15**
AERIAL PHOTO No:	**SPH 11/1, Sheet 3.1**	STRUCTURE ID	**B29640**
BCC CROSS SECTION No:	**B170**	AMTD (m):	**1651**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**3 spans, each 15.36** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**-2.20**	UPSTREAM OBVERT LEVEL:	**L3.54, C3.75, R3.63**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**-2.20**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**As above**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, B170**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**20.9**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**5.27**
PIER WIDTH (m):	**1.20**		
HEIGHT OF GUARDRAILS (m AHD):			**L 6.30, C 6.83, R 6.37**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1030mm high concrete railings**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 41**

CREEK	**BREAKFAST CREEK**
LOCATION	**ABBOTSFORD ROAD**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	478.6	3.28	3.22	60
50	428.7	2.93	2.88	50
20	355.1	2.48	2.43	50
10	313.2	2.23	2.19	40
5	273.1	2.0	1.96	40
2	205.4	1.63	1.61	20
1	174.3	1.49	1.47	20

NB: Results are based on ultimate case modelling.

Abbotsford Road, looking upstream

Table F.4 Hudson Road

CREEK	**BREAKFAST CREEK**
LOCATION	**HUDSON ROAD**

IMMUNITY RATING: > 100 yr

DATE OF SURVEY:	**APRIL 1998**	UBD REF	**140 D15**
AERIAL PHOTO No:	**SPH 11/1, Sheet 3.1**	STRUCTURE ID	**B29472**
BCC CROSS SECTION No:	**B190**	AMTD (m):	**1814**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**5 spans, each 50m**
UPSTREAM INVERT LEVEL:	**-3.80**	UPSTREAM OBVERT LEVEL:	**L3.39, C3.72, R3.80**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**-3.90**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**As above**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, B190**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**19.2**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**3.80**
PIER WIDTH (m):	**1.20**		
HEIGHT OF GUARDRAILS (m AHD):			**L5.37, C5.70, R4.78**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**980 mm high metal railings**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2 FOLIO No. 40**

CREEK	**BREAKFAST CREEK**
LOCATION	**HUDSON ROAD**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	480.2	3.47	3.40	70
50	429.0	3.10	3.04	60
20	355.3	2.63	2.57	60
10	313.2	2.34	2.31	30
5	273.1	2.10	2.07	30
2	205.3	1.7	1.68	20
1	174.3	1.54	1.52	20

NB: Results are based on ultimate case modelling.

Hudson Road, looking downstream

Table F.5 North Coast Railway

CREEK	**BREAKFAST CREEK**
LOCATION	**NORTH COAST RAILWAY**

IMMUNITY RATING:	**> 100 yr**

DATE OF SURVEY:	**APRIL 1998**	UBD REF	**140 D15**
AERIAL PHOTO No:	**SPH 11/2, Sheet 3.1**	STRUCTURE ID	**B29363**
BCC CROSS SECTION No:	**B200**	AMTD (m):	**1900**
STRUCTURE DESCRIPTION:			**Railway Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**3 spans, each 21.35m** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:		UPSTREAM OBVERT LEVEL:	**3.47**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.		DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**3.47**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes (partially interpolated), B200**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)		WEIR LEVEL (m AHD): (Level at which water overtops road)	
PIER WIDTH (m):			
HEIGHT OF GUARDRAILS (m AHD):			**N/A**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**N/A**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 43**

CREEK	**BREAKFAST CREEK**
LOCATION	**NORTH COAST RAILWAY**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	480.9	3.95	3.66	290
50	429.0	3.36	3.27	90
20	355.4	2.87	2.77	100
10	313.2	2.57	2.46	110
5	273.1	2.31	2.21	100
2	205.3	1.89	1.76	130
1	174.4	1.72	1.59	130

NB: Results are based on ultimate case modelling.

North Coast Railway, looking downstream

Table F.6 Ferny Grove Railway

CREEK	**BREAKFAST CREEK**
LOCATION	**FERNY GROVE RAILWAY**

IMMUNITY RATING:	**> 100 yr**

DATE OF SURVEY:	**APRIL 1998**	UBD REF	**140 C17**
AERIAL PHOTO No:	**SPH 11/3, Sheet 3.2**	STRUCTURE ID	**B28779**
BCC CROSS SECTION No:	**B260**	AMTD (m):	**2480**
STRUCTURE DESCRIPTION:			**Railway Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**7 spans, each 15m** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**-0.23**	UPSTREAM OBVERT LEVEL:	**6.76**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**-0.23**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**6.76**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			Yes (partially interpolated), B260
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**1.00**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**8.13**
PIER WIDTH (m):	**0.8**		
HEIGHT OF GUARDRAILS (m AHD):			**N/A**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**N/A**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			**1978**
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 43**

CREEK	**BREAKFAST CREEK**
LOCATION	**FERNY GROVE RAILWAY**

ARI (years)	DISCHARGE (m^3/s) Total	U/S WATER LEVEL (m AHD)	D/S WATER LEVEL (m AHD)	AFFLUX AT MAX FLOW (mm)
100	496.1	4.58	4.53	50
50	428.7	4.06	4.01	50
20	358.8	3.51	3.47	40
10	319.5	3.17	3.13	40
5	271.1	2.86	2.82	40
2	203.4	2.32	2.28	40
1	171.9	2.08	2.05	30

NB: Results are based on ultimate case modelling.

Ferny Grove Railway, looking downstream

Table F.7 Railway Loop

CREEK	**BREAKFAST CREEK**
LOCATION	**RAILWAY LOOP**

IMMUNITY RATING:	**> 100 yr**

DATE OF SURVEY:	**APRIL 1998**	UBD REF	**140 B18**
AERIAL PHOTO No:	**SPH 11/3, Sheet 3.2**	STRUCTURE ID	**B28556**
BCC CROSS SECTION No:	**B271**	AMTD (m):	**2700**

STRUCTURE DESCRIPTION: **Railway Bridge**

STRUCTURE SIZE **4 spans @ 15m, 1 span @12.5m**
For Culverts: Number of cells/pipes & sizes
For Bridges: Number of Spans and their lengths

UPSTREAM INVERT LEVEL:
UPSTREAM OBVERT LEVEL:

DOWNSTREAM INVERT LEVEL:
For culverts give floor level.
DOWNSTREAM OBVERT LEVEL:
For bridges give bed level

For Culverts
LENGTH OF CULVERT BARREL AT INVERT (m): **N/A**

LENGTH OF CULVERT BARREL AT OBVERT (m): **N/A**

TYPE OF LINING: **N/A**
(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?
If yes give details ie. Plan number and/or survey book number.
Note: This section should be at the highest part of the road
eg crown, kerb, hand rails guard rails whichever is higher.

WEIR WIDTH (m)
(In direction of flow,
ie. distance from u/s face to d/s face)
WEIR LEVEL (m AHD):
(Level at which water overtops road)

PIER WIDTH (m): **0.9**

HEIGHT OF GUARDRAILS (m AHD): **N/A**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND
HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS: **N/A**

The following should also be provided.
Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels.
For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.

CONSTRUCTION DATE OF CURRENT STRUCTURE:

PLAN NUMBER:

HAS THE STRUCTURE BEEN UPGRADED?
If yes, explain type and date of upgrade. Include plan number and location if applicable.

ADDITIONAL COMMENTS: **FIELD BOOK No. 8809/2**
FOLIO No. 43

CREEK	**BREAKFAST CREEK**
LOCATION	**RAILWAY LOOP**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	511.9	4.85	4.77	80
50	430.9	4.31	4.26	50
20	360.2	3.73	3.69	40
10	319.5	3.39	3.36	30
5	271.1	3.06	3.04	20
2	203.2	2.48	2.46	20
1	171.6	2.22	2.20	20

NB: Results are based on ultimate case modelling.

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Railway Loop, looking downstream

Table F.8 Inner City Bypass Off Ramp

CREEK	**BREAKFAST CREEK**
LOCATION	**INNER CITY BYPASS OFF RAMP**

IMMUNITY RATING:	**> 100 yr**

DATE OF SURVEY:		UBD REF	**139 R20**
AERIAL PHOTO No:	**SPH 11/3, Sheet 3.2**	STRUCTURE ID	**B27790**
BCC CROSS SECTION No:		AMTD (m):	**3485**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**5 spans @ 20m** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:		UPSTREAM OBVERT LEVEL:	**4.71**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.		DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**As above**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**No**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**30**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**5.95**
PIER WIDTH (m):	**1.0**		
HEIGHT OF GUARDRAILS (m AHD):			**N/A**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**N/A**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			**2001**
PLAN NUMBER:			**Q672/20/ST/BR/00600/AC**
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			

CREEK	**BREAKFAST CREEK**
LOCATION	**INNER CITY BYPASS OFF RAMP**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	388.7	5.29	5.23	60
50	366.6	4.79	4.73	60
20	335.9	4.21	4.15	60
10	308.3	3.89	3.83	60
5	274.5	3.53	3.46	70
2	206.6	2.92	2.84	80
1	172.8	2.62	2.54	80

NB: Results are based on ultimate case modelling.

Inner City Bypass Off Ramp (Horace Street), looking downstream

Table F.9 Bowen Bridge Road

CREEK	**BREAKFAST CREEK**
LOCATION	**BOWEN BRIDGE ROAD**

IMMUNITY RATING: > 100 yr*

* main bridge has > 100 yr immunity but approaches inundated for 10 yr ARI

DATE OF SURVEY:	**APRIL 1998**	UBD REF	**139 R20**
AERIAL PHOTO No:	**SPH 11/3, Sheet 3.2**	STRUCTURE ID	**B27510**
BCC CROSS SECTION No:	**B330**	AMTD (m):	**3781**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**4 spans, L-R 16.6, 15.3, 15.3, 9.1** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**-2.20**	UPSTREAM OBVERT LEVEL:	**3.30**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**-2.20**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**3.30**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, B330**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**33.0**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**4.30**
PIER WIDTH (m):	**0.4**		
HEIGHT OF GUARDRAILS (m AHD):			5.5
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**850 mm high metal railings**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 39**

CREEK	BREAKFAST CREEK
LOCATION	**BOWEN BRIDGE ROAD**

ARI (years)	DISCHARGE (m^3/s)	U/S WATER LEVEL (m AHD)	D/S WATER LEVEL (m AHD)	AFFLUX AT MAX FLOW (mm)
	Total			
100	538.9	5.55	5.36	190
50	442.5	5.07	4.87	200
20	367.2	4.54	4.30	240
10	321.5	4.19	3.97	220
5	272.7	3.79	3.61	180
2	203.8	3.13	3.0	130
1	169.6	2.8	2.7	100

NB: Results are based on ultimate case modelling.

Bowen Bridge Road, looking downstream

Table F.10 Downey Park Footbridge

CREEK	**BREAKFAST CREEK**
LOCATION	**DOWNEY PARK FOOTBRIDGE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**APRIL 1998**	UBD REF	**139 P20**
AERIAL PHOTO No:	**SPH 11/3, Sheet 3.2**	STRUCTURE ID	**B26908**
BCC CROSS SECTION No:	**B390**	AMTD (m):	**4369**
STRUCTURE DESCRIPTION:			**Arched concrete pedestrian bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**Single span, 56.8m** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**-1.37**	UPSTREAM OBVERT LEVEL:	**Edge 1.86 Cen 3.49**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**-1.37**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**As above**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, B390**
WEIR WIDTH (m) (In direction of flow, ie. Distance from u/s face to d/s face)	**3.35**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**2.37**
PIER WIDTH (m):	**N/A**		
HEIGHT OF GUARDRAILS (m AHD):			**Edge 3.82, Cen 6.09**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.25m metal railings**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 38**

CREEK	**BREAKFAST CREEK**
LOCATION	**DOWNEY PARK FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	147.2	5.69	5.69	0
50	143.3	5.22	5.22	0
20	141.9	4.73	4.73	0
10	141.2	4.40	4.40	0
5	137.3	4.02	4.02	0
2	129.0	3.43	3.43	0
1	124.1	3.15	3.15	0

NB: Results are based on ultimate case modelling.

Downey Park Footbridge, looking upstream

Table F.11 Noble Street Footbridge

CREEK	**BREAKFAST CREEK**
LOCATION	**NOBLE STREET FOOTBRIDGE**

IMMUNITY RATING:	**> 10 yr**

DATE OF SURVEY:	**APRIL 1998**	UBD REF	**139 N19**
AERIAL PHOTO No:	**SPH 11/3, Sheet 3.2**	STRUCTURE ID	**B26526**
BCC CROSS SECTION No:	**B440**	AMTD (m):	**4739**
STRUCTURE DESCRIPTION:			**Concrete Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**5 spans, L-R 9.1, 13.8, 15.4, 22.1, 10.8** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**-0.11**	UPSTREAM OBVERT LEVEL:	**4.09**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**-0.11**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**4.09**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, B440**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**2.65**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**4.60**
PIER WIDTH (m):	**1.5**		
HEIGHT OF GUARDRAILS (m AHD):			**5.45**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**760mm high metal railings with wire mesh**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 37**

CREEK	**BREAKFAST CREEK**
LOCATION	**NOBLE STREET FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	572.2	5.85	5.79	60
50	481.0	5.36	5.31	50
20	409.5	4.87	4.83	40
10	358.4	4.55	4.52	30
5	301.3	4.18	4.15	30
2	220.8	3.61	3.58	30
1	182.2	3.34	3.31	30

NB: Results are based on ultimate case modelling.

Noble Street Footbridge, looking downstream

Table F.12 Bishop Street Footbridge

CREEK	**BREAKFAST CREEK**
LOCATION	**BISHOP STREET FOOTBRIDGE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**APRIL 1998**	UBD REF	**139 J18**
AERIAL PHOTO No:	**SPH 11/5, Sheet 3.3**	STRUCTURE ID	**B25285**
BCC CROSS SECTION No:	**B560**	AMTD (m):	**5993**
STRUCTURE DESCRIPTION:			**Timber Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**5 spans, L-R 5.9, 6.4, 6.0, 11.9, 12.4** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**-0.20**	UPSTREAM OBVERT LEVEL:	**2.10**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**-0.20**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**2.10**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, B560**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**2.0**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**2.70**
PIER WIDTH (m):	**0.6**		
HEIGHT OF GUARDRAILS (m AHD):			**3.50**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**800mm high timber rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 36**

CREEK	**BREAKFAST CREEK**
LOCATION	**BISHOP STREET FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	486.4	6.92	6.68	240
50	415.9	6.40	6.20	200
20	349.7	6.02	5.83	190
10	311.7	5.72	5.55	170
5	255.6	5.35	5.19	160
2	191.1	4.69	4.57	120
1	158.8	4.3	4.19	110

NB: Results are based on ultimate case modelling.

Bishop Street Footbridge, looking downstream

Table F.13 Kelvin Grove Road (Inbound)

CREEK	**BREAKFAST CREEK**
LOCATION	**KELVIN GROVE ROAD (INBOUND)**

IMMUNITY RATING:	**100 yr**

DATE OF SURVEY:	**APRIL 1998**	UBD REF	**139 G19**
AERIAL PHOTO No:	**SPH 11/5, Sheet 3.3**	STRUCTURE ID	**B24742**
BCC CROSS SECTION No:	**B630**	AMTD (m):	**6514**
STRUCTURE DESCRIPTION:			**Concrete Road Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**5 spans, each 9.75** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**0.60**	UPSTREAM OBVERT LEVEL:	**5.60**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**0.60**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**5.60**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, B630**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**16**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**6.83**
PIER WIDTH (m):	**0.525**		
HEIGHT OF GUARDRAILS (m AHD):			**8.22**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**0.97m high concrete railings**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 35**

CREEK	**BREAKFAST CREEK**
LOCATION	**KELVIN GROVE ROAD (INBOUND)**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	627.2	7.74	7.07	670
50	562.6	7.25	6.76	490
20	452.3	6.43	6.07	360
10	431.6	6.18	5.91	270
5	323.4	5.91	5.71	200
2	237.9	5.21	5.07	140
1	191.9	4.78	4.67	110

NB: Results are based on ultimate case modelling.

Kelvin Grove Road (Inbound), looking upstream

Table F.14 Kelvin Grove Road (Outbound)

CREEK	**BREAKFAST CREEK**
LOCATION	**KELVIN GROVE ROAD (OUTBOUND)**

IMMUNITY RATING:	**> 100 yr**

DATE OF SURVEY:	**APRIL 1998**	UBD REF	**139 G19**
AERIAL PHOTO No:	**SPH 11/5, Sheet 3.3**	STRUCTURE ID	**B24742**
BCC CROSS SECTION No:	**B640**	AMTD (m):	**6549**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**5 spans, L-R 11.4, 9.75, 9.75, 9.75, 11.6** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**0.35**	UPSTREAM OBVERT LEVEL:	**7.15**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**0.35**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**7.15**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, B640**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**12.5**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**6.83**
PIER WIDTH (m):	**0.7**		
HEIGHT OF GUARDRAILS (m AHD):			**9.09**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.02m high metal railings**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 34**

CREEK	**BREAKFAST CREEK**
LOCATION	**KELVIN GROVE ROAD (OUTBOUND)**

Note: Kelvin Grove Road (Inbound) and Kelvin Grove Road (Outbound) were modelled as one structure in TUFLOW model. There is therefore only one table of flows and levels available for the structure. This table can be seen with the Kelvin Grove Road (Inbound) hydraulic structure reference sheet.

Kelvin Grove Road (Outbound), looking downstream

Table F.15 Murray Street Footbridge

CREEK	**BREAKFAST CREEK**
LOCATION	**MURRAY STREET FOOTBRIDGE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**APRIL 1998**	UBD REF	**139 F20**
AERIAL PHOTO No:	**SPH 11/5, Sheet 3.3**	STRUCTURE ID	**B24332**
BCC CROSS SECTION No:	**B660**	AMTD (m):	**6944**
STRUCTURE DESCRIPTION:			**Concrete Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**2 spans, 17.7 & 8.8** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**0.36**	UPSTREAM OBVERT LEVEL:	**2.76**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**0.36**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**2.76**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, B660**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**4.1**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**3.50**
PIER WIDTH (m):	**0.6**		
HEIGHT OF GUARDRAILS (m AHD):			**4.80**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.3m high knockdown metal railings**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 43**

CREEK	**BREAKFAST CREEK**
LOCATION	**MURRAY STREET FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	608.5	8.27	8.08	190
50	538.3	7.73	7.56	170
20	436.8	7.04	6.85	190
10	400.4	6.83	6.61	220
5	316.7	6.53	6.34	190
2	234.2	5.93	5.74	190
1	189.5	5.57	5.39	180

NB: Results are based on ultimate case modelling.

Murray Street Footbridge, looking downstream

Table F.16 Park Avenue Footbridge

CREEK	**ENOGGERA CREEK**
LOCATION	**PARK AVENUE FOOTBRIDGE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**139 E19**
AERIAL PHOTO No:	**SPH 11/5, Sheet 3.3**	STRUCTURE ID	**E23592**
BCC CROSS SECTION No:	**E34**	AMTD (m):	**7703**
STRUCTURE DESCRIPTION:			**Timber Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**4 spans, L-R 4.7, 9.25, 9.2, 4.7** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**0.97**	UPSTREAM OBVERT LEVEL:	**5.30**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**0.97**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**5.30**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E34**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**2**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**5.63**
PIER WIDTH (m):	**0.16**		
HEIGHT OF GUARDRAILS:			**6.52**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**840mm high timber rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 46**

CREEK	**ENOGGERA CREEK**
LOCATION	**PARK AVENUE FOOTBRIDGE**

ARI (years)	DISCHARGE (m^3/s)	U/S WATER LEVEL (m AHD)	D/S WATER LEVEL (m AHD)	AFFLUX AT MAX FLOW (mm)
	Total			
100	467.0	8.9	8.65	250
50	408.1	8.44	8.17	270
20	335.2	8.01	7.69	320
10	294.5	7.79	7.48	310
5	245.3	7.5	7.19	310
2	177.5	7.04	6.73	310
1	141.8	6.72	6.43	290

NB: Results are based on ultimate case modelling.

Park Avenue Footbridge, looking downstream

Table F.17 Corbie Street Footbridge

CREEK	**ENOGGERA CREEK**
LOCATION	**CORBIE STREET FOOTBRIDGE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**139 E18**
AERIAL PHOTO No:	**SPH 11/5, Sheet 3.3**	STRUCTURE ID	**E23261**
BCC CROSS SECTION No:	**E50**	AMTD (m):	**8034**
STRUCTURE DESCRIPTION:			**Arched Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**Single span of 19.3 m**
UPSTREAM INVERT LEVEL:	**3.72**	UPSTREAM OBVERT LEVEL:	**6.06L, 6.24C, 5.86R**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**3.72**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**As above**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E50**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**2.65**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**5.86**
PIER WIDTH (m):	**N/A**		
HEIGHT OF GUARDRAILS:			**L 7.46, C 7.64, R 7.26**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.4m high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1 FOLIO No. 45**

CREEK	**ENOGGERA CREEK**
LOCATION	**CORBIE STREET FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s) Total**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
100	470.1	9.8	9.62	180
50	408.7	9.46	9.23	230
20	335.8	9.08	8.85	230
10	297.7	8.82	8.61	210
5	244.4	8.51	8.31	200
2	177.3	7.92	7.76	160
1	141.7	7.48	7.36	120

NB: Results are based on ultimate case modelling.

Corbie Street Footbridge, looking downstream

Table F.18 Ashgrove Avenue

CREEK	**ENOGGERA CREEK**
LOCATION	**ASHGROVE AVENUE**

IMMUNITY RATING:	**> 50 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**139 G17**
AERIAL PHOTO No:	**SPH 11/5, Sheet 3.3**	STRUCTURE ID	**E22720**
BCC CROSS SECTION No:	**E70**	AMTD (m):	**8583**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		**5 spans, L-R 8.4, 9.2, 9.0, 9.2, 8.5** For Bridges: Number of Spans and their lengths	
UPSTREAM INVERT LEVEL:	**4.14**	UPSTREAM OBVERT LEVEL:	**10.44L, 9.44R**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**4.14**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**As above**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E70**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**15.1**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**10.70**
PIER WIDTH (m):	**0.6**		
HEIGHT OF GUARDRAILS:			**L12.65, R 11.64**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**940mm high concrete rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 44**

CREEK	**ENOGGERA CREEK**
LOCATION	**ASHGROVE AVENUE**

ARI (years)	DISCHARGE (m^3/s)	U/S WATER LEVEL (m AHD)	D/S WATER LEVEL (m AHD)	AFFLUX AT MAX FLOW (mm)	VELOCITY (m/s)	
	Total				Weir	Structure
100	466.8	11.27	10.68	590	0.0	3.1
50	406.6	10.85	10.35	500	0.0	2.8
20	338.1	10.37	9.94	430	0.0	2.4
10	296.3	10.04	9.66	380	0.0	2.2
5	246.6	9.61	9.29	320	0.0	1.9
2	178.4	8.9	8.66	240	0.0	1.5
1	143.4	8.44	8.23	210	0.0	1.5

NB: Results are based on ultimate case modelling.

Ashgrove Avenue, looking downstream

Table F.19 Quondong Street Bikeway Bridge

CREEK	**ENOGGERA CREEK**
LOCATION	**QUONDONG STREET BIKEWAY BRIDGE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:		UBD REF	**139 D17**
AERIAL PHOTO No:	**SPH 11/5, Sheet 3.3**	STRUCTURE ID	
BCC CROSS SECTION No:		AMTD (m):	**9450**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**Single spans of 7.5 m**
UPSTREAM INVERT LEVEL:		UPSTREAM OBVERT LEVEL:	**6.70**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.		DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**6.70**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**No**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**3.6**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**7.00**
PIER WIDTH (m):	**N/A**		
HEIGHT OF GUARDRAILS:			**8.20**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.2 m high Monowills handrail**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			**2004**
PLAN NUMBER:			**CD0389195**
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			

CREEK	**ENOGGERA CREEK**
LOCATION	**QUONDONG STREET BIKEWAY BRIDGE**

Note: This structure was not modelled in the TUFLOW model, due to the lack of impact on water levels. Information relating to hydraulic performance is therefore unavailable. Based on water levels in this area, the structure has less than a 2 year immunity and minimal impact on head losses.

Quondong Street Bikeway bridge

Table F.20 Pavonia Street Bikeway Bridge

CREEK	**ENOGGERA CREEK**
LOCATION	**PAVONIA STREET BIKEWAY BRIDGE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:		UBD REF	**139 D17**
AERIAL PHOTO No:	**SPH 11/5, Sheet 3.3**	STRUCTURE ID	
BCC CROSS SECTION No:		AMTD (m):	**9650**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**Single spans of 12 m**
UPSTREAM INVERT LEVEL:		UPSTREAM OBVERT LEVEL:	**8.01**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.		DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**8.01**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**No**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**3.6**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**8.31**
PIER WIDTH (m):	**N/A**		
HEIGHT OF GUARDRAILS:			**9.51**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.2 m high Monowills handrail**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			**2004**
PLAN NUMBER:			**CD0389195**
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			

CREEK	**ENOGGERA CREEK**
LOCATION	**PAVONIA STREET BIKEWAY BRIDGE**

Note: This structure was not modelled in the TUFLOW model, due to the lack of impact on water levels. Information relating to hydraulic performance is therefore unavailable. Based on water levels in this area, the structure has less than a 2 year immunity and minimal impact on head losses.

Pavonia Street Bikeway Bridge

Table F.21 Steege Street Footbridge

CREEK	**ENOGGERA CREEK**
LOCATION	**STEEGE STREET FOOTBRIDGE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**138 A17**
AERIAL PHOTO No:	**SPH 11/7, Sheet 3.4**	STRUCTURE ID	**E21032**
BCC CROSS SECTION No:	**E159**	AMTD (m):	**10263**
STRUCTURE DESCRIPTION:			**Timber Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**4 spans, L-R 4.65, 8.3, 8.4, 8.7** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**8.60**	UPSTREAM OBVERT LEVEL:	**11.34**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**8.60**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**11.34**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E159**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**1.7**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**11.90**
PIER WIDTH (m):	**0.4**		
HEIGHT OF GUARDRAILS:			**12.78**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**880mm high timber rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 42**

CREEK	**ENOGGERA CREEK**
LOCATION	**STEEGE STREET FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	465.9	13.84	13.81	30
50	407.2	13.55	13.51	40
20	380.2	13.18	13.15	30
10	363.8	12.93	12.91	20
5	343.3	12.60	12.58	20
2	323.4	12.04	12.02	20
1	322.3	11.94	11.89	50

NB: Results are based on ultimate case modelling.

Steege Street Footbridge, looking downstream

Table F.22 Stewart Road

CREEK	**ENOGGERA CREEK**
LOCATION	**STEWART ROAD**

IMMUNITY RATING:	**> 50 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**138 R19**
AERIAL PHOTO No:	**SPH 11/7, Sheet 3.4**	STRUCTURE ID	**E20554**
BCC CROSS SECTION No:	**E190**	AMTD (m):	**10768**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**3 spans, L-R 15.4, 16.8, 14.6**
UPSTREAM INVERT LEVEL:	**10.08**	UPSTREAM OBVERT LEVEL:	**17.01L, 15.56R**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**9.78**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**L 16.19, R 14.80**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E190**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**22.4**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**16.10**
PIER WIDTH (m):	**0.6**		
HEIGHT OF GUARDRAILS:			**L 19.12, R 17.67**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.12m high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1 FOLIO No. 42**

CREEK	**ENOGGERA CREEK**
LOCATION	**STEWART AVENUE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	547.0	16.48	15.67	810
50	409.6	16.14	15.38	760
20	341.8	15.7	14.99	710
10	300.2	15.39	14.74	650
5	250.4	14.96	14.42	540
2	179.9	14.27	13.88	390
1	142.9	13.85	13.53	320

NB: Results are based on ultimate case modelling.

Stewart Avenue, looking downstream

Table F.23 Mirrabooka Road

CREEK	**ENOGGERA CREEK**
LOCATION	**MIRRABOOKA ROAD**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**138 P19**
AERIAL PHOTO No:	**SPH 11/7, Sheet 3.4**	STRUCTURE ID	**E19956**
BCC CROSS SECTION No:	**E230**	AMTD (m):	**11361**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**3 spans of 9.6 m** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**10.95**	UPSTREAM OBVERT LEVEL:	**14.75**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**10.95**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**14.75**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E230**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**10.5**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**15.55**
PIER WIDTH (m):	**0.45**		
HEIGHT OF GUARDRAILS:			**16.5**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**850mm high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 41**

CREEK	**ENOGGERA CREEK**
LOCATION	**MIRRABOOKA ROAD**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	487.8	17.78	17.38	400
50	427.4	17.53	17.13	400
20	357.8	17.23	16.8	430
10	311.0	17.00	16.56	440
5	252.5	16.55	16.19	360
2	202.5	15.92	15.56	360
1	199.3	15.51	15.13	380

NB: Results are based on ultimate case modelling.

Mirrabooka Road, looking upstream

Table F.24 Mirrabooka Road Footbridge

CREEK	**ENOGGERA CREEK**
LOCATION	**MIRRABOOKA ROAD FOOTBRIDGE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**138 P19**
AERIAL PHOTO No:	**SPH 11/7, Sheet 3.4**	STRUCTURE ID	**E19946**
BCC CROSS SECTION No:	**E232**	AMTD (m):	**11367**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**3 spans, L-R 12.1, 9.8, 9.8** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**10.74**	UPSTREAM OBVERT LEVEL:	**15.34**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**10.74**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**15.35**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E232**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**2**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**15.60**
PIER WIDTH (m):	**0.4**		
HEIGHT OF GUARDRAILS:			**16.74**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.09m high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 40**

CREEK	**ENOGGERA CREEK**
LOCATION	**MIRRABOOKA ROAD FOOTBRIDGE**

Mirrabooka Road (road-bridge) and Mirrabooka Road (foot-bridge) were modelled as one structure in TUFLOW model. There is therefore only one table of flows and levels available for the structure. This table can be seen with the Mirrabooka Road (road-bridge) hydraulic structure reference sheet.

Mirrabooka Road Footbridge, looking upstream

Table F.25 Glenlyon Drive

CREEK	**ENOGGERA CREEK**
LOCATION	**GLENLYON DRIVE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**138 M19**
AERIAL PHOTO No:	**SPH 11/7, Sheet 3.4**	STRUCTURE ID	**E19417**
BCC CROSS SECTION No:	**E280**	AMTD (m):	**11899**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**2 spans of 10.3 m**
UPSTREAM INVERT LEVEL:	**12.43**	UPSTREAM OBVERT LEVEL:	**16.84L, 16.56R**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**12.43**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**As above**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E280**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**6.98**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**17.28**
PIER WIDTH (m):	**0.65**		
HEIGHT OF GUARDRAILS:			**L 18.72, R 18.38**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**920mm high GI pipe rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 39**

CREEK	**ENOGGERA CREEK**
LOCATION	**GLENLYON DRIVE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	480.5	19.61	19.00	610
50	417.3	19.37	18.77	600
20	349.7	19.08	18.47	610
10	305.9	18.86	18.25	610
5	252.4	18.52	17.94	580
2	178.2	17.69	17.25	440
1	140.7	17.02	16.70	320

NB: Results are based on ultimate case modelling.

Glenlyon Drive, looking downstream

Table F.26 Royal Parade Footbridge

CREEK	**ENOGGERA CREEK**
LOCATION	**ROYAL PARADE FOOTBRIDGE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**138 K19**
AERIAL PHOTO No:	**SPH 11/9, Sheet 3.5**	STRUCTURE ID	**E18103**
BCC CROSS SECTION No:	**E361**	AMTD (m):	**13210**
STRUCTURE DESCRIPTION:			**Timber Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**3 spans, L-R 5.4, 4.6, 6.2**
UPSTREAM INVERT LEVEL:	**16.69**	UPSTREAM OBVERT LEVEL:	**19.69**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**16.69**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**19.69**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E361**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**1.98**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**20.39**
PIER WIDTH (m):	**0.55**		
HEIGHT OF GUARDRAILS:			**21.26**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**870mm high timber rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1 FOLIO No. 38**

CREEK	**ENOGGERA CREEK**
LOCATION	**ROYAL PARADE FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	577.8	23.78	23.33	450
50	419.3	23.52	23.02	500
20	354.1	23.24	22.61	630
10	311.7	23.07	22.34	730
5	260.9	22.85	21.99	860
2	184.2	22.43	21.38	1050
1	140.9	22.11	20.94	1170

NB: Results are based on ultimate case modelling.

Royal Parade Footbridge, looking upstream

Table F.27 Gresham Street

CREEK	**ENOGGERA CREEK**
LOCATION	**GRESHAM STREET**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**158 K1**
AERIAL PHOTO No:	**SPH 11/9, Sheet 3.5**	STRUCTURE ID	**E17466**
BCC CROSS SECTION No:	**E412**	AMTD (m):	**13852**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**4 spans, L-R 6.6, 10.0, 8.5, 9.6** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**19.94**	UPSTREAM OBVERT LEVEL:	**22.84**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**19.94**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**22.84**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E412**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**10.7**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**23.64**
PIER WIDTH (m):	**0.45**		
HEIGHT OF GUARDRAILS:			**24.66**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.02m high GI pipe rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 36**

CREEK	ENOGGERA CREEK
LOCATION	GRESHAM STREET

ARI (years)	DISCHARGE (m^3/s) Total	U/S WATER LEVEL (m AHD)	D/S WATER LEVEL (m AHD)	AFFLUX AT MAX FLOW (mm)
100	458.2	26.49	25.61	880
50	401.3	26.22	25.35	870
20	337.6	25.86	25.02	840
10	295.5	25.60	24.76	840
5	249.7	25.27	24.44	830
2	176.6	24.51	23.82	690
1	137.3	23.82	23.38	440

NB: Results are based on ultimate case modelling.

Gresham Street, looking upstream

Table F.28 Ashgrove Golf Course Footbridge No 1

CREEK	**ENOGGERA CREEK**
LOCATION	**ASHGROVE G/C FOOTBRIDGE No 1**

IMMUNITY RATING:	**N/A**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**138 F20**
AERIAL PHOTO No:	**SPH 11/9, Sheet 3.5**	STRUCTURE ID	**N/A**
BCC CROSS SECTION No:	**E535**	AMTD (m):	**15055**
STRUCTURE DESCRIPTION:			**Timber Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**Single span of 12.9 m** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**23.42**	UPSTREAM OBVERT LEVEL:	**26.09**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**23.42**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**26.09**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E535**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**1.8**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**20.39**
PIER WIDTH (m):	**N/A**		
HEIGHT OF GUARDRAILS:			**26.51**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**180mm high GI pipe (30mm dia)**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 34**

CREEK	**ENOGGERA CREEK**
LOCATION	**ASHGROVE G/C FOOTBRIDGE No 1**

Note: This structure was not modelled in the TUFLOW model, due to the lack of impact on water levels. Information relating to hydraulic performance is therefore unavailable. Based on water levels in this area, the structure has less than a 2 year immunity and minimal impact on head losses.

Ashgrove Golf Course Footbridge No 1, looking upstream

Table F.29 Bennett Road

CREEK	**ENOGGERA CREEK**
LOCATION	**BENNETT ROAD**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**FEBRUARY 1998**	UBD REF	**138 E20**
AERIAL PHOTO No:	**SPH 11/9, Sheet 3.5**	STRUCTURE ID	**E16147**
BCC CROSS SECTION No:	**E539**	AMTD (m):	**15167**
STRUCTURE DESCRIPTION:			**Concrete Culverts**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**2 by 3.6 x 1.8m RCBC**
UPSTREAM INVERT LEVEL:	**25.60**	UPSTREAM OBVERT LEVEL:	**27.40**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**25.58**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**27.38**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**12.1**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**12.1**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**Concrete**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E539**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**12.1**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**27.97**
PIER WIDTH (m):	**0.4**		
HEIGHT OF GUARDRAILS:			**29.02**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.05m high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 33**

CREEK	**ENOGGERA CREEK**
LOCATION	**BENNETT ROAD**

ARI (years)	**DISCHARGE (m^3/s) Total**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
100	447.9	33.61	31.72	1890
50	392.3	33.15	31.35	1800
20	328.2	32.59	30.91	1680
10	286.8	32.24	30.62	1620
5	243.4	31.83	30.29	1540
2	175.2	31.12	29.73	1390
1	135.1	30.64	29.35	1290

NB: Results are based on ultimate case modelling.

Bennett Road, looking upstream

Table F.30 Ashgrove Golf Course Footbridge No 2

CREEK	**ENOGGERA CREEK**
LOCATION	**ASHGROVE G/C FOOTBRIDGE No 2**

IMMUNITY RATING:	**N/A**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**138 E20**
AERIAL PHOTO No:	**SPH 11/9, Sheet 3.5**	STRUCTURE ID	**N/A**
BCC CROSS SECTION No:	**E550**	AMTD (m):	**15245.4**
STRUCTURE DESCRIPTION:			**Timber Pedestrian bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**Single span of 20.4 m**
UPSTREAM INVERT LEVEL:	**24.75**	UPSTREAM OBVERT LEVEL:	**L24.8, R28.09**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**24.75**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**As above**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E550**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**1.8**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**28.39**
PIER WIDTH (m):			
HEIGHT OF GUARDRAILS:			**L 29.05, R 28.74**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**40 dia GI Pipe 200 high**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 32**

CREEK	**ENOGGERA CREEK**
LOCATION	**ASHGROVE G/C FOOTBRIDGE No 2**

Note: This structure was not modelled in the TUFLOW model, due to the lack of impact on water levels. Information relating to hydraulic performance is therefore unavailable. Based on water levels in this area, the structure has less than a 2 year immunity and minimal impact on head losses.

Ashgrove Golf Course Footbridge No 2, looking downstream

Table F.31 Ashgrove Golf Course Footbridge No 3

CREEK	**ENOGGERA CREEK**
LOCATION	**ASHGROVE G/C FOOTBRIDGE No 3**

IMMUNITY RATING:	**N/A**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**138 D20**
AERIAL PHOTO No:	**SPH 11/9, Sheet 3.5**	STRUCTURE ID	**N/A**
BCC CROSS SECTION No:	**E555**	AMTD (m):	**15417**
STRUCTURE DESCRIPTION:			**Timber Pedestrian bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**4 spans L-R 8.6, 9.0, 9.1, 8.45m** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**25.53**	UPSTREAM OBVERT LEVEL:	**L29.21, R28.94**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**25.53**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**As above**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E555**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**2.1**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**29.34**
PIER WIDTH (m):			
HEIGHT OF GUARDRAILS:			**L 29.57, R 29.84**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**50 dia GI Pipe 200 high**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 31**

CREEK	**ENOGGERA CREEK**
LOCATION	**ASHGROVE G/C FOOTBRIDGE No 3**

Note: This structure was not modelled in the TUFLOW model, due to the lack of impact on water levels. Information relating to hydraulic performance is therefore unavailable. Based on water levels in this area, the structure has less than a 2 year immunity and minimal impact on head losses.

Ashgrove Golf Course Footbridge No 3, looking downstream

Table F.32 Ashgrove Golf Course Footbridge No 4

CREEK	**ENOGGERA CREEK**
LOCATION	**ASHGROVE G/C FOOTBRIDGE No 4**

IMMUNITY RATING:	**N/A**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**138 D20**
AERIAL PHOTO No:	**SPH 11/9, Sheet 3.5**	STRUCTURE ID	**N/A**
BCC CROSS SECTION No:	**E560**	AMTD (m):	**15454.1**
STRUCTURE DESCRIPTION:			**Timber Pedestrian bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**Single span of 15.9m**
UPSTREAM INVERT LEVEL:	**25.14**	UPSTREAM OBVERT LEVEL:	**L29.98, R27.50**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**25.14**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**As above**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E560**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**1.66**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**27.80**
PIER WIDTH (m):			
HEIGHT OF GUARDRAILS:			**N/A**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**N/A**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 30**

CREEK	**ENOGGERA CREEK**
LOCATION	**ASHGROVE G/C FOOTBRIDGE No 4**

Note: This structure was not modelled in the TUFLOW model, due to the lack of impact on water levels. Information relating to hydraulic performance is therefore unavailable. Based on water levels in this area, the structure has less than a 2 year immunity and minimal impact on head losses.

Ashgrove Golf Course Footbridge No 4, looking downstream

Table F.33 Ashgrove Golf Course Footbridge No 5

CREEK	**ENOGGERA CREEK**
LOCATION	**ASHGROVE G/C FOOTBRIDGE No 5**

IMMUNITY RATING:	**N/A**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**138 D20**
AERIAL PHOTO No:	**SPH 11/9, Sheet 3.5**	STRUCTURE ID	**N/A**
BCC CROSS SECTION No:	**E570**	AMTD (m):	**15570.9**
STRUCTURE DESCRIPTION:			**Timber Pedestrian bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**Single span of 12.0m**
UPSTREAM INVERT LEVEL:	**25.80**	UPSTREAM OBVERT LEVEL:	**28.15**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**25.80**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**28.15**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E570**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**1.8**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**28.63**
PIER WIDTH (m):			
HEIGHT OF GUARDRAILS:			**28.95**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**35 dia GI Pipe 0.17 high**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 29**

CREEK	**ENOGGERA CREEK**
LOCATION	**ASHGROVE G/C FOOTBRIDGE No 5**

Note: This structure was not modelled in the TUFLOW model, due to the lack of impact on water levels. Information relating to hydraulic performance is therefore unavailable. Based on water levels in this area, the structure has less than a 2 year immunity and minimal impact on head losses.

Ashgrove Golf Course Footbridge No 5, looking upstream

Table F.34 Ashgrove Golf Course Causeway

CREEK	**ENOGGERA CREEK**
LOCATION	**ASHGROVE G/C CAUSEWAY**

IMMUNITY RATING:	**N/A**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**138 D20**
AERIAL PHOTO No:	**SPH 11/9, Sheet 3.5**	STRUCTURE ID	**N/A**
BCC CROSS SECTION No:	**E574**	AMTD (m):	**15645.6**
STRUCTURE DESCRIPTION:			**Concrete Vehicle Causeway**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**2 by 300 dia RCP**
UPSTREAM INVERT LEVEL:	**26.95**	UPSTREAM OBVERT LEVEL:	**27.25**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**26.85**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**27.15**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**4.6**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**4.6**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**Concrete**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E574**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**4.6**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**27.35**
PIER WIDTH (m):			
HEIGHT OF GUARDRAILS:			**N/A**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**N/A**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 13**

CREEK	**ENOGGERA CREEK**
LOCATION	**ASHGROVE G/C FOOTBRIDGE No 5**

Note: This structure was modelled in the TUFLOW model as a weir structure; information relating to hydraulic performance is therefore unavailable. Based on water levels in this area, the structure has less than a 2 year immunity and minimal impact on head losses.

Ashgrove Golf Course Causeway, looking upstream

Table F.35 Waterworks Road (Inbound)

CREEK	**ENOGGERA CREEK**
LOCATION	**WATERWORKS ROAD (INBOUND)**

IMMUNITY RATING:	**>100 yr**

DATE OF SURVEY:	**FEBRUARY 1998**	UBD REF	**138 B20**
AERIAL PHOTO No:	**SPH 11/11, Sheet 3.6**	STRUCTURE ID	**E15262**
BCC CROSS SECTION No:	**E620**	AMTD (m):	**16051**
STRUCTURE DESCRIPTION:			**Arched Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**2 spans of 13.82 m**
UPSTREAM INVERT LEVEL:	**28.37**	UPSTREAM OBVERT LEVEL:	**36.99**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**28.37**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**36.99**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E620**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**8.36**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**38.00**
PIER WIDTH (m):	**2.5**		
HEIGHT OF GUARDRAILS:			**39.22**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.08m high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 27**

CREEK	**ENOGGERA CREEK**
LOCATION	**WATERWORKS ROAD (INBOUND)**

ARI (years)	DISCHARGE (m^3/s)	U/S WATER LEVEL (m AHD)	D/S WATER LEVEL (m AHD)	AFFLUX AT MAX FLOW (mm)
	Total			
100	229.9	34.81	34.47	340
50	202.2	34.38	34.06	320
20	169.7	33.84	33.56	280
10	18.9	33.49	33.25	240
5	127.0	33.11	32.90	210
2	92.2	32.44	32.29	150
1	74.3	32.04	31.91	130

NB: Results are based on ultimate case modelling.

Waterworks Road, looking upstream

Table F.36 Waterworks Road (Outbound)

CREEK	**ENOGGERA CREEK**
LOCATION	**WATERWORKS ROAD (OUTBOUND)**

IMMUNITY RATING:	**>100 yr**

DATE OF SURVEY:		UBD REF	**138 B20**
AERIAL PHOTO No:		STRUCTURE ID	**E15262**
BCC CROSS SECTION No:		AMTD (m):	**16051**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**3 spans (total width 51.3 m)**
UPSTREAM INVERT LEVEL:		UPSTREAM OBVERT LEVEL:	**L36.86, R37.10**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.		DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**As above**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**No**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**12.5**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**38.53**
PIER WIDTH (m):	**Varies**		
HEIGHT OF GUARDRAILS: DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			**2000**
PLAN NUMBER:			**W12042**
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1 FOLIO No. 27**

CREEK	**ENOGGERA CREEK**
LOCATION	**WATERWORKS ROAD (INBOUND)**

Note: Waterworks Road (Inbound) and Waterworks Road (Outbound) were modelled as one structure in TUFLOW. There is therefore only one table of flows and levels available for the structure. This table can be seen with the Waterworks Road (Inbound) hydraulic structure reference sheet.

Waterworks Road, looking downstream

Table F.37 Walton Bridge Causeway

CREEK	**ENOGGERA CREEK**
LOCATION	**WALTON BRIDGE CAUSEWAY**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**FEBRUARY 1998**	UBD REF	**158 B1**
AERIAL PHOTO No:	**SPH 11/11, Sheet 3.6**	STRUCTURE ID	**E14657**
BCC CROSS SECTION No:	**E660**	AMTD (m):	**16656**
STRUCTURE DESCRIPTION:			**Corrugated Iron Pipe Culverts**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**4 by 1860mm dia**
UPSTREAM INVERT LEVEL:	**29.76**	UPSTREAM OBVERT LEVEL:	**31.62**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**29.74**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**31.60**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**1.2**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**1.2**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**Corrugated Iron**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E660**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**1.2**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**31.78**
PIER WIDTH (m):	**0.15**		
HEIGHT OF GUARDRAILS:			**N/A**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**N/A**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 26**

CREEK	**ENOGGERA CREEK**
LOCATION	**WALTON BRIDGE CAUSEWAY**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	238.8	36.06	35.34	720
50	208.0	35.74	34.99	750
20	172.6	35.34	34.53	810
10	149.0	35.06	34.23	830
5	126.6	34.75	33.90	850
2	89.4	34.20	33.33	870
1	71.7	33.81	32.99	820

NB: Results are based on ultimate case modelling.

Walton Bridge Causeway, looking downstream

Table F.38 Shopping Centre Footbridge

CREEK	**ENOGGERA CREEK**
LOCATION	**SHOPPING CENTRE FOOTBRIDGE**

IMMUNITY RATING:	**100 yr**

DATE OF SURVEY:	**FEBRUARY 1998**	UBD REF	**158 A1**
AERIAL PHOTO No:	**SPH 11/11, Sheet 3.6**	STRUCTURE ID	**E14596**
BCC CROSS SECTION No:	**E669**	AMTD (m):	**16717**
STRUCTURE DESCRIPTION:			**Steel Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**2 spans, 16.5 & 22.4 m**
UPSTREAM INVERT LEVEL:	**31.68**	UPSTREAM OBVERT LEVEL:	**37.43L, 36.44R**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**31.68**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**37.43L, 36.44R**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E669**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**2.62**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**36.68**
PIER WIDTH (m):	**0.15**		
HEIGHT OF GUARDRAILS:			**38.78L, 37.79R**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.35m high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 25**

CREEK	**ENOGGERA CREEK**
LOCATION	**SHOPPING CENTRE FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	236.1	36.45	36.06	390
50	207.4	36.14	35.74	400
20	172.0	35.74	35.34	400
10	149.1	35.45	35.06	390
5	123.9	35.14	34.75	390
2	87.9	34.57	34.20	370
1	68.1	34.21	33.81	400

NB: Results are based on ultimate case modelling.

Shopping Centre Footbridge, looking upstream

Table F.39 Tandara Street Footbridge

CREEK	**ENOGGERA CREEK**
LOCATION	**TANDARA STREET FOOTBRIDGE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**FEBRUARY 1998**	UBD REF	**157 R1**
AERIAL PHOTO No:	**SPH 11/11, Sheet 3.6**	STRUCTURE ID	**E14014**
BCC CROSS SECTION No:	**E709**	AMTD (m):	**17299**
STRUCTURE DESCRIPTION:			**Concrete Box Culverts**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**2 by 1.2 x 0.6m RCBC**
UPSTREAM INVERT LEVEL:	**33.74**	UPSTREAM OBVERT LEVEL:	**34.34**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**33.73**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**34.33**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**4.9**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**4.9**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**Concrete**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E709**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**4.9**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**35.06**
PIER WIDTH (m):	**0.4**		
HEIGHT OF GUARDRAILS:			**36.6**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.1m high GI pipe rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 24**

CREEK	**ENOGGERA CREEK**
LOCATION	**TANDARA STREET FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	185.0	38.44	38.02	420
50	166.7	38.23	37.80	430
20	141.2	37.95	37.47	480
10	123.6	37.79	37.24	550
5	105.6	37.63	36.98	650
2	76.4	37.35	36.55	800
1	60.5	37.18	36.27	910

NB: Results are based on ultimate case modelling.

Tandara Street Footbridge, looking upstream

Table F.40 Illowra Street

CREEK	**ENOGGERA CREEK**
LOCATION	**ILLOWRA STREET**

IMMUNITY RATING:	**> 100 yr**

DATE OF SURVEY:	**FEBRUARY 1998**	UBD REF	**137 P20**
AERIAL PHOTO No:	**SPH 11/11, Sheet 3.6**	STRUCTURE ID	**E13359**
BCC CROSS SECTION No:	**E750**	AMTD (m):	**17954**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**3 spans of 9.3 m**
UPSTREAM INVERT LEVEL:	**36.47**	UPSTREAM OBVERT LEVEL:	**43.32**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**36.47**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**43.32**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E750**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**10.39**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**43.70**
PIER WIDTH (m):	**0.6**		
HEIGHT OF GUARDRAILS:			**45.05**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.1m high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 22**

CREEK	ENOGGERA CREEK
LOCATION	**ILLOWRA STREET**

ARI (years)	DISCHARGE (m^3/s) Total	U/S WATER LEVEL (m AHD)	D/S WATER LEVEL (m AHD)	AFFLUX AT MAX FLOW (mm)
100	179.1	41.96	41.00	960
50	161.5	41.69	40.80	890
20	136.2	41.28	40.49	790
10	119.3	40.98	40.26	720
5	101.7	40.65	40.00	650
2	73.6	40.06	39.52	540
1	58.5	39.67	39.22	450

NB: Results are based on ultimate case modelling.

Illowra Street, looking upstream

Table F.41 Riaweena Street Footbridge

CREEK	**ENOGGERA CREEK**
LOCATION	**RIAWEENA STREET FOOTBRIDGE**

IMMUNITY RATING:	**100 yr**

DATE OF SURVEY:	**FEBRUARY 1998**	UBD REF	**157 N1**
AERIAL PHOTO No:	**SPH 11/11, Sheet 3.6**	STRUCTURE ID	**E12647**
BCC CROSS SECTION No:	**E811**	AMTD (m):	**18666**
STRUCTURE DESCRIPTION:			**Steel Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**2 spans of 14.5 m**
UPSTREAM INVERT LEVEL:	**40.17**	UPSTREAM OBVERT LEVEL:	**46.11L, 45.25R**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**40.17**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**46.11L, 45.25R**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E811**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**2.68**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**45.25**
PIER WIDTH (m):	**0.125**		
HEIGHT OF GUARDRAILS:			**47.38L, 46.52R**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.27m high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1 FOLIO No. 21**

CREEK	**ENOGGERA CREEK**
LOCATION	**RIAWEENA STREET FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	170.3	45.31	44.66	650
50	153.9	45.07	44.46	610
20	129.9	44.70	44.15	550
10	113.5	44.43	43.92	510
5	96.7	44.13	43.68	450
2	70.2	43.63	43.24	390
1	58.1	43.36	43.00	360

NB: Results are based on ultimate case modelling.

Riaweena Street Footbridge, looking downstream

Table F.42 School Road

CREEK	**ENOGGERA CREEK**
LOCATION	**SCHOOL ROAD**

IMMUNITY RATING:	**> 20 yr**

DATE OF SURVEY:	**FEBRUARY 1998**	UBD REF	**157 N2**
AERIAL PHOTO No:	**SPH 11/11, Sheet 3.6**	STRUCTURE ID	**E12237**
BCC CROSS SECTION No:	**E840**	AMTD (m):	**19076**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**Single span of 20.8 m**
UPSTREAM INVERT LEVEL:	**43.08**	UPSTREAM OBVERT LEVEL:	**46.58**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**43.08**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**46.58**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E840**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**16.7**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**47.38**
PIER WIDTH (m):	**N/A**		
HEIGHT OF GUARDRAILS:			**48.83**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.2m high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 20**

CREEK	ENOGGERA CREEK
LOCATION	SCHOOL ROAD

ARI (years)	DISCHARGE (m^3/s) Total	U/S WATER LEVEL (m AHD)	D/S WATER LEVEL (m AHD)	AFFLUX AT MAX FLOW (mm)
100	173.6	47.77	47.33	440
50	156.4	47.50	47.09	410
20	131.9	47.12	46.73	390
10	115.2	46.83	46.46	370
5	98.2	46.52	46.18	340
2	71.3	45.97	45.66	310
1	58.1	45.67	45.39	280

NB: Results are based on ultimate case modelling.

School Road, looking downstream

Table F.43 The Gap Pony Club Pipe Crossing

CREEK	**ENOGGERA CREEK**
LOCATION	**THE GAP PONY CLUB PIPE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**FEBRUARY 1998**	UBD REF	**157 M3**
AERIAL PHOTO No:	**SPH 11/11, Sheet 3.6**	STRUCTURE ID	**E11857**
BCC CROSS SECTION No:	**E868**	AMTD (m):	**19456**
STRUCTURE DESCRIPTION:			**Steel Pipeline**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**400 mm dia**
UPSTREAM INVERT LEVEL:	**44.80**	UPSTREAM OBVERT LEVEL:	**46.75**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**44.80**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**46.75**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E868**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**0.4**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**31.78**
PIER WIDTH (m):	**0.3**		
HEIGHT OF GUARDRAILS:			**N/A**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**N/A**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1 FOLIO No. 19**

CREEK	**ENOGGERA CREEK**
LOCATION	**THE GAP PONY CLUB PIPE**

Note: This structure was not modelled in the TUFLOW model, due to the lack of impact on water levels. Information relating to hydraulic performance is therefore unavailable. Based on water levels in this area, the structure has less than a 2 year immunity and minimal impact on head losses.

The Gap Pony Club Pipe, looking downstream

Table F.44 Dam Causeway

CREEK	**ENOGGERA CREEK**
LOCATION	**DAM CAUSEWAY**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**FEBRUARY 1998**	UBD REF	**157 H1**
AERIAL PHOTO No:	**SPH 11/13, Sheet 3.7**	STRUCTURE ID	**E10338**
BCC CROSS SECTION No:	**E942**	AMTD (m):	**20975**
STRUCTURE DESCRIPTION:			**Concrete Causeway**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**3 by 1.2 x 0.9 m RCBC**
UPSTREAM INVERT LEVEL:	**58.08**	UPSTREAM OBVERT LEVEL:	**58.98**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**58.03**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**58.93**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**3.88**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**3.88**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**Concrete**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, E941**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**3.88**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**59.29**
PIER WIDTH (m):	**N/A**		
HEIGHT OF GUARDRAILS:			**N/A**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**N/A**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 17**

CREEK	**ENOGGERA CREEK**
LOCATION	**DAM CAUSEWAY**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	103.5	60.42	60.19	230
50	99.6	60.37	60.13	240
20	90.6	60.22	59.96	260
10	79.7	60.06	59.77	290
5	73.3	59.98	59.68	300
2	61.4	59.82	59.49	330
1	55.6	59.75	59.40	350

NB: Results are based on ultimate case modelling.

Dam Causeway, looking upstream

Table F.45 Glenrosa Road

CREEK	**ITHACA CREEK**
LOCATION	**GLENROSA ROAD**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**159 D1**
AERIAL PHOTO No:	**SPH 11/5, Sheet 3.3**	STRUCTURE ID	**I17698**
BCC CROSS SECTION No:	**I20**	AMTD (m):	**25173**
STRUCTURE DESCRIPTION:			**Concrete Box Culverts**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**3 by 3.0 x 3.0 m RCBC**
UPSTREAM INVERT LEVEL:	**2.16**	UPSTREAM OBVERT LEVEL:	**5.16**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**2.13**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**5.13**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**12.2**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**12.2**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**Concrete**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I20**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**12.2**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**5.71**
PIER WIDTH (m):	**0.4**		
HEIGHT OF GUARDRAILS:			**6.71**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.0m high GI pipe rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 7**

CREEK	**ITHACA CREEK**
LOCATION	**GLENROSA ROAD**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	199.4	8.54	8.46	80
50	166.3	8.00	7.93	70
20	137.3	7.49	7.36	130
10	121.6	7.29	7.16	130
5	105.6	6.97	6.83	140
2	80.1	6.45	6.28	170
1	64.2	6.09	5.96	130

NB: Results are based on ultimate case modelling.

Glenrosa Road, looking downstream

Table F.46 Waterworks Road (Inbound)

CREEK	**ITHACA CREEK**
LOCATION	**WATERWORKS ROAD (INBOUND)**

IMMUNITY RATING:	**> 100 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**159 D2**
AERIAL PHOTO No:	**SPH 11/5, Sheet 3.3**	STRUCTURE ID	**I17314**
BCC CROSS SECTION No:	**I50**	AMTD (m):	**25557**
STRUCTURE DESCRIPTION:			**Arched Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**Single span of 10.65 m** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**4.45**	UPSTREAM OBVERT LEVEL:	**11.89**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**4.45**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**11.89**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I50**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**12**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**14.21**
PIER WIDTH (m):	**N/A**		
HEIGHT OF GUARDRAILS:			**15.13L, 15.83R**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**920mm high timber rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 8**

CREEK	**ITHACA CREEK**
LOCATION	**WATERWORKS ROAD (INBOUND)**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	205.9	10.71	8.93	1780
50	171.9	10.05	8.48	1570
20	141.6	9.44	8.17	1270
10	125.1	9.11	8.00	1110
5	107.5	8.74	7.81	930
2	80.1	8.13	7.47	660
1	64.5	7.79	7.27	520

NB: Results are based on ultimate case modelling.

Waterworks Road, looking upstream

Table F.47 Waterworks Road (Outbound)

CREEK	**ITHACA CREEK**
LOCATION	**WATERWORKS ROAD (OUTBOUND)**

IMMUNITY RATING:	**> 100 yr**

DATE OF SURVEY:		UBD REF	**159 D2**
AERIAL PHOTO No:	**SPH 11/5, Sheet 3.3**	STRUCTURE ID	**I17314**
BCC CROSS SECTION No:		AMTD (m):	**25557**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**2 span – L30 m, R20 m**
UPSTREAM INVERT LEVEL:		UPSTREAM OBVERT LEVEL:	**12.55**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.		DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**12.55**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**No**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**12**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**12.3**
PIER WIDTH (m):	**0.3**		
HEIGHT OF GUARDRAILS:			
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			**2001**
PLAN NUMBER:			**W12269**
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			

CREEK	**ITHACA CREEK**
LOCATION	**WATERWORKS ROAD (OUTBOUND)**

Note: Waterworks Road (Inbound) and Waterworks Road (Outbound) were modelled as one structure in TUFLOW. There is therefore only one table of flows and levels available for the structure. This table can be seen with the Waterworks Road (Inbound) hydraulic structure reference sheet.

Waterworks Road, looking downstream

Table F.48 Kenwyn Road

CREEK	**ITHACA CREEK**
LOCATION	**KENWYN ROAD**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**159 C2**
AERIAL PHOTO No:	**SPH 11/5, Sheet 3.3**	STRUCTURE ID	**I17015**
BCC CROSS SECTION No:	**I80**	AMTD (m):	**25856**
STRUCTURE DESCRIPTION:			**Concrete Box Culverts**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**2 by 2.1 x 1.25 m, and 2 by 1.8 x 1.25 m RCBC** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**6.36**	UPSTREAM OBVERT LEVEL:	**8.16**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**6.18**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**7.98**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**13.2**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**13.2**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**Concrete**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I80**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**13.2**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**8.08**
PIER WIDTH (m):	**0.3**		
HEIGHT OF GUARDRAILS:			**9.39**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.1m high timber rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 9**

CREEK	**ITHACA CREEK**
LOCATION	**KENWYN ROAD**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	215.9	10.95	10.88	70
50	181.1	10.38	10.28	100
20	148.1	9.95	9.80	150
10	130.3	9.78	9.58	200
5	110.8	9.62	9.36	260
2	82.2	9.42	9.07	350
1	65.4	9.28	8.85	430

NB: Results are based on ultimate case modelling.

Kenwyn Road, looking downstream

Table F.49 Fulcher Road

CREEK	**ITHACA CREEK**
LOCATION	**FULCHER ROAD**

IMMUNITY RATING:	**100 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**159 C1**
AERIAL PHOTO No:	**SPH 11/7, Sheet 3.4**	STRUCTURE ID	**I16642**
BCC CROSS SECTION No:	**I110**	AMTD (m):	**26229**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**2 spans, L-R 11.2, 11.55 m** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**8.41**	UPSTREAM OBVERT LEVEL:	**12.36**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**8.41**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**12.36**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I110**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**9.8**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**13.11**
PIER WIDTH (m):	**0.6**		
HEIGHT OF GUARDRAILS:			**14.16**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**890 high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 10**

CREEK	ITHACA CREEK
LOCATION	FULCHER ROAD

ARI (years)	DISCHARGE (m^3/s) Total	U/S WATER LEVEL (m AHD)	D/S WATER LEVEL (m AHD)	AFFLUX AT MAX FLOW (mm)
100	206.2	13.03	11.95	1080
50	169.4	12.65	11.67	980
20	137.9	12.23	11.40	830
10	121.3	11.99	11.25	740
5	104.0	11.70	11.06	640
2	77.4	11.23	10.75	480
1	62.1	10.92	10.52	400

NB: Results are based on ultimate case modelling.

Fulcher Road, looking upstream

Table F.50 Nathan Avenue Footbridge

CREEK	**ITHACA CREEK**
LOCATION	**NATHAN AVENUE FOOTBRIDGE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**159 B1**
AERIAL PHOTO No:	**SPH 11/7, Sheet 3.4**	STRUCTURE ID	**I16285**
BCC CROSS SECTION No:	**I130**	AMTD (m):	**26586**
STRUCTURE DESCRIPTION:			**Arched Steel Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**Single span of 21.9 m**
UPSTREAM INVERT LEVEL:	**9.35**	UPSTREAM OBVERT LEVEL:	**12.37L, 12.45C, 12.09R**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**9.35**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**As above**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I130**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**3.2**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**12.39**
PIER WIDTH (m):	**N/A**		
HEIGHT OF GUARDRAILS:			**13.95**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.2m high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2 FOLIO No. 11**

CREEK	**ITHACA CREEK**
LOCATION	**NATHAN AVENUE FOOTBRIDGE**

ARI (years)	DISCHARGE (m^3/s) Total	U/S WATER LEVEL (m AHD)	D/S WATER LEVEL (m AHD)	AFFLUX AT MAX FLOW (mm)
100	215.5	14.64	13.18	1460
50	176.9	14.39	12.84	1550
20	141.4	14.13	12.45	1680
10	122.7	13.96	12.22	1740
5	103.3	13.73	11.96	1770
2	76.6	13.22	11.51	1710
1	61.3	12.88	11.20	1680

NB: Results are based on ultimate case modelling.

Nathan Avenue Footbridge, looking upstream

Table F.51 Dean Street Footbridge

CREEK	**ITHACA CREEK**
LOCATION	**DEAN STREET FOOTBRIDGE**

IMMUNITY RATING:	**> 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**159 B2**
AERIAL PHOTO No:	**SPH 11/7, Sheet 3.4**	STRUCTURE ID	**I16047**
BCC CROSS SECTION No:	**I142**	AMTD (m):	**26824**
STRUCTURE DESCRIPTION:			**Steel Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**Single span of 16.93 m** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**10.47**	UPSTREAM OBVERT LEVEL:	**13.77**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**10.47**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**13.77**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I142**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**2**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**13.98**
PIER WIDTH (m):	**N/A**		
HEIGHT OF GUARDRAILS:			**15.09**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.1m high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 12**

CREEK	**ITHACA CREEK**
LOCATION	**DEAN STREET FOOTBRIDGE**

ARI (years)	DISCHARGE (m^3/s) Total	U/S WATER LEVEL (m AHD)	D/S WATER LEVEL (m AHD)	AFFLUX AT MAX FLOW (mm)
100	211.3	15.35	15.14	210
50	175.5	15.06	14.85	210
20	144.5	14.76	14.55	210
10	127.1	14.57	14.37	200
5	108.3	14.32	14.13	190
2	77.4	13.82	13.62	200
1	61.7	13.49	13.30	190

NB: Results are based on ultimate case modelling.

Dean Street Footbridge, looking upstream

Table F.52 Lugg Street Footbridge

CREEK	**ITHACA CREEK**
LOCATION	**LUGG STREET FOOTBRIDGE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**159 A2**
AERIAL PHOTO No:	**SPH 11/7, Sheet 3.4**	STRUCTURE ID	**I15778**
BCC CROSS SECTION No:	**I155**	AMTD (m):	**27093**
STRUCTURE DESCRIPTION:			**Steel Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**Single span of 20.0 m**
UPSTREAM INVERT LEVEL:	**11.98**	UPSTREAM OBVERT LEVEL:	**15.69L, 14.11R**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**11.98**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**15.69L, 14.11R**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I155**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**2.6**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**14.32**
PIER WIDTH (m):	**N/A**		
HEIGHT OF GUARDRAILS:			**17.0L, 15.42R**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.1m high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 14**

CREEK	**ITHACA CREEK**
LOCATION	**LUGG STREET FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	201.3	17.13	16.18	950
50	165.8	16.77	15.88	890
20	135.6	16.38	15.55	830
10	118.8	16.12	15.34	780
5	101.7	15.82	15.07	750
2	74.5	15.31	14.57	740
1	60.1	14.99	14.26	730

NB: Results are based on ultimate case modelling.

Lugg Street Footbridge, looking downstream

Table F.53 Lugg Street Pipe

CREEK	**ITHACA CREEK**
LOCATION	**LUGG STREET PIPE**

IMMUNITY RATING:	**N/A**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**159 A2**
AERIAL PHOTO No:	**SPH 11/7, Sheet 3.4**	STRUCTURE ID	**N/A**
BCC CROSS SECTION No:	**I156**	AMTD (m):	**27102**
STRUCTURE DESCRIPTION:			**640 mm dia Pipe in Creek Bed**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**640 mm dia**
UPSTREAM INVERT LEVEL:	**11.60**	UPSTREAM OBVERT LEVEL:	**11.90**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**11.60**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**11.90**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I156**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**0.64**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**N/A**
PIER WIDTH (m):	**N/A**		
HEIGHT OF GUARDRAILS:			**N/A**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**N/A**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 14**

CREEK	**ITHACA CREEK**
LOCATION	**LUGG STREET PIPE**

Note: This structure was not modelled in the TUFLOW model, due to the lack of impact on water levels. Information relating to hydraulic performance is therefore unavailable. Based on water levels in this area, the structure has less than a 2 year immunity and minimal impact on head losses.

Lugg Street Pipe, looking downstream

Table F.54 Jubilee Terrace

CREEK	**ITHACA CREEK**
LOCATION	**JUBILEE TERRACE**

IMMUNITY RATING: **> 100 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**158 R2**
AERIAL PHOTO No:	**SPH 11/7, Sheet 3.4**	STRUCTURE ID	**I15500**
BCC CROSS SECTION No:	**I170**	AMTD (m):	**27359**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**2 spans of 14.8 m**
UPSTREAM INVERT LEVEL:	**13.36**	UPSTREAM OBVERT LEVEL:	**17.86**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**13.36**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**17.86**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I170**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**23.4**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**18.88**
PIER WIDTH (m):	**1.2**		
HEIGHT OF GUARDRAILS:			**20.11**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.07m high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 15**

CREEK	**ITHACA CREEK**
LOCATION	**JUBILEE TERRACE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	204.6	18.47	17.82	650
50	169.9	18.00	17.44	560
20	139.4	17.54	17.05	490
10	122.8	17.26	16.81	450
5	104.7	16.95	16.53	420
2	75.3	16.40	16.05	350
1	60.7	16.06	15.76	300

NB: Results are based on ultimate case modelling.

Jubilee Terrace, looking downstream

Table F.55 Devonshire Street Footbridge

CREEK	**ITHACA CREEK**
LOCATION	**DEVONSHIRE STREET FOOTBRIDGE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**159 P1**
AERIAL PHOTO No:	**SPH 11/7, Sheet 3.4**	STRUCTURE ID	**I14945**
BCC CROSS SECTION No:	**I202**	AMTD (m):	**27926**
STRUCTURE DESCRIPTION:			**Concrete Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**Single span of 15.75 m** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**16.48**	UPSTREAM OBVERT LEVEL:	**20.51L, 19.08R**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**16.48**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**As above**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I202**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**1.8**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**19.50**
PIER WIDTH (m):	**N/A**		
HEIGHT OF GUARDRAILS:			**22.0L, 20.6R**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.1m high rails with wire mesh**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 16**

CREEK	**ITHACA CREEK**
LOCATION	**DEVONSHIRE STREET FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	186.9	20.89	20.62	270
50	156.4	20.66	20.37	290
20	128.4	20.44	20.10	340
10	112.9	20.30	19.93	370
5	97.8	20.15	19.73	420
2	72.7	19.84	19.36	480
1	58.2	19.60	19.11	490

NB: Results are based on ultimate case modelling.

Devonshire Street Footbridge, looking downstream

Table F.56 Glen Parade Footbridge

CREEK	**ITHACA CREEK**
LOCATION	**GLEN PARADE FOOTBRIDGE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**158 N2**
AERIAL PHOTO No:	**SPH 11/7, Sheet 3.4**	STRUCTURE ID	**I14584**
BCC CROSS SECTION No:	**I225**	AMTD (m):	**28285**
STRUCTURE DESCRIPTION:			**Timber Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**2 spans, L-R 8.9, 9.5** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**18.75**	UPSTREAM OBVERT LEVEL:	**21.35**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**18.75**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**21.35**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I225**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**2.12**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**21.90**
PIER WIDTH (m):	**0.15**		
HEIGHT OF GUARDRAILS:			**23.03**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.13m high timber rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 17**

CREEK	**ITHACA CREEK**
LOCATION	**GLEN PARADE FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	195.4	23.53	23.00	530
50	160.4	23.29	22.76	530
20	130.1	23.04	22.51	530
10	113.8	22.87	22.33	540
5	98.1	22.62	22.11	510
2	73.2	22.13	21.71	420
1	59.3	21.76	21.42	340

NB: Results are based on ultimate case modelling.

Glen Parade Footbridge

Table F.57 Coopers Camp Road

CREEK	**ITHACA CREEK**
LOCATION	**COOPERS CAMP ROAD**

IMMUNITY RATING:	**> 100 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**158 M3**
AERIAL PHOTO No:	**SPH 11/15, Sheet 3.8**	STRUCTURE ID	**I14090**
BCC CROSS SECTION No:	**I250**	AMTD (m):	**28781**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**2 spans, L-R 14.5, 14.0**
UPSTREAM INVERT LEVEL:	**22.90**	UPSTREAM OBVERT LEVEL:	**26.10**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**22.90**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**26.10**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I250**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**14.6**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**27.08**
PIER WIDTH (m):	**0.9**		
HEIGHT OF GUARDRAILS:			**28.28**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.2m high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 18**

CREEK	**ITHACA CREEK**
LOCATION	**COOPERS CAMP ROAD**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	188.7	26.53	26.03	500
50	154.4	26.17	25.74	430
20	126.1	25.83	25.47	360
10	111.3	25.63	25.30	330
5	96.0	25.42	25.11	310
2	71.9	25.05	24.79	260
1	57.4	24.80	24.58	220

NB: Results are based on ultimate case modelling.

Coopers Camp Road, looking upstream

Table F.58 Kamber Street Pipe

CREEK	**ITHACA CREEK**
LOCATION	**KAMBER STREET PIPE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**158 M3**
AERIAL PHOTO No:	**SPH 11/15, Sheet 3.8**	STRUCTURE ID	**I13995**
BCC CROSS SECTION No:	**I258**	AMTD (m):	**28876**
STRUCTURE DESCRIPTION:			**Pipe across Creek**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**1600 mm dia**
UPSTREAM INVERT LEVEL:	**22.51**	UPSTREAM OBVERT LEVEL:	**24.71**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**22.51**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**24.71**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I258**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**1.85**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**26.31**
PIER WIDTH (m):	**0.3**		
HEIGHT OF GUARDRAILS:			**N/A**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**N/A**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 19**

CREEK	**ITHACA CREEK**
LOCATION	**KAMBER STREET PIPE**

Note: This structure was not modelled in the TUFLOW model, due to the lack of impact on water levels. Information relating to hydraulic performance is therefore unavailable. Based on water levels in this area, the structure has less than a 2 year immunity and minimal impact on head losses.

Kamber Street Pipe, looking downstream

Table F.59 Coolibah Street Footbridge

CREEK	**ITHACA CREEK**
LOCATION	**COOLIBAH STREET FOOTBRIDGE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**158 M5**
AERIAL PHOTO No:	**SPH 11/15, Sheet 3.8**	STRUCTURE ID	**I13478**
BCC CROSS SECTION No:	**I274**	AMTD (m):	**29393**
STRUCTURE DESCRIPTION:			**Steel Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**Single span of 14.75 m** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**27.59**	UPSTREAM OBVERT LEVEL:	**29.79**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**27.59**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**29.79**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I274**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**1.8**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**30.30**
PIER WIDTH (m):	**N/A**		
HEIGHT OF GUARDRAILS:			**31.22**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**820mm high timber rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 20**

CREEK	**ITHACA CREEK**
LOCATION	**COOLIBAH STREET FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	180.5	32.14	30.80	1340
50	149.7	31.92	30.59	1330
20	123.6	31.72	30.42	1300
10	109.2	31.59	30.31	1280
5	93.3	31.45	30.19	1260
2	67.8	31.14	29.94	1200
1	53.9	30.90	29.79	1110

NB: Results are based on ultimate case modelling.

Coolibah Street Footbridge, looking downstream

Table F.60 Bowman Parade Footbridge

CREEK	**ITHACA CREEK**
LOCATION	**BOWMAN PARADE FOOTBRIDGE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**Design Drawing**	UBD REF	**158 M6**
AERIAL PHOTO No:		STRUCTURE ID	**I13238**
BCC CROSS SECTION No:	**I290**	AMTD (m):	**29634**
STRUCTURE DESCRIPTION:			**Fibre Composite-Concrete Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**3 spans of 6.00L, 9.50C, 6.00R m**
UPSTREAM INVERT LEVEL:	**30.60**	UPSTREAM OBVERT LEVEL:	**32.58**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**30.60**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**32.58**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**No**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**3.57**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**33.03**
PIER WIDTH (m):	**0.45**		
HEIGHT OF GUARDRAILS:			**34.43**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.4m high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER: CD080019 / 4101			
HAS THE STRUCTURE BEEN UPGRADED? Yes. See Above. If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			

CREEK	**ITHACA CREEK**
LOCATION	**BOWMAN PARADE FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	189.5	34.26	34.05	210
50	154.4	34.10	33.88	220
20	125.1	33.94	33.71	230
10	109.8	33.85	33.61	240
5	93.2	33.73	33.49	240
2	68.7	33.52	33.26	260
1	59.7	33.33	33.08	250

NB: Results are based on ultimate case modelling.

Bowman Parade Footbridge, looking downstream

Table F.61 Bowman Parade

CREEK	**ITHACA CREEK**
LOCATION	**BOWMAN PARADE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**158 M6**
AERIAL PHOTO No:	**SPH 11/15, Sheet 3.8**	STRUCTURE ID	**I13228**
BCC CROSS SECTION No:	**I295**	AMTD (m):	**29643**
STRUCTURE DESCRIPTION:			**Concrete Culverts**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**3 by 750mm dia RCP**
UPSTREAM INVERT LEVEL:	**30.96**	UPSTREAM OBVERT LEVEL:	**31.71**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**30.96**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**31.60**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**11.4**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**11.4**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**Concrete**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I295**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**11.4**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**32.17**
PIER WIDTH (m):	**1**		
HEIGHT OF GUARDRAILS:			**N/A**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**N/A**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 22**

CREEK	ITHACA CREEK
LOCATION	BOWMAN PARADE

ARI (years)	DISCHARGE (m^3/s) Total	U/S WATER LEVEL (m AHD)	D/S WATER LEVEL (m AHD)	AFFLUX AT MAX FLOW (mm)
100	191.2	34.26	34.09	170
50	156.7	34.10	33.92	180
20	127.8	33.94	33.76	180
10	112.8	33.85	33.65	200
5	96.0	33.73	33.53	200
2	70.8	33.52	33.30	220
1	56.2	33.33	33.12	210

NB: Results are based on ultimate case modelling.

Bowman Parade, looking downstream

Table F.62 Lilley Avenue Footbridge

CREEK	**ITHACA CREEK**
LOCATION	**LILLEY AVENUE FOOTBRIDGE**

IMMUNITY RATING:	**100 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**158 K5**
AERIAL PHOTO No:	**SPH 11/17, Sheet 3.9**	STRUCTURE ID	**I12901**
BCC CROSS SECTION No:	**I329**	AMTD (m):	**29976**
STRUCTURE DESCRIPTION:			**Concrete Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**3 spans - 10.3L, 10.3C, 9.3R**
UPSTREAM INVERT LEVEL:	**35.59**	UPSTREAM OBVERT LEVEL:	**38.89**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**35.59**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**38.89**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I329**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**2**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**39.16**
PIER WIDTH (m):	**0.4**		
HEIGHT OF GUARDRAILS:			**40.3**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.14m high steel rails with wire mesh**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2 FOLIO No. 23**

CREEK	**ITHACA CREEK**
LOCATION	**LILLEY AVENUE FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	155.4	39.14	38.92	220
50	128.6	38.91	38.68	230
20	102.1	38.64	38.42	220
10	91.1	38.51	38.29	220
5	78.4	38.36	38.15	210
2	57.2	38.05	37.84	210
1	46.1	37.82	37.63	190

NB: Results are based on ultimate case modelling.

Lilley Avenue Footbridge, looking downstream

Table F.63 Simpsons Road

CREEK	**ITHACA CREEK**
LOCATION	**SIMPSONS ROAD**

IMMUNITY RATING:	**100 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**158 K6**
AERIAL PHOTO No:	**SPH 11/17, Sheet 3.9**	STRUCTURE ID	**I12450**
BCC CROSS SECTION No:	**I361**	AMTD (m):	**30421**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**Single span of 20.7 m**
UPSTREAM INVERT LEVEL:	**40.05**	UPSTREAM OBVERT LEVEL:	**43.64L, 43.49R**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**40.05**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**44.25L, 44.11R**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I361**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**15.33**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**44.55**
PIER WIDTH (m):	**N/A**		
HEIGHT OF GUARDRAILS:			**46.53L, 46.39R**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.22m high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 24**

CREEK	**ITHACA CREEK**
LOCATION	**SIMPSONS ROAD**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	156.9	44.23	43.09	1140
50	129.5	43.82	42.82	1000
20	103.3	43.38	42.52	860
10	91.2	43.16	42.37	790
5	78.5	42.90	42.19	710
2	57.9	42.47	41.87	600
1	46.2	42.19	41.66	530

NB: Results are based on ultimate case modelling.

Simpsons Road, looking downstream

Table F.64 Carwoola Street

CREEK	**ITHACA CREEK**
LOCATION	**CARWOOLA STREET**

IMMUNITY RATING:	**> 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**158 G9**
AERIAL PHOTO No:	**SPH 11/17, Sheet 3.9**	STRUCTURE ID	**I11332**
BCC CROSS SECTION No:	**I440**	AMTD (m):	**31539**
STRUCTURE DESCRIPTION:			**Concrete Box Culverts**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**3 by 2.13 x 2.14 + 2 by 2.44 x 1.9**
UPSTREAM INVERT LEVEL:	**54.03**	UPSTREAM OBVERT LEVEL:	**56.12**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**53.98**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**56.20**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**19.6**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**19.6**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**Concrete**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I440**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**19.6**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**56.65**
PIER WIDTH (m):	**0.24**		
HEIGHT OF GUARDRAILS:			**57.7**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.05m high timber rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			**1974**
PLAN NUMBER:			**W5394**
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 25**

CREEK	**ITHACA CREEK**
LOCATION	**CARWOOLA STREET**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**	**VELOCITY (m/s)**	
	Total				**Weir**	**Structure**
100	113.0	58.10	56.46	1640	0.0	3.1
50	97.2	57.80	56.18	1620	0.0	2.8
20	75.9	57.56	55.91	1650	0.0	2.4
10	67.7	57.34	55.76	1580	0.0	2.2
5	58.8	57.09	55.58	1510	0.0	1.9
2	47.1	56.75	55.27	1480	0.0	1.5
1	35.0	56.23	55.05	1180	0.0	1.5

NB: Results are based on ultimate case modelling.

Carwoola Street, looking upstream

Table F.65 Sir Samuel Griffiths Drive

CREEK	**ITHACA CREEK**
LOCATION	**SIR SAMUEL GRIFFITHS DRIVE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**158 H10**
AERIAL PHOTO No:	**SPH 11/19, Sheet 3.10**	STRUCTURE ID	**I10743**
BCC CROSS SECTION No:	**I480**	AMTD (m):	**32128**
STRUCTURE DESCRIPTION:			**Concrete Pipe Culverts**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**5 by 1.8m dia RCP**
UPSTREAM INVERT LEVEL:	**60.65**	UPSTREAM OBVERT LEVEL:	**62.45**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**60.54**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**62.34**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**11.5**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**11.5**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**Concrete**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I480**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**11.5**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**63.19**
PIER WIDTH (m):	**0.15**		
HEIGHT OF GUARDRAILS:			**63.79**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**Armco rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 26**

CREEK	**ITHACA CREEK**
LOCATION	**SIR SAMUEL GRIFFITHS DRIVE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	50.1	64.01	62.22	1790
50	38.9	63.87	62.06	1810
20	34.4	63.72	61.89	1830
10	30.3	63.59	61.77	1820
5	26.1	63.41	61.62	1790
2	19.3	62.65	61.34	1310
1	15.2	62.28	61.13	1150

NB: Results are based on ultimate case modelling.

Sir Samuel Griffiths Drive, looking downsream

Table F.66 JC Slaughter Falls Crossing No 1

CREEK	**ITHACA CREEK**
LOCATION	**JC SLAUGHTER FALLS No 1**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**158 H12**
AERIAL PHOTO No:	**SPH 11/19, Sheet 3.10**	STRUCTURE ID	**I10383**
BCC CROSS SECTION No:	**I502**	AMTD (m):	**32488**
STRUCTURE DESCRIPTION:			**Concrete Pipe Culverts**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**3 by 1.2m dia RCP**
UPSTREAM INVERT LEVEL:	**65.76**	UPSTREAM OBVERT LEVEL:	**66.96**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**65.45**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**66.65**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**9.85**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**9.85**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**Concrete**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I502**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**9.85**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**68.34**
PIER WIDTH (m):	**0.15**		
HEIGHT OF GUARDRAILS:			**69.03**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**250 mm dia timber posts**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 27**

CREEK	**ITHACA CREEK**
LOCATION	**JC SLAUGHTER FALLS No 1**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	54.2	69.73	66.90	2830
50	44.1	69.48	66.77	2710
20	36.1	69.26	66.63	2630
10	31.8	69.12	66.55	2570
5	27.1	68.96	66.45	2510
2	19.8	68.62	66.20	2420
1	14.7	68.28	66.02	2260

NB: Results are based on ultimate case modelling.

JC Slaughter Falls No 1, looking upstream

Table F.67 JC Slaughter Falls Crossing No 2

CREEK	**ITHACA CREEK**
LOCATION	**JC SLAUGHTER FALLS No 2**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**158 J12**
AERIAL PHOTO No:	**SPH 11/19, Sheet 3.10**	STRUCTURE ID	**I10226**
BCC CROSS SECTION No:	**I512**	AMTD (m):	**32645**
STRUCTURE DESCRIPTION:			**Concrete Pipe Culverts**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**3 by 1.2m dia RCP**
UPSTREAM INVERT LEVEL:	**68.68**	UPSTREAM OBVERT LEVEL:	**69.88**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**68.48**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**69.68**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**7.33**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**7.33**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**Concrete**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I512**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**7.33**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**70.65**
PIER WIDTH (m):	**0.28**		
HEIGHT OF GUARDRAILS:			**N/A**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**N/A**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 28**

CREEK	**ITHACA CREEK**
LOCATION	**JC SLAUGHTER FALLS No 2**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	54.7	71.86	70.38	1480
50	44.6	71.67	70.14	1530
20	36.4	71.50	69.93	1570
10	32.1	71.40	69.80	1600
5	27.4	71.27	69.65	1620
2	20.1	71.04	69.36	1680
1	15.5	70.85	69.22	1630

NB: Results are based on ultimate case modelling.

JC Slaughter Falls No 2, looking upstream

Table F.68 JC Slaughter Falls Crossing No 3

CREEK	**ITHACA CREEK**
LOCATION	**JC SLAUGHTER FALLS No 3**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**MARCH 1998**	UBD REF	**158 H12**
AERIAL PHOTO No:	**SPH 11/19, Sheet 3.10**	STRUCTURE ID	**I10018**
BCC CROSS SECTION No:	**I525**	AMTD (m):	**32852**
STRUCTURE DESCRIPTION:			**Concrete Pipe Culverts**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**3 by 1.2m dia RCP**
UPSTREAM INVERT LEVEL:	**72.36**	UPSTREAM OBVERT LEVEL:	**73.56**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**72.34**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**73.54**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**7.3**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**7.3**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**Concrete**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, I525**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**7.3**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**74.70**
PIER WIDTH (m):	**0.35**		
HEIGHT OF GUARDRAILS:			**75.25**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**200mm dia timber posts**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/2** **FOLIO No. 29**

CREEK	**ITHACA CREEK**
LOCATION	**JC SLAUGHTER FALLS No 3**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	55.1	77.28	75.04	2240
50	45.0	76.80	74.77	2030
20	36.8	76.39	74.53	1860
10	32.4	76.14	74.39	1750
5	27.7	75.86	74.22	1640
2	20.4	75.36	73.93	1430
1	15.6	75.03	73.73	1300

NB: Results are based on ultimate case modelling.

JC Slaughter Falls No 3, looking upstream

Table F.69 Lochinvar Lane Footbridge

CREEK	**FISH CREEK**
LOCATION	**LOCHINVAR LANE FOOTBRIDGE**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**FEBRUARY 1998**	UBD REF	**138 B20**
AERIAL PHOTO No:	**SPH 11/11, Sheet 3.6**	STRUCTURE ID	**F12867**
BCC CROSS SECTION No:	**F11**	AMTD (m):	**30115**
STRUCTURE DESCRIPTION:			**Steel Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**Single span of 17.1 m**
UPSTREAM INVERT LEVEL:	**29.10**	UPSTREAM OBVERT LEVEL:	**32.10**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**29.10**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**32.10**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, F11**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**1.39**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**32.35**
PIER WIDTH (m):	**N/A**		
HEIGHT OF GUARDRAILS:			**33.4**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.3m high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 6**

CREEK	**FISH CREEK**
LOCATION	**LOCHINVAR LANE FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	162.2	34.86	34.43	430
50	135.5	34.53	34.02	510
20	112.8	34.15	33.52	630
10	101.2	33.91	33.21	700
5	87.9	33.61	32.87	740
2	69.4	32.89	32.27	620
1	57.3	32.41	31.89	520

NB: Results are based on ultimate case modelling.

Lochinvar Lane Footbridge, looking downstream

Table F.70 Romea Street

CREEK	**FISH CREEK**
LOCATION	**ROMEA STREET**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**FEBRUARY 1998**	UBD REF	**138 B20**
AERIAL PHOTO No:	**SPH 11/11, Sheet 3.6**	STRUCTURE ID	**F12829**
BCC CROSS SECTION No:	**F14**	AMTD (m):	**30153**
STRUCTURE DESCRIPTION:			**Concrete Box Culverts**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**2 by 3.6 x 1.2 m RCBC**
UPSTREAM INVERT LEVEL:	**29.48**	UPSTREAM OBVERT LEVEL:	**30.69**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**29.38**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**30.58**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**4.88**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**4.88**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**Concrete**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, F14**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**4.88**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**30.90**
PIER WIDTH (m):	**0.46**		
HEIGHT OF GUARDRAILS:			**32**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**100mm sq posts, 2.7m centres, 0.77m high**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1 FOLIO No. 7**

CREEK	**FISH CREEK**
LOCATION	**ROMEA STREET**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	149.4	35.12	34.86	260
50	127.1	34.77	34.53	240
20	108.0	34.38	34.15	230
10	98.3	34.14	33.91	230
5	86.0	33.83	33.61	220
2	67.5	33.08	32.89	190
1	55.5	32.59	32.41	180

NB: Results are based on ultimate case modelling.

Romea Street, looking upstream

Table F.71 Quirk Street

CREEK	**FISH CREEK**
LOCATION	**QUIRK STREET**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**FEBRUARY 1998**	UBD REF	**137 R19**
AERIAL PHOTO No:	**SPH 11/11, Sheet 3.6**	STRUCTURE ID	**F12186**
BCC CROSS SECTION No:	**F50**	AMTD (m):	**30796**
STRUCTURE DESCRIPTION:			**Concrete Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**2 spans of 7.65m**
UPSTREAM INVERT LEVEL:	**33.10**	UPSTREAM OBVERT LEVEL:	**35.69**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**33.10**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**35.69**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, F50**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**11**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**35.98**
PIER WIDTH (m):	**1**		
HEIGHT OF GUARDRAILS:			**37.29**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.06m high steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 8**

CREEK	**FISH CREEK**
LOCATION	**QUIRK STREET**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	187.2	37.64	36.48	1160
50	152.1	37.42	36.19	1230
20	124.8	37.22	35.95	1270
10	110.9	37.09	35.83	1260
5	96.2	36.95	35.70	1250
2	72.5	36.72	35.42	1300
1	58.0	36.53	35.20	1330

NB: Results are based on ultimate case modelling.

Quirk Street, looking downstream

Table F.72 Pangela Street Footbridge

CREEK	**FISH CREEK**
LOCATION	**PANGELA STREET FOOTBRIDGE**

IMMUNITY RATING:	**> 2 yr**

DATE OF SURVEY:	**FEBRUARY 1998**	UBD REF	**137 Q19**
AERIAL PHOTO No:	**SPH 11/11, Sheet 3.6**	STRUCTURE ID	**F11818**
BCC CROSS SECTION No:	**F80**	AMTD (m):	**31164**
STRUCTURE DESCRIPTION:			**Steel Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes			**Single span of 17.95 m** For Bridges: Number of Spans and their lengths
UPSTREAM INVERT LEVEL:	**34.24**	UPSTREAM OBVERT LEVEL:	**37.34**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**34.24**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**37.34**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, F80**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**3**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**38.14**
PIER WIDTH (m):	**N/A**		
HEIGHT OF GUARDRAILS:			**39.22**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.08m high knockdown steel rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 8A**

CREEK	**FISH CREEK**
LOCATION	**PANGELA STREET FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	174.1	39.53	38.52	1010
50	142.0	39.26	38.26	1000
20	116.6	38.95	38.02	930
10	103.2	38.75	37.86	890
5	88.7	38.49	37.68	810
2	66.1	37.90	37.36	540
1	52.9	37.57	37.11	460

NB: Results are based on ultimate case modelling.

Pangela Street Footbridge, looking downstream

Table F.73 Settlement Road

CREEK	**FISH CREEK**
LOCATION	**SETTLEMENT ROAD**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**FEBRUARY 1998**	UBD REF	**137 P18**
AERIAL PHOTO No:	**SPH 11/11, Sheet 3.6**	STRUCTURE ID	**F11384**
BCC CROSS SECTION No:	**F110**	AMTD (m):	**31598**
STRUCTURE DESCRIPTION:			**Concrete Pipe Culverts**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**6 by 1.83m dia RCP**
UPSTREAM INVERT LEVEL:	**36.42**	UPSTREAM OBVERT LEVEL:	**38.25**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**36.34**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**38.17**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**19.7**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**19.7**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**Concrete**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, F110**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**19.7**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**40.18**
PIER WIDTH (m):	**0.36**		
HEIGHT OF GUARDRAILS:			**41.17**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**0.95m GI pipe rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No. 9**

CREEK	FISH CREEK
LOCATION	SETTLEMENT ROAD

ARI (years)	DISCHARGE (m^3/s) Total	U/S WATER LEVEL (m AHD)	D/S WATER LEVEL (m AHD)	AFFLUX AT MAX FLOW (mm)
100	123.4	42.03	40.78	1250
50	104.6	41.84	40.55	1290
20	88.2	41.64	40.30	1340
10	79.1	41.52	40.15	1370
5	68.3	41.35	39.94	1410
2	51.4	40.83	39.51	1320
1	41.3	40.04	39.15	890

NB: Results are based on ultimate case modelling.

Settlement Road, looking upstream

Table F.74 Hilder Road

CREEK	**FISH CREEK**
LOCATION	**HILDER ROAD**

IMMUNITY RATING:	**100 yr**

DATE OF SURVEY:	**FEBRUARY 1998**	UBD REF	**137 K17**
AERIAL PHOTO No:	**SPH 11/13, Sheet 3.7**	STRUCTURE ID	**F10456**
BCC CROSS SECTION No:	**F180**	AMTD (m):	**32526**
STRUCTURE DESCRIPTION:			**Concrete Box Culverts**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**2 by 2.5 x 2.15m RCBC**
UPSTREAM INVERT LEVEL:	**46.24**	UPSTREAM OBVERT LEVEL:	**48.39**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**46.23**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**48.38**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**19.52**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**19.52**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**Concrete**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, F180**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**19.52**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**50.03**
PIER WIDTH (m):	**0.3**		
HEIGHT OF GUARDRAILS:			**50.9**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**900mm high GI pipe rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No.11**

CREEK	**FISH CREEK**
LOCATION	**HILDER ROAD**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	54.8	49.28	48.48	800
50	46.6	49.16	48.28	880
20	38.6	48.81	48.08	730
10	34.6	48.71	47.97	740
5	29.7	48.56	47.83	730
2	21.2	48.24	47.55	690
1	15.7	47.97	47.35	620

NB: Results are based on ultimate case modelling.

Hilder Road, looking downstream

Table F.75 Wittonga Park Footpath

CREEK	**FISH CREEK**
LOCATION	**WITTONGA PARK FOOTPATH**

IMMUNITY RATING:	**< 2 yr**

DATE OF SURVEY:	**FEBRUARY 1998**	UBD REF	**137 K17**
AERIAL PHOTO No:	**SPH 11/13, Sheet 3.7**	STRUCTURE ID	**F10434**
BCC CROSS SECTION No:	**F182**	AMTD (m):	**32548**
STRUCTURE DESCRIPTION:			**Concrete Pipe Culverts**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**2 by 1.5m dia RCP**
UPSTREAM INVERT LEVEL:	**47.47**	UPSTREAM OBVERT LEVEL:	**48.97**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**47.33**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**48.83**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**7.38**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**7.38**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**Concrete**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, F182**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**7.38**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**50.04**
PIER WIDTH (m):	**0.35**		
HEIGHT OF GUARDRAILS:			**50.85**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**950mm high GI pip rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1 FOLIO No.12**

CREEK	**FISH CREEK**
LOCATION	**WITTONGA PARK FOOTPATH**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	54.9	51.27	49.28	1990
50	46.6	51.15	49.16	1990
20	38.7	51.01	48.81	2200
10	34.7	50.94	48.71	2230
5	29.8	50.84	48.56	2280
2	21.5	50.59	48.24	2350
1	16.1	50.09	47.97	2120

NB: Results are based on ultimate case modelling.

Wittonga Park Footpath, looking downsream

Table F.76 Wittonga Park Footbridge

CREEK	**FISH CREEK**
LOCATION	**WITTONGA PARK FOOTBRIDGE**

IMMUNITY RATING:	**100 yr**

DATE OF SURVEY:	**FEBRUARY 1998**	UBD REF	**137 K18**
AERIAL PHOTO No:	**SPH 11/13, Sheet 3.7**	STRUCTURE ID	**F10224**
BCC CROSS SECTION No:	**F191**	AMTD (m):	**32758**
STRUCTURE DESCRIPTION:			**Arched Steel Pedestrian Bridge**
STRUCTURE SIZE For Culverts: Number of cells/pipes & sizes		For Bridges: Number of Spans and their lengths	**Single span of 14.5m**
UPSTREAM INVERT LEVEL:	**49.40**	UPSTREAM OBVERT LEVEL:	**52.54L, 52.78C**
DOWNSTREAM INVERT LEVEL: For culverts give floor level.	**49.40**	DOWNSTREAM OBVERT LEVEL: For bridges give bed level	**As above**
For Culverts LENGTH OF CULVERT BARREL AT INVERT (m):			**N/A**
LENGTH OF CULVERT BARREL AT OBVERT (m):			**N/A**
TYPE OF LINING: (e.g. concrete, stones, brick, corrugated iron)			**N/A**
IS THERE A SURVEYED WEIR PROFILE? If yes give details ie. Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails guard rails whichever is higher.			**Yes, F191**
WEIR WIDTH (m) (In direction of flow, ie. distance from u/s face to d/s face)	**2.7**	WEIR LEVEL (m AHD): (Level at which water overtops road)	**52.72**
PIER WIDTH (m):	**N/A**		
HEIGHT OF GUARDRAILS:			**53.82L, 54.06C**
DESCRIPTION OF ALL HAND AND GUARD RAILS AND HEIGHTS TO TOP AND UNDERSIDE OF GUARD RAILS:			**1.28m high steel hand rails**
The following should also be provided. Wingwall/Headwall details, entrance details eg. pipe flush with embankment or projecting, socket or square end, entrance rounding, levels. For bridges, details of piers and section under bridge including abutment details. Specify Survey Book No.			
CONSTRUCTION DATE OF CURRENT STRUCTURE:			
PLAN NUMBER:			
HAS THE STRUCTURE BEEN UPGRADED? If yes, explain type and date of upgrade. Include plan number and location if applicable.			
ADDITIONAL COMMENTS:			**FIELD BOOK No. 8809/1** **FOLIO No.13**

CREEK	**FISH CREEK**
LOCATION	**WITTONGA PARK FOOTBRIDGE**

ARI (years)	**DISCHARGE (m^3/s)**	**U/S WATER LEVEL (m AHD)**	**D/S WATER LEVEL (m AHD)**	**AFFLUX AT MAX FLOW (mm)**
	Total			
100	43.2	52.52	51.39	1130
50	35.1	52.35	51.28	1070
20	28.2	52.14	51.15	990
10	25.1	52.01	51.08	930
5	21.8	51.83	50.98	850
2	16.2	51.52	50.73	790
1	12.9	51.24	50.22	1020

NB: Results are based on ultimate case modelling.

Wittonga Park Footbridge, looking upstream

APPENDIX G: STRETCHING LIMITATIONS

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G.1 STRETCHING LIMITATIONS IN MAPPING

Types of limitations that may arise from the stretching and break-line process are as follows:

1. **Stretched structure head loss –** When a waterway crossing produces significant head loss the upstream surface may be incorrectly stretched to downstream areas. This can be managed by placing a break-line along the road or rail line that crosses the creek however the level difference produced by the structure will be stretched out to areas of ineffective flow where no such level difference would exist in reality.

2. **Over stretching on flat terrain –** Water Ride will stretch a surface until the terrain comes to within the threshold depth. On flat terrain stretching will continue indefinitely and break-lines need to be applied to restrict it. There is little way of knowing where the surface would realistically reach and the placement of break-lines in this situation is subjective.

3. **Misrepresented flow paths –** When flood waters break out of a main channel it is not uncommon for a separate flow path to form with an independent level profile. When stretching beyond the waterway corridor these potential flow paths can behave as break out areas that stretch an upstream surface too far downstream. Break-lines are applied to prevent this from happening but the potential flow paths can then be filled with inappropriate surfaces from the main channel, lower surfaces from downstream, or none at all.

4. **Tributaries merging –** At the confluence of two tributaries, one tributary can stretch over the stretched surface of another. Between tributaries break-lines can be placed along ridgelines or other features if they exist but a drop in level may be apparent where the surface of one tributary meets that of another either side of the break-lines.

5. **Artificial waterfalls –** When stretching a surface to produce the filled floodplain the same issues arise as when stretching a surface for mapping purposes. The use of break-lines will produce elevation drops in the filled floodplain terrain. This can result in waterfalls and artificial flow paths in the rare and extreme model simulations that would not occur in reality. These raw model results are then stretched to the existing terrain.

The following **Table G.1** contains a short description about the issues experienced and the fixes. The table also contains the location identifier of the areas with mapping limitations.

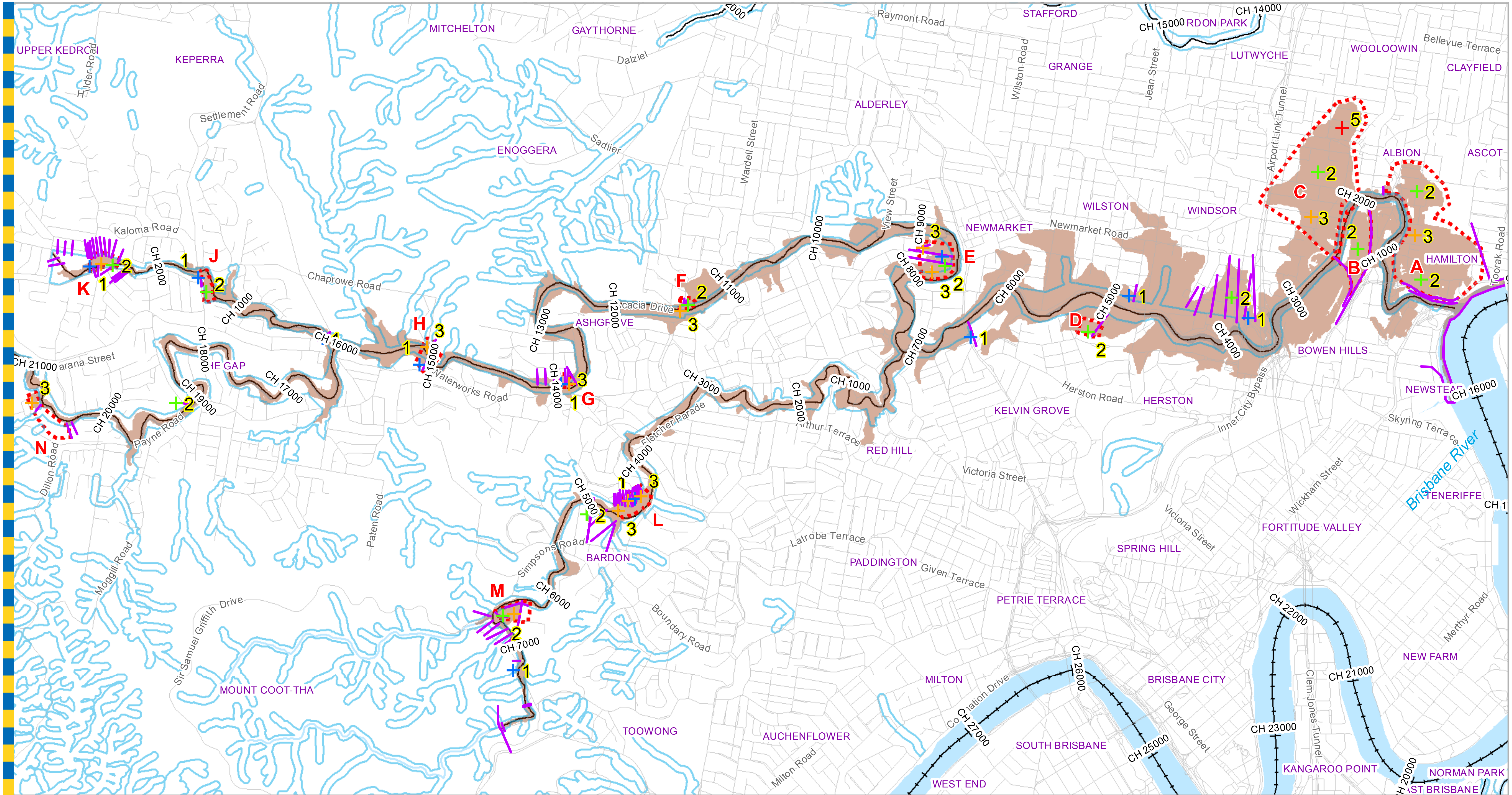
The following **Figure G.1** illustrates the location of the 100 Year ARI break-lines, limitation type and the locations of the areas with mapping issues.

Table G.1 Summary of Stretching Limitations

Limitation Number	Limitation Type	Location Description	Additional Comments
1	Stretched structure head loss	Areas G, H	Levels carried over from upstream. Stopped by using break-lines. In addition to the highlighted areas, this type of occurrence happened in some other locations too (refer **Figure G.1**)
2	Over stretching on flat terrain	Areas A, B, C, D, E, F, J, K, and M	High levels carried over from upstream. Had to be halted by using break-lines.
3	Misrepresented flow paths	Areas A, C, E, F, G, K, L, M and N	Upstream levels had to be halted to prevent filling of un-reasonable extent.
4	Tributaries merging	Nil	Some issues visible but not significant.
5	Artificial waterfalls	Area C	Occurred in +300 filled floodplain development scenario. Flow path breaks over filled floodplain in 200 Year ARI event only.

Note, among the highlighted areas with mapping limitations, areas A, B, C, L and M have been the subject of significant discrepancies. Hence, adoption of any post processing data from these areas should be exercised with care.

Figure G-1 Breakfast Creek Break Lines and Mapping Issues Areas



Legend

- Break Lines
- AMTD Line
- City Plan Waterway Corridors
- Mapping Issues Areas
- 1% AEP Ultimate Case Scenario Flood Inundation Extent
- Waterway/Waterbody

Issue Types

- 1
- 2
- 3
- 5

N / E / S / W

0 250 500 750 1,000
Metres

Prepared : 097142
Checked : NC
Revision : 0
Publication Date : 27 Jun 2014
Project Number : 110793

File : G:\BI\CD\Proj11\110793_Breakfast_Creek_2D_Model_Schedule_160\ArcInfo\GIM_110793_033.mxd

Brisbane City Council
City Projects Office
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Brisbane Qld 4001

For more information
visit www.brisbane.qld.gov.au
or call (07) 3403 8888

DATA INFORMATION

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Breakfast Creek Break Lines and Mapping Issues Areas

Figure G.1

GIM - 110793 - 033

APPENDIX H: PEER REVIEW COMMENTS

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Our Ref: L.B18265.002.docx

19 June 2014

Brisbane City Council
City Projects Office
saddam.pervez@brisbane.qld.gov.au

Attention: Saddam Pervez

Dear Saddam

RE: BREAKFAST CREEK - ENOGGERA CREEK TUFLOW MODEL: VERIFICATION OF MODELLING APPROACH

Background

In late 2010 Brisbane City Council (Council) approached BMT WBM on the subject of converting their existing 1D hydraulic model (built using DHI's MIKE11 hydraulic modelling package) of Breakfast Creek into a 2D hydraulic model. Council's reason for approaching BMT WBM is that we are the authors of TUFLOW, Council's preferred 2D hydraulic modelling package for the model conversion. Following this, BMT WBM was commissioned to prepare a technical brief for the conversion of the MIKE11 model to TUFLOW[1].

Rather than engage an external consultant to undertake the model conversion, Council embarked on developing the TUFLOW model in-house using the technical brief as a reference and with technical support from BMT WBM. This support included:

- Advice on the design of the TUFLOW model schematisation;
- Assistance with extracting the MIKE11 stream network and cross-section topography into ESTRY (TUFLOW's native 1D modelling component);
- Developing a tool to efficiently trim and geo-reference the ESTRY format cross-sections extracted from MIKE11;
- Advice on incorporation of structures;
- Advice on incorporation of Arup's Airport Link TUFLOW model;
- Assistance with setup of a multi 2D domain TUFLOW model;
- Identifying and troubleshooting instability problems; and
- Review of the final models.

[1] *Breakfast Creek MIKE11 Model Conversion: Technical Brief, BMT WBM, May 2011, report reference: R.B18265.001.01.doc*

Overview of Modelling Approach

The existing Airport Link (AL) TUFLOW model was established and calibrated by Arup. Council wished to incorporate this model with minimal change to the AL model structure. This was achieved by using a multi domain approach, whereby the upper domain was based on the MIKE11 model and LiDAR data and the lower domain was predominately composed of the AL model. Kelvin Grove Road was selected as the boundary between the upper and lower domains, which required the airport link model to be extended upstream to meet Kelvin Grove Road. The Kelvin Grove Road Bridge was modelled as a 1D structure, thus providing a convenient link between the upper and lower domains. The road embankment provides a convenient break in the floodplain that is not overtopped in the 100 year ARI flood event. For extreme flood events, where the road embankment is overtopped, a 2D-2D link was included to enable the transfer of flow from one domain to another.

While the lower domain cell size was based on the AL model (5m), the upper domain used a coarser (10m) cell size to achieve practical model run times. The creek widths in the upper domain are generally narrow compared to the 2D domain cell size. Thus a 1D/2D modelling approach was adopted in the upper domain, whereby the creek channel was modelled in 1D and linked to the 2D domain of the adjacent floodplain. To develop the 1D model of the creek channels in TUFLOW, The MIKE11 cross-sections were converted to an ESTRY format and trimmed to the bank tops using various bespoke tools. LiDAR survey was used to define the floodplain topography, and aerial imagery was used to delineate different land uses for prescribing surface roughness in the floodplain.

Models Reviewed

The following TUFLOW models were reviewed:

- Calibration and verification models;
- Design event models – 2, 5, 10, 20, 50 and 100 year ARI; and
- Extreme event models – 200, 500 and 2000 year ARI and PMF.

Limitations\Considerations

The model has been based on a pre-existing MIKE11 model, LiDAR survey and the Airport Link model. The following should be noted:

1. The creek topography upstream of Kelvin Grove Bridge was extracted from the MIKE11 model, which was based on a 1992 survey. It is possible that the current day topography has changed in some locations.
2. The structure data upstream of Kelvin Grove Bridge is based on hydraulic structure reference sheets contained in the Breakfast/Enoggera Creek Flood Study draft report. This flood study was undertaken in 1998/1999. It was beyond BMT WBM's scope of works to check whether any additional structures have been built or changes to structures have been made since the Breakfast/Enoggera Creek Flood Study.
3. A hydrology model was developed using WBNM for the 1998/1999 flood study. This model was used to create the inflow boundaries for the MIKE11 model. The results of this model were also used in the TUFLOW model. No revision of the hydrology was undertaken as part of BMT WBM's assistance with the TUFLOW model development.
4. The AL model has been adapted for use in the Breakfast Creek TUFLOW model by reprojecting the model to MGA Zone 56 and changing the origin of the 2D domain. The AL model has not been explicitly reviewed by BMT WBM, and is assumed to be fit for purpose. It is understood that Council have verified the model performance by simulating historical flood events and comparing the model results to measured historical flood data.
5. The calibration and verification models have been reviewed by BMT WBM with a focus on model performance in terms of stability and mass balance. The performance of the model in terms of its

ability to replicate historical flood records has been observed in Council's reporting, but the acceptability of this comparison has not been rigorously reviewed. Acceptance of the model calibration is the onus of Council.

Conclusion

The Breakfast Creek TUFLOW model has been developed by Council (Saddam Pervez) with the assistance of senior flood engineer, Richard Sharpe, from BMT WBM. The TUFLOW model structure conforms to current practice and the model performance (such as stability and mass balance) is considered appropriate for the purpose of the current flood study. It should be noted that whilst this review has undertaken reasonable and practical measures to confirm the predicted results, the review is not exhaustive, and limitations of the review and model are noted in this letter.

Yours faithfully,

BMT WBM Pty Ltd

Richard Sharpe

Senior Flood Engineer

Supervising Engineer[2]:

Jo Tinnion CPEng RPEQ (11395)

[2] *Supervising engineer signoff is based on information provided by Richard Sharpe and confidence in Richard's ability to undertake the review. Trust has been placed in the validity and completeness of the information provided by Richard.*

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