# Norman Creek Flood Study
# Volume 1 of 2



BRISBANE CITY

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# Norman Creek Flood Study

## Volume 1 of 2

**Prepared by Brisbane City Council's, City Projects Office**

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*Dedicated to a better Brisbane*

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# Executive Summary

## 1.1 Introduction

Brisbane City Council (BCC) is in the process of updating all of its flood studies to reflect the current conditions of the catchment and best practice flood modelling techniques. The most recent flood study for the Norman Creek catchment was undertaken in 1995 by Connell Wagner (now Aurecon). The most recent waterway study of Norman Creek is the Draft Norman Creek Water Quantity Assessment (WQA), which was undertaken by BCC in 2008.

The Norman Creek catchment is located south-east of Brisbane City within the Brisbane City Council (BCC) area. It is bounded by the Bulimba Creek catchment (east / south); Oxley Creek catchment (south / west); Brisbane River catchment (north / west) and Perrin Creek catchment (north / east).

The Norman Creek catchment covers an area of approximately 29.8 $km^2$ and encompasses several suburbs including Holland Park, Woolloongabba, Tarragindi, Greenslopes, Coorparoo, East Brisbane, Camp Hill and Norman Park. The Norman Creek catchment originates in the steep ridgelines of Toohey Forest and Mount Gravatt, and includes a number of major tributaries such as Ekibin Creek, Sandy Creek and Bridgewater Creek. Other smaller tributaries include Glindemann Creek, Mott Creek, Kingfisher Creek, Coorparoo Creek and Scott's Creek. The open channel areas within the catchment comprise a mixture of natural, mitigated (unlined) channel, concrete lined channel and dedicated overland flow paths with low flow pipe drainage. Norman Creek is a fully urbanised catchment, with the possibility of future intensification of current developed areas.

## 1.2 Study Objectives

The primary objectives for this project are as follows:

- Update the Norman Creek catchment hydrologic and hydraulic models (as required) to represent the current catchment conditions and best practice flood modelling techniques.
- Adequately calibrate and verify the models to historical storm events.
- Confirm that the hydrologic and hydraulic models are suitable to utilise for the purposes of design event modelling.
- Estimate design and extreme flood magnitudes.
- Determine design flood levels for the full range of design and extreme events up to 500 year ARI.
- Quantify the impacts of Minimum Riparian Corridor (MRC) and filling the floodplain outside the Waterway Corridor (WC).
- Produce flood inundation, flood depth and flood depth-velocity mapping for the selected range of design and extreme events up to the probable maximum flood (PMF).
- Quantify the potential impacts of climate change on flooding within the catchment.

## 1.3 Study Elements

The Norman Creek Flood Study consists of the following components:

### Calibration and Verification Modelling

Hydraulic models of the Norman Creek catchment have been developed using the MIKEFLOOD modelling software. Refinements to the previous RAFTS hydrologic model of the catchment have been undertaken using the latest version of the RAFTS software package (XP-RAFTS 2009).

The RAFTS model covers the entire Norman Creek catchment while the MIKEFLOOD model covers the majority of the open channel flow from Glindemann and Sandy Creeks downstream to the Norman Creek confluence with the Brisbane River. The majority of the open channel areas of Mott, Kingfisher, Coorparoo, Bridgewater, and Scott's Creeks are also included in the hydraulic model. The open-channel areas not included in the model are as follows;

- Sandy Creek – Upstream of Cracknell Road
- Ekibin Creek – Upstream of Pacific Motorway
- Mott Creek – Upstream of Logan Road
- Bridgewater Creek – Upstream of Old Cleveland Road

The calibrated RAFTS model from the Norman Creek Water Quantity Assessment (2008) was adopted for use with minimal modification in this study, with the most significant amendment being the addition of the 'External' sub-catchment[1] mainly for the purpose of extreme event modelling. Calibration of the MIKEFLOOD model was undertaken utilising two historical storms; namely 9th March 2001 and the 27th January 2013. Verification of the MIKEFLOOD model was also undertaken utilising two historical storms; namely 7th November 2004 and 20th November 2008.

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

- Pluviograph 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, eddy viscosity values, and the hydraulic structure representation. Cross-checks of the MIKEFLOOD structure head-losses were undertaken at the major bridge structures using the HEC-RAS software, from which it was confirmed that the model represented the structures adequately.

[1] External sub-catchment – A hydraulic analysis found that the pipe drainage system of this sub-catchment outfalls into the Brisbane River, however the exceedence flows is directed into the adjoining Gabba catchment and eventually into Norman Creek.

The hydraulic model was able to adequately replicate the historical calibration results for the 9th March 2001 and 27th January 2013 events, including the replication of the rising limbs of hydrograph(s). Modelled peak levels at the MHG and stream gauges were generally within 300 mm of recorded levels.
Utilising the adopted parameters from the calibration process, model verification was undertaken. Similar to the calibration results, the verification achieved a good agreement between the simulated and historical records for the 20th November 2008 event. However, the 2004 event run did not match the recorded values. The high spatial variability of the rainfall during this event is a plausible justification for this difference.

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

### Design and Extreme Events and Climate Change Modelling

The calibrated hydrologic and hydraulic models were used to simulate a range of design and extreme flood events from 2yr ARI to PMF. These analyses assumed ultimate catchment development conditions in accordance with the current version of BCC City Plan. As the Norman Creek catchment is considered to be fully developed, ultimate catchment conditions were based on the current catchment development make-up.

Three waterway scenarios were considered as follows:

- Scenario 1 - based on the current waterway conditions. No further modifications were made to the MIKEFLOOD 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 and development to the WC boundary to simulate potential development outside the WC. The waterway corridor used for this study was sourced from the current draft City Plan.

  Three additional flow conveyance zones were identified along Glindemann and Scott's Creek's and were represented in the model with the same attributes as a Waterway Corridor. It is recommended that these conveyance zones be considered for inclusion within the Waterway Corridor network in future revisions of City Plan.

The MIKEFLOOD modelling results were used to determine critical storm durations at selected locations, and flood immunity and headlosses for the hydraulic structures. 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 a rise in mean sea level. This analysis was undertaken for the 100yr, 200yr and 500yr ARI events.

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# Glossary of Terms

| Term | Definition |
|---|---|
| Annual Exceedance Probability (AEP) | The probability that a given rainfall total or flood flow will be exceeded in any one year. (see ARI/AEP conversion table) |
| Average Recurrence Interval (ARI) | The long-term average number of years between the occurrence of a flood as big as (or larger than) the selected event. For example, floods with a discharge as great as (or greater than) the 20 year ARI design flood will occur on average once every 20 years. |
| Brisbane Bar | Location at the mouth of the Brisbane River. |
| Catchment | The area of land draining through the main stream (as well as tributary streams) to a particular site. It always relates to an area above a specific location. |
| Digital Elevation Model (DEM) | A three-dimensional model of the ground surface elevation. |
| Design Event, Design Storm | A hypothetical flood/storm representing a specific likelihood of occurrence (for example the 100 year ARI). |
| Floodplain | Area of land subject to inundation by floods up to and including the Probable Maximum Flood (PMF) event |
| Flood Frequency Analysis (FFA) | Method of predicting flood flows at a particular location by fitting observed values at the location to a standard statistical distribution. |
| Flood Regulation Line (FRL) | Planning line used to denote extent of a waterway. The maximum encroachment of floodplain development. Superseded by the Waterway Corridor (see Waterway Corridor). |
| HEC-RAS | One-dimensional hydrodynamic modelling software package. |
| Hydrograph | A graph showing how the discharge or stage/flood level at any particular location varies with time during a flood. |
| Hydstra | File-based time-series data management system |
| Manning's 'n' | The Gauckler–Manning coefficient, used to represent roughness in 1D/2D flow equations. |
| Maximum Height Gauge (MHG) | An instrument for measuring a peak water level of a water body at a specific location during a specified time period. |
| MIKE11 | One-dimensional hydrodynamic modelling software package. |
| MIKE21 | Two-dimensional hydrodynamic modelling software package. |
| MIKEFLOOD | Software that dynamically couples a 1D MIKE11 and 2D MIKE21 model into a single model. |
| Minimum Riparian Corridor (MRC) | An area of (maximum) 15m width either side of the main flow channel, where future revegetation may occur. |
| Pluviograph | An instrument for measuring the amount of water that has fallen (ie. raingauge), with a feature to register the data in real time to demonstrate rainfall over a short period of time, often an automated graphing instrument. |
| Probable Maximum Flood (PMF) | An extreme flood deemed to be the largest flood that could conceivably occur at a specific location. |
| Probable Maximum Precipitation (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 |
| Stream(flow) Gauge | An instrument for measuring the water level in a water body, with the ability to register the data in real time. |
| Thiessen Polygon method | A method of determining spatial rainfall distribution over a catchment |

| Term | Definition |
| --- | --- |
| TUFLOW | Hydrodynamic modelling software package. |
| URBS | Hydrologic modelling software package. |
| Waterway Corridor (WC) | Planning line used to denote extent of a waterway. |
| XP-RAFTS | Hydrologic modelling software package. |

## ARI to AEP Conversion

| ARI (years) | AEP (%) |
| --- | --- |
| 2 | 50 |
| 5 | 20 |
| 10 | 10 |
| 20 | 5 |
| 50 | 2 |
| 100 | 1 |
| 200 | 0.5 |
| 500 | 0.2 |
| 2000 | 0.05 |

# 1.0 Introduction

## 1.1 Background

The Norman Creek catchment is located south-east of Brisbane City within the Brisbane City Council (BCC) area. It is bounded by the Bulimba Creek catchment (east / south); Oxley Creek catchment (south / west); Brisbane River catchment (north / west) and Perrin Creek catchment (north / east). Figure 1.1 indicates the locality of the Norman Creek catchment.

The most recent flood study for the catchment was undertaken in 1995 by Connell Wagner (now Aurecon). A number of waterway / catchment studies have since been undertaken for the Norman Creek catchment, the most recent of which was the 2008 Draft Norman Creek Water Quantity Assessment (BCC). A list of past studies is included in section 1.4.

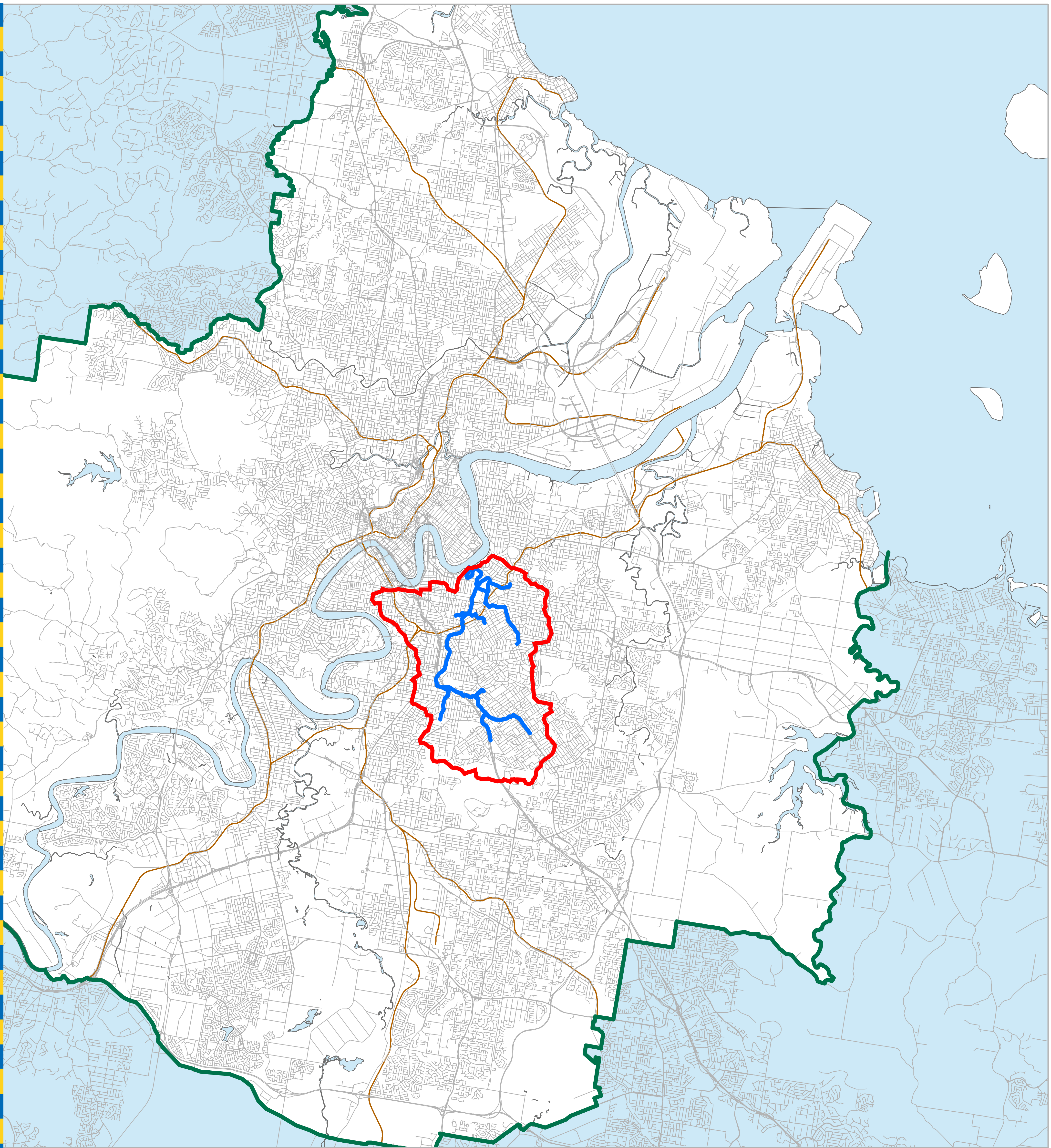
## 1.2 Study Objectives

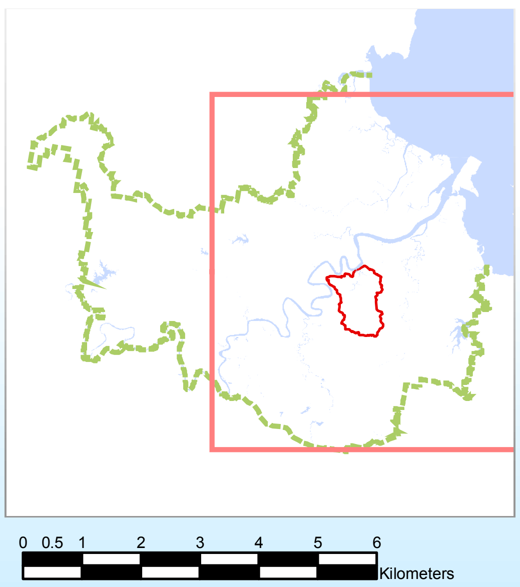
The primary objectives for this study are as follows:

- Update the Norman Creek catchment hydrologic and hydraulic models (as required) to represent the current catchment conditions and best practice flood modelling techniques.
- Adequately calibrate and verify the models to historical storm events.
- Confirm that the hydrologic and hydraulic models are suitable to utilise for the purposes of design event modelling.
- Estimate design and extreme flood magnitudes.
- Determine design flood levels for the full range of design and extreme events up to 500 year ARI.
- Quantify the impacts of Minimum Riparian Corridor (MRC) and filling the floodplain outside the Waterway Corridor (WC).
- Produce flood inundation, flood depth and flood depth-velocity mapping for the selected range of design and extreme events up to the PMF.
- Quantify the impacts of climate change on flooding within the catchment.

## 1.3 Scope of Work

As part of this study, the RAFTS hydrologic and MIKE11 hydraulic models of Norman Creek, developed as part of the 2008 Norman Creek Water Quantity Assessment (BCC), have been revised and updated (as required) to reflect current conditions of the Norman Creek catchment. The updated Norman Creek MIKEFLOOD hydraulic model utilises a combination of one-dimensional (MIKE11) and two-dimensional MIKE21 modelling.







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## Legend

- Norman Creek Catchment
- Norman Creek Centreline
- BCC Boundary
- Streets
- Railway Line




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# Figure 1.1: Locality Plan

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The scope of work comprised two main stages:

- Stage 1 – Model Calibration and Verification, and
- Stage 2 - Design and Extreme Event Modelling

Calibration was undertaken to two recorded historical storm events and verification to two more recent events to ensure the model was sufficiently reliable and robust to utilise for design and extreme event modelling.

The calibration and verification stage consisted of the following:

- Review and update the current RAFTS hydrologic model of the catchment to include the November 2008 and January 2013 historical flood events.
- Develop a linked 1D / 2D MIKEFLOOD model of the creek system to replace the existing 1D MIKE11 hydraulic model.
- Calibrate the MIKEFLOOD model to the March 2001 and January 2013 historical flood events. The RAFTS model was already sufficiently calibrated prior to this study.
- Verify the MIKEFLOOD model to the November 2004 and November 2008 historical flood events.

The calibrated hydrologic and hydraulic models were then used to determine anticipated flood profiles based on Australian Rainfall and Runoff (AR&R) rainfall patterns for the 2, 5, 10, 20, 50 and 100-yr Average Recurrence Interval (ARI) events, along with extreme rainfall events including the 200-yr ARI, 500-yr ARI, 2000-yr ARI and the Probable Maximum Flood (PMF). The hydraulic modelling includes consideration of the Minimum (Vegetated) Riparian Corridor (MRC) and the Waterway Corridor (WC). The MRC is modelled in recognition that at some unspecified time in the future, revegetation may occur, either through natural regeneration or as a result of community planting programs. Similarly, the WC assumes that development and filling may occur up to the corridor boundary.

The design and extreme event modelling consisted of the following:

- Estimating design and extreme flood magnitudes for the full range of events from 2-yr ARI to PMF.
- Simulating synthetic Australian Rainfall and Runoff (AR&R) design storms for multiple durations to determine the critical duration at various locations within the catchment.
- Utilising the calibrated RAFTS and MIKEFLOOD models to determine peak design flood levels for the full range of design and extreme events up to the PMF.
- Adjusting the model to simulate the impacts of MRC and filling outside the WC.
- Combining the modelling results for the various storm durations to produce peak results throughout the catchment for each ARI.
- Producing peak mapping results for flood inundation, flood depth and flood depth-velocity for the selected range of design and extreme events up to the PMF.
- Undertaking climate change modelling for the 100-yr, 200-yr and 500-yr ARI events to determine the impacts.

## 1.4 Previous Studies / Modelling History

### 1.4.1 Summary

A number of studies have been undertaken previously for the Norman Creek catchment. A summary of these studies is provided in Table 1.1.

Table 1.1 - Past studies of Norman Creek and Tributaries

| Title | Author | Date | Prepared for | Reach |
|---|---|---|---|---|
| Norman Creek Flood Mitigation Report | BCC | March 1987 | BCC | Norman Creek d/s of Logan Road |
| Norman Creek Model Report | BCC | December 1987 | BCC | Norman Creek, Ekibin Creek d/s of Marshall Road |
| Norman Creek Flood Study | Connell Wagner | 1995 | BCC | Norman Creek d/s of Ridge Street |
| South East Transit Project, Norman Creek Hydrologic Study | Cardno & Davies | June 1998 | Department of Main Roads | Ekibin Creek d/s of South East Freeway |
| Norman Creek Flood Regulation Line Review | City Design | June 1999 | BCC | Norman Creek d/s of Ridge Street |
| Bridgewater Creek catchment Local Stormwater Management Plan | Connell Wagner | February 2000 | BCC | Bridgewater Creek |
| Hydraulic Analysis at Norman Creek, Greenslopes | City Design | October 2000 | BCC | Norman Creek, adjacent to Nicholson Street |
| Bridgewater Creek Wetland MIKE11 Analysis | City Design | 2000 | BCC | Bridgewater Creek |
| Norman Creek Flood Investigation | City Design | November 2001 | BCC | Norman Creek, especially Stones Corner area |
| Ekibin Creek at Nicholson Street, Greenslopes, Flood Impact Assessment due to Proposed Revegetation Program | City Design | May 2002 | BCC | Norman Creek, especially Stones Corner Area |
| Norman Creek Water Quantity Assessment (2004) - Draft | Cardno | 2004 | BCC | Norman Creek from Glinemman Park |
| Norman Creek Water Quantity Assessment (2008) - Draft | City Design | 2008 | BCC | Norman Creek from Glinemman Park |

### 1.4.2 Norman Creek Flood Mitigation Report, 1987

This report was produced in conjunction with the 1987 Norman Creek Model Report (BCC). The report outlines all aspects of the proposed flood mitigation works (economics, environmental, flooding etc.). The flood mitigation works included:

- Construction of a floodway between Mowbray Terrace and Turbo Drive and filling of the defunct creek channel.
- Construction of a training wall on the west side of the channel downstream of Turbo Drive.
- Minor widening of Norman Creek between the Brisbane River and Mowbray Terrace.
- Construction of two high level floodways at Anglican Grammar School playing fields and south-west of Donaldson Street, Norman Park.

### 1.4.3 Norman Creek Model Report, 1987

The Norman Creek Model report was prepared by Brisbane City Council's Department of Works. The study was conducted to assess flooding in Norman Creek catchment, and to prepare a model for assessment of the proposed flood mitigation works. The study was prepared prior to mitigation works and used the HYDN and WASF models to access hydrology and hydraulics, respectively.

### 1.4.4 Norman Creek Flood Study, 1995

This study assessed the benefits of the mitigation works conducted within the creek in 1989 / 1990. The study was planned as a tool for determining the necessity for further mitigation works including the completion of the parts of the scheme not yet constructed. The study used RUBICON model for the hydraulic analysis.

### 1.4.5 South East Transit Project, Norman Creek Hydrologic Study, 1998

The study was conducted in support of the South-East Transit Project. The project involved the construction of a busway along the outbound lanes of the South-East Freeway. The constructed busway impinges on the floodplain of Ekibin Creek at Greenslopes. It utilised a RAFTS hydrologic model and a MIKE11 hydraulics model.

### 1.4.6 Norman Creek Flood Regulation Line Review, 1999

The purpose of this study was to review the existing flood regulation lines to ensure that certain criteria were met and to change the flood regulation lines where necessary. It was assumed that the original flood regulation lines were determined based on the results of the WASF modelling conducted in 1987 and did not take in to account the new flood regulation line criteria.

### 1.4.7 Hydraulic Analysis at Norman Creek (Greenslopes), 2000

The study was prepared to identify the most appropriate planting for the area, ensuring no worsening of flooding. The area of interest was along Ekibin Creek, from the crossing of the South-East Freeway to Merrell Street. Although the report title suggests that a hydraulic investigation was conducted, the study did not undertake a hydraulic analysis.

### 1.4.8 Bridgewater Creek Wetland MIKE11 Analysis, 2000

The Bridgewater Creek Wetland is located upstream of Old Cleveland Road on Bridgewater Creek. The wetland is designed to perform stormwater quality treatment on runoff from the upstream catchment. Secondary benefits of the wetland were reduced flooding, improved amenity and increased interest and awareness of catchment management issues. The analyses were completed using a MIKE11 model.

### 1.4.9 Norman Creek Flood Investigation, 2001

The objective of the study was to review the flooding characteristics of Norman Creek in light of the March 2001 event, with particular emphasis on the Stones Corner precinct. The study used a RAFTS hydrological model and a MIKE11 hydraulic model.

### 1.4.10 Ekibin Creek (Greenlopes) Flood Impact Assessment, 2002

This report compares the flooding impact of the proposed revegetation program with flooding due to existing vegetation. The analysis covers Ekibin Creek from the South East Freeway crossing to Woodford Street. The study is based on the MIKE11 model developed for the South East Transit Busway project.

### 1.4.11 Draft Norman Creek Water Quantity Assessment, 2004

Cardno was commissioned to undertake the Norman Creek Water Quantity Assessment in 2004 by BCC. Cardno was able to initiate the study and obtain a working calibration model, accurate to 2001 existing conditions. Cardno then produced a handover report (draft Norman Creek WQA, Cardno 2004) for BCC. At this point BCC took ownership of the model and continued to finalise the study.

### 1.4.12 Draft Norman Creek Water Quantity Assessment, 2008

BCC City Design undertook a study of Norman Creek at the beginning of December 2004. Cardno initiated the Water Quantity Assessment, completing it as a draft before handing it over to BCC for completion. The objectives of the Draft Norman Creek Water Quantity Assessment (2008) were to:

- Update the hydraulic model to incorporate current topographic information
- Update the hydraulic modelling software to utilise the current version (i.e. MIKE11 2005 SP4)
- Update the model to reflect current Minimum Riparian Corridor alignment.
- Update the model to reflect current waterway corridor alignment.
- Provide up to date design flood level information.

The finalisation included the following tasks:

- Incorporate new ALS survey data.
- Update of the MIKE11 model to 2005 version.
- Extend the MIKE11 model along the Glindemann Creek Tributary.
- Update structure information downstream of Birdwood Road.
- Refine design event predictions (2, 5, 10, 20, 50 and 100 year ARI) assuming existing and ultimate catchment scenarios.

To create the design model, BCC revised the Cardno calibration model and incorporated the following changes:

- Update of roughness coefficients throughout the model (in particular the Bridgewater Creek branch where MRC roughness's had been applied erroneously across the whole channel instead of only the banks);
- Glindemann Creek was extended up to Nursery Road. This includes a section of pipe drainage and overland flow paths;
- The Birdwood Road sub-development was included in the Ekibin Creek lower reach. This includes the addition of a large bridge, small causeway and channel alignment changes;
- The Sandy Creek rehabilitation upgrade was included into the model. This incorporates the channel works along Barr Street and the inclusion of a footbridge and 2 drop structures; and
- Some minor channel works undertaken post-2001.

Together these modifications update the model to represent existing 2007/2008 conditions. As well as Base Case scenario, MRC, FRL and MRC + FRL scenarios were created. The design model was verified with the November 2004 event to ensure it still achieved comparable results to the calibration model.

# 2.0 Catchment Details

## 2.1 Catchment and Major Tributaries

The Norman Creek catchment is located south-east of Brisbane and encompasses several suburbs including Holland Park, Woolloongabba, Tarragindi, Greenslopes, Coorparoo, East Brisbane, Camp Hill and Norman Park. The catchment has an approximate area of 29.8 km$^2$.

The Norman Creek catchment originates in the steep ridgelines of Toohey Forest and Mount Gravatt, and includes a number of major tributaries such as Ekibin Creek, Sandy Creek and Bridgewater Creek. Other smaller tributaries include Glindemann Creek, Mott Creek, Kingfisher Creek, Coorparoo Creek and Scott's Creek. Norman Creek is a fully urbanised catchment. That is, those areas zoned for development have been developed.

The eastern most of these sub-catchments, Mott Creek, runs through Holland Park, before passing under Logan Road and flowing into Norman Creek. Glindemann Creek, which is partly concrete-lined, runs west of Mott Creek, largely following Logan Road. It later joins with Ekibin Creek downstream of Marshall Road.

Sandy Creek, the western most of these upper waterways, links the hills of Tarragindi with Norman Creek at Ekibin Park South. Parkland lines both sides of Sandy Creek for most of its length. Norman Creek bends around Ekibin Park South and runs underneath the motorway and transitions into a concreted channel as it passes through parks and adjacent sporting fields in Greenslopes on its way to Stones Corner. Downstream of Logan Road, the waterway is unlined supporting significant riparian vegetation and is subject to significant tidal and backwater effects from the Brisbane River. Kingfisher Creek enters Norman Creek at Wooloongabba.

In the eastern half of the catchment, Coorparoo Creek and Bridgewater Creek join Norman Creek in the flatter catchment plains. Bridgewater Creek links parks and green spaces through Camp Hill and Coorparoo on its way to Norman Park. Norman Creek then links up with Scott's Creek eventually discharging its waters into Brisbane River.

The lower catchment tributaries including Kingfisher, Coorparoo, Bridgewater and Scott's Creeks are affected by tidal water along parts of their length. These waterways are drained via a combination of natural channel, concrete-lined open channel and underground piped drainage.

## 2.2 Land Use

The current development land use in the upper and middles reaches of the catchment consists mostly of low density residential development, whilst the lower reaches consist of a mixture of light industrial and low density residential areas. The Anglican Church Grammar School and Coorparoo College are also on the lower reaches of Norman Creek catchment.

The construction of several creek crossings and an extended tram service encouraged development in the Norman Creek catchment in the early 20th century. Development and growth has continued since then and now the catchment is considered entirely urbanised although some capacity for intensification remains. Review of available aerial photography indicates that the catchment has remained at a similar level of development since at least 1995.

Recent infrastructure development of note within the catchment in the vicinity of the waterway includes:

- The Eastern Busway (completed 2011) - just downstream of Logan Road (Stones Corner).
- The Veloway (bikeway - completed 2013) - adjacent to the South-East Freeway that runs along Ekibin Creek in Greenslopes.

# 3.0 Hydrometric Data and Storm Selection

A number of continuous recording rainfall gauges (pluviograph), maximum height gauges (MHGs) and continuous stream height gauging stations exist within the Norman Creek catchment and surrounding catchments. The historical data from these gauges has been collated and used for calibration and verification of the hydrologic and hydraulic models.

## 3.1 Selection of Historical Storm Events

Selection of specific events for calibration and verification was based on the size of the event, the availability of data and the date of the events (with the recent events generally taking precedence). The events selected for calibration and verification are listed in Table 3.1.

Table 3.1 – Events selected for Calibration and Verification

| Calibration | Verification |
|---|---|
| 9th March 2001 | 7th November 2004 |
| 27th January 2013 | 20th November 2008 |

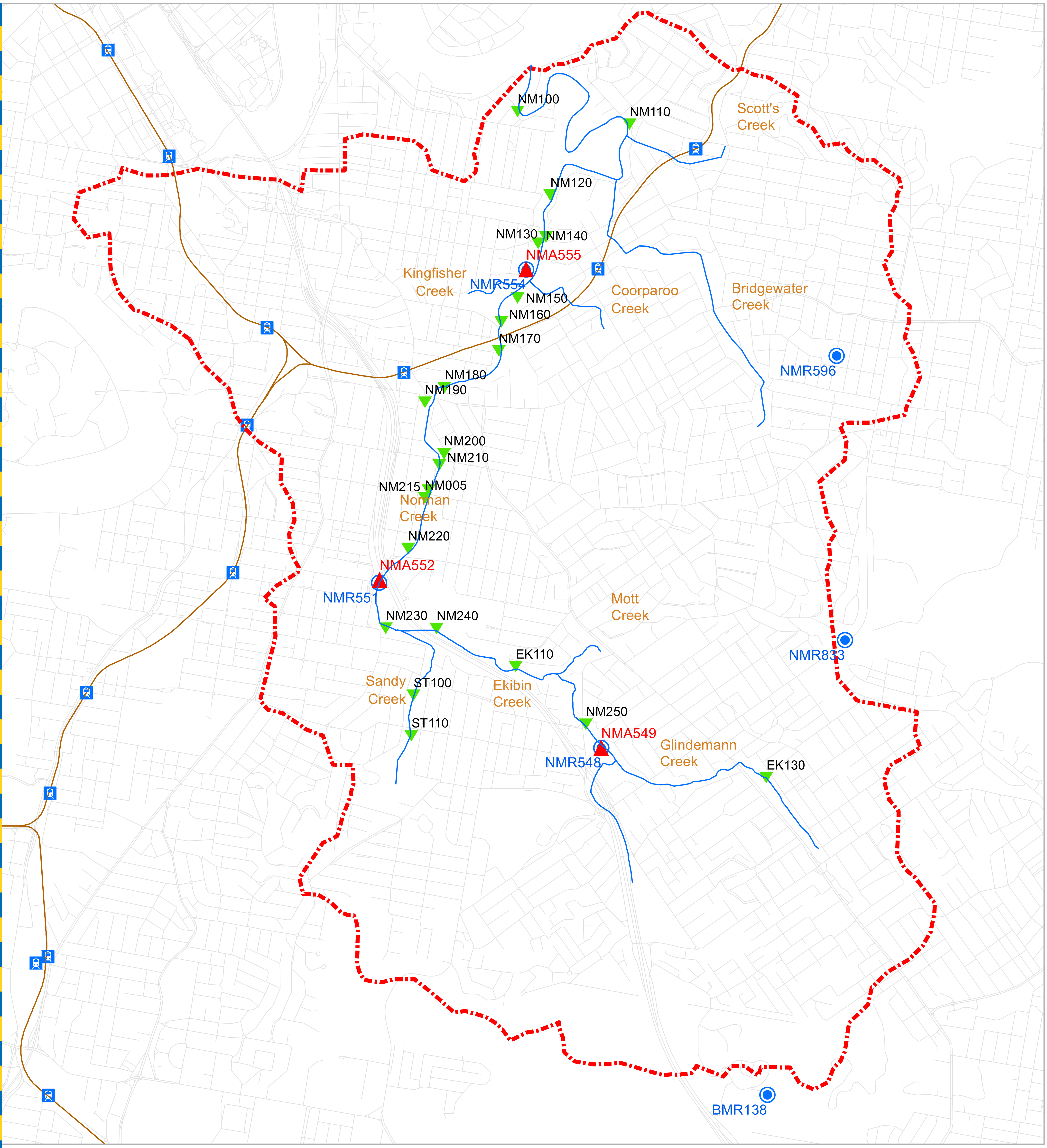
The predominant reasons for selecting these events included:

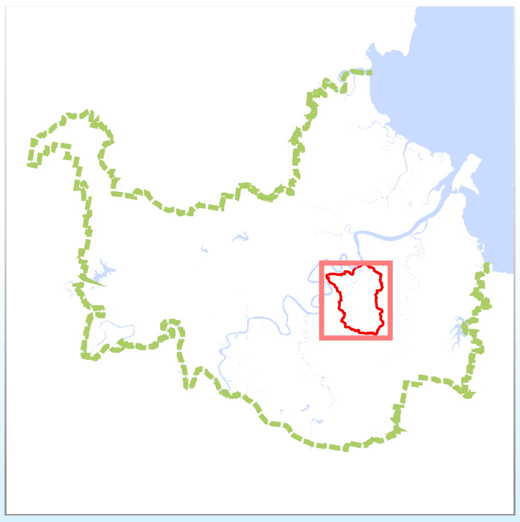
- Better historical data coverage when compared with earlier events (particularly for the 2013 event along Glindemann, Ekibin and Sandy Creeks)
- The selected events represent a full range of rainfall return periods, from approximately 2-yr ARI to greater than 100-yr ARI.
- The selected events capture the most up-to-date channel works and structure details in the vicinity of the waterway.
- The hydrologic and hydraulic models developed as part of the 2008 Norman Creek WQA (and updated as part of this study) have already been calibrated to the 9th March 2001 and 7th November 2004 events.

## 3.2 Availability of Historical Data for Selected Storms

### 3.2.1 Continuous Recording Rainfall (Pluviograph) Stations

There are six BCC owned rainfall pluviograph stations that were utilised for this study. Four are located within the Norman Creek catchment and two within the Bulimba Creek catchment. These gauges are distributed relatively evenly throughout the catchment, with the Bulimba Creek gauges located just upstream of the catchment in the Toohey Forest, and immediately to the East of the catchment near the corner of Cavendish and Boundary Road’s in Coorparoo. These gauges appear to adequately capture any potential for spatial variation in rainfall within the catchment. The locations of the gauges are indicated in Figure 3.1: Norman Creek catchment Map.



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**Legend**

- Norman Creek Centrelines
- Continuous Recording Stream Gauges
- Pluviograph Stations
- Maximum Height Gauges
- Norman Creek Catchment Boundary
- Railway Stations
- Railway Line
- Streets
- Creek Names




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# Figure 3.1: Norman Creek Catchment Map and Gauge Locations

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Table 3.2 indicates the availability of rainfall data for the selected calibration and verification events.

Table 3.2 – Rainfall gauge data availability

| Gauge ID | Location | Calibration | | Verification | |
|---|---|---|---|---|---|
| | | 9th March 2001 | 27th January 2013 | 7th Nov 2004 | 20th Nov 2008 |
| BMR138 | Park Road, Mount Gravatt | ✓ | ✓ | ✓ | ✓ |
| NMR554 | Caswell St, East Brisbane | ✓ | ✓ | ✓ | ✓ |
| NMR551* | Lewisham St Annerley | ✓ | × | ✓ | × |
| NMR833* | Boundary Road, Coorparoo | ✓ | × | ✓ | × |
| NMR548 | Joachim St, Holland Park West | ✓ | ✓ | ✓ | ✓ |
| NMR596 | Warilda St, Camp Hill | ✓ | ✓ | ✓ | ✓ |

*Gauges NMR551 and NMR833 were closed after 2004.

### 3.2.2 Continuous Recording Stream Gauges

Continuous recording stream height gauges collect water level data. There are currently two stream gauges operational in Norman Creek; one is located in the middle reach near Joachim Street in Holland Park West (NMA549) and the other in the downstream reach at Caswell Street, East Brisbane (NMA549). A further stream gauge, located near Waldheim Street (NMA552), has been closed and BCC records only exist for the 9th March 2001 event. NMA549 is the most downstream gauge and is influenced by tidal variations in water level. The locations of the continuous stream gauges are indicated in Figure 3.1: Norman Creek catchment Map. Table 3.3 indicates the availability of stream gauge data for the selected events.

Table 3.3 – Continuous Recording Stream Gauge data availability

| Branch | Gauge ID | Data Availability | | | |
|---|---|---|---|---|---|
| | | 9th Mar 2001 | 7th Nov 2004 | 20th Nov 2008 | 27th Jan 2013 |
| Ekibin Upper | NMA549* | ✓ | ✓ | ✓ | ✓ |
| Norman | NMA552* | ✓ | × | × | × |
| Norman | NMA555 | ✓ | ✓ | ✓ | ✓ |

### 3.2.3 Maximum Height Gauges (MHG)

Maximum Height Gauges (MHGs) record the maximum water level experienced in a flood event at the gauge location. A number of MHGs exist in the Norman Creek catchment, most of which have been replaced at least once in their existence. Data availability for these gauges is summarised in Table 3.4 and their locations are indicated in Figure 3.1: Norman Creek catchment Map. New gauges have recently been installed, specifically in Sandy Creek and Glindemann Creek, resulting in the 27th January 2013 event having better MHG coverage than the other events.

Table 3.4 – Maximum Height Gauge data availability

| Reach | Gauge ID | Data Availability | | | |
|---|---|---|---|---|---|
| | | 9th Mar 2001 | 7th Nov 2004 | 20th Nov 2008 | 27th Jan 2013 |
| Norman Creek | NM100 | * | * | * | ✓ |
| | NM110 | ✓ | ✓**** | * | ✓ |
| | NM120 | ✓ | * | ✓ | ✓ |
| | NM130 | ✓ | ✓ | ✓ | ✓ |
| | NM140 | ✓ | * | ✓ | ✓ |
| | NM150 | ✓ | - | - | - |
| | NM160 | ✓** | ✓ | ✓ | ✓ |
| | NM170 | ✓ | ✓ | ✓ | ✓ |
| | NM180 | ✓** | ✓ | ✓ | ✓ |
| | NM190 | ✓** | ✓ | ✓ | - |
| | NM200 | ✓** | ✓**** | * | * |
| | NM210 | DEST | ✓ | - | - |
| | NM215 | - | - | * | ✓**** |
| | NM220 | ✓ | * | ✓ | ✓ |
| | NM230 | ✓*** | ✓**** | ✓ | ✓** |
| Ekibin Creek Lower | NM240 | O/TOP | ✓ | * | DEST |
| | NM250 | ✓ | ✓**** | ✓**** | * |
| | EK110 | - | - | - | ✓ |
| Glindemann Creek | EK130 | - | - | - | ✓ |
| Sandy Creek | ST100 | - | - | - | ✓ |

| | |
|---|---|
| * | Level did not reach bottom of inner cup – no recorded level |
| ** | Gauge destroyed during event – level recorded from nearby debris height |
| *** | Level over top of inner gauge – level recorded from nearby debris height |
| **** | Level from nearby debris height |
| - | Data not available for this event |
| O/TOP | Gauge overtopped – no recorded level |
| DEST | Gauge destroyed during event – no recorded level |

### 3.2.4 Tidal Information

Historic tide information was obtained from two continuous stream gauges located in the Brisbane River. The stream gauges are operated by Maritime Safety Queensland (MSQ) and are located at the Brisbane Bar and Gateway Bridge. The tidal gauge data availability is indicated in Table 3.5.

Table 3.5 – Tide Gauge data availability

| Event | Data Availability |
|---|---|
| 9th March 2001 | Gateway Bridge Gauge |
| 7th November 2004 | Gateway Bridge Gauge |
| 20th November 2008 | Gateway Bridge Gauge |
| 27th January 2013 | Brisbane Bar Gauge |

As there is no stream gauge at the Norman Creek / Brisbane River confluence, shifts in levels and timing of the available downstream tidal data was undertaken to better represent the anticipated tide in Norman Creek. Level and timing shifts were applied based on available data in the *QLD Tide Tables (MSQ)* booklet for the year corresponding to each flood event.

## 3.3 Characteristics of Calibration Events

### 3.3.1 March 2001 event

The 9th March 2001 event was the largest recorded rainfall event within the Norman Creek catchment, significantly larger than all other recorded events. The event occurred over a period of approximately 5 hours in the afternoon of the 9th March 2001, with the peak rainfall falling between 5 pm and 6 pm. Approximately 160 to 210 mm of rainfall fell at each of the pluviograph stations on the day of the event.

Figure 3.2 presents a comparison of the Intensity-Frequency-Duration (IFD) curve for each pluviograph station against the IFD curves for Brisbane.

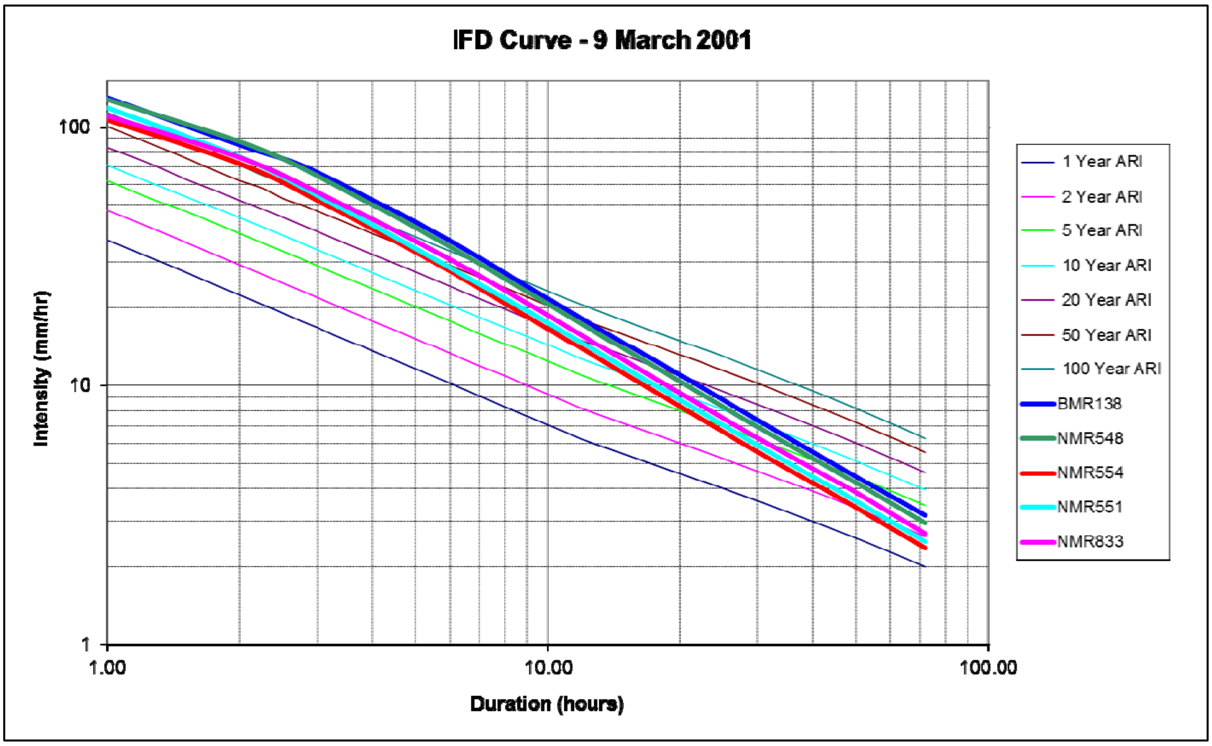



Figure 3.2: March 2001 Event – Comparison with Brisbane IFD

The rainfall intensity for this event appears to have been relatively evenly distributed throughout the catchment. Assuming a critical duration of approximately 3 hours for the catchment, the magnitude of the 9th March 2001 event is greater than or equal to the 100-yr ARI design rainfall event throughout the catchment, with the recorded rainfall slightly higher in the upper areas of the catchment. For areas of shorter critical duration (such as at the top ends of tributaries), a one hour critical duration yielded a design rainfall ARI greater than 100 years at all gauges.

The cumulative rainfall recorded by each rainfall gauge is plotted in Appendix A. The Thiessen Polygon diagram, which has been used to apportion the recorded gauge rainfall to each of the sub-catchments, is provided in Appendix C.

The pluviograph at Joachim Street, Holland Park West (NMR548) recorded the following rainfall ARIs on the 9th March 2001:

- 30 minutes: 1 in 88 years
- 1 hour rainfall: Greater than 100 years
- 2 hours rainfall: Greater than 100 years
- 6 hours rainfall: Greater than 100 years
- 12 hours rainfall: 1 in 38 years

Table 3.7 below indicates the 4-day and 14-day antecedent rainfall as well as the total event rainfall at the five pluviograph stations.

Table 3.6 - Rainfall characteristics (March 2001 event)

| Gauge ID | Antecedent Rainfall (mm) | | Event Rainfall (mm) | |
|---|---|---|---|---|
| | 14-day | 4-day | 9th March | 8th March to 10th March |
| BMR138 | 8 | 7 | 217 | 223 |
| NMR554 | 7 | 4 | 166 | 169 |
| NRM551 | 5 | 4 | 175 | 179 |
| NMR548 | 6 | 5 | 206 | 210 |
| NMR833 | 9 | 7 | 184 | 190 |

### 3.3.2 January 2013 event

The 27th January 2013 event was a long duration event beginning on the 25th January and continuing until the 28th January with rainfall peaking on the afternoon of the 27th January. Due to the long slow-moving nature of the storm, the catchment was considered to be already fully saturated prior to the peak of the storm moving through.

An IFD plot for each rainfall pluviograph is indicated in Figure 3.3. The IFD curves indicate that there is a very even distribution of rainfall throughout the catchment.

Assuming a critical duration of approximately 3 hours for the catchment, the 27th January 2013 event rainfall would be equivalent to an ARI of between 2 and 5 years. For areas of shorter critical duration (such as at the top ends of tributaries), a one hour critical duration yielded only a 1-yr ARI design rainfall at all gauges.

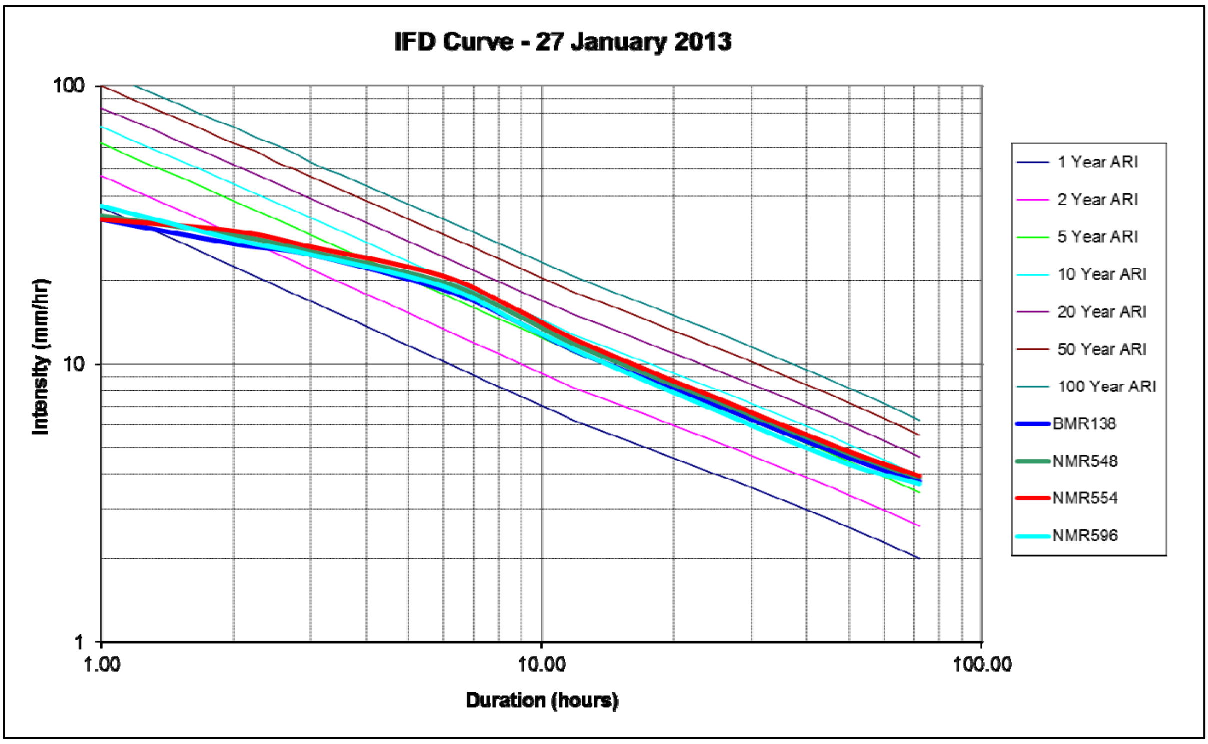



Figure 3.3: January 2011 Event – Comparison with Brisbane IFD

The cumulative rainfall recorded by each rainfall gauge is plotted in Appendix A. The Thiessen Polygon diagram, which has been used to apportion the recorded gauge rainfall to each of the sub-catchments, is provided in Appendix C.

The pluviograph at Joachim Street, Holland Park West (NMR548) recorded the following rainfall ARIs on the 27$^{th}$ January 2013:

- 1 hour rainfall: 1 in 1 years
- 2 hours rainfall: 1 in 2 years
- 6 hours rainfall: 1 in 7 years
- 12 hours rainfall: 1 in 6 years

Table 3.7 indicates the 4-day and 14-day antecedent rainfall as well as the total event rainfall at the four pluviograph stations.

Table 3.7 - Rainfall characteristics (January 2013 event)

| Gauge ID | Antecedent Rainfall (mm) | | Event Rainfall (mm) | |
|---|---|---|---|---|
| | 14-day | 4-day | 27th January | 26th January to 28th January |
| BMR138 | 85 | 79 | 165 | 253 |
| NMR554 | 99 | 94 | 179 | 252 |
| NMR548 | 94 | 89 | 175 | 255 |
| NMR596 | 100 | 96 | 161 | 233 |

## 3.4 Characteristics of Verification Events

### 3.4.1 November 2004 event

The November 2004 event extended over a period of approximately 5 hours on the 7th November 2004 with peak rainfall occurring just before noon. A significant proportion of the total rainfall for this event fell in just over 1.5 hours, indicating a very short but intense event. Approximately 60 to 150 mm of rainfall fell at each of the pluviograph stations on the 7th November.

An IFD plot for each rainfall pluviograph is indicated in
Figure 3.4. The IFD curves indicate that there is quite uneven distribution of rainfall throughout the catchment. The rainfall was more intense in the upper and middle sections of the catchment, particularly at Mt. Gravatt (BMR138), which recorded a significantly larger volume of rainfall than all other gauges.

Assuming a critical duration of approximately 3 hours for the catchment, the 7th November 2004 event rainfall would have an ARI of between 2 and 5 years in the lower catchment; 10 years in the middle / upper section of the catchment and 50 years in the very upper reach of the catchment. For areas of shorter critical duration (such as at the top ends of tributaries), a one hour critical duration yielded a 1-5-yr ARI event in the middle and lower catchment, and a 20-yr ARI event in the upper catchment.

The cumulative rainfall recorded by each rainfall gauge is plotted in Appendix A. The Thiessen Polygon diagram, which has been used to apportion the recorded gauge rainfall to each of the sub-catchments, is provided in Appendix C.

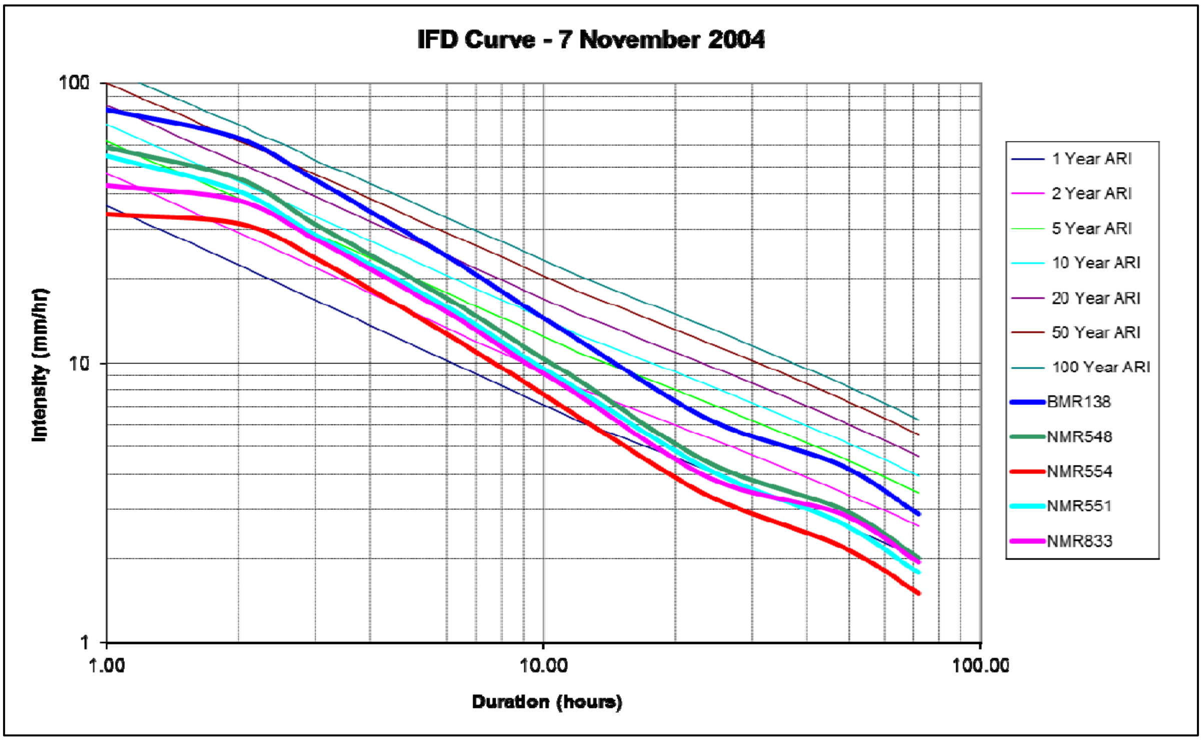



Figure 3.4: November 2004 Event – Comparison with Brisbane IFD

The pluviograph at Joachim Street, Holland Park West (NMR548) recorded the following rainfall ARIs on the 7th November 2004:

- 1 hour rainfall: 1 in 4 years
- 2 hours rainfall: 1 in 10 years
- 6 hours rainfall: 1 in 4 years
- 12 hours rainfall: 1 in 2 years

Table 3.8 indicates the 4-day and 14-day antecedent rainfall as well as the total event rainfall at the five pluviograph stations.

Table 3.8 - Rainfall characteristics (November 2004 event)

| Gauge ID | Antecedent Rainfall (mm) | | Event Rainfall (mm) | |
|---|---|---|---|---|
| | 14-day | 4-day | 7th November | 6th November to 8th November |
| BMR138 | 19 | 15 | 150 | 207 |
| NMR554 | 28 | 18 | 78 | 106 |
| NRM551 | 18 | 18 | 99 | 128 |
| NMR548 | 26 | 16 | 105 | 145 |
| NMR833 | 15 | 15 | 92 | 139 |

### 3.4.2 November 2008 event

The November 2008 event took place over a period of approximately 3 hours on the night of the 20th November, with peak rainfall occurring just after midnight on the 21st November. Antecedent rainfall was also observed within the catchment in the days leading up to the event, indicating that the catchment was already most likely saturated before the peak storm event passed through, possibly exacerbating flood levels in the catchment.

An IFD plot for each rainfall pluviograph is indicated in Figure 3.5. The IFD curves indicate that there are minor variations in the distribution of rainfall throughout the catchment, with recorded rainfall highest in the middle reaches of the catchment around Joachim Street, Holland Park West (NMR548) and lowest at the eastern boundary at Warilda Street, Camp Hill (NMR596).

Assuming a critical duration of approximately 3 hours for the catchment, the 20th November 2008 event rainfall would be equivalent to an ARI of between 1 and 5 years throughout the catchment. For areas of shorter critical duration (such as at the top ends of tributaries), a one hour critical duration also yielded 1-yr to 5-yr ARI design rainfall at all gauges.

The cumulative rainfall recorded by each rainfall gauge is plotted in Appendix A. The Thiessen Polygon diagram, which has been used to apportion the recorded gauge rainfall to each of the sub-catchments, is provided in Appendix C.

The pluviograph at Joachim Street, Holland Park West (NMR548) recorded the following rainfall ARIs on the 20th November 2008:

- 1 hour rainfall: 1 in 4 years
- 2 hours rainfall: 1 in 3 years
- 6 hours rainfall: 1 in 1 years
- 12 hours rainfall: 1 in 1 years

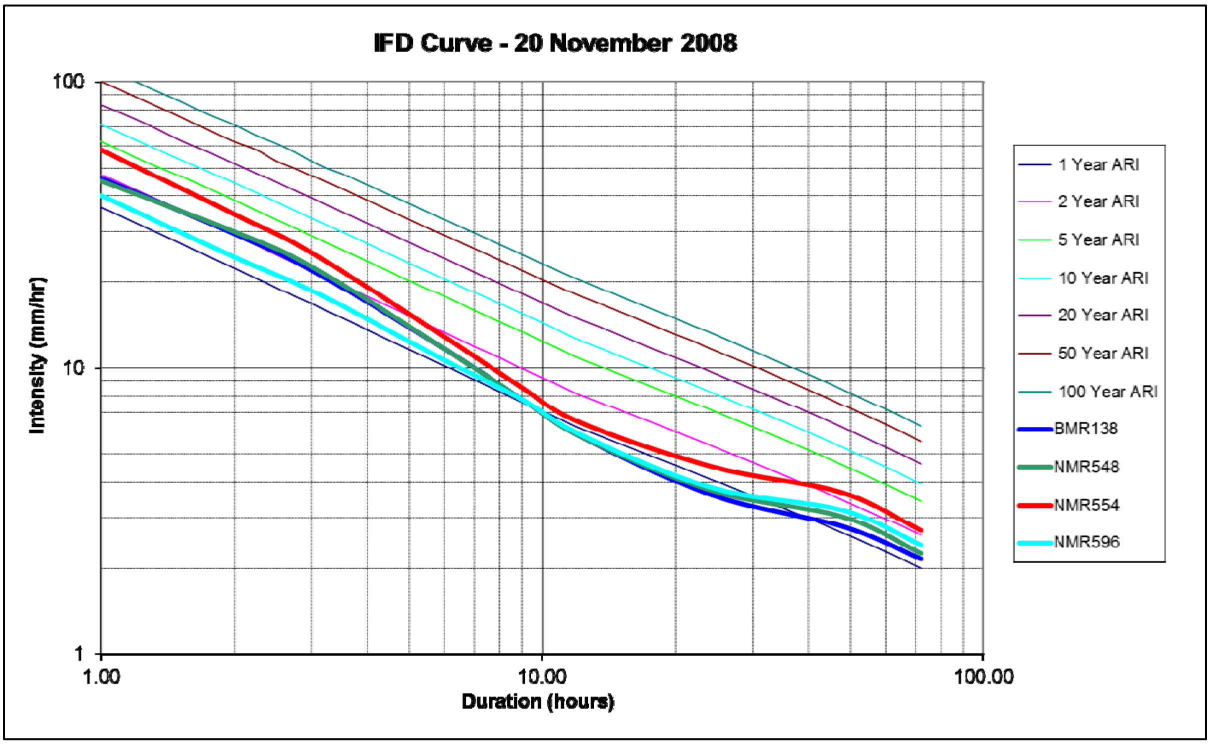



Figure 3.5: November 2008 Event – Comparison with Brisbane IFD

Table 3.9 below indicates the 4-day and 14-day antecedent rainfall as well as the total event rainfall at four pluviograph stations.

Table 3.9 - Rainfall characteristics (November 2008 event)

| Gauge ID | Antecedent Rainfall (mm) | | Event Rainfall (mm) | |
|---|---|---|---|---|
| | 14-day | 4-day | 20th November | 19th November to 21st November |
| BMR138 | 73 | 57 | 83 | 105 |
| NMR554 | 80 | 61 | 106 | 125 |
| NMR596 | 87 | 64 | 89 | 110 |
| NMR548 | 72 | 56 | 87 | 107 |

# 4.0 Hydrologic Model Development

## 4.1 Overview

The hydrologic model simulates the rainfall-runoff in the catchment and derives the outflow from each sub-catchment. The RAFTS model for the Norman Creek catchment was initially developed as part of the South East Transit study, by Cardno and Davies in 1998. This model was later used as part of the Norman Creek Water Quantity Assessment for both the 2004 (Cardno) and 2008 (BCC) reports with minimal modification to its input parameters. This model was jointly calibrated with the associated hydraulic model for a number of events during all model development stages, including the 2001 and 2004 events.

Preliminary assessment of the 2008 WQA RAFTS model indicated that it would be suitable for use in this study with only minimal modification. A review of a number of aspects of the model was also undertaken as discussed below.

The most significant modification to the RAFTS model was the addition of the 'External' subcatchment, which was previously omitted as there is proven in this study to be minimal impact on model results up to the 100yr ARI event. This catchment was primarily included for the simulation of the extreme event scenarios. A more in-depth discussion on this modification is included in Section 4.2.2.

Due to a significant discrepancy between the catchment slopes in the 2008 WQA RAFTS model and the 2008 Eastern Busway Stage 2 (SKM) RAFTS model, a review was undertaken. The methodology for catchment slope derivation used in the BCC model (i.e. equal-area method) was confirmed as more appropriate and thus catchment slopes were not altered.

Also of note was that the 2008 WQA RAFTS model did not include Gauge NMR596 in the rainfall distribution for the 9$^{th}$ March 2001 and 7$^{th}$ November 2004 events, despite there being available recorded rainfall data at these gauges during these events. This was reviewed and it was decided not to include this gauge for these events as the downstream location of the gauge would be unlikely to have a significant influence on peak flood levels in the modelled reaches of the catchment. The rainfall distribution therefore was not changed for the 2001 and 2004 events.

The 2008 WQA (BCC) RAFTS model therefore was adopted with only minimal modification for this study, and was run using the RAFTS 2009 software version.

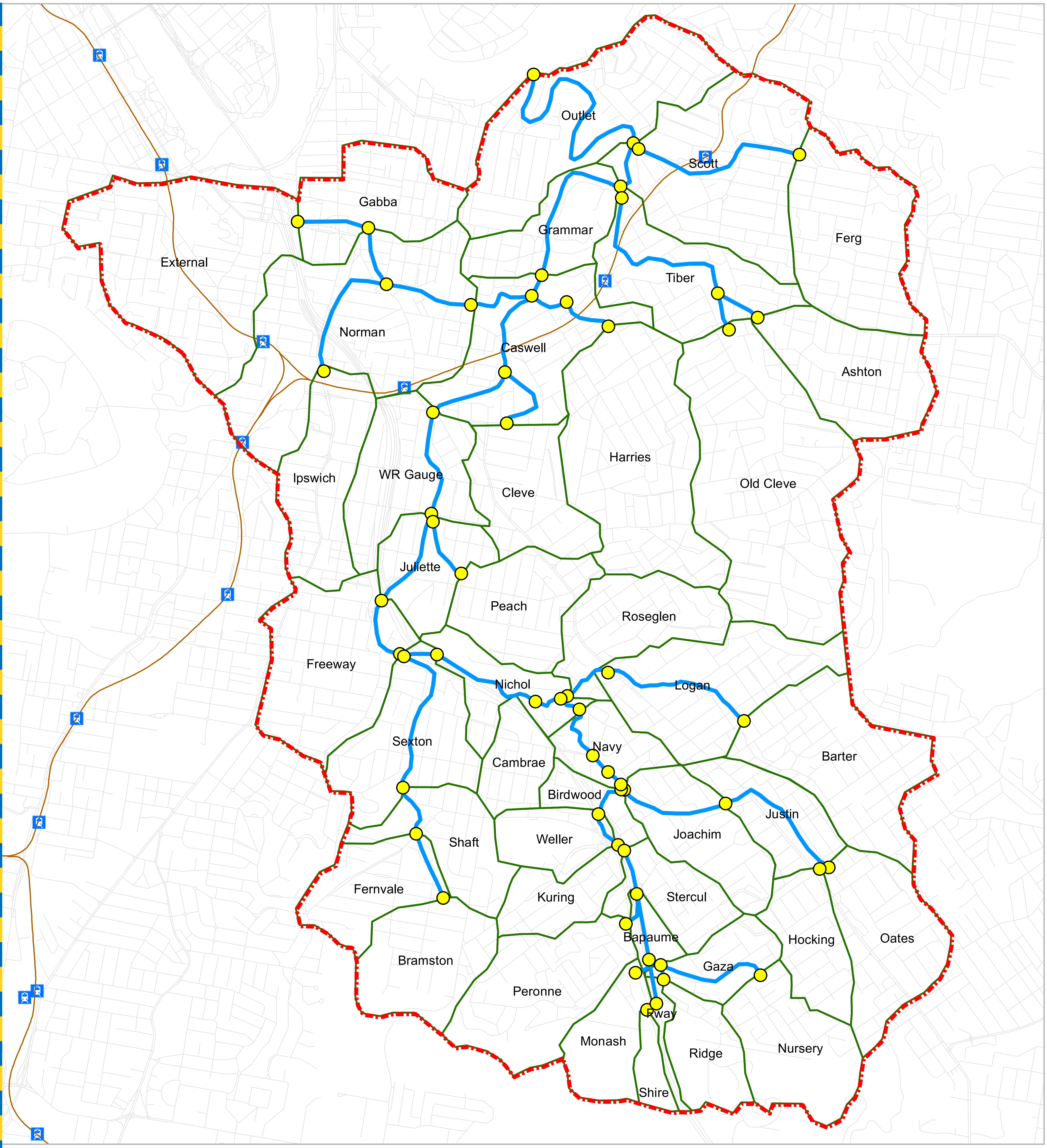
## 4.2 Sub-catchment Data

### 4.2.1 General

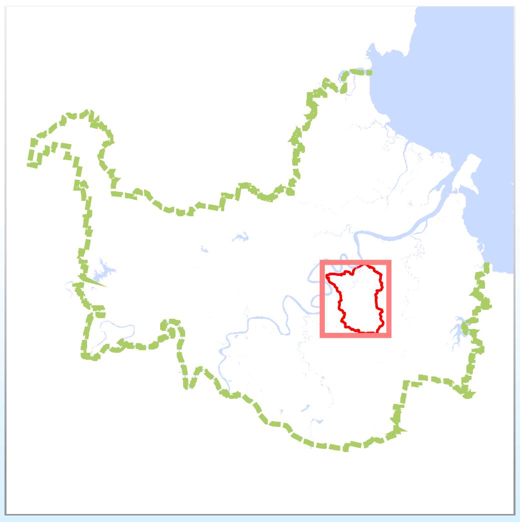
This section describes the sub-catchment parameters used in the RAFTS model. The adopted sub-catchment parameters for the calibration and verification events are presented in Appendix B. The same sub-catchment parameters have been used for all events due to the relatively recent age of the calibration and verification events, and the minimal changes in catchment / channel topography and development during this period.

### 4.2.2 Sub-catchment Delineation

The Norman Creek RAFTS model comprises 43 sub-catchments and the layout is indicated in Figure 4.1. For the inflows into the hydraulic model, the "Justin" sub-catchment flows were split into two separate inflows upstream and downstream of Logan Road based on their proportional areas.





**Legend**

- Norman Creek RAFTS Nodes
- Norman Creek RAFTS Reaches
- Norman Creek Catchment Boundary
- Norman Creek Subcatchments
- Railway Stations
- Railway Line
- Streets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# Figure 4.1: RAFTS Sub-catchment Delineation


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##### *4.2.2.1.1 External Sub-catchment*

The External sub-catchment is unique in that the piped drainage system outfalls into the Brisbane River, whereas the exceedence flow is directed into the adjoining Gabba sub-catchment and eventually into Norman Creek. To determine the magnitude of the exceedence flow being directed towards Norman Creek, a high-level hydraulic analysis was undertaken of the outlet pipe branch using EPA-SWMM.

Based on a review of the BCC drainage database and 2009 ALS contours, the following was ascertained:

- The main branch of the drainage system comprises a 2.7 m diameter pipe (and concrete-lined bored tunnel), which outfalls into the Brisbane River east of the Captain Cook Bridge. The length of this branch from Stanley Street (Merton Road intersection) to the outfall is approximately 675 m and the pipe invert level at Stanley Street was approximated as 7.7 m AHD.
- Once the capacity of this pipe is exceeded, the system will surcharge in the vicinity of Stanley Street, where the ground level is approximately 11 m AHD.
- Ponding will occur to a level of approximately 11.6 m AHD, at which point the exceedence runoff will flow into the below ground busway corridor.
- Runoff entering the busway corridor will initially pond and then start to flow onto Main Street and into the adjoining catchment once the water level in the busway corridor reaches approximately 9 m AHD.
- The components of the high-level EPA-SWMM model consisted of the following:
  - 675 m length of 2.7 m diameter pipe – represented as one link with an upstream pit and a downstream Brisbane River boundary condition. Once the upstream pit ponded to a level of 11.6 m AHD it was assumed to spill into the busway storage node.
  - Busway corridor – represented as a storage node with an invert level of 7.7 m AHD, inlet level of 11.6 m AHD, and an outlet level of 9 m AHD. The stage-storage relationship was derived from 2009 ALS survey and the drainage system of the busway was not considered.

A number of storm events were run through the model, with sensitivity undertaken on the major parameters, such as the hydraulic roughness of the pipe and the tailwater conditions in the Brisbane River. Based on this analysis, it was determined that the capacity of the 2.7 m diameter pipe would be approximately 30$m^3$/s and that this value would be applied to all events being modelled for the Norman Creek Flood Study. It is noted that the actual maximum flow in the pipe will vary between events, depending on the hydraulic head.

### 4.2.3 Sub-catchment Slope

As noted previously, a review of the 2008 WQA RAFTS model sub-catchment slopes indicated that the values appeared reasonable, therefore no changes were undertaken.

### 4.2.4 Percentage Impervious and Hydrologic Roughness (PERN)

The Norman Creek catchment is considered to be fully urbanised for the period encompassing all calibration and verification events. Therefore, the percentage impervious and PERN values established in the 2004 WQA RAFTS model have been adopted, representing ultimate catchment hydrological conditions. These conditions assume that the state of development within the catchment is at its ultimate condition, with reference to the current adopted planning scheme.

### 4.2.5 Link Data

The link data has not been changed from that used in the 2008 WQA RAFTS model.

## 4.3 Observed Rainfall Data

Each of the calibration and verification events was incorporated into the RAFTS model using data extracted from Council's HYDSTRA database in a standard format. This enabled the full rainfall period for each of the events to be modelled using a fast and reliable method.

Thiessen Polygons were drawn around each of the rainfall stations used to provide the pluviograph information for each of the events. All of the sub-catchments that fell within each of the created polygons were then assigned the pluviograph information from the corresponding rainfall station. This method was considered appropriate based on the good spatial coverage of the pluviograph stations. As noted previously, the rainfall distribution for the March 2001 and November 2004 events has not been changed from that used in the 2008 WQA RAFTS model. The Thiessen polygon rainfall distributions for the November 2008 and January 2013 events were developed based on available gauge information at the time of each event, and were incorporated into the model.

The Thiessen polygon diagrams are presented in Appendix C for reference.

# 5.0 MIKEFLOOD Model Set-up

## 5.1 Methodology

The characteristics of the Norman Creek catchment result in a 2D hydraulic model being more appropriate than a 1D hydraulic model for some areas of the catchment.

Characteristics influencing the need for a 2D model component include:

- Very flat and wide floodplain areas in the lower catchment.
- Large meander bends with short-circuiting in the lower catchment
- Significantly more overbank flow compared with in-channel flow in the middle and lower catchment.
- Poorly defined break-out flow paths.

Given that there is already a MIKE11 model of the catchment, it was deemed appropriate to leave parts of the model in 1D MIKE11 and convert the remainder to 2D MIKE21.

## 5.2 Available Data

The following data was utilised in the development of the MIKEFLOOD model:

- 2008 WQA MIKE11 model
- Numerous BCC survey datasets
- BCC 2002 and 2009 Airborne Laser Scanning (ALS) survey data
- Department of Transport and Main Roads (DTMR) 2012 Survey Data for Norman Creek Veloway
- BCC aerial photography – 2011, 2009, 2007, 2005, 2001, 1999, 1997 and 1995
- NearMap aerial imagery – 2009 to 2013
- Current version of BCC City Plan
- BCC Cadastre and GIS databases
- Hydraulic structure drawings/reference sheets. Refer to Appendix F for further details.

## 5.3 2D MIKE21 Set-up

### 5.3.1 Model Extent

Figure 5.1 indicates the extent of the 2D MIKE21 model as well as the inflow locations and hydraulic structures included in the model. The MIKE21 component extends from just upstream of Arnwood Place (Tarragindi) to the confluence of Norman Creek and the Brisbane River. Tributaries included in the 2D model include the channelised sections of Coorparoo Creek, Bridgewater Creek (from downstream of Old Cleveland Rd), Kingfisher Creek and Scott's Creek.

### 5.3.2 Topography

The base topography was created using 2009 BCC ALS data. The triangulated ALS data was converted to a 5 m grid digital elevation model (DEM) (MGA Zone 56) for use in the MIKE21 model.

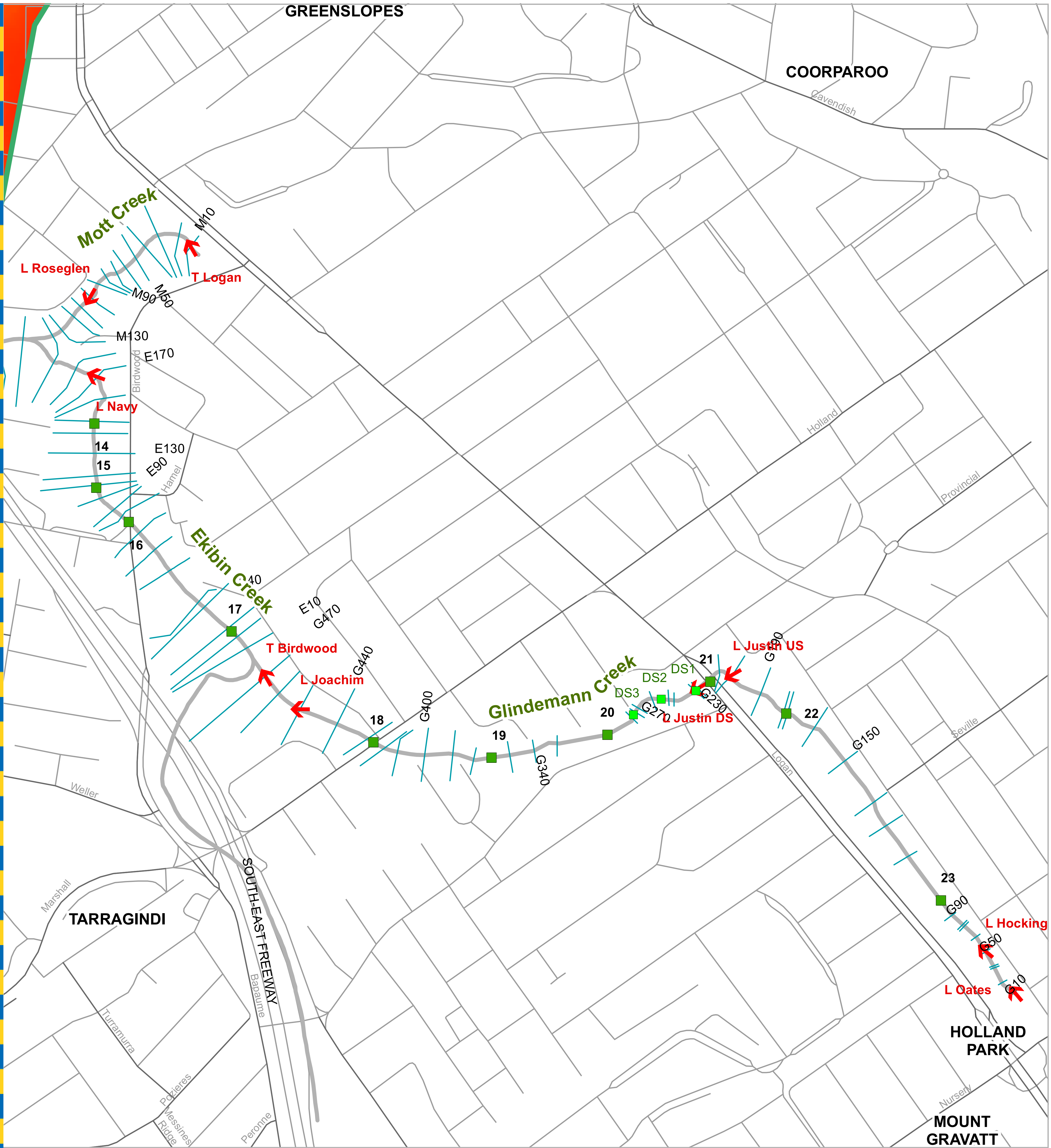
The in-bank channel areas of Norman Creek, Kingfisher Creek, Scott's Creek and Bridgewater Creek were embedded into the ALS DEM to better represent the channel conveyance in the 2D domain. The basis of the in-bank channel data was from the 2008 WQA MIKE11 model cross-sections. The survey information at the 2008 model cross-section locations were 'stamped' into the ALS DEM and the channel areas in between these sections were dug-out via an interpolation method. For the Norman Creek channel downstream of Logan Road, the channel was predominantly embedded using the 2006 BCC hydrodynamic survey point data, which was triangulated into a DEM and overlaid on top of the ALS DEM. The model bathymetry near the channel banks, where ground survey was not undertaken due to mangrove presence, was adjusted using the 2008 WQA MIKE11 model sections as a guide.

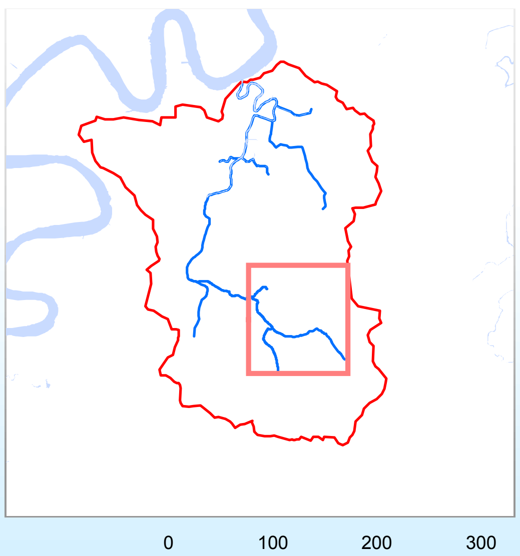
Detailed checks outside of the channel have not been undertaken on the accuracy of the 2009 ALS data. It is assumed that the data is representative of the actual topography and 'fit for purpose'.

### 5.3.3 Roughness

The Manning's roughness values indicated in Table 5.1 were adopted within the MIKE21 domain. BCC aerial photography, BCC City Plan and site visits were utilised to identify the land-use and major topographical features within the model domain.

The initial selection of appropriate roughness was based upon numerous site visits, experience with similar studies and relevant hydraulic literature.





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## Legend

- Norman Creek Catchment Boundary
- MIKE 21 Model Extents
- Structures
- DS - Drop Structures
- Inflow Locations
- MIKE 11 Cross Sections
- Norman Creek Centreline
- Streets



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# Figure 5.1: MIKEFLOOD Model Layout Map 1 of 3

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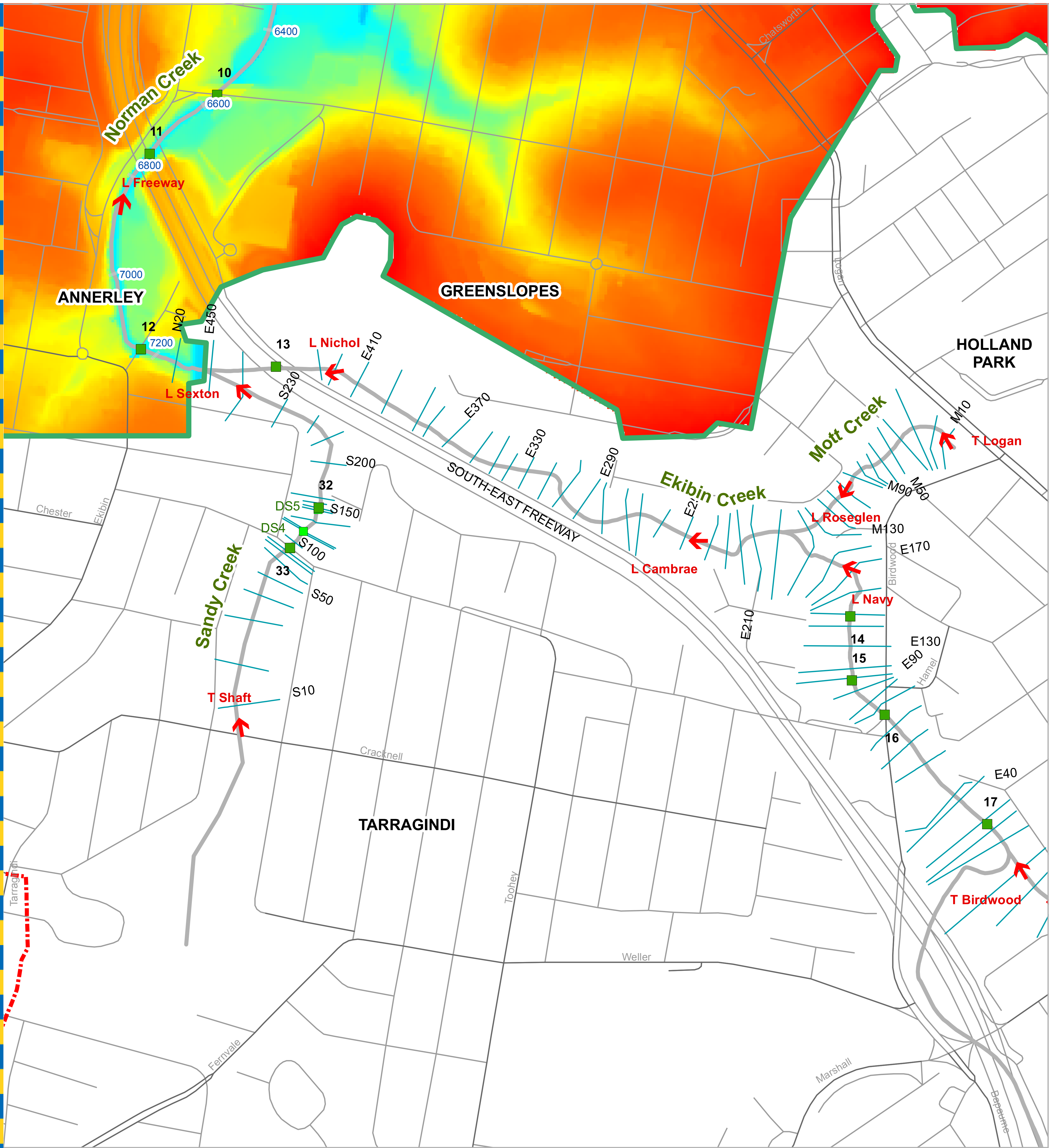


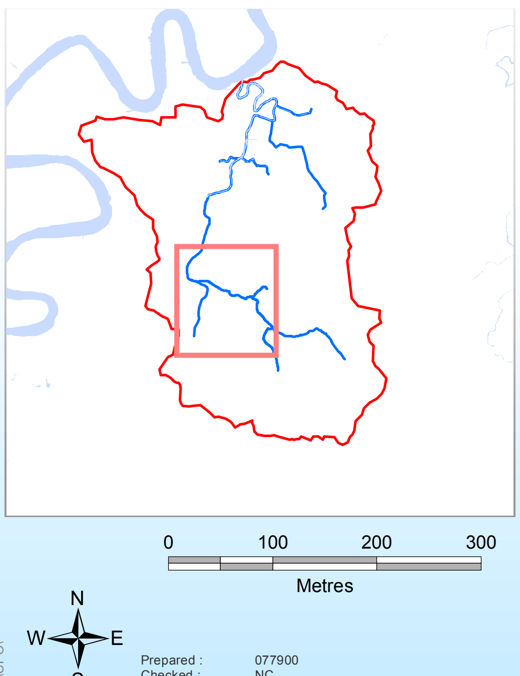


## Legend

- Norman Creek Catchment Boundary
- MIKE 21 Model Extents
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# Figure 5.1: MIKEFLOOD Model Layout
# Map 2 of 3

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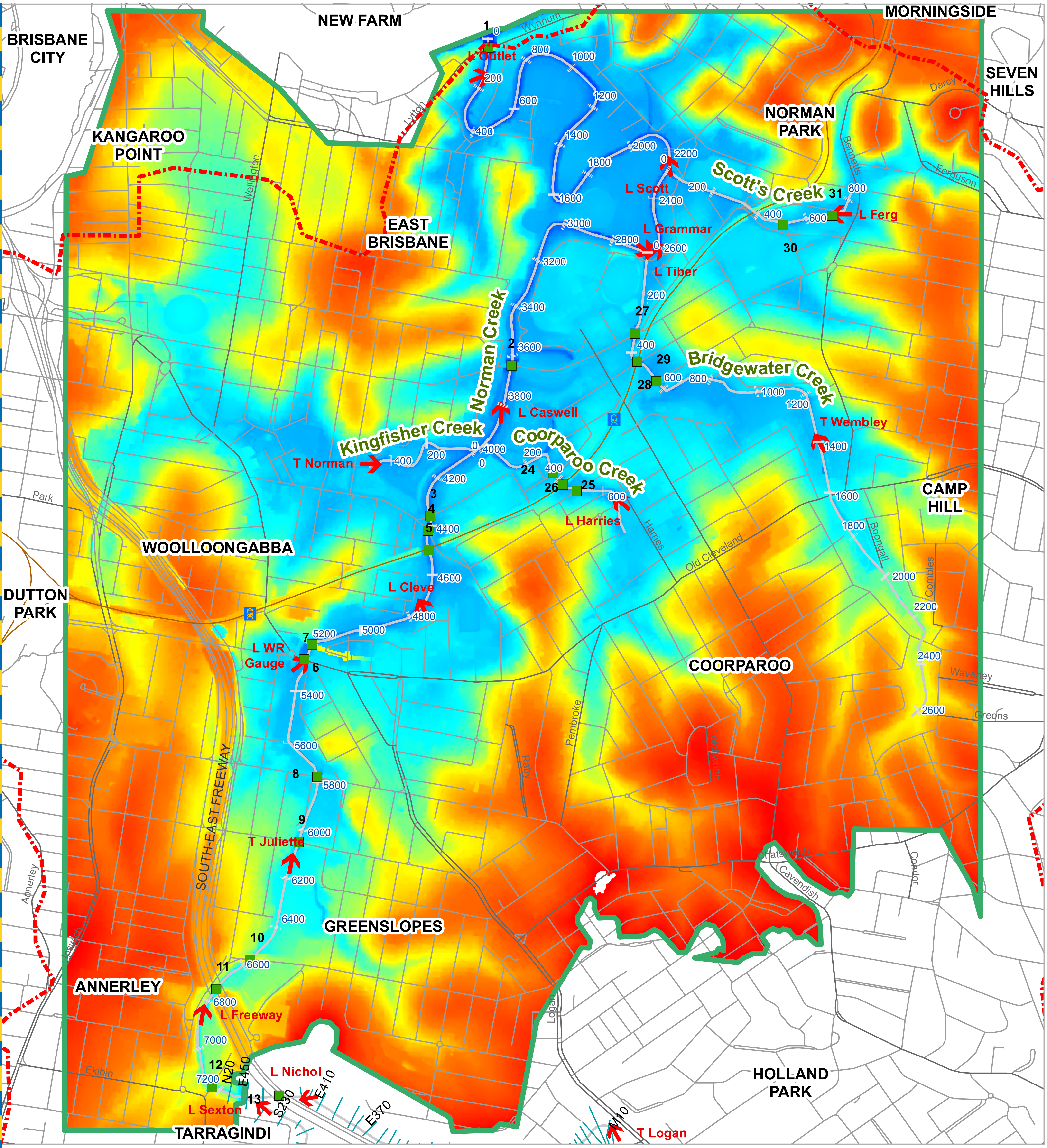


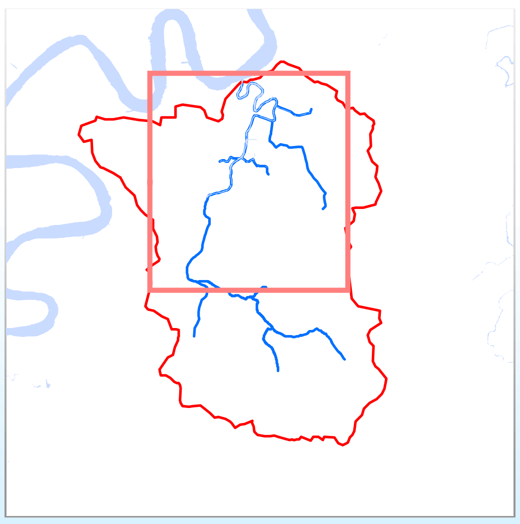

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## Legend

- Norman Creek Catchment Boundary
- MIKE 21 Model Extents
- Structures
- DS - Drop Structures
- Inflow Locations
- MIKE 11 Cross Sections
- Norman Creek Centreline
- Railway Line
- Streets



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# Figure 5.1: MIKEFLOOD Model Layout Map 3 of 3

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Table 5.1 - Typical Manning's roughness – 2D model

| Topographical feature / Land-use | Manning's Roughness (MIKE21) | |
|---|---|---|
| | Manning's 'n' | Manning's 'M' |
| Bitumen Road and Carparks | 0.017 | 60 |
| Concrete Lined Channel | 0.015 | 66.66 |
| In-Channel Bed Zones – minimal to no vegetation | 0.021 | 48 |
| Maintained Grass Areas and Parkland | 0.029 | 34.28 |
| Sparse Vegetation Zones | 0.04 – 0.05 | 20 – 25 |
| Dense Vegetation Zones | 0.06 | 16.666 |
| Mangroves | 0.08 | 12.5 |
| Building and Blockages | 0.10 | 10 |

### 5.3.4 Hydraulic Structures in the 2D Domain

The major bridge and culvert structures within the catchment were represented in the MIKEFLOOD model. The structures were generally located at road crossings but also included some piped drainage sections. Minor crossings such as pedestrian bridges have not been included in the MIKEFLOOD model. Culverts and bridges were modelled predominantly using the structure data from the 2008 WQA MIKE11 model and were verified against available hydraulic structure drawings. Some changes were made to a number of existing model structures after validation against on-site measurements and structure drawings.

The vast majority of hydraulic structures were modelled as 1D MIKE11 structures, both in the 1D and 2D domains. Table 5.2 indicates the hydraulic structures included in the 2D domain.

For the 2D section of the model, structures and weirs were included via one of the following methods:

- 1D culvert with 1D weir
- 1D culvert with 2D weir over bathymetry
- 1D bridge with 1D weir
- 1D bridge with 2D weir over bathymetry

The Minimum Energy Loss (MEL) culvert under the South-East Freeway, Greenslopes and the channel underneath the Cleveland Railway, Coorparoo were represented as open channels in the 2D bathymetry.

Table 5.2 – Hydraulic Structures in the 2D MIKE21 domain

| Location | ID | Structure Details | Origin of Data used for Coding the Structure |
|---|---|---|---|
| Norman Creek at Wynnum Road | 1 | Bridge | Design Drawings, Norman Creek WQA (2004/2008) |
| Norman Creek at Stanley St East | 2 | 12 / 3.6 x 3.6m RCB | Norman Creek WQA (2004) |
| Norman Creek at Turbo Drive | 3 | Bridge | Norman Creek WQA (2004), Aerial Site Measurements |
| Norman Creek at Deshon Street | 4 | Bridge | Norman Creek WQA (2004) |
| Norman Creek at Queensland Rail | 5 | Bridge | Norman Creek WQA (2004) |
| Norman Creek at Eastern Busway | 6 | Bridge | Design Drawings |
| Norman Creek at Logan Road | 7 | Bridge | Norman Creek WQA (2004) |
| Norman Creek at Cornwall Street | 8 | 9 / 2.7 x 2.8m RCB | Norman Creek WQA (2004) |
| Norman Creek at Juliette Street | 9 | Bridge | Norman Creek WQA (2004), BCC Survey, Photographic Aerial Measurements |
| Norman Creek at Ridge Street | 10 | 7 / 3.6 x 3.0m RCB | Norman Creek WQA (2004), Site Measurements |
| Norman Creek at SE Freeway (D/S) | 11 | Minimum Energy Loss Structure | Norman Creek WQA (2004) |
| Norman Creek at Arnwood Place | 12 | Bridge | Norman Creek WQA (2004), BCC Survey |
| Bridgewater Creek at Stanley Street | 27 | 6 / 1.8m RCP | Norman Creek WQA (2004), BCC Spatial information Database |
| Bridgewater Creek at Queensland Rail | 28 | Bridge | Norman Creek WQA (2004) |
| Bridgewater Creek at Temple Street | 29 | Bridge | Norman Creek WQA (2004) |
| Coorparoo Creek at Morley Street | 24 | Bridge | 2012 Lower Coorparoo Creek mitigation Study, Design Drawings, Photographic Site Measurements |
| Coorparoo Creek at Queensland Rail | 25 | 3 / 3 x 4 RCB and 1 / 3 x 2.4m RCB | 2012 Lower Coorparoo Creek Mitigation Works Study |
| Coorparoo Creek at Gladstone Street | 26 | 2 / 3 x 1.6m RCB | 2012 Lower Coorparoo Creek Mitigation Works Study |
| Scott's Creek at Adina Street | 30 | 3 / 2.7 x 1.25m RCB | Design Drawings, BCC Survey |
| Scott's Creek at Waite St Footbridge | 31 | Bridge | Design Drawings, BCC Survey |

### 5.3.5 Model Boundaries in the 2D Domain

Inflow locations in the MIKE21 model are indicated in Figure 5.1. Inflows in MIKE21 were represented as point inflows applied to one grid cell, or split evenly across a number of cells when the inflow discharge was high.

The inflow locations to the MIKE21 model were generally taken directly from the RAFTS model sub-catchment schematisation. An exception was the 'Justin' sub-catchment flows which were split in proportion to the contributing area into two separate inflows and applied upstream and downstream of Logan Road along Glindemann Creek.

A water level versus time (H-T) boundary was used at the downstream extent to represent conditions at the mouth of Norman Creek. For each event, tidal highs and lows were derived at the mouth and a tidal curve fitted. This information was based on recorded tidal data at the Brisbane Bar and Gateway Bridge gauges. As noted previously, this data was then shifted to better represent the anticipated actual tide in Norman Creek, which is upstream from the Brisbane Bar and Gateway Bridge, and hence will experience different peak and trough tidal levels which are also slightly delayed in time as the tide is propagated upstream.

Shifts to tidal levels and times were made by applying predicted information from the MSQ *Queensland Tide Tables* booklet. Information was taken from New Farm, considered the nearest location to the Norman Creek mouth where level and time shift data are available.

The boundary between the 1D and 2D models is located immediately upstream of Arnwood Place, Annerley, and is represented via a 'standard link' in the MIKEFLOOD couple file. The standard link transfers the calculated water level, discharge, and momentum at the boundary between the 1D and 2D models.

### 5.3.6 Eddy Viscosity in the 2D Domain

The Eddy Viscosity constant is used in the MIKE21 2D model to simulate the large-scale transfer of momentum caused by small-scale turbulent eddy flow across the model bathymetry. The eddy viscosity value can also be used to dampen the effect of model instabilities.

A global eddy viscosity value of 0.5 was adopted in the calibration and verification models, with the exception of areas at the 1D/2D structure links, where an eddy viscosity value of 10 was adopted. Both adopted values are in line with best practice for the software use.

## 5.4 1D MIKE11 Set-up

### 5.4.1 Model Extent

Figure 5.1 indicates the extent of the 1D MIKE11 model as well as the inflow locations and hydraulic structures included in the model. The 1D model was utilised for the area upstream of Arnwood Place, where the waterway is relatively channelised with minimal floodplain areas. The model extent includes:

- Glindemann Creek from downstream of Nursery Road, Holland Park West to the confluence with Ekibin Creek (Upper).
- Ekibin Creek (Lower and Upper)
- Mott Creek from Logan Road, Holland Park to the confluence with Ekibin Creek (Lower).
- Sandy Creek from Cracknell Road, Tarragindi to confluence with Ekibin Creek (Lower) and Norman Creek (start of Norman Creek)
- Top of Norman Creek to the boundary with the 2D MIKE21 domain, approximately 30 m upstream of Arnwood Place, Tarragindi.

### 5.4.2 Topography

The topography for the 1D model consisted of cross-sections data taken primarily from the 2008 WQA MIKE11 model, which was based on a combination of the following data:

- 2002 ALS data
- 2005 ground survey
- Birdwood Road Development Survey (2003)
- N4C Nicholson St Revegetation MIKE11 model (BCC 2001)
- Hydraulic structure drawings
- Measurements / estimates based on site visits

Enrichment of the MIKE11 cross-sections was undertaken as part of this study from the following information:

- 2006, 2011 and 2012 BCC ground survey data
- 2009 ALS data
- Department of Transport and Main Roads (DTMR) 2012 Survey Data for Norman Creek Veloway (for the Jan 2013 calibration, design and extreme events only)
- Hydraulic structure drawings
- Sandy Creek Rehabilitation Investigation (2007/8)
- Measurements / estimates based on site visits

Refer to Appendix D for a detailed log of the source data for each cross-section in the 1D model.

### 5.4.3 Roughness

Table 5.3 indicates the typical range of Manning's 'n' roughness coefficients applied to the 1D MIKE11 model reaches. The selection of appropriate roughness values was based upon numerous site visits, experience with similar studies and relevant hydraulic literature. The Manning's 'n' roughness coefficients are generally higher in the MIKE11 model compared to the MIKE21 model for meandering channels as the MIKE11 Manning's 'n' coefficient needs to include an allowance for simulating turbulence effects whilst the 2D model accounts for turbulence effects via a combination of the Manning's 'n' parameter and the 'eddy viscosity' constant. For straight uniform channels in the 2D domain, the MIKE21 Manning's 'n' roughness coefficient may be higher than in MIKE11 due to 'side friction' not being accounted for in the 2D model. The open channel areas in the MIKE21 domain are generally meandering in nature and subject to turbulence effects and therefore lower Manning's n' roughness values have generally been adopted. In areas where there are straight narrow channels (eg - concrete-lined channels) a similar Manning's 'n' roughness has been applied in both MIKE11 and MIKE21 models.

Table 5.3 - Typical Manning's n roughness – 1D model

| Topographical feature / Land-use | Adopted Manning's 'n' (MIKE11) |
|---|---|
| Bitumen Road and Carparks | 0.016 – 0.019 |
| Concrete Lined Channel | 0.015 – 0.018 |
| In-Channel Bed Zones – minimal to no vegetation | 0.03 – 0.036 |
| Maintained Grass Areas and Parkland | 0.035 – 0.042 |
| Sparse Vegetation Zones | 0.04 – 0.06 |
| Dense Vegetation Zones | 0.07 – 0.09 |
| Building and Blockages | 0.20 – above |

### 5.4.4 Hydraulic Structures in the 1D Domain

Table 5.4 indicates the hydraulic structures included in the 1D domain. The 1D MIKE11 model includes all major structures upstream of Arnwood Place within the model extents. These include major road crossings, drop structures and piped drainage within the creek. The majority of the structures kept the same arrangement as the 2008 WQA model, where a separate culvert / weir arrangement was used. However, for some areas where model instabilities were occurring, the weir and culvert have been merged together on the main branch, which is in accordance with current MIKE11 modelling best practice.

Table 5.4 – Hydraulic Structures in the 1D MIKE11 domain

| Location | ID | Structure Details | Origin of Data used for Coding the Structure |
|---|---|---|---|
| Ekibin Creek at SE Freeway (U/S) | 13 | 4 / 3.0 x 4.2 RCB | Norman Creek WQA (2004), BCC Spatial Information Database |
| Ekibin Creek at Birdwood Rd Development Bridge | 14 | Bridge | Norman Creek WQA (2004), Birdwood Rd Development Application Hydraulic Report |
| Ekibin Creek at Birdwood Rd Development Causeway | 15 | 4 / 0.9m RCP | Norman Creek WQA (2004), Birdwood Rd Development Application Hydraulic Report |
| Ekibin Creek at Birdwood Road | 16 | 8 / 1.8m RCP | Norman Creek WQA (2004), BCC Spatial Information Database |
| Ekibin Creek at Park Maintenance Path | 17 | 4 / 1.5m RCP | Norman Creek WQA (2004) |
| Glindemann Creek at Marshall Road | 18 | 4 / 1.5m RCP | Norman Creek WQA (2004), BCC Spatial Information Database |

| Location | ID | Structure Details | Origin of Data used for Coding the Structure |
|---|---|---|---|
| Glindemann Creek at Balis Street | 19 | 1 / 1.95m RCP | Design Drawings, BCC Spatial Information Database |
| Glindemann Creek at Iveagh Street | 20 | 2 / 1.8m RCP | BCC Spatial Information Database |
| Glindemann Creek at Justin St D/S Drop Structure | DS3 | Drop Structure | Norman Creek WQA (2008) |
| Glindemann Creek at Justin St U/S Drop Structure | DS2 | Drop Structure | Norman Creek WQA (2008) |
| Glindemann Creek at Logan Rd D/S Drop Structure | DS1 | Drop Structure | Norman Creek WQA (2008) |
| Glindemann Creek at Logan Road | 21 | 2 / 1.8m RCP | Design Drawings |
| Glindemann Creek at Glindemann Park Footbridge | 22 | 4 / 0.6m RCP | Design Drawings, Site Measurements |
| Glindemann Creek at Glindemann Park Overpipe | 23 | 1 / 1.8m RCP | Design Drawings, BCC Spatial Information Database |
| Sandy Creek Drop Structure | DS5 | Drop Stru. | Norman Creek WQA (2008) |
| Sandy Creek at Sunshine Avenue Footbridge | 32 | Bridge | Design Drawings, Site Measurements |
| Sandy Creek Drop Structure | DS4 | Drop Stru. | Norman Creek WQA (2008) |
| Sandy Creek at Sexton Street | 33 | 3 / 1.8m RCP | Norman Creek WQA (2004) |

### 5.4.5 Model Boundaries in the 1D Domain

Inflow locations in the MIKE11 model are indicated in Figure 5.1. Inflows in MIKE11 were represented as single point sources at selected nodes in the model.

The inflow locations to the MIKE11 model were generally taken directly from the RAFTS model sub-catchment schematisation.

# 6.0 Calibration and Verification

## 6.1 Overall Methodology

The common approach adopted in BCC flood studies is to undertake separate calibration / verification of both the hydrologic model and the hydraulic model. This method has typically been adopted in Australia as most hydraulic river modelling software does not incorporate a rainfall-runoff (hydrologic) generator. Also, by separately calibrating / verifying the hydrologic model, it can then be used as a "standalone" model to accurately predict design discharges without the need to run the hydraulic model.

Some common difficulties with this approach are (i) trying to adequately calibrate the hydrologic model in areas where there are substantial floodplain storage / attenuation effects; (ii) the requirement to use rating curves to convert recorded stage into discharge.

The 2008 WQA RAFTS model was calibrated / verified in conjunction with the 2008 WQA MIKE11 hydraulic model, rather than as a "standalone" model. This same approach was deemed suitable for this study in order to utilise this "calibrated model," which was previously calibrated to the March 2001 and November 2004 events being used in this study. For the purposes of this study the RAFTS model was deemed fit-for-purpose in its unchanged format. Thus, only the newly-developed hydraulic model developed as part of this study required calibration to the range of events chosen.

## 6.2 Calibration

### 6.2.1 Methodology

The calibration events were first simulated in the RAFTS model. The RAFTS flow hydrograph for each sub-catchment was then used as an inflow for the hydraulic model. An iterative process was then undertaken to calibrate the hydraulic model based on the adjustment of a number of parameters, including Manning's 'n' roughness, topography, handrail blockage and eddy viscosity (MIKE21); which is a factor taking into account localised eddy turbulence in the 2D model.

### 6.2.2 Adopted RAFTS Parameters

The 2008 WQA RAFTS model adopted parameter values as indicated in Table 6.1, as part of the calibration / verification process. These parameter values were also adopted as part of this study.

Table 6.1 – Adopted RAFTS Parameters from 2008 WQA RAFTS Model

| Parameter | Description | Adopted Value |
|---|---|---|
| n | Storage non-linearity exponent | -0.285 |
| Bx | Storage delay time coefficient multiplier | 3 |
| IL | Initial Loss (mm) | 0 |
| CL | Continuing Loss (mm/hr) | 0 |

### 6.2.3 Calibration to Stream Gauges

BCC flood studies aim to achieve a tolerance of +/- 0.15 m for the calibration to continuous recording stream gauges. The hydrograph should also demonstrate a good replication of the timing of peaks as well as the rising limb.

***March 2001 Event***

A comparison of recorded peak flood levels to simulated peak flood levels for the 9th March 2001 event at the stream gauge locations are indicated in Table 6.2. Figures 6.1 to 6.3 indicate the simulated versus recorded hydrograph at Joachim St, Holland Park West (NMA549), at Waldheim St, Annerley (NMA552) and at Caswell St, East Brisbane (NMA555), respectively.

Table 6.2 - March 2001 – Peak Flood Level Comparison

| Stream Gauge ID | Waterway | AMTD (m) | Peak Flood Level (m AHD) | | Difference (m) |
|---|---|---|---|---|---|
| | | | Recorded | MIKEFLOOD | |
| NMA549 | Ekibin Ck Upper | 2001 | 18.42 | 18.26 | -0.16 |
| NMA552 | Norman Ck | 6665 | 9.46[1] | 10.39 | 0.93 |
| NMA555[2] | Norman Ck | 3730 | 3.66 | 3.75 | 0.09 |

[1]Gauge reading is not reliable
[2]Gauge subject to tidal influence

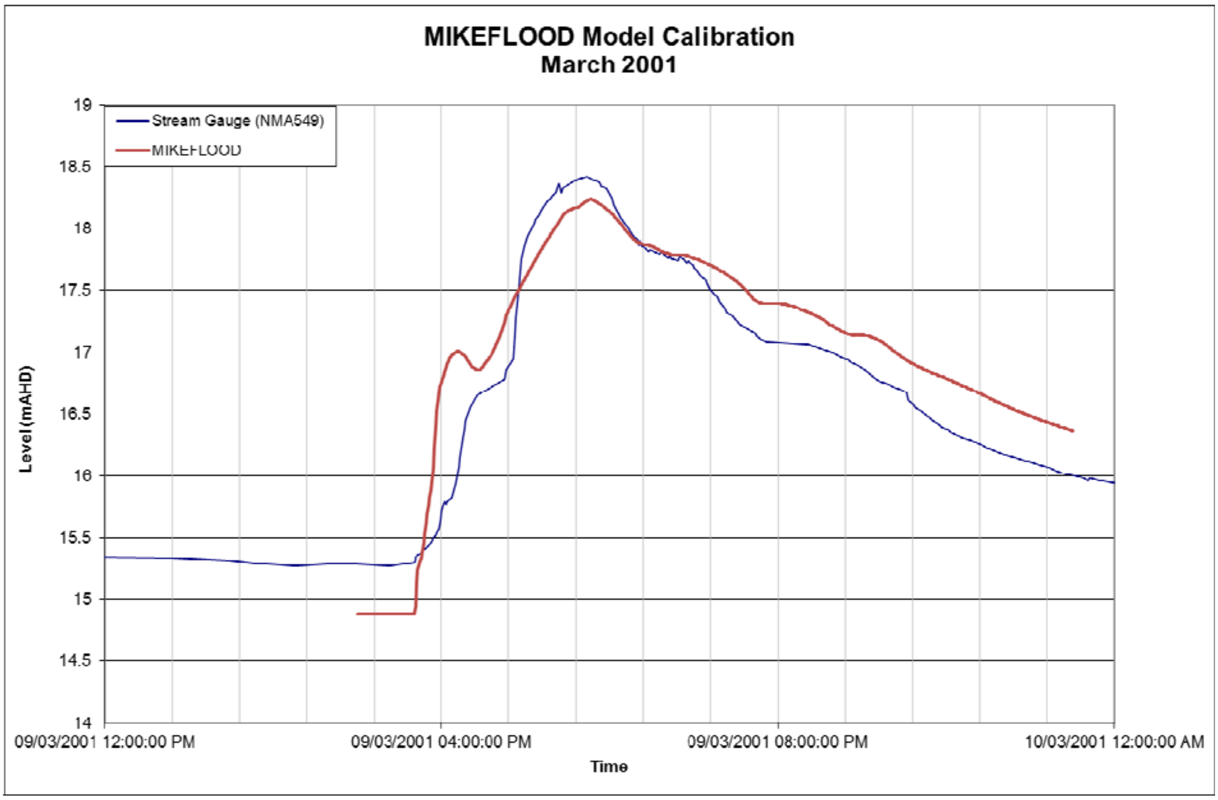



Figure 6.1: Stream Gauge at Joachim St, Holland Park West (NMA549) – Simulated versus recorded (March 2001)

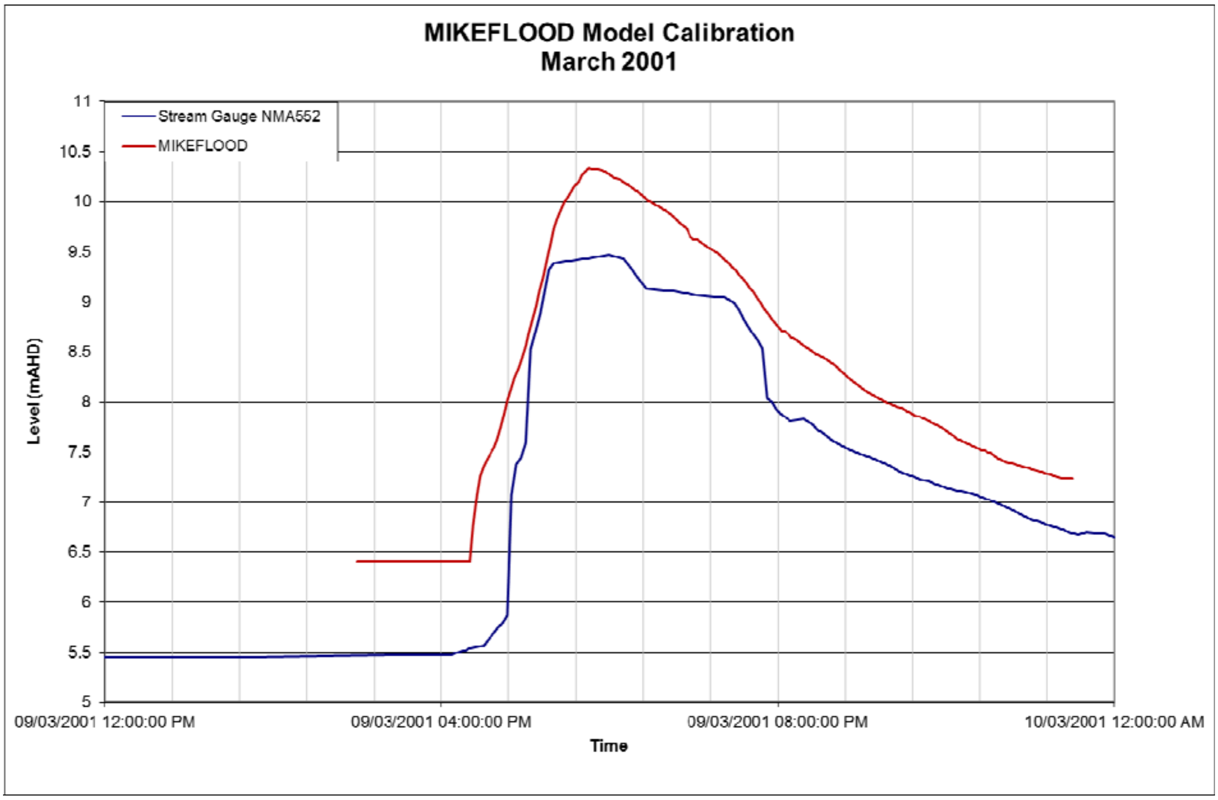



Figure 6.2: Stream Gauge at Waldheim St, Annerley (NMA552) – Simulated versus recorded (March 2001)

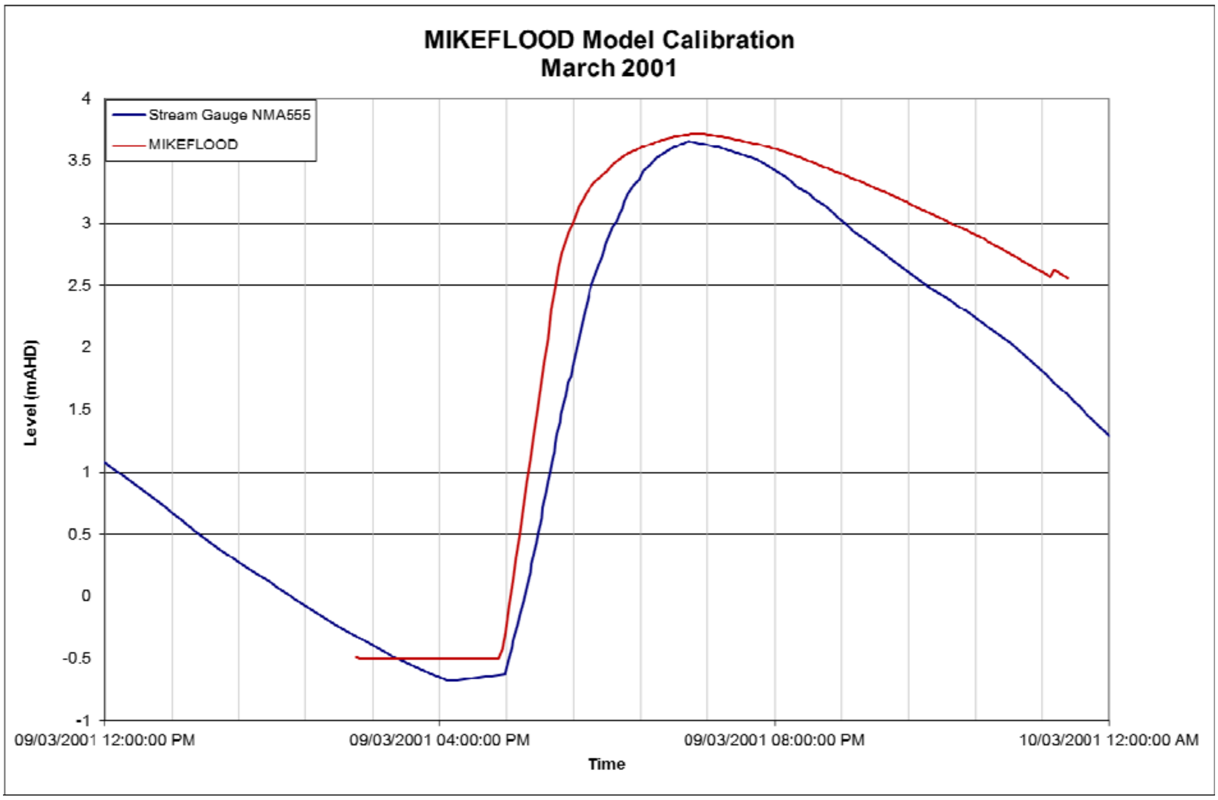



Figure 6.3: Stream Gauge at Caswell St, East Brisbane (NMA555) – Simulated versus recorded (March 2001)

### *January 2013 Event*

A comparison of recorded peak flood levels to simulated peak flood levels for the 27th January 2013 event at the stream gauge locations are indicated in Table 6.3. Figures 6.4 and 6.5 indicate the simulated versus recorded hydrograph for the event for stream gauges at Joachim St, Holland Park West (NMA549) and at Caswell St, East Brisbane (NMA555). The gauge at Waldheim St, Annerley (NMA552) was closed prior to this event.

Table 6.3 - January 2013 – Peak Flood Level Comparison

| Stream Gauge ID | Waterway | AMTD (m) | Peak Flood Level (m AHD) | | Difference (m) |
|---|---|---|---|---|---|
| | | | Recorded | MIKEFLOOD | |
| NMA549 | Ekibin Ck Upper | 2001 | 17.53 | 17.52 | -0.01 |
| NMA555* | Norman Ck | 3730 | 2.87 | 3.21 | 0.34 |

*Gauge subject to tidal influence

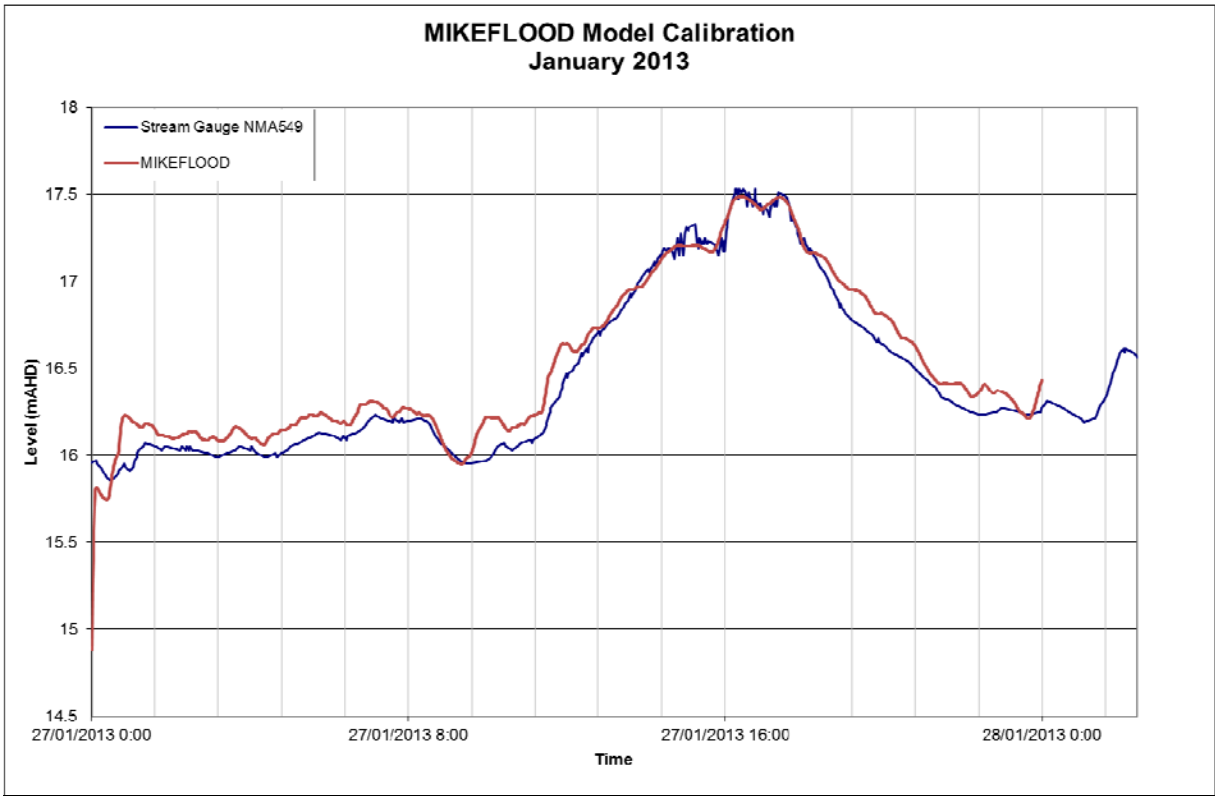



Figure 6.4: Stream Gauge at Joachim St, Holland Park West (NMA549) – Simulated versus recorded (January 2013)

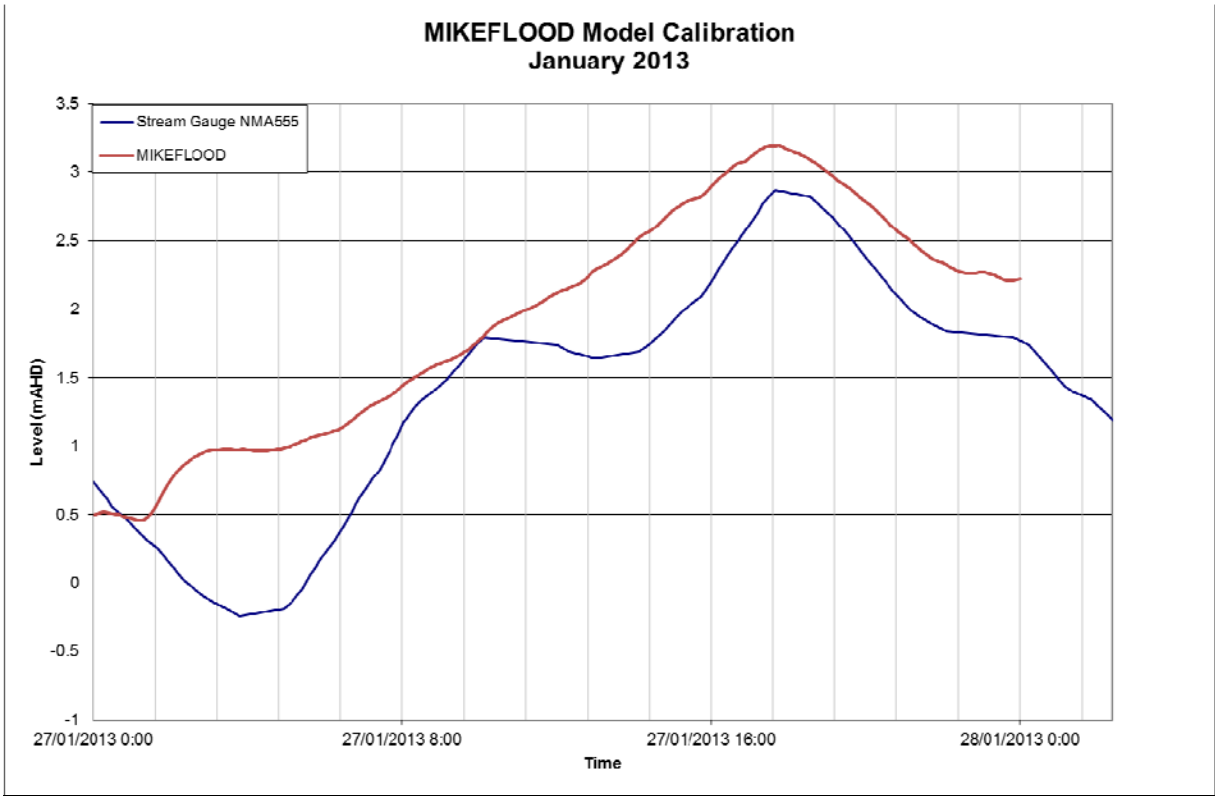



Figure 6.5: Stream Gauge at Caswell St, East Brisbane (NMA555) – Simulated versus recorded (January 2013)

### 6.2.4 Calibration to Maximum Height Gauges

BCC flood studies aim to achieve a tolerance of +/- 0.3 m for the calibration to MHGs. Tables 6.4 and 6.5 present a comparison of the recorded and simulated flood levels at the MHGs for the 9th March 2001 and 27th January 2013 events respectively.

***March 2001 Event***

Table 6.4 - Calibration to MHG Data (March 2001)

| MHG ID | Waterway | AMTD (m) | Peak Flood Level (m AHD) | | Difference (m) |
|---|---|---|---|---|---|
| | | | Recorded | MIKEFLOOD | |
| NM100 | Norman Ck | 314 | - | - | - |
| NM110 | Norman Ck | 2073 | 2.52 | 2.92 | 0.40 |
| NM120 | Norman Ck | 3145 | 3.22 | 3.15 | -0.07 |
| NM130 | Norman Ck | 3464 | 3.55 | 3.56 | 0.01 |
| NM140 | Norman Ck | 3517 | 3.55 | 3.71 | 0.16 |
| NM150 | Norman Ck | 3950 | 3.77 | 3.79 | 0.02 |
| NM160 | Norman Ck | 4222 | 3.96 | 4.08 | 0.12 |
| NM170 | Norman Ck | 4440 | 4.32 | 4.44 | 0.12 |
| NM180 | Norman Ck | 4991 | 4.86 | 4.58 | -0.28 |
| NM190 | Norman Ck | 5166 | 5.21 | 5.14 | -0.07 |
| NM200 | Norman Ck | 5600 | 5.50 | 5.44 | -0.06 |
| NM210 | Norman Ck | 5679 | - | - | - |
| NM215 | Norman Ck | 5880 | - | - | - |
| NM220 | Norman Ck | 6350 | 7.92 | 8.01 | 0.09 |
| NM230 | Norman Ck | 7048 | 10.77 | 11.17 | 0.40 |
| NM240 | Ekibin Ck Lower | 259 | - | - | - |
| NM250 | Ekibin Ck Lower | 1800 | 17.81 | 17.59 | -0.22 |
| EK110 | Ekibin Ck Lower | 957 | - | - | - |
| EK130 | Glindemann Ck | 1276 | - | - | - |
| ST100 | Sandy Ck | 682 | - | - | - |

### *January 2013 Event*

Table 6.5 – Calibration to MHG Data (January 2013)

| MHG ID | Waterway | AMTD (m) | Peak Flood Level (m AHD) | | Difference (m) |
|---|---|---|---|---|---|
| | | | Recorded | MIKEFLOOD | |
| NM100 | Norman Ck | 314 | - | - | - |
| NM110 | Norman Ck | 2073 | 2.18 | 2.19 | 0.01 |
| NM120 | Norman Ck | 3145 | 2.62 | 2.52 | -0.10 |
| NM130 | Norman Ck | 3464 | 2.73 | 2.78 | 0.05 |
| NM140 | Norman Ck | 3517 | 2.80 | 3.15 | 0.35 |
| NM150 | Norman Ck | 3950 | - | - | - |
| NM160 | Norman Ck | 4222 | 3.31 | 3.42 | 0.11 |
| NM170 | Norman Ck | 4440 | 3.45 | 3.66 | 0.21 |
| NM180 | Norman Ck | 4991 | 3.67 | 3.77 | 0.10 |
| NM190 | Norman Ck | 5166 | - | - | - |
| NM200 | Norman Ck | 5600 | - | - | - |
| NM210 | Norman Ck | 5679 | - | - | - |
| NM215 | Norman Ck | 5880 | 4.63 | 5.33 | 0.70 |
| NM220 | Norman Ck | 6350 | 7.49 | 7.39 | -0.10 |
| NM230 | Norman Ck | 7048 | 9.51 | 9.61 | 0.10 |
| NM240 | Ekibin Ck Lower | 259 | - | - | - |
| NM250 | Ekibin Ck Lower | 1800 | - | - | - |
| EK110 | Ekibin Ck Lower | 957 | 13.38 | 12.75 | -0.63 |
| EK130 | Glindemann Ck | 1276 | 27.71 | 27.57 | -0.14 |
| ST100 | Sandy Ck | 682 | 14.23 | 14.45 | 0.22 |

## 6.2.5 Calibration to Recorded Debris Heights

BCC flood studies aim to achieve a tolerance of +/- 0.5 m for the calibration to recorded debris heights. Table 6.6 presents a comparison of the recorded and simulated flood levels at the locations of the recorded debris heights for the 27th January 2013 event.

Table 6.6 – Calibration to Recorded Debris Heights (January 2013)

| Location | AMTD (m) | Peak Flood Level (m AHD) | | Difference (m) |
|---|---|---|---|---|
| | | Recorded | MIKEFLOOD | |
| 111 Deshon St, Woolloongabba | 4275 | 2.97 | 3.55 | 0.58 |
| 114 Deshon St, Woolloongabba | 4200 | 3.24 | 3.28 | 0.04 |
| Norman Ck D/S of Pacific Mwy, Greenslopes | 6535 | 8.02 | 8.24 | 0.22 |
| Norman Ck U/S of Pacific Mwy, Greenslopes | 6706 | 8.38 | 8.61 | 0.23 |

### 6.2.6 Major Hydraulic Structure Head-loss Checks

The four bridge structures included in the hydraulic model within the Norman Creek catchment were selected for structure head-loss verification. The objective of conducting this verification is to determine whether the head-loss (taken as the difference in flood level between the upstream and downstream of the bridge) through the bridges has been appropriately represented in the hydraulic model.

The verification was conducted using a steady-state HEC-RAS (4.1) 1D model. HEC-RAS is standard software used by BCC to verify the head-loss through a bridge, and it is regarded as having one of the most robust hydraulic structure modelling routine available. The HEC-RAS model was used to confirm the head-loss through modelled structures and to provide an additional level of confidence with regard to the structure results.

The four structures subjected to head-loss verification were:

- Bridge over Ekibin Creek lower at Birdwood Rd development, Birdwood Rd, Holland Park West (Structure ID 12)
- Bridge over Norman Creek at Arnwood Place, Tarragindi (Structure ID 10)
- Bridge over Norman Creek at Juliette St, Greenslopes (Structure ID 8)
- Bridge over Bridgewater Creek at Temple St, Coorparoo (Structure ID 25)

Generally, the MIKEFLOOD head-losses for the verified hydraulic structures were within +/- 0.3 m of the HEC-RAS values for a full range of flows up to an anticipated 100-yr ARI design event. This is considered reasonable and gives credence to the MIKEFLOOD results.

Refer to Appendix E for a detailed summary of the structure head-loss verification.

## 6.3 Verification

The 7th November 2004 and 20th November 2008 events were selected for the MIKEFLOOD model verification. Adopted RAFTS parameters as detailed in Section 6.2.2 were carried forward into the model verification phase.

### 6.3.1 Verification to Stream Gauges

BCC flood studies aim to achieve a tolerance of +/- 0.15 m for the verification to continuous recording stream gauges. The hydrograph should also demonstrate a good replication of the timing of peaks as well as the rising limb.

***November 2004***

A comparison of recorded peak flood levels to simulated peak flood levels for the 7th November 2004 event at the stream gauge locations are indicated in Table 6.7. Figures 6.6 and 6.7 indicate the simulated versus recorded hydrograph for the events for stream gauges at Joachim St, Holland Park West (NMA549) and at Caswell St, East Brisbane (NMA555). The stream gauge at Waldheim St, Annerley (NMA552) was closed prior to this event.

Table 6.7 - November 2004 – Peak Flood Level Comparison

| Stream Gauge ID | Waterway | AMTD (m) | Peak Flood Level (m AHD) | | Difference (m) |
|---|---|---|---|---|---|
| | | | Recorded | MIKEFLOOD | |
| NMA549 | Ekibin Ck Upper | 2001 | 17.82 | 17.79 | -0.03 |
| NMA555* | Norman Ck | 3730 | 2.49 | 3.14 | 0.65 |

*Gauge subject to tidal influence

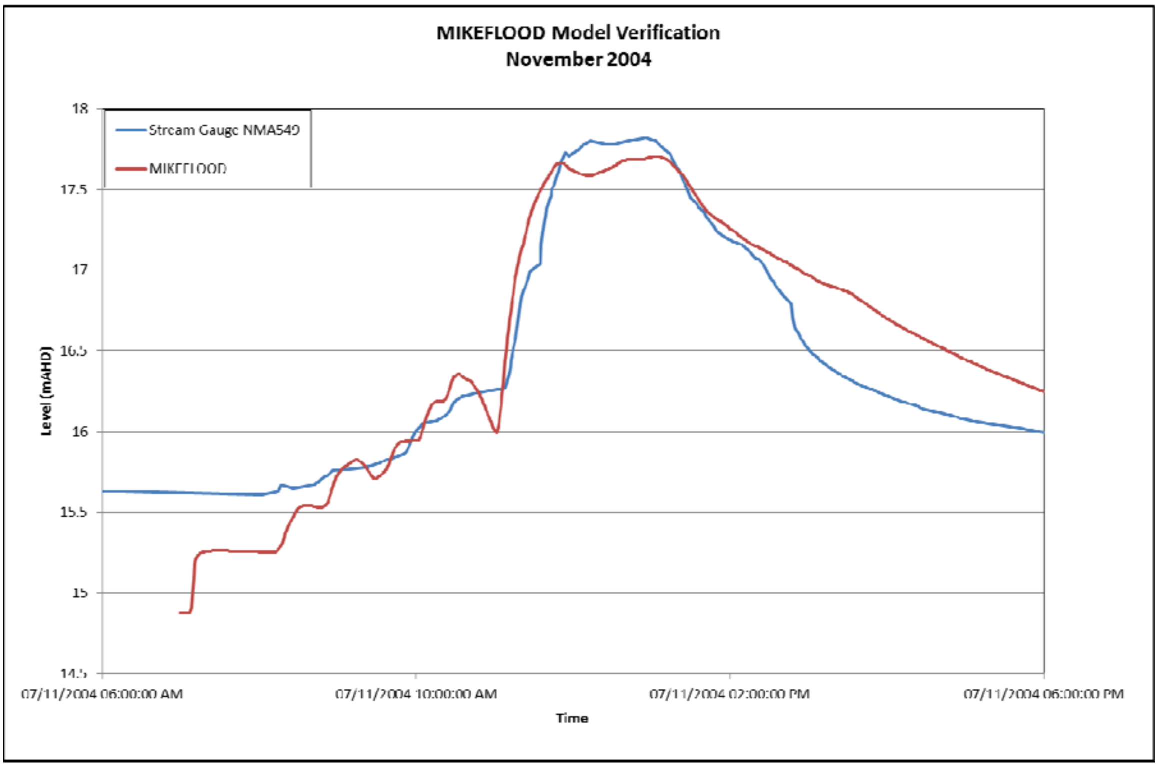



Figure 6.6: Stream Gauge at Joachim St, Holland Park West (NMA549) – Simulated versus recorded (November 2004)

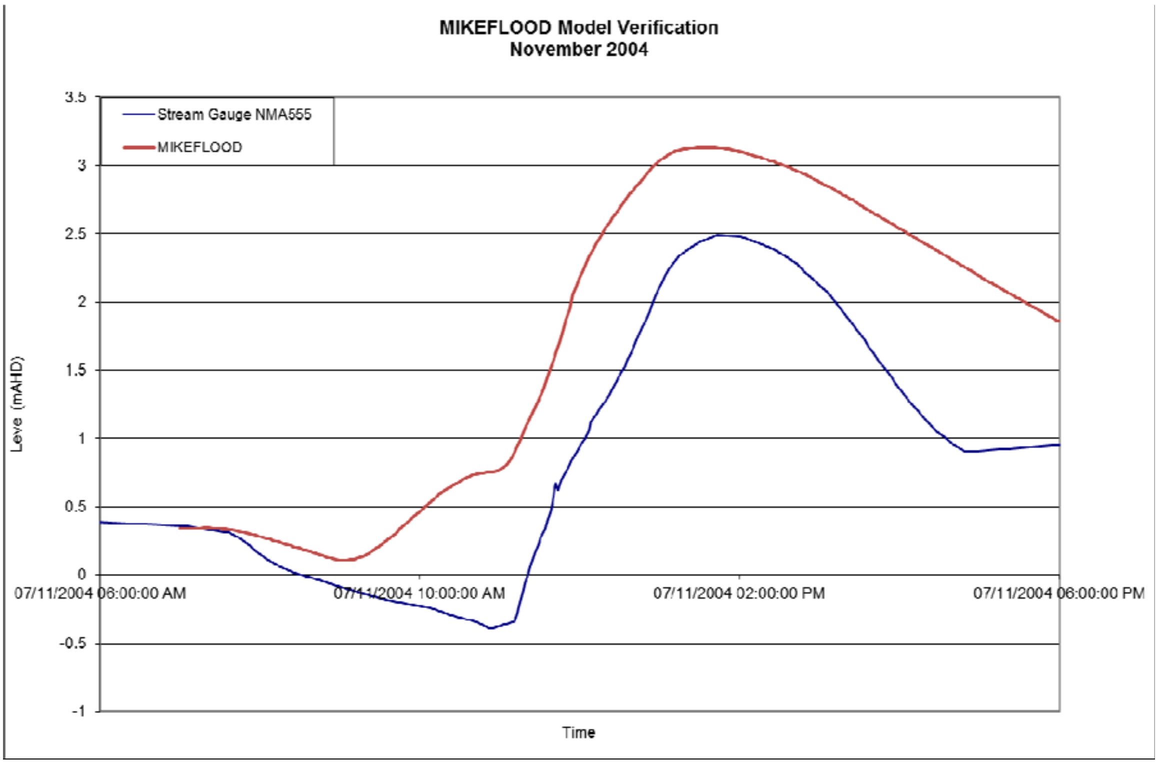



Figure 6.7: Stream Gauge at Caswell St, East Brisbane (NMA555) – Simulated versus recorded (November 2004)

### *November 2008*

A comparison of recorded peak flood levels to simulated peak flood levels for the 20th November 2008 event at Joachim St, Holland Park West (NMA549) is indicated in Table 6.8. Figure 6.8 indicates the simulated versus recorded hydrograph for the event at Joachim St, Holland Park West (NMA549). The stream gauge at Waldheim St, Annerley (NMA552) was closed prior to this event and the gauge at Caswell St, East Brisbane (NMA555) provided a faulty reading during this event.

Table 6.8 - November 2008 – Peak Flood Level Comparison

| Stream Gauge ID | Waterway | AMTD (m) | Peak Flood Level (m AHD) | | Difference (m) |
|---|---|---|---|---|---|
| | | | Recorded | MIKEFLOOD | |
| NMA549 | Ekibin Ck Upper | 2001 | 17.68 | 17.61 | -0.07 |

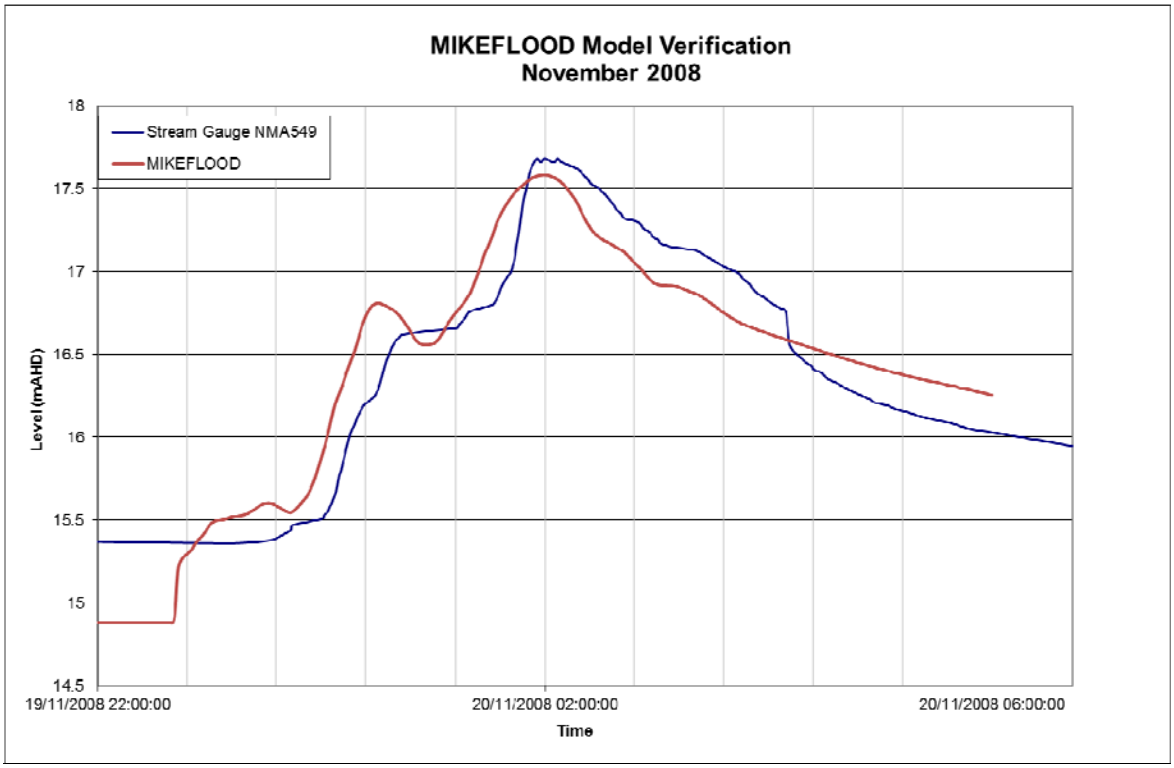



Figure 6.8: Stream Gauge at Joachim St, Holland Park West (NMA549) – Simulated versus recorded (November 2008)

## 6.3.2 Verification to Maximum Height Gauges

BCC flood studies aim to achieve a tolerance of +/- 0.3 m for the verification to MHGs. Tables 6.9 and 6.10 present a comparison of the recorded and simulated flood levels at the Maximum Height Gauges for the 7th November 2004 and 20th November 2008 events respectively.

***November 2004***

Table 6.9 - Verification to MHG data (November 2004)

| Stream Gauge ID | Waterway | AMTD (m) | Peak Flood Level (m AHD) | | Difference (m) |
|---|---|---|---|---|---|
| | | | Recorded | MIKEFLOOD | |
| NM100 | Norman Ck | 314 | - | - | - |
| NM110 | Norman Ck | 2073 | 1.48 | 2.07 | 0.59 |
| NM120 | Norman Ck | 3145 | - | - | - |
| NM130 | Norman Ck | 3464 | 2.38 | 2.70 | 0.32 |
| NM140 | Norman Ck | 3517 | - | - | - |
| NM150 | Norman Ck | 3950 | - | - | - |
| NM160 | Norman Ck | 4222 | 2.78 | 3.41 | 0.63 |
| NM170 | Norman Ck | 4440 | 3.06 | 3.69 | 0.63 |
| NM180 | Norman Ck | 4991 | 3.39 | 3.78 | 0.39 |
| NM190 | Norman Ck | 5166 | 3.56 | 4.16 | 0.60 |
| NM200 | Norman Ck | 5600 | 4.11 | 4.57 | 0.46 |
| NM210 | Norman Ck | 5679 | 4.20 | 4.92 | 0.72 |
| NM215 | Norman Ck | 5880 | - | - | - |
| NM220 | Norman Ck | 6350 | - | - | - |
| NM230 | Norman Ck | 7048 | 9.28 | 9.95 | 0.67 |
| NM240 | Ekibin Ck Lower | 259 | 11.41 | 11.34 | -0.07 |
| NM250 | Ekibin Ck Lower | 1800 | 15.42 | 16.79 | 1.37 |
| EK110 | Ekibin Ck Lower | 957 | - | - | - |
| EK130 | Glindemann Ck | 1276 | - | - | - |
| ST100 | Sandy Ck | 682 | - | - | - |

## *November 2008*

Table 6.10 - Verification to MHG data (November 2008)

| Stream Gauge ID | Waterway | AMTD (m) | Peak Flood Level (m AHD) | | Difference (m) |
|---|---|---|---|---|---|
| | | | Recorded | MIKEFLOOD | |
| NM100 | Norman Ck | 314 | - | - | - |
| NM110 | Norman Ck | 2073 | - | - | - |
| NM120 | Norman Ck | 3145 | 2.43 | 2.35 | -0.08 |
| NM130 | Norman Ck | 3464 | 2.62 | 2.56 | -0.06 |
| NM140 | Norman Ck | 3517 | 2.61 | 2.94 | 0.33 |
| NM150 | Norman Ck | 3950 | - | | |
| NM160 | Norman Ck | 4222 | 2.87 | 3.20 | 0.33 |
| NM170 | Norman Ck | 4440 | 3.19 | 3.43 | 0.24 |
| NM180 | Norman Ck | 4991 | 3.52 | 3.51 | -0.01 |
| NM190 | Norman Ck | 5166 | 3.64 | 3.86 | 0.22 |
| NM200 | Norman Ck | 5600 | - | - | - |
| NM210 | Norman Ck | 5679 | - | - | - |
| NM215 | Norman Ck | 5880 | - | - | - |
| NM220 | Norman Ck | 6350 | 6.59* | 7.40 | 0.81 |
| NM230 | Norman Ck | 7048 | 9.77 | 9.69 | -0.08 |
| NM240 | Ekibin Ck Lower | 259 | - | - | - |
| NM250 | Ekibin Ck Lower | 1800 | 16.27 | 16.42 | 0.15 |
| EK110 | Ekibin Ck Lower | 957 | - | - | - |
| EK130 | Glindemann Ck | 1276 | - | - | - |
| ST100 | Sandy Ck | 682 | - | - | - |

*The reading at this gauge is possibly an error, based on a comparison to recordings at similarly located gauges for the other events selected in this study.

## 6.4 Discussion of Results

### *March 2001, November 2008 and January 2013 events*

The results indicate that the model was able to adequately replicate the historical results for the March 2001, November 2008 and January 2013 events. The model was able to achieve a good match of the rising limbs of the hydrographs and the timing of the peak flows. Some outliers in the modelled results can be attributed to several recorded MHG levels being retrieved from nearby debris heights instead of from the gauge itself and also potentially from localised turbulence effects within the creek in the vicinity of the gauge.

The calibration of the March 2001 event to the stream gauge located at Waldheim St, Annerley (NMA552) was not achievable to within the specified tolerances. This is most likely due to the faulty operation of the gauge during the event, which had been previously noted in the 2004 Norman Creek WQA (Cardno).

The January 2013 peak at the Caswell St, East Brisbane (NMA555) gauge was high compared to the recorded hydrograph. Based on the shape of the rising limb, there appeared to be a higher volume of flow through the model than recorded at this location. The simulated levels near MHG NM140 were also consistently higher than the recorded levels in all events. This location is immediately upstream of Stanley Street East on Norman Creek and the flood characteristics are quite complex. The structure losses were checked against HEC-RAS and found to be consistent, thus it is believed a combination of the following are influencing the results:

- Localised effects due to the close proximity of the Stanley Street culverts
- Significant flood storage upstream of Stanley Street which may not be fully captured through the use of the ALS data to represent the channel and floodplain (where heavily vegetated mangrove areas are dominant).
- Presence of the old Norman Creek channel (meander bends) of which the bathymetry (and hence storage) is unlikely to be fully represented by ALS.
- The gauge is located between the major inflows of Coorparoo and Bridgewater Creeks, which are effectively un-calibrated tributaries.
- Tidal effects

### *November 2004 event*

The verification of the November 2004 event against the recorded levels at the majority of the MHG and stream gauge locations was not achievable to within the specified tolerances. Simulated peak flood levels were generally between 0.3 and 0.7 m higher than the observed flood levels. The exception being at gauges NM240 (MHG), located just upstream of the Freeway in Greenslopes and at the stream gauge located near Joachim St, Holland Park West (NMA549), both which are within the 1D model boundary. Both produced a good correlation to the recorded levels and the recorded hydrograph shape.

The November 2004 event produced highly variable rainfall throughout the catchment, particularly at the uppermost gauge. The highly variable nature of the rainfall throughout the catchment is the most likely reason for the higher than expected model results. The rainfall intensity was considerably higher in the upstream area of the catchment, particularly in the uppermost reaches in Toohey Forest (Mt. Gravatt gauge, BMR138). Based on a 3 hour critical duration, rainfall intensities ranged from 2-yr to 50-yr ARI at all gauges.

A sensitivity analysis on the Thiessen polygon distribution method for assigning rainfall pluviograph data to RAFTS sub-catchments was undertaken. Sub-catchments originally assigned to the rainfall gauge at Mt. Gravatt (BMR138) were instead assigned to the rainfall gauge at Joachim Street, Holland Park West (NMR548). Adjusted flows were then run through the hydraulic model, which indicated a vastly improved match to peak recorded levels, particularly in the 2D model area.

## 6.5 Summary

In summary, the model was able to adequately replicate the historical results for the 9 March 2001, 20 November 2008 and 27 January 2013 events, including the replication of the rising limbs of the Stream Gauge hydrographs. Modelled peak levels at the MHG and Stream Gauges were generally within a range of +/- 300 mm to recorded levels. The 7 November 2004 event did not match well with recorded levels; however, the high spatial variability of the rainfall during this event is a plausible justification for this difference.

Given the above results, the model is deemed fit-for-purpose for the simulation of the full suite of design flood events ranging from the 2yr ARI event to the PMF.

# 7.0 Design Events

## 7.1 Design Event Hydrology

### 7.1.1 General

For the purpose of this report, the term “design events” refers to those events with an Average Recurrence Interval (ARI) of 2 to 100 years. The term “extreme events” refers to those events with an ARI larger than 100 years. Section 7 details the derivation of the design flood hydrology for the design events.

### 7.1.2 Available Data

The following data was available for use in the determination of design flood levels:

- Calibrated 2013 RAFTS and MIKEFLOOD models
- 2004 Norman Creek Water Quantity Assessment (Cardno)
- 2008 Norman Creek Water Quantity Assessment (BCC)
- 2008 Norman Creek WQA MIKE11 model
- Latest BCC waterway corridor mapping (2013 Draft City Plan)
- BCC aerial photography
- Current version of BCC City Plan
- BCC Cadastre and GIS databases
- BCC Stormwater drainage drawings

### 7.1.3 Methodology

Design flood estimation is best determined by undertaking a flood frequency analysis of annual maximum and / or peak over threshold series from observed long-term stream flow records. However, in the Brisbane City Council region, the period of record is typically insufficient to enable sufficient confidence to warrant undertaking flood frequency methods. Table 7.1 [2] indicates some guidance for length of record versus expected error rate for flood frequency analysis.

On the basis that the three continuous recording stream gauges historically within the catchment (two active, one closed) have only approximately 20 years of records it has been deemed unsuitable to undertake flood frequency analysis for this study.

[2] Flood Frequency Analysis - University Corporation for Atmospheric Research, USA (2010)

Table 7.1 – Guidance for Length of Record versus Expected Error Rate

| ARI (year) | Required Length of Record (years) | |
|---|---|---|
| | ± 10% Error Level | ± 25% Error Level |
| 10 | 90 | 18 |
| 25 | 105 | 31 |
| 50 | 110 | 39 |
| 100 | 115 | 48 |

This study utilises the synthetic design storm concept from AR&R (1987) to estimate the design ARI flood in Norman Creek. This methodology was as follows:

- Design Intensity Frequency Duration (IFD) estimates are determined from AR&R for the full range of storm ARIs (2-yr to 100-yr) and durations (30 minute to 3-hr).
- Design temporal patterns are determined and design hyetographs produced for the full range of ARIs and durations.
- Appropriate design rainfall loss parameters are adopted.
- Using the calibrated models, design storms are simulated and the peak discharges and critical durations established within the model domain.

### 7.1.4 RAFTS Model Set-up

The calibrated RAFTS model was used to simulate the design storm rainfall-runoff and sub-catchment routing process. The following describes the adjustments made to the model in order to simulate the design events.

***Catchment Development***

The design events were modelled assuming ultimate catchment development conditions. Ultimate catchment conditions were also adopted for the extreme event and climate change modelling. As the catchment is considered to be already fully developed, the design event model adopted the same land use and PERN parameters as per the calibration model.

Appendix B indicates the RAFTS catchment parameters that were adopted for the calibration and design event modelling scenarios. The current adopted version of BCC City Plan was used to establish the ultimate catchment hydrological conditions in the 2004 WQA model, which was used in this study. The additional 'External' catchment uses the same methodology for determination of ultimate land-use conditions.

***Rainfall Losses***

The Initial Loss (IL) and Continuing Loss (CL) approach was used to simulate the rainfall losses in order to determine the rainfall excess. The IL is known to be the amount of rainfall that occurs before the start of surface runoff, while the CL is assumed to be the average loss rate throughout the remainder of the rainfall event.

The adopted rainfall losses used for the design, extreme and climate change events were as follows:

- IL = 0 mm, and
- CL = 0 mm/hr

These values were adopted from the 2008 WQA RAFTS model, and are consistent with the loss parameters adopted in the calibration and verification event models.

***Design hyetographs***
Design hyetographs were derived from the techniques in AR&R. Hyetographs were created for the 2-yr, 5-yr, 10-yr, 20-yr, 50-yr and 100-yr ARI events, considering durations of 30 minutes, 45 minutes, 1 hour, 1.5 hours, 2 hours and 3 hours.

## 7.2 Design Event Hydraulic Modelling

### 7.2.1 Modelled Scenarios

The MIKEFLOOD model was used to determine both discharges and flood levels for the 2-yr, 5-yr, 10-yr, 20-yr, 50-yr and 100-yr ARI events. These events were simulated for durations from 30 minutes to 270 minutes.

Table 7.2 indicates the three hydraulic scenarios utilised in the design modelling, noting that all design event scenarios were modelled using ultimate hydrological conditions.

Table 7.2 – Design Event Scenarios

| ARI (year) | Scenario 1 | Scenario 2 | Scenario 3 |
|---|---|---|---|
| 2 | ✓ | ✗ | ✓ |
| 5 | ✓ | ✗ | ✓ |
| 10 | ✓ | ✗ | ✓ |
| 20 | ✓ | ✗ | ✓ |
| 50 | ✓ | ✗ | ✓ |
| 100 | ✓ | ✓ | ✓ |

The following describes the hydraulic scenarios which were modelled. It should be noted that for all design scenarios, the majority of hydraulic road / bikeway structures have been simulated with a fully blocked handrail / guardrail.

***Scenario 1: Existing Waterway Conditions***
Scenario 1 or Existing Scenario is based on the current waterway conditions. The January 2013 calibration event model was used as the basis for the design event modelling as it

included the recently constructed Norman Creek Veloway (bikeway) along Ekibin Creek Lower, and the Eastern Busway over Norman Creek at Stones Corner.

***Scenario 2: Minimum Riparian Corridor (MRC)***

Scenario 2 or Minimum Riparian Corridor (MRC) Scenario includes an allowance for a riparian corridor along the edge of the channel. This involved firstly reviewing the existing vegetation and land-use adjacent to the channel to determine an appropriate Manning's 'n' roughness value for the riparian corridor. For most locations in the MIKE11 1D model, the default value of n = 0.15 was used. However, where the existing Manning's 'n' is higher than n = 0.15 or where vegetation growth is not possible (e.g. – road corridor), the Manning's 'n' was left unchanged. For the 2D MIKE21 component of the model, a default Manning's 'n' value of n = 0.12 was applied (Manning's 'M' = 8.33).

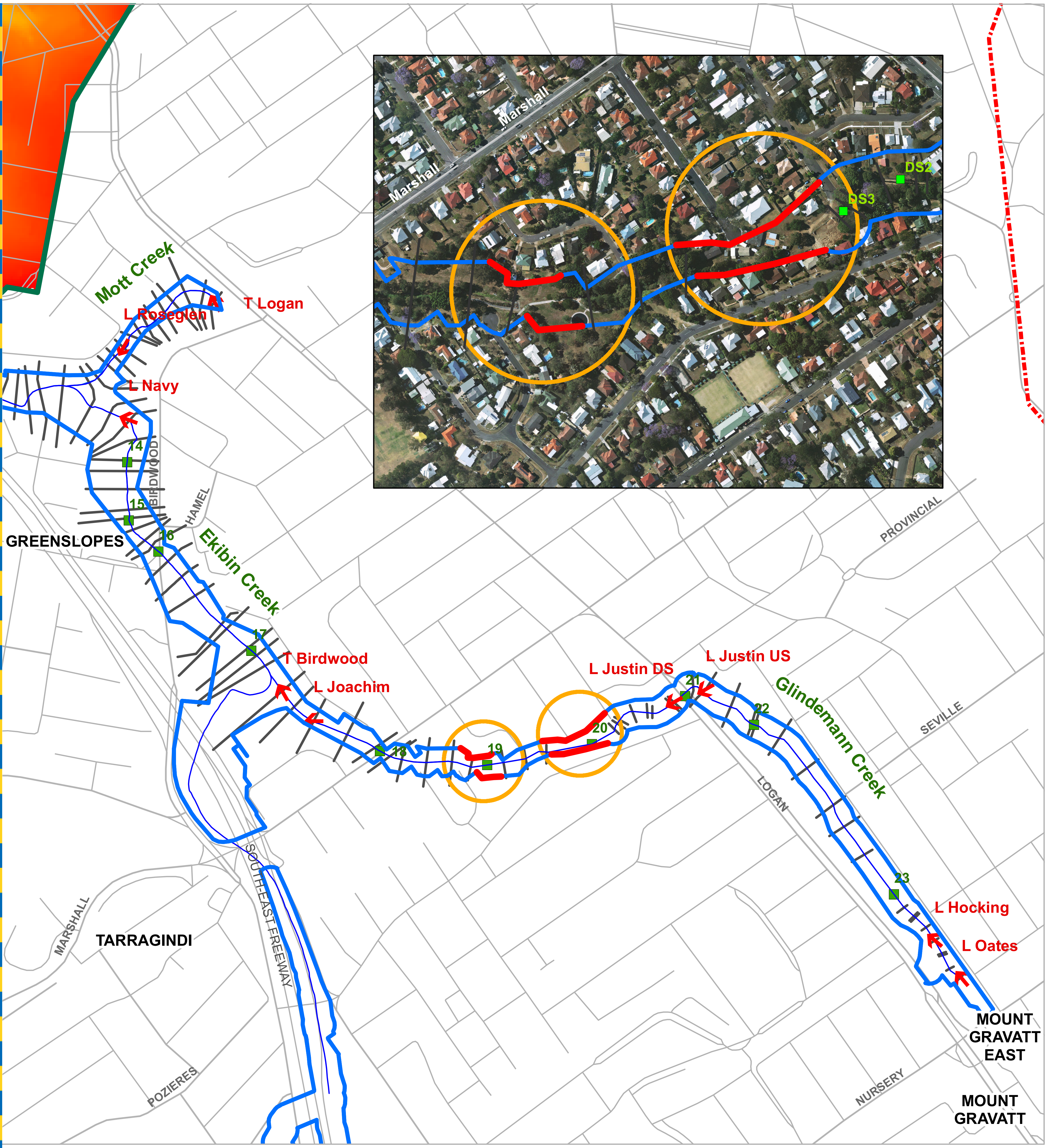
A 30 m wide corridor (15 m wide each side from the centreline or embankments of the channel) was defined by amending the Manning's 'M' cell values in the roughness layer of the MIKE21 model, and the cross-section Manning's 'n' values in the MIKE11 model. In areas where the 15 m width was not available, the MRC was set to the maximum possible width (i.e. less than 15 m).

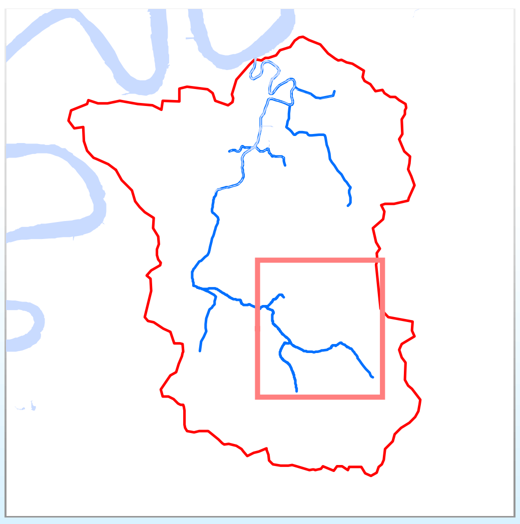
***Scenario 3: Filling to the Waterway Corridor (WC) + Minimum Riparian Corridor (MRC)***

Scenario 3 or Ultimate Scenario includes the assumptions in Scenario 2 and also assumes that filling has occurred up to the Waterway Corridor. In the design events (2-yr to 100-yr ARI) the filling acts as a barrier and the WC can be modelled simplistically as a glass-wall of infinite height. For the modelling of events greater than 100-yr ARI, the fill height outside of the WC is set to the 100-yr flood level (Scenario 3) plus 0.3 m to allow the flood extents to spread laterally, should this level be exceeded.

This is a simple and conservative assumption used to develop design planning levels. It does not necessarily reflect allowable development assumptions under City Plan.

The WC used in this study was taken from the current draft City Plan GIS layer. Three additional flow conveyance zones were identified along Glindemann and Scott's Creek's and were represented in the model with the same attributes as a Waterway Corridor. Figure 7.1 indicates the WC and additional flow conveyance zones for the modelling of Scenario 3 or Ultimate Scenario.



0 100 200 300

Metres

N W E S

**Legend**

- Flow Conveyance Zone
- Waterway Corridor
- Norman Creek Catchment Boundary
- MIKE 21 Model Extents
- Inflow Locations
- Structures
- MIKE 11 Cross Sections
- Streets

Prepared : 077900
Checked : NC
Revision : 0
Publication Date : 18 Nov 2013
Project Number : 130286

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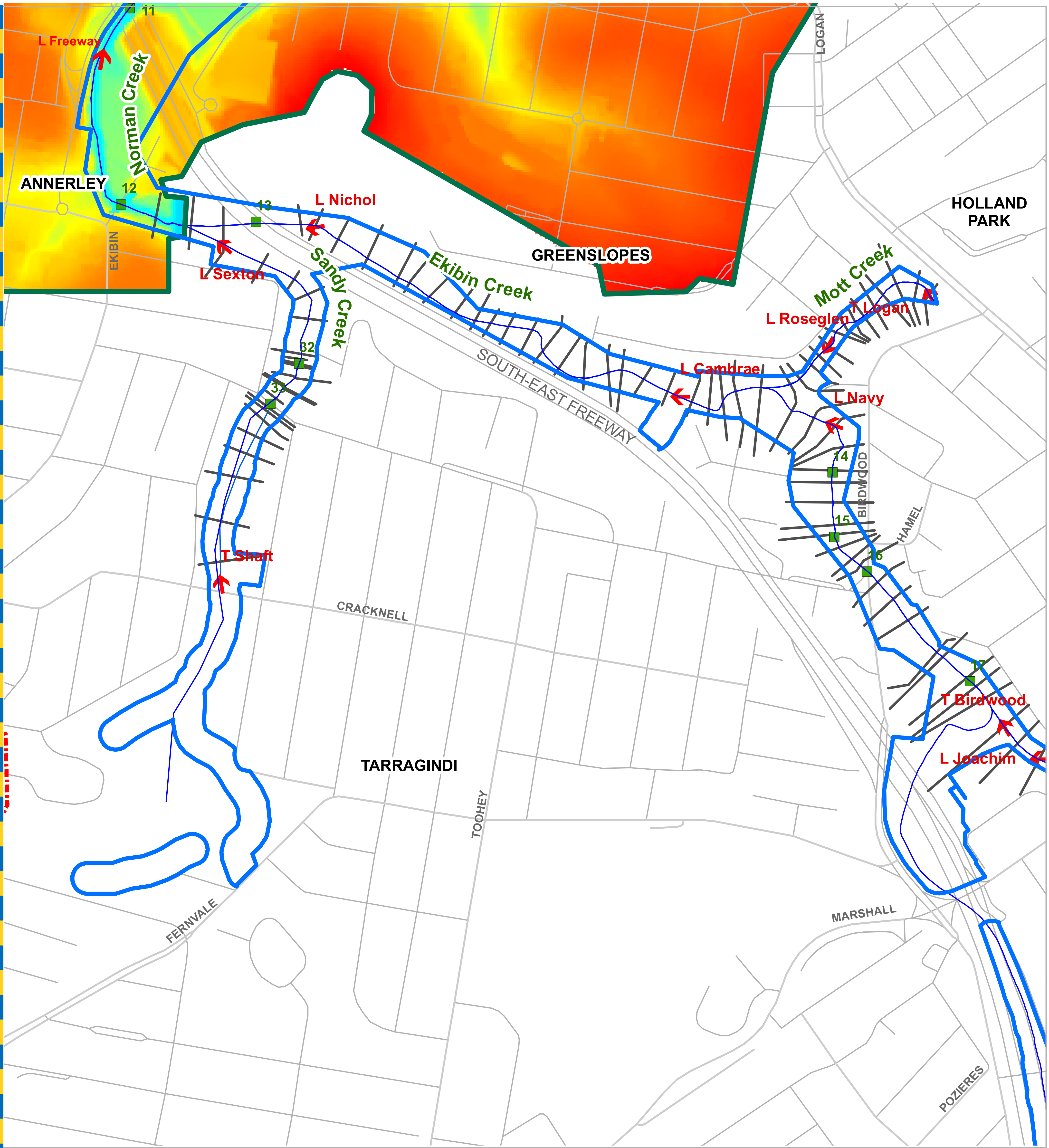
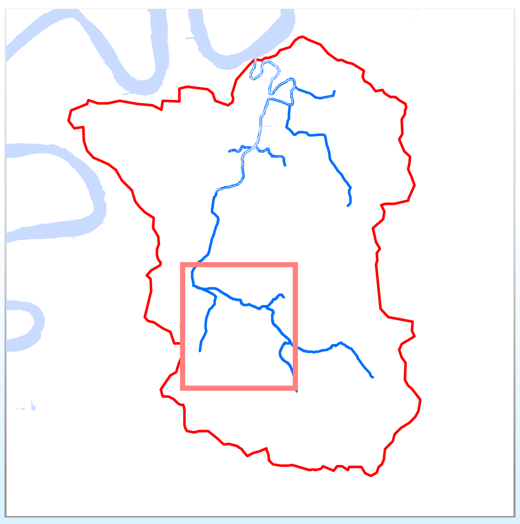
# Figure 7.1: MIKEFLOOD Waterway Corridor Map 1 of 3

GIM - 100001 - 001




## Legend

- Waterway Corridor
- Norman Creek Catchment Boundary
- MIKE 21 Model Extents
- Inflow Locations
- Structures
- MIKE 11 Cross Sections
- Streets

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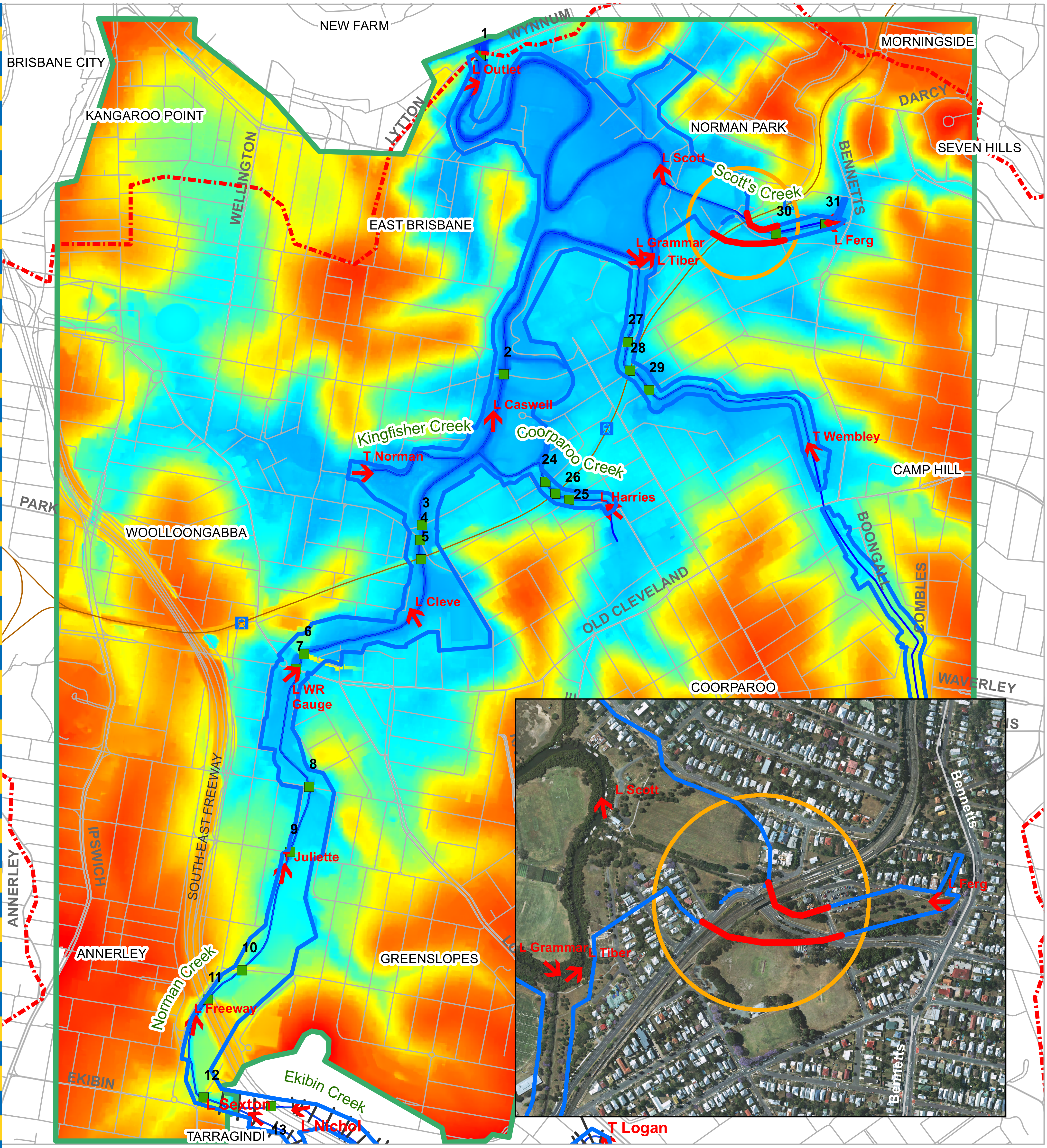
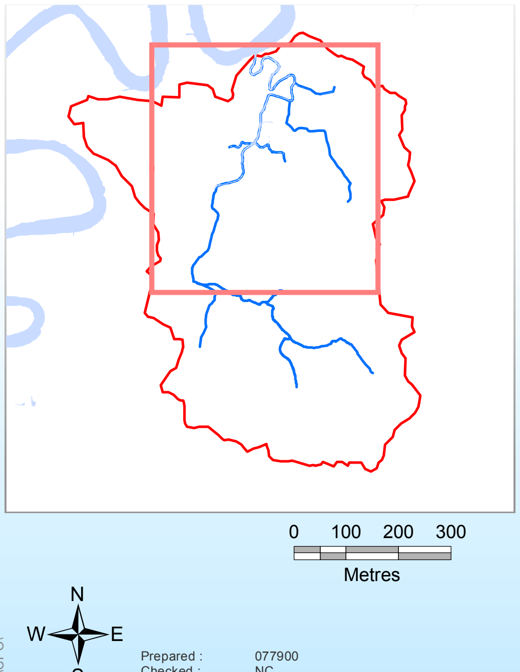
# Figure 7.1: MIKEFLOOD Waterway Corridor Map 2 of 3

GIM - 100001 - 001




## Legend

- Flow Conveyance Zone
- Waterway Corridor
- MIKE 21 Model Extents
- Norman Creek Catchment Boundary
- Inflow Locations
- Structures
- MIKE 11 Cross Sections
- Railway Line
- Streets



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# Figure 7.1: MIKEFLOOD Waterway Corridor Map 3 of 3

GIM - 100001 - 001

### 7.2.2 MIKEFLOOD model roughness

The hydraulic roughness in the calibrated MIKEFLOOD model was used as the basis for the Scenario 1 design events. As the catchment is already considered to be fully developed in the calibration/verification scenarios (specifically the January 2013 event used as the basis for the design event modelling), no model roughness changes were made.

### 7.2.3 MIKEFLOOD model boundaries

The design inflow boundaries to the MIKEFLOOD model were taken from the results of the RAFTS model for each ARI and duration. The inflow locations did not change from the calibrated MIKEFLOOD model. The boundary link between the 1D and 2D models was not changed from the calibrated MIKEFLOOD model.

The MIKEFLOOD model utilised a fixed water level (H-T) boundary at its downstream extent (i.e. Brisbane River). A Mean High Water Springs (MHWS) value of 1.06 m AHD was adopted for all design events.

It should be noted that the joint probability of fluvial and tidal events has not been considered in the modelling.

### 7.2.4 Eddy Viscosity in the 2D Domain

A global eddy viscosity value of 0.5 was adopted in the calibration and verification models, with the exception of areas at the 1D/2D structure links, where an eddy viscosity value of 10 was adopted. Both adopted values are in line with best practice for the software use.

The Eddy viscosity values in the design model are consistent with those adopted in the calibration model.

## 7.3 Modelling Results

### 7.3.1 Peak Discharge

Discharges predicted by the MIKEFLOOD model were extracted at crossing locations. These discharges are presented in Table 7.3 and represent the total flow at that location, including discharge through all culverts / bridges and associated bypass flow.

Table 7.3 – MIKEFLOOD Design Event Peak Discharge at Structures (Scenario 1)

| Creek / Channel | Structure Location | Peak Discharge ($m^3/s$) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2-yr ARI | 5-yr ARI | 10-yr ARI | 20-yr ARI | 50-yr ARI | 100-yr ARI |
| Norman Creek | Wynnum Road | 114.4 | 146.1 | 164.9 | 193.7 | 231.0 | 258.7 |
| | Stanley Street East | 97.4 | 126.2 | 142.7 | 172.2 | 212.4 | 240.0 |
| | Turbo Street | 83.9 | 115.6 | 132.2 | 161.2 | 194.1 | 224.3 |
| | Deshon Street | 84.2 | 115.8 | 132.9 | 161.6 | 194.6 | 224.8 |
| | Cleveland Rail | 84.3 | 115.9 | 133.6 | 162.3 | 195.1 | 225.3 |
| | Eastern Busway | 97.7 | 124.9 | 151.4 | 172.9 | 205.3 | 234.6 |
| | Logan Road | 95.9 | 121.9 | 146.6 | 167.7 | 200.3 | 231.1 |
| | Cornwall Street | 97.9 | 130.2 | 147.7 | 171.8 | 206.3 | 237.7 |
| | Juliette Street | 100.6 | 133.4 | 152.0 | 177.3 | 213.5 | 243.9 |
| | Ridge Street | 93.7 | 124.3 | 141.3 | 164.9 | 200.5 | 226.9 |
| | South East Freeway | 92.2 | 122.2 | 139.8 | 163.2 | 198.2 | 224.2 |
| | Arnwood Place | 89.8 | 118.5 | 135.7 | 160.0 | 189.7 | 213.1 |
| Ekibin Creek | South East Freeway | 79.2 | 102.4 | 115.6 | 134.0 | 158.1 | 177.5 |
| | Birdwood Road Dev. Bridge | 58.0 | 74.0 | 83.0 | 95.4 | 111.0 | 125.8 |
| | Birdwood Road Dev. Causeway | 58.0 | 74.0 | 82.9 | 95.4 | 111.0 | 125.8 |
| | Birdwood Road | 58.1 | 74.1 | 83.0 | 95.5 | 111.1 | 125.9 |
| | Park Maintenance Crossing | 58.7 | 75.2 | 84.1 | 96.7 | 111.9 | 126.4 |
| Glindemann Creek | Marshall Road | 20.8 | 24.1 | 25.3 | 27.2 | 30.4 | 35.1 |
| | Logan Road | 20.6 | 23.1 | 24.0 | 25.7 | 29.4 | 35.0 |
| | Glindemann Park Footbridge | 21.9 | 29.3 | 34.0 | 39.0 | 38.0 | 41.9 |
| | Glindemann Park Overpipe | 23.8 | 31.8 | 36.6 | 42.9 | 48.4 | 54.6 |
| Scott's Creek | Adina Street | 11.5 | 13.0 | 13.8 | 15.2 | 16.4 | 18.3 |
| | Waite Footbridge | 12.2 | 14.9 | 16.5 | 18.2 | 20.4 | 21.6 |
| Bridgewater Creek | Stanley Street East | 14.5 | 17.9 | 20.4 | 23.6 | 27.4 | 30.5 |
| | Cleveland Rail Crossing | 14.9 | 18.6 | 21.1 | 24.9 | 29.1 | 33.2 |
| | Temple Street | 39.5 | 47.6 | 52.8 | 57.5 | 64.7 | 69.2 |
| Sandy Creek | Sunshine Avenue Footbridge | 20.1 | 25.2 | 27.9 | 32.8 | 38.3 | 44.0 |
| | Sexton Street | 20.2 | 25.2 | 27.9 | 32.8 | 38.3 | 44.1 |
| Coorparoo | Morley Street | 42.8 | 49.8 | 54.1 | 59.7 | 64.3 | 70.0 |

| Creek / Channel | Structure Location | Peak Discharge ($m^3/s$) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2-yr ARI | 5-yr ARI | 10-yr ARI | 20-yr ARI | 50-yr ARI | 100-yr ARI |
| Creek | Cleveland Rail Crossing | 30.9 | 39.5 | 43.6 | 49.4 | 56.0 | 62.4 |
| | Gladstone Street | 31.4 | 40.1 | 46.2 | 52.9 | 59.2 | 64.4 |

### 7.3.2 Critical Durations

A range of event durations (30 minutes, 45 minutes, 1 hour, 1.5 hours, 2 hours and 3 hours) were simulated within the MIKEFLOOD model. Table 7.4 indicates the critical durations for the 2-yr to 100-yr ARI events based on peak water level at key locations within the catchment.

Table 7.4 – Critical Durations at Selected Locations (Scenario 1)

| Creek / Channel | Structure Location | Critical Duration (min) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2-yr ARI | 5-yr ARI | 10-yr ARI | 20-yr ARI | 50-yr ARI | 100-yr ARI |
| Norman Creek | Wynnum Road | 180 | 180 | 180 | 180 | 180 | 180 |
| | Stanley Street East | 180 | 180 | 180 | 180 | 180 | 180 |
| | Turbo Street | 120 | 120 | 120 | 180 | 180 | 180 |
| | Deshon Street | 120 | 120 | 120 | 120 | 120 | 120 |
| | Cleveland Rail | 120 | 120 | 120 | 120 | 120 | 120 |
| | Eastern Busway | 120 | 120 | 120 | 120 | 120 | 120 |
| | Logan Road | 120 | 120 | 120 | 120 | 120 | 120 |
| | Cornwall Street | 90 | 120 | 120 | 120 | 120 | 90 |
| | Juliette Street | 90 | 90 | 90 | 90 | 90 | 90 |
| | Ridge Street | 90 | 90 | 90 | 90 | 90 | 90 |
| | South East Freeway | 90 | 90 | 90 | 90 | 60 | 90 |
| | Arnwood Place | 60 | 60 | 60 | 90 | 60 | 90 |
| Ekibin Creek | South East Freeway | 60 | 60 | 60 | 60 | 60 | 60 |
| | Birdwood Road Dev. Bridge | 60 | 60 | 60 | 60 | 60 | 60 |
| | Birdwood Road Dev. Causeway | 60 | 60 | 60 | 60 | 60 | 60 |
| | Birdwood Road | 60 | 60 | 60 | 60 | 60 | 60 |
| | Park Maintenance Crossing | 60 | 60 | 60 | 60 | 60 | 60 |
| Glindemann | Marshall Road | 60 | 60 | 60 | 60 | 60 | 60 |

| Creek / Channel | Structure Location | Critical Duration (min) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2-yr ARI | 5-yr ARI | 10-yr ARI | 20-yr ARI | 50-yr ARI | 100-yr ARI |
| Creek | Logan Road | 60 | 60 | 60 | 60 | 60 | 60 |
| | Glindemann Park Footbridge | 30 | 30 | 60 | 60 | 60 | 60 |
| | Glindemann Park Overpipe | 30 | 30 | 60 | 60 | 60 | 60 |
| Scott's Creek | Adina Street | 60 | 60 | 60 | 60 | 60 | 180 |
| | Waite Footbridge | 60 | 60 | 60 | 60 | 60 | 60 |
| Bridgewater Creek | Stanley Street East | 120 | 180 | 180 | 180 | 180 | 180 |
| | Cleveland Rail Crossing | 120 | 90 | 120 | 120 | 120 | 180 |
| | Temple Street | 60 | 90 | 90 | 120 | 120 | 120 |
| Sandy Creek | Sunshine Avenue Footbridge | 30 | 60 | 60 | 60 | 60 | 60 |
| | Sexton Street | 30 | 60 | 60 | 60 | 60 | 60 |
| Coorparoo Creek | Morley Street | 60 | 60 | 60 | 60 | 60 | 60 |
| | Cleveland Rail Crossing | 60 | 60 | 60 | 60 | 60 | 60 |
| | Gladstone Street | 60 | 60 | 60 | 60 | 60 | 60 |

### 7.3.3 Peak Flood Levels

Tabulated peak flood level results are provided in Appendix G for Norman Creek and all major tributaries. These results are presented for the 2-yr to 100-yr ARI events for both Scenario 1 and Scenario 3. The peak flood levels are referenced to the existing Adopted Middle Thread Distance (AMTD).

### 7.3.4 Flood Mapping Products

The flood mapping products are provided in the separate A3 booklet as Appendix K (Volume 2). These mapping products have been provided for the following flood characteristics:

- Flood Extent Mapping (2yr to 100yr ARI Scenario 1)
- Flood Level Mapping (2yr to 100yr ARI Scenario 3)
- Flood Depth Mapping (2yr to 100yr ARI Scenario 3)

#### 7.3.4.1 Ultimate Scenario Flood Surface Generation and 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 (ie 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. The better control the process a tolerance is adopted in the determination of a wet cell, being a water depth of 300mm.

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 application of the break lines for this flood study is detailed in Appendix J.

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)

Particularly difficult areas to apply the stretching process to and which may benefit from further refinement are detailed in Appendix J.

### 7.3.5 Flood Immunity of Hydraulic Structures

The flood immunity of the structures under Scenario 1 was determined for each crossing by comparing peak flood levels upstream of the crossing with the minimum overtopping levels. The estimated structure immunities are presented in Table 7.5, of which the minimum event considered was the 2-yr ARI and the maximum was the 100-yr ARI. The results indicate that the flood immunity of the structures within the Norman Creek catchment varies considerably.

Hydraulic Structure Reference Sheets (HSRS) were also produced which outline the hydraulic characteristics of each structure. These are provided in Appendix F.

Table 7.5 – Existing Flood Immunity of Structures (Scenario 1)

| Creek / Channel | Structure Location | Minimum Overtopping Level (m AHD) | Flood Immunity |
|---|---|---|---|
| Norman Creek | Wynnum Road | 7 | Greater than 100 year ARI |
| | Stanley Street East | 2.52 | Less than 2 year ARI |
| | Turbo Street | 2.75 | Less than 2 year ARI |
| | Deshon Street | 2.1 | Less than 2 year ARI |
| | Cleveland Rail | 8.7 | Greater than 100 year ARI |
| | Eastern Busway | 7.5 | Greater than 100 year ARI |
| | Logan Road | 4.48 | 5 year ARI |
| | Cornwall Street | 4.8 | 2 year ARI |
| | Juliette Street | 7.2 | Greater than 100 year ARI |
| | Ridge Street | 9.2 | 10 year ARI |
| | South East Freeway | 16.9 | Greater than 100 year ARI |

| Creek / Channel | Structure Location | Minimum Overtopping Level (m AHD) | Flood Immunity |
|---|---|---|---|
| | Arnwood Place | 12 | Greater than 100 year ARI |
| Ekibin Creek | South East Freeway | 15.8 | Greater than 100 year ARI |
| | Birdwood Road Dev. Bridge | 16 | Greater than 100 year ARI |
| | Birdwood Road Dev. Causeway | 15 | 5 year ARI |
| | Birdwood Road | 16.06 | Less than 2 year ARI |
| | Park Maintenance Crossing | 17.6 | Less than 2 year ARI |
| Glindemann Creek | Marshall Road | 21 | 50 year ARI |
| | Logan Road | 28.3 | 10 year ARI |
| | Glindemann Park Footbridge | 26.5 | Less than 2 year ARI |
| | Glindemann Park Overpipe | 31 | 2 year ARI |
| Scott's Creek | Adina Street | 3.2 | 50 year ARI |
| | Waite Footbridge | 2.3 | Less than 2 year ARI |
| Bridgewater Creek | Stanley Street East | 2.95 | 10 year ARI |
| | Cleveland Rail Crossing | 4.5 | Greater than 100 year ARI |
| | Temple Street | 2.93 | 2 year ARI |
| Sandy Creek | Sunshine Avenue Footbridge | 12 | Greater than 100 year ARI |
| | Sexton Street | 14.6 | 5 year ARI |
| Coorparoo Creek | Morley Street | 3.1 | Less than 2 year ARI |
| | Cleveland Rail Crossing | 5.4 | Greater than 100 year ARI |
| | Gladstone Street | 2.7 | Less than 2 year ARI |

# 8.0 Extreme Event Modelling

## 8.1 Extreme Event Hydrology

### 8.1.1 General

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

(i) 200yr & 500yr ARI events

(ii) 2000-yr ARI event, and

(iii) Probable Maximum Precipitation (PMP)

### 8.1.2 200yr and 500yr ARI Events

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

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

Table 8.1 indicates the adopted 200yr and 500yr ARI design rainfall intensities with comparison to the adopted 100yr ARI.

Table 8.1 – Adopted IFD (200yr and 500yr ARI)

| Duration (hr) | Rainfall Intensity (mm/hr) | | |
|---|---|---|---|
| | 100yr ARI | 200yr ARI | 500yr 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-yr ARI design temporal pattern was adopted for both these events.

### 8.1.3 2000yr ARI

The 2000yr ARI IFD rainfall 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 200yr and 500yr 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 2000yr ARI CRC-Forge rainfall depth, which was determined as 340 mm.

### 8.1.4 PMP

For the PMP scenario, the 6 hour super-storm approach was also undertaken using the same temporal pattern as the 2000yr 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 $km^2$ and for durations up to 6 hours. To apply a consistent methodology across the majority of BCC an average catchment size of 60 $km^2$ 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 8.2 indicates the adopted super-storm temporal pattern and hyetographs for the 2000yr ARI and the PMP.

Table 8.2 – Adopted Super-storm Hyetographs

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

## 8.2 Extreme Event Hydraulic Modelling

### 8.2.1 Modelled Scenarios

The MIKEFLOOD model was used to determine both discharges and flood levels for the 200yr ARI, 500yr ARI, 2000yr ARI and the PMF.

Table 8.3 indicates the hydraulic scenarios considered in the extreme event modelling, noting that all extreme event scenarios were modelled using ultimate hydrological conditions. These scenarios have been previously described in Section 2.2.1.

Table 8.3 – Extreme Event Scenarios

| ARI (year) | Scenario 1 | Scenario 2 | Scenario 3 |
|---|---|---|---|
| 200 | ✓ | × | ✓ |
| 500 | ✓ | × | ✓ |
| 2000 | ✓ | × | × |
| PMF | ✓ | × | × |

### 8.2.2 MIKEFLOOD model roughness

No changes were made from the design event MIKEFLOOD model(s).

### 8.2.3 MIKEFLOOD model boundaries

The extreme event inflow boundaries to the MIKEFLOOD model were taken from the results of the RAFTS model for each ARI and duration. The inflow locations did not change from the design event MIKEFLOOD model.

The MIKEFLOOD model utilised a fixed water level (H-T) boundary at its downstream extent (i.e. Brisbane River). A Mean High Water Springs (MHWS) value of 1.06 m AHD was adopted for all extreme events.

### 8.2.4 Hydraulic Structures

Several hydraulic structures were removed from the MIKEFLOOD model in selected extreme event scenarios, and represented as a constriction in the MIKE21 model bathymetry. The structures, and the events for which they were removed from the model, are as follows:

- Cornwall St (2000yr and PMF Scenario 1)
- Logan Rd (2000yr and PMF Scenario 1)

## 8.3 Modelling Results

### 8.3.1 Peak Flood Levels

Tabulated peak flood level results are provided in Appendix H for Norman Creek and all major tributaries. These results are presented for the 200yr & 500yr ARI (Scenario 1 and Scenario 3).

### 8.3.2 Flood Mapping Products

The flood mapping products are provided in Appendix K (Volume 2). The flood extent maps have been provided for Scenario 1 (200yr, 500yr and 2000yr ARI) and flood level maps for Scenario 3 (200yr and 500yr ARI).

# 9.0 Climate Change Modelling

## 9.1 Background

Council's Natural Environment, Water and Sustainability (NEWS) Branch required longer term planning horizons to be considered in their program of flood studies by considering extreme flood events and potential climate change impacts. At this time, State Planning Policy 3/11 (now superseded by the Coastal Protection State Planning Regulatory Provision) and the Inland Flood Study (DERM, 2010) had provided guidance on assessing the potential impacts on communities and development of projected climate change effects, including sea level rise and increased rainfall intensities.

*The SPP 3/11 outlined 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 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) *2C by 2050*
    b) *3C by 2070*
    c) *4C by 2100*

To enable BCC to understand and plan for the impacts of climate change on flooding in the Norman Creek catchment, an analysis was undertaken, which can be summarised as follows:

- 2050 Planning Horizon
    - 10 % increase in rainfall intensity
    - 0.3 m increase in mean sea level

- 2100 Planning Horizon
    - 20 % increase in rainfall intensity
    - 0.8 m increase in mean sea level

## 9.2 Modelled Scenarios

The MIKEFLOOD model was used to determine climate change impacts for the 100yr, 200yr and 500yr ARI events. Table 9.1 indicates the events modelled and the respective climate change modifications undertaken.

Table 9.1 – Climate Change Modelling Scenarios

| Event | Scenario | Rainfall Condition | Adopted Tailwater | |
|---|---|---|---|---|
| | | | Condition | Level (m AHD) |
| 100yr ARI (2050) | 3 | + 10 % | MHWS + 0.3 m | 1.36 |
| 100yr ARI (2100) | 3 | + 20 % | MHWS + 0.8 m | 1.86 |
| 200yr ARI (2050) | 3 | + 10 % | MHWS + 0.3 m | 1.36 |
| 200yr ARI (2100) | 3 | + 20 % | MHWS + 0.8 m | 1.86 |
| 500yr ARI (2100) | 3 | + 20 % | MHWS + 0.8 m | 1.86 |

The rainfall intensity in the RAFTS model was increased by 10 % (or 20 %) and simulations undertaken to determine the climate change hydrographs. These hydrographs were then input into the Scenario 3 MIKEFLOOD models and simulations undertaken for all climate change scenarios.

## 9.3 Climate Change Impacts

### 9.3.1 Impact on Flood Level

Tables 9.2 to 9.4 indicate the increase in peak flood level at selected locations for the 100yr, 200yr and 500yr ARI events, respectively.

Table 9.2 – 100yr ARI Climate Change Impacts at Selected Locations (Scenario 3)

| Creek / Channel | Structure Location | Flood Level (m AHD) | | |
|---|---|---|---|---|
| | | Ultimate | 2050 | 2100 |
| Norman Creek | Wynnum Road | 1.46 | 1.76 | 2.23 |
| | Stanley Street East | 4.16 | 4.36 | 4.57 |
| | Turbo Street | 4.43 | 4.62 | 4.83 |
| | Deshon Street | 4.72 | 4.9 | 5.08 |
| | Cleveland Rail | 4.75 | 4.93 | 5.11 |
| | Eastern Busway | 5.31 | 5.52 | 5.67 |
| | Logan Road | 6.21 | 5.95 | 6.12 |
| | Cornwall Street | 6.23 | 6.35 | 6.49 |
| | Juliette Street | 7.24 | 7.36 | 7.48 |
| | Ridge Street | 9.58 | 9.68 | 9.76 |
| | South East Freeway | 10.29 | 10.41 | 10.55 |
| | Arnwood Place | 11.14 | 11.29 | 11.44 |
| Ekibin Creek | South East Freeway | 12.7 | 13.1 | 13.52 |
| | Birdwood Road Dev. Bridge | 15.77 | 15.96 | 16.17 |
| | Birdwood Road Dev. Causeway | 16.01 | 16.2 | 16.39 |
| | Birdwood Road | 17.78 | 17.87 | 17.97 |
| | Park Maintenance Crossing | 18.63 | 18.74 | 18.84 |
| Glindemann Creek | Marshall Road | 21.62 | 21.86 | 22.04 |
| | Logan Road | 29.09 | 29.28 | 29.41 |
| | Glindemann Park Footbridge | 29.12 | 29.31 | 29.45 |
| | Glindemann Park Overpipe | 32.68 | 32.76 | 32.85 |
| Scott's Creek | Adina Street | 3.45 | 3.62 | 3.88 |
| | Waite Footbridge | 3.51 | 3.65 | 3.89 |
| Bridgewater Creek | Stanley Street East | 3.78 | 4.02 | 4.24 |
| | Cleveland Rail Crossing | 5.02 | 5.08 | 5.16 |
| | Temple Street | 5.05 | 5.13 | 5.21 |
| Sandy Creek | Sunshine Avenue Footbridge | 12.09 | 12.26 | 12.48 |
| | Sexton Street | 15.31 | 15.4 | 15.48 |
| Coorparoo Creek | Morley Street | 4.46 | 4.56 | 4.71 |
| | Cleveland Rail Crossing | 4.59 | 4.7 | 4.73 |
| | Gladstone Street | 4.77 | 4.9 | 4.74 |

Table 9.3 – 200yr ARI Climate Change Impacts at Selected Locations (Scenario 3)

| Creek / Channel | Structure Location | Flood Level (m AHD) | | |
|---|---|---|---|---|
| | | Ultimate | 2050 | 2100 |
| Norman Creek | Wynnum Road | 1.46 | 1.76 | 2.23 |
| | Stanley Street East | 4.3 | 4.52 | 4.65 |
| | Turbo Street | 4.6 | 4.82 | 4.93 |
| | Deshon Street | 4.9 | 5.08 | 5.18 |
| | Cleveland Rail | 4.92 | 5.11 | 5.21 |
| | Eastern Busway | 5.48 | 5.69 | 5.86 |
| | Logan Road | 5.96 | 6.14 | 6.29 |
| | Cornwall Street | 6.35 | 6.5 | 6.64 |
| | Juliette Street | 7.37 | 7.5 | 7.59 |
| | Ridge Street | 9.68 | 9.78 | 9.87 |
| | South East Freeway | 10.41 | 10.58 | 10.65 |
| | Arnwood Place | 11.30 | 11.48 | 11.61 |
| Ekibin Creek | South East Freeway | 13.07 | 13.59 | 14.07 |
| | Birdwood Road Dev. Bridge | 15.86 | 16.1 | 16.32 |
| | Birdwood Road Dev. Causeway | 16.09 | 16.32 | 16.53 |
| | Birdwood Road | 17.81 | 17.92 | 18.0 |
| | Park Maintenance Crossing | 18.66 | 18.79 | 18.88 |
| Glindemann Creek | Marshall Road | 21.76 | 21.98 | 22.11 |
| | Logan Road | 29.17 | 29.36 | 29.49 |
| | Glindemann Park Footbridge | 29.20 | 29.39 | 29.53 |
| | Glindemann Park Overpipe | 32.69 | 32.78 | 32.87 |
| Scott's Creek | Adina Street | 3.49 | 3.7 | 3.92 |
| | Waite Footbridge | 3.56 | 3.72 | 3.94 |
| Bridgewater Creek | Stanley Street East | 4.01 | 4.23 | 4.4 |
| | Cleveland Rail Crossing | 5.08 | 5.15 | 5.23 |
| | Temple Street | 5.13 | 5.21 | 5.3 |
| Sandy Creek | Sunshine Avenue Footbridge | 12.18 | 12.4 | 13.49 |
| | Sexton Street | 15.33 | 15.42 | 15.5 |
| Coorparoo Creek | Morley Street | 4.48 | 4.6 | 4.72 |
| | Cleveland Rail Crossing | 4.63 | 4.73 | 4.84 |
| | Gladstone Street | 4.84 | 4.93 | 5.04 |

Table 9.4 – 500-yr ARI Climate Change Impacts at Selected Locations (Scenario 3)

| Creek / Channel | Structure Location | Flood Level (m AHD) | |
|---|---|---|---|
| | | Ultimate | 2100 |
| Norman Creek | Wynnum Road | 1.47 | 3.27 |
| | Stanley Street East | 4.57 | 4.84 |
| | Turbo Street | 4.87 | 5.12 |
| | Deshon Street | 5.13 | 5.37 |
| | Cleveland Rail | 5.16 | 5.41 |
| | Eastern Busway | 5.82 | 6.08 |
| | Logan Road | 6.25 | 6.5 |
| | Cornwall Street | 6.6 | 6.87 |
| | Juliette Street | 7.57 | 7.86 |
| | Ridge Street | 9.85 | 10.29 |
| | South East Freeway | 10.62 | 11.34 |
| | Arnwood Place | 11.57 | 12.83 |
| Ekibin Creek | South East Freeway | 13.91 | 15.0 |
| | Birdwood Road Dev. Bridge | 16.25 | 16.79 |
| | Birdwood Road Dev. Causeway | 16.46 | 16.97 |
| | Birdwood Road | 17.98 | 18.18 |
| | Park Maintenance Crossing | 18.85 | 19.11 |
| Glindemann Creek | Marshall Road | 22.07 | 22.27 |
| | Logan Road | 29.45 | 29.72 |
| | Glindemann Park Footbridge | 29.48 | 29.77 |
| | Glindemann Park Overpipe | 32.85 | 33.02 |
| Scott's Creek | Adina Street | 3.81 | 4.98 |
| | Waite Footbridge | 3.84 | 5.28 |
| Bridgewater Creek | Stanley Street East | 4.31 | 4.56 |
| | Cleveland Rail Crossing | 5.19 | 5.28 |
| | Temple Street | 5.25 | 5.35 |
| Sandy Creek | Sunshine Avenue Footbridge | 12.53 | 13.04 |
| | Sexton Street | 15.48 | 15.69 |
| Coorparoo Creek | Morley Street | 4.65 | 4.9 |
| | Cleveland Rail Crossing | 4.79 | 4.98 |
| | Gladstone Street | 4.98 | 5.19 |

# 10.0 Conclusion

This report details the calibration and verification event, design event, extreme event and climate change modelling for the Norman Creek catchment in the south-eastern area of the BCC region. Hydraulic models of the Norman Creek catchment have been developed using the MIKEFLOOD modelling software, whilst refinements to the previous hydrologic model of the catchment have been undertaken using the RAFTS software package. The RAFTS model covers the entire Norman Creek catchment while the MIKEFLOOD model covers the majority of the open channel flow from Glindemann and Sandy Creeks downstream to the Norman Creek confluence with the Brisbane River. The majority of the open channel areas of Mott, Kingfisher, Coorparoo, Bridgewater, and Scott's Creeks are also included in the hydraulic model.

The calibrated RAFTS model from the Norman Creek Water Quantity Assessment (2008) was adopted for use with minimal modification in this study, with the most significant amendment being the addition of the 'External' catchment mainly for the purpose of extreme event modelling. Calibration of the MIKEFLOOD model was undertaken utilising two historical storms; namely 9$^{th}$ March 2001 and the 27$^{th}$ January 2013. Verification of the MIKEFLOOD model was also undertaken utilising two historical storms; namely 7$^{th}$ November 2004 and 20$^{th}$ November 2008.

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, eddy viscosity values, and the hydraulic structure representation. Cross-checks of the MIKEFLOOD 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 9$^{th}$ March 2001 and 27$^{th}$ January 2013 events, including the replication of the rising 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 20$^{th}$ November 2008 event. However, the 7$^{th}$ November 2004 event run did not match the recorded values. The high spatial variability of the rainfall during this event, as discussed earlier in this report, is a plausible justification for this difference.

Given the results of the calibration and verification process were quite reasonable, the RAFTS and MIKEFLOOD 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 2yr ARI to PMF. These analyses assumed ultimate catchment development conditions in accordance with the current version of BCC City Plan. As the Norman Creek catchment is currently considered to be fully developed, with generally only future intensification of current developed areas possible, ultimate catchment conditions were based on the current catchment land-use.

Three waterway scenarios were considered. Scenario 1 is based on the current waterway conditions. No further modifications were made to the MIKEFLOOD model developed as part of the calibration / verification phase (specifically the 27$^{th}$ January 2013 calibration event model). 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.

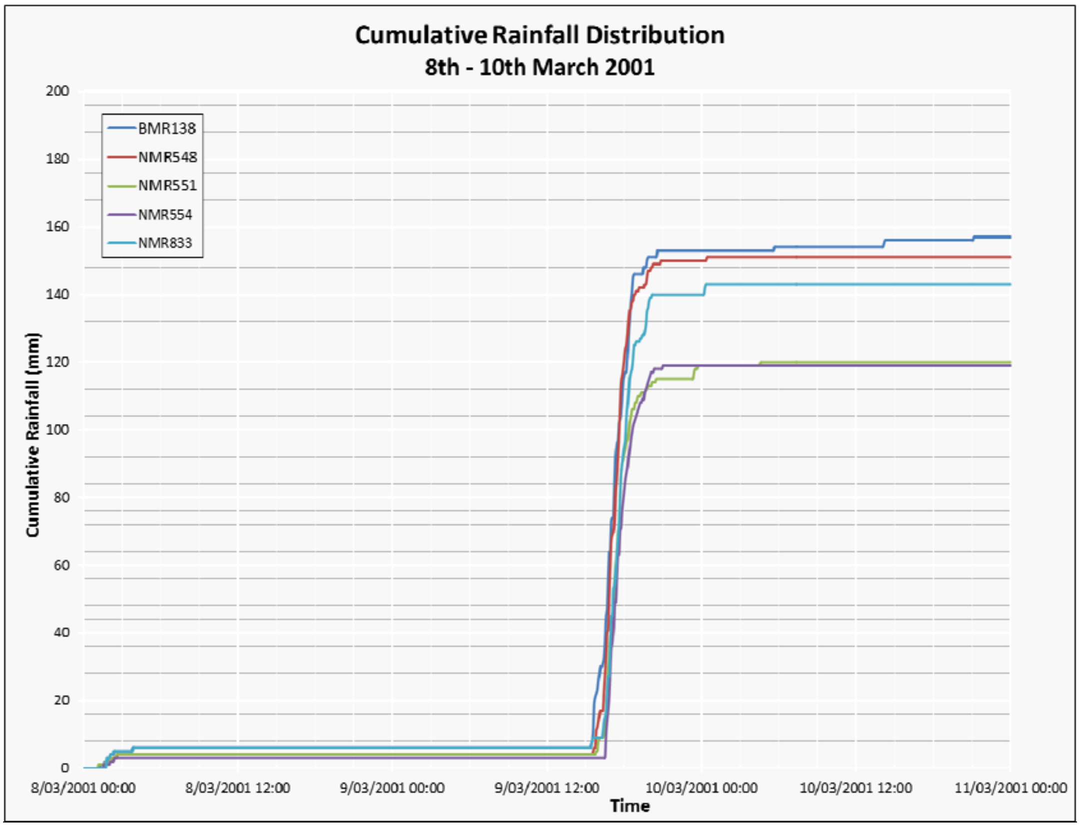
The waterway corridor used for this study was based on the current draft City Plan. Three additional flow conveyance zones were identified along Glindemann and Scott's Creek's and were represented in the model with the same attributes as a Waterway Corridor. It is recommended that these conveyance zones be considered for inclusion within the Waterway Corridor network in future revisions of City Plan.

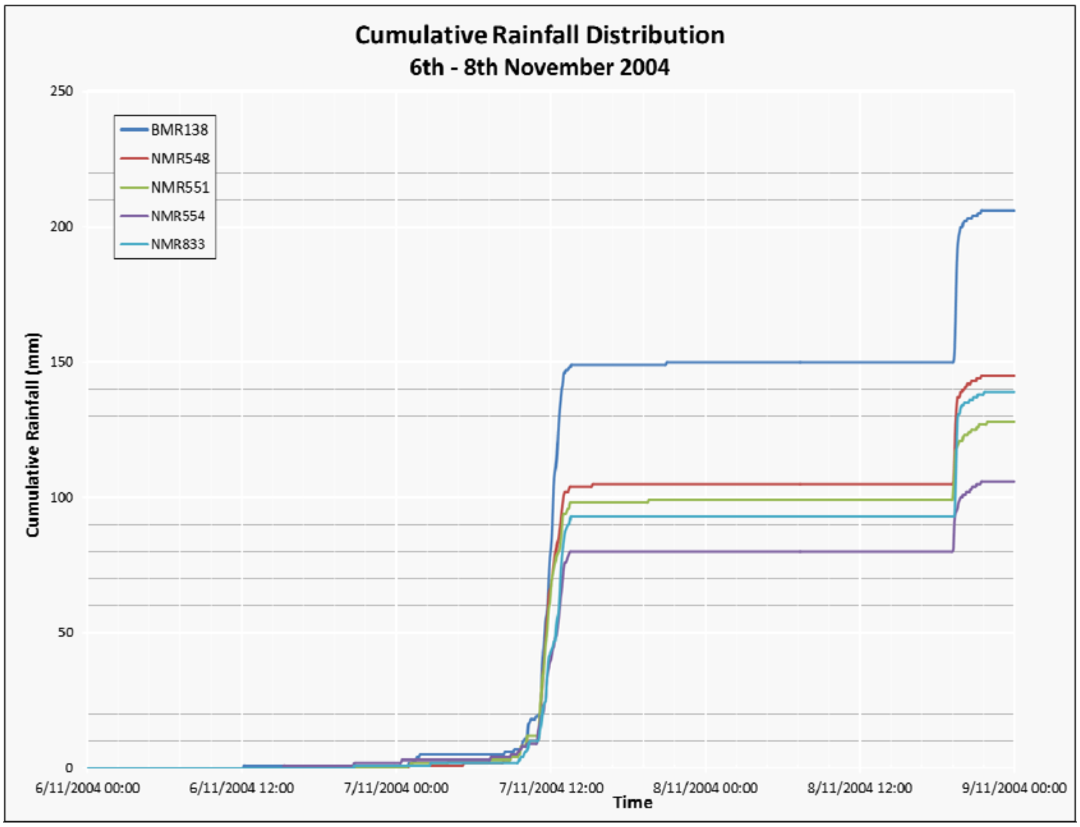
The MIKEFLOOD modelling results were used to determine critical storm durations at selected locations, and flood immunity and headlosses for the hydraulic structures. Results provided peak flood discharges and peak flood levels, which were used to produce peak flood extent, peak flood depth and peak flood depth-velocity mapping.

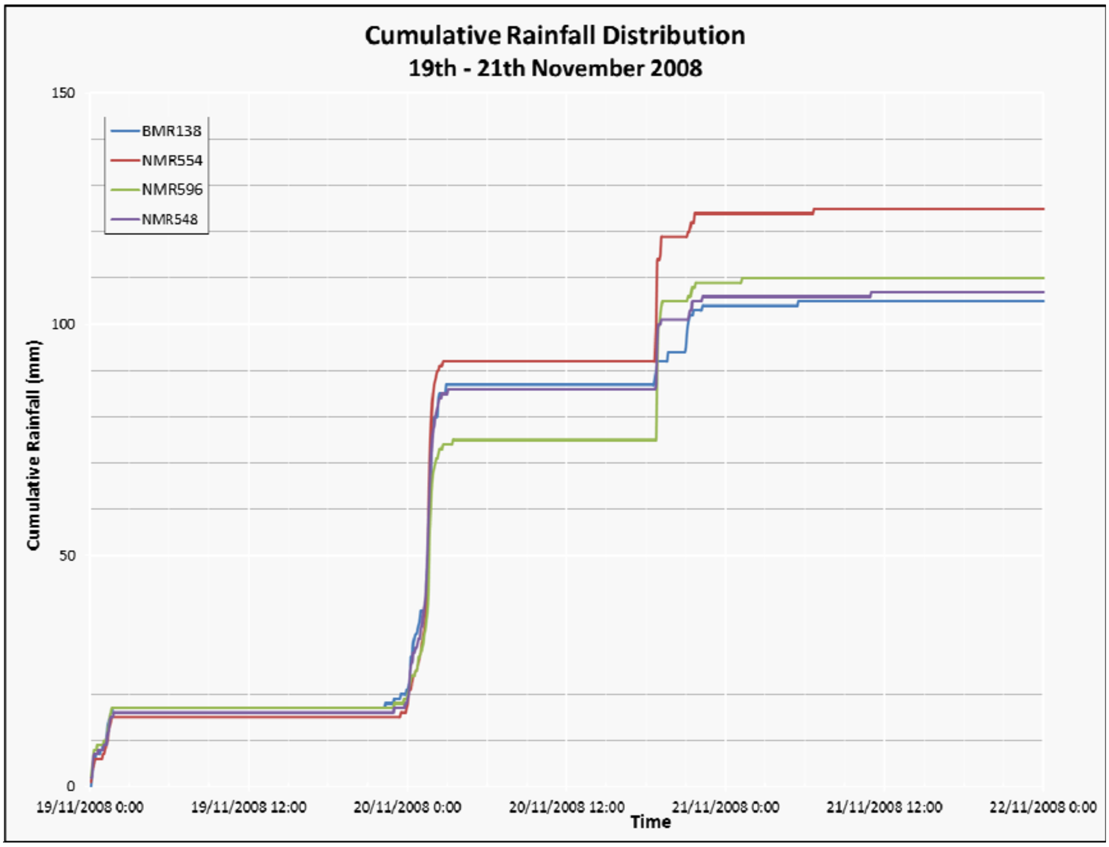
A climate change analysis was then undertaken to determine the impacts for two planning horizons; namely 2050 and 2100. This included making allowances for increased rainfall intensity and increased mean sea level rise. This analysis was undertaken for the 100yr, 200yr and 500yr ARI events.

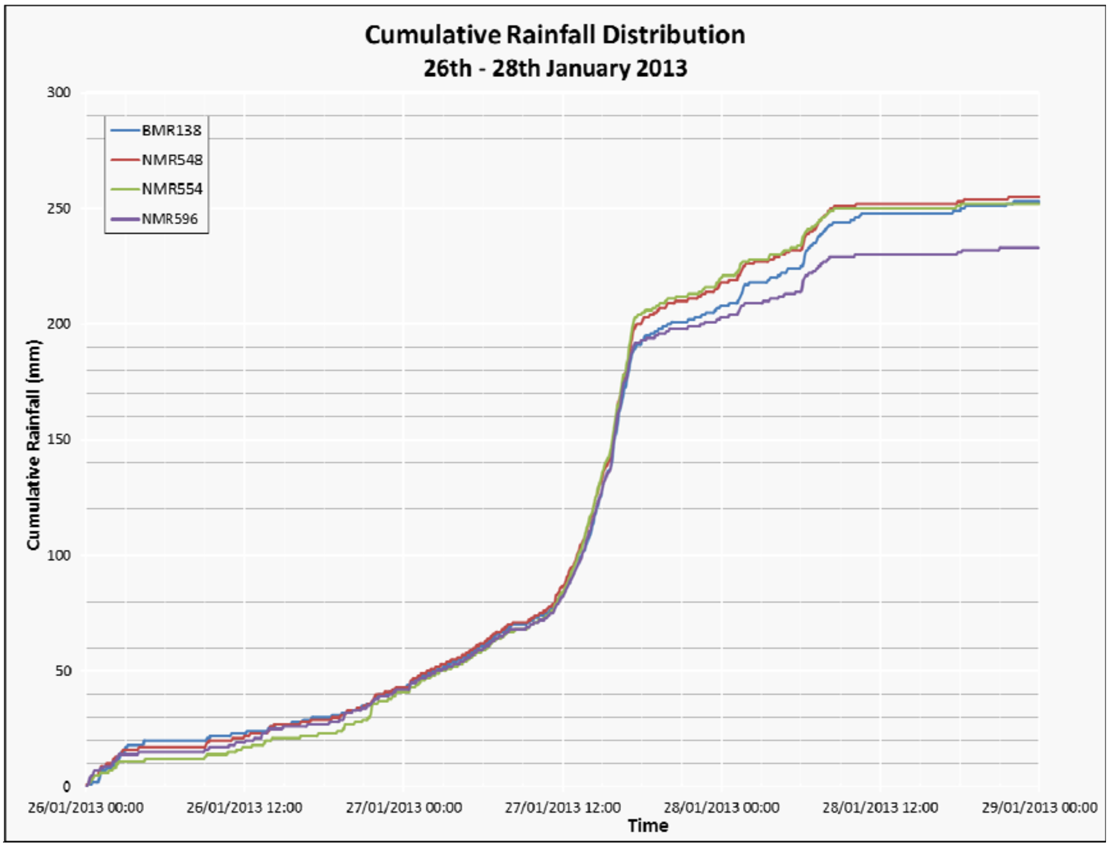
Hydraulic Structure Reference Sheets (HSRS) for all major crossings within the MIKEFLOOD model area were also prepared. The HSRS provide data for each hydraulic structure and includes data relating to the structure description, location, hydraulic performance and history, where available.

# Appendix A: Cumulative Rainfall Distribution


Cumulative Rainfall Distribution
8th - 10th March 2001
BMR138
NMR548
NMR551
NMR554
NMR833
Cumulative Rainfall (mm)
200
180
160
140
120
100
80
60
40
20
0
8/03/2001 00:00
8/03/2001 12:00
9/03/2001 00:00
9/03/2001 12:00
10/03/2001 00:00
10/03/2001 12:00
11/03/2001 00:00
Time


Cumulative Rainfall Distribution
6th - 8th November 2004
BMR138
NMR548
NMR551
NMR554
NMR833
Cumulative Rainfall (mm)
250
200
150
100
50
0
6/11/2004 00:00
6/11/2004 12:00
7/11/2004 00:00
7/11/2004 12:00
8/11/2004 00:00
8/11/2004 12:00
9/11/2004 00:00
Time


Cumulative Rainfall Distribution
19th - 21th November 2008
BMR138
NMR554
NMR596
NMR548
Cumulative Rainfall (mm)
150
100
50
0
19/11/2008 0:00
19/11/2008 12:00
20/11/2008 0:00
20/11/2008 12:00
21/11/2008 0:00
21/11/2008 12:00
22/11/2008 0:00
Time

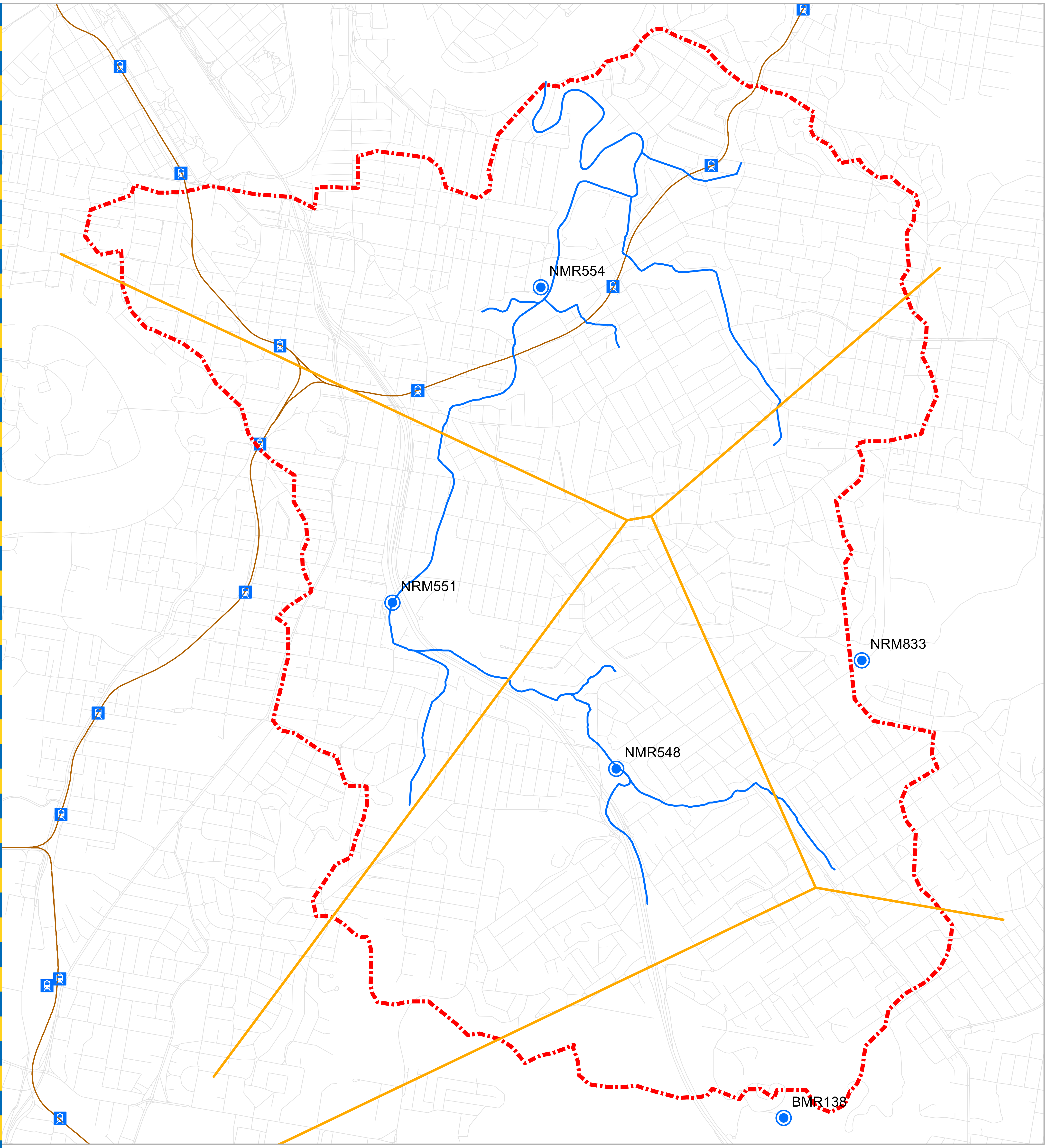

Cumulative Rainfall Distribution
26th - 28th January 2013
BMR138
NMR548
NMR554
NMR596
Cumulative Rainfall (mm)
300
250
200
150
100
50
0
26/01/2013 00:00
26/01/2013 12:00
27/01/2013 00:00
27/01/2013 12:00
28/01/2013 00:00
28/01/2013 12:00
29/01/2013 00:00
Time

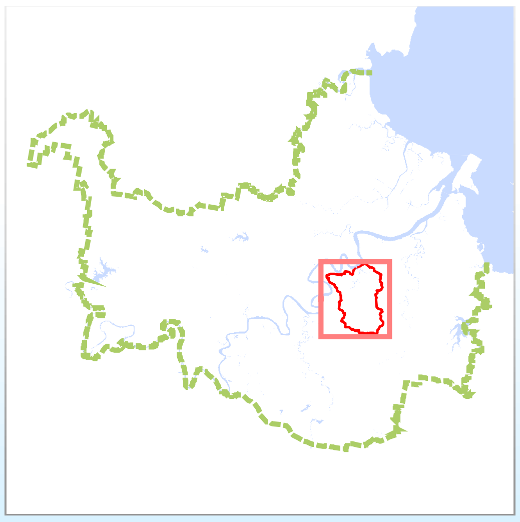
# Appendix B: RAFTS Sub-catchment Parameters

| | Total Area (ha) | Percentage Impervious (%) | Catchment Manning's n (Pervious) | Catchment Manning's n (Impervious) | Catchment Slope (%) |
|---|---|---|---|---|---|
| SHIRE | 12.97 | 0.90 | 0.1 | - | 3.9 |
| FWAY | 8.05 | 61.74 | 0.042 | 0.015 | 4.22 |
| NURSERY | 70.01 | 30.82 | 0.071 | 0.015 | 3.89 |
| RIDGE | 41.12 | 15.64 | 0.094 | 0.015 | 3.45 |
| GAZA | 31.3 | 35.53 | 0.044 | 0.015 | 2.77 |
| MONASH | 40.59 | 10.17 | 0.093 | 0.015 | 3.31 |
| PERONNE | 90.48 | 41.85 | 0.059 | 0.015 | 2.14 |
| BAPAUME | 11.3 | 44.07 | 0.046 | 0.015 | 4.31 |
| STERCUL | 40.1 | 56.63 | 0.026 | 0.015 | 4.83 |
| KURING | 35.49 | 46.38 | 0.05 | 0.015 | 4.4 |
| WELLER | 33.96 | 22.32 | 0.085 | 0.015 | 3.88 |
| BIRDWOOD | 19.08 | 53.51 | 0.033 | 0.015 | 4.35 |
| OATES | 79.29 | 57.64 | 0.033 | 0.015 | 2.51 |
| HOCKING | 46.99 | 53.33 | 0.03 | 0.015 | 2.77 |
| JUSTIN | 46.69 | 49.18 | 0.025 | 0.015 | 2.12 |
| JOACHIM | 58.54 | 51.76 | 0.03 | 0.015 | 1.61 |
| BRAMSTON | 67.74 | 36.39 | 0.066 | 0.015 | 3.3 |
| FERNVALE | 51.56 | 48.72 | 0.041 | 0.015 | 3.3 |
| SHAFT | 51.17 | 44.91 | 0.047 | 0.015 | 2.3 |
| NAVY | 31.99 | 48.58 | 0.032 | 0.015 | 2 |
| BARTER | 107.03 | 54.04 | 0.029 | 0.015 | 1.5 |
| LOGAN | 96.23 | 48.70 | 0.032 | 0.015 | 1.8 |
| ROSEGLEN | 66.72 | 56.47 | 0.025 | 0.015 | 1.6 |
| CAMBRAE | 32.26 | 53.04 | 0.029 | 0.015 | 4.6 |
| NICHOL | 39.39 | 47.02 | 0.039 | 0.015 | 0.6 |
| SEXTON | 81.33 | 48.97 | 0.031 | 0.031 | 1.7 |
| FREEWAY | 101.83 | 56.80 | 0.029 | 0.015 | 1.76 |
| JULIETTE | 48.39 | 30.48 | 0.035 | 0.015 | 2.33 |
| PEACH | 65.36 | 58.17 | 0.026 | 0.015 | 2.08 |
| WRGAUGE | 78.07 | 57.15 | 0.032 | 0.015 | 1.53 |
| CLEVEDS | 0.011 | 9.09 | 0.025 | 0.025 | 0.2 |
| CLEVE | 66.84 | 62.87 | 0.025 | 0.015 | 1.25 |
| IPSWICH | 67.44 | 68.56 | 0.025 | 0.015 | 1.2 |
| CASWELL | 102.06 | 51.58 | 0.037 | 0.015 | 0.15 |
| NORMAN | 176.87 | 71.50 | 0.025 | 0.015 | 0.77 |
| GABBA | 75.89 | 67.45 | 0.031 | 0.015 | 0.42 |
| HARRIES | 153.96 | 62.44 | 0.016 | 0.015 | 1.07 |
| GRAMMAR | 52.46 | 59.78 | 0.037 | 0.015 | 0.61 |
| SCOTT | 135.15 | 53.29 | 0.039 | 0.015 | 0.82 |
| OUTLET | 133.31 | 63.82 | 0.038 | 0.015 | 0.57 |
| FERG | 103.44 | 41.88 | 0.031 | 0.015 | 2.01 |

| | Total Area (ha) | Percentage Impervious (%) | Catchment Manning's n (Pervious) | Catchment Manning's n (Impervious) | Catchment Slope (%) |
|---|---|---|---|---|---|
| OLDCLEVE | 199.55 | 58.17 | 0.03 | 0.015 | 1.25 |
| ASHTON | 75.55 | 74.00 | 0.025 | 0.015 | 1.82 |
| TIBER | 79.98 | 60.48 | 0.042 | 0.015 | 0.87 |

# Appendix C: Thiessen Polygons



## Legend

- Rain Gauges March 2001 and November 2004
- Thiessen Polygon March 2001 and November 2004
- Norman Creek Catchment Boundary
- Railway Stations
- Norman Creek Centreline
- Railway Line
- Streets

0 150 300 450
Metres

N W E S

Prepared : 077900
Checked : NC
Revision : 0
Publication Date : 02 Aug 2013
Project Number : 130286

File : G:\BI\CPO\



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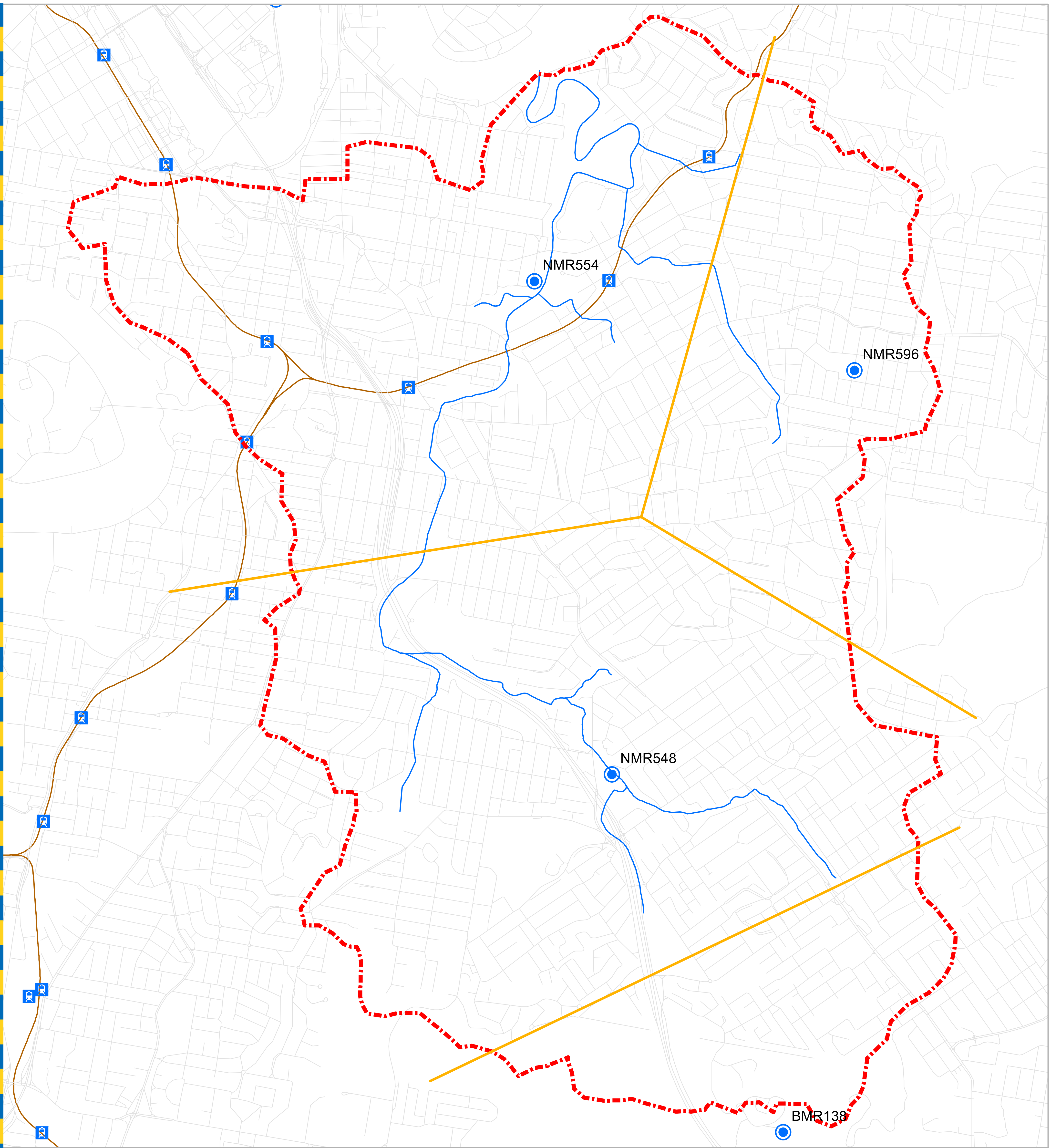
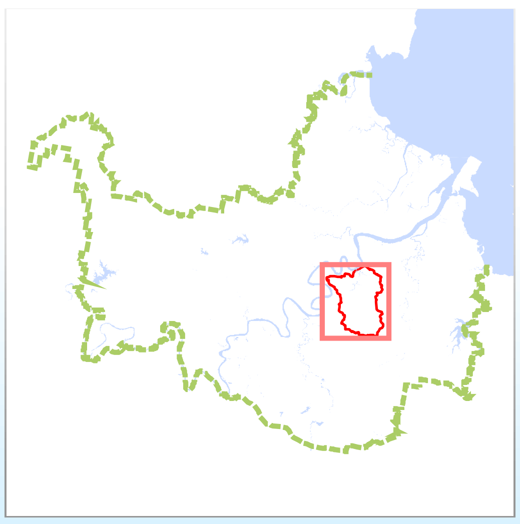
# Appendix C: Thiessen Polygon March 2001 and November 2004

GIM - 100001 - 001



## Legend

- Rain Gauge November 2008 and January 2013
- Thiessen Polygon November 2008 and January2013
- Norman Creek Catchment Boundary
- Norman Creek Centreline
- Railway Stations
- Streets
- Railway Line

0 150 300 450
Metres

N W E S

Prepared : 077900
Checked : NC
Revision : 0
Publication Date : 02 Aug 2013
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File : G:\BI\CPO\



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# Appendix C: Thiessen Polygon November 2008 and January 2013

GIM - 100001 - 001

# Appendix D: 1D Model Cross-Section Log

| Waterway | Chainage | AMTD | Section ID | Section Data |
|---|---|---|---|---|
| Ekibin Lower | 8318 | 1800 | E70 | Cross Sections at Stream Gauges (BCC Project 0390322) 2006 survey / 2009 ALS overbank |
| Ekibin Lower | 8365 | 1752 | E80 | 2003 Birdwood Road DEM / 2009 ALS |
| Ekibin Lower | 8385 | 1732 | E90 | 2003 Birdwood Road DEM / 2009 ALS |
| Ekibin Lower | 8420 | 1697 | E100 | 2003 Birdwood Road DEM / 2009 ALS |
| Ekibin Lower | 8447 | 1669 | E110 | 2003 Birdwood Road DEM / 2009 ALS |
| Ekibin Lower | 8466 | 1651 | E120 | 2003 Birdwood Road DEM / 2009 ALS |
| Ekibin Lower | 8511 | 1606 | E130 | 2003 Birdwood Road DEM / 2009 ALS |
| Ekibin Lower | 8550 | 1566 | E140 | 2003 Birdwood Road DEM / 2009 ALS |
| Ekibin Lower | 8573 | 1542 | E150 | 2003 Birdwood Road DEM / 2009 ALS |
| Ekibin Lower | 8625 | 1491 | E160 | 2003 Birdwood Road DEM / 2009 ALS |
| Ekibin Lower | 8670 | 1446 | E170 | 2003 Birdwood Road DEM / 2009 ALS |
| Ekibin Lower | 8714 | 1401 | E180 | 2003 Birdwood Road DEM / 2009 ALS |
| Ekibin Lower | 8761 | 1355 | E190 | 2003 Birdwood Road DEM / 2009 ALS / notch added at invert to equal Mott Ck connection section for model stability |
| Ekibin Lower | 8842 | 1275 | E200 | 2009 ALS |
| Ekibin Lower | 8893 | 1224 | E210 | 2009 ALS |
| Ekibin Lower | 8920 | 1191 | E220 | 2009 ALS |
| Ekibin Lower | 8967 | 1153 | E230 | N4C Nicholson St Reveg MIKE 11 model (for base invert level only) / ALS 2009 overbanks / notch added at invert to 6.77mAHD to match DS link invert for model stability |
| Ekibin Lower | 9004 | 1117 | E240 | N4C Nicholson St Reveg MIKE 11 model / ALS 2009 for right overbank |
| Ekibin Lower | 9056 | 1065 | E250 | Invert from N4C Nicholson St Reveg MIKE 11 model / ALS 2009 for overbanks |
| Ekibin Lower | 9109 | 1012 | E260 | Invert from N4C Nicholson St Reveg MIKE 11 model / ALS 2009 for overbanks |
| Ekibin Lower | 9155 | 967 | E270 | 2009 ALS overbanks / invert from N4C model CH 10193 / 2012 DTMR Veloway data for 270113 event and design events |
| Ekibin Lower | 9182 | 939 | E280 | 2009 ALS overbanks, invert from N4C model CH 10193 / 2012 DTMR Veloway data for 270113 event and design events |
| Ekibin Lower | 9232 | 888 | E290 | Invert from N4C Nicholson St Reveg MIKE 11 model / ALS 2009 overbanks / 2012 DTMR Veloway data for 270113 event and design events |
| Ekibin Lower | 9286 | 836 | E300 | Invert from N4C Nicholson St Reveg MIKE 11 model / ALS 2009 overbanks / 2012 DTMR Veloway data for 270113 event and design events |
| Ekibin Lower | 9333 | 788 | E310 | Invert from N4C Nicholson St Reveg MIKE 11 model / ALS 2009 overbanks / 2012 DTMR Veloway data for 270113 event and design events |
| Ekibin Lower | 9384 | 737 | E320 | N4C Nicholson St Reveg Project survey / ALS 2009 on extreme right overbank / 2012 DTMR Veloway data for 270113 event and design events |
| Ekibin Lower | 9431 | 690 | E330 | N4C Nicholson St Reveg Project survey / ALS 2009 on extreme right overbank / 2012 DTMR Veloway data for 270113 event and design events |

| Waterway | Chainage | AMTD | Section ID | Section Data |
|---|---|---|---|---|
| Ekibin Lower | 9467 | 655 | E340 | 2009 ALS for overbanks / invert N4C Nicholson St Reveg Project survey / 2012 DTMR Veloway data for 270113 event and design events |
| Ekibin Lower | 9498 | 624 | E350 | N4C Nicholson St Reveg Project survey / ALS 2009 on extreme right overbank / 2012 DTMR Veloway data for 270113 event and design events |
| Ekibin Lower | 9540 | 581 | E360 | N4C Nicholson St Reveg Project survey / 2012 DTMR Veloway data for 270113 event and design events |
| Ekibin Lower | 9601 | 521 | E370 | 2009 ALS for overbanks / invert from N4C Nicholson St Reveg Project survey / 2012 DTMR Veloway data for 270113 event and design events |
| Ekibin Lower | 9648 | 474 | E380 | 2009 ALS for overbanks / invert from N4C Nicholson St Reveg Project survey / 2012 DTMR Veloway data for 270113 event and design events |
| Ekibin Lower | 9673 | 449 | E390 | 2009 ALS for overbanks / invert from N4C Nicholson St Reveg Project survey / 2012 DTMR Veloway data for 270113 event and design events |
| Ekibin Lower | 9744 | 379 | E400 | 2009 ALS for overbanks / invert from N4C Nicholson St Reveg Project survey / 2012 DTMR Veloway data for 270113 event and design events |
| Ekibin Lower | 9811 | 310 | E410 | N4C Nicholson St Reveg Project survey / 2012 DTMR Veloway data for 270113 event and design events |
| Ekibin Lower | 9863 | 258 | E420 | 2009 ALS for overbanks / invert from N4C Nicholson St Reveg Project survey |
| Ekibin Lower | 9893 | 228 | E430 | 2009 ALS / amended invert to same invert as section 9980 in 2008 WQA Model |
| Ekibin Lower | 10045 | 77 | E440 | 2009 ALS with estimated invert from 2008 model section in vicinity |
| Ekibin Lower | 10107 | 15 | E450 | See Sandy S250 |
| Ekibin Upper | 8004 | 2112 | E10 | BCC Project 110732 Norman Ck 2026 survey (2011) / 2009 ALS overbank |
| Ekibin Upper | 8028 | 2082 | E20 | BCC Project 110732 Norman Ck 2026 survey (2011) / 2009 ALS overbank (invert widened for structure stability) |
| Ekibin Upper | 8040 | 2071 | W_EU_8 040 | BCC Project 110732 Norman Ck 2026 survey (2011) / 2009 ALS overbank |
| Ekibin Upper | 8058 | 2058 | E30 | BCC Project 110732 Norman Ck 2026 survey (2011) / 2009 ALS overbank (invert widened for structure stability) |
| Ekibin Upper | 8120 | 1996 | E35 | 2002 ALS with inbank from Drawing L-12-100 |
| Ekibin Upper | 8135 | 1981 | E40 | BCC Project 110732 Norman Ck 2026 survey (2011) / 2009 ALS overbank |
| Ekibin Upper | 8220 | 1896 | E50 | Cross Sections at Stream Gauges (0390322) 2006 survey |
| Ekibin Upper | 8271 | 1845 | E60 | Cross Sections at Stream Gauges (0390322) 2006 survey |
| Glindemann | 6054 | 1926 | G10 | 2009 ALS for overbank / trapezoidal for inbank / Drawing W11050 for invert |
| Glindemann | 6085 | 1895 | G20 | Drawing W11050 |
| Glindemann | 6115 | 1862 | G30 | Drawing W11050 |
| Glindemann | 6125 | 1857 | G40 | Drawing W11050 |
| Glindemann | 6154 | 1826 | G50 | Drawing W11050 |
| Glindemann | 6188 | 1792 | G60 | Drawing W11050 |
| Glindemann | 6218 | 1759 | G70 | Drawing W11050 |
| Glindemann | 6228 | 1755 | G80 | Drawing W11050 |
| Glindemann | 6253 | 1727 | G90 | Based on 2009 ALS / in-bank from Drawing W11050 CH 20 |
| Glindemann | 6260 | 1721 | G100 | Piped, Drawing 8063/2A |

| Waterway | Chainage | AMTD | Section ID | Section Data |
|---|---|---|---|---|
| Glindemann | 6390 | 1590 | G110 | Piped, Drawing 8063/2A |
| Glindemann | 6397 | 1583 | G120 | 2009 ALS / inbank from Survey 2005 |
| Glindemann | 6472 | 1507 | G130 | 2009 ALS / inbank from Survey 2005 |
| Glindemann | 6525 | 1455 | G140 | 2005 ground survey (BCC Project 041852) |
| Glindemann | 6624 | 1355 | G150 | 2005 ground survey (BCC Project 041852) |
| Glindemann | 6714 | 1265 | G160 | 2005 ground survey (BCC Project 041852) / 2009 ALS overbanks |
| Glindemann | 6773 | 1204 | G170 | 2005 ground survey (BCC Project 041852) / 2009 ALS overbanks |
| Glindemann | 6783 | 1196 | G180 | 2005 ground survey (BCC Project 041852) / 2009 ALS right overbank |
| Glindemann | 6843 | 1136 | G190 | 2005 ground survey (BCC Project 041852) / 2009 ALS overbanks |
| Glindemann | 6912 | 1067 | G200 | 2005 ground survey (BCC Project 041852) / 2009 ALS overbanks |
| Glindemann | 6944 | 1041 | G210 | 2009 ALS / Survey 2005 / invert from Drawing L-4-19 |
| Glindemann | 6993 | 987 | G220 | Drawing W8037 / 2009 ALS overbanks |
| Glindemann | 6998 | 980 | G230 | 2009 ALS |
| Glindemann | 7047 | 933 | G240 | Drawing W8037 / 2009 ALS overbanks |
| Glindemann | 7057 | 922 | G250 | Drawing W8037 |
| Glindemann | 7091 | 889 | G260 | Drawing W8037 / 2009 ALS overbanks |
| Glindemann | 7125 | 855 | G270 | Drawing W8037 / 2009 ALS overbanks |
| Glindemann | 7135 | 844 | G280 | Drawing W8037 / 2009 ALS overbanks |
| Glindemann | 7150 | 830 | G290 | Drawing W8037 / 2009 ALS overbanks |
| Glindemann | 7155 | 824 | G300 | Piped, Drawing 3087/1 |
| Glindemann | 7210 | 771 | G310 | Piped, Drawing 3087/1 |
| Glindemann | 7305 | 680 | G320 | Piped, Drawing 3087/1 |
| Glindemann | 7310 | 670 | G330 | Manual estimate based on site visit (2004 WQA model) / H115 Project survey / 2009 ALS |
| Glindemann | 7360 | 621 | G340 | H115 Project survey / 2009 ALS overbanks |
| Glindemann | 7408 | 573 | G350 | Drawing 4972/6 / 2009 ALS overbanks |
| Glindemann | 7413 | 567 | G360 | Piped, Drawing 4972/6 |
| Glindemann | 7475 | 505 | G370 | Piped, Drawing 4972/6 |
| Glindemann | 7480 | 500 | G380 | Manual estimate based on site visit (2004 WQA model) / H115 Project survey / 2009 ALS extensions |
| Glindemann | 7522 | 458 | G390 | 2009 ALS / invert adjusted (2004 WQA model) |
| Glindemann | 7577 | 403 | G400 | 2009 ALS / invert adjusted (2004 WQA model) |
| Glindemann | 7632 | 348 | G410 | 2009 ALS / invert adjusted (2004 WQA model) |
| Glindemann | 7659 | 322 | G420 | 2009 ALS / invert adjusted (2004 WQA model) |
| Glindemann | 7696 | 284 | G430 | 2009 ALS / inbank from site measurements (2004 WQA) / invert amended to ALS2009 |
| Glindemann | 7763 | 217 | G440 | 2009 ALS / Drawing L-12-100 |
| Glindemann | 7841 | 139 | G450 | 2009 ALS / Drawing L-12-100 |
| Glindemann | 7895 | 86 | G460 | 2009 ALS / Drawing L-12-100 |

| Waterway | Chainage | AMTD | Section ID | Section Data |
|---|---|---|---|---|
| Glindemann | 7938 | 43 | G470 | 2009 ALS / Norman 2026 survey for invert (BCC Project 110732) / notch added at invert to equal DS section connection for model stability |
| Mott | 1000 | 424 | M10 | 2009 ALS |
| Mott | 1034 | 390 | M20 | 2009 ALS |
| Mott | 1076 | 348 | M30 | Norman Ck 2026 Hydraulic Survey (BCC Project 120309) / ALS 2009 overbanks |
| Mott | 1111 | 313 | M40 | Norman Ck 2026 Hydraulic Survey (BCC Project 120309) / ALS 2009 overbanks |
| Mott | 1139 | 285 | M50 | Norman Ck 2026 Hydraulic Survey (BCC Project 120309) / ALS 2009 overbanks |
| Mott | 1167 | 257 | M60 | Norman Ck 2026 Hydraulic Survey (BCC Project 120309) / ALS 2009 overbanks |
| Mott | 1187 | 237 | M70 | Norman Ck 2026 Hydraulic Survey (BCC Project 120309) / ALS 2009 overbanks |
| Mott | 1210 | 214 | M80 | Norman Ck 2026 Hydraulic Survey (BCC Project 120309) / ALS 2009 overbanks |
| Mott | 1232 | 192 | M90 | Norman Ck 2026 Hydraulic Survey (BCC Project 120309) / ALS 2009 overbanks |
| Mott | 1264 | 160 | M100 | Norman Ck 2026 Hydraulic Survey (BCC Project 120309) / ALS 2009 overbanks |
| Mott | 1292 | 132 | M110 | Norman Ck 2026 Hydraulic Survey (BCC Project 120309) / ALS 2009 overbanks |
| Mott | 1316 | 108 | M120 | Norman Ck 2026 Hydraulic Survey (BCC Project 120309) / ALS 2009 overbanks |
| Mott | 1351 | 73 | M130 | ALS 2009 |
| Norman | 10220 | 7133 | N10 | Norman Ck 2026 Hydraulic Survey (BCC Project 120309) / ALS 2009 overbanks |
| Norman | 10255 | 7098 | N20 | Norman Ck 2026 Hydraulic Survey (BCC Project 120309) / ALS 2009 overbanks |
| Sandy | 1000 | 869 | S10 | Norman Ck 2026 Hydraulic Survey (BCC Project 120309) |
| Sandy | 1081 | 788 | S20 | Norman Ck 2026 Hydraulic Survey (BCC Project 120309) / ALS 2009 overbanks |
| Sandy | 1174 | 695 | S30 | Norman Ck 2026 Hydraulic Survey (BCC Project 120309) / ALS 2009 overbanks |
| Sandy | 1224 | 645 | S40 | Norman Ck 2026 Hydraulic Survey (BCC Project 120309) / ALS 2009 overbanks |
| Sandy | 1264 | 605 | S50 | Norman Ck 2026 Hydraulic Survey (BCC Project 120309) / ALS 2009 overbanks |
| Sandy | 1304 | 565 | S60 | Norman Ck 2026 Hydraulic Survey (BCC Project 120309) / ALS 2009 overbanks |
| Sandy | 1322 | 547 | S70 | 2009 ALS |
| Sandy | 1329 | 540 | S80 | 2009 ALS / revised invert to tie in with S70 and invert of structure |
| Sandy | 1351 | 518 | S100 | 2008 Ground Survey / 2009 ALS right overbank |
| Sandy | 1377 | 492 | S110 | 2009 ALS overbanks / 2008 Ground Survey (channel) copy of 2004 WQA model section 1379 |
| Sandy | 1379 | 490 | S120 | 2009 ALS overbanks / 2008 Ground Survey (channel) |
| Sandy | 1381 | 488 | S130 | 2009 ALS overbanks / 2008 Ground Survey (channel) copy of 2004 WQA model section 1379 |
| Sandy | 1408 | 461 | S140 | 2009 ALS / adjusted invert to WQA 2008 section at same location |

| Waterway | Chainage | AMTD | Section ID | Section Data |
|---|---|---|---|---|
| Sandy | 1430 | 439 | S150 | 2008 Ground Survey copy of WQA 2008 section 1432 / 2009 ALS overbanks |
| Sandy | 1432 | 437 | S160 | 2008 Ground Survey / 2009 ALS overbanks |
| Sandy | 1434 | 435 | S170 | 2008 Ground Survey copy of WQA 2008 section 1432 / 2009 ALS overbanks |
| Sandy | 1448 | 421 | E_S_1448 | 2008 Ground Survey |
| Sandy | 1444 | 425 | S180 | Copy of E_S_1448 / amended invert to 9.5mAHD for stability at bridge |
| Sandy | 1455 | 414 | S190 | 2009 ALS overbanks / S180 channel for in-channel (structure stability purposes) |
| Sandy | 1527 | 342 | S200 | 2008 Ground Survey |
| Sandy | 1579 | 290 | S210 | 2008 Ground Survey |
| Sandy | 1619 | 250 | S220 | 2008 Ground Survey |
| Sandy | 1688 | 181 | S230 | 2008 Ground Survey |
| Sandy | 1774 | 95 | S240 | 2009 ALS / invert interpolated from Sandy Ck Rehab Project sections Sec1 and Sec2 |
| Sandy | 1845 | 24 | S250 | Norman Ck 2026 (BCC Project 120309) survey / 2009 ALS overbanks |

# Appendix E: Structure Head-loss Comparison

Four bridge structures within the Norman Creek catchment were selected for structure head-loss verification. The verification was conducted using a steady-state HEC-RAS (4.1) 1D model. The four structures subjected to head-loss verification were:

- Bridge over Ekibin Creek lower at Birdwood Rd development, Birdwood Rd, Holland Park West (Structure ID 12)
- Bridge over Norman Creek at Arnwood Place, Tarragindi (Structure ID 10)
- Bridge over Norman Creek at Juliette St, Greenslopes (Structure ID 8)
- Bridge over Bridgewater Creek at Temple St, Coorparoo (Structure ID 25)

A comparison of head-losses across the structures in MIKEFLOOD and HECRAS are detailed in Table E1 to Table E4 below.

Table E1 – Structure Head-loss Comparison – Birdwood Rd, Holland Park West

| Approximate ARI (years) | Discharge ($m^3/s$) | MIKEFLOOD Structure Head-loss (m) | HEC-RAS Structure Head-loss (m) | Head-loss difference (MIKEFLOOD minus HEC-RAS) (m) |
|---|---|---|---|---|
| 100 | 126 | 0.07 | 0.18 | -0.11 |
| 50 | 111 | 0.05 | 0.10 | -0.05 |
| 20 | 95 | 0.03 | 0.08 | -0.05 |
| 10 | 83 | 0.03 | 0.09 | -0.06 |
| 5 | 74 | 0.03 | 0.08 | -0.05 |
| 2 | 58 | 0.02 | 0.07 | -0.05 |

Table E2 – Structure Head-loss Comparison – Arnwood Pl, Tarragindi

| Approximate ARI (years) | Discharge ($m^3/s$) | MIKEFLOOD Structure Head-loss (m) | HEC-RAS Structure Head-loss (m) | Head-loss difference (MIKEFLOOD minus HEC-RAS) (m) |
|---|---|---|---|---|
| 100 | 213 | 0.11 | 0.02 | 0.09 |
| 50 | 190 | 0.15 | 0.02 | 0.13 |
| 20 | 160 | 0.18 | 0.02 | 0.16 |
| 10 | 136 | 0.18 | 0.02 | 0.16 |
| 5 | 119 | 0.18 | 0.01 | 0.17 |
| 2 | 90 | 0.17 | 0.02 | 0.15 |

Table E3 – Structure Head-loss Comparison – Juliette St, Greenslopes

| Approximate ARI (years) | Discharge ($m^3/s$) | MIKEFLOOD Structure Head-loss (m) | HEC-RAS Structure Head-loss (m) | Head-loss difference (MIKEFLOOD minus HEC-RAS) (m) |
|---|---|---|---|---|
| 100 | 244 | 0.97 | 0.92 | 0.05 |
| 50 | 214 | 0.89 | 0.65 | 0.24 |
| 20 | 177 | 0.73 | 0.41 | 0.32 |
| 10 | 152 | 0.48 | 0.30 | 0.18 |
| 5 | 133 | 0.41 | 0.23 | 0.18 |
| 2 | 101 | 0.28 | 0.15 | 0.13 |

Table E4 – Structure Head-loss Comparison – Temple St, Coorparoo

| Approximate ARI (years) | Discharge ($m^3/s$) | MIKEFLOOD Structure Head-loss (m) | HEC-RAS Structure Head-loss (m) | Head-loss difference (MIKEFLOOD minus HEC-RAS) (m) |
|---|---|---|---|---|
| 100 | 69.2 | 0.05 | 0.10 | -0.05 |
| 50 | 64.7 | 0.08 | 0.12 | -0.04 |
| 20 | 57.5 | 0.10 | 0.15 | -0.05 |
| 10 | 52.8 | 0.12 | 0.19 | -0.07 |
| 5 | 47.6 | 0.13 | 0.17 | -0.04 |
| 2 | 39.5 | 0.14 | 0.16 | -0.02 |

# Appendix F: Hydraulic Structure Reference Sheets

| Structure | Creek | ID | Page |
|---|---|---|---|
| Glindemann Park Overpipe | Glindemann Creek | 23 | F-3 |
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| Logan Road | Glindemann Creek | 21 | F-9 |
| Iveagh Street Overpipe | Glindemann Creek | 20 | F-12 |
| Balis Street Overpipe | Glindemann Creek | 19 | F-15 |
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| South East Freeway (U/S) | Ekibin Creek | 13 | F-33 |
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| South East Freeway (D/S) | Norman Creek | 11 | F-45 |
| Ridge Street | Norman Creek | 10 | F-48 |
| Juliette Street | Norman Creek | 9 | F-51 |
| Cornwall Street | Norman Creek | 8 | F-54 |
| Logan Road | Norman Creek | 7 | F-57 |
| Eastern Busway | Norman Creek | 6 | F-60 |
| Cleveland Rail | Norman Creek | 5 | F-63 |
| Deshon Street | Norman Creek | 4 | F-66 |
| Turbo Drive | Norman Creek | 3 | F-69 |
| Stanley Street East | Norman Creek | 2 | F-72 |
| Wynnum Road | Norman Creek | 1 | F-75 |
| Temple Street | Bridgewater Creek | 29 | F-78 |
| Cleveland Rail | Bridgewater Creek | 28 | F-81 |
| Stanley Street | Bridgewater Creek | 27 | F-84 |
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| Cleveland Rail | Coorparoo Creek | 25 | F-90 |
| Morley Street | Coorparoo Creek | 24 | F-93 |
| Adina Street | Scott's Creek | 30 | F-96 |
| Waite Street Footbridge | Scott's Creek | 31 | F-99 |

| Creek | Glindemann Creek |
|---|---|
| Location | Glindermann Park Overpipe (ID 23) |

| | | | |
|---|---|---|---|
| INFO SOURCE: | Design Drawings, BCC Spatial Information Database | UBD REF: | 180 R16 |
| DATE OF SURVEY: | | ASSET ID: | P18000286 |
| MIKE CHAINAGE (m): | 6260 | AMTD (m) | 1721 |

STRUCTURE DESCRIPTION: Pipe Culvert

STRUCTURE SIZE: 1/1.8m RCP

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): 28.78 UPSTREAM OBVERT LEVEL (m AHD): 30.58

DOWNSTREAM INVERT LEVEL (m AHD): 27.88 DOWNSTREAM OBVERT LEVEL (m AHD): 29.68

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m): 130

LENGTH OF CULVERT BARREL AT OBVERT (m): 130

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 130 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: W8063

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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: 1989

HAS THE STRUCTURE BEEN UPGRADED?

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Culvert modelled as a 'closed circular' cross sections in the hydraulic model

| | |
|---|---|
| **Creek** | **Glindemann Creek** |
| **Location** | **Glindermann Park Overpipe (ID 23)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 54.6 | 32.65 | 31.09 | 1560 |
| 50 | 48.4 | 32.55 | 30.98 | 1570 |
| 20 | 42.9 | 32.45 | 30.88 | 1570 |
| 10 | 36.6 | 32.34 | 30.75 | 1590 |
| 5 | 31.8 | 32.24 | 30.66 | 1580 |
| 2 | 23.8 | 32.05 | 30.46 | 1590 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Glindemann Creek |
| --- | --- |
| Location | Glindermann Park Overpipe (ID 23) |


Glindemann Park Overflow

| | |
|---|---|
| **Creek** | **Glindemann Creek** |
| **Location** | **Glindemann Park Footbridge (ID 22)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | Design Drawings, Site Measurements | UBD REF: | 180 R16 |
| DATE OF SURVEY: | | ASSET ID: | |
| MIKE CHAINAGE (m): | 6778 | AMTD (m) | 1199 |

STRUCTURE DESCRIPTION: Pipe Culvert

STRUCTURE SIZE: 4/0.6m RCP

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

| | | | |
|---|---|---|---|
| UPSTREAM INVERT LEVEL (m AHD): | 25.4 | UPSTREAM OBVERT LEVEL (m AHD): | 26 |
| DOWNSTREAM INVERT LEVEL (m AHD): | 25.4 | DOWNSTREAM OBVERT LEVEL (m AHD): | 26 |
| For culverts give floor level | | For bridges give bed level | |

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m): 3.98

LENGTH OF CULVERT BARREL AT OBVERT (m): 3.98

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 3.98 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: W8063

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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: 1987

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Culvert modelled using a 'culvert' and 'weir' approach in the hydraulic model.

| | |
|---|---|
| **Creek** | **Glindemann Creek** |
| **Location** | **Glindemann Park Footbridge (ID 22)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 41.9 | 29.03 | 29.02 | 10 |
| 50 | 38.0 | 28.8 | 28.8 | 0 |
| 20 | 39.0 | 28.45 | 28.45 | 0 |
| 10 | 34.0 | 28.11 | 28.11 | 0 |
| 5 | 29.3 | 27.92 | 27.86 | 60 |
| 2 | 21.9 | 27.78 | 27.36 | 420 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Glindemann Creek |
| --- | --- |
| **Location** | **Glindemann Park Footbridge (ID 22)** |


Glindemann Park Footbridge Location

Glindemann Park Footbridge looking upstream

| Creek | Glindemann Creek |
|---|---|
| Location | Logan Rd Crossing (ID 21) |

| | | | |
|---|---|---|---|
| INFO SOURCE: | Design Drawings | UBD REF: | 180 P15 |
| DATE OF SURVEY: | | ASSET ID: | P18000001 |
| MIKE CHAINAGE (m): | 6969 | AMTD (m) | 1006 |

STRUCTURE DESCRIPTION: Pipe Culvert

STRUCTURE SIZE: 2/1.8m RCP

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): 24.3 UPSTREAM OBVERT LEVEL (m AHD): 26.1

DOWNSTREAM INVERT LEVEL (m AHD): 23.97 DOWNSTREAM OBVERT LEVEL (m AHD): 25.77

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m): 34.04

LENGTH OF CULVERT BARREL AT OBVERT (m): 34.04

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 34.04 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: L-4-19

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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: 1951

HAS THE STRUCTURE BEEN UPGRADED? Yes

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Culvert modelled using a 'culvert' and 'weir' approach in the hydraulic model. Logan Rd culverts have been extended in 1951.

| Creek | Glindemann Creek |
|---|---|
| **Location** | **Logan Rd Crossing (ID 21)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 35.0 | 29.01 | 26.59 | 2420 |
| 50 | 29.4 | 28.78 | 26.3 | 2480 |
| 20 | 25.7 | 28.43 | 26.09 | 2340 |
| 10 | 24.0 | 28.08 | 25.99 | 2090 |
| 5 | 23.1 | 27.82 | 25.93 | 1890 |
| 2 | 20.6 | 27.26 | 25.77 | 1490 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Glindemann Creek |
|---|---|
| Location | Logan Rd Crossing (ID 21) |


Logan Road Location

| | |
|---|---|
| **Creek** | **Glindemann Creek** |
| **Location** | **Iveagh St Overpipe (ID 20)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | Design Drawings, BCC Spatial Information Database | UBD REF: | 180 N15 |
| DATE OF SURVEY: | | ASSET ID: | P17000138 / 9 |
| MIKE CHAINAGE (m): | 7155 | AMTD (m) | 824 |

STRUCTURE DESCRIPTION: Pipe Culvert

STRUCTURE SIZE: 2/1.8m RCP

For Culverts: Number of cells/pipes & sizes  For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): 22.13  UPSTREAM OBVERT LEVEL (m AHD): 23.93

DOWNSTREAM INVERT LEVEL (m AHD): 20.76  DOWNSTREAM OBVERT LEVEL (m AHD): 22.56

For culverts give floor level  For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m): 147.46

LENGTH OF CULVERT BARREL AT OBVERT (m): 147.46

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 147.46  LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: W3087

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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: 1965

HAS THE STRUCTURE BEEN UPGRADED?

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Culvert modelled as a 'closed circular' cross sections in the hydraulic model

| | |
|---|---|
| **Creek** | **Glindemann Creek** |
| **Location** | **Iveagh St Overpipe (ID 20)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 37.1 | 25.56 | 22.92 | 2640 |
| 50 | 31.6 | 25.45 | 22.76 | 2690 |
| 20 | 27.5 | 25.21 | 22.65 | 2560 |
| 10 | 25.6 | 25.12 | 22.59 | 2530 |
| 5 | 24.3 | 25.02 | 22.56 | 2460 |
| 2 | 21.3 | 24.78 | 22.46 | 2320 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| | |
|---|---|
| **Creek** | **Glindemann Creek** |
| **Location** | **Iveagh St Overpipe (ID 20)** |


Iveagh Street Overpipe Location

| Creek | Glindemann Creek |
|---|---|
| Location | Balis St Overpipe (ID 19) |

| | | | |
|---|---|---|---|
| INFO SOURCE: | Design Drawings, BCC Spatial Information Database | UBD REF: | 180 M15 |
| DATE OF SURVEY: | | ASSET ID: | P17000007 |
| MIKE CHAINAGE (m): | 7413 | AMTD (m) | 567 |

STRUCTURE DESCRIPTION: Pipe Culvert

STRUCTURE SIZE: 1/1.95

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

| | | | |
|---|---|---|---|
| UPSTREAM INVERT LEVEL (m AHD): | 19.84 | UPSTREAM OBVERT LEVEL (m AHD): | 21.78 |
| DOWNSTREAM INVERT LEVEL (m AHD): | 19.4 | DOWNSTREAM OBVERT LEVEL (m AHD): | 21.35 |
| For culverts give floor level | | For bridges give bed level | |

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m): 61

LENGTH OF CULVERT BARREL AT OBVERT (m): 61

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 61 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: W3087

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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: 1965

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Culvert modelled as a 'closed circular' cross sections in the hydraulic model

| | |
|---|---|
| **Creek** | **Glindemann Creek** |
| **Location** | **Balis St Overpipe (ID 19)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 37.0 | 22.64 | 21.68 | 960 |
| 50 | 31.4 | 22.53 | 21.33 | 1200 |
| 20 | 27.3 | 22.45 | 21.12 | 1330 |
| 10 | 25.4 | 22.41 | 21.04 | 1370 |
| 5 | 24.1 | 22.39 | 20.98 | 1410 |
| 2 | 20.9 | 22.31 | 20.84 | 1470 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| | |
|---|---|
| **Creek** | **Glindemann Creek** |
| **Location** | **Balis St Overpipe (ID 19)** |


Balis Street Overpipe Location

| Creek | Glindemann Creek |
|---|---|
| Location | Marshall Rd (ID 18) |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA, BCC Spatial Information Database | UBD REF: | 180 L15 |
| DATE OF SURVEY: | 2004 | ASSET ID: | P17000008 |
| MIKE CHAINAGE (m): | 7680 | AMTD (m) | 301 |

STRUCTURE DESCRIPTION: Pipe Culvert

STRUCTURE SIZE: 4/1.5m RCP

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): 17.8 UPSTREAM OBVERT LEVEL (m AHD): 19.3

DOWNSTREAM INVERT LEVEL (m AHD): 17.7 DOWNSTREAM OBVERT LEVEL (m AHD): 19.2

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m): 19

LENGTH OF CULVERT BARREL AT OBVERT (m): 19

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 19 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: W707A

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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: 1959

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Culvert modelled using a 'culvert' and 'weir' approach in the hydraulic model

| | |
|---|---|
| **Creek** | **Glindemann Creek** |
| **Location** | **Marshall Rd (ID 18)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 35.1 | 21.5 | 19.88 | 1620 |
| 50 | 30.4 | 20.96 | 19.77 | 1190 |
| 20 | 27.2 | 20.46 | 19.69 | 770 |
| 10 | 25.3 | 20.27 | 19.63 | 640 |
| 5 | 24.1 | 20.14 | 19.58 | 560 |
| 2 | 20.8 | 19.83 | 19.47 | 360 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| | |
|---|---|
| **Creek** | **Glindemann Creek** |
| **Location** | **Marshall Rd (ID 18)** |

Marshall Road, looking upstream

Marshall Road, looking downstream

| | |
|---|---|
| **Creek** | **Ekibin Creek** |
| **Location** | **Park Maintenance Path (ID 17)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA | UBD REF: | 180 K14 |
| DATE OF SURVEY: | 2004 | ASSET ID: | L-12-100 |
| MIKE CHAINAGE (m): | 8040 | AMTD (m) | 2071 |

STRUCTURE DESCRIPTION: Pipe Culvert

STRUCTURE SIZE: 4/1.5m RCP

For Culverts: Number of cells/pipes & sizes    For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): 15.67    UPSTREAM OBVERT LEVEL (m AHD): 17.17

DOWNSTREAM INVERT LEVEL (m AHD): 15.6    DOWNSTREAM OBVERT LEVEL (m AHD): 17.1

For culverts give floor level    For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m): 16

LENGTH OF CULVERT BARREL AT OBVERT (m): 16

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 16    LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: L-12-100

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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: 1963

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Culvert modelled using a 'culvert' and 'weir' approach in the hydraulic model

| | |
|---|---|
| **Creek** | **Ekibin Creek** |
| **Location** | **Park Maintenance Path (ID 17)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 126.4 | 18.56 | 18.48 | 80 |
| 50 | 111.9 | 18.5 | 18.38 | 120 |
| 20 | 96.7 | 18.44 | 18.27 | 170 |
| 10 | 84.1 | 18.37 | 18.17 | 200 |
| 5 | 75.2 | 18.32 | 18.09 | 230 |
| 2 | 58.7 | 18.2 | 17.93 | 270 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Ekibin Creek |
|---|---|
| Location | Park Maintenance Path (ID 17) |

Maintenance Access, Joachim Street, looking upstream

Maintenance Access, Joachim Street, looking downstream

| | |
|---|---|
| **Creek** | **Ekibin Creek** |
| **Location** | **Birdwood Rd (ID 16)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA, BCC Spatial Information Database | UBD REF: | 180 J13 |
| DATE OF SURVEY: | 2004 | ASSET ID: | P17000001 |
| MIKE CHAINAGE (m): | 8346 | AMTD (m) | 1772 |

STRUCTURE DESCRIPTION: Pipe Culvert

STRUCTURE SIZE: 8/1.8m

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): 14 UPSTREAM OBVERT LEVEL (m AHD): 15.8

DOWNSTREAM INVERT LEVEL (m AHD): 13.97 DOWNSTREAM OBVERT LEVEL (m AHD): 15.77

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m): 25

LENGTH OF CULVERT BARREL AT OBVERT (m): 25

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 25 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: W976

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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: 1957

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Culvert modelled using a 'culvert' and 'weir' approach in the hydraulic model

| | |
|---|---|
| **Creek** | **Ekibin Creek** |
| **Location** | **Birdwood Rd (ID 16)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 125.9 | 17.73 | 16.77 | 960 |
| 50 | 111.1 | 17.61 | 16.66 | 950 |
| 20 | 95.5 | 17.39 | 16.52 | 870 |
| 10 | 83.0 | 17.17 | 16.41 | 760 |
| 5 | 74.1 | 16.98 | 16.32 | 660 |
| 2 | 58.1 | 16.56 | 16.15 | 410 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Ekibin Creek |
| --- | --- |
| Location | Birdwood Rd (ID 16) |


Birdwood Road location

Birdwood Road, looking donwstream

| | |
|---|---|
| **Creek** | **Ekibin Creek** |
| **Location** | **Birdwood Rd Dev Causeway (ID 15)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA, Birdwood Rd Dev. Application (Intelara Eng) | UBD REF: | 180 J13 |
| DATE OF SURVEY: | 2004 | ASSET ID: | |
| MIKE CHAINAGE (m): | 8457 | AMTD (m) | 1659 |

STRUCTURE DESCRIPTION: Pipe Culvert

STRUCTURE SIZE: 4/0.9 RCP

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

| | | | |
|---|---|---|---|
| UPSTREAM INVERT LEVEL (m AHD): | 13.5 | UPSTREAM OBVERT LEVEL (m AHD): | 14.4 |
| DOWNSTREAM INVERT LEVEL (m AHD): | 13.5 | DOWNSTREAM OBVERT LEVEL (m AHD): | 14.4 |

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m): 5.2

LENGTH OF CULVERT BARREL AT OBVERT (m): 5.2

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 5.2 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: N/A

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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: 2003?

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Information available from report prepared by Intelara Pty Ltd at the request of Philip Usher Constructions in support of a Development Approval Application for a 220 unit development at 95 & 129 Birdwood Road, Holland Park West. Modelled as a 'Irregular, Level-width Table' in the hydraulic model.

| | |
|---|---|
| **Creek** | **Ekibin Creek** |
| **Location** | **Birdwood Rd Dev Causeway (ID 15)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 125.8 | 15.59 | 15.46 | 130 |
| 50 | 111.0 | 15.44 | 15.31 | 130 |
| 20 | 95.4 | 15.27 | 15.14 | 130 |
| 10 | 82.9 | 15.11 | 14.98 | 130 |
| 5 | 74.0 | 14.99 | 14.87 | 120 |
| 2 | 58.0 | 14.77 | 14.64 | 130 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Ekibin Creek |
|---|---|
| Location | Birdwood Rd Dev Causeway (ID 15) |


Birdwood Street, Development Causeway location

Birdwood Street, Development Causeway, looking upstream

| | |
|---|---|
| **Creek** | **Ekibin Creek** |
| **Location** | **Birdwood Rd Dev Bridge (ID 14)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA, Birdwood Rd Dev. Application (Intelara Eng) | UBD REF: | 180 J12 |
| DATE OF SURVEY: | 2004 | ASSET ID: | |
| MIKE CHAINAGE (m): | 8565 | AMTD (m) | 1551 |

STRUCTURE DESCRIPTION: Bridge

STRUCTURE SIZE: 3 Span

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): 13 UPSTREAM OBVERT LEVEL (m AHD): 15.7

DOWNSTREAM INVERT LEVEL (m AHD): 13 DOWNSTREAM OBVERT LEVEL (m AHD): 15.7

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m): 9.1

LENGTH OF CULVERT BARREL AT OBVERT (m): 9.1

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 9.1 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: Development Application*

BRIDGE OR CULVERT DETAILS: Bridge details are not available in the report

Wingwall/Headwall 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: 2003?

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Information available from report prepared by Intelara Pty Ltd at the request of Philip Usher Constructions in support of a Development Approval Application for a 220 unit development at 95 & 129 Birdwood Road, Holland Park West. Modelled as a 'Irregular, Level-width Table' in the hydraulic model.

| Creek | Ekibin Creek |
|---|---|
| **Location** | **Birdwood Rd Dev Bridge (ID 14)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 125.8 | 15.35 | 15.28 | 70 |
| 50 | 111.0 | 15.2 | 15.15 | 50 |
| 20 | 95.4 | 15.02 | 14.99 | 30 |
| 10 | 83.0 | 14.87 | 14.84 | 30 |
| 5 | 74.0 | 14.76 | 14.73 | 30 |
| 2 | 58.0 | 14.54 | 14.52 | 20 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Ekibin Creek |
| --- | --- |
| **Location** | **Birdwood Rd Dev Bridge (ID 14)** |

Birdwood Road, Development Bridge, looking downstream

Birdwood Road, Development Bridge

| | |
|---|---|
| **Creek** | **Ekibin Creek** |
| **Location** | **South East Freeway (U/S) (ID 13)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA, BCC Spatial Information Database | UBD REF: | 180 E11 |
| DATE OF SURVEY: | 2004 | ASSET ID: | P16000004 |
| MIKE CHAINAGE (m): | 9976 | AMTD (m) | 146 |

STRUCTURE DESCRIPTION: Box Culvert

STRUCTURE SIZE: 4/3.0 x 4.2m RCBC

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

| | | | |
|---|---|---|---|
| UPSTREAM INVERT LEVEL (m AHD): | 7.68 (low flow); 8.42 (main flow) | UPSTREAM OBVERT LEVEL (m AHD): | 10.68 |
| DOWNSTREAM INVERT LEVEL (m AHD): | 7.28 (low flow); 8.22 (main flow) | DOWNSTREAM OBVERT LEVEL (m AHD): | |

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m): 130

LENGTH OF CULVERT BARREL AT OBVERT (m): 130

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 130 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: MRD113917 (S-99-2)

BRIDGE OR CULVERT DETAILS: Drawing from Department of Main Roads

Wingwall/Headwall 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: 1973

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Modelled as an 'Irregular, Depth-width Table' in the hydraulic model

| Creek | Ekibin Creek |
|---|---|
| **Location** | **South East Freeway (U/S) (ID 13)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 177.5 | 12.75 | 11.27 | 1480 |
| 50 | 158.1 | 12.38 | 11.05 | 1330 |
| 20 | 134.0 | 11.95 | 10.78 | 1170 |
| 10 | 115.6 | 11.6 | 10.53 | 1070 |
| 5 | 102.4 | 11.34 | 10.32 | 1020 |
| 2 | 79.2 | 10.86 | 9.92 | 940 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Ekibin Creek |
|---|---|
| Location | South East Freeway (U/S) (ID 13) |

South East Freeway, looking donwstream

South East Freeway, looking upstream

| | |
|---|---|
| **Creek** | **Sandy Creek** |
| **Location** | **Sexton St (ID 33)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA | UBD REF: | 180 E12 |
| DATE OF SURVEY: | 2004 | ASSET ID: | P16000003 |
| MIKE CHAINAGE (m): | 1340 | AMTD (m) | 529 |

STRUCTURE DESCRIPTION: Pipe Culvert

STRUCTURE SIZE: 3/1.8 RCP

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): 11.6 UPSTREAM OBVERT LEVEL (m AHD): 13.4

DOWNSTREAM INVERT LEVEL (m AHD): 11.6 DOWNSTREAM OBVERT LEVEL (m AHD): 13.4

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m): 17.45

LENGTH OF CULVERT BARREL AT OBVERT (m): 17.45

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 17.45 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: W4897

BRIDGE OR CULVERT DETAILS: Hand and guardrail information not available from drawing

Wingwall/Headwall 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: 1973

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Culvert modelled using a 'culvert' and 'weir' approach in the hydraulic model

| | |
|---|---|
| **Creek** | **Sandy Creek** |
| **Location** | **Sexton St (ID 33)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 44.1 | 15.28 | 13.29 | 1990 |
| 50 | 38.3 | 15.16 | 13.12 | 2040 |
| 20 | 32.8 | 15 | 12.95 | 2050 |
| 10 | 27.9 | 14.78 | 12.78 | 2000 |
| 5 | 25.2 | 14.55 | 12.69 | 1860 |
| 2 | 20.2 | 14.16 | 12.52 | 1640 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Sandy Creek |
|---|---|
| Location | Sexton St (ID 33) |

Sexton Street, looking upstream

Sexton Street, looking downstream

| Creek | Sandy Creek |
|---|---|
| Location | Sunshine Avenue Footbridge (ID 32) |

| | |
|---|---|
| INFO SOURCE: Design Drawings, Site Measurements | UBD REF: 180 E12 |
| DATE OF SURVEY: | ASSET ID: |
| MIKE CHAINAGE (m): 1449 | AMTD (m) 420 |

STRUCTURE DESCRIPTION: Pedestrian Footbridge

STRUCTURE SIZE: 1 span

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): 9.52

UPSTREAM OBVERT LEVEL (m AHD):

DOWNSTREAM INVERT LEVEL (m AHD): 9.51

DOWNSTREAM OBVERT LEVEL (m AHD):

For culverts give floor level

For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m):

LENGTH OF CULVERT BARREL AT OBVERT (m):

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 1.72

LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: B1960/W6156/382_1980

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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:

HAS THE STRUCTURE BEEN UPGRADED?

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Modelled as an 'Irregular, Level-width Table' in the hydraulic model

| Creek | Sandy Creek |
|---|---|
| **Location** | **Sunshine Avenue Footbridge (ID 32)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 44.0 | 11.86 | 11.77 | 90 |
| 50 | 38.3 | 11.69 | 11.59 | 100 |
| 20 | 32.8 | 11.51 | 11.4 | 110 |
| 10 | 27.9 | 11.33 | 11.24 | 90 |
| 5 | 25.2 | 11.23 | 11.14 | 90 |
| 2 | 20.1 | 11.05 | 10.93 | 120 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Sandy Creek |
|---|---|
| Location | Sunshine Avenue Footbridge (ID 32) |

Sunshine Avenue / Barr Street Footbridge, looking upstream

Sunshine Avenue / Barr Street Footbridge, looking upstream

| Creek | Norman Creek |
|---|---|
| Location | Arnwood Pl (ID 12) |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA, Available BCC survey | UBD REF: | 180 D10 |
| DATE OF SURVEY: | 2004 | ASSET ID: | B0100 |
| MIKE CHAINAGE (m): | N/A - 2D Model | AMTD (m) | 7184 |

STRUCTURE DESCRIPTION: Bridge

STRUCTURE SIZE: 3 span - mid span 18.3m, end spans 16.5m

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

| | | | |
|---|---|---|---|
| UPSTREAM INVERT LEVEL (m AHD): | 6 | UPSTREAM OBVERT LEVEL (m AHD): | varying (sloping arch bridge) |
| DOWNSTREAM INVERT LEVEL (m AHD): | 6 | DOWNSTREAM OBVERT LEVEL (m AHD): | varying (sloping arch bridge) |

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m):

LENGTH OF CULVERT BARREL AT OBVERT (m):

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 11 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH: 0.45m at top and 0.53m at bottom

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: G-7_20

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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: 1948

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Modelled as an 'Irregular, depth-width Table' in the hydraulic model

| Creek | Norman Creek |
|---|---|
| Location | Arnwood Pl (ID 12) |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 213.1 | 10.85 | 10.51 | 340 |
| 50 | 189.7 | 10.65 | 10.29 | 360 |
| 20 | 160.0 | 10.42 | 9.99 | 430 |
| 10 | 135.7 | 10.19 | 9.72 | 470 |
| 5 | 118.5 | 10.01 | 9.54 | 470 |
| 2 | 89.8 | 9.62 | 9.14 | 480 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Norman Creek |
|---|---|
| Location | Arnwood Pl (ID 12) |

Arnwood Place, looking upstream

Arnwood Place, looking upstream

| | |
|---|---|
| **Creek** | **Norman Creek** |
| **Location** | **South East Freeway (ID 11)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA | UBD REF: | 180 D9 |
| DATE OF SURVEY: | 2004 | ASSET ID: | |
| MIKE CHAINAGE (m): | N/A - 2D Model | AMTD (m) | 6800 |

STRUCTURE DESCRIPTION: Minimum Energy Loss Structure

STRUCTURE SIZE: Single Span

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

| | | | |
|---|---|---|---|
| UPSTREAM INVERT LEVEL (m AHD): | 5.37 (low flow); 5.58 (main flow) | UPSTREAM OBVERT LEVEL (m AHD): | 10.78 |
| DOWNSTREAM INVERT LEVEL (m AHD): | 5.07 (low flow); 5.58 (main flow) | DOWNSTREAM OBVERT LEVEL (m AHD): | |

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m):

LENGTH OF CULVERT BARREL AT OBVERT (m):

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 143 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER:

BRIDGE OR CULVERT DETAILS: Structure drawings not available

Wingwall/Headwall 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: 1973

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Structure modelled as a two-dimensional open channel in the hydraulic model due to minimal headloss across structure

| **Creek** | **Norman Creek** |
|---|---|
| **Location** | **South East Freeway (ID 11)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 224.2 | 10.22 | 9.57 | 650 |
| 50 | 198.2 | 9.99 | 9.46 | 530 |
| 20 | 163.2 | 9.69 | 9.29 | 400 |
| 10 | 139.8 | 9.32 | 8.9 | 420 |
| 5 | 122.2 | 9.06 | 8.67 | 390 |
| 2 | 92.2 | 8.56 | 8.32 | 240 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Norman Creek |
|---|---|
| **Location** | **South East Freeway (ID 11)** |

South East Freeway, looking downstream

| | |
|---|---|
| **Creek** | **Norman Creek** |
| **Location** | **Ridge St (ID 10)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA, Site Measurements | UBD REF: | 180 D8 |
| DATE OF SURVEY: | 1987 | ASSET ID: | - |
| MIKE CHAINAGE (m): | N/A - 2D Model | AMTD (m) | 6575 |

STRUCTURE DESCRIPTION: Minimum Energy Loss Structure

STRUCTURE SIZE: 7/2.75 x 3.2m RCBC

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

| | | | |
|---|---|---|---|
| UPSTREAM INVERT LEVEL (m AHD): | 4.39 (low flow); 5.68 (main flow) | UPSTREAM OBVERT LEVEL (m AHD): | 8.88 |
| DOWNSTREAM INVERT LEVEL (m AHD): | 4.39 (low flow); 5.58 (main flow) | DOWNSTREAM OBVERT LEVEL (m AHD): | |

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m): 51

LENGTH OF CULVERT BARREL AT OBVERT (m): 51

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 51 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: MRD129674

BRIDGE OR CULVERT DETAILS: Current structure replaced 2 by 0.46m diameter RCP constructed in 1939.

Wingwall/Headwall 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: 1975

HAS THE STRUCTURE BEEN UPGRADED? Yes

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Current structure replaced 2 by 0.46m diameter RCP constructed in 1939.

| Creek | Norman Creek |
|---|---|
| Location | Ridge St (ID 10) |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 226.9 | 9.57 | 7.88 | 1690 |
| 50 | 200.5 | 9.45 | 7.78 | 1670 |
| 20 | 164.9 | 9.25 | 7.64 | 1610 |
| 10 | 141.3 | 8.88 | 7.57 | 1310 |
| 5 | 124.3 | 8.64 | 7.53 | 1110 |
| 2 | 93.7 | 8.23 | 7.41 | 820 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Norman Creek |
|---|---|
| Location | Ridge St (ID 10) |

Ridge Street, looking upstream


Ridge Street, looking downstream

| | |
|---|---|
| **Creek** | **Norman Creek** |
| **Location** | **Juliette St (ID 9)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2008 Norman Creek WQA, BCC Survey, Photographic/Aerial Measurements | UBD REF: | 180 E7 |
| DATE OF SURVEY: | 1987 | ASSET ID: | B1080 |
| MIKE CHAINAGE (m): | N/A - 2D Model | AMTD (m) | 6072 |

STRUCTURE DESCRIPTION: Bridge

STRUCTURE SIZE: 2/11 m span (approx)

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): 1.86 UPSTREAM OBVERT LEVEL (m AHD): 5.76

DOWNSTREAM INVERT LEVEL (m AHD): 1.81 DOWNSTREAM OBVERT LEVEL (m AHD):

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m):

LENGTH OF CULVERT BARREL AT OBVERT (m):

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? 10.8134

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 14.1 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH: 0.45m at top and 0.53m at bottom

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: W4934/1, W4686

BRIDGE OR CULVERT DETAILS: Peir width information not available from drawing

Wingwall/Headwall 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: 1971

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Modelled as an 'Irregular, depth-width Table' in the hydraulic model

| | |
|---|---|
| **Creek** | **Norman Creek** |
| **Location** | **Juliette St (ID 9)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 243.9 | 6.9 | 5.93 | 970 |
| 50 | 213.5 | 6.74 | 5.85 | 890 |
| 20 | 177.3 | 6.46 | 5.73 | 730 |
| 10 | 152.0 | 6.09 | 5.61 | 480 |
| 5 | 133.4 | 5.92 | 5.51 | 410 |
| 2 | 100.6 | 5.59 | 5.31 | 280 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| | |
|---|---|
| **Creek** | **Norman Creek** |
| **Location** | **Juliette St (ID 9)** |

Juliete Street, looking upstream


Juliete Street, looking downstream

| | |
|---|---|
| **Creek** | **Norman Creek** |
| **Location** | **Cornwall St (ID 8)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA | UBD REF: | 180 E6 |
| DATE OF SURVEY: | 2004 | ASSET ID: | - |
| MIKE CHAINAGE (m): | N/A - 2D Model | AMTD (m) | 5801 |

STRUCTURE DESCRIPTION: Minimum Energy Loss Structure

STRUCTURE SIZE: 9/2.7 x 2.8m RCBC

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

| | | | |
|---|---|---|---|
| UPSTREAM INVERT LEVEL (m AHD): | 1.49 (low flow); 1.69 (main flow) | UPSTREAM OBVERT LEVEL (m AHD): | 4.4 |
| DOWNSTREAM INVERT LEVEL (m AHD): | 1.29 (low flow). 1.69 (main flow) | DOWNSTREAM OBVERT LEVEL (m AHD): | |
| For culverts give floor level | | For bridges give bed level | |

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m): 17

LENGTH OF CULVERT BARREL AT OBVERT (m): 17

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? 10.153

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 17 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: W4687

BRIDGE OR CULVERT DETAILS: Current structure replaced existing channel and 1.98m diameter RCP, located 10.5m east.

Wingwall/Headwall 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: 1972

HAS THE STRUCTURE BEEN UPGRADED? Yes

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Culvert modelled in hydraulic model using the 'bridge' approach

| | |
|---|---|
| **Creek** | **Norman Creek** |
| **Location** | **Cornwall St (ID 8)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 237.7 | 5.68 | 5.39 | 290 |
| 50 | 206.3 | 5.54 | 5.24 | 300 |
| 20 | 171.8 | 5.37 | 5.04 | 330 |
| 10 | 147.7 | 5.17 | 4.8 | 370 |
| 5 | 130.2 | 5.02 | 4.58 | 440 |
| 2 | 97.9 | 4.78 | 4.29 | 490 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| | |
|---|---|
| **Creek** | **Norman Creek** |
| **Location** | **Cornwall St (ID 8)** |

Cornwall Street, looking upstream

Cornwall Street, looking downstream

| | |
|---|---|
| **Creek** | **Norman Creek** |
| **Location** | **Logan Rd (ID 7)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA | UBD REF: | 180 E4 |
| DATE OF SURVEY: | 1987 | ASSET ID: | B0804 |
| MIKE CHAINAGE (m): | N/A - 2D Model | AMTD (m) | 5281 |

STRUCTURE DESCRIPTION: Bridge

STRUCTURE SIZE: 8/5.26m span

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): -0.54 UPSTREAM OBVERT LEVEL (m AHD): 3.95

DOWNSTREAM INVERT LEVEL (m AHD): -0.54 DOWNSTREAM OBVERT LEVEL (m AHD):

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m):

LENGTH OF CULVERT BARREL AT OBVERT (m):

TYPE OF LINING: 5.2578

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE? #REF!

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 22 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: W1346A or B_10_53

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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: 1953

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Bridge modelled in hydraulic model using the 'bridge' approach

| **Creek** | **Norman Creek** |
|---|---|
| **Location** | **Logan Rd (ID 7)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 231.1 | 5.28 | 5.02 | 260 |
| 50 | 200.3 | 5.12 | 4.86 | 260 |
| 20 | 167.7 | 4.92 | 4.64 | 280 |
| 10 | 146.6 | 4.68 | 4.39 | 290 |
| 5 | 121.9 | 4.4 | 4.12 | 280 |
| 2 | 95.9 | 3.93 | 3.69 | 240 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Norman Creek |
|---|---|
| Location | Logan Rd (ID 7) |

Logan Road, looking upstream

Logan Rd, looking downstream

| | |
|---|---|
| **Creek** | **Norman Creek** |
| **Location** | **Eastern Busway (ID 6)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | Design Drawings | UBD REF: | 180 E4 |
| DATE OF SURVEY: | - | ASSET ID: | - |
| MIKE CHAINAGE (m): | N/A - 2D Model | AMTD (m) | 5200 |

STRUCTURE DESCRIPTION: Bridge

STRUCTURE SIZE: 5 Span (to busway station) - 23m span length except easternmost span 24.4m length

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

| | | | |
|---|---|---|---|
| UPSTREAM INVERT LEVEL (m AHD): | -0.19 | UPSTREAM OBVERT LEVEL (m AHD): | Varying (minimum approx 3mAHD) |
| DOWNSTREAM INVERT LEVEL (m AHD): | -0.19 | DOWNSTREAM OBVERT LEVEL (m AHD): | Varying (minimum approx 3mAHD) |
| For culverts give floor level | | For bridges give bed level | |

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m):

LENGTH OF CULVERT BARREL AT OBVERT (m):

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 15 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH: 1.2

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: 201/U31/3

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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: 2010

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Bridge modelled as a 'closed irregular' cross section in the hydraulic model'

| **Creek** | **Norman Creek** |
|---|---|
| **Location** | **Eastern Busway (ID 6)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 234.6 | 4.9 | 4.55 | 350 |
| 50 | 205.3 | 4.74 | 4.39 | 350 |
| 20 | 172.9 | 4.52 | 4.18 | 340 |
| 10 | 151.4 | 4.27 | 3.94 | 330 |
| 5 | 124.9 | 4 | 3.81 | 190 |
| 2 | 97.7 | 3.58 | 3.44 | 140 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| | |
|---|---|
| **Creek** | **Norman Creek** |
| **Location** | **Eastern Busway (ID 6)** |

Eastern Busway, looking downstream

Eastern busway, looking downstream

| | |
|---|---|
| **Creek** | **Norman Creek** |
| **Location** | **Cleveland Rail (ID 5)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA | UBD REF: | 180 G2 |
| DATE OF SURVEY: | 1987 | ASSET ID: | W4070, L-6-20/41, L-6-20/64D |
| MIKE CHAINAGE (m): | N/A - 2D Model | AMTD (m) | 4505 |

STRUCTURE DESCRIPTION: Reinforced Concrete Bridge

STRUCTURE SIZE: 13 spans - most spans 6.1m length, others 7m length

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): -0.42 UPSTREAM OBVERT LEVEL (m AHD): 7.03

DOWNSTREAM INVERT LEVEL (m AHD): -0.42 DOWNSTREAM OBVERT LEVEL (m AHD): 7.03

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m):

LENGTH OF CULVERT BARREL AT OBVERT (m):

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 7.5 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: W4070, L-6-20/41, L-6-20/64D

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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: 1951

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Structure modelled as a two-dimensional open channel in the hydraulic model due to minimal headloss across structure

| Creek | Norman Creek |
|---|---|
| Location | Cleveland Rail (ID 5) |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 225.3 | 4.32 | 4.33 | -10 |
| 50 | 195.1 | 4.18 | 4.18 | 0 |
| 20 | 162.3 | 4 | 4 | 0 |
| 10 | 133.6 | 3.77 | 3.78 | -10 |
| 5 | 115.9 | 3.65 | 3.66 | -10 |
| 2 | 84.3 | 3.29 | 3.3 | -10 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Norman Creek |
|---|---|
| Location | Cleveland Rail (ID 5) |

Cleveland Rail, looking upstream

| | |
|---|---|
| **Creek** | **Norman Creek** |
| **Location** | **Deshon St (ID 4)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA | UBD REF: | 180 G2 |
| DATE OF SURVEY: | 1987 | ASSET ID: | B0580 |
| MIKE CHAINAGE (m): | N/A - 2D Model | AMTD (m) | 4440 |

STRUCTURE DESCRIPTION: Bridge

STRUCTURE SIZE: 2/15m span

For Culverts: Number of cells/pipes & sizes    For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): -1    UPSTREAM OBVERT LEVEL (m AHD): 2.1

DOWNSTREAM INVERT LEVEL (m AHD): -1    DOWNSTREAM OBVERT LEVEL (m AHD):

For culverts give floor level    For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m):

LENGTH OF CULVERT BARREL AT OBVERT (m):

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 17.3    LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH: 0.45

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: W10015

BRIDGE OR CULVERT DETAILS: Current bridge replaced an existing 3 span bridge built in 1969 (W4070).

Wingwall/Headwall 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: 1996

HAS THE STRUCTURE BEEN UPGRADED? Yes

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Bridge modelled in hydraulic model using the 'bridge' approach

| Creek | Norman Creek |
|---|---|
| Location | Deshon St (ID 4) |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 224.8 | 4.33 | 3.99 | 340 |
| 50 | 194.6 | 4.19 | 3.86 | 330 |
| 20 | 161.6 | 4 | 3.68 | 320 |
| 10 | 132.9 | 3.78 | 3.52 | 260 |
| 5 | 115.8 | 3.66 | 3.4 | 260 |
| 2 | 84.2 | 3.3 | 3.08 | 220 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Norman Creek |
|---|---|
| Location | Deshon St (ID 4) |


Deshon Street location

Deshon Street, looking upstream
(Cleveland rail in Background)

| | |
|---|---|
| **Creek** | **Norman Creek** |
| **Location** | **Turbo Drive (ID 3)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA, Aerial Site Measurements | UBD REF: | 180 G1 |
| DATE OF SURVEY: | 1987 | ASSET ID: | B2680 |
| MIKE CHAINAGE (m): | N/A - 2D Model | AMTD (m) | 4373 |

STRUCTURE DESCRIPTION: Bridge

STRUCTURE SIZE: 3 span/28m total length (approx)

For Culverts: Number of cells/pipes & sizes    For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): -0.65    UPSTREAM OBVERT LEVEL (m AHD): 2.38

DOWNSTREAM INVERT LEVEL (m AHD): -0.65    DOWNSTREAM OBVERT LEVEL (m AHD):

For culverts give floor level    For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m):

LENGTH OF CULVERT BARREL AT OBVERT (m):

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 9.35    LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH: 0.45

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: W4070

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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: 1968

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Modelled as an 'Irregular, depth-width Table' in the hydraulic model.

| **Creek** | **Norman Creek** |
|---|---|
| **Location** | **Turbo Drive (ID 3)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 224.3 | 3.99 | 3.87 | 120 |
| 50 | 194.1 | 3.86 | 3.73 | 130 |
| 20 | 161.2 | 3.68 | 3.54 | 140 |
| 10 | 132.2 | 3.52 | 3.37 | 150 |
| 5 | 115.6 | 3.41 | 3.26 | 150 |
| 2 | 83.9 | 3.08 | 2.98 | 100 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Norman Creek |
|---|---|
| Location | Turbo Drive (ID 3) |


Turbo Street, looking downstream

| | |
|---|---|
| **Creek** | **Norman Creek** |
| **Location** | **Stanley St East (ID 2)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA | UBD REF: | 160 H19 |
| DATE OF SURVEY: | 1987 | ASSET ID: | B1870 |
| MIKE CHAINAGE (m): | N/A - 2D Model | AMTD (m) | 3648 |

STRUCTURE DESCRIPTION: Box Culvert

STRUCTURE SIZE: 12/3.6 x 3.6m RCBC

For Culverts: Number of cells/pipes & sizes    For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): -1.75    UPSTREAM OBVERT LEVEL (m AHD): 1.91

DOWNSTREAM INVERT LEVEL (m AHD): -1.75    DOWNSTREAM OBVERT LEVEL (m AHD):

For culverts give floor level    For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m): 24.4

LENGTH OF CULVERT BARREL AT OBVERT (m): 24.4

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 24.4    LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: W6356

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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: 1987

HAS THE STRUCTURE BEEN UPGRADED? Yes

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Bridge modelled in hydraulic model using the 'bridge' approach

| | |
|---|---|
| **Creek** | **Norman Creek** |
| **Location** | **Stanley St East (ID 2)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 240.0 | 3.73 | 3.51 | 220 |
| 50 | 212.4 | 3.59 | 3.33 | 260 |
| 20 | 172.2 | 3.4 | 3.06 | 340 |
| 10 | 142.7 | 3.24 | 2.84 | 400 |
| 5 | 126.2 | 3.14 | 2.72 | 420 |
| 2 | 97.4 | 2.89 | 2.5 | 390 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Norman Creek |
|---|---|
| Location | Stanley St East (ID 2) |


Stanley Street East Location

Stanley Street East, looking donwstream

| | |
|---|---|
| **Creek** | **Norman Creek** |
| **Location** | **Wynnum Rd (ID 1)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | Design Drawings, 2004 Norman Creek WQA, 2008 Norman Creek WQA model | UBD REF: | 160 H4 |
| DATE OF SURVEY: | | ASSET ID: | B2190 |
| MIKE CHAINAGE (m): | N/A - 2D Model | AMTD (m) | 38 |

STRUCTURE DESCRIPTION: Bridge

STRUCTURE SIZE: 3 span - Middle span 18.5m, end spans 15.8m

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): -4 UPSTREAM OBVERT LEVEL (m AHD): 4.3

DOWNSTREAM INVERT LEVEL (m AHD): -4 DOWNSTREAM OBVERT LEVEL (m AHD): 4.3

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m):

LENGTH OF CULVERT BARREL AT OBVERT (m):

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 27 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH: 0.47

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: L-5-16

BRIDGE OR CULVERT DETAILS: Current bridge replaced concrete bridge build in 1901

Wingwall/Headwall 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: 1952

HAS THE STRUCTURE BEEN UPGRADED? Yes

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Bridge modelled in hydraulic model using the 'bridge' approach

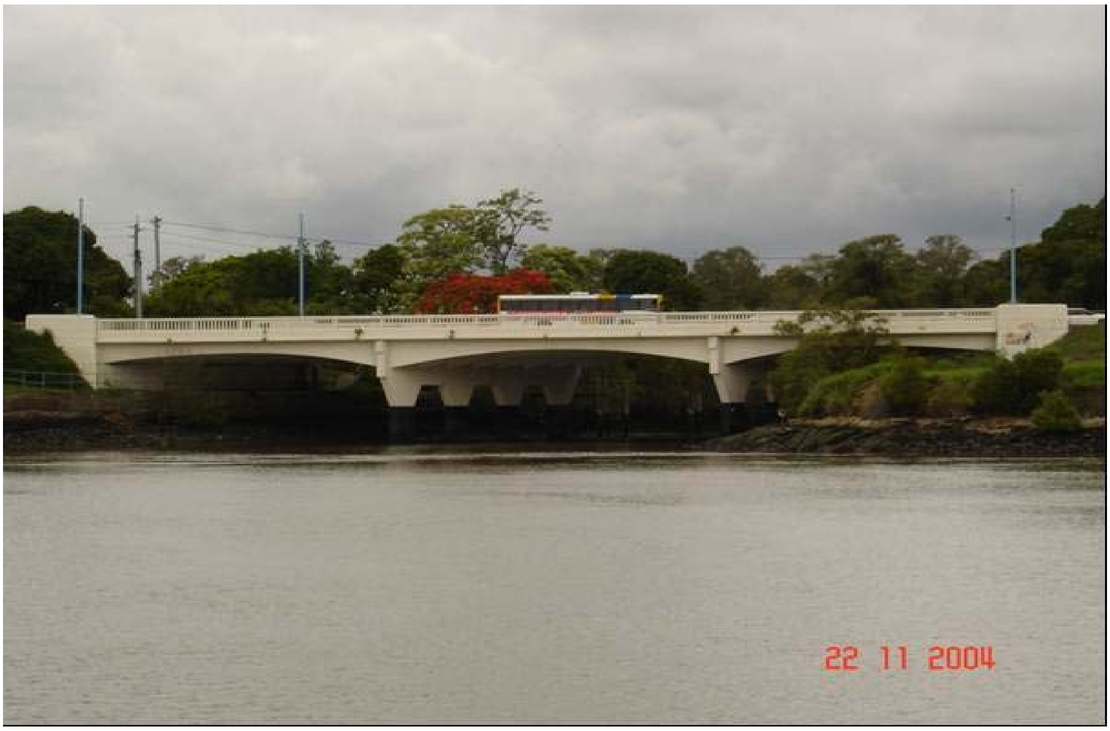
| | |
|---|---|
| **Creek** | **Norman Creek** |
| **Location** | **Wynnum Rd (ID 1)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 258.7 | 1.47 | 1.06 | 410 |
| 50 | 231.0 | 1.46 | 1.06 | 400 |
| 20 | 193.7 | 1.44 | 1.06 | 380 |
| 10 | 164.9 | 1.41 | 1.06 | 350 |
| 5 | 146.1 | 1.39 | 1.06 | 330 |
| 2 | 114.4 | 1.35 | 1.06 | 290 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Norman Creek |
|---|---|
| Location | Wynnum Rd (ID 1) |


Wynnum Road location




Wynnum Road, looking upstream

| | |
|---|---|
| **Creek** | **Bridgewater Creek** |
| **Location** | **Temple St (ID 29)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA | UBD REF: | 160 L19 |
| DATE OF SURVEY: | 1999 | ASSET ID: | B1981 |
| MIKE CHAINAGE (m): | N/A - 2D Model | AMTD (m) | 561 |

STRUCTURE DESCRIPTION: Bridge

STRUCTURE SIZE: Single Span

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): 0.8 UPSTREAM OBVERT LEVEL (m AHD): 2.26

DOWNSTREAM INVERT LEVEL (m AHD): 0.45 DOWNSTREAM OBVERT LEVEL (m AHD):

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m):

LENGTH OF CULVERT BARREL AT OBVERT (m):

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 14.56 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH: 0.75

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: W11407

BRIDGE OR CULVERT DETAILS: Current structure replaced RCBC built in 1948 (W148)

Wingwall/Headwall 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

HAS THE STRUCTURE BEEN UPGRADED? Yes

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Modelled as an 'Irregular, depth-width Table' in the hydraulic model.

| Creek | Bridgewater Creek |
|---|---|
| Location | Temple St (ID 29) |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 69.2 | 3.64 | 3.59 | 50 |
| 50 | 64.7 | 3.52 | 3.44 | 80 |
| 20 | 57.5 | 3.34 | 3.24 | 100 |
| 10 | 52.8 | 3.18 | 3.06 | 120 |
| 5 | 47.6 | 3.05 | 2.92 | 130 |
| 2 | 39.5 | 2.81 | 2.67 | 140 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Bridgewater Creek |
|---|---|
| Location | Temple St (ID 29) |

Temple Street, looking upstream

| Creek | Bridgewater Creek |
|---|---|
| Location | Cleveland Rail (ID 28) |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA | UBD REF: | 160 K19 |
| DATE OF SURVEY: | 1999 | ASSET ID: | |
| MIKE CHAINAGE (m): | | AMTD (m) | 449 |

STRUCTURE DESCRIPTION: Concrete Bridge

STRUCTURE SIZE: Single Span

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): 0.61 UPSTREAM OBVERT LEVEL (m AHD): 3.42

DOWNSTREAM INVERT LEVEL (m AHD): 0.11 DOWNSTREAM OBVERT LEVEL (m AHD):

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m):

LENGTH OF CULVERT BARREL AT OBVERT (m):

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 4.76 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER:

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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:

HAS THE STRUCTURE BEEN UPGRADED? Yes

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Structure modelled as a two-dimensional open channel in the hydraulic model due to minimal headloss across structure

| | |
|---|---|
| **Creek** | **Bridgewater Creek** |
| **Location** | **Cleveland Rail (ID 28)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 33.2 | 3.57 | 3.55 | 20 |
| 50 | 29.1 | 3.41 | 3.36 | 50 |
| 20 | 24.9 | 3.2 | 3.15 | 50 |
| 10 | 21.1 | 3.02 | 2.97 | 50 |
| 5 | 18.6 | 2.87 | 2.83 | 40 |
| 2 | 14.9 | 2.62 | 2.58 | 40 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| | |
|---|---|
| **Creek** | **Bridgewater Creek** |
| **Location** | **Cleveland Rail (ID 28)** |

Cleveland Rail, looking downstream

| Creek | Bridgewater Creek |
|---|---|
| Location | Stanley St (ID 27) |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2004 Norman Creek WQA, BCC Spatial Information Database | UBD REF: | 160 L19 |
| DATE OF SURVEY: | 1999 | ASSET ID: | N17000005 |
| MIKE CHAINAGE (m): | N/A - 2D Model | AMTD (m) | 324 |

STRUCTURE DESCRIPTION: Pipe Culvert

STRUCTURE SIZE: 6/1.8m RCP

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): 0
UPSTREAM OBVERT LEVEL (m AHD): 1.8

DOWNSTREAM INVERT LEVEL (m AHD): -0.25
DOWNSTREAM OBVERT LEVEL (m AHD): 1.55

For culverts give floor level
For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m): 46.2

LENGTH OF CULVERT BARREL AT OBVERT (m): 46.2

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 46.2
LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: W1955

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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: 1959

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Culvert modelled using a 'culvert' approach in the hydraulic model

| Creek | Bridgewater Creek |
|---|---|
| **Location** | **Stanley St (ID 27)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 30.5 | 3.52 | 3.1 | 420 |
| 50 | 27.4 | 3.33 | 2.94 | 390 |
| 20 | 23.6 | 3.1 | 2.73 | 370 |
| 10 | 20.4 | 2.91 | 2.58 | 330 |
| 5 | 17.9 | 2.75 | 2.48 | 270 |
| 2 | 14.5 | 2.51 | 2.31 | 200 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Bridgewater Creek |
| --- | --- |
| Location | Stanley St (ID 27) |


Stanley Street East Location


Stanley Street East / Tiber Street, looking upstream

| Creek | Coorparoo Creek |
|---|---|
| Location | Gladstone Street (ID 26) |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2012 Lower Coorparoo Creek Mitigation Works Study | UBD REF: | 180 J1 |
| DATE OF SURVEY: | | ASSET ID: | |
| MIKE CHAINAGE (m): | | AMTD (m) | 498 |

STRUCTURE DESCRIPTION: Box Culvert

STRUCTURE SIZE: 2/3 x 1.6m RCBC

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): UPSTREAM OBVERT LEVEL (m AHD):

DOWNSTREAM INVERT LEVEL (m AHD): DOWNSTREAM OBVERT LEVEL (m AHD):

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m): 31

LENGTH OF CULVERT BARREL AT OBVERT (m): 31

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 31 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER:

BRIDGE OR CULVERT DETAILS: Structure drawings not available

Wingwall/Headwall 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:

HAS THE STRUCTURE BEEN UPGRADED?

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Not modelled due to minimal headloss across structure

| | |
|---|---|
| **Creek** | **Coorparoo Creek** |
| **Location** | **Gladstone Street (ID 26)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 64.4 | 4.17 | 4.04 | 130 |
| 50 | 59.2 | 4.09 | 3.95 | 140 |
| 20 | 52.9 | 4.01 | 3.87 | 140 |
| 10 | 46.2 | 3.93 | 3.78 | 150 |
| 5 | 40.1 | 3.86 | 3.69 | 170 |
| 2 | 31.4 | 3.71 | 3.51 | 200 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Coorparoo Creek |
| --- | --- |
| Location | Gladstone Street (ID 26) |

Gladstone Street, looking upstream

| Creek | Coorparoo Creek |
|---|---|
| Location | Cleveland Rail (ID 25) |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2012 Lower Coorparoo Creek Mitigation Works Study | UBD REF: | 180 J1 |
| DATE OF SURVEY: | | ASSET ID: | |
| MIKE CHAINAGE (m): | | AMTD (m) | 428 |

STRUCTURE DESCRIPTION: Box Culvert

STRUCTURE SIZE: 3/3 x 4m RCBC, 1/3 x 2.4m RCBC

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): UPSTREAM OBVERT LEVEL (m AHD):

DOWNSTREAM INVERT LEVEL (m AHD): DOWNSTREAM OBVERT LEVEL (m AHD):

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m): 21

LENGTH OF CULVERT BARREL AT OBVERT (m): 21

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 21 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER:

BRIDGE OR CULVERT DETAILS: Structure drawings not available

Wingwall/Headwall 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:

HAS THE STRUCTURE BEEN UPGRADED?

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Structure modelled as a two-dimensional open channel in the hydraulic model due to minimal headloss across structure

| **Creek** | **Coorparoo Creek** |
|---|---|
| **Location** | **Cleveland Rail (ID 25)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 62.4 | 4.04 | 3.99 | 50 |
| 50 | 56.0 | 3.95 | 3.91 | 40 |
| 20 | 49.4 | 3.87 | 3.84 | 30 |
| 10 | 43.6 | 3.78 | 3.75 | 30 |
| 5 | 39.5 | 3.69 | 3.66 | 30 |
| 2 | 30.9 | 3.51 | 3.49 | 20 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| | |
|---|---|
| **Creek** | **Coorparoo Creek** |
| **Location** | **Cleveland Rail (ID 25)** |

Cleveland Rail - Main set of culverts

Cleveland Rail - Single bikeway culvert

| Creek | Coorparoo Creek |
|---|---|
| Location | Morley St (ID 24) |

| | | | |
|---|---|---|---|
| INFO SOURCE: | 2012 Lower Coorparoo Creek Mitigation Study, Design Drawings, Photographic Site | UBD REF: | 180 J1 |
| DATE OF SURVEY: | | ASSET ID: | B1430 |
| MIKE CHAINAGE (m): | N/A - 2D Model | AMTD (m) | 375 |

STRUCTURE DESCRIPTION: Bridge

STRUCTURE SIZE: Single Span

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): 0.12 UPSTREAM OBVERT LEVEL (m AHD): 2.625

DOWNSTREAM INVERT LEVEL (m AHD): -0.69 DOWNSTREAM OBVERT LEVEL (m AHD):

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m):

LENGTH OF CULVERT BARREL AT OBVERT (m):

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 9.5 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: W4060

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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: 1963

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Bridge modelled in hydraulic model using the 'bridge' approach

| | |
|---|---|
| **Creek** | **Coorparoo Creek** |
| **Location** | **Morley St (ID 24)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 70.0 | 3.95 | 3.76 | 190 |
| 50 | 64.3 | 3.87 | 3.63 | 240 |
| 20 | 59.7 | 3.8 | 3.44 | 360 |
| 10 | 54.1 | 3.71 | 3.3 | 410 |
| 5 | 49.8 | 3.63 | 3.19 | 440 |
| 2 | 42.8 | 3.46 | 2.95 | 510 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| Creek | Coorparoo Creek |
|---|---|
| Location | Morley St (ID 24) |


Morley Street Location

Morley Street, looking upstream

| | |
|---|---|
| **Creek** | **Scott's Creek** |
| **Location** | **Adina St (ID 30)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | Design Drawings, Available BCC Survey | UBD REF: | 160 N17 |
| DATE OF SURVEY: | | ASSET ID: | |
| MIKE CHAINAGE (m): | N/A - 2D Model | AMTD (m) | 427 |

STRUCTURE DESCRIPTION: Box Culvert

STRUCTURE SIZE: 3/2.7 x 1.25 RCBC

For Culverts: Number of cells/pipes & sizes    For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): 0    UPSTREAM OBVERT LEVEL (m AHD): 1.2

DOWNSTREAM INVERT LEVEL (m AHD): -0.495    DOWNSTREAM OBVERT LEVEL (m AHD): 0.705

For culverts give floor level    For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m):

LENGTH OF CULVERT BARREL AT OBVERT (m):

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 208    LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: L-6-31

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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:

HAS THE STRUCTURE BEEN UPGRADED?

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Culvert modelled using a 'culvert' approach in the hydraulic model

| **Creek** | **Scott's Creek** |
|---|---|
| **Location** | **Adina St (ID 30)** |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 18.3 | 3.3 | 3.03 | 270 |
| 50 | 16.4 | 3.15 | 2.85 | 300 |
| 20 | 15.2 | 2.96 | 2.62 | 340 |
| 10 | 13.8 | 2.76 | 2.45 | 310 |
| 5 | 13.0 | 2.64 | 2.35 | 290 |
| 2 | 11.5 | 2.37 | 2.17 | 200 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| | |
|---|---|
| **Creek** | **Scott's Creek** |
| **Location** | **Adina St (ID 30)** |

Adina Street, looking upstream

Adina Street, looking downstream

| | |
|---|---|
| **Creek** | **Scott's Creek** |
| **Location** | **Waite St Footbridge (ID 31)** |

| | | | |
|---|---|---|---|
| INFO SOURCE: | Design Drawings, Available BCC Survey | UBD REF: | 160 M17 |
| DATE OF SURVEY: | | ASSET ID: | CD 070306/4001-03 |
| MIKE CHAINAGE (m): | N/A - 2D Model | AMTD (m) | 723 |

STRUCTURE DESCRIPTION: Pedestrian Footbridge

STRUCTURE SIZE: Single Span

For Culverts: Number of cells/pipes & sizes For Bridges: Number of Spans and their lenghts

UPSTREAM INVERT LEVEL (m AHD): 0.21 UPSTREAM OBVERT LEVEL (m AHD): 2.2

DOWNSTREAM INVERT LEVEL (m AHD): 0.21 DOWNSTREAM OBVERT LEVEL (m AHD): 2.2

For culverts give floor level For bridges give bed level

For culverts:

LENGTH OF CULVERT BARREL AT INVERT (m):

LENGTH OF CULVERT BARREL AT OBVERT (m):

TYPE OF LINING:

(e.g. concrete, stones, brick, corrugated iron)

IS THERE A SURVEYED WEIR PROFILE?

If yes give details i.e Plan number and/or survey book number. Note: This section should be at the highest part of the road eg crown, kerb, hand rails whichever is higher.

WEIR WIDTH (m): 4 LOWEST POINT OF WEIR (m AHD):

(In direction of flow, i.e distance from u/s face to d/s face

PIER WIDTH:

HEIGHT OF HAND/GUARDRAIL:

Description of all hand and guardrails and height to top and underside of guardrails

PLAN NUMBER: CD 070306/4001-03

BRIDGE OR CULVERT DETAILS:

Wingwall/Headwall 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: 2007

HAS THE STRUCTURE BEEN UPGRADED? No

If, yes, explain type and date of upgrade. Include plan number and loaction if applicable.

ADDITIONAL COMMENTS:

Bridge modelled using a 'culvert' and 'weir' approach in the hydraulic model

| Creek | Scott's Creek |
|---|---|
| Location | Waite St Footbridge (ID 31) |

| ARI (years) | Discharge (m3/s) | U/S Water Level (m AHD) | D/S Water Level (m AHD) | Afflux* (mm) |
|---|---|---|---|---|
| 100 | 21.6 | 3.36 | 3.31 | 50 |
| 50 | 20.4 | 3.23 | 3.18 | 50 |
| 20 | 18.2 | 3.04 | 2.99 | 50 |
| 10 | 16.5 | 2.87 | 2.81 | 60 |
| 5 | 14.9 | 2.76 | 2.7 | 60 |
| 2 | 12.2 | 2.54 | 2.46 | 80 |

* Difference in water levels between upstream and downstream of the crossings/overland flow paths

| | |
|---|---|
| **Creek** | **Scott's Creek** |
| **Location** | **Waite St Footbridge (ID 31)** |

Waite Street Footbridge looking upstream

Waite Street Footbridge, looking downstream

# Appendix G: Design Event Peak Flood Levels

# *Norman Creek*

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - Existing Case Water Level (Scenario 1) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| | | 0 | 1.06 | 1.06 | 1.06 | 1.06 | 1.06 | 1.06 |
| **Wynnum Road** | | | | | | | | |
| | | 75 | 1.35 | 1.39 | 1.41 | 1.44 | 1.46 | 1.47 |
| | | 100 | 1.32 | 1.34 | 1.35 | 1.36 | 1.36 | 1.36 |
| | | 200 | 1.42 | 1.51 | 1.57 | 1.65 | 1.79 | 1.92 |
| | | 300 | 1.51 | 1.64 | 1.73 | 1.87 | 2.07 | 2.23 |
| | | 400 | 1.62 | 1.81 | 1.93 | 2.12 | 2.39 | 2.59 |
| | | 500 | 1.63 | 1.81 | 1.93 | 2.11 | 2.38 | 2.59 |
| | | 600 | 1.71 | 1.92 | 2.06 | 2.30 | 2.62 | 2.84 |
| | | 700 | 1.73 | 1.95 | 2.11 | 2.37 | 2.70 | 2.93 |
| | | 800 | 1.78 | 2.03 | 2.19 | 2.44 | 2.75 | 2.96 |
| | | 900 | 1.81 | 2.06 | 2.22 | 2.47 | 2.76 | 2.97 |
| | | 1000 | 1.86 | 2.11 | 2.26 | 2.49 | 2.78 | 2.98 |
| | | 1100 | 1.91 | 2.16 | 2.30 | 2.52 | 2.79 | 2.99 |
| | | 1200 | 1.95 | 2.20 | 2.34 | 2.54 | 2.81 | 3.00 |
| | | 1300 | 1.96 | 2.21 | 2.34 | 2.55 | 2.81 | 3.00 |
| | | 1400 | 1.97 | 2.22 | 2.35 | 2.55 | 2.80 | 3.00 |
| | | 1500 | 1.98 | 2.22 | 2.35 | 2.54 | 2.80 | 2.99 |
| | | 1600 | 2.01 | 2.24 | 2.37 | 2.57 | 2.82 | 3.00 |
| | | 1700 | 2.01 | 2.24 | 2.37 | 2.57 | 2.82 | 3.01 |
| | | 1800 | 2.04 | 2.26 | 2.38 | 2.57 | 2.82 | 3.01 |
| | | 1900 | 2.06 | 2.27 | 2.39 | 2.58 | 2.82 | 3.01 |
| | | 2000 | 2.07 | 2.28 | 2.39 | 2.58 | 2.83 | 3.01 |
| | | 2100 | 2.07 | 2.28 | 2.40 | 2.58 | 2.83 | 3.02 |
| | | 2200 | 2.10 | 2.30 | 2.41 | 2.59 | 2.84 | 3.02 |
| | | 2300 | 2.14 | 2.32 | 2.43 | 2.61 | 2.84 | 3.02 |
| | | 2400 | 2.16 | 2.33 | 2.44 | 2.61 | 2.85 | 3.03 |
| | | 2500 | 2.17 | 2.35 | 2.46 | 2.63 | 2.86 | 3.04 |
| | | 2600 | 2.23 | 2.40 | 2.51 | 2.67 | 2.89 | 3.06 |
| | | 2700 | 2.24 | 2.41 | 2.51 | 2.68 | 2.90 | 3.07 |
| | | 2800 | 2.25 | 2.41 | 2.51 | 2.67 | 2.88 | 3.06 |
| | | 2900 | 2.27 | 2.43 | 2.52 | 2.68 | 2.89 | 3.05 |
| | | 3000 | 2.31 | 2.47 | 2.57 | 2.72 | 2.92 | 3.08 |
| | | 3100 | 2.31 | 2.47 | 2.56 | 2.71 | 2.91 | 3.07 |
| | | 3200 | 2.34 | 2.50 | 2.60 | 2.76 | 2.97 | 3.12 |
| | | 3300 | 2.36 | 2.53 | 2.64 | 2.81 | 3.04 | 3.20 |
| | | 3400 | 2.41 | 2.60 | 2.72 | 2.92 | 3.18 | 3.37 |
| | | 3500 | 2.44 | 2.64 | 2.76 | 2.98 | 3.25 | 3.44 |
| | | 3600 | 2.49 | 2.70 | 2.83 | 3.05 | 3.32 | 3.50 |
| | | 3620 | 2.50 | 2.72 | 2.84 | 3.06 | 3.33 | 3.51 |
| **Stanley Street East** | | | | | | | | |
| | | 3675 | 2.89 | 3.14 | 3.24 | 3.40 | 3.59 | 3.73 |
| | | 3700 | 2.89 | 3.14 | 3.24 | 3.40 | 3.58 | 3.72 |
| | | 3800 | 2.90 | 3.15 | 3.25 | 3.41 | 3.59 | 3.72 |
| | | 3900 | 2.91 | 3.17 | 3.27 | 3.43 | 3.61 | 3.74 |
| | | 4000 | 2.92 | 3.18 | 3.28 | 3.43 | 3.62 | 3.75 |
| | | 4100 | 2.93 | 3.19 | 3.29 | 3.45 | 3.64 | 3.78 |
| | | 4200 | 2.94 | 3.20 | 3.31 | 3.47 | 3.67 | 3.80 |
| | | 4300 | 2.97 | 3.24 | 3.35 | 3.52 | 3.72 | 3.86 |
| | | 4360 | 2.98 | 3.26 | 3.37 | 3.54 | 3.73 | 3.87 |
| **Turbo Street** | | | | | | | | |
| | | 4385 | 3.08 | 3.41 | 3.52 | 3.68 | 3.86 | 3.99 |
| | | 4400 | 3.08 | 3.40 | 3.52 | 3.68 | 3.85 | 3.98 |
| | | 4420 | 3.08 | 3.40 | 3.52 | 3.68 | 3.86 | 3.99 |
| **Deshon Street** | | | | | | | | |
| | | 4460 | 3.30 | 3.66 | 3.78 | 4.00 | 4.19 | 4.33 |
| | | 4485 | 3.30 | 3.66 | 3.78 | 4.00 | 4.18 | 4.33 |
| **Cleveland Railway Crossing** | | | | | | | | |
| | | 4525 | 3.29 | 3.65 | 3.77 | 4.00 | 4.18 | 4.32 |
| | | 4600 | 3.32 | 3.68 | 3.80 | 4.03 | 4.22 | 4.36 |
| | | 4700 | 3.32 | 3.69 | 3.81 | 4.03 | 4.23 | 4.37 |
| | | 4800 | 3.34 | 3.71 | 3.83 | 4.05 | 4.25 | 4.40 |
| | | 4900 | 3.36 | 3.73 | 3.85 | 4.07 | 4.26 | 4.41 |
| | | 5000 | 3.40 | 3.77 | 3.90 | 4.13 | 4.33 | 4.48 |
| | | 5100 | 3.42 | 3.79 | 3.91 | 4.15 | 4.35 | 4.51 |
| | | 5180 | 3.44 | 3.81 | 3.94 | 4.18 | 4.39 | 4.55 |
| **Eastern Busway Crossing** | | | | | | | | |
| | | 5220 | 3.58 | 4.00 | 4.27 | 4.52 | 4.74 | 4.90 |

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - Existing Case Water Level (Scenario 1) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| | | 5257 | 3.69 | 4.12 | 4.39 | 4.64 | 4.86 | 5.02 |
| Logan Road | | | | | | | | |
| | | 5305 | 3.93 | 4.40 | 4.68 | 4.92 | 5.12 | 5.28 |
| | | 5400 | 3.94 | 4.41 | 4.68 | 4.92 | 5.11 | 5.26 |
| | | 5500 | 3.99 | 4.44 | 4.71 | 4.94 | 5.14 | 5.29 |
| | | 5600 | 4.01 | 4.46 | 4.72 | 4.96 | 5.16 | 5.31 |
| | | 5700 | 4.12 | 4.51 | 4.75 | 4.99 | 5.19 | 5.35 |
| | | 5766 | 4.29 | 4.58 | 4.80 | 5.04 | 5.24 | 5.39 |
| Cornwall Street | | | | | | | | |
| | | 5835 | 4.78 | 5.02 | 5.17 | 5.37 | 5.54 | 5.68 |
| | | 5900 | 4.80 | 5.02 | 5.15 | 5.34 | 5.50 | 5.63 |
| | | 6000 | 4.89 | 5.06 | 5.16 | 5.32 | 5.46 | 5.59 |
| | | 6053 | 5.31 | 5.51 | 5.61 | 5.73 | 5.85 | 5.93 |
| Juliette Street | | | | | | | | |
| | | 6090 | 5.59 | 5.92 | 6.09 | 6.46 | 6.74 | 6.90 |
| | | 6100 | 5.59 | 5.93 | 6.10 | 6.48 | 6.76 | 6.92 |
| | | 6200 | 5.92 | 6.15 | 6.29 | 6.60 | 6.87 | 7.02 |
| | | 6300 | 6.33 | 6.44 | 6.51 | 6.69 | 6.92 | 7.07 |
| | | 6400 | 6.84 | 7.00 | 7.06 | 7.13 | 7.25 | 7.31 |
| | | 6500 | 7.42 | 7.56 | 7.63 | 7.73 | 7.87 | 7.97 |
| | | 6522 | 7.41 | 7.53 | 7.57 | 7.64 | 7.78 | 7.88 |
| Ridge Street | | | | | | | | |
| | | 6628 | 8.23 | 8.64 | 8.88 | 9.25 | 9.45 | 9.57 |
| | | 6700 | 8.26 | 8.67 | 8.92 | 9.31 | 9.50 | 9.62 |
| | | 6735 | 8.32 | 8.67 | 8.90 | 9.29 | 9.46 | 9.57 |
| South East Freeway | | | | | | | | |
| | | 6864 | 8.56 | 9.06 | 9.32 | 9.69 | 9.99 | 10.22 |
| | | 6900 | 8.65 | 9.14 | 9.40 | 9.77 | 10.07 | 10.31 |
| | | 7000 | 8.83 | 9.25 | 9.46 | 9.78 | 10.07 | 10.31 |
| | | 7100 | 8.94 | 9.31 | 9.49 | 9.81 | 10.10 | 10.34 |
| | | 7167 | 9.14 | 9.54 | 9.72 | 9.99 | 10.29 | 10.51 |
| Arnwood Place | | | | | | | | |
| | | 7200 | 9.62 | 10.01 | 10.19 | 10.42 | 10.65 | 10.85 |
| | | 7300 | 9.76 | 10.17 | 10.37 | 10.62 | 10.88 | 11.09 |

## ***Scotts Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - Existing Case Water Level (Scenario 1) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| | | 0 | 2.14 | 2.32 | 2.43 | 2.61 | 2.84 | 3.02 |
| | | 100 | 2.16 | 2.34 | 2.44 | 2.61 | 2.84 | 3.03 |
| | | 200 | 2.16 | 2.34 | 2.45 | 2.61 | 2.85 | 3.03 |
| | | 300 | 2.17 | 2.35 | 2.45 | 2.62 | 2.85 | 3.03 |
| Adina Street | | | | | | | | |
| | | 554 | 2.37 | 2.64 | 2.76 | 2.96 | 3.15 | 3.30 |
| | | 600 | 2.39 | 2.65 | 2.77 | 2.97 | 3.16 | 3.31 |
| | | 700 | 2.42 | 2.67 | 2.79 | 2.98 | 3.17 | 3.31 |
| | | 710 | 2.46 | 2.70 | 2.81 | 2.99 | 3.18 | 3.31 |
| Waite Footbridge | | | | | | | | |
| | | 735 | 2.54 | 2.76 | 2.87 | 3.04 | 3.23 | 3.36 |
| | | 800 | 2.61 | 2.81 | 2.90 | 3.06 | 3.24 | 3.37 |

## ***Bridgewater Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - Existing Case Water Level (Scenario 1) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| | | 0 | 2.24 | 2.41 | 2.51 | 2.68 | 2.90 | 3.07 |
| | | 100 | 2.25 | 2.42 | 2.52 | 2.68 | 2.90 | 3.06 |
| | | 200 | 2.26 | 2.42 | 2.52 | 2.68 | 2.90 | 3.06 |
| | | 285 | 2.31 | 2.48 | 2.58 | 2.73 | 2.94 | 3.10 |
| Stanley Street East | | | | | | | | |
| | | 362 | 2.51 | 2.75 | 2.91 | 3.10 | 3.33 | 3.52 |
| | | 400 | 2.53 | 2.78 | 2.93 | 3.12 | 3.34 | 3.53 |
| | | 430 | 2.58 | 2.83 | 2.97 | 3.15 | 3.36 | 3.55 |
| Cleveland Railway Crossing | | | | | | | | |
| | | 467 | 2.62 | 2.87 | 3.02 | 3.20 | 3.41 | 3.57 |
| | | 500 | 2.67 | 2.92 | 3.06 | 3.24 | 3.44 | 3.59 |
| | | 542 | 2.67 | 2.92 | 3.06 | 3.24 | 3.44 | 3.59 |

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - Existing Case Water Level (Scenario 1) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| Temple Street | | | | | | | | |
| | | 580 | 2.81 | 3.05 | 3.18 | 3.34 | 3.52 | 3.64 |
| | | 600 | 2.84 | 3.07 | 3.20 | 3.35 | 3.53 | 3.65 |
| | | 700 | 2.86 | 3.09 | 3.22 | 3.37 | 3.55 | 3.67 |
| | | 800 | 2.86 | 3.10 | 3.22 | 3.37 | 3.55 | 3.67 |
| | | 900 | 2.86 | 3.10 | 3.22 | 3.37 | 3.55 | 3.67 |
| | | 1000 | 2.87 | 3.10 | 3.22 | 3.38 | 3.55 | 3.67 |
| | | 1100 | 2.95 | 3.11 | 3.23 | 3.38 | 3.56 | 3.68 |
| | | 1200 | 3.36 | 3.47 | 3.52 | 3.59 | 3.65 | 3.71 |
| | | 1300 | 3.43 | 3.52 | 3.57 | 3.63 | 3.69 | 3.74 |
| | | 1400 | 3.47 | 3.57 | 3.63 | 3.70 | 3.76 | 3.82 |
| | | 1500 | 3.87 | 4.00 | 4.06 | 4.13 | 4.18 | 4.24 |

## ***Coorparoo Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - Existing Case Water Level (Scenario 1) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| | | 0 | 2.92 | 3.18 | 3.28 | 3.43 | 3.62 | 3.75 |
| | | 100 | 2.93 | 3.18 | 3.28 | 3.44 | 3.62 | 3.76 |
| | | 200 | 2.93 | 3.18 | 3.28 | 3.44 | 3.62 | 3.76 |
| | | 300 | 2.95 | 3.18 | 3.29 | 3.44 | 3.62 | 3.76 |
| | | 360 | 2.95 | 3.19 | 3.30 | 3.44 | 3.63 | 3.76 |
| Morley Street | | | | | | | | |
| | | 390 | 3.46 | 3.63 | 3.71 | 3.80 | 3.87 | 3.95 |
| | | 400 | 3.47 | 3.64 | 3.72 | 3.82 | 3.89 | 3.97 |
| | | 408 | 3.49 | 3.66 | 3.75 | 3.84 | 3.91 | 3.99 |
| Cleveland Railway Crossing | | | | | | | | |
| | | 448 | 3.51 | 3.69 | 3.78 | 3.87 | 3.95 | 4.04 |
| | | 465 | 3.51 | 3.69 | 3.78 | 3.87 | 3.95 | 4.04 |
| Gladstone Street | | | | | | | | |
| | | 530 | 3.71 | 3.86 | 3.93 | 4.01 | 4.09 | 4.17 |
| | | 600 | 3.73 | 3.88 | 3.96 | 4.05 | 4.13 | 4.20 |

## ***Kingfisher Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - Existing Case Water Level (Scenario 1) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| | | 0 | 2.92 | 3.18 | 3.28 | 3.44 | 3.62 | 3.76 |
| | | 100 | 2.93 | 3.19 | 3.29 | 3.46 | 3.65 | 3.79 |
| | | 200 | 2.94 | 3.19 | 3.29 | 3.46 | 3.66 | 3.80 |
| | | 300 | 2.94 | 3.19 | 3.29 | 3.46 | 3.66 | 3.80 |
| | | 400 | 2.94 | 3.19 | 3.29 | 3.47 | 3.67 | 3.81 |

## ***Ekibin Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - Existing Case Water Level (Scenario 1) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| N20 | 10255 | 0 | 9.84 | 10.27 | 10.48 | 10.74 | 11.01 | 11.23 |
| E450 | 10107 | 15 | 9.92 | 10.35 | 10.56 | 10.82 | 11.10 | 11.32 |
| E440 | 10045 | 77 | 9.92 | 10.32 | 10.53 | 10.78 | 11.05 | 11.27 |
| South East Freeway | | | | | | | | |
| E430 | 9893 | 228 | 10.86 | 11.34 | 11.60 | 11.95 | 12.38 | 12.75 |
| E420 | 9863 | 258 | 10.92 | 11.41 | 11.67 | 12.02 | 12.46 | 12.83 |
| E410 | 9811 | 310 | 11.13 | 11.60 | 11.86 | 12.19 | 12.62 | 12.98 |
| E400 | 9744 | 379 | 11.30 | 11.74 | 11.98 | 12.31 | 12.71 | 13.06 |
| E390 | 9673 | 449 | 11.52 | 11.92 | 12.14 | 12.43 | 12.81 | 13.13 |
| E380 | 9648 | 474 | 11.60 | 11.96 | 12.17 | 12.45 | 12.82 | 13.13 |
| E370 | 9601 | 521 | 11.81 | 12.14 | 12.33 | 12.59 | 12.93 | 13.23 |
| E360 | 9540 | 581 | 12.00 | 12.30 | 12.47 | 12.70 | 13.01 | 13.30 |
| E350 | 9498 | 624 | 12.15 | 12.44 | 12.60 | 12.81 | 13.11 | 13.37 |
| E340 | 9467 | 655 | 12.26 | 12.56 | 12.73 | 12.95 | 13.24 | 13.50 |
| E330 | 9431 | 690 | 12.38 | 12.69 | 12.85 | 13.08 | 13.37 | 13.62 |
| E320 | 9384 | 737 | 12.45 | 12.76 | 12.93 | 13.16 | 13.45 | 13.70 |
| E310 | 9333 | 788 | 12.52 | 12.85 | 13.02 | 13.25 | 13.54 | 13.80 |

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - Existing Case Water Level (Scenario 1) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| E300 | 9286 | 836 | 12.70 | 13.00 | 13.16 | 13.37 | 13.64 | 13.87 |
| E290 | 9232 | 888 | 12.81 | 13.09 | 13.25 | 13.45 | 13.71 | 13.94 |
| E280 | 9182 | 939 | 12.84 | 13.12 | 13.26 | 13.46 | 13.71 | 13.93 |
| E270 | 9155 | 967 | 12.85 | 13.12 | 13.27 | 13.47 | 13.72 | 13.94 |
| E260 | 9109 | 1012 | 12.95 | 13.22 | 13.37 | 13.56 | 13.81 | 14.02 |
| E250 | 9056 | 1065 | 13.08 | 13.35 | 13.50 | 13.70 | 13.94 | 14.15 |
| E240 | 9004 | 1117 | 13.21 | 13.47 | 13.61 | 13.80 | 14.04 | 14.24 |
| E230 | 8967 | 1153 | 13.41 | 13.63 | 13.75 | 13.92 | 14.14 | 14.33 |
| E220 | 8920 | 1191 | 13.55 | 13.77 | 13.88 | 14.05 | 14.26 | 14.44 |
| E210 | 8893 | 1224 | 13.60 | 13.81 | 13.93 | 14.09 | 14.30 | 14.48 |
| E200 | 8842 | 1275 | 13.86 | 14.06 | 14.16 | 14.29 | 14.46 | 14.60 |
| E190 | 8761 | 1355 | 14.23 | 14.41 | 14.51 | 14.63 | 14.78 | 14.90 |
| E180 | 8714 | 1401 | 14.30 | 14.47 | 14.56 | 14.68 | 14.81 | 14.93 |
| E170 | 8670 | 1446 | 14.39 | 14.58 | 14.69 | 14.82 | 14.98 | 15.11 |
| E160 | 8625 | 1491 | 14.46 | 14.67 | 14.78 | 14.92 | 15.08 | 15.22 |
| E150 | 8573 | 1542 | 14.52 | 14.73 | 14.84 | 14.99 | 15.15 | 15.28 |
| **Bridwood Road Development Bridge** | | | | | | | | |
| E140 | 8550 | 1566 | 14.54 | 14.76 | 14.87 | 15.02 | 15.20 | 15.35 |
| E130 | 8511 | 1606 | 14.64 | 14.87 | 14.98 | 15.14 | 15.31 | 15.46 |
| **Birdwood Road Development Causeway** | | | | | | | | |
| E120 | 8466 | 1651 | 14.77 | 14.99 | 15.11 | 15.27 | 15.44 | 15.59 |
| E110 | 8447 | 1669 | 16.16 | 16.33 | 16.42 | 16.53 | 16.67 | 16.78 |
| E100 | 8420 | 1697 | 16.16 | 16.33 | 16.42 | 16.53 | 16.67 | 16.78 |
| E90 | 8385 | 1732 | 16.17 | 16.34 | 16.43 | 16.54 | 16.68 | 16.79 |
| E80 | 8365 | 1752 | 16.15 | 16.32 | 16.41 | 16.52 | 16.66 | 16.77 |
| **Birdwood Road** | | | | | | | | |
| E70 | 8318 | 1800 | 16.56 | 16.98 | 17.17 | 17.39 | 17.61 | 17.73 |
| E60 | 8271 | 1845 | 16.53 | 16.96 | 17.14 | 17.37 | 17.58 | 17.69 |
| E50 | 8220 | 1896 | 16.58 | 17.01 | 17.20 | 17.42 | 17.63 | 17.76 |
| E40 | 8135 | 1981 | 17.43 | 17.62 | 17.72 | 17.86 | 18.02 | 18.14 |
| E35 | 8120 | 1996 | 17.63 | 17.78 | 17.86 | 17.97 | 18.11 | 18.22 |
| E30 | 8058 | 2058 | 17.93 | 18.09 | 18.17 | 18.27 | 18.38 | 18.48 |
| **Park Maintenance Crossing** | | | | | | | | |
| E20 | 8028 | 2082 | 18.20 | 18.32 | 18.37 | 18.44 | 18.50 | 18.56 |
| E10 | 8004 | 2112 | 18.30 | 18.41 | 18.47 | 18.53 | 18.60 | 18.65 |
| | 7980 | 2136 | 18.38 | 18.48 | 18.53 | 18.58 | 18.64 | 18.70 |

## ***Glindemann Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - Existing Case Water Level (Scenario 1) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| | 7980 | 0 | 18.38 | 18.48 | 18.53 | 18.58 | 18.64 | 18.70 |
| G470 | 7938 | 43 | 18.77 | 18.86 | 18.90 | 18.96 | 19.03 | 19.08 |
| G460 | 7895 | 86 | 18.93 | 19.04 | 19.09 | 19.16 | 19.24 | 19.30 |
| G450 | 7841 | 139 | 18.99 | 19.10 | 19.15 | 19.22 | 19.30 | 19.37 |
| G440 | 7763 | 217 | 19.24 | 19.35 | 19.40 | 19.46 | 19.54 | 19.63 |
| G430 | 7696 | 284 | 19.47 | 19.58 | 19.63 | 19.69 | 19.77 | 19.88 |
| **Marshall Road** | | | | | | | | |
| G420 | 7659 | 322 | 19.83 | 20.14 | 20.27 | 20.46 | 20.96 | 21.50 |
| G410 | 7632 | 348 | 19.89 | 20.18 | 20.31 | 20.51 | 21.01 | 21.52 |
| G400 | 7577 | 403 | 20.21 | 20.43 | 20.52 | 20.66 | 21.05 | 21.55 |
| G390 | 7522 | 458 | 20.53 | 20.72 | 20.80 | 20.91 | 21.20 | 21.62 |
| G380 | 7480 | 500 | 20.74 | 20.90 | 20.97 | 21.05 | 21.26 | 21.64 |
| G370 | 7475 | 505 | 20.84 | 20.98 | 21.04 | 21.12 | 21.33 | 21.68 |
| G360 | 7413 | 567 | 22.31 | 22.39 | 22.41 | 22.45 | 22.53 | 22.64 |
| G350 | 7408 | 573 | 22.32 | 22.39 | 22.42 | 22.46 | 22.53 | 22.64 |
| G340 | 7360 | 621 | 22.40 | 22.48 | 22.51 | 22.55 | 22.64 | 22.75 |
| G330 | 7310 | 670 | 22.39 | 22.47 | 22.50 | 22.54 | 22.62 | 22.73 |
| G320 | 7305 | 680 | 22.46 | 22.56 | 22.59 | 22.65 | 22.76 | 22.92 |
| G300 | 7155 | 824 | 24.78 | 25.02 | 25.12 | 25.21 | 25.45 | 25.56 |
| G290 | 7150 | 830 | 24.92 | 25.11 | 25.25 | 25.35 | 25.66 | 25.72 |
| G280 | 7135 | 844 | 24.82 | 25.05 | 25.11 | 25.22 | 25.52 | 25.57 |
| G270 | 7125 | 855 | 24.86 | 25.07 | 25.14 | 25.25 | 25.52 | 25.64 |
| G260 | 7091 | 889 | 24.80 | 25.04 | 25.12 | 25.23 | 25.43 | 25.64 |
| G250 | 7057 | 922 | 24.77 | 25.00 | 25.08 | 25.19 | 25.39 | 25.59 |
| G240 | 7047 | 933 | 25.20 | 25.34 | 25.40 | 25.48 | 25.67 | 25.93 |
| G230 | 6998 | 980 | 25.26 | 25.41 | 25.46 | 25.54 | 25.72 | 25.98 |
| G220 | 6993 | 987 | 25.77 | 25.93 | 25.99 | 26.09 | 26.30 | 26.59 |

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - Existing Case Water Level (Scenario 1) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| **Logan Road** | | | | | | | | |
| G210 | 6944 | 1041 | 27.26 | 27.82 | 28.08 | 28.43 | 28.78 | 29.01 |
| G200 | 6912 | 1067 | 27.31 | 27.84 | 28.10 | 28.44 | 28.79 | 29.02 |
| G190 | 6843 | 1136 | 27.34 | 27.85 | 28.10 | 28.44 | 28.80 | 29.02 |
| G180 | 6783 | 1191 | 27.36 | 27.86 | 28.11 | 28.45 | 28.80 | 29.02 |
| **Glindemann Park Footbridge** | | | | | | | | |
| G170 | 6773 | 1209 | 27.78 | 27.92 | 28.11 | 28.45 | 28.80 | 29.03 |
| G160 | 6714 | 1265 | 27.83 | 27.98 | 28.13 | 28.46 | 28.80 | 29.03 |
| G150 | 6624 | 1355 | 28.14 | 28.32 | 28.42 | 28.54 | 28.81 | 29.03 |
| G140 | 6525 | 1455 | 29.34 | 29.54 | 29.62 | 29.73 | 29.81 | 29.89 |
| G130 | 6472 | 1507 | 29.94 | 30.10 | 30.18 | 30.27 | 30.35 | 30.43 |
| G120 | 6397 | 1583 | 30.41 | 30.60 | 30.70 | 30.83 | 30.93 | 31.04 |
| G110 | 6390 | 1590 | 30.46 | 30.66 | 30.75 | 30.88 | 30.98 | 31.09 |
| G100 | 6260 | 1721 | 32.05 | 32.24 | 32.34 | 32.45 | 32.55 | 32.65 |
| G90 | 6253 | 1727 | 32.05 | 32.25 | 32.34 | 32.45 | 32.55 | 32.65 |
| G80 | 6228 | 1755 | 32.06 | 32.26 | 32.36 | 32.48 | 32.58 | 32.68 |
| G70 | 6218 | 1759 | 32.05 | 32.25 | 32.35 | 32.46 | 32.56 | 32.67 |
| G60 | 6188 | 1792 | 32.09 | 32.30 | 32.40 | 32.52 | 32.63 | 32.73 |
| G50 | 6154 | 1826 | 32.22 | 32.44 | 32.54 | 32.67 | 32.78 | 32.89 |
| G40 | 6125 | 1857 | 32.43 | 32.66 | 32.78 | 32.93 | 33.05 | 33.18 |
| G30 | 6115 | 1862 | 32.52 | 32.73 | 32.84 | 32.98 | 33.10 | 33.22 |
| G20 | 6085 | 1895 | 32.79 | 32.98 | 33.09 | 33.22 | 33.33 | 33.44 |
| G10 | 6054 | 1926 | 33.05 | 33.25 | 33.35 | 33.49 | 33.59 | 33.70 |

## ***Sandy Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - Existing Case Water Level (Scenario 1) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| S240 | 1750 | 95 | 9.92 | 10.32 | 10.53 | 10.78 | 11.05 | 11.27 |
| S230 | 1688 | 181 | 10.17 | 10.56 | 10.76 | 10.98 | 11.19 | 11.39 |
| S220 | 1619 | 250 | 10.61 | 10.85 | 10.98 | 11.16 | 11.37 | 11.54 |
| S210 | 1579 | 290 | 10.75 | 10.98 | 11.09 | 11.28 | 11.48 | 11.66 |
| S200 | 1527 | 342 | 10.82 | 11.03 | 11.13 | 11.29 | 11.48 | 11.65 |
| S190 | 1455 | 414 | 10.93 | 11.14 | 11.24 | 11.40 | 11.59 | 11.77 |
| **Sunshine Avenue Footbridge** | | | | | | | | |
| S180 | 1444 | 425 | 11.05 | 11.23 | 11.33 | 11.51 | 11.69 | 11.86 |
| S170 | 1434 | 435 | 11.04 | 11.22 | 11.32 | 11.49 | 11.66 | 11.83 |
| S150 | 1430 | 439 | 11.71 | 11.89 | 11.98 | 12.15 | 12.33 | 12.59 |
| S140 | 1408 | 461 | 11.74 | 11.91 | 12.00 | 12.17 | 12.34 | 12.57 |
| S130 | 1381 | 488 | 11.77 | 11.95 | 12.04 | 12.21 | 12.38 | 12.60 |
| S110 | 1377 | 492 | 12.48 | 12.66 | 12.75 | 12.92 | 13.09 | 13.27 |
| S100 | 1351 | 518 | 12.52 | 12.69 | 12.78 | 12.95 | 13.12 | 13.29 |
| **Sexton Street** | | | | | | | | |
| S80 | 1329 | 540 | 14.16 | 14.55 | 14.78 | 15.00 | 15.16 | 15.28 |
| S70 | 1322 | 547 | 14.21 | 14.60 | 14.82 | 15.03 | 15.19 | 15.31 |
| S60 | 1304 | 565 | 14.24 | 14.62 | 14.83 | 15.04 | 15.20 | 15.32 |
| S50 | 1264 | 605 | 14.29 | 14.63 | 14.84 | 15.05 | 15.20 | 15.32 |
| S40 | 1224 | 645 | 14.47 | 14.68 | 14.86 | 15.06 | 15.21 | 15.33 |
| S30 | 1174 | 695 | 14.79 | 14.94 | 15.02 | 15.17 | 15.30 | 15.41 |
| S20 | 1081 | 788 | 15.91 | 16.03 | 16.09 | 16.17 | 16.23 | 16.30 |
| S10 | 1000 | 869 | 16.92 | 17.05 | 17.12 | 17.21 | 17.27 | 17.34 |

## ***Mott Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - Existing Case Water Level (Scenario 1) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| | 1365 | 59 | 14.23 | 14.41 | 14.51 | 14.63 | 14.78 | 14.90 |
| M130 | 1351 | 73 | 14.28 | 14.48 | 14.58 | 14.70 | 14.83 | 14.94 |
| M120 | 1316 | 108 | 14.41 | 14.65 | 14.77 | 14.92 | 15.05 | 15.17 |
| M110 | 1292 | 132 | 14.53 | 14.77 | 14.89 | 15.04 | 15.17 | 15.29 |
| M100 | 1264 | 160 | 14.70 | 14.96 | 15.09 | 15.26 | 15.40 | 15.53 |
| M90 | 1232 | 192 | 14.84 | 15.13 | 15.28 | 15.46 | 15.63 | 15.78 |
| M80 | 1210 | 214 | 14.88 | 15.18 | 15.33 | 15.52 | 15.68 | 15.83 |
| M70 | 1187 | 237 | 14.91 | 15.20 | 15.35 | 15.54 | 15.70 | 15.86 |
| M60 | 1167 | 257 | 15.07 | 15.36 | 15.51 | 15.70 | 15.86 | 16.02 |

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - Existing Case Water Level (Scenario 1) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| M50 | 1139 | 285 | 15.41 | 15.66 | 15.79 | 15.96 | 16.11 | 16.25 |
| M40 | 1111 | 313 | 15.79 | 16.05 | 16.19 | 16.37 | 16.52 | 16.65 |
| M30 | 1076 | 348 | 16.35 | 16.64 | 16.79 | 16.95 | 17.07 | 17.17 |
| M20 | 1034 | 390 | 17.13 | 17.39 | 17.52 | 17.65 | 17.76 | 17.85 |
| M10 | 1000 | 424 | 17.70 | 17.90 | 18.00 | 18.11 | 18.20 | 18.29 |

## ***Norman Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - MRC + WC (Scenario 3) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| | | 0 | 1.06 | 1.06 | 1.06 | 1.06 | 1.06 | 1.06 |
| **Wynnum Road** | | | | | | | | |
| | | 75 | 1.32 | 1.38 | 1.41 | 1.43 | 1.45 | 1.46 |
| | | 100 | 1.30 | 1.34 | 1.35 | 1.35 | 1.35 | 1.35 |
| | | 200 | 1.40 | 1.54 | 1.63 | 1.76 | 1.94 | 2.11 |
| | | 300 | 1.51 | 1.71 | 1.85 | 2.04 | 2.30 | 2.52 |
| | | 400 | 1.62 | 1.89 | 2.07 | 2.32 | 2.65 | 2.91 |
| | | 500 | 1.66 | 1.96 | 2.14 | 2.39 | 2.72 | 2.97 |
| | | 600 | 1.75 | 2.10 | 2.32 | 2.63 | 2.98 | 3.25 |
| | | 700 | 1.78 | 2.15 | 2.39 | 2.70 | 3.05 | 3.31 |
| | | 800 | 1.83 | 2.23 | 2.46 | 2.75 | 3.08 | 3.33 |
| | | 900 | 1.87 | 2.26 | 2.48 | 2.76 | 3.09 | 3.33 |
| | | 1000 | 1.92 | 2.30 | 2.50 | 2.77 | 3.09 | 3.34 |
| | | 1100 | 1.97 | 2.34 | 2.53 | 2.79 | 3.10 | 3.34 |
| | | 1200 | 2.00 | 2.36 | 2.55 | 2.80 | 3.11 | 3.35 |
| | | 1300 | 2.01 | 2.37 | 2.55 | 2.80 | 3.11 | 3.35 |
| | | 1400 | 2.03 | 2.37 | 2.55 | 2.80 | 3.11 | 3.35 |
| | | 1500 | 2.04 | 2.38 | 2.55 | 2.80 | 3.11 | 3.35 |
| | | 1600 | 2.06 | 2.40 | 2.57 | 2.81 | 3.12 | 3.36 |
| | | 1700 | 2.07 | 2.40 | 2.57 | 2.81 | 3.12 | 3.36 |
| | | 1800 | 2.08 | 2.40 | 2.57 | 2.81 | 3.12 | 3.36 |
| | | 1900 | 2.10 | 2.41 | 2.58 | 2.82 | 3.12 | 3.36 |
| | | 2000 | 2.11 | 2.41 | 2.58 | 2.82 | 3.12 | 3.36 |
| | | 2100 | 2.11 | 2.41 | 2.58 | 2.82 | 3.12 | 3.36 |
| | | 2200 | 2.13 | 2.42 | 2.59 | 2.82 | 3.12 | 3.36 |
| | | 2300 | 2.17 | 2.44 | 2.60 | 2.83 | 3.13 | 3.36 |
| | | 2400 | 2.20 | 2.46 | 2.61 | 2.84 | 3.13 | 3.37 |
| | | 2500 | 2.22 | 2.48 | 2.63 | 2.85 | 3.14 | 3.37 |
| | | 2600 | 2.27 | 2.52 | 2.66 | 2.87 | 3.15 | 3.38 |
| | | 2700 | 2.28 | 2.53 | 2.67 | 2.88 | 3.16 | 3.38 |
| | | 2800 | 2.29 | 2.53 | 2.67 | 2.88 | 3.15 | 3.38 |
| | | 2900 | 2.34 | 2.58 | 2.72 | 2.92 | 3.18 | 3.39 |
| | | 3000 | 2.40 | 2.64 | 2.78 | 2.98 | 3.23 | 3.44 |
| | | 3100 | 2.40 | 2.65 | 2.78 | 2.98 | 3.23 | 3.44 |
| | | 3200 | 2.46 | 2.73 | 2.88 | 3.09 | 3.34 | 3.56 |
| | | 3300 | 2.52 | 2.82 | 2.99 | 3.22 | 3.51 | 3.74 |
| | | 3400 | 2.59 | 2.93 | 3.12 | 3.38 | 3.69 | 3.93 |
| | | 3500 | 2.63 | 2.98 | 3.18 | 3.45 | 3.76 | 3.99 |
| | | 3600 | 2.69 | 3.05 | 3.25 | 3.51 | 3.81 | 4.04 |
| | | 3620 | 2.70 | 3.06 | 3.26 | 3.51 | 3.81 | 4.04 |
| **Stanley Street East** | | | | | | | | |
| | | 3675 | 3.04 | 3.34 | 3.48 | 3.68 | 3.95 | 4.16 |
| | | 3700 | 3.04 | 3.34 | 3.48 | 3.68 | 3.94 | 4.16 |
| | | 3800 | 3.07 | 3.36 | 3.50 | 3.70 | 3.96 | 4.18 |
| | | 3900 | 3.09 | 3.38 | 3.52 | 3.72 | 3.98 | 4.20 |
| | | 4000 | 3.10 | 3.39 | 3.53 | 3.73 | 3.99 | 4.21 |
| | | 4100 | 3.12 | 3.42 | 3.57 | 3.77 | 4.04 | 4.26 |
| | | 4200 | 3.15 | 3.46 | 3.61 | 3.82 | 4.08 | 4.30 |
| | | 4300 | 3.20 | 3.52 | 3.67 | 3.88 | 4.14 | 4.34 |
| | | 4360 | 3.22 | 3.54 | 3.69 | 3.90 | 4.15 | 4.35 |
| **Turbo Street** | | | | | | | | |
| | | 4385 | 3.32 | 3.64 | 3.79 | 4.00 | 4.24 | 4.43 |
| | | 4400 | 3.32 | 3.64 | 3.79 | 3.99 | 4.24 | 4.43 |
| | | 4420 | 3.32 | 3.64 | 3.79 | 4.00 | 4.24 | 4.43 |
| **Deshon Street** | | | | | | | | |
| | | 4460 | 3.50 | 3.84 | 4.04 | 4.27 | 4.49 | 4.72 |
| | | 4485 | 3.50 | 3.84 | 4.04 | 4.27 | 4.50 | 4.73 |
| **Cleveland Railway Crossing** | | | | | | | | |
| | | 4525 | 3.51 | 3.86 | 4.06 | 4.29 | 4.51 | 4.75 |
| | | 4600 | 3.55 | 3.89 | 4.09 | 4.32 | 4.55 | 4.79 |
| | | 4700 | 3.56 | 3.90 | 4.11 | 4.34 | 4.57 | 4.81 |
| | | 4800 | 3.59 | 3.93 | 4.14 | 4.37 | 4.60 | 4.85 |
| | | 4900 | 3.63 | 3.98 | 4.19 | 4.42 | 4.66 | 4.92 |
| | | 5000 | 3.68 | 4.04 | 4.25 | 4.49 | 4.74 | 5.02 |
| | | 5100 | 3.70 | 4.06 | 4.28 | 4.52 | 4.76 | 5.03 |
| | | 5180 | 3.74 | 4.11 | 4.33 | 4.57 | 4.83 | 5.10 |
| **Eastern Busway Crossing** | | | | | | | | |
| | | 5220 | 3.79 | 4.27 | 4.54 | 4.79 | 5.04 | 5.31 |

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - MRC + WC (Scenario 3) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| | | 5257 | 3.89 | 4.38 | 4.65 | 4.91 | 5.16 | 5.46 |
| **Logan Road** | | | | | | | | |
| | | 5305 | 4.12 | 4.64 | 4.91 | 5.17 | 5.54 | 5.81 |
| | | 5400 | 4.12 | 4.65 | 4.91 | 5.17 | 5.53 | 5.81 |
| | | 5500 | 4.15 | 4.67 | 4.93 | 5.18 | 5.54 | 5.84 |
| | | 5600 | 4.17 | 4.68 | 4.94 | 5.20 | 5.55 | 5.84 |
| | | 5700 | 4.23 | 4.69 | 4.94 | 5.19 | 5.55 | 5.84 |
| | | 5766 | 4.35 | 4.75 | 5.00 | 5.26 | 5.58 | 5.88 |
| **Cornwall Street** | | | | | | | | |
| | | 5835 | 4.84 | 5.17 | 5.39 | 5.61 | 6.00 | 6.23 |
| | | 5900 | 4.87 | 5.18 | 5.39 | 5.60 | 5.98 | 6.20 |
| | | 6000 | 4.93 | 5.19 | 5.39 | 5.58 | 5.95 | 6.19 |
| | | 6053 | 5.23 | 5.44 | 5.56 | 5.70 | 5.93 | 6.27 |
| **Juliette Street** | | | | | | | | |
| | | 6090 | 5.77 | 6.20 | 6.47 | 6.75 | 7.04 | 7.24 |
| | | 6100 | 5.77 | 6.20 | 6.48 | 6.76 | 7.05 | 7.25 |
| | | 6200 | 5.91 | 6.29 | 6.55 | 6.82 | 7.10 | 7.29 |
| | | 6300 | 6.37 | 6.53 | 6.67 | 6.88 | 7.14 | 7.31 |
| | | 6400 | 6.83 | 6.98 | 7.05 | 7.13 | 7.26 | 7.36 |
| | | 6500 | 7.40 | 7.55 | 7.62 | 7.72 | 7.85 | 7.97 |
| | | 6522 | 7.39 | 7.52 | 7.57 | 7.63 | 7.75 | 7.88 |
| **Ridge Street** | | | | | | | | |
| | | 6628 | 8.19 | 8.58 | 8.83 | 9.22 | 9.44 | 9.58 |
| | | 6700 | 8.33 | 8.71 | 8.96 | 9.34 | 9.55 | 9.70 |
| | | 6735 | 8.43 | 8.78 | 8.99 | 9.35 | 9.54 | 9.67 |
| **South East Freeway** | | | | | | | | |
| | | 6864 | 8.69 | 9.15 | 9.38 | 9.73 | 10.01 | 10.29 |
| | | 6900 | 8.81 | 9.25 | 9.49 | 9.83 | 10.12 | 10.40 |
| | | 7000 | 9.11 | 9.47 | 9.66 | 9.96 | 10.24 | 10.51 |
| | | 7100 | 9.26 | 9.59 | 9.76 | 10.03 | 10.29 | 10.57 |
| | | 7167 | 9.42 | 9.80 | 9.98 | 10.25 | 10.53 | 10.81 |
| **Arnwood Place** | | | | | | | | |
| | | 7200 | 9.78 | 10.13 | 10.33 | 10.59 | 10.88 | 11.14 |
| | | 7300 | 9.96 | 10.35 | 10.57 | 10.84 | 11.16 | 11.43 |

## ***Scotts Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - MRC + WC (Scenario 3) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| | | 0 | 2.17 | 2.44 | 2.60 | 2.83 | 3.13 | 3.36 |
| | | 100 | 2.19 | 2.45 | 2.61 | 2.84 | 3.13 | 3.37 |
| | | 200 | 2.19 | 2.46 | 2.61 | 2.84 | 3.13 | 3.37 |
| | | 300 | 2.20 | 2.46 | 2.61 | 2.84 | 3.13 | 3.37 |
| **Adina Street** | | | | | | | | |
| | | 554 | 2.40 | 2.72 | 2.90 | 3.12 | 3.31 | 3.45 |
| | | 600 | 2.43 | 2.74 | 2.91 | 3.13 | 3.31 | 3.45 |
| | | 700 | 2.45 | 2.75 | 2.92 | 3.14 | 3.32 | 3.45 |
| | | 710 | 2.49 | 2.78 | 2.94 | 3.15 | 3.32 | 3.46 |
| **Waite Footbridge** | | | | | | | | |
| | | 735 | 2.56 | 2.84 | 3.00 | 3.20 | 3.38 | 3.51 |
| | | 800 | 2.65 | 2.87 | 3.02 | 3.22 | 3.40 | 3.53 |

## ***Bridgewater Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - MRC + WC (Scenario 3) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| | | 0 | 2.28 | 2.52 | 2.67 | 2.88 | 3.16 | 3.38 |
| | | 100 | 2.28 | 2.53 | 2.67 | 2.88 | 3.16 | 3.38 |
| | | 200 | 2.29 | 2.53 | 2.67 | 2.88 | 3.15 | 3.38 |
| | | 285 | 2.32 | 2.57 | 2.70 | 2.90 | 3.17 | 3.39 |
| **Stanley Street East** | | | | | | | | |
| | | 362 | 2.42 | 2.84 | 3.04 | 3.28 | 3.55 | 3.78 |
| | | 400 | 2.44 | 2.87 | 3.07 | 3.31 | 3.58 | 3.80 |
| | | 430 | 2.46 | 2.90 | 3.10 | 3.33 | 3.61 | 3.82 |
| **Cleveland Railway Crossing** | | | | | | | | |
| | | 467 | 4.71 | 4.80 | 4.83 | 4.89 | 4.98 | 5.02 |
| | | 500 | 4.71 | 4.81 | 4.84 | 4.89 | 4.99 | 5.02 |
| | | 542 | 4.71 | 4.81 | 4.84 | 4.89 | 4.99 | 5.02 |

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - MRC + WC (Scenario 3) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| Temple Street | | | | | | | | |
| | | 580 | 4.71 | 4.82 | 4.85 | 4.91 | 5.01 | 5.05 |
| | | 600 | 4.71 | 4.82 | 4.85 | 4.91 | 5.01 | 5.06 |
| | | 700 | 4.72 | 4.82 | 4.86 | 4.92 | 5.02 | 5.07 |
| | | 800 | 4.72 | 4.83 | 4.86 | 4.92 | 5.03 | 5.08 |
| | | 900 | 4.72 | 4.83 | 4.86 | 4.93 | 5.04 | 5.09 |
| | | 1000 | 4.72 | 4.83 | 4.87 | 4.93 | 5.04 | 5.10 |
| | | 1100 | 4.72 | 4.83 | 4.87 | 4.94 | 5.06 | 5.11 |
| | | 1200 | 4.72 | 4.84 | 4.88 | 4.94 | 5.07 | 5.13 |
| | | 1300 | 4.72 | 4.84 | 4.88 | 4.95 | 5.08 | 5.15 |
| | | 1400 | 4.72 | 4.85 | 4.89 | 4.96 | 5.09 | 5.16 |
| | | 1500 | 4.73 | 4.85 | 4.90 | 4.97 | 5.11 | 5.18 |

## ***Coorparoo Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - MRC + WC (Scenario 3) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| | | 0 | 3.10 | 3.39 | 3.53 | 3.73 | 3.99 | 4.21 |
| | | 100 | 3.10 | 3.39 | 3.53 | 3.73 | 3.99 | 4.21 |
| | | 200 | 3.10 | 3.39 | 3.53 | 3.73 | 3.99 | 4.21 |
| | | 300 | 3.10 | 3.40 | 3.53 | 3.73 | 3.99 | 4.21 |
| | | 360 | 3.11 | 3.41 | 3.54 | 3.74 | 4.01 | 4.22 |
| Morley Street | | | | | | | | |
| | | 390 | 3.72 | 3.94 | 4.10 | 4.23 | 4.32 | 4.46 |
| | | 400 | 3.74 | 3.96 | 4.12 | 4.26 | 4.34 | 4.49 |
| | | 408 | 3.76 | 3.98 | 4.14 | 4.27 | 4.36 | 4.50 |
| Cleveland Railway Crossing | | | | | | | | |
| | | 448 | 3.79 | 4.02 | 4.18 | 4.33 | 4.44 | 4.59 |
| | | 465 | 3.79 | 4.03 | 4.19 | 4.34 | 4.46 | 4.60 |
| Gladstone Street | | | | | | | | |
| | | 530 | 3.99 | 4.19 | 4.32 | 4.47 | 4.63 | 4.77 |
| | | 600 | 4.03 | 4.27 | 4.40 | 4.56 | 4.72 | 4.87 |

## ***Kingfisher Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - MRC + WC (Scenario 3) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| | | 0 | 3.10 | 3.40 | 3.54 | 3.74 | 4.00 | 4.22 |
| | | 100 | 3.12 | 3.43 | 3.57 | 3.78 | 4.05 | 4.27 |
| | | 200 | 3.12 | 3.43 | 3.58 | 3.79 | 4.07 | 4.29 |
| | | 300 | 3.13 | 3.44 | 3.58 | 3.80 | 4.08 | 4.30 |
| | | 400 | 3.13 | 3.44 | 3.59 | 3.81 | 4.09 | 4.32 |

## ***Ekibin Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - MRC + WC (Scenario 3) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| N20 | 10255 | 0 | 10.04 | 10.45 | 10.68 | 10.96 | 11.30 | 11.58 |
| E450 | 10107 | 15 | 10.13 | 10.54 | 10.77 | 11.05 | 11.38 | 11.67 |
| E440 | 10045 | 77 | 10.13 | 10.52 | 10.74 | 11.02 | 11.36 | 11.65 |
| South East Freeway | | | | | | | | |
| E430 | 9893 | 228 | 10.78 | 11.26 | 11.52 | 11.86 | 12.33 | 12.70 |
| E420 | 9863 | 258 | 10.87 | 11.36 | 11.63 | 11.96 | 12.44 | 12.81 |
| E410 | 9811 | 310 | 11.12 | 11.60 | 11.86 | 12.18 | 12.64 | 13.00 |
| E400 | 9744 | 379 | 11.36 | 11.80 | 12.05 | 12.35 | 12.78 | 13.12 |
| E390 | 9673 | 449 | 11.60 | 12.01 | 12.24 | 12.51 | 12.92 | 13.24 |
| E380 | 9648 | 474 | 11.69 | 12.07 | 12.29 | 12.55 | 12.95 | 13.26 |
| E370 | 9601 | 521 | 11.92 | 12.28 | 12.48 | 12.73 | 13.11 | 13.41 |
| E360 | 9540 | 581 | 12.14 | 12.49 | 12.68 | 12.91 | 13.27 | 13.55 |
| E350 | 9498 | 624 | 12.32 | 12.67 | 12.86 | 13.08 | 13.43 | 13.70 |
| E340 | 9467 | 655 | 12.44 | 12.80 | 12.99 | 13.22 | 13.58 | 13.84 |
| E330 | 9431 | 690 | 12.54 | 12.91 | 13.11 | 13.34 | 13.70 | 13.97 |
| E320 | 9384 | 737 | 12.61 | 12.98 | 13.18 | 13.42 | 13.78 | 14.05 |
| E310 | 9333 | 788 | 12.67 | 13.06 | 13.26 | 13.50 | 13.87 | 14.13 |

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - MRC + WC (Scenario 3) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| E300 | 9286 | 836 | 12.81 | 13.17 | 13.36 | 13.58 | 13.94 | 14.19 |
| E290 | 9232 | 888 | 12.92 | 13.26 | 13.44 | 13.65 | 14.00 | 14.25 |
| E280 | 9182 | 939 | 12.99 | 13.32 | 13.50 | 13.71 | 14.05 | 14.30 |
| E270 | 9155 | 967 | 13.03 | 13.37 | 13.55 | 13.76 | 14.09 | 14.35 |
| E260 | 9109 | 1012 | 13.19 | 13.53 | 13.70 | 13.90 | 14.24 | 14.48 |
| E250 | 9056 | 1065 | 13.34 | 13.67 | 13.85 | 14.05 | 14.38 | 14.61 |
| E240 | 9004 | 1117 | 13.45 | 13.77 | 13.94 | 14.14 | 14.46 | 14.70 |
| E230 | 8967 | 1153 | 13.59 | 13.89 | 14.05 | 14.24 | 14.55 | 14.78 |
| E220 | 8920 | 1191 | 13.71 | 14.00 | 14.15 | 14.33 | 14.64 | 14.86 |
| E210 | 8893 | 1224 | 13.77 | 14.04 | 14.19 | 14.37 | 14.67 | 14.88 |
| E200 | 8842 | 1275 | 14.03 | 14.26 | 14.38 | 14.53 | 14.79 | 14.98 |
| E190 | 8761 | 1355 | 14.43 | 14.65 | 14.75 | 14.88 | 15.08 | 15.24 |
| E180 | 8714 | 1401 | 14.51 | 14.72 | 14.82 | 14.93 | 15.14 | 15.30 |
| E170 | 8670 | 1446 | 14.61 | 14.85 | 14.97 | 15.07 | 15.30 | 15.45 |
| E160 | 8625 | 1491 | 14.71 | 14.96 | 15.08 | 15.18 | 15.42 | 15.58 |
| E150 | 8573 | 1542 | 14.77 | 15.03 | 15.15 | 15.26 | 15.50 | 15.67 |
| **Bridwood Road Development Bridge** | | | | | | | | |
| E140 | 8550 | 1566 | 14.78 | 15.05 | 15.18 | 15.29 | 15.57 | 15.77 |
| E130 | 8511 | 1606 | 14.88 | 15.15 | 15.28 | 15.39 | 15.67 | 15.87 |
| **Birdwood Road Development Causeway** | | | | | | | | |
| E120 | 8466 | 1651 | 15.01 | 15.29 | 15.42 | 15.53 | 15.82 | 16.01 |
| E110 | 8447 | 1669 | 16.31 | 16.49 | 16.58 | 16.65 | 16.84 | 16.96 |
| E100 | 8420 | 1697 | 16.31 | 16.49 | 16.59 | 16.65 | 16.85 | 16.96 |
| E90 | 8385 | 1732 | 16.33 | 16.51 | 16.61 | 16.67 | 16.87 | 16.99 |
| E80 | 8365 | 1752 | 16.32 | 16.51 | 16.60 | 16.67 | 16.86 | 16.98 |
| **Birdwood Road** | | | | | | | | |
| E70 | 8318 | 1800 | 16.72 | 17.11 | 17.29 | 17.41 | 17.68 | 17.78 |
| E60 | 8271 | 1845 | 16.71 | 17.10 | 17.28 | 17.40 | 17.66 | 17.76 |
| E50 | 8220 | 1896 | 16.76 | 17.17 | 17.35 | 17.47 | 17.75 | 17.87 |
| E40 | 8135 | 1981 | 17.56 | 17.77 | 17.88 | 17.95 | 18.18 | 18.30 |
| E35 | 8120 | 1996 | 17.71 | 17.88 | 17.97 | 18.04 | 18.24 | 18.36 |
| E30 | 8058 | 2058 | 18.01 | 18.17 | 18.26 | 18.32 | 18.50 | 18.62 |
| **Park Maintenance Crossing** | | | | | | | | |
| E20 | 8028 | 2082 | 18.22 | 18.33 | 18.38 | 18.42 | 18.53 | 18.63 |
| E10 | 8004 | 2112 | 18.31 | 18.42 | 18.48 | 18.51 | 18.61 | 18.70 |
| | 7980 | 2136 | 18.38 | 18.49 | 18.53 | 18.56 | 18.65 | 18.73 |

## ***Glindemann Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - MRC + WC (Scenario 3) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| | 7980 | 0 | 18.38 | 18.49 | 18.53 | 18.56 | 18.65 | 18.73 |
| G470 | 7938 | 43 | 18.77 | 18.86 | 18.90 | 18.94 | 19.03 | 19.09 |
| G460 | 7895 | 86 | 18.93 | 19.04 | 19.09 | 19.13 | 19.24 | 19.32 |
| G450 | 7841 | 139 | 18.98 | 19.10 | 19.15 | 19.19 | 19.31 | 19.39 |
| G440 | 7763 | 217 | 19.23 | 19.35 | 19.40 | 19.44 | 19.55 | 19.67 |
| G430 | 7696 | 284 | 19.45 | 19.58 | 19.63 | 19.66 | 19.79 | 19.92 |
| **Marshall Road** | | | | | | | | |
| G420 | 7659 | 322 | 19.79 | 20.13 | 20.28 | 20.38 | 21.11 | 21.62 |
| G410 | 7632 | 348 | 19.83 | 20.15 | 20.31 | 20.42 | 21.15 | 21.65 |
| G400 | 7577 | 403 | 20.17 | 20.42 | 20.53 | 20.61 | 21.22 | 21.71 |
| G390 | 7522 | 458 | 20.48 | 20.70 | 20.80 | 20.87 | 21.37 | 21.79 |
| G380 | 7480 | 500 | 20.67 | 20.86 | 20.94 | 20.99 | 21.39 | 21.80 |
| G370 | 7475 | 505 | 20.79 | 20.95 | 21.01 | 21.07 | 21.45 | 21.84 |
| G360 | 7413 | 567 | 22.29 | 22.38 | 22.41 | 22.43 | 22.56 | 22.69 |
| G350 | 7408 | 573 | 22.30 | 22.39 | 22.42 | 22.44 | 22.56 | 22.69 |
| G340 | 7360 | 621 | 22.48 | 22.60 | 22.64 | 22.67 | 22.84 | 23.00 |
| G330 | 7310 | 670 | 22.55 | 22.66 | 22.70 | 22.73 | 22.91 | 23.07 |
| G320 | 7305 | 680 | 22.61 | 22.74 | 22.79 | 22.83 | 23.05 | 23.28 |
| G300 | 7154 | 824 | 24.85 | 25.07 | 25.15 | 25.21 | 25.55 | 25.70 |
| G290 | 7150 | 830 | 24.82 | 25.21 | 25.28 | 25.34 | 25.76 | 25.83 |
| G280 | 7135 | 844 | 24.88 | 25.08 | 25.16 | 25.22 | 25.52 | 25.72 |
| G270 | 7125 | 855 | 24.91 | 25.11 | 25.19 | 25.25 | 25.55 | 25.79 |
| G260 | 7091 | 889 | 24.83 | 25.08 | 25.16 | 25.23 | 25.52 | 25.78 |
| G250 | 7057 | 922 | 24.81 | 25.05 | 25.13 | 25.19 | 25.49 | 25.75 |
| G240 | 7047 | 933 | 25.18 | 25.34 | 25.40 | 25.45 | 25.75 | 26.05 |
| G230 | 6998 | 980 | 25.25 | 25.40 | 25.46 | 25.50 | 25.80 | 26.10 |
| G220 | 6993 | 987 | 25.75 | 25.92 | 25.99 | 26.04 | 26.39 | 26.73 |

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - MRC + WC (Scenario 3) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| Logan Road | | | | | | | | |
| G210 | 6944 | 1041 | 27.21 | 27.81 | 28.11 | 28.30 | 28.87 | 29.09 |
| G200 | 6912 | 1067 | 27.28 | 27.83 | 28.13 | 28.32 | 28.87 | 29.10 |
| G190 | 6843 | 1136 | 27.37 | 27.87 | 28.15 | 28.33 | 28.89 | 29.11 |
| G180 | 6783 | 1191 | 27.43 | 27.89 | 28.16 | 28.34 | 28.89 | 29.12 |
| Glindemann Park Footbridge | | | | | | | | |
| G170 | 6773 | 1209 | 27.75 | 27.90 | 28.17 | 28.35 | 28.90 | 29.12 |
| G160 | 6714 | 1265 | 27.93 | 28.10 | 28.22 | 28.38 | 28.91 | 29.13 |
| G150 | 6624 | 1355 | 28.47 | 28.70 | 28.81 | 28.91 | 29.06 | 29.24 |
| G140 | 6525 | 1455 | 29.62 | 29.84 | 29.95 | 30.05 | 30.18 | 30.28 |
| G130 | 6472 | 1507 | 30.15 | 30.36 | 30.47 | 30.56 | 30.69 | 30.79 |
| G120 | 6397 | 1583 | 30.55 | 30.82 | 30.96 | 31.08 | 31.27 | 31.41 |
| G110 | 6390 | 1590 | 30.60 | 30.86 | 31.00 | 31.11 | 31.31 | 31.44 |
| G100 | 6260 | 1721 | 32.04 | 32.26 | 32.36 | 32.43 | 32.58 | 32.68 |
| G90 | 6253 | 1727 | 32.04 | 32.26 | 32.36 | 32.43 | 32.58 | 32.68 |
| G80 | 6228 | 1755 | 32.07 | 32.30 | 32.40 | 32.49 | 32.64 | 32.75 |
| G70 | 6218 | 1759 | 32.07 | 32.30 | 32.41 | 32.50 | 32.66 | 32.77 |
| G60 | 6188 | 1792 | 32.17 | 32.42 | 32.55 | 32.64 | 32.82 | 32.95 |
| G50 | 6154 | 1826 | 32.37 | 32.64 | 32.77 | 32.88 | 33.07 | 33.22 |
| G40 | 6125 | 1857 | 32.56 | 32.84 | 32.99 | 33.11 | 33.31 | 33.46 |
| G30 | 6115 | 1862 | 32.64 | 32.90 | 33.05 | 33.17 | 33.37 | 33.52 |
| G20 | 6085 | 1895 | 32.95 | 33.19 | 33.32 | 33.43 | 33.62 | 33.75 |
| G10 | 6054 | 1926 | 33.15 | 33.38 | 33.51 | 33.61 | 33.79 | 33.92 |

## ***Sandy Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - MRC + WC (Scenario 3) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| S240 | 1750 | 95 | 10.13 | 10.52 | 10.74 | 11.02 | 11.36 | 11.65 |
| S230 | 1688 | 181 | 10.30 | 10.69 | 10.92 | 11.19 | 11.49 | 11.77 |
| S220 | 1619 | 250 | 10.71 | 11.00 | 11.16 | 11.37 | 11.62 | 11.86 |
| S210 | 1579 | 290 | 10.89 | 11.17 | 11.30 | 11.48 | 11.76 | 11.97 |
| S200 | 1527 | 342 | 10.94 | 11.19 | 11.32 | 11.48 | 11.74 | 11.95 |
| S190 | 1455 | 414 | 11.04 | 11.29 | 11.42 | 11.57 | 11.85 | 12.05 |
| Sunshine Avenue Footbridge | | | | | | | | |
| S180 | 1444 | 425 | 11.10 | 11.34 | 11.47 | 11.60 | 11.89 | 12.09 |
| S170 | 1434 | 435 | 11.09 | 11.32 | 11.45 | 11.58 | 11.86 | 12.07 |
| S150 | 1430 | 439 | 11.69 | 11.89 | 12.00 | 12.11 | 12.37 | 12.66 |
| S140 | 1408 | 461 | 11.73 | 11.91 | 12.01 | 12.12 | 12.38 | 12.64 |
| S130 | 1381 | 488 | 11.76 | 11.96 | 12.06 | 12.16 | 12.42 | 12.65 |
| S110 | 1377 | 492 | 12.47 | 12.67 | 12.77 | 12.87 | 13.13 | 13.31 |
| S100 | 1351 | 518 | 12.50 | 12.70 | 12.80 | 12.90 | 13.16 | 13.34 |
| Sexton Street | | | | | | | | |
| S80 | 1329 | 540 | 14.14 | 14.57 | 14.81 | 14.95 | 15.19 | 15.31 |
| S70 | 1322 | 547 | 14.18 | 14.63 | 14.85 | 14.98 | 15.21 | 15.33 |
| S60 | 1304 | 565 | 14.22 | 14.64 | 14.86 | 14.99 | 15.22 | 15.34 |
| S50 | 1264 | 605 | 14.28 | 14.65 | 14.87 | 14.99 | 15.22 | 15.34 |
| S40 | 1224 | 645 | 14.45 | 14.70 | 14.89 | 15.01 | 15.24 | 15.36 |
| S30 | 1174 | 695 | 14.77 | 14.93 | 15.03 | 15.13 | 15.32 | 15.44 |
| S20 | 1081 | 788 | 15.89 | 16.02 | 16.08 | 16.13 | 16.23 | 16.30 |
| S10 | 1000 | 869 | 16.89 | 17.03 | 17.10 | 17.16 | 17.26 | 17.34 |

## ***Mott Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - MRC + WC (Scenario 3) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| | 1365 | 59 | 14.43 | 14.65 | 14.75 | 14.88 | 15.08 | 15.24 |
| M130 | 1351 | 73 | 14.44 | 14.66 | 14.78 | 14.92 | 15.10 | 15.26 |
| M120 | 1316 | 108 | 14.50 | 14.77 | 14.89 | 15.02 | 15.21 | 15.36 |
| M110 | 1292 | 132 | 14.57 | 14.87 | 15.02 | 15.14 | 15.38 | 15.53 |
| M100 | 1264 | 160 | 14.75 | 15.07 | 15.23 | 15.31 | 15.61 | 15.77 |
| M90 | 1232 | 192 | 14.89 | 15.23 | 15.41 | 15.48 | 15.82 | 16.00 |
| M80 | 1210 | 214 | 14.94 | 15.28 | 15.46 | 15.52 | 15.87 | 16.05 |
| M70 | 1187 | 237 | 14.96 | 15.30 | 15.48 | 15.54 | 15.89 | 16.07 |
| M60 | 1167 | 257 | 15.11 | 15.44 | 15.61 | 15.65 | 16.02 | 16.20 |

| XSecID | M11 Chainage (m) | AMTD (m) | Design Flood Levels (m AHD) - MRC + WC (Scenario 3) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2yr | 5yr | 10yr | 20yr | 50yr | 100yr |
| | | | Peak | Peak | Peak | Peak | Peak | Peak |
| M50 | 1139 | 285 | 15.42 | 15.69 | 15.84 | 15.87 | 16.19 | 16.35 |
| M40 | 1111 | 313 | 15.79 | 16.05 | 16.19 | 16.23 | 16.54 | 16.70 |
| M30 | 1076 | 348 | 16.35 | 16.61 | 16.74 | 16.78 | 17.03 | 17.16 |
| M20 | 1034 | 390 | 17.11 | 17.37 | 17.50 | 17.53 | 17.77 | 17.88 |
| M10 | 1000 | 424 | 17.76 | 18.00 | 18.12 | 18.14 | 18.38 | 18.49 |

# Appendix H: Extreme Event Peak Flood Levels

## *Norman Creek*

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - Existing Case Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| | | 0 | 1.06 | 1.06 |
| **Wynnum Road** | | | | |
| | | 75 | 1.47 | 1.49 |
| | | 100 | 1.36 | 1.36 |
| | | 200 | 1.96 | 2.17 |
| | | 300 | 2.29 | 2.55 |
| | | 400 | 2.67 | 2.97 |
| | | 500 | 2.66 | 2.98 |
| | | 600 | 2.93 | 3.24 |
| | | 700 | 3.00 | 3.30 |
| | | 800 | 3.04 | 3.32 |
| | | 900 | 3.04 | 3.32 |
| | | 1000 | 3.05 | 3.33 |
| | | 1100 | 3.06 | 3.33 |
| | | 1200 | 3.07 | 3.34 |
| | | 1300 | 3.07 | 3.34 |
| | | 1400 | 3.07 | 3.34 |
| | | 1500 | 3.06 | 3.34 |
| | | 1600 | 3.07 | 3.34 |
| | | 1700 | 3.08 | 3.34 |
| | | 1800 | 3.08 | 3.35 |
| | | 1900 | 3.08 | 3.35 |
| | | 2000 | 3.08 | 3.35 |
| | | 2100 | 3.08 | 3.35 |
| | | 2200 | 3.09 | 3.35 |
| | | 2300 | 3.09 | 3.36 |
| | | 2400 | 3.09 | 3.36 |
| | | 2500 | 3.11 | 3.37 |
| | | 2600 | 3.13 | 3.38 |
| | | 2700 | 3.13 | 3.38 |
| | | 2800 | 3.12 | 3.38 |
| | | 2900 | 3.12 | 3.37 |
| | | 3000 | 3.14 | 3.37 |
| | | 3100 | 3.13 | 3.37 |
| | | 3200 | 3.19 | 3.43 |
| | | 3300 | 3.27 | 3.53 |
| | | 3400 | 3.45 | 3.71 |
| | | 3500 | 3.53 | 3.79 |
| | | 3600 | 3.60 | 3.85 |
| | | 3620 | 3.60 | 3.85 |
| **Stanley Street East** | | | | |
| | | 3675 | 3.81 | 4.02 |
| | | 3700 | 3.80 | 4.01 |
| | | 3800 | 3.81 | 4.02 |
| | | 3900 | 3.83 | 4.03 |
| | | 4000 | 3.83 | 4.04 |
| | | 4100 | 3.86 | 4.08 |
| | | 4200 | 3.90 | 4.11 |
| | | 4300 | 3.96 | 4.17 |
| | | 4360 | 3.97 | 4.18 |
| **Turbo Street** | | | | |
| | | 4385 | 4.11 | 4.30 |
| | | 4400 | 4.11 | 4.30 |
| | | 4420 | 4.11 | 4.30 |
| **Deshon Street** | | | | |
| | | 4460 | 4.46 | 4.65 |
| | | 4485 | 4.44 | 4.63 |
| **Cleveland Railway Crossing** | | | | |
| | | 4525 | 4.44 | 4.63 |
| | | 4600 | 4.49 | 4.68 |
| | | 4700 | 4.50 | 4.69 |
| | | 4800 | 4.52 | 4.72 |
| | | 4900 | 4.54 | 4.74 |
| | | 5000 | 4.62 | 4.83 |
| | | 5100 | 4.65 | 4.86 |
| | | 5180 | 4.69 | 4.91 |
| **Eastern Busway Crossing** | | | | |
| | | 5220 | 5.05 | 5.22 |

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - Existing Case Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| | | 5257 | 5.16 | 5.33 |
| Logan Road | | | | |
| | | 5305 | 5.42 | 5.67 |
| | | 5400 | 5.39 | 5.63 |
| | | 5500 | 5.42 | 5.66 |
| | | 5600 | 5.44 | 5.68 |
| | | 5700 | 5.48 | 5.74 |
| | | 5766 | 5.53 | 5.76 |
| Cornwall Street | | | | |
| | | 5835 | 5.81 | 6.06 |
| | | 5900 | 5.76 | 6.01 |
| | | 6000 | 5.70 | 5.95 |
| | | 6053 | 5.99 | 6.16 |
| Juliette Street | | | | |
| | | 6090 | 6.98 | 7.14 |
| | | 6100 | 7.00 | 7.16 |
| | | 6200 | 7.11 | 7.26 |
| | | 6300 | 7.14 | 7.29 |
| | | 6400 | 7.39 | 7.49 |
| | | 6500 | 8.05 | 8.17 |
| | | 6522 | 7.96 | 8.07 |
| Ridge Street | | | | |
| | | 6628 | 9.68 | 9.85 |
| | | 6700 | 9.72 | 9.88 |
| | | 6735 | 9.72 | 9.93 |
| South East Freeway | | | | |
| | | 6864 | 10.41 | 10.60 |
| | | 6900 | 10.50 | 10.71 |
| | | 7000 | 10.48 | 10.69 |
| | | 7100 | 10.52 | 10.73 |
| | | 7167 | 10.71 | 10.93 |
| Arnwood Place | | | | |
| | | 7200 | 11.04 | 11.28 |
| | | 7300 | 11.29 | 11.54 |

## ***Scotts Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - Existing Case Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| | | 0 | 3.09 | 3.36 |
| | | 100 | 3.09 | 3.36 |
| | | 200 | 3.09 | 3.36 |
| | | 300 | 3.10 | 3.36 |
| Adina Street | | | | |
| | | 554 | 3.39 | 3.51 |
| | | 600 | 3.40 | 3.52 |
| | | 700 | 3.40 | 3.53 |
| | | 710 | 3.41 | 3.53 |
| Waite Footbridge | | | | |
| | | 735 | 3.45 | 3.58 |
| | | 800 | 3.46 | 3.59 |

## ***Bridgewater Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - Existing Case Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| | | 0 | 3.13 | 3.38 |
| | | 100 | 3.13 | 3.38 |
| | | 200 | 3.13 | 3.38 |
| | | 285 | 3.16 | 3.42 |
| Stanley Street East | | | | |
| | | 362 | 3.60 | 3.86 |
| | | 400 | 3.61 | 3.87 |
| | | 430 | 3.63 | 3.88 |
| Cleveland Railway Crossing | | | | |
| | | 467 | 3.65 | 3.89 |
| | | 500 | 3.68 | 3.89 |
| | | 542 | 3.67 | 3.89 |

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - Existing Case Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| Temple Street | | | | |
| | | 580 | 3.74 | 3.91 |
| | | 600 | 3.74 | 3.91 |
| | | 700 | 3.76 | 3.92 |
| | | 800 | 3.76 | 3.92 |
| | | 900 | 3.76 | 3.92 |
| | | 1000 | 3.76 | 3.92 |
| | | 1100 | 3.77 | 3.92 |
| | | 1200 | 3.78 | 3.92 |
| | | 1300 | 3.78 | 3.92 |
| | | 1400 | 3.84 | 3.93 |
| | | 1500 | 4.26 | 4.34 |

## *Coorparoo Creek*

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - Existing Case Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| | | 0 | 3.83 | 4.04 |
| | | 100 | 3.84 | 4.05 |
| | | 200 | 3.84 | 4.05 |
| | | 300 | 3.84 | 4.05 |
| | | 360 | 3.84 | 4.05 |
| Morley Street | | | | |
| | | 390 | 3.97 | 4.08 |
| | | 400 | 3.99 | 4.10 |
| | | 408 | 4.01 | 4.12 |
| Cleveland Railway Crossing | | | | |
| | | 448 | 4.06 | 4.18 |
| | | 465 | 4.06 | 4.18 |
| Gladstone Street | | | | |
| | | 530 | 4.18 | 4.29 |
| | | 600 | 4.22 | 4.33 |

## *Kingfisher Creek*

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - Existing Case Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| | | 0 | 3.84 | 4.05 |
| | | 100 | 3.87 | 4.09 |
| | | 200 | 3.89 | 4.11 |
| | | 300 | 3.89 | 4.12 |
| | | 400 | 3.90 | 4.13 |

## *Ekibin Creek*

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - Existing Case Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| N20 | 10255 | 0 | 11.44 | 11.72 |
| E450 | 10107 | 15 | 11.52 | 11.80 |
| E440 | 10045 | 77 | 11.48 | 11.76 |
| South East Freeway | | | | |
| E430 | 9893 | 228 | 13.08 | 13.89 |
| E420 | 9863 | 258 | 13.15 | 13.94 |
| E410 | 9811 | 310 | 13.29 | 14.05 |
| E400 | 9744 | 379 | 13.35 | 14.09 |
| E390 | 9673 | 449 | 13.41 | 14.13 |
| E380 | 9648 | 474 | 13.41 | 14.12 |
| E370 | 9601 | 521 | 13.49 | 14.17 |
| E360 | 9540 | 581 | 13.54 | 14.19 |
| E350 | 9498 | 624 | 13.59 | 14.22 |
| E340 | 9467 | 655 | 13.71 | 14.31 |
| E330 | 9431 | 690 | 13.83 | 14.40 |
| E320 | 9384 | 737 | 13.90 | 14.46 |
| E310 | 9333 | 788 | 13.99 | 14.53 |

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - Existing Case Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| E300 | 9286 | 836 | 14.05 | 14.57 |
| E290 | 9232 | 888 | 14.11 | 14.60 |
| E280 | 9182 | 939 | 14.10 | 14.60 |
| E270 | 9155 | 967 | 14.11 | 14.60 |
| E260 | 9109 | 1012 | 14.18 | 14.64 |
| E250 | 9056 | 1065 | 14.30 | 14.74 |
| E240 | 9004 | 1117 | 14.39 | 14.81 |
| E230 | 8967 | 1153 | 14.47 | 14.87 |
| E220 | 8920 | 1191 | 14.56 | 14.94 |
| E210 | 8893 | 1224 | 14.60 | 14.98 |
| E200 | 8842 | 1275 | 14.70 | 15.03 |
| E190 | 8761 | 1355 | 14.98 | 15.24 |
| E180 | 8714 | 1401 | 15.00 | 15.26 |
| E170 | 8670 | 1446 | 15.17 | 15.41 |
| E160 | 8625 | 1491 | 15.28 | 15.52 |
| E150 | 8573 | 1542 | 15.34 | 15.59 |
| **Bridwood Road Development Bridge** | | | | |
| E140 | 8550 | 1566 | 15.42 | 15.74 |
| E130 | 8511 | 1606 | 15.52 | 15.83 |
| **Birdwood Road Development Causeway** | | | | |
| E120 | 8466 | 1651 | 15.65 | 15.95 |
| E110 | 8447 | 1669 | 16.81 | 17.01 |
| E100 | 8420 | 1697 | 16.81 | 17.01 |
| E90 | 8385 | 1732 | 16.83 | 17.02 |
| E80 | 8365 | 1752 | 16.80 | 17.00 |
| **Birdwood Road** | | | | |
| E70 | 8318 | 1800 | 17.75 | 17.92 |
| E60 | 8271 | 1845 | 17.71 | 17.87 |
| E50 | 8220 | 1896 | 17.78 | 17.95 |
| E40 | 8135 | 1981 | 18.16 | 18.35 |
| E35 | 8120 | 1996 | 18.25 | 18.43 |
| E30 | 8058 | 2058 | 18.50 | 18.67 |
| **Park Maintenance Crossing** | | | | |
| E20 | 8028 | 2082 | 18.57 | 18.69 |
| E10 | 8004 | 2112 | 18.67 | 18.78 |
| | 7980 | 2136 | 18.71 | 18.81 |

## ***Glindemann Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - Existing Case Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| | 7980 | 0 | 18.71 | 18.81 |
| G470 | 7938 | 43 | 19.09 | 19.19 |
| G460 | 7895 | 86 | 19.32 | 19.44 |
| G450 | 7841 | 139 | 19.41 | 19.55 |
| G440 | 7763 | 217 | 19.70 | 19.87 |
| G430 | 7696 | 284 | 19.95 | 20.13 |
| **Marshall Road** | | | | |
| G420 | 7659 | 322 | 21.67 | 22.01 |
| G410 | 7632 | 348 | 21.69 | 22.03 |
| G400 | 7577 | 403 | 21.72 | 22.06 |
| G390 | 7522 | 458 | 21.78 | 22.10 |
| G380 | 7480 | 500 | 21.79 | 22.11 |
| G370 | 7475 | 505 | 21.83 | 22.13 |
| G360 | 7413 | 567 | 22.70 | 22.84 |
| G350 | 7408 | 573 | 22.70 | 22.84 |
| G340 | 7360 | 621 | 22.80 | 22.95 |
| G330 | 7310 | 670 | 22.78 | 22.93 |
| G320 | 7305 | 680 | 22.99 | 23.25 |
| G300 | 7155 | 824 | 25.67 | 25.90 |
| G290 | 7150 | 830 | 25.80 | 26.02 |
| G280 | 7135 | 844 | 25.67 | 25.92 |
| G270 | 7125 | 855 | 25.73 | 26.00 |
| G260 | 7091 | 889 | 25.73 | 26.00 |
| G250 | 7057 | 922 | 25.68 | 25.96 |
| G240 | 7047 | 933 | 26.04 | 26.45 |
| G230 | 6998 | 980 | 26.09 | 26.50 |
| G220 | 6993 | 987 | 26.71 | 27.12 |

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - Existing Case Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| **Logan Road** | | | | |
| G210 | 6944 | 1041 | 29.07 | 29.36 |
| G200 | 6912 | 1067 | 29.08 | 29.37 |
| G190 | 6843 | 1136 | 29.09 | 29.37 |
| G180 | 6783 | 1191 | 29.09 | 29.37 |
| **Glindemann Park Footbridge** | | | | |
| G170 | 6773 | 1209 | 29.09 | 29.38 |
| G160 | 6714 | 1265 | 29.09 | 29.38 |
| G150 | 6624 | 1355 | 29.09 | 29.39 |
| G140 | 6525 | 1455 | 29.91 | 30.03 |
| G130 | 6472 | 1507 | 30.44 | 30.55 |
| G120 | 6397 | 1583 | 31.06 | 31.22 |
| G110 | 6390 | 1590 | 31.11 | 31.26 |
| G100 | 6260 | 1721 | 32.67 | 32.80 |
| G90 | 6253 | 1727 | 32.67 | 32.80 |
| G80 | 6228 | 1755 | 32.69 | 32.83 |
| G70 | 6218 | 1759 | 32.68 | 32.82 |
| G60 | 6188 | 1792 | 32.75 | 32.91 |
| G50 | 6154 | 1826 | 32.91 | 33.09 |
| G40 | 6125 | 1857 | 33.20 | 33.39 |
| G30 | 6115 | 1862 | 33.24 | 33.44 |
| G20 | 6085 | 1895 | 33.46 | 33.64 |
| G10 | 6054 | 1926 | 33.72 | 33.88 |

## ***Sandy Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - Existing Case Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| S240 | 1750 | 95 | 11.48 | 11.76 |
| S230 | 1688 | 181 | 11.58 | 11.86 |
| S220 | 1619 | 250 | 11.66 | 11.94 |
| S210 | 1579 | 290 | 11.75 | 12.02 |
| S200 | 1527 | 342 | 11.71 | 11.97 |
| S190 | 1455 | 414 | 11.83 | 12.09 |
| **Sunshine Avenue Footbridge** | | | | |
| S180 | 1444 | 425 | 11.89 | 12.15 |
| S170 | 1434 | 435 | 11.86 | 12.12 |
| S150 | 1430 | 439 | 12.65 | 13.10 |
| S140 | 1408 | 461 | 12.63 | 13.06 |
| S130 | 1381 | 488 | 12.64 | 13.12 |
| S110 | 1377 | 492 | 13.30 | 13.80 |
| S100 | 1351 | 518 | 13.33 | 13.73 |
| **Sexton Street** | | | | |
| S80 | 1329 | 540 | 15.30 | 15.46 |
| S70 | 1322 | 547 | 15.33 | 15.48 |
| S60 | 1304 | 565 | 15.34 | 15.49 |
| S50 | 1264 | 605 | 15.35 | 15.50 |
| S40 | 1224 | 645 | 15.35 | 15.51 |
| S30 | 1174 | 695 | 15.43 | 15.58 |
| S20 | 1081 | 788 | 16.31 | 16.41 |
| S10 | 1000 | 869 | 17.37 | 17.46 |

## ***Mott Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - Existing Case Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| | 1365 | 59 | 14.98 | 15.24 |
| M130 | 1351 | 73 | 15.02 | 15.26 |
| M120 | 1316 | 108 | 15.19 | 15.36 |
| M110 | 1292 | 132 | 15.31 | 15.48 |
| M100 | 1264 | 160 | 15.56 | 15.74 |
| M90 | 1232 | 192 | 15.81 | 16.02 |
| M80 | 1210 | 214 | 15.86 | 16.08 |
| M70 | 1187 | 237 | 15.88 | 16.10 |
| M60 | 1167 | 257 | 16.04 | 16.26 |

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - Existing Case Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| M50 | 1139 | 285 | 16.27 | 16.47 |
| M40 | 1111 | 313 | 16.67 | 16.84 |
| M30 | 1076 | 348 | 17.19 | 17.31 |
| M20 | 1034 | 390 | 17.87 | 17.99 |
| M10 | 1000 | 424 | 18.30 | 18.42 |

## *Norman Creek*

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - MRC + WC Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| | | 0 | 1.06 | 1.06 |
| **Wynnum Road** | | | | |
| | | 75 | 1.46 | 1.47 |
| | | 100 | 1.35 | 1.36 |
| | | 200 | 2.16 | 2.48 |
| | | 300 | 2.58 | 2.97 |
| | | 400 | 2.97 | 3.38 |
| | | 500 | 3.03 | 3.45 |
| | | 600 | 3.31 | 3.71 |
| | | 700 | 3.36 | 3.75 |
| | | 800 | 3.38 | 3.77 |
| | | 900 | 3.39 | 3.77 |
| | | 1000 | 3.39 | 3.77 |
| | | 1100 | 3.40 | 3.78 |
| | | 1200 | 3.40 | 3.78 |
| | | 1300 | 3.40 | 3.78 |
| | | 1400 | 3.40 | 3.78 |
| | | 1500 | 3.40 | 3.78 |
| | | 1600 | 3.41 | 3.79 |
| | | 1700 | 3.41 | 3.78 |
| | | 1800 | 3.41 | 3.78 |
| | | 1900 | 3.41 | 3.79 |
| | | 2000 | 3.41 | 3.79 |
| | | 2100 | 3.41 | 3.79 |
| | | 2200 | 3.41 | 3.79 |
| | | 2300 | 3.41 | 3.79 |
| | | 2400 | 3.42 | 3.79 |
| | | 2500 | 3.42 | 3.79 |
| | | 2600 | 3.43 | 3.80 |
| | | 2700 | 3.43 | 3.80 |
| | | 2800 | 3.43 | 3.80 |
| | | 2900 | 3.44 | 3.80 |
| | | 3000 | 3.48 | 3.83 |
| | | 3100 | 3.47 | 3.83 |
| | | 3200 | 3.61 | 3.94 |
| | | 3300 | 3.83 | 4.14 |
| | | 3400 | 4.04 | 4.35 |
| | | 3500 | 4.12 | 4.42 |
| | | 3600 | 4.17 | 4.46 |
| | | 3620 | 4.18 | 4.46 |
| **Stanley Street East** | | | | |
| | | 3675 | 4.30 | 4.57 |
| | | 3700 | 4.29 | 4.57 |
| | | 3800 | 4.31 | 4.59 |
| | | 3900 | 4.33 | 4.61 |
| | | 4000 | 4.34 | 4.62 |
| | | 4100 | 4.40 | 4.68 |
| | | 4200 | 4.45 | 4.73 |
| | | 4300 | 4.50 | 4.77 |
| | | 4360 | 4.51 | 4.78 |
| **Turbo Street** | | | | |
| | | 4385 | 4.60 | 4.87 |
| | | 4400 | 4.60 | 4.87 |
| | | 4420 | 4.60 | 4.86 |
| **Deshon Street** | | | | |
| | | 4460 | 4.90 | 5.13 |
| | | 4485 | 4.90 | 5.13 |
| **Cleveland Railway Crossing** | | | | |
| | | 4525 | 4.92 | 5.16 |
| | | 4600 | 4.97 | 5.21 |
| | | 4700 | 4.98 | 5.22 |
| | | 4800 | 5.02 | 5.26 |
| | | 4900 | 5.09 | 5.34 |
| | | 5000 | 5.18 | 5.44 |
| | | 5100 | 5.21 | 5.48 |
| | | 5180 | 5.27 | 5.53 |
| **Eastern Busway Crossing** | | | | |
| | | 5220 | 5.48 | 5.82 |

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - MRC + WC Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| | | 5257 | 5.63 | 5.93 |
| **Logan Road** | | | | |
| | | 5305 | 5.96 | 6.25 |
| | | 5400 | 5.93 | 6.23 |
| | | 5500 | 5.94 | 6.24 |
| | | 5600 | 5.95 | 6.26 |
| | | 5700 | 5.95 | 6.25 |
| | | 5766 | 6.00 | 6.30 |
| **Cornwall Street** | | | | |
| | | 5835 | 6.35 | 6.60 |
| | | 5900 | 6.34 | 6.59 |
| | | 6000 | 6.32 | 6.56 |
| | | 6053 | 6.43 | 6.68 |
| **Juliette Street** | | | | |
| | | 6090 | 7.37 | 7.57 |
| | | 6100 | 7.38 | 7.57 |
| | | 6200 | 7.42 | 7.62 |
| | | 6300 | 7.43 | 7.63 |
| | | 6400 | 7.45 | 7.61 |
| | | 6500 | 8.04 | 8.14 |
| | | 6522 | 7.94 | 8.07 |
| **Ridge Street** | | | | |
| | | 6628 | 9.68 | 9.85 |
| | | 6700 | 9.80 | 9.96 |
| | | 6735 | 9.80 | 10.02 |
| **South East Freeway** | | | | |
| | | 6864 | 10.41 | 10.62 |
| | | 6900 | 10.54 | 10.77 |
| | | 7000 | 10.65 | 10.88 |
| | | 7100 | 10.71 | 10.94 |
| | | 7167 | 10.96 | 11.21 |
| **Arnwood Place** | | | | |
| | | 7200 | 11.30 | 11.57 |
| | | 7300 | 11.61 | 11.91 |

## ***Scotts Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - MRC + WC Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| | | 0 | 3.41 | 3.79 |
| | | 100 | 3.42 | 3.79 |
| | | 200 | 3.42 | 3.79 |
| | | 300 | 3.42 | 3.79 |
| **Adina Street** | | | | |
| | | 554 | 3.49 | 3.81 |
| | | 600 | 3.49 | 3.81 |
| | | 700 | 3.50 | 3.81 |
| | | 710 | 3.50 | 3.81 |
| **Waite Footbridge** | | | | |
| | | 735 | 3.56 | 3.84 |
| | | 800 | 3.58 | 3.84 |

## ***Bridgewater Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - MRC + WC Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| | | 0 | 3.43 | 3.80 |
| | | 100 | 3.43 | 3.80 |
| | | 200 | 3.43 | 3.80 |
| | | 285 | 3.45 | 3.81 |
| **Stanley Street East** | | | | |
| | | 362 | 4.01 | 4.31 |
| | | 400 | 4.05 | 4.34 |
| | | 430 | 4.08 | 4.37 |
| **Cleveland Railway Crossing** | | | | |
| | | 467 | 5.08 | 5.19 |
| | | 500 | 5.09 | 5.21 |
| | | 542 | 5.09 | 5.21 |

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - MRC + WC Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| Temple Street | | | | |
| | | 580 | 5.13 | 5.25 |
| | | 600 | 5.13 | 5.26 |
| | | 700 | 5.15 | 5.28 |
| | | 800 | 5.16 | 5.31 |
| | | 900 | 5.17 | 5.32 |
| | | 1000 | 5.19 | 5.34 |
| | | 1100 | 5.21 | 5.37 |
| | | 1200 | 5.23 | 5.40 |
| | | 1300 | 5.25 | 5.44 |
| | | 1400 | 5.27 | 5.46 |
| | | 1500 | 5.29 | 5.49 |

## ***Coorparoo Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - MRC + WC Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| | | 0 | 4.34 | 4.62 |
| | | 100 | 4.35 | 4.62 |
| | | 200 | 4.35 | 4.62 |
| | | 300 | 4.35 | 4.62 |
| | | 360 | 4.35 | 4.62 |
| Morley Street | | | | |
| | | 390 | 4.48 | 4.65 |
| | | 400 | 4.51 | 4.68 |
| | | 408 | 4.53 | 4.70 |
| Cleveland Railway Crossing | | | | |
| | | 448 | 4.63 | 4.79 |
| | | 465 | 4.65 | 4.81 |
| Gladstone Street | | | | |
| | | 530 | 4.84 | 4.98 |
| | | 600 | 4.93 | 5.08 |

## ***Kingfisher Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - MRC + WC Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| | | 0 | 4.36 | 4.63 |
| | | 100 | 4.42 | 4.70 |
| | | 200 | 4.44 | 4.73 |
| | | 300 | 4.46 | 4.74 |
| | | 400 | 4.47 | 4.76 |

## ***Ekibin Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - MRC + WC Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| N20 | 10255 | 0 | 11.77 | 12.09 |
| E450 | 10107 | 15 | 11.86 | 12.18 |
| E440 | 10045 | 77 | 11.84 | 12.16 |
| South East Freeway | | | | |
| E430 | 9893 | 228 | 13.07 | 13.91 |
| E420 | 9863 | 258 | 13.17 | 13.98 |
| E410 | 9811 | 310 | 13.34 | 14.11 |
| E400 | 9744 | 379 | 13.44 | 14.18 |
| E390 | 9673 | 449 | 13.54 | 14.24 |
| E380 | 9648 | 474 | 13.56 | 14.25 |
| E370 | 9601 | 521 | 13.68 | 14.34 |
| E360 | 9540 | 581 | 13.81 | 14.42 |
| E350 | 9498 | 624 | 13.94 | 14.51 |
| E340 | 9467 | 655 | 14.08 | 14.63 |
| E330 | 9431 | 690 | 14.20 | 14.73 |
| E320 | 9384 | 737 | 14.28 | 14.80 |
| E310 | 9333 | 788 | 14.35 | 14.87 |

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - MRC + WC Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| E300 | 9286 | 836 | 14.41 | 14.91 |
| E290 | 9232 | 888 | 14.45 | 14.94 |
| E280 | 9182 | 939 | 14.50 | 14.98 |
| E270 | 9155 | 967 | 14.54 | 15.01 |
| E260 | 9109 | 1012 | 14.66 | 15.11 |
| E250 | 9056 | 1065 | 14.79 | 15.22 |
| E240 | 9004 | 1117 | 14.87 | 15.29 |
| E230 | 8967 | 1153 | 14.95 | 15.35 |
| E220 | 8920 | 1191 | 15.02 | 15.41 |
| E210 | 8893 | 1224 | 15.04 | 15.44 |
| E200 | 8842 | 1275 | 15.12 | 15.50 |
| E190 | 8761 | 1355 | 15.36 | 15.67 |
| E180 | 8714 | 1401 | 15.41 | 15.71 |
| E170 | 8670 | 1446 | 15.55 | 15.83 |
| E160 | 8625 | 1491 | 15.67 | 15.95 |
| E150 | 8573 | 1542 | 15.75 | 16.05 |
| **Bridwood Road Development Bridge** | | | | |
| E140 | 8550 | 1566 | 15.86 | 16.25 |
| E130 | 8511 | 1606 | 15.96 | 16.33 |
| **Birdwood Road Development Causeway** | | | | |
| E120 | 8466 | 1651 | 16.09 | 16.46 |
| E110 | 8447 | 1669 | 16.99 | 17.21 |
| E100 | 8420 | 1697 | 17.00 | 17.22 |
| E90 | 8385 | 1732 | 17.03 | 17.24 |
| E80 | 8365 | 1752 | 17.02 | 17.23 |
| **Birdwood Road** | | | | |
| E70 | 8318 | 1800 | 17.81 | 17.98 |
| E60 | 8271 | 1845 | 17.79 | 17.96 |
| E50 | 8220 | 1896 | 17.90 | 18.09 |
| E40 | 8135 | 1981 | 18.33 | 18.55 |
| E35 | 8120 | 1996 | 18.39 | 18.60 |
| E30 | 8058 | 2058 | 18.64 | 18.83 |
| **Park Maintenance Crossing** | | | | |
| E20 | 8028 | 2082 | 18.66 | 18.85 |
| E10 | 8004 | 2112 | 18.73 | 18.91 |
| | 7980 | 2136 | 18.76 | 18.92 |

## ***Glindemann Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - MRC + WC Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| | 7980 | 0 | 18.76 | 18.92 |
| G470 | 7938 | 43 | 19.11 | 19.24 |
| G460 | 7895 | 86 | 19.34 | 19.47 |
| G450 | 7841 | 139 | 19.44 | 19.59 |
| G440 | 7763 | 217 | 19.73 | 19.92 |
| G430 | 7696 | 284 | 19.99 | 20.19 |
| **Marshall Road** | | | | |
| G420 | 7659 | 322 | 21.76 | 22.07 |
| G410 | 7632 | 348 | 21.79 | 22.11 |
| G400 | 7577 | 403 | 21.84 | 22.16 |
| G390 | 7522 | 458 | 21.93 | 22.24 |
| G380 | 7480 | 500 | 21.93 | 22.26 |
| G370 | 7475 | 505 | 21.96 | 22.28 |
| G360 | 7413 | 567 | 22.74 | 22.89 |
| G350 | 7408 | 573 | 22.74 | 22.90 |
| G340 | 7360 | 621 | 23.04 | 23.25 |
| G330 | 7310 | 670 | 23.12 | 23.35 |
| G320 | 7305 | 680 | 23.34 | 23.69 |
| G300 | 7154 | 824 | 25.71 | 26.03 |
| G290 | 7150 | 830 | 25.71 | 26.03 |
| G280 | 7135 | 844 | 25.71 | 26.03 |
| G270 | 7125 | 855 | 25.78 | 26.13 |
| G260 | 7091 | 889 | 25.78 | 26.13 |
| G250 | 7057 | 922 | 25.74 | 26.10 |
| G240 | 7047 | 933 | 26.11 | 26.60 |
| G230 | 6998 | 980 | 26.16 | 26.64 |

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - MRC + WC Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| G220 | 6993 | 987 | 26.79 | 27.25 |
| Logan Road | | | | |
| G210 | 6944 | 1041 | 29.17 | 29.45 |
| G200 | 6912 | 1067 | 29.18 | 29.46 |
| G190 | 6843 | 1136 | 29.19 | 29.47 |
| G180 | 6783 | 1191 | 29.20 | 29.48 |
| Glindemann Park Footbridge | | | | |
| G170 | 6773 | 1209 | 29.20 | 29.48 |
| G160 | 6714 | 1265 | 29.21 | 29.50 |
| G150 | 6624 | 1355 | 29.31 | 29.61 |
| G140 | 6525 | 1455 | 30.30 | 30.44 |
| G130 | 6472 | 1507 | 30.81 | 30.95 |
| G120 | 6397 | 1583 | 31.43 | 31.62 |
| G110 | 6390 | 1590 | 31.47 | 31.65 |
| G100 | 6260 | 1721 | 32.69 | 32.85 |
| G90 | 6253 | 1727 | 32.69 | 32.85 |
| G80 | 6228 | 1755 | 32.77 | 32.93 |
| G70 | 6218 | 1759 | 32.78 | 32.95 |
| G60 | 6188 | 1792 | 32.98 | 33.18 |
| G50 | 6154 | 1826 | 33.25 | 33.47 |
| G40 | 6125 | 1857 | 33.50 | 33.72 |
| G30 | 6115 | 1862 | 33.56 | 33.78 |
| G20 | 6085 | 1895 | 33.78 | 33.98 |
| G10 | 6054 | 1926 | 33.95 | 34.14 |

## ***Sandy Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - MRC + WC Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| S240 | 1750 | 95 | 11.84 | 12.16 |
| S230 | 1688 | 181 | 11.96 | 12.28 |
| S220 | 1619 | 250 | 12.05 | 12.37 |
| S210 | 1579 | 290 | 12.11 | 12.43 |
| S200 | 1527 | 342 | 12.09 | 12.41 |
| S190 | 1455 | 414 | 12.15 | 12.46 |
| Sunshine Avenue Footbridge | | | | |
| S180 | 1444 | 425 | 12.18 | 12.53 |
| S170 | 1434 | 435 | 12.16 | 12.51 |
| S150 | 1430 | 439 | 12.72 | 13.21 |
| S140 | 1408 | 461 | 12.69 | 13.20 |
| S130 | 1381 | 488 | 12.70 | 13.29 |
| S110 | 1377 | 492 | 13.35 | 13.96 |
| S100 | 1351 | 518 | 13.37 | 14.06 |
| Sexton Street | | | | |
| S80 | 1329 | 540 | 15.33 | 15.48 |
| S70 | 1322 | 547 | 15.35 | 15.50 |
| S60 | 1304 | 565 | 15.36 | 15.51 |
| S50 | 1264 | 605 | 15.37 | 15.52 |
| S40 | 1224 | 645 | 15.39 | 15.54 |
| S30 | 1174 | 695 | 15.46 | 15.61 |
| S20 | 1081 | 788 | 16.32 | 16.42 |
| S10 | 1000 | 869 | 17.35 | 17.46 |

## ***Mott Creek***

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - MRC + WC Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| | 1365 | 59 | 15.36 | 15.67 |
| M130 | 1351 | 73 | 15.38 | 15.69 |
| M120 | 1316 | 108 | 15.44 | 15.72 |
| M110 | 1292 | 132 | 15.56 | 15.77 |
| M100 | 1264 | 160 | 15.79 | 16.02 |
| M90 | 1232 | 192 | 16.03 | 16.28 |
| M80 | 1210 | 214 | 16.08 | 16.33 |
| M70 | 1187 | 237 | 16.10 | 16.35 |

| XSecID | M11 Chainage (m) | AMTD (m) | Extreme Events - MRC + WC Water Levels (m AHD) | |
|---|---|---|---|---|
| | | | 200yr | 500yr |
| | | | Peak | Peak |
| M60 | 1167 | 257 | 16.24 | 16.48 |
| M50 | 1139 | 285 | 16.38 | 16.62 |
| M40 | 1111 | 313 | 16.73 | 16.95 |
| M30 | 1076 | 348 | 17.18 | 17.35 |
| M20 | 1034 | 390 | 17.90 | 18.06 |
| M10 | 1000 | 424 | 18.51 | 18.68 |

# Appendix I: Hydraulic Model Peer Review

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| Ref: | Init: | Date: |
|---|---|---|
| 43801257 | MOBA | 1 July 2013 |

## Review of MIKE FLOOD Model – Norman Creek Catchment

Dear Matthew

In accordance with your request, we have reviewed the MIKE FLOOD model developed by Brisbane City Council (BCC) with the purpose of assessing whether the model is technically sound, physically realistic and appropriate for determining the potential for flooding in the Norman Creek catchment. This letter report summarises our findings of the model build with brief recommendations where appropriate.

### General Overview

BCC has recently developed a coupled 1D/2D MIKE FLOOD model of the Norman Creek catchment located approximately 3km south-east of the Brisbane CBD. Norman Creek discharges into the Brisbane River near Wynnum Road. The developed MIKE FLOOD model covers an area of approximately 8km$^2$; inflows are applied as far south as Arnwood Place in Annerley. A 2D MIKE 21 model (5m grid size) is used to model the floodplain. Structures such as culverts, weirs and bridges are represented in a 1D MIKE 11 model. The two models are coupled via MIKE FLOOD. For this review, model setups for the March 2011 and January 2013 flood events and the corresponding results were assessed. Both flood events were used for model calibration.

The main difference between the two models, apart from inflow volumes, is that the MIKE 21 model for the January 2013 event includes the eastern busway structure immediately downstream of Logan Rd. The MIKE 11 model used for the 2013 flood event includes some amended cross-sections (geometry and roughness) to simulate 2013 conditions.

### MIKE 21 Model

#### Bathymetry

The extent of the model area is sufficient as the flood surface does not back up against ‘dry land’ cells on the model boundary. No obvious interpolation errors or rapidly changing/erroneous bed levels were observed in the grid data. The selection of a 5m grid resolution is appropriate considering the resulting 2D grid size of approximately 550,000 active cells. However, Norman Creek is represented by only two to three grid cells in the upstream part of the catchment. As the channel is not represented in the MIKE 11 model, the channel conveyance and transverse velocity distribution may not be resolved properly in this area.

**Time Step and Courant Number**
For MIKE FLOOD applications DHI recommends that a Courant number of less than 1 is maintained. With an approximate maximum flood depth of 5m and a time step of 0.25 seconds, the Courant number is approximately 0.4 in this model and within the recommended guideline.

**Flooding and Drying Depths**
Flooding and drying are enabled, as they must be for inland flooding applications. A flooding depth of 0.05 m and a drying depth of 0.02 m have been applied. These values are within the values generally recommended by DHI and are entirely valid for this application.

**Boundaries and Source Points**
One downstream boundary and thirty three source points have been incorporated in the MIKE 21 model. The boundary is specified as a varying tidal water level boundary. Most of the source point inflows have been applied to two or more grid cells; this is the correct approach to avoid excessive velocities or 'jetting' to occur at source point locations.

**Initial Surface Elevation**
The initial surface elevation was specified as a constant level for both models; the water levels match the first time step of the tide water level boundary. The initial water level results in the boundary cells being wet at the commencement of the simulation; this is a valid approach of modelling the boundary condition. Ponded areas have been filled in the initial condition map, reducing the volume of floodplain storage available at the start of the simulation.

**Eddy Viscosity**
Various empirical relationships exist for estimating appropriate values of eddy viscosity in the absence of observed eddy behaviour. High eddy values will normally smooth out the flow variability by transferring the high energy flow from one grid cell to the neighbouring cells with lower energies. A velocity based eddy viscosity of $0.5m^2/s$ has been applied globally within both models. This value is within the guidelines recommended by DHI for a grid size of 5m. At coupled cells an eddy viscosity of $10m^2/s$ was used to promote stability.

**Resistance**
Six different zones of resistance have been defined. These represent waterways, roads, concrete lined channels, residential/urban areas, dense vegetation, sparse vegetation and mangroves. Based on visual inspection of aerial photographs the number of regions and Manning's M values defined for these regions are generally appropriate.

## MIKE 11 Models

**Network**
The MIKE 11 model for the 2001 model consists of thirty eight branches, whilst the 2013 model consists of forty one branches. Both network files include three main branches; Glindemann Creek, Ekibin Creek Upper and Ekibin Creek Lower. The remaining branches are small, with lengths varying from 1m to 220m. These branches have been used to represent link channels, bridges and other hydraulic structures likely to affect flood conditions. For structures with lengths that exceeded 10m (two grid cells) only a culvert was modelled in MIKE 11. Overland flow exceeding the top of the culvert is modelled in the 2D domain. This is the correct approach to avoid duplication of flow capacity.

**Cross Sections**
Cross sections upstream and downstream of structures have a natural shape and their width has been reduced to the approximate width of the structure. All cross sections in the model have monotonically increasing conveyance curves with the exception of East_Busway (see left pane in Figure 1). To ensure the conveyance curve is monotonically increasing it is suggested to change the level selection method from 'automatic' to 'equidistant' for all cross sections. This will smooth out the conveyance curve and promote model stability (see right pane in Figure 1).

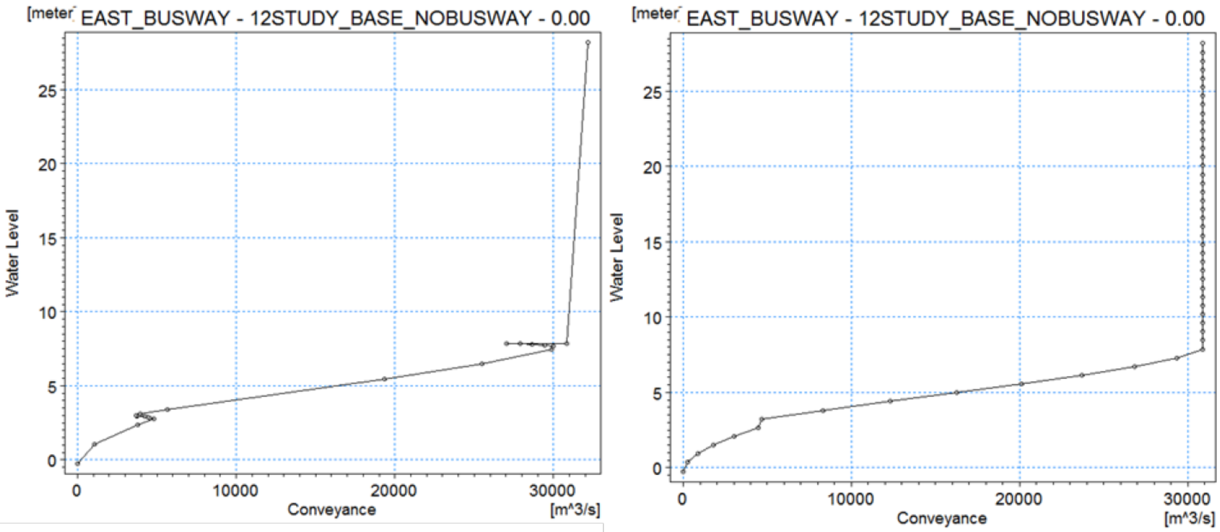



Figure 1 East_Busway conveyance using the 'automatic' level selection method (left) and the 'equidistant' level selection method (right)

The invert levels of the cross sections match the level 'z' values in the MIKE 21 bathymetry to which the cross sections are coupled. This improves model stability and is considered good modelling practice.

Transversely distributed Manning's n values of up to 0.24 have been applied to each cross section, with higher Manning's n values applied to the floodplains and lower Manning's n values applied to the main channels. Any roughness values defied in the hydrodynamic parameter (*.HD11) file are thus being ignored. The bed resistance implementation is considered appropriate.

**Boundary Conditions**
Fifty four and fifty six boundary conditions have been assigned in the boundary file for the 2001 model and the 2013 model, respectively. Water level boundaries have been defined at both ends of the branches used to represent structures. This is the necessary and accepted approach when coupling branches to a MIKE 21 grid. Inflow boundaries have been defined at the upstream ends of the three main branches. A constant water level has been used at the downstream MIKE 11 boundary for Ekibin Creek Lower which is coupled to the MIKE 21 model domain using a standard couple. Overall, the MIKE11 boundary conditions are found to be appropriate.

**Hydrodynamic Parameters**
The Delta value on the Default Parameters tab of the HD11 file is used to control the time centring of the solution scheme. The solution scheme is fully centred in time when delta is equal to 0.5. A delta value greater than 0.5 will have a dissipative effect on the wave front; but can also improve model stability. A value of 0.6 was found to have been applied. This is acceptable for MIKE FLOOD applications where time steps are small.

## MIKE FLOOD Models
The MIKE FLOOD platform is used to allow the exchange of water between the MIKE 21 and MIKE 11 models. The following sections describe the types of linking and the associated parameters currently defined in the models.

**Standard and Structure Links**
Thirty three and thirty five standard and structure links have been defined in the 2001 and 2013 models, respectively. Depth adjustment has been activated, as all structures are coupled to two or more MIKE 21 cells.

A momentum factor of one has been applied to all links in both model setups, which is appropriate. Exponential smoothing factors of 0.2 and 0.1 have been applied to all links in both model setups. The exponential smoothing factor introduces smoothing of the water level values transferred between the models. A value of one means no smoothing will be applied whereas a value closer to zero creates strong smoothing in the model and may aid stability. The adopted exponential smoothing factors are appropriate.

**MIKE FLOOD Results**

The 2001 MIKE 21 model has a two and a half minute save interval and produces a result file of approximately 1.5GB. The 2013 MIKE 21 model has a five minute save interval and produces a result file of approximately 2.1GB. Both the save intervals and the model result file sizes are appropriate. Both MIKE 11 models have a 50 second save interval, which could be increased to e.g. three or five minutes.

An animation of the overland water movement did not show water experiencing sharp changes in flow direction at any locations. The overland flow velocity is generally low with an average maximum current velocity of 0.6m/s. At twelve grid cells the maximum current velocity is high reaching up to 15m/s. These cells are located in the vicinity of coupled cells. The high velocities are likely a result of a high bed level gradient. It is recommended to review the bathymetry in these areas and smooth out the bed elevations where possible.

Minor instabilities were found in the MIKE 11 result files. A common instability found in both MIKE 11 result files is at the 'CleveRail_Bridgewater' structure (see Figure 2 and Figure 3). The graphical representation of the culvert at this location has been plotted in Figure 4. The head loss for this structure is minimal, less than 3cm on average for both large and small flow events. Strucutres with very small head losses can cause model instabilities. It is recommended that the 'CleveRail_Bridgewater' structure is removed as it does not affect the modelling results significantly.

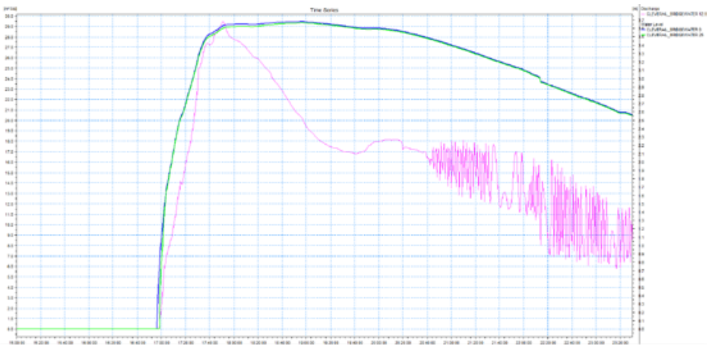


Figure 2 2001 model results at CleveRail_Bridgewater (blue - water level upstream, green – water level downstream, pink – structure discharge)

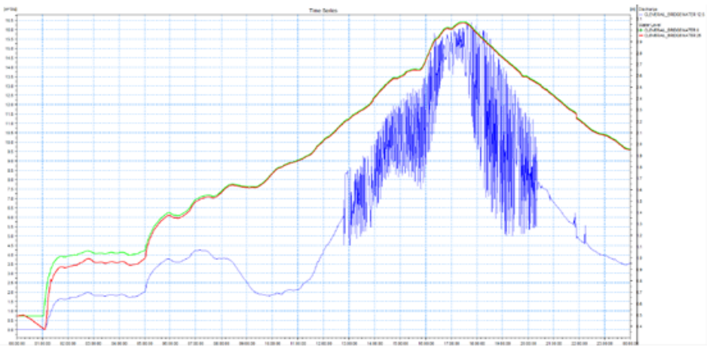


Figure 3 2013 model results at CleveRail_Bridgewater (green - water level upstream, red – water level downstream, blue – structure discharge)

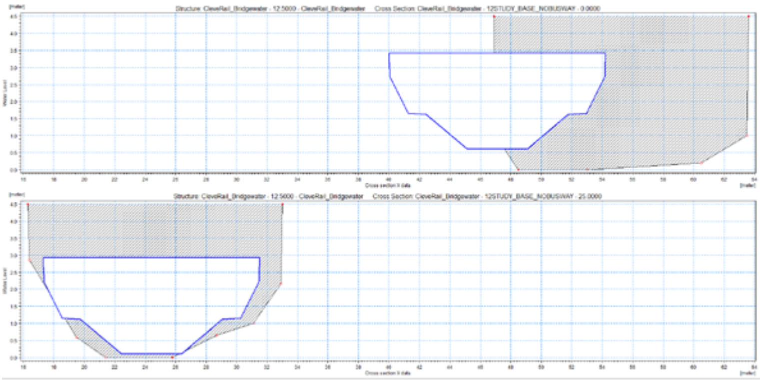


Figure 4 Culvert at CleveRail_Bridgewater plotted with the upstream (top) and downstream (bottom) cross sections as background

Figure 5 demonstrates instabilities that occurred within the MIKE 11 results at the structure labelled 'Wynnum'. Upon closer inspection of the coupling it was observed that the downstream couple locations for Wynnum were not 'matching' the upstream coupled cells as Figure 6 displays. It is recommended that the downstream couple locations are adjusted to the appropriate cell locations (see Figure 6). It is also recommended to enlarge the zone of localised increased eddy viscosity values to promote stability.

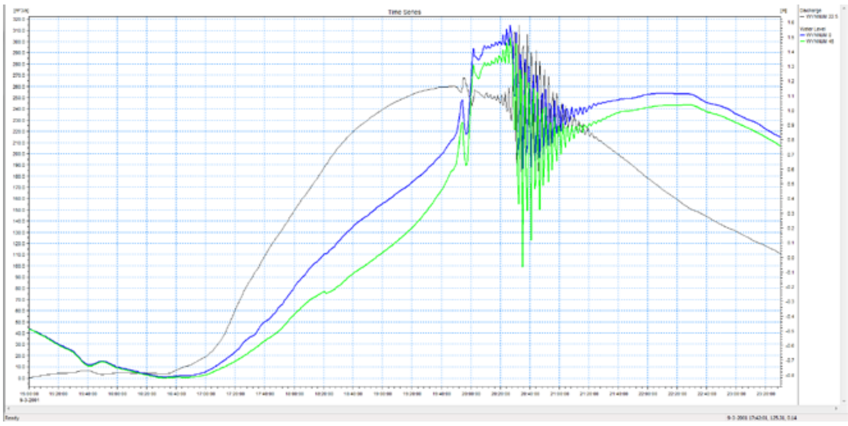


Figure 5 Wynnum 22.5, 2001 results

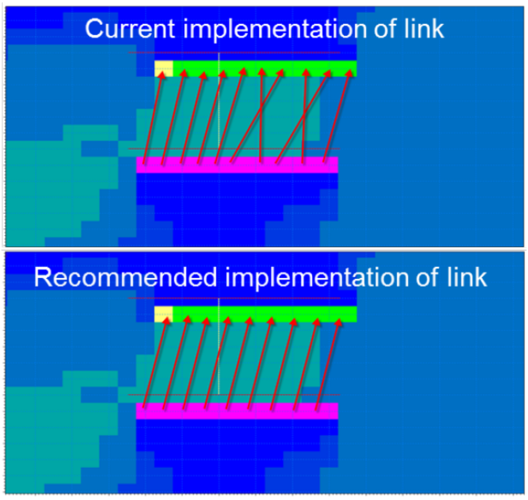



Figure 6 Recommended implementation of coupled cells

Instability in discharge, oscillating near the peak has been observed along Glindemann Creek between chainages 7900 and 8000 in the 2013 MIKE 11 results (see Figure 7). A test run was performed increasing the roughness values within the river channel from Manning's n of 0.018 to 0.048. Increasing the roughness resolved the instability as shown in Figure 8. It is therefore recommended to increase the channel roughness in reaches where instabilities occur.

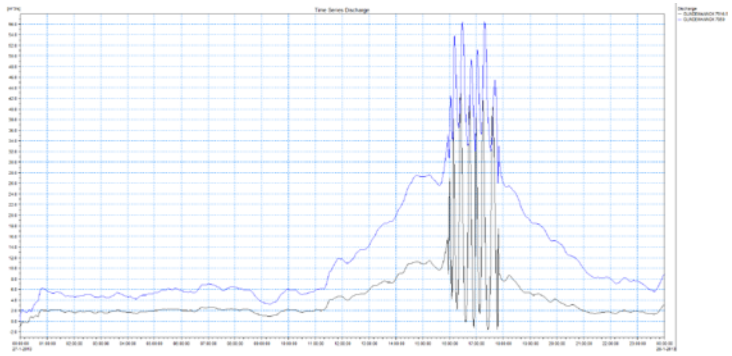


Figure 7 Modelled discharges at Glindemann Creek (chainages 7916.5 and 7959)

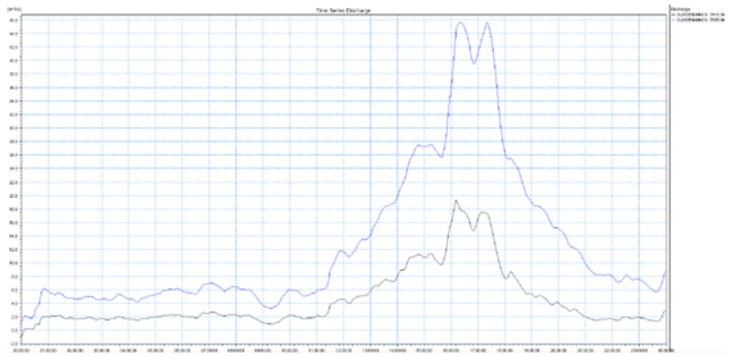


Figure 8 Modelled discharges at Glindemann Creek (chainages 7916.5 and 7959) after increasing channel roughness

## Summary

Overall the model has been built within the generally accepted guidelines. With the following recommendations the model will be suitable for assessing the potential for flooding and flood hazard within the Norman Creek catchment.

Key recommendations:

- Review the MIKE 21 bathymetry in areas where the maximum current velocities are very high;
- Ensure the coupling of upstream and downstream cells in MIKE FLOOD is correctly implemented;
- Review each coupled structure discharge plot in the MIKE 11 result file for instabilities and assessment in context of the structure's hydraulic impact on the results; and
- Increase the channel roughness in reaches where instabilities are observed.

Optional:

- Increase the MIKE 11 save interval to e.g. 3 minutes.

Please do not hesitate to contact me if you require further clarification.

Kind regards

**DHI**

Monika Balicki
Senior Engineer

Mark Britton
Global Corporate Relationship Manager (RPEQ No. 06815)

# Appendix J: Flood Surface Generation Limitations

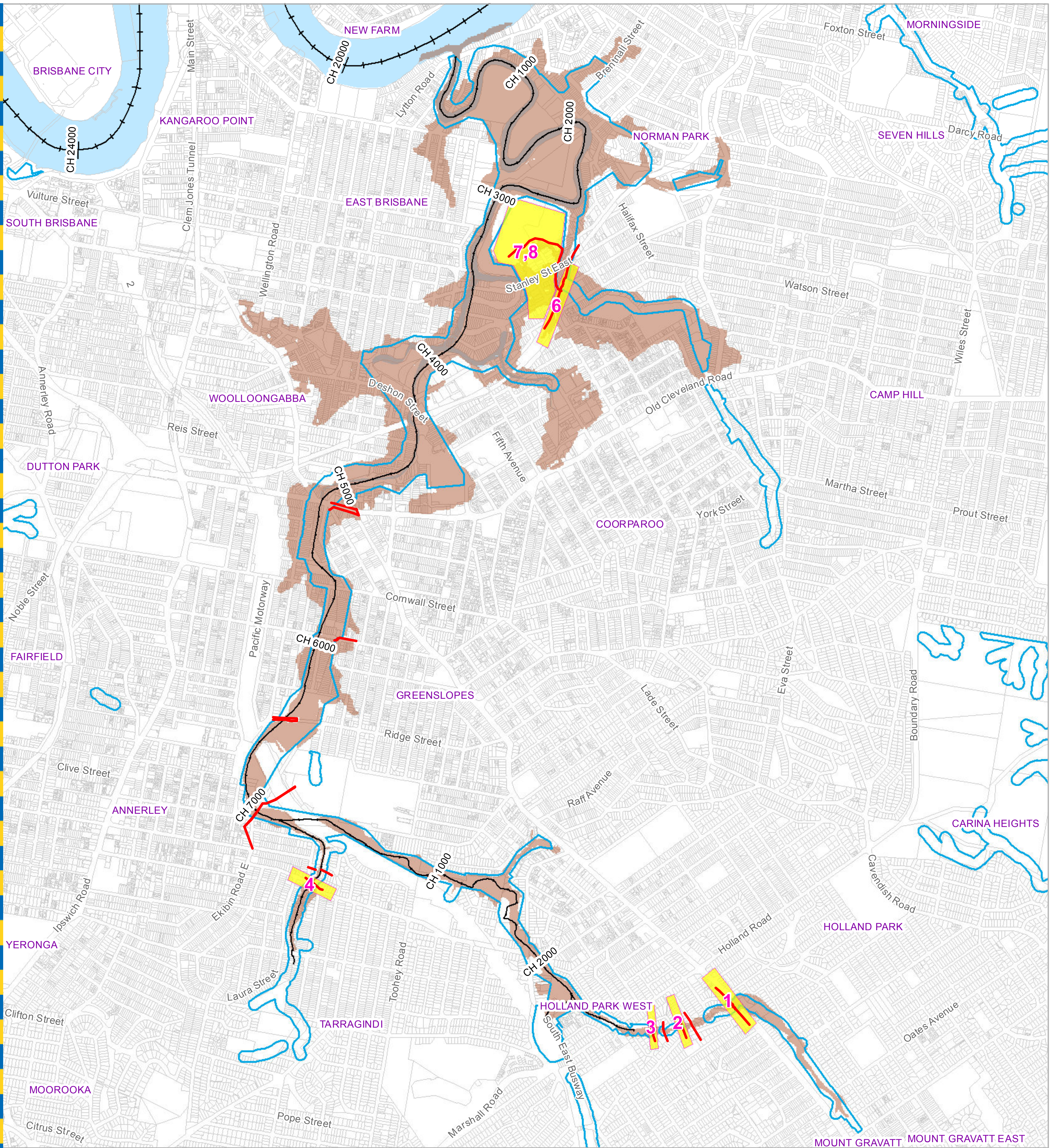
Table J1 details a summary of the limitations involved in the generation of flood surfaces for this study using the WaterRide software package.

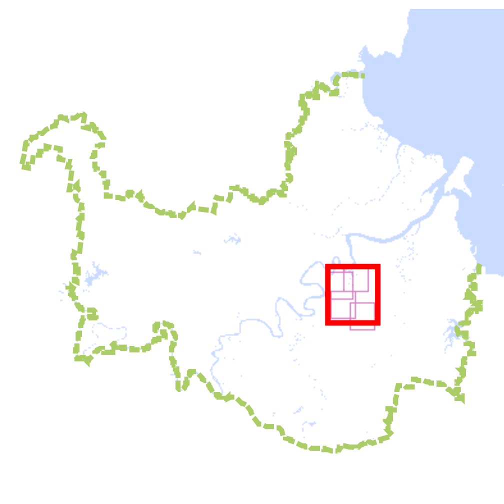
Table J1 – Limitations of the WaterRide software in flood surface generation

| Limitation Number | Limitation Type | Location Description | Additional Comments |
|---|---|---|---|
| 1 | Break line added to restrict weir flow at structure | Logan Rd crossing, Glindemann Creek | The break line does not allow weir overflow to stretch out onto the floodplains on downstream side of structure. In reality, weir overflow would occur and flow overland on the downstream floodplains and then back into the main channel. However, the upstream level is too high to stretch directly downstream. |
| 2 | Break line added to restrict overland flow at end of overland flow path | Iveagh St overland flow path, Glindemann Creek | The break line does not allow overland/floodplain flow to traverse downstream of the overland flow path. In reality, flow may traverse over the floodplain downstream of the overland flow path before flowing back into the main channel, but it cannot be replicated with the stretching software. |
| 3 | Break line added to restrict overland flow at end of overland flow path | Balis St overland flow path, Glindemann Creek | The break line does not allow overland/floodplain flow to traverse downstream of the overland flow path. In reality, flow may traverse over the floodplain downstream of the overland flow path before flowing back into the main channel, but it cannot be replicated with the stretching software. |
| 4 | Break line added to restrict weir flow at structure | Sexton St crossing, Sandy Creek | The break line does not allow weir overflow to stretch out onto the floodplains on downstream side of structure. In reality, weir overflow would occur and flow overland on the downstream floodplains and then back into the main channel. However, the upstream level is too high to stretch directly downstream. |
| 5 | Flood level drop on left bank upstream | Cornwall St crossing, Norman Creek | The flood levels in the existing case scenario taper down gradually |

| Limitation Number | Limitation Type | Location Description | Additional Comments |
|---|---|---|---|
| | of structure | | toward the structure on the left bank floodplain. The limitation in the stretching exercise in the ultimate case scenario results in a sudden drop in levels as opposed to a gradual drop. |
| 6 | Break line added to restrict weir flow at structure | Railway crossing, Bridgewater Creek | The break line does not allow weir overflow to stretch out onto the floodplains on downstream side of structure. In reality, weir overflow would occur and flow overland on the downstream floodplains and then back into the main channel. However, the upstream level is too high to stretch directly downstream. |
| 7 | Flood level from Norman Creek stretched across floodplain and over to Bridgewater Ck | Area bounded by Norman Ck, Bridgewater Ck, Stanley St East, and Railway Line | In reality, a flood level gradient would be present between Norman Creek and Bridgewater Creek in this area. However, this cannot be replicated with the stretching software. |
| 8 | Flood level from Norman Creek restricted to area upstream of Giffin Park | Area bounded by Norman Ck, Bridgewater Ck, Stanley St East, and Railway Line | In reality, the flood levels (during the larger and extreme events), will flow overland through this area downstream and then back into Norman Creek. However, the upstream flood levels are too high to stretch to these downstream areas. |

Particularly difficult areas to apply the stretching process to and which may benefit from further refinement are detailed in Figure J1 below. The areas on the figure are numbered as per the numbered limitations detailed in Table J1 above. The break lines adopted for the 100yr ARI Ultimate Case scenario stretching exercise are also included in Figure J1.



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Prepared : 097142
Checked : JS
Revision : 0
Publication Date : 27 Jun 2014
Project Number : 130286

File : G:\BICD\Proj\13\130286_Norman_Creek_Flood_Study\ArcGIS\GIM_130286_112.mxd

## Legend

- WaterRide Break Line
- AMTD Line
- City Plan Waterway Corridors
- 1% AEP Ultimate Case Scenario Flood Inundation Extent
- Stretched Area for Improvement
- Waterway/Waterbody

**For Information Only - Not Council Policy**


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### DATA INFORMATION

The flood maps must be read in conjunction with the flood study report and interpretedby a qualified professional engineer. The flood maps are based on the best data available to Brisbane City Council ("Council") at the time the maps were developed. Council, and the copyright owners listed below, give no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) presented in these maps and the user uses and relies upon the data in the maps at its own sole risk and liability. Council is not liable for errors or omissions in the flood maps. To the full extent that it is able to do so in law, the Council disclaims all liability (including without limitation, liability in negligence) for any loss, damage or costs (including indirect and consequential loss and damage), caused by or arising from anyone using or relying on the data contained in the flood maps for any purpose whatsoever.



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# Norman Creek WaterRide Break Lines and Stretched Areas for Improvement

Figure J.1

GIM - 130286 - 112