Ref 700

DUFFILL WATTS & KING

WAIHI BEACH RESIDENTIAL AREA STORMWATER STUDY

ANALYSIS OF EXISTING NETWORK AND FUTURE DEVELOPMENT

REFERENCE NUMBER: 19020

OCTOBER 2001

REPORT PREPARED FOR:
DUFFILL WATTS & KING

REPORT PREPARED BY:
TONKIN & TAYLOR LTD

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EXECUTIVE SUMMARY

This report summarises the investigations carried out between June 2001 and September 2001 by Tonkin & Taylor Ltd for Duffill Watts & King in relation to the stormwater system in the Waihi Beach Residential Area. The purpose of the investigations was to identify the areas presently suitable for residential sub-division in terms of flood hazard.

Rainfall-runoff from sub-catchments within the study area was modelled using the Danish Hydraulics Institute MOUSE software. Stormwater runoff hydrographs for the existing development and Maximum Probable Development scenarios were determined for a range of rainfall intensities representing Annual Exceedance Probabilities (AEP) of approximately 100 %, 50 %, 20 % and 2 % (i.e. equivalent 1 year, 2 year, 5 year and 50 year return periods). Critical storm durations were determined for the catchments.

Stormwater catchment and sub-catchment boundaries were defined using 0.5 m contour data provided by Western Bay of Plenty District Council (WBoPDC).

The existing level of development in each catchment was assessed by measuring the total impervious area (roof and paved areas) from available aerial photography. The maximum probable development potential in the catchment was approximated by assuming an impervious ratio of 50% within residentially zoned areas of the catchments.

A MOUSE hydraulic model of the stormwater infrastructure network was developed using asset and topographical data collated for this study. The model included the primary (pipes and open channels) and secondary stormwater networks (overland flow paths and ponding areas).

Stormwater asset data was provided primarily from the WBoPDC asset database, with field survey commissioned to fill data gaps and resolve

1.0 Introduction

1.1 General

In June 2001, Tonkin and Taylor Ltd (T&T) was appointed by Duffill Watts & King Ltd (DWK) on behalf of the Western Bay of Plenty District Council (WBoPDC) to investigate the performance of the stormwater infrastructure in the Waihi Beach Residential Area.

The principal objective of WBoPDC with regard to that initial investigation of the existing stormwater infrastructure at Waihi Beach was:

- to define catchments within the Residential Area in which in-fill subdivision may immediately proceed without upgrading of the stormwater systems in order to meet the present service standard

Following preliminary reporting of modelling results in July 2001, DWK issued complementary briefs in August 2001 and September 2001, which sought additional modelling investigations with respect to the overland flow paths in the Waihi Beach Residential Area, and likely future stormwater infrastructure works.

1.2 Scope

The scope of the investigations was set out in two DWK letters to T&T dated 25 June and 30 July 2001(refer Appendix A). The scope covers an assessment of the capacity of the primary and secondary components (pipes, culverts, open channels and overland flow paths) of the existing stormwater system at Waihi Beach.

For the purposes of this study, the Waihi Beach Residential Area is defined as the area of the following five stormwater catchments:

- Waihi Beach North
- Wallnutt Avenue
- Two Mile Creek

- Three Mile Creek
- Island View

This study is the first phase of investigations that will ultimately determine the upgrading works necessary to construct a stormwater system to cater for the design runoff from future Maximum Probable Development (MPD) of the catchments.

The methodology for this study incorporated the following tasks:

- checking the completeness of existing WBoPDC stormwater and topographical data
- identification of additional survey requirements
- compilation of input data (impervious areas, catchment boundaries, pipe invert and connectivity data, open channel and overland flow path dimensions)
- development of a MOUSE hydrological and hydraulic model
- determination of the extent of MPD in the catchments
- determination of modelling boundary conditions (utilising where appropriate results from existing computational hydraulic models)
- calculation of runoff hydrographs
- calculation of design flows in primary and secondary network
- assessment of the extent of overland flow and surface flooding in extreme events
- determination of flood hazard
- identification and preliminary costing of future infrastructure works to alleviate flooding

1.3 Report Structure

Section 2 of the report describes the background to the investigations including the existing infrastructure, present and likely future development, WBoPDC performance standards, and the data available for the investigations. In Section 3 the scope of the site visit during the investigations is outlined.

Section 4 presents a description of the hydrological conditions for the Waihi Beach Residential Area, and the modelling approach is described in Section 5.

Modelling results for both existing conditions and likely future conditions are discussed in Section 6. Section 7 includes a preliminary discussion of the limits on future subdivision and stormwater infrastructure necessary to enable development to proceed in the Waihi Beach Residential Area.

2.0 Background

2.1 Present Development

Development in the Waihi Beach Residential Area is concentrated generally along the beach front, extending from the Waihi Stream mouth in the north to Island View, some 5 km to the south towards the Katikati entrance to Tauranga Harbour (refer Figure 1). In the northern part of the Residential Area there has also been development on the higher ground away from the beach.

The present minimum allowable property size is 800 m^2. However, there are some properties of less area than this, subdivided presumably before the present property size restriction came into force.

2.2 Existing Infrastructure

The stormwater infrastructure serving the Waihi Beach Residential Area comprises a network of connected pipes and open channel swales. However, in some areas no formal stormwater network exists.

Stormwater from properties is managed in the following ways:

- Connection directly to the piped stormwater network
- Connection to outlets in the road side kerb and channel
- Discharge directly to watercourses
- On-site disposal: either to soakholes or directly onto the ground

2.3 Future Subdivision

It is proposed in the future to permit further subdivision of properties to 350 m^2 minimum size. A consequence of this, and the further development that will follow, will be increased impermeable areas due to roofs and paving for driveways, etc. Stormwater runoff can be expected to increase in volume and peak flow rate.

WESTERN BAY OF PLENTY DISTRICT COUNCIL
WAIHI BEACH RESIDENTIAL AREA STORMWATER STUDY
ANALYSIS OF EXISTING NETWORK AND FUTURE DEVELOPMENT

TONKIN & TAYLOR LTD
ENVIRONMENTAL & ENGINEERING CONSULTANTS
■ AUCKLAND □ WELLINGTON □ HAMILTON □ WELLINGTON □ NELSON □ WHANGAREI

APR FILE 19020

FIGURE 1

2.4 WBoPDC Service Standards

The WBoPDC code of practice for subdivision and development (WBoPDC, February 2001) requires the following stormwater standards for primary and secondary flow paths:

- Primary (piped) stormwater systems: 20 % AEP minimum (5 year return period)
- Stormwater systems to recreation fields and streets without alternative access: 10 % AEP minimum (10 year return period)
- Stormwater systems to protect residential property, commercial and industrial buildings: 2 % AEP minimum (50 year return period)
- Stormwater systems to protect major communal facilities: 1 % AEP minimum (100 year return period)

2.5 Available Data and Survey

The following data were provided to T&T by DWK and/or WBoPDC at the commencement of this study:

- Cadastral land boundary data for the area
- District Plan zone boundary information
- 0.5 m contour information
- stormwater infrastructure information in the form of pipe, manhole and outlet data from the WBoPDC ORIGIN database
- digital colour aerial photography
- information from previous flood surveys

Following review of these data and the requirements of the modelling, the following information was sought and provided by Engineering Survey and Design Ltd, registered surveyors of Tauranga:

- additional manhole and pipe invert levels to complement/clarify the existing data provided
- information on connectivity of the stormwater system
- topographical survey of low-lying areas within the Residential Area

- surveyed levels on significant hydraulic features (e.g. road crown levels, open channel cross sections and overland flow paths)

A review of the stormwater infrastructure data provided by WBoPDC against data collected in the field as part of this study indicated apparent errors in the data management for some elements of the network. In particular these were:

- pipe invert levels at the end of the line, and for example at cesspits
- pipe invert levels at pipe junctions
- erroneous pipe gradients
- truncated invert and manhole lid levels

These were clarified by additional field survey.

3.0 Site Visit

T&T staff visited the site in July 2001 to investigate particular features and observe the lie of the land to assist in model definition, discretisation and calibration.

During the site visit the following aspects were addressed:

- Inspection of outlets from the reticulated stormwater network (to the open watercourses and the foreshore)
- Inspection of inlet configurations at culverts in the system
- Location and condition of open channels
- Assessment of potential ponding areas, and clarification of likely overland flow paths
- General condition of the stormwater network (cesspits, road swales, kerb and channel)
- Prevalent method(s) of stormwater disposal from residential properties
- Soil types and variation across the area
- General topography and clarification of subcatchment boundaries
- Evidence of historical flooding

4.0 Hydrology

4.1 Catchments Descriptions

The Waihi Beach Residential Area comprises five principal catchments (refer Figure 1):

- **Waihi Beach North** (250 ha)

  This catchment includes the redundant water supply dam and associated catchment (206 ha) and residential development in the lower catchment along the beach. The outflow from the dam is conveyed to the foreshore along a watercourse that passes through the Waihi Beach Camping Ground and under Waihi Beach Road via two 1525 mm diameter pipe culverts.

  Approximately two thirds of the residential area discharges to this watercourse, with the remaining one third discharging to the beach through an open channel flowing through the Surf Club carpark.

- **Wallnutt Avenue** (99 ha)

  Runoff from this catchment, including a significant proportion derived from undeveloped land upstream of the Residential Area, is discharged to the beach through a lined watercourse through private property immediately north of Ocean View Road.

  Approximately 21 ha of the residential development discharge to a stormwater network that flows through private properties located between Marine and Wallnutt Avenues. A further 4 ha of developed properties discharge to the watercourse at the beach via an open channel and 300 mm pipe located east of Savage Avenue.

- **Two Mile Creek** (548 ha)

  Most of this catchment is undeveloped, with only 21 ha in residential land use. Upland flow is conveyed in Two Mile Stream through the

Residential Area north of Wilson Road, discharging to the beach between Shaw Road and Seaforth Road.

Approximately 5 ha of residential property along the foreshore, generally to the east of Dillon Street and between Park Avenue and Hillary Street, discharges directly to the beach. However, the two outfalls servicing this area are generally blocked with sand.

Runoff from the rest of the developed area in the catchment is discharged to Two Mile Creek through ten outfalls, five on the north and five on the south of the creek.

- **Three Mile Creek** (767 ha)
  Similarly to the Two Mile Creek catchment, most of this catchment is undeveloped (715 ha), with runoff from this area conveyed through the stream to discharge on the beach immediately north of Glen Isla Place.

  The majority of residential development in this catchment is located to the north of Three Mile Creek. Runoff from these properties (29 ha) is conveyed to the creek through three open channel drains running north to south. A further 8 ha of properties located north of Bonito Avenue in the Island View residential area discharge to Three Mile Creek through an open channel located east of Seaforth Road.

- **Island View** (20 ha)
  Properties in Island View south of Bonito Avenue and north of Marlin Avenue discharge through a piped stormwater network into the Tauranga Harbour on Emerton Road in the vicinity of the aerodrome. The catchment to the south of Marlin Avenue is not served by a reticulated stormwater network.

4.2 Land Use

Impervious areas in the catchment, being roofs and paved area including driveways and roads were defined and measured in area using the areal photography provided by WBoPDC. These data were determined for each subcatchment and used in the derivation of peak runoff flows in modelling of the stormwater system.

4.3 Geology

The Waihi Beach Residential Area is located in and about low-level foothills behind Waihi Beach. Along the beach there is a strip of relict sand dunes with ground levels generally less than RL 10 m. The foothills have a low to moderate relief of around RL 10 m close to the Residential Area, gradually increasing up to RL 20 m to RL 30 m some 2 km to the west and north, where they border a very steep range of hills up to 270 m high.

The geology of the area has been previously investigated in some detail and reported in an earlier study by T&T for WBoPDC in relation to the proposed diversion of Two and Three Mile Creeks (T&T, 2001)

There are two broad soil types in the Residential Area:

- Relict sand dunes soils present along the beachfront. These soils have a relatively high infiltration potential.
- Soils derived from volcanic deposits and some cemented sands in the higher ground behind the coastal beachfront strip. These soils will generally inhibit infiltration and exhibit a higher runoff potential.

The infiltration parameters used in modelling were determined with reference to:

- Understanding of local geological conditions from earlier T&T projects
- reference to NZ Geological Survey mapping of the region
- infiltration tests carried out in the area (Manukau Consultants, 1996)
- information gathered from both published and unpublished reports of stormwater investigations in similar soils

The infiltration model utilised in the runoff modelling was based on the Horton Method, with the following parameters:

- Relict sand dunes soils: Initial loss: 50 mm/hour
  Ultimate loss: 25 mm/hour
  Decay constant: 2 hours
- Higher ground volcanic soils: Initial loss: 25 mm/hour
  Ultimate loss: 12 mm/hour
  Decay constant: 2 hours

These correspond to runoff coefficients of between 0.1 and 0.3, and between 0.7 and 0.9 for the relict sand dune soils and volcanic soils respectively during a 20 % AEP storm (5 year return period equivalent) depending on the slope of the terrain.

4.4 Design Rainfall and Storm Profiles

In accordance with the WBoPDC code of practice design rainfall depths were determined using the NIWA High Intensity Rainfall Database (HIRDS), and are presented in Table 1 below.

Table 1: Design Rainfall Data

Annual Exceedance Probability	Equivalent Return Period (years)	Design Rainfall (mm)	
		2 hours	24 hours
100 %	1	23	71
50 %	2	46	142
20 %	5	61	189
2 %	50	94	288

Notes
- Data from HIRDS v1.50
- 100 % AEP rainfall approximated by extrapolation of HIRDS data for 1.01 return period

The temporal distribution of rainfall for the design storms was derived using the Chicago Storm Method (Maidment et al, 1988).

To determine the critical rainfall duration for the catchments a range of Chicago storm profiles were considered.

The critical runoff response from the upper catchments was found to occur in a 24 hour storm profile, which included rainfall intensities representing a range of rainfall durations between 2 and 24 hours.

For the smaller, residential catchments the 2 hour storm profile, representing storms between 10 minutes and 2 hour hours long, was found to be critical.

5.0 Model Formulation

5.1 Model Software and Construction

The hydrological and hydraulic models for modelling the stormwater systems in the Waihi Beach Residential Area were constructed using the Danish Hydraulics Institute (DHI) MOUSE software package. This is a network model capable of simulating both piped and open channel unsteady flow conditions.

Data for definition of the model (topography, catchment boundaries, stormwater network element definitions, etc) were managed in an ArcView GIS database. This was linked directly to the MOUSE software to create the model structure. The hydraulic model developed included the primary pipe and open channel flow paths, as well as overland flow paths and surface storage locations. It was generally assumed that all pipes flow at full capacity.

Plans showing the model layout and principal elements are included in Appendix B.

5.2 Boundary Conditions

Boundary conditions for modelling the stormwater system in the Residential Area came from three sources:

- Design rainfall (as described in Section 4)
- Runoff hydrographs of the runoff from the upper catchments determined using models developed by T&T in other studies for WBoPDC
- Water levels (tidal and stream flood levels)

The combination of rainfall and tidal boundary conditions followed the recommendations of Environment Bay of Plenty set out in the draft hydrological modelling standards (February 2001):

- For the 20 % AEP rainfall event, a 10 % AEP storm surge with an allowance of 0.49 m for sea level rise to 2100

- For the 2 % AEP rainfall event, a 5 % AEP storm surge with an allowance of 0.49 m for sea level rise to 2100

5.3 Hydrological Scenarios

In order to assess the performance of the total stormwater system, both short and longer duration storms (2 hour and 24 hour) for the 20 % AEP and 2 % events AEP were modelled to determine the influence of flood levels in the streams on flooding of properties in close proximity to the streams.

As part of the extended brief (August 2001) the 100 % and 50 % AEP 2 hour storm events were also modelled. The boundary conditions for these events were derived from MHWS tide levels.

5.4 Calibration

There is no detailed monitoring information that relates the observed extent of flooding to coincident rainfall recorded in the catchments. The nearest rainfall gauges that record short duration data are located at Waihi and Tuapiro and are of limited use for Waihi Beach modelling investigations.

However, the general extent of historical flood events has been surveyed on some occasions. These survey data were used as a general guideline for calibration of the model. In broad terms the modelling results for the more extreme events indicated a flooding extent which corresponds to that experienced in the more severe historical storms.

5.5 Development Scenarios

5.5.1 Existing Development

The existing land use was determined as described above, utilising the available aerial photography.

The average impervious proportions of the residential areas were as follows:

- Waihi Beach North: 38 %
- Wallnutt Avenue: 31 %
- Two Mile Creek: 27 %
- Three Mile Creek: 27 %
- Island View: 24 %

5.5.2 Maximum Probable Development

The MPD analysis included for development of only those properties already zoned for residential land use. The properties above Mayor View Drive in the Wallnutt Avenue catchment presently zoned residential, but which have not yet been subdivided, were not assumed to be subdivided in the MPD scenario. It is understood that any further subdivision in this area will be restricted unless it can be shown that stormwater runoff will not increase due to development activity. The WBoPDC reserve located within The Crescent, while also zoned residential, was assumed to remain as reserve land in the MPD analysis.

The maximum intensity of development for the MPD scenario was determined in consultation with DWK after reference to the WBoPDC District Plan indicated no limits on site coverage. A maximum impervious coverage ratio of 50 % for residential property areas was adopted for MPD modelling.

6.0 Modelling Results

6.1 General

The detailed modelling results are presented in Tables C.1 to C.3 included in Appendix C, and the maps of predicted 2 % AEP flood hazard areas included in Appendix D:

- The tables present data defining levels of service available in the existing network, and potential maximum flows in the system, and notional upgrades of pipes in the existing network
- The plans show the extent and location of flooding expected during a 2 % AEP storm event. Overland flow paths are also identified. The plans also indicate the potential for further development based on WBoPDC stormwater service performance standards.

It is noted that an anomaly exists in some locations between supplied stormwater lid levels and the level information derived from the supplied contour data. Where this anomaly was evident the supplied contour levels appear to be between 0.2 m and 0.8 m above surveyed ground and lid levels. Limited field survey data confirmed this difference.

The level difference was most apparent in low-lying and vegetated areas, where a difference of between 0.5 m and 0.8 m was noted. Levels were generally in good agreement within the road reserve although differences of between 0.2 m and 0.5 m were noted in some places. It is possible that the difference in levels between the two data sets is due to the difficulty inherent in photogrammetric interpretation of aerial survey for contours in vegetated areas.

In the construction of the stormwater model the supplied lid and invert levels were used for definition of the pipe network, complemented as appropriate with data collected as part of this study. For definition of the overland flow and storage components the apparent difference in levels was taken into account in the construction of the model.

Plans showing the Waihi Beach Residential Area subcatchments categorised as above and the present restrictions on future development are included in Appendix E. Preliminary cost estimates for works to be carried out in the minor and significant works subcatchments are included in Appendix F. As well as cost estimates, the schedules therein identify:

- the principal works elements in the subcatchments
- the area of benefit
- the number of properties that would benefit from the works

These schedules are intended only as a guide for prioritisation of stormwater infrastructure improvements that may considered in the Waihi Beach Residential Area. Further more detailed investigations will be required to confirm feasibility and the cost estimates that should be used for capital works budgeting purposes.

The schedules essentially identify conceptual piped and pumping solutions to convey the modelled peak excess runoff. Further investigations may refine the actual works to be implemented, with consideration of alternative stormwater management techniques, such as for instance detention tanks on individual properties, open channel swales in the road reserve, and alternative development guidelines.

8.0 Applicability

This report has been prepared for the benefit of Duffill Watts & King with respect to the particular brief given to T&T, and it may not be relied upon in other contexts or for any other purpose without prior review and agreement by T&T.

TONKIN & TAYLOR LTD
Environmental and Engineering Consultants

Report prepared by:

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David Stephenson

Tom Bassett

Authorised for Tonkin & Taylor by:

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John Grimston

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14 July, 2004
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APPENDIX A

SCOPE OF INVESTIGATIONS

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CONSULTING ENGINEERS

SHORT FORM AGREEMENT
CONSULTING ENGAGEMENT

Between: **Tonkin & Taylor Ltd (The Consultant)**

Postal Address: **P O Box 5271, Auckland**

Physical Address: **19 Morgan Street, Newmarket**

And: **Duffill Watts and King Limited (The Client)**

Project:	**Location:**
Phase 2 of the Waihi Beach stormwater management system detail investigation and report, covering WB North, Wallnutt Avenue, One and Two Mile Creek catchments as well as Island View.	Desktop investigation and report.

Scope & Nature of Services:

To carry out the additional works as discussed. The following are the expected deliverables:

1. Final report covering the entire Waihi Beach stormwater investigation.
2. Tabular presentation of data defining levels of service available in the current stormwater system, the system being inclusive of secondary flowpaths, in the format agreed upon. The tabular presentation should also indicate the notional "upgrades" of pipe sizes to achieve unrestricted catchment flows, together with potential maximum flows for each leg of the system.
3. Colour coded maps showing development potential for the areas investigated considering the adequacy of current total stormwater systems (reticulated and secondary flowpaths), similar to those produced under phase 1(reticulation only). These maps must also show and define overland flowpaths and ponding or floodable areas.
4. Final system model (mouse) supplied in electronic format.

Programme for Services:

Provide final report by Friday 21st September 2001. Present draft report at meeting prior to this date to receive comment from Client for inclusion in final report.

Fees & Frequency of Payments:

Monthly invoices based on a time basis fee, the total of which will not exceed (ex GST) without prior approval by DWK.

Information or Services to be Provided by the Client:

Access to all available and relevant infrastructure details and equipment

The Client engages the Consultant to provide the services described above and the Consultant agrees to perform the services for the remuneration provided above. Both parties agree to be bound by the provision of the Short Form Model Conditions of Engagement (overleaf) and any variations noted below. Once signed, this agreement, together with the conditions overleaf and any attachments, will replace all or any oral agreement previously reached between the parties.

Variations to the Short Form Model Conditions of Engagement Overleaf

Payment will be made after receipt of invoice from the Consultant and on receipt of payment from WBOPDC.

Consultant Signatory:	**Duffill Watts and King Ltd (Client)**
Print Name:	**Print Name:** A G McCartney
Date:	**Date:** 17 August 2001

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Duffill Watts & King Ltd

CONSULTING ENGINEERS

SHORT FORM AGREEMENT
CONSULTING ENGAGEMENT

Between:	**Tonkin & Taylor Ltd (The Consultant)**
Postal Address:	**P O Box 5271, Auckland**
Physical Address:	**19 Morgan Street, Newmarket**
And:	**Duffill Watts and King Limited (The Client)**

Project:	**Location:**
Waihi Beach stormwater management system detail investigation and report, covering WB North, Wallnutt Avenue, One and Two Mile Creek catchments as well as Island View.	Desktop investigation and report.

Scope & Nature of Services:
To carry out a detailed investigation into the stormwater management system, to report on current levels of service provided by the system, highlight system deficiencies below the WBOPDC development standards and report on the findings. A map is to be produced showing areas within the current Residential areas able to be further developed or subdivided using the existing stormwater system without modification (ie within catchments having surplus drainage capacity). This will be done in accordance with the T&T proposal dated 4 July 2001 (ref 19020- attached), and will include:

1. Data collection and review (includes site visit)
2. Model development and system assessment
3. Reporting (text and plans)

Programme for Services:
Provide final report by Tuesday 31st July 2001. Present draft report at meeting prior to this date to receive comment from Client for inclusion in final report.

Fees & Frequency of Payments:
Monthly invoices based on a time basis fee, the total of which will not exceed (ex GST) without prior approval by DWK.

Information or Services to be Provided by the Client:
Access to all available and relevant infrastructure details and equipment

The Client engages the Consultant to provide the services described above and the Consultant agrees to perform the services for the remuneration provided above. Both parties agree to be bound by the provision of the Short Form Model Conditions of Engagement (overleaf) and any variations noted below. Once signed, this agreement, together with the conditions overleaf and any attachments, will replace all or any oral agreement previously reached between the parties.

Variations to the Short Form Model Conditions of Engagement Overleaf
Payment will be made after receipt of invoice from the Consultant and on receipt of payment from WBOPDC.

Consultant Signatory:	**Duffill Watts and King Ltd (Client)**
Print Name: TJK	**Print Name:** A G McCartney
Date: 13/7/01	**Date:** 11 July 2001

Tonkin & Taylor

Our Ref: 19020
4 July 2001

Duffill Watts and King Ltd.
32 Christopher St
Tauranga

FILE 55027/4/2/14
DUFFILL WATTS & KING LTD - Tauranga
05 JUL 2001

DIR	REF	REF	ACT
			DR

Attention: Mr D Richardson

Dear Sir

Waihi Beach Stormwater Infrastructure Analysis
Phase 1 Investigations

After our recent telecon (Richardson/Bassett) and following our proposal dated 27 June 2001, we are pleased to confirm the basis on which we will complete the Phase 1 investigations of the existing stormwater network in the Waihi Beach Residential Area.

1.0 Background

Western Bay of Plenty District Council (WBoPDC) has two objectives with regard to investigations of the existing stormwater infrastructure at Waihi Beach:

- to define catchments within the residential area in which infill subdivision may immediately proceed without upgrading of the stormwater systems to meet the present service standard
- to identify the upgrading works required to enable adequate removal of stormwater so that maximum development can proceed in the residential area

Our earlier proposal addressed the scope and deliverables required to meet both objectives, with a two-phased approach to the investigations and deadlines at the end of July and end of August for the Phase 1 and Phase 2 reports respectively.

Given the uncertainty about the resource commitment required to meet the deadlines, especially with regard to the Phase 2 investigations that will be determined to a great extent by the results of the Phase 1 studies, this proposal addresses the Phase 1 investigations only.

2.0 Scope

The Phase 1 investigations will comprise modelling analyses to define current service levels in the existing stormwater network of the Waihi Beach Residential Area, and will result in the following deliverables:

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PO Box 5271, Wellesley St, Auckland 1036, Ph: 64-9-355 6000, Fax: 64-9-307 0265, Email: auck@tonkin.co.nz, Website: www.tonkin.co.nz

- Maps highlighting the areas where infill subdivision may proceed without any upgrading of the existing stormwater infrastructure
- Tabular summary of all components of the stormwater system including current and required service levels
- Phase 1 study report

The five catchments within the Waihi Beach Residential Area are:

- Island View
- Two Mile Creek
- Three Mile Creek
- Wallnutt Avenue
- Waihi Beach North

The scope of any second phase investigations regarding the costing and prioritisation of identified upgrading works will be determined following completion of the Phase 1 studies and are not part of the present proposal. Any Phase 2 investigations to follow directly the Phase 1 reporting can be determined in the context of the network analysis results and the budget available to investigate any required remedial options to improve the service standard of the stormwater infrastructure.

3.0 Methodology

The methodology for these Phase 1 investigations will follow generally the methodology set out in our earlier proposal letter dated 12 June 2001 under Sections 3.1 (Data Collection and Review), 3.2 (Model Construction and Operation) and 3.3 (Reporting), with the following detailed tasks:

1. Checking of data / survey requirements (survey not included)
2. Model building including identification of impervious areas, sub-catchments boundaries, pipe details, model nodes and overland flow paths,
3. Data entry of missing pipe, manhole and topographical information
4. Transfer of GIS data to MOUSE model
5. Determination of modelling boundary conditions (rainfall and tailwater levels)
6. Determination of Maximum Probable Development (MPD) limits
7. Calculation of design flows
8. Site visit
9. Calibration of hydraulic model
10. Analysis of existing network
11. Reporting on performance of existing stormwater infrastructure including detailed tabulation of current service levels and maps identifying in-fill subdivision areas
12. Meetings and client liaison

APPENDIX B

WAIHI BEACH RESIDENTIAL AREA STORMWATER MODEL LAYOUT

Western Bay of Plenty District Council

Waihi Beach Stormwater Modelling

Stormwater Network Modelling

MOUSE Model Layout - Sheet 3 of 3

TONKIN & TAYLOR LTD ENVIRONMENTAL & ENGINEERING CONSULTANTS ■ AUCKLAND □ WHANGAREI □ WELLINGTON □ HAMILTON □ CHRISTCHURCH □ NELSON	DRAWN DGS 11/2001 DRAFTING CHECKED TB 11/2001 APPROVED APR FILE 19020.apr \ Model layout MOUSE Network Layout - Issue 2 Sheet 3 of 3 PROJECT No. 19020

Legend

- Stormwater catchment boundaries
- Stormwater sub-catchments

Modelled Stormwater Nodes

- Box
- Culvert (in)
- Culvert (out)
- Catchpit
- Headwall
- Junction
- Manhole
- Open Channel
- Outlet
- Storage Node

Modelled Stormwater Pipe and Channel Features

- Open channel
- Pipe
- Soak
- Weir
- Overland Flow

100 0 100 200 Metres

1:2500 at A1 Size

Western Bay of Plenty District Council

Waihi Beach Stormwater Modelling

Stormwater Network Modelling

MOUSE Model Layout - Sheet 1 of 3

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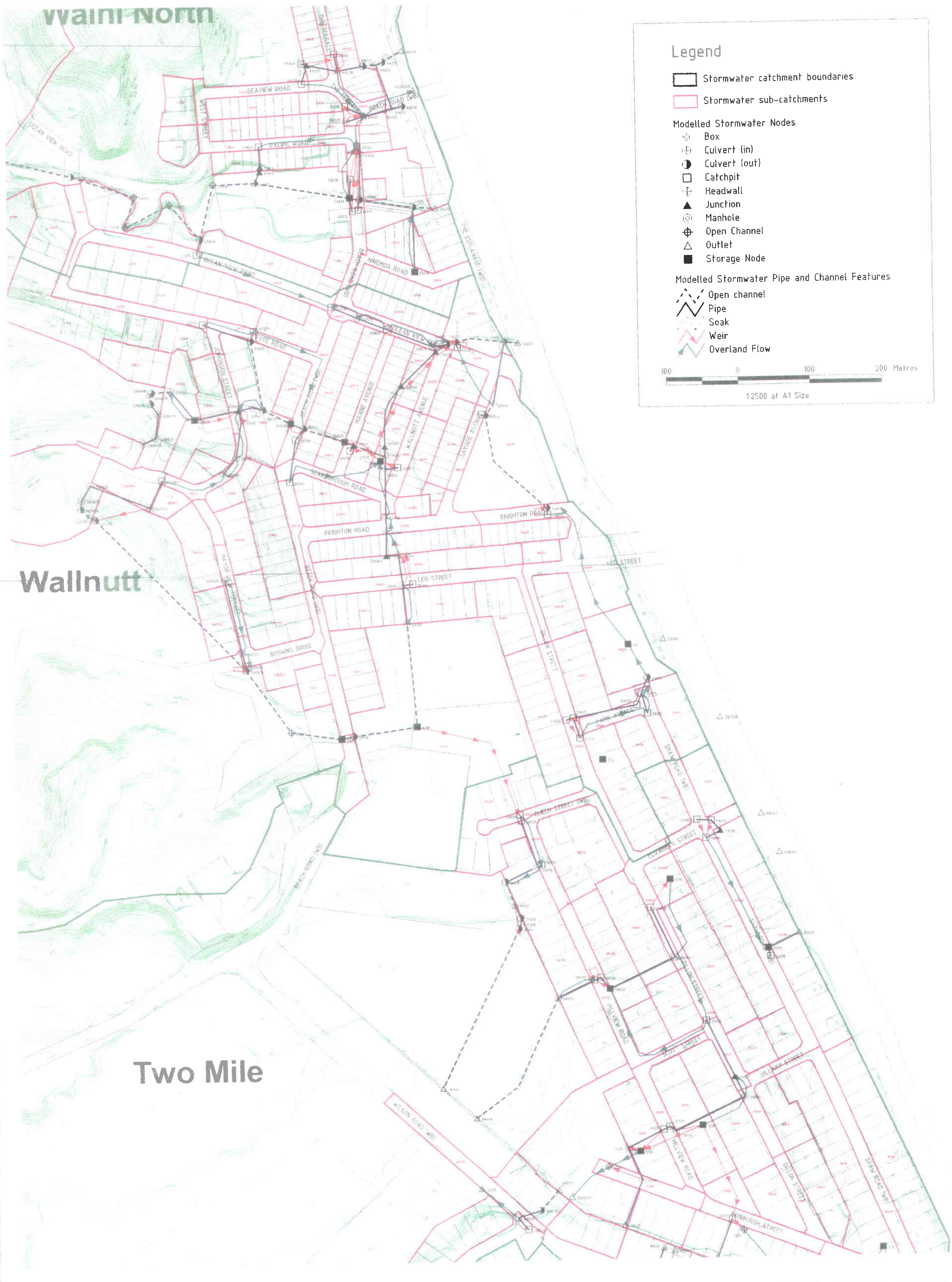
DRAWN	DGS 11/2001
DRAFTING CHECKED	TB 11/2001
APPROVED	
APR FILE	19020.apr \ Model layout
	MOUSE Network Layout - Issue 2 Sheet 1 of 3
PROJECT No.	19020



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Stormwater Network Modelling
MOUSE Model Layout - Sheet 2 of 3

DRAWN	DGS 11/2001
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MOUSE Network Layout - Issue 2 Sheet 2 of 3	
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APPENDIX C

TABULAR SUMMARY OF MODELLING RESULTS

PIPE LOCATION		Pipe	Simulated MPD Pipe Flows in Existing Network					Network Capacity				Potential MPD design flows		
Upstream	Downstream	Dia. (mm)	1 year 100 % AEP	2 year 50% AEP	5 year 20% AEP	50 year 2% AEP	Critical duration	Full pipe flow (l/s)	Surcharged flow (l/s)*	Pipe capacity in years		1 year 100 % AEP	2 year 50% AEP	5 year 20% AEP
AA020	AA015	750	0.171	0.486	0.584	0.748	2 hour	0.485	0.748	> 5 years		0.173	0.545	0.677
AA030	AA025	450	0.091	0.312	0.369	0.485	24 hour	0.551	0.485	> 5 years	#	0.091	0.320	0.405
AA035	AA030	450	0.064	0.207	0.405	0.384	2 hour	0.829	0.384	2-5 years	#	0.064	0.207	0.405
AA040	AA035	300	0.010	0.156	0.305	0.216	24 hour	0.338	0.216	2-5 years	#	0.010	0.156	0.305
AB010	AA030	225	0.030	0.048	0.044	0.057	24 hour	0.038	0.057	1-2 years		0.030	0.093	0.073
AC010	AA035	300	0.061	0.176	0.179	0.184	2 hour	0.163	0.184	2-5 years		0.061	0.183	0.206
BA012	AA020	300	0.051	0.077	0.079	0.083	neither	0.039	0.083	1-2 years		0.055	0.143	0.148
BA012	BA010	300	0.001	0.009	0.011	0.016	2 hour	0.025	0.016	> 5 years	#	0.001	0.004	0.005
BA015	BA012	300	0.053	0.074	0.076	0.080	2 hour	0.000	0.080	1-2 years		0.056	0.133	0.138
BA020	BA015	300	0.028	0.066	0.058	0.063	24 hour	0.077	0.063	1-2 years	#	0.031	0.114	0.137
BA025	BA020	450	0.006	0.025	0.034	0.053	2 hour	0.201	0.053	> 5 years	#	0.006	0.024	0.034
BC010	BA020	225	0.010	0.036	0.050	0.062	2 hour	0.075	0.062	> 5 years	#	0.010	0.036	0.050
CA030	CA025	1575	0.098	0.316	0.545	4.172	24 hour	3.087	4.172	> 5 years		0.105	0.316	0.543
CA030	CA025	1575	0.098	0.316	0.545	4.171	24 hour	3.087	4.171	> 5 years		0.105	0.316	0.543
CB010	CA015	225	0.023	0.036	0.038	0.039	2 hour	0.029	0.039	1-2 years		0.031	0.139	0.183
CC010	CA025	225	0.000	0.001	0.001	0.004	24 hour	0.149	0.004	> 5 years	#	0.000	0.001	0.001
CD015	CA030	225	0.010	0.040	0.055	0.066	2 hour	0.101	0.066	> 5 years	#	0.010	0.040	0.055
CD015	CA030	225	0.010	0.040	0.055	0.035	2 hour	0.101	0.035	1-2 years	#	0.010	0.040	0.055
CF020	CA025	300	0.087	0.104	0.108	0.112	2 hour	0.052	0.112	1-2 years		0.083	0.290	0.330
CF025	CF020	300	0.087	0.105	0.110	0.115	2 hour	0.099	0.115	1-2 years		0.084	0.291	0.327
CH010	CA035	225	0.037	0.051	0.054	0.061	2 hour	0.104	0.061	1-2 years	#	0.042	0.134	0.147
CH015	CH010	225	0.038	0.052	0.059	0.061	2 hour	0.277	0.061	1-2 years	#	0.046	0.127	0.168
CH020	CH015	225	0.039	0.053	0.059	0.062	2 hour	0.106	0.062	1-2 years	#	0.056	0.134	0.198
CJ010	CA040	300	0.051	0.174	0.178	0.182	2 hour	0.126	0.182	1-2 years		0.051	0.186	0.262
DA035	DA025	900	0.889	1.318	1.319	1.366	2 hour	1.296	1.366	1-2 years		0.871	1.696	1.743
DA040	DA035	900	0.867	1.294	1.312	1.235	24 hour	0.566	1.235	1-2 years		0.849	1.659	1.677
DA045	DA040	1200	0.868	1.293	1.311	1.236	24 hour	1.619	1.236	1-2 years	#	0.862	1.659	1.676
DA050	DA045	1200	0.874	1.302	1.372	1.440	2 hour	1.578	1.440	1-2 years	#	0.894	1.887	2.483
DA065	DA050	750	0.373	0.546	0.545	0.557	24 hour	0.422	0.557	1-2 years		0.343	0.654	0.901
DA070	DA065	750	0.345	0.499	0.498	0.568	24 hour	0.187	0.568	1-2 years		0.338	0.771	1.073
DA080	DA070	750	0.329	0.497	0.496	0.535	24 hour	0.410	0.535	1-2 years		0.335	0.683	1.021
DA085	DA080	750	0.302	0.492	0.493	0.487	24 hour	0.416	0.487	1-2 years		0.277	0.488	0.631
DA090	DA085	750	0.301	0.492	0.492	0.487	24 hour	0.698	0.487	1-2 years	#	0.279	0.527	0.631
DA095	DA090	750	0.283	0.488	0.490	0.655	2 hour	0.813	0.655	> 5 years	#	0.228	0.408	0.497
DA105	DA095	750	0.233	0.463	0.470	0.440	24 hour	0.789	0.440	> 5 years	#	0.120	0.318	0.397
DA115	DA110	300	0.142	0.209	0.222	0.043	24 hour	0.122	0.043	<1 year	#	0.089	0.113	0.119
DAD010	DAD015	200	0.028	0.059	0.058	0.057	2 hour	0.058	0.057	1-2 years	#	0.027	0.100	0.133
DAD015	DAD020	200	0.037	0.050	0.048	0.050	24 hour	0.040	0.050	1-2 years		0.037	0.238	0.193
DAD020	DAD025	300	0.074	0.131	0.150	0.045	2 hour	0.416	0.045	<1 year	#	0.162	0.369	0.395
DAD025	DAD030	300	0.081	0.141	0.161	0.043	2 hour	0.323	0.043	<1 year	#	0.089	0.339	0.363

PIPE LOCATION		Pipe	Simulated MPD Pipe Flows in Existing Network					Network Capacity				Potential MPD design flows		
Upstream	Downstream	Dia. (mm)	1 year 100 % AEP	2 year 50% AEP	5 year 20% AEP	50 year 2% AEP	Critical duration	Full pipe flow (l/s)	Surcharged flow (l/s)*	Pipe capacity in years		1 year 100 % AEP	2 year 50% AEP	5 year 20% AEP
DAE015	DAE010	150	0.015	0.033	0.045	0.059	2 hour	0.027	0.059	1-2 years		0.037	0.131	0.271
DAF020	DAF025	150	0.062	0.064	0.056	0.055	2 hour	0.051	0.055	<1 year		0.088	0.277	0.381
DAF025	DAF030	225	0.096	0.091	0.091	0.092	2 hour	0.042	0.092	<1 year		0.186	0.638	0.881
DAF030	DAF035	225	0.098	0.098	0.097	0.097	2 hour	0.044	0.097	<1 year		0.198	0.692	0.963
DB010	DA015	300	0.034	0.055	0.061	0.086	2 hour	0.024	0.086	> 5 years		0.036	0.056	0.066
DC010	DA020	225	0.023	0.056	0.081	0.062	24 hour	0.062	0.062	1-2 years	#	0.025	0.138	0.177
DH010	DA050	900	0.519	0.942	0.971	1.062	2 hour	2.265	1.062	1-2 years	#	0.555	1.296	1.516
DH020	DH015	750	0.471	1.019	1.069	1.011	2 hour	1.323	1.011	1-2 years	#	0.496	1.540	1.943
DH030	DH025	900	0.220	0.621	0.815	1.092	2 hour	1.132	1.092	> 5 years	#	0.217	0.665	0.802
DH030	DH025	900	0.220	0.621	0.815	1.092	2 hour	1.132	1.092	> 5 years	#	0.217	0.665	0.802
DH040	DH035	900	0.175	0.636	0.856	1.225	2 hour	0.789	1.225	> 5 years		0.174	0.622	0.820
DH045	DH040	900	0.177	0.637	0.857	1.231	2 hour	3.186	1.231	> 5 years	#	0.176	0.623	0.821
DH050	DH045	900	0.120	0.421	0.544	0.735	2 hour	0.499	0.735	> 5 years		0.120	0.432	0.575
DH060	DH050	900	0.042	0.153	0.210	0.320	2 hour	0.425	0.320	> 5 years	#	0.042	0.153	0.210
DI010	DA065	225	0.034	0.045	0.046	0.036	2 hour	0.036	0.036	<1 year	#	0.036	0.094	0.121
DL010	DA095	300	0.082	0.078	0.122	0.108	neither	0.178	0.108	1-2 years	#	0.093	0.152	0.157
DN010	DH015	225	0.052	0.122	0.124	0.117	2 hour	0.085	0.117	1-2 years		0.052	0.178	0.258
DO010	DH025	300	0.078	0.150	0.151	0.152	2 hour	0.201	0.152	1-2 years	#	0.077	0.253	0.314
DO015	DO010	300	0.078	0.150	0.151	0.152	2 hour	0.125	0.152	1-2 years		0.077	0.253	0.348
DQ010	DH045	225	0.059	0.098	0.098	0.099	2 hour	0.065	0.099	1-2 years		0.059	0.100	0.138
DQ015	DQ010	150	0.043	0.057	0.053	0.055	24 hour	0.050	0.055	1-2 years		0.043	0.139	0.190
DQ020	DQ015	150	0.026	0.055	0.054	0.057	2 hour	0.065	0.057	1-2 years	#	0.035	0.082	0.112
DU015	DA025	300	0.094	0.123	0.121	0.120	2 hour	0.085	0.120	1-2 years		0.093	0.330	0.408
DU020	DU015	300	0.092	0.176	0.179	0.176	2 hour	0.152	0.176	1-2 years		0.092	0.331	0.450
DU025	DU020	300	0.083	0.171	0.171	0.173	2 hour	0.195	0.173	1-2 years	#	0.083	0.302	0.415
DU030	DU025	300	0.083	0.166	0.162	0.154	neither	0.153	0.154	1-2 years		0.083	0.303	0.381
DV015	DV010	225	0.035	0.032	0.031	0.089	2 hour	0.014	0.089	2-5 years		0.034	0.088	0.106
DW015	DW010	300	0.063	0.111	0.128	0.148	2 hour	0.089	0.148	2-5 years		0.060	0.145	0.191
DY020	DY010	525	0.175	0.592	0.690	0.477	2 hour	0.700	0.477	1-2 years	#	0.176	0.597	0.645
DY020	DY010	525	0.175	0.592	0.690	0.050	2 hour	0.700	0.050	<1 year	#	0.176	0.597	0.645
DZ015	DY010	300	0.015	0.041	0.043	0.031	2 hour	0.236	0.031	1-2 years	#	0.018	0.055	0.059
EA015	EA010	300	0.075	0.089	0.099	0.099	2 hour	0.038	0.099	<1 year		0.239	0.496	0.810
EA020	EA015	300	0.073	0.066	0.068	0.109	2 hour	0.129	0.109	<1 year	#	0.171	0.382	0.450
EA025	EA020	300	0.117	0.122	0.123	0.112	24 hour	0.100	0.112	<1 year		0.172	0.363	0.472
EA030	EA025	300	0.047	0.037	0.036	0.051	2 hour	0.191	0.051	<1 year	#	0.057	0.111	0.144
EB010	EA015	300	0.022	0.024	0.016	0.023	2 hour	0.043	0.023	<1 year	#	0.033	0.041	0.051
EC010	EA025	300	0.028	0.033	0.030	0.038	24 hour	0.126	0.038	<1 year	#	0.052	0.100	0.121
FA010	FA015	300	0.001	0.001	0.001	0.001	2 hour	0.166	0.001	<1 year	#	0.001	0.001	0.001
FA020	FA015	300	0.024	0.041	0.030	0.052	2 hour	0.174	0.052	2-5 years	#	0.024	0.041	0.053
FB010	FA010	375	0.001	0.001	0.032	0.001	neither	0.051	0.001	<1 year	#	0.001	0.001	0.028

PIPE LOCATION		Pipe	Simulated MPD Pipe Flows in Existing Network					Network Capacity				Potential MPD design flows		
Upstream	Downstream	Dia. (mm)	1 year 100 % AEP	2 year 50% AEP	5 year 20% AEP	50 year 2% AEP	Critical duration	Full pipe flow (l/s)	Surcharged flow (l/s)*	Pipe capacity in years		1 year 100 % AEP	2 year 50% AEP	5 year 20% AEP
FC015	FC010	225	0.068	0.073	0.075	0.081	neither	0.043	0.081	> 5 years		0.068	0.073	0.075
FC020	FC015	225	0.044	0.052	0.022	0.256	2 hour	0.056	0.256	> 5 years		0.047	0.052	0.053
GA016	GA010	300	0.091	0.093	0.095	0.096	2 hour	0.032	0.096	<1 year		0.152	0.360	0.409
GA021	GA016	300	0.044	0.050	0.047	0.050	2 hour	0.043	0.050	<1 year		0.063	0.074	0.076
GA026	GA021	225	0.046	0.048	0.046	0.048	2 hour	0.014	0.048	<1 year		0.063	0.074	0.075
GB010	GA016	300	0.069	0.059	0.070	0.080	2 hour	0.094	0.080	<1 year	#	0.091	0.299	0.336
HA020	HA015	310	0.071	0.121	0.125	0.140	2 hour	0.108	0.140	<1 year		0.151	0.250	0.335
HA025	HA020	300	0.046	0.068	0.085	0.071	2 hour	0.073	0.071	<1 year	#	0.127	0.214	0.266
HA030	HA025	225	0.030	0.043	0.047	0.047	2 hour	0.038	0.047	<1 year		0.103	0.188	0.231
HA035	HA030	225	0.040	0.047	0.048	0.058	2 hour	0.056	0.058	<1 year		0.077	0.182	0.227
HA040	HA035	225	0.039	0.039	0.039	0.041	2 hour	0.028	0.041	<1 year		0.078	0.176	0.222
JAB015	JAB010	300	0.113	0.105	0.107	0.107	2 hour	0.081	0.107	<1 year		0.168	0.369	0.764
JAC015	JAC010	300	0.017	0.058	0.069	0.072	2 hour	0.073	0.072	> 5 years	#	0.017	0.058	0.069
JAC020	JAC015	300	0.017	0.058	0.069	0.072	2 hour	0.119	0.072	> 5 years	#	0.017	0.058	0.069
JAD015	JAD010	300	0.210	0.267	0.255	0.248	2 hour	0.267	0.248	<1 year	#	0.546	0.587	0.698
JAD020	JAD015	225	0.047	0.072	0.070	0.073	2 hour	0.119	0.073	1-2 years	#	0.047	0.115	0.118
JB010	JA015	300	0.092	0.096	0.101	0.112	2 hour	0.022	0.112	<1 year		0.205	0.442	0.832
JC015	JC010	300	0.051	0.102	0.125	0.173	2 hour	0.098	0.173	2-5 years		0.061	0.133	0.189
JC018	JC015	300	0.042	0.072	0.105	0.107	2 hour	0.096	0.107	2-5 years		0.059	0.094	0.125
JC020	JC018	225	0.024	0.042	0.054	0.071	2 hour	0.033	0.071	2-5 years		0.036	0.063	0.083
JF010	JC018	300	0.029	0.045	0.075	0.091	2 hour	0.157	0.091	> 5 years	#	0.029	0.032	0.044
JL015	JL010	300	0.035	0.074	0.116	0.133	2 hour	0.099	0.133	> 5 years		0.035	0.075	0.129
JM010	JA020	600	0.090	0.201	0.264	0.411	2 hour	0.569	0.411	> 5 years	#	0.098	0.246	0.343
JM015	JM010	600	0.091	0.201	0.265	0.414	2 hour	0.189	0.414	> 5 years		0.098	0.247	0.345
JM020	JM015	450	0.049	0.104	0.121	0.160	2 hour	0.192	0.160	2-5 years	#	0.056	0.151	0.201
JM025	JM020	450	0.049	0.104	0.121	0.160	2 hour	0.140	0.160	2-5 years		0.056	0.153	0.203
JM040	JM035	450	0.027	0.060	0.087	0.141	24 hour	0.197	0.141	> 5 years	#	0.027	0.060	0.089
JM045	JM040	450	0.027	0.060	0.086	0.141	24 hour	0.000	0.141	> 5 years		0.027	0.059	0.089
JS010	JA025	300	0.083	0.091	0.099	0.109	2 hour	0.036	0.109	<1 year		0.229	0.328	0.438
JS015	JS010	300	0.068	0.077	0.079	0.081	2 hour	0.054	0.081	<1 year		0.214	0.294	0.384
JS020	JS015	300	0.059	0.069	0.071	0.078	2 hour	0.075	0.078	<1 year		0.170	0.203	0.232
JS025	JS020	300	0.066	0.072	0.077	0.080	2 hour	0.060	0.080	<1 year		0.148	0.150	0.152
JS035	JS025	300	0.067	0.073	0.079	0.084	2 hour	0.086	0.084	<1 year	#	0.150	0.153	0.158
JS040	JS035	300	0.145	0.146	0.147	0.149	2 hour	0.122	0.149	<1 year		0.244	0.488	0.740
JS045	JS040	225	0.057	0.052	0.045	0.074	2 hour	0.053	0.074	1-2 years		0.051	0.084	0.138
JS050	JS045	225	0.034	0.034	0.033	0.038	2 hour	0.021	0.038	> 5 years		0.036	0.037	0.037
JY015	JY010	450	0.216	0.441	0.443	0.440	2 hour	0.088	0.440	1-2 years		0.238	0.446	0.449
JY025	JY020	750	0.224	0.618	0.631	0.748	2 hour	0.958	0.748	> 5 years	#	0.246	0.640	0.688
KA015	KA010	225	0.044	0.091	0.102	0.101	2 hour	0.085	0.101	2-5 years		0.044	0.092	0.148
LA015	LA010	300	0.099	0.105	0.107	0.113	2 hour	0.022	0.113	2-5 years		0.097	0.109	0.113

PIPE LOCATION		Pipe	Simulated MPD Pipe Flows in Existing Network					Network Capacity				Potential MPD design flows		
Upstream	Downstream	Dia. (mm)	1 year 100 % AEP	2 year 50% AEP	5 year 20% AEP	50 year 2% AEP	Critical duration	Full pipe flow (l/s)	Surcharged flow (l/s)*	Pipe capacity in years		1 year 100 % AEP	2 year 50% AEP	5 year 20% AEP
LA020	LA015	300	0.065	0.084	0.099	0.102	2 hour	0.056	0.102	1-2 years		0.083	0.218	0.319
LA025	LA020	300	0.049	0.063	0.066	0.071	2 hour	0.033	0.071	<1 year		0.075	0.160	0.218
LB010	LA020	300	0.034	0.075	0.106	0.114	2 hour	0.294	0.114	> 5 years	#	0.038	0.075	0.110
LC010	LA020	300	0.036	0.052	0.048	0.047	2 hour	0.069	0.047	1-2 years	#	0.036	0.075	0.130
MA015	MA010	300	0.062	0.069	0.083	0.088	2 hour	0.095	0.088	1-2 years	#	0.047	0.097	0.103
MA020	MA015	300	0.062	0.069	0.083	0.088	2 hour	0.054	0.088	1-2 years		0.047	0.097	0.103
MA025	MA020	300	0.040	0.040	0.040	0.055	2 hour	0.089	0.055	<1 year	#	0.080	0.066	0.062
MA030	MA025	300	0.040	0.040	0.040	0.055	2 hour	0.060	0.055	<1 year	#	0.082	0.067	0.062
MA035	MA030	300	0.094	0.167	0.189	0.212	2 hour	0.118	0.212	2-5 years		0.094	0.200	0.376
NA040	NA035	450	0.264	0.612	0.616	0.602	24 hour	0.152	0.602	1-2 years		0.284	1.421	2.740
NA050	NA045	450	0.258	0.433	0.428	0.432	2 hour	0.152	0.432	1-2 years		0.277	0.542	0.542
NA060	NA055	450	0.259	0.375	0.369	0.373	2 hour	0.215	0.373	1-2 years		0.279	1.106	1.553
NA066	NA065	450	0.258	0.405	0.406	0.407	24 hour	0.088	0.407	1-2 years		0.269	0.431	0.432
NA075	NA070	450	0.274	0.295	0.271	0.291	2 hour	0.176	0.291	1-2 years		0.285	0.483	0.418
NA080	NA075	450	0.253	0.248	0.239	0.254	2 hour	0.161	0.254	<1 year		0.268	0.428	0.376
NA085	NA080	300	0.094	0.092	0.092	0.092	neither	0.147	0.092	<1 year	#	0.249	0.434	0.428
NA090	NA085	300	0.095	0.093	0.092	0.092	neither	0.080	0.092	<1 year		0.253	0.488	0.430
NB015	NA013	300	0.052	0.104	0.128	0.117	2 hour	0.086	0.117	2-5 years		0.052	0.114	0.214
ND015	ND010	900	0.267	0.689	0.847	1.479	2 hour	1.512	1.479	> 5 years	#	0.301	0.789	1.051
ND025	ND020	675	0.158	0.476	0.549	0.671	2 hour	0.250	0.671	1-2 years		0.187	0.779	1.064
ND030	ND025	675	0.160	0.476	0.549	0.671	2 hour	2.155	0.671	1-2 years	#	0.191	0.785	1.068
ND035	ND030	675	0.144	0.372	0.428	0.529	2 hour	1.383	0.529	1-2 years	#	0.166	0.653	0.902
ND045	ND040	525	0.077	0.134	0.202	0.322	2 hour	0.290	0.322	2-5 years		0.085	0.199	0.322
ND055	ND050	225	0.054	0.063	0.057	0.057	2 hour	0.036	0.057	1-2 years		0.054	0.111	0.191
NG010	ND030	300	0.069	0.138	0.166	0.233	2 hour	0.064	0.233	> 5 years		0.069	0.139	0.174
NG015	NG010	300	0.027	0.056	0.058	0.051	2 hour	0.163	0.051	1-2 years	#	0.027	0.056	0.074
NG020	NG015	225	0.027	0.054	0.060	0.064	2 hour	0.050	0.064	2-5 years		0.027	0.055	0.069
NH015	ND035	225	0.071	0.068	0.067	0.069	2 hour	0.046	0.069	<1 year		0.099	0.309	0.324
NH020	NH015	225	0.020	0.020	0.019	0.019	2 hour	0.060	0.019	<1 year	#	0.029	0.078	0.115
NI015	ND036	225	0.031	0.045	0.055	0.053	2 hour	0.026	0.053	1-2 years		0.046	0.083	0.156
NI020	NI015	225	0.008	0.022	0.029	0.037	2 hour	0.024	0.037	> 5 years		0.007	0.012	0.020
NJ015	ND037	300	0.038	0.105	0.107	0.098	2 hour	0.059	0.098	1-2 years		0.037	0.121	0.168
NJ020	NJ015	225	0.025	0.065	0.061	0.061	2 hour	0.059	0.061	1-2 years		0.025	0.090	0.122
NM015	ND038	225	0.040	0.063	0.060	0.060	neither	0.050	0.060	1-2 years		0.042	0.147	0.204
NM020	NM015	225	0.040	0.069	0.061	0.062	24 hour	0.049	0.062	1-2 years		0.040	0.149	0.206
NQ010	NA080	225	0.010	0.008	0.008	0.008	2 hour	0.014	0.008	<1 year	#	0.012	0.013	0.015
NU010	NH015	225	0.054	0.052	0.050	0.051	2 hour	0.053	0.051	<1 year	#	0.071	0.234	0.245
Q015	Q010	300	0.120	0.128	0.126	0.125	24 hour	0.073	0.125	<1 year		0.297	0.627	0.792
Q020	Q015	300	0.058	0.070	0.072	0.070	2 hour	0.235	0.070	<1 year	#	0.101	0.172	0.197
RA015	RA010	225	0.063	0.063	0.068	0.069	2 hour	0.045	0.069	<1 year		0.112	0.241	0.371

PIPE LOCATION		Pipe	Simulated MPD Pipe Flows in Existing Network					Network Capacity				Potential MPD design flows		
Upstream	Downstream	Dia. (mm)	1 year 100 % AEP	2 year 50% AEP	5 year 20% AEP	50 year 2% AEP	Critical duration	Full pipe flow (l/s)	Surcharged flow (l/s)*	Pipe capacity in years		1 year 100 % AEP	2 year 50% AEP	5 year 20% AEP
RA020	RA015	225	0.057	0.052	0.049	0.049	2 hour	0.049	0.049	<1 year	#	0.087	0.185	0.214
SA025	SA015	600	0.066	0.141	0.232	0.513	2 hour	0.576	0.513	> 5 years	#	0.074	0.170	0.294
SB010	SA025	225	0.046	0.054	0.062	0.074	2 hour	0.033	0.074	1-2 years		0.035	0.101	0.150
TA025	TA020	300	0.082	0.089	0.094	0.138	24 hour	0.104	0.138	1-2 years		0.111	0.198	0.207
TB015	TB010	300	0.024	0.043	0.065	0.092	2 hour	0.058	0.092	> 5 years		0.024	0.055	0.089
TB015	TB010	300	0.024	0.043	0.065	0.092	2 hour	0.058	0.092	> 5 years		0.024	0.055	0.089
TD015	TB010	375	0.069	0.129	0.164	0.196	2 hour	0.059	0.196	2-5 years		0.068	0.144	0.263
TD015	TB010	375	0.069	0.129	0.164	0.196	2 hour	0.059	0.196	2-5 years		0.068	0.144	0.263
TD020	TD015	375	0.125	0.264	0.277	0.286	2 hour	0.241	0.286	2-5 years		0.126	0.266	0.497
TD025	TD020	375	0.092	0.193	0.194	0.208	2 hour	0.249	0.208	2-5 years	#	0.092	0.196	0.360
TG010	TD015	225	0.013	0.022	0.021	0.020	2 hour	0.037	0.020	1-2 years	#	0.013	0.028	0.043
TI010	TD025	300	0.011	0.031	0.041	0.033	2 hour	0.078	0.033	2-5 years	#	0.011	0.023	0.047
TJ010	TD025	300	0.044	0.096	0.189	0.340	2 hour	0.058	0.340	> 5 years		0.044	0.095	0.188
TL015	TL010	225	0.051	0.056	0.057	0.059	2 hour	0.038	0.059	> 5 years		0.051	0.056	0.057
TM015	TM010	225	0.034	0.067	0.071	0.072	2 hour	0.055	0.072	1-2 years		0.034	0.073	0.127
TO015	TO025	300	0.010	0.022	0.030	0.035	2 hour	0.000	0.035	> 5 years		0.010	0.021	0.030
TO025	TO030	300	0.000	0.000	0.021	0.041	24 hour	0.172	0.041	> 5 years	#	0.000	0.000	0.029
TO025	TO030	300	0.000	0.000	0.021	0.041	24 hour	0.172	0.041	> 5 years	#	0.000	0.000	0.029
UA015	UA010	225	0.013	0.028	0.051	0.060	2 hour	0.089	0.060	> 5 years	#	0.013	0.028	0.051
UA020	UA015	225	0.013	0.029	0.051	0.060	2 hour	0.125	0.060	> 5 years	#	0.013	0.029	0.051
UB015	UB010	225	0.024	0.033	0.054	0.066	2 hour	0.019	0.066	2-5 years		0.030	0.056	0.092
UB020	UB015	225	0.021	0.033	0.054	0.066	2 hour	0.090	0.066	2-5 years	#	0.044	0.063	0.092
UC015	UC010	225	0.035	0.048	0.051	0.065	2 hour	0.039	0.065	> 5 years		0.039	0.055	0.062
UC020	UC015	225	0.044	0.058	0.061	0.065	2 hour	0.104	0.065	> 5 years	#	0.049	0.055	0.059
UD015	UD010	225	0.036	0.062	0.069	0.076	2 hour	0.071	0.076	1-2 years		0.036	0.083	0.105
UD020	UD015	225	0.036	0.062	0.069	0.076	2 hour	0.136	0.076	1-2 years	#	0.036	0.084	0.105
VA015	VB010	375	0.032	0.062	0.077	0.079	2 hour	0.083	0.079	2-5 years	#	0.031	0.063	0.117
VA015	VB010	375	0.032	0.062	0.077	0.079	2 hour	0.083	0.079	2-5 years	#	0.031	0.063	0.117
VA020	VA015	375	0.064	0.125	0.154	0.158	2 hour	0.116	0.158	2-5 years		0.063	0.129	0.236
VA025	VA020	375	0.063	0.124	0.150	0.117	2 hour	0.115	0.117	1-2 years		0.063	0.131	0.239
WA031	WA030	825	0.245	0.543	0.878	1.058	2 hour	0.481	1.058	> 5 years		0.257	0.586	1.041
WA040	WA035	825	0.258	0.583	0.917	1.104	2 hour	0.626	1.104	> 5 years		0.263	0.594	1.077
WA050	WA045	900	0.277	0.612	1.221	1.596	2 hour	2.360	1.596	> 5 years	#	0.284	0.626	1.136
WA060	WA050	900	0.255	0.539	1.118	1.428	2 hour	0.710	1.428	> 5 years		0.263	0.552	1.032
WA065	WA060	900	0.234	0.493	1.029	1.232	2 hour	1.287	1.232	> 5 years	#	0.241	0.505	0.950
WA070	WA065	900	0.227	0.438	0.924	1.250	2 hour	0.414	1.250	> 5 years		0.234	0.451	0.859
WA075	WA070	750	0.083	0.184	0.458	0.445	2 hour	0.429	0.445	> 5 years		0.080	0.183	0.406
WH010	WA070	675	0.118	0.248	0.422	0.621	2 hour	0.649	0.621	> 5 years	#	0.118	0.248	0.435
WH015	WH010	675	0.107	0.225	0.391	0.560	2 hour	0.432	0.560	> 5 years		0.107	0.225	0.407
WH020	WH015	600	0.088	0.189	0.317	0.430	2 hour	0.346	0.430	> 5 years		0.088	0.188	0.337

PIPE LOCATION		Pipe	Simulated MPD Pipe Flows in Existing Network					Network Capacity			Potential MPD design flows		
Upstream	Downstream	Dia. (mm)	1 year 100 % AEP	2 year 50% AEP	5 year 20% AEP	50 year 2% AEP	Critical duration	Full pipe flow (l/s)	Surcharged flow (l/s)*	Pipe capacity in years	1 year 100 % AEP	2 year 50% AEP	5 year 20% AEP
WH025	WH020	375	0.054	0.118	0.177	0.224	2 hour	0.142	0.224	> 5 years	0.054	0.118	0.204
WH030	WH025	300	0.041	0.092	0.137	0.143	2 hour	0.093	0.143	2-5 years	0.041	0.092	0.161
WI010	WH010	300	0.010	0.022	0.034	0.063	2 hour	0.260	0.063	> 5 years #	0.010	0.022	0.034
WJ010	WH015	300	0.018	0.041	0.077	0.137	2 hour	0.166	0.137	> 5 years #	0.018	0.041	0.077
WR010	WA075	600	0.056	0.116	0.343	0.423	2 hour	0.286	0.423	> 5 years	0.057	0.120	0.361
WR015	WR010	525	0.010	0.038	0.152	0.111	2 hour	0.160	0.111	2-5 years #	0.010	0.039	0.168
WV010	WA075	525	0.011	0.030	0.067	0.084	2 hour	0.175	0.084	> 5 years #	0.009	0.024	0.074
YA015	YA010	225	0.026	0.060	0.066	0.070	2 hour	0.063	0.070	1-2 years	0.033	0.094	0.131

Notes:
* surcharged pipe flows have been derived from 2% AEP storm analysis and are equal to peak pipe flow in a 2% AEP event
\# indicates that pipe capacity is restricted by backwater effects

50 year (2% AEP) Extreme Event Flows : Pipe Network

PIPE LOCATION		Pipe	Existing development		MPD		Critical
Upstream	Downstream	Dia. (mm)	2 hour	24 hour	2 hour	24 hour	duration
AA020	AA015	750	0.713	0.491	0.748	0.532	2 hour
AA030	AA025	450	0.486	0.419	0.462	0.485	varies
AA035	AA030	450	0.409	0.093	0.384	0.276	2 hour
AB010	AA030	225	0.045	0.024	0.045	0.057	varies
AC010	AA035	300	0.183	0.093	0.184	0.122	2 hour
BA012	AA020	300	0.084	0.081	0.083	0.083	varies
BA012	BA010	300	0.016	0.006	0.016	0.005	2 hour
BA015	BA012	300	0.080	0.077	0.080	0.077	2 hour
BA020	BA015	300	0.052	0.055	0.056	0.063	24 hour
BA025	BA020	450	0.050	0.009	0.053	0.014	2 hour
BC010	BA020	225	0.060	0.012	0.062	0.020	2 hour
CA030	CA025	1575	1.495	4.166	1.494	4.172	24 hour
CA030	CA025	1575	1.495	4.166	1.494	4.172	24 hour
CB010	CA015	225	0.039	0.035	0.039	0.035	2 hour
CC010	CA025	225	0.002	0.004	0.001	0.004	24 hour
CD015	CA030	225	0.061	0.015	0.066	0.022	2 hour
CD015	CA030	225	0.061	0.015	0.066	0.022	2 hour
CF020	CA025	300	0.111	0.072	0.112	0.074	2 hour
CF025	CF020	300	0.113	0.072	0.115	0.074	2 hour
CH015	CH010	225	0.061	0.045	0.061	0.040	2 hour
CH020	CH015	225	0.065	0.046	0.062	0.041	2 hour
CJ010	CA040	300	0.182	0.089	0.182	0.107	2 hour
DA035	DA025	900	1.362	1.311	1.366	1.316	2 hour
DA040	DA035	900	1.252	1.292	1.203	1.235	24 hour
DA045	DA040	1200	1.251	1.291	1.202	1.236	24 hour
DA050	DA045	1200	1.454	1.329	1.440	1.344	2 hour
DA065	DA050	750	0.557	0.567	0.437	0.557	24 hour
DA070	DA065	750	0.514	0.544	0.467	0.568	24 hour
DA080	DA070	750	0.512	0.539	0.435	0.535	24 hour
DA085	DA080	750	0.512	0.532	0.377	0.487	24 hour
DA090	DA085	750	0.512	0.532	0.376	0.487	24 hour
DA095	DA090	750	0.604	0.545	0.655	0.514	2 hour
DA105	DA095	750	0.501	0.525	0.350	0.440	24 hour
DA115	DA110	300	0.253	0.253	0.041	0.043	varies
DAD010	DAD015	200	0.057	0.041	0.057	0.053	2 hour
DAF020	DAF025	150	0.056	0.066	0.055	0.053	varies
DAF025	DAF030	225	0.092	0.091	0.092	0.091	2 hour
DAF030	DAF035	225	0.097	0.078	0.097	0.096	2 hour
DB010	DA015	300	0.075	0.064	0.086	0.080	2 hour
DC010	DA020	225	0.086	0.065	0.059	0.062	varies
DH010	DA050	900	1.049	0.930	1.062	0.946	2 hour
DH020	DH015	750	1.069	0.916	1.011	0.924	2 hour
DH030	DH025	900	1.056	0.420	1.092	0.463	2 hour
DH040	DH035	900	1.167	0.303	1.225	0.377	2 hour
DH045	DH040	900	1.171	0.299	1.231	0.374	2 hour
DH050	DH045	900	0.700	0.208	0.735	0.263	2 hour
DH060	DH050	900	0.313	0.067	0.320	0.084	2 hour
DI010	DA065	225	0.046	0.034	0.036	0.026	2 hour
DL010	DA095	300	0.111	0.123	0.108	0.108	varies
DN010	DH015	225	0.119	0.102	0.117	0.108	2 hour

50 year (2% AEP) Extreme Event Flows : Pipe Network

PIPE LOCATION		Pipe	Existing development		MPD		Critical
Upstream	Downstream	Dia. (mm)	2 hour	24 hour	2 hour	24 hour	duration
DO010	DH025	300	0.153	0.097	0.152	0.139	2 hour
DO015	DO010	300	0.153	0.097	0.152	0.139	2 hour
DQ010	DH045	225	0.099	0.086	0.099	0.087	2 hour
DQ015	DQ010	150	0.053	0.053	0.053	0.055	varies
DQ020	DQ015	150	0.054	0.043	0.057	0.046	2 hour
DU015	DA025	300	0.120	0.119	0.120	0.117	2 hour
DU020	DU015	300	0.175	0.157	0.176	0.172	2 hour
DU025	DU020	300	0.171	0.140	0.173	0.170	2 hour
DU030	DU025	300	0.152	0.139	0.154	0.154	varies
DV015	DV010	225	0.039	0.027	0.089	0.048	2 hour
DW015	DW010	300	0.142	0.079	0.148	0.130	2 hour
DY020	DY010	525	0.726	0.492	0.477	0.402	2 hour
DY020	DY010	525	0.726	0.492	0.477	0.402	2 hour
DZ015	DY010	300	0.065	0.024	0.031	0.014	2 hour
EA015	EA010	300	0.099	0.075	0.099	0.084	2 hour
EA020	EA015	300	0.068	0.057	0.109	0.105	2 hour
EA025	EA020	300	0.124	0.057	0.109	0.112	varies
EA030	EA025	300	0.022	0.005	0.051	0.029	2 hour
EB010	EA015	300	0.022	0.017	0.023	0.008	2 hour
EC010	EA025	300	0.018	0.004	0.029	0.038	varies
FA010	FA015	300	0.001	0.001	0.001	0.000	varies
FA020	FA015	300	0.054	0.002	0.052	0.027	2 hour
FB010	FA010	375	0.001	0.001	0.001	0.001	varies
FC015	FC010	225	0.077	0.066	0.081	0.081	varies
FC020	FC015	225	0.051	0.052	0.256	0.192	varies
GA016	GA010	300	0.095	0.089	0.096	0.089	2 hour
GB010	GA016	300	0.081	0.055	0.080	0.062	2 hour
HA025	HA020	300	0.055	0.030	0.071	0.066	2 hour
HA030	HA025	225	0.046	0.028	0.047	0.044	2 hour
HA035	HA030	225	0.058	0.027	0.058	0.040	2 hour
HA040	HA035	225	0.040	0.027	0.041	0.039	2 hour
JAB015	JAB010	300	0.104	0.065	0.108	0.098	2 hour
JAC015	JAC010	300	0.074	0.037	0.074	0.037	2 hour
JAC020	JAC015	300	0.074	0.037	0.074	0.037	2 hour
JAD015	JAD010	300	0.287	0.238	0.320	0.245	2 hour
JAD020	JAD015	225	0.076	0.071	0.076	0.071	2 hour
JB010	JA015	300	0.105	0.062	0.112	0.105	2 hour
JC015	JC010	300	0.164	0.040	0.173	0.075	2 hour
JC018	JC015	300	0.098	0.037	0.107	0.075	2 hour
JC020	JC018	225	0.067	0.022	0.072	0.060	2 hour
JF010	JC018	300	0.095	0.051	0.096	0.053	2 hour
JL015	JL010	300	0.117	0.026	0.133	0.046	2 hour
JM010	JA020	600	0.378	0.133	0.412	0.172	2 hour
JM015	JM010	600	0.378	0.133	0.414	0.172	2 hour
JM020	JM015	450	0.136	0.118	0.166	0.159	2 hour
JM025	JM020	450	0.136	0.118	0.165	0.159	2 hour
JM040	JM035	450	0.116	0.110	0.146	0.144	2 hour
JM045	JM040	450	0.115	0.109	0.146	0.144	2 hour
JS010	JA025	300	0.110	0.067	0.109	0.068	2 hour
JS015	JS010	300	0.079	0.062	0.081	0.065	2 hour

50 year (2% AEP) Extreme Event Flows : Pipe Network

PIPE LOCATION		Pipe	Existing development		MPD		Critical
Upstream	Downstream	Dia. (mm)	2 hour	24 hour	2 hour	24 hour	duration
JS020	JS015	300	0.060	0.050	0.078	0.058	2 hour
JS025	JS020	300	0.069	0.062	0.080	0.065	2 hour
JS035	JS025	300	0.069	0.063	0.084	0.066	2 hour
JS040	JS035	300	0.151	0.093	0.149	0.142	2 hour
JS045	JS040	225	0.064	0.043	0.074	0.052	2 hour
JS050	JS045	225	0.032	0.025	0.038	0.035	2 hour
JY015	JY010	450	0.446	0.189	0.440	0.257	2 hour
JY025	JY020	750	0.764	0.347	0.748	0.373	2 hour
KA015	KA010	225	0.097	0.002	0.101	0.050	2 hour
LA015	LA010	300	0.109	0.061	0.110	0.104	2 hour
LA020	LA015	300	0.108	0.058	0.105	0.093	2 hour
LA025	LA020	300	0.067	0.031	0.072	0.062	2 hour
LB010	LA020	300	0.127	0.003	0.120	0.038	2 hour
LC010	LA020	300	0.052	0.016	0.049	0.042	2 hour
MA015	MA010	300	0.086	0.032	0.088	0.064	2 hour
MA020	MA015	300	0.090	0.032	0.089	0.064	2 hour
MA025	MA020	300	0.047	0.023	0.056	0.041	2 hour
MA030	MA025	300	0.047	0.023	0.056	0.041	2 hour
MA035	MA030	300	0.212	0.004	0.222	0.106	2 hour
NA040	NA035	450	0.641	0.636	0.635	0.630	2 hour
NA050	NA045	450	0.446	0.438	0.453	0.440	2 hour
NA060	NA055	450	0.385	0.381	0.392	0.383	2 hour
NA066	NA065	450	0.424	0.421	0.425	0.426	varies
NA075	NA070	450	0.274	0.276	0.293	0.277	varies
NA080	NA075	450	0.252	0.250	0.261	0.245	2 hour
NA085	NA080	300	0.091	0.090	0.090	0.090	varies
NA090	NA085	300	0.091	0.091	0.090	0.090	varies
NB015	NA013	300	0.090	0.018	0.117	0.060	2 hour
ND015	ND010	900	1.243	0.794	1.549	1.002	2 hour
ND025	ND020	675	0.654	0.332	0.724	0.523	2 hour
ND030	ND025	675	0.654	0.332	0.724	0.523	2 hour
ND035	ND030	675	0.549	0.324	0.576	0.475	2 hour
ND045	ND040	525	0.304	0.149	0.360	0.247	2 hour
ND055	ND050	225	0.074	0.019	0.058	0.059	varies
NG010	ND030	300	0.218	0.011	0.235	0.078	2 hour
NG015	NG010	300	0.068	0.008	0.052	0.031	2 hour
NG020	NG015	225	0.070	0.008	0.065	0.030	2 hour
NH015	ND035	225	0.069	0.067	0.067	0.065	2 hour
NH020	NH015	225	0.022	0.020	0.019	0.017	2 hour
NI015	ND036	225	0.068	0.021	0.054	0.041	2 hour
NI020	NI015	225	0.040	0.012	0.042	0.027	2 hour
NJ015	ND037	300	0.117	0.058	0.101	0.067	2 hour
NJ020	NJ015	225	0.061	0.040	0.062	0.049	2 hour
NM015	ND038	225	0.061	0.050	0.061	0.061	varies
NM020	NM015	225	0.062	0.050	0.061	0.062	varies
NQ010	NA080	225	0.014	0.014	0.010	0.008	varies
NU010	NH015	225	0.052	0.052	0.052	0.051	varies
Q015	Q010	300	0.130	0.128	0.131	0.129	2 hour
Q020	Q015	300	0.073	0.063	0.075	0.067	2 hour
RA015	RA010	225	0.050	0.031	0.073	0.043	2 hour

50 year (2% AEP) Extreme Event Flows : Pipe Network

PIPE LOCATION		Pipe	Existing development		MPD		Critical
Upstream	Downstream	Dia. (mm)	2 hour	24 hour	2 hour	24 hour	duration
RA020	RA015	225	0.041	0.006	0.050	0.044	2 hour
SA025	SA015	600	0.474	0.257	0.508	0.336	2 hour
SB010	SA025	225	0.066	0.014	0.072	0.062	2 hour
TA025	TA020	300	0.108	0.058	0.109	0.094	2 hour
TB015	TB010	300	0.100	0.011	0.107	0.055	2 hour
TB015	TB010	300	0.100	0.011	0.107	0.055	2 hour
TD015	TB010	375	0.223	0.034	0.207	0.086	2 hour
TD015	TB010	375	0.223	0.034	0.207	0.086	2 hour
TD020	TD015	375	0.367	0.050	0.285	0.154	2 hour
TD025	TD020	375	0.277	0.048	0.208	0.117	2 hour
TO025	TO030	300	0.024	0.000	0.040	0.006	2 hour
UA015	UA010	225	0.063	0.010	0.064	0.015	2 hour
UA020	UA015	225	0.063	0.010	0.064	0.015	2 hour
UB015	UB010	225	0.066	0.020	0.067	0.024	2 hour
UB020	UB015	225	0.066	0.021	0.067	0.027	2 hour
UC015	UC010	225	0.062	0.036	0.064	0.041	2 hour
UC020	UC015	225	0.062	0.041	0.064	0.048	2 hour
UD015	UD010	225	0.078	0.023	0.079	0.053	2 hour
UD020	UD015	225	0.078	0.024	0.079	0.053	2 hour
VA015	VB010	375	0.102	0.003	0.083	0.036	2 hour
VA015	VB010	375	0.102	0.003	0.083	0.036	2 hour
VA020	VA015	375	0.208	0.007	0.167	0.072	2 hour
VA025	VA020	375	0.164	0.005	0.128	0.070	2 hour
WA031	WA030	825	1.145	0.194	1.082	0.399	2 hour
WA040	WA035	825	1.191	0.194	1.132	0.399	2 hour
WA050	WA045	900	1.641	0.194	1.607	0.402	2 hour
WA060	WA050	900	1.456	0.146	1.442	0.354	2 hour
WA065	WA060	900	1.270	0.142	1.236	0.322	2 hour
WA070	WA065	900	1.202	0.139	1.251	0.310	2 hour
WA075	WA070	750	0.485	0.048	0.437	0.126	2 hour
WH010	WA070	675	0.615	0.069	0.626	0.145	2 hour
WH015	WH010	675	0.553	0.056	0.570	0.132	2 hour
WH020	WH015	600	0.427	0.048	0.445	0.109	2 hour
WH025	WH020	375	0.224	0.033	0.227	0.068	2 hour
WH030	WH025	300	0.154	0.031	0.144	0.054	2 hour
WI010	WH010	300	0.063	0.012	0.063	0.012	2 hour
WJ010	WH015	300	0.125	0.006	0.138	0.020	2 hour
WO010	WA070	450	0.161	0.001	0.184	0.027	2 hour
WR010	WA075	600	0.464	0.012	0.425	0.066	2 hour
WR015	WR010	525	0.179	0.004	0.110	0.012	2 hour
WV010	WA075	525	0.109	0.011	0.080	0.054	2 hour
YA015	YA010	225	0.067	0.025	0.070	0.069	2 hour

50 year (2% AEP) Extreme Event Flows : Open Channel and Overland Flow

PIPE LOCATION		Modelled	Existing development		MPD		Critical
Upstream	Downstream	Flow	2 hour	24 hour	2 hour	24 hour	duration
AA015	AA010	Open	0.700	0.490	0.741	0.534	2 hour
AA025	AA020	Open	0.671	0.440	0.699	0.478	2 hour
AA030	BA020	Open	0.123	0.099	0.143	0.155	varies
AC010	BA020	Open	0.268	0.000	0.303	0.000	2 hour
BA020	CLUBOUT	Open	0.804	0.155	1.180	0.304	2 hour
BD010	CA055	Open	2.944	8.380	2.942	8.397	24 hour
BROF02	STAC	Open	0.316	0.038	0.831	0.195	2 hour
CA015	CA010	Open	3.065	8.487	3.065	8.540	24 hour
CA025	CA015	Open	3.032	8.385	3.032	8.400	24 hour
CA030	CF025	Open	0.005	0.005	0.005	0.029	varies
CA035	CA030	Open	2.957	8.659	2.954	8.696	24 hour
CA038	CA035	Open	2.946	8.467	2.943	8.503	24 hour
CA040	CA038	Open	2.946	8.467	2.943	8.503	24 hour
CA045	CA040	Open	2.943	8.379	2.941	8.396	24 hour
CA050	CA045	Open	2.944	8.380	2.941	8.397	24 hour
CA055	CA050	Open	2.943	8.380	2.942	8.397	24 hour
CA060	BD010	Open	2.942	8.263	2.941	8.261	24 hour
CB010	CA015	Open	0.405	0.083	0.485	0.121	2 hour
CF025	BA020	Open	0.505	0.118	0.690	0.184	2 hour
CH020	CF025	Open	0.332	0.033	0.360	0.065	2 hour
CJ010	DU030	Open	0.220	0.000	0.242	0.000	2 hour
DA015	DA010	Open	2.763	2.016	3.042	2.506	2 hour
DA020	DA015	Open	2.617	1.955	2.842	2.397	2 hour
DA025	DA020	Open	1.462	1.422	1.460	1.426	2 hour
DA070	STF	Open	1.707	0.493	1.655	0.598	2 hour
DA080	DA070	Open	1.477	0.367	1.574	0.456	2 hour
DA090	DA080	Open	1.085	0.413	1.133	0.466	2 hour
DA105	DA095	Open	0.165	0.055	0.119	0.021	2 hour
DA110	STH	Open	0.566	2.447	2.527	2.667	24 hour
DA120	DA115	Open	3.080	2.673	2.307	2.494	varies
DAA010	DH060	Open	0.001	0.001	0.001	0.001	varies
DAB010	DAA015	Open	0.000	0.000	0.000	0.000	varies
DAD010	DQ020	Open	0.146	0.000	0.156	0.000	2 hour
DAD030	DAE015	Open	0.111	0.075	0.095	0.037	2 hour
DAE010	DAF035	Open	1.316	0.463	0.961	0.068	2 hour
DAF020	DAF025	Open	0.472	0.043	0.518	0.087	2 hour
DAF025	DAF035	Open	1.194	0.164	1.275	0.252	2 hour
DAF035	DA120	Open	2.670	0.705	1.615	0.465	2 hour
DB010	DC010	Open	0.338	0.096	0.532	0.344	2 hour
DH015	DH010	Open	1.109	1.015	1.069	1.017	2 hour
DH025	DH020	Open	3.374	1.058	3.596	1.185	2 hour
DH035	DH030	Open	2.109	0.757	2.119	0.863	2 hour
DH045	DH035	Open	0.000	0.000	0.000	0.000	varies
DH060	DH050	Open	0.000	0.000	0.000	0.000	varies
DO015	STF	Open	0.377	0.000	0.412	0.000	2 hour
DQ015	DH045	Open	0.368	0.005	0.398	0.024	2 hour
DQ020	DQ015	Open	0.265	0.000	0.282	0.000	2 hour
DU015	DA020	Open	0.745	0.069	0.895	0.143	2 hour
DU020	DU015	Open	0.675	0.000	0.820	0.036	2 hour
DU025	DU020	Open	0.642	0.000	0.772	0.022	2 hour

50 year (2% AEP) Extreme Event Flows : Open Channel and Overland Flow

PIPE LOCATION		Modelled	Existing development		MPD		Critical
Upstream	Downstream	Flow	2 hour	24 hour	2 hour	24 hour	duration
DU030	DU025	Open	0.711	0.000	0.837	0.069	2 hour
DV010	DB010	Open	0.316	0.139	0.514	0.364	2 hour
DW010	DV010	Open	0.264	0.117	0.400	0.294	2 hour
DY010	DH035	Open	0.514	0.399	0.501	0.371	2 hour
DY020	DH025	Open	0.962	0.021	1.086	0.079	2 hour
DZ015	DY020	Open	0.949	0.200	0.987	0.242	2 hour
EA010	STI	Open	1.962	0.109	2.105	0.495	2 hour
EA015	EA010	Open	1.820	0.011	1.856	0.231	2 hour
EB010	EA015	Open	1.312	0.029	1.462	0.146	2 hour
EC010	EB010	Open	1.056	0.000	1.190	0.101	2 hour
ED02	EDOUT	Open	0.018	0.000	0.021	0.000	2 hour
ED04	EDINOUT	Open	0.078	0.011	0.261	0.312	varies
FA015	FB010	Open	0.167	0.000	0.189	0.023	2 hour
FA020	FB010	Open	0.113	0.000	0.134	0.000	2 hour
FB010	FC015	Open	0.337	0.005	0.370	0.069	2 hour
FC015	STL	Open	0.000	0.000	0.000	0.000	varies
GA010	JY025	Open	3.299	2.851	3.865	2.812	2 hour
GA026	GB010	Open	2.436	2.671	3.138	2.518	varies
GB010	GA010	Open	2.656	2.666	3.267	2.571	varies
HA015	HA005	Open	0.373	0.490	0.762	0.476	varies
HA020	HA015	Open	0.259	0.000	0.659	0.159	2 hour
HA035	JS050	Open	0.039	0.000	0.035	0.006	2 hour
JAB015	STS	Open	1.374	0.000	1.506	0.299	2 hour
JAC010	STP	Open	0.073	0.037	0.073	0.037	2 hour
JAD010	JAD005	Open	0.234	0.134	0.238	0.159	2 hour
JAD015	JX015	Open	1.082	0.209	1.090	0.261	2 hour
JB010	STL	Open	1.297	0.003	1.414	0.248	2 hour
JB020	SHAWOUT	Open	0.000	0.000	0.000	0.000	varies
JC015	DILLOUT	Open	0.000	0.000	0.000	0.000	varies
JM015	WILOUT	Open	0.000	0.000	0.000	0.000	varies
JM035	JM025	Open	0.118	0.111	0.148	0.146	2 hour
JM050	JM045	Open	0.114	0.108	0.144	0.143	2 hour
JS040	STM	Open	1.206	0.000	1.415	0.121	2 hour
JS045	JS040	Open	0.336	0.000	0.291	0.031	2 hour
JS050	HA030	Open	0.568	0.000	0.649	0.092	2 hour
JY010	JA035	Open	2.925	2.768	3.542	2.688	2 hour
JY020	JY015	Open	0.729	0.337	0.731	0.347	2 hour
KA015	STJAB	Open	0.192	0.000	0.240	0.000	2 hour
LA010	ND017	Open	0.103	0.059	0.127	0.140	varies
LA015	ND017A	Open	0.682	0.000	0.780	0.065	2 hour
MA020	LOOPOUT	Open	0.083	0.000	0.091	0.000	2 hour
NA025	NA020	Open	4.124	2.612	4.391	2.856	2 hour
NA030	NA025	Open	4.133	1.348	4.413	1.504	2 hour
NA035	NA030	Open	4.128	1.127	4.405	1.282	2 hour
NA045	NA040	Open	4.058	1.089	4.328	1.232	2 hour
NA055	NA050	Open	3.733	0.997	4.006	1.138	2 hour
NA063	NA060	Open	2.745	0.745	3.046	0.884	2 hour
NA065	NA063	Open	1.544	0.426	1.758	0.563	2 hour
NA067	NA066	Open	1.549	0.424	1.739	0.562	2 hour
NA070	NA067	Open	1.436	0.421	1.609	0.528	2 hour

50 year (2% AEP) Extreme Event Flows : Open Channel and Overland Flow

PIPE LOCATION		Modelled	Existing development		MPD		Critical
Upstream	Downstream	Flow	2 hour	24 hour	2 hour	24 hour	duration
NA080	NA070	Open	1.280	0.393	1.437	0.481	2 hour
NA090	NA080	Open	1.903	0.431	2.101	0.593	2 hour
NB015	SEAOF	Open	0.289	0.000	0.298	0.000	2 hour
ND010	ND005	Open	1.260	0.838	1.526	1.040	2 hour
ND017	ND015	Open	2.813	0.841	3.269	1.111	2 hour
ND017A	ND017	Open	0.648	0.000	0.757	0.064	2 hour
ND018	ND017	Open	0.688	0.412	1.196	0.567	2 hour
ND020	ND018	Open	0.899	0.380	1.367	0.582	2 hour
ND036	ND035	Open	0.422	0.248	0.486	0.373	2 hour
ND037	ND036	Open	0.378	0.222	0.434	0.357	2 hour
ND038	ND037	Open	0.349	0.193	0.402	0.314	2 hour
ND040	ND038	Open	0.315	0.162	0.371	0.257	2 hour
ND046	ND045	Open	0.299	0.126	0.357	0.215	2 hour
ND050	ND046	Open	0.064	0.018	0.054	0.055	varies
NG020	ND035	Open	0.240	0.000	0.281	0.000	2 hour
NJ015	ND037	Open	0.204	0.000	0.220	0.015	2 hour
NJ020	NJ015	Open	0.142	0.000	0.151	0.002	2 hour
NM020	ND038	Open	0.248	0.000	0.279	0.035	2 hour
NP010	ND046	Open	0.296	0.109	0.361	0.168	2 hour
NP015	NP010	Open	0.076	0.016	0.071	0.015	2 hour
O015	JM050	Open	0.099	0.014	0.099	0.014	2 hour
Q010	Q007	Open	5.004	1.188	5.295	1.423	2 hour
SB010	RA015	Open	0.785	0.000	0.879	0.153	2 hour
SC035	SA025	Open	2.528	0.111	2.740	0.347	2 hour
SC040	SC035	Open	1.586	0.094	1.733	0.312	2 hour
SEAOF	SEAOUT	Open	1.445	0.014	1.555	0.173	2 hour
STAD	STAE	Open	0.001	0.000	0.002	0.000	2 hour
STAF	STAFOUT	Open	0.520	0.095	0.886	0.199	2 hour
STH	DA105	Open	0.484	0.520	0.345	0.525	*24 hour*
STI	DW015	Open	0.784	0.080	0.821	0.199	2 hour
STK	HA035	Open	0.000	0.000	0.000	0.000	varies
STN	ED04	Open	0.078	0.006	0.261	0.255	2 hour
STQ	STP	Open	0.361	0.086	0.420	0.122	2 hour
STS	JC020	Open	0.064	0.018	0.068	0.046	2 hour
STU	NI020	Open	0.028	0.011	0.036	0.022	2 hour
STV	LC010	Open	0.016	0.000	0.061	0.011	2 hour
TA020	SA025	Open	0.138	0.080	0.141	0.120	2 hour
TA025	SB010	Open	0.646	0.000	0.722	0.069	2 hour
TB010	SC040	Open	1.137	0.084	0.941	0.282	2 hour
TD015	TB010	Open	4.882	0.000	0.415	0.000	2 hour
TD020	TD015	Open	0.586	0.000	0.566	0.000	2 hour
TI010	TB010	Open	0.114	0.000	0.123	0.000	2 hour
TL010	SC035	Open	0.287	0.023	0.331	0.054	2 hour
TL015	TA025	Open	0.212	0.000	0.227	0.009	2 hour
TM010	SC040	Open	0.072	0.014	0.072	0.039	2 hour
TM015	TL015	Open	0.168	0.000	0.188	0.000	2 hour
TO010	TO030	Open	0.370	0.015	0.502	0.095	2 hour
TO015	STY	Open	0.077	0.000	0.146	0.000	2 hour
TO030	TB015	Open	0.198	0.021	0.250	0.110	2 hour
UA020	UB020	Open	0.045	0.000	0.049	0.000	2 hour

50 year (2% AEP) Extreme Event Flows : Open Channel and Overland Flow

PIPE LOCATION		Modelled	Existing development		MPD		Critical
Upstream	Downstream	Flow	2 hour	24 hour	2 hour	24 hour	duration
UBC010	HANOUT	Open	0.730	0.004	0.817	0.065	2 hour
UC020	UB020	Open	0.403	0.010	0.450	0.035	2 hour
UD020	UC020	Open	0.196	0.000	0.219	0.000	2 hour
VA020	TO010	Open	0.411	0.000	0.542	0.000	2 hour
VB010	TO010	Open	0.173	0.007	0.150	0.071	2 hour
WA035	WA031	Open	1.159	0.194	1.094	0.399	2 hour
WA045	WA040	Open	1.577	0.195	1.527	0.401	2 hour
WA060	WA045	Open	0.000	0.000	0.000	0.000	varies
WA065	WA060	Open	0.000	0.000	0.000	0.000	varies
WH010	WA075	Open	0.000	0.000	0.000	0.000	varies
WH015	WH010	Open	0.000	0.000	0.000	0.000	varies
WH020	WH015	Open	0.000	0.000	0.000	0.000	varies
WH025	WH030	Open	0.000	0.000	0.000	0.000	varies
WH030	STZ	Open	0.158	0.000	0.199	0.000	2 hour
WO010	WA065	Open	0.000	0.000	0.000	0.000	varies
WR010	STAA	Open	0.000	0.000	0.002	0.000	varies
WR015	VA025	Open	0.365	0.000	0.403	0.000	2 hour
WV010	STAC	Open	0.253	0.000	0.328	0.001	2 hour
YA015	STAD	Open	0.166	0.000	0.153	0.014	2 hour
AA040	AA030	Weir	0.277	0.000	0.424	0.345	2 hour
AB010	AA030	Weir	0.222	0.040	0.237	0.938	varies
BA025	BA020	Weir	0.000	0.000	0.000	0.000	varies
BC010	BA020	Weir	0.022	0.000	0.029	0.000	2 hour
CC010	CF025	Weir	0.165	0.042	0.166	0.042	2 hour
CD015	CF025	Weir	0.000	0.000	0.000	0.000	varies
CG020	CF025	Weir	0.000	0.000	0.000	0.000	varies
DA095	DA090	Weir	0.000	0.000	0.000	0.000	varies
DA115	DA110	Weir	0.080	2.137	2.319	2.509	24 hour
DAD015	DAE010	Weir	0.085	0.006	0.098	0.033	2 hour
DAE015	DAE010	Weir	1.177	0.276	0.811	0.000	2 hour
DAF030	DAF035	Weir	0.144	0.080	0.141	0.035	2 hour
DAM	CA060	Weir	2.942	8.263	2.941	8.261	24 hour
DC010	DA020	Weir	0.332	0.092	0.541	0.354	2 hour
DH010	STF	Weir	0.529	0.228	0.549	0.469	2 hour
DH020	DH010	Weir	0.273	0.070	0.340	0.228	2 hour
DH030	DH025	Weir	0.000	0.000	0.000	0.000	varies
DH050	DH045	Weir	0.000	0.000	0.000	0.000	varies
DI010	STF	Weir	0.116	0.051	0.170	0.067	2 hour
DL010	DA090	Weir	0.476	0.000	0.503	0.034	2 hour
DN010	DH010	Weir	0.321	0.004	0.335	0.016	2 hour
DQ010	DH045	Weir	0.093	0.000	0.095	0.000	2 hour
DW015	DW010	Weir	0.000	0.000	0.268	0.092	varies
EA025	EC010	Weir	0.319	0.000	0.355	0.021	2 hour
EA030	EC010	Weir	0.379	0.000	0.426	0.052	2 hour
HA025	HA020	Weir	0.220	0.000	0.288	0.039	2 hour

50 year (2% AEP) Extreme Event Flows : Open Channel and Overland Flow

PIPE LOCATION		Modelled	Existing development		MPD		Critical
Upstream	Downstream	Flow	2 hour	24 hour	2 hour	24 hour	duration
HA030	HA020	Weir	0.169	0.000	0.500	0.141	2 hour
HA040	STK	Weir	0.522	0.000	0.578	0.053	2 hour
JAC015	STP	Weir	0.000	0.000	0.000	0.000	varies
JAC020	STP	Weir	0.068	0.000	0.068	0.000	2 hour
JAD020	JAD015	Weir	0.315	0.031	0.316	0.031	2 hour
JC020	JC015	Weir	0.000	0.000	0.000	0.000	varies
JF010	JC015	Weir	0.134	0.019	0.135	0.005	2 hour
JL015	ED02	Weir	0.128	0.000	0.136	0.000	2 hour
JM025	JM015	Weir	0.000	0.000	0.000	0.000	varies
JM045	JM015	Weir	0.000	0.000	0.000	0.000	varies
JM050	JF010	Weir	0.000	0.000	0.000	0.000	varies
JS010	ED04	Weir	0.000	0.009	0.041	0.058	24 hour
JS015	STN	Weir	0.302	0.049	0.303	0.030	2 hour
JS020	STN	Weir	0.237	0.081	0.236	0.082	2 hour
JS035	STM	Weir	0.449	0.040	0.507	0.168	2 hour
JY025	JY010	Weir	2.608	2.632	3.179	2.555	varies
LA025	STV	Weir	0.788	0.001	0.855	0.140	2 hour
LB010	LA015	Weir	0.113	0.000	0.141	0.000	2 hour
LC010	LA015	Weir	0.273	0.000	0.288	0.010	2 hour
MA030	MA020	Weir	0.000	0.000	0.000	0.000	varies
NA040	NA035	Weir	3.666	0.531	3.949	0.672	2 hour
NA050	NA045	Weir	3.488	0.872	3.743	1.006	2 hour
NA060	NA055	Weir	3.521	0.842	3.789	0.979	2 hour
NA066	NA065	Weir	1.141	0.004	1.343	0.138	2 hour
ND015	ND010	Weir	0.000	0.000	0.000	0.000	varies
ND035	ND020	Weir	0.000	0.000	0.470	0.000	varies
ND045	ND040	Weir	0.000	0.000	0.001	0.000	varies
ND055	ND046	Weir	0.310	0.000	0.368	0.053	2 hour
NH020	ND035	Weir	0.217	0.038	0.235	0.064	2 hour
NI015	NI020	Weir	0.259	0.000	0.302	0.000	2 hour
NI020	ND035	Weir	0.000	0.000	0.000	0.000	varies
NQ010	NA080	Weir	0.103	0.025	0.103	0.025	2 hour
NU010	ND020	Weir	0.482	0.045	0.524	0.089	2 hour
Q015	Q010	Weir	1.877	0.368	1.961	0.459	2 hour
Q020	Q010	Weir	0.975	0.142	1.048	0.213	2 hour
RA020	RA015	Weir	0.283	0.000	0.317	0.030	2 hour
SA025	RA020	Weir	0.000	0.000	0.001	0.000	varies
SB010	SA025	Weir	0.000	0.000	0.000	0.000	varies
STAA	WR015	Weir	0.000	0.000	0.000	0.000	varies
STAB	STAC	Weir	0.000	0.000	0.000	0.000	varies
STAD	BROF02	Weir	0.314	0.038	0.829	0.194	2 hour
STAE	STAF	Weir	1.362	0.070	1.467	0.200	2 hour
STF	DA020	Weir	1.927	0.710	2.309	1.055	2 hour
STH	GA026	Weir	2.166	2.573	2.936	2.385	varies
STJAB	JAB015	Weir	0.000	0.000	0.000	0.000	varies
STL	JB020	Weir	0.000	0.000	0.000	0.002	varies
STM	STN	Weir	0.085	0.033	0.296	0.202	2 hour
STM	JL015	Weir	0.000	0.000	0.010	0.005	varies
STP	Q010	Weir	2.093	0.549	2.212	0.623	2 hour
STU	STS	Weir	0.000	0.000	0.000	0.000	varies

50 year (2% AEP) Extreme Event Flows : Open Channel and Overland Flow

PIPE LOCATION		Modelled	Existing development		MPD		Critical
Upstream	Downstream	Flow	2 hour	24 hour	2 hour	24 hour	duration
STW	MA030	Weir	0.000	0.000	0.054	0.003	varies
STZ	VA020	Weir	0.508	0.001	0.624	0.001	2 hour
TA025	TA020	Weir	0.000	0.000	0.000	0.000	varies
TB015	TB010	Weir	0.000	0.000	0.054	0.000	varies
TD025	TD020	Weir	0.379	0.000	0.432	0.000	2 hour
TG010	TB010	Weir	0.167	0.000	0.166	0.000	2 hour
TL015	TL010	Weir	0.237	0.000	0.279	0.000	2 hour
TO015	TO010	Weir	0.064	0.000	0.105	0.000	2 hour
TO025	TO030	Weir	0.061	0.000	0.068	0.000	2 hour
UB020	UBC010	Weir	0.731	0.004	0.818	0.065	2 hour
VA025	STZ	Weir	0.681	0.000	0.769	0.000	2 hour
WA050	WA045	Weir	0.000	0.000	0.000	0.000	varies
WA070	WA065	Weir	0.000	0.000	0.000	0.000	varies
WA075	STAA	Weir	0.000	0.000	0.000	0.000	varies
WI010	STAA	Weir	0.000	0.000	0.000	0.000	varies
WJ010	WH015	Weir	0.000	0.000	0.021	0.000	varies

APPENDIX D

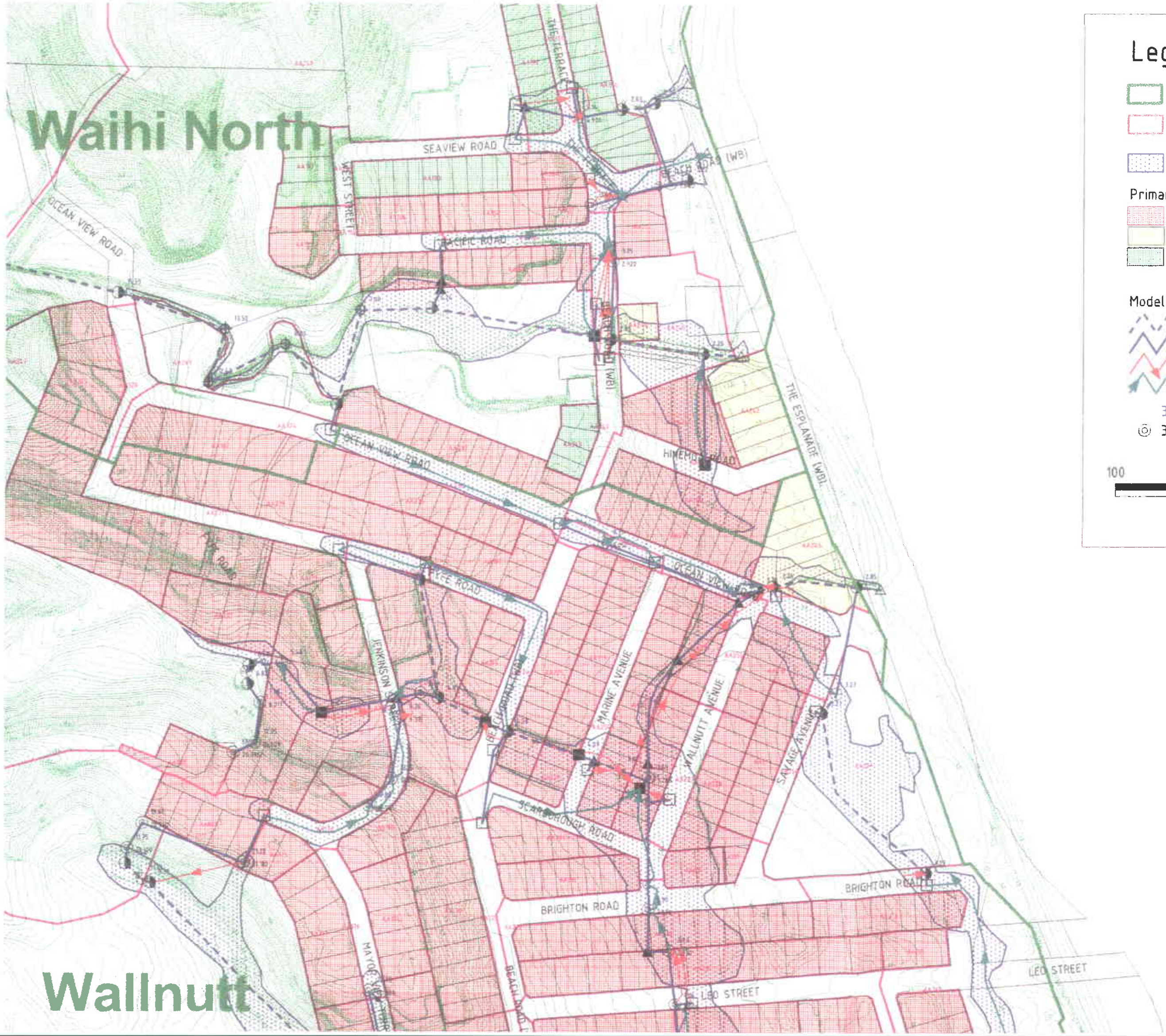
FLOOD HAZARD PLANS

Western Bay of Plenty District Council

Waihi Beach Stormwater Modelling

Maximum Probable Development

Predicted Flood Hazard - Sheet 1 of 3



TONKIN & TAYLOR LTD	DRAWN	DGS 11/2001
ENVIRONMENTAL & ENGINEERING CONSULTANTS	DRAFTING CHECKED	TB 11/2001
■ AUCKLAND ☐ WHANGAREI	APPROVED	
☐ WELLINGTON ☐ HAMILTON	APR FILE	19020.apr \ Flood hazard layout
☐ CHRISTCHURCH ☐ NELSON	Flood Hazard Layout - Issue 2 Sheet 1 of 3	
	PROJECT No.	19020

Legend

- Stormwater catchment boundaries
- Subcatchment boundaries
- Estimated extent of 2% AEP flood hazard

Primary network compliance with WBoPDC CoP

- Primary system does not meet WBoPDC CoP Standards
- No formal stormwater system
- Primary system meets WBoPDC CoP Standards

Modelled Stormwater System

- Open channel
- Pipe
- Weir
- Overland Flow

3.55 Peak modelled water level (m RL)

3.451 Manhole lid level (m RL)

100 0 100 200 Metres

1:2500 at A1 Size

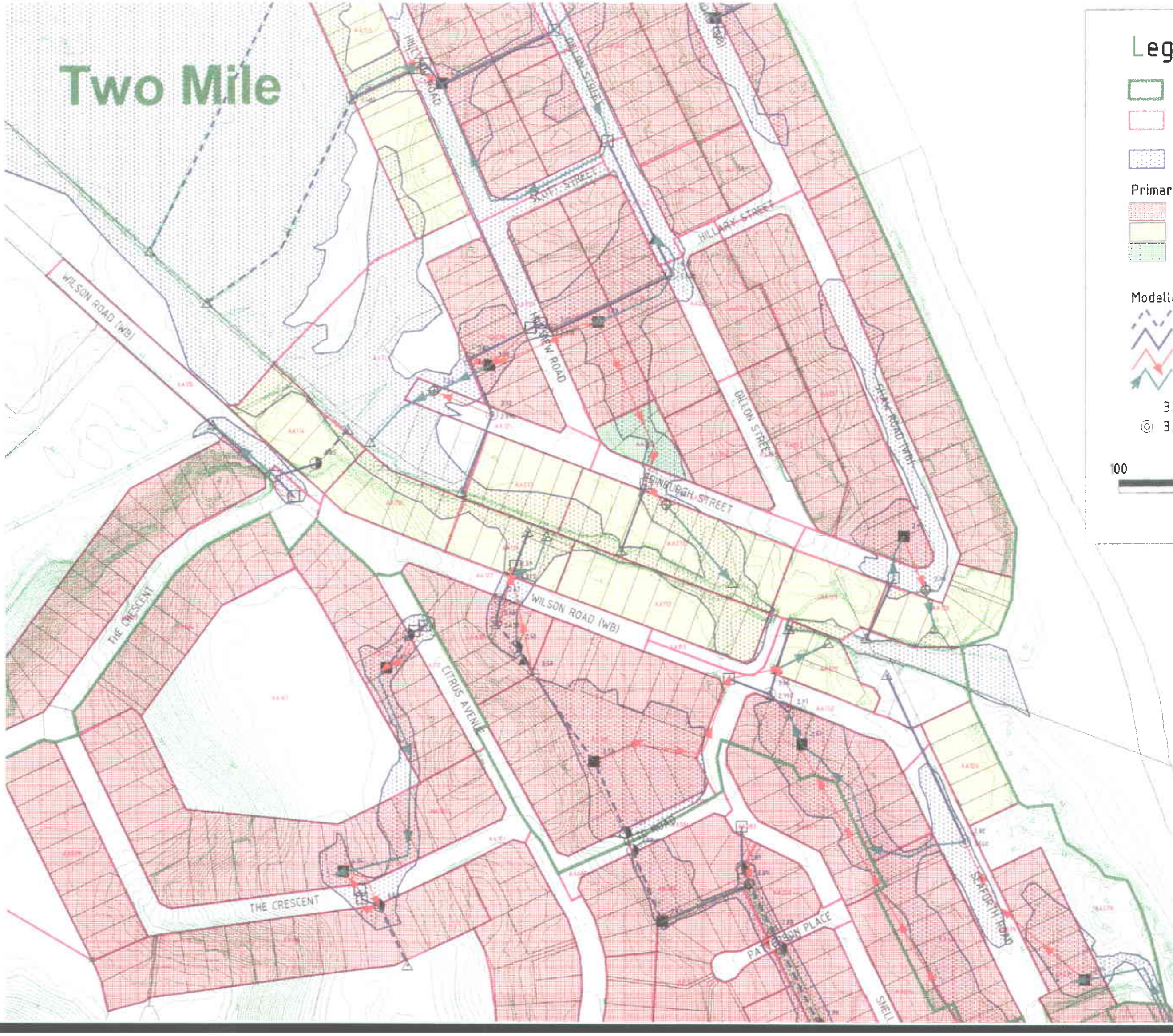

Wallnutt
Two Mile
LEO STREET
BROWNS DRIVE
BEACH ROAD (WB)
DILLON STREET
PARK AVENUE
SHAW ROAD (WB)
ELIZABETH STREET
SCOTT STREET
HILLARY STREET
WILSON ROAD (WB)
EDINBURGH STREET

Western Bay of Plenty District Council
Waihi Beach Stormwater Modelling

Maximum Probable Development

Predicted Flood Hazard - Sheet 2 of 3

TONKIN & TAYLOR LTD ENVIRONMENTAL & ENGINEERING CONSULTANTS ■ AUCKLAND ☐ WHANGAREI ☐ WELLINGTON ☐ HAMILTON ☐ CHRISTCHURCH ☐ NELSON	DRAWN	DGS 11/2001
	DRAFTING CHECKED	TB 11/2001
	APPROVED	
	APR FILE 19020 apr \ Flood hazard layout	
	Flood Hazard Layout - Issue 2 Sheet 2 of 3	
	PROJECT No. 19020	



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100 0 100 200 Metres

1:2500 at A1 Size


Three Mile N
Three Mile S
ANGUS LANE
SNELL CRESCENT
AYR STREET
THE LOOP
SEAFORTH ROAD

Western Bay of Plenty District Council

Waihi Beach Stormwater Modelling

Maximum Probable Development

Predicted Flood Hazard - Sheet 3 of 3

DRAWN	DGS 11/2001
DRAFTING CHECKED	TB 11/2001
APPROVED	
APR FILE	19020.apr \ Flood hazard layout
	Flood Hazard Layout - Issue 2 Sheet 3 of 3
PROJECT No.	19020

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- ■ AUCKLAND
- □ WELLINGTON
- □ CHRISTCHURCH
- □ WHANGAREI
- □ HAMILTON
- □ NELSON

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1:2500 at A1 Size


Island View
NOTE:
THE EXTENT OF 2% AEP FLOODING
SHOWN IN ISLAND VIEW IS BASED
ON A PROPOSED UPGRADE OF THE
STORMWATER NETWORK IN THIS AREA
THE PRIMARY SYSTEM CAPACITY
CLASSIFICATION IS BASED ON THE
EXISTING NETWORK
BROADWAY ROAD
MARLIN AVENUE
SEAFORTH ROAD
DOLPHIN AVENUE
WAITI AVENUE
ALBACORE AVENUE