CLAYTON UTZ

Brisbane City Council

BCC

Queensland Floods Commission Inquiry

Inquiry

Statement of Martin James Reason

- 1 September 2011

Volume 2 of 2

CLAYTON UTZ – BRISBANE CITY COUNCIL
REQUIREMENT # 1675984
STATEMENT OF MARTIN JAMES REASON SM#1699801
Attach# 1699829;1699834;1699810 File 540236/1
Volume 2 OF 2 ORIGINAL

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JM

QFCI

Date: 20/09/11

Exhibit Number: 544

Statement of Martin James Reason

I, Martin James Reason, Acting Manager of City Planning & Economic Development, Brisbane City Council, of 266 George Street, Brisbane, in the State of Queensland, state on oath as follows:

A. Attachment **MJR-1** is a copy of a notice from the Commissioner of the Queensland Floods Commission of Inquiry (**Commission**) dated 10 August 2011 requiring me to provide certain information to the Commission in the form of a statement by 1 September 2011 (**Notice**). This Statement is provided in response to the Notice.

B. For the purposes of responding to the Notice and preparing this Statement I have, in my position as Acting Manager of City Planning & Economic Development Branch of the Brisbane City Council (**Council**), had access to:

(a) the business records of Council; and

(b) Council officers,

to obtain information to provide a response to the Notice. Unless otherwise stated, the matters set out in this Statement are based on my own knowledge and the information derived from the above sources.

C. The documents from the above sources and attached to this Statement have been collated by Council officers under my instruction.

D. I set out below my responses to each of the questions set out in the Notice.

Qualifications and Background

1. My qualifications include a Bachelor of Regional Town Planning from the University of Queensland.

2. I have been a qualified Town Planner for sixteen years.

3. I hold the position of Acting Manager of City Planning & Economic Development. The Manager of City Planning and Economic Development, [redacted] is currently on leave overseas. I ordinarily hold the position of Principal, Strategic Infrastructure Planning and have held that position [redacted]nce January 2010. As at May 2011, I also became the Principal, Urban Design.

[redacted]

Martin James Re[redacted]

LOCAL CODE CONTENT

9.3.x Flood Hazard Overlay code

9.3.1.1 Application

This code applies to assessing
• material change of use where located within the Flood Hazard Overlay and:
- not contained entirely under the roofline of an existing building, or
- involving land disturbing development, or
- involving an increase in floor area located on floodable land, or
(except where assessable only against the Standard Building Regulation)
• reconfiguring a lot where located within the Flood Hazard Overlay and :
- involving land disturbing development, or
- located on floodable land
• operational works or building works where located within the Flood Hazard Overlay and:
- involving land disturbing development, or
- involving the creation of additional impervious surfaces, or
- located on floodable land

→ confirm this picks up filling.
→ would involve, as an intrinsic element of the development proposal, to **building** or other **work (except where assessable only against the Standard Building Regulation)** that involves any physical alteration to a watercourse or floodway including vegetation clearing29, or involves net filling exceeding 50 cubic metres;
→ ERAs
→ Storm tide areas (this code or separate code?)

When using this code, reference should be made to section 1.5 and where applicable section 1.6 located in Part 1-About the planning scheme.

When this code is referred to in a table of assessment in Part 5:
(1) Part <A> of the code applies only to self-assessable development;
(2) Part <B> of the code applies only to development requiring compliance assessment;
(3) Part <C> of the code applies only to assessable development.

When this code is listed in a table of assessment as assessment criteria, it is to be read as if the following codes also form part of this code. The following codes will form assessment criteria where their purpose is applicable to the proposal:
- *list all secondary codes currently in 'Using this code section', add the new code names if known in square brackets*
- Biodiversity [Biodiversity]
- Landscaping [Landscaping]
- Acid sulphate soil [Potential and actual acid sulphate soils]
- Gas and Oil Pipeline [Regional infrastructure corridors and substations]
- Services works and infrastructure [Services works and infrastructure]
- Stormwater management [Stormwater management]
- Transport, access, parking and servicing [Transport, access, parking and servicing]
- Waste water management [Waste water management]
- Waterway [Waterway]
- Wetland [Wetland]

insert other notes here

9.3.1.2 Purpose

The purpose of the Flood Hazard Overlay code is to:

(a) Ensure development in flood hazard areas does not cause (directly or cumulatively), or increase the risks or hazards associated with flooding.
(b) Ensure development is compatible with the nature of the hazard...
(c) Minimise as far as practicable the adverse impacts from natural hazards
(d) Ensure development does not result in an unacceptable risk to people or property.
(e) Create a flood resilient development pattern and building form within the floodplain.

Something about principles of floodplain risk management : risk management approach to x types of development.

The purpose of the Flood Hazard Overlay code will be achieved through the following overall outcomes:

(1) Development maintains or improves the safety of people from flood hazard
(2) Ensure development minimises damage to property
(3) Essential community services remain functional during and immediately after food events.
(4) Development does not cause or have the cumulative potential to cause, an adverse impact on other properties or to use land within the floodplain.
(5) Development provides for efficient flood recovery in that it reduces or manages the extent of disturbance to residents, businesses infrastructure?? and public facilities.
(6) Public safety and the environment are not adversely impacted by the impacts of flood water on hazardous materials manufactured or stored in bulk (SPP 4)
(7) New development within floodplains does not significantly burden the City's counter disaster response efforts during a flood emergency.

9.3.1.3 Assessment criteria

Part A – Self-assessable development criteria

<insert the following table or 'There are no self-assessable criteria for this code.'>

Flood Hazard Overlay code table x(A) – for self-assessable development

Self-assessable outcomes	
<subheading eg Where in Precinct x - xxx>	
SO1	
SO1	
<subheading>	
SO1	
SO1	

Part B – Development requiring compliance assessment criteria

<insert the following table or 'There are no compliance assessment criteria for this code.'>

Very unlikely you will be putting anything in here until city-wide decisions made on how/when compliance assessment will be used

Flood Hazard Overlay code table x(B) – for development requiring compliance assessment

Compliance outcomes
<subheading>

CO1	
CO1	
<subheading>	
CO1	
CO1	

Part C – Assessable development criteria

<insert the following table or 'There are no general assessment criteria for this code.'>

Flood Hazard Overlay code table x(C) – for assessable development only

Topics to cover:
Risk/safety
Flood Immunity
Property
Location of development
Essential building services
Critical infrastructure
Emergency response
Access, traffic, emergency access and egress, evacuation routesw
Hazardous materials stored in bulk (plus pollution)
Stormwater management
Don't impact on other properties.
Cumulative impact
Overland flow.
Flood storage

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SAFETY & RISK

Xxx	Safety of people, including evacuation in flood events Risk/safety		
	P2 Development does not pose or increase the risk to life from flooding, taking into consideration the following for all flood events: • Shortening of flood warning times • Number of people likely to need evacuation • Impact on the availability of traffic use and evacuation routes • Additional burden placed on Council's resources or emergency services This list from SPP o Accounts for the extent and severity of flood hazard (including depth, velocity, rate of rise of flood water and effective warning time, duration of flooding) o Accounts for the increase in population resident on the site o Vulnerability of the use. o Accounts for ease of evacuation based on the number and vulnerability of the population to be evacuated o Functionality of evacuation routes in events up to and including the DFE for relevant flood types. o The type of use o Impact on the availability of traffic use and evacuation routes o Availability of passable evacuation routes to xxx(eg. arterial road) for evacuation considering the size of the flood event.		Where in a high flood hazard area: • Development does not intensify population within high hazard waterway flooding areas. Where in a low flood hazard area, .;.. {BECAUSE WE CANNOT BE SPECIFIC AS FOR SOME DEVELOPMENTS IT WILL NOT BE AN ISSUE} **→ possible inclusions, from SPP 1/03code** 1.4 ***For non-residential development and development involving temporary or moveable residential structures (e.g. caravan parks and camping grounds):*** **b)** there is at least one evacuation route that remains passable for emergency evacuations during all floods up to and including the DFE; **or** **c)** the premises are located in an area where there is sufficient flood warning time to enable safe evacuation; **or** **d)** a safe refuge is available for people within the development site.
	- Emergency response **- ability to get out...refuge vs. access** **? vertical evacuation?** {FLOOD EVACUATION}		
Flood Planning Requirements			
	P4 Development provides an acceptable flood immunity for its purpose that protects people, minimises property damage and implements best floodplain management practices		**AX.X** Development in areas within the flood hazard overlay occurs in accordance with Table XX1, Compatible Landuses for flood hazard.

	* Unpack this, or build up the Acceptable solutions		
	PX Development levels for buildings [???and incidental works???] respond to the nature of the hazard and protect people and property.		**A4.1** Flood immunity requirements for buildings and incidental works are in accordance with Tables 1.2 and 1.3 – habitable and non habitable floor levels. AX.X Other requirements.
	PX Land use and development is compatible with the nature of the relative hazard at higher events greater than the DFE		AX.X Development in areas within the flood hazard overlay occurs in accordance with Table XX2, Additional Requirements for Flood Hazard in events above DFE.
→ miscellaneous extra elements – for consideration			
	Intensification of development Development or redevelopment in established areas achieves acceptable safety and amenity outcomes Intensification of development does not occur in floodprone areas if the flood hazard is not acceptable → definition of acceptable flood hazard and what it considers. → what would make it acceptable (extent of mitigation) → refer to our table – not in a high or medium hazard area, AND/OR not meeting XXX requirement.		The lot has the required immunity or Flood hazard for new development is avoided and/ or eliminated by filling (where permitted) and siting of all elements of the development, including site access. → does this apply only where infill? Or only for risk approach? Or other? → about how hazard can be calculated. → write up our warning and evacuation time assumptions etc as a description of the hazard… → requirements for eg. on the site…
	redevelopment or new development on existing sites or extensions to existing residential/ accommodation uses **achieves risk mitigation through through siting and site design, building scale, design, construction and materials used.** Development is located, designed and constructed so that there is no risk of a dwelling being made structurally unsound or unfit for habitation in any flood event up to or including the defined flood event for all types of flooding affecting the site, accounting for climate change.		

Table XX1 Compatible Landuses for flood hazard

→ similar to Gold Coast method list by exception

Possible layouts of matrices for tables.

Residential Uses						
✓ denotes acceptable degree of hazard						
*** denotes where risk mitigation will be considered in accordance with xxxxx.**						
Use	Type of flooding	Nil	VL	L	H	VH
	River					
	Creek					
	Stormtide					
	River					
	Creek					
	Stormtide					
	River					
	Creek					
	Stormtide					

OR

Residential Uses					
✓ - acceptable degree of hazard					
*** - where risk mitigation will be considered in accordance with xxxxx.**					
River	Nil	VL	L	H	VH
House, xxx,xxx,xxx					
Creek/Waterway	Nil	VL	L	H	VH
House, xxx,xxx,xxx					
Storm Tide	Nil	Low		High	
House, xxx,xxx,xxx					

OR

Residential Uses				
Level of Acceptable Hazard		Creek/Waterway Flooding	River Flooding	Storm Tide
	No acceptable degree of hazard	List uses in here.		
	Very Low			
	Low			
	High			
	Very High			

TABLE A1.2
CATEGORIES OF FLOOD IMMUNITY LEVELS

Flooding type (Note 1)	**Minimum design floor or pavement levels (mAHD)** (Note 4) (Refer Table A1.3 for assignment of these categories)				
	Category A	**Category B**	**Category C**	**Category D**	**Category E**
Brisbane River	DFL + 0.5m	DFL + 0.3m	DFL	20y ARI	20y ARI
Waterway[A]	100y ARI + 0.5m	100y ARI + 0.3m	100y ARI	100y ARI	20y ARI
Local flooding[B]	50y ARI + 0.5m	50y ARI + 0.3m	50y ARI	50y ARI	20y ARI
Storm tide	100y ARI + 0.5m	100y ARI + 0.3m	100y ARI	50y ARI	50y ARI

NOTES:

1. Where the site is subject to more than one type of flooding (ie local flooding and/or waterway flooding and/or river flooding and/or storm tide), the minimum flood immunity level is the highest level determined from these sources. It should be noted that the flood immunity level in some older inner city areas is often controlled by local ponding.
2. If no flood levels are available from Council's Floodwise Property Report for a site (often the case with local flooding), the applicant should engage a suitably qualified Registered Professional Engineer in Queensland (RPEQ) to undertake appropriate hydrologic and hydraulic assessments to estimate a flood level.

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A A waterway (including those indicated on the Planning Scheme Maps) is defined as any element of a river, creek, stream, gully or drainage channel, including the bed and banks typically with a catchment area greater than 30 hectares.

B Local flooding usually occurs when the capacity of the underground piped drainage system is exceeded and/or when the overland flow path is blocked. Localised overland flow paths generally traverse along roadways and in the older established areas, through private properties within existing low points and gullies. A localised overland flow path is not characterised by well-defined bed and banks and the contributing catchment is generally less than 30 hectares.

Table XX1 Compatible Landuses for flood hazard
Maximum hazard level for new development

Residential Uses
✓ denotes acceptable degree of hazard *** denotes where risk mitigation will be considered in accordance with xxxxx.**

Use	Type of flooding	Nil	VL	L	H	VH
Re development of existing lots in residential areas.	River		Site level for all new areas			
	P1					
	P2					
	P3					
	P4					
	P5		Type of House:			
	Creek					
	Stormtide		Medium		High	

Use	Type of flooding	Nil	VL	L	H	VH
	River	All new residential areas.	Dwelling House Dual Occupancy MUD 3Storey			
	Creek		Dwelling House Dual Occupancy			
	Stormtide		Medium		High	

Sample for how matrix might work...

Use	Type of flooding	Nil	VL	L	H	VH
Commercial Uses * denotes risk management approach required.	River		Shop Shopping Centre Food & Drink Outlet Office Hardware & Trade Supplies Agricultural Supplies Store Animal Keeping	Function Facility Nightclub Outdoor Sales Showroom Sales Office Shop* Shopping Centre* Food & Drink Outlet* Office* Agricultural Supplies Store* Hardware & Trade Supplies* Animal Keeping* Car Park* Car Park (ancilliary)	Garden Centre Market (temporary) Roadside stalls Function Facility* Food & Drink Outlet* Nightclub* Office* Outdoor Sales* Sales Office* Car Park* Car Park (ancilliary)	Market* Garden Centre* Bulk Landscape Supplies Wholesale Nursery
	Creek		Shop Shopping Centre Food & Drink Outlet Market Office Agricultural Supplies Store Hardware & Trade Supplies Animal Keeping Car Park (ancilliary)	Garden Centre Hardware & Trade Supplies Outdoor Sales Showroom Sales Office Shop* Shopping Centre* Food & Drink Outlet* Market* Theatre* Office* Agricultural Supplies Store* Animal Keeping* Car Park*	Bulk Landscape Supplies Roadside stalls Garden Centre* Outdoor Sales*	Bulk Landscape Supplies* Wholesale Nursery*

	Storm tide		Medium		High	

Use	Type of flooding	Nil	VL	L	H	VH
Community Uses	River		Child Care Centre Community Care Centre Educational establishment (primary or secondary)	To be filled out according to agreed matrices.		
	Creek		Child Care Centre Community Care Centre Educational establishment (primary or secondary)			
	Stormtide		Medium		High	

OR

Residential Uses **✓- acceptable degree of hazard** *** - where risk mitigation will be considered in accordance with xxxxx.**					
River	Nil	VL	L	H	VH
Creek/Waterway	Nil	VL	L	H	VH
House, xxx,xxx,xxx					
Storm Tide	Nil	Low		High	
House, xxx,xxx,xxx					

Table X2 Landuse and Built Form Compatibility Requirements for Larger Events
→ need to establish our version of the precincts.

Brisbane River Flooding Sorry, haven't reworded this yet.	
Land use	Proposed provisions for larger events
Subdivision	Where in Brisbane River Corridor Precinct 1: • No subdivision within the area affected by the DFE for Brisbane River Flooding • No subdivision in areas which are High hazard or Very High Hazard areas in a 500 year ARI event, considering the depth critieria noted above (ie. 2.5m to 5m deep; and greater than 5m deep in the 500 year ARI event).
Intensification of residential land uses (increases in number of dwellings, eg. multi-unit dwellings).	City-wide???? Or Precinct 1??? • No intensification of residential development in areas which are High hazard (2.5-5m deep) or Very High Hazard areas (greater than 5m deep) in a 500 year ARI event. • Buildings to use resilient building form for one storey above the required floor level.
Additional requirements for 2-3 storey multi-unit dwellings	• No 2-3 storey multi-unit dwellings in Low hazard area for river flooding at DFE • Buildings to use resilient building form for one storey above the required floor level.
Commercial uses.	Built form requirements only essential services and fire control services located above xx level.
Any other uses: eg. high risk facilties (aged care, correctional, etc).	

Creek Flooding Sorry, haven't reworded this yet.	
Land use	Requirements for larger events
Subdivision	• Supported in low hazard areas. [confirm, this is at DFE or xxx ARI event] ???
Intensification of residential land uses (increases in number of dwellings, eg. multi-unit dwellings).	• Supported in low hazard areas.
Additional requirements for 2-3 storey multi-unit	• Per land use compatibility with hazard, supported in low hazard areas. • → are we still thinking about this?

dwellings	
Commercial uses.	
Other uses, eg. aged care/high risk uses.	
??? ERAs???	

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TABLE A1.3

ASSIGNED FLOOD IMMUNITY LEVELS

BCA building classification*	Development Types and Design Levels Assigned design floor or pavement levels	Category Refer to Table 1.2 Categories of flood immunity levels for applicable immunity
Class 1-4	Habitable room*:	Category A
	Non-habitable room including patio and courtyard	Category B except for Class 1a building where the 50y ARI + 0.3m applies to Brisbane River
	Non-habitable part of a Class 2 or Class 3 building excluding the essential services@ control room:	Risk management approach to Brisbane River flooding (refer Section 4) is permitted
	Parking located in the building undercroft of a multi-unit dwelling	**Category C**
	Carport 1, unroofed carpark, Vehicular manoeuvring areas	**Category D**
	Essential electrical services@ of a Class 2 or Class 3 building only	**Category A(4)**
	Basement parking entry #	**Category C + 300mm**
Class 5, **Class 6,** **Class 8**	Building floor level:	Category C Risk management approach to Brisbane River flooding is permitted
	Garage or carpark located in the building undercroft#:	Category C
	Carport[1] or unroofed carpark:	Category D
	Vehicular access and manoeuvring areas:	Category D
	Essential electrical services @	Class 8 – Category C(4) Class 5 &6 – Category A(4)
Class 7a	Refer to the relevant building class specified in this table	
Class 7b	Building floor level:	Category C Risk management approach to Brisbane River flooding is permitted
	Vehicular access and manoeuvring areas	Category D
	Essential electrical services @	Category C
Class 9 Need to introduce exceptions, eg. for aged care &	Building floor level:	Category A
	Garage or carpark located in the building undercroft#:	Category C

scale, or possible high risk use criteria	Carport[1] or unroofed carpark:	Category D
	Vehicular access and manoeuvring areas: → do we need a trigger here for essential services, see note 3 with class 9 mention	Category D
Class 10a	Carparking facility	Refer to the relevant building class specified in this table
	Shed[1] or the like:	Category D
Class 10b	Swimming pool:	Category E
	Associated mechanical and electrical pool equipment:	Category C
	Other structures:	Flood immunity standard does not apply

* Refer Section xxxx for definitions. (BCA)
@ Essential services include any room used for fire control panel, telephone PABX, sensitive substation equipment including transformers, low voltage switch gear, high voltage switch gear, battery chargers, protection control and communication equipment, low voltage cables, high voltage cables, and lift controls etc.

Basement carparks must be suitably waterproofed and all air vents, air conditioning ducts, pedestrian access and entry/exit ramps at the carpark entrance have flood immunity in accordance with this table.

1. A shelter for a motor vehicle, which has a roof and one or more open sides, and which can be built against the side of a building.

2. A slight or rough structure built for shelter and storage; or a large strongly built structure, often open at the sides or end.

3. where a building includes a combination of uses that includes a component of classes 2,3 or 9, the essential services for that building shall comply with the requirements of the building class with the greatest flood immunity requirement.

4. Where essential services are proposed in a basement below the specified flood immunity level in Table 5 as part of a risk management approach to Brisbane River flooding or Creek/waterway flooding, the flood immunity of all air vents, air conditioning ducts, pedestrian access, lift shafts and entry/exit ramps at the basement entrance and any other openings into that basement must conform to Category A for Residential development, and the relevant basement entry level of all other uses. This will require a fully watertight basement design to prevent floodwaters entering the basement to ensure flood immunity.

[1] A slight or rough structure built for shelter and storage; or a large strongly built structure, often open at the sides or end.

Performance outcomes		Acceptable outcomes	
Xxx Risk Management			
	Where a risk management approach is indicated in Table Xx, PXX A risk management assessment is provided demonstrating: - building materials are constructed of flood compatible materials to XX level. - xxx - xxx.		→ check this against the new ABCB draft standard for what we can include.
Xxx Resilient building form and mitigation measures			
	P5 Development does not result in buildings, their foundations, or structures being subject to high hazard flood conditions. {FLOOD HAZARD – BUILDINGS & RESIDENTS}		**A5.1** Development is located outside of any high hazard flood area for waterway and local flooding sources **A5.3** Structures in floodplains are designed and constructed to resist hydrostatic and hydrodynamic forces as a result of inundation or relevant Australian Standard (whichever is the greater)
	Other specific mitigation things we need to include, eg. for specific uses.		
Xxx Specific land uses - community			
	P6 Ensure any private open space and public spaces (excluding sport & recreation areas) that are encouraging community use are not subject to high hazard flood conditions or result in poor amenity. {FLOOD HAZARD – COMMUNITY} GAB		**A6.1** Any private open space or publically accessible areas are not subject to high hazard flood areas **A6.2** All private open space areas meet the appropriate flood immunity standard in accordance with Councils **Subdivision and Development Guidelines**

SUBDIVISION

Extra stuff to address: from [redacted]

I found why our Moggill Weekes Rd example was confusing - there are no QPP definitions for subdivision - this needs to be included in hazard matrix as it relates to intensification of use, where it is currently characterised by a House. This is where the precincts would kick in I guess.

Some issues I have been dealing with in river flooding that your code needs to address:

Issue 1

1 into 2 subdivisions in Chelmer, where land levels are 4.5-6m AHD and flood level was around 9 m AHD (high hazard). We should not be intensifying these high hazard areas, particularly when the only solution is to create a "small lot". Currently we would have to approve these as they can show that they could still reasonably construct a house to house code by having non-habitable ground level.

Solution - Dont allow subdivision in high hazard areas of River, or at least don't allow them to create "small lots" as given the building height issues and narrow frontage.

Because subdivision is not in QPP you need to state in code I guess.

Issue 2

Dont allow reconfigure of boundaries (eg 2 into 2) where new lot would be placed into a worse flood hazard category, or have reduced flood immunity of existing road access.

This is all consistent with existing City Plan intents regarding intensifying flood plains, but focuses more on the nasty bits (high hazard).

Cheers,

[redacted]

Reconfiguration of lots in flood affected areas.			
	All new residential lots are safe, provide suitable amenity, allow future dwellings of any form to be constructed to flood immunity standards and are not unnecessarily burdened by stormwater easements		A X.1 Any flood affected part of the lot is not impacted by high hazard flood conditions (velocity x depth product >0.6 m2/s) and not located in a high hazard overlay for Waterway/Creek flooding.

	or infrastructure Is this for all lots?		
	In infill residential subdivisions, P1 Lots are provided with an appropriate area and dimensions for the siting and construction of buildings, provision of outdoor space, convenient vehicle access and parking. P2 Boundary realignments that do not create a new lot (eg 2 into 2 subdivisions) must improve the hazard, flood immunity and amenity of the new lots, including from overland flow (?).		For infill residential subdivisions, ie. creating 6 lots or less where partly or fully surrounded by developed sites and: • there is no dedication and opening of a road • site area is less than 2,500 m2 in an area with existing road frontage A X.1 Any new infill residential lot created must have 300 m2 or 60% (whichever is greater) consolidated area that meets Council's flood immunity standard as specified in Table A1.1. This area must consider statutory setback requirements. Despite Table A1.1, lots are filled to a minimum of the 20 year ARI fill level where infill subdivision is • affected only by flooding from the Brisbane River, and • where a house on all new lots could reasonably be constructed to comply with [Table Axxx, plus other provisions, specify] and height limitations in City Plan,. ??? Only houses? (??? Any freeboard?). ← is this broader than subdivision: does it need to be on its own, eg. to pick up redevelopment of existing houses??? AX.2 Development does not realign boundaries in a manner that would create a lot within an existing overland flow path or other high hazard flooding area. ?? can we clarify this? Eg. Partially within etc. AX.3 anything else to meet P2...eg. no square corners etc. as discussed?
	For residential and/or industry subdivisions (freehold lots or community title scheme) where there is dedication and opening of road or where the subdivision creates more than 6 lots: PO X New lots achieve a level of flood immunity which: • Reflects best practice... • Is Safe for people and structures		For a residential and/or industry subdivisions (freehold lots or community title scheme) where there is dedication and opening of road or where the subdivision creates more than 6 lots: AX.1 design lot levels comply with Table A1.1. AX.2 anything else we need to say?

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	on site... • .... (does not rely on xxxx to protect people and property...) • provides unburdened building areas for new buildings The flood immunity standards are assigned to eliminate the creation of new lots below the desired flood immunity level and provide unburdened building areas for new buildings.		
			What about Commercial? Mixed use? SOME DIFFERENCES AS OFTEN IT IS NOT WORTH FILLING A LOT WHEN THEY WILL DIG IT OUT AND BUILD A BASEMENT! → Do we need any provisions for them then, or are we OK?
	In residential subdivisions involving the creation of a new road, the location of overland flow paths achieve: • ensures all new lots are unaffected by overland flows • stormwater is conveyed safely through the subdivision during major flooding with regard to its location and hazard → insert overland flow path definition • [clarify if this is ALL residential subdivisions] • Can this merge with previous? no becuase prior is about lot sizing this is about safety of flowpaths in big subdivisions.		In residential subdivisions involving the creation of a new road: AX.1 Overland flow paths are located in roadways, parks, creeks or pathways and are not located within private allotments AX.2 When overland flow within the road reserve is directed into pedestrian pathways, calculations are provided that demonstrate that overland flow does not enter the adjacent blocks during the 50 year ARI Storm. AX.3 Overland flow paths, excluding designated channels and waterways, which are modified to suit the development achieve a 50 year ARI depth* velocity product that is ≤0.6 m2/s. *Note for designated channels: channels usually have clearly defined bed and banks and service catchments larger than 30 ha*

RECONFIGURATION OF LOT (SUBDIVISION)

TABLE A1.1
FLOOD PLANNING LEVELS FOR SUBDIVISION

Flooding type (Note 1)	**Minimum lot levels (mAHD)** (Note 2)	
	Residential	**Other than residential**
Brisbane River	DFL + 0.3m (Note 3)	DFL

Waterway[A]	100y ARI + 0.3m	100y ARI
Local flooding[B]	50y ARI + 0.3m	50y ARI
Storm tide	100y ARI + 0.3m	100y ARI

NOTES:

3. Where the site is subject to more than one type of flooding (ie local flooding and/or waterway flooding and/or river flooding and/or storm tide), the minimum flood immunity level is the highest level determined from these sources. It should be noted that the flood immunity level in some older inner city areas is often controlled by local ponding.
4. If no flood levels are available from Council's Floodwise Property Report for a site (often the case with local flooding), the applicant should engage a suitably qualified Registered Professional Engineer in Queensland (RPEQ) to undertake appropriate hydrologic and hydraulic assessments to estimate a flood level.

DRAFT

A A waterway (including those indicated on the Planning Scheme Maps) is defined as any element of a river, creek, stream, gully or drainage channel, including the bed and banks typically with a catchment area greater than 30 hectares.

B Local flooding usually occurs when the capacity of the underground piped drainage system is exceeded and/or when the overland flow path is blocked. Localised overland flow paths generally traverse along roadways and in the older established areas, through private properties within existing low points and gullies. A localised overland flow path is not characterised by well-defined bed and banks and the contributing catchment is generally less than 30 hectares.

ACCESS AND EVACUATION

Site Access and Evacuation			
	{SAFE ACCESS} **P8** Access points to any development provide for the safety of people and vehicles		**A8** Driveways are not affected by high hazard flood conditions for Waterway and/or local flooding sources
	{FLOOD IMMUNITY - PARKING} **P7** Development design (including any carparking areas) reduces property damage, provides flood immune access to the property and, where applicable ensures the safety of all people by ensuring that the development levels are set above the relevant design flood level or storm surge level •		AX.X (7?) Vehicular accommodation and access area for uncovered short term car parking bays or unenclosed car parking is • A maximum depth of 200mm in a 50 year ARI flood, • Not flooded more frequently than a 10 year ARI flood, • In an area subject only to low flood hazard. **A7** All other development (including ancillary structures and carparking areas) is located at or above the minimum flood immunity levels in accordance with Tables XXX and XXXX. *Note: compliance with this acceptable solution can be demonstrated by the submission of a hydraulic and hydrology report identifying flood levels and development design levels*
	3.1 NEW ROADS - FLOOD IMMUNITY All new dedicated or internal roads created in any subdivision achieve an acceptable level of flood immunity		AX.X All new dedicated or internal roads within any subdivision (freehold lots or community title scheme) comply with the minimum levels specified in Table A1.5. OR AX.X For Brisbane River Flooding only, flood immunity no worse than the surrounding roads.
	P9 New bridges and culverts are to minimise traffic disruption, allow for emergency access and ensure safety of all people during floods. {ROAD INFRASTRUCTURE}		**A9.1** Road flood immunity and flood free access is provided in accordance with Council's **Subdivision and Development Guidelines** **A9.2** The bridge &/or culvert design achieves best practice with regard to design, maintenance and serviceability standards.
	CYCLIST AND PEDESTRIAN FACILITIES Cyclist and pedestrian facilities		AX.X Onroad cyclist and pedestrian facilities comply with the road trafficability standards specified in

DRAFT

	achieve an acceptable level of flood immunity to: • [VERB] Maintenance costs • [amenity] • [viability of the route under normal circumstances]		Section 3: Off road cyclist facilities including those traversing through parks and adjacent to watercourses should generally achieve at least the 2 year ARI flood immunity standard for all flooding sources except the Brisbane River. ← need to be more definitive about this. WIVENHOE PROVIDES 10 YR MITIGATION SO NOT AN ISSUE In the case of Brisbane River and the Moreton Bay area, the design level should be a minimum of 2.1 m AHD. ← is this figure still current? I USED HAT + CLIMIATE CHANGE, WHICH ALSO GIVES APPROX 100 Y STORM TIDE LEVEL WITH NO CLIMATE CHANGE Council approval is required for lesser standards and a flood risk management plan provided. → do we rephrase this into a risk based approach? YES *Note: Where the site is subject to more than one type of flooding sources, the more stringent criteria will apply.*
	Access for emergency services to the site is maintained in all events up to the DFE. Council will also consider other issues such as the number of affected properties and the proposed use of the development. → need to specify development types, eg. new critiera needed for utilities, depots, other things needed in disaster situations.		AX.X The development site has trafficable access from at least one suburban route (or higher category road network) to maintain emergency services access. To meet this requirement, the road network between the development site and the closest suburban or convenience centre demonstrates that: 1. The **time of closure** for the 50 year ARI flood event from all the nominated flooding sources except the Brisbane River does not exceed 6 hours 2. The **Average Annual Time of Closure (AATC)** from all the nominated flooding sources except the Brisbane River does not exceed 2 hours. → clarify vehicle types? ambulance which is a car → At the DFE? Trafficable at what event? For areas affected by Brisbane River Flooding,..

TABLE A1.5
FLOOD IMMUNITY LEVELS FOR NEW ROADS WITHIN A SUBDIVISION

Flooding type [1]	Minimum design levels at crown of road (mAHD) [2]	
	Residential development	Industrial/ commercial development
Brisbane River [3]	Defined Flood Level	20y ARI
Waterway[A]	100y ARI	50y ARI
Local flooding[B]	50y ARI	50y ARI
Storm tide	100y ARI	100y ARI

NOTES:

1. Where the site is subject to more than one type of flooding (ie local flooding and/or waterway flooding and/or river flooding and/or storm tide), the minimum flood immunity level is the highest level determined from these sources. It should be noted that the flood immunity level in some older areas is often controlled by local ponding.--> is this an acceptable solution.
2. If no hydraulic modelling data is available, the applicant should engage a suitably qualified Registered Professional Engineer in Queensland (RPEQ) to undertake appropriate hydrologic and hydraulic assessments.
3. A risk management approach to flood immunity of roads for Brisbane River flooding can be applied. Typically such roads would have a flood immunity no worse than the surrounding roads.

A A waterway (including those indicated on the Planning Scheme Maps) is defined as any element of a river, creek, stream, gully or drainage channel, including the bed and banks typically with a catchment area greater than 30 hectares.

B Local flooding usually occurs when the capacity of the underground piped drainage system is exceeded and/or when the overland flow path is blocked. Localised overland flow paths generally traverse along roadways and in the older established areas, through private properties within existing low points and gullies. A localised overland flow path is not characterised by well-defined bed and banks and the contributing catchment is generally less than 30 hectares.

→ exceptions eg. HI??

→ Any changes to this?

ACCESS TO SUBDIVISIONS - Flood immunity for existing roads (excluding infill subdivision or other development)			
			AX.X The existing dedicated road fronting the subdivision or providing access within 200m of the development complies with the flood immunity standards specified in Table 1.6 In addition, the level of serviceability of the existing dedicated road must also conform to the requirements of Section 3.2

			and consider the flood hazard with respect to safety of vehicles and people. YES

TABLE A1.6
FLOOD IMMUNITY LEVELS FOR EXISTING DEDICATED ROAD PROVIDING ACCESS TO OR FRONTING A DEVELOPMENT

Flooding type [1]	Minimum design levels at crown of road (m AHD) [2]			
	Local access [3]	Neighbourhood access [3]	Industrial access [3]	District access/ suburban route/ arterial route [3]
Brisbane River	20y ARI	50y ARI	20y ARI	50y ARI
Waterway[A]	20y ARI	50y ARI	20y ARI	50y ARI
Local flooding[B]	20y ARI	20y ARI	20y ARI	20y ARI
Storm tide	20y ARI	50y ARI	20y ARI	50y ARI

NOTES:

1. Where the site is subject to more than one type of flooding (ie local flooding and/or waterway flooding and/or river flooding and/or storm tide), the minimum flood immunity level is the highest level determined from these sources. It should be noted that the flood immunity level in some older areas is often controlled by local ponding.
2. If no hydraulic modelling data is available, the applicant should engage a suitably qualified Registered Professional Engineer in Queensland (RPEQ) to undertake appropriate hydrologic and hydraulic assessments.
3. Refer to Chapter 1 of Part B of this document for description of the road hierarchy.

A A waterway (including those indicated on the Planning Scheme Maps) is defined as any element of a river, creek, stream, gully or drainage channel, including the bed and banks typically with a catchment area greater than 30 hectares.

B Local flooding usually occurs when the capacity of the underground piped drainage system is exceeded and/or when the overland flow path is blocked. Localised overland flow paths generally traverse along roadways and in the older established areas, through private properties within existing low points and gullies. A localised overland flow path is not characterised by well-defined bed and banks and the contributing catchment is generally less than 30 hectares.

PROPERTY DAMAGE

Xxx Impacts on surrounding area/sites (cumulative, neighbours etc)			
	P3 The proposed development or site works must not adversely impact on flooding or drainage of properties that are upstream, downstream or adjacent to the development site *{ADVERSE IMPACTS}*		**A3.1** The proposal meets the requirements of Councils ***Developing Floodprone Land PSP*** & ***Subdivision & Development Guidelines*** and does not result in an increase in flood level, flood hazard or flood duration on upstream, downstream or adjacent properties **A3.2** Development or site works do not significantly block constrict or divert waterway or local overland flow paths for all storm events **A3.3** All development or site works are

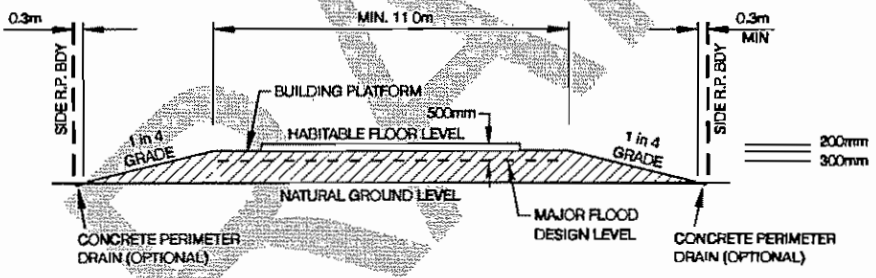
			located outside of a waterway corridor, wetland, natural hazard management area (flood) and overland flow path
	Location of development		
	Essential building services		
	Development must have a lawful point of discharge		

FLOOD STORAGE, FILLING, CUMULATIVE IMPACTS & OVERLAND FLOW

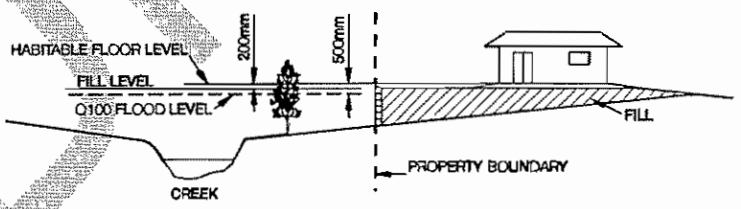
Flood Storage, Filling, Cumulative Impacts			
	P8 Development within waterways and local flooding (overland flow paths) does not adversely affect surrounding properties due to loss of flood storage associated with cumulative impacts of filling, or involve significant redistribution of flood storage from high to lower areas in the floodplain. *Note: this performance criteria does not apply to Brisbane River flooding or Storm Tide.* {FLOOD STORAGE}		**A8.1** No filling is undertaken within the 20 year ARI flood extent of any waterway/creek or Waterway Corridor. **A8.2** Filling of land does not constrict or severely block overland flow paths. **A8.3** Where cumulative loss of flood storage would adversely impact on downstream properties, any earthworks within the floodplain complies with Council's **Compensatory Earthworks Planning Scheme Policy** **A8.4** No filling is undertaken within high hazard overlay areas for Waterway flooding, or within high hazard local flooding (overland flow paths)
	P9 Development retains the hydraulic capacity of existing overland flow paths for all storm events {OVERLAND FLOW FILLING}		**A9.1** No earthworks are undertaken within existing overland flow paths **A9.2** Development does not rely on piped drainage infrastructure to manage major storm events (eg 50 or 100 year ARI flows) **A9.3** Easements for drainage are provided over overland flow paths
	FILLING Any proposed development, especially those involving filling, needs to take account of existing or created overland flow paths and make due provision in the design. *Impacts of filling within areas affected by flooding will need to be assessed by a flood study RPEQ.*		Development is designed, sited and constructed to remove hazard from existing or created overland flow paths. → specify information requirements, or link to PSP which outlines requirements for this.
	LEVEES Design of structural mitigation works to meet flood immunity → intrinsic solution → cannot lead to an increase in damage or danger through being		AO X.1 Development does not utilise levees to satisfy flood immunity requirements.

	breached or overtopped in extreme storms (up to xxxx),		

	Earthworks Filling of land within or fronting the floodplain ensures: 1) Batters are provided with grades suitable to allow safe egress of people 2) The use of retaining walls is minimised		Any earthworks activities adjacent to waterways and overland flow paths must comply with all the provisions of the *Brisbane City Plan* (refer to illustration on Figure A1.1). Where earthworks are adjacent to waterways and overland flow paths (see Figure 1.1 Filling of Land (Batters)) • The building platform is a minimum of 1.1m in width • There is a 1.4 grade (maximum???) from natural ground level to building platform • Major flood design level is xx + ????? 300+200???? AX.X Retaining walls are…whatever diagram is about…



FILLING OF LAND (BATTERS)



FILLING OF LAND (RETAINING WALLS)

FIGURE A1.1

NOTES:

1. Where the neighbouring property is low lying with existing drainage problems Council may require a concrete perimeter drain at the toe of the embankment or retaining wall.
2. The toe of all embankments adjoining public space (eg park, road reserve, etc) should be at least 0.3 m clear of the property alignment. All embankments to neighbouring properties are to be maintainable. In most cases, a batter of 1V in 4H is desirable but steeper landscaped embankments may be considered. Where the property adjoins parkland the batters are to be no steeper than 1V in 6H to allow easy access.
3. Retaining walls instead of the earth batters may be accepted with approval of Development Assessment subject to appropriate landscaping to soften the visual impact of the retaining wall. Refer to Chapter 3 of Part B of this document.

4. Retaining wall structures should conform to the requirements set out in the Building Regulation 2006. In general any retaining walls greater than 1.0 m in height will require a building application and structural certification. Where the combined height of a fence and a wall exceeds 2.0 m, the aforementioned requirements plus the written authorisation from the neighbour will need to be provided with the engineering drawings.

Xxx Overland Flow			
	P10 Any new buildings or structures within existing overland flow paths must be suspended (fully or partially) to prevent diversion of floodwaters, protect structures from flood loads and ensure that the conveyance capacity of any existing overland flow path is not reduced for any storm event. { BONSW}		**A10.1** – Any building or structure suspended (fully or partially) over an overland flow path is provided with the minimum clearance as shown in **Table A##** for the applicable flood standard **A10.2** – Suspended structures and ground level treatments of undercroft areas complies with acceptable solutions shown within the ***Developing Floodprone Land PSP.***
	P01 - Any new buildings within existing overland flow paths must be suspended (fully or partially) to protect structures from flood loads, ensure that the conveyance capacity of any existing overland flow path is not reduced for any storm event and prevent diversion of floodwaters. **?? Is this this same as above?**		A01 – Any building (fully or partially) over a overland flow path is provided with a 1.5 meter minimum clearance from existing ground level to the lowest finished level **?? Is this this same as above?**
	P11 The development provides an open floodway that allows the conveyance of flood flows up to and including the Probable Maximum Flood along a overland flow path or waterway {BONSW}		A4.1 Any suspended building or structure within overland flow path (local flooding) does not fully enclose the flow path A4.2 Statutory boundary requirements are provided to all site boundaries affected by local flooding sources
	For overland flow paths that are not designated channels (channels usually have clearly defined bed and banks) or waterways, the overland flow path may be altered to suit the development provided that the 50y ARI depth*velocity product is ≤0.6 m2/s. Compensatory earthworks must not cause the depth velocity product to exceed 0.6 m2/s nor concentrate flows onto adjacent properties. Flood storage capacity areas below the 50y ARI flood levels must be preserved by matching any filled area with an excavated area of equal volume at the same levels.		

Table A### - Minimum Building Clearances

	Minimum Clearance Requirement(1)

Local Flooding - Low Hazard	Lowest floor level is to be 1.5 meters[2] above highest ground elevation in undercroft area
Local Flooding - High Hazard	Lowest floor level is to be 2.5 meters[2] above highest ground elevation in undercroft area
any Waterway Flooding	Lowest floor level is to be 2.5 meters[2] above highest ground elevation in undercroft area

Notes:

(1) The minimum under-croft only relates to the minimum clearance requirements and not flood immunity levels. Where the flood immunity requirement with freeboard in the Subdivision & Development Guidelines results in a higher finished floor level that higher level needs to be adopted.

(2) This height provides clearance from any beam, slab or slung service and provision for maintenance. It provides 500mm debris clearance and some allowance for extreme floods to replicate the function of an uncovered overland flowpath.

?? How does this relate to the one above??

Overland Flow Flooding (<500mm flood depth only)

	Low Hazard Overland Fow (depth <500mm)
MCU Application	Slab level of 1500 mm above highest ground in undercroft area[1]
House Code	Floor level 1500 mm (min) off highest ground level

Notes:

(3) This height provides for a minimum clearance of 1 m from any beam, slab or slung service for maintenance. It provides 500mm debris clearance, allowance for larger floods and allows for velocity head component. Extreme floods would likely still be conveyed within this undercroft area.

(4) The minimum under-croft only relates to the minimum clearance requirements and not flood immunity levels. Where the flood immunity requirement with freeboard in the Subdivision & Development Guidelines results in a higher finished floor level that higher level needs to be adopted.

High hazard requires 2m clearance (approximately 2.5 m from ground level to allow for slabs, beams and services).

UNDERCROFTS – Reword for PSP??

BUILDING UNDERCROFT REQUIREMENTS			
	P5 Development does not result in buildings, their foundations, or structures being subject to high hazard flood conditions.		**A4.2** Building undercroft requirements are in accordance with Councils ***Developing Floodprone Land PSP***
	PX Development does not result in buildings, their foundations or structures being subject to high hazard flood conditions. Buildings partially spanning overland flow paths (or area affected by waterway flooding) • Do not block or channel in greater events • Are not subject to high hazard in		AX X Where a building is suspended partially or fully over an overland flow path, or areas affected by Waterway flooding, the undercroft area is suitably stabilised. *This may be accomplished by providing a concrete slab, gabion or rock riprap surface treatment.* AX X Rock selection • the size of rock is appropriate for the velocity or shear stress estimated through the site for

	xx sections of the building??? • Provides efficient drainage... • Resists scour • Does not increase flood hazard under the structure • Is appropriate to the risk where there is an obvious likelihood of injury or loss of life. • Conveyance of floodwaters is primarily outside of the undercroft area • Does not create adverse flooding impacts by concentrating flows on down slope properties • Does not create a new low point in the channel • Does not concentrate likelihood of debris loading on building structures • Does not cause high hazard flood conditions under structures where none existed before • Matches existing levels at down-slope boundary (what is concept here?) • Provides sufficient clearance for and does not obstruct flows travelling laterally across flow paths. • Provides for maintenance access and OH&S compliance.		design manning's roughness conditions AX.X **Where high flood hazard conditions exist:** When a building is suspended fully or partially over an overland flow path (or area affected by Waterway Flooding) • a minimum 2m clearance is achieved under the building that is generally free of any obstructions except building piers • undercroft areas are designed in accordance with the developing Floodprone Land PSP **Where Low Flood Hazard exists from overland flow flooding only:** **AX.X** The undercroft is to be the higher of 1500mm from existing ground level to the lowest finished floor level, or the required flood immunity level **AX.X Where for an undercroft with excavation, (see Figure 2,3 & 4):** • Undercroft height is greater than 1.5m at the lowest point from ground level to xxxxx (FFL), or 2m where flow depth is greater than 500mm) • undercroft areas are designed in accordance with the developing Floodprone Land PSP • There is no significant increase in flood hazard under structure (a velocity x depth product of 0.4 m2/s applies to high risk areas where there is an obvious likelihood of injury or loss of life). • development is not built to boundary, and is set back a minimum of 1m (or as required by the hydraulic analysis) so that no part of the flow transition into teh undercroft area is impeded. *Note: See Developing Floodprone Land Planning Scheme Policy for further explanation*

ESSENTIAL SERVICES

** this section needs a lot of compiling: the different SPPs have different lists of essential community infrastructure,

Specific Uses

4.4 ~~Xxx~~ Protection and Operation of Infrastructure & Essential Services Critical infrastructure		
Essential community infrastructure is able to function effectively during and immediately after flood events		Essential community infrastructure, as listed in table X, - meets immunity requirements set out in Table X - other requirements: road access...
P10 Essential electrical services proposed as part of development are located with due regard to flood risks associated with the public safety, function and economic consequences. {ESSENTIAL SERVICES}		**A10** All rooms housing essential electrical services have flood immunity in accordance with Council's **Subdivision and Development Guidelines** **Anything to add to this? Lachlan Carkeet's work?**

The flood immunity standards specified in Table A1.3 are not adequate for community infrastructure[2] and some high risk private development. The *State Planning Policy 1/03: Mitigating the Adverse Impacts of flood, Bushfire and Landslide* (SPP 1/03) requires that these infrastructure have higher levels of flood protection than many other forms of development.

Community infrastructure performs vital response and recovery roles during and immediately after a natural hazard event, or store valuable or irreplaceable items. The recommended flood immunity levels as set out in the *SPP Guideline 1/03* are provided in Table A1.4.

The flood immunity standards specified in Table A1.3 are not adequate for community infrastructure[3] and some high risk private development. The *State Planning Policy 1/03: Mitigating the Adverse Impacts of flood, Bushfire and Landslide* (SPP 1/03) requires that these infrastructure have higher levels of flood protection than many other forms of development. Community infrastructure performs vital response and recovery roles during and immediately after a natural hazard event, or store valuable or irreplaceable items. The recommended flood immunity levels as set out in the *SPP Guideline 1/03* are provided in Table A1.4.

TABLE A1.4

FLOOD IMMUNITY LEVELS FOR COMMUNITY INFRASTRUCTURE

Type of community infrastructure	Recommended flood levels
Emergency services	500y ARI
Emergency shelters	200y ARI
Police facilities	200y ARI
Hospitals and associated facilities	500y ARI
Stores of valuable records or items of historic or cultural significance (eg galleries and libraries)	200y ARI
State-controlled roads Works of an electricity entity not otherwise listed in this table Railway lines, stations and associated facilities Aeronautical facilities Communication network facilities	No specific recommended level but development proponents should ensure that the infrastructure is optimally located and designed to achieve suitable levels of service, having regard to the processes and policies of the administering government agency.
Power stations	500y ARI
Major switch yards	500y ARI
Substations	200y ARI
Sewage treatment plants	DFE
Water treatment plants	200y ARI

1. The following types of community infrastructure provide services vital to the wellbeing of the community:
   - police and emergency services facilities including emergency shelters;
   - hospitals and associated institutions;
   - facilities for the storage of valuable records or items of cultural or historic significance;
   - State-controlled roads;
   - railway lines, stations and associated facilities;
   - aeronautical facilities;
   - communication network facilities;
   - works of an electricity entity under the Electrical Safety Act 2002; and
   - water cycle management infrastructure.

Essential community service infrastructure: emergency services infrastructure, emergency shelters, police facilities, hospitals and associated facilities, stores of valuable records or heritage items, power stations and substations, major switch yards, communications facilities, sewerage treatment plants, water treatment plants and public benefit assets.

Public benefit asset:

a) transport infrastructure described in the definition of community infrastructure in Schedule 2 of the Sustainable Planning Regulation 2009 (excluding wharves, public jetties, ports, port facilities and navigational facilities) and transport infrastructure described in the definition of development infrastructure in Schedule 3 of the Sustainable Planning Act 2009 (excluding ferry terminals)
b) Aeronautical facilities of State significance described in SPP 1/02: Development in the Vicinity of Certain Airports and Aviation Facilities, and associated facilities
c) emergency services facilities
d) domestic gas pipelines
e) operating works under the *Electricity Act 1994*
f) storage, works and administrative facilities associated with the provision or maintenance of the essential community service infrastructure.

*major switch yards
* schools

Table 3-4

Type of infrastructure	Recommended storm-tide event level (RSTEL)
Emergency services *	0.2 % annual exceedance probability (AEP)
Emergency shelters	see reference 1*
Hospitals and associated facilities	0.2 % AEP
Major switch yards and substations *	0.5 % AEP
Police facilities *	0.5 % AEP
Power stations	0.2 % AEP
Sewerage treatment plants*	Storm-tide inundation area
School facilities	0.5 % AEP
Stores of valuable records or items of historic or cultural significance (e.g. galleries and libraries).	0.5 % AEP
Water treatment plants *	0.5 % AEP
• State controlled roads, railway lines, stations and associated facilities • Aeronautical facilities • Works of an electricity entity not otherwise listed in this table • Communication network facilities	No specific recommended storm-tide event level but development proponents should ensure that the infrastructure is optimally located and designed to achieve suitable levels of service, having regard to the processes and policies of the administering government agency.

* The RSTEL applies only to electrical and other equipment that, if damaged by floodwater or debris, would prevent the infrastructure from functioning. This equipment should either be protected from damage or designed to withstand inundation. Also some police and emergency services facilities (e.g. water police and search and rescue operations) are dependent on direct water access. The RSTELs do not apply to these aspects but other operational areas should be located above the RSTEL to the greatest extent feasible.

Reference 1* : Design guidelines for Queensland public cyclone shelter posted at <www.distaster.qld.gov.au>.

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HAZARDOUS GOODS

Xxx Management of hazardous goods		
P11 public safety and the environment are not adversely affected by the detrimental impacts of floodwater on hazardous materials manufactured or stored in bulk proposed as part of development {POLLUTION DURING FLOODS}		Industrial activities listed In Table Xx take place above the Defined Flood Event (DFE) → **do we need more protection for for high hazard uses, eg. Major Hazard Facilities?** OR A11.2 Structures used for the manufacture or storage of hazardous materials in bulk are flood-proofed to prevent the intrusion of floodwaters from a Defined Flood Event (DFE). AND A11.3 ***Note: flood protection levees or pump drainage systems are not acceptable methods to meet the above acceptable solutions.*** → for the nominated ones, do we make them eliminate the flood risk? → do we nominate other requirements, eg. up to higher events where up river?
		A11.1 The manufacture or storage in bulk of hazardous materials takes place above the Defined Flood Event (DFE)

Development Within Waterway Corridors

Building within Waterway Corridors is generally not supported and any development will need to meet the requirements of the Compensatory Earthworks Planning Scheme Policy.

On-site development and impact management.
Off site impact management

Table XX ERAs unsuitable for flood prone areas... (do we want to specify this more?)	
ERA Number	Description
5	Alcohol production
6	Asphalt manufacturing
7	Chemical manufacturing
8	Chemical storage
9	Hydrocarbon gas refining
10	Gas producing
11	Oil refining or processing
12	Plastic product manufacturing
18	Boilermaking or engineering
21	Motor vehicle workshop operation
28	Sugar milling or refining
29	Metal foundry operation
30	Metal smelting and refining
32	Battery manufacturing
36	Pulp or paper manufacturing
38	Surface coating
39	Tanning
40	Textile manufacturing
46	Chemically treating timber
48	Wooden and laminated product manufacturing
49	Boat maintenance or repair
52	Battery recycling
54	Drum and container reconditioning
55	Regulated waste recycling or reprocessing
56	Regulated waste storage
57	Regulated waste transport
58	Regulated waste treatment
60	Waste disposal
61	Waste incineration and thermal treatment
62	Waste transfer station operation
63	Sewage treatment
64	Water treatment

ASSESSMENT TABLES

Preferred format for tables still to be developed
Identify whether being within an overlay or not meeting specific code content is intended to vary the level of assessment and document desired provisions.

MAPPING

List each map title

- *List each legend item*

List all proposed figures

OTHER CONTENT

Recommend any other revisions required to City Plan to align with draft Local / Overlay Code eg update to Strategic Framework, PSPs, zoning etc.
Once approved by CRP, include in Task Transfer Register

City Plan element	Proposed change	Task allocated / actioned
		CAB x / TAB x

OUTSTANDING ISSUES

Identify any matters that have not been able to be resolved / are awaiting outcomes of other studies / all the remaining tasks that need to be undertaken, prior to the content being finalised.
Once approved by CRP, include in Task Transfer Register

Outstanding matter	Awaiting on	Task allocated / actioned
		CAB x / TAB x

Proposed methodology for identifying flood hazard and flood planning for the proposed Flood Hazard Overlay Code.

Version 1: August 2011

1. Introduction

This document outlines the proposed approach and methodology for defining flood hazard areas, determining planning levels, and managing filling within the floodplain in order to inform provisions being developed for the new Brisbane City Plan.

The proposed approach addresses all types of flooding relevant to the Brisbane City Council local government area, namely river, creek/waterway, overland flow, tidal and storm tide flooding.

The purpose of this outline is to allow review and critique of the proposed methodology ahead of further development and finalisation of planning provisions for the new City Plan. Peer review of this methodology will be sought in September 2011.

Peer review of this methodology is being sought to support development of mapping and code provisions ahead of a further intended peer review prior to finalisation of the code.

2. Background

A considerable portion of Brisbane has been built in the floodplain, and is likely to flood in events up to and beyond the DFE.

Queensland Government legislation requires Council to prepare a flood code and associated mapping of flood hazard as part of the development of Brisbane City Council's new planning scheme.

The new flood code is required to comply, as a minimum, with the requirements of the Queensland Government's State Planning Policy 1/03 (SPP 1/03), and the higher level policies of the South East Queensland Regional Plan. In addition to SPP 1/03, the new Queensland Government State Planning Policy for Coastal Protection (SPPCP), which forms part of the Queensland Coastal Plan provides the fundamental requirements for managing Storm Tide Hazard.

The recommendations of a number of recent reviews are also important determinants of the proposed approach to determining hazards for Brisbane. These include:

- The Lord Mayor's Taskforce for Suburban Flooding
- Joint Flood Taskforce Final Report
- Flood Review Board xxxxx.
- Brisbane Flood January 2011 - Independent Review of Brisbane City Council's Response

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Responding to these documents requires an approach better informed by best practice than SPP 1/03, which dates from 2003, and is currently being reviewed.

The proposed approach outlined in this document has been developed in-house between March and August 2011. Development has considered information availability, usefulness and regulatory impacts, and existing policies and land use planning settings. Ability of the approach and method to support a simple to communicate flood code is of high importance.

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3. Purpose and Aims

The aims of the proposed methodology are:

- To identify the extent and severity of flood hazard for river and creek flooding within which additional planning provisions need to be triggered to protect people, infrastructure and property, and to guide strategies mapping. This should:
    - consider multiple flood events beyond the DFE and up to PMF in land use provisions.
    - account for factors raised in SPP 1/03 relevant to landuse, notably depth, velocity, concentration time and duration, and additional risk factors such as warning time and vulnerability.
    - appropriately account for interaction between different types of flooding
- To incorporate climate change assumptions into land use planning provisions.
- To resolve known issues with Council's existing adopted policies and provisions, and move Council provisions towards a best practice approach.
- To enable the creation of a system of mapping that
    - Is straightforward to understand and communicate, and can be understood by members of the public
    - allows for updating as more complete information becomes available.
- To utilise existing Council information to the maximum extent, and allow for easy updates to the new City Plan as improved information becomes available.
- Allow for appropriate mapping and provisions to be completed in draft by mid December 2011, for completion in April 2012.
- To identify interim provisions to address issues with existing policy for managing cumulative impacts from filling that will be effective until more complete information becomes available to facilitate a more detailed response.

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Scope clarification

This proposed methodology focuses on inputs needed to develop generic, city-wide land use planning measures to flood risk management, while recognising that floodplain risk management in Brisbane relies on a combination of mitigation responses, which include disaster/emergency management, flood mitigation work, land use planning and community information and capacity building.

The scope of this methodology specifically includes:

- Identifying methods to respond to flooding from overland flow, creeks/waterways, rivers and storm tide.
- Responding to changes due to climate change in determination and responses to hazards, including increases in storm tide, sea level rise, and rainfall intensity, within project constraints.

This methodology does not include:

- Calculation of impacts from increased peak flows, due to development. This will be determined and incorporated at a later date.
- The complete floodplain risk management analysis and cost/benefit analysis of flood mitigation options, recommended by the Joint Flood Taskforce (although this is primarily used for capital flood mitigation works, not landuse planning)
- Review of Disaster Management, Community Education and mitigation measures (although considers such aspects in determination of hazard).

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Assumptions

The development of this model was based on the following assumptions:

- The updated State Planning Policy will not be released in time for the preparation of the flood code. However, it is expected that the new State Planning Policy will move towards best practice.
- The outcomes of the Queensland Government's Commission of Inquiry due in February 2012 are uncertain, but it is likely that findings will reflect recent best practice.
- Scheduled projects will proceed as planned and budgeted, in particular, the updating of Creek/waterway flood models to 2015.
- A revised Brisbane River Flood Study (and associated actions, as recommended by the Joint Flood Taskforce) will not be available before the completion of the new City Plan.
- Mitigation measures (other than land use planning) will be investigated (separately) for existing developed areas on the floodplain.
- Existing provisions in the Brisbane City Plan 2000 provide an extensive base which flood work can draw on. Review of these provisions and policy settings will be required, but many provisions will remain relevant. Recommendations for changes will be made by exception. (I don't get this, it will be a pretty big rewrite from how I see it?)
- Council's existing flood information can be relied upon to the extent of its intended purpose.
- A risk based approach considers flooding beyond the DFE, and recognises that risk can be mitigated by appropraite landuse, site design and building form.

Constraints on hazard area identification and use

- The timing of the delivery of the NDRM flood component is tied to the progress of the new Brisbane City Plan. Draft Flood provisions are to be completed by December 2011 ahead of the release of the Commission of Inquiry findings. Finalisation of the provisions is to take place after release of the Inquiry findings in February 2012. Finalisation of the provisions is currently scheduled for April 2011. Regardless, the application of flood hazard is not new in Australia and any recommendations about flood hazard should align with existing best practice.
- Work on the flood code is being undertaken in-house, relying on a significant body of existing information and policy for managing flooding in Brisbane.
- Council's planning scheme (which pre-dates the State Planning Policy 1/03) is not technically compliant with existing State Requirements, lacking mapping of flood hazard areas.
- Time and budget does not allow additional flood modelling and/or preparation of new flood models.
- Definition of hazard areas will require endorsement from Council.
- Provisions must satisfy relevant legislation.
- Impacts on development (including Council's resources to process development applications, costs to applicants, and strategic impacts) will be considered as part of evaluation of proposed responses,
- The flood code is being prepared within the context of a wider Council response to flooding in different areas, which includes Disaster Management Planning, Community education and capacity building, mitigation measures for existing areas, and land use planning.
- A balanced approach with other city-wide strategic objectives, recognising social, economic and environmental impacts, will be sought in determining/reviewing land use planning settings.

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- The proposed approach recognises that building siting, construction, design and materials can mitigate flood risk in some locations. The location of an area below the DFE does not necessarily preclude development in that location, however it will affect the type, siting and characteristics of the development which may be considered appropriate.
- Existing approved uses in Brisbane retain existing use rights which cannot be altered through the planning scheme.
- Aus Building Code provisions?

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Approach to river and creek flooding

The minimum requirement of SPP 1/03 is for planning schemes to include "natural hazard management areas" based on a defined flood event within which flood hazard is to be managed, and include provisions to do this.
The minimum standard set in SPP for the DFE for flood hazard is set at the 100 year ARI.

The existing Brisbane City Plan is technically not compliant with SPP 1/03. The City Plan predates the State Planning policy, but while updates have occurred to bring it more in line with the policy, the scheme does not map natural hazard management areas. However, the scheme's planning levels for development (minimum floor levels, road and lot levels) are based upon DFEs set at or above the requirements of SPP 1/03. The scheme has also been updated to reflect State requirements for essential community infrastructure, where greater immunity is required.

In describing the process for planning scheme preparation, the SPP Guidelines refer to Floodplain Management in Australia - best practice principles and guidelines (SCARM 37, 2000), and highlight key principles including identification of hazard based on consideration of factors such as depth and velocity, and consideration of events above the DFE. However these are not mandated in the SPP, except for Essential Community Infrastructure.

Since the adoption of the Brisbane City Plan in 2000, and the State Planning Policy 1/03 in 2003, events, including the January 2011 flood and subsequent studies and reviews have meant that the minimum requirements of these documents have been superseded by calls for an increased Defined Flood Event, and a move to a risk based approach to flood plain management, including consideration of events up to the PMF. Moreover, recent and emerging advice and requirements to account for climate change in planning schemes provides a further imperative to move beyond Council's Q100-centric approach to flood plain management, towards consideration of greater events in planning and allowance for uncertainty in flood level estimation.

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The adoption of the Temporary Local Planning Instrument 01/11 - Brisbane Interim Flood Response in mid 2011 established an increased DFL for floor levels in residential buildings affected by Brisbane River flooding. This is carried forward in the proposed methodology. However, other aspects of flood hazard remain unaddressed. Of particular concern is the current scheme's lack of identification or management of creek flood hazard in areas where potential exists for flood events similar to those recently witnessed in Toowoomba and the Lockyer Valley to occur.

In addition, a changing legislative environment, including an update to the SPP 1/03, currently underway, and the potential findings of the Queensland Government's Commission of Inquiry, makes it advantageous to ensure preparation of provisions for Council's new planning scheme better reflects best practice floodplain

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management. The new planning scheme is to last ten years, with a review at five years.

Preparation of the planning scheme must be completed ahead of numerous, potentially highly influential pieces of information becoming available. These include

- the 2014 review of Australian Rainfall & Runoff, which will supersede the Queensland Government's interim advice (in the Inland Flood Study) on factoring in changes in rainfall intensity due to climate change into flood models
- the new Brisbane River Flood Study
- Updates to Council's waterway/creek models (to a consistent integrated 1D/2D methodology that will allow detail analysis and mapping of flood behaviour).

However, these documents are more related to changes in the methodology used for technical investigations and improvements to existing studies. The code can be structured to allow such information to be readily incorporated when available (eg revised flood levels incorporating increases in rainfall intensity).

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Existing data

Glen and Brany to provide summary of what we have on:

- River
- Creek
- Overland Flow
- Waterway Corridors
- Filling
- Peak Flow

Proposed Approach

The proposed approach covers the following areas:

1) identification of flood hazard areas at the DFE
2) definition of flood planning levels for development levels and other levels as relevant.
3) Consideration of higher floods in terms of flood resilience.
4) Management of cumulative impacts from filling and development.

Description is organised by flood type.

General Assumptions about velocity

The SPP 1/03 Guideline refers to standards and methodologies contained in SCARM, including suggested standards for defining extreme, high, medium and low hazard (Appendix 2). These refer to a variety of criteria including velocity, depth, and duration and concentration/warning/evacuation time as part of the standard.

Existing Council information is not sufficient for the definition of hazard areas with consideration to velocity according to the methodology in the SCARM guideline, or other similar methodologies. In particular, Council does not have sufficient data or models to calculate and map velocity for the vast majority of individual creeks, or the Brisbane River . The update of waterway models, which will occur over the next 4 years, will bring creek/waterway models up to a consistent, 2D format which will allow this analysis.

Within the Brisbane River velocity is not a major issue when compared to flood depth, as apart from within the River banks many existing developed areas are subject to very low velocity backwaters. In addition, the substantial warning time means that people are less likely to be within higher velocity areas as they flood, or can easily move from those areas before velocity becomes significant.

Alternatively creeks/waterways are areas where velocity is more critical. With the absence of detailed information the proposed methodology uses frequency of flooding (eg within the 5 or 10 year ARI flood extent) and the location of deepest flooding (>500 mm of floodwater in the 100 year ARI flood) to approximate locations where velocity (and hazard) is likely to be highest. Alternatively, shallower areas that are not regularly flooded are identified as flood fringe areas.

General Assumptions about warning time

No detailed assumptions are made about warning times based on times to closure of evacuation routes. Brisbane does not have identified evacuation routes. Instead, Council's Disaster Management section respond to emerging circumstances based on an assessment at the time. Assumptions about warning time made in the methodology are based on the type of flooding, and generally assume that river

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flooding has warning time, and that creeks/waterways and overland flow flooding do not have any reliable warning time to reduce the category of flood hazard.

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(What about storm tide assumption on warning time?)

Assumptions about climate change
Climate change assumptions guiding the process are as follows:

Topic	Assumption	From	Status
Sea Level Rise	0.8m by 2100	SEQ Regional Plan	Mandatory minimum
Storm Tide	1.5m above Highest Astronomical Tide (where no detailed study)	SPP for Coastal Protection	Mandatory (from mid 2011 when the SPPCP is enacted)
Rainfall Intensity (for flood studies between 100 and 500 year ARI)	5% increase in rainfall intensity per degree of global warming. + 20C by 2050; + 30C by 2070; and + 40C by 2100.	Qld Government – Inland Flood Study	Advice until new national Rainfall & Runoff figures in 2014

It is proposed to use tidal flooding and Storm Tide inundation levels which comply with the default requirements of the new Queensland Coastal Plan. These assumptions factor in 0.8m of Sea Level Rise and 1.5m above HAT for Storm Tide (which includes 0.8m for SLR). The Queensland government has provided requirements for definition of Storm Tide hazard as above and below 1.0m for high and medium hazard areas respectively.

Storm Tide mapping provided by the Queensland Government, which includes mapping of their calculation of their mandated hazard categories will be used for Storm Tide, in the absence of other information within Council.

Updates to climate change assumptions are expected:

a. In 2014 as revised Australian Rainfall & Runoff figures (for rainfall intensity).
b. With revisions to the State Planning Policy for Coastal Protection following IPCC report releases (for sea level rise and storm tide).

Treatment of rainfall intensity in the new Flood Hazard Code, pending State support, is proposed to include figures from the inland flood study for creeks only where working models exist that conforms to the standard methodology for creek flood studies – incorporated into the DFEs derived for the individual creeks. Updates to the flood code based on newly available river and waterway models will occur regularly after the code is enacted.

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Brisbane River Flooding

The flood hazard overlay is are intended to represent areas where flood hazard may exist, for planning purposes. These areas are not exhaustive.

It is proposed to identify 4 flood hazard areas for the Brisbane River (NB: names of areas may change). The categories are based on flood depth and have been based on implications to building form.

Area	Description
Very High Hazard Area	Deeper than 5m in the January 2011 event or existing Defined Flood Event, whichever is greater. These areas are also likely to be at greater risk during only moderate river flooding (eg 20 year ARI events).
High Hazard Area	2.5m deep at the January 2011 event or existing Defined Flood Event, whichever is greater, to 5m deep in the same event.
Low Hazard Area	January 2011 event or existing Defined Flood Event, whichever is greater, to 2.5m deep in the January 2011 event or existing Defined Flood Event, whichever is greater.
Very Low Hazard Area	Between 2000 year ARI and January 2011 event or existing Defined Flood Event, whichever is greater. OR Located within the 20 year ARI inundation extent. ←did we agree to lose this last one?

The proposed approach to Brisbane River Flooding is characterised by:

- Incorporation of a hazard category above the DFE, allowing the flood hazard overlay to trigger
  - provisions for critical infrastructure (as mandated by the State),
  - mitigation of impacts to a specified higher level, accounting for significant differences in the increase of hazard in particular parts of the river with small increases in flow in larger events.
- Flood planning levels that ensure equity across the city in terms of certainty about likelihood of flooding, accounting for variation in flood levels across the city.
- Calculation of flood hazard levels linked to building form requirements.

The proposed approach is based on the following assumptions:

Summary of Assumptions	
Depth	• Considered to be the major factor in river flood. Primary impact is pressure on structures, and damage and hazard (danger) due to depth of inundation. • Able to be calculated considering DFE information. • Evacuation is likely to be required earlier than shallower (higher) areas of the floodplain as low lying areas maybe cut-off early in the flood. • people may need to travel further from lower parts of the floodplain to evacuate to higher ground. • Greater constraint on development form and ability to develop land to relevant flood planning levels. • Variation of flood depth in different events varies in different places in the river – corresponding roughly to

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	Brisbane River Corridor Precincts.
Velocity	• Areas closer to Wivenhoe Dam (Moggill etc) are likely to exhinit higher total floodplain velocity than say the Brisbane CBD. • In-river velocity varies according to location along Brisbane River. However velocity up to 5 m/s expected between banks. • Overbank velocity is much reduced due to higher roughness, less conveyance and backwater areas. • Only likely to be a factor within the flood way. Velocities sufficient to sweep away permanent structures not assumed for river flooding. • Debris impact is considered a subset of velocity. ??? Moggill increases? Risk based approach.
Flood Warning time	• Warning time is assumed to exist. • SPP Guideline approximates 12 hours as having warning time for evacuation. Most of Brisbane has at least 24 hours warning time. • Moggill area: reduced warning time to be factored in.
Duration	• Scientific estimate of range we're considering: xxxx • Assumed to be too short to have a significant enough impact on structures to warrant specific calculation of impact. • River flooding duration can result in additional damage.
Frequency	Areas flooded to significant depth are likely to also be more regularly flooded. However, Wivenhoe Dam reduces the frequency of flooding in smaller ARI events for the Brisbane River.

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The flood hazard areas will be used to:

- Identify compatible development types and landuse related to QPP in terms of their vulrenability to flooding (eg critical infrastructure and residential having more regard to hazard compared to a sporting field).
- Trigger building form requirements reflecting the level of hazard. This is likely to include the type of construction, vertical evacuation consideration, access and evacuation requirements, match of compatibility of landuses with flood hazard.
- Trigger requirements for the siting of buildings.

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Further information about the sources and rationales behind the selection of particular depths is included in Table XXX.

Information about the proposed strategy to manage filling is summarised in section XXx.

Mapping of hazard will be at a cadastral scale, with provisions referring to areas on a site within the hazard areas.

Flood Planning Levels

Flood events beyond the Defined Flood Event (DFE) have markedly different impacts across different precincts of the Brisbane River. In areas such as Moggill where the River floodplain is narrower there is much greater increase in flood level for only small increases in River discharge beyond that used for setting the DFE. These

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changes can greatly exceed any freeboard provided to account for uncertainty. By comparison in the CBD such minor flow increases may only create minor changes in flood level that are within the freeboard provided by the development. This was clearly visible in the January 2011 flood where new development in New Farm with 500mm freebaord was unaffected by flooding, where alternatively at Mogill a new development would have required 2m freeboard to achieve a similar level of flood immunity for that flow. This clearly shows that the allowance for uncertainty in freeboard for habitable areas was not equitable across the floodplain.

For this reason, the following method for identifying flood planning levels (and therefore floor levels, lot planning levels etc) is proposed to account for variations and provide an equitable level of flood immunity.

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It is proposed to extrapolate the level of immunity given by the January 2011 flood event level at the City Bar plus 500mm freeboard to upstream locations considering the xxxx whatever its called – slope of the water. This will result in differentiated flood planning levels upstream from the City Bar. The extrapolation will be based on the xxxx, as shown in the diagram below, which represents…….

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Council's current flood planning level in all places in the Brisbane River is DFL + 500mm. However, due to topographical and xxx variations, flood levels in the river vary, with the result that small increases in flow can result in large increases in flood levels in upstream areas. ¶

Insert diagram of river heights.

PLOT DFL + 500mm FREEBOARD VS ACTUAL IRFL ALONG RIVER TO SHOW DEVIATION THAT OCCURS.

Do we need to say something about a mapping formula?
Explanation of why we chose IRFL + 500 at the City Bar??? WHY PICK 500MM FREEBOARD AT ALL?

In all locations, it is intended to express the flood planning level as a value which corresponds to the habitable floor level. Other levels, such as non-habitable floor levels and lot levels will be expressed as a level related to a Defined Flood Event as per current City Plan.

Additional provisions are likely to be necessary upstream of xxxx location, to account for likely increases in hazard due to velocity and reductions in warning time compared to the rest of the river. These will be addressed through the following:

- Xx
- Xx
- Xx

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Climate Change
?? will this be OK because we're accounting for higher flood levels? - NOT REALLY, IDEALLY NEW STUDY WILL INCORPORATE INCREASED INTENSITY. BUT SOMEHOW I THINK THEY WILL NOT DO THIS (BECAUSE NOT COUNCIL STUDY) AND ONLY ESTIMATE A TRUE Q100 IN THE RIVER BASED ON CURRENT RAINFALL INTENSITY DATA.

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About asset life and what we're doing or not doing?

Accounting for higher flood levels.
A risk based approach considers impacts of higher flood events on people, infrastructure and property. To do this, it is proposed to....

Benefits
Table X below summarises the strengths and weaknesses of the proposed methodology.

Strengths

Weaknesses

Mitigations for weaknesses

South Pine River flooding?

Do we need to say anything specific about South Pine River – even something generic about how we're calculating hazard. – (No, it maybe a river but it is also a Waterway – treat it the same as a Waterway/Creek)

Creek/Waterway Flooding

It is proposed to identify the following for creek/waterway flood hazard.

	Descriptors
Very High Hazard Area (or High Hazard Floodway)	Within the 10 year ARI flood extent to define an area (floodway) that will convey over half of the 100 year ARI flow. , &/or Velocity depth product of >1.5 m^2/s &/or and or flood depth >2000mm.
High Hazard Area	≥500mm deep in 100 year ARI flood event to 10 year ARI flood extent, &/or Velocity depth product of >0.6 m^2/s
Low Hazard Area	100 year ARI flood event to 500m depth in that event, , &/or Velocity depth product of <0.6 m^2/s,
Very Low Hazard Area	Between PMF (or 100 year ARI flood event plus 2.5m where PMF has not been modelled) and 100 year ARI flood event.

Note, we were going to check whether the 10 year ARI was appropriate for the big creeks.

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Deleted: or to 1.2 m/s velocity.

The proposed approach to Creek/Waterway flooding is characterised by:

- Xxx
- Xxx
-
- Calculation of flood hazard levels linked to building form requirements.

The flood hazard areas will be used to:

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- Trigger building form requirements reflecting the level of hazard. This is likely to include the structural strength of the construction (affecting type), provisions for level of enclosure of undercroft space for water circulation, access and evacuation requirements, and match of compatibility of landuses with flood hazard.
- Xxx
- xxx

Further information about the sources and rationales behind the selection of particular depths is included in Table XXX. (A3 table by James)

Information about the proposed strategy to manage filling is summarised in section XXx.

Mapping of hazard will be at a cadastral scale, with provisions referring to areas on a site within the hazard areas.

Creek Flooding	
Depth	• Scientific estimate of range we're considering is likely or possible • Depth approximation from DFE (100 year ARI) for creek flooding • Note that not all creeks have been modelled, so PMF and other levels not available for all creeks. New modelling by Water Resources will identify extent of floodplain.
Velocity	• Scientific estimate of range we're considering is likely/possible • Velocity information not available for most creeks – updates to modelling required before this can be applied. • Use of frequency information to approximate velocity (floodway) for land use planning purposes. • Velocity x depth product consideration for future studies, but not complete reliance on that information
Concentration & warning time	• Scientific estimate of range we're considering likely to happen • Concentration is assumed to be too fast to allow warning time. • SPP Guideline regards less than 12 hours as no warning time.
Duration	• Assumed to be too short to have a significant enough impact on structures to warrant specific calculation of impact.

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The approach is such that it is not reliant on a definition of hazard that relates to a velocity x depth product. This is because such estimates are very biased on roughness assumptions and often do not contribute to planning (eg a flood depth of 200mm moving at 2 m/s may not be safe for persons, but has minimal implications to landuse where development or filling would remove this risk). The sole adoption of velocity depth products would identify many areas of land that are high hazard that would not have significant issues mitigating this hazard safely.

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Summary of number of properties in each hazard area, number and percentage of landuses in each category

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From GIS; and provide some comments.

Flood Planning Levels

The proposal is to keep a similar level of flood immunity as required by existing City Plan. This generally relates to the 100 year ARI flood level for most development.

Higher events:

- Extrapolated in absence of models: justification of 2.5m estimate – doesn't matter if difference to PMF is 100mm or 2 m, in either case it will impact on a full development level.
-

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Rainfall intensity increases with climate change.

The Queensland Government's Inland Flood Study contains recommended assumptions for rainfall intensity increases due to climate change for flood modelling. However, Council only has a limited number of models that can run. As such it is proposed to….

→ are there some we can run immediately.

→ about updating with time.

Overland Flow Flooding (Local Flooding)

As per existing City Plan provisions:

Local Flooding		
	Low Hazard	< 500mm flood depth in 50 year ARI storm &/or velocity x depth product of < 0.6 m^2/s
	High Hazard	> 500mm flood depth in 50 year ARI storm &/or velocity x depth product of > 0.6 m^2/s

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The categorisation of high hazard where persons safety is an issue would be any velocity x depth product >0.4 m^2/s &/or depth >300mm.

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Identification of flood hazard areas: Storm Tide

Storm Tide		o
	Low Hazard	o Storm Tide Inundation at 2100 (per DERM definition and mapping) where depth is less than 1m. (Qld Government recommended): Low – the inundation depth is less than 1 m with wave heights less than 0.9 m, and the product of depth x velocity is less than 0.3 m2/s.
	High Hazard	o Storm Tide Inundation at 2100 (per DERM definintion and mapping) where depth is greater than 1m. (Qld Government recommended): High – most residential structures will incur moderate to severe damage. The inundation depth is 1 m or more with braking waves of 0.9 m or higher, and/or peak flows with a product of depth x velocity of 0.3 m2/s or greater.

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Relationship with Floodwise Layers

- Updates to mapping and to the Floodwise Property Report will be necessary to incorporate new information. Mapping updates (reflecting any changes to the DFL based on new modelling) will need to go through the planning scheme amendment process.

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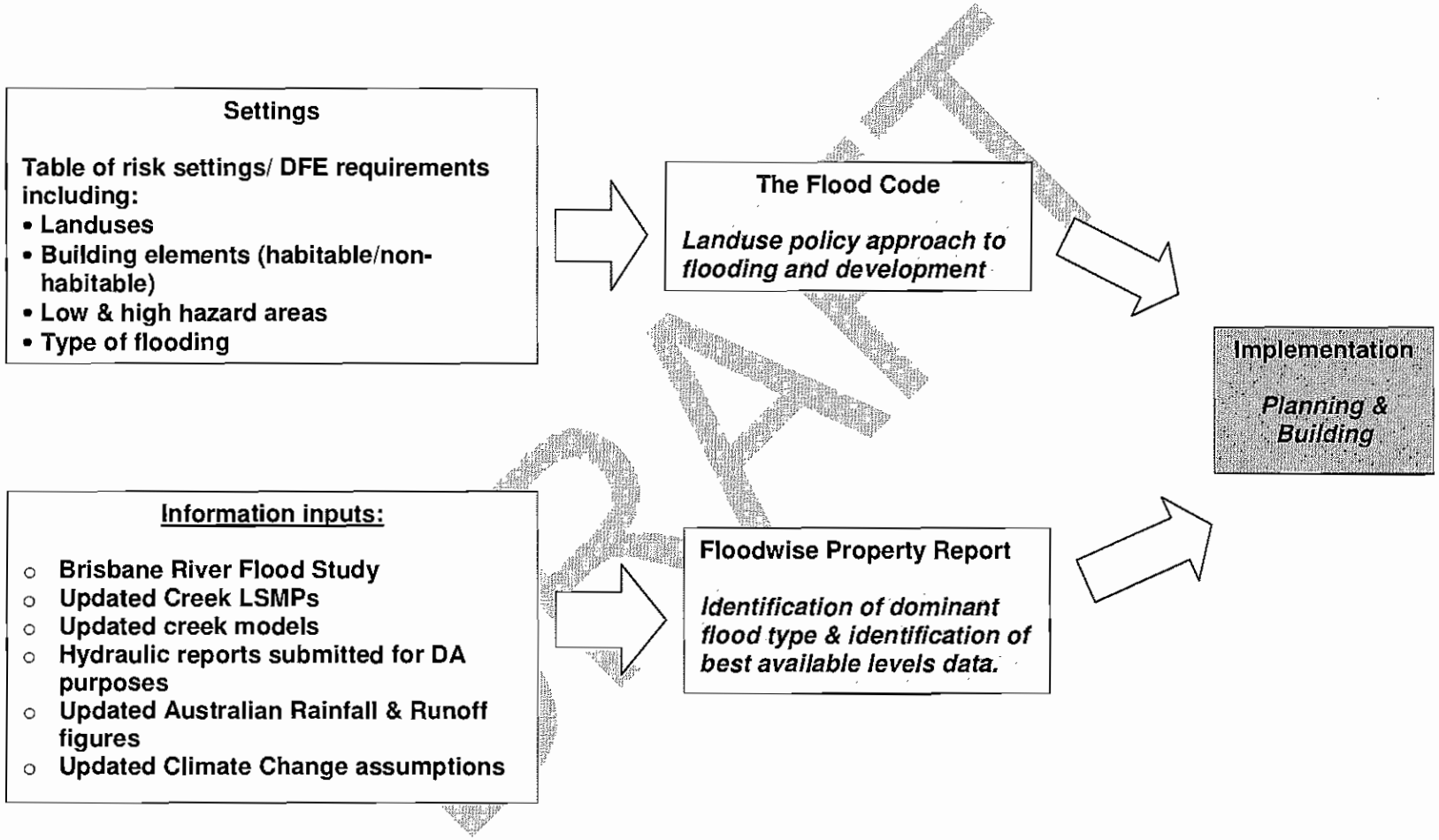

Relationship between Flood Code and Floodwise Property Report for Planning & Building Purposes

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Table XX: Source of standards supporting proposed methodology

Flood Planning Standard	Relevant to:	Source /Based on Where from (name source)?	Rationale (why we chose it)
2000 year ARI flood standard	Very Low Hazard River Flooding	o Waterway Design: A guide to the Hydraulic design of Bridges, Culverts & Floodways (Austroads 1994) – Commonwealth Guideline.	This is a standard applied to the serviceability ultimate limit state of major infrastructure such as Bridges. That is the infrastructure must be designed for the effects of a flood that has a 5% chance of being exceeded during the design life of the infrastructure (e.g. assuming a 100 year design life for infrastructure this equates to a 2000 year ARI flood event). This shows that while a 200 year event appears very rare (0.05% chance per year), within any 100 year period its probability of occurring is actually 5% which is as likely as a 20 year ARI storm occurring in any one year. Given planning in floodplains will potentially lock in some landuses and major infrastructure for periods of at least 100 years, this 2000 year ARI flood probability needs to be considered in landuse planning.
2011 Flood Event (per description in TLPI)	Very Low Hazard River Flooding Low Hazard River Flooding	o 2011 Flood event (per definition in TLPI, or improved if mapping is available). o Following JFT and FRB findings	o Established in recommendations from JFT and FRB. o Largest historical flood with Wivenhoe in Place that the community can relate too. o Revised River modelling may determine this event is closer to 100 year ARI flood (approximately 3 events of this magnitude have occurred in 150 year period). Keeping DFL for River may result in new development being built under expected standard. o Exceeds SPP requirement.
100 year ARI	Creek Flooding	o Universal flood standard for building design o Existing City Plan standard o SCARM	o Existing City Plan standard o Fatalities unacceptable at this probability of flooding - SCARM (Section E.12) o Was adopted in Australia in 1970's but when most floodprone land had "low population numbers"
50 year ARI	Overland flow (local flooding)	o Existing City Plan standard	o Existing City Plan standard o Not used by other authorities???? Only saves about 100-200mm on FFL??
Hazard Standard	**Relevant to:**	**Source /Based on Where from (name source)?**	**Rationale (why we chose it)**
300mm depth	Possible use for building/development requirements for creek flooding for land uses specifically involving children, however this will not be built into the hazard mapping.	o SCARM (pg72) o	o Limit as which it is generally unsafe for children to move through with any significant velocity component (SCARM Fig J.1 – limit at 1m/s velocity) o Cars start floating or being damaged at this depth (SCARM pg 69)
500mm depth Limited to 1.2m/s velocity	Low Hazard Creek Flooding. High hazard Creek flooding	o Explantation of source????	o Safe for adults to wade through (dependent on velocity)
1m depth		o ABCB (part/number xxxx), requirements for xxx.	o Depth limit for structural design of buildings with any velocity component
1.5m depth	Low Hazard River Flooding	o SCARM - wading difficult/dangerous for adult @ >1.2m (pg 69) and Fig J.1 (1.5m wading limit at zero	o Limit of filling (due to streetscape amenity and stability during floods) o Highset house compatible.

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Deleted: Very Low hazard Creek flooding ¶

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		velocity)	
2.5m depth	High hazard	o SCARM (>2m depth damage to lightly framed buildings)	o Exceeds full ground floor height of dwelling, with implications for height of dwelling and building form(slab vs. high set, number of storeys).
Less than 5m	Very High Hazard River flooding	o	o Total inundation of dwelling – possibly very high houses for flood immunity to DFL. o Explain link between frequency and velocity here.
Within 10 year flood extent	Very High Hazard Creek flooding (essentially the floodway of a creek or River)	o	o Within floodway, high velocity expected, debris impact potential, regular inundation and filling impacts.
Within 20 year flood extent	Very High Hazard River flooding	o	o Regular inundation would lead to amenity loss, high annual average damages, excessive flood depths in larger flood events.

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Identification of flood hazard areas: Overland Flow

Overland Flow		

Consideration of combinations of Events

Use of flood mapping

1. Instances where it is desirable to vary the required immunity standard will be identified by exception, and taken forward for discussion and endorsement before being finalised in the new codes. This identification will be based on an assessment of risk posed by flood hazard including consideration of the vulnerability of the use, benefits derived from permitting uses in particular locations, and the ease and extent to which mitigation of risk to an acceptable standard (per the SPP 1/03 definition) is possible through development controls.

2. Minimum provisions for essential community infrastructure (such as hospitals) are contained in the Subdivision & Development Guidelines. These standards mirror those in the State Planning Policy 1/03. Changes to these are not proposed unless a particular risk is identified through review of planning areas accompanying the identification and mapping of hazard areas. (It is noted that the Queensland Coastal Plan also contains standards for Storm Tide affected areas, in a format that varies from SPP 1/03. These will need to be integrated).

Flood Immunity Levels and hazard – use compatibility

→ types of provisions we are investigating.

→ Built form and other requirements.

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Flood type & Area	Hazard Level	Type of provisions
River Flood – General		
Precinct 1		
Precinct 2		
Precinct 3		
Precinct 4		
Precinct 5		
Creek Flooding		
	Very High	
	High	
	Low	

Limits on ERAs in particular areas
About evacuation in Brisbane

- No evacuation routes.

Approach to Filling and compensatory earthworks

If we'll have this developed enough in time???

Conclusions

Where to from here

Peer Review

→ Proposed endorsement from
1) Water Resources
2) Other Stakeholders (eg. City Assets, DA)
3) Council committees.

Summary of timings

Code Development
→ relationship with other codes and structures.
→

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Natural Disaster Risk Management Inputs into the City Plan Project – Flood Component.

Stage 1: Scoping Report

June 2011

Natural Disaster Risk Management Project

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Version	Date	Officer
1	22 July 2011	[redacted]

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   - ClimateSmart Adaptation 2007 – 2012,
   - The Draft South East Queensland Climate Change Management Plan 2009

12) Existing Studies
   - Report on Brisbane City Natural Disaster Risk Management Study – Brisbane River Flooding Phase (2004).
   - Report on Brisbane City Natural Disaster Risk Management Study – Other Water Borne Hazards Phase (2004).
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APPENDIX 1 - *Flood Code Workshop Minutes*

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Contents:

Part 1: NDRM Overview & Scope

1) Document purpose

This document summarises the scoping phase (Phase 1) of the Natural Disaster Risk Management Project, (Flooding Component).

It outlines scoping work undertaken for the NDRM project between January and April 2011, and outlines tasks required to take the project forward, and the time required for this. The ultimate aim of this work is to inform the preparation of a Flood Hazard Code for inclusion in the new Brisbane City Plan.

Stage 2 will consist of a summary of the completed technical investigations required to support code preparation, with preparation of the draft Codes to occur in Stage 3.

2) Overview of NDRM project and discussion of scope.

The NDRM project will provide natural disaster risk management input to the new City Plan in the form of a code or codes and associated spatial information. This outcome will enhance community resilience to these natural hazards by influencing the consideration of development through the planning and development assessment phases.

Specifically, for each hazard, this input will be provided via two tasks:

1. Investigation of the feasibility of implementing the recommendations of the Natural Disaster Risk Management and the City Plan – Consideration of State Planning Policy 1/03 report (the Gaskell Report); and

2. Where identified, actioning the recommendations from the report and additional tasks to fulfill the scope of the project.

The scope of work is further defined to the nature of information that is relevant to a Planning Scheme (City Plan) prepared under the *Sustainable Planning Act 2009* (SPA) and the Queensland Planning Provisions (QPP). The project will provide such input in the form of a code or codes for an overlay or overlays relevant to natural disasters of flooding, bushfire and landslide in accordance with State Planning Policy (SPP) 1/03.

The scope of work must be provided within the format (physical and electronic), timing and deliverables required for the larger City Plan Review project.

Deliverables of the flooding component of the NDRM project are:

- Reviewed strategic plan map
- Reviewed Strategic Plan Intents
- Hazard maps for City Plan
- CP flood code other code amendments, level of assessment etc.
- Consequential Amendments (eg. Neighbourhood Plans)
- Recommended Non scheme actions

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3) Flooding Hazard Scoping Method and Activities

Scoping for the Flood Hazard component of this project was undertaken between January and May 2011.

Scoping Activities consisted of:

- Desktop review of documents and technical requirements
- One City Planning scoping workshop (1 February) reviewing John Gaskell & Associates' recommendations (The Gaskell Report)
- One formal internal stakeholder meeting (21 February 2011) - City Planning, Water Resources, Development Assessment and Disaster Management.
- Weekly flood code working meetings with Development Assessment and Water Resources.
- Presentations to and feedback from Town Planning Sub Committee.

This scoping phase has also been informed by:

- New City Plan scope, timing, and linked areas of work.
- Meeting with New City Plan project Content Review Panel for City Plan project.

4) Scope Inclusions

For the purpose of this project, the following scope inclusions are noted:

- This project investigates land use and infrastructure planning measures for inclusion in the planning scheme for Brisbane. This includes updates to the Brisbane Strategic Plan, land use recommendations, code items, mapping, and design standards in a format consistent with the New City Plan project and the legislative and policy settings and requirements for SPA, QPP and SPP 1/03.
- Responding to relevant BCC studies, including the Lord Mayor's Taskforce for Suburban Flooding, Joint Flood Taskforce, and Flood Review Board to the extent relevant to inputs into the new City Plan.
- Coastal hazards relevant to flooding (storm tide and sea level rise) and high level climate change adaptation principles and guidelines, in accordance with the Queensland Coastal Plan.
- Spatial information where required to updates, revises or presents new information required for compliance with legislative and policy requirements and the format of the new City Plan and Council GIS systems.
- Key stakeholder consultation required to develop the technical basis of the scope of work.
- Site based work is limited only to short duration general site visits and not involving field measurement, placing, maintaining or recovering of monitoring devise and equipment.

5) Scope Exclusions.

The following scope exclusions are noted:

- Investigation into structural/engineering flood mitigation measures
- Flood risk analysis for specific flood sources factoring in non-planning mitigation measures (eg. emergency response capability, engineering mitigation).

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- Review of Internal Council DSS (although standards for flood immunity contained in the Subdivision and Development Guidelines will be considered).
- Counter Disaster/emergency planning investigations and other non-land use planning measures related to flood hazard management.
- Flood hazard management provisions covered by the Building Code of Australia and/or the Queensland Development Code, although recommendations to the governing agencies for these standards may be put forward in the final stage of this project.
- Investigation into design standards for infrastructure not within Council's planning control. This includes Queensland Urban Utilities and other agencies.
- Consultation with the general public.
- Drafting of codes and policies not pertaining to natural disaster risk management.
- Actions relevant to climate change mitigation (eg. carbon emissions reduction)
- Technical investigation into climate change induced changes (eg. rainfall patterns, impact of bay islands on storm surge).
- No detailed fieldwork or monitoring is provided for (general site visits and consultation are inclusions as described above).

6) Assumptions

The following assumptions underlie the recommended work as outlined in this report:

- The Queensland Government's current Review of SPP 1/03 will not be completed in time to affect the scope of this work.
- Although not yet in effect, the Queensland Coastal Plan and State Planning Policy for Coastal Protection is an endorsed document which must be addressed in the new City Plan.

7) Constraints

- The project must proceed in City Plan timeframes, within the nominated budget.
- Information available or likely to become available within the life of the project is noted as a key constraint. The plan will be based on the best information available at the time.
- Changes to key legislation and policy directions are likely within the life of the project. These will be accommodated as they arise.

Part 2: Background

8) Legislative and Policy Requirements

The following documents have been reviewed for their effect on how Council may manage flooding hazard in Brisbane.

- *Sustainable Planning Act 2009* (SPA) and the Queensland Planning Provisions (QPP)
- South East Queensland Regional Plan
- State Planning Policy 1/03: Mitigating the Adverse Impacts of Flood, Bushfire and landslip (& Guideline)
- Queensland Coastal Plan (including State Planning Policy for Coastal Protection)
- Queensland Development Code & Building Code of Australia

Main influences are summarised in Table 2 below.

Summary of Policy and Legislative Requirements for Flooding Phase

Sustainable Planning Act 2009 (SPA)

The *Sustainable Planning Act 2009* regulates planning and development in Queensland. The act seeks to:

- manage the development process including ensuring the process is accountable, effective and efficient and delivers sustainable outcomes;
- manage the effects of development on the environment, including managing the use of premises
- continue the coordination and integration of local, regional and state planning.

Advancing the Act's purpose includes

- avoiding, if practicable, or otherwise lessening, adverse environmental effects of development, including climate change and adverse effects on human health, and
- applying standards of amenity, conservation, energy, health and safety in the built environment that are cost-effective and for the public benefit.

The SPA establishes the QPP, SEQ Regional Plan, SPP 1/03 and other legislation controlling new City Plan content, as well as requirements for how and when the new City Plan is prepared.

Draft Queensland Planning Provisions (QPP)

The Draft Queensland Planning Provisions (QPP) outline a consistent format and structure for all local government planning schemes across Queensland.

The QPP prescribes new land use definitions, mapping requirements and plan structure. Both mandatory and optional components are outlined in the QPP, to enable the preparation of a planning scheme which reflects the unique local dimensions of an area.

South East Queensland Regional Plan 2009-2031

The SEQ Regional Plan is a 20 year forward plan for South East Queensland region, prepared by the Queensland Government. The plan directs State and Local Government planning activities. It includes dwelling targets for local government areas, as well as Strategic Outcomes, Desired Regional Outcomes, principles and policies which local government planning schemes must accord with.

Part D, Regional Policies outlines a desired regional outcome for sustainability and climate change that includes the region growing and change in a sustainable manner, "becoming resilient to natural hazards", including the projected effects of climate change.

Principle 1.4 under Natural hazards and climate change adaptation:

Increase the resilience of communities, development, essential infrastructure, natural environments and economic sectors to natural hazards including the projected effects of climate change.

- 1.4.1 Reduce the risk from natural hazards, including the projected effects of climate change, by avoiding areas with high exposure and establishing adaptation strategies to minimise vulnerability to riverine flooding, storm tide or sea level rise inundation, coastal erosion, bushfires and landslides.
- 1.4.2 Reduce the risk from natural hazards, including the projected effects of climate change, by establishing adaptation strategies to minimise vulnerability to heatwaves and high temperatures, reduced and more variable rainfall, cyclones and severe winds, and severe storms and hail.

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- 1.4.3 Planning schemes and development decisions shall be in accordance with the Queensland Coastal Plan, including the range of potential sea level rises.

Notes under 1.4 add the following:

- Implementation of natural hazard and climate change adaptation policies will be achieved through building community resilience, avoiding vulnerable development in hazardous areas and incorporating design measures that are suited to more varied climatic conditions.
- The planning process in SEQ can reduce the risks from natural hazards and the projected effects of climate change through:
  - avoiding hazardous areas
  - improving the design of developments and infrastructure
  - improving community preparedness to respond to natural hazards
  - enhancing the resilience of natural systems
  - maximising opportunities for rural industries in the face of increasing climate variability.
- SEQ local governments and the state government will implement State Planning Policies (including State Planning Policy 1/03 Mitigating the Adverse Impacts of Flooding, *State Coastal Management Plan* and develop local disaster management plans for sensitive locations such as areas that may be susceptible to sea level rise, storm surge, coastal erosion and riverine flooding.
- Planning for natural hazards in SEQ will be informed by the projected sea level rise outlined in the Queensland Coastal Plan. The sea level rises in the Queensland Coastal Plan are:
  - for land not already subject to a development commitment, a sea level rise of 0.8 m by 2100 will need to be taken into account
  - for land already subject to a development commitment the following projected sea level rise needs to be accommodated for the year of end of planning period (asset life):
    2050 - 0.3 m, 2060 - 0.4 m, 2070 - 0.5 m, 2080 - 0.6 m, 2090 - 0.7 m, 2100 - 0.8 m.
- Other natural hazards, such as earthquakes and tsunamis, are unlikely to occur in SEQ.
- Biological hazards such as pests and diseases will also be affected by climate change and will be principally managed through federal, state and local government biosecurity programs.

Principle 2.4 under Managing the Coast:

Maintain, protect and enhance the values of the region's coast, including the foreshore, coastal wetlands, dunes, coastal processes, marine ecosystems, significant coastal values and marine waters.

Policies

2.4.1 Locate, design and manage coastal development to avoid or mitigate adverse effects on coastal values.

2.4.2 Ensure development other than maritime infrastructure avoids erosion prone areas, storm tide inundation hazard areas, and undeveloped sections of tidal waterways in accordance with the Queensland Coastal Plan.

2.4.3 Ensure that development on the coast or in tidal waters maintains natural physical coastal processes or ensures that there is no increased risk of shoreline erosion to adjacent areas of coastline.

2.4.4 Maintain and enhance safe public access to the foreshore and coastal waters and ensure public access is designed and maintained to conserve coastal resources.

2.4.5 Ensure land use and infrastructure plans are consistent with the Moreton Bay Marine Park zones and fish habitat zones and management plans for the region.

Principle 11.6 under Overland flow and flood management:

Provide necessary flood immunity for infrastructure and buildings, and resilience to potential climate change flooding, while seeking to maintain the natural flow regime.

- 11.6.1 Avoid areas of unacceptable flood risk, including additional risks from climate change, and areas where development may unacceptably increase flood risk elsewhere.
- 11.6.2 Achieve acceptable flood immunity through water sensitive movement and detention infrastructure that minimises alterations to natural flow regimes, including floodplain connectivity.

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Notes under 11.6 add the following commentary:

- Development in a flood hazard area should be avoided if the earthworks and infrastructure required to attain an acceptable level of flood immunity significantly alter the natural flow regime and have an unacceptable effect on environmental values. Where feasible, natural flow and inundation patterns should be restored, including connectivity between rivers and floodplains and beneficial flooding of agricultural areas. This will also minimise the concentration of flows and flooding downstream.
- The flood hazard area should be determined based on a defined flood event, taking into account the effects of climate change on rainfall and storm surges.
- In urban areas, these flow alterations (increased flows due to urban development) should be managed by using water sensitive urban design.
- All development should be assessed to ensure flow alterations are acceptable in relation to flood risk and environmental flows.
- Overland flow is regulated in the Moreton Basin under the *Water Resource (Moreton) Plan 2007.*

6.3 Healthy and Safe Communities:

Develop healthy and safe environments that encourage community activity, participation and healthy lifestyles, and prevent crime.

The notes below 6.3 list characteristics of healthy and safe communities including:

- use best practice urban design to create built environments that foster and enhance community safety
- consider major emergency situations, such as floods, chemical hazards, fires and traffic accidents, which require efficient emergency services.

State Planning Policy 1/03: Mitigating the Adverse Impacts of Flood, Bushfire and Landslide (& Guideline) (SPP 1/03)

SPP 1/03 is established under the SPA 2009. The New City Plan is required to comply with the State Planning Policy. The SPP aims to ensure that the natural hazards of flood, bushfire and landslide are adequately considered when making decisions about development. The policy applies

- when development applications are assessed,
- when planning schemes are made or amended,
- and when land is designated for community infrastructure.

SPP 1/03 was prepared in 2003. Some of its provisions are noted to be time-damaged. A review is currently underway, but is not expected before the due date for the completion of the flood code and its integration into the City Plan.

The SPP requires the identification of natural hazard management areas (NHMA) within which minimising risks to the community should be a key consideration in development assessment and the preparation of planning schemes. Annex 2 defines a natural hazard management area (flooding) as:

a) A natural hazard management area (flood) is land inundated by a Defined Flood Event (DFE) and identified in a planning scheme.
b) The Queensland Government's stated position in the SPP is that, generally, the appropriate flood event for determining a natural hazard management area (flood) is the 1% Annual Exceedance Probability (AEP) flood. However, it may be appropriate to adopt a different DFE depending on the circumstances of individual localities. This is a noted to be a matter that should be reviewed when preparing or undertaking relevant amendments to a planning scheme.

The SPP applies in NHMAs to material changes of use and reconfigurations of a lot that:

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- increase the number of people living or working in the NHMA, except where the premises are only occupied on a short-term or intermittent bases (eg. by construction/maintenance workers).
- Involve institutional uses where evacuation people may be particularly difficult (eg. hospitals, education establishments, child care, aged care, nursing homes and high security correctional centres).
- Involve the manufacture or storage of hazardous materials in bulk or
- In natural hazard management areas for flood, to building or other work (that is an intrinsic part of the development) that involves any physical alteration to a watercourse or floodway including vegetation clearing or involves net filling exceeding 50 cubic metres (or threshold adopted by Local Government, as appropriate to local circumstances. 50m3 is the threshold for earthworks of State Interest).

The policy contains six main outcome statements:

OUTCOME 1

Within natural hazard management areas, development to which the SPP applies is compatible with the nature of the natural hazard except where:

- **The development proposal is a development commitment; or**
- **there is an overriding need for the development in the public interest and no other site is suitable and reasonably available for the proposal.**

Annex 4 contains Specific Outcomes for **compatibility with the nature of the hazard**, namely:

1. Development maintains the safety of people on the development site from all floods up to and including the DFE.
2. Development does not result in adverse impacts on people's safety or the capacity to use land within the floodplain.
3. Development minimises the potential damage from flooding to property on the development site.
4. Public safety and the environment are not adversely affected by the detrimental impacts of floodwater on hazardous materials manufactured or stored in bulk.
5. Essential services infrastructure (e.g. on-site electricity, gas, water supply, sewerage and telecommunications) maintains its function during a DFE.

For **overriding need**, 6.11, the proposal should result in a significant overall benefit to the whole or a significant part of the community in social, economic or environmental terms that outweighs the adverse impacts arising from the development's exposure to natural hazards. Consideration of exposure is:

- the increased risk to life, property and/or the environment;
- the increased demand for emergency services; and
- the potential risk of increased community pressure for hazard remediation works.
- Increased risk to people is a significant consideration when determining overriding need.

Specifically, overriding need means that development should :

- serve an essential community need (e.g. a healthcare facility),
- significantly improve the community's access to services (e.g. a community centre or other facility that reduces travel times for a significant proportion of the community),
- provide significant long-term economic benefit (e.g. a major new employment opportunity, or an industry with synergies with existing activities in the area),
- or provide significant environmental benefits (e.g. where other alternative sites would require clearing of remnant vegetation or other areas of significant environmental value such as important habitat areas). **(SPP Guideline 6.21)**

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The development application should also demonstrate that a similar benefit could not be achieved by developing other suitable and reasonably available sites. 6.24 in the SPP Guideline outlines criteria and a method for assessing reasonable availability of alternative sites.

OUTCOME 2
Development that is not compatible with the nature of the natural hazard but is otherwise consistent with Outcome 1:

- **Minimises as far as practicable the adverse impacts from natural hazards; and**
- **Does not result in an unacceptable risk to people or property.**

Unacceptable risk is defined as a situation where people or property are exposed to a predictable hazard event that may result in serious injury, loss of life, failure of community infrastructure, or property damage that would make a dwelling unfit for habitation.

OUTCOME 3
Wherever practicable, community infrastructure to which the SPP applies is located and designed to function effectively during and immediately after natural hazard events commensurate with a specified level of risk.

OUTCOME 4
Natural hazard management areas are identified in the planning scheme.

OUTCOME 5
The planning scheme contains planning strategies that aim to:

- **ensure that development in natural hazard management areas is compatible with the nature of the hazard.**
- **Minimise the impacts from natural hazards on existing developed areas; and**
- **Prevent development from materially increasing the extent or the severity of natural hazards**

OUTCOME 6
The Planning Scheme measures:

a) **include code(s) designed to achieve development outcomes consistent with Section 6; and**
b) **ensure that development to which this SPP applies is assessable or self-assessable against that planning scheme code(s).**

The planning scheme, or planning scheme policy(s), specifies the information expected to be submitted with development applications subject to the codes.

The SPP Guideline outlines acceptable methodology and sources to develop the code and mapping. Outcomes 1-3 are to be met in planning schemes through the inclusion of natural hazard management areas, and a flood hazard code.

Natural Disaster Risk Management and the City Plan – Consideration of SPP 1/03 by John Gaskell Planning Consultants 2010 analyses the compliance of the Brisbane City Plan 2000 with the requirements of SPP 1/03. The Gaskell report notes the following specific requirements arising from the SPP:

- The SPP does not specify the method by which *natural hazard management areas (flood)* are to be determined. The SPP Guideline recommends the floodplain management study process described in national best practice guidelines (SCARM, 2000), but acknowledges that the substantial resources required to implement that

process may not always be available or necessary. Information on a range of simplified approaches that can be used to obtain information on flood extent and flood hazard is given.

- Best practice floodplain management emphasises the importance of considering the potential consequences of floods larger than the DFE and managing these residual risks through appropriate emergency management strategies. SCARM, referred to in the SPP, recognises that flood damage will still occur during events between the 1% AEP flood and the Probable Maximum Flood, that would occupy the entire flood plain.
- Council (at the time of Gaskell's report) was yet to move towards the flood hazard classification approach detailed in Appendix J of SCARM described in SPP 1/03. The SPP guideline states that the assessment (of natural hazard management areas) 'may include the assessment of relative levels of severity in relation to natural hazards'. A move to an approach of mapping hazard, which is based on an analysis of both flood depth and velocity for the modelled event, would require a considerable upgrade of Council's flood data.
- The SPP does not specifically address the issue of inundation caused by stormwater travelling as overland or pipe flow prior to entering a watercourse.

SPP 1/03 is currently being reviewed. The review is scheduled for completion in 2013.

Queensland Coastal Plan (including State Planning Policy for Coastal Protection).

The State Planning Policy for Coastal Protection (SPP) is an endorsed State Planning Policy, expected to be enacted by the Queensland Government in about late August of 2011, dependent on changes to supporting legislation being made to enable full operation of the plan. DERM have indicated that some small wording changes and additions/clarifications, as well as an additional guideline (for Coastal Adaptation Plans) will be available at the time the SPP comes into effect.

The State Planning Policy for Coastal Protection (SPP) sets out criteria for land-use planning, coastal activities and development assessment within the coastal zone, consistent with the objectives of Coastal Protection and Management Act 1995.

The policy defines coastal hazards as including coastal erosion, storm tide inundation and permanent inundation as a result of rising sea levels. It states that development constraints in vulnerable areas are justified by the environmental, financial and social costs associated with these hazards.

Application:
The State Planning Policy for Coastal Protection is a statutory instrument under SPA, and has effect when a local planning instrument is made or amended, when development applications are assessed and when land is designated for community infrastructure. Per B6, when identifying land for urban purposes, rural residential or maritime purposes for a planning scheme, the policy outcomes in Part C (listed in the table below), as well as the code in Annex 2 should be considered.

The SPP also applies to development assessment. Triggers are listed in two categories at B7 (land within the coastal management district) and B8 (land within the coastal zone, but not within the coastal management district).

Within the Coastal Management District, requirements apply to:

- building work, subject to location requirements
- assessable operational works
- reconfiguration

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- material changes of use resulting in operational works or building work (meeting size or locational requirements (generally greater than 1000m2).

Within the Coastal zone but not within the Coastal Management District, requirements apply to:

- material changes of use requiring vegetation clearing in certain areas, new permanent structures for accommodation purposes meeting certain locational requirements, requiring filling of greater than 1000m2 in particular locations
- reconfiguring a lot in particular locations that would increase the number or residential dwellings and premises
- operational works in particular areas for filling more than 1000m2 or clearing vegetation.

However, the following the SPP does not apply to:

a) building work that is assessable only against the Building Act 1975
b) carrying out operational work that is clearing an area of high ecological significance to the extent necessary for a domestic activity.

The SPP's Annex 2 provides a development assessment code to be used in assessing development applications until the planning scheme is updated to comply with, and specifically state that they comply with, the SPP.

SPP provisions apply within the coastal zone, which extends landward to cover all coastal islands and the part of the mainland that is generally either five kilometres from the coastline or where land first reaches the height of 10 metres Australian Height Datum (AHD), whichever is further from the coast.

When making or amending a local planning instrument, Section E1 outlines criteria to evaluate achievement of SPP outcomes:

a) coastal hazard areas, erosion prone areas, areas of high ecological significance, and areas of general ecological significance are identified by zones or overlays contained in a local planning instrument
b) adaptation strategies for relevant coastal hazard areas are appropriately incorporated in a local planning instrument
c) development to which the policy applies is made assessable or self assessable
d) the allocation of uses and any assessment codes are consistent with the principles and policies of the SPP and the specific outcomes at Annex 2
e) the planning instrument states the information applicants will need to provide with their development applications.

E.2 The Coastal Hazards Guideline and the SPP for Coastal Protection Guideline contain further information. The State has indicated that a further guideline, for adaptation planning, is being prepared.

Section C outlines Policy Outcomes, specifically that:

C.1 **Development in the coastal zone is planned, located, designed, constructed and operated to:**

a) avoid the social, financial and environmental costs arising from the impacts of coastal hazards, taking into account the projected effects of climate change
b) manage the coast to protect, conserve and rehabilitate coastal resources and biological diversity
c) preferentially allocate land on the coast for coastal-dependent development.

C.2 The policy outcome will be achieved when development to which the policy applies is consistent with each of the principles, policies and applicable specific outcomes set out in the

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code at Annex 2, for the following topic areas:

Topic Area	Principle(s)
1. Land-use planning	**Allocating areas for urban development avoids or minimises the exposure of communities to the risk of adverse coastal hazard impacts, maximises the conservation of coastal resources and preferentially allocates land on the coast for coastal-dependent development.**
2. Coastal hazards	**Communities and development are protected from adverse coastal hazard impacts taking into account the projected effects of climate change and the preference for allowing the natural fluctuation of the foreshore and foreshore ecosystems to continue, including, in response to rising sea levels.**
3. Nature conservation	**Areas of high ecological significance are protected and areas of general ecological significance on land and other ecological values are conserved.**
4. Scenic amenity	**The scenic amenity of the coast is protected and enhanced.**
5. Public access	**Public access to the coast is maintained and enhanced for current and future generations.**
6. Coastal-dependent development	**Protect and maintain opportunities for sustainable coastal-dependent development in a manner that minimises impacts on coastal resources.**
7. Canals and artificial waterways.	**Coastal resources are protected from canal or artificial waterway development.**

Part D of the SPP outlines acceptable circumstances for not fully achieving the policy as when the proposed development:

a) provides an overriding need in the public interest
b) is a development commitment; or
c) is for a public benefit asset (which include some types of transport infrastructure, aeronautical facilities, emergency services facilities, domestic gas pipelines, some storage, works and administrative facilities, and some operating works for electricity provision).

Annex 5 outlines factors which determine overriding need in the public interest, namely:

a) the overall social, economic and environmental benefits of the development outweigh any detrimental effect upon the natural values of the site and adjacent areas; and any conflicts with the policy outcome of this policy; and
b) the development cannot be located elsewhere so as to avoid conflicting with the policy outcome of this policy

Uses requiring relatively few locational requirements to function; or interests in or options over a site; or a site's availability or ownership are specifically excluded as factors for determining overriding need in the public interest.

Despite this, development in the public interest must still:

a) achieve the policy outcomes of this plan and the development outcome(s) set out in the

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development assessment code, where relevant, to the maximum extent practicable where this would not compromise the intrinsic characteristics of the development

b) provide an environmental offset for any residual adverse impact on an area of high ecological significance that cannot be avoided
c) provide for the natural effect of physical coastal processes to continue outside the development area.

Climate Change Assumptions

The SPP for Coastal Protection, and its guidelines, reiterate the 0.8m provision in the SEQ Regional Plan for sea level rise to 2100. It also provides a default setting for storm tide of 1.5m above the highest astronomical tide (HAT) to 2100, to be used in absence of a detailed study. The plan also notes a 10% increase in cyclone intensity, although advice provided in DERM's Queensland Coastal Plan training session noted that the increase in cyclone intensity has already been factored into storm tide assumptions for South East Queensland, with this assumption being more significant for more northern parts of the state.

Provisions in the plan affecting development of City Plan inputs

Land Allocation

- Planning schemes must avoid allocating new areas for urban purposes within areas affected by storm tide, tidal inundation or erosion, other than coastal dependent development, industrial development or temporary/relocatable uses including openspace/ recreation.
- 2.2.1 outlines default landuses for the coastal zone which apply unless for one of the exceptions specified in the plan. The default landuses for hazard areas are:
    - Coastal dependent development
    - Temporary, readily relocatable, or able to be abandoned
    - Essential community service infrastructure that cannot feasibly be located elsewhere
    - Redevelopment that does not increase the risk to people and property from exposure to adverse coastal impacts.

  DERM have advised that additional clarification of 'not increasing the risk to people and property" will be included in the enacted version, specifying increase as an increase in the number of dwellings or premises, or people working on site.
- For a maximum of five years until an adaptation plan is in place (part of an SPP compliant scheme), development in areas affected by high or medium hazard from Storm Tide, which is not of the type listed in 2.2.1 will be subject to a risk management approach. Further criteria for this will be included in an update to the SPP Guideline in coming months.
- Erosion provisions listed for within the Coastal Management District do not allow development within the CMD unless it is one of the default landuses.
- While an adaptation plan can (to some extent) override requirements for coastal hazards for Storm Tide, erosion prone area provisions remain. Council has been requested to speak with DERM (Selwyn Salton) regarding treatment of areas under the SPP where filling/other mitigation works will make them no longer affected by permanent tidal inundation by 2100 (which are currently flagged as erosion prone areas).
- Schedule 2, Table 3-4 provides storm-tide immunity requirements for essential community service infrastructure.
- DERM have prepared mapping including storm tide hazard areas, and erosion prone areas, including those calculated to be subject to erosion from permanent inundation at 2100 from sea level rise.

Adaptation Plans

- Local Planning instruments are to incorporate a coastal hazard adaption strategy for urban localities projected to be within a high coastal hazard area between the commencement of the SPP and the year 2100. The strategies are to assess the mitigation options including retreat, avoidance and defence mechanisms, and a cost benefit analysis to determine the most cost

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effective works or actions. The strategies are to describe:
  - Mitigation works
  - Costing and a cost benefit analysis
  - Funding arrangements
  - Timelines for the commencement and completion of the mitigation works.
- Adaptation Strategies are to be incorporated into planning schemes.
- DERM will be a concurrence agency for assessing applications within the Coastal Zone.

Building Codes & Australian Standards

The National Construction Code guidelines currently regulate the following inundation risks:

- poor drainage
- elements of design vulnerable to water leaking
- redirected sewer water
- resistance to main, surface, ground water and storm water issues

The key water issues that the code addressed are:

- prevention of poor drainage where frequently affected by flooding or water inundation causing the deterioration of sub-floor elements.
- Minimising the risk of water leaking into or accumulating within a building
- Minimising the risk of other property being damaged
- Protection from redirected sewer water
- Resistance to main, surface water and ground water
- Managing surface water from 1 in 20 year and 1 in 100 year storms
- Outfall, water entrance and water damage
- Some mention of roads and walls to prevent water penetration of building elements.
- Stormwater Drainage compliance
- Specific roof coverings
- Waterproofing of wet areas in buildings
- Damp proofing

However, despite the current code not addressing flood vulnerability, the Australian Building Codes Board has drafted a standard for the construction of buildings on flood-prone land to be implemented in 2013. The document outlines the basic construction design requirements and standards in the event of a flood, specific flood actions that occur during an event including; waves, erosions, debris and scour. It also specifies elevation requirements, foundation requirements, and requirements for structural connections, materials, flood proofing, utilities and egress.

An alternative draft also provided addresses advisory information to improve building resilience to flood conditions, structural and non-structural design elements, and assessment criteria for the repair of flood damaged buildings. The identification of flood hazard areas, flood-prone structures and the appropriate location of buildings in flood-prone areas was also been established. A summary of relevant state/territory flood related building and planning provisions to provide comparison was also included in the document.

The new standard is understood to:

- Only deal with:
  1 - Buildings where people will sleep (BCA Classes 1 to 4 and 9)
  2 - Non coastal areas
  3 - Structural performance of building components rather than what is more generally referred to as resilient building design

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- Note the need to move away from a "Q100 mentality" and dealing with a broader range of risks up to and beyond defined flood events.
- Other positions are likely to change include the prescription of freeboard values, closer consideration of basement flooding, and reference to photovoltaics.

9) Existing Council Planning Provisions

Review of City Plan Provisions

The Brisbane City Plan 2000 pre-dates the State Planning Policy 1/03, which was introduced in May 2003. The location and extent of provisions in the Brisbane City Plan 2000 are summarised in the table below.

Comment [BCC1]: May or Sept?

A more complete analysis is contained in *Natural Disaster Risk Management and the City Plan – Consideration of SPP 1/03 by John Gaskell Planning Consultants 2010.*

Table 1: Summary of Provisions in the Brisbane City Plan

Section	Provisions
Chapter 2 The Strategic Plan: Desired Environmental Outcomes:	Flooding is referred to in several sections of the Strategic Plan. *DEO 3.1.1* ***Brisbane's environmental quality and natural assets are protected and restored and contribute effectively to no net loss of biodiversity, the management of public health and the social and cultural wellbeing of the community...*** **3.1.2.2 Enhance the aquatic ecology and quality of ground and surface water, including wetlands, the Brisbane River, and other waterways and water bodies through:** **- minimising damage**—minimising filling in floodplains, erosion, run–off, siltation and other forms of water pollution DEO 3.2.1 Community Life, Health and Safety: ***Brisbane is a safe, healthy and vibrant place to live, offering a wide range of local and regional services, facilities and activities and diverse housing, community, cultural and recreational choices.*** **3.2.2.8 Achieve a safe, secure, equitable and comfortable City through:** **(c) reducing risks** – planning to reduce the risks of loss of life, injury, property damage and community disruption resulting from landslip, subsidence, flooding, bushfires, storms and other emergencies and disasters, mindful of the need to maintain emergency access, egress and escape routes to facilitate emergency response **DEO 3.6.1** ***Brisbane has efficient and equitable transport, power, telecommunications, water, waste water treatment and stormwater management infrastructure*** **3.6.2.1 Ensure an adequate standard and capacity of community amenities associated with new development through:** **- waterways**—ensuring that the flood carrying capacity of waterways

	is not adversely affected by development. **4.1.2.3 Some parts of the Emerging Community Area and Future Industry Area are unsuitable for urban development where there is a need to protect or preserve:** **- flood liable land** **Strategic Plan Elements** The elements of the Strategic Plan also provide high level statements supporting the regulation of development subject to flooding in Brisbane City. In the Brisbane Green Space System (Section 4.1 of the Strategic Plan) the key green space values are outlined including the following: ***Green space corridors** are also intended to serve as physical breaks and buffersin the urban area, to increase the sense of identity for local communities and to serve floodway and drainage functions.* The Green Space Corridors highlight flooding and drainage functions. Section 4.1.2.3 "Protecting important elements in the Emerging Community Area and Future Industry Area" identifies that 'flood liable land' is unsuitable for urban development. In the Industrial locations (Section 4.3 of the Strategic Plan) specific reference is made to the Brisbane-Ipswich Corridor in Section 4.3.2.2 which includes a key strategic direction to: • *develop open space corridors along creeks, wetlands and watercourses for flooding, drainage and wildlife.* The Gaskell report comments that the Strategic Plan provides broad statements about protecting public safety but lacks a more specific approach to clearly identify the overall purpose of regulating development to avoid adverse impacts from flooding.
Chapter 3: Areas and Assessment Processes.	. There is limited reference to flooding in the Areas section of Chapter 3. Chapter 3 contains land use outcomes and levels of assessment as well as guidance and requirements for general assessment processes, including exemptions (excluding development from assessment against the City Plan). In relation to flooding, the City Plan specifically identifies exemptions for filling or excavation as follows: • to a depth of one vertical metre or less from ground level on land which the Acid Sulphate Soil Code and Wetland Code and / or Waterway code do not apply, and where the site is not listed on the Contaminated Land Register or Environmental Management Register; OR • top dressing to a depth of less than 100 vertical millimetres from ground level on land to which the Wetland Code and/ or Waterway Code applies. Chapter 3 also identifies the definition for filling or excavation.
Chapter 4: Local plans	There are some general references to flooding and flood plains in the Local Plans however these Local Plans often lack specific controls relying on the more general processes and requirements of the City Plan to manage / regulate flood issues.
Chapter 5: Codes	A number of key codes provide the basis for the detailed regulation of flooding in the City Plan.

Gaskell generally comments that the codes the codes could be improved with better references and more specific policy statements and standards as to how flood risk is managed and assessed.

Table 2 Summary of relevant Code Provisions

Code	Description
Filling and Excavation Code	A specific purpose statement that identifies no adverse impacts from filling on upstream, downstream or adjoining properties, matched with Performance Criteria and Acceptable Solutions to similar effect. The acceptable solution states that no filling is acceptable below Q100 levels, within waterway corridors or wetlands. The performance criteria requires 'no increase in flooding or drainage problems'). The performance criteria requires filling and excavation to be carried out in accordance with the Compensatory Earthworks Planning Scheme Policy
House Code	This code seeks to exclude development in a waterway corridor and sets minimum habitable and non habitable floor levels for houses. Houses that are constructed in the waterway corridor, or cannot meet flood immunity levels require an application (usually code assessment). This allows for assessment of flooding issues for those applications.
Park Planning and Design Code	The code is only relevant where a land dedication for parkland is required or contributed in lieu of a monetary contribution by development. The acceptable solutions are Q5 flood immunity for recreation areas (except where the land would benefit recreation such as flat land for a sports field) and Q100 immunity for buildings (clubhouse, equipment store etc).
Stormwater Management Code	This is the main code with assessment criteria for flooding issues. The code contains performance criteria and acceptable solutions that development 'must not adversely impact' on properties upstream, downstream or adjacent. Additional performance criteria relate to the need to manage property runoff safely. The code has specific performance criteria and acceptable solutions for managing flood impacts.
Structure Planning Code	The code is triggered by any impact assessable development including reconfiguring a lot or material change of use in an Emerging Community Area or a Future

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		Industry Area. The code requires the preparation of a detailed structure plan to guide future development in these areas including the identification of relevant constraints for development such as flooding. The code requires the identification in a structure plan of flood affected land identified as being below the Flood Regulation Line.	
	Subdivision Code	Limited broad or detailed guidance for management of impacts on flooding Relies on other codes in relation to the management of stormwater, however, Gaskell suggests some stronger stormwater management / overland flow statements may be warranted.	
	Waterway Code	Limited broad or detailed guidance for management of impacts on flooding Relies on other codes in relation to the management of stormwater.	
Planning Scheme Policies	The two relevant planning scheme policies (PSP) contain significant and detailed provisions relevant to flooding. However they have a low level of statutory impact, and are more able to be waived if circumstances permit. A more robust approach would be relocate much of the content of these policies to the codes where a more stringent application of the standards can be applied. **Subdivision and Development Guidelines** The Subdivision and Development Guidelines provide the most robust and indepth approach to assessing the impacts of development on flooding. The guidelines are a Planning Scheme Policy prepared as part of the Brisbane City Plan 2000, and support the regulation of development (primarily through codes) contained within the City Plan. The policy provides technical standards, requirements and processes for assessing flood issues. In particular a range of key codes provide direct reference to the Guidelines. Two sections in the guidelines are relevant to flooding and stormwater management. Part A, Chapter 1 of the document addresses flood affected land, and sets out flood immunity standards for residential developments, including intensifying use in infill development; □ flood immunity standards for industrial / commercial developments; road trafficability; and earthworks adjacent to waterways and flow paths. Part B, Chapter 2 addresses Stormwater Drainage requirements including lawful point of discharge, stormwater outlets, easements, pumped stormwater drainage, building over/near stormwater		

	facilities, and design parameters. And water sensitive urban design. Infrastructure requirements for different types of drainage are also included. **Compensatory Earthworks Planning Scheme Policy** The Compensatory Earthworks Planning Scheme Policy provides in-depth assessment requirements for development to mitigate the impacts of filling and excavation on flooding where called up by the performance criteria in the Filling and Excavation Code. The PSP sets out requirements for development when reshaping of land is proposed within a waterway corridor. The objective of the PSP is to *"... ensure that earthworks reduce neither the flood–storage capacity nor flood–carrying capacity of the area within a Waterway Corridor"*. The policy states that earthworks within a Waterway Corridor must demonstrate that they: • do not conflict with the Waterway Code or the Filling and Excavation Code; and • do not adversely impact the hydraulic characteristics of the watercourse with impacts cited including: - reducing the flood–carrying capacity of a watercourse; and/or - reducing flood storage; and/or - altering the hydraulic control of the stream and thus causing scour and sedimentation. The policy sets out the application requirements of development to provide 'compensatory earthworks' (incrementally calculated) rather than 'balanced earthworks' (total fill = total cut) where proposed in a waterway corridor.

Comment:

Temporary Local Planning Instrument

Brisbane City Council's *Temporary Local Planning Instrument (TLPI) 01/11 - Brisbane Interim Flood Response* was put in place as ain interim response to the January 2011 Brisbane River flood. A TLPI is a one year temporary instrument that can temporarily suspend sections of the planning scheme were need and urgency criteria can be met for doing so. A standard update to the City Plan can take up to about 18 months to put in place. The TLPI applies to the land affected by the January 2011 Brisbane River flooding as well as by waterway or creek flooding.

It affects residential development including filling, as well as the location of essential services (electricity supply, telecommunications, fire services) in both residential and commercial buildings.

The TLPI:

- introduces the Interim Residential Flood Level (IRFL) which will require building levels to be increased
- allows building heights to increase in response to increased floor levels
- requires the location of essential services (electricity supply, telecommunications, fire services) to be either higher than the IRFL or sufficiently waterproofed
- states filling and retaining walls must not create local drainage problems or cause

amenity issues

- determines instances where resilient building materials will have to be used in developments.
- Allows variation in nimimum site levels usually required under City Plan where it can be demonstrated that a house can reasonably be built that achieves other immunity requirement, in order to protect local amenity.

Consistent with the recommendations of the Joint Flood Taskforce, the Interim Residential Flood Level is the 2011 flood level, or the existing DFE, whichever is higher. Q100 is used as the DFE for creek flooding.

Amendment to City Plan prior to New City Plan

An amendement to the City Plan 2000 is being prepared by the City Plan Implementation Team to cover the period between the expiry of the TLPI in mid 2012 and the commencement of the new City Plan, likely in 2013/2014. The scope of the amendment is likely to be similar to the TLPI, but will potentially include additional issues, as well as adjustments based on feedback on the TLPI's performance.

10) Existing Plans, Policies and Guidance

Lord Mayor's Taskforce for Suburban Flooding

The Lord Mayor's Taskforce on Suburban Flooding was established in 2005 to examine possible strategies to reduce the effects of significant rain events on areas of the city liable to frequent flooding, including reducing the impact of creek and overland flow flooding on the owners and occupiers of flood-prone land, as well as reducing private losses from flooding.

The Taskforce's objectives and outcomes were:

1. Consider the existing, future and residual flood risks and examine actions to reduce the impact of flood events on residents in flood-prone areas.
2. Determine longer term strategies to reduce the impact of flooding on the city.
3. Evaluate the feasibility and likely costs of the strategies and actions.
4. Provide specific recommendations and create a prioritised list of work to be undertaken.

The Taskforce released a strategy which identified 22 major findings to improve Council's policy and practices regarding management of creek and overland flow flooding, under four management measures:

1. Non Structural Measures, aimed at reducing or avoiding the susceptibility of new and existing development to flooding, (keeping people and vulnerable activities away from floodwaters). These include **Land Use Controls**, **Environmental Management** and **Voluntary Residential House Buy-Back**.

2. Structural Measures, aimed at physically modifying the natural behaviour of flooding and reducing the frequency and impact of flooding, (keeping floodwaters away from people and managing the impact floodwaters have on structures). These include **Structural Controls** (to ensure adequate design, construction and maintenance of structure flood controls), and **Development and Building Controls** (to define appropriate development and building controls for floodprone areas).

3. Flood Preparedness Measures, aimed at 'getting people ready for floods before they come. This includes flood risk management planning, flood studies,

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information management, education and communication, flood forecasting and warning, flood insurance, and legal and administrative measures.

4. Flood Emergency Measures, aimed at 'helping affected people to cope and recover from the effects of flooding.

Relevant recommendations from the taskforce are included with responses in Part 3 of this report.

Joint Flood Taskforce

Brisbane City Council's Joint Flood Taskforce Report was formed to investigate the January 2011 flood event and make recommendations within 30 days in order to provide interim guidance on flood levels and controls over the next 1 to 2 years. The Taskforce Report was endorsed in March 2011.

The Taskforce was charged with investigating the following questions:

1. How does the January 20011 flood event compare to the Q100 as presently defined and Brisbane City Council's Defined Flood Event (DFE)?
2. Does Q100, as it is currently described, remain the best estimate of a 1 in 100 year event?
3. Accordingly, what standard should be used to enable new development and redevelopment to proceed with confidence and certainty?

This report only considered river flooding within Brisbane, therefore excluding creek flooding, flooding in the Bremer River, and the impact of climate change. This report assumes Dams were operated inline with current legislated operating procedures, and did not consider the appropriateness of the Wivenhoe Dam operation procedures.

Taskforce findings concerned matters including examination of the January 2011 flood event, flood risk management options and flood control levels in Brisbane. Key findings were:

Conclusions and Recommendations
The Taskforce considered that the January 2011 flood event was larger than the Brisbane City Council's Defined Flood Event, and recommended that the actual January 2011 flood event (or the existing DFL, whichever is higher) be used as the interim standard on which Brisbane City Council should base its decisions concerning new development and redevelopment affected by Brisbane River Flooding.

It also recommended that a comprehensive flood study be commissioned to review flood flows and levels within the Brisbane River catchment and that additional technical investigations be undertaken.

Recommendations are summarised in Part 3, with responses.

Inland Flood Study

The Inland Flooding Study was a joint project undertaken by the Department of Environment and Resource Management, Department of Infrastructure and Planning and the Local Government Association of Queensland in 2010, designed to improve Queensland's resilience to extreme flood events due to climate change.

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The project was established to recommend options to increase community resilience to extreme flood events by providing:

- a recommended climate change factor for use by local councils in future flood studies
- specific policy options for improved flood risk management in the Gayndah case study area
- recommendations for inclusion in the review of the State Planning Policy 1/03 Mitigating the Adverse Impacts of Flood, Bushfire and Landslide.

The study delivers guidance for local councils on planning for increased flood risk from extreme events resulting from climate change, providing climate change assumptions for rainfall intensity, and a worked example of how the effects of climate change can be incorporated into planning schemes under State Planning Policy 1/03. Documents resulting from the study are:

- *The final report Increasing Queensland's Resilience to Inland Flooding in a Changing Climate*
- *Policy Options for Improved Flood Risk Management Using the Gayndah Case Study Area (including a worked example applied to the Gayndah Case Study area)*
- *Scientific Advisory Group Report (discussion of assumptions and methodology for factoring increases in rainfall intensity into flood modelling)*
- *Inland Flooding Study Partnership fact sheet*

Outcomes from the study.

1. Climate change factors for flood studies

The study provides local governments with a recommended climate change factor for increased rainfall intensity for incorporation into flood studies. It proposes a 5 per cent increase in rainfall intensity per degree of global warming. This 5 per cent increase in rainfall intensity per degree of global warming can be incorporated into the 1-in-100, 1-in-200 and 1-in-500 year flood levels for the location and design of new development in the State Planning Policy 1/03. Local governments are advised to use the following temperature increases and planning timeframes:

- 2^0C by 2050
- 3^0C by 2070
- 4^0C by 2100.

This climate change factor is limited to flood risk management for planning purposes as described by the State Planning Policy 1/03 and does not extend to more frequent events such as a 1-in-50 year flood or more extreme events than a 1-in-500 year flood. The climate change factor applies to floods arising from rainfall events of at least one hour or more.

The climate change factor given in the study will be reviewed and updated when a national position on how to factor climate change into fl ood studies is finalised. The outcomes of this national review are not expected to be available before 2014.

The climate change factors derived for this study fall within the 3-10 per cent range per degree of global warming recognised in the best available scientifi c literature.

2. Policy options for Gayndah township case study

Two options for incorporating rainfall intensity due to climate change were explored and included in the study. The two options recommended apply the same climate

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change factor, but offer two implementation approaches developed in consultation with the North Burnett Regional Council. Option 1 uses new flood maps showing revised extreme event flood levels for 2050, 2070 and 2100 that include the climate change factor. Whereas Option 2 uses the Council's recent flood study to approximate future extreme event flood levels under climate change.

The report calculated that, based on modeling, for the Gayndah township, the current 1-in-200 flood level will approximate to the 1-in-100 year flood event by 2050, and the current 1-in-500 year flood level will approximate to the 1-in-100 year flood level by 2100.

While the recommended policy options are specific to the Gayndah township, the approach is published for information to other local governments in Queensland.

3. Recommendations for the State Planning Policy 1/03 review

The Inland Flooding Study makes a number of recommendations that relate to the review of the State Planning Policy 1/03. These include identifying how frequently flood studies should be reviewed and/or updated, and investigating the circumstances in which councils should be able to have a 'Defined Flood Event' that is higher or lower than the 1-in-100 year flood.

Flood Review Board

The Flood Response Review Board was a BCC established investigation reviewing Council's response to the Brisbane flood in January 2011.

Its purpose included:

- Determining the effectiveness of Council's disaster management arrangements
- Determining the effectiveness of flood prevention and stormwater infrastructure
- analysis of the reasons for Council's riverine infrastructure failures
- analysis of the integration of Council's response with other agencies
- reviewing the effectiveness of the response, including:
    - *field operations*
    - *evacuation*
    - *intelligence management and dissemination*
    - *forward planning*
    - *management of supporting agencies*
    - *logistics planning and procurement arrangements*
    - *contractor support and management*
    - *management of volunteers (individuals through to large commercial support)*
    - *waste and debris management and disposal transition to recovery*

The 53 recommendations from the report have been developed into an Action Plan outlining proposed implementation. This will be developed over coming norths. Key findings relevant to preparation of provisions for the City Plan are summarized below.

- Large floods occur in Brisbane with unpredictable frequency, causing great loss and hardship to the city and its citizens.
- Council does not have a free hand in setting planning regulations for the city, needing to work within the legal framework created by State legislation.

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- Council's planning regulations and guidelines have been influenced to a significant degree, by the Defined Flood Level (DFL) adopted in 1978, which is partly credited with guiding development away from flood-prone areas.
- Almost 90% of residential properties in Brisbane that were flood affected are in areas that had been predominantly developed prior to 1978.
- Council is progressively implementing the "Key Actions" recommended by the Lord Mayor's Taskforce on Suburban Flooding (2005).
- A complete Flood Risk Management analysis of flood affected areas in the city is recommended. Though very expensive, the analysis should be seen as vital for an important metropolis.
- Of the engineering options that Council could consider for flood prevention in Brisbane, only two measures, backflow prevention devices and use of levees to protect specific high value infrastructure, are found to be appropriate for further consideration.
- The Board commended Council for its Growth Planning Strategy which envisages growth centres and transport corridors outside potentially flood affected areas and notes that 89.5% of all flood affected residential properties were in areas developed predominantly prior to 1978.
- The Board commended Council for its progressive implementation of the recommendations of the Lord Mayor's Taskforce on Suburban Flooding (2005) which has resulted in a reduction in the risk of flooding in recently developed areas.
- The Board commended the development of strategies and effective planning instruments to encourage development of flood resilient building design and construction.
- In relation to the Brisbane Central Business District and high-rise residential building inundation, Council should consider hosting a symposium for all affected parties with a view to identifying best practice approaches to ensure improved flooding resilience.
- Council should investigate the feasibility of the installation of devices to prevent backflow from river flooding in locations such as in parts of the Central Business District (CBD) and In high rise buildings which would not have been flooded otherwise, where all those potentially affected by backflow flooding have responsibility for oversight of the maintenance of the device in working order
- Council should investigate the feasibility and appropriateness of establishing local levees to protect areas of strategic significance such as the Rocklea Markets. This will require a complete risk based flood management analysis.
- The Board recommended that the term, Defined Flood Level, be used exclusively in public documents concerning flood planning levels for Brisbane, regardless of the cause of the flooding.
- In relation to planning, Council should undertake a complete flood risk management analysis for the area of Brisbane affected by flooding from the Brisbane River and associated tributaries in line with National Flood Risk Advisory Group (NFRAG) and other relevant guidelines. This would require a detailed assessment of the benefits and costs of a full range of flood mitigation options.
- The Board commended the initiative of Council in developing strategies and effective planning instruments to encourage development of flood resilient building design and construction.

11) Other Plans

Climate change Brisbane's Plan for Action

Brisbane City Council's 'Plan for Action on Climate Change and Energy' outlines actions for responding to climate change (mitigation and adaptation) under eight

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strategic areas (leadership and partnering; decision making; communication and education; strategic and land use planning; sustainable transport; preparedness for change, emergencies and surprises; natural resource management; research).

Relevant actions from the plan are:

Action 3 Developing partnerships with the Queensland and Commonwealth Governments to achieve policy changes. For the Queensland Government, this is noted to include:

- Creating a 'round table' for sustainability, including responsibility for climate change and peak oil adaptation.
- Funding adaptation measures, such as relocation of buildings and infrastructure from high risk areas as necessary.

Action 6 By 2012, Council will conduct an assessment of the implications of climate change and peak oil for all of its facilities and infrastructure.

Action 13 Council will account for climate change and peak oil in the upcoming major City Plan review and ensure that these planning instruments are used to their full potential for climate change and peak oil adaptation.

Immediately develop a discrete package of interim amendments to City Plan that will upgrade the plan to address policy issues that are already well understood, such as:

- check the Q100 flood level
- enhanced stormwater and flood-related infrastructure requirements

Ensure that infrastructure charges plans incorporate the full costs of infrastructure development and then consider providing transparent incentives to encourage sustainable development (for example the Sustainable Development Incentives Policy).

Action 22 Council will engage with owners and managers of critical infrastructure in the city and encourage them to address risk from climate change and peak oil.

- Require forward planning for Council assets, especially water supply, wastewater treatment plants, stormwater, roads and bridges.

Communicate with major employers and significant businesses to advise them of Council's response to climate change and peak oil risks and encourage them to conduct contingency and forward planning

Action 23 Enhance Council's commitment to disaster management and ensure that disaster management planning fully accounts for climate change related impacts.

- Establish flooding and storm surge response plans.

Action 27

- Increase bushland reserves and connectivity between them as a vital component of the regional carbon sink and to provide additional protection of natural areas from changing micro-climatic conditions.
- Investigate the vulnerability of significant local natural areas (for example wetlands) to climate changes.

Action 30 Seek input from research bodies and experts conducting research and development for issues directly relevant to Brisbane's response

to climate change and peak oil. Topics include, amongst other things:

- Understanding sea level rise and storm surge impacts on Brisbane.

ClimateSmart Adaption 2007 – 2012,

The ClimateSmart Adaptation 2007-2012 report is an action plan for managing the impacts of climate change for Queensland. It supports national actions for adaptation from stakeholder input and state priorities relevant to Queensland. The actions aim to capture benefits from early adaption planning, reduce vulnerability in priority sectors, and establish the foundations needed for future adaption actions. All actions listed in the plan are assigned to Queensland Government agencies.

1. Prepare regional-scale climate change projections for priority areas, to offer more localised information for planning and decision making. 'Downscale' the broad climate change projections currently provided to enable assessments of the impacts of climate change.	End 2010
3. Prepare a climate change vulnerability assessment of Queensland's regions and sectors.	End 2007
15. Integrate climate change considerations and new projections into: • decisions about water infrastructure • water-quality management of dams and reservoirs • water planning (including water resource plans, resource operations plans, and regional water supply strategies) and water-quality improvement programs.	End 2012
16. Diversify water-supply sources to reduce dependency on vulnerable supplies. This requires: • considering climate change in regional water security plans • investigating the potential of less climate dependant water supply options.	End 2012
21. Integrate downscaled and regional climate change projections into hydrological models for water planning and assessment of changes in flood risk for urban and infrastructure planning.	End 2010
29. Improve understanding about the risks and impacts of climate change to coastal Queensland: • continue storm-tide and wave monitoring systems • improve projections of inundation and flooding due to changes in sea level and extreme events • work with local government to identify and map areas most at risk from storm tides • integrate the information gained into advice and tools (e.g. digital elevation modelling of coastal Queensland).	End 2010
30. Contribute to the development of a Queensland Local Government Climate Change Management Strategy.	End 2007
31. Ensure regional planning activities under the *Integrated Planning Act 1997* draw together state and local government responses to climate change, including the: • 2010 review of the SEQ Regional Plan • Far North Queensland Regional Plan.	End 2010
32. Incorporate changes in flood risk due to climate change in the proposed State Flood Risk Management Policy, local government floodplain management plans and relevant state guidelines.	End 2010

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33. Update the *Queensland Urban Drainage Manual* as needed to refl ect changes in hydrology associated with climate change.	End 2012
34. Periodically review physical infrastructure to determine: • the extent to which climate change may affect operational performance • whether measures are needed to ensure system durability, safety and reliability.1	End 2010
35. Review the effectiveness of existing planning tools in addressing the increased risks from climate change, including the: • *State Planning Policy 1/03: Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* • *State Coastal Management Plan* • local government planning schemes.	Mid-2008
36. Review planning guidance given to local government on shoreline erosion management to ensure it integrates climate change, and establish an associated grants scheme.	Mid-2011
50. Improve models for sediment movement and salinity intrusion in coastal and riverine environments to ensure they incorporate: • sea-level rise • increases in rainfall intensity • changes to sediment supply • impacts on engineering, nourishment and other management measures.	End 2011
51. Build the capacity of disadvantaged communities to effectively respond to the potential social and economic impacts of climate change.	End 2012
52. Continue to provide planning and emergency management advice on storm tides, and investigate whether measures are adequate for the next 30 years.	End 2012
53. Ensure that reviews of local disaster management plans include relevant climate change issues.	End 2010

The Draft South East Queensland Climate Change Management Plan 2009

The *Draft South East Queensland Climate Change Management Plan* was prepared by the Department of Infrastructure and Planning to help communities in South East Queensland more resilient to the possible impacts of climate change and to reduce greenhouse gas emissions, and to guide future development and infrastructure. The climate change planning actions within the report are aimed to be consistent with Queensland Government policies on affordable housing and practical and cost effective for local governments to incorporate into new planning schemes.

The SEQRP and the draft SEQCCMP have a key and strategic role in driving responses to natural hazards and climate change adaption in conjunction with other approaches such as disaster management plans.

Actions in the draft plan align with the scope of the SEQ Regional Plan, and relate to the following range of planning decisions:

- *development (and associated infrastructure) that is regulated through planning legislation, including local government planning schemes, structure or master plans and development applications*
- *relevant state agency plans and policies*
- *statutory and non-statutory planning actions*
- *planning support actions, such as providing spatial information and planning guidance.*

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The plan's draft actions are intended to implement the climate change policies of the SEQ Regional Plan based on suggestions identified through preliminary consultations. The following action summaries are of relevance to local government landuse planning.

SEQRP2009 Principle: *Natural Hazards and Climate Change Adaption*	SEQRP2009 Policies: *Coastal Hazards*	20. Prepare a new Queensland Coastal Plan and supporting guidelines
		21. Update the current guideline, Mitigating the adverse impacts of storm tide inundation to incorporate current climate change science
		22. Implement the policies of the new Queensland Coastal Plan through regional and local planning, and development and infrastructure decision making in SEQ
		23. Acquire fine-scale digital elevation data for coastal areas for use in assessing risk and mapping hazard-prone areas in SEQ
		24. Prepare and publish regional- and local-scale risk assessments and maps of coastal hazard-prone areas using the methodology, sea-level rise and storm-intensity factors in the new Queensland Coastal Plan
	SEQRP2009 Policies: *Riverine flooding, bushfires, high temperatures and other natural hazards*	25. Review and update State Planning Policy (SPP) 1/03—Mitigating the Adverse Impacts of Flood, Bushfire and Landslide, and develop supporting guidelines
		26. Develop guidelines for the preparation of hazard and risk maps including the projected effects of climate change on natural hazards within the scope of the revised SPP 1/03
		27. Develop a regional summary of projected climate change impacts for SEQ
		28. Prepare local-scale climate-resilient urban planning and design guidelines and performance criteria for sensitive areas
	SEQRP 2009 Policies: Building resilience through increased awareness and behaviour change	32. Develop and implement a communications strategy to support actions to build resilience to natural hazards and the projected effects of climate change in SEQ

12) Existing Studies

Report on Brisbane City Natural Disaster Risk Management Study – Brisbane River Flooding Phase (2004).

The Report on Brisbane City Natural Disaster Risk Management Study – Flooding Phase. was prepared as part of Brisbane City Council's (BCC) multi-hazard Natural Disaster Risk Management Study (NDRMS) undertaken in cooperation with the Queensland Government (Counter Disaster and Rescue Services, Department of Emergency Services) and the Commonwealth Government's Department of Transport and Regional Services (DOTARS).

Deliverables of the study were:
- A Knowledge Base (bibliography of references)

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• The Risk Methodology
• Example of a Risk Assessment
• Mitigation Strategies
• A Communications Strategy Paper
• Sample Maps

The study assumes Defined Flood Events based on flow rates which equate to a one-in-20 year, a one-in-100 year, and a one-in-1000 year event respectively. The one-in-100 year event was the primary focus of a series of workshops, which examined community consequences of a flood.

The study examined:

- Flood preparedness measures
  - Public education and awareness
  - Forecasts and warning systems
  - Flood Studies
  - Insurance
- Flood Emergency Measures.
  - Disaster Management Structures
  - Disaster Management Plans
  - Response Capability
  - Implementation of training and exercise
- Structural Measures (including building controls and structural controls for flood-related infrastructure (e.g. drainage programs and upgrades etc)
- Non Structural Measures (including land use planning controls and guidelines and environmental management).

These measures were then compared to existing strategies. It was found that Brisbane City Council already has in train most of these strategies, incorporated in mainstream planning and budgetary processes, and therefore found the risks are already well managed.

Maps of affected areas were produced.

A communications paper *Brisbane River Flood: Strategic Framework for Communications* was developed as the basis for a comprehensive, on-going, community education program comprising a public education and awareness campaign (to build knowledge and awareness) and a communications campaign (for use during a disaster event).

Risk Management Assessment
A risk analysis was conducted as part of the project, specifically considering the Port of Brisbane and the river mouth to Breakfast Creek as sample risk areas. Relevant current and potential mitigation solutions to impacts were also identified in the report.

A comprehensive set of mitigation strategies were developed as a result of the study. They cover flood preparedness measures, flood emergency measures, structural measures and non-structural measures. Relevant mitigation strategies for the NDRM flooding work are :

- Inform the development/real estate industries about the risks and mitigation strategies associated with river flood. This needs to be a targeted campaign for this important stakeholder group.

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- *Flood studies* – Conduct further studies (for different defined flood events, including the Probable maximum Flood) to inform disaster management planning and operational processes.
- Review building controls to ensure these conform to State Planning Policy
- Ensure planning scheme policies of Brisbane City Plan 2000 comply with
- State Planning Policy on *Mitigating the Adverse Impacts of Flood,Bushfire and Landslide* and with DNRM's State Flood Plan.
- Review the Strategic Plan to ensure compliance with the State Planning Policy
- Incorporate updated mapping in City Plan.

These measures were then compared to existing strategies. ***It was found that Brisbane City Council already has in train most of these strategies; and they are incorporated in mainstream planning and budgetary processes. To this extent the risks are already well managed.***

The major deficiency identified was in flood preparedness (public education and awareness)

Report on Brisbane City Natural Disaster Risk Management Study – Other Water Borne Hazards Phase (2004).

Brisbane City Council and other stakeholders commissioned the Report on Brisbane City Natural Disaster Risk Management Study – Other Water Based Hazards Phase (Severe Storm, East Coast Low and Storm Tide). The report was prepared as part of a wider Natural Disaster Risk Management project undertaken in cooperation with the Queensland Government (Counter Disaster and Rescue Services, Department of Emergency Services) and the Commonwealth Government's Department of Transport and Regional Services (DOTARS).

Deliverables for the project included:

- An updated Knowledge Base (bibliography of useful documents for reference)
- Risk Assessments for:
    - East Coast Low
    - Severe Storm
    - Storm Tide
- Mitigation measures for each of the above hazards
- Storm Tide Maps showing affected infrastructure and property for a defined storm tide event (roughly equating to the 1 in 100 year event with allowances for climate change.
- A communications strategy

Map Products

East Coast Low and Severe Storm were not mapped mapping products, since these two hazards are regarded as being possible throughout the City. Storm tide maps were produced, showing a storm tide level of 2.5 mAHD, based on a combination of astronomical tides, with an allowance for a sea level rise of 0.3m.

Critical infrastructure and properties potentially affected by the 2.5m Storm Tide event were also mapped.

Water Based Hazard Communications Strategy

The Communications and Consultation Strategy for Other Water Based Hazards (East Coast Low, Severe Storm and Storm Tide) methodology provides a broad outline of the audiences, key messages and channels for communicating to residents and ratepayers about water based hazards.

Risk Management Assessment
A risk analysis was conducted as part of the project examining Brisbane City, Bay Islands and adjacent coastal areas including fresh water wetlands and tidal affected waterways and wetlands

Aspects of hazards identified were:

- High winds/tornado
- Heavy rain
- Hail damage
- Lightning Strike
- Wave Action
- Flooding of drainage systems
- Flooding of waterways
- Storm tide
- Inundation of low-lying areas
- Inundation by saline water

Specific Risks were identified under the following categories:

- Lifelines and critical infrastructure threatened
- Natural environment threatened
- Threat to built environment and property
- People endangered
- Disruption to economic and community activities

Flood Hazard Mitigation Strategies
The report identifies mitigation stratigies in its risk analysis.

The most significant exposures for each of the three natural disasters are summarised below.

East Coast Low:
Hazard 1 Heavy Rain – Lifelines and critical infrastructure threatened – HIGH (for both current and residual risk)

Hazard 2 Flooding of Drainage System
- 1) Lifelines and critical infrastructure threatened – HIGH (for both current and residual risk)
- 2) People endangered – HIGH (for both current and residual risk)

Severe Storm:
• Hazard 1 High Winds – Lifelines and critical infrastructure threatened – HIGH (for both current and residual risk)
• Hazard 2 Heavy Rain - Lifelines and critical infrastructure threatened – HIGH (for both current and residual risk)
• Hazard 3 Flooding of Drainage System
- 1) Lifelines and critical infrastructure threatened – HIGH (for both current and residual risk)
- 2) People endangered – HIGH (for both current and residual risk)

Storm Tide:
• Hazard 1 Wave Action – Lifelines and critical infrastructure threatened – HIGH (for both current and residual risk)

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There are no Very High or Extreme risks requiring immediate action.

The report recommended that the deliverables be passed to City Policy and Strategy Division for use in their business processes

Brisbane Valley Flood Damage Minimisation Study - Brisbane City Flood Damage Assessment

The Brisbane Valley Flood Damage Minimisation Study - Brisbane City Flood Damage Assessment was undertaken in 2006 by BCC staff, assisted and peer reviewed by Water & Environment Pty.

The study was undertaken as part of the Brisbane Valley Flood Damage Minimisation Study (BVFDMS) in conjunction with Ipswich City Council and Esk Shire Council. The overall study aimed to estimate potential flood damage in the Brisbane Valley and then assess the flood operation rules for the Wivenhoe Dam flood gates to determine whether
the current rules can be modified to reduce flood damage in the valley.

The work focuses on flood damage assessment for Brisbane River floods.

The study findings summarise the residential, non-residential and total potential flood damage that will be experienced in the Brisbane City area for flood discharges ranging from 1000 m^3/s to 10000 m^3/s. The number of residential properties and the number of nonresidential
buildings that will incur flood damage for each of the flood events are also shown. A graph is provided estimating the flood damages in millions against flood discharges.

Brisbane River Hydraulic Model to Probable Maximum Flood (PMF) Report

The Brisbane River Hydraulic Model to Probable Maximum Flood (PMF) Final Report (2009) was prepared for Families & Community Services Branch (Disaster Management) by City Design.

The report uses a model (a two dimensional (2D) TUFLOW hydraulic model for the Brisbane River floodplain from Wivenhoe Dam to Moreton Bay) to anticipate flows in the Brisbane River at different levels, up to the probable maximum flood.

· Model outputs have been translated into flood emergency response tools to be utilised during a river flooding event for emergency preparation and response planning. Specifically, these including:

- Inundation mapping
- Critical infrastructure mapping and reporting
- Isolated area mapping
- Evacuation zone mapping

However, it is noted that further work is required, including to

- Incorporate into the 2D model the Council's new survey data (available in late 2009) and produce an addendum report
- Incorporate the results of this Project into the Council's Disaster Management Planning; ***Threat Specific Plan for River Flood and Storm Surge Event (2008)***.
- Develop a community safety education campaign

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- Investigate 'innovative ways' that the results of this project can be applied to improve the interpretation across the various disciplines within the Council.

Calculation of the isolated areas in different scale events is of particular interest to the NDRM project. To do this, a GIS methodology was developed to calculate sites' flood free access to roads out of their immediate area (not only access to a local road).

Additional Inputs

Additional inputs to the development of the flood code include:

- Draft flood code (Water Resources with John Gaskell 2007)
- Development Assessment comments on what is needed for the flood code, and Water Resources Action Plan for addressing this.

13) Gaskell Report – Gap Analysis for City Plan and SPP 1/03

The Natural Disaster Risk Management and the City Plan – Consideration of SPP 1/03 report (The Gaskell Report) was prepared in 2009/2010 by John Gaskell Planning Consultants in collaboration with Environmental and Community Risk International (ECRI) and WRM Water and Environment.

The report reviews the compliance of the Brisbane City Plan 2000 with SPP 1/03, and conducts a gap analysis to identify necessary improvements.

With regard to flooding, the review and gap analysis raises the following key issues:

Gap Analysis between Brisbane City Plan 2000 and SPP 1/03 – from Gaskell 2010

State Planning Policy 1/03	Gap analysis
Outcome 1: Within natural hazard management areas, development to which this SPP applies is compatible with the nature of the natural hazard, except where: • the development proposal is a development commitment; or • there is an overriding need for the development in the public interest and no other site is suitable and reasonably available for the proposal.	• It is considered that the City Plan is compliant with Outcome 1. • Information on the severity of flood hazard, if available, could be helpful in assessing development against the requirements of the SPP. • In relation to flood, the City Plan is currently deficient in identifying the location and extent of natural hazard management areas. • However flood immunity standards are provided in the subdivision and development guidelines planning scheme policy and flood data is available to Council and development proponents for the purposes of development assessment. • In particular, City Plan development Codes, against which the majority of development is assessed, contain some performance criteria that relate directly to compatibility of development with the flood hazard. For example, the Stormwater Management Code. *The proposed stormwater management system or site works must not* *adversely impact on flooding or drainage of properties that are upstream,* *downstream or adjacent to the subject site.* • Design standards for flood immunity are primarily contained within Council's Subdivision and Development Guidelines, which are referenced by numerous development Codes (in particular the filling and excavation

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	code and stormwater management code). The Subdivision and Development Guidelines specify required minimum flood immunity levels for allotments, floor levels and road trafficability, depending upon the type of development. The Guidelines also specify flood immunity levels for community infrastructure which correspond to the recommended levels of immunity provided in SPP 1/03. • The subdivision and development guidelines establish the "low flood hazard zone" criteria that defines the limit on where the intensification of land use (redevelopment/infill development) may be permissible • Classification of the severity of hazard is not required under the SPP, this information, if available, could be helpful in assessing development against the requirements of the SPP.
Outcome 2: Development that is not compatible with the nature of the natural hazard but is otherwise consistent with Outcome 1: • minimises as far as practicable the adverse impacts from natural hazards; and • does not result in an unacceptable risk18 to people or property.	• It is considered that the City Plan is compliant with Outcome 2. • Through the various development Codes and the Subdivision and Development • Guidelines, City Plan requires development to comply with Outcome 1 of the SPP. In a case where this was not possible, the same mechanisms would be used to ensure compliance with Outcome 2 of the SPP.
Outcome 3: Wherever practicable, community infrastructure to which this SPP applies is located and designed to function effectively during and immediately after natural hazard events commensurate with a specified level of risk.	• It is considered that the City Plan is compliant with Outcome 3. • Table 1.4 of Chapter 1 (page 6) of the Subdivision and Development Guidelines (a planning scheme policy in the City Plan) directly references the flood immunity levels recommended in SPP 1/03 and hence is compliant with Outcome 3.
Outcome 4: Natural hazard management areas are identified in the planning scheme.	• It is considered that the City Plan is not compliant with Outcome 4 as no mapping sets out the 'location and extent' of the natural hazard management areas. • City Plan does not currently identify the location and extent of natural hazard management areas for flood, although this information is available. There is some ambiguity in the terms used in City Plan to describe flood hazard. The adopted Defined Flood Event should be clearly identified. The definition and role of Flood Regulation Lines should be clarified. • Available flood mapping does not explicitly state what criteria or event has been used to derive the adopted flood extents. The Subdivision and Development Guidelines refer to events of different ARI and also to a defined flood level (DFL), based on the 3.7 mAHD level at the Brisbane Port Office Gauge. Gaskell suggests this is ambiguous as it is uncertain what flow rate, if any, has been used in combination with the Port Office level to derive the DFL

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	throughout the city. • The SPP refers to the adoption of a defined flood event, the probability of which can be estimated, rather than a defined flood level which could potentially be more arbitrary. • The methodology used to define Flood Regulation Lines is unclear and hence it is uncertain how these lines relate to the definition of natural hazard management areas since Regulation Lines do not necessarily define the limit of flooding for a DFE.
Outcome 5: The planning scheme contains planning strategies that aim to: • ensure that development in natural hazard management areas is compatible with the nature of the natural hazard; • minimise the impacts from natural hazards on existing developed areas; and • prevent development from materially increasing the extent or the severity of natural hazards.	• It is considered that the City Plan is compliant with Outcome 5. • There is scope for the City Plan to provide a stronger and more integrated policy and regulatory basis to assess flood risk issues (consideration of depth and velocity)
Outcome 6: The planning scheme measures: a) include a code(s) designed to achieve development outcomes consistent with Section 6; and b) ensure that development to which this SPP applies is assessable or self-assessable against that planning scheme code(s). The planning scheme, or planning scheme policy(s), specifies the information expected to be submitted with development applications subject to the code(s).	• It is considered that the City Plan is compliant with Outcome 6 in that assessment of flood risk is triggered for development including: development for a house, including assessment of development of a house in a waterway corridor and for habitable and non habitable rooms to achieve flood immunity; and filling and excavation, including filling and excavation in a waterway. • Other development, where requiring a code or impact assessment applications, contains assessment against applicable codes such as the Stormwater Management Code which contains provisions which require assessment of flood issues. • City Plan specifies the information expected to be submitted with development applications, albeit at a very high level. • Improvements can be made to increase the clarity of Council's code requirements including bringing parts of the Subdivision and Development Guidelines into the planning scheme.

Part 3: Findings

14) Response to Gaskell Report Recommendations:

Considering the key tasks as identified above, Table 3 below outlines the main recommendations from the Gaskell Report, with the recommended response as outlined in stakeholder discussions, and the reason for this recommendation.

Where marked, it will not be possible to determine the degree of impact on land uses across the city likely from implementing recommendations until mapping tasks have been completed to a degree that allows identification of affected landuses and areas, and subsequent analysis of cost/benefit and risk to people and property to be undertaken.

Recommendation	Recommended Response	Rationale
5.13 Recommendations for the New City Plan		
• Ensuring that a strategic planning level the issues of community safety, including the protection of life and property, are key considerations in the assessment of development;	Adopt	The draft Strategic Plan contains wording to increase the emphasis on community safety and protection of life and property.
• Including the natural hazard management areas mapping for all three different hazards in the City Plan;	Adopt	This is a requirement of the SPP 1/03. Updates to floodwise property reports will be required to match updated mapping.
• Including relevant codes to o assess the risks and impacts arising from proposed development in the natural hazard management areas to understand their compatibility (or otherwise), and o [assess] whether further information or conditions will address the requirements of the risk management framework of the new codes;	Adopt	This is a requirement of the SPP 1/03. Content of codes will include a framework for assessing risk and management requirements.
• Including relevant level of assessment for assessing development in natural hazard areas. This may include self assessable or compliance assessment when the hazard assessment can be provided by external (other than a code or impact assessment application) means to meet requirements. The level of assessment will depend	Adopt	This will be considered when drafting provisions for the new City Plan, and during regulatory impact assessment.

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Recommendation	Recommended Response	Rationale
on the assessment of risk and how the risk will be assessed when applications are made.		
• Determining the mapping for the natural hazard management areas in the new planning scheme will be a critical part of the process. • Considerable work has been completed on all three natural hazards and this mapping will need to be incorporated into the new City Plan. The natural hazard management area maps, with the accompanying provisions, will provide a clear basis for the assessment of development in these areas.	Noted. Existing information will be used as a basis for mapping, with consideration also given to emerging requirements (such as a move to a risk based approach) and information (including climate change assumptions and upgraded modelling).	Flood hazard mapping work will necessarily draw on existing information in Council. Recommendations from investigations into the January 2011 flood event, and the adoption of the new Queensland Coastal Plan will influence mapping of natural hazards. A new methodology for determining hazard areas that incorporates requirements from all sources, including the Queensland Government's Commission of Inquiry (due January) will be developed. It is also noted that there is likely to be a high level of change in the first five years of the planning scheme's life, with updated information becoming available which will need to be able to be incorporated as easily as possible into the scheme. This is an influence on the methodology and structure of provisions chosen..
• Houses are the most common form of development in Brisbane City. Houses, when they meet the acceptable solutions of the House Code, or the Residential Design – Small Lot Code, are self assessable. Wherever possible, self assessable or compliance assessment processes should be relied on for houses so as not to increase the number of code or impact assessment applications being lodged and assessed by Council. • However, there will be some circumstances where a new application will be required for a House in a natural hazard management area. The new code(s) should carefully evaluate what assessment is required, and whether this can be achieved by qualified professionals using the Risksmart process.	Adopt	The desirability of preserving self /compliance assessment where possible is noted. Assessment into appropriate levels of assessment will be part of developing City Plan provisions.
5.2 Flooding Recommendations and Strategy		

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Recommendation	Recommended Response	Rationale
• Include stronger strategic level guidance within Council's new strategic plan for protection of people and property from flood risk;	Adopt	The draft Strategic Plan contains wording to increase the emphasis on community safety and protection of life and property. This will be further reviewed. Strategic outcomes, including the influence of hazard areas on growth areas, industrial areas and essential community infrastructure will also be undertaken, and the draft Strategic Plan updated accordingly.
• Include a complete Natural Hazard Management Area map for the DFE for the city. In addition clarify the DFE for the Natural Hazard Management Areas;	Adopt	Mapping will recognise the DFE for different flood types, including the DFE set for the river in accordance with recommendations from the JFT, FRB and other reviews after the January 2011 flood. The inclusion of mapping for the whole city is a requirement of SPP 1/03. Consistent with moving to a risk based approach which recognises hazard in larger events, and worked examples from the Queensland Government, the DFE will not be the limit of the area where hazard management provisions apply. This is part of a move away from a "Q100 or bust" approach, in accordance with best practice. Endorsement of where this partially existing place will be expanded.
• Prepare associated codes and policies to support management of flood risk assessment.	Adopt	This is a requirement of SPP 1/03 and a necessary part of preparing the new City Plan.
• Incorporate risk assessment and floor level standards into the codes (rather than associated policies);	Adopt	A review of City Plan flood immunity standards for all land uses is necessary as part of a move to a risk based approach and new hazard mapping. Conversion of all City Plan provisions to a new Queensland Planning Provisions compliant scheme will require the creation of a new flood hazard code, in addition to review and consolidation of all flood hazard management provisions in the City Plan, including provisions which currently sit within the

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Recommendation	Recommended Response	Rationale
		Subdivision and Development Guidelines.
• Consider incorporating a risk assessment for development proposals that considers flood hazard (flood depth and water velocity). This could be an inclusion in the relevant natural hazard management – flood code. This is recommended as an appropriate response to SPP 1/03 and in line with best practice (SCARM);	Adopt to the extent that this can be incorporated. Suggest staged introduction to be updated as improved information becomes available. Further investigation into how this can be incorporated proceeding.	SPP Guideline references SCARM as a recommended method achieving this recommendation. Council's information about the components of flood hazard (including depth, velocity, warning time, duration) varies across the city, reflecting the age and different methodologies adopted in flood studies for different catchments. Information on velocity is particularly limited for creek flooding, to which it is most relevant. A methodology is being investigated to move towards the proposed risk assessment approach, recognising that improved information will become available over the next 5 years with updates to creek models across the city to a consistent 2D methodology. Until this time, alternative ways of identifying areas of likely highest velocity and means to review development in these areas are being investigated. Requirements for building siting, design, construction and appropriate land use in areas will be structured to reflect the need for hazard, including velocity, to be managed, and .
• The adopted Defined Flood Event should be clearly identified and the definition and role of Flood Regulation Lines should be clarified.	Adopt	Clear identification of the DFE will be necessary in drafting the new code. Investigation is underway into filling within the flood plain as part of managing cumulative impact. Through the work to be completed (as part of a consultancy to be managed by Water Resources), Council's position on filling, and the role and future use (if any) of Flood Regulation Lines will be clarified. References in different parts of City Plan will be amended as a consequence.
• Where detailed flood data is available, review Area/ Zones and compatible land use in areas of high risk – ie. Areas of high depth and high velocity. This will depend	Adopt, to the extent possible given information	A methodology is being developed to identify high hazard areas, taking into account information availability, and the ability to update this bearing in mind improved information over

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Recommendation	Recommended Response	Rationale
on whether this information is available from the flood data in Council, and whether this can be assessed against the City Plan requirements for infill development. This will need considerable investigation and possibly resolution at a policy level to determine any actions that are required.	(model) constraints and endorsement.	the next five years. A review of the strategic implications of the hazard mapping will be undertaken, and provisions developed for development appropriate to the level of hazard. The hazard mapping will be an overlay, but the underlying zoning of the land will be reviewed in places where the level of hazard is not consistent with conducting the uses implied by the zone. Endorsement of proposed changes will be required for this.
• The extent of exempt development (and consequently the extent of filling) within the natural hazard flood areas may require review to test compatibility with the natural hazard;	Adopt	This will be considered during technical investigations (filling), and a review of exempt development undertaken as part of code drafting. Consideration will also include fast tracked development (eg. Risk smart).
• Other Design Codes may need to be amended to state more clearly the requirements for habitable and non habitable floor levels.	Noted. Investigate best location for floor level requirements for all uses.	This is part of code drafting. Discussion and decision by the new City Plan team is required regarding the location of floor level requirements for the best structure of the New City Plan.
• In relation to the SPP 1/03, and the State Government's preparation of any revisions of the SPP 1/03, it would also be highly desirable to bring the storm tide aspects of the Coastal Management Plan under a revised SPP 1/03 rather than it being in a separate policy document. That would greatly improve the likelihood that it will not be overlooked. It will also make it a lot easier to standardise the approach to all forms of inundation hazard.	Not Applicable. Recommendation is for the Queensland Government.	The Queensland Government has released the SPP for Coastal Protection, which covers coastal hazards including tidal and storm tide inundation. Structure of provisions relating to these when brought into a compliant City Plan is being discussed. The desirability of locating provisions together with other flood hazard provisions, or separately in a Coastal Hazards Code will be considered, factoring in the likely size, complexity and similarity of provisions likely to sit within each code.
Review State Government documents addressing climate change including: • 'Climate Q: towards a greener Queensland' which includes	Undertake review as part of scoping an	A review of requirements of documents noted has been conducted. The State Planning Policy for Coastal Protection in conjunction with SPP 1/03 and the SEQ

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Recommendation	Recommended Response	Rationale
broad strategies to reduce • greenhouse gases and increases resilience against climate change impacts; • ClimateSmart 2050, which include a series of short, medium and long term actions to reduce Queensland's greenhouse gas emissions; and • ClimateSmart Adaption 2007 – 2012, which contains 62 actions in response to climate change. • The SEQ Regional Plan - contains policies and strategies which set the high level policy Framework for responding to climate change impacts. • The draft SEQ Climate Change Management Plan - provides an action plan to further the actions in the SEQ Regional Plan, which may impact on the management of natural hazards into the future. • The Draft Coastal Management Plan 2009, which sets out requirements for development including for development 'not already subject to a development commitment' a sea level rise of 0.8m 'will need to be taken into account. These climate change strategies and actions will need careful consideration in the new City Plan, and in the risk management of natural hazards in the assessment of new development under the new City Plan.	appropriate response to climate change. Proceed as soon as possible with discussions regarding Council's Climate Change Adaptation response. Seek clarification as to extent of work that falls within NDRM (and New City Plan) scope.	Regional Plan contain the most specific and detailed requirements for the planning scheme. The advice from the State to have regard to the Inland Flood Study regarding rainfall intensity is also significant clarification of requirements for Council. Of particular relevance to the new City Planand flood code is the requirement for adapation plans to be put in place within 5 years where intensification of development is proposed in areas affected by coastal hazards. Adaptation planning has extensive requirements far exceeding NDRM timeframes and budget. It is proposed that the NDRM project would put forward adaptation planning guidelines and high level strategic principles, to be followed in coming years by more detailed work. This approach would require Council and State endorsement.

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15) Lord Mayor's Taskforce on Suburban Flooding

Recommendation	Recommended Response	Rationale
2: Review and strengthen, where necessary, land use planning controls in City Plan to ensure no adverse impact from flooding: (Priority No. 1 Action with Taskforce Ranking No. 1) ***Council should undertake a comprehensive review of land use planning controls as specified in City Plan to ensure that development (greenfield) and redevelopment (infill) take into account their cumulative impact, and that there are no adverse impacts on properties from flooding and that ecological functions are retained.***	**Support – to the degree possible given project and information constraints.**	The NDRM project scope is to review land use planning controls in City Plan. Ensuring no adverse impact from flooding will be noted as a high level principle, which measures in the plan will seek to address. The proposed process for the development of the flood code includes a strategic review of land uses (including growth areas, new communities, industrial areas) against hazard. Consultancies are also proposed to address cumulative impacts due to peak flows and due to filling within the flood plain. A Complete risk analysis proposed as part of the Joint Flood Taskforce. However such a full review is beyond the timeframe and scope of the NDRM project. Parallel work being conducted in the New City Plan team addresses water quality and ecological functions (see Vicki Grieshaber).

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2.1 Option A (Supported by 6 votes out of 10 possible votes) - Create 'Flooding Code' as a Primary Code in City Plan specific to both greenfield and infill developments. All Sub-actions relevant to this new Flooding Code are to be considered for inclusion in it. Option B (Supported by 2 votes out of 10 possible votes) - The City Plan should consider flooding and climate change as significant. Option A is to be adopted.	Support	Option A: A flood hazard code is a requirement of State Planning Policy 1/03. It will be created through the NDRM project. The flood code will focus on management of flood hazard. Review of the Stormwater Management Code, Filling and Excavation Code, Waterway Code, Wetlands Code, Compensatory Earthworks PSP and the Subdivision and Development Guidelines will occur in parallel, though the NDRM team working with the new City Plan Team. Flood hazard provisions will be concentrated into the flood code, except where it is more practical for them to be located elsewhere (such as the priority for the House Code to remain free standing). Option B: Legislative and other changes since the release of the taskforce findings make it essential for climate change to be considered as significant and to be factored into flood management.
2.2 Control filling within overland flow paths, waterway corridors and floodplains especially with regards to 'cumulative impact'.	Support	A consultancy (to be completed by October 2011) is proposed to evaluate the impact of filling within the floodplain (including outside of waterway corridors). Given the current absence of sufficient data to determine the location of critical storage areas (for protection, such as by change of zoning), it is hoped that the consultancy above will identify a methodology for determining and protecting these across the city. Provisions to prevent filling within overland flow paths are being investigated. This will also look at building over stormwater as an issue. Given time and budget constraints, it is likely that the position advocated in the New City Plan will be refined as improved information becomes available.

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2.3 Reassess the allowance in City Plan of 1.0m of fill to be placed without approval in Waterway Corridor, overland flow paths and flood risk areas.	Support reassessment	Current City Plan provisions do not allow placing of 1.0m of fill in waterway corridors. See response to 2.2 above.
2.4 Option A (Supported by 6 votes out of 10 possible votes) - Prohibit development and filling inside City Plan Waterway Corridors. The objective is to protect and enhance the water flow, water quality, ecology, and open space, and recreational and amenity values of the City's waterways, subject to ground truthing of the Waterway Corridor. Option B (Supported by 4 votes out of 10 possible votes) – City Plan review to incorporate performance criteria that specifically address flooding and require no adverse impact to downstream, upstream and adjacent properties or ecological processes, taking into full account the cumulative effect. Option A is to be adopted.	Option A: Solutions to protecting water flow, quality including consideration of areas wider than the waterway to be investigated. Option B not feasible.	NDRM focus includes consideration of the location of filling within the floodplain, including in waterway corridors. Review of waterway corridor boundaries and groundtruthing of these areas to ensure they are adequate for flood storage/conveyance is beyond the scope and resources of the NDRM project. Waterway corridors are proposed to be retained for the water quality, environmental, amenity and other functions noted. The filling consultancy described under 2.2 aims to help identify a strategy through with water flow and storage can be managed. As noted, Option B is not feasible considering the reasonableness and regulatory impact on the broad range of developments it would apply to.
2.5 Restrict further filling and development within the area of 100 year ARI or Defined Flood Event flood to satisfy the new 'Flooding Code' in Sub-action 2.1. (6 votes for, 2 against out of 8 possible votes).	Support	Per comments from 2.1 to 2.5 above, the consultancy on filling and peak flows will assist in determining how this is to be undertaken.
2.6 Develop guidelines/ practice documents for specific catchments, specifically for the issues of the catchment or potential new development areas.	N/A	NDRM work for the new City Plan has a city-wide scope. Water Resources is piloting Catchment Floodplain Management Studies that will address these issues.
2.7 Investigate if the planning process can reduce the magnitudes of peak flows.	Support	A consultancy being managed by Water Resources due to be completed in October 2011 is investigating peak flows from development. Results from this will be considered in developing provisions for the new City Plan.

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2.8 Make provision in Council Policy, City Plan and Codes to not allow the practice of cut and fill in Waterway Corridors where there will be an adverse effect on the incremental flood storage. (7 votes for, 1 against out of 8 possible votes).	Review of current measures pending results of filling consultancy.	Review of the operation of the compensatory earthworks planning scheme policy, and its relationship to the filling consultancy is included in NDRM scope.
3: Review and strengthen, where necessary, development and building controls in City Plan to ensure no adverse impact from flooding: **(Priority No. 1 Action with Taskforce Ranking No. 4)** *In conjunction with Key Action 2, City Plan and building legislation need to be enhanced to ensure controls are adequate to ensure that developments and buildings do not adversely impact on flooding or drainage of properties that are upstream, downstream, and adjacent.*	Support review of provisions.	Review of provisions necessary part of code preparation. It is proposed to take forward existing principles in City Plan, such including having no adverse impact from flooding on adjoining properties. On a larger scale, further investigation will result from the peak flow consultancy, looking at how flows from intensified infill development should best be managed.
3.2 Amend the City Plan House Code to require that 'lots on land that is subject to flooding' are to be code assessable against the requirements of the 'Flooding Code' recommended in Action 2 Sub-action 2.1.	Support review of level of assessment and flood requirements in House Code	Review of level of assessment to be undertaken. For practical implementation reasons, the House Code likely to remain self contained (rather than referring to the Flood hazard overlay code). However, appropriate flood management requirements included in the House code.
3.4 Update current building regulations/ controls/ advice and guidelines that relate to the 'flood proofing' of properties in floodprone areas. Standards will apply to both new construction and redevelopment works.	Support, where within City Plan scope.	Building Codes Australia is currently developing flood resilience provisions for residential buildings. A flood resilient design code is to be developed in 2011 by the City Plan Implementation Team. Additional measures may be included in the flood overlay code, however overlaps with BCA jurisdiction will need to be carefully managed.
3.5 Consider relaxing 8.5m roof height where relaxation is required to achieve non-flood habitable areas where houses are identified as being in one of the flooding categories.	Support – continuation of TLPI provisions.	Relaxation to roof height controls have been included in the TLPI for river and creek flooding, to the extent necessary to achieve the new flood immunity requirements. Continuation of these measures is proposed so that adjustment of local streetscapes can be completed. Refinement of the existing provisions may be warranted.

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3.6 Subject to a cost benefit assessment, where infill development is proposed and the condition status of existing drainage infrastructure is not known, the carrying capacity is to be established prior to development approval.	Not relevant	As part of new City Plan preparation, Priority infrastructure Planning is being undertaken, considering growth estimates, that will factor in new infrastructure needs including the stormwater network. This will cover the whole city, factoring in the strategic growth pattern. Investigation at DA stage should not be required. Confirm with DA/PIP teams.
3.8 Amend and strengthen codes/ policies based on appropriate quality modelling. Develop a best practice document to support codes and policies.	Code to be developed assuming progressive updates with improved modelling	Modelling improvements for creeks to a standard methodology is funded to be rolled out to 2015. The flood overlay code will be designed assuming progressive upgrades with improved information. Intent of recommendation regarding a best practice document is unclear. However completion of the document is not within NDRM scope.
3.9 Review building standards for infill development to promote suspended floors to avoid need for cut and fill.	Building design measures appropriate to flood hazard to be investigated.	Building and site design measures, including lower site height requirements in infill areas where this will have amenity impacts will be investigated. Some measures already included in TLPI for river flood response. Wider requirements for building form considering hazard are part of development of the flood immunity response for the flood code.
3.10 Accept alternate solutions on remnant blocks in built up areas where a better outcome for water quality and sustainability would result from development	Unclear intention.	Intent of recommendation is unclear.
3.11 Recognising that industrial developments have large roof and hard surface areas, Council should encourage integrated water management measures in these developments.	IWCM is not in NDRM scope. Parallel work underway.	IWCM is encouraged in industrial areas (though some forms, such as co-locating water capture and high water users may be some time off due to water pricing). Parallel work is underway as part of New City Plan (Vicki Grieshaber with Water Resources).
3.12 Identify appropriate water cycle outcomes including development footprints for industrial lots where there are areas of valuable eco-hydrological functions including flood storage and waterway functions.	Support (through other new City Plan work)	Parallel work is underway as part of New City Plan (Vicki Grieshaber with Water Resources)..

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4.2 Ensure planning controls on new development on existing sites achieve no adverse impact on flooding.	Support	Existing requirement to be taken forward in new flood provisions
4.4 Council to liaise with State Government to ensure that planning legislation is amended, if necessary, in order that proposed developments take full account of cumulative effects on flooding so that developments do not adversely impact on flooding or drainage of properties that are upstream, downstream, and adjacent to the subject site.	Support investigation into management of cumulative impacts of development.	Liaison with State Government not expected to be necessary. Consideration of cumulative impact is consistent with best practice. See responses for 2.2 - 2.7 for proposed actions.
4.9 Solutions should be multi purpose, eg. include socio-economic, ecological, amenity, natural resource and cultural aspects of land use across flood-prone areas, as well as the associated flood risk and hazard.	Support	Consideration of multiple values is a fundamental principle underpinning the the Sustainable Planning Act, and the development of the New City Plan. Flood risk mitigation solutions and risk management approaches are being investigated.
4.13 Identify opportunities and determine the appropriate nature and means for community consultation in Council's flood risk management planning process. External stakeholders and representatives of flood-prone communities should be represented at this forum. Special attention should be paid to improving consultation and awareness with flood-prone communities.	Not within NDRM scope.	Community engagement to be dealt with through other existing Council forums, through Water Resources activities and the response to the 2011 flood. These include possible activiteis through catchment floodplain management plans, being developed. NDRM scope is to develop city-wide generic provisions for managing landuse in the floodplain. Proposed concepts are proposed to be presented to the City Plan Reference Group – which includes community and development industry representatives.
4.16 Provide feedback on the reviews of City Plan and Local Laws to ensure the recommended mix of Management Measures from this report are incorporated into the appropriate statutory instruments,eg. land use plans, codes of building and development conditions, local emergency plans, etc.	Water Resources is part of the NDRM project working group.	
4.18 Provide feedback on what is acceptable risk of flooding in houses in older areas.	Support	Immunity requirements, including for redevelopment of existing houses is within NDRM scope. This will include review of provisions in the TLPI.

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7.1 Clearly explain the requirements of City Plan to the community, developers and private certifiers.	Support	Part of communication and delivery of new City Plan.
9.6 Assess how the cumulative impact from new development is determined.	Support	Consultancies (filling and peak flows) to be conducted by Water Resources, to be completed by October 2011.
9.16 Adopt a procedure for assigning 'hazard categories' as a basis for prescribing land use controls in flood-prone areas.	Support	Part of preparing the flood overlay code. Methodology to be peer reviewed and approved prior to finalisation of the code provisions.
9.17 Collect flood behaviour data needed for a 'flood hazard analysis', develop a 'standard' procedure for assessing hazard in flood studies, and ensure that the necessary data are generated by flood studies.	Support measures for ongoing improvement	Flood hazard analysis for the new City Plan provisions will be based on information available at the time, to be updated when new information becomes available (over the next 5 years).
9.18 Establish the size and significance of overland flow and creek tributary flooding problems in Brisbane and assess the feasibility and accuracy of developing a 'rapid means' of addressing these problems.	Support investigation of improvements to overland flow provisions to address issues	Several issues have been identified with the way that overland flow provisions in the existing City Plan work. Areas to be addressed are discussed in the Issues section at the back of this document. Further investigation of methods which could be contained within the new flood hazard code will be investigated as part of the project.
9.21 Before any new filling is approved within a floodplain, modelling should be undertaken to determine whole of catchment impacts, including cumulative impacts.	Do not support this action. Instead, study into the impacts of filling to be completed by October 2011	Study (consultancy) into the impacts of filling to be completed by October 2011 will guide the response to this. Improvements and refinements to the information and policy responses may be required over several years. Any proposed provisions to be subject to regulatory impact assessment, to ensure impacts on Council and applicants is reasonable.
9.22 Ascertain whether or not development across the city is increasing impervious areas. Determine what the real impact is on creek and overland flow flooding.	Support – to the extent possible within NDRM timeframes and resources.	Consultancy into peak flows to be completed October 2011. This is likely to provide initial information into this matter. However, given the size of the consultancy, it is unlikely to be conclusive and further investigation is likely to be necessary.

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13.2 Strengthen the provisions of City Plan, Codes and Local Laws to prevent and remove unauthorised filling and rehabilitate areas affected within waterway corridors.	Support clarification of City Plan provisions to the extent they have influence on this issue.	Rehabilitation to be addressed through parallel New City Plan work. While NDRM work will aim to provide clear and strong codes, unauthorised filling once it has occurred is a compliance issue (CARS Branch).
14.3 The actual capacity compared to design capacity of stormwater drainage should be established by developers prior to development approval of infill multi-unit development.		Confirm with DA & PIP team. In all growth areas, the Priority Infrastructure Plan will factor in detailed estimates of likely population and subsequent demand, to calculate future infrastructure needs. Where infill development occurs, which will only supported where responding to local needs, the PIP will also have estimates of capacity.
15: Review and strengthen, where necessary, Council's Local Area Plans, Natural Assets Local Law, Waterways Policy and Wetlands Policy to ensure vegetation within waterway corridors is adequately protected whilst flooding discharge capacity is not reduced.	To be progressed via NES and new City Plan.	Review of provisions for vegetation protection is being progressed by NES and the new City Plan team. Planning for waterway corridors assumes revegetation.
16.1 Encourage the use of Water Sensitive Urban Design (WSUD) in greenfield and infill development including: • Incorporate rainwater storage tanks in all new and existing buildings – residential and commercial. • Reduce hard surface areas, eg. tracked driveways. • Provide a pervious layer under car park surfaces with infiltration trenches from recessed edged garden beds to provide for water conveyance and tree root development. • Retaining walls should have agricultural pipes to manage sheet flow that will affect downstream properties. 16.2 Encourage recycling of stormwater runoff from development sites.	Support investigation into impact of urban infill development on peak flows, and development of resulting City Plan provisions, as appropriate.	Support investigation into impact of urban infill development on peak flows, and development of resulting City Plan provisions. The development of provisions for the new City Plan will be limited to new City Plan timing. It is possible that ongoing work will be appropriate to refine responses. WSUD measures are also generally supported, requirements to be developed further in parallel work with Water Resources and the New City Plan project (Vicki Grieshaber).

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16.3 City Plan to include a map of 100 year ARI flood line for all waterways.	Support	100 year ARI has been adopted as the DFE for creek flooding. Therefore this will form part of required mapping of flood hazard areas under SPP 1/03.

16) Joint Flood Taskforce

Recommendation	Recommended Response	Rationale
That the actual January 2011 flood event, as observed during the event, be used as the interim standard, on which Brisbane City Council bases its decisions concerning new development and redevelopment, with the essential condition that, wherever a higher level has been set as the current DFL, the higher level must apply; and that this interim standard apply until conclusion of the Commission of Inquiry and the comprehensive flood study recommended below is completed.	Temporarily adopted in TLPI. City Plan amendment being progressed by CP Implementation Team. This assumption being incorporated into flood code preparation.	This is the currently endorsed Council position. Implementation of this level (and associated changes, such as residential building height in affected areas) has already commenced. Flood Review Board reiterated this finding. It is recognised that this DFL will likely to be supplanted with the Brisbane River flood study to be completed in coming years. Provisions in the new City Plan to be designed to be updated as relevant.
That all data relating to the January 2011 flood event be gathered from all sources and archived so that further analysis can make use of all data available.	City Plan provisions to be designed to be easy to update as future studies become available.	These studies are beyond the scope of the NDRM study. Actions 2-6 are encompassed in Water Resources technical responses to the 2011 Flood, and are likely to be a component in the proposed flood study to be completed in coming years.
That the bathymetry (river bed and banks) of the Brisbane River and its tributaries and the characteristics of the bed material from Wivenhoe dam to the mouth be measured as soon as possible.		
That a comprehensive flood study be commissioned to review flood flows and levels within the Brisbane River catchment making full use of the data relating to the January 2011 flood event.		
That the effects of morphological (river bed level and cross section) changes due to sediment erosion and deposition during flood events be studied for a range of flood magnitudes to determine their effects on flood levels.		
That consideration be given to whether a Monte Carlo		

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Recommendation	Recommended Response	Rationale
approach to the flood risk for the Brisbane Catchment is feasible...This may include consideration whether two or more types of rainfall events should be built into the statistical analysis for theoretical floods...		
That a complete Flood Risk Management analysis for the area of Brisbane affected by flooding from the Brisbane River and its tributaries be carried out. It is essential to move from the Q100 mentality and to adopt a risk management approach in line with National Flood Risk Advisory Group (NFRAG) and other relevant guidelines. The risk management approach would require a detailed assessment of the benefits and costs of a full range of flood mitigation options.	Code preparation to proceed ahead of this analysis.	A complete flood risk analysis is beyond the time and scope of the NDRM project. A move from the "Q100 mentality" will be built into the new flood code approach. Investigation of mitigation options to be undertaken by Water Resources outside of new City Plan timeframes.

17) Flood Review Board

Recommendation	Recommended Response	Rationale
The Board recommends that, in relation to planning, Council undertake a complete flood risk management analysis for the area of Brisbane affected by flooding from the Brisbane River and associated tributaries in like with the Natural Flood Risk Advisory Group (NFRAG) and other relevant guidelines. This would require a detailed assessment of the benefits and costs of a full range of flood mitigation options.	Code preparation to proceed ahead of this analysis.	This recommendation is brought forward from the Joint Flood Taskforce Report. A complete flood risk analysis is beyond the time and scope of the NDRM project, and will be progressed separately. The move to a risk based approach beyond the "Q100 mentality" will be built into the new flood code approach. Investigation of mitigation options to be undertaken by Water Resources outside of new City Plan timeframes. Hazard mapping to be updated with new hazard level when any new mitigation measures are put in place.

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18) Summary of Issues for Further Investigation.

The following issues have emerged as needing further clarification in Stage 2:

Identification of hazard areas – Requirements

SPP 1/03 requires planning schemes to identify natural hazard management areas, which for flooding, equate to areas subject to inundation at the Defined Flood Event.

The SPP Guideline (7.2) notes that:

> During the process of making or amending planning schemes, local governments are required to assess the potential impacts of development in areas subject to the natural hazards... wherever practicable, natural hazard management areas should be identified through a comprehensive and detailed natural hazard assessment study.
>
> This assessment ...may include the assessment of relative levels of severity in relation to particular hazards. The scope of studies will vary between local governments, and sometimes between different locations within the same local government area. The variation in scope should depend on the size and distribution of the population, the degree of risk to people, property, economic activity and the environment posed by development in areas affected by natural hazards, the availability or difficulty of obtaining and analysing information, and the capacity and resources of the local government.

As noted in the Gaskell report (p28), "Whilst classification of the severity of hazard is not required under the SPP, this information, if available, could be helpful in assessing development against the requirements of the SPP."

The report notes that the subdivision and development guidelines (SDG) establish the "low flood hazard zone" criteria that define the limit on where the intensification of land use (redevelopment/infill development) may be permissible. However, it states that it is not clear what information Council currently has with respect to medium or high severity of flood hazard within the natural hazard management area, or whether any such information, if available, is used in development assessment. Provisions in the SDGs refer to SCARM guidelines (Floodplain management in Australia – Best Practice Principles and Guidelines).

The SPP Guideline also refers to the SCARM guideline's categories for identifying flood hazard, including consideration of depth and velocity. The SPP Guideline recommends the floodplain management study process described in national best practice guidelines (SCARM, 2000), but acknowledges that the resources required to implement that process may not always be available or necessary.

As Gaskell notes, "Council is yet to move towards the flood hazard classification approach detailed in Appendix J of SCARM (2000) described in SPP 1/03. The SPP guideline states that the assessment (of natural hazard management areas) 'may include the assessment of relative levels of severity in relation to natural hazards'. A move to an approach of mapping hazard, which is based on an analysis of both flood depth and velocity for the modelled event, would require a considerable upgrade of Council's flood data.

Gaskell's recommendations are therefore:

- Consider incorporating a risk assessment for development proposals that considers flood hazard (flood depth and water velocity). This could be an inclusion in the relevant natural hazard management – flood code. This is recommended as an appropriate response to SPP 1/03 and in line with best practice (SCARM);
- Where detailed flood data is available review Area/ Zones and compatible land use in

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areas of high risk – ie. Areas of high depth and high velocity. This will depend on whether this information is available from the flood data in Council, and whether this can be assessed against the City Plan requirements for infill development. This will need considerable investigation and possibly resolution at a policy level to determine any actions that are required.

Following the events of January 2011, including severe impacts of creek flooding in areas such as Grantham and Toowoomba, and the existence in Brisbane of areas with the potential for Grantham-like flood events, greater clarification of hazard within the DFE to be an aim of flood code development is highly relevant. Best practice described in the SCARM guidelines also includes consideration of hazard in events greater than the DFE, which is also relevant to some aspects of Brisbane River flooding. However, as noted in the Gaskell report, risk beyond the DFE will often be managed by non-planning means, such as emergency response.

Reviews following the Brisbane River flood, and recommendations from the Lord Mayor's Taskforce for suburban flooding support this approach, and the move to a risk based approach to planning for flood hazard, which moves beyond the "Q100 or bust" which is the minimum standard required in the SPP.

The scope, timing and budget of the NDRM project do not extend to comprehensive and detailed risk assessment. This is likely to be realized in following years, following the recommendation of the Flood Review Board Report.

However, the availability of significant (if not complete) flood information for Brisbane should be recognized, along with a full range of existing flood provisions. As such, the preparation of the flood code will be a combination of reviewing and updating as necessary the existing City Plan provisions, and expanding on new material in key areas.

It is intended that clarification of the level of flood hazard and creating a tighter link with development provisions for flood affected areas will be a focus of the new flood code.

Flood hazard area classification – methodology design

Council currently has insufficient information to identify hazard areas based on velocity in many creek catchments, and for the Brisbane River.

However, for planning purposes, a methodology is being investigated to consider depth and frequency of flooding as a means of identifying likely high hazard.

Further refinements are also being investigated to recognize the difference in flood height at different events in different parts of the Brisbane River, potentially through application of different freeboards based on zones along the river.

Review of methodology

This methodology, and the thresholds proposed for definition of different levels of hazard will require internal and political endorsement. This will be sought after a peer review of the proposed methodology in August 2011.

Availability of information to support initial

The mapping methodology is being developed to accommodate information gaps in Council's information. However, some gaps may remain, affecting what can be shown in the flood overlay. These include

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code release.

- Modelled levels for some creeks above DFE.
- Modelled levels for some creeks below DFE (eg. 5 year ARI)

A way of working around these information gaps will be investigated. An inventory of flood mapping is being prepared to this purpose.

Provision for updating code and mapping with new information and modelling

New information affecting mapping of hazards in Brisbane will become available over the next five years, through the legislative review period for the new City Plan and into the early years of its implementation. This information is likely to include:

- Waterway modeling (to be rolled out over next 4 years to ensure all models are functional, 2D, and to a standard methodology)
- New Brisbane River Flood model and other JFT required studies
- Implementation of any mitigation measures for river flooding resulting from post January 2011 flood investigation actions
- Potential delivery of local mitigation measures based on Catchment Floodplain management plans
- Potential changes to climate change assumptions for sea level rise and storm tide following 2014 IPCC round
- Release of new Australian Rainfall & Runoff figures for rainfall intensity factoring in climate change.

As the information relates to hazard, it will need to be incorporated into the new City Plan in a timely manner.

Design of mapping and codes should facilitate simple updates to technical assumptions on which hazard areas are calculated (climate change assumptions; flood modeling) without requiring extensive changes to code provisions or other sections of the City Plan.

Further investigation with the Queensland Government is required as to how these amendments might occur in minimal time.

Method for updating mapping when mitigation measures are put in place also to be discussed with Water Resources.

QPP Mapping issues

The new Queensland Planning Provisions require local government to format their planning schemes in a consistent manner, using common zones, definitions and mapping symbols. QPP planning schemes will be electronic documents.

The QPP is still in draft, and mapping symbols are yet to be finalized. Draft versions do not allow sufficient or flexible enough mapping symbols to map hazard areas according to a best practice methodology.

Discussion is continuing with the Queensland Government about the symbols, titles for categories, and degree of flexibility which local governments require to meet SPP requirements, bearing in mind differences between local governments across Queensland.

Cumulative Impact

The Lord Mayor's Taskforce for Suburban Flooding has outlined cumulative impact of development and filling as an area for further investigation and treatment under the

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new City Plan. Further discussion included below under *Filling in the flood plain* and *Peak Flows*

Filling in the floodplain

The Lord Mayor's Taskforce for Suburban Flooding (Issue x, x, and x) has identified filling in waterways and within floodplains as an issue, and an area to be investigated and responded to in completing the new City Plan.

Filling within floodplains can potentially increase the severity of flood events, and the corresponding hazard and risk to people and property. This happens incrementally across the floodplain if flood conveyance is blocked or diverted, or if flood storage areas are not preserved.

Council currently has insufficient information to identify the location of critical storage areas at a strategic level, or know the impact of development/filling in particular locations.

Issues that have been identified with City Plan's current treatment of filling include:

- Inexact definition of waterway corridors means default City Plan provisions allow for filling within floodplains.
- The existing compensatory earthworks planning scheme policy provides for design solutions to enable compensatory filling and excavation within the waterway corridor, but may lead to situations where filling outside of the waterway corridor will lead to increased flood depths, velocity and hazard in larger than the event being designed for (the DFE).
- Uncertainty as to the contribution of different areas of the city which may be desirable to fill for other strategic purposes.

A consultancy is proposed to investigate the contribution of areas within the floodplain in different flood events, and to make recommendations for areas where filling should not be allowed. This will have implications for existing provisions (currently located in the Subdivision and Development Guidelines, and associated provisions for matters such as subdivision)

The consultancy is expected to take 3 months, for delivery in October 2011. Due to the available funding, it is not expected that the consultancy will be definitive. The approach is that this consultancy will be based on case studies of catchments that will give us enough information to extrapolate values city wide.

Peak Flow

The Lord Mayor's Taskforce For Suburban Flooding has also identified investigation into the contribution of infill development to peak flows as areas for investigation.

Increased residential density, such as is proposed in the Strategic Plan's growth areas, will increase peak flows from those areas, due to the increase in non-permeable surfaces. Identification of the scale of this to be expected, and potential solutions to this will be beneficial for ongoing planning, including priority infrastructure planning.

Flood Regulation Lines

Flood regulation lines are lines used by Council to indicate floodplain areas reserved for flood water storage and

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flow, where development may be restricted. They are a method of accounting for cumulative impact from development and filling. City Plan's Structure Planning Code requires mapping of flood affected land, identified as land that is below the Flood Regulation Line.

References to flood regulation lines appear in the following locations in City Plan:

- Chapter 4, pg 70b: Holland Park Tarragindi District Local Plan
- Chapter 5, pg 31: Centre Amenity & Performance Code
- Chapter 5, pg 56: Child Care Facility Code
- Chapter 5, pg 61: Commercial Character Building Code
- Chapter 5, pg 67: Community Use Code
- Chapter 5, pg 221: Structure Planning Code

Identified issues with Flood Regulation Lines include that they do not recognise larger events than the calculated event, or flooding to existing areas which are lower than the assumed level used in calculating the line.

The Gaskell Report notes that the methodology used to define Flood Regulation Lines is unclear, and that clarification is needed regarding the relationship of the DFE and the flood regulation lines.

Clarification of whether FRLs will continue to be used will be possible with the results from the filling consultancy discussed above. In addition, the definition of flood hazard will be independently defined, such that

Clear identification of the DFE

The Gaskell report notes as an issue that Council's available flood mapping does not explicitly state what criteria or event has been used to derive the adopted flood extents. Council's flood immunity requirements in the Subdivision and Development Guidelines refer to events of different average recurrence interval (ARI) and also to a defined flood level (DFL), based on the 3.7 mAHD level at the Brisbane Port Office Gauge.

However, the report suggests this is an ambiguous definition, since it is uncertain what flow rate, if any, has been used in combination with the Port Office level to derive the DFL throughout the city.

The report notes that "Council also uses a defined flood level based on the highest recorded flood level (typically the 1974 flood level) plus 700 mm. It is unclear whether this is the same as the DFL based on the 3.7 mAHD level at the Port Office Gauge." Water Resources have clarified that this is for when information is not available (modelled).

The SPP refers to the adoption of a defined flood event, the probability of which can be estimated, rather than a defined flood level which could potentially be more arbitrary.

Clarification on issues with definitions is being sought, and appropriate definitions put into the new code.

Overland Flow

Issues with Council's current provisions for overland flow in the City Plan have been noted with regard to:

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- Need for revised provisions controlling diverting and filling for small subdivisions (1 into 2)
- Partially or fully enclosing overland flow paths (examples of multi-unit dwelling design that does this)
- Issues of safe site access
- Previous provisions in the subdivision and development guidelines requiring a 15m buffer from the river have been removed: reinstatement proposed.

Investigation of provisions and approaches to handling overland flow is proposed for early August 2011.

Resilient building design

As a result of the review of City Plan immunity provisions, further consideration on siting, construction and design requirements for resilient buildings are likely to be relevant.

Basic provisions encouraging resilient building design in areas being rebuilt after the flood were included in the Temporary Local Planning Instrument.

City Plan/Building codes jurisdiction
City Plan must not overlap with the scope of building codes provisions.

Further clarification of the scope of the City Plan with regard to building type, design, siting and construction (including structural requirements and materials) is needed.

The Australian Building Codes Board (Flood Reference Group) is currently developing a draft Standard for:

1. Buildings where people will sleep (BCA Classes 1 to 4 and 9), therefore excluding shops, offices, factories, warehouses etc.
2. Non coastal areas
3. Structural performance of building components.

Their work is likely to require change to avoid conflicts with existing BCC positions on a range of detailed matters including
- the prescription of freeboard values,
- closer consideration of basement flooding
- reference to photovoltaics etc.

The BCA standard is due in mid 2012.

Further clarification on the scope of potential measures for inclusion in City Plan will be needed concurrent with code preparation.

Resilient Design Code
The City Plan Implementation Team (Lachlan Carkeet) has been tasked with preparing a Resilient Design Code for December 2011. This work is in its early stages.

Preliminary scoping indicates that this work is likely to:
- be relevant to all types of development (including community use, commercial, industrial, residential)
- apply to new building work.
- Be relevant to all types of flooding

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Subject matter for consideration in the code is likely to include:

- Safety and risk to life
- Minimizing costs to rectify damage
- Protect amenity for neighbours
- Protect continued passage of water through and around the land
- Prevent diversion of water onto adjoining properties;
- Managing pollution and debris
- Impact of materials used as Sacrificial aspects of buildings

Given the closeness of the timing of the development of this amendment and the new City Plan, clarification of how this work will be incorporated into the new City Plan will be needed.

Review of flood levels

A review of Council's existing flood immunity standards will be undertaken as part of the preparation of the flood code.

- Adoption of the 2011 flood event (or DFE whichever is higher), is proposed to be carried forward, consistent with the Flood Review Board and Joint Flood Taskforce.
- Suggested changes to flood immunity standards in the City Plan will be identified by exception.
- Adopting a risk management approach that responds to the nature of the hazard may, in some locations, mean requiring mitigation measures beyond the DFE. Discussion and endorsement of a position regarding this will be necessary. This may be relevant to existing residential areas in the upstream parts of the Brisbane River, where hazard is likely to increase significantly in response to a small increase in flows.
- Some changes to required immunity may result from closer evaluation of potential mitigation measures.

Clarification is required of the process to get changes approved. Finalisation of provisions will be subject to findings of the Queensland Government's Commission of Inquiry.

Position on providing incentives to facilitate building form change.

Neighbourhood Planning have requested a city-wide position on development intensification in flood prone areas with a view to using density increases as in incentive for more flood resilient building forms to take the place of less resilient development. Allowing this would allow an increase in the population of flood affected areas.

The draft Strategic Plan took the position that growth should not be located in flood prone areas. This was a position that was commended by the Flood Review Board.

Clarification as to Council's position on this will entail definition of performance for mitigation measures considered to make the development consistent with the nature of the natural hazard (at DFE). This will include clarification of requirements around access, load on emergency services, building performance and functionality of building services.

Many of these positions will be developed through the review of flood levels and

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resilient building design measures, for subsequent endorsement. This discussion is also relevant to the strategic plan review, requiring clarification of the characteristics and extent of development considered to constitute local need.

Release of any advice on this subject before February 2012 is not advised so as not to pre-empt the findings of the Queensland Government's Commission of Inquiry.

Strategic Impacts

Strategic review of planned growth areas will be undertaken as part of preparing inputs to the New City Plan. This is likely to include:

- Improvements to the strategic plan to reflect protection of people and property from flood hazard (reflecting a beyond Q100 position)
- Climate change adaptation principles, guidelines and land use updates.
- Review of strategic landuse and amendments where relevant:
  - Planned growth areas.
  - Industrial land
  - Existing residential areas
  - Commercial development
  - Critical infrastructure

Particular issues are anticipated around the impact of flood hazard on industrial development, considering pollution. A review of flood compatible ERAs has already been undertaken. Further investigation into how industrial areas might adapt to flood hazard will be undertaken with New City Plan officers addressing this.

Climate change impacts are discussed separately below.

Commission of Inquiry Response

The timing of the Queensland Government's Commission of Inquiry will be challenging for the flood code to meet the timing of the new City Plan. Now deferred from January to February 2011, the allowance of two months for the review of the plan, discussion of Council positions and endorsement of changes to the proposed code is unlikely to be practicable, particularly when the block out period leading up to the Local Government Elections is factored in. Further discussion of this requirement will be linked to the timing of the New City Plan, the availability of E&C committees leading up to April, and the fact that the code cannot be finalised ahead of the Commission of Inquiry.

Climate change assumptions

Confirmation of climate change assumptions for flood planning is required for mapping and planning work to go ahead.

It is proposed to use the mandated requirements from the Queensland Government, as summarized in the table below.

Topic	Assumption	From	Status
Sea Level Rise	0.8m by 2100	SEQ Regional Plan	Mandatory minimum
Storm Tide	1.5m above Highest Astronomical Tide (where no detailed study)	SPP for Coastal Protection	Mandatory (from mid 2011)

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Rainfall Intensity (for flood studies between 100 and 500 year ARI)	5% increase in rainfall intensity per degree of global warming. + 20C by 2050; + 30C by 2070; and + 40C by 2100.	Qld Government – Inland Flood Study	Advice until new national Rainfall & Runoff figures in 2014

Issues with climate change assumptions are outlined below:

Mapping of Rainfall Intensity

In the absence of creek models (to be updated over the next four years), Council has no mechanism to model the additional rainfall into the flood mapping. Options available to Council are:

- Discuss with State a staggered introduction of modeling with rainfall assumptions built in as creek models are updated, acknowledging that there would be a period of up to 4 years where no climate change allowance was built into Council's mapping. (Preferred option, subject to State agreement and BCLP advice)
- Devise another method (non-modelling based) to factor in changes in rainfall intensity.

Discussion of this with the Queensland Government to be pursued as soon as possible.

Climate Change Adaptation

The new State Planning Policy for Coastal Protection has been endorsed by the Queensland Government, but is not expected to be enacted before the end of August 2011.

The plan outlines specific locational requirements for different types of development, and requires local governments to produce adaptation plans for areas where intensification of development is proposed.

As a result of the plan linking compliance with the SPP with the approval of new planning schemes, the new City Plan will need to demonstrate compliance with the SPP.

Given the work and complications involved with producing a compliant planning scheme with adaptation plans, it is suggested to propose to the State that the New City Plan contain adaptation principles and guidelines, as well as provisions consistent with the SPP for Coastal Protection. Adaptation plans would be progressed at a later date, giving priority to high growth locations affected by coastal hazards (ATC and Albion). This will be pursued in August 2011.

Any indication of the future direction of development in the Strategic Plan is likely to be controversial in advance of community engagement with affected communities. No mechanism for completing climate change adaptation plans has been decided.

The SPP for Coastal Protection contains a Development Assessment code to be used in advance of a compliant planning scheme being adopted. This is likely to be enacted at the end of August 2011. Many likely development applications to Council will trigger risk assessment under the SPP. The State is updating guidelines to provide more information about what these risk assessments must cover, but these will not be available before the SPP is enacted.

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City Planning will need to give advice to DA about the commencement of the SPP and how it is to be treated.

Addressing of climate change adaptation planning frameworks is a significant challenge to NDRM timing and resources. Further discussion may be required to clarify the extent of NDRM scope with regard to this Council response.

Communication of measures

Communication of measures and implications of the new flood code is likely to be an issue in terms of community understanding, and also acceptance.

Simplicity of provisions will need to be a focus in code development. Communication of proposals within Council for endorsement is likely to be an issue in terms of the complexity of what is proposed.

Public communications materials will need to be prepared about the changes and impacts of the new policy. This is likely to include fact sheets and frequently asked questions. This will be addressed in the final stages of the NDRM project (January to June 2012).

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19) Actions Required

The Following Key Tasks have been identified as necessary for the completion of the flooding phase of the NDRM project.

Task Area	Details	Date	Dependencies
Determine stakeholder issues and needs	• Stakeholder meetings to identify issues, tasks, and potential solutions.	Feb 2011	
	• Regular meetings with key stakeholders to develop content	Ongoing	Availability of relevant expertise
	• Provide advice to Neighbourhood Planning about appropriate responses to existing flood prone areas (particularly whether intensification is appropriate). • City Planning to provide advice to Development Assessment regarding Queensland Coastal Plan – clarify match with NDRM scope	August – October 2011 Mid 2011 around time for Coastal Plan taking effect	Higher level agreement on city-wide position and directions. BCLP advice as appropriate.

	• Meet with Qld Government contacts at key points. Points for discussion will include:
	  • Climate change assumptions
	  • Climate change adaptation parameters and priority strategy
		August – October 2011.	State availability
			Internal discussions on climate change response and assumptions.

Information Review	• Review relevant legislation, notably SPP 1/03 and SPP for Coastal Protection, and associated guidelines, Building Codes ○ Reconcile requirements and be clear of SPP Coastal Protection and SPP 1/03 where not the same (eg. Definitions for essential community infrastructure)	Feb - Sep 2011 May 2011 - April 2012	With release of QPP drafts
	• Review of QPP requirements and definitions	Feb – July 2011 Mar – July 2011	

	• Review recommendations from relevant studies and incorporate responses as relevant:
	  • Lord Mayor's Taskforce for Suburban Flooding
	  • Joint Flood Taskforce, Flood Review Board, Existing NDRM studies (2004-2005)
	  • Qld Government Commission of Inquiry
		Feb – Apr 2012	Timely release of report findings.
			Very efficient analysis and agreement on Council response

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Task Area	Details	Date	Dependencies
	• Review existing endorsed policy positions including City Plan codes, any interim position/TLPI produced by BCC to address flood needs. • Review all existing Council policy, public communications on climate change etc, including relevant actions in Brisbane's Plan for Action on Climate Change & Energy 2007. • Coordinate with emerging work (Flood Resilience code, related new City Plan codes and overlays, interim amendments to City Plan to replace the TLPI, Catchment Floodplain Management Planning) • Include consideration of issues raised in climate change forums to date (eg. Ross Cope's risk identification work for NES, Neighbourhood Planning, individual program partners' work to date).	Feb – Sep 2011 July 2011 Ongoing, as relevant Mar – Aug 2011	Awareness and timely development of these projects Awareness, participation in review of these
Confirm mapping inputs, methodology & prepare natural hazard management area mapping	• Confirm criteria, methodology and assumptions for mapping • Evaluate practicality of incorporating consideration of flood depth and velocity o Identify existing information and gaps. o Understand difficulty of determining velocity and depth (including if developers can/should provide detail for some applications); • Confirm DFEs (considering study recommendations). • Create clear descriptions of all events selected as DFEs/DFLs (and how they were calculated) • Clarify appropriate assumptions re: multiple events together and multiple catchments. • map depth and velocity according to accepted methodology • devise method to factor into flood hazard considerations stepped flood scenarios beyond DFE to PMF scenario for different flood types.	Development Mar – Aug 2011 Methodology review – Aug 2011 Mapping- Aug – Oct 2011 Endorsement Aug – Sep 2011	Availability of data for mapping Availability of GIS support for mapping Peer review – August 2011 Endorsement (at many levels) of proposed methodology.
	• Clarify and get endorsement to use climate change assumptions relevant to flooding (including rainfall intensity and storm surge), and extent to which these must be factored in.	August 2011	DMT, E&C Planning Guidance (and other as relevant) support State support for proposed

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Task Area	Details	Date	Dependencies
	• Clarify how rainfall assumptions should be factored into draft flood code (mapping, other allowance, progressive roll out) and seek endorsement of approach	Aug – Oct 2011	approach
	• Investigate update mechanisms to enable updates to new City Plan overlay mapping and DFEs with new information. In particular, investigate SPA provisions for minor amendments.	July/ August – as part of development of mapping	
Strategic Mapping, impact analysis & Strategic Plan review	• Based on hazard mapping, undertake strategic review of o land uses (and zoning) o access routes, o growth corridors, new communities o industrial areas o critical and community infrastructure locations (including consideration of social and economic impacts) for city, o Flood storage areas (if known (and subsequent to consultancy) • Mapping and evaluation of climate change affected areas (all impact types) to identify issues per location, and area type (residential, industrial etc). • Identify proposed changes to existing provisions based on hazard overlay • Seek endorsements for proposed policy changes and changes to Strategic plan areas. o Review and update where necessary, Strategic Plan principles (Strategic Outcomes, Land Use Principles etc) considering SPP 1/03, and SPP for Coastal Protection policy outcomes to ensure strong guidance for protection of people, infrastructure and property	August – November 2011 Oct 2011 Sep – Nov 2011 Concurrent with Climate Change Adaptation response	• Mapping availability • City planning involvement in strategic decisions. • Endorsement of climate change assumptions and high level approach. • State agreement to prioritisation strategy • Clarification re: adaptation guideline approach, and what needs to be indicated in Strategic Plan for climate change adaptation Coordination with City Plan team.
Investigations	Immunity settings • Decide on a risk management approach to be incorporated into code development (eg. considering NSW and UK examples). • Decide on risk thresholds for hazard mapping and document basis for	Mar – Aug 2011	Stakeholder involvement Stakeholder and administrative

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Task Area	Details	Date	Dependencies
	this. • Review flood immunity settings in City Plan. Recommend and seek endorsement for changes as necessary. o Review level of risk per land use (with consideration of taskforce results); and considering commercial, building costs and other impacts o Determine appropriate responses to thresholds (eg. Uses, mitigation measures) o Decide where risk management approach is appropriate to be implemented (which land uses and which circumstances) o Review and specify risk assessment requirements		endorsement of approach Availability of information
	Cumulative Impacts: Impact of Filling • Investigate filling and requirements for flood storage capacity and flow/displacement via consultancy to be managed by Water Resources. • Complete mapping based on suggested method to identify storage areas. (Inhouse – Water Resources led) • Develop and agree approach to be taken forward in new City Plan o Review Compensatory earthworks provisions, if relevant. o Clarify role and use of Flood Regulation Lines. • Integrate findings into City Plan (City Planning led) • Endorsement of proposed responses Peak Flows • Investigate impacts of development on peak flow via consultancy responding to Lord Mayor's Taskforce for Suburban Flooding, to be managed by Water Resources. • Integrate findings into City Plan provisions as relevant (City Planning led) • Endorsement of proposed responses	July – Oct 2011 Oct – Dec 2011 Oct – Dec 2011 Oct – Dec 2011 July – Oct 2011 Oct – Dec 2011 Oct – Dec 2011	Timely completion of consultancy GIS mapping support Stakeholder advice, participation, and endorsement as necessary Endorsement of approach Timely completion of consultancy Stakeholder advice and participation Endorsement of approach
	Overland Flow • Investigate solutions to identified issues with overland flow	August -	Agreement on approach

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Task Area	Details	Date	Dependencies
	○ Building over flow paths (fully and partially) ○ Relationship between performance criteria wording/requirements and outcomes being proposed (reword criteria to suggest alternative solutions) ○ Requirements for where assessment is fast tracked ○ Risk assessment requirements. • Establish/confirm appropriate measures and risk/immunity level for this • Endorsement of proposed responses • Codify solution	December	Endorsement of approach
	<u>Provisions and land use for industrial areas</u> • Work with NES Pollution prevention and hazardous industry officers to identify appropriate land uses and acceptable mitigation measures for industrial areas subject to flood hazard. • Identify other uses requiring special provisions (eg. Petrol stations) • Work with new City Plan team (Robert Imrie) to integrate proposed impacts on industrial areas from flood hazard provisions and immunity standards review. • Calculate impacts on industrial land. • Further discussions with Water Resources about idea of flood defences on private land (eg. Levees)	May – November 2011	Availability of NES and other stakeholders to participate. GIS mapping support Agreement and political endorsement for proposed solutions.
	<u>Movement and Access</u> • Review of requirements for access, emergency evacuation and other movement requirements affected by flooding, including provisions that should apply to areas that become isolated in different size flood events.	Jun – Nov 2011	
	<u>Resilient Building Design & Amenity Impacts</u> • Review and incorporate research into resilient building design by CP Implementation team, including investigation of level provisions are required to, and relationship with building codes.	Jun – Nov 2011	Code development and Seminar by CP Implementation team.
	<u>Coastal Hazards</u> • Investigation into new SPP for Coastal Protection requirements for Coastal adaptation. • Clarify ownership of response, strategic impact and required response to SPP Coastal protection's requirements for Coastal Erosion	Jun – Sep 2011 Aug – Sep 2011	 High level support and endorsement

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Task Area	Details	Date	Dependencies
	• Confirm climate change legal obligations with BCLP, including land use, infrastructure design and PIP. • Compile climate change adaptation issues to progress at managerial level including discussions with DIP and DERM about upcoming assumptions and appropriate settings (given status of policy). • Considering climate change requirements, policy and issues, evaluate possible types of policy approaches/solutions, and thresholds for when responses should apply.	July – Sep 2011 Ongoing July 2011 – June 2012 July – June 2012 (with draft in Dec 2011)	State discussion of key principles.
Code Development	Draft code content: • Identify approach to code structure for new City Plan, including stand alone codes, code triggers and ease of use of self assessable requirements. • Reorder and convert current City Plan provisions to meet QPP requirements and new scheme needs, including a flood code o Incorporate new mapping and code provisions in accordance with risk model to be adopted into City Plan o Review existing code provisions, including match between and effect of acceptable solutions and performance criteria. o Incorporate floor level standards and risk assessment requirements into code(s) o Amend Design Codes if necessary (eg. Industrial, Centre Design Codes) to state the requirements for habitable and non habitable floor levels more clearly. o Clearly explain in the new City Plan how levels for relevant DFEs are calculated o Specify information required to be provided to support development applications. o Review and amend subdivision and development guidelines (and redistribute as appropriate) o Incorporate, where appropriate, provisions endorsed from any interim position (such as the TLPI) o Ensure code content is straightforward where non Council assessment is involved (eg. by certifiers). o Review links between code provisions and PIP.	July – Nov 2011 July – Nov 2011	Peer review of proposed methodology Stakeholder review and timely provision of comments (October – December) Participation of relevant stakeholders during process.

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Task Area	Details	Date	Dependencies
	○ Review existing policy settings for exempt development (also fast tracked and self assessable development): ○ Review impacts eg. on acid sulphate soils, others. ○ Review extent of filling conducted as exempt development within the floodplain/below DFE to test impact on hazard, safety, property, infrastructure and hazardous industry. ○ Review of performance of Building Approvals • Review and incorporate appropriate level of assessment in planning scheme development. • Ensure mechanism for progressive updating of plans with improving information. • Coordinate with Water Resources for update to Floodwise Property Reports prior to code release	Oct – Dec 2011 Throughout Feb – June 2012	Relevant consultancy results Post endorsement of code
Interim Response	• Coordinate with CP Implementation Team's preparation of CP amendment to replace TLPI.	Aug – Dec 2011	CP Implementation Team
Regulatory Impact Assessment	• Regulatory impact assessment to determine feasibility of impacts on developers. Eg. cost of reports and that information requirements are reasonable.	• Discussion during code preparation • Nov 2011 – April 2012	
Peer Review	• Seek peer review of provisions prior to finalisation of strategic plan and city plan.	• Initial guidance Aug 2011 • Review Dec 2011 and/or April 2012	Budget availability for review. Availability of suitable consultant.
Reporting & Endorse-ment	• Regular reporting to NDRM project control group. • Reporting to New City Plan Content Review Panel, as appropriate. • Continued information/endorsement/ presentations and discussion of policy positions with DMT, Planning Guidance & E&C as necessary.	Monthly As required	

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Task Area	Details	Date	Dependencies
	• Continued information/ liaison with State agencies as required. • Ongoing climate change briefing and discussion through relevant forums.	As needed August – April 2012	Support and guidance from senior management

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Linkages and Dependencies with City Planning

Table 2: Linkages with other City Plan work areas.

Impacts	Codes Potentially Impacted	CP Stakeholders affected
Strategic Plan review including evaluation of impacts of flood hazard response on Growth corridors, new communities Industrial areas, critical infrastructure, road hierarchy	Strategic Plan: all relevant areas.	[redacted] Neighbourhood Planning (advice re: planning for flood affected areas)
High level climate change principles and adaptation plan guideline	Strategic Plan	[redacted]
Changes to provision for flood immunity including site level requirements.	Subdivision Code, Structure Planning Code, Subdivision & development guideline House Code Child Care Facility code Park Planning & Design Code	[redacted]
Potential changes to peak flow assumptions	Subdivision & Development Guidelines Links with PIP	[redacted]
Changes to requirements for filling, including where it will be allowed.	Subdivision Code, Structure Planning Code, Subdivision & development guideline Filling & Excavation Code Stormwater Management Code Waterway Code Compensatory Earthworks Planning Scheme Policy	[redacted]
Potential provisions for building type allowed in particular hazard locations.	House Code	
Re-evaluation of road networks in terms of flood immunity and emergency function.		[redacted]
Resilience provisions affecting design such as building design, materials, location of uses in buildings (in specific locations). Design codes, for design, building heights etc.	Design Codes (residential, centre, industrial)	QRA, QDC, Urban Design, DA (TST), Implementation Team, Neighbourhood Planning (potentially)
Mapping – consistency with QPP Maps to be included as Strategic Plan maps (if relevant)		[redacted]

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Work Breakdown and Resources Estimate

Table 3 below outlines responsibilities and proposed resourcing for key tasks.

Key Task	Description	Responsibility	Resources to complete
Cumulative Impacts	Filling in the floodplain consultancy (Jul – Oct 2011)	Water Resources [redacted]	Water Resources funding – consultancy also meets LMTFSF recommendations
	Peak Flows consultancy (Jul – Oct 2011)	Water Resources [redacted]	Water Resources funding – consultancy also meets LMTFSF recommendations
	Implementation of findings for peak flows and filling (Aug – Nov 2011)	CP with Flood working group	In house work GIS mapping
Overland flow provisions review	Devise and get endorsement for revised treatment of overland flow	Flood working group	In house work (subject to August peer review if possible) GIS mapping (possible)
Mapping of hazard areas	Once endorsed methodology, map hazard areas	Water Resources/ City Planning	In house work GIS (Paul Weston & CP team)
Review of flood immunity standards	Review flood standards Get endorsement for changes Codify responses	Flood working group CP and Water Resources to seek endorsement	In house work
Resilient Design provisions	Investigate resilient design Avoid overlaps with BCA provisions Integrate provisions into New City Plan.	[redacted] (Resilient design code development) CP/DA/WRes integration	CP Implementation team work. NDRM to coordinate with them.
Climate Change Adaptation Response and Guidelines	Secure high level response High level adaptation principles Adaptation guidelines. August – Dec 2011	CP lead with Divisional stakeholders [redacted] City Planning with Divisional Stakeholders Water Resources major role.	GIS mapping Water Resources and CP involvement in conducting discussions
Review of industrial areas response to flooding	Review Strategic impact on industrial areas (and way forward) May – August 2011	NCP (industrial work – Rob Imrie) Flood working group NES [redacted] CP lead.	In house work.
General Code Development	Development Codes, redistribute provisions	Flood working group, CP lead.	In house work Stakeholder review required
Code testing	Testing of provisions against real DA scenarios	DA [redacted]	In house work – DA resourcing
Peer Review	Review method midway Review of proposed code (December/ March, timing to be discussed)	Water Resources coordination Flood working group to compile summary of methodology for review	Funding for peer review including: - mid point methodology review - final review
Floodwise Property Report update	Water Resources update to floodwise property report to match endorsed hazard area methodology	Water Resources	- Endorsement of hazard area requirements and methodology. - Water Resources GIS staff to complete.

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Summary of Key Decision Points

Table 4 below outlines key decision points anticipated for the flooding component of the project.

Decision	Stakeholder Inputs needed	Deciding entity
Confirm actions to be taken forward through flood component.	• WRes • City Planning • DA	• PCG
Confirm hazard mapping methodology and inclusions	• WRes • City Planning • DA	• [redacted]
Confirm proposed responses to land use impacts identified through strategic mapping.	• WRes • New City Plan team (and Content Review Panel)	• DMT • E&C Planning Guidance
Endorse natural hazard management area mapping	• WRes • City Planning • DA	• [redacted] • DMT • E&C Planning Guidance • E&C Strategy
Confirm proposed risk thresholds and development triggers	• WRes • City Planning • DA • Other affected stakeholders	• [redacted] • DMT • E&C Planning Guidance • E&C Strategy
Endorse proposed planning responses and code items.	• WRes • Other stakeholders: Wider City Planning, DA, City Assets, NES, others) • New City Plan team (and Content Review Panel) • New City Plan Reference Group (external) • BCLP	• PCG • DMT • E&C Planning Guidance • E&C Strategy
Endorse proposed code (New City Plan format)	• Stakeholders as above • All relevant chairs	• PCG • DMT, E&C Planning Guidance • E&C Formal Full Council

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1) Timing

Project timelines are linked to the timelines of the City Plan project. Specific phases are as outlined below.

Table 5: Summary of project timeframes.

Stage	Start	Finish
Stage 1: Scoping	January 2011	April 2011
Stage 2: Content Development	April 2011	December 2011
Stage 3: Code Drafting	August 2011	April 2012

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APPENDICES

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APPENDIX 1
NDRM Project
Flood Code Workshop Minutes
Monday 21 February 1.30-3.30

Meeting Attendees

City Planning [redacted]

Water Resources [redacted]

Development Assessment [redacted]

Disaster Management [redacted]

Theme	Details
NDRM Outline	• NDRM project is funded through disaster management. • The project's scope includes ensuring City Plan complies with SPP 1/03 • Timings are affected by Flood Recovery Review Board findings (Arnison), and State Government commission results. No decisions can be made before these are released. • BCC's 30 day review will also be factored in. • The NDRM flood component needs almost final proposals for December 2011, before release of Qld Government Commission of Inquiry. It all has to be finalised before the election (or as close as possible, given the time and availability of endorsement). This timing is linked to City Plan timings. • Work for the new City Plan 2012 has to be shared amongst divisions.

2007/8 Flood Code Development History	• Reasons why the 2007/2008 flood code work did not proceed:
	  • The extent of impacts of the proposed provisions on land use Consequential amendments to the City Plan were too big for an interim amendment (and therefore costly) (because flood provisions are scattered throughout the City Plan.
	  • Code proposed too many exception clauses (eg. x applies, except where…)

Waterway corridors	• Waterway maps
	  • The waterway maps have been amended over time. They are 10 years old and need a lot of ground-truthing. at the moment they are less than 80% accurate, there is some "big stuff" missing.
	  • It would not be a massive task to clean the maps up. They just need some consistency and good forward thinking.
	• Waterway ownership policy needs to be reviewed (with a view to getting more waterway land into public ownership).
	• The flood provisions will focus on flood hazard. This is a separation from environmental concerns. The treatment of these two as separate entities needs to be thought about carefully.
	• A change to flood hazard mapping might be better received publicly than changes to waterway corridors. Any significant change to the current

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	waterway corridors would present many issues with residents.
Mapping	• SPP 1/03 requires mapping of hazard areas. • Preparation of the required mapping would require some GIS and engineering expertise. It would take two GIS experienced hydraulic engineers a couple of months to complete the task. • Mapping would have separate layers for different purposes (overlays). • City Design hold the information, so they will need to be involved in any review. So the steps in our process might include: a. An information audit b. Determining our desired next position • There will be rolling upgrades to flood mapping over the next 5 years (to a newer methodology) – In the longer term we will be in a better position information-wise. • There are issues with using information from DAs to help with calculations, in terms of use conditions on the information, and reliability. • There should be a central repository of information. • It might be more efficient to choose a risk model, sketch the details of what we want to do, then find out the information.
Overland flow	• Codes like the house code would be able to include improvements while remaining free standing as overlays could be used and we would not need to see applications that are not in the hazard areas.
Risk model and mapping	• Several models should be put forward for the way to progress. This should be done quite early in the piece, to get endorsement of the approach to take forward. • It would be good if information about flood hazard were more publicly accessible. • The SCARM guidelines are useful, but are getting a bit dated now. • There are some new guidelines out. See Australian Rainfall & Runoff • NSW has the strongest risk models in Australia. • Also see the UK guidelines as an example. • Also note the Gold Coast approach (which has requirements for evacuation). • Drew Bewsher is a good flood plain risk management consultant currently engaged by Council. o It might be beneficial to get his advice as a specialised consultant o We could ask him to look at options for risk models, do a literature search of international best practice. o Such a consultancy would likely cost about $40-50K and take about 3 weeks to complete. • City Planning should meet with Water Resources to talk about the risk model • There should be evaluation of the pros & cons of each. • The risk model will inform mapping information requirements. • Water Resources and City Planning need to work together to get this work done. Two pieces of research are pertinent to investigation on flood risk management:

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	• [redacted] has completed a literature review. Get a copy. • Neil Collins has done a review for local Councils, which discusses the legal can's & cant's.

Depth & Velocity	• Depth & Velocity might be useful for identifying risk areas, depending on the risk methodology we use.
	  • 2D modelling would be useful.
	  • We have some information with our 1D model.
	  • We need to review how much information we've got.
	  • We have information about depth, but not velocity.
	  • We lack information about flow paths.
	• We would like to have flow paths in hazard mapping ie. blanket DV (Depth & Velocity) mapping
	• [redacted] has some strong views on mapping via topography.
	
	We need to consider the usefulness of knowing velocity.
	  • The SPP guideline mentions depth and velocity.
	  • Velocity would also be useful considering the issues around the pontoons and pylons from the recent flood.
	  • We might need to regulate pylons and pylon heights: Many of the pontoons that floated away were designed for a maximum of 3 m/s, whereas in flood conditions, actual velocity was ten times that.
	  • Until it's regulated, they will build it as cheaply as they can. 3m/second is probably OK for Cabbage Tree Creek, but not the Brisbane River. Higher pylons are needed too.

Compensation	• Investigation into injurious affection and compensation impacts on Council is required early in the piece. What will change in our requirements expose us to?

Cumulative effect	Cumulative effect is a potentially tricky area.
	There are two types of impacts:
	• Filling on flood plains
	• Cumulative flow generation (eg. you get more flow from hardstand).
	
	• It is hard to tackle changes to catchment development. Do we need a regional/ catchment wide view for new development to determine measures? Or reserve mitigation measures for existing problems?
	
	• A lot also depends on the capacity downstream.
	• DA need confidence regarding the capacity of the catchment.
	• At the moment our provisions say no adverse impacts pre and post development.
	• There is some question as to the contribution of hard surfaces.
	  ○ In the UK, there are rules about houses and non-permeable surfaces.
	  ○ It is an issue in terms of Industrial /big sheds and whether they are tripling the flows and spends (from rainfall) into storm water drains compared to rainfall on grass.
	  ○ What would be the impact of many unit blocks taking up most of the block, vs. gardens and back yards?

Code	• The structure of flood provisions, and mapping are all in the mix in the creation of the new code(s). We have to translate the planning scheme

DRAFT

BCC.134.0288

	over to QPP anyway. • The State Government requires us to include hazard mapping, and for flooding to be addressed in codes. • Politically, there is support for a 'flood code'. • Codes should encourage resilience or resilient building design in the City Plan. • Part of this project is reviewing the location of information within the scheme, and bringing some things up into the codes out of policies or guidelines. So this includes review of what is in the Subdivision and Development Guidelines.

Actions:

Theme	Action
Future progress.	• CP to send meeting for next week to continue flood risk model discussion. • Water Resources to forward the brief they are looking at regarding the risk model and what needs to be looked at. • CP to forward minutes.

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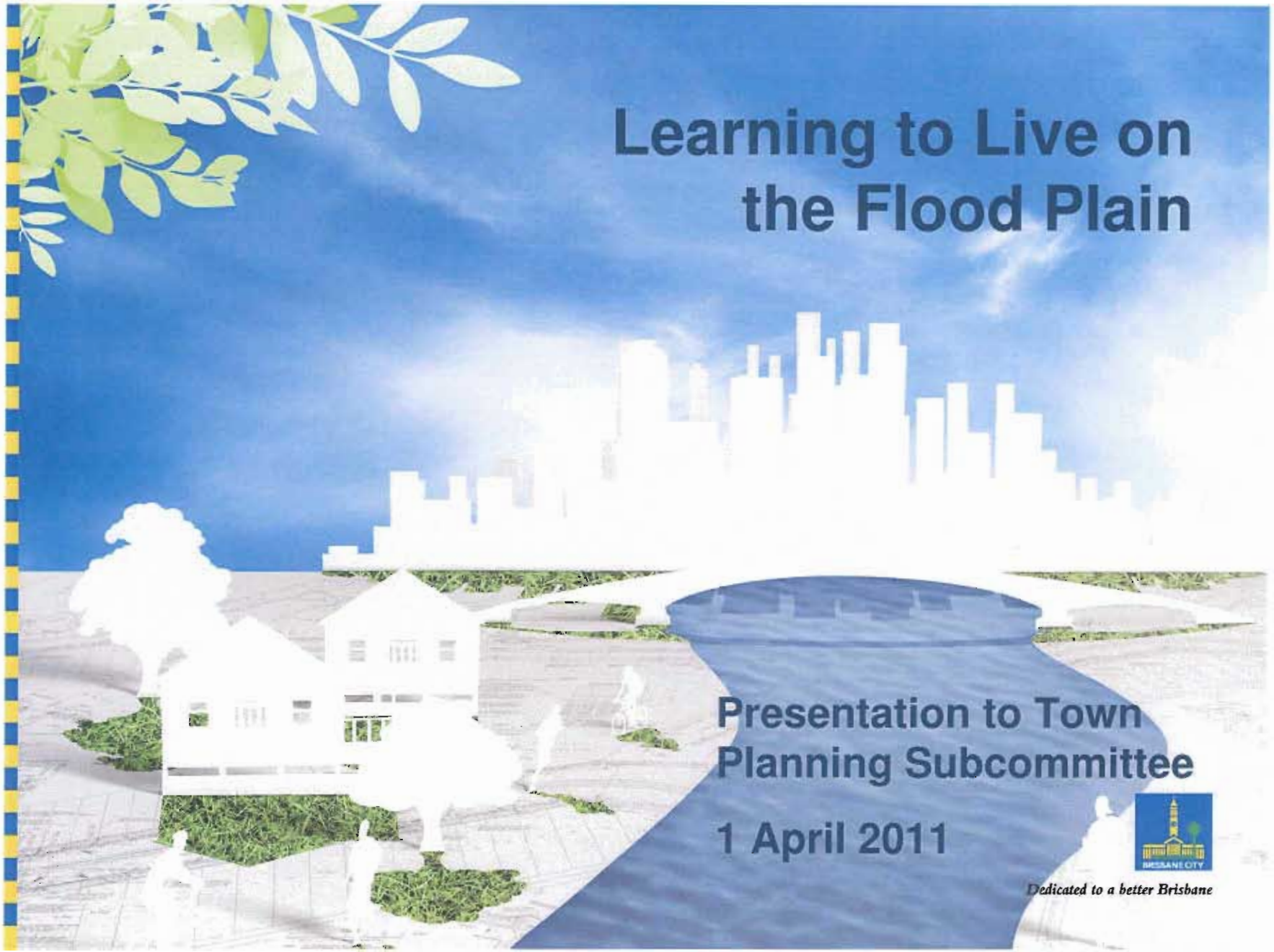
Learning to Live on the Flood Plain
Presentation to Town Planning Subcommittee
1 April 2011
BRISBANE CITY
Dedicated to a better Brisbane

Purpose

- Explain key milestones in delivery of flooding code based on a risk management approach.



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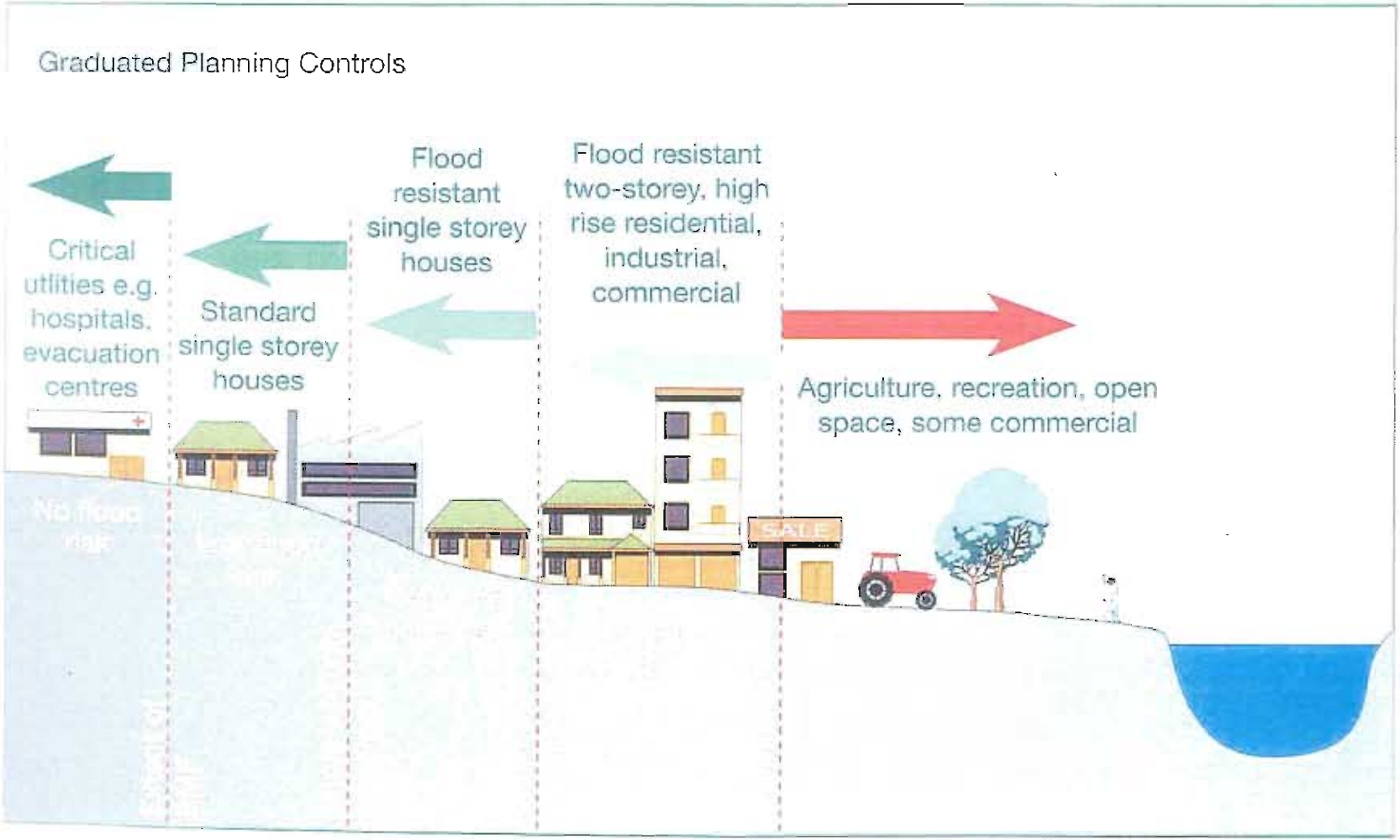
Risk Based Planning Controls



Foundations

Hazard mapping Inputs & methodology

Determine Risk settings (thresholds) eg. non habitable

Issues investigation eg. flood storage

QPP conversion & structure for City Plan.

Determine appropriate planning responses and mitigation measures for new uses

Make first cut hazard maps

Mitigation/adaptation of existing land uses

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Integration

Compare maps against:

- Strategic Plan growth corridors
- sensitive infrastructure & land uses

IWCM measures
Resilient building design
New subdivision design

Integrate or Resolve Issues

Draft codes, maps, other provisions

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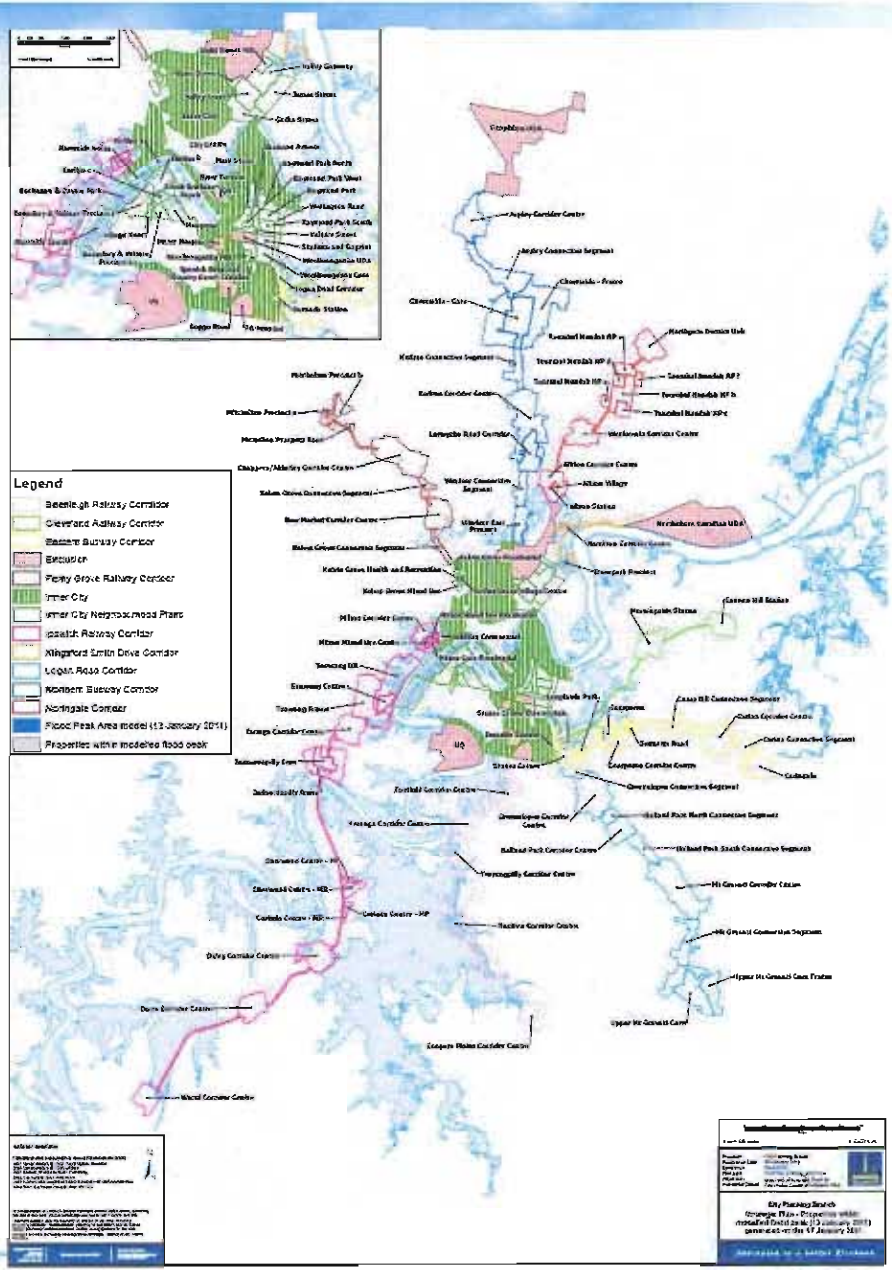
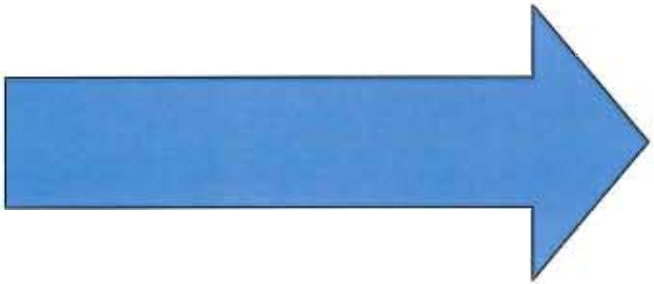
- Growth corridors to be rechecked for flood susceptibility (draft Strategic Plan does not rely on land below the Q100 line to accommodate regional growth targets)

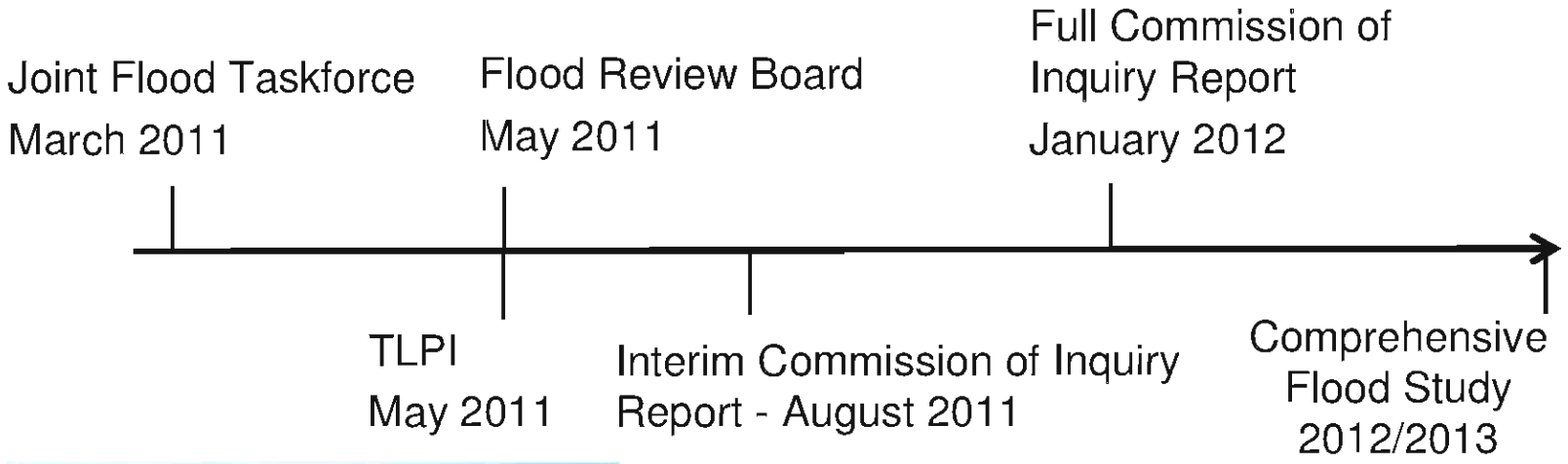


Products



- Strategic Plan updates – maps & intents
- Flood Hazard Maps
- Flood Hazard Code
- Other City Plan amendments, eg. updates to Local / Neighbourhood Plans
- Recommended complementary actions

Timeline



Foundations
Jan 2011 – June 2011

Integration
May 2011 – Dec 2011

Production
Sep 2011 - April 2012

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Any Questions?



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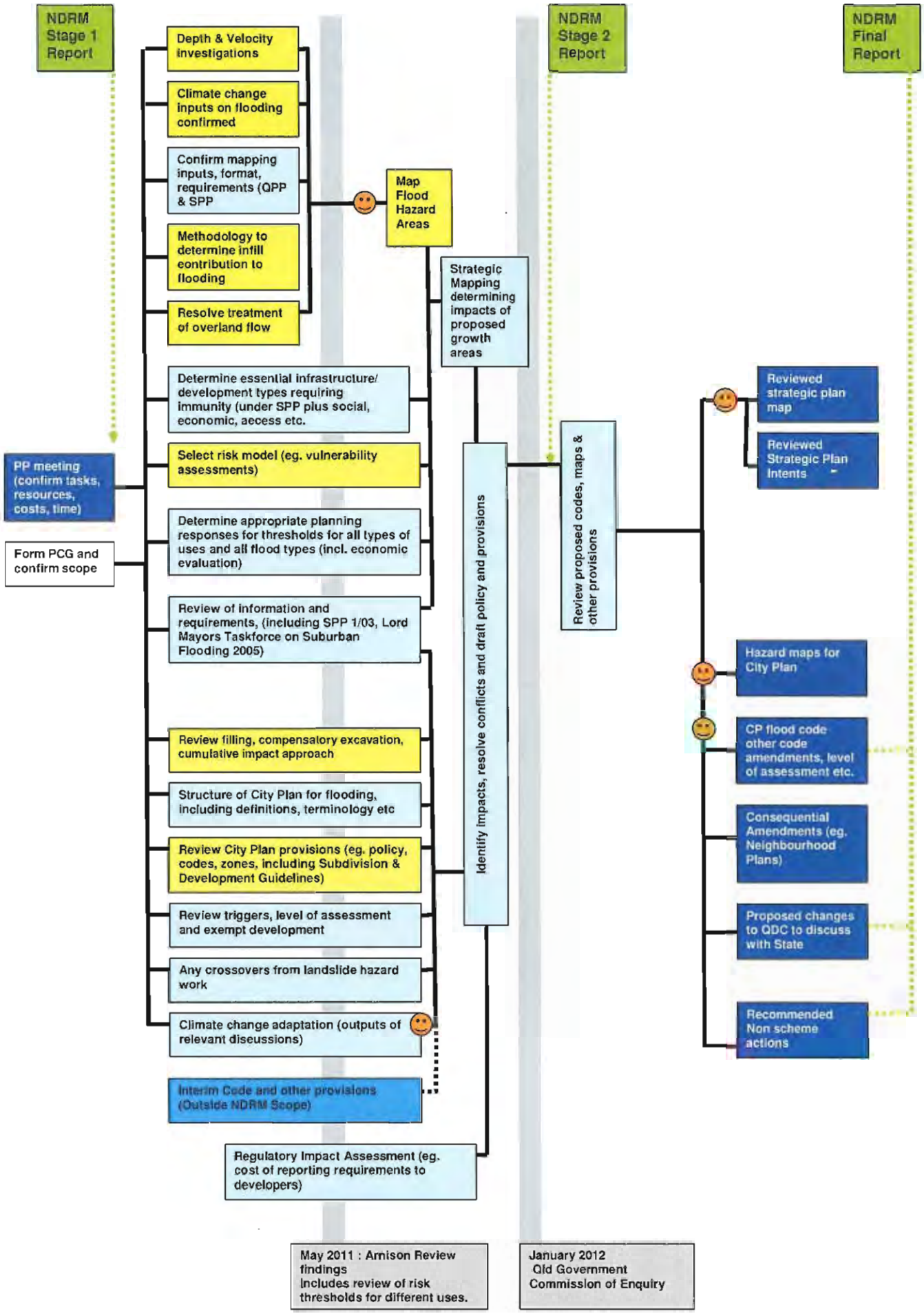

NDRM - FLOODING COMPONENT SUMMARY

PGC/Other endorsement

6 Flooding flow chart Workshop

Review of information and requirements	• 2005 Lord Mayor's Taskforce for suburban flooding. • Findings from Arnison Review and Qld Government Commission of Enquiry. • SPP and guidelines • QPP requirements and definitions.
Taskforce Integration	• Identify cross-over pieces of work and opportunities to collaborate/benefit from Qld Government and BCC Taskforces • Integrate with possible interim flood code.

Depth and Velocity Investigations	• Evaluate practicality of incorporating consideration of flood depth and velocity (per recommendation 11)
	  • Understand difficulty of determining velocity and depth (including if developers can/should provide detail for some applications);
	  • Identify existing information and gaps to inform decision regarding depth and velocity risk based approach.
	  • Water Resources/GIS (other stakeholders) to advise on system implications cost to include depth and velocity and likely duration
	  • Prepare mapping (in coordination with mapping task below)
	If it is decided to progress this:
	  • Determine criteria for grades of risk (high, medium)
	  • Determine thresholds of concern for different uses (when and what sort of responses are required?)
	  • Determine appropriate responses for the different thresholds

Mapping	• Confirm criteria for mapping natural hazard areas-
	  • considering SCARM guidelines.
	  • Confirm existing assumptions (what is included in Q100/DFE) and clarify what should be built in (including assumptions about flooding in wider catchment).
	  • Clarify climate change assumptions (including rain burst and storm surge).
	  • Clarify appropriate assumptions re: multiple events together and multiple catchments.
	• Confirm information availability and feasibility of sourcing data if needed.
	• Confirm mapping requirements (QPP, SPP and data)
	• Prepare mapping for natural hazard areas.
	• Clarify DFE (linked to Arnison Review)
	• Clarify role of flood regulation lines.
	• Investigate how to/ whether to include overland flow in calculation of flood hazard areas.

Impacts of infill development & cumulative effect	• Discuss including impacts of infill development in calculation of flood areas
	• Methodology for incorporating cumulative effect for assessment of applications (per LMs taskforce recommendations) – including:
	  • Possible changes to filling and excavation rules
	• Review existing policy settings for exempt development: are settings for filling and development right, including in/near waterway corridors, acid sulphate soils, others.
	  • Compensatory earthworks policy (is it having the desired effect?)

Overland flow	• Investigate and confirm preferred approach for overland flow (Including overland flow is not an SPP requirement but is recommended in Gaskell Report and by LM's taskforce for suburban flooding recommendation)
Strategic Plan Review & Strategic Mapping	• Review strategic plan in light of SPP policy outcomes for flooding • Incorporate results of flooding taskforces. • Undertake strategic mapping and review of strategic land use planning to ensure new growth areas and key infrastructure are well located (or appropriate management plans in place otherwise). This should be based on stepped scenarios, including probable maximum flood scenario for different flood types. • Undertake flood risk assessment for all types of flooding, including overland flow. • Review acceptable level of risk per land use (with consideration of taskforce results); and considering commercial, building costs and other impacts • Investigate impacts of the proposed development pattern and requirements for flood storage capacity and flow/displacement, and impacts on overland flow at an appropriate scale)

Risk Model	• Decide on a risk management approach/model to be taken forward (eg. considering NSW and UK examples, Rob Wrights proposed interim solution).
	  • Evaluate strengths and weaknesses of different approaches.
	  • Confirm fit with SPP requirements.
	  • Review level of risk per land use and risk settings (including interim BCC position and Arnison review).
	• Get endorsed approach to take forward.

Scheme Drafting	• Review of existing codes and provisions, ensuring acceptable solutions and performance criteria are appropriate.
	• Identify relevant codes (residential, industrial; centre design codes, and any others) for clarification of floor levels (dependent on State/Council review).
	• Review and reorganize planning scheme to meet QPP requirements, and to include a flood code.
	  o Identify appropriate code provisions
	  ▪ Overland flow and design provisions to manage it.
	  ▪ Resilient design provisions
	  ▪ Building heights for flood immunity (refine from interim if needed)
	  ▪ Water quality measures
	  o Identify approach to code structure for new City Plan.
	  o Review existing codes and provisions, ensuring acceptable solutions and performance criteria are appropriate.
	  o Identify how OPP definitions might be used, taking into account risks
	  o Are there any PIP implications for flooding (see LMs taskforce recommendations, questions about flood infrastructure, tracking carrying capacity and condition of existing infrastructure (if relevant).
	• Incorporate appropriate level of assessment in planning scheme development.
	  o Review policy settings for exempt development, including in and near waterways, acid sulphate soils etc.
	  o Devise straightforward assessment for where non Council assessment is involved.
	• Clarify the DFE clearly noting in the new City Plan how it was calculated.
	• City Plan code and mapping preparation

Review	• Seek peer review of provisions ([redacted] and BCC content specialists) prior to finalisation of strategic plan and city plan.
Discussions	• Continued information/endorsement/presentations and discussion of policy positions with PGC.



Project Management Plan

City Planning Branch

City Planning and Sustainability Division

Natural Disaster Risk Management Input to the New City Plan

PROJECT OWNER: [redacted]

Document Change History

Document Control Sheet

If you have any questions regarding this document or if you have a suggestion for improvements, please contact:

Project Manager	[redacted]
Phone	[redacted]

Version History

Version	Author	Issue Purpose	Date
1.0	[redacted]	Initial draft	30 Sep 2011
1.1	[redacted]	Initial draft revised (for distribution)	30 March 2011
1.2			

Project Owner Endorsement

The following officer has **endorsed** this document.

Name	[redacted]		
Position	Principal Regional and Strategic Planning		
Signature		Date	

Divisional Manager Approval

The following officer has **approved** this document.

Name	[redacted]		
Position	Division Manager, City Planning and Sustainability		
Signature		Date	

* Project ownership transferred from Disaster Management to City Planning for 2011-2012 financial year.

Distribution List

1. Distribution 1 (first draft)

1. Distribution 1 (First Draft)

Name	Position

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1. DOCUMENT PURPOSE

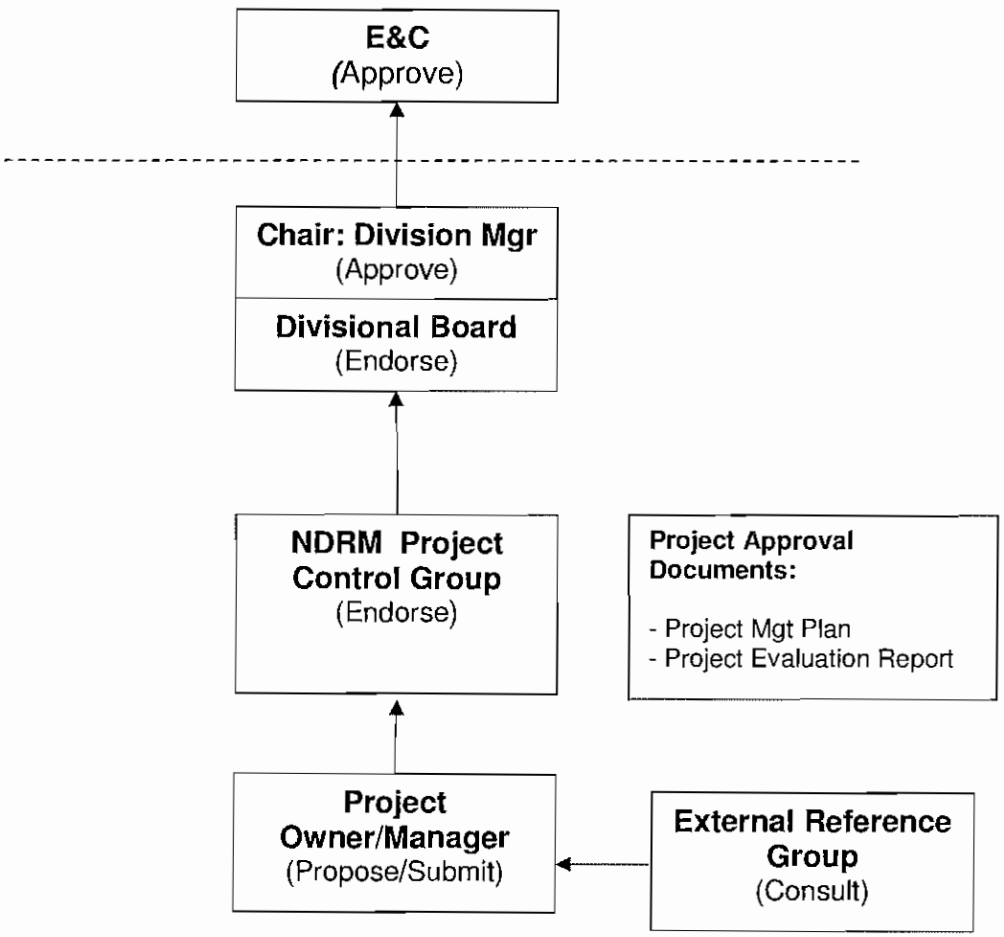
The Project Management Plan (PMP) defines the detail of how the project will be managed. It defines the processes to be applied through planning, monitoring and implementation: i.e., the who, what, where, when and how. Details of the project, including cost forecasts, schedule, risk management plans etc, should be either included in the main body of the document or as attachments.

The PMP is used as a management tool for the Project Manager and Project Owner and as a reference for the project team and project stakeholders. The key audience for this document is the project team, including the project owner and project manager.

The PMP will also be used, in conjunction with other relevant deliverable documents, to support the Project Owner in making informed decisions for the project.

2. GOVERNANCE

The Project Control Group is proposed as the key decision making body for the project responsible for the project's overall direction and delivery. The PCG will champion the project within Council and is responsible for committing resources and approving the terms of reference and project plan.



2.1. Project/Program Control Group Roles and Responsibilities

Name	Role	Responsibilities
[redacted]	PCG Chairperson	Responsible for overall project governance. This position owns the budget and is therefore ultimately accountable for the success of the project. The role involves leadership of the project, convening and chairing the PCG, signing off on key deliverables and supporting the project manager
[redacted]	PCG member and key stakeholder	Senior Officer working on a project.
[redacted]	Project Manager	The Project Manager is responsible for the day to day running and management of the project and project team. They report to the Project Owner and PCG.
[redacted]	PCG Member	Advisor to the Chair
[redacted]	PCG Member	Advisor to the Chair
[redacted]	PCG Member	Advisor to the Chair
[redacted]	PCG Member	Advisor to the Chair

3. CHANGE CONTROL PROCESS

Any requests made to change project deliverables or scope must first be subject to initial analysis by the project manager so as to identify potential impacts on any of the project functions. This analysis should be presented to the program manager so that a decision can be reached as to what to do. This information should be presented so that its impacts on each function can be easily seen.

Project Functions

- Scope
- Time
- Cost
- Scope
- Quality
- Human Resource
- Risk
- Communication
- Procurement

All requests are to be in writing, must be documented as part of this Project Management Plan and be recorded on a Change Register.

4. PROJECT SCOPE

The proposed scope of work for this project is to provide natural disaster management input to the new City Plan in the form of a code or codes and associated spatial information. This outcome will enhance

community resilience to these natural hazards by influencing the consideration of development through the planning and development assessment phases.

Specifically, this input will be provided via two tasks::

1. To investigate the feasibility of implementation the recommendations of the Natural Disaster Risk Management and the City Plan – Consideration of State Planning Policy 1/03 report; and

2. Where identified action the recommendations from the report and additional tasks to fulfil the scope of the project.

The scope of work is further defined to the nature of information that is relevant to a Planning Scheme (City Plan) prepared under the *Sustainable Planning Act 2009* (SPA) and the Queensland Planning Provisions (QPP). The project will provide such input in the form of a code or codes for an overlay or overlays relevant to natural disasters of flooding, bushfire and landslide in accordance with State Planning Policy (SPP) 1/03.

The scope of work must be provided within the format (physical and electronic), timing and deliverables required for the larger City Plan Review project.

The project will be undertaken in 3 phases as follows:

- **Phase 1 - Feasibility Investigation**

  This phase is focussed on establishing the feasibility of the recommendations made in the Natural Disaster Risk Management and the *City Plan – Consideration of State Planning Policy 1/03 report.* A key activity in this phase will be an internal stakeholder meeting to discus feasibility, scope and resource allocation. A further key outcome of the meeting will be direction about standards to be achieved (particularly for bushfire risk).The key deliverables from this phase will be:

  Phase 1 Recommendations Feasibility Report: This report will provide an assessment of the recommendations from the *City Plan – Consideration of State Planning Policy 1/03 report* and their capacity to be realised based on the project budget, Council priorities and the City Plan project plan. This report will also resolve key policy direction around such technical matters as standards and requirements council will address in relation to bushfire and flood levels. Recent bushfire experiences in NSW, Victoria and the ACT have revised bushfire hazard assessment and planning and the January 2011 river flood and subsequent response has also changed Councils flood planning direction. Likewise, coastal issues have revised storm surge and sea level rise policy settings. Both issues (and landslide) are broadly affected by impacts of climate change.

  Phase 2 Task Briefs: these briefs will be for project team members, partners and possibly consultancies required to deliver the outcomes identified ion the Phase 1 Recommendations Feasibility Report. These briefs will be an appendix to that report.

- **Phase 2 - Policy and Technical Basis Development**

  This phase provides for the base technical information investigation and development that is required to action the scope determined in the previous phase. This phase will include spatial information being developed. key deliverables from this phase will be:

  Phase 2 Task Outputs: Outputs as specified in the briefs from Phase 2 Task Briefs. These outputs will be a combination of reports, summaries, assessments/reviews and spatial information. Most of these tasks will be undertaken concurrently by a combination of the project team, project partners, consultants and key stakeholders as contributors.

  Phase 2 Summary and Technical Information Basis Report: This report will provide a summary of the outputs from Phase 2 in order to provide the policy basis for Phase 3. The various technical and policy task outputs will be combined as appendices to this report. In some instances, spatial information will also be provided and hard copies will be included in the report while electronic information will be linked to the project folder.

- **Phase 3 - City Plan Code Development**

This phase provides for the conversion of technical information and issues to be developed into policy and then specific code elements. key deliverables from this phase will be:

Phase 3 Summary and Project Report: This report will provide a summary of the project and its deliverables.

Final Draft NDRM Code or Codes: The code or codes for input to the new City Plan will be provided. These will be preceded by initial draft and revised draft before the final draft.

Final Draft NDRM Spatial Information (mapping): Any spatial output will also be provided. Such information forms part of the input to the new City Plan.

Additional Action and Information Report for Non-Code Outcomes: It is likely that a range of information will be identified that is not all directly applicable to the requirements for a code or codes in the new City Plan. These will be collated and included in this report. Depending on the material, recommendations will also be made about the way this information can be used for other action or reference. This report will also include an implementation strategy inclusive of training packages for internal stakeholders and external stakeholders.

Further information is included per hazard in attached Hazard briefs.

Updated flow charts per content area attached with flow charts.

4.1.1. Specific Inclusions

Specific inclusions are:

- A code or codes in a format consistent with the City Plan Review project and the legislative and policy settings and requirements for SPA, QPP and SPP 1/03 and associated changes including updates to the Strategic Plan.
- Preparation of a Critical Infrastructure Plan for Brisbane which accords with requirements of SPP 1/03.
- Spatial information where required that updates, revises or presents new spatial information required for compliance with legislative and policy requirements and the format of the new City Plan and Council GIS systems.
- Key stakeholder consultation required to develop the technical basis of the scope of work.
- Site based work is limited only to short duration general site visits and not involving field measurement, placing, maintaining or recovering of monitoring devise and equipment.

4.1.2. Specific Exclusions

Specific exclusions are:

- Consultation with the general public.
- Drafting of codes and policies not pertaining to natural disaster risk management.
- Development of policy settings/responses for climate change mitigation.
- No detailed field work or monitoring is provided for (general site visits and consultation are inclusions as described above).

4.1.3. Assumptions

The main assumptions are:

- The legislative and key policy environment will remain substantially stable throughout the project life (superficially that SPA, QPP and SPP 1/03 remain stable).
- The roles and responsibilities of the principal stakeholders will remain relatively constant.
- Sufficient budget will remain allocated to complete the project in 2010/11 and 2011/12.
- Staff and resources will be available as and when planned by the project.

4.1.4. Constraints

The main constraints are:

- The new code and associated spatial information must be within the format and content specified by SPA, QPP, SPP 1/03 and the direction provided for the new City Plan.
- Project timelines are linked to the timelines of the City Plan project and the flood component of this project is also dependant on the recommendations of the Qld Government Commission of Inquiry.
- Milestones as indicated in section 6 (Schedule Management) are to be complied with.

4.1.5. Dependencies

Each phase will depend on the previous phase being completed successfully. The whole project is dependent on the related and broader City Plan Review project in so far as direction about format and presentation will be provided in addition to drafting instructions for codes.

The flood component of the project is also dependent on the outcomes of the Flood Review Board, Queensland Government Commission of Inquiry outcomes, and directions from the Town Planning Sub Committee for the flood response.

5. COST MANAGEMENT

5.1. Project Cost Estimates

The budget for this project for this financial year is $70,000 with an additional $140,000 to be provided in the 2011/2012 financial year. The project will finalise in the 2011/12 financial year. The broad breakdown of the budget across the two year period and by phase is as follows:

Breakdown	2010/11 Year	2011/12 Year	TOTAL
Technical Investigations	$20,000	$50,000-	**$70,000**
Staff costs	$50,000	$90,000	**$140,000**
TOTAL	**$70,000**	**$140,000**	**$210,000**

The project will provide monthly budget and performance reports through PERFORM.

6. SCHEDULE MANAGEMENT

6.1. PROJECT PHASING

The project will be undertaken in 3 phases and 3 streams (Flood, Bushfire and Landslide) as follows:

- **Phase 1 - Feasibility Investigation**

  This phase is focussed on establishing the feasibility of the recommendations made in the Natural Disaster Risk Management and the City Plan – Consideration of State Planning Policy 1/03 report

- **Phase 2 - Policy and Technical Basis Development**

  This phase provides for the base technical information investigation and development that is required to action the scope determined in the previous phase. This phase will include spatial information being developed.

- **Phase 3 - City Plan Code Development**

  This phase provides for the conversion of technical information and issues to be developed into policy and then specific code elements.

6.2. PROJECT SCHEDULE SUMMARY

Key activity / milestone	Start Date		End Date	
	Planned	Actual	Planned	Actual
Phase 1 Feasibility investigation • **Phase 1 report** • **Scope briefs for identified Phase 2 activity**				
Bushfire	January 2011		April 2011	
Landslide	January 2011		April 2011	
Flooding	January 2011		April 2011	
Phase 2 Policy and Technical Basis Development • **Phase 2 report** • **Specific Phase 2 Activity outputs** • **Spatial Information output**				
Bushfire	April 2011		September 2011	
Landslide	April 2011		September 2011	
Flooding	April 2011		December 2011	
Phase 3 City Plan Code Development • **Phase 3 report** • **Final draft code** • **Final draft supporting GIS information** • **Additional action and information report for non code outcomes**				
Bushfire	September 2011		November 2011	
Landslide	September 2011		November 2011	
Flooding	December 2011		April 2012	
Critical Infrastructure				
Draft Critical Infrastructure Plan	March 2011		May 2011	
Inclusion into Codes			As per Phase 3 end dates	

7. PROCUREMENT AND CONTRACT MANAGEMENT

Type of good/service needed	Source/Procurement Type
Professional or Technical Consultant	Panel of Providers
Stakeholder meetings	Consumables and venue (if required)
Travel (vehicle and if required)	Council car pool

All procurement will be in accordance with Council procedures. Panel members will be used for any consultancy or professional services.

Phase 1 will provide the specific scope and brief for any consultancies. It is however anticipated that consultancies will be required to specifically address:

- bushfire hazard management and current industry practice (including interstate experiences);
- bushfire hazard mapping (most likely sourced from internal provider);
- inundation level mapping accounting for current policy environment; and
- internal and external stakeholder training packages materials.

8. RISK MANAGEMENT

8.1. Risk Management

Significant issues and risks will be documented and tracked to resolution by the Project Manager. The primary tools in identifying risk, mitigation and ongoing tracking are via:

- Risk assessment workshop in Phase 1;
- Risk register; and
- Reporting on risk at project management meetings and to the PCG.

If resolution cannot be achieved by the Project Manager and Project Director matters will be referred to the PCG and the responsible person/committee for consideration and resolution.

8.2. Risk Summary

Risk Item	Current Risk Rating	Mitigation/Management Strategy	Responsible Officer
Political risk: acceptability of investigating climate change based issues and potential limit on scope or project overall.	Moderate	Liaison with QLD Govt to confirm policy direction and advice	[redacted]
Budget risk: budget spans 2 years and may be modified/withdrawn.	Moderate-High	Budget reduced for current financial year – close monitoring of funds will continue	[redacted]
Governance Risk: Budget is managed from DM/FACS while scope is	Low	Process currently underway to transfer funds and ownership to	[redacted]

managed from CP/CPAS and may affect overall delivery.		CPAS	
Technical Risk: adopting current 'best or better' practice will require detailed and up to date technical information which m ay not be available currently	High	Wherever possible, technical solutions designed to be updated as information becomes available	[redacted]
Policy Risk: Rapidly changing flood risk policy environment due to Jan 2011 flood event	High	Constant communication with stakeholders Wherever possible, technical solutions designed to be updated as information becomes available	[redacted]
Stakeholder Risk: Changes to scope and timelines resulting from Council wide flood response impacting on project	High	Constant communication with stakeholders	[redacted]
Policy Risk: Federal and State agencies are reviewing/revising various aspects of content basis for this project and may set increased standards than those being considered.	HIgh	Liaison with QLD and federal governments to confirm policy direction as far as possible	[redacted]

9. COMMUNICATIONS AND STAKEHOLDER MANAGEMENT

9.1. Communication and Stakeholder Strategy

Stakeholder Name	Stakeholder Position	Area of Interest
City Plan Team	City Planning Branch	New City Plan
[redacted]	City Planning Branch	City Plan – Neighbourhood plans
[redacted]	Development Assessment Branch	Development Assessment
[redacted]	Disaster Management Branch	All hazards
[redacted]	Water Resources Branch	Flood
[redacted]	Natural Environment & Sustainability	Bushfire
Cr Cooper	Elected representative	Chairman, Neighbourhood Planning and Development Assessment Chair, Town Planning Sub Committee for Flood Recovery

Cr Knapp	Elected representative	Chairman, Family and Community Services Committee
Cr Matic	Elected representative	Chairman, Environment, Parks And Sustainability Committee
	Brisbane City Legal Practice (BCLP)	Legal implications of provisions
DCS, EMQ, DLGP, DERM	Queensland Government	State government policy and planning
Queensland Reconstruction Authority	Queensland Government	Flood Response
City Plan Ref Group	Community and Peak Bodies	Mixed – non Government

10. QUALITY MANAGEMENT

10.1. Quality Management Plan

Quality Management for the project will be undertaken via a variety of mechanisms, as outlined below.

Document Control
- Use of standardised protocols and templates for work undertaken
- Use of standard protocols for document naming and filing
- Use of Council systems for document management (electronic and paper filing systems)

Content Control
- Liaison with internal program partners and stakeholder groups.
- Briefings and feedback from formal Council Committees when necessary (E&C, PGC)

Procurement
- Strict adherence to Council procedures for procurement
- Use of pre-approved panel of providers for consultancy work.
- Compliance with Council's budget reporting procedures

10.2. Project Document Control

The Project Manager will be responsible for the collation and control of all documentation pertaining to this project.

Documentation to be included under Project Document Control, but not limited to;
- Project Management Plan (all versions)
- Change requests (emails, forms, documented conversations etc)
- Reports to stakeholders (PCG, Owners and Program Managers as well as any corporate reports)
- Budget reports (inc. any variations or changes to budget)
- Correspondence in relation to the project both internal to BCC and external (relevant third parties and staff)

For full listing and guidance please refer to the Information Management section of CityWeb

11. BENEFITS REALISATION

The benefits from this project are related to, outlined a best described in the Program Outline for

Public Health and Safety (Program 7).

- Public Health (7.1) We will protect and promote the health of Brisbane's residents.
- Citizens' Security (7.2). Personal security of citizens and their property, security of the city and effective disaster and emergency management and community safety services.

The program takes a proactive approach to promote the safety of all residents and visitors through building awareness of, and resilience to a range of potential harms from natural or human causes. Council will work closely with residents and with a range of stakeholder organisations at a regional and state level to achieve this.

Our goal is to protect and enhance the health and safety of Brisbane's community.

Program 4 – Growing City and City Plan

12. PROJECT COMPLETION

12.1. Completion Activities

Completion Activity	Responsible Person	Position
Conduction an evaluation	[redacted]	Project Manager
Finalisation	[redacted]	Project Manager

13. PERFORMANCE MEASURES

Functional Area	Performance Measurement
Governance	90% regular attendance for PCG and project team meetings,
Scope Management	Scope register maintained
Cost Management	Cost tolerance is within 5% of total project estimate.
Schedule Management	Schedule tolerance is within a reasonable timeframe

Our ref: Doc 1691249

2 September 2011

Martin Reason
Acting Planning Manager
Brisbane City Council
C/- Clayton Utz

REQUIREMENT TO PROVIDE STATEMENT TO COMMISSION OF INQUIRY

I, Justice Catherine E Holmes, Commissioner of Inquiry, pursuant to section 5(1)(d) of the *Commissions of Inquiry Act 1950* (Qld), require Mr Reason to provide a written statement, under oath or affirmation, to the Queensland Floods Commission of Inquiry, in which the said Mr Reason gives an account of:

1. The groundwork that has been done for the preparation of the:

    a. Flood hazard provisions referred to in paragraph 3.17 of the Fifth Statement of Colin David Jensen to the Commission of Inquiry dated 31 August 2011; and
    b. Flood Code referred to in paragraph 3.18 of the Fifth Statement of Colin David Jensen to the Commission of Inquiry dated 31 August 2011.

    All relevant briefing notes, papers, records of decisions and draft Flood Codes should be attached.

2. The mechanism or trigger for provision of a flood study as part of development applications to Council as referred to in paragraph 5.17 of Brisbane City Council's second submission to the Commission of Inquiry.

3. The process followed in assessing development applications insofar as they include a flood study and/or hydrological or hydraulic expert reports as part of the development application. In giving this account please explain how the flood study or expert report is assessed by Council to determine whether it demonstrates compliance with the Brisbane City Plan 2000.

400 George Street Brisbane
GPO Box 1738 Brisbane
Queensland 4001 Australia
Telephone 1300 309 634
Facsimile +61 7 3405 9750
www.floodcommission.qld.gov.au
ABN 82 696 762 534

In addressing these matters, Mr Reason is to:

- provide all information in his possession and identify the source or sources of that information;
- make commentary and provide opinions he is qualified to give as to the appropriateness of particular actions or decisions and the basis of that commentary or opinion.

Mr Reason may also address other topics relevant to the Terms of Reference of the Commission in the statement, if he wishes.

The statement is to be provided to the Queensland Floods Commission of Inquiry by Friday, 9 September 2011.

The statement can be provided by post, email or by arranging delivery to the Commission by emailing info@floodcommission.qld.gov.au.

C Holmes

Commissioner
Justice C E Holmes

Second Statement of Martin James Reason

I, Martin James Reason, Acting Manager of City Planning & Economic Development, Brisbane City Council, of 266 George Street, Brisbane, in the State of Queensland, state on oath as follows:

1. Attached is a copy of a notice from the Commissioner of the Queensland Floods Commission of Inquiry (**Commission**) dated 2 September 2011 requiring me to provide certain information to the Commission in the form of a statement by 9 September 2011 (**Notice**) shown as attachment **MJR-19**. This Statement is provided in response to the Notice.

2. For the purposes of responding to the Notice and preparing this Statement I have, in my position as Acting Manager of City Planning & Economic Development Branch of the Brisbane City Council (**Council**), had access to:

   (a) the business records of Council; and

   (b) Council officers,

   to obtain information to provide a response to the Notice.

3. Unless otherwise stated, the matters set out in this Second Statement are based on my own knowledge and the information derived from the above sources. Unless otherwise stated, the documents attached to this Second Statement have been collated by me or by Council officers under my direction and instruction.

4. In responding to the Notice, I refer to my first statement dated 1 September 2011 (**First Statement**).

1. The groundwork that has been done for the preparation of the:

a. Flood hazard provisions referred to in paragraph 3.17 of the Fifth Statement of Colin David Jensen to the Commission of Inquiry dated 31 August 2011; and

b. Flood code referred to in paragraph 3.18 of the Fifth Statement of Colin David Jensen to the Commission of Inquiry dated 31 August 2011.

All relevant briefing notes, papers, records, of decisions and draft Flood Codes should be attached.

5. In responding to the Notice, the Commission may find it helpful if I deal with 1(a) and 1(b) together.

[redacted]

[redacted]

Witness

6. The amendments described in the Fifth Statement of Colin David Jensen form part of a broader project to prepare a new planning scheme for the Brisbane local government area (New City Plan). The New City Plan is a requirement of the *Sustainable Planning Act 2009* (SPA) and will replace the current City Plan 2000.

7. Mr Jensen in his statement referred to necessary groundwork to prepare the New City Plan. I infer that he was referring to the deliberations which have been carried out by Council officers with a view to developing the framework for, and potential scope and content of, a Flood Code.

8. I must emphasise that, as Mr Jensen indicated, the deliberations of Council's officers are just that: deliberations. They have reached differing levels of maturity, depending on the issue, but as yet, to my knowledge, based on the documents that have been identified in the time available, there is no recommendation ready to be made to Council.

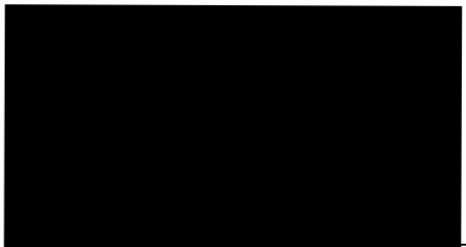
9. It would be reasonable to expect that many of the provisions of City Plan 2000 would be carried over into the New City Plan. As part of carrying these provisions over, revisions or amendments may need to be made.

10. Mr Jensen's statement referred to these anticipated amendments specifically at paragraph 3.17.

11. The table below provides an outline of some of the preliminary work that has been done to date in the preparation of the New City Plan particularly in relation to natural disaster risk management in accordance with SPP1/03.

12. The documents below reference the Town Planning Sub Committee formed as part of the Lord Mayor's Recovery Task Group specifically to advise Council officers on the development of land use planning policy to respond to the January 2011 flood.

13. The documents referred to in the table below reflect broad and frank discussions between officers and are not Council policy. In many cases, the documents represent preliminary drafts to inform discussions and are not reflective of a resolution of the issues raised. Such resolution will require a broad multi-disciplinary consensus and the balancing of numerous issues at a policy level.





Martin James Reason **Witness**

Document	Brief description of document for the Commission's assistance
Natural Disaster Risk Management Input into the New City Plan - Project Management Plan	This document outlines the strategy for achieving compliance with State Planning Policy 1/03 for the New City Plan. Attachment **MJR-20**
Natural Disaster Risk Management Flooding Component Summary (Flow Diagram) referred to in the document above	This is a flow diagram illustrating the deliverables, main stages and milestones for the completion of the flooding component of the Natural Disaster Risk Management Project. Attachment **MJR-21**
Learning to Live on the Floodplain - Powerpoint presentation delivered to the Lord Mayor's Recovery Task Group - Town Planning Sub-Committee on 1 April 2011.	This presentation outlining the main concepts, process and milestones for delivery of the flood code was delivered to the Town Planning Sub Committee on 1 April 2011. Attachment **MJR-22**
Natural Disaster Risk Management Input into the New City Plan – Stage 1: Scoping Report	This report from June 2011 summarises the scoping phase of the flood component of the Natural Disaster Risk Management Project. Attachment **MJR-23**
Proposed methodology for identifying flood hazard and flood planning for the proposed Flood Hazard Overlay Code	This draft document, developed in August – September 2011 outlines the proposed methodology for defining flood hazard areas for use within the Flood Code. This document is being developed ahead of presentation to stakeholders on 9 September 2011, and external review scheduled for mid September 2011. This document contains concepts and provisions still under discussion. Attachment **MJR-24**
Draft Flood Hazard Overlay Code - 22 August 2011	This working document is the draft of the flood hazard overlay code, set out in the QPP template. It incorporates new material and material relocated from other places in City Plan 2000, notably the Subdivision & Development Guidelines. This document contains concepts and provisions still under discussion. Attachment **MJR-25**

[redacted]

Martin James Reason

[redacted]

Witness

2.	**The mechanism or trigger for provision of a flood study as part of development applications to Council as referred to in paragraph 5.17 of Brisbane City Council's second submission to the Commission of Inquiry.**

14. A "flood study" may refer to a wide range of documents of varying complexity, depending on the particular development application and constraints applicable to the relevant land. A flood study may range from a stormwater management plan for a single lot, to a detailed hydraulic or hydrologic study for a complex development or catchment.

15. A flood study is required where an applicant for a development approval must demonstrate that the proposed development will achieve a suitable level of flood immunity, and that the proposed development will not cause an adverse impact on surrounding properties from an increase in flood levels or duration.

16. I have provided information below on the relevant application of City Plan to the Commission's requirement. I note however that during the development assessment process, further information may be requested from the applicant to demonstrate how the standards in City Plan 2000 are met. This is further addressed in response to requirement 3 below.

17. A flood study may generally be triggered for three development scenarios - for a development application for a detached house, a development application for other than a detached house, and where an application involves filling and/or excavation.

Detached House

18. The House Code requires development to achieve acceptable levels of flood immunity in accordance with the levels specified in Table 1 of the Code. If a proposed development for a detached house complies with the acceptable solutions in the House Code, the development is generally self assessable and no further assessment by Brisbane City Council is required in relation to flooding.

19. As described in my First Statement, if a proposal for a detached house does not meet the Acceptable Solutions in the House Code, the development will become assessable development requiring a development application to be made to Council. As part of the assessment process, the applicant would need to demonstrate that the proposal complies with City Plan 2000, primarily by assessment of the proposal against the House Code, including the Acceptable Solutions (which incorporate Table 1 of the Code), Performance Criteria and the Purpose of the Code. In relation to flooding, the applicant must demonstrate that the proposal will meet P[redacted]Solution P6 of the House Code, which requires *"Habitable rooms,*

[redacted]

Martin James Reason [redacted] Witness

non–habitable areas (e.g. utility areas, garage, laundry and storage room) to have acceptable levels of flood immunity".

20. As part of the assessment to determine the proposed development's compliance with P6 described above, if not provided as part of the development application, Council will normally request that the applicant provide a flood study as evidence that acceptable levels of flood immunity can be achieved. Council's engineers assess the flood study to ensure that a suitable level of immunity is achieved. This is further detailed in my response to Requirement 3 below.

Development Other than a Detached House

21. As described in my previous statement, all applications for assessable development must be assessed against applicable codes. As shown in Figure 1 of my First Statement, development is ultimately assessed against the Stormwater Management Code and/or the Subdivision and Development Guidelines.

22. Performance Criteria 1 of section 4.2 of the Stormwater Management Code requires that "*The proposed stormwater management system or site works must not adversely impact on flooding or drainage of properties that are upstream, downstream or adjacent to the subject site*".

23. Acceptable Solution 3.1 for Performance Criteria 3 of section 4.2 of the Stormwater Management Code identifies relevant development levels by reference to the Subdivision and Development Guidelines. As outlined in my First Statement , the Subdivision and Development Guidelines contain comprehensive criteria in relation to flood immunity.

24. The Stormwater Management Code also contains notes that outline the information that can be provided to demonstrate compliance with the Acceptable Solution and/or Performance Criteria. For example, the note attached to A3.1 for P3 states "... *compliance with this acceptable solution can be demonstrated by the submission of a hydraulic and hydrology report identifying flood levels and development design levels (as part of a SBSMP)* [Site Based Stormwater Management Plan]"

Filling and Excavation

25. The Filling and Excavation Code is applicable to earthworks assessable under City Plan (generally greater than 1 metre of fill), and earthworks associated with applications made for uses as described in paragraphs 21 to 24 above.

[redacted] [redacted]

Martin James Reason Witness

26. Performance Criteria 3 of the Filling & Excavation Code (flooding and drainage problems) states that "*Filling or excavation must not directly, indirectly or cumulatively, cause any increase in flooding or drainage problems.*"

27. Acceptable Solution 3 of the Filling and Excavation Code includes a note detailing what hydraulic information can be provided to demonstrate compliance. The note is described in full below:

> *Note: compliance with Acceptable Solutions A3.1 to A3.5 can be demonstrated through the submission of a report detailing:*
> *• calculations for flood modelling of the riparian zone, including ground cover, understorey and canopy vegetation*
> *• management strategies to prevent adverse flooding and minimise changes to run–off characteristics consistent with Council's current Subdivision and Development Guidelines and Environmental Best Management Practice for Waterways and Wetlands 1996*

3. The process followed in assessing development applications insofar as they include a flood study and/or hydrological or hydraulic expert reports as part of the development application. In giving this account please explain how the flood study or expert report is assessed by Council to determine whether it demonstrates compliance with the Brisbane City Plan 2000.

28. This request is not specifically within my expertise to answer, however I have made inquiries with Council officers and based on those discussions can provide the following information.

29. Development applications under SPA that are lodged with Council are assessed by Council's Development Assessment Branch, or for applications that are identified as lower risk, through Council's RiskSmart program. Applications are assessed in accordance with SPA and against the provisions of City Plan and its applicable codes, policies and guidelines as described in the response to [redacted]s 1 and 2, above.

[redacted]

Martin James Reason **Witness**

30. All development applications (including RiskSmart applications) for which Council is the assessment manager are ultimately decided by Council, either by full Council, or under delegation to a Council officer.

31. The process for assessment of a development application is the Integrated Development Assessment System (**IDAS**) as set out in SPA. IDAS was introduced in 1998 under the now repealed *Integrated Planning Act 1997*.

32. When a development application for assessable development is received, the application is considered by a team of senior town planners within Council's Development Assessment Branch, where key issues for the application are identified and the application is allocated to a case officer to manage the assessment.

33. The case officer is supported by technical specialists within the Development Assessment Branch, including town planners, engineers (including hydrologists), engineering technicians and other specialists such as architects and ecologists. Part of the initial assessment by the Development Assessment Branch described in paragraph 32 above, includes identification of appropriate specialists within Council to be engaged in the development assessment process. Further identification of appropriate specialists may be undertaken as the assessment proceeds.

34. I understand that flood studies are assessed by specialist engineers against the relevant provisions of the City Plan with reference to *Australian Rainfall and Runoff Guideline* and the *Queensland Urban Drainage Manual.* These specialist engineers provide a technical assessment with recommendations to the case officer to approve, approve with conditions or refuse once all information relevant to the consideration of the application has been received. The specialist engineer may also request further information which the case officer will refer back to the applicant.

35. Detail of the practices and procedures adopted by the specialist engineers in providing advice to the case officer is a matter that I am not familiar with and more appropriately addressed by one of Council's engineers practising in that part of Council.

36. The RiskSmart process is available for a limited range of low-risk development applications. The RiskSmart process effectively replaces the case manager referred to in paragraphs 31 to 35 above, with a Council-accredited consultant. For RiskSmart applications that require consideration of flooding issues, compliance with Council's flood immunity standards is certified by an external Registered Professional Engineer of Queensland (RPEQ).

[redacted]

Martin James Reason **Witness**

37. The case manager for all applications will prepare a report to Council (or Council's delegate) which addresses key issues for the application (which may include flooding issues) and make a recommendation to approve (in whole or part), approve with conditions, refuse or give a preliminary approval for the development application.

I make this statement conscientiously believing the same to be true, and by virtue of the provisions of the Oaths Act 1867 (Qld).

Dated 9 September 2011

Signed and declared by Martin James Reason at
Brisbane in the State of Queensland
this 9th day of September 2011
Before me:

[redacted]

Signature of person before whom the declaration is made

[redacted]

Signature of declarant

[redacted]

declaration is made

MJR-18

BRISBANE CITY COUNCIL'S APPROVAL PACKAGE

APPLICATION DETAILS

This package relates to the application detailed below:

Address of site:	[redacted] SOFTSTONE ST, TENNYSON QLD 4105
Real property description of site:	SP104107/L566 Y'PILLY SP164685/L1 Y'PILLY
Aspects of development and type of approval:	1. Material Change Of Use (Preliminary Approval) - Preliminary Approval Residential development. 2. Material Change Of Use (Development Permit) - Indoor Sport & Recreation (Tennis Centre Stadium), Outdoor Sport & Recreation (Outdoor courts), Convention Centre (Function Rooms) & ancillary uses including Office, Restaurant and Shop 3. Material Change Of Use (Development Permit) - STAGE 1 Residential: Multi Unit Dwelling - Buildings E & F, and Park 4. Material Change Of Use (Development Permit) - STAGE 2 Residential: Multi Unit Dwelling - Building D, and Shop/Restaurant (100m2) 5. Standard Advice (Non Development Advice) - Advice to developer for the Tennis Centre and all residential buildings 6. Carrying Out Operational Work (Development Permit) - Disturbance to Marine Plants 7. Referral Agency Requirements (Non Development Advice) - Environmental Protection Agency- Contaminated Land 8. Referral Agency Requirements (Non Development Advice) - Queensland Transport & Translink 9. Referral Agency Requirements (Non Development Advice) - Advice Agency - Energex Ltd 10. Referral Agency Requirements (Non Development Advice) - Advice Agency - Powerlink 11. Referral Agency Requirements (Non Development Advice) - Advice Agency Dept of Natural Resources Mines & Water
Description of proposal:	Negotiated Decision - State Tennis Centre (Indoor & Outdoor Sport and Recreation and offices, conference facilities, cafe and outdoor lighting) Multi Unit Dwellings, Park and Centre Activities (cafe/restaurant, shop and office) Operational Works for Disturbance of Marine Plants
Purpose:	Indoor Sport and Recreation, Outdoor Sport and Recreation, Shop, Office, Convention Centre, Restaurant (cafe), Multi-unit Dwelling, Park, Operational Work for disturbance of marine plants
Council File Reference:	DRS/USE/H05-933802
kage status:	APPROVED - Version 1 (9th of October, 2006 11:53:26 AM)
age generated on:	9th of October, 2006

PROJECT TEAM

The assessment of this application has been undertaken by:

STEVEN SCHWARTZ
ASSESSMENT MANAGER
Development Assessment Team
SOUTH BRISBANE
ADMINISTRATION CENTRE
Development and Regulatory Services
[redacted]

MARIO FURLAN
Architect
Development Assessment Team
SOUTH BRISBANE
ADMINISTRATION CENTRE
Development and Regulatory Services
[redacted]

[redacted]
Ecologist
Development Assessment Team
BRISBANE ADMINISTRATION CENTRE
Development and Regulatory Services
[redacted]

[redacted]
Landscape Architect
Development Assessment Team
CENTRAL BRISBANE
ADMINISTRATION CENTRE
Development and Regulatory Services
[redacted]

RORY KELLY
Principal Planner
Development Assessment Team
SOUTH BRISBANE
ADMINISTRATION CENTRE
Development and Regulatory Services
[redacted]

[redacted]
Pollution Officer
Development Assessment Team
BRISBANE ADMINISTRATION CENTRE
Development and Regulatory Services
[redacted]

SAMUEL GAY
Engineering Officer
Development Assessment Team
SOUTH BRISBANE
ADMINISTRATION CENTRE
Development and Regulatory
Services
[redacted]

[redacted]
Town Planner
Development Assessment Team
SOUTH BRISBANE
ADMINISTRATION CENTRE
Development and Regulatory
Services
[redacted]

[redacted]
Landscape Architect Officer
Development Assessment Team
SOUTH BRISBANE
ADMINISTRATION CENTRE
Development and Regulatory
Services
[redacted]

DRAWINGS AND DOCUMENTS

The term 'drawings and documents', or similar expressions, means:

Drawing or Document	Number	Plan Date
Development Approval Building Envelope Plan	00-DA0002 REV. D	03-APR-2006 (Received)
Development Approval Building Envelope Elevations	00-DA0003 REV.D	31-MAR-2006 (Received)
Staging Plan	00-DA0004 REV.D	28-JUL-2006 (Received)
Building 01 Floor Plan Gymnasium	01-DA1011 REV E	04-APR-2006 (Received)
Building 01 Elevations Gymnasium	01-DA1600 REV C	04-APR-2006 (Received)
Development Approval General Arrangement Plan Building D,E &F Basement 1	30-DA1005 REV B	15-NOV-2006 (Received)
Development Approval General Arrangement Plan Building D,E &F Basement 2	30-DA1006 REV B	09-NOV-2005 (Received)
Development Approval General Arrangement Plan Building D,E &F Basement 1 - Part A	30-DA1007 REV B	09-NOV-2005 (Received)
Development Approval General Arrangement Plan Building D,E &F Basement 1 - Part B	30-DA1008 REV B	09-NOV-2005 (Received)
Development Approval General Arrangement Plan Building D,E &F Basement 2 - Part A	30-DA1009 REV B	09-NOV-2005 (Received)
Development Approval General Arrangement Plan Building D,E &F Basement 2 - Part B	30-DA1010 REV B	09-NOV-2005 (Received)
Development Approval Building F Cover Sheet	31-DA0000 REV D	31-MAR-2006 (Received)
Development Approval Building F Site Plan	31-DA0001 REV. C	15-NOV-2005 (Received)
Development Approval General Arrangement Plan Building F - Level 1	31-DA1011 REV. C	15-NOV-2005 (Received)
Development Approval General Arrangement Plan Building F - Level 2	31-DA1012 REV. B	08-NOV-2005 (Received)
Development Approval General Arrangement Plan Building F - Level 03-06	31-DA1013 REV. C	31-MAR-2006 (Received)
Development Approval General Arrangement Plan Building F - Level 07	31-DA1017 REV. A	03-APR-2006 (Received)
Development Approval General Arrangement Plan Building F - Level 08	31-DA1018 REV C	03-APR-2006 (Received)
Development Approval General Arrangement Plan Building F - Level 09	31-DA1019 REV C	03-APR-2006 (Received)
Development Approval Elevation Sheet Building F - Roof Plan	31-DA1025 REV C	03-APR-2006 (Received)
Development Approval Balcony Screen Plans Building F	31-DA1030 REV A	31-MAR-2006 (Received)
Development Approval Balcony Screen Elevations Building F - Sheet 1 of 2	31-DA1040 REV A	31-MAR-2006 (Received)
Development Approval Balcony Screen Elevations Building F- Sheet 2 of 2	31-DA1041 REV A	31-MAR-2006 (Received)
Development Approval Elevation Sheet 1Building F	31-DA1600 REV D	31-MAR-2006 (Received)
Development Approval Elevation Sheet 2 with Section Building F	31-DA1601 REV D	31-MAR-2006 (Received)
Development Approval Section 1 - Before and After Building F	31-DA1610 REV A	31-MAR-2006 (Received)
Development Approval Section 2 - Before and After Building F	31-DA1611 REV A	03-APR-2006 (Received)
Development Approval Building E - Cover Sheet	41-DA0000 REV C	06-NOV-2005 (Received)
Development Approval General Arrangement Plan Building E Site Plan	41-DA0001 REV C	08-NOV-2005 (Received)
Development Approval General Arrangement Plan Building E - Level 01	41-DA1011 REV C	15-NOV-2005 (Received)
Development Approval General Arrangement Plan Building E - Level 02	41-DA1012 REV B	08-NOV-2005 (Received)
Development Approval General Arrangement Plan Building E - Level 03-07	41-DA1013 REV B	08-NOV-2005 (Received)

Development Approval General Arrangement Plan Building E - Level 08	41-DA1018 REV B	08-NOV-2006 (Received)
Development Approval General Arrangement Plan Building E - Level 09	41-DA1019 REV B	08-NOV-2005 (Received)
Development Approval General Arrangement Plan Building E - Level 10	41-DA1020 REV B	08-NOV-2006 (Received)
Development Approval General Arrangement Plan Building E - Roof Plan	41-DA1025 REV B	08-NOV-2005 (Received)
Development Approval Balcony Screen Plans Building E	41-DA1030 REV A	31-MAR-2006 (Received)
Development Approval Balcony Screen Elevations Building E - Sheet 1 of 2	41-DA1040 REV A	31-MAR-2006 (Received)
Development Approval Elevation Sheet 1 with section Building E	41-DA1600 REV C	08-NOV-2005 (Received)
Development Approval Elevation Sheet 2 Building E	41-DA1601 REV C	08-NOV-2005 (Received)
Development Approval Section 3 - Before and After Building E	41-DA1610 REV A	31-MAR-2006 (Received)
Development Approval Building D - Cover Sheet	51-DA0000 REV D	31-MAR-2006 (Received)
Development Approval General Arrangement Plan Building D - Site Plan	51-DA0001 REV C	15-NOV-2005 (Received)
Development Approval General Arrangement Plan Building D - Level 01	51-DA1011 REV B	15-NOV-2005 (Received)
Development Approval General Arrangement Plan Building D - Level 02	51-DA1012 REV B	08-NOV-2005 (Received)
Development Approval General Arrangement Plan Building D - Level 03-06	51-DA1013 REV B	15-NOV-2005 (Received)
Development Approval General Arrangement Plan Building D - Level 07	51-DA1017 REV B	08-NOV-2005 (Received)
Development Approval General Arrangement Plan Building D - Level 08	51-DA1018 REV B	08-NOV-2005 (Received)
Development Approval General Arrangement Plan Building D - Level 09	51-DA1019 REV B	08-NOV-2005 (Received)
Development Approval General Arrangement Plan Building D - Level 10	51-DA1020 REV C	31-MAR-2006 (Received)
Development Approval General Arrangement Plan Building D - Level 11	51-DA1021 REV A	31-MAR-2006 (Received)
Development Approval General Arrangement Plan Building D - Roof Plan	51-DA1025 REV C	31-MAR-2006 (Received)
Development Approval Balcony Screen Plans Building D - Sheet 1 of 2	51-DA1030 REV A	31-MAR-2006 (Received)
Development Approval Balcony Screen Plans Building D - Sheet 2 of 2	51-DA1031 REV A	31-MAR-2006 (Received)
Development Approval Balcony Screen Elevations Building D - Sheet 1 of 2	51-DA1040 REV A	31-MAR-2006 (Received)
Development Approval Balcony Screen Elevations Building D - Sheet 2 of 2	51-DA1041 REV A	31-MAR-2006 (Received)
Development Approval Section 4 - Before and After Building D	51-DA1610 REV A	03-APR-2006 (Received)
North Elevation	A-EL-01.DA REV. H	01-AUG-2006 (Received)
South Elevation	A-EL-02.DA REV. H	01-AUG-2006 (Received)
West Elevation	A-EL-03.DA REV. H	01-AUG-2006 (Received)
East Elevation	A-EL-04.DA REV. H	01-AUG-2006 (Received)
Floor Plan 1	A-FP-01_MEDIA 03.DA REV. H	01-AUG-2006 (Received)
Floor Plan 2	A-FP-02.DA REV. H	01-AUG-2006 (Received)
Floor Plan 3 Non Event Mode	A-FP-03_NON-EVENT.DA REV. H	01-AUG-2006 (Received)
Floor Plan 4	A-FP-04.DA REV. H	01-AUG-2006 (Received)
Roof Plan	A-RP-03.DA REV. H	01-AUG-2006 (Received)
Section A-A	A-SC-A.DA REV. H	01-AUG-2006 (Received)

Section B-B	A-SC-B.DA REV. H	01-AUG-2006 (Received)
Landscape Master Plan	LANDSCAPE MASTER PLAN	01-AUG-2006 (Received)
Masterplan Concourse Level	M-SP-FP02.DA REV.H	01-AUG-2006 (Received)
Site Masterplan	M-SP-RP.DA REV.H	01-AUG-2006 (Received)
Diagram A	SK 1 [A]	01-AUG-2006 (Received)
Riverside Park Promenade	L-2038-A7L-205 (as amended in red)	29-SEP-2006 (Plan Date)
Detail cross sections through access road - Services through easement	00-SK0049 REV. B	14-SEP-2006 (Received)

HIGHLIGHTS

Due to their importance, the following conditions have been highlighted in **bold** in this document:
20,22,29,82,84,94,150,152,162,209

ADVICE

Please see the attached document for any advices.

Section to Which These Conditions Relate: **1. Material Change Of Use (Preliminary Approval)**

Section Name: **Preliminary Approval Residential development.**

GENERAL/PLANNING REQUIREMENTS

	TIMING
1) Development of the site is to be generally in accordance with Master Plan M-SP-RP.DA REV.H received 1 August 2006. *GUIDELINE* *This condition refers to the Master Plan to which the Preliminary Approval relates and is the primary means of defining the extent of the approval.*	As indicated
2) Any land transferred to the Council for Public Purposes (Parkland or Community Facilities) and/or for Road Purposes is to be shall be not be on the Environmental Management Register and or the Contaminated Land Register, unless agreed to by the future asset owner. *GUIDELINE* *This requirement is imposed to ensure the condition of the land is of a standard acceptable to the future asset owner.*	As indicated

3) For the purpose of this Preliminary Approval pursuant to Section 3.1.6(2) of the *Integrated Planning Act*, all assessable development shall be subject to the following Level of Assessment Table and Applicable City Plan Codes:

As indicated

Self Assessment	Applicable Code
Outdoor Lighting where complying with Acceptable Solutions in the Light Nuisance Code	Light Nuisance Code
Park where complying with the Acceptable Solutions in the Park Code	Park Code
Home Business where complying with the self assessable Acceptable Solutions in the Home Business Code	Home Business Code
Code Assessment	**Applicable Code**
Operational Work for **Filling or Excavation**	Filling and Excavation Code
Multi Unit Dwelling (as defined in Chapter 3 Part 10 of the City Plan) where: • complying with the conditions in the Preliminary Approval; and • the relevant "secondary codes" are to be considered part of the "primary code".	Stephen District Local Plan Code Residential Design-High Density Code
Shop or Restaurant (as defined in Chapter 3 Part 10 of the City Plan) where: • the combined Gross Floor Area is no greater than 100 square metres; • complying with the condition of the Preliminary Approval; and • the relevant "secondary codes" are to be considered part of the "primary code".	Centre Design Code Centre Amenity and Performance Code
Satellite Dish (where not exempt development)	Satellite Dish Code
Park where not complying with the Acceptable Solutions in the Park Code	Park Code
Reconfiguring a lot, other than volumetric subdivision not associated with an existing or approval building	Subdivision Code
Impact Assessment - Generally Appropriate	**Applicable Code**
Short Term Accommodation	Short Term Accommodation Code
Utility Installation	
Home Business where not complying with the self assessable Acceptable Solutions in the Home Business Code	Home Business Code
Volumetric subdivision where not associated with an existing or approved building	Subdivision Code
Impact Assessment - Generally Inappropriate	**Applicable Code**

Any other material change of use	

The above Level of Assessment Table shall be read in conjunction with City Plan 2000, Chapter 3, Section 2 - General Assessment Process - as at the date of this approval taking effect.

GUIDELINE

This condition is imposed to ensure that all future assessable development on the site shall be subject to the Level of Assessment Table above. This should be read in conjunction with the most recent version of amendments of City Plan 2000. The preliminary approval overrides City Plan 2000 pursuant to Section 3.1.6 of the Integrated Planning Act 1997. The applicable primary code(s) used in assessing any assessable development are those identified as being an applicable code(s) in the above table. For any enquires about this condition, please contact the Assessment Manager.

4) Prior to the endorsement of any Community Management Statement or the commencement of a Material Change of Use and/or Reconfiguration of a Lot for the last stage of the residential development or as agreed to by the Lead Principal Planner South, transfer to the Brisbane City Council, in fee simple on trust for Public Purposes (parkland and community facilities) land indicated on the Master Plan M-SP-RP.DA REV.H received 1 August 2006, having an area not less than 1.87 Hectares. *GUIDELINE* *This condition outlines the total area of land to be transferred to Council on trust prior to completion of the last stage of the residential development on the site. The condition also acknowledges that the land may be transferred over a number of stages as development of the residential units occurs. Section 5.1.12 of IPA allows for the giving of land for public parks in fee simple provided the land is given on trust. For any enquires about this condition, please contact the Assessment Manager.*	As indicated

5) Ensure that with any Material Change of Use and/or Reconfiguration of a lot, which ever is sooner, all future development maintains the following: (a) The combined maximum Gross Floor Area for the residential buildings does not exceed 90,338m^2 where: (i) Buildings A, B and C have a maximum combined Gross Floor Area of 43,905 m^2 ; and (ii) Buildings D, E and F have a maximum combined Gross Floor Area of 46,433 m^2 . (b) Buildings A B & C are contained within the approved building envelope plans 00-DA0002 rev D and 00-DA0003 rev D; (c) The following heights apply as shown on plan 00-DA0003 rev D where : Building A has a maximum height of 45.52 AHD and stepped down to 30.00 AHD Building B has a maximum height of 45.52 AHD; and Building C has a maximum height of 48.52 AHD and stepped down to 39.50 AHD (d) Individual building setbacks to the Brisbane River are to be generally as shown on Dwg No. 00-DA0002 Rev D and no less than: Building A - 30.0m Building B - 27.7m Building C - 35.0m (e) The design elements to reduce the appearance of building bulk includes but is not limited to those design elements shown in diagram SK1(a); f) The car parking within any residential building is to be maintained exclusively for the ancillary use of the residential occupants. The parking is not to be made available to the general public and there is to be no advertising signage erected on or in the vicinity of the site advertising the availability of car parking to the general public or non residents of the building/s. (g) The rooftops contribute to the architectural distinction of the building and create a coherent roofscape for the building by the inclusion of the following design aspects: (i) The rooftop is designed to enable future inclusion of satellite dishes/telecommunication facilities in an unobtrusive manner; and (ii) Roofscape must be attractive and not marred by cluttered display of plant and equipment. (h) Any screening device to balconies or terraces are not fully enclosed and are designed as an integral part of the building and are installed/constructed as part of the construction of the building; (i) No additional pedestrian access to or from the site to the Tennyson Riverside Parkland is to be provided other than in the locations as shown on the approved plan(s) and documents; (j) Any vacant part of the site is to present as attractive temporary parkland where not incorporated into and used as part of the construction management plan. Where buildings are demolished and, for whatever reason, redevelopment is delayed for more than 3 months, the following works are carried out: • site is cleared of all rubble, debris and demolition materials • site is levelled to the same level as the adjoining footpath and turfed so it can be mowed • site is landscaped with perimeter planting consisting of advanced specimens of fast growing species in accordance with the Planting Species Planning Scheme Policy • drainage is provided to prevent ponding • site is maintained so there is no sediment run off onto adjacent premises, roads or footpaths • site is maintained to ensure no nuisance to adjacent premises, roads or footpaths • public access is provided where public safety can be maintained (k) Car parking for the Multi-unit Dwellings is to be provided at a rate of: i. An average of two vehicle spaces per dwelling unit for units with two or more bedrooms; ii. An average of one vehicle space per dwelling unit for one bedroom units; and iii. 0.25 vehicle spaces per dwelling unit for visitors. *GUIDELINE* *This condition is imposed to outline where the proposal is to incorporate other matters not mentioned in the Acceptable Solutions in the relevant code(s). This condition should be read in conjunction with Condition 3 of this approval package.*	As indicated Prior to the commencement of the use

6) Incorporate into the design and construction of any residential building, best practice sustainable development technology and design practices addressing but not limited to: i. Passive design; ii. Water use; iii. Materials use; iv. Energy use; v. Site impacts; vi. Transport impacts; and vii. Social and community impacts *GUIDELINE* *This condition is imposed to ensure that the proposed buildings are designed to incorporate best practice sustainable development practices.*	As indicated

MONETARY CONTRIBUTIONS & SECURITIES

	TIMING
7) Water supply and Sewerage Headworks: Prior to endorsement of a "Community Management Statement", Prior to a Material Change of Use and/or Reconfiguration of a Lot, which ever is sooner, pay to Council a monetary contribution towards the cost of water supply sewerage head works at the rate prevailing at the time when payment is made. The contribution is calculated on the current applicable rate per Equivalent Tenement based on the proposed use of the site. **This condition will be applied to any Material Change of Use and/or Reconfiguration of a Lot application until such time as the "Infrastructure Charges Plan" is applied over the subject site as defined in Section 5.1.4 of the Integrated Planning Act.** *GUIDELINE* *This condition is imposed to require the payment of a proportional contribution towards a satisfactory sewerage treatment system within the locality of the site. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	As indicated

	TIMING
8) All future development applications for a Material Change of Use, are to submit Vegetation Management Plan which includes the following: (a) The VMP is to be in the form of scaled plans and supporting documentation generally in accordance with Vegetation Retention Plans BO4254-SK70 & SK71 and associated schedules that includes at least the following information: i. The extent of the VMP is to include evaluation of all areas including, proposed road reserves, external works and development areas; ii. The location and description of existing vegetation including species and botanical name plus the height and canopy spread; iii. The location and extent of all site works including all proposed infrastructure and areas of earthworks. iv. Detail design of all civil works is to be cognisant of environmental values. Alternative solutions may be required in some instances, to protect significant vegetation (eg alternative service alignments, variations to batter slopes and tunnel boring); v. The location and description of all vegetation to be retained and that to be removed; vi. A description of all measures to be used to protect vegetation and habitat features to be retained during construction; vii. A description of all pruning and tree surgery works (to AS 4373/96) to maintain health and stability of trees and reduce potential hazards for future residents; viii. The location and extent of storage and stockpile areas for cleared vegetation and site mulch; ix. A description of all methods to salvage and/or re-use cleared vegetation. Generally cleared vegetation is to be mulched for reuse in landscape/rehabilitation works; and x. Details of all measures to protect and recover fauna during clearing operations, including; presence of a qualified wildlife officer during clearing operations, preclearing inspections, staging and sequence of clearing and recovery procedures. *GUIDELINE* *This condition is imposed where the site contains vegetation, fauna and habitat features that should be retained, protected and/or managed as part of the development of the site. Before carrying out any site works it will be necessary to obtain a detailed design approval from the Council by submitting an application accompanied by a Vegetation Management Plan. Once the works are implemented, it will be necessary to arrange for the Delegate, Licensing and Compliance, Development and Regulatory Services, to inspect and approve them. For enquiries about this condition, please contact the Ecologist, Development Assessment.*	As indicated

	TIMING
9) The developer is to maintain (at the developers expense) all parkland shown on Master Plan 00-DA0001 to a standard that will be satisfactory to be accepted "on maintenance" (practical completion) and "off maintenance" (final completion) until such time as the following has occurred:	As indicated
(a) an area not less than 1.87 Hectares is transferred to the Brisbane City Council, in fee simple on trust for Public Purposes (parkland and community facilities) as indicated on the Master Plan 00-DA0001; and	
(b) The works to be constructed for the final stage of the parkland dedication is to a standard that will be satisfactory to be accepted "on" and "off" maintenance as a Council asset, by the Councils Delegate for a period of 12 months; and	Prior to the commencement of the use
(c) The bond for the works within the parkland is returned to the developer.	
GUIDELINE *This condition advises the developer that the parkland within the development as shown on the Master Plan is to be maintained by the developer until the final stage of the parkland has been dedicated and is "off maintenance". The on maintenance period is 12 months as per Councils Subdivision and Development Guidelines.*	

10) All future development applications for a Material Change of Use, are to submit a Landscape Management and Site Works plan for the parkland prepared in accordance with Councils "Public Riverside Facilities Design and Maintenance Manual" Council's "Subdivision and Development Design Guidelines", Best Trade Practice and which includes the following: (a) (i) **Existing site conditions:** existing contours, and vegetation on site and on adjoining properties (including footpath) which impact on the site. Any earthworks proposed within the vicinity of vegetation to be retained including the riparian vegetation above and below the highwater mark. Existing buildings to be retained ie pump station, overland flow paths, existing services any feature of cultural significance, the location of the Mean Spring High Water Mark and the highest summer highwater mark along the Brisbane River, surveyed property boundary, stormwater outlets to the Brisbane River are to be documented. (ii) **Proposed site conditions:** proposed surface treatments and indicative spot levels, including but not limited to buldings, walkways, car parking areas, field gullies, services (above and below ground level), retaining or revetment walls, existing buildings to be retained ie pump station, overland flow paths, the Mean Spring High Water Mark and the highest summer highwater mark along the Brisbane River, surveyed property boundary, the location of any proposed services alignments. (iii) **Extent, function and character of areas within the park:** proposed surface treatments, activity zones such as quiet areas, viewing, passive and active open space zones, pathway alignments, plant massing and buffer planting and critical interface points and shade tree planting. (iv) **Proposed resolution of earthworks:** location, height and type of retaining walls, depth of topsoil, mulch and drainage, levels and grades to all critical interfaces and areas, stabilisation of steep areas, interface with adjoining land uses and the footpath. (v)**Shared pedestrian/bicycle path within the Tennyson Riverside Park is as follows:** a. the riverside pathway is varying in width, with a minimum width of 3 metres; b. is designed according to the specification of the *Public Riverside Facilities Design and Maintenance Manual*; c. where no part of the riverside pathway extends over the property alignment of the site to the Brisbane River; and d. the riverside pathway is to be designed generally in accordance with the EDAW Riverside Park Promenade Drawing L-2038-A1L-205 dated 29/09/06 as amended in red to show minimum path widths; (vi) **Park embellishments:** park furniture such as seating, drinking fountains, bike racks, rubbish bin enclosures, barbeques, picnic facilities, signage, any educational facilities, and play equipment; seating; (vii) **Specification notes:** standard specification notes including but not limited to soil preparation, methods for the protection of vegetation to be retained during construction activity on site, maintenance establishment and irrigation; (viii) **Proposed planting palette:** indicative tree, shrub, ground cover and accent plant species, together with intended size at time of planting; (ix) **Rehabilitation of riparian corridor:** with riparian vegetation community and enhancement of habitat features; and (x) **Proposed finishes palette:** for all hard landscape items such as paths, pavers, retaining walls , railings and fences and any other ground treatments such as decking. *GUIDELINE* *This condition outlines the minimum requirements for the development of the parkland within the site to an acceptable Council standard.*	As indicated

11) All future development applications for a Material Change of Use, are to submit a Landscape Concept Plan which includes at least the following: (a) (i) **Existing site conditions:** existing contours, and vegetation on site and on adjoining properties (including footpath) which impact on the site. Any earthworks proposed within the vicinity of vegetation to be retained is to be documented. (ii) **Proposed site conditions:** proposed surface treatments and indicative spot levels, including but not limited to buildings, driveways, car parking areas, field gullies, services (above and below ground level) and retaining walls. (iii) **Extent, function and character of areas to be landscaped:** proposed plant massing to address buffer planting and critical interface points, shade tree planting. (iv) **Proposed resolution of earthworks:** location, height and type of retaining walls, stabilisation of steep areas, interface with adjoining land uses and the footpath. (v) **Typical construction detail:** for critical issues including sections showing depth of topsoil, mulch and drainage medium for proposed retaining walls within landscaped areas. (vi) **Specification notes:** standard specification notes including but not limited to soil preparation, methods for the protection of vegetation to be retained during construction activity on site, maintenance establishment and irrigation. (vii) **Proposed planting palette:** indicative tree, shrub, ground cover and accent plant species, together with intended size at time of planting. *GUIDELINE* *This condition outlines the minimum requirements of any landscaping plan submitted for the site to ensure landscaping of the site is to a high standard.*	As indicated

ENGINEERING

	TIMING
12) All proposed residential buildings are to be designed in accordance with Council's "Subdivision and Development Guidelines" to ensure that minimum habitable floor levels are 500 mm above the 100 year (ARI) flood level (river and creek flooding) or 500 mm above the 50 year (ARI) (overland flow level) whichever is the greater. Minimum non-habitable floor levels are to be not less than 50 year (ARI) or 100 year (ARI) flood levels (which ever is the greater). *GUIDELINE* *This condition is imposed when the site is affected by flooding. The 100 year ARI event is applicable to river and/or creek flooding. If the catchment is localised, the 50 year ARI event will be applicable unless the site is also affected by creek or river flooding in which case the higher flood level is used. For any other enquiries about this condition, please contact the Engineering Officer.*	Prior to lodging a development permit for building works

Section to Which These Conditions Relate: 2. Material Change Of Use (Development Permit)

Section Name: Indoor Sport & Recreation (Tennis Centre Stadium), Outdoor Sport & Recreation (Outdoor courts), Convention Centre (Function Rooms) & ancillary uses including Office, Restaurant and Shop

GENERAL/PLANNING REQUIREMENTS

	TIMING
13) Carry out the approved development generally in accordance with the approved drawings and documents. *GUIDELINE* *This condition refers to the approved plans, drawings and documents to which the approval relates and is the primary means of defining the extent of the approval. Approved plans, drawings and documents are stamped PLANS and DOCUMENTS referred to in the APPROVAL and are dated to reflect the date of approval of the application by Council's Delegate.*	While development is occurring on site and then to be maintained ✓
14) Complete all building work associated with this development approval, including work required by any of the following conditions. Such building work is to be carried out generally in accordance with the approved plans, drawing(s), and/or documents and, where the building work is assessable development, in accordance with a current development permit. *GUIDELINE* *This condition is imposed to ensure all building work associated with the use is in place before the use commences. It is not appropriate that the site be used without such work being completed. Please note that the work referred to in this condition involves operational work and may therefore constitute 'assessable development'. The Council informs you there fore that this condition does not authorise assessable development to occur and a development permit may therefore be necessary. Please refer to the Council's information sheets. For any enquiries about this condition, please contact the Assessment Manager.*	Prior to the commencement of the use ✓
15) Complete all operational work associated with this development approval, including work required by any of the following conditions. Such operational work is to be carried out generally in accordance with the approved plans, drawing(s), and/or documents or, if requiring a further approval from the Council, in accordance with the relevant approval(s). *GUIDELINE* *This condition is imposed to ensure all operational works associated with the use are completed before the use commences. It is not appropriate that the site be used without such work being completed in accordance with any detailed design approvals. Please note that the work referred to in this condition involves operational work and may therefore constitute 'assessable development'. The Council informs you there fore that this condition does not authorise assessable development to occur and a development permit may therefore be necessary. Please refer to the Council's information sheets. For any enquiries about this condition, please contact the Assessment Manager.*	Prior to the commencement of the use ✓

16) Maintain the approved development (including landscaping, parking, driveways and other external spaces) in accordance with the approved drawing(s) and/or documents, and any relevant Council engineering or other approval required by the conditions. *GUIDELINE* *This condition restricts changes that can be made to the approved development. Approved plans and documents are stamped PLANS and DOCUMENTS referred to in the APPROVAL and are dated to reflect the date of determination of the application by the Council's delegate. The extent to which plans can be modified is constrained by the definition of 'minor change' in schedule 10 and the requirements of section 3.5.24 of the "Integrated Planning Act 1997". It will be necessary to make a new application if the change is not a minor change. For any enquires about this condition, please contact the Assessment Manager.*	To be maintained ✓
17) Provide and maintain unimpeded and safe 24-hour public access through the designated public pedestrian spaces, including pedestrian footpaths, bicycle paths, and public plaza areas, and ensuring that access ways are designed to cater for disabled persons in accordance with "Australian Standard AS1428.1". *GUIDELINE* *This condition is imposed to ensure on-going safe public access to designated public pedestrian spaces within the development.*	To be maintained ✓
legible copy of the approved drawings and documents bearing "Council Approval" and the Development Approval Conditions package is to be available on site at all times during construction and earthworks. *GUIDELINE* *This condition is imposed to ensure compliance with the development conditions of approval. The copy of the conditions and plans should be located in any site management office or with the site foreman. Any copies of conditions or plans that are illegible shall be deemed to be non compliance with this condition of approval.*	As indicated ✓

19) Prior to building work for the proposed building commencing on the site undertake the following works. (a) Remove the existing buildings on the site; and (b) Cap all services to the building and stabilise the exposed ground surface with grass seeding. (c) Where buildings are demolished and, for whatever reason, redevelopment is delayed for more than 3 months, the following works are carried out: • site is cleared of all rubble, debris and demolition materials; • site is levelled to the same level as the adjoining footpath and turfed so it can be mowed; • site is landscaped with perimeter planting consisting of advanced specimens of fast growing species in accordance with the Planting Species Planning Scheme Policy; • drainage is provided to prevent ponding; • site is maintained so there is no sediment run off onto adjacent premises, roads or footpaths; • site is maintained to ensure no nuisance to adjacent premises, roads or footpaths; and • public access is provided where public safety can be maintained *GUIDELINE* *This condition is imposed to ensure that all structures are removed or relocated appropriately to ensure that no future legacy remains for the ultimate property owners. It should also be noted that the removal of structures includes the removal of all existing concrete slabs and foundations and footings of any removed structures.*	As indicated ✓
20) Prior to issuing the relevant Development Permit for Building Works for the State Tennis Centre above ground works, submit to the satisfaction of the Principal Lead Planner, Development Assessment Team South, the following plans and details showing the facade treatments and external materials (including undercroft treatments) colours and finishes: **(a) A colour scheme showing materials and finishes to the stadium and administration buildings fronting the access road in accordance with the materials details noted on the approved plan(s) & drawing(s);** **(b) Notwithstanding the requirements of part (a) of this condition and the notations on the approved plans and drawings, the materials and finishes of the stadium and administration building must be high quality pre-finished materials and included with details required to be submitted by this condition;** **(c) The schedule is to be submitted as a sample board including materials and actual paint swatches of the proposed external paint colours and accompanied by coloured elevations and a written tabulation of how particular parts of the structure and ancillary finishes are to be finished.** **d) Implement the above approved detailed design treatments.** *GUIDELINE* *This condition is intended to ensure that the colours and materials used are appropriate for the intended character and image for the surrounding area. The requirement is intended to avoid a built form and street character that is dominated by glass surfaces, that increases local affects from reflectivity, glare and heat.*	**As indicated** ✓

21) Prior to any works commencing on the site and then to be maintained until completion of the development, erect on the Softstone Street and Tennyson Memorial Avenue frontages of the site, and in a location adjacent to the proposed access to Fairfield Road (between Fairfield Rd access and Ortive Street), an "Information Sign" as outlined below: (a) A brief description of the development proposed; (b) The sign/ is to list the name, postal and/or email address and a contact telephone number for the following parties (where relevant) that are undertaking work on the site: Developer; Project Coordinator; Architect/Building Designer; Builder; Civil Engineer; Civil Contractor/s; and Landscape Architect; (c) The lettering on the sign is to be at least 25 millimetres in height, be of regular weight and in sentence case; (d) The sign is to be a minimum size of 1,200 millimetres by 900 millimetres; (e) The maximum area of the sign is to be 2.0m^2; (f) The sign must be placed on or within 1.5 metres of, the road frontage for the land and mounted at least 300 millimetres above ground level; (g) The sign must be placed on the road frontages as indicated above in this condition; (h) The sign is to contain no commercial or corporate advertising other than the name, logo or slogan of the parties outlined in part (a) of this condition (i) The sign is to be non illuminated; (j) Both the sign and the supporting structure are to be made of weatherproof material and to be properly maintained at all times; and (k) The sign/s are to be located on the subject property and is to comply with the General Requirements for Signage contained within the Local Laws Policy "Control of Outdoor Advertising" specifically with regard to Traffic Safety, Clearances and Structural Systems. (l) Prior to the erection of the sign, lodge a copy of the wording and proposed dimensions of the "Information Sign" with Council. *GUIDELINE* *This condition is imposed to provide information regarding the development and project team. Where signage is carried out in accordance with Permitted Advertisement provisions contained within the Local Law Policy "Control of Outdoor Advertising" the display of the sign is exempt from the payment of fees, the need for a licence or the making of an application.*	As indicated ✓

22) Provide a copy of the Brisbane City Council approval package including the development approval conditions, approved plans & documents and the Decision Notice to the following and as indicated(where applicable): (a) all consultants preparing or lodging applications for "Operational Works"; (b) all consultants preparing or lodging applications to satisfy conditions requiring compliance assessment under Schedule 12 of the *Integrated Planning Regulation 1998*; (c) all consultants preparing or lodging applications for "Carryout Building Works"; and (d) all contractors carrying out site works or building works associated with or resulting from this Development Permit. *GUIDELINE* *This condition is imposed to ensure that all consultants, contractors and Building Certifiers involved with completing the development are aware of the particular requirements of this site.*	As indicated Prior to lodging a development permit for building works Prior to site works commencing
23) Prior to site/building works commencing for each stage, undertake an on-site Pre Start meeting (a) Co-ordinate the attendance of the relevant **development/ building/ arborist/ site consultants and contractors** with the following Brisbane City Council Officers or their nominated representatives: • **Principal Engineer**, Development Assessment Team South, Development Assessment • **Landscape Architect**, Development Assessment Team South, Development Assessment • **Principal Lead Planner,** Development Assessment Team South, Development Assessment (b) This meeting is requested to discuss relevant site/building/operational work requirements for each stage, including but not limited to: • Contamination • Landscape Management and Site Works Plan (riverside walkway, parkland and private land) • Sustainable development features • Special Vegetation Management Plan • Streetscape Works Plan • Construction Management Plan • Event Management Plan • Construction parking • Road & Footpath Closure Permits and other additional permits • Public & Workplace Safety • Maintenance of a pedestrian and cyclist thoroughfare through the site • Compliance with Council's Erosion and Sediment Control Guidelines relating to earthworks on a construction site • Tree protection measures • Relocation of existing services *GUIDELINE* *This condition is imposed when the construction activities need to be limited to manage the impact on the surrounding area. Please telephone 3403 8888 to arrange a suitable meeting time.*	As indicated

24) Install and maintain secure bicycle parking and associated support facilities for employees and visitors to the Tennis Centre and bicycle parking facilities for visitors to the Tennyson Riverside Parkland consistent with the approved plans and documents, and generally in accordance with Chapter 10 of "*Austroads Part 14 - Bicycles*". *GUIDELINE* *This condition is imposed because bicycle parking and associated facilities are required to provide convenient facilities for cyclists and safe storage of bicycles to encourage cycling as an alternative for car commuting and also cater for short term requirements such as couriers bicycle facilities.*	Prior to the commencement of the use & then to be maintained
25) Prepare an Event Transport Management Plan (a) Submit for approval of the Principal Lead Planner as Delegate of Council, Development Assessment Team South, an Event Management Traffic Control Plan (EMTCP) for all events staged within the Tennis Stadium in accordance with the Guidelines and Policies of the Brisbane City Plan 2000 and the following details, where applicable, for the three event modes of the approved development. The EMTCP is to acknowledge the restrictions detailed in the NOTES following the numbered items: i. Provision of alternative pedestrian/cyclist routes through and around the site; ii. Existing and proposed kerbside allocation signs and linemarking such as bus stops, loading zones and parking meters; iii. Temporary vehicular access points; iv. Temporary public transport and taxi access points v. Employee and visitor parking areas; vi. How goods/ food stuffs etc are to be loaded/unloaded; vii. Location of any remote loading areas; viii. Temporary toilets and amenities; ix. Community Consultation strategy including notification to adjoining residents and property owners; x. Anticipated programming including duration and start and finish times; and xi. Emergency management including access location and evacuation plan; xii. Any police permits require/sought. *GUIDELINE* *This condition is imposed to manage the impacts of all events undertaken within the main tennis stadium. In preparing the Event Management Traffic Control Plan consultation is to occur with the Brisbane City Council Road Closure Officer, Brisbane Transport Bus Coordinator and a representative from Translink.*	Prior to the commencement of the use & then to be maintained
26) Install and maintain a suitable system of lighting, to operate from dusk to dawn, within all areas where the public will be given access. *GUIDELINE* *This condition is imposed to ensure on-going safe public access to designated public pedestrian spaces within the development*	Prior to the commencement of the use & then to be maintained

27) Incorporate and maintain the following sustainable components within the Tennis Centre:			Prior to the commencement of the use & then to be maintained ✓
Tennis Centre and ancillary uses	Basin & Sink Taps	• 4-Star rated tapware or flow regulating device installed in pipe work upstream of all basin and sink taps • No 'insinkerators' are to be installed	
	Toilets	• 4-Star rated dual flush	
	Irrigation system	• Subsurface or microjet spray/dripper system and controlled using soil moisture sensors • Programmable irrigation controller with rain sensor • Sub water meters on irrigation supply line	
	Outdoor taps	• Trigger nozzles on all outdoor hoses • 3-Star rated flow regulating devices installed in pipework upstream of all outdoor taps	
	Water harvesting tank	• Water harvesting storage tank(s) • Water harvesting tank plumbed into irrigation system • Water harvesting tank plumbed into car / bin washing area	
	Showers	3-Star rated showerhead	
	Clothes washer	4-Star rated laundry washing machine	
	Dishwasher (Other than for commercial use)	4-Star rated dishwasher	
GUIDELINE *This condition is imposed to ensure that the development is sustainable in terms of careful and efficient use of water utilising current best practice.*			
28) The area of the building nominated on the approved plans of layout for Restaurant, Convention Centre (function rooms), Office and Shop uses are to remain ancillary to the use of the site as a Tennis Centre. *GUIDELINE* *This condition is imposed to clarify the proposed use of the site.*			At all times ✓
All aspects of development as outlined within this section, to which the conditions relate in the "Development Approval Package", are to be completed before midnight on 30 November 2010. *GUIDELINE* *This condition is imposed pursuant to 3.5.21A(2)(a) of the Integrated Planning Act 1997. The intent of this condition is to specify the particular time assessable development or an aspect of assessable development is to be completed before the development lapses. Any extension of the period stated in the condition is required to be made in accordance with Sections 3.5.22 and 3.5.33 of the Integrated Planning Act.*			As indicated ✓

30) Supply, install and maintain on the site artworks (including but not necessarily limited to, sculptures, ceramic works, mosaics and wall reliefs) by a recognised artist or crafts person. Where these art works or part there of, are located on land to be dedicated to Council, undertake the following: (a) Plan for artworks or sculptures that meet the following criteria: i. Be suitable for the setting in terms of design, choice of materials, durability and resistance to vandalism; and, ii. Be satisfactory to the owner/developer of the subject site and the Delegate, Development Assessment; (b) Install the endorsed artworks or sculptures. *GUIDELINE* *This condition recognises the importance of the proposed development and is intended to ensure that artwork is included to enhance the Tennis Centre.*	Prior to the commencement of the use ✓ To be maintained

MONETARY CONTRIBUTIONS & SECURITIES

	TIMING
31) Pay to Council any outstanding charges or expenses levied by the Council over the subject land. *GUIDELINE* *This condition is imposed to ensure that there are no outstanding charges existing over the subject site, including outstanding rates. If there are out standing monies, they must be paid prior to commencement of the use.*	Prior to the commencement of the use ✓
32) Pay to Council a monetary contribution towards the cost of water headworks, as outlined below, **at the rate prevailing when the contribution is paid.** *This payment must be made prior to the issue of a plumbing compliance permit for the site.* The contribution is calculated on 87.7 ETs (Equivalent Tenement) at the current rate of $4,729.00 per ET, for Water System Infrastructure Charges Plan Area - Mt Crosby South W9. A credit for the existing use on the site has been included in this calculation. The amount payable is currently assessed at $414,733.30 and comprises of the following : • Treatment Headworks component: $82,438.00 • Distribution Headworks component: $332,295.30 • Total contribution: $414,733.30 This headwork charge is the **current rate for the 2006/2007 financial year.** *GUIDELINE* *This condition is imposed to require the payment of a proportional contribution towards a satisfactory water supply treatment system to the site. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to the permanent water/sewer connection being made to the site or prior to endorsement of a community management statement, whichever is sooner ✓

33) Pay to Council a monetary contribution towards the cost of sewerage headworks, as outlined below, **at the rate prevailing when the contribution is paid.** *This payment must be made prior to the issue of a plumbing compliance permit for the site.* The contribution is calculated on 87.7 ETs (Equivalent Tenement) at the current rate of $4,494.00 per ET, for Sewerage Scheme Charge Area - S2 - MLBN01. A credit for the existing use on the site has been included in this calculation. The amount payable is currently assessed at $394,123.80 and comprises of the following : • Treatment Headworks component: $132,777.80 • System Headworks component: $261,346.00 • Total contribution: $394,123.80 This headwork charge is the **current rate for the 2006/2007 financial year.** *GUIDELINE* *This condition is imposed to require the payment of a proportional contribution towards a satisfactory sewerage treatment system within the locality of the site. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to the commencement of the use or prior to endorsement of a community management statement, whichever is sooner ✓

ARCHITECTURE

	TIMING
Construct external pedestrian circulation walkways from the street frontage entry to each front door of the development in accordance with AS 1428.1, Parts 1 - 4 *Australian Standard for Access and Mobility* with particular regard to: i. Ramping requirements (including gradients and slip resistance); ii. Handrail requirements; iii. Visual impairment requirements for changes in gradient; and iv. Tactile tiling in a visually contrasting colour to both sides of the driveway crossover. *GUIDELINE* *This condition is imposed to ensure external access areas are appropriately designed and constructed for all users. For any enquiries about this condition, please contact the Development Assessment Team Architect.*	Prior to the commencement of the use & then to be maintained ✓
35) Submit to the Delegate, Development Assessment documentary evidence that: (a) The level of light reflectivity from the approved development will not exceed 20 percent; and (b) The level of solar (heat) reflectivity from the approved development will not exceed 20 percent. *GUIDELINE* *This condition is imposed to protect the amenity and appearance of the surrounding area from adverse impacts such as heat transmission and light reflectivity arising from the use of excessively reflective glass in building facades and large expanses of reflective roofing material.*	Prior to the commencement of the use & then to be maintained ✓

36) Install a lighting system to the underside of the proposed awning over the footpath in accordance with the following: (a) Provides lighting to public footpaths covered by permanent awnings to a minimum of 20 lux (horizontal plane) at footpath level; (b) The lighting system meets the requirement of the City Plan 2000 - *~~Awning Lighting Code~~*; (c) The lighting system adequately illuminates any pedestrian way covered by the subject awning from dusk until dawn; and (d) Is to be maintained by the owner of the building in a safe and good working order. *GUIDELINE* *This condition is intended to ensure that pedestrians can move safely in front of the site. For any enquiries about this condition, please contact the City Lighting Unit, Local Asset Services Central District (Ph: 3403 0307).*	Prior to the commencement of the use & then to be maintained Prior to the commencement of the use To be maintained
37) Provide screening for any externally mounted airconditioning or mechanical plant installations in accordance with the following requirements: i. No unscreened installations on the proposed development are to be visible from the surrounding sites; and ii. Any installations which are required to be located on roof, wall or garden areas are to be appropriately screened or shaped according to the acoustic requirements of this development package and consistent with materials used elsewhere on the facade of the building so as to integrate in a complementary manner with the overall design of the roof, wall or garden area in which the installation is to be located. *GUIDELINE* *This condition is imposed to ensure appropriate visual outcomes in relation to mechanical plant areas. For any enquiries about this condition, please contact the Assessment Manager.*	Prior to the commencement of the use & then to be maintained

	TIMING
38) Prepare and landscape the site in accordance with a Landscape Management, Site Works and Planting Plan. (a) Submit and receive approval by the Delegate, Development Assessment for a detailed Landscape Plan for all on-site landscape works relevant to this component of the development identified on the approved plans of layout ~~L-201/P2, L-202/P2, L-203/P2, and L-204/P2~~. The plan is to be prepared at a scale of 1:100 by a suitably qualified and experienced Landscape Architect, and must comply with the "Brisbane City Plan 2000-Landscaping Code". The plan should include the following: i) Siteworks: • Pavement finishes are to be chosen in accordance with the types specified in the Centres Detailed Design Manual or to the satisfaction of the Landscape Architect Development Assessment South; • Access and mobility in accordance with AS1428.1; • Identification, protection and retention of the existing vegetation; • The extent of soft and hard landscape works; • Existing and proposed finished levels to external works particularly in critical areas (eg. top and toe of retaining walls, steps and adjoining boundaries); • Extent of basement and roof lines; • Description/detail of critical design elements where applicable (eg. stabilisation of batters, retaining walls, podium planters, trees in car park areas, fences etc.); • pedestrian lights; • **Where artworks are proposed, provide locations and full details;** • Location of the underground services; • Location of any pad-mounted electricity transformers; • Furniture to enhance comfort and amenity; • Free standing shade structures; • Balustrade, planter boxes and any other structures; • Hazard tactile pavers at driveways and non-signalised kerb ramps in accordance with AS1428.4. ii) Planting: • A planting schedule listing proposed plants by botanical names, numbers, spacing and size at time of planting; • Tiered planting consisting of trees, shrubs and groundcovers to residential boundaries; • Shade trees, low shrubs and groundcovers to all other landscape areas on the site; • Shade trees throughout the car park area at a ratio of 1 tree per 6 car spaces or part thereof; and • Screen planting to utility spaces. • Planting of low maintenance species • Basic specification notes for soil preparation and planting, including mulching and soil type both existing and imported; and • Roofwater collection device locations; • Provision of a reticulated irrigation system to all landscape areas within the development with connection to a non-mains water supply point.	Prior to site works commencing
(b) Carry out the landscaping and associated works documented in the approved Landscape Management and Site Works Plan in accordance with standard Best Trade Practice.	Prior to the commencement of the use & then to be maintained
(c) Advise Council upon completion of the landscape works by completing the development details and Part B of the Compliance Certificate-Landscaping. *GUIDELINE* *This condition is imposed when there is a landscape component to a High Level development application, and Council requires more details of the proposed landscape works.*	Prior to the commencement of the use

39) Provide streetscape works in accordance with the following:	Prior to commencement of operational works/building works
(a) Submit a *'Streetscape Works Plan'* for detailed design approval of the Landscape Architect, Development Assessment, for required works to be undertaken within the new road footpath reserve. The works are to be constructed to a standard and of materials consistent with Council's Subdivision and Development Guidelines, City Plan 2000 and an approved *'Streetscape Works Plan'*. The plans are to include but not be restricted to the following: i. **Pavement finishes** in accordance with the 'Centres Detail Design Manual' and to the satisfaction of the Landscape Architect Development Assessment South ii. minimum 2m wide pedestrian footpath to the southern side of the proposed new road extension from the Fairfield Rd intersection and to the Softstone street intersection as indicated on the approved plans of layout; iii. street trees in tree grates with tree guards to hardstand areas and central plaza, integrated in the proposed pavement pattern; iv. street trees to centre medians and road verge in accordance with Council's Subdivision and Development Guidelines; v. street tree species are to be specified to the satisfaction of the Landscape Architect Development Assessment South; vi. streetscape planting of low maintenance species; vii. pedestrian lights; viii. specifications, contours and levels for any proposed bikeways, footpaths, roadways and parking in the proposed open space; ix. a Plant Schedule itemising all proposed plants by botanical name and specifying total plant numbers and size at the time of planting. x. all furniture to be supplied in accordance with Council's preferred supply list or to the satisfaction of the Landscape Architect Development Assessment South; xi. location of the underground services; xii. street furniture to enhance footpath comfort and amenity; xiii. free standing shade structures; xiv. all finished surface levels; xv. balustrade, planter boxes and any other structures; and xvi. hazard tactile pavers at driveways and non-signalised kerb ramps in accordance with AS1428.4;	
(b) Details of a costing and maintenance program, including the following: • Costing of all works indicated on the Landscape Management and Site Works Plan; and • Details of a 12-month maintenance plan for all proposed landscaping, including staging of works and time schedules, methods of establishment and projected ongoing maintenance costs.	
(c) Obtain all necessary approvals for the satisfactory construction of these works.	Prior to undertaking the works
(d) Carry out the landscaping and associated works documented in the approved Landscape Management and Site Works Plan in accordance with standard Best Trade Practice.	
(e) Upon completion of the landscape works advise Compliance Team South to organise an "on maintenance" inspection.	
GUIDELINE *This condition is imposed to ensure that the external spaces are developed in a way that enhances the subject proposal and contributes positively to the streetscape character and overall image and quality of public spaces throughout the City. Streetscape works are to be carried out in accordance with the approved plans and workmanship is to be of acceptable standards and maintained accordingly. The Centres Detail Design Manual is available for purchase at all Council Customer Service Centres. The final locations and number of items of street furniture is to be determined by the Landscape Architect, Development Assessment. For any enquiries about this condition, please contact the Landscape Architect, Development Assessment. The plan (minimum 8 copies), together with the appropriate fee, should be lodged at the Development and Regulatory Services? Counter, Floor 1, Brisbane Administration Centre. Refer to Appendix F of the Centres Detail Design Manual.*	

POLLUTION

	TIMING
40) (i) The Public Address System must be designed to meet a noise limit of 50 dB(A) L Amax adj at the proposed residential units as per recommendations of the acoustic report prepared by Palmer Acoustics Pty Ltd dated November 2005. (ii)Submit certification from an appropriately qualified consultant that an appropriate Public Address System has been installed which achieves the above criteria. *GUIDELINE* *This condition is imposed to minimise noise impacts on adjoining residential uses.*	To be maintained ✓
41) Submit certification to the Pollution Officer, Development Assessment Development and Regulatory Services, from an independent and appropriately qualified acoustic consultant which demonstrates that the noise emissions from all new plant and equipment will not exceed the following levels at the nearest sensitive receiving environment. (a) Emissions of noise from mechanical plant and equipment when measured as the adjusted equivalent continuous A-weighted sound pressure level (LAeq,adj,T), with a measurement time interval (T) of at least 15 minutes, at work and/or living areas and sleeping areas of any noise sensitive place must not exceed 45 dB(A) from 0700 to 2200. (b) Emissions of noise from mechanical plant and equipment when measured as the adjusted equivalent continuous A-weighted sound pressure level (LAeq,adj,T), with a measurement time interval (T) of at least 15 minutes, at work and/or living areas of any noise sensitive place must not exceed 45 dB(A) from 2200 to 0700. (c) Emissions of noise from mechanical plant and equipment when measured as the adjusted equivalent continuous A-weighted sound pressure level (LAeq,adj,T), with a measurement time interval (T) of at least 15 minutes, at sleep areas of any noise sensitive place must not exceed 40 dB(A) from 2200 to 0700. *GUIDELINE* *This condition is imposed to ensure that plant and equipment noise generated by the development does not adversely impact any near-by sensitive receiving environments*	Prior to the commencement of the use ✓
42) Any metal grills, metal plates or similar subject to vehicular traffic must be acoustically damped to prevent environmental nuisance. *GUIDELINE* *This condition is imposed to ensure that noise vehicle movements do not cause environmental nuisance.*	Prior to the commencement of the use & then to be maintained ✓

43) i) All stormwater runoff from car parks, driveways, hardstand areas, loading areas etc from the site must be treated by stormwater quality best management practices before discharge to the stormwater system in accordance with Stormwater Quality Management Report prepared by GHD and dated November 2005. Strategies may involve discharge to grass swales, landscaping, infiltration trenches, mini-wetlands or in-ground proprietary stormwater quality improvement devices. These practices must adequately remove key pollutants of concern. The stormwater quality best management practices utilised on the site must provide, as a minimum, for the following: • Q 3 month flow; • capture of sediment/suspended solids to meet best practice discharge guidelines (80% of course sediment 5mm diameter or less, and 50% of fine sediment 0.1mm diameter or less); • capture of litter; and • no visible discharges of hydrocarbons eg oils, greases. ii) Submit certification from an appropriately qualified person that stormwater quality best management practices as specified above has been provided on site. *GUIDELINE* *This condition is imposed to ensure that all stormwater from the site is treated using best practice management practices.*	Prior to the commencement of the use ✓
All sealed traffic areas must be cleaned as necessary to prevent emissions of particulate matter. *GUIDELINE* *The condition is imposed to prevent particulate emissions from traffic areas.*	To be maintained ✓

	TIMING
45) Prepare a Construction Management Plan for the subject site. (a) Submit for approval of the Engineering Delegate, Development and Regulatory Services, a Construction Management Plan in accordance with the *Transport, Access, Parking and Servicing Planning Scheme Policy* of the *Brisbane City Plan 2000* and the following details, where applicable, of the construction phase of the approved development. The CMP is to acknowledge the restrictions detailed in the NOTES following the numbered items: 1. Provision of alternative pedestrian routes, past or around the site; 2. Existing and proposed kerbside allocation signs and linemarking such as bus stops, loading zones and parking meters; 3. Temporary vehicular access points; 4. Employee and visitor parking areas; 5. How materials are to be loaded/unloaded; 6. Location of any remote loading areas; 7. Location of materials, structures, plant and equipment to be stored or placed on the construction site; 8. Anticipated staging, programming. 9. EPA approved hours of construction NOTE: Approval for on street work zones will only be considered where it can be demonstrated that no reasonable alternative can be provided due to site constraints and that traffic and public transport capacity and operations are not compromised. (b) Obtain relevant permits from the Engineering Delegate, Development and Regulatory Services, to carry out any works within the road reserve required by the approved Construction Management Plan. The Construction Management Plan may require modification, with Council approval, to reflect relevant legislation, traffic and public transport capacity and operations as well as industry best practice prevailing at the time of the permit application and throughout the construction activities; (c) Implement and maintain the approved Construction Management Plan. *GUIDELINE* *This condition is imposed when the construction activities need to be limited to manage the impact on the surrounding area., This condition is intended to apply throughout the period of site preparation to the completion of the development.*	Prior to lodging a development permit for building works ✓

46) Minimise on-site erosion and the release of sediment or sediment-laden stormwater from the site at all times through compliance with an approved Erosion and Sediment Control (ESC) Program for the site. (a) Submit an Erosion and Sediment Control (ESC) Program which complies with Council's Erosion and Sediment Control Standard (Version 9 or later), and receive approval from the Engineering Delegate, Development Assessment, prior to the commencement of land-disturbing activities; (b) Implement and modify as necessary the approved ESC Program to maintain compliance with the Erosion and Sediment Control Standard (Version 9 or later) at all times during the period from when land-disturbing activities begin to when responsibility for the site no longer lies with the applicant. *GUIDELINE* *This condition is imposed where the land-disturbing development (as defined in the current version of Council's Erosion and Sediment Control Standard) involves site works that could lead to significant erosion and loss of sediment from the site. The ESC Program must be prepared in accordance with Councils Erosion and Sediment Control Standard (Version 9 or later), and may include detailed plans, descriptions of control measures, monitoring programs and maintenance procedures. Please note that the work referred to in this condition involves operational work and therefore requires an operational works application to be submitted. Relevant guidelines to assist in the preparation of ESC Programs include the: "Soil Erosion and Sediment Control - Engineering Guidelines for Queensland Construction Sites" The Institute of Engineers, Australia (Qld), 1996 (or later version); "Sediment Basin Design Guidelines", Brisbane City Council, February 2000 (or later version); and "Best Practice Guidelines for the Control of Stormwater Pollution from Building Sites" and accompanying fact sheets, Brisbane City Council and Gold Coast City Council, 2000 (or later version). NB. The ESC Program may form part of a Site Based Stormwater Management Plan (that addresses short and long-term stormwater management from a quality and quantity perspective) or an Environmental Management Plan (EMP). For any enquiries about this condition, please contact the Engineering Delegate, Development Assessment.*	Prior to site works commencing (ie. any land-disturbing development) ✓ While site works (eg. operational works, building works) are occurring and until exposed soil areas are permanently stabilised (eg. turfed, concreted)

47) Undertake the works on the site in accordance with an Earthworks Plan approved by the Engineering Delegate, Development Assessment. (a) Submit an earthworks plan (and obtain approval from the Engineering Delegate, Development Assessment), prepared by a Registered Professional Engineer of Queensland (RPEQ), and in accordance with Council's *"Subdivision and Development Guidelines"* demonstrating how the development will comply with this requirement and the following: • The location of any cut and/or fill; • The quantity of fill to be deposited and finished fill levels; • Maintenance of access roads to and from the site such that they remain free of all fill material and are cleaned as necessary; • The existing and proposed finished levels (extending into the adjacent properties); • Preservation of all drainage structures from the effects of structural loading generated by the earthworks; • Protection of adjoining properties and roads from ponding or nuisance from stormwater; • That all vehicles exiting from the site will be cleaned and treated so as to prevent material being tracked or deposited on public roads. (b) All fill material placed on the site is to be free of contaminants (as defined by section 11 of the Environmental Protection Act 1994), noxious, hazardous, deleterious and organic materials. Suitable fill material is deemed to comply with the requirements of clause 4.3, AS 3798, Guidelines on Earthworks for Commercial and Residential Developments. (c) Prepare the following details for presentation to the Council's Engineering Delegate at a pre-start meeting arranged by the consultant supervising the contractor: • The type of fill to be used and the manner in which it is to be compacted; • Details of any proposed access routes to the site which are intended to be used to transport fill to the site; • Engineering details of any haul roads to be built to facilitate the placement of fill on the site; • The contractor is responsible for maintaining the access roads near the site such that they remain free of all fill material and are cleaned as necessary; • Damage to Council assets will need to be repaired at no cost to Council; • Public footpaths fronting the site are to remain safe at all times; and • Compliance with Council's Erosion and Sediment Control Guidelines relating to earthworks on a construction site. (d) Implement and maintain the provisions of a Site Based Stormwater Management Plan which is consistent with Council's *"Subdivision & Development Guidelines"* (2000 or later version) and aims to prevent or minimise the contamination of stormwater and the release of contaminated stormwater from the site during construction and operational works. *GUIDELINE* *This condition is imposed for applications when significant earthworks are proposed in conjunction with a development proposal. Site Based Stormwater Management Plans (that address short and long term stormwater management from a quality and quantity perspective) may be part of Environmental Management Plans (EMPs) and include ESC Programs/Management Plans. For any enquiries about this condition, please contact the Engineering Delegate, Development Assessment.*	Prior to site works/building works commencing ✓ While site/operational works/building works is occurring

48) Grant the following easement(s): (a) Easements for sewerage and water supply purposes in favour of Brisbane city Council over sewerage rising mains or water mains; (b) Easements for underground drainage, open cut, overland flow and access purposes as may be required over that part of the site below the Flood Regulation Line and/or that part of the site affected by 100 year average recurrence interval (ARI) flooding, generally as indicated on drawing B04254-SK78 revision B, in favour of Brisbane City Council; *GUIDELINE* *This condition is imposed to provide access, maintenance of services and to protect drainage paths if required. Easements in favour of the Brisbane City Council are required to have the necessary easement documentation prepared (free of costs and compensation to Council) by the Brisbane City council. Easements not in favour of the Brisbane City Council are required to have the necessary documentation prepared by the applicant's private solicitors. Easements are to be shown on a Survey Plan and lodged with the Delegate Plan Sealing, Licensing Sealing and Certificates Unit. Enquiries regarding any legal documentation can be directed to Licensing, Sealing and Certificates Unit, Development and Regulatory Services (pH 3403 9050). For any other enquiries about this condition, please contact the Engineering Delegate, Development Assessment.*	Prior to the commencement of the use ✓
49) Any retaining walls greater than 1.0 metre in height are required to be structurally certified for design and construction by a Registered Professional Engineer Queensland (RPEQ). The certification is to include the stormwater drainage (surface and seepage water) associated with the wall ensuring that the water is directed to an acceptable lawful and legal point of discharge and does not cause any ponding, nuisance or disturbance to adjacent property owners. *GUIDELINE* *This condition is intended to ensure that retaining walls associated with the development that are higher than 1 metre, are designed and constructed to industry standards and also, to ensure that no adverse impact is created by the structures on the surrounding properties. The retaining wall designer should note that timber retaining walls facing onto Council property (including the road reserve) will not be permitted. Retaining walls facing onto road reserve or parkland are to be contained entirely within the proposed development site, including the retaining wall's footings. Where retaining walls are proposed to be constructed between adjoining properties, it is also suggested that the use of timber sleeper retaining walls be restricted due to their limited life and the potential problems they may cause to future property owners. Where the combined height of the retaining wall and fence exceeds 2.0 metres, a Development Permit for Building Work will need to be granted. For any enquires about this condition please contact the Engineering Delegate, Development Assessment.*	Prior to the commencement of the use ✓

50) Provide internal signs and line markings generally in accordance with the approved drawings and documents and in accordance with Austroads and the Manual of Uniform Traffic Control Devices. (a) Prepare detailed engineering plans prepared by a Registered Professional Engineer of Queensland (RPEQ), and in accordance with Council's "Subdivision and Development Guidelines" showing the design of the sign and line marking work; (b) Construct the works in accordance with the engineering plans; and (c) Submit "As Constructed" plans to the Engineering Delegate, Development and Regulatory Services, approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's "Subdivision and Development Guidelines") certifying that the works have been completed in accordance with the approved design and any approved modifications and that the works required by this condition are in accordance with "Austroads" and the "Manual of Uniform Traffic Control Standards". *GUIDELINE* *This condition is intended to ensure that the development is signed and lined in accordance with the relevant standards.*	Prior to the commencement of the use Prior to lodging a development permit for building works ✓
51) Construct and delineate or sign (as required) the following requirements as indicated on the approved plan(s) of layout: 'a) Construct a pavement of minimum Type A standard and surface with an impervious material (including associated drainage) to the area on which motor vehicles will be driven and/or parked. [Construction of such pavement is to be certified by a Registered Professional Engineer of Queensland (RPEQ)]; (b) The driveways at grades shown on the approved plans and documents (or if not shown at grades not greater than those set out in *"Brisbane City Plan 2000 - Transport, Access, Parking and Servicing Planning Policy"*); (c) Manoeuvring on site for Outside Broadcast vehicles, buses, and service vehicles and for the loading and unloading of the vehicle(s); (d) Parking on the site for 162 cars, including a minimum of 2 spaces for persons with a disability, and for the loading and unloading of vehicles within the site; (e) A directional visitor parking sign at the vehicle entrance to the site adjacent to or clearly visible from the vehicle entrance to the site; (f) An appropriate area for the storage and collection of refuse, including recyclables, in a position which is accessible to service vehicles on the site; (g) The internal paved areas are to be signed and delineated in accordance with the approved plans, Manual of Uniform Traffic Control Devices and Austroads. *GUIDELINE* *The "Brisbane City Plan 2000 - Transport, Access, Parking and Servicing Planning Policy" requires adequate on-site provision of parking, servicing and manoeuvring areas. This condition specifies detailed design requirements as indicated on the approved drawings and documents to which the approval relates.*	Prior to the commencement of the use & then to be maintained ✓

52) Obtain written permission from Council to build over or near storm water infrastructure (pipe drainage system or an easement for overland flow), or, to relocate a storm water drainage system, all at no cost to Council.	Prior to lodging a development permit for building works
(a) Submit engineering plans and calculations (if required), prepared by a Registered Professional Engineer Qld (RPEQ) and in accordance Council's *"Guidelines for Building Over or Near Stormwater Facilities"* in the *"Subdivision and Development Guidelines"* showing the manner in which it is intended to preserve the existing storm water drainage structures (or overland flow easements) within the site from damage, structural loading or obstruction. Obtain approval for the design from the Engineering Delegate, Development Assessment, Development and Regulatory Services.	✓
(b) Complete the works in accordance with the approved engineering plans.	Prior to the commencement of the use
(c) Submit "As Constructed" plans including an asset register (if required) of any modified or relocated stormwater drainage structure or other Council asset. The plans are to be approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's *"Subdivision and Development Guidelines"*) and certified that the works have been completed in accordance with the approved design and any approved modifications.	Prior to the commencement of the use
GUIDELINE *This condition has been imposed to ensure that acceptable measures will be incorporated into the development to protect Council's Infrastructure. For any enquiries about this condition, please contact Council's Customer Contact Centre on ph. 3403 8888.*	

Run-off from roof and developed surface areas of the site, and any run-off onto the site from adjacent areas, are to be collected internally and directed to a lawful point of discharge in accordance with Council's "Subdivision and Development Guidelines".	Prior to site works/building works commencing
(a) Submit drainage plans and engineering calculations (as a part of the development's Site Based Stormwater Quantity Management Plan) in accordance with Council's *"Subdivision and Development Guidelines"* showing the design of the drainage of the roof and developed surfaces. Obtain approval from the Engineering Delegate, Development Assessment. Such plans are to show adequate survey information on areas adjoining the site with particular attention to any nuisance or annoyance to adjoining property owners. Please note all constructed stormwater outlets that are proposed to discharge directly to a waterway, shall ensure an appropriate waterway setback, reduction in flow outlet velocity and concentration and, include any supplementary planting works that may be required (refer *"Stormwater Outlets in Parks and Waterways"*, BCC July 2000);	✓
(b) Complete the works in accordance with the approved engineering plans and other elements of the development's Site Based Stormwater Management Plan; and	While site/operational works/building works is occurring
(c) Submit "As Constructed" plans approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's *"Subdivision and Development Guidelines"*) certifying that the works have been completed in accordance with the approved design and any approved modifications.	Prior to the commencement of the use
GUIDELINE *The purpose of this condition is to ensure that stormwater run off from the site and adjacent properties will be handled adequately. Disposal by gravity pipeline is required if practical. Use of pumps for disposal of stormwater may be approved only if the applicant can show evidence to Council of having taken all reasonable steps to obtain written permission from adjacent property owners for construction of a gravity pipeline, and of this being unobtainable. The proposal may include water saving and reuse devices such as rain water tanks provided that the proposal satisfies Council that devices will be satisfactorily maintained by the owners of the property. For any enquiries about this condition, please contact the Engineering Delegate, Development Assessment.*	

54) Provide a stormwater drainage connection for the future development of all adjoining upstream properties in accordance with an approved drainage plan and Council's "Subdivision and Development Guidelines". (a) Submit engineering plans and calculations and obtain approval from the Engineering Delegate, Development Assessment; (b) Complete the works in accordance with the approved engineering plans and in accordance with, Council's *"Subdivision and Development Guidelines"*; and (c) Submit "As Constructed" plans including an asset register (if required), approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's *"Subdivision and Development Guidelines"*) certifying that the works have been completed in accordance with the approved design and any approved modifications. *GUIDELINE* *This condition is intended to ensure that the subject development does not prejudice stormwater drainage of adjacent properties. The stormwater drainage required by this condition needs to be encompassed by an easement granted in favour of the Council, as may be required. For any enquiries about this condition, please contact the Engineering Delegate, Development Assessment.*	Prior to the commencement of the use Prior to undertaking the works
55) Manage on-site drainage, ponding and discharge: (a) Design, construct, and thereafter maintain, rehabilitate or replace the following facilities in accordance with the approved plan(s) of layout. These works are to be designed, constructed and maintained in accordance with the following documents: 1.0 Stormwater Management Code of the City Plan; 2.0 Services Works and Infrastructure Code of the City Plan; 3.0 The Subdivision and Development Guidelines; 4.0 QUDM. (b) A Certificate of Completion (as per Chapter 3, Appendix B of Part E of the Subdivision and Development Guidelines) certified by a Registered Professional Engineer of Queensland (RPEQ) is required as proof of compliance with this condition. A copy of the Certificate of Completion is to be forwarded to the Engineering Delegate. NOTE: The design, design documentation, (including test results) and the Certificate of Completion are to be forwarded to and retained by the current and future owner(s) as proof of initial compliance with this Condition of Development and to assist in the on-going compliance with this Condition of Development and any future auditing. *GUIDELINE* *The purpose of this condition is to ensure that stormwater run off from the site and adjacent properties will be handled adequately. Disposal by gravity pipeline is required if practical. Use of pumps for disposal of stormwater may be approved, however details and plans would need to be approved by the Engineering Delegate. The applicant would need to show evidence to Council of having taken all reasonable steps to obtain written permission from adjacent property owners for construction of a gravity pipeline, and of this being unobtainable. For any enquiries about this condition, please contact the Engineering Delegate, Development Assessment.*	Prior to the commencement of the use & then to be maintained

56) Run off from the site and run off concentrated on the site from local catchments for storms up to the 50 year (ARI) flood event and for a 100 year (ARI) flood event for creek and river flooding, is to be managed in accordance with approved drainage plans and Council's "Subdivision and Development Guidelines" so as not to have any adverse effect on neighbouring properties.	Prior to lodging a development permit for building works
(a) Design and construct all buildings to have the appropriate freeboard in accordance with the Council's *"Subdivision and Development Guidelines"* so as not to be flooded during a 50 year (ARI) local flood event or a 100 year (ARI) creek or river flood event whichever is the higher flood level;	
(b) Submit engineering plans and calculations, prepared by a Registered Professional Engineer Qld (RPEQ) and in accordance with the Council's "Subdivision and Development Guidelines", demonstrating how the development will comply with this requirement. Such plans are to show adequate survey information on areas adjoining the site with particular attention to ponding of water and overland flow paths and building pads. Additionally, the submitted information is to determine the extent of any stormwater drainage works and the width of any overland flow easements. Obtain approval for the design from the Engineering Delegate, Development Assessment, Development and Regulatory Services;	✓
(c) Complete the works in accordance with the approved engineering plans; and	Prior to the commencement of the use
(d) Submit "As Constructed" plans including an asset register (if required), approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's *"Subdivision and Development Guidelines"*) certifying that the works have been completed in accordance with the approved design and any approved modifications.	Prior to the commencement of the use
GUIDELINE *This condition is intended to ensure that the design of the subject development accounts for the stormwater run off and/or if stormwater drainage patterns in the vicinity of the site require improvements. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	
57) Design and construct all proposed buildings in accordance with Council's *"Subdivision and Development Guidelines"* to ensure that minimum habitable floor levels are 500 mm above the 100 year (ARI) flood level (river and creek flooding) or 500 mm above the 50 year (ARI) (overland flow level) whichever is the greater.	Prior to lodging a development permit for building works
• All service sheds must ensure that the storage level for chemical purposes are to be not less than 500 mm above the 50 year (ARI) or 100 year (ARI) flood levels (which ever is the greater).	✓
GUIDELINE *This condition is imposed when the site is affected by flooding. The 100 year ARI event is applicable to river and/or creek flooding. If the catchment is localised, the 50 year ARI event will be applicable unless the site is also affected by creek or river flooding in which case the higher flood level is to be used. For flood level information, Council Flood Reports are now available from any of Council's Customer Service Centres and Regional Business Centres. The new Flood Report provides the latest flood information for a nominated property plus other useful information about flooding and your development.*	

58) Provide underground electricity services in accordance with an approved electricity reticulation plan and the Council's "Subdivision and Development Guidelines (Public Utilities Section)". Note: Even though the development may be in an area serviced by overhead electricity, UNDERGROUND supply to the development is now required - no additional poles or overhead mains are to be erected. (a) Lodge electricity reticulation plans showing and the proposed electricity services and obtain approval from the City Lighting Unit, Local Asset Services Central District; (b) Enter into an agreement with an electricity supplier to provide underground electricity services in accordance with the above approved electricity reticulation plans; and (c) Forward a copy of the agreement to the Engineering Delegate, Development and Regulatory Services. *GUIDELINE* *This condition is imposed when a proposed development would require the provision of electricity services in accordance with Council's "Guidelines for the Provision of Underground Electricity". Please refer to the Council's information sheet on lodging detailed design applications. For any enquiries about this condition, please contact the City Lighting Unit (PH 3403 0307) regarding electricity reticulation plans or Energex (PH: 131 253) regarding electricity supply.*	Prior to the commencement of the use Prior to undertaking the works
59) Provide a public lighting system in accordance with an approved street lighting design plan and Council's "Street Lighting Design Guidelines". (a) Lodge street lighting design plans showing the proposed public lighting system and obtain approval from the City Lighting Unit, Local Asset Services Central District; (b) Enter into an agreement with an electricity supplier to provide a public lighting system in accordance with the above approved lighting design plans; and (c) Forward a copy of the agreement to the Engineering Delegate, Development and Regulatory Services. *GUIDELINE* *This condition is imposed when a proposed development requires the provision of public lighting facilities in accordance with the "Street Lighting Design Guidelines". Please refer to the Council's information sheet on lodging detailed design applications. For any enquiries about this condition, please contact the City Lighting Unit (PH 3403 0307) regarding electricity reticulation plans or Energex (PH: 131 253) regarding electricity supply.*	Prior to the commencement of the use Prior to undertaking the works
60) Supply and install all service conduits and meet the cost of any alterations to public utility mains, existing mains, services or installations required in connection with the approved development. This includes the relocation of any fire hydrants and valves from within the limits of the development's vehicular footway crossings if applicable. (a) Complete the works required by this condition; (b) Submit "As Constructed" plans including an asset register (if required), approved by a registered Professional Engineer Queensland (RPEQ) (in accordance with Council's *"Subdivision and Development Guidelines"* and "Water and Sewerage Reticulation Standards") showing the works required by this condition. *GUIDELINE* *This condition is imposed when additions, alterations or extensions to service conduits, mains and other services are required as a result of the approved development. Applicants should liaise with the appropriate service authorities. For any enquiries about this condition, please contact the Engineering Delegate, Development Assessment (regarding advice on traffic signal conduits, stormwater, water supply and sewerage mains etc.) or the relevant public utility authorities (for advice on other services).*	Prior to the commencement of the use

61) Provide underground telecommunication services to the proposed development. (a) Enter into an agreement with a telecommunication company and provide underground telecommunication services within and adjacent to the proposed development; and (b) Forward a copy of the agreement to the Engineering Delegate, Development and Regulatory Services. *GUIDELINE* *This condition is imposed to ensure that the provision of essential communication services are provided to the development. For any enquiries about this condition, please contact relevant service carriers regarding communications or Telstra (pH 132 200).*	Prior to the commencement of the use Prior to undertaking the works
62) Construct the following road works with any associated drainage and services in accordance with an approved detail design and Council's "Subdivision and Development Guidelines": (a) The road 30.0 metres wide to be classified as Type C (designed for 85 percentile 30 km/hr maximum); (b) A suitably sealed area for the provision of a temporary refuse vehicle turning area; (c) Submit functional layout plans showing the extent of the road works. Obtain approval from the Engineering Delegate, Development Assessment; (d) Submit engineering plans prepared by a Registered Professional Engineer Queensland (RPEQ), and in accordance with Council's *"Subdivision and Development Guidelines"* showing the design of the roadworks including any external signs and permanent traffic safety signs, markings and devices (if required). **{If the stormwater Quality Improvement strategy includes the use of swales then the swale profile shall be in accordance with the Swale Profiles shown on Council's standard drawing UMS 151 or as determined by the Engineering Delegate, Development Assessment. }**. Obtain approval from the Engineering Delegate, Development Assessment; (e) Construct the works in accordance with the approved engineering plans to a standard that will be satisfactory to be accepted "on-maintenance" and "off-maintenance" as a Council asset, by the Engineering Delegate, Development Assessment; and (f) Submit "As Constructed" plans including an asset register (if required), approved by a Registered Professional Engineer Queensland (RPEQ) (to a standard specified in Council's *"Subdivision and Development Guidelines"*) certifying that the works have been completed in accordance with the approved design and any approved modifications. *GUIDELINE* *This condition is imposed when new roads are to be constructed and dedicated to Council. For any enquiries about this condition please contact the Engineering Delegate, Development Assessment.*	Prior to undertaking the works Prior to the commencement of the use Prior to the commencement of the use

63) Construct a cul-de-sac to the intersection of Ortive Street and Fairfield Road and reinstate the kerb and channel, road pavement, footways and footpaths, generally as per Drawing B04254-SK58 revision A and in accordance with Council's Standards. (a) Obtain a permit from the Engineering Delegate, prior to carrying out such works within the road reserve. (b) Construction of such works must be certified by a Registered Professional Engineer-Queensland (RPEQ). A copy of the certification, ensuring the works have been constructed in accordance with Council's Standards, must be forwarded to the Engineering Delegate. (c) The contractor/developer is to correspond with residents at Ortive Street to ensure they are kept up to date of construction scheduling to minimise disruptions. *GUIDELINE* *This condition is imposed to prevent vehicle ingress or egress between Ortive Street and Fairfield Road. For any enquiries about this condition please contact the Engineering Delegate, Development Assessment.*	Prior to undertaking the works ✓ Prior to the commencement of the use Prior to site works commencing
64) Undertake the following road works with any associated drainage and services in association with vehicle access to the site. (a) Construct a Roundabout at the intersection of King Arthur Terrace, Softstone Street and the western access to the site generally in accordance with Drawing number B04254-SK65 revision C. Construct new type D concrete kerb and channel and associated drainage (taking into account any road widening if required) and Type C road pavement from the lip of the new kerb and channel to the edge of the existing road pavement with any appropriate tapers (the minimum width of road construction/reconstruction is to be 1.2 metres). (b) Construct a Signalised Intersection at the intersection of Fairfield Road and the eastern access to the site generally in accordance with Drawing number B04254-SK58 revision A. Construct new type D concrete kerb and channel and associated drainage (taking into account any road widening if required) and Type C road pavement from the lip of the new kerb and channel to the edge of the existing road pavement with any appropriate tapers (the minimum width of road construction/reconstruction is to be 1.2 metres). (c) Submit engineering plans prepared by a Registered Professional Engineer of Queensland (RPEQ), and in accordance with Council's "Subdivision and Development Guidelines" showing the design of the roadworks including any external signs and permanent traffic safety signs, markings and devices (if required). Obtain approval from the Engineering Delegate, Development Assessment, Development and Regulatory Services; (d) Construct the works in accordance with the approved engineering plans to a standard that will be satisfactory to be accepted "on" and "off" maintenance" as a Council asset, by the Engineering Delegate, Development and Regulatory Services; and (e) Submit "As Constructed" plans including an asset register, approved by a Registered Professional Engineer Queensland (RPEQ) (to a standard specified in Council's *"Subdivision and Development Guidelines"*) certifying that the works have been completed in accordance with the approved design and any approved modifications. *GUIDELINE* *This condition is imposed when works within the road reserve or future road reserve are required, and to ensure that the required works are carried out in accordance with this approval and relevant standards. The work required by this condition is to be carried out in accordance with Council's "Subdivision and Development Guidelines". For enquiries regarding this condition, please contact the Engineering Delegate, Development Assessment.*	Prior to the commencement of the use Prior to undertaking the works ✓

65) Provide external signs and line markings and or modifications to external parking signs, bus facilities, traffic signal layouts, parking meters and line markings as may be required by the approved development: Generally in accordance with the approved drawings and documents; In accordance with an approved detailed design; and/or In accordance with "Austroads" and the "Manual of Uniform Traffic Control Devices".	Prior to the commencement of the use
(a) Submit detailed engineering plans prepared by a Registered Professional Engineer of Queensland (RPEQ), and in accordance with Council's "Subdivision and Development Guidelines" showing the design of the sign and line marking work. Obtain approval from the Engineering Delegate, Development Assessment, Development and Regulatory Services;	Prior to undertaking the works
(b) Construct the works in accordance with the approved engineering plans to a standard that will be satisfactory to be accepted "on" and "off" maintenance" as a Council asset, by the Engineering Delegate, Development and Regulatory Services; and	
(c) Submit "As Constructed" plans including an asset register (if required), approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's *"Subdivision and Development Guidelines"*) certifying that the works have been completed in accordance with the approved design and any approved modifications and that the works required by this condition are in accordance with *"Austroads"* and the *"Manual of Uniform Traffic Control Standards"*.	
(d) Submit certification by a Registered Professional Engineer of Queensland (RPEQ) that the works required by this condition are in accordance with Austroads and the Manual of Uniform Traffic Control Devices.	
GUIDELINE *This condition is intended to ensure that the development is signed and lined in accordance with the relevant standards. A fee is payable to cover the Council's cost incurred in the preparation of any plans, adjusting its records and carrying out any work if necessary. If Council is to carry out the works, a minimum of six (6) weeks notice is required. For enquiries regarding this condition, please contact the Engineering Delegate, Development Assessment.*	
66) Undertake the following works to provide safe pedestrian access to the Tennis centre:	Prior to the commencement of the use
(a) Construct a footpath a minimum width of 1.2 metres at the Softstone Street and Fairfield Road Access points generally in accordance with Drawings B04254-SK65 revision C and Drawing B04254-SK58 and in accordance with Council's *"Subdivision and Development Guidelines"*. The design of the footpath works is to include any permanent safety signs, markings and devices (if required).	
(b) Construct a 4.0 metre wide Pedestrian link to the Yeerongpilly Railway Station Overpass generally as per drawing B04254-SK59 Revision A.	
(c) Construct all footpaths to a standard that will be satisfactory to be accepted "on" and "off" maintenance" as a Council asset, by the Engineering Delegate, Development and Regulatory Services; and	
(d) Submit "As Constructed" plans including an asset register, approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's *"Subdivision and Development Guidelines"*) certifying that the works have been completed in accordance with the approved design and any approved modifications.	
GUIDELINE *This condition requires works to be undertaken in the road reserve. The intention of the condition is to ensure that the adjoining footpaths are designed and constructed to a standard suited to the demands created by the approved development. For advise regarding alignment and levels of the proposed works and any other enquires about this condition, please contact the Engineering Delegate, Development Assessment.*	

67) Repair any damage to existing kerb and channel, footpath or roadway (including removal of concrete slurry from footways, roads, kerb and channel and stormwater gullies and drainlines) that may occur during any works carried in association with the approved development. *GUIDELINE* *The intention of this condition is to ensure that any works undertaken as part of the approved development do not damage Council assets or leave Council assets in an unacceptable and unsightly manner. For enquiries regarding this condition, please contact the Engineering Delegate, Development Assessment.*	Prior to the commencement of the use ✓
68) Be responsible for internal (on-site) collection of refuse and recyclables from the development. (a) Enter into an agreement with Council's City Waste Services to provide a bulk bin collection service to the development; (b) The applicant/owner must indemnify Council and its agents in respect of any damage to the pavement and other driving surfaces; (c) The applicant/owner shall notify future owners/body corporate that the development has been approved on the basis that an indemnity is provided for refuse collection vehicles to enter the property; (d) Forward a copy of the written indemnity agreement with City Waste Services to the Engineering Delegate, Development and Regulatory Services; (e) Forward a copy of the written undertaking required to advise future owners/body corporate to the Engineering Delegate, Development and Regulatory Services. *GUIDELINE* *This condition is imposed to ensure that adequate arrangements are made for the collection of refuse and recyclables from the approved development. For any enquiries about this condition, please contact the Coordinator of City Waste Contract Services, pH: 3403 8612 or 3403 8613).*	Prior to the commencement of the use Prior to the commencement of the use & then to be maintained Prior to the commencement of the use & then to be maintained ✓
69) Construct a 200 mm diameter water main from "A" to "B" as detailed on Drawing number B04254-SK57 in accordance with Council's "Water and Sewerage Reticulation Standards". (Such work does not include connection to the water main). (a) Submit engineering plans prepared by a Registered Professional Engineer Queensland (RPEQ), and in accordance with Council's *"Water and Sewerage Reticulation Standards"* showing the design the works. Obtain the approval from the Engineering Delegate, Development Assessment, Development and Regulatory Services; (b) Pay to Council the cost of live connection to the water mains; (c) Construct the works in accordance with the approved engineering plans to a standard that will be satisfactory to be accepted "on" and "off" maintenance as a Council asset, by the Engineering Delegate, Development and Regulatory Services; (d) Submit "As Constructed" plans including an asset register, including an asset register, approved by a Registered Professional Engineer Queensland (RPEQ) (to a standard specified in Council's *"Water and Sewerage Reticulation Standards"*) certifying that the works have been completed in accordance the approved design and any approved modifications. *GUIDELINE* *This condition is imposed to bring water supply infrastructure to the site or to augment the existing system. For enquiries regarding this condition, please contact the Engineering Delegate, Development Assessment.*	Prior to undertaking the works ✓ Prior to the commencement of the use Prior to the commencement of the use

70) Provide a water service with approved Council meter assembly and meter box to the front real property boundary of the development in accordance with Council's "Water and Sewerage Reticulation Standards". Where a mixed usage site is approved for development and the proposed development comprises mixed classifications as defined by the Building Code of Australia containing any of Classes 5 to 9 and any of Classes 2 to 4, then the developer must provide a separate metered water service for the Class 2 to 4 occupancy as opposed to the Class 5 to 9 occupancy. This requirement is exclusive of any special fire service consideration i.e. internal hydrants, fire hose reels and sprinkler systems.	Prior to undertaking the works
(a) Submit engineering plans prepared by the RPEQ (Registered Professional Engineer Queensland) , and in accordance with Council's *"Water and Sewerage Reticulation Standards"* showing service and meter works. (The size of the service shall be determined by the water supply requirement of the proposed development). Obtain the approval from the Engineering Delegate, Development Assessment, Development and Regulatory Services;	
(b) Pay to Council the cost of live connection to the water main;	
(c) Such construction is to be to a standard that is satisfactory to be accepted on an off maintenance;	Prior to the commencement of the use or prior to endorsement of a community management statement, whichever is sooner
(d) If the meters are purchased other than from Council, pay to council a documentation fee for each water service provided. If the meters are purchased from Council, forward a copy of the receipt of purchase to the Engineering Delegate, Development and Regulatory Services.	Prior to the commencement of the use or prior to endorsement of a community management statement, whichever is sooner
GUIDELINE *This condition is imposed to supply a water service and a meter(s) to a Development / Community Title Development / Standard / Building or Volumetric format. The meter(s) shall be accessible to BCC employees or agents for the purpose of reading and maintaining the meter(s). The meter(s) will become and remain property of the Brisbane City Council.*	
71) Obtain written permission from the Engineering Delegate, Development and Regulatory Services, to build over or near sewer infrastructure, or to relocate the sewer/sewer infrastructure at no cost to Council. *GUIDELINE* *This condition is imposed so that the council does not incur costs associated with the erection of a building or structure over or near a sewer and/or sewer infrastructure. To avoid unnecessary expense and delay, the Council strongly recommends that the developer apply for permission to "Build Over Sewer" prior to the lodgement of any further development applications. For any enquiries regarding this condition, please contact the Delegate, Development Assessment.*	Prior to lodging a development permit for building works

72) Construct the sewer as detailed on Sketch Number B04254-SK57 including a New Sewer Pump Station and Rising Main in accordance with Council's "Water and Sewerage Reticulation Standards". (Such work does not include connection to the sewer main).	Prior to undertaking the works
(a) Submit engineering plans prepared by a Registered Professional Engineer Queensland (RPEQ), and in accordance with Council's *"Water and Sewerage Reticulation Standards"* showing the design the works. Obtain the approval from the Engineering Delegate, Development Assessment, Development and Regulatory Services;	
(b) Pay to Council the cost of live connection to the sewer mains;	
(c) Construct the works in accordance with the approved engineering plans to a standard that will be satisfactory to be accepted "on" and "off" maintenance as a Council asset, by the Engineering Delegate, Development and Regulatory Services;	Prior to the commencement of the use
(d) Submit "As Constructed" plans including an asset register, approved by a Registered Professional Engineer Queensland (RPEQ) (to a standard specified in Council's *"Water and Sewerage Reticulation Standards"*) certifying that the works have been completed in accordance the approved design and any approved modifications.	Prior to the commencement of the use
GUIDELINE *Please note that the work referred to in this condition involves This condition is imposed to bring sewerage infrastructure to the site or to augment the existing system. Plans must be prepared in accordance with Council's "Water and Sewerage Reticulation Standards" and may therefore constitute assessable development. It will be necessary to obtain the consent of the owner of all properties through which any proposed sewer passes. This will be a mandatory part of the application for engineering approval. For enquiries regarding this condition, please contact the Engineering Delegate, Development Assessment.*	

73) Provide a sewer property connection to serve the development designed and constructed in accordance with approved engineering plans and Council's "Water and Sewerage Reticulation Standards". NB. The size of the connection shall be determined by the total number of fixture units.	Prior to undertaking the works
(a) Submit engineering plans prepared by a Registered Professional Engineer Queensland (RPEQ), and in accordance with Council's *"Water and Sewerage Reticulation Standards"* showing the design the works. Obtain the approval from the Engineering Delegate, Development Assessment, Development and Regulatory Services;	
(b) Pay to Council the cost of live connection to the sewer main;	
(c) Construct the works in accordance with the approved engineering plans to a standard that will be satisfactory to be accepted "on" and "off" maintenance as a Council asset, by the Engineering Delegate, Development and Regulatory Services;	Prior to the commencement of the use
(d) Submit "As Constructed" plans including an asset register, approved by a Registered Professional Engineer Queensland (RPEQ) (to a standard specified in Council's *"Water and Sewerage Reticulation Standards"*) certifying that the works have been completed in accordance the approved design and any approved modifications.	Prior to the commencement of the use
GUIDELINE *This condition is imposed to provide a separate new sewerage connection to the development. For enquiries regarding this condition, please contact the Engineering Delegate, Development Assessment.*	

Section to Which These Conditions Relate: 3. Material Change Of Use (Development Permit)

Section Name: STAGE 1 Residential: Multi Unit Dwelling - Buildings E & F, and Park

GENERAL/PLANNING REQUIREMENTS

	TIMING
74) Carry out the approved development generally in accordance with the approved documents and drawings as amended in red to show location of paths. *GUIDELINE* *This condition refers to the approved plans, drawings and documents to which the approval relates and is the primary means of defining the extent of the approval. Approved plans, drawings and documents are stamped PLANS and DOCUMENTS referred to in the APPROVAL and are dated to reflect the date of approval of the application by Council's Delegate.*	While development is occurring on site and then to be maintained
75) Complete all building work associated with this development approval, including work required by any of the following conditions. Such building work is to be carried out generally in accordance with the approved plans, drawing(s), and/or documents and, where the building work is assessable development, in accordance with a current development permit. *GUIDELINE* *This condition is imposed to ensure all building work associated with the use are in place before the use commences. It is not appropriate that the site be used without such work being completed. Please note that the work referred to in this condition involves operational work and may therefore constitute 'assessable development'. The Council informs you there fore that this condition does not authorise assessable development to occur and a development permit may therefore be necessary. Please refer to the Council's information sheets. For any enquiries about this condition, please contact the Assessment Manager.*	Prior to the commencement of the use
76) Complete all operational work associated with this development approval, including work required by any of the following conditions. Such operational work is to be carried out generally in accordance with the approved plans, drawing(s), and/or documents or, if requiring a further approval from the Council, in accordance with the relevant approval(s). *GUIDELINE* *This condition is imposed to ensure all operational works associated with the use are completed before the use commences. It is not appropriate that the site be used without such work being completed in accordance with any detailed design approvals. Please note that the work referred to in this condition involves operational work and may therefore constitute 'assessable development'. The Council informs you therefore that this condition does not authorise assessable development to occur and a development permit may therefore be necessary. Please refer to the Council's information sheets. For any enquiries about this condition, please contact the Assessment Manager.*	Prior to the commencement of the use

77) Access to Tennyson Riverside Parkland and Pedestrian walkway: (a) No additional pedestrian access to or from the site to the riverside parkland is to be provided other than in the locations as shown on the approved plan(s) and documents; *GUIDELINE* *This condition has been imposed upon the proposed development as Council has determined that direct access to the adjoining Council parkland needs to be restricted. This is to reduce pedestrian/cyclist conflict and to ensure any future works and/or use requirements of the Council parkland are not prejudiced. For any enquiries regarding this condition please contact the Assessment Manager.*	Prior to the commencement of the use & then to be maintained
78) Maintain the approved development (including landscaping, parking, driveways and other external spaces) in accordance with the approved drawing(s) and/or documents, and any relevant Council engineering or other approval required by the conditions. *GUIDELINE* *This condition restricts changes that can be made to the approved development. Approved plans and documents are stamped PLANS and DOCUMENTS referred to in the APPROVAL and are dated to reflect the date of determination of the application by the Council's delegate. The extent to which plans can be modified is constrained by the definition of 'minor change' in schedule 10 and the requirements of section 3.5.24 of the "Integrated Planning Act 1997". It will be necessary to make a new application if the change is not a minor change. For any enquires about this condition, please contact the Assessment Manager.*	To be maintained
79) The Community Management Statement (CMS) for Buildings E & F will not be endorsed by Council until the east-west access road linking Softstone Street with Fairfield Road is dedicated as road. *GUIDELINE* *This condition is imposed to ensure an orderly development sequence for the residential buildings and the Tennyson Riverside Parkland.*	As indicated
80) A legible copy of the approved drawings and documents bearing "Council Approval" and the Development Approval Conditions package is to be available on site at all times during construction and earthworks. *GUIDELINE* *This condition is imposed to ensure compliance with the development conditions of approval. The copy of the conditions and plans should be located in any site management office or with the site foreman. Any copies of conditions or plans that are illegible shall be deemed to be non compliance with this condition of approval.*	As indicated

81) Prior to building work for the proposed building commencing on the site undertake the following works. (a) Remove the existing buildings on the site; and (b) Cap all services to the building and stabilise the exposed ground surface with grass seeding. (c) Where buildings are demolished and, for whatever reason, redevelopment is delayed for more than 3 months, the following works are carried out: • site is cleared of all rubble, debris and demolition materials; • site is levelled to the same level as the adjoining footpath and turfed so it can be mowed; • site is landscaped with perimeter planting consisting of advanced specimens of fast growing species in accordance with the Planting Species Planning Scheme Policy; • drainage is provided to prevent ponding; • site is maintained so there is no sediment run off onto adjacent premises, roads or footpaths; • site is maintained to ensure no nuisance to adjacent premises, roads or footpaths; and • public access is provided where public safety can be maintained *GUIDELINE* *This condition is imposed to ensure that all structures are removed or relocated appropriately to ensure that no future legacy remains for the ultimate property owners. It should also be noted that the removal of structures includes the removal of all existing concrete slabs and foundations and footings of any removed structures.*	As indicated
82) Prior to issuing the relevant Development Permit for Building Works, submit to the satisfaction of the Principal Lead Planner, Development Assessment Team South, the following plans and details showing the facade treatments and external materials colours and finishes: **(a) A colour scheme showing materials and finishes to buildings E and F in accordance with the materials details noted on the approved plan(s) & drawing (s);** **(b) Notwithstanding the requirements of part (a) of this condition and the notations on the approved plans and drawings, the materials and finishes of the buildings must be high quality pre-finished materials and included with details required to be submitted by this condition;** **(c) The schedule is to be submitted as a sample board including materials and actual paint swatches of the proposed external paint colours and accompanied by coloured elevations and a written tabulation of how particular parts of the structure and ancillary finishes are to be finished.** **(d) Implement the above approved detailed design treatments.** *GUIDELINE* *This condition is intended to ensure that the colours and materials used are appropriate for the intended character and image for the surrounding area. The requirement is intended to avoid a built form and street character that is dominated by glass surfaces, that increases local affects from reflectivity, glare and heat.*	As indicated

83) Prior to any works commencing on the site and then to be maintained until completion of the development, erect on the Softstone Street and Tennyson Memorial Avenue frontages of the site, and in a location adjacent to the proposed access to Fairfield Road (between Fairfield Rd access and Ortive Street), an "Information Sign" as outlined below: (a) A brief description of the development proposed; (b) The sign/ is to list the name, postal and/or email address and a contact telephone number for the following parties (where relevant) that are undertaking work on the site: Developer; Project Coordinator; Architect/Building Designer; Builder; Civil Engineer; Civil Contractor/s; and Landscape Architect; (c) The lettering on the sign is to be at least 25 millimetres in height, be of regular weight and in sentence case; (d) The sign is to be a minimum size of 1,200 millimetres by 900 millimetres; (e) The maximum area of the sign is to be 2.0m^2; (f) The sign must be placed on or within 1.5 metres of, the road frontage for the land and mounted at least 300 millimetres above ground level; (g) The sign must be placed on the road frontages as indicated above in this condition; (h) The sign is to contain no commercial or corporate advertising other than the name, logo or slogan of the parties outlined in part (a) of this condition (i) The sign is to be non illuminated; (j) Both the sign and the supporting structure are to be made of weatherproof material and to be properly maintained at all times; and (k) The sign/s are to be located on the subject property and is to comply with the General Requirements for Signage contained within the Local Laws Policy "Control of Outdoor Advertising" specifically with regard to Traffic Safety, Clearances and Structural Systems. (l) Prior to the erection of the sign, lodge a copy of the wording and proposed dimensions of the "Information Sign" with Council. *GUIDELINE* *This condition is imposed to provide information regarding the development and project team. Where signage is carried out in accordance with Permitted Advertisement provisions contained within the Local Law Policy "Control of Outdoor Advertising" the display of the sign is exempt from the payment of fees, the need for a licence or the making of an application.*	As indicated

84) Provide a copy of the Brisbane City Council approval package including the development approval conditions, approved plans & documents and the Decision Notice to the following and as indicated(where applicable): (a) all consultants preparing or lodging applications for "Operational Works"; (b) all consultants preparing or lodging applications to satisfy conditions requiring compliance assessment under Schedule 12 of the *Integrated Planning Regulation 1998*; (c) all consultants preparing or lodging applications for "Carryout Building Works"; and (d) all contractors carrying out site works or building works associated with or resulting from this Development Permit. *GUIDELINE* *This condition is imposed to ensure that all consultants, contractors and Building Certifiers involved with completing the development are aware of the particular requirements of this site.*	As indicated Prior to lodging a development permit for building works Prior to site works commencing
85) Prior to site/building works commencing for each stage, undertake an on-site Pre Start meeting (a) Co-ordinate the attendance of the relevant **development/ building/ arborist/ site consultants and contractors** with the following Brisbane City Council Officers or their nominated representatives: • **Principal Engineer**, Development Assessment Team South, Development Assessment • **Landscape Architect**, Development Assessment Team South, Development Assessment • **Principal Lead Planner,** Development Assessment Team South, Development Assessment (b) This meeting is requested to discuss relevant site/building/operational work requirements for each stage, including but not limited to: • Landscape Management and Site Works Plan (Riverwalk, Parkland and Private Land) • Special Vegetation Management Plan • Streetscape Works Plan • Construction Management Plan • Event Management Plan • Construction parking • Road & Footpath Closure Permits and other additional permits • Public & Workplace Safety • Maintenance of a pedestrian and cyclist thoroughfare through the site • Compliance with Council's Erosion and Sediment Control Guidelines relating to earthworks on a construction site • Tree protection measures • Relocation of existing services *GUIDELINE* *This condition is imposed when the construction activities need to be limited to manage the impact on the surrounding area. Please telephone 3403 8888 to arrange a suitable meeting time.*	As indicated

86) Any land transferred to the Council for Public Purposes (Parkland or Community Facilities) and/or for Road Purposes is not to be on the Environmental Management Register and or the Contaminated Land Register, unless agreed to by the future asset owner. Work within the area of the easement adjacent to the proposed roundabout on the east-west access road is to be carried out generally in accordance with Detail Cross Sections Through Access Road - Services Through Easement drawing number 00-SK0049 revision B prior to dedication of the road to Council.. *GUIDELINE* *This condition is imposed to ensure the condition of the land is of a standard acceptable to the future asset owner.*	As indicated
87) The use of the proposed gym as shown on plan DA1011-RevE is to be ancillary to the residential use on the site as indicated below: (a) That the gym is to be located within Common Property and not for the exclusive use of any residential occupant on the site; (b) That the facility is to be limited for the use by residents, guests and invitees of the residential unit owners and/or tenants; and (c) That the facility is not to be used for commercial uses other than management/letting activities associated with the Common Property. *GUIDELINE* *This condition is intended to clarify how the Common Property Area, in particular the proposed ancillary facilities located within Common Property, will be for the use of the residents within the development. These uses are considered part of the overall development of the site and are ancillary to the predominant residential use of the site as per the Preliminary Approval issued over the site. The Community Management Statement is to reflect this.*	As indicated

88) All fencing, retaining walls, mechanical ventilation constructed to the Tennyson Riverside Parkland boundary of the site shall be generally in accordance with the following: a. FencingAll fencing (including footings/foundations and maintenance course) is to be a maximum height from finsihed ground level of 1.8 metres; and The 1.8 metre high fence is to be of semi transparent design (75% transparency) fence along the dwelling units and terrace /recreational area facing the park as indicated on the approved plans. The colour of fencing shall blend with the landscape area ie. earthy tonal colours, so as not to detract from the riverscape or be visually intrusive when viewed from the Brisbane River. b. Retaining WallsNo retaining walls are to be constructed along the riverside park boundary; and Where retaining walls are proposed within the landscape setback from the Tennyson Riverside Parkland, the retaining wall shall be screened and coloured such that they blend with the landscape area, ie. having earthy tonal colours, so as not to detract from the riverscape or be visually intrusive when viewed from the Brisbane River. (Note: the requirements of this condition do not apply to the proposed revetment wall along the river frontage of the park as shown on the approved drawings.) c. Mechanical Ventilation/ExhaustsNo mechanical ventilation/exhausts are to be constructed along the Tennyson Riverside Parkland boundary including any pedestrian walkway and Where mechanical ventilation/exhausts are proposed within the landscape setback from the riverside park, the structure shall be screened and coloured such that they blend with the landscape area, ie. having earthy tonal colours, so as not to detract from the riverscape or be visually intrusive when viewed from the Brisbane River. *GUIDELINE* *This condition is imposed to ensure visual privacy between the development and adjoining properties and to minimise the impacts on the visual amenity when the development is viewed from the public parkland. This condition is also imposed to ensure that the design and height of the fence will enable adequate surveillance between the park and the residential units. The fencing within each stage must be erected and completed prior to the commencement of the use of that stage of the development.*	Prior to the commencement of the use & then to be maintained
89) Provide an enclosure around the pool filter and pump. The enclosure is to be sealed block work with concrete lid, solid door mounted in a steel frame built into the block work with acoustic seals to all four edges of the door. If ventilation is required these must be acoustically treated grilles. *GUIDELINE* *This condition is to ensure that acoustic levels are maintained so as to protect the amenity of adjoining land owners.*	Prior to the commencement of the use & then to be maintained

90) Use of the Pool pump and pool filter are to comply with the following: (a) Noise levels for the pool filter and pump are to comply with the Environmental Protection Agency noise levels as stated in Section 6Y(1) of the Environmental Protection Regulation 1998 as amended from time to time. (b) The use of the pool, and pool surrounds are to be used only between the hours of 6am to 10pm seven days a week. *GUIDELINE* *This condition is imposed to minimise any nuisance effects of the pool to adjoining residents. Hours are as specified in discussions with adjoining land owners.*	Prior to the commencement of the use & then to be maintained At all times
91) Construct and maintain the residential development to include the following: (a) Fixed, external privacy screens or fixed obscure glazing to the upper floor windows as shown on the approved plans 51-DA1030-Rev A & 51-DA1031-Rev A, 51-DA1040-Rev A&51-DA1041-Rev A; (b) Fixed privacy screens up to 1.8 metres above floor level to the balconies as shown on the approved plans; *GUIDELINE* *This condition is imposed to identify important design details of the dwelling or where these necessary design details are not indicated on the approved plans.*	Prior to the commencement of the use & then to be maintained

92) The following sustainable features are to be installed and maintained within the proposed development (as indicated):

Prior to the commencement of the use & then to be maintained

Individual privately-owned units	Toilets	4-Star rated dual flush
	Showers	3-Star rated showerhead
	Basin & Sink Taps	• 4-Star rated tapware or flow regulating device installed in pipe work upstream of all basin and sink taps • No 'insinkerators' are to be installed
	Smart Water Meters	Install water meters to each unit to monitor water usage (this does not replace the Council water meter)
	Dishwasher	4-Star rated dishwasher
Body Corporate-managed areas	Basin & Sink Taps	4-Star rated tapware or flow regulating device installed in pipe work upstream of all basin and sink taps
	Pool	Pool covers are to be provided and maintained to any swimming pools or spas installed
	Pressure limiting devices on domestic water service lines	Pressure reducing valves set to a maximum of 300kPa. Valves installed to serve clusters of units with a minimum of 1 valve per floor level
	Irrigation system	• Subsurface or microjet spray/dripper system and controlled using soil moisture sensors • Programmable irrigation controller with rain sensor • Sub water meters on irrigation supply line
	Outdoor taps	• Trigger nozzles on all outdoor hoses • 3-Star rated flow regulating devices installed in pipework upstream of all outdoor taps
	Rainwater tank	• Rainwater storage tank(s) • Rainwater tank plumbed into irrigation system • Rainwater tank plumbed into any pool top-up • Rainwater tank plumbed into car / bin washing area
	Smart Water Meters	Install water meters to the water supply servicing the Body Corporate areas to monitor water usage (this does not replace the Council water meter)

GUIDELINE
This condition is imposed to ensure that the development is sustainable in terms of careful and efficient use of water utilising current best practice. This condition acknowledges that an installation of the clothes washer may not be provided by the developer.

93) Any Community Management Statement for the site is to contain the following requirements: (a) All balconies and terraces shown on the approved drawings and documents, are to remain unenclosed with no shutters, glazing, louvres or similar permanent structures other than those consistent with the relevant "Brisbane City Plan 2000 - Residential Design-High Density Code", and clearly depicted on the approved drawings. (b) The visitor parking spaces are to remain available for use by all bona-fide visitors, guests or invitees of the site's tenants. (c) Provision on site for a minimum of 228 resident/tenants parking spaces. (d) Provision on site for a minimum of 28 visitor parking spaces not included within any exclusive use area. (e) All external visitor parking bays on the site are to freely available to bona-fide visitors to the State Tennis Centre or Tennyson Riverside Parkland for a maximum period of 6 hours every 24 hours; (f) Visitor parking bays, including exclusive use visitor bays, are not to be fitted with a roller door, gate or similar device preventing access to visitor parking bays. (g) No gates or similar devices are to be placed at the vehicle entry of the development preventing vehicle access to the site (h) Screening for any externally mounted airconditioning or mechanical plant installations in accordance with the following requirements: i) No unscreened installations on the proposed development are to be visible from the surrounding sites; and ii) Any installations which are required to be located on roof, wall or garden areas are to be appropriately screened or shaped according to the acoustic requirements of this development package and so as to integrate in a complementary manner with the overall design of the roof, wall or garden area in which the installation is to be located. (i) That the gym is to be (a) located within Common Property; (b) be restricted for use by residents, guests and invitees of the residential unit owners and/or tenants; and (c) is not to be used for commercial uses other than management/letting activities associated with the Common Property. (j) Stormwater runoff from each individual terrace/balcony, is to be collected internally from the centre of that balcony and be discharged to the internal stormwater drainage system for the site. (k) All sealed traffic areas must be cleaned as necessary to prevent emissions of particulate matter. (l) Maintain a directional visitor parking sign at the vehicle entrances to the site adjacent to or clearly visible from the vehicle entrance to the site. (m) The use of the pool, and pool surrounds are to be used only between the hours of 6am to 10pm seven days a week. (n) Maintain the acoustic damping of any metal grills, metal plates or similar subject to vehicular traffic to prevent environmental nuisance. (o) Noise levels for the pool filter and pump are to comply with the Environmental Protection Agency noise levels as stated in Section 6Y(1) of the Environmental Protection Regulation 1998 as amended from time to time. (p) The installation and maintenance of the sustainable elements outlined within the conditions of this approval package. *GUIDELINE* *This condition is imposed to ensure the ongoing operation, appearance and maintenance of the development under a Community Management Statement is in accordance with the development permit and the approved plans and documents. For any enquiries about this condition, please contact the Assessment Manager. This condition also acknowledges an agreement between the developer and owner of the site at the time the application was made to permit parkland and State Tennis Centre uses to use the external visitor parking bays.*	As indicated

94) All aspects of development as outlined within this section, to which the conditions relate in the "Development Approval Package", are to be completed before midnight on 30 November 2010. *GUIDELINE* *This condition is imposed pursuant to 3.5.21A(2)(a) of the Integrated Planning Act 1997. The intent of this condition is to specify the particular time assessable development or an aspect of assessable development is to be completed before the development lapses. Any extension of the period stated in the condition is required to be made in accordance with Sections 3.5.22 and 3.5.33 of the Integrated Planning Act.*	As Indicated
95) Provide a written statement from a person who is qualified in using a recognised energy rating system, such as BERS (Brisbane Energy Rating System), Nathers or other recognised system, that the building(s) comply with the *"Brisbane City Plan 2000 - Energy Efficiency Code".* *GUIDELINE* *This condition is imposed on all building work for offices, hotels and shops with a GFA over 2500m2 and for all new residential buildings except a house.*	Prior to lodging a development permit for building works
96) Submit to the Delegate, Development Assessment documentary evidence that: (a) The level of light reflectivity from the approved development will not exceed 20 percent; and (b) The level of solar (heat) reflectivity from the approved development will not exceed 20 percent. *GUIDELINE* *This condition is imposed to protect the amenity and appearance of the surrounding area from adverse impacts such as heat transmission and light reflectivity arising from the use of excessively reflective glass in building facades.*	Prior to the commencement of the use & then to be maintained
97) The overall height of the proposed buildings are to be in accordance with the following requirements: (a) Construct the floor levels generally in accordance with the floor levels on the approved elevations and sections 00-DA0003 rev D, 41-DA1600 rev C, 41-DA1601 rev C, 31-DA1600 rev D, 31-DA1601 rev D, with the maximum building height (including lift overruns, roof plant, and 'pop-up' structures) not to exceed the following: **Minimum Habitable Floor Level**: 8.40 AHD **Car Park Podium:** 15.00 AHD **Building E**: 45.52 AHD **Building F**: 42.50 AHD and 31.50 AHD for the stepped section to level 7 (b) Submit certification from a licensed surveyor that the as-constructed floor levels and maximum building heights are in accordance with part (a) of this condition. This information is to be submitted to the Delegate, Development Assessment Team. *GUIDELINE* *This condition is imposed to ensure the floor levels and maximum overall height of the proposed building is in accordance with the development approval. The relaxation of the maximum height limit is to permit a minor encroachment of the roof line. This encroachment shall not exceed 200mm and is only permitted for the area shown on the approved plan and is not to extend further than this area. For any enquiries about this condition, please contact the Development Assessment Team Architect.*	Prior to the commencement of the use

98) Construct pedestrian circulation walkways from the street frontage to the foyer/lift doors of the development in accordance with AS 1428 Parts 1 - 4 *Australian Standard for Access and Mobility* with particular regard to: i. Ramping requirements (including gradients and slip resistance); ii. Handrail requirements; iii. Visual impairment requirements for changes in gradient; and iv. Tactile tiling in a visually contrasting colour to both sides of the driveway crossover. *GUIDELINE* *This condition is imposed to ensure external access areas are appropriately designed and constructed for the all users. For any enquiries about this condition, please contact the Development Assessment Team Architect.*	Prior to the commencement of the use & then to be maintained
99) Provide solar protective / solar protected glass where screening devices are not provided to windows having a western aspect. *GUIDELINE* *This condition is imposed to ensure an appropriate level of climatic control to provide a comfortable internal living environment. For any enquiries about this condition, please contact Architect Assessment.*	Prior to the commencement of the use & then to be maintained
Stormwater runoff from each individual terrace/balcony, is to be collected internally from the centre of that balcony and be discharged to the internal stormwater drainage system for the site. *GUIDELINE* *This condition is imposed to minimise the potential for run off from the balconies onto the park users and to avoid the water stain marks associated with drainage from balconies directly onto the side wall of buildings.*	Prior to the commencement of the use & then to be maintained
101) Any artwork proposed to be provided in the Tennyson Riverside Parkland is to be designed in accordance with the Public Riverside Facilities Design and Maintenance Guidelines and satisfy the following criteria; (a) Be suitable for the setting in terms of design, choice of materials, durability and resistance to vandalism; and, (b) Be satisfactory to the owner/developer of the subject site and the Delegate, Development Assessment. Details of the location and nature of the proposed artworks are to be included in the detailed Landscape Plan and approval of the Delegate is to be obtained prior to installation of such works. *GUIDELINE* *This condition recognises the importance of the proposed development and is intended to ensure that artwork will enhance the development and the Tennyson Riverside Parkland.*	As indicated

MONETARY CONTRIBUTIONS & SECURITIES

	TIMING
102) Pay to Council any outstanding charges or expenses levied by the Council over the subject land. *GUIDELINE* *This condition is imposed to ensure that there are no outstanding charges existing over the subject site, including outstanding rates. If there are out standing monies, they must be paid prior to commencement of the use.*	Prior to the commencement of the use

103) Pay to Council a monetary contribution towards the cost of sewerage headworks, as outlined below, **at the rate prevailing when the contribution is paid**. *This payment must be made prior to the issue of a plumbing compliance permit for the site.* The contribution is calculated on 108.6 ETs (Equivalent Tenement) at the current rate of $4,494.00 per ET, for Sewerage Scheme Charge Area - S2 - MLBN01. A credit for the existing use on the site has been included in this calculation. The amount payable is currently assessed at $488,048.00 and comprises of the following : • Treatment Headworks component: $164,420.00 • System Headworks component: $323,628.00 • Total contribution: $488,048.00 This headwork charge is the **current rate for the 2006/2007 financial year.** *GUIDELINE* *This condition is imposed to require the payment of a proportional contribution towards a satisfactory sewerage treatment system within the locality of the site. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to the permanent water/sewer connection being made to the site or prior to endorsement of a community management statement, whichever is sooner
104) Pay to Council a monetary contribution towards the cost of water headworks, as outlined below, **at the rate prevailing when the contribution is paid.** *This payment must be made prior to the issue of a plumbing compliance permit for the site.* The contribution is calculated on 97.74 ETs (Equivalent Tenement) at the current rate of $4,729.00 per ET, for Water System Infrastructure Charges Plan Area - Mt Crosby South W9. A credit for the existing use on the site has been included in this calculation. The amount payable is currently assessed at $462,212.46 and comprises of the following : • Treatment Headworks component: $91,875.60 • Distribution Headworks component: $370,336.86 • Total contribution: $462,212.46 This headwork charge is the **current rate for the 2005/2006 financial** *GUIDELINE* *This condition is imposed to require the payment of a proportional contribution towards a satisfactory water supply treatment system to the site. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to the permanent water/sewer connection being made to the site or prior to endorsement of a community management statement, whichever is sooner

ARCHITECTURE

	TIMING
105) Treatment of balconies and terraces. (a) All balconies and terraces shown on the approved drawings and documents, are to remain unenclosed with no shutters, glazing, louvres or similar permanent fixtures other than those consistent with the relevant "Brisbane City Plan 2000 - Residential Design - High Density Code" and clearly depicted on the approved drawings. *GUIDELINE* *This condition is imposed to minimise bulk and protect the appearance of the development within the area. For any enquiries about this condition, please contact the Assessment Manager, Development Assessment.*	Prior to the commencement of the use & then to be maintained

106) Provide screening for any externally mounted airconditioning or mechanical plant installations in accordance with the following requirements: i. No unscreened installations on the proposed development are to be visible from the surrounding sites; and ii. Any installations which are required to be located on roof, wall or garden areas are to be appropriately screened or shaped according to the acoustic requirements of this development package and so as to integrate in a complementary manner with the overall design of the roof, wall or garden area in which the installation is to be located. *GUIDELINE* *This condition is imposed to ensure appropriate visual outcomes in relation to mechanical plant areas. For any enquiries about this condition, please contact the Development Assessment Team Architect.*	Prior to the commencement of the use & then to be maintained

	TIMING
107) Protect and enhance existing vegetation, fauna and habitat features on the subject site. (a) Submit a Vegetation Management Plan (VMP) and obtain approval from the Delegate, Development Assessment. The VMP is to be in the form of scaled plans and supporting documentation generally in accordance with Vegetation Retention Plans BO4254-SK70 & SK71 and associated schedules that includes at least the following information: • The extent of the VMP is to include evaluation of all areas including, proposed road reserves, external works and development areas; • The location and description of existing vegetation including species and botanical name plus the height and canopy spread; • The location and extent of all site works including all proposed infrastructure and areas of earthworks. • Detail design of all civil works is to be cognisant of environmental values. Alternative solutions may be required in some instances, to protect significant vegetation (eg alternative service alignments, variations to batter slopes and tunnel boring); • The location and description of all vegetation to be retained and that to be removed; • A description of all measures to be used to protect vegetation and habitat features to be retained during construction; • A description of all pruning and tree surgery works (to AS 4373/96) to maintain health and stability of trees and reduce potential hazards for future residents; • The location and extent of storage and stockpile areas for cleared vegetation and site mulch; • A description of all methods to salvage and/or re-use cleared vegetation. Generally cleared vegetation is to be mulched for reuse in landscape/rehabilitation works; and • Details of all measures to protect and recover fauna during clearing operations, including; presence of a qualified wildlife officer during clearing operations, preclearing inspections, staging and sequence of clearing and recovery procedures.	To be lodged prior to or concurrently with any other operational works application
(b) Arrange a pre-start meeting with the Delegate, Licensing and Compliance;	Prior to site works commencing
(c) Protect, enhance and manage vegetation by implementing the requirements and carrying out the works in accordance with the approved VMP.	To be maintained
GUIDELINE *This condition is imposed where the site contains vegetation, fauna and habitat features that should be retained, protected and/or managed as part of the development of the site. Before carrying out any site works it will be necessary to obtain a detailed design approval from the Council by submitting an application accompanied by a Vegetation Management Plan. Once the works are implemented, it will be necessary to arrange for the Delegate, Licensing and Compliance, Development and Regulatory Services, to inspect and approve them. For enquiries about this condition, please contact the Ecologist, Development Assessment.*	

	TIMING
108) Submit together with the Vegetation Management Plan, a detailed arborist's report for the works proposed in the land to be dedicated to Council in trust for Public Purposes (Parkland and Community Facilities) This report is to be generally in accordance with the Vegetation Management Plan as submitted to the Ecologist Development Assessment South and be prepared by a qualified arborist (minimum Level 5) for the existing trees located within the land to be dedicated to Council in trust for Public Purposes. The arborist report must include but not be limited to the following information:	As indicated
(a) i. Details of the subject trees to be removed and retained including: height, spread, diameter at breast height (DBH), species and canopy spread and valid reasons for removal. Health concerns for the vegetation are to be clearly indicated in the report for any trees to be removed; ii. Where works are proposed within the canopy zone of trees for retention then recommendations on clearances, suitable material/s and construction technique/s for paving surrounding these trees are to be provided; iii. Where trees are proposed for retention provide the tree protection zone details and extent; iv. Proposed measures to be undertaken to retain vegetation without effecting the health; v. Description of any best practice root and canopy works; vi. Clear indication of the extent of any canopy pruning required for vehicle access clearance, dead wooding and any canopy lifting required to provide a visual balance; vii. Detailed site management and tree protection techniques to be undertaken during construction; viii. Post construction management techniques; and ix. Monitoring as deemed necessary.	To be lodged prior to or concurrently with any other operational works application
(b) Obtain approval from the Delegate, Development Assessment for the above requirements.. *GUIDELINE* *This condition is intended to identify and ensure the retention of existing vegetation within the proposed parkland can be managed to ensure its longevity. In preparing this report consideration should also be given to the matters contained within the Vegetation Management Plan.*	

109) Undertake and maintain the following Landscape Management and Site Works within the proposed Parkland as indicated below:	As indicated
(a) Submit a Landscape Management and Site Works Plan for the works proposed in the Council parkland and obtain approval from the Delegate, Development Assessment. This plan is to be generally in accordance with the Landscape Master Plan dated July 2006 as amended in red, and is to include the following: I. A description of existing site conditions and proposed site preparation, including: • Existing contours and proposed finished levels including sections across and through the parkland at critical points; • Location of all underground services existing within the proposed parkland (eg. the depth and route of any drainage, water reticulation, sewerage, electricity, gas, telecommunications etc.); • Location of existing vegetation in the parkland including species names, height and spread of canopy and clearly indicating vegetation to be retained and provide the reasons for removing or disturbing other vegetation. Where pathway locations conflict with significant vegetation then they area to be relocated. Specify methods of recycling vegetation where possible; • Location and description of any vegetation and landscape features on adjoining properties with the potential to impact upon the proposed parkland. Also include the location and description of all existing and proposed fencing and retaining walls within and abutting the parkland; • Demolition work of any kind to be carried out within the parkland; • Any feature of cultural or heritage significance within the parkland; • Location, extent and comprehensive details, including cross-sections of permanent and temporary water bodies/courses, drainage and stormwater works, and • Proposed stormwater structures that will mitigate the impacts of stormwater flows within the parkland. II. Identification of a general scope of work, including the following: • Removal of weed species, barbed wire, building materials, rubbish, debris and other obstacles which may present a public liability risk; • Provision of erosion control measures where required; • Provision of a 25mm reticulated water service to the park; • Provision of a power connection to the park; • Indication of protection measures from damage for existing vegetation to be retained; • Construction (prior to the commencement of works) of a star picket fence around the proposed parkland to protect from vehicular damage and storage of materials. The fence is to be inspected by the Delegate, Licensing and Compliance, and remain on-site until Practical Completion (On-maintenance); • Construction of vehicular barriers/bollards along park frontages to prevent unauthorised vehicular access to the park; • Provision of a lock-rail access point for maintenance vehicles to each road frontage; • Specifications, contours and levels for any proposed bikeways, footpaths, roadways and parking in the proposed parkland; • Proposed building and development works including location of all services, park furniture, picnic facilities and play equipment etc.; • Surface treatments and extent of proposed planting; • Topdressing and planting with perennial grasses of all open areas, grassing is to achieve 80% coverage at the time of Practical Completion (On-maintenance); • A Plant Schedule itemising all proposed plants by botanical name and specifying total plant numbers and size at the time of planting. III. Site specific works: • **Demonstrate compliance with Brisbane City Council's "Public Riverside Facilities Design and Maintenance Manual", dated July 2003;** • All furniture to be supplied in accordance with Council's preferred supply list and to the satisfaction of the Landscape Architect Development Assessment South; • Provide details of proposed pavement treatments to landscape areas for stormwater infiltration; • Provide details of proposed pedestrian handrails and barriers to river edge interfaces; • Provide details of any proposed fencing interfaces with adjoining land. Where fences abut adjoining council land they are to be a minimum of 50%	To be lodged prior to or concurrently with any other operational works application

transparent pool style fencing;
- Provide heights, extent and locations of proposed retaining walls. Propose retaining walls within the public realm are to be less then 1m high;
- Provide details of proposed bicycle / pedestrian pathway in accordance with part (b) of this condition;
- All pathway and accessways are to be designed in accordance with regard to the relevant Australian Standards. Pathways are to be a maximum of 1:20 grade and designed in accordance with AS1428.1. Riverfront pathways are to be adjusted in width, radii and grades as required to comply with Austroads specifications with regard to bikeways;
- Reduce the extent of planting within the public realm to ensure maximum widths of 3.5m. Species are to be selected for hardiness and low maintenance. A mixture of low shrubs, groundcovers and clear trunk trees are to be provided to ensure sightlines are maintained and issues of CEPTED adequately addressed. Shrub planting is to be provided at key locations to ensure screening of blank or undesirable walls or elements or mechanical plant;
- Planting is to comprise a minimum of 70% native species to the Greater Brisbane Area. Species are to be suitable for the riparian / marine environment and be selected in accordance with **Brisbane City Council's "Public Riverside Facilities Design and Maintenance Manual", dated July 2003**;
- Detailed construction documentation is to be provided for the proposed bioretention gardens. Gardens are to be clearly demonstrated to be low maintenance and maintenance accessible;
- Provide construction level detail of all proposed works within the public parkland.
- Provide ex-ground stock large riparian canopy trees eg. AGATHIS robusta, ARAUCARIA cunninghamii, ELAEOCARPUS grandis, in grouped or single plantings. These are to be spaced according to the species' mature size requirements to the open space areas and be located so as to provide visual attenuation to the built form;
- Provide specification and details for all paving areas in accordance with the general requirements of Council's Centre Detail Design manual. Finishes are to be specified to the satisfaction of landscape Architect Development Assessment South.

IV. Details of a costing and maintenance program, including the following:

- Costing of all works indicated on the Landscape Management and Site Works Plan; and
- Details of a 12-month maintenance plan for all proposed landscaping, including staging of works and time schedules, methods of establishment and projected ongoing maintenance costs.

(b) Shared pedestrian/bicycle path within the Tennyson Riverside Park is as follows:

i. is designed generally in accordance with EDAW Riverside Park Promenade Drawing L-2038-A1L-205 dated 29/09/06 as amended in red to show path widths;
ii. is designed according to the specification of the Public Riverside Facilities Design and Maintenance Manual;
iii. no part of the riverside pathway, including handrails and fencing, extends over the property alignment of the site to the Brisbane River;
iv. where the total width of the parkland (measured from the building edge to site boundary) is less than 10 metres, the pathway is located as close as practicable to the alignment of the site to the Brisbane River; and
v. where the access width is less than 10 metres, surface finishes are to be limited to one or more of the following:
   - concrete;
   - hardwood timber decking;
   - vegetated garden areas; or
   - other surface treatment as approved by the Landscape Architect, Development Assessment Team South.

(c) Provide a monetary contribution bond for the on going maintenance cost of the proposed the above works within the parkland.
The bond is to be held in trust until such time as:

Prior to the commencement of the use or prior to endorsement of a community management statement, whichever is sooner

i. the total area of 1.87 hectares of land is transferred to the Brisbane City Council in fee simple on trust for Public Purposes; and
ii. the final park transfer is accepted "off maintenance" as a Council asset by the Delegate of Council.

(d) Carry out the landscaping and associated works documented in the approved Landscape Management and Site Works Plan in accordance with standard Best Trade

Prior to the commencement of the use or prior to

Practice and to a standard that will be satisfactory to be accepted "On-maintenance" (Practical Completion) and "Off-maintenance" (Final Completion) as a Council asset, by the Delegate, Licensing and Compliance. (e) Maintain the landscaping and associated works documented in the approved Landscape Management and Site Works Plan in accordance with standard Best Trade Practice and to a standard that will be satisfactory to be accepted "On-maintenance" (Practical Completion) and "Off-maintenance" (Final Completion) as a Council asset, until such time as: i. the total area of 1.87 hectares of land is transferred to the Brisbane City Council in fee simple on trust for Public Purposes; and ii. the final park transfer is accepted "off maintenance" as a Council asset by the Delegate of Council. *GUIDELINE* *This condition is imposed when proposed parkland is to be transferred to the Brisbane City Council in trust. The required works are the minimum works that are required to ensure that the proposed parkland is acceptable for transfer. For further details on parkland design, please refer to Council's "Environmental Best Management Practices" document for parkland (EBMP) and "Public Riverside Facilities Design and Maintenance Manual".*	endorsement of a community management statement, whichever is sooner

110) Prepare and landscape the site in accordance with a Landscape Management, Site Works and Planting Plan.	Prior to site works commencing
(a) Submit and receive approval by the Delegate, Development Assessment for a detailed Landscape Plans for all private on-site landscape works identified on the approved Landscape Master Plan dated July 2006. The plans are to be prepared at a scale of 1:100 or 1:200 by a suitably qualified and experienced Landscape Architect/Designer, and must comply with the "Brisbane City Plan 2000- Landscaping Code". The plan should include the following: i) Siteworks: • Amendments in red on the approved plans of layout to show footpath extension along north western side of visitor parking; • Identification, protection and retention of the existing vegetation as identified in the Vegetation Management Plan, to be submitted concurrently to the Ecologist Development Assessment South; • The extent of soft and hard landscape works; • Extent of basement and roof lines; • Full extent of carpark works including but not limited to; WSUD principles, permeable paving, and stormwater infiltration areas. Full details of any bioretention swales, infiltration gardens etc.; • Locations of bin enclosures with adequate screening and attenuation; • Locations of pad-mounted electricity transformers; • Clear and easily accessible pedestrian pathways. Paths are to be in accordance with AS1428.1; • Location and details (heights, materials) of fencing, retaining walls and ramps; • Existing and proposed finished levels to external works particularly in critical areas (eg. top and toe of retaining walls and steps); • Provide detailed sections of critical interface areas between private and public land; • Description/detail of critical design elements where applicable (eg. stabilisation of batters, podium planters); • A minimum 50m2 is to be provided as communal open space per building. Private open space provisions are to be entirely exclusive of public areas; • Provide a slection of plant stock in 200 litre bags and ex-ground stock large riparian canopy trees eg. AGATHIS robusta, ARAUCARIA cunninghamii, ELAEOCARPUS grandis, in grouped or single plantings. These are to be spaced according to the species' mature size requirements to the open space areas and be located so as to provide visual attenuation to the built form; • Basic specification notes for soil preparation and planting, including mulching and soil types both existing and imported; and • Provision of at least one hosecock to each garden area, and a reticulated irrigation system with connection to a non-mains supply to all common landscape areas. Provide rootwater / recycled water collection locations for irrigation of common landscape areas; ii) Planting: • A planting schedule listing proposed plants by botanical names, numbers and size at time of planting; • Shade trees at ratio of 1 per 6 carparking bays; • Planting is to comprise a minimum of 70% native species to the Greater Brisbane Area. Species are to be suitable for the riparian / marine environment and be selected in accordance with **Brisbane City Council's "Public Riverside Facilities Design and Maintenance Manual", dated July 2003;** • Tiered planting consisting of trees, shrubs and groundcovers to all garden areas; • Screen planting including columnar trees and screen shrubs to common boundaries of the site; and • Provision of canopy trees at regular spacing dependent on the mature size characteristics adjacent to the street frontage(s) of the site.	To be lodged prior to or concurrently with any other operational works application
(b) Carry out the landscaping and associated works documented in the approved Landscape Management and Site Works Plan in accordance with standard Best Trade Practice.	Prior to the commencement of the use & then to be maintained
(c) Advise Council upon completion of the landscape works by completing the development details and Part B of the Compliance Certificate-Landscaping.	Prior to the commencement of the use
GUIDELINE *This condition is imposed when there is a landscape component to a High Level development application, and Council requires more details of the proposed landscape works.*	

POLLUTION

	TIMING
111) The proposed residential units are required to comply with the following. (a) Submit a revised acoustic report for approval by the Pollution Officer Development Assessment Team South which demonstrates that the proposed residential development will achieve the relevant maximum recommended design sound level specified in Australian Standard AS2107, "Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors"using the methods set out in Australian Standard AS3671- "Acoustics - Road Traffic Noise Intrusion Building Siting and Construction". (b) Design and construct all proposed residential units affected by road traffic in accordance with the building treatments recommended in the approved acoustic consultants report to achieve the relevant maximum recommended design sound levels specified in Australian Standard AS2107 "Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors" using the methods set out in Australian Standard AS3671- "Acoustics - Road Traffic Noise Intrusion Building Siting and Construction". (c) Submit certification from an independent and appropriately qualified acoustic consultant which demonstrates that the necessary acoustic treatments referred to in the approved acoustic consultant's report have been implemented into the buildings envelope of the proposed dwellings to achieve the relevant maximum recommended design sound level specified in Australian Standard AS2107, "Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors". *GUIDELINE* *This condition is imposed to ensure that noise impacts on the residential units are adequately managed.*	Prior to site works/building works commencing At the time of construction Prior to the commencement of the use
112) Air conditioning must be provided to all units as determined in the acoustic report prepared by Palmer Acoustics Pty Ltd and dated November 2005.	Prior to the commencement of the use or prior to endorsement of a community management statement, whichever is sooner
113) Any metal grills, metal plates or similar subject to vehicular traffic must be acoustically damped to prevent environmental nuisance. *GUIDELINE* *This condition is imposed to ensure that noise vehicle movements do not cause environmental nuisance.*	Prior to the commencement of the use & then to be maintained

114) Acid sulfate soils must be appropriately managed as detailed below: (a) Implement an Acid Sulfate Soils Management Plan prepared by Soil Surveys dated March 2006 in accordance with the *State Planning Policy 2/02 – Planning and Managing Development Involving Acid Sulfate Soils* and associated guidelines and technical documents. (b) Provide certification to the Pollution Officer, Development Assessment, Development and Regulatory Services that an Acid Sulfate Soils Managment Plan, has been developed and implemented. *GUIDELINE* *This condition is imposed where: Works are proposed on sites that contain acid sulfate soils or potential acid sulfate soils; the applicant has submitted an Acid Sulfate Soil Investigation Report for Council consideration and demonstrated that the Acceptable Solution can be met; and a Preliminary Acid Sulfate Soil Management Plan is required (but not required to be approved by Council). It is generally used where less than 500m3 of soil will be disturbed, the watertable is not affected, and the disturbance impacts in areas that host potential acid sulfate soils can be appropriately managed. For any enquiries about this condition, please contact the Pollution Officer. For acid sulfate soils, a suitably qualified and experienced person is a person with: Qualifications in agricultural or environmental soils science with specialisation in soil chemistry and hydrology; at least 2 years experience in acid sulfate soil management; and accreditation by a professional organisation such as the Australian Society of Soil Science.*	Prior to site works commencing While site/operational works/building works is occurring Prior to the commencement of the use
1[illegible] i) All stormwater runoff from carparks, driveways, hardstand areas, loading areas etc from the site must be treated by stormwater quality best management practices before discharge to the stormwater system in accordance with Stormwater Quality Management Report prepared by GHD and dated November 2005. Strategies may involve discharge to grass swales, landscaping, infiltration trenches, mini-wetlands or in-ground proprietary stormwater quality improvement devices. These practices must adequately remove key pollutants of concern. The stormwater quality best management practices utilised on the site must provide, as a minimum, for the following: • Q 3 month flow; • capture of sediment/suspended solids to meet best practice discharge guidelines (80% of course sediment 5mm diameter or less, and 50% of fine sediment 0.1mm diameter or less); • capture of litter; and • no visible discharges of hydrocarbons eg oils, greases. ii) Submit certification from an appropriately qualified person that stormwater quality best management practices as specified above has been provided on site.	Prior to the commencement of the use
1[illegible] Pool water wastes including filter backwash, drainage and overflow waters shall be treated and disposed in accordance with the Brisbane City Council Subdivision and Development Guidelines - Part C Water Quality Management Guidelines. *GUIDELINE* *This condition is imposed where water quality may be affected as a result of the development.*	To be maintained

117) Construct a car wash bay for the washing of vehicles. The car wash bay shall be provided with a tap, paved with an impervious material, graded and drained to sewer in accordance with a hydraulics plan approved by the Principal Officer Plumbing, Development & Regulatory Services. *GUIDELINE* *This condition recognises the need to provide a facility for a car wash bay within the site*	Prior to the commencement of the use & then to be maintained
118) All sealed traffic areas must be cleaned as necessary to prevent emissions of particulate matter. *GUIDELINE* *The condition is imposed to prevent particulate emissions from traffic areas.*	To be maintained

ENGINEERING

	TIMING
119) Prepare a Construction Management Plan for the subject site. (a) Submit for approval of the Engineering Delegate, Development and Regulatory Services, a Construction Management Plan in accordance with the *Transport, Access. Parking and Servicing Planning Scheme Policy* of the *Brisbane City Plan 2000* and the following details, where applicable, of the construction phase of the approved development. The CMP is to acknowledge the restrictions detailed in the NOTES following the numbered items: 1. Provision of alternative pedestrian routes, past or around the site; 2. Existing and proposed kerbside allocation signs and linemarking such as bus stops, loading zones and parking meters; 3. Temporary vehicular access points; 4. Employee and visitor parking areas; 5. How materials are to be loaded/unloaded; 6. Location of any remote loading areas; 7. Location of materials, structures, plant and equipment to be stored or placed on the construction site; 8. Anticipated staging, programming. 9. EPA approved hours of construction NOTE: Approval for on street work zones will only be considered where it can be demonstrated that no reasonable alternative can be provided due to site constraints and that traffic and public transport capacity and operations are not compromised. (b) Obtain relevant permits from the Engineering Delegate, Development and Regulatory Services, to carry out any works within the road reserve required by the approved Construction Management Plan. The Construction Management Plan may require modification, with Council approval, to reflect relevant legislation, traffic and public transport capacity and operations as well as industry best practice prevailing at the time of the permit application and throughout the construction activities; (c) Implement and maintain the approved Construction Management Plan. *GUIDELINE* *This condition is imposed when the construction activities need to be limited to manage the impact on the surrounding area., This condition is intended to apply throughout the period of site preparation to the completion of the development.*	Prior to lodging a development permit for building works

120) Minimise on-site erosion and the release of sediment or sediment-laden stormwater from the site at all times through compliance with an approved Erosion and Sediment Control (ESC) Program for the site. (a) Submit an Erosion and Sediment Control (ESC) Program which complies with Council's Erosion and Sediment Control Standard (Version 9 or later), and receive approval from the Engineering Delegate, Development Assessment, prior to the commencement of land-disturbing activities; (b) Implement and modify as necessary the approved ESC Program to maintain compliance with the Erosion and Sediment Control Standard (Version 9 or later) at all times during the period from when land-disturbing activities begin to when responsibility for the site no longer lies with the applicant. *GUIDELINE* *This condition is imposed where the land-disturbing development (as defined in the current version of Council's Erosion and Sediment Control Standard) involves site works that could lead to significant erosion and loss of sediment from the site. The ESC Program must be prepared in accordance with Councils Erosion and Sediment Control Standard (Version 9 or later), and may include detailed plans, descriptions of control measures, monitoring programs and maintenance procedures. Please note that the work referred to in this condition involves operational work and therefore requires an operational works application to be submitted. Relevant guidelines to assist in the preparation of ESC Programs include the: "Soil Erosion and Sediment Control - Engineering Guidelines for Queensland Construction Sites" The Institute of Engineers, Australia (Qld), 1996 (or later version); "Sediment Basin Design Guidelines", Brisbane City Council, February 2000 (or later version); and "Best Practice Guidelines for the Control of Stormwater Pollution from Building Sites" and accompanying fact sheets, Brisbane City Council and Gold Coast City Council, 2000 (or later version). NB. The ESC Program may form part of a Site Based Stormwater Management Plan (that addresses short and long-term stormwater management from a quality and quantity perspective) or an Environmental Management Plan (EMP). For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to site works commencing (ie. any land-disturbing development) While site works (eg. operational works, building works) are occurring and until exposed soil areas are permanently stabilised (eg. turfed, concreted)

121) Undertake the works on the site in accordance with an Earthworks Plan approved by the Engineering Delegate, Development Assessment. (a) Submit an earthworks plan (and obtain approval from the Engineering Delegate, Development Assessment), prepared by a Registered Professional Engineer of Queensland (RPEQ), and in accordance with Council's *"Subdivision and Development Guidelines"* demonstrating how the development will comply with this requirement and the following: • The location of any cut and/or fill; • The quantity of fill to be deposited and finished fill levels; • Maintenance of access roads to and from the site such that they remain free of all fill material and are cleaned as necessary; • The existing and proposed finished levels (extending into the adjacent properties); • Preservation of all drainage structures from the effects of structural loading generated by the earthworks; • Protection of adjoining properties and roads from ponding or nuisance from stormwater; • That all vehicles exiting from the site will be cleaned and treated so as to prevent material being tracked or deposited on public roads. (b) All fill material placed on the site is to be free of contaminants (as defined by section 11 of the Environmental Protection Act 1994), noxious, hazardous, deleterious and organic materials. Suitable fill material is deemed to comply with the requirements of clause 4.3, AS 3798, Guidelines on Earthworks for Commerial and Residential Developments. (c) Prepare the following details for presentation to the Council's Engineering Delegate at a pre-start meeting arranged by the consultant supervising the contractor: • The type of fill to be used and the manner in which it is to be compacted; • Details of any proposed access routes to the site which are intended to be used to transport fill to the site; • Engineering details of any haul roads to be built to facilitate the placement of fill on the site; • The contractor is responsible for maintaining the access roads near the site such that they remain free of all fill material and are cleaned as necessary; • Damage to Council assets will need to be repaired at no cost to Council; • Public footpaths fronting the site are to remain safe at all times; and • Compliance with Council's Erosion and Sediment Control Guidelines relating to earthworks on a construction site. (d) Implement and maintain the provisions of a Site Based Stormwater Management Plan which is consistent with Council's *"Subdivision & Development Guidelines"* (2000 or later version) and aims to prevent or minimise the contamination of stormwater and the release of contaminated stormwater from the site during construction and operational works. *GUIDELINE* *This condition is imposed for applications when significant earthworks are proposed in conjunction with a development proposal. Site Based Stormwater Management Plans (that address short and long term stormwater management from a quality and quantity perspective) may be part of Environmental Management Plans (EMPs) and include ESC Programs/Management Plans. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to site works/building works commencing While site/operational works/building works is occurring

122) Grant the following easement(s): (a) Easements for underground drainage, overland flow, open cut, and access purposes as may be required, in favour of Brisbane City Council; (b) Easements for underground drainage, open cut, overland flow and access purposes as may be required over that part of the site below the Flood Regulation Line and/or that part of the site affected by 100 year average recurrence interval (ARI) flooding, in favour of Brisbane City Council; *GUIDELINE* *This condition is imposed to provide access, maintenance of services and to protect drainage paths if required. Easements in favour of the Brisbane City Council are required to have the necessary easement documentation prepared (free of costs and compensation to Council) by the Brisbane City council. Easements not in favour of the Brisbane City Council are required to have the necessary documentation prepared by the applicant's private solicitors. Easements are to be shown on a Survey Plan and lodged with the Delegate Plan Sealing, Licensing Sealing and Certificates Unit. Enquiries regarding any legal documentation can be directed to Licensing, Sealing and Certificates Unit, Development and Regulatory Services (pH 3403 9050). For any other enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to the commencement of the use
123) Remove all improvements and obstructions from the area of the corner truncation(s) and area of dedicated road and reinstate the area as footway in accordance Council's "Subdivision and Development Guidelines". (a) Provide a certificate from a Registered Surveyor, certifying that all improvements and/or obstructions have been removed from the area of corner trunctation(s) and area of dedicated road; (b) Provide a certificate certifying that the works required by this condition have been completed; (c) Forward a copy of the certification from a registered surveyor together with the request for survey plan endorsement, to the Delegate Plan Sealing, Licensing, Sealing and Certificates Unit, Development and Regulatory Services. *GUIDELINE* *This condition is imposed when a corner truncation or road dedication requiries removal of all improvements (eg. fences, gates, letter boxes, garden beds and plots and other constructed items etc.) and obstructions (eg. existing earth banks, vegetation etc.) from the area of new road. It should be noted that significant trees and certain types of vegetation may be left in place. The retention of a particular item is site specific and retained at the discretion of the Engineering Delegate. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to the commencement of the use

124) Any retaining walls greater than 1.0 metre in height are required to be structurally certified for design and construction by a Registered Professional Engineer Queensland (RPEQ). The certification is to include the stormwater drainage (surface and seepage water) associated with the wall ensuring that the water is directed to an acceptable lawful and legal point of discharge and does not cause any ponding, nuisance or disturbance to adjacent property owners. All retaining walls are to comply with the City Plan Filling and Excavation Code. *GUIDELINE* *This condition is intended to ensure that retaining walls associated with the development that are higher than 1 metre, are designed and constructed to industry standards and also, to ensure that no adverse impact is created by the structures on the surrounding properties. The retaining wall designer should note that timber retaining walls facing onto Council property (including the road reserve) will not be permitted. Retaining walls facing onto road reserve or parkland are to be contained entirely within the proposed development site, including the retaining wall's footings. Where retaining walls are proposed to be constructed between adjoining properties, it is also suggested that the use of timber sleeper retaining walls be restricted due to their limited life and the potential problems they may cause to future property owners. Where the combined height of the retaining wall and fence exceeds 2.0 metres, a Development Permit for Building Work will need to be granted. For any enquires about this condition please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to the commencement of the use
125) Provide internal signs and line markings generally in accordance with the approved drawings and documents and in accordance with Austroads and the Manual of Uniform Traffic Control Devices. (a) Prepare detailed engineering plans prepared by a Registered Professional Engineer of Queensland (RPEQ), and in accordance with Council's "Subdivision and Development Guidelines" showing the design of the sign and line marking work; (b) Construct the works in accordance with the engineering plans; and (c) Submit "As Constructed" plans to the Engineering Delegate, Development and Regulatory Services, approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's "Subdivision and Development Guidelines") certifying that the works have been completed in accordance with the approved design and any approved modifications and that the works required by this condition are in accordance with "Austroads" and the "Manual of Uniform Traffic Control Standards". *GUIDELINE* *This condition is intended to ensure that the development is signed and lined in accordance with the relevant standards.*	Prior to the commencement of the use Prior to lodging a development permit for building works

126) Construct and delineate or sign (as required) the following requirements as indicated on the approved plan(s) of layout: (a) Construct a pavement of minimum Type A standard and surface with an impervious material (including associated drainage) to the area on which motor vehicles will be driven and/or parked. [Construction of such pavement is to be certified by a Registered Professional Engineer of Queensland (RPEQ)]; (b) The driveways at grades shown on the approved plans and documents (or if not shown at grades not greater than those set out in *"Brisbane City Plan 2000 - Transport, Access, Parking and Servicing Planning Policy"*); (c) Manoeuvring on site for a LRV and for the loading and unloading of the vehicle(s); (d) Parking on the site for a minimum of 228 cars and 28 visitor car spaces and for the loading and unloading of vehicles within the site; (e) 3 of the above parking spaces are to be provided for people with disabilities; (f) A minimum 2.3 metres height clearance to all undercover vehicle aisles and manoeuvring area that are not part of a designated tenant parking space and a minimum of 2.5 metres above parking spaces for people with disabilities (Note, The minimumn clear height shall be measured to the lowest appurtenance on the ceiling - ie. fire sprinklers, services, lighting fixtures, signs etc.); (g) A height clearance sign located at the entrance(s) to undercover car parking areas; (h) A directional visitor parking sign at the vehicle entrance to the site adjacent to or clearly visible from the vehicle entrance to the site; (i) An appropriate area for the storage and collection of refuse, including recyclables, in a position which is accessible to service vehicles on the site; (j) The internal paved areas are to be signed and delineated in accordance with the approved plans, Manual of Uniform Traffic Control Devices and Austroads. *GUIDELINE* *The "Brisbane City Plan 2000 - Transport, Access, Parking and Servicing Planning Policy" requires adequate on-site provision of parking, servicing and manoeuvring areas. This condition specifies detailed design requirements as indicated on the approved drawings and documents to which the approval relates.*	Prior to the commencement of the use & then to be maintained

127) Obtain written permission from Council to build over or near storm water infrastructure (pipe drainage system or an easement for overland flow), or, to relocate a storm water drainage system, all at no cost to Council. (a) Submit engineering plans and calculations (if required), prepared by a Registered Professional Engineer Qld (RPEQ) and in accordance Council's *"Guidelines for Building Over or Near Stormwater Facilities"* in the *"Subdivision and Development Guidelines"* showning the manner in which it is intended to preserve the existing storm water drainage structures (or overland flow easements) within the site from damage, structural loading or obstruction. Obtain approval for the design from the Engineering Delegate, Development Assessment, Development and Regulatory Services.	Prior to lodging a development permit for building works
(b) Complete the works in accordance with the approved engineering plans.	Prior to the commencement of the use
(c) Submit "As Constructed" plans including an asset register (if required) of any modified or relocated stormwater drainage structure or other Council asset. The plans are to be approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's *"Subdivision and Development Guidelines"*) and certified that the works have been completed in accordance with the approved design and any approved modifications. *GUIDELINE* *This condition has been imposed to ensure that acceptable measures will be incorporated into the development to protect Council's Infrastructure. For any enquiries about this condition, please contact Council's Customer Contact Centre on ph. 3403 8888.*	Prior to the commencement of the use

128) Run-off from roof and developed surface areas of the site, and any run-off onto the site from adjacent areas, are to be collected internally and directed to a lawful point of discharge in accordance with Council's "Subdivision and Development Guidelines". (a) Submit drainage plans and engineering calculations (as a part of the development's Site Based Stormwater Quantity Management Plan) in accordance with Council's *"Subdivision and Development Guidelines"* showing the design of the drainage of the roof and developed surfaces. Obtain approval from the Engineering Delegate, Development Assessment. Such plans are to show adequate survey information on areas adjoining the site with particular attention to any nuisance or annoyance to adjoining property owners. Please note all constructed stormwater outlets that are proposed to discharge directly to a waterway, shall ensure an appropriate waterway setback, reduction in flow outlet velocity and concentration and, include any supplementary planting works that may be required (refer *"Stormwater Outlets in Parks and Waterways"*, BCC July 2000); (b) Complete the works in accordance with the approved engineering plans and other elements of the development's Site Based Stormwater Management Plan; and (c) Submit "As Constructed" plans approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's *"Subdivision and Development Guidelines"*) certifying that the works have been completed in accordance with the approved design and any approved modifications. *GUIDELINE* *The purpose of this condition is to ensure that stormwater run off from the site and adjacent properties will be handled adequately. Disposal by gravity pipeline is required if practical. Use of pumps for disposal of stormwater may be approved only if the applicant can show evidence to Council of having taken all reasonable steps to obtain written permission from adjacent property owners for construction of a gravity pipeline, and of this being unobtainable.The proposal may include water saving and reuse devices such as rain water tanks provided that the proposal satisfies Council that devices will be satisfactorily maintained by the owners of the property. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to site works/building works commencing While site/operational works/building works is occurring Prior to the commencement of the use
129) Provide a stormwater drainage connection for the future development of all adjoining upstream properties in accordance with an approved drainage plan and Council's "Subdivision and Development Guidelines". (a) Submit engineering plans and calculations and obtain approval from the Engineering Delegate, Development Assessment; (b) Complete the works in accordance with the approved engineering plans and in accordance with, Council's *"Subdivision and Development Guidelines"*; and (c) Submit "As Constructed" plans including an asset register (if required), approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's *"Subdivision and Development Guidelines"*) certifying that the works have been completed in accordance with the approved design and any approved modifications. *GUIDELINE* *This condition is intended to ensure that the subject development does not prejudice stormwater drainage of adjacent properties. The stormwater drainage required by this condition needs to be encompased by an easement granted in favour of the Council, as may be required. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to the commencement of the use Prior to undertaking the works

130) Manage on-site drainage, ponding and discharge: (a) Design, construct, and thereafter maintain, rehabilitate or replace the following facilities in accordance with the approved plan(s) of layout. These works are to be designed, constructed and maintained in accordance with the following documents: 1.0 Stormwater Management Code of the City Plan; 2.0 Services Works and Infrastructure Code of the City Plan; 3.0 The Subdivision and Development Guidelines; 4.0 QUDM. (b) A Certificate of Completion (as per Chapter 3, Appendix B of Part E of the Subdivision and Development Guidelines) certified by a Registered Professional Engineer of Queensland (RPEQ) is required as proof of compliance with this condition. A copy of the Certificate of Completion is to be forwarded to the Engineering Delegate. NOTE: The design, design documentation, (including test results) and the Certificate of Completion are to be forwarded to and retained by the current and future owner(s) as proof of initial compliance with this Condition of Development and to assist in the on-going compliance with this Condition of Development and any future auditing. *GUIDELINE* *The purpose of this condition is to ensure that stormwater run off from the site and adjacent properties will be handled adequately. Disposal by gravity pipeline is required if practical. Use of pumps for disposal of stormwater may be approved, however details and plans would need to be approved by the Engineering Delegate. The applicant would need to show evidence to Council of having taken all reasonable steps to obtain written permission from adjacent property owners for construction of a gravity pipeline, and of this being unobtainable. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to the commencement of the use & then to be maintained

131) Run off from the site and run off concentrated on the site from local catchments for storms up to the 50 year (ARI) flood event and for a 100 year (ARI) flood event for creek and river flooding, is to be managed in accordance with approved drainage plans and Council's "Subdivision and Development Guidelines" so as not to have any adverse effect on neighbouring properties. (a) Design and construct all buildings to have the appropriate freeboard in accordance with the Council's *"Subdivision and Development Guidelines"* so as not to be flooded during a 50 year (ARI) local flood event or a 100 year (ARI) creek or river flood event whichever is the higher flood level; (b) Submit engineering plans and calculations, prepared by a Registered Professional Engineer Qld (RPEQ) and in accordance with the Council's "Subdivision and Development Guidelines", demonstrating how the development will comply with this requirement. Such plans are to show adequate survey information on areas adjoining the site with particular attention to ponding of water and overland flowpaths and building pads. Additionally, the submitted information is to determine the extent of any stormwater drainage works and the width of any overland flow easements. Obtain approval for the design from the Engineering Delegate, Development Assessment, Development and Regulatory Services; (c) Complete the works in accordance with the approved engineering plans; and (d) Submit "As Constructed" plans including an asset register (if required), approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's *"Subdivision and Development Guidelines"*) certifying that the works have been completed in accordance with the approved design and any approved modifications. *GUIDELINE* *This condition is intended to ensure that the design of the subject development accounts for the stormwater run off and/or if stormwater drainage patterns in the vicinity of the site require improvements. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to lodging a development permit for building works Prior to the commencement of the use Prior to the commencement of the use
132) Design and construct all proposed buildings in accordance with Council's *"Subdivision and Development Guidelines"* to ensure that minimum habitable floor levels are 500 mm above the 100 year (ARI) flood level (river and creek flooding) or 500 mm above the 50 year (ARI) (overland flow level) whichever is the greater. • Minimum non-habitable floor levels are to be not less than 300 mm above the 50 year (ARI) or 100 year (ARI) flood levels (which ever is the greater). *GUIDELINE* *This condition is imposed when the site is affected by flooding. The 100 year ARI event is applicable to river and/or creek flooding. If the catchment is localised, the 50 year ARI event will be applicable unless the site is also affected by creek or river flooding in which case the higher flood level is to be used. For flood level information, Council Flood Reports are now available from any of Council's Customer Service Centres and Regional Business Centres. The new Flood Report provides the latest flood information for a nominated property plus other useful information about flooding and your development.*	Prior to lodging a development permit for building works

133) Provide underground electricity services in accordance with an approved electricity reticulation plan and the Council's "Subdivision and Development Guidelines (Public Utilities Section)". Note: Even though the development may be in an area serviced by overhead electricity, UNDERGROUND supply to the development is now required - no additional poles or overhead mains are to be erected. (a) Lodge electricity reticulation plans showing and the proposed electricity services and obtain approval from the City Lighting Unit, Local Asset Services Central District; (b) Enter into an agreement with an electricity supplier to provide underground electricity services in accordance with the above approved electricity reticulation plans; and (c) Forward a copy of the agreement to the Engineering Delegate, Development and Regulatory Services. *GUIDELINE* *This condition is imposed when a proposed development would require the provision of electricity services in accordance with Council's "Guidelines for the Provision of Underground Electricity". Please refer to the Council's information sheet on lodging detailed design applications. For any enquiries about this condition, please contact the City Lighting Unit (pH 3403 0307) regarding electricity reticulation plans or Energex (pH: 131 253) regarding electricity supply.*	Prior to the commencement of the use Prior to undertaking the works
134) Provide a public lighting system in accordance with an approved street lighting design plan and Council's "Street Lighting Design Guidelines". (a) Lodge street lighting design plans showing the proposed public lighting system and obtain approval from the City Lighting Unit, Local Asset Services Central District; (b) Enter into an agreement with an electricity supplier to provide a public lighting system in accordance with the above approved lighting design plans; and (c) Forward a copy of the agreement to the Engineering Delegate, Development and Regulatory Services. *GUIDELINE* *This condition is imposed when a proposed development requires the provision of public lighting facilities in accordance with the "Street Lighting Design Guidelines". Please refer to the Council's information sheet on lodging detailed design applications. For any enquiries about this condition, please contact the City Lighting Unit (pH 3403 0307) regarding electricity reticulation plans or Energex (pH: 131 253) regarding electricity supply.*	Prior to the commencement of the use Prior to undertaking the works
135) Supply and install all service conduits and meet the cost of any alterations to public utility mains, existing mains, services or installations required in connection with the approved development. This includes the relocation of any fire hydrants and valves from within the limits of the development's vehicular footway crossings if applicable. (a) Complete the works required by this condition; (b) Submit "As Constructed" plans including an asset register (if required), approved by a registered Professional Engineer Queensland (RPEQ) (in accordance with Council's *"Subdivision and Development Guidelines"* and "Water and Sewerage Reticulation Standards") showing the works required by this condition. *GUIDELINE* *This condition is imposed when additions, alterations or extensions to service conduits, mains and other services are required as a result of the approved development. Applicants should liaise with the appropriate service authorities. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services (regarding advise on traffic signal conduits, stormwater, water supply and sewerage mains etc.) or the relevant public utility authorities (for advice on other services).*	Prior to the commencement of the use

136) Provide underground telecommunication services to the proposed development. (a) Enter into an agreement with a telecommunication company and provide underground telecommunication services within and adjacent to the proposed development; and (b) Forward a copy of the agreement to the Engineering Delegate, Development and Regulatory Services. *GUIDELINE* *This condition is imposed to ensure that the provision of essential communication services are provided to the development. For any enquiries about this condition, please contact relevant service carriers regarding communications or Telstra (pH 132 200).*	Prior to the commencement of the use Prior to undertaking the works
137) Undertake the following works to provide safe pedestrian access: (a) Construct a footpath a minimum width of 1.2 metres at the Softstone Street and Fairfield Road Access points generally in accordance with Drawings B04254-SK65 revision C and Drawing B04254-SK58 and in accordance with Council's *"Subdivision and Development Guidelines"*. The design of the footpath works is to include any permanent safety signs, markings and devices (if required). (b) Construct a 4.0 metre wide Pedestrian link to the Yeerongpilly Railway Station Overpass generally as per drawing B04254-SK59 Revision A. (c) Construct all footpaths to a standard that will be satisfactory to be accepted "on" and "off" maintenance" as a Council asset, by the Engineering Delegate, Development and Regulatory Services; and (d) Submit "As Constructed" plans including an asset register, approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's *"Subdivision and Development Guidelines"*) certifying that the works have been completed in accordance with the approved design and any approved modifications. *GUIDELINE* *This condition requires works to be undertaken in the road reserve. The intention of the condition is to ensure that the adjoining footpaths are designed and constructed to a standard suited to the demands created by the approved development. For advise regarding alignment and levels of the proposed works and any other enquires about this condition, please contact the Engineering Delegate, Development Assessment.*	Prior to the commencement of the use
138) Repair any damage to existing kerb and channel, footpath or roadway (including removal of concrete slurry from footways, roads, kerb and channel and stormwater gullies and drainlines) that may occur during any works carried in association with the approved development. *GUIDELINE* *The intention of this condition is to ensure that any works undertaken as part of the approved development do not damage Council assets or leave Council assets in an unacceptable and unsightly manner. For enquiries regarding this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to the commencement of the use

139) Be responsible for internal (on-site) collection of refuse and recyclables from the development.	Prior to the commencement of the use
(a) Enter into an agreement with Council's City Waste Services to provide a bulk bin collection service to the development;	
(b) The applicant/owner must indemnify Council and its agents in respect of any damage to the pavement and other driving surfaces;	Prior to the commencement of the use & then to be maintained
(c) The applicant/owner shall notify future owners/body corporate that the development has been approved on the basis that an indemnity is provided for refuse collection vehicles to enter the property;	Prior to the commencement of the use & then to be maintained
(d) Forward a copy of the written indemnity agreement with City Waste Services to the Engineering Delegate, Development and Regulatory Services;	
(e) Forward a copy of the written undertaking required to advise future owners/body corporate to the Engineering Delegate, Development and Regulatory Services.	
GUIDELINE *This condition is imposed to ensure that adequate arrangements are made for the collection of refuse and recyclables from the approved development. For any enquiries about this condition, please contact the Co-Ordinator of City Waste Contract Services, pH: 3403 8612 or 3403 8613).*	
140) Provide a water service with approved Council meter assembly and meter box to the front real property boundary of the development in accordance with Council's "Water and Sewerage Reticulation Standards". Where a mixed usage site is approved for development and the proposed development comprises mixed classifications as defined by the Building Code of Australia containing any of Classes 5 to 9 and any of Classes 2 to 4, then the developer must provide a separate metered water service for the Class 2 to 4 occupancy as opposed to the Class 5 to 9 occupancy. This requirement is exclusive of any special fire service consideration i.e. internal hydrants, fire hose reels and sprinkler systems.	Prior to undertaking the works
(a) Submit engineering plans prepared by the RPEQ (Registered Professional Engineer Queensland) , and in accordance with Council's *"Water and Sewerage Reticulation Standards"* showing service and meter works. (The size of the service shall be determined by the water supply requirement of the proposed development). Obtain the approval from the Engineering Delegate, Development Assessment, Development and Regulatory Services;	
(b) Pay to Council the cost of live connection to the water main;	
(c) Such construction is to be to a standard that is satisfactory to be accepted on an off maintenance;	Prior to the commencement of the use or prior to endorsement of a community management statement, whichever is sooner
(d) If the meters are purchased other than from Council, pay to council a documentation fee for each water service provided. If the meters are purchased from Council, forward a copy of the receipt of purchase to the Engineering Delegate, Development and Regulatory Services.	Prior to the commencement of the use or prior to endorsement of a community management statement, whichever is sooner
GUIDELINE *This condition is imposed to supply a water service and a meter(s) to a Development / Community Title Development / Standard / Building or Volumetric format. The meter(s) shall be accessible to BCC employees or agents for the purpose of reading and maintaining the meter(s). The meter(s) will become and remain property of the Brisbane City Council.*	

141) Obtain written permission from the Engineering Delegate, Development and Regulatory Services, to build over or near sewer infrastructure, or to relocate the sewer/sewer infrastructure at no cost to Council. *GUIDELINE* *This condition is imposed so that the council does not incur costs associated with the erection of a building or structure over or near a sewer and/or sewer infrastructure. To avoid unnecessary expense and delay, the Council strongly recommends that the developer apply for permission to "Build Over Sewer" prior to the lodgement of any further development applications. For any enquiries regarding this condition, please contact the Delegate, Development and Regulatory services.*	Prior to lodging a development permit for building works
142) Provide a sewer property connection to serve the development designed and constructed in accordance with approved engineering plans and Council's "Water and Sewerage Reticulation Standards". NB. The size of the connection shall be determined by the total number of fixture units. (a) Submit engineering plans prepared by a Registered Professional Engineer Queensland (RPEQ), and in accordance with Council's *"Water and Sewerage Reticulation Standards"* showing the design the works. Obtain the approval from the Engineering Delegate, Development Assessment, Development and Regulatory Services; (b) Pay to Council the cost of live connection to the sewer main; (c) Construct the works in accordance with the approved engineering plans to a standard that will be satisfactory to be accepted "on" and "off" maintenance as a Council asset, by the Engineering Delegate, Development and Regulatory Services; (d) Submit "As Constructed" plans including an assest register, approved by a Registered Professional Engineer Queensland (RPEQ) (to a standard specified in Council's *"Water and Sewerage Reticulation Standards"*) certifying that the works have been completed in accordance the approved design and any approved modifications. *GUIDELINE* *This condition is imposed to provide a separate new sewerage connection to the development. For enquiries regarding this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to undertaking the works Prior to the commencement of the use Prior to the commencement of the use

Section to Which These Conditions Relate: **4. Material Change Of Use (Development Permit)**

Section Name: **STAGE 2 Residential: Multi Unit Dwelling - Building D, and Shop/Restaurant (100m2)**

GENERAL/PLANNING REQUIREMENTS

	TIMING
143) Carry out the approved development generally in accordance with the approved document (s) and/or drawing(s). *GUIDELINE* *This condition refers to the approved plans, drawings and documents to which the approval relates and is the primary means of defining the extent of the approval. Approved plans, drawings and documents are stamped PLANS and DOCUMENTS referred to in the APPROVAL and are dated to reflect the date of approval of the application by Council's Delegate.*	While development is occurring on site and then to be maintained
144) Complete all building work associated with this development approval, including work required by any of the following conditions. Such building work is to be carried out generally in accordance with the approved plans, drawing(s), and/or documents and, where the building work is assessable development, in accordance with a current development permit. *GUIDELINE* *This condition is imposed to ensure all building work associated with the use are in place before the use commences. It is not appropriate that the site be used without such work being completed. Please note that the work referred to in this condition involves operational work and may therefore constitute 'assessable development'. The Council informs you there fore that this condition does not authorise assessable development to occur and a development permit may therefore be necessary. Please refer to the Council's information sheets. For any enquiries about this condition, please contact the Assessment Manager.*	Prior to the commencement of the use
145) Complete all operational work associated with this development approval, including work required by any of the following conditions. Such operational work is to be carried out generally in accordance with the approved plans, drawing(s), and/or documents or, if requiring a further approval from the Council, in accordance with the relevant approval(s). *GUIDELINE* *This condition is imposed to ensure all operational works associated with the use are completed before the use commences. It is not appropriate that the site be used without such work being completed in accordance with any detailed design approvals. Please note that the work referred to in this condition involves operational work and may therefore constitute 'assessable development'. The Council informs you therefore that this condition does not authorise assessable development to occur and a development permit may therefore be necessary. Please refer to the Council's information sheets. For any enquiries about this condition, please contact the Assessment Manager.*	Prior to the commencement of the use

146) Maintain the approved development (including landscaping, parking, driveways and other external spaces) in accordance with the approved drawing(s) and/or documents, and any relevant Council engineering or other approval required by the conditions. *GUIDELINE* *This condition restricts changes that can be made to the approved development. Approved plans and documents are stamped PLANS and DOCUMENTS referred to in the APPROVAL and are dated to reflect the date of determination of the application by the Council's delegate. The extent to which plans can be modified is constrained by the definition of 'minor change' in schedule 10 and the requirements of section 3.5.24 of the "Integrated Planning Act 1997". It will be necessary to make a new application if the change is not a minor change. For any enquires about this condition, please contact the Assessment Manager.*	To be maintained
147) The Community Management Statement (CMS) for Building D will not be endorsed by Council until: a. The east west access road linking Softstone Street with Fairfield Road is dedicated as road; and b. The CMS for Buildings E and F has been endorsed; or c. The CMS for Buildings E and F and the CMS for Building D are submitted concurrently for endorsement; or d. A combined CMS for Buildings D, E and F is submitted for endorsement. *GUIDELINE* *This condition is imposed to ensure an orderly development sequence for the residential buildings and the Tennyson Riverside Parkland.*	As indicated
148) A legible copy of the approved drawings and documents bearing "Council Approval" and the Development Approval Conditions package is to be available on site at all times during construction and earthworks. *GUIDELINE* *This condition is imposed to ensure compliance with the development conditions of approval. The copy of the conditions and plans should be located in any site management office or with the site foreman. Any copies of conditions or plans that are illegible shall be deemed to be non compliance with this condition of approval.*	As indicated
149) Prior to building work for the proposed building commencing on the site undertake the following works. (a) Remove the existing buildings on the site; and (b) Cap all services to the building and stabilise the exposed ground surface with grass seeding. *GUIDELINE* *This condition is imposed to ensure that all structures are removed or relocated appropriately to ensure that no future legacy remains for the ultimate property owners. It should also be noted that the removal of structures includes the removal of all existing concrete slabs and foundations and footings of any removed structures.*	As indicated

150) Prior to issuing the relevant Development Permit for Building Works, submit to the satisfaction of the Principal Lead Planner, Development Assessment Team South, the following plans and details showing the facade treatments and external materials colours and finishes: (a) A colour scheme showing materials and finishes to building D in accordance with the materials details noted on the approved plan(s) & drawing(s); (b) Notwithstanding the requirements of part (a) of this condition and the notations on the approved plans and drawings, the materials and finishes of the buildings must be high quality pre-finished materials and included with details required to be submitted by this condition; (c) The schedule is to be submitted as a sample board including materials and actual paint swatches of the proposed external paint colours and accompanied by coloured elevations and a written tabulation of how particular parts of the structure and ancillary finishes are to be finished. (d) Implement the above approved detailed design treatments. *GUIDELINE* *This condition is intended to ensure that the colours and materials used are appropriate for the intended character and image for the surrounding area. The requirement is intended to avoid a built form and street character that is dominated by glass surfaces, that increases local affects from reflectivity, glare and heat.*	As indicated

151) Prior to any works commencing on the site and then to be maintained until completion of the development, erect on the Softstone Street and Tennyson Memorial Avenue frontages of the site, and in a location adjacent to the proposed access to Fairfield Road (between Fairfield Rd access and Ortive Street), an "Information Sign" as outlined below: (a) A brief description of the development proposed; (b) The sign/ is to list the name, postal and/or email address and a contact telephone number for the following parties (where relevant) that are undertaking work on the site: Developer, Project Coordinator: Architect/Building Designer; Builder; Civil Engineer; Civil Contractor/s; and Landscape Architect; (c) The lettering on the sign is to be at least 25 millimetres in height, be of regular weight and in sentence case; (d) The sign is to be a minimum size of 1,200 millimetres by 900 millimetres; (e) The maximum area of the sign is to be 2.0m^2; (f) The sign must be placed on or within 1.5 metres of, the road frontage for the land and mounted at least 300 millimetres above ground level; (g) The sign must be placed on the road frontages as indicated above in this condition; (h) The sign is to contain no commercial or corporate advertising other than the name, logo or slogan of the parties outlined in part (a) of this condition (i) The sign is to be non illuminated; (j) Both the sign and the supporting structure are to be made of weatherproof material and to be properly maintained at all times; and (k) The sign/s are to be located on the subject property and is to comply with the General Requirements for Signage contained within the Local Laws Policy "Control of Outdoor Advertising" specifically with regard to Traffic Safety, Clearances and Structural Systems. (l) Prior to the erection of the sign, lodge a copy of the wording and proposed dimensions of the "Information Sign" with Council. *GUIDELINE* *This condition is imposed to provide information regarding the development and project team. Where signage is carried out in accordance with Permitted Advertisement provisions contained within the Local Law Policy "Control of Outdoor Advertising" the display of the sign is exempt from the payment of fees, the need for a licence or the making of an application.*	As indicated

152) Provide a copy of the Brisbane City Council approval package including the development approval conditions, approved plans & documents and the Decision Notice to the following and as indicated(where applicable): (a) all consultants preparing or lodging applications for "Operational Works"; (b) all consultants preparing or lodging applications to satisfy conditions requiring compliance assessment under Schedule 12 of the *Integrated Planning Regulation 1998*; (c) all consultants preparing or lodging applications for "Carryout Building Works"; and (d) all contractors carrying out site works or building works associated with or resulting from this Development Permit. *GUIDELINE* *This condition is imposed to ensure that all consultants, contractors and Building Certifiers involved with completing the development are aware of the particular requirements of this site.*	As indicated Prior to lodging a development permit for building works Prior to site works commencing
153) Prior to site/building works commencing for each stage, undertake an on-site Pre Start meeting (a) Co-ordinate the attendance of the relevant **development/ building/ arborist/ site consultants and contractors** with the following Brisbane City Council Officers or their nominated representatives: • **Principal Engineer**, Development Assessment Team South, Development Assessment • **Landscape Architect**, Development Assessment Team South, Development Assessment • **Principal Lead Planner**, Development Assessment Team South, Development Assessment (b) This meeting is requested to discuss relevant site/building/operational work requirements for each stage, including but not limited to: • Landscape Management and Site Works Plan (Riverwalk, Parkland and Private Land) • Special Vegetation Management Plan • Streetscape Works Plan • Construction Management Plan • Event Management Plan • Construction parking • Road & Footpath Closure Permits and other additional permits • Public & Workplace Safety • Maintenance of a pedestrian and cyclist thoroughfare through the site • Compliance with Council's Erosion and Sediment Control Guidelines relating to earthworks on a construction site • Tree protection measures • Relocation of existing services *GUIDELINE* *This condition is imposed when the construction activities need to be limited to manage the impact on the surrounding area. Please telephone 3403 8888 to arrange a suitable meeting time.*	As indicated

154) Any land transferred to the Council for Public Purposes (Parkland or Community Facilities) and/or for Road Purposes is not be on the Environmental Management Register and or the Contaminated Land Register, unless agreed to by the future asset owner. *GUIDELINE* *This condition is imposed to ensure the condition of the land is of a standard acceptable to the future asset owner.*	As indicated
155) All fencing, retaining walls, mechanical ventilation constructed to the Tennyison Riverside Parkland boundary of the site shall be generally in accordance with the following: Fencing • All fencing (including footings/foundations and maintenace course) is to be a maximium height from finished ground level of 1.8 metres; and • The 1.8 metre high fence is to be of semi transparent design (75% transparency) fence along the dwelling units and terrace /recreational area facing the park as indicated on the approved plans. The colour of fencing shall blend with the landscape area ie. earthy tonal colours, so as not to detract from the riverscape or be visually intrusive when viewed from the Brisbane River. Retaining Walls • No retaining walls are to be contrusted along the riverside park boundary; and • Where retaining walls are proposed within the landscape setback from the Tennyison Riverside Parkland, the retaining wall shall be screened and coloured such that they blend with the landscape area ie.having earthy tonal colours, so as not to detract from the riverscape or be visually intrusive when viewed from the Brisbane River. Mechanical Ventilation/Exhausts • No mechanical ventilation/exhausts are to be contrusted along the Tennyison Riverside Parkland boundary including any pedestrian walkway and • Where mechanical ventilation/exhausts are proposed within the landscape setback from the riverside park, the structure shall be screened and coloured such that they blend with the landscape area ie.having earthy tonal colours, so as not to detract from the riverscape or be visually intrusive when viewed from the Brisbane River. *GUIDELINE* *This condition is imposed to ensure visual privacy between the development and adjoining properties and to minimise the impacts on the visual amenity when the development is viewed from the public parkland. This condition is also imposed to ensure that the design and height of the fence will enable adequate surveillance between the park and the residential units. The fencing within each stage must be erected and completed prior to the commencement of the use of that stage of the development.*	Prior to the commencement of the use & then to be maintained
156) Provide an enclosure around the pool filter and pump. The enclosure is to be sealed block work with concrete lid, solid door mounted in a steel frame built into the block work with acoustic seals to all four edges of the door. If ventilation is required these must be acoustically treated grilles. *GUIDELINE* *This condition is to ensure that acoustic levels are maintained so as to protect the amenity of adjoining land owners.*	Prior to the commencement of the use & then to be maintained

157) Use of the Pool pump and pool filter are to comply with the following: (a) Noise levels for the pool filter and pump are to comply with the Environmental Protection Agency noise levels as stated in Section 6Y(1) of the Environmental Protection Regulation 1998 as amended from time to time. (b) The use of the pool, and pool surrounds are to be used only between the hours of 6am to 10pm seven days a week. *GUIDELINE* *This condition is imposed to minimise any nuisance effects of the pool to adjoining residents. Hours are as specified in discussions with adjoining land owners.*	Prior to the commencement of the use & then to be maintained At all times
158) Construct and maintain the residential development to include the following: (a) Fixed, external privacy screens or fixed obscure glazing to the upper floor windows as shown on the approved plans 51-DA1030-Rev A & 51-DA1031-Rev A, 51-DA1040-Rev A&51-DA1041-Rev A; (b) Fixed privacy screens up to 1.8 metres above floor level to the balconies as shown on the approved plans; *GUIDELINE* *This condition is imposed to identify important design details of the dwelling or where these necessary design details are not indicated on the approved plans.*	Prior to the commencement of the use & then to be maintained

159) The following sustainable features are to be installed and maintained within the proposed development (as indicated):	Prior to the commencement of the use & then to be maintained

Individual privately-owned units	Toilets	4-Star rated dual flush
	Showers	3-Star rated showerhead
	Basin & Sink Taps	• 4-Star rated tapware or flow regulating device installed in pipe work upstream of all basin and sink taps • No 'insinkerators' are to be installed
	Smart Water Meters	Install water meters to each unit to monitor water usage (this does not replace the Council water meter)
	Dishwasher	4-Star rated dishwasher
Body Corporate-managed areas	Basin & Sink Taps	4-Star rated tapware or flow regulating device installed in pipe work upstream of all basin and sink taps
	Pool	Pool covers are to be provided and maintained to any swimming pools or spas installed
	Pressure limiting devices on domestic water service lines	Pressure reducing valves set to a maximum of 300kPa. Valves installed to serve clusters of units with a minimum of 1 valve per floor level
	Irrigation system	• Subsurface or microjet spray/dripper system and controlled using soil moisture sensors • Programmable irrigation controller with rain sensor • Sub water meters on irrigation supply line
	Outdoor taps	• Trigger nozzles on all outdoor hoses • 3-Star rated flow regulating devices installed in pipework upstream of all outdoor taps
	Rainwater tank	• Rainwater storage tank(s) • Rainwater tank plumbed into irrigation system • Rainwater tank plumbed into any pool top-up • Rainwater tank plumbed into car / bin washing area
	Smart Water Meters	Install water meters to the water supply servicing the Body Corporate areas to monitor water usage (this does not replace the Council water meter)

GUIDELINE
This condition is imposed to ensure that the development is sustainable in terms of careful and efficient use of water utilising current best practice. This condition acknowledges that an installation of the clothes washer may not be provided by the developer.

160) The use of the site for the purpose of the Shopand or Restaurant is to be in accordance with the definition contained within the City Plan 2000), limited to a combined/maximum 100m^2 of Gross Floor Area and is located on the site as shown on the approved plans of layout. *GUIDELINE* *This condition is imposed to identify the location of the shop use on the site and limit its floor area.*	To be maintained

161) Any Community Management Statement for the site is to contain the following requirements: (a) All balconies and terraces shown on the approved drawings and documents, are to remain unenclosed with no shutters, glazing, louvres or similar permanent structures other than those consistent with the relevant "Brisbane City Plan 2000 - Residential Design-High Density Code", and clearly depicted on the approved drawings. (b) The visitor parking spaces are to remain available for use by all bona-fide visitors, guests or invitees of the site's tennants. (c) Provision on site for a minimum of 176 resident/tenants parking spaces. (d) Provision on site for a minimum of 22 visitor parking spaces not included in an exclusive use area. (e) All external visitor parking bays on the site are to freely available to bona-fide visitors to the State Tennis Centre or Tennyson Riverside Parkland for a maximum period of 6 hours every 24 hours; (f) Visitor parking bays, including exclusive use visitor bays, are not to be fitted with a roller door, gate or similar device preventing access to visitor parking bays. (g) No gates or similar devices are to be placed at the vehicle entry of the development preventing vehicle access to the site (h) Screening for any externally mounted airconditioning or mechanical plant installations in accordance with the following requirements: i) No unscreened installations on the proposed development are to be visible from the surrounding sites; and ii) Any installations which are required to be located on roof, wall or garden areas are to be appropriately screened or shaped according to the acoustic requirements of this development package and so as to integrate in a complementary manner with the overall design of the roof, wall or garden area in which the installation is to be located. (i) That the gym is to be (a) located within Common Property; (b) be restricted for use by residents, guests and invitees of the residential unit owners and/or tenants; and (c) is not to be used for commercial uses other than management/letting activities associated with the Common Property. (j) Stormwater runoff from each individual terrace/balcony, is to be collected internally from the centre of that balcony and be discharged to the internal stormwater drainage system for the site. (k) All sealed traffic areas must be cleaned as necessary to prevent emissions of particulate matter. (l) Maintain a directional visitor parking sign at the vehicle entrances to the site adjacent to or clearly visible from the vehicle entrance to the site. (m) The use of the pool, and pool surrounds are to be used only between the hours of 6am to 10pm seven days a week. (n) Maintain the acoustic damping of any metal grills, metal plates or similar subject to vehicular traffic to prevent environmental nuisance. (o) Noise levels for the pool filter and pump are to comply with the Environmental Protection Agency noise levels as stated in Section 6Y(1) of the Environmental Protection Regulation 1998 as amended from time to time. (p) The use of the site for the purpose of the Shop/Restaurant is to be in accordance with: the definition contained within the City Plan 2000); limited to a maximum combined 100m2 of Gross Floor Area; and is located on the site as shown on the approved plans of layout. (q) The installation and maintenance of the sustainable elements outlined within the conditions of this approval package. *GUIDELINE* *This condition is imposed to ensure the ongoing operation, appearance and maintenance of the development under a Community Management Statement is in accordance with the development permit and the approved plans and documents. For any enquiries about this condition, please contact the Assessment Manager.*	As indicated

162) All aspects of development as outlined within this section, to which the conditions relate in the "Development Approval Package", are to be completed before midnight on 30 November 2010. *GUIDELINE* *This condition is imposed pursuant to 3.5.21A(2)(a) of the Integrated Planning Act 1997. The intent of this condition is to specify the particular time assessable development or an aspect of assessable development is to be completed before the development lapses. Any extension of the period stated in the condition is required to be made in accordance with Sections 3.5.22 and 3.5.33 of the Integrated Planning Act.*	As indicated
163) Provide a written statement from a person who is qualified in using a recognised energy rating system, such as BERS (Brisbane Energy Rating System), Nathers or other recognised system, that the building(s) comply with the *"Brisbane City Plan 2000 - Energy Efficiency Code"*. *GUIDELINE* *This condition is imposed on all building work for offices, hotels and shops with a GFA over 2500m2 and for all new residential buildings except a house.*	Prior to lodging a development permit for building works
164) The overall height of the proposed buildings are to be in accordance with the following requirements: (a) Construct the floor levels generally in accordance with the floor levels on the approved elevations and sections 00-DA0003 rev D, 51-DA1600 rev B, 51-DA1601 rev B, with the maxmum building height (including lift overruns, roof plant, and 'pop-up' structures) not to exceed the following: **Minimum Habitable Floor Level**: 8.40 AHD **Car Park Podium:** 15.00 AHD **Building D**: 48.52 AHD and 40.50 AHD for the eastern stepped section and 39.50 AHD for the western stepped section. (b) Submit certification from a licensed surveyor that the as-constructed floor levels and maximum building heights are in accordance with part (a) of this condition. This information is to be submitted to the Delegate, Development Assessment Team. *GUIDELINE* *This condition is imposed to ensure the floor levels and maximum overall height of the proposed building is in accordance with the development approval. The relaxation of the maximum height limit is to permit a minor encroachment of the roof line. This encroachment shall not exceed 200mm and is only permitted for the area shown on the approved plan and is not to extend further than this area. For any enquiries about this condition, please contact the Development Assessment Team Architect.*	Prior to the commencement of the use
Any artwork proposed to be provided in the Tennyson Riverside Parkland is to be designed in accordance with the Public Riverside Facilities Design and Maintenance Guidelines and satisfy the following criteria; (a) Be suitable for the setting in terms of design, choice of materials, durability and resistance to vandalism; and, (b) Be satisfactory to the owner/developer of the subject site and the Team Leader, Development Assessment Team South. Details of the location and nature of the proposed artworks are to be included in the detailed Landscape Plan and approval of the Delegate is to be obtained prior to installation of such works.	Prior to the commencement of the use As indicated

166) Construct pedestrian circulation walkways from the street frontage to the foyer/lift doors of the development in accordance with AS 1428 Parts 1 - 4 *Australian Standard for Access and Mobility* with particular regard to: i. Ramping requirements (including gradients and slip resistance); ii. Handrail requirements; iii. Visual impairment requirements for changes in gradient; and iv. Tactile tiling in a visually contrasting colour to both sides of the driveway crossover. *GUIDELINE* *This condition is imposed to ensure external access areas are appropriately designed and constructed for the all users. For any enquiries about this condition, please contact the Development Assessment Team Architect.*	Prior to the commencement of the use & then to be maintained
167) Provide solar protective / solar protected glass where screening devices are not provided to windows having a western aspect. *GUIDELINE* *This condition is imposed to ensure an appropriate level of climatic control to provide a comfortable internal living environment. For any enquiries about this condition, please contact Architect Assessment.*	Prior to the commencement of the use & then to be maintained
Stormwater runoff from each individual terrace/balcony, is to be collected internally from the centre of that balcony and be discharged to the internal stormwater drainage system for the site. *GUIDELINE* *This condition is imposed to minimise the potential for run off from the balconies onto the park users and to avoid the water stain marks associated with drainage from balconies directly onto the side wall of buildings.*	Prior to the commencement of the use & then to be maintained

MONETARY CONTRIBUTIONS & SECURITIES

	TIMING
169) Pay to Council any outstanding charges or expenses levied by the Council over the subject land. *GUIDELINE* *This condition is imposed to ensure that there are no outstanding charges existing over the subject site, including outstanding rates. If there are out standing monies, they must be paid prior to commencement of the use.*	Prior to the commencement of the use

170) Pay to Council a monetary contribution towards the cost of sewerage headworks, as outlined below, **at the rate prevailing when the contribution is paid**. *This payment must be made prior to the issue of a plumbing compliance permit for the site.* The contribution is calculated on 81.6 ETs (Equivalent Tenement) at the current rate of $4,494.00 per ET, for Sewerage Scheme Charge Area - S2 - MLBN01. A credit for the existing use on the site has been included in this calculation. The amount payable is currently assessed at $366,710.00 and comprises of the following :	Prior to the permanent water/sewer connection being made to the site or prior to endorsement of a community management statement, whichever is sooner

• Treatment Headworks component:	$123,542.00
• System Headworks component:	$243,168.00
• Total contribution:	$366,710.00

This headwork charge is the **current rate for the 2006/2007 financial year.**

GUIDELINE
This condition is imposed to require the payment of a proportional contribution towards a satisfactory sewerage treatment system within the locality of the site. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.

171) Pay to Council a monetary contribution towards the cost of water headworks, as outlined below, **at the rate prevailing when the contribution is paid**. *This payment must be made prior to the issue of a plumbing compliance permit for the site.* The contribution is calculated on 73.44 ETs (Equivalent Tenement) at the current rate of $4,729.00 per ET, for Water System Infrastructure Charges Plan Area - Mt Crosby South W9. A credit for the existing use on the site has been included in this calculation. The amount payable is currently assessed at $347,297.76 and comprises of the following :	Prior to the permanent water/sewer connection being made to the site or prior to endorsement of a community management statement, whichever is sooner

• Treatment Headworks component:	$69,033.60
• Distribution Headworks component:	$278,264.16
• Total contribution:	$347,297.76

This headwork charge is the **current rate for the 2005/2006 financial**

GUIDELINE
This condition is imposed to require the payment of a proportional contribution towards a satisfactory water supply treatment system to the site. For any enquiries about this condition, please contact the Engineering Delegate, Development Assessment.

ARCHITECTURE

	TIMING
Treatment of balconies and terraces. (a) All balconies and terraces shown on the approved drawings and documents, are to remain unenclosed with no shutters, glazing, louvres or similar permanent fixtures other than those consistent with the relevant "Brisbane City Plan 2000 - Residential Design - High Density Code" and clearly depicted on the approved drawings. *GUIDELINE* *This condition is imposed to minimise bulk and protect the appearance of the development within the area. For any enquiries about this condition, please contact the Assessment Manager, Development Assessment.*	Prior to the commencement of the use & then to be maintained

173) Provide screening for any externally mounted airconditioning or mechanical plant installations in accordance with the following requirements: i. No unscreened installations on the proposed development are to be visible from the surrounding sites; and ii. Any installations which are required to be located on roof, wall or garden areas are to be appropriately screened or shaped according to the acoustic requirements of this development package and so as to integrate in a complementary manner with the overall design of the roof, wall or garden area in which the installation is to be located. *GUIDELINE* *This condition is imposed to ensure appropriate visual outcomes in relation to mechanical plant areas. For any enquiries about this condition, please contact the Development Assessment Team Architect.*	Prior to the commencement of the use & then to be maintained

	TIMING
174) Protect and enhance existing vegetation, fauna and habitat features on the subject site.	To be lodged prior to or concurrently with any other operational works application
(a) Submit a Vegetation Management Plan (VMP) and obtain approval from the Delegate, Development Assessment. The VMP is to be in the form of scaled plans and supporting documentation generally in accordance with Vegetation Retention Plans BO4254-SK70 & SK71 and associated schedules that includes at least the following information: • The extent of the VMP is to include evaluation of all areas including, proposed road reserves, external works and development areas; • The location and description of existing vegetation including species and botanical name plus the height and canopy spread; • The location and extent of all site works including all proposed infrastructure and areas of earthworks. • Detail design of all civil works is to be cognisant of environmental values. Alternative solutions may be required in some instances, to protect significant vegetation (eg alternative service alignments, variations to batter slopes and tunnel boring); • The location and description of all vegetation to be retained and that to be removed; • A description of all measures to be used to protect vegetation and habitat features to be retained during construction; • A description of all pruning and tree surgery works (to AS 4373/96) to maintain health and stability of trees and reduce potential hazards for future residents; • The location and extent of storage and stockpile areas for cleared vegetation and site mulch; • A description of all methods to salvage and/or re-use cleared vegetation. Generally cleared vegetation is to be mulched for reuse in landscape/rehabilitation works; and • Details of all measures to protect and recover fauna during clearing operations, including; presence of a qualified wildlife officer during clearing operations, preclearing inspections, staging and sequence of clearing and recovery procedures.	
(b) Arrange a pre-start meeting with the Delegate, Licensing and Compliance;	Prior to site works commencing
(c) Protect, enhance and manage vegetation by implementing the requirements and carrying out the works in accordance with the approved VMP.	Prior to survey plan endorsement
GUIDELINE *This condition is imposed where the site contains vegetation, fauna and habitat features that should be retained, protected and/or managed as part of the development of the site. Before carrying out any site works it will be necessary to obtain a detailed design approval from the Council by submitting an application accompanied by a Vegetation Management Plan. Once the works are implemented, it will be necessary to arrange for the Delegate, Licensing and Compliance, Development and Regulatory Services, to inspect and approve them. For enquiries about this condition, please contact the Ecologist, Development Assessment.*	

	TIMING
175) Transfer to the Brisbane City Council, in fee simple on trust for Public Purposes (parkland and community facilities) land indicated on the approved drawings and documents having an area not less than 0.6892 Hectares. (a) Submit to the Delegate Plan Sealing, Licensing Sealing and Certificates Unit, a Survey Plan showing in detail the land to be dedicated. (b) Lodge the Endorsed Survey Plan with the Registrar of Titles, Department of Natural Resources. *GUIDELINE* *This condition represents the park contribution for the relevant stage and is based on the section 5.1.2 of IPA.*	Prior to the commencement of the use or prior to endorsement of a community management statement, whichever is sooner Prior to the commencement of the use
176) Submit together with the Vegetation Management Plan, a detailed arborist's report for the works proposed in the land to be dedicated to Council in trust for Public Purposes (Parkland and Community Facilities) This report is to be generally in accordance with the Vegetation Management Plan as submitted to the Ecologist Development Assessment South and be prepared by a qualified arborist (minimum Level 5) for the existing trees located within the land to be dedicated to Council in trust for Public Purposes. The arborist report must include but not be limited to the following information: (a) i. Details of the subject trees to be removed and retained including: height, spread, diameter at breast height (DBH), species and canopy spread and valid reasons for removal. Health concerns for the vegetation are to be clearly indicated in the report for any trees to be removed; ii. Where works are proposed within the canopy zone of trees for retention then recommendations on clearances, suitable material/s and construction technique/s for paving surrounding these trees are to be provided; iii. Where trees are proposed for retention provide the tree protection zone details and extent; iv. Proposed measures to be undertaken to retain vegetation without effecting the health; v. Description of any best practice root and canopy works; vi. Clear indication of the extent of any canopy pruning required for vehicle access clearance, dead wooding and any canopy lifting required to provide a visual balance; vii. Detailed site management and tree protection techniques to be undertaken during construction; viii. Post construction management techniques; and ix. Monitoring as deemed necessary. (b) Obtain approval from the Delegate, Development Assessment for the above requirements.. *GUIDELINE* *This condition is intended to identify and ensure the retention of existing vegetation within the proposed parkland can be managed to ensure its longevity. In preparing this report consideration should also be given to the matters contained within the Vegetation Management Plan.*	As indicated To be lodged prior to or concurrently with any other operational works application

177) Undertake and maintain the following Landscape Management and Site Works within the proposed Parkland as indicated below:	As indicated
(a) Submit a Landscape Management and Site Works Plan for the works proposed in the Council parkland and obtain approval from the Delegate, Development Assessment. This plan is to be generally in accordance with the Landscape Master Plan dated July 2006 as amended in red, and is to include the following: I. A description of existing site conditions and proposed site preparation, including: • Existing contours and proposed finished levels including sections across and through the parkland at critical points; • Location of all underground services existing within the proposed parkland (eg. the depth and route of any drainage, water reticulation, sewerage, electricity, gas, telecommunications etc.); • Location of existing vegetation in the parkland including species names, height and spread of canopy and clearly indicating vegetation to be retained and provide the reasons for removing or disturbing other vegetation. Where pathway locations conflict with significant vegetation then they area to be relocated. Specify methods of recycling vegetation where possible; • Location and description of any vegetation and landscape features on adjoining properties with the potential to impact upon the proposed parkland. Also include the location and description of all existing and proposed fencing and retaining walls within and abutting the parkland; • Demolition work of any kind to be carried out within the parkland; • Any feature of cultural or heritage significance within the parkland; • Location, extent and comprehensive details, including cross-sections of permanent and temporary water bodies/courses, drainage and stormwater works, and • Proposed stormwater structures that will mitigate the impacts of stormwater flows within the parkland. II. Identification of a general scope of work, including the following: • Removal of weed species, barbed wire, building materials, rubbish, debris and other obstacles which may present a public liability risk; • Provision of erosion control measures where required; • Provision of a 25mm reticulated water service to the park; • Provision of a power connection to the park; • Indication of protection measures from damage for existing vegetation to be retained; • Construction (prior to the commencement of works) of a star picket fence around the proposed parkland to protect from vehicular damage and storage of materials. The fence is to be inspected by the Delegate, Licensing and Compliance, and remain on-site until Practical Completion (On-maintenance); • Construction of vehicular barriers/bollards along park frontages to prevent unauthorised vehicular access to the park; • Provision of a lock-rail access point for maintenance vehicles to each road frontage; • Specifications, contours and levels for any proposed bikeways, footpaths, roadways and parking in the proposed parkland; • Proposed building and development works including location of all services, park furniture, picnic facilities and play equipment etc.; • Surface treatments and extent of proposed planting; • Topdressing and planting with perennial grasses of all open areas, grassing is to achieve 80% coverage at the time of Practical Completion (On-maintenance); • A Plant Schedule itemising all proposed plants by botanical name and specifying total plant numbers and size at the time of planting. III. Site specific works: • **Demonstrate compliance with Brisbane City Council's "Public Riverside Facilities Design and Maintenance Manual", dated July 2003;** • All furniture to be supplied in accordance with Council's preferred supply list and to the satisfaction of the Landscape Architect Development Assessment South; • Provide details of proposed pavement treatments to landscape areas for stormwater infiltration; • Provide details of proposed pedestrian handrails and barriers to river edge interfaces; • Provide details of any proposed fencing interfaces with adjoining land. Where fences abut adjoining council land they are to be a minimum of 50%	To be lodged prior to or concurrently with any other operational works application

transparent pool style fencing;
- Provide heights, extent and locations of proposed retaining walls. Propose retaining walls within the public realm are to be less then 1m high;
- All pathway and accessways are to be designed in accordance with regard to the relevant Australian Standards. Pathways are to be a maximum of 1:20 grade and designed in accordance with AS1428.1. Riverfront pathways are to be adjusted in width, radii and grades as required to comply with Austroads specifications with regard to bikeways;

- Provide details of proposed bicycle / pedestrian pathway in accordance with part (b) of this condition;
- Reduce the extent of planting within the public realm to ensure maximum widths of 3.5m. Species are to be selected for hardiness and low maintenance. A mixture of low shrubs, groundcovers and clear trunk trees are to be provided to ensure sightlines are maintained and issues of CEPTED adequately addressed. Shrub planting is to be provided at key locations to ensure screening of blank or undesirable walls or elements or mechanical plant;
- Planting is to comprise a minimum of 70% native species to the Greater Brisbane Area. Species are to be suitable for the riparian / marine environment and be selected in accordance with **Brisbane City Council's "Public Riverside Facilities Design and Maintenance Manual", dated July 2003**;
- Detailed construction documentation is to be provided for the proposed bioretention gardens. Gardens are to be clearly demonstrated to be low maintenance and maintenance accessible;
- Provide construction level detail of all proposed works within the public parkland.
- Provide ex-ground stock large riparian canopy trees eg. AGATHIS robusta, ARAUCARIA cunninghamii, ELAEOCARPUS grandis, in grouped or single plantings. These are to be spaced according to the species' mature size requirements to the open space areas and be located so as to provide visual attenuation to the built form;
- Provide specification and details for all paving areas in accordance with the general requirements of Council's Centre Detail Design manual. Finishes are to be specified to the satisfaction of landscape Architect Development Assessment South.

IV. Details of a costing and maintenance program, including the following:

- Costing of all works indicated on the Landscape Management and Site Works Plan; and
- Details of a 12-month maintenance plan for all proposed landscaping, including staging of works and time schedules, methods of establishment and projected ongoing maintenance costs.

(b) Shared pedestrian/bicycle path within the Tennyson Riverside Park is as follows:

i. is designed generally in accordance with EDAW Riverside Park Promenade Drawing L-2038-A1L-205 dated 29/09/06 as amended in red to show path widths;
ii. is designed according to the specification of the Public Riverside Facilities Design and Maintenance Manual;
iii. no part of the riverside pathway, including handrails and fencing, extends over the property alignment of the site to the Brisbane River;
iv. where the total width of the parkland (measured from the building edge to site boundary) is less than 10 metres, the pathway is located as close as practicable to the alignment of the site to the Brisbane River; and
v. where the access width is less than 10 metres, surface finishes are to be limited to one or more of the following:
    - concrete;
    - hardwood timber decking;
    - vegetated garden areas; or
    - other surface treatment as approved by the Landscape Architect, Development Assessment Team South.

(c) Provide a monetary contribution bond for the on going maintenance cost of the proposed the above works within the parkland.
The bond is to be held in trust until such time as:

Prior to the commencement of the use or prior to endorsement of a community management statement, whichever is sooner

i. the total area of 1.87 hectares of land is transferred to the Brisbane City Council in fee simple on trust for Public Purposes; and
ii. the final park transfer is accepted "off maintenance" as a Council asset by the Delegate of Council.

(d) Carry out the landscaping and associated works documented in the approved

Prior to the commencement of

Landscape Management and Site Works Plan in accordance with standard Best Trade Practice and to a standard that will be satisfactory to be accepted "On-maintenance" (Practical Completion) and "Off-maintenance" (Final Completion) as a Council asset, by the Delegate, Licensing and Compliance. (e) Maintain the landscaping and associated works documented in the approved Landscape Management and Site Works Plan in accordance with standard Best Trade Practice and to a standard that will be satisfactory to be accepted "On-maintenance" (Practical Completion) and "Off-maintenance" (Final Completion) as a Council asset, until such time as: i. the total area of 1.87 hectares of land is transferred to the Brisbane City Council in fee simple on trust for Public Purposes; and ii. the final park transfer is accepted "off maintenance" as a Council asset by the Delegate of Council. *GUIDELINE* *This condition is imposed when proposed parkland is to be transferred to the Brisbane City Council in trust. The required works are the minimum works that are required to ensure that the proposed parkland is acceptable for transfer. For further details on parkland design, please refer to Council's "Environmental Best Management Practices" document for parkland (EBMP) and "Public Riverside Facilities Design and Maintenance Manual".*	the use or prior to endorsement of a community management statement, whichever is sooner

178) Prepare and landscape the site in accordance with a Landscape Management, Site Works and Planting Plan.	Prior to site works commencing
(a) Submit and receive approval by the Delegate, Development Assessment for a detailed Landscape Plans for all private on-site landscape works identified on the approved Landscape Management Plan dated July 2006. The plans are to be prepared at a scale of 1:100 or 1:200 by a suitably qualified and experienced Landscape Architect/Designer, and must comply with the "Brisbane City Plan 2000- Landscaping Code". The plan should include the following: i) Siteworks: • Identification, protection and retention of the existing vegetation as identified in the Vegetation Management Plan, to be submitted concurrently to the Ecologist Development Assessment South; • The extent of soft and hard landscape works; • Extent of basement and roof lines; • Full extent of carpark works including but not limited to; WSUD principles, permeable paving, and stormwater infiltration areas. Full details of any bioretention swales, infiltration gardens etc.; • Locations of bin enclosures with adequate screening and attenuation; • Clear and easily accessible pedestrian pathways as amended in red on the approved plans of layout to show a pedestrain pathway along the north western interface with the external visitor car park. Paths are to be in accordance with AS1428.1; • Location and details (heights, materials) of fencing, retaining walls and ramps; • Existing and proposed finished levels to external works particularly in critical areas (eg. top and toe of retaining walls and steps); • Provide detailed sections of critical interface areas between private and public land; • Description/detail of critical design elements where applicable (eg. stabilisation of batters, podium planters); • A minimum 50m2 is to be provided as communal open space per building. Private open space provisions are to be entirely exclusive of public areas; • Providea selection of plant stock in 200 litre bags and ex-ground stock large riparian canopy trees eg. AGATHIS robusta, ARAUCARIA cunninghamii, ELAEOCARPUS grandis, in grouped or single plantings. These are to be spaced according to the species' mature size requirements to the open space areas and be located so as to provide visual attenuation to the built form; • Basic specification notes for soil preparation and planting, including mulching and soil types both existing and imported; and • Provision of at least one hosecock to each garden area, and a reticulated irrigation system with connection to a non-mains supply to all common landscape areas. ii) Planting: • A planting schedule listing proposed plants by botanical names, numbers and size at time of planting; • Shade trees at ratio of 1 per 6 carparking bays; • Planting is to comprise a minimum of 70% native species to the Greater Brisbane Area. Species are to be suitable for the riparian / marine environment and be selected in accordance with **Brisbane City Council's "Public Riverside Facilities Design and Maintenance Manual", dated July 2003;** • Tiered planting consisting of trees, shrubs and groundcovers to all garden areas; • Screen planting including columnar trees and screen shrubs to common boundaries of the site; and • Provision of canopy trees at regular spacing dependent on the mature size characteristics adjacent to the street frontage(s) of the site.	To be lodged prior to or concurrently with any other operational works application
(b) Carry out the landscaping and associated works documented in the approved Landscape Management and Site Works Plan in accordance with standard Best Trade Practice.	Prior to the commencement of the use & then to be maintained
(c) Advise Council upon completion of the landscape works by completing the development details and Part B of the Compliance Certificate-Landscaping.	Prior to the commencement of the use
GUIDELINE *This condition is imposed when there is a landscape component to a High Level development application, and Council requires more details of the proposed landscape works.*	

POLLUTION

	TIMING
179) The proposed residential units are required to comply with the following. (a) Submit a revised acoustic report for approval by the Pollution Officer Development Assessment Team South which demonstrates that the proposed residential development will achieve the relevant maximum recommended design sound level specified in Australian Standard AS2107, "Acoustics - Recomended Design Sound Levels and Reverberation Times for Building Interiors"using the methods set out in Australian Standard AS3671- "Acoustics - Road Traffic Noise Intrusion Building Siting and Construction". (b) Design and construct all proposed residential units affected by road traffic in accordance with the building treatments recommended in the approved acoustic consultants report to achieve the relevant maximum recommended design sound levels specified in Australian Standard AS2107 "Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors" using the methods set out in Australian Standard AS3671- "Acoustics - Road Traffic Noise Intrusion Building Siting and Construction". (c) Submit certification from an independent and appropriately qualified acoustic consultant which demonstrates that the necessary acoustic treatments referred to in the approved acoustic consultant's report have been implemented into the buildings envelope of the proposed dwellings to achieve the relevant maximum recommended design sound level specified in Australian Standard AS2107, "Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors". *GUIDELINE* *This condition is imposed to ensure that noise impacts on the residential units are adequately managed.*	Prior to site works/building works commencing At the time of construction Prior to the commencement of the use
180) Any metal grills, metal plates or similar subject to vehicular traffic must be acoustically damped to prevent environmental nuisance. *GUIDELINE* *This condition is imposed to ensure that noise vehicle movements do not cause environmental nuisance.*	Prior to the commencement of the use & then to be maintained

181) Acid sulfate soils must be appropriately managed as detailed below: (a) Implement an Acid Sulfate Soils Management Plan prepared by Soil Surveys dated March 2006 in accordance with the *State Planning Policy 2/02 – Planning and Managing Development Involving Acid Sulfate Soils* and associated guidelines and technical documents. (b) Provide certification to the Pollution Officer, Development Assessment, Development and Regulatory Services that an Acid Sulfate Soils Management Plan, has been developed and implemented. *GUIDELINE* *This condition is imposed where: Works are proposed on sites that contain acid sulfate soils or potential acid sulfate soils; the applicant has submitted an Acid Sulfate Soil Investigation Report for Council consideration and demonstrated that the Acceptable Solution can be met; and a Preliminary Acid Sulfate Soil Management Plan is required (but not required to be approved by Council). It is generally used where less than 500m3 of soil will be disturbed, the watertable is not affected, and the disturbance impacts in areas that host potential acid sulfate soils can be appropriately managed. For any enquiries about this condition, please contact the Pollution Officer. For acid sulfate soils, a suitably qualified and experienced person is a person with: Qualifications in agricultural or environmental soils science with specialisation in soil chemistry and hydrology; at least 2 years experience in acid sulfate soil management; and accreditation by a professional organisation such as the Australian Society of Soil Science.*	Prior to site works commencing While site/operational works/building works is occurring Prior to the commencement of the use
1. i) All stormwater runoff from carparks, driveways, hardstand areas, loading areas etc from the site must be treated by stormwater quality best management practices before discharge to the stormwater system in accordance with Stormwater Quality Management Report prepared by GHD and dated November 2005. Strategies may involve discharge to grass swales, landscaping, infiltration trenches, mini-wetlands or in-ground proprietary stormwater quality improvement devices. These practices must adequately remove key pollutants of concern. The stormwater quality best management practices utilised on the site must provide, as a minimum, for the following: • Q 3 month flow; • capture of sediment/suspended solids to meet best practice discharge guidelines (80% of course sediment 5mm diameter or less, and 50% of fine sediment 0.1mm diameter or less); • capture of litter; and • no visible discharges of hydrocarbons eg oils, greases. ii) Submit certification from an appropriately qualified person that stormwater quality best management practices as specified above has been provided on site.	Prior to the commencement of the use
183) Pool water wastes including filter backwash, drainage and overflow waters shall be treated and disposed in accordance with the Brisbane City Council Subdivision and Development Guidelines - Part C Water Quality Management Guidelines. *GUIDELINE* *This condition is imposed where water quality may be affected as a result of the development.*	To be maintained

184) Construct a car wash bay for the washing of vehicles. The car wash bay shall be provided with a tap, paved with an impervious material, graded and drained to sewer in accordance with a hydraulics plan approved by the Principle Officer Plumbing, Development & Regulatory Services. *GUIDELINE* *This condition recognises the need to provide a facility for a car wash bay within the site*	Prior to the commencement of the use & then to be maintained
185) All sealed traffic areas must be cleaned as necessary to prevent emissions of particulate matter. *GUIDELINE* *The condition is imposed to prevent particulate emissions from traffic areas.*	To be maintained

ENGINEERING

	TIMING
186) Prepare a Construction Management Plan for the subject site. (a) Submit for approval of the Engineering Delegate, Development and Regulatory Services, a Construction Management Plan in accordance with the *Transport, Access. Parking and Servicing Planning Scheme Policy* of the *Brisbane City Plan 2000* and the following details, where applicable, of the construction phase of the approved development. The CMP is to acknowledge the restrictions detailed in the NOTES following the numbered items: 1. Provision of alternative pedestrian routes, past or around the site; 2. Existing and proposed kerbside allocation signs and linemarking such as bus stops, loading zones and parking meters; 3. Temporary vehicular access points; 4. Employee and visitor parking areas; 5. How materials are to be loaded/unloaded; 6. Location of any remote loading areas; 7. Location of materials, structures, plant and equipment to be stored or placed on the construction site; 8. Anticipated staging, programming. 9. EPA approved hours of construction NOTE: Approval for on street work zones will only be considered where it can be demonstrated that no reasonable alternative can be provided due to site constraints and that traffic and public transport capacity and operations are not compromised. (b) Obtain relevant permits from the Engineering Delegate, Development and Regulatory Services, to carry out any works within the road reserve required by the approved Construction Management Plan. The Construction Management Plan may require modification, with Council approval, to reflect relevant legislation, traffic and public transport capacity and operations as well as industry best practice prevailing at the time of the permit application and throughout the construction activities; (c) Implement and maintain the approved Construction Management Plan. *GUIDELINE* *This condition is imposed when the construction activities need to be limited to manage the impact on the surrounding area., This condition is intended to apply throughout the period of site preparation to the completion of the development.*	Prior to lodging a development permit for building works

187) Minimise on-site erosion and the release of sediment or sediment-laden stormwater from the site at all times through compliance with an approved Erosion and Sediment Control (ESC) Program for the site.	Prior to site works commencing (ie. any land-disturbing development)
(a) Submit an Erosion and Sediment Control (ESC) Program which complies with Council's Erosion and Sediment Control Standard (Version 9 or later), and receive approval from the Engineering Delegate, Development Assessment, prior to the commencement of land-disturbing activities;	
(b) Implement and modify as necessary the approved ESC Program to maintain compliance with the Erosion and Sediment Control Standard (Version 9 or later) at all times during the period from when land-disturbing activities begin to when responsibility for the site no longer lies with the applicant.	While site works (eg. operational works, building works) are occurring and until exposed soil areas are permanently stabilised (eg. turfed, concreted)
GUIDELINE *This condition is imposed where the land-disturbing development (as defined in the current version of Council's Erosion and Sediment Control Standard) involves site works that could lead to significant erosion and loss of sediment from the site. The ESC Program must be prepared in accordance with Councils Erosion and Sediment Control Standard (Version 9 or later), and may include detailed plans, descriptions of control measures, monitoring programs and maintenance procedures. Please note that the work referred to in this condition involves operational work and therefore requires an operational works application to be submitted. Relevant guidelines to assist in the preparation of ESC Programs include the: "Soil Erosion and Sediment Control - Engineering Guidelines for Queensland Construction Sites" The Institute of Engineers, Australia (Qld), 1996 (or later version); "Sediment Basin Design Guidelines", Brisbane City Council, February 2000 (or later version); and "Best Practice Guidelines for the Control of Stormwater Pollution from Building Sites" and accompanying fact sheets, Brisbane City Council and Gold Coast City Council, 2000 (or later version). NB. The ESC Program may form part of a Site Based Stormwater Management Plan (that addresses short and long-term stormwater management from a quality and quantity perspective) or an Environmental Management Plan (EMP). For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	

188) Undertake the works on the site in accordance with an Earthworks Plan approved by the Engineering Delegate, Development Assessment. (a) Submit an earthworks plan (and obtain approval from the Engineering Delegate, Development Assessment), prepared by a Registered Professional Engineer of Queensland (RPEQ), and in accordance with Council's *"Subdivision and Development Guidelines"* demonstrating how the development will comply with this requirement and the following: • The location of any cut and/or fill; • The quantity of fill to be deposited and finished fill levels; • Maintenance of access roads to and from the site such that they remain free of all fill material and are cleaned as necessary; • The existing and proposed finished levels (extending into the adjacent properties); • Preservation of all drainage structures from the effects of structural loading generated by the earthworks; • Protection of adjoining properties and roads from ponding or nuisance from stormwater; • That all vehicles exiting from the site will be cleaned and treated so as to prevent material being tracked or deposited on public roads. (b) All fill material placed on the site comprising only natural earth and rock and is to be free of contaminants (as defined by section 11 of the Environmental Protection Act 1994), noxious, hazardous, deleterious and organic materials. Suitable fill material is deemed to comply with the requirements of clause 4.3, AS 3798, Guidelines on Earthworks for Commercial and Residential Developments. (c) Prepare the following details for presentation to the Council's Engineering Delegate at a pre-start meeting arranged by the consultant supervising the contractor: • The type of fill to be used and the manner in which it is to be compacted; • Details of any proposed access routes to the site which are intended to be used to transport fill to the site; • Engineering details of any haul roads to be built to facilitate the placement of fill on the site; • The contractor is responsible for maintaining the access roads near the site such that they remain free of all fill material and are cleaned as necessary; • Damage to Council assets will need to be repaired at no cost to Council; • Public footpaths fronting the site are to remain safe at all times; and • Compliance with Council's Erosion and Sediment Control Guidelines relating to earthworks on a construction site. (d) Implement and maintain the provisions of a Site Based Stormwater Management Plan which is consistent with Council's *"Subdivision & Development Guidelines"* (2000 or later version) and aims to prevent or minimise the contamination of stormwater and the release of contaminated stormwater from the site during construction and operational works. *GUIDELINE* *This condition is imposed for applications when significant earthworks are proposed in conjunction with a development proposal. Site Based Stormwater Management Plans (that address short and long term stormwater management from a quality and quantity perspective) may be part of Environmental Management Plans (EMPs) and include ESC Programs/Management Plans. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to site works/building works commencing While site/operational works/building works is occurring

189) Grant the following easement(s): (a) Easements for underground drainage, overland flow, open cut, and access purposes as may be required, in favour of Brisbane City Council; (b) Easements for underground drainage, open cut, overland flow and access purposes as may be required over that part of the site below the Flood Regulation Line and/or that part of the site affected by 100 year average recurrence interval (ARI) flooding, in favour of Brisbane City Council; *GUIDELINE* *This condition is imposed to provide access, maintenance of services and to protect drainage paths if required. Easements in favour of the Brisbane City Council are required to have the necessary easement documentation prepared (free of costs and compensation to Council) by the Brisbane City council. Easements not in favour of the Brisbane City Council are required to have the necessary documentation prepared by the applicant's private solicitors. Easements are to be shown on a Survey Plan and lodged with the Delegate Plan Sealing, Licensing Sealing and Certificates Unit. Enquiries regarding any legal documentation can be directed to Licensing, Sealing and Certificates Unit, Development and Regulatory Services (pH 3403 9050). For any other enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to the commencement of the use
190) Remove all improvements and obstructions from the area of the corner truncation(s) and area of dedicated road and reinstate the area as footway in accordance Council's Subdivision and Development Guidelines". (a) Provide a certificate from a Registered Surveyor, certifying that all improvements and/or obstructions have been removed from the area of corner truncation(s) and area of dedicated road; (b) Provide a certificate certifying that the works required by this condition have been completed; (c) Forward a copy of the certification from a registered surveyor together with the request for survey plan endorsement, to the Delegate Plan Sealing, Licensing, Sealing and Certificates Unit, Development and Regulatory Services. *GUIDELINE* *This condition is imposed when a corner truncation or road dedication requires removal of all improvements (eg. fences, gates, letter boxes, garden beds and plots and other constructed items etc.) and obstructions (eg. existing earth banks, vegetation etc.) from the area of new road. It should be noted that significant trees and certain types of vegetation may be left in place. The retention of a particular item is site specific and retained at the discretion of the Engineering Delegate. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to the commencement of the use

191) Any retaining walls greater than 1.0 metre in height are required to be structurally certified for design and construction by a Registered Professional Engineer Queensland (RPEQ). The certification is to include the stormwater drainage (surface and seepage water) associated with the wall ensuring that the water is directed to an acceptable lawful and legal point of discharge and does not cause any ponding, nuisance or disturbance to adjacent property owners. All retaining walls are to comply with the City Plan Filling and Excavation Code. *GUIDELINE* *This condition is intended to ensure that retaining walls associated with the development that are higher than 1 metre, are designed and constructed to industry standards and also, to ensure that no adverse impact is created by the structures on the surrounding properties. The retaining wall designer should note that timber retaining walls facing onto Council property (including the road reserve) will not be permitted. Retaining walls facing onto road reserve or parkland are to be contained entirely within the proposed development site, including the retaining wall's footings. Where retaining walls are proposed to be constructed between adjoining properties, it is also suggested that the use of timber sleeper retaining walls be restricted due to their limited life and the potential problems they may cause to future property owners. Where the combined height of the retaining wall and fence exceeds 2.0 metres, a Development Permit for Building Work will need to be granted. For any enquires about this condition please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to the commencement of the use
1' Provide internal signs and line markings generally in accordance with the approved drawings and documents and in accordance with Austroads and the Manual of Uniform Traffic Control Devices. (a) Prepare detailed engineering plans prepared by a Registered Professional Engineer of Queensland (RPEQ), and in accordance with Council's "Subdivision and Development Guidelines" showing the design of the sign and line marking work; (b) Construct the works in accordance with the engineering plans; and (c) Submit "As Constructed" plans to the Engineering Delegate, Development and Regulatory Services, approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's "Subdivision and Development Guidelines") certifying that the works have been completed in accordance with the approved design and any approved modifications and that the works required by this condition are in accordance with "Austroads" and the "Manual of Uniform Traffic Control Standards". *GUIDELINE* *This condition is intended to ensure that the development is signed and lined in accordance with the relevant standards.*	Prior to the commencement of the use Prior to lodging a development permit for building works

193) Construct and delineate or sign (as required) the following requirements as indicated on the approved plan(s) of layout: (a) Construct a pavement of minimum Type A standard and surface with an impervious material (including associated drainage) to the area on which motor vehicles will be driven and/or parked. [Construction of such pavement is to be certified by a Registered Professional Engineer of Queensland (RPEQ)]; (b) The driveways at grades shown on the approved plans and documents (or if not shown at grades not greater than those set out in *"Brisbane City Plan 2000 - Transport, Access, Parking and Servicing Planning Policy"*); (c) Manoeuvring on site for a LRV and for the loading and unloading of the vehicle(s); (d) Parking on the site for a minimum of 176 tenant cars, 22 visitor cars and for the loading and unloading of vehicles within the site; (e) 2 of the above parking spaces are to be provided for people with disabilities; (f) Supply, install and maintain within an area to be determined by the Delegate, Development Assessment, artworks (including but not necessarily limited to, sculptures, ceramic works, mosaics, wall reliefs, relic of the sites previous use/s, interpretive signage) by a recognised artist or crafts person or the appropriate professional depending on the item installed; (g) A height clearance sign located at the entrance(s) to undercover car parking areas; (h) A directional visitor parking sign at the vehicle entrance to the site adjacent to or clearly visible from the vehicle entrance to the site; (i) An appropriate area for the storage and collection of refuse, including recyclables, in a position which is accessible to service vehicles on the site; (j) The internal paved areas are to be signed and delineated in accordance with the approved plans, Manual of Uniform Traffic Control Devices and Austroads. *GUIDELINE* *The "Brisbane City Plan 2000 - Transport, Access, Parking and Servicing Planning Policy" requires adequate on-site provision of parking, servicing and manoeuvring areas. This condition specifies detailed design requirements as indicated on the approved drawings and documents to which the approval relates.*	Prior to the commencement of the use & then to be maintained

194) Obtain written permission from Council to build over or near storm water infrastructure (pipe drainage system or an easement for overland flow), or, to relocate a storm water drainage system, all at no cost to Council.	Prior to lodging a development permit for building works
(a) Submit engineering plans and calculations (if required), prepared by a Registered Professional Engineer Qld (RPEQ) and in accordance Council's *"Guidelines for Building Over or Near Stormwater Facilities"* in the *"Subdivision and Development Guidelines"* showing the manner in which it is intended to preserve the existing storm water drainage structures (or overland flow easements) within the site from damage, structural loading or obstruction. Obtain approval for the design from the Engineering Delegate, Development Assessment, Development and Regulatory Services.	
(b) Complete the works in accordance with the approved engineering plans.	Prior to the commencement of the use
(c) Submit "As Constructed" plans including an asset register (if required) of any modified or relocated stormwater drainage structure or other Council asset. The plans are to be approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's *"Subdivision and Development Guidelines"*) and certified that the works have been completed in accordance with the approved design and any approved modifications.	Prior to the commencement of the use
GUIDELINE *This condition has been imposed to ensure that acceptable measures will be incorporated into the development to protect Council's Infrastructure. For any enquiries about this condition, please contact Council's Customer Contact Centre on ph. 3403 8888.*	

195) Run-off from roof and developed surface areas of the site, and any run-off onto the site from adjacent areas, are to be collected internally and directed to a lawful point of discharge in accordance with Council's "Subdivision and Development Guidelines". (a) Submit drainage plans and engineering calculations (as a part of the development's Site Based Stormwater Quantity Management Plan) in accordance with Council's *"Subdivision and Development Guidelines"* showing the design of the drainage of the roof and developed surfaces. Obtain approval from the Engineering Delegate, Development Assessment. Such plans are to show adequate survey information on areas adjoining the site with particular attention to any nuisance or annoyance to adjoining property owners. Please note all constructed stormwater outlets that are proposed to discharge directly to a waterway, shall ensure an appropriate waterway setback, reduction in flow outlet velocity and concentration and, include any supplementary planting works that may be required (refer *"Stormwater Outlets in Parks and Waterways"*, BCC July 2000); (b) Complete the works in accordance with the approved engineering plans and other elements of the development's Site Based Stormwater Management Plan; and (c) Submit "As Constructed" plans approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's *"Subdivision and Development Guidelines"*) certifying that the works have been completed in accordance with the approved design and any approved modifications. *GUIDELINE* *The purpose of this condition is to ensure that stormwater run off from the site and adjacent properties will be handled adequately. Disposal by gravity pipeline is required if practical. Use of pumps for disposal of stormwater may be approved only if the applicant can show evidence to Council of having taken all reasonable steps to obtain written permission from adjacent property owners for construction of a gravity pipeline, and of this being unobtainable.The proposal may include water saving and reuse devices such as rain water tanks provided that the proposal satisfies Council that devices will be satisfactorily maintained by the owners of the property. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to site works/building works commencing While site/operational works/building works is occurring Prior to the commencement of the use
196) Provide a stormwater drainage connection for the future development of all adjoining upstream properties in accordance with an approved drainage plan and Council's "Subdivision and Development Guidelines". (a) Submit engineering plans and calculations and obtain approval from the Engineering Delegate, Development Assessment; (b) Complete the works in accordance with the approved engineering plans and in accordance with, Council's *"Subdivision and Development Guidelines"*; and (c) Submit "As Constructed" plans including an asset register (if required), approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's *"Subdivision and Development Guidelines"*) certifying that the works have been completed in accordance with the approved design and any approved modifications. *GUIDELINE* *This condition is intended to ensure that the subject development does not prejudice stormwater drainage of adjacent properties. The stormwater drainage required by this condition needs to be encompassed by an easement granted in favour of the Council, as may be required. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to the commencement of the use Prior to undertaking the works

197) Manage on-site drainage, ponding and discharge: (a) Design, construct, and thereafter maintain, rehabilitate or replace the following facilities in accordance with the approved plan(s) of layout. These works are to be designed, constructed and maintained in accordance with the following documents: 1.0 Stormwater Management Code of the City Plan; 2.0 Services Works and Infrastructure Code of the City Plan; 3.0 The Subdivision and Development Guidelines; 4.0 QUDM. (b) A Certificate of Completion (as per Chapter 3, Appendix B of Part E of the Subdivision and Development Guidelines) certified by a Registered Professional Engineer of Queensland (RPEQ) is required as proof of compliance with this condition. A copy of the Certificate of Completion is to be forwarded to the Engineering Delegate. NOTE: The design, design documentation, (including test results) and the Certificate of Completion are to be forwarded to and retained by the current and future owner(s) as proof of initial compliance with this Condition of Development and to assist in the on-going compliance with this Condition of Development and any future auditing. *GUIDELINE* *The purpose of this condition is to ensure that stormwater run off from the site and adjacent properties will be handled adequately. Disposal by gravity pipeline is required if practical. Use of pumps for disposal of stormwater may be approved, however details and plans would need to be approved by the Engineering Delegate. The applicant would need o show evidence to Council of having taken all reasonable steps to obtain written permission from adjacent property owners for construction of a gravity pipeline, and of this being unobtainable. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to the commencement of the use & then to be maintained

198) Run off from the site and run off concentrated on the site from local catchments for storms up to the 50 year (ARI) flood event and for a 100 year (ARI) flood event for creek and river flooding, is to be managed in accordance with approved drainage plans and Council's "Subdivision and Development Guidelines" so as not to have any adverse effect on neighbouring properties. (a) Design and construct all buildings to have the appropriate freeboard in accordance with the Council's *"Subdivision and Development Guidelines"* so as not to be flooded during a 50 year (ARI) local flood event or a 100 year (ARI) creek or river flood event whichever is the higher flood level; (b) Submit engineering plans and calculations, prepared by a Registered Professional Engineer Qld (RPEQ) and in accordance with the Council's "Subdivision and Development Guidelines", demonstrating how the development will comply with this requirement. Such plans are to show adequate survey information on areas adjoining the site with particular attention to ponding of water and overland flowpaths and building pads. Additionally, the submitted information is to determine the extent of any stormwater drainage works and the width of any overland flow easements. Obtain approval for the design from the Engineering Delegate, Development Assessment, Development and Regulatory Services; (c) Complete the works in accordance with the approved engineering plans; and (d) Submit "As Constructed" plans including an asset register (if required), approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's *"Subdivision and Development Guidelines"*) certifying that the works have been completed in accordance with the approved design and any approved modifications. *GUIDELINE* *This condition is intended to ensure that the design of the subject development accounts for the stormwater run off and/or if stormwater drainage patterns in the vicinity of the site require improvements. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to lodging a development permit for building works Prior to the commencement of the use Prior to the commencement of the use
199) Design and construct all proposed buildings in accordance with Council's *"Subdivision and Development Guidelines"* to ensure that minimum habitable floor levels are 500 mm above the 100 year (ARI) flood level (river and creek flooding) or 500 mm above the 50 year (ARI) (overland flow level) whichever is the greater. • Minimum non-habitable floor levels are to be not less than 300 mm above the 50 year (ARI) or 100 year (ARI) flood levels (which ever is the greater). *GUIDELINE* *This condition is imposed when the site is affected by flooding. The 100 year ARI event is applicable to river and/or creek flooding. If the catchment is localised, the 50 year ARI event will be applicable unless the site is also affected by creek or river flooding in which case the higher flood level is to be used. For flood level information, Council Flood Reports are now available from any of Council's Customer Service Centres and Regional Business Centres. The new Flood Report provides the latest flood information for a nominated property plus other useful information about flooding and your development.*	Prior to lodging a development permit for building works

200) Provide a public lighting system in accordance with an approved street lighting design plan and Council's "Street Lighting Design Guidelines". (a) Lodge street lighting design plans showing the proposed public lighting system and obtain approval from the City Lighting Unit, Local Asset Services Central District; (b) Enter into an agreement with an electricity supplier to provide a public lighting system in accordance with the above approved lighting design plans; and (c) Forward a copy of the agreement to the Engineering Delegate, Development and Regulatory Services. *GUIDELINE* *This condition is imposed when a proposed development requires the provision of public lighting facilities in accordance with the "Street Lighting Design Guidelines". Please refer to the Council's information sheet on lodging detailed design applications. For any enquiries about this condition, please contact the City Lighting Unit (pH 3403 0307) regarding electricity reticulation plans or Energex (pH: 131 253) regarding electricity supply.*	Prior to the commencement of the use Prior to undertaking the works
201) Supply and install all service conduits and meet the cost of any alterations to public utility mains, existing mains, services or installations required in connection with the approved development. This includes the relocation of any fire hydrants and valves from within the limits of the development's vehicular footway crossings if applicable. (a) Complete the works required by this condition; (b) Submit "As Constructed" plans including an asset register (if required), approved by a registered Professional Engineer Queensland (RPEQ) (in accordance with Council's *"Subdivision and Development Guidelines"* and "Water and Sewerage Reticulation Standards") showing the works required by this condition. *GUIDELINE* *This condition is imposed when additions, alterations or extensions to service conduits, mains and other services are required as a result of the approved development. Applicants should liaise with the appropriate service authorities. For any enquiries about this condition, please contact the Engineering Delegate, Development and Regulatory Services (regarding advise on traffic signal conduits, stormwater, water supply and sewerage mains etc.) or the relevant public utility authorities (for advice on other services).*	Prior to the commencement of the use
202) Provide underground telecommunication services to the proposed development. (a) Enter into an agreement with a telecommunication company and provide underground telecommunication services within and adjacent to the proposed development; and (b) Forward a copy of the agreement to the Engineering Delegate, Development and Regulatory Services. *GUIDELINE* *This condition is imposed to ensure that the provision of essential communication services are provided to the development. For any enquiries about this condition, please contact relevant service carriers regarding communications or Telstra (pH 132 200).*	Prior to the commencement of the use Prior to undertaking the works

203) Construct a paved footpath along the site frontage(s). (a) Construct a footpath a minimum width of 1.2 metres at the Softstone Street and Fairfield Road Access points generally in accordance with Drawings B04254-SK65 revision C and Drawing B04254-SK58 and in accordance with Council's "Subdivision and Development Guidelines". The design of the footpath works is to include any permanent safety signs, markings and devices (if required). (b) Construct the works to a standard that will be satisfactory to be accepted "on" and "off" maintenance" as a Council asset, by the Engineering Delegate, Development and Regulatory Services; and (c) Submit "As Constructed" plans including an asset register, approved by a Registered Professional Engineer of Queensland (RPEQ) (to a standard specified in Council's *"Subdivision and Development Guidelines"*) certifying that the works have been completed in accordance with the approved design and any approved modifications. *GUIDELINE* *This condition requires works to be undertaken in the road reserve. The intention of the condition is to ensure that the adjoining footpaths are designed and constructed to a standard suited to the demands created by the approved development. For advise regarding alignment and levels of the proposed works and any other enquires about this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to the commencement of the use
Repair any damage to existing kerb and channel, footpath or roadway (including removal of concrete slurry from footways, roads, kerb and channel and stormwater gullies and drainlines) that may occur during any works carried in association with the approved development. *GUIDELINE* *The intention of this condition is to ensure that any works undertaken as part of the approved development do not damage Council assets or leave Council assets in an unacceptable and unsightly manner. For enquiries regarding this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	Prior to the commencement of the use
205) Be responsible for internal (on-site) collection of refuse and recyclables from the development. (a) Enter into an agreement with Council's City Waste Services to provide a bulk bin collection service to the development; (b) The applicant/owner must indemnify Council and its agents in respect of any damage to the pavement and other driving surfaces; (c) The applicant/owner shall notify future owners/body corporate that the development has been approved on the basis that an indemnity is provided for refuse collection vehicles to enter the property; (d) Forward a copy of the written indemnity agreement with City Waste Services to the Engineering Delegate, Development and Regulatory Services; (e) Forward a copy of the written undertaking required to advise future owners/body corporate to the Engineering Delegate, Development and Regulatory Services. *GUIDELINE* *This condition is imposed to ensure that adequate arrangements are made for the collection of refuse and recyclables from the approved development. For any enquiries about this condition, please contact the Co-Ordinator of City Waste Contract Services, pH: 3403 8612 or 3403 8613).*	Prior to the commencement of the use Prior to the commencement of the use & then to be maintained Prior to the commencement of the use & then to be maintained

206) Provide a water service with approved Council meter assembly and meter box to the front real property boundary of the development in accordance with Council's "Water and Sewerage Reticulation Standards". Where a mixed usage site is approved for development and the proposed development comprises mixed classifications as defined by the Building Code of Australia containing any of Classes 5 to 9 and any of Classes 2 to 4, then the developer must provide a separate metered water service for the Class 2 to 4 occupancy as opposed to the Class 5 to 9 occupancy. This requirement is exclusive of any special fire service consideration i.e. internal hydrants, fire hose reels and sprinkler systems.	Prior to undertaking the works
(a) Submit engineering plans prepared by the RPEQ (Registered Professional Engineer Queensland) , and in accordance with Council's *"Water and Sewerage Reticulation Standards"* showing service and meter works. (The size of the service shall be determined by the water supply requirement of the proposed development). Obtain the approval from the Engineering Delegate, Development Assessment, Development and Regulatory Services;	
(b) Pay to Council the cost of live connection to the water main;	
(c) Such construction is to be to a standard that is satisfactory to be accepted on an off maintenance;	Prior to the commencement of the use or prior to endorsement of a community management statement, whichever is sooner
(d) If the meters are purchased other than from Council, pay to council a documentation fee for each water service provided. If the meters are purchased from Council, forward a copy of the receipt of purchase to the Engineering Delegate, Development and Regulatory Services.	Prior to the commencement of the use or prior to endorsement of a community management statement, whichever is sooner
GUIDELINE *This condition is imposed to supply a water service and a meter(s) to a Development / Community Title Development / Standard / Building or Volumetric format. The meter(s) shall be accessible to BCC employees or agents for the purpose of reading and maintaining the meter(s). The meter(s) will become and remain property of the Brisbane City Council.*	
207) Obtain written permission from the Engineering Delegate, Development and Regulatory Services, to build over or near sewer infrastructure, or to relocate the sewer/sewer infrastructure at no cost to Council. *GUIDELINE* *This condition is imposed so that the council does not incur costs associated with the erection of a building or structure over or near a sewer and/or sewer infrastructure. To avoid unnecessary expense and delay, the Council strongly recommends that the developer apply for permission to "Build Over Sewer" prior to the lodgement of any further development applications. For any enquiries regarding this condition, please contact the Delegate, Development and Regulatory services.*	Prior to lodging a development permit for building works

208) Provide a sewer property connection to serve the development designed and constructed in accordance with approved engineering plans and Council's "Water and Sewerage Reticulation Standards". NB. The size of the connection shall be determined by the total number of fixture units.	Prior to undertaking the works
(a) Submit engineering plans prepared by a Registered Professional Engineer Queensland (RPEQ), and in accordance with Council's *"Water and Sewerage Reticulation Standards"* showing the design the works. Obtain the approval from the Engineering Delegate, Development Assessment, Development and Regulatory Services;	
(b) Pay to Council the cost of live connection to the sewer main;	
(c) Construct the works in accordance with the approved engineering plans to a standard that will be satisfactory to be accepted "on" and "off" maintenance as a Council asset, by the Engineering Delegate, Development and Regulatory Services;	Prior to the commencement of the use
(d) Submit "As Constructed" plans including an asset register, approved by a Registered Professional Engineer Queensland (RPEQ) (to a standard specified in Council's *"Water and Sewerage Reticulation Standards"*) certifying that the works have been completed in accordance the approved design and any approved modifications.	Prior to the commencement of the use
GUIDELINE *This condition is imposed to provide a separate new sewerage connection to the development. For enquiries regarding this condition, please contact the Engineering Delegate, Development and Regulatory Services.*	

Section to Which These Conditions Relate:

5. Standard Advice (Non Development Advice)

Section Name:

Advice to developer for the Tennis Centre and all residential buildings

GENERAL/PLANNING REQUIREMENTS

	TIMING
209) The preferred location for the parking of contractor/construction vehicles or the storage of construction materials associated with the erection of Residential Buildings A, B and C, is on the Department of Primary Industry site to the east of the Fairfield Rd/Softstone Street roundabout connector road subject to earthworks (proposed cut) as shown on Plan B04254-SK61 dated 22 February 2006.	As indicated

POLLUTION

	TIMING
210) This approval does not include fuel burning for emergency generators. *GUIDELINE* *The condition is imposed to prevent environmental harm or nuisance from fuel burning.*	To be maintained

STANDARD ADVICE

	TIMING
211) If any trees on the footpaths abutting the subject properties are required to be trimmed or removed for access purposes, the necessary approvals and permits being obtained from the Manager, Department of Development and Regulatory Services, at the owner's cost. Trees damaged or removed are to be replaced with suitable mature trees at the applicant's cost.	As indicated
212) Disposal, handling, removal and restoration of any building materials containing asbestos being in accordance with the Workplace Health and Safety Regulations 1989.	As indicated
213) This approval does not include fuel burning for emergency generators.	As indicated
[illegible]) The necessary permits to cross the footpath with construction vehicles being obtained from Licensing and Compliance, Development and Regulatory Services Branch (contact 3403 8888).	As indicated

215) All development involving the emission of noise and dust from building/construction activities requires that the emission be in accordance with the requirements of the Environmental Protection Regulation 1998 Part 2A - Environmental Nuisance. Pursuant to the Environmental Protection Regulation 1998 Part 2A - Environmental Nuisance- 6W. A builder or building contractor must not carry out building work on a building site in a way that makes or causes audible noise to be made from the building work- (a) on a Sunday or public holiday, at any time; or (b) on a Saturday or business day, before 6.30 a.m. or after 6.30 p.m. **Please note: The above information has been provided to the applicant as an advice only, and does not form part of the development approval conditions. This advice has been provided to the applicant to inform them of other obligations they may have to comply with (under state legislation or local laws) prior to their activity commencing.**	As indicated
216) Any damage incurred to the footpath and/or kerbing and channelling during the development process are to be repaired to the satisfaction of the Manager, Department of Development and Regulatory Services.	As indicated
All development where the public are invited or permitted to be present involving amusements or entertainments including football, function room, theatres, games etc are required to hold or obtain a current Entertainment Venue & Event Licence pursuant to the Local Law (Entertainment Venues & Events) 1999. Licences can be obtained from Brisbane City Council-Licensing & Compliance. To obtain a Licence Information Kit contact the call centre on 3403 8888. Prior to building works plans and specifications are to be lodged for approval to the Brisbane City Council's Licensing and Compliance Section of Customer and Community Services. **Please note: The above information has been provided to the applicant as an advice only, and does not form part of the development approval conditions. This advice has been provided to the applicant to inform them of other obligations they may have to comply with (under state legislation or local laws) prior to their activity commencing.**	As indicated
218) All development involving an Environmentally Relevant Activity as defined by the Environmental Protection Regulation 1998 requires that an application for a material change of use for an environmentally relevant activity be submitted to the administering authority (Environmental Protection Agency or Brisbane City Council), in accordance with the Environment Protection Act 1994 and the Integrated Planning Act 1997. **Please note: The above information has been provided to the applicant as an advice only, and does not form part of the development approval conditions. This advice has been provided to the applicant to inform them of other obligations they may have to comply with (under state legislation or local laws) prior to their activity commencing.**	As indicated

219) The *Dangerous Goods Safety Management Regulation 2001* requires that occupiers of premises storing flammable and combustible liquids hold a licence. Licences are required for all storage greater than minor storage quantities. Minor storage limits are detailed in *Australian Standard AS1940 - The Storage and Handling of Flammable and Combustible Liquids.* It is the occupier's responsibility to obtain the required licence prior to commencement of the activity. Occupiers can be fined up to $1500 for failing to hold a current licence. Licences can be obtained from Brisbane City Council-Licensing & Compliance. To obtain a *Licence Information Kit* contact the call centre on 3403 8888. Plans and specifications must be lodged for approval by Council's Licensing & Compliance Section prior to building works commencing. Please note that building approvals do not include approval for storing flammable and combustible liquids. Council recommends that occupiers submit licence applications prior to obtaining building approvals. Otherwise, subsequent building modifications may be required to satisfy licence requirements. These can be expensive and will cause delays. **Please note: The above information has been provided to the applicant as an advice only, and does not form part of the development approval conditions. This advice has been provided to the applicant to inform them of other obligations they may have to comply with (under state legislation or local laws) prior to their activity commencing.**	As indicated
220) All development involving the preparation, packing, storing, handling, serving, selling or carrying of food requires that its design, installation and operation be approved pursuant to the Food Hygiene Regulations of 1989. The premises is required to be registered and the operator is to hold a licence with Brisbane City Council to operate the business under the above regulations. Licences can be obtained from Brisbane City Council-Licensing & Compliance. To obtain a Licence Information Kit contact the call centre on 3403 8888. Prior to building works plans and specifications are to be lodged for approval to Licensing and Compliance. **Please note: The above information has been provided to the applicant as an advice only, and does not form part of the development approval conditions. This advice has been provided to the applicant to inform them of other obligations they may have to comply with (under state legislation or local laws) prior to their activity commencing.**	As indicated
221) All materials listed as dangerous goods under *"The Australian Code For The Transport Of Dangerous Goods By Road and Rail" (ADG Code)* must be stored and handled on site in accordance with the relevant Australian Standard which applies to the Dangerous Goods Class of the material. *GUIDELINE* *This condition is imposed to ensure adequate safety standards are maintained where dangerous.*	To be maintained
222) All flammable and combustible liquids must be stored and handled in accordance with the Dangerous Goods Safety Management Act 2001. *GUIDELINE* *This condition is imposed to ensure adequate safety standards are maintained where Class 3 dangerous goods (Flammable and Combustible Liquids) are stored.*	To be maintained

223) Pursuant to the Environmental Protection Act 1994 Part 8 - Contaminated Land- "371(1) If the owner or occupier of land becomes aware a notifiable activity is being carried out on the land, the owner or occupier must, within 22 business days after becoming aware the activity is being carried out, give notice to the administering authority in the approved form." The administering authority for contaminated land matters is the Environmental Protection Agency. **Please note: The above information has been provided to the applicant as an advice only, and does not form part of the development approval conditions. This advice has been provided to the applicant to inform them of other obligations they may have to comply with (under state legislation or local laws) prior to their activity commencing.**	As indicated
224) Ensure that there is equitable access for disabled persons to and within the site in accordance with the Queensland Anti-Discrimination Act 1991, the Federal Disability Discrimination Act 1992 and Australian Standard AS1428 Parts 1-4 Australian Standard for Access and Mobility. You are notified of your responsibility to ensure that access is appropriately designed and constructed for all users as required by relevant legislation and standards. This development approval does not indicate that the proposal complies with these requirements. Determination of compliance with these requirements is the sole esponsibility of the owner/builder/developer of the proposal. **Please note: The above information has been provided to the applicant as an advice only, and does not form part of the development approval conditions. This advice has been provided to the applicant to inform them of other obligations they may have to comply with (under state legislation or local laws) prior to their activity commencing.**	As indicated
225) The dedication of the Fairfield Road and Softstone Street roundabout connection road is to be dedicated to the Crown as road. prior to the commencement of the use for the purposed tennis center or endorsement of the Community Management Statement for any of the proposed residential buildings. The dedication of the road requires a Development Permit for Reconfiguration of a Lot and the creation of at least three allotments.	As indicated
226) The discharge of waste liquids to the sewerage system must be conducted in accordance with the conditions of a Trade Waste Approval. Permits can be obtained from Brisbane City Council's Trade Waste Section. For further information on permits please contact the call centre on 3403 8888. **Please note: The above information has been provided to the applicant as an advice only, and does not form part of the development approval conditions. This advice has been provided to the applicant to inform them of other obligations they may have to comply with (under state legislation or local laws) prior to their activity commencing.**	As indicated

Section to Which These Conditions Relate: 6. Carrying Out Operational Work (Development Permit)

Section Name: Disturbance to Marine Plants

GENERAL/PLANNING REQUIREMENTS

	TIMING
227) Brisbane City Council advise that the Department of Primary Industries and Fisheries as concurrence agency has imposed the conditions contained in the letter dated 02/05/2006 Reference No 05-00555/NAM/140/004(339). For any enquiries concerning these conditions contact [redacted]	As indicated

Section to Which These Conditions Relate: 7. Referral Agency Requirements (Non Development Advice)

Section Name: Environmental Protection Agency- Contaminated Land

GENERAL/PLANNING REQUIREMENTS

	TIMING
228) Brisbane City Council advise that the Environmental Protection Agency as concurrence agency has imposed the conditions contained in the letter dated 12/06/2006 reference No App'n:929 Part 1 File No: BNE2841. For any enquiries concerning these conditions [redacted]	As indicated

Section to Which These Conditions Relate: 8. Referral Agency Requirements (Non Development Advice)

Section Name: Queensland Transport & Translink

GENERAL/PLANNING REQUIREMENTS

	TIMING
229) Brisbane City Council advise that Queensland Transport as concurrence agency has imposed the conditions contained in the letter dated 21/08/2006 Reference No 890/1115 (13) BRIS-83 P20260. For any enquiries concerning these conditions contact [redacted]	As indicated

Section to Which These Conditions Relate: 9. Referral Agency Requirements (Non Development Advice)

Section Name: Advice Agency - Energex Ltd

STANDARD ADVICE

	TIMING
230) Brisbane City Council advise that Energex Ltd as advice agency has supplied advice regarding easements contained in the letter dated 14/08/2006, Reference No. 710/52/12 L0800. For any enquiries about this advice contact [redacted]	As indicated

Section to Which These Conditions Relate:	10. Referral Agency Requirements (Non Development Advice)
Section Name:	Advice Agency - Powerlink

STANDARD ADVICE

	TIMING
231) Brisbane City Council advise that Powerlink Queensland as advice agency has supplied advice contained in the letter dated 22/08/2006, Reference No. Mirvac-Tennys DA. For any enquiries about this advice contact [redacted]	As indicated

Section to Which These Conditions Relate: 11. Referral Agency Requirements (Non Development Advice)

Section Name: Advice Agency Dept of Natural Resources Mines & Water

GENERAL/PLANNING REQUIREMENTS

	TIMING
232) Brisbane City Council advise that the Department of Natural Resources, Mines and Water as advice agency has supplied advice contained in the letter dated 27/04/2006, Reference No. IR1205IPS0002. For any enquiries about this advice contact [redacted]	As indicated

** End of Package **

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BRISBANE CITY COUNCIL'S APPROVAL PACKAGE

APPLICATION DETAILS

This package relates to the application detailed below

Address of Site:	2118 IPSWICH RD OXLEY QLD 4075 2130 IPSWICH RD OXLEY QLD 4075 2138 IPSWICH RD OXLEY QLD 4075 32 BLUNDER RD OXLEY QLD 4075 35 FACTORY RD OXLEY QLD 4075
Real Property Description of Site:	L7 RP.211559 L5 RP.211558 L1 RP.211559 L1 RP.211891 L1 RP.183737
Aspects of development and type of approval:	DA - Material Change of Use Development Permit - Shop
Council File Reference:	A001636889 Permit Reference Number/s: DAMC167553407.
Package Status:	APPROVED - Version 1 (12th of September, 2007 8:06:31 PM)
Package Generated:	23/06/2009

PROJECT TEAM

The assessment of this application has been undertaken by:

Roger GREENWAY Senior Urban Planner, Development Assessment Development Assessment South	Rory KELLY Regional Manager Development Assessment South BSQ	[redacted] Urban Planner, Development Assessment Development Assessment South BSQ
Samuel GAY Engineer, Development Assessment Development Assessment East BSQ	[redacted] Senior Landscape Architect, Development Assessment Development Assessment Central BSQ	[redacted] Pollution Officer, Development Assessment Development Assessment South BSQ
Principal Urban Planner, Development Assessment Development Assessment South BSQ	Urban Planner, Development Assessment Development Assessment South	

DRAWINGS AND DOCUMENTS

The term 'drawings and documents' or similar expressions mean:

Drawing or Document	Number	Plan Date
Tree Retention Plan	3500401-TRP-01 Revision 2	26-JUL-2006
Waterway and Wetland Rehabilitation Plan	35005401-WWRP-01	26-JUL-2006
Site Plan	030 Revision C (Amended In Red 22-JUN-2007)	24-JAN-2007
Parking Level Plan	100 Revision F	24-JAN-2007
Level 01 Plan	101 Revision G	24-JAN-2007
Roof Plan	110 Revision C	14-MAY-0007
Sections	120 Revision E	14-MAY-0007
Elevations	130 Revision D (Amended In Red 22-JUN-2007)	24-JAN-0007
Landscape Concept Plan	LP-SD-01 A (Amended In Red 22-JUN-2007)	26-JUL-2006

Advice

Please see the attached document(s) for any advices.

APPROVAL CONDITIONS

Permit to Which These Conditions Relate:	DA - Material Change of Use
Activity(ies):	Shop
Stage:	Dev. Permit MCU - Shop (Showroom, Retail Warehouse)

General/Planning Requirements

	Timing
1) Copy of Approval to Consultants Provide a copy of the Brisbane City Council approval package including the development approval conditions, approved plans & documents and the Decision Notice to the following and as indicated (where applicable): a. All consultants preparing or lodging applications for "Operational Works"; b. All consultants preparing or lodging applications to satisfy conditions requiring compliance assessment under Schedule 12 of the *Integrated Planning Regulation 1998*; c. Prior to lodging a development permit for building works, all consultants preparing or lodging applications for "Carrying Out Building Works"; and d. Prior to site works commencing, all contractors carrying out site works or building works associated with or resulting from this Development Permit. *GUIDELINE* *This condition is imposed to ensure that all consultants, contractors and Building Certifiers involved with completing the development are aware of the particular requirements of this site.*	As indicated
2) Information Signage Prior to any works commencing on the site and then to be maintained until completion of the development, erect an 'Information Sign' as outlined below: - a. A brief description of the proposed development; b. The sign/s is/are to list the name, postal and/or email address and a contact telephone number for each of the following parties (where relevant) that are undertaking work on the site: - - Developer, - Project Coordinator, - Architect / Building Designer, - Building Contractor, - Civil Engineer, - Civil Contractor/s, and - Landscape Architect;	As indicated

c. The lettering on the sign is to be at least 25mm in height, be of regular weight and in sentence case; d. The sign is to be a minimum size of 1,200mm by 900mm; e. The maximum area of the sign is to be 2.0m¿. f. The sign must be placed on or within 1.5m of the road frontage for the land and mounted at least 300mm above ground level; g. If the land has more than one road frontage, the information sign must be placed on each road frontage for the land; h. The sign is to contain no commercial or corporate advertising other than the name, logo or slogan of the parties outlined in part (b) of this condition; i. The sign is to be non illuminated; j. Both the sign and the supporting structure are to be made of weatherproof material and to be properly maintained at all times; k. The sign(s) is/are to be located on the subject property and is/are to comply with the General Requirements for Signage contained within the Local Laws Policy "Control of Outdoor Advertising", specifically with regard to Traffic Safety, Clearances and Structural Systems. l. Prior to erection of the sign(s), submit a copy of the wording and the dimensions of the proposed sign(s) to Council. *GUIDELINE* *This condition is imposed to ensure that the public is provided with information regarding the development during construction stage. Where signage is erected in accordance with the Permitted Advertisement Provisions contained within the Local Laws Policy "Control of Outdoor Advertising", the display of the sign is exempt from the making of an application and payment of fees to Council, and the need for a licence.*	
3) **Approved Drawings & Documents** A legible copy of the Approved Drawings and Documents bearing "Council Approval" and the Development Approval Conditions package is to be available on site at all times during construction and earthworks. *GUIDELINE* *This condition is imposed to ensure compliance with the development conditions of approval. The copy of conditions and plans should be located in any site management office or with the site foreman. Any copies of conditions or plans that are illegible will be deemed non-compliant with this condition.*	As indicated
4) **Carry Out The Approved Development** Carry out the approved development generally in accordance with the Approved Drawings and Documents, **as amended in red by Council on 22 June 2007** generally showing - i. Amendments required to the proposed landscaping; and ii. Signage is NOT part of this approval. **The above descriptions of amendments made in red must be read in conjunction with the Approved Drawings and Documents bearing Council's approval stamp.** *GUIDELINE* *This condition refers to the Approved Drawings and Documents, to which*	While development is occurring on the site and then to be maintained

this approval relates, and is the primary means of defining the extent of this approval. Approved Drawings and Documents are stamped 'PLANS AND DOCUMENTS REFERRED TO IN THE APPROVAL' and are dated to reflect the date of approval of the development application by Council's delegate.	
5) Complete All Building Work Complete all building work associated with this development approval, including work required by any of the following conditions. Such building work is to be carried out generally in accordance with the Approved Drawings and Documents and, where the building work is assessable development, in accordance with a current Development Permit for Carrying Out Building Work. *GUIDELINE* *This condition is imposed to ensure all building work associated with the use are in place before the use commences. It is inappropriate that the site be used without such work being completed. Please note that the work referred to in this condition may constitute 'Assessable Development'. Council informs you therefore that this condition does not authorise assessable development to occur and a development permit may therefore be necessary. Please refer to Council's information sheets. For any enquiries regarding this condition, please contact the Assessment Manager.*	Prior to commencement of use
6) Complete All Operational Work Complete all operational work associated with this development approval, including work required by any of the following conditions. Such operational work is to be carried out generally in accordance with the Approved Drawings and Documents, or if requiring a further approval from the Council, in accordance with the relevant approval(s). *GUIDELINE* *This condition is imposed to ensure all operational work associated with the use are in place before the use commences. It is inappropriate that the site be used without such work being completed. Please note that the work referred to in this condition may constitute 'Assessable Development'. Council informs you therefore that this condition does not authorise assessable development to occur and a development permit may therefore be necessary. Please refer to Council's information sheets. For any enquiries regarding this condition, please contact the Assessment Manager.*	Prior to commencement of use
7) RISK MANAGEMENT Reduce the residual risk from flood inundation to future users and property using or gaining access to those areas of the site subject to flooding as follows: Submit to the Lead Principal Planner Development Assessment South, for approval of a Risk Management Plan, prepared by a qualified and experienced practitioner in risk assessment, evaluation and/or treatment in accordance with the requirements of AS/NZS 4360-2004 Risk Management dealing with the specific concern of flooding of the carpark level that is subject to a Q100 - Brisbane River and Oxley Creek flood events and the potential consequences associated with such inundation with the car park fully occupied based on the following:	Prior to the commencement of the use and then to be maintained

1. The flood events at: • Q20 - Oxley Creek and Brisbane River flooding event; • Q50 - Oxley Creek and Brisbane River flooding events; and • Q100 - Oxley Creek and Brisbane River flooding events; and . 2. The Flood Study by Cardno, Job number 3500/54 dated 31 January 2007. *GUIDELINE* *This condition is imposed to ensure the use of the car parking area subject to flooding is managed to reduce the residual risk from flood inundation to future users and property using or gaining access to those areas of the site subject to flooding. Preparation of the Risk Management Plan should have regard to the Risk Management Plan 3500/54 Dated 3 Mat 2007 submitted as part of this application.*	
7(a) RISK MANAGEMENT Incorporate into any recommendations of the Risk Management Plan the following: a. The installation of a permanent dual water level sensor/monitors in Oxley Creek to alert of an impending flood event; b. A maintenance plan for the water monitors/sensors installed; c. The installation and maintenance of visual and audible warning devices to alert users of the car park of the impending inundation; d. A register of suitably trained employees to monitor the Oxley Creek water sensors and coordination evacuations of the areas subject to inundation during a flood event; e. A procedural plan for the flood evacuation of the car park during the specific flood events addressed by the Risk Management Plan.	Prior to the commencement of the use and then to be maintained
7(b) RISK MANAGEMENT Implement and maintain the recommendations of the approved "Risk Management Plan" including the following: a. All alarm probes are to have fitted with an active status reporting system linked telemetry; b. Signage clearly visible at the entrance to and within the carpark to remind patrons that the lower "carparking area" has the potential to flood, of the evacuation protocols and assembly areas; c. The above requirements together with the recommendations of the approved Risk Management Plan are incorporated into the terms and conditions of any new lease/rental agreement or renewal of existing leases.	Prior to the commencement of the use and then to be maintained
7(c) RISK MANAGEMENT Update the approved Risk Management Plan as required to reflect current standards and best practices. Any updates or modifications are to be sent to the Principal Lead Planner Development Assessment South in writing within 14 days quoting the application number A001636889 and outline the changes made and the reason for changes.	Prior to the commencement of the use and then to be maintained

8) **Maintain The Approved Development** Maintain the approved development (including landscaping, parking, driveways and other external spaces) in accordance with the Approved Drawings and Documents, and any relevant Council or other approval required by the conditions. *GUIDELINE* *This condition restricts changes that can be made to the approved development. Approved Drawings and Documents are stamped 'PLANS AND DOCUMENTS REFERRED TO IN THE APPROVAL' and are dated to reflect the date of approval of the development application by the Council's delegate. The extent to which plans can be modified is constrained by the definition of 'minor change' in Schedule 10 and the provisions of S.3.5.24 of the Integrated Planning Act 1997. It will be necessary to make a new application if the change is not a minor change. For any enquiries about this condition, please contact the Assessment Manager.*	To be maintained
9) **Expiration of Relevant Period** **All aspects of development as outlined within this section, to which the conditions relate in the 'Development Approval Package', are to be completed within the period ending midnight 31 July 2011.** *GUIDELINE* *This condition is imposed pursuant to S.3.5.21A(2)(a) of the Integrated Planning Act 1997. The intent of this condition is to specify the particular time assessable development or an aspect of assessable development is to be completed before this development approval lapses. Any extension of the period stated in the condition is required to be made in accordance with S.3.5.22 and S.3.5.33 of the Integrated Planning Act 1997.*	As indicated
10) **Community Management Statement** The Community Management Statement for the site is to contain by-laws which reflect the following requirements: a. All vehicle manoeuvring areas, disabled bay(s) and landscaping as shown on the approved plans of layout are not to form part of any exclusive use area; b. No more than 2 car parking spaces are to be allocated for exclusive use of any tenancy (unit) on the site; c. All sealed traffic areas must be cleaned as necessary to prevent emission of particulate matter; d. The refuse bin area(s) is to remain available at all times to all units; e. Maintenance of the undercroft area; f. Maintenance of signage clearly visible at the entrance to and within the carpark to remind patrons that the lower "carparking area" has the potential to flood, the evacuation protocols and assembly areas. *GUIDELINE* *This condition is imposed to ensure the ongoing operation, appearance and maintenance of the development under a Community Management Statement is in accordance with the development permit and the approved plans and documents. For any enquiries about this condition, please contact the Assessment Manager.*	As indicated

MJR-16

Dedicated to a better Brisbane

Queensland Government
Department of Emergency Services

Emergency Management EMQ Queensland

DOTARS

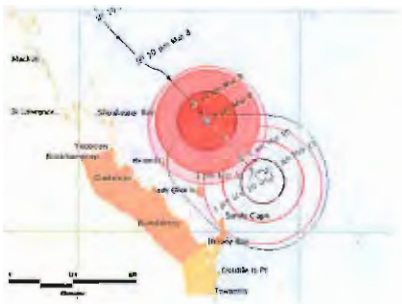
DEPARTMENT OF TRANSPORT AND REGIONAL SERVICES

Brisbane River Hydraulic Model to Probable Maximum Flood (PMF) Final Report

24 June 2009

Prepared for
Families and Community Services Division
Brisbane City Council

Prepared by
Flood Management
City Design









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Issue No.	Date of Issue	Amdt	Prepared By (Author/s)		Edited and Proofread By		Reviewed By		Approved for Issue (Project Director)	
			Name	Initials	Name	Initials	Name	Initials	Name	Initials
1	24 June 2009		James Charalambous	[redacted]	Evan Caswell	[redacted]	[redacted] Evan Caswell [redacted]	[redacted]	Ken Morris	[redacted]

Executive Summary

The Brisbane River Hydraulic Model to Probable Maximum Flood (PMF) Project has delivered a two dimensional (2D) TUFLOW hydraulic model for the Brisbane River floodplain from Wivenhoe Dam to Moreton Bay. The 2D model encompasses a study area of 4,500 square kilometres or about one third of the Brisbane River catchment, which in total covers 13,500 square kilometres. The development of this 2D 'mega model' is considered a significant technical achievement.

The following project success factors established for the project have been achieved:

- A 2D calibrated Brisbane River PMF hydraulic model has been produced and deemed acceptable following peer review by key stakeholders

- Model outputs have been translated into flood emergency response tools to be utilised during a river flooding event for emergency preparation and response planning. Specifically, these deliverables include:

    - Inundation mapping
    - Critical infrastructure mapping and reporting
    - Isolated area mapping
    - Evacuation zone mapping

- The community of Brisbane are better informed and are able to respond more effectively in the event of a Brisbane River flood as a result of the above works

- Relevant actions and outcomes of the Council's ***Corporate Plan (2008-2012)*** and ***Lord Mayor's Taskforce on Suburban Flooding (2005)*** have been addressed

Overall this project represents a significant improvement in the flood response capability of the Council. However, in the context of educating and preparing the Brisbane community for a major flooding event there is more work to be undertaken.

Following on from this achievement, it is recommended that further work should be undertaken and include:

1. Incorporate into the 2D model the Council's new survey data (available in late 2009) and produce an addendum report

2. Incorporate the results of this Project into the Council's Disaster Management Planning; ***Threat Specific Plan for River Flood and Storm Surge Event (2008)***.

3. Develop a community safety education campaign that integrates the outcomes of this project and other related projects (for example 'Be FloodWise Campaign'), the focus of which should relate to the publishing and use of the project deliverables in the public domain and on the Council's website. This will improve awareness to river flooding and empower the

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community to self-assess individual flood risk and make appropriate and safe decisions for a range of river flooding events from minor to extreme.

4. Deliver training to the State Emergency Service (SES), Emergency Coordination Centre (ECC), the Flood Information Centre (FIC), senior management, and other relevant personnel within the Council in the use and application of the flood emergency response tools.

5. Investigate 'innovative ways' that the results of this project can be applied to improve the interpretation across the various disciplines within the Council.

6. Annually review the outcomes of this study to integrate new initiatives and developments.

7. Investigate possible external revenue options through State and Commonwealth Government grants to fund eligible and related future works.

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1.0 Introduction

Brisbane is a sub-tropical city that has developed around its river and major creeks. Historically, the city experiences high annual rainfall with a climate and topography that make some areas susceptible to flooding. Much of the flooding that occurs in Brisbane's suburbs relates to the many creeks, watercourses and stormwater systems that make up the landscape of our river city. Minimising flood damage is a community-wide responsibility. Although Brisbane City Council has an important part to play, residents and businesses can lessen the effect that flooding has on their properties and families, while also assisting the wider community to respond to, and recover from a flood.

To support our community to be 'flood prepared', the Council has developed the 'Be FloodWise Campaign'. Though this campaign the Council has developed a range of materials that provide information to assist in personal flood management. Many of the actions suggested in the 'Be FloodWise' guides are low-cost and easy to implement.

The Council has a responsibility under State legislation to manage the impacts of, and where possible mitigate against the adverse impact of disaster events, such as floods. The ***Disaster Management Act (2003)*** forms the legislative basis for disaster management activities within all levels of government in Queensland. For local government this includes the preparation of disaster management plans and guidelines, helping communities mitigate and prepare for the potential adverse impacts of disaster events and promote best practice disaster management including a comprehensive "all hazards" approach.

In February 2005, The Lord Mayor of Brisbane commissioned a Taskforce on Suburban Flooding which proposed several key priority actions. These included a voluntary home purchase scheme for identified 'at-risk' residential properties and the reviewing and strengthening of land use planning, development and building controls to ensure future activities have no adverse effect on flooding. The report also recommended a community education and awareness program and the development of early warning systems aimed at enhancing community capacity to prepare for and manage the impacts of flooding.

In addition to the above, the Council's ***Corporate Plan (2008-2012)*** outlines the medium to long term outcomes for the City that each program is working to achieve. Within the Council, two program areas, Program 2 and Program 7 deliver disaster management strategies.

Program 2 is the Council's ***Integrated Water Management Program***. Its objective is for the Brisbane River and Moreton Bay catchments to be managed to reduce the impacts of flooding. This is to be achieved through:

- providing easy and free access to flood information on www.brisbane.qld.gov.au,
- establishing best practice disaster response and flood management procedures, and
- progressing the ***Lord Mayor's Taskforce on Suburban Flooding (2005)*** recommendations.

Program 7 is the Council's ***Public Health and Safety Program***. Its objective is to establish by 2010 a system of regionally consistent flood warnings in collaboration with the Bureau of Meteorology and

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other regional Councils and to establish natural disaster management plans to support best practice disaster response and flood management procedures. This will be achieved through taking an "all hazards" approach to safeguarding Brisbane against natural disasters, including flooding.

The Council's existing hydraulic model of the Brisbane River has simulated to the 1974 flood profile, as it occurred. However, even with the construction of Wivenhoe Dam larger floods than occurred in 1974 are possible. Therefore, the basis of this project is to provide a flood emergency response capability up to and including the Probable Maximum Flood (PMF). The flood emergency response tools or key deliverables from this project include:

- Inundation mapping
- Critical infrastructure mapping and reporting
- Isolated area mapping
- Evacuation zone mapping

It is important to note that the results of this project inform the Council's emergency response capabilities and mitigation planning and do not in any way impact or influence the Council's land use planning policies and decisions.

2.0 Background

In order to provide a flood emergency response capability up to and including the PMF it was necessary to improve upon the Council's existing one dimensional (1D) hydraulic model and develop a two dimensional (2D) calibrated model of the Brisbane River. The reasoning for this is because the possible schematisation of a 1D flood model does not easily represent 'channel breakouts' or the 'short-circuiting' of flood flow across river bends experienced during major flooding events. Furthermore, the Council's existing disaster response capacity (inundation maps and reporting) is limited to a flood event comparable in size to 1974. Refer to Appendix D for more on the history of the Brisbane River 1D models.

This project was also based on legislation and a number of related projects including:

- Legislative requirements contained in the ***Disaster Management Act (2003)***
- The Council of Australian Governments (COAG) review of Natural Disasters in Australia resulting in the report ***Natural Disasters in Australia: Reforming mitigation, relief and recovery arrangements (2004)***
- ***Report No. 2 for 2004-05: Audit of the Queensland Disaster Management System (2004).***
- ***The Brisbane City Natural Disaster Risk Management Study (2005)***
- The establishment of the ***Lord Mayor's Taskforce on Suburban Flooding (2005)*** and subsequent recommendations report
- ***The Brisbane Valley Flood Damage Minimisation Study (2007)***

In February 2007, the Council submitted an application for funding under the Natural Disaster Mitigation Program (NDMP) 2007 – 2008 to the State Department of Emergency Services (DES) and the Commonwealth Department of Transport and Regional Services (DoTaRs) for the Brisbane River Hydraulic Model Review to Probable Maximum Flood (PMF) Project.

The application was successful with the various approval processes taking place during the remainder of 2007. Refer to Appendix B for further information on the NDMP funding process. The project commenced in February 2008 and was delivered within the 2008-2009 financial year.

3.0 Project Objectives

The original objectives of this project were:

- To develop a calibrated and peer reviewed two-dimensional (2D) Brisbane River Hydraulic Model to PMF (hereafter referred to as the '2D model') for five (5) key flood profiles up to and including the Probable Maximum Flood (PMF).

- To develop a number of flood emergency response tools from the 2D model. These deliverables include:

    - Inundation mapping
    - Critical infrastructure mapping and reporting
    - Isolated area mapping
    - Evacuation zone mapping

3.1 Variation to Project Objectives

During the course of the project variations to the original scope were made as follows:

1. The number of flood profiles analysed was increased from five (5) to ten (10).
2. Additional work was undertaken on the hydrology used in this study.

Refer to Section 5.0 for the project definition and scope of works.

4.0 Project Success Factors

The criteria against which the success of this project are to be measured include:

- A 2D calibrated Brisbane River PMF hydraulic model is developed and deemed acceptable following peer review by stakeholders
- Outputs from the model are able to be translated into flood response tools utilised for flood disaster and emergency response planning
- As a result of the above works the community of Brisbane are better informed and are able to respond more effectively in the event of a Brisbane River flood
- The related actions and outcomes of the Council's ***Corporate Plan (2008-2012)*** and ***Lord Mayor's Taskforce on Suburban Flooding (2005)*** are addressed

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5.0 Project Definition

5.1 In Scope

The following tasks were included in the project's original scope of works:

- Hydraulic model scoping
- Hydraulic model development
- Hydraulic model calibration
    - Coarse
    - Detailed
- Flood profile modelling (5 events only)
- Development of flood response tools
    - Inundation mapping
    - Critical infrastructure mapping and reporting
    - Isolated area mapping
    - Evacuation zone mapping
- Project documentation
- Project management reporting
    - Monthly project status
    - Monthly financial status
- Peer Review

5.2 Out of Scope

The following tasks were excluded from the project's scope of works:

- Survey and site specific photogrammetry
- Tidal calibration and flood frequency analysis
- Response tool implementation and public education

5.3 Variations

5.3.1 Flood Profiles

During the project five (5) additional flood profiles were added to the scope of works to provide a greater range of events. Therefore ten (10) flood profiles and associated flood response tools were analysed and developed respectively. Refer to Section 12.6 for details on the Flood Profile Series.

5.3.2 Hydrology

Following a review of available information further hydrology works were deemed necessary to achieve the project's outcomes and these are detailed in Section 12.0 and Appendices H, I, J & K.

6.0 Project Governance

Paramount to the success of this project is the development of the governance structure and associated responsibilities as outlined in Table 1.

Table 1: Project Governance

Name	Role	Responsibilities
Client and Service Provider Arrangements		
[redacted]	Project Client	Monitor project on behalf of Project Sponsor Sign off of Project Management Plan
Ken Morris	Project Director	Overall project delivery accountability Oversee technical working and project control groups
James Charalambous	Project Manager	Operational project management Project reporting and financial reporting
[redacted]	Grants Coordinator	Contractual/grant management and project context
Technical Team		
James Charalambous	Technical Project Manager and Senior Project Engineer	Project management and oversee all technical activities Undertake 2D modelling/hydrology works
[redacted]	Senior Engineering Surveyor	Review survey data, digital terrain model (DTM) & assist with processing of mapping deliverables
[redacted]	Spatial Data Officer Spatial Data Specialist	Oversee production of mapping deliverables Oversee 'Corporate' mapping requirements
[redacted]	Project Manager	Representing the interests of the Fernvale Lowood Flood Study
[redacted]	Project Engineer	Project delivery and quality
Peer Review Team		
[redacted]	Peer Reviewer – Hydraulics (BMT WBM P/L)	Provide input and expert peer review of TUFLOW modelling
Greg Roads	Peer Reviewer – Hydrology (WRM Water and Env. P/L)	Provide input and expert peer review of hydrology works
Evan Caswell	Peer Reviewer – Deliverables and Final Report	Provide input and expert peer review of the flood emergency response tools and final report

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7.0 Stakeholders

Table 2 identifies key stakeholders, their role and organisation, including the interest they have in the initiation, execution and delivery of the project. Membership of stakeholders is categorised into the Project Control Group (PCG) and the Technical Working Group (TWG). Refer also Appendix K for a list of stakeholder meetings.

Table 2: Stakeholder Information

Stakeholder Role	Stakeholder Name	Stakeholder Organisation	Interest
Primary Client/PCG Member	[redacted]	Community Safety & Disaster Management	Client - Families and Community Services
Project Sponsor	[redacted]	Community Safety & Disaster Management	Client - Families and Community Services
State Client/PCG Member	[redacted]	Department of Emergency Services Queensland	Client - Emergency Management Queensland
SES Operations and Logistics	[redacted]	SES Local Controllor	Stakeholder - Families and Community Services/SES
PCG/TWG Member	John Ruffini	Department of Natural Resources and Water*	Representing the interests of the DNRW
PCG/TWG Member	Rob Drury, Barton Maher, Terry Maloue	Seqwater	Representing the interests of Seqwater
PCG/TWG Member	Rob Ayre	Sunwater	Representing the interests of Sunwater
PCG/TWG Member	Peter Baddiley & [redacted]	Bureau of Meteorology	Representing the interests of the Bureau of Meteorology
PCG/TWG Member	[redacted]	Ipswieh City Council	Representing the interests of Ipswich City Council
PCG Member	[redacted]	Gold Coast City Council	Representing the interests of Gold Coast City Council
PCG Member	[redacted]	Somerset Regional Council	Representing the interests of Somerset Regional Council
PCG Member	Bill Weeks	Department of Main Roads	Representing the interests of DMR
Peer Review/TWG Member	[redacted]	BMT WBM P/L	Technical Reviewer
Peer Review/TWG Member	Greg Roads	WRM Water and Env. P/L	Technical Reviewer
Projeet Team			
Project Director	Ken Morris	City Design	Project delivery and quality
Peer Review	Evan Caswell	City Design	Project delivery and quality
Project Manager	James Charalambous	City Design	Project delivery and quality
Project Manager	[redacted]	City Design	Fernvale Lowood Flood Study
Grants Management	[redacted]	City Design	Grants Coordinator
Projeci Enginecr	[redacted]	City Design	Project delivery and quality
Spatial Data Officer	[redacted]	City Design	Mapping Deliverables
Senior Engineering Surveyor	[redacted]	City Design	Survey & Mapping Deliverables
Spatial Data Specialist	[redacted]	I- Division	Mapping Deliverables

*DNRW is now the Department of Environment and Resource Management

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8.0 Related Projects

8.1.1 Lord Mayor's Taskforce on Suburban Flooding 2005

The primary objective of the Taskforce was to develop strategies to reduce the impact of flooding on residents in areas subject to frequent and sometimes severe inundation. The taskforce identified that all flood risk information relating to a Brisbane River event was to be extended beyond the Defined Flood Event (DFE) to a PMF event.

8.1.2 Brisbane City Natural Disaster Risk Management Study 2005

The flood emergency response tools component of Brisbane River to PMF project has been identified and scoped as a direct result of the Brisbane City Natural Disaster Risk Management Study. Representatives from approximately 18 agencies - local, state, federal, private and community were heavily consulted throughout the delivery of the risk management study.

The study recommended a range of flood preparedness measures to enable the community and the authorities to better respond to a river flood event. One recommendation was for the Council to conduct further flood studies over a range of flood events up to and including the PMF.

8.1.3 Brisbane Valley Flood Damage Minimisation Study 2007

The primary aim of the study was to gain a greater understanding of the potential flood damage caused by a range of river flood events in the Brisbane River catchment and determine if the operating rules for Brisbane Valley dams could be modified to minimise this damage.

8.1.4 Threat Specific Plan for River Flood and Storm Surge Event 2008

The project is to complete the Council's Disaster Management Planning Framework as outlined in the *Disaster Management Act 2003*. The 'threat specific plan' for a flood emergency event includes the Council's response, initial recovery actions and key tasks associated with a Brisbane River flood corresponding to the DFE and a 'storm surge or tide event' to 2.5m AHD. The 'threat specific plan' will incorporate the flood emergency response tools from this project.

8.1.5 Flood Study of Fernvale and Lowood 2009

Flood profiles and inundation extents for a suite of events including PMF will be produced as part of the study. The project will deliver a design report and produce associated flood maps. It is also funded under NDMP and is to be delivered by June 2009.

9.0 Study Area

The Brisbane River catchment has an area of 13,570 square kilometres. This catchment is illustrated in Figure 1 and has been classified into various 'subregions' for the purposes of hydrologic modelling.

The digital terrain model (DTM) - essentially the land surface topography used for the 2D model - encompasses an area approximately 83.4 km (Easting length) by 53.8 km (Northing length) from Wivenhoe Dam to Moreton Bay. This represents an area of approximately 4500 square kilometres or about one third of the total Brisbane River catchment. The DTM includes the three key floodplain areas:

- Lockyer Valley (Lockyer Creek)
- Ipswich Valley (Bremer River) and
- Lower Brisbane River floodplains (Wivenhoe Dam to Moreton Bay),

The DTM (illustrated in Figure 2) essentially forms the study area and the basis for the 2D model development undertaken as part of this project. Due to the vastness of the study area encompassed by the DTM, the 2D model has been labelled a 'mega model'.

10.0 Data

The data collection phase for this project was comprehensive and can be summarised as follows:

1. DTM development
2. Hydrology data
3. Stream data

The data collection involved contacting representatives from all levels of government and the private sector over a twelve (12) month period and is detailed in Appendix C.

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11.0 Modelling Platform

11.1 History of Brisbane River 1D Model

The historical development of the one dimensional (1D) Brisbane River model is described in Appendix D. This information provides the background and highlights the need for a new 2D modelling platform to achieve the project outcomes.

11.2 Project Approach - 2D Model

Originally it was planned to develop an expanded 1D model for this project. However City Design's recent 2D modelling experiences indicated the 'channel breakouts' would be complex and difficult to explicitly define in a 1D modelling format (refer to Figure 4 which provides an example of a 'channel breakout' or 'short-circuiting' of flood flow across river bends). Therefore, it was concluded that to develop a PMF model in a 1D format would not be feasible, nor would it deliver the anticipated outcomes and benefits to the client.

Accordingly the project was re-scoped to replace the original 1D modelling approach using MIKE 11 with a 2D modelling approach. Following evaluation of the 2D modelling platforms available on the market, TUFLOW was selected. Appendix E outlines the scoping exercise and appraisal. The appropriate change management processes were undertaken and variations to contract were submitted to the Department of Emergency Services (DES) for review and subsequently approved.

11.3 Hydraulic Model Development

The hydraulic model development is detailed in Appendix F.

12.0 Hydrology and Calibration

12.1 Introduction

The hydrology used in this study can be categorised as follows:

- Calibration hydrology
  - 1974 - Primary Calibration Event
  - 1996 - Verification Event
- Flood Profiles Series
  - 10 events

The calibration hydrology was based on the Brisbane and Pine Rivers Flood Study (1994) undertaken by the State Government. The flood profiles series was based on hydrology from the ***Brisbane River Extreme Flood Estimation Study*** undertaken by WRM Water and Environment P/L (2007).

12.2 WT42D Hydrology Model

The Brisbane and Pine Rivers Flood Study (1994) used the WT42D hydrology model. This model was adopted for this study. The WT42D model is a rainfall routing model. Refer to Appendix G for further information on WT42D.

12.3 1974 - Primary Calibration Event

The January 1974 event was adopted as the 'primary' calibration event for this study. The 1974 event was a significant historical flooding event for the Brisbane River. It was classified as the major flooding event of the twentieth century and is also the most recent, occurring 35 years ago. Refer to Appendices C, H and I for details of the 1974 calibration methodology and results.

12.4 1996 - Verification Event

The May 1996 event was used as a 'verification' event only for this study. This flooding produced only minor flooding in Brisbane and there was less historical data available compared with the 1974 event. Accordingly a lesser weighting was placed on the calibration process and results from the 1996 event. Refer to Appendices C and J which contain the 1996 calibration methodology and results.

12.5 Outcomes of Hydrology and Calibration Process

The calibration process for this study was undertaken from August 2008 to March 2009 (refer to Appendix K for meeting dates) with results presented to stakeholders at the 5 March PCG meeting.

There was agreement at this meeting that a 2D calibrated Brisbane River PMF hydraulic model had been developed and is 'acceptable' for the purposes of this study.

12.6 Flood Profile Series

The Flood Profile Series was based on hydrology from the ***Brisbane River Extreme Flood Estimation Study (2007)*** conducted by WRM P/L and is listed in Table 3.

Table 3: Flood Profile Series

Flood Profile	Peak Discharge at the Port Office Gauge (m^3/s)	Approximate Event
Minor Event		
1.	**3,000**	
Moderate Event		
2.	**4,000**	
3.	**5,000**	
Major Event		
4.	**7,000**	**DFE**
5.	**9,000**	
6.	**10,000**	**1974 historical event**
Extreme Event		
7.	**12,000**	**1893 historical event**
8.	**15,000**	
9.	**21,000**	
10.	**38,000**	**PMF**

The Flood Profile Series hydrology is based on only one type of storm; namely, one being centred over the Brisbane River catchment. Naturally any number of different storms can occur within the Brisbane River during a river flood event with 'catchment variability' related to:

- rainfall spatial patterns
- rainfall temporal patterns
- rainfall intensity and peak storm bursts
- antecedent conditions

Therefore it is recommended that the future revision of the flood emergency response tools takes into account 'catchment variability'. In the future it is envisaged that the 'interactive' flood emergency response tools would take BOM predictions of rainfall and flood levels during the flooding event and translate these into mapping products (similar to those pre-prepared as part of this project). Such works are beyond the scope of this study.

13.0 Deliverables

13.1 Introduction

The flood response tools developed as part of this study were subjected to a detailed scoping and review process which was conducted from October 2008 to June 2009 and involved (ten) 10 separate meetings as detailed in Appendix L. The purpose of these meetings was to scope and produce mapping deliverables suitable for the end user now and in the future. The meetings addressed the following issues:

- Update on modelling process and progress
  - Calibration
  - Flood profiles
- For each response tool produced the following criteria were considered
  - Ease of interpretation
  - End user and operational suitability
  - SES, ECC and FIC suitability
  - Possible future applications of response tools (i.e. internet and community)
  - Community use and education
  - Electronic and hardcopy use of the data
  - Contingency requirements
  - Maintenance requirements

13.2 Final Products

Flood emergency response tools from the project include 85 maps. These are listed in Table 4 and are attached in Appendix A.

Table 4: Deliverables

Deliverable	Product	Figure Numbers
Inundation mapping	One key map and three sub-area maps (west, south, east) Total: 10 key maps and 30 sub-areas maps	101-140
Critical infrastructure mapping & reporting	Three example maps 10 digital GIS layers corresponding to each flood profile	141-143
Isolated areas	One key map	144
Evacuation zone mapping	One key map and three sub-area maps (west, south, east) Total: 10 key maps and 30 sub-areas maps 1 combined key map	145-184 185

Note: For reporting purposes, the majority of mapping deliverables are printed as 'ISO A3' (210mm x 297mm) attachments in Appendix A. However the majority of mapping deliverables are intended to be viewed as 'ISO A0' (841mm x 1189mm) and so explains the small font size in Appendix A

14.0 Conclusions

A 2D hydraulic TUFLOW model has been developed for the Brisbane River. The model extents encompass the Brisbane River floodplain from Wivenhoe Dam to Moreton Bay, and this area is approximately 4,500 square kilometres or approximately one third of the total Brisbane River catchment which is 13,500 square kilometres. The development of this 2D 'mega model' is considered a significant technical achievement.

Overall this project represents a significant improvement in the flood response capability of the Council. However in the context of educating and preparing the Brisbane community for a major flooding event there is certainly much more work to be undertaken. These works have been identified in Section 15.0.

The project success factors established for this project have been achieved and include:

- A 2D calibrated Brisbane River PMF hydraulic model has been produced and deemed acceptable when peer reviewed by stakeholders

- Model outputs have been translated into flood response tools and mapping deliverables which can be utilised for flood disaster and emergency response planning specifically these deliverables include:

    - Inundation mapping
    - Critical infrastructure mapping and reporting
    - Isolated areas mapping
    - Evacuation zone mapping

- The community of Brisbane are better informed and are able to respond more effectively in the event of a Brisbane River flood as a result of the above works

- Relevant actions and outcomes of the Council's ***Corporate Plan (2008-2012)*** and ***Lord Mayor's Taskforce on Suburban Flooding (2005)*** are addressed

15.0 Recommendations

Recommendations from this project relate to future works and include:

1. Incorporate the Council's new survey data (available in late 2009) with subtasks as follows:
    - Revise the digital terrain model (DTM) used in this study with the latest information
    - Rerun the calibration events
    - Check and modify model parameters as necessary to achieve calibration
    - Rerun the flood profiles
    - Reproduce the deliverable and digital mapping layers
    - Produce a succinct addendum report

2. Incorporate the results of the project as part of the Council's Disaster Management Planning; ***Threat Specific Plan for River Flood and Storm Surge Event (2008)***.

3. Develop a community safety education campaign that integrates the outcomes of this project and other related projects (for example, 'Be FloodWise Campaign'), the focus of which should relate to the publishing and use of the project deliverables in the public domain and on the Council's website. This will improve awareness to river flooding and empower the community to self-assess individual flood risk and make appropriate and safe decisions during a river flooding event.

4. Deliver training for SES, ECC, FIC, senior management and other identified personnel within the Council in the use and application of the flood emergency response tools.

5. Investigate 'innovative ways' that the results of this project can be applied to improve the interpretation across the various disciplines within the Council. For example, overlaying the flood profiles and associated flood surfaces on 3D models of the city or utilising available technologies that modify flood surfaces according to predictions from the BOM. Both these examples would provide a greater understanding of a major river flood and provide an advanced flood response tool to allow interpretation of forecasts.

6. Annually review the outcomes of this study to integrate new initiatives and developments. These include:
    - the Draft SEQ regional plan 2009-2031
    - climate change
    - advancements in technology
    - changes in the operational requirements of the 'end user'
    - improvements to the format, style and required output of the mapping deliverables
    - changes in the input data (such as improved survey data or hydrology inputs)
    - the availability of additional calibration events

7. Investigate possible external revenue options through State and Commonwealth Government grants to fund eligible and related future works.

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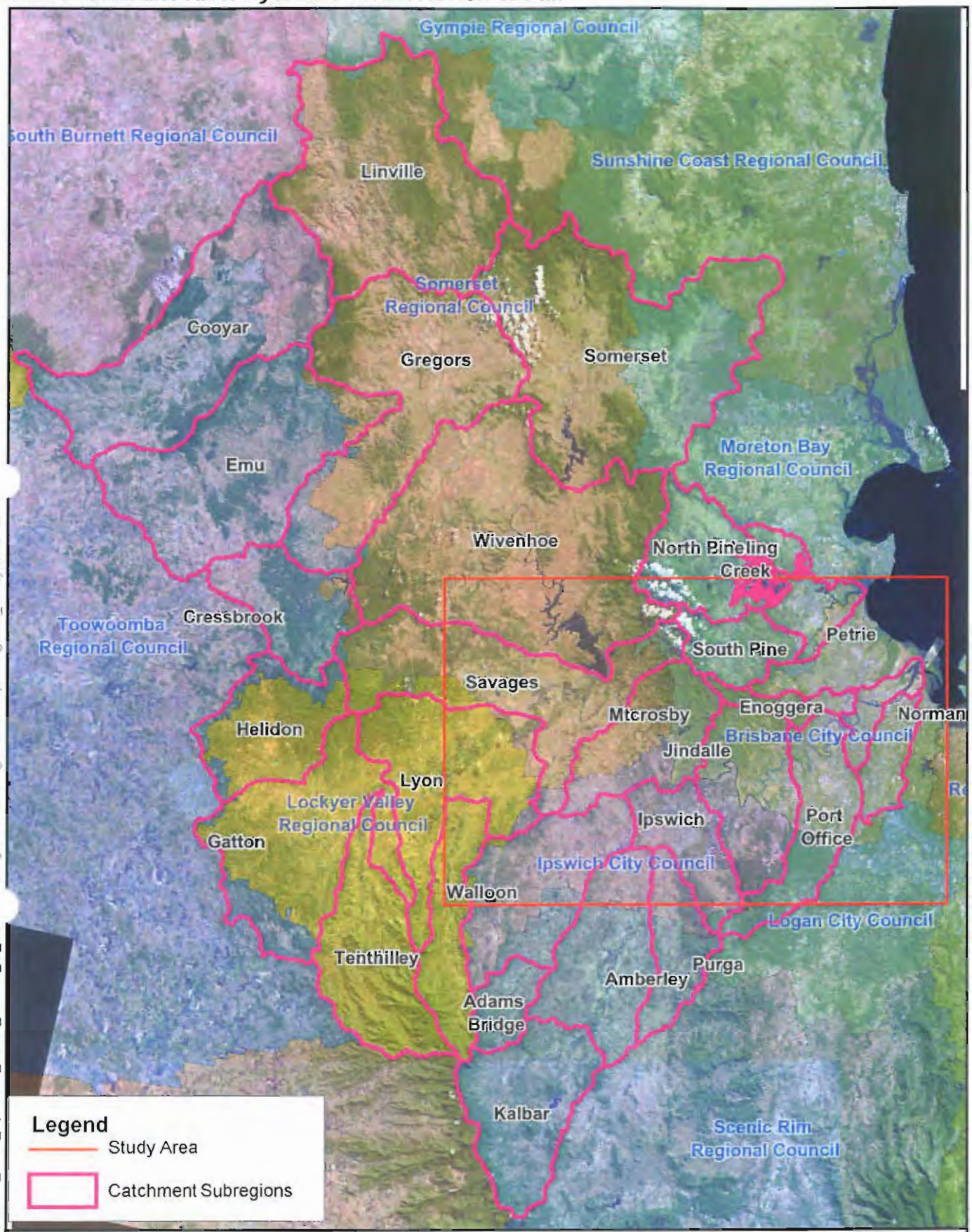

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Brisbane River Catchment with Study Area

Figure 1

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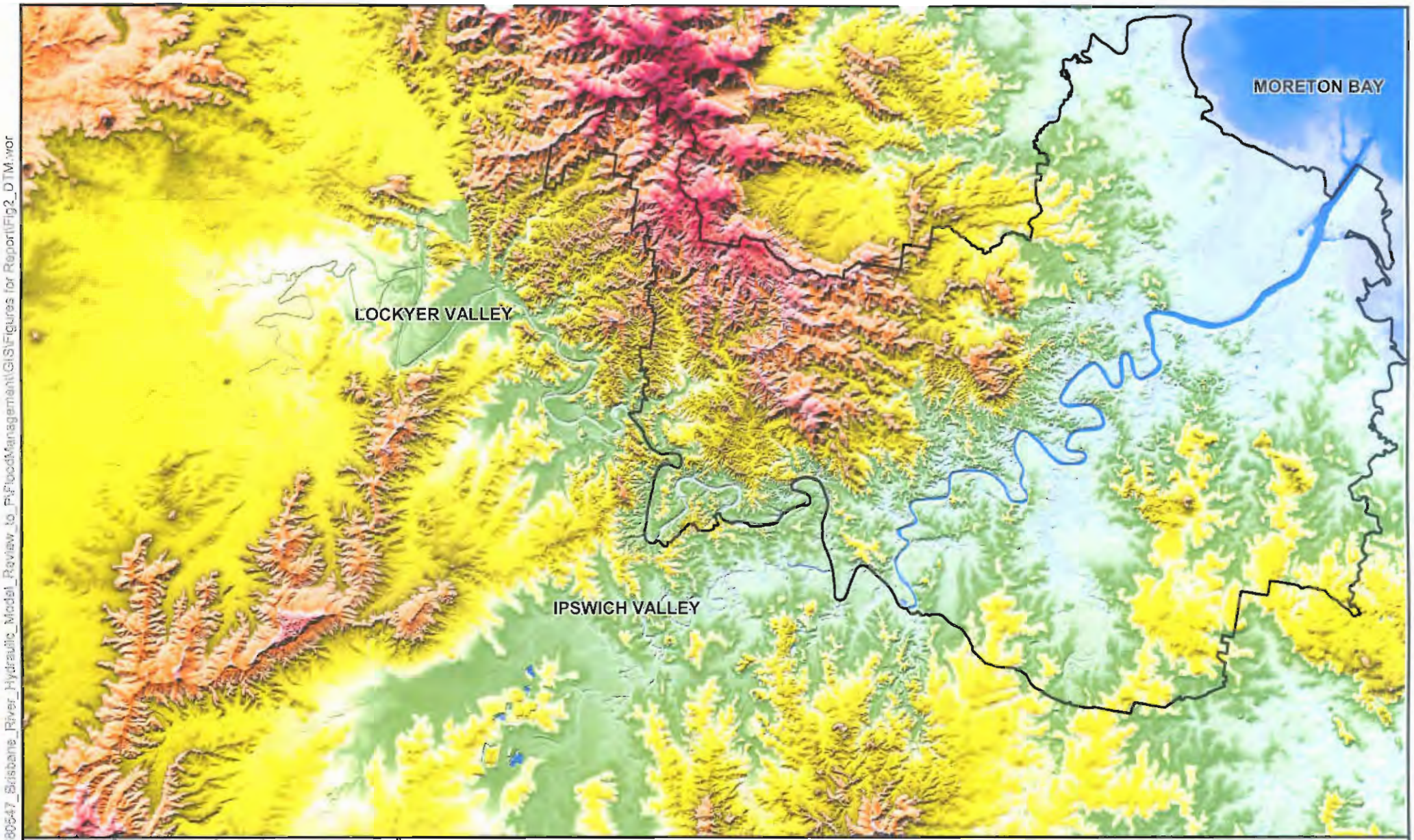

Digital Terrain Model (DTM) for Study Area

Figure 2

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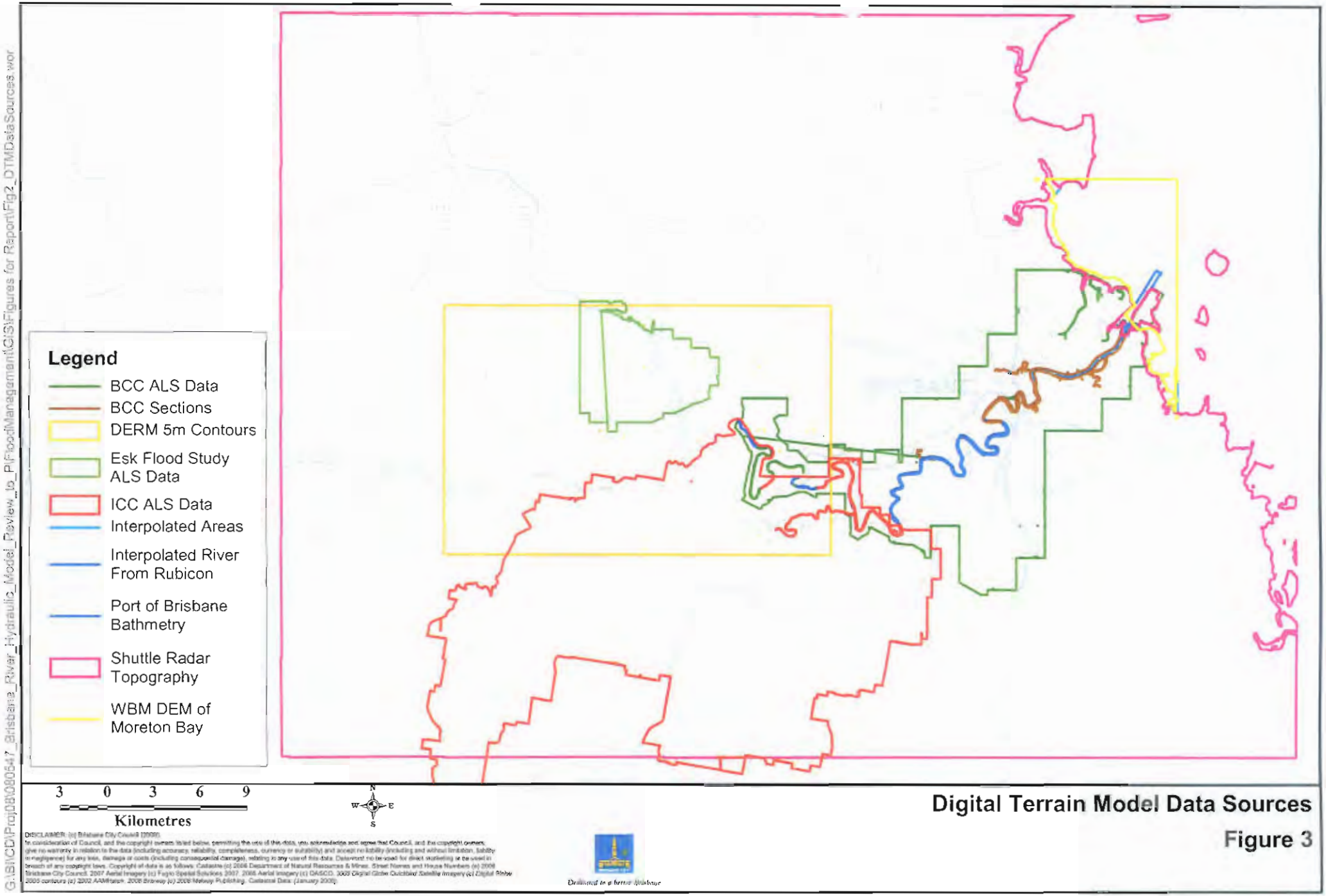

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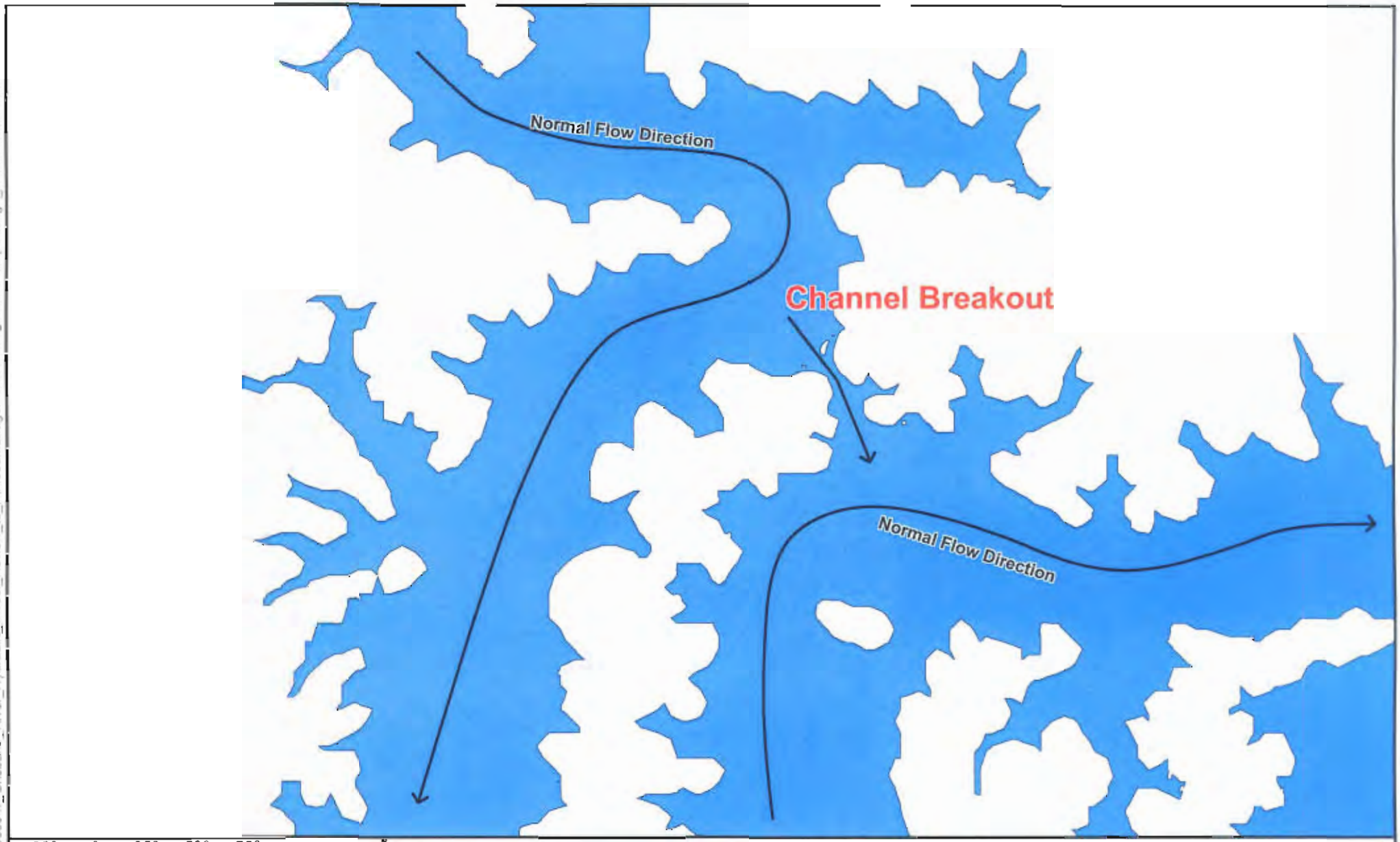

Example of a River "Channel Breakout"

Figure 4

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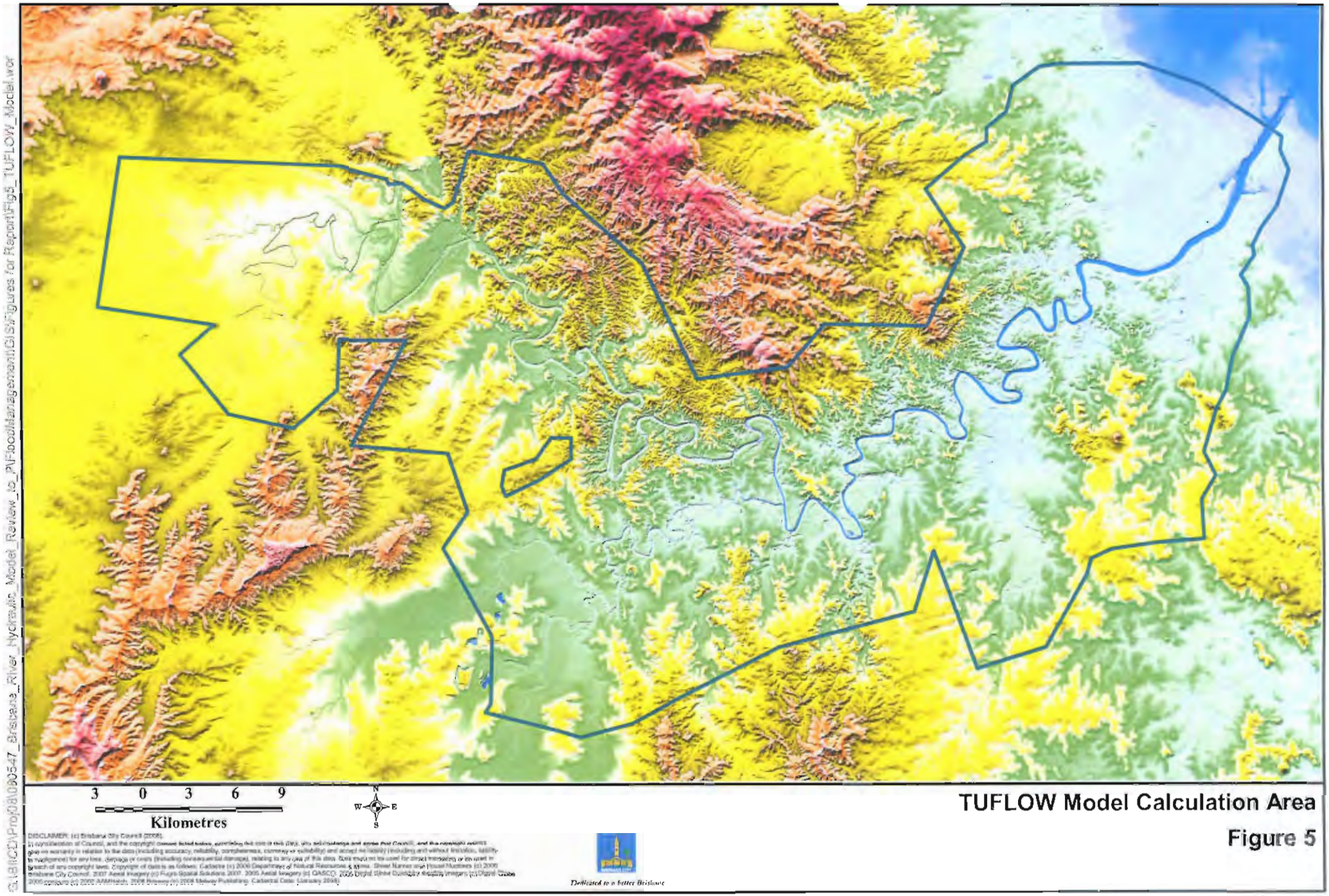

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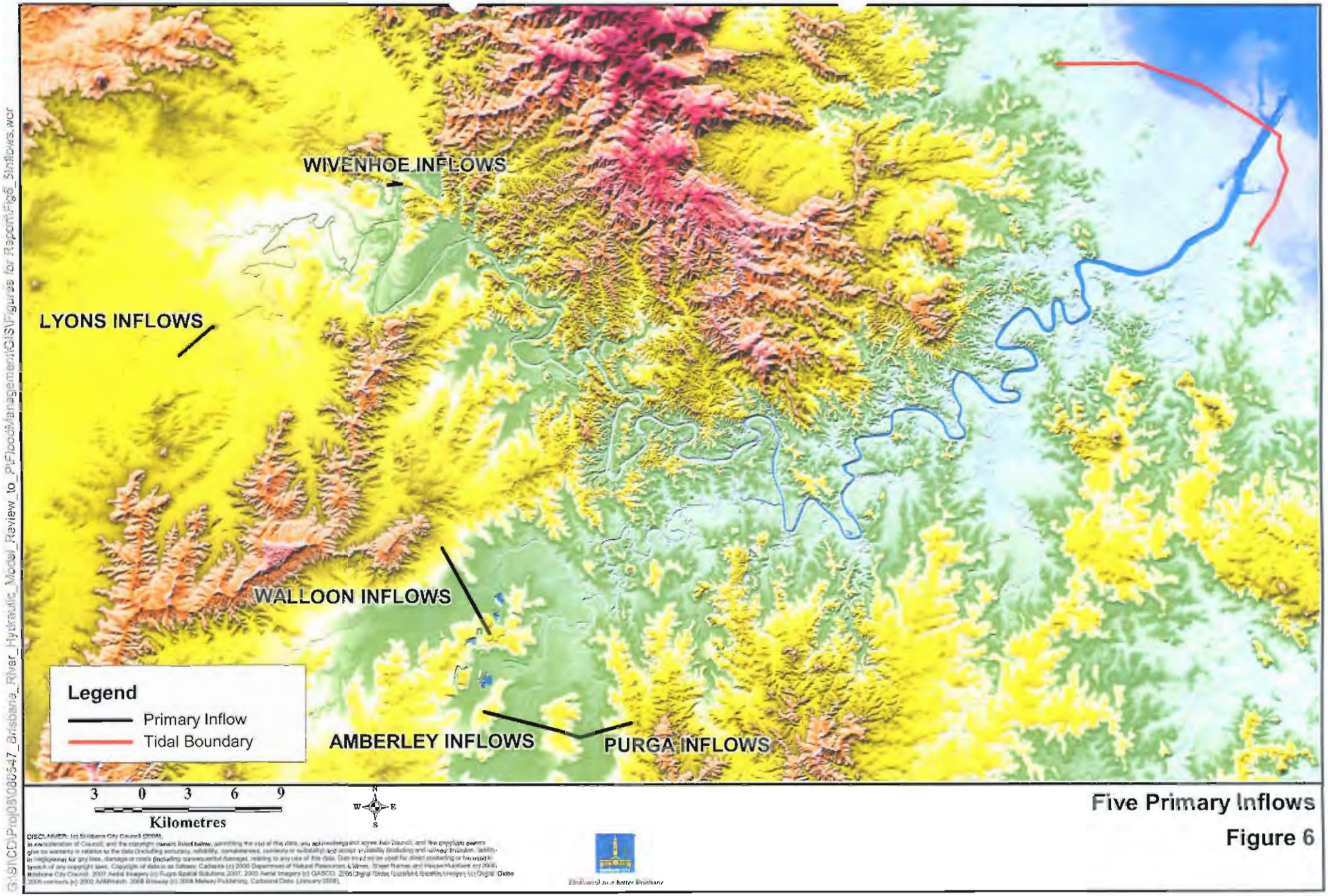

Five Primary Inflows

Figure 6

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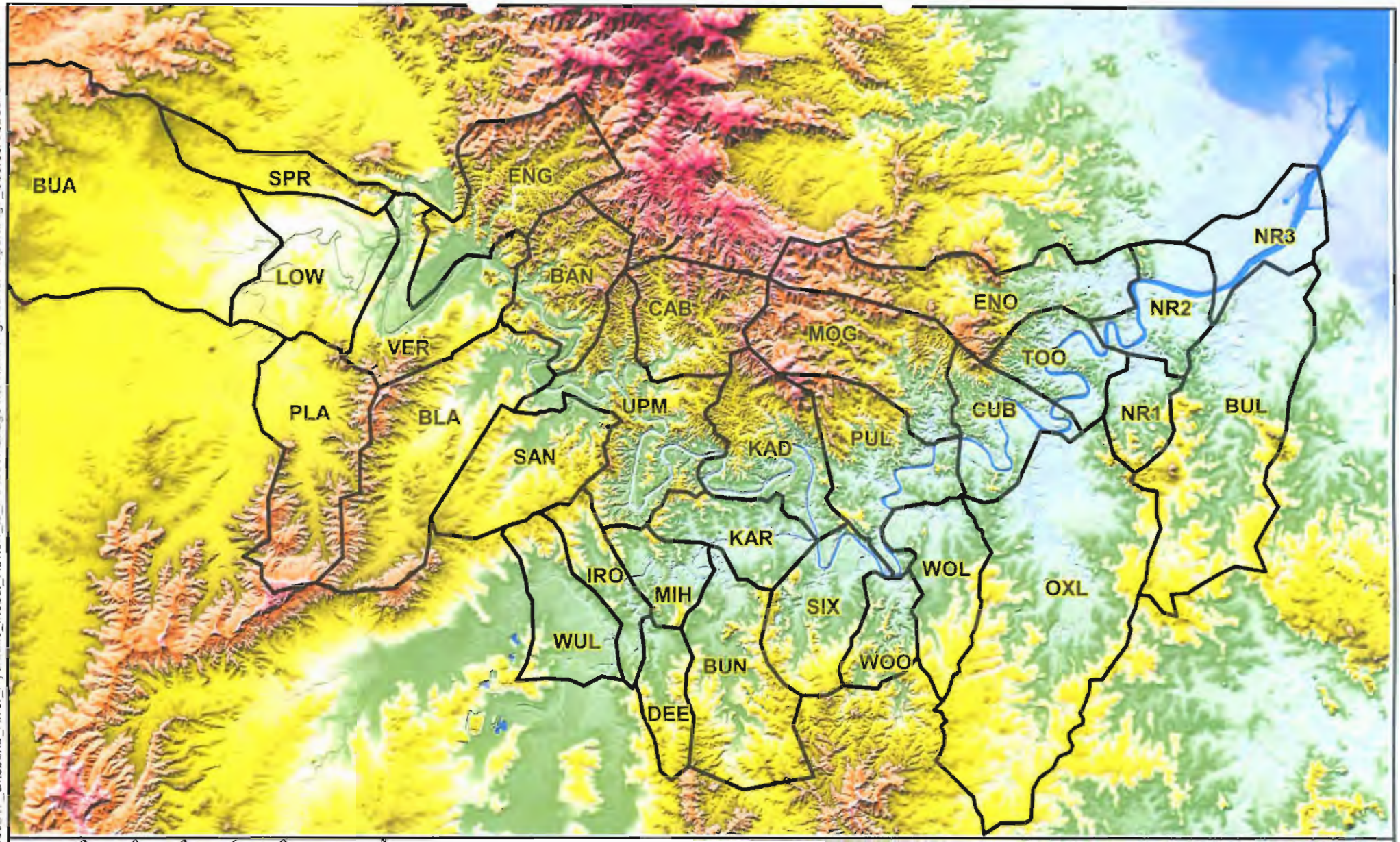

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2D Source of Areas - Calibration Model

Figure 7

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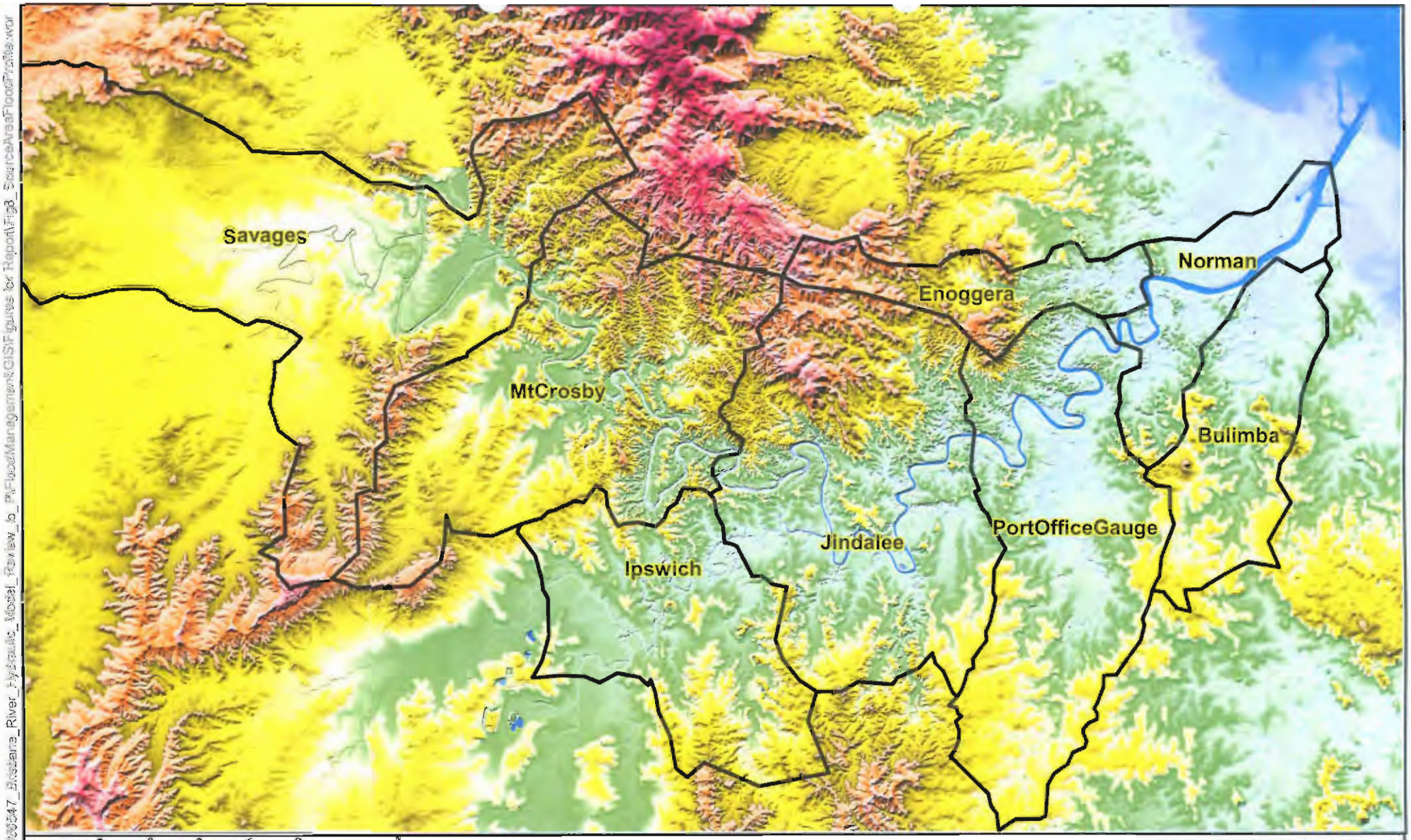
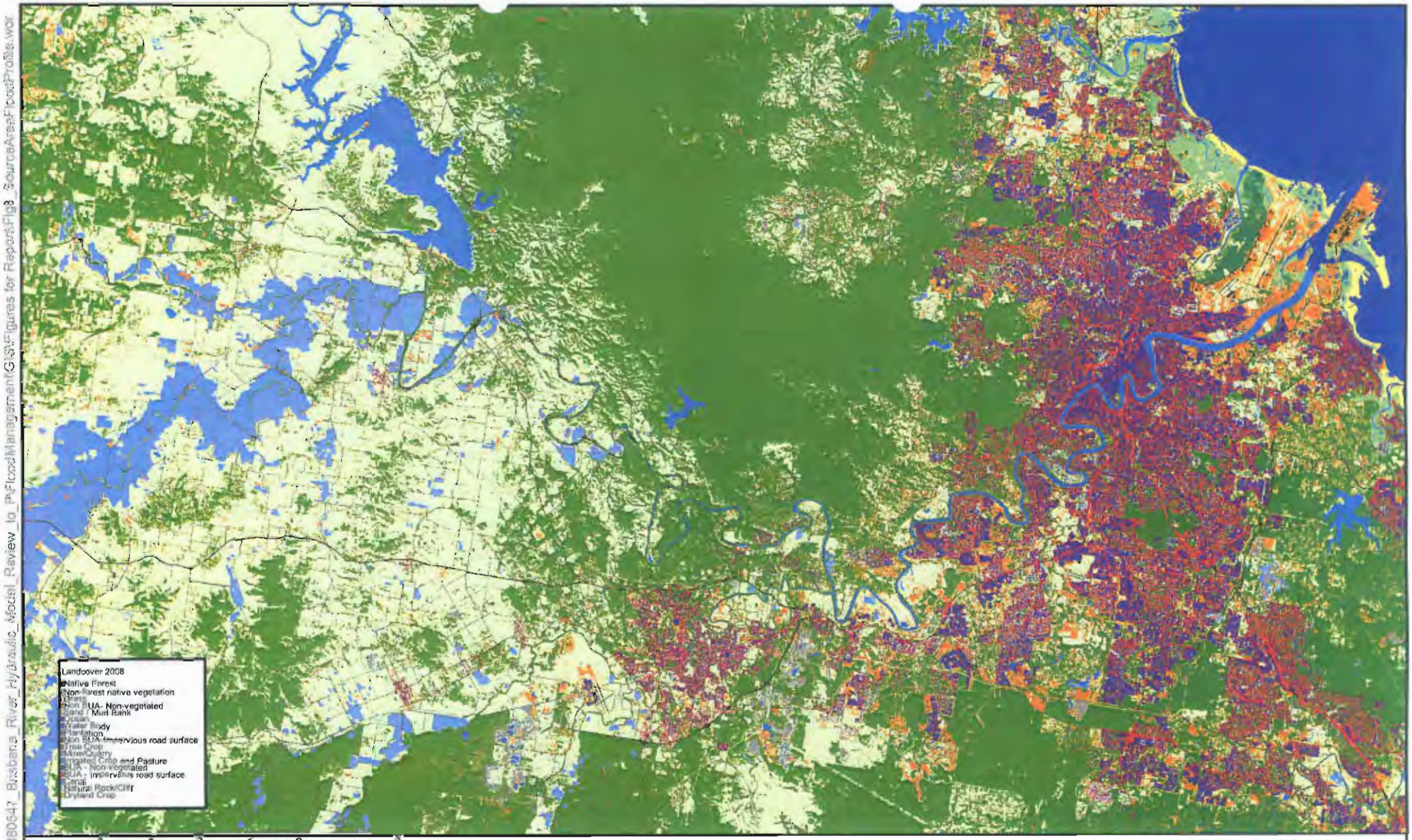


2D Source of Areas - Flood Profile Model

Figure 8



Example of Land Cover Data

Figure 9

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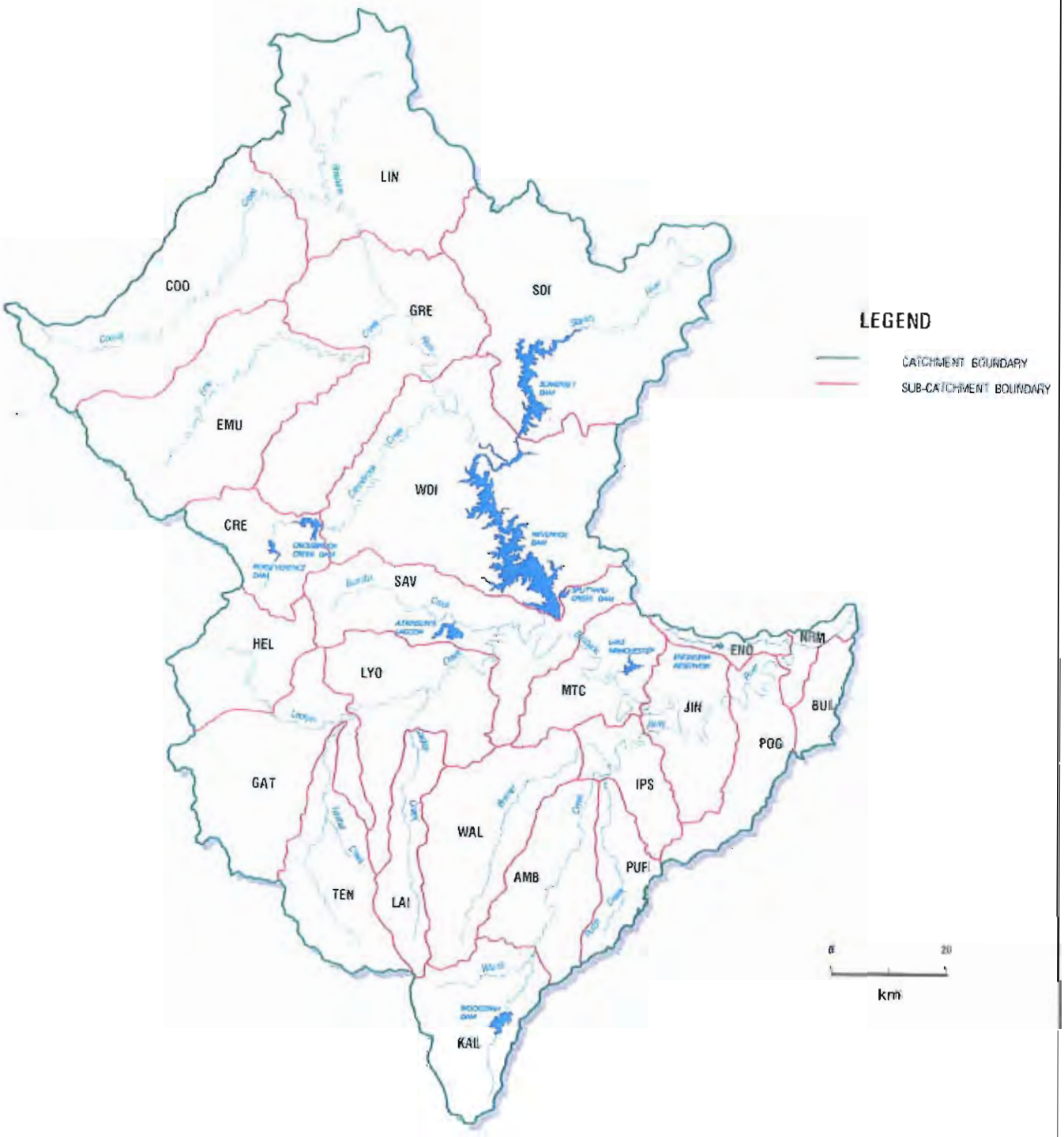

Image from "Brisbane River and Pine Rivers Flood Study" (1994), SEQWB

10 0 10 20 30
Kilometres

WT42D Model Region Subdivision

Figure 10

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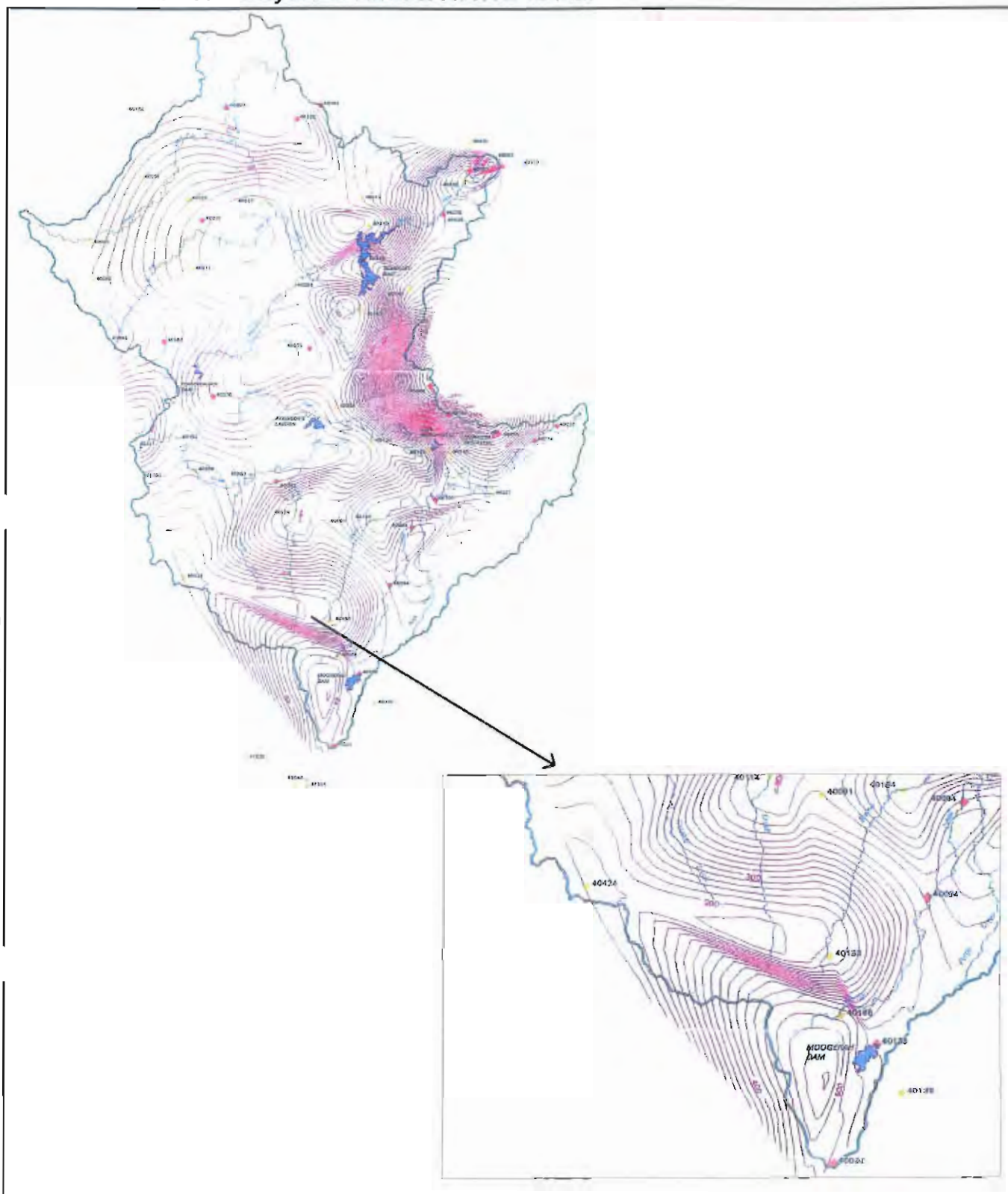

Image from "Brisbane River and Pine Rivers Flood Study" (1994), SEQWB

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1974 Rainfall Isohyets

Figure 12

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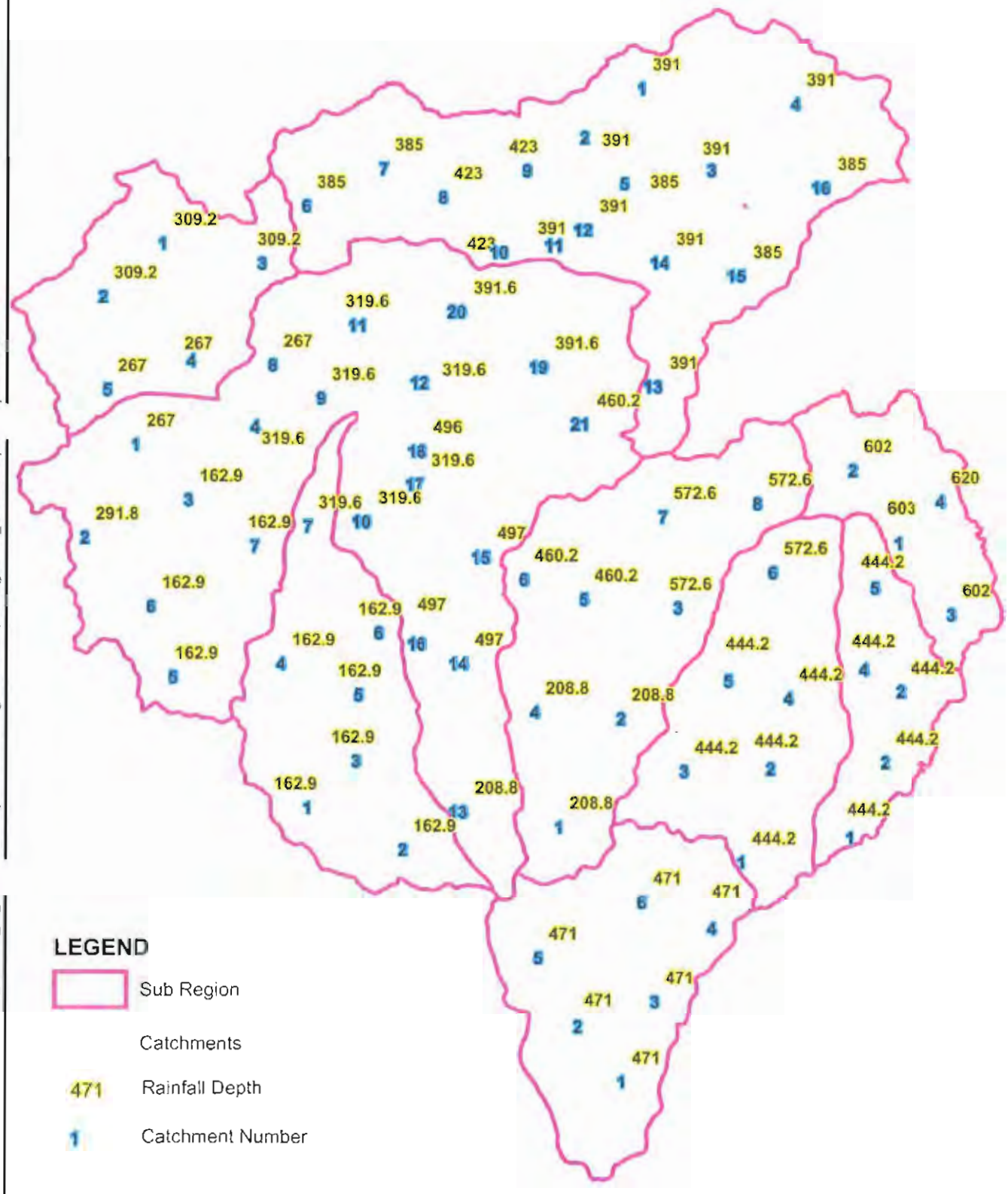

WT42D 1974 Rainfall Depths for Lockyer Creek and Bremer River - Original

Figure 13

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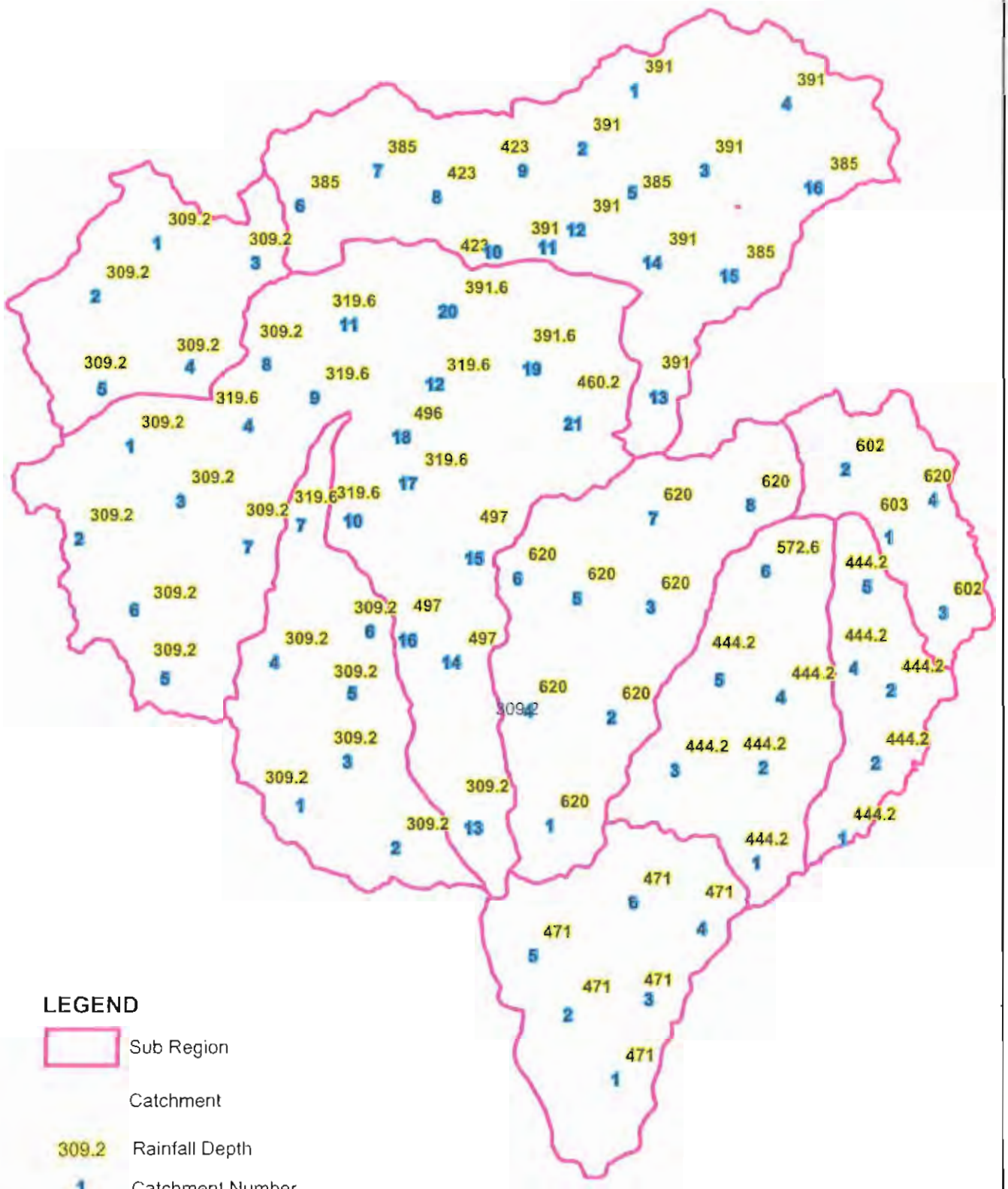

WT42D 1974 Rainfall Depths for Lockyer Creek and Bremer River - Modified

Figure 14

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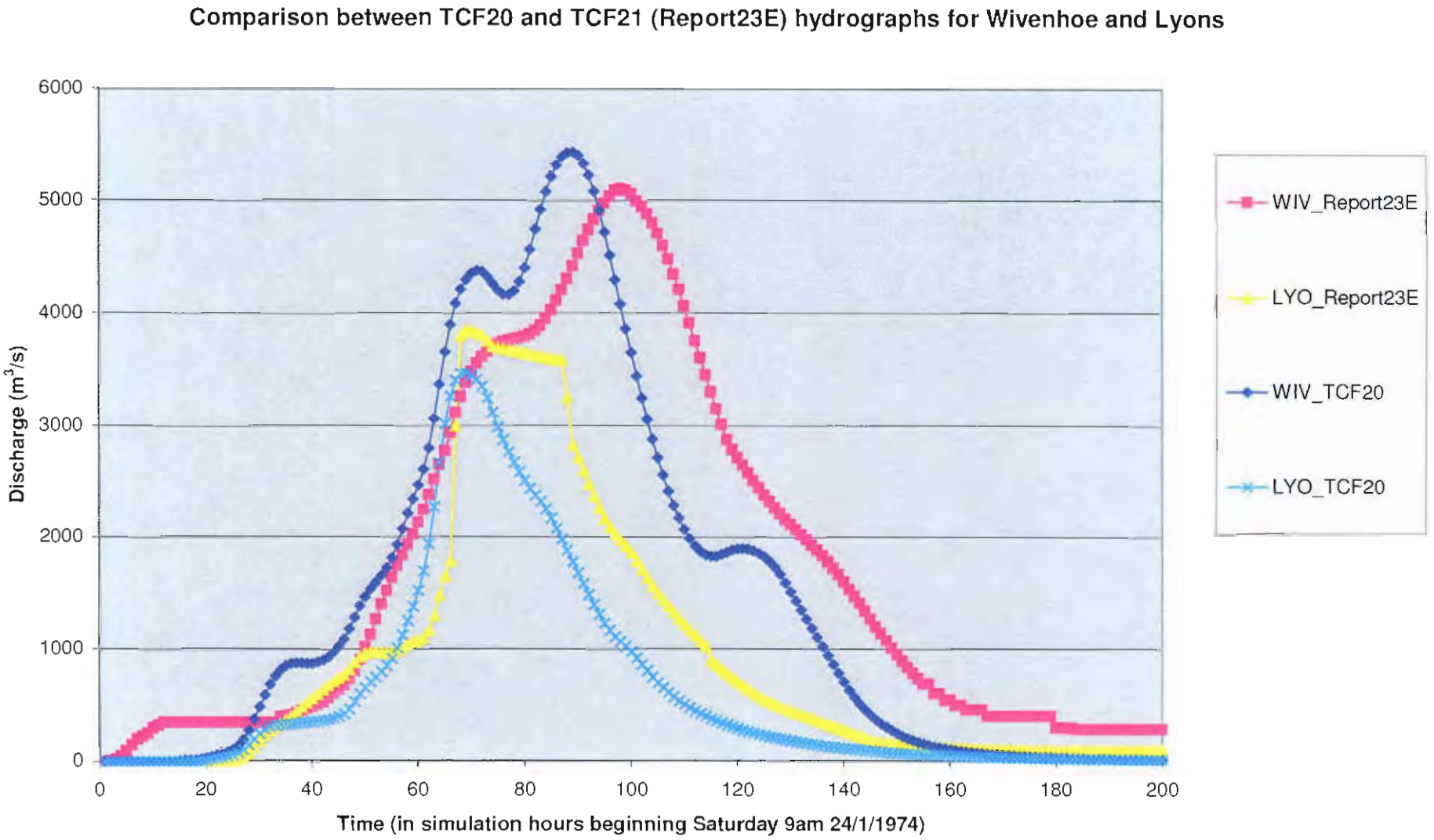


Figure 15: Comparison of Primary Inflow Hydrographs (Wivenhoe and Lyons)

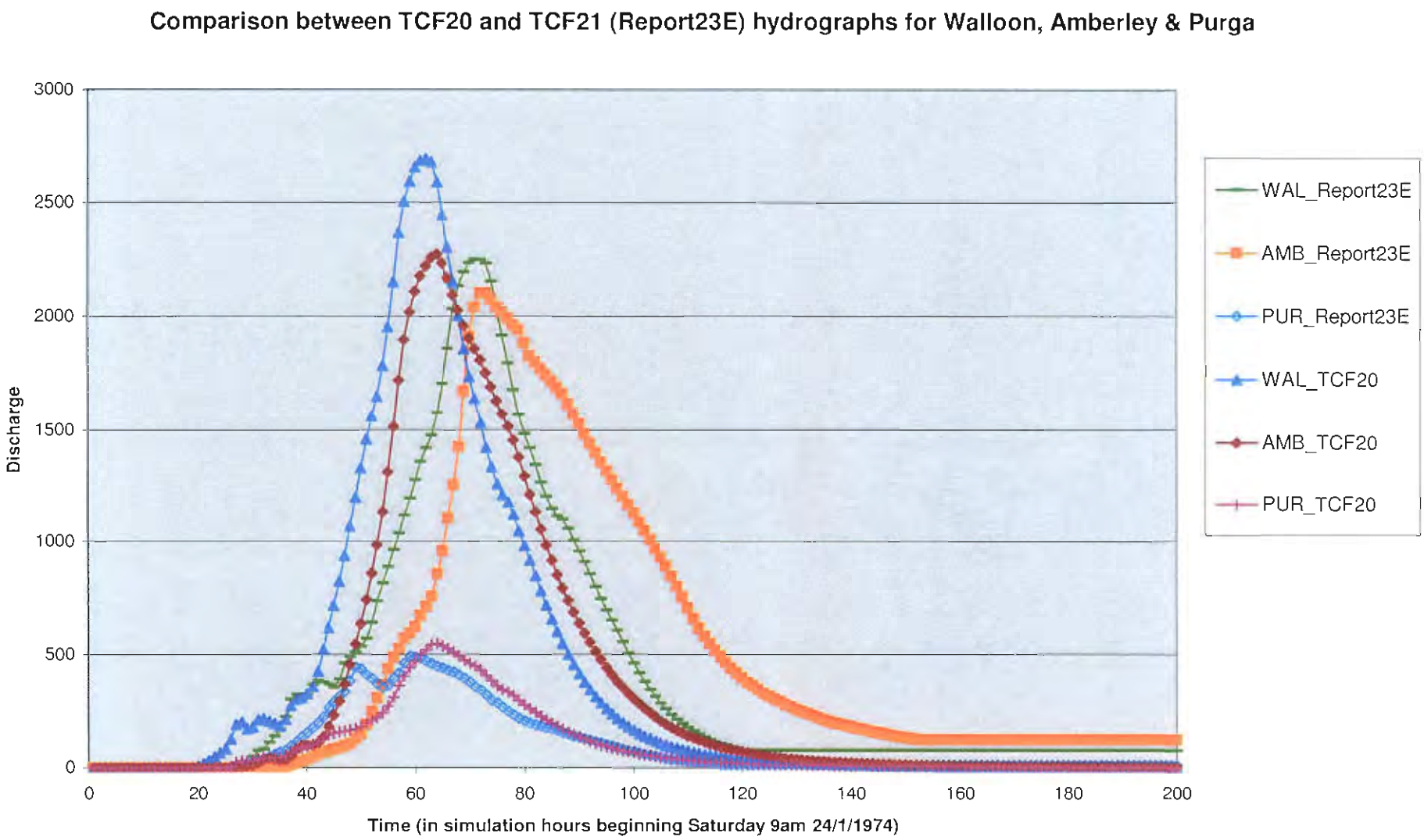
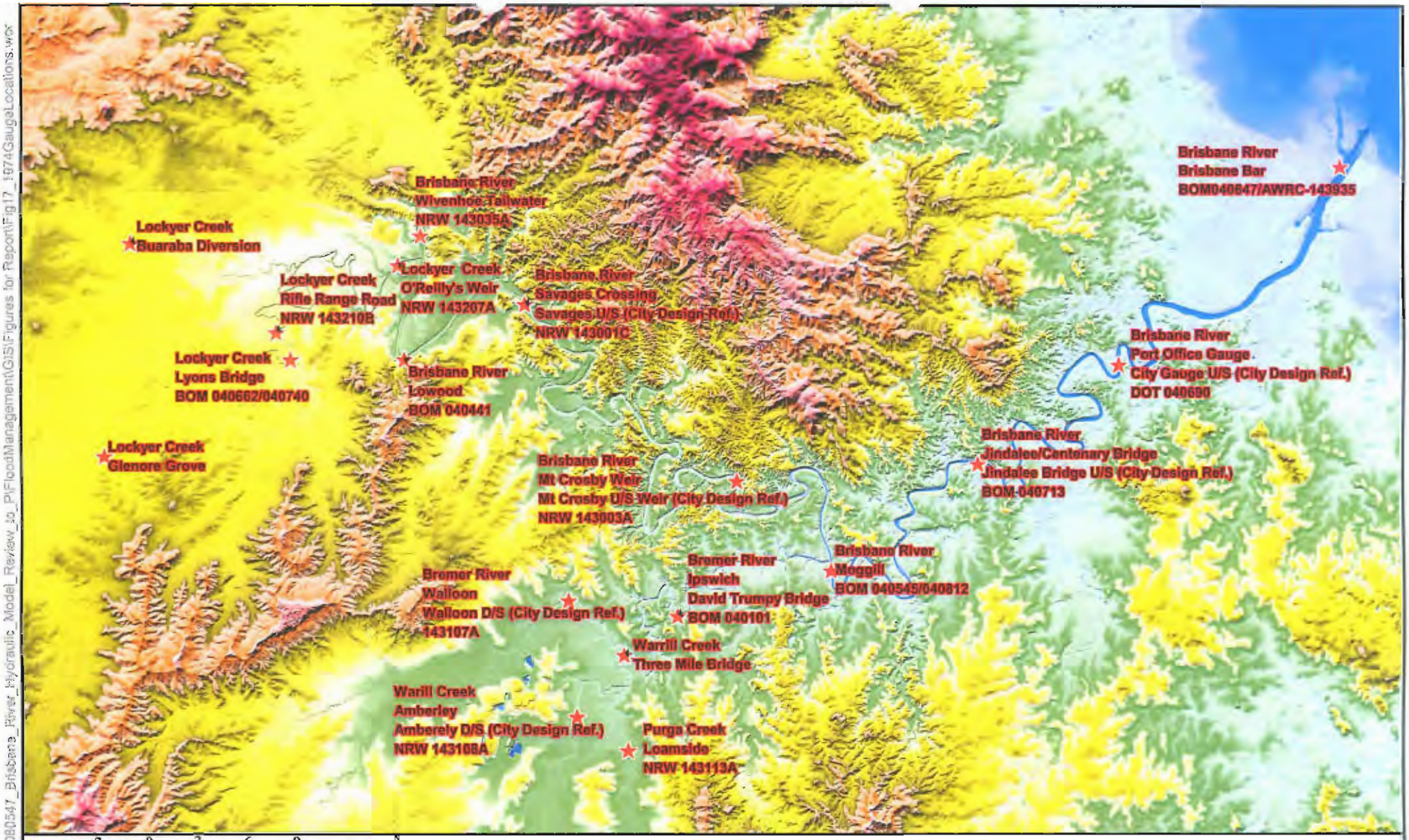


Figure 16: Comparison of Primary Inflow Hydrographs
(Walloon, Amberley and Purga Inflows)



1974 Calibration - Gauge Locations

Figure 17

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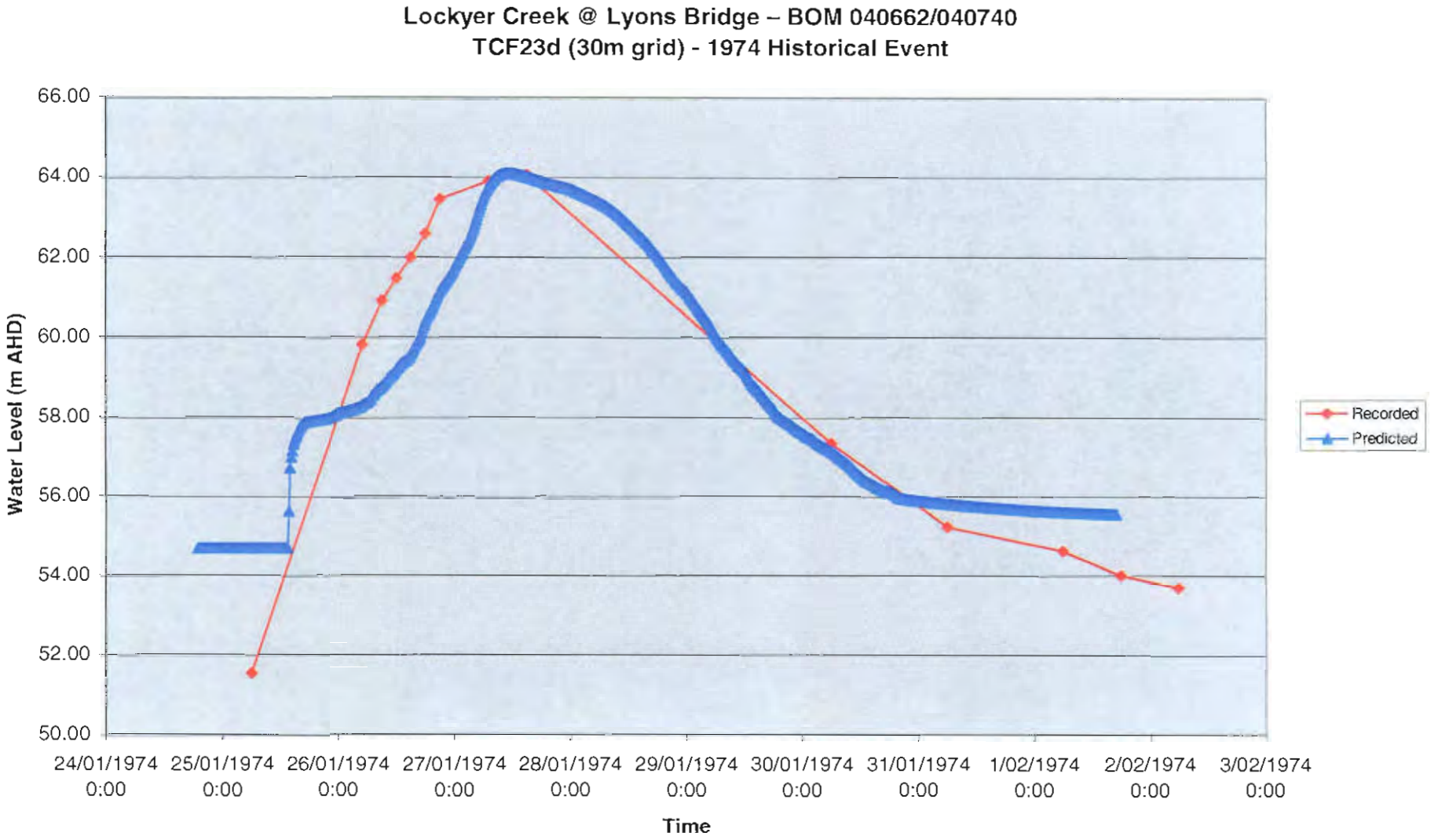


Figure 18: Lockyer Creek @ Lyons Bridge - Water Level Comparison

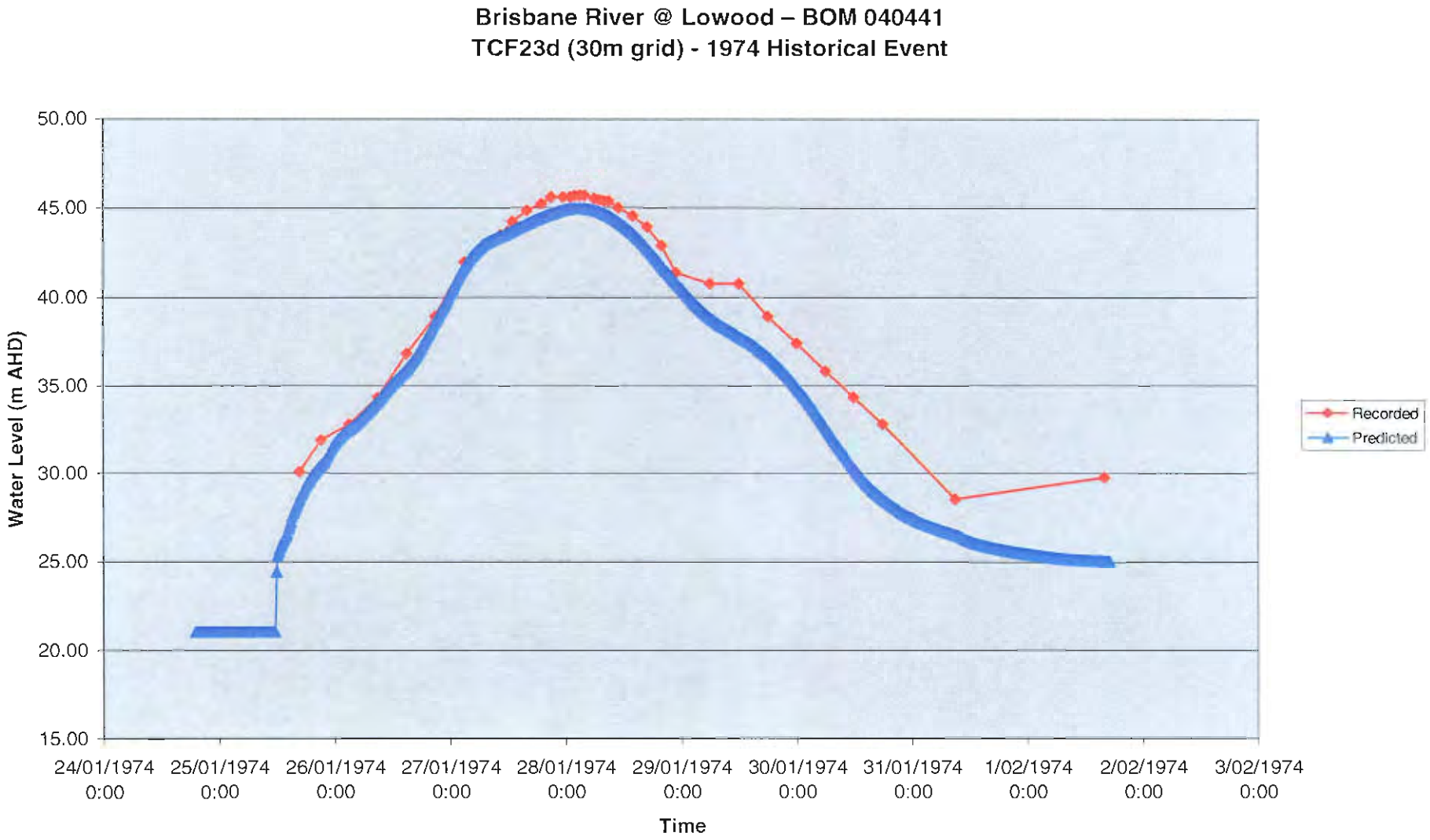


Figure 19: Brisbane River @ Lowood - Water Level Comparison

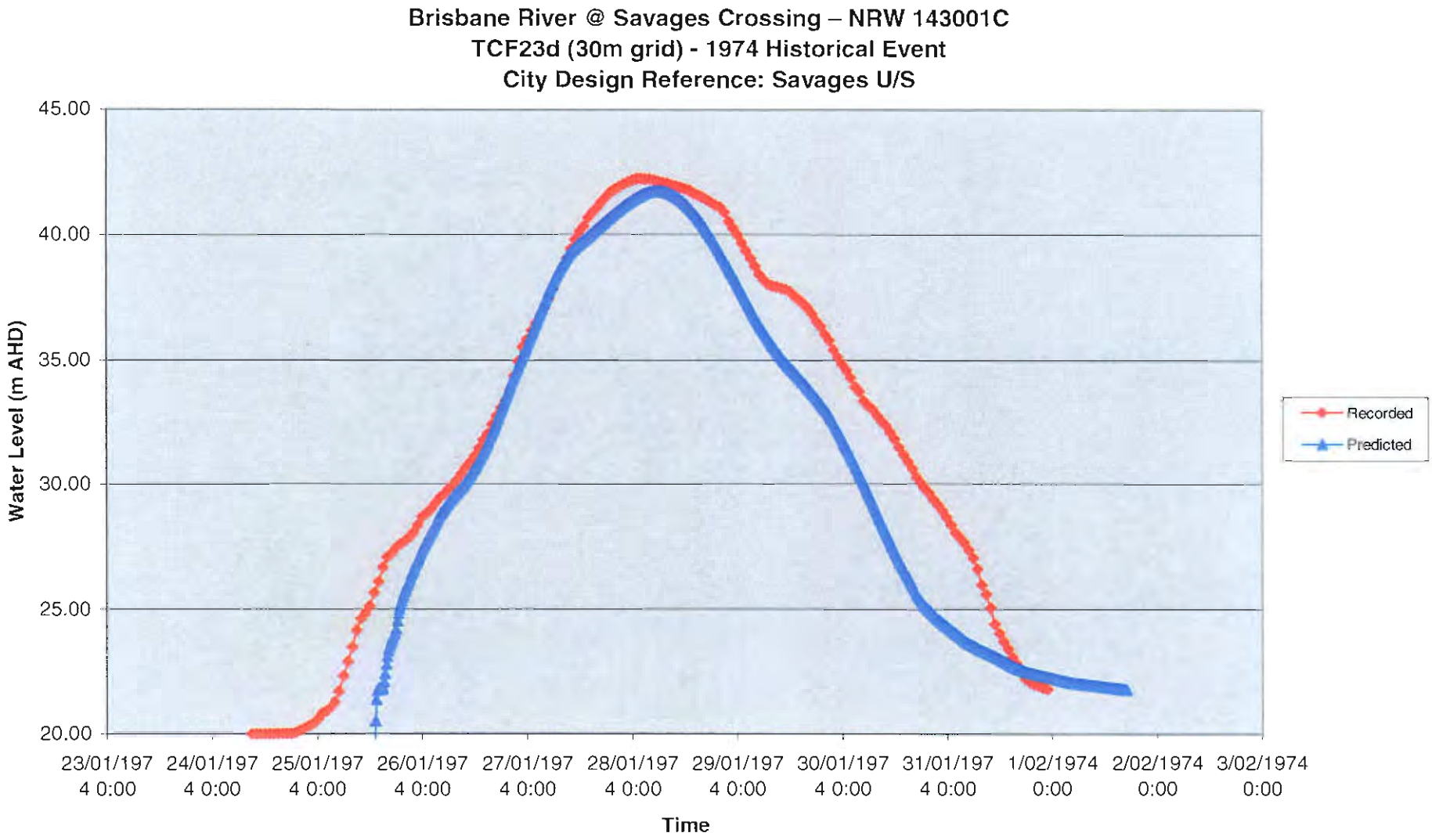


Figure 20: Brisbane River @ Savages Crossing - Water Level Comparison

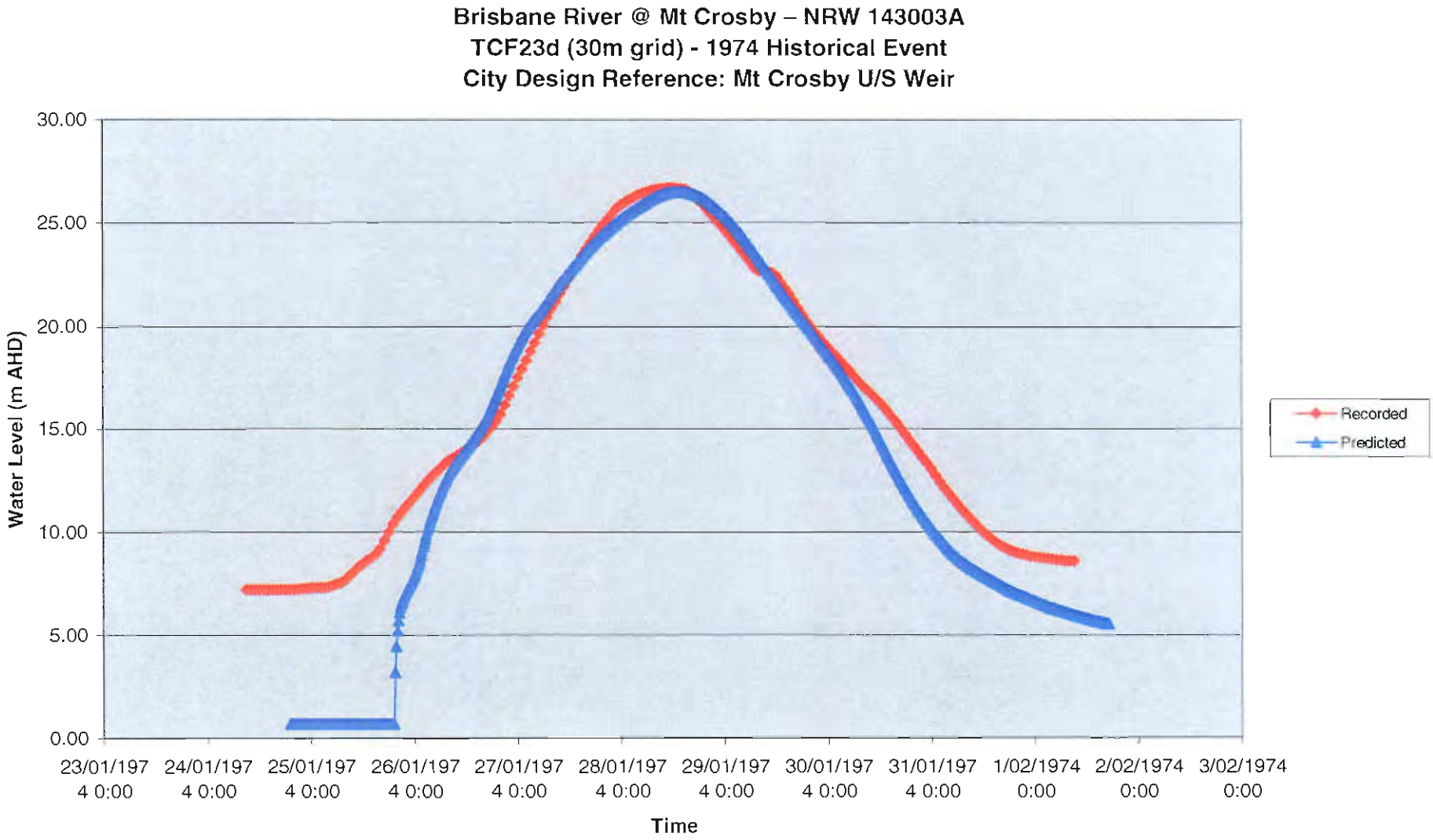


Figure 21: Brisbane River @ Mt Crosby - Water Level Comparison

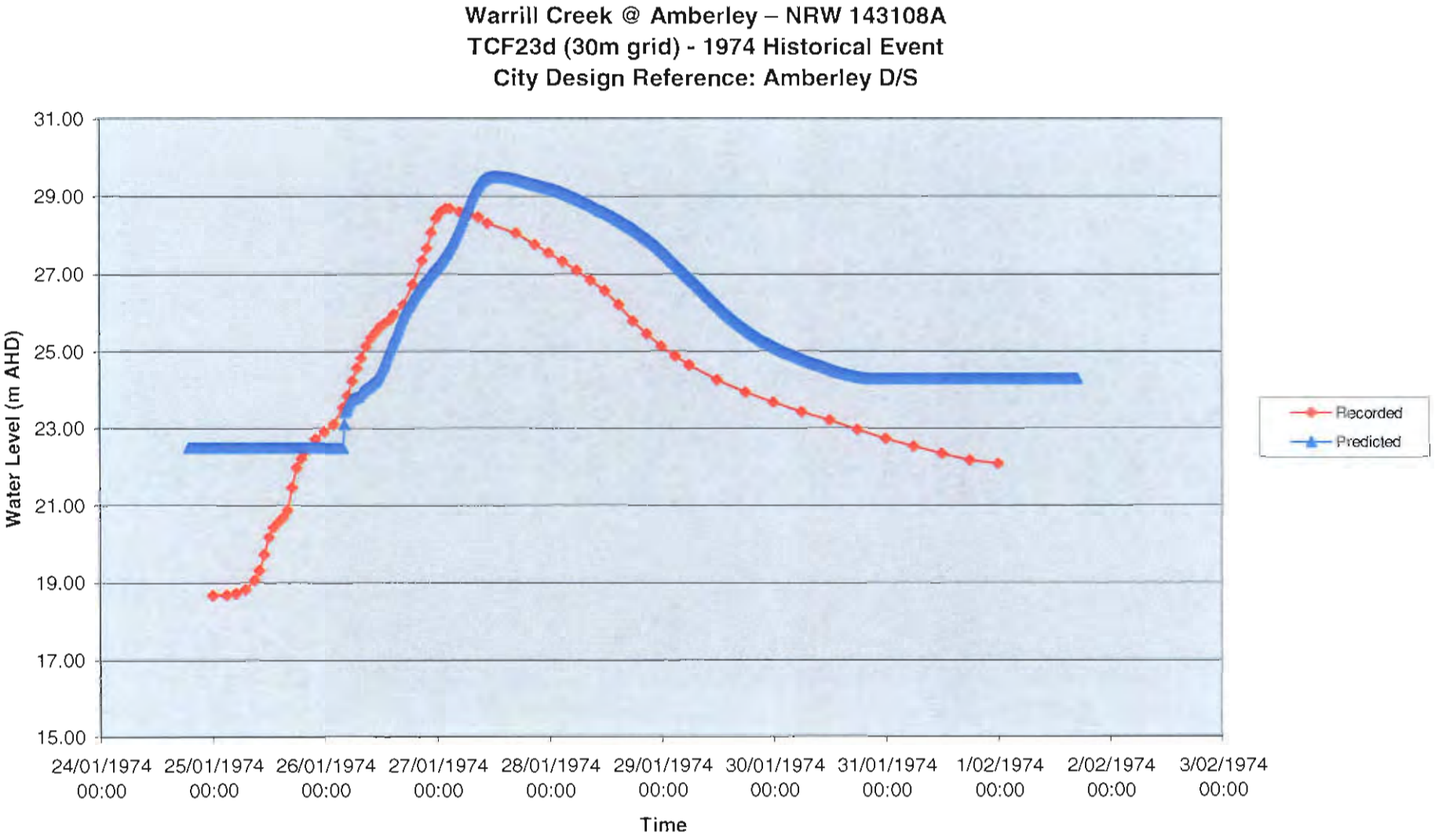


Figure 22: Warrill Creek @ Amberley - Water Level Comparison

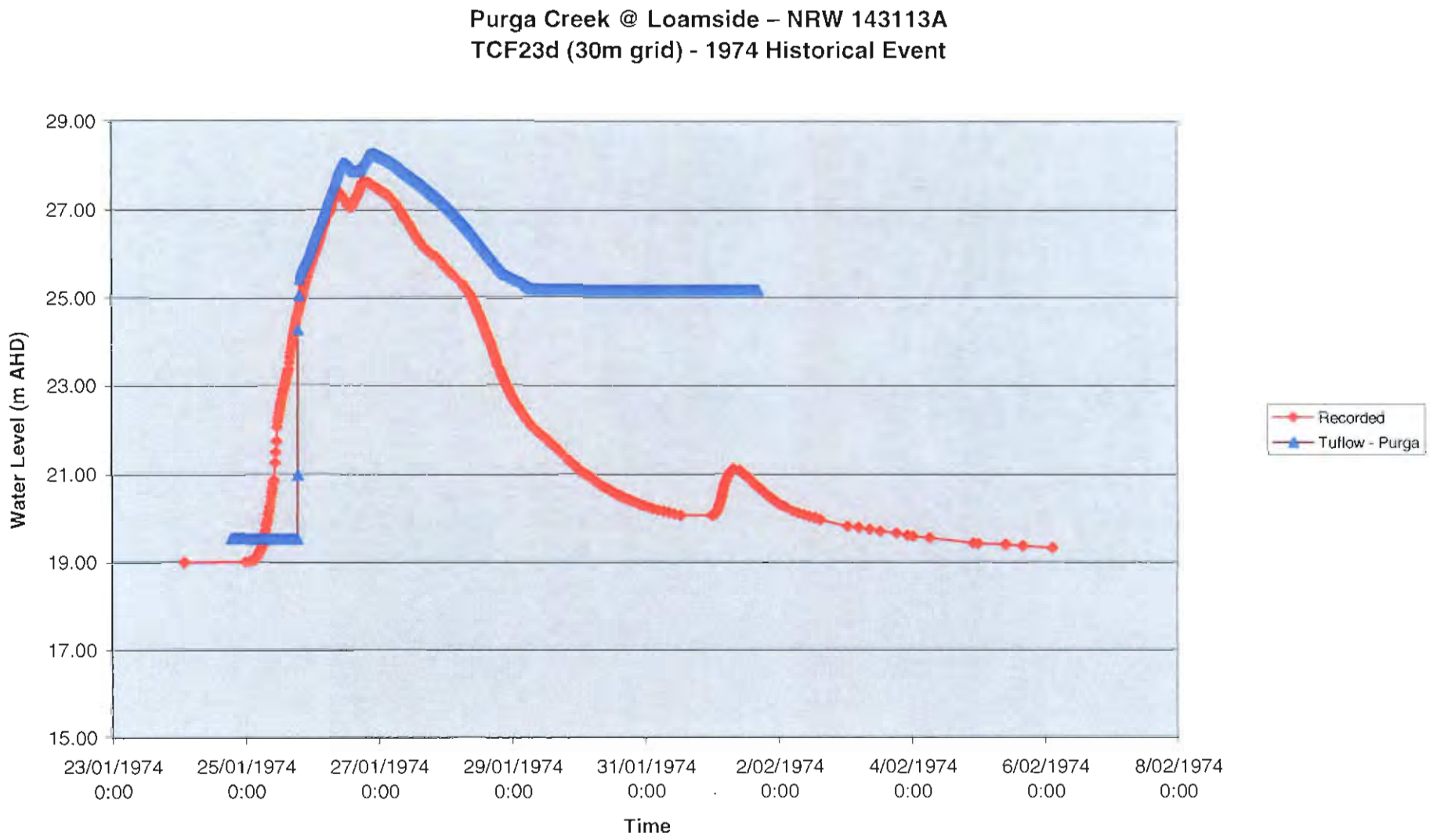


Figure 23: Purga Creek @ Loamside - Water Level Comparison

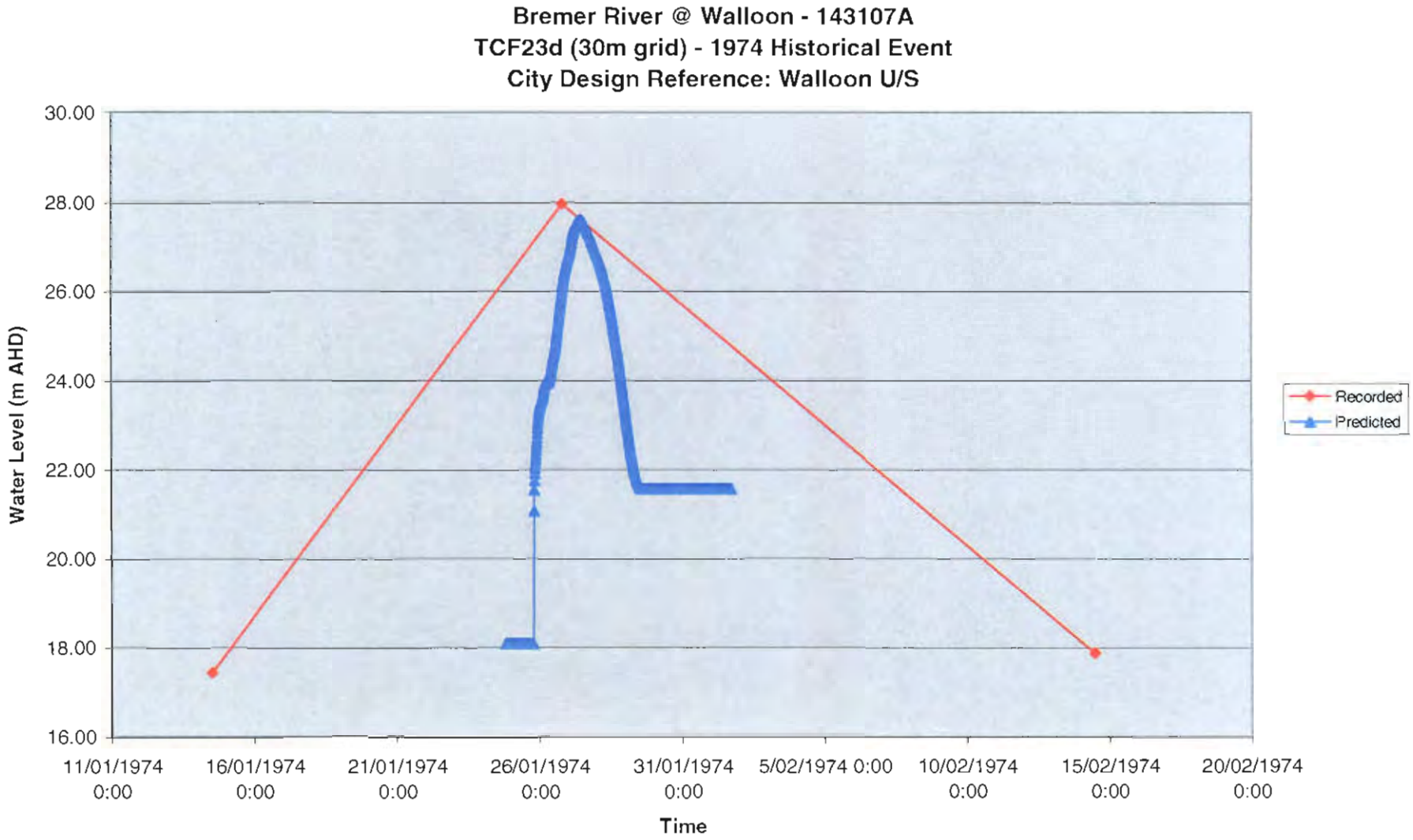


Figure 24: Bremer River @ Walloon - Water Level Comparison

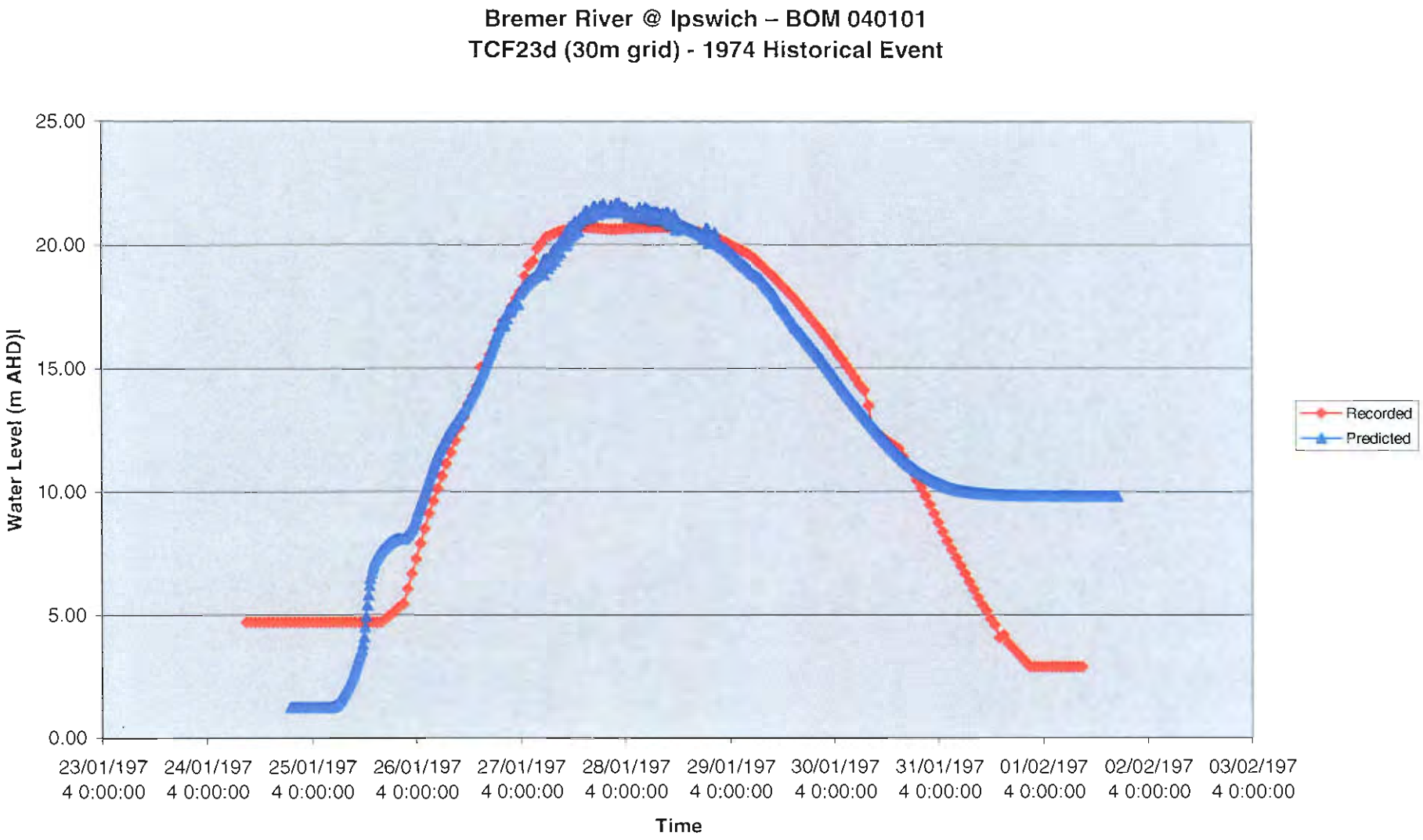


Figure 25: Bremer River @ Ipswich - Water Level Comparison

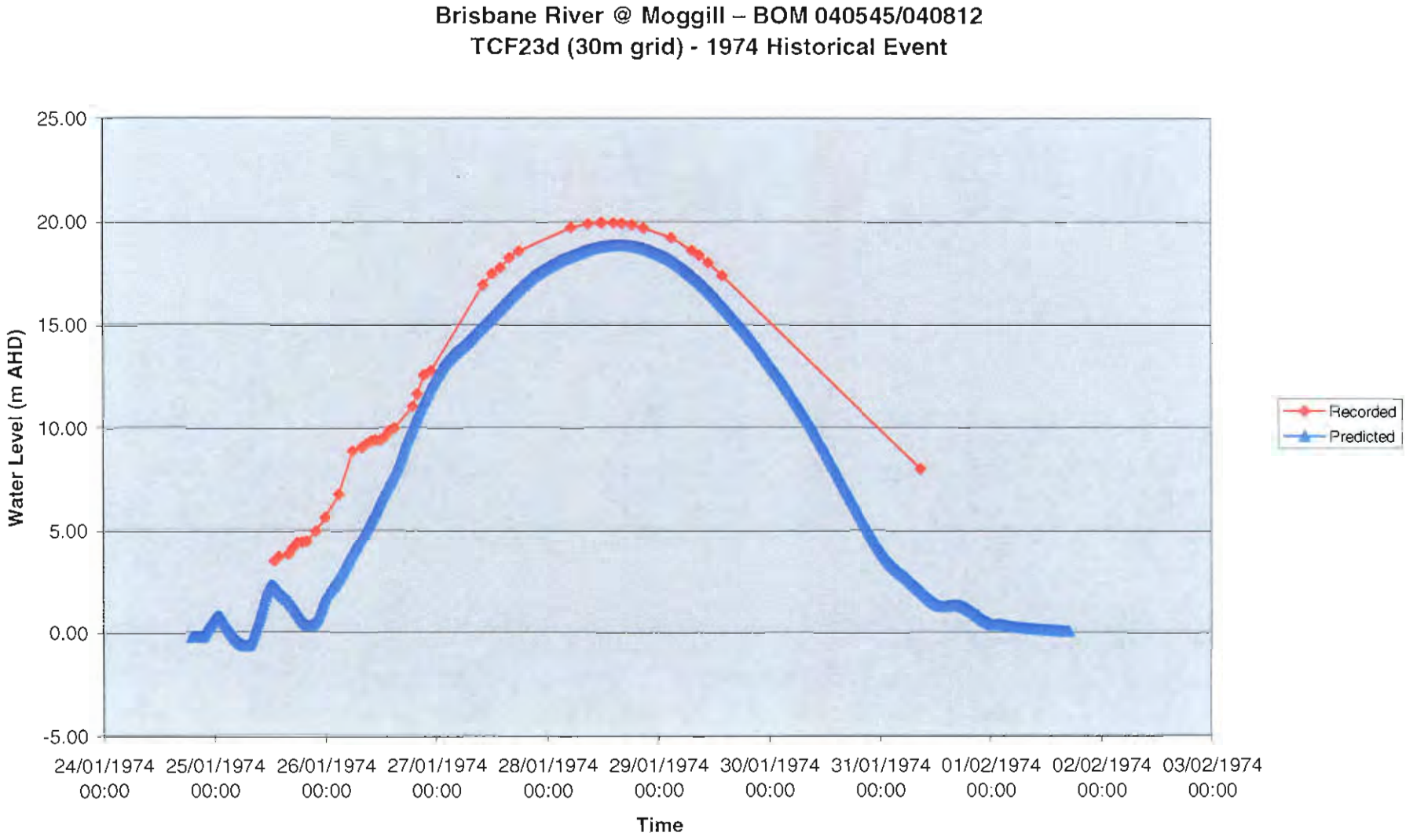


Figure 26: Brisbane River @ Moggill - Water Level Comparison

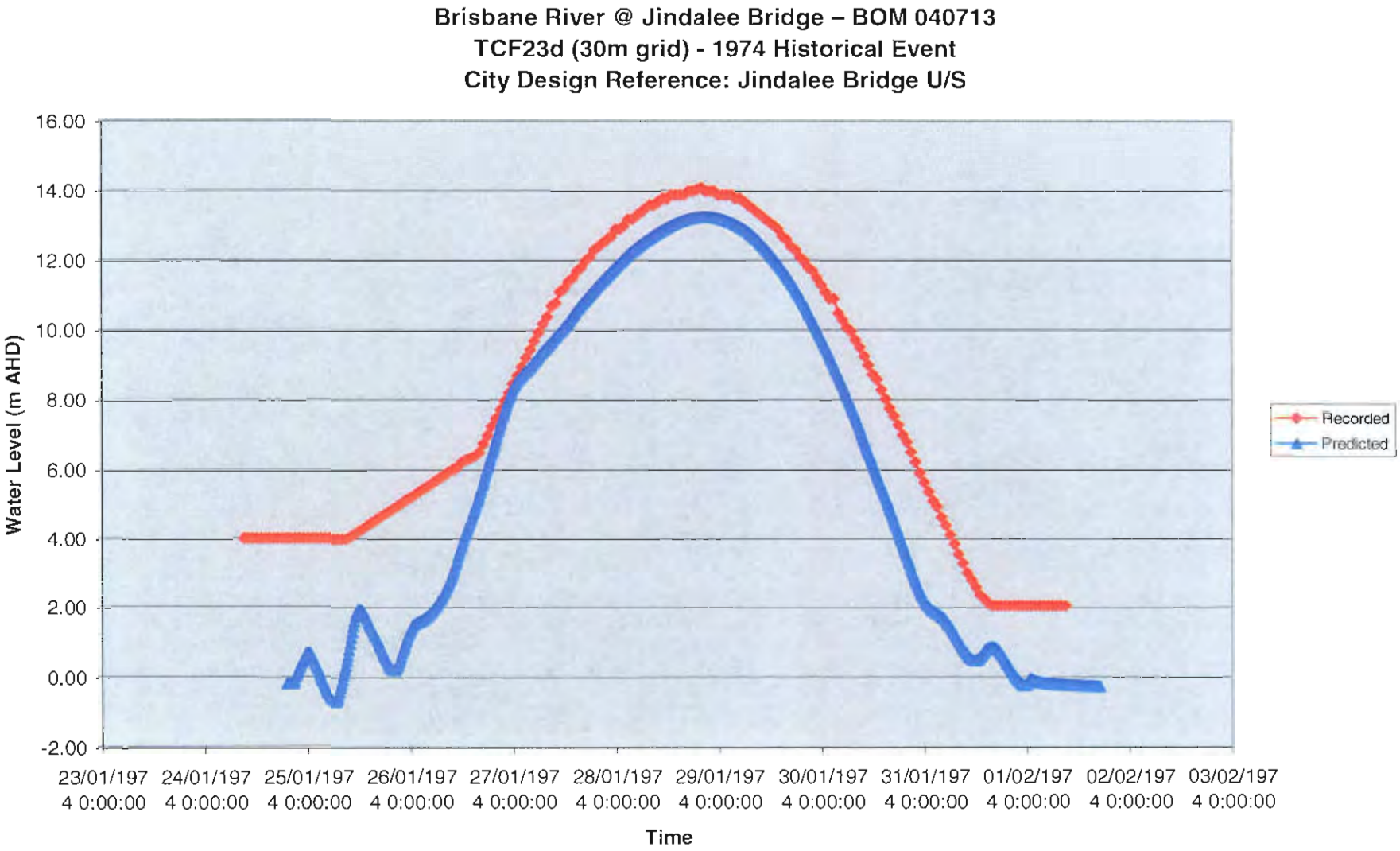


Figure 27: Brisbane River @ Jindalee - Water Level Comparison

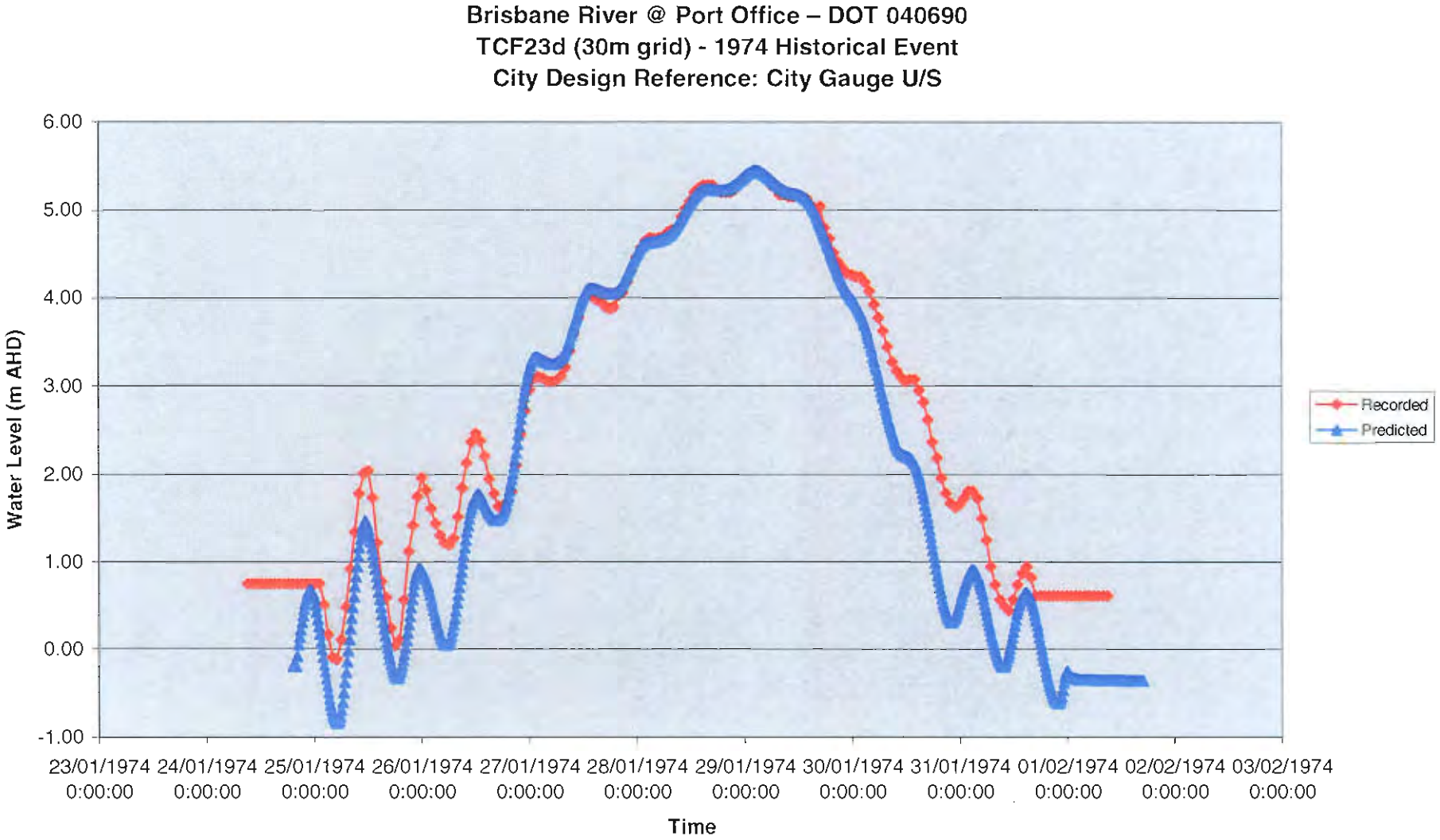


Figure 28: Brisbane River @ Port Office - Water Level Comparison

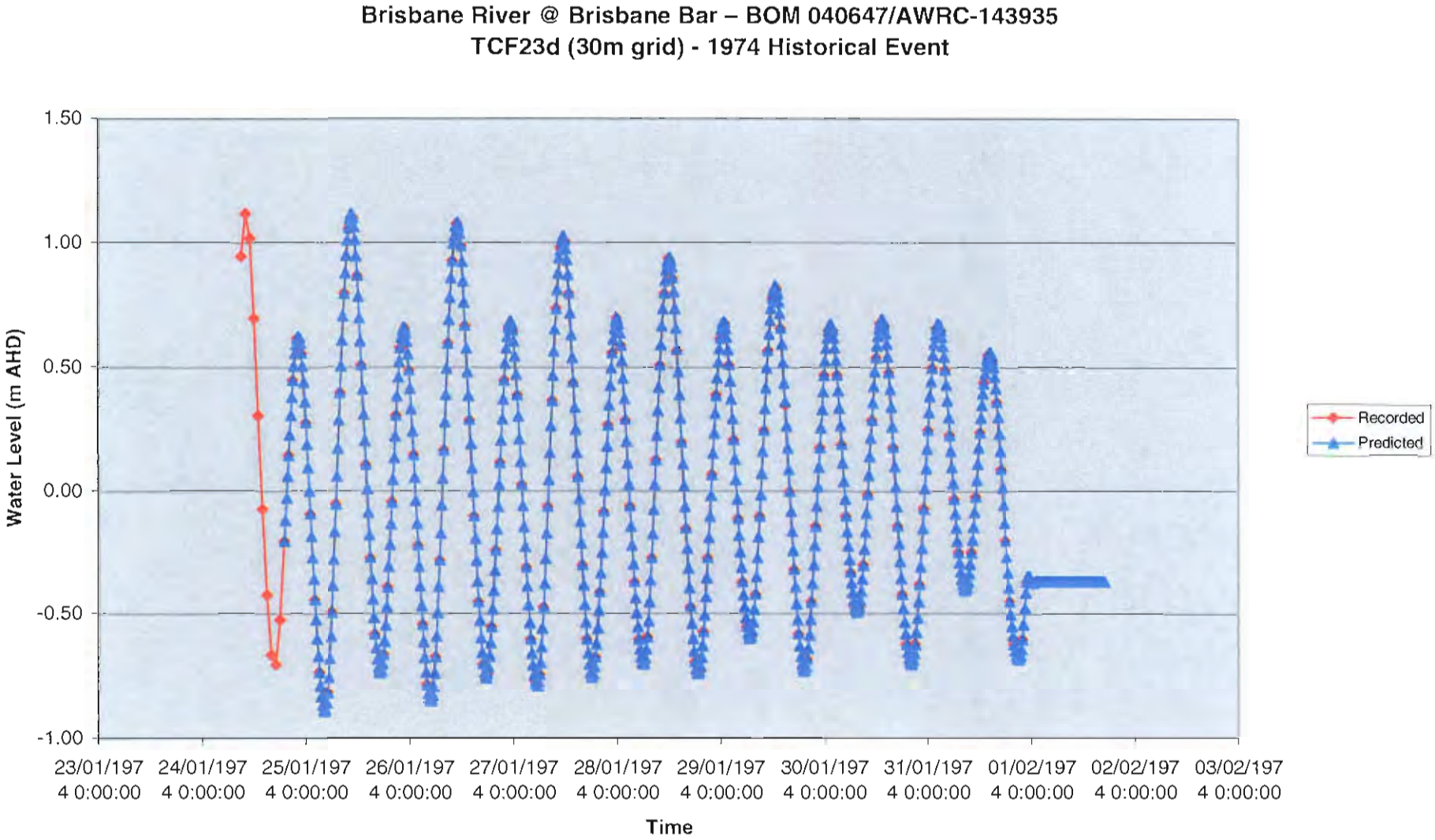


Figure 29: Brisbane River @ Brisbane Bar - Water Level Comparison

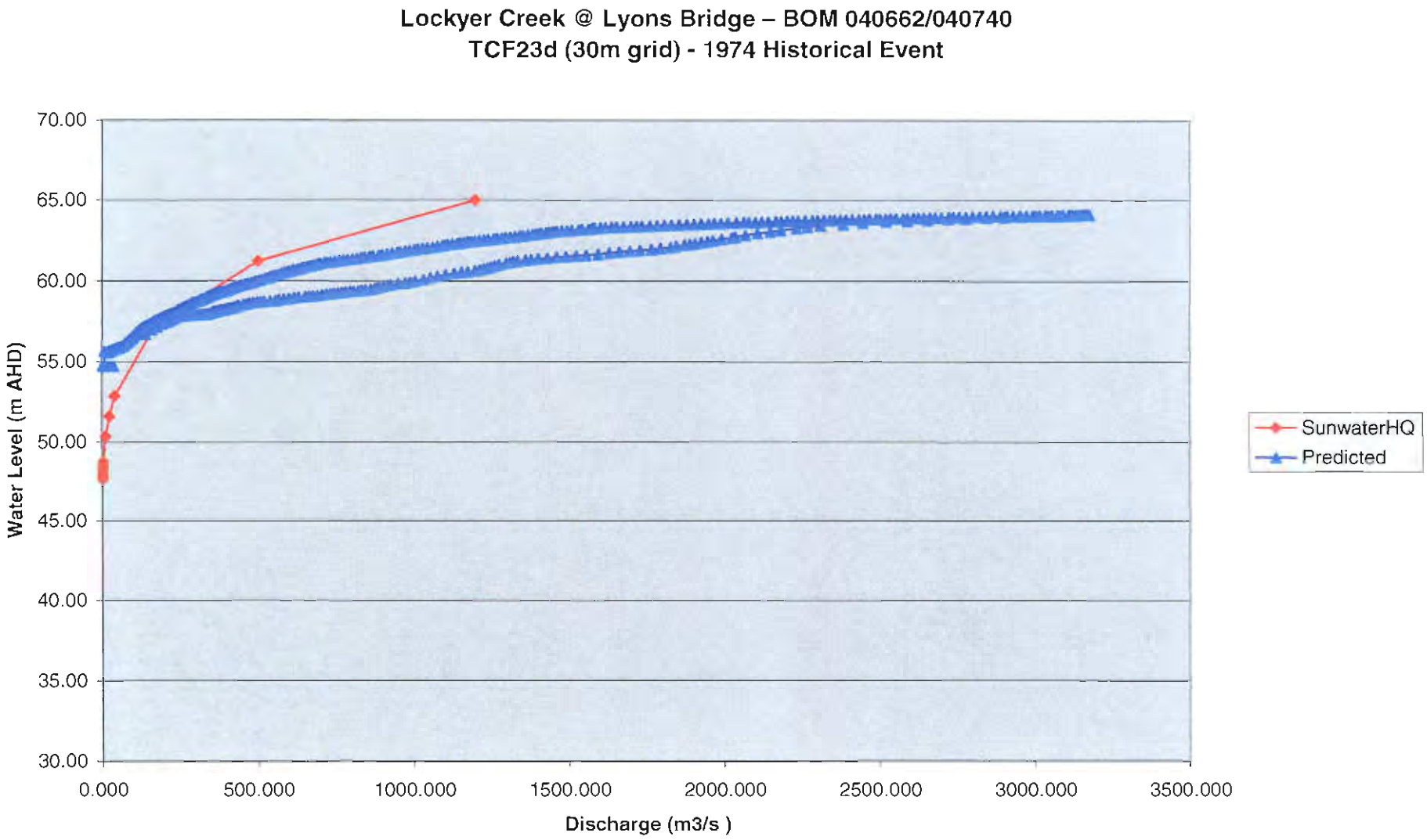


Figure 30: Lockyer Creek @ Lyons Bridge - Rating Curve Comparison

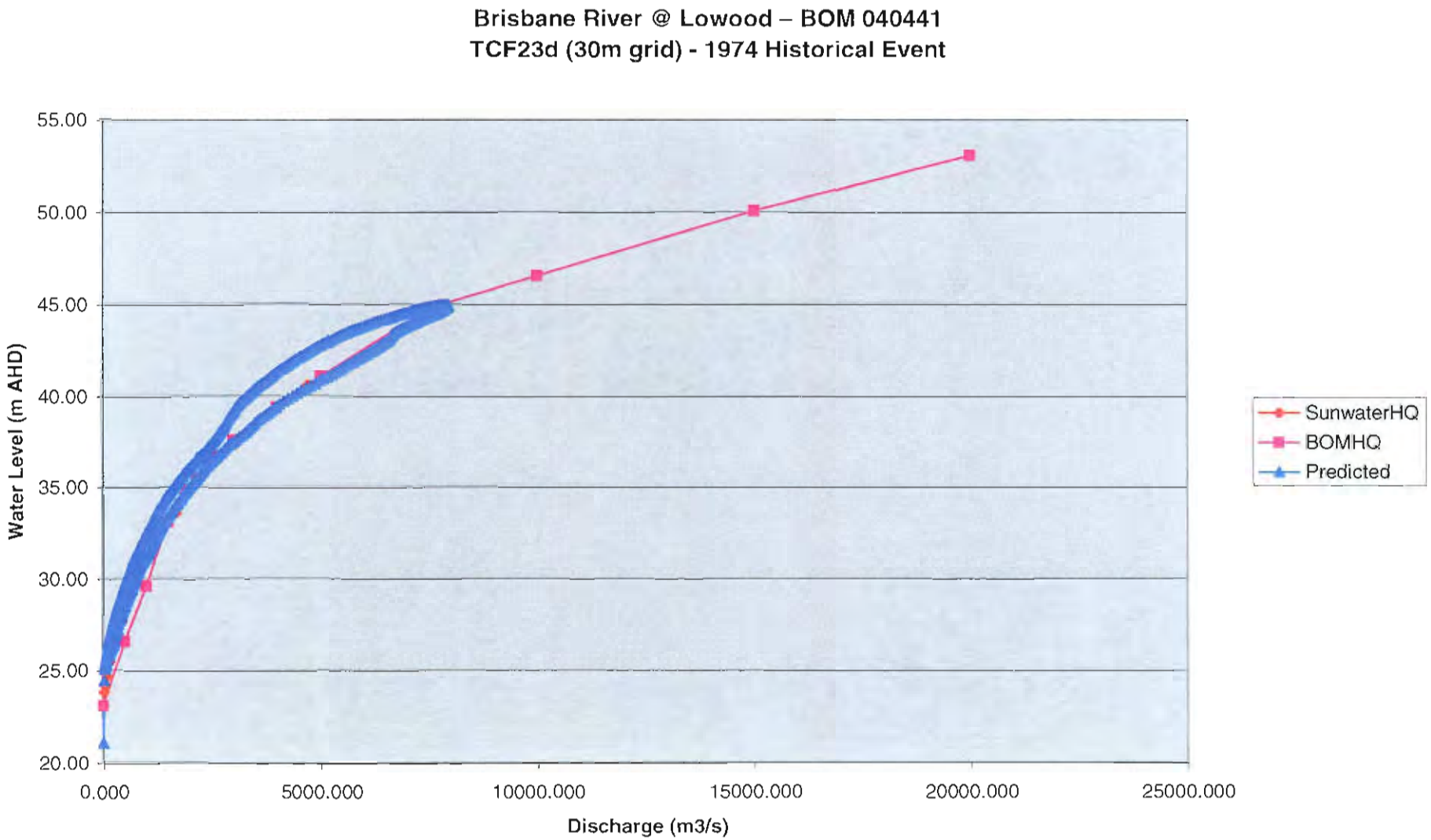


Figure 31: Brisbane River @ Lowood - Rating Curve Comparison

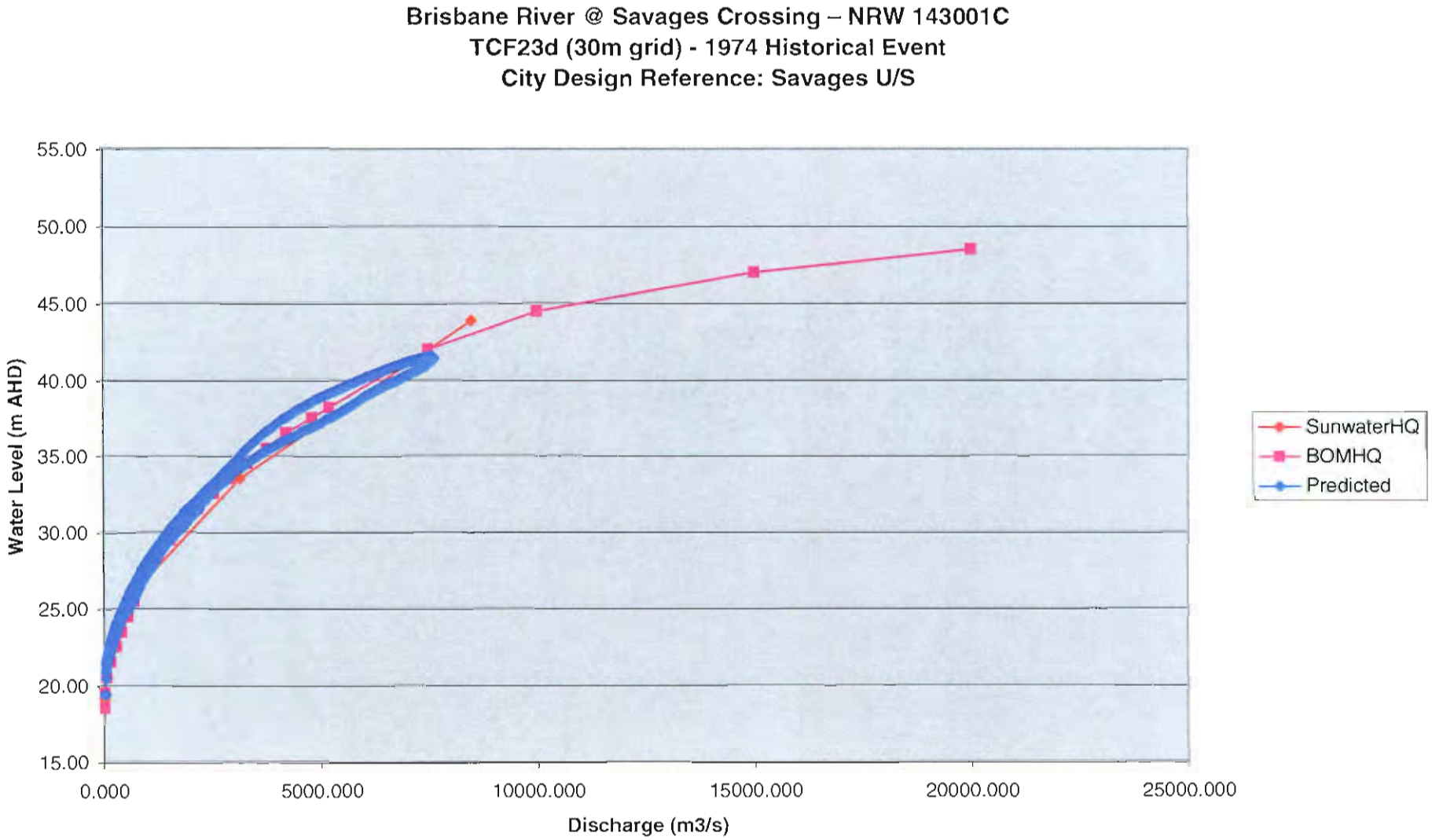


Figure 32: Brisbane River @ Savages Crossing - Rating Curve Comparison

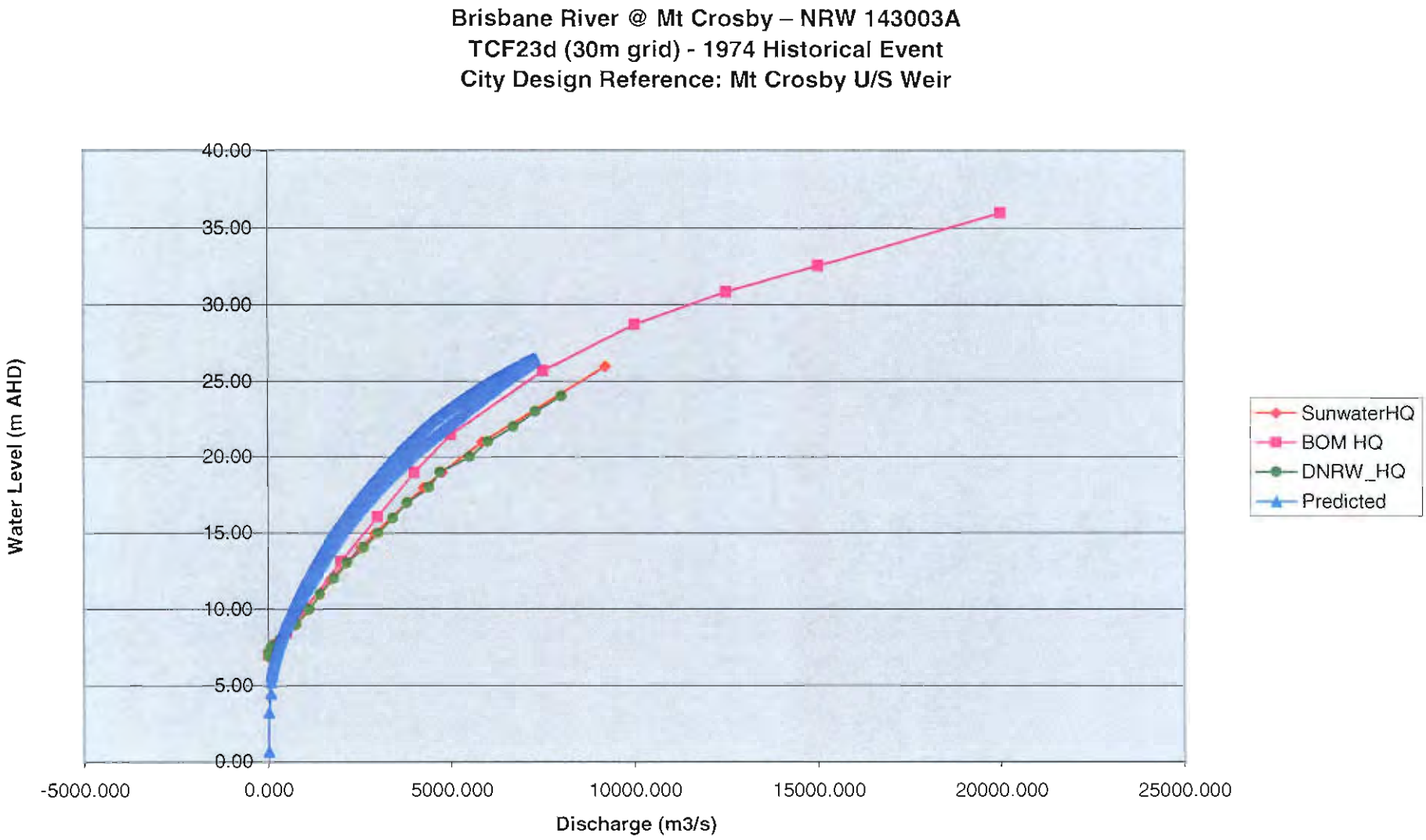


Figure 33: Brisbane River @ Mt Crosby - Rating Curve Comparison

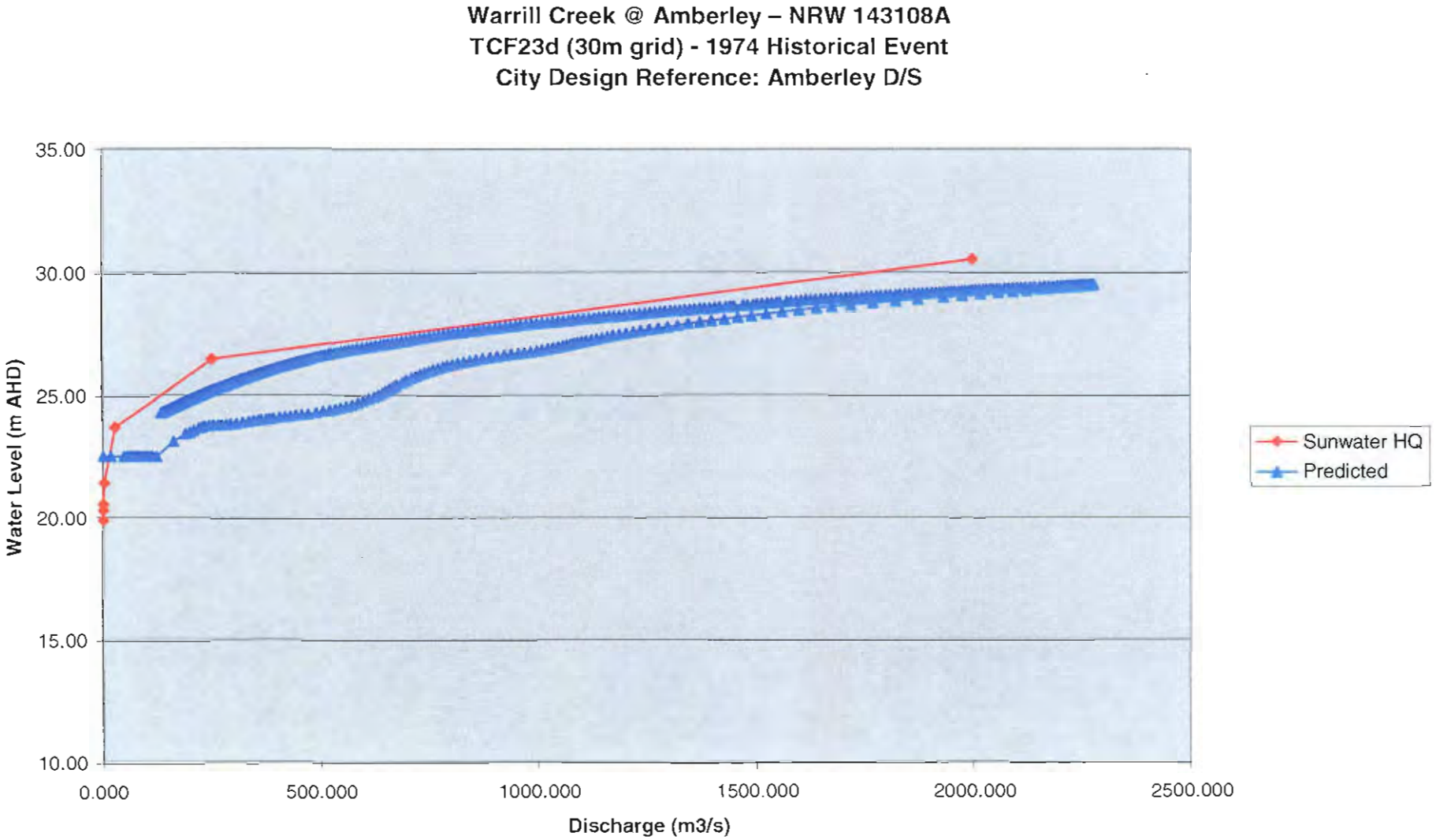


Figure 34: Warrill Creek @ Amberley - Rating Curve Comparison

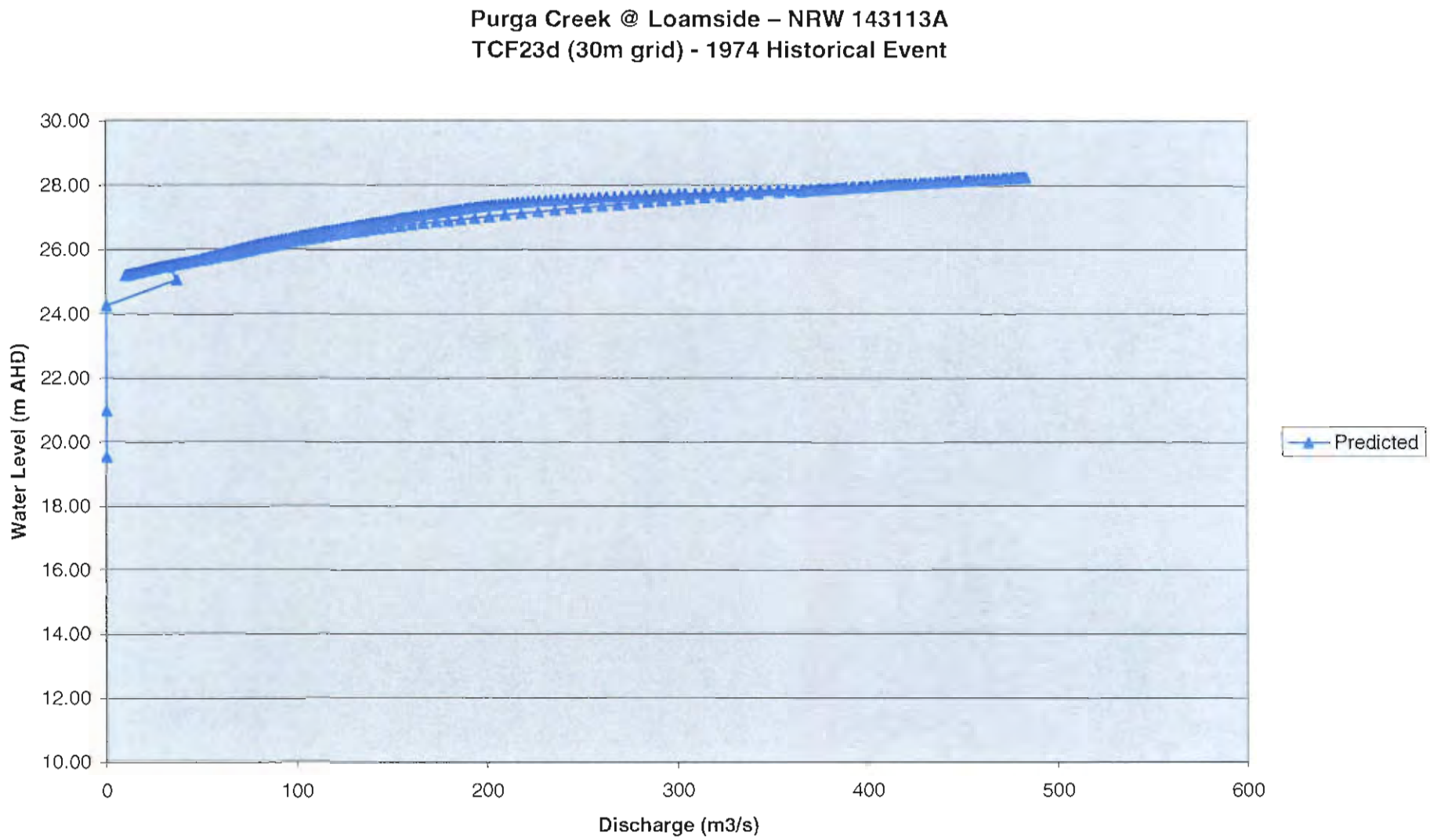


Figure 35: Purga Creek @ Loamside - Rating Curve Comparison

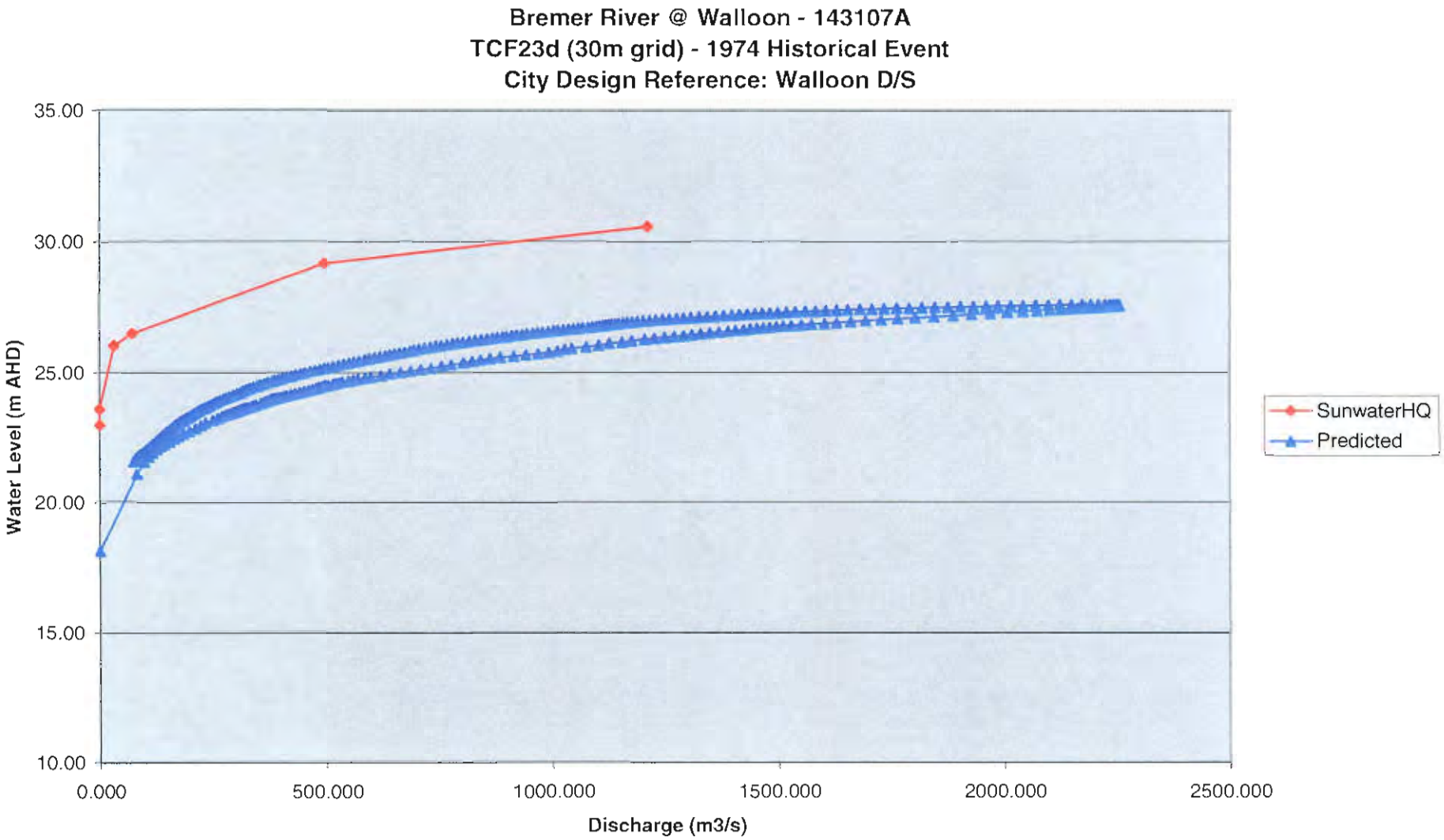


Figure 36: Bremer River @ Walloon - Rating Curve Comparison

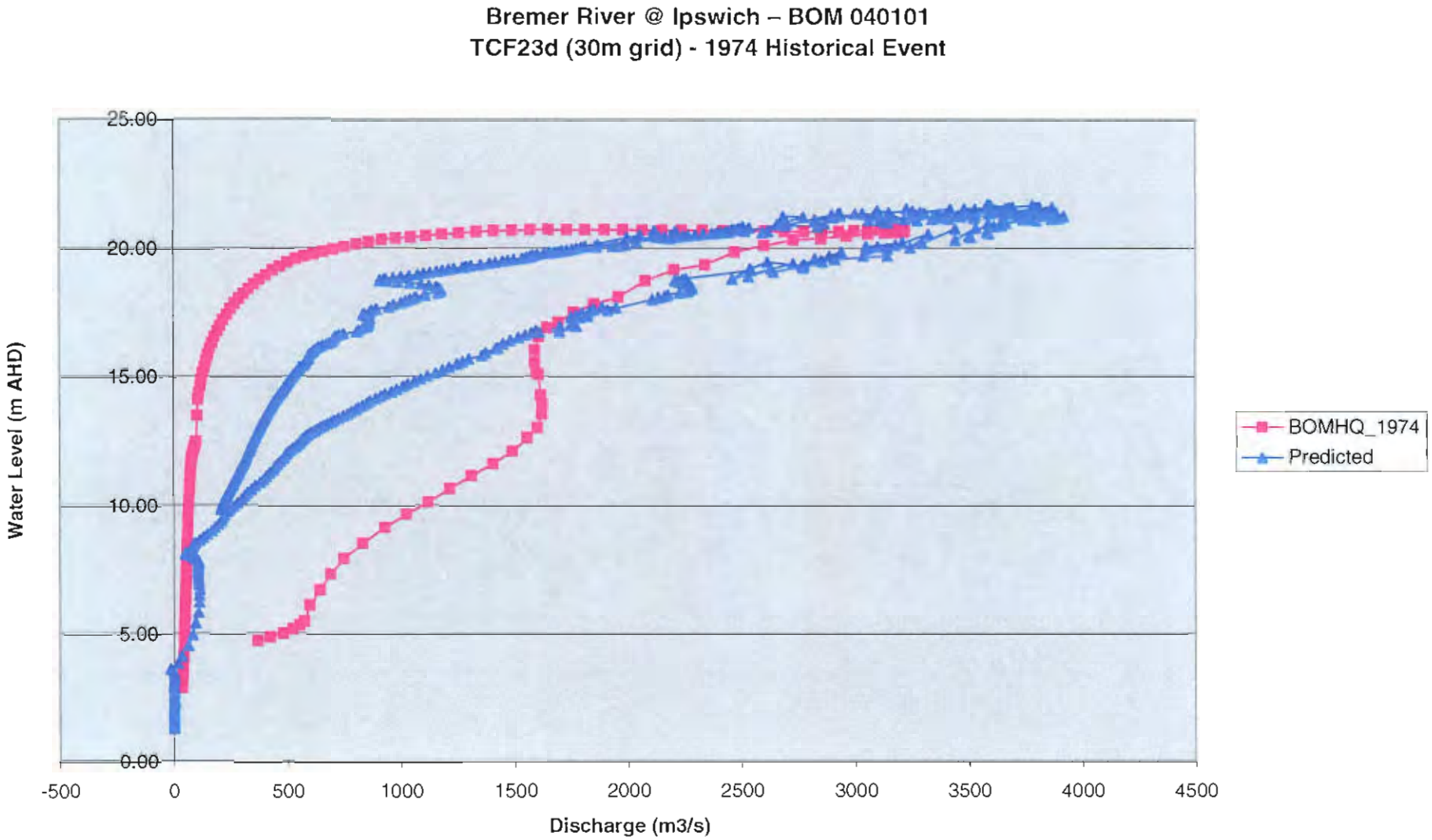


Figure 37: Bremer River @ Ipswich - Rating Curve Comparison

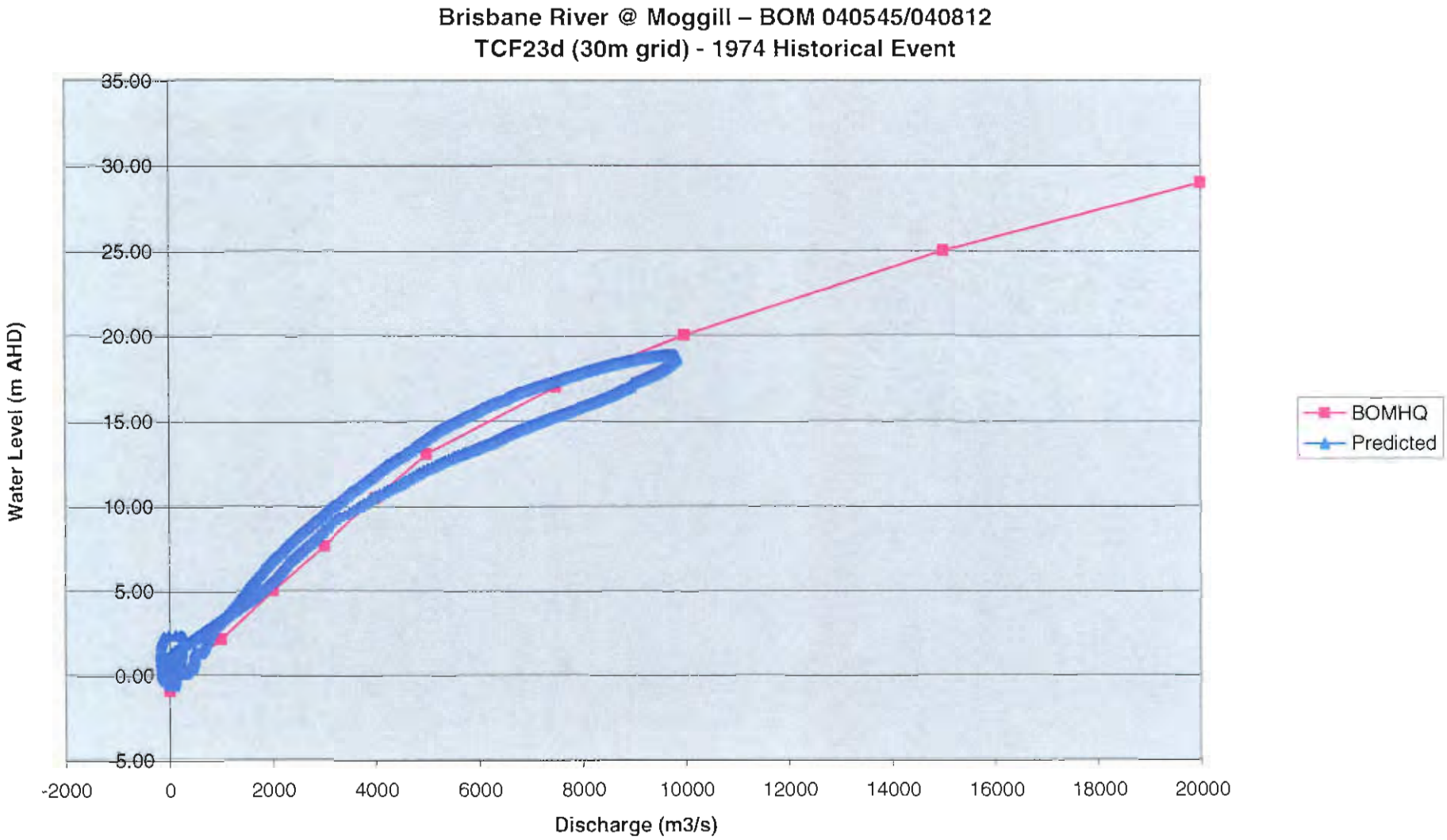


Figure 38: Brisbane River @ Moggill - Rating Curve Comparison

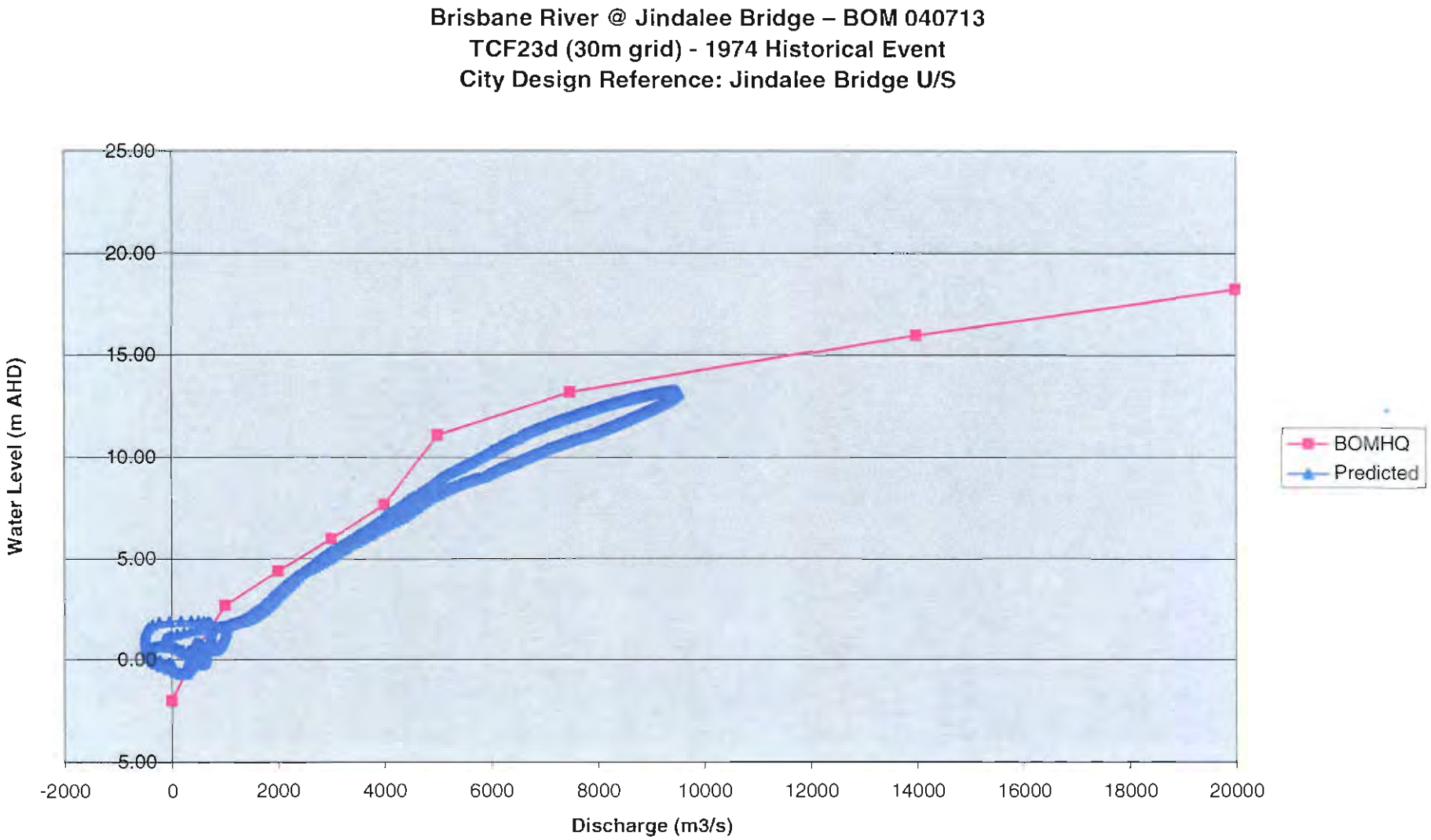


Figure 39: Brisbane River @ Jindalee - Rating Curvel Comparison

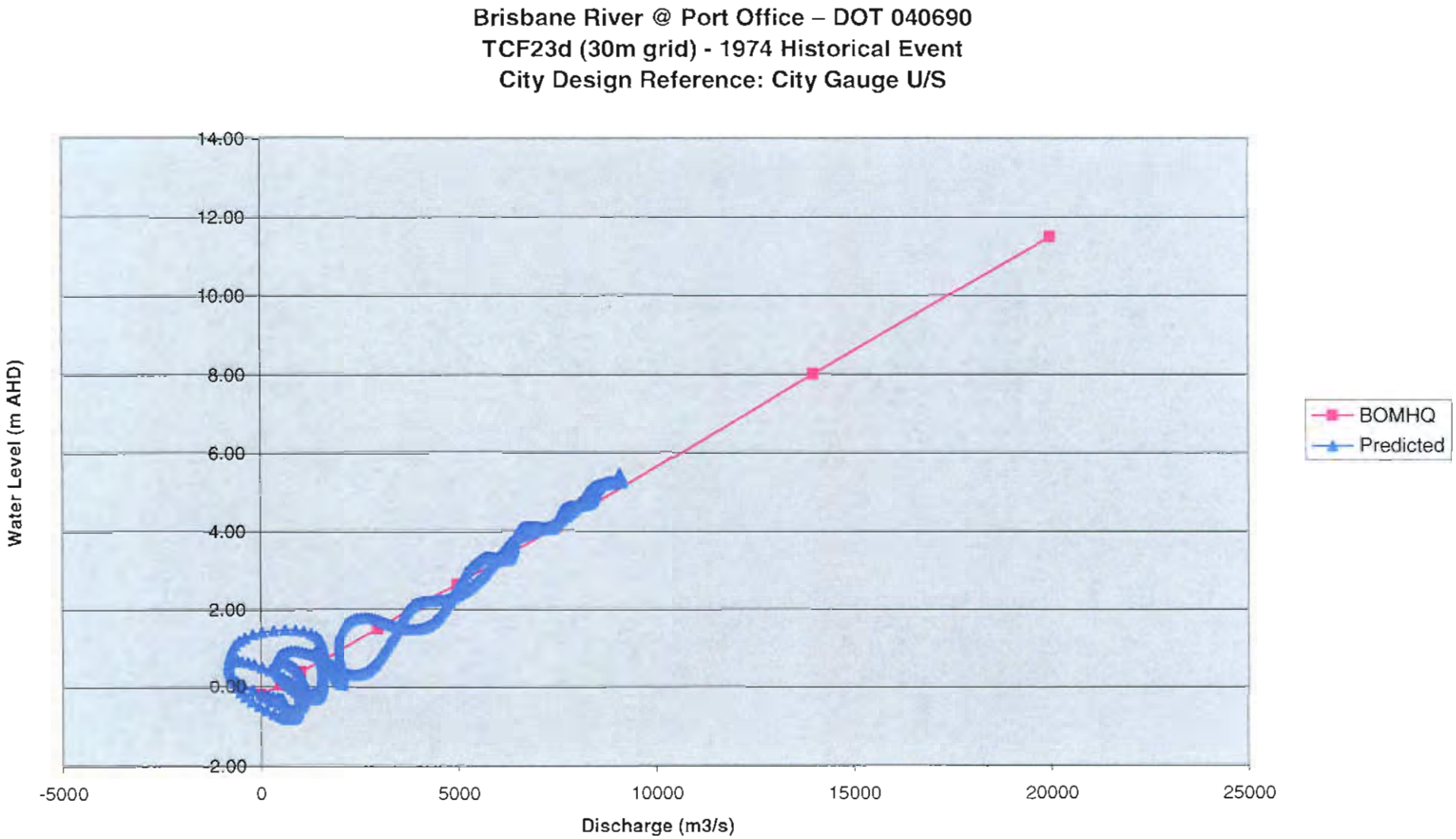


Figure 40: Brisbane River @ Port Office - Rating Curve Comparison

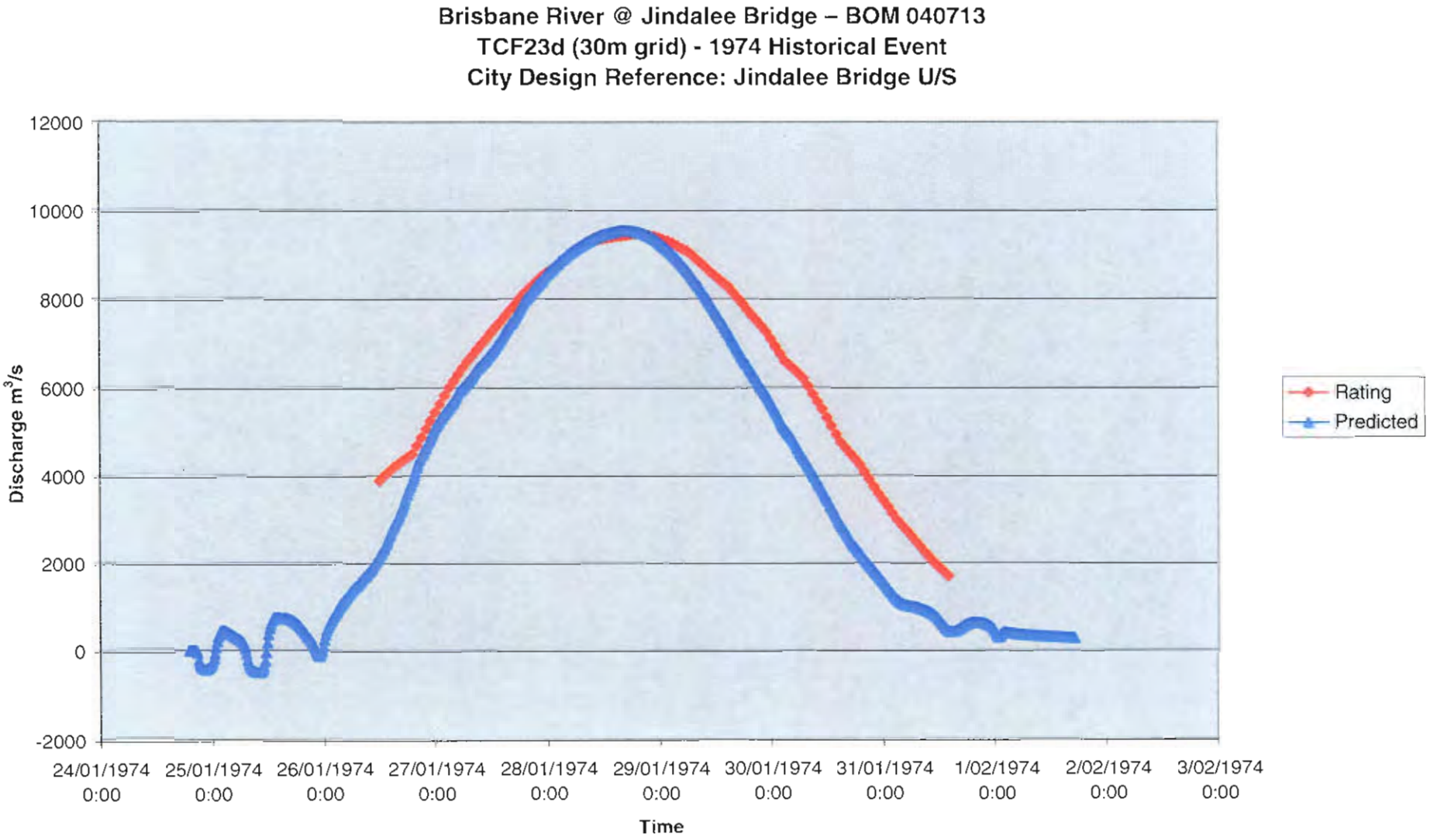
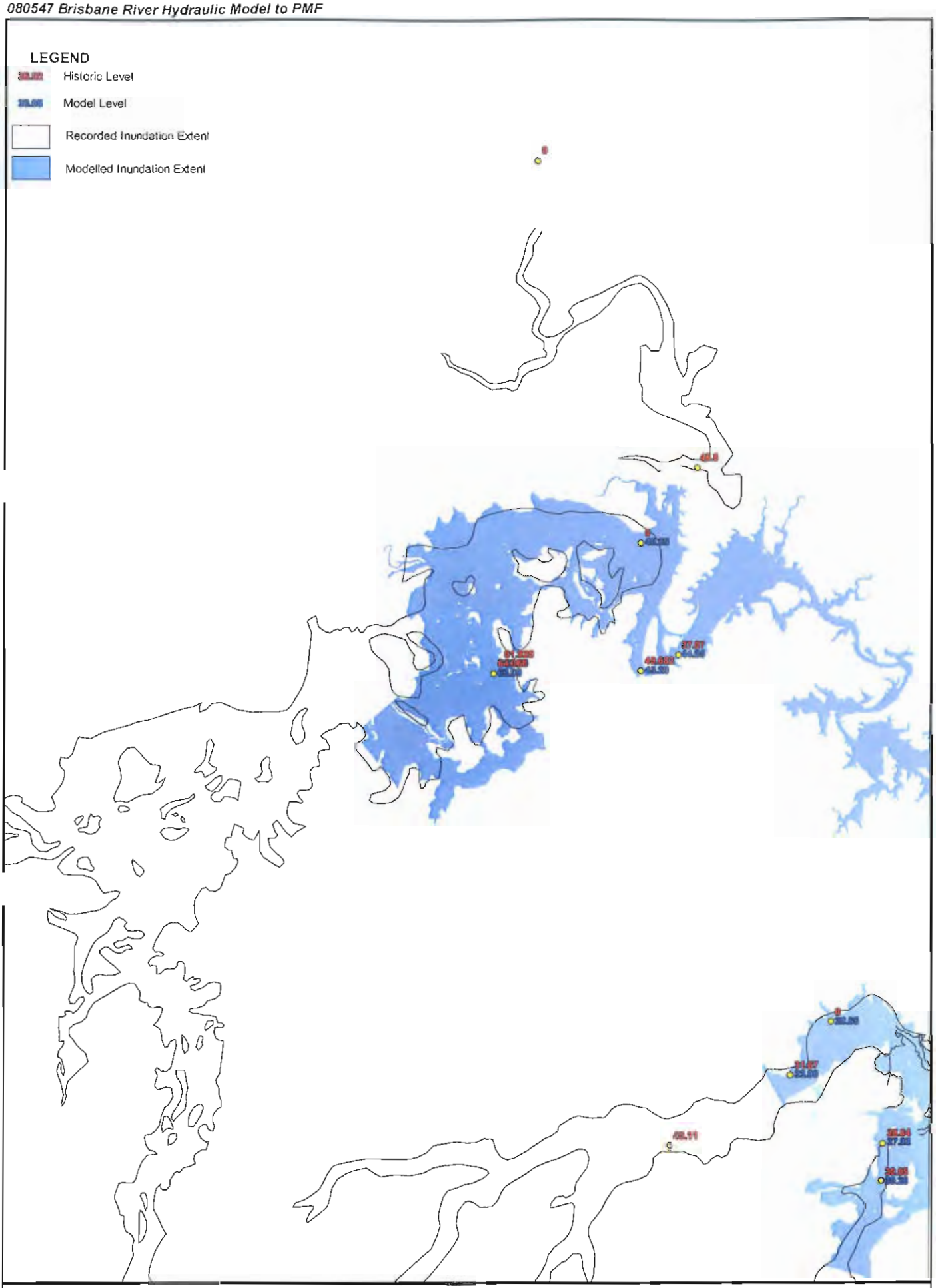


Figure 41: Discharge Rating Comparisonr @ Jindalee



1974 Inundation Extents and Spot Levels - 1 of 5
Figure 42

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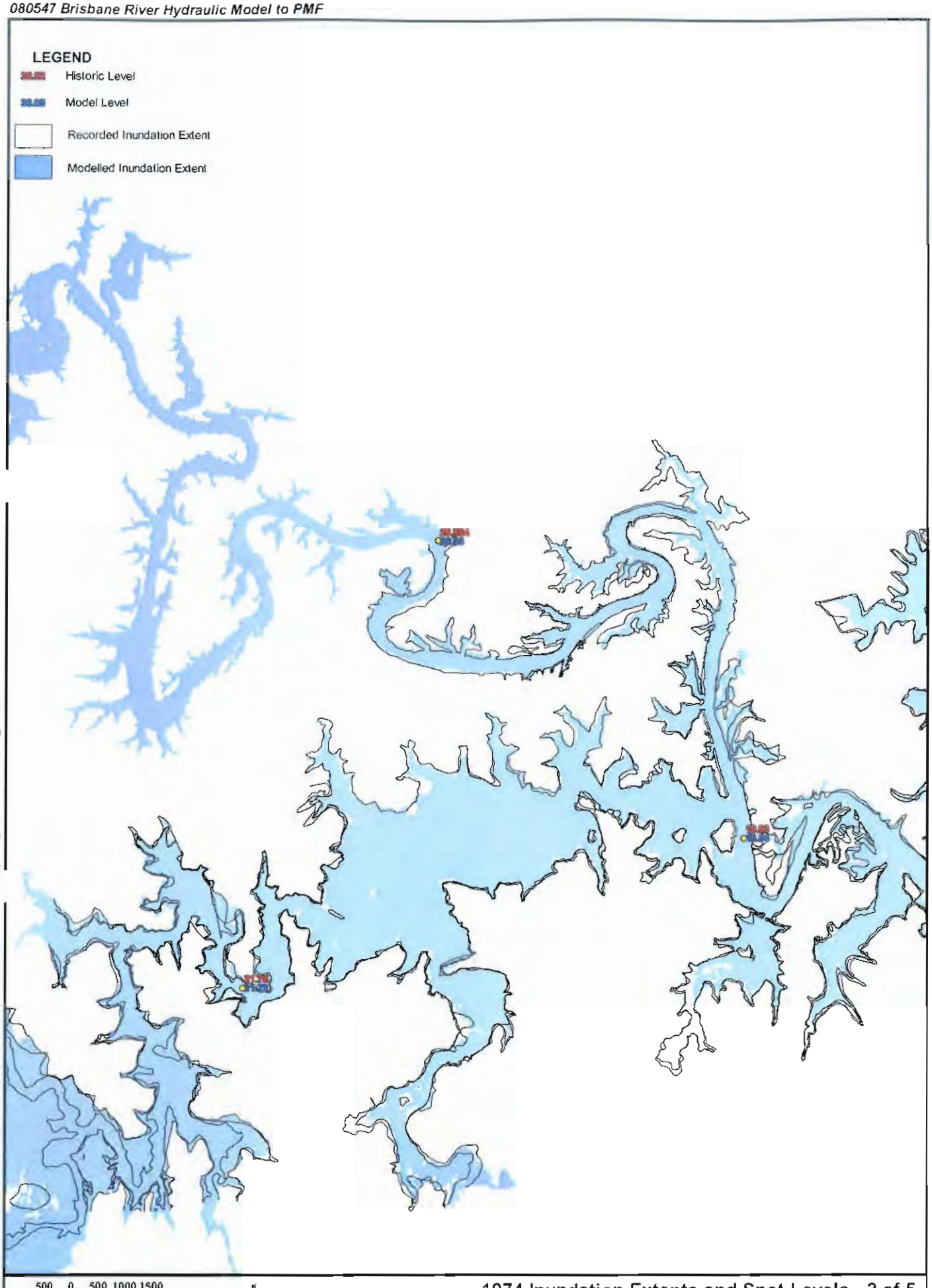

1974 Inundation Extents and Spot Levels - 2 of 5
Figure 43

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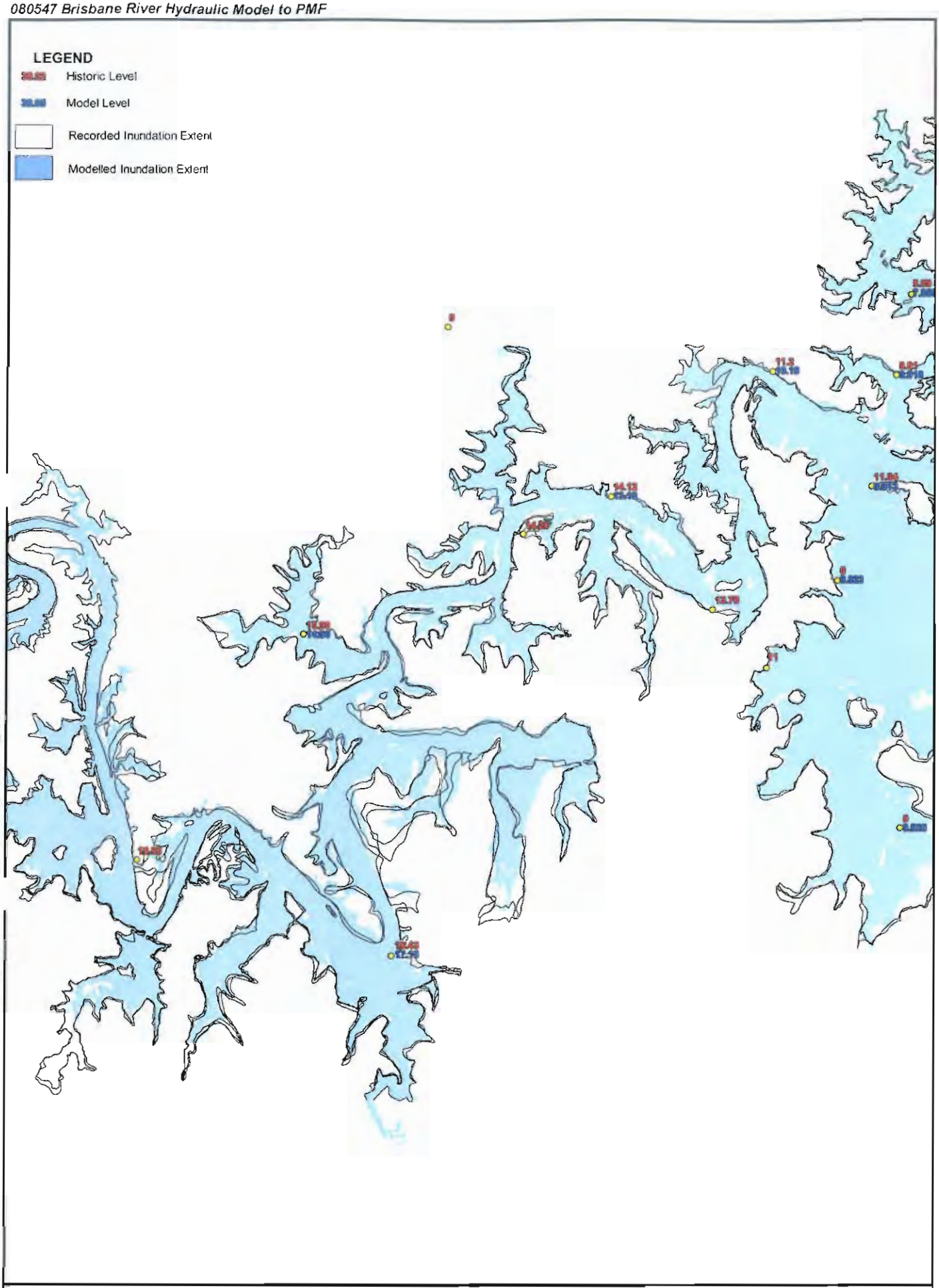
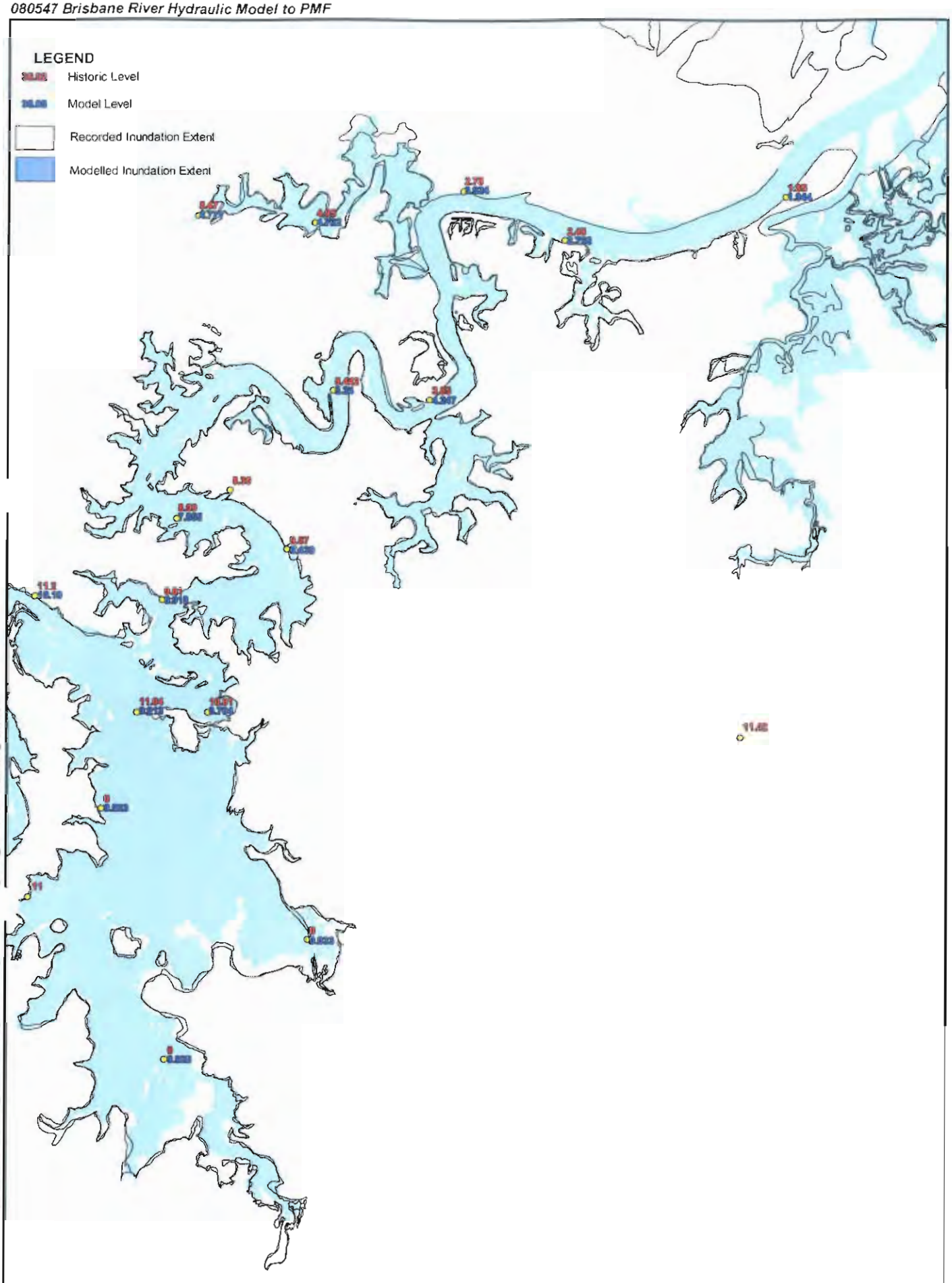


1974 Inundation Extents and Spot Levels - 3 of 5
Figure 44



1974 Inundation Extents and Spot Levels - 4 of 5

Figure 45

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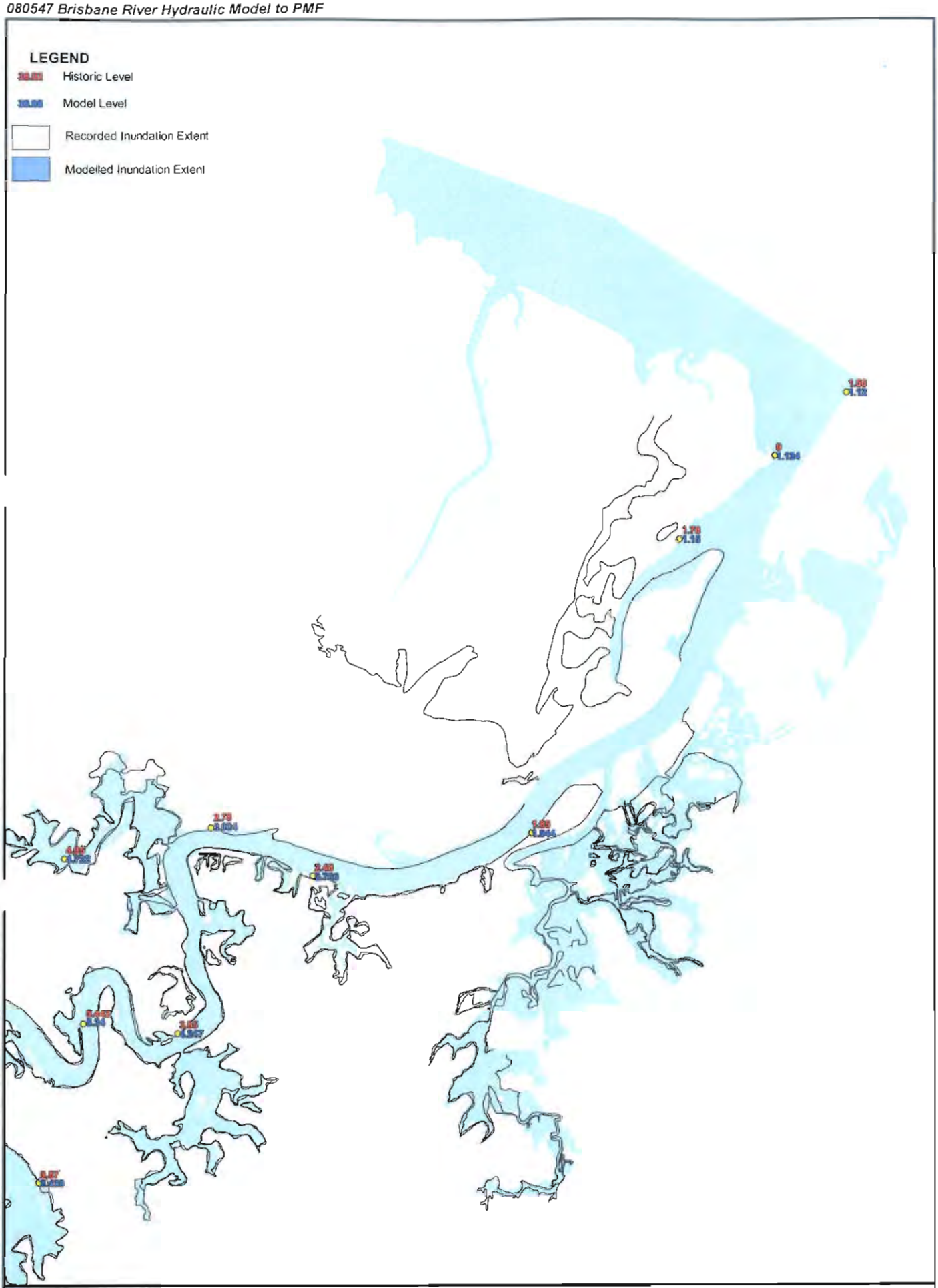

1974 Inundation Extents and Spot Levels - 5 of 5
Figure 46

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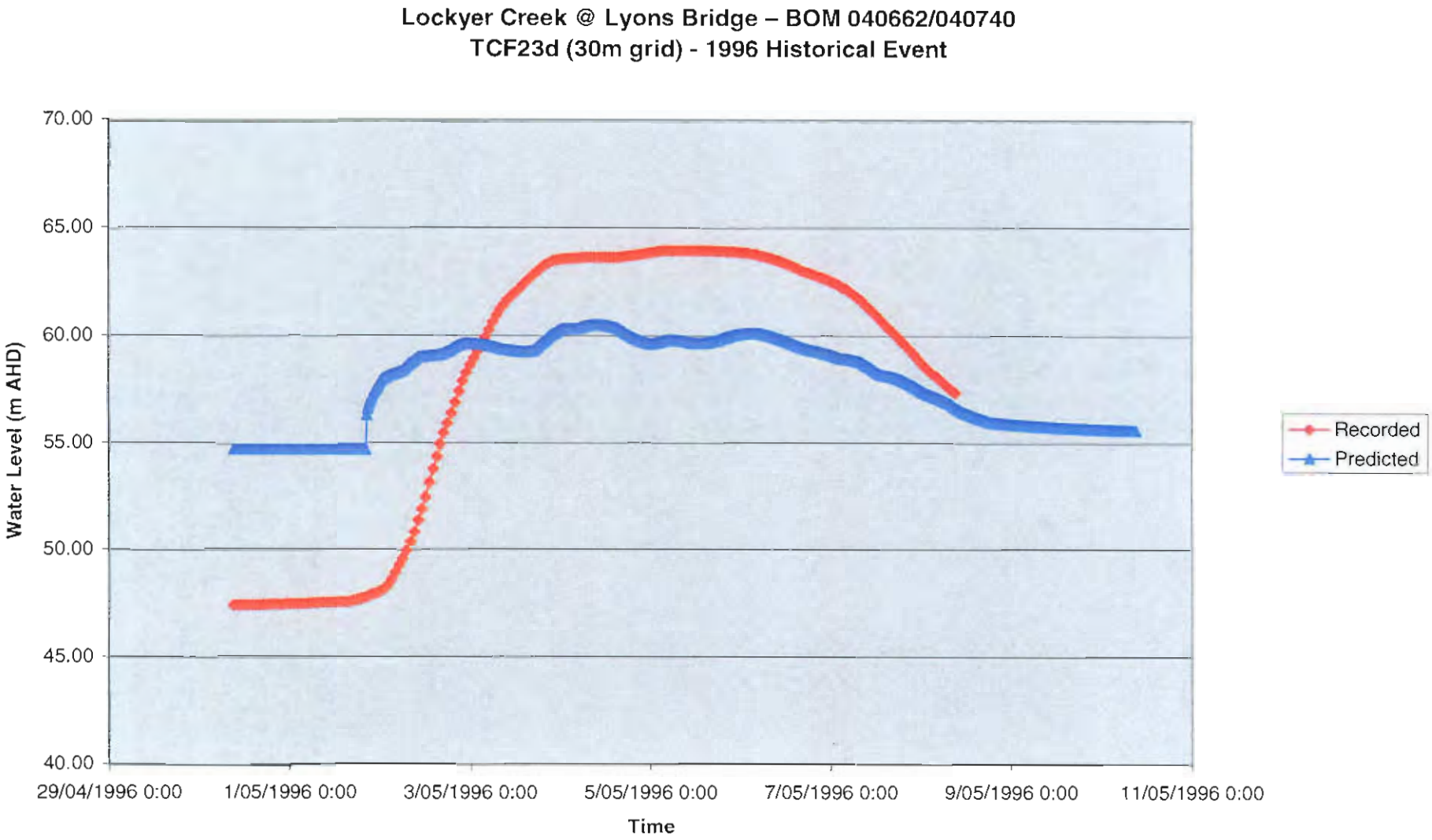

Figure 47: Lockyer Creek @ Lyons Bridge - Water Level Comparison

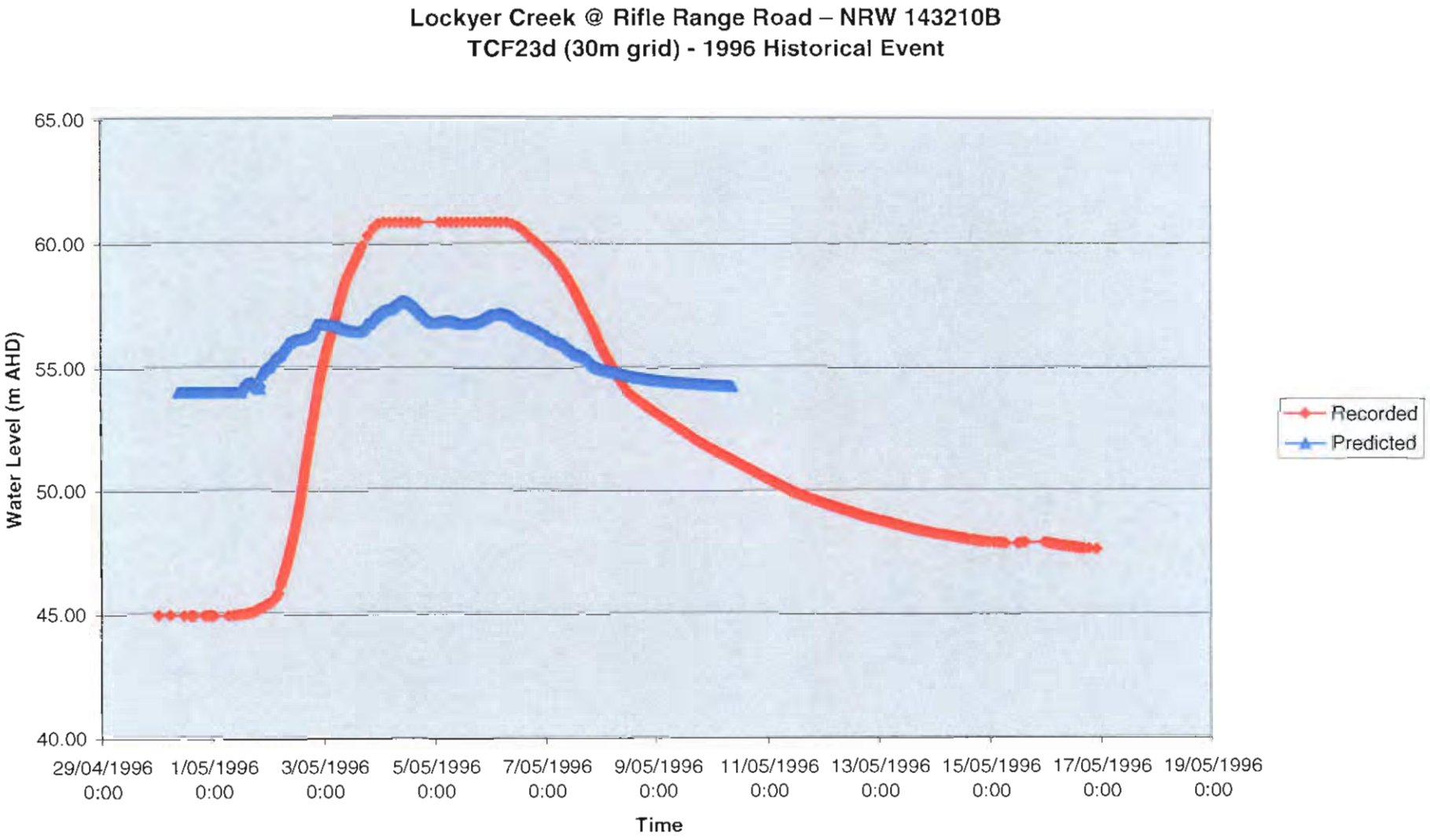

Figure 48: Lockyer Creek @ Rifle Rannge Road - Water Level Comparison

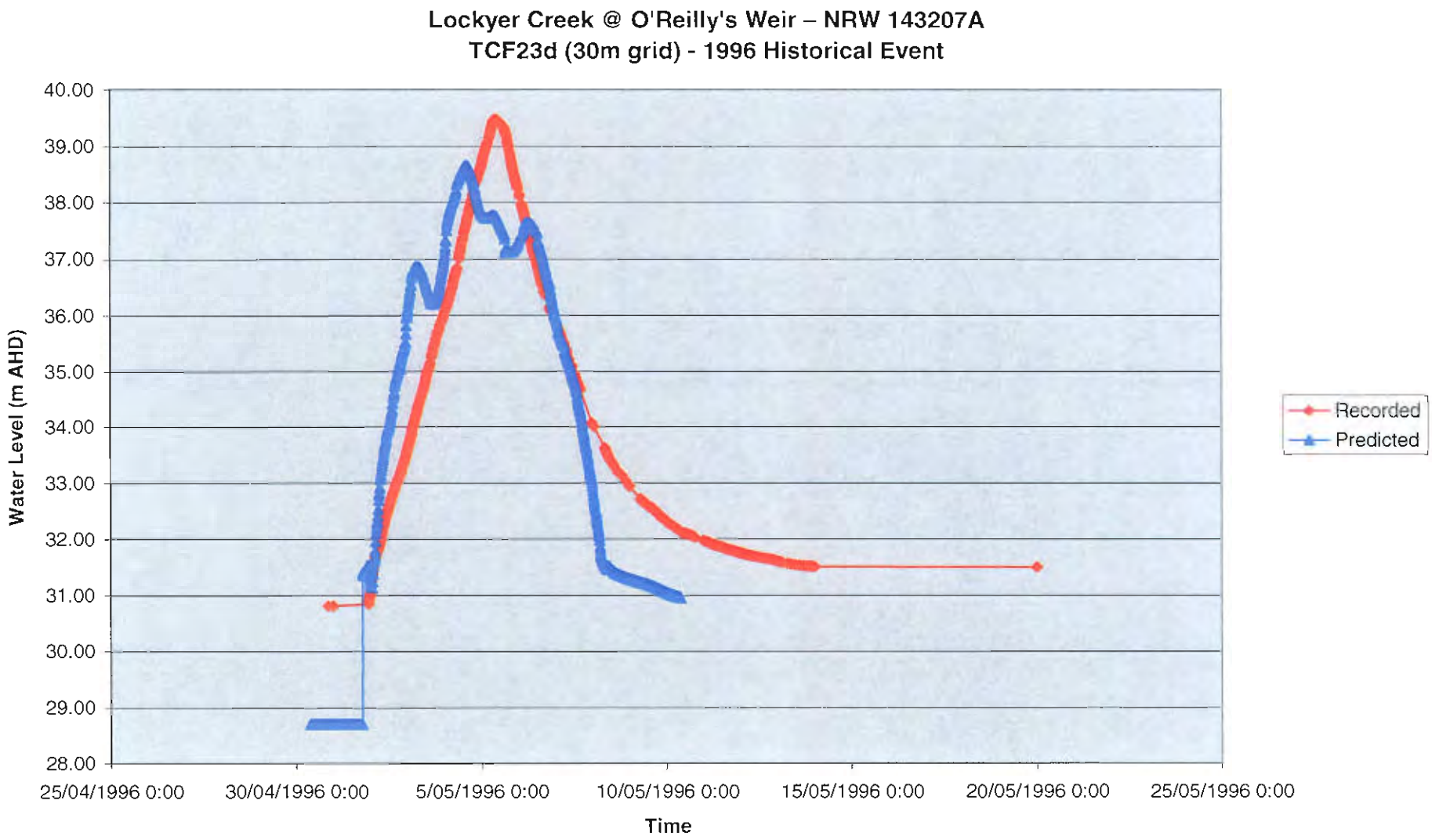

Figure 49: Lockyer Creek @ O'Reilly's Weir - Water Level Comparison

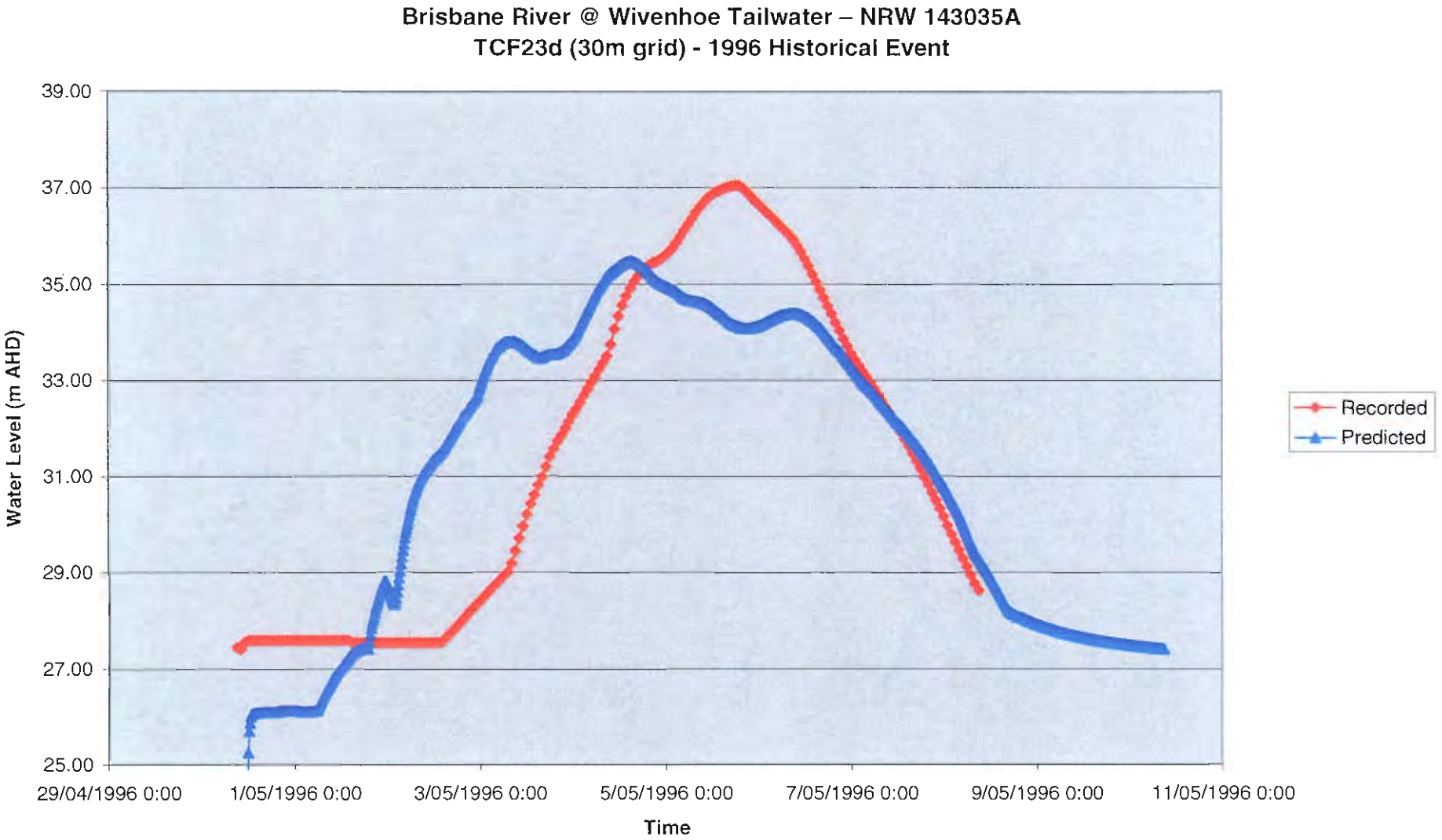

Figure 50: Brisbane River @ Wivenhoe Tailwater - Water Level Comparison

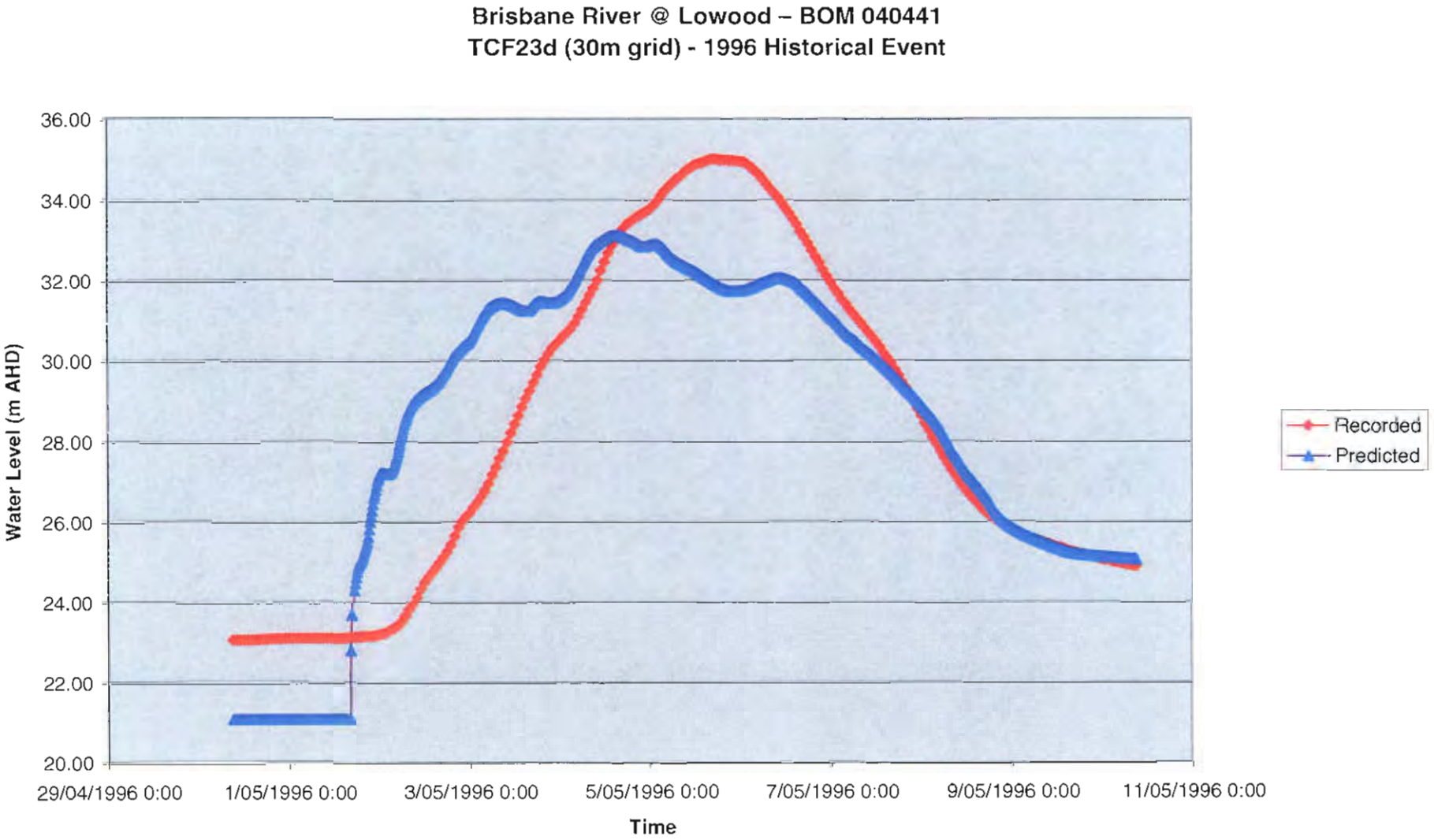

Figure 51: Brisbane River @ Lowood - Water Level Comparison

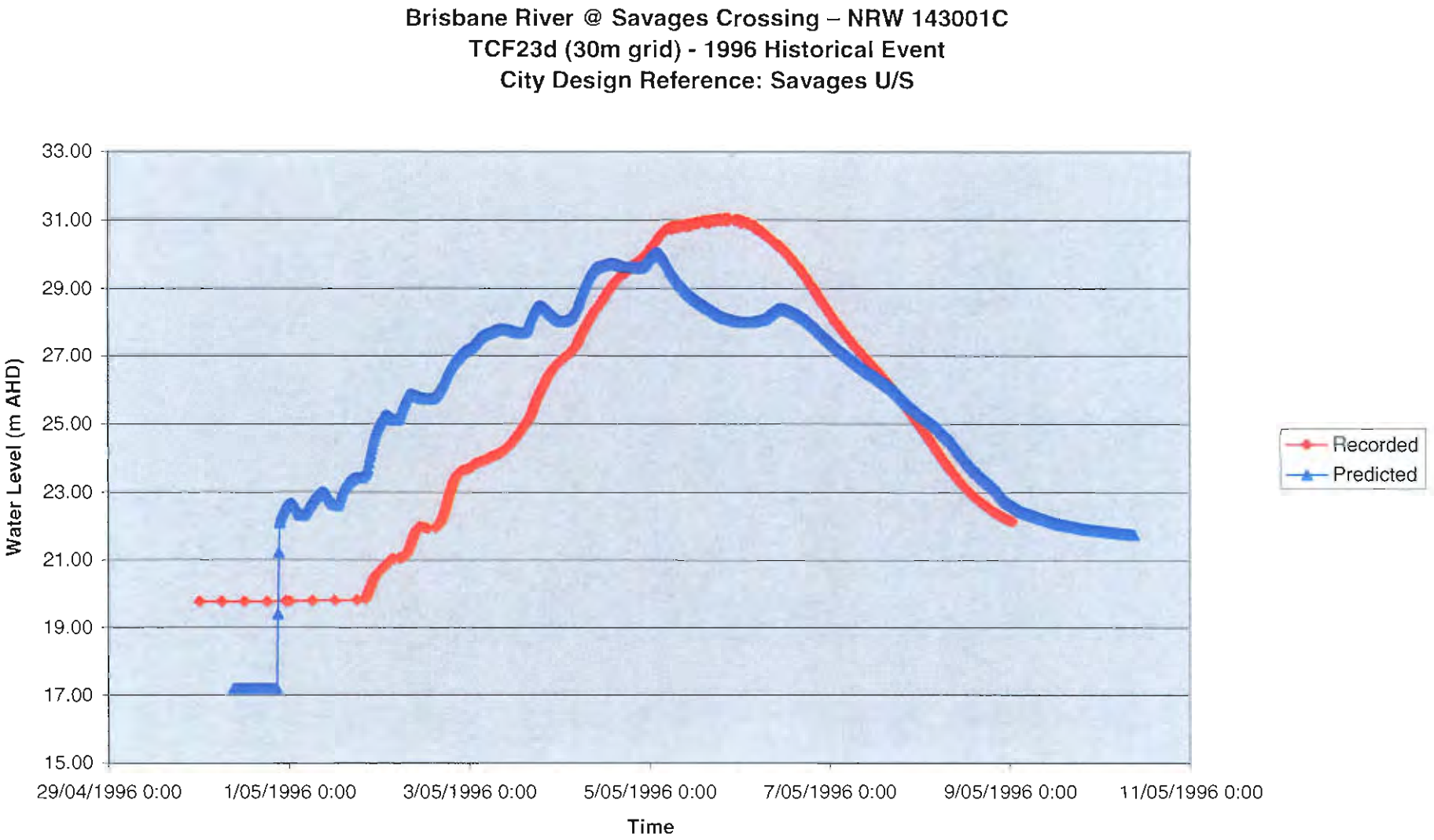

Figure 52: Brisbane River @ Savages Crossing - Water Level Comparison

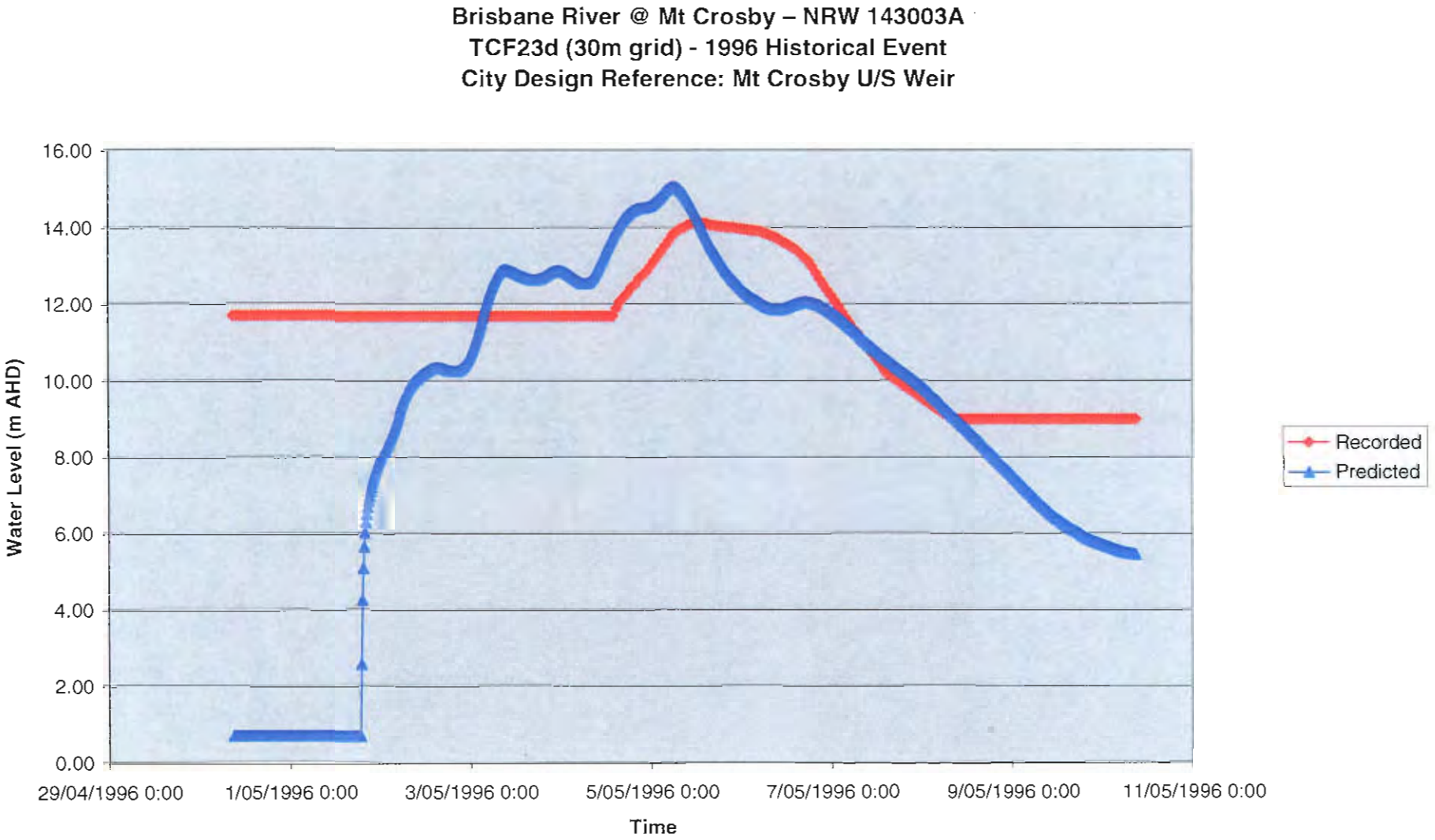

Figure 53: Brisbane River @ Mt Crosby - Water Level Comparison

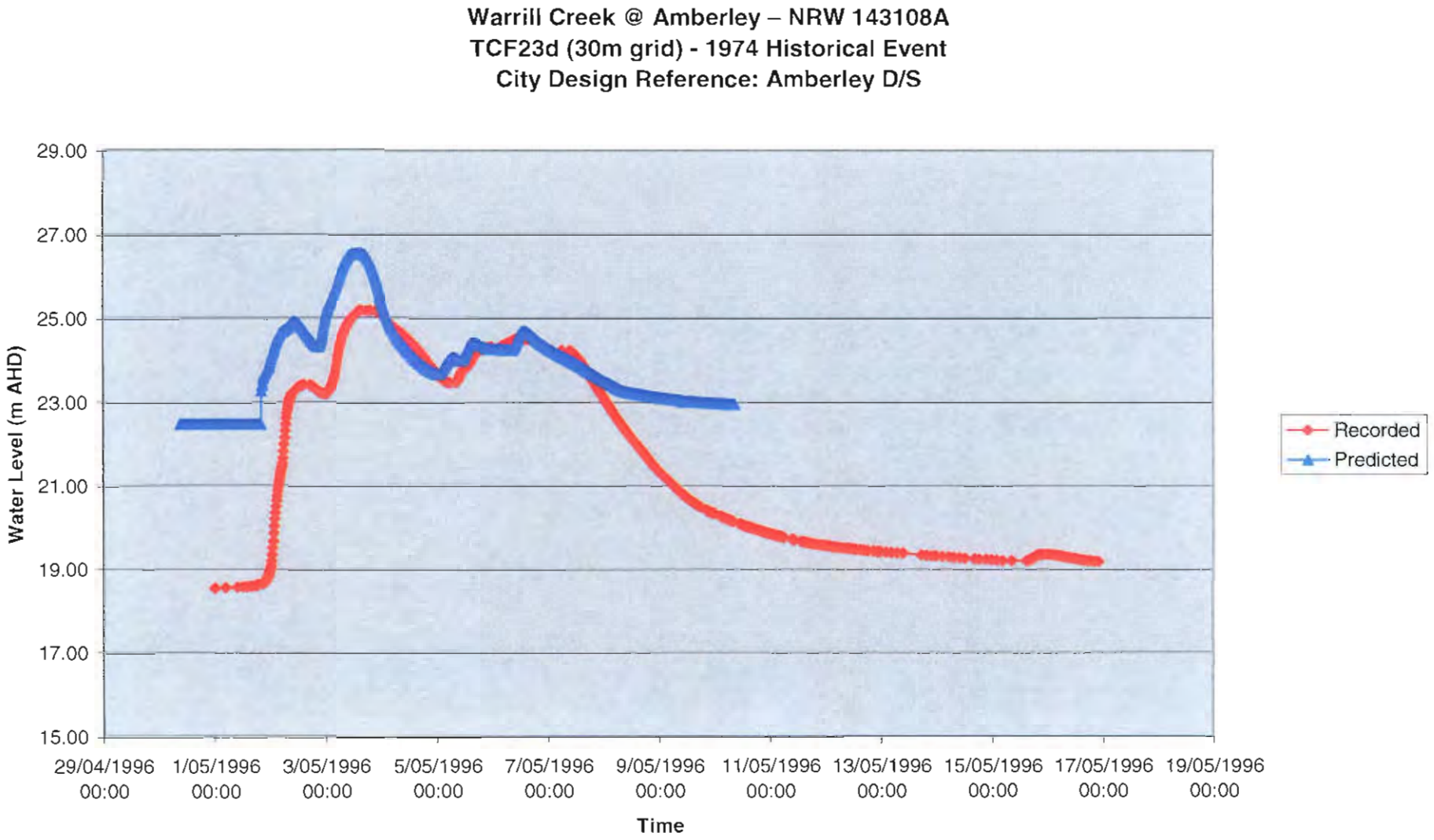

Figure 54: Warrill Creek @ Amberley - Water Level Comparison

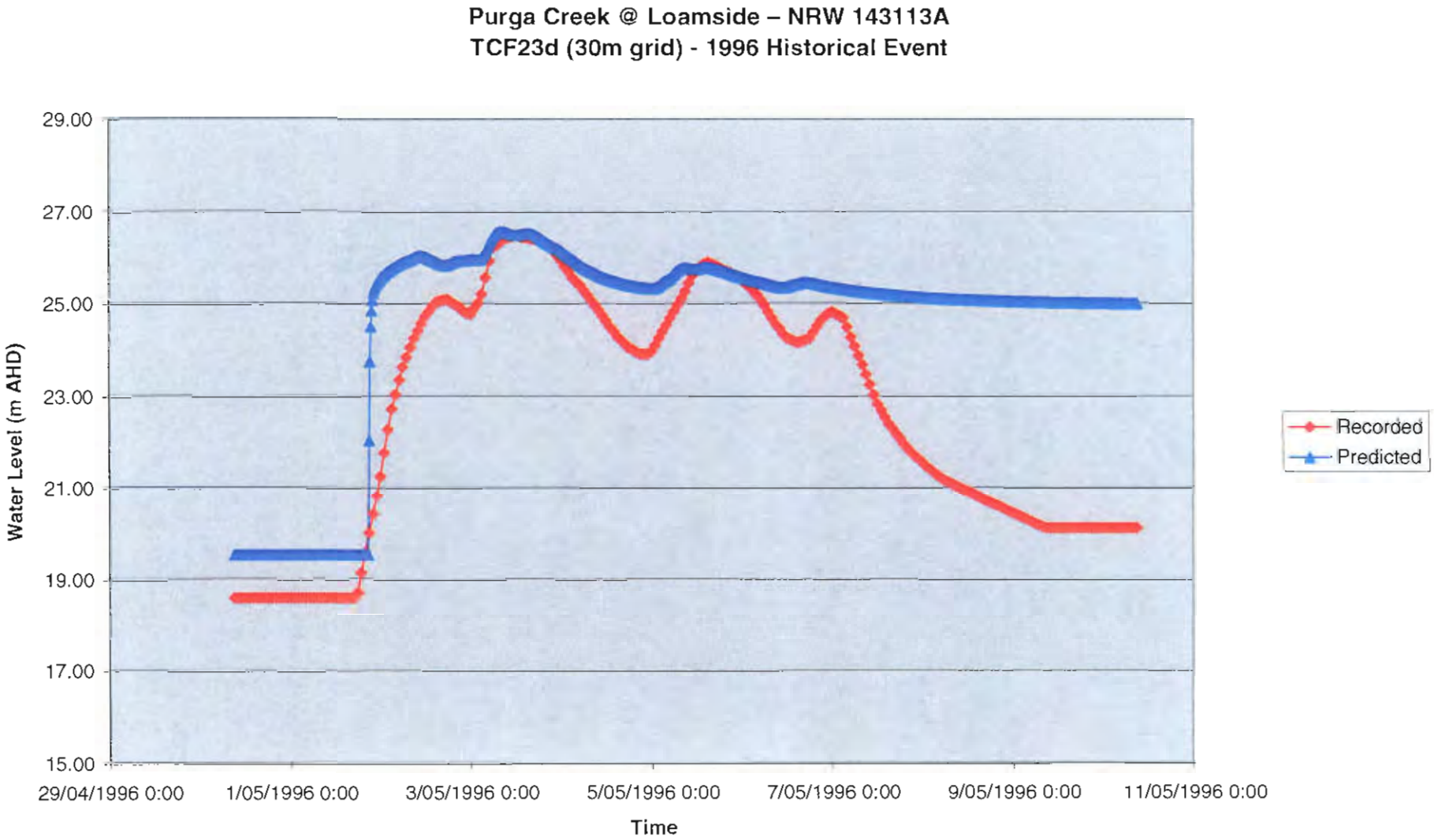

Figure 55: Purga Creek @ Loamside - Water Level Comparison

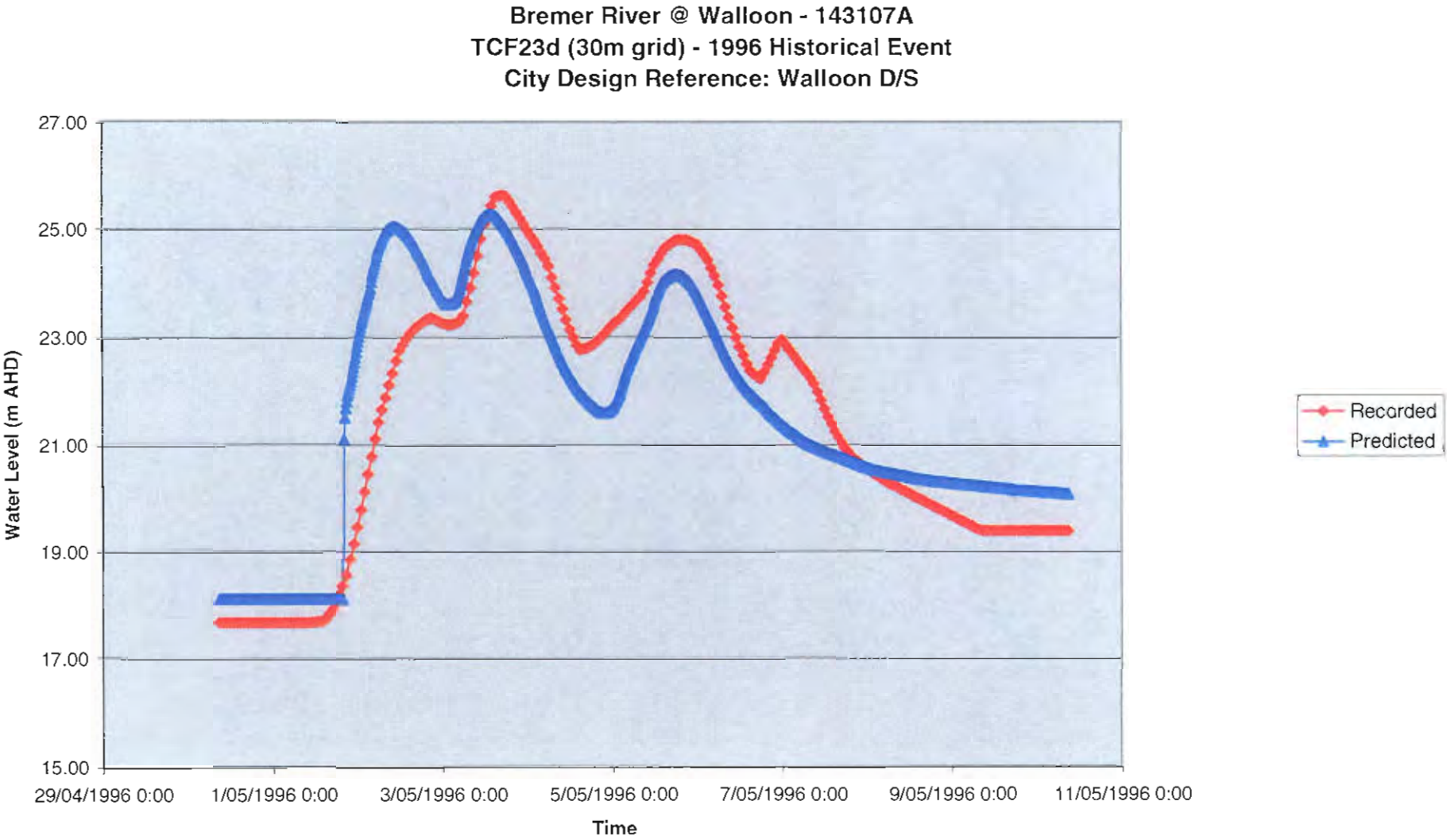

Figure 56: Bremer River @ Walloon - Water Level Comparison

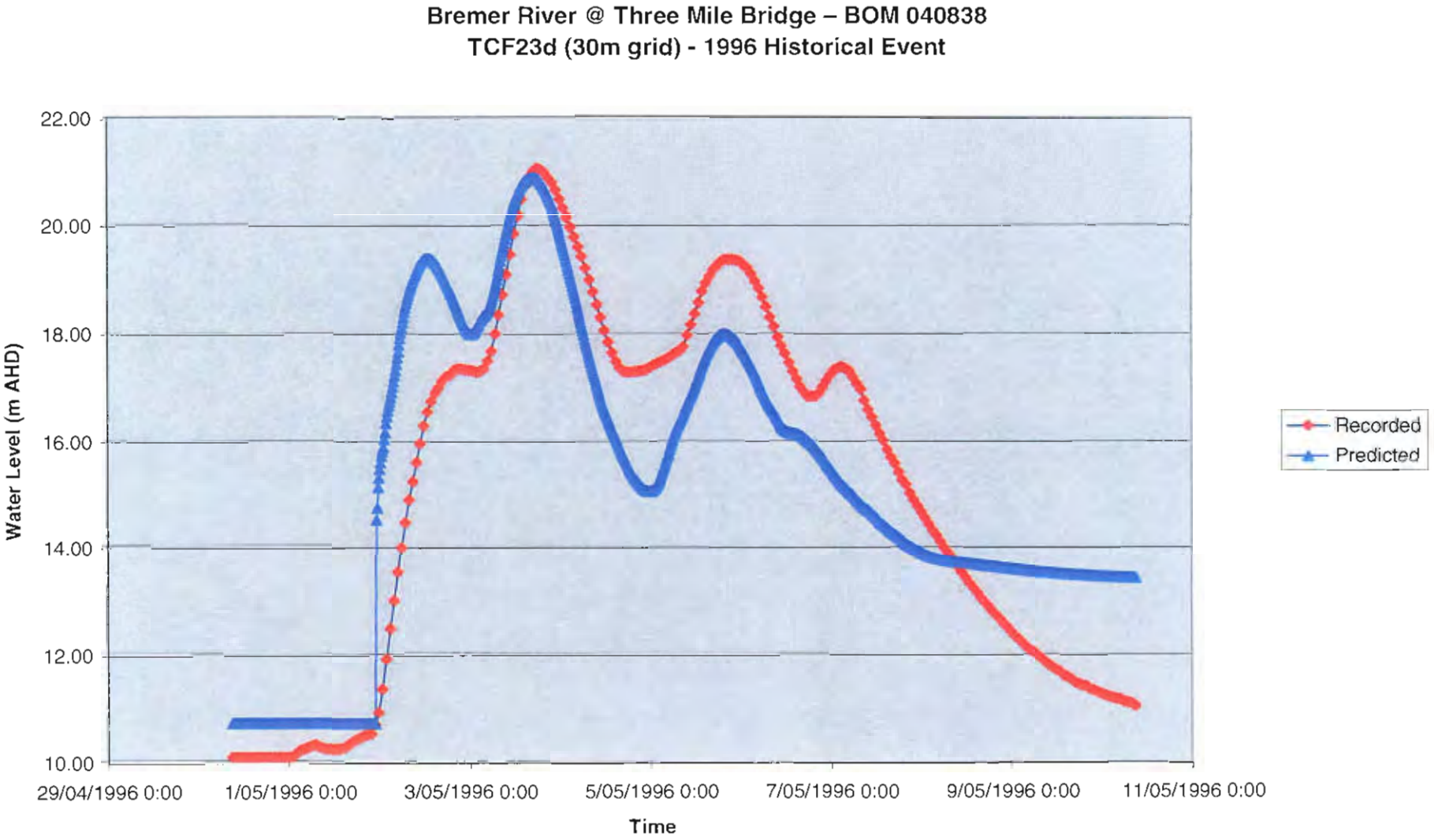

Figure 57: Bremer River @ Three Mile Bridge - Water Level Comparison

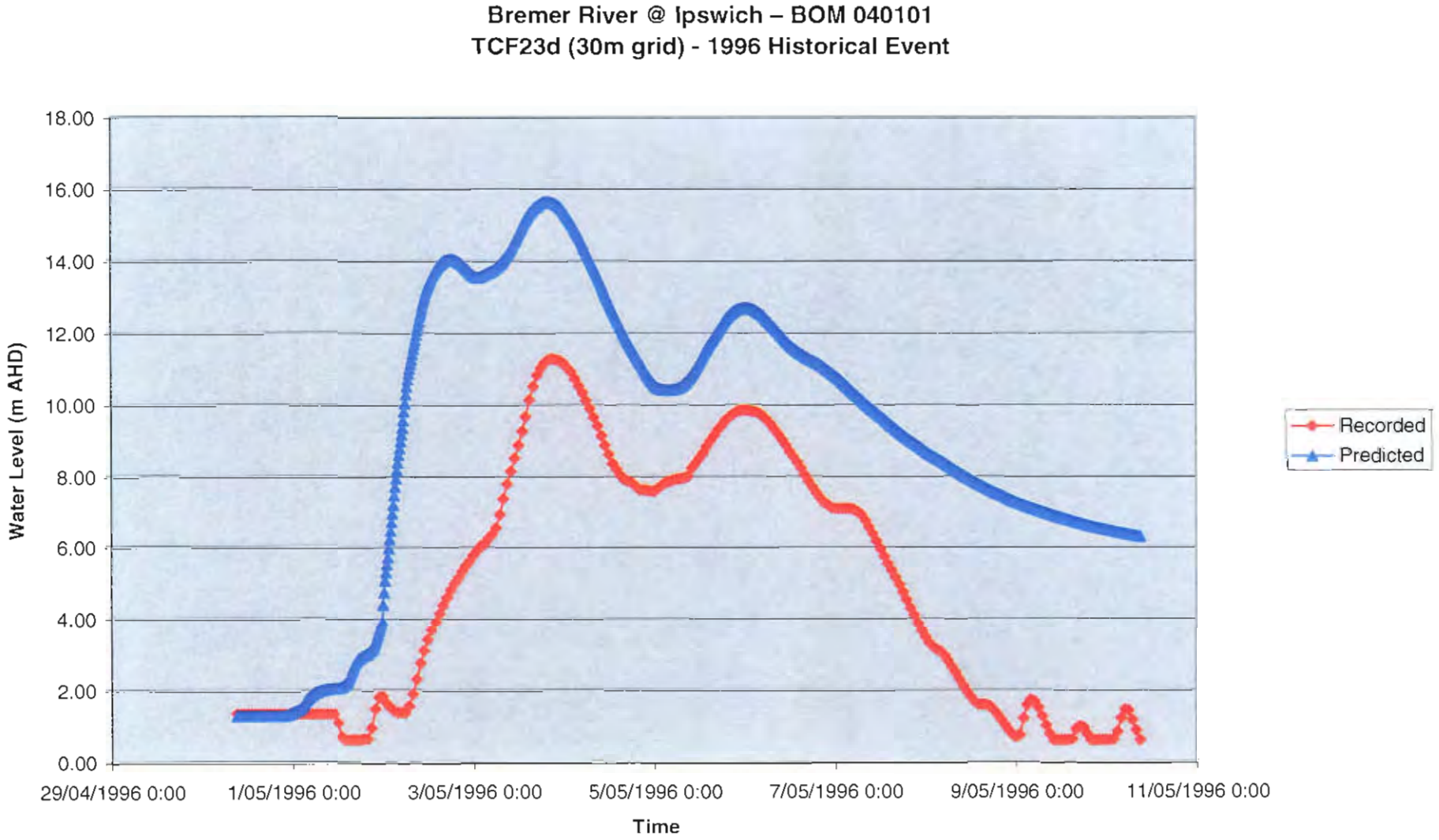

Figure 58: Bremer River @ Ipswich - Water Level Comparison

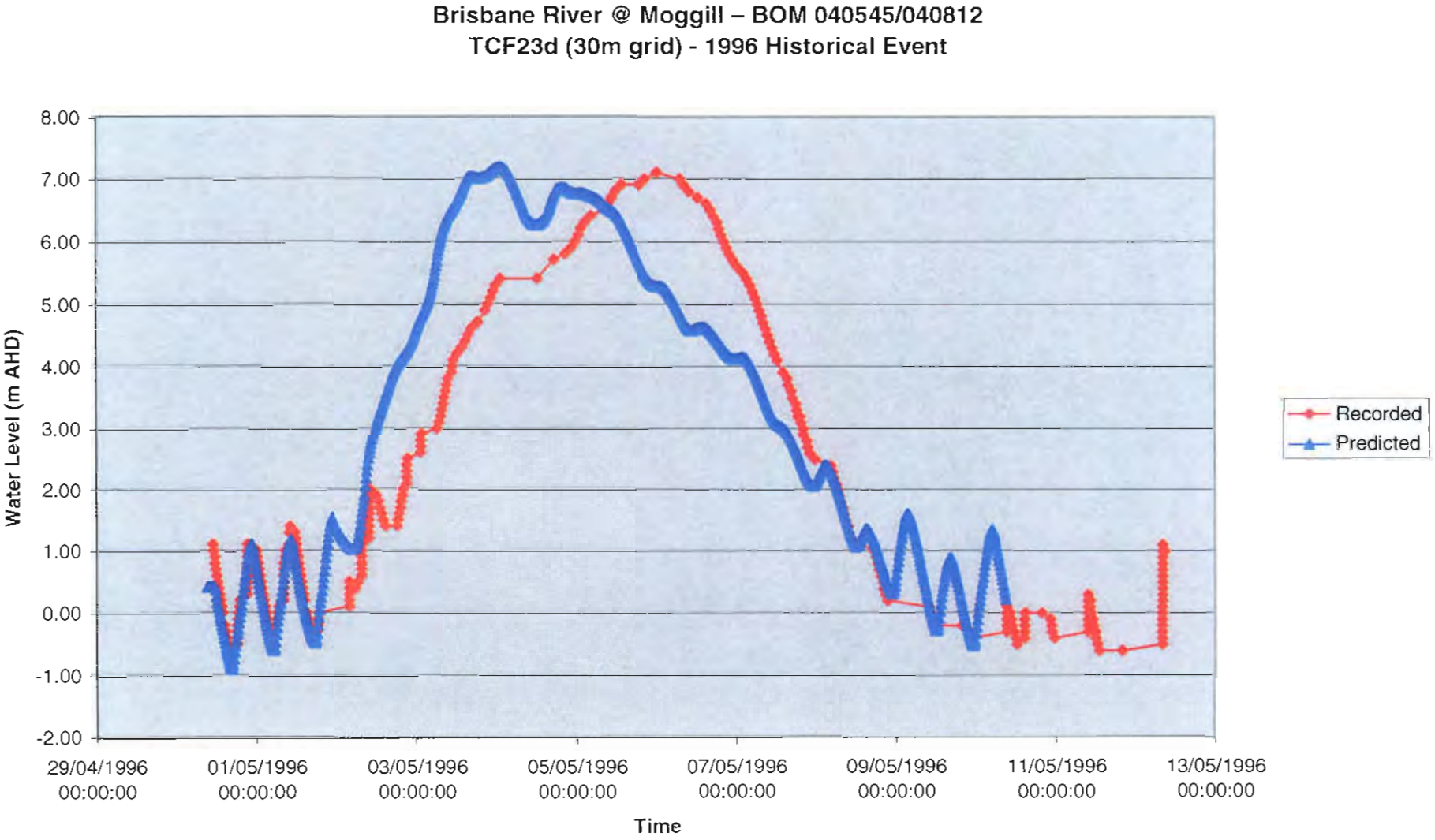

Figure 59: Brisbane River @ Moggill - Water Level Comparison

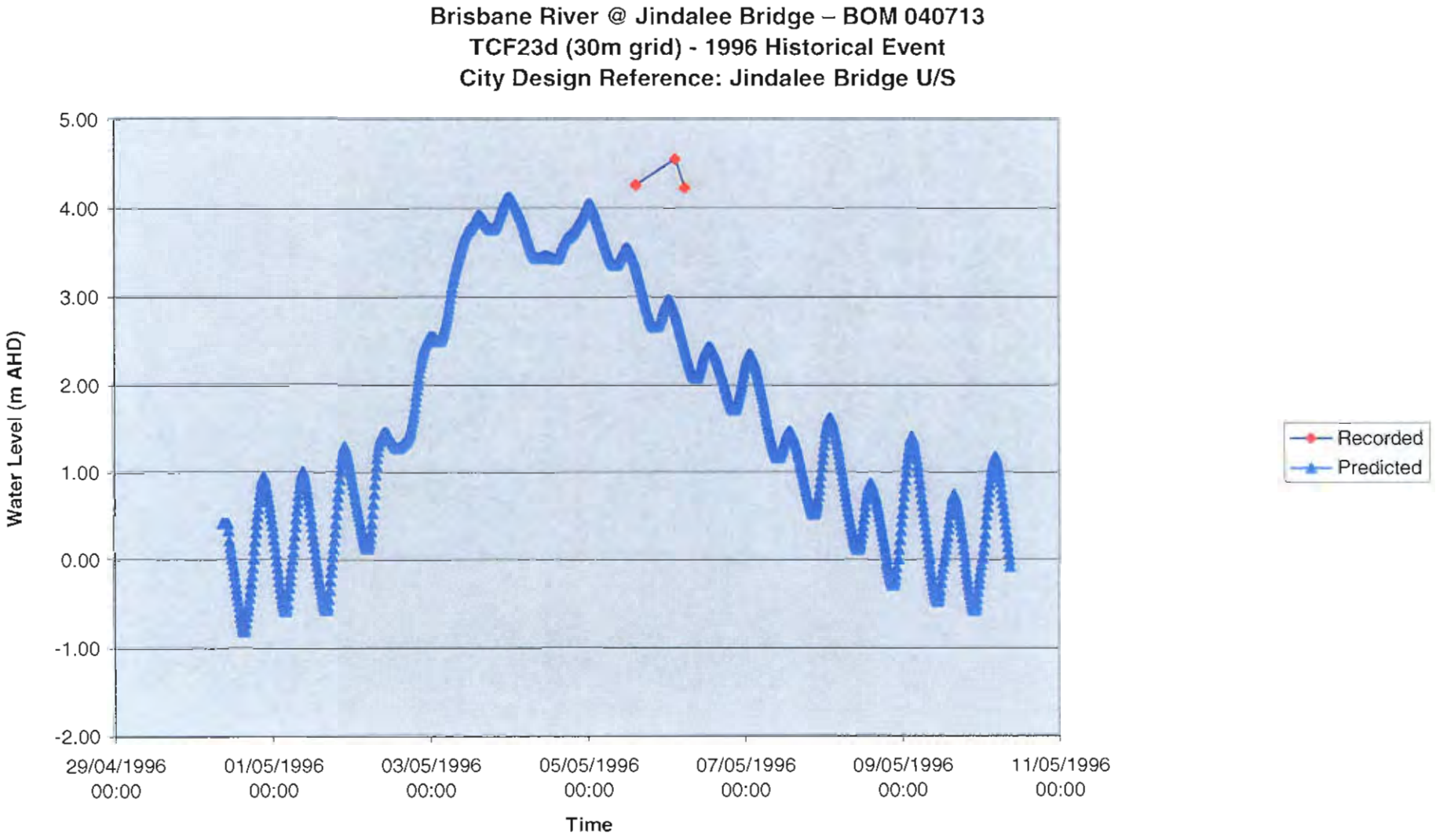

Figure 60: Brisbane River @ Moggill - Water Level Comparison

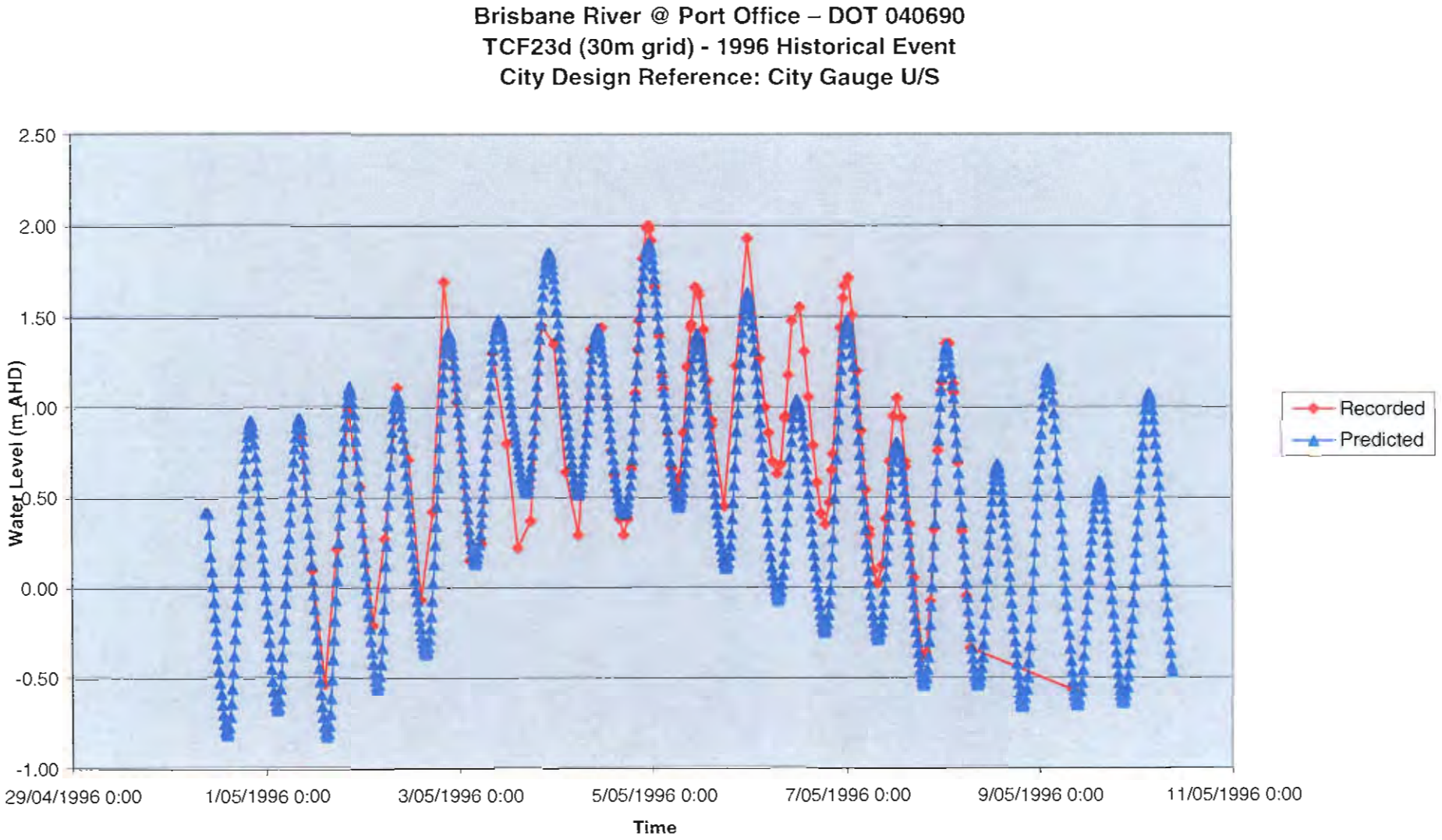

Figure 61: Brisbane River @ Port Office - Water Level Comparison

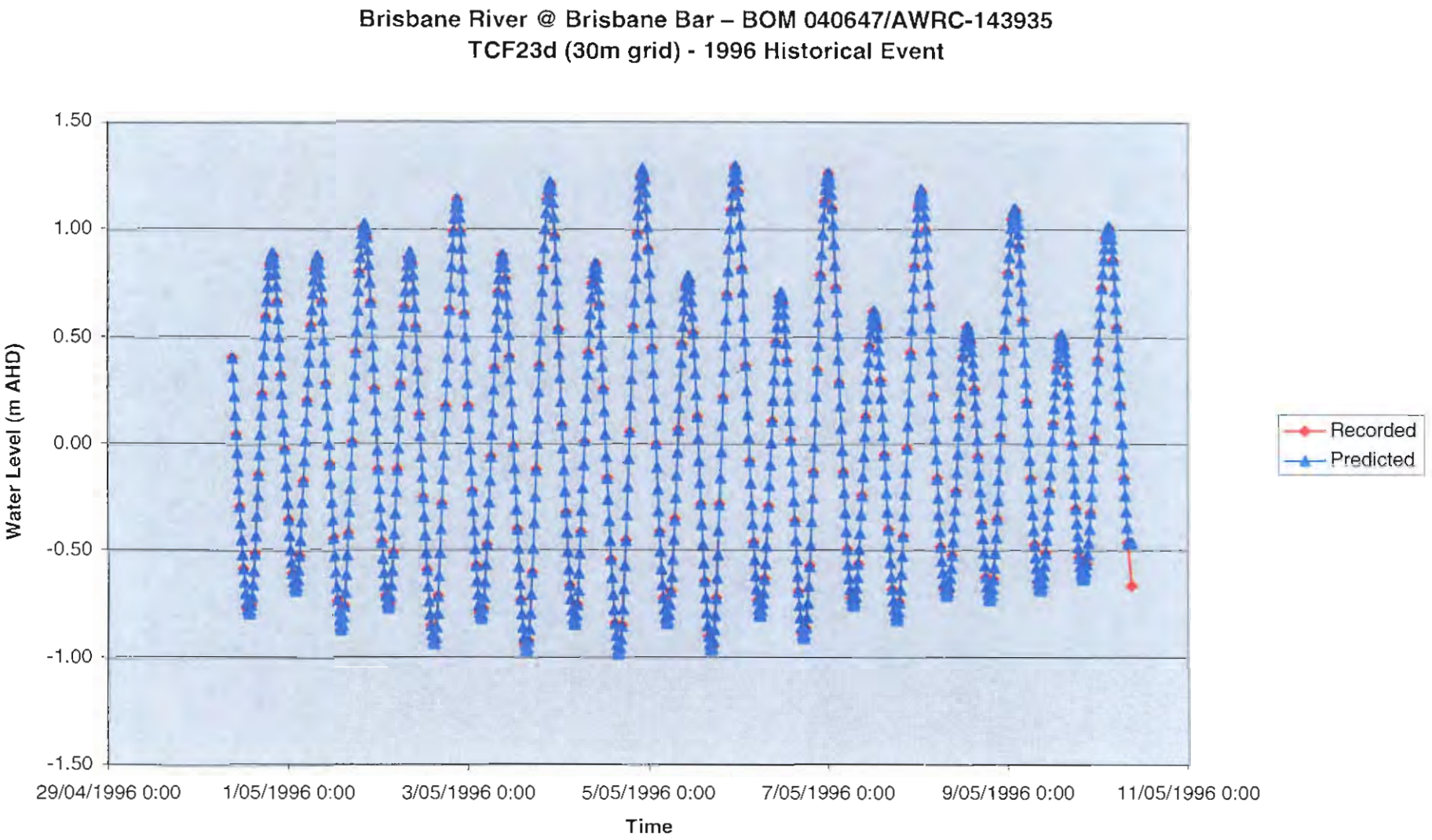

Figure 62: Brisbane River @ Brisbane Bar - Water Level Comparison



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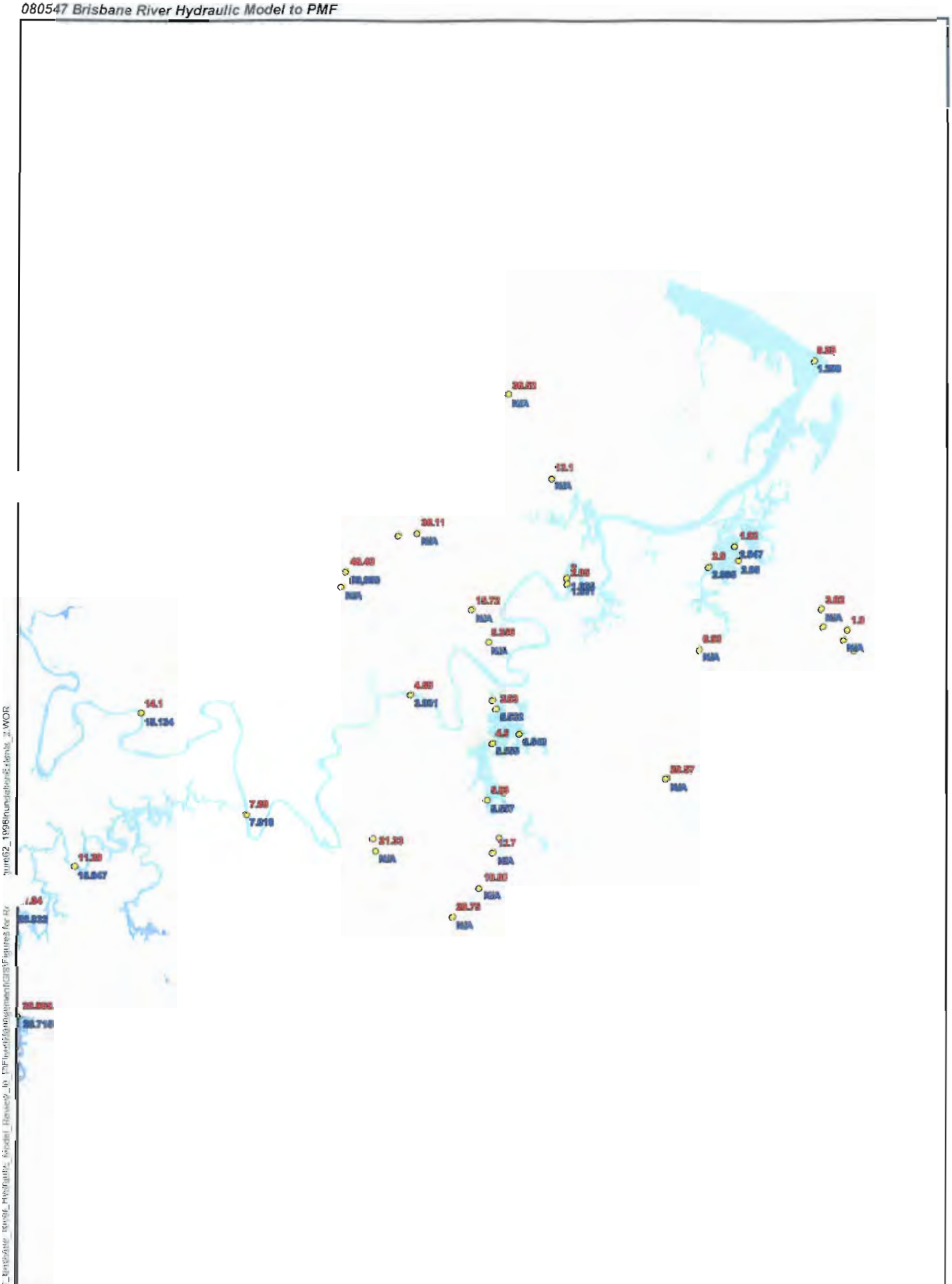
1996 Inundation Extents and Spot Levels - 1 of 2
Figure 63



1996 Inundation Extents and Spot Levels - 2 of 2
Figure 64

BCC. 009.6461

Appendix B Project Context

B1 State and Federal Legislative Requirements

In June 2001, the Council of Australian Governments (COAG) commissioned a review of Australia's approach and arrangements for dealing with natural disasters. The review objective was to determine whether current arrangements for assessing disaster risks, taking mitigation action and dealing with natural disasters when and as they occur, provide an effective framework to meet the needs of those affected by natural disasters.

The resulting report ***Natural Disasters in Australia: Reforming mitigation, relief and recovery arrangements*** (February 2004), concluded that current arrangements could be improved by broadening the focus of disaster management beyond historic disaster response and reaction, towards anticipation and mitigation of disasters. This report recommended a unified national approach to natural disasters and the adoption of a national framework to:

- create safer, more sustainable communities in social, economic and environmental terms
- reduce risks, damage and losses from natural disasters
- find the right balance between mitigation, preparedness, response, relief & recovery activities
- recognise the investment and savings opportunities provided by mitigation

The report also described desirable attributes of a national framework for natural disaster management as well as twelve commitments by all levels of government to reform Australia's natural disaster management over the next five years. The general themes of these commitments were the development of:

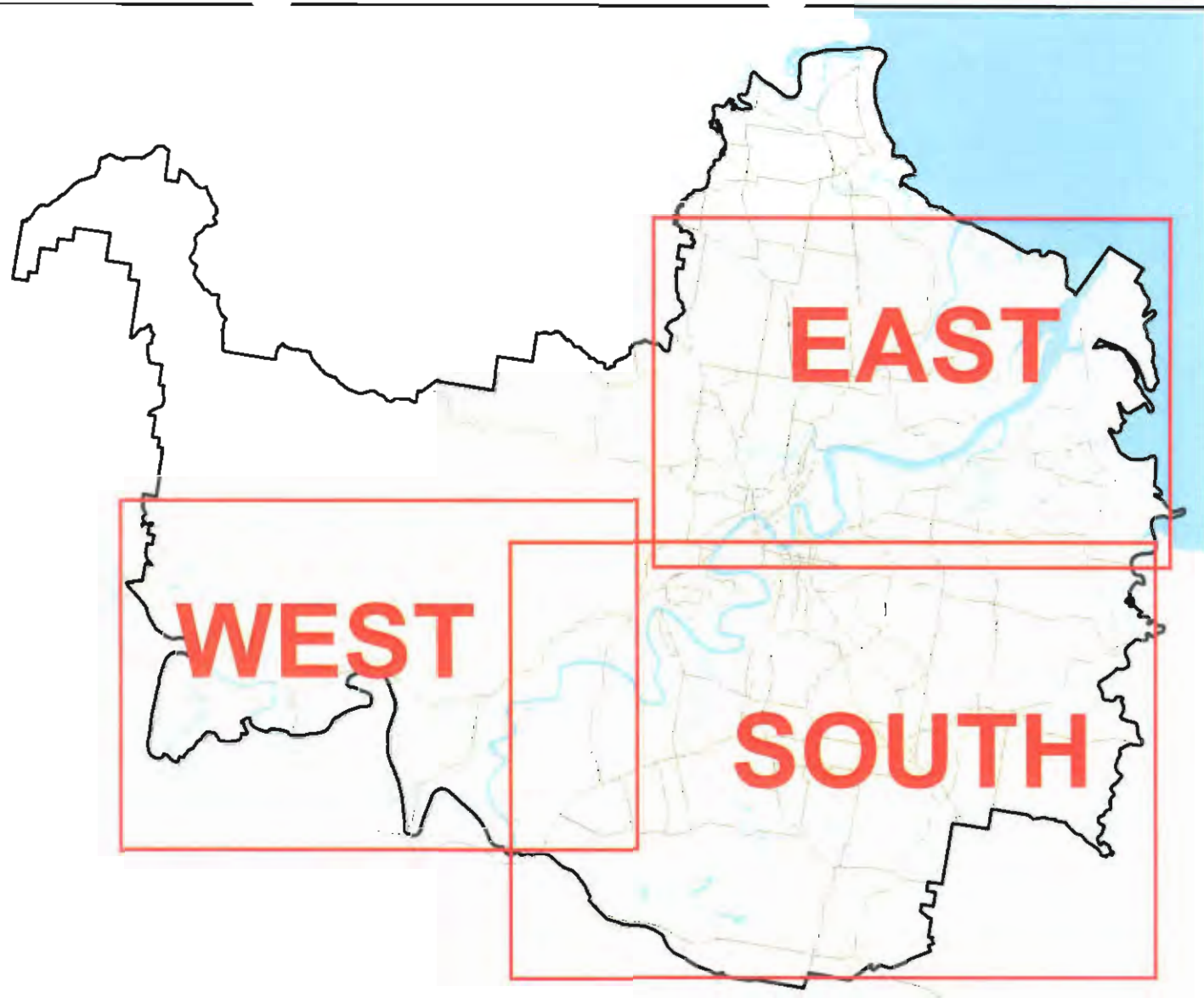
- systematic and rigorous disaster risk assessments and mitigation measures and strategies
- a nationally consistent system of data collection, research and analysis and cost-sharing principles for natural disaster management with a stronger focus on anticipation, mitigation, and recovery and resilience
- effective land use planning, development and building controls
- national practices in community awareness, education and warnings
- enhanced Commonwealth Natural Disaster Relief Arrangements and support for emergency management volunteers

In August 2004, the Queensland Audit Office (QAO) tabled its ***Report No. 2 for 2004-05: Audit of the Queensland Disaster Management System***. QAO considered that the report was of strategic importance in the development of a more holistic, integrated and balanced approach to disaster management in Queensland under the Disaster Management Act 2003.

B2 NDMP Funding Arrangements

The NDMP is a national program aimed at identifying and addressing natural disaster risk priorities across the nation. Funds are available for natural disaster mitigation works, measures and related

BCC.009.6463



3 0 3 6 9

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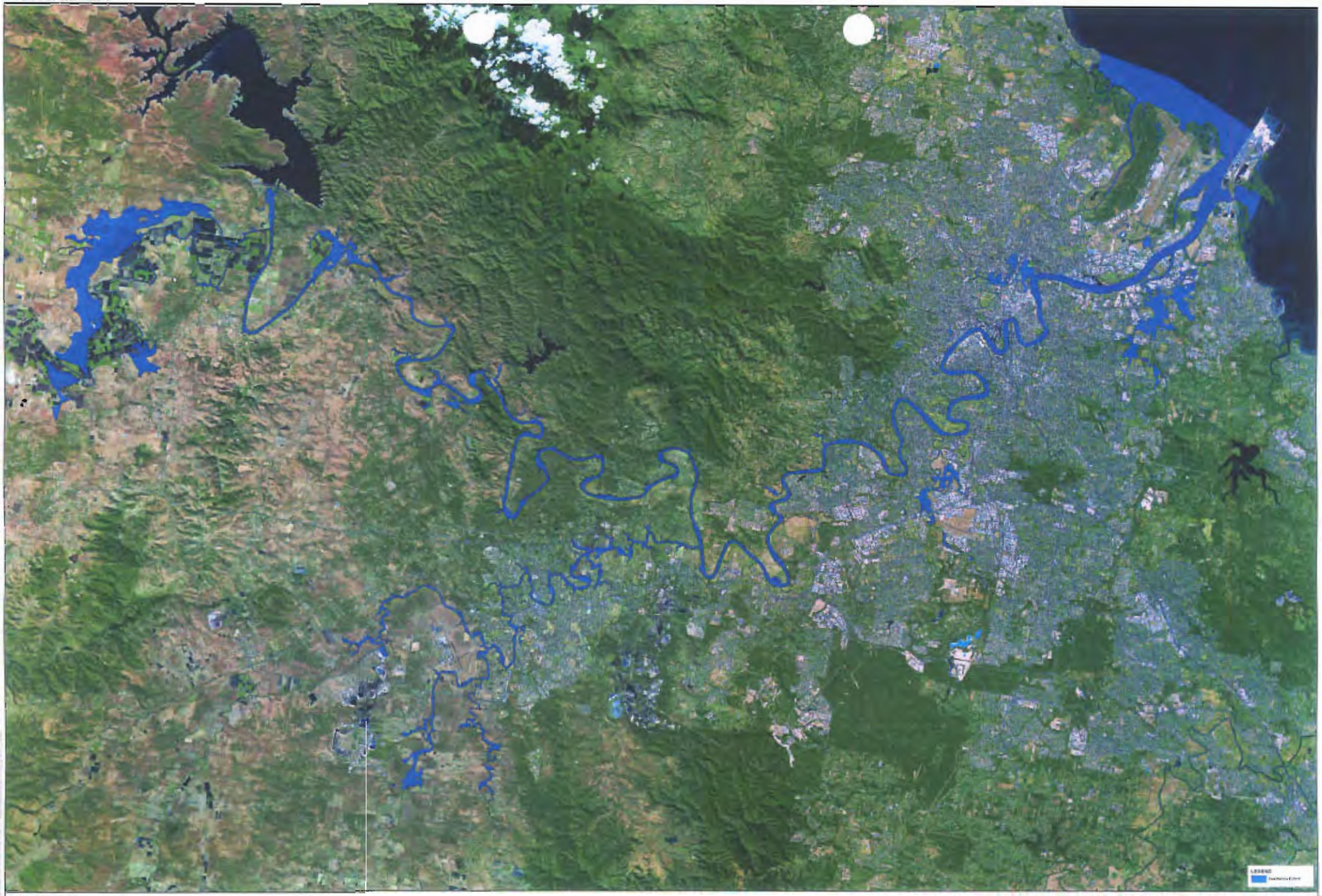
Key Map for Inundation and Evacuation Maps

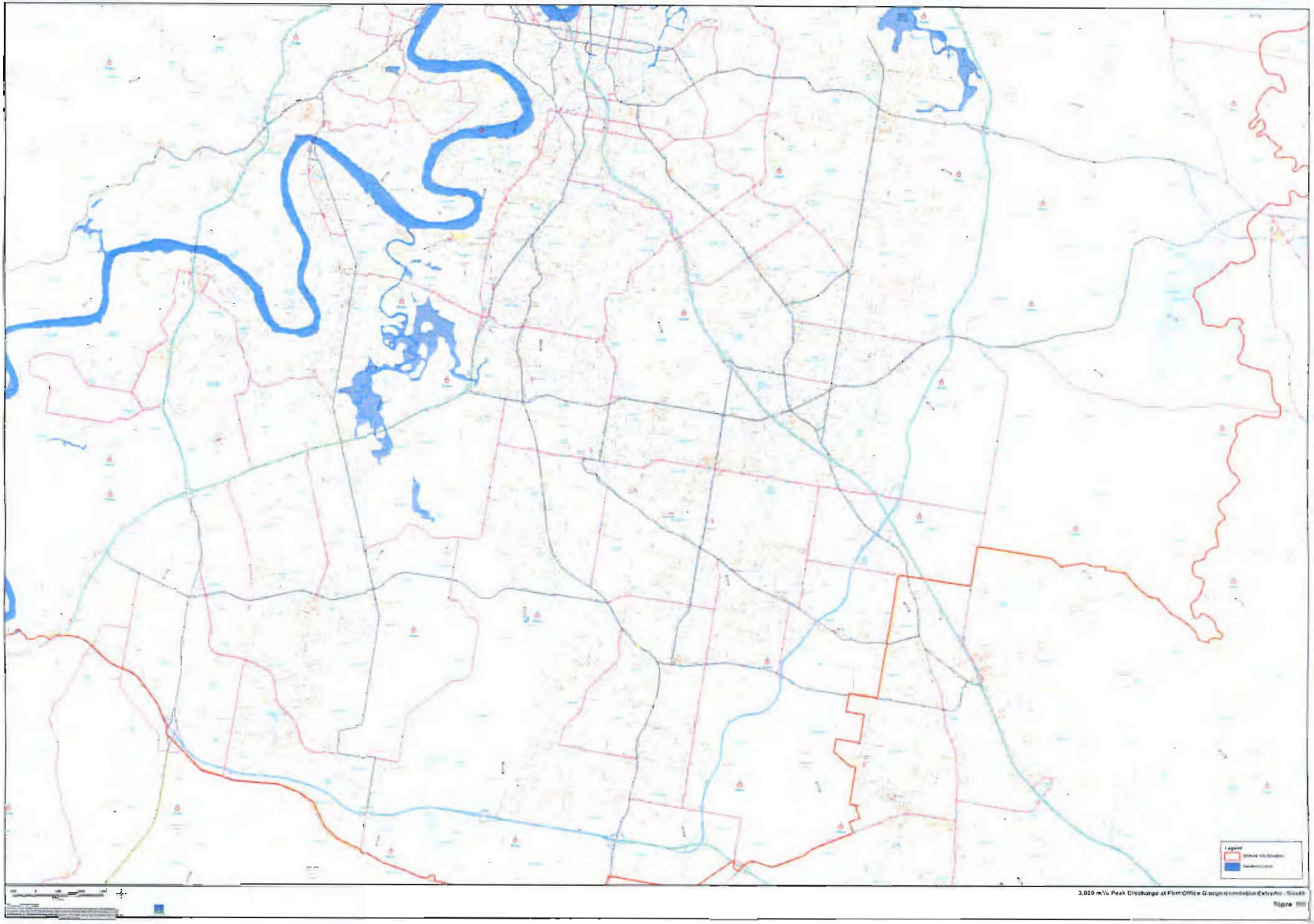
Figure 100





3,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - West

Figure 102



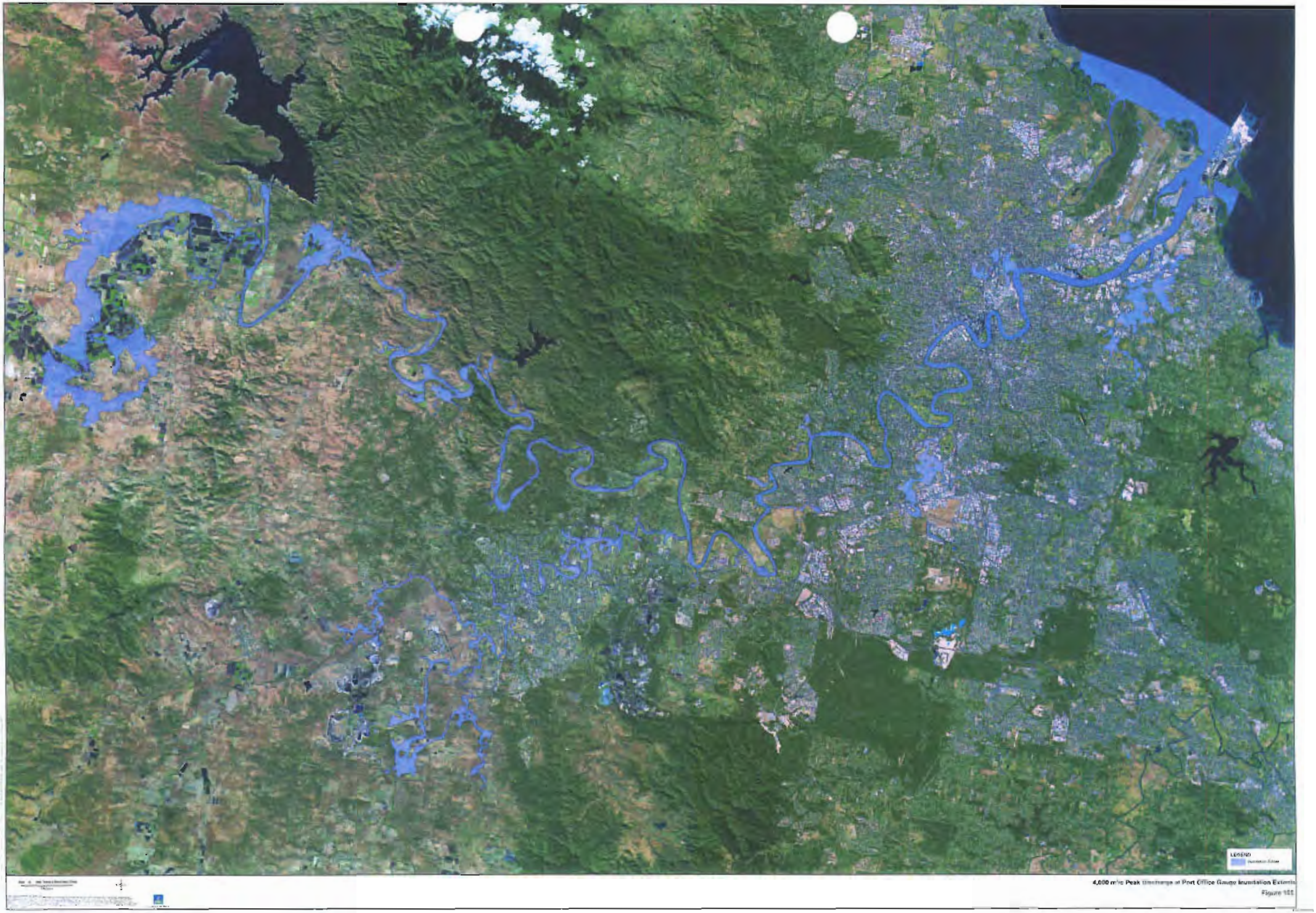
3,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - South

Figure 103

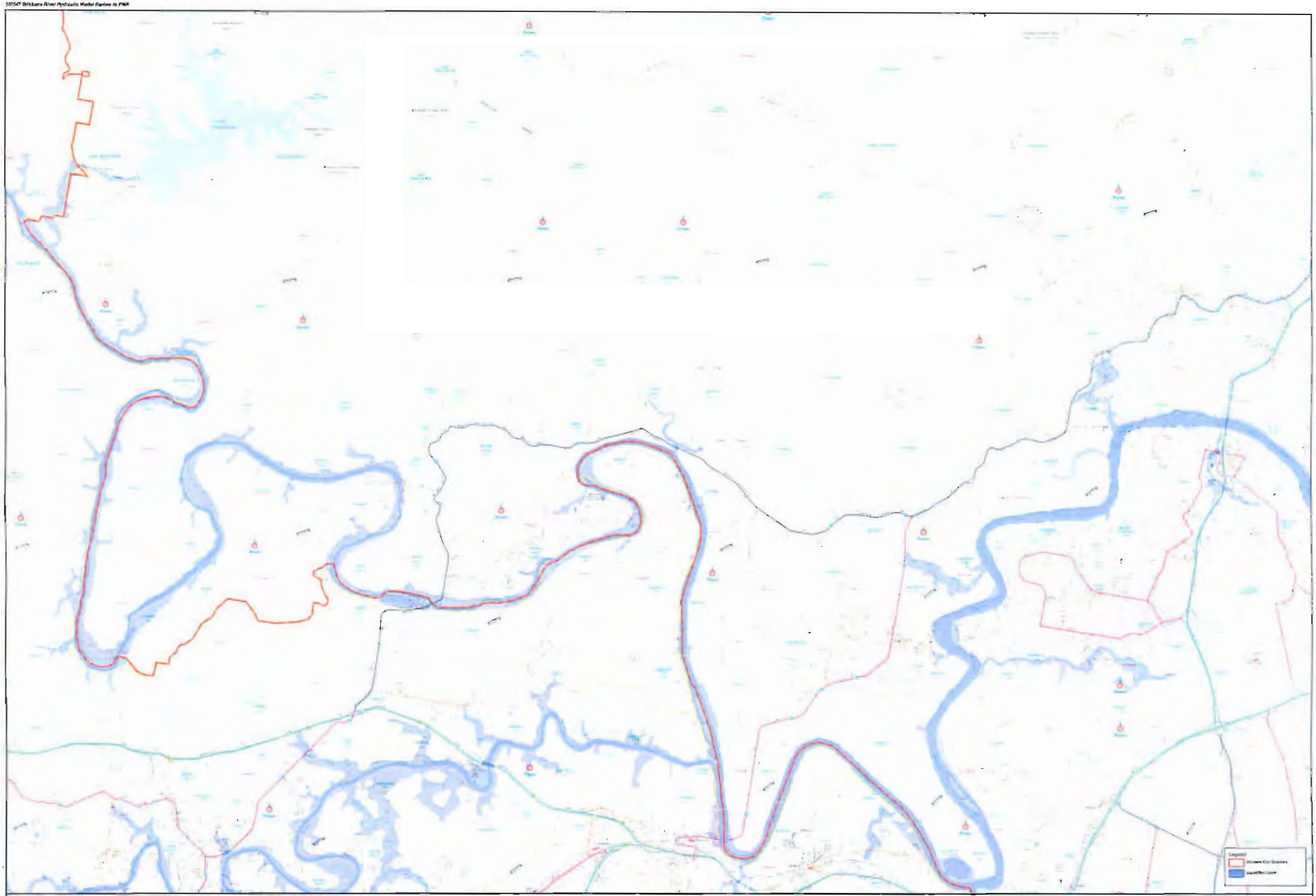


3,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - East

Figure 104

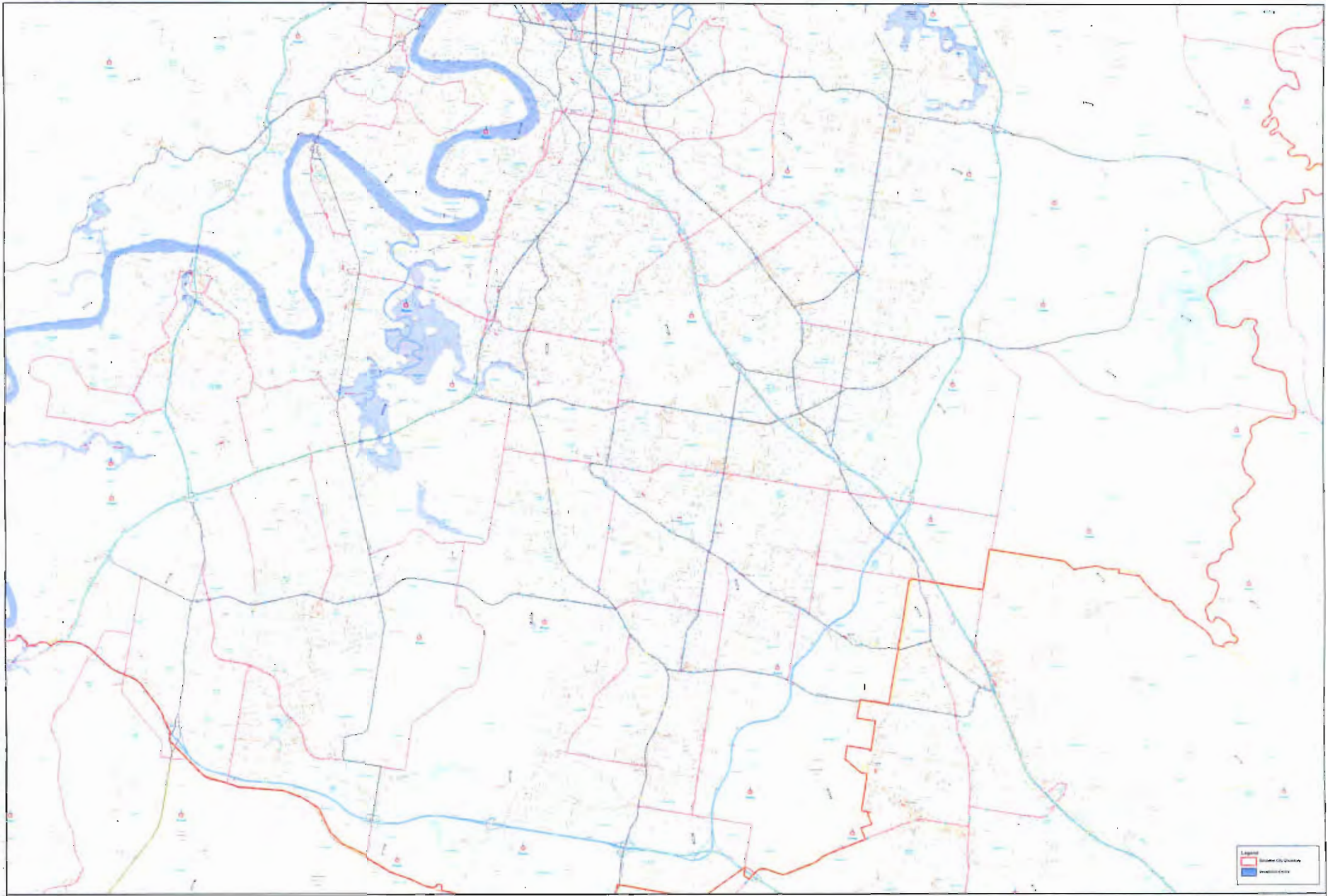


4,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents



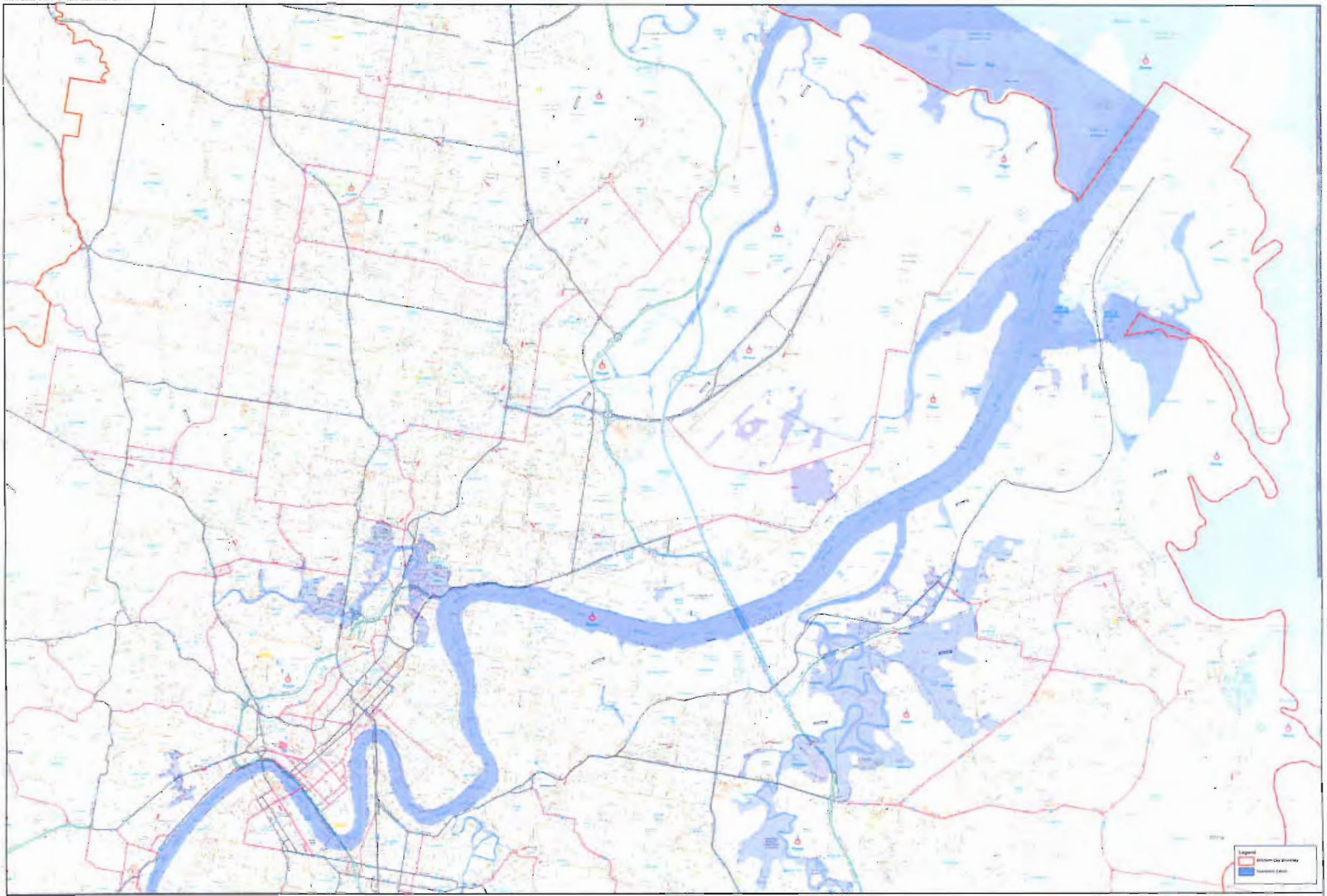
4,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - West

Figure 106



4,000 m³/s Peak Discharge at Port Office Gauge Inundation Extent - South

Figure 167



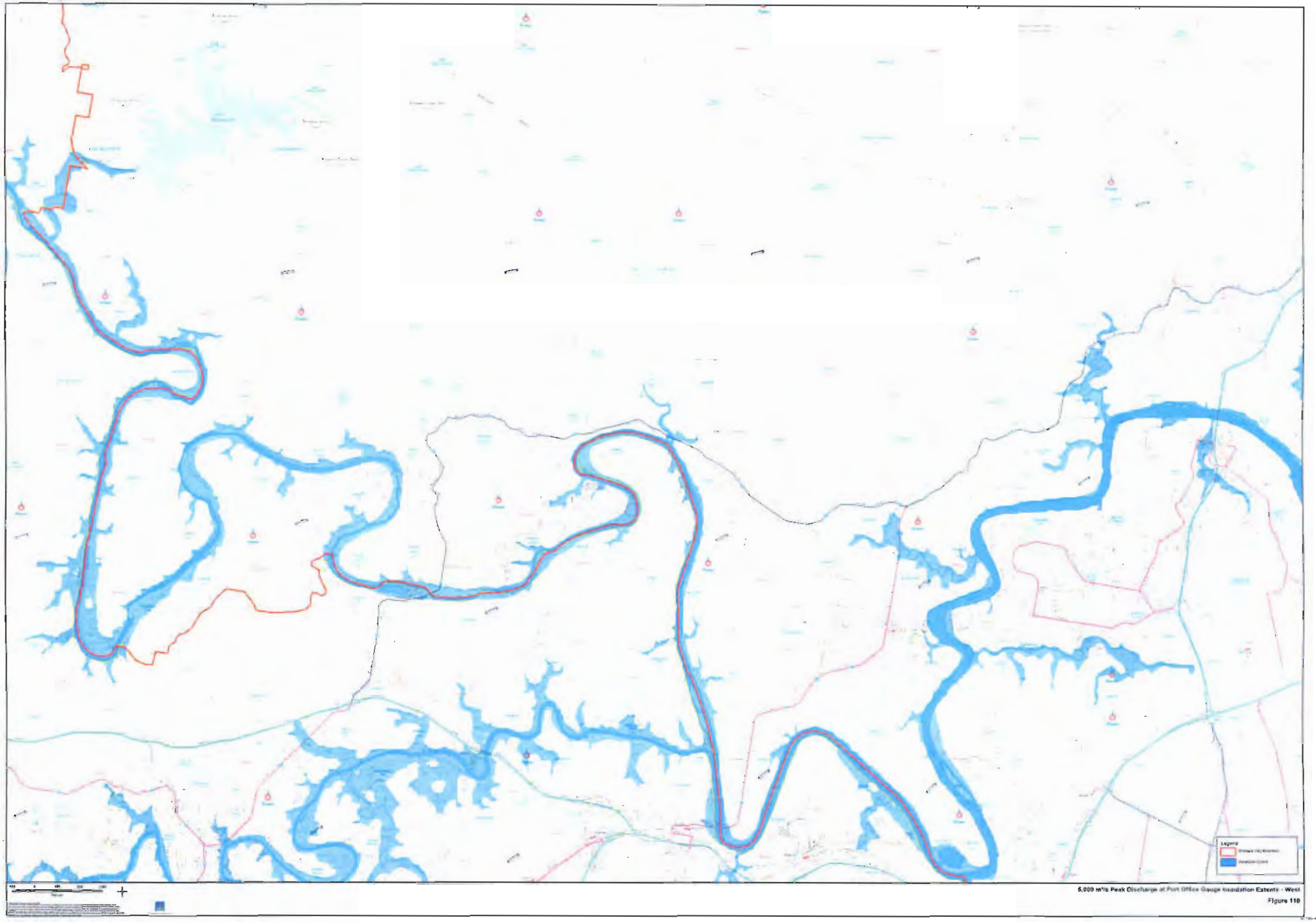
4,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - Sheet

Figure 109



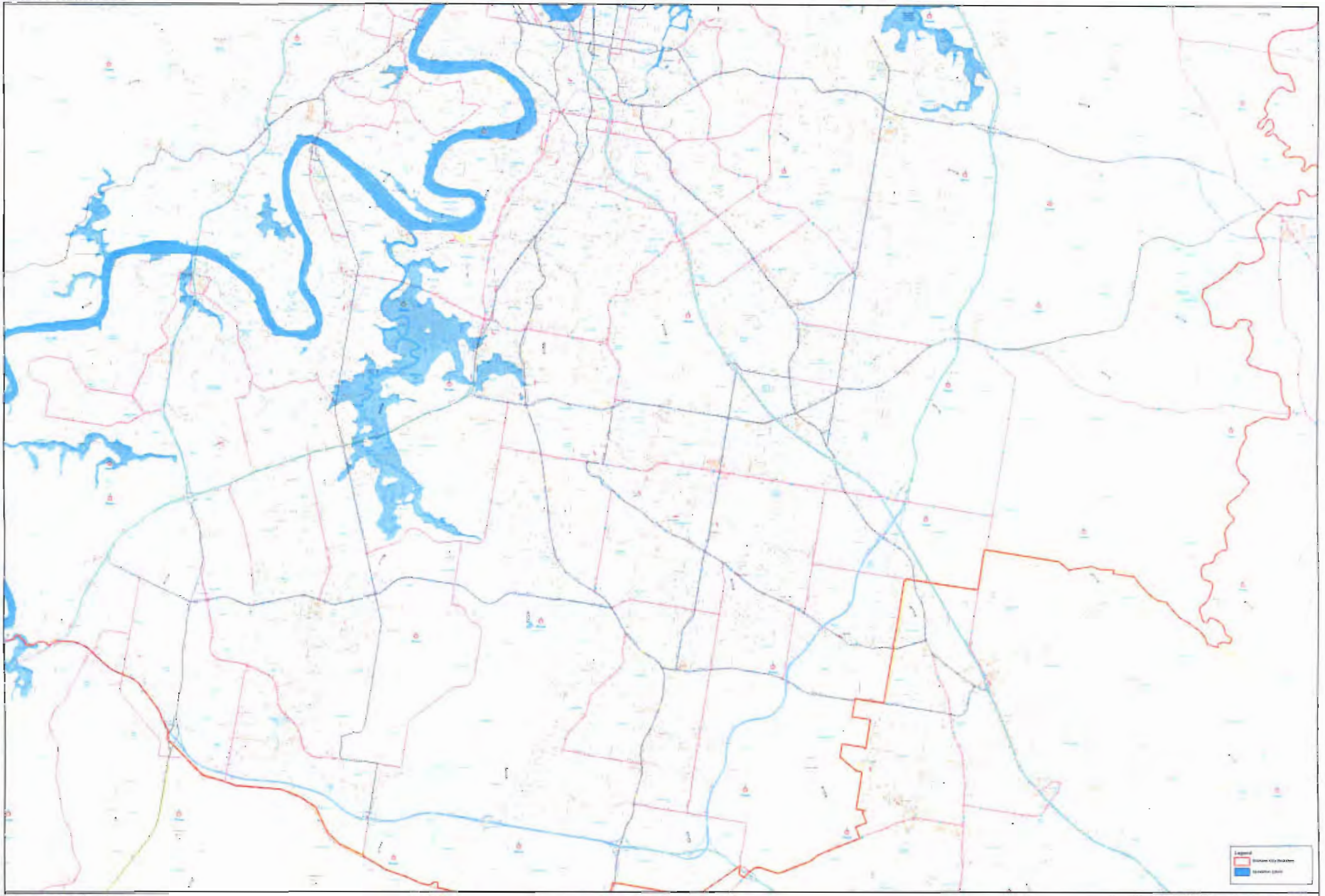
5,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents

Figure 109



6,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - West

Figure 110



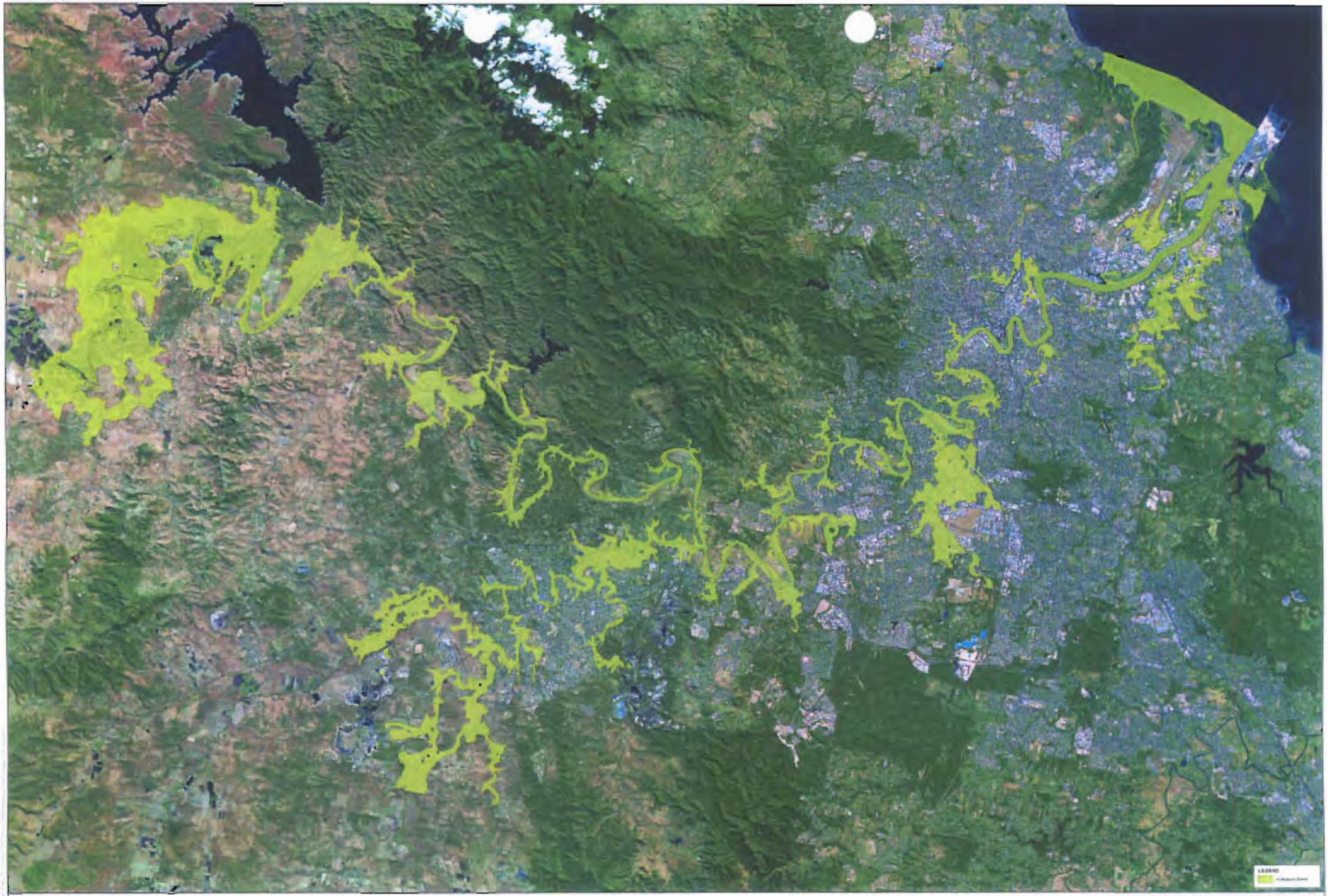
5,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - South

Figure 111



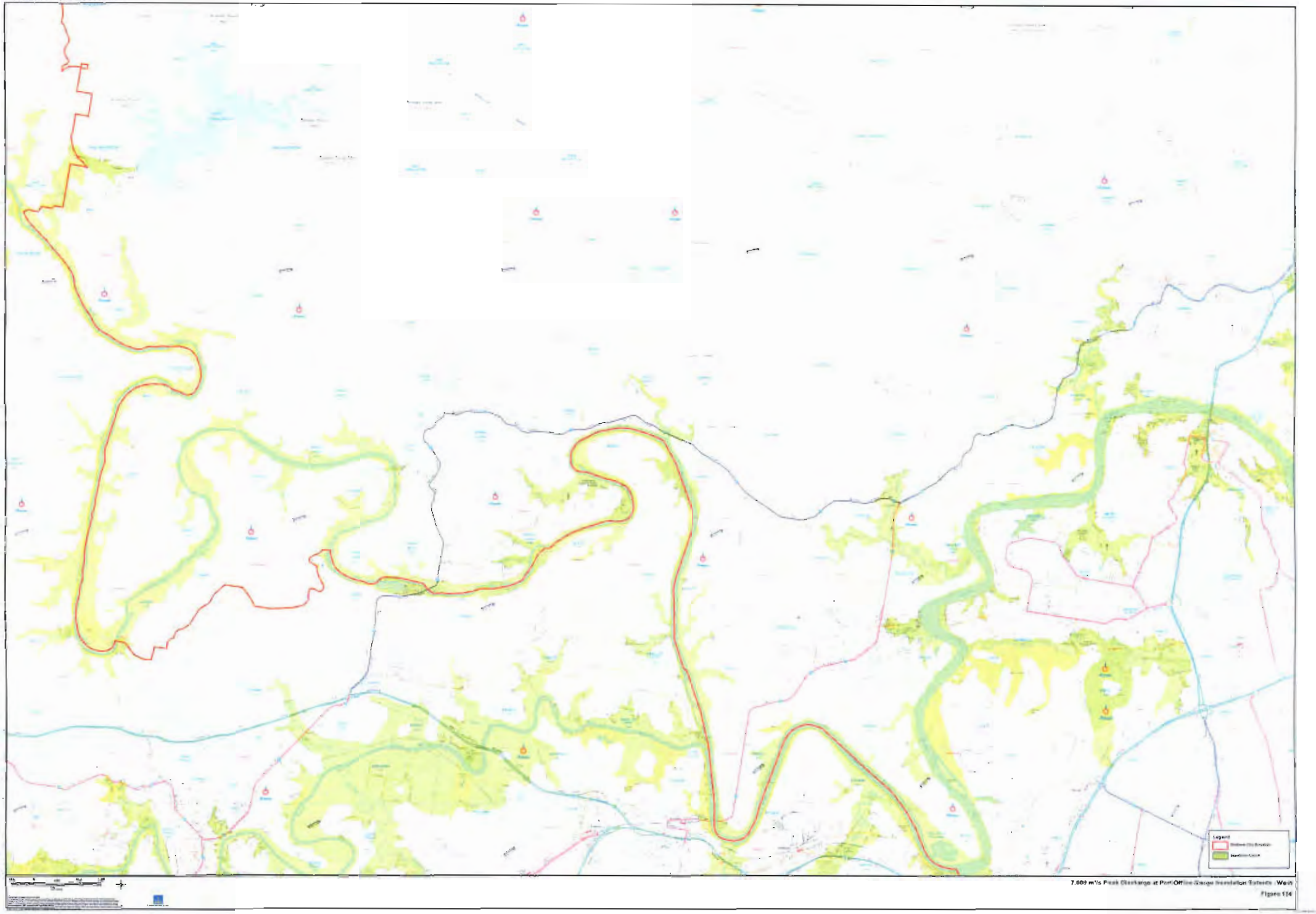
5,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - East

Figure 1/2



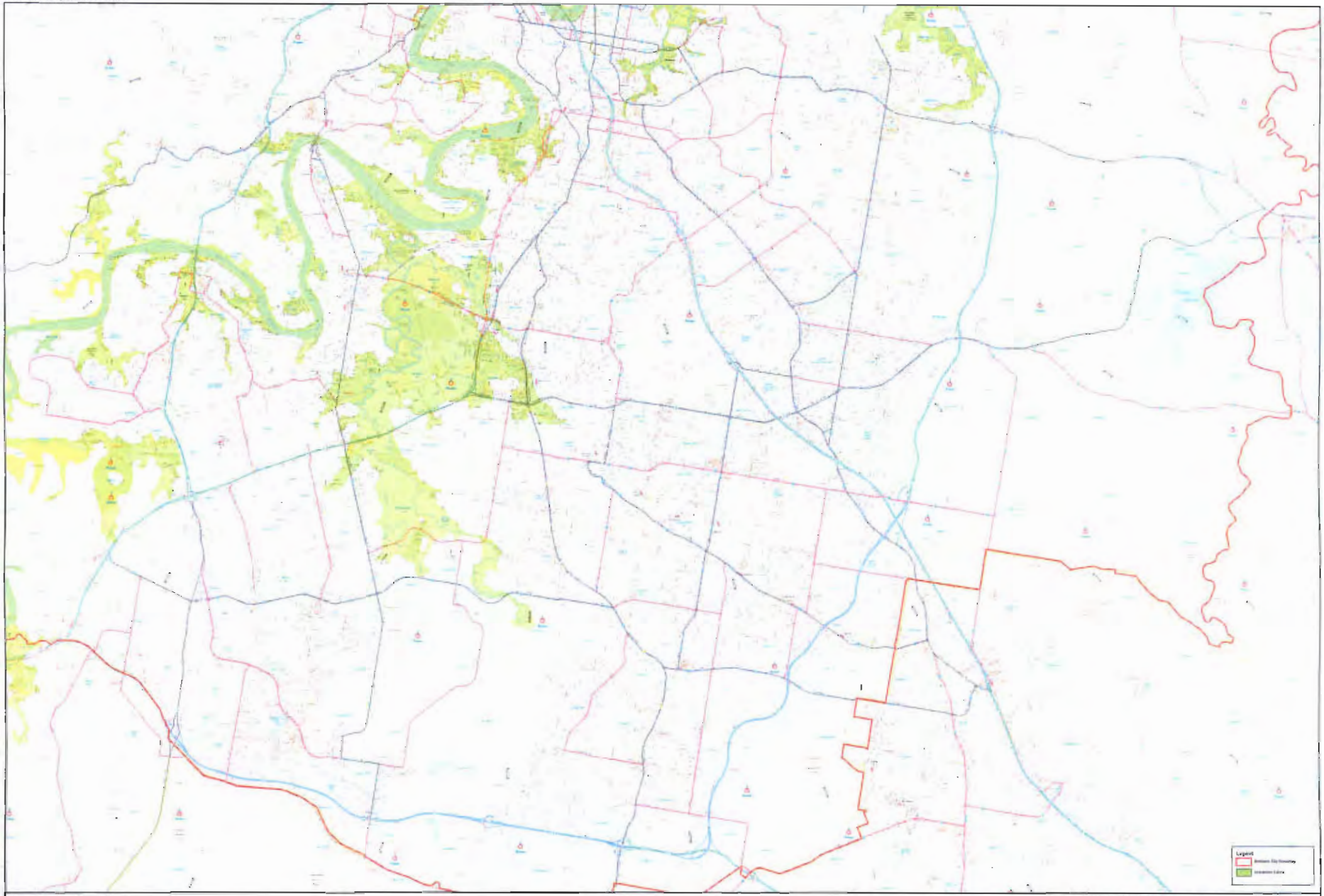
7,888 m³/s Peak Discharge at Port Office Gauge Inundation Extents

Figure 113



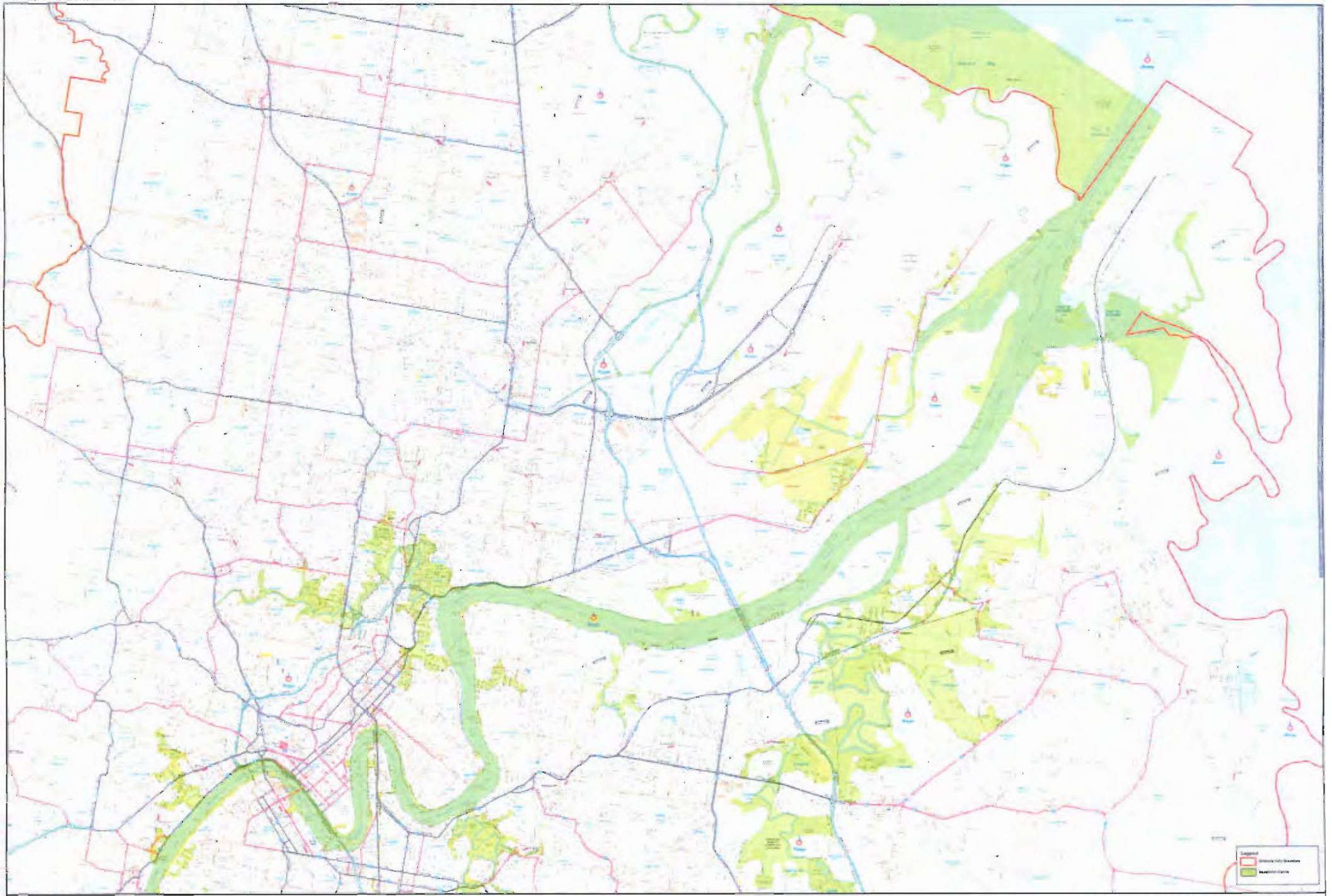
7,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - West

Figure 1/4



7,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - South

Figure 115



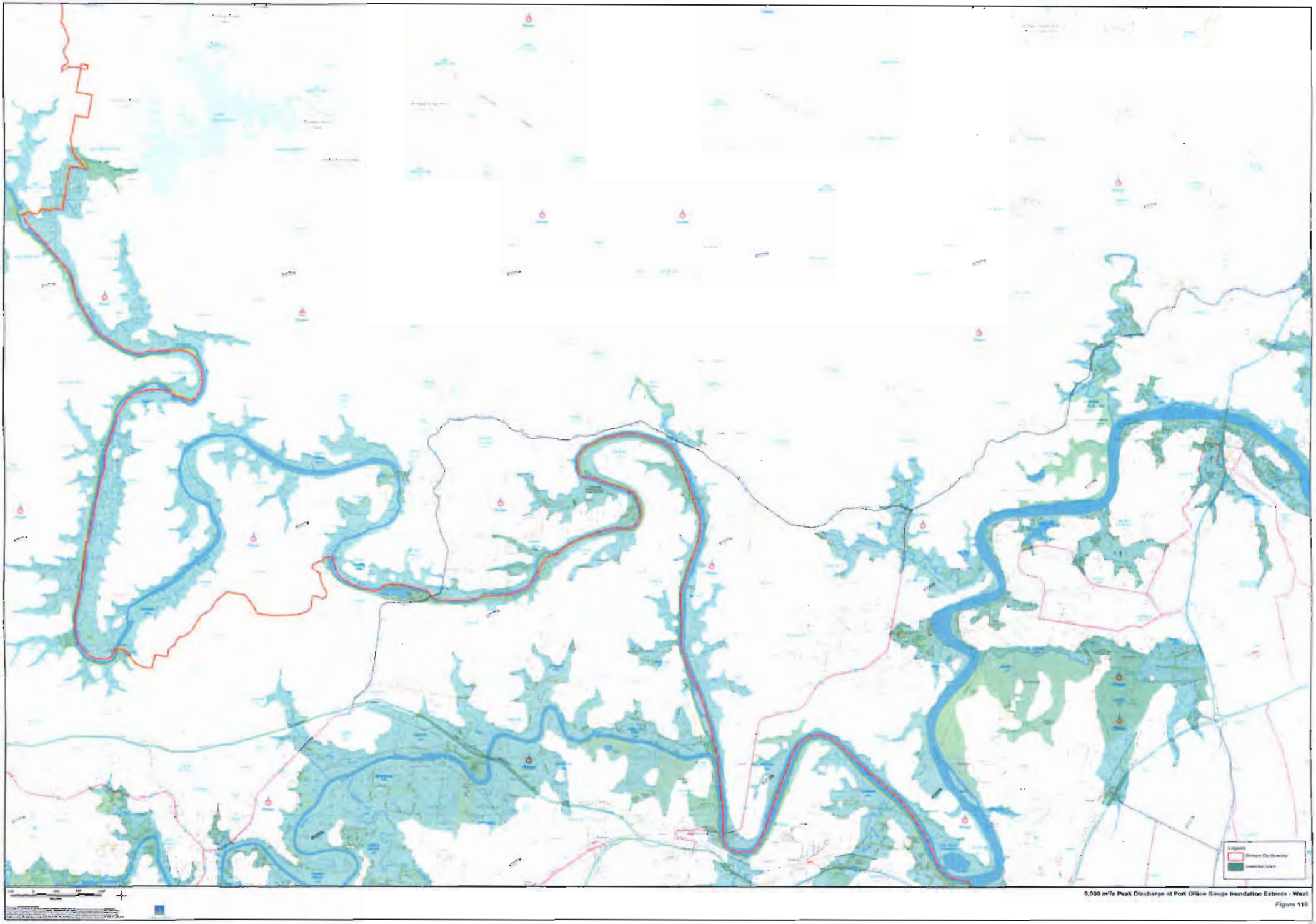
7,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - Post

Figure 116



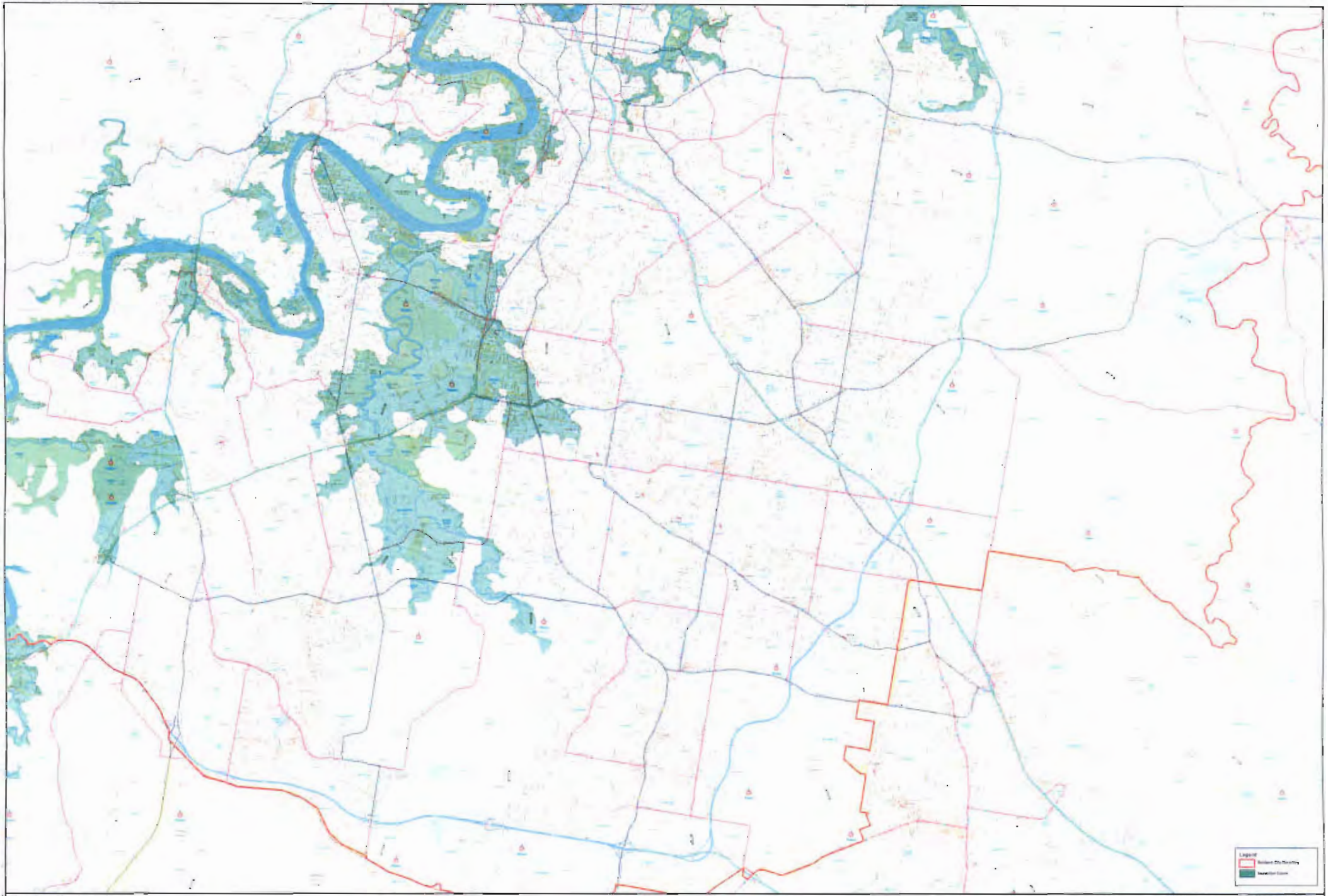
0.000 m³/s Peak Discharge at Port Office Gauge Inundation Extent

Figure 117



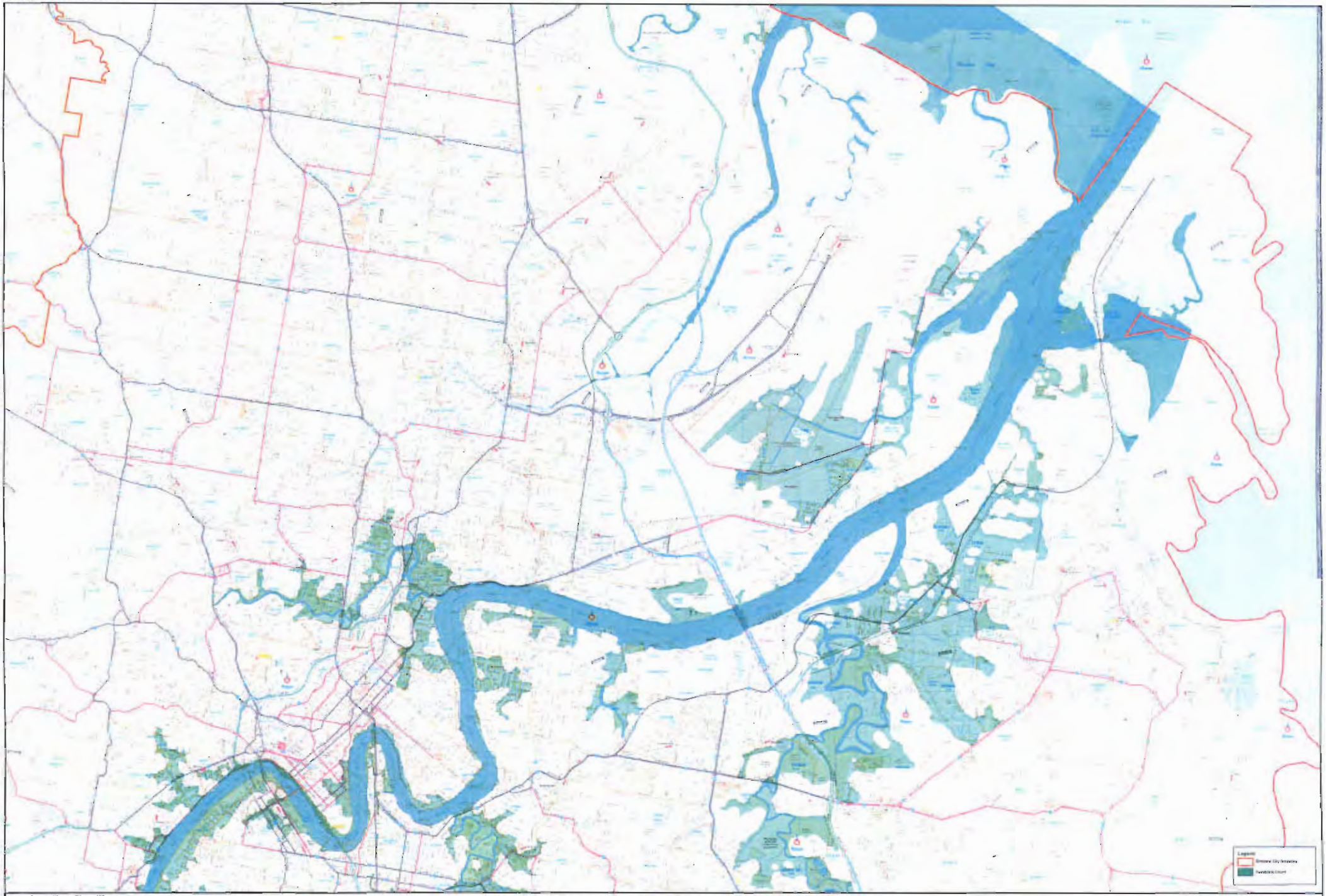
9,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - West

Figure 11B



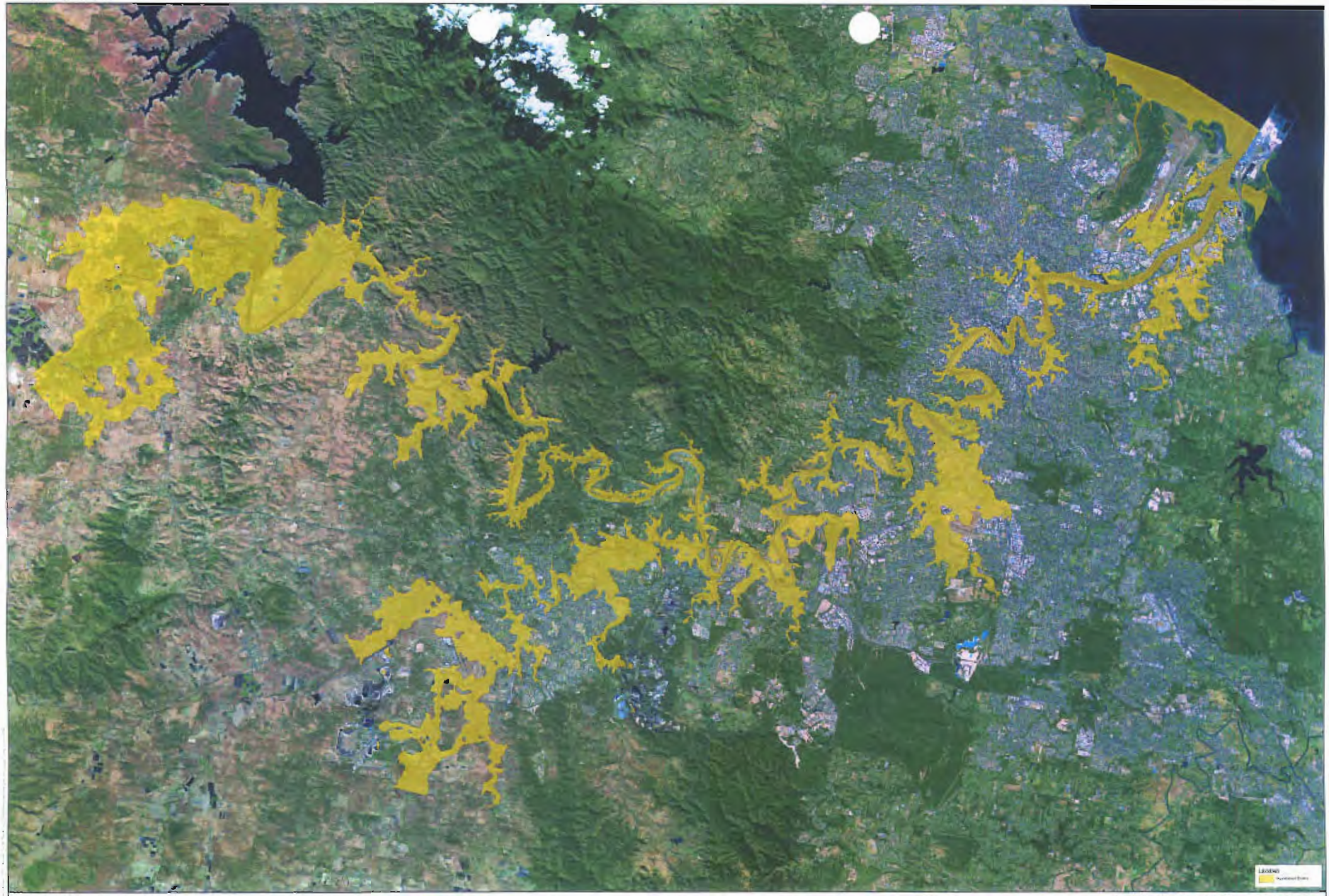
9,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - South

Figure 110



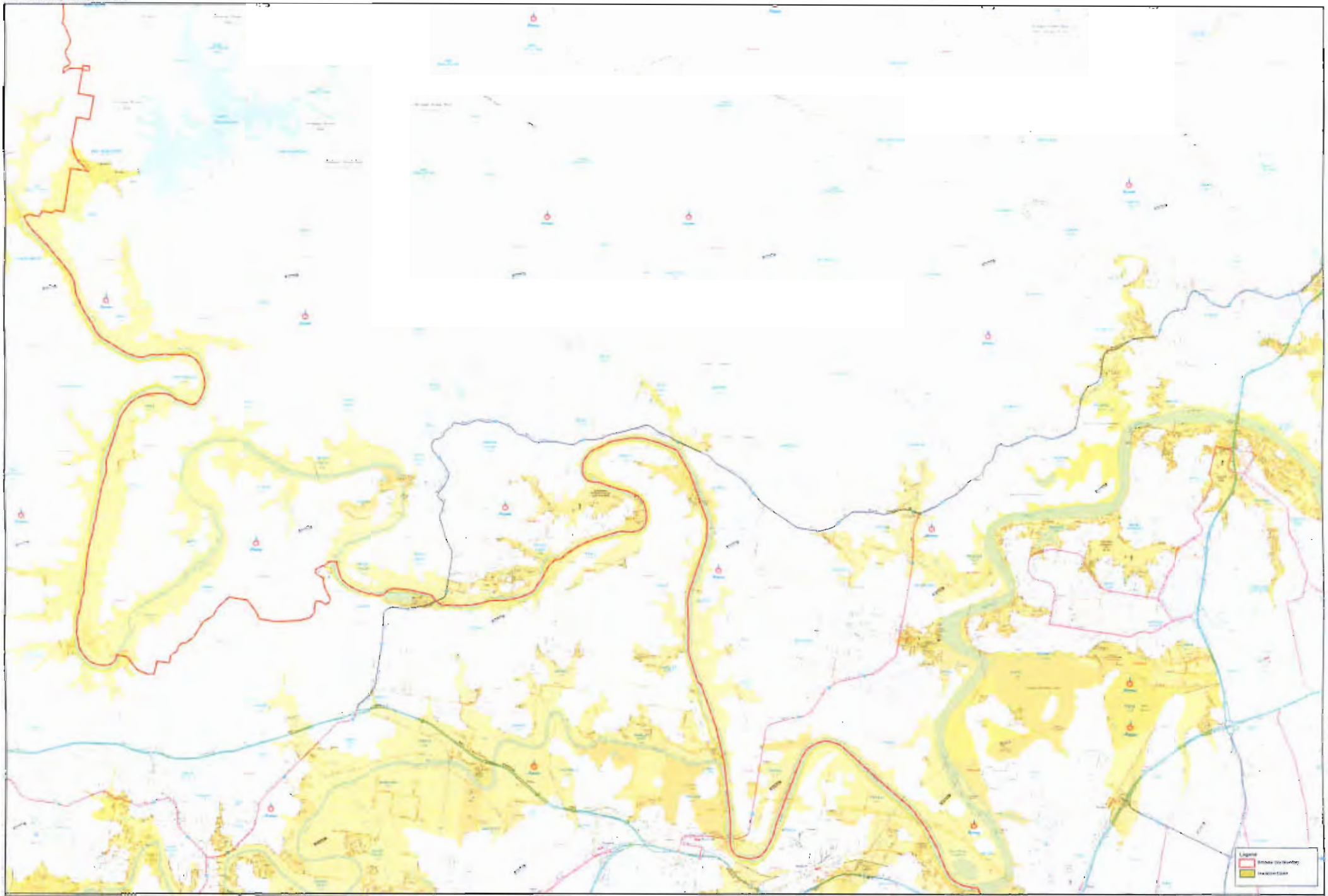
9,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - East

Figure 120



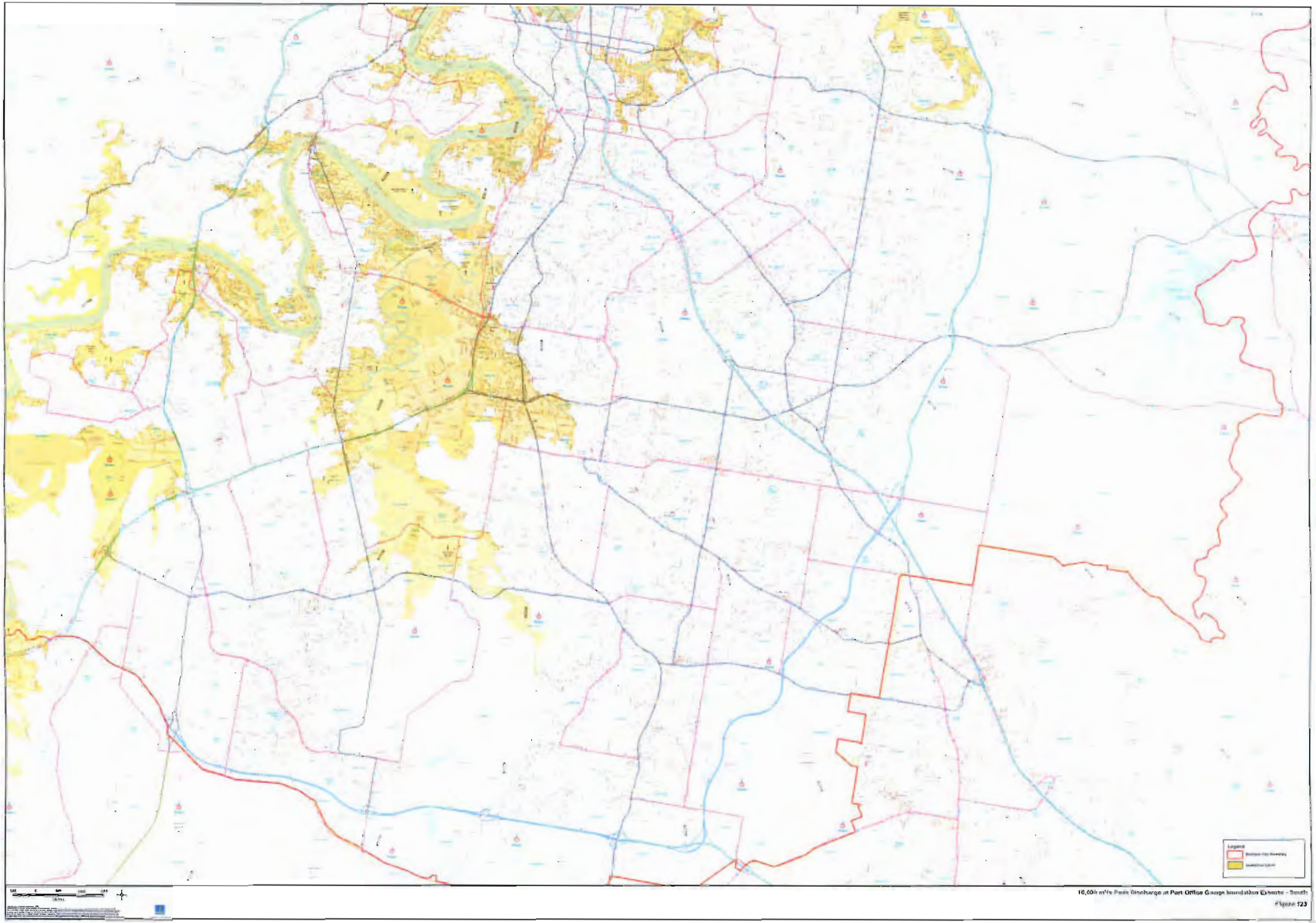
10,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents

Figure 121



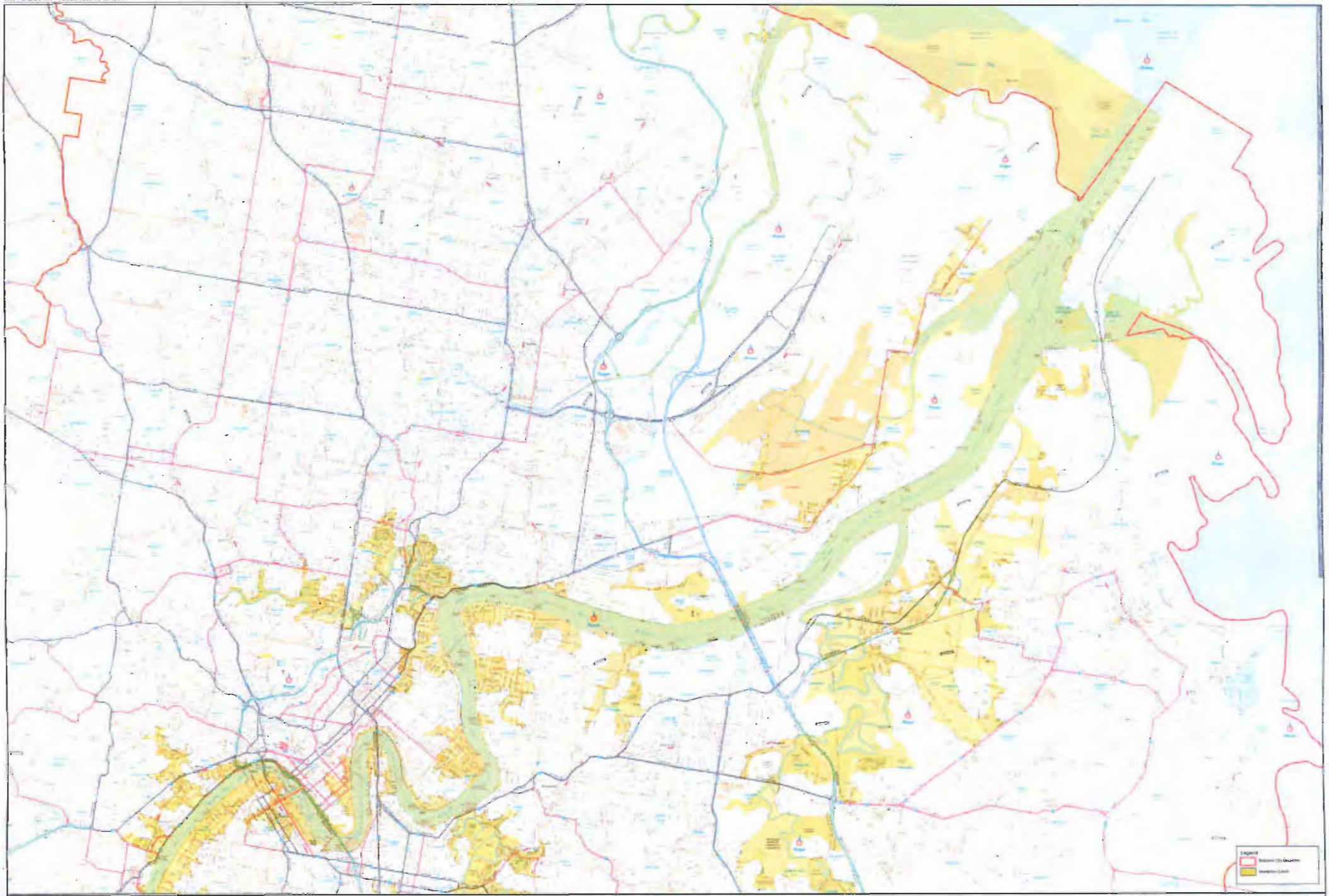
10,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - West

Figure 122



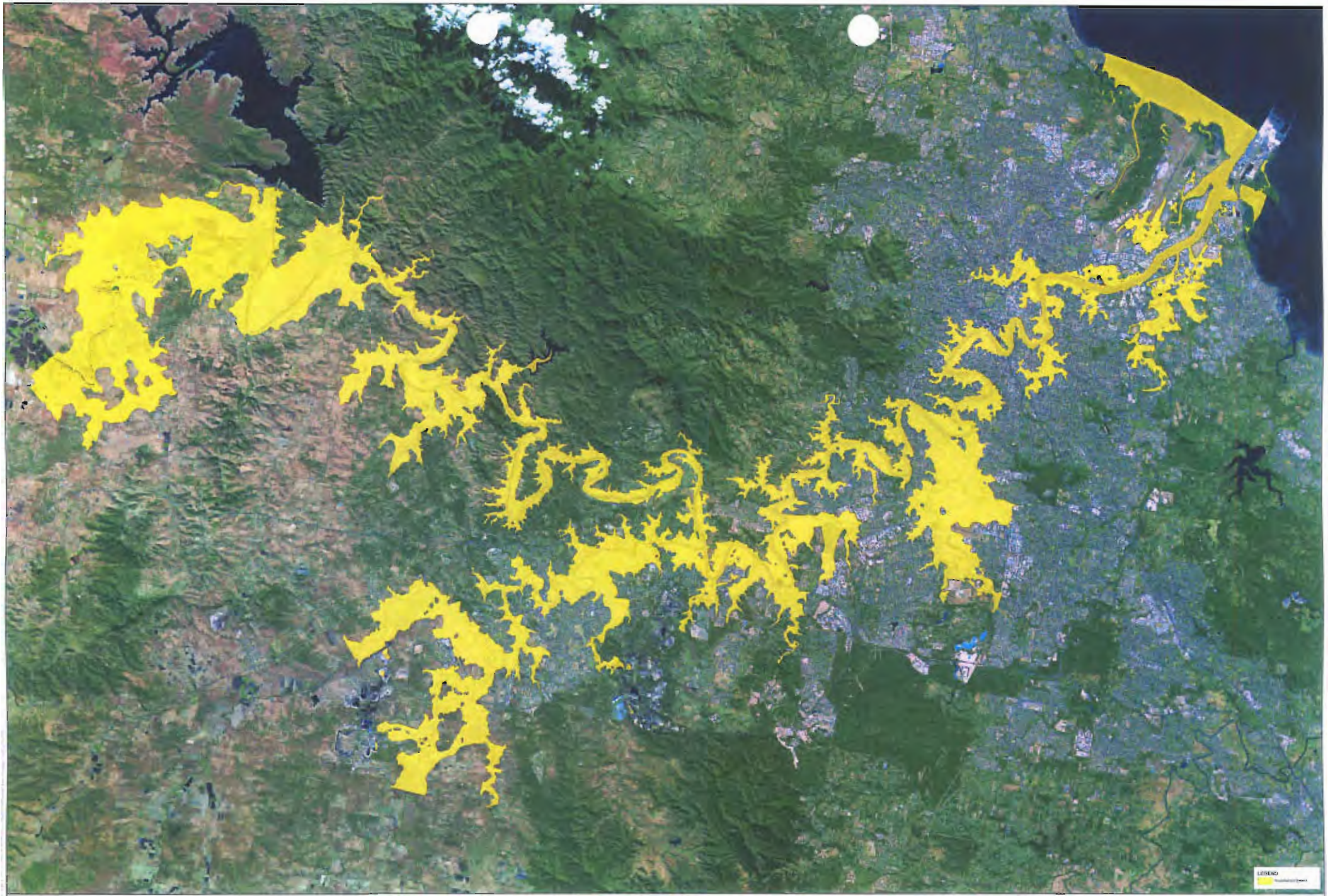
10,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - South

Figure 123



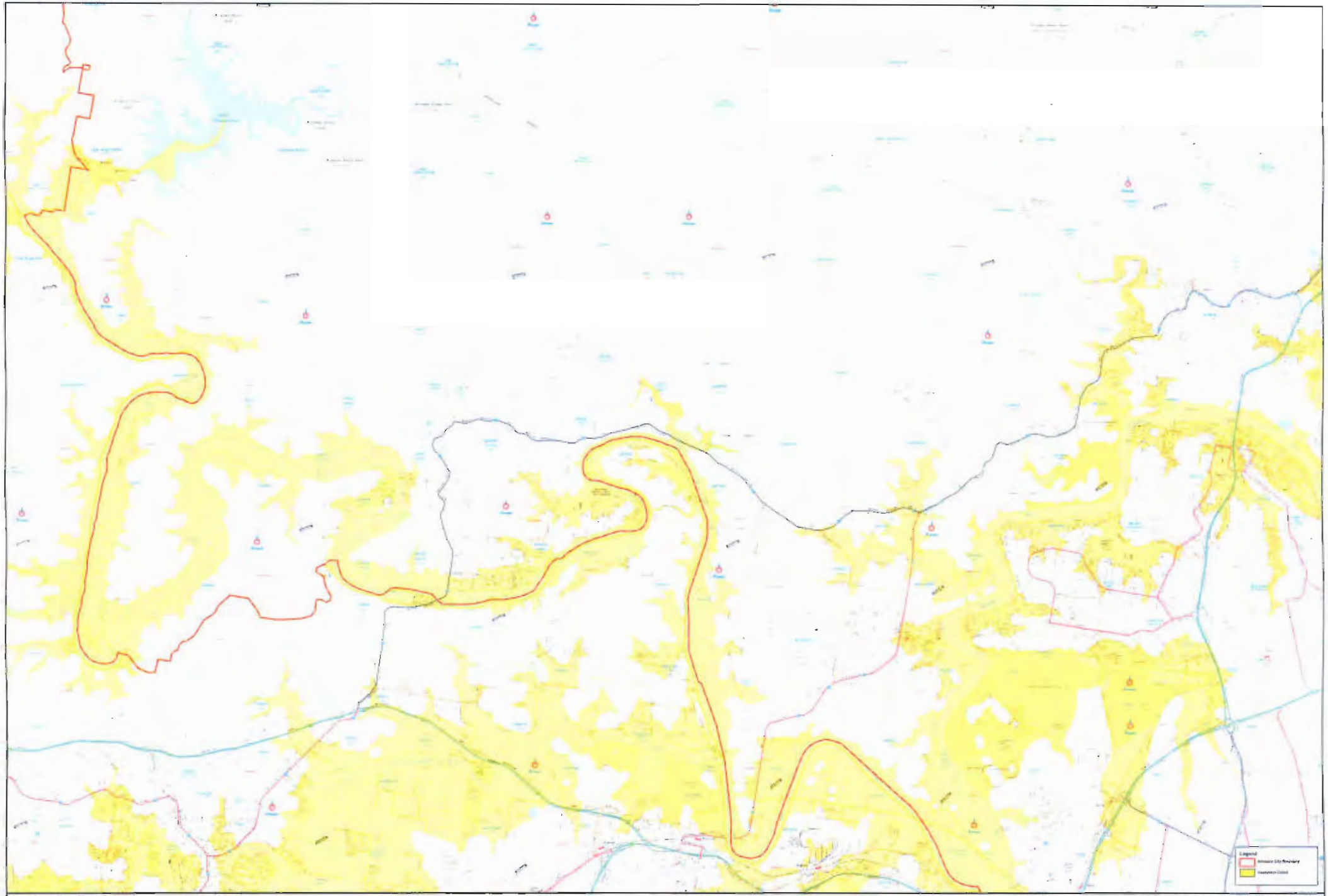
10,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - Event

Figure 124



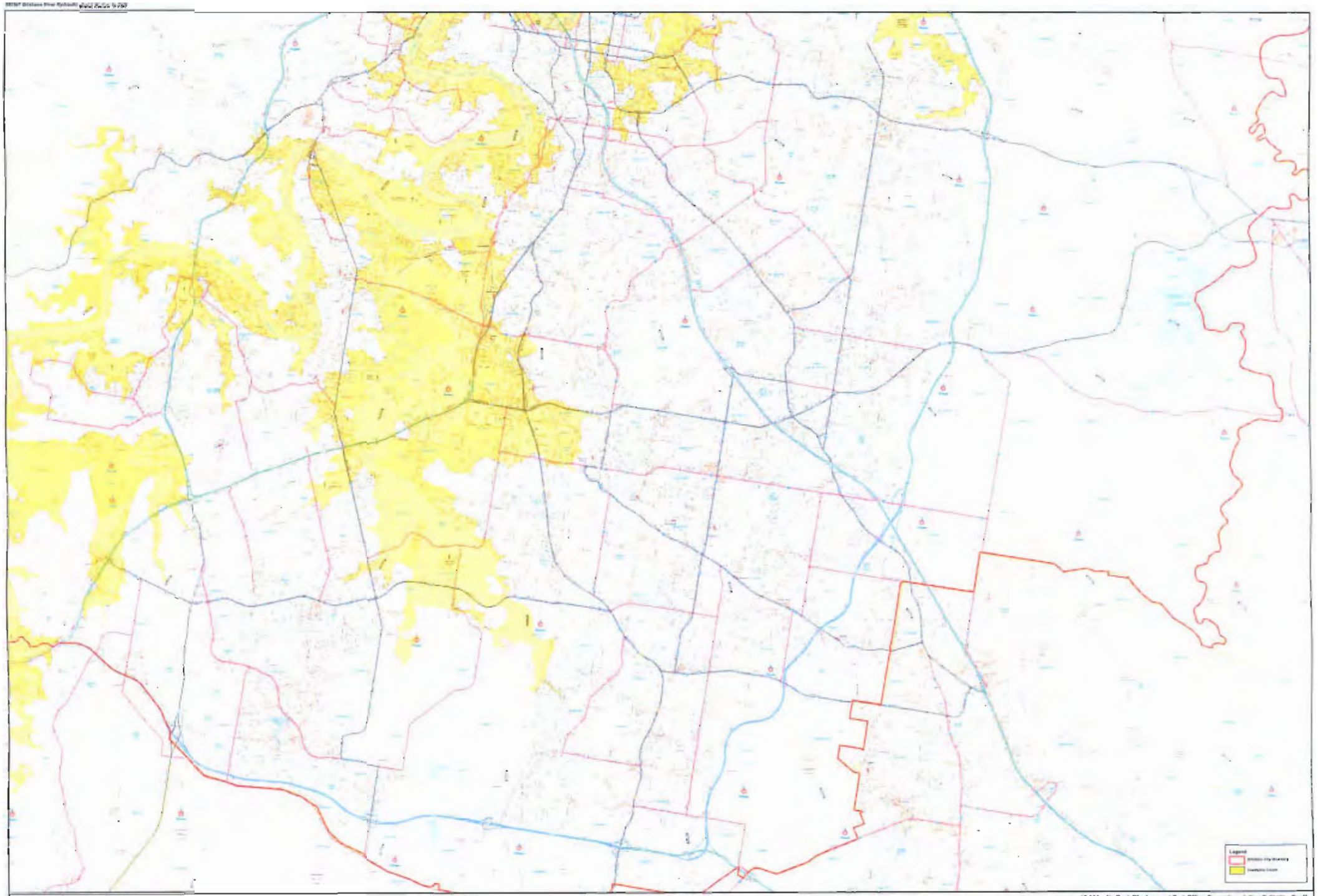
12,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents

Figure 125



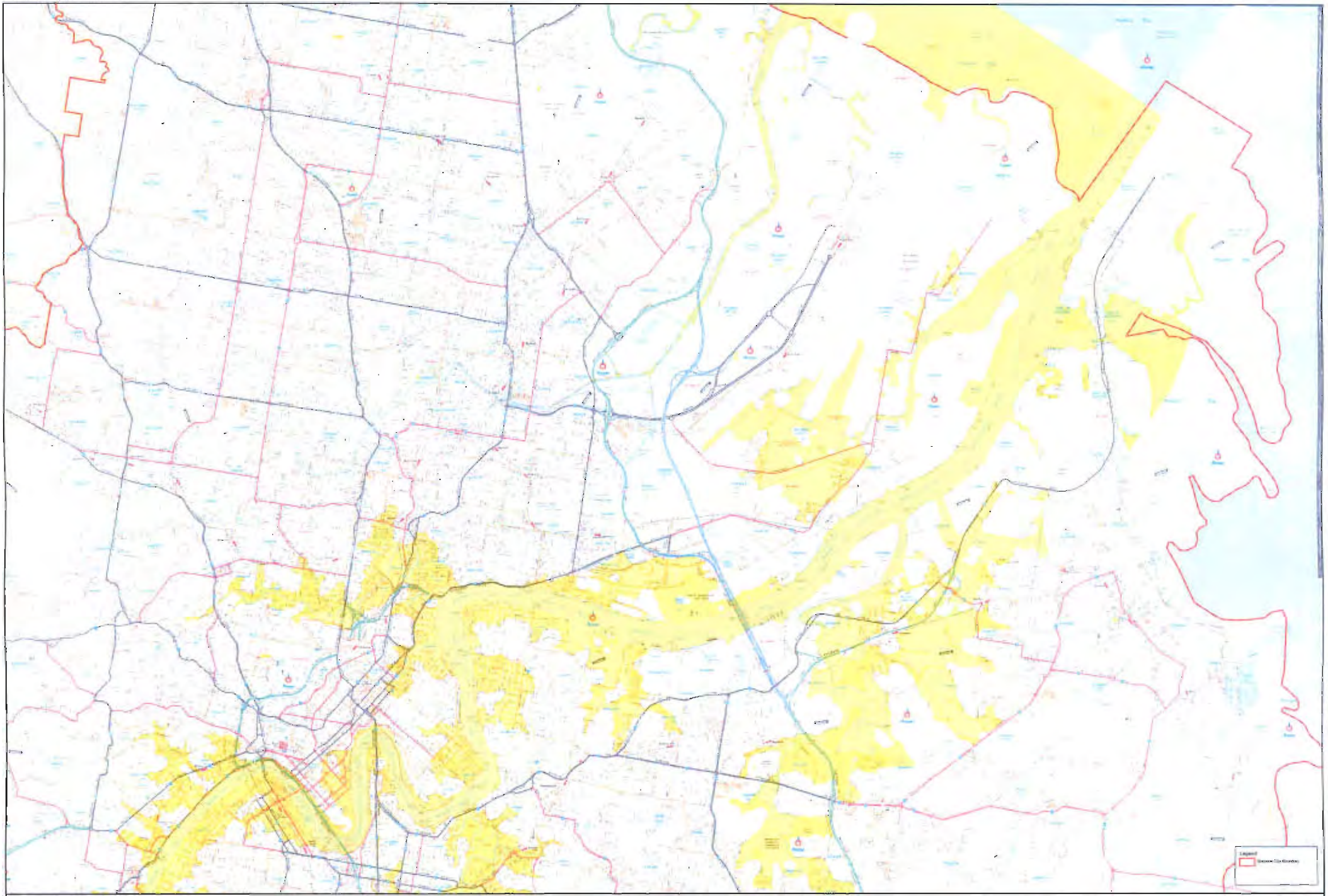
12,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - West

Figure 12E



12,000 m³/s Peak Discharge at Fort Office Gauge Inundation Extents - South

Figure 12



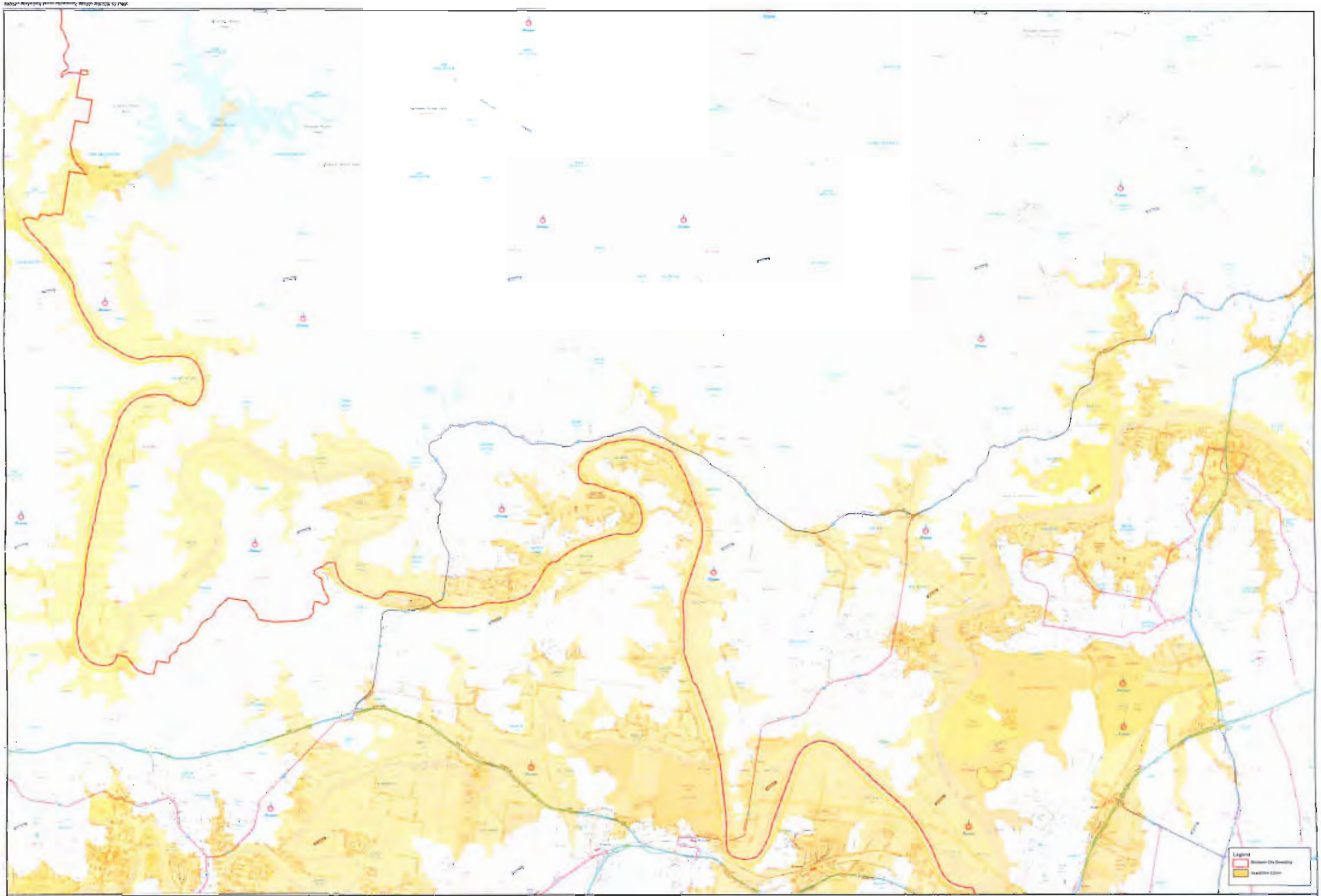
12,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - East

Figure 12B



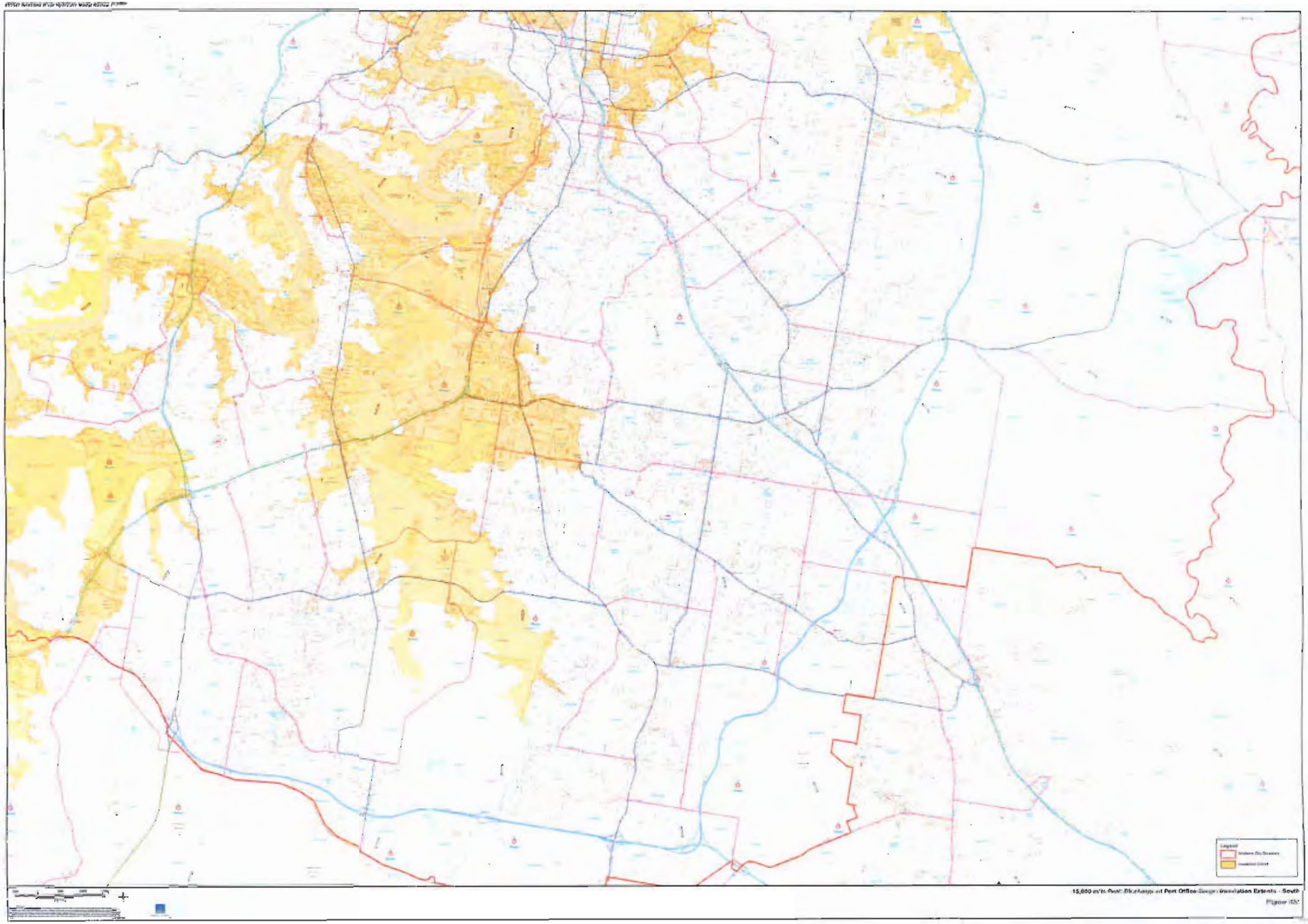
:5,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents

Figure A.29



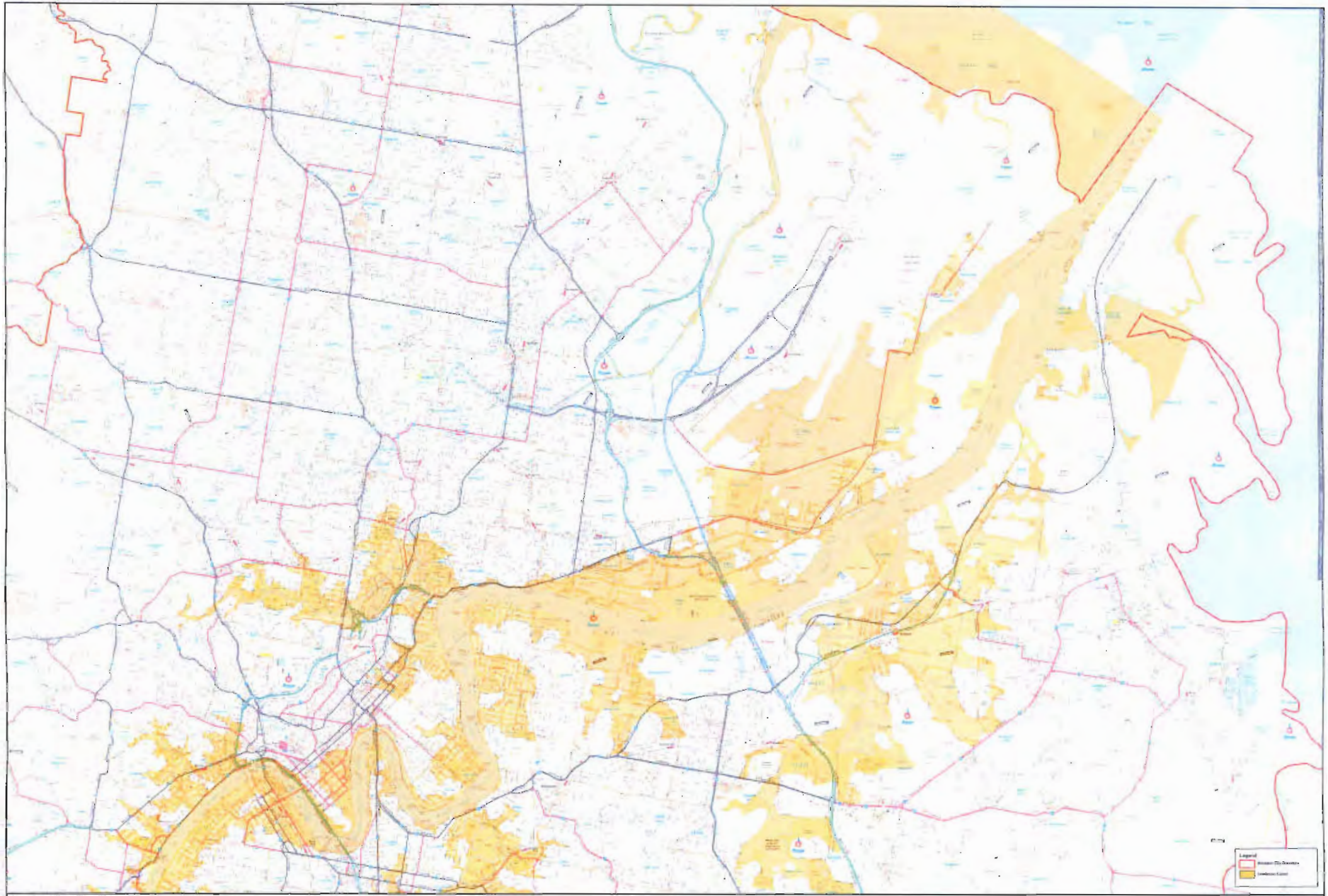
15,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - West

Figure 130



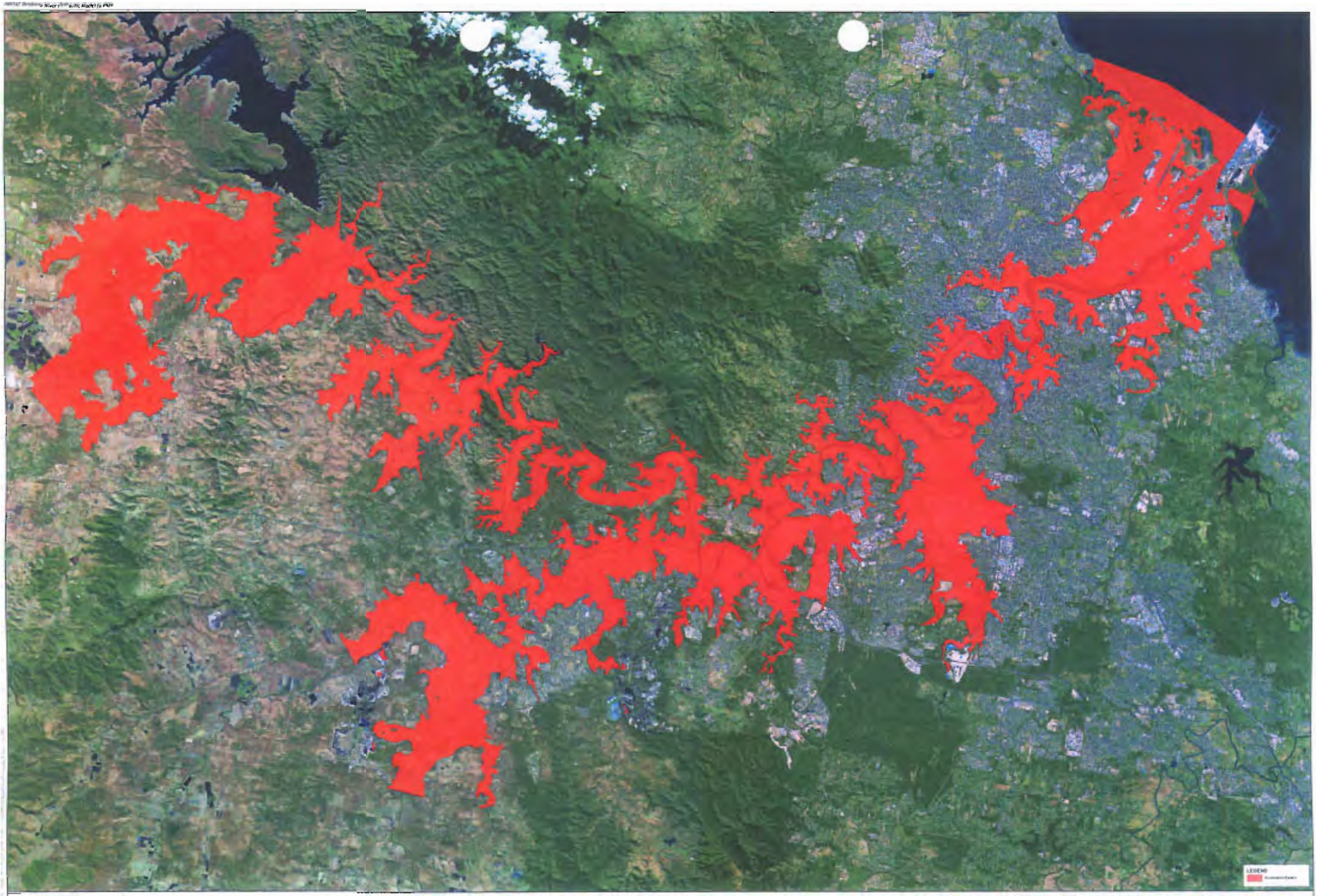
15,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - South

Figure 10b



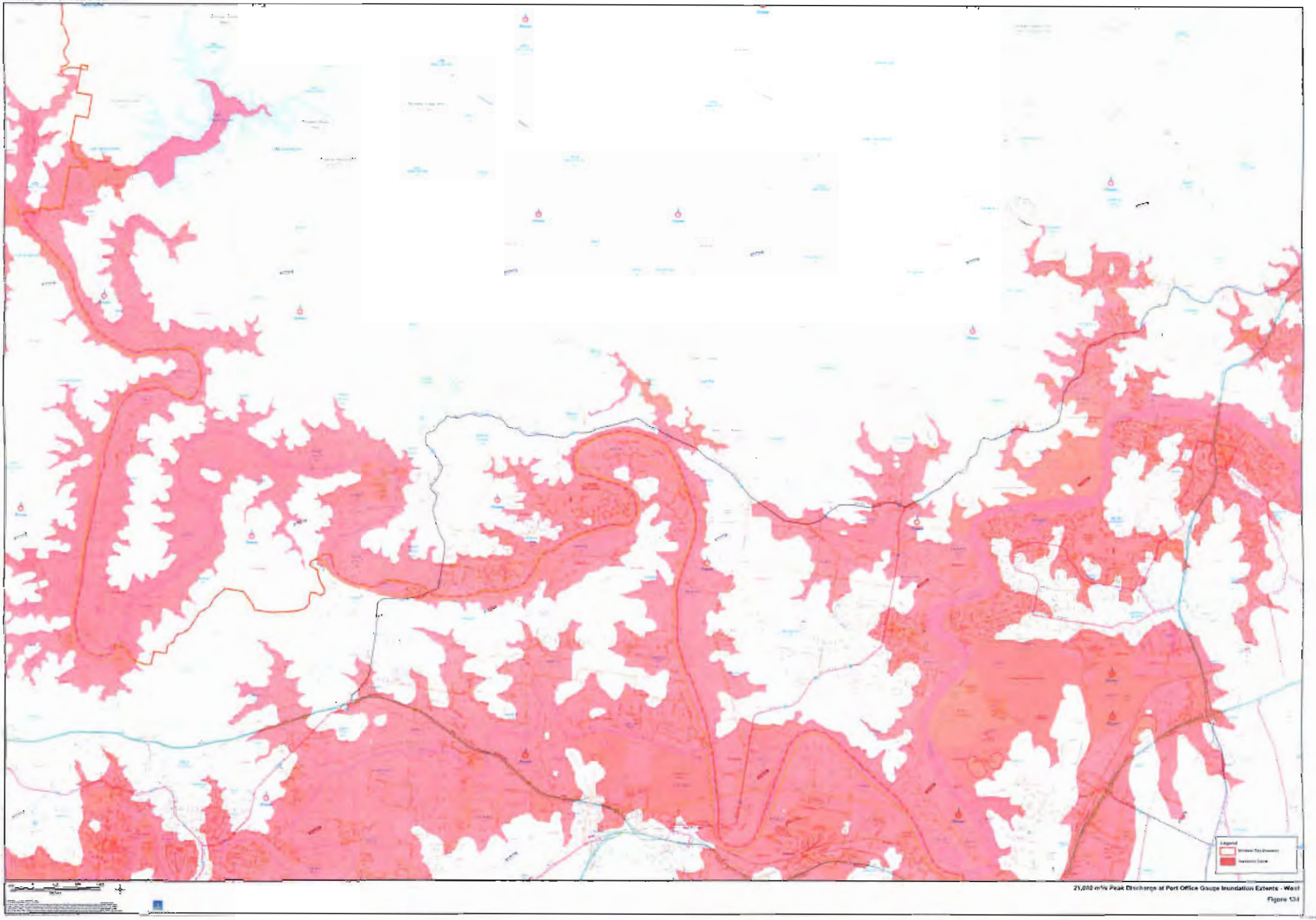
15,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - East

Figure 132



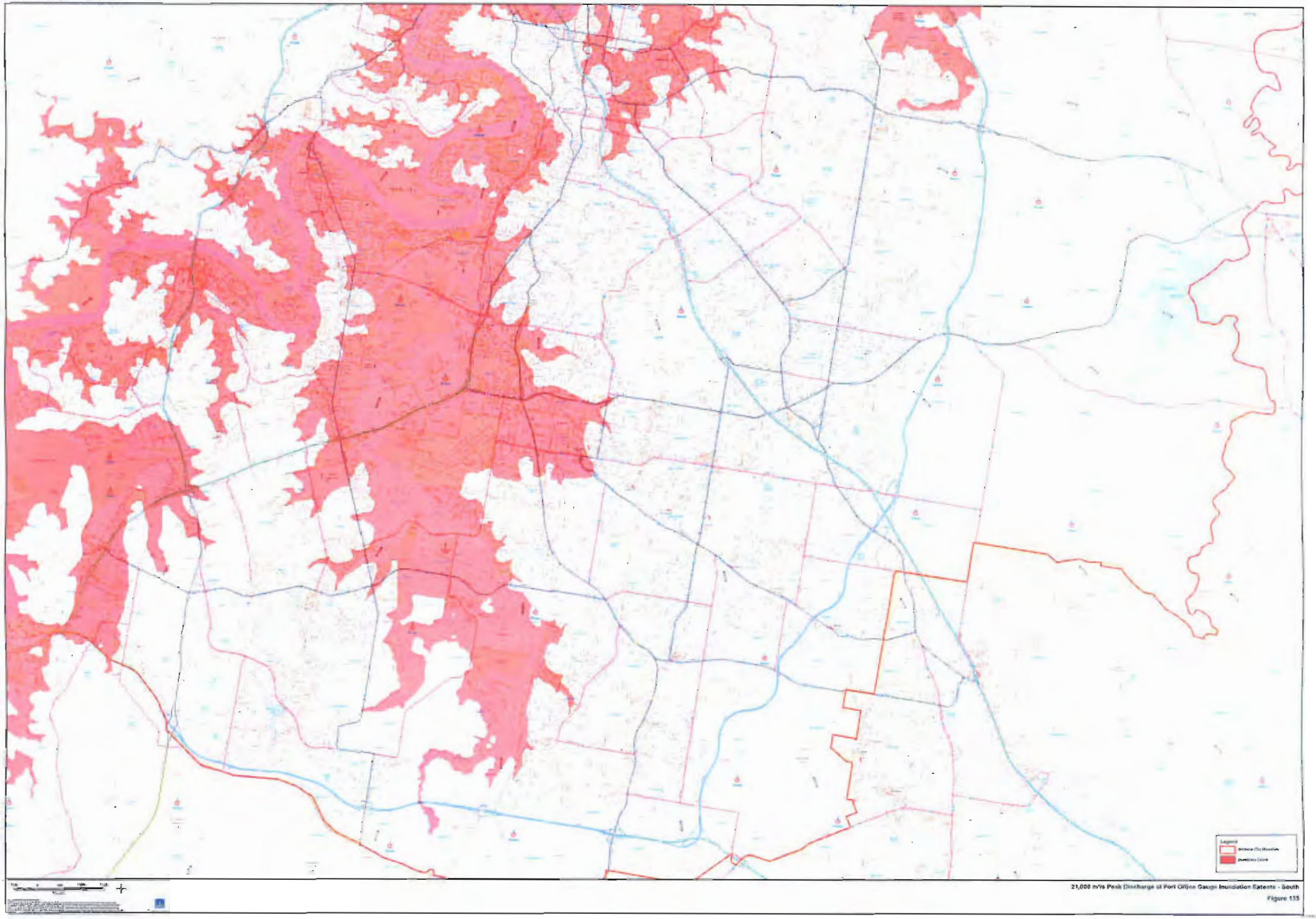
21,100m³/s Peak Discharge at Port Office Gauge Inundation Extents

Figure 133



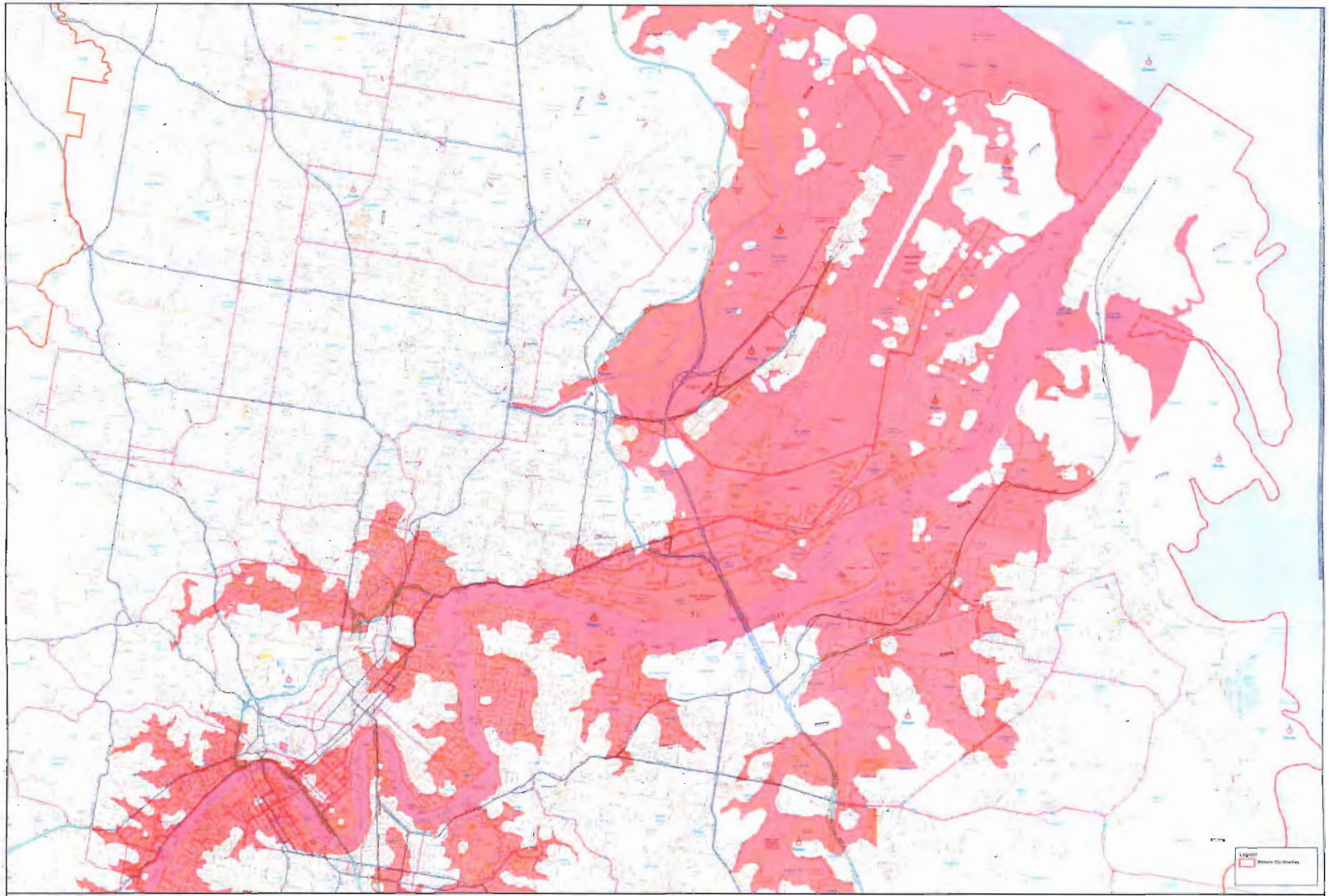
21,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - West

Figure 13.4



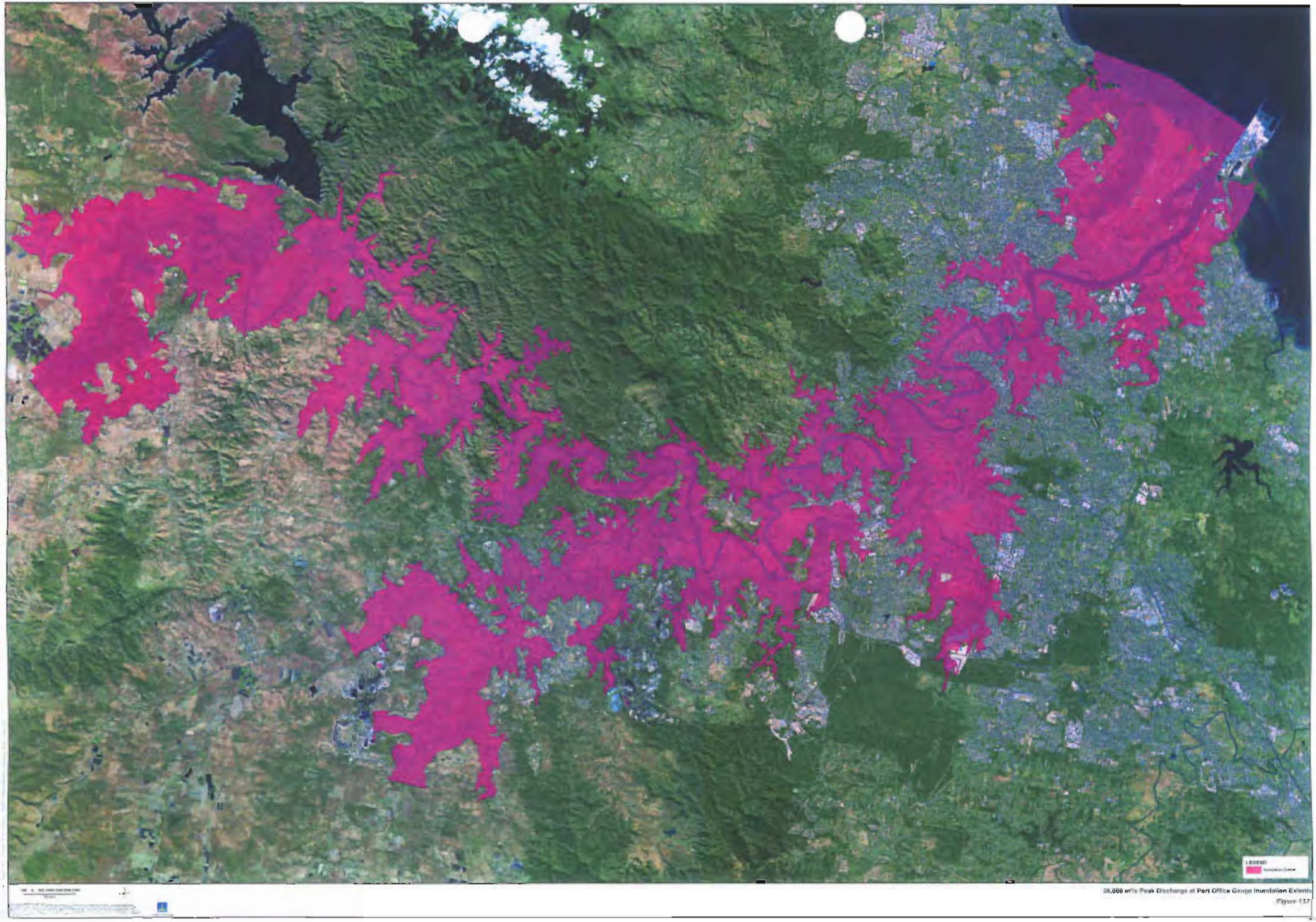
21,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - South

Figure 135

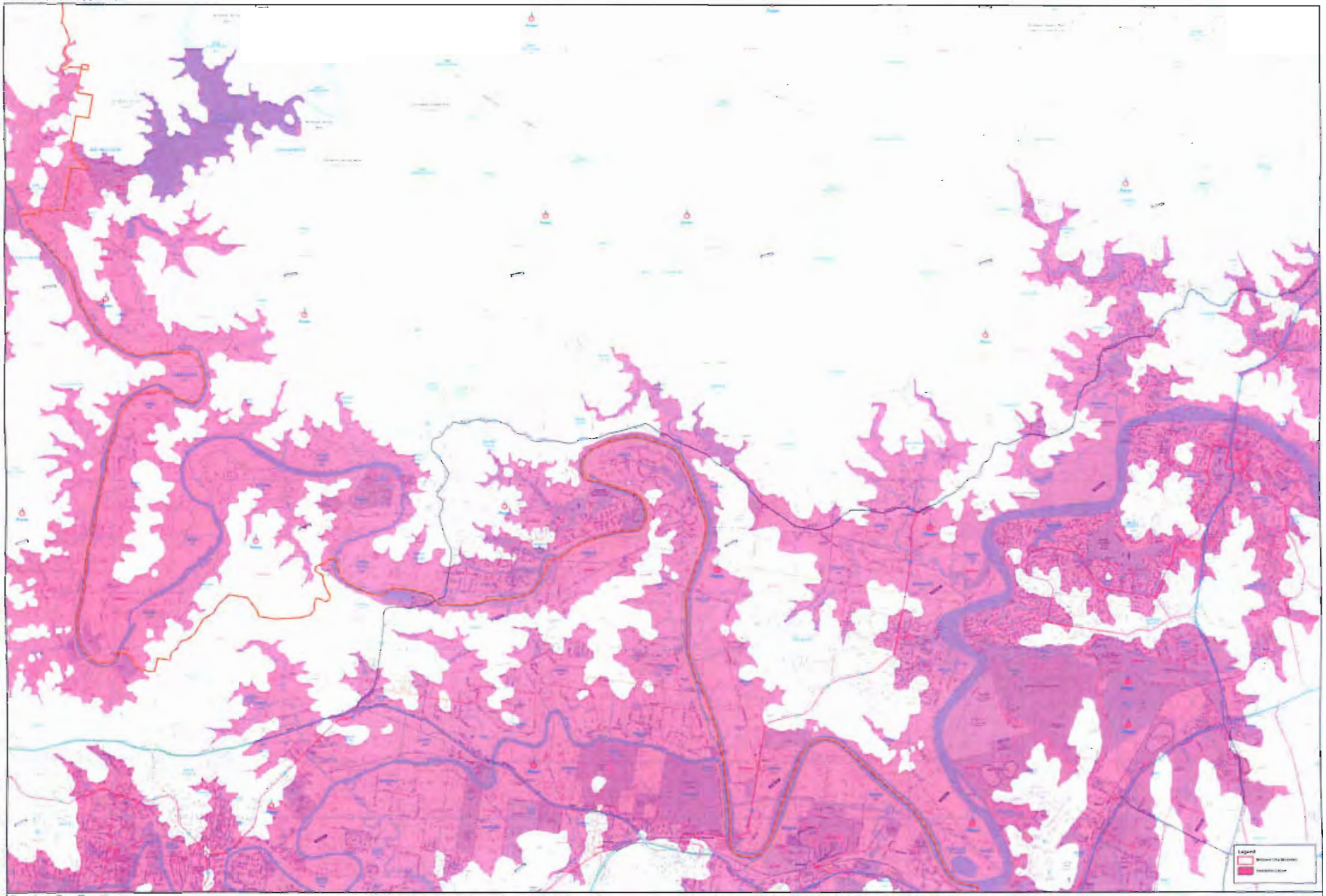


21,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - East

Figure 136

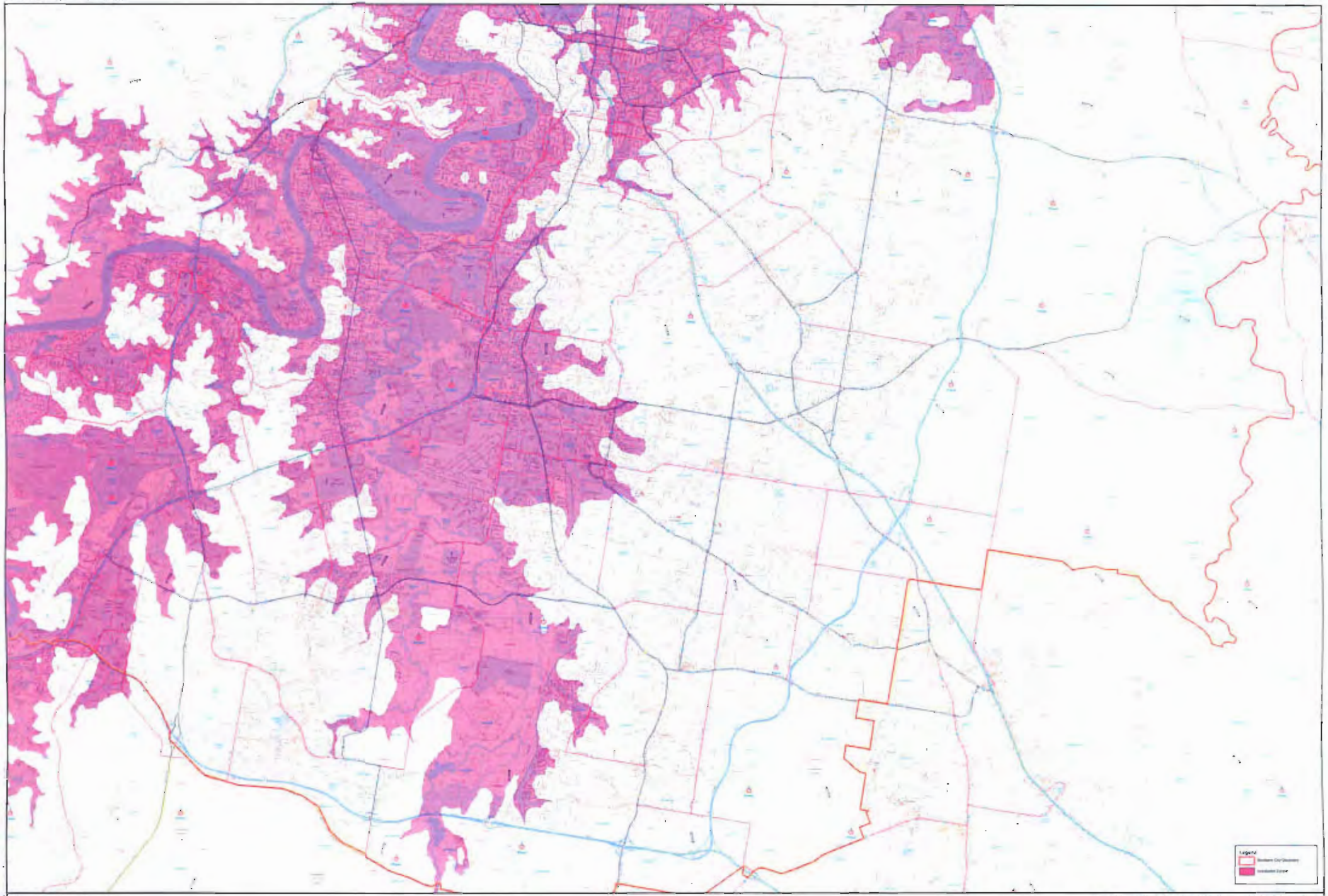


38,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents
Figure 137



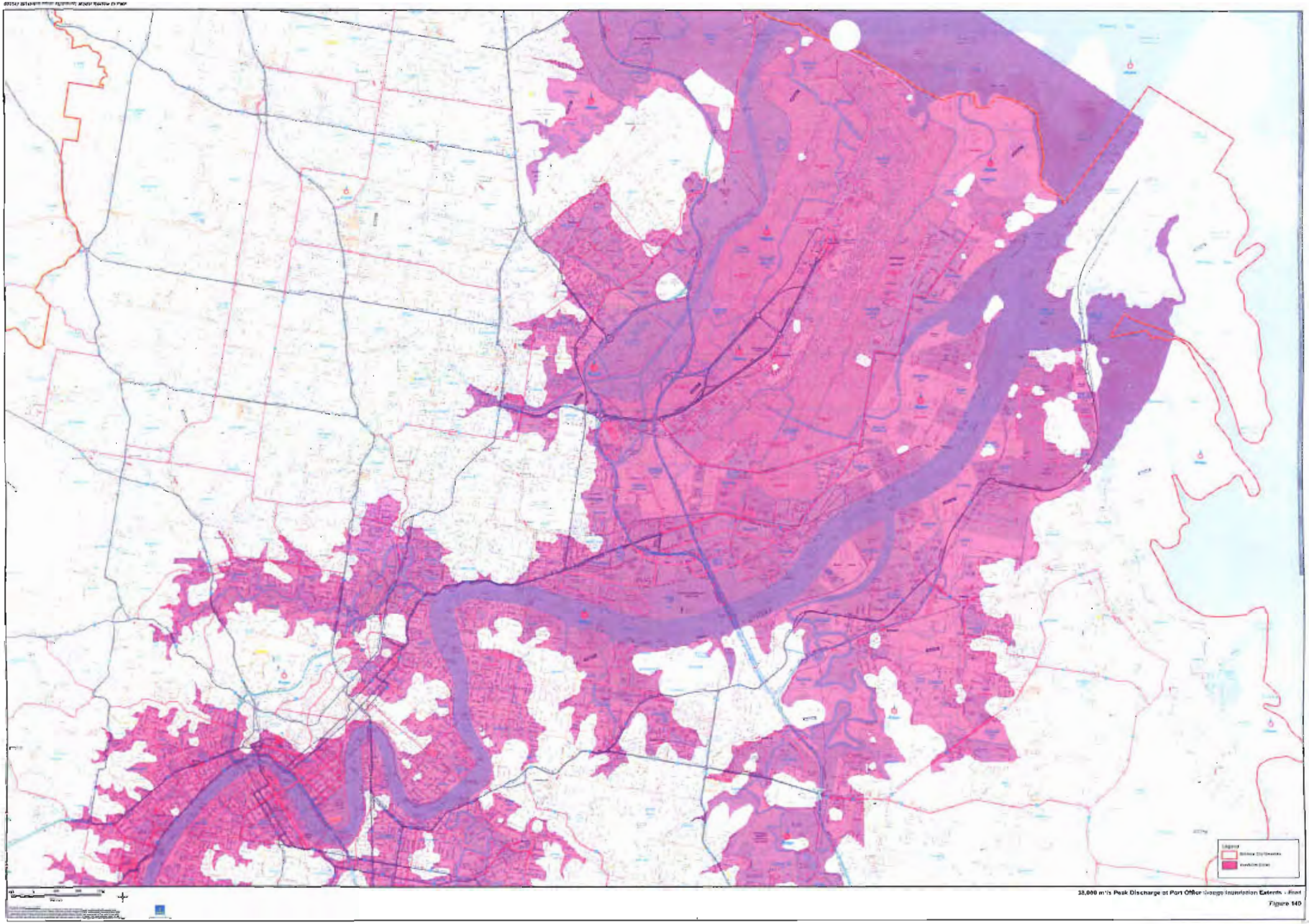
38,000 m³/s Peak Discharge (at Port Office Gauge Height) on Extents - West

Figure 138



38,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - South

Figure 139



38,000 m³/s Peak Discharge at Port Office Gauge Inundation Extents - Final

Figure 140

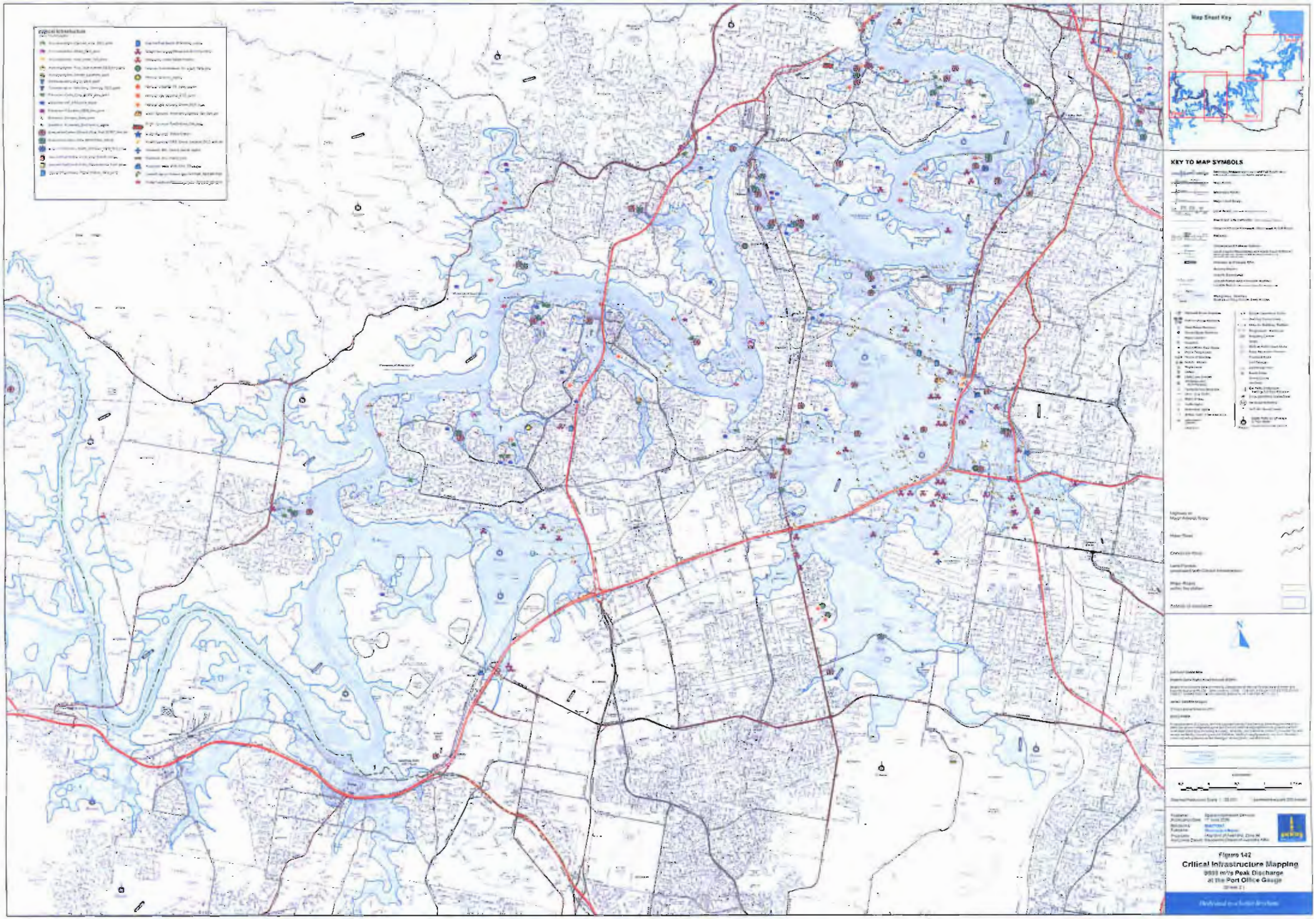


Figure 141

Critical Infrastructure Mapping

9000 m³/s Peak Discharge at the Port Orfico Gauge

(Sheet 1)


Critical Infrastructure
Map Sheet Key
KEY TO MAP SYMBOLS
Figure 142
Critical Infrastructure Mapping
9500 m³/s Peak Discharge
at the Port Office Gauge

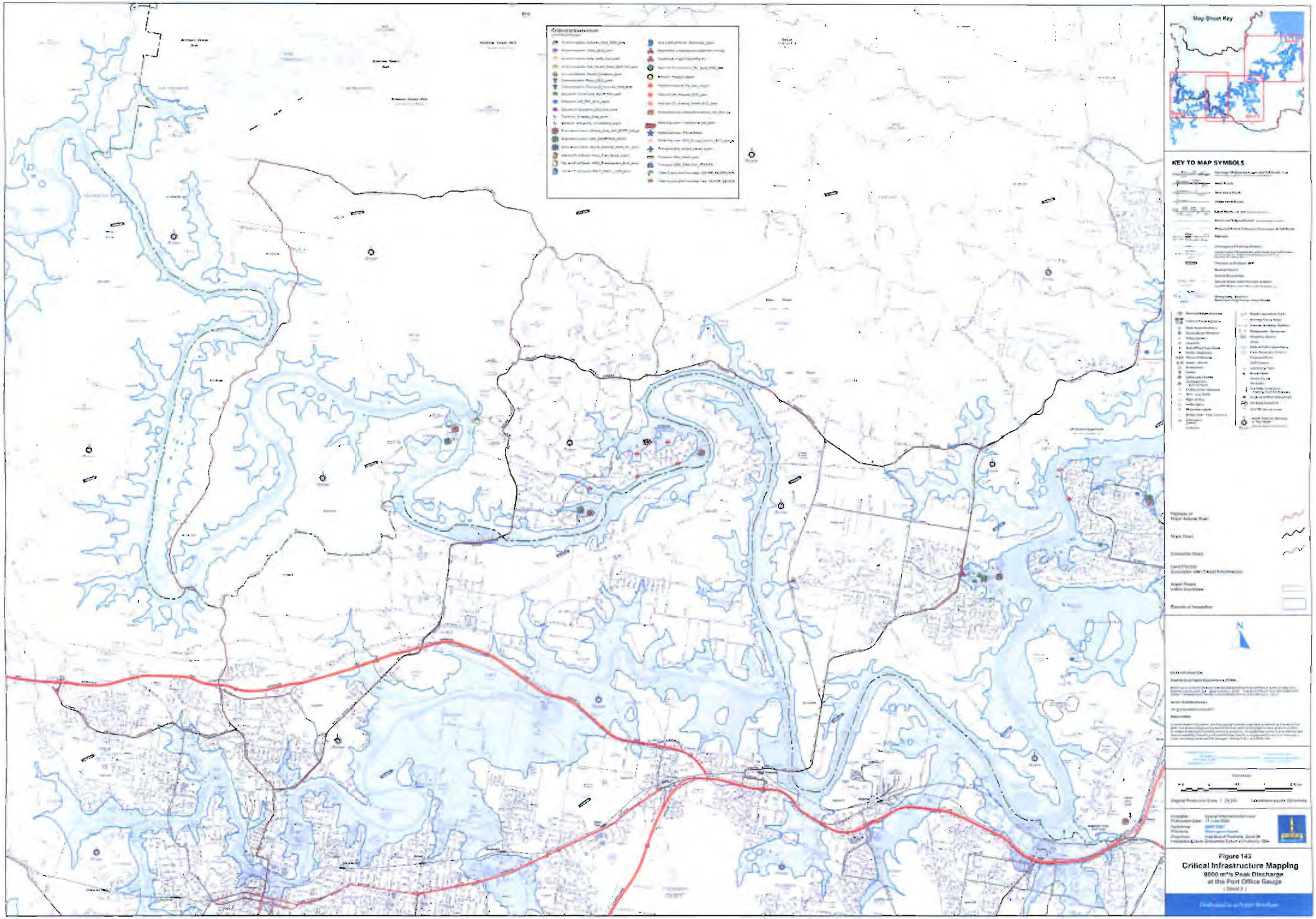
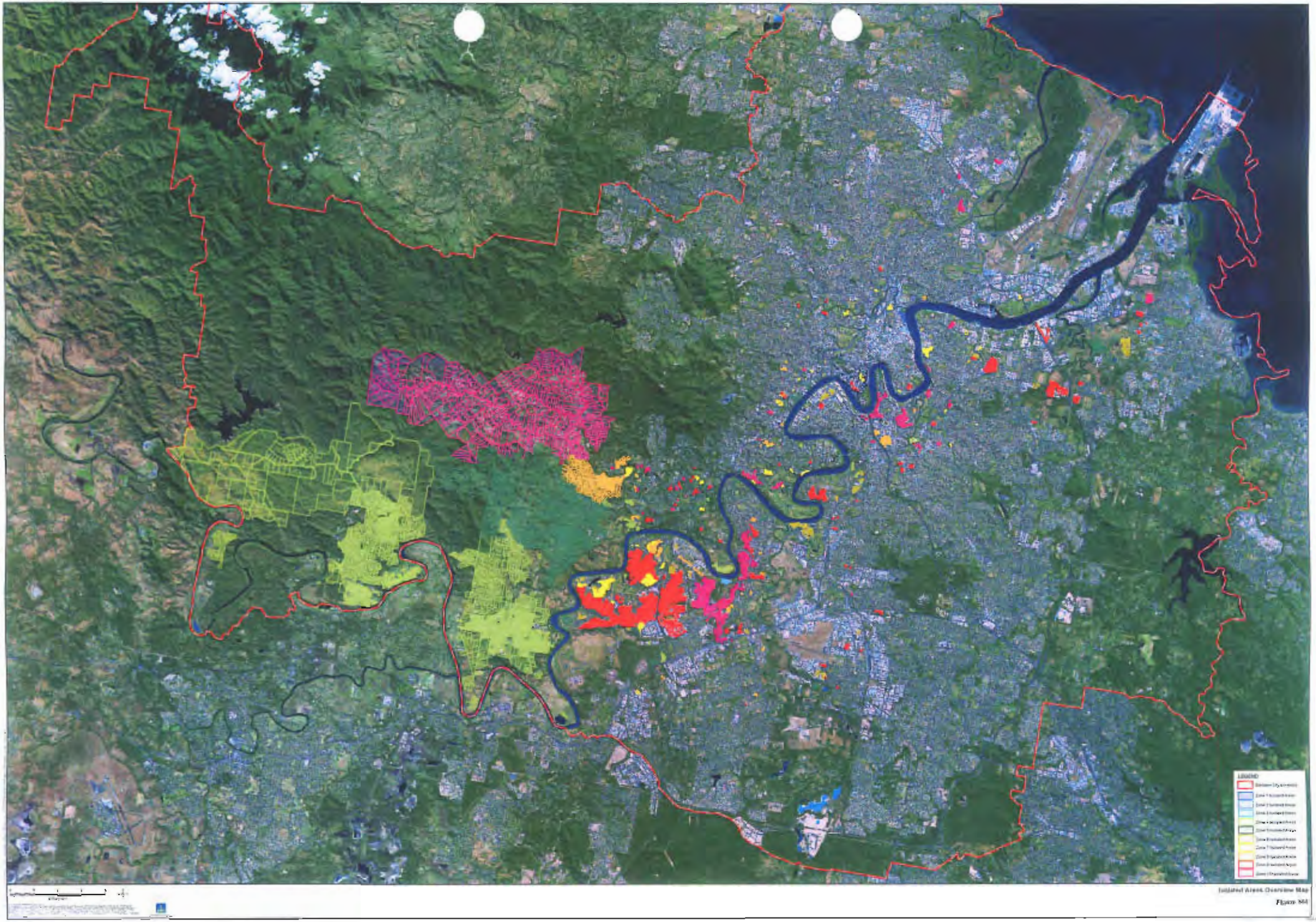
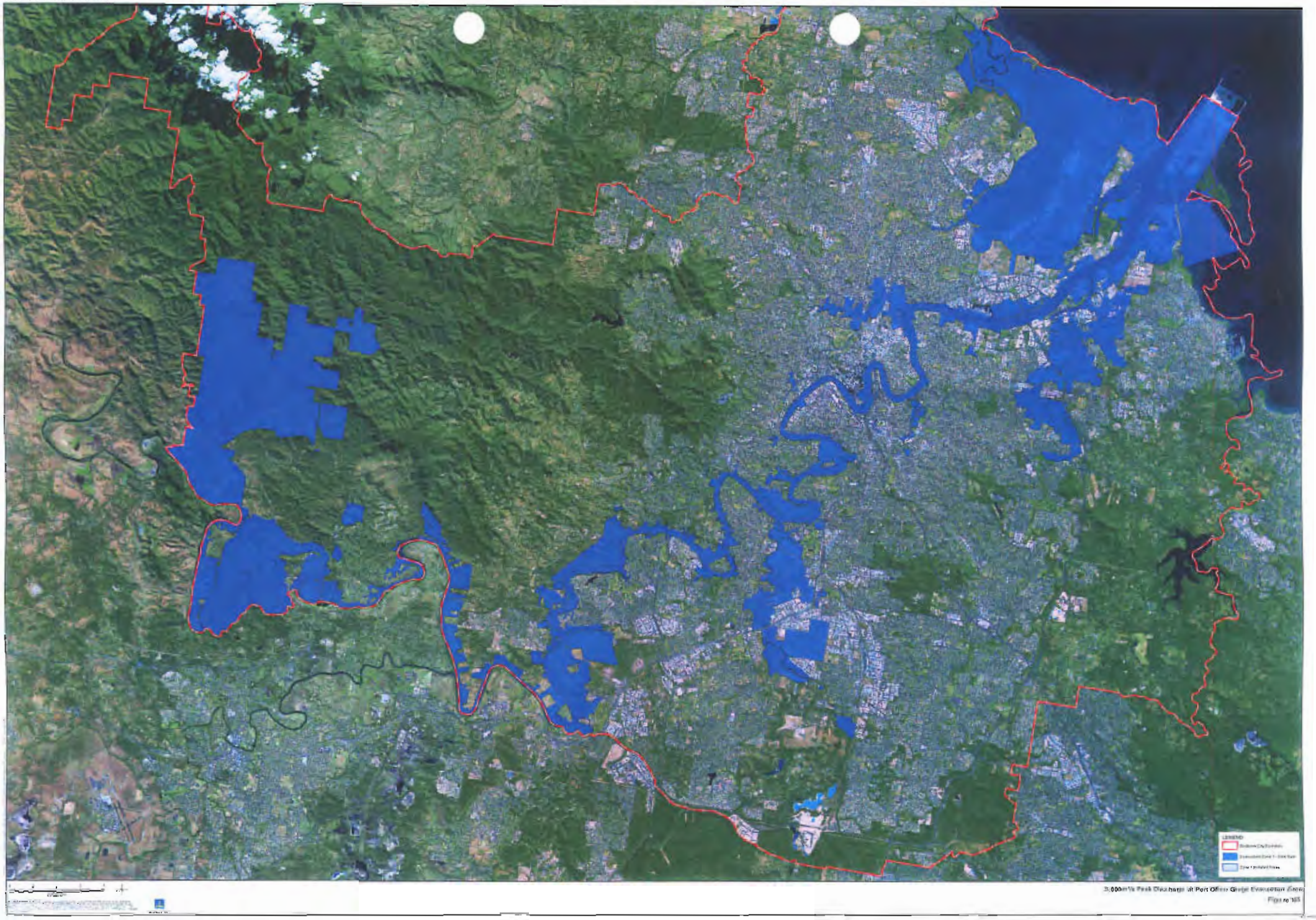


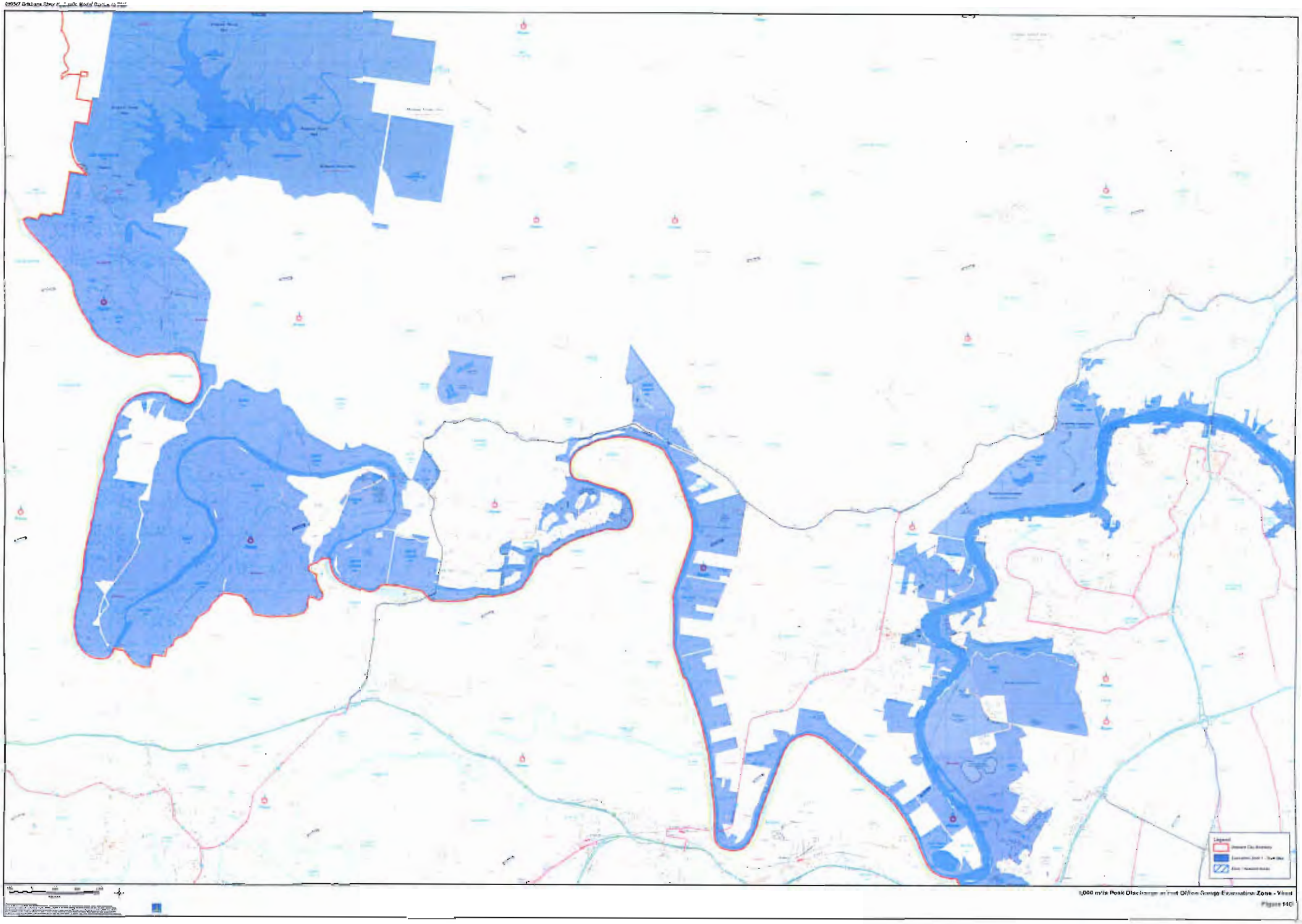
Figure 143
Critical Infrastructure Mapping
9060 m³/s Peak Discharge
at the Port Office Gauge
(Sheet 1)



Isolated Areas Overview Map

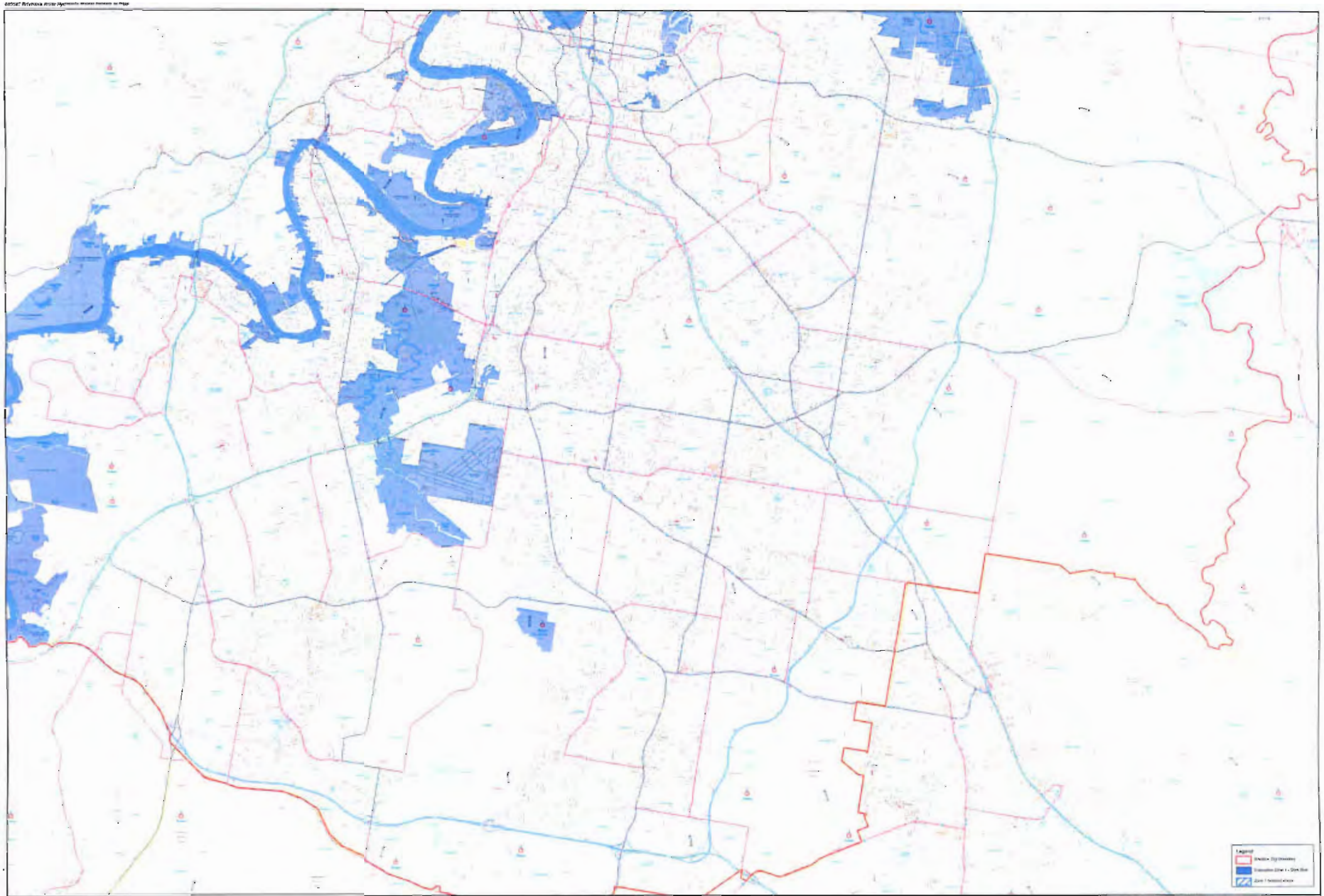
Figure M4


LEGEND



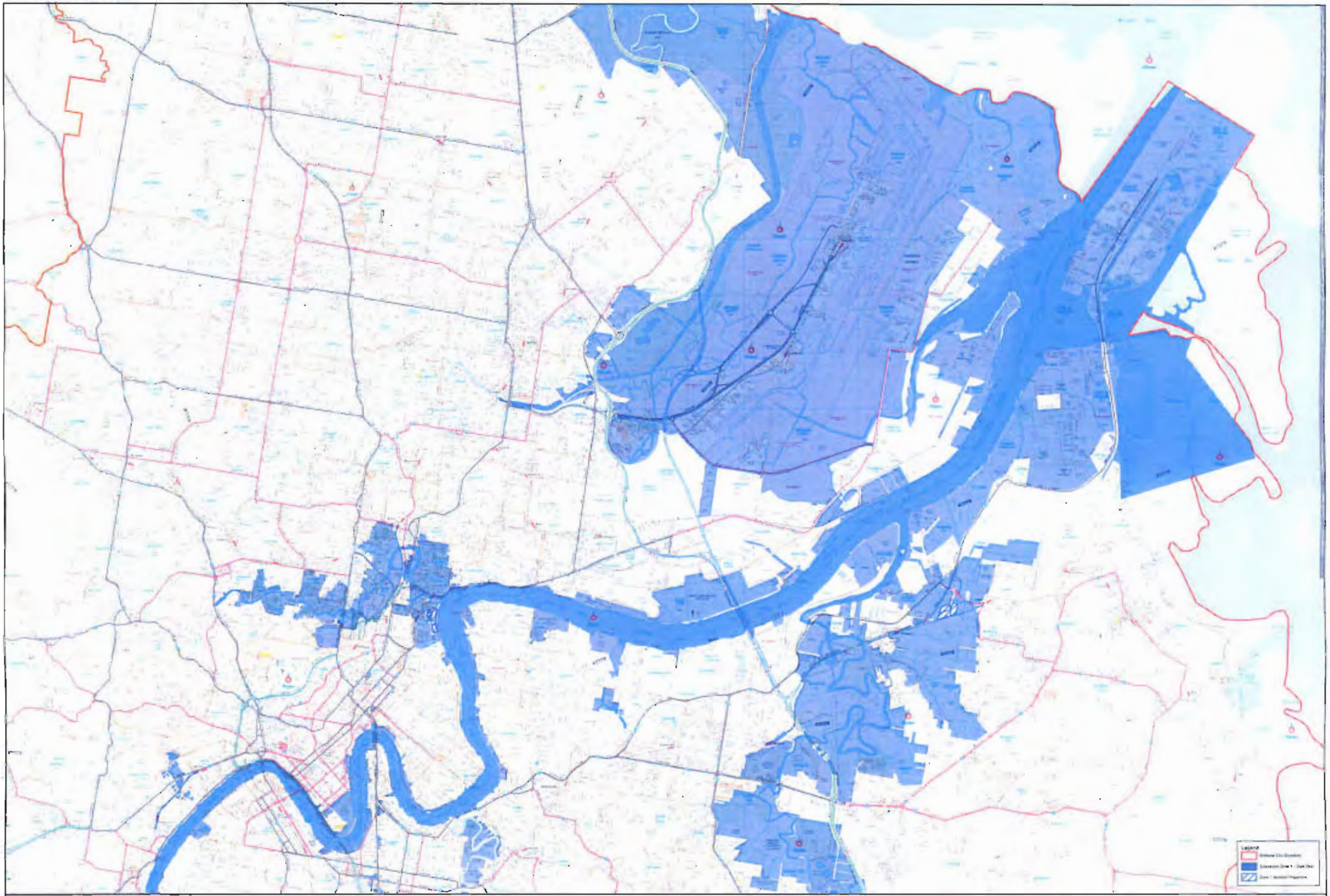
1,000 m³/s Peak Discharge at Post Office Gauge Evacuation Zone - Vinod

Figure 14(i)



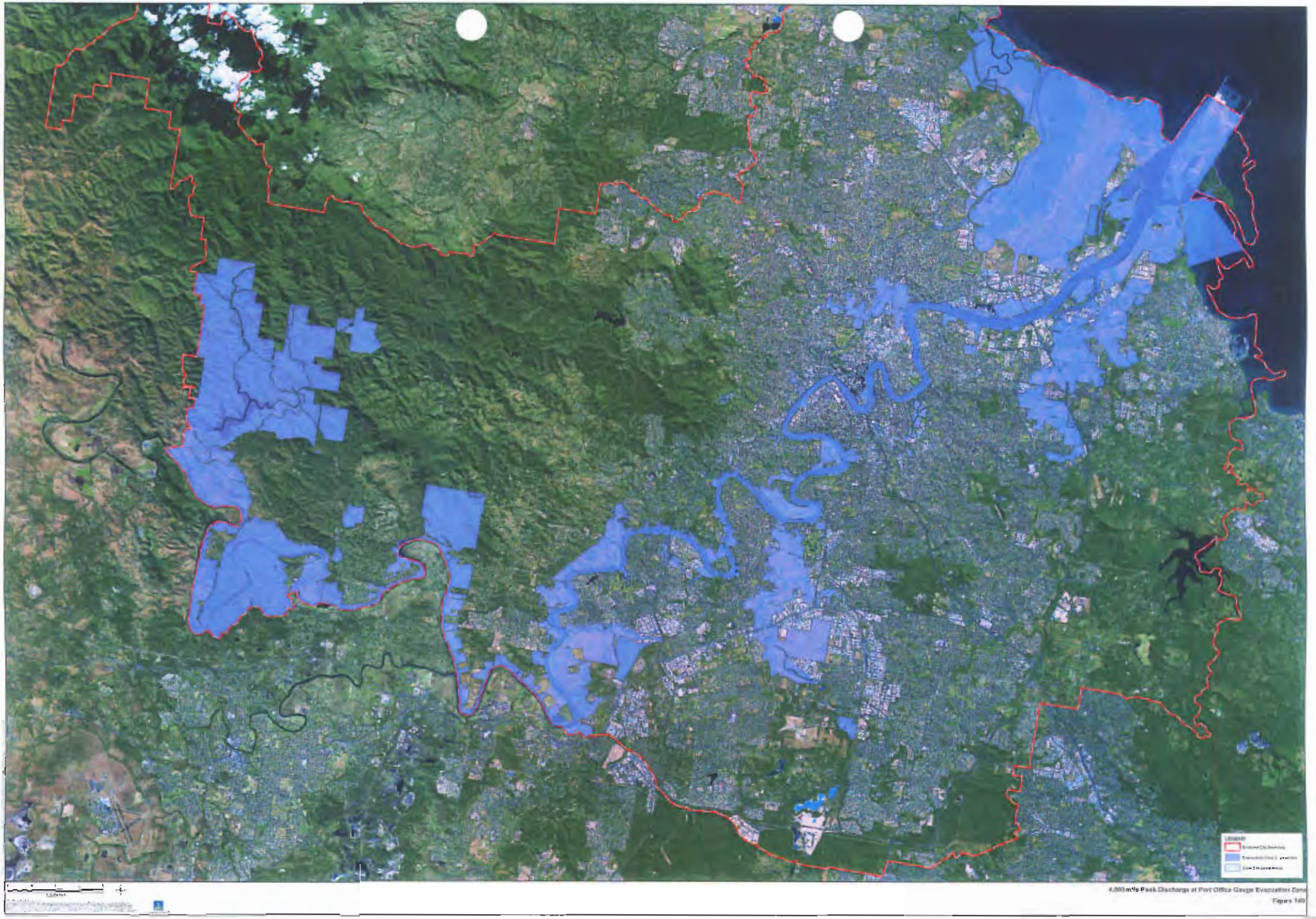
3,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - South

Figure 167



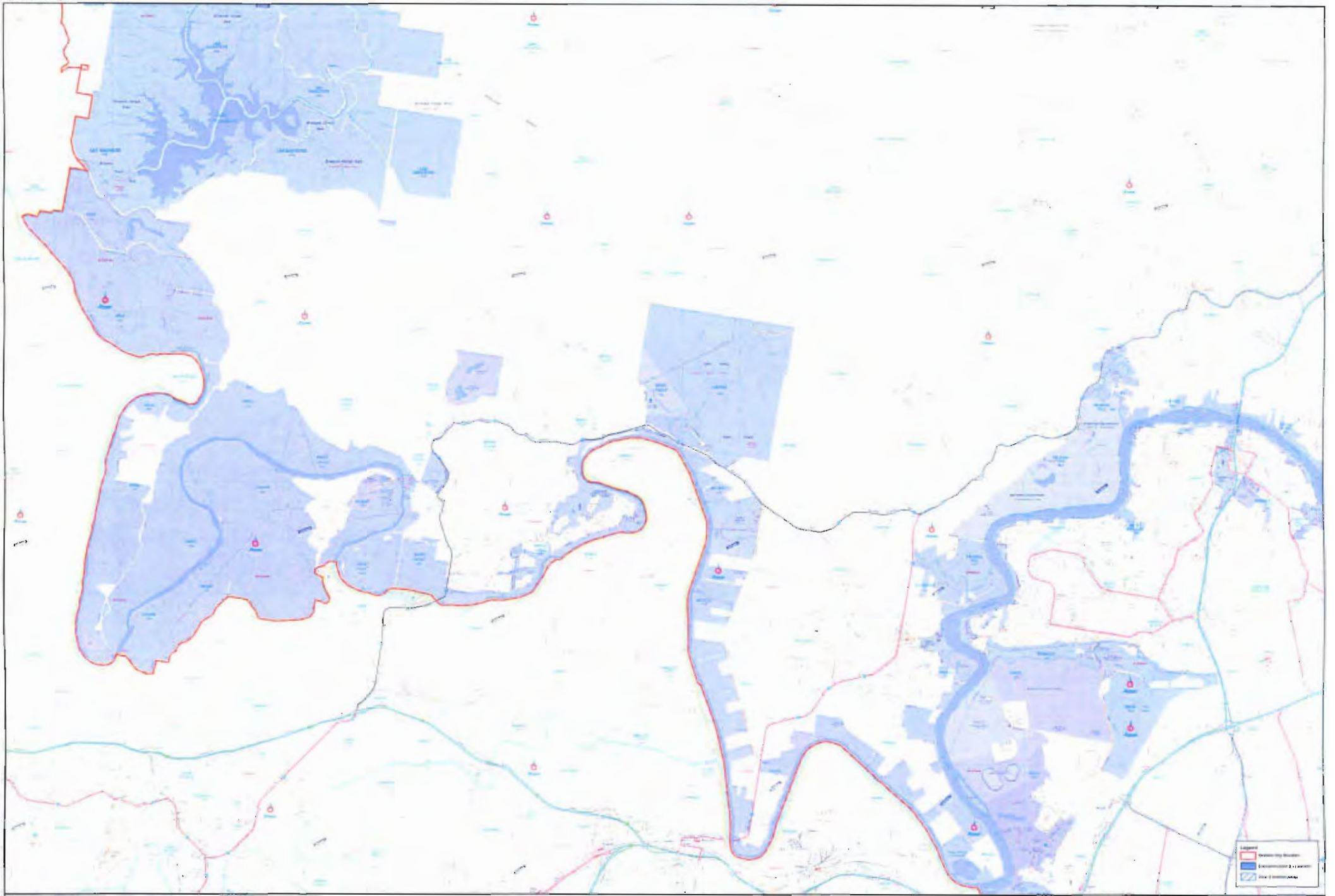
3,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - East

Figure 148



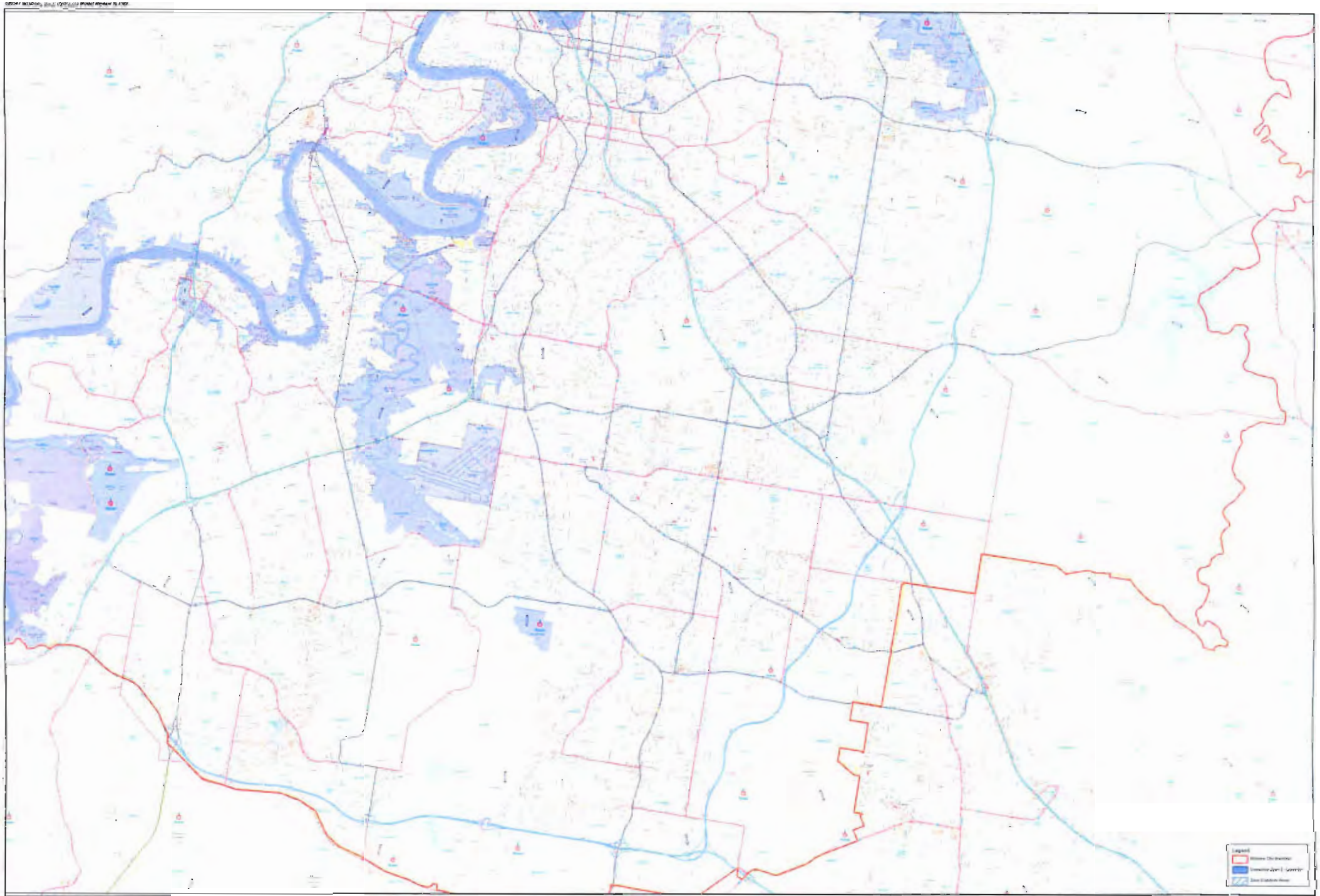
4,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone

Figure 149



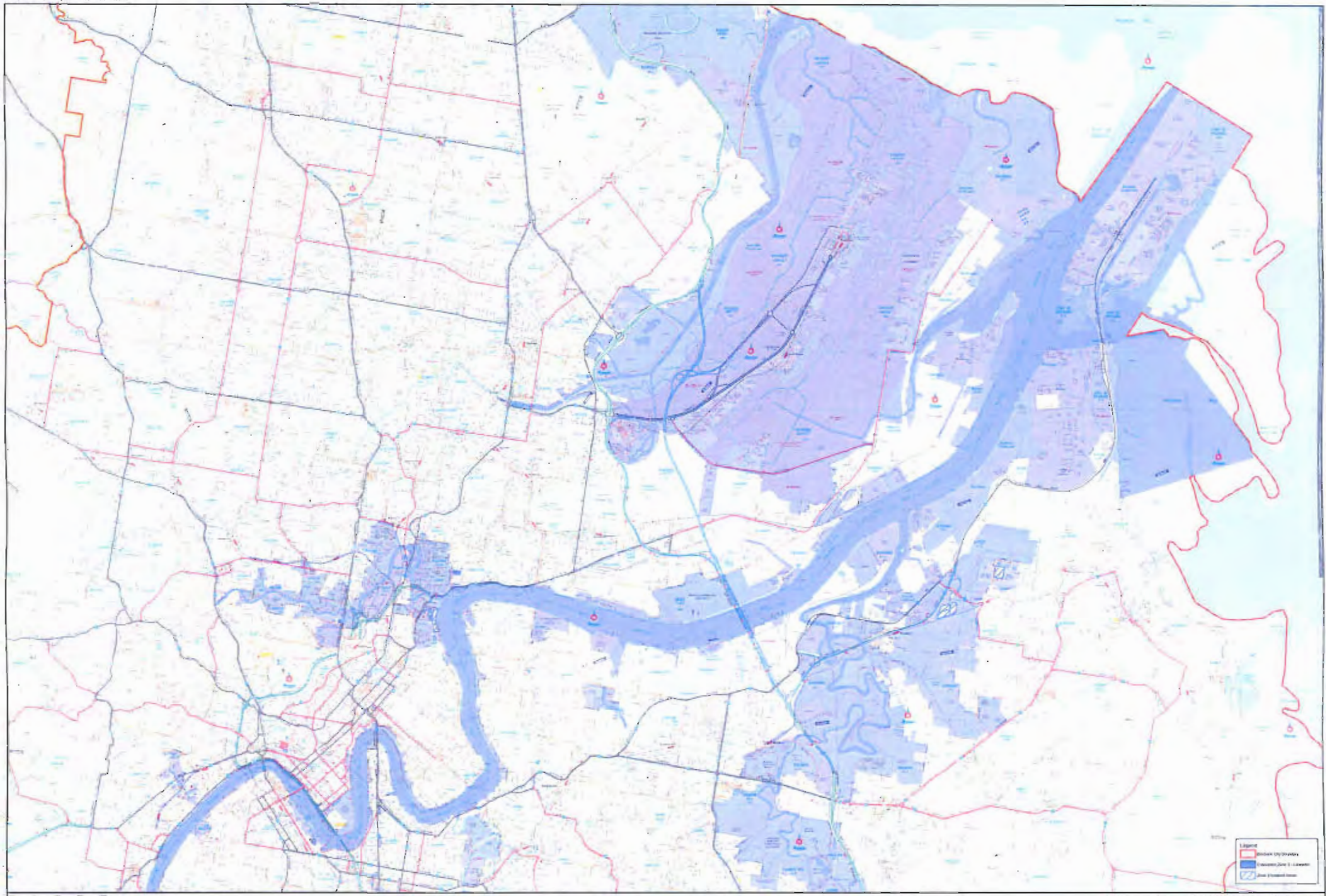
4,800 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - West

Figure 150



4,000 m³/s Peak Discharge at Port Orford Gauge Evacuation Zone - South

Figure 151



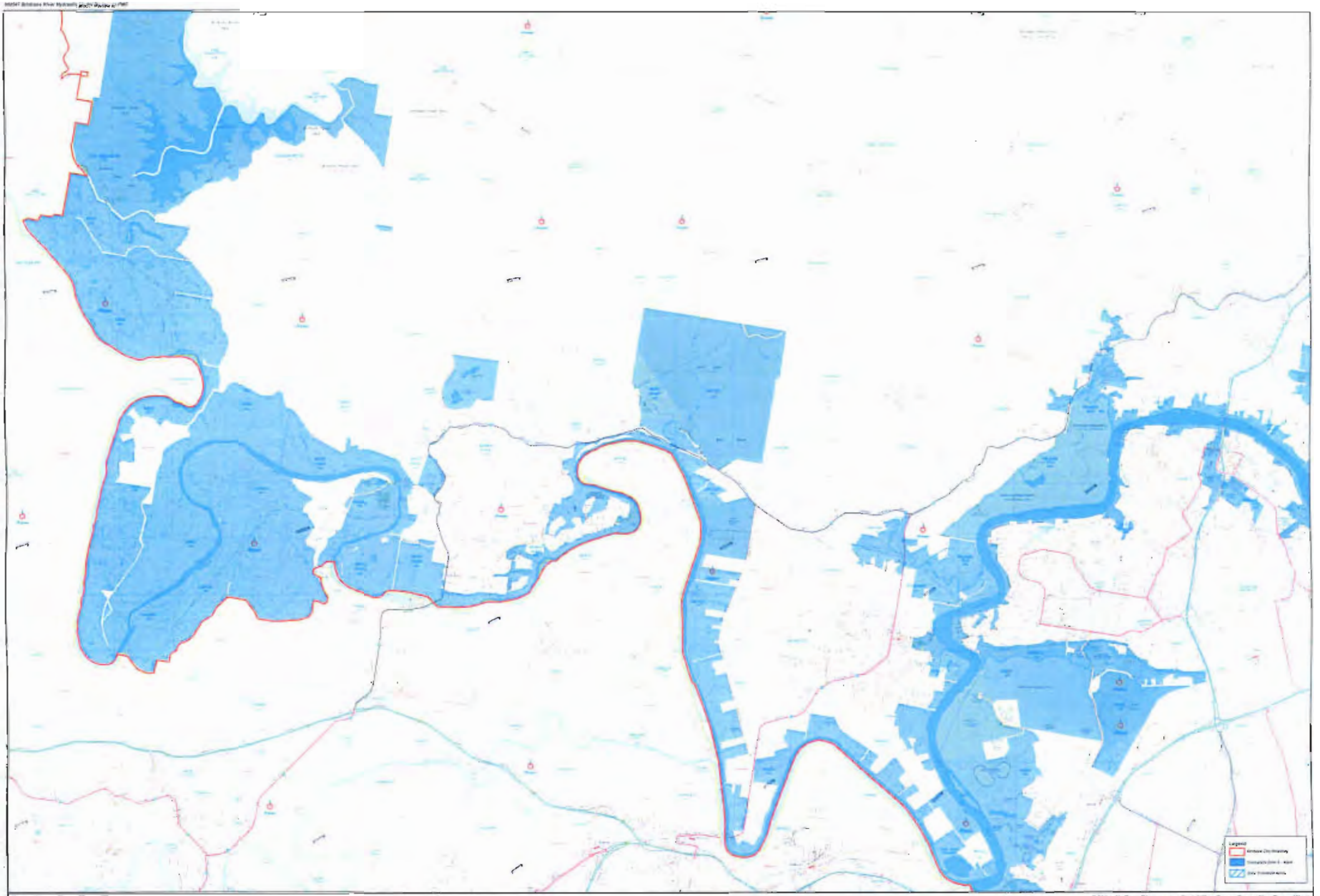
4,000 m³/s Peak Discharge of Port Office Gauge Evacuation Zone - East

Figure 15



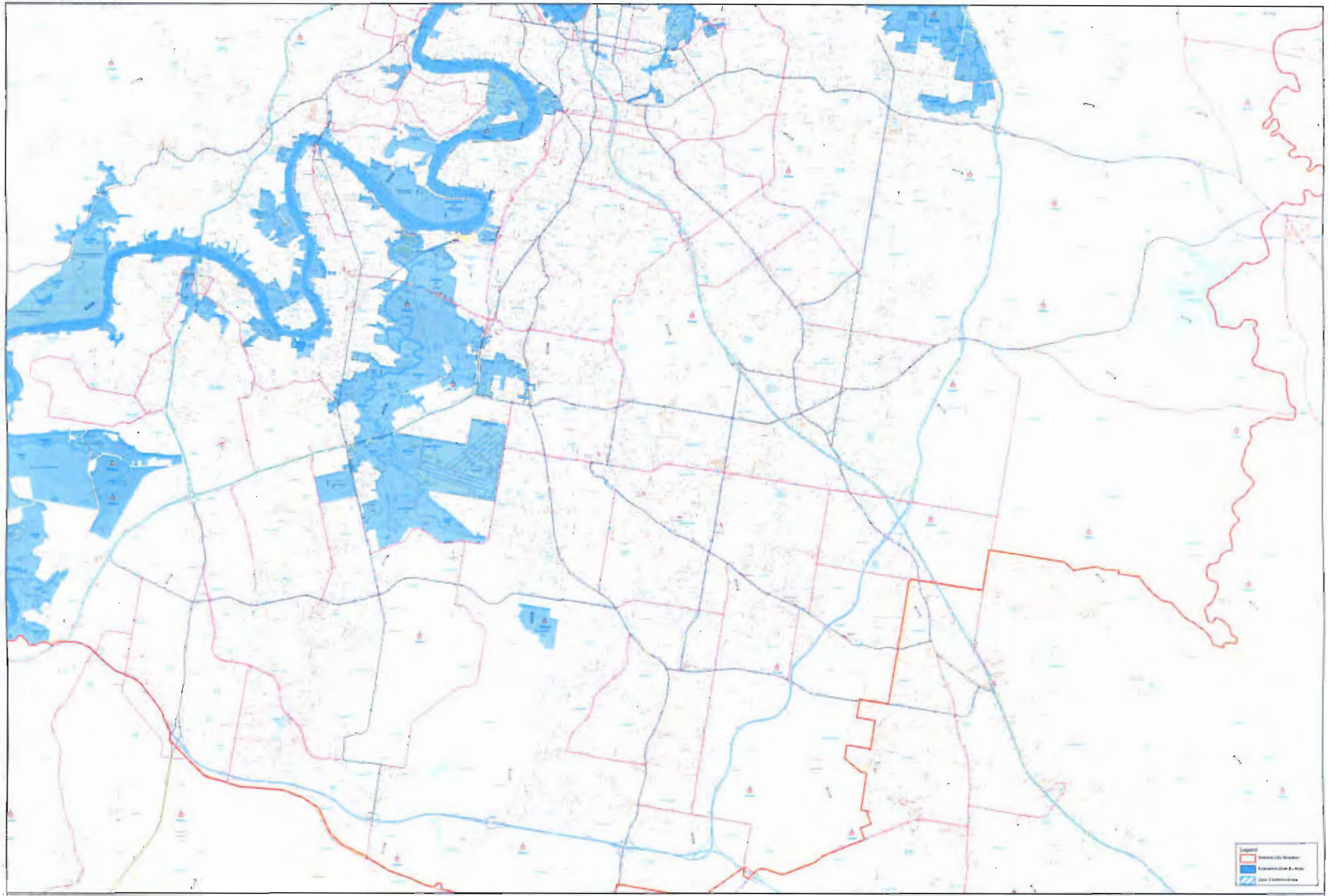
5,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone

Figure 153



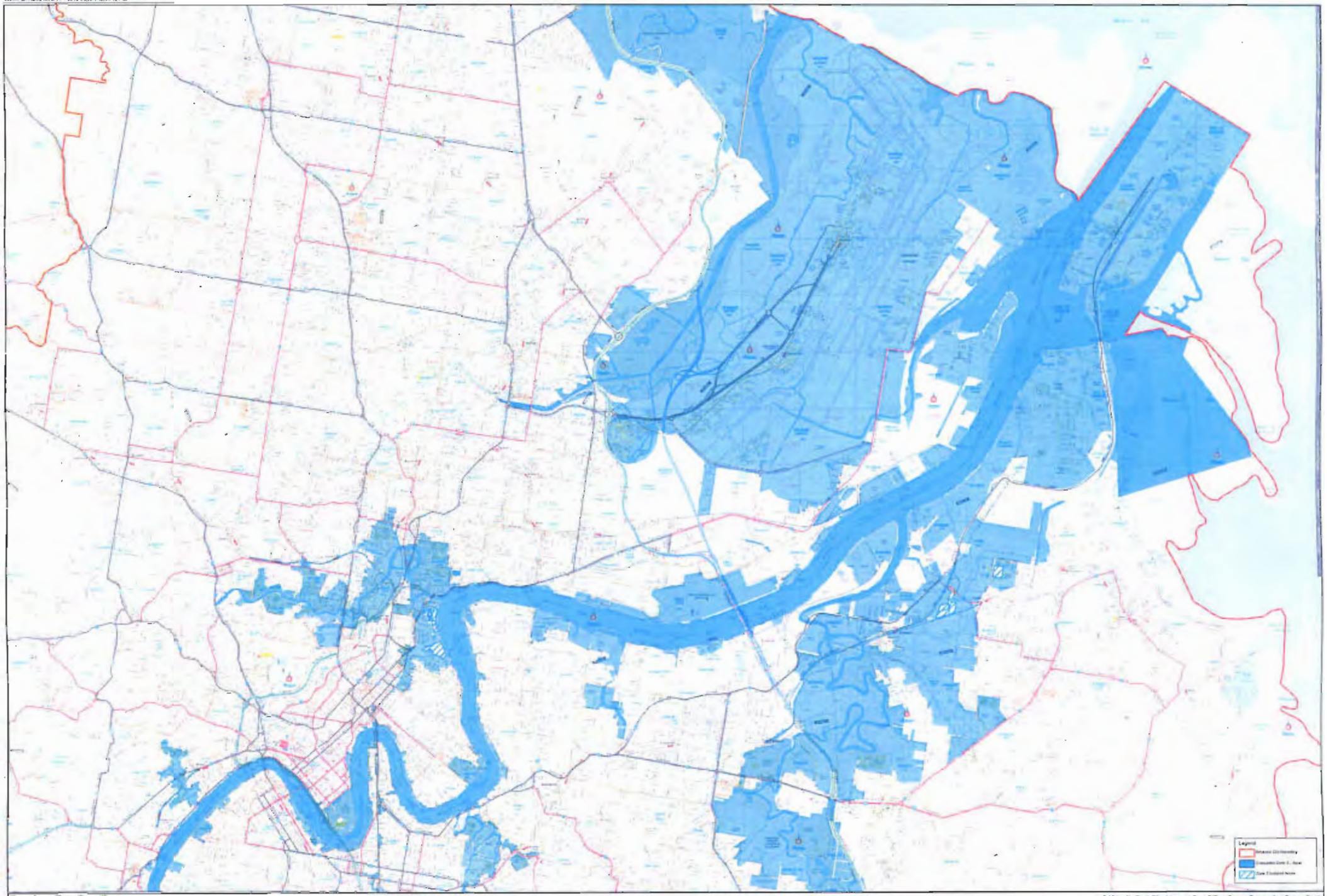
5,930 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - West

Figure 154



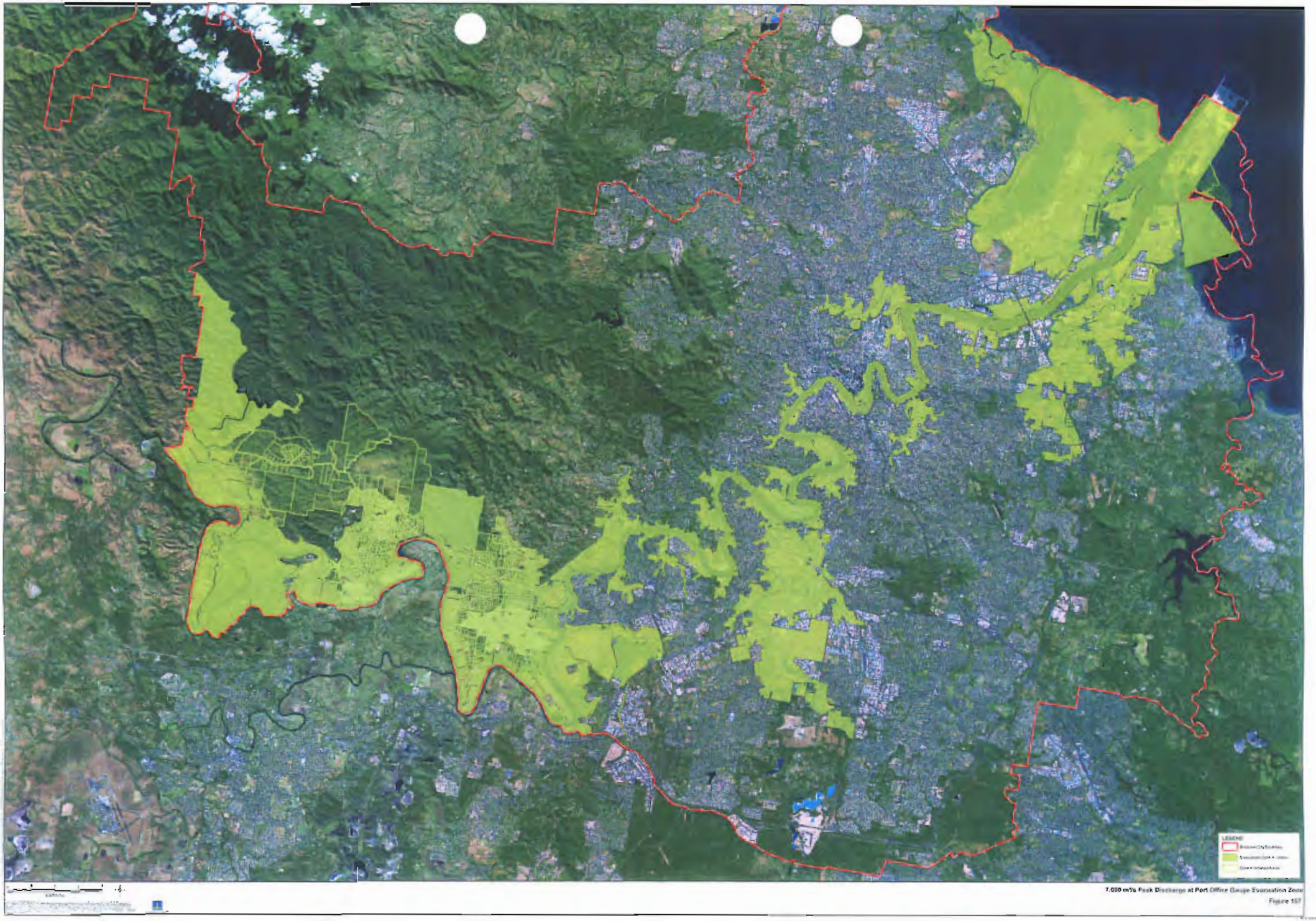
5,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - South

Figure 155



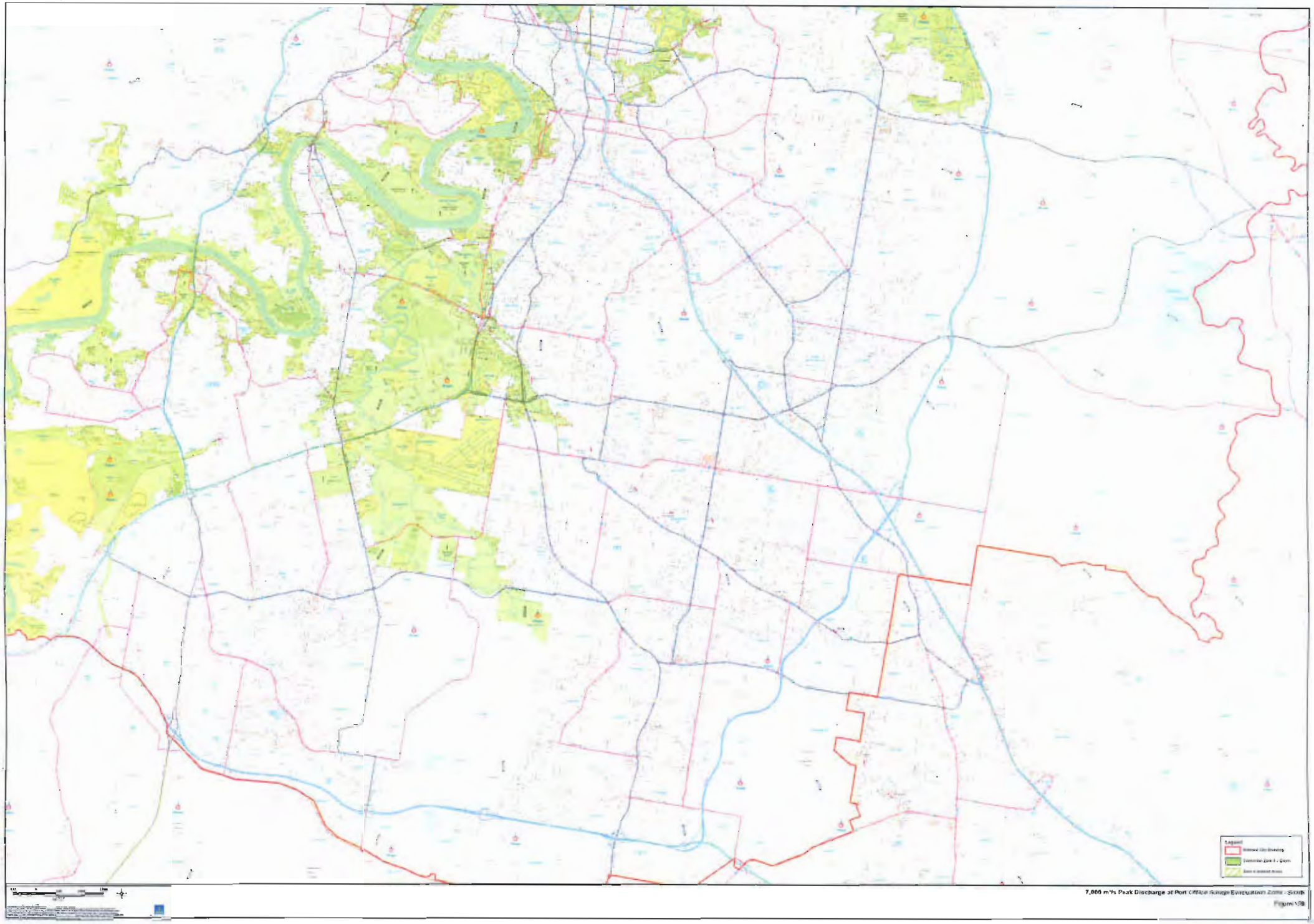
6,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - East

Figure 15C



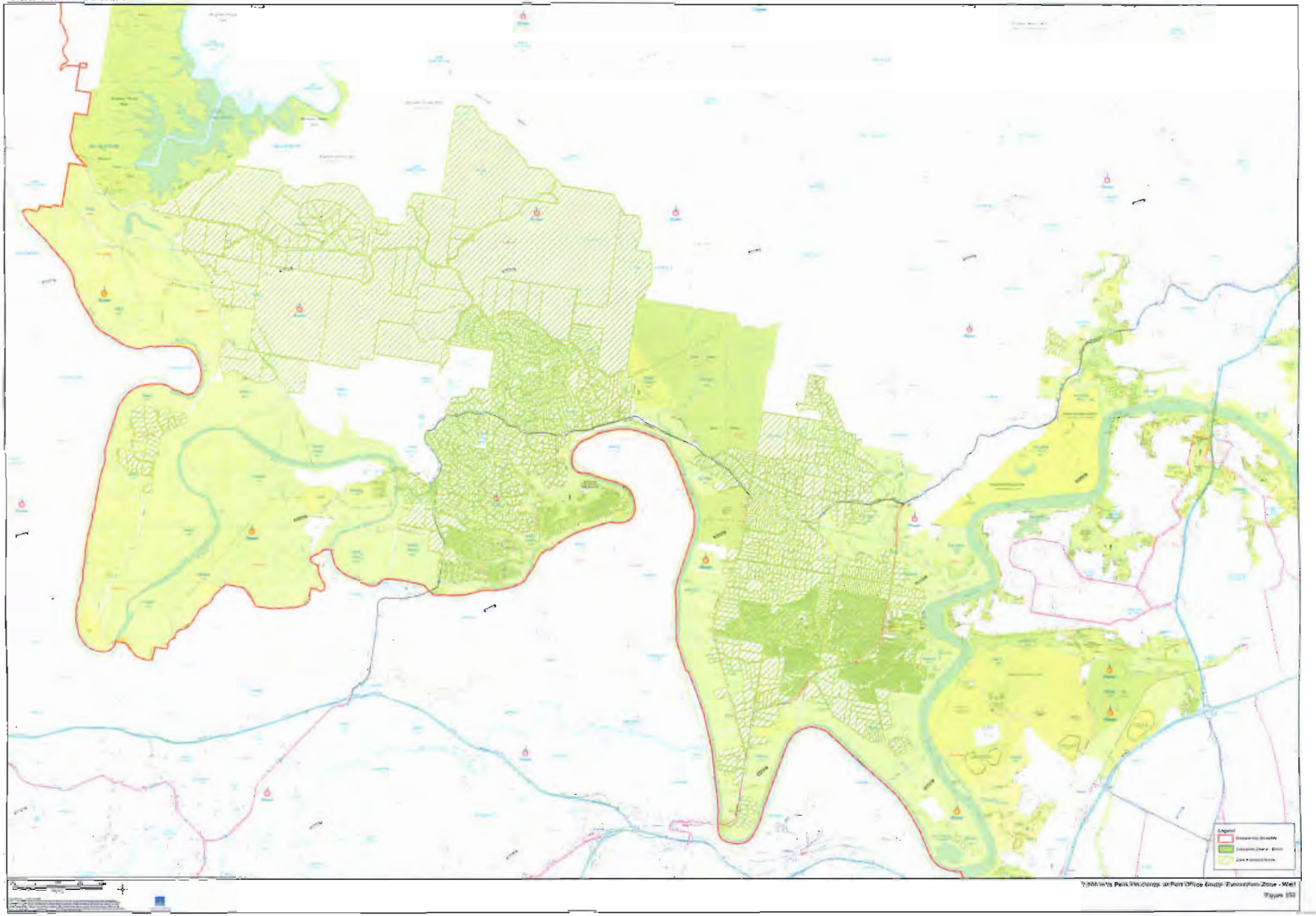
7,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone

Figure 167



7,000 m³/s Peak Discharge at Port Office Range Evacuation Zone - South

Figure 159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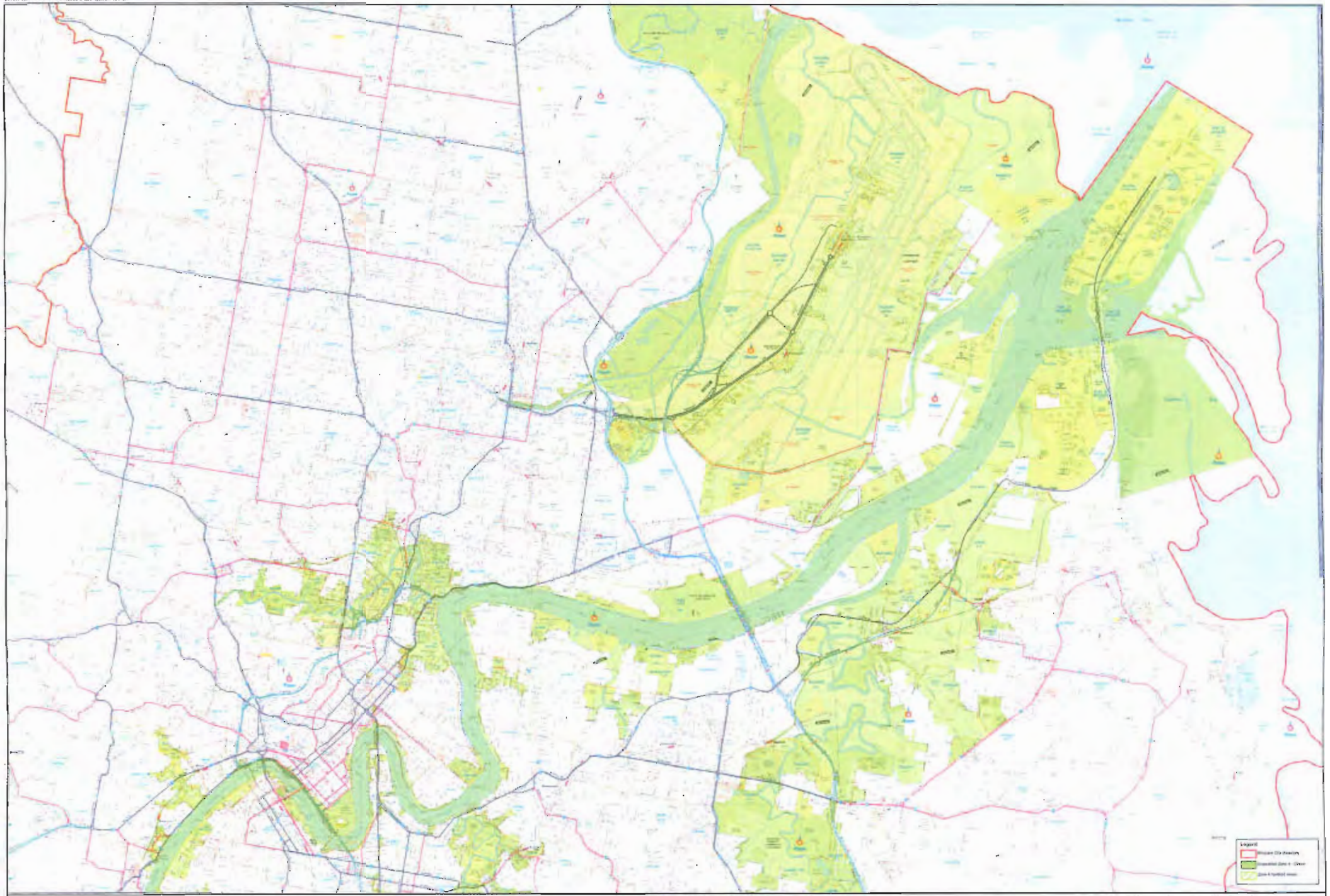
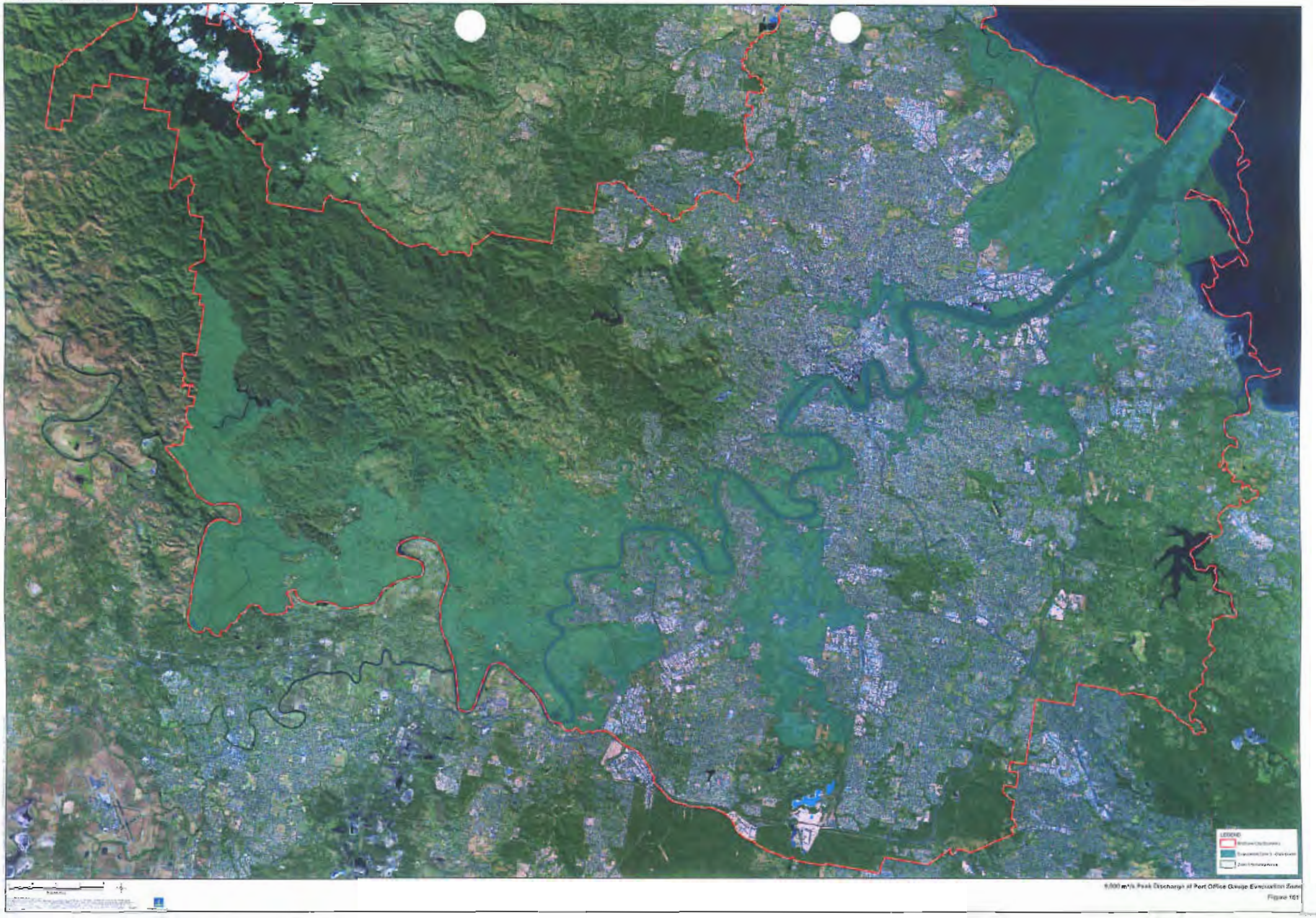


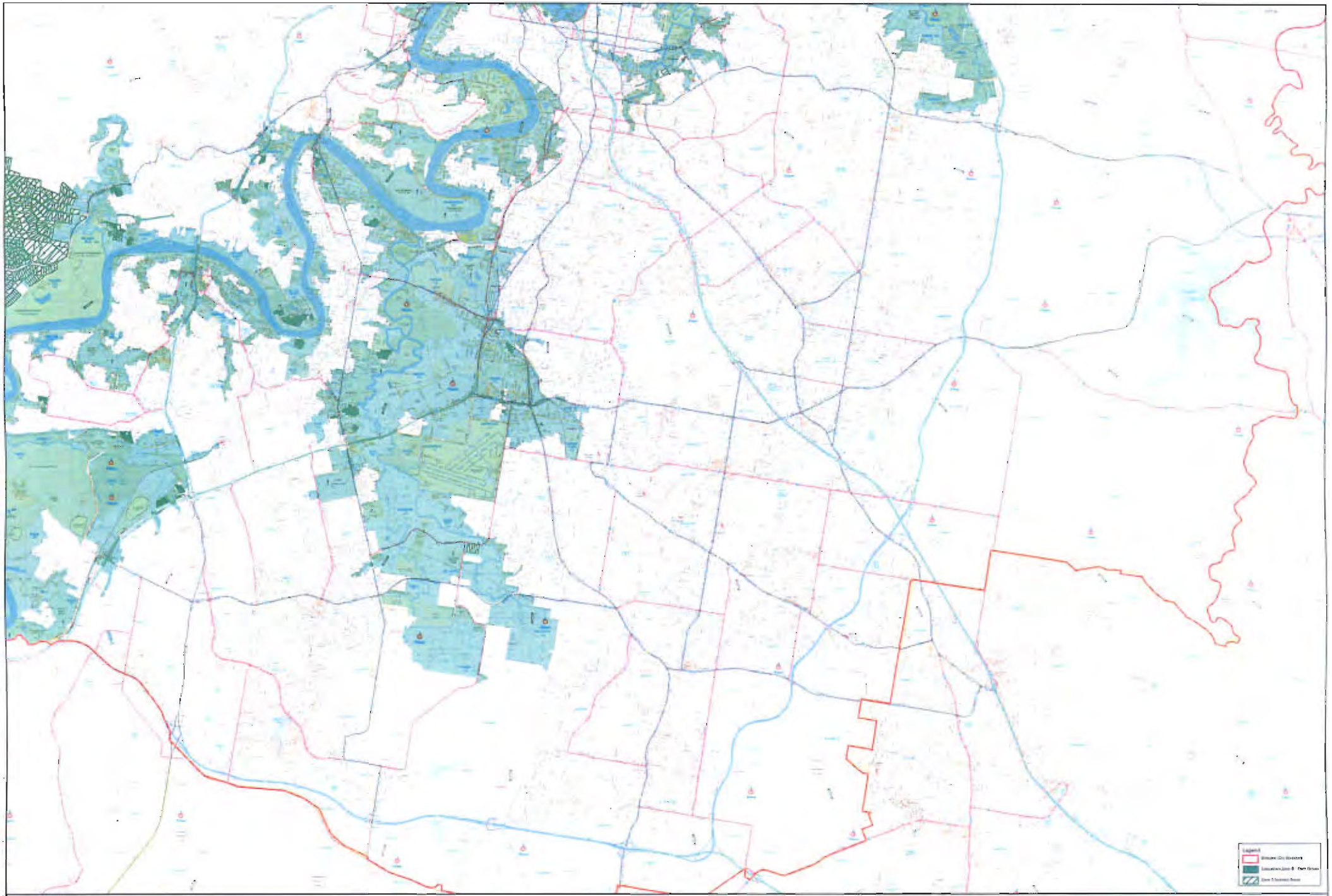
7,000m³/s Red Discharge at Port Office Gauge Evacuation Zone - East

Figure 160



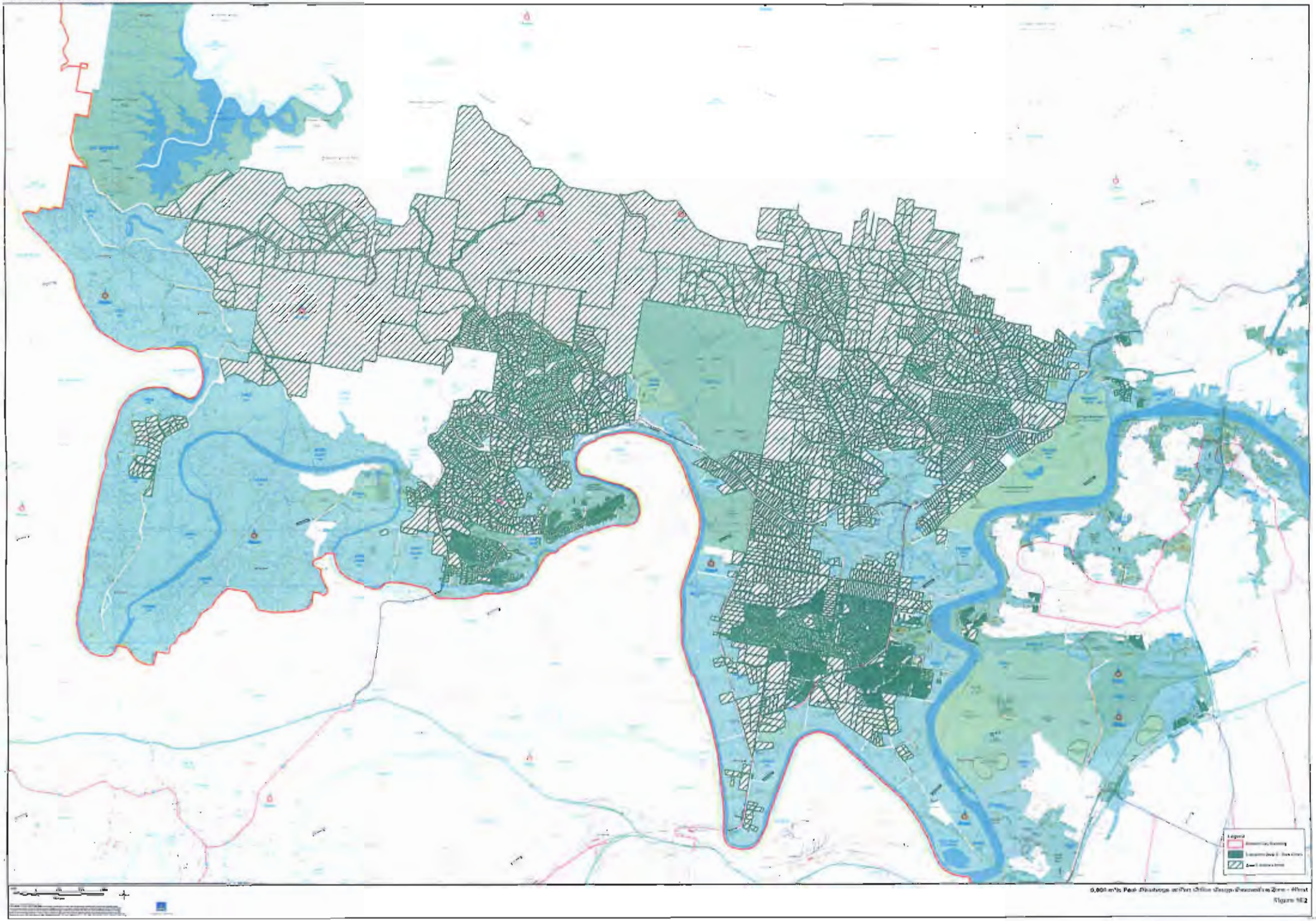
9,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone

Figure 161



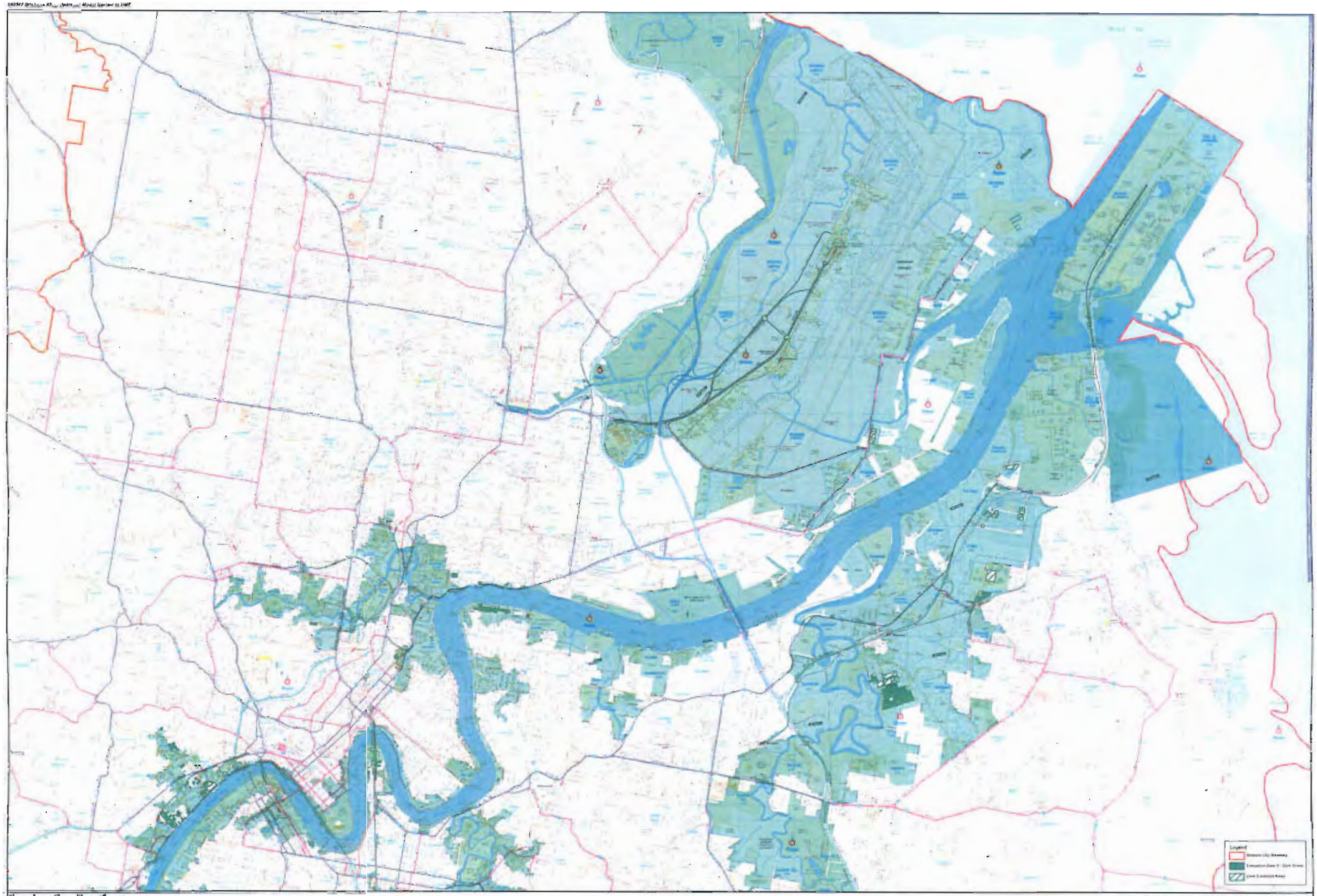
9,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - South

Figure 103



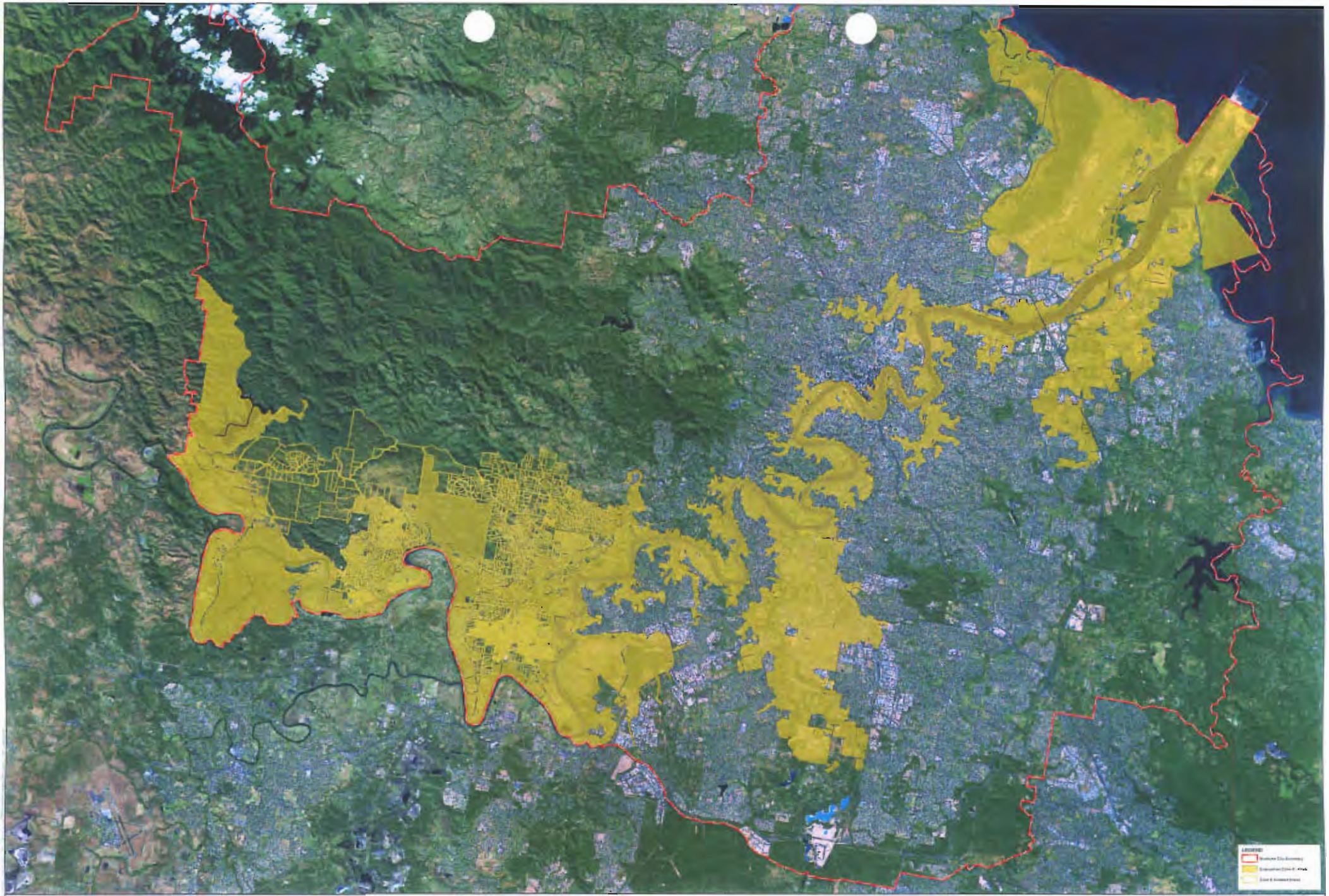
0,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - Wrest

Figure 162



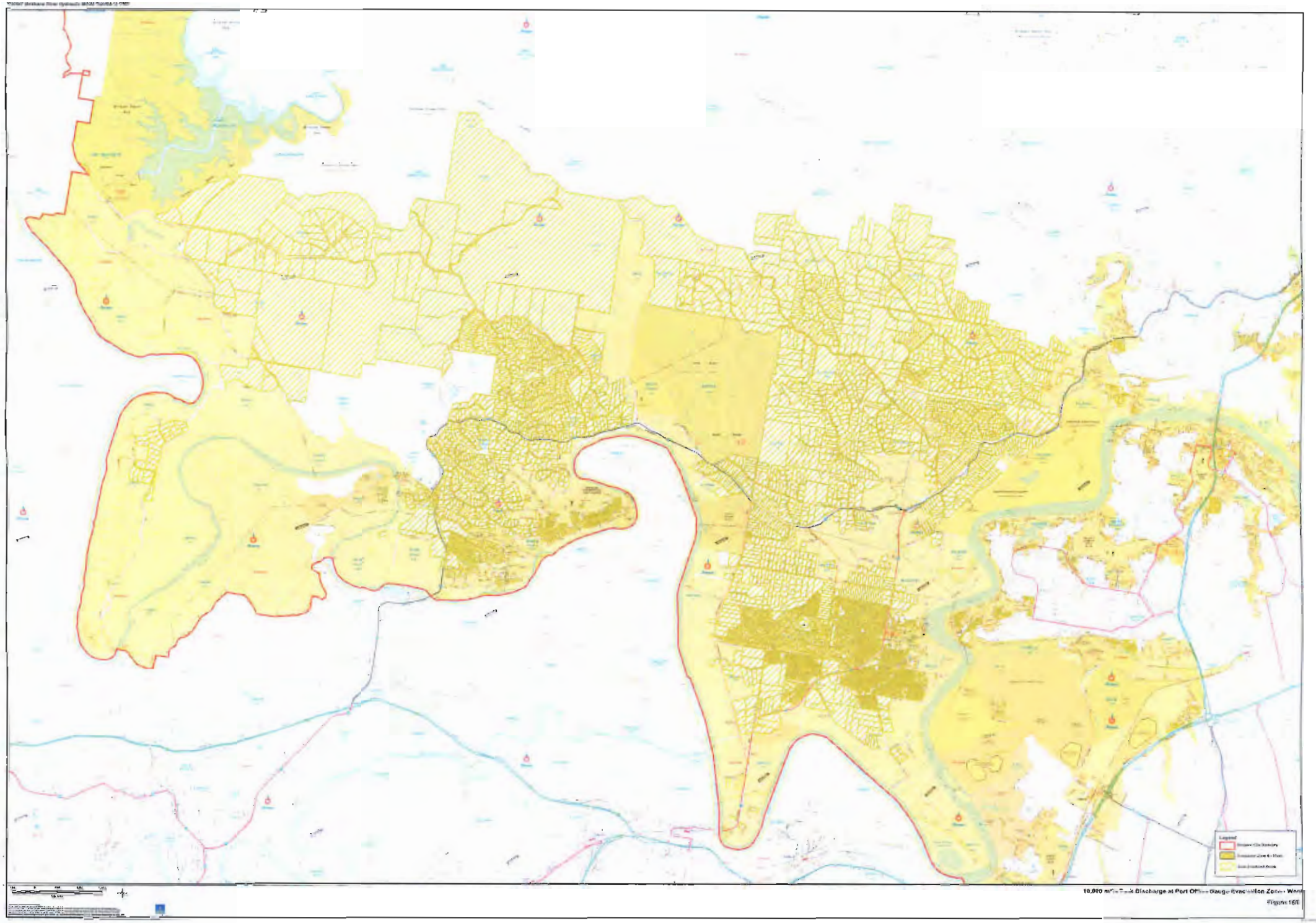
9,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - East

Figure 16A



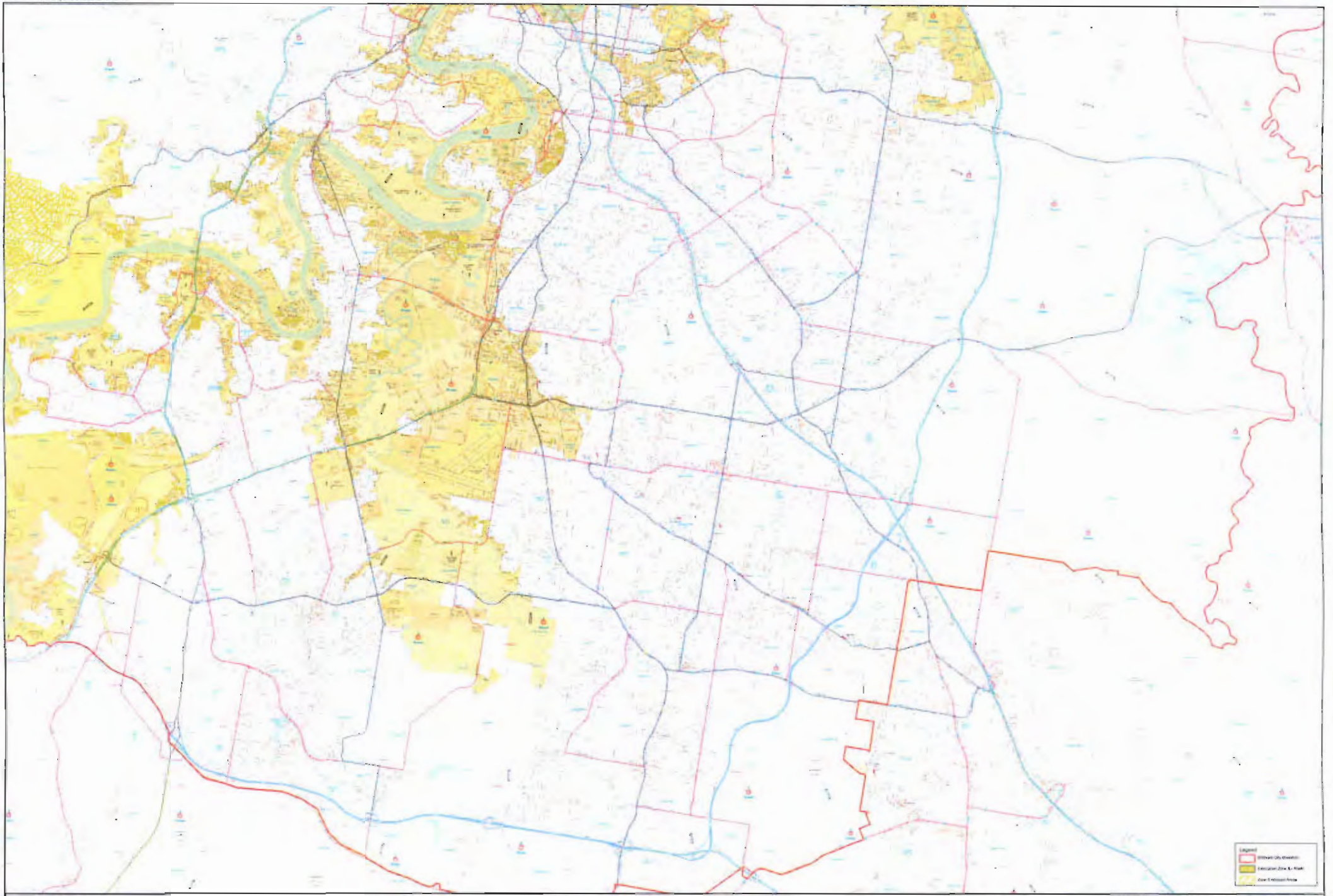
10,000 m³/s Peak Breakdown at Port Office Gauge Evacuation Zone

Figure 165



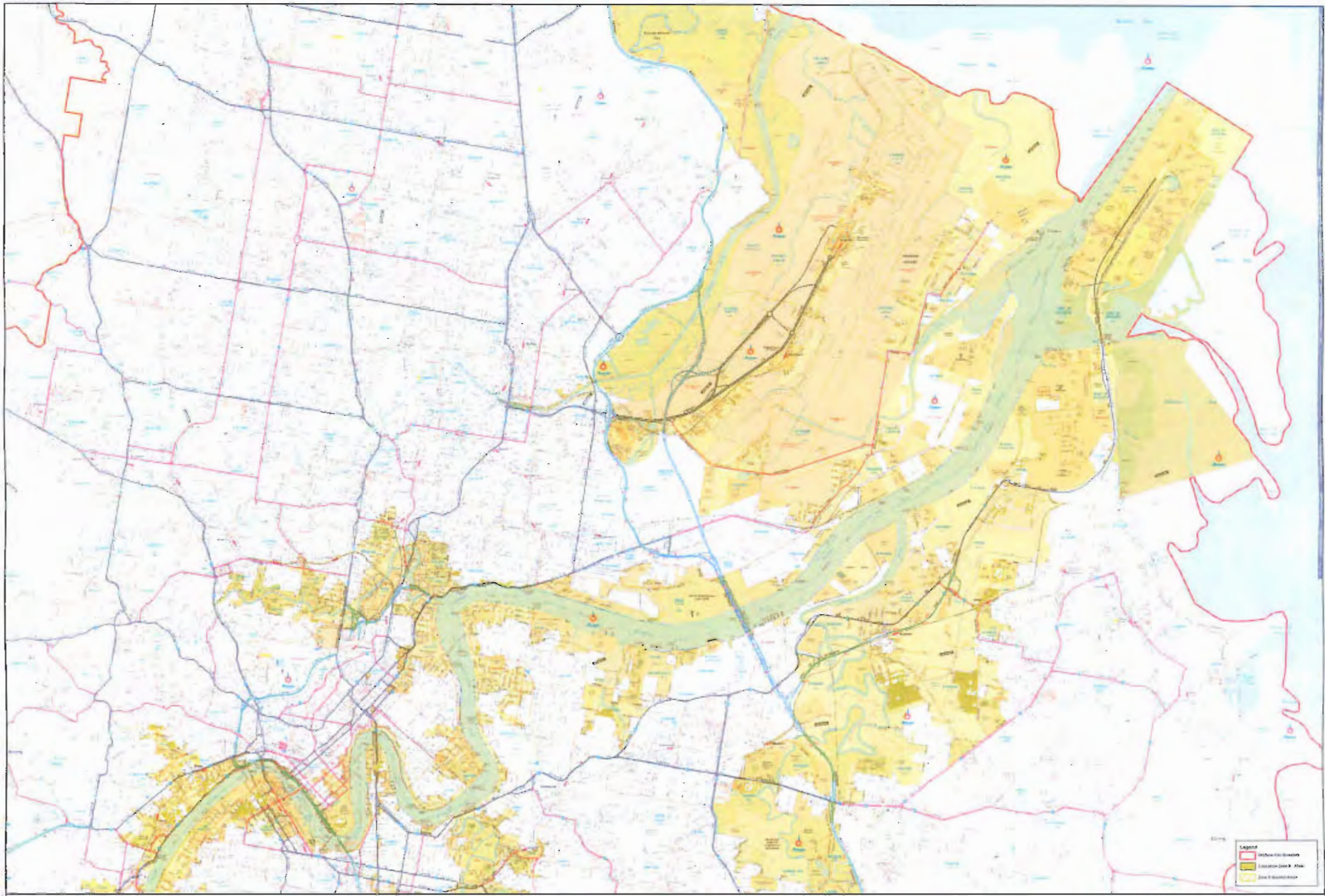
10,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zones - West

Figure 16ft



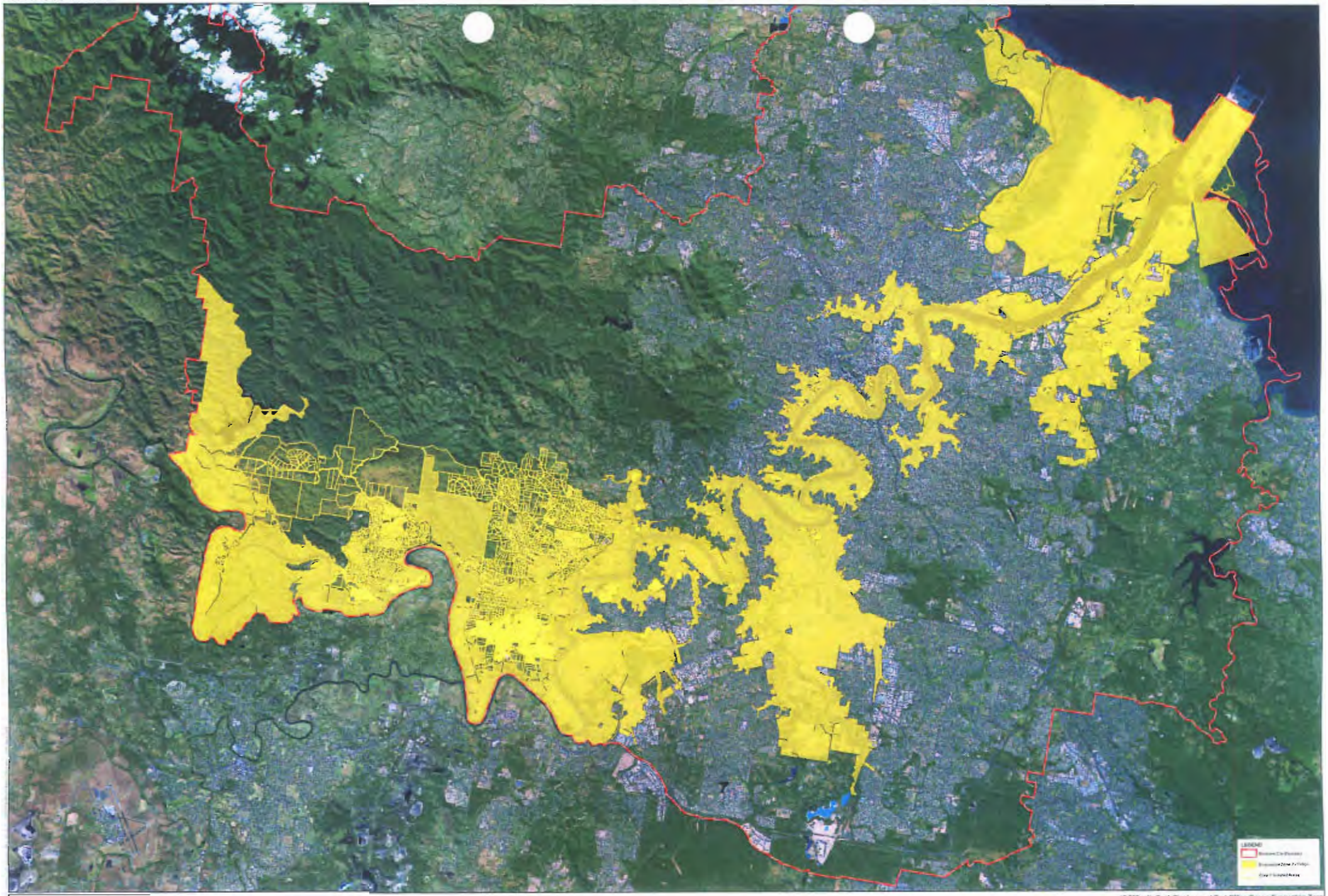
10,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - South

Figure 167



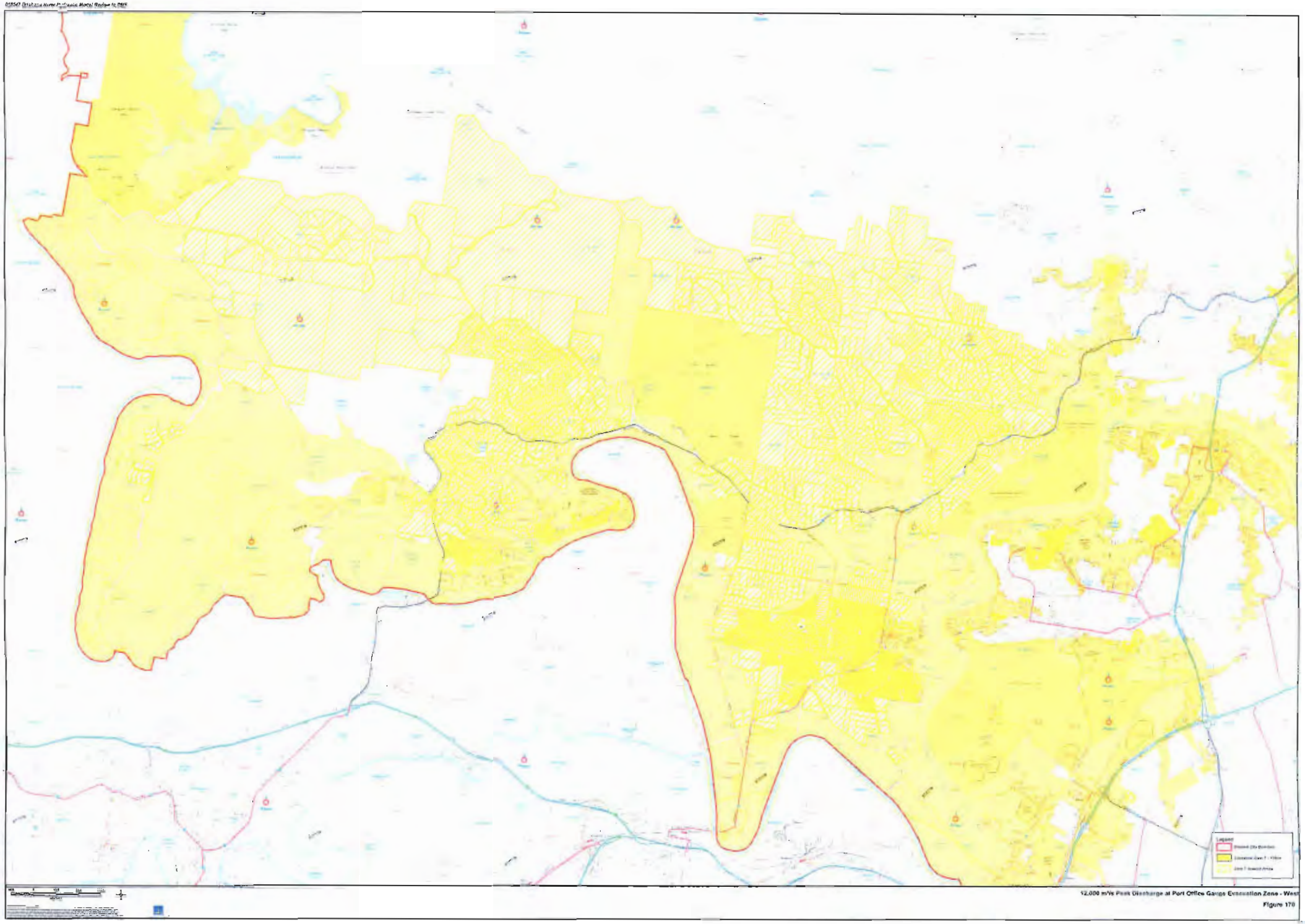
10,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - East

Figure 16a



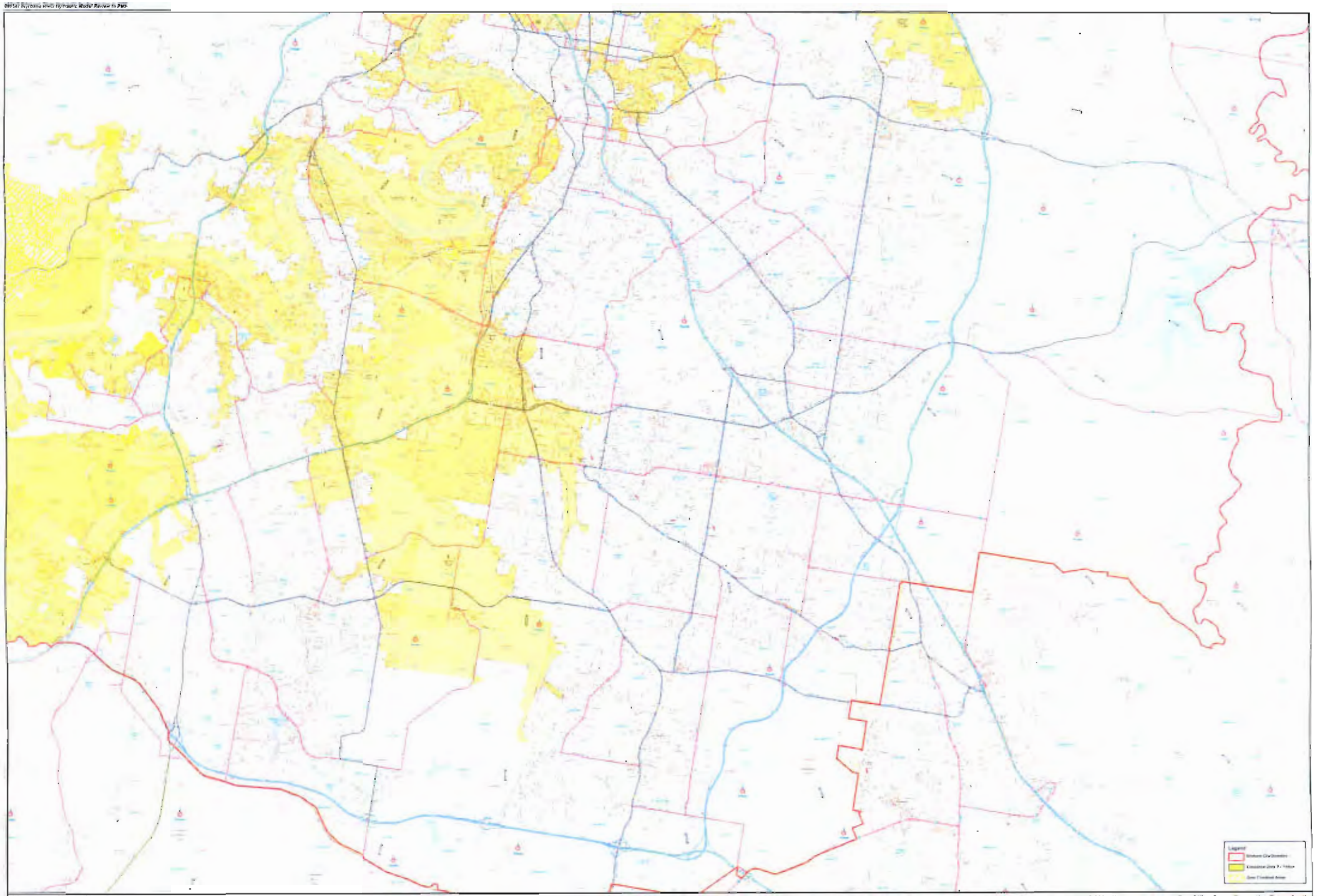
12,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone

Figure 169



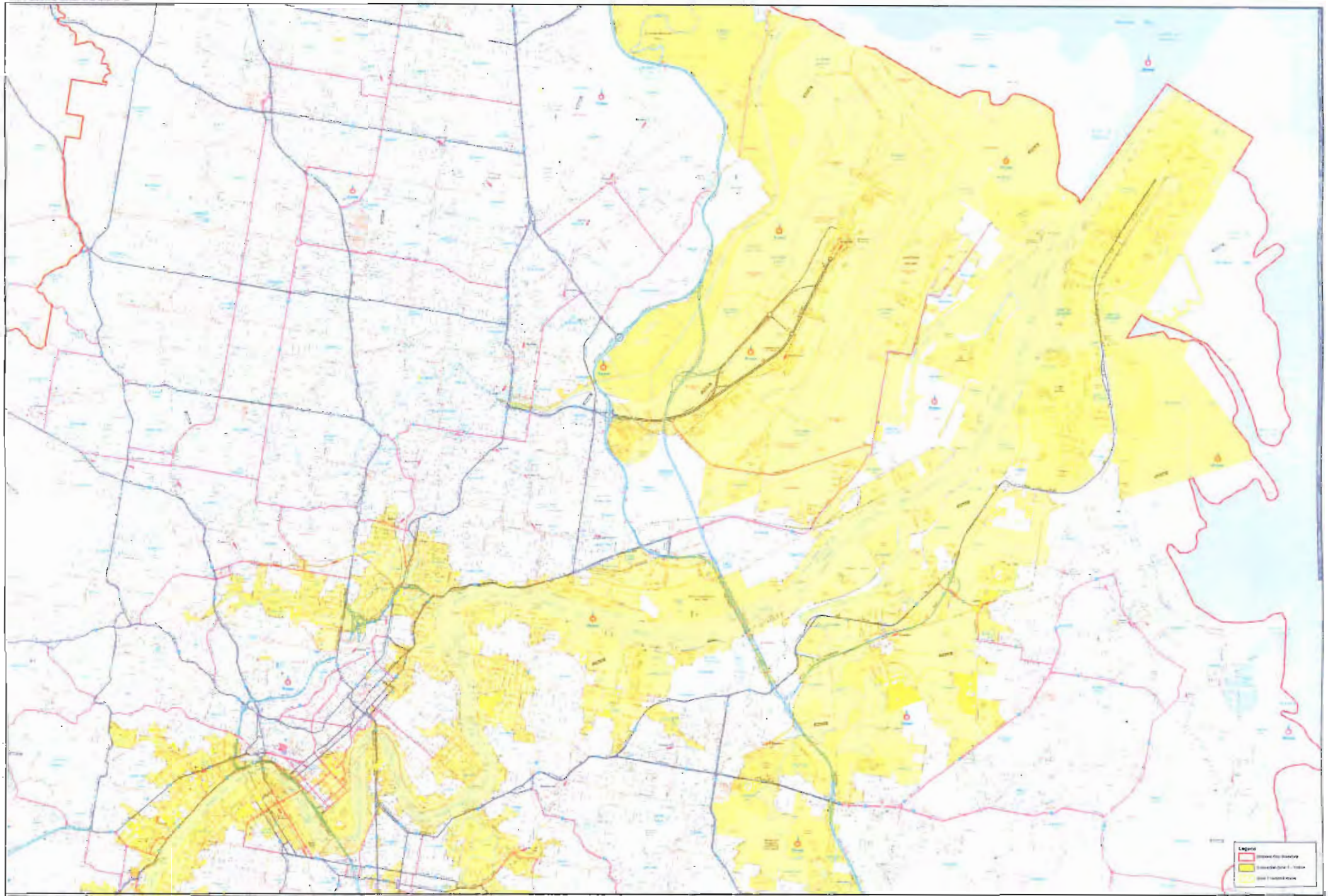
12,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - West

Figure 170



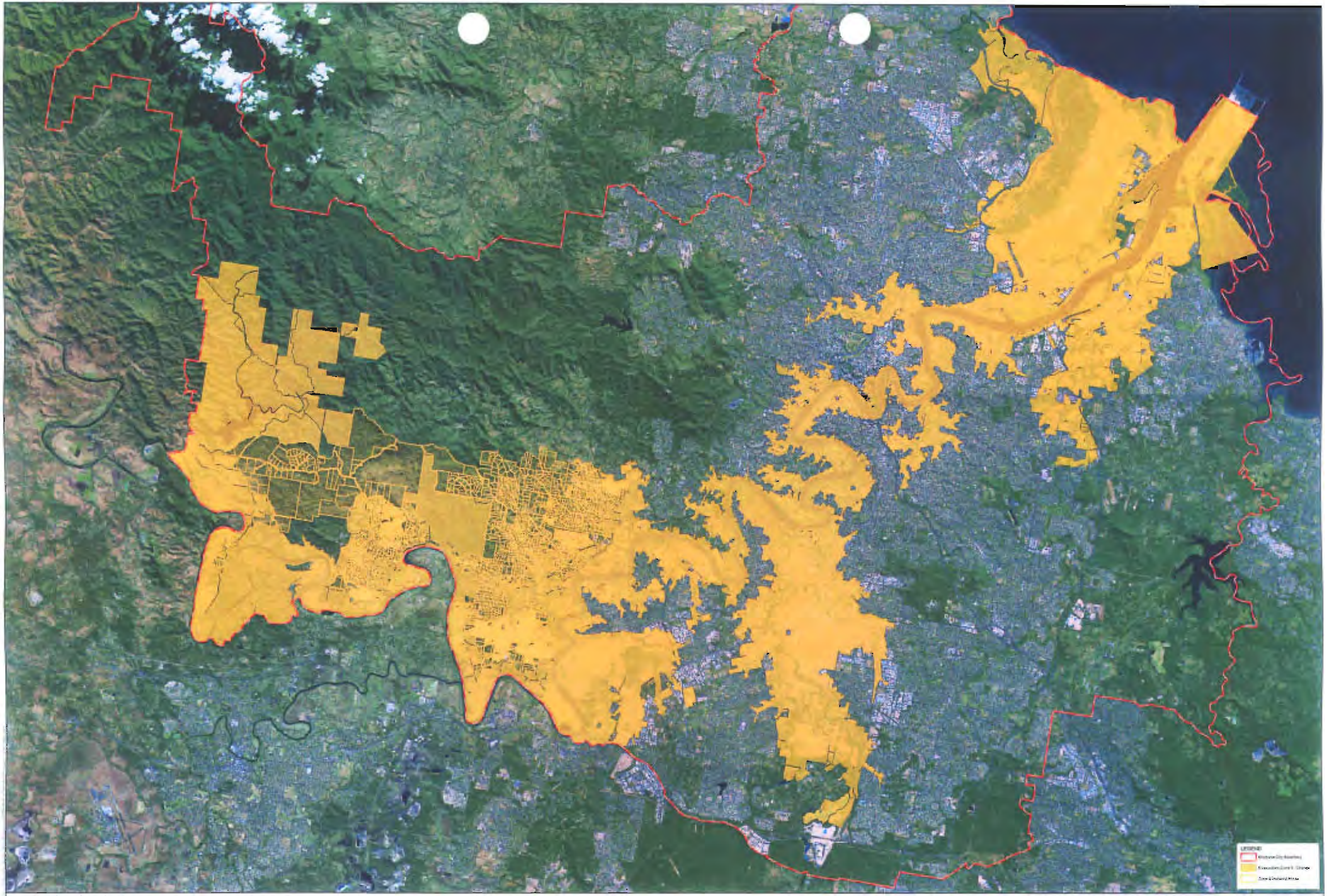
12,000 m³/s Peak Discharge at Port Office Gauge Examination Zone - North

Figure 171



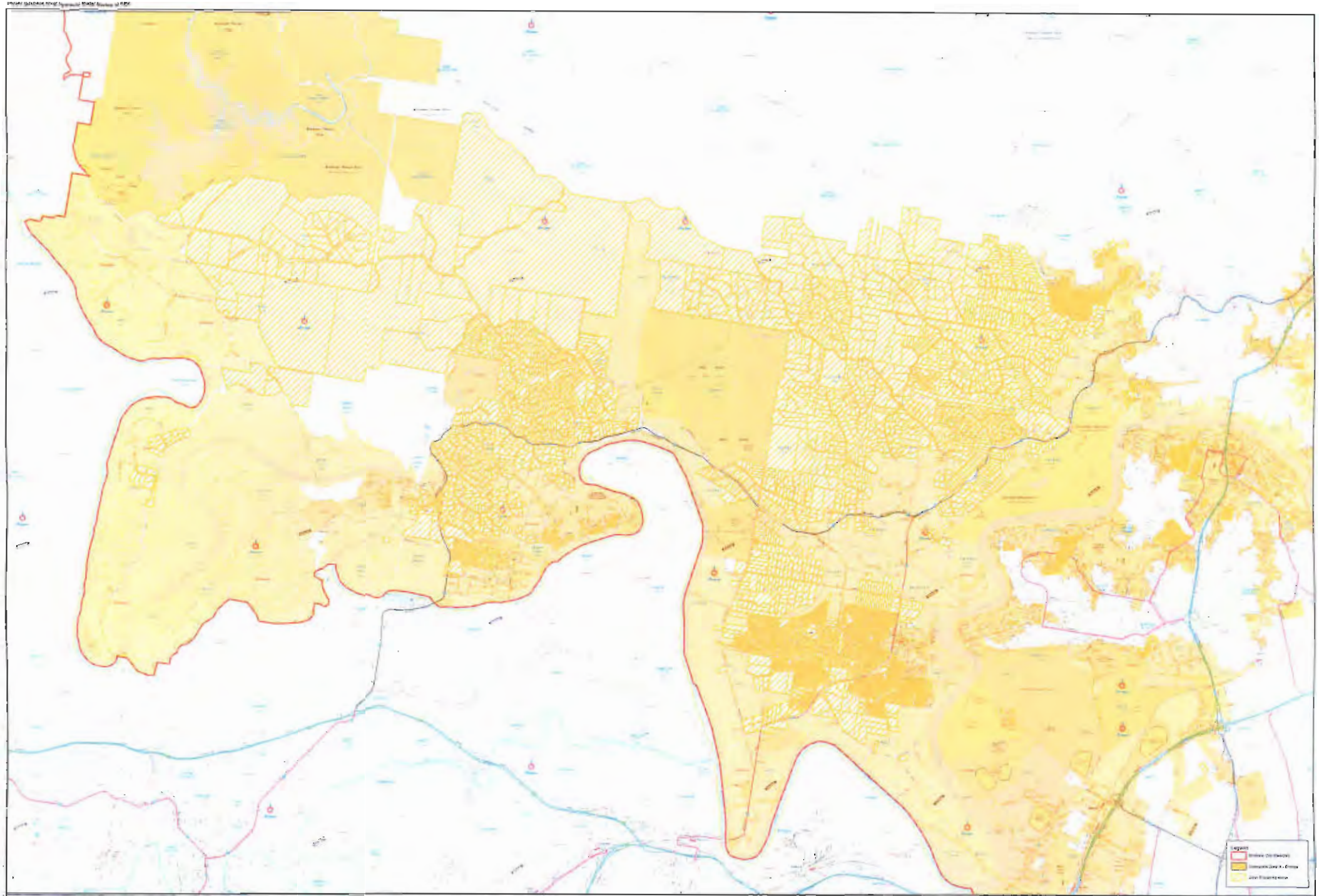
12,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - East

Figure 172



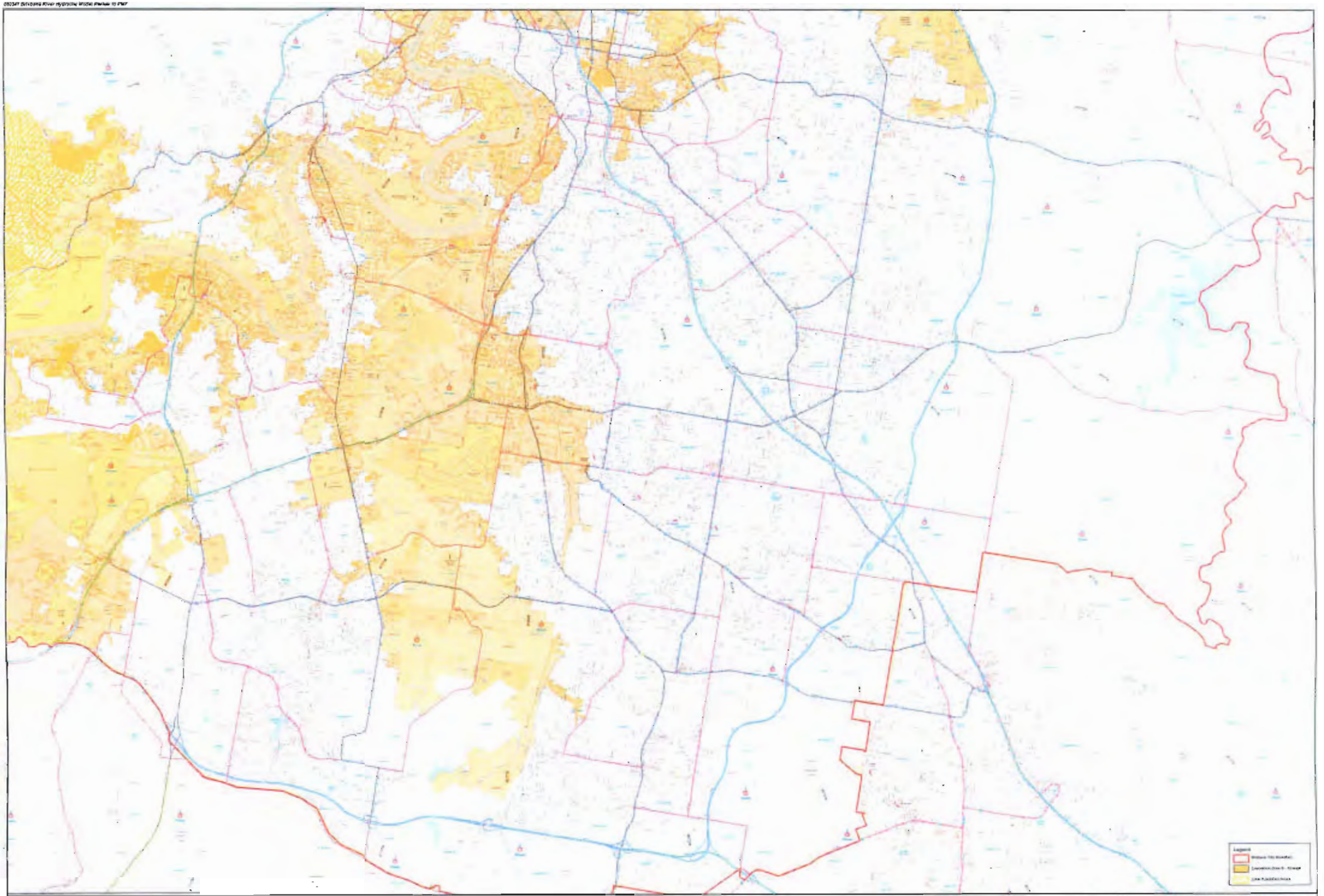
15,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone

Figure 113



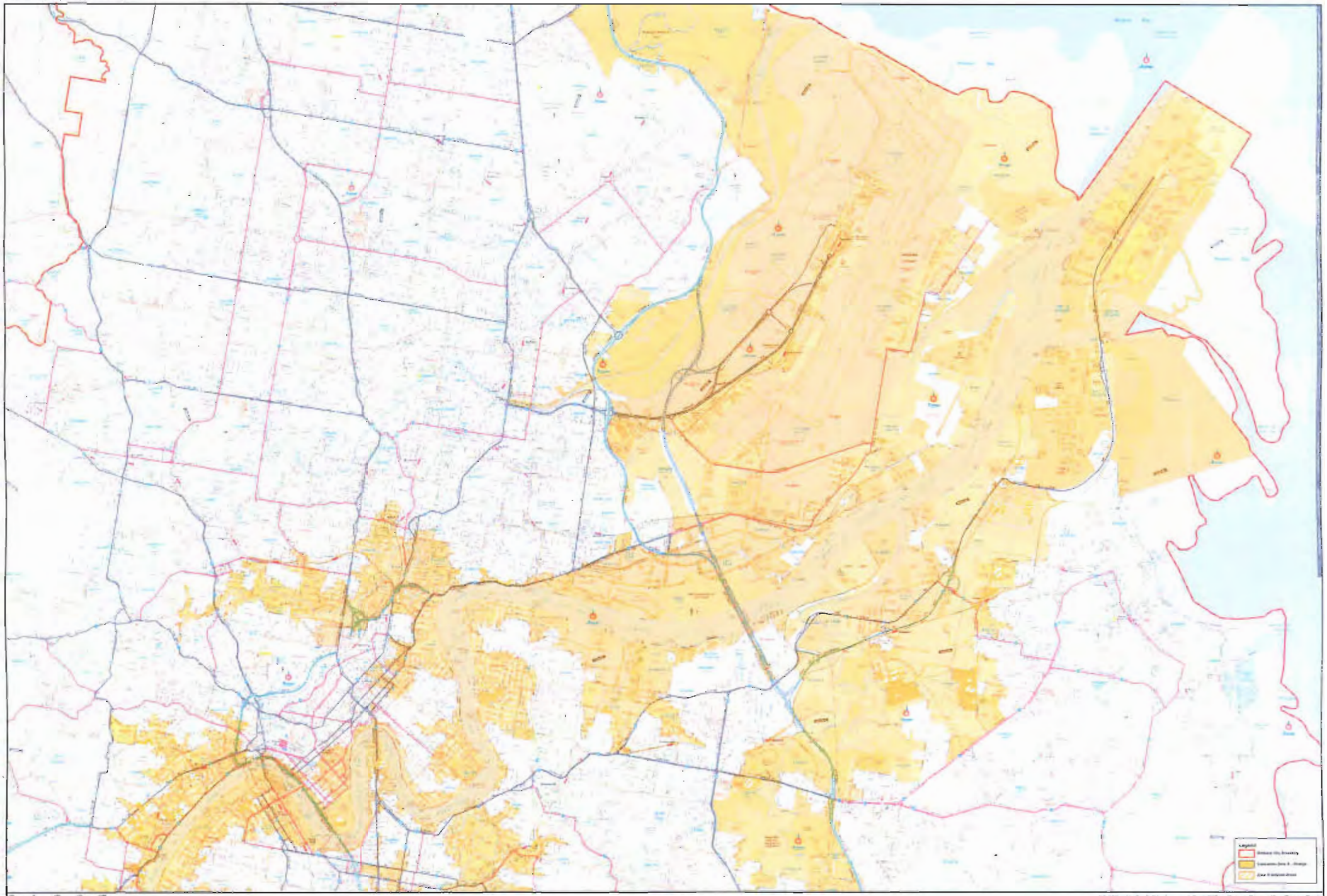
15,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - West

Figure 17-6



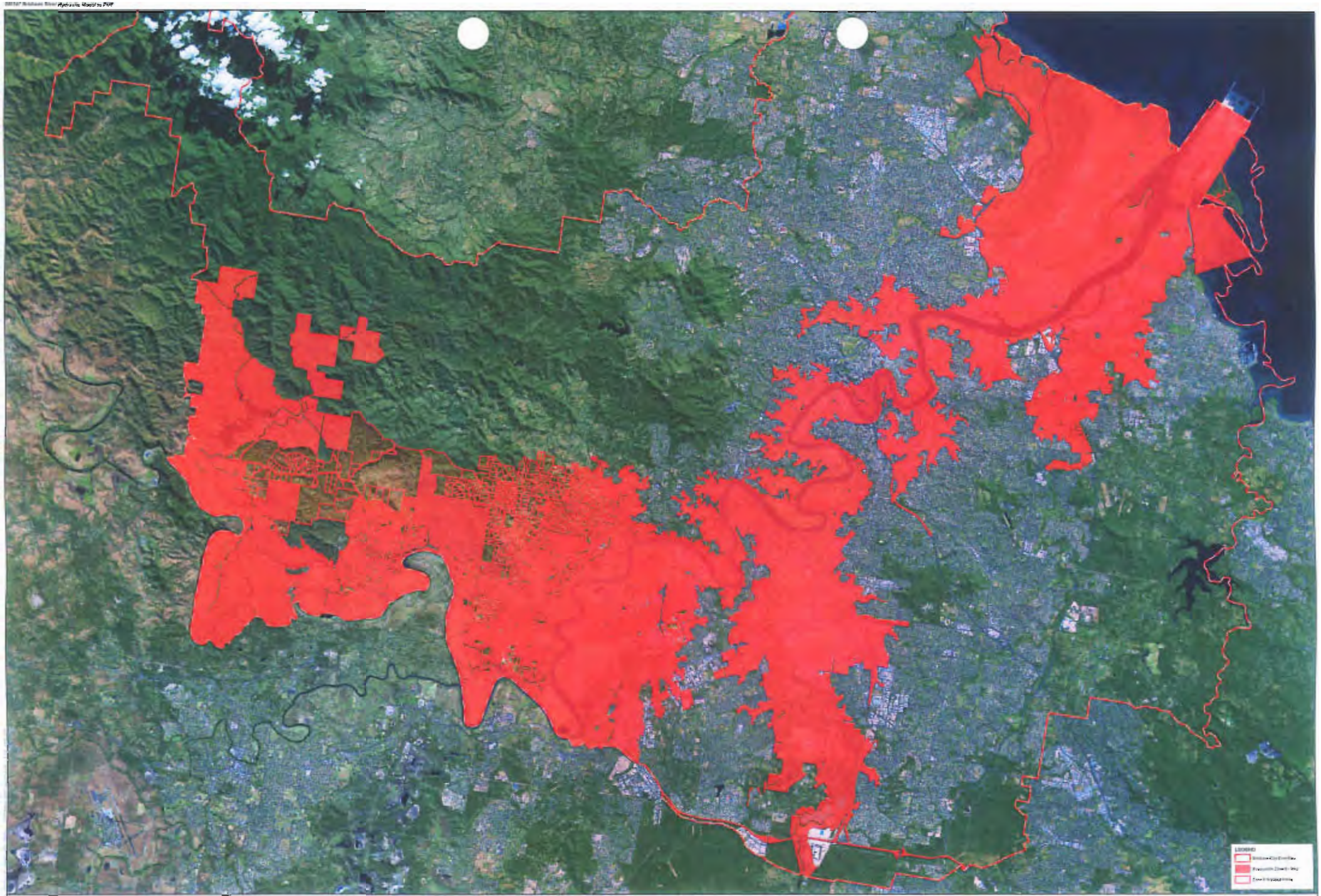
15,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - South

Figure 175



15,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - East

Figure 176



21,000 cfs Peak Discharge at Post Office Gauge Evacuation Zone

Figure 177

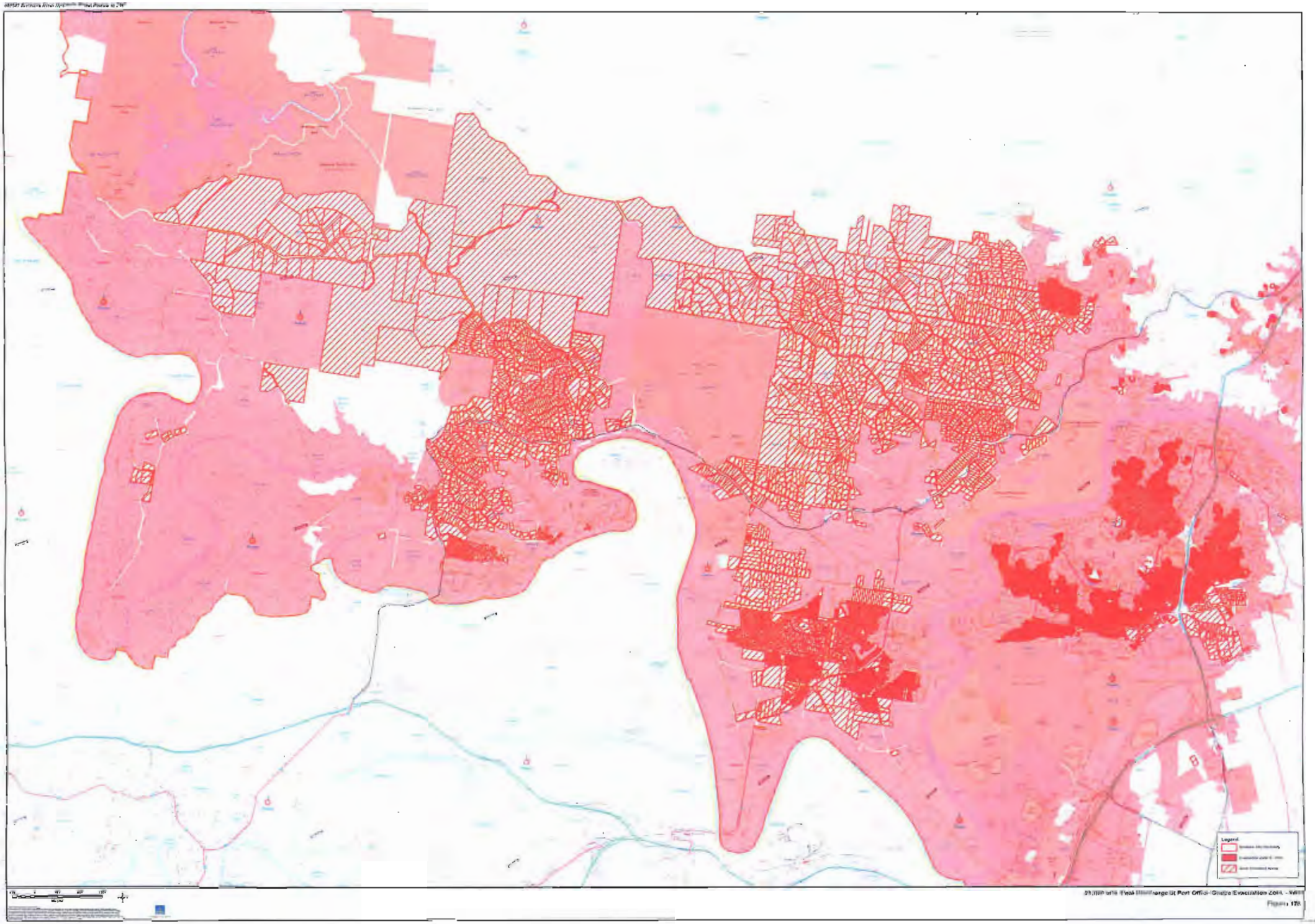
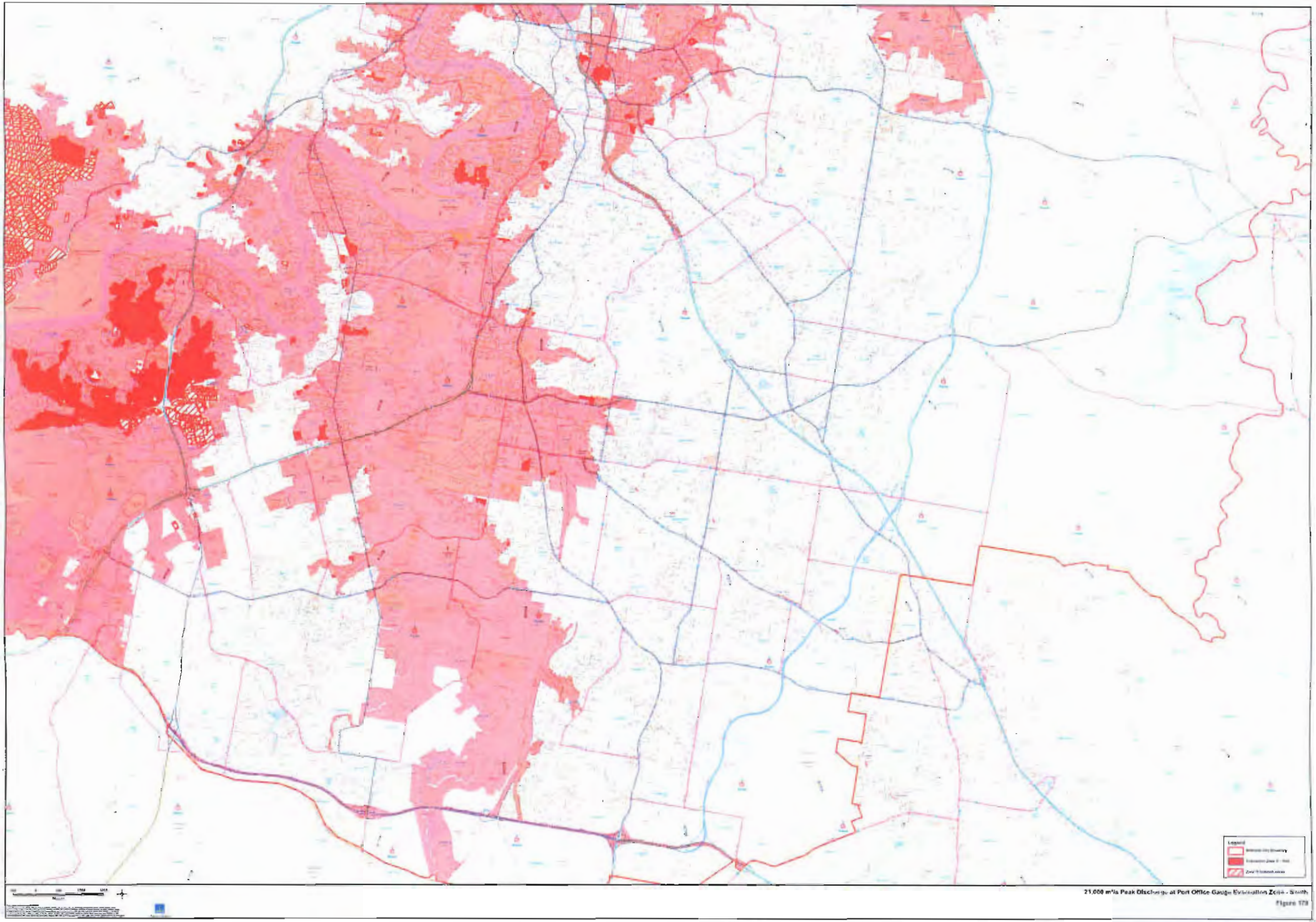
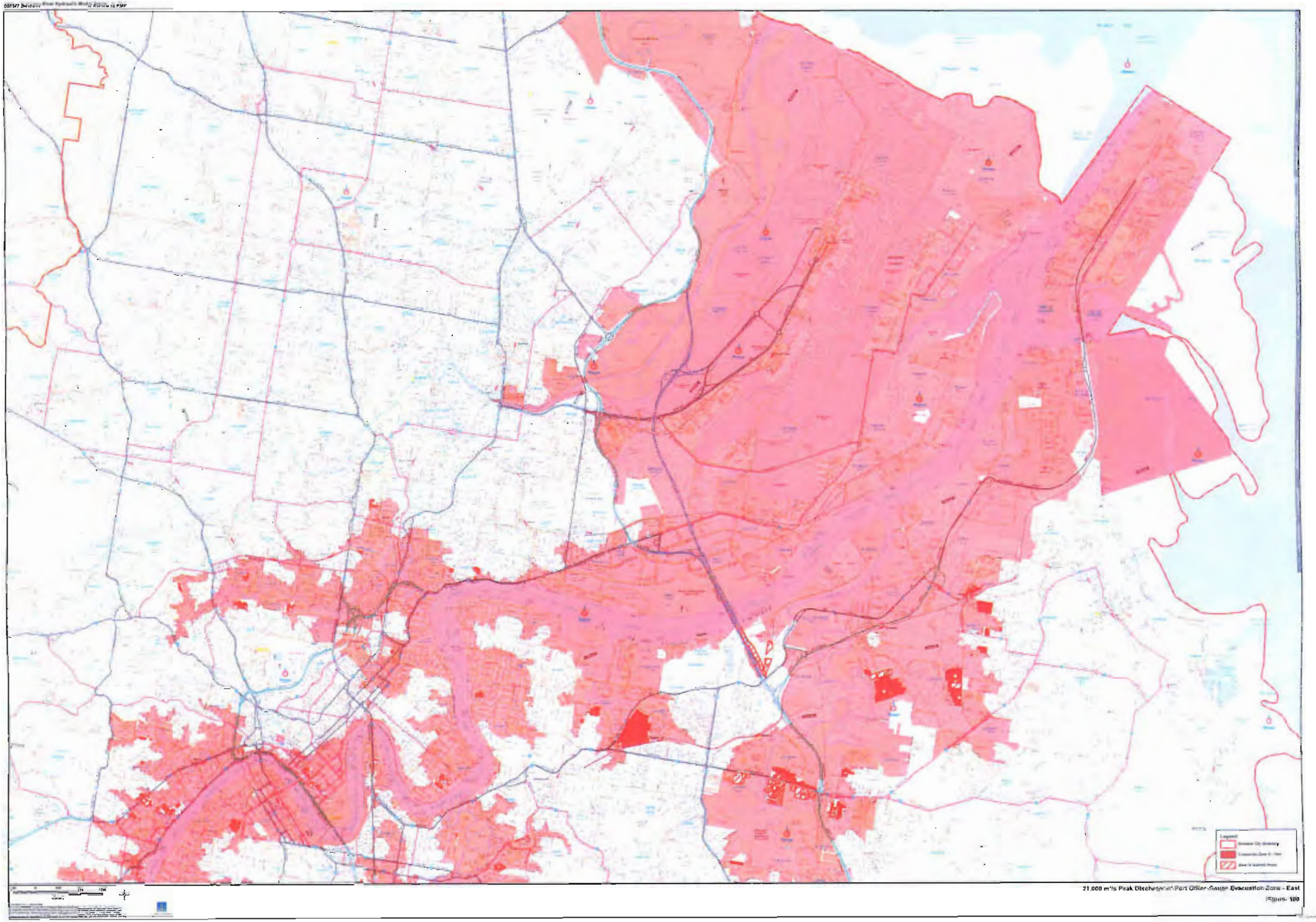


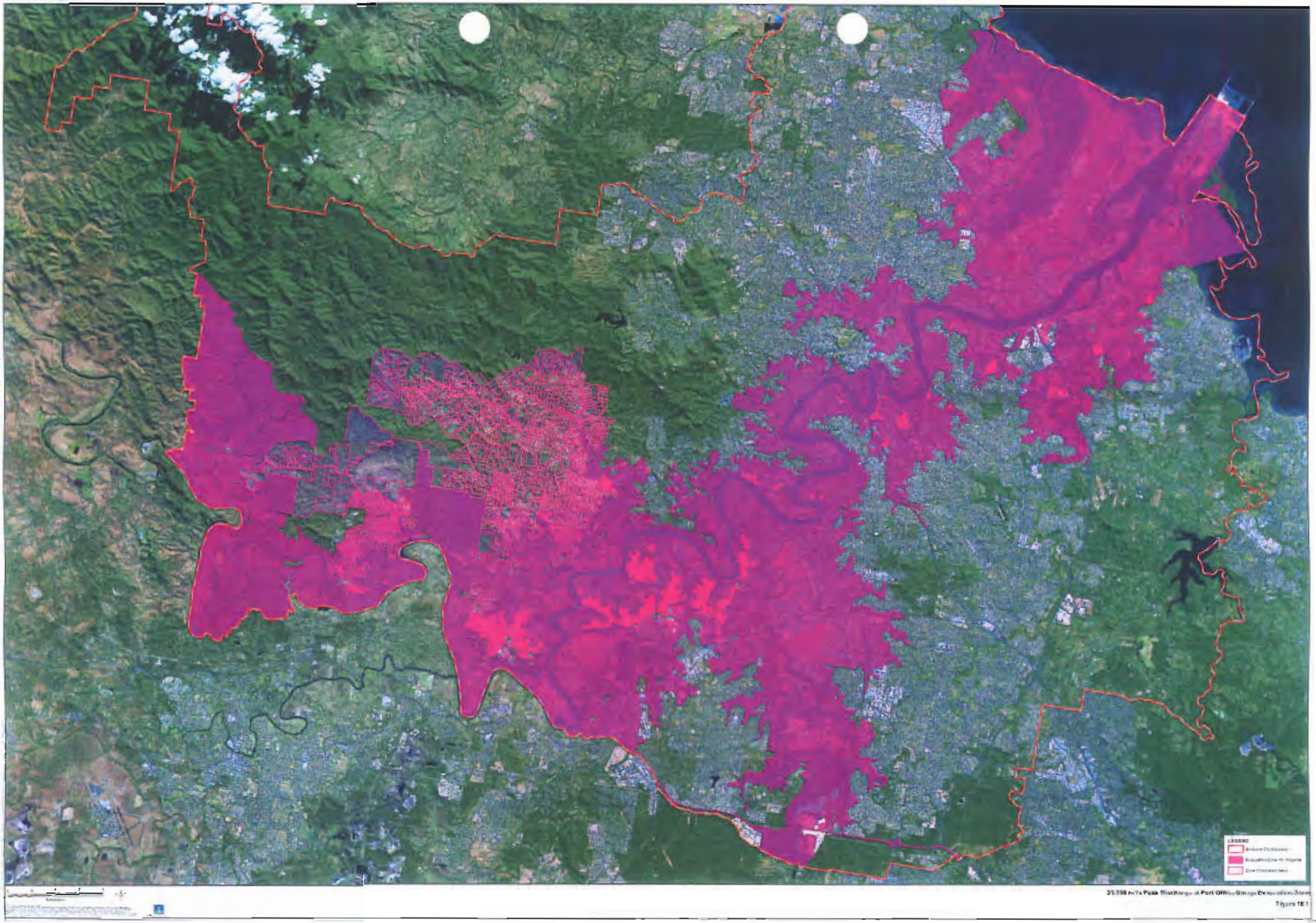
Figure 178



21,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - South

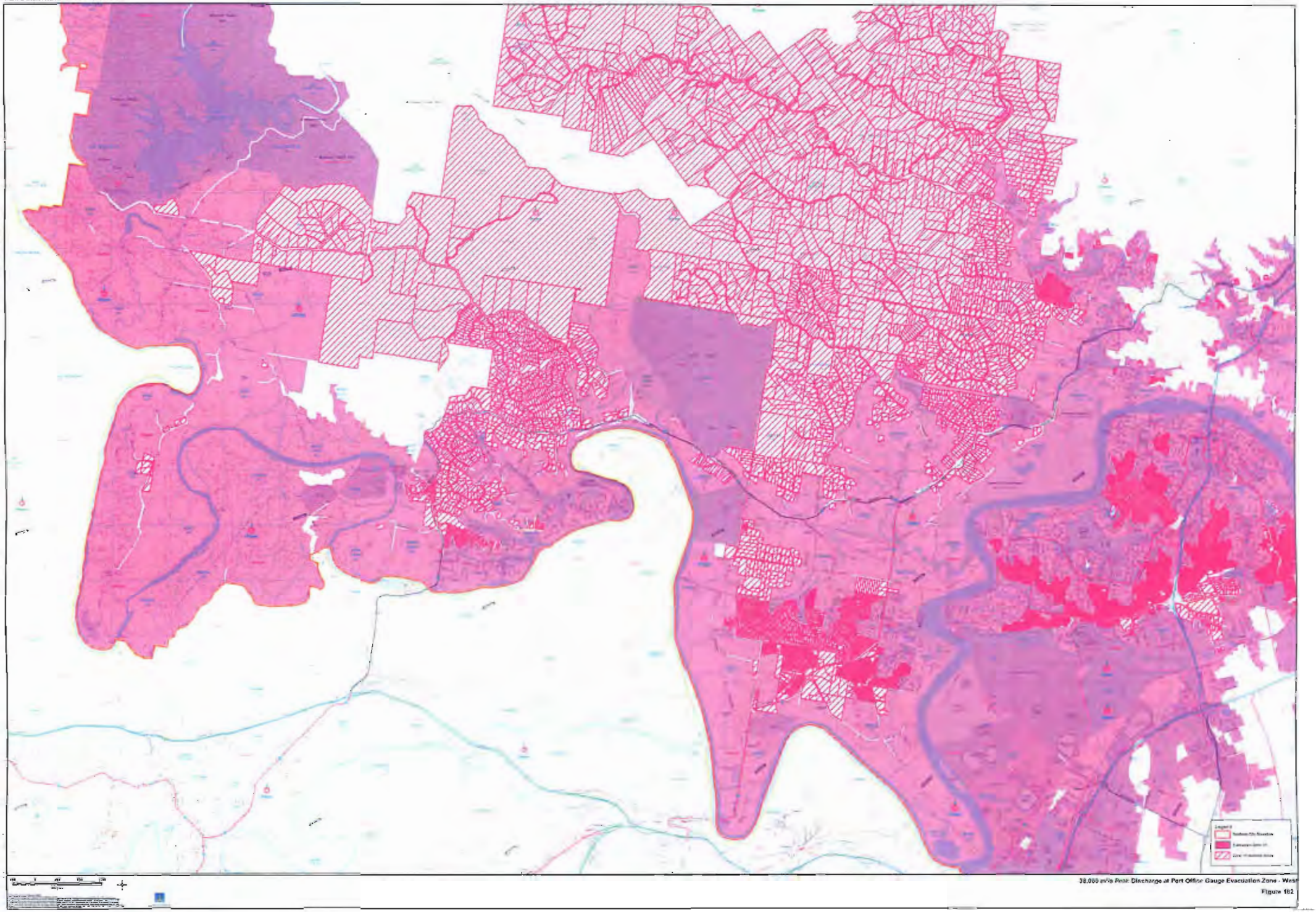
Figure 179


21,000 m³/s Peak Discharge at Port Allen Gauge Evacuation Zone - East
Figure: 180



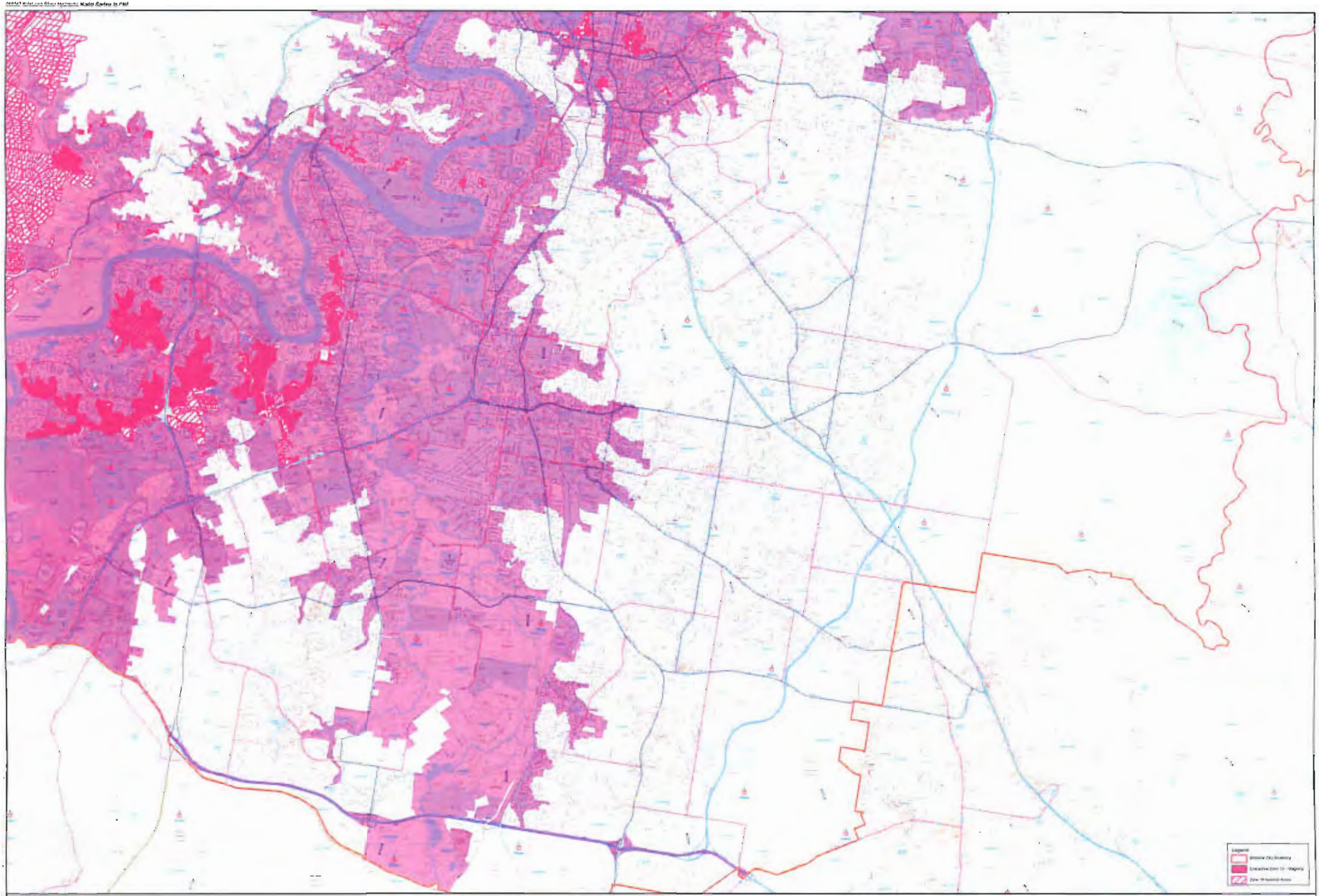
35,100 m³/s Peak Discharge at Port Office Gauge Extraction Zone

Figure 18.1



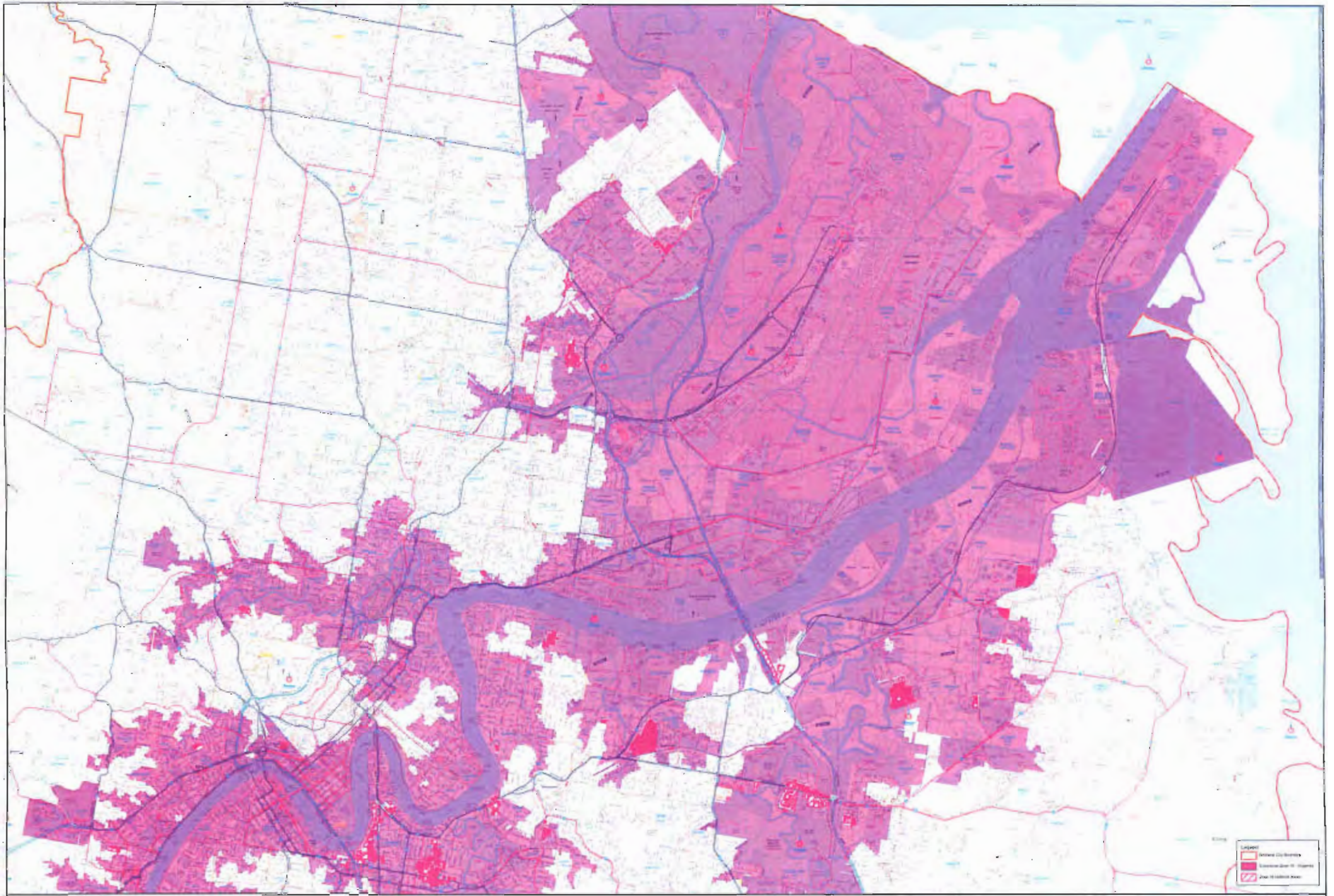
38,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - West

Figure 182



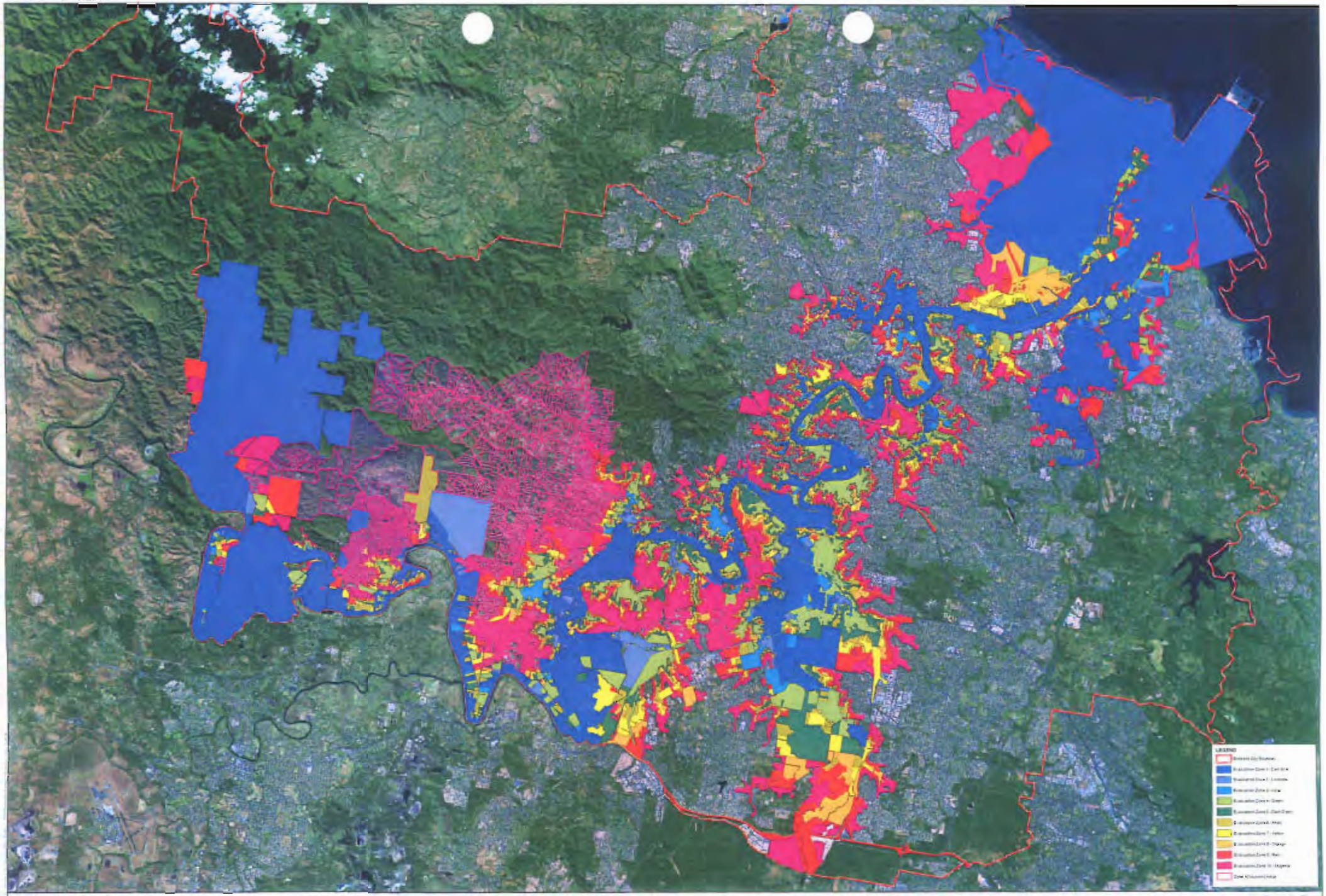
38,000 m³/s Peak Discharge at Port Gibson Gauge Evacuation Zone - South

Figure 183



38,000 m³/s Peak Discharge at Port Office Gauge Evacuation Zone - Case

Figure 184



All Evacuation Zones
Figure 155

activities that contribute to safer, sustainable communities better able to withstand the effects of natural disasters.

All three spheres of government provide funding under the NDMP (Natural Disaster Mitigation Program). Generally, the Australian Government contributes up to one third of approved project costs. State and Territory governments are required to match this funding. The individual funding contribution from each participating Local Government was calculated using current and future population projections to ensure an equitable distribution of project costs.

In February 2007, the Council submitted an application for funding under the Natural Disaster Mitigation Program (NDMP) 2007 – 2008 to the State Department of Emergency Services (DES) and the Commonwealth Department of Transport and Regional Services (DoTaRs) for the Brisbane River Hydraulic Model Review to Probable Maximum Flood (PMF) Project.

On 14 September 2007, Jude Munro, CEO, BCC, received written advice from the Hon Jim Lloyd MP, Minister for Local Government, Territories and Roads, that he had approved the application for Australian Government funding under the 2007-08 round of the NDMP. The Australian Government had approved $120,000 representing its third contribution to the overall Project cost of $360,000.

On 9 November 2007, Jude received written advice from [redacted] Director, Disaster Mitigation, Emergency Management Queensland (EMQ) from the Department of Emergency Services (DES) approving the State funding for the Project under the 2007-08 round of the NDMP. The total funding to be received by the State for the Project is $120,000.

On 15 January 2008, Jude received written advice from the DES that the Project Management Plan (PMP) had been approved and that the Funding Agreement was ready for her signature. On 30 January 2008, BCC executed the Funding Agreement and returned both signed copies to the DES for processing.

Appendix C Data

C1 Introduction

The data collection phase for this project was comprehensive and can be summarised as follows:

1. DTM Development
2. Hydrology Data
3. Recorded Data

Data was collected from various sources of government and across the private sector as follows:

Commonwealth:

- Bureau of Meteorology (BOM)
- CSIRO (Commonwealth Scientific and Industrial Research Organisation)

State Government:

- Department of Natural Resources and Water (DNRW)
- Port of Brisbane (POB)
- Sunwater
- Seqwater
- SEQ Catchments
- Maritime Safety Queensland

Local Government:

- Brisbane City Council (BCC)
- Ipswich (ICC)
- Somersert Regional Council (SRC)
- Logan City Council (LCC)

Private Sector:

- WRM Water and Environment P/L
- BMT WBM P/L

C2 Digital Terrain Model (DTM) Development

The collection of data and development of the DTM is a key task for this project. Data sources for the DTM include and are listed below and illustrated in Figure 3:

- Brisbane City Council – Airborne laser scanning (ALS) survey data (2002)
- Brisbane City Council – Brisbane River cross-sections (circa 1995)
- Ipswich City Council – ALS survey data (circa 2002)
- Port of Brisbane – Brisbane river channel bathymetry (1995-2009 depends on reach)

- Somerset Regional Council – ALS survey data 2008 undertaken for the Fernvale Lowood Flood Study (City Design, 2009)
- DNRW 5m Contours (circa 1980's)
- Port of Brisbane and BMT WBM P/L - Moreton Bay Data (chart data date unknown)
- NASA Shuttle Radar survey data (circa 2000)

The DTM has been developed on the best information available. Whilst every endeavour was made to construct a DTM representative of the river's bathymetry and floodplains, some areas have been identified as requiring a further improvement in accuracy. The Council expects to receive new ALS survey data in late 2009 that will be of a better vertical accuracy than the ALS data available for this study. Areas identified that would benefit from improved representation or will become available in the future include:

- Interpolation between bathymetry and ALS survey data sets in the inter-tidal zones
- Bathymetry of the Bremer River
- NASA Shuttle Radar (survey data extents are detailed in Figure 3)

Therefore it is highly recommended that the DTM and hydraulic model be updated upon receipt of this information.

The DTM was further analysed by 'sensitivity tests'. Refer to Section I9 for the results of these tests.

C3 Hydrology Data

1974 Calibration Event Data

The primary source of 1974 data was the 1994 Brisbane River and Pine Rivers Flood Study. These reports form part of the series of 27 reports produced for the South East Queensland Water Board (SEQWB) and are an integral part of this study. The reports utilised from this series include:

- Report 7A: Brisbane River Flood Hydrology
- Report 7B: Brisbane River Flood Hydrology
- Report 7C: Brisbane River Flood Hydrology
- Report 13: Brisbane River Flood Hydrology
- Report 19A: Brisbane River Flood Hydrology
- Report 19B: Brisbane River Flood Hydrology
- Report 23A: Brisbane River System Wivenhoe Dam – Moreton Bay Hydraulic Models
- Report 23B: Brisbane River System Wivenhoe Dam – Moreton Bay Hydraulic Models
- Report 23C: Brisbane River System Wivenhoe Dam – Moreton Bay Hydraulic Models
- Report 23D: Brisbane River System Wivenhoe Dam – Moreton Bay Hydraulic Models
- Report 23E: Brisbane River System Wivenhoe Dam – Moreton Bay Hydraulic Models

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In addition to the above, digital or electronic information from the 1994 flood study was collected as follows:

- WT42D 'hydrology model' (hydrology model for the 1974 event)
- WT42D 'hydrology model' 1974 rainfall files
- 'Rubicon Flows' spreadsheet obtained from Sunwater (26 June 2008)
- RUBICON 'hydraulic model' cross-sections
- 1974 survey spots levels
- 1974 coverages or inundation extents
- 1974 rating curve data
- Discharge hydrograph and water level hydrograph spreadsheet

Additional reports specifically collected for the 1974 event also include:

- Proceedings of Symposium, January 1974 Flood Moreton Region, The Institution of Engineers, Australia, Queensland Division, August 1974.

- Brisbane River Flood Investigations Final Report, Snowy Mountains Engineering Corporation November 1975.

1996 Calibration Event Data

The May 1996 flood event was utilised as a 'verification' event for this study. In contrast to the 1974 event where there was quite a collection of existing data and previous hydrology works undertaken, this was not the case for the 1996 event. Consequently a significant data collection and rainfall analysis exercise was required for this event.

Rainfall data was collected primarily from State and Commonwealth government agencies. The primary source of 1996 rainfall data was made available by the BOM for use in their URBS rainfall-runoff models for the Flood Warning Centre (FWC). This rainfall data formed the basis of a spatial analysis downstream of the Wivenhoe Dam supplemented where necessary with the Council's rainfall station records.

Since there was essentially no discharge from Wivenhoe Dam during the 1996 event (10 m^3/s), the contribution of rainfall falling upstream of the dam was ignored and collation of rainfall data was limited to downstream of the dam. This rainfall data was then spatially located so that a Thiessen (Voronoi) polygon analysis could be undertaken. Thiessen (Voronoi) polygons define individual areas of influence around each of a set of points (rainfall stations). They are mathematically defined by the perpendicular bisectors of the lines between all points.

In addition to the above, further 1996 event data was collected as follows:

- Miscellaneous data for the 1996 event from DNRW
- 1996 survey spots levels from DNRW
- 1996 BOM May 1996 Report

C4 Additional Data

In addition to the event-specific information for the 1996 and 1974 flood events, data was collected from a number of different sources to allow hydrologic and hydraulic modelling to be undertaken. This includes:

- Gauge location and gauge zero data from:
  - BOM - Index of Queensland River Height Stations: (http://www.bom.gov.au/hydro/flood/qld/networks/section3.shtml)
  - BOM - Queensland and Flood Warning River Height Stations- survey details (http://www.bom.gov.au/hydro/flood/qld/networks/section6.shtml)
  - DRNW - Queensland and Flood Warning River Height Stations- survey details (http://www.nrw.qld.gov.au/watershed/precomp/nf_tsi/143_bris.htm)
- Brisbane River Extreme Flood Estimation Study by WRM Water and Environment P/L, 2007 for the development of the Flood Profile Series
- ICC Reports
  - Ipswich Rivers Flood Studies – Phase One and Phase Two, 2007
  - Ipswich River Flood Studies – Phase Three Report, 2002.
  - Ipswich River Flood Study Rationalisation Project – Phase Three Report 2006.

Appendix D History of Brisbane River 1D Models

D1 1996-2000

Sinclair Knight Merz (SKM) originally developed the 1D MIKE11 model which was completed in 1998 as a component of the Brisbane River Flood Study. SKM subsequently extended the model in 2000 for the Ipswich Rivers Flood Study to include the lower reaches of the Bremer River and tributaries referred to as the Ipswich Rivers. The work was undertaken for Ipswich City Council (ICC).

During the study, many additional rivers and creeks were added to the hydraulic model. This model is referred to as the Ipswich Rivers model. These additional rivers/creeks changed the Brisbane River routing characteristics and as a consequence the model needed to be re-calibrated. Re-calibration was only performed within the Ipswich City Council boundary.

D2 2003-2004

Further work was required to re-calibrate the Ipswich Rivers model within the Brisbane City boundary. This work was undertaken in the later half of 2003 and completed in February 2004 and included input from an Expert Panel of Review (EPR) with in regard to the hydrology. The 1974 and 1955 flood events were used to calibrate the hydraulic model. These events were chosen because they provided an adequate calibration range so that the 1 in 100 year design event (estimated to be 6,000m^3/s) could be accurately modelled.

The EPR works constitute the latest calibrated 1D model for lower Brisbane River. This 2004 calibrated model of the Brisbane River is referred to as the 'SKM model'. It is calibrated to a maximum discharge of approximately 10,000 m^3/s corresponding to the 1974 flood event.

D3 2004-2005

In 2004, 2005 the Ipswich Rivers model was extended further by the Wivenhoe Alliance as part of the Wivenhoe Spillway Augmentation Study. The additional works included extending cross-sections and providing link branches in the lower reaches of the model. The primary focus of this work was the design of the dam with respect to the augmentation of the existing spillway to cater for the new discharge estimate of the PMF (Probable Maximum Flood) and its anticipated impact on downstream flood levels.

The Wivenhoe Alliance model represents the latest changes undertaken to the model, however the model is not calibrated nor the results verified against previous model results. The development of the Wivenhoe model occurred in stages by various organisations and has resulted in a range of alternative modelling techniques being adopted throughout the model. This has progressively contributed to a

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number of stability issues occurring within the model and the progressive reduction of the model time step in order to maintain numerical stability.

D4 Summary

As discussed in Sections D1-D3, the current Brisbane River hydraulic model is a one-dimensional (1D) MIKE11 model used for floodplain management purposes. This 1D model is only calibrated up to a maximum discharge of approximately 10,000m^3/s (1974 historical event) at the city gauge.

Due to the inherent characteristics of the 1D model (through its use of cross-sections) the modelling of extreme floods is not possible. This is because the schematisation of 1D flood model does not easily represent overland flow otherwise known as 'channel breakouts'. Furthermore the accuracy of these 'channel breakouts' (illustrated in Figure 4) if schematised using a 1D model can be questionable as they rely on the hydraulic modeller's interpretation of flood behaviour in the river.

Appendix E Scoping Exercise and Model Appraisal

E1 Introduction

Advances in computer technology primarily relating to speed of the 'microprocessor' otherwise known as the central processing unit (CPU) have allowed the conceptualisation of this project. Ten years ago it would not have been possible to develop a 2D 'mega' model for Brisbane River, however with the improvements in the CPU technology it is now possible.

Accordingly one of the first tasks of this project was to appraise the available modelling software and determine a suitable modelling platform. So in early 2008 a scoping exercise was undertaken. Two software packages were evaluated:

- MIKE21 (Council's existing 2D modelling platform)
- TUFLOW

In order to evaluate the software a 'test' model was developed. This involved developing a coarse digital terrain model (DTM) approximating the study area as defined in Section 9.0.

E2 MIKE21 'Test' Model

A MIKE21 'test' model was developed. The study area was not as large as that defined in Section 9.0. The MIKE21 model consisted of a 67.7 km (Easting length) by 38.4 km (Northing length). This represented a model calculation area of approximately 2600 square kilometres

The model set-up was as follows:

- PMF simulation
- 120 hr simulation time
- time-steps:
    - 1 second for 45m grid
    - 2 seconds for 90m grid
- 'tapered' boundaries were adopted at the top and bottom ends
- 'top-end' inflow and tailwater boundary conditions only
- constant Manning's n roughness and eddy viscosity were adopted for the model.
- model extents were limited to Teneriffe in order to provide a 'constrictive termination' (and therefore explaining the smaller study area extents)

E3 TUFLOW 'Test' Model

A TUFLOW 'test' model was also developed. The study area was as per that defined in Section 9.0. being an area approximately 83.4 km (Easting length) by 53.8 km (Northing length). The area used for model calculation purposes is 1800 square kilometres based on the approximate PMF inundation extents. In comparison to MIKE21 this is a 30% reduction in model calculation area.

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The model set-up was as follows:

- PMF simulation
- 150 hr simulation time
- time-steps:
  - 15 seconds for 45m grid
  - 20 seconds for 90m grid
- 'top-end' inflow and tailwater boundary conditions only
- constant Manning's n roughness were adopted for the model.
- model extends to Moreton Bay

The 30% reduction in the TUFLOW model calculation area (when compared to MIKE21) is counterbalanced by the 25% increase in simulation runtime. Therefore for comparative purposes an equivalent assessment has been achieved.

E4 CPU Time

The CPU processing time results of the 'test' models are presented in Table 5. The results indicated that TUFLOW is between 3-6 times faster than MIKE21 depending upon the grid resolution.

Table 5: Model CPU Processing Time

	CPU Processing Time (hrs)	
	MIKE21 (2600 km^2) (model simulation time: 120 hrs)	**TUFLOW (1800 km^2) (model simulation time: 150 hrs)**
90m grid	9.1	2.7
45m grid	93.8	14.7

E5 Assessment Criteria

The criteria for evaluation of the software for the scoping study included (detailed in Table 6):

- Model stability and speed
- Boundary set-up and stability
- Model flexibility and structures
- Availability of technical support
- Industry acceptance

Table 6: Comparison of MIKE21 and TUFLOW Software – Scoping Study Results

Criteria	Objective Assessment (Ranking 1-10)	
	MIKE21	TUFLOW
1. Model stability and speed	5	8
2. Boundary set-up and stability	5	8
3. Model flexibility and structures	6	8
4. Availability of technical support	8	8
5. Industry acceptance	8	8
Total	32	40

E6 Outcome

The development of a 2D 'mega' model for the Brisbane River required a scoping exercise and development of a 'test' model to appraise the available modelling platforms.

It was found that the TUFLOW model provided a superior processing speed and model stability when compared to MIKE21. In addition TUFLOW offered greater flexibility with regard to boundary set-up/definition and multiple 2D domains and structures.

As a result, after evaluating the best software available on the market in an objective manner, the outcome of the scoping study was that TUFLOW offered the superior modelling platform for this project.

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Appendix F Hydraulic Model Development

F1 Introduction

The initial development of the TUFLOW 2D hydraulic model involved:

- DTM development - evaluation and confirmation of available data sources
- Set-up of model area (active cells for model calculation)
- Set-up of boundary conditions (refer to Section F5)
- Base Manning's 'n' values (TUFLOW materials file)
- Additional base case items:
    - Set-up of arterial roads (BCC area only to allow extreme flood passage)
    - Set-up of arterial railways (BCC area only to allow extreme flood passage)
    - Set-up of 1D culverts layer in relation to items 5 and 6 above
    - Set-up of Central Business District (CBD) bridge structures

F2 DTM Development

The DTM development is covered in Appendix C.

F3 Grid Size

The initial development of the 2D TUFLOW model was undertaken primarily using 90m and 45m grids. Final model simulations used for the flood profiles series were undertaken using a 30m grid.

F4 Model Area

The model area (1700 km^2) used for calculation purposes is illustrated in Figure 5.

F5 Boundary Conditions

The boundary conditions for the hydraulic are categorised as follows:

1. Primary inflow boundary and tidal boundary conditions
2. 2D Source over Areas (otherwise referred to as SA's) or lateral inflows

Primary Inflows and Tidal Boundary Conditions

There are (6) six primary inflows and one (1) tidal boundary condition respectively in the model. These are illustrated in Figure 6 as inflow 'polylines' (mapinfo layer)

Table 7: Boundary Conditions

Primary Inflows and Tidal Inflow Boundary Condition (number)	
Upper Brisbane River	Wivenhoe or Middle Creek (for historical events before 1983) inflow (1)
Lockyer Creek	Lyons inflow (1)
Bremer River	Walloon, Amberley and Purga inflows (3)
Tidal	Bar (1)

The boundary conditions detailed in Table 7 above remain unchanged in number and location for both the calibration and design hydrology.

2D Source over Areas (SA's) - Lateral Inflows

The 2D SA's are TUFLOW layers defining the polygons of sub-catchment areas for applying a source (flow) directly onto 2D domains. The 2D SA's are based on the Brisbane River and Pine Rivers Study (1994) with minor modifications reflecting improvements in sub-catchment definition based on the latest survey information.

Refer to Table 8. Figure 7 and Figure 8 illustrate the calibration model and flood profile model SA's respectively.

Table 8: 2D Source over Areas – Lateral Inflows

Calibration Model (Sub-catchment level)		**Flood Profile Model (Sub-region level)**
1.SPR: Spring Creek	16. MIH; Mihi Creek	1.Savages
2.BUA: Buaraba Creek	17.KAD: Karana Downs	2.MtCrosby
3. PLA: Plain Creek	18. KAR: Karalee	3.Ipswich
4. LOW: Lower Lockyer	19. SIX; Six Mile Creek	4.Jindalee
5.VER: Vernor	20.WOO; Woogaroo Creek	5.PortOfficeGauge
6.ENG: New England Creek	21. WOL: Wolston Creek	6.Enoggera
7. BAN: Banks Creek	22. PUL; Pullen Pullen Creek	7.Bulimba
8.BLA: Black Snake Creek	23. MOG: Moggill Creek	8.Norman
9. SAN: Sandy Creek	24.OXL: Oxley Creek	
10. CAB: Cabbage Tree Creek (Lake Manchester)	25. CUB: Cubberla Creek	
	26. TOO: Toowong Creek	
11. UPM: Upper Mt Crosby	27. ENO: Enoggera Creek	
12.DEE: Deebing Creek	28. BUL: Bulimba Creek	
13.BUN: Bundamba Creek	29.NR1: Norman Creek Sub-area #1	
14.WUL: Wulkaraka Creek	30.NR2: Norman Creek Sub-area #2	
15. IRO: Ironpot Creek	31.NR3: Norman Creek Sub-area #3	

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F6 Manning's 'n' Values

Landcover data from SEQ Catchments was utilised to assign Manning's 'n' values and create a 'materials file' or roughness map in TUFLOW.

The landuse categories from this data set and associated Manning's 'n' value are detailed in Table 9.

Table 9: SEQ Catchments Landcover Data - Landuse Categories June 2008

SEQ Catchments – Landcover Data Categories	Adopted Manning's 'n' Values
1. Non-forest native vegetation	0.08
2. Non BUA- Non-vegetated	0.03
3. Grass	0.03
4.Sand / Mud Bank	0.025
5. Plantation	0.10
6. Water Body	0.025
7. Non Built Up Area (BUA)-Impervious road surface	0.02
8. Tree Crop	0.10
9. Native Forest	0.12
10. Ocean	0.02
11.Mine/Quarry	0.05
12. Irrigated Crop and Pasture	0.08
13. BUA - Non-vegetated	0.10
14. BUA - Impervious road surface	0.02
15. Canal	0.02
16. Natural Rock/Cliff	0.06
17.Dryland Crop	0.08
18. Blank	0.03

F7 Bridges

Only six (6) CBD bridge structures have been represented in the model to date; the reason being that the primary focus of this project is the development of maps for flood disaster and emergency response planning.

Accordingly the intent of this study was to use readily available data. Therefore bridge representation in the 2D model was limited to the CBD reach, aligning with the ***Northbank Flood Impact Analysis (NFIA) and Property Flood Damages Analysis (PFDA)*** undertaken in 2008.

In order to create a rigorous 'flood study' model of SEQ, it is then recommended that all major bridge structures are included in the model in the future. Such work is beyond the scope of this study.

Table 10 lists the CBD bridges 'coded' into TUFLOW for the calibration and flood profile model.

Table 10: Central Business District (CBD) Bridges

Bridge	Included in Calibration Model (1974 and 1996)	Included in Flood Profile Model
1. Merivale Bridge	Yes	Yes
2. William Jolly Bridge	Yes	Yes
3. Victoria Bridge	Yes	Yes
4. Goodwill Bridge	No (circa 2001)	Yes
5. Captain Cook Bridge	Yes	Yes
6. Story Bridge	Yes	Yes

In addition to the Northbank (2008) study, Table 11 contains details of 'as constructed drawings' and other data that was also used to code the bridges.

Table 11: As Constructed Drawings

Bridge	As Constructed Drawings and Other Data
1.Merivale Bridge	W5601
2.William Jolly Bridge	General Arrangement Drawings
3.Victoria Bridge	117888
4.Goodwill Bridge	Arup Memorandum and Drawings – dated 1999
5.Captain Cook Bridge	117408
6. Story Bridge	General Elevation Plan – 1935

Appendix G WT42D

G1 Overview

The computer program WT42D was written in September 1987 by Warren Shallcross, Surface Water Group, Water Resources Division. The program was written in Fortran on a Univac 1192 computer at the Centre for Information Technology and Communications (CITEC).

The object of the program is to simulate the non-linear runoff-routing model for flood estimation described by Mein, Laurenson and McMahon (1974). Program WT42 produces similar results to program WT87 although the internal setup is quite different. Further information can be found in the manual entitled:

Queensland Water Resources Commission
Water Resources Division
Surface Water
Hydrology Section

Computer Program WT42
Flood Estimation by Runoff Routing
Water Assessment Natural Resources and Mines
November 1987

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Appendix H 1974 Historical Event – Base Data

H1 Introduction

The basis of the 1974 hydrology used in this study is the ***Brisbane and Pine Rivers Flood Study*** (1994). Therefore the objective for this study was to adopt or reproduce the 1974 hydrology from the 1994 study. This is because a significant amount of work had been undertaken in 1994 on this event.

Initially it was hoped that the boundary conditions for the 1974 event could be traced to a spreadsheet and that these could be simply input into the 2D TUFLOW hydraulic model.

H2 'RubiconFlows' Spreadsheet

A spreadsheet was located in June 26, 2008 by the State and provided to City Design. It was called 'RubiconFlows' (Note: 'Rubicon' was tbe hydraulic model used in the 1994 flood study.) At that point in time the 'RubiconFlows' spreadsheet was assumed to be the basis of the 'calibration hydrology' for the 1994 flood study. It contained the following events (boundary conditions for 1994 Rubicon hydraulic model)

- February 1893
- July 1973
- January 1974
- April 'A' 1989
- April 'B' 1989

Closer inspection of the 'January 1974' event data contained within the 'RubiconFlows' spreadsheet indicated that of the required 37 boundary conditions (refer to Appendix F, Section F5 for a complete listing), only 31 were available with six missing. The six (6) missing 1974 boundary conditions included:

1. Wivenhoe
2. Lyons
3. Buaraba
4. Norman Creek sub-catchment 1
5. Norman Creek sub-catchment 2
6. Norman Creek sub-catchment 3

These were critical and therefore it was necessary to rerun the WT42D model to reproduce the missing boundary conditions.

H3 WT42D 1974 Calibration Model

Further data collection exercises were undertaken on the 22 September 2008 and 9 October 2008 with the State providing City Design with a working WT42D model and associated data for the 1974 event.

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The 'original' WT42D 1974 calibration model consisted of the following:

- batch file
- river catchment files 'rcf' and
- rainfall files (*.J74) - referring to January 1974.

Table 12: WT42D 1974 Batch File

	1974 RUN.BAT						
Executable	**River Catchment File**	**Rainfall**	**Delay Time**	**Storage Index**	**Initial Loss**	**Continuing Loss**	**Output Hydrograph**
WT42D	COO.RCF (Cooyar)	COO.J74	43.6	0.8	0	2.7	COO.HYD
WT42D	LIN.RCF (Linville)	LIN.J74	20.6	0.8	30	5.6	LIN.HYD
WT42D	EMU.RCF (Emu)	EMU.J74	37.2	0.8	5	3.5	EMU.HYD
WT42D	GRE.RCF (Gregors)	GRE.J74	20.1	0.8	10	0.1	GRE.HYD
WT42D	CRE.RCF (Cresbook)	CRE.J74	34.3	0.8	0	4	CRE.HYD
WT42D	SOM.RCF (Somerset)	SOM.J74	80.7	0.8	0	0.2	SOM.HYD
WT42D	MID.RCF (Middle)	MID.J74	108.5	0.8	0	5.2	MID.HYD
WT42D	HEL.RCF (Helidon)	HEL.J74	15	0.8	0	2.5	HEL.HYD
WT42D	TEN.RCF (Tenthill)	TEN.J74	19	0.8	0	2.5	TEN.HYD
WT42D	LYO.RCF (Lyons)	LYO.J74	75	0.8	0	2.5	LYO.HYD
WT42D	WAL.RCF (Walloon)	WAL.J74	44	0.8	0	2.5	WAL.HYD
WT42D	KAL.RCF (Kalbar)	KAL.J74	34	0.8	65	2.6	KAL.HYD
WT42D	AMB.RCF (Amberley)	AMB.J74	35	0.8	65	2.6	AMB.HYD
WT42D	PUR.RCF (Purga)	PUR.J74	49	0.8	30	2.1	PUR.HYD
WT42D	IPS.RCF (Ipswich)	IPS.J74	15.7	0.8	10	2	IPS.HYD
WT42D	SAV.RCF (Savages)	SAV.J74	45	0.8	20	3.5	SAV.HYD
WT42D	MTC.RCF (Mt Crosby)	MTC.J74	47	0.8	0	2.5	MTC.HYD
WT42D	JIN.RCF (Jindalee)	JIN.J74	20.8	0.8	10	2.6	JIN.HYD
WT42D	POG.RCF (Port Office Gauge)	POG.J74	19.3	0.8	10	2	POG.HYD

A review of the river catchment files or 'rcf' files listed above, indicates the model has been set-up at a regional level illustrated in Figure 10. Therefore, it was necessary to modify a number of the river catchment files to produce the localised sub-catchment inflows for each of the 37 boundary conditions. Specifically this would require 'print statements' being added to the following river catchment files:

- SAV.RCF (Savages)
- MTC.RCF (Mt Crosby)
- IPS.RCF (Ipswich)
- JIN.RCF (Jindalee)
- POG.RCF (Port Office Gauge)

These river catchment files predominantly refer to locations in the lower Brisbane River catchment and align with the hydraulic model study area extents as displayed in Figure 10. In addition to the above works river catchment files needed to be created for:

- ENO.RCF (Enoggera)
- BUL.RCF (Bulimba)
- NRM.RCF (Norman)

This was because the provided WT42D 1974 model terminated at Port Office Gauge.

H4 WT42D 1974 Verification Process

To ensure the consistency of results with the original model provided, a verification process was undertaken by City Design. The verification process included:

- Comparison of local hydrograph inflows (peak and shape) to the 'RubiconFlows' spreadsheet
- Comparison of regional hydrographs (peak and shape)

The verification process above confirmed that the discretisation of the original model into local inflows or the 37 boundary conditions had been undertaken successfully. As this process was quite involved a region by region analysis was undertaken as listed below.

Table 13: WT42D 1974 – Verification Process

River Catchment File	Print Statements Added	Final Results Simulation	Original Peak (m^3/s)	Verification Peak (m^3/s)	Verification Output Hydrograph
SAV#1.RCF (Savages)	6	'Run2'	6362	6369	SAV#1.HYD
MTC#1.RCF (Mt Crosby)	5	'Run2'	7033	7045	MTC#1.HYD
IPS#3.RCF (Ipswich)	5	'Run4'	4188	4292	IPS#3.HYD
JIN#J.RCF (Jindalee)	7	'Run2'	8278	8312	JIN#1.HYD
POG#1.RCF (Port Office Gauge)	3	'Run1'	9495	9495	POG#1.HYD

The peak values from the verification process outlined in Table 13 illustrate that the 'print statement' changes to the original 'rcf' files have made little difference to the total hydrograph values. In any case the local inflows and not the total hydrographs detailed in Table 13 were input to the hydraulic model as boundary conditions. These local hydrographs were plotted against the original 'RubiconFlows' spreadsheet and were generally verified as being a correct match or in the right order of magnitude.

In summary the checking process detailed above has provided suitable inputs for the purposes of this 1974 calibration exercise. Further details of this verification process (including local hydrograph graphical and peak comparisons) can be found in the project directory itself and extend beyond the scope of this report. The spreadsheet is located under the WT42D directory and is named: 'RubiconFlows_SW26June2008_WT42DRerunComparison'. Refer to Figure 11 for the directory layout.

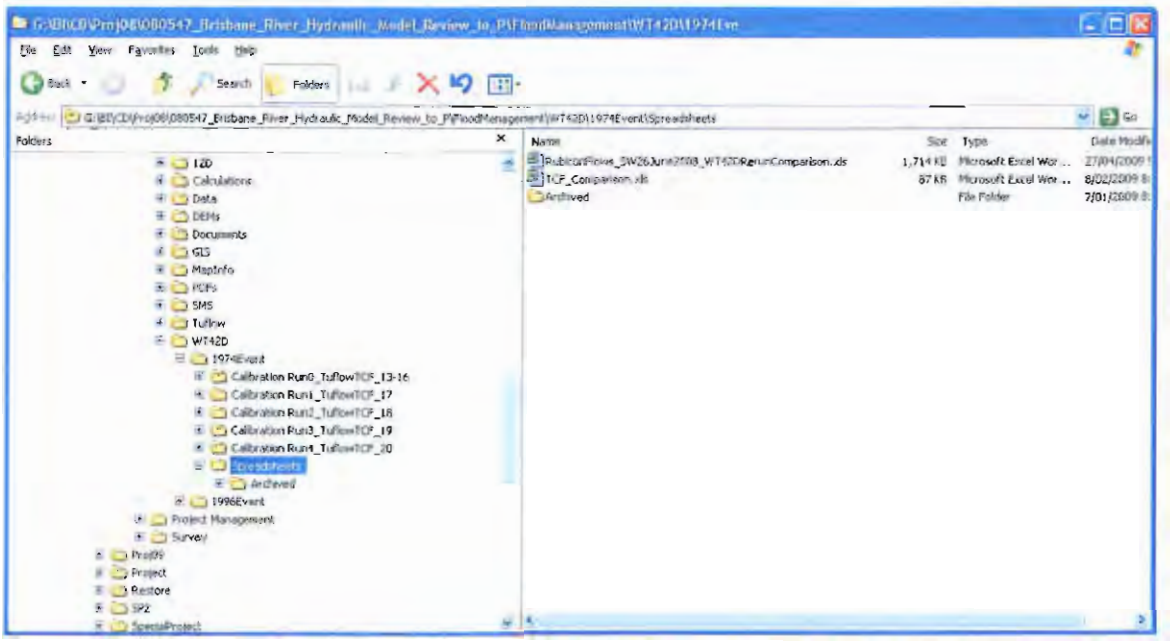

Figure 11: 'RubiconFlows' Spreadsheet Location

H5 Review of 1974 Primary Inflows

Once the verification process had been completed, a review of the primary inflows was undertaken as part of improving the model calibration. The primary inflows have been identified previously in Table 7 and comprise:

- Wivenhoe (Middle Creek)
- Lyons
- Walloon, Amberley and Purga

The review process above indicated that calculated inflows from the WT42D model had not been adopted in the 'RubiconFlows' spreadsheet. Instead it was determined that recorded or actual inflow

hydrographs (*.ACT) had been used at these locations and in the WT42D model computations, see Table 14. This was verified later following discussions with the State.

Table 14: WT42D 1974 – Comparison of Recorded and Calculated Peak Discharges

River Catchment File	WT42D Actual Hydrograph	WT42D Actual Peak (m^3/s)	Calculated Hydrograph	Calculated Peak (m^3/s)	Difference to Actual (%)
Wivenhoe	WIV.ACT	4813	WIV.HYD	5438	+13
Lyons	LYO.ACT	2075	LYO.HYD	2611	+26
Walloon	IPS.ACT	2920	WAL.HYD	1521	-52%
Amberley	PUR.ACT	1942	PUR.HYD	2272	+17
Purga	AMB.ACT	466	PUR.HYD	551	+18

The above table illustrates that there are significant differences between the recorded or actual hydrographs and those calculated hydrographs from the 1974 WT42D model particularly at Walloon and Lyons.

Further investigation and discussions with the State regarding these differences revealed that a significant amount of work had been undertaken during the Brisbane and Pine Rivers Flood Study (1994) for the 1974 flood event. The work was undertaken in order to resolve the complex floodplain characteristics of Lockyer Creek (where significant storage effects and two-dimensional flow characteristics are evident) as well as matching the timing of the flood flow through the Bremer River. Furthermore in both the Lockyer Creek and Bremer River systems gauge failures at O'Reilly's Weir and Walloon (143107A gauge overtopped) respectively complicated the calibration process.

In summary, previous work by the State involved supplementing the WT42D calculated outputs with recorded data (*.ACT hydrographs) at the five (5) primary inflow locations in order to achieve a better calibration. This explained why the 'RubiconFlows' spreadsheet contained both calculated and recorded inflow data. This finding as well as a number of 'hold point reviews' (detailed in Appendix K) led to significant works on the 1974 hydrology being undertaken as part of this study. The work was necessary in order to achieve a satisfactory calibration result. Refer to Appendix I for a description of the 1974 hydrology extension works undertaken as part of this project in order to improve the calibration of the model.

H6 Summary

Initially it was hoped that the boundary conditions for the 1974 event could be based on available data from the Brisbane and Pine Rivers Flood Study (1994). Upon a detailed review of the available information from the 1994 study and in consultation with the 'peer review team' further works were deemed necessary to achieve the objectives of this project. These works are detailed in Appendix I.

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Appendix I 1974 Historical Event – Extension Works

I1 Introduction

The 1974 'extension works' build upon the original 1974 hydrology from the Brisbane and Pine Rivers Flood Study (1994) and were undertaken in order to improve calibration of the model to the 1974 event. These works align with the scope of work in Section 5.1 and can be categorised as follows:

1. Coarse Calibration – 45m Grid
2. Detailed Calibration – 30m Grid

I2 Coarse Calibration Overview (45m Grid)

The coarse calibration works involved a number of hydrology scenarios for a TUFLOW 45m grid model. The 1974 hydrology scenarios investigated as part of this study are listed in Table 15 and discussed in detail in the following paragraphs.

Table 15: Coarse Calibration - 1974 Hydrology Scenarios

Description of Works and Simulation Name	Hydrology Description		Comments
	Five (5) Primary Inflows (Wiv, Lyo, Wal, Amb, Pur)	Lateral Inflows (31 locations)	
Phase 1: Initial Works			
TCF15a/b	Recorded ('*.act' files)	WT42D calc	Attempts to match 'RubiconsFlows.xls'
TCF16a/b	WT42D calc	WT42D calc	100% calculated from WT42D
Phase 2: Remove Rosevale Gauge			
TCF17a/b	WT42D calc	WT42D calc	Trial 1 of 4: Removal of the Rosevale gauge40183.
TCF18a/b	WT42D calc	WT42D calc	Trial 2 of 4
TCF19a/b	WT42D calc	WT42D calc	Trial 2 of 4
TCF20a/b	WT42D calc	WT42D calc	Trial 3 of 4
Phase 3: Incorporate Report 23E Inflows			
TCF21a/b	Report 23E primary inflows Wiv, Lyo, Wal, Amb & Pur	TCF20	Incorporates comments from State to digitise and adopt primary inflows from Report 23E
TCF22a/b	TCF20: Wiv & Lyo Report23E: Wal, Amb, Pur	TCF20	Incorporates a combination of TCF20 and Report 23E
TCF22a1/b1	TCF20: Wiv & Lyo Report23E: Wal, Amb, Pur	TCF20	Incorporates a combination of TCF20 and Report 23E Final DTM for study. **TCF22a1 – Final iteration for the 1974 historical event coarse (45m grid) calibration.**

Reference in Table 15 is made to TUFLOW control file (TCF) number and 'a' /'b' runs (Section I3)

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These scenarios comprised three key phases of work and are based on a number of key technical meetings, listed in Appendix K.

1. Initial Works
2. Rosevale Rainfall Gauge
3. Incorporate Report 23E(1994) primary boundary conditions inflows (five in total)

Phase One - Initial Works

The initial works involved reproduction of inflows matching the 'RubiconFlows' spreadsheet. Refer to Appendix H, Section H4 for further information. The initial works indicated that predicted values were lower than recorded (Section I4) so rather than embarking upon major changes to the hydraulic model the 'sensitivity' of the input hydrology was investigated through phases two and three.

Phase Two - Removal of the Rosevale Rainfall Gauge 40183

Following a technical meeting conducted on the 22 January 2009 (listed in Appendix K) and investigation into the rainfall used in the 'original' WT42D 1974 calibration model, it was found that there was likely to be an anomaly. This assertion was based on the rainfall distribution from Figure 5.8 from Report 7a (1994) which has been reproduced in Figure 12 and Figure 13 of this report. The anomaly relates to the Rosevale gauge.

Including the Rosevale gauge in the 'rainfall isohyets' as per Figure 5.8 Report 7a (1994) produces a significant reduction in the rainfall totals (for the 83 hour period) to less than 200mm. This is compared to rainfall totals in the adjacent regions of around 400 to 500mm. Therefore the purpose of this phase of works was to remove the 'influence' of the Rosevale gauge (TCF 17-20 in Table 15) by adjusting the rainfall totals at Helidon, Tenthill, Lyons and Walloon.

The original rainfall depths and final trial (TCF22) are illustrated in Figure 13 and Figure 14 respectively. Table 16 lists the comparison in peak calculated discharges.

Table 16: WT42D 1974 – Comparison of Calculated Peak Discharges

	WT42D Calculated Peak Discharge (m^3/s)				
River Catchment File	**Original**	**Trial 1 TCF17**	**Trial 2 TCF18**	**Trial 3 TCF19**	**Trial 4 TCF20**
Wivenhoe	5438	5438	5438	5438	5438
Lyons	2611	4969	3697	3463	3463
Walloon	1521	2128	2146	2439	2691
Amberley	2272	2272	2272	2272	2272
Purga	551	551	551	551	551

Phase Three – Report 23E (1994)

Following completion of phase two a hold point review meeting was conducted on the 5 February 2009 (detailed in Appendix K). The outcome of this meeting was:

1. Acceptance that the Rosevale gauge represented an anomaly in the data
2. The primary inflows used for calibration purposes should be based on Report 23E (1994).

Accordingly these hydrographs were digitised and supplemented the lateral inflow hydrographs from the phase two works. Further sensitivity analysis was also undertaken in this phase using a combination of Report23E and WT42D calculated primary inflows. Refer to Table 17, Figure 15 and Figure 16 which details the comparisons.

Table 17: Primary Inflow Comparison

	Primary Peak Discharge Comparions (m^3/s)			
River Catchment File	Original	TCF20 (Trial 4)	TCF 21 (Report 23E)	TCF22 (Combination of TCF 20 & Report 23E)
Wivenhoe	5438	5438	5108	5438
Lyons	2611	3463	3850	3463
Walloon	1521	2691	2251	2251
Amberley	2272	2272	2103	2103
Purga	551	551	495	495

I3 Coarse Calibration (45m Grid) Manning's 'n' Adjustments

The 'a' and 'b' naming convention (suffixes) in Table 15 refers to the calibration process where two sets of Manning's n values were investigated simultaneously for each scenario. No other adjustments to other categories were made. Refer to Table 18 for details of the adjustments. The 'Water Body' category represents the channel of the Brisbane River and has the most influence on flood levels.

Table 18: 1974 Coarse Hydrology Scenarios (45m Grid) -Suffixes

Naming Convention	SEQ Catchments Category	Coarse Calibration Manning's 'n' Values	Adjustment from base value in Table 9	Global adjustment to other Table 9 categories
'a'	6. Water Body	0.030	+0.005	None
'b'	6. Water Body	0.035	+0.010	None

I4 Coarse Calibration Results (45m Grid)

During the coarse calibration process results were compared to recorded 1974 data as follows:

1. Peak water levels
2. Water level hydrographs (for evaluation of timing and volume of hydrograph)
3. Rating curves
4. Discharge rating at Jindalee (January 1974 Floods Moreton Region, Engineers Australia, 1974) pp 46
5. 1974 recorded flood inundation extents and spot levels.

Comprehensive reporting of all iterations for the coarse calibration is beyond the scope of this report however a peak water level summary and peak rating comparison is provided in Table 21 and Table 22 respectively. The comparisons are made against Table 19 and Table 20 with gauge locations illustrated in Figure 17.

Table 19: 1974 Historical Event – Recorded Peak Water Level (m AHD)

Location and Gauge Reference	1974 Water Level
Lyons Bridge – BOM 040662/040740	64.07
Lowood – BOM 040441	45.70
Savages – NRW 143001C	42.25
Mt Crosby – NRW 143003A	26.69
Amberley (Warrill Creek) – NRW 143108A	28.69
Loamside (Purga Creek) – NRW 143113A	27.64
Walloon (Bremer River) - 143107A	27.96
Ipswich – BOM 040101	20.72
Moggill – BOM 040545/040812	19.93
Jindalee Bridge – BOM 040713	14.10
Port Office – DOT 040690	5.44
Brisbane Bar – BOM 040647/AWRC-143935	1.12

Table 20: 1974 Historical Event – Recorded Peak Rating (m^3/s)

Location	Rating
Jindalee	9514

Table 21: 1974 Historical Event – Coarse Calibration Results (45m Grid) Peak Water Level Comparison (m AHD)

Location	TCF 15a	TCF 15b	TCF 16a	TCF 16b	TCF 17a	TCF 17b	TCF 18a	TCF 18b	TCF 19a	TCF 19b	TCF 20a	TCF 20b	TCF 21a	TCF 21b	TCF 22a	TCF 22b	TCF 22a1	TCF 22b1
Lyons	62.70 (-1.37)	62.67 (-1.40)	63.25 (-0.82)	63.26 (-0.81)	64.73 (+0.66)	64.73 (+0.66)	64.18 (+0.11)	64.18 (+0.11)	64.05 (-0.02)	64.06 (-0.01)	64.06 (-0.01)	64.06 (-0.01)	64.28 (+0.21)	64.27 (+0.20)	64.06 (-0.01)	64.07 (0.00)	**64.12 (+0.05)**	64.12 (+0.05)
Lowood	44.13 (-1.57)	44.20 (-1.50)	44.85 (-0.86)	44.91 (-0.79)	46.37 (+0.67)	46.41 (+0.71)	45.63 (-0.07)	45.69 (-0.01)	45.45 (-0.26)	45.52 (-0.19)	45.45 (-0.26)	45.52 (-0.19)	45.57 (-0.13)	45.66 (-0.04)	45.45 (-0.25)	45.52 (-0.18)	**44.96 (-0.75)**	45.02 (-0.68)
Savages	41.05 (-1.20)	41.14 (-1.11)	41.90 (-0.35)	41.99 (-0.26)	44.01 (+1.76)	44.08 (+1.83)	42.85 (0.60)	42.93 (+0.68)	42.64 (+0.39)	42.71 (+0.46)	42.64 (+0.39)	42.71 (+0.46)	42.82 (+0.57)	42.90 (+0.65)	42.64 (+0.39)	42.72 (+0.47)	**41.73 (-0.52)**	41.82 (-0.43)
Mt Crosby	25.85 (-0.84)	26.02 (-0.67)	26.21 (-0.48)	26.34 (-0.35)	28.68 (+1.99)	28.85 (+2.16)	27.40 (+0.71)	27.54 (+0.85)	27.15 (+0.46)	27.32 (+0.63)	27.19 (+0.50)	27.35 (+0.66)	27.49 (+0.80)	27.64 (+0.95)	27.24 (+0.55)	27.41 (+0.72)	**26.45 (-0.24)**	26.60 (-0.09)
Amberley	29.29 (+0.60)	29.29 (+0.60)	29.49 (+0.80)	29.49 (+0.80)	29.50 (+0.82)	29.50 (+0.82)	29.51 (+0.82)	29.51 (+0.82)	29.51 (+0.82)	29.51 (+0.82)	29.52 (+0.83)	29.52 (+0.83)	29.36 (+0.67)	29.36 (+0.67)	29.36 (+0.67)	29.36 (+0.67)	**29.39 (+0.70)**	29.39 (+0.70)
Loamside	28.34 (+0.70)	28.34 (+0.70)	28.57 (+0.94)	28.57 (+0.94)	28.59 (+0.96)	28.59 (+0.96)	28.59 (+0.96)	28.60 (+0.96)	28.61 (+0.98)	28.61 (+0.98)	28.64 (+1.00)	28.64 (+1.00)	28.38 (+0.75)	28.38 (+0.75)	28.38 (+0.75)	28.38 (+0.75)	**28.31 (+0.68)**	28.31 (+0.68)
Walloon	28.13 (+0.17)	28.13 (+0.17)	27.00 (-0.96)	27.01 (-0.96)	27.55 (-0.41)	27.55 (-0.41)	27.56 (-0.40)	27.56 (-0.40)	27.78 (-0.18)	27.78 (-0.18)	27.94 (-0.03)	27.94 (-0.02)	27.57 (-0.39)	27.57 (-0.39)	27.57 (-0.39)	27.57 (-0.39)	**27.56 (-0.40)**	27.56 (-0.40)
Ipswich	22.25 (+1.53)	22.32 (+1.60)	20.57 (-0.15)	20.66 (-0.06)	21.26 (+0.54)	21.33 (+0.61)	21.27 (+0.55)	21.34 (+0.62)	21.58 (+0.86)	21.67 (+0.95)	21.85 (+1.13)	21.91 (+1.19)	20.98 (+0.26)	21.07 (+0.35)	21.06 (+0.34)	21.17 (+0.45)	**21.45 (+0.73)**	21.55 (+0.83)
Moggill	18.62 (-1.31)	18.94 (-0.99)	17.22 (-2.71)	17.56 (-2.37)	18.99 (-0.94)	19.31 (-0.62)	18.13 (-1.80)	18.48 (-1.45)	18.22 (-1.71)	18.55 (-1.39)	18.37 (-1.56)	18.69 (-1.24)	18.57 (-1.37)	18.91 (-1.02)	18.81 (-1.12)	19.16 (-0.77)	**18.99 (-0.95)**	19.33 (-0.60)
Jindalee	13.26 (-0.84)	13.66 (-0.44)	12.06 (-2.04)	12.48 (-1.62)	13.54 (-0.56)	13.86 (-0.24)	12.86 (-1.24)	13.24 (-0.86)	12.93 (-1.17)	13.30 (-0.80)	13.04 (-1.06)	13.43 (-0.67)	13.17 (-0.93)	13.59 (-0.51)	13.33 (-0.77)	13.73 (-0.37)	**13.37 (-0.73)**	13.75 (-0.35)
Port Office	5.51 (+0.07)	5.94 (+0.50)	4.79 (-0.65)	5.22 (-0.22)	5.54 (0.10)	6.03 (+0.59)	5.23 (-0.22)	5.59 (+0.15)	5.28 (-0.16)	5.61 (+0.17)	5.35 (-0.09)	5.70 (+0.26)	5.36 (-0.08)	5.79 (+0.35)	5.45 (+0.01)	5.91 (+0.47)	**5.44 (0.00)**	5.89 (+0.45)
Bar	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	**1.12 (0.00)**	1.12 (0.00)

Table 22: 1974 Historical Event – Coarse Calibration Results (45m Grid) Peak Rating Comparison (m^3/s)

Location	TCF 15a	TCF 15b	TCF 16a	TCF 16b	TCF 17a	TCF 17b	TCF 18a	TCF 18b	TCF 19a	TCF 19b	TCF 20a	TCF 20b	TCF 21a	TCF 21b	TCF 22a	TCF 22b	TCF 22a1	TCF 22b1
Jindalee	9150 (-364)	9102 (-412)	8156 (-1358)	8080 (-1434)	9490 (-24)	9376 (-138)	8838 (-676)	8748 (-766)	8901 (-613)	8789 (-725)	8995 (-519	8911 (-603)	9157 (-357)	9089 (-425)	9346 (-168)	9287 (-227)	**9452 (-62)**	9350 (-164)

I5 Detailed Calibration Overview (30m Grid)

The detailed calibration works builds upon the coarse calibration Phase 3 'hydrology works' detailed in Sections I1-I4. These are detailed in Table 23.

Table 23: Detailed Calibration - 1974 Hydrology Scenarios

Description of Works and Simulation Name	Hydrology Description		Comments
	Five (5) Primary Inflows (Wiv, Lyo, Wal, Amb, Pur)	Lateral Inflows (31 locations)	
TCF22a/b	TCF20: Wiv & Lyo Report23E: Wal, Amb, Pur	TCF20	Incorporates a combination of TCF20 and Report 23E
TCF22a1/b1	TCF20: Wiv & Lyo Report23E: Wal, Amb, Pur	TCF20	Incorporates a combination of TCF20 and Report 23E Final DTM for study.
TCF23a/b/c/d	TCF20: Wiv & Lyo Report23E: Wal, Amb, Pur	TCF20	Incorporates a combination of TCF20 and Report 23E Final DTM for study. **TCF23d – Final iteration for the 1974 historical event detailed (30m grid) calibration.**

I6 Detailed Calibration (30m Grid) Manning's 'n' Adjustments

The Manning's 'n' adjustments used for the 30m grid modelling are listed in Table 24 and Table 25 according to the two simulation iterations being TCF22 and TCF23, respectively. The adjustments relate to the original set of Manning's 'n' values detailed in Table 9 (Section F6).

Table 24: 1974 Detailed Hydrology Scenarios (30m Grid) – TCF 22 Suffixes

Naming Convention	SEQ Catchments Category	Coarse Calibration Manning's 'n' Values	Adjustment from base value in Table 9	Global adjustment to other Table 9 categories
'a'	6. Water Body	0.030	+0.005	None
'b'	6. Water Body	0.035	+0.010	None

Table 25: 1974 Detailed Hydrology Scenarios (30m Grid) –TCF23 Suffixes

Naming Convention	SEQ Catchments Category	Coarse Calibration Manning's 'n' Values	Adjustment from base value in Table 9	Global adjustment to other Table 9 categories
'a'	6. Water Body	0.0275	+0.0025	+0.0025
'b'	6. Water Body	0.030	+0.005	+0.0050
'c'	6. Water Body	0.0325	+0.0075	+0.0025
'd'	6. Water Body	0.035	+0.010	+0.0025

I7 Detailed Calibration Results (30m Grid)

Criteria from Section I4 were also used to evaluate the detailed calibration results as follows:

1. Peak water levels: As per section I4 a peak water level summary and peak rating comparison is provided in Table 26 and Table 27 respectively (for all detailed calibration iterations).

2. Water level hydrographs: Figure 18 to Figure 29 (TCF23d)

3. Rating curves: Figure 30 to Figure 40 (TCF23d)

4. Discharge rating: Figure 40 (TCF23d)

5. 1974 flood inundation extents and spot levels: Figure 42 to Figure 46 (TCF23d).

I8 Rating Curve Data

Rating curve data for the comparison detailed above was provided by:

- Sunwater
- BOM and
- NRW.

Table 26: 1974 Historical Event – Detailed Calibration Results (30m Grid) Peak Water Level Comparison (m AHD)

Location	TCF 22a	TCF 22b	TCF 22a1	TCF 22b1	TCF 23a	TCF 23b	TCF 23c	TCF 23d
Lyons	64.06 (-0.01)	64.06 (-0.01)	64.06 (-0.01)	64.07 (0.00)	64.11 (+0.04)	64.15 (+0.08)	64.11 (+0.04)	**64.11 (+0.04)**
Lowood	45.23 (-0.47)	45.31 (-0.39)	44.75 (-0.95)	44.85 (-0.85)	44.88 (-0.83)	45.05 (-0.65)	44.95 (-0.75)	**44.99 (-0.72)**
Savages	42.43 (+0.18)	42.52 (+0.27)	41.49 (-0.76)	41.57 (-0.68)	41.64 (-0.61)	41.86 (-0.39)	41.72 (-0.53)	**41.76 (-0.49)**
Mt Crosby	26.78 (+0.09)	26.95 (+0.26)	26.18 (-0.51)	26.38 (-0.31)	26.21 (-0.48)	26.43 (-0.26)	26.40 (-0.29)	**26.49 (-0.20)**
Amberley	29.46 (+0.77)	29.46 (+0.77)	29.46 (+0.77)	29.46 (+0.77)	29.51 (+0.82)	29.55 (+0.87)	29.51 (+0.82)	**29.51 (+0.82)**
Loamside	28.23 (+0.59)	28.23 (+0.59)	28.23 (+0.59)	28.23 (+0.59)	28.26 (+0.62)	28.29 (+0.65)	28.26 (+0.62)	**28.26 (+0.62)**
Walloon	27.54 (-0.43)	27.54 (-0.42)	27.54 (-0.42)	27.54 (-0.42)	27.60 (-0.36)	27.67 (-0.30)	27.60 (-0.36)	**27.61 (-0.36)**
Ipswich	21.28 (+0.56)	21.45 (+0.73)	21.54 (+0.82)	21.70 (+0.98)	21.43 (0.71)	21.68 (+0.96)	21.33 (+0.61)	**21.70 (+0.98)**
Moggill	18.28 (-1.65)	18.69 (-1.24)	18.40 (-1.53)	18.81 (-1.12)	18.22 (-1.71)	18.48 (-1.45)	18.65 (-1.28)	**18.84 (-1.09)**
Jindalee	12.71 (-1.39)	13.21 (-0.89)	12.75 (-1.35)	13.26 (-0.84)	12.49 (-1.61)	12.76 (-1.34)	13.02 (-1.08)	**13.26 (-0.84)**
Port Office	4.91 (-0.53)	5.47 (+0.02)	4.94 (-0.51)	5.46 (+0.02)	4.69 (-0.75)	4.93 (-0.51)	5.19 (-0.25)	**5.45 (+0.01)**
Bar	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	1.12 (0.00)	**1.12 (0.00)**

Table 27: 1974 Historical Event – Detailed Calibration Results (30m Grid) Peak Rating Comparison (m^3/s)

Location	TCF 22a	TCF 22b	TCF 22a1	TCF 22b1	TCF 23a	TCF 23b	TCF 23c	TCF 23d
Jindalee	9567 (+53)	9481 (-33)	9657 (+143)	9584 (+70)	9652 (+138)	9547 (+33)	9557 (+43)	**9528 (+14)**

I9 Sensitivity Analysis

Sensitivity analyses were undertaken using the 1974 final calibration run (TCF23d). The sensitivity tests were completed after the calibration of the model and the flood profile series. Two scenarios were investigated (see Table 28) based on uncertainties in the DTM data as discussed in Section C2:

1. Remove 'Dredge Holes'
2. Remove 'Smoothing Algorithms'

Accordingly the purpose of these sensitivity analyses was to determine the influence of each scenario on the calibration process, particularly Manning's n values.

Table 28: Detailed Calibration - 1974 Sensitivity Analysis

Description of Works and Simulation Name	Hydrology Description		Comments
	Five (5) Primary Inflows (Wiv, Lyo, Wal, Amb, Pur)	Lateral Inflows (31 locations)	
ST01_023d (30m and 45m grids)	TCF20: Wiv & Lyo Report23E: Wal, Amb, Pur	TCF20	Incorporates a combination of TCF20 and Report 23E Final DTM for Study Sensitivity Test 01: Removes 'dredge holes' from the bathymetry in order to determine the effect of dredging on the Brisbane River during the 1970s
ST02_023d (30m and 45m grids)	TCF20: Wiv & Lyo Report23E: Wal, Amb, Pur	TCF20	Incorporates a combination of TCF20 and Report 23E Final DTM for study. Sensitivity Test 02: Removes smoothing algorithm applied to the lower Brisbane River reach due to poor DTM data along river bounds.

The results of the sensitivity analysis or sensitivity tests ST01 and ST02 are presented in Table 29.

ST01- Sensitivity Test 01 - Remove Dredge Holes

The results indicate that removing the influence of dredge holes (filling them) could account for significant calibration differences at the Jindalee and Moggill gauges (refer to Table 26) and to a lesser extent the Ipswich gauge for the 1974 calibration event.

The sensitivity results suggest the dredging undertaken from the 1970's to the 1990's in the lower Brisbane River reach (downstream of the Bremer River confluence to the City gauge) would reduce flood levels by around 200mm to 600mm if a comparative 1974 event were to occur again. This would also explain the slightly higher Manning's 'n' values adopted during the calibration process.

ST02- Sensitivity Test 02 - Remove Smoothing Algorithm

The results indicate that removing the smoothing algorithm (TUFLOW model function) will generally reduce results in the lower Brisbane River reach by 50mm to 250mm. The use of the smoothing algorithm which was utilised to remove the deficiencies in the DTM, would again also help explain the need for slightly higher Manning's n values for the 1974 calibration.

Summary

Due to time constraints the results of both sensitivity tests could not be used for the final flood profile series model runs however it is recommended that these results be incorporated into any future recalibration works, particularly the removal of the smoothing algorithm.

Table 29: 1974 Historical Event – Sensitivity Results (30m Grid) Peak Water Level Comparison (m AHD)

Location	TCF 23d	ST01 23d	ST02 23d
Lyons	64.11	64.11 (0.00)	64.11 (0.00)
Lowood	44.99	44.99 (0.00)	44.99 (0.00)
Savages	41.76	41.76 (0.00)	41.76 (0.00)
Mt Crosby	26.49	26.63 (+0.14)	26.57 (+0.08)
Amberley	29.51	29.51 (0.00)	29.51 (0.00)
Loamside	28.26	28.26 (0.00)	28.26 (0.00)
Walloon	27.61	27.61 (0.00)	27.61 (0.00)
Ipswich	21.70	21.83 (+0.13)	21.48 (-0.22)
Moggill	18.84	19.37 (+0.53)	19.09 (+0.25)
Jindalee	13.26	13.86 (+0.59)	13.42 (+0.16)
Port Office	5.45	5.65 (+0.20)	5.49 (+0.04)
Bar	1.12	1.12 (0.00)	1.12 (0.00)

Appendix J 1996 Historical Event

J1 Introduction

The May 1996 event was used as a 'verification event' and was not a significant flooding event in regard to Brisbane River and the operation of the Wivenhoe Dam. However, the 1996 flooding in the Lockyer and Laidley Creeks was significant, in fact the worst recorded since 1974.

J2 WT42D 1996 Calibration Model

The WT42D models for the 1996 event were collected from:

- Sunwater
- WRM Water and Environment P/L

The 1996 WT42D model includes relevant changes to the Savages Crossing subregion due to the inclusion of Wivenhoe dam and minor differences in the Ipswich subregion when compared to the 1974 WT42D model. A comparison was undertaken between the two model sets supplied above. From this comparison a 1996 'verification event' model was developed and the following works undertaken:

1. Coarse Calibration – 45m Grid
2. Detailed Calibration – 30m Grid

J3 Coarse Calibration Overview (45m Grid)

The coarse calibration works involved the following hydrology scenarios. These scenarios are linked to the 1974 calibration process and are listed in Table 30.

Table 30: Coarse Calibration - 1996 Hydrology Scenarios

Description of Works and Simulation Name	Hydrology Description	Comments
Phase 1: Initial Works		
TCF15a/b	WT42D calc	Initial attempt of 1996 calibration
Phase 2: Final Run		
TCF15a1	WT42D calc	Final 1996 run for coarse calibration. Adopts Manning's n 'a' adjustments as per Table 18 (as per 1974 calibration) and utilises final DTM

Reference in Table 30 is made to TUFLOW control file (TCF) number and 'a'/'b' runs consistent with Appendix I, Section I3.

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J4 Coarse Calibration Results (45m Grid)

During the coarse calibration process results were compared to recorded 1996 data as follows:

1. Peak water levels
2. Water level hydrographs (for evaluation of timing and volume of hydrograph)
3. 1996 flood inundation extents and spot levels.

Comprehensive reporting of all iterations for the coarse calibration is beyond the scope of this report however a peak water level summary is provided in Table 32 and comparisons made against Table 31 with gauge locations illustrated in Figure 17.

Table 31: 1996 Historical Event – Recorded Peak Water Level (m AHD)

Location and Gauge Reference	1996 Water Level
Lyons Bridge – DNR40662/040740	63.93
Rifle Range Road – NRW143210B	60.84
O'Reilly's Weir – NRW 143207A	39.47
Wivenhoe Tailwater – NRW143035A	37.05
Lowood – BOM 040441	34.99
Savages – NRW 143001C	31.07
Mt Crosby – NRW 143003A	14.10
Amberley (Warrill Creek) – NRW 143108A	25.18
Loamside (Purga Creek) – NRW 143113A	26.47
Walloon (Bremer River) - 143107A	25.64
Three Mile Bridge- BOM 040838	21.04
Ipswich – BOM 040101	11.29
Moggill – BOM 040545/040812	7.10
Jindalee Bridge – BOM 040713	4.55
Port Office – DOT 040690	2.00
Brisbane Bar – BOM 040647/AWRC-143935	1.29

Table 32: 1996 Historical Event – Coarse Calibration Results (45m Grid) Peak Water Level Comparison (m AHD)

Location	TCF 15a	TCF 15b	TCF 15a1
Lyons	60.56 (-3.37)	60.56 (-3.37)	61.17 (-2.76)
Rifle Range	58.27 (-2.57)	58.27 (-2.57)	58.93 (-1.91)
O'Reilly's	39.35 (-0.13)	39.37 (-0.10)	38.89 (-0.58)
Wivenhoe TW	36.48 (-0.57)	36.58 (-0.47)	35.60 (-1.45)
Lowood	34.04 (-0.95)	34.15 (-0.84)	33.16 (-1.83)
Savages	31.51 (+0.44)	31.60 (+0.53)	30.16 (-0.91)
Mt Crosby	18.16 (4.06)	18.22 (+4.12)	15.10 (+1.00)
Amberley	26.48 (+1.30)	26.48 (+1.30)	26.61 (+1.43)
Loamside	26.82 (+0.36)	26.82 (+0.36)	26.71 (+0.25)
Walloon	25.37 (-0.27)	25.37 (-0.27)	25.34 (-0.30)
Three Mile	20.78 (-0.26)	20.79 (-0.25)	20.84 (-0.20)
Ipswich	15.03 (+3.74)	15.09 (+3.80)	15.65 (+4.36)
Moggill	6.94 (-0.16)	7.38 (+0.28)	7.01 (-0.09)
Jindalee	4.01 (-0.54)	4.31 (-0.24)	3.93 (-0.62)
Port Office	1.84 (-0.16)	1.93 (-0.07)	1.89 (-0.11)
Bar	1.30 (+0.01)	1.30 (+0.01)	1.30 (+0.01)

J5 Detailed Calibration Overview (30m Grid)

The detailed calibration works builds upon the coarse calibration Phase 3 'hydrology works' detailed in Sections I1-I4. Refer to Table 33 for a description of works.

Table 33: Detailed Calibration - 1996 Hydrology Scenarios

Description of Works and Simulation Name	Hydrology Description	Comments
TCF23d	WT42D calc	First & final 1996 run for detailed calibration. Adopts Manning's n 'a' adjustments as per Table 25 (as per 1974 calibration) and utilises final DTM

Reference in Table 33 is made to TUFLOW control file (TCF) number 'd' runs consistent with Appendix I, Section I6.

J6 Detailed Calibration Results (30m Grid)

Criteria from Section I4 were also used to evaluate the detailed calibration results as follows:

1. Peak Water Level: As per section I4 a peak water level summary is provided in Table 34 (for all detailed calibration iterations).

2. Water Level hydrographs: Figure 47to Figure 62

3. 1996 Flood Inundation Extents and Spot Levels: Figure 63 to **Error! Reference source not found.** (TCF23d)

Table 34: 1996 Historical Event – Detailed Calibration Results (30m Grid) Peak Water Level Comparison (m AHD)

Location	TCF 23d
Lyons	60.52 (-3.40)
Rifle Range	57.66 (-3.18)
O'Reilly's	38.66 (-0.82)
Wivenhoe TW	35.49 (-1.56)
Lowood	33.11 (-1.88)
Savages	30.05 (-1.01)
Mt Crosby	15.05 (+0.95)
Amberley	26.55 (+1.37)
Loamside	26.55 (+0.09)
Walloon	25.28 (-0.36)
Three Mile	20.86 (-0.18)
Ipswich	15.64 (+4.35)
Moggill	7.18 (+0.08)
Jindalee	4.18 (-0.37)
Port Office	1.90 (-0.10)
Bar	1.30 (+0.01)

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Appendix K Key Stakeholder Meetings

Meeting Type	Date	Meeting Description	Attendees List
PCG	6 Jun. 2008	Project Inception	PCG and TWG (refer to Table 2 for the list of attendees)
TWG	12 Dec. 2008	Technical Review	TWG
TM	22 Jan. 2009	1974 Calibration Review	[redacted] & James Charalambous.
TM	2 Feb. 2009	1974 Calibration Review (Discuss 'RubiconFlows' spreadsheet)	John Ruffini & James Charalambous.
TM	4 Feb. 2009	1974 Calibration Review (Discuss 'RubiconFlows' spreadsheet)	Rob Ayre & James Charalambous.
TM	5 Feb. 2009	1974 Calibration Review	[redacted] & James Charalambous.
Hold Point Review 1	11 Feb. 2009	1974 Calibration Review	[redacted] Greg Roads, John Ruffini, Rob Ayre, Ken Morris, [redacted] and James Charalambous
Hold Point Review 2	18 Feb. 2009	1974 Calibration Review	[redacted] Greg Roads, John Ruffini, Rob Ayre, Ken Morris, [redacted] and James Charalambous
PCG	5 Mar. 2009	Calibration Sign-off	PCG and TWG
PCG	11 Jun. 2009	Project Deliverables and Completion	PCG and TWG

Project Control Group, Technical Working Group; TM: Technical Meeting

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Appendix L Response Tools Scoping

Meeting Type	Date	Meeting Description	Attendees List
RTSM1	18 Dec 2008	Flood Response Tools	[redacted] Ken Morris, Evan Caswell [redacted] and James Charalambous
RTSM2	14 Jan 2009	Flood Response Tools	[redacted] and James Charalambous
RTSM3	22 Jan 2009	Flood Response Tools	[redacted] Ken Morris, Evan Caswell, [redacted] Peter Murray and James Charalambous
RTSM4	5 Feb. 2009	Flood Response Tools	[redacted] Ken Morris, Evan Caswell, [redacted] and James Charalambous
RTSM5	18 Feb. 2009	Flood Response Tools	[redacted] Ken Morris, Evan Caswell, [redacted] and James Charalambous
RTSM6	26 Mar. 2009	Flood Response Tools	[redacted], and James Charalambous
RTSM7	22 Apr 2009	Flood Response Tools	[redacted] Evan Caswell, [redacted] and James Charalambous
RTSM8	12 May 2009	Flood Response Tools	[redacted] Evan Caswell [redacted] and James Charalambous
RTSM9	26 May 2009	Flood Response Tools	[redacted] James Charalambous
RTSM10	9 June 2009	Flood Response Tools	[redacted] and James Charalambous

RTSM: Response tools scoping meeting

MJR-15

BCC.006.0030

Review of

BRISBANE RIVER FLOOD STUDY

Report to Brisbane City Council

Independent Review Panel

Russell Mein (Chair), Colin Apelt, John Macintosh, Erwin Weinmann

3 September 2003

BCC.006.0010

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Executive Summary

This review was commissioned by the Brisbane City Council, so as to obtain independent and expert advice as to 'whether the August 2003 estimates of the Q100 flow and level at the Brisbane Port Office are reasonable'. [Q100 designates the peak discharge that can be expected to be equalled or exceeded once every 100 years on average].

In the conduct of the review, the Panel had two presentation/discussion sessions with representatives of the prime consultant (Sinclair Knight Merz), City Design, and the Department of Natural Resources and Mines (one session). Two draft reports (SKM, dated 8 and 28 August 2003, respectively) with the latest estimates of the Q100 values were the key documents.

It should be stated at the outset that the estimation of Q100 for a catchment of this size (nearly 14000 sq. km) is a challenging task. The extreme variability of rainfall, the change in catchment response due to the construction of dams, and the variable conditions in the tidal section of the river, are some of the factors which complicate the application of 'standard' flood methodologies. The advent of new techniques for flood frequency analysis and for extreme rainfall estimates, together with much improved hydraulic routing methods for estuaries, has added much to the technologies now available for flood estimation.

The Panel:

(i) have reviewed the methodology used by SKM to determine the Q100 river flow and level

(ii) believe that the appropriate technical processes have been followed in this study

(iii) based on the evidence available to it, is of the view that, for the Brisbane Port Office, the best current estimates for

- the Q100 flow is 6000 m^3/s
- the Q100 level is 3.3 m AHD

There is an inevitable degree of uncertainty in any estimates of this kind; in this case, heightened by the variable influence of the Somerset and Wivenhoe Dams on different storm events on the Brisbane River Catchment. A quite plausible range for the Q100 flow is 5000 to 7000 m^3/s and for the Q100 level, 2.8 to 3.8 m AHD. It seems certain that the position of the best estimates in the respective ranges can be more precisely determined, and the width of these ranges could be significantly reduced, with further investigation as outlined in Section 5.2 of this report.

The Panel notes that the current 'best estimates' of Q100 and the corresponding flood level at the Port Office provide a sufficient basis for a decision on whether the currently adopted flood levels are broadly acceptable. However, for general flood risk assessments and risk-based flood management decisions, more refined flood frequency estimates will ultimately be required.

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Acknowledgment

The provision of material from representatives of the Brisbane City Council, City Design, Department of Natural Resources and Mines, and Sinclair Knight Merz greatly helped the Panel in the conduct of this review. It is a pleasure to acknowledge the high level of cooperation accorded to the Panel by these organisations in responses to questions and requests for information. In doing so, it is important to stress that the Panel has reached its conclusions independently, based on its own interpretations of the material supplied to it.

BCC.006.0063

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1. Introduction

1.1 Purpose of report.

The Brisbane City Council (BCC) appointed a Review Panel in July 2003 to provide independent advice to, and make expert assessment of, a study being conducted by Sinclair Knight Merz (SKM) on design flood flows and levels in the Brisbane River. This report provides the Panel's determination as to whether the SKM estimates of the Q100 flow and level (ie. those likely to be equalled or exceeded on an average once in 100 years) are reasonable.

1.2 Background

A number of studies have been carried out in recent years to estimate the risk of flooding of areas of Brisbane from the Brisbane River. Given the size and complexity of the catchment, exacerbated by tidal effects in the downstream river reaches, the task is a challenging one; it is not surprising that there has been considerable variability in the design estimates of both flow and level. These are documented in the "Chronology of Events" prepared by Council (Appendix 1).

There have been major advances in the last five years in the methodology used to estimate extreme floods from rainfall, including design data that was not previously available for large catchments. The 2003 SKM Study was commissioned to provide an updated estimate of design flood with the new technologies, with the Panel providing an independent review role (see Appendix for Terms of Reference). The Panel met with the consultants and others for progress presentations on 31 July and 14 August 2003, and received draft copies of the relevant sections of the SKM report on 22 August.

1.3 Guide to this report

This review begins with a general overview of what can be termed best practice in flood hydrology (Chapter 2). It then highlights the particular characteristics of the catchment and estuarine zone of the Brisbane River which affect flood flows and levels (Chapter 3). Chapter 4 gives the Panel's assessment of the methodology used in the most recent Brisbane Flood Study (SKM, 2003 (a) and (b)), with comments on the results obtained. The Conclusion (Chapter 5) provides a statement as the most likely value of the Q100 flood and level at the Port Office in Brisbane, and the uncertainty that exists in these estimates. Recommendations for the work required to reduce this remaining uncertainty are included.

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2. Design flood estimation – aims and best practice methodology

2.1 Introduction

Design flood estimation is not a simple process of following clearly defined standards and guidelines but it involves a considerable degree of judgement by the investigator. Before assessing the different studies and comparing their results, it is therefore useful to discuss more broadly what design flood estimation aims to achieve, what methods are available to achieve these aims and what issues are involved in applying the methods.

This section starts by explaining the aims of design flood estimation and introducing the most important principles and technical terms used in design flood estimation. The introductory description of best practice methodology is divided into three parts: flood frequency analysis, rainfall-based approaches for estimating design flood flows and hydraulic methods for converting design flood flows to design flood levels. The section concludes with a discussion of uncertainty in design flood estimates and its implications.

2.2 Aims and principles of design flood estimation

Flooding is a natural part of the flow regime of the Brisbane River and its tributaries. Its major cause is heavy storm rainfall over parts or all of the Brisbane River catchment. The nature and magnitude of flooding resulting from heavy storms depends also on catchment conditions, with the worst floods occurring when a heavy rainfall occurs over an already wet catchment. Major land use changes in the catchment have the potential to modify the flood response to storm rainfall, as do major storage developments such as the construction of Somerset and Wivenhoe Dams. For planning and floodplain management, design flood estimation must therefore relate to the *current or expected future catchment conditions*.

The distribution of flood events over time is almost random; there is no clearly discernible or predictable pattern of how flood flow periods occur. Similarly, the magnitude of flood events also varies randomly. It is therefore not possible to predict the actual occurrence of the next flood but only to estimate the *average flood frequency*, expressed as the average number of years between occurrences of floods of a given magnitude and referred to as the Average Recurrence Interval (or ARI). The aim of design flood estimation is to establish the *flood frequency curve* for a site of interest, or the relationship between flood magnitude and flood frequency.

The observations from *historic flood events* provide the main source of information for design flood estimation. Because of the great variability of climate and catchment conditions producing floods, each observed flood event differs from the next one with respect to one or several flood characteristics. For the purpose of flood management and design it is therefore necessary to define representative flood events which reflect the most likely combinations of the different flood characteristics for different magnitudes of events. These *defined flood events (DFE)* or *design flood events* are derived from historic flood data by means of statistical frequency analysis or by hydrologic modelling methods.

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For a particular flood event, the maximum flood levels reached at different locations along the river are the characteristics of most direct interest to floodplain management. However, these are closely related to the peak flows experienced at those locations, which lend themselves better to frequency analysis. Design flood estimation therefore involves two steps. In the first step, *hydrologic* estimation methods are applied to estimate *design flood flows*, specifically peak flow rates for given ARIs, expressed in m^3/s. In the case of the Brisbane River Flood Study, the design flow of specific interest is Q100, the estimated peak flood flow with an ARI of 100 years. In the second step, *hydraulic* methods are then applied to convert the design flood flows to *design flood levels*. In the case of the lower Brisbane River, which is subject to tidal influences, there is no unique relationship between flood flows and flood levels, and a set of representative design conditions have to be assumed in the hydraulic analysis.

The methods applied in design flood estimation should follow best practice guidelines, to the extent that these have been formulated and are applicable to a specific situation. In Australia, the adopted guidelines for design flood estimation are documented in 'Australian Rainfall and Runoff – a Guide to Design Flood Estimation' (ARR, IEAust, 1999). These guidelines are not prescriptive, and in more complex flood estimation situations such as the Brisbane River catchment, they allow for a substantial degree of subjective interpretation by the designer, based on experience and professional judgement.

While designers and decision makers generally require a "best estimate" of the flood magnitude for a given ARI, it must be recognised that usually such estimates involve a considerable degree of uncertainty which may need to be allowed for in the decision making process. An indicative range of uncertainty is provided by confidence limits around the best estimate.

A range of different methods is available to the designer for both the hydrologic and hydraulic analysis components. In each specific case, the selection of the most appropriate method depends on the amount and quality of the data available, the particular characteristics of the catchment and the intended use and importance of the flood estimates. In situations where the design flood estimates are used to support decisions with far-reaching consequences, the approach should make best use of all relevant sources of data and information, and comparative analysis using a number of methods would be desirable. In the case of the Brisbane River Flood Study, the various investigators have followed two main approaches in the hydrologic analysis:

- frequency analysis of flood events extracted from streamflow records, and
- hydrologic modelling approaches to derive simulated design flood events from design rainfall events.

In the following, these two approaches are described in more detail.

2.3 Frequency analysis of observed flood data

The expected frequency of floods of different magnitudes can be assessed by a statistical frequency analysis of observed flood events. For this purpose, a series of

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annual maximum flood events is extracted from an essentially complete record of streamflow data at a stream gauging station that has operated over a sufficiently long period of time. For this analysis to be meaningful, the data in the flood series have to reasonably satisfy the following basic assumptions:

- the occurrence of flood events is *random* and the events used in the analysis are *independent* of each other
- the events in the flood series are *homogeneous* (from the same population of events), *stationary* (free of any significant time trend) and *consistent* (not affected by any changes in the methods of measuring the data)
- the flood data being analysed are *representative* of the flood conditions of interest

In considering these assumptions it must be recognised that flood flows are not directly observed, but are estimated from observed water levels at the gauging site by means of a rating curve. The rating curve is established from flow velocity measurements (gaugings) for different flow magnitudes, but often the range of gaugings does not extend to the largest observed floods. Flood flow estimates for these larger events thus need to be based on extrapolated rating curves and are of lower accuracy.

Where the flood data do not readily satisfy some of the basic assumptions of statistical frequency analysis, because of changed catchment conditions or different methods of observation, adjustments need to be applied to some data points to render the series more homogeneous. In some cases, additional data on large historical floods may also be available, but these are generally based on less accurate forms of flood observations. Decisions on the use of adjusted and possibly lower quality data involve a trade-off between the benefit of potentially useful additional information and the danger of contaminating a reliable data series with "noise" from lower quality data.

Another potentially useful source of flood data is from other stream gauging stations in the same catchment or from stations in neighbouring catchments that have similar flood characteristics. If the flood data from these stations, after some form of standardisation, satisfy the assumption of homogeneity, they can be combined to undertake a regional flood frequency analysis. Again the balance between additional information and noise introduced by regional data needs to be carefully assessed.

For each data series to be analysed, a theoretical probability distribution is fitted which should reflect the characteristics of the empirical flood frequency distribution defined by the observed floods. The fitted distribution can then be used to estimate flood magnitudes over the full range of ARIs of interest; this often involves some degree of extrapolation beyond the range of observed floods. Many different probability distributions and parameter estimation methods are available for this fitting process, but only a relatively small number of these are used in standard Australian practice. In more complex flood estimation situations, such as the Brisbane River catchment, the choice of distribution and parameter estimation method can have a significant bearing on the resulting design flood estimates.

In practice, the dilemma involved in the selection of the most appropriate data set and analysis method from a range of alternatives is often addressed by undertaking flood

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frequency analyses for a number of different flood series using a range of methods. The results of these analyses are then carefully evaluated, and the estimates considered to be most plausible and reliable selected as a design basis.

Since the preparation of the current version of the Australian guidelines on flood frequency analysis (ARR, IEAust, 1999), which were originally published in 1987, a number of important developments in flood frequency analysis methodology have taken place. In addition to the Log-Pearson 3 (LP3) distribution recommended in ARR, a range of other generalised distributions are now available for fitting, and the traditional product moment method for determining distribution parameters has been supplemented by the more robust L-moment and LH-moment methods. Bayesian methods of flood frequency analysis [redacted] allow different weights to be assigned to different forms of flood data, so that their influence on the final design flood estimate reflects the different levels of information content. These newer developments not only provide analysts with more powerful and flexible tools for flood frequency analysis, they also give a clearer indication of the uncertainties in design flood estimates (see Section 2.6). The guidelines on flood frequency analysis in Book IV of ARR (IEAust, 1999) are currently being revised, and the revision team has indicated that these newer developments will form an integral part of the new guidelines.

2.4 Rainfall-based approaches

Since floods are generally produced by heavy rainfall, an alternative to flood frequency analysis is to focus the attention on storm rainfalls and their transformation to flood events. Rainfall-based approaches overcome the lack of direct flood observations for the conditions of interest by incorporating knowledge of physical hydrologic and hydraulic processes into models that simulate how floods are generated. Because of the complex nature and high degree of temporal and spatial variability of processes, the models are forced to adopt a simplified, conceptual representation of the catchment and the governing processes. To the extent that the model structure reflects the key catchment characteristics, and the model parameters can be validated against observations, the models provide a reliable and flexible tool to derive design floods for a significantly broader range of conditions than is directly reflected in the observed flood data. However, the reliability of the design flood estimates reduces with increasing degree of extrapolation beyond the range of direct observations.

The basic input to flood estimation models is design rainfall data for the specific catchment and the ARI of interest. The most important design rainfall characteristics for storms of different durations are the average rainfall intensity over the catchment, and the likely distribution of rainfall in time and space. These design rainfall characteristics have been derived from analysis of data from many rainfall stations in a region and are available from design rainfall databases (e.g. ARR99, CRC-FORGE). The different design rainfall characteristics are combined to define a design storm event for a given rainfall duration and ARI.

Design storm events provide the basic probability input to the procedure. The "design event approach" adopted in Australia assumes that the 100-year ARI flood is produced by a 100-year design storm event. For this assumption to be satisfied, all

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intermediate steps in the transformation of design rainfall to design flood need to be effected in a "probability-neutral" fashion; this means that parameters such as rainfall losses, initial storage contents and other flood modifying factors need to be selected in such a way that they are not biasing the probability of the simulated design flood.

The selection of a representative design storm and associated other design assumptions should be supported by the analysis of catchment-specific data, but in a catchment as large and complex as the Brisbane River catchment, the selection of these design inputs may still involve a considerable degree of professional judgement. In such situations it is desirable to check the appropriateness of the assumptions made by applying the model first to reproduce floods for catchment conditions for which reliable results of flood frequency analysis are available. In the case of the lower Brisbane River under current conditions, special complexity is introduced into the modelling process by the presence of Somerset and Wivenhoe Dams and their operation under flood conditions. It is therefore advisable to apply the hydrologic model to the pre-dam situation first and validate the results against the results of flood frequency analysis for pre-dam conditions.

2.5 Converting design flood flows to design flood levels

Hydraulic calculations are necessary to determine the design flood levels associated with a design flood. These calculations take account of the flow carrying capacity of the river channel and of the resistance to flow, including boundary shear and energy losses due to channel bends, bridges and other obstructions. The effects of tributary streams and of over-bank flooding must also be taken into account.

An appropriate water level must be specified at the downstream end of the river system. This is often referred to as the tailwater level.

The flood travels down the river system as a flood wave and it is modified as it progresses. The changes in the flood wave must be calculated correctly to establish the peak flood levels at different locations along the river.

In current practice, the hydraulic calculations are carried out with a computer software system that takes full account of the dynamics of the flood wave. This is described as the 'hydraulic model'. A number of well established hydraulic model systems are in use currently. The MIKE11 system was used by SKM and the RUBICON system was used by DNRM for the Brisbane River Flood Studies. Each of these hydraulic models is well established and is consistent with current best practice.

It is essential for the hydraulic model to be calibrated before it can be used to calculate design flood levels. In the process of calibration, the model is made to reproduce the observed flood levels for one or more historic floods for which sufficient data have been measured. This is achieved by adjusting the resistance and energy loss parameters in the model until satisfactory agreement is obtained between the flood levels calculated with the hydraulic model and the measured flood data.

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2.6 Uncertainty

While designers and decision makers generally require a single valued "best estimate" of the design flood magnitude for a given ARI, it must be recognised that, by necessity, design flood estimates involve a considerable degree of uncertainty which may need to be allowed for in the decision making process.

A substantial degree of uncertainty in flood frequency estimates is inherent from the high degree of variability of hydrologic factors producing floods and the limited sample available from the total population of floods. Additional uncertainty may arise from the following sources of error in the basic data and in the methods of design flood estimation:

- systematic errors and inconsistencies in the basic rainfall and water level observations at gauging sites (e.g. for early historical data and very large events)
- uncertainty in the rating curves used to convert water level observations to flow estimates (particularly for large floods and for sites affected by tidal influences)
- errors introduced by the adjustment of flood data for the effects of changes in hydrologic and hydraulic catchment conditions (e.g. dams and changes to lower Brisbane River cross-sections)
- uncertainty in the choice of the correct model (distribution) for flood frequency analysis and in the estimation of its parameters
- uncertainty introduced by simplified representation of catchment characteristics in hydrologic models and estimation of model parameters

The confidence limits around the 'best estimates' obtained from flood frequency analysis give an indication of how some of these uncertainties affect the resulting design flood estimates, but they generally do not reflect all the uncertainty factors involved in the flood estimation process.

While the band of uncertainty around the 'best estimate' of a design flood may be so large that the decisions made using a lower bound estimate or an upper bound estimate would be substantially different, it should also be recognised that the adopted standards for floodplain management allow for some degree of uncertainty. In situations of unavoidable large uncertainty, consistency of approach in terms of current-best-practice may become the overriding consideration in determining the design basis.

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3. The Brisbane River - particular issues for design flood estimation

3.1 Introduction

Chapter 2 set out to explain flood estimation techniques in general. For a specific catchment, it is important to choose techniques suitable for the task in hand, as well as to identify the features that will have a bearing on the flood response.

In the case of the Brisbane River, its large area is of considerable import. Its land-use has changed over the period of record. There are two very large water supply dams that are also operated so as to mitigate floods. In the lower reaches of the Brisbane River, the ocean levels affect flood levels. These aspects are each discussed further in respective sections below, followed by a discussion of the available data of relevance for a flood study.

3.2 Size of catchment

ARR99 defines any catchment that commands an area in excess of 1,000km^2 as being 'large'. The Brisbane River commands a catchment area of approximately 14,000km^2 and clearly sits within the large catchment category.

The variability of rainfall over the catchment is a key influence on floods in the Brisbane River. Differentials in excess of 1,000mm have been observed within the catchment for historical events. Similar gradients are also evident in design rainfall estimates by CRC FORGE estimates of design rainfalls.

Investigations by SKM (2003 (a)), for example, have found that spatial variability in rainfall distribution about the catchment alone can be responsible for variability in design discharges of the order of ±2,000m^3/s under 1% AEP design rainfall conditions. The problem is exacerbated when large dams exist on the catchment, and when rainfall may be centred above or below the dams

Variability of rainfall temporal pattern over the catchment is an added complication, but of lesser importance than spatial variability.

3.3 Catchment characteristics

Within any catchment, runoff response to rainfall is largely controlled by characteristics that fall into the following three general categories: Topography (draining system structure, catchment area, grades etc); Land classification (land use, soil type, vegetation etc); Waterway capacity (conveyance and storage).

These characteristics serve to dictate a catchment's response to rainfall, that is, the depth of rainfall that reports as runoff, the rate of runoff, and its duration of occurrence.

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In many instances it is not necessary to explicitly account for key catchment characteristics in detail, as their influences can be adequately defined within a simplified scope of modelling parameters that are determined through a process of calibration against historical records.

Characteristics within the Brisbane River catchment have been continually changing, primarily as a result of progressive settlement and development. These changes will have had an effect on runoff characteristics (flood flow rates and levels), but one considered small in relation to the impact of the large dams, Wivenhoe and Somerset.

Investigations by both BCC and SKM have assumed that the only change in catchment characteristic of importance has been the construction of these dams. Under the circumstances this assumption is considered reasonable, given that most other key catchment characteristics can be considered to have largely remained unchanged over the years. It is noted that although development of the major regional centres of Brisbane and Ipswich Cities will have resulted in substantial change to local runoff characteristics, the overall impact on Brisbane River flooding is expected to be relatively small on account of the relatively small area of the overall catchment occupied. Catchment change has therefore been presented with respect to two scenarios: "No Dams"; and "With Dams".

3.4 Position and size of major storages

As noted previously, there are two major dams located within the catchment that provide both water supply and flood attenuation service:

- Wivenhoe Dam:
  - Completed: 1985
  - Water supply storage capacity: 1,150,000ML (approximately)
  - Regulated temporary flood storage capacity: 1,450,000ML (approximately)
  - Location: Brisbane River upstream from confluence with Bremer River
  - Catchment: approx. 7,000km^2
- Somerset Dam:
  - Completed: 1959
  - Water supply storage capacity: 370,000ML (approximately)
  - Regulated temporary flood storage capacity: 524,000ML (approximately)
  - Location: Stanley River upstream from confluence with Brisbane River

[information extracted from SKM 2003 (b)]

Clearly, the amount of flood storage is these dams is very significant relative to the design runoff volumes, so the correct simulation of these dams (and their operation during events) is of paramount importance.

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3.5 Effect of tides and storm surge on flood levels

Brisbane River remains tidally affected up to around Colledge's Crossing, or approximately 86km upstream from its mouth in Moreton Bay. Mean High Water Spring Tide (MHWS) in the bay is at approximately 0.9mAHD. The potential for storm surge effect in the bay is relatively significant (BCC, Discrepancy in Predicted Flow Rate in Brisbane River, undated):

- MHWS 0.9mAHD
- January 1974 Storm Surge: 1.6mAHD
- May 1996 Storm Surge: 2.8mAHD

Sensitivity investigations undertaken by BCC to assess the likely effect of bay water levels on flood levels at Brisbane Port Office found the following:

- It appears the tidal and storm surge fluctuations can account for approximately a ±2m range in bay levels (ie –0.9mAHD to +2.8mAHD).
- The effects of tidal and/or storm surge influences in the bay diminish as discharges increase:
  - ±2m at zero flow;
  - ±0.8m at around 5,000 m^3/s;
  - ±0.5m at around 10,000 m^3/s (close to BCC estimate of January 1974 flow); and
  - nil (ie. completely drown out) at discharges greater than approximately 14,000 m^3/s.

The stage discharge curve was computed using the calibrated Mike11 Model developed in the 1998 and 2000 flood studies. It was compared with the Bureau of Meteorology data and found to be different. The Bureau of Meteorology discharge-stage information was derived to suit the Bureau of Meteorology flood forecasting model and has not yet been adequately verified.

Forensic investigations by BCC have also attempted to quantify the likely effect of historic dredging and excavation works about the entrance of the river. This work was undertaken to aid with their adjustment historic flood level estimates for an alternative FFA of flood data at river gauge stations to the downstream of Colledge's Crossing.:

- Removal of a bar at the mouth of Brisbane River in around 1864 is estimated to have resulted in lowering "large" flood levels at Port Office by approximately 0.4m;
- Dredging about the port in around 1917 is estimated to have resulted in lowering "small" floods by approximately 1.5m, with little effect on "large" floods. (According to the Bureau of Meteorology, this lowering should be only 0.6 m.)

3.6 Data available

A considerable amount of rainfall and stream flow data is available, and has been accessed in the conduct of the various investigations by BCC, SKM, BOM and

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Key data sources include:

- AEP 1 in 100 Rainfall Depths, Temporal and Spatial Patterns, Areal Reduction Factors for the Brisbane River Catchment CRC FORGE analysis undertaken by DNRM.
- Long-term daily rainfall totals from a significant number (around 130) of stations through the catchment.
- Daily stage height data and rating curves, utilised by SKM:
    - Brisbane River @ Savages Crossing (143001) – 72 years
    - Warrill Creek @ Amberley (143108) – 40 years
    - Lockyer Creek @ Lyons Bridge (143210) – 22 years
    - Lockyer Creek @ O'Reilly's Weir (143207) – 53 years
    - Daily stage height data and rating curves (calibration), utilised by BCC:
        - Brisbane River @ Brisbane Port Office – data from 1841
        - Brisbane River @ Moggill – data from 1893
        - Brisbane River @ Mt Crosby – data from 1864
        - Brisbane River @ Lowood – data from 1890
- Historic flood levels and estimated flow rates at Lowood, 1893 and 1825
- Peak annual flow series data for Savages Crossing (1890-2000) for assessed adjustments "No Dams" and "With Dams" scenarios.

It is also understood that relatively detailed waterway cross-sectional / bathymetry information is available for Brisbane River from around Moggill Gauge to the entrance.

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4. Evaluation of recent studies

4.1 Introduction

Chapters 3 & 4 set out the current best-practice methodology for flood estimation, and the characteristics of the Brisbane River catchment that need special consideration. They thus provide the context for the review of the techniques adopted for, and the results from, the SKM 2003 study.

This chapter looks first at the flood frequency analysis of the flows at Savages crossing (Sect. 4.2), then at the results for the same location (pre-dams) obtained using the rainfall-based method (4.3), before comparing the two (4.4). It then considers the simulation of the catchment response to large storms with the Wivenhoe and Somerset Dams in place, as used to estimate the current Q100 for the Port Office (4.5). The conversion of this design flow to a design level is examined next (4.6). The chapter concludes with consideration of the uncertainty in the estimates (4.7), and a statement of the Panel's views on the recommended values of flood level at the Port Office (4.8).

4.2 Flood frequency analyses (pre-dam)

Among the several stream gauging stations located along the Brisbane River between Wivenhoe Dam and the Brisbane Port Office, the combined record from the gauges at Savages Crossing, Lowood and Vernor (from here on referred to as Savages Crossing) provides the longest record of high quality flood data, and has therefore been adopted by SKM as the key site for flood frequency analysis.

Four different flood data sets have been prepared for the Savages Crossing site and have been used for separate flood frequency analyses by SKM. Data Sets 1 to 3 relate to the pre-dam situation, while Data Set 4 attempts to represent the current situation with Somerset and Wivenhoe Dams providing a substantial degree of flood mitigation for the lower Brisbane River. The continuous record period represented by these data sets varies from 42 to 111 years, with the historical record period extended in some cases to include the large flood of January 1893, and in one case also the similarly large flood thought to have occurred in 1825.

For the *pre-dam* situation, the SKM draft report presents the results from a total of 12 different cases analysed to assess the sensitivity of the Q100 estimates to variations in the following factors:

- Inclusion or omission of January 1893 and 1825 historical floods
- Extension of recorded flood data set by inclusion of the following additional periods:
  - from 1890 to 1909 (extended by DNRM using IQQM model)
  - from 1959 to 1982 (with and without DNRM adjustment for impact of Somerset Dam)
  - from 1983 to 2000 (with DNRM adjustment for impact of Wivenhoe Dam)
- Inclusion or omission of information from regional flood frequency analysis
- Fitting of Generalised Pareto (GP) or Log-Pearson 3 (LP3) distribution

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- Application of FLIKE or GetDat flood frequency analysis packages which use different parameter estimation methods

The Q100 estimates obtained from these 12 separate analyses varied from 6,700 m^3/s to 15,700 m^3/s, with the most plausible range given by SKM as 10,000 to 14,000 m^3/s. Based on the results of the two most plausible cases, SKM adopt the 'best estimate' of Q100 as 12,000 m^3/s.

The Panel considers the flood frequency analysis approach taken by SKM to be appropriate and agrees with the conclusion that the 'best estimate' of Q100 for the pre-dam case at Savages Crossing is approximately 12,000 m^3/s. While the 90% confidence limits around the best-case distributions are somewhat wider, the plausible range of uncertainty for the Q100 estimate is about 10,000 to 14,000 m^3/s.

Additional flood frequency analysis work was also undertaken by City Design for a range of sites between Savages Crossing and Brisbane Port Office. For each site, available information from various sources was combined to derive a most plausible rating curve for the full range of flood magnitudes of interest. While this work is not as rigorous in terms of the quality and consistency of the data used and the methods of frequency analysis applied, it nevertheless provides useful confirmation of the SKM estimates. City Design's 'best estimate' of Q100 at Savages Crossing for the pre-dam case is 10,800 m^3/s.

Based on these results, it is of interest to note that, in the absence of Somerset Dam, the January 1974 storm would have produced about a 70-year flood at Savages Crossing, while the January 1893 flood is estimated as having an ARI of 100 to 150 years.

4.3 Rainfall-based flood estimates (pre-dam)

To estimate the runoff generated by rain falling on the catchment, SKM used the RAFTS runoff routing model. They had calibrated this model satisfactorily during previous studies on the catchment of the Brisbane River, so that further calibration effort was considered unnecessary. The Panel were willing to accept the adequacy of the calibrated RAFTS model without specific review.

Design values of 10 mm initial loss and 1 mm/h continuing loss, distributed uniformly over the catchment, were used to estimate the Q100 event. The Panel considers these values acceptable for an extreme event on the Brisbane River catchment. (The assumption of zero losses would increase the Q100 estimate by about 15%).

As explained in Sect. 3.2, a particular challenge for design flood estimation on large catchments is the appropriate depth and variability of rainfall to use in the calculation. SKM adopted the recent CRC-FORGE work to get the average depth for each storm duration – with appropriate areal reduction factors (Sect. 3.6). The Panel endorse this.

The critical storm durations of 30 h at Savages Crossing and 72 h at Moggill/Port Office seem reasonable, and accord with other studies. Representative patterns in accordance with ARR (Pilgrim, 1998) were adopted. To assess sensitivity to temporal patterns, five patterns were applied to the catchment average CRC Forge rainfall 48

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hour storm duration. The RAFTS model was used with nil losses. At Savages Crossing and at the Port Office, the ARR standard temporal pattern produced the smallest peak flows. The largest peak flows at these locations were produced by the 1974 historic temporal patterns, these being larger than the ARR peaks by 15% at Savages Crossing and by 10% at the Port Office.

Spatial distribution is a factor which can have a significant effect (especially for the post-dams case – Section 4.5). The Panel suggested using patterns from a number of large storms on the catchment, and SKM have done this for seven events. The result gives an approximate indication of the influence of spatial pattern on flood peaks of the 100 year ARI event (8000 to 11500 m^3/s, pre-dam case at Savages Crossing). The median value (of about 10000 m^3/s) is an appropriate vale for comparison with the flood frequency study (see next section).

4.4 Comparison of FFA and rainfall-based estimates (pre-dam)

The comparison of results from frequency analysis and rainfall-based estimates is a form of check undertaken to assess the degree of consistency in the results using different data sources, methods and assumptions. In the evaluation of the comparative results, allowance has to be made for the different degrees of reliability attached to the estimates from different approaches.

The most recent SKM studies produced the following Q100 estimates for the pre-dam situation at Savages Crossing:

Table 4.1 Summary of Q100 estimates at Savages Crossing (pre-dam conditions)

Method	Q100 estimates [m^3/s]		
	Best Estimate	Plausible Range	
		Lower Bound	Upper Bound
Flood Frequency Analysis	12,000	10,000	14,000
RAFTS Modelling	10,000	8,000	11,500

The comparison indicates that, while the plausible ranges of estimates from the two approaches overlap to some degree, the RAFTS modelling produces estimates that are significantly lower.

In the Panel's judgement, the flood frequency analysis estimates are based on relatively long streamflow records at a number of sites, and while there is considerable doubt on the reliability of large floods at individual sites, there is sufficient confirming information from flood observations at other sites to lend credence to the adopted Q100 estimate.

For the rainfall-based estimates, the design rainfall depths used to define design storms for the catchment are also based on the analysis of a large database of long-term rainfall records from many stations within and around the catchment. However, the RAFTS model converting these design rainfalls to design storms requires many assumptions regarding model parameters and secondary design inputs, such as spatial/temporal patterns of design rainfall and losses, and their variation with storm

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magnitude. The uncertainty involved in these assumptions may introduce bias into the estimation of the 100-year flood from a 100-year storm rainfall depth.

The Panel therefore considers that the pre-dam Q100 estimate at Savages Crossing from RAFTS modelling estimate may be low by 10 to 20%. It would be desirable to assess, if the tendency for underestimation of peak flows also affects the estimate of flood volumes associated with Q100 in a similar fashion, as the post-dam flood peaks at Brisbane are largely determined by the inflow volumes to the dams. However, at this stage the information available does not allow this to be confirmed.

The expected tendency for underestimation in the rainfall-based approach should be taken into account when the RAFTS model is used to estimate design floods for the lower Brisbane River catchment under post-dam conditions.

4.5 Calculation of the post-dam flood discharges

Both the Somerset and Wivenhoe storages are capable of significantly modifying flood flows from their commanded catchments. The amount of flood attenuation that can be achieved by the structures is dependent upon a range of conditions, including:

- The antecedent storage inventory
- The volume and duration of the flood inflow hydrograph
- The rate of controlled discharge from the storage.

Under flood conditions both storages are operated in accordance with predefined rules controlling discharge to the downstream waterway. It is understood that these rules have been established with the objective of mitigating the potential impact of flooding on downstream communities and infrastructure. These rules are relatively complex and are not amenable to simplification.

In consideration of the significant impact that Wivenhoe and Somerset Dams can potentially have on the timing and magnitude of downstream flood flows it is necessary that proper account be taken of dam operation in any hydrological assessment. To this end, DNRM have established a hydrological model of the Brisbane River catchment for the purpose of simulating the expected performance of dam operation. It is understood that the model functions on a continuous simulation basis and utilised historical time series rainfall data to simulate an associated time series of waterway and dam flows. Although DNRM have made available the outputs from this model, no other details have been documented. This being the case, the Panel cannot comment on the efficacy of the model.

Review of historical dam routing results from the DNRM model for the period 1890 to 2000 has indicated that it should be possible to operate the dams to reduce peak flood flow rates by about 60% on average. It is interesting to note that the model indicates a January 1974 flood attenuation of nearly 50%, with a peak inflow rate of 10,500m^3/s and outflow rate of 5,500m^3/s.

Flood frequency analysis by SKM of the DNRM dam routing time series showed that standard frequency distributions, such as the *Generalised Pareto* and *Log Pearson*

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Type III, do not fit the data well. It is expected that this occurrence is largely due to the highly modified and non-linear nature of the flood hydrograph transformation by the dams. The Panel therefore considers the Q100 estimate from this analysis to be unreliable and not suitable as a basis for checking the results of hydrologic modelling for the post-dam case.

Hydrological modelling of the catchment has also been undertaken by SKM. This work has used the RAFTS program to undertake the basic rainfall-runoff-routing process, and a program from DNRM to simulate the routing of flow hydrographs (generated using RAFTS in this instance) through the Somerset and Wivenhoe storages under post-dam scenario conditions. SKM used the models to generate design flood flow rates from synthetically generated design storm events – in this case 1 in 100 AEP design CRC FORGE rainfall events.

The SKM application of the RAFTS hydrological model was used to both make estimates of:

- Design Q100 flow rates at Savages Crossing under both pre- and post-dam conditions
- Typical variability in Q100 flow rates that might reasonably be attributed to differences in the spatial distribution of rainfall across the catchment during the course of the driving storm event.

As noted above, SKM used the CRC FORGE method to establish the design 1 in 100 AEP storm event - comprising total rainfall depth, temporal and spatial rainfall distributions, and associated areal reduction factors. Typical "real event" spatial distributions for rainfall were also extracted from 7 historical storms events of significance. No specific criterion was applied to the selection of events, other than that the data was readily available for utilisation within the relatively limited time constraints afforded by the scope of current investigations.

It is noted that CRC FORGE rainfall was applied to the 7 historical spatial distributions, and not the actual rainfall associated with the event. This approach satisfied the investigation objective that was to sample the typical variability in runoff flow rates as might be produced by different spatial distributions of rainfall under both pre- and post-dams development scenarios.

Outcomes of SKM investigations are summarised in the following tabulation. In reviewing this information it should be noted that the base estimate is derived from RAFTS modelling using the CRC FORGE rainfall spatial distribution (eg 9,600 m^3/s at Savages Crossing for the pre-dams case). An indication of plausible range was obtained from calculation of the difference between the median valuation of the seven historical spatial distributions, and the second highest and second lowest bounding values (ie values at rank positions 2 and 6, with the median being at rank position 4). These ranges were then superimposed upon the RAFTS based estimates to give the plausible ranges listed in Table 4.2.

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Table 4.2 RAFTS based Pre- and Post-Dam Q100 flow estimates (m^3/s) with indication of plausible range of variability

Location	Pre-Dams			Post-Dams			Reduction (%)
	RAFTS Q100	Plausible Bound		RAFTS Q100	Plausible Bound		
		Lower	Upper		Lower	Upper	
Savages Crossing	9,600	8,100	10,800	5,400	3,900	6,600	40
Moggill	10,100	9,500	10,800	5,000	4,200	6,000	50
Port Office	10,100	9,500	10,800	5,000	4,200	6,000	50

Review of the above outcomes indicates:

- The pre-dams best estimate of peak discharge at Savages Crossing (9,600 m^3/s) is 20% lower than that derived by SKM using FFA (see Section 4.2). This being the case it is probable that the estimate of post-dams peak discharge is also low.
- The variability indicated by analysis of historical spatial rainfall distributions appears to be generally consistent with that concluded by SKM on the basis of FFA work. This may be taken to indicate that the noted variance is probably physically realistic.
- Variability in post-dam flow estimates is significant, being of the order of 40% of the design base discharge value.
- The attenuated peak flood flow rate factors are generally consistent with that reflected in the source DNRM data.
- There appears to be little attenuation of flood flow rates between Moggill and Port Office. This characteristic is totally consistent with independent observations as reported by BCC.
- Savages Crossing peak discharges are of the same order as those further downstream.

The issue of variance between FFA and RAFTS model results has not yet been fully addressed by SKM. Nevertheless, SKM have investigated the sensitivity of estimated Q100 flow rates to assumed loss rates. The key outcome of this sensitivity appraisal was that the noted variance could not be fully explained by the influence of assumed rainfall losses. The cause for this variance warrants further investigation.

SKM also undertook investigations to assess the effect of antecedent dam storage inventory levels on the attenuation of flood flow rate. Analyses using antecedent inventories of 50% and 75% full supply volume indicated significant impact. However, prior analysis by BCC of the likelihood of the occurrence of antecedent drawdown was small, and that a FSL assumption is justified.

As a check on design flows, SKM used the RAFTS model to simulate the 1893 and 1974 historical flood events with both dams in place and with dam operating procedures applied. The peak flow calculated at the Port Office for the 1974 flood event was 6800 m^3/s. It is difficult to relate this result with those obtained from systematic study of 1 in 100 AEP rainfall events discussed above.

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The Panel considers that flow estimates based on flood frequency analyses (Section 4.2) presents a fair assessment of *Best Estimates* under pre-dam conditions (ie Q100 of 12,000m^3/s with a plausible range between 10,000m^3/s and 14,000m^3/s). As noted above, RAFTS flow estimates are considered low, around 20% under pre-dam conditions. Under post-dam conditions the Panel would expect Q100 flows downstream of Wivenhoe dam to be of the order of 50% of those under pre-dam (as found by RAFTS, Table 4.3) – that is, 50% of 12,000m^3/s, or 6,000m^3/s.

In consideration of the above, the Panel considers that Q100 flow values presented in Table 4.3 below presents a fair and reasonable assessment of Q100 flow rates for design purposes – *on the basis of information currently made available to the Panel.*

Table 4.3 Panel Recommended Pre- and Post-Dam Q100 flow estimates (m^3/s) with indication of plausible range of variability

Location	Pre-Dams			Post-Dams		
	Q100	Plausible Bound		Q100	Plausible Bound	
		Lower	Upper		Lower	Upper
Savages Crossing	12,000	10,000	14,000	6,000	4,000	8,000
Moggill	12,000	11,000	13,000	6,000	5,000	7,000
Port Office	12,000	11,000	13,000	6,000	5,000	7,000

4.6 Estimation of design flood levels

Flood levels along the Brisbane River were calculated with the MIKE11 hydraulic model. The model extends upstream from the Brisbane bar to approximately 15km downstream from Savages Crossing. The inflow hydrograph at the upstream end was provided from a RAFTS hydrological model that has its output approximately 2 km upstream from the end of the MIKE11 model. The DNRM dam operations have been applied in producing this hydrograph and it includes Lockyer Creek flows. Downstream from this point, there are approximately 150 inflow locations in the MIKE11 model. At the downstream end the water level was set at MHWS (0.92 m AHD) and held constant throughout the entire flood simulation.

The MIKE11 hydraulic model that was developed for the Ipswich Rivers Flood Studies was used to calculate design flood levels in the Brisbane River. The Panel has not examined the calibration of the model. SKM reports that the calibration at the Port Office and at Moggill is considered good but that calibration has not been done at other locations along the Brisbane River within Brisbane City. Consequently, flood levels estimated for locations other than at the Port Office and at Moggill must be treated with care. It is noted also that the need to extrapolate the rating curves causes some uncertainty in the calibration of the hydraulic model, because of the uncertainty that attaches to the estimates of the flows of large floods used in calibration.

The hydraulic model was run with input flows calculated from CRC Forge rainfall estimates, spatially distributed with areal reduction factors, for the 1% AEP design rainfall, for seven durations. The critical duration was 72 hours and, for this case, the

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peak flow calculated at the Port Office is 5060 m^3/s and the peak flood level is 2.68 m AHD.

The peak flow at the Port Office calculated with the hydraulic model is similar to that calculated with the RAFTS model (5,000 m^3/s, Section 4.5). However, the Panel considers that the values of Q100 estimated from RAFTS modelling may be low by 10 to 20% (see Sections 4.4, 4.5) and it has formed the opinion that the current best estimate for the Q100 flow at the Port Office is 6,000 m^3/s, as explained in section 4.8. It follows that the flood level, 2.68 m AHD, may be low and it would be desirable to calculate the flood level corresponding to a peak flow of 6,000 m^3/s. From simple interpolation in an approximate rating based on the MIKE11 results in the 2003 SKM study, the flood level for this flow is estimated at 3.3 m AHD.

The use of a constant water level at MHWS at the downstream end of the hydraulic model is consistent with what was adopted for the original Brisbane River Study. This may appear to result in slightly high estimates of flood levels in the tidally affected reaches of the river. However, the flood hydrograph is of long duration and the flow in the tidal reaches will be very close to the peak for a time interval similar to or greater than the interval between low tide and high tide. Therefore, the use of a constant water level at MHWS may not be conservative. It is known also that storm surges are often associated with the severe large weather patterns that produce large flood events. The Panel considers that a Monte Carlo analysis to examine the joint probabilities of flow rates and tide levels, including influences of storm surges, is required to resolve this issue.

4.7 Sources of remaining uncertainty

Rating curve extrapolation

At all of the flow gauging stations the maximum gauged flow is substantially smaller than the maximum estimated flow. For example, at Savages the maximum gauged flow is of order 30 - 45% of the estimated 1974 peak flow (SKM, 2003 (b)). Extrapolation of the rating curve to such an extent is a source of considerable uncertainty in the estimates of the larger flows that influence the FFA in the range of the Q100.

The need to extrapolate the rating curves also causes uncertainty in the calibration of the hydraulic model, because of the uncertainty that attaches to the estimates of the flows of large floods used in the calibration.

Unfortunately, little can be done to reduce these uncertainties until gaugings can be obtained during larger flood events.

Spatial and temporal pattern variability

The results obtained with seven historical spatial distributions of rainfall in the hydrological modelling show that the estimate of Q100 is substantially affected by the spatial distribution used. At Savages, the pre-dams estimates of Q100 ranged from 11507 to 8005 m^3/s and the post-dams estimates ranged from 7047 to 5213 m^3/s (SKM, 2003 (a)).

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The results from a limited assessment of the effects of different temporal patterns for the pre-dam case showed variations in peak flows of 15% at Savages Crossing and of 10% at the Port Office.

Larger estimates of Q100 may result from spatial and temporal patterns of rainfall other than those modelled. This question could be resolved by a full Monte Carlo analysis.

Correlation of losses with storm occurrence

In the hydrological modelling the initial loss was set at 10mm and the continuing loss at 1.0mm/hr (SKM, 2003 (a)). These losses are within the ranges that are considered reasonable for eastern Queensland. It has been stated that 'A Q100 event ... generally occurs in a season of wet winters and high rainfall summers' (BCC, 1999). This has provided the basis for the use of relatively low losses in the hydrological modelling. Nevertheless, this has not been examined rigorously. Further, it is uncertain whether pre-event wetting of the catchment prior to large storm events may result in even smaller losses and larger peak flows.

These issues would be clarified by a correlation analysis of pre-event catchment soil moisture levels with storm occurrences.

Correlation of pre-event dam levels with storm occurrence

The set of post-dams estimates of flows downstream from Wivenhoe dam were calculated with the assumption that the dam was at FSL, RL 67.0 m AHD, in all cases. Sensitivity tests showed that the estimated peak flow at the Port Office Gauge is reduced by about 13% if Wivenhoe dam is 75% full with SWL at RL 64.0 m AHD at the start of the flood event (SKM, 2003 (a)). Data sets are available that would enable a correlation analysis to establish the most likely pre-event dam level.

Calibration of hydraulic model

The MIKE11 hydraulic model that was developed for the Ipswich Rivers Flood Studies was used to calculate design flood levels in the Brisbane River. The model calibration at the Port Office and at Moggill is considered good but it has not been calibrated at other locations along the Brisbane River within Brisbane City. The model should be calibrated throughout the length of the river within Brisbane City to provide good estimates of flood levels throughout.

4.8 Best estimates of the 100 year ARI at the Port Office

As noted in previous section, the spatial distribution of the design storm used to calculate the Q100 is critical. For this reason, the Panel requested SKM to calculate Q100 estimates using the spatial distributions from seven historical large storms. The range of Q100 for the Port Office was 3400 to 7121 m^3/s. The Panel considers this to be an extreme range, it is unlikely to be a fair indication of the likely uncertainty of the Q100 flood flow.

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If the outermost two are 'dropped', the range reduces to 5000 to 6800 m^3/s, with the median being 5900 m^3/s (SKM, 2003(a), Table 7). After rounding these values in recognition of their approximate nature, the Panel regard 6000 m^3/s as the best current estimate of the Q100 flow-rate, with 5000 m^3/s being the lower estimate of Q100, and 7000 m^3/s being the upper. [As noted in the Conclusion, further work is needed to refine the position of this estimate in the range, and to reduce the size of the range itself]

The Q100 level calculated at the Port Office with the hydraulic model is 2.68 m AHD. However, the flow associated with this level is 5060 m^3/s, while the Panel regard 6000 m^3/s as the best current estimate of the Q100 flow. The best estimate of the Q100 level corresponding to this flow is 3.3 m AHD, with 2.8 and 3.8 m AHD being the levels corresponding to the lower and upper estimates of flow.

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5. Conclusion

5.1 Panel findings

The estimation of Q100 for a catchment of this size (13570 sq. km) is a challenging task. The extreme variability of rainfall, the change in catchment response due to the construction of dams, and the variable conditions in the tidal section of the river, are some of the factors which complicate the application of 'standard' flood methodologies. The advent of new techniques for flood frequency analysis and for extreme rainfall estimates, together with much improved hydraulic routing methods for estuaries, has added much to the technologies now available for flood estimation. The Panel notes that the further studies done by SKM, in conjunction with City Design, took advantage of these new techniques.

With respect to its Terms of Reference, the Panel:

(i) have reviewed the methodology used by SKM to determine the Q100 river flow and level;

(ii) believe that the appropriate technical processes have been followed in this study;

(iii) based on the evidence available, is of the view that, for the Brisbane Port Office, the best current estimates for

- the Q100 flow is 6000 m^3/s
- the Q100 level is 3.3 m AHD

There is an inevitable degree of uncertainty in any estimates of this kind. The Panel believes the possible range for flow to be 5000 to 7000 m^3/s; for level to be 2.8 to 3.8 m AHD.

The Panel notes that the current 'best estimates' of Q100 and of the corresponding flood level at the Port Office, provide a sufficient basis for a decision on whether the currently adopted flood levels are broadly acceptable. However, for general flood risk assessments and risk-based flood management decisions, more refined flood frequency estimates will ultimately be required.

5.2 Recommendations for Further Work

a) The SKM 2003 study has demonstrated the very significant effect of assumed storm variability on the estimated post-dams flows at the Port Office. The Panel believes that this variability could be reduced if a similar study was conducted, but using Monte Carlo methodology to simulate the possible combinations of storm temporal and spatial patterns (instead of seven observed storms). Such a study could also properly estimate and account for the correlations between event occurrence, losses and reservoir drawdown (instead of using fixed average values). The Panel strongly recommends that such a study be done as Council moves towards a risk-based approach to flood management.

b) More confidence would be engendered in the results if there was a better match between the flood frequency analysis of observed data and the estimates obtained

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from the rainfall-based RAFTS model. The current variance of around 20% is not desirable. Given the importance of runoff volume in a situation involving large dams, the Panel recommend that:

(i) Calibration of the RAFTS model be re-visited with the view to reducing the variance with FFA outcomes to within acceptable bounds.

(ii) Frequency analysis of event volumes be carried out, and compared with runoff volumes predicted by the RAFTS model from design rainfalls of corresponding frequency.

c) The MIKE11 model of the Brisbane River should be calibrated throughout the length of the river within Brisbane City to provide good estimates of flood levels throughout.

d) Consideration should be given to including the effect of tidal variation on flood levels in the estuarine zone. This would involve a Monte Carlo type analysis to examine the joint probabilities of flow-rates and tide height.

e) The DNRM model for simulating the expected operation and effect of Wivenhoe and Somerset Dams on flood flows, and associated data, should be independently reviewed when the DNRM final report is made available.

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6. References

BCC (1999) Report, Further Investigations for the Brisbane River Flood Study (Draft), December 1999.

IEAust (1999) Australian Rainfall and Runoff – A Guide to Flood Estimation, (Reprinted Edition), Institution of Engineers, Australia, Barton ACT.

[redacted] (1999) Comprehensive at-site flood frequency analysis using Monte Carlo Bayesian inference, Water Resources Research, 35(5), 1551-1558.

SKM (2003(a)) Report, Further Investigations of Hydrology & Hydraulics Incorporating Dam Operations and CRC Forge Rainfall Estimated (Draft), 28 August 2003.

SKM (2003(b)) Report, Flood Frequency Analysis of Brisbane River (Draft), 8 August 2003.

BCC.006.0088

Appendix – Terms of Reference and Chronology of Events
(Documents from Brisbane City Council)

TERMS OF REFERENCE

for

Brisbane River Flood Study

Independent Expert Review Panel

Background

A chronology of events to date has been included at the end of this document. It outlines the work undertaken so far to determine the Q100 Brisbane River flood level. The Brisbane City Plan 2000 uses the Q100 as the key input in the determination of development control levels adjacent to the river. The Q100 currently used is based on a study that was completed about the same time as Wivenhoe Dam was constructed. This 1984 figure of 6,800 m^3/s has been used as the basis for setting development control levels for nearly twenty years.

Council commenced extensive work into hydrologic and hydraulic aspects of the catchment after the 1993 DNR study indicated that the Q100 flow at the Brisbane Port Office may be as high as 9,380 m^3/s. The 1998 study undertaken for Council by SKM recommended a Q100 of 9,560 m^3/s. In June and December 1999 BCC's City Design produced draft reports that recommended Q100's of 8,600 m^3/s and 8,000 m^3/s respectively.

Preliminary results from the 2003 DNRM study on flows in the Brisbane River indicate a Q100 of 6,000-7,000 m^3/s at the Brisbane Port Office. BCC is undertaking further work to assess the results of the various methods.

BCC and SKM are now using updated information (including the DNRM results) to review the flood frequency analysis and determine the revised Q100 flood level at the Brisbane Port Office.

Even if the Q100 changes from 6,800 m^3/s, it is likely that the Development Control Level will remain the same as is currently used in the Brisbane City Plan.

Role

The role of this expert panel is to determine whether the August 2003 estimates of Q100 flow and level at the Brisbane Port Office are reasonable.

Objectives

1. Review the methodology that has been used to calculate estimates of Q100 river flow (1998 – 2003)
2. Ensure that the appropriate technical process has been followed for the 2003 Q100 river flow / level at the Brisbane Port Office.
3. If required, provide specific recommendations on further work be undertaken
4. Assess the suitability of the 2003 Q100 river flow / level for design purposes..

Outcome sought

It is expected that the expert panel will produce a report providing opinions, recommendations and advice on the technical process followed and the estimated Q100 river flow / level at the Brisbane Port Office

BCC.006.0089

Membership of Panel

- Professor **Russell Mein** (Chair) – Experience: Former CEO of CRC for Catchment Hydrology and former Chairman of ARR Advisory Panel
- Professor **Colin Apelt** – Experience: Former Head of the Department of Civil Engineering, University of Queensland
- Dr **John MacIntosh** – Experience: Chairman Engineers Australia National Committee on Water Engineering, and Director / Principal Water Engineer with consultants Water Solutions Pty Ltd
- **Erwin Weinmann** – Experience: Deputy Director CRC for Catchment Hydrology (Monash Node), Senior Lecturer in water subjects at Monash University and Co-author of Book VI (Estimation of Large and Extreme Floods)

Responsibilities of Members

- To read briefing materials provided prior to meetings.
- To attend and participate in meetings of the expert panel.
- To assess and report on the methodology and process used to determine the Q100 flow / level at the Brisbane Port Office.

Timing

It is initially anticipated that there will be two meetings of the expert panel:

- Thursday 31 July – to review the work done to date and agree on the process to finalise the Q100.
- Mid August – to consider the findings of the Q100 investigation and to critically assess the Q100 determined at the Brisbane Port Office

The objective is to deliver a brief report to the Manager Water Resources outlining the findings by 25 August 2003.

Brisbane River Flood Study
Chronology of Events

1984 Reports for Brisbane City Council and Water Resources Commission. Q100 river flow set at 6,800 m^3/s (or cubic metres per second). This flow was used as the basis for flood levels for development control level.

1993 DNR study undertaken for the (now) South East Queensland Water Corporation to examine operating rules for the dam. The study determined that Q100 flow was 9,380 m^3/s. The report recommended that further work be undertaken to determine areal reduction factors. DNR consider this flow volume was seen as an overestimation as it was not specifically produced for the Q100 event in Brisbane. This prompted Council to re-examine flood levels in the river and led to commissioning the SKM report, which commenced in November1996.

1998 Model developed and draft SKM report received by Council, proposing Q100 flow of 9,560 m^3/s.

1998 Report and results reviewed by Council officers who determined that this flow was based on assumptions that equated to a lower probability of flooding than the Q100. This resulted in Council commissioning Professor Russell Mein, eminent hydrologist, to undertake an independent review of the work to date.

1998 December, received Professor Mein's review of the draft SKM report. This review stated;

> The overall approach for the hydrologic component of the study ... is appropriate. However ... conservative assumptions in key input variables point to the likelihood

BCC.006.0090

that the magnitude of the Q100 obtained in this Study is an over-estimate." Professor Mein made six recommendations for work needed to address the issues of concern.

1999 June, draft review by City Design. Note that this revised downwards the Q100 flow to 8,600 m3/s as a result of the additional analysis–a reduction of 10% on the SKM report (This draft report did not fully address Professor Mein's review recommendations). This is the report referred to by the Courier Mail in its stories on flooding which appeared in the newspaper from 24 June 2003 to 5 July 2003.

1999 December, review by City Design. This draft report entitled "Further Investigations for the Brisbane River Flood Study" was to fully incorporate Professor Mein's recommendations and revised the Q100 flood discharge down again to 8,000 m^3/s as the analysis was refined. It should be noted that this report again did not fully address Professor Mein's peer review analysis.

2000 January to September, review of all these reports, discussions with external stakeholders, including South East Queensland Water Corporation, Department of Natural Resources, Bureau of Meteorology. Council continued to review the draft June and December reports as the peer review recommendations had not been fully addressed.

2000 October, Brisbane River Flood Study Technical Workshop held. Purpose – to ensure that the definitive flood study report would be technically rigorous and adopt an approach / methodology that is consistent with the current practices, using the latest available information. Participants included Professor Mein, BCC Waterways and City Design, Department of Natural Resources, Bureau of Meteorology, South East Queensland Water Corporation, Institution of Engineers National Committee on Water Engineering and Ipswich City Council.

Action plan arising from October workshop identifies FORGE Study being undertaken by DNR for SEQ Water Corporation. At this time, the continuous simulation study was due to be finalised by December 2000 and was consistent with Professor Mein's comments, as well as the current approach by the CRC for Catchment Hydrology.

Preliminary results showed the DNR Q100 level as closer to the BCC 1984 study than the 1992 DNR study, which reinforced our position on the over-estimation of the Q100 flood flows. The workshop concluded that the FORGE work being done would need to be taken into account. In addition, the workshop suggested that we take into account the areal reduction factors, which it was estimated may produce a 20% reduction in total rainfall at the Brisbane Port Office gauge.

Since 2000 Council has been in contact with DNRM every few months to check on the progress of the report. Officers of DNRM have consistently reassured us as to the probability of the Q100 flow figure being close to, or at the level of the 1984 Q100 figure.

Council has been taking other actions as well, for example, raising community awareness of flooding issues with tools such:

- Council's flood information system which predicts flood levels in the river during major flood events,
- Upgraded system which will automate and improve the accuracy of Q100 on individual properties,
- Fact sheets and articles in publications and information on Council's website.

On Friday 27 June 2003 BCC received preliminary advice from DNRM that the Q100 flood flows at the Brisbane Port Office would be between 6,000 and 7,000 m^3/s. This affirmed that the preliminary estimate from early reports was likely to be an over-estimate. This is consistent with their advice from the October 2000 workshop and from contacts with DNRM since then.

—oOo—

MJR-14

MEMORANDUM

Brisbane City Council

Water Resources Branch
Urban Management Division
Floor 5 69 Ann Street
Brisbane Qld
GPO Box 1434
Brisbane Qld 4001

Telephone 3403 4870
Facsimile 3403 9456

TO:	Jude Munro, Chief Executive Officer
COPY TO:	Michael Kerry, Divisional Manager Urban Management [redacted], Divisional Manager City Business
FROM:	Barry Ball, Manager Water Resources Mary Shortland, Manager City Design
DATE:	22 July 2003
SUBJECT:	Design Standards for River Structures

The purpose of this memo is to provide background information on the basis of flood frequency derivation and more specifically to clarify design standards used for river structures. It follows the meeting between you and staff from Water Resources Branch and City Design.

Before discussion on the various design parameters used for the river structures, it is helpful to outline the background of Council's derivation of flood flows and levels for the river, as this will better put these discussions into context.

Background

In **1978** E&C decided that the 3.7 m Port Office profile should be used as the basis for setting habitable floor levels (Administrative Policy AP065). "4 Chain" maps originally prepared in 1982 and amended in 1987 referred to a Post Wivenhoe Q100 level equivalent to the 3.7 m profile.

A Brisbane River flood analysis memorandum, dated **18 September 1984** was prepared by [redacted] an engineer with Water Supply & Sewerage Department (copy attached). The memorandum includes a flood frequency curve with flow estimates from Q5 to Q one hundred million. The curve is a combination of historical data to estimate floods up to Q100 and modelled rainfall estimates for floods greater than Q1000. The modelled rainfall estimates would have been obtained from ongoing Water Resources Commission investigations at that time. A smooth line was drawn between the results from the two types of methodologies. It is assumed that the 6,800 m^3/s Q100 value was derived from interpreting this flood frequency curve.

This flood frequency curve was distributed to a Brisbane River Flood Maps Committee established by the Coordinator General Department. The committee adopted the flood frequency curve on the **8th November 1984**.

In **1985** the 1975 pre-Wivenhoe flood profile chart was modified to include the probabilities for Wivenhoe Dam in place. These probabilities with Wivenhoe Dam in place were based on the 1984 flood frequency curve. A subsequent chart based on the 1985 chart was drawn by BCC's Works Department in **1988** (copy attached) and includes a Q100 profile that corresponds to the 3.7m Brisbane Port Office flood profile.

In the normal conduct of business the 1988 chart and the 4-chain maps comprise the key information available from the various studies undertaken in the mid 1980's. The 1988 chart shows river levels and flows for flood frequencies from 1 in 25 to 1 in 50,000 for the Brisbane River from Mt Crosby to Luggage Point.

The Q100 read from the 1988 chart is currently used for setting development control levels for both Council and private building structures because it is consistent with Council's 1978 policy of 3.7m AHD at the Brisbane Port Office. City Design also uses these levels in their designs of Council building structures.

Q2000 can be estimated from the 1988 chart. However flow velocities, which are required for bridge design cannot be read from the 1988 chart. To determine velocities a separate model would have to be developed that replicates flows and flood heights shown in the 1988 chart.

In **1998** Sinclair Knight Merz (SKM) produced a final draft report commissioned by Council's Works Department. The methodology adopted is similar to that used in 1984 in that flood records were used to estimate frequencies up to Q100 and modelled rainfall data was used for the extreme event of Probable Maximum Flood (PMF). This report estimated a much higher flow for the Q100 event.

Expert opinion from Professor Russell Mein on **9 December 1998** considered that "the overall approach for the hydrologic component of the study ... is appropriate.", and that "unless there are compensating factors not yet identified, the Q100 obtained in the Study is likely to be an over-estimate".

Subsequent work was undertaken by City Design in June and December **1999** to address the issues raises by Professor Mein's review of the SKM report and focussed on determining the Q100 flow and level. This work could not be used to determine Q2000 without further studies to estimate extreme floods. The determination of extreme floods would have been undertaken once the Q100 issue had been resolved.

In **2001** the Ipswich City Council report, also completed by SKM, expanded on the City Design 1999 work and incorporated the estimate for probable maximum precipitation from the Bureau of Meteorology. The Q2000 flood event could be estimated from this work.

Design of River Structures

Q100 is used to determine the rise in water level (afflux) due to the bridge constriction.

Since 1992, Q2000 has been used to determine bridge structural strength for flood flow. When Q2000 flood levels and velocities are not available the current bridge design code cannot be used for the assessment of flood loads on bridges. In these cases City Design's practice has been to develop a load factor to be applied to the Q100 flood load to achieve the same design strength as the pre-1992 Bridge design code. This load factor was calculated to be 1.4. It does not infer that the Q2000 can be calculated from the Q100 based on this factor. It does infer that bridge design strength achieves the pre-1992 bridge design code requirements.

Three river structures were discussed at the meeting on **Tuesday 15 July 2003**, namely the Goodwill Bridge, the New Farm RiverWalk Floating Walkway and the Green Bridge. The comments below on each of the structures are set out in chronological order.

Goodwill Bridge (1999)

Engineering consultant WBM was commissioned by the Southbank Corporation to analyse the hydraulic performance of the bridge to provide velocities for the structural design of the bridge in **October 1999**. WBM used the 1988 chart to model flows from 6,700 m^3/s to 20,050 m^3/s (1 in 50,000). Increases in flood levels (afflux) were assessed using Q100 and flow velocities for structural design were based on the Q2000 flow.

State Development assumed responsibility for the bridge and submitted their design to BCC for comment. At that time the Brisbane River Flood Study was being reviewed and the flow from the Draft June 1999 report was not accepted as the Q100 flood flow. However it was considered prudent as a precautionary step to check the structural integrity of the bridge for the levels and velocities corresponding to this flow.

State Development was therefore requested by letter from Waterways, dated **11 November 1999**, that: "The load factor for the bridge is at least 1.4 when the water level is 5.0 m AHD and the debris load is applied at a peak water velocity of 2.9 m/s". This requirement was intentionally not represented to State Development as a particular flow (m^3/s) but was provided only as a check on the structural strength of the bridge. The letter was specifically worded so that it in no way compromised the 1988 information that was being used in the design process.

Council also advised in the same letter that it undertook its own studies to calculate the bridge afflux. This calculation was based on the June 1999 City Design draft report. Council asked the State Development to advise how they were to minimise the afflux caused by the bridge.

Note that State Development's hydraulic consultant WBM in their report of 19 October 1999 advised that they calculated an afflux of 60mm using the 1988 chart figures. BCC calculated the same level of afflux would apply for the 5.0m AHD event. This is expected since the afflux depends on flow velocities, which tend not to change significantly.

State Development's structural consultant Ove Arup advised on the **19 November 1999** that the Q2000 levels (from the 1988 chart) and velocities with a load factor of 1.0 were far more onerous than the load case mentioned by Council in its 11 November 1999 letter. In fact the controlling load case for the structural design of the bridge was found to be ship impact (which is independent of Q100).

New Farm RiverWalk Floating Walkway (2001)

There is no standard or code for floating walkways so City Design developed a set of design parameters in consultation with City Planning. These design parameters indicated that the strength of the walkway was to be based on the load from a Q2000 flow or the load from a Q100 flow with a load factor of 1.4. The marine specialist consultant (International Marina Consultants) normally designs marine structures for a Q100 flood load with a load factor of 1.5. WBM was engaged to prepare a sophisticated 3D model of the river in the New Farm reach.

WBM requested Q100 rather than the Q2000 from City Design's Water & Environment Group as this was the normal information required for the design of floating structures. Waterways advised City Design by e-mail dated **12 March 2001** that the current Q100 was to be used. In setting up its model WBM attempted to match the 3.7m AHD level at the Brisbane Port Office and reported a flow of 6,570 m^3/s rather than 6,800 m^3/s. This is close enough for modelling purposes. WBM presented their preliminary report on **29 March 2001.**

It should be noted that Q2000 was not considered as the marine specialist did not request it and no code or standard required it. Therefore the question of using the Ipswich flood study did not arise.

Green Bridge (2002)

Preliminary design of the Green Bridge was carried out in **May 2002**. The critical load case for the design of the bridge piers turned out to be ship impact not flood load.

The bridge code requires the use of Q2000 extreme flood flow data for the structural design of the bridge. The Ipswich model had determined extreme flood flows based on the most recent Bureau of Meteorology data.

As the Q2000 estimate is based on extreme flood event hydrology, City Design determined that the Ipswich flood study (released in **July 2001**) contained the most reliable extreme event data, from which a Q2000 could be estimated. After consultation with Waterways it was jointly agreed to issue the hydraulic consultant (DHI) with the Q2000 derived from data in this report. These data were used to prepare a specialised 3D model of the St Lucia reach. This enabled velocity distributions in the both horizontal and vertical planes to be calculated.

The 3D model was also used to check afflux caused by the bridge using a flow of 8,000 m^3/s. This was expedient as a model based on 8000 m^3/s was readily available and on the understanding that if there were no design changes required with the 8,000 m^3/s flow then there would not be a problem at 6,800 m^3/s. The afflux calculated using the 8,000 m^3/s flow was found acceptable.

If the 1988 chart was used a separate model would need to be developed to replicate the flows and flood heights shown in the 1988 chart. This would have required additional time and costs that were not warranted.

Conclusion

City Design and Water Resources Branch work collaboratively in providing flood information for various purposes. Information has been provided consistently considering the circumstances prevailing at the time, utilising best engineering judgement and in the best Interests of community safety. For example the use of 3.7 m AHD Brisbane Port Office profile Council policy for setting habitable floor levels for houses is also used by City Design to design Council buildings such as libraries, depots offices etc.

The process of determining parameters for structures built on or adjacent to the river has been enhanced as the result of this discussion. In future a ~~form showing agreed parameters will be signed~~ by Water Resources and City Design and placed on the appropriate file as a record of that decision.

both will jointly approve & sign off on the agreed parameters before completing

If you would like to discuss any aspects of this memo, please call us on [redacted] or [redacted] respectively.

Barry Ball
Manager Water Resources
URBAN MANAGEMENT DIVISION

Mary Shortland
Manager City Design
CITY BUSINESS DIVISION

DEPARTMENT OF WATER SUPPLY AND SEWERAGE

KLH/LBP

[redacted]

18th

MEMORANDUM: The Investigating Engineer

The Effect of Wivenhoe Dam on the Frequency of Flooding in the Lower Brisbane River

With both the Wivenhoe Dam and the manual of flood control operations for the Somerset Dam-Wivenhoe Dam system nearing completion, it has been necessary to re-examine the effect of Wivenhoe Dam on the frequency of flooding in the urban areas.

The flood maps published in 1975 quoted flood frequencies calculated for Somerset Dam alone in operation. In 1977, once construction on Wivenhoe Dam had commenced, a study of the effect of Wivenhoe Dam on the historical floods was completed. A flood control strategy was assumed and the resultant flood discharges were subjected to frequency analysis. The Boughton distribution was judged to be the best fit distribution and this distribution has been used to estimate the frequencies of floods with Wivenhoe Dam also in operation.

In writing the flood control operations manual, it was necessary to develop a number of procedures dependent on the magnitude and origin of the flood. Because of the small number of major floods in the historical record, it was also necessary to synthesise a range of low probability floods and the P.M.F. These floods were generated from low probability rainfalls using a runoff-routing model. The synthesised floods had probabilities in the range 2%-0.001% with the P.M.F. having a probability of 0.000001%.

The effect of Wivenhoe Dam on flooding in the Brisbane River was estimated by applying the proposed procedures to the historical and synthesised floods. The proposed procedures create a discontinuity in the distribution of flood discharges. Small and medium sized floods (2-4 metres on the Brisbane City Gauge) originating in the upper Brisbane and Stanley catchments will be reduced to non-damaging freshes, i.e., less than 2 metres on the Brisbane City Gauge. Major floods from the upper catchments will be reduced but still cause extensive inundation and damage in the urban areas. Flood levels for these major floods are expected to exceed 3.5 metres on the Brisbane City Gauge.

Floods in the range 2-3.5 metres at the Brisbane City Gauge will originate in the catchment below Wivenhoe Dam, i.e. metropolitan creeks, Bremer River, the middle Brisbane River catchment and Lockyer Creek. Flows of these magnitudes originating in any of these catchments have a low probability (estimated less than 1%). The only historical flood for which these catchments would have caused flooding of the urban areas without the contributions from the upper catchments was in January 1974.

All but two of the historical annual peak floods analysed could be reduced to non-damaging flows in the urban areas, i.e., below the 2 metre flood profile. This corresponds to the discharge level to be used for the emptying of the

BCC.081.0279

flood storage of Wivenhoe Dam. The floods of February 1893 and January 1974 would be reduced to approximately 4 metres and 4.6 metres on the Brisbane City Gauge respectively if the procedures in the manual were strictly followed. However, these levels can be reduced to 3.4 metres and 4 metres respectively using the discretionary powers of the Engineer. These levels are 0.6 and 1 metre higher than previously estimated in 1978.

The procedures were designed to ensure the safety of the dams whilst reducing the magnitude of downstream flooding. For floods of magnitudes similar to 1893 and 1974, there is ample storage available for the Engineer to use his discretionary powers.

The synthesised floods with probabilities of 2% and 1% could be reduced to non-damaging freshes, while the remaining synthesised floods, being significantly larger than the largest historical flood, would result in flood levels much higher than those reached in the January 1974 flood.

The probability plot of flood discharges with Wivenhoe Dam in operation is shown on Figure 1, the discharges for the floods of 1893 and 1974 corresponding to discretionary operation. The discontinuous distribution of discharge is demonstrated by the clusters at 1000, 1600 and 3500-4000 m^3/s and the jump to 6000 m^3/s for the 1893 flood. Since discharges less than 4000 m^3/s do not cause damage in the urban areas and this discharge is to be used for the emptying of the flood storage, it is necessary to allocate probabilities to floods in excess of this discharge only. There are only two historical and four synthesised data points in this range, and the straight line shown is considered to be a reasonable estimate of the probabilities of damaging floods.

The Boughton distribution frequency curve calculated in 1978 is plotted by comparison. There is no appreciable difference between the straight line and the curve for probabilities less than 1% and, in fact, the Boughton curve is a reasonably fit for discharges in excess of 1000 m^3/s. This distribution has been used since 1978 and it is considered that probabilities from this distribution can be used for discharges less than 4000 m^3/s if these are required.

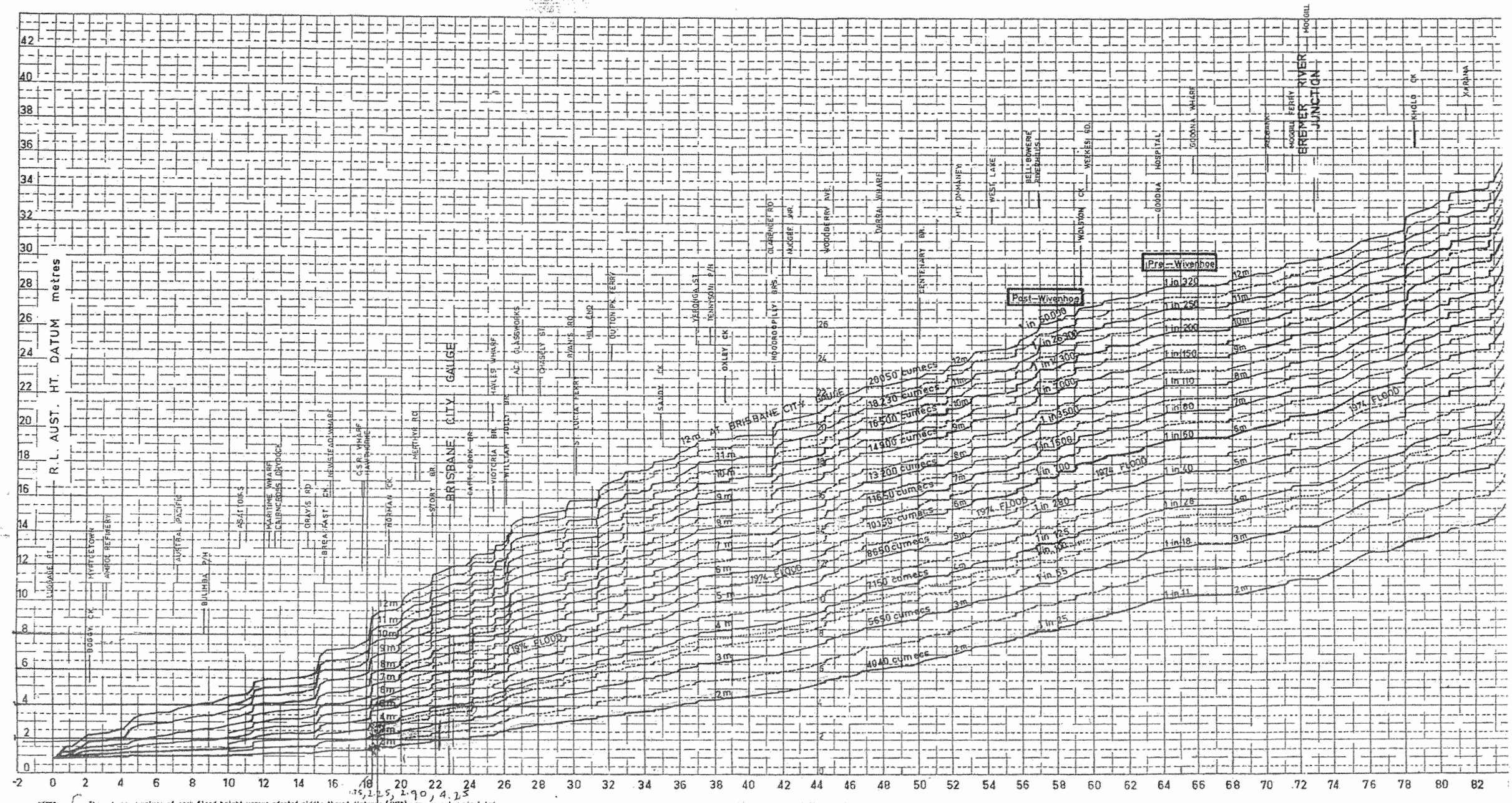


W.S. Investigation

BCC.081.0280

Fig 1

BCC.081.0281



NOTES:

The plotted values of peak flood height versus adopted middle thread distance (AMTD) were computer simulated on the basis of river channel surveys by the Department of Harbours and Marine, bank contours by the Survey Department, discharge measurements at Centenary Bridge by the Queensland Irrigation and Water Supply Commission in 1950 and 1974 and from flood level surveys by Brisbane City Council in 1968 and 1974. The simulation was based on a standard 2 metre tide on Port Office Datum (= 0.85m on A.H.D.) and all plotted levels are on Australian Height Datum (A.H.D.) Each plotted envelope corresponds to an even flood level at the Brisbane City gauge ranging from 2m to 12m by half metre increments.

Peak flood flows were assumed to be uniform from the junction of the Bremer River (AMTD 72.5 kilometres) to the south of the Brisbane River and a uniform flow of 85% of the above peak value was assumed between Mt. Crosby (AMTD 90.7 kilometres) and the Bremer Junction (AMTD 72.5 kilometres).

Frequencies for Brisbane River flooding were derived by Brisbane City Council in 1984 as an annual series from date from 1887 to 1983 for the condition of Somerset Dam and Wivenhoe Dam in operation and 1974 (post flood) conditions of the Brisbane River channel.

1.75, 2.25, 2.90, 4.25

50% OF ORIGINAL SCALE

BCC.081.0282

MJR-13

DEPARTMENT OF WATER SUPPLY AND SEWERAGE

KLH/LBP

[redacted]

18th September 1984

MEMORANDUM: The Investigating Engineer

The Effect of Wivenhoe Dam on the Frequency of Flooding in the Lower Brisbane River

With both the Wivenhoe Dam and the manual of flood control operations for the Somerset Dam-Wivenhoe Dam system nearing completion, it has been necessary to re-examine the effect of Wivenhoe Dam on the frequency of flooding in the urban areas.

The flood maps published in 1975 quoted flood frequencies calculated for Somerset Dam alone in operation. In 1977, once construction on Wivenhoe Dam had commenced, a study of the effect of Wivenhoe Dam on the historical floods was completed. A flood control strategy was assumed and the resultant flood discharges were subjected to frequency analysis. The Boughton distribution was judged to be the best fit distribution and this distribution has been used to estimate the frequencies of floods with Wivenhoe Dam also in operation.

In writing the flood control operations manual, it was necessary to develop a number of procedures dependent on the magnitude and origin of the flood. Because of the small number of major floods in the historical record, it was also necessary to synthesise a range of low probability floods and the P.M.F. These floods were generated from low probability rainfalls using a runoff-routing model. The synthesised floods had probabilities in the range 2%-0.001% with the P.M.F. having a probability of 0.000001%.

The effect of Wivenhoe Dam on flooding in the Brisbane River was estimated by applying the proposed procedures to the historical and synthesised floods. The proposed procedures create a discontinuity in the distribution of flood discharges. Small and medium sized floods (2-4 metres on the Brisbane City Gauge) originating in the upper Brisbane and Stanley catchments will be reduced to non-damaging freshes, i.e., less than 2 metres on the Brisbane City Gauge. Major floods from the upper catchments will be reduced but still cause extensive inundation and damage in the urban areas. Flood levels for these major floods are expected to exceed 3.5 metres on the Brisbane City Gauge.

Floods in the range 2-3.5 metres at the Brisbane City Gauge will originate in the catchment below Wivenhoe Dam, i.e. metropolitan creeks, Bremer River, the middle Brisbane River catchment and Lockyer Creek. Flows of these magnitudes originating in any of these catchments have a low probability (estimated less than 1%). The only historical flood for which these catchments would have caused flooding of the urban areas without the contributions from the upper catchments was in January 1974.

All but two of the historical annual peak floods analysed could be reduced to non-damaging flows in the urban areas, i.e., below the 2 metre flood profile. This corresponds to the discharge level to be used for the emptying of the

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flood storage of Wivenhoe Dam. The floods of February 1893 and January 1974 would be reduced to approximately 4 metres and 4.6 metres on the Brisbane City Gauge respectively if the procedures in the manual were strictly followed. However, these levels can be reduced to 3.4 metres and 4 metres respectively using the discretionary powers of the Engineer. These levels are 0.6 and 1 metre higher than previously estimated in 1978.

The procedures were designed to ensure the safety of the dams whilst reducing the magnitude of downstream flooding. For floods of magnitudes similar to 1893 and 1974, there is ample storage available for the Engineer to use his discretionary powers.

The synthesised floods with probabilities of 2% and 1% could be reduced to non-damaging freshes, while the remaining synthesised floods, being significantly larger than the largest historical flood, would result in flood levels much higher than those reached in the January 1974 flood.

The probability plot of flood discharges with Wivenhoe Dam in operation is shown on Figure 1, the discharges for the floods of 1893 and 1974 corresponding to discretionary operation. The discontinuous distribution of discharge is demonstrated by the clusters at 1000, 1600 and 3500-4000 m^3/s and the jump to 6000 m^3/s for the 1893 flood. Since discharges less than 4000 m^3/s do not cause damage in the urban areas and this discharge is to be used for the emptying of the flood storage, it is necessary to allocate probabilities to floods in excess of this discharge only. There are only two historical and four synthesised data points in this range and the straight line shown is considered to be a reasonable estimate of the probabilities of damaging floods.

The Boughton distribution frequency curve calculated in 1978 is plotted by comparison. There is no appreciable difference between the straight line and the curve for probabilities less than 1% and, in fact, the Boughton curve is a reasonably fit for discharges in excess of 1000 m^3/s. This distribution has been used since 1978 and it is considered that probabilities from this distribution can be used for discharges less than 4000 m^3/s if these are required.

[redacted]

W.S. Investigation

BCC.081.0280

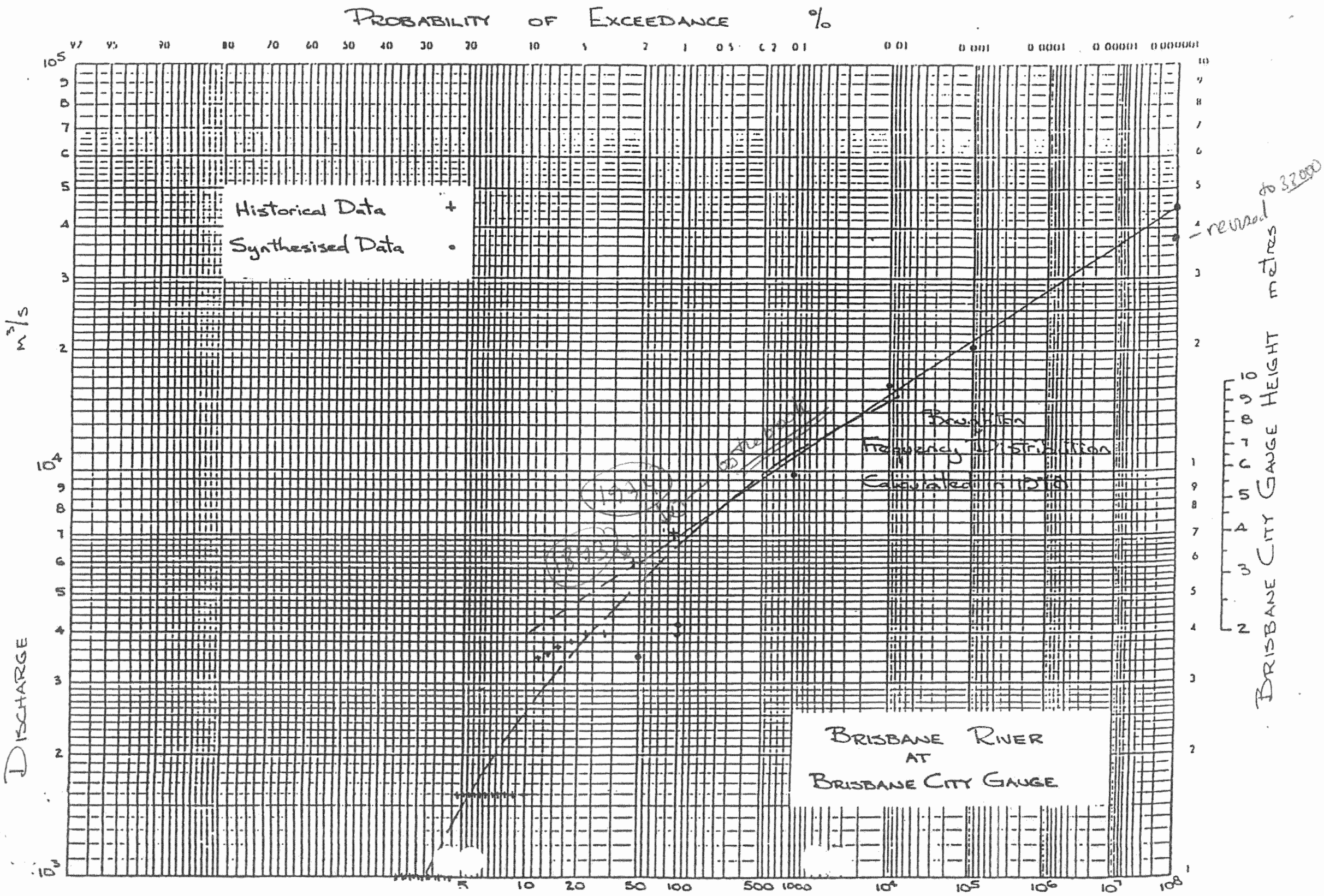


Fig. 1

BCC.081.0281

MJR-12

SERIAL NO. (034) SAFETY AND SECURITY - 10.1.1

BRISBANE CITY COUNCIL POLICY

AFFECTING THE TOWN PLAN OR ANY PART OF SUCH PLAN

Establishment and Co-ordination Committee's recommendation of 4th December, 1978 presented to Council on 5th December, 1978, and ADOPTED.

BRISBANE RIVER FLOODS - RESTRICTION ON RESIDENTIAL USE

That the Council adops the following as policy under Section 11 of the City of Brisbane Town Planning Act 1964-1977:-

(1) Consent should not be granted to development -

(a) being a development commenced after the appointed day and not being the erection of a building or other structure involving erection carried out in relation to an existing building or any use of such building or other structure; and

(b) containing more than one dwelling unit or one rooming unit,

if the floor level of any habitable room is at or below the level of the Brisbane River flood which would have a height at the Brisbane City Gauge of 3.7 metres above the Australian Height Datum.

(2) The Board should not approve an application in respect of a proposal plan providing for a subdivision of land in which any proposed residential allotment would be so inundated by the waters of the Brisbane River flood which would have a height at the Brisbane City Gauge of 3.7 metres above the Australian Height Datum that such allotment would not -

(a) contain a sufficient site for a detached house; and

(b) have access to such site; and

(c) have such access from roads,

which site, access and roads would be above such a flood.

BCC.042.4109

MJR-11

10·01402·07·00

DEPARTMENT OF WORKS

TWC:GB

~~304/45/225~~

REF. 223/01/18

- 3 NOV 1978

CENTRAL RECORDS

31 August 1978

MEMORANDUM:

Chief Engineer and Manager

APPROVAL FOR THE ERECTION OF DWELLINGS IN FLOOD PRONE AREAS

The Establishment and Co-ordination Committee at its meeting held on 13 September 1976 approved of a memorandum of the Manager, Department of Health Parks and Building in which the anticipated 1974 river flood level after Wivenhoe Dam formed the basis of recommended floor levels for habitable rooms.

To date, the Works Department has advised of the anticipated effects by adopting a flood storage component for the proposed Wivenhoe Dam of 1.04 million Ml. This results in a 1974 type river flood being reduced from a level of 5.5 m to a level of 3.7 m approximately (Australian Height Datum) at the Brisbane City Gauge.

The flood storage component has subsequently been set at 1.4 million Ml, and it is now anticipated the 1974 type flood controlled by the dam would be mitigated to 3 m at the Brisbane City Gauge. This would have the effect of lowering the actual floor levels recommended up until now. By way of example, flood levels in the Oxley Creek area are affected as follows.

Level at Brisbane City Gauge	Anticipated Level Oxley Creek Area
5.5 - actual 1974	R.L. 40 ft. BCC
3.7 - mitigated level currently used	R.L. 29 ft. BCC
3 - mitigated level from larger dam	R.L. 25 ft. BCC

For this larger dam, the 3 m mitigated flood is estimated to be an average 1 in 55 years event, and the 3.7 m mitigated flood to be an average 1 in 100 years event. It is considered that immunity from the 1 in 100 year flood is a minimum desirable standard.

The matter has been discussed with the Department of Health Parks and Building and that Department agrees with the Works Department in the following recommendation.

.../2

RECOMMENDATION

1. That the 3.7 m flood at the Brisbane City Gauge be retained as a basis for recommending habitable floor levels of dwellings in areas prone to Brisbane River flooding.

[redacted]

A/Engineer for Design

Town Clerk

I concur.

[redacted]

APPROVED BY THE ESTABLISHMENT AND CO-ORDINATION COMMITTEE. 30/10/78

[redacted]

(1) Mgr H.P.& B.

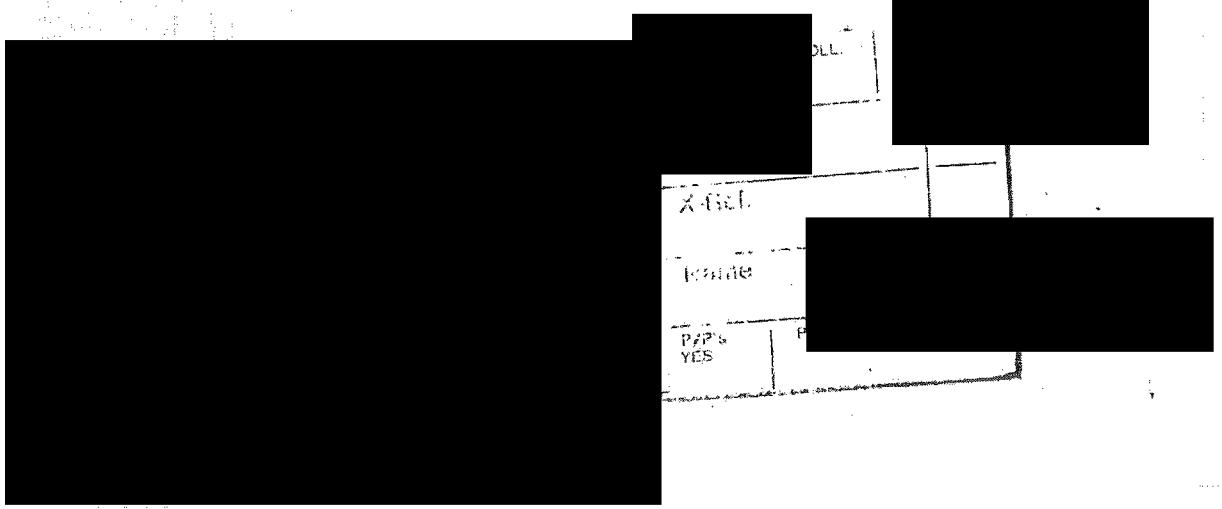
(2) Retur[redacted]

Original retained with Establish[redacted] Co-ordination Committe[redacted] Minutes

[redacted]

RECEIVED
DEPT. OF CITY ADMIN.
30 OCT 1978
GENERAL ADMIN. BRANCH

[redacted]



MJR-10

DEPARTMENT OF WATER SUPPLY AND SEWERAGE
KLH/LBP

21 March 1978

MEMORANDUM: The Investigating Engineer

Brisbane River Flood Frequency Studies

Frequency analyses have been carried out using flows at Moggill to determine the frequency of river flooding in the Brisbane area. The analyses were carried out for existing conditions (i.e. Somerset Dam only) and for conditions after the construction of Wivenhoe Dam with a flood storage of 1.4 million megalitres.

Three different probability distributions were fitted to the plotted positions of the data for both conditions. The distributions tested were Log Pearson Type III, Pearson Type III and Boughton's Empirical. These distributions are plotted together with the data on Figs. (i) and (ii) for existing and post-Wivenhoe conditions respectively.

For existing conditions Log Pearson Type III was marginally the best fit while Boughton' Empirical was the best fit for the post-Wivenhoe data. For both conditions Pearson Type III was the second best fit.

The Maximum Probable Flood for the Brisbane River under existing conditions is 19,500 cumecs. This is generally given a return period of 10,000 years or more. Reference to Fig. (i) shows that although Log Pearson Type III fits the plotted data marginally better than Pearson Type III, the return period for the Maximum Probable Flood is 300 years. Pearson Type III gives a return period in excess of 10,000 years for this event.

Log Pearson Type III has been recommended as the distribution to be used in flood frequency studies of natural flows. It appears that a curve of best fit, fitted by eye, lying between Log Pearson Type III and Pearson Type III gives a better estimate of flood frequencies in the damage zone (ie. Flood heights greater than 1 metre on the Brisbane City Gauge) as shown in Fig. (iii).

The flood storage of 1.4 million megalitres for Wivenhoe Dam is so large that only the top ten ranked annual floods would rise above 1 metre on the Brisbane City Gauge. Only the top three annual floods would rise above the 1968 flood level (2 metres on the Brisbane City Gauge) and cause significant damage. The remaining floods could be either fully stored in the dam and released at a low flow or else allowed to pass through the storage with minor reduction inpeak flow. Bridge submergence flows would be a major parameter in determining discharge rates. Bremer River and Lockyer Creek would provide the major components of the flow through the Brisbane area.

Although the inflows to flood storages can be analysed using formal frequency functions, the Irrigation and Water Supply Commission advises that the fitting of formal frequency functions to the outflows of a flood storage can yield meaningless results. A curve, fitted by eye to the plotted data, yields more meaningful results and is recommended.

Reference to Fig. (ii) shows that Boughton's Empirical function cannot be significantly bettered as a curve of best fit for post-Wivenhoe data.

..2

Wivenhoe Dam would reduce a 5.5 metre flood under existing conditions to a 3 m flood and a 3.5 metre flood to a 2 metre flood. The table shows that the return periods of 5.5 metre and 3.5 metre floods under existing conditions to be 50 years and 23 years respectively using Log Pearson Type III and the 3 metre and 2 metre floods post-Wivenhoe to have return periods of 55 years and 25 years respectively using Boughton's Empirical method. These results are consistent even though different functions are used.

The results of the flood frequency studies are in the table, which shows the return period of floods rising to given levels on the Brisbane City Gauge.

B.C.G. Ht. m	Flow Cumecs	Existing Conditions		Post-Wivenhoe
		Log Pearson III	Curve of Fit	Boughton
2	4,040	11	11	25
2.5	4,840	14	14	35
3	5,650	18	18	55
3.5	6,445	23	25	80
4	7,150	28	32	125
4.5	7,900	34	40	165
5	8,650	40	52	280
5.5	9,370	50	70	400
6	10,150	60	90	625
7	11,650	80	135	1,300
8	13,200	110	275	3,500
9	14,900	150	580	9,000
10	16,500	200	1,400	>10,000
11	18,230	250	3,200	>>10,000
12	20,050	320	10,000	>>10,000

K.L. Hegerty

PROBABILITY OF EXCEEDANCE %

99.99 99.9 99.8 99 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01

cumecs

FLOW

SOMERSET DAM ONLY

Log Pearson III

Pearson III

Boughton

RETURN PERIOD years

BRISBANE CITY GAUGE metres.

GORMACK GRAPH PAPERS, CHRISTCHURCH N.Z. P222Y Probability x 2 cycle log

PROBABILITY OF EXCEEDANCE %

99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05

10^5 9 8 7 6 5 4 3 2

cumecs

10^4 9 8 7 6 5 4 3 2

FLOW

10^3

0.01 0.05 0.1 0.2 0.5 1 2 5 10

SOMERSET DAM ONLY

Arbitrary Curve of Fit

2 5 10 20 50 100 200 500 1000 5000

RETURN PERIOD years

P222Y Probability x 2 cycle log

GORMACK GRAPH PAPERS : CHRISTCHURCH N Z

BCC:081.0174

PROBABILITY OF EXCEEDANCE %

99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01

FLOW cumecs

10^5 1 9 8 7 6 5 4 3 2

10^4 1 9 8 7 6 5 4 3 2

10^3 1

0.01 0.05 0.1 0.2 0.5 1 2 5 10 20 50 100 200 500 1000 5000

RETURN PERIOD years

BRISBANE CITY GAUGE metres

12 11 10 9 8 7 6 5 4 3 2

Log Pearson III

Baughton

Pearson III

SOMERSET PLUS WIVENHOE

P222Y Probability x 2 cycle log

GORMACK GRAPH PAPERS, CHRISTCHURCH N.Z.

BCC.081.0175

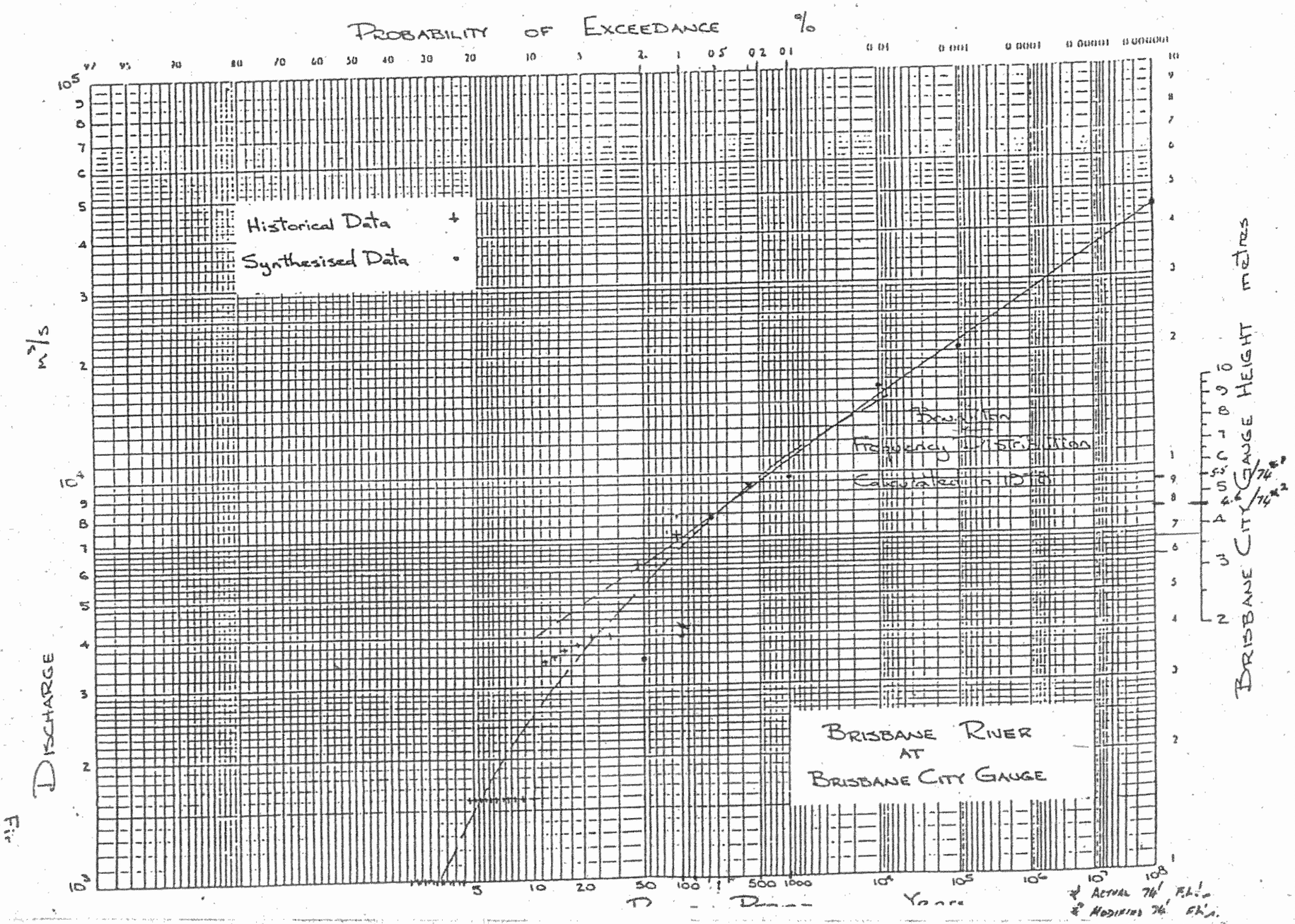
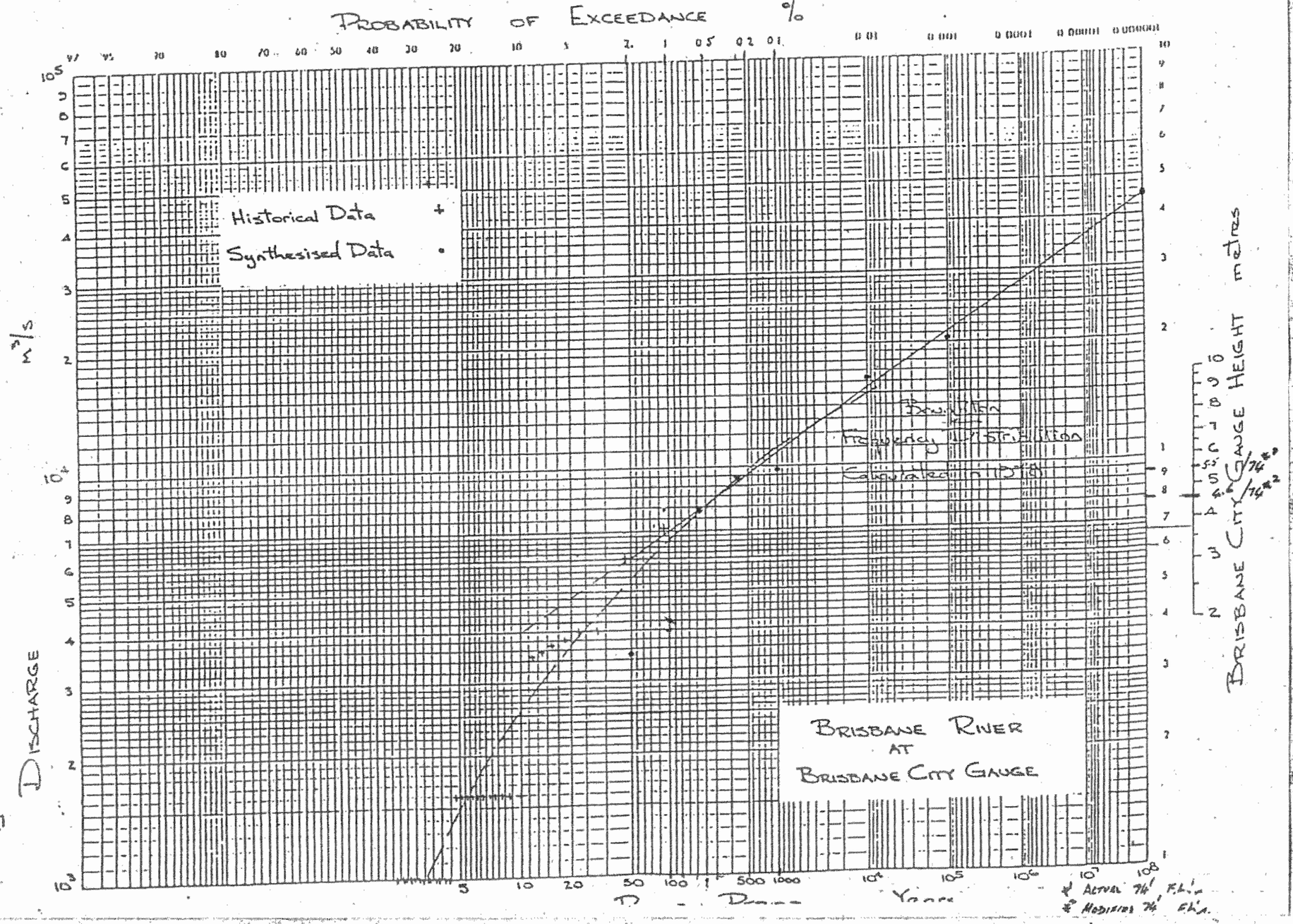

PROBABILITY OF EXCEEDANCE %
Historical Data +
Synthesised Data •
Frequency Distribution
Calculated in 1978
BRISBANE RIVER
AT
BRISBANE CITY GAUGE
DISCHARGE
m³/s
BRISBANE CITY GAUGE HEIGHT metres
Years
* ACTUAL 74' F.L.'s
* MODIFIED 74' F.L.'s

Fig.


PROBABILITY OF EXCEEDANCE %
99 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.01 0.001 0.0001 0.00001
Historical Data +
Synthesised Data •
DISCHARGE m³/s
Fig.
BRISBANE RIVER AT BRISBANE CITY GAUGE
Frequency Curve
Calculated
T - Years
3 10 20 50 100 500 1000
BRISBANE CITY GAUGE HEIGHT metres
* ACTUAL 74' F.L.
* MODIFIED 74' F.L.

BCC.081.0177

MJR-9

52418

6

DEPARTMENT OF HEALTH, PARKS AND BUILDING

4th August, 1976.

MAP:DFO

MEMORANDUM:

TOWN CLERK

Approval for the Erection of Dwellings in Flood Prone Areas

As a result of detailed surveys and debris levels recorded by Council surveyors after the January '74 Flood, the effect of the flood on land in many areas was plotted on 4 chain maps and this information has been used as a basis for determining the suitability of a site for residential development.

It has been the practice on receipt of a building application for the erection of a dwelling on land affected by the flood to forward a standard memo to the Works Department seeking their comments, and until such time as a reply is received the applicant is informed that approval of the building application must be withheld.

Information which is received from the Works Department sets out in detail the extent to which the site was flooded and the anticipated reduced level after the construction of the Wivenhoe Dam.

When the habitable floor level of the dwelling as designed will be above the anticipated flood level after the Wivenhoe Dam has been constructed, it has been the practice of the Department to recommend that the building application be approved, subject to the lower part of the house not containing any habitable rooms, and all material used in this area to be flood resistant, such as concrete block, brickwork or concrete.

This is normally acceptable to the applicant, who in almost every case is aware of the fact that the site was affected by flooding, and this has dictated the design of the house to the extent that it is usually high-set, with accommodation for cars and laundry and storage rooms at ground level.

There has been a number of cases recently, however, where the applications have been returned from the Works Department with endorsements to the effect that the building application should be refused because the floor level will be below the 1974 flood level, and further consideration be given after the Wivenhoe Dam is constructed.

It is felt that this inconsistency is resulting in undue hardship for builders and home owners, and it would be desirable to adopt a firm policy as to what action should be taken in this regard.

The facts as contained in the attached file No. 223/15/2850/76 will clearly illustrate the difficulty this department is experiencing with proposals of this nature, and also the lack of authority to refuse a building application.

...../2.

BCC.081.0178

The above facts are submitted for the consideration of the Committee, with a recommendation that, on receipt of a building application for the erection of a dwelling on a site in a flood prone area, the application be referred to the Department of Works for comments, and approval granted in those cases where investigations have revealed that the floor level of any habitable rooms will be above the anticipated flood level after the Wivenhoe Dam has been constructed, and any part of the dwelling below this level to be constructed out of flood resistant material such as concrete block, brickwork or poured concrete.

[redacted]

[redacted]

ACTION TAKEN
15/9/76
TOWN CLERK

Subject to applicants being informed that Council records will be noted so that intending future purchasers will be able to find out the flood-prone problem.

APPROVED
J. Sleeman
Lord Mayor
76

[redacted]

[redacted]

MJR-8

Brisbane City Council

FloodWise Property Report

Report Reference
1743893
01/09/2011 15:21:45

Dedicated to a better Brisbane

The FloodWise Property Report is a free report to inform Brisbane residents and professionals about flood risks for a specified lot or property so they may better prepare for flooding and to plan and build in accordance with Council requirements. A flood level higher than those shown below can occur in any year, although such events are rare.

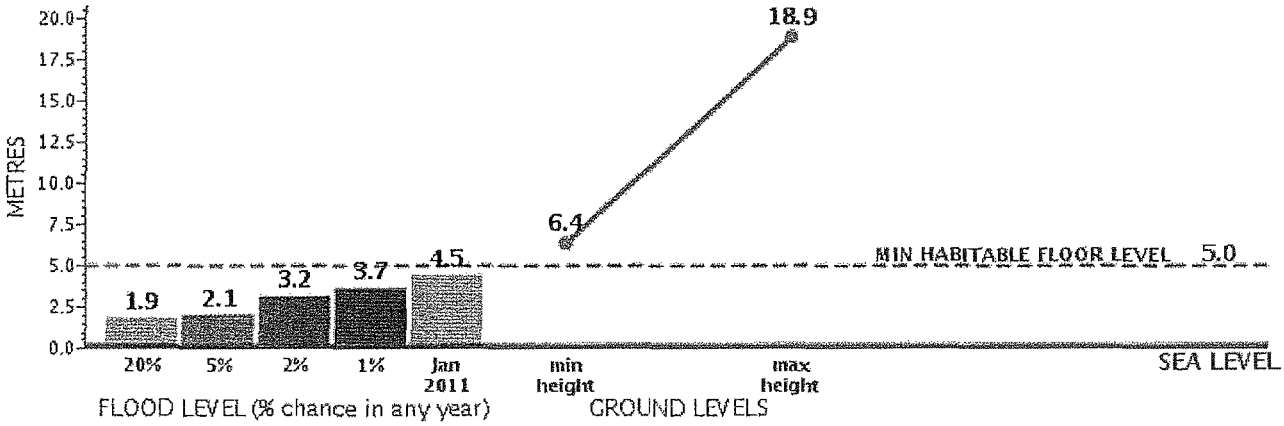
To find out more about how the contents of this report may affect your ability to build or renovate, as well as Council advice on how to protect your property and family by being FloodWise, visit www.brisbane.qld.gov.au, a Customer Service Centre or call (07) 3403 8888.

PROPERTY DETAILS:

Address: U 1 WATERMARK RESIDENCES [redacted]
(user selected)

Lot Details: L.1/BUP.106664

FLOOD LEVEL INFORMATION



Flood Levels
The blue bars in the graph above show the percentage chance of that level being reached or exceeded in any year. The orange bar shows the January 2011 flood level at this address or lot.

Ground Levels (Min - Max)
The line above shows this property's lowest and highest ground levels. Confirm with a surveyor.

Minimum Habitable Floor Level
The dotted line in the graph above depicts the minimum height above sea level that habitable areas of development must be constructed to, i.e. lounge, kitchen or bedroom. Council recommends you confirm existing floor levels with a surveyor.



For a detailed summary of anticipated flood levels and flags see technical summary over page.

HIGHEST SOURCE OF FLOODING

RIVER The highest source of flooding affecting this property originates from a river. For more information about flooding in your area you can view and download Council's Flood Flag Maps by visiting www.brisbane.qld.gov.au/floodmap

Technical Summary

Use this summary to supply information about this property to surveyors, builders, certifiers, architects and engineers who may request this FloodWise Property Report. This summary has been designed to be easily read if scanned or faxed.

Property Details

Address: **U 1 WATERMARK RESIDENCES** [redacted]
(as known to Council) [redacted]

Lot Details: **L.1/BUP.106664**

Flooding Information

Minimum Ground Level (AHD)	6.4 m
Maximum Ground Level (AHD)	18.9 m
Interim Residential Flood Level (IRFL)	4.5 m
Interim Residential Flood Level Source	RIVER
Minimum Habitable Floor Level (AHD)	5.0 m

Estimated Peak Flooding Levels

ARI (Years)	% chance	Level (AHD)	Source
5	20%	1.9 m	STORM TIDE
20	5%	2.1 m	STORM TIDE
50	2%	3.2 m	RIVER
100 or DFL	1%	3.7 m	RIVER
January 2011		4.5 m	RIVER

Flooding may also occur from:	STORM TIDE

Disclaimer

1 Defined Flood Levels and Interim Residential Flood Levels, and the Minimum Habitable Floor Levels based on them, are determined from the information available to Council at the date of issue. These flood levels, for a particular property, may change if more detailed information becomes available or changes are made in the method of calculating flood levels.

2 Council makes no warranty or representation regarding the accuracy or completeness of a FloodWise Property Report. Council disclaims any responsibility or liability in relation to the use or reliance by any person on a FloodWise Property Report.

Useful Definitions

Australian Height Datum (AHD) – The reference level for defining ground levels in Australia. The level of 0.0m AHD is approximately mean sea level.

Average Recurrence Interval (ARI) or % Chance – The probability of experiencing a flood of a particular magnitude. ARI can be interpreted in terms of years (frequency). ARI levels quoted in this report are measured in height above sea level (AHD). ARI can also be described as the percentage chance that a location will flood in any one year. For example, a 5 year ARI flood event corresponds to a 20% likelihood of a flood of this magnitude or greater occurring in any one year.

Defined Flood Level (DFL) – The flood level associated with a defined flood event. Commonly, the standard used is the 100 year ARI. For further information refer to the House Code in Brisbane City Plan 2000, specifically Table 1: House Flood Immunity Levels for residential property.

Maximum and Minimum Ground Level – Highest and lowest ground levels on the property based on available ground level information. A Registered Surveyor can confirm exact ground levels.

Minimum Habitable Floor Level – The minimum level above sea level at which habitable areas of development (generally including bedrooms, living rooms, kitchen, study, family and rumpus rooms) must be constructed.

City Plan 2000 – City Plan 2000 sets out what you can build and where new development should go. Council assesses proposed new development against the City Plan 2000.

Interim Residential Flood Level (IRFL) – The flooding standard adopted by Council following the January 2011 flood event to be applied to new residential development.

Find Out More

Whether you are building, buying, renting or preparing your property for flooding, obtaining a FloodWise Property Report is the first step in determining your property's flood risk. Council's 'Be FloodWise' series of publications can assist you to plan ahead, respond to and recover from flooding. They are available online at: http://www.brisbane.qld.gov.au/floodwise or by phoning Brisbane City Council on (07) 3403 8888.

The 'Be FloodWise' publications include:

Preparing for Flooding

Assess your flood risk, prepare for and respond to, flood events.

Be FloodWise - A guide for residents

Buying / Renting

Assess the flood risk of a property before making a decision to rent or buy.

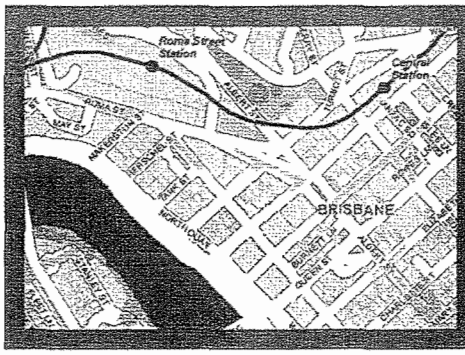
Buying and renting fact sheet

Building or Renovating

Renovations around your home or business can impact on your flooding exposure. Ensure your house meets City Plan 2000 flood immunity

Building and renovating fact sheet

If you are planning to renovate or build, Council recommends you engage a Registered Professional Engineer of Queensland to undertake a thorough assessment of all flood risks specific to the property.



Get a Free Flood Flag Map

Find out more about predicted flooding in your suburb or area by downloading a free Flood Flag Map. The map shows overland flow paths and where flooding may occur from creeks, rivers and storm tides on a suburb scale.

For more information visit **www.brisbane.qld.gov.au/floodmap** or visit a Council Customer Service Centre

MJR-7

DECISION OF THE BRISBANE CITY COUNCIL

ESTABLISHMENT AND CO-ORDINATION Committee's Recommendation of 24 November 2003

Presented to Council: 2 DECEMBER 2003; and ADOPTED

J SETTING OF FLOOD DEVELOPMENT LEVELS AND ADOPTION OF NEW FLOOD MEASUREMENT STANDARDS
295/10/10

82. The Divisional Manager, Urban Management Division, provides the following background information in relation to this matter.

83. Throughout this document the terminology Q100 is used. Q100 refers to the flow that has a one in one hundred chance of being exceeded in any year. Q100 is equivalent to the 100 year Average Recurrence Interval (100 year ARI) terminology used in some publications. As the flow varies along the river, the flow is related to a reference point. For the present purpose Q100 refers to the flow in the river at the Brisbane Port Office gauge, which is near the corner of Edward and Alice Streets.

84. Administrative Policy No. AP065 – *Erection of Dwellings in Flood Prone Areas* was adopted by the Establishment and Co-ordination Committee on 30 October 1978, and still applies. This policy states that flood levels are a basis for recommending habitable floor levels of dwellings erected in areas prone to Brisbane River flooding, and that the 3.7m Australian Height Datum (AHD) flood level at the Brisbane City Gauge applies. It is recommended that, while this standard remain the same for habitable development, the nomenclature be changed to separate this standard from the standard pertaining to other structures requiring Q100 information as part of the design process, eg. pontoons.

85. In 1984, a Brisbane City Council (BCC) study determined that Q100 = 6,800 cumecs (m^3/sec), which corresponds to 3.7m AHD at the Brisbane Port Office. A committee comprising representatives from BCC and State Government signed off on this flow in November 1984.

86. A graph is used to determine flood levels along the length of the river corresponding to the 3.7m AHD level at the Brisbane Port Office gauge. The graph was prepared in 1988, and has been used ever since to set development levels along the river. It is proposed that the levels interpreted from this graph continue to be used for development purposes.

87. Work undertaken by the State Government in the 1990s, indicated that the Q100 flow in the river might have been higher than the 6,800 cumecs estimated in the 1980s.

88. In November 1996, BCC commissioned Sinclair Knight Merz (SKM) to undertake a study of flood flows in the Brisbane River. One of the outputs of that report was an estimation of the Q100 flow. Following is a chronology of the work undertaken since then:

- 1998 February – Draft SKM Report
- 1998 December - Peer review [redacted]
- 1999 June and December - City Design's Draft Reports
- 2000 October – Review of issues and progress by stakeholders. The Department of Natural Resources (DNR) committed to provide information on Areal Reduction Factors (ARF) within a few months

- 2003 June – the Department of Natural Resources and Mines (DNRM) produces draft results with Areal Reduction Factors and estimated a Q100 flow of 6,000-7,000 cumecs at the Brisbane Port Office

- 2003 July and August – SKM and City Design undertake rainfall and flow analysis using the latest DNRM information

- 2003 September – Independent expert panel completes its review into the Q100 flow and level at the Brisbane Port Office gauge

89. The expert panel determined that the plausible range for the Q100 flow in the Brisbane River is 5,000 to 7,000 cumecs, corresponding to levels of 2.8 to 3.8 m AHD respectively. Thus the current Q100 of 6,800 cumecs is within the plausible range.

90. The expert panel's best estimate is that Q100 is 6,000 cumecs. This corresponds to 3.3m AHD at the Brisbane Port Office Gauge. The panel advised that the best estimate of Q100 and the corresponding flood level at the Brisbane Port Office provide sufficient basis for a decision on whether the currently adopted flood levels are broadly acceptable.

91. Currently, flood immunity levels adjacent to the Brisbane River are based on 3.7m AHD at the Brisbane Port Office, which is equivalent to 6,800 cumecs. On the basis that this level is within the plausible range determined by the expert panel, and given the uncertainty in estimation of flows and corresponding flood levels, climate variability and the accuracy of prediction methods, it is appropriate to maintain the existing flood immunity levels for development purposes.

92. The following is a history of habitable floor levels in residential developments adjacent to the river:

Year	Standard for Habitable Floor
1992	Q100
1997 approximately	Q100 + 525 mm
2000 City Plan House Code and Subdivision and Development Guidelines	Q100 + 500 mm

93. The Subdivision and Development Guidelines are read in conjunction with City Plan. Section 2.0 of the Guidelines titled "Flood Affected Land" tabulates Minimum Flood Immunity Levels for developments (eg. development level for habitable floors = 100year ARI+0.5m {= Q100 + 500mm}).

94. The National Floodplain Management Manual 2000 introduces the concept of a Defined Flood Level (DFL). The DFL is set by the relevant agency (in this case BCC) and can correspond to the Q100 level, or some other flow level set by the agency. In some jurisdictions development levels are set based on an historic flood event. It is proposed that Q100 be replaced with DFL along the Brisbane River. Further, it is proposed that the DFL be based on the level that has been used for setting development levels on the river for at least the past 15 years, ie. 3.7m AHD at the Brisbane Port Office, which corresponds to a flow of 6,800 cumecs at that location.

95. The following Attachments are submitted:

- "B" - a graph showing the proposed Defined Flood Level along the Brisbane River and how it relates to the new Q100;

- "C" - the draft wording of proposed revised Policy AP065;

- "D" - the proposed change to table 1 of the Brisbane City Plan House Code; and

- "E" - the proposed amendments to the relevant tables B2.2.1 and B2.2.2 from the Subdivision and Development Guidelines.

96. If approved, the proposed changes to Brisbane City Plan 2000 will be sent to the Minister for a first state interest check and for authority to publicly consult on the proposed amendments.

Implications of Proposal

97. Implications include:

- Current development levels adjacent to the Brisbane River remain unchanged – consistent approach in maintaining development levels based on estimated flood levels;
- The terminology in Policy AP065, the Minimum Immunity Levels tables from the Subdivision and Development Guidelines and the City Plan will need to be changed to include Defined Flood Level (DFL). For example, the flood immunity level for a habitable floor constructed adjacent to the Brisbane Port Office:
  - Current House Code: 100 year ARI + 500 mm (= 3.7+0.5m AHD)
  - Proposed amendment to House Code: DFL + 500 mm (= 3.7+0.5m AHD);
- Administrative Policy AP065 "Erection of Dwellings in Flood Prone Areas" will need to be updated to indicate the same basic intent but clarify terminology; and
- The estimated Q100 has decreased from 6,800 cumecs to 6,000 cumecs, so the likelihood of flooding at properties adjacent to the river has decreased as a result of the recent study (ie. those properties will now be slightly less likely to flood than previously estimated).

Customer Impact

98. By adopting the recommendations in this submission, there will not be any changes to design flood levels on the river for development impacted by City Plan. The level that customers receive corresponding to the 100 year ARI prior to this submission will be the same as the DFL that they will receive if this submission is approved. The changes will only be to the terminology. Changes will be made to the City Plan and associated documents using the standard amendment process, which takes up to two years. In the interim, the terminology used in the existing documents will be used.

99. The Divisional Manager therefore submits the following draft resolution, with which the Committee concurs.

100. **RECOMMENDATION:**

THAT IT BE RESOLVED THAT –

(i) As:

(a) Council has now received definitive and reliable advice from an expert panel on the appropriate Q100 flow and level at the Brisbane Port Office Gauge;

(b) on the basis of that advice, it is appropriate that Council reconsider its published position in relation to Brisbane River Flood Levels;

(c) the expert panel's estimate of the Q100 flow at the Brisbane Port Office Gauge is in the range of 5,000 to 7,000 cumecs with a best estimate of 6,000 cumecs;

(d) this range indicates that the current adopted flood immunity level of 3.7m AHD (based on 6,800 cumecs) at the Brisbane Port Office Gauge is still the most appropriate level;

(e) current best practice indicates the adoption of a new measurement standard called the "Defined Flood Level" in the addition to 100 year ARI (Q100) flow methodology;

THEN COUNCIL:

(1) **ADOPTS THE EXPERT PANEL'S BEST ESTIMATE OF THE NEW Q100 FLOW AT THE BRISBANE PORT OFFICE GAUGE TO BE 6,000 CUMECS;**

(2) **DETERMINES THAT THE CURRENT ADOPTED FLOOD IMMUNITY LEVEL OF 3.7m AHD AT THE BRISBANE PORT OFFICE GAUGE IS STILL THE MOST APPROPRIATE LEVEL;**

(3) **DETERMINES** as a consequence of (1) and (2) **THAT THERE IS NO NEED TO CHANGE CURRENT DEVELOPMENT LEVELS FOR PROPERTIES ADJACENT TO THE BRISBANE RIVER;**

(4) **DETERMINES THAT IN FUTURE, THE FLOOD LEVEL USED TO SET DEVELOPMENT LEVELS FOR PROPERTIES ADJACENT TO THE BRISBANE RIVER BE DETERMINED BY THE "DEFINED FLOOD LEVEL" AS SET BY COUNCIL;**

(5) **DETERMINES THAT THE CURRENT DEFINED FLOOD LEVEL BE SET AT 3.7m AHD AT THE BRISBANE PORT OFFICE GAUGE;**

(6) **DETERMINES THAT ADMINISTRATIVE POLICY AP 065, ERECTION OF DWELLINGS IN FLOOD PRONE AREAS, BE RESCINDED AND REPLACED WITH THE DRAFT POLICY AP065** submitted at Attachment "C";

(7) **DETERMINES THAT THE SUBDIVISION AND DEVELOPMENT GUIDELINES BE AMENDED** as set out in Attachment "E" submitted;

(8) **RESOLVES THAT** that pursuant to the requirements of Section 1(1) of Schedule 1 of the *Integrated Planning Act 1997* (IPA), **COUNCIL PROPOSES TO PREPARE AMENDMENTS TO BRISBANE CITY PLAN 2000 TO AMEND HOUSE FLOOD IMMUNITY LEVELS IN THE HOUSE CODE;**

(9) **RESOLVES THAT** pursuant to Section 9(2) of Schedule 1 of IPA, **COUNCIL PROPOSES AMENDMENTS TO THE PLANNING SCHEME TO CHANGE THE HOUSE CODE** as set out in Attachment "D" submitted;

(10) directs that action be taken, pursuant to Section 9(3) of Schedule 1 of IPA, and that the Minister be given a copy of the proposed amendments for consideration of State interests.

24/11 – 4K. 3

295|10|10

X.REF

INFORMATION MANAGEMENT
A03/35282

1.0 FILE NUMBER 295/10/10

SUBMISSION TO THE ESTABLISHMENT AND CO-ORDINATION COMMITTEE

2.0 TITLE

Setting of Flood Development levels and adoption of new Flood Measurement Standards.

3.0 ISSUE / PURPOSE

To recommend to Council that:-

(a) existing flood development levels be retained;
(b) it adopt a new 100 year ARI (Q100) flow at the Brisbane Port Office;
(c) to set the Defined Flood Level (DFL) for development adjacent to the Brisbane River;
(d) to authorise appropriate amendments to City Plan and other relevant policies and guidelines.

4.0 PROPONENT

[redacted] Divisional Manager, Urban Management Division
~~Water Resources Branch, Urban Management Division~~

5.0 SUBMISSION PREPARED BY

[redacted] (PWPOFM) Principal Officer Water Resources Branch, Urban Management Division

6.0 DATE

APPROVED
24 NOV 2003

24 November 2003

7.0 FOR E&C APPROVAL OR RECOMMENDATION T[redacted]

For recommendation to Council

8.0 IF FOR RECOMMENDATION TO COUNCIL, IS A[redacted]
REQUIRED UNDER AN ACT OR ORDINANCE ?

Yes. Schedule 1 of the Integrated Planning Act 1997.

9.0 RECOMMENDATION

RECEIVED
24 NOV 2003
COMMITTEE SECTION

That Council resolve as per draft resolution Attachment "A".

10.0 DIVISIONAL MANAGER

[redacted]

I Recommend Accordingly

[redacted]

11.0 BACKGROUND

Throughout this document the terminology Q100 is used. Q100 refers to the flow that has a 1 in 100 chance of being exceeded in any year. Q100 is equivalent to the 100 year Average Recurrence Interval (100 year ARI) terminology used in some publications. As the flow varies along the river we relate the flow to a reference point. For the present purpose Q100 refers to the flow in the river at the Brisbane Port Office gauge which is near the near corner of Edward and Alice Streets.

Administrative Policy No. AP065 – *Erection of Dwellings in Flood Prone Areas* was adopted by E&C on 30/10/78 and still applies. This policy states that flood levels are a basis for recommending habitable floor levels of dwellings erected in areas prone to Brisbane River flooding, and that the 3.7m AHD flood level at the Brisbane City Gauge applies. It is recommended that, while this standard remain the same for habitable development, the nomenclature be changed to separate this standard from the standard pertaining to other structures requiring Q100 information as part of the design process eg pontoons.

In 1984 a BCC study determined that Q100 = 6,800 cumecs (m^3/sec) which corresponds to 3.7m AHD at the Brisbane Port Office. A committee comprising representatives from BCC and State Government signed off on this flow in November 1984.

A graph is used to determine flood levels along the length of the river corresponding to the 3.7m AHD level at the Brisbane Port Office gauge. The graph was prepared in 1988 and has been used ever since to set development levels along the river. It is proposed that the levels interpreted from this graph continue to be used for development purposes.

Work undertaken by State Government in the 1990's indicated that the Q100 flow in the river might have been higher than the 6,800 cumecs estimated in the 1980's.

In November 1996 BCC commissioned Sinclair Knight Merz to undertake a study of flood flows in the Brisbane River. One of the outputs of that report was an estimation of the Q100 flow. Following is a chronology of the work undertaken since then:

- 1998 February –Draft SKM Report
- 1998 December - Peer review [redacted]
- 1999 June and December - City Design's Draft Reports
- 2000 October – Review of issues and progress by stakeholders. DNR committed to provide information on Areal Reduction Factors (ARF) within a few months
- 2003 June – DNRM produces draft results with Areal Reduction Factors and estimated a Q100 flow of 6,000-7,000 cumecs at the Brisbane Port Office
- 2003 July and August –SKM and City Design undertake rainfall and flow analysis using the latest DNRM information
- 2003 September – Independent expert panel completes its review into the Q100 flow and level at the Brisbane Port Office gauge

The expert panel determined that the plausible range for the Q100 flow in the Brisbane River is 5,000 to 7,000 cumecs, corresponding to levels of 2.8 to 3.8 m AHD respectively. Thus the current Q100 of 6,800 cumecs is within the plausible range.

The expert panel's best estimate is that Q100 is 6,000 cumecs. This corresponds to 3.3m AHD at the Brisbane Port Office Gauge. The panel advised that the best estimate of Q100 and the corresponding flood level at the Brisbane Port Office provide sufficient basis for a decision on whether the currently adopted flood levels are broadly acceptable.

Currently flood immunity levels adjacent to the Brisbane River are based on 3.7m AHD at the Brisbane Port Office, which is equivalent to 6,800 cumecs. On the basis that this level is within the plausible range determined by the expert panel, and given the uncertainty in estimation of flows and corresponding flood levels, climate variability and the accuracy of prediction methods it is appropriate to maintain the existing flood immunity levels for development purposes.

The following is a history of habitable floor levels in residential developments adjacent to the river:

Year	Standard for Habitable Floor
1992	Q100
1997 approximately	Q100 + 525 mm
2000 City Plan House Code and Subdivision and Development Guidelines	Q100 + 500 mm

The Subdivision and Development Guidelines are read in conjunction with City Plan. Section 2.0 of the Guidelines titled "Flood Affected Land" tabulates Minimum Flood Immunity Levels for developments (eg development level for habitable floors = 100year ARI+0.5m (= Q100 + 500mm))

The National Floodplain Management Manual 2000 introduces the concept of a Defined Flood Level (DFL). The DFL is set by the relevant agency (in this case BCC) and can correspond to the Q100 level, or some other flow level set by the agency. In some jurisdictions development levels are set based on an historic flood event. It is proposed that Q100 be replaced with DFL along the Brisbane River. Further, it is proposed that the DFL be based on the level that has been used for setting development levels on the river for at least the past 15 years, ie 3.7m AHD at the Brisbane Port Office, which corresponds to a flow of 6,800 cumecs at that location.

Attached are:

"B" a graph showing the proposed Defined Flood Level along the Brisbane River and how it relates to the new Q100.
"C" the draft wording of proposed revised Policy AP065
"D" the proposed change to table 1 of the Brisbane City Plan House Code
"E" the proposed amendments to the relevant tables B2.2.1 and B2.2.2 from the Subdivision and Development Guidelines

If approved the proposed changes to City Plan 2000 will be sent to the Minister for a first state interest check and for authority to publicly consult on the proposed amendments.

12.0 CONSULTATION

The following have been consulted in the preparation of this submission:

- [redacted] Manager Brisbane City Legal Practice
- [redacted] Strategic Planning/Project Manager City Planning
- [redacted] Group Manager Water and Environment City Design
- [redacted] Team Leader Team 6 Development Assessment

13.0 IMPLICATIONS OF PROPOSAL

Implications include:

- Current development levels adjacent to the Brisbane River remain unchanged – consistent approach in maintaining development levels based on estimated flood levels.
- The terminology in Policy AP065, the Minimum Immunity Levels tables from the Subdivision and Development Guidelines and the City Plan will need to be changed to include Defined Flood Level (DFL). For example the flood immunity level for a habitable floor constructed adjacent to the Brisbane Port Office:
    - Current House Code: 100 year ARI + 500 mm (= 3.7+0.5m AHD)
    - Proposed amendment to House Code: DFL + 500 mm (= 3.7+0.5m AHD)
- Administrative Policy AP065 "Erection of Dwellings in Flood Prone Areas" will need to be updated to indicate the same basic intent but clarify terminology
- The estimated Q100 has decreased from 6,800 cumecs to 6,000 cumecs, so the likelihood of flooding at properties adjacent to the river has decreased as a result of the recent study (ie those properties will now be slightly less likely to flood than previously estimated).

14.0 CORPORATE PLAN IMPACT

Nil

15.0 CUSTOMER IMPACT

By adopting the recommendations in this submission there won't be any changes to design flood levels on the river for development impacted by City Plan. The level that customers receive corresponding to the 100 year ARI prior to this E&C Submission will be the same as the DFL that they will receive if this submission is approved. The changes will only be to the terminology. Changes will be made to the City Plan and associated documents using the standard amendment process – which takes up to two years. In the interim, the terminology used in the existing documents will be used.

16.0 ENVIRONMENTAL IMPACT

Nil

17.0 POLICY IMPACT

It will be necessary to amend Policy No. AP065, Table 1 of the House Code of City Plan and Tables B2.2.1 and B2.2.2 of the Subdivision and Development Guidelines to reflect this E&C decision.

18.0 FINANCIAL IMPACT

Nil.

19.0 HUMAN RESOURCE IMPACT

Nil

20.0 URGENCY

Within normal course of business.

21.0 PUBLICITY / MARKETING STRATEGY

There has already been publicity for the river flooding issues and meetings held with key groups. Further presentations will be programmed after acceptance of this policy.

22.0 OPTIONS

1. Adopt a Defined Flood Level for the Brisbane River based on the flood profile corresponding to 3.7m AHD at the Brisbane Port Office gauge (located adjacent to the corner of Alice and Edward Streets) and amend terminology in the Subdivision and Development Guidelines accordingly. Accept the expert panel's best estimate that Q100 = 6,000 cumecs at the Brisbane Port Office gauge.

2. Base the Defined Flood Levels on Q100 = 6,000 cumecs (3.3m AHD at the Brisbane Port Office gauge). This does not make provision for climate variation.

3. Don't adopt Q100 = 6,000 cumecs and maintain the existing flows and levels, ie Q100 = 6,800 cumecs (3.7m AHD at Brisbane Port Office gauge) together with City Plan and Policy 065. This is inconsistent with the expert panel's recommendation.

Option 1 is the recommended option.

---o0o---

Attachment "A"

DRAFT RESOLUTION TO SET FLOOD DEVELOPMENT LEVELS AND TO ADOPT NEW FLOOD MEASUREMENT STANDARDS.

[**Recommendation:** that Council resolve that:-]
[**Resolution:** that:-]

1. As:-

(a) Council has now received definitive and reliable advice from an expert panel on the appropriate Q100 flow and level at the Brisbane Port Office Gauge;

(b) on the basis of that advice, it is appropriate that Council reconsider its published position in relation to Brisbane River Flood Levels;

(c) the expert panel's estimate of the Q100 flow at the Brisbane Port Office Gauge is in the range of 5,000 to 7,000 cumecs with a best estimate of 6000 cumecs;

(d) this range indicates that the current adopted flood immunity level of 3.7AHD (based on 6,800 cumecs) at the Brisbane Port Office Gauge is still the most appropriate level;

(e) current best practice indicates the adoption of a new measurement standard called the "Defined Flood Level" in the addition to 100 year ARI (Q100) flow methodology;

then:-

(i) adopts the expert panels best estimate of the new Q100 flow at the Brisbane Port Office gauge to be 6,000 cumecs;

(ii) determines that that the current adopted flood immunity level of 3.7AHD at the Brisbane Port Office Gauge is still the most appropriate level;

(iii) determines as a consequence of (i) and (ii) that there is no need to change current development levels for properties adjacent to the Brisbane River;

(iv) determines that in future the flood level used set development levels for properties adjacent to the Brisbane River be determined by the "Defined Flood Level" as set by Council;

(v) that the current Defined Flood Level be set at 3.7AHD at the Brisbane Port Office Gauge;

(vi) that Administrative Policy AP 065 Erection of Dwellings in Flood Prone Areas be rescinded and replaced with the draft Policy AP065 at Attachment "C";

(vii) that the Subdivision and Development Guidelines be amended as set out in Attachment "E";

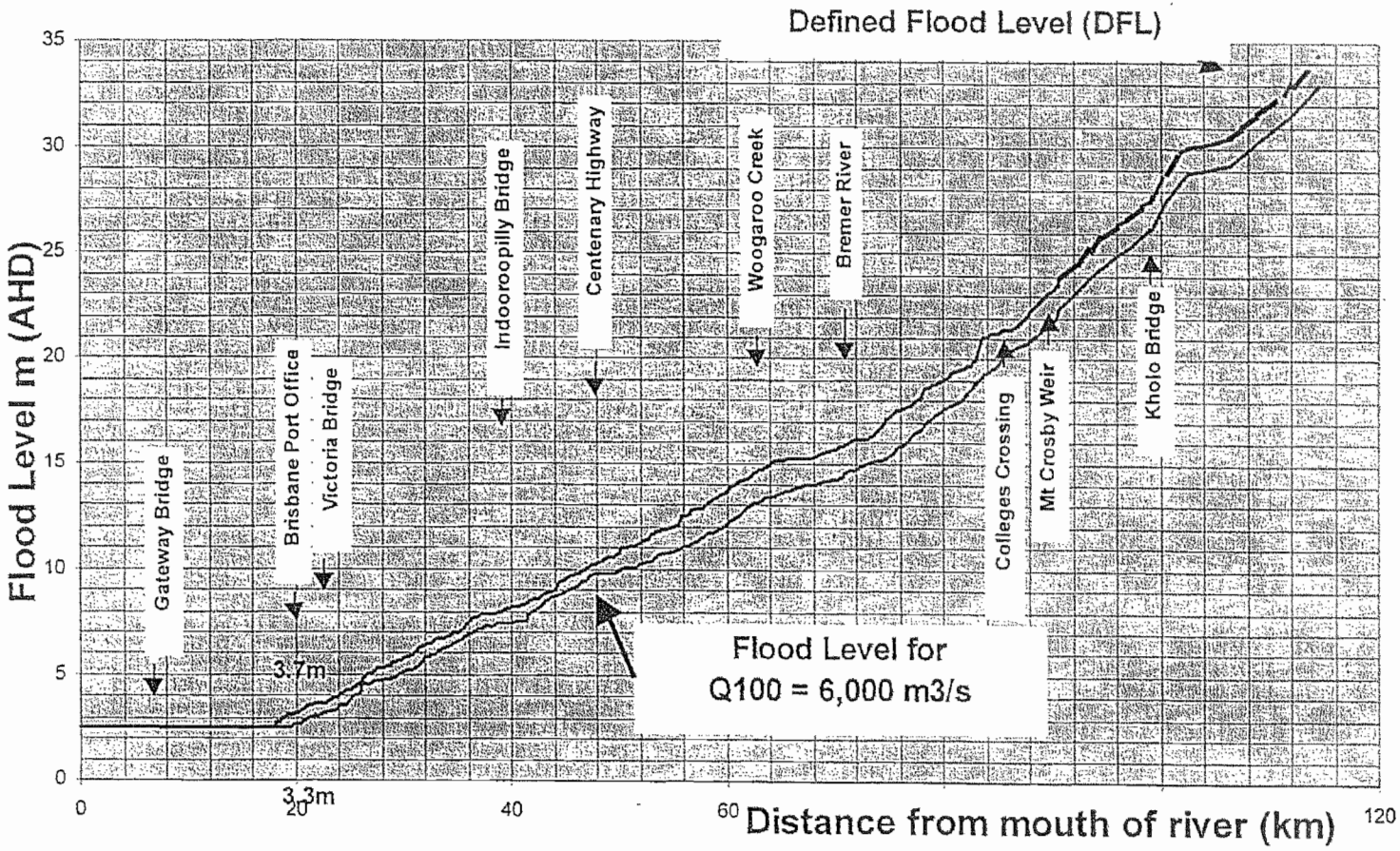
(viii) that pursuant to the requirements of Section 1(1) of Schedule 1 of the Integrated Planning Act 1997 ("IPA"), Council proposes to prepare amendments to Brisbane City Plan 2000 to amend House Flood Immunity Levels in the House Code;

(ix) that pursuant to Section 9(2) of Schedule 1 of IPA, Council proposes amendments to the Planning Scheme to change the House Code as set out in Attachment "D";

(x) Council directs that action be taken, pursuant to Section 9(3) of Schedule 1 of IPA. And give the Minister a copy of the proposed amendments for consideration of state interests.

BCC.042.4265

Attachment B: Proposed Defined Flood Level along the Brisbane River



Attachment C.

Draft Council Policy AP065 Erection of Dwellings in Flood Prone Areas

AP065 Erection of Dwellings in Areas Prone to Brisbane River Flooding

Overview

Flooding levels relevant to determining habitable floor levels in areas liable to Brisbane River flooding and standards of flood immunity.

Policy

In determining habitable floor levels the 3.7m AHD level at the Brisbane City Gauge is to be used from the river flood profiles derived in 1988.

That level constitute the "Defined Flood Level".

The 100 year Average Recurrence Interval (Q100) flow for the Brisbane Rive at the Brisbane Port Office Gauge is 6,000 cumecs.

Authority

E&C 24/11/2003

Further Assistance

Principal Waterways Program Officer Flood Management Stormwater, Water Resources, Urban Management Division.

Related Information

File 223/1/18
Local Government Act (as amended) Part X1, Section 37(10)

See policies -

AP074 Flood Management for Flood Plain Management

Page Owner: PWPOFM Valid From: 24-Nov-2003 Disclaimer/Copyright

Attachment D
Amendment to Brisbane City Plan 2000

That Table 1 of Brisbane City Plan 2000 House Code Table 1 be replaced with the following:-

Brisbane City Plan 2000 House Code Table 1: House Immunity Levels

Type of Flooding	Minimum Ground Level for House Pad after filling (where permitted)	Habitable Floor level	Non-habitable Areas (ie. Utility areas, garage, laundry and storage room)
Brisbane River	Defined Flood Level + 300mm	Defined Flood Level + 500mm	50 year ARI + 300mm
Creek or waterway	100 year ARI + 300mm	100 year ARI + 500mm	100 year ARI + 300mm
Localised Overland flowpath or designed open channel	50 year ARI + 300mm	50 year ARI + 500mm	50 year ARI + 300mm
Storm surge	100 year ARI + 300mm	100 year ARI + 500mm	100 year ARI + 300mm

'ARI' means Average Recurrence Interval and is defined in the definitions.
'Defined Flood Level' means The flood level associated with the flood event selected for the management of flood hazard.

Note:
Where subject to more than one type of flooding the highest immunity level as determined for each case applies.

Attachment E

Amendments to the Subdivision and Development Guidelines Chapter 2

Replace tables B2.2.1 and B2.2.2 with the following:

TABLE B2.2.1
MINIMUM FLOOD IMMUNITY LEVELS FOR
RESIDENTIAL DEVELOPMENTS

Flooding Type (Note 1)	Minimum Design Levels (mAHD)			
	Conventional Subdivision	Existing Lot & Redevelopment/ Infill Development		
	Allotment Fill	Habitable Floor	Non-Habitable Areas (Note 2)	Carparking (Note 3)
Brisbane River	Defined Flood Level + 0.3m	Defined Flood Level + 0.5m	Defined Flood Level + 0.3m	20y ARI
Creek or Waterway	100y ARI + 0.3m	100y ARI + 0.5m	100y ARI + 0.3m	100y ARI
Localised Overland Flow Path	50y ARI + 0.3m	50y ARI + 0.5m	50y ARI + 0.3m	50y ARI
Designed Open Channel	50y ARI + 0.3m	50y ARI + 0.5m	50y ARI + 0.3m	50y ARI
Storm Surge (Note 4)	100y ARI + 0.3m	100y ARI + 0.5m	100y ARI + 0.3m	100y ARI

TABLE B2.2.2
MINIMUM FLOOD IMMUNITY LEVELS FOR
INDUSTRIAL/COMMERCIAL DEVELOPMENTS

Flooding Type (Note 1)	Minimum Design Levels (mAHD)			
	Conventional Subdivision	Existing Lot & Redevelopment/ Infill Development		
	Allotment Fill	Habitable Floor (if applicable)	Non-Habitable Areas (Note 2)	Carparking (Note 3)
Brisbane River	Defined Flood Level	Defined Flood Level + 0.5m	Defined Flood Level	20y ARI
Creek or Waterway	100y ARI	100y ARI + 0.5m	100y ARI	100y ARI
Localised Overland Flow Path	50y ARI	50y ARI + 0.5m	50y ARI	50y ARI
Designed Open Channel	50y ARI	50y ARI + 0.5m	50y ARI	50y ARI
Storm Surge (Note 4)	100y ARI	100y ARI + 0.5m	100y ARI	100y ARI

MJR-6

E+C MONDAY 24/11

FIRST DRAFT 21/11/2003

1.0 FILE NUMBER

SUBMISSION TO THE ESTABLISHMENT AND CO-ORDINATION COMMITTEE

2.0 TITLE

Setting of Flood Development levels and adoption of new Flood Measurement Standards.

3.0 ISSUE / PURPOSE

To recommend to Council that:-

(a) existing flood development levels be retained;
(b) it adopt a new 100 year ARI (Q100) flow at the Brisbane Port Office;
(c) to set the Defined Flood Level (DFL) for development adjacent to the Brisbane River;
(d) to authorise appropriate amendments to City Plan and other relevant policies and guidelines.

4.0 PROPONENT

Barry Ball, Manager Water Resources Branch, Urban Management Division

5.0 SUBMISSION PREPARED BY

Gavin Blakey, Principal Officer Water Resources Branch, Urban Management Division

6.0 DATE

24 November 2003

7.0 FOR E&C APPROVAL OR RECOMMENDATION TO COUNCIL ?

For recommendation to Council

8.0 IF FOR RECOMMENDATION TO COUNCIL, IS A COUNCIL RESOLUTION REQUIRED UNDER AN ACT OR ORDINANCE ?

Yes. Schedule 1 of the Integrated Planning Act 1997.

9.0 RECOMMENDATION

That Council resolve as per draft resolution Attachment "A".

10.0 DIVISIONAL MANAGER

[redacted]

Divisional Manager
URBAN MANAGEMENT

11. BACKGROUND

Throughout this document the terminology Q100 is used. Q100 refers to the flow that has a 1 in 100 chance of being exceeded in any year. Q100 is equivalent to the 100 year Average Recurrence Interval (100 year ARI) terminology used in some publications. As the flow varies along the river we relate the flow to a reference point. For the present purpose Q100 refers to the flow in the river at the Brisbane Port Office gauge which is near the near corner of Edward and Alice Streets.

Administrative Policy No. AP065 – *Erection of Dwellings in Flood Prone Areas* was adopted by E&C on 30/10/78 and still applies. This policy states that flood levels are a basis for recommending habitable floor levels of dwellings erected in areas prone to Brisbane River flooding, and that the 3.7m AHD flood level at the Brisbane City Gauge applies. It is recommended that, while this standard remain the same for habitable development, the nomenclature be changed to separate this standard from the standard pertaining to other structures requiring Q100 information as part of the design process eg pontoons.

In 1984 a BCC study determined that Q100 = 6,800 cumecs (m^3/sec) which corresponds to 3.7m AHD at the Brisbane Port Office. A committee comprising representatives from BCC and State Government signed off on this flow in November 1984.

A graph is used to determine flood levels along the length of the river corresponding to the 3.7m AHD level at the Brisbane Port Office gauge. The graph was prepared in 1988 and has been used ever since to set flood immunity levels along the river. For example Q100, Q50, Q20 are all interpreted from this graph to set flood immunity levels prescribed in the House Code and / or Subdivision and Development Guidelines. It is proposed that the levels interpreted from this graph continue to be used for these purposes.

Work undertaken by State Government in the 1990's indicated that the Q100 flow in the river might have been higher than the 6,800 cumecs estimated in the 1980's.

In November 1996 BCC commissioned Sinclair Knight Merz to undertake a study of flood flows in the Brisbane River. One of the outputs of that report was an estimation of the Q100 flow. Following is a chronology of the work undertaken since then:

- 1998 February –Draft SKM Report
- 1998 December - Peer review [redacted]
- 1999 June and December - City Design's Draft Reports
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- 2003 July and August –SKM and City Design undertake rainfall and flow analysis using the latest DNRM information
- 2003 September – Independent expert panel completes its review into the Q100 flow and level at the Brisbane Port Office gauge

The expert panel determined that the plausible range for the Q100 flow in the Brisbane River is 5,000 to 7,000 cumecs, corresponding to levels of 2.8 to 3.8 m AHD respectively. Thus the current Q100 of 6,800 cumecs is within the plausible range.

The expert panel's best estimate is that Q100 is 6,000 cumecs. This corresponds to 3.3m AHD at the Brisbane Port Office Gauge. The panel advised that the best estimate of Q100

and the corresponding flood level at the Brisbane Port Office provide sufficient basis for a decision on whether the currently adopted flood levels are broadly acceptable.

Currently flood immunity levels adjacent to the Brisbane River are based on 3.7m AHD at the Brisbane Port Office, which is equivalent to 6,800 cumecs. On the basis that this level is within the plausible range determined by the expert panel, and given the uncertainty in estimation of flows and corresponding flood levels, climate variability and the accuracy of prediction methods it is appropriate to maintain the existing flood immunity levels for development purposes.

The following is a history of habitable floor levels in residential developments adjacent to the river:

Year	Standard for Habitable Floor
1992	Q100
1997 approximately	Q100 + 525 mm
2000 City Plan House Code and Subdivision and Development Guidelines	Q100 + 500 mm

The Subdivision and Development Guidelines are read in conjunction with City Plan. Section 2.0 of the Guidelines titled "Flood Affected Land" tabulates Minimum Flood Immunity Levels for developments (eg development level for habitable floors = 100year ARI+0.5m (= Q100 + 500mm))

The National Floodplain Management Manual 2000 introduces the concept of a Defined Flood Level (DFL). The DFL is set by the relevant agency (in this case BCC) and can correspond to the Q100 level, or some other flow level set by the agency. In some jurisdictions development levels are set based on an historic flood event. It is proposed that Q100 be replaced with DFL along the Brisbane River. Further, it is proposed that the DFL be based on the level that has been used for setting development levels on the river for at least the past 15 years, ie 3.7m AHD at the Brisbane Port Office, which corresponds to a flow of 6,800 cumecs at that location.

Attached are:_

"B" the communication plan which outline how the various stakeholders will be engaged on issues relating to flood flows and levels adjacent to the Brisbane River.
"C" a graph showing the proposed Defined Flood Level along the Brisbane River and how it relates to the new Q100.
"D" the draft wording of proposed revised Policy AP065
"E" the proposed change to table 1 of the Brisbane City Plan House Code
"F" the proposed amendments to the relevant tables B2.2.1 and B2.2.2 from the Subdivision and Development Guidelines

If approved the proposed changes to City Plan 2000 will be sent to the Minister for a first state interest check and for authority to publicly consult on the proposed amendments.

12.0 CONSULTATION

The following have been consulted and are in agreement with the proposal:

- [redacted] Manager Brisbane City Legal Practice
- [redacted] Strategic Planning/Project Manager City Planning

- [redacted] Group Manager Water and Environment City Design
- [redacted] Team Leader Team 6 Development Assessment

13.0 IMPLICATIONS OF PROPOSAL

Implications include:

- Current development levels adjacent to the Brisbane River remain unchanged – consistent approach in maintaining development levels based on estimated flood levels.
- The terminology in Policy AP065, the Minimum Immunity Levels tables from the Subdivision and Development Guidelines and the City Plan will need to be changed to include Defined Flood Level (DFL). For example the flood immunity level for a habitable floor constructed adjacent to the Brisbane Port Office:
    - Current House Code: 100 year ARI + 500 mm (= 3.7+0.5m AHD)
    - Proposed amendment to House Code: DFL + 500 mm (= 3.7+0.5m AHD)

- Administrative Policy AP065 "Erection of Dwellings in Flood Prone Areas" will need to be updated to indicate the same basic intent but clarify terminology
- The estimated Q100 has decreased from 6,800 cumecs to 6,000 cumecs, so the likelihood of flooding at properties adjacent to the river has decreased as a result of the recent study (ie those properties will now be slightly less likely to flood than previously estimated).

14.0 CORPORATE PLAN IMPACT

Nil

15.0 CUSTOMER IMPACT

By adopting the recommendations in this submission there won't be any changes to design flood levels on the river for development impacted by City Plan. The level that customers receive corresponding to the 100 year ARI prior to this E&C Submission will be the same as the DFL that they will receive if this submission is approved. The changes will only be to the terminology. Changes will be made to the City Plan and associated documents using the standard amendment process – which takes up to two years. In the interim, the terminology used in the existing documents will be used.

16.0 ENVIRONMENTAL IMPACT

Nil

17.0 POLICY IMPACT

It will be necessary to amend Policy No. AP065, Table 1 of the House Code of City Plan and Tables B2.2.1 and B2.2.2 of the Subdivision and Development Guidelines to reflect this E&C decision.

18.0 FUNDING IMPACT

Nil.

19.0 HUMAN RESOURCE IMPACT

Nil

20.0 URGENCY

Within normal course of business.

21.0 PUBLICITY / MARKETING STRATEGY

A communication plan is attached.

22.0 OPTIONS

1. Adopt a Defined Flood Level for the Brisbane River based on the flood profile corresponding to 3.7m AHD at the Brisbane Port Office gauge (located adjacent to the corner of Alice and Edward Streets) and amend terminology in the Subdivision and Development Guidelines accordingly. Accept the expert panel's best estimate that Q100 = 6,000 cumecs at the Brisbane Port Office gauge.

2. Base the Defined Flood Levels on Q100 = 6,000 cumecs (3.3m AHD at the Brisbane Port Office gauge). This does not make provision for climate variation.

3. Don't adopt Q100 = 6,000 cumecs and maintain the existing flows and levels, ie Q100 = 6,800 cumecs (3.7m AHD at Brisbane Port Office gauge) together with City Plan and Policy 065. This is inconsistent with the expert panel's recommendation.

Option 1 is the recommended option.

---o0o---

Attachment "A"

DRAFT RESOLUTION TO SET FLOOD DEVELOPMENT LEVELS AND TO ADOPT NEW FLOOD MEASUREMENT STANDARDS.

[Recommendation: that Council resolve that:-]
[Resolution: that:-]

1. As:-

   (a) Council has now received definitive and reliable advice from an expert panel on the appropriate Q100 flow and level at the Brisbane Port Office Gauge;

   (b) on the basis of that advice, it is appropriate that Council reconsider its published position in relation to Brisbane River Flood Levels;

   (c) the expert panel's estimate of the Q100 flow at the Brisbane Port Office Gauge is in the range of 5,000 to 7,000 cumecs with a best estimate of 6000 cumecs;

   (d) this range indicates that the current adopted flood immunity level of 3.7AHD (based on 6,800 cumecs) at the Brisbane Port Office Gauge is still the most appropriate level;

   (e) current best practice indicates the adoption of a new measurement standard called the "Defined Flood Level" in the addition to 100 year ARI (Q100) flow methodology;

   then:-

   (i) adopts the expert panels best estimate of the new Q100 flow at the Brisbane Port Office gauge to be 6,000 cumecs;

   (ii) determines that that the current adopted flood immunity level of 3.7AHD at the Brisbane Port Office Gauge is still the most appropriate level;

   (iii) determines as a consequence of (i) and (ii) that there is no need to change current development levels for properties adjacent to the Brisbane River;

   (iv) determines that in future the flood level used set development levels for properties adjacent to the Brisbane River be determined by the "Defined Flood Level" as set by Council;

   (v) that the current Defined Flood Level be set at 3.7AHD at the Brisbane Port Office Gauge;

   (vi) that Administrative Policy AP 065 Erection of Dwellings in Flood Prone Areas be rescinded and replaced with the draft Policy AP065 at Attachment "D";

   (vii) that the Subdivision and Development Guidelines be amended as set out in Attachment "F";

(viii) that pursuant to the requirements of Section 1(1) of Schedule 1 of the Integrated Planning Act 1997 ("IPA"), Council proposes to prepare amendments to Brisbane City Plan 2000 to amend House Flood Immunity Levels in the House Code;

(ix) that pursuant to Section 9(2) of Schedule 1 of IPA, Council proposes amendments to the Planning Scheme to change the House Code as set out in Attachment "E";

(x) Council directs that action be taken, pursuant to Section 9(3) of Schedule 1 of IPA. And give the Minister a copy of the proposed amendments for consideration of state interests.

Attachment B: Communication Plan

STAKEHOLDERS:

- General public, including potential buyers
- Councillors and Wards offices
- BCC (staff, documents eg City Plan) State / Federal Agencies and other Councils
- Associations
- Media
- Property owners affected by river flooding (current Q100, or new Q100)

GENERAL PUBLIC:

- Letter was sent to residents early July 2003
- Already have flood fact sheets on BCC website
- Expert Panel report available on BCC website
- Flood info currently available at property scale
- Automated flood form launch early December
- Abbreviated BR flood report on BCC website
- Include item in Livable Brisbane Rates Notice
- Call Centre Script to reflect new information

COUNCILLORS:

- Briefing already conducted 9 September
- Information available as for General Public (provide them with copies of this info)
- If required, a fact sheet on Brisbane River flooding can be prepared and made available in Ward offices for Wards affected by river flooding

BCC and OTHER GOVERNMENT:

- BCC (staff, documents such as City Plan)
- State / Federal Agencies and other Councils
- Targeted briefings or information to key stakeholders, eg DRS, DA teams, DNRM, BoM, Ipswich City Council outlining BCC decision
- Info will be available as for general public

ASSOCIATIONS:

- Identify key Associations, eg UDIA, REIQ, and invite their senior managers to a briefing on BCC decision and available information
- Send them copies of information available to General Public

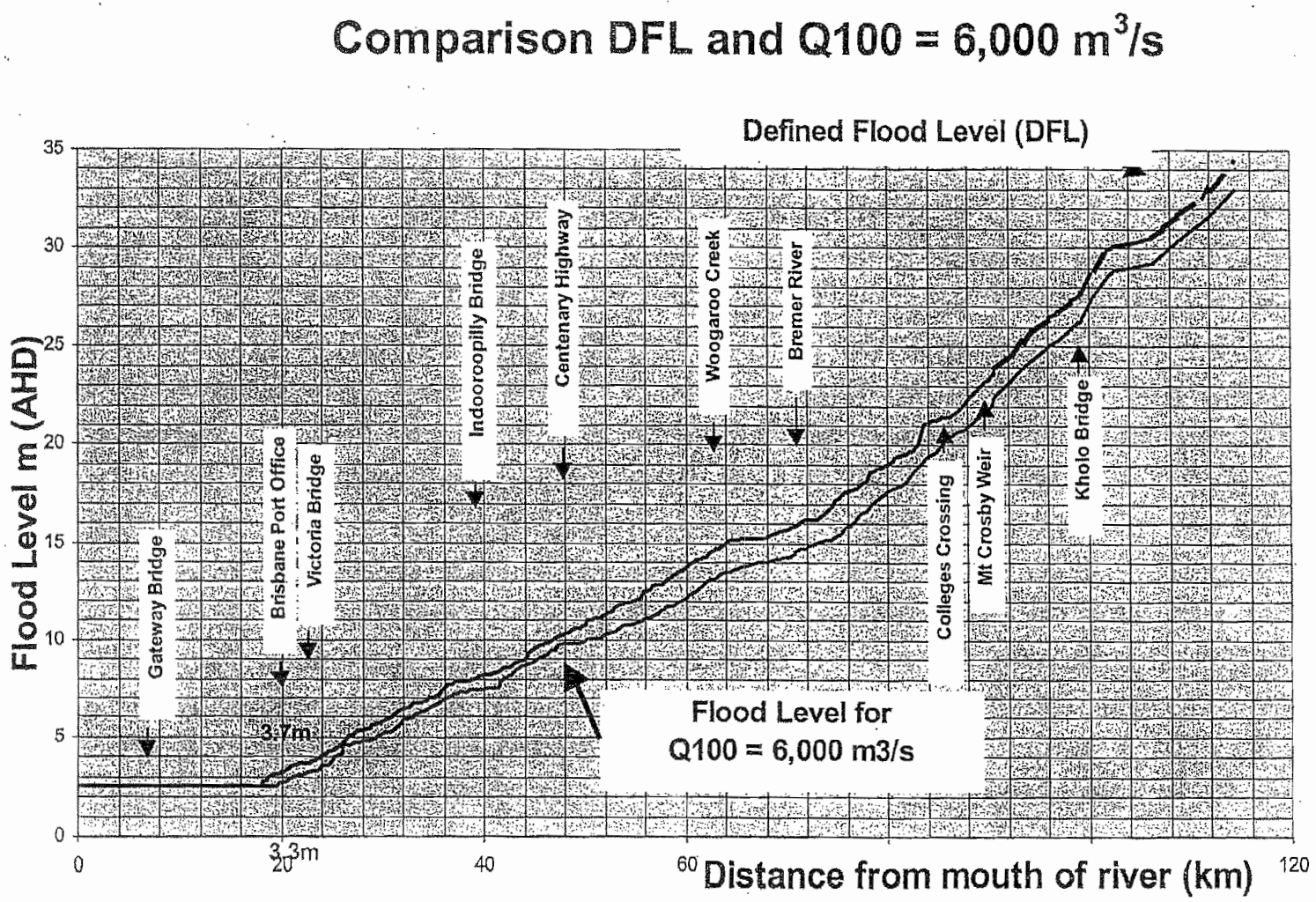
MEDIA:

- Media will have access to same information as general public
- Provide information as requested by media

AFFECTED PROPERTY OWNERS:

- Principle: relevant information should be available/communicated to affected owners
- Already have access to information available to general public on request
- If development level stays same then same property owners will be affected. Some will <u>not</u> now be flooded in Q100 event.
- Publicise availability of information
- Individually advise property owners

Attachment C: Proposed Defined Flood Level along the Brisbane River



BCC.019.0110

Attachment D.

Draft Council Policy AP065 Erection of Dwellings in Flood Prone Areas

AP065 Erection of Dwellings in Areas Prone to Brisbane River Flooding

Overview

Flooding levels relevant to determining habitable floor levels in areas liable to Brisbane River flooding and standards of flood immunity.

Policy

In determining habitable floor levels the 3.7m AHD level at the Brisbane City Gauge is to be used from the river flood profiles derived in 1988.

That level constitute the "Defined Flood Level".

The 100 year Average Recurrence Interval (Q100) flow for the Brisbane Rive at the Brisbane Port Office Gauge is 6,000 cumecs.

Authority

E&C 24/11/2003

Further Assistance

Principal Waterways Program Officer Stormwater, Waterways, Urban Management Division.

Related Information

File 223/1/18
Local Government Act (as amended) Part X1, Section 37(10)

See policies -

AP074 Flood Management for Flood Plain Management

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Attachment E
Amendment to Brisbane City Plan 2000

That Table 1 of Brisbane City Plan 2000 House Code Table 1 be replaced with the following:-

Brisbane City Plan 2000 House Code Table 1: House Immunity Levels

Type of Flooding	Minimum Ground Level for House Pad after filling (where permitted)	Habitable Floor level	Non-habitable Areas (ie. Utility areas, garage, laundry and storage room)
Brisbane River	Defined Flood Level + 300mm	Defined Flood Level + 500mm	50 year ARI + 300mm
Creek or waterway	100 year ARI + 300mm	100 year ARI + 500mm	100 year ARI + 300mm
Localised Overland flowpath or designed open channel	50 year ARI + 300mm	50 year ARI + 500mm	50 year ARI + 300mm
Storm surge	100 year ARI + 300mm	100 year ARI + 500mm	100 year ARI + 300mm

'ARI' means Average Recurrence Interval and is defined in the definitions.
'Defined Flood Level' means The flood level associated with the flood event selected for the management of flood hazard.

Note:
Where subject to more than one type of flooding the highest immunity level as determined for each case applies.

Attachment F

Amendments to the Subdivision and Development Guidelines Chapter 2

Replace tables B2.2.1 and B2.2.2 with the following:

TABLE B2.2.1
MINIMUM FLOOD IMMUNITY LEVELS FOR
RESIDENTIAL DEVELOPMENTS

Flooding Type (Note 1)	Minimum Design Levels (mAHD)			
	Conventional Subdivision	Existing Lot & Redevelopment/ Infill Development		
	Allotment Fill	Habitable Floor	Non-Habitable Areas (Note 2)	Carparking (Note 3)
Brisbane River	Defined Flood Level + 0.3m	Defined Flood Level + 0.5m	Defined Flood Level + 0.3m	20y ARI
Creek or Waterway	100y ARI + 0.3m	100y ARI + 0.5m	100y ARI + 0.3m	100y ARI
Localised Overland Flow Path	50y ARI + 0.3m	50y ARI + 0.5m	50y ARI + 0.3m	50y ARI
Designed Open Channel	50y ARI + 0.3m	50y ARI + 0.5m	50y ARI + 0.3m	50y ARI
Storm Surge (Note 4)	100y ARI + 0.3m	100y ARI + 0.5m	100y ARI + 0.3m	100y ARI

TABLE B2.2.2
MINIMUM FLOOD IMMUNITY LEVELS FOR
INDUSTRIAL/COMMERCIAL DEVELOPMENTS

Flooding Type (Note 1)	Minimum Design Levels (mAHD)			
	Conventional Subdivision	Existing Lot & Redevelopment/ Infill Development		
	Allotment Fill	Habitable Floor (if applicable)	Non-Habitable Areas (Note 2)	Carparking (Note 3)
Brisbane River	Defined Flood Level	Defined Flood Level + 0.5m	Defined Flood Level	20y ARI
Creek or Waterway	100y ARI	100y ARI + 0.5m	100y ARI	100y ARI
Localised Overland Flow Path	50y ARI	50y ARI + 0.5m	50y ARI	50y ARI
Designed Open Channel	50y ARI	50y ARI + 0.5m	50y ARI	50y ARI
Storm Surge (Note 4)	100y ARI	100y ARI + 0.5m	100y ARI	100y ARI

MJR-5

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ECR i

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BRISBANE CITY COUNCIL

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1. INTRODUCTION

1.1 Purpose of this Report

This report has been prepared for Brisbane City Council by John Gaskell Planning Consultants, Environmental & Community Risk International, [redacted], and WRM Water and Environment. This report reviews Brisbane City Council's planning scheme to determine how well it addresses Natural Disaster Risk Management requirements of the State Planning Policy 1/03 - Mitigating the Adverse Impacts of Flood, Bushfire and Landslide (SPP 1/03).

The purpose of the report is to provide Council with a clear understanding as to whether it currently meets its obligations under SPP 1/03. This report assesses Council's City Plan and the most appropriate policy and regulatory tools to respond to the SPP 1/03.

1.2 Structure of the Report

The report is structured in the following manner:

- Section 1, this section, which is an introduction to the report;
- Section 2, which summarises legislative requirements relevant to this study;
- Section 3, which provides a review of the current natural hazard risk management within the City Plan document;
- Section 4, identifying a gap analysis between the City Plan and the requirements of the State Planning Policy 1/03 *Mitigating the adverse impacts of flood, bushfire and landslide* DLGP & DES, 2003a)
- Section 5 which documents the recommended strategy; and
- Section 6 which is the conclusion.

1.3 Methodology

The tasks in the methodology for the study are set out below:

Task 1	Project Inception
Task 2	Review of Legislative Requirements
Task 3	Review of Current City Plan
Task 4	Gap Analysis
Task 5	Prepare Draft Report and City Plan Strategy
Task 6	Review and Finalisation of Report

2. REVIEW OF LEGISLATIVE REQUIREMENTS

2.1 Overview

This section of the report outlines the legislative framework for natural hazard risk mitigation in the regulation of development. The main focus of the legislative context is the *Integrated Planning Act 1997* which sets out the basis for local government to regulate development through their planning schemes, as well as providing a mechanism for State interests to be expressed in State Planning Policies. The *Sustainable Planning Act 2009* is in effect from 18 December 2009, and replaces the *Integrated Planning Act 1997*. The move to replace the *Integrated Planning Act 1997* with the *Sustainable Planning Act 2009* is an 'evolution' as many of the provisions in the new Act remain similar.

SPP 1/03 *Mitigating the adverse impacts of flood, bushfire and landslide* DLGP & DES, 2003a) sets out the State's interest in ensuring that the natural hazards of flood, bushfire and landslide are adequately considered when making decisions about development. In its development, SPP 1/03 was seen as a significant boost to disaster risk management in Queensland by virtue of its capacity to limit the growth of development in hazard prone locations. It was, none-the-less recognised that the provisions of SPP 1/03 could not have any significant impact on reducing risks in established development.

The Brisbane City Plan 2000 did not explicitly address SPP 1/03 provisions because it was prepared prior to the SPP 1/03 being prepared and implemented. However, as part of the City Plan's current major review, the Queensland Department of Community Services will require a comprehensive review and response to the SPP 1/03, consistent with the requirements of SPP 1/03 when planning schemes undergo a major review.

2.2 Integrated Planning Act 1997

At the broadest level the *Integrated Planning Act 1997* (IPA) requires the advancing of the Act's purpose in seeking to achieve ecological sustainability (Sections 1.2.1 and 1.2.2 of the Act). This term incorporates the 'cultural, economic, physical and social wellbeing of people and communities' including 'safe and sustainable development' (S1.3.6 of IPA). Consequently, planning schemes and development assessment processes are expected to take account of natural hazards such as flooding, bushfire and landslide.

In addition, IPA identifies that where a planning scheme is changed to take account of a natural hazard, no compensation as a result of the change to the planning scheme is payable. Compensation is not payable where, if development occurred under the superseded planning scheme, such development:

> *(i) would have led to significant risk to persons or property from natural processes (including flooding, land slippage or erosion) and the risk could have been significantly reduced by conditions attached to a development approval; ...*

This is an important statement that highlights the fundamental process of consideration of natural hazards and where appropriate making the necessary changes to the planning scheme, without being exposed to compensation claims.

The IPA identifies the requirements and powers for introducing State Planning Policies. Section 2.4.1 of the Integrated Planning Act includes the enabling provisions for State Government to prepare State Planning Policies:

*(1) A **State planning policy** is an instrument, made by the Minister under this part, about matters of State interest.*

(2) A State planning policy is a statutory instrument under the Statutory Instruments Act 1992 and has the force of law.

State Planning Policies must be addressed in the preparation of planning schemes and are part of the criteria in decision making rules for applications in the IPA. (Refer to Section 3.5.13 and 3.5.14).

2.3 State Planning Policy 1/03

2.3.1 Introduction and Overview

On the 11th September 2003 the State Government commenced the State Planning Policy 1/03 *Mitigating the adverse impacts of flood, bushfire and landslide*. This State Planning Policy requires that the natural hazards of flood, bushfire and landslide are adequately considered when making decisions about development. Importantly this SPP applies both to the preparation of planning schemes and to the assessment of development through local government planning schemes. The clear intent of SPP 1/03 is to minimize the growth of development in hazard-prone areas and as such is regarded as a major contribution to the process of disaster risk reduction. It is also recognized that the planning process can only have a significant impact on reducing inappropriate new development; it has limited or no capacity to reduce risks in areas that are already developed.

SPP 1/03 contains the State's legislative requirements for addressing natural hazard risk management in planning schemes. In addition, development assessment provisions are provided for those planning schemes that pre-date the implementation of SPP 1/03.

Importantly, SPP 1/03 states that when a planning scheme has appropriately reflected the SPP then the planning scheme is regarded as the local interpretation and expression of the SPP for development assessment purposes. That is, the SPP is only used in development assessment when a planning scheme has not 'appropriately' reflected the SPP. The preparation of the current Brisbane City Plan 2000 (commencing October 2000) was prior to the introduction of the SPP 1/03 and therefore was not able to explicitly reflect the SPP.

The policy approach contained in the SPP 1/03 is to require the identification of 'natural hazard management areas' so that requirements for development can be applied to mitigate the adverse impacts of flood, bushfire, and landslide. Default 'natural hazard management areas' are identified where planning schemes have not incorporated their own natural hazard management area maps. In addition, the SPP provides specific standards of development for community infrastructure, so that essential community infrastructure can be operational during and immediately after natural hazard events.

***Natural hazard management area**: an area that has been defined for the management of a natural hazard (flood, bushfire or landslide), but may not reflect the full extent of the area that may be affected by the hazard (e.g. land above the 1% AEP floodline may flood during a larger flood event). Natural hazard management areas for flood, bushfire or landslide are described in Annex 3.*

The SPP contains six Outcomes; the first three relating to development assessment, and the remaining three relating to making and amending a planning scheme.

2.3.2 Use of the SPP 1/03 in Development Assessment (Outcomes 1 to 3)

Outcomes 1 to 3 of the SPP apply in development assessment, where a planning scheme has not incorporated the requirements of SPP 1/03. Outcome 1 of the SPP 1/03 states the following:

> *Within natural hazard management areas, development to which this SPP applies is compatible with the nature of the natural hazard, except where:*
>
> - *The development proposal is a development commitment; or*
> - *There is an overriding need for the development in the public interest and no other site is suitable and reasonably available for the proposal.*

Outcome 1 requires development to be 'compatible' with the natural hazard, except where the development proposal reflects a 'development commitment', or where there is an 'overriding need' for the development in the public interest. Both terms are further described in the Glossary as follows:

> ***Development commitment**: includes any of the following:*
>
> - *Development with a valid preliminary approval;*
> - *A material change of use that is code assessable or otherwise consistent with the requirements of the relevant planning scheme;*
> - *A reconfiguration of a lot and/or works that is consistent with the requirements (including any applicable codes) of the relevant planning scheme; or*
> - *Development consistent with a designation for community infrastructure.*

The SPP sets out 'development compatibility' by requiring specific outcomes set out in Annex 4.

'Overriding need' refers to the 'significant overall benefit' that must accrue for the whole or a significant part of the community in social, economic or environmental terms that outweighs the adverse impacts arising from the exposure to natural hazards. Other tests include checking the availability of other sites and the extent of increased risk to people from the proposal. (In statutory terms this is a significant test that would be difficult to meet under ordinary circumstances. In addition, there are some Planning and Environment Court decisions about this language as the SEQ Regional Plan has used similar terms).

Outcome 2 states the following:

> *Development that is not compatible with the nature of the natural hazard but is otherwise consistent with Outcome 1:*
>
> - *Minimises as far as practicable the adverse impacts from natural hazards; and*
> - *Does not result in an unacceptable risk to people or property.*

Outcome 2 is a 'default' outcome where Outcome 1 cannot be met, so that adverse impacts from the natural hazard are minimised as far as possible and do not result in 'unacceptable risk' to people or property.

'Unacceptable risk' is defined as:

> *'a situation where people or property are exposed to a predictable hazard event that may result in serious injury, loss of life, failure of community infrastructure, or property damage that would make a dwelling unfit for habitation.'*

Outcome 3 of the SPP 1/03 relates to community infrastructure:

> *Wherever practicable, community infrastructure to which this SPP applies is located and designed to function effectively during and immediately after natural hazard events commensurate with a specified level of risk.*

Outcome 3 is self explanatory in relation to the importance of community infrastructure being operational during and after a natural hazard event.

2.3.3 Use of SPP 1/03 in Making or Amending a Planning Scheme (Outcomes 4 to 6)

The SPP 1/03 is also used to identify the requirements for making or amending a planning scheme. Once adopted the planning scheme that has reflected these requirements of the SPP has only to rely on their planning scheme for assessment of development applications, rather than the SPP 1/ 03 Outcomes 1 through 3.

Outcome 4 is stated as follows:

> *Natural hazard management areas are identified in the planning scheme.*

Outcome 4 requires that the planning scheme identify the location and extent of natural hazard management areas.

Outcome 5 sets out the following requirement:

The planning scheme contains planning strategies that aim to:

- *Ensure that development in natural hazard management areas is compatible with the nature of the natural hazard;*
- *Minimise the impacts from natural hazards on existing developed areas; and*
- *Prevent development from materially increasing the extent or the severity of natural hazards.*

The SPP requires the planning scheme to contain strategies to minimise the impacts of natural hazards on areas of existing development, bringing the 'optimum' level of protection from natural hazards that is 'achievable under the circumstances of the particular locality'.

The SPP requires planning schemes to also include strategies that ensure no increase in the severity of natural hazard impacts through the assessment of development. (eg. maintaining flood carrying capacity of waterways through assessing development such as filling).

Outcome 6 requires the following:

The planning scheme measures:

a) *Include a code(s) designed to achieve development outcomes consistent with Section 6; and*

b) *Ensure that development to which the SPP applies is assessable or self-assessable against that planning scheme code(s).*

The planning scheme, or planning scheme policy(s), specifies the information expected to be submitted with development applications subject to the code(s).

Outcome 6 requires the planning scheme to address the SPP through a code to achieve development outcomes required by the SPP. In addition the SPP requires that all levels of assessment (self, code or impact assessment) in planning schemes assess natural hazard risks.

The State Planning Policy 1/03 Guideline provides advice and information on interpreting and implementing the State Planning Policy 1/03. The SPP Guideline has been given legal status in assisting the interpretation of the SPP.

2.4 Specific Requirements for Bushfire Arising from SPP 1/03

Annex 3 of the SPP defines a natural hazard management area (bushfire) as an area identified by a local government in its planning scheme consistent with the conclusions of a bushfire hazard assessment prepared in accordance with Appendix 3 of the SPP Guideline, or reflecting the Medium and High hazard areas of Bushfire Risk Analysis Maps prepared by the Queensland Fire and Rescue Services (QFRS).

Appendix 3 of the SPP Guideline provides guidance for the mapping of the boundaries for a *natural hazard management area (bushfire)*. The Appendix describes this methodology as follows:

> *The methodology involves quantitative and qualitative assessments. The quantitative element requires an assessment of three key characteristics of land that have been found to be the main determinants of the severity of bushfire hazard. These factors are vegetation communities, slope and aspect.*

This methodology, or a variant of it that is approved by the QFRS, should be used. In the absence of such mapping the Medium and High hazard areas of Bushfire Hazard Maps prepared by the QFRS should be used.

The natural hazard management area (bushfire) mapping developed by Brisbane City Council conforms to the provisions of Appendix 3 of the SPP. It was developed by BCC GIS staff using Council's very high resolution digital elevation model (DEM) to derive slope and aspect layers and a combination of EPA and BCC's own vegetation mapping. The approach set out in Appendix 3 was modified slightly and follows the approach developed by [redacted] in his bushfire risk analysis of Pine Rivers Shire ([redacted] 2003).

The key modification employed by [redacted] was in the weighting applied to aspect. The differences are detailed in the following table.

ASPECT	RATING	SPP 1/03 Hazard Score
North to North-West	2	3.5
South-West to North-West	3	2 - 3

South-West to South	1	2
North to East	0.5	1
All slopes <3%	0.5	0
East to South	0	0

These modifications to SPP methodology were based on an analysis of wind direction on days of fire weather taken from the records from climate stations across south east Queensland over the 52 years 1950 to 2002. These modifications were discussed with senior QFRS staff who presented no objections to their use.

The weight to be applied to individual vegetation types were also modified slightly because the guide used in the SPP 1/03 Guidelines are far broader than the vegetation types included in the EPA and BCC vegetation mapping. The weight applied to the more detailed vegetation classifications were based on the advice and input from experienced rural fire fighters and managers, including staff from the Brisbane Forest Park and QFRS.

The mapping was completed on a 20m grid and classified to either High, Moderate and Low fire hazard ratings. The areas of High hazard were buffered by 100m and the Moderate hazard areas buffered by 50m as required by the SPP Guideline methodology. This buffering is designed to ensure an appropriate separation between the hazard and development. The distances (in the mapping) reflect the posed by the potentially damaging radiant heat from the respective levels of hazard.

Annex 4 of the SPP sets out two specific outcomes that should be achieved for development in a *natural hazard management area (bushfire)* to be compatible with the nature of the bushfire hazard as required under Outcome 1 of the SPP.

1. *Development maintains the safety of people and property by:*
   a) *avoiding areas of High and Medium bushfire hazard; or*
   b) *mitigating the risk through:*
      - *allotment design and the siting of buildings: and*
      - *including firebreaks that provide adequate:*
        - *setbacks between buildings/structures and hazardous vegetation, and*
        - *access for fire fighting/other emergency vehicles*
      - *providing adequate road access for fire fighting/other emergency vehicles and safe evacuation; and*
      - *providing an adequate and accessible water supply for fire fighting purposes.*

2. *Public safety and the environment are not adversely affected by the detrimental impacts of bushfire on hazardous materials manufactured or stored in bulk.*

Appendix 5B of the SPP Guidelines provides non-binding advice on how detailed measures that directly address the two specifically required outcomes for development in a *natural hazard management area (bushfire)* might be incorporated into a planning scheme.

The Brisbane City Council bushfire maps prepared under these guidelines is further discussed in Section 4 Gap Analysis.

2.5 Specific Requirements for Flood Arising from SPP 1/03

A *natural hazard management area (flood)* is defined as land inundated by a Defined Flood Event (DFE). The SPP does not dictate the magnitude of the DFE, which is defined as the flood event adopted by a local government for the management of development at a particular location. However, Annex 3 of the SPP states the Queensland Government's position that the 1% Annual Exceedance Probability (AEP) flood (also referred to the Q100 or 100 year Average Recurrence Interval flood) is generally suitable as the DFE. This approach is consistent with current best practice in floodplain management (SCARM, 2000) which recognises that flood damage will still occur during events between the 1% AEP flood and the Probable Maximum Flood (the largest flood which could possibly occur, i.e. it would occupy the entire flood plain). Nevertheless, best practice floodplain management emphasises the importance of considering the potential consequences of floods larger than the DFE and managing these residual risks through appropriate emergency management strategies.

The SPP does not specify the method by which *natural hazard management areas (flood)* are to be determined and refers to the SPP Guideline to provide further advice on this issue. The SPP Guideline recommends the floodplain management study process described in national best practice guidelines (SCARM, 2000), but also acknowledges that the substantial resources required to implement that process may not always be available or necessary. The SPP Guideline provides information on a range of simplified approaches that can be used to obtain information on flood extent and flood hazard.

The mapping of the *natural hazard management area (flood)* currently employed by BCC is divided between river flooding (both the Brisbane River and Pine River) and creek flooding (the numerous creeks that flow to the Brisbane River). It is understood that the river flood mapping identifies the extent of inundation for a modelled event with an annual exceedence probability (AEP) of 1%. The 1% AEP event is recommended in SPP 1/03 as being the DFE. It is also understood that this modelling is recent and was undertaken using industry standard methods and Council's very high resolution DEM.

The creek flooding is understood to be a composite of various modelling and historic flood level studies undertaken by various consultants and agencies. This composite mapping reflects Council's considered understanding of the DFE for creek flooding, notionally a 1% AEP event.

Council is yet to move towards the flood hazard classification approach detailed in Appendix J of SCARM (2000) described in SPP 1/03. The SPP guideline states that the assessment (of natural hazard management areas) 'may include the assessment of relative levels of severity in relation to natural hazards'. A move to an approach of mapping hazard, which is based on an analysis of both flood depth and velocity for the modelled event, would require a considerable upgrade of Council's flood data. (This is further discussed in Section 6 of this report).

The definition of flood adopted within the SPP is based on water which overtops the natural or artificial banks of a watercourse. Hence, the SPP does not specifically address the issue of inundation caused by stormwater travelling as overland or pipe flow prior to entering a watercourse.

Annex 4 of the SPP adopts the following five outcomes that should be achieved for development to be compatible with the nature of the hazard as required under Outcome 1 of the SPP:

> *1. Development maintains the safety of people on the development site from all floods up to and including the DFE.*

2. Development does not result in adverse impacts on people's safety or the capacity to use land within the floodplain.

3. Development minimises the potential damage from flooding to property on the development site.

4. Public safety and the environment are not adversely affected by the detrimental impacts of floodwater on hazardous materials manufactured or stored in bulk.

5. Essential services infrastructure (e.g. on-site electricity, gas, water supply, sewerage and telecommunications) maintains its function during a DFE.

2.6 Specific Requirements for Landslide Arising from SPP 1/03

Annex 3 of the SPP defines a *natural hazard management area (landslide)* as an area identified by a local government in its planning scheme consistent with the conclusions of a landslide hazard assessment prepared in accordance with Appendix 4 of the SPP Guideline, or including all land of 15% and greater slope, as well as reflecting land known or suspected of being unstable or potentially impacted by landslide. In the case of Brisbane City Council, the landslide hazard assessment prepared by Granger and Leiba (2004) modifies and exceeds the statutory requirements.

Appendix 4 of the SPP Guideline provides guidance for the mapping of the boundaries for a *natural hazard management area (landslide)*. That guidance does not specify a particular methodology other than it should be based on local conditions and take into account a range of factors including past events, slope, soils, water and underlying geology. The SPP Guideline provides references to methodologies that may be appropriate, particularly focusing on *Landslide Risk Management Concepts and Guidelines*, prepared by the Australian Geomechanics Society in 2000, amongst others. Where such a methodology is not used, the Guideline sets a slope of 15% as the default threshold above which local governments should consider a landslide hazard to exist.

The *natural hazard management area (landslide)* mapping used by BCC was developed by their GIS staff to specifications set by [redacted]. It conforms to the approach suggested in Appendix 4 of the SPP and adopts a methodology employed in the landslide chapter of [redacted] which defines the landslide potential by specifically combining data on both slope and geology. The slope component of this mapping was based on the BCC high resolution DEM and employed a grid size of 10m. It was recognised by BCC staff at the time that grid size could influence the slope values significantly. A grid resolution as fine as 10m is likely to lead to many small areas to be included as having a landslide hazard that would not be captured were the resolution 20m, for example. The landslide hazard mapping also identified areas along the Brisbane River in which there is an identified risk of bank collapse. This zone is a simple 50 m-wide buffer from the river bank.

It is important to note that SPP 1/03 applies to 'natural slopes'. In already developed areas 'cut slopes' are also recommended to be taken into account.

Annex 4 of the SPP sets out one specific outcome that should be achieved for development in a *natural hazard management area (landslide)* to be compatible with the nature of the landslide hazard as required under Outcome 1 of the SPP:

1. Development maintains the safety of people, property and hazardous materials manufactured or stored in bulk from the risk of landslide.

Appendix 5C of the SPP Guidelines provides non-binding advice on how detailed measures that directly address the specifically required outcome for development in a *natural hazard management area (landslide)* might be incorporated into a planning scheme.

The extent to which BCC currently achieves the specific outcomes in *natural hazard management areas (landslide)*, in terms of its compliance with or provision for the requirements and solutions offered by the SPP Guidelines, will be assessed under Gap Analysis in Section 4 of this report.

2.7 The Sustainable Planning Act 2009

The *Sustainable Planning Act 2009* is expected to come into effect in December 2009, which brings a range of 'evolutionary' changes to the *Integrated Planning Act 1997*. An important aspect of the *Sustainable Planning Act 2009* is the consideration of climate change as part of advancing the Act's purpose:

> *(ii) take account of short and long-term environmental effects of development at local, regional, State and wider levels, including, for example, the effects of development on climate change...*
>
> *(c) avoiding, if practicable, or otherwise lessening, adverse environmental effects of development, including, for example—*
> *(i) climate change and urban congestion; and*
> *(ii) adverse effects on human health; and*
>
> *(iv) potential adverse impacts on climate change are taken into account for development, and sought to be addressed through sustainable development, including, for example, sustainable settlement patterns and sustainable urban design.*

Other specific aspects of the *Sustainable Planning Act 2009* for note in relation to this study include:

- the hierarchy of planning instruments; The Act sets out a hierarchy of planning instruments, wherein State Planning Policies are considered a 'higher order' planning instrument than local government planning schemes;
- new requirements for 'properly made applications', where technical reports are required to be completed with the lodgement of the application rather than rely on information request processes;
- the requirement for State Government agencies to prepare State Planning Policies where a State planning interest is expressed that influences planning schemes; and
- new processes for amending planning schemes.

2.8 Queensland Planning Provisions

The State's planning reform agenda includes a new requirement for local government to prepare planning schemes consistent with the Queensland Planning Provisions (QPP). At the time of completing this report (December 2009) the QPP was still in draft form and yet to be released as a final document.

The QPP will provide a template for all planning schemes in Queensland including:

- consistent structure, layout and headings;
- the requirement for a strategic plans, albeit in a 'straightjacket' of consistent topic areas;
- a consistent suite of zones, of which local authorities can choose some or all of the zones;
- a consistent approach to level of assessment tables;
- definitions across the state; and
- consistent code formats.

The main significance to natural hazard risk management is the approach to overlay maps and related codes. The QPP identifies that land identified by overlay maps will be able to:

- identify level of assessment changes (that is, if land is included in an overlay category, this can result in changes of assessment, such as houses becoming code or impact assessment where ordinarily they may be self assessable);
- requiring development in these areas to be assessed against a code addressing the overlay (or constraint) mapping.

The QPP identifies that overlay maps (and related provisions) may be prepared for Bushfire Hazard, Landslide Hazard and Flood Hazard.

3. REVIEW OF CURRENT CITY PLAN

3.1 Overview

This section of the paper provides a review of the current City Plan regulatory framework in relation to flooding, bushfire and landslide hazard management.

The objectives of SPP 1/03 are reflected in numerous components of City Plan. For each hazard, the review has documented the relevant City Plan requirements from each of the following sections of City Plan:

- Chapter 2 (The Strategic Plan),
- Chapter 3 (Areas and Assessment Processes),
- Chapter 4 (Local Plans),
- Chapter 5 (Codes), and
- Planning Scheme Policies.

3.2 Bushfire Hazard

3.2.1 Chapter 2 The Strategic Plan

The Strategic Plan contains two sections. The first section contains Desired Environmental Outcomes (DEO) and associated strategies. The second section contains elements which provide physical form to the City Wide Desired Environmental Outcomes (DEOs). The elements are a geographic expression of the DEO's and strategies that collectively outline the broad outcomes intended for the City.

The following sections of the City Plan provide a broad basis or 'head of power' for more detailed consideration of bushfire hazard issues in the City Plan's more detailed regulation such as codes.

Desired Environmental Outcomes

DEO 3.1.1 *Natural Environment and Waterways* contains aspects related to bushfire:

> *3.1.1* ***Desired Environmental Outcome***
> *Brisbane's environmental quality and natural assets are protected and restored and contribute effectively to no net loss of biodiversity, the management of public health and the social and cultural wellbeing of the community...*

Related strategies to achieve this DEO include the following strategy:

> *3.1.2.1 Maintain and restore the City's biodiversity through:*
> ...
>
> *(c)* ***fire management****—ensuring that fire management measures are compatible with the protection and restoration of biodiversity.*
>
> ...

DEO 3.2.1 *Community Life, Health and Safety* contains a general reference to safety and includes a detailed strategy relating to safety and reducing risks of bushfires:

> *3.2.1* ***Desired Environmental Outcome***

Brisbane is a safe, healthy and vibrant place to live, offering a wide range of local and regional services, facilities and activities and diverse housing, community, cultural and recreational choices.

The related strategies from this DEO include the following strategy:

3.2.2.8 Achieve a safe, secure, equitable and comfortable City through:

(d) ***reducing risks*** *– planning to reduce the risks of loss of life, injury, property damage and community disruption resulting from landslip, subsidence, flooding, bushfires, storms and other emergencies and disasters, mindful of the need to maintain emergency access, egress and escape routes to facilitate emergency response*

Strategic Plan Elements

No references are made to bushfire (references to fire hazards associated with hazardous industrial activities are made) in the elements of the strategic plan.

Comment: The Strategic Plan provides limited broad statements about protecting public safety. However the Strategic Plan lacks a more specific approach to bushfire; specifically, to state more clearly the overall purpose of regulating development to avoid adverse impacts from bushfire.

3.2.2 Chapter 3 Areas and Assessment Processes

Areas are the way in which land is identified in the planning scheme that determines land use outcomes and level of assessment for proposed development. There are limited references to bushfire hazard in the Areas section of Chapter 3 as follows:

- Sections 3.4.2 and 3.5.2 providing the DEOs for the Environmental Protection Area and the Rural Area respectively include the following DEO:

  Exposure to risks of bushfires and land instability is minimised.

- The intents for the Low Density Residential Area, Character Residential Area and Low-Medium Density Residential Area in Sections 5.2.1, 5.3.1 and 5.4.1 respectively state the following in relation to building envelopes on small lots:

  ...
  Building envelopes for houses on small lots are defined so that amenity impacts to nearby dwellings and their private open spaces are minimised, in terms of maintaining access to sunlight, daylight and privacy.
  The building envelopes also seek to increase safety from fire hazard, ...

The only relevant aspects in terms of the level of assessment tables in the area provisions is that currently the level of assessment for a house in the Rural Area or Environmental Protection Area requires code assessment (notifiable) where not located within an approved Building Location Plan and where on a lot less than 1ha in the Rural Area or 4ha in the Environmental Protection Area. Building location plans are approved at subdivision stage and are required to address natural hazard requirements at this stage of the development in determining appropriate locations for future dwellings (albeit in a limited way - refer to section 3.2.4 in relation to the subdivision code).

Accordingly, where a code assessment application is required for houses not located in accordance with an approved building location plan, this provides an opportunity for Council to more closely assess bushfire hazard risk under the relevant acceptable

solutions in the house code (specific location requirements are set out where a building location plan has not been approved addressing bushfire hazard mitigation among other hazard risks and ecological impacts); however, this scenario only applies to development in the Rural Area or Environmental Protection Area. In addition, minimum lot size for subdivision in the Rural Area and Environmental Protection Area is 10 hectares; therefore the trigger for assessment (less than 1ha in Rural Areas or 4ha in Environmental Protection Areas) is likely to only occur where new houses are proposed on existing vacant lots.

Comment: The area provisions assume a bushfire hazard risk may only occur in the Rural and Environmental Protection Areas which may not capture all relevant locations and development where bushfire risk exists.

3.2.3 Chapter 4 Local Plans

Local Plans provide specific direction for discrete parts of the City overriding the more general provisions of the City Plan. Limited references to bushfire hazard management were identified in the local plans with a notable exception being the Mt Coot-tha Local Plan.

The Mt Coot-tha Local Plan in particular includes development principle 2.6 in relation to natural hazard events:

> *2.6 Natural hazardous events, including bushfire, landslip and flooding, are to be appropriately managed so as not to pose an unacceptable risk to life and property.*
>
> *This is intended to be achieved by:*
>
> - *restricting proposals in areas of high bushfire hazard or areas prone to landslip or flooding*
> - *applying standards to assessable development so that the risk of damage/loss of life from bushfire, landslip and flooding is minimised.*

The precinct intents further identify those areas that are constrained by gradient, soil stability and bushfire hazard and this is further reflected in the local plan mapping.

Specifically in relation to bushfire hazard, the local plan code also includes acceptable solutions applying to development located in the bushfire hazard areas identified in the local plan mapping. Acceptable solutions include building design requirements, provision of water for fire fighting (tank or swimming pool is provided where hydrants are not available) and bushfire risk reduction requirements in accordance with a bushfire hazard management plan provided as part of a development application (e.g. vegetation management, fire breaks, buildings away from ridge lines etc.).

Comment: The Mt Coot-tha Local Plan provides a example for how bushfire hazard mitigation can be regulated in local planning areas and may have broader relevance for the other general Area provisions in the City Plan for bushfire hazard risk areas. The specific standards and references in the local plan and code may require review to achieve best practice standards as part of the broader consideration of provisions for other parts of the City.

3.2.4 Chapter 5 Codes

Outside the Mt Coot-tha Local Plan and House Code, there are limited provisions in the general codes applying to development that regulate bushfire hazard management in the City Plan; however, a summary of the relevant provisions is provided in Table 1 below.

Table 1 Summary of relevant Code Provisions

Code	**Summary of Provisions Applicable to Regulating Bushfire Issues**	**Comment**
House Code	A self assessable code that includes additional provisions that seek to ensure houses are not exposed to unreasonable risk from bushfire that apply to houses where located in the Environmental Protection, Rural Areas and Very-Low Density Residential Potential Development Area as identified in a local plan.	The house code is a self assessable code that all houses must comply with. The code identifies (section 4.3) that Environmental Protection and Rural Areas are designated as 'bushfire prone areas'. Acceptable solutions in the code state that houses constructed in the applicable areas must ensure a water supply of 45,000L is available for fire fighting where reticulated water is not supplied and that landscaping employs fire resistant plant species within the building location plan area. This allows for some assessment of bushfire hazard issues in those areas that are particularly at risk although in a limited way.
Landscaping Code	The code applies to assessable development (other than detached houses) and addresses bushfire hazard in relation to landscaping (perhaps inappropriately) under a performance criterion for Crime Prevention Through Environmental Design (CPTED).	The acceptable solution states that fire resistant plant species are planted in areas of bushfire hazard and landscaping is designed to minimise the hazard.
Subdivision Code	The code applies to all development for a reconfiguration of a lot and includes performance criteria and acceptable solutions that apply in the 'bushfire prone areas' ('generally applicable to Greenspace Areas and lands directly adjoining Greenspace Areas')	Specific provisions include building location plan requirements, subdivision layout and design requirements to address bushfire hazards.

Comment: The Subdivision Code and House Code provide limited regulation of bushfire hazard management but only in relation to domestic development and only in the Rural Area and Environmental Protection Areas. Further, the relevant provisions apply regardless of the level of bushfire hazard risk at the relevant locations which is not identified in the City Plan and which may impact on the appropriateness of the provisions. This highlights a gap in the regulation of Bushfire Hazard Management in the City Plan.

3.2.5 Planning Scheme Policies

There are no relevant provisions in relation to bushfire hazard management in the planning scheme policies.

3.3 Flooding

3.3.1 Chapter 2 The Strategic Plan

Desired Environmental Outcomes

DEO 3.1.1 *Natural Environment and Waterways* contains aspects related to flooding:

> *3.1.1* ***Desired Environmental Outcome***
> *Brisbane's environmental quality and natural assets are protected and restored and contribute effectively to no net loss of biodiversity, the management of public health and the social and cultural wellbeing of the community...*

Related strategies from this DEO include the following:

> *3.1.2.2 Enhance the aquatic ecology and quality of ground and surface water, including wetlands, the Brisbane River, and other waterways and water bodies through:*
> ...
>
> *(b)* ***minimising damage*** *– minimising filling in floodplains, erosion, run-off, siltation and other forms of water pollution.*
>
> ...

DEO 3.2.1 *Community Life, Health and Safety* contains a general reference to safety and includes a detailed strategy relating to safety and reducing risks of flooding:

> *3.2.1* ***Desired Environmental Outcome***
> *Brisbane is a safe, healthy and vibrant place to live, offering a wide range of local and regional services, facilities and activities and diverse housing, community, cultural and recreational choices.*

The related strategies from this DEO include the following strategy:

> *3.2.2.8 Achieve a safe, secure, equitable and comfortable City through:*
>
> *(c)* ***reducing risks*** *– planning to reduce the risks of loss of life, injury, property damage and community disruption resulting from landslip, subsidence, flooding, bushfires, storms and other emergencies and*

disasters, mindful of the need to maintain emergency access, egress and escape routes to facilitate emergency response

DEO 3.6.1 *Infrastructure* refers to infrastructure provision and stormwater management and includes a strategy in relation to flood carrying capacity of waterways:

3.1.1 ***Desired Environmental Outcome***
Brisbane has efficient and equitable transport, power, telecommunications, water, waste water treatment and stormwater management infrastructure.

The relevant related strategy is provided as follows:

3.6.2.1 Ensure an adequate standard and capacity of community amenities associated with new development through:

...

(f) ***waterways*** *– ensuring that the flood carrying capacity of waterways is not adversely affected by development.*

...

Strategic Plan Elements

The elements of the Strategic Plan also provide high level statements supporting the regulation of development subject to flooding in Brisbane City.

In the Brisbane Green Space System (Section 4.1 of the Strategic Plan) the key green space values are outlined including the following:

Green space corridors *are also intended to serve as physical breaks and buffers in the urban area, to increase the sense of identity for local communities and to serve floodway and drainage functions.*

....

Following from the Brisbane Green Space components it is the Green Space Corridors that highlight flooding and drainage functions.

Section 4.1.2.3 "Protecting important elements in the Emerging Community Area and Future Industry Area" identifies that 'flood liable land' is unsuitable for urban development.

In the Industrial locations (Section 4.3 of the Strategic Plan) specific reference is made to the Brisbane-Ipswich Corridor in Section 4.3.2.2 which includes a key strategic direction to:

...

- *develop open space corridors along creeks, wetlands and watercourses for flooding, drainage and wildlife.*

No further mention of flooding is made in Section 4.2 Residential Neighbourhoods, Section 4.4 Centres, Section 4.5 Movement System, Section 4.6 Native Title or Section 4.7 Heritage.

Comment: As noted above in relation to bushfire hazard, the Strategic Plan provides broad statements about protecting public safety but lacks a more specific approach to clearly identify the overall purpose of regulating development to avoid adverse impacts from flooding.

3.3.2 Chapter 3 Areas and Assessment Processes

City Plan determines land use outcomes and level of assessment for proposed development through the designation of "Areas". There is limited reference to flooding in the Areas section of Chapter 3.

Chapter 3 also contains guidance and requirements for general assessment processes, including exemptions (Exemptions exclude development from being assessed against the City Plan). In relation to flooding, the City Plan specifically identifies exemptions for filling or excavation as follows:

- to a depth of one vertical metre or less from ground level on land which the Acid Sulphate Soil Code and Wetland Code and / or Waterway code do not apply, and where the site is not listed on the Contaminated Land Register or Environmental Management Register; OR

- top dressing to a depth of less than 100 vertical millimetres from ground level on land to which the Wetland Code and/ or Waterway Code applies.

(Section 2.3, page 5, Chapter 3)

These parameters provide important thresholds for when an application is required.

Chapter 3 also identifies the definition for filling or excavation:

> *Filling or excavation means operational work for excavating or filling that materially affects premises or their use.*

Comment: The triggers for where applications will be required and where they are not required seek to strike a balance between assessing the more significant applications, and unnecessarily having to assess low risk applications. These thresholds may require review.

3.3.3 Chapter 4 Local Plans

Local Plans provide specific direction for discrete parts of the City overriding the more general provisions of the City Plan. There are some general references to flooding and flood plains in the Local Plans however these Local Plans often lack specific controls relying on the more general processes and requirements of the City Plan to manage / regulate flood issues.

3.3.4 Chapter 5 Codes

There are a number of key codes that provide the basis for the detailed regulation of flooding in the City Plan. A summary of these is provided in table 2 below.

Table 2 Summary of relevant Code Provisions

Code	**Summary of Provisions Applicable to Regulating Flood Issues**	**Comment**
Filling and	Specific Purpose statement	The purpose statement is quite

Code	Summary of Provisions Applicable to Regulating Flood Issues	Comment
Excavation Code	that identifies no adverse impacts from filling on upstream, downstream or adjoining properties. Specific Performance Criteria and acceptable solutions for filling regarding flood impacts.	stringent in its requirement for filling to not cause any adverse impacts upstream, downstream or adjacent. The acceptable solution states that no filling is acceptable below Q100 levels, within waterway corridors or wetlands. If this is not achieved an assessment against the performance criteria is required. ('no increase in flooding or drainage problems'). The performance criteria requires filling and excavation to be carried out in accordance with the Compensatory Earthworks Planning Scheme Policy (refer to section 3.3.5 below for details of the policy).
House Code	A self assessable code that seeks to exclude development in a waterway corridor and sets minimum habitable and non habitable floor levels.	This is a self assessable code that all houses must comply with. Houses that are constructed in the waterway corridor, or cannot meet flood immunity levels require an application (usually code assessment). This allows for assessment of flooding issues for those applications.
Park Planning and Design Code	The code applies to subdivision applications where the dedication of parkland is required. Performance Criteria and Acceptable Solutions require parkland to achieve flood immunity.	The code is only relevant where a land dedication for parkland is required or contributed in lieu of a monetary contribution by development. The acceptable solutions are Q5 flood immunity for recreation areas (except where the land would benefit recreation such as flat land for a sports field) and Q100 immunity for buildings (clubhouse, equipment store etc).
Stormwater Management Code	The code contains performance criteria and acceptable solutions that development 'must not adversely impact' on properties upstream, downstream or adjacent. Additional performance	This is the main code with assessment criteria for flooding issues. The code has specific performance criteria and acceptable solutions for managing flood impacts.

Code	Summary of Provisions Applicable to Regulating Flood Issues	Comment
	criteria relate to the need to manage property runoff safely.	
Structure Planning Code	The code is triggered by any impact assessable development including reconfiguring a lot or material change of use in an Emerging Community Area or a Future Industry Area. The code requires the preparation of a detailed structure plan to guide future development in these areas including the identification of relevant constraints for development such as flooding.	The code requires the identification in a structure plan of flood affected land identified as being below the Flood Regulation Line.
Subdivision Code	Limited broad or detailed guidance for management of impacts on flooding	Relies on other codes in relation to the management of stormwater, however, some stronger stormwater management / overland flow statements may be warranted.
Waterway Code	Limited broad or detailed guidance for management of impacts on flooding	Relies on other codes in relation to the management of stormwater.

Comment: The codes are the most important regulatory mechanism in the City Plan in relation to flooding. The codes need to contain both the broader policy requirements associated with regulating development to minimise flooding, as well as the detailed development standards. The Stormwater Management Code provides a sound basis for the assessment of flood issues in the regulation of development. However the codes could be improved with better references and more specific policy statements and standards as to how flood risk is managed and assessed.

3.3.5 Planning Scheme Policies

Subdivision and Development Guidelines

The Subdivision and Development Guidelines are a Planning Scheme Policy prepared as part of the Brisbane City Plan 2000. Consequently this policy supports the regulation of development (primarily through codes) contained within the City Plan. The policy provides technical standards, requirements and processes for assessing flood issues arising from the regulation of development in the City Plan. In particular a range of key codes (such as the Stormwater Management Code) provide a direct reference to the Guidelines.

The Subdivision and Development Guidelines provide two sections that are relevant to flooding and stormwater management. Part A, Chapter 1 of the document addresses flood affected land, and sets out:

- flood immunity standards for residential developments, including intensifying use in infill development;
- flood immunity standards for industrial / commercial developments;
- road trafficability; and
- earthworks adjacent to waterways and flow paths.

Compensatory Earthworks Planning Scheme Policy

The compensatory earthworks planning scheme policy (PSP) sets out requirements for development when reshaping of land is proposed within a waterway corridor. The objective of the PSP is to "... *ensure that earthworks reduce neither the flood-storage capacity nor flood-carrying capacity of the area within a Waterway Corridor".* The policy states that for earthworks to be acceptable within a Waterway Corridor it must be demonstrated that they:

- do not conflict with the Waterway Code or the Filling and Excavation Code; and
- do not adversely impact the hydraulic characteristics of the watercourse with impacts cited including:
  - reducing the flood-carrying capacity of a watercourse; and/or
  - reducing flood storage; and/or
  - altering the hydraulic control of the stream and thus causing scour and sedimentation.

The policy sets out the application requirements of development to provide 'compensatory earthworks' rather than 'balanced earthworks' where proposed in a waterway corridor. The distinction between the two is described in section 3 of the policy as follows:

> *To preserve the hydraulic characteristics within a Waterway Corridor, the volume of 'cut' and 'fill' must be compensatory between incremental flood levels* (i.e. not a simple 'total fill <= total cut'). *In Example 2, the volume of 'fill' is equal to or less than the volume of 'cut' between each incremental level. If more 'fill' than 'cut' were added between levels (see Example 1, 5.2 – 5.4m AHD) then the flood-storage capacity and flood-carrying capacity within a Waterway Corridor would be reduced for certain flood events with adverse consequences to flooding.*
>
> *Example 1: Balanced Earthworks*

Level (m AHD)	Cut (m^3)	Fill (m^3)
5 – 5.2	600	200
5.2 – 5.4	300	500
5.4 – 5.6	400	600
Total	*1,300*	*1,300*

> *Example 2: Compensatory Earthworks*

Level (m AHD)	Cut (m^3)	Fill (m^3)
5 – 5.2	600	≤600
5.2 – 5.4	300	≤300
5.4 – 5.6	400	≤400
Total	*1,300*	*1,300*

Comment: The Subdivision and Development Guidelines provide the most robust and in-depth approach to assessing the impacts of development on flooding. Similarly, the Compensatory Earthworks Planning Scheme Policy provides in-depth assessment requirements for development to mitigate the impacts of filling and excavation on flooding where called up by the performance criteria in the Filling and Excavation Code. However, the policies have a low level of statutory impact being planning scheme policies, and accordingly, are more able to be waived if circumstances permit. A more robust approach is to apply the appropriate broader principles and standards contained in the planning scheme policies to the codes where a more stringent application of the standards can be applied.

3.4 Landslide Hazard

3.4.1 Chapter 2 The Strategic Plan

Desired Environmental Outcomes

DEO 3.2.1 *Community Life, Health and Safety* contains a general reference to safety and includes a detailed strategy relating to safety and reducing risks of 'landslip and subsidence':

> *3.2.1* ***Desired Environmental Outcome***
> *Brisbane is a safe, healthy and vibrant place to live, offering a wide range of local and regional services, facilities and activities and diverse housing, community, cultural and recreational choices.*

The related strategies from this DEO include the following relevant strategy:

> *3.2.2.8 Achieve a safe, secure, equitable and comfortable City through:*
>
> *(c)* ***reducing risks*** *– planning to reduce the risks of loss of life, injury, property damage and community disruption resulting from landslip, subsidence, flooding, bushfires, storms and other emergencies and disasters, mindful of the need to maintain emergency access, egress and escape routes to facilitate emergency response*

Strategic Plan Elements

No references are made to landslide hazards or other relevant references in the elements of the strategic plan.

Comment: Comments noted above in relation to bushfire hazard and flooding apply. More specific statements are needed to clearly identify the overall purpose of regulating development to avoid adverse impacts from landslide hazard.

3.4.2 Chapter 3 Areas and Assessment Processes

Areas are the way in which land is identified in the planning scheme that determines land use outcomes and level of assessment for proposed development. There are limited references to landslide hazard in the Areas section of Chapter 3 as follows:

- As noted in relation to bushfire hazard, Sections 3.4.2 and 3.5.2 providing the DEOs for the Environmental Protection Area and the Rural Area respectively include the following DEO which also refers to land instability:

  Exposure to risks of bushfires and land instability is minimised.

No other references are made to landslide hazard in chapter 3. The level of assessment tables do not vary the level of assessment for development that may be subject to landslide hazard other than where for a house where a building location plan does not exist and where on a lot less than 1ha in the Rural Area or 4ha in the Environmental Protection Area. In this case the level of assessment is changed from self assessment to code (notifiable). The variation to the level of assessment under these circumstances is also not directly linked to landslide hazard and relates to building location plans which address additional aspects of siting and design including other natural hazards.

Comment: The Area provisions include very limited reference to landside and the Environmental Protection Area and Rural Area may not be the only locations where a landslide hazard may occur.

3.4.3 Chapter 4 Local Plans

Limited references to landslide hazard management were identified in the local plans with exceptions identified in the Mt Coot-tha and Fig Tree Pocket Local Plan as detailed below.

Mt Coot-tha Local Plan

The level of assessment for houses remains self assessable where complying with the acceptable solutions in the local plan code for houses in slope constraint areas (i.e. where located in a "*low slope constraint area*" (0% to 20% slope category) identified in the local plan mapping (or where located in accordance with a building location plan and use access approved at subdivision stage)); however, the level of assessment becomes code assessable (notifiable) where not meeting the acceptable solutions (i.e. where located in a moderate slope constraint area (20–33% slope category) or high slope constraint area (in excess of 33% slope)).

All other code and impact assessable development (i.e. not in a low slope constrained area) is subject to additional acceptable solutions stating that development does not occur in the high slope constraint area and erosion and sedimentation impacts are minimised in accordance with an Erosion and Sediment Control Plan as well as a range of additional requirements in relation to building and operational works such as minimising cut and fill activities, limiting retaining walls, preference to pole type foundations rather than slab on ground, driveway grades, and revegetation requirements are provided.

Fig Tree Pocket Local Plan

The Fig Tree Pocket Local Plan includes similar provisions by way of mapping and acceptable solutions in the code in relation to steep land; however, the outcomes sought are in relation to protecting ecological values in terms of erosion and sediment loss and impacts on waterways rather than protection of people and property.

Comments: The Mt Coot-tha Local Plan provides the most detailed provisions for the assessment of landslide hazard in the City Plan but is obviously limited in application where applying only to the Mt Coot-tha area.

3.4.4 Codes

There are a number of key codes that provide limited basis for the detailed regulation of landslide hazard in the City Plan. A summary of these is provided in table 3 below.

Table 3 Summary of relevant Code Provisions

Code	**Summary of Provisions Applicable to Regulating Landslide Issues**	**Comment**
House Code	Self assessable code that applies to all houses. The code includes a performance criterion stating that houses in the Environmental Protection, Rural Areas and Very-low Density Residential Potential Development Area as identified in a Local Plan must not be subject to unreasonable risk from landslip or instability. The acceptable solution requires a house to be located in accordance with a building location plan or on land with a natural grade of less than 1 in 4 (25%) measured over a 40m by 40m area.	There are very limited provisions assessing landslide hazard and they only apply in the specific locations noted.
Structure Planning Code	The code is triggered by any impact assessable development including reconfiguring a lot or material change of use in an Emerging Community Area or a Future Industry Area and requires the preparation of a detailed structure plan to guide future development in these areas including the identification of relevant constraints for development such as steeply sloping land.	The code requires the identification in a structure plan of steeply sloping land that is generally unsuitable for urban development because of potential instability, erosion or other hazard caused by clearing steep land.
Subdivision Code	The code includes section 5.4 providing performance criteria and acceptable	A range of acceptable solutions are provided that seek to ensure allotments are located on land

	solutions in relation to geotechnical stability.	with a suitable grade and provide suitable building sites without requiring excessive cut and fill. Building location plans are required.

Comments: The codes are the most important regulatory mechanism in the City Plan in relation to Landslide Hazard but are currently lacking in terms of both broader policy requirements associated with regulating development to minimise landslide hazard as well as the detailed development standards which are limited in application. The codes are limited in their application (currently limited to houses and in new or outer-City development areas such as Emerging Community, Future Industry, Rural and Environmental Protection Areas) by the lack of clearly identified landslide hazard risks in the City Plan (i.e. such as by maps).

3.4.5 Planning Scheme Policies

There are no relevant provisions in relation to landslide management in the planning scheme policies.

3.5 Summary

The audit of the City plan provisions in relation to bushfire, flooding and landslide hazards has identified:

- there is a broad reference to public safety and risk management in the Strategic Plan as a way of how the City Plan addresses this issue on a broad level, but a lack of emphasis on these matters when compared with environmental protection;
- The Area provisions and level of assessment triggers in City Plan have assumed a broad-brush application of bushfire and landslide hazard risk to the Rural and Environmental Protection Areas alone;
- important thresholds in relation to flooding are located in the introductory sections of Chapter 3 (in terms of the definition of Filling and Excavation and the exemptions for filling);
- the most important regulation of development in relation to flooding occurs in the codes, which could be amended to strengthen the assessment of flood issues;
- the most important regulation of development in relation to bushfire and landslide hazard also occurs in the codes but is currently limited in application and effectiveness by assumptions about the locations of these hazards (i.e. limited to Rural and Environmental Protection Areas and/or to development triggering the structure planning code and/or subdivision code) and lack of detailed identification of these hazards;
- the Subdivision and Development Guidelines and Compensatory Earthworks Planning Scheme Policy contain a thorough process and detailed standards for assessment of flood issues but lack the statutory force of codes; and

- The Mt Coot-tha Local Plan provides a sound example of how bushfire and landslide hazard can be appropriately regulated and contains the most direct and purposeful provisions in the City Plan in relation to these hazards.

The audit of the City Plan has identified some areas in the existing provisions for further review and possible amendment as a way of strengthening the way in which development is assessed for bushfire, flooding and landslide hazards.

4. GAP ANALYSIS

4.1 Overview

This section of the report draws from the previous analysis of the State Planning Policy 1/03 against the City Plan, and sets out the gaps in relation to the matters that will be required to be addressed to ensure the new City Plan adequately addresses the requirements of the SPP 1/03.

Some comments have been made in relation to the use of the first three outcomes of the SPP 1/03 in development assessment in Council. However, the scope of work for this study has not required an evaluation of the current development assessment practice against the requirements of the SPP 1/03; rather, these comments are made as a constructive way to assist current development assessment processes to better address SPP 1/03.

4.2 Gap Analysis - Flooding

4.2.1 Outcomes 1 to 3: Development Assessment

Outcome 1

Outcome 1 requires development to be 'compatible' with the natural hazard, except where the development proposal reflects a development commitment, or where there is an overriding need for the development in the public interest.

The current City Plan is considered to be partly compliant with Outcome 1.

Annex 4 of SPP 1/03 provides the following 5 outcomes that should be achieved for development to be compatible with the nature of flood hazard:

> ***1.*** *Development maintains the safety of people on the development site from all floods up to and including the DFE.*
>
> ***2.*** *Development does not result in adverse impacts on people's safety or the capacity to use land within the floodplain.*
>
> ***3.*** *Development minimises the potential damage from flooding to property on the development site.*
>
> ***4.*** *Public safety and the environment are not adversely affected by the detrimental impacts of floodwater on hazardous materials manufactured or stored in bulk.*
>
> ***5.*** *Essential services infrastructure (e.g. on-site electricity, gas, water supply, sewerage and telecommunications) maintains its function during a DFE.*

In order to assess development under the requirements of outcome 1 of the SPP it is first necessary to identify whether development is located within a natural hazard management area. In relation to flood, the City Plan is currently deficient in identifying the location and extent of natural hazard management areas and this is discussed further under outcome 4 below.

However flood immunity standards are provided in the subdivision and development guidelines planning scheme policy and flood data is available to Council and development proponents for the purposes of development assessment.

In particular, City Plan development Codes referred to in section 3.4 above, against which the majority of development is assessed, contain some performance criteria that relate directly to compatibility of development with the flood hazard. For example, the Stormwater Management Code includes the following Performance Criteria which seeks to achieve the second outcome in Annex 4:

> *The proposed stormwater management system or site works must not adversely impact on flooding or drainage of properties that are upstream, downstream or adjacent to the subject site.*

Design standards for flood immunity are primarily contained within Council's Subdivision and Development Guidelines, which are referenced by numerous development Codes (in particular the filling and excavation code and stormwater management code). The Subdivision and Development Guidelines specify required minimum flood immunity levels for allotments, floor levels and road trafficability, depending upon the type of development. The Guidelines also specify flood immunity levels for community infrastructure which correspond to the recommended levels of immunity provided in SPP 1/03.

The subdivision and development guidelines establish the "low flood hazard zone" criteria that defines the limit on where the intensification of land use (redevelopment/infill development) may be permissible; however, it is unclear what information Council currently has with respect to medium or high severity of flood hazard within the natural hazard management area, or whether any such information, if available, is used in development assessment. Whilst classification of the severity of hazard is not required under the SPP, this information, if available, could be helpful in assessing development against the requirements of the SPP.

Outcome 2

Outcome 2 is a 'default' outcome where Outcome 1 cannot be met, so that adverse impacts from the natural hazard are minimised as far as possible and do not result in 'unacceptable risk' to people or property.

City Plan is compliant with Outcome 2.

Through the various development Codes and the Subdivision and Development Guidelines, City Plan requires development to comply with Outcome 1 of the SPP. In a case where this was not possible, the same mechanisms would be used to ensure compliance with Outcome 2 of the SPP.

Outcome 3

Outcome 3 relates to the importance of community infrastructure being operational during and after a natural hazard event.

Table 1.4 of Chapter 1 (page 6) of the Subdivision and Development Guidelines (a planning scheme policy in the City Plan) directly references the flood immunity levels recommended in SPP 1/03 and hence is compliant with Outcome 3.

4.2.2 Outcomes 4 to 6: Making and Amending a Planning Scheme

Outcome 4

Outcome 4 requires that the planning scheme identify the location and extent of natural hazard management areas.

City Plan does not currently identify the location and extent of natural hazard management areas for flood. This information is available, and flood extents for river flooding, creek flooding and stormwater inundation due to overland flow have recently been made publicly available through Council's website. However, City Plan is technically not compliant with Outcome 4, as no mapping sets out the 'location and extent' of the natural hazard management areas.

Note that the SPP defines flood as water which overtops the natural or artificial banks of a watercourse. Hence, there is no requirement under the SPP to identify areas inundated by overland flow or to include these areas within the natural hazard management area.

There are several points of ambiguity with respect to Council's flood information and requirements when compared to the requirements of SPP 1/03:

- Available flood mapping does not explicitly state what criteria or event has been used to derive the adopted flood extents.

- Council's flood immunity requirements in the Subdivision and Development Guidelines refer to events of different average recurrence interval (ARI) and also to a defined flood level (DFL), based on the 3.7 mAHD level at the Brisbane Port Office Gauge. This is an ambiguous definition, since it is uncertain what flow rate, if any, has been used in combination with the Port Office level to derive the DFL throughout the city. It is understood that Council also uses a defined flood level based on the highest recorded flood level (typically the 1974 flood level) plus 700 mm. It is unclear whether this is the same as the DFL based on the 3.7 mAHD level at the Port Office Gauge. The SPP refers to the adoption of a defined flood event, the probability of which can be estimated, rather than a defined flood level which could potentially be more arbitrary.

- City Plan's Structure Planning Code requires mapping of flood affected land, identified as land that is below the Flood Regulation Line. Flood Regulation Lines are defined in Chapter 3 of City Plan (p. 69) as:

    - *lines used by Council to indicate floodplain areas reserved for flood water storage and flow, where development may be restricted.*

- The methodology used to define Flood Regulation Lines is unclear and hence it is uncertain how these lines relate to the definition of natural hazard management areas since Regulation Lines do not necessarily define the limit of flooding for a DFE.

Outcome 5

Outcome 5 sets out the following requirement:

The planning scheme contains planning strategies that aim to:

- *Ensure that development in natural hazard management areas is compatible with the nature of the natural hazard;*

- *Minimise the impacts from natural hazards on existing developed areas; and*

- *Prevent development from materially increasing the extent or the severity of natural hazards.*

City Plan complies with Outcome 5, as discussed under Outcome 1.

There is scope for the City Plan to provide a stronger and more integrated policy and regulatory basis to assess flood risk issues, which is discussed in Section 5 of this report.

Outcome 6

Outcome 6 requires the planning scheme to include a code(s) to achieve development outcomes required by the SPP and to ensure that development to which the SPP applies requires assessment against that code(s) (i.e. relevant development is self, code or impact assessable). In addition, the SPP requires that the planning scheme or planning scheme policy specifies the information expected to be submitted with development applications subject to the code(s).

City Plan is generally compliant with Outcome 6 in that assessment of flood risk is triggered for development including:

- development for a house, including assessment of development of a house in a waterway corridor and for habitable and non habitable rooms to achieve flood immunity; and

- filling and excavation, including filling and excavation in a waterway.

Other development, where requiring a code or impact assessment applications, contains assessment against applicable codes such as the Stormwater Management Code which contains provisions which require assessment of flood issues.

City Plan does specify the information expected to be submitted with development applications, albeit at a very high level. For example, under Flooding Performance Criteria P1, the Stormwater Management Code indicates that:

> *compliance with this acceptable solution can be demonstrated by the submission of a hydraulic and hydrology report (as part of a SBSMP) identifying potential flooding impacts on upstream, downstream or adjacent properties.*

The subdivision and development guidelines also refer to the potential need to "undertake appropriate hydrologic and hydraulic assessments".

However, it is recognised that improvements can be made to increase the clarity of Council's code requirements including bringing parts of the Subdivision and Development Guidelines into the planning scheme.

4.2.3 Summary

Table 1 provides a summary of the level of compliance of City Plan with the requirements of SPP 1/03. City Plan generally complies with the requirements of the SPP, but is technically non-compliant with Outcome 4 because the flood hazard management area is not identified within City Plan. There is some ambiguity in the terms used in City Plan to describe flood hazard. It is recommended that the adopted Defined Flood Event be clearly identified and that the definition and role of Flood Regulation Lines be clarified.

Further, there are improvements to the operation and effectiveness of the assessment of flood in the City Plan which are recommended to be addressed in the new City Plan.

Table 1 Summary of City Plan Compliance with SPP 1/03

SPP Outcome	Level of compliance	Key Gaps or Opportunities for Improvement
1	Compliant	Information on the severity of flood hazard, if available, could be helpful in assessing development against the requirements of the SPP.
2	Compliant	
3	Compliant	
4	Not compliant	City Plan does not currently identify the location and extent of natural hazard management areas for flood, although this information is available. There is some ambiguity in the terms used in City Plan to describe flood hazard. The adopted Defined Flood Event should be clearly identified. The definition and role of Flood Regulation Lines should be clarified.
5	Compliant	
6	Compliant	

4.3 Gap Analysis - Bushfire

4.3.1 Outcomes 1 to 3: Development Assessment

Outcome 1

City Plan 2000 was developed before publication of SPP 1/03 and consequently does not contain strategies or codes based on a *natural hazard management area (bushfire)*. It does, however, designate two specific areas (Environmental Protection and Rural) as 'bushfire prone'. When these areas, together with the areas designated as Conservation Area, are excluded from the *natural hazard management area (bushfire)* mapping shown in Figure 2, the residual areas of bushfire prone land (under the SPP 1/03 definitions) are relatively small. These are shown in Figure 1.

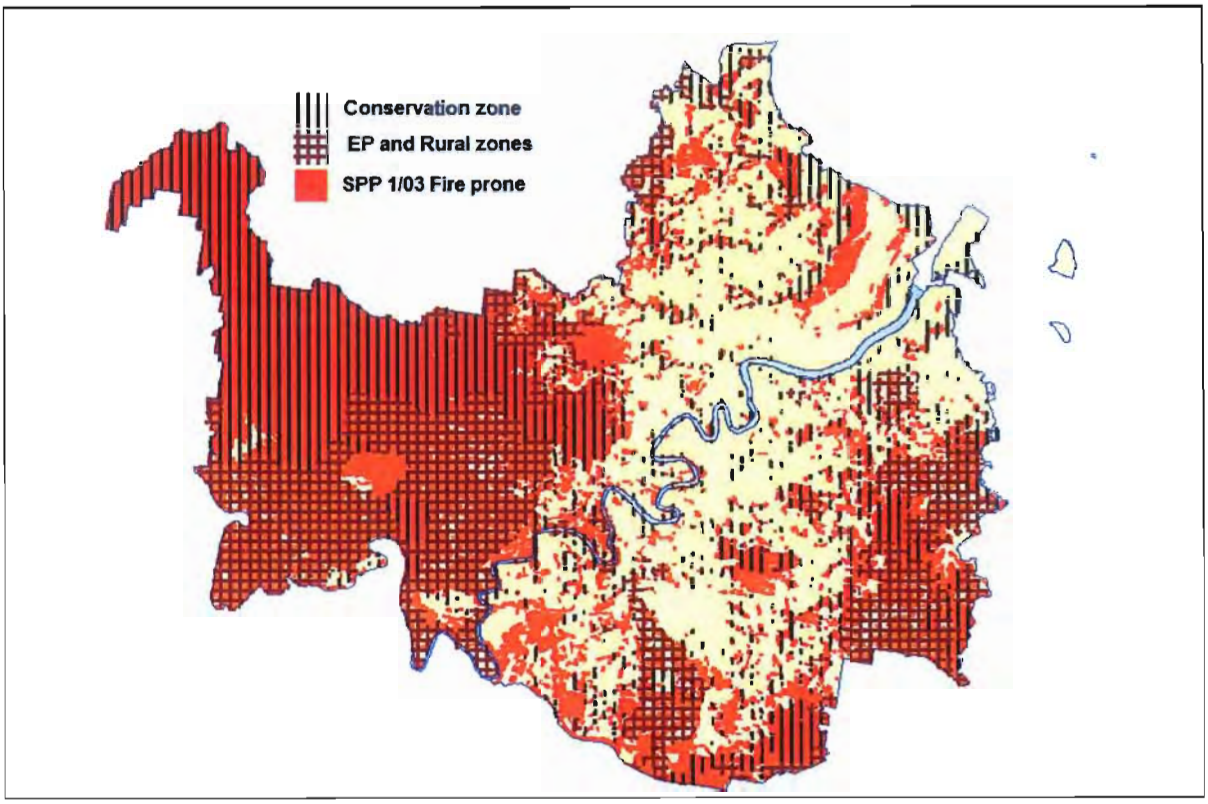

Figure 1: Brisbane City fire prone land classifications

The most notable residual areas are the extractive industry zone predominantly in Kholo, the Kokoda Barracks area in Enoggera, the airport precincts in Eagle Farm and the Griffith University campus in Nathan.

The Strategic Plan contains specific strategies aimed at avoiding the adverse impacts of bushfires in 'bushfire prone' areas. Importantly for the application of the SPP 1/03, the section of the Strategic Plan containing Desired Environmental Outcomes identify the most specific reference to bushfires (3.1.2.1) relates to their potential impact on biodiversity rather than on community safety. Bushfires are also addressed, along with other hazards, in 3.2.2.8 of the Strategic Plan (Chapter 2 of the City Plan) which has a focus on reducing risks.

Outcome 2

The bushfire-related House, Landscape and Subdivision Codes detailed for the Environmental Protection and Rural Areas are compatible with the nature of the bushfire hazard in that they are aimed at minimising the impact of bushfire on residential development in those zones. They may not, however, adequately meet the 'acceptable risk' test and may need to be revised and expanded. There are, for example, more appropriate codes for property fire planning and the provision of fire fighting water and other resources now widely promoted than those covered in the City Plan. These are addressed below in the discussion of Outcome 5.

There are no provisions for addressing bushfire hazards in other areas that carry a residual bushfire risk. Management of that residual risk is currently achieved through Council's Bushfire Management Strategy that emphasises the management of fuel on Council-controlled land.

It is recognised that there are always conflicts likely to emerge between measures aimed at preserving biodiversity with those that are aimed at minimising bushfire hazards. Currently City Plan tends to give greater emphasis to preserving biodiversity than it does to minimising bushfire hazards.

Outcome 3

Community infrastructure is not addressed in the context of bushfire.

The table below summarises the gaps that exist between the SPP 1/03 Development Outcomes and the current City Plan.

Summary of relationships between SPP 1/03 outcomes 1 to 3 and City Plan 2000

SPP 1/03 Outcome	City Plan Gap
1: Development is compatible with the nature of the hazard	Applied only to Environmental Protection and Rural Areas
2: Minimise the impact of the hazard	Codes may not meet 'acceptable risk' criteria
3: Application to community infrastructure	Not addressed in the context of bushfire

4.3.2 Outcomes 4 to 6: Making and Amending a Planning Scheme

Outcome 4

The mapping undertaken by Council in 2003 and described in section 2.5 above meets the requirements of SPP 1/03 and can be directly incorporated in a new City Plan as defining the *natural hazard management area (bushfire)* for Brisbane City. **This mapping will extend the area classified as 'bushfire prone' into areas other than Environmental Protection and Rural Areas,** including both 'Greenfield' areas and existing residential areas identified for densification through infill or redevelopment.

The statistics relating to parts of the Emerging Communities and Future Industrial Areas (the potential 'Greenfield' development areas) that fall within the *natural hazard management area (bushfire)* mapping are summarised in Tables a and aa. The statistics for the 'infill' residential areas are in Tables b abd bb.

The table below identifies the number of 'Greenfield' parcels with medium or high bushfire exposure:

AREA	HIGH FIRE	MEDIUM FIRE
Emerging Communities	639	5855
Future Industry	45	189
Totals	684	6044
% all parcels	4.56	40.64

The table below identifies the area (sq km) of 'Greenfield' parcels with medium or high bushfire exposure within Brisbane City:

AREA	HIGH FIRE	MEDIUM FIRE
Emerging Communities	3.163	25.965
Future Industry	2.041	5.095
Totals	5.204	31.051
% total area	9.41	56.17

The table below identifies the number of 'residential infill' parcels with medium or high bushfire exposure:

AREA	HIGH FIRE	MEDIUM FIRE
Low-medium Res	141	2288
Medium density Res	0	33
High density residential	0	6
Totals	141	2327
% all parcels	0.12	1.91

The table below identifies the area (sq km) of Brisbane City parcels with medium or high bushfire exposure:

AREA	HIGH FIRE	MEDIUM FIRE
Low-medium Res	0.036	1.337
Medium density Res	0	0.075
High density residential	0	0.009
Totals	0.036	1.421
% total area	0.05	2.22

Outcome 5

The current City Plan does not contain specific strategies (i.e. in Chapter 2) that address bushfire hazard. This should be addressed in the new Strategic Plan in the City Plan.

The Interim report of the 2009 Victorian Bushfire Royal Commission (Victoria, 2009; para 8.6 p206), for example, includes the following observation:

> *Designation of a wildfire management overlay by a local council imposes planning controls to ensure that:*
> - *water is available to enable life and property to be defended from wildfire*
> - *there is safe access for emergency and other vehicles*
> - *the design and siting of buildings and works improves protection for life and minimises the level of fire impact*
> - *fuel (ground fuel and shrubs) is managed to reduce potential fire intensity in the vicinity of buildings.*

Similar strategies might be considered for inclusion in the new City Plan[1].

Outcome 6

As discussed above in relation to Outcome 2, City Plan already contains House, Landscape and Subdivision Codes that are aimed at minimising the risks posed by bushfire in new developments. These codes are very brief and can be greatly expanded and improved. They will also need to be structured to take into account the expanded area covered by the natural hazard management area (bushfire) and its application to areas to which such codes are currently applied.

Under part 4.2 of the existing House Code Performance Criteria P2 states:

> *House must not be exposed to unreasonable risk from bushfire.*

Two acceptable solutions are offered:

> ***A2.1*** *House has a minimum water supply of 45,000L available and retained for fire fighting purposes, where not supplied with reticulated water*
> ***A2.2*** *Landscaping employs fire resistant plant species less than 5m in height for any landscaping within the building location plan area*

The provision of fire fighting water is clearly appropriate in areas that do not have a reticulated supply, but the code should go further to stipulate that any pump should be independent of the mains power supply and that tank and pipe material (e.g. PVC) are not susceptible to damage under radiant heat. The installation of sprinkler systems on buildings supplied by that reserve for fire fighting water are increasingly seen as a highly desirable requirement in those areas of high risk.

The planting of 'fire resistant' or 'fire retardant' vegetation as a barrier or screen to filter out wind-driven sparks and embers, or to act as a barrier against radiant heat and flame, is advocated by some authorities as one of a suite of strategies [redacted]. Whilst some species of vegetation may provide a degree of protection and screen plantings can add to the depth of fire defences if combined with other strategies, this approach should not be the only strategy adopted. The FABC (FABC, 2005) draws attention to the fact that:

> *Whilst some plants may not burn in low to moderately intense fires, all plants can burn in high intensity fires (those fires when you and your home are most at risk).*
>
> *You should not rely on published lists of 'fire retardant', 'fire resistant' or 'hard-to-burn' plant species.*

The appropriate management of vegetation around buildings and infrastructure facilities is the key, not just the selection of species.

Performance Criteria P3 states:

> *Vehicle access must be safe from hazards and must not adversely impact on landscape values.*

Suggested solutions include:

A3 *Access:*

[1] The Interim Report states that building and planning issues will be addressed in its final report due in 2010.

- *is via an access road approved at subdivision stage*
- *is not less than 3.5m wide with passing bays at a minimum of 100m intervals to allow for emergency vehicle access*

OR

Access:

- *is at grades of less than 1 in 4*
- *does not require cut and fill in excess of a total of 2m in height*
- *is not less than 3.5m wide with passing bays at a minimum of 100m intervals to allow for emergency vehicle access*
- *is shared with at least one adjoining vacant allotment (if any)*

These solutions are appropriate to all new developments. Provision should also be made for the maintenance of fuel along these access roads as responsibility for this critical process will depend on whether they are public roads (Council of Department of Main Roads) or private roads (e.g. the body corporate in a community title scheme).

Under the Landscape Code performance criteria P15 states:

> *The landscape design must enhance personal safety and reduce the potential for and fear of crime and vandalism by incorporating crime prevention through environmental design (CPTED) principles*
> *Note: for guidance on assessing the incorporation of crime prevention through environmental design principles refer to the* ***Crime Prevention Through Environmental Design (CPTED) Planning Scheme Policy***

One of the three solutions is:

> ***A15.3*** *Fire resistant species are planted in areas of bushfire hazard and the landscaping designed to minimise bushfire hazard*

The comments made regarding the use of 'fire resistant' species above are also applicable in the landscaping code.

Under the Subdivision Code, section 5.4 (Safety, hazard risk and amenity) subsection 5.4.2 states:

> *Bushfire hazard (generally applicable to Greenspace Areas and lands directly adjoining Greenspace Areas)*

Performance criteria P2 under 5.4.2 states:

> *Fire management measures and design elements must be adopted to minimise bushfire hazard and to ensure access or evacuation in emergencies.*

The six acceptable solutions are all appropriate and will need to be applied to all areas that will be defined as bushfire prone within the *natural hazard management area (bushfire)*. They are based on publications including CSIRO/SA (1993), DHLGP/QFRS (1994) and QFRA (1998). Experience with severe bushfires since the late 1990s (e.g. Canberra in 2006 and Victoria in 2009) have led to considerable revision of accepted practice in subdivision design in bushfire prone areas. Those practices should be incorporated in the new City Plan.

In addition a classification of 'bushfire prone' should trigger a requirement under the *Standard Building Regulation* of AS 3959-2009 *Building in bushfire prone areas* (SA,

2009)[2]. This standard is accompanied by the guideline SAA HB 36-1993 *Building in bushfire prone areas – information and advice* CSIRO/SA, 1993).

The table below summarises the gaps that exist between the SPP 1/03 Plan Amendment Outcomes and the current City Plan.

SPP 1/03 Outcome	City Plan Gap
4: Include a natural hazard management area (bushfire)	The 2003 bushfire mapping is suitable for use as natural hazard management area (bushfire) mapping and is recommended for inclusion in the City Plan
5: Plan to include planning strategies relating to the hazard	No strategies currently included relating to bushfire
6: Planning scheme to include relevant codes	The existing codes need to be expanded and applied to all areas that fall into the natural hazard management area (bushfire)

Mapping

Under the proposed QPP the *natural hazard management area (bushfire)* will meet the requirements of the overlay (or constraints) mapping for bushfire that will trigger the application of new City Plan planning codes and standards. The natural hazard management areas will separately trigger the requirements under the *Standard Building Regulation* such as AS 3959-2009.

However a review of the accuracy of the 2003 *natural hazard management area (bushfire)* mapping is required as it is based on vegetation mapping that is now as much as seven or eight years old. Given the dynamic nature of vegetation (through both clearing and re-vegetation) it would be appropriate for the vegetation element of this mapping to be reviewed and if warranted, the *natural hazard management area (bushfire)* mapping should be updated to reflect the current vegetation regime.

It would also be appropriate for vegetation mapping and its link to the bushfire mapping to be reviewed at least once every five years.

Fire Planning

Given the experience of the 2009 'Black Saturday' fires in Victoria there has been considerable attention given to fire planning in bushfire prone areas. The Interim Report of the Victorian Bushfire Royal Commission (Victoria, 2009), for example, makes several observations and recommendations relating to property-level fire planning. A requirement to develop and maintain a property-level fire plan along the lines recommended by the South East Queensland Fire and Biodiversity Consortium (FABC) might be considered for inclusion in the House Code, especially in Environmental Protection and Rural Areas. See publications such as FABC (2002), FABC (2005) [redacted].

Climate Change

The current City Plan does not make provisions for changes to the bushfire regime across the City in the light of climate variability and the forecast impacts of climate change.

[2] This third edition of AS 3959 was published in March 2009 after at least 8 years of review and revision. The Guideline (HB 36 - 1993) has been under review and revision since 2005.

Among the issues that may impact on bushfire hazards under climate change scenarios are an increase in fire intensity in forested areas due to longer periods of drought and a decline in available fire fighting water resources during drought.

The recent draft for public consultation of the South East Queensland Climate Change Management Plan (DIP, 2009) includes several draft action plans that are relevant here. They include:

> *Draft action 25. Review and update State Planning Policy (SPP) 1/03—Mitigating the Adverse Impacts of Flood, Bushfire and Landslide, and develop supporting guidelines*
>
> *Draft action 26. Develop guidelines for the preparation of hazard and risk maps including the projected effects of climate change on natural hazards within the scope of the revised SPP 1/03.*

4.4 Gap Analysis – Landslide

4.4.1 Overview

Placed in context, landslide hazard and the impacts of landslide in Brisbane can be considered to be relatively low by world standards. However, in several instances, houses and infrastructure have been destroyed and large roadway excavations have failed in and around Brisbane city as a result of man-made excavations and uncontrolled water flow in small, isolated geological basins of relatively young and weak sedimentary rocks. River-bank collapse has also occurred in many instances in the past, in some instances with serious consequences to property.

Notwithstanding, there are serious gaps in the way in which the City Plan addresses landslide risk in Brisbane. The most obvious is that there has never been a natural hazard management area (landslide) formally identified for Brisbane and there are is a lack of specific or substantive text or codes applied to identifying and reducing landslide hazard or risk. These gaps are discussed below firstly in terms of the planning strategy outcomes, and then development assessment outcomes expected from SPP1/03.

In summary the gaps are identified below:

- Most of the recorded landslides in Brisbane have occurred on flat-lying riverbanks or undulating 'Tertiary" sediments. This is a key aspect of the future codes which will need to be addressed?
- None of the BCC plans or provisions or codes acknowledge that the recorded landslide events having the most impact on houses and buildings in Brisbane have been on slopes less than 20% and often less than 15% (even if the SPP had been acknowledged). In this regard the Mt Coot-tha local plan is certainly limited in application.
- While there is some acknowledgement of the need to limit cut and fill activities, there is no concept development of a limiting slope for a given lithology. Such would help guide the maximum slopes of artificial cuts.
- The codes need to recognise the inescapable link between landslides and groundwater, and not just the tenuous link between landslides and steep slopes.

It appears that the background report on landslides by [redacted] and [redacted] needs to be integrated into the background knowledge base for the review of the City Plan to shape the requirements of the City Plan code required by the SPP.

4.4.2 Outcomes 1 to 3: Development Assessment

Outcome 1

The current City Plan does not contain the required mapping or codes at the current time to adequately assess landslip, which will need to be addressed in the new City Plan. Consequently it is unlikely that the City Plan, and current development assessment processes meet Outcome 1 of the SPP 1/03.

As a consequence of having no formal NHMA (landslide) in place, and no substantive provisions in the City plan and codes, any development that is compatible with the nature of the landslide hazard results only from the initiatives of the developer or awareness of a Council officer, and is not guided in a consistent manner by local government planning scheme provisions.

Attempts have been made in the Mt Coot-tha Local Plan to make reference to slope constraint areas, namely:

Low: 0% (0 degrees) to 20% (11.3 degrees)
Medium: 20% (11.3 degrees) to 33% (16.7 degrees)
High: greater than 33% (16.7 degrees)

These slope constraint thresholds neither fit with the SPP requirements based on 15% slope, nor make sense in relation to practical observations and natural slope thresholds set as a consequence by [redacted].

Outcome 2

It is considered that the City Plan fails to meet SPP Outcome 2 in that certain development, while it may not compatible with the nature of the landslide hazard but is otherwise consistent with Outcome 1, may not necessarily be required to ensure adverse impacts from natural hazards are minimised. Again, it is difficult to determine if Council's development assessment processes are assessing these aspects of landslip required by Outcome 2 of the SPP. Nor does the current City Plan necessarily ensure that the development results in unacceptable risk to people and property.

The City Plan does not contain the required mapping or codes to adequately assess landslip; consequently it becomes the discretion of the Council officers in assessing the perceived risk from landslip as to whether that aspect is investigated in a development assessment. Ordinarily steeper slopes require supporting information through an information request to address landslip. However, as Section 3 describes, the landslip is not just a product of steepness of slope, and a broader understanding and supporting map of landslip risk is needed to assist officers in identifying potential risk.

There are no substantive requirements contained within the City Plan to ensure that development results in minimal adverse impacts from natural hazards, and does not result in unacceptable risk to people and property, even though that development proposal might be a development commitment or that there is overriding need for the development in the public interest.

Outcome 3

The City Plan fails to meet SPP Outcome 3 in that there is no substantive provision made to constrain the location and design for the development of community infrastructure with regard to landslide hazard.

While it is possible to point to situations whereby hospitals, for example, might not be able to function effectively as a result of a major landslide event, smaller community infrastructure in the form of ferry landings or river-side walkways might prove to be more susceptible in the event of major river-bank collapse scenarios. This type of infrastructure, however, might well fall into the category described by the SPP where its location would be deemed necessary when weighed against its need to serve the community effectively under normal circumstances.

However, this study is unable to conclusively determine whether this aspect is being complied with in current Council development assessment process.

4.4.3 Outcomes 4 to 6: Making and Amending a Planning Scheme

Outcome 4

The new City Plan will be required to meet SPP Outcome 4 by including a natural hazard management area (NHMA) for landslide.

Mapping suitable for incorporation into the creation of an NHMA for landslide (given the provisos suggested below) has been carried out by [redacted] on behalf the Brisbane City Council.

The most important specific issue for the City Plan is the critical landslide hazard posed in small, isolated Palaeogene (previously Tertiary) sedimentary basins containing relatively young and only weakly lithified sediments. It is in these areas where the majority of landslide damage has historically occurred in Brisbane, and where it can be expected to occur in the future. Collapse of river-bank alluvium and colluvium is the other major cause of damage.

The mapping [redacted] adopts a consistent methodology that is founded in the concept expressed in the SPP that steeper slopes attract higher landslide hazard. The SPP sets a threshold slope of 15% (8.5 degrees), above which slopes on all rock types are conditionally considered as potentially unstable. [redacted] on the other hand, have adopted a modified and improved scheme whereby the stability of each of the mapped major rock/engineering soil types in Brisbane is considered separately. As a result, the area of mapped landslide hazard depends on a combination of both the rock type occurrence and the slope threshold assumed stable for that specific rock type. These proposed thresholds vary from as low as 7 degrees to over 25 degrees in the various rock types present within Brisbane city boundaries. The method employed by Granger & Leiba has been shown to function well and provide good estimates of landslide hazard in mapping for other local authorities around Brisbane.

Unfortunately, as it stands, the mapping scheme currently employed for Brisbane appears to give undue and distracting attention to steep slopes on Neranleigh Fernvale and Bunya Phyllite rock types, whereas in practice, only comparatively small wedge failures and rockfalls are expected from over-steepened slopes. Conversely, the mapping by itself does not identify the much more significant areas of landslide hazard in some of the Palaeogene basins, despite the low threshold set for this rock type. This aspect is adequately addressed in the text [redacted] The anomaly arises because natural slopes in the Palaeogene basins are generally less than those considered critical

for failure. Landslide hazard generally arises only where man-made excavations over-steepen slopes beyond the threshold value.

This aspect highlights the need for the City Plan to address not only natural slopes or pre-existing slopes, but also excavated and particularly temporary slopes in specific rock or soil types in its considerations. Currently there is no clear signal provided to developers that Palaeogene (Tertiary) sediments form potential areas for the most serious landslide failures in Brisbane.

There is renewed urgency with the increasing and large-scale development and road works taking place in the southwest of Brisbane where more Palaeogene basins are being encountered. Recent examples are available (just outside Brisbane city boundaries) where State Government authorities and related consultant input may have failed to fully recognise the risk posed by these Palaeogene basins, with the subsequent collapse of hundreds of metres of road cuts where threshold slopes had been far exceeded and inadequate support provided.

Outcome 5

The new City Plan needs to meet SPP Outcome 5 by including strategies and codes in the planning scheme that ensure development in the NHMA is compatible with the nature of the landslide hazard.

Even in the absence of an NHMA (landslide), there should be strategies contained within the City Plan that meet the intention of the SPP.

Importantly, the supporting code(s) for landslip assessment could be addressed by the application including an assessment of geotechnical conditions, and consequently the incorporation of any recommendations, by a registered engineer. This may be possible through a self assessable assessment or through a compliance or similar assessment, to adequately manage application numbers within Council.

Outcome 6

The new City Plan will need to incorporate codes in the planning scheme designed to assess and address natural hazard risks from landslip.

5. RECOMMENDED STRATEGY

5.1 Summary

5.1.1 Summary

The purpose of the report is to provide Council with a clear understanding as to whether it currently meets its obligations under SPP 1/03. This report assesses Council's City Plan and the most appropriate policy and regulatory tools to respond to the SPP 1/03.

The previous sections of the report include analysis and gaps where:

- Current development assessment practice is recommended to address the SPP 1/03; and
- Where the preparation of the new City Plan is needed to address the requirements of SPP 1/03.

This section summarises recommendations in relation to the City Plan addressing the requirements of SPP 1/03.

5.1.2 Development Assessment under the Current City Plan

A number of recommendations have emerged from the gap analysis which identifies assessment processes that are required against the SPP 1/03. These areas include:

- A broader consideration of bushfire management where the mapping covers areas outside the Environmental Protection Area and Rural Area. The maps could be used in the assessment of applications as a way of requiring a Bushfire Management Report or similar reporting;
- A broader consideration of landslip in the assessment of current applications. The consideration of landslip in other than steep land is an important aspect of assessment. The mapping could be used as an interim arrangement for the applicant to ensure that a geotechnical report is completed to address soil type, water management and / or landslide risks.

It may be that Council chooses to raise awareness of these issues through the availability of mapping, so that land owners can consider the information and recommendations about new development in those areas. This has been achieved through Council's floodwise program where mapping of overland flow, and flood searches have raised awareness of these hazards and how to be better prepared to address them. If this approach is pursued then updating and ground truthing of the bushfire and landslide maps is recommended.

Where development is currently not assessable under the City Plan, these assessments cannot occur and the processes under the Building Act (including the use of structural engineers for footings, bushfire risk area) will need to be relied on in the interim period.

5.1.3 New City Plan

The main strategy for the preparation of the new City Plan that is derived from the assessment in this report that includes:

- Ensuring that a strategic planning level the issues of community safety, including the protection of life and property, are key considerations in the assessment of development;
- Including the natural hazard management areas mapping for all three different hazards in the City Plan;

- Including relevant codes to assess the risks and impacts arising from proposed development in the natural hazard management areas to understand their compatibility (or otherwise), and whether further information or conditions will address the requirements of the risk management framework of the new codes;

- Including relevant level of assessment for assessing development in natural hazard areas. This may include self assessable or compliance assessment when the hazard assessment can be provided by external (other than a code or impact assessment application) means to meet requirements. The level of assessment will depend on the assessment of risk and how the risk will be assessed when applications are made.

Determining the mapping for the natural hazard management areas in the new planning scheme will be a critical part of the process. Considerable work has been completed on all three natural hazards and this mapping will need to be incorporated into the new City Plan. The natural hazard management area maps, with the accompanying provisions, will provide a clear basis for the assessment of development in these areas.

Houses are the most common form of development in Brisbane City. Houses, when they meet the acceptable solutions of the House Code, or the Residential Design – Small Lot Code, are self assessable. Wherever possible, self assessable or compliance assessment processes should be relied on for houses so as not to increase the number of code or impact assessment applications being lodged and assessed by Council.

However, there will be some circumstances where a new application will be required for a House in a natural hazard management area. The new code(s) should carefully evaluate what assessment is required, and whether this can be achieved by qualified professionals using the Risksmart process.

Further, the requirements for bushfire protection in the built form may conflict with ecological outcomes. These aspects will need to be resolved at a policy level, and in the provisions, to provide clarity for applicants and Council's assessment teams in the future. For example, clearer direction is needed in bushfire prone areas where mature trees (such as Eucalypts) are required to be protected where they are located immediately adjacent to new development.

5.2 Flooding

Recommendations and Strategy

The recommendations and strategy for addressing flood risk in the new City Plan includes:

- Include stronger strategic level guidance within Council's new strategic plan for protection of people and property from flood risk;

- Include a complete Natural Hazard Management Area map for the DFE for the city. In addition clarify the DFE for the Natural Hazard Management Areas;

- Prepare associated codes and policies to support management of flood risk assessment.

- Incorporate risk assessment and floor level standards into the codes (rather than associated policies);

- Consider incorporating a risk assessment for development proposals that considers flood hazard (flood depth and water velocity). This could be an inclusion in the relevant natural hazard management – flood code. This is recommended as an appropriate response to SPP 1/03 and in line with best practice (SCARM);

- The adopted Defined Flood Event should be clearly identified and the definition and role of Flood Regulation Lines should be clarified.

- Where detailed flood data is available review Area/ Zones and compatible land use in areas of high risk – ie. Areas of high depth and high velocity. This will depend on whether this information is available from the flood data in Council, and whether this can be assessed against the City Plan requirements for infill development. This will need considerable investigation and possibly resolution at a policy level to determine any actions that are required.

- The extent of exempt development (and consequently the extent of filling) within the natural hazard flood areas may require review to test compatibility with the natural hazard;

- Other Design Codes may need to be amended to state more clearly the requirements for habitable and non habitable floor levels.

In relation to the SPP 1/03, and the State Government's preparation of any revisions of the SPP 1/03, it would also be highly desirable to bring the storm tide aspects of the Coastal Management Plan under a revised SPP 1/03 rather than it being in a separate policy document. That would greatly improve the likelihood that it will not be overlooked. It will also make it a lot easier to standardise the approach to all forms of inundation hazard.

5.3 Bushfire

Recommendations and Strategy

- Adopt a Natural Hazard Risk Management (Bushfire) mapped area to regulate bushfire prone land in the City Plan;

- Include stronger strategic level guidance within Council's new strategic plan for protection of people and property from bushfire risk;

- Adopt a related Natural Hazard Risk Management (Bushfire) Code to assess bushfire risk across land (not limited to Conservation, Environmental Protection and Rural Area land);

- Amend related codes such as the Subdivision Code and Structure Planning Code to address bushfire management mitigation strategies;

- Amend the House code to assess new houses (and possibly some major extensions) on land included within the Natural Hazard Risk Management (bushfire) mapped area. This may include self assessable or compliance solutions to reduce Council

assessment procedures. (This may occur under the natural hazard management areas of the new planning scheme separate to the House Code).

5.4 Landslide

Recommendations and Strategy

- A natural hazard management area (landslide) must be developed for Brisbane. Council has already commissioned a study that considers both slope and rock type together and provides a firm basis for an NHMA.

- More awareness is required of the major landslide potential posed by Palaeogene sedimentary basins.

- Landslide hazard and risk need to be considered for artificial excavations as well as natural slopes.

- More awareness is required of the critical role of groundwater in landslides.

- The new City Plan should:

    a. incorporate the latest in landslide literature and research;
    b. adopt a strategic approach to management of landslide hazard and risk;
    c. ensure that adopted codes and planning schemes serve to meet the planning outcomes of SPP1/03.

- In this regard, the new City Plan should ensure that:

    a. proposed development in all areas of Brisbane is in line with the actual nature of the landside hazard;
    b. fast-tracked development does not result in increased risk from landslide;
    c. careful consideration is given to the benefits and risks of developing community infrastructure in areas of potentially high landslide hazard such as river banks.

- Special provisions be incorporated in the new City Plan to ensure, even in the case of development commitments or where an overriding need for development in the public interest short-circuits normal processes in the SPP, that adverse impacts from development are minimised and that the development does not result in unacceptable risk to people and property.

- The new City Plan should weigh carefully the benefits and risks of constraining the location and design of community infrastructure development, especially in relation to riverside developments where the likelihood of river-bank collapse is high.

- The landslide hazard mapping scheme [redacted] which combines slope and rock type be adopted as the initial basis for a Natural Hazard Management Area (landslide) for Brisbane;

- The Palaeogene sedimentary basins that give rise to the highest hazard are identified and highlighted as areas of higher risk in the face of development so that developers are formally made aware of the degree and extent and history of landslide hazard, while at the same time;

- The accompanying Natural Hazard Risk Management (Landslip) Code is recommended to contain firm accompanying guidelines (in the code or supporting policy) and are recommended to be produced and promoted for reducing the likelihood of slope failure in artificial excavations (in addition to natural slopes) in all rock types, but particularly in Palaeogene basin sediments;

- The role played by groundwater and uncontrolled surface water in the promotion of landslide hazard, particularly in Palaeogene basin sediments, is defined and made clear to developers/ builders;

- Reference in the SPP to *Landslide Risk Management Concepts and Guidelines* prepared by the Australian Geomechanics Society should be updated to include the latest 2007 publication on *Landslide Risk Assessment and Management.*

5.5 Emerging Issues and Recommendations

5.5.1 Climate Change

The State Government have released a number of strategies to address climate change including:

- 'Climate Q: towards a greener Queensland' which includes broad strategies to reduce greenhouse gases and increases resilience against climate change impacts;

- ClimateSmart 2050, which include a series of short, medium and long term actions to reduce Queensland's greenhouse gas emissions; and

- ClimateSmart Adaption 2007 – 2012, which contains 62 actions in response to climate change.

The SEQ Regional Plan contains policies and strategies which set the high level policy framework for responding to climate change impacts. The draft SEQ Climate Change Management Plan provides an action plan to further the actions in the SEQ Regional Plan, which may impact on the management of natural hazards into the future.

In addition, the Draft Coastal Management Plan 2009, prepared under the Coastal Management and Protection Act 1995, sets out requirements for development including for development 'not already subject to a development commitment' a sea level rise of 0.8m 'will need to be taken into account.

Accordingly, although beyond the scope of this study, these climate change strategies and actions will need careful consideration in the new City Plan, and in the risk management of natural hazards in the assessment of new development under the new City Plan.

5.5.2 Earthquake and High Wind

Earthquake and high wind are not required to be considered in the planning scheme in response to the SPP 1/03, and are not a requirement of this study. However the following observations about earthquake and high wind are noted:

The study team considered that high winds and earthquake risk are able to be mapped. SPP 1/03 contains the following paragraph:

4.3 As the hazards associated with strong winds and earthquakes are not amenable to clear spatial definition, they are difficult to address through land use planning mechanisms. Design and construction standards are the most appropriate mechanisms for mitigating risk from earthquakes and strong winds. The Standard Building Regulation specifies construction standards for buildings and most non-building structures. Therefore, strong winds and earthquakes are not addressed by this SPP.

There is already mapping of earthquake hazard potential [redacted]. This follows the approach contained in AS 1170.4 *Minimum design loads on structures Part 4: Earthquake loads AS 1170.4-1993* and 2001 draft DR 00902 *Structural design - General requirements and design actions Part 4: Earthquake actions.* Similar mapping of Launceston developed by AGSO in 1996 is 'unofficially' used by planners in Launceston City Council to direct developers and engineers to the appropriate design requirements for earthquake within the city.

Similarly, the wind loading standard AS 1170.2 is also expressed in spatial terms, such as distance from the coast, open land, slopes etc. Planning SA has produced a wind loading map for the Adelaide area that is based on that standard. The SA map also shows a line that marks the boundary of the corrosion zone established under Table 3.3.3.1 of the Building Code of Australia (i.e. the Standard Building regulations).

Although beyond the scope of this study, these aspects are recommended to be reviewed in the future to understand the risks and potential management of the risks. Alternatively, if these aspects are best managed at a building construction level under the Building Act, then it is recommended that a response from the State Government be sought as to how this is best addressed under Queensland building laws.

6. CONCLUSION

This report has been prepared for Brisbane City Council by John Gaskell Planning Consultants, Environmental & Community Risk International, [redacted] and WRM Water and Environment.

This report reviews Brisbane City Council's planning scheme to determine how well it addresses Natural Disaster Risk Management requirements of the State Planning Policy 1/03 - Mitigating the Adverse Impacts of Flood, Bushfire and Landslide (SPP 1/03). The report identifies a series of actions that are recommended to be addressed to respond to SPP 1/03. The main recommendations support the improved strategic planning (policy) context for community safety, incorporation of mapping for natural hazard management areas, and preparing relevant provisions that support the assessment of natural hazard risk.

7. REFERENCES

CSIRO/SA, 1993: *SAA HB 36: Building in bushfire-prone areas – information and advice*, Commonwealth Scientific and Industrial Research Organisation, Canberra and Standards Australia, Homebush.

CSIRO/SA SCARM (2000), *Floodplain Management in Australia: Best Practice Principles and Guidelines,* Standing Committee on Agriculture and Resource Management (SCARM), Report 73,CSIRO Publishing

DHLGP/QFRS, 1994: *Bushfire prone areas- siting and design of residential buildings*, Department of Housing, Local Government and Planning and Queensland Fire and Rescue Service, Brisbane.

DIP, 2009: *South East Queensland climate change management plan: draft for public consultation*, Department of Infrastructure and Planning, Brisbane.

DIP, 2009: *South East Queensland Regional Plan 2009 – 2031* Department of Infrastructure and Planning, Brisbane.

FABC, 2002: *Individual property fire management planning kit*, Southeast Queensland Fire and Biodiversity Consortium, Brisbane.

FABC, 2005: *Bushfire safety for your home and garden*, pamphlet, Southeast Queensland Fire and Biodiversity Consortium, Brisbane

[redacted]2003: *Landscape and building design for bushfire areas*, CSIRO Publishing, Collingwood.

QFRA, 1998: *Bushfire hazard planning in Queensland*, Queensland Fire and Rescue Authority, Brisbane.

SA, 2009: *Australian Standard AS3959-2009: Building in bushfire prone areas*, Standards Australia, Homebush.

[redacted]2002: *Best practice fire management manual operational level guidelines and procedures*, Southeast Queensland Fire and Biodiversity Consortium, Brisbane.

Victoria, 2009: *2009 Victorian bushfires Royal Commission interim report*, Parliament of Victoria, Melbourne.

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1. INTRODUCTION

1.1 Purpose of this Report

This report has been prepared for Brisbane City Council by John Gaskell Planning Consultants, Environmental & Community Risk International, [redacted], and WRM Water and Environment. This report reviews Brisbane City Council's planning scheme to determine how well it addresses Natural Disaster Risk Management requirements of the State Planning Policy 1/03 - Mitigating the Adverse Impacts of Flood, Bushfire and Landslide (SPP 1/03).

The purpose of the report is to provide Council with a clear understanding as to whether it currently meets its obligations under SPP 1/03. This report assesses Council's City Plan and the most appropriate policy and regulatory tools to respond to the SPP 1/03.

1.2 Structure of the Report

The report is structured in the following manner:

- Section 1, this section, which is an introduction to the report;
- Section 2, which summarises legislative requirements relevant to this study;
- Section 3, which provides a review of the current natural hazard risk management within the City Plan document;
- Section 4, identifying a gap analysis between the City Plan and the requirements of the State Planning Policy 1/03 *Mitigating the adverse impacts of flood, bushfire and landslide* DLGP & DES, 2003a)
- Section 5 which documents the recommended strategy; and
- Section 6 which is the conclusion.

1.3 Methodology

The tasks in the methodology for the study are set out below:

Task 1	Project Inception
Task 2	Review of Legislative Requirements
Task 3	Review of Current City Plan
Task 4	Gap Analysis
Task 5	Prepare Draft Report and City Plan Strategy
Task 6	Review and Finalisation of Report

2. REVIEW OF LEGISLATIVE REQUIREMENTS

2.1 Overview

This section of the report outlines the legislative framework for natural hazard risk mitigation in the regulation of development. The main focus of the legislative context is the *Integrated Planning Act 1997* which sets out the basis for local government to regulate development through their planning schemes, as well as providing a mechanism for State interests to be expressed in State Planning Policies. The *Sustainable Planning Act 2009* is in effect from 18 December 2009, and replaces the *Integrated Planning Act 1997*. The move to replace the *Integrated Planning Act 1997* with the *Sustainable Planning Act 2009* is an 'evolution' as many of the provisions in the new Act remain similar.

SPP 1/03 *Mitigating the adverse impacts of flood, bushfire and landslide* DLGP & DES, 2003a) sets out the State's interest in ensuring that the natural hazards of flood, bushfire and landslide are adequately considered when making decisions about development. In its development, SPP 1/03 was seen as a significant boost to disaster risk management in Queensland by virtue of its capacity to limit the growth of development in hazard prone locations. It was, none-the-less recognised that the provisions of SPP 1/03 could not have any significant impact on reducing risks in established development.

The Brisbane City Plan 2000 did not explicitly address SPP 1/03 provisions because it was prepared prior to the SPP 1/03 being prepared and implemented. However, as part of the City Plan's current major review, the Queensland Department of Community Services will require a comprehensive review and response to the SPP 1/03, consistent with the requirements of SPP 1/03 when planning schemes undergo a major review.

2.2 Integrated Planning Act 1997

At the broadest level the *Integrated Planning Act 1997* (IPA) requires the advancing of the Act's purpose in seeking to achieve ecological sustainability (Sections 1.2.1 and 1.2.2 of the Act). This term incorporates the 'cultural, economic, physical and social wellbeing of people and communities' including 'safe and sustainable development' (S1.3.6 of IPA). Consequently, planning schemes and development assessment processes are expected to take account of natural hazards such as flooding, bushfire and landslide.

In addition, IPA identifies that where a planning scheme is changed to take account of a natural hazard, no compensation as a result of the change to the planning scheme is payable. Compensation is not payable where, if development occurred under the superseded planning scheme, such development:

> *(i) would have led to significant risk to persons or property from natural processes (including flooding, land slippage or erosion) and the risk could have been significantly reduced by conditions attached to a development approval; ...*

This is an important statement that highlights the fundamental process of consideration of natural hazards and where appropriate making the necessary changes to the planning scheme, without being exposed to compensation claims.

The IPA identifies the requirements and powers for introducing State Planning Policies. Section 2.4.1 of the Integrated Planning Act includes the enabling provisions for State Government to prepare State Planning Policies:

*(1) A **State planning policy** is an instrument, made by the Minister under this part, about matters of State interest.*

(2) A State planning policy is a statutory instrument under the Statutory Instruments Act 1992 and has the force of law.

State Planning Policies must be addressed in the preparation of planning schemes and are part of the criteria in decision making rules for applications in the IPA. (Refer to Section 3.5.13 and 3.5.14).

2.3 State Planning Policy 1/03

2.3.1 Introduction and Overview

On the 11th September 2003 the State Government commenced the State Planning Policy 1/03 *Mitigating the adverse impacts of flood, bushfire and landslide*. This State Planning Policy requires that the natural hazards of flood, bushfire and landslide are adequately considered when making decisions about development. Importantly this SPP applies both to the preparation of planning schemes and to the assessment of development through local government planning schemes. The clear intent of SPP 1/03 is to minimize the growth of development in hazard-prone areas and as such is regarded as a major contribution to the process of disaster risk reduction. It is also recognized that the planning process can only have a significant impact on reducing inappropriate new development; it has limited or no capacity to reduce risks in areas that are already developed.

SPP 1/03 contains the State's legislative requirements for addressing natural hazard risk management in planning schemes. In addition, development assessment provisions are provided for those planning schemes that pre-date the implementation of SPP 1/03.

Importantly, SPP 1/03 states that when a planning scheme has appropriately reflected the SPP then the planning scheme is regarded as the local interpretation and expression of the SPP for development assessment purposes. That is, the SPP is only used in development assessment when a planning scheme has not 'appropriately' reflected the SPP. The preparation of the current Brisbane City Plan 2000 (commencing October 2000) was prior to the introduction of the SPP 1/03 and therefore was not able to explicitly reflect the SPP.

The policy approach contained in the SPP 1/03 is to require the identification of 'natural hazard management areas' so that requirements for development can be applied to mitigate the adverse impacts of flood, bushfire, and landslide. Default 'natural hazard management areas' are identified where planning schemes have not incorporated their own natural hazard management area maps. In addition, the SPP provides specific standards of development for community infrastructure, so that essential community infrastructure can be operational during and immediately after natural hazard events.

***Natural hazard management area**: an area that has been defined for the management of a natural hazard (flood, bushfire or landslide), but may not reflect the full extent of the area that may be affected by the hazard (e.g. land above the 1% AEP floodline may flood during a larger flood event). Natural hazard management areas for flood, bushfire or landslide are described in Annex 3.*

The SPP contains six Outcomes; the first three relating to development assessment, and the remaining three relating to making and amending a planning scheme.

2.3.2 Use of the SPP 1/03 in Development Assessment (Outcomes 1 to 3)

Outcomes 1 to 3 of the SPP apply in development assessment, where a planning scheme has not incorporated the requirements of SPP 1/03. Outcome 1 of the SPP 1/03 states the following:

> *Within natural hazard management areas, development to which this SPP applies is compatible with the nature of the natural hazard, except where:*
>
> - *The development proposal is a development commitment; or*
> - *There is an overriding need for the development in the public interest and no other site is suitable and reasonably available for the proposal.*

Outcome 1 requires development to be 'compatible' with the natural hazard, except where the development proposal reflects a 'development commitment', or where there is an 'overriding need' for the development in the public interest. Both terms are further described in the Glossary as follows:

> ***Development commitment**: includes any of the following:*
>
> - *Development with a valid preliminary approval;*
> - *A material change of use that is code assessable or otherwise consistent with the requirements of the relevant planning scheme;*
> - *A reconfiguration of a lot and/or works that is consistent with the requirements (including any applicable codes) of the relevant planning scheme; or*
> - *Development consistent with a designation for community infrastructure.*

The SPP sets out 'development compatibility' by requiring specific outcomes set out in Annex 4.

'Overriding need' refers to the 'significant overall benefit' that must accrue for the whole or a significant part of the community in social, economic or environmental terms that outweighs the adverse impacts arising from the exposure to natural hazards. Other tests include checking the availability of other sites and the extent of increased risk to people from the proposal. (In statutory terms this is a significant test that would be difficult to meet under ordinary circumstances. In addition, there are some Planning and Environment Court decisions about this language as the SEQ Regional Plan has used similar terms).

Outcome 2 states the following:

> *Development that is not compatible with the nature of the natural hazard but is otherwise consistent with Outcome 1:*
>
> - *Minimises as far as practicable the adverse impacts from natural hazards; and*
> - *Does not result in an unacceptable risk to people or property.*

Outcome 2 is a 'default' outcome where Outcome 1 cannot be met, so that adverse impacts from the natural hazard are minimised as far as possible and do not result in 'unacceptable risk' to people or property.

'Unacceptable risk' is defined as:

> *'a situation where people or property are exposed to a predictable hazard event that may result in serious injury, loss of life, failure of community infrastructure, or property damage that would make a dwelling unfit for habitation.'*

Outcome 3 of the SPP 1/03 relates to community infrastructure:

> *Wherever practicable, community infrastructure to which this SPP applies is located and designed to function effectively during and immediately after natural hazard events commensurate with a specified level of risk.*

Outcome 3 is self explanatory in relation to the importance of community infrastructure being operational during and after a natural hazard event.

2.3.3 Use of SPP 1/03 in Making or Amending a Planning Scheme (Outcomes 4 to 6)

The SPP 1/03 is also used to identify the requirements for making or amending a planning scheme. Once adopted the planning scheme that has reflected these requirements of the SPP has only to rely on their planning scheme for assessment of development applications, rather than the SPP 1/ 03 Outcomes 1 through 3.

Outcome 4 is stated as follows:

> *Natural hazard management areas are identified in the planning scheme.*

Outcome 4 requires that the planning scheme identify the location and extent of natural hazard management areas.

Outcome 5 sets out the following requirement:

The planning scheme contains planning strategies that aim to:

- *Ensure that development in natural hazard management areas is compatible with the nature of the natural hazard;*
- *Minimise the impacts from natural hazards on existing developed areas; and*
- *Prevent development from materially increasing the extent or the severity of natural hazards.*

The SPP requires the planning scheme to contain strategies to minimise the impacts of natural hazards on areas of existing development, bringing the 'optimum' level of protection from natural hazards that is 'achievable under the circumstances of the particular locality'.

The SPP requires planning schemes to also include strategies that ensure no increase in the severity of natural hazard impacts through the assessment of development. (eg. maintaining flood carrying capacity of waterways through assessing development such as filling).

Outcome 6 requires the following:

The planning scheme measures:

a) *Include a code(s) designed to achieve development outcomes consistent with Section 6; and*

b) *Ensure that development to which the SPP applies is assessable or self-assessable against that planning scheme code(s).*

The planning scheme, or planning scheme policy(s), specifies the information expected to be submitted with development applications subject to the code(s).

Outcome 6 requires the planning scheme to address the SPP through a code to achieve development outcomes required by the SPP. In addition the SPP requires that all levels of assessment (self, code or impact assessment) in planning schemes assess natural hazard risks.

The State Planning Policy 1/03 Guideline provides advice and information on interpreting and implementing the State Planning Policy 1/03. The SPP Guideline has been given legal status in assisting the interpretation of the SPP.

2.4 Specific Requirements for Bushfire Arising from SPP 1/03

Annex 3 of the SPP defines a natural hazard management area (bushfire) as an area identified by a local government in its planning scheme consistent with the conclusions of a bushfire hazard assessment prepared in accordance with Appendix 3 of the SPP Guideline, or reflecting the Medium and High hazard areas of Bushfire Risk Analysis Maps prepared by the Queensland Fire and Rescue Services (QFRS).

Appendix 3 of the SPP Guideline provides guidance for the mapping of the boundaries for a *natural hazard management area (bushfire)*. The Appendix describes this methodology as follows:

> *The methodology involves quantitative and qualitative assessments. The quantitative element requires an assessment of three key characteristics of land that have been found to be the main determinants of the severity of bushfire hazard. These factors are vegetation communities, slope and aspect.*

This methodology, or a variant of it that is approved by the QFRS, should be used. In the absence of such mapping the Medium and High hazard areas of Bushfire Hazard Maps prepared by the QFRS should be used.

The natural hazard management area (bushfire) mapping developed by Brisbane City Council conforms to the provisions of Appendix 3 of the SPP. It was developed by BCC GIS staff using Council's very high resolution digital elevation model (DEM) to derive slope and aspect layers and a combination of EPA and BCC's own vegetation mapping. The approach set out in Appendix 3 was modified slightly and follows the approach developed by [redacted] in his bushfire risk analysis of Pine Rivers Shire ([redacted] 2003).

The key modification employed by [redacted] was in the weighting applied to aspect. The differences are detailed in the following table.

ASPECT	RATING	SPP 1/03 Hazard Score
North to North-West	2	3.5
South-West to North-West	3	2 - 3

South-West to South	1	2
North to East	0.5	1
All slopes <3%	0.5	0
East to South	0	0

These modifications to SPP methodology were based on an analysis of wind direction on days of fire weather taken from the records from climate stations across south east Queensland over the 52 years 1950 to 2002. These modifications were discussed with senior QFRS staff who presented no objections to their use.

The weight to be applied to individual vegetation types were also modified slightly because the guide used in the SPP 1/03 Guidelines are far broader than the vegetation types included in the EPA and BCC vegetation mapping. The weight applied to the more detailed vegetation classifications were based on the advice and input from experienced rural fire fighters and managers, including staff from the Brisbane Forest Park and QFRS.

The mapping was completed on a 20m grid and classified to either High, Moderate and Low fire hazard ratings. The areas of High hazard were buffered by 100m and the Moderate hazard areas buffered by 50m as required by the SPP Guideline methodology. This buffering is designed to ensure an appropriate separation between the hazard and development. The distances (in the mapping) reflect the posed by the potentially damaging radiant heat from the respective levels of hazard.

Annex 4 of the SPP sets out two specific outcomes that should be achieved for development in a *natural hazard management area (bushfire)* to be compatible with the nature of the bushfire hazard as required under Outcome 1 of the SPP.

1. *Development maintains the safety of people and property by:*
   a) *avoiding areas of High and Medium bushfire hazard; or*
   b) *mitigating the risk through:*
      - *allotment design and the siting of buildings: and*
      - *including firebreaks that provide adequate:*
        - *setbacks between buildings/structures and hazardous vegetation, and*
        - *access for fire fighting/other emergency vehicles*
      - *providing adequate road access for fire fighting/other emergency vehicles and safe evacuation; and*
      - *providing an adequate and accessible water supply for fire fighting purposes.*

2. *Public safety and the environment are not adversely affected by the detrimental impacts of bushfire on hazardous materials manufactured or stored in bulk.*

Appendix 5B of the SPP Guidelines provides non-binding advice on how detailed measures that directly address the two specifically required outcomes for development in a *natural hazard management area (bushfire)* might be incorporated into a planning scheme.

The Brisbane City Council bushfire maps prepared under these guidelines is further discussed in Section 4 Gap Analysis.

2.5 Specific Requirements for Flood Arising from SPP 1/03

A *natural hazard management area (flood)* is defined as land inundated by a Defined Flood Event (DFE). The SPP does not dictate the magnitude of the DFE, which is defined as the flood event adopted by a local government for the management of development at a particular location. However, Annex 3 of the SPP states the Queensland Government's position that the 1% Annual Exceedance Probability (AEP) flood (also referred to the Q100 or 100 year Average Recurrence Interval flood) is generally suitable as the DFE. This approach is consistent with current best practice in floodplain management (SCARM, 2000) which recognises that flood damage will still occur during events between the 1% AEP flood and the Probable Maximum Flood (the largest flood which could possibly occur, i.e. it would occupy the entire flood plain). Nevertheless, best practice floodplain management emphasises the importance of considering the potential consequences of floods larger than the DFE and managing these residual risks through appropriate emergency management strategies.

The SPP does not specify the method by which *natural hazard management areas (flood)* are to be determined and refers to the SPP Guideline to provide further advice on this issue. The SPP Guideline recommends the floodplain management study process described in national best practice guidelines (SCARM, 2000), but also acknowledges that the substantial resources required to implement that process may not always be available or necessary. The SPP Guideline provides information on a range of simplified approaches that can be used to obtain information on flood extent and flood hazard.

The mapping of the *natural hazard management area (flood)* currently employed by BCC is divided between river flooding (both the Brisbane River and Pine River) and creek flooding (the numerous creeks that flow to the Brisbane River). It is understood that the river flood mapping identifies the extent of inundation for a modelled event with an annual exceedence probability (AEP) of 1%. The 1% AEP event is recommended in SPP 1/03 as being the DFE. It is also understood that this modelling is recent and was undertaken using industry standard methods and Council's very high resolution DEM.

The creek flooding is understood to be a composite of various modelling and historic flood level studies undertaken by various consultants and agencies. This composite mapping reflects Council's considered understanding of the DFE for creek flooding, notionally a 1% AEP event.

Council is yet to move towards the flood hazard classification approach detailed in Appendix J of SCARM (2000) described in SPP 1/03. The SPP guideline states that the assessment (of natural hazard management areas) 'may include the assessment of relative levels of severity in relation to natural hazards'. A move to an approach of mapping hazard, which is based on an analysis of both flood depth and velocity for the modelled event, would require a considerable upgrade of Council's flood data. (This is further discussed in Section 6 of this report).

The definition of flood adopted within the SPP is based on water which overtops the natural or artificial banks of a watercourse. Hence, the SPP does not specifically address the issue of inundation caused by stormwater travelling as overland or pipe flow prior to entering a watercourse.

Annex 4 of the SPP adopts the following five outcomes that should be achieved for development to be compatible with the nature of the hazard as required under Outcome 1 of the SPP:

> *1. Development maintains the safety of people on the development site from all floods up to and including the DFE.*

2. Development does not result in adverse impacts on people's safety or the capacity to use land within the floodplain.

3. Development minimises the potential damage from flooding to property on the development site.

4. Public safety and the environment are not adversely affected by the detrimental impacts of floodwater on hazardous materials manufactured or stored in bulk.

5. Essential services infrastructure (e.g. on-site electricity, gas, water supply, sewerage and telecommunications) maintains its function during a DFE.

2.6 Specific Requirements for Landslide Arising from SPP 1/03

Annex 3 of the SPP defines a *natural hazard management area (landslide)* as an area identified by a local government in its planning scheme consistent with the conclusions of a landslide hazard assessment prepared in accordance with Appendix 4 of the SPP Guideline, or including all land of 15% and greater slope, as well as reflecting land known or suspected of being unstable or potentially impacted by landslide. In the case of Brisbane City Council, the landslide hazard assessment prepared by Granger and Leiba (2004) modifies and exceeds the statutory requirements.

Appendix 4 of the SPP Guideline provides guidance for the mapping of the boundaries for a *natural hazard management area (landslide)*. That guidance does not specify a particular methodology other than it should be based on local conditions and take into account a range of factors including past events, slope, soils, water and underlying geology. The SPP Guideline provides references to methodologies that may be appropriate, particularly focusing on *Landslide Risk Management Concepts and Guidelines*, prepared by the Australian Geomechanics Society in 2000, amongst others. Where such a methodology is not used, the Guideline sets a slope of 15% as the default threshold above which local governments should consider a landslide hazard to exist.

The *natural hazard management area (landslide)* mapping used by BCC was developed by their GIS staff to specifications set by [redacted]. It conforms to the approach suggested in Appendix 4 of the SPP and adopts a methodology employed in the landslide chapter of [redacted] which defines the landslide potential by specifically combining data on both slope and geology. The slope component of this mapping was based on the BCC high resolution DEM and employed a grid size of 10m. It was recognised by BCC staff at the time that grid size could influence the slope values significantly. A grid resolution as fine as 10m is likely to lead to many small areas to be included as having a landslide hazard that would not be captured were the resolution 20m, for example. The landslide hazard mapping also identified areas along the Brisbane River in which there is an identified risk of bank collapse. This zone is a simple 50 m-wide buffer from the river bank.

It is important to note that SPP 1/03 applies to 'natural slopes'. In already developed areas 'cut slopes' are also recommended to be taken into account.

Annex 4 of the SPP sets out one specific outcome that should be achieved for development in a *natural hazard management area (landslide)* to be compatible with the nature of the landslide hazard as required under Outcome 1 of the SPP:

1. Development maintains the safety of people, property and hazardous materials manufactured or stored in bulk from the risk of landslide.

Appendix 5C of the SPP Guidelines provides non-binding advice on how detailed measures that directly address the specifically required outcome for development in a *natural hazard management area (landslide)* might be incorporated into a planning scheme.

The extent to which BCC currently achieves the specific outcomes in *natural hazard management areas (landslide)*, in terms of its compliance with or provision for the requirements and solutions offered by the SPP Guidelines, will be assessed under Gap Analysis in Section 4 of this report.

2.7 The Sustainable Planning Act 2009

The *Sustainable Planning Act 2009* is expected to come into effect in December 2009, which brings a range of 'evolutionary' changes to the *Integrated Planning Act 1997*. An important aspect of the *Sustainable Planning Act 2009* is the consideration of climate change as part of advancing the Act's purpose:

> *(ii) take account of short and long-term environmental effects of development at local, regional, State and wider levels, including, for example, the effects of development on climate change...*
>
> *(c) avoiding, if practicable, or otherwise lessening, adverse environmental effects of development, including, for example—*
> *(i) climate change and urban congestion; and*
> *(ii) adverse effects on human health; and*
>
> *(iv) potential adverse impacts on climate change are taken into account for development, and sought to be addressed through sustainable development, including, for example, sustainable settlement patterns and sustainable urban design.*

Other specific aspects of the *Sustainable Planning Act 2009* for note in relation to this study include:

- the hierarchy of planning instruments; The Act sets out a hierarchy of planning instruments, wherein State Planning Policies are considered a 'higher order' planning instrument than local government planning schemes;
- new requirements for 'properly made applications', where technical reports are required to be completed with the lodgement of the application rather than rely on information request processes;
- the requirement for State Government agencies to prepare State Planning Policies where a State planning interest is expressed that influences planning schemes; and
- new processes for amending planning schemes.

2.8 Queensland Planning Provisions

The State's planning reform agenda includes a new requirement for local government to prepare planning schemes consistent with the Queensland Planning Provisions (QPP). At the time of completing this report (December 2009) the QPP was still in draft form and yet to be released as a final document.

The QPP will provide a template for all planning schemes in Queensland including:

- consistent structure, layout and headings;
- the requirement for a strategic plans, albeit in a 'straightjacket' of consistent topic areas;
- a consistent suite of zones, of which local authorities can choose some or all of the zones;
- a consistent approach to level of assessment tables;
- definitions across the state; and
- consistent code formats.

The main significance to natural hazard risk management is the approach to overlay maps and related codes. The QPP identifies that land identified by overlay maps will be able to:

- identify level of assessment changes (that is, if land is included in an overlay category, this can result in changes of assessment, such as houses becoming code or impact assessment where ordinarily they may be self assessable);
- requiring development in these areas to be assessed against a code addressing the overlay (or constraint) mapping.

The QPP identifies that overlay maps (and related provisions) may be prepared for Bushfire Hazard, Landslide Hazard and Flood Hazard.

3. REVIEW OF CURRENT CITY PLAN

3.1 Overview

This section of the paper provides a review of the current City Plan regulatory framework in relation to flooding, bushfire and landslide hazard management.

The objectives of SPP 1/03 are reflected in numerous components of City Plan. For each hazard, the review has documented the relevant City Plan requirements from each of the following sections of City Plan:

- Chapter 2 (The Strategic Plan),
- Chapter 3 (Areas and Assessment Processes),
- Chapter 4 (Local Plans),
- Chapter 5 (Codes), and
- Planning Scheme Policies.

3.2 Bushfire Hazard

3.2.1 Chapter 2 The Strategic Plan

The Strategic Plan contains two sections. The first section contains Desired Environmental Outcomes (DEO) and associated strategies. The second section contains elements which provide physical form to the City Wide Desired Environmental Outcomes (DEOs). The elements are a geographic expression of the DEO's and strategies that collectively outline the broad outcomes intended for the City.

The following sections of the City Plan provide a broad basis or 'head of power' for more detailed consideration of bushfire hazard issues in the City Plan's more detailed regulation such as codes.

Desired Environmental Outcomes

DEO 3.1.1 *Natural Environment and Waterways* contains aspects related to bushfire:

> *3.1.1* ***Desired Environmental Outcome***
> *Brisbane's environmental quality and natural assets are protected and restored and contribute effectively to no net loss of biodiversity, the management of public health and the social and cultural wellbeing of the community...*

Related strategies to achieve this DEO include the following strategy:

> *3.1.2.1 Maintain and restore the City's biodiversity through:*
> ...
>
> *(c)* ***fire management****—ensuring that fire management measures are compatible with the protection and restoration of biodiversity.*
>
> ...

DEO 3.2.1 *Community Life, Health and Safety* contains a general reference to safety and includes a detailed strategy relating to safety and reducing risks of bushfires:

> *3.2.1* ***Desired Environmental Outcome***

Brisbane is a safe, healthy and vibrant place to live, offering a wide range of local and regional services, facilities and activities and diverse housing, community, cultural and recreational choices.

The related strategies from this DEO include the following strategy:

3.2.2.8 Achieve a safe, secure, equitable and comfortable City through:

(d) ***reducing risks*** *– planning to reduce the risks of loss of life, injury, property damage and community disruption resulting from landslip, subsidence, flooding, bushfires, storms and other emergencies and disasters, mindful of the need to maintain emergency access, egress and escape routes to facilitate emergency response*

Strategic Plan Elements

No references are made to bushfire (references to fire hazards associated with hazardous industrial activities are made) in the elements of the strategic plan.

Comment: The Strategic Plan provides limited broad statements about protecting public safety. However the Strategic Plan lacks a more specific approach to bushfire; specifically, to state more clearly the overall purpose of regulating development to avoid adverse impacts from bushfire.

3.2.2 Chapter 3 Areas and Assessment Processes

Areas are the way in which land is identified in the planning scheme that determines land use outcomes and level of assessment for proposed development. There are limited references to bushfire hazard in the Areas section of Chapter 3 as follows:

- Sections 3.4.2 and 3.5.2 providing the DEOs for the Environmental Protection Area and the Rural Area respectively include the following DEO:

  Exposure to risks of bushfires and land instability is minimised.

- The intents for the Low Density Residential Area, Character Residential Area and Low-Medium Density Residential Area in Sections 5.2.1, 5.3.1 and 5.4.1 respectively state the following in relation to building envelopes on small lots:

  ...
  Building envelopes for houses on small lots are defined so that amenity impacts to nearby dwellings and their private open spaces are minimised, in terms of maintaining access to sunlight, daylight and privacy.
  The building envelopes also seek to increase safety from fire hazard, ...

The only relevant aspects in terms of the level of assessment tables in the area provisions is that currently the level of assessment for a house in the Rural Area or Environmental Protection Area requires code assessment (notifiable) where not located within an approved Building Location Plan and where on a lot less than 1ha in the Rural Area or 4ha in the Environmental Protection Area. Building location plans are approved at subdivision stage and are required to address natural hazard requirements at this stage of the development in determining appropriate locations for future dwellings (albeit in a limited way - refer to section 3.2.4 in relation to the subdivision code).

Accordingly, where a code assessment application is required for houses not located in accordance with an approved building location plan, this provides an opportunity for Council to more closely assess bushfire hazard risk under the relevant acceptable

solutions in the house code (specific location requirements are set out where a building location plan has not been approved addressing bushfire hazard mitigation among other hazard risks and ecological impacts); however, this scenario only applies to development in the Rural Area or Environmental Protection Area. In addition, minimum lot size for subdivision in the Rural Area and Environmental Protection Area is 10 hectares; therefore the trigger for assessment (less than 1ha in Rural Areas or 4ha in Environmental Protection Areas) is likely to only occur where new houses are proposed on existing vacant lots.

Comment: The area provisions assume a bushfire hazard risk may only occur in the Rural and Environmental Protection Areas which may not capture all relevant locations and development where bushfire risk exists.

3.2.3 Chapter 4 Local Plans

Local Plans provide specific direction for discrete parts of the City overriding the more general provisions of the City Plan. Limited references to bushfire hazard management were identified in the local plans with a notable exception being the Mt Coot-tha Local Plan.

The Mt Coot-tha Local Plan in particular includes development principle 2.6 in relation to natural hazard events:

> *2.6 Natural hazardous events, including bushfire, landslip and flooding, are to be appropriately managed so as not to pose an unacceptable risk to life and property.*
>
> *This is intended to be achieved by:*
>
> - *restricting proposals in areas of high bushfire hazard or areas prone to landslip or flooding*
> - *applying standards to assessable development so that the risk of damage/loss of life from bushfire, landslip and flooding is minimised.*

The precinct intents further identify those areas that are constrained by gradient, soil stability and bushfire hazard and this is further reflected in the local plan mapping.

Specifically in relation to bushfire hazard, the local plan code also includes acceptable solutions applying to development located in the bushfire hazard areas identified in the local plan mapping. Acceptable solutions include building design requirements, provision of water for fire fighting (tank or swimming pool is provided where hydrants are not available) and bushfire risk reduction requirements in accordance with a bushfire hazard management plan provided as part of a development application (e.g. vegetation management, fire breaks, buildings away from ridge lines etc.).

Comment: The Mt Coot-tha Local Plan provides a example for how bushfire hazard mitigation can be regulated in local planning areas and may have broader relevance for the other general Area provisions in the City Plan for bushfire hazard risk areas. The specific standards and references in the local plan and code may require review to achieve best practice standards as part of the broader consideration of provisions for other parts of the City.

3.2.4 Chapter 5 Codes

Outside the Mt Coot-tha Local Plan and House Code, there are limited provisions in the general codes applying to development that regulate bushfire hazard management in the City Plan; however, a summary of the relevant provisions is provided in Table 1 below.

Table 1 Summary of relevant Code Provisions

Code	**Summary of Provisions Applicable to Regulating Bushfire Issues**	**Comment**
House Code	A self assessable code that includes additional provisions that seek to ensure houses are not exposed to unreasonable risk from bushfire that apply to houses where located in the Environmental Protection, Rural Areas and Very-Low Density Residential Potential Development Area as identified in a local plan.	The house code is a self assessable code that all houses must comply with. The code identifies (section 4.3) that Environmental Protection and Rural Areas are designated as 'bushfire prone areas'. Acceptable solutions in the code state that houses constructed in the applicable areas must ensure a water supply of 45,000L is available for fire fighting where reticulated water is not supplied and that landscaping employs fire resistant plant species within the building location plan area. This allows for some assessment of bushfire hazard issues in those areas that are particularly at risk although in a limited way.
Landscaping Code	The code applies to assessable development (other than detached houses) and addresses bushfire hazard in relation to landscaping (perhaps inappropriately) under a performance criterion for Crime Prevention Through Environmental Design (CPTED).	The acceptable solution states that fire resistant plant species are planted in areas of bushfire hazard and landscaping is designed to minimise the hazard.
Subdivision Code	The code applies to all development for a reconfiguration of a lot and includes performance criteria and acceptable solutions that apply in the 'bushfire prone areas' ('generally applicable to Greenspace Areas and lands directly adjoining Greenspace Areas')	Specific provisions include building location plan requirements, subdivision layout and design requirements to address bushfire hazards.

Comment: The Subdivision Code and House Code provide limited regulation of bushfire hazard management but only in relation to domestic development and only in the Rural Area and Environmental Protection Areas. Further, the relevant provisions apply regardless of the level of bushfire hazard risk at the relevant locations which is not identified in the City Plan and which may impact on the appropriateness of the provisions. This highlights a gap in the regulation of Bushfire Hazard Management in the City Plan.

3.2.5 Planning Scheme Policies

There are no relevant provisions in relation to bushfire hazard management in the planning scheme policies.

3.3 Flooding

3.3.1 Chapter 2 The Strategic Plan

Desired Environmental Outcomes

DEO 3.1.1 *Natural Environment and Waterways* contains aspects related to flooding:

> *3.1.1* ***Desired Environmental Outcome***
> *Brisbane's environmental quality and natural assets are protected and restored and contribute effectively to no net loss of biodiversity, the management of public health and the social and cultural wellbeing of the community...*

Related strategies from this DEO include the following:

> *3.1.2.2 Enhance the aquatic ecology and quality of ground and surface water, including wetlands, the Brisbane River, and other waterways and water bodies through:*
> ...
>
> *(b)* ***minimising damage*** *– minimising filling in floodplains, erosion, run-off, siltation and other forms of water pollution.*
>
> ...

DEO 3.2.1 *Community Life, Health and Safety* contains a general reference to safety and includes a detailed strategy relating to safety and reducing risks of flooding:

> *3.2.1* ***Desired Environmental Outcome***
> *Brisbane is a safe, healthy and vibrant place to live, offering a wide range of local and regional services, facilities and activities and diverse housing, community, cultural and recreational choices.*

The related strategies from this DEO include the following strategy:

> *3.2.2.8 Achieve a safe, secure, equitable and comfortable City through:*
>
> *(c)* ***reducing risks*** *– planning to reduce the risks of loss of life, injury, property damage and community disruption resulting from landslip, subsidence, flooding, bushfires, storms and other emergencies and*

disasters, mindful of the need to maintain emergency access, egress and escape routes to facilitate emergency response

DEO 3.6.1 *Infrastructure* refers to infrastructure provision and stormwater management and includes a strategy in relation to flood carrying capacity of waterways:

3.1.1 ***Desired Environmental Outcome***
Brisbane has efficient and equitable transport, power, telecommunications, water, waste water treatment and stormwater management infrastructure.

The relevant related strategy is provided as follows:

3.6.2.1 Ensure an adequate standard and capacity of community amenities associated with new development through:

...

(f) ***waterways*** *– ensuring that the flood carrying capacity of waterways is not adversely affected by development.*

...

Strategic Plan Elements

The elements of the Strategic Plan also provide high level statements supporting the regulation of development subject to flooding in Brisbane City.

In the Brisbane Green Space System (Section 4.1 of the Strategic Plan) the key green space values are outlined including the following:

Green space corridors *are also intended to serve as physical breaks and buffers in the urban area, to increase the sense of identity for local communities and to serve floodway and drainage functions.*

....

Following from the Brisbane Green Space components it is the Green Space Corridors that highlight flooding and drainage functions.

Section 4.1.2.3 "Protecting important elements in the Emerging Community Area and Future Industry Area" identifies that 'flood liable land' is unsuitable for urban development.

In the Industrial locations (Section 4.3 of the Strategic Plan) specific reference is made to the Brisbane-Ipswich Corridor in Section 4.3.2.2 which includes a key strategic direction to:

...

- *develop open space corridors along creeks, wetlands and watercourses for flooding, drainage and wildlife.*

No further mention of flooding is made in Section 4.2 Residential Neighbourhoods, Section 4.4 Centres, Section 4.5 Movement System, Section 4.6 Native Title or Section 4.7 Heritage.

Comment: As noted above in relation to bushfire hazard, the Strategic Plan provides broad statements about protecting public safety but lacks a more specific approach to clearly identify the overall purpose of regulating development to avoid adverse impacts from flooding.

3.3.2 Chapter 3 Areas and Assessment Processes

City Plan determines land use outcomes and level of assessment for proposed development through the designation of "Areas". There is limited reference to flooding in the Areas section of Chapter 3.

Chapter 3 also contains guidance and requirements for general assessment processes, including exemptions (Exemptions exclude development from being assessed against the City Plan). In relation to flooding, the City Plan specifically identifies exemptions for filling or excavation as follows:

- to a depth of one vertical metre or less from ground level on land which the Acid Sulphate Soil Code and Wetland Code and / or Waterway code do not apply, and where the site is not listed on the Contaminated Land Register or Environmental Management Register; OR

- top dressing to a depth of less than 100 vertical millimetres from ground level on land to which the Wetland Code and/ or Waterway Code applies.

(Section 2.3, page 5, Chapter 3)

These parameters provide important thresholds for when an application is required.

Chapter 3 also identifies the definition for filling or excavation:

> *Filling or excavation means operational work for excavating or filling that materially affects premises or their use.*

Comment: The triggers for where applications will be required and where they are not required seek to strike a balance between assessing the more significant applications, and unnecessarily having to assess low risk applications. These thresholds may require review.

3.3.3 Chapter 4 Local Plans

Local Plans provide specific direction for discrete parts of the City overriding the more general provisions of the City Plan. There are some general references to flooding and flood plains in the Local Plans however these Local Plans often lack specific controls relying on the more general processes and requirements of the City Plan to manage / regulate flood issues.

3.3.4 Chapter 5 Codes

There are a number of key codes that provide the basis for the detailed regulation of flooding in the City Plan. A summary of these is provided in table 2 below.

Table 2 Summary of relevant Code Provisions

Code	**Summary of Provisions Applicable to Regulating Flood Issues**	**Comment**
Filling and	Specific Purpose statement	The purpose statement is quite

Code	Summary of Provisions Applicable to Regulating Flood Issues	Comment
Excavation Code	that identifies no adverse impacts from filling on upstream, downstream or adjoining properties. Specific Performance Criteria and acceptable solutions for filling regarding flood impacts.	stringent in its requirement for filling to not cause any adverse impacts upstream, downstream or adjacent. The acceptable solution states that no filling is acceptable below Q100 levels, within waterway corridors or wetlands. If this is not achieved an assessment against the performance criteria is required. ('no increase in flooding or drainage problems'). The performance criteria requires filling and excavation to be carried out in accordance with the Compensatory Earthworks Planning Scheme Policy (refer to section 3.3.5 below for details of the policy).
House Code	A self assessable code that seeks to exclude development in a waterway corridor and sets minimum habitable and non habitable floor levels.	This is a self assessable code that all houses must comply with. Houses that are constructed in the waterway corridor, or cannot meet flood immunity levels require an application (usually code assessment). This allows for assessment of flooding issues for those applications.
Park Planning and Design Code	The code applies to subdivision applications where the dedication of parkland is required. Performance Criteria and Acceptable Solutions require parkland to achieve flood immunity.	The code is only relevant where a land dedication for parkland is required or contributed in lieu of a monetary contribution by development. The acceptable solutions are Q5 flood immunity for recreation areas (except where the land would benefit recreation such as flat land for a sports field) and Q100 immunity for buildings (clubhouse, equipment store etc).
Stormwater Management Code	The code contains performance criteria and acceptable solutions that development 'must not adversely impact' on properties upstream, downstream or adjacent. Additional performance	This is the main code with assessment criteria for flooding issues. The code has specific performance criteria and acceptable solutions for managing flood impacts.

Code	Summary of Provisions Applicable to Regulating Flood Issues	Comment
	criteria relate to the need to manage property runoff safely.	
Structure Planning Code	The code is triggered by any impact assessable development including reconfiguring a lot or material change of use in an Emerging Community Area or a Future Industry Area. The code requires the preparation of a detailed structure plan to guide future development in these areas including the identification of relevant constraints for development such as flooding.	The code requires the identification in a structure plan of flood affected land identified as being below the Flood Regulation Line.
Subdivision Code	Limited broad or detailed guidance for management of impacts on flooding	Relies on other codes in relation to the management of stormwater, however, some stronger stormwater management / overland flow statements may be warranted.
Waterway Code	Limited broad or detailed guidance for management of impacts on flooding	Relies on other codes in relation to the management of stormwater.

Comment: The codes are the most important regulatory mechanism in the City Plan in relation to flooding. The codes need to contain both the broader policy requirements associated with regulating development to minimise flooding, as well as the detailed development standards. The Stormwater Management Code provides a sound basis for the assessment of flood issues in the regulation of development. However the codes could be improved with better references and more specific policy statements and standards as to how flood risk is managed and assessed.

3.3.5 Planning Scheme Policies

Subdivision and Development Guidelines

The Subdivision and Development Guidelines are a Planning Scheme Policy prepared as part of the Brisbane City Plan 2000. Consequently this policy supports the regulation of development (primarily through codes) contained within the City Plan. The policy provides technical standards, requirements and processes for assessing flood issues arising from the regulation of development in the City Plan. In particular a range of key codes (such as the Stormwater Management Code) provide a direct reference to the Guidelines.

The Subdivision and Development Guidelines provide two sections that are relevant to flooding and stormwater management. Part A, Chapter 1 of the document addresses flood affected land, and sets out:

- flood immunity standards for residential developments, including intensifying use in infill development;
- flood immunity standards for industrial / commercial developments;
- road trafficability; and
- earthworks adjacent to waterways and flow paths.

Compensatory Earthworks Planning Scheme Policy

The compensatory earthworks planning scheme policy (PSP) sets out requirements for development when reshaping of land is proposed within a waterway corridor. The objective of the PSP is to "... *ensure that earthworks reduce neither the flood-storage capacity nor flood-carrying capacity of the area within a Waterway Corridor".* The policy states that for earthworks to be acceptable within a Waterway Corridor it must be demonstrated that they:

- do not conflict with the Waterway Code or the Filling and Excavation Code; and
- do not adversely impact the hydraulic characteristics of the watercourse with impacts cited including:
  - reducing the flood-carrying capacity of a watercourse; and/or
  - reducing flood storage; and/or
  - altering the hydraulic control of the stream and thus causing scour and sedimentation.

The policy sets out the application requirements of development to provide 'compensatory earthworks' rather than 'balanced earthworks' where proposed in a waterway corridor. The distinction between the two is described in section 3 of the policy as follows:

> *To preserve the hydraulic characteristics within a Waterway Corridor, the volume of 'cut' and 'fill' must be compensatory between incremental flood levels* (i.e. not a simple 'total fill <= total cut'). *In Example 2, the volume of 'fill' is equal to or less than the volume of 'cut' between each incremental level. If more 'fill' than 'cut' were added between levels (see Example 1, 5.2 – 5.4m AHD) then the flood-storage capacity and flood-carrying capacity within a Waterway Corridor would be reduced for certain flood events with adverse consequences to flooding.*
>
> *Example 1: Balanced Earthworks*

Level (m AHD)	Cut (m^3)	Fill (m^3)
5 – 5.2	600	200
5.2 – 5.4	300	500
5.4 – 5.6	400	600
Total	*1,300*	*1,300*

> *Example 2: Compensatory Earthworks*

Level (m AHD)	Cut (m^3)	Fill (m^3)
5 – 5.2	600	≤600
5.2 – 5.4	300	≤300
5.4 – 5.6	400	≤400
Total	*1,300*	*1,300*

Comment: The Subdivision and Development Guidelines provide the most robust and in-depth approach to assessing the impacts of development on flooding. Similarly, the Compensatory Earthworks Planning Scheme Policy provides in-depth assessment requirements for development to mitigate the impacts of filling and excavation on flooding where called up by the performance criteria in the Filling and Excavation Code. However, the policies have a low level of statutory impact being planning scheme policies, and accordingly, are more able to be waived if circumstances permit. A more robust approach is to apply the appropriate broader principles and standards contained in the planning scheme policies to the codes where a more stringent application of the standards can be applied.

3.4 Landslide Hazard

3.4.1 Chapter 2 The Strategic Plan

Desired Environmental Outcomes

DEO 3.2.1 *Community Life, Health and Safety* contains a general reference to safety and includes a detailed strategy relating to safety and reducing risks of 'landslip and subsidence':

> *3.2.1* ***Desired Environmental Outcome***
> *Brisbane is a safe, healthy and vibrant place to live, offering a wide range of local and regional services, facilities and activities and diverse housing, community, cultural and recreational choices.*

The related strategies from this DEO include the following relevant strategy:

> *3.2.2.8 Achieve a safe, secure, equitable and comfortable City through:*
>
> *(c)* ***reducing risks*** *– planning to reduce the risks of loss of life, injury, property damage and community disruption resulting from landslip, subsidence, flooding, bushfires, storms and other emergencies and disasters, mindful of the need to maintain emergency access, egress and escape routes to facilitate emergency response*

Strategic Plan Elements

No references are made to landslide hazards or other relevant references in the elements of the strategic plan.

Comment: Comments noted above in relation to bushfire hazard and flooding apply. More specific statements are needed to clearly identify the overall purpose of regulating development to avoid adverse impacts from landslide hazard.

3.4.2 Chapter 3 Areas and Assessment Processes

Areas are the way in which land is identified in the planning scheme that determines land use outcomes and level of assessment for proposed development. There are limited references to landslide hazard in the Areas section of Chapter 3 as follows:

- As noted in relation to bushfire hazard, Sections 3.4.2 and 3.5.2 providing the DEOs for the Environmental Protection Area and the Rural Area respectively include the following DEO which also refers to land instability:

  Exposure to risks of bushfires and land instability is minimised.

No other references are made to landslide hazard in chapter 3. The level of assessment tables do not vary the level of assessment for development that may be subject to landslide hazard other than where for a house where a building location plan does not exist and where on a lot less than 1ha in the Rural Area or 4ha in the Environmental Protection Area. In this case the level of assessment is changed from self assessment to code (notifiable). The variation to the level of assessment under these circumstances is also not directly linked to landslide hazard and relates to building location plans which address additional aspects of siting and design including other natural hazards.

Comment: The Area provisions include very limited reference to landside and the Environmental Protection Area and Rural Area may not be the only locations where a landslide hazard may occur.

3.4.3 Chapter 4 Local Plans

Limited references to landslide hazard management were identified in the local plans with exceptions identified in the Mt Coot-tha and Fig Tree Pocket Local Plan as detailed below.

Mt Coot-tha Local Plan

The level of assessment for houses remains self assessable where complying with the acceptable solutions in the local plan code for houses in slope constraint areas (i.e. where located in a "*low slope constraint area*" (0% to 20% slope category) identified in the local plan mapping (or where located in accordance with a building location plan and use access approved at subdivision stage)); however, the level of assessment becomes code assessable (notifiable) where not meeting the acceptable solutions (i.e. where located in a moderate slope constraint area (20–33% slope category) or high slope constraint area (in excess of 33% slope)).

All other code and impact assessable development (i.e. not in a low slope constrained area) is subject to additional acceptable solutions stating that development does not occur in the high slope constraint area and erosion and sedimentation impacts are minimised in accordance with an Erosion and Sediment Control Plan as well as a range of additional requirements in relation to building and operational works such as minimising cut and fill activities, limiting retaining walls, preference to pole type foundations rather than slab on ground, driveway grades, and revegetation requirements are provided.

Fig Tree Pocket Local Plan

The Fig Tree Pocket Local Plan includes similar provisions by way of mapping and acceptable solutions in the code in relation to steep land; however, the outcomes sought are in relation to protecting ecological values in terms of erosion and sediment loss and impacts on waterways rather than protection of people and property.

Comments: The Mt Coot-tha Local Plan provides the most detailed provisions for the assessment of landslide hazard in the City Plan but is obviously limited in application where applying only to the Mt Coot-tha area.

3.4.4 Codes

There are a number of key codes that provide limited basis for the detailed regulation of landslide hazard in the City Plan. A summary of these is provided in table 3 below.

Table 3 Summary of relevant Code Provisions

Code	**Summary of Provisions Applicable to Regulating Landslide Issues**	**Comment**
House Code	Self assessable code that applies to all houses. The code includes a performance criterion stating that houses in the Environmental Protection, Rural Areas and Very-low Density Residential Potential Development Area as identified in a Local Plan must not be subject to unreasonable risk from landslip or instability. The acceptable solution requires a house to be located in accordance with a building location plan or on land with a natural grade of less than 1 in 4 (25%) measured over a 40m by 40m area.	There are very limited provisions assessing landslide hazard and they only apply in the specific locations noted.
Structure Planning Code	The code is triggered by any impact assessable development including reconfiguring a lot or material change of use in an Emerging Community Area or a Future Industry Area and requires the preparation of a detailed structure plan to guide future development in these areas including the identification of relevant constraints for development such as steeply sloping land.	The code requires the identification in a structure plan of steeply sloping land that is generally unsuitable for urban development because of potential instability, erosion or other hazard caused by clearing steep land.
Subdivision Code	The code includes section 5.4 providing performance criteria and acceptable	A range of acceptable solutions are provided that seek to ensure allotments are located on land

	solutions in relation to geotechnical stability.	with a suitable grade and provide suitable building sites without requiring excessive cut and fill. Building location plans are required.

Comments: The codes are the most important regulatory mechanism in the City Plan in relation to Landslide Hazard but are currently lacking in terms of both broader policy requirements associated with regulating development to minimise landslide hazard as well as the detailed development standards which are limited in application. The codes are limited in their application (currently limited to houses and in new or outer-City development areas such as Emerging Community, Future Industry, Rural and Environmental Protection Areas) by the lack of clearly identified landslide hazard risks in the City Plan (i.e. such as by maps).

3.4.5 Planning Scheme Policies

There are no relevant provisions in relation to landslide management in the planning scheme policies.

3.5 Summary

The audit of the City plan provisions in relation to bushfire, flooding and landslide hazards has identified:

- there is a broad reference to public safety and risk management in the Strategic Plan as a way of how the City Plan addresses this issue on a broad level, but a lack of emphasis on these matters when compared with environmental protection;
- The Area provisions and level of assessment triggers in City Plan have assumed a broad-brush application of bushfire and landslide hazard risk to the Rural and Environmental Protection Areas alone;
- important thresholds in relation to flooding are located in the introductory sections of Chapter 3 (in terms of the definition of Filling and Excavation and the exemptions for filling);
- the most important regulation of development in relation to flooding occurs in the codes, which could be amended to strengthen the assessment of flood issues;
- the most important regulation of development in relation to bushfire and landslide hazard also occurs in the codes but is currently limited in application and effectiveness by assumptions about the locations of these hazards (i.e. limited to Rural and Environmental Protection Areas and/or to development triggering the structure planning code and/or subdivision code) and lack of detailed identification of these hazards;
- the Subdivision and Development Guidelines and Compensatory Earthworks Planning Scheme Policy contain a thorough process and detailed standards for assessment of flood issues but lack the statutory force of codes; and

- The Mt Coot-tha Local Plan provides a sound example of how bushfire and landslide hazard can be appropriately regulated and contains the most direct and purposeful provisions in the City Plan in relation to these hazards.

The audit of the City Plan has identified some areas in the existing provisions for further review and possible amendment as a way of strengthening the way in which development is assessed for bushfire, flooding and landslide hazards.

4. GAP ANALYSIS

4.1 Overview

This section of the report draws from the previous analysis of the State Planning Policy 1/03 against the City Plan, and sets out the gaps in relation to the matters that will be required to be addressed to ensure the new City Plan adequately addresses the requirements of the SPP 1/03.

Some comments have been made in relation to the use of the first three outcomes of the SPP 1/03 in development assessment in Council. However, the scope of work for this study has not required an evaluation of the current development assessment practice against the requirements of the SPP 1/03; rather, these comments are made as a constructive way to assist current development assessment processes to better address SPP 1/03.

4.2 Gap Analysis - Flooding

4.2.1 Outcomes 1 to 3: Development Assessment

Outcome 1

Outcome 1 requires development to be 'compatible' with the natural hazard, except where the development proposal reflects a development commitment, or where there is an overriding need for the development in the public interest.

The current City Plan is considered to be partly compliant with Outcome 1.

Annex 4 of SPP 1/03 provides the following 5 outcomes that should be achieved for development to be compatible with the nature of flood hazard:

> ***1.*** *Development maintains the safety of people on the development site from all floods up to and including the DFE.*
>
> ***2.*** *Development does not result in adverse impacts on people's safety or the capacity to use land within the floodplain.*
>
> ***3.*** *Development minimises the potential damage from flooding to property on the development site.*
>
> ***4.*** *Public safety and the environment are not adversely affected by the detrimental impacts of floodwater on hazardous materials manufactured or stored in bulk.*
>
> ***5.*** *Essential services infrastructure (e.g. on-site electricity, gas, water supply, sewerage and telecommunications) maintains its function during a DFE.*

In order to assess development under the requirements of outcome 1 of the SPP it is first necessary to identify whether development is located within a natural hazard management area. In relation to flood, the City Plan is currently deficient in identifying the location and extent of natural hazard management areas and this is discussed further under outcome 4 below.

However flood immunity standards are provided in the subdivision and development guidelines planning scheme policy and flood data is available to Council and development proponents for the purposes of development assessment.

In particular, City Plan development Codes referred to in section 3.4 above, against which the majority of development is assessed, contain some performance criteria that relate directly to compatibility of development with the flood hazard. For example, the Stormwater Management Code includes the following Performance Criteria which seeks to achieve the second outcome in Annex 4:

> *The proposed stormwater management system or site works must not adversely impact on flooding or drainage of properties that are upstream, downstream or adjacent to the subject site.*

Design standards for flood immunity are primarily contained within Council's Subdivision and Development Guidelines, which are referenced by numerous development Codes (in particular the filling and excavation code and stormwater management code). The Subdivision and Development Guidelines specify required minimum flood immunity levels for allotments, floor levels and road trafficability, depending upon the type of development. The Guidelines also specify flood immunity levels for community infrastructure which correspond to the recommended levels of immunity provided in SPP 1/03.

The subdivision and development guidelines establish the "low flood hazard zone" criteria that defines the limit on where the intensification of land use (redevelopment/infill development) may be permissible; however, it is unclear what information Council currently has with respect to medium or high severity of flood hazard within the natural hazard management area, or whether any such information, if available, is used in development assessment. Whilst classification of the severity of hazard is not required under the SPP, this information, if available, could be helpful in assessing development against the requirements of the SPP.

Outcome 2

Outcome 2 is a 'default' outcome where Outcome 1 cannot be met, so that adverse impacts from the natural hazard are minimised as far as possible and do not result in 'unacceptable risk' to people or property.

City Plan is compliant with Outcome 2.

Through the various development Codes and the Subdivision and Development Guidelines, City Plan requires development to comply with Outcome 1 of the SPP. In a case where this was not possible, the same mechanisms would be used to ensure compliance with Outcome 2 of the SPP.

Outcome 3

Outcome 3 relates to the importance of community infrastructure being operational during and after a natural hazard event.

Table 1.4 of Chapter 1 (page 6) of the Subdivision and Development Guidelines (a planning scheme policy in the City Plan) directly references the flood immunity levels recommended in SPP 1/03 and hence is compliant with Outcome 3.

4.2.2 Outcomes 4 to 6: Making and Amending a Planning Scheme

Outcome 4

Outcome 4 requires that the planning scheme identify the location and extent of natural hazard management areas.

City Plan does not currently identify the location and extent of natural hazard management areas for flood. This information is available, and flood extents for river flooding, creek flooding and stormwater inundation due to overland flow have recently been made publicly available through Council's website. However, City Plan is technically not compliant with Outcome 4, as no mapping sets out the 'location and extent' of the natural hazard management areas.

Note that the SPP defines flood as water which overtops the natural or artificial banks of a watercourse. Hence, there is no requirement under the SPP to identify areas inundated by overland flow or to include these areas within the natural hazard management area.

There are several points of ambiguity with respect to Council's flood information and requirements when compared to the requirements of SPP 1/03:

- Available flood mapping does not explicitly state what criteria or event has been used to derive the adopted flood extents.

- Council's flood immunity requirements in the Subdivision and Development Guidelines refer to events of different average recurrence interval (ARI) and also to a defined flood level (DFL), based on the 3.7 mAHD level at the Brisbane Port Office Gauge. This is an ambiguous definition, since it is uncertain what flow rate, if any, has been used in combination with the Port Office level to derive the DFL throughout the city. It is understood that Council also uses a defined flood level based on the highest recorded flood level (typically the 1974 flood level) plus 700 mm. It is unclear whether this is the same as the DFL based on the 3.7 mAHD level at the Port Office Gauge. The SPP refers to the adoption of a defined flood event, the probability of which can be estimated, rather than a defined flood level which could potentially be more arbitrary.

- City Plan's Structure Planning Code requires mapping of flood affected land, identified as land that is below the Flood Regulation Line. Flood Regulation Lines are defined in Chapter 3 of City Plan (p. 69) as:

    - *lines used by Council to indicate floodplain areas reserved for flood water storage and flow, where development may be restricted.*

- The methodology used to define Flood Regulation Lines is unclear and hence it is uncertain how these lines relate to the definition of natural hazard management areas since Regulation Lines do not necessarily define the limit of flooding for a DFE.

Outcome 5

Outcome 5 sets out the following requirement:

The planning scheme contains planning strategies that aim to:

- *Ensure that development in natural hazard management areas is compatible with the nature of the natural hazard;*

- *Minimise the impacts from natural hazards on existing developed areas; and*

- *Prevent development from materially increasing the extent or the severity of natural hazards.*

City Plan complies with Outcome 5, as discussed under Outcome 1.

There is scope for the City Plan to provide a stronger and more integrated policy and regulatory basis to assess flood risk issues, which is discussed in Section 5 of this report.

Outcome 6

Outcome 6 requires the planning scheme to include a code(s) to achieve development outcomes required by the SPP and to ensure that development to which the SPP applies requires assessment against that code(s) (i.e. relevant development is self, code or impact assessable). In addition, the SPP requires that the planning scheme or planning scheme policy specifies the information expected to be submitted with development applications subject to the code(s).

City Plan is generally compliant with Outcome 6 in that assessment of flood risk is triggered for development including:

- development for a house, including assessment of development of a house in a waterway corridor and for habitable and non habitable rooms to achieve flood immunity; and

- filling and excavation, including filling and excavation in a waterway.

Other development, where requiring a code or impact assessment applications, contains assessment against applicable codes such as the Stormwater Management Code which contains provisions which require assessment of flood issues.

City Plan does specify the information expected to be submitted with development applications, albeit at a very high level. For example, under Flooding Performance Criteria P1, the Stormwater Management Code indicates that:

> *compliance with this acceptable solution can be demonstrated by the submission of a hydraulic and hydrology report (as part of a SBSMP) identifying potential flooding impacts on upstream, downstream or adjacent properties.*

The subdivision and development guidelines also refer to the potential need to "undertake appropriate hydrologic and hydraulic assessments".

However, it is recognised that improvements can be made to increase the clarity of Council's code requirements including bringing parts of the Subdivision and Development Guidelines into the planning scheme.

4.2.3 Summary

Table 1 provides a summary of the level of compliance of City Plan with the requirements of SPP 1/03. City Plan generally complies with the requirements of the SPP, but is technically non-compliant with Outcome 4 because the flood hazard management area is not identified within City Plan. There is some ambiguity in the terms used in City Plan to describe flood hazard. It is recommended that the adopted Defined Flood Event be clearly identified and that the definition and role of Flood Regulation Lines be clarified.

Further, there are improvements to the operation and effectiveness of the assessment of flood in the City Plan which are recommended to be addressed in the new City Plan.

Table 1 Summary of City Plan Compliance with SPP 1/03

SPP Outcome	Level of compliance	Key Gaps or Opportunities for Improvement
1	Compliant	Information on the severity of flood hazard, if available, could be helpful in assessing development against the requirements of the SPP.
2	Compliant	
3	Compliant	
4	Not compliant	City Plan does not currently identify the location and extent of natural hazard management areas for flood, although this information is available. There is some ambiguity in the terms used in City Plan to describe flood hazard. The adopted Defined Flood Event should be clearly identified. The definition and role of Flood Regulation Lines should be clarified.
5	Compliant	
6	Compliant	

4.3 Gap Analysis - Bushfire

4.3.1 Outcomes 1 to 3: Development Assessment

Outcome 1

City Plan 2000 was developed before publication of SPP 1/03 and consequently does not contain strategies or codes based on a *natural hazard management area (bushfire)*. It does, however, designate two specific areas (Environmental Protection and Rural) as 'bushfire prone'. When these areas, together with the areas designated as Conservation Area, are excluded from the *natural hazard management area (bushfire)* mapping shown in Figure 2, the residual areas of bushfire prone land (under the SPP 1/03 definitions) are relatively small. These are shown in Figure 1.

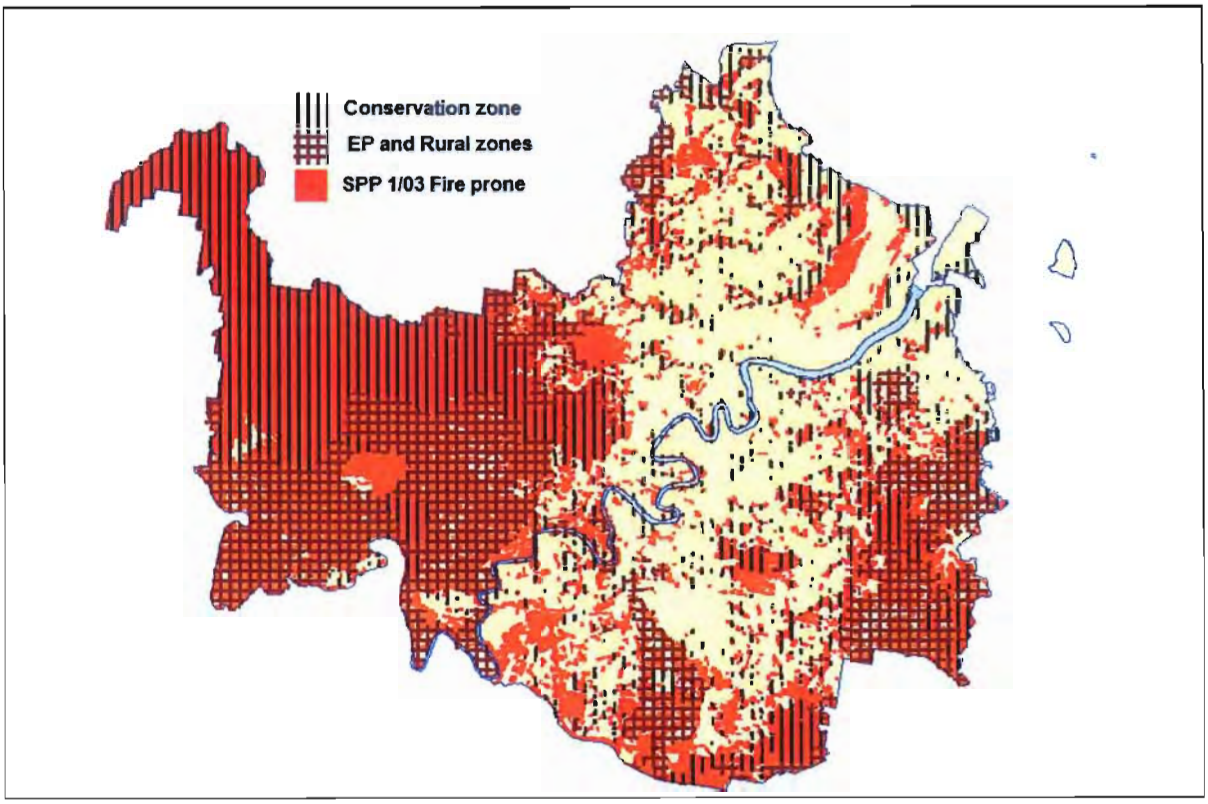

Figure 1: Brisbane City fire prone land classifications

The most notable residual areas are the extractive industry zone predominantly in Kholo, the Kokoda Barracks area in Enoggera, the airport precincts in Eagle Farm and the Griffith University campus in Nathan.

The Strategic Plan contains specific strategies aimed at avoiding the adverse impacts of bushfires in 'bushfire prone' areas. Importantly for the application of the SPP 1/03, the section of the Strategic Plan containing Desired Environmental Outcomes identify the most specific reference to bushfires (3.1.2.1) relates to their potential impact on biodiversity rather than on community safety. Bushfires are also addressed, along with other hazards, in 3.2.2.8 of the Strategic Plan (Chapter 2 of the City Plan) which has a focus on reducing risks.

Outcome 2

The bushfire-related House, Landscape and Subdivision Codes detailed for the Environmental Protection and Rural Areas are compatible with the nature of the bushfire hazard in that they are aimed at minimising the impact of bushfire on residential development in those zones. They may not, however, adequately meet the 'acceptable risk' test and may need to be revised and expanded. There are, for example, more appropriate codes for property fire planning and the provision of fire fighting water and other resources now widely promoted than those covered in the City Plan. These are addressed below in the discussion of Outcome 5.

There are no provisions for addressing bushfire hazards in other areas that carry a residual bushfire risk. Management of that residual risk is currently achieved through Council's Bushfire Management Strategy that emphasises the management of fuel on Council-controlled land.

It is recognised that there are always conflicts likely to emerge between measures aimed at preserving biodiversity with those that are aimed at minimising bushfire hazards. Currently City Plan tends to give greater emphasis to preserving biodiversity than it does to minimising bushfire hazards.

Outcome 3

Community infrastructure is not addressed in the context of bushfire.

The table below summarises the gaps that exist between the SPP 1/03 Development Outcomes and the current City Plan.

Summary of relationships between SPP 1/03 outcomes 1 to 3 and City Plan 2000

SPP 1/03 Outcome	City Plan Gap
1: Development is compatible with the nature of the hazard	Applied only to Environmental Protection and Rural Areas
2: Minimise the impact of the hazard	Codes may not meet 'acceptable risk' criteria
3: Application to community infrastructure	Not addressed in the context of bushfire

4.3.2 Outcomes 4 to 6: Making and Amending a Planning Scheme

Outcome 4

The mapping undertaken by Council in 2003 and described in section 2.5 above meets the requirements of SPP 1/03 and can be directly incorporated in a new City Plan as defining the *natural hazard management area (bushfire)* for Brisbane City. **This mapping will extend the area classified as 'bushfire prone' into areas other than Environmental Protection and Rural Areas,** including both 'Greenfield' areas and existing residential areas identified for densification through infill or redevelopment.

The statistics relating to parts of the Emerging Communities and Future Industrial Areas (the potential 'Greenfield' development areas) that fall within the *natural hazard management area (bushfire)* mapping are summarised in Tables a and aa. The statistics for the 'infill' residential areas are in Tables b abd bb.

The table below identifies the number of 'Greenfield' parcels with medium or high bushfire exposure:

AREA	HIGH FIRE	MEDIUM FIRE
Emerging Communities	639	5855
Future Industry	45	189
Totals	684	6044
% all parcels	4.56	40.64

The table below identifies the area (sq km) of 'Greenfield' parcels with medium or high bushfire exposure within Brisbane City:

AREA	HIGH FIRE	MEDIUM FIRE
Emerging Communities	3.163	25.965
Future Industry	2.041	5.095
Totals	5.204	31.051
% total area	9.41	56.17

The table below identifies the number of 'residential infill' parcels with medium or high bushfire exposure:

AREA	HIGH FIRE	MEDIUM FIRE
Low-medium Res	141	2288
Medium density Res	0	33
High density residential	0	6
Totals	141	2327
% all parcels	0.12	1.91

The table below identifies the area (sq km) of Brisbane City parcels with medium or high bushfire exposure:

AREA	HIGH FIRE	MEDIUM FIRE
Low-medium Res	0.036	1.337
Medium density Res	0	0.075
High density residential	0	0.009
Totals	0.036	1.421
% total area	0.05	2.22

Outcome 5

The current City Plan does not contain specific strategies (i.e. in Chapter 2) that address bushfire hazard. This should be addressed in the new Strategic Plan in the City Plan.

The Interim report of the 2009 Victorian Bushfire Royal Commission (Victoria, 2009; para 8.6 p206), for example, includes the following observation:

> *Designation of a wildfire management overlay by a local council imposes planning controls to ensure that:*
> - *water is available to enable life and property to be defended from wildfire*
> - *there is safe access for emergency and other vehicles*
> - *the design and siting of buildings and works improves protection for life and minimises the level of fire impact*
> - *fuel (ground fuel and shrubs) is managed to reduce potential fire intensity in the vicinity of buildings.*

Similar strategies might be considered for inclusion in the new City Plan[1].

Outcome 6

As discussed above in relation to Outcome 2, City Plan already contains House, Landscape and Subdivision Codes that are aimed at minimising the risks posed by bushfire in new developments. These codes are very brief and can be greatly expanded and improved. They will also need to be structured to take into account the expanded area covered by the natural hazard management area (bushfire) and its application to areas to which such codes are currently applied.

Under part 4.2 of the existing House Code Performance Criteria P2 states:

> *House must not be exposed to unreasonable risk from bushfire.*

Two acceptable solutions are offered:

> ***A2.1*** *House has a minimum water supply of 45,000L available and retained for fire fighting purposes, where not supplied with reticulated water*
> ***A2.2*** *Landscaping employs fire resistant plant species less than 5m in height for any landscaping within the building location plan area*

The provision of fire fighting water is clearly appropriate in areas that do not have a reticulated supply, but the code should go further to stipulate that any pump should be independent of the mains power supply and that tank and pipe material (e.g. PVC) are not susceptible to damage under radiant heat. The installation of sprinkler systems on buildings supplied by that reserve for fire fighting water are increasingly seen as a highly desirable requirement in those areas of high risk.

The planting of 'fire resistant' or 'fire retardant' vegetation as a barrier or screen to filter out wind-driven sparks and embers, or to act as a barrier against radiant heat and flame, is advocated by some authorities as one of a suite of strategies [redacted]. Whilst some species of vegetation may provide a degree of protection and screen plantings can add to the depth of fire defences if combined with other strategies, this approach should not be the only strategy adopted. The FABC (FABC, 2005) draws attention to the fact that:

> *Whilst some plants may not burn in low to moderately intense fires, all plants can burn in high intensity fires (those fires when you and your home are most at risk).*
>
> *You should not rely on published lists of 'fire retardant', 'fire resistant' or 'hard-to-burn' plant species.*

The appropriate management of vegetation around buildings and infrastructure facilities is the key, not just the selection of species.

Performance Criteria P3 states:

> *Vehicle access must be safe from hazards and must not adversely impact on landscape values.*

Suggested solutions include:

A3 *Access:*

[1] The Interim Report states that building and planning issues will be addressed in its final report due in 2010.

- *is via an access road approved at subdivision stage*
- *is not less than 3.5m wide with passing bays at a minimum of 100m intervals to allow for emergency vehicle access*

OR

Access:

- *is at grades of less than 1 in 4*
- *does not require cut and fill in excess of a total of 2m in height*
- *is not less than 3.5m wide with passing bays at a minimum of 100m intervals to allow for emergency vehicle access*
- *is shared with at least one adjoining vacant allotment (if any)*

These solutions are appropriate to all new developments. Provision should also be made for the maintenance of fuel along these access roads as responsibility for this critical process will depend on whether they are public roads (Council of Department of Main Roads) or private roads (e.g. the body corporate in a community title scheme).

Under the Landscape Code performance criteria P15 states:

> *The landscape design must enhance personal safety and reduce the potential for and fear of crime and vandalism by incorporating crime prevention through environmental design (CPTED) principles*
> *Note: for guidance on assessing the incorporation of crime prevention through environmental design principles refer to the* ***Crime Prevention Through Environmental Design (CPTED) Planning Scheme Policy***

One of the three solutions is:

> ***A15.3*** *Fire resistant species are planted in areas of bushfire hazard and the landscaping designed to minimise bushfire hazard*

The comments made regarding the use of 'fire resistant' species above are also applicable in the landscaping code.

Under the Subdivision Code, section 5.4 (Safety, hazard risk and amenity) subsection 5.4.2 states:

> *Bushfire hazard (generally applicable to Greenspace Areas and lands directly adjoining Greenspace Areas)*

Performance criteria P2 under 5.4.2 states:

> *Fire management measures and design elements must be adopted to minimise bushfire hazard and to ensure access or evacuation in emergencies.*

The six acceptable solutions are all appropriate and will need to be applied to all areas that will be defined as bushfire prone within the *natural hazard management area (bushfire)*. They are based on publications including CSIRO/SA (1993), DHLGP/QFRS (1994) and QFRA (1998). Experience with severe bushfires since the late 1990s (e.g. Canberra in 2006 and Victoria in 2009) have led to considerable revision of accepted practice in subdivision design in bushfire prone areas. Those practices should be incorporated in the new City Plan.

In addition a classification of 'bushfire prone' should trigger a requirement under the *Standard Building Regulation* of AS 3959-2009 *Building in bushfire prone areas* (SA,

2009)[2]. This standard is accompanied by the guideline SAA HB 36-1993 *Building in bushfire prone areas – information and advice* CSIRO/SA, 1993).

The table below summarises the gaps that exist between the SPP 1/03 Plan Amendment Outcomes and the current City Plan.

SPP 1/03 Outcome	City Plan Gap
4: Include a natural hazard management area (bushfire)	The 2003 bushfire mapping is suitable for use as natural hazard management area (bushfire) mapping and is recommended for inclusion in the City Plan
5: Plan to include planning strategies relating to the hazard	No strategies currently included relating to bushfire
6: Planning scheme to include relevant codes	The existing codes need to be expanded and applied to all areas that fall into the natural hazard management area (bushfire)

Mapping

Under the proposed QPP the *natural hazard management area (bushfire)* will meet the requirements of the overlay (or constraints) mapping for bushfire that will trigger the application of new City Plan planning codes and standards. The natural hazard management areas will separately trigger the requirements under the *Standard Building Regulation* such as AS 3959-2009.

However a review of the accuracy of the 2003 *natural hazard management area (bushfire)* mapping is required as it is based on vegetation mapping that is now as much as seven or eight years old. Given the dynamic nature of vegetation (through both clearing and re-vegetation) it would be appropriate for the vegetation element of this mapping to be reviewed and if warranted, the *natural hazard management area (bushfire)* mapping should be updated to reflect the current vegetation regime.

It would also be appropriate for vegetation mapping and its link to the bushfire mapping to be reviewed at least once every five years.

Fire Planning

Given the experience of the 2009 'Black Saturday' fires in Victoria there has been considerable attention given to fire planning in bushfire prone areas. The Interim Report of the Victorian Bushfire Royal Commission (Victoria, 2009), for example, makes several observations and recommendations relating to property-level fire planning. A requirement to develop and maintain a property-level fire plan along the lines recommended by the South East Queensland Fire and Biodiversity Consortium (FABC) might be considered for inclusion in the House Code, especially in Environmental Protection and Rural Areas. See publications such as FABC (2002), FABC (2005) [redacted].

Climate Change

The current City Plan does not make provisions for changes to the bushfire regime across the City in the light of climate variability and the forecast impacts of climate change.

[2] This third edition of AS 3959 was published in March 2009 after at least 8 years of review and revision. The Guideline (HB 36 - 1993) has been under review and revision since 2005.

Among the issues that may impact on bushfire hazards under climate change scenarios are an increase in fire intensity in forested areas due to longer periods of drought and a decline in available fire fighting water resources during drought.

The recent draft for public consultation of the South East Queensland Climate Change Management Plan (DIP, 2009) includes several draft action plans that are relevant here. They include:

> *Draft action 25. Review and update State Planning Policy (SPP) 1/03—Mitigating the Adverse Impacts of Flood, Bushfire and Landslide, and develop supporting guidelines*
>
> *Draft action 26. Develop guidelines for the preparation of hazard and risk maps including the projected effects of climate change on natural hazards within the scope of the revised SPP 1/03.*

4.4 Gap Analysis – Landslide

4.4.1 Overview

Placed in context, landslide hazard and the impacts of landslide in Brisbane can be considered to be relatively low by world standards. However, in several instances, houses and infrastructure have been destroyed and large roadway excavations have failed in and around Brisbane city as a result of man-made excavations and uncontrolled water flow in small, isolated geological basins of relatively young and weak sedimentary rocks. River-bank collapse has also occurred in many instances in the past, in some instances with serious consequences to property.

Notwithstanding, there are serious gaps in the way in which the City Plan addresses landslide risk in Brisbane. The most obvious is that there has never been a natural hazard management area (landslide) formally identified for Brisbane and there are is a lack of specific or substantive text or codes applied to identifying and reducing landslide hazard or risk. These gaps are discussed below firstly in terms of the planning strategy outcomes, and then development assessment outcomes expected from SPP1/03.

In summary the gaps are identified below:

- Most of the recorded landslides in Brisbane have occurred on flat-lying riverbanks or undulating 'Tertiary" sediments. This is a key aspect of the future codes which will need to be addressed?
- None of the BCC plans or provisions or codes acknowledge that the recorded landslide events having the most impact on houses and buildings in Brisbane have been on slopes less than 20% and often less than 15% (even if the SPP had been acknowledged). In this regard the Mt Coot-tha local plan is certainly limited in application.
- While there is some acknowledgement of the need to limit cut and fill activities, there is no concept development of a limiting slope for a given lithology. Such would help guide the maximum slopes of artificial cuts.
- The codes need to recognise the inescapable link between landslides and groundwater, and not just the tenuous link between landslides and steep slopes.

It appears that the background report on landslides by [redacted] and [redacted] needs to be integrated into the background knowledge base for the review of the City Plan to shape the requirements of the City Plan code required by the SPP.

4.4.2 Outcomes 1 to 3: Development Assessment

Outcome 1

The current City Plan does not contain the required mapping or codes at the current time to adequately assess landslip, which will need to be addressed in the new City Plan. Consequently it is unlikely that the City Plan, and current development assessment processes meet Outcome 1 of the SPP 1/03.

As a consequence of having no formal NHMA (landslide) in place, and no substantive provisions in the City plan and codes, any development that is compatible with the nature of the landslide hazard results only from the initiatives of the developer or awareness of a Council officer, and is not guided in a consistent manner by local government planning scheme provisions.

Attempts have been made in the Mt Coot-tha Local Plan to make reference to slope constraint areas, namely:

Low: 0% (0 degrees) to 20% (11.3 degrees)
Medium: 20% (11.3 degrees) to 33% (16.7 degrees)
High: greater than 33% (16.7 degrees)

These slope constraint thresholds neither fit with the SPP requirements based on 15% slope, nor make sense in relation to practical observations and natural slope thresholds set as a consequence by [redacted].

Outcome 2

It is considered that the City Plan fails to meet SPP Outcome 2 in that certain development, while it may not compatible with the nature of the landslide hazard but is otherwise consistent with Outcome 1, may not necessarily be required to ensure adverse impacts from natural hazards are minimised. Again, it is difficult to determine if Council's development assessment processes are assessing these aspects of landslip required by Outcome 2 of the SPP. Nor does the current City Plan necessarily ensure that the development results in unacceptable risk to people and property.

The City Plan does not contain the required mapping or codes to adequately assess landslip; consequently it becomes the discretion of the Council officers in assessing the perceived risk from landslip as to whether that aspect is investigated in a development assessment. Ordinarily steeper slopes require supporting information through an information request to address landslip. However, as Section 3 describes, the landslip is not just a product of steepness of slope, and a broader understanding and supporting map of landslip risk is needed to assist officers in identifying potential risk.

There are no substantive requirements contained within the City Plan to ensure that development results in minimal adverse impacts from natural hazards, and does not result in unacceptable risk to people and property, even though that development proposal might be a development commitment or that there is overriding need for the development in the public interest.

Outcome 3

The City Plan fails to meet SPP Outcome 3 in that there is no substantive provision made to constrain the location and design for the development of community infrastructure with regard to landslide hazard.

While it is possible to point to situations whereby hospitals, for example, might not be able to function effectively as a result of a major landslide event, smaller community infrastructure in the form of ferry landings or river-side walkways might prove to be more susceptible in the event of major river-bank collapse scenarios. This type of infrastructure, however, might well fall into the category described by the SPP where its location would be deemed necessary when weighed against its need to serve the community effectively under normal circumstances.

However, this study is unable to conclusively determine whether this aspect is being complied with in current Council development assessment process.

4.4.3 Outcomes 4 to 6: Making and Amending a Planning Scheme

Outcome 4

The new City Plan will be required to meet SPP Outcome 4 by including a natural hazard management area (NHMA) for landslide.

Mapping suitable for incorporation into the creation of an NHMA for landslide (given the provisos suggested below) has been carried out by [redacted] on behalf the Brisbane City Council.

The most important specific issue for the City Plan is the critical landslide hazard posed in small, isolated Palaeogene (previously Tertiary) sedimentary basins containing relatively young and only weakly lithified sediments. It is in these areas where the majority of landslide damage has historically occurred in Brisbane, and where it can be expected to occur in the future. Collapse of river-bank alluvium and colluvium is the other major cause of damage.

The mapping [redacted] adopts a consistent methodology that is founded in the concept expressed in the SPP that steeper slopes attract higher landslide hazard. The SPP sets a threshold slope of 15% (8.5 degrees), above which slopes on all rock types are conditionally considered as potentially unstable. [redacted] on the other hand, have adopted a modified and improved scheme whereby the stability of each of the mapped major rock/engineering soil types in Brisbane is considered separately. As a result, the area of mapped landslide hazard depends on a combination of both the rock type occurrence and the slope threshold assumed stable for that specific rock type. These proposed thresholds vary from as low as 7 degrees to over 25 degrees in the various rock types present within Brisbane city boundaries. The method employed by Granger & Leiba has been shown to function well and provide good estimates of landslide hazard in mapping for other local authorities around Brisbane.

Unfortunately, as it stands, the mapping scheme currently employed for Brisbane appears to give undue and distracting attention to steep slopes on Neranleigh Fernvale and Bunya Phyllite rock types, whereas in practice, only comparatively small wedge failures and rockfalls are expected from over-steepened slopes. Conversely, the mapping by itself does not identify the much more significant areas of landslide hazard in some of the Palaeogene basins, despite the low threshold set for this rock type. This aspect is adequately addressed in the text [redacted] The anomaly arises because natural slopes in the Palaeogene basins are generally less than those considered critical

for failure. Landslide hazard generally arises only where man-made excavations over-steepen slopes beyond the threshold value.

This aspect highlights the need for the City Plan to address not only natural slopes or pre-existing slopes, but also excavated and particularly temporary slopes in specific rock or soil types in its considerations. Currently there is no clear signal provided to developers that Palaeogene (Tertiary) sediments form potential areas for the most serious landslide failures in Brisbane.

There is renewed urgency with the increasing and large-scale development and road works taking place in the southwest of Brisbane where more Palaeogene basins are being encountered. Recent examples are available (just outside Brisbane city boundaries) where State Government authorities and related consultant input may have failed to fully recognise the risk posed by these Palaeogene basins, with the subsequent collapse of hundreds of metres of road cuts where threshold slopes had been far exceeded and inadequate support provided.

Outcome 5

The new City Plan needs to meet SPP Outcome 5 by including strategies and codes in the planning scheme that ensure development in the NHMA is compatible with the nature of the landslide hazard.

Even in the absence of an NHMA (landslide), there should be strategies contained within the City Plan that meet the intention of the SPP.

Importantly, the supporting code(s) for landslip assessment could be addressed by the application including an assessment of geotechnical conditions, and consequently the incorporation of any recommendations, by a registered engineer. This may be possible through a self assessable assessment or through a compliance or similar assessment, to adequately manage application numbers within Council.

Outcome 6

The new City Plan will need to incorporate codes in the planning scheme designed to assess and address natural hazard risks from landslip.

5. RECOMMENDED STRATEGY

5.1 Summary

5.1.1 Summary

The purpose of the report is to provide Council with a clear understanding as to whether it currently meets its obligations under SPP 1/03. This report assesses Council's City Plan and the most appropriate policy and regulatory tools to respond to the SPP 1/03.

The previous sections of the report include analysis and gaps where:

- Current development assessment practice is recommended to address the SPP 1/03; and
- Where the preparation of the new City Plan is needed to address the requirements of SPP 1/03.

This section summarises recommendations in relation to the City Plan addressing the requirements of SPP 1/03.

5.1.2 Development Assessment under the Current City Plan

A number of recommendations have emerged from the gap analysis which identifies assessment processes that are required against the SPP 1/03. These areas include:

- A broader consideration of bushfire management where the mapping covers areas outside the Environmental Protection Area and Rural Area. The maps could be used in the assessment of applications as a way of requiring a Bushfire Management Report or similar reporting;
- A broader consideration of landslip in the assessment of current applications. The consideration of landslip in other than steep land is an important aspect of assessment. The mapping could be used as an interim arrangement for the applicant to ensure that a geotechnical report is completed to address soil type, water management and / or landslide risks.

It may be that Council chooses to raise awareness of these issues through the availability of mapping, so that land owners can consider the information and recommendations about new development in those areas. This has been achieved through Council's floodwise program where mapping of overland flow, and flood searches have raised awareness of these hazards and how to be better prepared to address them. If this approach is pursued then updating and ground truthing of the bushfire and landslide maps is recommended.

Where development is currently not assessable under the City Plan, these assessments cannot occur and the processes under the Building Act (including the use of structural engineers for footings, bushfire risk area) will need to be relied on in the interim period.

5.1.3 New City Plan

The main strategy for the preparation of the new City Plan that is derived from the assessment in this report that includes:

- Ensuring that a strategic planning level the issues of community safety, including the protection of life and property, are key considerations in the assessment of development;
- Including the natural hazard management areas mapping for all three different hazards in the City Plan;

- Including relevant codes to assess the risks and impacts arising from proposed development in the natural hazard management areas to understand their compatibility (or otherwise), and whether further information or conditions will address the requirements of the risk management framework of the new codes;

- Including relevant level of assessment for assessing development in natural hazard areas. This may include self assessable or compliance assessment when the hazard assessment can be provided by external (other than a code or impact assessment application) means to meet requirements. The level of assessment will depend on the assessment of risk and how the risk will be assessed when applications are made.

Determining the mapping for the natural hazard management areas in the new planning scheme will be a critical part of the process. Considerable work has been completed on all three natural hazards and this mapping will need to be incorporated into the new City Plan. The natural hazard management area maps, with the accompanying provisions, will provide a clear basis for the assessment of development in these areas.

Houses are the most common form of development in Brisbane City. Houses, when they meet the acceptable solutions of the House Code, or the Residential Design – Small Lot Code, are self assessable. Wherever possible, self assessable or compliance assessment processes should be relied on for houses so as not to increase the number of code or impact assessment applications being lodged and assessed by Council.

However, there will be some circumstances where a new application will be required for a House in a natural hazard management area. The new code(s) should carefully evaluate what assessment is required, and whether this can be achieved by qualified professionals using the Risksmart process.

Further, the requirements for bushfire protection in the built form may conflict with ecological outcomes. These aspects will need to be resolved at a policy level, and in the provisions, to provide clarity for applicants and Council's assessment teams in the future. For example, clearer direction is needed in bushfire prone areas where mature trees (such as Eucalypts) are required to be protected where they are located immediately adjacent to new development.

5.2 Flooding

Recommendations and Strategy

The recommendations and strategy for addressing flood risk in the new City Plan includes:

- Include stronger strategic level guidance within Council's new strategic plan for protection of people and property from flood risk;

- Include a complete Natural Hazard Management Area map for the DFE for the city. In addition clarify the DFE for the Natural Hazard Management Areas;

- Prepare associated codes and policies to support management of flood risk assessment.

- Incorporate risk assessment and floor level standards into the codes (rather than associated policies);

- Consider incorporating a risk assessment for development proposals that considers flood hazard (flood depth and water velocity). This could be an inclusion in the relevant natural hazard management – flood code. This is recommended as an appropriate response to SPP 1/03 and in line with best practice (SCARM);

- The adopted Defined Flood Event should be clearly identified and the definition and role of Flood Regulation Lines should be clarified.

- Where detailed flood data is available review Area/ Zones and compatible land use in areas of high risk – ie. Areas of high depth and high velocity. This will depend on whether this information is available from the flood data in Council, and whether this can be assessed against the City Plan requirements for infill development. This will need considerable investigation and possibly resolution at a policy level to determine any actions that are required.

- The extent of exempt development (and consequently the extent of filling) within the natural hazard flood areas may require review to test compatibility with the natural hazard;

- Other Design Codes may need to be amended to state more clearly the requirements for habitable and non habitable floor levels.

In relation to the SPP 1/03, and the State Government's preparation of any revisions of the SPP 1/03, it would also be highly desirable to bring the storm tide aspects of the Coastal Management Plan under a revised SPP 1/03 rather than it being in a separate policy document. That would greatly improve the likelihood that it will not be overlooked. It will also make it a lot easier to standardise the approach to all forms of inundation hazard.

5.3 Bushfire

Recommendations and Strategy

- Adopt a Natural Hazard Risk Management (Bushfire) mapped area to regulate bushfire prone land in the City Plan;

- Include stronger strategic level guidance within Council's new strategic plan for protection of people and property from bushfire risk;

- Adopt a related Natural Hazard Risk Management (Bushfire) Code to assess bushfire risk across land (not limited to Conservation, Environmental Protection and Rural Area land);

- Amend related codes such as the Subdivision Code and Structure Planning Code to address bushfire management mitigation strategies;

- Amend the House code to assess new houses (and possibly some major extensions) on land included within the Natural Hazard Risk Management (bushfire) mapped area. This may include self assessable or compliance solutions to reduce Council

assessment procedures. (This may occur under the natural hazard management areas of the new planning scheme separate to the House Code).

5.4 Landslide

Recommendations and Strategy

- A natural hazard management area (landslide) must be developed for Brisbane. Council has already commissioned a study that considers both slope and rock type together and provides a firm basis for an NHMA.

- More awareness is required of the major landslide potential posed by Palaeogene sedimentary basins.

- Landslide hazard and risk need to be considered for artificial excavations as well as natural slopes.

- More awareness is required of the critical role of groundwater in landslides.

- The new City Plan should:

    a. incorporate the latest in landslide literature and research;
    b. adopt a strategic approach to management of landslide hazard and risk;
    c. ensure that adopted codes and planning schemes serve to meet the planning outcomes of SPP1/03.

- In this regard, the new City Plan should ensure that:

    a. proposed development in all areas of Brisbane is in line with the actual nature of the landside hazard;
    b. fast-tracked development does not result in increased risk from landslide;
    c. careful consideration is given to the benefits and risks of developing community infrastructure in areas of potentially high landslide hazard such as river banks.

- Special provisions be incorporated in the new City Plan to ensure, even in the case of development commitments or where an overriding need for development in the public interest short-circuits normal processes in the SPP, that adverse impacts from development are minimised and that the development does not result in unacceptable risk to people and property.

- The new City Plan should weigh carefully the benefits and risks of constraining the location and design of community infrastructure development, especially in relation to riverside developments where the likelihood of river-bank collapse is high.

- The landslide hazard mapping scheme [redacted] which combines slope and rock type be adopted as the initial basis for a Natural Hazard Management Area (landslide) for Brisbane;

- The Palaeogene sedimentary basins that give rise to the highest hazard are identified and highlighted as areas of higher risk in the face of development so that developers are formally made aware of the degree and extent and history of landslide hazard, while at the same time;

- The accompanying Natural Hazard Risk Management (Landslip) Code is recommended to contain firm accompanying guidelines (in the code or supporting policy) and are recommended to be produced and promoted for reducing the likelihood of slope failure in artificial excavations (in addition to natural slopes) in all rock types, but particularly in Palaeogene basin sediments;

- The role played by groundwater and uncontrolled surface water in the promotion of landslide hazard, particularly in Palaeogene basin sediments, is defined and made clear to developers/ builders;

- Reference in the SPP to *Landslide Risk Management Concepts and Guidelines* prepared by the Australian Geomechanics Society should be updated to include the latest 2007 publication on *Landslide Risk Assessment and Management.*

5.5 Emerging Issues and Recommendations

5.5.1 Climate Change

The State Government have released a number of strategies to address climate change including:

- 'Climate Q: towards a greener Queensland' which includes broad strategies to reduce greenhouse gases and increases resilience against climate change impacts;

- ClimateSmart 2050, which include a series of short, medium and long term actions to reduce Queensland's greenhouse gas emissions; and

- ClimateSmart Adaption 2007 – 2012, which contains 62 actions in response to climate change.

The SEQ Regional Plan contains policies and strategies which set the high level policy framework for responding to climate change impacts. The draft SEQ Climate Change Management Plan provides an action plan to further the actions in the SEQ Regional Plan, which may impact on the management of natural hazards into the future.

In addition, the Draft Coastal Management Plan 2009, prepared under the Coastal Management and Protection Act 1995, sets out requirements for development including for development 'not already subject to a development commitment' a sea level rise of 0.8m 'will need to be taken into account.

Accordingly, although beyond the scope of this study, these climate change strategies and actions will need careful consideration in the new City Plan, and in the risk management of natural hazards in the assessment of new development under the new City Plan.

5.5.2 Earthquake and High Wind

Earthquake and high wind are not required to be considered in the planning scheme in response to the SPP 1/03, and are not a requirement of this study. However the following observations about earthquake and high wind are noted:

The study team considered that high winds and earthquake risk are able to be mapped. SPP 1/03 contains the following paragraph:

4.3 As the hazards associated with strong winds and earthquakes are not amenable to clear spatial definition, they are difficult to address through land use planning mechanisms. Design and construction standards are the most appropriate mechanisms for mitigating risk from earthquakes and strong winds. The Standard Building Regulation specifies construction standards for buildings and most non-building structures. Therefore, strong winds and earthquakes are not addressed by this SPP.

There is already mapping of earthquake hazard potential [redacted]. This follows the approach contained in AS 1170.4 *Minimum design loads on structures Part 4: Earthquake loads AS 1170.4-1993* and 2001 draft DR 00902 *Structural design - General requirements and design actions Part 4: Earthquake actions.* Similar mapping of Launceston developed by AGSO in 1996 is 'unofficially' used by planners in Launceston City Council to direct developers and engineers to the appropriate design requirements for earthquake within the city.

Similarly, the wind loading standard AS 1170.2 is also expressed in spatial terms, such as distance from the coast, open land, slopes etc. Planning SA has produced a wind loading map for the Adelaide area that is based on that standard. The SA map also shows a line that marks the boundary of the corrosion zone established under Table 3.3.3.1 of the Building Code of Australia (i.e. the Standard Building regulations).

Although beyond the scope of this study, these aspects are recommended to be reviewed in the future to understand the risks and potential management of the risks. Alternatively, if these aspects are best managed at a building construction level under the Building Act, then it is recommended that a response from the State Government be sought as to how this is best addressed under Queensland building laws.

6. CONCLUSION

This report has been prepared for Brisbane City Council by John Gaskell Planning Consultants, Environmental & Community Risk International, [redacted] and WRM Water and Environment.

This report reviews Brisbane City Council's planning scheme to determine how well it addresses Natural Disaster Risk Management requirements of the State Planning Policy 1/03 - Mitigating the Adverse Impacts of Flood, Bushfire and Landslide (SPP 1/03). The report identifies a series of actions that are recommended to be addressed to respond to SPP 1/03. The main recommendations support the improved strategic planning (policy) context for community safety, incorporation of mapping for natural hazard management areas, and preparing relevant provisions that support the assessment of natural hazard risk.

7. REFERENCES

CSIRO/SA, 1993: *SAA HB 36: Building in bushfire-prone areas – information and advice*, Commonwealth Scientific and Industrial Research Organisation, Canberra and Standards Australia, Homebush.

CSIRO/SA SCARM (2000), *Floodplain Management in Australia: Best Practice Principles and Guidelines,* Standing Committee on Agriculture and Resource Management (SCARM), Report 73,CSIRO Publishing

DHLGP/QFRS, 1994: *Bushfire prone areas- siting and design of residential buildings*, Department of Housing, Local Government and Planning and Queensland Fire and Rescue Service, Brisbane.

DIP, 2009: *South East Queensland climate change management plan: draft for public consultation*, Department of Infrastructure and Planning, Brisbane.

DIP, 2009: *South East Queensland Regional Plan 2009 – 2031* Department of Infrastructure and Planning, Brisbane.

FABC, 2002: *Individual property fire management planning kit*, Southeast Queensland Fire and Biodiversity Consortium, Brisbane.

FABC, 2005: *Bushfire safety for your home and garden*, pamphlet, Southeast Queensland Fire and Biodiversity Consortium, Brisbane

[redacted]2003: *Landscape and building design for bushfire areas*, CSIRO Publishing, Collingwood.

QFRA, 1998: *Bushfire hazard planning in Queensland*, Queensland Fire and Rescue Authority, Brisbane.

SA, 2009: *Australian Standard AS3959-2009: Building in bushfire prone areas*, Standards Australia, Homebush.

[redacted]2002: *Best practice fire management manual operational level guidelines and procedures*, Southeast Queensland Fire and Biodiversity Consortium, Brisbane.

Victoria, 2009: *2009 Victorian bushfires Royal Commission interim report*, Parliament of Victoria, Melbourne.

MJR-4

State Planning Policy

Mitigating the Adverse Impacts of Flood, Bushfire and Landslide

Queensland Government
Department of Local Government and Planning
Department of Emergency Services

BCC.100.5893

STATE PLANNING POLICY 1/03

Mitigating the Adverse Impacts of Flood, Bushfire and Landslide

BCC.100.5894

Integrated Planning Act 1997

STATE PLANNING POLICY 1/03
Mitigating the Adverse Impacts of Flood, Bushfire and Landslide

The Minister for Local Government and Planning adopted State Planning Policy 1/03 on 19 May 2003.

Making of the State Planning Policy

State Planning Policy 1/03 was made under Schedule 4 of the *Integrated Planning Act 1997.*

Commencement

State Planning Policy 1/03 **took effect on 1 September 2003.**

POSITION STATEMENT

The Queensland Government considers that development should minimise the potential adverse impacts of flood, bushfire and landslide on people, property, economic activity and the environment.

1. PURPOSE OF THE POLICY

1.1 This State Planning Policy ('the SPP') sets out the State's interest in ensuring that the natural hazards of flood, bushfire, and landslide[1] are adequately considered when making decisions about development.

2. APPLICATION OF THE POLICY

2.1 Under the *Integrated Planning Act 1997* (IPA), the SPP has effect when development applications are assessed, when planning schemes are made or amended and when land is designated for community infrastructure.[2]

Development to which the Policy applies

2.2 The SPP applies to development involving the:

- actions or activities described in paragraph A1.1 of Annex 1; and
- community infrastructure described in paragraph A1.2 of Annex 1.

2.3 In addition, the SPP addresses development that has the potential to increase the extent or severity of natural hazards, but this aspect of the SPP applies only when planning schemes are being made or amended.

Areas to which the Policy applies

2.4 The SPP generally applies throughout Queensland. However, the application of the SPP for bushfire and landslide is limited to the local governments listed in Annex 2.

3. USING THE POLICY

3.1 The main outcome statements are depicted in bold type (Outcome 1 to Outcome 6) and must be read in conjunction with the rest of the text.

3.2 This SPP addresses only development issues associated with minimising the potential adverse impacts of flood, bushfire and landslide. To achieve some of the SPP outcomes, development proposals may include works (e.g. filling, firebreaks or retaining structures) that would have unacceptable impacts on the natural environment, heritage or amenity values. Achieving the outcomes of this SPP is not an automatic justification for a development proposal being inconsistent with policies on amenity, conservation or other matters.

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1 See Section 9, Glossary.

2 The SPP 1/03 Guideline: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* describes in more detail how the SPP applies.

3.3 When a planning scheme appropriately reflects the SPP[3], the planning scheme is to be regarded as the local interpretation and expression of the SPP for development assessment purposes.

3.4 Technical terms are described in Section 9, Glossary.

3.5 The SPP 1/03 Guideline: *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* ('the SPP Guideline'), as amended from time to time, provides advice about how to implement the SPP, and is declared to be 'extrinsic material' under the *Statutory Instruments Act 1992*.[4]

4. THE NEED TO MITIGATE THE ADVERSE IMPACTS OF NATURAL HAZARDS

4.1 A natural hazard is a naturally occurring situation or condition with the potential for loss or harm to the community or environment. Natural hazards do not have to become natural disasters. Effective land use planning is an important means of reducing the community's vulnerability to natural hazards and promoting resilient communities.

4.2 In Queensland the main natural hazard threats are cyclones/severe storms, floods, storm tide inundation, bushfires, landslide and earthquake. The risks and consequences from these hazards vary around the State depending on the location, the physical characteristics of land and the type of development. Cyclones are particularly potent natural hazards as the consequences of a cyclone can include a combination of flood, storm tide inundation, strong winds and landslide. For the purposes of this SPP, the consequences of cyclones are regarded as separate hazards.

4.3 As the hazards associated with strong winds and earthquakes are not amenable to clear spatial definition, they are difficult to address through land use planning mechanisms. Design and construction standards are the most appropriate mechanisms for mitigating risk from earthquakes and strong winds. The *Standard Building Regulation* specifies construction standards for buildings and most non-building structures. Therefore, strong winds and earthquakes are not addressed by this SPP.

4.4 Storm tide inundation hazard is addressed under the *State Coastal Management Plan – Queensland's Coastal Policy 2001* (State Coastal Plan), and is therefore excluded from this SPP except to the extent that cumulative impacts (e.g. flooding can be exacerbated under storm tide conditions) may need to be considered in determining the extent and severity of hazard under this SPP.

4.5 Natural disasters are a significant and rising cost to the community. They are estimated to have cost Queensland an average of $239 million per year (in 1999 prices) in direct and indirect tangible costs between 1967 and 1999.[5] In addition, there are significant intangible costs associated with loss of life, injury, human suffering, loss of productivity and environmental degradation.

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3 The Minister formally identifies in the planning scheme those SPPs that have been appropriately reflected.

4 Refer to the SPP Guideline for an explanation of 'extrinsic material'.

5 Bureau of Transport Economics Report 103, Economic Costs of Natural Disasters in Australia, Commonwealth of Australia 2001.

4.6 The *Queensland Greenhouse Policy Framework*[6] acknowledges the growing scientific consensus that the enhanced greenhouse effect is changing the world's climate, and that Queensland will be vulnerable to the effects of climate change. Predicted changes include reductions in annual rainfall but increases in rainfall intensity, sea level and coastal erosion, bushfire risk, flood risk and damage to transport infrastructure and low-lying human settlements. The nature of these changes will vary across Queensland. These changes will have significant impacts on the nature and extent of natural hazards and, consistent with the precautionary principle[7], should be considered when undertaking natural hazard assessments or developing natural hazard mitigation strategies. The State Coastal Plan provides general direction for addressing potential impacts of climate change in the coastal zone.

4.7 Inappropriate development in areas susceptible to natural hazards significantly increases the risks (and associated costs) to the community. This SPP aims to minimise these risks by ensuring that the potential adverse impacts of natural hazards are adequately considered when development applications are assessed, when planning schemes are made or amended and when land is designated for community infrastructure.

5. THE POLICY APPROACH

5.1 The SPP requires the identification of *natural hazard management areas*[8] within which minimising risks to the community should be a key consideration in development assessment and the preparation of planning schemes. Until natural hazard management areas are identified in planning schemes, the natural hazard management areas outlined in Annex 3 should be used for development assessment.

5.2 In relation to certain important types of community infrastructure[9], the SPP aims to ensure that they are able to maintain operation during and immediately after major natural hazard events wherever practicable. The SPP applies to these types of community infrastructure anywhere in Queensland[10], not only within natural hazard management areas.

6. DEVELOPMENT OUTCOMES AND DEVELOPMENT ASSESSMENT

6.1 When development applications are assessed against this SPP or land is designated for community infrastructure, regard must be had to Outcomes 1 to 3 and the remainder of Section 6. However, this SPP is not to be used when assessing development applications for building work assessable only against the *Standard Building Regulation.*

6.2 The assessment manager needs certain information when assessing development applications for consistency with Outcomes 1 to 3. If not provided with a development application, such information should be the subject of an information request under the Integrated Development Assessment System (IDAS).[11]

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6 Queensland Greenhouse Policy Framework: A Climate of Change, State of Queensland, September 2001.
7 The precautionary principle is defined in s1.2.3(2) of the *Integrated Planning Act 1997.*
8 See Section 9, Glossary.
9 See paragraph A1.2, Annex 1.
10 Except, in relation to bushfire and landslide, those local government areas not included in Annex 2.
11 See Section 9, Glossary.

Development in natural hazard management areas

6.3 When assessing development applications for the development listed in paragraph A1.1 of Annex 1, regard must be had to Outcomes 1 and 2.

Outcome 1:	**Within natural hazard management areas, development to which this SPP applies is compatible with the nature of the natural hazard[12], except where:** • **the development proposal is a development commitment[13]; or** • **there is an overriding need for the development in the public interest and no other site is suitable and reasonably available for the proposal.**

Identifying natural hazard management areas and severity of hazard

6.4 Annex 3 describes the natural hazard management areas for flood, bushfire and landslide that apply to this outcome. Information on the location of natural hazard management areas and, in some instances, the severity[14] of hazard within those areas may be obtained from State or local government. Information on the severity of natural hazards will not always be available, but where it is available it should be provided with the development application. The SPP Guideline provides further information on how to identify natural hazard management areas and the severity of hazard.

6.5 In the case of landslide hazard for which the natural hazard management area may be based on a slope calculation[15], the slope of the development site may need to be determined when preparing a development application.

6.6 The natural hazard management area for flood hazard is dependent on a local government adopting a flood event for the management of development in a particular locality[16] and identifying the affected area in the planning scheme. Until this occurs the SPP does not take effect for development assessment in relation to flood hazard in that locality.

6.7 When assessing applications for development, the assessment manager will need to confirm whether the proposed development is located within a natural hazard management area. The assessment manager will also need to confirm the severity of hazard where such information is available.

Determining development compatibility

6.8 In natural hazard management areas, development that achieves the relevant specific outcomes set out in Annex 4 is compatible with the nature of the natural hazard. Development applications should demonstrate such achievement.

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12 See Section 9, Glossary for a definition of 'nature of the natural hazard'.

13 See Section 9, Glossary.

14 Areas are often classified according to the estimated severity of a particular hazard in that location (e.g. High, Medium, Low severity). Classification in this fashion is not always necessary or appropriate. However, where such information is available it should be used to assist development assessment.

15 Refer to Annex 3.

16 This is referred to as the Defined Flood Event, see Section 9, Glossary.

Development commitments

6.9 A development proposal that is consistent with Outcome 1 because of a development commitment should also achieve Outcome 2.

Overriding need

6.10 In some cases, it may be possible to demonstrate that a proposed development that is incompatible with the nature of the natural hazard would meet a particular public need to an extent that would override some aspects of the risk associated with the natural hazard.

6.11 Determining an overriding need in the public interest will depend on the circumstances of the particular development proposal. The proposal should result in a significant overall benefit to the whole or a significant part of the community in social, economic or environmental terms that outweighs the adverse impacts arising from the development's exposure to natural hazards. Also, the development application should demonstrate that a similar benefit could not be achieved by developing other suitable and reasonably available sites. Increased risk to people is a significant consideration when determining overriding need.[17]

6.12 A development proposal that is consistent with Outcome 1 because of an overriding public need should also achieve Outcome 2.

Outcome 2:	**Development that is not compatible with the nature of the natural hazard but is otherwise consistent with Outcome 1:** • **minimises as far as practicable the adverse impacts from natural hazards; and** • **does not result in an unacceptable risk[18] to people or property.**

6.13 Development achieves Outcome 2 when it is brought as near as practicable to the level required to comply with the specific outcomes in Annex 4, and the development would not result in an unacceptable risk to people or property. Assessment of the latter requirement will require consideration of the on-site and external impacts of the proposed development. Annex 5 specifies the minimum measures required to avoid an unacceptable risk.[19]

Community infrastructure anywhere in Queensland

6.14 When assessing development applications or designating land for community infrastructure described in paragraph A1.2 of Annex 1, regard must be had to Outcome 3. Community infrastructure development that involves any of the actions or activities in paragraph A1.1 of Annex 1 and is located in a natural hazard management area should also achieve Outcomes 1 and 2.

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17 The SPP Guideline provides advice about interpreting 'overriding need'.

18 See Section 9, Glossary.

19 The SPP Guideline provides advice on achieving Outcome 2.

Outcome 3: Wherever practicable, community infrastructure to which this SPP applies is located and designed to function effectively during and immediately after natural hazard events commensurate with a specified level of risk.

6.15 Wherever practicable, community infrastructure should be capable of performing its role in maintaining the health, safety and wellbeing of the community in the event of a natural disaster. However, locating and designing community infrastructure to withstand any natural hazard event, no matter how severe, would be unrealistic. Accordingly, the SPP Guideline sets out appropriate levels of risk for differing types of community infrastructure and provides advice on assessing community infrastructure proposals against Outcome 3. Locating and designing community infrastructure to withstand these specified levels of risk also needs to be weighed against the need for that infrastructure to serve the community effectively in normal circumstances when there is no natural hazard event.

6.16 Where designing the community infrastructure to function effectively at the specified level of risk in Outcome 3 is not practicable, the development should be designed to function at the highest level of risk that is practicable.[20]

7. MAKING AND AMENDING A PLANNING SCHEME

7.1 Planning schemes should aim to achieve Outcomes 1 to 3 by identifying natural hazard management areas and containing appropriate planning strategies and development assessment measures.

Identifying natural hazard management areas

Outcome 4: Natural hazard management areas are identified in the planning scheme.

7.2 Clearly identifying areas potentially affected by flood, bushfire and landslide is necessary to assist in formulating planning strategies and detailed planning measures that minimise risks to people, property, economic activity and the environment. The SPP Guideline provides advice on how to identify natural hazard management areas and severity of hazard (where appropriate). The SPP Guideline also provides advice on including the impacts of climate change when identifying a natural hazard management area.

[20] The SPP Guideline provides advice about deciding appropriate levels of risk in this circumstance.

Reflecting the SPP in planning strategies

Outcome 5: **The planning scheme contains planning strategies that aim to:**

- **ensure that development in natural hazard management areas is compatible with the nature of the natural hazard;**
- **minimise the impacts from natural hazards on existing developed areas; and**
- **prevent development from materially increasing the extent or the severity of natural hazards.**

7.3 Allocated land uses and associated development within natural hazard management areas should be consistent with Outcomes 1 to 3.

7.4 The planning scheme should include strategies aimed at minimising the impacts of natural hazards on areas of existing development. In particular, new development in existing developed areas should provide the optimum level of protection from natural hazards that is achievable under the circumstances of the particular locality. The SPP Guideline contains advice on how this can be achieved.

7.5 The planning scheme should also include strategies that prevent material increases in the extent or the severity of natural hazards. In relation to flooding, the planning scheme should aim to maintain the flood carrying capacity of rivers, streams and floodways, and the flood storage function of floodplains and waterways. For bushfire hazard, the planning scheme should include strategies that would prevent development (such as plantation forestry) from increasing bushfire risk for existing and planned communities and facilities. The SPP Guideline contains advice on devising these strategies.

Reflecting the SPP in detailed planning scheme measures

Outcome 6: **The planning scheme measures:**

a) **include a code(s) designed to achieve development outcomes consistent with Section 6; and**
b) **ensure that development to which this SPP applies is assessable or self-assessable against that planning scheme code(s).**

The planning scheme, or planning scheme policy(s), specifies the information expected to be submitted with development applications subject to the code(s).

7.6 The combination of development assessment tables, code(s) and other assessment measures in the planning scheme needs to ensure that all relevant development is assessed against specific development standards that are consistent with Section 6. The SPP Guideline provides further advice on how this can be achieved.

7.7 Section 6 and the SPP Guideline describe the information that should be submitted with development applications. The planning scheme or supporting planning scheme policy(s) should make it clear that where such information is not provided with a development application, that information will be subject to an information request under IDAS.

8. INFORMATION AND ADVICE ON THE POLICY

8.1 Queensland Department of Emergency Services (DES) can provide information and advice on interpreting and implementing the SPP, the relevant contacts in appropriate agencies for specific natural hazard mitigation issues, planning for and managing disaster risks, sources of financial assistance for undertaking disaster risk management studies, hazard studies, developing disaster mitigation plans and the interpretation and use of the Bushfire Risk Analysis maps.

8.2 Queensland Department of Local Government and Planning (DLGP) can provide advice about reflecting the SPP in planning schemes and the operation of IDAS.

8.3 Queensland Department of Natural Resources and Mines (NR&M) can provide advice on landslide and floodplain management issues and the latest climate change science advances.

8.4 Queensland Environmental Protection Agency (EPA) can provide advice and information on storm tide and climate change issues.

9. GLOSSARY

9.1 The following terms are used in the SPP as defined below.

Annual exceedance probability (AEP): the likelihood of occurrence of a flood of a given size or larger in any one year; usually expressed as a percentage. For example, if a peak flood discharge of 500 cubic metres per second has an AEP of 5%, it means that there is a 5% risk (i.e. probability of 0.05 or a likelihood of 1 in 20) of a peak flood discharge of 500 metre^3/second or larger occurring in any one year. The AEP of a flood event gives no indication of when a flood of that size will occur next.

Bushfire: an uncontrolled fire burning in forest, scrub or grassland vegetation, also referred to as wildfire.

Climate change: a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

Defined flood event (DFE): the flood event adopted by a local government for the management of development in a particular locality. The DFE is generally not the full extent of flood-prone land.

Development commitment: includes any of the following[21]:

- development with a valid preliminary approval;
- a material change of use that is code assessable or otherwise consistent with the requirements of the relevant planning scheme;
- a reconfiguration of a lot and/or work that is consistent with the requirements (including any applicable codes) of the relevant planning scheme; or
- development consistent with a designation for community infrastructure.

[21] Note that a designation in a forward planning document such as a strategic plan or development control plan under a transitional planning scheme is not a development commitment for the purposes of this SPP. Also the SPP does not apply to development assessable only against the *Standard Building Regulation*.

Flood: the temporary inundation of land by expanses of water that overtop the natural or artificial banks of a watercourse i.e. a stream, creek, river, estuary, lake or dam.

Floodplain: an area of land adjacent to a creek, river, estuary, lake, dam or artificial channel, which is subject to inundation by the Probable Maximum Flood (PMF).

Floodway[22]: those areas of the floodplain where a significant discharge of water occurs during the DFE. Floodways are often aligned with naturally defined channels and even if partially blocked would cause a significant redistribution of flood flow, or a significant increase in flood levels. What constitutes a floodway may vary from one floodplain or part of a floodplain to another. Floodways will normally be identified as part of a floodplain management study or flood study where their importance in the overall behaviour of flood flows can be properly taken into account. Where a study to determine floodways using local criteria has not been undertaken, a floodway (for the purposes of this SPP) shall be an area where, at the DFE, the floodwater has:

- a velocity–depth product of 0.3 square metres per second or greater; **or**
- a velocity of 1 metre per second or greater.

Hazardous materials in bulk: hazardous materials as defined in the *Dangerous Goods Safety Management Act 2001* (except that radioactive substances and infectious substances[23] are excluded for the purposes of this SPP) in quantities that:

- would be equivalent to or exceed the minimum quantities set out to determine a Large Dangerous Goods Location in the *Dangerous Goods Safety Management Regulation*; or
- would require a licence for a magazine for the storage of an explosive under the *Explosives Regulation 1955*.

IDAS: Integrated Development Assessment System (IDAS) is a framework that establishes a common statutory system under the *Integrated Planning Act 1997* for making, assessing and deciding development applications, regardless of the nature of development, its location in Queensland or the authority administering the regulatory control.

Landslide: a movement of material downslope in a mass as a result of shear failure at the boundaries of the mass.

Mitigation: any measure intended to reduce the severity of a natural hazard.

Natural disaster: a natural hazard event that severely disrupts the fabric of a community and requires the intervention of the various levels of government to return the community to normality.

Natural hazard: a naturally occurring situation or condition with the potential for loss or harm to the community, property or environment. The natural hazards addressed in this SPP are flood, bushfire and landslide.

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[22] Local governments may adopt an alternative definition of floodway in their planning scheme to provide a more accurate reflection of the flood characteristics in a particular locality. Refer to Appendix 2 for additional information on floodways and their identification.

[23] Radioactive substances are appropriately managed under the *Radiation Safety Act 1999*, and facilities dealing with infectious substances are subject to Australian Standards and the Office of Gene Technology.

Natural hazard management area: an area that has been defined[24] for the management of a natural hazard (flood, bushfire or landslide), but may not reflect the full extent of the area that may be affected by the hazard (e.g. land above the 1% AEP floodline may flood during a larger flood event). Natural hazard management areas for flood, bushfire or landslide are described in Annex 3.

Nature of the natural hazard: the important characteristics of the hazard including the type of hazard and its severity.

Probable maximum flood (PMF): the largest flood that could reasonably occur at a particular location, resulting from the probable maximum precipitation. The PMF defines the extent of flood-prone land. Generally, it is not physically or financially possible to provide general protection against this event.

Risk: a concept used to describe the likelihood of harmful consequences arising from the interaction of hazards, community and the environment.

Unacceptable risk: a situation where people or property are exposed to a predictable hazard event that may result in serious injury, loss of life, failure of community infrastructure, or property damage that would make a dwelling unfit for habitation.

Vegetation clearing[25]: removing or cutting down, ringbarking, pushing over, poisoning or in any way destroying a tree, shrub or other plant (other than grass), but does **not** include:

- lopping, pruning or mowing for maintenance purposes;
- work associated with management practices for the conduct of an agricultural or forestry use[26];
- clearing vegetation for essential management including:
  - for establishing or maintaining a firebreak to protect a building, property boundary or paddock;
  - vegetation that is likely to endanger the safety of a person or property on the land because the vegetation is likely to fall;
  - for maintaining an existing fence, stock yard, shed, road or other built infrastructure; or
  - for maintaining a garden or orchard.

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[24] A natural hazard management area may be defined using a different term (e.g. bushfire prone area; flood affected area).

[25] Proposals that involve vegetation clearing may also be required to address relevant requirements of the *Vegetation Management Act 1999,* as well as local laws and the planning scheme. Information and advice on these matters should be sought from NR&M and the local government.

[26] Work associated with forestry and management practices for the conduct of an agricultural use (other than the clearing of native vegetation on freehold land) is exempt development that may not be made assessable or self-assessable under the IPA.

ANNEX 1

Development to which this Policy applies

A1.1 In natural hazard management areas this Policy applies as follows:

a) in natural hazard management areas for **flood**, **bushfire** or **landslide** to **material changes of use** and associated **reconfigurations of a lot** that:
- increase the number of people living or working in the natural hazard management area (e.g. residential development, shopping centres, tourist facilities, industrial or commercial uses) except where the premises are only occupied on a short-term or intermittent basis (e.g. by construction/maintenance workers, certain agricultural and forestry workers); or
- involve institutional uses where evacuating people may be particularly difficult (e.g. hospitals, education establishments, child care, aged care, nursing homes and high security correctional centres); or
- involve the manufacture or storage of hazardous materials in bulk[27]; or
- would involve the building or other work described in (b) and (c) below as an intrinsic element of the development proposal; and

b) in natural hazard management areas for **flood**, to **building**[28] or other **work** that involves any physical alteration to a watercourse or floodway including vegetation clearing[29], or involves net filling exceeding 50 cubic metres[30]; and

c) in natural hazard management areas for **landslide**, to **building**[28] or other **work** on potentially unstable slopes that involves:
- earthworks exceeding 50 cubic metres[30] (other than the placement of topsoil); or
- vegetation clearing[29]; or
- redirecting the existing flow of surface or groundwater.

AND

A1.2 Throughout **Queensland**[31] to the following types of **community infrastructure** that provide services vital to the wellbeing of the community:
- police and emergency services facilities including emergency shelters;
- hospitals and associated institutions;
- facilities for the storage of valuable records or items of cultural or historic significance[32];
- State-controlled roads;
- railway lines, stations and associated facilities;
- aeronautical facilities;
- communication network facilities;
- works of an electricity entity under the *Electrical Safety Act 2002*; and
- water cycle management infrastructure.

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27 See Section 9, Glossary for a definition of hazardous materials in bulk.
28 Except where the building work is accessible only against the *Standard Building Regulation*.
29 See Section 9, Glossary.
30 This is the threshold for defining earthworks of State interest to which the SPP applies. Local governments may adopt lower thresholds to reflect the particular flooding or landslide hazard characteristics of different localities.
31 Except in relation to bushfire and landslide, those local government areas not included in Annex 2.
32 Including facilities for the storage of public records under the *Public Records Act 2002*.

ANNEX 2

Areas within which the SPP applies for Bushfire and Landslide

A2.1 For **bushfire** the SPP applies in the following local government areas as they were defined on 1 September 2002.

Atherton Shire Council
Banana Shire Council
Bauhinia Shire Council
Beaudesert Shire Council
Bendemere Shire Council
Biggenden Shire Council
Boonah Shire Council
Booringa Shire Council
Bowen Shire Council
Brisbane City Council
Broadsound Shire Council
Bungil Shire Council
Burdekin Shire Council
Burnett Shire Council
Caboolture Shire Council
Cairns City Council
Calliope Shire Council
Caloundra City Council
Cambooya Shire Council
Cardwell Shire Council
Chinchilla Shire Council
Clifton Shire Council
Cook Shire Council
Cooloola Shire Council
Crows Nest Shire Council
Dalrymple Shire Council
Douglas Shire Council
Duaringa Shire Council
Eacham Shire Council
Eidsvold Shire Council
Emerald Shire Council
Esk Shire Council
Etheridge Shire Council
Fitzroy Shire Council
Flinders Shire Council
Gatton Shire Council
Gayndah Shire Council
Gladstone City Council
Gold Coast City Council
Herberton Shire Council
Hervey Bay City Council
Hinchinbrook Shire Council
Inglewood Shire Council
Ipswich City Council
Isis Shire Council
Jericho Shire Council
Johnstone Shire Council
Jondaryan Shire Council
Kilcoy Shire Council
Kilkivan Shire Council
Kingaroy Shire Council
Kolan Shire Council
Laidley Shire Council
Livingstone Shire Council
Logan City Council
Mackay City Council
Mareeba Shire Council
Maroochy Shire Council
Maryborough City Council
Millmerran Shire Council
Mirani Shire Council
Miriam Vale Shire Council
Monto Shire Council
Mount Morgan Shire Council
Mundubbera Shire Council
Murgon Shire Council
Murilla Shire Council
Nanango Shire Council
Nebo Shire Council
Noosa Shire Council
Perry Shire Council
Pine Rivers Shire Council
Pittsworth Shire Council
Redcliffe City Council
Redland Shire Council
Rockhampton City Council
Rosalie Shire Council
Sarina Shire Council
Stanthorpe Shire Council
Tara Shire Council
Taroom Shire Council
Thuringowa City Council
Tiaro Shire Council
Toowoomba City Council
Townsville City Council
Waggamba Shire Council
Wambo Shire Council
Warwick Shire Council
Whitsunday Shire Council
Wondai Shire Council
Woocoo Shire Council

Cherbourg Aboriginal Council
Hope Vale Aboriginal Council
Lockhart River Aboriginal Council
Napranum Aboriginal Council
Palm Island Aboriginal Council
Woorabinda Aboriginal Council
Wujal Wujal Aboriginal Council
Yarrabah Aboriginal Council

A2.2 The areas subject to this SPP are not altered by administrative changes to local government boundaries or names.

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A2.3 For **landslide** the SPP applies in the following local government areas as they were defined on 1 September 2002:

Atherton Shire Council
Banana Shire Council
Bauhinia Shire Council
Beaudesert Shire Council
Biggenden Shire Council
Boonah Shire Council
Bowen Shire Council
Brisbane City Council
Broadsound Shire Council
Burdekin Shire Council
Burnett Shire Council
Caboolture Shire Council
Cairns City Council
Calliope Shire Council
Caloundra City Council
Cambooya Shire Council
Cardwell Shire Council
Clifton Shire Council
Cooloola Shire Council
Cook Shire Council
Crows Nest Shire Council
Dalrymple Shire Council
Douglas Shire Council
Duaringa Shire Council
Eacham Shire Council
Emerald Shire Council
Esk Shire Council
Fitzroy Shire Council
Gatton Shire Council
Gayndah Shire Council
Gladstone City Council
Gold Coast City Council
Herberton Shire Council
Hervey Bay City Council
Hinchinbrook Shire Council
Ipswich City Council
Isis Shire Council
Johnstone Shire Council
Jondaryan Shire Council
Kilcoy Shire Council
Kilkivan Shire Council
Kingaroy Shire Council
Kolan Shire Council
Laidley Shire Council
Livingstone Shire Council
Logan City Council
Mackay City Council
Mareeba Shire Council
Maroochy Shire Council
Maryborough City Council
Mirani Shire Council
Miriam Vale Shire Council
Monto Shire Council
Mt Morgan Shire Council
Nanango Shire Council
Nebo Shire Council
Noosa Shire Council
Peak Downs Shire Council
Perry Shire Council
Pine Rivers Shire Council
Redland Shire Council
Rockhampton City Council
Rosalie Shire Council
Sarina Shire Council
Stanthorpe Shire Council
Taroom Shire Council
Thuringowa City Council
Tiaro Shire Council
Toowoomba City Council
Torres Shire Council
Townsville City Council
Wambo Shire Council
Warwick Shire Council
Whitsunday Shire Council
Woocoo Shire Council
Bamaga Island Council
Cherbourg Aboriginal Council
Hope Vale Aboriginal Council
Injinoo Aboriginal Council
Lockhart River Aboriginal Council
Mapoon Aboriginal Council
Napranum Aboriginal Council
New Mapoon Aboriginal Council
Palm Island Aboriginal Council
Umagico Aboriginal Council
Woorabinda Aboriginal Council
Wujal Wujal Aboriginal Council
Yarrabah Aboriginal Council

A2.4 The areas subject to this SPP are not altered by administrative changes to local government boundaries or names.

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ANNEX 3

Natural hazard management areas

Flood

A3.1 A natural hazard management area (flood) is land inundated by a Defined Flood Event (DFE)[33] and identified in a planning scheme.

A3.2 The Queensland Government's position is that, generally, the appropriate flood event for determining a natural hazard management area (flood) is the 1% Annual Exceedance Probability (AEP) flood. However, it may be appropriate to adopt a different DFE depending on the circumstances of individual localities. This is a matter that should be reviewed when preparing or undertaking relevant amendments to a planning scheme. Local governments proposing to adopt a lower DFE in their planning scheme to determine a natural hazard management area (flood) for a particular locality will be expected to demonstrate to the satisfaction of the Department of Emergency Services (DES) and the Department of Natural Resources and Mines (NR&M) that the proposed DFE is appropriate to the circumstances of the locality[34].

Bushfire

A3.3 A natural hazard management area (bushfire) is:

a) an area identified by a local government in its planning scheme consistent with the conclusions of a bushfire hazard assessment prepared in accordance with Appendix 3 of the SPP Guideline or other methodology approved by the Queensland Fire and Rescue Service (QFRS); or

b) where such a study has not been undertaken, an area identified by a local government in its planning scheme, reflecting the Medium and High hazard area of the Bushfire Risk Analysis maps produced by the QFRS, suitably modified following a visual assessment of the accuracy of the maps by the local government; or

c) where an area has not been identified by a local government, the Medium and High hazard areas on the Bushfire Risk Analysis maps produced by the QFRS.

Landslide

A3.4 A natural hazard management area (landslide) is:

a) an area identified by a local government in its planning scheme consistent with the conclusions of a landslide hazard assessment prepared in accordance with Appendix 4 of the SPP Guideline; or

b) where such a study has not been undertaken, an area identified by a local government in its planning scheme and including all land of 15% and greater slope and other land known or suspected by the local government as being geologically unstable, together with other areas that the local government considers may be adversely affected by a landslide event;[35] or

---

[33] See Section 9, Glossary.

[34] Local Governments are encouraged to adopt a DFE and identify natural hazard management areas (flood) in a planning scheme as soon as possible to enable the application of the SPP to development in flood prone areas. Appendix 2 in the SPP Guideline gives examples of simple flood study alternatives that may be appropriate for interim use until comprehensive flood studies are completed, or for longer-term use by low-growth local governments with capacity and resource constraints. Appendix 2 also provides guidance on the key issues to be considered when determining an appropriate DFE.

[35] For example, land below an area known or suspected as being geologically unstable that may be affected by debris flows.

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c) where an area has not been identified by a local government, all land with a slope of 15% or greater.[36]

A3.5 The SPP Guideline provides information on methodologies for identifying natural hazard management areas in planning schemes and advice on sources of financial assistance available for such studies.

[36] Refer to the SPP Guideline for a suitable methodology to calculate slope.

ANNEX 4

Compatibility of development in natural hazard management areas with the nature of the hazard

A4.1 This Annex sets out the specific outcomes that should be achieved for development to be compatible with the nature of hazard as required under Outcome 1 of the SPP. Development proposals that demonstrate compliance with each of the specific outcomes that are applicable to the particular development achieve Outcome 1 of the SPP.

A4.2 The SPP Guideline provides advice on how to achieve these specific outcomes.

Natural hazard	Specific outcomes
FLOOD	**1.** Development maintains the safety of people on the development site from all floods up to and including the DFE. **2.** Development does not result in adverse impacts on people's safety or the capacity to use land within the floodplain. **3.** Development minimises the potential damage from flooding to property on the development site. **4.** Public safety and the environment are not adversely affected by the detrimental impacts of floodwater on hazardous materials manufactured or stored in bulk. **5.** Essential services infrastructure (e.g. on-site electricity, gas, water supply, sewerage and telecommunications) maintains its function during a DFE.
BUSHFIRE	**6.** Development maintains the safety of people and property by: **a)** avoiding areas of High or Medium bushfire hazard; or **b)** mitigating the risk through: • allotment design and the siting of buildings; and • including firebreaks that provide adequate: – setbacks between buildings/structures and hazardous vegetation, and – access for fire-fighting/other emergency vehicles; • providing adequate road access for fire-fighting/other emergency vehicles and safe evacuation; and • providing an adequate and accessible water supply for fire-fighting purposes. **7.** Public safety and the environment are not adversely affected by the detrimental impacts of bushfire on hazardous materials manufactured or stored in bulk.
LANDSLIDE	**8.** Development maintains the safety of people, property and hazardous materials manufactured or stored in bulk from the risk of landslide.

ANNEX 5

Determining unacceptable risk in accordance with Outcome 2

A5.1 Outcome 1 does not require development proposals that are either a development commitment[37], or satisfy an overriding need in the public interest to be compatible with the nature of the natural hazard. However, Outcome 2 requires such development proposals to achieve the specific outcomes for compliance with Outcome 1 as far as practicable, and not to result in an unacceptable risk to people and property.

A5.2 The following table sets out the minimum outcomes a development should achieve to avoid unacceptable risk. Appendix 5 of the SPP Guideline provides more information (including associated Probable Solutions) on how to achieve these outcomes.

Minimum requirements to satisfy the 'unacceptable risk' test:

Natural hazard	Minimum requirements
FLOOD	Achievement of specific outcomes 1, 2 and 4 in Annex 4.
BUSHFIRE	Achievement of the following elements from specific outcome 6 in Annex 4: • providing adequate road access for fire-fighting and other emergency vehicles and safe evacuation; and • providing an adequate and accessible water supply for fire-fighting purposes.
LANDSLIDE	Achievement of specific outcome 8 in Annex 4.

[37] See Section 9, Glossary.

Published by:

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1.0 INTRODUCTION

Development on land affected by flooding will be assessed against the risk, hazard and adverse consequences caused by flooding. This chapter outlines Council's design criteria that aim to reduce property damage and ensure safety of persons.

Floodable land is any land that is affected by river, creek or localised flooding. The three types of flooding are described as follows:

- River flooding occurs when there is widespread prolonged rain over the catchment of the Brisbane River.
- Creek flooding occurs when bankfull capacities are exceeded. On average Brisbane's natural creeks have a 50-100% chance of exceeding their bankfull capacities in any one year.
- Local flooding occurs when components of the stormwater drainage system such as pipes and gully inlets are blocked and/or design capacity is exceeded and/or when the overland flow path is blocked by a building or fence. (Note: The 'Flood Search Flag' theme in Council's BIMAP database generally refers to indicative areas of known potential creek/river flooding problems based on historical flood records. The areas currently mapped under this theme do not extend to any areas with potential localised overland flow problems. The FloodWise Property Report is a free report issued by Council and is designed to provide property based information about flood levels.)

2.0 FLOOD IMMUNITY

2.1 RECONFIGURING A LOT

For a subdivision (freehold lots or community title scheme) where there is dedication and opening of road or where the subdivision creates more than 6 lots, design levels must comply with Table A1.1. The flood immunity standards are assigned to eliminate the creation of new lots below the desired flood immunity level.

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TABLE A1.1
FLOOD IMMUNITY LEVELS FOR SUBDIVISION

Flooding type (Note 1)	**Minimum lot levels (mAHD)** (Note 4)	
	Residential	**Other than residential**
Brisbane River (Note 2)	DFL + 0.3m	DFL
Waterway[A]	100y ARI + 0.3m	100y ARI
Local flooding[B]	50y ARI + 0.3m	50y ARI
Storm tide (Note 3)	100y ARI + 0.3m	100y ARI

NOTES:

1. Where the site is subject to more than one type of flooding (ie local flooding and/or waterway flooding and/or river flooding and/or storm tide), the minimum flood immunity level is the highest level determined from these sources. It should be noted that the flood immunity level in some older inner city areas is often controlled by local ponding.
2. The Defined Flood Level (DFL) for Brisbane River is based on the 3.7 mAHD level at the Brisbane Port Office Gauge. This standard was adopted by Council on 2 December 2003.
3. A storm tide is the effect on coastal water levels of a storm surge combining with the normally occurring astronomical tide. Storm surge (or more correctly meteorological tide) is a rise above normal water level due to the combined effects of surface wind stress and atmospheric pressure fluctuations caused by severe weather conditions such as tropical cyclone. The 100 year ARI storm tide is 2.5 mAHD. This value incorporates 0.3 m allowance to offset the potential effects of climate change.
4. If no hydraulic modelling data is available, the applicant should engage a suitably qualified Registered Professional Engineer in Queensland (RPEQ) to undertake appropriate hydrologic and hydraulic assessments.

For the purpose of this chapter, an infill subdivision refers to a subdivision where there is no dedication and opening of road and where the subdivision creates 6 lots or less. Infill subdivision typically occurs in a site either fully or partly surrounded by developed sites, for example, reconfiguring an existing 1215 m^2 lot to 3 individual 405 m^2 lots with frontage to an existing road.

Lots must have an appropriate area and dimensions for the siting and construction of potential buildings, the provision of outdoor space, convenient vehicle access and parking. For this reason, it is required that 60% of the new lot size or 300 m^2 rectangular shaped area (whichever is the greater area), achieves the flood immunity standards specified in Table A1.1.

A A waterway (including those indicated on the Planning Scheme Maps) is defined as any element of a river, creek, stream, gully or drainage channel, including the bed and banks.

B Local flooding usually occurs when the capacity of the underground piped drainage system is exceeded and/or when the overland flow path is blocked. Localised overland flow paths generally traverse along roadways and in the older established areas, through private properties. A localised overland flow path is not characterised by well-defined bed and banks and the contributing catchment is generally less than 30 hectares.

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2.3 OTHER DEVELOPMENTS

2.3.1 Definition

For the purpose of this chapter, other developments refer to a development or redevelopment in an established area, which usually involves the intensification of land use in a site either fully or partly surrounded by developed sites. Typical examples include:

- The start of a new use of the premises (eg construction of a factory on a vacant lot).
- The re-establishment on the premises of a use that has been abandoned.
- A material change in the intensity or scale of the use of the premises (eg changing use of land from a house to a multi-unit building, increasing the gross floor area, etc).

2.3.2 Design Floor/Pavement Levels

Brisbane City Council will only consider the intensification of land use in floodable areas if the flood hazard is acceptable. However, it is preferred that filling be undertaken (no adverse impacts in accordance with *City Plan*) to eliminate flood hazard risks in the first instance so that the lot has the required flood immunity.

The acceptable degree of hazard is characterised by an inundation depth of ≤0.5 m and flow velocity of ≤2.0 m/s and depth*velocity product of ≤0.6 m^2/s from all flooding sources except the Brisbane River. Flooding from these sources can peak in a matter of a few hours. The hazard criteria are applied to the building footprint measured from the outermost projections of all roofed buildings and structures. The adopted hazard parameters are generally based on the following criteria set out in the publication *Floodplain Management in Australia - Best Practice Principles and Guidelines* (Commonwealth of Australia, 2000):

- The ability to evacuate people and possessions by trucks.
- The ability for fit adults to wade through floodwaters.
- Low flood damage potential.

Brisbane River can take a day to peak between Wivenhoe dam and the Brisbane City Gauge, thus allowing time to disseminate flood warnings. For this reason, Brisbane City Council have adopted a risk management approach to selected building types at existing lots and infill sites that do not meet the prescribed flood immunity standard (refer Section 4.0) as a result of backwater influence from the Brisbane River or direct river flooding.

Design levels for buildings and incidental works must comply with the flood immunity standards specified in Tables A1.2 and A1.3. Design levels are assigned to each building class as defined in the *Building Code of Australia* (refer Section 2.3.3 for definitions). The assigned flood immunity standards for developments in an established area recognises that the site is constrained in meeting the higher standard as required for a subdivision, whilst achieving acceptable safety and amenity outcomes.

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TABLE A1.2
CATEGORIES OF FLOOD IMMUNITY LEVELS

Flooding type (Note 1)	**Minimum design floor or pavement levels (mAHD)** (Note 4) (Refer Table A1.3 for assignment of these categories)				
	Category A	**Category B**	**Category C**	**Category D**	**Category E**
Brisbane River (Note 2)	DFL + 0.5m	DFL + 0.3m	DFL	20y ARI	20y ARI
Waterway[A]	100y ARI + 0.5m	100y ARI + 0.3m	100y ARI	100y ARI	20y ARI
Local flooding[B]	50y ARI + 0.5m	50y ARI + 0.3m	50y ARI	50y ARI	20y ARI
Storm tide (Note 3)	100y ARI + 0.5m	100y ARI + 0.3m	100y ARI	50y ARI	50y ARI

NOTES:

1. Where the site is subject to more than one type of flooding (ie local flooding and/or waterway flooding and/or river flooding and/or storm tide), the minimum flood immunity level is the highest level determined from these sources. It should be noted that the flood immunity level in some older areas is often controlled by local ponding.
2. The Defined Flood Level (DFL) for Brisbane River is based on the 3.7 mAHD level at the Brisbane Port Office Gauge. This standard was adopted by Council on 2 December 2003.
3. A storm tide is the effect on coastal water levels of a storm surge combining with the normally occurring astronomical tide. Storm surge (or more correctly meteorological tide) is a rise above normal water level due to the combined effects of surface wind stress and atmospheric pressure fluctuations caused by severe weather conditions such as tropical cyclone. The 100 and 50 year ARI storm tides are 2.5 mAHD and 2.2 mAHD respectively. These values incorporate 0.3 m allowance to offset the potential effects of climate change.
4. If no hydraulic modelling data is available, the applicant should engage a suitably qualified Registered Professional Engineer in Queensland (RPEQ) to undertake appropriate hydrologic and hydraulic assessments.

A A waterway (including those indicated on the Planning Scheme Maps) is defined as any element of a river, creek, stream, gully or drainage channel, including the bed and banks.

B Local flooding usually occurs when the capacity of the underground piped drainage system is exceeded and/or when the overland flow path is blocked. Localised overland flow paths generally traverse along roadways and in the older established areas, through private properties. A localised overland flow path is not characterised by well-defined bed and banks and the contributing catchment is generally less than 30 hectares.

TABLE A1.3
ASSIGNED FLOOD IMMUNITY LEVELS

BCA building classification*	**Assigned design floor or pavement levels** (Refer Table A 1.1 for interpretation of flood immunity categories)
Class 1a & 1b, Class 2, Class 3, Class 4	Habitable room*: Category A Non-habitable room including patio and courtyard: Category B, except for Class 1a building where the 50y ARI + 0.3m applies to Brisbane River Non-habitable part of a Class 2 or Class 3 building excluding the essential services@ control room: Risk management approach to Brisbane River flooding (refer Section 4) is permitted Garage associated with a building that is Class 1, 2, 3, or 4: Category B, except for Class 1a building where the 50y ARI + 0.3m applies to Brisbane River Carpark located in the building undercroft# of a multi-unit dwelling associated with a building that is Class 1, 2, 3, or 4: Category B Carport[1] or unroofed carpark: Category D Vehicular access and manoeuvring areas: Category D
Class 5, Class 6, Class 8	Building floor level: Category C, risk management approach to Brisbane River flooding is permitted (does not apply to the essential services@ control room) Garage or carpark located in the building undercroft#: Category C Carport[1] or unroofed carpark: Category D Vehicular access and manoeuvring areas: Category D
Class 7a	Refer to the relevant building class specified in this table
Class 7b	Building floor level: Category C, risk management approach to Brisbane River flooding is permitted (does not apply to the essential services@ control room) Vehicular access and manoeuvring areas: Category D
Class 9a, 9b, 9c	Building floor level: Category A Garage or carpark located in the building undercroft#: Category C Carport[1] or unroofed carpark: Category D Vehicular access and manoeuvring areas: Category D
Class 10a	Carparking facility: Refer to the relevant building class specified in this table Shed[2] or the like: Category D
Class 10b	Swimming pool: Category E Associated mechanical and electrical pool equipment: Category C Other structures: Flood immunity standard does not apply

* Refer Section 2.3.3 for definitions.

@ Essential services may include fire control panel, electrical switchboard, telephone, PABX, mains distribution, etc.

Basement carparks can be constructed to below the specified levels provided that suitably waterproofed perimeter walls, air vents, and entry/exit ramps at the carpark entrance are above the Defined Flood Level (DFL) for Brisbane River and 100 year ARI flood levels for all the other flooding sources.

1 A shelter for a motor vehicle, which has a roof and one or more open sides, and which can be built against the side of a building.

2 A slight or rough structure built for shelter and storage; or a large strongly built structure, often open at the sides or end.

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The flood immunity standards specified in Table A1.3 may not be adequate for community infrastructure[3]. The *State Planning Policy 1/03: Mitigating the Adverse Impacts of flood, Bushfire and Landslide* (SPP 1/03) requires that these infrastructure have higher levels of flood protection than many other forms of development. Community infrastructure performs vital response and recovery roles during and immediately after a natural hazard event, or store valuable or irreplaceable items. The recommended flood immunity levels as set out in the *SPP Guideline 1/03* are provided in Table A1.4.

TABLE A1.4
FLOOD IMMUNITY LEVELS FOR COMMUNITY INFRASTRUCTURE

Type of community infrastructure	**Recommended flood levels**
Emergency services	500y ARI
Emergency shelters	200y ARI
Police facilities	200y ARI
Hospitals and associated facilities	500y ARI
Stores of valuable records or items of historic or cultural significance (eg galleries and libraries)	200y ARI
State-controlled roads Works of an electricity entity not otherwise listed in this table Railway lines, stations and associated facilities Aeronautical facilities Communication network facilities	No specific recommended level but development proponents should ensure that the infrastructure is optimally located and designed to achieve suitable levels of service, having regard to the processes and policies of the administering government agency.
Power stations	500y ARI
Major switch yards	500y ARI
Substations	200y ARI
Sewage treatment plants	DFE
Water treatment plants	200y ARI

[3] The following types of community infrastructure provide services vital to the wellbeing of the community:
- police and emergency services facilities including emergency shelters;
- hospitals and associated institutions;
- facilities for the storage of valuable records or items of cultural or historic significance;
- State-controlled roads;
- railway lines, stations and associated facilities;
- aeronautical facilities;
- communication network facilities;
- works of an electricity entity under the Electrical Safety Act 2002; and
- water cycle management infrastructure.

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2.3.3 Building Code Definitions

The classification of a building or part of a building is determined by the purpose for which it is designed, constructed or adapted to be used. Classifications in accordance with the *Building Code of Australia* (BCA) are as follows:

Class 1: one or more buildings which in association constitute -

(a) **Class 1a** - a single dwelling being -
  (i) a detached house; or
  (ii) one of a group of two or more attached dwellings, each being a building, separated by a fire-resisting wall, including a row house, terrace house, town house or villa unit; or

(b) **Class 1b** - a boarding house, guest house, hostel or the like
  (i) with a total area of all floors not exceeding 300 m^2 measured over the enclosing walls of the Class 1b; and
  (ii) in which not more than 12 persons would ordinarily be resident,

which is not located above or below another dwelling or another Class of building other than a private garage.

Class 2: a building containing 2 or more sole-occupancy units each being a separate dwelling.

Class 3: a residential building, other than a building of Class 1 or 2, which is a common place of long term or transient living for a number of unrelated persons, including -

(a) a boarding-house, guest house, hostel, lodging-house or backpackers accommodation; or

(b) a residential part of an hotel or motel; or

(c) a residential part of a school; or

(d) accommodation for the aged, children or people with disabilities; or

(e) a residential part of a health-care building which accommodates members of staff; or

(f) a residential part of a detention centre.

Class 4: a dwelling in a building that is Class 5, 6, 7, 8 or 9 if it is the only dwelling in the building.

Class 5: an office building used for professional or commercial purposes, excluding buildings of Class 6, 7, 8 or 9.

Class 6: a shop or other building for the sale of goods by retail or the supply of services direct to the public, including -

(a) an eating room, cafe, restaurant, milk or soft-drink bar; or

(b) a dining room, bar, shop or kiosk part of a hotel or motel; or

(c) a hairdresser's or barber's shop, public laundry, or undertaker's establishment; or

(d) market or sale room, showroom, or service station.

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Class 7: a building which is -

(a) **Class 7a** - a *carpark*[4]; or

(b) **Class 7b** - for storage, or display of goods or produce for sale by wholesale.

Class 8: a laboratory, or a building in which a handicraft or process for the production, assembling, altering, repairing, packing, finishing, or cleaning of goods or produce is carried on for trade, sale, or gain.

Class 9: a building of a public nature -

(a) **Class 9a** - a health-care building; including those parts of the building set aside as a laboratory; or

(b) **Class 9b** - an *assembly building*[5], including a trade workshop, laboratory or the like in a primary or secondary school, but excluding any other parts of the building that are of another Class; or

(c) **Class 9c** - an *aged care building*

Class 10: a non-habitable building or structure -

(a) **Class 10a** - a non-habitable building being a *private garage*[6], carport, shed, or the like; or

(b) **Class 10b** - structure being a fence, mast, antenna, retaining or free-standing wall, swimming pool, or the like.

A building or part of a building may have more than one classification applying to the whole building or to the whole of that part of the building.

Habitable room means a room used for normal domestic activities, and -

(a) includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room and sunroom; but

(b) excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes-drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods.

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4 Carpark means a building that is used for the parking of motor vehicles that is neither a private garage nor used for the servicing of vehicles, other than washing, cleaning or polishing. (Source: BCA)

5 Assembly building means a building where people may assemble for -
(a) civic, theatrical, social, political or religious purposes; or
(b) educational purposes in a school, early childhood centre, preschool, or the like; or
(c) entertainment, recreational or sporting purposes; or
(d) transit purposes. (Source: BCA)

6 Private garage means -
(a) any garage associated with a Class 1 building; or
(b) any single storey of a building of another Class capable of accommodating not more than 3 vehicles, if there is only one such storey in the building; or
(c) any separate single storey garage associated with another building where such garage is capable of accommodating not more than 3 vehicles. (Source: BCA)

3.0 ROAD TRAFFICABILITY

3.1 STANDARDS

All new dedicated or internal roads within any subdivision (freehold lots or community title scheme) must comply with the minimum levels specified in Table A1.5.

TABLE A1.5
FLOOD IMMUNITY LEVELS FOR NEW ROADS WITHIN A SUBDIVISION

Flooding type [1]	Minimum design levels at crown of road (mAHD) [4]	
	Residential development	Industrial/ commercial development
Brisbane River [2]	Defined Flood Level	50y ARI
Waterway[A]	100y ARI	50y ARI
Local flooding[B]	50y ARI	50y ARI
Storm tide [3]	100y ARI	100y ARI

NOTES:

1. Where the site is subject to more than one type of flooding (ie local flooding and/or waterway flooding and/or river flooding and/or storm tide), the minimum flood immunity level is the highest level determined from these sources. It should be noted that the flood immunity level in some older areas is often controlled by local ponding.
2. The Defined Flood Level (DFL) for Brisbane River is based on the 3.7 mAHD level at the Brisbane Port Office Gauge. This standard was adopted by Council on 2 December 2003.
3. A storm tide is the effect on coastal water levels of a storm surge combining with the normally occurring astronomical tide. Storm surge (or more correctly meteorological tide) is a rise above normal water level due to the combined effects of surface wind stress and atmospheric pressure fluctuations caused by severe weather conditions such as tropical cyclone. The 100 year ARI storm tide is 2.5 mAHD. This value incorporates 0.3 m allowance to offset the potential effects of climate change.
4. If no hydraulic modelling data is available, the applicant should engage a suitably qualified Registered Professional Engineer in Queensland (RPEQ) to undertake appropriate hydrologic and hydraulic assessments.

The existing dedicated road fronting the development or providing access within 200 m of the development must comply with the flood immunity standards specified in Table A1.6. In addition, the level of serviceability of the existing dedicated road must also conform to the requirements of Section 3.2.

A A waterway (including those indicated on the Planning Scheme Maps) is defined as any element of a river, creek, stream, gully or drainage channel, including the bed and banks.

B Local flooding usually occurs when the capacity of the underground piped drainage system is exceeded and/or when the overland flow path is blocked. Localised overland flow paths generally traverse along roadways and in the older established areas, through private properties. A localised overland flow path is not characterised by well-defined bed and banks and the contributing catchment is generally less than 30 hectares.

TABLE A1.6
FLOOD IMMUNITY LEVELS FOR EXISTING DEDICATED ROAD PROVIDING ACCESS TO OR FRONTING A DEVELOPMENT

Flooding type [1]	Minimum design levels at crown of road (mAHD) [2]			
	Local access [3]	Neighbourhood access [3]	Industrial access [3]	District access/ suburban route/ arterial route [3]
Brisbane River	20y ARI	50y ARI	20y ARI	50y ARI
Waterway[A]	20y ARI	50y ARI	20y ARI	50y ARI
Local flooding[B]	20y ARI	20y ARI	20y ARI	20y ARI
Storm tide [4]	20y ARI	50y ARI	20y ARI	50y ARI

NOTES:

1. Where the site is subject to more than one type of flooding (ie local flooding and/or waterway flooding and/or river flooding and/or storm tide), the minimum flood immunity level is the highest level determined from these sources. It should be noted that the flood immunity level in some older areas is often controlled by local ponding.
2. If no hydraulic modelling data is available, the applicant should engage a suitably qualified Registered Professional Engineer in Queensland (RPEQ) to undertake appropriate hydrologic and hydraulic assessments.
3. Refer to Chapter 1 of Part B of this document for description of the road hierarchy.
4. A storm tide is the effect on coastal water levels of a storm surge combining with the normally occurring astronomical tide. Storm surge (or more correctly meteorological tide) is a rise above normal water level due to the combined effects of surface wind stress and atmospheric pressure fluctuations caused by severe weather conditions such as tropical cyclone. The 50 and 20 year ARI storm tides are 2.2 and 2.1 mAHD respectively. These values incorporate 0.3 m allowance to offset the potential effects of climate change.

3.2 SERVICEABILITY

The level of serviceability to be provided to traffic at a waterway crossing will depend upon the ARI of the flood for which the creek crossing will be passable to traffic and the duration of road closure during times of flooding. Trafficability will depend upon the combination of depth and velocity of flow over a floodway, when the frictional resistance between a vehicle's tyres and the floodway surface is overcome and the vehicle loses stability.

A A waterway (including those indicated on the Planning Scheme Maps) is defined as any element of a river, creek, stream, gully or drainage channel, including the bed and banks.

B Local flooding usually occurs when the capacity of the underground piped drainage system is exceeded and/or when the overland flow path is blocked. Localised overland flow paths generally traverse along roadways and in the older established areas, through private properties. A localised overland flow path is not characterised by well-defined bed and banks and the contributing catchment is generally less than 30 hectares.

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Trafficable access to the development site from at least one suburban route (or higher category road network) is required to maintain emergency services. In this instance, the applicant must satisfactorily demonstrate compliance with the two trafficability criteria specified below, applied to the road network between the development site and the closest suburban or convenience centre. Council will also consider other issues such as the number of affected properties and the proposed use of the development.

1. The **time of closure** for the 50 year ARI flood event from all the nominated flooding sources with the exception of Brisbane River, must not exceed 6 hours
2. The **Average Annual Time of Closure (AATC)** from all the nominated flooding sources with the exception of Brisbane River, must not exceed 2 hours.

Road closure is normally assumed when the total head (static plus velocity) on a carriageway with a two-way crossfall or across the highest edge of a carriageway with a one-way crossfall exceeds 300 mm. For detailed procedures or explanations of terminologies, the applicant should make reference to the publication *Waterway Design. A Guideline to the Hydraulic Design of Bridges, Culverts and Floodways* (Austroads, 1994).

The time of closure is calculated by drawing a horizontal line on the hydrograph at the trafficable discharge level and measuring the time for which the flow is above this level. (Note: The time of closure for each ARI event is not necessarily the design hydrograph that produces the highest peak flood level but rather the critical duration envelope is usually derived from a series different duration flood hydrographs. For example for a given trafficable capacity, the 24 hour storm may generate the longest time of closure at the crossing rather than the 6 hour critical duration storm that produces the highest peak flood level at the crossing.)

4.0 BRISBANE RIVER FLOODING

4.1 BACKGROUND

The Brisbane River has been the focus of city life, trade and commerce since the settlement of Brisbane. The Brisbane River catchment covers an area of 13 570 km^2 and is bounded on the west by the Great Dividing Range and by a number of smaller coastal ranges to the east and north. Most of the catchment comprises forest and grazing land, with the exception of the Brisbane-Ipswich metropolitan areas and a number of small rural townships. Several dams and reservoirs, most notably Somerset Dam and Wivenhoe Dam, regulate the flows in the Brisbane River and its major tributaries.

4.2 RISK MANAGEMENT APPROACH

4.2.1 General

Flood risk management is a formal means of identifying and managing the existing, future and residual risks of flooding. A suitably qualified professional consultant must be engaged to undertake the risk management evaluation in accordance with the framework outlined in AS 4360 Risk Management. The key aim is to ensure that risks (including safety, environmental, social and economic) associated with the proposed use are compatible with the level of flood immunity. For example a warehouse for the purpose of storing perishable goods such as fruits and vegetables will incur less flood damage losses when compared to a warehouse used to store electrical appliances. The storage of hazardous chemicals may not be an appropriate use.

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4.2.2 Warning Time

Flood hazard can be reduced by evacuation if adequate time is available. The longer the warning period, the greater time there is available for evacuating people and removing goods and possessions. However, even if people and possessions are fully evacuated, a flood will still cause significant damage to buildings and to infrastructure and still cause substantial community disruption.

Available warning time is determined largely by catchment characteristics. The larger the catchment and the slower the rate of rise of floodwaters, the longer the available warning time. In small steep catchments, there is often no available warning time as the catchments respond too quickly.

Brisbane City Council has a flood forecasting model that utilises Council's network of real time rainfall and flood level monitoring systems and flood modelling program, together with Council's geographical information system (BIMAP) to provide a flood warning and information service to the community. Brisbane River can take a day to peak between Wivenhoe dam and the Brisbane City Gauge, thus allowing time to disseminate flood warnings.

4.2.3 Scope of Application

The risk assessment only applies to a select group of building types (nominated in Table A1.3) proposed in development sites located in established areas that do not meet the prescribed flood immunity standard for Brisbane River.

4.2.4 Risk Management Process

There are instances where the exact use is not known (eg centre and industrial activities) and instances where the use is known (eg lobby of an apartment block). Therefore the risk management formulation should cover a range of proposed and likely uses. The key elements of the flood risk management process should include:

1. Identification of the stakeholders exposed to or affected by the risk of flooding.
2. Identification of public and private property, social systems and environmental elements at risk of flooding.
3. Estimation of flood risks ie the likelihood and consequences of flooding. This evaluation will involve the undertaking of a quantitative analysis that uses numerical values (rather than the descriptive scales used in qualitative and semi-quantitative analysis) for both consequences and likelihood. The quality of the analysis depends on the accuracy and completeness of the numerical values used.
4. Assessment of the acceptability of flood risk. This evaluation will involve the determination of the total flood damage (potential) for a range of annual exceedance probabilities (PMF, 1%, 2%, 5%, 10%, 20%, 50%), and the average annual damage. Flood damages are generally divided into two categories of tangible and intangible damages. Tangible damages[7] are financial and can be measured in monetary terms. Intangible damages[8] are usually difficult to estimate in financial terms. The owner (and future owners) must assume all responsibility

[7] Tangible damages include the cost of repairing items damaged by floodwaters or the loss in value caused by floodwaters wetting goods and possessions (direct damages), together with the loss of wages and extra outlays incurred during clean-up and in post-flood recovery (indirect damages).

[8] Intangible damages include the increased levels of physical and psychological illness and emotional distress caused by the flood. A flood is a traumatic experience for many.

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and all liability for all losses, damages and costs that might be incurred as a result of the reduced flood immunity standards.

5. Definition of flood risk management strategies. As a minimum, this assessment must address the following items.
   - The proposed method of perpetuating the restricted use (through appropriate forms of legal documentation, notation on titles, rate notices, etc) and conveying the risk management data to future owners and leaseholders.
   - The procedure to conduct emergency evacuation and rescue operations.

5.0 CYCLIST AND PEDESTRIAN FACILITIES

On road cyclist and pedestrian facilities must comply with the road trafficability standards specified in Section 3. However off road facilities including those traversing through parks and adjacent to watercourses, should generally achieve at least the 2y ARI flood immunity standard for all flooding sources except Brisbane River. In the case of Brisbane River and the Moreton Bay area, the design level should be a minimum of 2.1 mAHD. Where the site is subject to more than one type of flooding sources, the more stringent criteria will apply. Council approval is required for lesser standards.

6.0 EARTHWORKS

Any earthworks activities adjacent to waterways and overland flow paths must comply with all the provisions of the *Brisbane City Plan* (refer to illustration on Figure A1.1). The applicant should ensure that the development proposal does not adversely impact on the hydraulic conveyance or flood storage.

Hydraulic conveyance is a measure of the flow carrying capacity of a watercourse and is a function of the geometry and surface impedance of that watercourse. The loss of conveyance from obstruction or filling is usually characterised by increases in flood levels upstream. Mathematical models that are appropriate to assess the impacts of flood flow conveyance include HEC-RAS steady state hydraulic model and MIKE-11 hydrodynamic model.

As floodwaters flowing in a watercourse rise during a flood event and overtop the banks, a portion of floodwaters are transferred into storage areas of the floodplain where the flow velocities are small in comparison with the main channel. The loss of critical **flood storage** from obstruction or filling is usually characterised by increases in flow velocities and/or flood levels downstream. Mathematical models that are appropriate to assess the impacts of flood storage include RAFTS runoff routing model and MIKE-11 hydrodynamic model.

For overland flow paths that are not designated channels (channels usually have clearly defined bed and banks) or waterways, the overland flow path may be altered to suit the development provided that the 50y ARI depth*velocity product is $\leq 0.6\ m^2/s$. Compensatory earthworks must not cause the depth velocity product to exceed $0.6\ m^2/s$ nor concentrate flows onto adjacent properties. Flood storage capacity areas below the 50y ARI flood levels must be preserved by matching any filled area with an excavated area of equal volume at the same levels.

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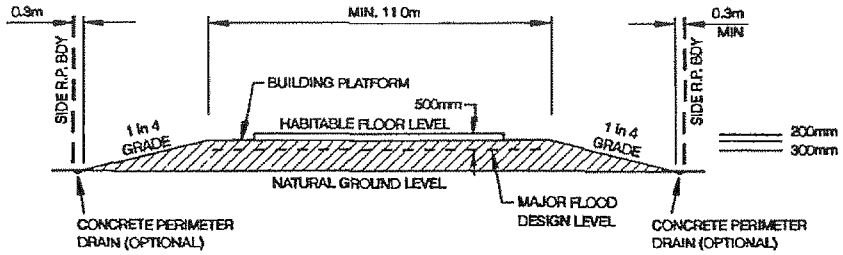
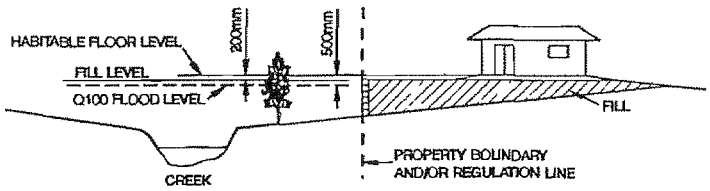


FILLING OF LAND (BATTERS)



FILLING OF LAND (RETAINING WALLS)

NOTES:

1. Where the neighbouring property is low lying with existing drainage problems Council may require a concrete perimeter drain at the toe of the embankment or retaining wall.
2. The toe of all embankments adjoining public space (eg park, road reserve, etc) should be at least 0.3 m clear of the property alignment. All embankments to neighbouring properties are to be maintainable. In most cases, a batter of 1V in 4H is desirable but steeper landscaped embankments may be considered. Where the property adjoins parkland the batters are to be no steeper than 1V in 6H to allow easy access.
3. Retaining walls instead of the earth batters may be accepted with approval of Development Assessment subject to appropriate landscaping to soften the visual impact of the retaining wall. Refer to Chapter 3 of Part B of this document.
4. Retaining wall structures should conform to the requirements set out in the Building Regulation 2006. In general any retaining walls greater than 1.0 m in height will require a building application and structural certification. Where the combined height of a fence and a wall exceeds 2.0 m, the aforementioned requirements plus the written authorisation from the neighbour will need to be provided with the engineering drawings.

FIGURE A1.1
TYPICAL FILLING EXAMPLE

7.0 LEVEES

Historically, levees have been used as a structural flood mitigation measure in Brisbane to reduce existing flood losses. However, Council will not permit the use of levees in new developments to satisfy flood immunity standards, for the following reasons:

- There is no guarantee that the levees will remain with the land.
- Levees are a band-aid solution rather than an intrinsic solution.
- There is possibility that levees can be breached or overtopped in extreme storms, which can lead to an increase in damage, and subsequently greater potential for damage.

BCC.113.0785

MJR-1

Our ref: Doc 1675982

10 August 2011

Mr Martin Reason
Acting Planning Manager
Brisbane City Council
C/- Clayton Utz
[redacted]
GPO Box 55
BRISBANE QLD 4001

REQUIREMENT TO PROVIDE A STATEMENT TO COMMISSION OF INQUIRY

I, Justice Catherine E Holmes, Commissioner of Inquiry, pursuant to section 5(1)(d) of the *Commissions of Inquiry Act 1950* (Qld), require Mr Martin Reason, Acting Planning Manager, to provide a written statement, under oath or affirmation, to the Queensland Floods Commission of Inquiry, in which the said Mr Reason:

- provides all information in his possession and identifies the source or sources of that information;
- makes commentary and provides opinions he is qualified to give as to the appropriateness of particular actions or decisions and the basis of that commentary or opinion;

in respect of the following topics:

1. A summary of the assessment criteria contained in council's planning scheme(s) and how such criteria are used to assess applications for development in the natural hazard management area.

2. A description of how the natural hazard management area, as it relates to flood affected land, is reflected in the planning scheme.

3. Details of Council's defined flood event including a description of:
   a) how the defined flood event was chosen;
   b) the way in which the council's defined flood event was calculated or determined.

4. A description of any planning requirements to have evacuation routes and/or early warning systems for areas identified to be at high risk of flooding, including information about how the existence of such evacuation routes and/or early warning systems are communicated to occupiers of areas at high risk of flooding.

5. A description of any controls or standards used to assess the storage of chemicals or other Environmentally Relevant Applications for development below the Q100 flood line or the Council's defined flood event.

400 George Street Brisbane
GPO Box 1738 Brisbane
Queensland 4001 Australia
Telephone 1300 309 634
Facsimile +61 7 3405 9750
www.floodcommission.qld.gov.au
ABN 82 696 762 534

6. A description of any conditions imposed by Council on the approval of development applications to ensure that hazardous materials affected by flood water do not affect public safety and/or the environment.

7. A description of how levee banks are regulated in the council area using specific examples.

8. Details of council infrastructure (sewers, roads, stormwater etc) that was affected by flooding during the period 1 December 2010 to 31 January 2011.

9. A description of the measures used by Council to protect Council infrastructure (sewers, roads, stormwater etc) and to ensure such infrastructure functions during a defined flood event.

Mr Reason may also address other topics relevant to the Terms of Reference of the Commission in the statement, if he wishes.

The statement is to be provided to the Queensland Floods Commission of Inquiry by 5 pm, Thursday 1 September 2011.

The statement can be provided by post, email or by arranging delivery to the Commission by emailing info@floodcommission.qld.gov.au.

C. Holmes

Commissioner
Justice C E Holmes

4. My previous work history is as follows:

(a) Town Planning Consultant with Planning Australia Services from April 1998 September 1998;

(b) Town Planner for the Development Assessment Branch of Council from 1998 to 2000;

(c) Senior Town Planner from 2000 to 2003 for Council;

(d) Senior Programme Officer in the Infrastructure Coordination and Financing unit from 2003 to 2006 for Council, including a staff exchange position via the Lord Mayor's Office as a Senior Strategic Planner for the Shenzhen Municipal Planning Bureau, People's Republic of China from August 2005 to December 2005;

(e) Senior Project Manager for Planning for Regeneration Limited, in the United Kingdom, from 2006 to 2008; and

(f) Senior Strategic Planner for Urban Design and Heritage with the Greater London Authority, in the United Kingdom from May 2008 to December 2009.

General observations

5. To assist the Commission in understanding my specific responses of the questions asked it seems useful to set out the following five general observations.

6. First, for the purposes of this Statement I will regularly refer to Council's Subdivision and Development Guidelines Current Edition 2008 (**Subdivision and Development Guidelines**):

(a) Section 2.3.3 of the Subdivision Development Guidelines sets out a full series of definitions from the Building Code of Australia;

(b) Table A1.3 of the Subdivision and Development Guidelines assigns flood immunity levels to each of the building classifications;

(c) The levels themselves are defined in table A1.2. of the Subdivision Development Guidelines for Brisbane River and other kinds of flooding affecting the City.

[redacted] [redacted]

Martin James Reason

Attachment **MJR-2** is a copy of Chapter 1 Flood Affected Land of the Subdivision Development Guidelines.

7. Second, it is common in discussion relating to flood immunity levels to speak of the "*Defined Flood Level*" (**DFL**) and the "*Q100*". While this is understandable shorthand, it is important to bear in mind when reading this statement that Council's planning scheme and planning policies, including the Subdivision and Development Guidelines, provide for a graduated series of flood immunity levels, which vary depending on the nature of the development. While these flood immunity levels are normally derived from the DFL or the Q100, the planning scheme and planning policies also derive flood immunity levels from different Annual Exceedence Probabilities (**AEP**) such as Q50 and in some cases Q20. For example:

   (a) an open-sided carport subject to Brisbane River flooding must achieve a flood immunity level of Q20; and

   (b) a hospital and associated facilities must achieve a flood immunity level of Q500.

8. Therefore, while it might be convenient to refer to DFL or Q100, it is important to remember that the required flood immunity is a factor of the particular development and an acceptable level of hazard, and therefore the required flood immunity will vary between development types.

9. Third, the differing flood immunity levels specified in the planning scheme reflect policy judgments about the balance between managing public safety and the risk of economic loss from flooding, on the one hand, and permitting normal residential and economic activity to occur, on the other.

10. Fourth, although flood immunity levels might change from time to time, it is normal town planning practice that changes to such levels do not have retrospective effect (i.e. existing lawful uses can continue). Therefore, as a general policy property owners are permitted to maintain and rebuild existing premises on a like for like basis.

11. Fifth, this statement focuses on Brisbane River flooding and does not deal in any detail with flood immunity levels for other sources of flooding. However, Council has flood immunity levels applied through its planning scheme for other sources of flooding including tidal surge, overland flow and cr[redacted]looding. In general terms, the approach to flood immunity levels for

[redacted]

these flooding sources is the same as that described in detail in this Statement in respect of Brisbane River flooding.

Response to the Notice

1.	**A summary of the assessment criteria contained in council's planning scheme(s) and how such criteria are used to assess applications for development in the natural hazard management area.**
2.	**A description of how the natural hazard management area, as it relates to flood affected land, is reflected in the planning scheme.**

12. It is convenient to respond to Topics 1 and 2 of the Notice together.

13. I refer to Council's Submission 2 dated 8 April 2011, which has been provided to the Commission (**Submission 2**).

14. In responding to Topics 1 and 2, I particularly refer to paragraphs 4.18 to 4.39 inclusive, and 5.1 to 5.34 inclusive of Submission 2, as well as the Glossary at paragraph 3.1.

15. Since Submission 2 was provided to the Commission, Council has:

    (a) implemented the *Temporary Local Planning Instrument 01/11 - Brisbane Interim Flood Response* (**TLPI**). Attachment **MJR-3** is a copy of the TLPI; and

    (b) by the TLPI, adopted an interim residential flood level as the basis for development assessment, which is described as the higher of:

        (i) the Brisbane River - January 2011 Event; or

        (ii) the DFL based on the Brisbane River flood event using a flood height profile of 3.7 metres AHD at the Brisbane City Gauge.

16. The term "*natural hazard management area*" is contained in *State Planning Policy 1/03 - Mitigating the Adverse Impacts of Flood, Bushfire and Landslide* (**SPP 1/03**). For the purposes of this Statement, I have assumed this is the context in which the Commission is seeking information. Attachment **MJR-4** is a copy of SPP 1/03.

17. SPP 1/03 de[redacted]hazard management area as follows:

[redacted]

Martin James Reason

"an area that has been defined for the management of a natural hazard (flood, bushfire or landslide), but may not reflect the full extent of the area that may be affected by the hazard (e.g. land above the 1% AEP floodline may flood during a larger flood event)".

Natural hazard management areas regarding flood, bushfire or landslide are described in Annexure 3 to SPP 1/03.

18. In relation to flooding, Annexure 3 of SPP 1/03 goes on to provide as follows:

(a) "*A3.1 - A natural hazard management area (flood) is land inundated by a Defined Flood Event (DFE) and identified in a planning scheme.*"

(b) "*A3.2 - The Queensland Government's position is that, generally, the appropriate flood event for determining a natural hazard management area (flood) is the 1% Annual Exceedence Probability (AEP) flood. However, it may be appropriate to adopt a different DFE depending on the circumstances and individual locality. This is a matter that should be reviewed when preparing or undertaking relevant amendments to a planning scheme.*"

19. Council's adopted planning scheme is *City Plan 2000* (**City Plan**) which took effect in late 2000. City Plan does not expressly use the term "*natural hazard management area*", but rather imposes planning restrictions and controls on development below Council's DFL or Q100 level, as applicable. In addition, in some cases City Plan requires that buildings be constructed an additional height above predicted flood levels where applicable. This is referred to as "*freeboard*". The amount of freeboard required depends on the particular development being considered.

20. The view of John Gaskell Planning Consultants who provided a report titled *Brisbane City Council - Natural Disaster Risk Management and the City Plan - Consideration of SPP 1/03* is that strict compliance with SPP 1/03 would require the incorporation into City Plan of maps which show the natural hazard management area. Attachment **MJR-5** is a copy of the Report. City Plan does not contain such a map.

21. However in my opinion, the amount of complex and dynamic information relevant to a large and active [redacted] such as Brisbane City is too extensive to be practically contained in such

a map within the planning scheme. While there is no single map of the natural hazard management area in City Plan, Council has a publicly available and detailed flood mapping system. I understand this system has been previously described in Council submissions and statements. Any person can identify the flood hazard area for any part of the City by a simple search either over the internet or in person at one of Council's Customer Service Centres. Those searches give access to individual FloodWise Property Reports for each property and Flood Flag Maps for each suburb or area which show areas of potential inundation based on Council's various flood immunity levels (DFL for River flooding and relevant levels for other sources of flooding).

22. I also note that, although City Plan, in its original form, pre-dates the adoption of SPP 1/03 and therefore does not adopt the terminology "*natural hazard management area*", the amended City Plan relevantly provides that:

> "*ongoing consultation with the State Government agencies occurred throughout the preparation of the plan to ensure that local level policy complements regional and State policies. City Plan explicitly recognises, and is consistent with, the following State planning policies...State Planning Policy 1/03 - Mitigating the Adverse Impacts of Flood, Bushfire and Landslide.*"

23. I was not involved in setting Council's policies regarding flood immunity levels. I can, however, provide details of the policy and the basis on which the policy was determined based on Council documentation available to me. In particular, Council's current approach to flood planning controls for Brisbane River flooding is explained in a memorandum to the Establishment & Co-ordination (**E&C**) Committee dated 24 November 2003 entitled: "*Setting of Flood Development Levels and Adoption of New Flood Measurement Standards.*" Attachment **MJR-6** is a copy of the memorandum.

24. The memorandum relevantly states:

"*Throughout this document the terminology Q100 is used. Q100 refers to the flow that has a 1 in 100 chance of being exceeded in any year. Q100 is equivalent to the 100 year Average Recurrence Interval (100 year ARI) terminology used in some publications. As the flow varies along the river we relate the flow to a reference point. For the present purpose Q100 refers to the flow in the river at the Brisbane Port Office gauge which is near the corner of Edward and Alice Streets.*

[redacted]

Martin James Reason **W** [redacted]

Administrative Policy No. AP065 - Erection of Dwellings in Flood Prone Areas was adopted by E&C on 30/10/78. The policy states that flood levels are a basis for recommending habitable floor levels of dwellings erected in areas prone to Brisbane River flooding, and that the 3.7m AHD flood level at the Brisbane City Gauge applies. It is recommended that, while this standard remain the same for habitable development, the nomenclature be changed to separate this standard from the standard pertaining to other structures requiring Q100 information as part of the design process eg pontoons.

In 1984 a BCC study determined that Q100 = 6,800 cumecs (m^3/sec) which corresponds to 3.7m AHD at the Brisbane Port Office. A committee comprising representatives from BCC and the State Government signed off on this flow in November 1984.

A graph is used to determine flood levels along the length of the river corresponding to the 3.7m AHD level at the Brisbane Port Office gauge. The graph was prepared in 1988 and has been used ever since to set development levels along the river. It is proposed that the levels interpreted from this graph continue to be used for development purposes.

...

The expert panel determined [in September 2003] that the plausible range for the Q100 flow in the Brisbane River is 5,000 to 7,000 cumecs, corresponding to levels of 2.8 to 3.8m AHD respectively. Thus the current Q100 of 6,800 cumecs is within the plausible range.

The expert panel's best estimate is that Q100 is 6,000 cumecs. This corresponds to 3.3m AHD at the Brisbane Port Office Gauge. The panel advised that the best estimate of Q100 and the corresponding flood level at the Brisbane Port Office provide sufficient basis for a decision on whether the currently adopted flood levels are broadly acceptable.

Currently flood immunity levels adjacent to the Brisbane River are based on 3.7m AHD at the Brisbane Port Office, which is the equivalent of 6,800 cumecs. On the basis that this level is within the plausible range determined by the expert panel, and given the uncertainty in estimation of flows and corresponding flood levels, climate variability and the accuracy of prediction methods it is appropriate to maintain the flood immunity levels for development purposes.

The following is a history of habitable floor levels in residential developments adjacent to the river:

[redacted]

[redacted]

Year	*Standard for Habitable Floor*
1992	*Q100*
1997 approximately	*Q100 + 525 mm*
2000 City Plan House Code and Subdivision and Development Guidelines	*Q100 + 500 mm*

The Subdivision and Development Guidelines are read in conjunction with City Plan. Section 2.0 of the Guidelines titled "Flood Affected Land" tabulates Minimum Flood Immunity Levels for developments (eg development level for habitable floors = 100 year ARI + 0.5m (= Q100 + 500mm)).

The National Floodplain Management Manual 2000 introduces the concept of a Defined Flood Level (DFL). The DFL is set by the relevant agency (in this case BCC) and corresponds to the Q100 level, or some other flow based on a historical flood event. It is proposed that Q100 be replaced with DFL along the Brisbane River. Further, it is proposed that the DFL be based on the level that has been used for setting development levels on the river for at least the past 15 years, ie 3.7m AHD at the Brisbane Port Office, which corresponds to a flow at 6,800 cumecs at that location.

..."

(It should be noted that the 2008 version of the Subdivision and Development Guidelines refer to DFL +500mm).

25. On 2 December 2003, the E&C Committee decided:

"*THAT IT BE RESOLVED THAT -*

(i) As:

(a) Council has now definitive and reliable advice from an expert panel on appropriate Q100 flow and level at the Brisbane Port Office Gauge;

[redacted]

[redacted]

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(b) *on the basis of that advice, it is appropriate that Council reconsider its published position in relation to Brisbane River Flood Levels;*

(c) *the expert panel's estimate of the Q100 flow at the Brisbane Port Office Gauge is in the range of 5,000 to 7,000 cumecs with a best estimate of 6,000 cumecs;*

(d) *this range indicates that the current adopted flood immunity level of 3.7m AHD is still the most appropriate level;*

(e) *current best practice indicates the adoption of a new measurement standard called the "Defined Flood Level" in the [sic] addition to 100 year (Q100) flow methodology;*

THEN COUNCIL:

(1) *ADOPTS THE EXPERT PANEL'S BEST ESTIMATE OF THE NEW Q100 FLOW AT THE BRISBANE PORT OFFICE GAUGE TO BE 6,000 CUMECS;*

(2) *DETERMINES THAT THE CURRENT ADOPTED FLOOD IMMUNITY LEVEL OF 3.7m AHD AT THE BRISBANE PORT OFFICE GAUGE IS STILL THE MOST APPROPRIATE LEVEL;*

(3) *DETERMINES as a consequence of (1) and (2) THAT THERE IS NO NEED TO CHANGE CURRENT DEVELOPMENT LEVELS FOR PROPERTIES ADJACENT TO THE BRISBANE RIVER;*

(4) *DETERMINES THAT IN FUTURE, THE FLOOD LEVEL USED TO SET DEVELOPMENT LEVELS FOR PROPERTIES ADJACENT TO THE BRISBANE RIVER BE DETERMINED BY THE "DEFINED FLOOD LEVEL" AS SET BY COUNCIL;*

(5) *DETERMINES THAT THE CURRENT DEFINED FLOOD LEVEL BE SET AT 3.7m AHD AT THE BRISBANE PORT OFFICE GAUGE;*

[redacted] [redacted]

Martin James Reason

Attachment **MJR-7** is a copy of the E&C decision.

26. As can be seen from the above history, the position may be summarised as follows:

(a) Since about 1978, it has been Council policy that flood levels are a basis for recommending habitable floor levels of dwellings erected in areas prone to Brisbane River flooding. At that time, Council adopted the level of 3.7m AHD at the Brisbane City Gauge, requiring habitable floor levels to be built to at least this level.

(b) In 1984, a Council study determined that Q100 = 6,800 cumecs (m^3/sec), which corresponds to 3.7m AHD at the Brisbane City Gauge.

(c) In 2003, the expert panel conducted a review and determined that the best estimate of Q100 = 6,000 cumecs (m^3/sec), which corresponds to 3.3m AHD at the Brisbane City Gauge. The expert panel found that the range for the Q100 flow in the Brisbane River is 5,000 to 7,000 cumecs, corresponding to levels of 2.8 to 3.8m AHD, respectively. The earlier Q100 of 6,800 cumecs was therefore within this range.

(d) In December 2003, on the basis that the 3.7m AHD level was within the range determined by the expert panel, and given the uncertainty in estimation of flows and corresponding flood levels, climate variability and the accuracy of prediction methods, Council resolved it was appropriate to maintain the flood immunity level of 3.7m AHD at the Brisbane City Gauge for development purposes. This level (being the prior Q100) has been referred to, since December 2003, as the DFL for Brisbane River flooding.

27. Further, from about December 1997 (with the introduction of the Subdivision and Development Guidelines), Council required an additional height above DFL of up to 500mm, by way of freeboard, as part of its development flood controls.

28. As set out in paragraph 18(b) above, the Queensland Government's position under SPP 1/03 is that "*the appropriate flood event for determining a natural hazard management area (flood) is the 1% Annual Exceedence Probability (AEP) flood*".

[redacted] [redacted]

29. The "*1% Annual Exceedence Probability (AEP) flood*" referred to in SPP 1/03 is also known as the Q100 flood. As explained above, the current Q100 for the Brisbane River was calculated to be 6,000 cumecs, which corresponds to 3.3m AHD at the Brisbane City Gauge.

30. However, Council generally adopts the DFL (3.7 AHD at the Brisbane City Gauge) as the flood level used to set development levels for properties adjacent to the Brisbane River, in some cases together with a specified amount of additional freeboard.

31. City Plan implements the flood immunity standards (Q100 or DFL, whichever is relevant to the particular development) to provide for a site by site assessment of development, including assessment of flood risk impact.

32. City Plan implements the DFL, or such other relevant immunity levels as referred to in paragraph 7 above, through various Codes. All development proposals subject to the planning scheme are assessed against these Codes.

33. Council requires development to comply with the applicable flood immunity levels specified in the Codes. However, City Plan cannot under the *Sustainable Planning Act 2009* (Qld) (consistently with the position under the previous *Integrated Planning Act 1997* (Qld)), absolutely prohibit development below the applicable immunity level. The development assessment process must contemplate the possibility that development might not meet the flood immunity level but still meet the requirements of City Plan. However, it is very difficult to demonstrate that an acceptable level of flood immunity has been achieved by any means other than by compliance with the flood immunity level specified in the Codes.

34. There is a conceptual difference in the way that self-assessable and code assessable development is assessed on the one hand, and impact assessable development is assessed on the other. That difference rarely effects the way in which the flood immunity standards in City Plan are ultimately applied in the assessment of the development. For the purposes of this Statement, I consider it sufficient to focus on the manner in which flood immunity standards are applied in code and self assessable development.

35. The general application of the Codes is as follows.

36. Each Code has a Purpose, Performance Criteria, and Acceptable Solutions relating to each Performance Criteria. The Codes are applied in assessment of development in the following mann[redacted]

Martin James Reason

(a) The requirement for approval is that the development fulfil the Purpose of the Code.

(b) If a development proposal complies with the Acceptable Solution, it will be deemed to comply with that part of the Purpose of the Code.

(c) If a development proposal does not comply with the Acceptable Solution, it will be assessed against the relevant Performance Criteria in the Code.

37. So, for example, the House Code provides, relevant to flood immunity:

(a) The purpose of the House Code is, relevantly, to ensure that houses are not subject to unreasonable hazards or noise because of their location;

(b) By Performance Criterion P6, that "*Habitable rooms, non–habitable areas (e.g. utility areas, garage, laundry and storage room) have acceptable levels of flood immunity*"; and

(c) By Acceptable Solution A6.2, that "*Where a lot is on floodable land, the minimum levels for non–habitable areas (including utility areas, garage, laundry and storage room) are not less than those set out in Table 1*" (where Table 1 refers, for habitable floor levels, to the 100 year ARI level plus 500mm).

38. Generally, houses compliant with the Acceptable Solutions of the House Code are self-assessable and an application to Council is not required. Compliance in these instances is confirmed through certification by a private certifier.

39. Development for a house which does not comply with the Acceptable Solutions is subject to assessment by Council. In assessing the application, Council must consider the Performance Criteria of the House Code, and in particular, the flooding requirements. Therefore, it is open to an applicant to demonstrate to Council that it can achieve the performance criterion in some alternative way. Thus, the prospect exists that development that does not meet the specified habitable floor level could nonetheless be approved. That said, I cannot think practically how this would be achieved.

40. For all other assessable development a similar method is applied to that described above in implementing flood immunity levels through the planning scheme. Outside development assessed against the House Code, the primary mechanism for assessment of a development pro[redacted]sal aga[redacted]ncil's flood immunity standards is [redacted] Subdivisio[redacted] and Development

Guidelines. The Subdivision and Development Guidelines are called-up by either a Primary Code or via a Secondary Code. All development is assessed against a Primary Code. For example, subdivision is assessed against the Subdivision Code (which is a Primary Code) and often, also against Secondary Codes which supplement the Primary Code. An example of a Secondary Code is the Stormwater Management Code.

41. The Acceptable Solution and Performance Criteria approach described for the House Code above applies in general terms to assessment against these other Codes.

42. As set out in paragraph 4.33 of Submission 2, the relevant tables in the House Code use the terminology "100 year ARI" rather than "DFL". However, there do not appear to be any practical impacts for flood immunity levels arising from the terminology used, because the levels specified in FloodWise Property Reports (which are the primary source of information for flood immunity levels available to the public) are based on the DFL of 3.7m at the Brisbane City Gauge. Attachment **MJR-8** is an example FloodWise Property Report for a property near the Brisbane City Gauge on Thornton Street at Kangaroo Point showing the "Q100" at 3.7m AHD.

43. Figure 1 provides a general summary of common development activity and how it might be considered under the City Plan. It describes scenarios which are subject to the full range of levels of assessment provided for in the *Sustainable Planning Act 2009* (Qld), including exempt development, self-assessable development, code assessable development, and impact assessable development. It also outlines, by example, how the Codes are applied in assessing development applications against the flood immunity provisions of City Plan.

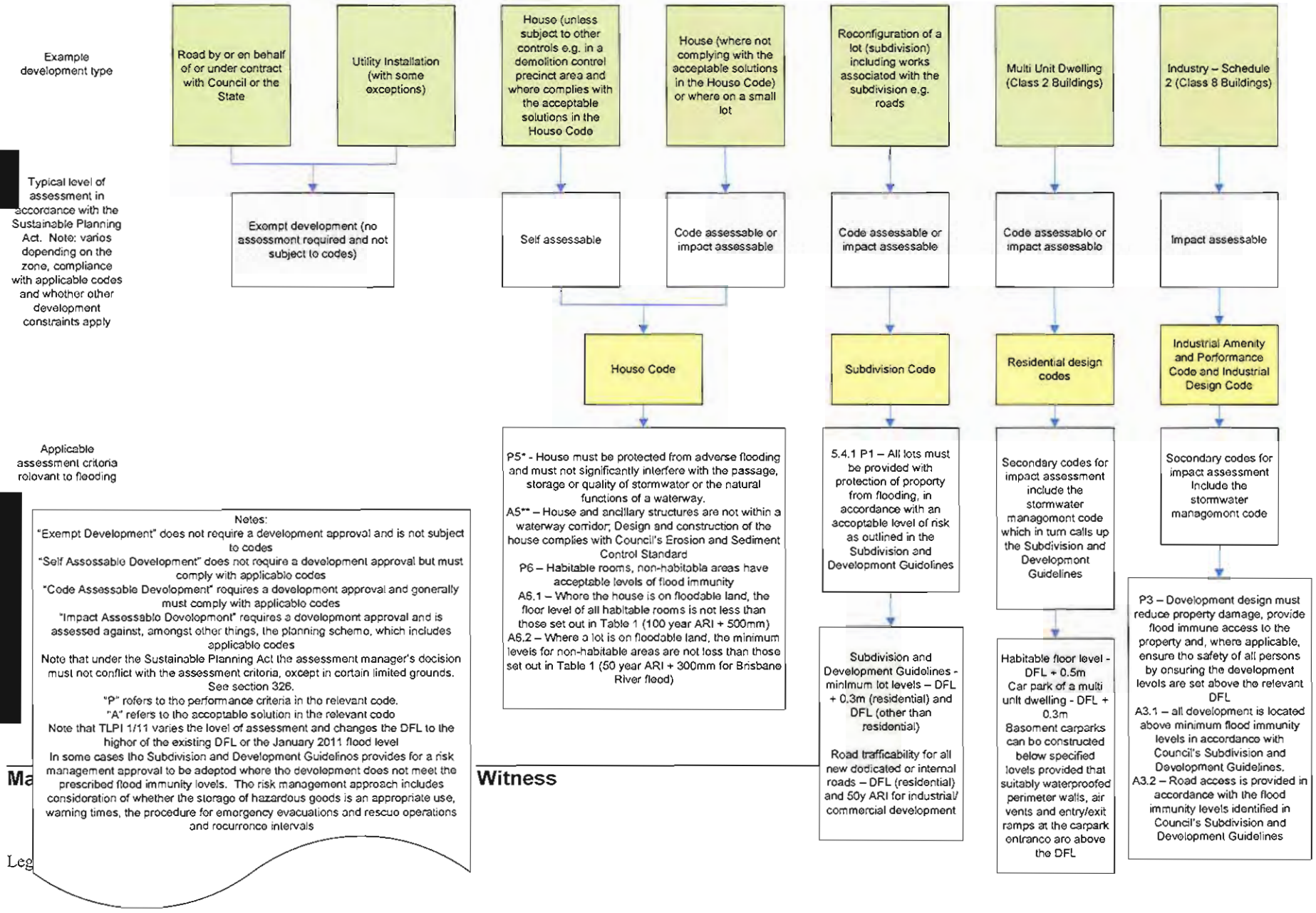
[redacted]

Martin James Reason

[redacted]

[redacted]

Figure 1: High level examples of flood assessment criteria for selected development scenarios under City Plan 2000



[redacted]

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3.	**Details of Council's defined flood event including a description of:**	
	(a)	**how the defined flood event was chosen;**
	(b)	**the way in which the council's defined flood event was calculated or determined.**

44. This topic does not fall within my area of particular area expertise. However, I am able to provide the information set out below from Council records.

45. The report of the Joint Flood Taskforce dated 8 March 2011 confirms that Council's Defined Flood Event **(DFE)** is a theoretical event. It is a design flood determined by reference to the 1974 flood event as mitigated by construction of the Wivenhoe Dam (which was constructed after 1974). The DFE for Brisbane River flooding reflects a theoretical Brisbane River flood event having a flow of 6,800 m^3/s with a resulting DFL measuring 3.7m AHD at the Brisbane City Gauge. The DFL reflects the slope of the flood profile and thus increases in level height progressively upstream and decreases in level height downstream from the Brisbane City Gauge. As commented earlier, this level was first adopted in 1978 and was reconfirmed in 2003 following peer review by an independent panel of experts.

46. It has been set out in paragraphs 24 to 26 the process by which Council formally adopted the DFL. The history of how the DFE was chosen and the way in which the DFL was determined and calculated, together with the sources of the information, are set out in the following paragraphs (based on Council documents).

47. The concept of setting the "*habitable floor level*" for post 1974 development by reference to the anticipated flood level at the development site taking into account the likely mitigating effect of the Wivenhoe Dam was initially proposed by Council in 1976. On 4 August 1976, Council's Manager Department of Health, Parks and Building prepared a memorandum in the following terms:

"*Approval for the Erection of Dwellings in Flood Prone Areas*

As a result of detailed surveys and debris levels recorded by Council surveyors after the January '74 Flood, the effect of the flood on land in many areas was plotted on 4 chain maps and this information has been used as a basis for determining the suitability of a site for residential development.

[redacted]

Martin James Reason

[redacted]

It has been the practice on receipt of a building application for the erection of a dwelling on land affected by the flood to forward a standard memo to the Works Department seeking their comments, and until such time as a reply is received the applicant is informed that approval of the building application must be withheld.

Information which is received from the Works Department sets out in detail the extent to which the site was flooded and the anticipated reduced level after the construction of the Wivenhoe Dam.

When the habitable floor level of the dwelling as designed will be above the anticipated flood level after the Wivenhoe Dam has been constructed, it has been the practice of the Department to recommend that the building application be approved, subject to the lower part of the house not containing any habitable room, and all material used in this area to be flood resistant, such as concrete block, brickwork or concrete."

The memorandum went on to provide:

"... a recommendation that, on receipt of a building application for the erection of a dwelling on a site in a flood prone area, the applicant be referred to the Department of Works for comments, and approval granted in those cases where investigations have revealed that the floor level of any habitable rooms will be above the anticipated flood level after the Wivenhoe Dam has been constructed, and any part of the dwelling below this level to be constructed out of flood resistant material such as concrete block, brickwork or poured concrete."

48. On 13 September 1976, Council's E&C Committee approved this memorandum. Attachment **MJR-9** is a copy of the memorandum.

49. On 21 March 1978, [redacted] Engineer, Council's Department of Water Supply and Sewerage prepared a memorandum stating that flood frequency studies (using flows at Moggill) had been carried out to determine the frequency of river flooding in the Brisbane area. The analyses were carried out for existing conditions (i.e. on basis that only the Somerset Dam was built at that time) and for conditions after the construction of the Wivenhoe Dam with a flood storage of 1.4 million megalitres. Three different probability distributions were fitted to the plotted positions of the data for both of these conditions. The distributions tested were "Log Pearson Type III", "Pearson Type III" and "Boughton's Empirical".

50. [redacted]ed in the memorandum dated 21 March 1978 [redacted]

Martin James Reason Wi[redacted]

"...

For existing conditions Log Pearson Type III was marginally the best fit while Boughton's Empirical was the best fit for the post-Wivenhoe data.

...

Reference to Fig. (ii) shows that Boughton's Empirical function cannot be significantly bettered as a curve of best fit for post-Wivenhoe data."

51. The Boughton Empirical curve for the post-Wivenhoe condition attached to [redacted] memorandum dated 21 March 1978 shows an ARI 100 flow of in the order of 6,800 m^3/s and an ARI 100 level of in the order of 3.7m AHD at the Brisbane City Gauge. Attachment **MJR-10** is a copy of the memorandum and Boughton Empirical curve.

52. On 30 October 1978, the E&C Committee approved a memorandum dated 31 August 1978 from Council's Chief Engineer and Manager, Department of Works. This memorandum noted that Council's Works Department advised that the anticipated effect of the proposed Wivenhoe Dam was to reduce a 1974 type River flood from a level of 5.5 m to approximately 3.7 m AHD at the Brisbane City Gauge. The mitigated 3.7 m flood was estimated to be an average 1 in 100 year event. This was considered to be the minimum desirable immunity standard. The memorandum recommended:

> "*That the 3.7 m flood at the Brisbane City Gauge be retained as a basis for recommending habitable floor levels of dwellings in areas prone to Brisbane River flooding.*"

Attachment **MJR-11** is a copy of the memorandum dated 31 August 1978.

53. Administrative Policy No. AP065 - 'Erection of Dwellings in Flood Prone Areas' (**Policy AP065**) was adopted by the E&C Committee on 30 October 1978. It adopted 3.7m AHD at the Brisbane City Gauge as the recommended habitable floor level of dwellings erected in areas prone to Brisbane River flooding based on the recommendation above.

54. On 5 December 1978, Council adopted the '*Brisbane River Floods – Restriction on Residential Use*' Policy. This policy confirmed the 3.7 m AHD Brisbane City Gauge level required by Council for the floor level of any habitable room and for site access and roads for

applications in respect of a subdivision of land for residential allotment. Attachment **MJR-12** is a copy of the Approval.

55. On 18 September 1984, [redacted] prepared a further memorandum which included the flowing information:

"*The Effect of Wivenhoe Dam on the Frequency of Flooding in the Lower Brisbane River*

With both the Wivenhoe Dam and the manual of flood control operations for the Somerset Dam - Wivenhoe Dam system nearing completion, it has been necessary to re-examine the effect of Wivenhoe Dam on the frequency of flooding in the urban areas.

The flood maps published in 1975 quoted flood frequencies calculated for Somerset Dam alone in operation. In 1977, once construction on Wivenhoe Dam had commenced, a study of the effect of Wivenhoe Dam on the historical floods was completed. A flood control strategy was assumed and the resultant flood discharges were subjected to frequency analysis. The Boughton distribution was judged to be the best fit distribution and this distribution has been used to estimate the frequencies of floods with Wivenhoe Dam also in operation.

...

The probability plot of flood discharges with Wivenhoe Dam in operation is shown on Figure 1, the discharges for the floods of 1893 and 1974 corresponding to discretionary operation.

...

The Boughton distribution frequency curve calculated in 1978 is plotted by comparison. There is no appreciable difference between the straight line and the curve for probabilities less than 1% ..."

Attachment **MJR-13** is a copy of the memorandum dated 18 September 1984.

56. A memorandum dated 22 July 2003 from the Manager Water Resources and the Manager City Design to Council's Chief Executive Officer sets out the following chronology from the date of [redacted] second memorandum of 18 September 1984:

(a) The flood frequency curve (see above) was distributed to a Brisbane River Flood Maps Committee established by the Coordinator General's Department. The Committee adopted the flood frequency curve on 8 November 1984.

(b) In 1985, the 1975 pre-Wivenhoe flood profile chart was modified to include the probabilities for Wivenhoe Dam in place. These probabilities with Wivenhoe Dam in place were based on the 1984 flood frequency curve.

(c) A subsequent chart based on the 1985 chart was drawn by Council's Works Department in 1988. This includes a Q100 profile that corresponds to the 3.7 m Brisbane City Gauge flood profile. The 1988 chart shows river levels and flows for flood frequencies from 1 in 25 to 1 in 50,000 for the Brisbane River from Mt Crosby to Luggage Point.

Attachment **MJR-14** is a copy of the memorandum dated 22 July 2003, including the 1988 chart.

57. Council continued to model and review flood levels for the Brisbane River. In 2003, the expert Independent Review Panel (**Independent Panel**), referred to earlier, was commissioned for the purpose of reviewing the findings of studies undertaken by Council and its consultants.

58. As noted earlier, the current Q100 for Brisbane River flooding was determined by the Independent Panel in a Report dated 3 September 2003. The Independent Panel also endorsed the continuing use of the (higher) control level of 3.7m AHD at the City Gauge.

Attachment **MJR-15** is a copy of the Independent Panel's Report.

59. The membership of the Independent Panel was:

(a) Professor Russel Mein (Chair) - Former CEO of the Cooperative Research Centre for Catchment Hydrology for Catchment Hydrology and former Chairman of the Australian Rainfall & Runoff Advisory Panel;

(b) Professor Colin Apelt - Former Head of the Department of Civil Engineering, University of Qld;

(c) Dr John Macintosh - Chairman of Engineers Australia National Committee on Water E[redacted]eering; and

[redacted]

Martin James Reason Wit[redacted]

(d) Erwin Weinmann - Deputy Director of the Cooperative Research Centre for Catchment Hydrology (Monash Node), Senior Lecturer in water subjects at Monash University, and co-author of Book VI of Australian rainfall and runoff (estimation of large and extreme floods).

60. The Independent Panel was appointed by Council in July 2003 to provide advice on, and to make an expert assessment of, a study then being conducted by Sinclair Knight Mertz (SKM) on the design flood flows and levels in the Brisbane River.

61. Specifically, the Independent Panel found that, based upon the evidence available, the best current estimate for the Brisbane City Gauge is that the Q100 flow is 6,000 m^3/s with a corresponding Q100 level of 3.3 m AHD. The Independent Panel was of the opinion that a plausible range for the Q100 flow and level was 5,000 to 7,000 m^3/s and 2.8 m to 3.8 m AHD, respectively. The Independent Panel found that this best estimate of Q100, and the corresponding flood levels at the Brisbane City Gauge, provided a sufficient basis for a decision by Council on whether the flood level of 3.7 m AHD adopted by Council (since 1978) was broadly acceptable.

62. A decision was subsequently made by Council on 2 December 2003, with the benefit of the Independent Panel's findings, to maintain the DFE at 6,800 m^3/s.

63. Subsequently, a study on the Probable Maximum Flood (**PMF**) of the Brisbane River was completed by Council in 2009. I understand that the PMF defined in the SPP1/03 is the largest flood that could reasonably occur at a particular location resulting from the probable maximum precipitation. The PMF defines the extent of flood-prone land. Generally, it is not physically or financially possible to provide general immunity against this event. The PMF Study indicates that the reason for this study was to inform Council's flood emergency response capability up to and including the PMF.

64. The flood emergency response tools or key deliverables from this project include:

(a) inundation mapping;

(b) critical infrastructure mapping and reporting;

(c) isolated area mapping; and

(d) [redacted]ne mapping.

[redacted]

Martin James Reason **Witne**[redacted]

Attachment **MJR-16** is a copy of the PMF Study.

65. Council also prepares a range of studies to support flood planning and the management and mitigation of flooding for local areas and creeks.

4.	**A description of any planning requirements to have evacuation routes and/or early warning systems for areas identified to be at high risk of flooding, including information about how the existence of such evacuation routes and/or early warning systems are communicated to occupiers of areas at high risk of flooding.**

66. City Plan does not specifically require that early warning systems or evacuation routes for areas at high risk of flooding be imposed, if by that the Commission means planning requirements which regularly compel the development of evacuation plans and evacuation routes as part of the development assessment process for all development applications.

67. However, the matter of evacuation plans and early warning systems is not entirely unaddressed in the planning policies under the City Plan. I refer to clause 4.2 of the Subdivision Development Guidelines which relevantly provides:

> ***4.2 RISK MANAGEMENT APPROACH***
>
> ***4.2.1 General***
>
> *Flood risk management is a formal means of identifying and managing the existing, future and residual risks of flooding. A suitably qualified professional consultant must be engaged to undertake the risk management evaluation in accordance with the framework outlined in AS 4360 Risk Management. The key aim is to ensure that risks (including safety, environmental, social and economic) associated with the proposed use are compatible with the level of flood immunity. For example a warehouse for the purpose of storing perishable goods such as fruits and vegetables will incur less flood damage losses when compared to a warehouse used to store electrical appliances. The storage of hazardous chemicals may not be an appropriate use.*
>
> ***4.2.2 Warning Time***
>
> *Flood hazard can be reduced by evacuation if adequate time is available. The longer the warning period, the greater time there is available for evacuating people and removing*
>
> [redacted]*ever, even if p*[redacted]*uated, a flood*

will still cause significant damage to buildings and to infrastructure and still cause substantial community disruption.

Available warning time is determined largely by catchment characteristics. The larger the catchment and the slower the rate of rise of floodwaters, the longer the available warning time. In small steep catchments, there is often no available warning time as the catchments respond too quickly.

Brisbane City Council has a flood forecasting model that utilises Council's network of real time rainfall and flood level monitoring systems and flood modelling program, together with Council's geographical information system (BIMAP) to provide a flood warning and information service to the community. Brisbane River can take a day to peak between Wivenhoe dam and the Brisbane City Gauge, thus allowing time to disseminate flood warnings.

4.2.3 Scope of Application

The risk assessment only applies to a select group of building types (nominated in Table A1.3) proposed in development sites located in established areas that do not meet the prescribed flood immunity standard for Brisbane River.

4.2.4 Risk Management Process

There are instances where the exact use is not known (eg centre and industrial activities) and instances where the use is known (eg lobby of an apartment block). Therefore the risk management formulation should cover a range of proposed and likely uses. The key elements of the flood risk management process should include:

1. Identification of the stakeholders exposed to or affected by the risk of flooding.

2. Identification of public and private property, social systems and environmental elements at risk of flooding.

3. Estimation of flood risks ie the likelihood and consequences of flooding. This evaluation will involve the undertaking of a quantitative analysis that uses numerical values (rather [redacted] *ales used in qualit* [redacted] *for both*

[redacted]

consequences and likelihood. The quality of the analysis depends on the accuracy and completeness of the numerical values used.

4. Assessment of the acceptability of flood risk. This evaluation will involve the determination of the total flood damage (potential) for a range of annual exceedance probabilities (PMF, 1%, 2%, 5%, 10%, 20%, 50%), and the average annual damage. Flood damages are generally divided into two categories of tangible and intangible damages. Tangible damages are financial and can be measured in monetary terms. Intangible damages are usually difficult to estimate in financial terms. The owner (and future owners) must assume all responsibility and all liability for all losses, damages and costs that might be incurred as a result of the reduced flood immunity standards.

5. Definition of flood risk management strategies. As a minimum, this assessment must address the following items.

- *The proposed method of perpetuating the restricted use (through appropriate forms of legal documentation, notation on titles, rate notices, etc) and conveying the risk management data to future owners and leaseholders.*
- *The procedure to conduct emergency evacuation and rescue operations.*

[underlining added]

68. While for some applications it would be consistent with the Subdivision and Development Guidelines for Council to impose conditions on a development approval requiring early warning and evacuation planning, the group of building types nominated in clause 4.2.3 involve a narrow range of buildings and structures in which the risk management approach described in clause 4.2 could be applicable.

69. I am also aware of the possibility that in the case of impact assessable development, the assessment of which may involve consideration of high level criteria contained in the Strategic Plan, it may be open to Council to impose conditions relating to early warning and evacuation. The Strategic Plan relevantly provides, in respect of the supporting strategy to meet the Desired Environmental Outcome of Natural Environment and Waterways:

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3.2.2.8 Achieve a safe, secure, equitable and comfortable City through:	. . . *(c) **reducing risks**—planning to reduce the risks of loss of life, injury, property damage and community disruption resulting from landslip, subsidence, flooding, bushfires, storms and other emergencies and disasters, mindful of the need to maintain emergency access, egress and escape routes to facilitate emergency response* . . .

70. I also note in relation to evacuation routes that Council's planning scheme requires new roads in all new subdivisions and all significant infill subdivisions to be constructed at DFL (residential subdivision) and 50 year ARI (commercial and industrial development).

71. Attachment **MJR-17** is an example of conditions imposed on a development approval by Council requiring early warning and/or evacuation plans.

5. A description of any controls or standards used to assess the storage of chemicals or other Environmentally Relevant Applications for development below the Q100 flood line or the Council's defined flood event.

72. I understand it is the intention of the Commission that my response to this query address Environmentally Relevant Activities (**ERAs**) under the *Environmental Protection Act 1994* (Qld) (**EP Act**). I further understand that the Commission's requirement is directed towards those particular ERAs that have been devolved to Council.

73. I have set out below Council's interpretation of the relevant controls and standards relating to ERAs.

74. Pursuant to section 101 of the *Environmental Protection Regulation 2008*, the administration and enforcement of the EP Act in relation to specified Chapter 4 activities is devolved to the local government for the local government area where the activity is, or is to be, carried out. The devolved activities include poultry farming, boiler making or engineering, motor vehicle workshop operation, chemical storage within certain thresholds, metal recovery within certain thresholds, surface coating within certain thresholds, as well as others.

[redacted]

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75. An application for an ERA is not assessed against City Plan, but rather the relevant assessment criteria as specified in the EP Act. It is my understanding, based on discussions with relevant officers in Council, that the assessment criteria in the EP Act do not include criteria relating to storage of chemicals or other hazardous materials within floodable areas.

76. Applications for ERAs will sometimes be lodged either concurrently with, or subsequent to, other development applications relating to the planning use of the land to accommodate that particular ERA. It is this "planning use" application (be it for the subdivision of land or a material change of use) that enlivens Council's assessment under City Plan and controls on development on land that is affected by the Q100 or DFL.

77. In these instances, the assessment process as set out in Figure 1 of Submission 2, Figure 1 of this Statement and the responses to Topics 1 and 2 above will apply, with the applicable flood standards being applied to the development.

6. A description of any conditions imposed by Council on the approval of development applications to ensure that hazardous materials affected by flood water do not affect public safety and/or the environment.

78. In answering this query, I have assumed that the Commission by the term "*hazardous materials*" is inferring something separate to a development applications for approval for an ERA (which is addressed above).

79. Under the definitions of City Plan, development applications that will involve the storage, manufacture, or use of "*hazardous materials*" will generally fall within the definition of Industry - Schedule 2 identified in Chapter 3 of City Plan.

80. Industry - Schedule 2 is defined to include the storage, handling, use or production of dangerous goods as defined in the Australian Code for the Transport of Dangerous Goods where meeting the class and quantity thresholds prescribed in City Plan.

81. Industry - Schedule 2 is generally impact assessable development for City Plan and is assessable against the Industrial Amenity and Performance Code and Industrial Design Code.

82. Council's Subdivision and Development Guidelines are called up through the Industrial Design Code which also calls up the Stormwater Management Code, as shown in Figure 1 of

[redacted] [redacted]

83. Council applies the same assessment considerations in relation to proposed development within the Industry - Schedule 2 category in areas subject to flooding as set out in the response to Topics 1 and 2 and set out in section 4 of Submission 2. This includes matters in relation to waterway health which are contained within the Waterways Code.

84. In addition to the incidental regulation of storage of hazardous materials arising from requirements for industrial development set out above, Council also on some occasions imposes conditions on the approval of development applications targeting directly the storage of hazardous material above relevant flood immunity levels.

85. Attachment **MJR-18** contains an example of conditions imposed on development approvals by Council relating to storage of hazardous materials.

7. A description of how levee banks are regulated in the council area using specific examples.

86. Section 7 of Council's Subdivision and Development Guidelines provides that "*Council will not permit the use of levees in new developments to satisfy flood immunity standards*".

87. Levee banks have not been traditionally used for flood immunity in Brisbane City.

88. Council is currently undertaking a project to look at the feasibility and appropriateness of the use of levees to protect areas of strategic significance in response to the Flood Response Review Board recommendations.

89. There is only one purpose-built levee that I am aware of in Brisbane City, though it is possible that informal levees exist.

90. The Urban Land Development Authority (**ULDA**) has recently approved the construction of a levee to protect Telegraph Road adjacent to its Fitzgibbon urban development project. The ULDA, not Council, is responsible for approval of this work.

8. Details of council infrastructure (sewers, roads, stormwater etc) that was affected by flooding during the period 1 December 2010 to 31 January 2011.

91. I am aware that Council commissioned the external consultants Cardno and Arup to report on the flood damage to Council's infrastructure. I have been advised that these reports are in

[redacted]mission.

Mart[redacted] Wi[redacted]

9.	**A description of the measures used by Council to protect Council infrastructure (sewers, roads, stormwater etc) and to ensure such infrastructure functions during a defined flood event.**

92. I understand that the physical measures used to protect Council infrastructure are to be dealt with by other Council witnesses, so I will not repeat that information here.

93. In terms of planning controls under City Plan, development for a "*utility installation*" is generally exempt development, where a "*utility installation*" is defined to include (amongst other things):

(a) a use of premises for supply of water, hydraulic power, electricity or gas excluding power generation plants burning 100kg or more of fuel an hour;

(b) provision of sewerage or drainage services, other than a sewage treatment works;

(c) transport services, including an airstrip, wharf, railway, tramway, air transport, water transport, harbour or river undertaking.

94. In addition, development involving the construction, maintenance or operation of roads and busways, and things associated with roads and busways by or on behalf of or under contract with Brisbane City Council or the Queensland Government is generally exempt development under City Plan (see Figure 1 of this Statement).

95. Consequently, a development approval is not required for such development, and the Codes of City Plan will not apply to this development.

96. Where development of such infrastructure is exempt from assessment against the planning scheme or self-assessable it is my understanding that generally, acceptable flood resilience is determined through professional certification by a Registered Professional Engineer (Queensland) (**RPEQ**).

97. Some infrastructure is provided to Council through conditions on a development approval, and is designed and built by external parties before being dedicated to Council. The design of this infrastructure is governed by the planning process, primarily through the Subdivision and Development Guidelines, development conditions and compliance assessment.

[redacted] [redacted]

Martin James Reason **W**

98. The requirement to construct infrastructure to achieve acceptable flood immunity is generally required through conditions of the development approval. Generally, new allotments cannot be created until the infrastructure has been approved or, preferably, constructed and dedicated to Council on maintenance, and proven to comply with Council's standards in relation to flood immunity.

I make this statement conscientiously believing the same to be true, and by virtue of the provisions of the Oaths Act 1867 (Qld).

Dated 1 September 2011

Signed and declared by Martin James Reason at
in the State of Queensland
this 1ST day of SEPTEMBER 20 11
Before me:

[redacted]

[redacted]

declaration is

Signature of declarant

[redacted]

declaration is made