APPENDIX 10: CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

Citiswich Stage 7

5 October 2023

Litoria Consulting
PO Box 461
Paddington Qld 4064
Level 3/22 Wandoo Street
Fortitude Valley Q 4006
T 07 3852 4855
info@litoria.com.au
litoria.com.au

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Title:	Construction Environmental Management Plan
Client:	Walker Bremer Park Pty Ltd
Date:	5 October 2023
Version:	2.1
Distribution:	Peter MacLeod, Walker Corporation Sam Smith, Walker Corporation

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CONTENTS

1 INTRODUCTION

The following Construction Environment Management Plan (CEMP) has been prepared by Litoria Consulting on behalf of Walker Bremer Park Pty Ltd for the construction of Stage 7 of the Citiswich development. The total site area is 115 ha. Figure 1 shows an aerial photo of the site. The land is comprised of the following lots:

- Lot 13 on SP238272 (11.5 ha),
- Lot 34 on SP326668 (43.8 ha), and
- Lot 2 on RP104683 (56.6 ha).

The objectives of the CEMP are to:

- Ensure the works avoid and protect environmental values of the site;
- Where impacts are unavoidable, mitigate and manage potential environmental impacts during the construction of the project;
- Develop a procedure for auditing compliance and environmental management performance;
- Ensure compliance with the proponent's statutory obligations;
- Ensure compliance with relevant local and state approvals, including:
    - Upcoming approval under the EPBC Act (EPBC 2021/9112) for assessment of impact to the Grey-headed Flying-fox;
    - A preliminary approval for Material Change of Use of Premises, Bremer Business, Ipswich City Council (3356/2002/MAMC/A);
    - Environmental Protection Agency, Stare Concurrence agency response (5927 Part 5);
    - An Operational Works Bulk Earthworks approval, Ipswich City Council (3668/2013/O); and
    - A Department of State Development, Infrastructure and Planning (SDA-0813-004253), Concurrence agency response, Development Permit for Operational Work, bulk earthworks, Citiswich Stage 7).

The CEMP has been prepared in accordance with the relevant approval and the Australian Government's Environmental Management Plan Guidelines (Commonwealth of Australia 2014). The CEMP is divided into the following sections:

- Conditions of approval;
- Project description;
- Objectives;
- Environmental management roles and responsibilities;
- Inspections, monitoring, auditing and reporting;
- Environmental training;
- Emergency contacts and procedures;
- Potential environmental impacts and risks;
- Environmental management measures;

- Audit and review; and,
- Glossary of terms.

FIGURE 1: AERIAL PHOTOGRAPH OF THE SITE (NEARMAP 2022)

2 CONDITIONS OF APPROVAL

Table 1 outlines the relevant conditions of the approvals, along with the sections of this CEMP that address each of the conditions. Copies of the approvals are attached in Appendix 1.

TABLE 1: RELEVANT APPROVAL CONDITIONS.

Approval	Condition	Requirement	Plan reference	Demonstration that condition requirements are met
MCU (3356/2002/ MAMC/A)	18	Stormwater: a) The developer shall provide all necessary stormwater drainage (both internal and external to the development) and such drainage works (except for roofwater systems) shall be designed and constructed in accordance with QUDM such that the overall drainage system caters for a storm event with an ARI of 100 years. b) Overland flow paths shall be suitably designed to cater for the water from a storm event with an ARI of 100 years. In the case where the piped system is carrying part of the flow, the overland flow paths shall be designed to cater for that volume which is represented by the difference between the predicted volume from the storm event with an ARI of 100 years and the capacity of the pipe system, noting the requirements of QUDM. c) All stormwater flows within and adjacent to the Bremer Business Park Area, other than inter-allotment drainage, shall be confined to dedicated roads, drainage reserves, registered drainage easements or within parkland. The registered drainage easements, if related to piped drainage, shall be centrally located over such underground pipe system and shall be not less than 4.0 m wide, except for drainage easements required for side boundaries which may be 3.0 m wide where approved by the Senior Development Engineer. In addition, the easements shall be of suitable width to contain the predicted overland flow from the storm event with an ARI of 100 years in that location. d) No ponding or redirection of stormwater shall occur onto adjoining land unless specifically approved by Council in consultation with the owner of the adjoining land. e) Due consideration shall be given in these and future designs and construction of the development in relation to the effect of the developed catchment flows on the downstream discharge receival areas. Suitable stormwater control devices are to be provided to ensure that there is no increase in flows in watercourses. Such control devices are to be designed so as to integrate the landscaping, recreational, infrastructural and drainage roles of watercourses. f) Each proposed residential, commercial and/or industrial allotment shall be designed to comply with QUDM, Council's standards and the New Ipswich City Planning Scheme, including unimpeded access to a road system which is also above the design flood level.	Section 10.1.4	The Water Quality Management sub-plan addresses management practices to control stormwater quality during construction. Where relevant, other requirements have been met through development design.

		g) There shall be no filling or removal of material in the flood area below the flood level associated with an ARI of 100 years without the approval of the Senior Development Engineer. There shall be minimal disturbance to vegetation in the flood area unless prior written approval is obtained from Council. h) Filling in proposed Lots, which are adjacent to the watercourse shown on the proposal plan, shall not be undertaken without the written approval of Council.		
MCU (3356/2002/ MAMC/A)	19	Health and Environmental Protection Requirements: Conditions 20 – 21, unless otherwise stated, shall be completed to the satisfaction of the Chief Environmental Health Officer.	Section 10.1.4	The Water Quality Management sub-plan addresses the requirement for this permit condition to be met.
MCU (3356/2002/ MAMC/A)	20	Contaminated Land: The developer shall ensure all land to be dedicated to Council is not listed on either the Contaminated Land Register or the Environmental Management Register prior to dedication. In this regard the developer shall be responsible for all works associated with the removal of any land to be dedicated to Council from these registers. The developer shall provide details to Council demonstrating that the requirements of this condition have been met prior to the issuing of a Development Permit for Building Works and/or prior to the issuing of a Development Permit for Reconfiguring a Lot and/or Development Permit for a Material Change of Use (Code or Impact or Self-Assessable (if applicable)).	Section 10.1.4 Section 10.1.8	The Water Quality Management sub-plan and the Waste Management sub-plan describe measures to control acid sulphate soils and other contamination sources so there is no negative impact on the site in land dedicated for Council or elsewhere.
MCU (3356/2002/ MAMC/A)	21	Stormwater Quality: The developer shall submit to and receive approval from the Health and Environmental Protection Manager for a Master Stormwater Quality Management Plan for the Bremer Business Park Area (the Master SQMP) prior to the issuing of a Development Permit for Building Works and/or prior to the issuing of a Development Permit for Reconfiguring a Lot and/or Development Permit for a Material Change of Use (Code or Impact or Self-Assessable (if applicable)). A suitably qualified and experienced professional must prepare the Master SQMP. The Master SQMP must: a) Provide a management approach that ensures:	Section 10.1.4	The Water Quality Management sub-plan addresses management practices to control and assess stormwater quality and sedimentation.

i) Stormwater quality management measures for the Bremer Business Park Area consist of physical treatment measures to ensure that the stormwater discharged from a land use type complies with the pollutant levels identified in Table 1 below;
ii) Stormwater quality management measures for residential areas and roads consist of physical treatment measures to ensure that the stormwater discharged from these areas comply with the pollutant levels identified in Table 1 below;
iii) The matters of water sensitive urban design (WSUD), stormwater management and stormwater quality will be addressed throughout the Bremer Business Park Area in an integrated approach, and
iv) A refined Conceptual Design Stormwater Quality Management Plan (the Conceptual Design SQMP) is supplied for each development site prior to the issuing of a Development Permit for Building Works and/or prior to the issuing of a Development Permit for Reconfiguring a Lot and/or Development Permit for a Material Change of Use (Code or Impact or Self-Assessable (if applicable)) and then a Detailed Design Stormwater Quality Management Plan (the Detailed Design SQMP) is supplied for each development site prior to the issuing of a Development Permit for Operational Works.
v) Demonstrate, through appropriate pollutant export modelling (e.g. AQUALM or MUSIC), that the pollutant levels in the stormwater discharged from the Bremer Business Park Area comply with the pollutant levels identified in Table 1 below.

TABLE 1:

Indicator	Modified ecosystem, wildlife, cultural heritage, secondary & visual recreation, industry, stock and irrigation
Total Phosphorus	70 ug/L
Total Nitrogen	650 ug/L
Suspended solids	15mg/L for combined wet and dry periods 90% ile < 100mg/L for wet weather periods
Oils and grease	no visible films or odour
Organic Carbon	As determined through the investigations into organic carbon on the site.

		Litter/gross pollutants: No anthropogenic (man-made) material greater than 5mm in any dimension Riparian vegetation & habitat: Protect & restore consistent with Council policy and plans Cultural heritage: Protect & restore consistent with Council policy and plans Levels are upper limits for median values or ranges in which medians should lie, unless otherwise stated. Dependencies on hardness iron and chromium shown in brackets are difficult to quantify. They may be ignored initially but subsequently considered if the pollutant level range is exceeded. For more information refer to the latest Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC). A wet weather period is defined as "any period where stormwater runoff leaves the site".		
MCU (3356/2002/ MAMC/A)	22	Conservation, Parks and Sport Requirements: Conditions 23 – 26, unless otherwise stated, shall be completed to the satisfaction of the Conservation, Parks and Sport Manager.	Section 10	Following the sub-plans in this document will ensure operational works are completed to the satisfaction of the Conservation, Parks and Sport Manager.
MCU (3356/2002/ MAMC/A)	23	Parkland Dedication/Requirements: [1] Parkland works within the area included in the Open Space Sub-Area under the Bremer Business Park Preliminary Approval shall be undertaken generally in accordance with Plan Number 01, revision N Q, Overall Landscape Master Plan,	Section 10	Following the sub-plans in this document will ensure that staging, landscaping, and dedication are

[1] Note: only some locations in this condition pertain to Citiswich Stage 7 development

dated 14/09/2015 7/12/2017 and Plan Number 02, revision N Q, Indicative Circulation Hierarchy Plan, dated 14/09/2015 7/12/2017, prepared by Place Design Group. Open space shall be dedicated, free of cost to and compensation by Council, in fee simple, in accordance with the following requirements.

completed to the satisfaction of this condition.

TABLE 2:

Location	OPW approval requirements	Timing of works	Dedication
Eastern Tributary Park South	Landscape plans to be approved with the first operational works application associated with a reconfiguring a lot approval for industrial/business lots within stage 2.	Works to be finalised prior to 31 December 2013.	Park is to be dedicated to Council either with plan sealing of the first lot in stage 2 or as otherwise determined by a reconfiguration permit for stage 2.
Warrego Highway south side buffer landscaping	Landscape plans to be approved with the first operational works application associated with a reconfiguring a lot approval for industrial/business lots within stage 1.	Works to be finalised prior to 31 December 2013.	Not required.
Stage 5 buffer in accordance with application no. 5760/15	Landscape plans to be approved with the first operational works application associated with a reconfiguring ~~a lot approval for industrial/business lots~~	Works to be finalised prior to dedication or as otherwise determined by a ~~reconfiguration permit or~~	Prior to plan sealing of the first lot ~~adjacent to the buffer (not including balance lots) or as otherwise determined by a reconfiguration permit or operational works permit for~~

	~~within stage 5~~ application no. 5760/15.	~~operational works permit for stage 5~~ application no. 5760/15.	~~stage 5~~ as part of application no. 5760/15.
Stage 6 – 5,000m2 local recreational park	Landscape plans to be approved with the first operational works application associated with a reconfiguring a lot approval for industrial/business lots within stage 6.	Works to be finalised prior to dedication or as otherwise determined by a reconfiguration permit or operational works permit for stage 6 or deed between Council and Walker.	Park is to be dedicated as otherwise determined by a reconfiguration permit or operational works permit for stage 6 or deed between Council and Walker.
Stage 6 – eastern landscape buffer	Landscape plans to be approved with the first operational works application associated with a reconfiguring a lot approval for industrial/business lots within stage 6.	Works to be finalised prior to dedication or as otherwise determined by a reconfiguration permit or operational works permit for stage 6 or deed between Council and Walker.	Park is to be dedicated as otherwise determined by a reconfiguration permit or operational works permit for stage 6 or deed between Council and Walker.
Stage 6 – western landscape buffer	Landscape plans to be approved with the first operational works application associated with a reconfiguring a lot approval for	Works to be finalised prior to dedication or as otherwise determined by a reconfiguration	Park is to be dedicated as otherwise determined by a reconfiguration permit or operational works permit for stage 6 or deed between Council and Walker.

	industrial/business lots within stage 6.	permit or operational works permit for stage 6 or deed between Council and Walker.	
Archer Street Park	Landscape plans to be approved with the first operational works application associated with a reconfiguring a lot approval for industrial/business lots within stage 7 or as agreed between Council and Walker.	Works to be finalised prior to dedication or as otherwise determined by a reconfiguration permit or operational works permit for stage 7 or as agreed between Council and Walker.	Prior to plan sealing of the first lot (not including balance lots) for stage 7 or as otherwise determined by a reconfiguration permit or operational works permit for stage 7 or as determined by an option deed to be exercised by Council to buy the land for $1 in the following time frame: 1 July 2018, with a caveat that Walker may extend this timeframe for a further 5 years, after which further extensions may be sought and agreed to.
Bremer River Riparian Park	Detailed landscape plans to be approved with the first operational works application associated with a reconfiguring a lot approval for industrial/business lots within stage 7.	Works to be finalised prior to dedication or as otherwise determined by a reconfiguration permit or operational works permit for stage 7.	Prior to plan sealing of the first lot adjacent to the open space (not including balance lots) or as otherwise determined by a reconfiguration permit or operational works permit for stage 7.

MCU (3356/2002/ MAMC/A)	24	Clearing/Disturbance within Proposed Parkland: a) No clearing shall be undertaken in proposed parkland without the prior approval of the Conservation, Parks and Sport Manager. b) All areas of disturbance within parkland including areas of erosion and bare ground shall be rehabilitated. All batters and banks shall be fully stabilised and vegetated to the satisfaction of the Conservation, Parks and Sport Manager.	Section 10.1.4	The Vegetation Management sub-plan addresses management practices that ensure clearing and disturbances only occur in approved area.
MCU (3356/2002/ MAMC/A)		Quality of Park Dedication: Land to be dedicated for park purposes shall be upgraded to the satisfaction of the Conservation, Parks and Sport Manager as follows: a) Declared plants, environmental weeds and rubbish shall be removed; b) Dead trees shall be removed, and dangerous trees made safe within 10 m of proposed house blocks or proposed pathways or playgrounds; c) Open areas shall be grassed and left in mowable condition; d) Open areas shall be free of rocks, stumps, humps and hollows; e) Disturbed areas shall be revegetated using indigenous plant species; f) A cleared 4m wide mowable strip shall be formed behind proposed house blocks; g) All rubbish shall be removed from parkland; h) Parkland shall be freely and safely drained; i) All playground equipment and park furniture shall meet Australian Standards both in supply and installation; j) No overburden or spoil shall be pushed or deposited into parkland; k) Water, sewer and power service shall be provided to the proposed park; and l) There shall be no removal of soil or filling around trees.	Section 10.1.4 Section 10.1.3 Section 10.1.8	The Vegetation Management, Pest Management and Waste management sub-plans enforce measures that ensure the quality of land dedicated for park purposes.
EPA - Concurrence Agency Response (5927)	1	Prior to the commencement of any operational works, building works or remediation works, the applicant must conduct or commission an investigation of land in accordance with the *Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland* to scientifically assess whether lands described as Lot 13 SL 2982, Lot 2 RP 86838 and Lot 2 RP 104683 are contaminated and submit reports about the investigations to the Environmental Protection Agency (Contaminated Land Unit) to enable Suitability Statements to be issued for Lot 13 SL	Section 10.1.8	The Waste Management sub-plan addresses the requirement for this reporting to be submitted prior to works.

		2982, Lot 2 RP 86838 and Lot 2 RP 104683 specifying that the land is suitable for the intended use.		
EPA - Concurrence Agency Response (5927)	3	Prior to the commencement of any operational works, building works or remediation works, the applicant must conduct or commission an investigation of land in accordance with the *Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland to* scientifically assess whether lands excluding those described as Lot 13 SL 2982, Lot 2 RP 86838 and Lot 2 RP 104683 are suitable for the intended use and submit reports about the investigations to the Environmental Protection Agency (Contaminated Land Unit), to enable the EPA to determine if the land is suitable for the intended use.	Section 10.1.8	The Waste Management sub-plan addresses the requirement for this reporting to be submitted prior to works.
EPA - Concurrence Agency Response (5927)	8	The removal of any contaminated soil from the site requires prior approval from the Environmental Protection Agency (EPA) (Contaminated Land Unit) under the *Environmental Protection Act 1994* (EP Act) under Section 424.	Section 10.1.8	The Waste Management sub-plan addresses these requirements.
OPW Bulk Earthworks (3668/2013/ OW)	8	<u>Sediment and Erosion Management</u> a) The Developer is responsible for the installation and maintenance of erosion and sediment management facilities and truck shake down facilities from the time of commencement of construction until the works have been completed. All management facilities must be designed, installed and maintained in accordance with the latest version of the document *"Best Practice Erosion and Sediment Control"* published by the International Erosion and Sediment Control Association Australasia. Sediment and erosion control and truck shake down facilities must be installed and available for inspection prior to commencement of work. b) If the Assessment Manager determines that erosion and sediment originating from the site has caused sediment deposit and/or erosion on other property, the Developer shall be responsible to restore any damage. Such restoration works must be completed in the time and to a standard determined by the Assessment Manager. Should the Developer fail to complete the restoration works determined by the Assessment Manager within the specified time or to a satisfactory standard, Council may complete the work and recover all costs from the Developer associated with that work. For this purpose, the Developer must lodge a $10,000.00 silt and erosion bond	Section 10.1.1 Section 10.1.4	The Vegetation Management sub-plan and the Water Quality management sub-plan addresses requirements to manage, measure and mitigate all sedimentation and erosion impacts on the site.

		with Council, prior to commencement of works, which shall only be released by Council at the time of completion of the works and satisfactory revegetation of the site. Where Council determines that a drawdown of the bond is required, the Developer must restore the bond to its full amount within ten (10) business days of a notice from Council to that effect.		
SDAP OPW (SDA-0813-004253)	2	• Development must be in accordance with the *Citiswich Masterplan Flood Investigation (Including Local Flooding Assessment),* Project No. LJ8714/R3/V5 by Cardno Lawson Treloar dated 24 August 2012 and *Warrego Highway Hydraulic Assessment Letter,* LJ8714/Lt88 MPG: la by Cardno (QLD) Pty Ltd dated 05 August 2013 (Appendix). • Stormwater management for the development must ensure no worsening or actionable nuisance to the state-controlled road network caused by peak discharges, flood levels, frequency/duration of flooding, flow velocities, water quality, sedimentation and scour effects. • Any excavation, filling, paving, landscaping, construction or any other works to the land must not: • create any new discharge points for stormwater runoff onto the state-controlled road; • interfere with and/or cause damage to the existing stormwater drainage on the state-controlled road; • surcharge any existing culvert or drain on the state-controlled road; • reduce the quality of stormwater discharge onto the state-controlled road. • The applicant must provide RPEQ certification to the Department of Transport and Main Roads that the development has been designed and constructed in accordance with parts (a) and (b) of this condition.	Section 10.1.4	The Water Quality Management sub-plan addresses management requirements for management of stormwater, runoff, sedimentation and drainage.
SDAP OPW (SDA-0813-004253)	3	• The applicant must ensure that no dust/debris from the subject site enter the Warrego Highway (Ipswich – Toowoomba) during the construction phase of the development. • The applicant must install screening and abatement measures in accordance with the *Erosion & Sediment Control Plan*, 7902-44-014-201.1 by Cardno (QLD) Pty Ltd dated 05/07/13 as a minimum (Appendix).	Section 10.1.6	The Air Quality Management sub-plan addresses management requirements for control of dust debris using monitoring and fencing.

3 PROJECT DESCRIPTION

The Citiswich Estate (former Bremer Business Park) is a 350ha master-planned estate with industrial / business, residential, commercial, and retail uses. It is located in the Southwest Industrial corridor, 8 km northwest of the Ipswich CBD & 40km from Brisbane CBD. The southern boundary of the estate is bound by the Brisbane to Ipswich Rail Line. The Bremer River establishes the northern border of the estate. The Estate is bisected (east-west) by the Warrego Highway. The locality is within the suburbs of Bundamba & Riverview, which are mixed-use areas with predominantly industrial and farm uses and pockets of residential.

The Citiswich estate is divided into seven (7) stages. The subject site is Stage 7, the final stage of the Citiswich development that covers land located to the north of the Warrego Highway. The subject site includes areas which have been historically cleared of remnant vegetation and developed for other purposes including:

- Infrastructure including sewer, water, gas, and electricity grid transmission lines (HVP),
- Mining and quarrying, including areas of mining heritage and residual undermined areas[2],
- Grazing[3].

There is some existing sewer, water, gas and electricity infrastructure on the site. In addition, the Queensland Department of Transport and Main Roads has recently approved planning (long-term) for the Warrego Highway between Dinmore and Helidon which indicates the full extent of future upgrade requirements. The subject site includes a corridor of land against the Warrego Highway which is to be reserved to enable future corridor widening or expansion of the highway.

The proposed plan of development in Stage 7 includes subdivision for industrial land use, open space areas, parkland, and vegetation rehabilitation and will be supported by servicing, traffic, pedestrian and road access infrastructure. The development footprint is shown in Figure 2.

A non-comprehensive list of construction activities for the development of Citiswich Stage 7 include:

- Vegetation clearing and stripping / stockpiling topsoil;
- Use of temporary laydown areas and mulch piles;
- Maintenance of protected vegetation including weed control; and
- Installation of temporary and/or permanent erosion and sediment control measures;

[2] It is understood that DTMR have since filled some of the undermining voids.

[3] Current land use.

- Earthworks including cut and fill;
- Stormwater treatment infrastructure including a potential bio-basin;
- Construction of stormwater and drainage structures, batters, and earth bunds;

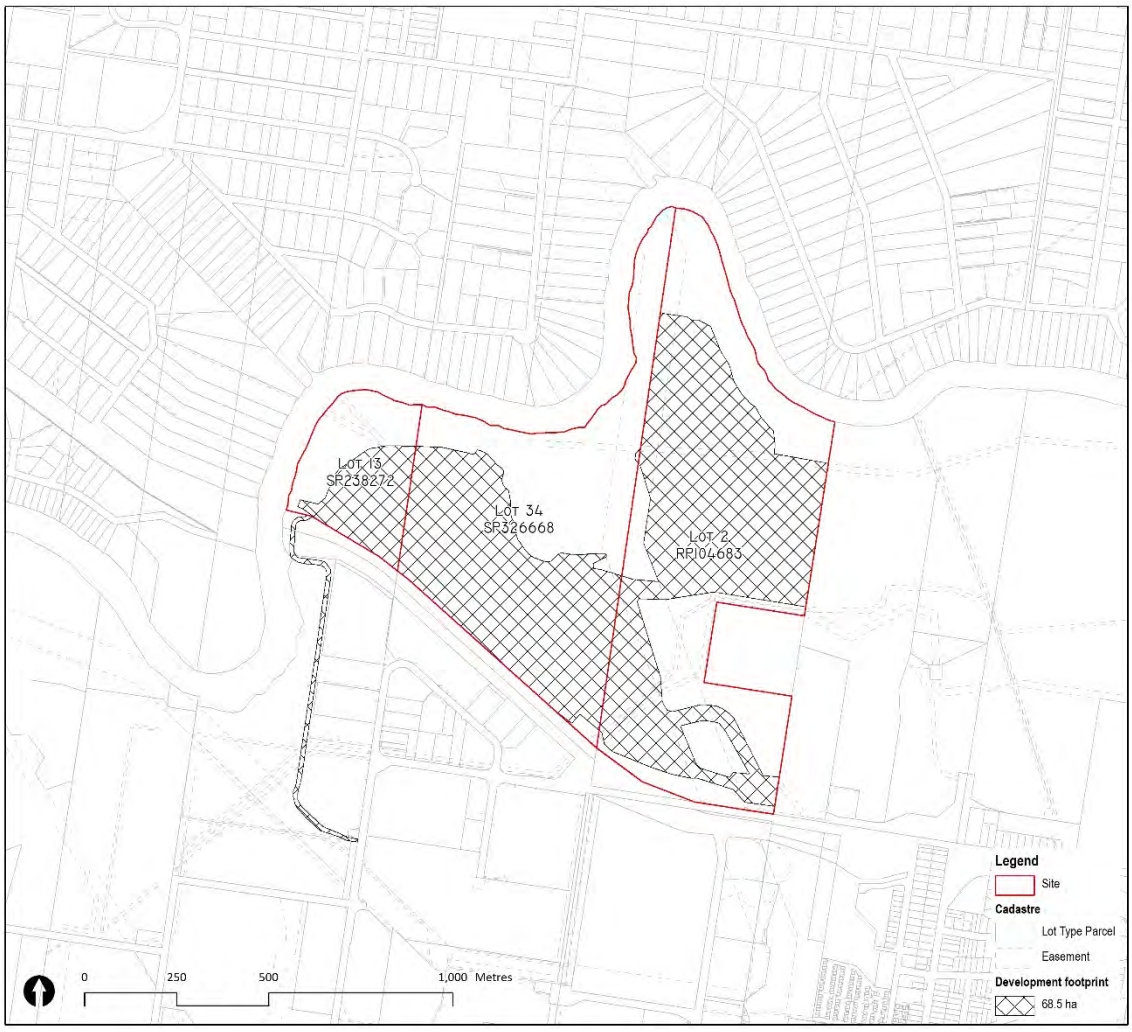

FIGURE 2: CITISWICH PROPOSED DEVELOPMENT.

4 OBJECTIVE

The objective of the CEMP is to ensure that all works comply with the relevant legislation and conditions of approval.

In carrying out their activities on site, all contractors must ensure that all reasonable and practicable measures are taken to prevent or minimise the likelihood of environmental harm being caused.

The CEMP provides contractors with guidance for their relevant activities and ensures that all works are managed to prevent and to minimise any adverse effects on the environment, particularly on the Grey-headed Flying-fox and its habitat within the project footprint. This will be achieved by identifying and reducing environmental risks, providing appropriate training for all contractors, and promoting environmental awareness of the project.

The CEMP covers all environmental aspects associated with the works, providing control measures to minimise adverse effects on the environment. Monitoring and reporting requirements, corrective actions and key responsibilities are also outlined.

The CEMP covers key environmental themes that will be the focus of management, as follows:

- Vegetation clearing and management;
- Fauna management, with a focus on the Grey-headed Flying-fox;
- Pest management;
- Water quality, including erosion and sediment control and stormwater management;
- Air quality management;
- Noise management; and,
- Waste management.

This CEMP aims to ensure that the information contained within this management plan is consistent with all conditions as set out in Section 2. Where the CEMP imposes a higher standard of environmental performance than the standard required under the conditions of this approval, the contractor or registered operator must follow the requirements as set out in the CEMP.

5 ENVIRONMENTAL MANAGEMENT ROLES AND RESPONSIBILITIES

Positive environmental outcomes are dependent on the clear and unambiguous assignment of accountability and responsibilities of key positions within the organisational structure. The contractor will be ultimately responsible for compliance with the CEMP and will oversee the implementation of the CEMP with the Site Environmental Manager (SEM) and sub-contractors.

The CEMP is to be implemented by all site personnel and contractors prior to and during the process of construction and is to be administered by the SEM or their agent, the contractor(s) responsible for the removal / clearing of vegetation and relevant construction works, revegetation / landscape contractor and a licensed Wildlife Spotter Catcher.

A copy of the CEMP, including the Personnel Register, (Appendix 4) is to be maintained on-site during construction phases, and where relevant, operation of the facility post-construction. The Personnel Register is to be kept updated with any new contact information.

Environmental management and compliance with the CEMP will be overseen by the SEM.

5.1 OVERALL RESPONSIBILITIES

All site personnel are responsible for complying with the CEMP. Employees, contractors, sub-contractors and suppliers are required to:

- Take all reasonable steps to seek information on the environmental requirements of the project;
- Undertake all activities in accordance with the CEMP and any associated documents;
- Ensure that they are aware of the relevant person in charge of overseeing compliance with the CEMP;
- Supervise the environmental performance of each task against the CEMP;
- Report any activity which has, will have, or has the potential to cause environmental harm;
- Notify the SEM of any non-compliance with the CEMP;
- Complete pre-start checks and inspections of all equipment prior to works and to report any equipment defects;
- Ensure that they undertake any environmental training provided and understand their obligations under the CEMP and relevant legislation; and,

- Complete the Personnel Register (Appendix 4) to acknowledge they have read and understood all aspects of the CEMP and the Environmental Inspection Checklist (EIC; Appendix 5).

The CEMP will be included in all site inductions to ensure that employees, contractors, sub-contractors and suppliers are aware of their responsibilities.

5.2 SITE ENVIRONMENTAL MANAGER

The SEM is responsible for compliance with the CEMP and any relevant legislation. The SEM is responsible for:

- Maintenance, review and implementation of the CEMP;
- Auditing and compliance in accordance with the CEMP requirements;
- Assisting project personnel to understand their roles and responsibilities under the CEMP;
- Ensuring that adequate training has been provided to all site personnel;
- Carrying out regular inspections of work areas in accordance with CEMP and legislative requirements;
- Identifying environmental incidents or issues and implementation of management measures to avoid and minimise environmental harm;
- Being present on site during high-risk activities, such as during clearing of vegetation; and,
- Maintaining environmental records.

SEM contact details can be found in the contacts list (Appendix 6).

If separate contractors will be responsible for various stages of the works, the CEMP is to be updated as required with details of the relevant SEM.

6 INSPECTIONS, MONITORING, AUDITING, AND REPORTING

This section outlines the environmental inspections, monitoring, auditing, and reporting requirements for this project. These activities ensure the project is compliant with all federal legislative requirements and will ensure identification of all non-compliance issues.

Construction phases throughout the life of the project have been identified as:

1. Pre-construction;
2. Construction; and,
3. Post-construction.

All environmental management procedures and sub-plans within this CEMP relate to activities performed during all three phases of construction. All site personnel must make themselves aware of all environmental management procedures and sub-plans. All site personnel will receive training and inductions regarding environmental management plans prior to accessing the site.

A copy of the CEMP, including the Personnel Register (Appendix 4) and EIC (Appendix 5), is to be maintained on-site during the construction phase of the development.

6.1 ENVIRONMENTAL INSPECTIONS

The Site Environment Manager or delegate will conduct weekly environmental inspections to monitor and evaluate the effectiveness of on-site environmental controls.

Environmental inspections will be recorded using the EIC (Appendix 5) and will be used to record any maintenance or equipment defects. Inspection frequencies are listed in Table 2.

TABLE 2: ENVIRONMENTAL INSPECTION REQUIREMENTS.

Type of Inspection	Inspection Frequency	Form Used
Active work sites	Weekly	EIC
Incident or Complaint	Event	Incident form
Non-compliance	Event	Incident form

6.2 ENVIRONMENTAL MONITORING

To ensure compliance with all aspects of the CEMP, environmental monitoring will be performed through each phase of construction, as set out in Table 3. Details for environmental monitoring procedures are outlined within each of the respective environmental management sub-plans.

TABLE 3: ENVIRONMENTAL MONITORING REQUIRED AT EACH PHASE OF CONSTRUCTION.

Construction Phase	Monitoring Programs
Pre-construction	Vegetation Management; Fauna Management; Pest Management; and, Water Quality Management.
Construction	Vegetation Management; Fauna Management; Pest Management: Water Quality Management; Air Quality Management; Noise Management; and, Waste Management.
Post-construction	Vegetation Management; Pest Management; and, Water Quality Management.

The implementation of the environmental monitoring will be the responsibility of the SEM, or delegate, and will include:

- Coordinating sample collection and documentation;
- Coordination of sample and monitoring equipment;
- Ensuring monitoring frequency is in accordance with all approvals, permits, Australian Standards (AS), and any other industry standards;
- Data management and representation of results;
- Reporting non-compliance or incidents related to monitoring;
- Responsible for the implementing any corrective actions related to non-compliance or monitoring incidences;
- Training of personnel in monitoring procedures, and;
- Arranging specialist consultants to conduct monitoring duties, as required.

All instruments, equipment and measuring devices used for measuring or monitoring in accordance with any condition of this approval must be calibrated in the following way:

- If a statutory instrument or standard made under a law of the State prescribes standards for calibrating the equipment — in accordance with that statutory instrument or standard; or,

- Otherwise — according to any relevant AS applicable to the calibration of the equipment.

In addition to recording monitoring data, the following information will also be recorded:

- Name of recorder(s);
- Date and time of monitoring and/or sampling;
- Location of sampling, including general information such as nearest road, property name, descriptive information, as well as GPS coordinates, and;
- Photographs of monitoring location, as well as surrounding area.

6.3 AUDITING

Auditing will be undertaken to verify compliance with all aspects of the CEMP. Audits will be conducted by the SEM, or delegate:

- Prior to any project or construction works for any stage of the project;
- At the completion of any project or construction works;
- During or after any major corrective actions or remediation works; and,
- Periodically throughout the life of the project.

Audits will include a review of compliance with the CEMP, compliance with each condition of approval and any prior corrective actions.

6.4 REPORTING

The SEM is responsible for the preparation of monthly reports on environmental compliance. The monthly reports will summarise compliance and non-compliance with all monitoring requirements within the CEMP. The monthly reports will also summarise any environmental incidents and environmental issues that occurred during the month. The monthly report will include relevant incident report numbers and summarise improvements that have been made to address environmental issues and incidents.

6.5 NON-CONFORMANCE PROCEDURE

Non-conformance with the CEMP will be immediately reported to the SEM for remedial action. Actions taken shall reflect the magnitude of environmental impact.

For minor non-conformance incidents, the SEM shall specify remedial actions in accordance with the CEMP. An example of a minor incident is the inadequate maintenance of temporary sediment and erosion control structures.

For major non-conformance:

- Construction works will immediately cease;
- Applicable authority will be notified of extent of non-conformance; and,
- Remedial actions to be carried out in consultation with relevant officers and SEM as necessary.

An example of major non-conformance is the removal of vegetation marked for retention or injury to wildlife.

6.6 INCIDENT REPORTING

Ongoing monitoring includes the assessment of incidents and hazards identified by site personnel. It is the responsibility of all personnel to report any incidents to the SEM. An environmental incident is any breach of the environmental management procedures detailed in the CEMP, or any other unplanned action detrimental to the environment.

All environmental incidents must be recorded using an Incident Reporting Form (Appendix 7) along with any corrective and preventative actions taken to address the environmental incident. The details of the incident are to be recorded by the SEM, or delegate, in the Corrective Actions Register (Appendix 8).

As reports are submitted, it is the SEM's role to ensure that the forms are completed, and management measures are initiated or updated accordingly to reflect the information provided. The CEMP is to be updated to reflect any changes or additions to management measures.

If the incident results in a severe impact on Matters of National Environmental Significance the SEM, or delegate, is to provide an incident investigation report to the Commonwealth Department of the Environment within one week of being notified of the incident. Examples of a severe incident include impacts to a species or community listed as a Matter of National Environmental Significance, for example, unapproved clearing of critical fauna habitat.

6.7 COMPLAINT REPORTING

The SEM will maintain a register of complaints. Complaints relating to environmental aspects will be treated as environmental incidents in terms of investigation and will include a record of any action taken with respect to the complaint.

The person undertaking the activity to which this approval relates must record the following information for each complaint received about the activity:

- Time, date, name and contact details of the complainant;
- Reasons for the complaint;
- Any investigations undertaken by the person undertaking the activity to which this approval relates;

- Conclusions formed by the person undertaking the activity to which this approval relates following the investigation; and,
- Any actions taken by the person undertaking the activity to which this approval relates to resolve the complaint(s).

6.8 CORRECTIVE ACTIONS

All corrective actions identified for incidents, complaints and non-conformance audit results are to be recorded in a Corrective Actions Register, administered by the SEM. The register will be monitored weekly by the SEM to ensure that corrective actions listed in the register are completed.

The register is to include the following details:

- Date & location of incident / complaint / non-conformance;
- Details of incident/complaint / non-conformance;
- Actions taken to control the incident / complaint/ non-conformance and prevent any future occurrence;
- Date by which the corrective action will be completed (unless ongoing); and,
- Appropriate sign-off, indicating that the incident / complaint/ non-conformance was investigated and followed up appropriately.

7 ENVIRONMENTAL TRAINING

The SEM, or delegate, will provide site personnel and site visitors with suitable environmental training to ensure they are competent to perform their work in an environmentally acceptable manner. Environmental training will be given as part of the site induction procedure and will be performed prior to site access.

All forms and relevant associated material are to be stored in both a digital and hard copy format for a period of at least two (2) years.

The person undertaking the activity to which this approval relates must keep a record of the training provided to employees, including:

- Names of all persons who undertook the training;
- Date on which the training was provided; and,
- An outline of the training provided.

The environmental training will ensure the following:

- That all personnel and site visitors are aware of the CEMP and related documents;
- That all personnel are aware of their responsibilities;
- That all site personnel have familiarised themselves with the CEMP and its procedures;
- That all site personnel have signed a register noting that they have reviewed and will comply with the requirements of the CEMP;
- That all contractors shall review and carry out activities in accordance with measures outlined with in the CEMP and guide construction including civil works as necessary, in consultation with the SEM.

8 EMERGENCY CONTACTS AND PROCEDURES

In the event of an environmental incident, the priority is the ensure the safety of all site personnel and the neighbouring community. All practical steps shall then be taken to minimise further environmental damage through the implementation of the appropriate contingency and corrective actions, as outlined in the CEMP environmental management sub-plans in Section 10.

All environmental incidents must be immediately reported to the SEM. Emergency contact information can be found in the contacts listed in Appendix 6.

9 POTENTIAL ENVIRONMENTAL IMPACTS AND RISKS

The following section sets out the results of a qualitative risk assessment applied to the potential environmental impacts associated with project actions.

Each environmental risk has been given a rating in terms of likelihood (Table 4; qualitative measure of likelihood – how likely is it that this event / incident will occur after control strategies have been put in place) and consequence (Table 5; qualitative measure of consequences rating – what will be the consequences / results / outcome if this event / issue does occur), then combined using a risk rating matrix (Table 6) to generate a risk rating of low, medium, high or severe.

The qualitative risk assessment (Table 7) must be updated by the SEM at the following times:

- Prior to initial commencement of works;
- Prior to vegetation clearing operations;
- At the completion of vegetation clearing operations;
- As required following non-conformances or other changes to procedures; and,
- Annually, as part of the review and audit procedures.

TABLE 4: LIKELIHOOD RISK RATING DESCRIPTION.

Descriptor	Description
Highly likely	Is expected to occur in most circumstances
Likely	Will probably occur during the life of the project
Possible	Might occur during the life of the project
Unlikely	Could occur, but is considered unlikely or doubtful to occur
Rare	May occur, but only in exceptional circumstances

TABLE 5: CONSEQUENCES RISK RATING DESCRIPTION.

Descriptor	Description
Minor	Minor incident of environmental damage that can be reversed
Moderate	Isolated but substantial instances of environmental damage that could be reversed with intensive efforts
High	Substantial instances of environmental damage that could be reversed with intensive efforts
Major	Major loss of environmental amenity and real danger of continuing
Critical	Severe widespread loss of environmental amenity and irrecoverable environmental damage

TABLE 6: RISK RATING MATRIX.

		Consequence				
		Minor	Moderate	High	Major	Critical
Likelihood	Highly likely	Medium	High	High	Severe	Severe
	Likely	Low	Medium	High	High	Severe
	Possible	Low	Medium	Medium	High	Severe
	Unlikely	Low	Low	Medium	High	High
	Rare	Low	Low	Low	Medium	High

TABLE 7: ENVIRONMENTAL RISK ASSESSMENT.

Item	Construction Phase	Factor	Potential Environmental Impacts	Likelihood	Consequence	Inherent Risk	Planned Mitigation	Likelihood	Consequences	Residual Risk
1	Pre-construction	Vegetation clearing and management	Clearing outside approved boundary or unapproved removal of trees	Likely	Major	High	Vegetation Management sub-plan	Unlikely	Major	High
2		Fauna	Injury or mortality	Possible	Major	High	Vegetation Management sub-plan; Fauna Management sub-plan	Unlikely	Major	High
4		Threatened Fauna: Grey-headed Flying-fox	Injury or mortality	Unlikely	Critical	High	Vegetation Management sub-plan; Fauna Management sub-plan	Rare	Critical	High
5			Unapproved removal of critical habitat	Likely	Critical	Severe	Vegetation Management sub-plan; Fauna Management sub-plan	Unlikely	Critical	High
6		Pest management	Spread of weeds and fire ants	Likely	Major	High	Pest Management Sub-plan	Unlikely	Major	High
7		Water quality	Erosion and loss of topsoil	Likely	High	High	Water Quality Management Sub-plan	Unlikely	High	Medium
8		Air Quality	Dust emissions during clearing impacting adjacent stakeholders	Possible	Moderate	Medium	Air Quality Management Sub-plan	Unlikely	Moderate	Low
9	Construction	Vegetation clearing and management	Damage or accidental clearing of vegetation outside approved boundary or unapproved removal of trees	Likely	Major	High	Vegetation Management Sub-plan	Unlikely	Major	High
10		Fauna	Injury or mortality	Possible	Major	High	Vegetation Management sub-plan; Fauna Management sub-plan	Unlikely	Major	High
12		Threatened Fauna: Grey-headed Flying-fox	Injury or mortality	Possible	Critical	Severe	Vegetation Management sub-plan; Fauna Management sub-plan	Unlikely	Critical	High
13			Unapproved removal of critical habitat	Likely	Critical	Severe	Vegetation Management sub-plan; Fauna Management sub-plan	Unlikely	Critical	High
14		Pest management	Spread of weeds and fire ants	Likely	Major	High	Pest Management sub-Plan	Unlikely	Major	High
15		Water quality	Erosion and loss of topsoil	Likely	High	High	Water Quality Management sub-plan	Unlikely	High	Medium
16		Air Quality	Dust emissions during clearing impacting adjacent stakeholders	Possible	Moderate	Medium	Air Quality Management sub-plan	Unlikely	Moderate	Low
17		Noise	Negative impact to the social environment through excess noise and vibration	Unlikely	Moderate	Medium	Noise Management sub-plan	Rare	Moderate	Low
18		Waste	Environmental harm caused by incorrect storage of waste	Possible	Moderate	Medium	Waste Management sub-plan	Unlikely	Moderate	Low
20	Post-construction	Vegetation clearing and management	Damage or accidental clearing of vegetation outside approved boundary or unapproved removal of trees	Possible	Major	High	Vegetation Management sub-plan	Rare	Major	Medium
21		Fauna	Injury or mortality	Possible	Major	High	Vegetation Management sub-plan; Fauna Management sub-plan	Rare	Major	Medium

Item	Construction Phase	Factor	Potential Environmental Impacts	Likelihood	Consequence	Inherent Risk	Planned Mitigation	Likelihood	Consequences	Residual Risk
23		Threatened Fauna: Grey-headed Flying-fox	Injury or mortality	Unlikely	Critical	High	Vegetation Management sub-plan; Fauna Management sub-plan	Rare	Critical	High
24			Unapproved removal of critical fauna habitat	Possible	Critical	Severe	Vegetation Management sub-plan; Fauna Management sub-plan	Rare	Critical	High
25		Pest management	Spread of weeds and fire ants	Likely	Major	High	Pest Management sub-plan	Rare	Major	Medium
26		Water quality	Erosion and loss of topsoil	Likely	High	High	Water Quality Management sub-plan	Rare	High	Low

10ENVIRONMENTAL MANAGEMENT MEASURES

The following sections summarise the activities, timing and management responses for the pre-construction, construction, and post-construction stages of works. Compliance with the environmental management procedures set out in this CEMP ensures all activities carried out on-site comply with environmental obligations, including those listed in Section 2 of the CEMP.

A series of management sub-plans have been developed that cover work activities during all three stages of works on-site. The various plans apply in the following stages.

The following environmental management sub-plans have been identified for pre-construction works:

- Vegetation Management;
- Fauna Management;
- Pest Management; and,
- Water Quality Management.

The following environmental management sub-plans have been identified for construction works:

- Vegetation management;
- Fauna management;
- Pest management;
- Water quality management;
- Air quality management;
- Noise management; and,
- Waste management.

The following environmental management sub-plans have been identified for post-construction works:

- Vegetation management;
- Pest management; and,
- Water quality management.

10.1 ENVIRONMENTAL MANAGEMENT SUB-PLANS

10.1.1 VEGETATION MANAGEMENT

Vegetation clearing and management must only occur in accordance with the project approvals. Clearing may only occur within the approved areas marked as 'Clearing Area' in.

Areas of retained vegetation are to be protected during works and maintained with weed control methods. Specifically, care is to be taken to preserve the areas of vegetation marked as 'retained'.

All vegetation clearing and ongoing vegetation management must meet all approval conditions.. This includes all management actions outlined in the Vegetation Management sub-plan (Table 8). Additionally, all clearing of assessable native vegetation must be staged in accordance with operational needs.

Prior to, during and post clearing of assessable native vegetation, sediment and erosion controls must be implemented in accordance with the Water Quality Management sub-plan (Table 12) as outlined in Section 10.1.4.

TABLE 8: VEGETATION CLEARING AND MANAGEMENT SUB-PLAN

Vegetation Clearing and Management		
Objectives		
• Clearing and management of vegetation in accordance with approvals.		
1. KPI's and Targets		
Details		
• No clearing or damage to native vegetation outside of the approved clearing areas. • Disturbed areas are stabilised as soon as possible following disturbance.		
2. Management Actions		
Description	**Responsibility**	**Timing**
An Operational Works approval for vegetation clearing is obtained and approved by Ipswich Regional Council.	PM	Prior to clearing
Approved clearing areas are identified and demarcated using GPS coordinates and flagged star pickets.	PM	Prior to clearing
Vegetation conservation areas are identified, demarcated, and where applicable, tree protection fencing is erected.	PM	Prior to clearing
Vegetation protection fencing is to be established at the interface between all works areas and vegetation to be retained during clearing works.	SEM	Prior to clearing
Tree protection zones (TPZ) are to be established around all trees to be conserved which are near proposed working areas (i.e., adjacent to the confirmed working areas extents).	SEM	Prior to clearing
TPZs are to be established in accordance with *AS 4970 – Protection of trees on development sites*. TPZs include the assembly of mesh tree barriers / guards to protect 'at risk' retained trees from encroachment / accidental damage.	SEM	Prior to clearing
A Wildlife Spotter Catcher is to inspect all areas to be cleared prior to the commencement of works.	SEM	Prior to clearing
TPZs are to be established prior to the commencement of any clearing or site works. Within the TPZ, the following activities are not permitted: • Storage and mixing of materials; • Vehicle parking; • Liquid disposal; • Machinery repairs and/or refuelling; • Construction of site office or shed; • Combustion of any material;	SEM	Prior to clearing

Vegetation Clearing and Management		
• Stockpiling of soil, rubble or debris; • Any filling or excavation including trenching, topsoil skimming and/or surface excavation, unless otherwise approved by the Chief Executive Officer; and, • Unauthorised application of pesticides, herbicides or chemicals.		
Restrict access to all areas outside of the approved clearing and construction areas.	SEM	At all times
Ensure vegetation clearing, including tree felling, does not impact areas outside of approved clearing areas.	SEM	During clearing
Ensure all vehicle and personnel movement is limited to the approved clearing and construction areas.	SEM	At all times
Ensure that all fauna management measures are strictly followed prior to, and during vegetation clearing and management.	SEM	At all times
Vegetation removal is to be undertaken by suitably qualified contractors.	SEM	During clearing
Vegetation clearing is to be staged or to take place sequentially, moving from west to east, allowing fauna to move to adjoining habitats.	SEM	During clearing
All vegetation that is cleared on the site shall be mulched on-site and used for onsite landscaping works.	SEM	During clearing
Vegetation cleared and not suitable for mulching shall be removed and disposed of in an approved disposal facility.	SEM	During clearing
Land clearing debris must not be pushed into gullies, watercourses, other drainage line or waterlogged areas, or any areas outside of the approved clearing extent.	SEM	During clearing
Vegetation clearing must not occur outside of the approved clearing areas (Figure 2) and must not exceed the approved area of clearing listed under the forthcoming EPBC approval.	SEM	During clearing
Mulch stockpiles are to be located in existing cleared areas, outside of TPZs and at least 40m away from waterway / wetland areas.	SEM	At all times
Mulch stockpiles are to be managed in accordance with best practice design standards for erosion and sediment control.	SEM	At all times
Any exposed or damaged tree roots are identified and treated in accordance with *AS 4373—2007 – Pruning of amenity trees*.	SEM	At all times
Any tree pruning or maintenance works is carried out by qualified arborist accordance with *AS 4373—2007 – Pruning of amenity trees*.	SEM	At all times

Vegetation Clearing and Management		
Arborist / contractor to treat any damaged trees. Works are to be undertaken by a qualified minimum Level 5 Arborist or suitably qualified person.	SEM	At all times
Site briefings for all staff must occur prior to any major works and before commencement of works daily to discuss approved clearing processes and provide clear understanding of areas to be protected from construction.	SEM	Prior to clearing and major works

3. Monitoring Description	Responsibility	Frequency
Inspect clearing areas to ensure only vegetation marked for clearing are removed or damaged.	SEM	Daily during clearing
Inspect project boundaries to ensure flagging, fencing and TPZ fencing are intact, and no boundary breach has occurred.	SEM	Daily during clearing Bi-monthly during clearing
Cleared vegetation has not been pushed into gullies, watercourses, other drainage line or waterlogged areas.	SEM	Daily during clearing
Ensure required fauna controls, including Wildlife Spotter Catcher, in place for disturbance works.	SEM	Daily during clearing
Inspect cleared vegetation is stored correctly and/or mulched and used on-site.	SEM	Daily during clearing

Examples of Contingency and Corrective Actions Incident	Corrective Action	Responsibility
Incorrect placement /storage of cleared vegetation	Report and investigate as an incident.	SEM
	Report immediately to SEM.	PM
	Halt activities until impacted area is reviewed by SEM.	SEM
	Rehabilitate impacted areas.	SEM
	Retrain relevant personnel in regard to CEMP procedures and controls.	SEM
	Report and investigate as an incident.	SEM

Vegetation Clearing and Management		
Clearing of vegetation outside of approved clearing areas	Report immediately to SEM.	PM
	Halt activities until impacted area is reviewed by SEM.	SEM
	Re-demarcate boundary with temporary fencing.	SEM
	Rehabilitate impacted areas.	SEM
	Retrain relevant personnel in regard to CEMP procedures and controls.	SEM

10.1.2 FAUNA MANAGEMENT

The approval holder must ensure a pre-clearing survey is undertaken by a suitably qualified person within 24 hours before any clearing of vegetation, to identify any fauna present. A suitably qualified Wildlife Spotter Catcher must also be present during all vegetation clearing works.

The approval holder must not clear any vegetation supporting any fauna until such time that the individual(s) vacates the vegetation or is relocated by a suitably qualified person.

Veterinary care, or assistance from a wildlife refuge, must be sought if any fauna are found injured within the project site while clearing and/or construction occurs within the project site. To reduce risk of injury to fauna, all vehicles and plant machinery must stay on pre-determined routes and roads and must adhere to site speed limits at all times.

Further management and control actions are outlined in the Fauna Management sub-plan (Table 10).

Grey-headed Flying-fox Management

The Grey-headed Flying-fox (*Pteropus poliocephalus*) is a listed threatened species under the EPBC Act and requires management on site to ensure their protection and wellbeing during any works onsite (Department of Agriculture Water and the Environment 2021).

The developer and/or their contractor must complete proper inspection of all vegetation prior to clearing for the presence of fauna, particularly Grey-headed Flying-fox. The developer and/or their contractor must take utmost caution to prevent unnecessary clearing. All workers must ensure their actions avoid or effectively mitigate direct and indirect impacts on the Grey-headed Flying-fox, and their habitat within the project footprint.

The following management control measures (Table 9) have been identified in regard to the management of the Grey-headed Flying-fox. Further fauna management measures can be found in Table 10.

TABLE 9: GREY-HEADED FLYING-FOX MANAGEMENT CONTROLS

Management Control / Activity	Responsibility	Effectiveness of Management Action	Environmental Outcomes	Measure, Monitor, Audit, Activity and Frequency
Environmental contract documentation to address specific erosion and sediment control and landscape and revegetation requirements to be managed during the construction and post-construction phase of the project.	Owner's engineer, Proponent	This will assist in minimising indirect impacts to habitat through a reduction in sediment loss and associated water quality impacts.	Minimisation of indirect impacts on the Grey-headed Flying-fox.	Audit prior to request for tender release. Auditing of contract documentation will be undertaken in accordance with the Construction Environment Management Plan (CEMP).
Vegetation clearing limits will be defined under the contract documentation, to minimise the extent of vegetation clearing whilst allowing construction to occur, considering erosion and sediment control devices.	Owner's engineer, Proponent	Vegetation clearing limits will ensure minimisation of clearing required for the project and reduce impacts on the Grey-headed flying fox habitat.	Avoid unnecessary removal of Grey-headed Flying-fox habitat.	Audit prior to request for tender release. Auditing of contract documentation will be undertaken in accordance with the CEMP.
Additional workspace areas (laydown areas) are to be placed in previously cleared areas or on the project pad where possible.	Construction contractor	This will minimise the vegetation clearing required for the project.	Avoid unnecessary removal of Grey-headed Flying-fox habitat.	CEMP to be audited for completeness prior to mobilisation, as well as auditing for compliance during and post-construction.
Incorporation of no-go zones and vegetation clearing limits with specific vegetation clearing requirements and methodologies within the contract documentation. All vehicles and plant will stay on pre-determined routes and adhere to site construction and operation rules relating to speed limits. Speed limits would be clearly signposted to minimise the potential for fauna impact.	Owner's engineer, Proponent	Implementation of no-go zones and restricted access routes will prevent inadvertent disturbance within habitat to be retained.	Avoid fauna collisions / mortality from construction equipment and enable the relocation of MNES away from the working areas as appropriate.	Audit prior to request for tender release. Auditing of contract documentation will be undertaken in accordance with the CEMP. A register of wildlife incidents (fauna strike and mortality) will be established and maintained as part of the CEMP.

Management Control / Activity	Responsibility	Effectiveness of Management Action	Environmental Outcomes	Measure, Monitor, Audit, Activity and Frequency
Any clearing of native vegetation must be carried out in a way that ensures: • Grey-headed Flying-fox individuals have enough time to move from the area being cleared without human intervention; and, • Links between habitats are maintained to allow individuals to move from the area being cleared; and, • A tree or habitat feature is not cleared / removed if – - Grey-headed Flying-fox is present; or, - The crown of the habitat tree overlaps with another tree in which an individual is present. • A habitat tree or feature is only cleared / disturbed under the guidance of a Wildlife Spotter Catcher.	SEM	Management of vegetation clearing and habitat disturbance will reduce direct impacts on the Grey-headed Flying-fox and allow safe dispersal during the removal of potential habitat.	Prevent increased fauna mortality from the project and guide and direct fauna movement between retained / rehabilitated potential habitat.	Audit prior to request for tender release. Auditing of contract documentation will be undertaken in accordance with the CEMP. A register of wildlife incidents (fauna strike and mortality) will be established and maintained as part of the CEMP.
Vegetation or habitat features (e.g., roosts) containing Grey-headed Flying-foxes are to be demarcated with high visibility flagging tape and no further clearing is to take place within 20m of the vegetation / habitat feature until such time as the individual(s) has completely vacated the site. Any interactions with the individuals or management measures are to be determined in consultation with the licensed Wildlife Spotter Catcher for advice.	SEM	Management of vegetation clearing and habitat disturbance will reduce direct impacts on the Grey-headed Flying-fox and allow safe dispersal during the removal of potential habitat.	Prevent increased fauna mortality from the project and guide and direct fauna movement between retained / rehabilitated potential habitat.	Audit prior to request for tender release. Auditing of contract documentation will be undertaken in accordance with the CEMP. A register of wildlife incidents (fauna strike and mortality) will be established and maintained as part of the CEMP.

Management Control / Activity	Responsibility	Effectiveness of Management Action	Environmental Outcomes	Measure, Monitor, Audit, Activity and Frequency
All site personnel and contractors will report any evidence of Grey-headed Flying-fox and suspected habitat features (i.e., roosts), regardless of whether or not the person suspects the habitat feature belongs to the GHFF, to the SEM and Wildlife Spotter Catcher, The Wildlife Spotter Catcher will inspect the reported area for evidence of the species and if species usage is confirmed, a 20m exclusion zone will be established around the fauna and/or habitat feature.	SEM	Identification of potential habitat features or species throughout the impact area by all site personnel will reduce impacts on the Grey-headed Flying-fox.	Prevent increased fauna mortality from the project and guide and direct fauna movement between retained / rehabilitated potential habitat.	Audit prior to request for tender release. Auditing of contract documentation will be undertaken in accordance with the CEMP. A register of wildlife incidents (fauna strike and mortality) will be established and maintained as part of the CEMP.

TABLE 10: FAUNA MANAGEMENT SUB-PLAN.

Fauna management		
Objectives		
• Relocation, protection, and management of native fauna. • No injury or death of the Grey-headed Flying-fox as a result of the project.		
1. KPI's and Targets		
Details		
• No harm or injury to any native fauna including the Grey-headed Flying-fox. • No unapproved disturbance of any native fauna habitat. • Wildlife spotter catcher present during all clearing works. • No possible predators are introduced to the site.		
2. Management Actions		
Description	Responsibility	Timing
A suitably qualified Wildlife spotter catcher must also be present on-site during all vegetation clearing works.	SEM	At all times during clearing
The approval holder must not clear any vegetation supporting any fauna until such time that any present fauna vacates the vegetation or are relocated by a suitably qualified person.	SEM	At all times
Veterinary care, or assistance from a wildlife refuge, must be sought if any fauna are found injured within the project site while clearing and/or construction occurs within the project site.	SEM	At all times
To reduce risk of injury to fauna, all vehicles and plant machinery must stay on pre-determined routes and roads and must adhere to site speed limits at all times.	SEM	At all times
The approval holder must ensure a pre-clearing survey is undertaken by a suitably qualified person within 24 hours before any clearing of vegetation within the project site to identify any fauna present, particularly Grey-headed Flying-foxes in canopies.	SEM	Prior to clearing, with 24hr of proposed activities
Immediately prior to the commencement of clearing and on each day that vegetation clearing is to take place, a licensed Wildlife spotter catcher should be on site in the event that fauna are observed which require protection, relocation or in case of fauna injury.	SEM	Prior to, and at all times during clearing
Licensed Wildlife spotter catcher to inspect trees to be trimmed / removed and identify hollows for retention / salvage, respectively.	SEM	Prior to clearing

Fauna management		
Non-itinerant fauna (other than Koalas and Grey-headed Flying-foxes) are, where practicable, relocated / ushered to nearby patches of vegetation or nearby bushland – refer to licensed Wildlife spotter catcher for advice.	SEM	Prior to, and at all times during clearing
Vegetation or habitat features containing threatened fauna, including Grey-headed Flying-fox(es) is to be demarcated with high visibility flagging tape and no further clearing is take place within 20m of the vegetation / habitat feature until such time as individual(s) has completely vacated the vegetation and the site. Any interaction with the individuals or management measures are to be determined in consultation with the Wildlife Spotter Catcher for advice.	SEM	Prior to, and at all times during clearing
All areas containing ponded water are to be dewatered under the supervision of the Wildlife Spotter Catcher.	SEM	At all times
Where identified, active hollows, nests or other breeding places are not to be interfered with. Tampering with an animal breeding place is in violation of the Nature Conservation Act 1999 under section 332 of the Nature Conservation (Wildlife Management) Regulation 2006 in the exception of removal or tampering that is part of an approved species management program, or the person holds a damage mitigation permit for the animal and the permit authorises the removal or tampering.	SEM	At all times
An approved koala exclusion fence is in place on the southern boundary of the property, and the manual vehicle access gate is closed.	SEM	At all times
All domesticated animals are prohibited from site.	SEM	At all times
Personnel are prohibited from interacting with and/or feeding native or non-native fauna on-site.	SEM	At all times
All vehicles will stay on pre-determined routes and adhere to site speed limits. Speed limits to be clearly signposted to minimise potential for fauna impact.	SEM	At all times
A register of wildlife incidents (fauna strike and mortality) will be established and maintained as part of the CEMP.	SEM	At all times
3. Monitoring		
Description	Responsibility	Frequency
Visual inspection for presence of fauna within approved vegetation clearing areas by licensed Wildlife Spotter Catcher.	SEM	Daily (prior to, and during clearing)

Fauna management		
Visual inspection of protected (non-approved) vegetation within 20m of proposed clearing areas by licensed Wildlife Spotter Catcher.	SEM	Daily (prior to, and during clearing)
Appropriate barriers, protection, and signage in place for all protected areas.	SEM	Daily

Examples of Contingency and Corrective Actions		
Incident	**Corrective Action**	**Responsibility**
Koala(s) or Grey-headed Flying-fox(es) foraging on vegetation within or adjacent to site during vegetation clearing or management.	Report as an incident (no investigation required).	SEM
	Report immediately to wildlife spotter/catcher.	SEM
	Halt activities until vegetation containing Koala(s) is demarcated with high visibility flagging tape. No further clearing to take place within 20m of the vegetation until such time as Koala(s) has completely vacated the vegetation and the site – refer to licensed Wildlife spotter catcher for advice.	SEM
Native fauna (other than Koala(s)) present onsite.	Report as an incident (no investigation required).	SEM
	Report immediately to Fauna Spotter Catcher.	SEM
	If the fauna is not at risk of being impacted (not in proximity to vegetation clearing or management activities) allow the fauna to move on in own time.	SEM
	If fauna is at risk of being impacts, halt vegetation clearing or management activities until fauna have moved on or are removed by a qualified Fauna Spotter Catcher.	SEM
Injured fauna present onsite	Report and investigate as an incident.	SEM
	Report immediately to the Fauna Spotter Catcher.	SEM
	If animal is at further risk, contact RSPCA animal Emergency Hotline on the provided contacts list (Appendix 6).	SEM

10.1.3 PEST MANAGEMENT

Movement of equipment across the site, in addition to vegetation clearing activities has the potential to introduce and/or spread weeds and other pest species, such as fire ants (*Solenopsis invicta*). The impact of weed and other pest invasion and spread include:

- Loss of biodiversity;
- Loss of habitat;
- Increased fire risk and changes to fire regimes; and
- Introduction of weeds and pests detrimental to nearby agricultural areas.

Weeds and other pests will be managed by the implementation of the Pest Management sub-plan, detailed in Table 11.

TABLE 11: PEST MANAGEMENT SUB-PLAN (INCLUDING PEST PLANTS AND FIRE ANTS).

Pest Management		
Objectives		
• To prevent the spread of weeds and pests within the site. • To prevent the spread of weeds and pests to neighbouring properties. • To prevent the introduction of new weeds and pests to the site. • No possible predators are introduced to the site. • No new disease or pathogen is introduced. • To control existing weed infestations so as not to increase in habitat areas.		
1. KPI's and Targets		
Details		
• No introduction of new weed or pest species to the site or neighbouring properties. • No spread of weeds or pests within the site. • To effectively control or eradicate existing weed or pest species within the site. • No new disease or pathogen is introduced to the site.		
2. Management Actions		
Description	**Responsibility**	**Timing**
Conduct weed control for target species on a seasonal basis as per optimal control for each target species.	SEM	Seasonal as per optimal control for each target species
Conduct follow up weed and pest surveys following the completion of all clearing activities to compare with the original baseline survey.	SEM	Following clearing
Ensure all vehicles, equipment and plant undergo a thorough inspection prior to access to site and are free of plant material and soil.	SEM	At all times
Ensure soil used on-site adheres to the soil movement guidelines as outlined in the *Biosecurity Regulation 2016* (Qld) for fire ant movement controls.	SEM	At all times
Ensure soil and mulch used on site is uncontaminated, and free of weeds and pests.	SEM	At all times
In areas that have been subject to weed management, conduct seasonal control of weeds to maintain weed levels and prevent re-infiltration.	SEM	Seasonal
Control any infestation of weeds or pests on site.	SEM	As required

Pest Management		
Locate cleared vegetation and mulch stockpiles away from areas where runoff from rainfall may occur.	SEM	At all times
3. Monitoring		
Description	Responsibility	Frequency
Prior to excavating or disturbing any ground, conduct thorough visual inspection for fire ants or signs of fire ants.	SEM	At all times
Visual inspection of cleared vegetation and mulch stockpiles for weeds and pests.	SEM	At all times during and after clearing
Visual inspection of landscaping areas within site and along boundaries for weeds and pests.	SEM	At all times
Appropriate records of weed spraying and/or removing are being recorded.	SEM	At all times

Examples of Contingency and Corrective Actions		
Incident	Corrective Action	Responsibility
New weed infestation occurring onsite, on mulch stockpiles, or within landscaping areas.	Report and investigate as an incident.	SEM
	Arrange for weed or pest control by a suitably trained contractor.	SEM
	Increase monitoring frequency until weed or pest occurrence has been controlled.	SEM
	Retrain relevant personnel in regard to CEMP procedures and controls.	SEM
Fire ants identified on site	Report and investigate as an incident.	SEM
	Notify personnel who are suitably trained[4] in the identification of fire ants.	SEM
	If a suspected nest is observed, the suitably trained personnel can use a long rod or stick to gently prod the nest and inspect for any ants present.	SEM
	Advise Biosecurity Queensland if fire ants are confirmed or suspected.	SEM

[4] Free training available from Biosecurity Queensland.

10.1.4 WATER QUALITY MANAGEMENT

Erosion may be a factor through all phases of construction. Erosion within the site will most likely be caused by rainfall and surface runoff. Erosion may have the following impacts:

- Deposition of sediment on neighbouring properties.
- Nuisance impacts on neighbouring properties; and,
- Channeling and deposition within the site

All erosion and stormwater control devices set out in the sub-plans shall be installed on the development site. Responsibility for maintenance shall rest with the relevant site manager. Details of required operation and maintenance procedures shall be supplied for future Council reference if required.

TABLE 12: WATER QUALITY MANAGEMENT SUB-PLAN (INCLUDING EROSION AND SEDIMENT CONTROL).

Water quality management, including erosion and sediment control		
Objectives		
• To minimise erosion during construction. • Manage stormwater across site during construction phases. • No adverse impacts on adjacent properties.		
1. KPI's and Targets		
Details		
• No visible signs of erosion within or at the boundaries of the site. • Address all complaints regarding erosion and stormwater runoff. • No irreparable collapse or destabilisation of the site from erosion. • No evidence of erosion or sedimentation of waterways as a result of the project.		
2. Management Actions		
Description	**Responsibility**	**Timing**
Erosion and sediment control measures installed in accordance with: • Soil Erosion and Sediment Control Engineering Guidelines for Queensland Construction Sites (The Institution of Engineers, Australia Queensland Division June 1996); • Best Practice Erosion and Sediment Control (International Erosion Control Association 2008); and, • Any relevant permit conditions, including all relevant preliminary approval conditions for Material Change of Use of Premises, Bremer Business, Ipswich City Council (3356/2002/MAMC/A); - Conditions 20 – 21, unless otherwise stated, shall be completed to the satisfaction of the Chief Environmental Health Officer.	SEM	Prior to and throughout construction phases
Stormwater control measures installed in accordance with: • Water by Design Bioretention Technical Design Guidelines Version 1.1, October 2014; • Healthy Waterways Water Sensitive Urban Design Technical Design Guidelines for Southeast Queensland Version 1, June 2006; • Water by Design Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands Version 1.1, April 2010; • Fire ant relevant permit conditions; and • All relevant preliminary approval for Material Change of Use of Premises, Bremer Business, Ipswich City Council (3356/2002/MAMC/A);	SEM	Prior to and throughout construction phases

Water quality management, including erosion and sediment control		
- Conditions 20 – 21, unless otherwise stated, shall be completed to the satisfaction of the Chief Environmental Health Officer		
Where required, construct earth bunds around the perimeter of the site.	SEM	Prior to works
Stormwater drainage structures shall be designed so that there is 'no worsening' of runoff beyond that which occurs on the existing undeveloped site.	SEM	Prior to and throughout construction phases
All complaints regarding erosion and water stormwater runoff are to be recorded within a Complaints Register immediately.	SEM	At all times
All complaints regarding erosion and stormwater runoff are to be addressed within 24 hours if severe, or within one week for minor complaints.	SEM	At all times
There shall be no deposition of sediment from the project site on to neighbouring properties.	SEM	At all times
There shall be no nuisance impacts as a result of erosion, stormwater runoff, or sedimentation on to neighbouring properties.	SEM	At all times
There shall be no channeling and/or deposition as a result of erosion, stormwater runoff, or sedimentation within the site.	SEM	At all times
3. Monitoring		
Description	**Responsibility**	**Frequency**
Visual inspection of earthwork bunds, drainage channels, gullies, and perimeter of site for signs of erosion, bank slumping, or the formation of rills and gullies.	SEM	Daily throughout construction phase
Inspections after each storm event to assess the adequacy of the erosion control measures.	SEM	As required
During construction phase of operations, end of day inspection of erosion and sediment control devices and rectification where required.	SEM	Daily
Daily following a rainfall event, inspection and sediment removal where required as soon as practicable.	SEM	As required
Examples of Contingency and Corrective Actions		
Incident	**Corrective Action**	**Responsibility**

Water quality management, including erosion and sediment control		
Signs of erosion	Report and investigate as an incident.	SEM
	Remediate erosion and stabilise.	SEM
	'Make good' any damage or non-performing erosion control devices and clean up any sediment that has left the site or is on the roads within and external to the site.	SEM
Complaint received	Report and investigate as an incident.	SEM
	Complaint must be addressed within 24 hours if severe, or within one week for minor complaints.	SEM
	Review procedures and adjust if required.	SEM
	Notify the PM if the complaint escalates to a serious concern that cannot be addressed by the SEM.	SEM
	Retrain relevant personnel regarding CEMP procedures and controls.	SEM

10.1.5 AIR QUALITY MANAGEMENT

Construction works must occur, so they do not cause unreasonable interference with the amenity of adjoining premises by reason of noise, vibration, electrical or electronic interference, smell, fumes, vapour, steam, soot, ash, dust, grit, oil or otherwise.

Dust control measures (Table 13) will be implemented to achieve compliance with Workplace Exposure Standards for Airborne Contaminants (Safe Work Australia 2019) and applicable workplace health and safety regulations.

TABLE 13: AIR QUALITY MANAGEMENT SUB-PLAN.

Dust management		
Objectives		
• To minimise dust lift during construction. • No adverse impacts on adjacent properties.		
1. KPI's and Targets		
Details		
• To ensure dust and particulate matter do not exceed allowable air quality concentrations. • Address all complaints regarding dust management.		
2. Management Actions		
Description	Responsibility	Timing
Screening and abatement measures along the Warrego Highway must be installed to prevent dust and debris infiltration onto the highway in accordance with the Erosion & Sediment Control Plan, 7902-44-014-201.1 by Cardno (QLD) Pty Ltd dated 05/07/13 as a minimum.	SEM	Prior to works
Where required, install wind fencing around the perimeter of the site, taking into consideration the use of natural wind fencing (vegetation) as a natural wind barrier.	SEM	Prior to works
Water trucks are to water down unsealed roads and working surfaces during operation to reduce dust lift.	SEM	Prior to works
All complaints regarding dust are to be recorded within a Complaints Register immediately.	SEM	At all times
All complaints regarding dust are to be addressed within 24 hours if severe, or within one week for minor complaints.	SEM	At all times
All trucks removing materials from site will be loaded inside site perimeter.	SEM	At all times
All loads shall be securely covered prior to exiting site perimeter.	SEM	At all times
Minimise stockpiling of material.	SEM	At all times
Maintain stabilised access roads and driveways.	SEM	At all times
Maintain clean roadways wherever possible, particularly at entry / exit points.	SEM	At all times
Dust and particulate matter must not exceed the allowable following levels when measured at any nuisance sensitive place or downwind of the project site (see Monitoring section below for further details).	SEM	At all times

Dust management 3. Monitoring Description	Responsibility	Frequency
Visual inspection of wind fences for signs of dust deposition.	SEM	Daily throughout construction phase
Monitoring of dust lift-off during works, or windy conditions.	SEM	As required
Dust and particulate matter with an aerodynamic diameter of ≤2.5 micrometre (μm) (PM2.5) suspended in the atmosphere must not exceed 25 micrograms per cubic metre over a 24-hour averaging time, at a nuisance sensitive or commercial place downwind of the authorised place, when monitored in accordance with: • Any relevant AS to the extent it is relevant to the measurement of PM2.5 particles; or, • Any alternative method of monitoring PM2.5 which may be permitted by the 'Air Quality Sampling Manual' as published from time to time by the administering authority.	SEM	Daily
Dust and particulate matter with an aerodynamic diameter of ≤10 micrometre (μm) (PM10) suspended in the atmosphere must not exceed 50 micrograms per cubic metre over a 24-hour averaging time, at a nuisance sensitive or commercial place downwind of the authorised place, when monitored in accordance with: • AS 3580.9.6 of 2003 (or more recent editions) 'Ambient air — Particulate matter - Determination of suspended particulate PM10 high-volume sampler with size-selective inlet — Gravimetric method'; or • Any alternative method of monitoring PM10 which may be permitted by the 'Air Quality Sampling Manual' as published from time to time by the administering authority	SEM	Daily
Dust deposition must not exceed 120 milligrams per square metre per day, when monitored in accordance with AS 3580.10.1 of 2003 (or more recent editions).	SEM	Daily

Examples of Contingency and Corrective Actions Incident	Corrective Action	Responsibility
Observation of excessive dust lift-off during work operations	Report and investigate as an incident.	SEM
	Apply water as an immediate dust suppressant measure.	SEM
	Halt work within proximity of the area until cause of dust is addressed.	SEM
	Increase dust mitigation measures (e.g., more water trucks) as required.	SEM

Dust management		
Complaint received	Report and investigate as an incident.	SEM
	Complaint must be addressed within 24 hours if severe, or within one week for minor complaints.	SEM
	Review procedures and adjust if required.	SEM
	Notify the PM if the complaint escalates to a serious concern that cannot be addressed by the SEM.	SEM
	Retrain relevant personnel in regard to CEMP procedures and controls.	SEM

10.1.6 NOISE MANAGEMENT

Noise associated with construction of the proposed development shall be in accordance with the *Environmental Protection Act 1994* (Qld) and subordinate *Environmental Protection (Noise) Policy 2019* (Qld) and associated noise management criteria (Table 14).

Noise from the activity to which this approval relates must not cause an environmental nuisance at any nuisance sensitive place or commercial place.

The method of measurement and reporting of noise levels must comply with the latest edition of the Noise Measurement Manual (Queensland Department of Environment and Science 2020) (Appendix 9) as published from time to time by the administering authority.

Where a construction noise complaint(s) is received, noise compliance monitoring must be undertaken as soon as practicable by the contractor.

TABLE 14: NOISE MANAGEMENT SUB-PLAN.

Noise management		
Objectives		
• To minimise noise during construction. • No adverse noise impacts on adjacent properties.		
1. KPI's and Targets		
Details		
• Address all complaints regarding noise management.		
2. Management Actions		
Description	**Responsibility**	**Timing**
Where required, install noise abatement barriers or fencing around the perimeter of the site.	SEM	Prior to and throughout construction phases
Where required, make use of noise attenuating controls at the source, such as mufflers or acoustic screens.	SEM	Prior to works
All complaints regarding noise are to be recorded within the Corrective Actions Register.	SEM	At all times
All complaints regarding noise are to be addressed within 24 hours if severe, or within one week for minor complaints.	SEM	At all times
Locate static sources of noise such as the generators as remotely as possible from noise sensitive receivers.	SEM	Prior to works
Modification of work activities where noise or vibration is found to cause unacceptable impact.	SEM	At all times
Hours of construction must be in accordance with: • The provisions of any relevant local law; or, • In the absence of any relevant local law or condition, the hours of construction must be limited to 0630–1830 Monday to Saturday and not at all on Sunday and public holidays.	SEM	At all times
3. Monitoring		

Noise management		
Description	Responsibility	Frequency
Visual inspection of noise barriers and fences for signs of damage.	SEM	Daily throughout construction phase
Monitoring noise levels during works to ensure they do not exceed permittable levels	SEM	At all times
Noise compliance monitoring shall be undertaken in accordance Noise Measurement Manual (Queensland Department of Environment and Science 2020) or *AS 1055-1997 Acoustics – Description and measurement of environmental noise*. Noise compliance monitoring results shall be provided to the regulator.	SEM	At all times

Examples of Contingency and Corrective Actions		
Incident	Corrective Action	Responsibility
Observation of excessive noise during work operations	Report and investigate as an incident.	SEM
	Halt work within proximity of the area until cause of excessive noise is addressed.	SEM
Complaint received	Report and investigate as an incident.	SEM
	Complaint must be addressed within 24 hours if severe, or within one week for minor complaints.	SEM
	Review procedures and adjust if required.	SEM
	Notify the PM if the complaint escalates to a serious concern that cannot be addressed by the SEM.	SEM
	Retrain relevant personnel regarding CEMP procedures and controls.	SEM

10.1.7 WASTE MANAGEMENT

All refuse storage, removal and collection methods must be in accordance with any relevant local government policy or standard or, where no relevant local government policy or standard exists, are to be in accordance with the *Waste Reduction and Recycling Act 2011* (Qld) so as not to cause any unreasonable interference with the amenity to the surrounding area and to provide an acceptable level of amenity for future users of the site (Table 15).

Solid waste includes vegetation cleared as part of the proposed development. Cleared 'green waste' is to be managed by the contractor in accordance with the CEMP. Other solid waste is to be disposed of at landfill in accordance with Council's local laws and regulations.

Waste management follows the waste hierarchy:

- Avoid;
- Reduce;
- Reuse;
- Recycle;
- Treat; and,
- Dispose.

The following waste storage practices should also be implemented and adhered to at all times.

In addition, it must be ensured that the land is not contaminated prior to works, as referenced under the permit for the EPA[5] - Concurrence Agency Response. A scientifically robust investigation of land in accordance with the Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland must be completed to assess contamination of land and submitted to the EPA.

Asbestos or Asbestos Containing Material

Where asbestos or asbestos containing material (ACM) is found on site during construction works, asbestos shall be managed in accordance with the:

- *Work Health and Safety Act 2011* (Qld) (WHS Act);
- *Work Health and Safety Regulation 2011* (Qld) (WHS Regulation);
- Code of Practice: How to Safely Remove Asbestos (Qld); and,
- Code of Practice: How to Manage and Control Asbestos in the Workplace (Qld).

[5] Required to be submitted to the Environmental Protection Agency. The relevant department is to be contacted at the time the works are undertaken.

Where asbestos or ACM is found on the site, a site-specific Asbestos Management Plan should be put in place. The plan must be administered by the principal contractor and include:

- Identification and signage of the asbestos or ACM;
- Safe work procedures and control measures;
- Incidents or emergency procedures; and,
- Consultation, information and training responsibilities for staff and contractors.

Chemical Storage

All fuels and chemicals must be stored in an onsite containment system of a type suitable to prevent the spillage of the material and its discharge to the environment.

In all instances, the storage and handling of chemicals and fuels done in accordance with the relevant AS (as amended or substituted by a later standard) shall be taken to be sufficient for compliance with relevant conditions in Section 2.

See the following ASs for requirements for storage and handling of chemicals and fuels:

- *AS1940 — 2004 The storage and handling of flammable and combustible liquids*;
- *AS3780 — 2008 The storage and handling of corrosive substances*; and
- *AS/NZS 3833:2007 The storage and handling of mixed classes of dangerous goods, in packages and bulk intermediate containers*.

Spill Kits

The person undertaking any waste management or activity that includes the use of chemicals must keep an appropriate spill kit, personal protective equipment, operator instructions and emergency procedure guides for the management of wastes and chemicals associated with the activity in a place accessible to all employees.

Employees undertaking any waste management activity or handing chemicals must have received appropriate training in the use of the spill kit and the handling of chemicals stored on-site. Training must be repeated at intervals no greater than two years.

TABLE 15: WASTE MANAGEMENT SUB-PLAN.

Waste management		
Objectives		
• To minimise and manage waste during construction. • No adverse waste impacts on adjacent properties.		
1. KPI's and Targets		
Details		
• All waste is managed correctly.		
2. Management Actions		
Description	**Responsibility**	**Timing**
The removal of any contaminated soil from the site requires prior approval from the Environmental Protection Authority (EPA) (Contaminated Land Unit) under the *Environmental Protection Act 1994* (EP Act) under Section 424.	SEM	At all times.
All waste should be placed in appropriate disposal containers and areas during construction.	SEM	At all times
All waste should be removed from site and disposed of appropriately.	SEM	At all times
Where possible ensure that waste onsite is appropriately covered.	SEM	At all times
Covered bins are provided to collect waste and prevent fauna being attracted to the work site.	SEM	At all times
An adequate number of an appropriate type of commercial and bulk waste containers shall be provided at a central location to accommodate all waste produced on the site.	SEM	At all times
All waste collected on the site to be removed not less than once per week.	SEM	At all times
Appropriate spill kits, personal protective equipment, operator instructions and emergency procedure guides for the management of wastes and chemicals must be in a place accessible to all employees.	SEM	At all times

Waste management		
All fuels and chemicals must be stored in an onsite containment system of a type suitable to prevent the spillage of the material and its discharge to the environment.	SEM	At all times
All general and regulated waste records, including transfer station dockets and waste tracking certificates, are to be retained.	SEM	At all times
Waste must be stored, pending its lawful disposal to landfill or to a recycling facility, or another place with the written approval of the administering authority, in a location at the authorised place where it is not visible to a person outside the authorised place.	SEM	At all times
Waste (other than wastewater or sludges in any evaporation pond) must be removed from the authorised place within the timeframe specified for the waste as follows: • If the waste is surplus from the construction of the development — within three (3) months after construction is completed; or, • Otherwise — within three (3) months of the waste being generated.	SEM	At all times
Waste storage areas are to be signed and located away from environmentally sensitive areas.	SEM	At all times
Burning of waste is prohibited.	SEM	At all times
Adequately sized refuse bins will be made available on-site and will have suitable lids to prevent access by animals.	SEM	At all times
Construction site is to be kept in an orderly and hygienic standard, free of litter and waste.	SEM	At all times
3. Monitoring		
Description	**Responsibility**	**Frequency**
Visual inspection of waste and chemical storage facilities.	SEM	Weekly
Monitoring waste movement and disposal during works.	SEM	As required

Waste management		
Visual inspection to ensure appropriate bunding is maintained and operated correctly.	SEM	Weekly

Examples of Contingency and Corrective Actions		
Incident	**Corrective Action**	**Responsibility**
Observation of incorrectly stored waste during work operations	Report and investigate as an incident.	SEM
	Halt work within proximity of the area until waste is stored correctly.	SEM
	Train relevant personnel in the correct waste management procedures.	SEM
Complaint received	Complaint must be addressed within 24 hours if severe, or within one week for minor complaints.	SEM
	Review procedures and adjust if required.	SEM
	Notify the PM if the complaint escalates to a serious concern that cannot be addressed by the SEM	SEM
	Retrain relevant personnel regarding CEMP procedures and controls.	SEM

11 AUDIT AND REVIEW

11.1 ENVIRONMENTAL AUDITING

Compliance with the CEMP will be achieved through self-administered weekly monitoring and subsequent reporting to the relevant authority (if required).

Environmental auditing, monitoring and compliance will be overseen by the SEM; however, all personnel entering the site must familiarise themselves with the CEMP and acknowledge their responsibility to comply with the Plan's requirements.

In addition, an EIC has been prepared which provides a procedure for auditing compliance with the CEMP. The audit will be administered by the proponent's SEM.

11.2 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN REVIEW

As the project progresses, environmental impacts may change. As such, it is important that this CEMP is revised to address any environmental impacts arising from the changes in activities.

The CEMP will be reviewed by the project manager as required if any additional activities are to be carried out. Each review period will investigate:

- Potential gaps between the CEMP management measures and on-site construction activities;
- Assessment of any incidents or near misses that occurred since the previous review; and,
- Employee and workplace compliance.

The review should include consultation between employees and management to review and discuss concerns.

Ongoing monitoring and review of the CEMP ensures that risk identification and management measures are constantly assessed, ensuring the efficiency and effectiveness of the CEMP.

The Project Manager's details are located in the site contacts list (Appendix 5).

12 GLOSSARY

Acronym	Description
CEMP	Construction Environment Management Plan
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
SEM	Site Environmental Manager
TPZ	Tree Protection Zone
PM	Project Manager
ACM	Asbestos containing material
AS	Australian Standard

13 REFERENCES

Commonwealth of Australia (2014). Environmental Management Plan Guidelines.

Department of Agriculture Water and the Environment (2021). National Recovery Plan for the Grey-headed Flying-fox 'Pteropus poliocephalus'

Nearmap. (2022). "Nearmap PhotoMaps." from https://www.nearmap.com/au/en.

Queensland Department of Environment and Science (2020). "Noise measurement manual."

Safe Work Australia (2019). Workplace exposure standards for airborne contaminants

APPENDICES

APPENDIX 1 – EXISTING APPROVALS

QLD – CITISWICH BUSINESS PARK – HISTORY – STAGE 7

APPLICATIONS AND SUBMISSIONS

Historical Summary of Applications / Submissions	Lodged	Status
RECONFIGURATION OF LOT APPLICATIONS (ROL) – SUBDIVISIONS – STAGE 7		
DA 4210 / 2008 Stage 7 - Reconfiguration of a Lot (48 lots + park + road). *No DA permit issued. The application lapsed because we could not comply with the requirements of the information response.*	02.06.08	Lapsed 14.03.12
DA 2900 / 2009 Stage 7 – ROL. DMR 10m reservation. Nth side of Warrego Highway. *Approved 22.1.2010.*	11.05.09	Lapsed 22.01.12
DA 5450 / 2010 Stage 7 – ROL. Subdivide lot 13 SP 227111 into two lots. Lot 13 (north of Warrego Hwy) and Lot 131 (south of Warrego Hwy). *The relevant period of the approval is subject to s. 341 of the Sustainable Planning Act 2009. Permit lapses 2 February 2013 in accordance with s.341 of SPA, if a survey plan is not given to Council before this date.* *Lots registered 14.05.12 (lots 13 & 131 on SP 238272). No further action required.*	13.08.10	Approved 02.02.11
DA 6231 / 2018 Stage 7 – ROL. Subdivide Lot 34 into 2 lots (separate north and south of Warrego Hwy). *The relevant period of the approval is subject to s. 85 of the Planning Act 2016, i.e. 4 years (22.10.22).* *Lots registered 08.10.21 (Lots 103 & 34 on SP 326668). No further action required.*	07.08.18	Approved 22.10.18
DA 7995 / 2023 Stage 7 – ROL + OW. ROL – 3 lots into 15 industrial lots + park + road reserve; OW – earthworks (fill to min. 19.0m) & waterway barrier works. *Note: prepared & lodged by Plan A Town Planning P/L on behalf of Walker Bremer Park P/L.*	03 08 23	← Under Assessment
OPERATIONAL WORKS APPLICATIONS (OPW) – CIVIL WORKS – STAGE 7		
DA 5426 / 2010 OPW. Stage 7A (west). Bulk earthworks. *Decision Notice dated – 30 May 2011.* *Walker has no need for development approval 5426/2010 in light of approval – 7540/2010. Pursuant to s. 379 of Sustainable Planning Act 2009, Walker requested Council to cancel approval 5426/2010. Council cancelled application 26 November 2012. No further action.*	13.08.10	Cancelled 26.11.12
DA 7540 / 2010 OPW. Stage 7 (balance). Bulk earthworks. *Decision Notice dated – 02 November 2012.* *The relevant period is 2 years unless the development happens before. Condition 12(a) uses the words "unless the development happens. " The meaning of these words in their plain letter law interpretation is - "unless the development is completed within the relevant period." The works are substantially started, but not completed.* *The approval has bene extended on 3 occasions. Currency period is up to & including 02 November 2018.* *QLD Team confirms this DA can lapse.*	03.11.10	Lapsed 02.11.18
Amendment # 1 Extend permit to 2 November 2016. *Approved 16.10.2014.*	05.09.14	Lapsed 02.11.18
Amendment # 2 Move approx. 5,000m^2 contaminated soil from Stage 4 to Stage 7 under an EHP Soil Disposal Permit.	N/A	Withdrawn
Amendment # 3 Extend permit to 2 November 2017. *Approved 28.11.2016.*	27.10.16	Lapsed 02.11.18
Amendment # 4 Extend permit to 2 November 2018. *Approved 14.03.2017.*	27.02.17	Lapsed 02.11.18

QLD – CITISWICH BUSINESS PARK – HISTORY – STAGE 7

Historical Summary of Applications / Submissions	Lodged	Status
DA 3668 / 2013 OPW. Stage 7. Maximise the fill (min. 16.5m) in Stage 7, within the footprint of the current Preliminary Approval and allowing a 30-metre corridor to drain the Warrego Highway low point. *QLeave – 152279.* *Decision Notice dated – 10 December 2013.* *The relevant period of the approval is subject to condition 12(a) which limits the approval to 2 years unless the development happens before. The development has not started.* *An extended relevant period may be agreed upon as per condition 12 (b) which invites the lodgement of s. 383 application under the Sustainable Planning Act 2009.* *This DA also has an associated Road Corridor Permit – see "Other Submissions".* *The approval has been extended on 8 occasions. Currency period is up to & including 10 December 2023.*	15.08.13	Approved 10.12.13
Amendment # 1 Extend permit to 10 December 2016.	23.10.13	Approved 30.11.15
Amendment # 2 Extend permit to 10 December 2017.	27.10.16	Approved 29.11.16
Amendment # 3 Extend permit to 10 December 2018.	01.03.17	Approved 15.03.17
Amendment # 4 Extend permit to 10 December 2019.	27.03.17	Approved 08.05.18
Amendment # 5 Extend permit to 10 December 2020.	09.12.19	Approved 10.02.20
Amendment # 6 Extend permit to 10 December 2021.	06.11.20	Approved 18.11.20
Amendment # 7 Extend permit to 10 December 2022.	08.10.21	Approved 25.10.21
Amendment # 8 Minor Change. Redirect stormwater runoff.	19.01.22	Approved 16.06.22
Amendment # 9 Extend permit to 10 December 2023.	28.10.22	Approved 02.12.22
Amendment # 10 Minor Change. Include new approved plans detailing stormwater outfall to Bremer River to satisfy condition 6(f). Condition 6(f) now deleted.	08.02.23	Approved 14.03.23
DA XXXX / 2023 OPW. Stage 7. Bulk earthworks (stormwater drainage to Bremer River). *Related to OW DA 3668 / 2013 – condition 6(f).*	■	
DA XXXX / 2023 OPW. Stage 7. Bulk earthworks (fill to minimum 19.0m).	■	
DA OPW. Stage 7. Major civil works. *Related to ROL DA XXXX / 2023.*	■	
DA OPW. Stage 7. Street landscaping. *Related to ROL DA XXXX / 2023.*	■	
DA OPW. Stage 7. Street lighting. *Related to ROL DA XXXX / 2023.*	■	
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QLD – CITISWICH BUSINESS PARK – HISTORY – STAGE 7

Historical Summary of Applications / Submissions	Lodged	Status
QUEENSLAND URBAN UTILITIES (QUU) – WATER / SEWER – STAGE 7		
22-SAN-61075 Stage 7. Service Advice Notice – future water / sewer connections for development of Stage 7. *(Note: Service Advice Notices are pre lodgement advice – required before lodging applications for water / sewer approval).*	15.07.22	Approved 24.08.22
23-XXX-XXXXX Stage 7. Water. *Related to ROL DA TBA.*	■	
23-XXX-XXXXX Stage 7. Sewer. *Related to ROL DA TBA.*	■	
MATERIAL CHANGE OF USE (+ combined OPW) – STAGE 7		
DA MCU. Stage 7. Details TBA.	■	
OTHER – REMOVAL OF VEGETATION – STAGE 7		
Exempt Clearing - DES Reference: 30956 & APP0039833 Stage 7. Application to Dept of Environment & Science (DES) for Exempt Clearing Notification (Protected Plants) on Lot 13 SP238272, Lot 34 SP288488 and Lot 2 RP104683. *Acknowledgement received via email from Litoria on 07.09.19, and lasts two (2) years from the date of submission, being 05.08.19.*	05.08.19	Approved 07.09.19
Vegetation Clearing – EPBC No. 2021 / 9112 Clearing of vegetation approval required under the EPBC Act (Australian Government).	01.12.21	← Under Assessment
PMAV Certification – 2020 / 013850 Certification of a Property Map of Assessable Vegetation (PMAV) on Lot/s 2 RP104683 & 9 RP846150 & 25 SP214482 & 4 SP220852 & 13 SP238272 & 1000,906 SP270961 & 131 SP271849 & 34 SP315309 & 301 SP315313 & 299 SP318183. Category X area and Category C area. *Permit issued by DNRME (Qld Govt) and is made under s.20C of the Vegetation Management Act 1999.*		Approved 04.12.20
Amendment # 1 Amend PMAV Certification 2020 / 013850 in accordance with EPBC Approval 2021 / 9112.	■	
OTHER – FAUNA APPLICATIONS – STAGE 7		
Koala Habitat Mapping Amend Koala Habitat Mapping in accordance with EPBC Approval 2021 / 9112.	■	
OTHER – REMOVE LAND FROM EMR – STAGE 7		
Remove Lot 13 SP 238272 from EMR Stage 7. Remove Lot 13 SP 238272 from Environmental Management Register. *Issued by Dept of Environment & Heritage Qld.*	11.03.14	Approved 08.04.14
Remove Lot 2 RP 104683 from EMR Stage 7. Remove Lot 2 RP 104683 from Environmental Management Register. *Issued by Dept of Environment & Science.*	16.08.18	Approved 06.09.18
OTHER – ROAD APPLICATIONS – STAGE 7		
DTMR Road Corridor Permit No. 1259 (DTMR Ref No. 500/424) Stage 7. Road Corridor Permit. Temporary underpass of Warrego Highway using the Bremer River Bridge. *Note: This permit was issued in association with DA Permit OPW 5426 / 2010 dated 30.5.11.*	04.10.10	Approved 10.06.11
DTMR RCP0001523 Stage 7. Road Corridor Permit. Temporary underpass of the Warrego Highway using the Bremer River Bridge. *Required for Stage 7 bulk earthworks OPW / 3668 / 2013. Note: Expired 25.11.2014.*	30.08.13	Approved 26.11.13
DTMR RCP0001750 (extension to 1523) Stage 7. Road Corridor Permit – temporary underpass of the Warrego Highway using the Bremer River Bridge. *Required for Stage 7 bulk earthworks OPW / 3668 / 2013. Note: Expired 10.12.2015.*	12.11.14	Approved 17.11.14

QLD – CITISWICH BUSINESS PARK – HISTORY – STAGE 7

Historical Summary of Applications / Submissions	Lodged	Status
DTMR RCP0002065 (extension to 1523) Stage 7. Road Corridor Permit – temporary underpass of the Warrego Highway using the Bremer River Bridge. *Required for Stage 7 bulk earthworks OPW / 3668 / 2013. Note: Expired 10.12.2016.*	28.10.15	Approved 26.02.16
DTMR RCP0004663 (replaces expired RCP0001523) Stage 7. Road Corridor Permit – temporary underpass of the Warrego Highway using the Bremer River Bridge. *Required for Stage 7 bulk earthworks OPW / 3668 / 2013. Expires: 28 June 2024.*	23.03.22	Approved 21.11.22

APPENDIX 2 – STORMWATER MANAGEMENT PLAN

Cardno LawsonTreloar
Shaping the Future

Citiswich Masterplan

Flooding Investigation (Including Local Flooding Assessment)

Project Number: LJ8714/R3/V5
(Incorporating Amendment No. 1)

Prepared for Walker Corporation Pty Ltd

August 2012

Cardno (Qld) Pty Ltd
Trading as Cardno Lawson Treloar
ABN 57 051 074 992

Level 11 Green Square North Tower
515 St Paul's Terrace
Fortitude Valley Qld 4006
Locked Bag 4006 Fortitude Valley
Queensland 4006 Australia

Telephone: 07 3369 9822
Facsimile: 07 3369 9722
International: +61 7 3369 9822

cardno@cardno.com.au
www.cardno.com.au

Originated as J8714/R3 – March 2007

Fifth Edition 2012

Reissued incorporating Amendment No.1 (August 2012)

This Report was prepared by Cardno (Qld) Pty Ltd Trading as Cardno Lawson Treloar, to supersede LJ8714/R3/v5 – May 2012.

This Report incorporates Amendment No. 1 (August 2012). The changes are indicated in the text by a marginal bar and amendment number against the text, table, figure or part thereof affected.

Document Control:

Version	Date	Author		Reviewer	
		Name	Initials	Name	Initials
1	8 March 2007	Kate Quinn	KTQ	Daniel Niven	DNN
2	27 August 2007	Kate Quinn	KTQ	John McArthur	JMcA
3	30 November 2011	Laurence Allan	LRA	Daniel Niven	DNN
4	17 April 2012	Laurence Allan	LRA	Daniel Niven	DNN
5	11 May 2012	Laurence Allan	LRA	Daniel Niven	DNN
A1 5 (+A1)	24 August 2012	Laurence Allan		Daniel Niven	

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1 INTRODUCTION

This masterplan flooding report has been prepared by Cardno Lawson Treloar (CLT), specialist hydrologic and hydraulic consultants, for the overall master plan of the proposed Citiswich industrial development located off the Warrego Highway at Bundamba in Ipswich City. This report has been completed for Walker Corporation Pty Ltd (Walker), the project managers and developer of the proposed development. This report provides advice in relation to flood management, including identification and management of key constraints for the masterplan development.

The site is located on both sides of the Warrego Highway downstream of the highway crossing of the Bremer River. The real property description of the site includes: Lot 13 on SP250293, Lot 34 on SP222633, Lot 2 on RP104683, Lot 8 on SP214482, Lot 101 on SP238269, Lot 1 on SP249408, Lot 1 on SP221686, Lot 2 on SP249408, Lot 3 on SP249408, Lot 2 on RP854997, Lot 16 on SP220855, Lot 1 on SP222644, Lot 4 on SP220850, Lot 4 on RP92591, Lot 5 on RP92591, Lot 1 on SP179307, Lot 11 on SP151177, Lot 14 on SP221438, Lot 12 on SP222638, Lot 2 on SP238270, Lot 996 on SP227111, Lot 7 on SP167997 (Bundamba Substation), Lot 22 on SP163216 (Capral Aluminium), Lot 5 on SP140694 (Humes), Lot 23 on SP222633, Lot 25 on SP214482 and Lot 12 on SP222644. The site location and extents are shown on Figure 1.

This overall development received preliminary approval for a Material Change of Use from Ipswich City Council on 6 July 2004. The overall site '*Concept Master Plan for Stormwater Quality Management*' was prepared by Sinclair Knight Merz (SKM) dated 12 September 2003, in support of the preliminary MCU application.

This report details the masterplan flood assessment of the proposed Citiswich industrial development in accordance with Ipswich City Council's (ICC) '*Ipswich Planning Scheme*' (2006) in support of the overall proposed development. As part of future applications additional flood assessments will be provided to Council ensure that the Planning Scheme and Conditions of Development are achieved in accordance with this masterplan study, as minor changes to the design occur.

This report also addresses ICC's '*Temporary Planning Instrument 01/2011 Flood Regulation'* further details are provided in Section 9.

This report has been updated to include details and flood assessments with regards to the January 2011 and 1974 historic flood events. The regional flood assessment analyses three scenarios, as follows;

- Pre-developed (Base) scenario: This considers the site prior to Walker commencing works;
- Existing current scenario: This considers the site in its current condition as of August 2011; and
- Masterplan (Ultimate) scenario: This considers the fully developed completed site.

ICC have designated the Brisbane River 30hour SKM ultimate 1 in 50 year Average Recurrence Interval (ARI) (16.22mAHD) as the design event for development affected by the Brisbane River regional flood event, with the local tributary 1 in 100 year ARI adopted as the design event for development in areas above 16.22mAHD. Along with the regional flooding assessment, this report also includes the masterplan flood assessments for the western and eastern local tributaries through the Citiswich development. This local assessment has only assessed the pre-developed (base) and masterplan (ultimate) scenarios.

2 CITISWICH SITE DESCRIPTION

2.1 Pre-Developed (Base) Site Description

The pre-developed (base) site is defined at September 2006, before Walker commenced works at the Citiswich development. The overall site covers an area of approximately 374ha and is bordered by the Bremer River to the north, the Ipswich Railway line and Brisbane Road to the south, River Road to the west and existing residential areas. In September 2006, the majority of the site was cleared and used for cattle grazing with a small portion of the site used for effluent disposal for the Australian Hardboards Limited (AHL) operations. The site also surrounds the Bundamba electrical substation and the Humes Hardboard factories. Details are shown on Figure 1.

As part of the AHL decommissioned effluent disposal the site also includes a number of existing dams and drainage channels. These were decommissioned with the installation of an effluent treatment plant for the AHL effluent.

There are two main gullies that traverse the site, along the western and eastern extents of the site. Both gullies discharge to the Bremer River located at the site's northern boundary. The site has with a gentle ridge running south-east to north-west. Figure 5 shows the local pre-developed catchment boundaries.

There are several significant external local catchments draining through the site, although the regional backwater flooding from the Brisbane River dominates the design flood levels within areas of the site below 16.22mAHD.

2.2 Existing Current Site Description

The existing current site is defined from survey data provided by ACOR of the site as it was in August 2011 and includes the current developed fill levels within Stage 1 and filled levels of Stages 4 and 7, including excavated levels within the Archer Street Park.

2.3 Masterplan (Ultimate) Development Site Description

The proposed overall Masterplan development comprises of industrial allotments ranging in size from approximately 2000m^2 to 120,000m^2 and associated new roadway infrastructure and also includes residential lots within the south west corner of the site. Fill is required to achieve flood immunity of the lots within the Citiswich site from the higher of either the SKM ultimate regional 1 in 50 year ARI (Council Defined Flood Event) or the local 1 in 100 year ARI flood levels. Some reworking of the local tributaries is also proposed to be constructed. Site access to will be from Brisbane Road, Ashburn Road, Bognuda Street and the Warrego Highway.

Details of the fill extents are presented on Figure 4 for the ultimate flood extents. The creek alignment through the Archer Street Parklands has been included, although no cut has been considered in this analysis. The model has also assumed there are no culverts under the service road in the Ultimate Fill scenario. This effectively assumes that all the upstream catchment (upstream of the Warrego Highway) along the western tributary is filled and the associated flood storage is not considered in the assessment.

3 DATA

3.1 General Data

The flooding assessment detailed in this report has been based on:

- Detailed site survey data provided by Walker;
- 12d Model tins for the pre-developed, existing current and ultimate scenarios provided by Cardno Civil;
- Laser survey of the surrounding site supplied by Terranean Mapping Technologies;
- 1m contour information, digital orthophotos and property data supplied by ICC;
- ACOR Baseline Consultants' engineering drawings (Stage 2 and 6);
- 1:25,000 scale topographic maps, supplied by SUNMAP; and
- ICC's one-dimensional Mike11 dynamic model of the Bremer and Brisbane Rivers prepared by SKM.

3.2 Previous Flood Investigations

ICC commissioned SKM to carry out a hydraulic investigation of the major creeks and rivers within the ICC district. The hydraulic assessment was undertaken using Danish Hydraulic Institutes (DHI) dynamic one-dimensional Mike11 model (version 1999b). Both existing and ultimate flow scenarios were modelled with calibration of the model to historic data. SKM's assessment also investigated both local and regional (Brisbane River) flooding.

Details of this modelling is presented in the report prepared by SKM *'Ipswich Rivers Flood Studies Phase One and Phase Two'* (July 2000). Since the release of this report, SKM have updated the Brisbane River assessment for Brisbane City Council (BCC). Accordingly, ICC have recommended that the 1 in 50 year ARI discharge and flood levels presented by SKM (2000) be adopted as the design storm event for all development within the Bremer River floodplain.

From a review of the Mike11 model results, it is clear that the Brisbane River flooding dominates the SKM ultimate 50 year ARI flood levels within the Bremer River and Bundamba Creek through the site extent. The design 1 in 50 year ARI flood level for the site is RL16.22mAHD.

3.3 Historic Flood Events

ICC has provided the following flood levels at the Citiswich site for the two significant historic flood events that have occurred in recent generations:

- 1974 flood event – RL 20.5mAHD; and
- 2011 flood event – RL 18.7mAHD.

4 METHODOLOGY

A detailed flood assessment has been undertaken to determine the impacts of the proposed Citiswich Masterplan development for both local and regional flooding characteristics. The methodology for this assessment is described below:

- Develop a hydraulic model to test the impacts of the site for the regional flood event. Calibrate the base case hydraulic model to the Mike11 model built by SKM.
- Carry out a cumulative impact assessment in a sub-model of SKM's Mike11 model and the SOBEK 2D model.
- Update the hydraulic model for the regional flood event to consider three scenarios: "Pre-developed (base)", "Existing current developed site as of August 2011" and "Masterplan (ultimate) developed".
- Simulate the regional flood models for extreme flood events to produce hazard mapping using SKM's 1 in 100, 200 and 500 year ARI events.
- Undertake a desktop storage impact assessment within the site boundary for all three model scenarios.
- Develop hydrologic models to test the impact of the site on the local catchment flows with external catchments in an ultimate developed condition.
- Develop hydraulic models of the local tributaries to test the impacts of the site for the local flood event. These models utilise the flow hydrographs from the above mentioned hydrologic models.

5 REGIONAL HYDRAULIC ASSESSMENT

5.1 Approach

Hydraulic analysis has been performed to determine peak flood levels for the site and to ensure that the site development will remain flood free up to the design flood event. Furthermore, the analysis will ensure the site development will not adversely impact other adjacent properties, upstream or downstream of the site and be in accordance with the appropriate Local Authority design standards.

The hydraulic assessment has been undertaken using Deltares SOBEK 1D/2D (Version 2.12.003) fully dynamic software package. SOBEK has been used in accordance with ICC's '*Ipswich Planning Scheme*' (2006) and '*Queensland Urban Drainage Manual*' (2008).

Two flood events have been tested to assess the potential impact of the proposed masterplan development;

- Bremer River Flooding (18hour duration); and
- Brisbane River Flooding (30hour duration).

It should be noted that the 30 hour duration was identified by SKM as the critical Brisbane River event and the 18 hour duration identified as the critical Bremer River event. The Brisbane River event dominates the peak flood levels at the site.

Both of these flood events were tested with the following scenarios:

- Pre-Developed (Base): This case models the site and surrounds in its original pre-developed condition prior to any works being conducted by Walker for the Citiswich development. Figure 2 presents the pre-developed (base) topography.
- Existing Current: This case models the site and surrounds in its current existing condition as of August 2011. No cut has been modelled within the Archer Street Park. Figure 3 presents the existing current topography.
- Masterplan (Ultimate) Developed Case: This case is based on the Base Case and includes fill and cut for the proposed Citiswich masterplan development. No cut is proposed within the Archer Street Park. Figure 4 presents the masterplan topography.

The upstream and downstream boundaries for the SOBEK model have been taken from the SKM's Mike11 Model (version 1999b) of the Bremer River area. Table 5.1 presents the corresponding Mike11 cross-section to the SOBEK boundary. Details of the boundary locations are shown on Figures 2, 3 and 4.

Table 5.1 Boundary Locations and Peak Values

SOBEK 2D Boundary ID	Mike11 Cross-Section Chainage	Type of Boundary	Peak Value from Mike11 Model (SKM Ultimate 50 year ARI)	
			Brisbane River Flood (30hour Duration)	Bremer River Flood (18hour Duration)
SCH	SCH 13055	Discharge	62m³/s	34m³/s
BREM	BREM 1018565	Discharge	2781m³/s	2556m³/s
BUND	BUND 38501.25	Discharge	243m³/s	240m³/s
Tailwater	BREM 1028190	Water Surface Level	16.215mAHD	8.501mAHD

The roughness maps for all the scenario cases were based on aerial photographs supplied by Ipswich City Council and the design plans provided by ACOR.

The pre-developed case was calibrated to the results presented in the report prepared by SKM *'Ipswich Rivers Flood Studies Phase One and Phase Two'* (July 2000).

Table 5.2 details the ARI and durations simulated in the SOBEK hydraulic model.

Table 5.2 ARI's and Durations Simulated in SOBEK

ARI (Years)	Duration (hours)	Flow Condition	Dominating Flood	Pre-Developed (Base)	Existing Current Case	Ultimate Design Case
2	18	Ultimate	Bremer River	Yes	Yes	Yes
5	18	Ultimate	Bremer River	Yes	Yes	Yes
10	18	Ultimate	Bremer River	Yes	Yes	Yes
20	18	Ultimate	Bremer River	Yes	Yes	Yes
50	18	Ultimate	Bremer River	Yes	Yes	Yes
100	18	Ultimate	Bremer River	Yes	Yes	Yes
200	18	Ultimate	Bremer River	Yes	Yes	Yes
500	18	Ultimate	Bremer River	Yes	Yes	Yes
5	30	Ultimate	Brisbane River	Yes	Yes	Yes
10	30	Ultimate	Brisbane River	Yes	Yes	Yes
20	30	Ultimate	Brisbane River	Yes	Yes	Yes
50	30	Ultimate	Brisbane River	Yes	Yes	Yes
100	30	Ultimate	Brisbane River	Yes	Yes	Yes
200	30	Ultimate	Brisbane River	Yes	Yes	Yes
500	30	Ultimate	Brisbane River	Yes	Yes	Yes

5.2 SOBEK 2D Results

A1 Figures 2, 3 and 4 show the reporting points within the SOBEK 2D hydraulic model used to assess the impact of the proposed masterplan development.

Both the Bremer River and Brisbane River flood pre-developed case water surface levels are similar to those presented in SKM's flooding report for ICC, with a maximum difference of 5mm, which is well within the tolerances of the models. Thus the SOBEK 2D model is considered suitable to assess the proposed changes to the site.

Table 5.3 details the predicted peak water surface levels and impacts associated with the proposed masterplan development for the Brisbane River flood case.

Table 5.3 SKM Ultimate 50 year ARI Water Surface Levels – Brisbane River Flood

SOBEK 2D Reporting ID	Water Surface Level (mAHD)			Impact (m)	
	Pre-Developed (Base)	Existing Current	Ultimate Masterplan	Existing Current	Ultimate Masterplan
A	16.217	16.217	16.217	-	-
B	16.217	16.217	16.217	-	-
C	16.216	16.216	16.216	-	-
D	16.215	16.215	16.215	-	-

Appendices A, B and C contain plots of the predicted Brisbane River peak water surface levels, depths, speed and hazard for the Pre-Developed (Base), Existing Current and Masterplan Ultimate cases respectively. Appendix D contains the impact plot figures between the Masterplan Ultimate case compared to the Pre-Developed (Base) case as well as the Existing Current case compared to the Pre-Developed Base case. Results show that no adverse flood level increases are predicted external to the site.

Appendix C.5 depicts the site specific hazard (safety product) plots due to the proposed development. For the purpose of this assessment hazard categorisation is based on the Brisbane City Council's *'Subdivision and Development Guidelines'* (2008) and is presented in the following table.

Table 5.4 Brisbane City Council Hazard Categorisation Criteria

Hazard Category	Depth (m)	Flow Velocity (m/s)	Hazard (m^2/s)
Low	≤ 0.5	≤ 0.2	≤ 0.6
High	> 0.5	> 0.2	> 0.6

Table 5.5 details the predicted peak water surface levels and impacts associated with the proposed Ultimate Design for the Bremer River Flood case.

Table 5.5 SKM Ultimate 50 year ARI Water Surface Levels – Bremer River Flood

SOBEK 2D Reporting ID	Water Surface Level (mAHD)			Impact (m)	
	Pre-Developed (Base)	Existing Current	Ultimate Masterplan	Existing Current	Ultimate Masterplan
A	11.976	11.977	11.980	0.001	0.004
B	12.759	12.763	12.762	0.004	0.003
C	10.984	10.984	10.986	-	0.002
D	8.627	8.627	8.627	-	-

Appendices E, F and G contain plots of the predicted Bremer River peak water surface levels, depths, speed and hazard for the Pre-Developed (Base), Existing Current and Masterplan Ultimate cases respectively. Appendix H contains the impact plot figures between the Masterplan Ultimate case compared to the Pre-Developed (Base) case as well as the Existing Current case compared to the Pre-Developed Base case. Results show that no adverse flood level increases are predicted external to the site, with the exception of the Existing Current case SKM 50 year event. It is noted that these impacts are as a result of survey of the site in August 2011, and is not the ultimate proposed case.

The results presented in this report indicate that the proposed ultimate design fill and cut will not adversely impact on the flood levels external to the site and that the flood immunity of the Warrego Highway has not been reduced. In particular, the hydraulic modelling suggests that the proposed works will not result in increases in peak flood levels in the vicinity of the development for the Brisbane River 30 hour ultimate SKM 1 in 50 year ARI scenario. Appendix H shows that flood levels in the vicinity of the Warrego Highway do not increase during the design flood event.

5.3 Rate of Rise Analysis – Regional Flooding

The rate of rise of floodwaters determines the time available for flood warning and evacuation. The following charts compare the rate of rise for reporting points A, B, C and D (refer to Figure 2 for reporting point locations), for all Brisbane and Bremer River flood events modelled.

Chart 1 Rate of Rise - SKM 5 Year Brisbane River Event

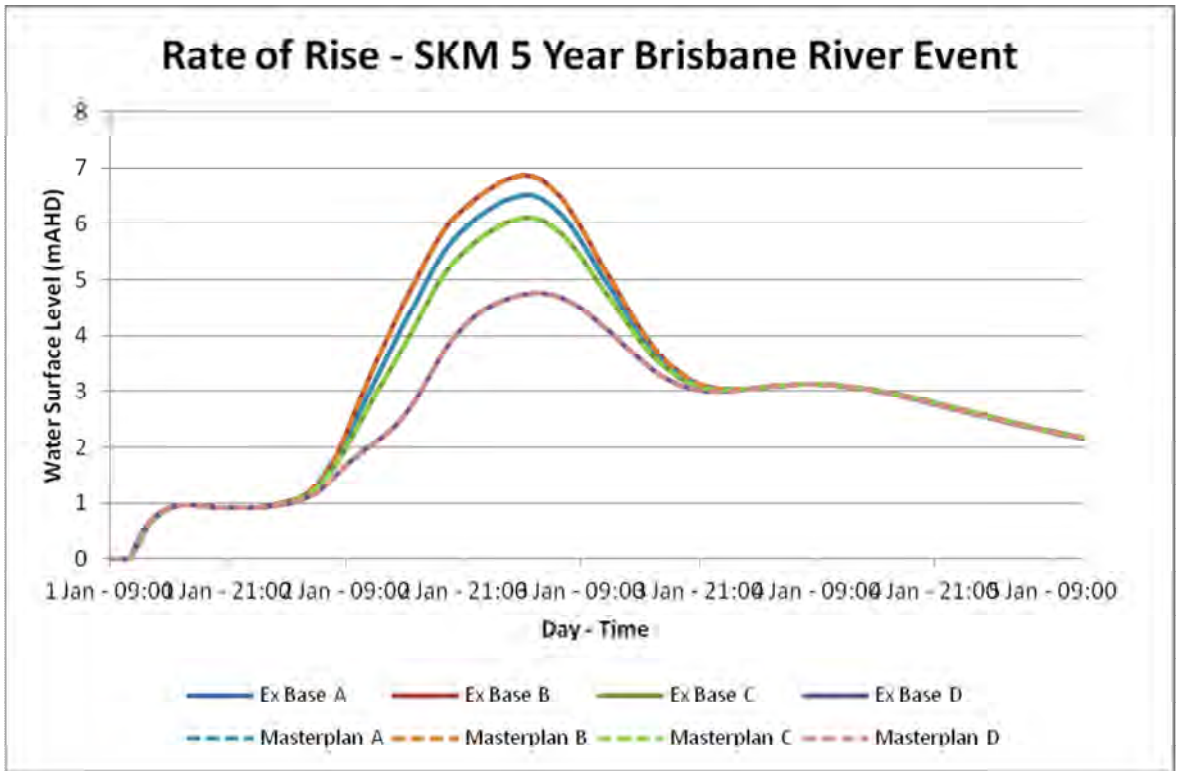


Chart 2 Rate of Rise - SKM 10 Year Brisbane River Event

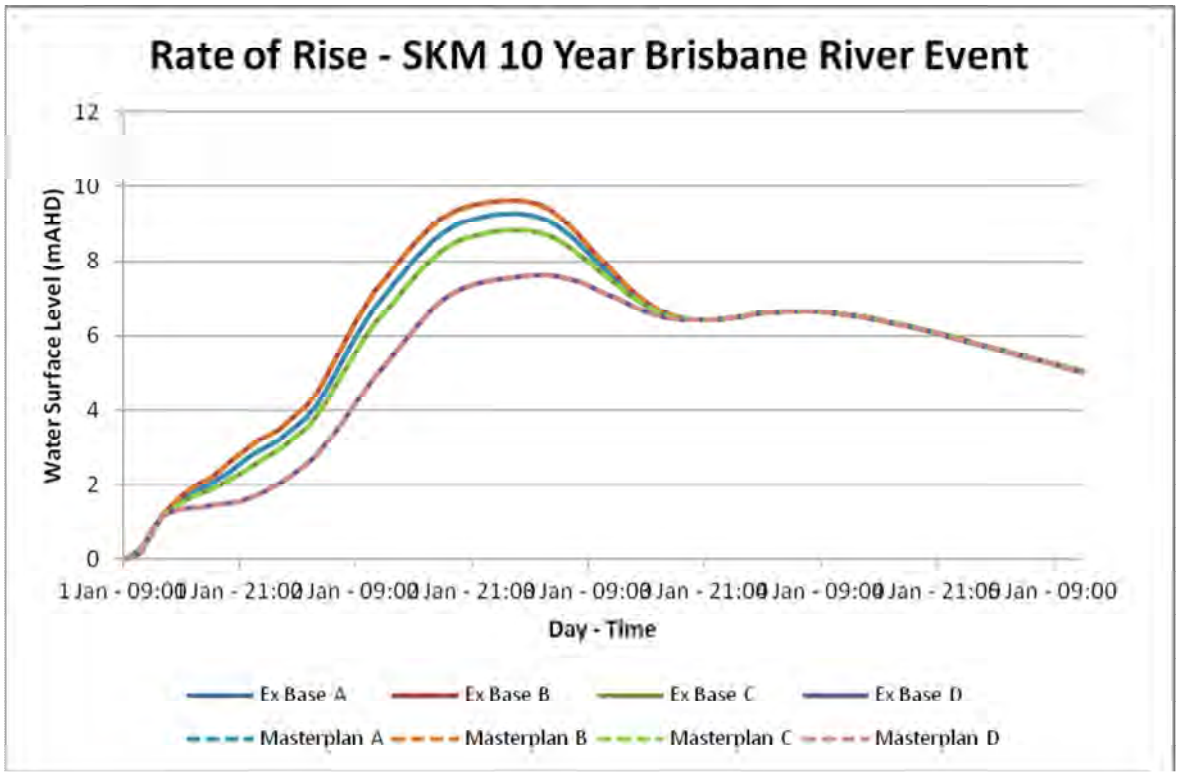


Chart 3 Rate of Rise - SKM 20 Year Brisbane River Event

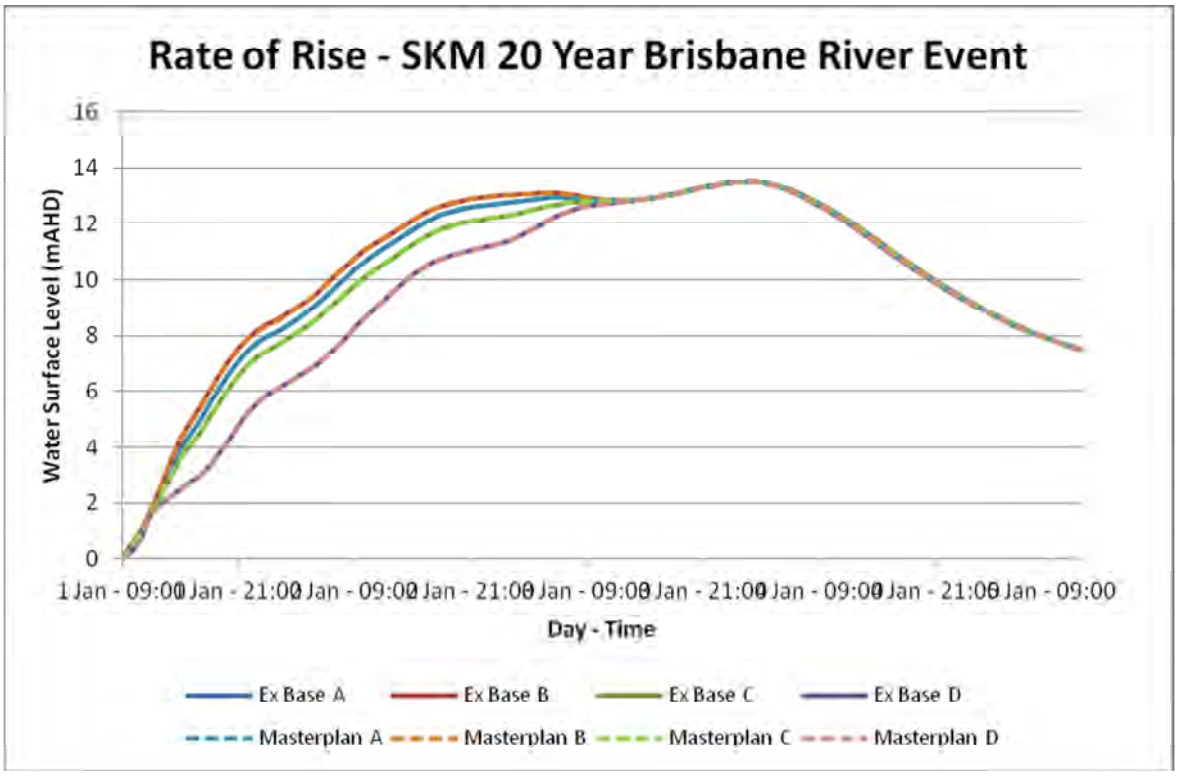


Chart 4 Rate of Rise - SKM 50 Year Brisbane River Event

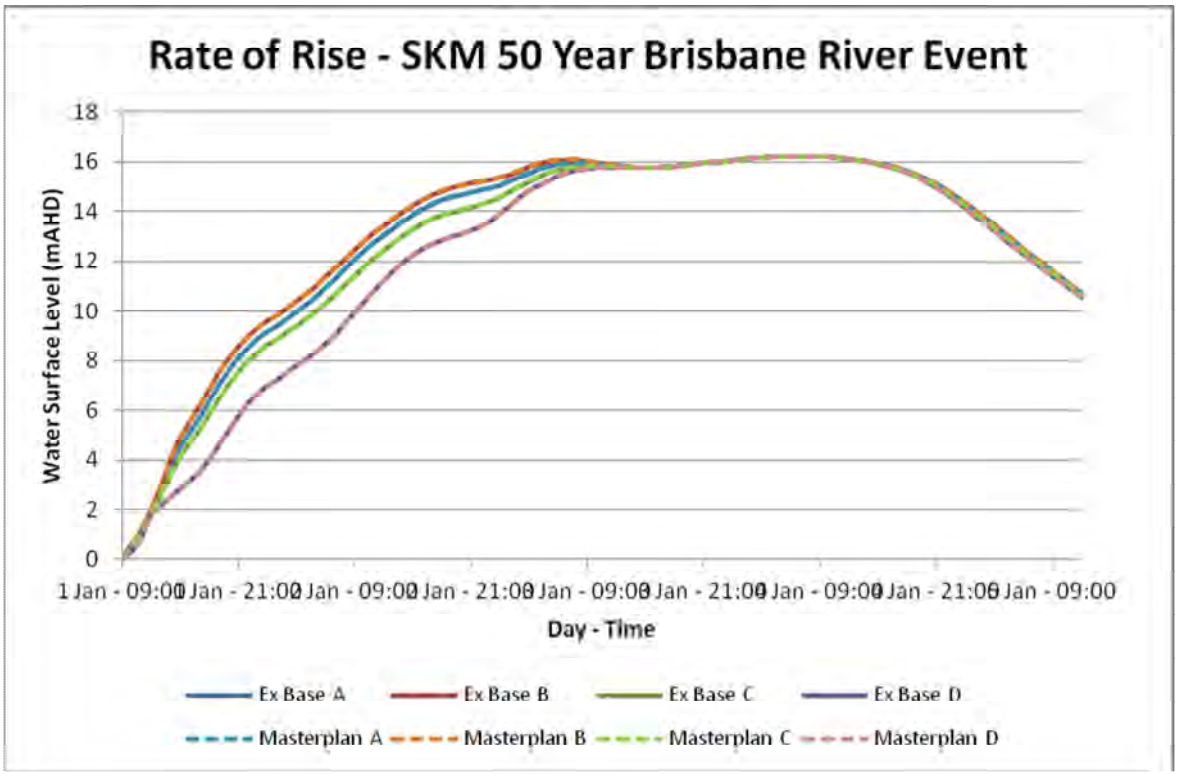


Chart 5 Rate of Rise - SKM 2 Year Bremer River Event

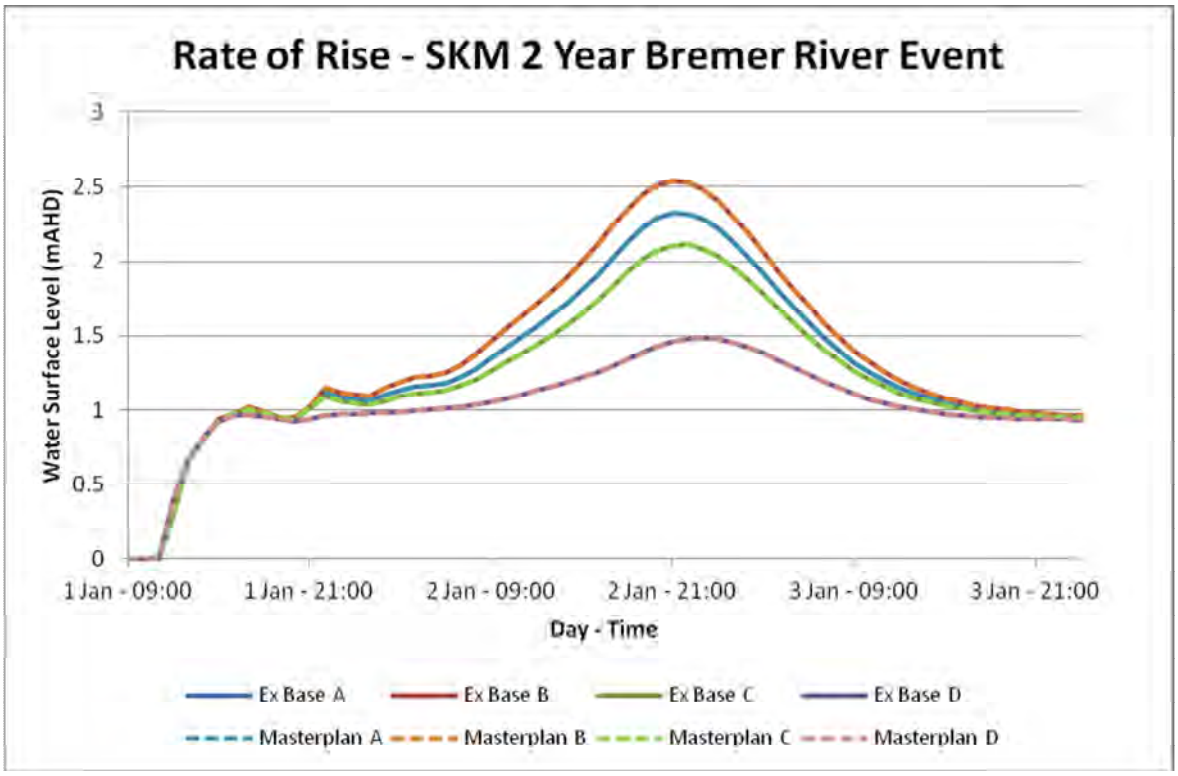


Chart 6 Rate of Rise - SKM 5 Year Bremer River Event

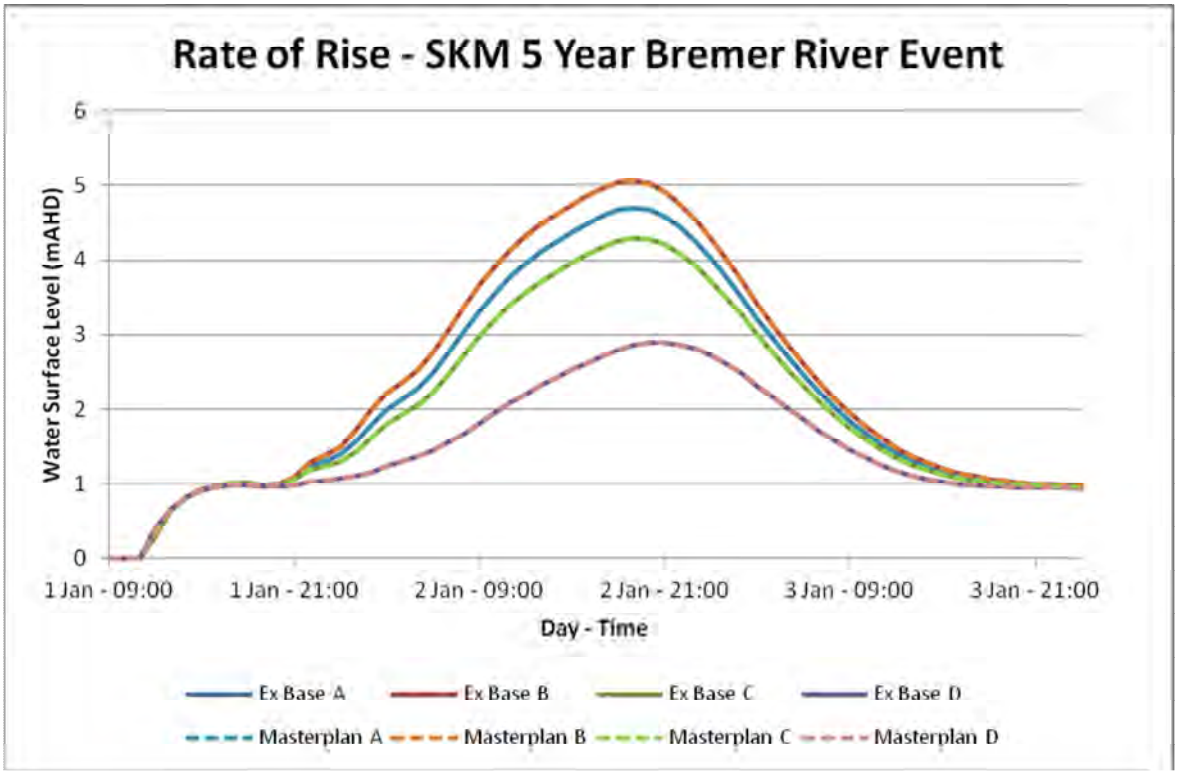


Chart 7 Rate of Rise - SKM 10 Year Bremer River Event

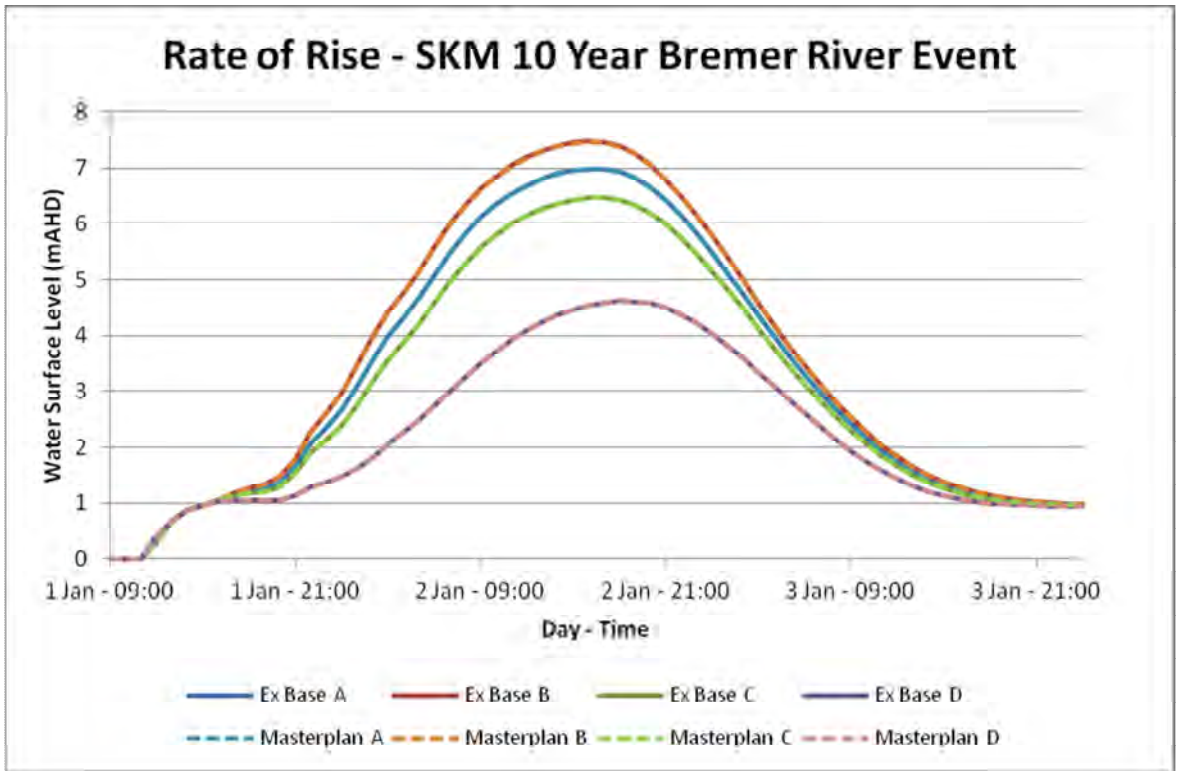


Chart 8 Rate of Rise - SKM 20 Year Bremer River Event

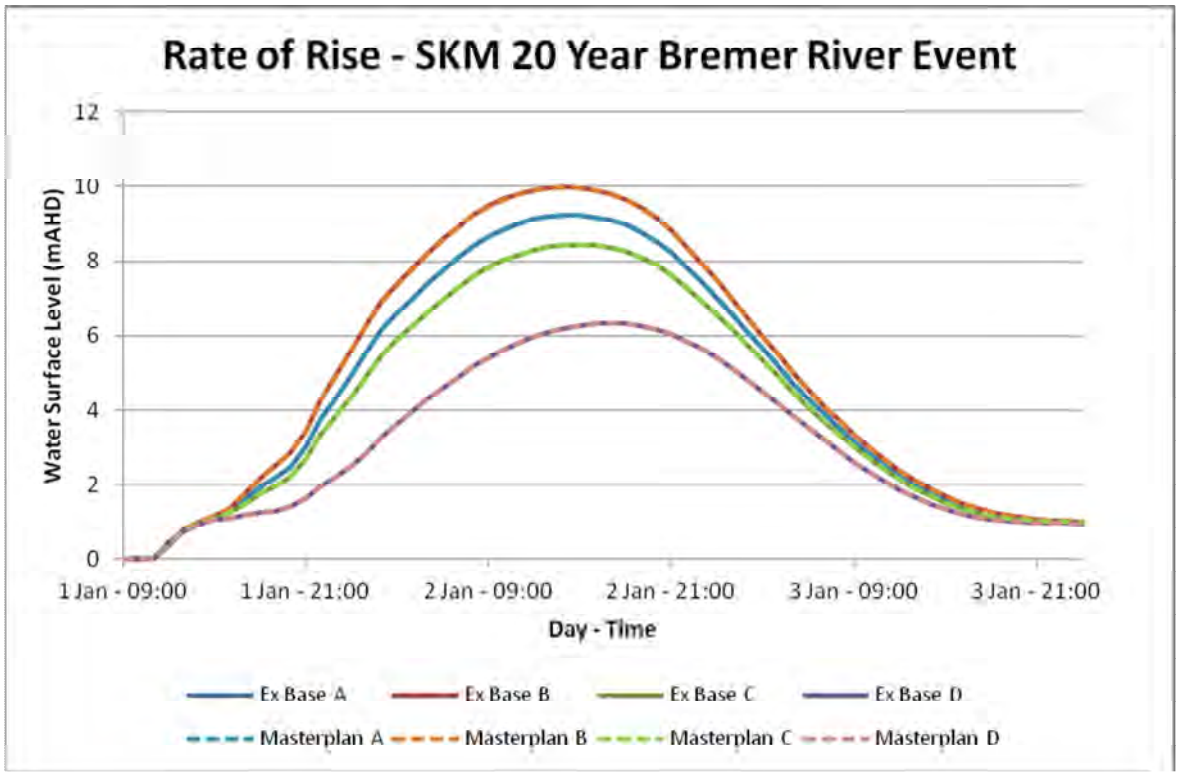
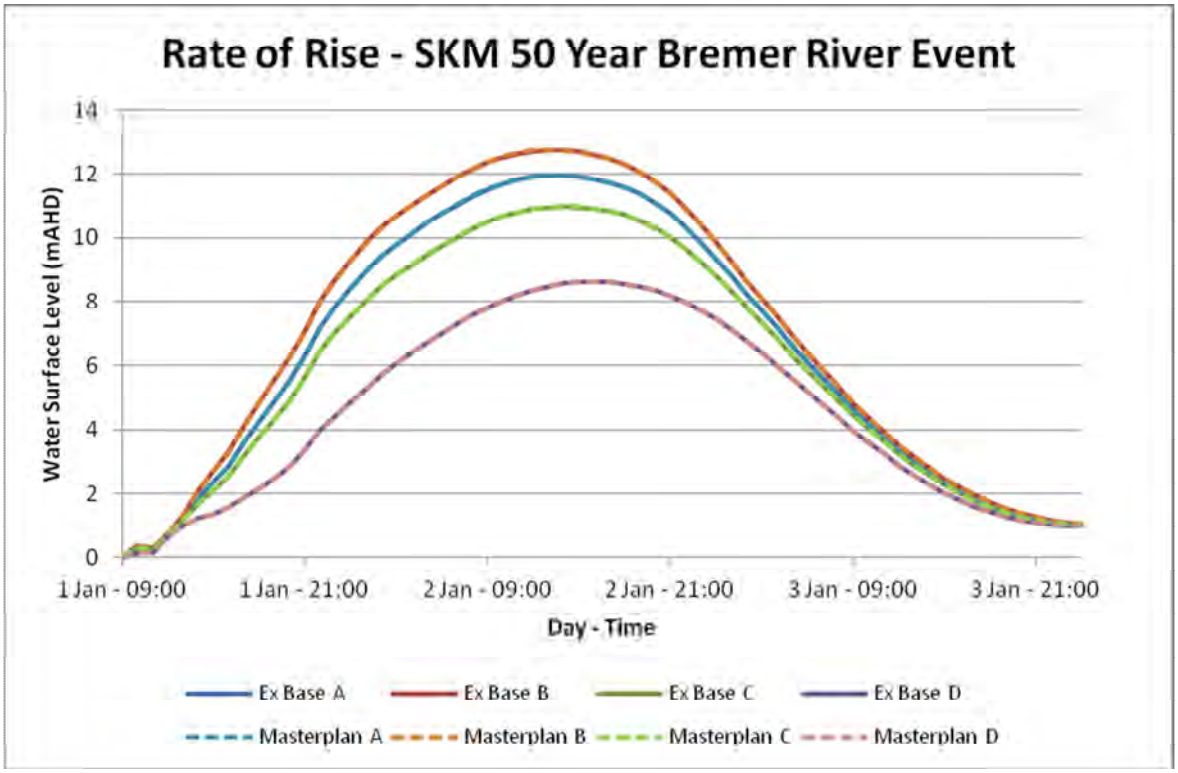


Chart 9 Rate of Rise - SKM 50 Year Bremer River Event



As is illustrated by the above charts, the proposed earthworks of the development will have negligible impacts on the rate of rise of floodwaters, upstream, through and downstream of the site.

6 CUMULATIVE FLOODING IMPACT ASSESSMENT

6.1 Flood Storage Assessment

A flood storage impact assessment was conducted within the site boundary at four established levels:

- 13.30mAHD – 1 in 20 year ARI development level;
- 16.22mAHD – the SKM regional Brisbane River 30 hour 1 in 50 year ARI flood level;
- 18.70mAHD – the January 2011 estimated peak flood level; and
- 20.50mAHD – the 1974 peak flood level.

The percentage loss of flood storage due to the ultimate masterplan scenario compared to the pre-developed (base) case are shown in Table 6.1.

Table 6.1 Storage Calculations Within Site Boundary

Stage (mAHD)	Storage (m^3)			Impact (Masterplan vs. Base Case)	
	Pre-Developed (Base)	Existing Current	Ultimate Masterplan	m^3	%
13.300	2,759,300	2,756,200	2,631,521	-127,799	-4.6
16.220	6,290,900	5,604,500	4,721,196	-1,569,704	-25.0
18.700	10,579,570	10,436,085	8,613,127	-1,966,443	-18.6
20.500	14,150,400	14,001,300	12,756,356	-1,394,044	-9.9

Table 6.1 above indicates that the maximum loss of storage occurs at the SKM 50 year ARI level, with almost 25% of flood storage within the site lost. The level of loss of flood plain storage this equates to during a flood event is detailed in Table 6.2.

Table 6.2 Storm Volume (SKM 50yr ARI) Upstream of Warrego Highway

Dominating Flood	Storage (m^3)			Impact	
	Pre-Developed (Base)	Existing Current	Ultimate Masterplan	m^3	%
Bremer River	258,871,900	258,868,800	258,744,121	-127,779	-0.05
Brisbane River	385,154,100	384,467,700	383,584,396	-1,569,704	-0.41

A1

The results indicate that the loss of floodplain storage during a flood event is no more than approximately 0.41% for the SKM 50 year ARI event. This is considered negligible in terms of the overall floodplain management.

6.2 Mike11 Approach

To further consider the flood storage impacts CLT have conducted a cumulative flooding impact assessment for the entire masterplan development at Citiswich. CLT utilised an extract of the ICC Mike11 model to carry out this assessment, the extent of the sub-model is as follows:

- Bremer River Branch: from cross-section BREM1021460 to BREM1028490, inclusive; and
- Brisbane River Branch: from cross-section BNE1005325 to BNE1007410, inclusive.

The SKM Ultimate 50 year ARI 30hour duration storm event was assessed as defined in ICC Planning Policy. The time series adopted was the same as that used for the 30hour duration (i.e. from 1 January 1999 9:00am to 11 January 1999 8:30am) with a 3 minute time step.

The inflow and tailwater hydrographs were extracted from the supplied BRIS50U30H.res11 file. The inflow and tailwater locations are as follows:

- Bremer River Inflow Location: BREM1021190.0
- Brisbane River Inflow Location: BNE1005067.5
- Brisbane River Tailwater Location: BNE1007410.0

The following scenarios were simulated:

- Existing Case (Case E01) – This is the sub-model of the ICC Mike11 model (as described above) with no changes to cross-section raw data or processed data.
- Cumulative Case (Case P01) – This case takes the Existing Case E01 and modifies the processed data within the Bremer River reach from cross-section BREM1021460 to BREM1028490 inclusive. The modification involves changing the storage width above 13.3mAHD (the 1 in 20 development level) to the width in the processed data when the level is at or just less than 13.3mAHD. This is to test the effect of filling in the flood plain at levels greater than the 1 in 20 development level.
- Storage Case (Case P02) – This case is based on the Cumulative Case P01 with additional storage added at cross-section BREM1022950, located upstream of the Warrego Highway. This is to test the effects of additional storage.

Note the existing case Mike11 model already includes additional storage at BREM1020450 and BREM1028190. These additional storages were added as part of SKM's calibration of the Mike11 model to historic storm events.

6.3 Mike11 Results

A1 Appendix I details the results of the above cases. The results indicate that the fill does not impact upon the conveyance and thus water levels as there were no impacts (less than 1mm) between the Cumulative Case and the Existing Case. The results also indicate that the water levels are not influenced by storage as there were no impacts (less than 1mm) between the Storage Case and the Existing Case.

6.4 SOBEK2D Approach

The cumulative impact assessment was then carried out utilising the SOBEK2D hydraulic model used to assess flood levels.

The following scenarios were simulated:

- Cumulative Case (Case D04a) – This case takes the Existing Case and includes filling of the modelled flood plain above the SKM Ultimate 50 year ARI flood level.
- Storage Case (Case D04b) – This case takes the Cumulative Case with several storage areas added. (Refer Figure J2, Appendix J).

The SKM Ultimate 50 year ARI storm event was assessed as defined in ICC Planning Policy. The simulated time period was from 1 January 1999 9:00am to 6 January 1999 11:30pm with a 1 minute time step.

6.5 SOBEK2D Results

Appendix J contains the results of the SOBEK2D cumulative impact modelling. The results indicate that the water levels are not influenced by the Cumulative Case.

7 LOCAL HYDROLOGIC ASSESSMENT

7.1 Approach

The hydrologic analysis has been undertaken using the Watershed Bounded Network Model (WBNM) 2007 Version 1.04. WBNM is a non-linear runoff routing software package produced by the University of Wollongong in New South Wales. WBNM has been used in accordance with Council's *'Ipswich Planning Scheme'* (2006), *'Queensland Urban Drainage Manual'* (2008) and *'Australian Rainfall and Runoff'* (1998).

A hydrologic model has been set up to include the site and external catchments. The total catchment and sub-catchment extents were determined from the supplied aerial survey and the 1:25,000 topographic maps produced by the Queensland Department of Environment and Resource Management. The WBNM model layout and sub-catchment boundaries are shown in Figures 5 and 6 for pre-development and post-development cases respectively.

The WBNM model was used to assess the impacts of the proposed Citiswich development on the peak flows discharging from the site for a full range of ARI's (1 in 1 to 1 in 100 years) and for storms of 10 to 720 minutes in duration.

The hydrologic modelling considers the following scenarios:

- Pre-Development: This scenario assumes the Citiswich site is in its original (natural terrain) pre-developed condition prior to any works being conducted by Walker for the Citiswich development. The catchments external to the Citiswich site are assumed in their existing state as per the images on the 1:25,000 scale topographic maps. Figure 5 shows the pre-development catchment layout.
- Post-Development: This scenario assumes the Citiswich site extents are in their ultimate developed situation in accordance with the Citiswich Masterplan. The catchments external to the Citiswich site are assumed to be in their existing state. Figure 6 shows the post-development catchment layout.
- Ultimate Development: This scenario assumes the Citiswich site extents are in their ultimate developed situation in accordance with the Citiswich Masterplan. The catchments external to the Citiswich site are assumed to be in their ultimate developed state. Figure 7 shows the post-development catchment layout.

7.2 Model Assumptions

The WBNM model assumes land uses as per ICC Planning Scheme Maps and aerial photography. The adopted fraction impervious and C_{10} value for each land use, as detailed in QUDM (2008), is listed in Table 7.1.

Table 7.1 Runoff Coefficient and Fraction Impervious for Land Uses

Land Use Category	C_{10}	Fraction Impervious (%)
Open space	0.70	5
Business and Industry	0.89	95
Residential Rural	0.71	20
Residential Medium Density	0.83	70
Residential Low Density	0.78	50
Special Use	0.89	95

Table 7.2 details the initial and continuing losses adopted for the WBNM model based on the calibration of the WBNM pre-development model to the Rational Method. A catchment lag of 1.3 was adopted for all ARI events.

Table 7.2 Adopted WBNM Parameters

ARI (years)	Pervious		Impervious	
	Initial Loss (mm)	Continuing Loss (mm/hr)	Initial Loss (mm)	Continuing Loss (mm/hr)
1, 2, 5	5	2.5	0	0
10, 20	2.5	2.5	0	0
50, 100	0	2	0	0

7.3 Model Validation

7.3.1 Rational Method Assessment

The pre-development case has been validated to flows derived using the Rational Method approach. There are two validation points located at the bottom of the western tributary catchment (Node RPWest) and the bottom of the eastern tributary catchment (Node RPEast) as shown on Figure 5. Table 7.3 details the Rational Method parameters used.

Table 7.3 Rational Method Parameters

Parameter	Western Tributary Catchment (Node RPWest)	Eastern Tributary Catchment (Node RPEast)
Area (ha)	216.16	452.77
C_{10}	0.78	0.64
Time of Concentration (min)	50	70

Details of the pre-development validation of peak flows are shown in Table 7.4 below. Details of the Rational Method calculation for both the west and east catchments can be found in Appendix K.

Table 7.4 Ultimate Pre-Development WBNM Calibration Results

ARI (Years)	Predicted Peak Pre-Development Flow (m^3/s) Western Catchment (Node RPWest)			Predicted Peak Pre-Development Flow (m^3/s) Eastern Catchment (Node RPEast)		
	Rational	WBNM	Impacts	Rational	WBNM	Impacts
1	14.5	14.1	-0.4	20.0	20.6	0.6
2	20.1	19.8	-0.3	27.6	28.6	1.0
5	29.3	28.2	-1.1	40.4	40.6	0.2
10	35.3	35.0	-0.3	48.8	49.5	0.7
20	43.3	42.6	-0.7	60.0	59.9	-0.1
50	56.8	53.6	-3.2	78.7	76.5	-2.2
100	66.9	62.0	-4.9	92.9	88.7	-4.2

Table 7.4 indicates that an acceptable level of validation is achieved for the WBNM model and that this model is considered suitable for the purposes of assessing the flood changes for the Citiswich site.

7.3.2 Ipswich Planning Scheme: Implementation Guideline No.24

Flows predicted by the WBNM model have also been compared to flows estimated from the methodology detailed in Table 7.4 and Council's 'Implementation Guideline 24 - *Stormwater Management*' (IG24). The parameters used in this method are specified in Table 7.4 of Council's IG24 are listed in Table 7.5 below.

Table 7.5 Implementation Guideline No.24 Calibration Parameters

Node	Parameter	
	50 Year ARI 72 Hour Rainfall Intensity (mm/hr)	Catchment Area (km^2)
RPWest	4.5	4.53
RPEast		2.16

A comparison of the WBNM model predicted flows to those determined using IG24 are detailed in Tables 7.6 and 7.7.

Table 7.6 ICC's IG24 Method Vs WBNM Validation – RPWest

ARI (years)	Implementation Guideline 24 Method Peak Flow (m^3/s)	WBNM (Existing Case) Peak Flow (m^3/s)	Variance (%)
2	0.75	19.8	96%
5	1.62	28.2	94%
10	2.33	35.0	93%
20	3.15	42.6	93%
50	4.44	53.6	92%
100	5.62	62.0	91%

Table 7.7 ICC's IG24 Method Vs WBNM Validation – RPEast

ARI (years)	Implementation Guideline 24 Method Peak Flow (m^3/s)	WBNM (Existing Case) Peak Flow (m^3/s)	Variance (%)
2	4.08	28.6	86%
5	8.76	40.6	78%
10	12.64	49.5	74%
20	17.04	59.9	72%
50	24.05	76.5	69%
100	30.41	88.7	66%

As shown in the above tables, the flows derived from ICC's IG24 method appear to be significantly lower than those predicted by the Rational Method Assessment detailed in Section 7.3.1. Calibrating the WBNM model to the flows predicted by the IG24 method would potentially mean that parameters used in the WBNM model would fall outside the range of recommended values, accordingly the ultimate catchment flows would be significantly less than the flows predicted based on current modelling in accordance with industry accepted standards. If IG24 was used as the basis for calibration of the hydraulic model it would result in the significant under design of flood mitigation channels and culverts. Subsequently, ICC have confirmed that the IG24 should only be used for catchments:

- >20,000 hectares; and
- The Rational Method can be used for validation purposes for this assessment due to the sites relative small catchment.

7.4 Results

The predicted peak flows discharging into the Bremer River from the western tributary for the pre-development and post-development scenarios are presented in Table 7.8.

Table 7.8 WBNM Predicted Peak Flows Western Tributary - RPWest

ARI (Years)	Pre-Developed			Post-Developed			Impact (Pre- vs. Post-Dev) (m^3/s)
	Flow (m^3/s)	Critical Duration (min)	Time to peak (min)	Flow (m^3/s)	Critical Duration (min)	Time to peak (min)	
1	14.05	60	53	20.36	60	37	6.31
2	19.76	60	50	27.49	60	36	7.73
5	28.32	60	49	38.08	60	36	9.75
10	34.96	60	47	45.58	60	36	10.63
20	42.61	60	45	54.80	60	36	12.18
50	53.58	60	45	66.33	60	36	12.75
100	62.04	60	45	76.33	60	36	14.29

The results in Table 7.8 indicate that without mitigation the proposed Citiswich masterplan is predicted to cause an increase in peak flows entering the Bremer River from the western tributary. These increases will not affect peak flooding in the Bremer River as this is dominated by the regional Brisbane River event, some 10m higher. The hydrographs generated from the hydrologic model were used as the boundary conditions for the hydraulic model. Further details are provided in Section 8 with detailed WBNM results presented in Appendix L.

The predicted peak flows discharging into the Bremer River from the eastern tributary for the pre-development and post-development scenarios are presented in Table 7.9.

Table 7.9 WBNM Predicted Peak Flows Eastern Tributary - RPEast

ARI (Years)	Pre-Developed			Post-Developed			Impact (Pre- vs. Post-Dev) (m^3/s)
	Flow (m^3/s)	Critical Duration (min)	Time to peak (min)	Flow (m^3/s)	Critical Duration (min)	Time to peak (min)	
1	20.55	90	79	20.40	90	75	-0.15
2	28.59	90	76	28.03	90	73	-0.56
5	40.58	90	75	39.69	60	50	-0.89
10	49.48	90	73	48.62	60	50	-0.87
20	59.93	60	57	59.15	60	50	-0.78
50	76.45	60	57	74.87	60	50	-1.58
100	88.68	60	56	86.76	60	50	-1.92

The results in Table 7.9 indicate that without mitigation the Citiswich development is not predicted to cause an increase in peak flows entering the Bremer River from the eastern tributary.

8 LOCAL HYDRAULIC ASSESSMENT

This section details the hydraulic assessment of the Citiswich development using Deltares one-dimensional (1D) fully dynamic hydraulic modelling package SOBEK (Version 2.10.003 used for the eastern tributary and Version 2.11.002c used for the western tributary). A 1D model was adopted for the local assessment due to the simple one dimensional flow characteristics through the tributaries. The assessment includes discussion of the hydraulic model set up of the two major tributaries which flow through the site (named the western and eastern tributary), proposed mitigation options within the Citiswich development and a summary of the hydraulic results.

8.1 Western Tributary

The latest assessment of the western tributary was undertaken for Stage 6. The details of that assessment are contained within CLT's '*Citiswich Stage 6 Stormwater Management Strategy to Support Operational Works Application*' dated November 2011 (ref: LJ8714/R15/V2). The relevant components of that study in terms of the masterplan are detailed below.

8.1.1 Modelled Scenarios

The western tributary local assessment considers the following modelling scenarios:

- Western Tributary Pre-Development Case: This case models the western tributary that passes through the site and assumes the site in its original pre-developed condition prior to any works being conducted by Walker for the Citiwsich development. The model incorporates the pre-development hydrologic flows as described in Section 7 with the layout shown on Figure 8.
- Western Tributary Post-Development Case: This case modifies the pre-development case to match the proposed development modifications, including the channel realignment. No cut is proposed within the Archer Street Park. The model incorporates the post-development hydrologic flows as described in Section 7 with the layout shown on Figure 9.

A1

- Western Tributary Ultimate Development Case: This case modifies the pre-development case to match the proposed development modifications, including the channel realignment. No cut is proposed within the Archer Street Park. The model incorporates the ultimate development hydrologic flows as described in Section 7 with the layout shown on Figure 9. This scenario is used for design of the channels.

A1

8.1.2 Pre-Development Setup

The pre-developed hydraulic model cross-sections and culvert details were based on detailed aerial and ground surveys. The pre-developed SOBEK model layout is shown on Figure 8 and is based on the pre-developed (base) SOBEK model established for the Masterplan assessment.

The SOBEK model adopts a tailwater level of 2.623mAHD at the Bremer River, which is the level of the Bremer River (18 hour) 2 year ARI event.

Based on the aerial photography and a site inspection, a Manning's 'n' roughness value of 0.05 has been adopted. The cross sections upstream of the site in the existing lots on Bird Street assumed a Manning's 'n' roughness of 0.15 due to the existing dwellings, fences and gardens.

8.1.3 Post-Development and Ultimate Development Setup

The post-developed hydraulic model is based on ACOR Stages 4 and 6 engineering design and the Cardno engineering design through the Archer Street Parklands. The post-developed SOBEK model layout is shown on Figure 9. The existing Bird Street culvert (1.05m RCP) will be connected to an inlet structure and drain via 3/1.2m RCPs to downstream of 'Road 1'. This inlet structure will collect overland flows from the existing Bird Street lots into the proposed culverts.

A re-profiled channel will convey flows through the site. The channel will be grassed-lined with a low flow channel along the invert, and hence a roughness value of 0.04 has been adopted. Internal road crossings are assumed to convey the local 100 year ARI flood flows. A sensitivity assessment assuming 20% blockage of all inlets and crossings has also been considered, in accordance with Section 10.04.10 of QUDM (2008).

The ultimate developed SOBEK model incorporates the ultimate development hydrologic flows as described in Section 7 with the same layout as the post-developed hydraulic model.

8.1.4 Hydraulic Results

A comparison between the pre- and post-developed predicted water surface levels, depths, flows and velocities for all ARIs are presented in Appendix M.1.

The modelling results for the ultimate development case indicate that the flood flow will be contained within the channel within acceptable velocities (<2.5m/s) for a grassed line channel. Detailed SOBEK results for the ultimate
A1 development case are presented in Appendix M.2. A drop structure has been incorporated into the hydraulic design in the vicinity of Archer Street which results in velocities greater than 2.5m/s, the proposed concrete drop structure will be adequately designed and detailed to account for these higher localised velocities.

The hydraulic assessment indicates an increase in discharge within the western tributary is predicted to occur as a consequent of development however these impacts are contained within the proposed channels through the Citiswich site. The development fill pads of individual stages are above the predicted local tributary 100 year ARI flood levels presented in Appendix M.2.

Local outlet scour protection measures will be required immediately downstream of the road crossing culverts.

The re-profiled drainage easements are to be turf-lined, and results indicate that velocities will remain below 2.5m/s
A1 during the local 100 year ARI event, in accordance with ICC requirements. A drop structure has been incorporated into the hydraulic design in the vicinity of Archer Street which results in velocities greater than 2.5m/s, the proposed concrete drop structure will be adequately designed and detailed to account for these higher localised velocities.

- Eastern Tributary Pre-Development Case: This case models the eastern tributary that passes through the site and assumes the Citiswich site is in its original pre-developed condition prior to any works being conducted by Walker for the Citiswich development. The model incorporates the pre-development hydrologic flows as described in Section 7 with the model layout shown on Figures 10 and 11.
- Eastern Tributary Post-Development Case: This case modifies the pre-development case to include the proposed works. The model incorporates the post-development hydrologic flows as described in Section 7 with the layout shown on Figure 12.
- Eastern Tributary Ultimate Development Case: This case modifies the pre-development case to include the proposed works. The model incorporates the ultimate development hydrologic flows as described in Section 7 with the layout shown on Figure 12.

8.2.2 Pre-Development Setup

The pre-developed hydraulic model cross-sections and culvert details were based on detailed aerial and ground surveys. The pre-developed SOBEK model layout is shown on Figures 10 and 11.

The SOBEK model adopts a tailwater level of 2.294mAHD at the Bremer River, which is the level of the Bremer River (18 hour) 2 year ARI event.

Based on the aerial photography and a site inspection, a Manning's 'n' roughness value of 0.07 has been adopted for the existing tributary, with the exception of cross-sections upstream of Brisbane Road (sect1_259 to 409) where an 'n' value of 0.04 has been adopted.

8.2.3 Post-Development and Ultimate Development Setup

The proposed development and fill extents associated with Stage 2 are constrained by DERM's no earthworks zone and Council's Temporary Local Planning Instrument (TLPI) flood regulation line. The adopted post-developed hydraulic models are based on the pre-developed hydraulic model updated to incorporate the Stage 2 development and fill extents. The adopted Manning's 'n' roughness values have remained unchanged from the pre-development case. Excavation of cross-sections through Stage 2C (sect1_1045 to XS AA) have been incorporated to ensure no adverse flood impacts external to the site.

The ultimate developed SOBEK model incorporates the ultimate development hydrologic flows as described in Section 7 with the same layout as the post-developed hydraulic model.

8.2.4 Hydraulic Results

A comparison between the pre- and post-developed water surface levels, depths, flows and velocities for all ARIs are presented in Appendix N.1. Detailed SOBEK results for the ultimate development case are presented in Appendix N.2.

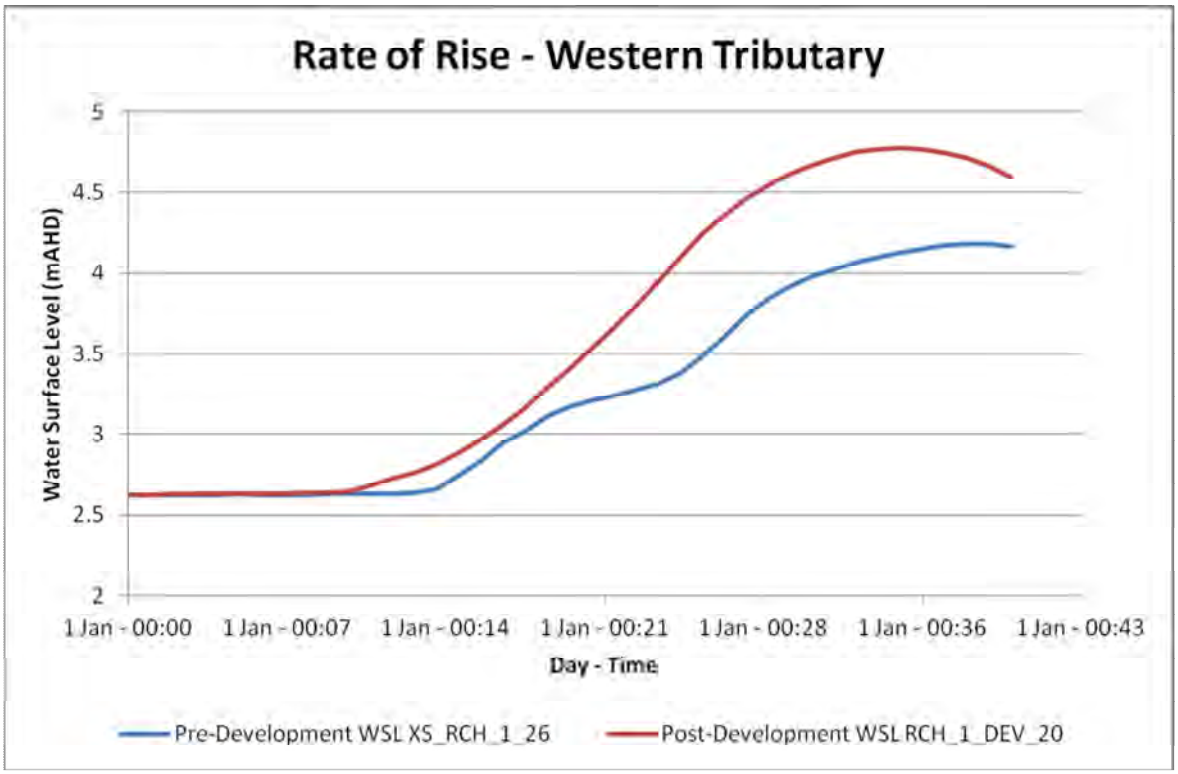
Results in Appendix N indicate the proposed development is not predicted to cause adverse flood impacts external to the site including the Warrego Highway.

It is recommended that final fill levels are set based on the higher of the post-devlopment or Ultimate Development results.

8.3 Rate of Rise Analysis – Local Flooding

The rate of rise of floodwaters determines the time available for flood warning and evacuation. A rate of rise analysis has been undertaken for the discharge locations of both the Western and Eastern tributaries during the local 1 in 100 year ARI event.

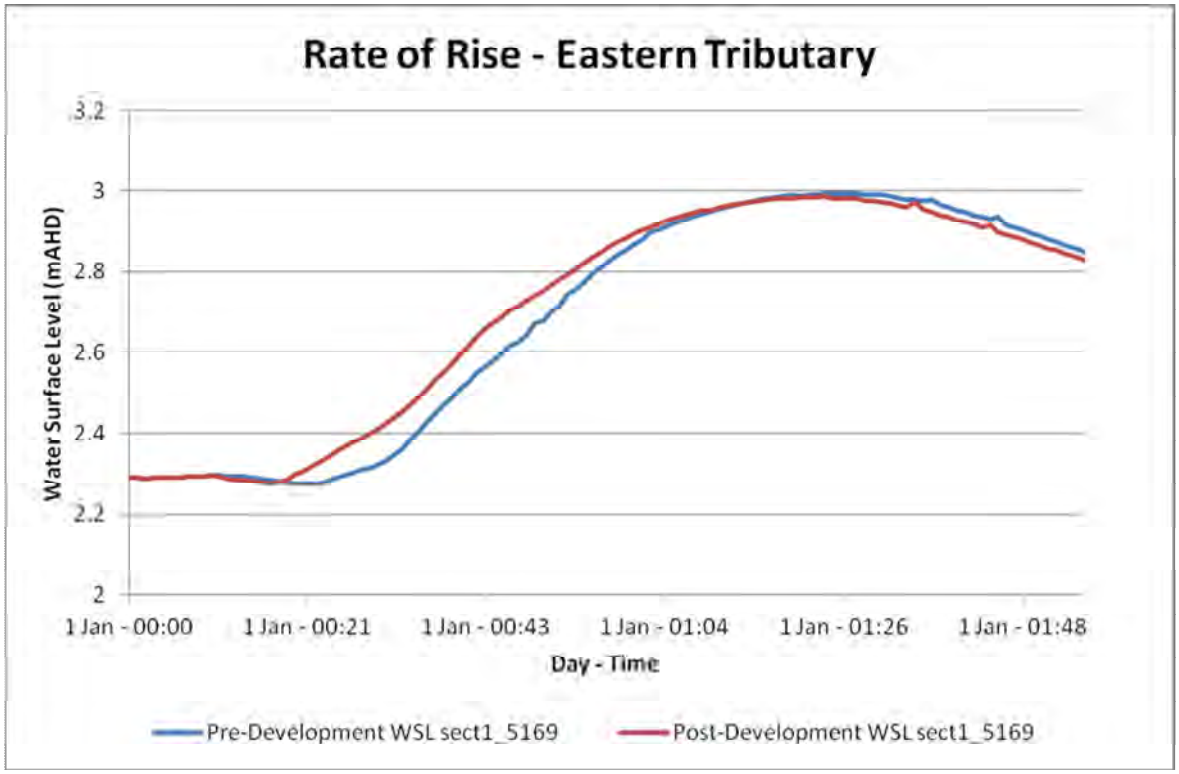
Plate 8.1 Rate of Rise Graph – Western Tributary Discharge Location



As shown in Plate 8.1, the post-development peak water surface level is predicted to be approximately 0.6 m above the pre-development level; however, it should be noted that the whole western tributary will be completely re-profiled as an engineered channel, accordingly the flood characteristics within the tributary have changed significantly. The local hydraulic assessment detailed in Section 8.1 demonstrates that the proposed channel realignment and earthworks are not predicted to cause adverse flood impacts upstream or downstream of the site.

The rate of rise of floodwaters presented in Plate 8.1 increases from approximately 3.7 m/hr under the pre-development condition to approximately 5.1 m/hr after completion of the proposed development. Although the floodwater rate of rise has increased, which implies less time is available for households to respond to the flood, it should be noted that flood evacuation is dependent on not only the warning time, but also the infrastructure (e.g. roads, bridges etc.) available for evacuation. All internal road crossings are designed to convey at least the local 100 year ARI flood flows, therefore allowing safe evacuation across and away from the site. In conjunction with a comprehensive flood evacuation plan, the proposed development is not predicted to result in potential evacuation difficulties.

Plate 8.2 Rate of Rise Graph – Eastern Tributary Discharge Location



As shown in Plate 8.2, the peak water surface level and the rate of rise of floodwaters are consistent between the pre- and post- development cases. The slight timing difference in the post-development scenario is due to the increase of fraction impervious of the development compared to the pre-developed land use.

9 STORMWATER MANAGEMENT DESIGN OBJECTIVES

As outlined in *'South East Queensland Regional Plan 2009-2031 - Implementation Guideline No.7'* (2009) (SEQ IG7), the design objectives for managing urban stormwater are listed below:

- Stormwater Quality Management: This objective aims to protect receiving water by reducing the percentage of sediment, phosphorus, nitrogen and litter in stormwater runoff generated by urban development, compared with that in untreated runoff. CLT has carried out detailed pollutant export analysis using MUSIC Version 3.01 to assess the possible pollutant loads from the proposed Citiswich masterplan development. Details of the MUSIC modeling are presented in CLT's *'Citiswich – Masterplan Stormwater Management Strategy (Response to Stage 1 Healthy Waterways Review)'* dated February 2009 (ref: LJ8714/R4/V3).
- Frequent Flow Management: This objective aims to protect in-stream ecosystems from the effects of more frequent runoff by capturing the initial runoff from impervious areas. In developed catchments, this will ensure that the frequency of hydraulic disturbance will remain similar to what it was prior to any development works.
- Waterway Stability Management: This objective aims to reduce exacerbated in-stream erosion downstream of urban areas by controlling the magnitude and duration of sediment- transporting flows.

This section details the assessments undertaken to demonstrate compliance with the Frequent Flow Management and Waterway Stability objectives set out in SEQ IG7.

9.1 Frequent Flow Management

According to the guidelines, for a development that has a fraction impervious greater than 40%, the first 15mm of runoff from the impervious surfaces should be captured. This volume of storage should be available again within 24 hours.

Of the total area of the Citiswich masterplan site (approximately 320ha), approximately 71% is impervious; therefore, the first 15mm runoff volume from the impervious portion is to be captured in accordance with the above guidelines. This volume is calculated to be approximately 34,080m^3. This storage will be achieved by re-use from the rainwater tanks and filtration through the bio-retention systems. Bio-retention systems will drain in a more rapid rate than 24 hours as the saturated hydraulic conductivity of a bioretention is generally around 180 mm/hour, and so will therefore be able to treat more than 15mm of runoff per day.

9.1.1 Methodology

To assess the amount of runoff that passes through the bio-retention systems and whether the frequent flow criterion is satisfied, the methodology presented in the Bligh Tanner and DesignFlow publication '*Stormwater Infrastructure Option to Achieve Multiple Water Cycle Outcomes'* (report for Queensland Water Commission, 2009, p34) was adopted. To be conservative the rainwater tanks were removed from the analysis. The methodology involves:

- Use MUSIC to calculate the average annual runoff produced by the first 15 mm of runoff from the impervious portion of the site; this is the amount of runoff that is required to be captured.
- Use MUSIC to calculate the average annual runoff that can be captured by the bio-retention systems; and
- If the annual runoff that passes through the bio-retention system is greater than the annual runoff produced by the first 15 mm of runoff from the impervious portion of the site, then the frequent flow objective has been met.

9.1.2 MUSIC Modeling

CLT has considered the following modeled scenarios:

- Scenario 1 – Post-development catchment conditions without treatment. This scenario is used to simulate the daily runoff from the Citiswich masterplan site over a continuous 10-year period, which is then used to calculate the average annual runoff produced by the first 15 mm of runoff per day from all the impervious areas (34,080m^3/day);
- Scenario 2 – Post-development catchment condition with bio-retention basins proposed in the following Stormwater Management Strategies (SWMS's) produced by CLT:
  - 'Citiswich, Stage 1 – Stormwater Management Strategy to Support Operational Works Development Application – Response to Healthy Waterways Review), dated February 2009 (ref: LJ8714/R5/V3);
  - 'Citiswich Estate, Stage 2 – Stormwater Management Strategy to Support Reconfiguration of Lot & Bulk Earthworks Applications including Preliminary Approval to Vary the Effect of a Planning Scheme – Response to Decision Notice', dated February 2012 (ref: LJ8714/R17/V5);
  - 'Citiswich, Stage 4 – Stormwater Management & Flooding Assessment to Support Re-Configuration of Lot Application & Preliminary Approval to Vary the Effect of the Planning Scheme – Response to Information Request', dated March 2011 (ref: LJ8714/R12/V2);
  - 'Citiswich, Stage 6 – Stormwater Management Strategy to Support Operational Works Application – Compliance with QUU's Water Supply Standards', dated November 2011 (ref: LJ8714/R15/V2);
  - 'Citiswich, Stage 7 – Stormwater Management Strategy to Support a Reconfiguration of Lot Development Application', dated September 2008 (ref: LJ8714/R8); and
  - Citiswich, Masterplan Stormwater Management Strategy (Response to Stage 1 Healthy Waterways Review)', dated February 2009 (ref: LJ8714/R4/V3).

This scenario is used to determine the amount of runoff that can be captured by the proposed bio-retention systems.

The catchment areas and land uses assumed in the frequent flow management assessment are as per MUSIC assessments detailed in the above SWMS's.

Over 20 years of continuous rainfall data from the Amberley Station (Number 40004) was obtained from the Bureau of Meteorology for the period 01/05/1980 to 30/11/2004. Table 9.1 presents the statistical assessment of the annual rainfall totals from the Amberley Station.

Table 9.1 Statistical Results for the Daily Rainfall at Amberley

Statistical Parameter	Annual Rainfall (mm)
Average	768
Median	773
10th Percentile	487
90th Percentile	1043

The adopted 10 year period considered in the frequent flow management assessment was from January 1985 to December 1994. This period include an average rainfall over the 10 years of 768 mm. It also contained a wet year (1989 – 1047 mm), and a dry year (1994 – 470 mm) and an average year (1985 – 732 mm).

The potential evaporation details were obtained from the Bureau of Meteorology using the co-ordinates of the Amberley Station.

The following assumptions were made in the modelling:

- The Scenario 1 model was run using a daily time step to simulate the daily runoff from the site;
- The Scenario 2 model was run using a 30 minute time step as running it with a 6 minute time step created result output files that were too large for post-processing tools to handle, while running it with a daily time step skipped the peaks from the flow, overestimating the treatment capacity of the bio-retention basins;
- The pollutant generation parameters are adopted from Healthy Waterways '*MUSIC Modelling Guidelines'* (Version 1.0, 2010), with a break down into macro scale parameters. (i.e. roof water, roads and ground);
- Industrial lots were modelled using the industrial source node detailed in Healthy Waterways' '*MUSIC Modelling Guidelines'* (Version 1.0, 2010);
- Where catchments included multiple lots, catchment areas and treatment device areas were combined into a single node area to reduce run times and memory space requirements; and
- No flow routing has been assumed, which provides a conservative estimate of treatment device efficiency.

The results of the frequent flow volume MUSIC analysis show that:

- The average annual runoff produced by first 15mm of runoff from all the impervious areas is 512,407m^3; and
- The average annual volume of stormwater that passes through the bio-retention system is 802,077m^3.

As the annual runoff that passes through the bio-retention system is greater than the average annual runoff produced by the first 15mm of runoff from the site impervious areas, it can be concluded that the frequent flow management criterion is satisfied.

9.2 Waterway Stability

Since the waterway stability objective aims to control in-stream erosion, the objective is only applicable where runoff from or within the site passes through or drains to an unlined non-tidal watercourse or wetland. As discussed previously in Section 8, it is proposed to re-profile the whole western tributary and a portion of the eastern tributary downstream of the Warrego Highway. The re-profiled channel will be grassed-lined with a low flow channel along the invert. As these portions of channel will be completely modified, the waterway stability objective is not deemed necessary for this portion of the development.

The predicted 1 year ARI pre- and post-development peak flood levels for the portion of the eastern tributary upstream of the Warrego Highway are shown in Table 9.1 below. Cross sections external to the Citiswich site are marked with asterisks.

Table 9.2 SOBEK Peak 1 Year ARI Discharge and Velocity

Pre - ID	Post - ID	Discharge (m^3/s)			Velocity (m/s)		
		Pre	Post	Impact	Pre	Post	Impact
Railway							
sect1_517	sect1_517	4.43	4.43		0.94	0.94	
sect1_581*	sect1_581*	4.43	4.43		1.22	1.22	
sect1_674*	sect1_674*	4.46	4.47	0.01	0.27	0.27	
sect1_784*	sect1_784*	5.83	5.94	0.11	1.21	1.22	0.01
sect1_897*	sect1_897*	5.83	5.94	0.11	1.31	1.33	0.02
sect1_937*	sect1_937*	5.83	5.94	0.11	0.77	0.98	0.21
Hoepner Road							
sect1_1045	sect1_1045	5.82	5.94	0.12	0.90	0.83	-0.07
sect1_1142	XS CC	7.06	7.58	0.52	0.32	0.33	0.01
sect1_1271	XS BB	6.89	6.88	-0.01	0.55	0.33	-0.22
USRail	USRail	6.87	6.83	-0.04	1.11	0.50	-0.61
Railway							
sect1_1386*	sect1_1386*	6.86	6.82	-0.04	0.64	0.64	
sect1_1443*	sect1_1443*	6.86	6.82	-0.04	0.64	0.64	
sect1_1569*	sect1_1569*	15.81	15.95	0.14	1.52	1.53	0.01
sect1_1659*	sect1_1659*	15.79	15.95	0.16	1.16	1.16	
sect1_1741*	sect1_1741*	15.75	15.92	0.17	0.95	0.93	-0.02
Railway							
sect1_1789*	sect1_1789*	15.73	15.91	0.18	1.19	1.20	0.01
sect1_1851*	sect1_1851*	15.71	15.89	0.18	0.99	0.99	
sect1_1927*	sect1_1927*	15.68	15.87	0.19	0.99	0.99	
sect1_1996*	sect1_1996*	15.66	15.85	0.19	1.17	1.17	
sect1_2070*	sect1_2070*	15.65	15.85	0.20	1.75	1.76	0.01

Pre - ID	Post - ID	Discharge (m^3/s)			Velocity (m/s)		
		Pre	Post	Impact	Pre	Post	Impact
sect1_2098*	sect1_2098*	15.65	15.85	0.20	0.91	0.91	
sect1_2116*	sect1_2116*	15.65	15.84	0.19	1.35	1.35	
sect1_2134*	sect1_2134*	15.65	15.84	0.19	1.24	1.22	-0.02
sect1_2152*	sect1_2152*	15.64	15.83	0.19	0.67	0.66	-0.01
sect1_2189*	sect1_2189*	15.63	15.82	0.19	0.97	0.93	-0.04
sect1_2222	sect1_2222	15.63	15.83	0.20	1.63	1.66	0.03
sect1_2236	sect1_2236	15.63	15.83	0.20	0.95	0.96	0.01
sect1_2281	sect1_2281	18.34	18.65	0.31	0.53	0.53	
sect1_2348	sect1_2348	18.32	18.64	0.32	0.88	0.88	
sect1_2410*	sect1_2410*	18.30	18.62	0.32	0.36	0.37	0.01
sect1_2422*	sect1_2422*	18.29	18.62	0.33	0.58	0.58	
sect1_2437*	sect1_2437*	18.29	18.61	0.32	0.82	0.83	0.01
sect1_2459*	sect1_2459*	18.28	18.61	0.33	0.92	0.93	0.01
sect1_2474*	sect1_2474*	18.28	18.61	0.33	0.86	0.88	0.02
sect1_2507	sect1_2507	18.26	18.61	0.35	0.98	1.07	0.09
sect1_2534	sect1_2534	18.21	18.59	0.38	0.50	0.65	0.15
sect1_2576	sect1_2576	18.13	18.57	0.44	0.38	0.61	0.23
sect1_2629	sect1_2629	18.07	18.53	0.46	0.63	0.88	0.25
sect1_2687	sect1_2687	18.05	18.44	0.39	1.07	0.44	-0.63
sect1_2725	sect1_2725	18.49	18.94	0.45	0.86	0.82	-0.04
Warrego Highway							

As mentioned previously, the goal of waterway stability management is to reduce exacerbated in-stream erosion downstream of the proposed development. Although minor flow impacts (<1.8%) have been identified for the 1 year ARI event, CLT has considered a number of factors to demonstrate that the proposed development will not cause any adverse erosion effects or sediment problems to adjacent properties or habitats, thus achieving the goal set out in SEQ IG7.

As detailed in Section 8.06 of QUDM (2008), the typical scour velocity for the portion of the eastern tributary upstream of the Warrego Highway is 2.0 m/s (grassed bank). Table 9.2 shows velocities at all cross sections are below the scour velocity of 2.0m/s, indicating this portion of channel is not prone to bank and stream erosion.

It should be noted that the SOBEK hydraulic modeling does not take into consideration of all the bio-retention systems proposed for the Citiswich development, thus overestimating the flows discharging into the downstream waterways. The frequent flow management assessment detailed in Section 9.1 has demonstrated that proposed bio-retention systems are capable of capturing at least the first 15 mm of runoff from all impervious surfaces within the Citiswich development.

10 IPSWICH CITY COUNCIL PLANNING SCHEME

A1 On 14 June 2011 Ipswich City Council adopted Temporary Local Planning Instrument 01/2011 – Flooding Regulation (TLPI). The TLPI took effect on 20 June 2011 and was renewed as the TLPI 01/2012 with effect from 20 June 2012 and will cease to have effect on 19 June 2013 or when it is repealed in accordance with the provisions of the *Sustainable Planning Act 2009*. The purpose and general effect of the TLPI is to provide improved flood regulation based on a revised flood regulation line and associated development provisions. This TLPI applies to the area in which the Ipswich Planning Scheme 2006 applies and overrides the provisions A1 contained in the Ipswich Planning Scheme 2006 to the extent of matters outlined in Parts 1 to 7 of the TLPI.

The TLPI 01/2012 encompasses:

(1) The replacement of the Flooding and Urban Stormwater Flow Path Areas Overlay Map (OV5) to incorporate a revised flood regulation line in the form of the Adopted Flood Regulation Line.

(2) The replacement of the following sections of the Ipswich Planning Scheme 2006 to reflect the revised flood regulation line and enhance the application of existing flood regulations:

   (a) Part 11, Section 11.4.7: Flooding and urban Stormwater Flow Path Areas;

   (b) Part 11, Table 11.4.3: Assessment Categories and Relevant Assessment Criteria for Development Constraints Overlays – Making a Material Change of Use;

   (c) Part 11, Table 11.4.4: Assessment Categories and Relevant Assessment Criteria for Development Constraints Overlays – Other Development; and

   (d) Part 12, Section 12.15.4 – Earthworks Code (including Lot Filling) Clause (8) Flooding and Drainage.

(3) The inclusion of four Special Opportunity Areas to encourage the transition of existing flood affected residential areas to low impact non residential uses.

	PLANNING PROVISION	COMMENT	✓
	PART 11, SECTION 11.4.7 – FLOODING AND URBAN STORMWATER FLOW PATH AREAS		
(1)	*Specific Outcomes*		
(b)	Land Situated Below the 1 in 20 Development Line – Commercial, Industrial and Other Non Residential Uses (i) Where possible, the design and layout of buildings provides for— (A) parking, or other low intensive, or non habitable uses at ground level; and (B) retail, commercial and work areas above the parking areas, to increase flood immunity. (ii) Expensive plant and equipment and stock are located in the area of the site or building with the greatest flood immunity. (iii) The building materials and surface treatments used below the adopted flood regulation line are resistant to water damage and do not include wall cavities that may be susceptible to the intrusion of water and sediment. (iv) Electrical installations are sited in the area of greatest flood immunity. (v) Electrical switchboards, main data servers and the like are positioned above the adopted flood regulation line with all electrical and data installations below this level designed and constructed to withstand submergence in flood water. (vi) Access routes are designed or alternative emergency evacuation routes are provided so that in a flood event occupants can escape to a safe and secure area. (vii) The concentration of people in flood affected areas, particularly within areas affected by significant flood flows (i.e. one metre or more in depth), is avoided unless it can be demonstrated that the overall use is appropriate, eg sporting fields, and where there is likely to be adequate warning and access to a safe evacuation route in the event of a flood. (viii) Buildings are located to avoid areas affected by significant flood flows (i.e. one metre or more in depth), or where there is no alternative, buildings are designed to be capable of withstanding the static and dynamic loads, including debris loads, applicable to a flood event equivalent to the adopted flood regulation line. (ix) Materials stored on-site— (A) are those that are readily able to be moved in a flood event; (B) are not hazardous or noxious, or comprise materials that may cause a deleterious effect on the environment if discharged in a flood event; and (C) where capable of creating a safety hazard by being shifted by flood waters, are contained in order to minimise movement in times of flood.	Land within the Citiswich development below the 1 in 20 Development Line is not proposed to be used for industrial and other non-residential uses. This specific outcome is not applicable. Accordingly, no further consideration is required in relation to outcomes 1(b)(i) to (xii).	N/A

A1

	PLANNING PROVISION	COMMENT	✓
	(x) The development does not increase the flood hazard (e.g. by way of increased depth, duration or velocity of flood waters or a reduction in warning times) for other properties. (xi) All earthworks are to comply with any applicable development criteria set out in an approved floodplain management plan. Where a floodplain management plan does not exist for the catchment, no filling of land or reduction of flood storage capacity is permitted below the 1 in 20 development line. (xii) The clearing of native vegetation within the stream banks is avoided.		
(d)	Land Situated Between the 1 in 20 Development Line and the Adopted Flood Regulation Line – Commercial, Industrial and Other Non Residential Uses (i) The design and layout of buildings provides for— (A) parking, or other low intensive, or non habitable uses at ground level; and (B) retail, commercial and work areas above the parking areas, to increase flood immunity. (ii) Expensive plant and equipment and stock are located in the area of the site or building with the greatest flood immunity. (iii) The building materials and surface treatments used below the adopted flood regulation line are resistant to water damage and do not include wall cavities that may be susceptible to the intrusion of water and sediment. (iv) Buildings and other structures are sited on the highest part of the site to increase flood immunity. (v) Electrical installations are sited in the area of greatest flood immunity. (vi) Electrical switchboards, main data servers and the like are positioned above the adopted flood regulation line with all electrical and data installations below this level designed and constructed to withstand submergence in flood water. (vii) Access routes are designed or alternative emergency evacuation routes are provided so that in a flood event occupants can escape to a safe and secure area.	The land within Citiswich situated between the 1 in 20 Development Line and the Adopted Flood Regulation Line (approx. RL20.5m) is proposed to be used for industrial and other non-residential uses. The proposed earthworks will ensure that all lots achieve the higher of the SKM regional 1 in 50 year ARI flood level (16.22mAHD) or the local 1 in 100 year ARI flood level including any freeboard as required. In relation to items (i) – (vi) these matters are relevant to future MCU Development Applications (DAs). Notwithstanding future DAs are capable of complying with these requirements.	✓
A1	(viii) Buildings are located to avoid areas affected by significant flood flows (i.e. one metre or more in depth), or where there is no alternative, buildings are designed to be capable of withstanding the static and dynamic loads, including debris loads, applicable to a flood event equivalent to the adopted flood regulation line.	(vii) Hoepner Road, Ashburn Road, Bognuda Street and the Warrego Highway provide flood free access and evacuation from the site.	✓
	(ix) Materials stored on-site— (A) are those that are readily able to be moved in a flood event; (B) are not hazardous or noxious, or comprise materials that may cause a deleterious effect on the environment if discharged in a flood event; and (C) where capable of creating a safety hazard by being shifted by flood waters, are contained in order to	In relation to items (viii) – (ix) these matters are relevant to future MCU DAs. Notwithstanding future DAs are capable of complying with these requirements.	✓

	PLANNING PROVISION	COMMENT	✓
	minimise movement in times of flood.		
	(x) The development does not increase the flood hazard (e.g. by way of increased depth, duration or velocity of flood waters or a reduction in warning times) for other properties.	(x) Assessment contained in Sections 5 to 8 indicates that the proposed development does not increase the flood hazard to external properties.	✓
	(xi) The clearing of native vegetation within the stream banks is avoided.	(xi) Clearing of stream bank vegetation is avoided as much as possible. Further details will be provided with future applications.	✓
A1	(xii) All earthworks are to comply with any applicable development criteria set out in an approved floodplain management plan. Where a floodplain management plan does not exist for the catchment, no earthworks (including filling) is permitted on land below the adopted flood regulation line, unless: (A) the land is located above the 1 in 20 development line; and (B) such earthworks result in the rehabilitation and repair of the hydrological network and the riparian ecology of the waterway; and (C) an assessment, undertaken by a suitably qualified consultant, demonstrates that the reforming of the land does not negatively impact on the overall hydrology, hydraulics and flood capacity of the waterway and does not in any way result in the reduction of flood storage capacity on the site.	(xii) Earthworks are proposed beneath the 1 in 20 development line. The assessments presented above indicate that the no adverse impact on the flooding characteristics and storage is predicted to occur.	✓
(e)	Urban Stormwater Flow Path Areas		
A1	(i) Access routes are designed or alternative evacuation routes are provided so that in the event of a serious incident occupants can escape to a safe and secure area.	(i) Hoepner Road, Ashburn Road, Bognuda Street and the Warrego Highway provide flood free access and evacuation from the site.	✓
	(ii) Adequate stormwater drainage infrastructure and suitable overland flow paths are provided to carry the 1 in 100 Average Recurrence Interval (ARI) stormwater flow through the property while providing a freeboard of 500mm on the floors of all habitable areas and minimising damage owing to scouring from excessive flow velocities.	(ii) It is proposed that all lots achieve the higher of the SKM regional 1 in 50 year ARI flood level (16.22mAHD) or the local 1 in 100 year ARI flood level including any freeboard as required.	✓
	(iii) Buildings and other works are designed and located so that nearby properties are not affected by any surcharge/afflux generated as a result of the buildings or other works.	(iii) Assessment contained in Sections 7 & 8 indicates that the proposed development does not increase the flood hazard to external properties.	✓
	(iv) Buildings and other works are designed and located to accommodate existing and proposed stormwater drainage infrastructure and overland flow paths.	(iv) Complies, as per this report	✓
	(v) Any damage to existing stormwater drainage infrastructure and overland flow paths resulting from building and other works are rectified prior to the commencement of the new use.	(v) Capable of complying if required	N/A

	PLANNING PROVISION	COMMENT	✓
(f)	Community Infrastructure (i) Key elements of community infrastructure are able to function effectively during and immediately after flood hazard events.	Key community infrastructure comprises roads and proposed open space. The site roads are flood free. The open space is affected by flooding.	✓
	Probable Solutions		
(a)	Electrical Installations (i) The incoming power supply, including all metering equipment is, where possible, located above the adopted flood regulation line. (ii) Electrical switchboards, main data servers and the like are positioned above the adopted flood regulation line with all electrical and data installations below this level designed and constructed to withstand submergence in flood water. (iii) All wiring, power outlets and switches are, to the maximum extent possible, located above the adopted flood regulation line. (iv) All conduits located below the adopted flood regulation line are installed so that they will be self-draining. (v) Heating and air conditioning systems are, to the maximum extent possible, located above the adopted flood regulation line.	In relation to items (i) – (v) these matters are relevant to future MCU DAs. Notwithstanding future DAs are capable of complying with these requirements, as all lots are to be located above the adopted flood regulation line.	✓
(b)	Structural Adequacy (i) Buildings are designed to provide the following minimum safety factors when subjected to significant flood flows (i.e. one metre or more in depth)— (A) 1.5 against failure by sliding or over turning; and (B) 1.33 against flotation. (ii) Footings and foundations are designed to take account of any reduced bearing capacity on account of submerged soil.	In relation to items (i) – (v) these matters are relevant to future MCU DAs. Notwithstanding future DAs are capable of complying with these requirements.	✓
(c)	Evacuation Routes (i) At least one road access will remain passable for the performance of emergency evacuations at a level of no more than 300mm below the adopted flood regulation line.	Hoepner Road, Ashburn Road, Bognuda Street and the Warrego Highway provide flood free access and evacuation from the site.	✓
(d)	Earthworks (i) Earthworks do not negatively affect flood conveyance characteristics or reduce flood storage capacity through the importation of fill to the site, or any alteration to a watercourse or floodway.	Assessment contained in Sections 5 to 8 of this report indicate no worsening of flooding external to the site.	✓
(e)	Clearing of Vegetation (i) Clearing of vegetation does not involve the removal of native vegetation from land within a Designated Watercourse or land within 30m of a Designated Watercourse or within 10 metres of the top of the bank of a Designated Watercourse where the slope of the bank exceeds 15% (refer Figure 11.4.12).	It is noted that very limited vegetation exists where earthworks are proposed. It is proposed to vegetate the local tributaries with native species upon completion of earthworks.	✓

A1

		PLANNING PROVISION	COMMENT	✓
	(f)	Community Infrastructure (i) Key elements of community infrastructure are sited and designed to achieve the levels of flood immunity as set out in the State Planning Policy and associated Guidelines for Natural Disaster Mitigation.	Key community infrastructure comprises roads and proposed open space. The site roads are flood free. The open space is affected by flooding.	✓
A1		PART 12, SECTION 12.15.4 – EARTHWORKS CODE (INCLUDING LOT FILLING) CLAUSE (8)		
	(8)	*Specific Outcomes – Flooding and Drainage*		
A1	(a)	All earthworks are to comply with any applicable development criteria set out in an approved floodplain management plan. Where a floodplain management plan does not exist for the catchment, no earthworks (including filling) is permitted on land below the adopted flood regulation line, unless: (i) the land is located above the 1 in 20 development line; and (ii) such earthworks result in the rehabilitation and repair of the hydrological network and the riparian ecology of the waterway; and (iii) an assessment, undertaken by a suitably qualified consultant, demonstrates that the reforming of the land does not negatively impact on the overall hydrology, hydraulics and flood capacity of the waterway and does not in any way result in the reduction of flood storage capacity on the site.	Earthworks are proposed beneath the 1 in 20 development line. The assessments presented above indicate that the no adverse impact on the flooding characteristics and storage is predicted to occur.	✓
A1	(b)	Earthworks — (i) do not cause any increase in flooding or drainage problems; (ii) do not cause an impediment to flood waters; or (iii) do not negatively impact upstream or down stream properties.	The assessments presented within this report indicate that the no adverse impact on the flooding characteristics and storage is predicted to occur.	✓
A1	(c)	Earthworks are avoided in natural gullies and overland flow paths.	It is noted that earthworks are proposed within the overland flow paths. The assessments presented within this report indicate that the no adverse impact on the flooding characteristics and storage is predicted to occur upon completion of earthworks.	×

11 RESPONSE TO COUNCIL INFORMATION REQUEST

Council recently reviewed Cardno Lawson Treloar's *'Citiswich Masterplan – Flooding Investigation (Including Local Flooding Assessment)'* dated November 2011 (ref LJ8714/R3/V3) and issued a request for information (dated 21 December 2011). This report has been updated to address the items related to Council's request for further information as follows:

The following section details each the individual comments provided by Council and their corresponding response, proposed by CLT, to address each comment.

- *Item 1 Section 2 – Catchment Description*

  (a) For pre developed case, contributing area from subcatchment B8 to Node A7 to be verified. It is understood that this particular catchment in part drains to B1 rather than A7.

Catchment B8 relates to the Capral site and its associated drainage. The hydrologic model has been reviewed and updated accordingly as detailed in this report (see Section 7). Figures 5, 6 and 7 show the updated catchment layouts.

(b) Figure 6 needs amendment for post developed land use of subcatchments 1 & 2 which are low density residential not industrial (this may not vary much on contributing flow). Also, Stage 4 does not appear consistent with recent proposed development areas, specifically area north of Archer Street.

Figure 6 has been updated and attached to this report.

- *Item 2 Section 3 – Data*

  (a) Sect 3.3 - Need clarification on assumed 1974 flood level which should be 20.5m AHD not 18.7m AHD and to be cross checked with the data in Sect 6.

The report and relevant figures have been updated to reflect ICC's revised flood levels for the 1974 and 2011 flood levels of 20.5mAHD and 18.7mAHD respectively.

- Item 3 Section 5 – Regional Hydraulic Assessment

  (a) Table 5-2 - Correlation between SKM's ARIs and SOBEK's ARIs except 1 in 50 year needs to be justified.

In accordance with Council the Defined Flood Event is the Ultimate 1 in 50 year ARI defined in the SKM 1999 *'Ipswich Rivers Flood Studies Phase One and Phase Two'*. This report and relevant figures have been amended to only reference the SKM ultimate regional storm events.

(b) Sobek Reporting ID A, B, C & D needs to be clearly identified in respective maps.

SOBEK reporting locations have been identified to all relevant figures.

(c) Sensitivity analysis for vegetation of riparian corridor.

Sensitivity analysis for vegetation of the riparian corridor is currently being undertaken and the results of this assessment are expected to be included in a future addendum to this report, as discussed with Council on 31st May 2011.

(d) Provide within report comment/rational and explanation for cause concerning Fig D.1.1 U/S Boundary model output erroneous result.

The SOBEK 2D model parameter conditions have been thoroughly investigated and amended to eliminate the erroneous result as detailed in this report.

(e) Provide within report comment/rational/explanation for cause where model afflux results demonstrate a negative afflux output.

Revise modelling no longer has a negative afflux output.

(f) Provide definition of "...will not adversely impact" extent. What does this mean in context of model accuracy and output etc?

In section 5.2 of the report the sentence "....will not adversely impact" is defined in the context of the report as the proposed works will not result in an increase in peak flood levels upstream or downstream of the development.

(g) Table 5.4, Impact units appear to be incorrect (mm) and does not correlate with that determined by model, eg. 0.001 mm or m.

Table 5.4 units have been corrected from millimetres to meters. The report has been updated to eliminate any further units discrepancies.

- Item 4 Section 6 – Cumulative Flooding Impact Assessment

(a) Table 6.1 - needs to incorporate the storage calculation corresponding to actual 1974 flood level

Flood storage calculations have been included for the January 2011 event (18.7mAHD) and the 1974 event (20.5mAHD).

(b) Need clarification on Table 6.2 results, specifically how determination of values and which 100 year ARI (is this SKM Q50).

The report has been amended to only make reference to SKM's ultimate regional flows, of which the 1 in 50 year ARI is the design flood event.

(c) Table 6.1 should show change to storage below RL 13.3m AHD. Some compensatory earthworks have already been undertaken, refer to ACOR tin drawings.

Table 6.1 shows a change of storage below 13.3mAHD.

- *Item 5 Section 7 – Local Hydrology Assessment*

(a) Pre- and post development scenarios- clarification on assumption of ultimate developed situation for external catchment. For comparison, use existing external catchment v's developed internal. However for design of channel use ultimate catchment.

In keeping with the flood commission requirements, Council has requested that the original modelling assumptions used in the CLT's *'Citiswich Masterplan – Flooding Investigation (Including Local Flooding Assessment)'* dated November 2011 (ref LJ8714/R3/V3) are to be changed.

Council's recommended design scenarios to be modelled are as follows:

- Pre – Development Case: hydraulic modelling based on the existing external and existing site topographies;
- Post – development Case: hydraulic modelling based on the existing external and developed site topographies; and
- Ultimate Case: hydraulic modelling based on the ultimate external and developed site topographies.

The previously developed hydrological WBNM model and the one-dimensional SOBEK flood model have been updated to meet the revised development cases requested by council. The report and all relevant figures have been changed to reflect the new scenarios. Refer to Sections 7 and 8 of the report.

(b) Sect 7.2.2 increased post developed flows for all ARIs and no mitigation proposed, hence the ultimate catchment design criteria. However, waterway stability to maintain pre developed Q1 flow and first 15mm detention need to be considered.

A frequent flow assessment has been conducted as detailed in Section 9 of this report.

(c) Rational method not appropriate for model calibration where catchment tc > 30 mins, refer to ICC Planning Scheme Implementation Guideline #24 for direction.

The ICC Planning Scheme Implementation Guideline #24 was adopted by Council on the 20th September 2011. Through discussion with Council (Gary Ellis) it was identified that this Guideline was based on SKM's *'Integrated Water Management Principles and Objectives'* (2010) and is only appropriate for large ungauged catchments greater than 2000ha. Since the Citiswich site is significantly less than 2000ha Council have agreed (ref email to Daniel Niven, 2nd February 2012) that the rational method is considered acceptable to verify the WBNM model.

- *Item 6 Section 8 – Local Hydrology Assessment*

(a) No peak velocity table for the Western Tributary is supplied for pre and post developed scenarios.

Peak velocity tables for the Western tributary for the pre-, and post- and ultimate development scenarios are provided in Appendix M.

- *Item 7 Section 9 – Appendix C.4 – Site Specific Hazard (Safety Product)*

  (a) Provide definition for category: extreme, high, medium and low.

For the purpose of this assessment flood hazard categorisation is based on the Brisbane City Council's *'Subdivision and Development Guidelines'* (2008). These guidelines only assign either a high or low flood hazard as defined in Table 5.4 of this report.

- *Item 8 Section 9 – Appendix D*

  (a) Clarify/justify afflux Figure D.1.1 (refer above comment)

The SOBEK 2D model parameter conditions have been thoroughly investigated and amended to eliminate the results typically within model accuracy.

- *Item 9 – Additional Email from Gary Ellis (ICC) to Daniel Niven (21 December 2011)*

  "Further to my earlier email, it is critical to also include an assessment of any changes to rate of rise for local and regional flooding. This was an omission of earlier study identified as part of peer review."

An assessment for changes in rate of rise for local and regional flooding is undertaken and detailed in Section 5 and 9 respectively.

- *Item 10 – Additional Email from Gary Ellis (ICC) to Daniel Niven (13 February 2012)*

  "As part of your update/revision in response to Council info request could you also please revisit the report introduction and ensure that current Lot/RP's for the site are recorded accurately. E.g. Lot 34 on SL3911 does not exist."

Lot/RP's for the site are updated to reflect the latest sub-division information prepared by B&P Surveys. A copy of the plan is included in the reference drawings section of this report.

12 CONCLUSION

CLT has completed a full assessment of the flooding relating to the Citiswich development. This assessment has considered both the regional and local tributaries.

The flood assessment has demonstrated the regional flooding across the Citiswich Site, for both the Brisbane (30 hour) and Bremer (18 hour) River events the proposed earthworks are not predicted to cause any adverse flood impacts. An assessment of the flood storage has indicated that the proposed works will reduce the flood storage within the confines of the site extents by up to 31.5%. The impact of this loss across the total catchment flood storage is no more than 0.1% loss of flood storage. This has been demonstrated to cause no adverse flood impacts. Flood Hazard for extreme events has been presented across the site.

The local tributary assessments for both the eastern and western tributaries have indicated that the proposed works are predicted to increase the local catchment flows discharging directly to the Bremer River. At the Bremer River these changes in flood levels are contained within the Citiswich site. These increases will not affect peak flooding in the Bremer River as this is dominated by the regional Brisbane River event, some 10m higher. The proposed works within the tributaries has demonstrated that no adverse flood impacts are predicted to occur within the site extents not dominated by the regional flood event. The re-profiled drainage easements are to be turf-lined, and results indicate that velocities will remain below 2.5m/s during the local 1 in 100 year ARI event, in accordance with ICC requirements

In summary this flood assessment has demonstrated that the Citiswich masterplan site is not predicted to cause adverse impact beyond the extents of the site. It is anticipated that the assessments will be refined on a stage by stage basis as the development progresses. Each of these assessments will be in accordance with the findings of this masterplan assessment.

13 REFERENCES

Cardno Lawson Treloar, August 2007, *'Bremer Business Park, Masterplan Flooding Investigation'*. (ref: LJ8714/R3/V2)

Cardno Lawson Treloar, September 2008, *'Citiswich, Stage 7 – Stormwater Management Strategy to Support a Reconfiguration of Lot Development Application',* (ref: LJ8714/R8).

Cardno Lawson Treloar, February 2009, '*Citiswich, Masterplan Stormwater Management Strategy (Response to Stage 1 Healthy Waterways Review)',* (ref: LJ8714/R4/V3).

Cardno Lawson Treloar, February 2009, '*Citiswich, Stage 1 – Stormwater Management Strategy to Support Operational Works Development Application – Response to Healthy Waterways Review)',* (ref: LJ8714/R5/V3);

Cardno Lawson Treloar, March 2011, *'Citiswich, Stage 4 – Stormwater Management & Flooding Assessment to Support Re-Configuration of Lot Application & Preliminary Approval to Vary the Effect of the Planning Scheme – Response to Information Request',* (ref: LJ8714/R12/V2);

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Cardno Lawson Treloar, November 2011, '*Citiswich Estate Stage 2 Stormwater Management Strategy to Support Reconfiguration of Lot & Bulk Earthworks Applications including Preliminary Approval to Vary the Effect of a Planning Scheme*' (ref: LJ8714/R17/V4).

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14 QUALIFICATIONS

This report has been prepared by Cardno Lawson Treloar (CLT) specifically for Walker Corporation Pty Ltd and specifically to provide advice on Stormwater Management Planning for the ultimate masterplan of the proposed Citiswich industrial development.

Our analysis and overall approach has been specifically catered to the particular requirements of Walker Corporation Pty Ltd, and may not be applicable beyond this scope. For this reason any other third parties are not authorised to utilise this report without further input and advice from CLT.

CLT has relied on the following information provided by others:

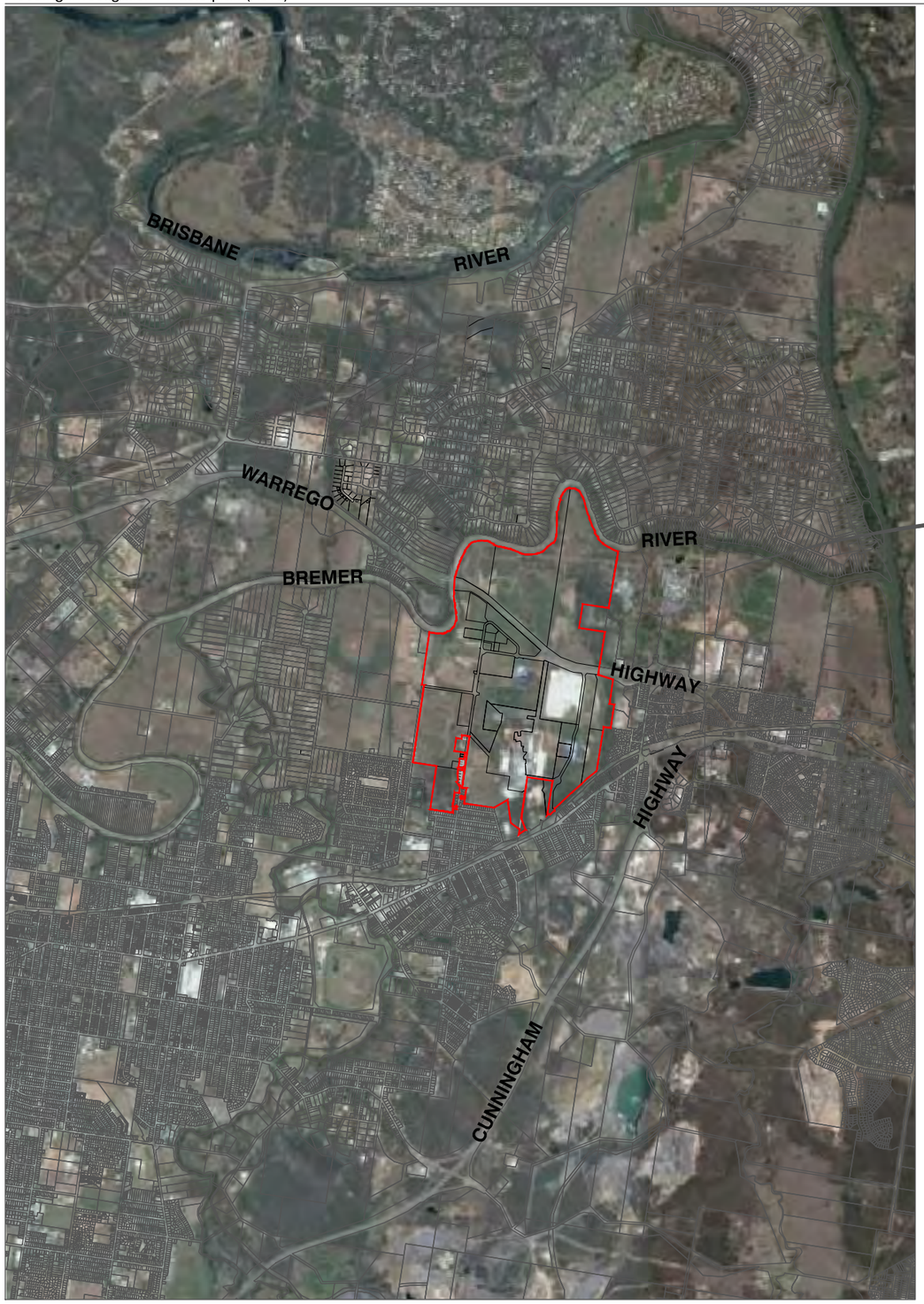
- Detailed Site survey data provided by Walker Corporation Pty Limited;
- 12d Model tins for the pre-developed, existing current and ultimate scenarios provided by ACOR;
- Laser survey of the surrounding site supplied by Terranean Mapping Technologies;
- 1m Contour information, digital orthophotos and property data supplied by Ipswich City Council;
- ACOR Baseline Consultants' engineering drawings;
- Masterplan layout supplied by ACOR;
- 1:25,000 scale topographic maps, supplied by SUNMAP;
- Storage balance calculations and figures prepared and supplied by ACOR; and
- Sinclair Knight Merz (SKM) one-dimensional Mike11 dynamic model of the major creeks and rivers within the Ipswich City Council district.

The accuracy of the report is dependent upon the accuracy of this information.

While CLT's report accurately assesses peak flows from design storms in accordance with current industry design standards and guidelines. The regional flow data used in this assessment is based on the information provided by the Ipswich City Council. It is recognised that these design flows are based on limited historic calibrations in the vicinity of the site. As such, future flood levels may vary from those predicted.

Figures

Cardno Lawson Treloar



0.5 0 0.5 1.0 1.5 2.0 2.5km
1:50,000

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1:15,000

Scale 1:15000 (A3)

FIGURE 1
SITE LOCATION

Rev: 0 Date: May 2012

Project No.: LJ8714

Walker Corporation Pty Limited

CAD FILE: O:\LJ8714\Figures\R3v5_Masterplan_Flooding\Figure 1.dwg
XREFs: xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 12:36pm

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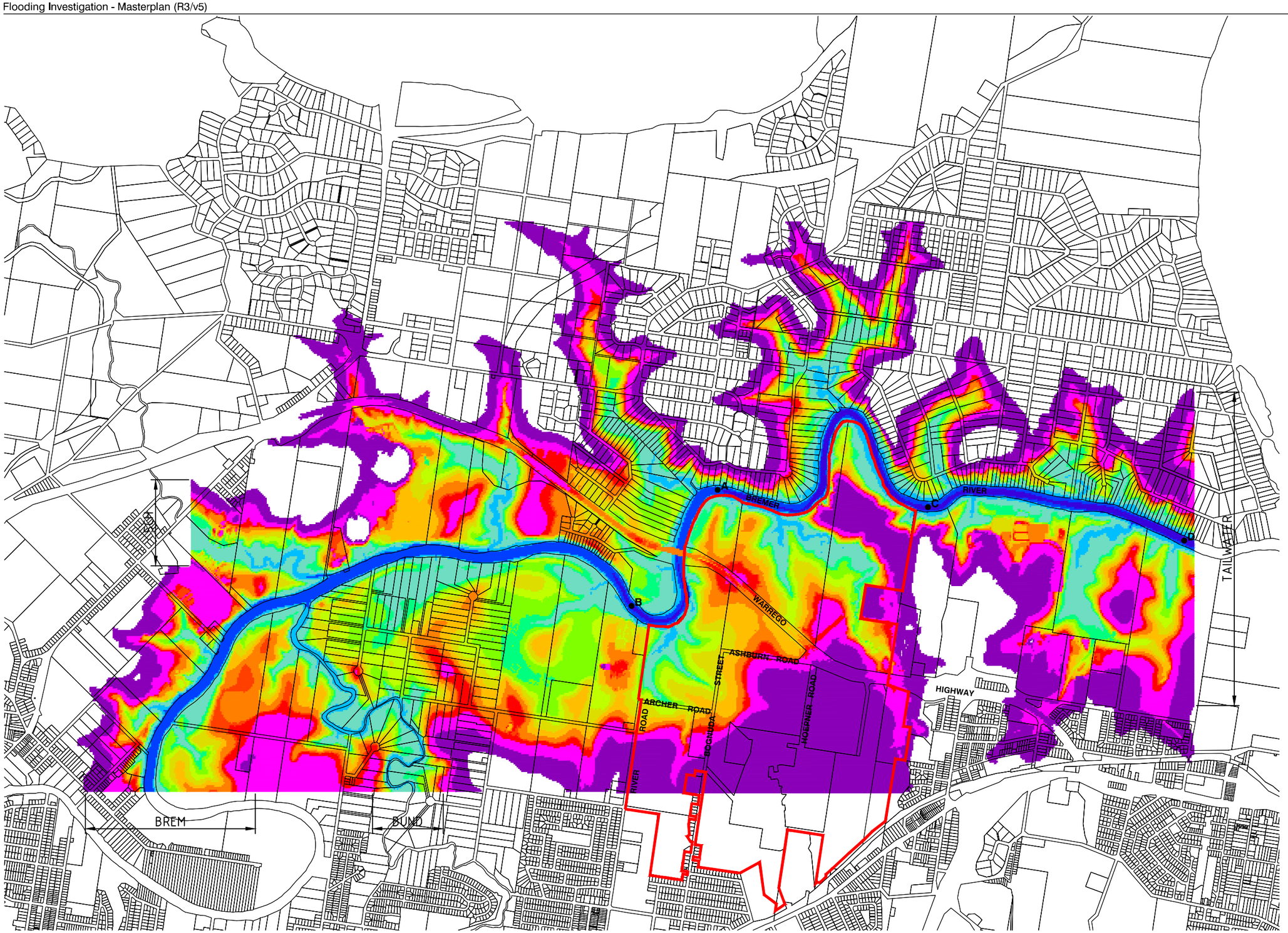

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FIGURE 2
SOBEK 2D PRE-DEVELOPED TOPOGRAPHY

Rev: 0 Date: May 2012

Project No.: LJ8714

PRINT DATE: 11 May, 2012 - 4:43pm

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

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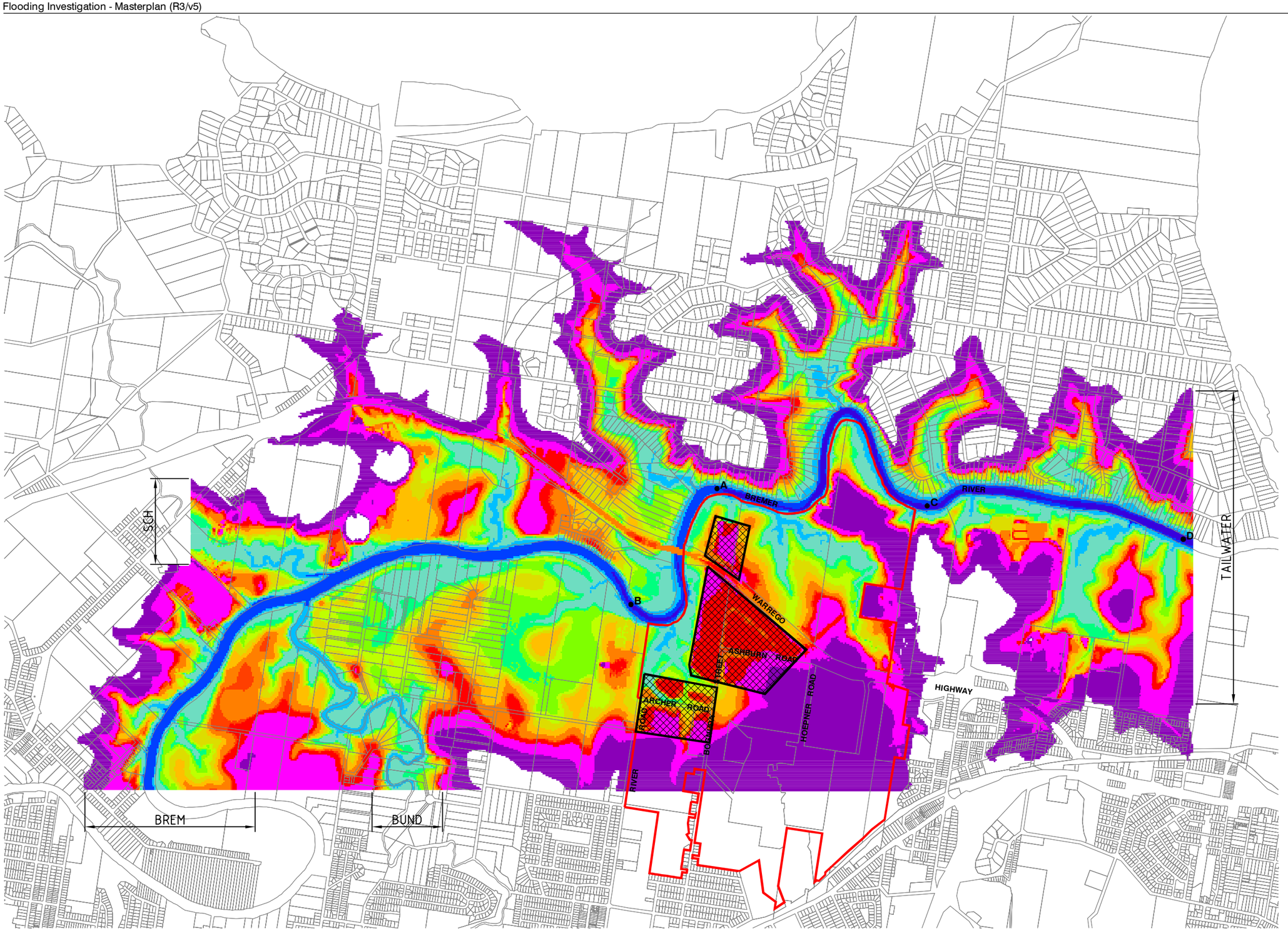


Scale 1:25000 (A3)

FIGURE 3
SOBEK 2D E□ISTING CURRENT TOPOGRAPHY

Rev: A1 **Date: August 2012**

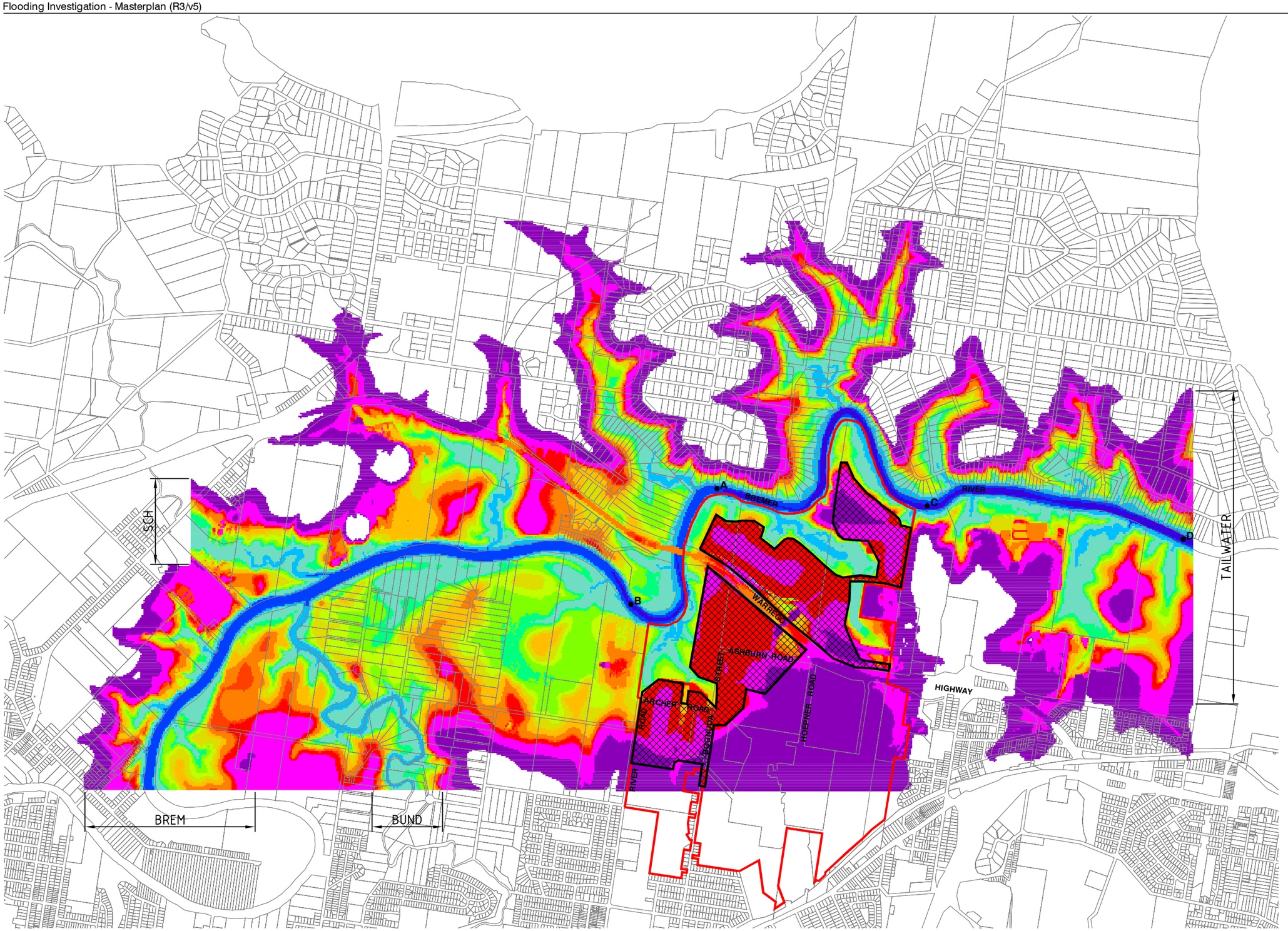
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: O:\LJ8714\Figures\SOBEK2D_figs\E08c_BRIS\Figure_R3v4_E08c_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 17 August, 2012 - 3:43pm

Cardno Lawson Treloar



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Scale 1:25000 (A3)

FIGURE 4

SOBEK 2D MASTERPLAN ULTIMATE DEVELOPED TOPOGRAPHY

Rev: A1 **Date: August 2012**

Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: O:\LJ8714\Figures\SOBEK2D_figs\D14_BRIS\Figure_R3v4_D14_Bris.dwg
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PRINT DATE: 17 August, 2012 - 3:34pm

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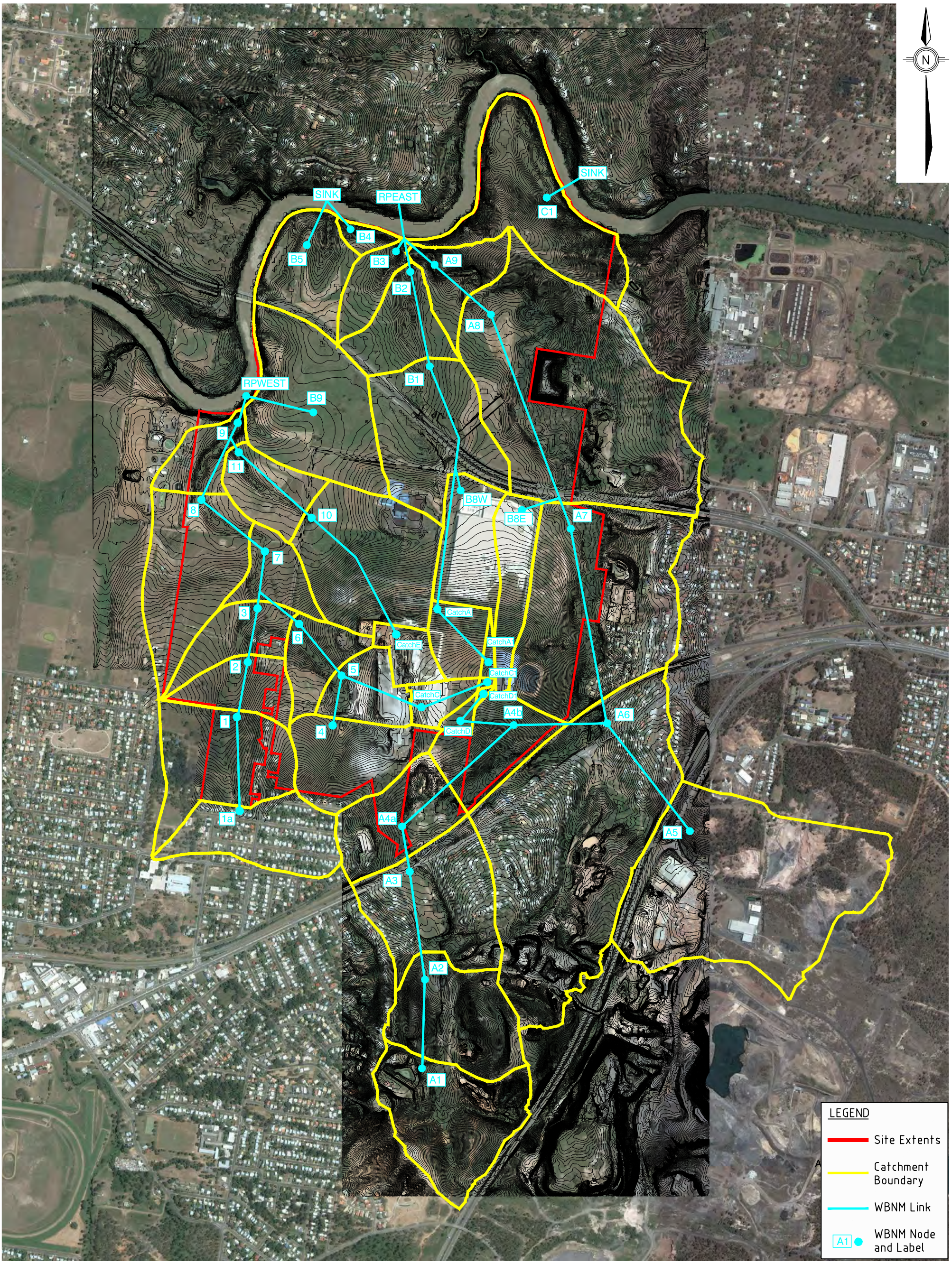

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Scale 1:15000 (A3)

FIGURE 5

PRE DEVELOPMENT WBNM MODEL CATCHMENT DELINEATION

Rev: Orig. Date: May 2012

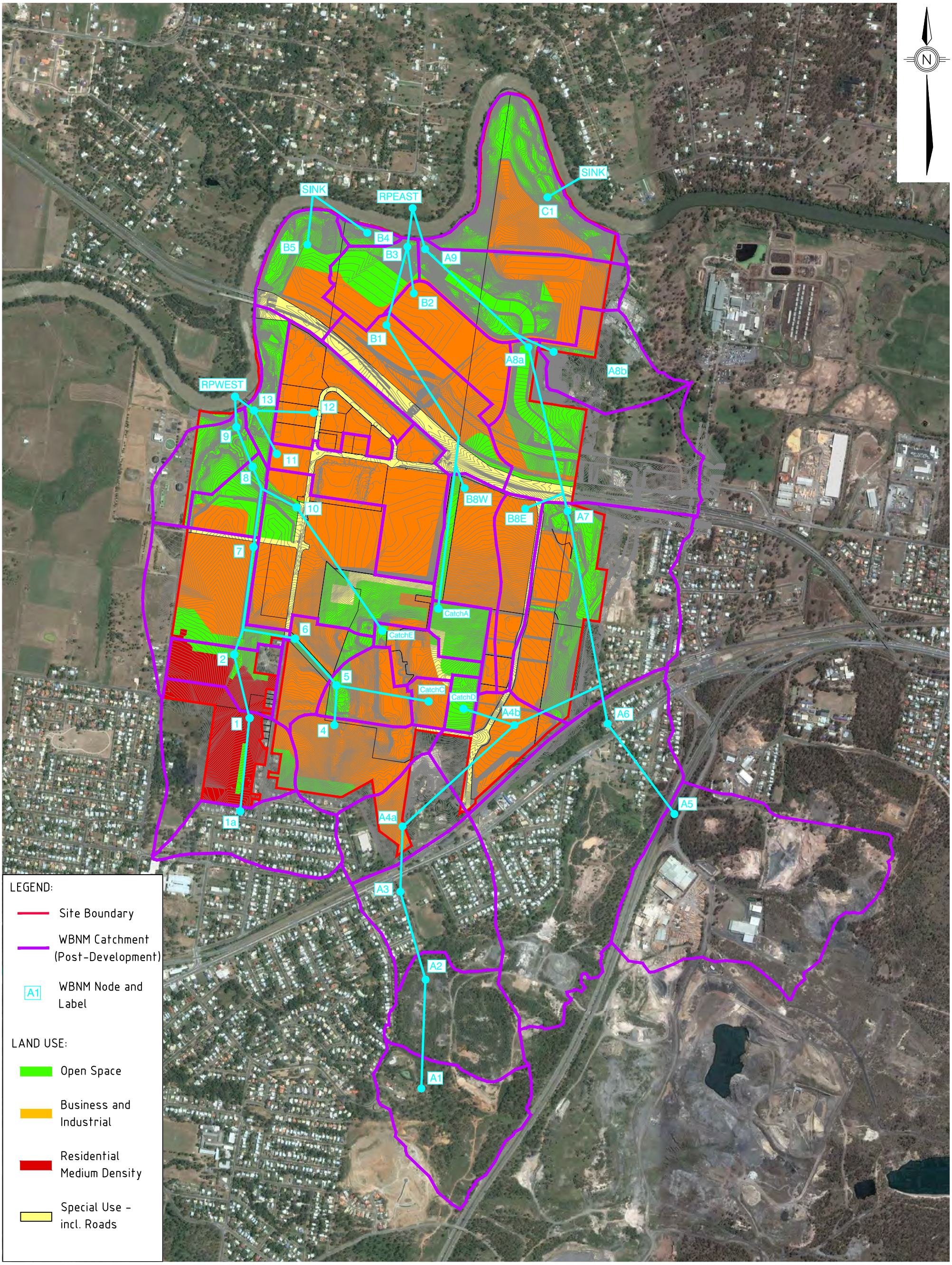
Project No.: LJ8714

Walker Corporation Pty Limited

CAD FILE: O:\LJ8714\Figures\R3v5_Masterplan_Flooding\Figure 5 - WBNM Existing.dwg
XREF's:

PRINT DATE: 11 May, 2012 - 12:38pm

Cardno Lawson Treloar



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Scale 1:15000 (A3)

FIGURE 6

POST DEVELOPMENT WBNM MODEL CATCHMENT DELINEATION

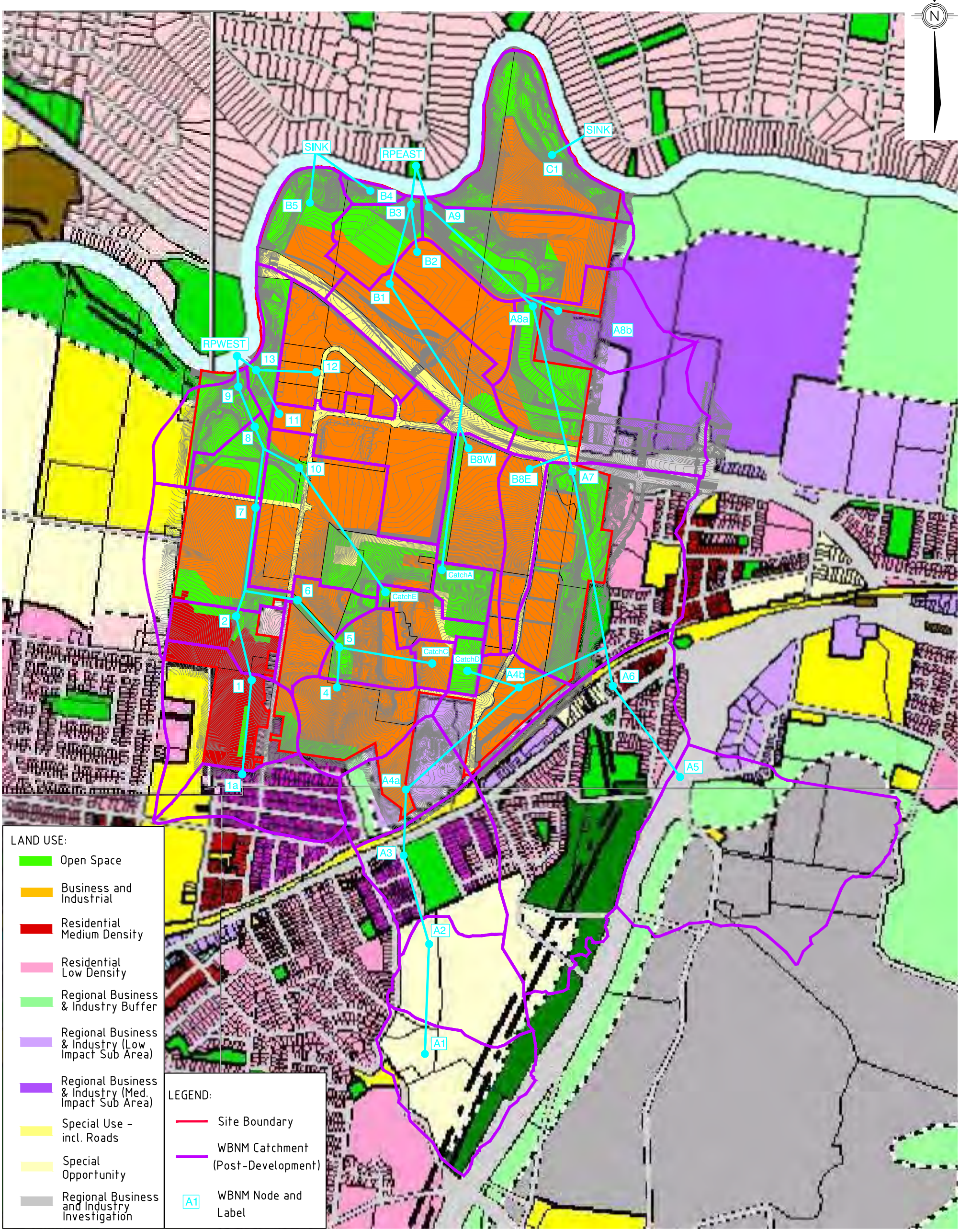
Rev: A1 Date: August 2012

Project No.: LJ8714

PRINT DATE: 21 August, 2012 - 11:26am

Walker Corporation Pty Limited

Cardno Lawson Treloar



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Scale 1:15000 (A3)

FIGURE 7

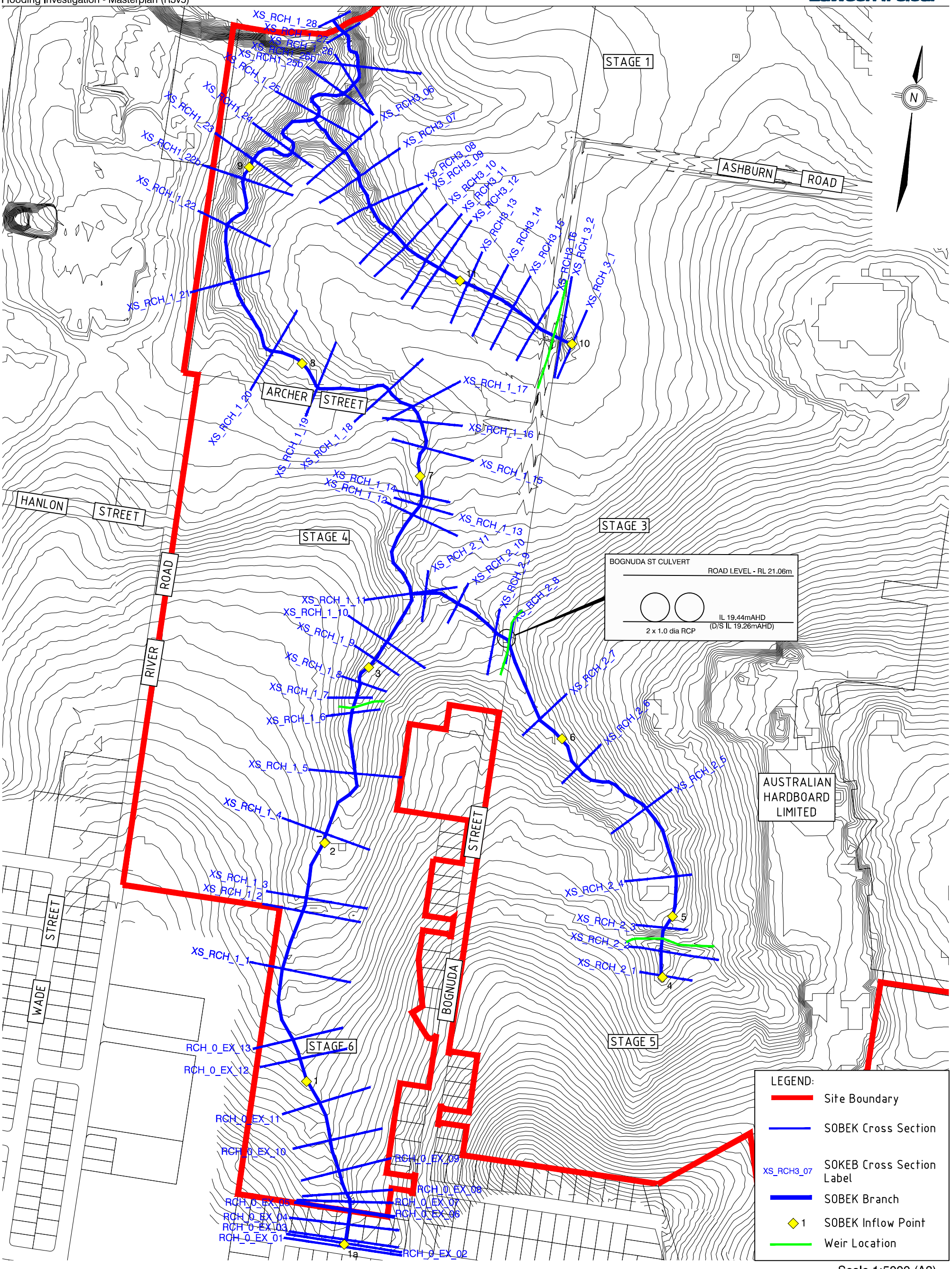
ULTIMATE DEVELOPMENT WBNM MODEL CATCHMENT DELINEATION

Rev: A1 Date: August 2012

Project No.: LJ8714

PRINT DATE: 21 August, 2012 - 11:31am

Cardno Lawson Treloar



50 0 50 100 150 200 250m
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Scale 1:5000 (A3)

FIGURE 8

WESTERN TRIBUTARY: SOBEK 1D PRE-DEVELOPMENT MODEL LAYOUT AND TOPOGRAPHY

Rev: Orig. Date: May 2012

Project No.: LJ8714

Walker Corporation Pty Ltd

PRINT DATE: 11 May, 2012 - 1:32pm

CAD FILE: O:\LJ8714\Figures\R3v5_Masterplan_Flooding\Figure 8 - SOBEK West Pre-development.dwg
XREF's: 15784Dk; WLK25_lot reconf Rev f; Master2007; 10338_PR03(D)

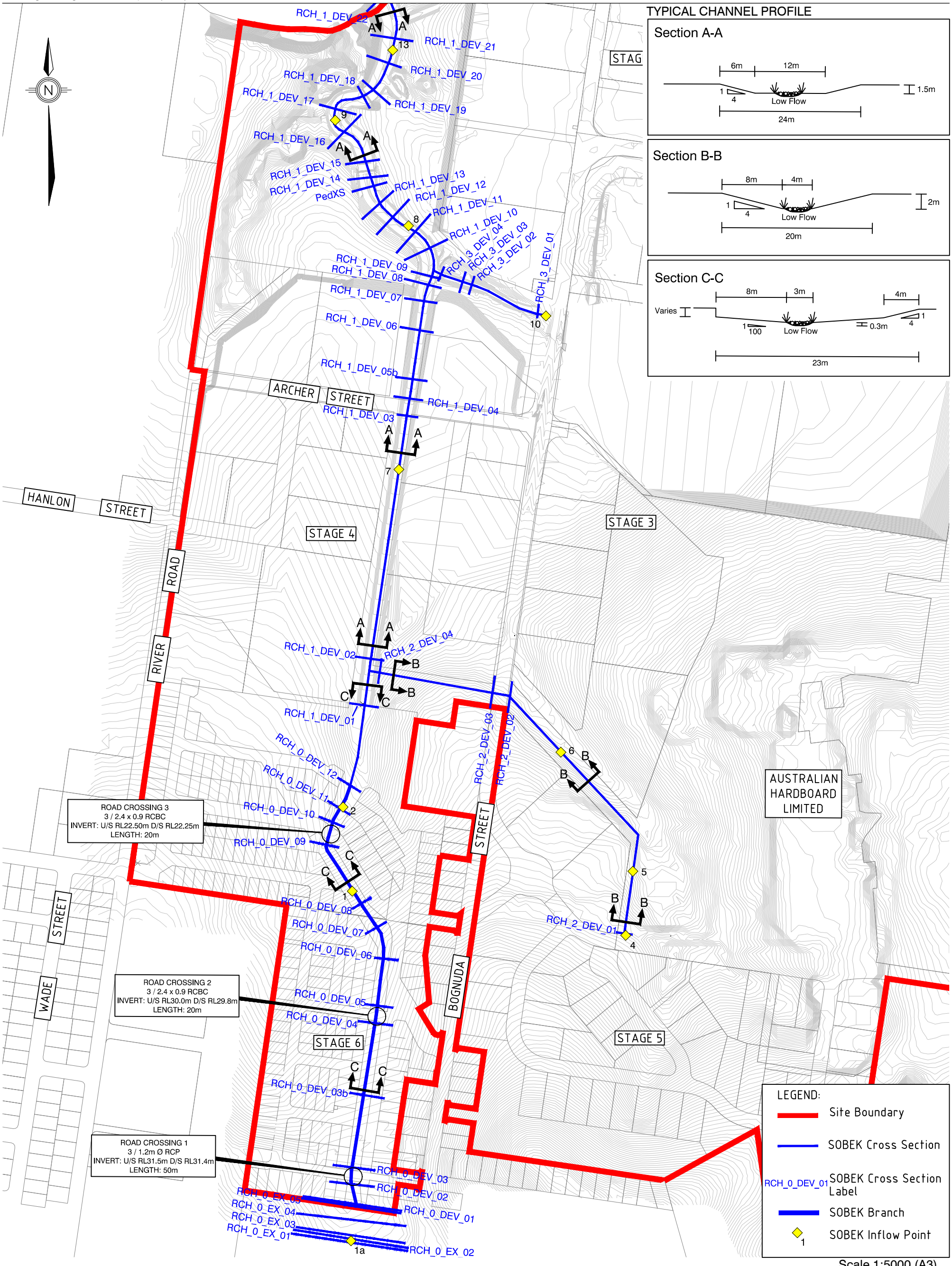
Cardno Lawson Treloar

TYPICAL CHANNEL PROFILE

Section A-A

Section B-B

Section C-C



Scale 1:5000 (A3)

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1:5000

FIGURE 9

WESTERN TRIBUTARY: SOBEK 1D POST-DEVELOPMENT (MASTERPLAN) MODEL LAYOUT

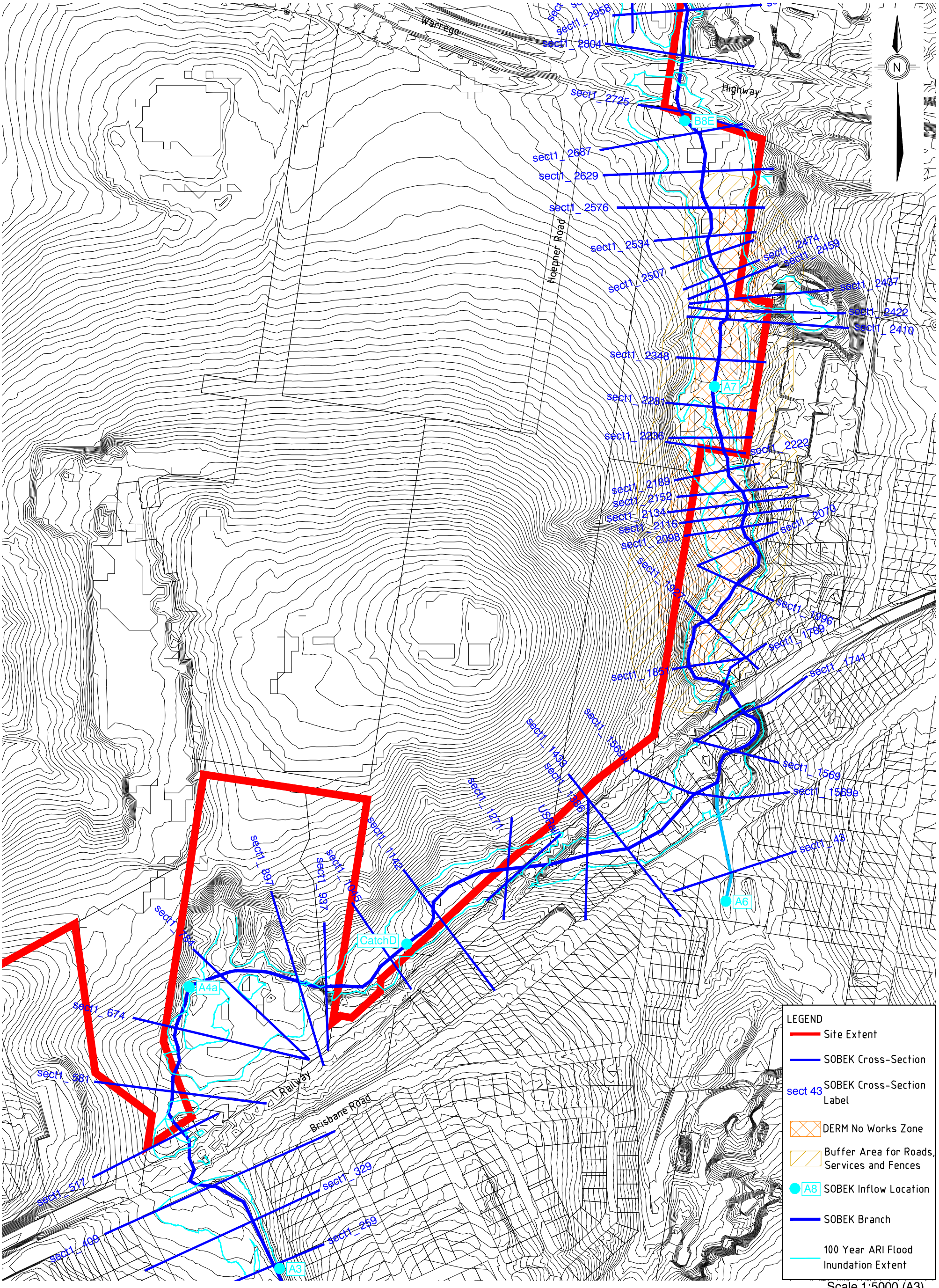
Rev: A1 Date: August 2012

Project No.: LJ8714

Walker Corporation Pty Ltd

PRINT DATE: 21 August, 2012 - 11:10am

Cardno Lawson Treloar



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Scale 1:5000 (A3)

FIGURE 10

EASTERN TRIBUTARY: SOBEK 1D PRE-DEVELOPMENT MODEL LAYOUT AND TOPOGRAPHY (SOUTHERN EXTENTS)

Rev: Orig. Date: May 2012

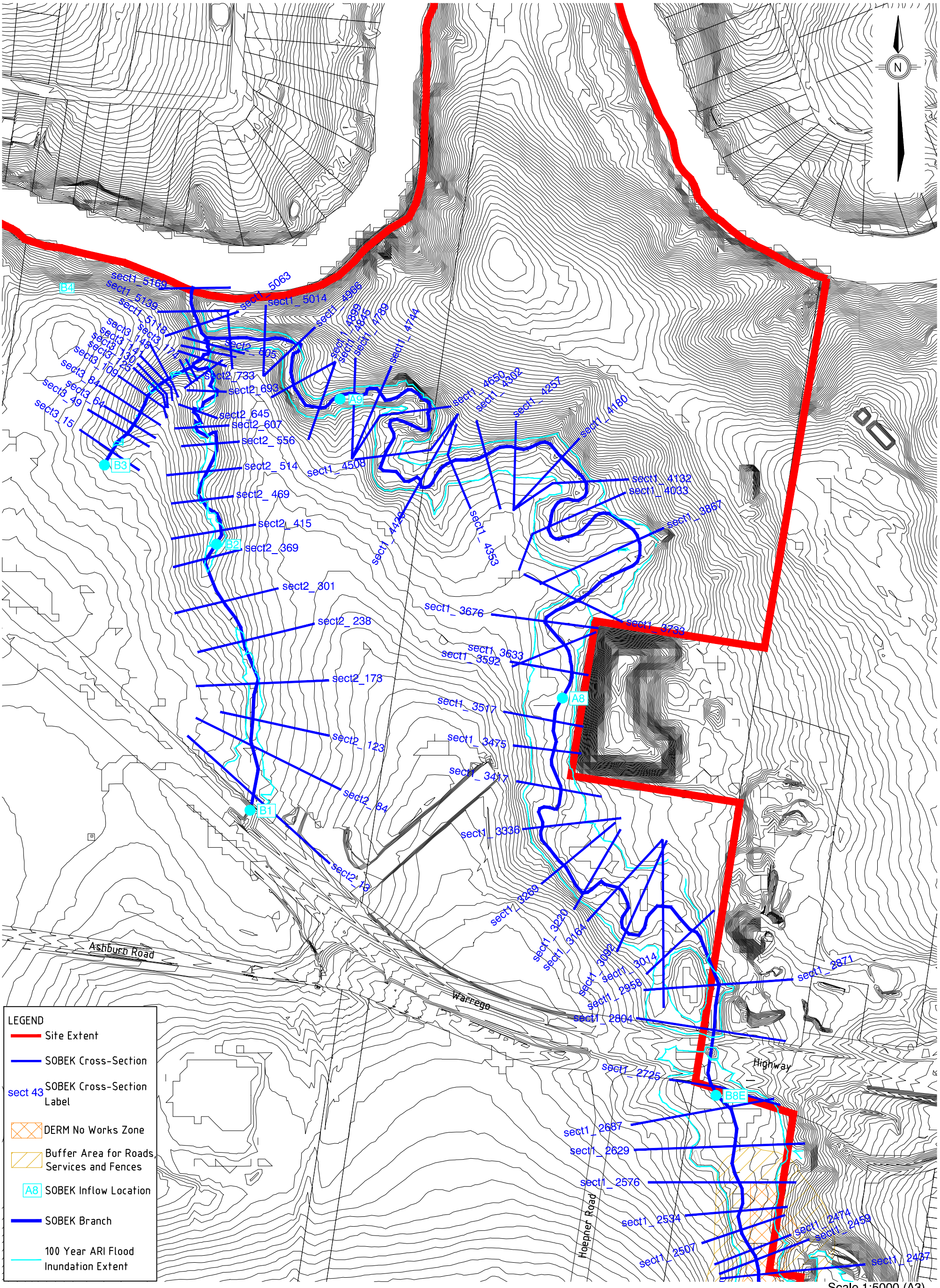
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: O:\LJ8714\Figures\R3v5_Masterplan_Flooding\Figure 10.dwg
XREF's: Conts ST DU15a; rec20111111

PRINT DATE: 11 May, 2012 - 1:37pm

Cardno Lawson Treloar



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1:5000

Scale 1:5000 (A3)

FIGURE 11

EASTERN TRIBUTARY: SOBEK 1D PRE-DEVELOPMENT MODEL LAYOUT AND TOPOGRAPHY (NORTHERN EXTENTS)

Rev: Orig. Date: May 2012

Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: O:\LJ8714\Figures\R3v5_Masterplan_Flooding\Figure 11.dwg
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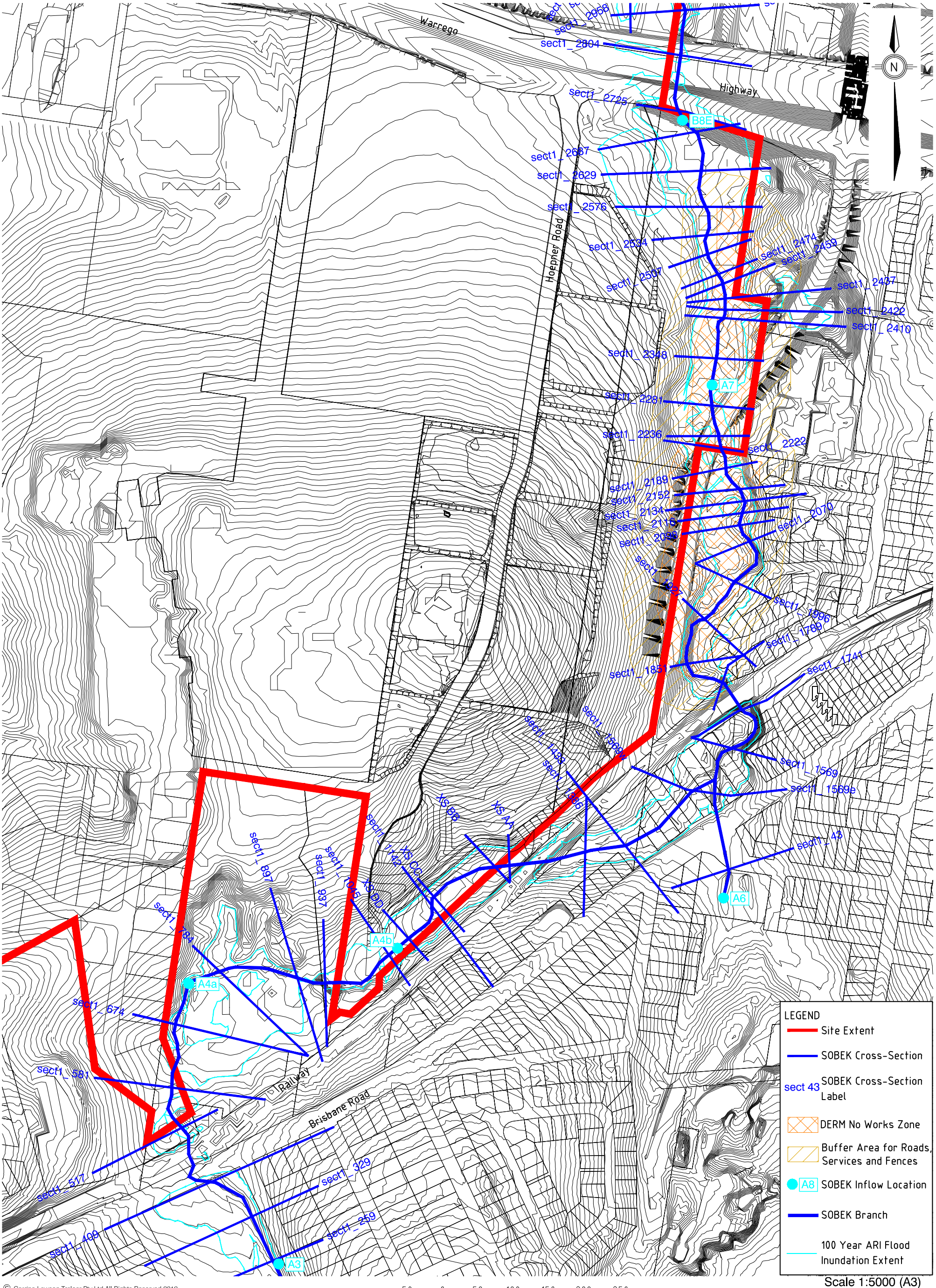
PRINT DATE: 11 May, 2012 - 1:41pm

Cardno Lawson Treloar



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Scale 1:5000 (A3)

FIGURE 12

EASTERN TRIBUTARY: SOBEK 1D POST-DEVELOPMENT (MASTERPLAN) MODEL LAYOUT(SOUTHERN EXTENTS)

Rev: Orig. Date: May 2012

Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: O:\LJ8714\Figures\R3v5_Masterplan_Flooding\Figure 12 - SOBEK West.dwg
XREF's: Conts ST DU15a; rec20111111

PRINT DATE: 11 May, 2012 - 1:43pm

REFERENCE DRAWINGS

DATE PLOTTED: 18 April 2012 8:36 AM BY: BRENDAN VASSALLO (BRISBANE)

PRELIMINARY
Date 18 April, 2012

LAYOUT PLAN
SCALE 1:5000

50 0 50 100 150 200 250m
1:5000 - A1 1:10000 - A3

Rev	Date	Description	Drawn	Appr.

Cardno (Qld) Pty Ltd ACN: 051 074 992
Level 11, North Tower, 515 St Paul's Terrace, Fortitude Valley 4006
Locked Bag 4006, Fortitude Valley Qld 4006
Phone (07) 3369 9822 Fax (07) 3369 9722
Email: cardno@cardno.com.au Web: www.cardno.com.au

Quality System — Quality Endorsed Company — AS 9001 Lic. 5960 Standards Australia

Drawn	B.V	Date 17/04/2012
Checked	P.J.O	Date 17/04/2012
Designed	F.V	Date 17/04/2012
Verified		Date
Approved	RPEQ:	Date

Client: WALKER CORPORATION PTY LTD

CITISWITCH

PREDEVELOPMENT CASE

Status: PRELIMINARY

Date	Datum	Scale	Size
17/04/2012	A.H.D.	AS SHOWN	A1

Drawing Number: 7902.44.006-SK001 Revision: -

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XREFs: X-BNE-LOGO; X-GRP-A1-SHT; X-CONTS; X-7902.44.006-BASE
CAD FILE: L:\7902-44 Citiswitch\006\Design and Documentation\Acad\Drawings\7902.44.006-SK001 - SK003 Development Conditions.dwg

PRELIMINARY

Date 18 April, 2012

LAYOUT PLAN
SCALE 1:5000

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1:5000 - A1 1:10000 - A3

Rev	Date	Description	Drawn	Appr.

Cardno (Qld) Pty Ltd ACN: 051 074 992
Level 11, North Tower, 515 St Paul's Terrace, Fortitude Valley 4006
Locked Bag 4006, Fortitude Valley Qld 4006
Phone (07) 3369 9822 Fax (07) 3369 9722
Email: cardno@cardno.com.au Web: www.cardno.com.au

Quality System
Quality Endorsed Company
AS 9001 Lic. 5960 Standards Australia

Drawn	B.V	Date	17/04/2012
Checked	P.J.O	Date	17/04/2012
Designed	F.V	Date	17/04/2012
Verified		Date	
Approved	RPEQ:	Date	

Client: WALKER CORPORATION PTY LTD

CITISWITCH

EXISTING CASE

Status: PRELIMINARY

Date	Datum	Scale	Size
17/04/2012	A.H.D.	AS SHOWN	A1

Drawing Number: 7902.44.006-SK002 Revision: -

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PRELIMINARY

Date.....11 May, 2012.....

LAYOUT PLAN
SCALE 1:5000

50 0 50 100 150 200 250m
1:5000 - A1 1:10000 - A3

Rev	Date	Description	Drawn	Appr.
A	11/05/2012	STAGE 4 LAYOUT AND CONTOURS UPDATED		

Cardno (Qld) Pty Ltd ACN: 051 074 992
Level 11, North Tower, 515 St Paul's Terrace, Fortitude Valley 4006
Locked Bag 4006, Fortitude Valley Qld 4006
Phone (07) 3369 9822 Fax (07) 3369 9722
Email: cardno@cardno.com.au Web: www.cardno.com.au

Quality Endorsed Company
AS 9001 Lic. 6960 Standards Australia

Drawn	B.V	Date	17/04/2012
Checked	P.J.O	Date	17/04/2012
Designed	F.V	Date	17/04/2012
Verified		Date	
Approved	RPEQ:	Date	

Client WALKER CORPORATION PTY LTD

CITISWITCH

MASTERPLAN CASE

Status PRELIMINARY

Date	Datum	Scale	Size
17/04/2012	A.H.D.	AS SHOWN	A1

Drawing Number 7902.44.006-SK003 Revision A

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150mm ON A1 ORIGINAL

CITISWICH ESTATE LAND HOLDINGS AND ADJACENT LAND HOLDINGS

AS AT 19th MARCH, 2012

LEGEND

- WALKER BREMER PARK PTY LTD
- SEAHAMPTON PTY LTD
- WALKER CORPORATION PTY LTD
- COUNCIL/STATE AGENCIES
- OTHER

BREMER RIVER

13 SP250293
34 SP222633
2 RP104683
"AUSTRALIAN MEAT HOLDINGS"
1 RP 104683
23 SP222633
WARREGO HIGHWAY
HAWKINS CRES
21 SP227109
25 SP214482
Pt 101
8 SP214482
Pt 101
Pt 101 SP238269
11 SP151177
14 SP221438
ASHBURN ROAD
12 SP222638
1 RP854996
SEWAGE TREATMENT PLANT
996 SP227111
2 SP238270
22 SP 163216 "CAPRAL ALUMINIUM"
HOEPNER ROAD
15 RP905858
2 RP854997
14 RP905858
ROAD
RIVER
ARCHER STREET
7 SP167997 "BUNDAMBA SUB STN"
1 SP249408
1 SP221686
STREET
5 SP 140694 "HUMES"
Pt 1 SP222644
12 SP222644
900 RP836232
16 SP220855
RIVER ROAD
1 SP179307
Pt 1 SP222644
4,5 RP92591
Pt 1 SP222644
BOGNUDA
SP 220853
9
2 SP249408
6 SP220853 "PELICANO"
3 SP249408
2 SP220851
4 SP220852
BOUNDARY ST
CARBERRY ST
"WILLOWBANK DEV."
BRISBANE - IPSWICH RAILWAY
BRISBANE ROAD
BIRD ST

B & P SURVEYS
File No. – J:\41891\dwgs\17488D rev F.pro

SCALE 1:10000

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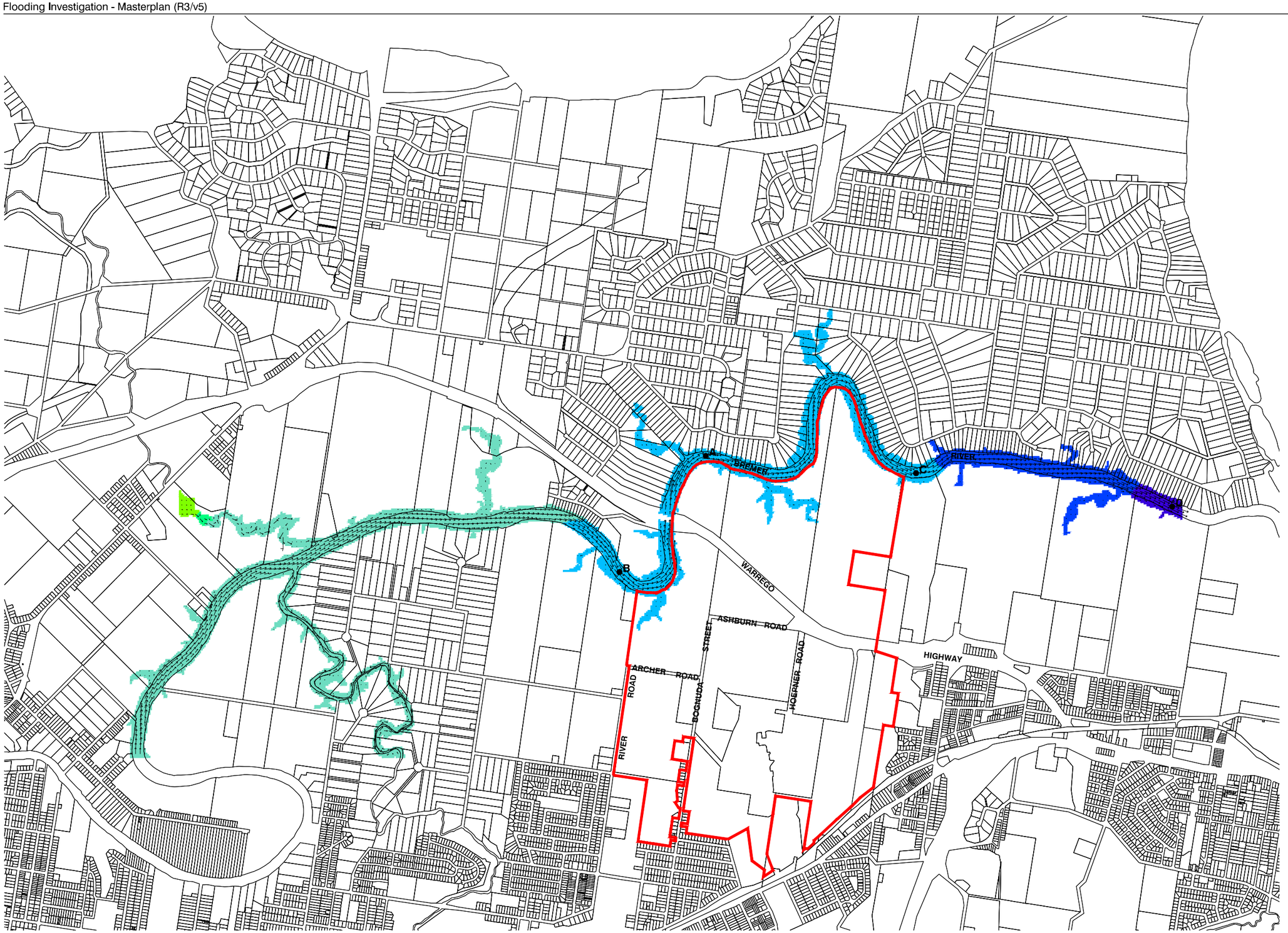
Appendix A.1

Brisbane River Flood SOBEK 2D Pre-Developed Base Case Results – Water Surface Level

Cardno Lawson Treloar



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Scale 1:25000 (A3)

FIGURE A.1.1
BASE CASE - WATER SURFACE LEVELS - SKM ULTIMATE 5 YEAR EVENT (Bris_E08)

Rev: 0 Date: May 2012

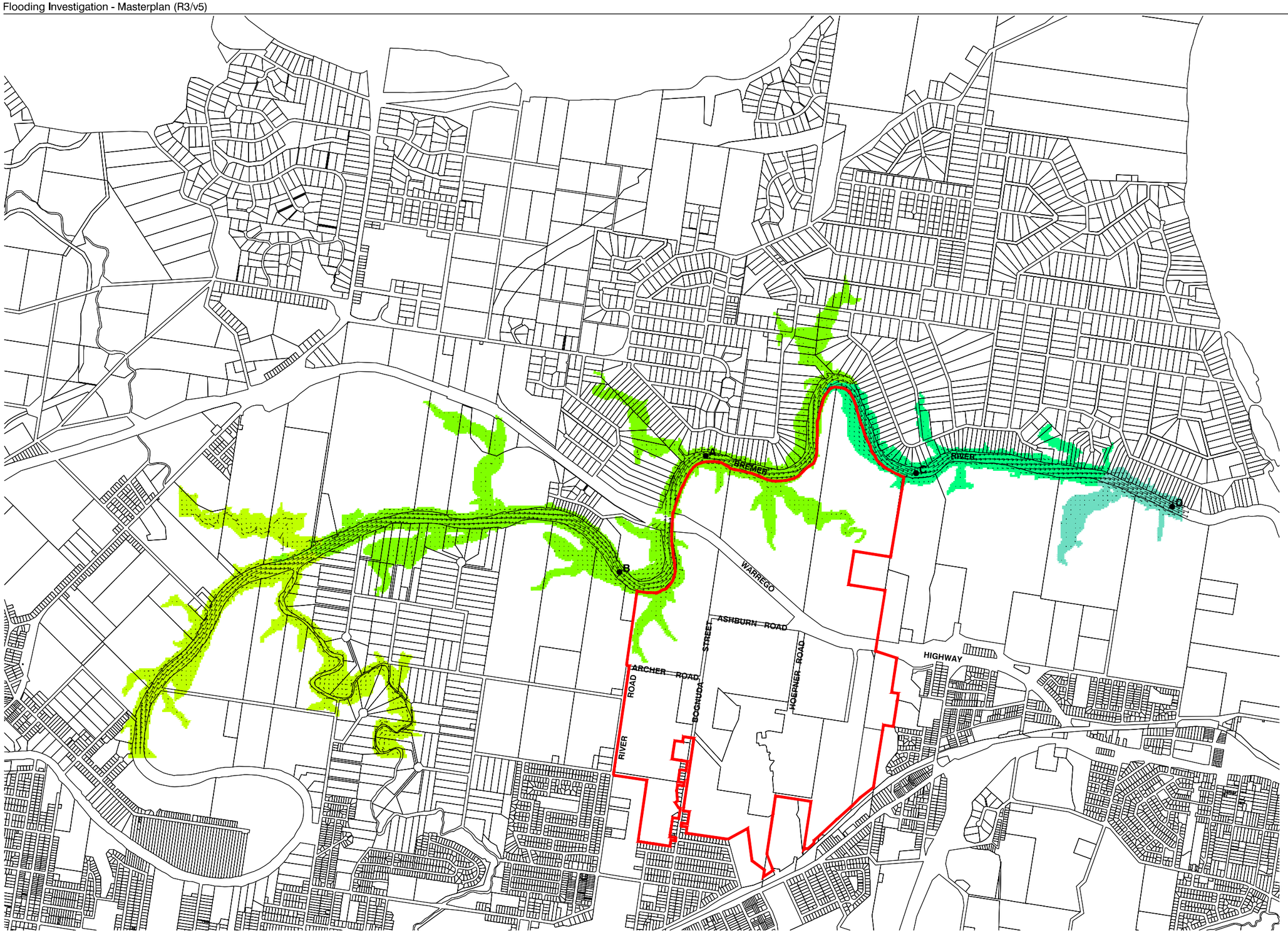
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 4:44pm

Cardno Lawson Treloar



Scale 1:25000 (A3)

FIGURE A.1.2

BASE CASE - WATER SURFACE LEVELS - SKM ULTIMATE 10 YEAR EVENT (Bris_E08)

Rev: 0 Date: May 2012

Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DC08_MGA

PRINT DATE: 11 May, 2012 - 4:44pm

Cardno Lawson Treloar

Scale 1:25000 (A3)

FIGURE A.1.3

BASE CASE - WATER SURFACE LEVELS - SKM ULTIMATE 20 YEAR EVENT (Bris_E08)

Rev: 0 Date: May 2012

Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08_Bris.dwg
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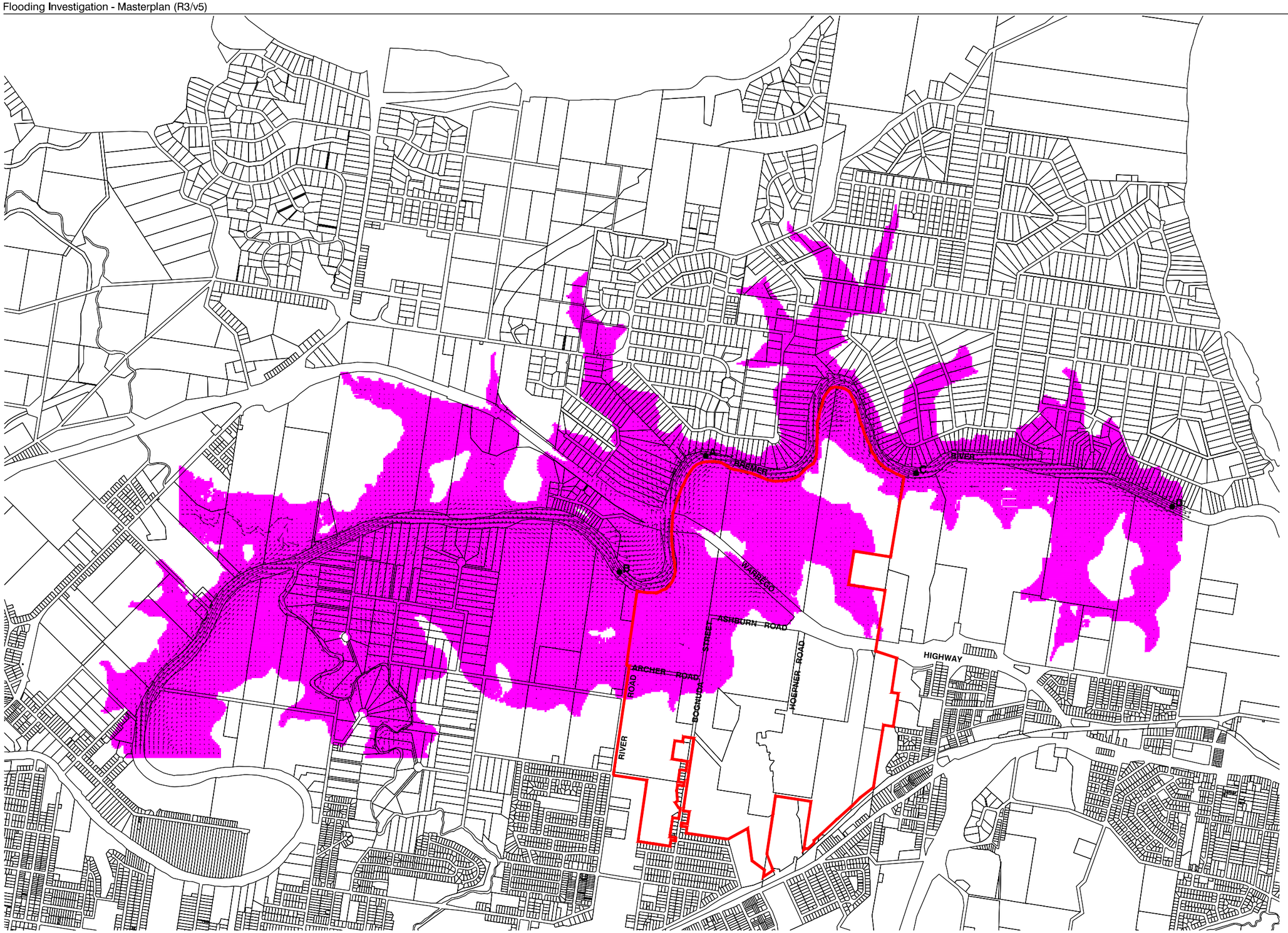
Cardno Lawson Treloar



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Scale 1:25000 (A3)

FIGURE A.1.4

BASE CASE - WATER SURFACE LEVELS - SKM ULTIMATE 50 YEAR EVENT (Bris_E08)

Rev: 0 Date: May 2012

Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08_Bris.dwg
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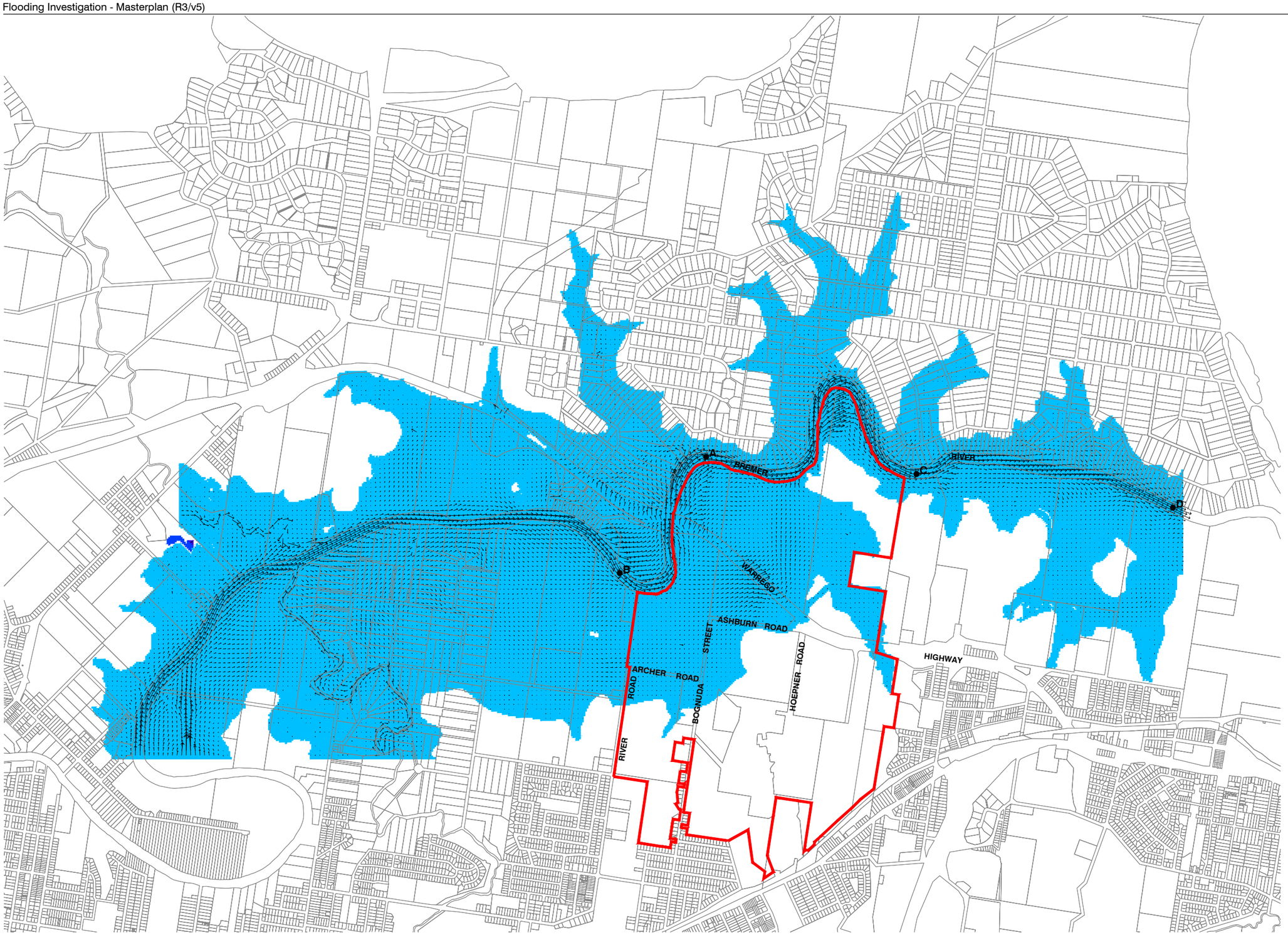

N

LEGEND

Site Boundary

A Reporting Points

VELOCITIES

→ 1m/s

WATER SURFACE LEVEL (mAHD)

- Above 21.00
- 20.75 to 21.00
- 20.50 to 20.75
- 20.25 to 20.50
- 20.00 to 20.25
- 19.75 to 20.00
- 19.50 to 19.75
- 19.25 to 19.50
- 19.00 to 19.25
- 18.75 to 19.00
- 18.50 to 18.75
- 18.25 to 18.50
- 18.00 to 18.25
- Below 18.00

250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE A.1.5

BASE CASE - WATER SURFACE LEVELS - SKM ULTIMATE 100 YEAR EVENT (Bris_E08a)

Rev: 0 Date: May 2012

Project No.: LJ8714

Walker Corporation Pty Ltd

PRINT DATE: 11 May, 2012 - 5:39pm

CAD FILE: O:\LJ8714\Figures\R3v5_Masterplan_Flooding\Appendices\App A\Figure_R3v5_E08a_Bris.dwg
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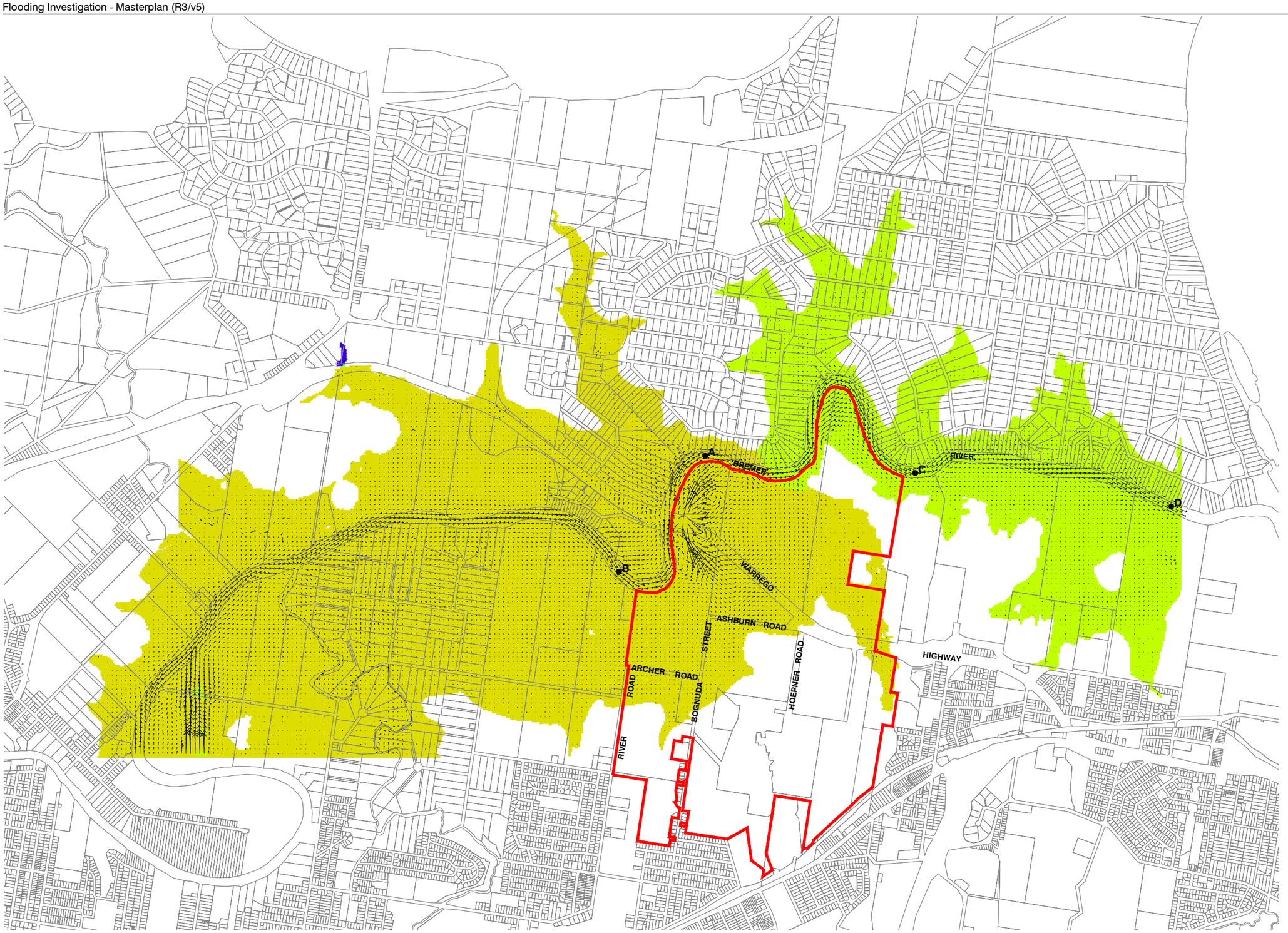
Cardno Lawson Treloar



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Scale 1:25000 (A3)

FIGURE A.1.6

BASE CASE - WATER SURFACE LEVELS - SKM ULTIMATE 200 YEAR EVENT (Bris_E08a)

Rev: 0 Date: May 2012

Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: O:\LJ8714\Figures\R3v5_Masterplan_Flooding\Appendices\App A\Figure_R3v5_E08a_Bris.dwg
XREFs: xref-Results; xr-Inswich_DEDB_M6A

PRINT DATE: 11 May, 2012 - 5:39pm

Cardno Lawson Treloar

N

LEGEND

Site Boundary

A Reporting Points

VELOCITIES

→ 1m/s

WATER SURFACE LEVEL (mAHD)

- Above 21.00
- 20.75 to 21.00
- 20.50 to 20.75
- 20.25 to 20.50
- 20.00 to 20.25
- 19.75 to 20.00
- 19.50 to 19.75
- 19.25 to 19.50
- 19.00 to 19.25
- 18.75 to 19.00
- 18.50 to 18.75
- 18.25 to 18.50
- 18.00 to 18.25
- Below 18.00

250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE A.1.7

BASE CASE - WATER SURFACE LEVELS - SKM ULTIMATE 500 YEAR EVENT (Bris_E08a)

Rev: 0 Date: May 2012

Project No.: LJ8714

Walker Corporation Pty Ltd

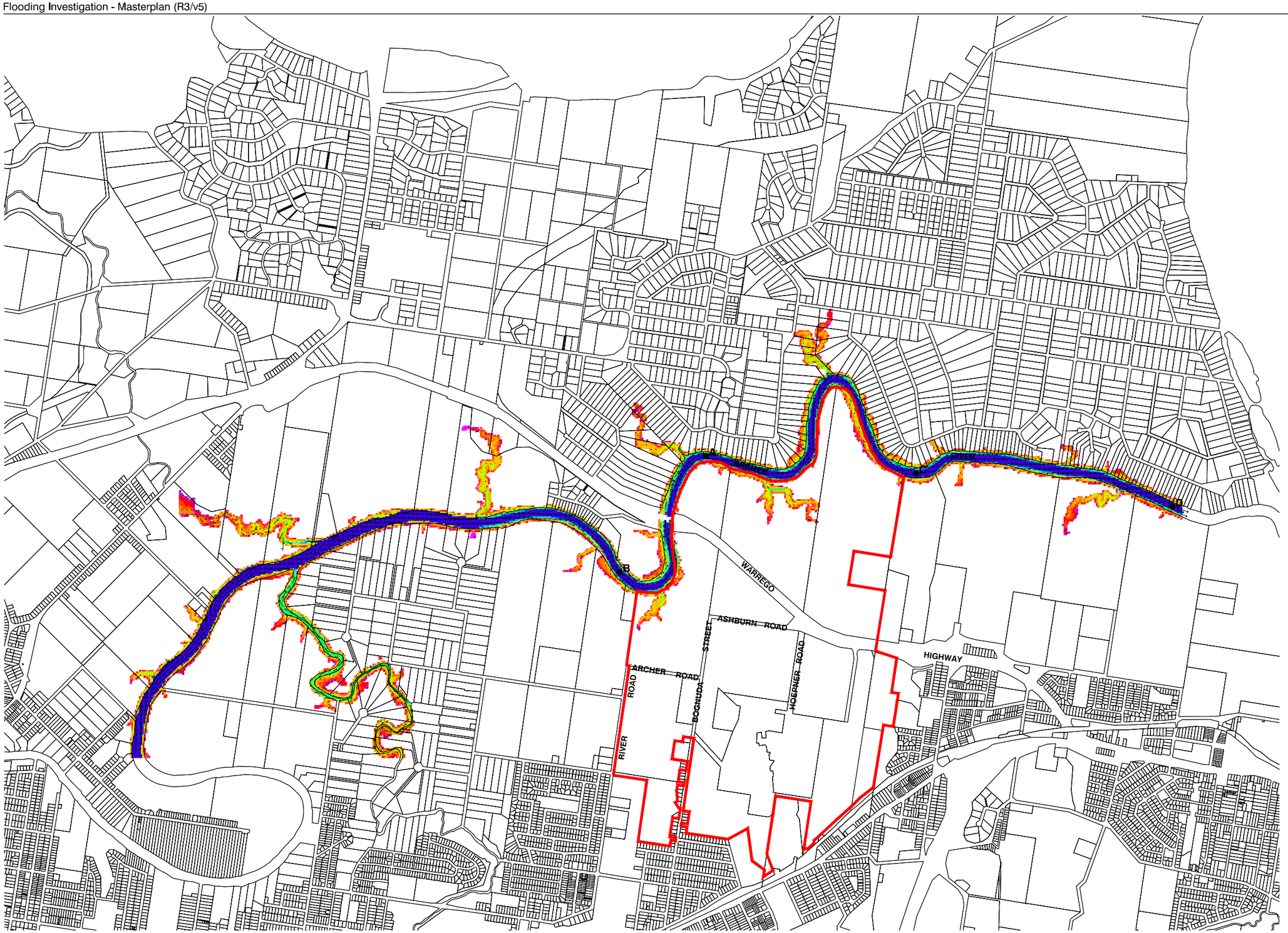
CAD FILE: O:\LJ8714\Figures\R3v5_Masterplan_Flooding\Appendices\App A\Figure_R3v5_E08a_Bris.dwg
XREFs: xref-Results; xr-Ipswich_DEM8_M6A

PRINT DATE: 11 May, 2012 - 5:40pm

Appendix A.2

Brisbane River Flood SOBEK 2D Pre-Developed Base Case Results – Depth

Cardno Lawson Treloar



250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE A.2.1
BASE CASE - DEPTH - SKM ULTIMATE 5 YEAR EVENT (Bris_E08)

Rev: 0 Date: May 2012

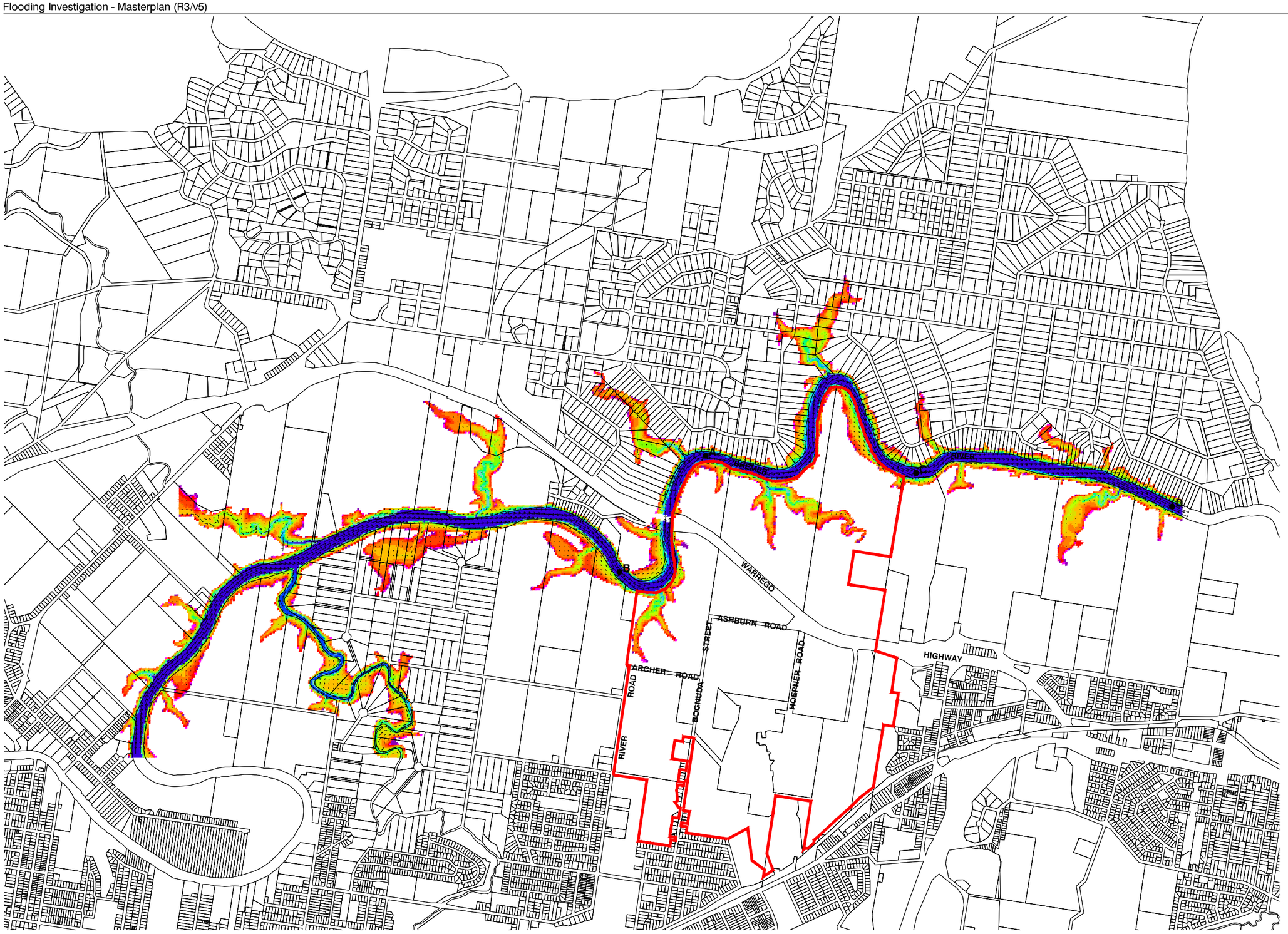
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 4:45pm

Cardno Lawson Treloar



Scale 1:25000 (A3)

FIGURE A.2.2

BASE CASE - DEPTH - SKM ULTIMATE 10 YEAR EVENT (Bris_E08)

Rev: 0 Date: May 2012

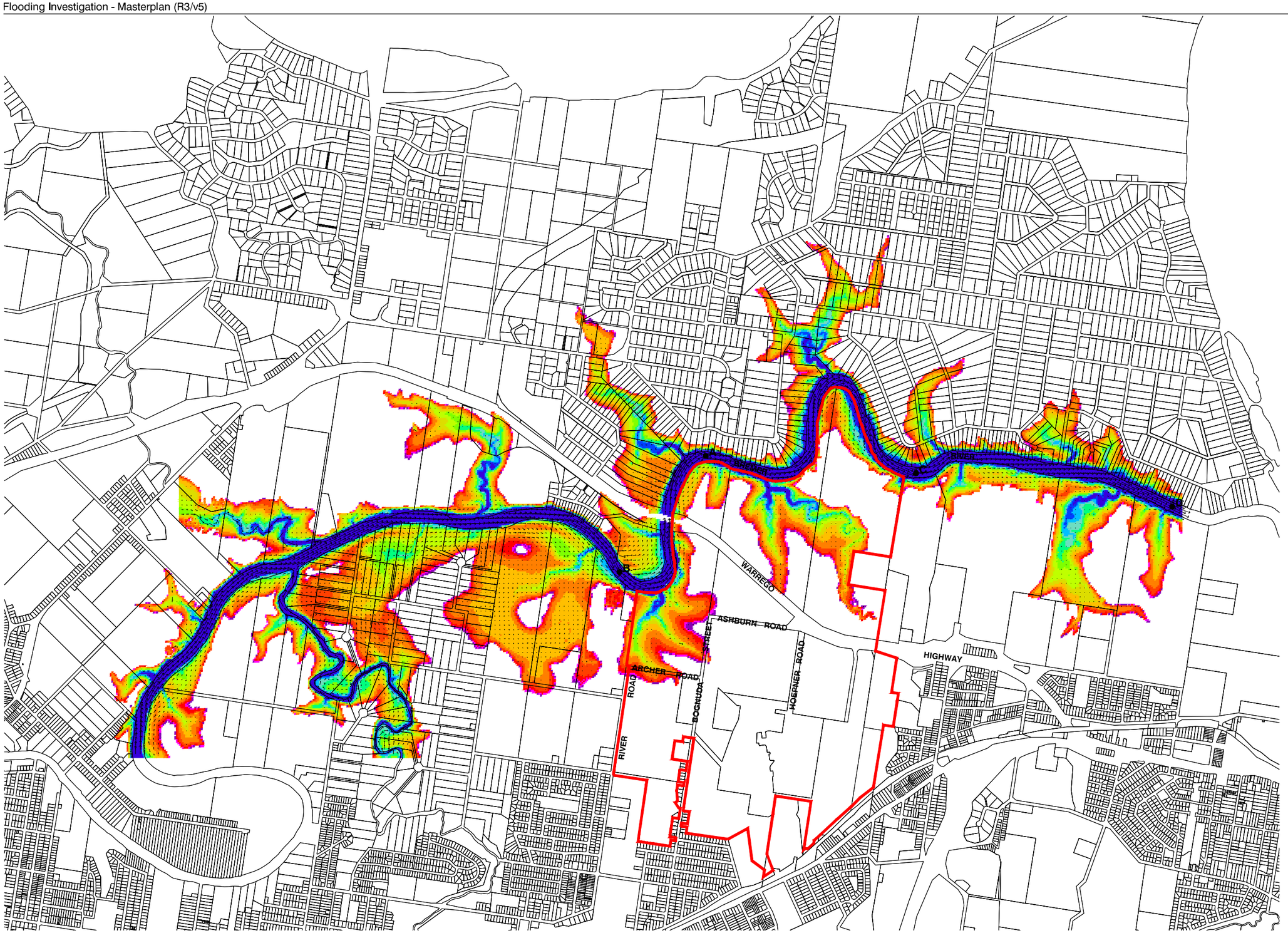
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 4:46pm

Cardno Lawson Treloar



250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE A.2.3

BASE CASE - DEPTH - SKM ULTIMATE 20 YEAR EVENT (Bris_E08)

Rev: 0 Date: May 2012

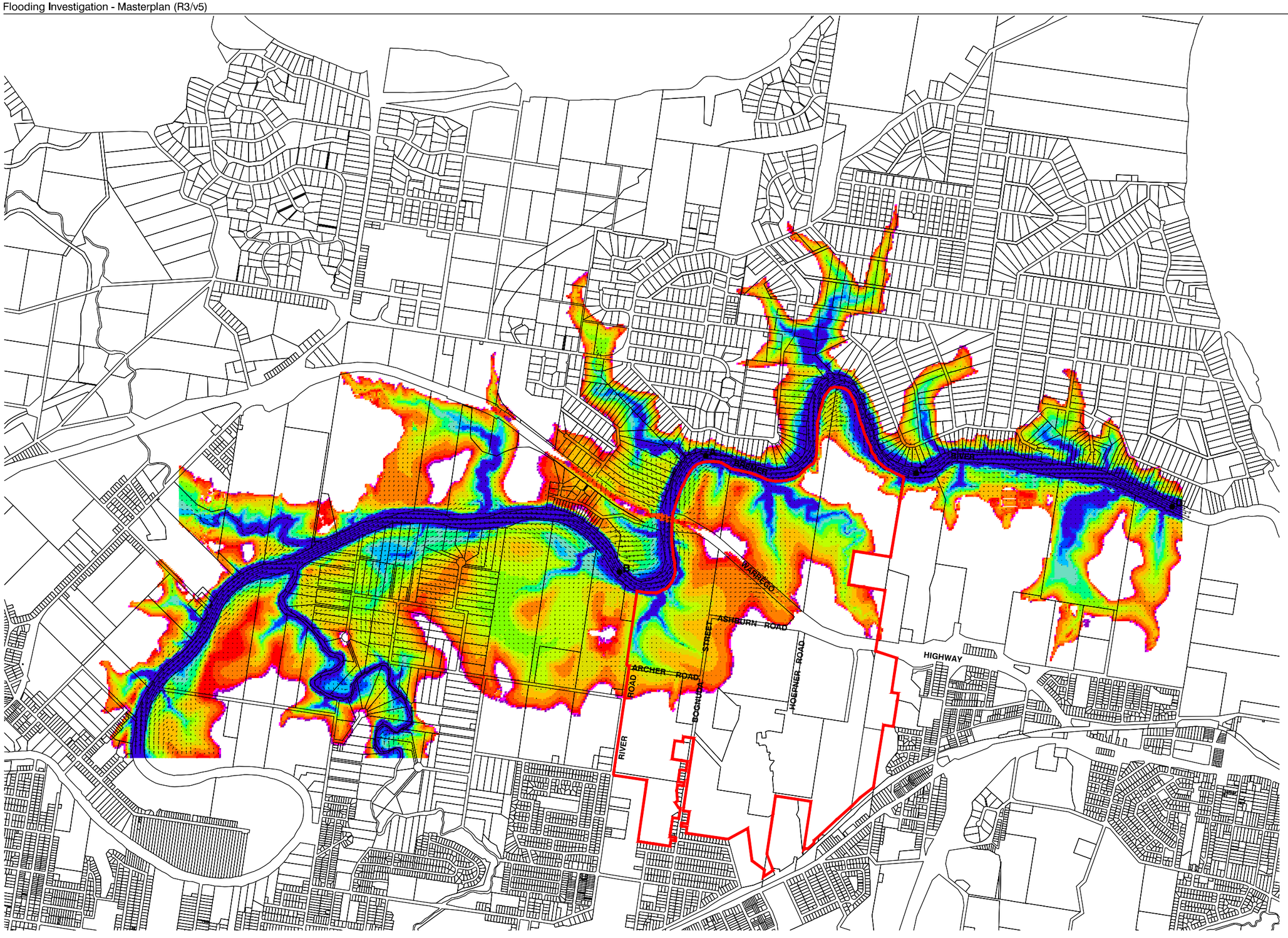
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DEDB_MGA

PRINT DATE: 11 May, 2012 - 4:46pm

Cardno Lawson Treloar



250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE A.2.4

BASE CASE - DEPTH - SKM ULTIMATE 50 YEAR EVENT (Bris_E08)

Rev: 0 Date: May 2012

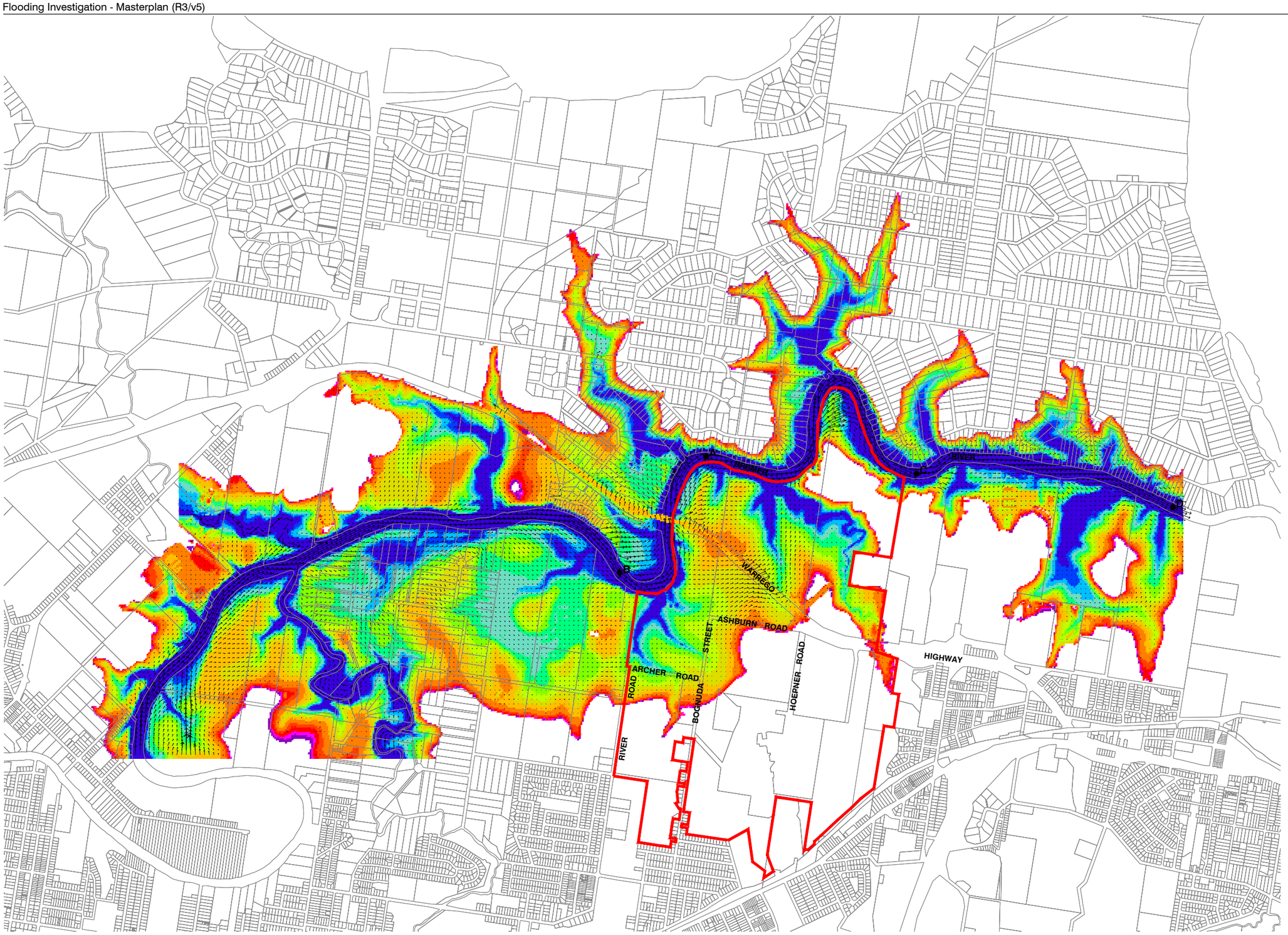
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 4:47pm

Cardno Lawson Treloar



250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE A.2.5

BASE CASE - DEPTH - SKM ULTIMATE 100 YEAR EVENT (Bris_E08a)

Rev: 0 Date: May 2012

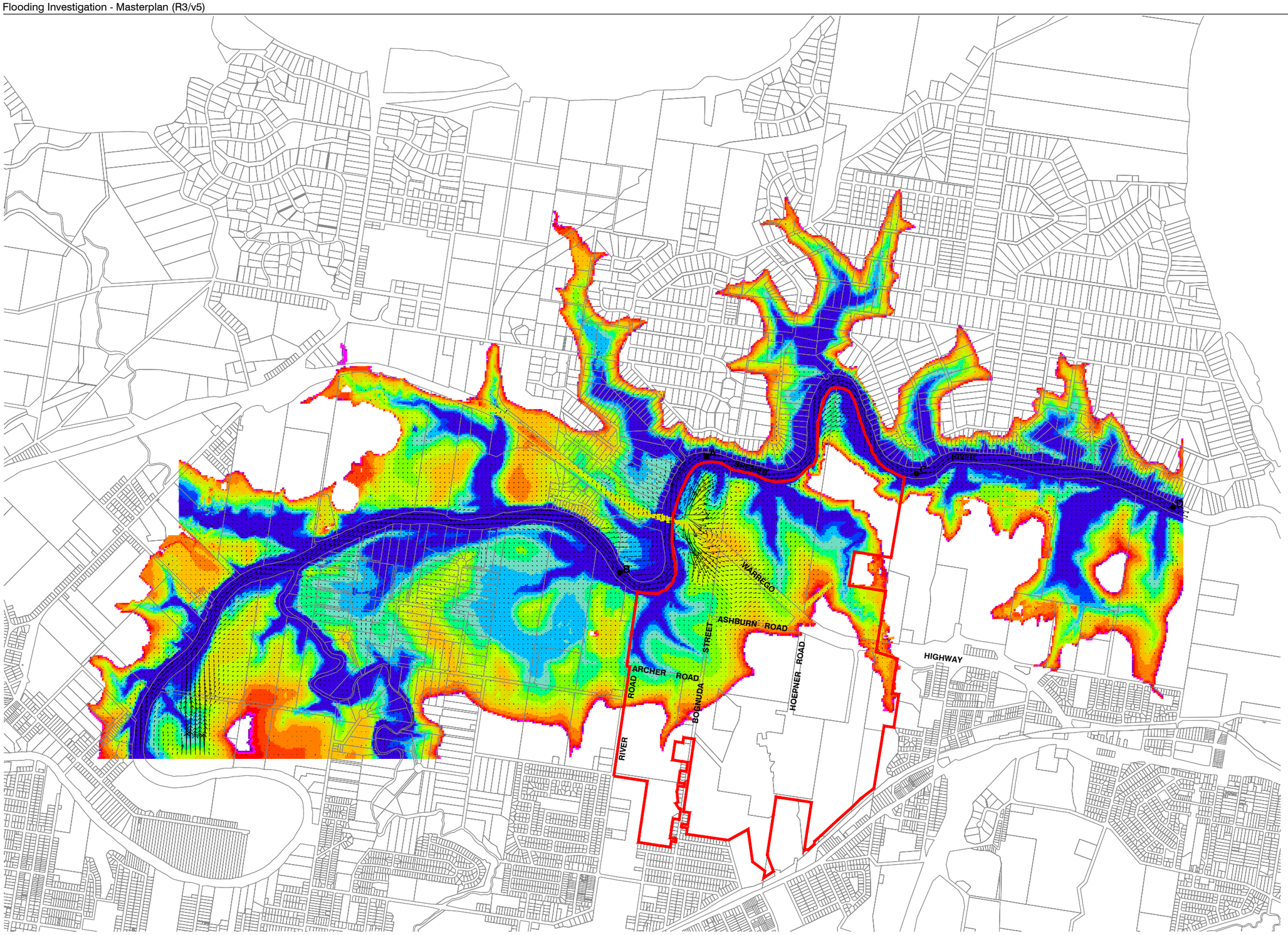
Project No.: LJ8714

PRINT DATE: 11 May, 2012 - 5:41pm

Walker Corporation Pty Ltd

CAD FILE: O:\LJ8714\Figures\R3v5_Masterplan_Flooding\Appendices\App A\Figure_R3v5_E08a_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DEDB_MGA

Cardno Lawson Treloar



250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE A.2.6

BASE CASE - DEPTH - SKM ULTIMATE 200 YEAR EVENT (Bris_E08a)

Rev: 0 Date: May 2012

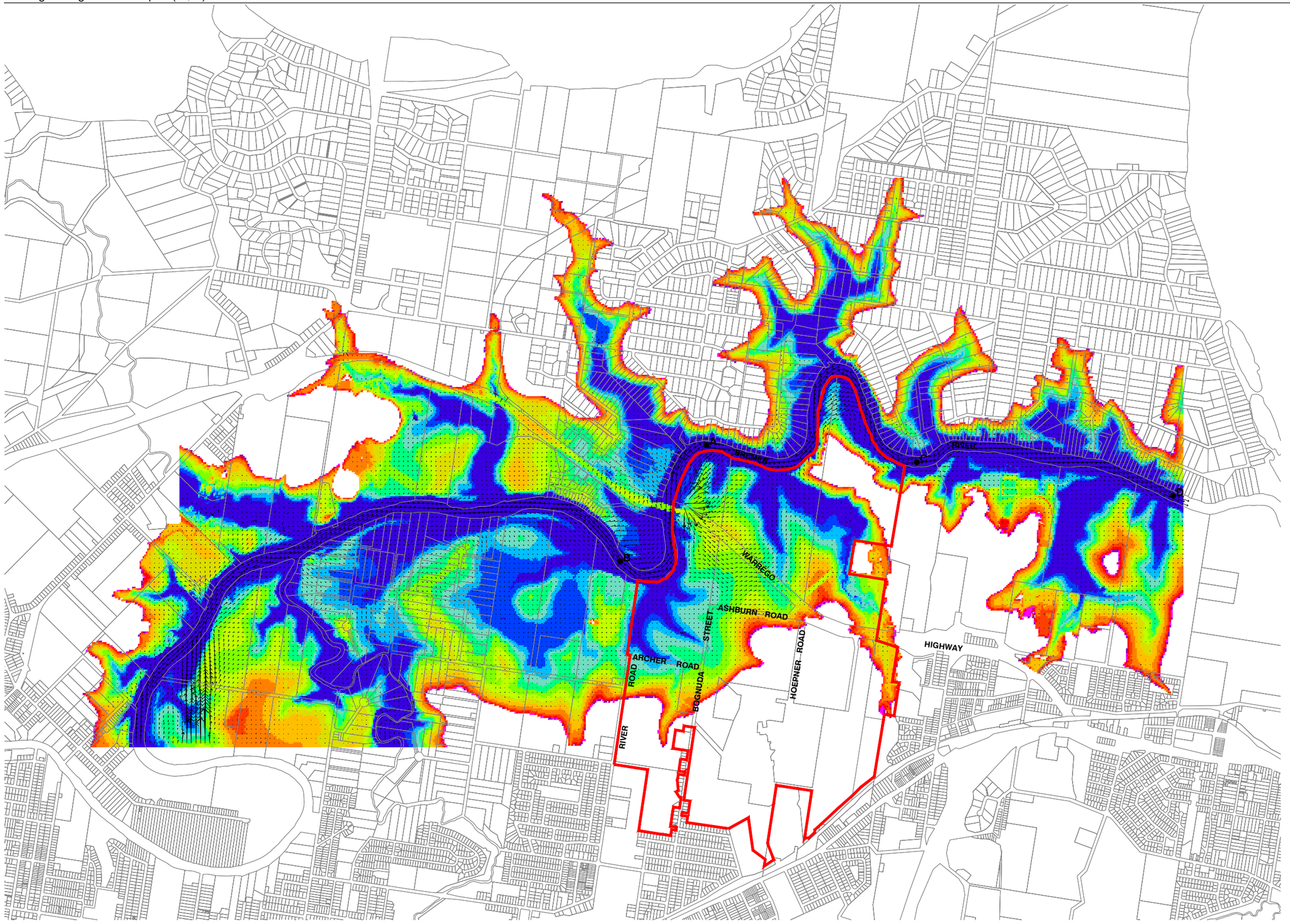
Project No.: LJ8714

PRINT DATE: 11 May, 2012 - 5:41pm

Walker Corporation Pty Ltd

CAD FILE: O:\LJ8714\Figures\R3v5_Masterplan_Flooding\Appendices\App A\Figure_R3v5_E08a_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DEM; xr-Ipswich_MGA

Cardno Lawson Treloar



N

LEGEND

Site Boundary

A Reporting Points

VELOCITIES

→ 1m/s

DEPTH (m)

- Above 10.00
- 9.00 to 10.00
- 8.00 to 9.00
- 7.00 to 8.00
- 6.00 to 7.00
- 5.00 to 6.00
- 4.00 to 5.00
- 3.00 to 4.00
- 2.00 to 3.00
- 1.00 to 2.00
- 0.50 to 1.00
- 0.20 to 0.50
- 0.10 to 0.20
- 0.01 to 0.10

250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE A.2.7

BASE CASE - DEPTH - SKM ULTIMATE 500 YEAR EVENT (Bris_E08a)

Rev: 0 Date: May 2012

Project No.: LJ8714

Walker Corporation Pty Ltd

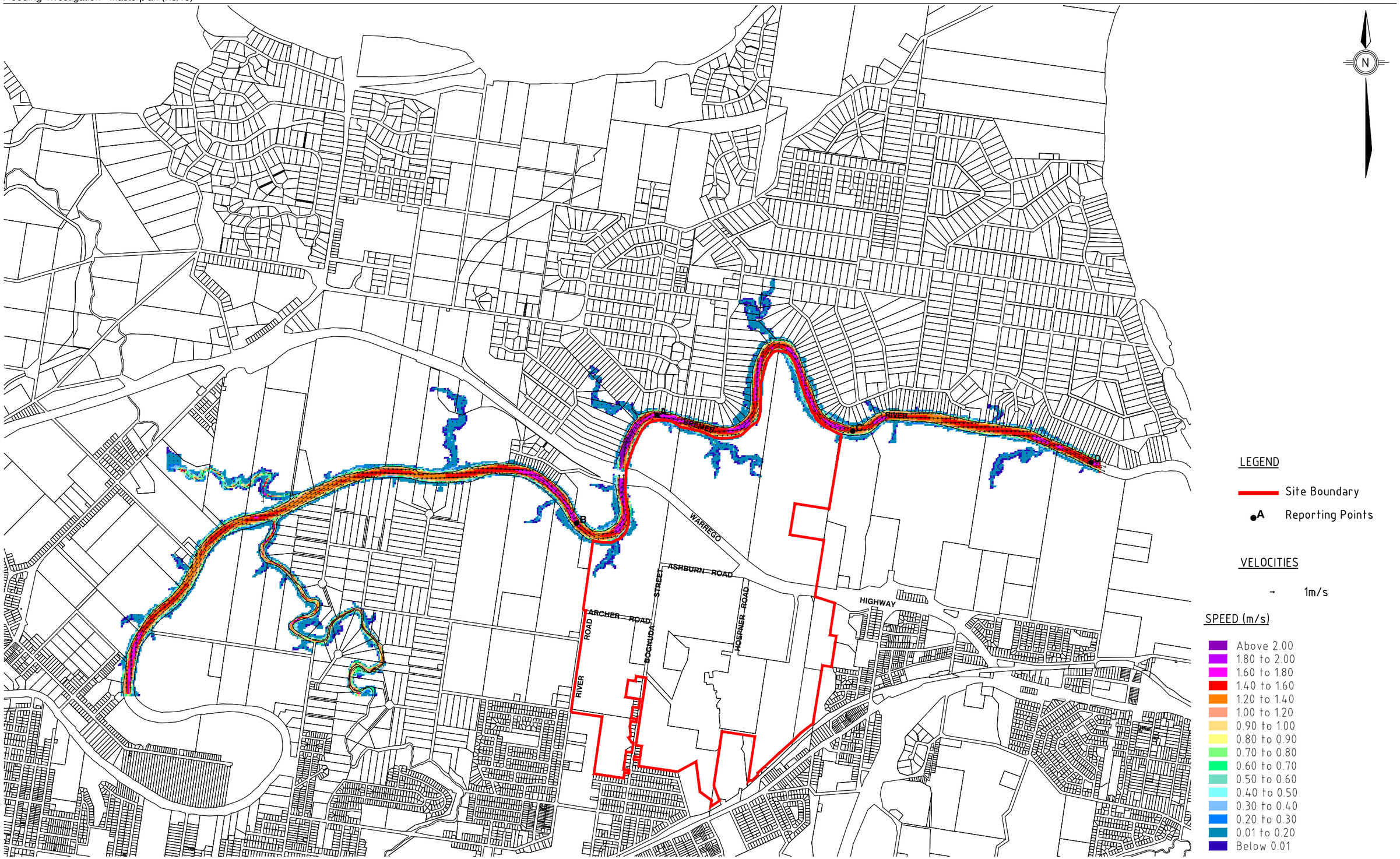
CAD FILE: O:\LJ8714\Figures\R3v5_Masterplan_Flooding\Appendices\App A\Figure_R3v5_E08a_Bris.dwg
XREFS: xref-Results; xr-Ipswich_DEDB_M6A

PRINT DATE: 11 May, 2012 - 5:42pm

Appendix A.3

Brisbane River Flood SOBEK 2D Pre-Developed Base Case Results – Speed

Cardno Lawson Treloar



Scale 1:25000 (A3)

FIGURE A.3.1

BASE CASE - SPEED - SKM ULTIMATE 5 YEAR EVENT (Bris_E08)

Rev: 0 Date: May 2012

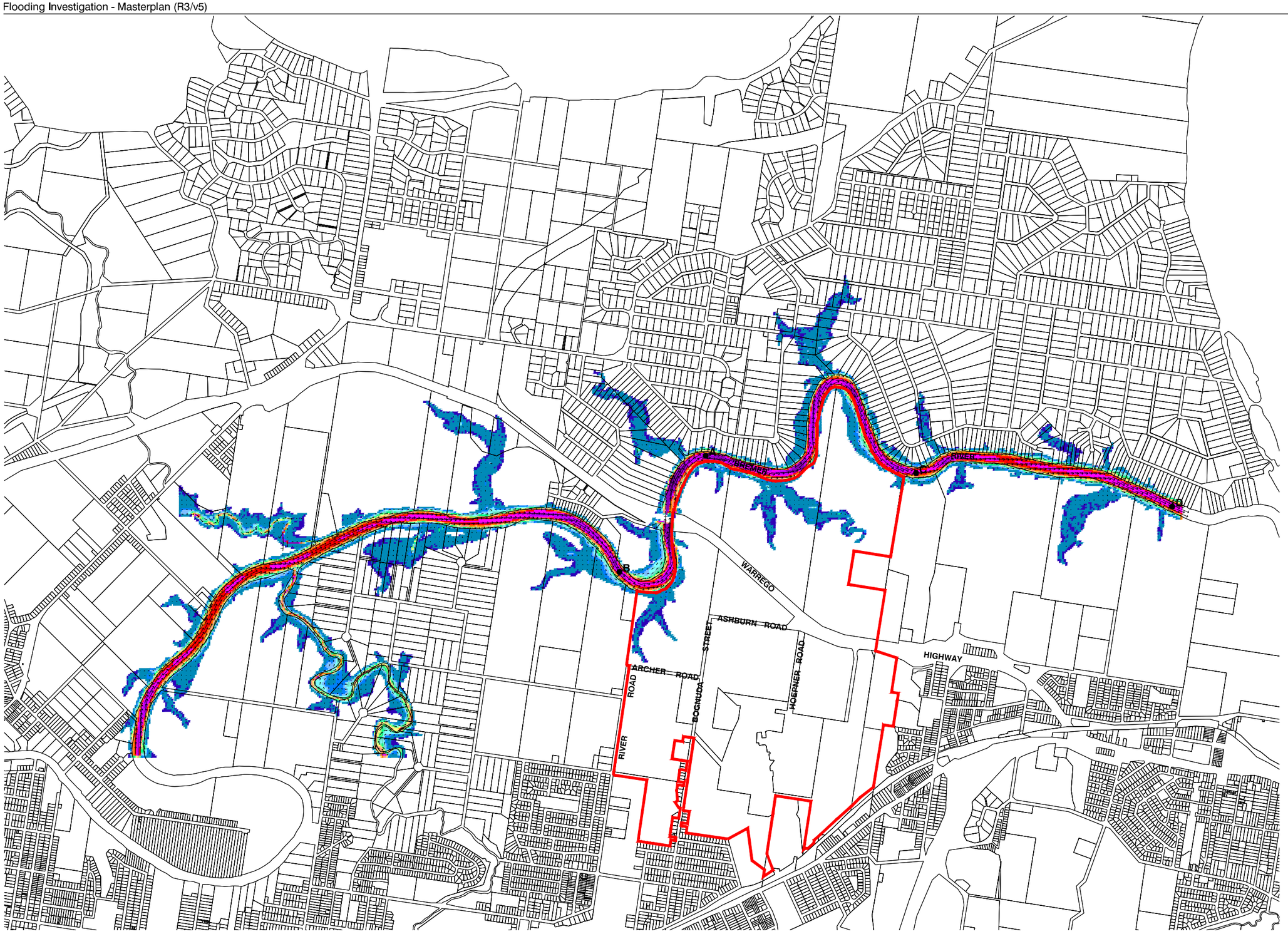
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 4:47pm

Cardno Lawson Treloar



Scale 1:25000 (A3)

FIGURE A.3.2

BASE CASE - SPEED - SKM ULTIMATE 10 YEAR EVENT (Bris_E08)

Rev: 0 Date: May 2012

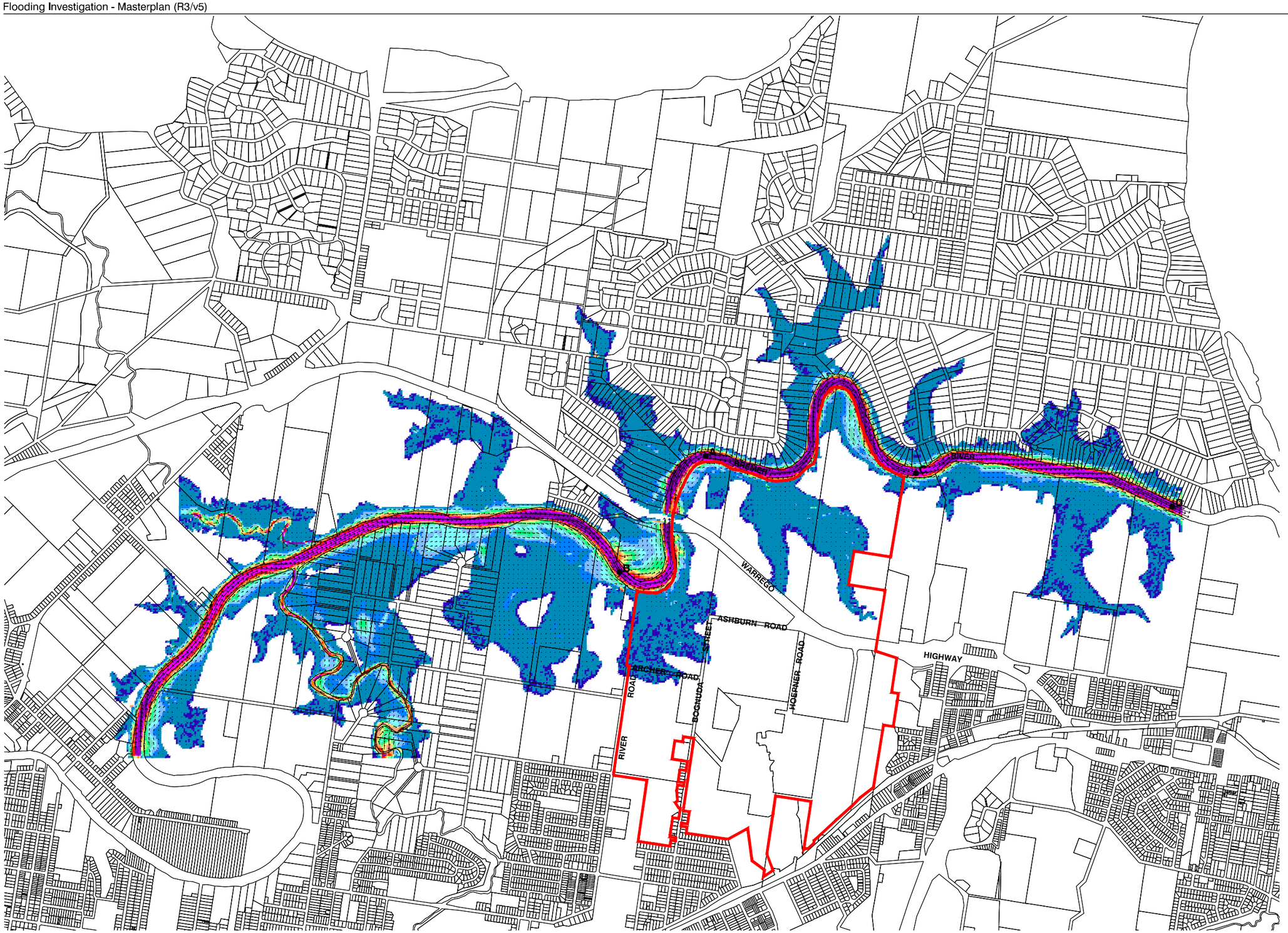
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 4:47pm

Cardno Lawson Treloar



250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE A.3.3

BASE CASE - SPEED - SKM ULTIMATE 20 YEAR EVENT (Bris_E08)

Rev: 0 Date: May 2012

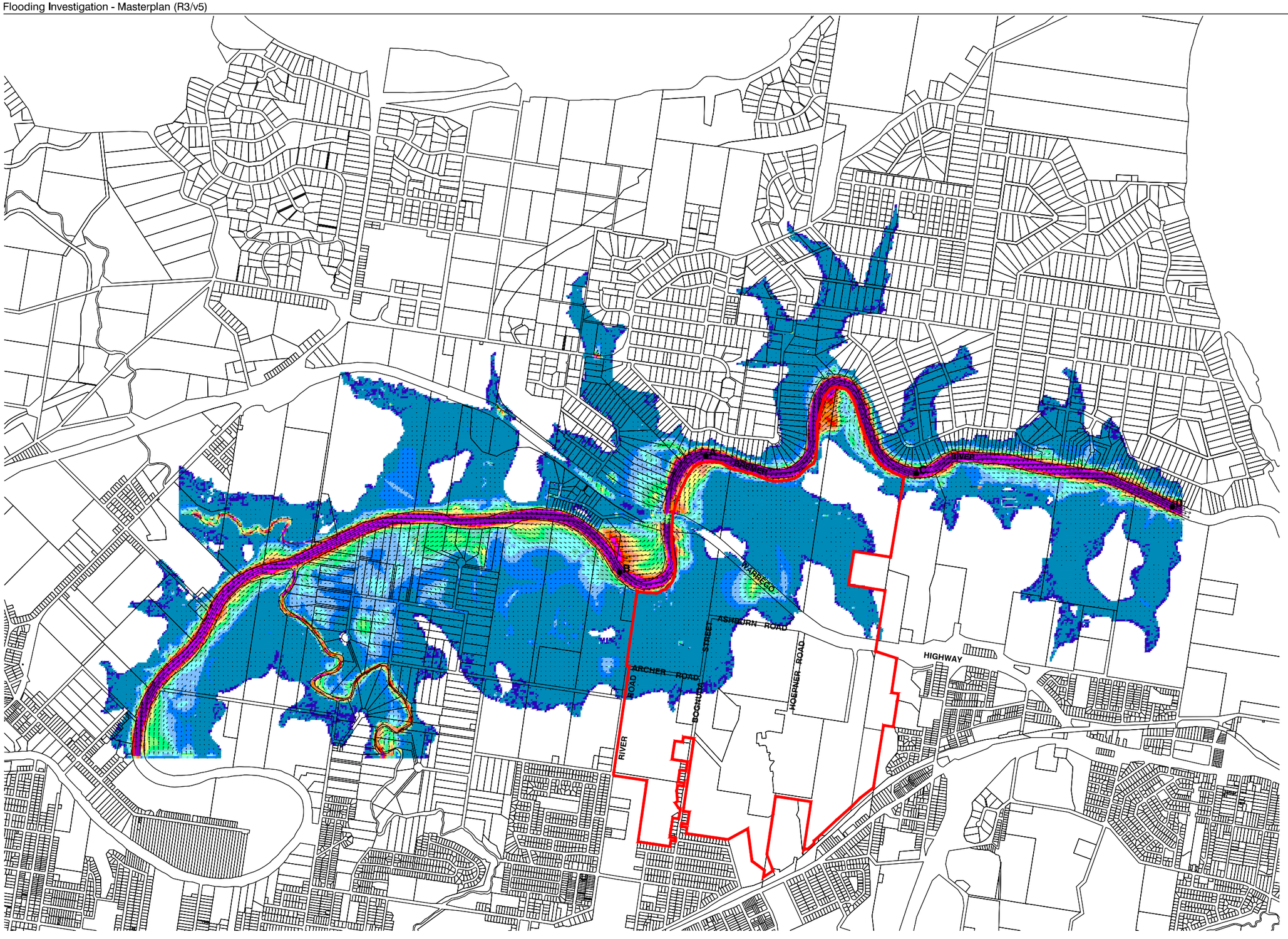
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 4:48pm

Cardno Lawson Treloar



250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE A.3.4

BASE CASE - SPEED - SKM ULTIMATE 50 YEAR EVENT (Bris_E08)

Rev: 0 Date: May 2012

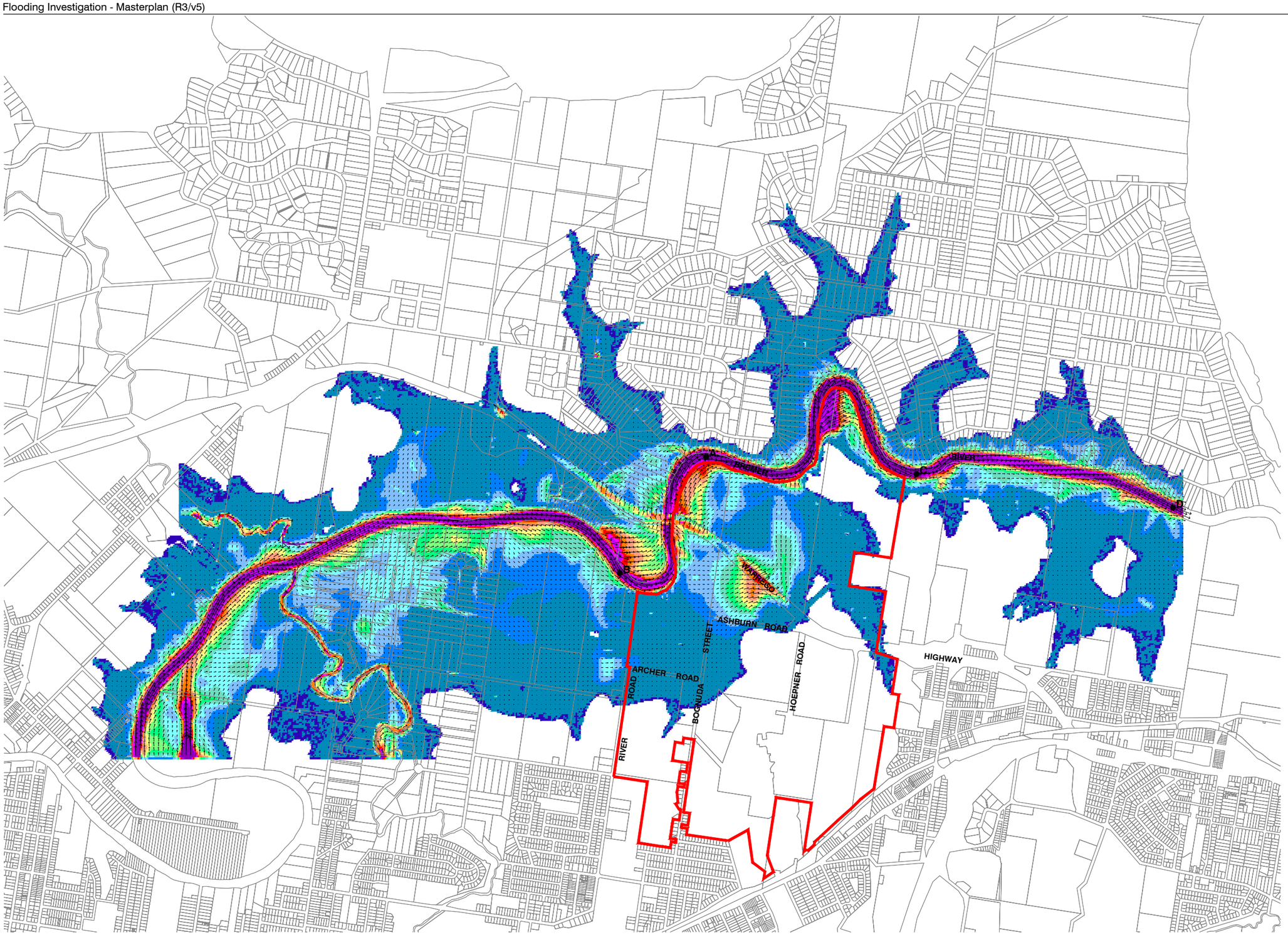
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 4:48pm

Cardno Lawson Treloar



250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE A.3.5

BASE CASE - SPEED - SKM ULTIMATE 100 YEAR EVENT (Bris_E08a)

Rev: 0 Date: May 2012

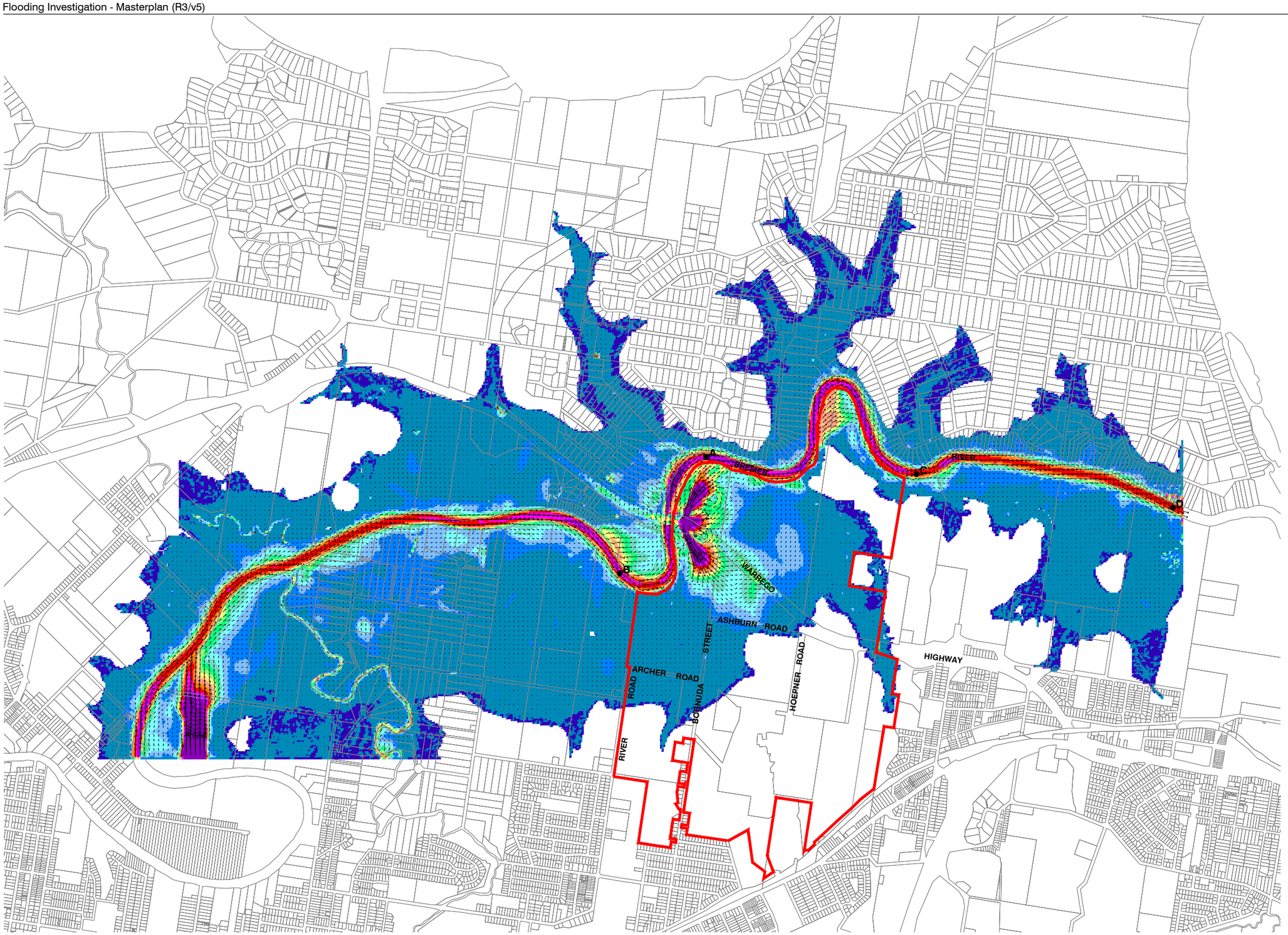
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: O:\LJ8714\Figures\R3v5_Masterplan_Flooding\Appendices\App A\Figure_R3v5_E08a_Bris.dwg
XREFs: xref-Results; xr-Ipswich_DEOB_M6A

PRINT DATE: 11 May, 2012 - 5:43pm

Cardno Lawson Treloar



250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE A.3.6

BASE CASE - SPEED - SKM ULTIMATE 200 YEAR EVENT (Bris_E08a)

Rev: 0 Date: May 2012

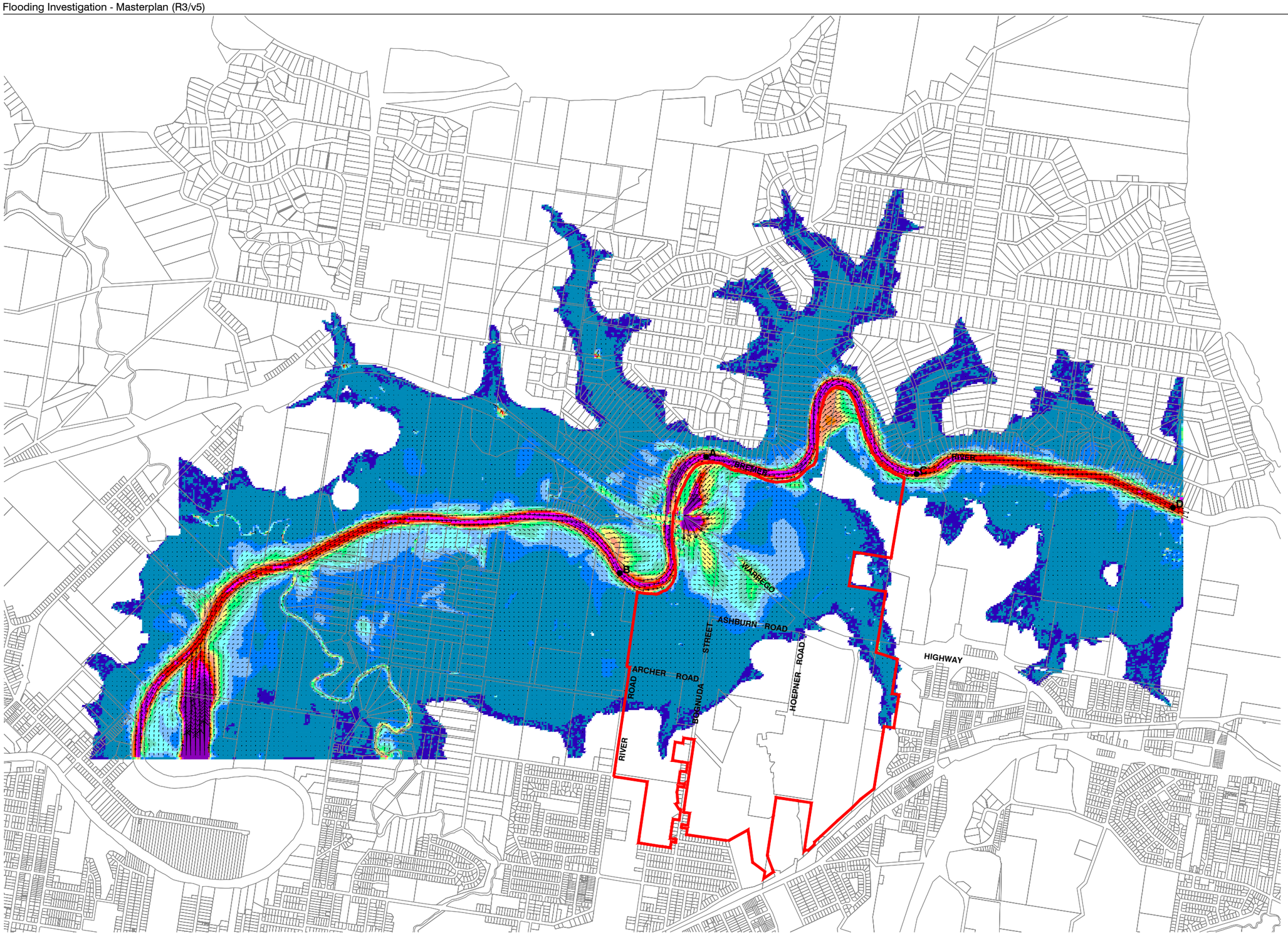
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: O:\LJ8714\Figures\R3v5_Masterplan_Flooding\Appendices\App A\Figure_R3v5_E08a_Bris.dwg
XREFs: xref-Results; xr-Inswich_DEM8_M6A

PRINT DATE: 11 May, 2012 - 5:43pm

Cardno Lawson Treloar



250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE A.3.7

BASE CASE - SPEED - SKM ULTIMATE 500 YEAR EVENT (Bris_E08a)

Rev: 0 Date: May 2012

Project No.: LJ8714

Walker Corporation Pty Ltd

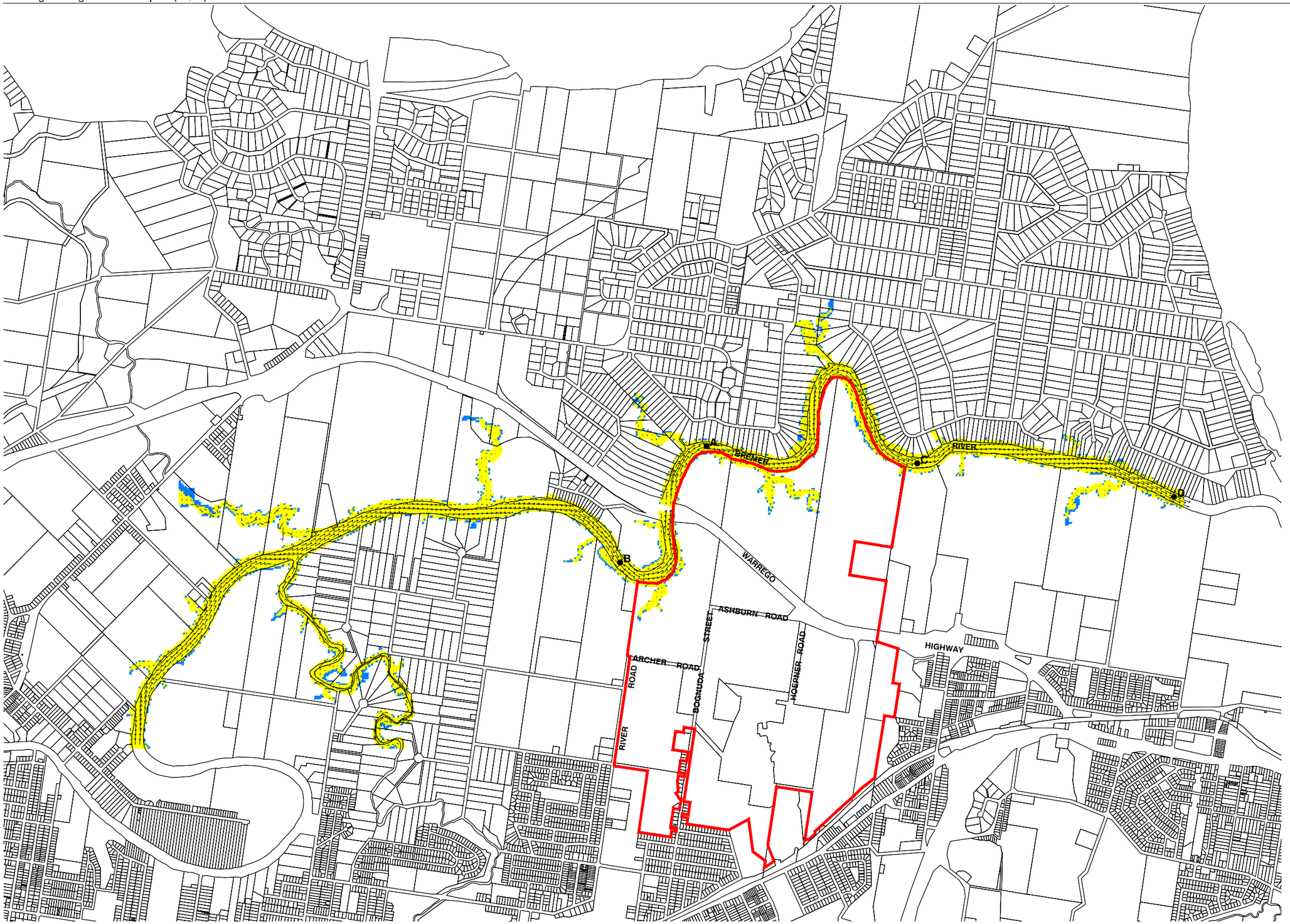
CAD FILE: O:\LJ8714\Figures\R3v5_Masterplan_Flooding\Appendices\App A\Figure_R3v5_E08a_Bris.dwg
XREFs: xref-Results; xr-Inswich_DEM8_M6A

PRINT DATE: 11 May, 2012 - 5:44pm

Appendix A.4

Brisbane River Flood SOBEK 2D Pre-Developed Base Case Results – Hazard (Safety Product)

Cardno Lawson Treloar



Scale 1:25000 (A3)

FIGURE A.4.1

BASE CASE - HAZARD (SAFETY PRODUCT) - SKM ULTIMATE 5 YEAR EVENT (Bris_E08)

Rev: 0 Date: May 2012

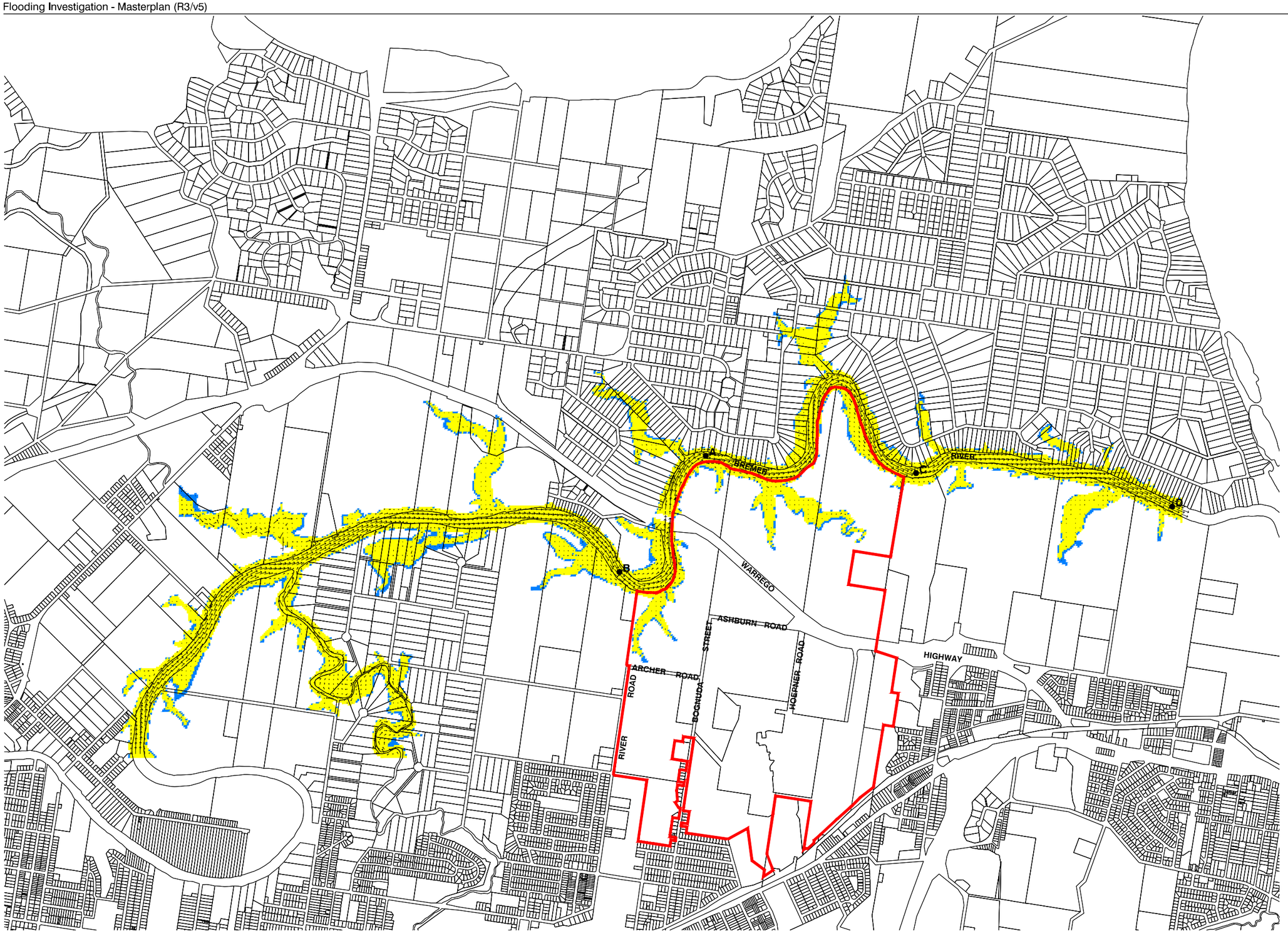
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 4:49pm

Cardno Lawson Treloar



Scale 1:25000 (A3)

FIGURE A.4.2

BASE CASE - HAZARD (SAFETY PRODUCT) - SKM ULTIMATE 10 YEAR EVENT (Bris_E08)

Rev: 0 Date: May 2012

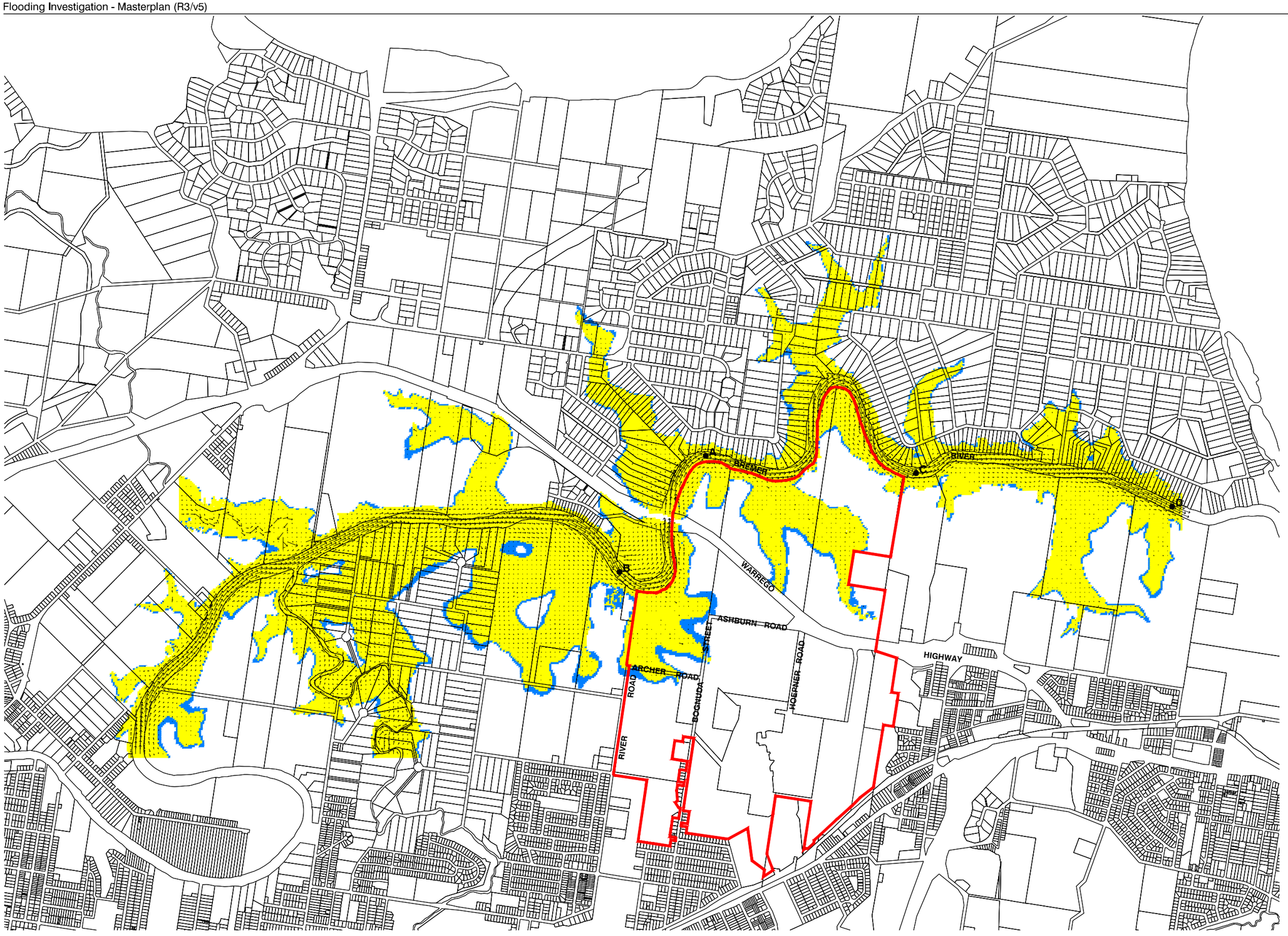
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 4:49pm

Cardno Lawson Treloar



Scale 1:25000 (A3)

FIGURE A.4.3

BASE CASE - HAZARD (SAFETY PRODUCT) - SKM ULTIMATE 20 YEAR EVENT (Bris_E08)

Rev: 0 Date: May 2012

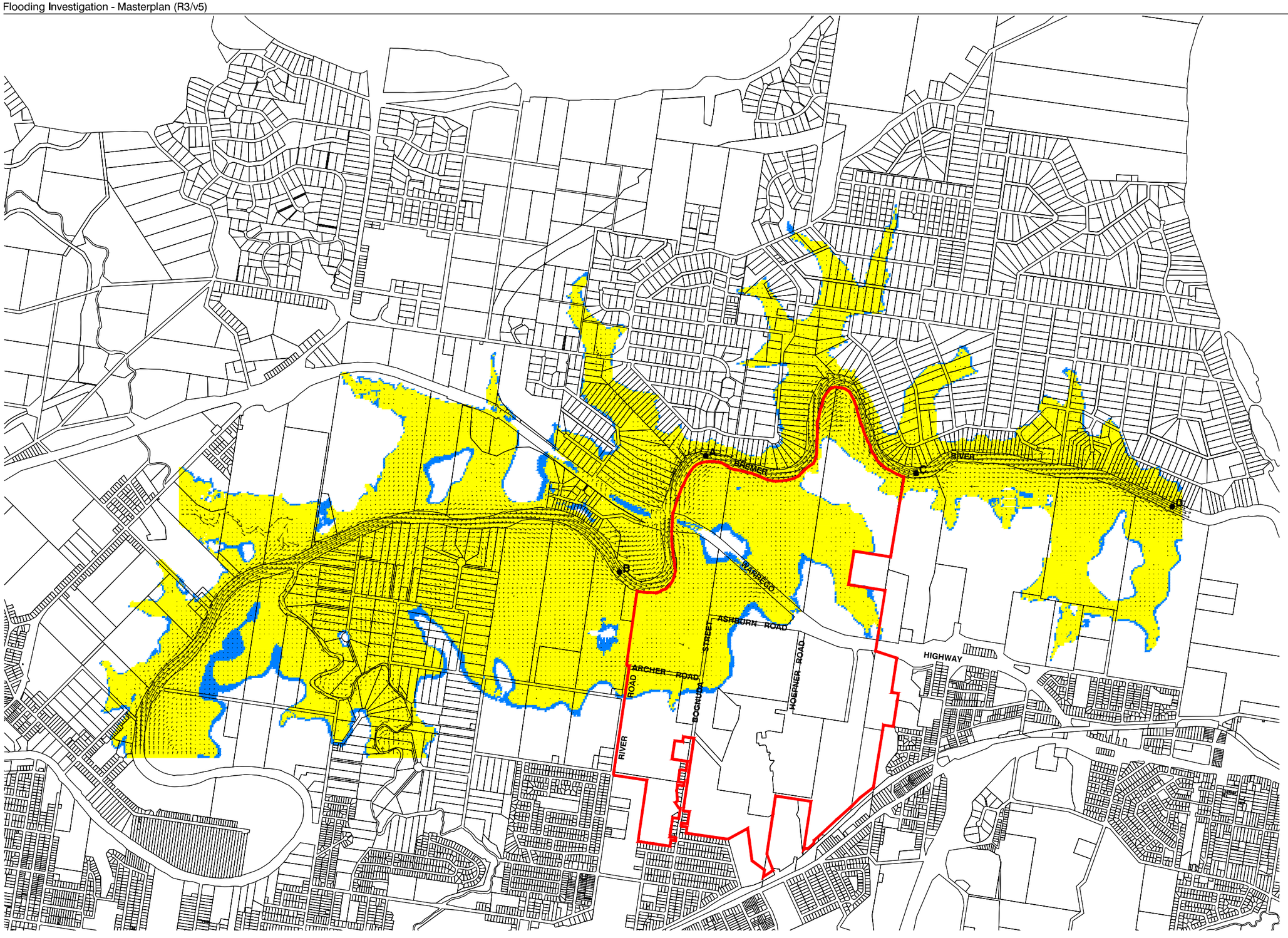
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 4:49pm

Cardno Lawson Treloar



Scale 1:25000 (A3)

FIGURE A.4.4

BASE CASE - HAZARD (SAFETY PRODUCT) - SKM ULTIMATE 50 YEAR EVENT (Bris_E08)

Rev: 0 Date: May 2012

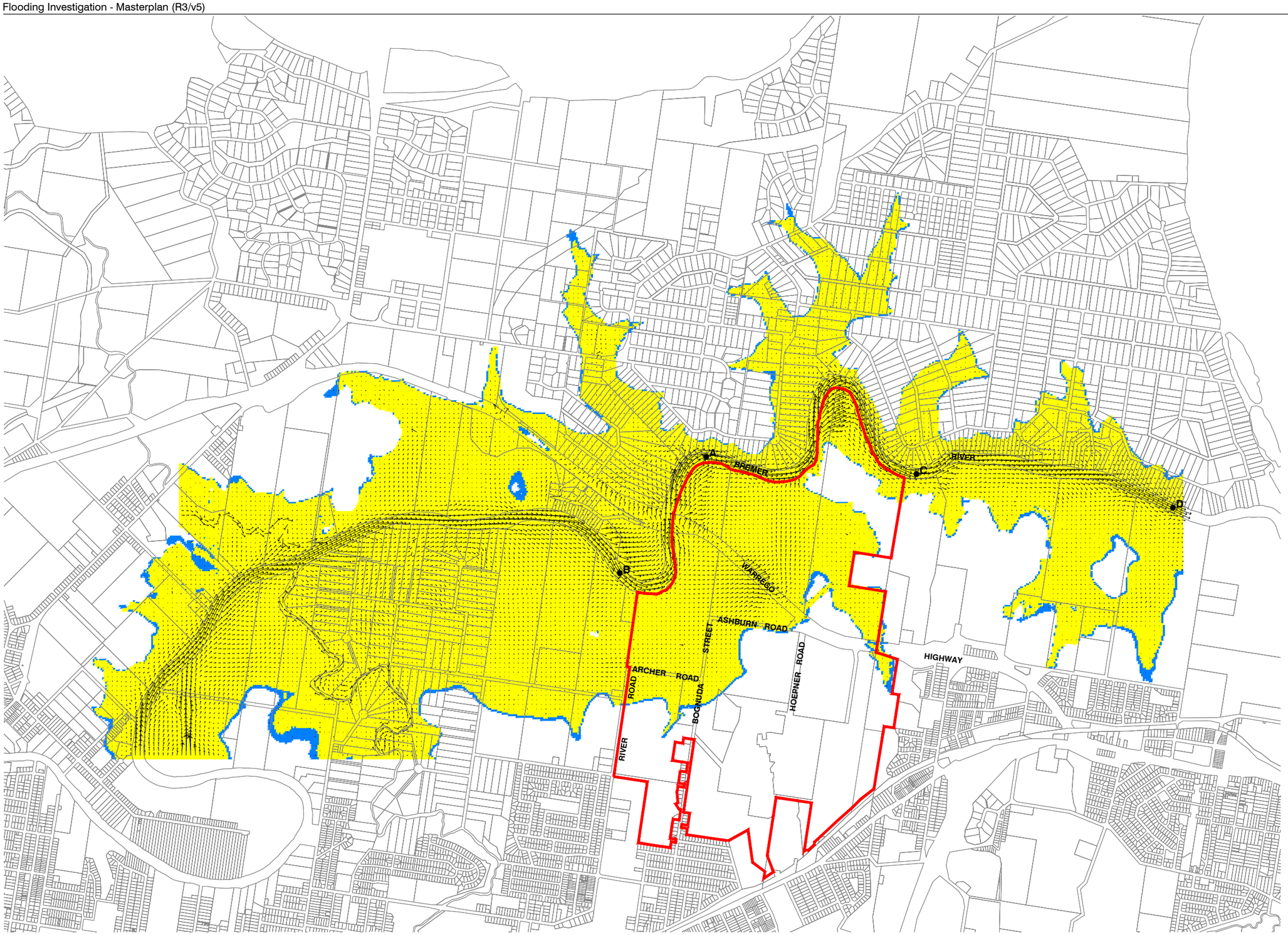
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 4:50pm

Cardno Lawson Treloar



Scale 1:25000 (A3)

FIGURE A.4.5

BASE CASE - HAZARD (SAFETY PRODUCT) - SKM ULTIMATE 100 YEAR EVENT (Bris_E08a)

Rev: 0 Date: May 2012

Project No.: LJ8714

Walker Corporation Pty Ltd

PRINT DATE: 11 May, 2012 - 5:45pm

CAD FILE: O:\LJ8714\Figures\R3v5_Masterplan_Flooding\Appendices\App A\Figure_R3v5_E08a_Bris.dwg
XREFs: xref-Results; xr-Ipswich_QCDB_MGA

Cardno Lawson Treloar

Scale 1:25000 (A3)

FIGURE A.4.6

BASE CASE - HAZARD (SAFETY PRODUCT) - SKM ULTIMATE 200 YEAR EVENT (Bris_E08a)

Rev: 0 Date: May 2012

Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: O:\LJ8714\Figures\R3v5_Masterplan_Flooding\Appendices\App A\Figure_R3v5_E08a_Bris.dwg
XREFs: xref-Results; xr-Inswich_DEDB_M6A

PRINT DATE: 11 May, 2012 - 5:45pm

Cardno Lawson Treloar

Scale 1:25000 (A3)

FIGURE A.4.7

BASE CASE - HAZARD (SAFETY PRODUCT) - SKM ULTIMATE 500 YEAR EVENT (Bris_E08a)

Rev: 0 Date: May 2012

Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: O:\LJ8714\Figures\R3v5_Masterplan_Flooding\Appendices\App A\Figure_R3v5_E08a_Bris.dwg
XREFs: xref-Results; xr-Inswich_DEDB_M6A

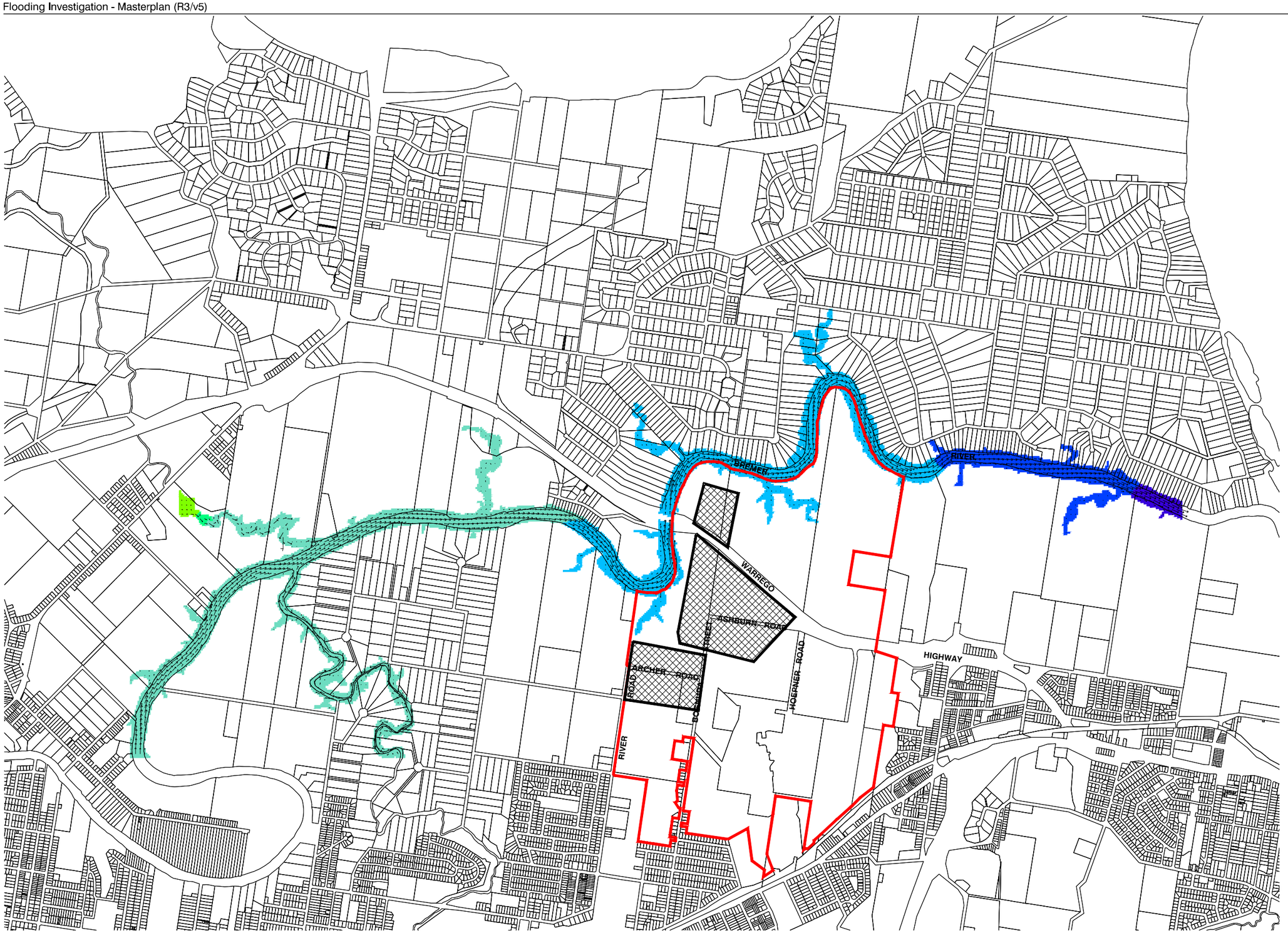
PRINT DATE: 11 May, 2012 - 5:46pm

Appendix B.1

Brisbane River Flood SOBEK 2D Existing Current Case

Results – Water Surface Level

Cardno Lawson Treloar



250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE B.1.1

EXISTING CURRENT - WATER SURFACE LEVELS - SKM ULTIMATE 5 YEAR EVENT (Bris_E08c)

Rev: 0 Date: May 2012

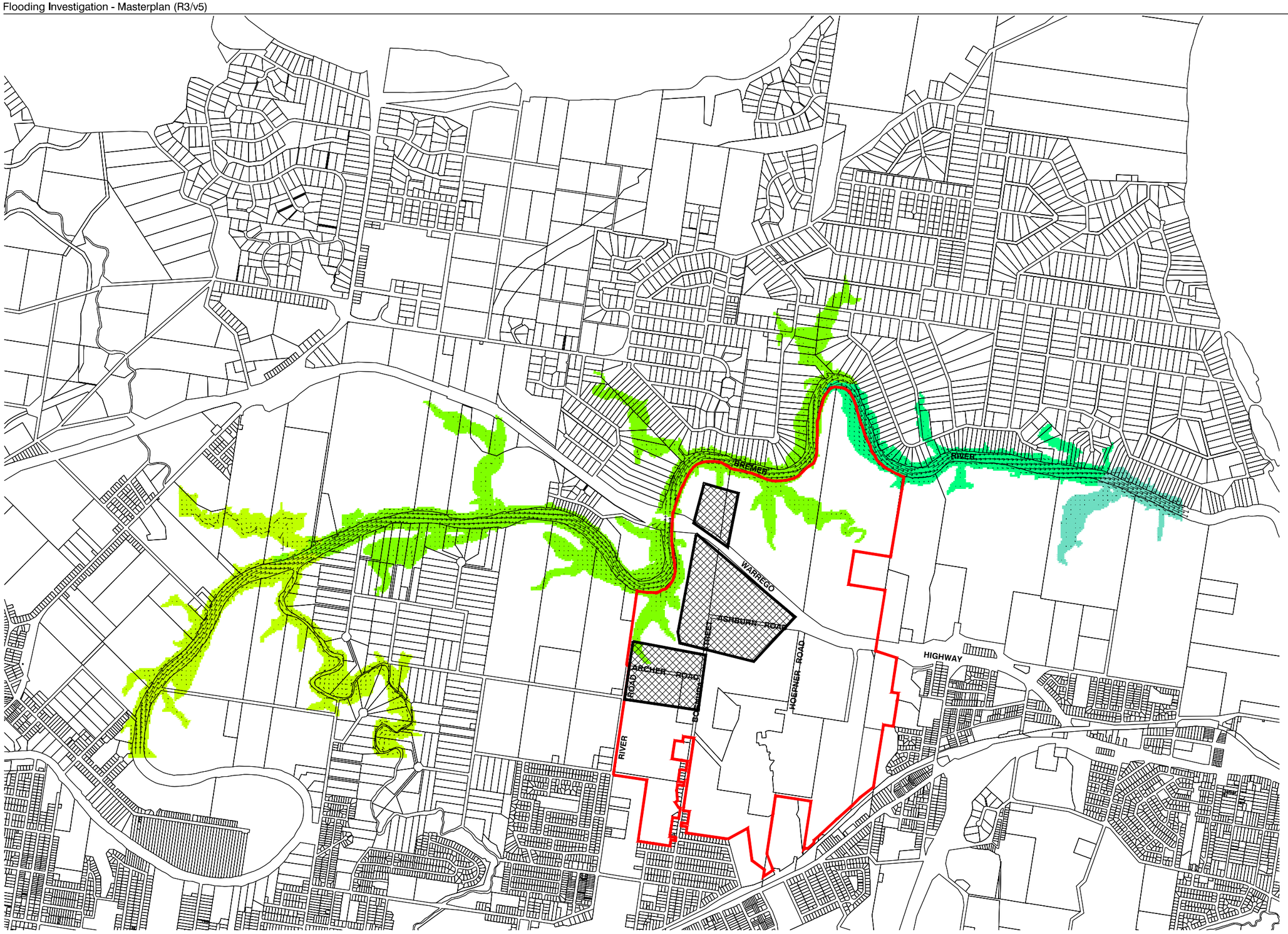
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08c_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 2:38pm

Cardno Lawson Treloar



Scale 1:25000 (A3)

FIGURE B.1.2

EXISTING CURRENT - WATER SURFACE LEVELS - SKM ULTIMATE 10 YEAR EVENT (Bris_E08c)

Rev: 0 Date: May 2012

Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08c_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 2:39pm

Cardno Lawson Treloar

Scale 1:25000 (A3)

FIGURE B.1.3

EXISTING CURRENT - WATER SURFACE LEVELS - SKM ULTIMATE 20 YEAR EVENT (Bris_E08c)

Rev: 0 Date: May 2012

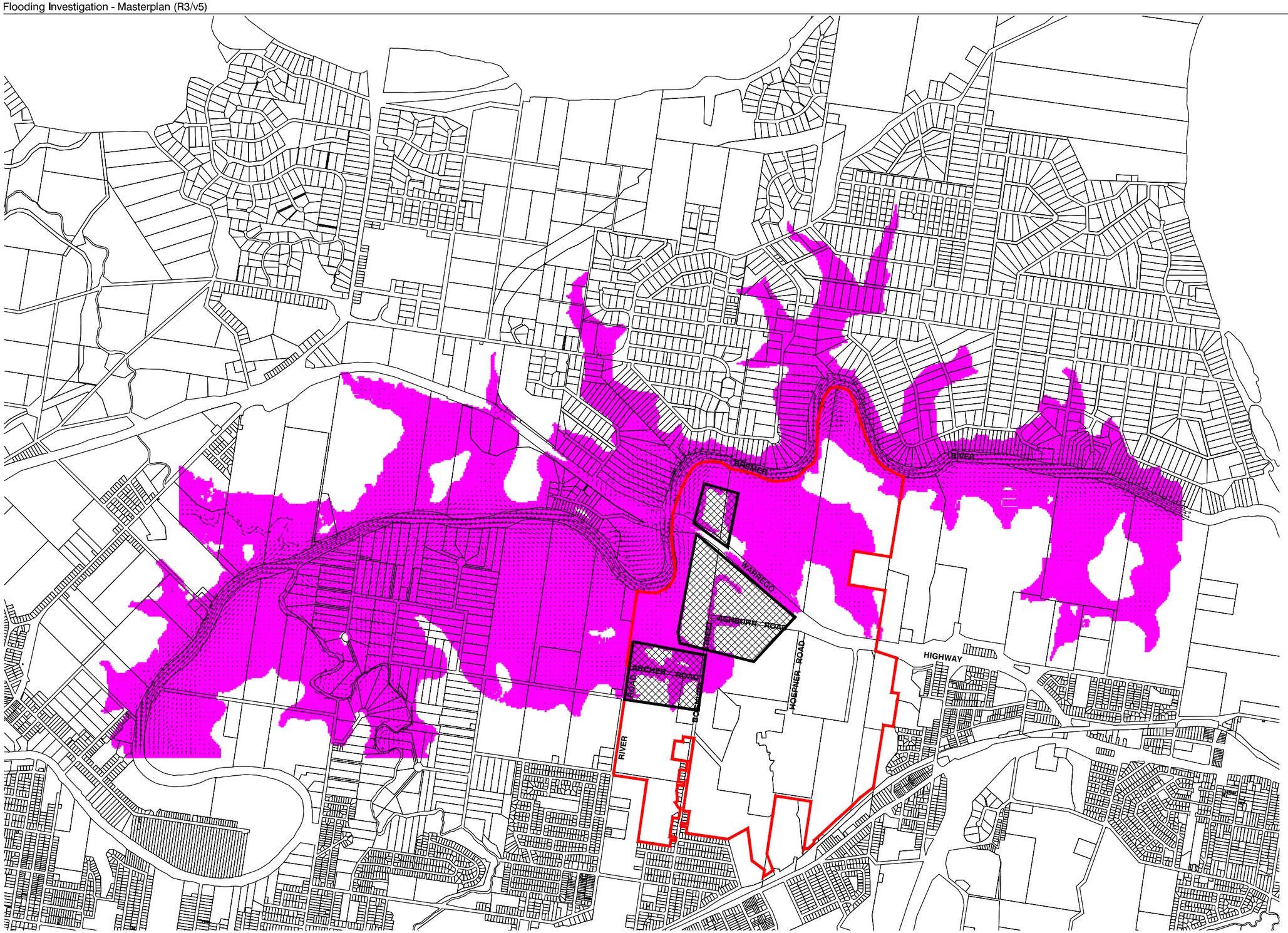
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08c_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 2:39pm

Cardno Lawson Treloar



Scale 1:25000 (A3)

FIGURE B.1.4

EXISTING CURRENT - WATER SURFACE LEVELS - SKM ULTIMATE 50 YEAR EVENT (Bris_E08c)

Rev: 0 Date: May 2012

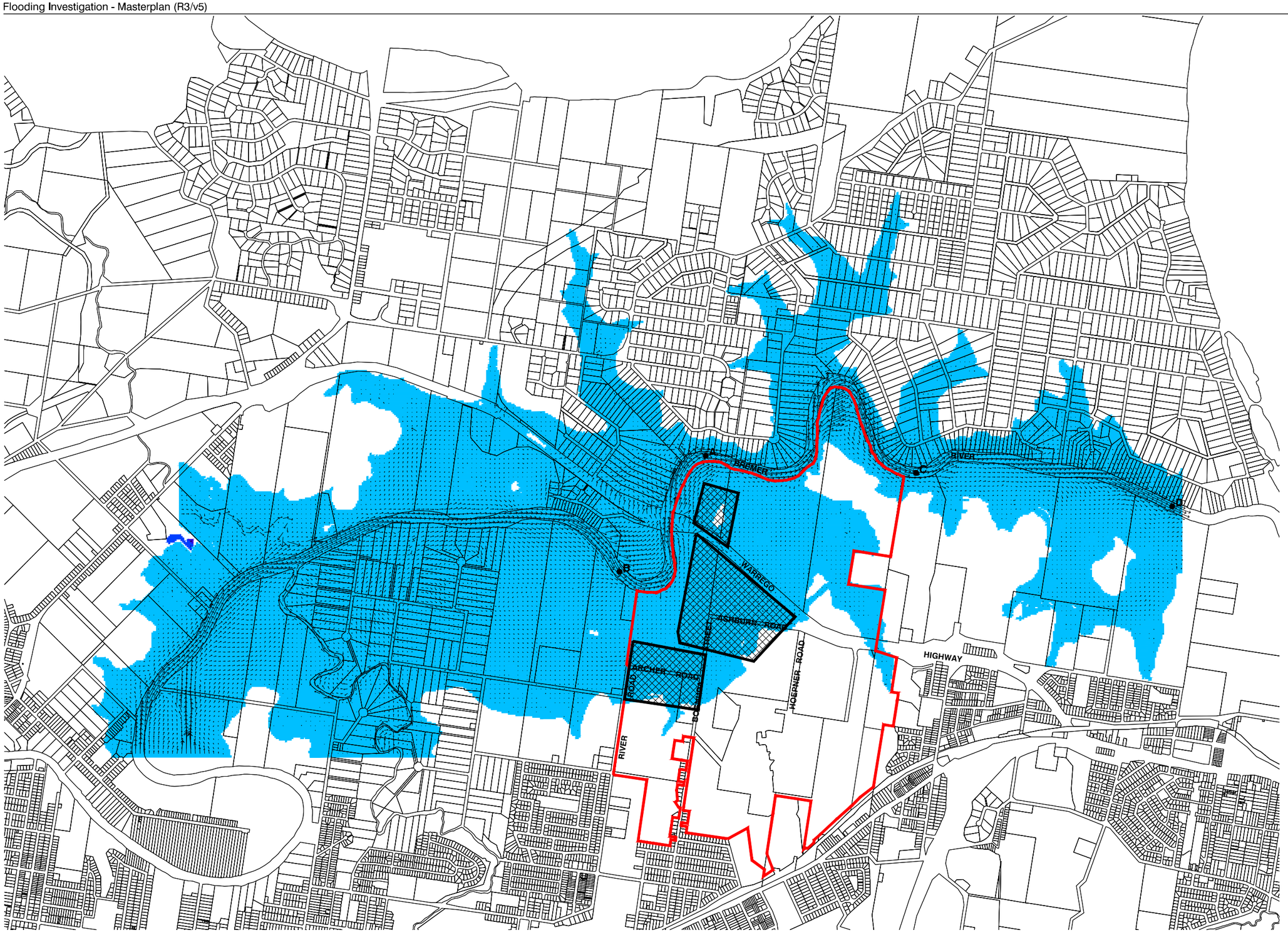
Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08c_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 2:39pm

Cardno Lawson Treloar



250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE B.1.5

EXISTING CURRENT - WATER SURFACE LEVELS - SKM ULTIMATE 100 YEAR EVENT (Bris_E08d)

Rev: 0 Date: May 2012

Project No.: LJ8714

Walker Corporation Pty Ltd

CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08d_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 2:50pm

Cardno Lawson Treloar

250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE B.1.6

EXISTING CURRENT - WATER SURFACE LEVELS - SKM ULTIMATE 200 YEAR EVENT (Bris_E08d)

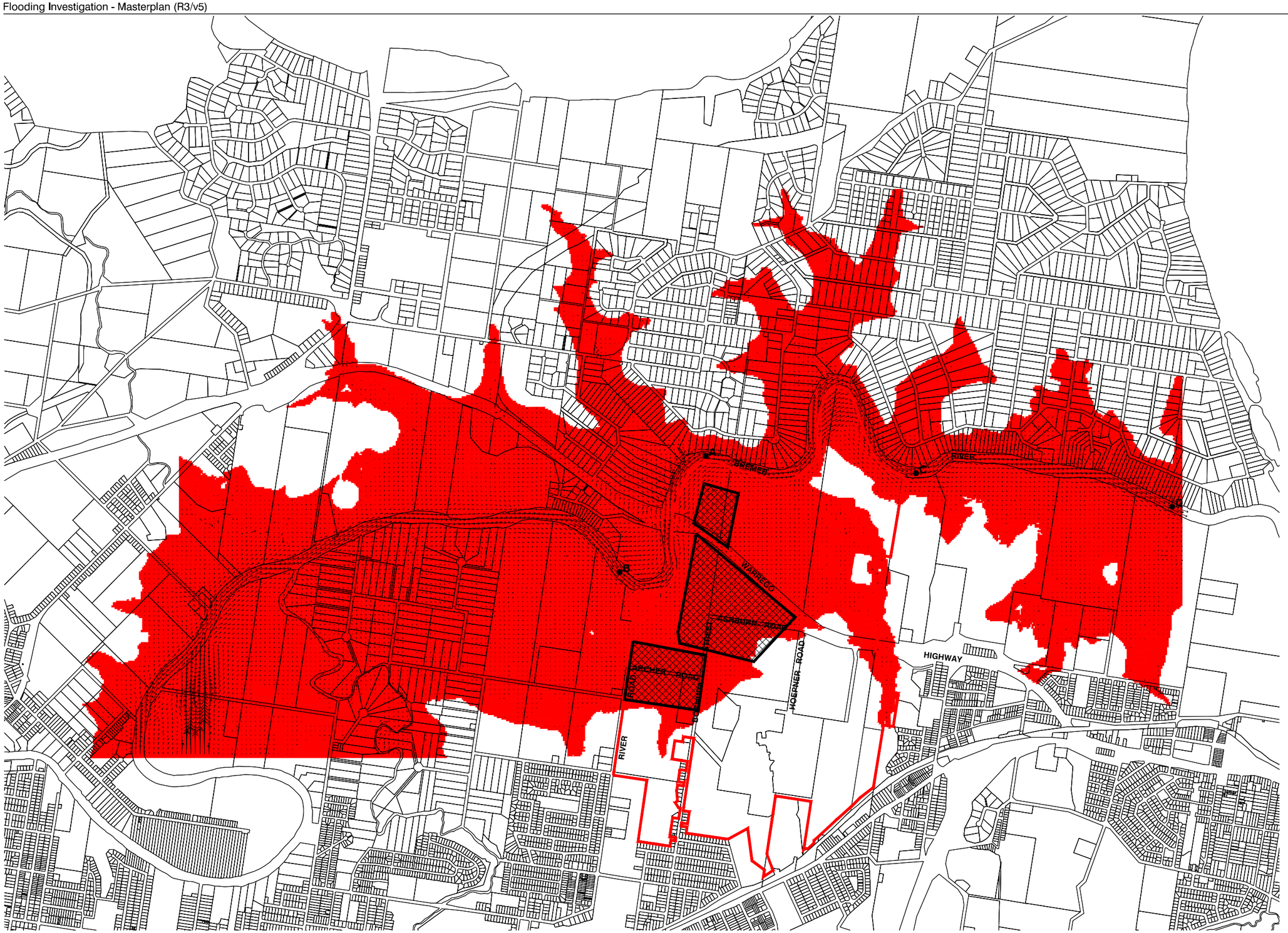
Rev: 0 Date: May 2012

Project No.: LJ8714

PRINT DATE: 11 May, 2012 - 2:50pm

Walker Corporation Pty Ltd
CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08d_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

Cardno Lawson Treloar



Scale 1:25000 (A3)

FIGURE B.1.7

EXISTING CURRENT - WATER SURFACE LEVELS - SKM ULTIMATE 500 YEAR EVENT (Bris_E08d)

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Project No.: LJ8714

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XREF's: xref-Results; xr-Ipswich_DCDB_MGA

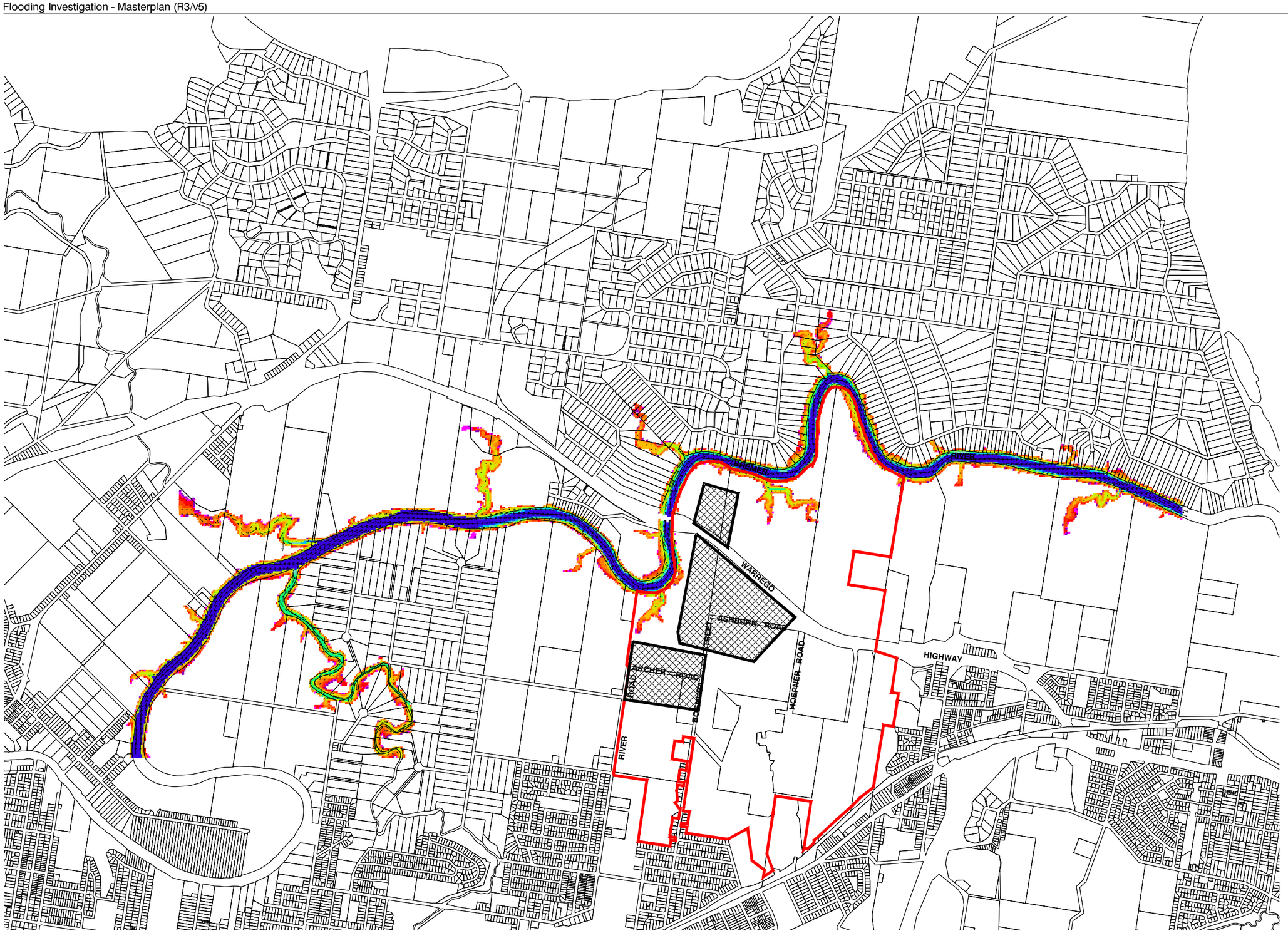
PRINT DATE: 11 May, 2012 - 2:51pm

Appendix B.2

Brisbane River Flood SOBEK 2D Existing Current Case

Results – Depth

Cardno Lawson Treloar



250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE B.2.1

EXISTING CURRENT - DEPTH - SKM ULTIMATE 5 YEAR EVENT (Bris_E08c)

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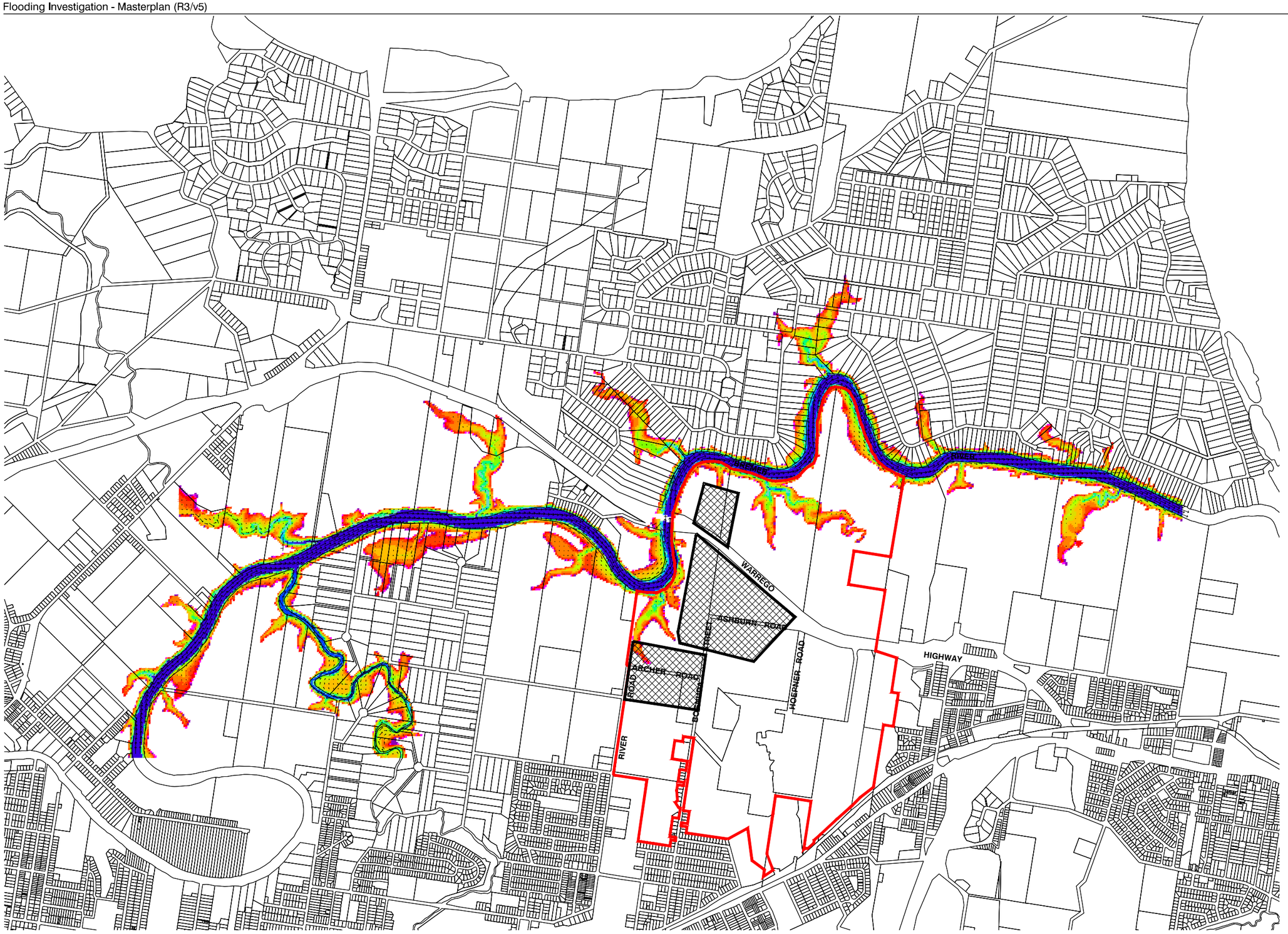
CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08c_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 2:40pm

Cardno Lawson Treloar



250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE B.2.2

EXISTING CURRENT - DEPTH - SKM ULTIMATE 10 YEAR EVENT (Bris_E08c)

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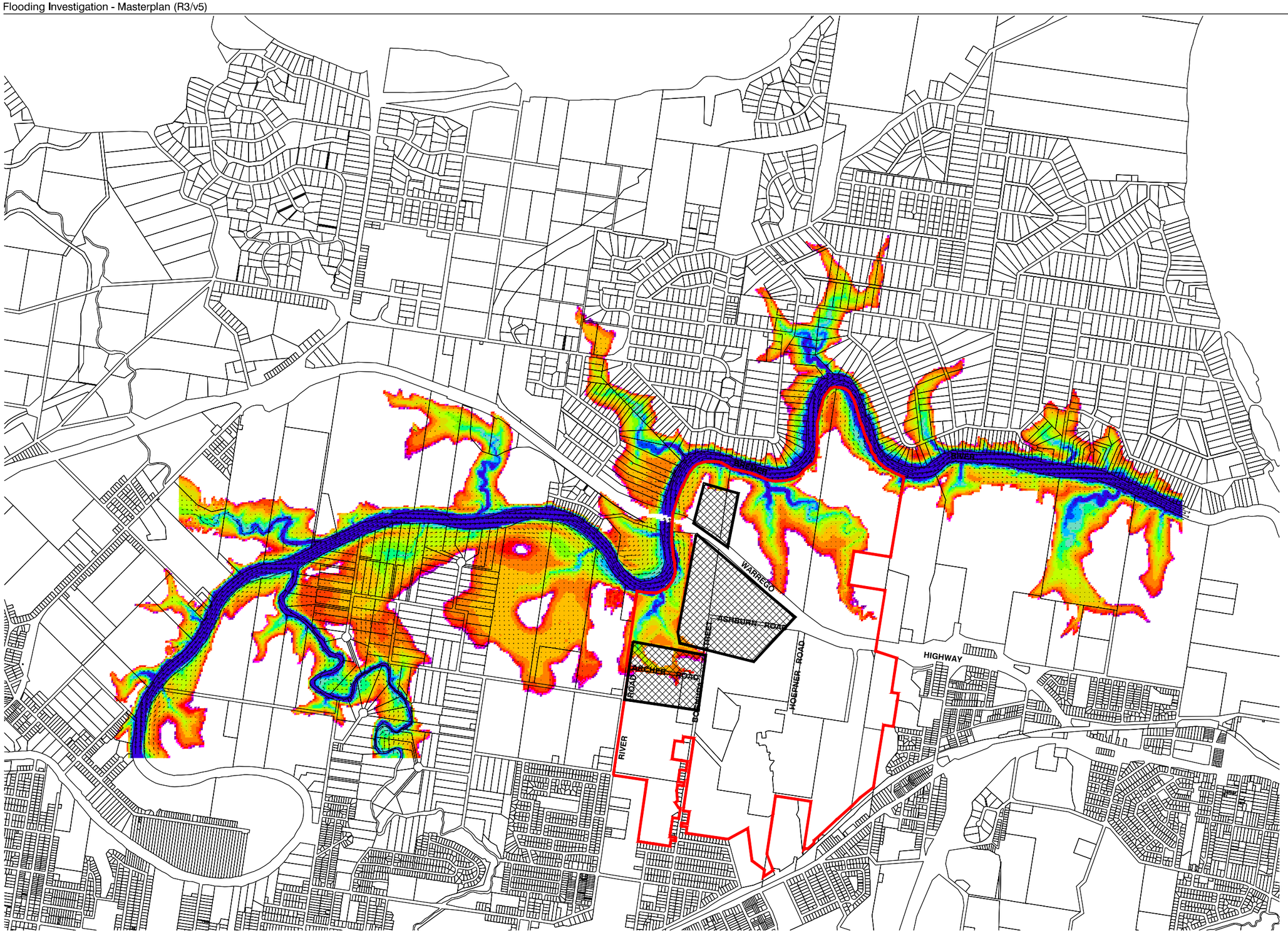
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

Cardno Lawson Treloar



250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE B.2.3

EXISTING CURRENT - DEPTH - SKM ULTIMATE 20 YEAR EVENT (Bris_E08c)

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Project No.: LJ8714

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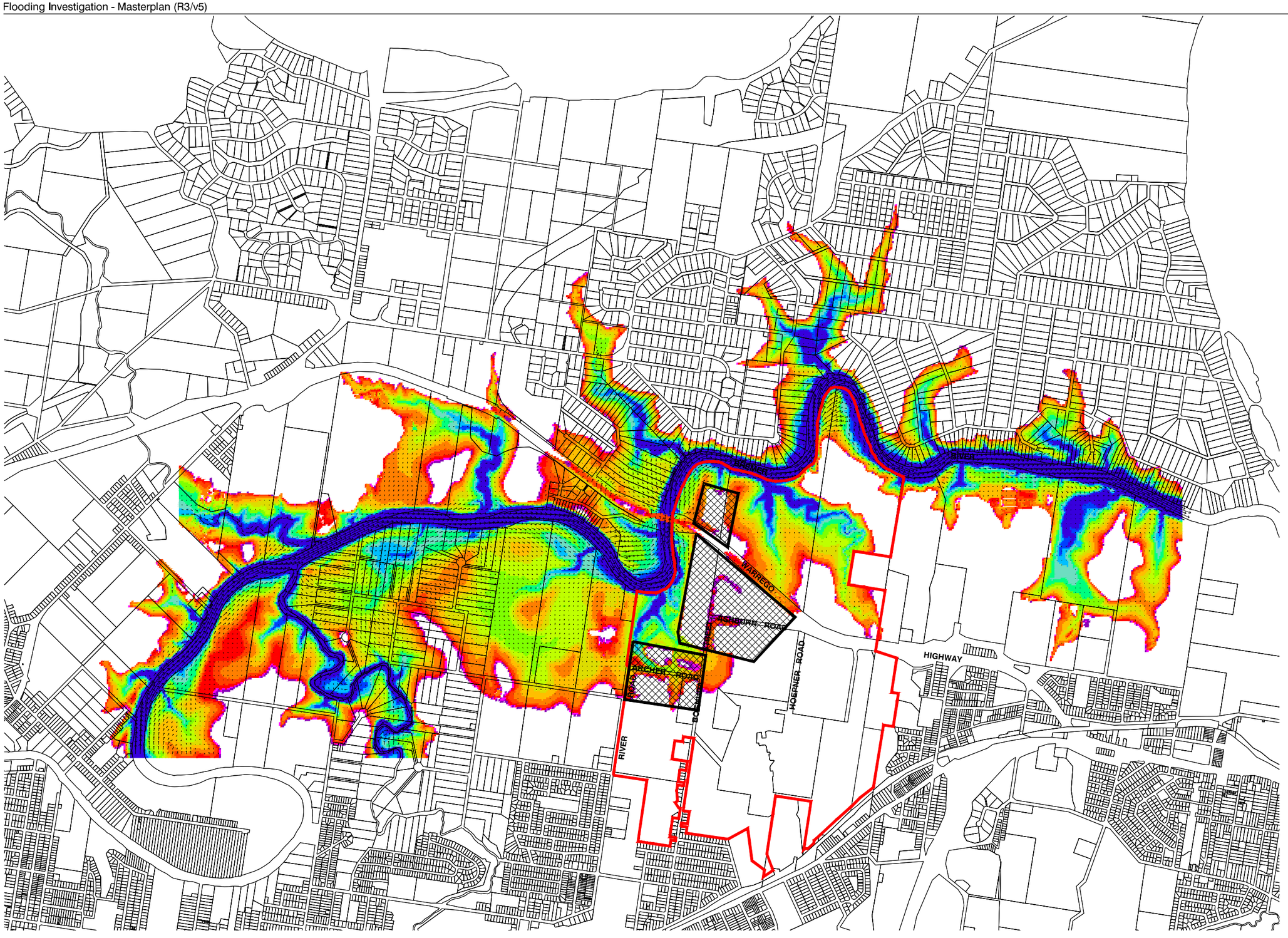
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

PRINT DATE: 11 May, 2012 - 2:41pm

Cardno Lawson Treloar



250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE B.2.4

EXISTING CURRENT - DEPTH - SKM ULTIMATE 50 YEAR EVENT (Bris_E08c)

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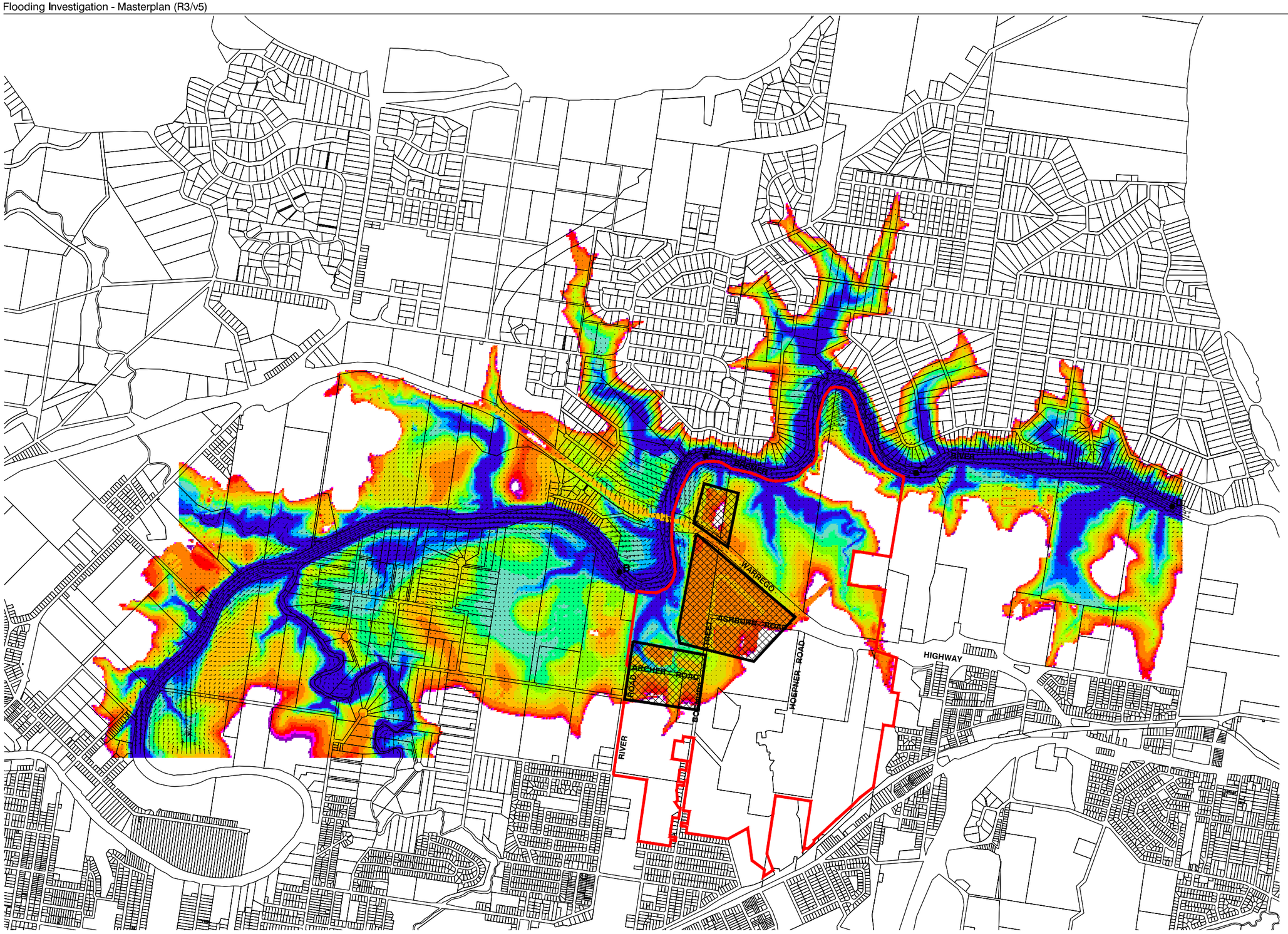
XREF's: xref-Results; xr-Ipswich_DCDB_MGA
PRINT DATE: 11 May, 2012 - 2:41pm

Cardno Lawson Treloar



250 0 250 500 750 1000 1250m
1:25,000

Scale 1:25000 (A3)

FIGURE B.2.5

EXISTING CURRENT - DEPTH - SKM ULTIMATE 100 YEAR EVENT (Bris_E08d)

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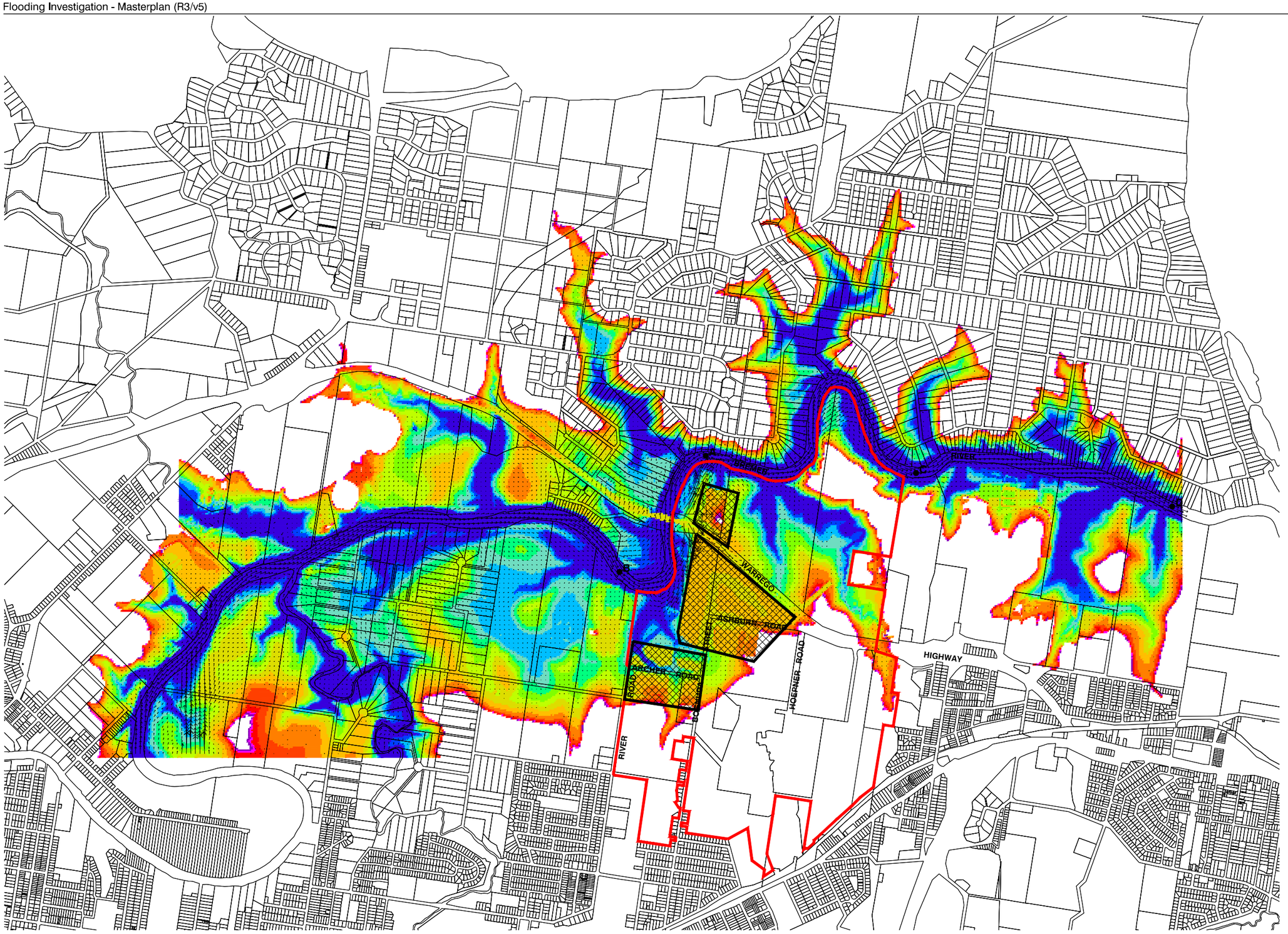
CAD FILE: C:\Users\james.martin\local settings\temp\AcPublish_5320\Figure_R3v5_E08d_Bris.dwg
XREF's: xref-Results; xr-Ipswich_DCDB_MGA

Cardno Lawson Treloar



Scale 1:25000 (A3)

FIGURE B.2.6

EXISTING CURRENT - DEPTH - SKM ULTIMATE 200 YEAR EVENT (Bris_E08d)

Rev: 0 Date: May 2012

Project No.: LJ8714

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XREF's: xref-Results; xr-Ipswich_DCDB_MGA

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