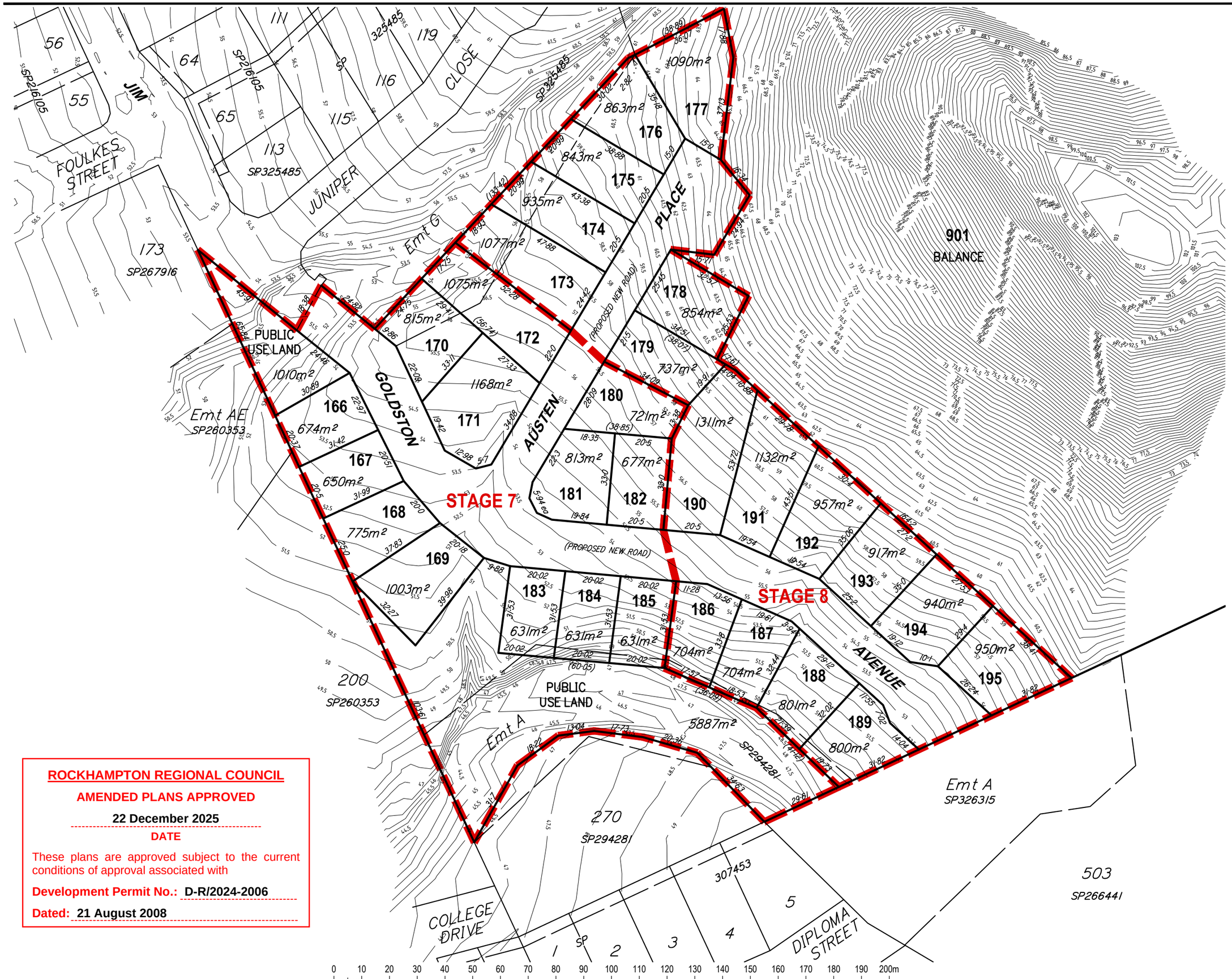

ROCKHAMPTON REGIONAL COUNCIL

AMENDED PLANS APPROVED

22 December 2025

DATE

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D-R/2024-2006

Dated: 21 August 2008

IMPORTANT NOTE

This plan was prepared to accompany an application to Rockhampton Regional Council and should not be used for any other purpose.

The dimensions and areas shown hereon are subject to field survey and also to the requirements of council and any other authority which may have requirements under any relevant legislation.

In particular, no reliance should be placed on the information on this plan for any financial dealings involving the land.

This note is an integral part of this plan.

client
Keppel Developments Pty Ltd A.C.N. 153 837 293

project
Crestwood Estate Jim Goldston Avenue, Norman Gardens

plan of
Reconfiguration Plan Stages 7 & 8
(1 Lot into 30 Lots + PUL + Balance)

rpd

Lot 901 on SP325485

lga
Rockhampton Regional Council

issue	date	details	authorised
A	16-11-2025	Replaces Plan 6555-07-ROL-A (18-08-2021)	RJKF
-	-	-	-

created

capricornsurveygroupcq
SURVEYING & PLANNING SOLUTIONS
07 4927 5199 | reception@csgcq.com.au | 132 Victoria Parade, Rockhampton QLD 4700

scale **1:1250 @ A3**
datum **AHD**
sheet no. **1 of 1**
cad file **9789-07-ROL-A**
plan no. **9789-07-ROL**
issue **A**

Cardno (Qld) Pty Ltd
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Hervey Bay
Sunshine Coast
Toowoomba
Gold Coast
Gosford
Baulkham Hills
Wollongong
Busselton

Papua New Guinea
Indonesia
Vietnam
China
Kenya
United Arab Emirates
United Kingdom
United States

PROPOSED RESIDENTIAL SUBDIVISION FOULKES STREET ROCKHAMPTON

OUR REFERENCE: 439101-153

DEVELOPMENT PERMIT FOR RECONFIGURATION OF A LOT (1 LOT INTO 2 LOTS WITH DRAINAGE RESERVE)

Response to Information Request D-1647/2007

Revision 1

Prepared for:

Jim & Kathryn Rundle

Prepared by:

Cardno (Qld) Pty Ltd

Compiler:

Chris Shields

Date:

14th July 2008

Cardno (Qld) Pty Ltd
814 Norman Road, Norman
Gardens QLD 4701

INFORMATION REQUEST RESPONSE

Application No.: **D-1647/2007**
Application Description: **Reconfiguring a Lot (3 Lots) and Operational Works**

In accordance with section 3.3.6 of the *Integrated Planning Act 1997*, an Information Request has been issued to you in respect to your development application. As set out on the last page of your information request, under section 3.3.8 of the *Integrated Planning Act 1997* there are three (3) ways that you can respond to the Information Request. To ensure that Council is clear in understanding your position in respect to the Information Request, you are required to complete this page and return it to Council with your response (if there is one) to the Information Request.

Therefore, please tick one of the following boxes, attach this page to your Information Request response (if you are making one), sign the bottom of the page and return this page to Council.

☐ I have provided you with all of the Information requested within the Information Request and ask you therefore to proceed with the assessment of the development application based on the information I have provided.

☑ I have provided you with part of the Information requested within the Information Request and ask you therefore to proceed with the assessment of the development application based on the information I have provided and that this response be taken to be a Notice under section 3.3.8(b) of the *Integrated Planning Act 1997*.

☐ I do not intend to provide you with any of the Information requested within the Information Request and ask you to proceed with the assessment of the development application based on the information I have provided and that this response be taken to be a Notice under section 3.3.8(c) of the *Integrated Planning Act 1997*.

C Mueller — 14/07/08

Applicant's Signature **Dated**

Important Note
Any response to Council that does not include this page properly completed or does not include specific references to section 3.3.8 of the *Integrated Planning Act 1997* in terms of the type of Information Request response being made, will be treated not as an Information Request response and will therefore not proceed the development application into the next stage of IDAS (Integrated Development Assessment System). Council may respond to any information submitted as a means of finalising or clarifying the information requested to be submitted, however there is no specific timeframe for Council to do so, and doing so does not reduce the Council's statutory decision making period.

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Appendices

Appendix A – Amended Development Proposal Drawings (Rev C)

Appendix B – Landscaping Drawings

Appendix C – Approved Street Lighting Design for Chancellors Estate Stg1

Appendix D – Drainage Reserve Photo

Appendix E – Detailed Flood Study

Planning

Item 1

Please demonstrate how the proposed subdivision will comply with Acceptable Solution A1 and A6.1 of the **Reconfiguring a Lot Code,** Performance Criteria 3(d) and 4 of the **Norman Road Residential Area Code** and Performance Criteria 1 of the **Parking and Access Code.** *NOTE: It is required that the proposal include pedestrian paths for the full length of Foulkes Street and Norman Road.*

Response:

Concrete pedestrian footpaths have already been constructed for the full Foulkes St frontage as part of the Chancellors Estate Stage 1 civil works contract. No further response required.

Item 2

Please indicate the anticipated access to proposed Lot 1, in accordance with Acceptable Solution A3.1 of the **Reconfiguring a Lot Code.** The acceptable solution outlines that *"Access is provided to an allotment that previously had no access". NOTE: It is advised that both lots have access indicated on plan 439101-153-001 and 439101-153-007.*

Response:

Access to proposed Lot 1 will remain unchanged and remain directly onto Foulkes St. This is the lowest order adjoining road in accordance with the CMDG hierarchy. The approximate location of this existing access is shown on Dwg 439101-153-007 (Rev C) attached in Appendix A.

Access to proposed Lot 2 is via a combined drainage / access easement on Lot 3 within Chancellors Estate Stage 1, from internal Road A. This is nominated as an Access Place and has been accepted within the Operational Works approval of Chancellors Estate Stage 1 as the appropriate access point for proposed Lot 2. This access, as well as all relevant service connections are shown on Dwg. 439101-153-003 (Rev C) attached in Appendix A.

Item 3

The application has applied for a 3 lot subdivision, however, in checking this, the third lot cannot be established. Please demonstrate the location of all three lots. *NOTE: The proposed drainage easement is not included as a lot, and will be donated in favour of Council. If it is found that the application is only for 2 lots, a refund of $240 will be issued upon request.*

Response:

There are only 2 new allotments proposed, with the drainage reserve being incorrectly included as a "lot" in the application. It therefore seems that the $240 refund to Jim and Kathryn Rundle is in order, and would be appreciated as soon as practical.

Item 4

Please submit to Council a Concept Landscaping Plan, prepared by a suitably qualified person, that is in accordance with the Landscape Code and Planning Policy No. 6 - Planting Species showing all proposed landscaped areas. The landscaping plan (A3 size and drawn to scale) shall show the following: -

- outline of the proposed structures;

- existing vegetation and proposed vegetation to be removed;
- proposed furniture, art and/or public information boards;
- proposed planting within the site (including quantity, species, spacing between each, expected height at the time of planting and the expected mature height);
- paths and paving including pedestrians and cycle ways (location, materials used and showing entry points that are reinforced); and
- the method of planting and the proposed maintenance program.

The landscape plan shall demonstrate the following: -

a) adequate shade for all car parking areas (in reference to the Landscape Code and Planning Policy No. 6 - recommended shade trees); and

b) all proposed landscaping is be in accordance with Crime Prevention Though Environmental Design Code (CPTED) principals.

Due to Rockhampton's climate it is suggested that where possible existing mature trees on site are retained.

NOTE: As the proposal adjoins existing pedestrian infrastructure, it is required that the application include landscaping for the required pedestrian paths. It is advised that particular attention be paid to Acceptable Solution 8.1 of the ***Landscape Code,*** *when landscaping beside the pedestrian paths.*

Response:

As part of the landscaping design for Chancellors Estate Stage 1 (adjacent to the subject site), the Landscape Architect compiled details and planting schedules which incorporated the drainage reserve within Lot 2 on RP6187770, as well as details for the pedestrian footpath landscaping for the full Foulkes St frontage of the subject site. These details are attached in Appendix B.

Item 5

Please indicate compliance with Acceptable Solution A4.3 of the **Reconfiguring a Lot Code.** *NOTE: Please indicate the proposed location of a building envelope so that does not traverse within 5 metres of the drainage easement.*

Response:

Due to the large profile of the proposed drainage channel, and frequency at which the runoff from the catchment would achieve flows close to capacity (1 in 100 ARI), it is suggested that a standard 1.5m offset from the drainage reserve boundary is acceptable for the building envelope within proposed Lot 2. Similarly, the building envelope is proposed to be offset 1.5m from the roofwater drainage easement through proposed Lot 2. This is shown in Dwg. 439101-153-003 (Rev C) attached in Appendix A.

Item 6

Please demonstrate how the proposed development is in compliance with Acceptable Solution A14.6 of the **Reconfiguring** a **Lot Code.** *NOTE: Please include the location of proposed street lighting facing Foulkes Street. Alternatively, if Chancellors Estate has already made provisions for such services, please locate these on amended site plans.*

Response:

A full street lighting design was compiled and certified in accordance with AS1158 for Chancellors Estate Stage 1, which incorporated the proposed lights within the Foulkes St

median, and along the western side of Road A. A copy of these Council approved plans are attached in Appendix C. No further street lighting design is therefore required.

Item 7

Please indicate how proposed lot 2 is in accordance with Acceptable Solution 3 of the **Crime Prevention Through Environmental Design Code.** *NOTE: It is required that either fencing or landscaping be used to distinguish between public and private land.*

Response:

It is highly likely that the future owner of Lot 2 will provide a fence that provides protection from people entering the drainage reserve from within Lot 2, which will also act to prevent people from entering private land from the public drainage reserve. The applicant does not propose to fence the land at this stage.

Item 8

Please demonstrate compliance with Performance Criteria 13 of the **Landscape Code.** *NOTE: this should be considered in conjunction with Information Request item (4). As there is an established streetscape created by Chancellors Estate, your streetscape should reflect this.*

Response:

Please refer to Item 4 Response.

Item 9

Please demonstrate how the proposed development is in compliance with Performance Criteria 2 of the **Water Quality and Quantity Code.** *NOTE: proposed plantings must maintain the integrity of the waterway, and include native plantings.*

Response:

As detailed in the Item 4 response and the landscaping drawings attached in Appendix B, the proposed plantings within the drainage reserve are proposed to maintain the integrity of the banks (in conjunction with the proposed MaxJute© matting or similar), provide good visual amenity, and maintain a low profile in order to minimise maintenance and the likelihood of being 'pushed over' by higher flows. All plants have been selected for their low maintenance, durability and ability to be provide binding and stabilisation of the embankments. Note that planting frequency will reflect adjacent natural area, whilst using plants from within the landscaping plan attached in Appendix B.

Item 10

Please demonstrate how the proposed development complies with Performance Criteria 2 (and applicable Acceptable Solutions) of the **Biodiversity and Nature Conservation Code.** *NOTE: This is an important aspect of the development, as it has been identified that the proposed drainage easement is a waterway corridor, and includes sensitive natural environments. Proposed revegetation should be sensitive to all requirements.*

Response:

Please refer to Item 4 and Item 9 response.

Item 11

Please demonstrate compliance with Performance Criteria 5 of the **Biodiversity and Nature Conservation Code.** *NOTE: Please pay particular attention to Acceptable*

Solution A5.1, whereby it requires a 30 metre buffer. This is particularly applicable to proposed lot 2.

Response:

As there is currently no sensitive vegetation in the proposed drainage reserve, this particular item is not applicable, and the buffer therefore does not apply in this instance. Please refer to Appendix D for a recent photo of the drainage reserve area.

Item 12

Please demonstrate how the development is in compliance with Acceptable Solution 4 and Performance Criteria 11 & 12 of the **Reconfiguring a Lot Code** and Performance Criterion 5 of the **Norman Road Residential Area Code.** *NOTE: it is required that open space be dedicated in favour of Council. The donation* ***may not*** *include drainage easements or any form of waterway corridor. For further guidance and requirements please refer to* ***Planning Policy No. 5 - Open Space Infrastructure Contributions.***

Response:

It is proposed that the Open Space contribution be waived in this case, due to the significant earthworks and landscaping proposed at no cost to Council, which ensures that the drainage reserve is easily maintainable and provides good visual amenity.

Development Engineering

Item 1

Please provide a Flood Study, prepared and certified by a suitably qualified and experienced Registered Professional Engineer of Queensland (RPEQ), for the major watercourse traversing the site (Lot 2 on RP618770). This Flood Study shall determine and clearly report all relevant engineering design details associated with flooding in the watercourse and the proposed open channel including, but not limited to, the following:

(a) the 100 year Average Recurrence Interval (Q100) flood levels, discharge volume and velocity for the existing watercourse configuration and the proposed open channel configuration (reported using Australian Height Datum, AHD, as the vertical datum);

(b) the 10 year Average Recurrence Interval (Q10) flood levels, discharge volume and velocity for the existing watercourse configuration and the proposed open channel configuration (reported using Australian Height Datum, AHD, as the vertical datum);

(c) all input parameters used in the HEC-RAS modelling and demonstrate that they are representative of both the existing watercourse and the proposed drainage channel; and

(d) a complete set of suitably scaled cross-sections and long-sections for both the existing watercourse and the proposed drainage channel as used in the HEC-RAS modelling.

All assumptions for the existing, post-development and ultimate development scenarios must be clearly stated.

Response:

A detailed flood study addressing all items above is attached in Appendix E.

Item 2

Please demonstrate how the proposed open channel complies with the Capricorn Municipal Development Guidelines, Section D5.12 "Open Channels" and the Queensland Urban Drainage Manual, Section 8.00 "Open Channel Hydraulics" including, but not limited to, the following:

(a) Please demonstrate how the proposed development complies with the requirements of the Capricorn Municipal Development Guidelines and Section 8.10(d) of the Queensland Urban Drainage Manual - Recommended Maximum Channel Side Slopes, which states, in part:

"The maximum channel sides slopes for grass lined sections should preferably be 1 on 6 (1V on 6H), with an absolute maximum of 1 on 4 (1V on 4H). If grass lined channels are designed with side slopes steeper than 1 on 4 (1V on 4H), regular maintenance may become impractical and the channel may eventually become overgrown. These conditions would reduce the capacity of the channel and could subsequently lead to flooding of low lying areas upstream. Channels lined with ground covers may be permitted to have maximum side slopes of 1 on 2 (1V on 2 H), however design of such channels must include considerations of potential future increases in channel roughness, and considerations of channel side slope stability."

(b) Please demonstrate that the proposed development complies with the specified requirements in Section 8.08 of the Queensland Urban Drainage Manual - Channel Freeboard. The recommended channel freeboard is the maximum of:

(i) 0.3 metres, or

(ii) 20% of the channel depth; or

(iii) flow velocity head.

(c) Please demonstrate how the proposed development complies with Section 8.13 of the Queensland Urban Drainage Manual - Other Considerations, which states, in part, that:

"(a) *Access / Maintenance Berms*

It is recommended that the overall easement / reserve width for an open channel provide for an access / maintenance berm of minimum width 4.5 metres on one side of the channel. This access / maintenance berm may be located within the channel itself at a lower elevation than the design flood level but should be located at a level corresponding to at least the 1 year ARI flow depth.

Where access and maintenance cannot be achieved for the whole channel from one side, it may be necessary to provide a similar access / maintenance berm on both sides of the channel. Notwithstanding the above provisions a 1.5 metre wide safety / access strip should be provided along at least one side of the channel above the design flood level in addition to the access / maintenance berm."

(d) Please demonstrate how the proposed development complies with Section 8.10(c) of the Queensland Urban Drainage Manual - Recommended Maximum Flow Velocities.

(e) The Capricorn Municipal Development Guidelines, Clause D5.11 (2), requires that proposed "Overland flow paths shall be located on public land." Please demonstrate

how the application complies with this requirement.

(f) Please demonstrate how the proposed open channel will provide for low-flow events consistent with the Capricorn Municipal Development Guidelines and the Queensland Urban Drainage Manual.

Response:

(a) the proposed drainage channel has 1:2 batter slopes and is retained by the use of MaxJute or similar product anchored into the banks (in accordance with the manufacturer's specifications), in conjunction with landscaping that considers native plants, low maintenance, durability and good visual amenity (as detailed in Item 4). The roughness of this channel profile has adequately been incorporated into the HEC-RAS model, which is shown within the Flood Study attached in Appendix E.

(b) this is addressed in the Flood Study attached in Appendix E.

(c) it is proposed that a 3.5m wide maintenance berm above the Q1 level, is to provided in the base of the drainage channel in order to allow service vehicles access to the base. This is shown in the typical detail on Dwg. 439101-153-002 Rev C attached in Appendix A. This has also been incorporated into the HEC-RAS model used for the Flood Study.

(d) the flow velocities for the proposed channel are detailed within the Flood Study attached in Appendix E, and are within the limits prescribed in Section 8.10(c) of QUDM.

(e) the overland flow path is detailed within the Flood Study attached in Appendix E, and demonstrates that the drainage reserve boundaries cater for this on the downstream side of the culvert structure in Foulkes St.

(f) the proposed channel is to have 1:20 slopes within it's base to form an invert along the centre of the channel. In addition, low flows are catered for through the use of the rock lined channel along the centre line as detailed in the Flood Study attached in Appendix E.

Item 3

The proposed drainage easement in favour of Council shown on Drawing 439101-153-003 (Rev C) needs to be a minimum of 3 metres wide in lieu of 2 metres shown in order to comply with the requirements of the Capricorn Municipal Development Guidelines. Please amend the proposal plans accordingly.

Response:

The drainage easement has been amended to provide the required 3m width. This is shown in amended Dwg. 439101-153-003 (Rev C) attached in Appendix A.

Item 4

Please relocate the stormwater outlet RW0/5 as close as practicable to the toe of the batter slope in the proposed drainage channel.

Response:

As shown in Dwg. 439101-153-003 (Rev C) attached in Appendix A, the roofwater outlet

R0/5 is shown to discharge at the toe of the channel batter as required.

Item 5

Please demonstrate how the proposed development complies with the Norman Road Residential Area Code in the Rockhampton City Plan. In order to comply with A3.1 of this Code a dedication of 1.0 metre is required from the Foulkes Street frontage of Lot 2 on RP618770 to provide for the future Trunk Collector classification (22 metre wide road reserve) of Foulkes Street. Please revise and resubmit the proposal plans showing the 1.0 metre dedication from the frontage of Lot 2 on RP618770 as road reserve. In addition, please provide the three chord truncation to the corner of the subject site at the intersection or Foulkes Street and Norman Road in order to comply with A27.2 of the Reconfiguring a Lot Code.

Response:

It is considered unnecessary at this stage to provide the 1.0m strip for the Foulkes St road reserve widening for the full frontage, or the three chord truncation at Norman Rd, as the RoL application is predominantly to provide the drainage reserve for Council. It is proposed at this stage to provide the required 1m widening from the western boundary of Chancellors Estate Stage 1, to the western boundary of the nominated drainage reserve within Lot 2 on RP618770. This is shown in Dwg. 439101-153-003 (Rev C)

The current use of the land will not change as a result of this application, and the opportunity exists at the future development application stage for Council to acquire the balance of this widening.

Item 6

Please show a building envelope on proposed Lot 2 and detail the minimum floor level ensuring that a minimum freeboard of 500mm is provided above the Defined Flood Event (Q100) in accordance with the Flood Prone Land Code.

Response:

The proposed building envelope for Lot 2 is shown in Dwg. 439101-153-003 (Rev C). It is important to note that the top of the drainage channel batter slope provides the required freeboard as detailed in the Item 2(b) response, and therefore provides flood immunity to any structure constructed on this lot.

Item 7

In relation to the proposed filling and excavation activity on the site please provide information to demonstrate that the excavation or filling will not adversely affect the amenity of adjoining or nearby properties in accordance with Performance Criteria P2 of the Filling or Excavation Code. This assessment should address the following matters:

(a) Proposed measures to manage dust emissions from excavation and filling;

(b) Demonstrate that excavation or filling does not concentrate or divert stormwater runoff into an adjoining site;

(c) Demonstrate that the excavation and filling will not cause or allow the ponding of water on the site or any other adjoining land;

(d) Identify proposed vegetation to be cleared as part of the excavation process.

Response:

(a) dust emissions are proposed to be controlled through the use of water trucks working in conjunction with any cut / fill activities, as well as on any construction traffic routes.

(b) as shown in Dwgs. 439101-153-002 (Rev C) and 439101-153-003 (Rev C), the proposed earthworks will not concentrate or divert stormwater runoff into adjoining sites; rather, the flows will be controlled within a defined channel. Details of the stormwater runoff volumes can be obtained from the Flood Study attached in Appendix E.

(c) the proposed channel longitudinal section detailed in the enclosed Flood Study shows that there is to be no ponding within the site due to a constant grade to the north. It also shows that the invert of the channel ties into the natural surface at the northern boundary of the subject site, therefore avoiding any ponding within the adjacent site to the north.

(d) all existing vegetation within the earthworks areas shown on Dwg. 439101-153-002 (Rev C) attached in Appendix A, is proposed to be removed to allow topsoil to be stripped, and fill to be placed and compacted. Some larger trees towards the south-western boundary of the earthworks may be able to be retained if minimal fill is required around their bases.

Item 8

Please address the requirements of the External Works and Servicing Code and demonstrate how the proposed development complies with the requirements of the same Code.

Response:

Both proposed Lots 1 and 2 are shown to be fully serviced, as Lot 1 currently has a dwelling present, and the services for Lot 2 are shown in Dwg. 439101-153-003 (Rev C) attached in Appendix A.

Item 9

The proposed access to the base of the drainage channel shown on Drawing 439101-153-007(A) appears to be located in an area where the batter slopes exceed those suitable for practical access to be achievable. Furthermore, the fencing associated with the culvert structure appears to conflict with the proposed location of the maintenance access. Therefore, the proposed maintenance access from Foulkes Street to the Drainage Reserve is not acceptable due to its proximity to the existing culvert structure and associated end structures, wingwalls, fencing and batter slopes. Please provide an alternative acceptable solution shown on a suitably scaled and adequately dimensioned plan. In addition, please identify all existing service infrastructure located on the road verge or in the vicinity of the proposed access. The proposed access to the Drainage Reserve needs to be suitable for heavy earthmoving equipment such as a 12 tonne excavator and, as a minimum, a Heavy Rigid Vehicle (HRV) as defined in AS2890.2-2002. Please demonstrate that the proposed access provides suitable access to the floor of the proposed channel and the culvert structure for the aforementioned maintenance machinery.

Response:

Since construction of the culvert under Foulkes St, the access proposed from Foulkes St is not practical. As discussed in recent meetings between Cardno and RRC representatives, access to the drainage reserve for maintenance is to be provided through the lot to the north of the subject site, via an easement from Norman Rd. The landowner is agreeable to providing an access easement through his land until such time as access is available via public land and roadways.

An "Amendment to Application" resulting from an RFI Response will be submitted to Council to include the downstream lot in the current application, with the downstream landowner's endorsement. This will allow Council to have legal access to the drainage reserve from the lot to the north, a general arrangement of which is shown on Dwg. 439101-153-001 (Rev C) attached in Appendix A.

Item 10

Please provide revised development proposal plans in response to the above information request items consistent with Planning Policy No. 15 in the Rockhampton City Plan.

Response:

A full set of revised development proposal plans is attached in Appendix A.

Fitzroy River Water (FRW)

Item 1

The applicant is required to demonstrate how the proposed development intends to provide a sewer connection point to service proposed lot 1. The new connection point shall command the entire lot.

Response:

It is proposed that Lot 1 will continue to use the septic system as it currently does as-of-right. There is no change of use in relation to this lot.

Appendix A

Amended Development Proposal Drawings (Rev C)

Important Note:

Please note that these drawings represent the proposals generally, however some details are to be modified as per the Flood Study attached in Appendix E. These amendments will be fully incorporated into the plans submitted for Operational Works Approval.

Cardno

Cardno (Qld) Pty Ltd ACN: 051 074 992

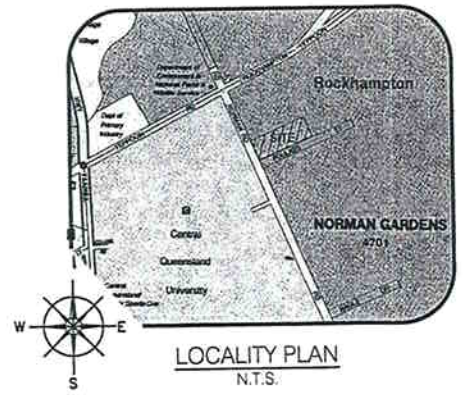
J & K RUNDLE

RESIDENTIAL SUBDIVISION 1 INTO 2 LOTS WITH DRAINAGE RESERVE

LOT 2 ON RP618770
FOULKES STREET, ROCKHAMPTON

DRAWING LIST	
Drg No.	Description
439101-153-000	TITLE SHEET
439101-153-001	GENERAL LAYOUT PLAN
439101-153-002	EARTHWORKS PLAN
439101-153-003	SERVICES AND RECONFIGURATION DETAILS

STANDARD DRAWINGS	
Capricorn Municipal Development Guidelines Standard Drawings	
SD-D-010	EXCAVATION, BEDDING & BACKFILLING OF DRAINAGE PIPES



LOCALITY PLAN
N.T.S.

SET OUT CO-ORDINATES

BASED ON
HORIZONTAL DATUM CADASTRAL
VERTICAL DATUM A.H.D
CONTACT CAPRICORN SURVEY GROUP PTY LTD
FOR DETAILS OF P.S.M. 68223

439101-153-000 Rev C
Job No. - 439101-153-01 Date - July 2008

CAD FILE NAME: 439101-153-000 (C) Title Sheet.dwg

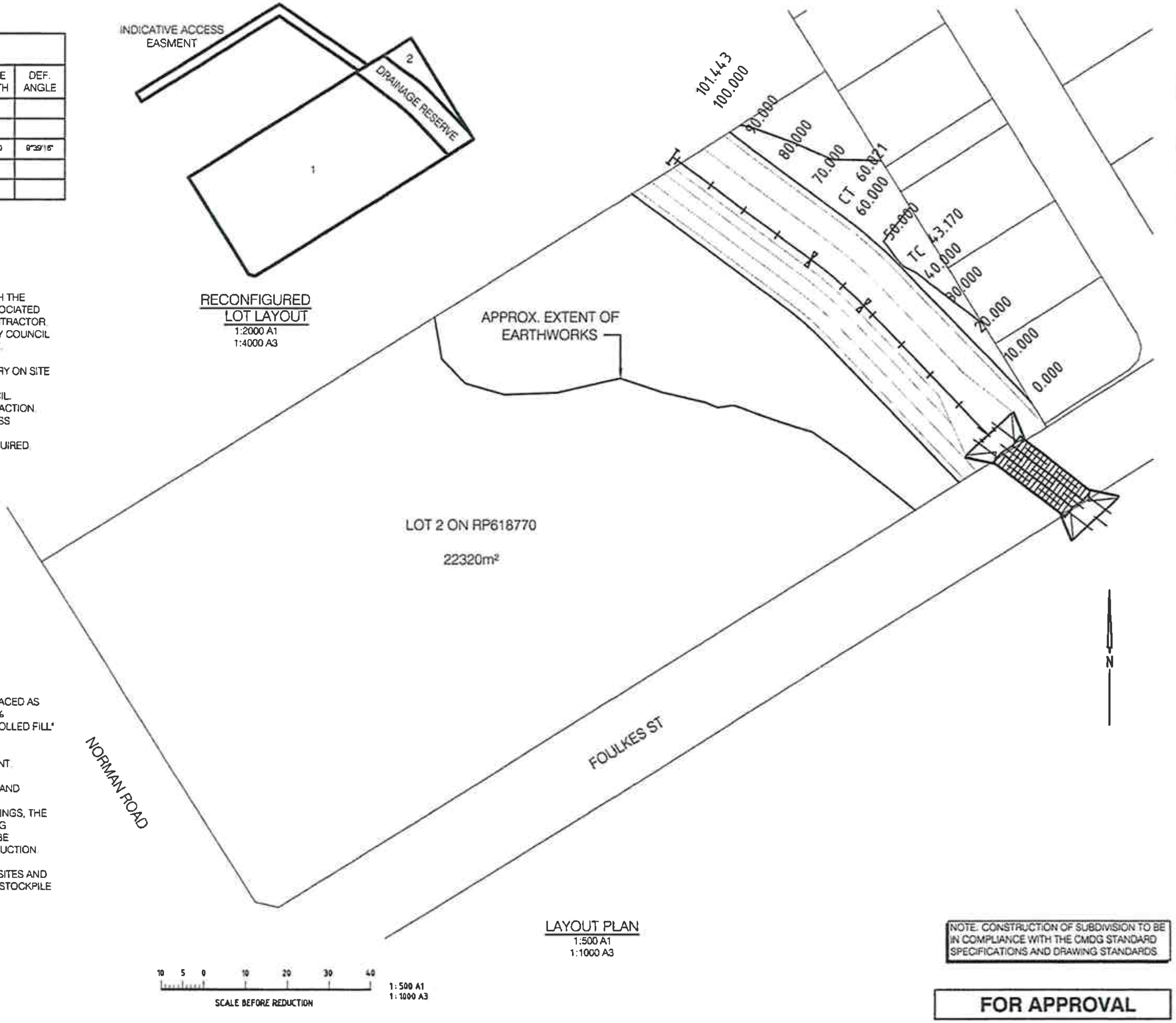
CHANNEL CONTROL LINE SETOUT DETAILS								
PT	CHAINAGE	EASTING	NORTHING	LEVEL	BEARING	RAD/SPIRAL	ANGLE LENGTH	DEF. ANGLE
IP1	0.000	5161.973	5136.073	35.366				
TC	43.170	5132.048	5167.189	33.766	316°07'07"			
IP2	51.595	5126.155	5173.276			100.000	-16.850	9°39'16"
CT	60.021	5119.403	5178.295	33.145	306°27'51"			
IP3	101.443	5086.089	5202.913	32.784				

GENERAL

1. ALL DIMENSIONS ON THE JOB ARE IN METRES UNLESS SHOWN OTHERWISE.
2. THE CONTRACTOR SHALL VERIFY THE LOCATIONS OF ALL EXISTING SERVICES WITH THE RELEVANT AUTHORITIES BEFORE COMMENCING CONSTRUCTION. ANY COSTS ASSOCIATED WITH REPAIRING DAMAGE TO EXISTING SERVICES SHALL BE PAID FOR BY THE CONTRACTOR.
3. ALL WORK SHALL BE CARRIED OUT IN ACCORDANCE WITH THE ROCKHAMTON CITY COUNCIL (R.C.C) STANDARD SPECIFICATION AND DRAWINGS UNLESS DIRECTED OTHERWISE.
4. ALL LEVELS IN THIS CONTRACT ARE AUSTRALIAN HEIGHT DATUM.
5. LEVELS FOR CONNECTION TO EXISTING WORKS MAY BE VARIED WHERE NECESSARY ON SITE TO ACHIEVE A SATISFACTORY SMOOTH FINISH TO THE EXISTING WORKS.
6. ALL MATERIALS SHALL BE TRANSPORTED ONLY ON ROUTES APPROVED BY COUNCIL.
7. METHOD OF DISPOSAL OF ALL WASTE MATERIALS SHALL BE TO COUNCIL'S SATISFACTION.
8. ALL LEVELS ARE DTM DERIVED FOR LAYOUTS, LONGITUDINAL SECTIONS AND CROSS SECTIONS. CONTRACTOR TO CONFIRM ON SITE BEFORE CONSTRUCTION.
9. DEVELOPER TO APPOINT CONTRACT FOR ALL FENCING AND LANDSCAPING IF REQUIRED.

EARTHWORKS

10. ALL FILL AREAS SHALL BE COMPACTED TO 95% STD. ALL EXCESS SPOIL TO BE PLACED AS DIRECTED BY THE SITE SUPERINTENDENT. ALL FILL UNDER ROADS SHALL BE 100% STANDARD COMPACTION. LEVEL 1 GTA CONTROL AND CERTIFICATE FOR "CONTROLLED FILL" IS AS PER AUSTRALIAN STANDARD NO. 3798.
11. ALL EARTHWORKS QUANTITIES ARE SOLID FILL.
12. EARTHWORKS SPOIL IS TO BE STOCKPILED AS DIRECTED BY THE SUPERINTENDENT. TOPSOIL IS TO BE STRIPPED TO A DEPTH OF 75mm AND STOCKPILED FOR LATER RESPREADING. AREAS REQUIRED FILLING OR ROADWORKS ARE TO BE STRIPPED AND VEGETATION IN OTHER AREAS SHALL BE RETAINED.
13. NOT WITHSTANDING THE LIMITS OF CUTTING AND FILLING SHOWN ON THE DRAWINGS, THE ACTUAL LIMITS SHALL BE DETERMINED ON SITE BY THE SUPERINTENDENT DURING CONSTRUCTION. SIMILARLY, FINISHED SURFACE LEVELS FOR ALLOTMENTS MAY BE ADJUSTED BY A WRITTEN DIRECTION OF THE SUPERINTENDENT DURING CONSTRUCTION (REFER JOB SPECIFICATION).
14. SILT FENCING IS TO BE PLACED ON THE DOWN STREAM SIDE OF ALL STOCKPILE SITES AND AN ADEQUATE CUTOFF DRAIN IS TO BE PLACED ON THE UPSTREAM SIDE OF ALL STOCKPILE SITES.



NOTE: CONSTRUCTION OF SUBDIVISION TO BE IN COMPLIANCE WITH THE CMDG STANDARD SPECIFICATIONS AND DRAWING STANDARDS.

FOR APPROVAL

No	DATE	REVISIONS	REC.	APPR.
C	14/07/08	DRAINAGE RESERVE AMENDED	CWS	CWS
B	03/06/08	ACCESS EASEMENT ADDED	CWS	CWS
A	26/07/07	FOR CONSTRUCTION	CWS	CGF

DRAWN: C. SHIELDS
DESIGNED: C. SHIELDS
CHECKED: C. FRANKLIN
A1 DATUM:
RECOMMENDED: PROJECT MANAGER C. FRANKLIN
APPROVED: PROJECT DIRECTOR

Cardno

Cardno (Qld) Pty Ltd

J & K RUNDLE

BULK EARTHWORKS & CHANNEL REPROFILING
LOT 2 ON RP618770

GENERAL LAYOUT PLAN

DATE: 26/07/07
DRAWING No:
439101-153-001
Rev C

FILL MANAGEMENT NOTES

1. THE FILL MATERIAL WILL COMPRISE ONLY NATURAL EARTH AND ROCK AND SHALL BE FREE OF CONTAMINANTS, NOXIOUS, HAZARDOUS, DELETERIOUS AND ORGANIC MATERIAL AND SHALL BE FREE DRAINING
2. NO DEMOLITION MATERIAL TO BE USED AS FILL MATERIAL
3. THE FILL SHALL BE COMPACTED IN LAYERS NOT EXCEEDING 300MM AND TO A MINIMUM OF 95 % DRY DENSITY RATIO USING STANDARD COMPACTION AND IN ACCORDANCE WITH AS 1289 29 LEVEL 1 CERTIFICATION IS TO BE ACHIEVED
4. ANY VEHICLE EXITING THE DEVELOPMENT SITE SHALL PASS OVER THE TRUCK SHAKE DOWN FACILITY PRIOR TO EXITING THE SITE IN THE NOMINATED SHAKE DOWN AREA TO ENSURE NO MATERIAL IS DEPOSITED ONTO ROADWAYS.
5. THE PLACEMENT OF FILL IS TO BE EXECUTED SUCH THAT NUISANCE OR PONDING TO ADJOINING PROPERTY AND ROADS DOES NOT OCCUR
6. FILLING WORKS WITHIN THE SITE SHALL ONLY TAKE PLACE BETWEEN THE HOURS OF: 6:30AM - 6:30PM MONDAY TO SATURDAY NO FILLING WORKS ON SUNDAY

SEDIMENT MANAGEMENT NOTES

1. TOPSOIL AND SUBSOIL SHOULD BE STOCKPILED SEPARATELY.
2. NO NET LOSS OF SEDIMENT SHOULD OCCUR FROM THE WORK SITE. THIS WILL NECESSITATE THE USE OF APPROPRIATE EROSION AND SEDIMENT CONTROLS. THESE SHOULD BE IMPLEMENTED AT THE SITE ESTABLISHMENT PHASE AND MAINTAINED THROUGHOUT THE CONSTRUCTION PERIOD
3. CARE SHOULD BE TAKEN TO PREVENT SEDIMENT FROM ENTERING THE STORMWATER SYSTEM. THIS MAY INVOLVE PLACING APPROPRIATE SEDIMENT CONTROLS AROUND STOCKPILES AND/OR SILT TRAPS AROUND GULLIES
4. CONSTRUCTION OF ALL SEDIMENT MANAGEMENT DEVICES, TO THE APPROVAL OF COUNCIL'S SUBDIVISION ENGINEER, SHALL BE COMPLETED AND EFFECTIVE PRIOR TO:
   (i) STRIPPING OF TOPSOIL AND GRASS
   (ii) BULK EARTHWORKS TO THE SITE
   (iii) SERVICES INSTALLATION
   (iv) ROAD PAVEMENT CONSTRUCTION
5. ALL SEDIMENT MANAGEMENT MEASURES ARE TO REMAIN IN PLACE UNTIL INSTRUCTION IS RECEIVED IN WRITING FROM THE ENGINEER TO REMOVE ALL/PART OF THE SILT CONTROL APPLICATIONS.
6. BOTH TEMPORARY AND PERMANENT SEDIMENT MANAGEMENT/EROSION CONTROL DEVICES SHALL BE MAINTAINED AT A SUITABLE LEVEL/CONDITION THROUGHOUT CONSTRUCTION TO THE SATISFACTION OF THE COUNCIL'S SUBDIVISION ENGINEER.
7. ALL WORK TO BE IN ACCORDANCE WITH LOCAL COUNCIL'S REQUIREMENTS FOR URBAN EROSION AND SEDIMENT CONTROL.
8. SEDIMENT MANAGEMENT MEASURES ARE TO BE MAINTAINED THROUGHOUT THE MAINTENANCE PERIOD
9. ROADWAY GULLY INLETS SHALL BE PROVIDED WITH TEMPORARY INLET PROTECTION DURING CONSTRUCTION (REFER DETAIL ON JOB DRAWINGS OR APPROVED EQUIVALENT)
10. TURF STRIPS (0.600M WIDE) ARE TO BE PLACED BEHIND THE BACK OF KERB/KERB AND CHANNEL ALONG ITS FULL LENGTH
11. PRIOR TO START OF CONSTRUCTION THE CONTRACTOR SHALL OBTAIN APPROVAL FROM COUNCIL FOR THE NOMINATED LOCATIONS OF ACCESS POINTS AND WASH DOWN ZONE.
12. THE APPROVED SITE ACCESS POINTS SHALL BE ESTABLISHED PRIOR TO ANY WORKS BEING CARRIED OUT AND ADEQUATELY MAINTAINED THROUGHOUT CONSTRUCTION.
13. SEDIMENT CONTROL FENCES ARE TO BE INSTALLED AROUND AREAS OF FILL AND STOCKPILES

NOTES

1. EARTHWORKS BATTERS, GENERALLY SHALL NOT EXCEED A SLOPE OF 4H. TO 1V. HOWEVER IF AN EARTH BATTER IS CONSTRUCTED STEEPER, THE BATTER SHALL BE TOPSOILED AND TURFED / HYDROMULCHED IMMEDIATELY THE EARTHWORKS ARE COMPLETED
2. RETAIN AND PROTECT, DURING ANY CONSTRUCTION ACTIVITIES ALL EXISTING VEGETATION OUTSIDE THE LIMIT OF THE EARTHWORKS

ENVIRONMENTAL MANAGEMENT NOTES

NOISE
ALL NOISE GENERATING MOBILE AND STATIONARY PLANT AND EQUIPMENT AND PROCESSES SHALL BE CONTROLLED TO MINIMISED NOISE EMISSION IN ACCORDANCE WITH AS2436 GUIDE TO NOISE CONTROL ON CONSTRUCTION, MAINTENANCE AND DEMOLITION SITES. SITE WORKING HOURS SHALL BE AS FOLLOWS:
MONDAY-SATURDAY 6.30AM TO 6.30PM
SUNDAY NO WORK PERMITTED

DUST
THE CONTRACTOR SHALL PROVIDE WATER TRUCKS, AS REQUIRED, TO MINIMISE OR ELIMINATE THE DUST PROBLEMS CAUSED BY ON SITE TRAFFIC MOVEMENT AND DRY AND WINDY WEATHER CONDITIONS.

WASTE MANAGEMENT
SERVICING OF VEHICLES IS TO TAKE PLACE IN DEFINED LOCATIONS. PETROLEUM PRODUCTS ARE TO BE STORED IN A SECURE, BUNDED COMPOUND. FOLLOWING THE COMPLETION OF WORKS ALL CONSTRUCTION WASTE IS TO BE REMOVED FROM THE SITE AND DISPOSED OF AT A WASTE DISPOSAL FACILITY.

EARTHWORKS AND ROADWORKS NOTES

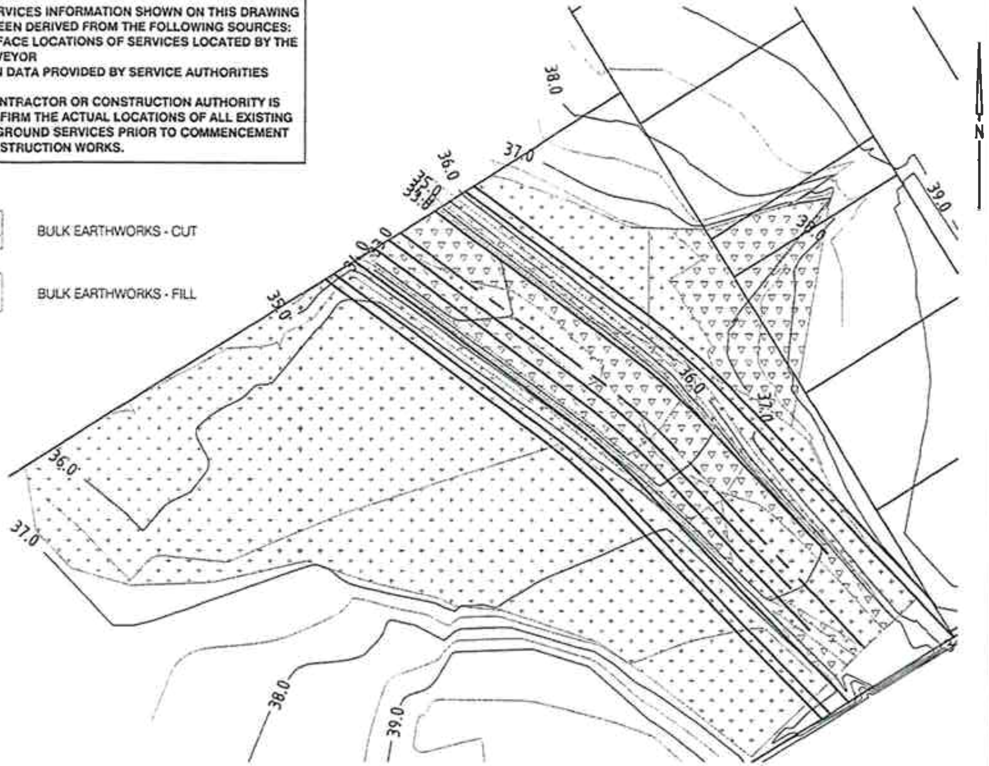
1. CONTROL TESTING OF EARTHWORKS SHALL BE UNDERTAKEN IN ACCORDANCE WITH AS 3798.
2. FILL SHALL BE PLACED AND COMPACTED TO THE FOLLOWING STANDARDS:
   (i) COHESIVE MATERIAL: ALLOTMENT FILL SHALL ACHIEVE A MINIMUM DRY DENSITY RATIO OF 98% OR HIGHER
3. ROADWORK EMBANKMENTS SHALL COMPACTED TO THE FOLLOWING STANDARD:
   (i) MINIMUM DRY DENSITY RATIO OF 95% FOR COHESIVE MATERIAL
   (ii) OR MINIMUM DRY DENSITY RATIO OF 80% FOR NON COHESIVE MATERIAL TO A DEPTH OF 300mm BELOW SUBGRADE LEVEL.
4. FIELD DENSITY TEST SHALL BE UNDERTAKEN AT THE FOLLOWING MINIMUM FREQUENCY
   (i) TYPE 1 LARGE SCALE OPERATIONS LOT FILLINGS AND ROAD EMBANKMENTS
   (a) 1 TEST PER LAYER OR 200mm THICKNESS PER MATTERIAL TYPE PER 2500m² OR,
   (b) 1 TEST PER 500m³ DISTRIBUTED REASONABLY EVENLY THROUGHOUT FULL DEPTH AND AREA OR,
   (c) 3 TEST PER VISIT WHICHEVER REQUIRES THE MOST TESTS.
5. ROAD PAVEMENT SHALL BE PLACED AND COMPACTED TO ACHIEVE A MINIMUM DRY DENSITY RATIO (M.D.D.R.) OF 100% STANDARD.

NOTE: CONSTRUCTION OF SUBDIVISION TO BE IN COMPLIANCE WITH THE CMDG STANDARD SPECIFICATIONS AND DRAWING STANDARDS

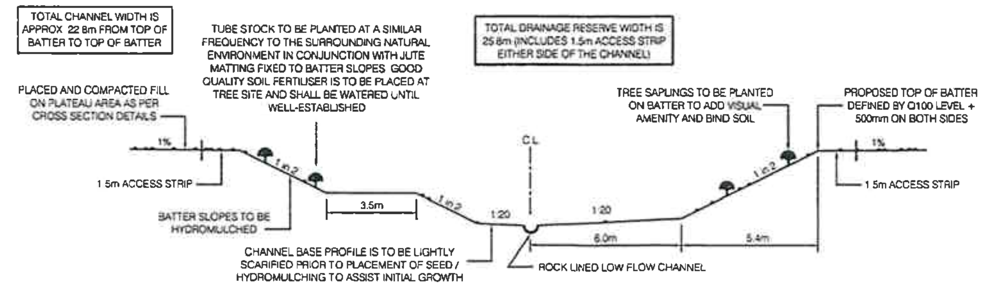
NOTE:
THE SERVICES INFORMATION SHOWN ON THIS DRAWING HAVE BEEN DERIVED FROM THE FOLLOWING SOURCES:
- **SURFACE LOCATIONS OF SERVICES LOCATED BY THE SURVEYOR**
- **PLAN DATA PROVIDED BY SERVICE AUTHORITIES**

THE CONTRACTOR OR CONSTRUCTION AUTHORITY IS TO CONFIRM THE ACTUAL LOCATIONS OF ALL EXISTING UNDERGROUND SERVICES PRIOR TO COMMENCEMENT OF CONSTRUCTION WORKS.

BULK EARTHWORKS - CUT
BULK EARTHWORKS - FILL



LAYOUT PLAN
1:400 A1
1:800 A3



CHANNEL TYPICAL SECTION
1:100 A1
1:200 A3

FOR APPROVAL

Rev	DATE	REVISIONS		
C	14/07/08	CHANNEL PROFILE AMENDED	CWS	CWS
B	03/06/08	CHANNEL PROFILE AMENDED	CWS	CWS
A	26/07/07	FOR CONSTRUCTION	CWS	CGF

DRAWN: C. SHIELDS
DESIGNED: C. SHIELDS
CHECKED: C. FRANKLIN
A1 DATUM:
RECOMMENDED: PROJECT MANAGER C. FRANKLIN
APPROVED: PROJECT DIRECTOR STUART GOAK
439101-153-002 (C) Earthworks Plan.dwg

Cardno
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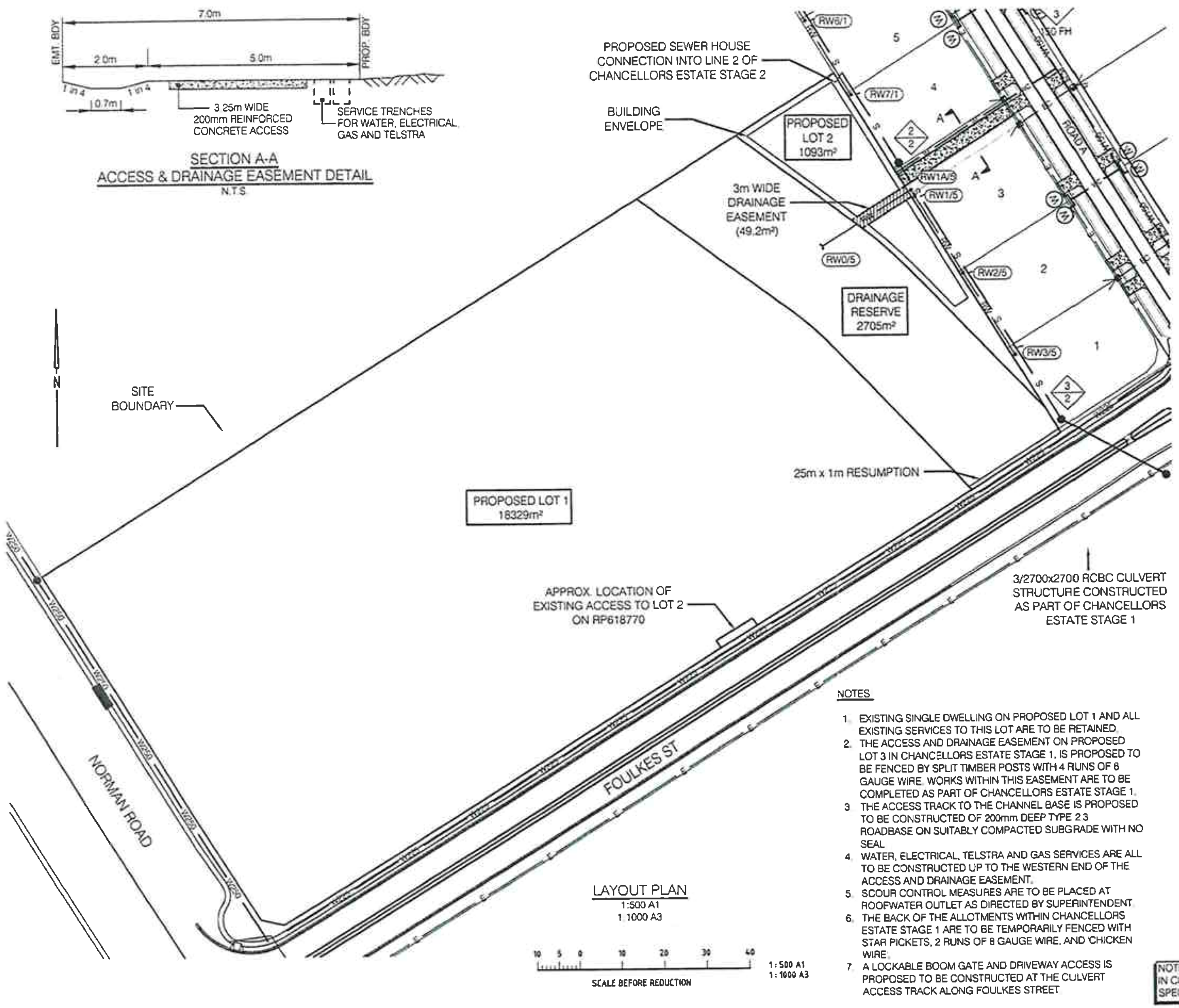
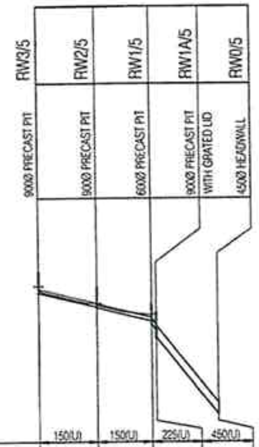
Email: rocky@cardno.com.au

J & K RUNDLE
BULK EARTHWORKS & CHANNEL REPROFILING
LOT 2 ON RP618770
EARTHWORKS PLAN
DATE: 26/07/07
DRAWING No:
439101-153-002
Rev C



ROOFWATER SETOUT TABLE

PIT NUMBER	EASTING	NORTHING
RW 0/5	5120.098	5182.520
RW1A/5	5141.218	5195.711
RW 1/5	5142.165	5194.180
RW 2/5	5153.477	5175.912
RW 3/5	5165.593	5156.346



STRUCTURE NAME	RW3/5	RW2/5	RW1/5	RW1A/5	RW0/5
STRUCTURE DESCRIPTION	900Ø PRECAST PIT	900Ø PRECAST PIT	600Ø PRECAST PIT	900Ø PRECAST PIT WITH GRATED LID	450Ø HEADWALL
WATER LEVEL IN STRUCTURE	38.217	37.527	37.092	-	-
HYDRAULIC GRADE LEVEL	38.217 / 38.103	37.526 / 37.508	37.076 / 37.063	-	-
DEPTH TO INVERT	0.849	0.849 / 0.869	0.696 / 0.771	0.825 / 1.050	0.000 BACKFILL HEADWALL
INVERT LEVEL OF DRAIN	37.553	37.378 / 37.358	36.821 / 36.746	36.425 / 36.200	33.190
DESIGN SURFACE LEVEL	38.602	38.227	37.517	37.250	33.190
ROAD CHAINAGE (Offset)	-	-	-	-	-
RUNNING CHAINAGE	0.000	23.014	44.501	46.301	71.201

	RW3/5 – RW2/5	RW2/5 – RW1/5	RW1/5 – RW1A/5	RW1A/5 – RW0/5
PIPE SIZEmm (Class)	150(U)	150(U)	225(U)	450(U)
PIPE GRADE %	2.50%	2.50%	17.83%	12.09%
PIPE SLOPE 1 in X	40.00	40.00	5.61	8.27
FULL PIPE FLOW VELOCITY (m/s)	0.53	1.07	-	-
PART FULL FLOW VELOCITY (m/s)	1.46	1.75	-	-
PIPE FLOW (Cumecs)	0.010	0.020	-	-
PIPE CAPACITY AT GRADE (Cumecs)	0.031	0.031	-	-
Length	23.014	21.487	1.800	24.900

RL 28.000 AHD

LINE 5

NOTES

1. EXISTING SINGLE DWELLING ON PROPOSED LOT 1 AND ALL EXISTING SERVICES TO THIS LOT ARE TO BE RETAINED.
2. THE ACCESS AND DRAINAGE EASEMENT ON PROPOSED LOT 3 IN CHANCELLORS ESTATE STAGE 1, IS PROPOSED TO BE FENCED BY SPLIT TIMBER POSTS WITH 4 RUNS OF 8 GAUGE WIRE. WORKS WITHIN THIS EASEMENT ARE TO BE COMPLETED AS PART OF CHANCELLORS ESTATE STAGE 1.
3. THE ACCESS TRACK TO THE CHANNEL BASE IS PROPOSED TO BE CONSTRUCTED OF 200mm DEEP TYPE 2.3 ROADBASE ON SUITABLY COMPACTED SUBGRADE WITH NO SEAL.
4. WATER, ELECTRICAL, TELSTRA AND GAS SERVICES ARE ALL TO BE CONSTRUCTED UP TO THE WESTERN END OF THE ACCESS AND DRAINAGE EASEMENT.
5. SCOUR CONTROL MEASURES ARE TO BE PLACED AT ROOFWATER OUTLET AS DIRECTED BY SUPERINTENDENT.
6. THE BACK OF THE ALLOTMENTS WITHIN CHANCELLORS ESTATE STAGE 1 ARE TO BE TEMPORARILY FENCED WITH STAR PICKETS, 2 RUNS OF 8 GAUGE WIRE, AND CHICKEN WIRE.
7. A LOCKABLE BOOM GATE AND DRIVEWAY ACCESS IS PROPOSED TO BE CONSTRUCTED AT THE CULVERT ACCESS TRACK ALONG FOULKES STREET

NOTE: CONSTRUCTION OF SUBDIVISION TO BE IN COMPLIANCE WITH THE CMDG STANDARD SPECIFICATIONS AND DRAWING STANDARDS.

FOR APPROVAL

Rev	DATE	REVISIONS		
C	14/07/08	DRAINAGE RESERVE AMENDED	CWS	CWS
B	03/05/08	DRAINAGE EASEMENT AMENDED	CWS	CWS
A	25/07/07	FOR CONSTRUCTION	CWS	CCF
			REC.	APPR.

DRAWN: C. SHIELDS
DESIGNED: C. SHIELDS
CHECKED: C. FRANKLIN
A1 DATUM:
RECOMMENDED: PROJECT MANAGER C. FRANKLIN
APPROVED: PROJECT DIRECTOR STUART DOAK RPEQ 3227

439101-153-003 (C) Services and Reconfiguration Details.dwg

Cardno

Cardno (Qld) Pty Ltd ACN 051 074 992
1 Aquatic Place, North Rockhampton Q 4701
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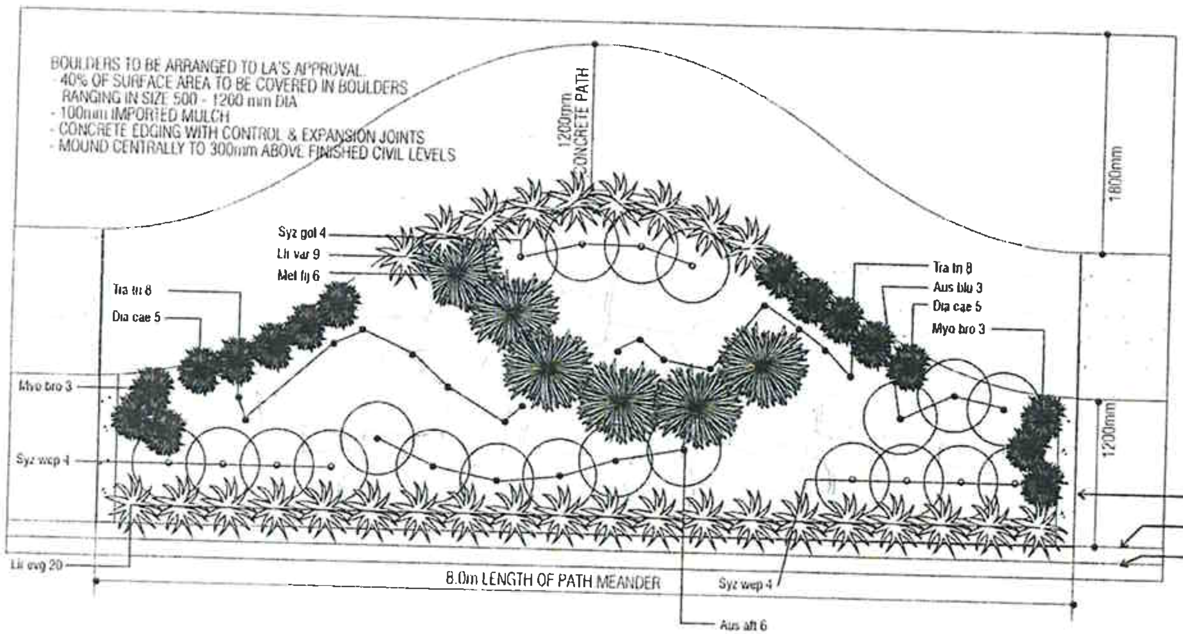
J & K RUNDLE
BULK EARTHWORKS & CHANNEL REPROFILING
LOT 2 ON RP618770
SERVICES AND RECONFIGURATION DETAILS

DATE: 25/07/07
DRAWING No
439101-153-003
C

Appendix B

Landscaping Drawings



3 BOULDER FEATURES - PATH MEANDER PLAN / TYPICAL SETOUT

SCALE 1:40

PLANTING SCHEDULE

CODE	BOTANICAL NAME	POT SIZE	PER ROCK FEATURE	TOTAL ROCK FEATURES 17NO.	TOTAL SWALE FEATURES 3NO.	ENTRY & NORTH BK	STH BANK and STH CULVERT	TOTAL STI ESTATE
Aus blu	Austromyrtus 'Blushing Beauty'	140mm	3 no.	51 no.	0 no.	14 no.	0 no.	65 no.
Aus ino	Austromyrtus inophloia	140mm	0 no.	0 no.	0 no.	14 no.	0 no.	14 no.
Aus aft	Austromyrtus acmenoides 'Afterglow'	140mm	6 no.	102 no.	0 no.	14 no.	0 no.	116 no.
Cal daw	Callistemon "Dawson River Weeper'	140mm	0 no.	0 no.	0 no.	14 no.	0 no.	14 no.
Cri ped	Crinum pedunculatum; Spider lily	140mm	0 no.	0 no.	0 no.	200 no.	200 no.	400 no.
Dia bre	Dianella brevipedunculata	140mm	0 no.	0 no.	0 no.	14 no.	200 no. (75mm)	214 no.
Dia cae	Dianella caerulia	140mm	10 no.	170 no.	0 no.	14 no.	0 no.	184 no.
Gre poo	Grevillea 'Poorinda Royal Mantle'	75mm	0 no.	0 no.	0 no.	400 no.	0 no.	400 no.
Lir var	Liriope muscari 'Variegata"	140mm	9 no.	153 no.	66 no.	0 no.	0 no.	219 no.
Lir evg	Liriope muscari 'Evergreen Giant'	140mm	20 no.	340 no.	186 no.	94 no.	0 no.	620 no.
Lir isa	Liriope 'Isabella'	140mm	0 no.	0 no.	0 no.	14 no.	0 no.	14 no.
Lom con	Lomandra confertifolia	75mm	0 no.	0 no.	0 no.	700 no.	400 no.	1100 no.
Lom ela	Lomandra elongata	75mm	0 no.	0 no.	0 no.	500 no.	200 no.	700 no.
Lom hys	Lomandra hystrix	75mm	0 no.	0 no.	0 no.	500 no.	200 no.	700 no.
Lom lon	Lomandra longifolia	75mm	0 no.	0 no.	0 no.	500 no.	200 no.	700 no.
Mel fij	Metrosideros 'Fiji Fire'	140mm	6 no.	102 no.	36 no.	14 no.	0 no.	152 no.
Myo bro	Myoporum parvifolium 'broad leaf'	140mm	6 no.	102 no.	0 no.	0 no.	0 no.	102 no.
Myo par	Myoporum parvifolium fine leaf'	140mm	0 no.	0 no.	78 no.	0 no.	0 no.	78 no.
Syz gol	Syzigium Hinterland Gold	140mm	4 no.	68 no.	0 no.	14 no.	0 no.	82 no.
Syz wep	Syzigium Weeping Gem	140mm	8 no.	136 no.	36 no.	14 no.	0 no.	186 no.
Syz lit	Syzigium Little Gem	140mm	0 no.	0 no.	30 no.	14 no.	0 no.	44 no.
Tra tri	Trachelospermum jasminoides tricolor	140mm	16 no.	272 no.	0 no.	0 no.	0 no.	272 no.

REVISION	ISSUE DATE	AMENDMENT
E	14.02.08	PLANTING DETAIL
D	17.10.07	AMEND PAVER
C	15.06.07	OP WORKS TENDER
B	12.01.07	FOR REVIEW
A	02.01.07	PRELIMINARY

FOR OP WORKS APPROVAL / TENDER PURPOSES ONLY NOT FOR CONSTRUCTION

PROJECT

NORMAN ROAD, ROCKHAMPTON

CHANCELLORS ESTATE - STAGE 1

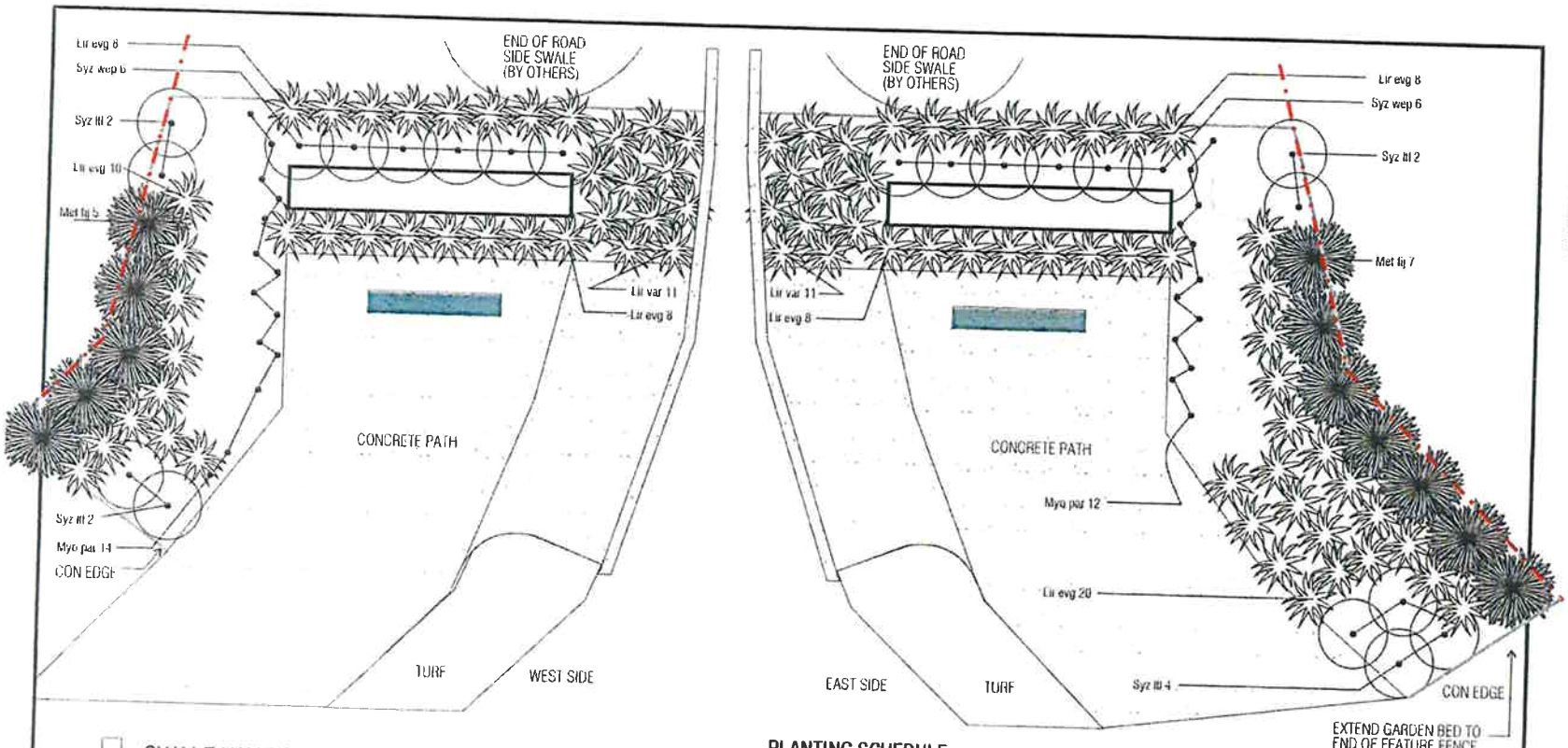
DRAWING TITLE:

LANDSCAPE OP WORKS

PLANTING PLAN

FEBRUARY 2008
DRAWING NO: LDOC 636 1500

Design Instincts

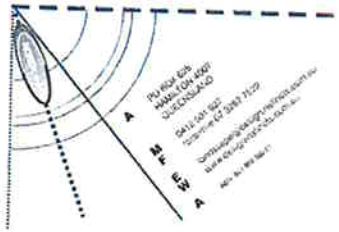


3 SWALE WALLS - KEY PLAN - TYPICAL PLANTING SETOUT

SCALE 1:40

PLANTING SCHEDULE

CODE	BOTANICAL NAME	POT SIZE	PER ROCK FEATURE	TOTAL ROCK FEATURES 17NO.	TOTAL SWALE FEATURES 3NO.	ENTRY & NORTH BK	STH BANK and STH CULVERT	TOTAL ST1 ESTATE
Aus blu	Austromyrtus 'Blushing Beauty'	140mm	3 no.	51 no	0 no.	14 no.	0 no.	65 no.
Aus mo	Austromyrtus inophiloia	140mm	0 no.	0 no.	0 no.	14 no.	0 no	14 no
Aus alt	Austromyrtus acmenioides 'Afterglow'	140mm	6 no.	102 no	0 no.	14 no.	0 no.	116 no.
Cal daw	Callistemon 'Dawson River Weeper'	140mm	0 no.	0 no.	0 no	14 no	0 no.	14 no.
Cri ped	Crinum pedunculatum; Spider lily	140mm	0 no.	0 no.	0 no	200 no.	200 no.	400 no.
Dia bre	Dianella brevipedunculata	140mm	0 no.	0 no.	0 no	14 no	200 no. (75mm)	214 no.
Dia cae	Dianella caerulia	140mm	10 no.	170 no.	0 no	14 no.	0 no.	184 no.
Gre poo	Grevillea 'Poorinda Royal Mantle'	75mm	0 no.	0 no.	0 no.	400 no	0 no.	400 no.
Lir var	Liriope muscari 'Variegata'	140mm	9 no.	153 no.	66 no.	0 no.	0 no.	219 no.
Lir evg	Liriope muscari 'Evergreen Giant'	140mm	20 no	340 no.	186 no.	94 no.	0 no.	620 no.
Lir isa	Liriope 'Isabella'	140mm	0 no.	0 no.	0 no.	14 no.	0 no	14 no.
Lom con	Lomandra confertifolia	75mm	0 no.	0 no	0 no.	700 no	400 no.	1100 no.
Lom ela	Lomandra elongata	75mm	0 no.	0 no.	0 no.	500 no.	200 no.	700 no.
Lom hys	Lomandra hystrix	75mm	0 no.	0 no.	0 no.	500 no.	200 no.	700 no.
Lom lon	Lomandra longifolia	75mm	0 no.	0 no.	0 no	500 no.	200 no.	700 no.
Met fij	Metrosideros 'Fiji Fire'	140mm	6 no	102 no	36 no.	14 no	0 no.	152 no
Myo bro	Myoporum pavifolium 'broad leaf'	140mm	6 no.	102 no.	0 no	0 no.	0 no.	102 no.
Myo par	Myoporum parvifolium 'fine leaf'	140mm	0 no.	0 no.	78 no	0 no	0 no	78 no
Syz gol	Syzigium Hinterland Gold	140mm	4 no	68 no.	0 no.	14 no	0 no.	82 no.
Syz wep	Syzigium Weeping Gum	140mm	8 no.	136 no.	36 no.	14 no.	0 no.	186 no.
Syz ltl	Syzigium Little Gem	140mm	0 no	0 no.	30 no.	14 no.	0 no	44 no
Tra lri	Trachelospermum jasminoides tricolor	140mm	16 no.	272 no.	0 no.	0 no	0 no.	272 no.



REVISION	ISSUE DATE	AMENDMENT
E	14.02.08	PLANTING DETAIL
D	07.12.07	AMEND LAYER
C	19.11.07	OP WKS TENDER
B	12.01.07	FOR REVIEW
A	02.01.07	PRELIMINARY

FOR OP WORKS APPROVAL / TENDER PURPOSES ONLY
NOT FOR CONSTRUCTION

CLIENT: Jayness Pty Ltd
ENGINEERING: Cardno
LANDSCAPE ARCHITECTS: Design Instincts
SURVEYORS: Cadastral Surveys

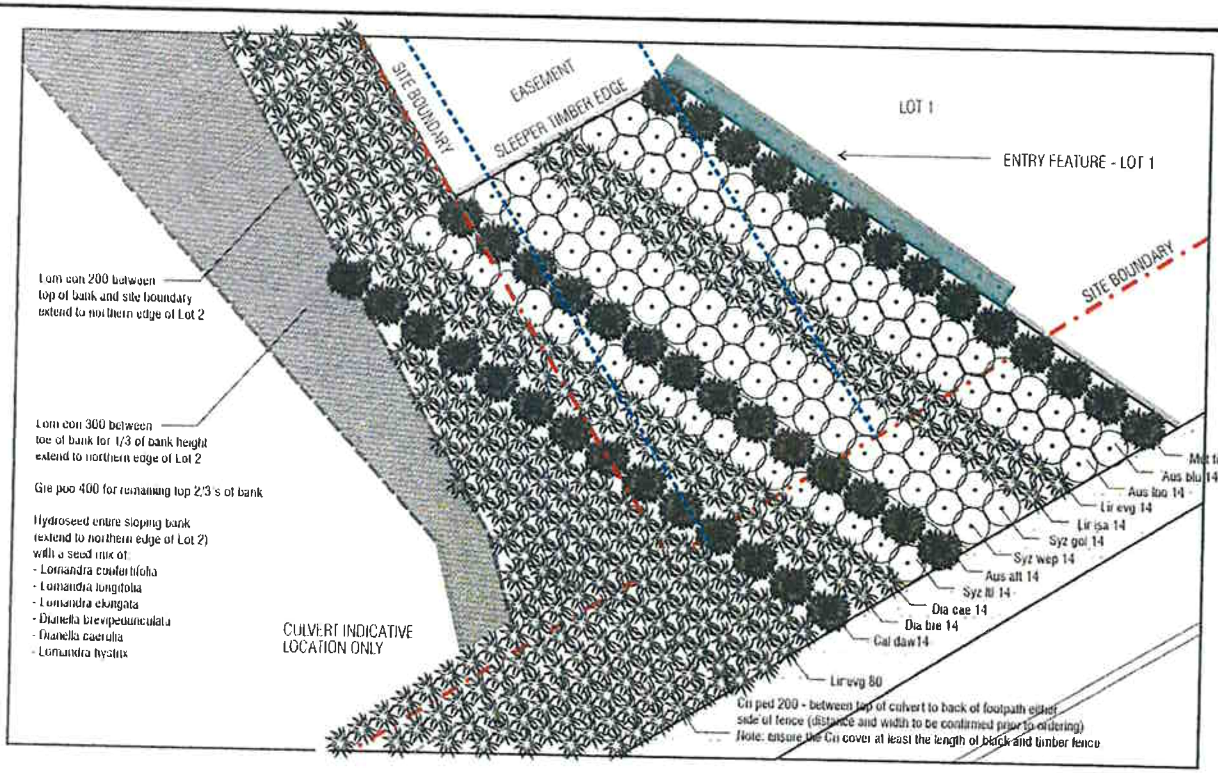
PROJECT
NORMAN ROAD, ROCKHAMPTON
CHANCELLORS ESTATE - STAGE 1

DRAWING TITLE:

LANDSCAPE OP WORKS
PLANTING PLAN

FEBRUARY 2008
DRAWING NO: LDOC 636 1600

Design Instincts
LANDSCAPE ARCHITECTS



3 ENTRY FEATURE - LOT 1 - (NORTH EAST SIDE OF CULVERT)

SCALE 1:80

TYPICAL PLANTING SETOUT

SOUTH SIDE OF CULVERT
Cri ped 200 - between top of culvert to back of kerb either side of fence (distance and width to be confirmed prior to ordering) Note: ensure the Cri cover at least the length of black fence

NORTH WEST AND SOUTH SIDE OF CULVERT
Tube stock planting and hydroseeding on banks
Lom con 200 to top of banks northwest and southeast and southwest wing.

Hydroseed entire sloping bank with a seed mix of:
- Lomandra confertifolia
- Lomandra longifolia
- Lomandra elongata
- Dianella brevipedunculata
- Dianella caerulia
- Lomandra hystrix

SOUTH SIDE OF FOULKES ST
75mm stock with hoop pine curls:
Lomandra confertifolia 200
Lomandra longifolia 200
Lomandra elongata 200
Dianella brevipedunculata 200
Dianella caerulia 200
Lomandra hystrix 200

PLANTING SCHEDULE

CODE	BOTANICAL NAME	POT SIZE	PER ROCK FEATURE	TOTAL ROCK FEATURES 17NO.	TOTAL SWALE FEATURES 3NO.	ENTRY & NORTH BK	STH BANK and STH CULVERT	TOTAL ST1 ESTATE
Aus blu	Austromyrtus 'Blushing Beauty'	140mm	3 no.	51 no	0 no.	14 no.	0 no	65 no
Aus ino	Austromyrtus inophloia	140mm	0 no.	0 no.	0 no.	14 no.	0 no	14 no
Aus aft	Austromyrtus acmenoides 'Afterglow'	140mm	6 no.	102 no.	0 no.	14 no.	0 no.	116 no
Cal daw	Callistemon "Dawson River Weeper'	140mm	0 no.	0 no.	0 no.	14 no.	0 no.	14 no.
Cri ped	Crinum pedunculatum; Spider lily	140mm	0 no	0 no.	0 no	200 no	200 no	400 no.
Dia bre	Dianella brevipedunculata	140mm	0 no.	0 no.	0 no	14 no.	200 no. (75mm)	214 no.
Dia cae	Dianella caerulia	140mm	10 no.	170 no	0 no	14 no.	0 no.	184 no.
Gre poo	Grevillea 'Poorinda Royal Mantle'	75mm	0 no.	0 no.	0 no	400 no	0 no.	400 no.
Lir var	Liriope muscari 'Variegata"	140mm	9 no.	153 no.	66 no.	0 no.	0 no.	219 no.
Lir evg	Liriope muscari 'Evergreen Giant'	140mm	20 no	340 no.	186 no.	94 no	0 no.	620 no.
Lir isa	Liriope 'Isabella'	140mm	0 no.	0 no	0 no.	14 no.	0 no.	14 no
Lom con	Lomandra confertifolia	75mm	0 no.	0 no.	0 no.	700 no	400 no	1100 no.
Lom ela	Lomandra elongata	75mm	0 no.	0 no.	0 no	500 no.	200 no.	700 no.
Lom hys	Lomandra hystrix	75mm	0 no.	0 no.	0 no.	500 no.	200 no	700 no.
Lom lon	Lomandra longifolia	75mm	0 no.	0 no.	0 no.	500 no.	200 no.	700 no.
Met fij	Metrosideros 'Fiji Fire'	140mm	6 no.	102 no	36 no.	14 no.	0 no.	152 no.
Myo bro	Myoporum pavifolium 'broad leaf'	140mm	6 no.	102 no	0 no	0 no.	0 no.	102 no
Myo par	Myoporum parvifolium fine leaf'	140mm	0 no.	0 no	78 no.	0 no	0 no.	78 no.
Syz gol	Syzigium Hinterland Gold	140mm	4 no.	68 no.	0 no	14 no	0 no	82 no
Syz wep	Syzigium Weeping Gem	140mm	8 no	136 no.	36 no	14 no.	0 no	186 no.
Syz lil	Syzigium Little Gem	140mm	0 no	0 no.	30 no	14 no	0 no.	44 no.
Tra tri	Trachelospermum jasminoides tricolor	140mm	16 no.	272 no.	0 no.	0 no.	0 no	272 no

FOR OP WORKS APPROVAL
TENDER PURPOSES ONLY
NOT FOR CONSTRUCTION

PROJECT
NORMAN ROAD, ROCKHAMPTON
CHANCELLORS ESTATE - STAGE 1

DRAWING TITLE:
LANDSCAPE OP WORKS
PLANTING PLAN

FEBRUARY 2008
DRAWING NO: LDOC 636 1700

Design Instincts

MaxJute™ thick

soil stabilisation & mulching mat

Benefits

HALTS EROSION
Exposed soils are protected with biodegradable Ma
thick, providing erosion control for up to 18 mont

MULCHES
MaxJute™ thick acts as a roll-on mulch, adding org
matter to the soil as it breaks down. Suppress mos
weeds while planted vegetation is establishing.

RETAINS WATER
MaxJute™ thick greatly reduces moisture loss due t
evaporation, and conforms to the contours of the g

100% ORGANIC
MaxJute™ thick contains no plastic meshes and will
entangle wildlife or machinery.

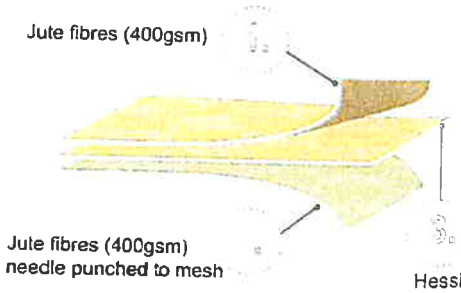
OTHER FEATURES
Reduces heat absorption, helping to protect plant
Flexible and strong when being laid.

Specifications

Name	MaxJute™ thick
Material	100% organic biodegradabl jute fibres. Needle-punched high den matting. Brown colour.
Construction	Central hessian (3oz) scrim and lower layers of jute fi needle-punched onto the
Mass	750–800gsm (nominal)
Density	110–120kg/m² (nominal)
Pinning rate	3 pins per m² (see Installation Sheet)

Dimensions	**Length**	**Width**	Ar
Standard	25m	1.83m	45
Wide	25m	3.66m	9
Narrow	25m	0.9m	2

Available in other widths on request. Also avail
weed mat squares, under the brand name 'Max-
Contact Treemax sales staff for fire-retardant op
Caution advised where fire is a risk.



Field tip

> Preliminary weed control is essential before installation. Several weed species may have the ability to penetrate the matting. Examples are Paspalum spp, Allium spp (Onion weed), Kikuyu grass, Couch grass, some Secale spp (Rye) and Cyperus rotundas (Nut grass).

Appendix C

Approved Street Lighting Design for Chancellors Estate Stage 1

NOTES

ALL STREET LIGHTS ARE BASE PLATE MOUNTED UNLESS NOTED OTHERWISE
OUTREACHES ARE TO BE ADJUSTED PERPENDICULAR TO THE KERB
CONDUIT DEPTHS, ALIGNMENTS, POLYMERIC PROTECTION BENDS AND OTHER TRENCHING DETAILS ARE TO BE REFERRED TO THE UNDERGROUND CONSTRUCTION MANUAL AND CIVIL WORKS SPECIFICATIONS AND DRAWINGS.

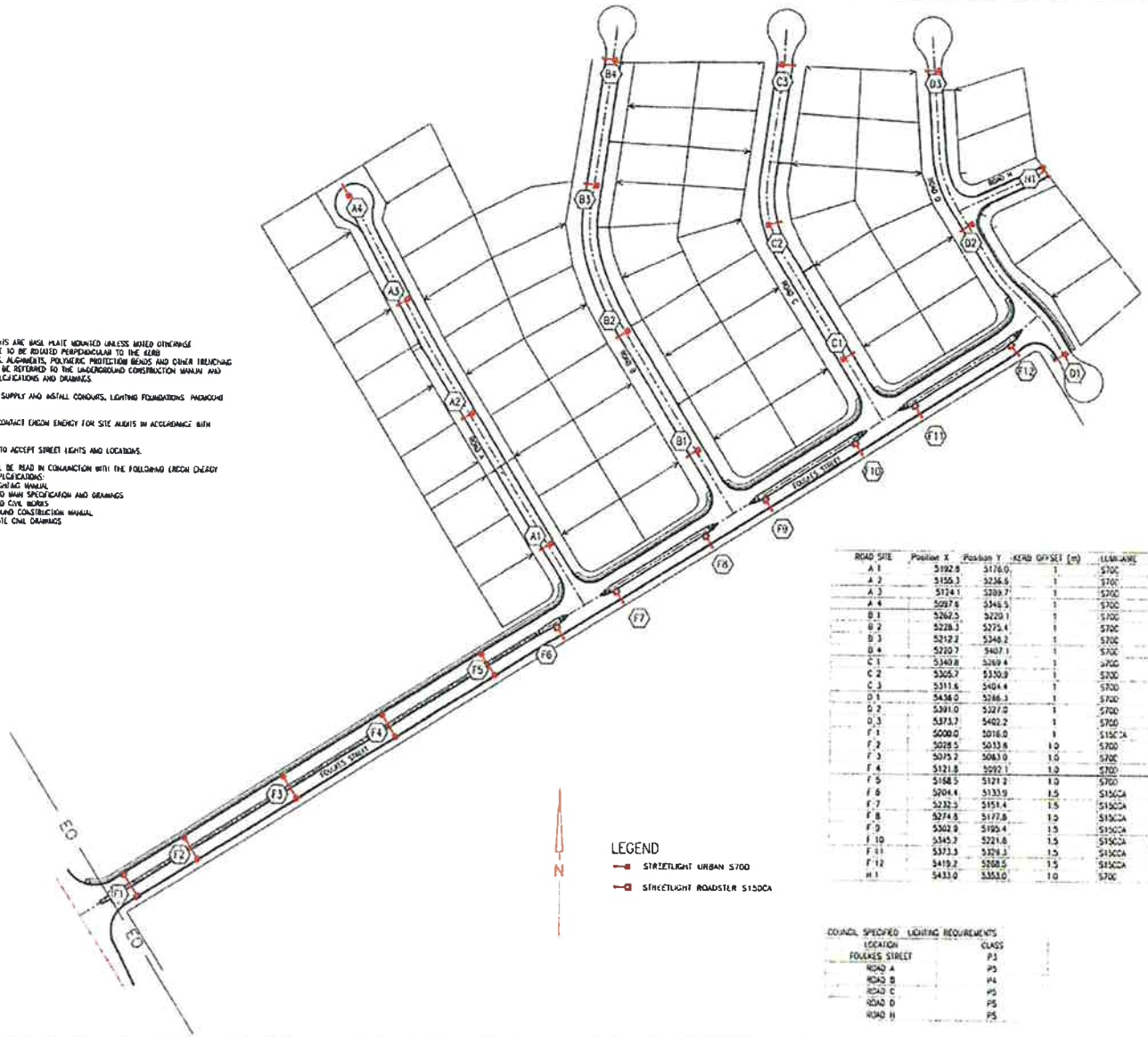
DEVELOPERS TO SUPPLY AND INSTALL CONDUITS, LIGHTING FOUNDATIONS PADMOUNT AND SITE FINISH

DEVELOPER TO CONTACT ENCOM ENERGY FOR SITE AUDITS IN ACCEARDANCE WITH RSC07

LOCAL COUNCIL TO ACCEPT STREET LIGHTS AND LOCATIONS.

THIS PLAN SHALL BE READ IN CONJUNCTION WITH THE FOLLOWING ENCOM ENERGY MANUALS AND SPECIFICATIONS:

- PUBLIC LIGHTING MANUAL
- RSC06 AND MAIN SPECIFICATION AND DRAWINGS
- RSC07 AND CIVIL WORKS
- UNDERGROUND CONSTRUCTION MANUAL
- APPROPRIATE CIVIL DRAWINGS



LEGEND

- STREETLIGHT URBAN S700
- STREETLIGHT ROADSTER S150CA

ROAD SITE	Position X	Position Y	KERB OFFSET (m)	LUMINAIRE	MOUNTING HEIGHT (m)	OUTREACH (m)	TYPE
A 1	5192.8	5178.0	1	S700	7.5	1.5	MINOR ROAD STREETLIGHT
A 2	5156.3	5236.6	1	S700	7.5	1.5	MINOR ROAD STREETLIGHT
A 3	5124.1	5289.7	1	S700	7.5	1.5	MINOR ROAD STREETLIGHT
A 4	5097.8	5346.5	1	S700	7.5	1.5	MINOR ROAD STREETLIGHT
B 1	5260.5	5220.1	1	S700	7.5	1.5	MINOR ROAD STREETLIGHT
B 2	5228.3	5275.4	1	S700	7.5	1.5	MINOR ROAD STREETLIGHT
B 3	5212.2	5348.2	1	S700	7.5	1.5	MINOR ROAD STREETLIGHT
B 4	5220.7	5407.1	1	S700	7.5	1.5	MINOR ROAD STREETLIGHT
C 1	5340.8	5269.4	1	S700	7.5	1.5	MINOR ROAD STREETLIGHT
C 2	5305.7	5350.9	1	S700	7.5	1.5	MINOR ROAD STREETLIGHT
C 3	5311.6	5404.4	1	S700	7.5	1.5	MINOR ROAD STREETLIGHT
D 1	5436.0	5286.3	1	S700	7.5	1.5	MINOR ROAD STREETLIGHT
D 2	5391.0	5327.0	1	S700	7.5	1.5	MINOR ROAD STREETLIGHT
D 3	5373.7	5402.2	1	S700	7.5	1.5	MINOR ROAD STREETLIGHT
F 1	5000.0	5016.0	1	S150CA	9	2 x 3	MAJOR ROAD STREETLIGHT
F 2	5028.5	5033.8	1.0	S700	7.5	2x1.5	MINOR ROAD STREETLIGHT
F 3	5075.2	5063.0	1.0	S700	7.5	2x1.5	MINOR ROAD STREETLIGHT
F 4	5121.8	5092.1	1.0	S700	7.5	2x1.5	MINOR ROAD STREETLIGHT
F 5	5168.5	5121.2	1.0	S700	7.5	2x1.5	MINOR ROAD STREETLIGHT
F 6	5204.4	5133.9	1.5	S150CA	9	3	MAJOR ROAD STREETLIGHT
F 7	5232.3	5151.4	1.5	S150CA	9	3	MAJOR ROAD STREETLIGHT
F 8	5274.5	5177.8	1.0	S150CA	9	3	MAJOR ROAD STREETLIGHT
F 9	5302.9	5195.4	1.5	S150CA	9	3	MAJOR ROAD STREETLIGHT
F 10	5345.7	5221.6	1.5	S150CA	9	3	MAJOR ROAD STREETLIGHT
F 11	5373.3	5239.1	1.5	S150CA	9	3	MAJOR ROAD STREETLIGHT
F 12	5419.2	5268.5	1.5	S150CA	9	3	MAJOR ROAD STREETLIGHT
H 1	5433.0	5353.0	1.0	S700	7.5	1.5	MINOR ROAD STREETLIGHT

COUNCIL SPECIFIED LIGHTING REQUIREMENTS

LOCATION	CLASS
FOULKES STREET	P3
ROAD A	P5
ROAD B	P4
ROAD C	P5
ROAD D	P5
ROAD H	P5

Approved Plans for
D737/2006 Date. 31/10/07
Authorised Signature
Manager Development Engineering

ISSUE	DESCRIPTION OF AMENDMENT	DATE	INITIAL
D	MINOR ROAD LUMINAIRES RELOCATED AS PER REQUEST	23.10.2007	DM
C	AMENDED COUNCIL REQUIREMENTS	20.09.2007	DM
B	CHANGES TO MINOR ROADWAYS AS REQUESTED	31.08.2007	DM
A	FOR APPROVAL	27.07.2007	DM

PUBLIC AREA LIGHTING TO AS/NZS1158 P3, P4 & P5 CLASSIFICATIONS AS APPROPRIATE.

ELECTRICAL DESIGN TO LINCOM DESIGN REQUIREMENTS 1000 MCCUTCHEON SPEC 5777

ELECTRICAL SERVICES

PUBLIC LIGHTING PLAN, PUBLIC LIGHTING SCHEDULE

Elecon
Electrical Design & Construct

CHANCELLOR ESTATE STAGE 1

DRAWN	DATE	SCALE
DM	23.10.2007	1:1000 at A1

DRAWING No. CHA7236-E100 ISSUE D

JOB No. CARDNO

APPROVED

Elecon

Electrical Design & Construct

Appendix D

Drainage Reserve Photo

Appendix E

Detailed Flood Study

Cardno
Shaping the Future

LOT 2 ON RP618770, ROCKHAMPTON

Flood Study

11 July 2008
Job No. R1031/01-3

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Document Control

Version	Date	Author		Reviewer	
		Name	Initials	Name	Initials
1	18 June 2008	Carlos Gonzalez	CG	Martin Giles	MG
2	11 July 2008	Carlos Gonzalez	C.G	Martin Giles	MG

NORMAN ROAD SUBDIVISION, ROCKHAMPTON
FLOOD STUDY ADDENDUM REPORT

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APPENDICES

1. INTRODUCTION

It is proposed by Mintgrove Pty Ltd to reconfigure a lot located on Norman Road and Foulkes Street, City of Rockhampton. The property, which is shown on Figure 1, is described as Lot 2 on RP618770, Rockhampton Regional Council.

As part of the application to reconfigure Lot 2 on RP618770, a hydrologic investigation was undertaken to determine the peak flow rates and flood levels corresponding to the 100, 50, 20, 10, 2, 5 and 1 year Average Recurrence Interval (ARI) events within the tributary crossing the subject lot.

In September 2005, Cardno conducted a hydraulic study to determine the extent of inundation within an adjacent property (Lot 2 on RP849709) and to recommend the measures required to allow the proposed development layout to be achieved.

The hydraulic study (Cardno 2005) was submitted to Rockhampton City Council as part of the application for development approval for the site at 850 Norman Road, Norman Gardens, City of Rockhampton (application No. D-1970/2006). In July 2007, an addendum report was prepared to respond a request for further information issued by Council and to determine the extent of inundation within the property located immediately upstream of the subject site (Lot 1 on RP618770).

The present study comprises a detailed hydraulic study of the unnamed tributary of Limestone Creek running trough the subject site (and sites located downstream). This new study addresses the impact of the channel reprofiling and culverts proposed as part of the proposed lot reconfiguration to complement previous flood studies prepared by Cardno.

The present report also discusses the measures taken to eliminate the risk of bank erosion within the proposed channel reprofilling.

The layout proposed for the site is shown on Figure 2. To address the impact of the proposed lot reconfiguration on flooding conditions within the site, three development scenarios were analysed within the present study:

- Existing conditions;
- Partially developed conditions; and
- Fully developed conditions

The existing case reflects the current development level within the site and the downstream lots. No modifications to the tributary are considered for this scenario. However, a small section of Lot 2 on RP614078 which will be filled to accommodate a sewerage pump station and the road crossing (with culverts underneath) which provide access to the pumping station are reflected in this scenario (refer Figure 2).

For the partially developed case, the stretch of tributary lying within the site will be reconfigured to a 23 metre wide channel to improve flow conveyance. Foulkes Street and the corresponding culverts located underneath (just upstream of the site) were also included in this case. The small section of Lot 2 on RP614078 which will be filled to accommodate a sewerage pump station and the road crossing (with culverts underneath) which provide access to the pumping station are also reflected in this scenario (refer Figure 2). For this scenario the rest of the tributary remains unchanged.

For the fully developed case, the existing tributary will be reconfigured to a 23 metre wide channel. Foulkes Street and the corresponding culverts located underneath (just upstream of the site) were also included in this case. This scenario also includes channel reprofilling for the lots located downstream of the subject site. The stretch of tributary located within Lot 1 on RP618770 will be also reconfigured to a 23 metre wide channel.

DEVELOPMENT APPLICATION FOR RECONFIGURING A LOT (3 LOTS) AND OPERATIONAL WORKS – APPLICATION NO. D-1647/2007 – L2 RP618770 – 814 NORMAN ROAD, NORMAN GARDENS QLD 4701 FOR CARDNO (QLD) PTY LTD

After having completed a preliminary assessment of the abovementioned development application, it has been determined that additional information is required to be submitted in order that Council may make a proper assessment of the development proposal. It is requested that further information be submitted in response to the following matters:

Engineering

1. *Please provide a Flood Study, prepared and certified by a suitably qualified and experienced Registered Professional Engineer of Queensland (RPEQ), for the major watercourse traversing the site (lot 2 on RP618770). This Flood Study shall determine and clearly report all relevant engineering design details associated with flooding in the watercourse and the proposed open channel including, but not limited to, the following:*

   The 100 year Average Recurrence Interval (Q100) flood levels, discharge volume and velocity for the existing watercourse configuration and the proposed open channel configuration (reported using Australian Height Datum, AHD, as the vertical datum);
   The 10 year Average Recurrence Interval (Q10) flood levels, discharge volume and velocity for the existing watercourse configuration and the proposed open channel configuration (reported using Australian Height Datum, AHD, as the vertical datum);
   All input parameters used in the HEC-RAS modelling and demonstrate that they are representative of both the existing watercourse and the proposed drainage channel; and
   A complete set of suitably scaled cross-sections and long-sections for both the existing watercourse and the proposed drainage channel as used in the HEC-RAS modelling.

   All assumptions for the existing, post-development and ultimate development scenarios must be clearly stated.

2. *Please demonstrate how the proposed open channel complies with the Capricorn Municipal Development Guidelines, Section D5.12 "Open Channels" and the Queensland Urban Drainage Manual, Section 8.00 "Open Channel Hydraulics" including, but not limited to, the following:*

   a) *Please demonstrate how the proposed development complies with the requirements of the Capricorn Municipal Development Guidelines and Section 8.10(d) of the Queensland Urban Drainage Manual – Recommended Maximum Channel Side Slopes, which sates, in part:*

      "The maximum channel sides slopes for grass lined sections should preferably be 1 on 6 (1V on 6H), with an absolute maximum of 1 on 4 (1V on 4H). If grass lined channels are designed with side slopes steeper than 1 on 4 (1V on 4H), regular maintenance may become impractical and the channel may eventually become overgrown. These conditions would reduce the capacity of the channel and could subsequently lead to flooding of low lying areas upstream. Channels lined with ground covers may be permitted to have maximum side slopes of 1 on 2 (1V on 2H), however design of such channels must include considerations of potential future increases in channel roughness, and considerations of channel side slope stability."

2. PEAK FLOW RATES

The peak flow rates occurring at various points within the catchment for the 100 year event were previously calculated (Cardno 2005) using the Rational Method in accordance with the *Queensland Urban Drainage Manual* (Neville Jones & Associates et al 1992)(QUDM). The catchment areas draining into the site and the subcatchments adopted for the analysis are shown on Figure 3.

Significant parts of the catchment draining to Norman Road will be left in an undeveloped state. A portion of the catchment will become low density residential development according to the Rockhampton City Plan (refer to Appendix A). Peak flow rates calculated in the present study are considered to be conservative as they are based on full development of the Norman Road residential precinct. Therefore, the peak flow rates reported in this study consider only the future development scenario within the catchment.

Appropriate fraction impervious and runoff coefficients were defined for these land uses based on Tables 5.04.1 and 5.04.2 of QUDM. The runoff coefficient derived for the 10 year event was multiplied by a frequency factor of 1.2 (Table 5.04.3 of QUDM) to derive the 100 year runoff coefficient.

The time of concentration for each subcatchment was calculated using a combination of Friend's Equation (Equation 5.05.1 of QUDM) for overland sheet flow, and the stream velocity method (Table 5.05.4 of QUDM) for stream flow. Due to the steepness of the catchment, the overland sheet flow length was limited to 50 metres, as runoff would quickly collect in rills.

The areas of bushland and development applicable to each subcatchment, the time of concentration for each subcatchment and the peak flow rates for the 100 year event calculated at various points of interest are listed in Table 1. The catchment plan is shown on Figure 3.

Peak flow rates corresponding to the design ARI events (1, 2, 5, 10, 20 and 50 years) were also calculated for the major watercourse flowing through the site to calculate the capacity of the culverts beneath Foulkes Street. The design ARI event flow rates (1 to 50 years) for the major tributary are presented in Table 2. Note that these flowrates represent the worst case scenario, as they correspond to the post-development conditions of the catchment.

Table 2 Peak Flow Rates- 1 to 50 Year Events

Location	Time of Conc. (min)	Rainfall intensity (mm/h)			Areas		Peak Flow (m^3/s)		
		50 yr	20 yr	10 yr	Bushland (ha)	Developed (ha)	50 yr	20 yr	10 yr
Major Creek System									
MJ1	16.9	172.5	144.4	124.3	51.87	9.64	21.1	16.1	13.2
MJ2	25.0	143.0	120.0	103.0	91.89	11.19	28.8	22.0	18.0
MJ3	29.3	131.4	110.4	94.7	156.36	28.29	48.0	36.8	30.1
MJ6	46.8	101.8	86.2	73.6	156.36	48.01	42.2	32.6	26.5
MJ4	10.8	211.6	176.4	151.2	12.62	0.00	5.0	3.8	3.1
MJ5	24.4	144.8	121.2	104.2	12.62	8.80	6.6	5.1	4.1
MJ6 (Foulkes St)	46.8	101.8	86.2	73.6	168.98	56.15	46.7	36.1	29.3
MJ9	13.0	195.0	163.0	140.0	0.00	4.32	2.1	1.6	1.3
MJ7	57.7	90.8	76.4	65.8	168.98	66.69	44.0	33.8	27.7
MJ8	65.1	85.3	71.6	61.3	168.98	71.37	42.3	32.4	26.4
Location	**Time of Conc. (min)**	**Rainfall intensity (mm/h)**			**Areas**		**Peak Flow (m^3/s)**		
		5 yr	**2 yr**	**1 yr**	**Bushland (ha)**	**Developed (ha)**	**5 yr**	**2 yr**	**1 yr**
Major Creek System									
MJ1	16.9	109.3	84.2	65.2	51.87	9.64	11.0	7.6	5.5
MJ2	25.0	90.0	70.0	54.0	91.89	11.19	14.9	10.4	7.6
MJ3	29.3	83.4	64.7	50.0	156.36	28.29	25.2	17.5	12.7
MJ6	46.8	64.9	50.9	39.2	156.36	48.01	22.2	15.6	11.3
MJ4	10.8	132.2	101.8	78.6	12.62	0.00	2.6	1.8	1.3
MJ5	24.4	91.2	70.6	54.6	12.62	8.80	3.4	2.4	1.7
MJ9	13.0	122	95	73	0.00	4.32	1.1	0.8	0.5
MJ6 (Foulkes Street)	46.8	64.9	50.9	39.2	168.98	56.15	24.6	17.2	12.5
MJ7	57.7	58.4	45.3	35.0	168.98	66.69	23.4	16.2	11.8
MJ8	65.1	54.4	42.3	32.8	168.98	71.37	22.3	15.5	11.3

Note: Refer to Figure 3 for location of subcatchments

The small filled section of Lot 2 on RP614078 accommodating the sewerage pump station, the road crossing (with two 250 mm pipes underneath) which provides access to the pumping station and the road profile of Rockhampton-Yeppoon Road (with the two 2700X2400 mm reinforced concrete box culverts underneath) are also included in this scenario. For this scenario the rest of the tributary remains unchanged.

Normal depth was adopted as the tailwater level condition for the model. This depth was determined by calculating the slope between the most downstream cross sections, which was evaluated to be 0.1 percent.

The 100 and 10 year ARI events flood levels resulting from the analysis are presented in Table 4. The corresponding 100 year ARI extent of inundation for this scenario is plotted on Figure 4.

3.3 Fully Developed Case

As previously stated in the flood study prepared by Cardno in July 2007, a stretch of approximately 300 metres of tributary downstream of the subject site will be reconfigured in the near future, this channel works are not the subject of the present study (between cross sections A20 and A300) but are modelled, as they will impact on the flooding conditions within the subject site.

The model of the fully developed scenario includes reprofilling the section of tributary crossing the subject site and the site located immediately downstream (Lot 1 on RP618770) to a 230 metre wide channel (approximately 230 metres between cross sections A190 and A415). The stretch of tributary located within Lot 2 on RP849709 will be reconfigured to a 40 metre wide channel to counteract the conveyance loss in the tributary due to the filling in the western section of the site. The pump station access road (including the culverts underneath) was also included in this case. The modified cross section plots for the fully developed case are provided in Appendix D.

The new 23 metre wide channel will generally have 1:2 batter slopes and will be approximately 3.26 metres deep. A 3.5 metre maintenance berm will be located within the channel above the inundation level corresponding to the 1 year ARI event. A cross section of the proposed channel is shown in Figure 5. The invert slope of the proposed channel along the subject property will be 2 % (1 in 50) while the invert slope of channel within Lot 1 on RP618770 will be 1.1% (1 in 90). The proposed channel includes a 1.5 metre wide, 0.3 metre deep low flow trapezoidal drain. The invert width of the proposed channel will be 8 metres and will have a crossfall of 1 in 20.

It can be noted that the ultimate channel configuration may vary from that modelled provided similar results are achieved.

A Manning's n value of 0.10 was conservatively assumed for the channel and bank areas in each cross section. The three 2700X2700 mm box culverts (RCBC) and the road profile of Foulkes Street were also included in the model for the developed scenario.

The small filled section of Lot 2 on RP614078 accommodating the sewerage pump station, the road crossing (with two 250 mm pipes underneath) which provides access to the pumping station and the road profile of Rockhampton-Yeppoon Road (with the two 2700X2400 mm reinforced concrete box culverts underneath) are also included in this scenario.

Table 4 Partially Developed Case Peak Flood Levels

Reach Name	Cross-section	100 year ARI Event			10 year ARI Event	
		Peak Flow (m^3/s)	Water Level (m AHD)	Channel Velocity (m/s)	Peak Flow (m^3/s)	Water Level (m AHD)
north	A829	5.93	50.50	0.79	3.13	50.30
north	A792	5.93	48.55	1.67	3.13	48.58
north	A740	5.93	46.54	0.73	3.13	46.27
north	A673	7.79	43.51	1.96	4.14	43.54
north	A590	7.79	38.90	0.92	4.14	38.35
southcomb	A972	49.27	44.82	2.12	26.45	44.50
southcomb	A896	49.27	43.37	0.94	26.45	42.97
southcomb	A796	49.27	40.90	1.94	26.45	40.77
southcomb	A590	49.27	38.90	0.92	49.27	38.35
combined	A510	55	38.83	0.38	29.32	37.91
combined	A430	55	38.55	1.53	29.32	37.59
combined	Culvert (Foulkes Street)					
combined	A415	55	37.58	2.32	29.32	37.00
combined	A410	55	37.62	1.41	29.32	36.99
combined	A400	55	37.56	1.20	29.32	36.95
combined	A386	55	37.32	1.81	29.32	36.76
combined	A362	55	36.82	1.82	29.32	36.28
combined	A340	55	36.32	1.90	29.32	35.80
outlet	A325	51.43	36.02	1.80	27.75	35.51
outlet	A320	51.43	35.91	1.82	27.75	35.41
outlet	A300	51.43	35.52	0.86	27.75	34.81
outlet	A252	51.43	35.10	1.01	27.75	34.48
outlet	A226	51.43	34.79	1.28	27.75	34.16
outlet	A200	51.43	34.53	0.80	27.75	33.85
outlet	A190	51.43	34.43	0.67	27.75	33.73
outlet	A150	51.43	34.22	1.30	27.75	33.60
outlet	Culvert (Pump station access road)					
outlet	A135	51.43	33.10	1.98	27.75	32.52
outlet	A130	51.43	33.17	0.81	27.75	32.52
outlet	A109	49.84	33.09	0.60	26.50	32.36
outlet	A58	49.84	32.88	0.55	26.50	31.77
outlet	A36	49.84	32.86	0.49	26.50	31.74
outlet	A21	49.84	32.85	0.40	26.50	31.73
outlet	A20	49.84	32.67	1.81	26.50	31.61
outlet	Culvert (Yeppoon road)					
outlet	A-15	49.84	31.65	2.12	26.50	31.33
outlet	A-85	49.84	31.64	0.35	26.50	31.26

Note: cross sections located within the site are shaded

Table 6 Increase in Flood Levels

Reach Name	Cross-section	Afflux (mm) Partially developed vs. Existing		Afflux (mm) Fully developed vs. Existing	
		100 year ARI Event	10 year ARI Event	100 year ARI Event	10 year ARI Event
north	A829	80	0	80	0
north	A792	-160	0	-160	0
north	A740	140	0	140	0
north	A673	-230	0	-230	0
north	A590	390	0	390	0
southcomb	A972	-140	-50	-140	-50
southcomb	A896	140	30	140	30
southcomb	A796	-260	-60	-260	-60
southcomb	A590	390	0	390	0
combined	A510	560	220	560	220
combined	A430	1260	630	1260	630
combined	Culvert (Foulkes Street)				
combined	A415	520	310	530	310
combined	A410	770	500	770	500
combined	A400	830	610	830	610
combined	A386	710	610	730	610
combined	A362	440	570	520	600
combined	A340	260	480	420	540
outlet	A325	200	450	390	530
outlet	A320	-10	-10	330	420
outlet	A252	0	0	240	240
outlet	A226	-10	0	260	260
outlet	A200	0	10	130	170
outlet	A190	0	10	-10	10
outlet	A150	-10	0	-10	0
outlet	Culvert (Pump station access road)				
outlet	A135	20	0	-120	-420
outlet	A130	10	0	-120	-420
outlet	A109	20	0	-120	-490
outlet	A58	10	0	-10	-30
outlet	A36	0	0	-10	-10
outlet	A21	0	0	-10	-10
outlet	A20	0	0	20	30
outlet	Culvert (Yeppoon road)				
outlet	A-15	0	0	-10	-70
outlet	A-85	0	0	0	0

Note: cross sections located within the site are shaded

4. SPECIFIC RESPONSE

Outlined in the following section are the specific responses to each of the items requested in Council's Request for Further Information.

Item 1.
Please provide a Flood Study, prepared and certified by a suitably qualified and experienced Registered Professional Engineer of Queensland (RPEQ), for the major watercourse traversing the site (lot 2 on RP618770). This Flood Study shall determine and clearly report all relevant engineering design details associated with flooding in the watercourse and the proposed open channel including, but not limited to, the following:

- *The 100 year Average Recurrence Interval (Q100) flood levels, discharge volume and velocity for the existing watercourse configuration and the proposed open channel configuration (reported using Australian Height Datum, AHD, as the vertical datum);*
- *The 10 year Average Recurrence Interval (Q10) flood levels, discharge volume and velocity for the existing watercourse configuration and the proposed open channel configuration (reported using Australian Height Datum, AHD, as the vertical datum);*
- *All input parameters used in the HEC-RAS modelling and demonstrate that they are representative of both the existing watercourse and the proposed drainage channel; and*
- *A complete set of suitably scaled cross-sections and long-sections for both the existing watercourse and the proposed drainage channel as used in the HEC-RAS modelling.*

All assumptions for the existing, post-development and ultimate development scenarios must be clearly stated.

Response:

A flood study titled "Lot 2 on RP618770, Rockhampton, Flood Study" has been completed by Cardno to address Council's request.

Flood levels, peak flow rates and velocities have been calculated for both the 100 and 10 year Average Recurrence Interval (ARI) events and are reported in Tables 3 and 4. Three development scenarios (existing, partially developed and fully developed) were analysed within the present study.

The existing case reflects the current development level within the site. No modifications to the tributary crossing the site are considered for this scenario. However, a small section of Lot 2 on RP614078 which will be filled to accommodate a sewerage pump station and the road crossing (with culverts underneath) which provide access to the pumping station are reflected in this scenario (refer Figure 2).

For the partially developed case, the stretch of tributary lying within the site will be reconfigured to a 23 metre wide channel to improve flow conveyance within the tributary. Foulkes Street and the corresponding culverts located underneath (just upstream of the site) were also included in this case. The small filled section of Lot 2 on RP614078 accommodating the sewerage pump station, the road crossing (with two 250 mm pipes underneath) which provides access to the pumping station and the road profile of Rockhampton-Yeppoon Road (with the two 2700X2400 mm reinforced concrete box culverts underneath) are also included in this scenario. For this scenario the rest of the tributary remains unchanged.

Chainage	Max Ch Elevation (m AHD)	100yr ARI W.L (m AHD)	0.2*depth (m)	Freeboard (m)
A415	38.65	37.59	0.43	1.06
A410	38.58	37.62	0.45	0.96
A400	38.21	37.56	0.51	0.65
A386	37.93	37.32	0.52	0.61
A362	37.45	36.84	0.52	0.61
A340	37.01	36.40	0.52	0.61
A325	36.73	36.18	0.53	0.55
A320	36.63	36.10	0.54	0.53
A300	36.21	35.86	0.57	0.35
A252	35.70	35.34	0.57	0.36
A226	35.41	35.06	0.57	0.35
A200	35.01	34.66	0.57	0.35
A190	34.75	34.42	0.58	0.33

c) *Please demonstrate how the proposed development complies with Section 8.13 of the Queensland Urban Drainage Manual – Other Considerations, which states, in part, that:*

"(a) Access/Maintenance Berms

It is recommended that the overall easement/reserve width for an open channel provide for an access/maintenance berm of minimum width 4.5 metres on one side of the channel. This access/maintenance berm may be located within the channel itself at a lower elevation than the design flood level but should be located at a level corresponding to at least the 1 year ARI flow depth.

Where access and maintenance cannot be achieved for the whole channel from one site, it may be necessary to provide a similar access/maintenance berm on both sides of the channel. Notwithstanding the above provisions a 1.5 metre wide safety/access strip should be provided along at least one side of the channel above the design flood level in addition to the access/maintenance berm."

Response:

A 3.5 m wide maintenance berm would be placed in the left side of the channel. The table below reports the elevation of the berm and the 1 year ARI flow depths within the channel obtained with HECRAS. According to this table, it is clear that the maintenance berm will be above the 1 year ARI flow depth at all times.

Chainage	Berm Elevation (m AHD)	1yr ARI W.L (m AHD)
A400	36.33	36.28
A386	36.33	36.12
A362	35.85	35.64
A340	35.41	35.18
A325	35.13	34.91
A320	35.03	34.82
A300	34.61	34.55
A252	34.10	34.04
A226	33.81	33.75
A200	33.41	33.35
A190	33.15	33.11

5. CONCLUSION

It is proposed by Mintgrove Pty Ltd to reconfigure a lot located at the corner of Norman Road and Foulkes Street, City of Rockhampton.

In September 2005, Cardno was commissioned to conduct a hydraulic study to determine the extent of inundation through the properties located downstream of the site. The report of the subject hydraulic study (Cardno 2005) was submitted to Rockhampton City Council as part of the application for development approval for the subject sites and Council issued a request for further information on 4 July 2007 in order to complete its assessment.

An addendum flood study of the unnamed tributary of Limestone Creek running trough the subject sites was conducted in response to the Request for Further Information and was issued to Council in July 2007.

As part of the application to reconfigure Lot 2 on RP618770, a new hydrologic investigation was undertaken to determine the peak flow rates and flood levels corresponding to the 100, 50, 20, 10, 2, 5 and 1 year Average Recurrence Interval (ARI) events within the tributary crossing the subject lot.

The present report describes the methodology of the study and details the impact on flood levels of channel reprofiling and culverts proposed as part of the development.

To address the impact of the proposed development on flooding conditions within the site, three development scenarios were analysed within the present study:

- Existing conditions;
- Partially developed conditions; and
- Developed conditions

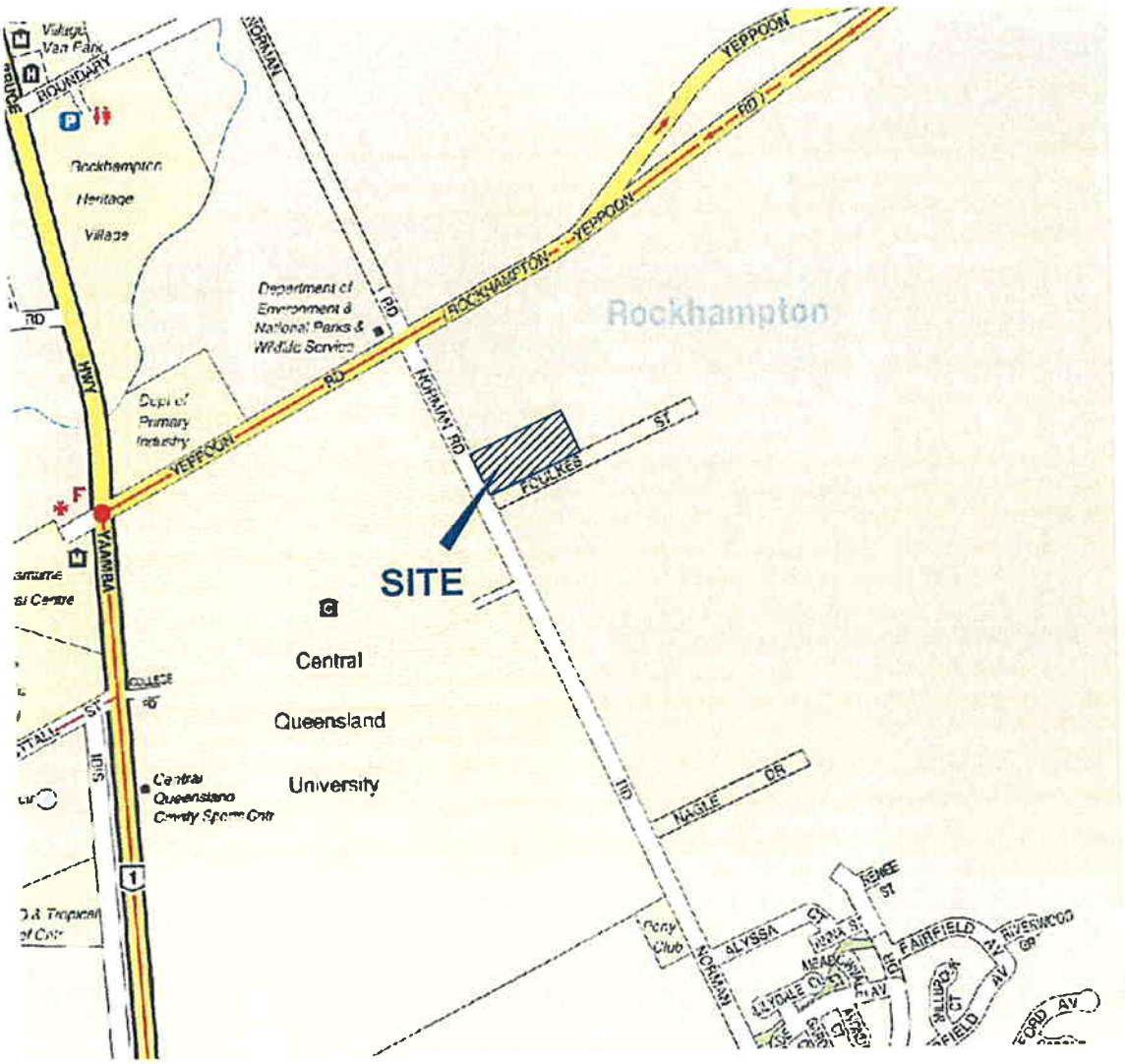
Based on the calculated flood levels for the developed scenario, it can be noted that the maximum increase in flood level within the site for this scenario is 830 mm. This afflux has a negligible impact on the site as it will be contained within the proposed channel at all times.

Present results also showed that Foulkes Street is immune to flooding in occurrence of the 100 year ARI event. However, Foulkes Street and its associated culvert cause a maximum increase in flood levels of 1260 mm upstream of the site in occurrence of the 100 year ARI storm event. This afflux will be dissipated within 350 metres from the upstream side of the culvert.

Obtained velocities indicate that a maximum velocity of 1.80 m/s will occur within the proposed channel. The longitudinal slope of the channel varies between 1.1 and 2.0 %, the banks of the channel are considered to comprise erosion resistant soil, as the invert of the channel will be grassed and the batters of the channel will be lined with a jute mat and landscaped plantings. Therefore the obtained velocities are lower than the permissible velocities recommended in Table 9.05.3 of QUDM 2007 for channels with gradients between 1 and 2 % (2.1 to 2.8 m/s).

Velocities occurring at the downstream end of the Foulkes Street culvert's apron indicate that the 10 metres of creek located immediately downstream of the culvert apron should be protected to avoid scour (including the banks). Loose rocks with a d_{50} of at least 100 mm are recommended as scour protection devices. Further, it is recommended to place a 250 mm high masonry/concrete sill at the end of the concrete apron to control the occurrence of hydraulic jumps downstream of the culvert.

FIGURES



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150 0 150 300 450 600 750m
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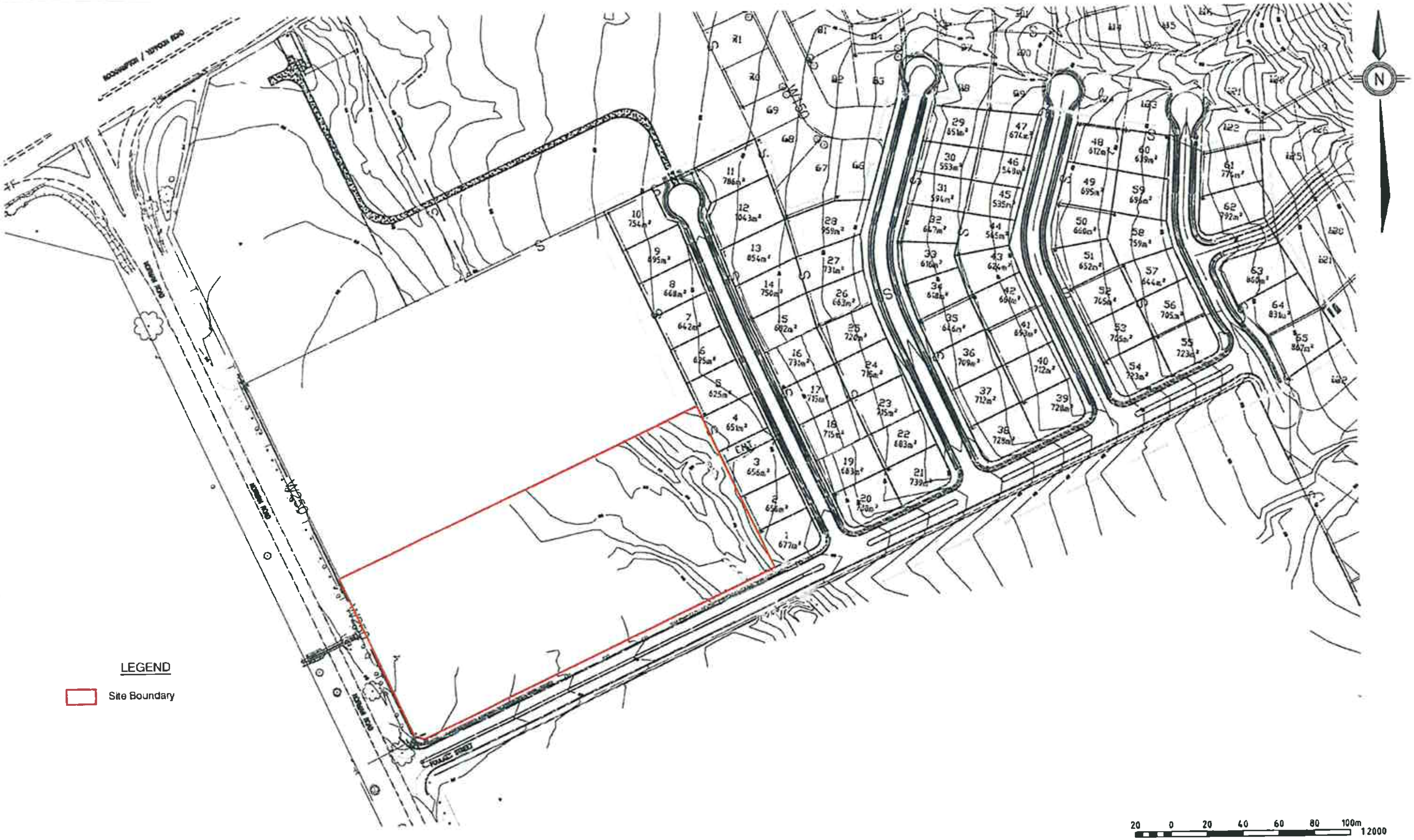
FIGURE 1
LOCALITY PLAN

Project No.: R1031-01-3

Rev: Orig. Date: 17 June 2008

Mintgrove Pty Ltd



LEGEND

Site Boundary

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Scale 1:2000 (A3)

FIGURE 2

PROPOSED DEVELOPMENT LAYOUT

Project No.: R1031-01-3

Rev: Orig. Date: 17 June 2008

Mintgrove Pyt Ltd

Rev: Orig. Date: 17 June 2008

Mintgrove Pty Ltd

N.T.S.

FIGURE 3
CATCHMENT PLAN

Project No.: R1031-01-3

Cardno

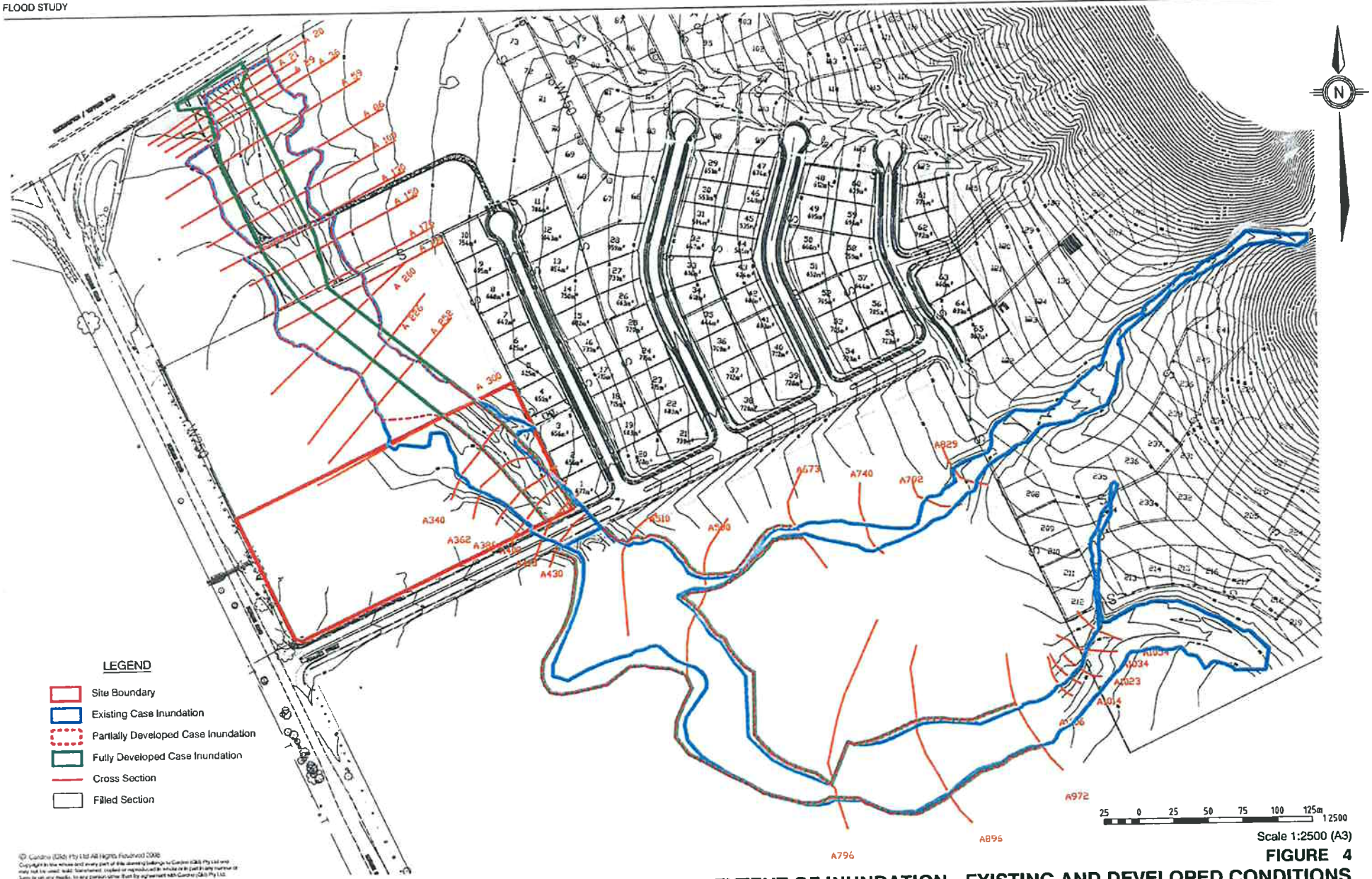

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FIGURE 4

100YR EXTENT OF INUNDATION - EXISTING AND DEVELOPED CONDITIONS

Project No.: R1031-01-3

Rev: Orig. Date: 17 June 2008

Mintgrove Pyt Ltd

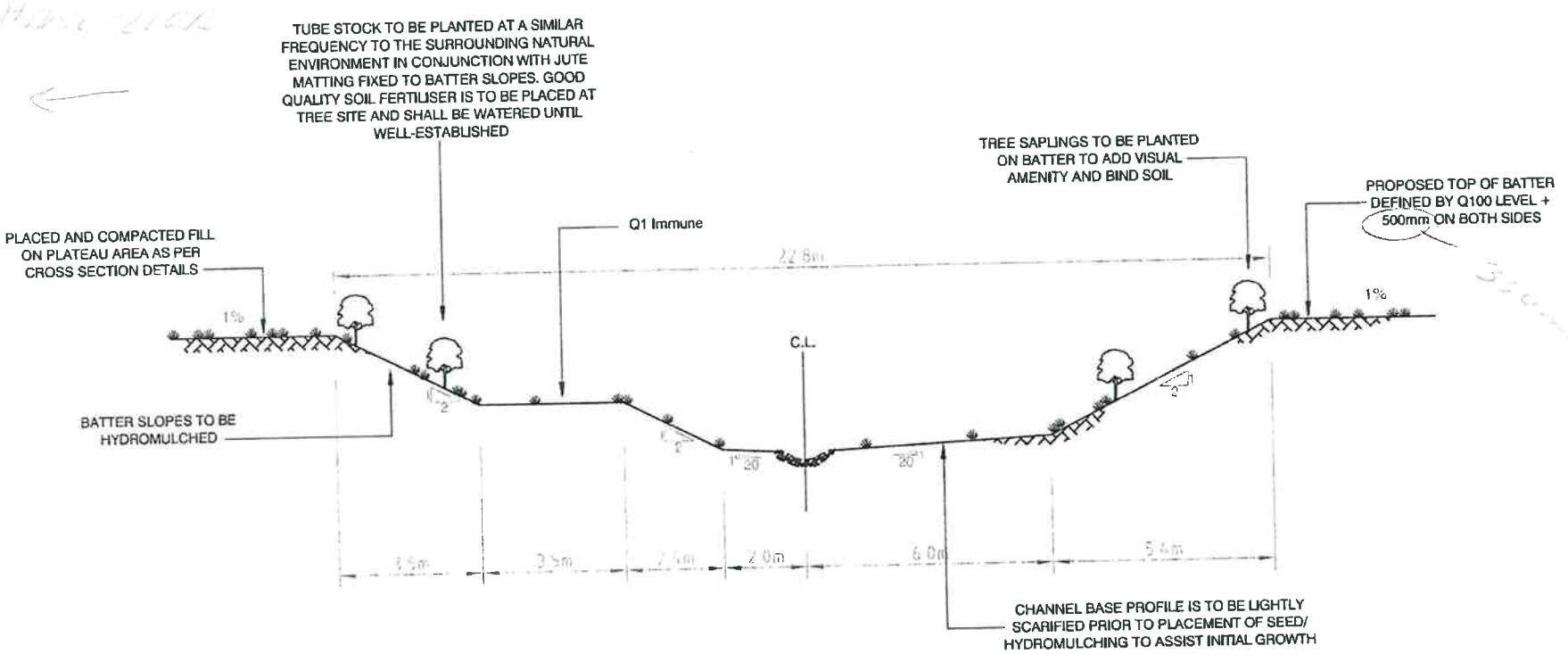

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FIGURE 5
PROPOSED CHANNEL CROSS SECTION

Project No.: R1031-01-3

PRINT DATE: 08 July, 2008 - 4:47pm

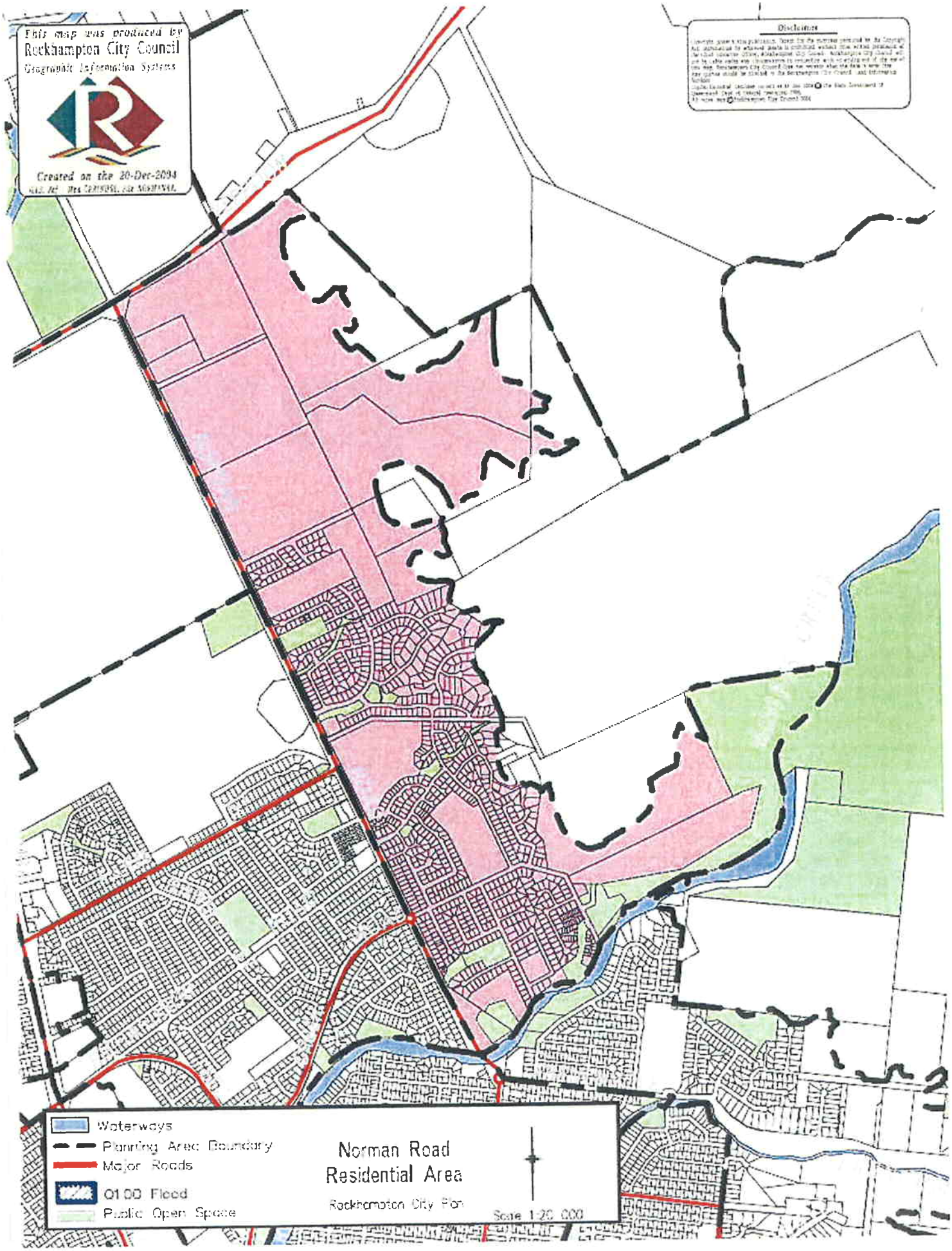
Rev: Orig. Date: 17 June 2008

Mintgrove Pty Ltd

CAD FILE: J:\R1031-01\Sub 03\acad\June 08\Figure 5 - Proposed Channel Crossection_v2.dwg
XREF's

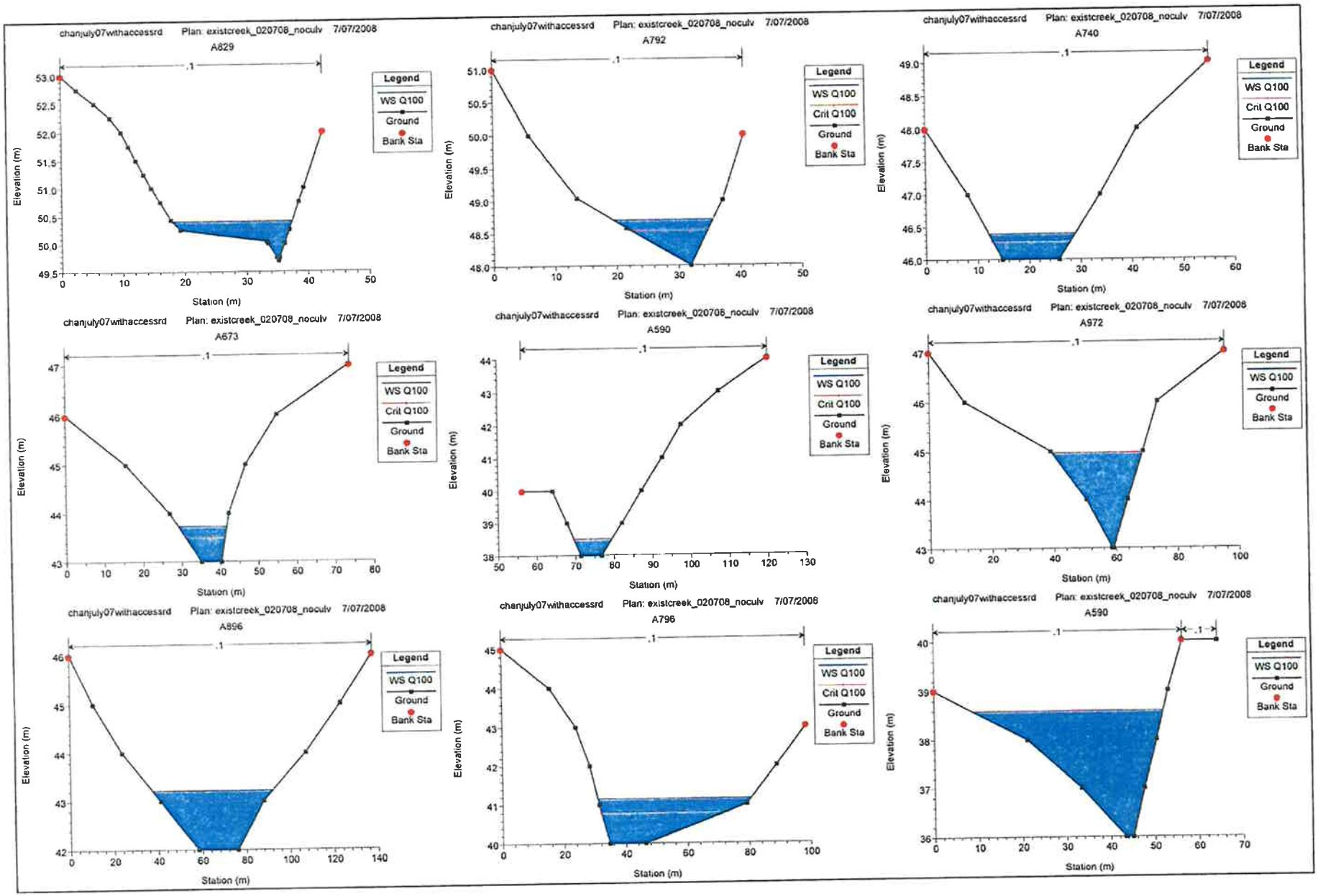
APPENDIX A

Norman Road Residential Area Plan


This map was produced by
Rockhampton City Council
Geographic Information Systems
Created on the 20-Dec-2004
Disclaimer
Waterways
Planning Area Boundary
Major Roads
Q100 Flood
Public Open Space
Norman Road
Residential Area
Rockhampton City Plan
Scale 1:20 000

APPENDIX B

HECRAS Cross Sections (Existing Case)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Ground
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A792
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Crit Q100
Ground
Bank Sta
Elevation (m)
Station (m)
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Crit Q100
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Bank Sta
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Station (m)
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A673
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Crit Q100
Ground
Bank Sta
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Station (m)
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A590
Legend
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Crit Q100
Ground
Bank Sta
Elevation (m)
Station (m)
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Bank Sta
Elevation (m)
Station (m)
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A896
Legend
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Elevation (m)
Station (m)
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A796
Legend
WS Q100
Crit Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: existcreek_020708_noculv 7/07/2008
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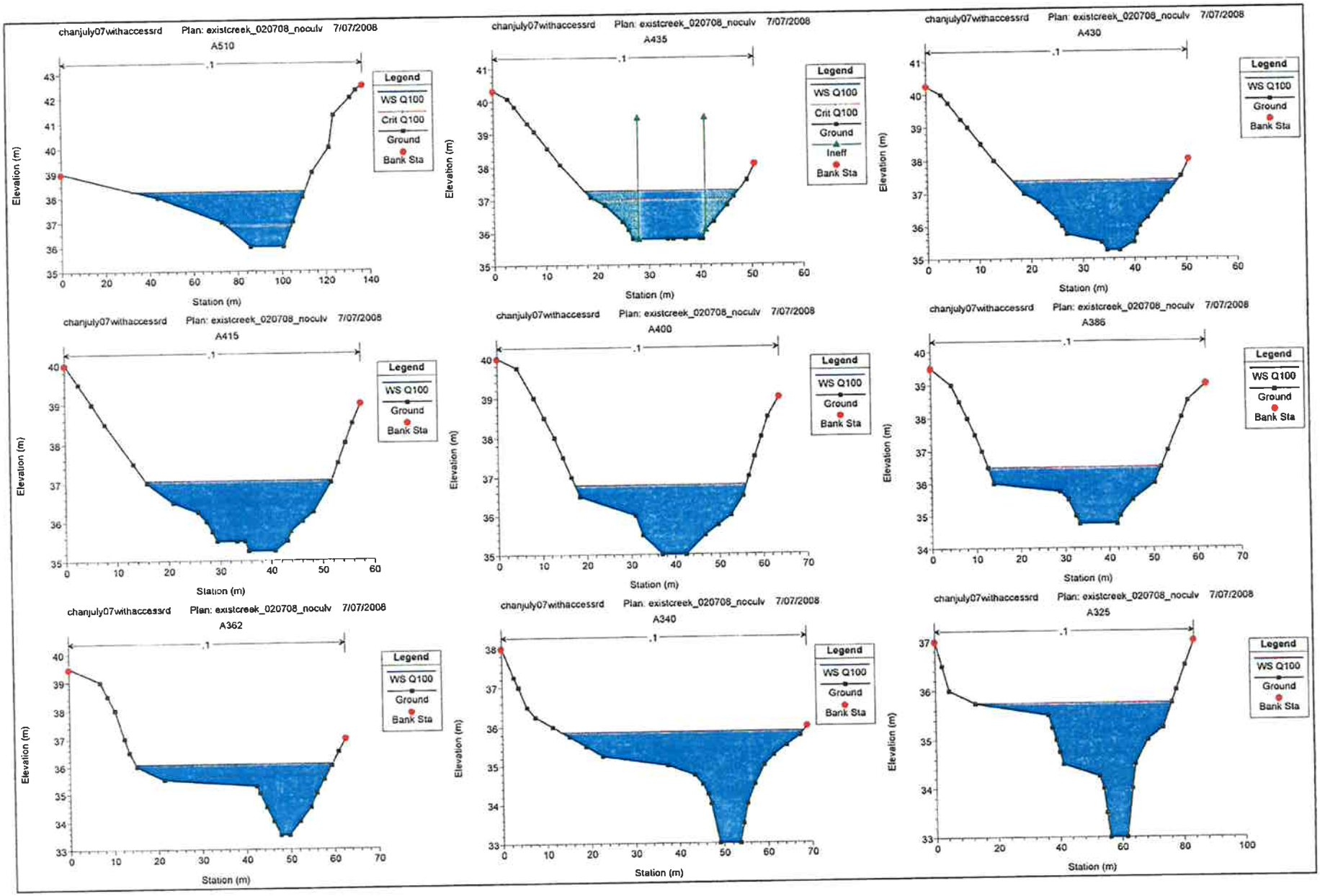
Legend
WS Q100
Ground
Bank Sta
Elevation (m)
Station (m)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Crit Q100
Ground
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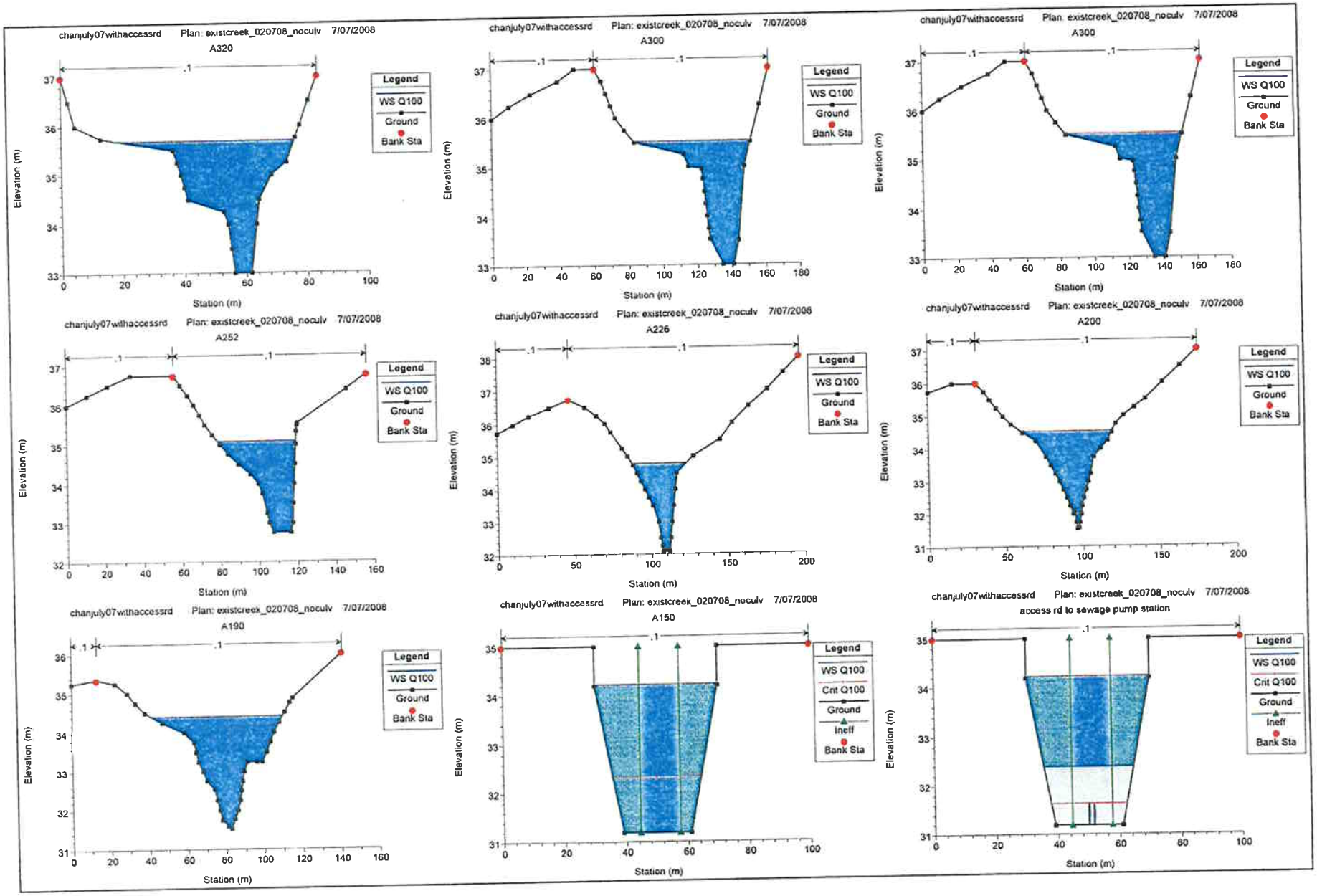
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Station (m)
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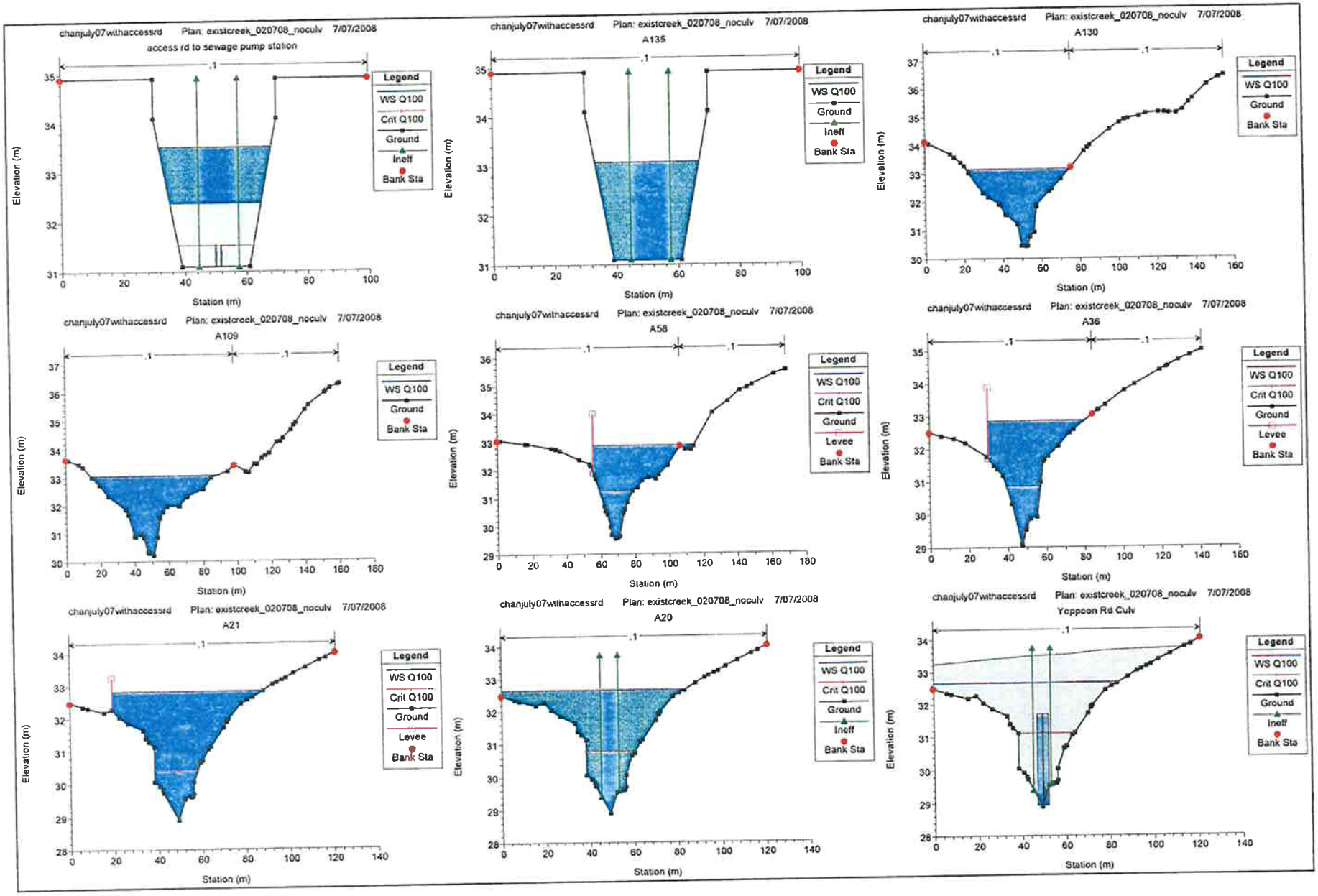
A190
Legend
WS Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: existcreek_020708_noculv 7/07/2008
A150
Legend
WS Q100
Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: existcreek_020708_noculv 7/07/2008
access rd to sewage pump station
Legend
WS Q100
Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)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access rd to sewage pump station
Legend
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Crit Q100
Ground
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Bank Sta
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Station (m)
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Legend
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Legend
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Crit Q100
Ground
Levee
Bank Sta
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A36
Legend
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Crit Q100
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Bank Sta
Elevation (m)
Station (m)
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A21
Legend
WS Q100
Crit Q100
Ground
Levee
Bank Sta
Elevation (m)
Station (m)
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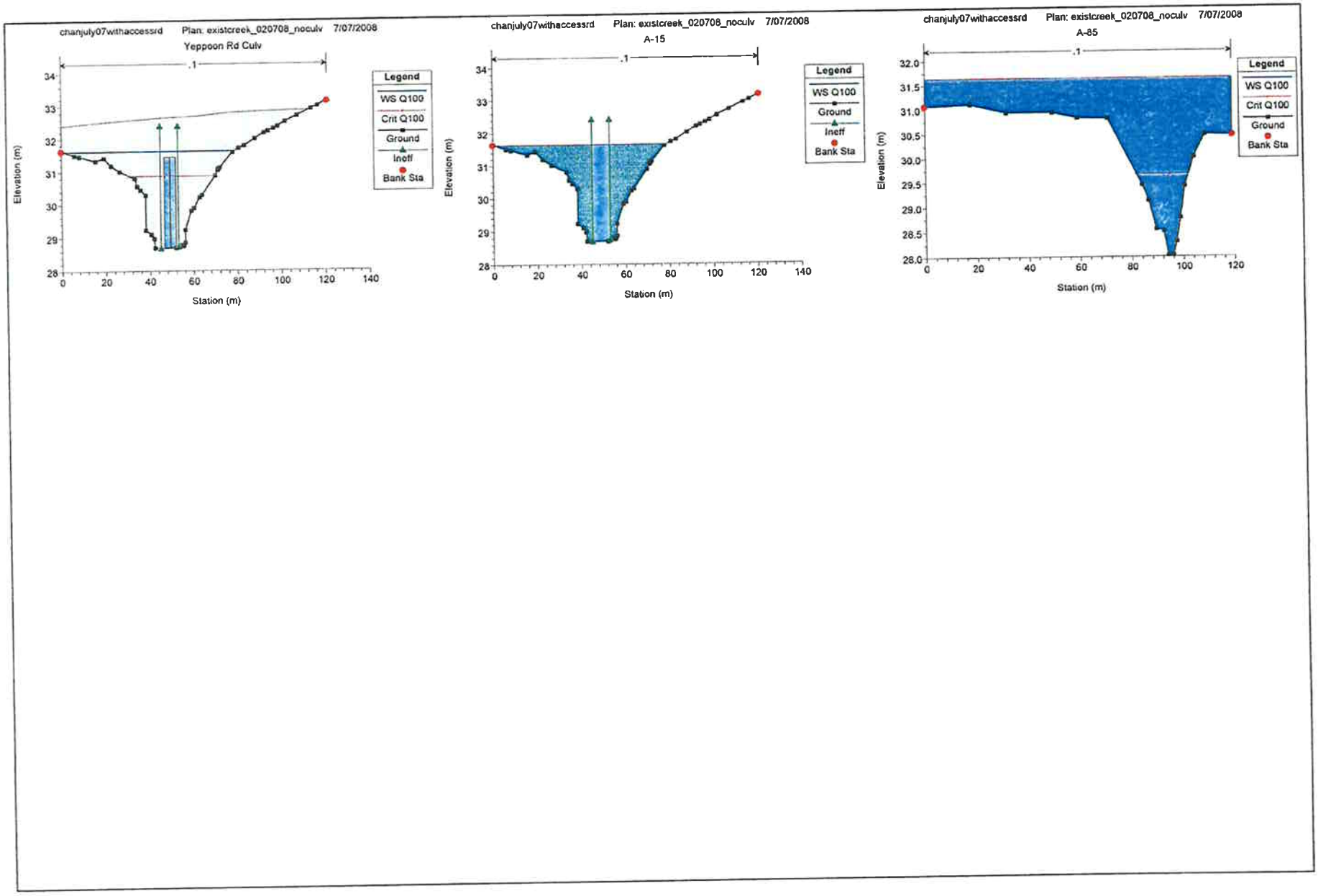
A20
Legend
WS Q100
Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: existcreek_020708_noculv 7/07/2008
Yeppoon Rd Culv
Legend
WS Q100
Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)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Yeppoon Rd Culv
Legend
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Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: existcreek_020708_noculv 7/07/2008
A-15
Legend
WS Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: existcreek_020708_noculv 7/07/2008
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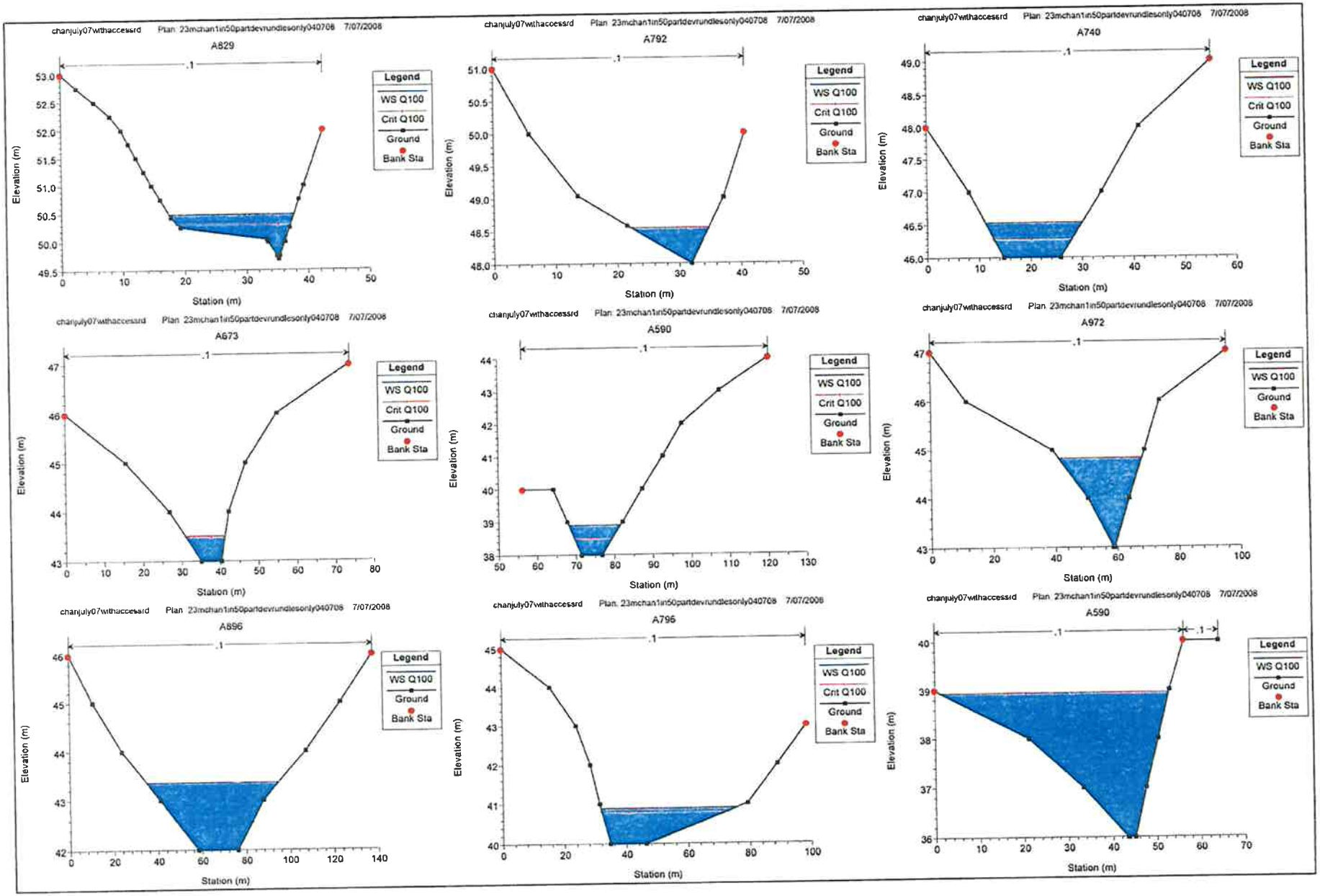
Crit Q100
Ground
Bank Sta
Elevation (m)
Station (m)

APPENDIX C

HECRAS Cross Sections (Partially Developed Case)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Station (m)
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Crit Q100
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Bank Sta
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Station (m)
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A673
Legend
WS Q100
Crit Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
A590
Legend
WS Q100
Crit Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
A972
Legend
WS Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
A896
Legend
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Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
A795
Legend
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Crit Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
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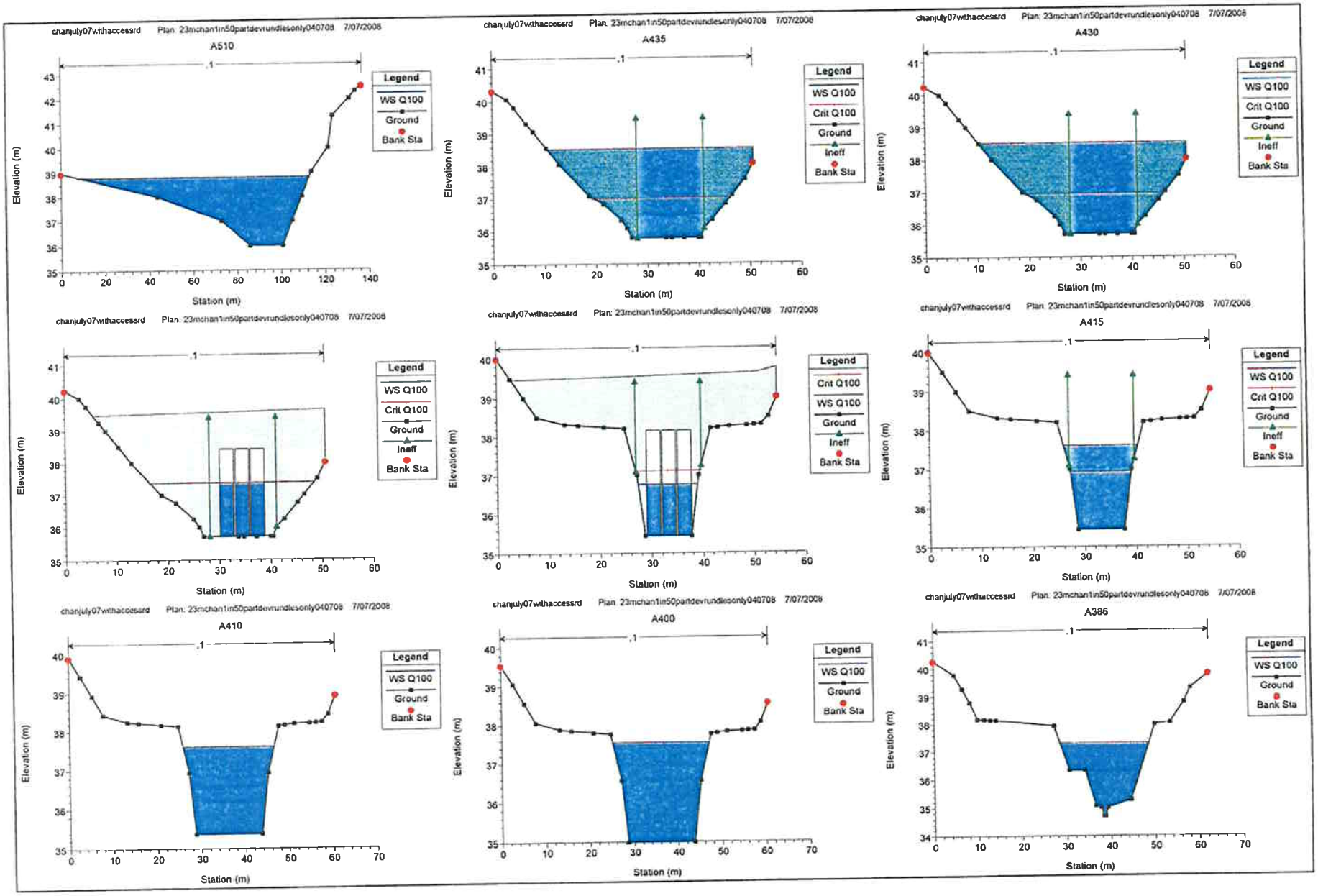
Elevation (m)
Station (m)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Station (m)
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Crit Q100
Ground
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Bank Sta
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Station (m)
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Legend
WS Q100
Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
Legend
Crit Q100
WS Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
A415
Legend
WS Q100
Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
A410
Legend
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Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
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Legend
WS Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
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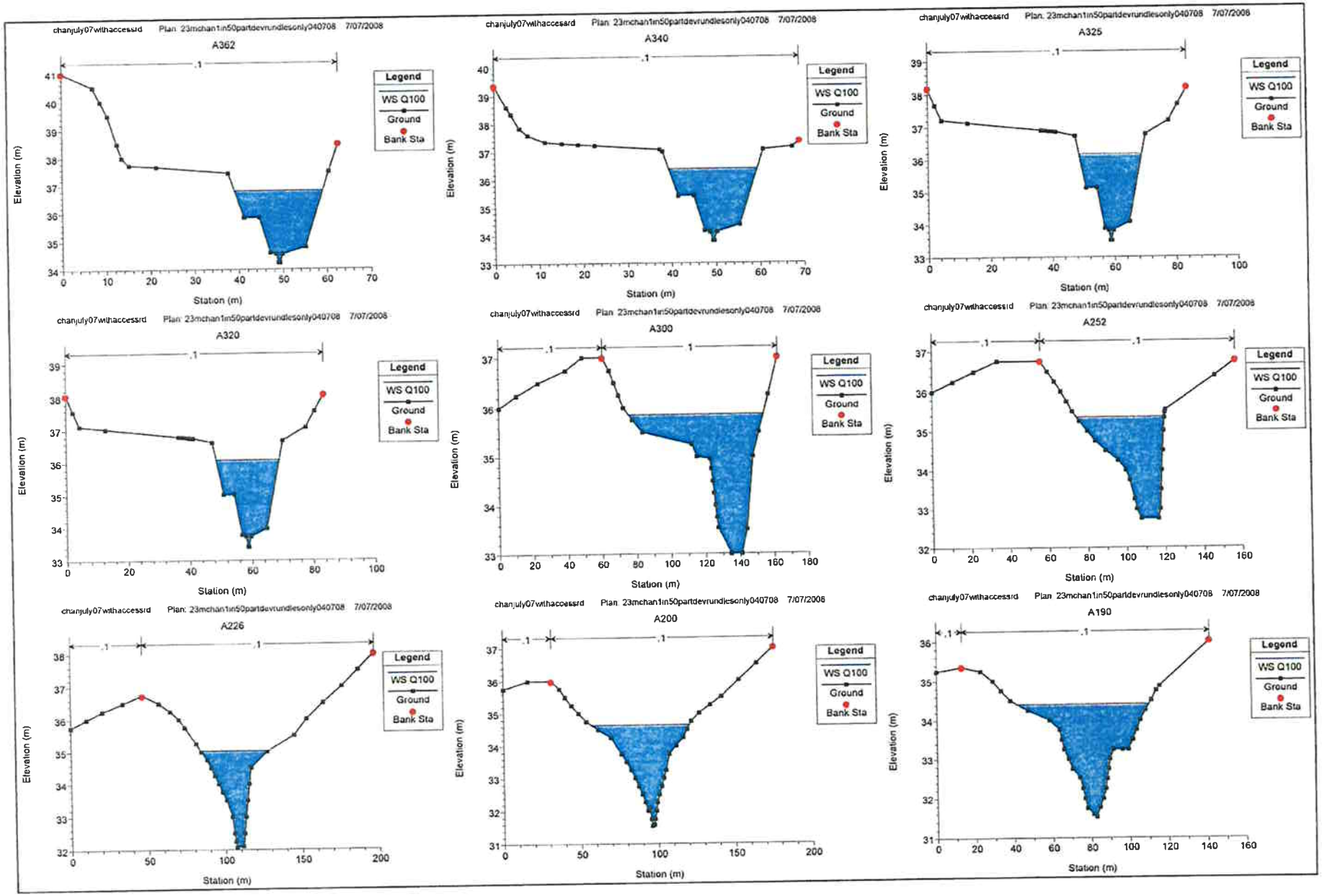
Station (m)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Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
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Legend
WS Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
A300
Legend
WS Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
A252
Legend
WS Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
A226
Legend
WS Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
A200
Legend
WS Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
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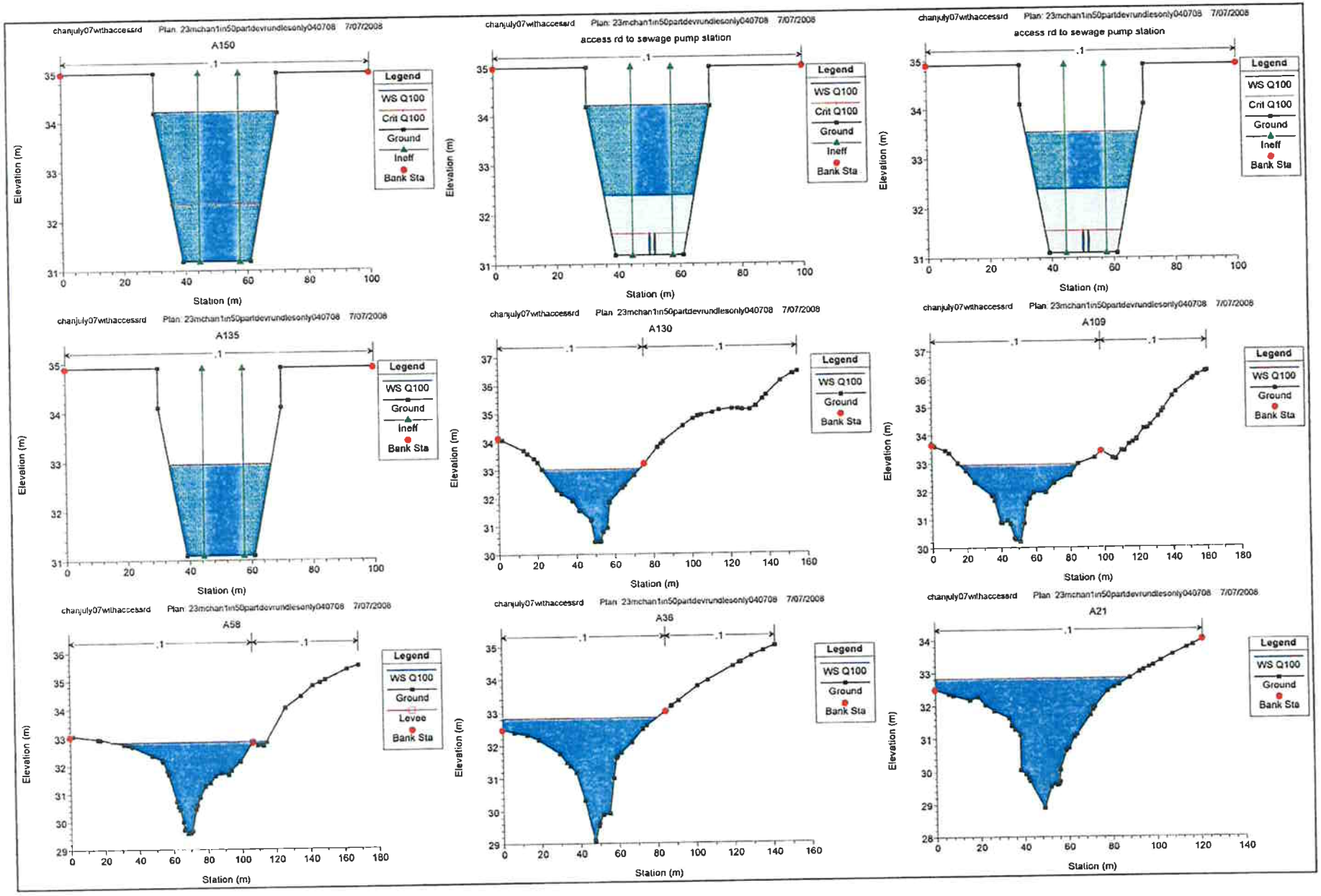
Station (m)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A150
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WS Q100
Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07wthaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
access rd to sewage pump station
Legend
WS Q100
Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07wthaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
access rd to sewage pump station
Legend
WS Q100
Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07wthaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
A135
Legend
WS Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07wthaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
A130
Legend
WS Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07wthaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
A109
Legend
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Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07wthaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
A58
Legend
WS Q100
Ground
Levee
Bank Sta
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Station (m)
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A36
Legend
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Ground
Bank Sta
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Station (m)
chanjuly07wthaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
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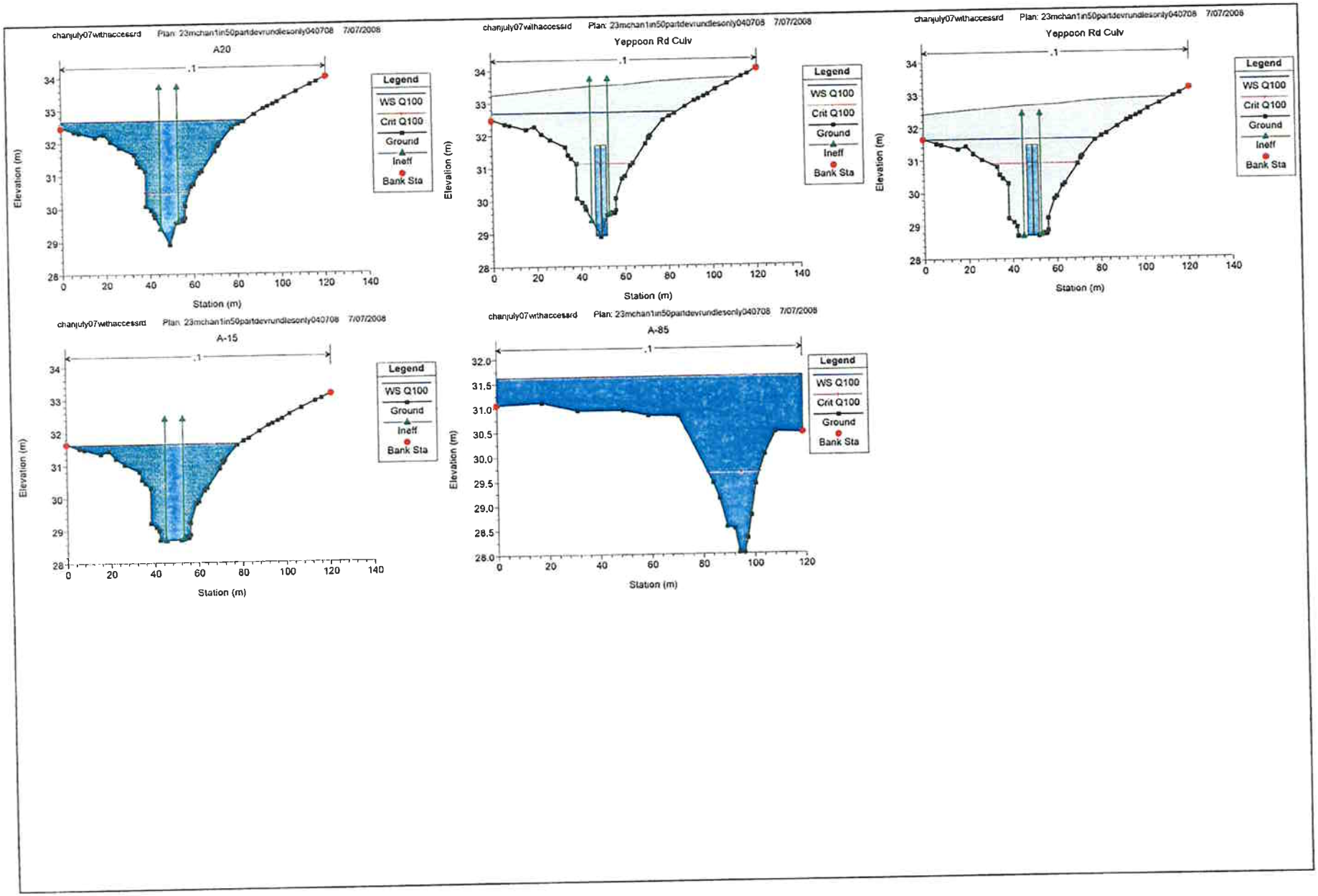
Station (m)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Ground
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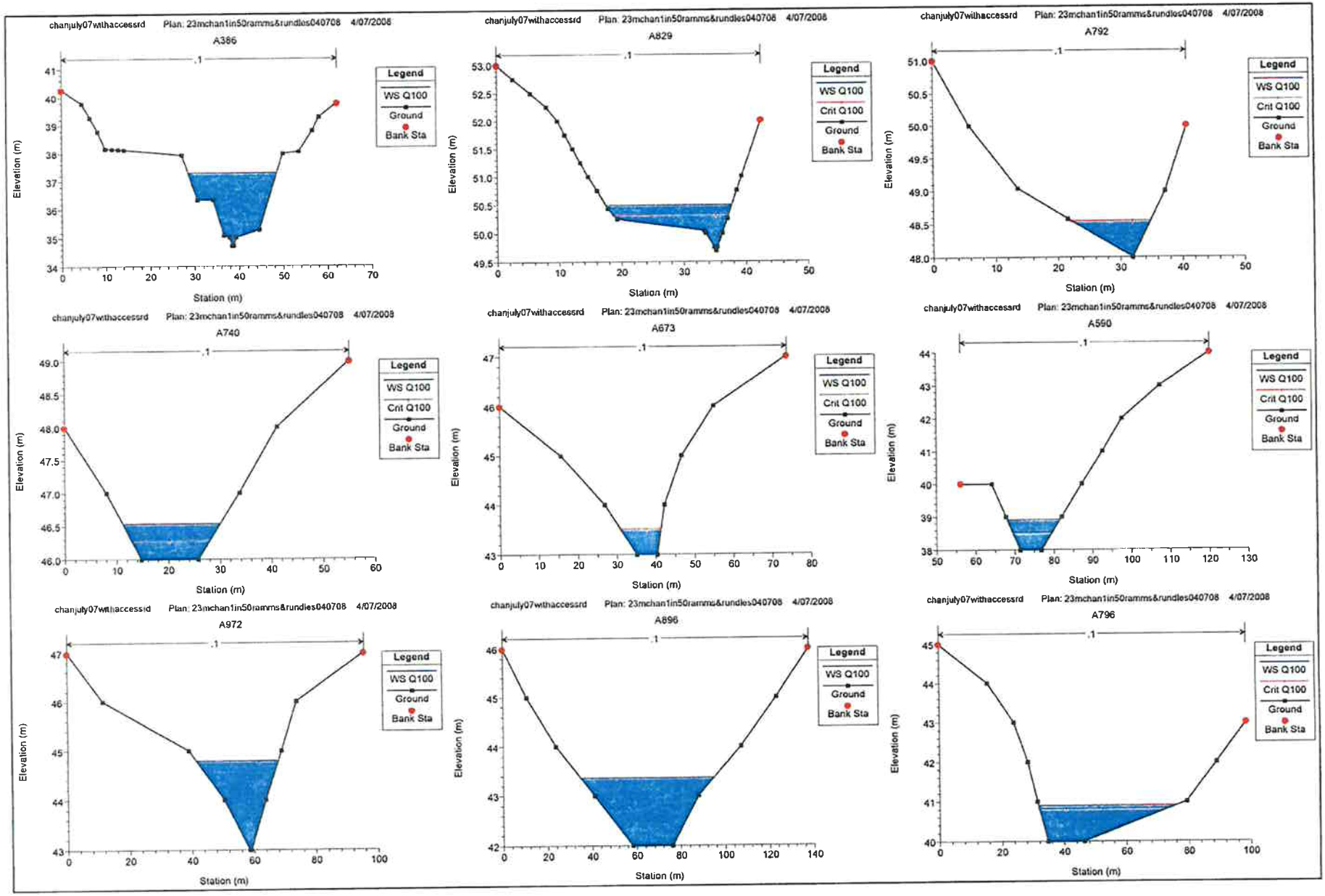
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
Yeppoon Rd Culv
Legend
WS Q100
Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
Yeppoon Rd Culv
Legend
WS Q100
Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
A-15
Legend
WS Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50partdevrundlesonly040708 7/07/2008
A-85
Legend
WS Q100
Crit Q100
Ground
Bank Sta
Elevation (m)
Station (m)

APPENDIX D

HECRAS Cross Sections (Fully Developed Case)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A829
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Crit Q100
Ground
Bank Sta
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Station (m)
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Legend
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Crit Q100
Ground
Bank Sta
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Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
A740
Legend
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Crit Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
A673
Legend
WS Q100
Crit Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
A590
Legend
WS Q100
Crit Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
A972
Legend
WS Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
A896
Legend
WS Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
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Crit Q100
Ground
Bank Sta
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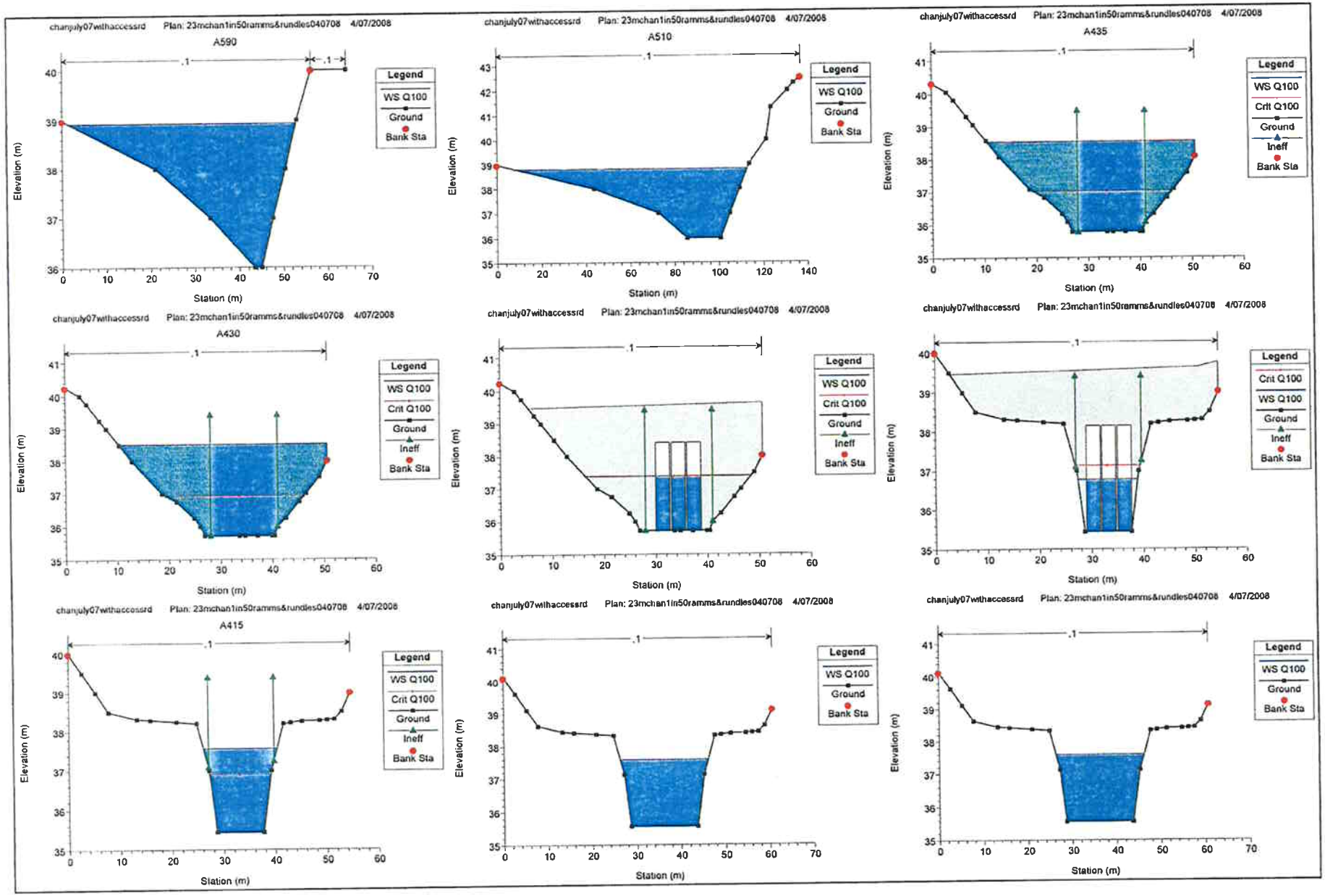
Station (m)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Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
A510
Legend
WS Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
A435
Legend
WS Q100
Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
A430
Legend
WS Q100
Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
Legend
WS Q100
Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
Legend
Crit Q100
WS Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
A415
Legend
WS Q100
Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
Legend
WS Q100
Ground
Bank Sta
Elevation (m)
Station (m)
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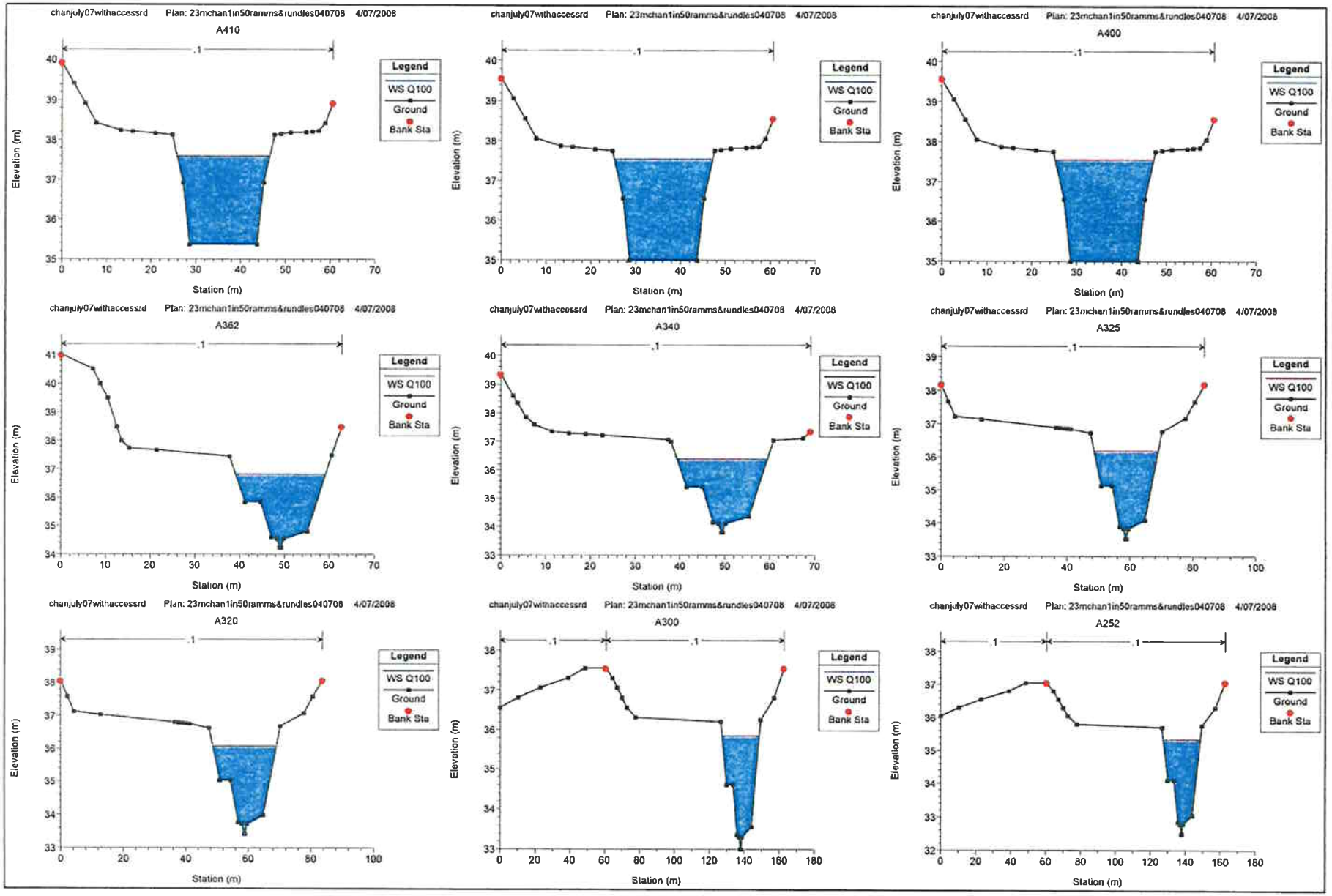
Station (m)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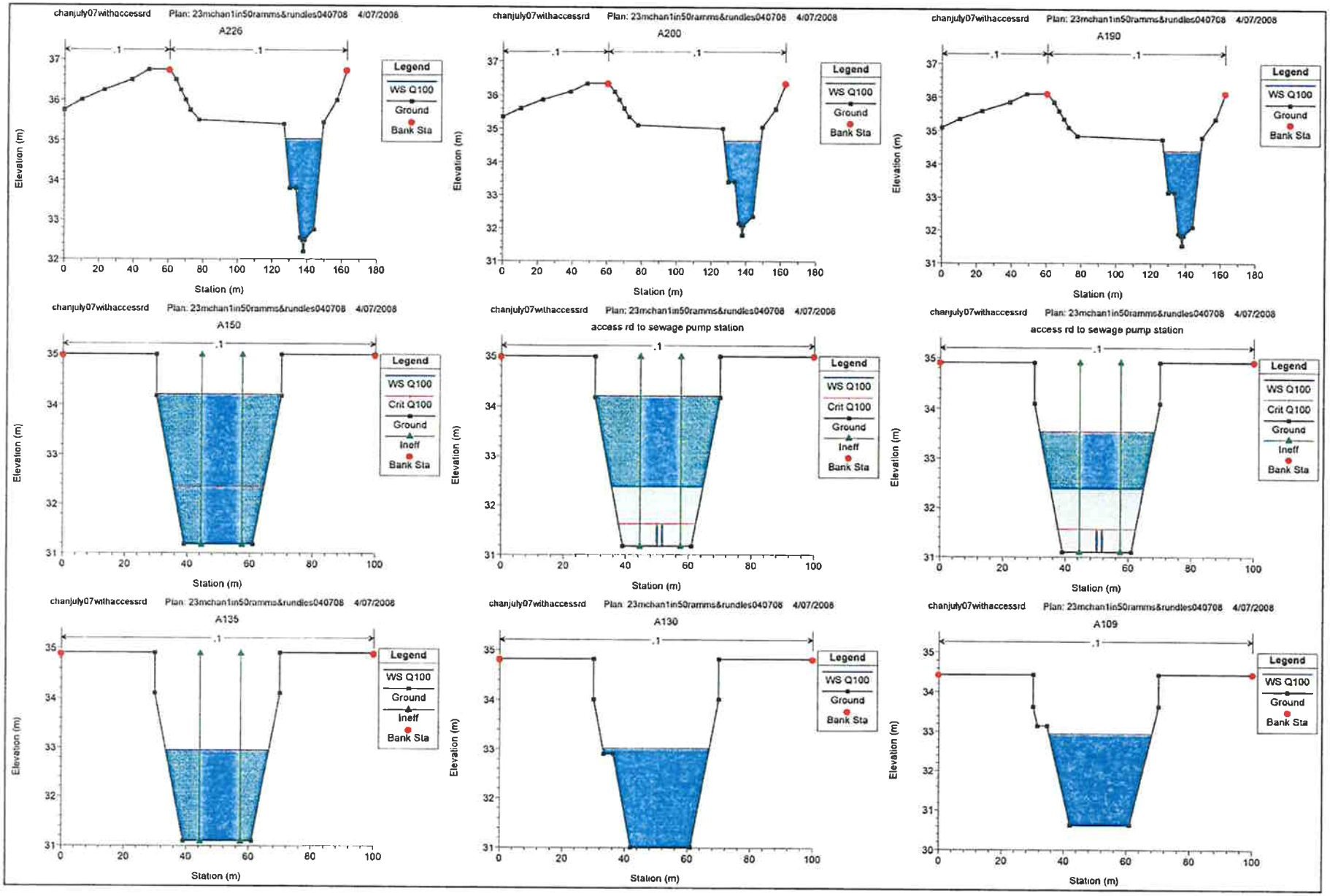
A410
A400
A362
A340
A325
A320
A300
A252
Legend
WS Q100
Ground
Bank Sta
Elevation (m)
Station (m)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Ground
Bank Sta
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Station (m)
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Legend
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Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
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Legend
WS Q100
Ground
Bank Sta
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Station (m)
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Legend
WS Q100
Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
access rd to sewage pump station
Legend
WS Q100
Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
access rd to sewage pump station
Legend
WS Q100
Crit Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
A135
Legend
WS Q100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
A130
Legend
WS Q100
Ground
Bank Sta
Elevation (m)
Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
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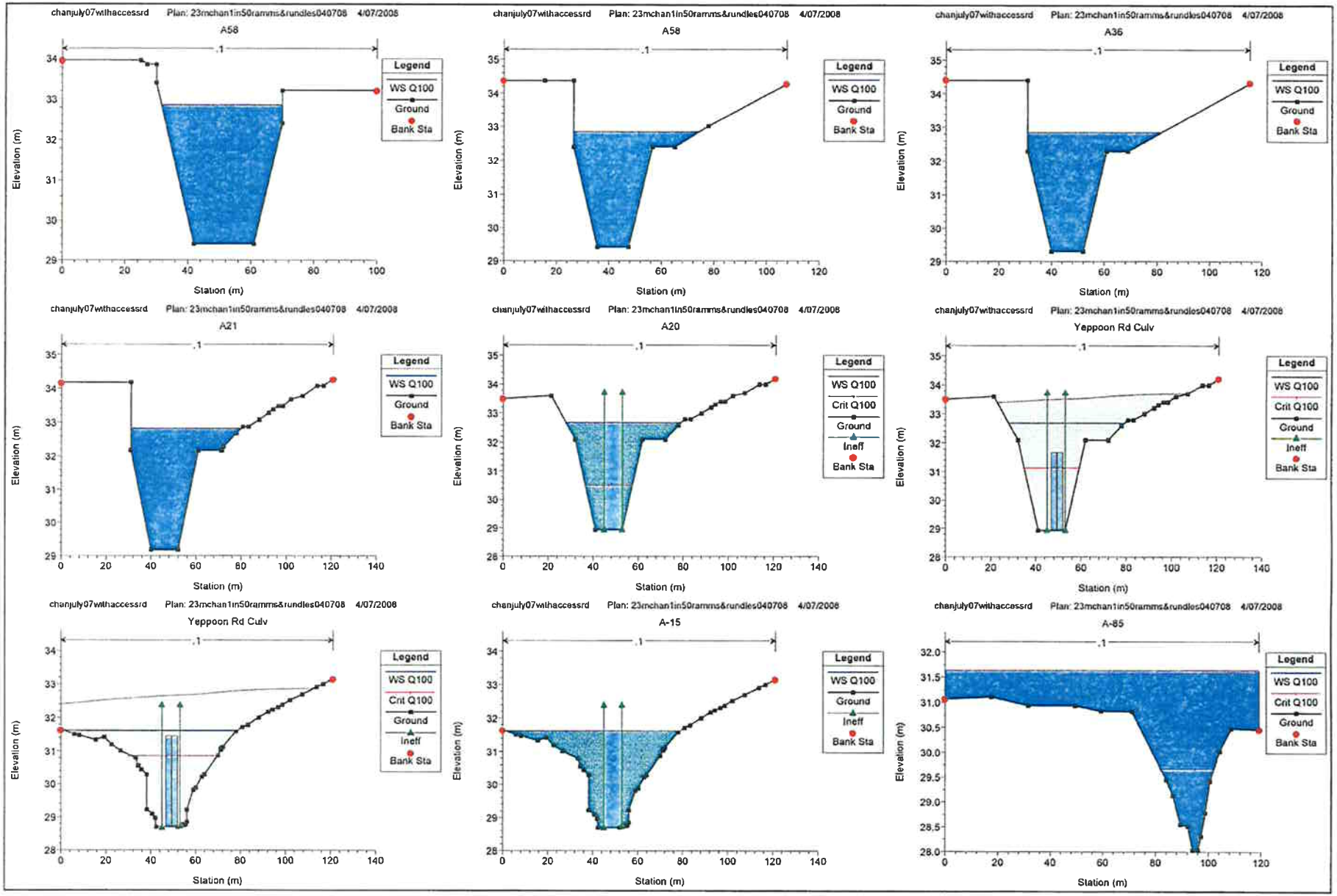
Station (m)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Bank Sta
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Station (m)
chanjuly07withaccessrd Plan: 23mchan1in50ramms&rundles040708 4/07/2008
A58
Legend
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Ground
Bank Sta
Elevation (m)
Station (m)
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Ground
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Crit Q100
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Ineff
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Station (m)
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Yeppoon Rd Culv
Legend
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Crit Q100
Ground
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Yeppoon Rd Culv
Legend
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Crit Q100
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Elevation (m)
Station (m)
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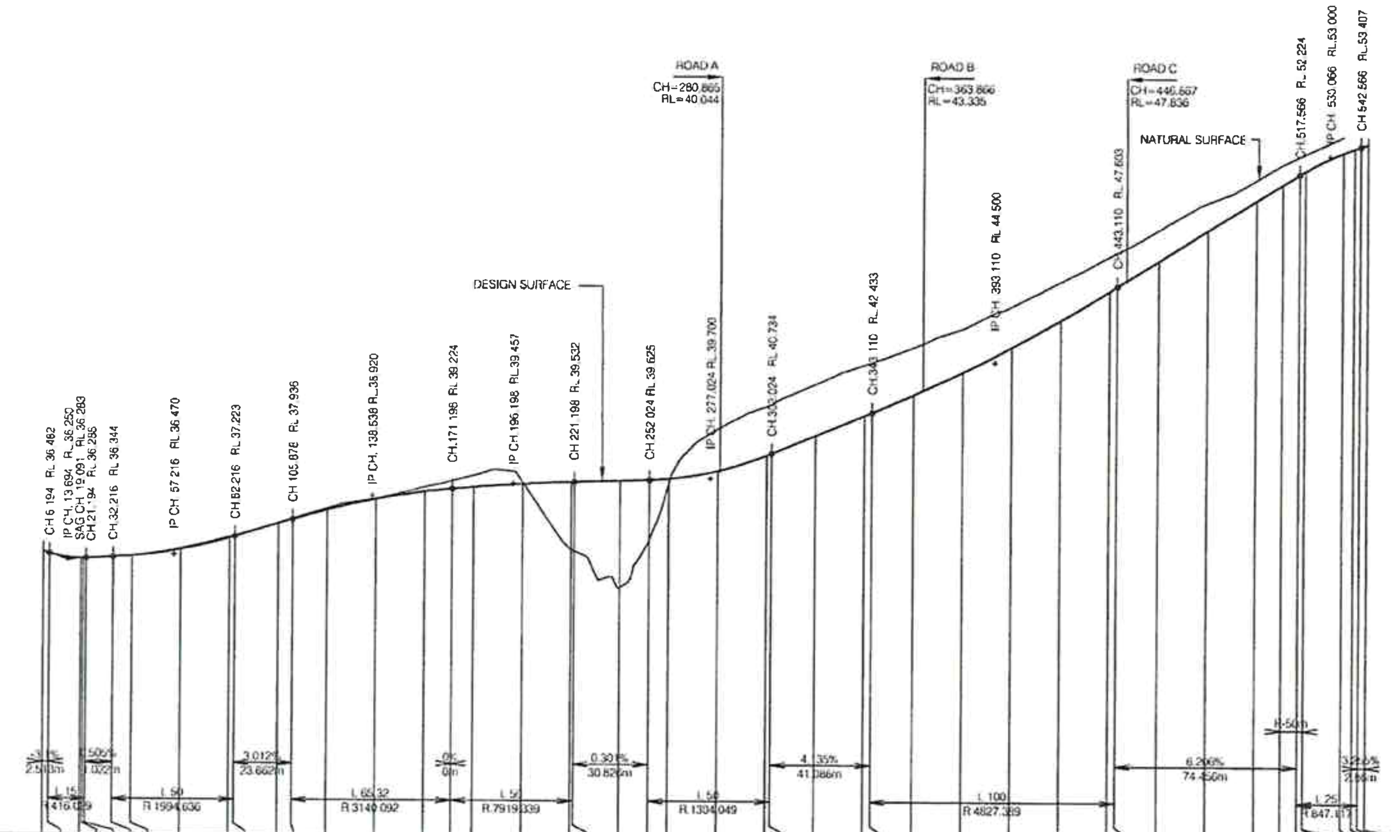
A-85
Legend
WS Q100
Crit Q100
Ground
Bank Sta
Elevation (m)
Station (m)

APPENDIX E

Details of Channel and Foulkes Street Culvert

NOTE: CONSTRUCTION OF SUBDIVISION TO BE IN COMPLIANCE WITH THE CMDM STANDARD SPECIFICATIONS AND DRAWING STANDARDS.



Horiz Curve Data

Vertical Geometry Grade (%)
Vertical Grade Length (m)

Vertical Curve Length (m)
Vertical Curve Radius (m)

DATUM R.L.25.000

CHAINAGE	KERB LEVELS RHS	KERB LEVELS LHS	NAT. SURFACE ON ROAD CENTRELINE	CUT / FILL DEPTH	DESIGN LEVELS ON ROAD CENTRELINE
0					
6.184	36.296	36.296	36.460	-0.023	36.482
19.091	36.096	36.096	36.279	-0.003	36.283
20	36.097	36.097	36.264	0.000	36.264
21.194	36.101	36.101	36.290	0.002	36.288
32.216	36.157	36.157	36.349	0.006	36.344
40	36.211	36.211	36.394	-0.005	36.398
60	36.491	36.491	36.717	0.039	36.678
80	36.971	36.971	37.205	0.048	37.158
82.216	37.036	37.036	37.262	0.039	37.223
100	37.572	37.572	37.776	0.018	37.759
105.876	37.749	37.749	37.973	0.037	37.936
120	38.149	38.149	38.402	0.066	38.336
140	38.629	38.629	38.799	0.021	38.778
160	39.007	39.007	39.284	0.185	39.100
171.196	39.175	39.175	39.552	0.328	39.224
180	39.284	39.284	39.775	0.473	39.301
200	39.452	39.452	39.509	0.069	39.440
220	39.513	39.513	36.746	-2.783	39.528
221.198	39.513	39.513	36.690	-2.842	39.532
240	39.577	39.577	35.203	-4.386	39.589
252.024	39.724	39.724	37.162	-2.462	39.625
260	39.848	39.848	39.488	-0.185	39.673
280	40.211	40.211	41.733	1.723	40.009
300	40.839	40.839	42.669	2.018	40.652
302.024	40.921	40.921	42.746	2.012	40.734
320	41.664	41.664	43.585	2.108	41.477
340	42.491	42.491	44.381	2.077	42.304
343.11	42.619	42.619	44.488	2.055	42.433
360	43.347	43.347	45.095	1.934	43.160
380	44.286	44.286	45.865	1.766	44.099
400	45.307	45.307	46.786	1.666	45.120
420	46.411	46.411	47.775	1.551	46.224
440	47.598	47.598	48.810	1.399	47.411
443.11	47.790	47.790	48.976	1.375	47.603
460	48.838	48.838	49.900	1.246	48.651
480	50.080	50.080	51.018	1.125	49.893
500	51.321	51.321	51.991	0.857	51.134
510.763	51.939	51.969	52.627	0.825	51.802
517.566	52.411	52.411	52.963	0.739	52.224
519.937		52.555	53.076	0.708	52.368
520		52.559	53.079	0.707	52.372
535.426			53.785	0.641	53.144
540					53.319
542.566					53.407
545.426					53.500

HOR. 20 10 0 20 40 60 80 1:1000 A1 1:2000 A3

VERT. 2 1 0 2 4 6 8 1:100 A1 1:200 A3

SCALE BEFORE REDUCTION

LONGITUDINAL SECTION - FOULKES STREET

FOR CONSTRUCTION

0	30.10.06	FOR CONSTRUCTION
A	27.03.06	FIRST ISSUE

B ODONNELL
D OLEOLA
E FRANKLIN
C FRANKLIN

R1031-01-07-009-FOULKES STREET LONGITUDINAL SECTION.dwg

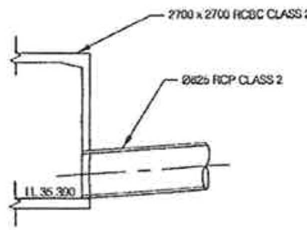
JOPADOO PTY LTD
CHANCELLORS ESTATE, STAGE 1
FOULKES STREET, ROCKHAMPTON
FOULKES STREET LONGITUDINAL SECTION
SHEET 1

27.03.06

R1031-01-07-009 0 A

CULVERT HEADWALL & WINGWALL SETOUT

POINT NO	X CO-ORD	Y CO-ORD
1	5182.700	5110.836
2	5182.424	5110.719
3	5179.708	5117.138
4	5185.205	5120.432
5	5186.950	5122.742
6	5193.766	5121.285
7	5193.703	5120.982
8	5167.680	5141.341
9	5167.958	5141.458
10	5170.672	5135.039
11	5165.176	5131.744
12	5163.431	5129.434
13	5156.615	5130.891
14	5156.677	5131.185



SECTION C-C
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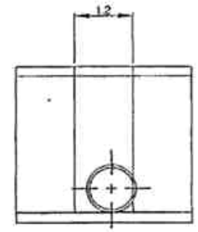
SCALE: 1:100 A3



SECTION B-B
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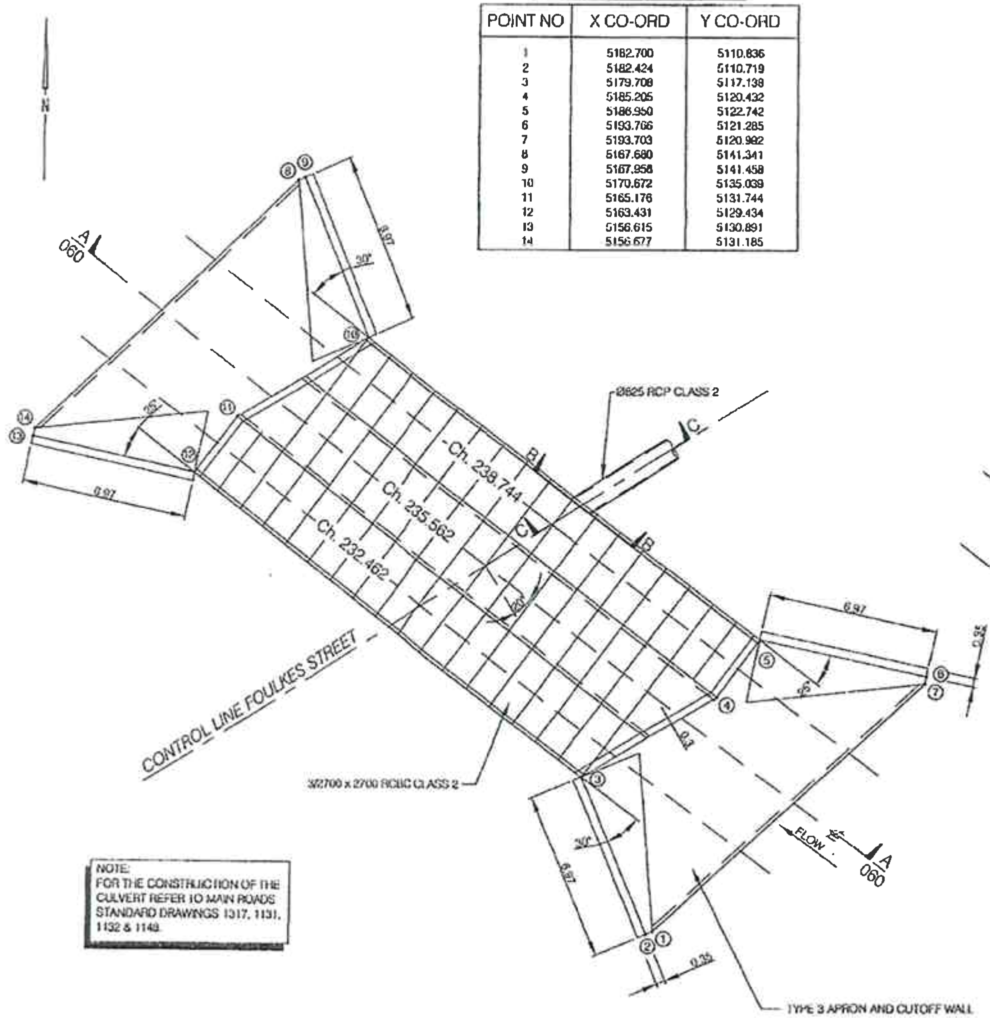
SCALE: 1:100 A3

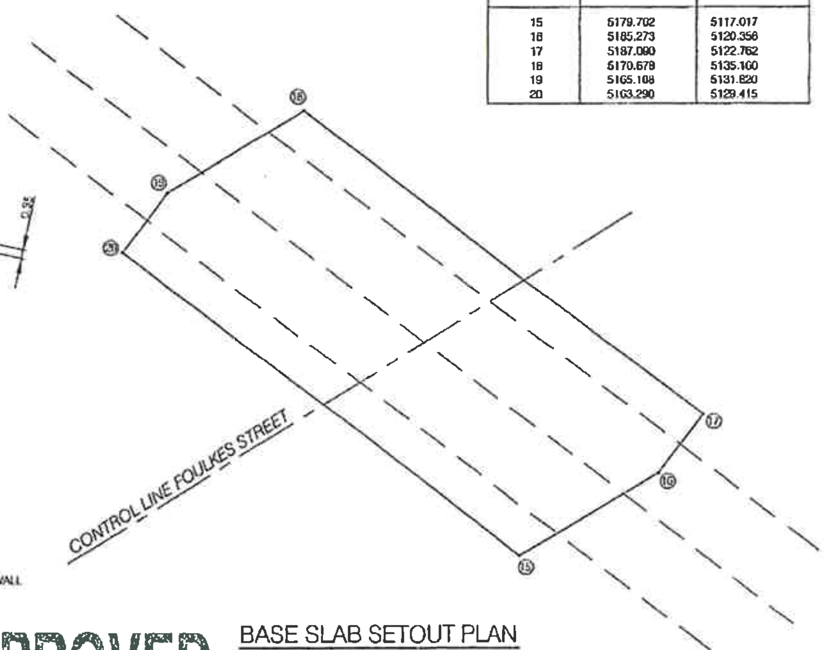
CULVERT BASE SLAB SETOUT

POINT NO	EASTING	NORTHING
15	5179.702	5117.017
16	5185.273	5120.356
17	5187.090	5122.762
18	5170.678	5135.160
19	5165.108	5131.820
20	5163.290	5129.415



NOTE:
FOR THE CONSTRUCTION OF THE CULVERT REFER TO MAIN ROADS STANDARD DRAWINGS 1317, 1131, 1132 & 1149.

CULVERT SETOUT PLAN
SCALE: 1:100 A1
SCALE: 1:200 A3



BASE SLAB SETOUT PLAN
SCALE: 1:100 A1
SCALE: 1:200 A3

APPROVED

NOTE: CONSTRUCTION OF SUBDIVISION TO BE IN COMPLIANCE WITH THE CMDM STANDARD SPECIFICATIONS AND DRAWING STANDARDS.

FOR CONSTRUCTION

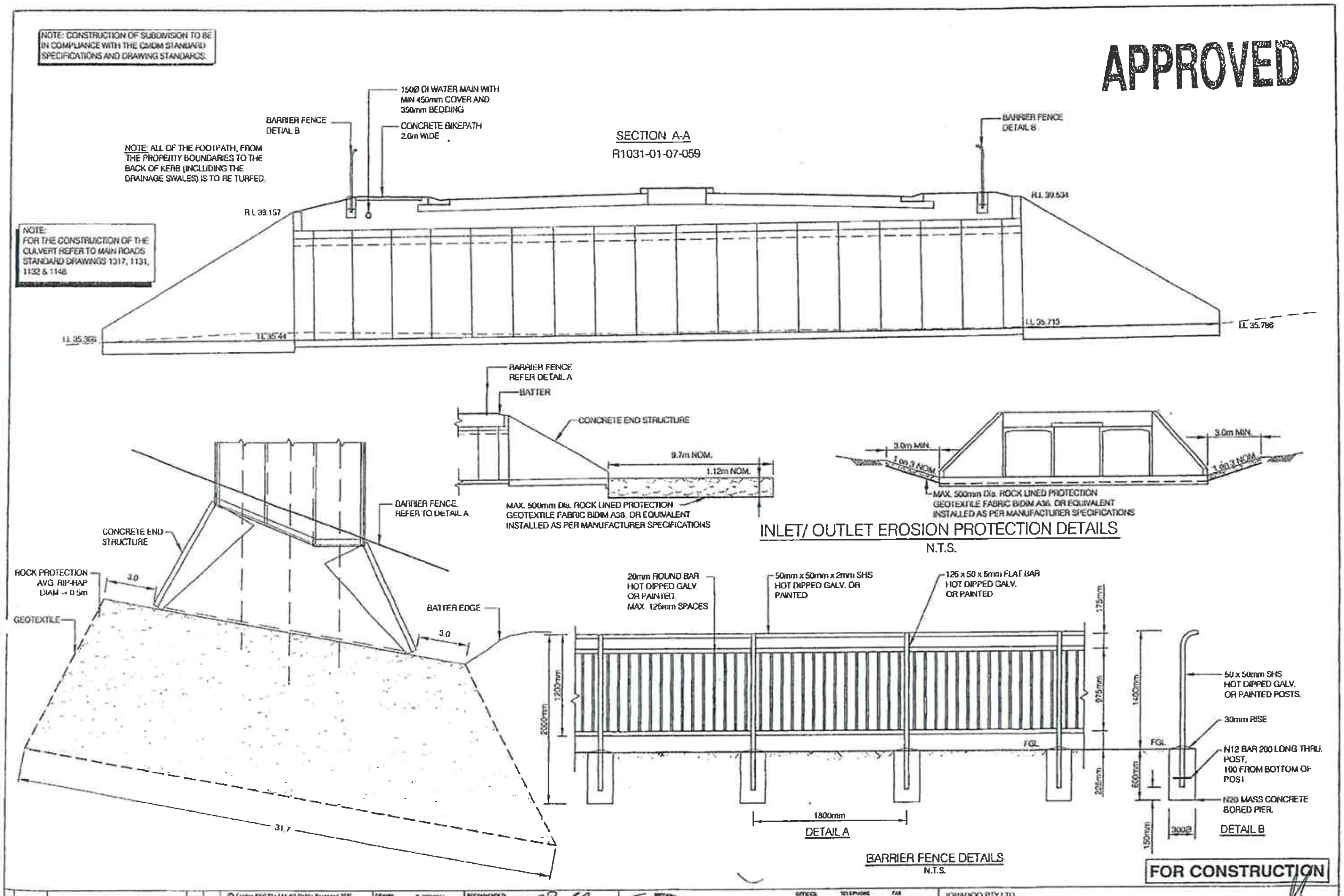
A	27.03.06	FIRST ISSUE
No	DATE	REVISIONS

DRAWN: B. GODWILL · DESIGNED: D. CROCKA · CHECKED: C. FRANKLIN
RECOMMENDED: PROJECT MANAGER · C. FRANKLIN
APPROVED: PROJECT DIRECTOR
A1 · DATUM:
R1031-01-07-060-CULVERT SETOUT PLAN.dwg

Cardno
Cardno (Qld) Pty Ltd

JOPADOO PTY LTD
CHANCELLORS ESTATE, STAGE 1
FOULKES STREET, ROCKHAMPTON
CULVERT SETOUT PLAN

DATE: 27.03.06
DRAWING No: R1031-01-07-060 · A



A	27.03.06	FIRST ISSUE
REV.	DATE	REVISIONS

DRAWN: B. BROMELL
DESIGNED: B. CUCOLA
CHECKED: C. FRANKISH
A1 DATUM:

Cardno

Cardno (Qld) Pty Ltd

JOPADOO PTY LTD
CHANCELLORS ESTATE, STAGE 1
FOULKES STREET, ROCKHAMPTON
CULVERT LONGITUDINAL SECTION & EROSION PROTECTION DETAILS

R1031-01-07-061 A

a) Foulkes Street Culvert (view from upstream apron)

b) Foulkes Street Culvert (view from upstream)

c) Foulkes Street Culvert (detail of downstream rockpad)

d) Foulkes Street Culvert (detail of downstream apron)

BROWN
Smart Consulting

Engineering Infrastructure Report

Crestwood Estate – Corner Rockhampton – Yeppoon Road & Norman Road, Norman Gardens

Residential Development – Stages 7 and 8 (31 Lots)

Prepared for Citimark Properties

Report No / Project No. R12063
June 2013

BROWN
Smart Urban

COMMERCIAL IN CONFIDENCE

DOCUMENT CONTROL

Engineering Report - 2012

Issue	Date	Issue Details	Author	Checked	Approved
A	16/04/13	Original Issue	MD	RS	

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APPENDICES

1. INTRODUCTION

Brown Consulting (QLD) Pty Ltd has prepared the following report to address the civil engineering issues associated with the Application for amendment of the "Development Permit for Reconfiguration of a Lot" for stages 7 and 8 which consist of 31 allotments of Crestwood Estate. Stages 7 and 8 are a continuation of existing approvals comprising of the fully constructed stage 1 from the formally known Chancellors Estate and stages 2, 3A, 4, 5 & 6 of Crestwood Estate. This residential subdivision is proposed for development on existing Lot 300 on SP216105 and has previously received Reconfiguration of a Lot approval for stages 2, 3A and 4.

An extension of time and permissible change to the approval for stages 5 and 6 has been submitted to Rockhampton Regional Council for assessment and approval. Further to this, stages 7 and 8 have previously received Reconfiguration of a Lot approval and this engineering infrastructure report is in support of an application for amendment to this previous approval. In conjunction with this, Operational Works Applications have been completed and submitted to the Rockhampton Regional Council for assessment of stages 2, 3A, and 4 in separate applications.

Stages 7 and 8 are located to the east of Foulkes Street continuing on from the previously constructed Jim Goldston Avenue, which was completed as part of stage 1 of the former Chancellors Estate and extended as part of stage 4 of the Crestwood development. The Crestwood Development is located adjacent to CQ University as well as other residential developments along the Norman Road growth corridor in the popular Norman Gardens suburb. The locality of the subject site can be seen in the following illustration.

2. STAGING

This proposal is for a 31 lot residential subdivision to be constructed over 2 stages (stages 7 & 8) (refer Appendix B). These proposed 31 allotments are a continuation of existing approvals comprising of the fully constructed stage 1 of the former Chancellors Estate and Stage 2, 3A, 4, 5 & 6 of Crestwood Estate. Stage 1 of the formally known Chancellors Estate consists of 65 residential allotments many of which are currently occupied with new homes. Stage 2 of Crestwood Estate comprises of 25 allotments, stage 3A consists of 14 allotments and stage 4 consists of 7 allotments all of which are for residential purposes. In addition, there are 20 allotments in stage 5 and 28 allotments in stage 6.

With the proposed 31 allotments included as part of this application for amendment to the Reconfiguration of a Lot approval for stages 7 and 8, stage 7 comprises of 20 residential allotments whilst stage 8 consists of 11 residential allotments. In the entire Crestwood development, there are 205 residential allotments excluding the existing 65 allotments from the former Chancellors Estate. Stages 3B, 9, 10 and 11 are future stages and a separate Reconfiguration of a Lot application will be submitted for these particular stages of the development.

A development plan prepared by Capricorn Survey Group is included in Appendix A and a staging plan prepared by Brown Consulting is enclosed in Appendix B.

3. GOOD PRACTICE URBAN DESIGN PRINCIPLES

The proposed development has been designed to incorporate best practices for urban developments, which are as follows:

- A mixture of gentle graded blocks, sloping allotments and elevated allotments will be incorporated into the proposed development. This ensures that the majority of the community is catered for from first home owners, to investors to luxury dwellings.

- Single access to Norman Road (Sub-Arterial Road) for the entire development with suitable approaches and sight distances. No allotments will gain access from either Norman Road or Foulkes Street (Major Collector Road). In particular, stages 7 and 8 of the development access from Jim Goldston Avenue which continues from stage 4 and is classified as a Minor Urban Collector standard road for this section.

- Pedestrian links are strategically positioned throughout the development joining roadways, while providing good access to amenities within the development and also to external roadway networks.

- Stormwater drainage strategies will be incorporated and consist of natural vegetated swales and channels and bio-retention systems, providing low maintenance stormwater polishing and ensuring runoff is managed and discharged with minimal impact to the environment, whilst adding to the appearance of the development.

4. SITEWORKS/EROSION CONTROL/GROUND CONDITION

Siteworks for the development will consist of the following stages:

- Clearing and grubbing
- Bulk earthworks
- Underground services installation
- Roadworks and stormwater drainage works
- Final detailed works
- Vegetation establishment and landscaping

A preliminary earthworks plan for the development has been included in Appendix C1 of this report.

All stockpiles are to be segregated into topsoil, pavements, sands and protected with appropriate silt traps and fences. All stockpiles are to be accessed from the upstream side to reduce erosion and maintain consistency throughout the project construction phase. Erosion control measures are to be implemented during construction in accordance with the Capricorn Municipal Development Guidelines requirements (refer Appendix C2). All erosion control measures are to be closely monitored by the Principal Contractor and re-established after all rain events or due to any vandalism.

5. SEWERAGE RETICULATION

A sewerage reticulation strategy has been prepared for the proposed residential development (Refer Appendix D).

Existing gravity sewer reticulation is located within the vicinity of the proposed stages 7 and 8 of the Crestwood development. A gravity sewer network is currently installed and operational to service existing allotments in stage 1 of the former Chancellors estate. This gravity sewer network flows into a sewage pump station completed as part of the stage 1 operational works. The sewage pump station has been commissioned by Rockhampton Regional Council and has the capacity to service the entire Crestwood development.

Stages 7 and 8 will connect into existing gravity reticulation mains completed as part of the existing stage 1 flowing into the existing sewage pump station. No upgrades will be required to existing sewer infrastructure associated with providing sewer reticulation to stages 7 and 8 of the development. With the existing sewage pump station in proximity to stages 7 and 8 and the pump station having the capacity to service the entire development, a Sewerage Network Analysis has not been requested from Rockhampton Regional Council. If council require a Sewerage Network Analysis, this can be completed as part of the future operational works application.

Appendix D includes concept plans of the proposed sewer reticulation strategy for stages 7 and 8. The digital terrain model of the development site completed by Capricorn Survey Group indicates that the site has steep terrain with a natural slope of 1 in 4 in various areas and generally falls towards the road reserve of Norman Road. Therefore based on the data provided, there appears to be no engineering difficulties with obtaining sufficient grades and cover for the proposed reticulation network to service stages 7 and 8 of the development.

6. WATER RETICULATION

A water reticulation strategy has been prepared for the subject land (refer Appendix E1).

All internal allotments will be serviced by new reticulation mains situated in all new road reserves and designed to provide good loop connections throughout the site. Internal fire hydrants will be installed on all new watermains at 80m centres and in accordance with the requirements of the Capricorn Municipal Development Guidelines.

The development will connect into the water reticulation main on Jim Goldston Avenue. This water main was completed as part of the existing stage 1 of the former Chancellors Estate and extended as part of the stage 4 works. Ultimately, the existing water main connects into a reticulation main in the Foulkes Street road reserve which is serviced by the Norman Road water network.

A water supply network analysis has been requested from Rockhampton Regional Council to ensure that the proposed development does not adversely affect the pressure and flow rates to existing surrounding allotments and infrastructure. The letter requesting this analysis is included in Appendix E2.

7. STORMWATER MANAGEMENT

The aim of the stormwater strategy is to try to maintain the natural flowpaths that flow through the development site with minimal realignment. Water quantity and quality objectives are to be met in accordance with the QUDM, CMDG & Healthy Waterways ensuring the surrounding environment, allotments and infrastructure are not adversely affected due to this residential subdivision. Please refer to the Stormwater Management Report for details regarding water quantity and quality measures to be implemented in the development works.

8. ROADWORKS/PEDESTRIAN NETWORKS

8.1. Roadworks/Road Hierarchy

The proposed development will be accessed from Jim Goldston Avenue (refer Appendix F).

The entire Crestwood development is accessed from Foulkes Street which is classified as a Major Urban Collector Road in accordance with the Capricorn Municipal Development Guidelines. Foulkes Street has an estimated traffic flow of between 3000 – 6000 AADT and has the capacity to adequately cater for the entire Crestwood development.

Stages 7 and 8 receive access from Jim Goldston Avenue which services a number of existing allotments and is proposed to service future allotments. Jim Goldston Avenue varies in road hierarchy, however is classified as a Minor Urban Collector Road from the intersection of Foulkes Street through to the common boundary of stage 4 and 7 of Crestwood.

It is proposed that Jim Goldston Avenue will continue through stages 7 and 8 as a Minor Urban Collector standard road in accordance with the Capricorn Municipal Development Guidelines. The traffic flow catchment for Jim Goldston Avenue from the intersection of Foulkes Street through stages 7 and 8 is approximately 38 allotments. Therefore, the traffic generation from these allotments will be in the range of 380 AADT. With a Minor Urban Collector having the capability to service 76 – 300 allotments or a traffic generation of 751 – 3000 AADT, Jim Goldston Avenue from the intersection of Foulkes Street through stages 7 and 8 will have the capacity for future growth to service any neighbouring developments in the future.

Jim Goldston Avenue in stages 7 and 8 will be constructed at 7.5m wide (invert to invert) and be constructed in a minimum 18.0m wide road reserve for a Minor Urban Collector standard road in accordance with the Capricorn Municipal Development Guidelines. A 1.2m concrete pathway will be extended for the full length of Jim Goldston Avenue in the proposed stages 7 and 8.

Road L will be constructed as an Urban Access Place in accordance with the Capricorn Municipal Development Guidelines. Road L will service under 25 allotments and have a traffic flow no greater than 250 AADT allowing an Urban Access Place standard road to be adequate. Road L will be constructed at 5.5m wide (invert to invert) in a minimum 16.0m wide road reserve. No pathway is required for this roadway.

The proposed Lot 270 as part of stage 8 will gain access via Jim Goldston Avenue through an extended driveway between proposed allotments 186 and 187. This is demonstrated on the engineering drawings provided as part of this engineering infrastructure report. A drainage easement will be instigated as a result of the proposed driveway for this Lot 270 crossing the stormwater drainage channel through this stage of the development.

8.2. Intersection Sight Distance

The intersection of Jim Goldston Avenue and Road L in stage 7 has been strategically designed and planned to comply with the sight distance requirements in accordance with the Department of Transport and Main Roads Queensland, Road Planning Design Manual (RPDM), Section 13 – Intersections at Grade. With Road L intersecting Jim Goldston Avenue on a horizontal curve, the intersection has been modelled and designed in order to meet the sight distance requirements of the RPDM. With Jim Goldston Avenue being a Minor Urban Collector road, a design speed of 50km/h is required as per the Capricorn Municipal Development Guidelines.

As per Table 13.5 of Section 13 – Intersections at Grade from the RPDM, the Safe Intersection Sight Distance (SISD) for a road with a design speed of 50km/h and a desirable 2.5 second reaction time is 96.0m. Jim Goldston Avenue has a longitudinal grade towards the intersection of Road L of approximately 0.5% – 1.5%. In accordance with Table 13.6 of Section 13 – Intersections at Grade from the RPDM, no correction has been applied to the Safe Intersection Sight Distance (SISD) due to the minimal longitudinal grade of the roadway within the vicinity of the intersection.

Therefore, for the Jim Goldston Avenue and Road L intersection, the Safe Intersection Sight Distance (SISD) required for the 50km/h design speed of Jim Goldston Avenue and a desirable 2.5 second reaction time is 96.0m in both directions.

This intersection has been designed to meet these requirements for sight distance in horizontal geometry with the minimum distance from the lip of kerb of Jim Goldston Avenue to the vehicle's driver set at 3.0m as per Section 13 – Intersections at Grade from the RPDM and this is illustrated in Appendix F of this report. With Jim Goldston Avenue having a longitudinal grade of around 0.5% – 1.5% on the approaches of the intersection, there is no difficulties with obtaining sight distance in relation to the vertical geometry of the intersecting Jim Goldston Avenue and Road L. This is detailed on the Jim Goldston Avenue longitudinal section included in Appendix F.

Furthermore, the access for allotment 270 within stage 8 of the development has been checked to comply with the sight distance requirements as outlined in the Road Planning Design Manual (RPDM). With Jim Goldston Avenue classified as a Minor Urban Collector standard road and therefore having a speed environment of 50km/h, the Safe Intersection Sight Distance (SISD) required for this access is 96.0m in both directions. The vertical geometry of Jim Goldston Avenue is minimal within the vicinity of this allotment access; therefore no correction of this distance is required as per the requirements outlined in the RPDM. Included in appendix F of this Engineering Infrastructure Report is a plan detailing the sight distance available for this proposed allotment access. The access has been strategically designed and planned to intersect with Jim Goldston Avenue at a suitable horizontal and vertical geometry and therefore meets the requirements for Safe Intersection Sight Distance (SISD) as indicated.

8.3. Summary

Preliminary longitudinal sections of all roads are illustrated in Appendix F. All proposed roads will be built in accordance with the Capricorn Municipal Development Guidelines with all public roads having a maximum slope of 1:6. Private driveways will have a maximum longitudinal grade of 1:5 in accordance with the Capricorn Municipal Development Guidelines. The cross sectional profiles of each road will be as per standard drawings in the Capricorn Municipal Development Guidelines. Detailed longitudinal and cross sections will be included in the future Operational Works Application.

The proposed road hierarchy plan, roadworks plan, sight distance detail plan, preliminary typical sections and longitudinal sections of all roads are included in Appendix F of this engineering report.

9. ELECTRICAL AND TELECOMMUNICATION

Existing underground electrical and underground telecommunication services were installed as part of stage 1 of the former Chancellors Estate and extended in the road reserve of Jim Goldston Avenue as part of the stage 4 development works of Crestwood. These existing services could be utilised to service stages 7 and 8 of this development (refer Appendix G). Electrical reticulation design plans will be completed by Ergon Energy, which will be included with the future Operational Works Applications. NBN Co will be engaged to supply a telecommunications offer of supply for ensuring the most up to date services are available for this development.

10. CONCLUSION

There appears to be no engineering infrastructure difficulties with the proposed stages 7 and 8 of the residential subdivision 'Crestwood Estate' located on the corner of Rockhampton – Yeppoon Road and Norman Road, Norman Gardens. A review of the services proposed for this development and their impact on surrounding services, indicates that there is no impediment to development.

There is a workable design strategy for traffic and access, stormwater drainage, sewerage reticulation, water supply, electricity and telecommunications. Minor alterations in design may eventuate from future applications, however the fundamentals of the design strategy ensures that service provisions will not pose a serious constraint to development.

If you should have any questions regarding this report, please do not hesitate to contact the Brown Consulting Office in Rockhampton.

APPENDIX A – Development Plans

IMPORTANT NOTE

This plan was prepared to accompany a reconfiguration of a lot application to Rockhampton Regional Council and should not be used for any other purpose.

The dimensions and areas shown hereon are subject to field survey and also to the requirements of council and any other authority which may have requirements under any relevant legislation.

In particular, no reliance should be placed on the information on this plan for any financial dealings involving the land.

This note is an integral part of this plan.

client
Citimark Properties

project
Crestwood Estate
Jim Goldston Avenue,
Norman Gardens

plan of
Lot Reconfiguration
Stage 7
(13 Lots + Open Space)

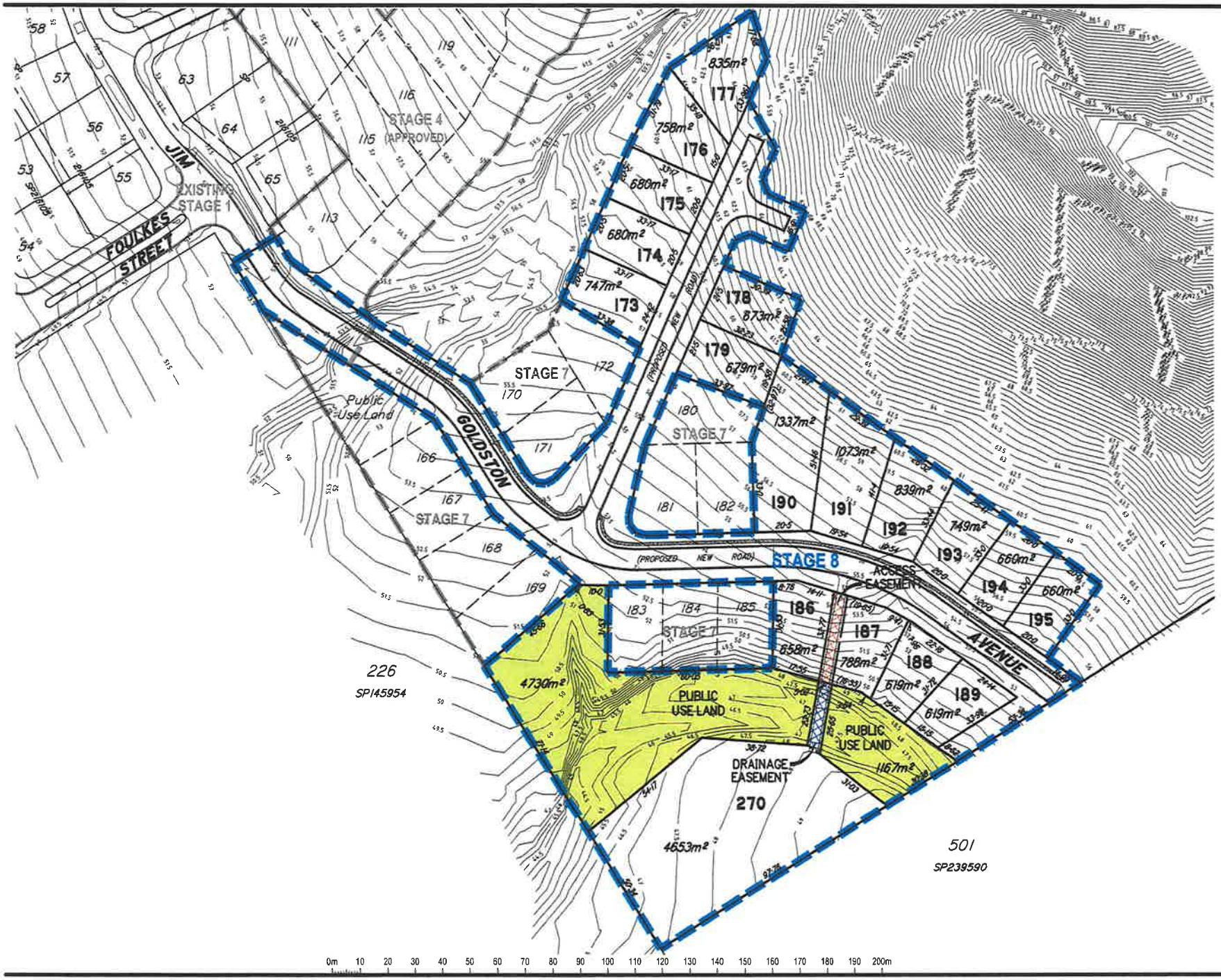
rpd
Lot 300 on SP216105
Parish of Murchison
County of Livingstone

lga
Rockhampton Regional Council

rev	date	details	authorised
A	24-06-2013	initial issue	

created
CSG capricorn survey group (cq)

scale 1:1250 @ A3	datum AHD
sheet no 1 of 1	cad file 5782-07-ROL-A
plan no 5782-07-ROL	revision A



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This note is an integral part of this plan.

client
Citimark Properties

project
Crestwood Estate
Jim Goldston Avenue,
Norman Gardens

plan of
Lot Reconfiguration
Stage 8
(18 Lots + Open Space)

rpd
Lot 300 on SP216105
Parish of Murchison
County of Livingstone

lga
Rockhampton Regional Council

rev	date	details	authorised
A	04-09-2012	Initial Issue	RJW

drawing
CSG
capricorn survey group (cq)

scale
1:1250 @ A3
datum
AHD
sheet no.
1 of 1
cad file
5782-08-ROL-A
plan no
5782-08-ROL
revision
A

APPENDIX B – Staging Plan

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BROWN
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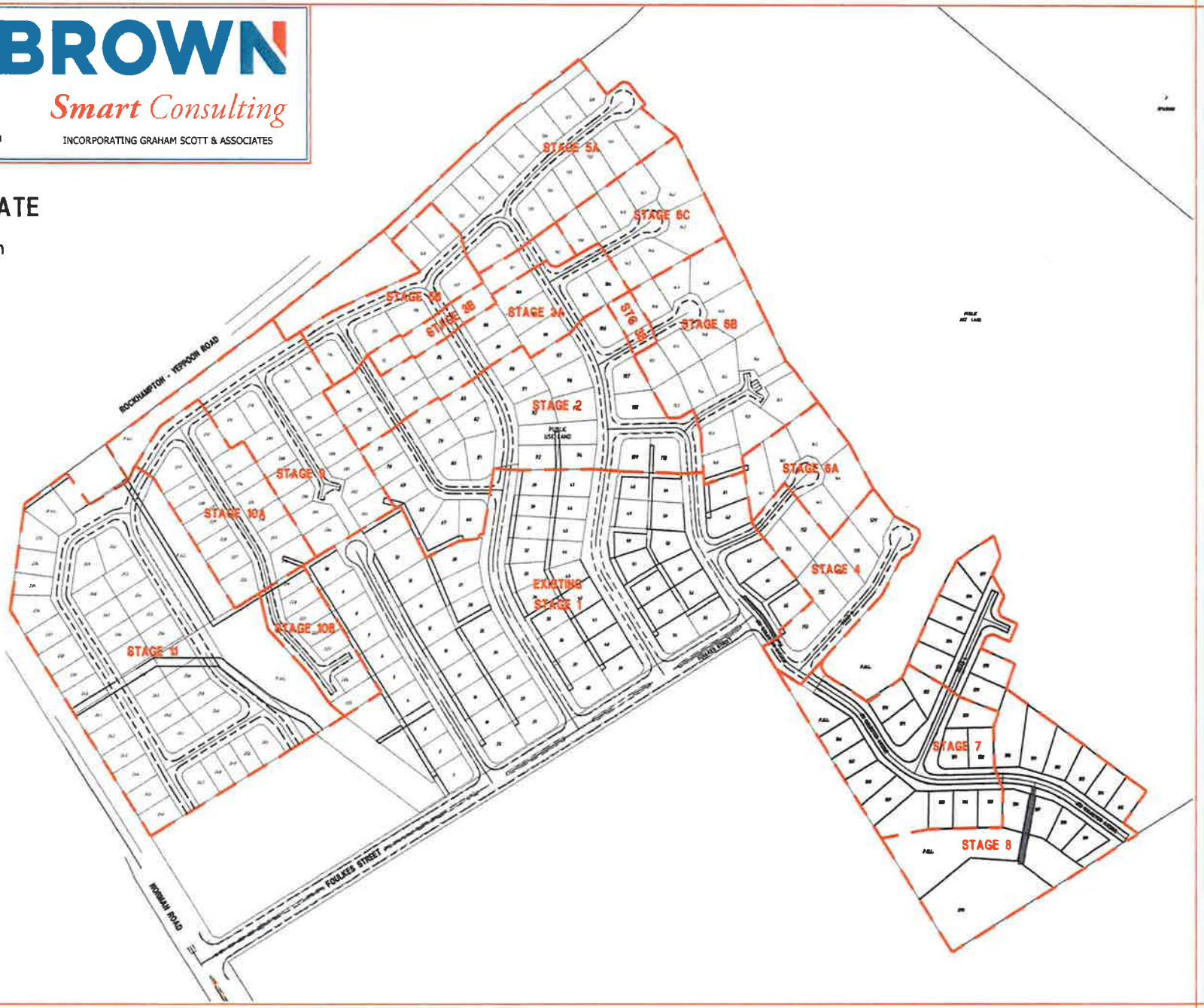
INCORPORATING GRAHAM SCOTT & ASSOCIATES

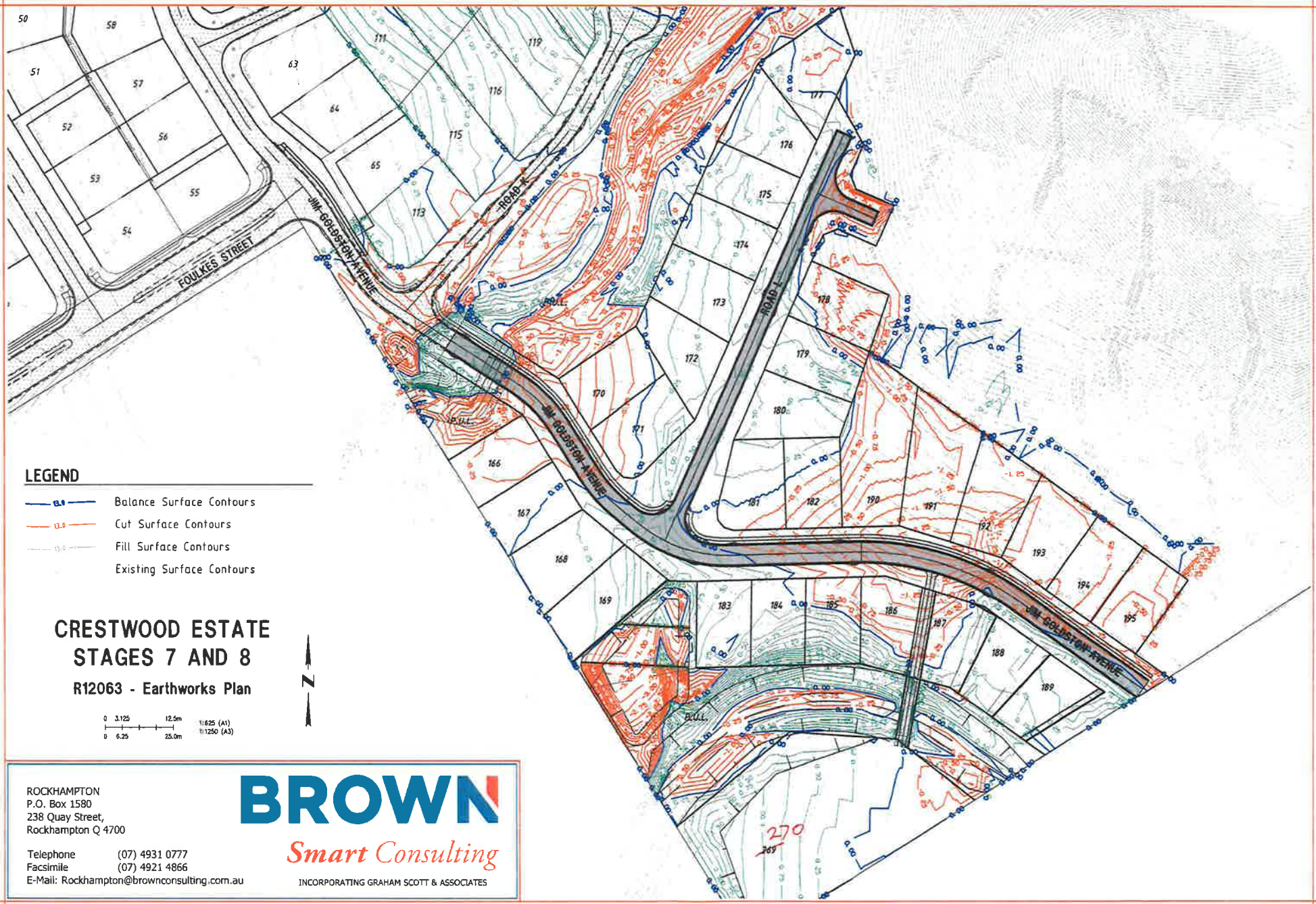
CRESTWOOD ESTATE

R12063 - Staging Plan

NOT TO SCALE



APPENDIX C1 – Preliminary Earthworks Plan



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APPENDIX C2 – CMDG Erosion Requirements

CAPRICORN MUNICIPAL DEVELOPMENT GUIDELINES

CONTROL OF EROSION AND SEDIMENTATION

C211

CONSTRUCTION SPECIFICATION

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Keeping the Capricorn Municipal Development Guidelines up-to-date

The Capricorn Municipal Development Guidelines are living documents which reflect progress of municipal works in the Capricorn Region. To maintain a high level of currency that reflects the current municipal environment, all guidelines are periodically reviewed with new editions published and the possibility of some editions to be removed. Between the publishing of these editions, amendments may be issued. It is important that readers assure themselves they are using current guideline, which should include any amendments which may have been published since the guideline was printed. A guideline will be deemed current at the date of development approval for construction works.

GENERAL

C211.01 SCOPE

1. The work to be executed under this Specification consists of the construction of structures and the implementation of measures to control erosion and sedimentation. These may be temporary or permanent.

2. The Contractor shall plan and carry out the whole of the Works to avoid erosion and sedimentation of the site, surrounding country, watercourses, waterbodies and wetlands in compliance with the requirements of the Environmental Protection Act, 1994 and Amendments, Regulations and Policies, and Local Government's Adopted Policies where available.

C211.02 REFERENCE DOCUMENTS

1. Documents referenced in this Specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

Documents Standards Test Methods

(a) Council Specifications

C212	-	Clearing and Grubbing
C213	-	Earthworks
C273	-	Landscaping

(b) QLD State Legislation

The Environmental Protection Act, 1994 and Amendments, Regulations and Policies

(c) Other

Institution of Engineers Australia, Queensland Division (IEAQ)
- Soil Erosion and Sediment Control - Engineering Guidelines for Queensland Construction Sites, 1996.

Brisbane City Council (BCC)
- Integrated Environmental Management System Manual, 1997.

C211.03 EROSION AND SEDIMENTATION CONTROL STRATEGY

1. For consideration of erosion and sedimentation control measures, the site shall be divided into sections based on the catchment area draining to each permanent drainage structure in the works. In addition to the area bounded by the road reserve, the sections shall include:

Site Sections

(a) access and haulage tracks,

(b) borrow pits and

(c) compound areas, such as Contractor's facilities and concrete batching areas.

2. Prior to pre-start meeting, the Contractor shall submit to Local Government an Erosion and Sedimentation Control Strategy for each of the nominated sections. This Strategy shall be superimposed on half-sized Erosion Control and Stormwater Management drawings of the works and shall be detailed for each catchment area of the works. The Strategy should incorporate the measures included on the plan to protect adjoining landowners, significant areas and receiving waters. The contractor shall incorporate into the Strategy those additional measures deemed necessary to accommodate the proposed construction methods and construction sequence to be employed for the construction of the works.

Section Plan

3. The Strategy shall consist of scale diagrams indicating:

Plan Inclusions

(a) features of the site including contours and drainage paths,

(b) relevant construction details of all erosion and sedimentation control structures to be employed,

(c) all permanent and temporary erosion and sedimentation control measures, including the control measures to be implemented in advance of, or in conjunction with, clearing and grubbing operations as required under the Specification for CLEARING AND GRUBBING C212,

(d) an order of works based upon construction and stabilisation of all culverts and surface drainage works at the earliest practical stage, and

(e) proposed time schedules for construction of structures and implementation of measures to control erosion and sedimentation.

(f) Strategies for identification and protection of vegetation as required by Local Government.

4. The IEAQ Guidelines and the Brisbane City Council Manual provides guidance on typical permanent and temporary erosion and sedimentation control measures which may be required and guidance in the preparation of an Erosion and Sedimentation Control Plan.

Guidance

5. No work shall commence until Local Government has approved the Erosion and Sedimentation Control Strategy. Such approval shall not relieve the Contractor of the full responsibility to provide whatever measures are required for effective erosion and sedimentation control at all times. The strategy shall be provided to Local Government prior to the pre-start meeting.

Contractor's Responsibility

6. The Contractor shall adhere to the approved Erosion and Sedimentation Control Strategy. The Contractor shall submit a revised Strategy for approval by Local Government in advance of intended variation from the approved Strategy.

Adherence to Plan

C211.04 EROSION AND SEDIMENTATION CONTROL MEASURES

1. Erosion and sedimentation control measures shall include, but shall not be limited to, the following:

Scope

(a) The minimisation of disturbance of the natural ground and retention of vegetation.

(b) The installation of permanent drainage structures before the removal of topsoil and commencement of earthworks for formation within the catchment area of each structure.

(c) The prompt completion of all permanent and temporary drainage works, once commenced, to minimise the period of exposure of disturbed areas.

(d) The stabilisation of diversion and catch drains to divert uncontaminated runoff from outside the site, clear of the site. Catch drains shall be installed and lined before the adjacent ground is disturbed and the excavation is commenced.

(e) The passage of uncontaminated water through the site without mixing with contaminated runoff from the site.

(f) The provision of contour and diversion drains across exposed areas before, during and immediately after clearing and the re-establishment and maintenance of these drains during soil removal and earthworks operations.

(g) The provision of sediment filtering or sediment traps, in advance of and in conjunction with earthworks operations, to prevent contaminated water leaving the site.

(h) The restoration of the above drainage and sedimentation control works on a day to day basis to ensure that no disturbed area is left without adequate means of containment and treatment of contaminated water.

(i) The limitation of areas of erodible material exposed at any time to those areas being actively worked.

(j) The minimisation of sediment loss during construction of embankments by means such as temporary or reverse superelevations during fill placement, constructing berms along the edge of the formation leading to temporary batter flumes and short term sediment traps.

(k) The progressive vegetation of the site, in accordance with the Specification for LANDSCAPING, as work proceeds.

PERMANENT EROSION AND SEDIMENTATION CONTROL

C211.05 EARTHWORKS FOR PERMANENT EROSION AND SEDIMENTATION CONTROL BASINS

Planned Levels

1. Earthworks for permanent erosion and sedimentation control basins shall be constructed to the planned levels and dimensions shown on the Drawings or such levels and dimensions as determined by the Superintendent.

Site Preparation

2. The entire storage and embankment foundation area of permanent erosion and sedimentation control basins shall be cleared in accordance with the Specification for CLEARING AND GRUBBING C212 and shall be stripped of topsoil and any unsuitable material under embankments removed in accordance with the Specification for EARTHWORKS C213.

Compaction Requirements

3. The embankments shall be constructed in accordance with the Specification for EARTHWORKS C213.

C211.06 INLETS, SPILLWAYS AND LOW FLOW OUTLETS FOR SEDIMENTATION CONTROL BASINS AND SEDIMENT TRAPS

Rock Mattresses

1. Inlets and spillways shall be constructed using rock filled woven galvanised steel mattresses laid on a needle punched, mechanically bonded, non-woven geotextile filter fabric, unless detailed otherwise shown on the Drawings. The rock filled mattresses shall be laid in accordance with the manufacturer's instructions and Specification.

Plastic Pipe Outlet

2. A low flow outlet consisting of a 150 mm diameter plastic pipe shall be installed unless detailed otherwise as shown in the Drawings.

C211.07 CLEANING SEDIMENTATION CONTROL STRUCTURES

1. The Contractor shall clean out permanent sedimentation control structures, cleaning out whenever the accumulated sediment has reduced the capacity of the structure by 50 per cent or more, or whenever the sediment has built up to a point where it is less than 300 mm below the spillway crest. All permanent sedimentation control structures shall be cleaned out by the Contractor prior to Practical Completion of the Works. ***Contractor's Responsibility***

2. Accumulated sediment shall be removed from permanent sedimentation control structures in such a manner as not to damage the structures. The sediment removed shall be disposed of in such locations that the sediment will not be conveyed back into the construction areas or into watercourses. The Contractor shall provide and maintain suitable access to permanent sedimentation control structures to allow cleaning out in all weather conditions. ***Removal of Sediment***

TEMPORARY EROSION AND SEDIMENTATION CONTROL

C211.08 GENERAL

1. The Contractor shall ensure that effective erosion and sedimentation control is provided at all times. ***Contractor's Responsibility***

2. Runoff from all areas where the natural surface is disturbed by construction, including access roads, depot and stockpile sites, shall be free of pollutants before it is either dispersed to stable areas or directed to natural watercourses. The Contractor shall be responsible for all temporary erosion and sedimentation control measures required for this purpose. ***Pollutant Free***

3. The Contractor shall provide and maintain slopes, crowns and drains on all excavations and embankments to ensure satisfactory drainage at all times. Water shall not be allowed to pond on the works unless such ponding is part of an approved Erosion and Sedimentation Control Strategy. ***Maintenance by Contractor***

C211.09 TEMPORARY DRAINS

1. Runoff from areas exposed during the work shall be controlled by construction of temporary contour drains and/or temporary diversion drains. Generally, a temporary contour drain or temporary diversion drain takes the form of a channel constructed across a slope with a ridge on its lower side. They may require progressive implementation and frequent alteration as the work progresses. ***Control of Runoff***

2. Contour drains, which follow points on the natural surface of approximately the same elevation, shall be provided immediately after a construction site is cleared to intercept and divert runoff from the site to nearby stable areas at non-erosive velocities. Contour drains shall be formed with a grade of neither less than 1 per cent nor more than 1.5 per cent and shall be spaced at intervals of neither less than 20 m nor more than 50 m, depending on the erodibility of the exposed soil. ***Contour Drains***

3. Diversion drains shall be provided across haul roads and access tracks when such roads and access tracks are identified as constituting an erosion hazard due to their steepness, soil erodibility or potential for concentrating runoff flow. Diversion drains shall be formed to intercept and divert runoff from the road or track to stable outlets. Spacing of diversion drains shall not be greater than that required to maintain runoff at non-erosive velocities. ***Diversion Drains***

C211.10 TEMPORARY SEDIMENT TRAPS

1. Temporary sediment-trapping devices shall be provided during construction to remove sediment from sediment-laden runoff flowing from areas of 0.5 hectares or more before the runoff enters natural watercourses or adjacent land. ***Sediment Traps***

C211.11 BATTER PROTECTION

1. The Contractor shall take all necessary action to protect batters from erosion. ***Contractor's Responsibility***

2. Scour of newly-formed fill batters during and after embankment construction shall be minimised by diverting runoff from the formation away from the batter until vegetation is established. ***Scour Control***

C211.12 MAINTENANCE AND INSPECTION

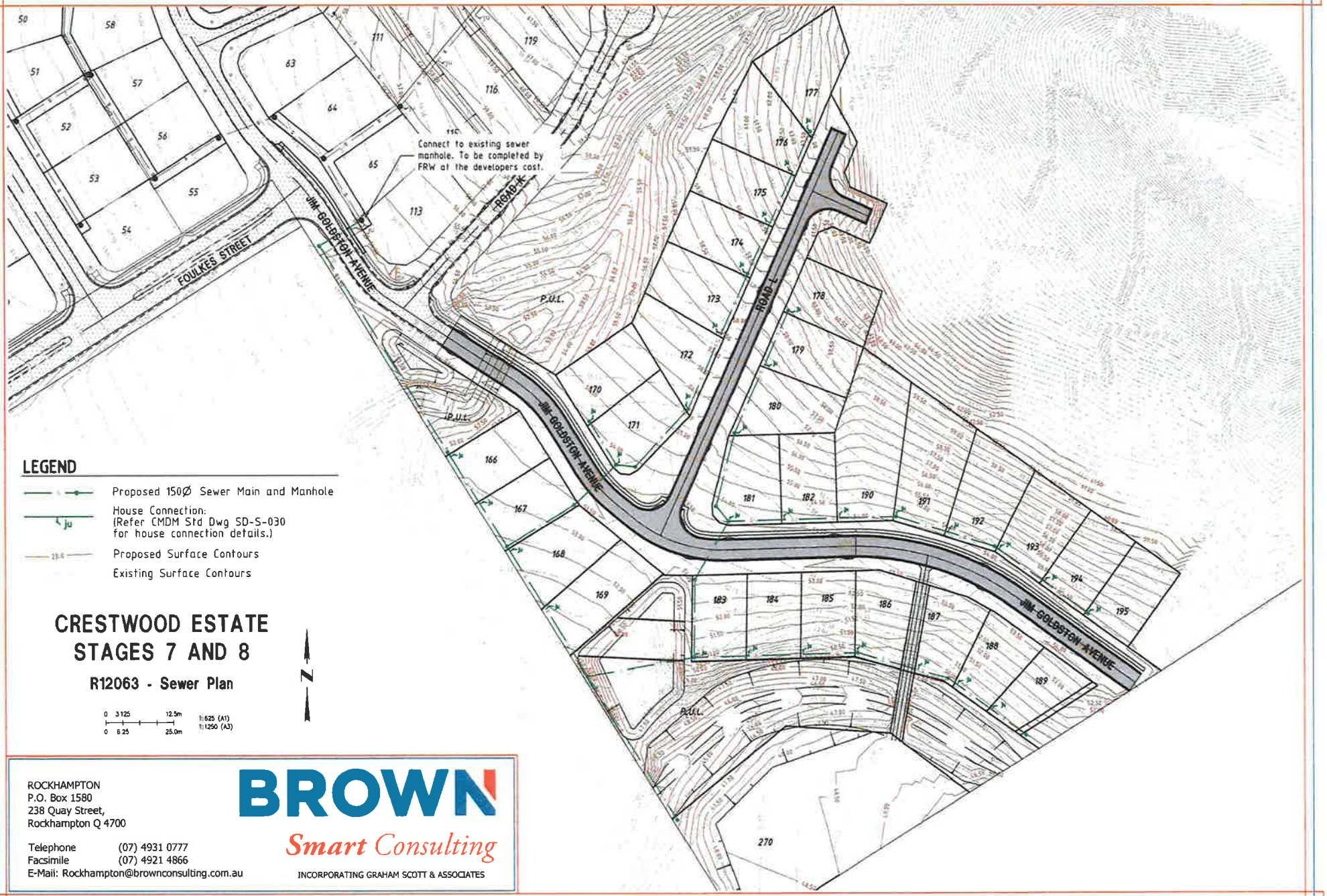
1. The Contractor shall inspect all temporary erosion and sedimentation control works after each rain period and during periods of prolonged rainfall. Any defects revealed by such inspections shall be rectified immediately and these works shall be cleaned, repaired and augmented as required, to ensure effective erosion and sedimentation control thereafter. ***Contractor's Responsibility***

2. The Contractor shall provide and maintain access for cleaning out sedimentation control works. ***Access***

C211.13 REMOVAL

1. All temporary erosion and sedimentation control works shall be removed by the Contractor when revegetation is established on formerly exposed areas before the end of the Contract. All materials used for the temporary erosion and sedimentation control works shall be removed from the site or otherwise disposed by the Contractor. ***Contractor's Responsibility***

APPENDIX D – Preliminary Sewerage Layout Plan



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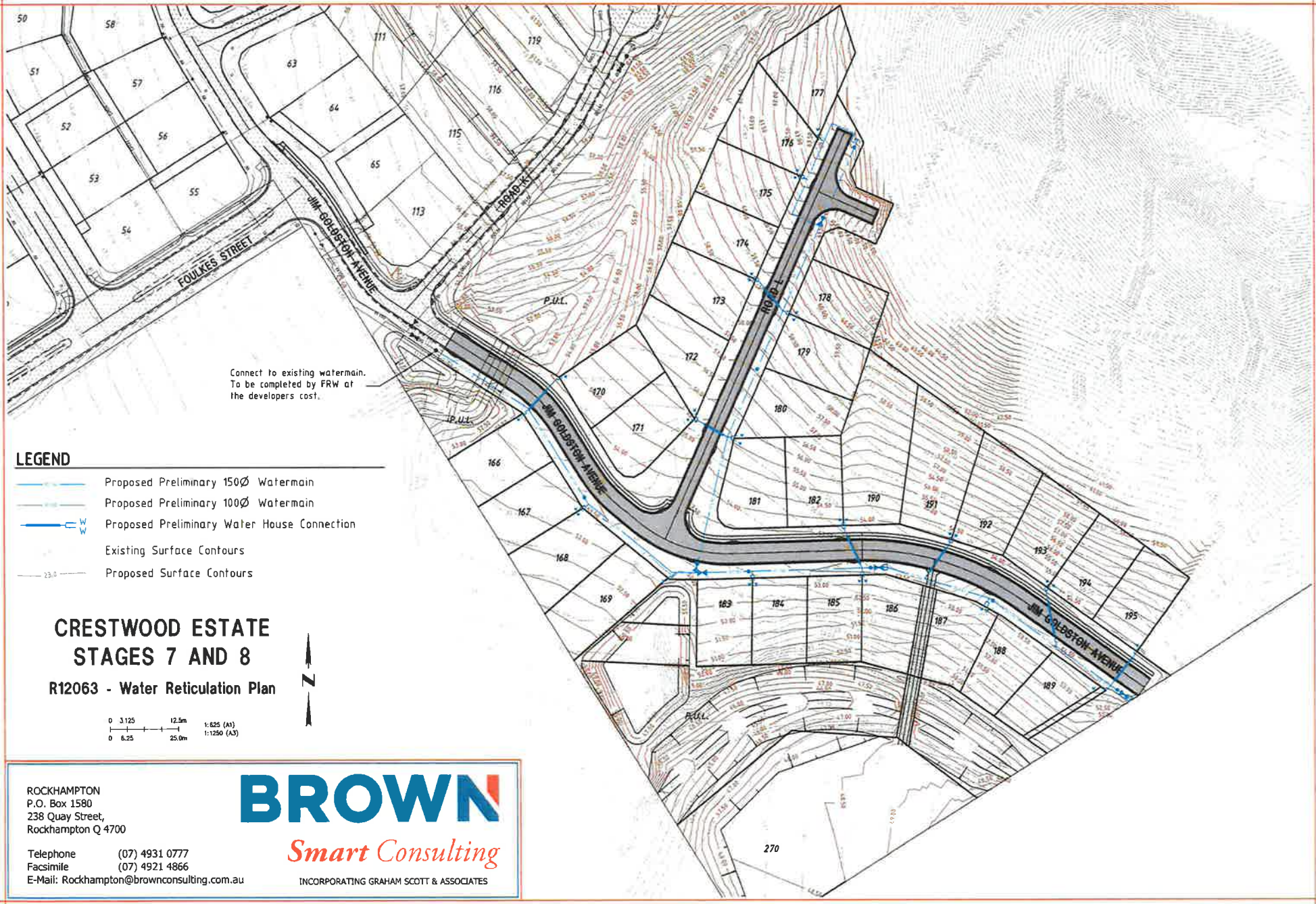
APPENDIX E1 – Preliminary Water Reticulation Plans



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APPENDIX E2 – Letter Requesting Water Supply Network Analysis

Our Ref: R12063/RS:aj/Ltr.FRW.Request.for.private.works.quotation.stages.5-11
Contact: Russell Schirmer

BROWN
Smart Consulting

Fitzroy River Water
PO Box 1860
ROCKHAMPTON QLD 4700

16 April 2013

Attention: Mr Peter Wheelhouse

Dear Peter,

Request for Private Works Quotation
Crestwood Estate – Corner Rockhampton/Yeppoon Road & Norman Road, North Rockhampton
Residential Development – Stages 5, 6, 7, 8, 9, 10 and 11

On behalf of our client, Citimark Properties QLD Pty Ltd, we hereby request Rockhampton Regional Council/Fitzroy River Water to prepare a Private Works Quotation to carry out a water supply network analysis for the above-mentioned development.

This request for private works quotation is in relation to stages 5, 6, 7, 8, 9, 10 and 11 with all proposed lots included in these stages to be serviced with water reticulation.

To assist you with this application we have enclosed the following:

- A plan of the proposal showing the ultimate development

Please note your Quotation should be addressed to:-

Citimark Properties QLD Pty Ltd
C/- Brown Consulting QLD Pty Ltd
PO Box 1580
ROCKHAMPTON QLD 4700

Should you have any questions at all, please do not hesitate to contact our office and speak with Russell Schirmer.

Yours sincerely
Brown Consulting (Qld) Pty Ltd

Russell Schirmer
Civil Manager - Rockhampton

Encl. Site Plan
Cc Citimark Properties QLD Pty Ltd

238 Quay Street, Rockhampton, Queensland 4700
Incorporating Graham Scott & Associates
Telephone +61 7 4931 0777 Facsimile +61 7 4921 4866

Brown Consulting (QLD) Pty Ltd
ABN 38 109 428 506
BrownConsulting.com.au/GrahamScott

Private Works
Application for Water and Sewerage Services
ABN 59 923 523 766

FITZROY RIVER WATER
Business Unit of RRC

Phone: 4932 9000 or 1300 22 55 77 **Fax:** 4936 8862 or 1300 22 55 79
Address: PO Box 1860, Rockhampton QLD 4700
Email: enquiries@rrc.qld.gov.au
www.frw.com.au

PRIVACY NOTICE: Rockhampton Regional Council is collecting the personal information you supply on this form for the purpose of processing your application for water and sewerage services. Your personal details will not be disclosed to any other person or agency external to Council without your consent unless required or authorised by law.

Separate application forms to be completed for water and sewerage requests			
Applicant's Name:	Russell Schirmer		
Company Name:	Citimark Properties QLD Pty Ltd		
Postal Address:	C:/ Brown Consulting 238 Quay St Rockhampton QLD 4700		
Telephone:	4931 0777	**Mobile:**	0418 743 523
Fax:	4921 4866	**Email:**	Russell.Schirmer@brownconsulting.com.au
Property Owner's Name:	Citimark Properties QLD Pty Ltd		
Work Site Address:	300 Yeppoon Road, Norman Gardens		
Site Description: (e.g. plan number)	Lot 300 SP216105		

Full description of work request. ***Please attach applicable site plans and drawings.***
(Note: 50% deposit is payable on acceptance of a private works quotation)

Water Supply Network Analysis

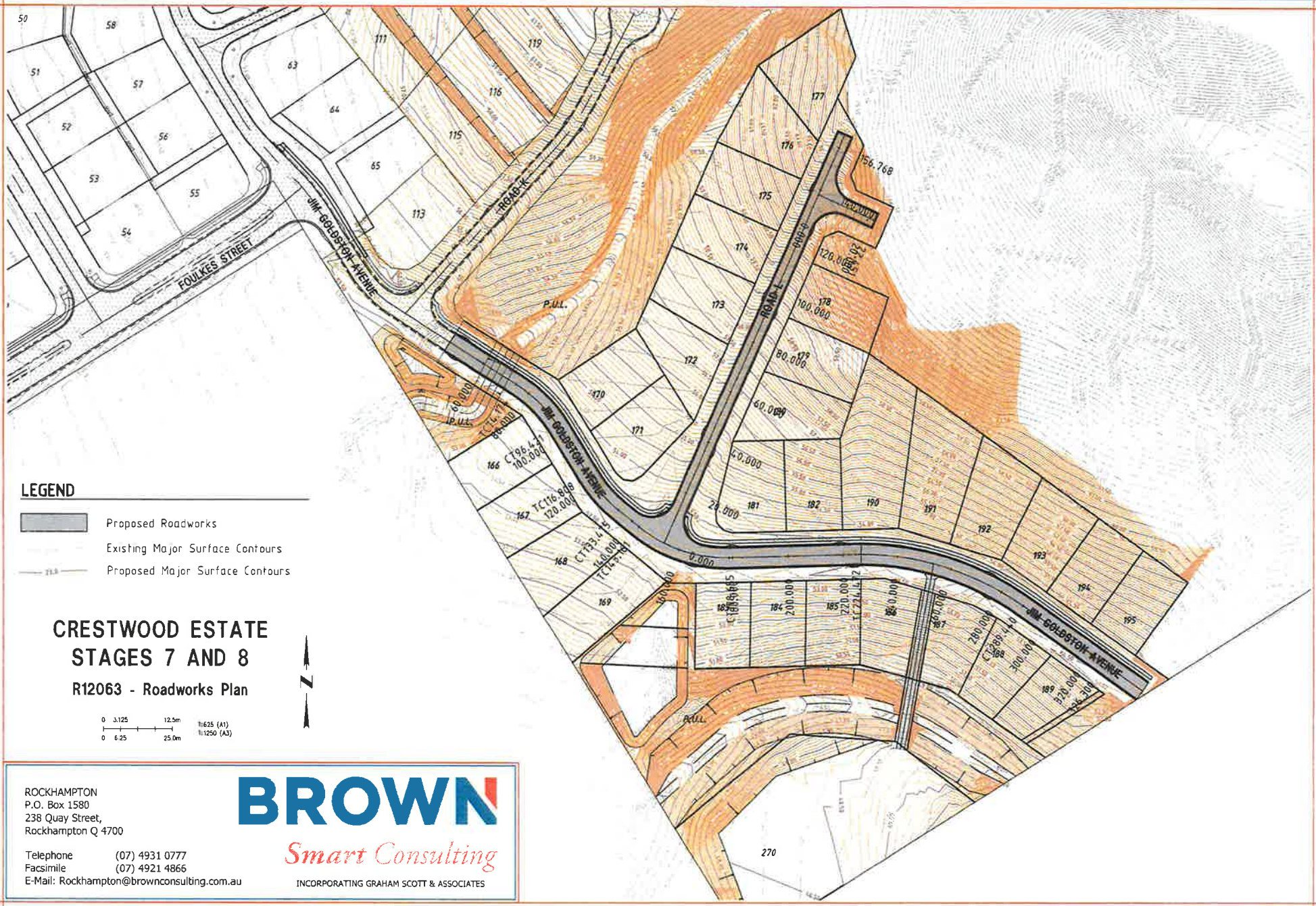
Applicant's Signature:		**Date:**	16/4/13

Please return completed form to: Customer Service, Rockhampton Regional Council,
PO Box 1860 Rockhampton QLD 4700
Fax: 4936 8862 or 1300 22 55 79
Email: enquiries@rrc.qld.gov.au

OFFICE USE ONLY	Date Rec'd	Pathways Application No.	CSO Initials

Customer Service>Dataworks>Network Services Administration Officer

APPENDIX F1 – Roadworks Plan



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APPENDIX F2 – Road Hierarchy Plan

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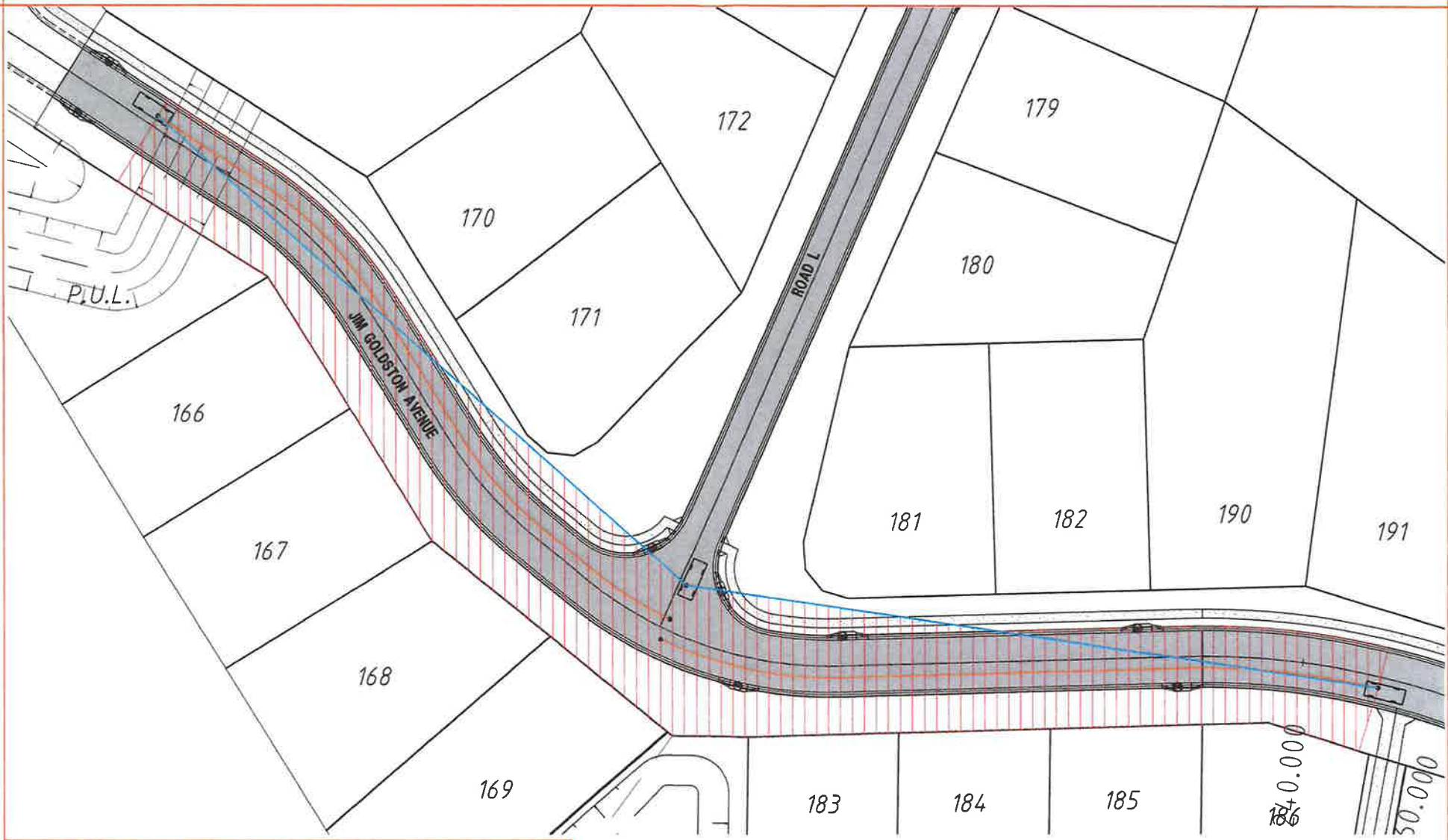
APPENDIX F3 – Intersection Sight Distance Plans



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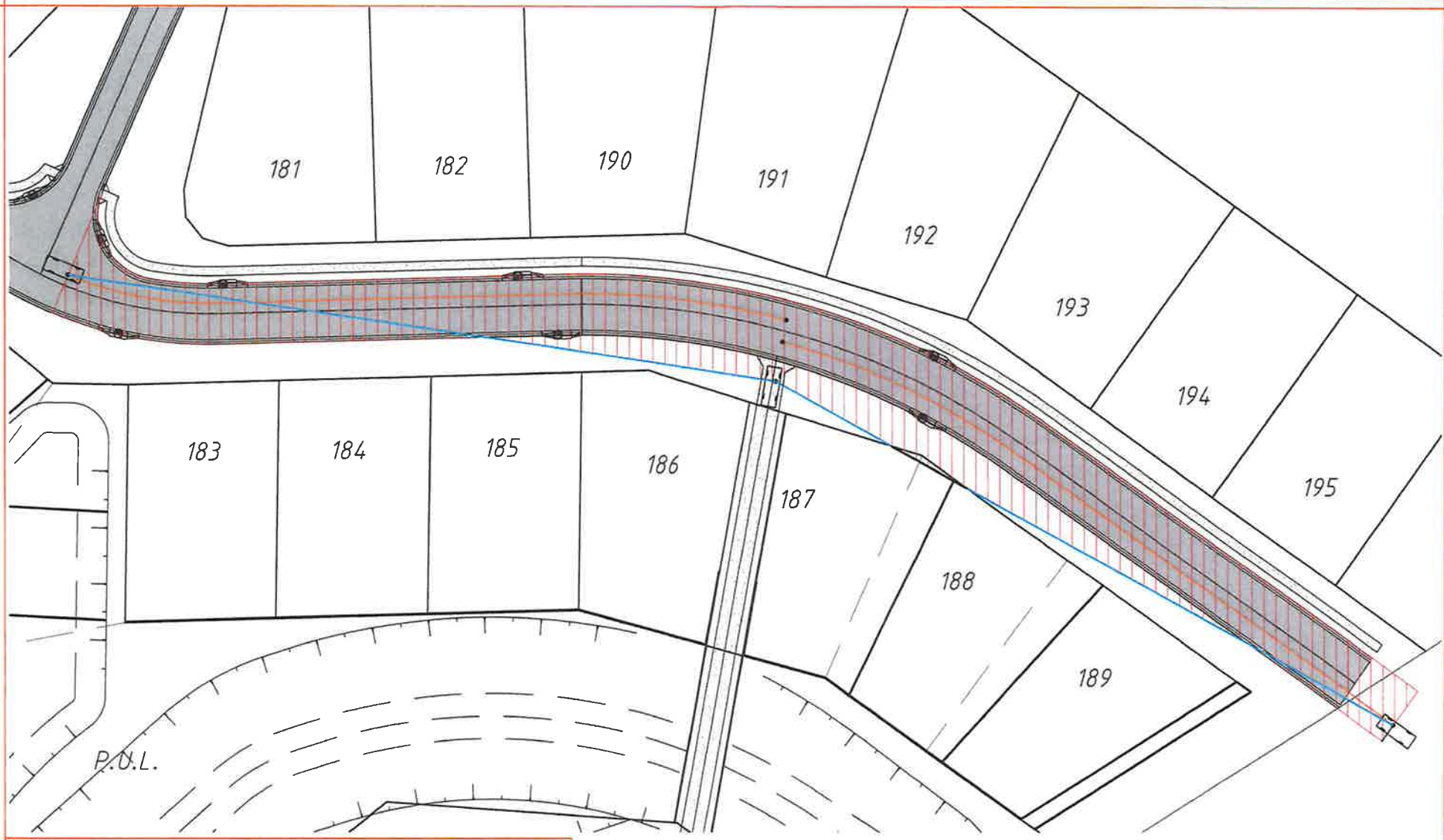
CRESTWOOD ESTATE
STAGES 7 AND 8
R12063 - Sight Distance Plan
Jim Goldston and Road L

0 1.25 5.0m
0 2.5 10.0m
1:250 (A1)
1:500 (A3)

N

LEGEND

Traffic Sight Distance Area
Intersection Jim Goldston
Avenue and Road L



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CRESTWOOD ESTATE
STAGES 7 AND 8
R12063 - Sight Distance Plan
Lot 269 Access

0 1.25 5.0m
0 2.5 10.0m
1:250 (A1)
1:500 (A3)

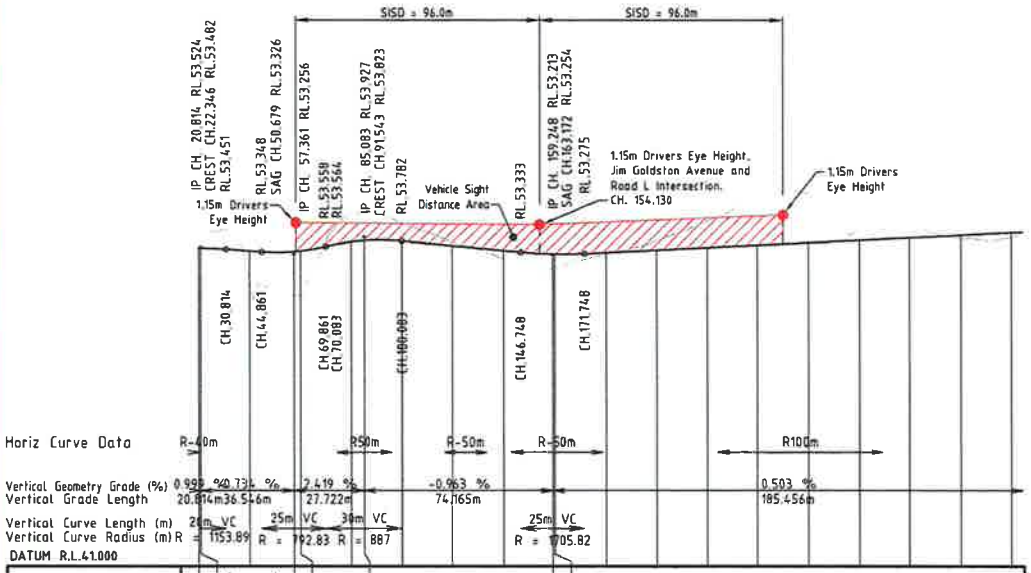
N

LEGEND

Traffic Sight Distance Area
Intersection Jim Goldston Avenue and Road L

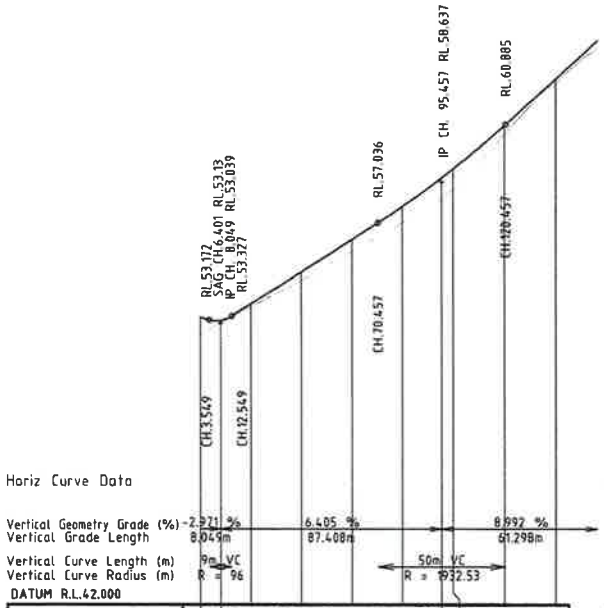
BROWN
Smart Urban

APPENDIX F4 – Roadworks Preliminary Longitudinal Sections



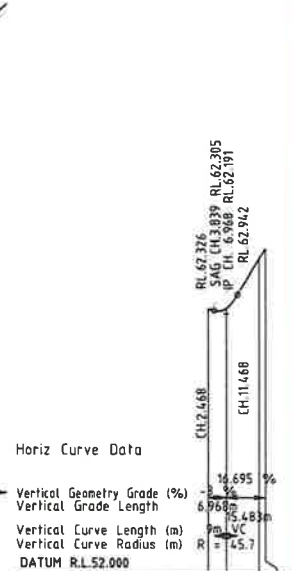
VOLUMES																						
	CUT		110	0	111	289	163	18	0	5	116	436	1330	2514	1552	1228	941	486	11			
	FILL		28	470	112	0	3	148	287	78	122	38	0	0	7	20	55	90	7			
KERB LEVELS RHS		53.375	53.376	53.219	53.251	53.277	53.644	53.695	53.679	53.486	53.294	53.154	53.153	53.213	53.313	53.414	53.514	53.615	53.715	53.816	53.917	54.017
KERB LEVELS LHS		53.375	53.376	53.219	53.251	53.277	53.644	53.695	53.679	53.486	53.294	53.154	53.153	53.213	53.313	53.414	53.514	53.615	53.715	53.816	53.917	54.017
CUT / FILL DEPTH		-0.673	-0.628	1.199	1.753	1.782	-1.047	-1.075	-0.721	-0.146	0.359	0.568	0.539	0.069	-0.356	-1.043	-1.878	-1.953	-0.452	-0.419	0.154	0.187
DESIGN LEVELS ON ROAD CENTRELINE		53.480	53.481	53.383	53.355	53.381	53.748	53.800	53.783	53.591	53.398	53.258	53.257	53.317	53.418	53.518	53.619	53.719	53.820	53.920	54.021	54.121
NAT. SURFACE ON ROAD CENTRELINE		54.102	54.109	52.185	51.601	51.599	54.796	54.875	54.504	53.737	53.039	52.690	52.718	53.248	53.273	54.561	55.497	55.673	54.271	54.339	53.867	53.935
CHAINAGE		20.000	20.814	40.000	57.361	60.000	80.000	85.083	100.000	120.000	140.000	159.248	160.000	180.000	200.000	220.000	240.000	260.000	280.000	300.000	320.000	340.000	344.248

JIM GOLDSTON AVENUE



VOLUMES												
	CUT		125	110	0	111	289	163	18	0		
	FILL		0	28	470	112	0	3	148	264		
KERB LEVELS RHS		53.278	53.73	55.011	56.292	57.596	58.725	59.079	60.769	62.568		
KERB LEVELS LHS		53.144	53.73	55.011	56.292	57.596	58.725	59.079	60.769	62.568		
CUT / FILL DEPTH		0.719	0.122	0.118	0.35	0.464	0.622	0.83	0.811	0.351	0.139	
DESIGN LEVELS ON ROAD CENTRELINE		53.278	53.144	53.804	55.085	56.366	57.670	58.799	59.154	60.844	62.642	
NAT. SURFACE ON ROAD CENTRELINE		52.559	53.022	53.686	54.735	55.902	57.049	57.968	58.342	59.154	60.492	62.503
CHAINAGE		0.000	8.049	20.000	40.000	60.000	80.000	95.457	100.000	120.000	140.000	156.768

ROAD L



VOLUMES								
	CUT		125	16				
	FILL		0	0				
KERB LEVELS RHS		62.400	64.292	64.292				
KERB LEVELS LHS		62.400	64.292	64.292				
CUT / FILL DEPTH		0.108	-0.602	-0.946	-0.957			
DESIGN LEVELS ON ROAD CENTRELINE		62.292	62.412	64.367	64.776			
NAT. SURFACE ON ROAD CENTRELINE		62.292	63.014	65.313	65.733			
CHAINAGE		0.000	6.968	20.000	22.451			

ROAD L - T JUNCTION

CRESTWOOD ESTATE
STAGES 7 AND 8

R12063 - Road Longitudinal Sections Plan

0 10.0 40.0m 1:2000 H
0 1.0 4.0m 1:200 V

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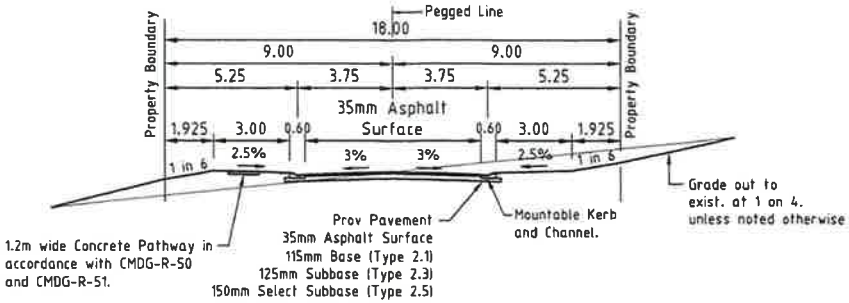
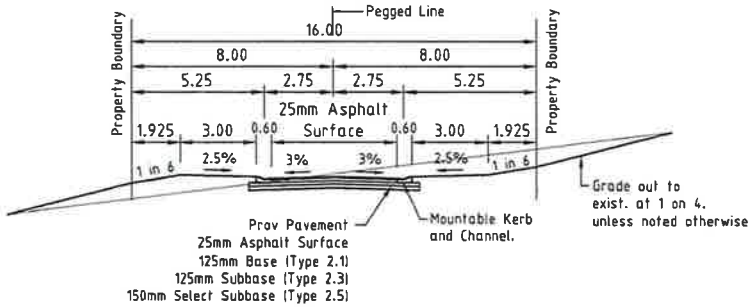
APPENDIX F5 – Roadworks Typical Sections



JIM GOLDSTON AVENUE

MINOR URBAN COLLECTOR



ROAD L

URBAN ACCESS PLACE

CRESTWOOD ESTATE
STAGES 7 AND 8

R12063 - Typical Sections

NOT TO SCALE

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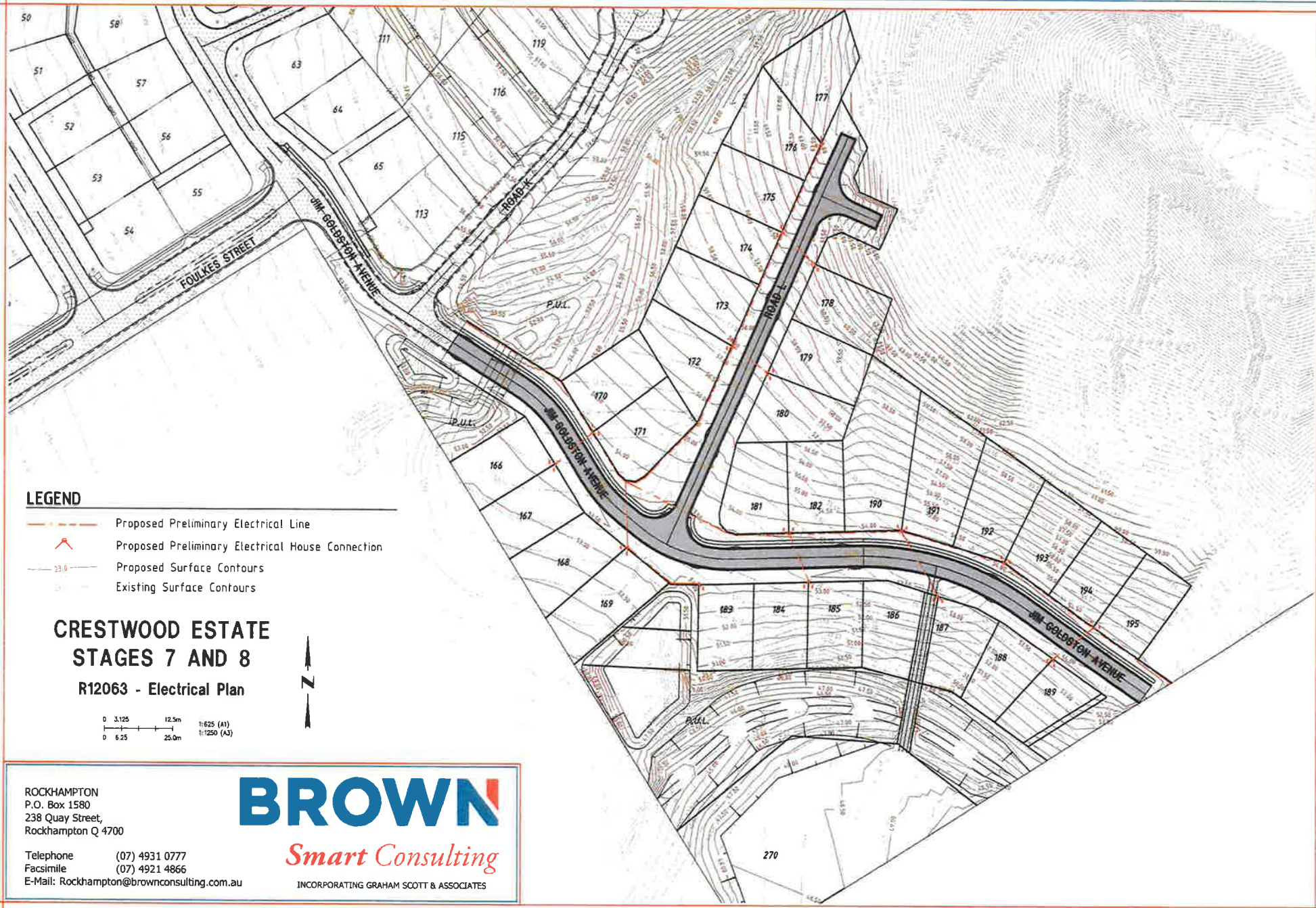
APPENDIX G – Preliminary Electrical Layout Plan



LEGEND

- Proposed Preliminary Electrical Line
- Proposed Preliminary Electrical House Connection
- Proposed Surface Contours
- Existing Surface Contours

CRESTWOOD ESTATE
STAGES 7 AND 8

R12063 - Electrical Plan

0 3.125 12.5m 1:625 (A1)
0 6.25 25.0m 1:1250 (A3)

N

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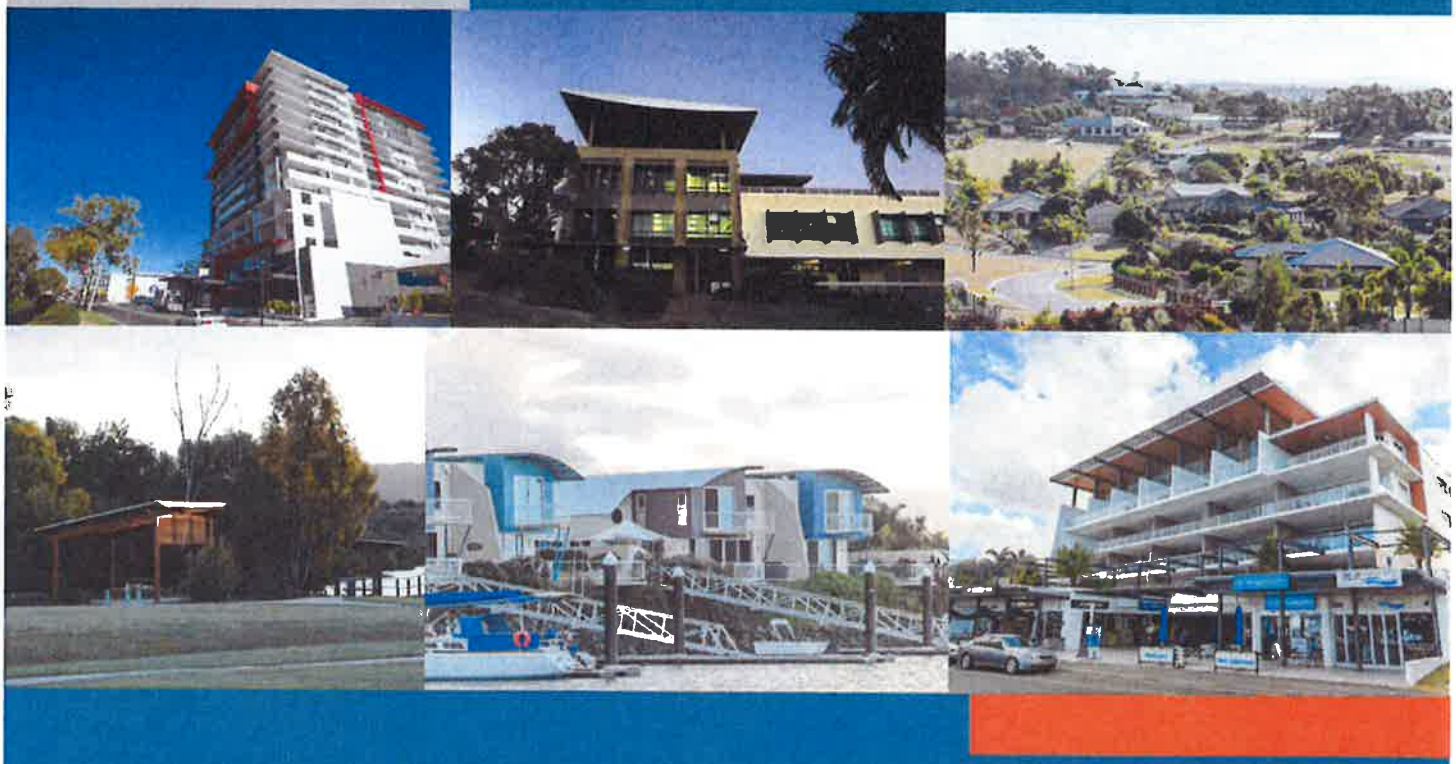


Stormwater Management Report

Civil Engineering Services

Crestwood Estate, 205 Lot Residential Development – Stages 7 & 8 (31 Lots)

Corner Rockhampton/Yeppoon Road & Norman Road, Rockhampton

Prepared for Citimark Properties

Report No / Project No. R12063
June 2013

COMMERCIAL IN CONFIDENCE

DOCUMENT CONTROL

Stormwater Management Report - Stages 7 & 8 – June 2013

Issue	Date	Issue Details	Author	Checked	Approved
A	June 2013	Report	LM	RS	Graham Scott RPEQ 2412

238 Quay Street, Rockhampton Qld 4700
Telephone: (07) 4931 0777

PO Box 1580, Rockhampton Qld 4700
Fax: (07) 4921 4866

TABLE OF CONTENTS

1. INTRODUCTION/BACKGROUND

This stormwater management report has been prepared on behalf of Citimark Properties in support of the Reconfigure of a Lot Application for Stages 7-8 of Crestwood Estate. The proposed subdivision is located on the corner of Rockhampton/Yeppoon Road and Norman Road, North Rockhampton. The proposed development will include a mixture of residential allotments ranging in size of 656m² to approximately 4,530m², refer Appendix A for Development Plan of the proposed development. Appendix B illustrates the staging of Crestwood Estate.

The intent of the Stormwater Management Report is to provide guidelines and recommendations to incorporate into Operational Works procedures, to minimise the impact of the subdivision on the surrounding environment, infrastructure, and property owners.

The development site is currently cleared vacant residential land that is the balance land to previously constructed Stage 1 (Crestwood Estate). The topography of the development side, based from Capricorn Survey Groups DTM, demonstrates that the majority of the site is housed in 1 main catchment. This catchment includes all lots in Stages 7 & 8 as well as undeveloped land above Crestwood Estate. This above catchment and all of Stages 7 & 8 discharges to the existing gully running access the southern corner of the development and into the neighbour southern allotment. This gully is part of the major flowpath that crosses Foulkes Street and Rockhampton/Yeppoon Road and discharges into Limestone Creek. This major flowpath has been addressed by Cardno as part of the approved works associates with Stage 1 of Chancellors Estate (now known as Crestwood). A detailed flood modelling analysis was conducted by Cardno which has been adopted for the development. The Flood Study completed by Cardno identifies flows during peak events for 1-100 year ARI storms. These flows have been adopted in this Stormwater Management Report. The Cardno flood study has assessed 3 cases: Existing situation, partially developed and fully developed for the proposed subdivision. The Flood Study has identified that no detention is required for the proposed development. This is an outcome we have adopted with the exception of discharging to the downstream allotment to Stage 7. We have taken a conservative approach and included detention for where the developed portion of Stage 7 & 8 discharges to the downstream neighbouring allotment. This is illustrated in the following sections of this Stormwater Management Report. This proposed report also addressing Water Quality requirements in accordance with 'Healthy Waters'.

2. EXISTING STORMWATER QUANTITY ASSESSMENT

Stage 7 & 8 of the proposed Residential Development has been split into 1 distinct existing catchment (refer Appendix C). This is:

Table 2.1

CATCHMENT	AREA
A	6.54ha

Existing catchment flows have been prepared in accordance with the Capricorn Municipal Development Guidelines (CMDG) and the Queensland Urban Drainage Manual (QUDM).

Existing Catchment A

The existing time of concentration has been calculated in accordance with the QUDM requirements, using 'Friends' Equation.

The time of concentration for existing Catchment A is 10.8 minutes. This has been calculated in accordance with the QUDM stream flow method.

The Catchment area of existing Catchment A is approximately 6.54ha, as illustrated in Appendix C. This catchment has been determined by existing contour data generated from Capricorn Survey Groups DTM. In accordance with Australian Rainfall and Runoff (AR&R) and Rockhampton Regional Council's (RRC) Stormwater Intensity Charts, the rainfall intensity for the Q_{100} flood event was calculated at 237mm/hr.

In accordance with the QUDM, Section 5.04, the coefficient for runoff for a 100 year ARI flood event is calculated at 0.708 (0.59 x 1.2).

The estimated Q_{100} flow rate discharging from existing Catchment A is calculated using the Rational Method, in accordance with the QUDM. This flow rate is 3.047m^3/s approximately.

The Q_{100} flow rate for existing catchment A are as follows:

Table 2.2

CATCHMENT	FLOW (m^3/s)
A	3.047

There are 2 main channels flowing through Stages 7 & 8, which discharge upstream undeveloped flows. These flow have been established in Cardno Pty Ltd Flood Study DEC-RAS Modelling. The peak flows from this HEC-RAS modelling have been used to size the 2 main channels to ensure their reshaping does not have adverse impacts on the surrounding lots and infrastructure.

Refer Appendix D for Calculations.

3. PROPOSED STORMWATER QUANTITY ASSESSMENT

The one (1) distinct main catchment has been used to calculate the proposed Q_{100} development flow which in turn is used to size the proposed detention basin that controls the peak flow discharging from the side to pre-developed peak flows.

Proposed Catchment 1

The development time of concentration has been generated using 'Friends' Equation, in accordance with the QUDM.

The time of concentration for Developed Catchment 1 is 7.1 minutes. This has been determined by using the stream flow method in accordance with the QUDM.

The area of proposed Catchment 1 is approximately 6.54ha, as illustrated in Appendix E.

In accordance with Australian Rainfall and Runoff and Rockhampton Regional Council's Stormwater Intensity Charts, the rainfall intensity for a Q_{100} flood event is calculated at 284mm/hr.

In accordance with the QUDM, Section 5.04, the runoff coefficient for a 100 year ARI flood event is calculated at 0.84 (0.7 x 1.2).

Using the Rational Method, in accordance with the QUDM, the estimated Q_{100} flow rate discharging from proposed Sub-Catchment 1 are calculated at 4.33m^3/s.

The Q_{100} flow rate for proposed catchment 1 are as follows:

Table 3.1

CATCHMENT	FLOW (m^3/s)
1	4.33

4. PROPOSED MAJOR STORMWATER SYSTEMS

To ensure that upstream and downstream allotments are not adversely affected by the proposed residential development, a number of Stormwater Flooding Control Systems will be incorporated into the design. These include, and not limited to, detention/bio-retention basins, overflow weirs, vegetated channels, culvert crossings and erosion protection.

Detention Basin

The proposed detention basin has been sized to control the peak flows discharging from site to calculated pre-development flows.

Sizing of the proposed detention basin is as per Section 6.06.11 of the QUDM, and recommendations supplied by Griffith University (QLD) School of Engineers 'Preliminary Estimation Methods for Sizing Detention Basins in Queensland'. Included in these recommendations are guidelines for the use of each preliminary estimation method mentioned in Section 6.06.1 of the QUDM, as per Table 1 below.

Table 4.1

Condition (r)	Method
0.00 – 0.25	Boyd Method
0.25 – 0.45	Basha Method
0.45 – 0.60	Carroll Method
0.60 – 1.00	Culp Method

Overflow weirs have been calculated ensuring sufficient freeboard is achieved to all surrounding proposed allotments in accordance with the QUDM.

In accordance with Section 6.06.1 of the QUDM, an assessment of the required onsite detention storage for proposed Catchment 1 (existing Catchment A) is 700m³ (approximately). A conservative approach has been used with a 25% safety factor added to the required storage volume. This is considered very conservative considering the approved Flood Study completed by Cardno Pty Ltd demonstrates that no detention is required for the proposed development. Based on this conservative approach the need to complete a detailed computer model (XPSWMM) is not warranted. The detention basin will detain the increase in Q_{100} flood discharge from pre to post conditions, and will ensure that the pre-developed Q_{100} flow rate of 3.047m³/s is maintained at the discharge outlet of Detention Basin 1. This detention basin will be situated in the Public Use Land between lots 169 & 183 providing easy access for maintenance purposes.

Detention basin 1 will be a tiered basin to accommodate the natural slope of the land. Each tier will discharge to the next via a minor flow pipe outlet and major flow weir structure. A concept plan of this arrangement is included in Appendix E. Detailed documentation is to be included with the future Operational Works Application.

OVERFLOW WEIRS

In accordance with the QUDM, a weir calculation has been completed ensuring the discharge flow from the detention basin and bio-retention basin is safely directed to the legal point of discharge. Broad Crested Weir Structures have been modelled.

The weir structure for Basin 1, discharging proposed Catchment 1, is approximately 15m wide at a depth of 0.26m. This weir structure will safely discharge the gap flow (Q_{100} minus Q_2) into the existing gully at a peak flowrate of no greater than the pre-developed Q_{100} flow rate.

Refer Appendix D for weir calculations.

VEGETATED CHANNELS/SWALE DRAINS

There are two (2) significant channels/swales to be incorporated into the proposed development of stages 7 & 8, which are as follows:

- Existing Channel flowing between stages 4 & 7 (Channel 1); and
- Existing channel flowing between lots 183-189 & 270 (Channel 2).

Channel 1

Channel 1 is an existing natural flow path running through the development site between stages 4 & 7. This flowpath has been previously modelled by Cardno Pty Ltd in their approved Flood Study. The calculated flow rate of 5.93m²/s (Q_{100}) has been used to size the reshaped channel as per Cardno Flood Study. The reshaped profile of Channel 1 is illustrated in Appendix E. The Q_{100} flow depth in Channel 1 will be approximately 360mm deep, which will be easily contained in the Channel area while providing freeboard requirements in accordance with the QUDM. Channel 1 will be fully detailed with the future Operational Works Application.

Channel 2

Channel 2 is the existing major flowpath that runs through the corner of the development, through the neighbouring allotment, under Foulkes Street, through Stage 11 of Crestwood Estate and into the road reserve at Rockhampton/Yeppoon Road at the existing major culvert structure (2/2700 x 2400 RCBC). This channel has been well documented in Cardno Pty Ltd approved Flood Study, which shows the peak Q_{100} flow running through Stage 8 is 49.27m³/s. This flow rate has been adopted to size the reshaped channel. The reshaped profile of Channel 2 is illustrated in Appendix E. The Q_{100} flow depth in Channel 2 will be approximately 1,120mm deep, which will be easily contained in the Channel area while providing freeboard requirements in accordance with the QUDM. Channel 1 will be fully detailed with the future Operational Works Application.

Profiles of the channel/swale drains and stormwater calculations a found in Appendix D and F.

Culvert Crossings

There are two (2) significant culvert crossings to be incorporated into Stages 7 & 8 of Crestwood Estate. The culvert crossings are where Channel 1 crosses Jim Goldston Avenue and where Channel 2 crosses the access to proposed lot 270. Culvert crossing 1 has been sized as 2/1200 x 600 RCBC with the height of water over Jim Goldston Avenue during a Q_{100} event being limited to 126mm. This is in accordance with requirements setout in the QUDM.

Culvert crossing 2 has been sized as 4/3000 x 1200 RCBC with the height of water over the access for Lot 270 during a Q_{100} event being limited to 210mm. This is in accordance with the requirements of the QUDM.

EROSION PROTECTION

The proposed detention basin should be constructed first as part of the earthworks, to be utilised as temporary silt traps, minimising any impact on the surrounding environment during construction. Temporary silt fencing and earth bunding/grader rills should also be included during the construction process to capture, control and divert runoff into the temporary silt traps. These construction erosion control / protection systems need to be monitored regularly during construction and reinstated if and where required. Inflow and overflow systems of the proposed detention basins will incorporate long term erosion protection measures, ensuring ongoing maintenance is minimal and the surrounding environment is protected. All channels and buffers will be vegetated with turf, plants and hydromulching, designed to prevent silt erosion from stormwater runoff, along with assisting with water polishing and improving the aesthetics of the development. Rock protection should be provided at the outlet of all pipe drainage, while the overflow weirs of each detention basin should be fully turfed, reducing the chance of fine silt erosion, which leads to full soil erosion. Full ground cover of the overflow weirs is essential for good erosion management.

The section of overflow channel just upstream of each proposed culvert crossing should be fully turfed (including batters), while rock protection should be installed at each downstream headwall of the culvert crossings, ensuring post construction erosion management practices are in place.

5. WATER QUALITY ASSESSMENT

5.1. Site Specific Objects

Due to the site's proximity to Limestone Creek, it is important that the site presents no worsening in terms of water quality following development. As the development is residential in character, the water quality parameters of relevance to the site are suspended solids, nutrients (nitrogen and phosphorus), litter and faecal coliforms.

Of these parameters, the detailed modelling of litter and faecal coliforms is not possible at present, using the industry standard analysis package (MUSIC – refer below) due to the lack of information regarding export rates.

The modelling of defined water quality objectives has therefore necessarily focused on suspended solids and nutrients (nitrogen and phosphorus).

In the absence of Rockhampton Regional Council water quality objectives, load reduction targets stated in the "Urban Stormwater Quality Planning Guidelines 2010" were adopted and are stated below:

85% Reduction of Total Suspended Solids
70% Reduction in Total Phosphorus
45% Reduction in Total Nitrogen
90% Reduction in Gross Pollutants

These targets are measured against the pollutant load generated for the untreated developed scenario. Load reduction targets will be modelled as they more closely represent effects on Limestone Creek.

5.2. MUSIC Water Quality Analysis Methodology

In order to determine the effectiveness of different water quality treatment measures and meeting the water quality objectives, a stormwater quality analysis was performed using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) Version 5.1.

The models consist of three types of nodes:

- Source nodes representing different land uses and defining size of sub catchments
- Treatment Node representing different types of water quality treatment measures
- Receiving nodes represent the outlet point for the catchment under consideration. Each model only has one receiving node
-

The model requires the user to specify meteorological data (rainfall and evaporation), soil properties and pollutant loads for each catchment. Suitable parameters for the MUSIC model were adopted in accordance with the recommendations of Mackay Regional City Council MUSIC Guidelines Version 1.1 2008 in the absence of Rockhampton Regional Council MUSIC Guidelines.

Climate data for the catchment was sourced from the Rockhampton rainfall data using the November 1989 to October 1998 rainfall events and the Rockhampton monthly Potential Evapo-transpiration (PET) with a 6-minute rainfall time step. The hydrologic routing option for the modelling was the "No Routing" option. This option generates more conservative results from the treatment measures as the runoff is modelled reaching the treatment measure all at the same time rather than allowing for travel and detention stages as the runoff progresses through the catchment.

A MUSIC model was created to determine the post development scenario with no WSUD and post development scenario with WSUD treatments. The source nodes for the post-development scenario were based upon the site master plan and have been shown in Tables 2.1 – 2.6. Ultimately; the receiving node for sites' catchments is Limestone Creek.

In accordance with Mackay Regional Council Water Quality Guidelines typical percentage impervious when splitting residential land uses recommends the following:

Table 2.1

Land Use Category	% Overall Catchment	% Impervious
Roof	35%	100%
Road Reserve	25%	70%
Remainder	40%	19%
Overall	100%	60%

Table 2.2: Post Development Sub-Catchment Land Uses Catchment WQA

NODE	AREA (ha)	% CATCHMENT	% IMPERVIOUS
Roof to Pipe	0.393	17.5%	100%
Roof to Urban	0.393	17.5%	100%
Road Reserve	0.899	25%	70%
Remainder	0.562	40%	19%
Total	2.248	100%	60%

Table 2.3: Post Development Sub-Catchment Land Uses Catchment WQB

NODE	AREA (ha)	% CATCHMENT	% IMPERVIOUS
Roof to Pipe	0.052	17.5%	100%
Roof to Urban	0.052	17.5%	100%
Remainder	0.193	65%	19%
Total	0.298	100%	60%

Table 2.4: Post Development Sub-Catchment Land Uses Catchment WQC

NODE	AREA (ha)	% CATCHMENT	% IMPERVIOUS
Roof to Pipe	0.079	17.5%	100%
Roof to Urban	0.079	17.5%	100%
Remainder	0.293	65%	19%
Total	0.452	100%	60%

Table 2.5: Post Development Sub-Catchment Land Uses Catchment WQD

NODE	AREA (ha)	% CATCHMENT	% IMPERVIOUS
Road Reserve	0.086	100%	70%
Total	0.086	100%	70%

Table 2.6: Post Development Sub-Catchment Land Uses Catchment WQE

NODE	AREA (ha)	% CATCHMENT	% IMPERVIOUS
Single Allotment	0.453	100%	11%
Total	0.453	100%	11%

The above Tables 2.2 – 2.6 demonstrate a 50/50 split between the roof water nodes, this indicates an assumed split that only half the roof water will be captured by the roof water, gutters and downpipes network when the remaining runoff will go to ground and will be captured as natural runoff. Refer to the Water Sensitive Urban Design (WSUD) concept drawing in Appendix A for identification of sub catchment zones / areas for post development condition. The MUSIC model is based on a split catchment approach and will incorporate various treatment nodes. All the 5 sub-catchments ultimately discharge into Limestone Creek.

The Mackay Regional Councils' MUSIC Runoff Generation Parameters used for the modelling are detailed in Table 2.7.

Table 2.7: Runoff Generation Parameters

Parameter	Cpland
Field Capacity (mm)	80
Infiltration Capacity Coefficient a	200
Infiltration Capacity Exponent b	1

Rainfall Threshold (mm)	1
Soil Capacity (mm)	200
Initial Storage (%)	30
Daily Recharge Rate (%)	0.5
Daily Baseflow Rate (%)	0.16
Initial Depth (mm)	10
Daily Deep Seepage (%)	2

Table 2.8: Pollutant Export Relationships

Land Use for MUSIC Source Node (Residential)	Parameter	Total Suspended Solids (Log10 mg/L)		Total Phosphorus (Log10 mg/L)		Total Nitrogen (Log10 mg/L)	
		Base Flow	**Storm Flow**	**Base Flow**	**Storm Flow**	**Base Flow**	**Storm Flow**
Road	Mean	1.0	2.43	-0.97	-0.30	0.20	0.26
	Std Deviation	0.34	0.39	0.31	0.31	0.20	0.23
Roof	Mean	-	1.30	-	-0.89	-	0.26
	Std Deviation	0.34	0.39	0.31	0.31	0.20	0.23
Ground Level	Mean	1.0	2.18	-0.97	-0.47	0.20	0.26
	Std Deviation	0.34	0.39	0.31	0.31	0.20	0.23

***Source: Mackay MUSIC Guidelines 1.1*

5.3. Proposed Treatment Train

It is proposed to use a combination of open swales, small buffer strips and Bio-Retention Basins to treat post development runoff from the site. The development can be separated into two main contributing

catchments. For the purpose of this water quality analysis the site has been divided into 5 sub-catchments (refer Table 2.2 - 2.6) which ultimately all end up discharging to Limestone Creek.

The northern catchment comprises of four sub-catchments being WQA, WQB, WQC & WQD. The combined area for these three catchments is approximately 3.084ha. The remaining sub-catchment (WQE) forms the southern portion of the development, a single allotment divided from the northern portion by the Main Channel allowing existing external stormwater catchments to flow through our subject site. (See WSUD drawing Appendix A)
As part of the post development scenario the combined catchments WQA, WQB & WQC will be captured by a series swale drains (A1, B1 & C1) located at the rear of the allotments. Incorporated within these swale drains is a roof water pit and pipe network sized to allow for a Q100 major event to the Bio-Retention Basin (1).

Due to sub-catchment WQE representing a single allotment, for the purposes of this study it has been assumed that a single dwelling and driveway would result in approximately 500sq m of impervious area, thus resulting in a fraction impervious of 11%. (See Table 2.6) The post development scenario for the remaining sub-catchment WQE will directly generate runoff from the catchment into the Main Channel, which will act as a swale drain treatment device to assist achieving the required pollutant load reductions.
All post development flows will discharge from the Bio-Retention Basin into the Main Channel and will ultimately discharge into Limestone Creek.

In order to meet the water quality objectives, the filtration area within the Bio-Retention Basin has been preliminarily sized to have minimum areas as represented in Table 2.9 below. The basin has been sized to have a minimum 400mm depth layer of filtration material with an additional 100mm transition layer to prevent filtration media blocking the subsoil drains over time and a further 200mm drainage layer in which the subsoil drain is to be laid.

Post development flows from Catchments WQA; WQB; & WQC will have the added benefit of utilising grassed buffer strips to assist in the treatment of sheet flows from these catchments. It is anticipated that approximately 30-50% of the upstream catchments will sheet flow over these grassed areas.

The MUSIC model screen print showing drainage links and treatment devices is identified in the below image – Figure 1.

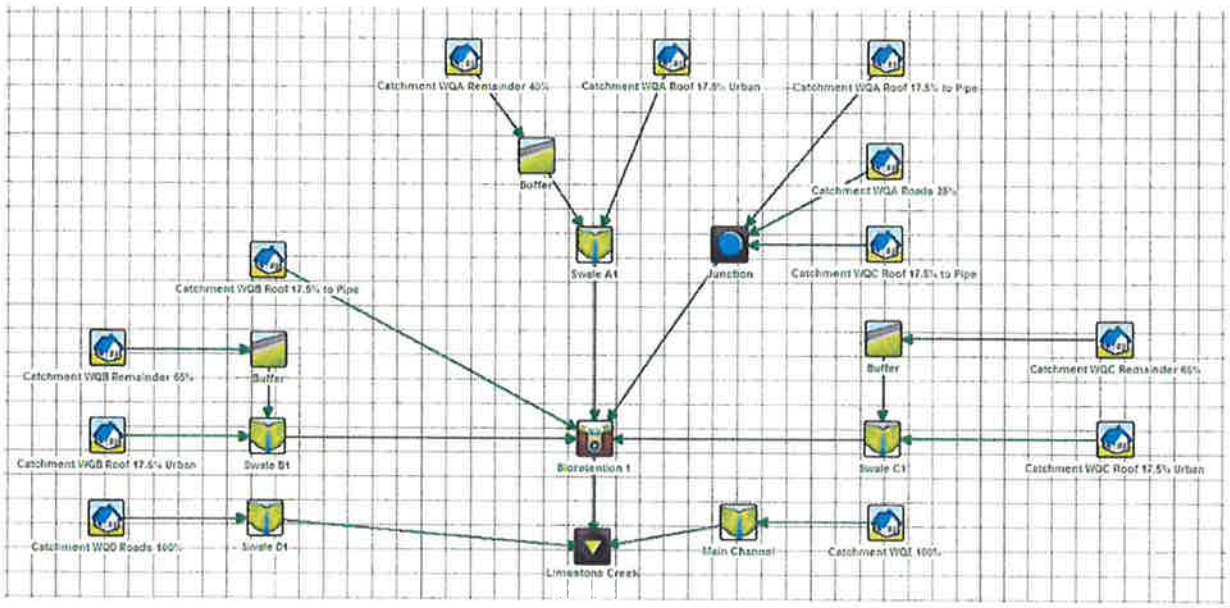


Figure. 1 – Treatment Train

Bio Retention Basin

Table 2.9: Bio-Retention Basin Properties

Basin	Contributing Catchments	Extended Detention Depth (m) (m)	Infiltration Filter Area (m²)	Filter Depth (m)
Basin 1	WQA; WQB; WQC	0.500	800	0.400

Swale Drains

Refer Figures 2, 3 & 4 for all Swales and Main Channel parameters adopted for this analysis.

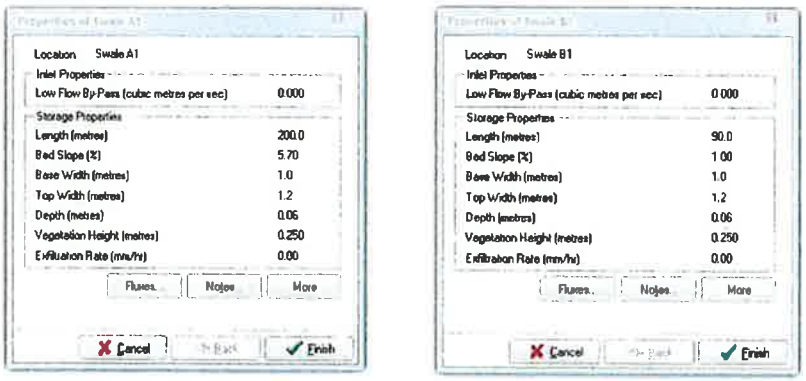


Figure 2 – Swale A1 & B1

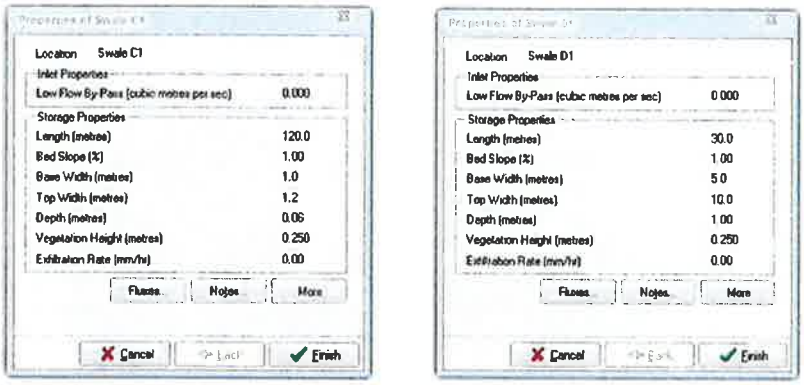


Figure 3 – Swale C1 & D1

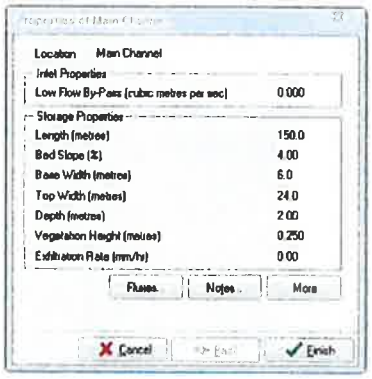


Figure 4 – Main Channel

5.4. Quality Modelling Results

The properties of the treatment devices shown above are based on default values in MUSIC and some recommended values in the MUSIC guidelines.

Scenario 1 – Fully Developed site with and without Water Sensitive Urban Design Techniques.

The detailed results produced by the model for the development are presented in Table 2.10.

The treatment train modelling results for the modelled scenario with all catchments shows that the development with utilisation of Water Sensitive Urban Design techniques effectively reduces the pollutant loads to levels compliant with the annual pollutant load reductions stated earlier in the Site Specific Objectives.

Total Suspended Solids target reduction achieved ~97.9%

Total Phosphorus target reduction achieved ~71.8%

Total Nitrogen target reduction achieved ~68.4%

Gross Pollutants target reduction achieved ~100%

Table 2.10: MUSIC Water Quality Results – Total Annual Loads

Catchment WQA – WQE - Total Annual Load (kg/year)								
Pollutants	**Total Suspended Solids (TSS)**		**Total Phosphorus (TP)**		**Total Nitrogen (TN)**		**Gross Pollutants (GP)**	
Mitigation	Dev. No mitigation	WSUD	Dev. No mitigation	WSUD	Dev. No mitigation	WSUD	Dev. No mitigation	WSUD
Pollutant Loading	4,970	104	10.3	2.90	60.1	19.0	604	0
Target Reduction	85% of Developed		70% of Developed		45% of Developed		90% of Developed	
Achieved Reduction	97.9% of Developed		71.8% of Developed		68.4% of Developed		>90% of Developed	

5.5. Management Methodology

The following methodology will be followed through the construction and operational phase of the Bio-Retention Basins proposed as part of the development.

5.5.1. Construction Phase

Construction of the development and the following building works on site has the potential to mobilise large quantities of sediment in runoff. For Bio-Retention Basins to perform as designed there is a need to protect filter media and basin vegetation during this phase of the development. Therefore a Staged Construction and Establishment Method for construction of the Bio-Retention Basin will be followed. The stages for construction and establishment will be as follows:

1. Functional Installation – Initially Bio-Retention Basins can be used as Sediment Basins. Once the majority of site construction works have been completed earthworks and shaping to create the layout and functional elements of the basin will be undertaken. This includes the installation of inlets, outlet structures, subsoil drainage, transition layers and filter media. The filter media is to be covered with a protective geofabric which is top-soiled and turfed

or grass seeded. Silt fences are to be erected around the outside of the basins to exclude silt and restrict access to the basins.

2. Building Construction – Protective erosion and sediment control measures are to remain in place as the basins are to function as temporary Sediment Basins for the duration of the Building Construction Phase. Access to the basins is to be restricted throughout building construction phase.
3. Operational Establishment - Following completion of the Building Construction Phase turf, topsoil and protective geofabric is removed and each basin re-planted with vegetation and landscaping as proposed. For vegetation to establish properly regular watering and removal of weeds is required following planting.

5.5.2. Operational Phase

Following construction activities regular inspections of the Bio-Retention Basin are required in order to ensure vegetation establishes and the properties of the filter media remain effective. Procedures to be adopted for the carrying out inspections and maintenance of the basin are presented in Table 2.7 on the following page.

Table 2.11: Bio-Retention Basin Inspection & Maintenance Requirements

Treatment Device / Property	Inspection	Inspection Frequency	Maintenance
Bio-Retention Basin			
Litter & Weeds	Visually check for litter, weeds and debris within the Bio-Retention Basin.	Quarterly for first year then annually after establishment. Also after flood events.*	Remove litter, weeds and debris from basin and dispose of at approved waste disposal facility.
Inlet and Outlet	Visually check for blockages within the inlet and outlet pits and blocked weep holes within inlet pits.	Quarterly for first year then annually after establishment. Also after flood events.*	Remove any blockages or debris within inlet pits or blockages to weep holes.
Sedimentation	Visually check surface of Bio-Retention Basin for accumulation of sediment.	Quarterly for first year then annually after establishment. Also after flood events.*	Remove accumulated sediment where it is smothering vegetation.
Scour, Erosion and Vehicle Damage	Visually check Bio-Retention Basin surface for scouring and areas of erosion or vehicle damage.	Quarterly for first year then annually after establishment. Also after flood events.*	Repair damage to Bio-Retention Basin surface and filter media if exposed. Undertake replanting if necessary and maintain frequent watering of area until vegetation has established.
Vegetation	Visually check for any planted vegetation that has died.	Quarterly for first year then annually after establishment. Also after flood events.*	Remove dead vegetation and replace with stock of equivalent size and species as detailed in plant schedule. Maintain frequent watering until new vegetation has established.
	Photograph Bio-Retention Basin from same location for yearly review.	Annually during summer months.	N/A
	Map propagation of Bio-Retention Basin vegetation for yearly review.	Annually during summer months.	N/A
Filter Media	Check surface of Bio-Retention Basin for any isolated "boggy" areas.	Annually.	Increase infiltration rate by tilling the surface of the filter media.
	Visually check and determine time of ponding within basin after a storm event.	Annually during wetter periods.	If duration of ponding exceeds 48 hours trail tilling of the surface of the filter media. If no improvement occurs then dispose and replace the top 100 to 150mm layer of filter media.
Subsoil Drainage	Check subsoil drainage for blockages.	Every 5 years during dry periods.	If blockage discovered remove by flushing subsoil drainage pipe. Collecting and dispose flushed material appropriately.

***Source: Water by design Maintaining Vegetated Stormwater Assets, February 2012.*

** Note that inspections are to take place monthly and following flood events for first six (6) months of operation. Flood Event defined as period of rainfall with intensity greater than 2 year Average Recurrence Interval (ARI).*

6. CONCLUSION

This Stormwater Management Report identifies key infrastructure to be included in the Operational Works design documentation, ensuring minimal impact on upstream and downstream properties.

All storm events up to and including 100 year ARI events have been assessed. Detention/bio-retention basins, weirs, vegetated channels, culvert crossings and inlet structures are to be incorporated into the development works, to control the rate of discharge entering downstream drainage systems and natural flowpaths.

Onsite detention storage will be required in one (1) permanent locations. The detention basin characteristics are as follows:

Structure	Capacity	Discharge Weir
Basin 1	700m^3	15m

Channels/swales are required and will control and discharge the peak flow, ensuring the requirements of the QUDM are met, including 300mm minimum freeboard to all surrounding allotments.

Culvert crossings have been identified to be incorporated into the development. These culvert structures are as follows and are to be constructed in accordance with the Capricorn Municipal Development Guidelines:

Culvert 1 –2/1200 x 600 RCBC (discharging Channel 1)
Culvert 2 – 4/3000 x 1200 RCBC (discharging Channel 2)

With the above mentioned elements included into the proposed development, no adverse effects on surrounding properties and existing infrastructure should occur during flood events, up to and including 100 year ARI.

In accordance with the Queensland Water Quality Guidelines, we believe that we have demonstrated that the proposed stormwater water quality strategy meets the annual load reduction percentages. The bio retention areas and swale systems may alter from what is mentioned within this Report during detailed design but the fundamentals will remain the same.

Should further information be required regarding the Stormwater Management Report, please don't hesitate to contact BROWN Consulting Rockhampton Office on 07 4931 0777.

BROWN
Smart Consulting

APPENDIX A – Overall Master Plan

IMPORTANT NOTE

This plan was prepared to accompany a reconfiguration of a lot application to Rockhampton Regional Council and should not be used for any other purpose.

The dimensions and areas shown hereon are subject to field survey and also to the requirements of council and any other authority which may have requirements under any relevant legislation.

In particular, no reliance should be placed on the information on this plan for any financial dealings involving the land.

This note is an integral part of this plan.

client
Citimark Properties

project
Crestwood Estate
Jim Goldston Avenue, Norman Gardens

plan of
Lot Reconfiguration
Stage 7
(13 Lots + Open Space)

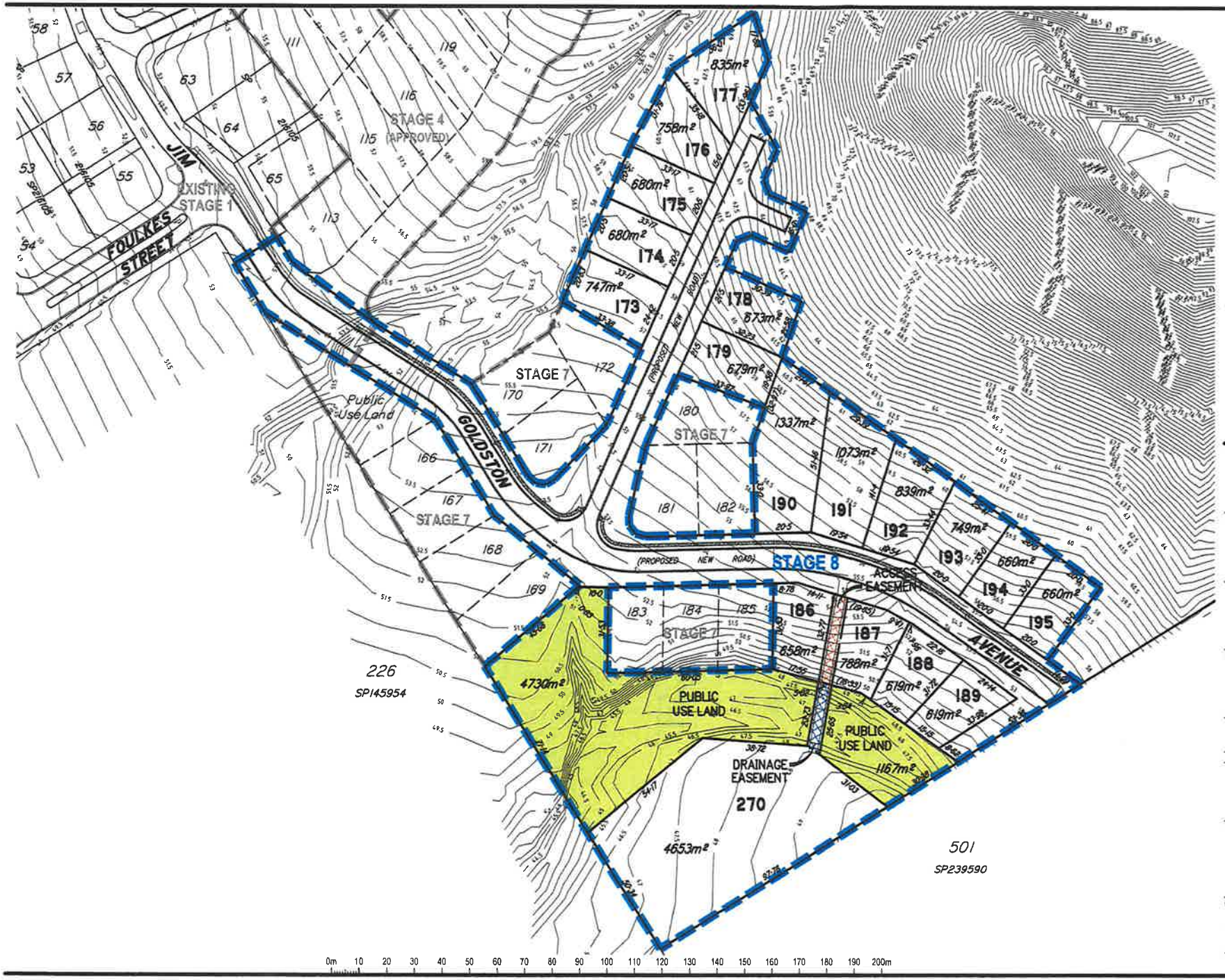
rpd
Lot 300 on SP216105
Parish of Murchison
County of Livingstone

lga
Rockhampton Regional Council

rev	date	details	authorised
A	24-06-2013	Initial Issue	RJH

created
CSG
capricorn survey group (cq)

scale: 1:1250 @ A3
datum: AHD
sheet no.: 1 of 1
cad file: 5782-07-ROL-A
plan no.: 5782-07-ROL
revision: A



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This note is an integral part of this plan.

client

Citimark Properties

project

Crestwood Estate
Jim Goldston Avenue,
Norman Gardens

plan of

Lot Reconfiguration
Stage 8
(18 Lots + Open Space)

rpd

Lot 300 on SP216105
Parish of Murchison
County of Livingstone

lga

Rockhampton Regional Council

rev	date	details	authorised
A	04.06.2015	Initial Issue	RJG

created

CSG
capricorn survey group (cq)

scale	datum
1:1250 @ A3	AHD
sheet no.	cad file
1 of 1	5782-08-ROL-A
plan no	revision
5782-08-ROL	A

APPENDIX B – Staging Plan

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E-Mail: Rockhampton@brownconsulting.com.au

BROWN
Smart Consulting
INCORPORATING GRAHAM SCOTT & ASSOCIATES

CRESTWOOD ESTATE

R12063 - Staging Plan

NOT TO SCALE

BROWN
Smart Consulting

APPENDIX C – Catchment Plan

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Smart Consulting
INCORPORATING GRAHAM SCOTT & ASSOCIATES

BROWN
Smart Consulting

APPENDIX D – Calculations

CRESTWOOD ESTATE - Stages 7 & 8

JIM GOLDSTON AVE

ROCKHAMPTON

Q_{100} Drainage Calculations

Friend's Equation

Length (m)=	20	Overland Sheet Flow Length	Catchment A (existing)
n =	0.06	Surface Roughness (Horton's)	
Slope (%)=	30		
t =	(107nL^0.333)/(S^0.2)		
t =	8.8	**Minutes**	
	0.2	**Minutes (Stream flow @ 30% grade)**	
	0.3	**Minutes (Stream flow @ 20% grade)**	
	1.6	**Minutes (Stream flow @ 12.5% grade)**	
	10.8	**Minutes (incl Stream flow)**	

CRESTWOOD ESTATE - Stages 7 & 8
JIM GOLDSTON AVE
ROCKHAMPTON
Q_{100} Drainage Calculations

Friend's Equation

Length (m)=	20	Overland Sheet Flow Length	Catchment A (proposed)
n =	0.035	Surface Roughness (Horton's)	
Slope (%)=	30		
t =	(107nL^0.333)/(S^0.2)		
t =	5.1	**Minutes**	
	0.2	**Minutes (Stream flow @ 30% grade)**	
	0.3	**Minutes (Stream flow @ 20% grade)**	
	1.6	**Minutes (Stream flow @ 12.5% grade)**	
	7.1	**Minutes (incl Stream flow)**	

21/06/2013 Job No: R12063

CRESTWOOD ESTATE - Stages 7 & 8
JIM GOLDSTON AVE
ROCKHAMPTON
Q_{100} Drainage Calculations

Existing Undeveloped Site

Catchment	Q_{100} Rainfall Intensity (mm/hr)	C_{100} runoff coefficient
A	237	0.708

Q100 Flow Rates (Q=FCIA)

Catchment	Area (m^2)	Flow (m^3/s)	Flow (L/s)
A	65368	3.047	3047

21/06/2013 Job No: R12063

CRESTWOOD ESTATE - Stages 7 & 8
JIM GOLDSTON AVE
ROCKHAMPTON
Q_{100} Drainage Calculations

Proposed Developed Site

Catchment	Q_{100} Rainfall Intensity (mm/hr)	C_{100} runoff coefficient
1	284	0.84

Q100 Flow Rates (Q=FCIA)

Catchment	Area (m^2)	Flow (m^3/s)	Flow (L/s)
1	65368	4.332	4332

21/06/2013

Job No: R12063

CRESTWOOD ESTATE - Stages 7 & 8
JIM GOLDSTON AVE
ROCKHAMPTON
Q_{100} Drainage Calculations

Proposed Detention Basins

Undeveloped Catchment	Developed Catchment	Undeveloped Flow Q_{pre} (m^3/s)	Developed Flow Q_{post} (m^3/s)	Percentage Increase (%)	Reduction Ratio (r) $\frac{Q_{Post} - Q_{Pre}}{Q_{Post}}$
A	A	3.047	4.332	29.66%	0.30

Developed Catchment	Time of Concentration (mins)	Time of Concentration (secs)	2.66 x TOC (secs)
A	7.14	428.26	1139.17

Detention Basin Number	Developed Catchment	Inflow Volume (Vi) (m^3)	Total Inflow Volume per Detention Basin(V_i) (m^3)	CULP Required Storage Volume (V_s) (m^3)	BOYD Required Storage Volume (V_s) (m^3)	CARROLL Required Storage Volume (V_s) (m^3)	BASHA Required Storage Volume (V_s) (m^3)	BASHA Required Storage Volume (V_s) x 25% safety factor (m^3)
1	A	2467.28	2467.28	388.69	731.87	410.13	560.28	700.35

L = Q / (1.7 x h^(3/2)) [m]

Assumptions		
Blockage factor -	0.9	Basin Weirs
	0.5	Culvert inlet

Basin/Weir No	Q (l/sec)	h (m)	L (m)
1	3046.802	0.260	15.000

21/06/2013

Job No: R12063

CRESTWOOD ESTATE - Stages 7 & 8
JIM GOLDSTON AVE
ROCKHAMPTON
Q_{100} Drainage Calculations

Proposed Channels / Swales

Water Level = 98.255 *m*

Sect No.	RL1 (m)	RL2 (m)	W (m)	Bank Slope	n	Depth 1 (m)	Depth 2 (m)	Width (m)	Area (m^2)	p (m)	q (m^3/sec)	V (m/sec)	Slope (%)
Channel 1	100.000	98.000	8.000	0.250	0.043	0.000	0.255	1.021	0.130	1.053	0.168	1.292	5.00
	98.000	97.900	2.000	0.050	0.028	0.255	0.355	2.000	0.611	2.002	2.209	3.618	5.00
	97.900	98.000	2.000	-0.050	0.028	0.355	0.255	2.000	0.611	2.002	2.209	3.618	5.00
	98.000	100.000	8.000	-0.250	0.043	0.255	0.000	8.000	1.021	8.004	1.346	1.318	5.00
								13.021	2.373		5.93 m3/sec		

Water Level = 99.152 *m*

Sect No.	RL1 (m)	RL2 (m)	W (m)	Bank Slope	n	Depth 1 (m)	Depth 2 (m)	Width (m)	Area (m^2)	p (m)	q (m^3/sec)	V (m/sec)	Slope (%)
Channel 2	100.000	98.667	8.000	0.167	0.043	0.000	0.485	2.908	0.705	2.948	1.093	1.551	3.00
	98.667	98.333	2.000	0.167	0.028	0.485	0.819	2.000	1.303	2.028	6.003	4.607	3.00
	98.333	98.033	3.000	0.100	0.028	0.819	1.119	3.000	2.906	3.015	17.537	6.035	3.00
	98.033	98.333	3.000	-0.100	0.028	1.119	0.819	3.000	2.906	3.015	17.537	6.035	3.00
	98.333	98.667	2.000	-0.167	0.028	0.819	0.485	2.000	1.303	2.028	6.003	4.607	3.00
	98.667	100.000	8.000	-0.167	0.043	0.485	0.000	2.908	0.705	2.948	1.093	1.551	3.00
								15.816	9.827		49.27 m3/sec		

CulvertW - Design Case No 1

(File: STG78.CUL - Date: 21-6-2013)

2 No 1200x600 RCBC (1.212x0.610) at a slope= 1.40%

Inlet RL 51.800m Outlet RL 51.500m

Culvert Data

Using Mannings 'n' = 0.013
Entrance Loss Coefficient 'k= 0.500
Entrance - Wingwall flare 90-15 deg

Weir Data

Weir Length = 20.000mWeir Coefficient = 0.577
Weir Crest Height = 1.800m (RL 53.300m)

No Channel Data specified to be used

Headwater

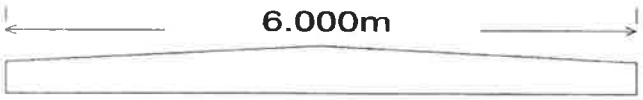
Approach Flow	= 5.930m3/s
Flow in each Culvert	= 2.205m3/s
Flow over weir	= 1.519m3/s (depth = 0.126m)
Tailwater depth	= 0.360m (RL 51.860m)
Using fixed Tailwater depth	
Critical depth at outlet	= 0.694m (RL 52.194m)
Effective tailwater depth	= 0.610m (RL 52.110m)
Head Loss in Culvert	= 0.943m
Depth at outlet adopted to calculate outlet velocity	= 0.480m (RL 51.980m)
Outlet Velocity	= 3.776m/s

INLET control

Headwater is at RL 53.426m - 0.126m above Weir Crest
Tailwater is at RL 51.860m - 0.360m above outlet invert

CulvertW - Design Case No 2

(File: STG78.CUL - Date: 21-6-2013)



4 No 3000x1200 RCBC (3.048x1.219) at a slope= 1.67%

Inlet RL 46.600m Outlet RL 46.500m

Culvert Data

Using Mannings 'n' = 0.013
Entrance Loss Coefficient = 0.500
Entrance - Wingwall flare 90-15 deg

Weir Data

Weir Length = 15.000m Weir Coefficient = 0.577
Weir Crest Height = 2.100m (RL 48.600m)

No Channel Data specified to be used

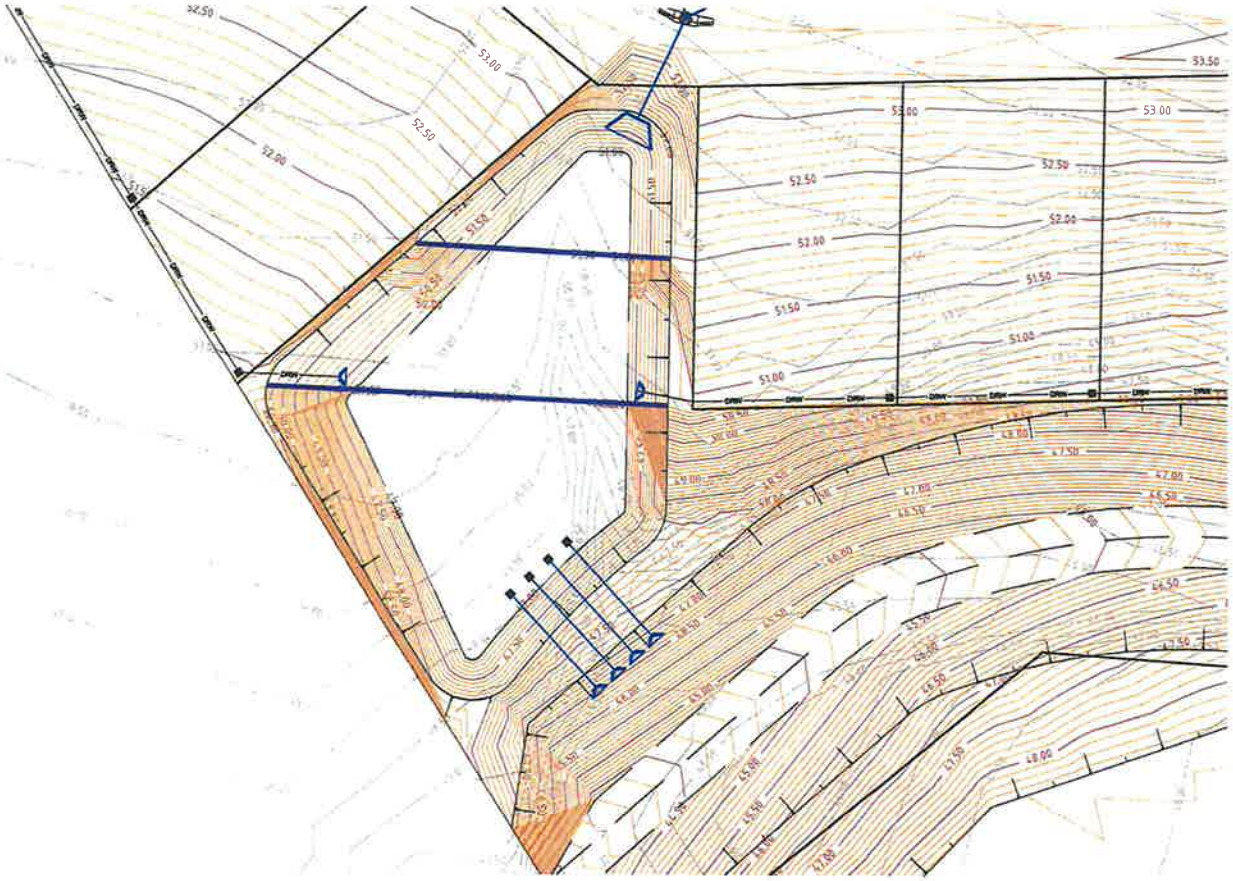
Headwater

Approach Flow	= 49.270m3/s
Flow in each Culvert	= 11.705m3/s
Flow over weir	= 2.451m3/s (depth = 0.210m)
Tailwater depth	= 1.100m (RL 47.600m)
Using fixed Tailwater depth	
Critical depth at outlet	= 1.142m (RL 47.642m)
Effective tailwater depth	= 1.181m (RL 47.681m)
Head Loss in Culvert	= 0.783m
Depth at outlet adopted to calculate outlet velocity	= 0.649m (RL 47.149m)
Outlet Velocity	= 5.891m/s

INLET control

Headwater is at RL 48.810m - 0.210m above Weir Crest
Tailwater is at RL 47.600m - 1.100m above outlet invert

APPENDIX E – Stormwater Concept Plans

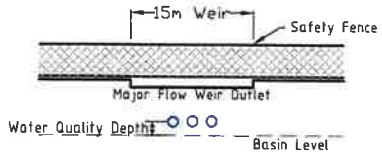


LEGEND

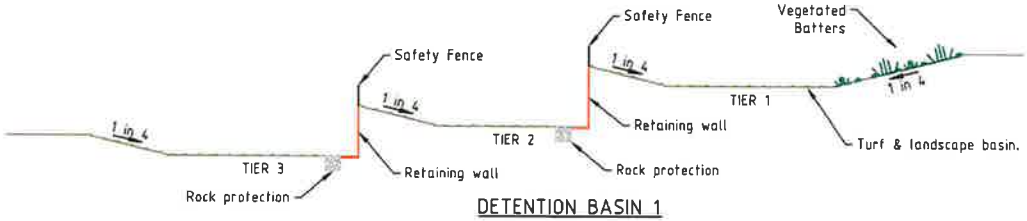
- Top of Batter
- Toe of Batter
- 57.00 Proposed Surface Contours
- Existing Surface Contours
- Proposed Retaining Wall

0 1.25 5.0m
0 2.5 10.0m

1:250 (A1)
1:500 (A3)



CONCRETE WEIR DETAIL
NOT TO SCALE



DETENTION BASIN 1
TYPE SECTION
NOT TO SCALE

Preliminary Detention Basin Concept

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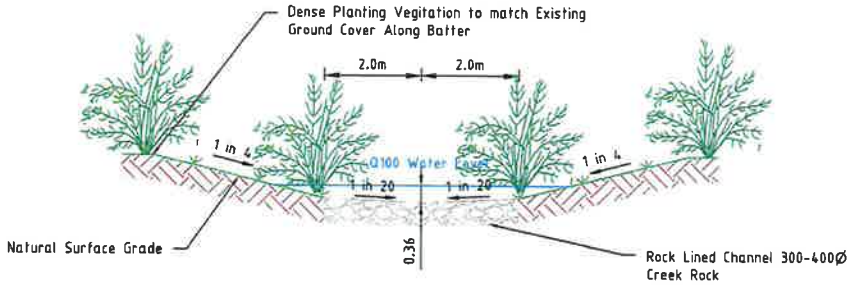
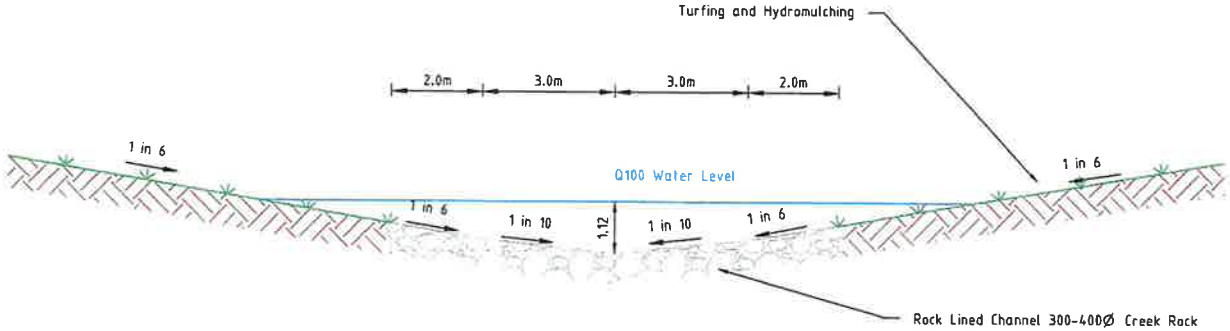
APPENDIX F – Channel Profile Sketches



CHNNEL PROFILE 1



CHNNEL PROFILE 2

CRESTWOOD ESTATE
STAGES 7 AND 8
R12063 - CHANNEL CROSS SECTIONS PLAN

N

0 0.3125 1.25m
0 0.625 2.5m
1:62.5 (A1)
1:125 (A3)

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APPENDIX G – Stormwater Management Water Quality Plan

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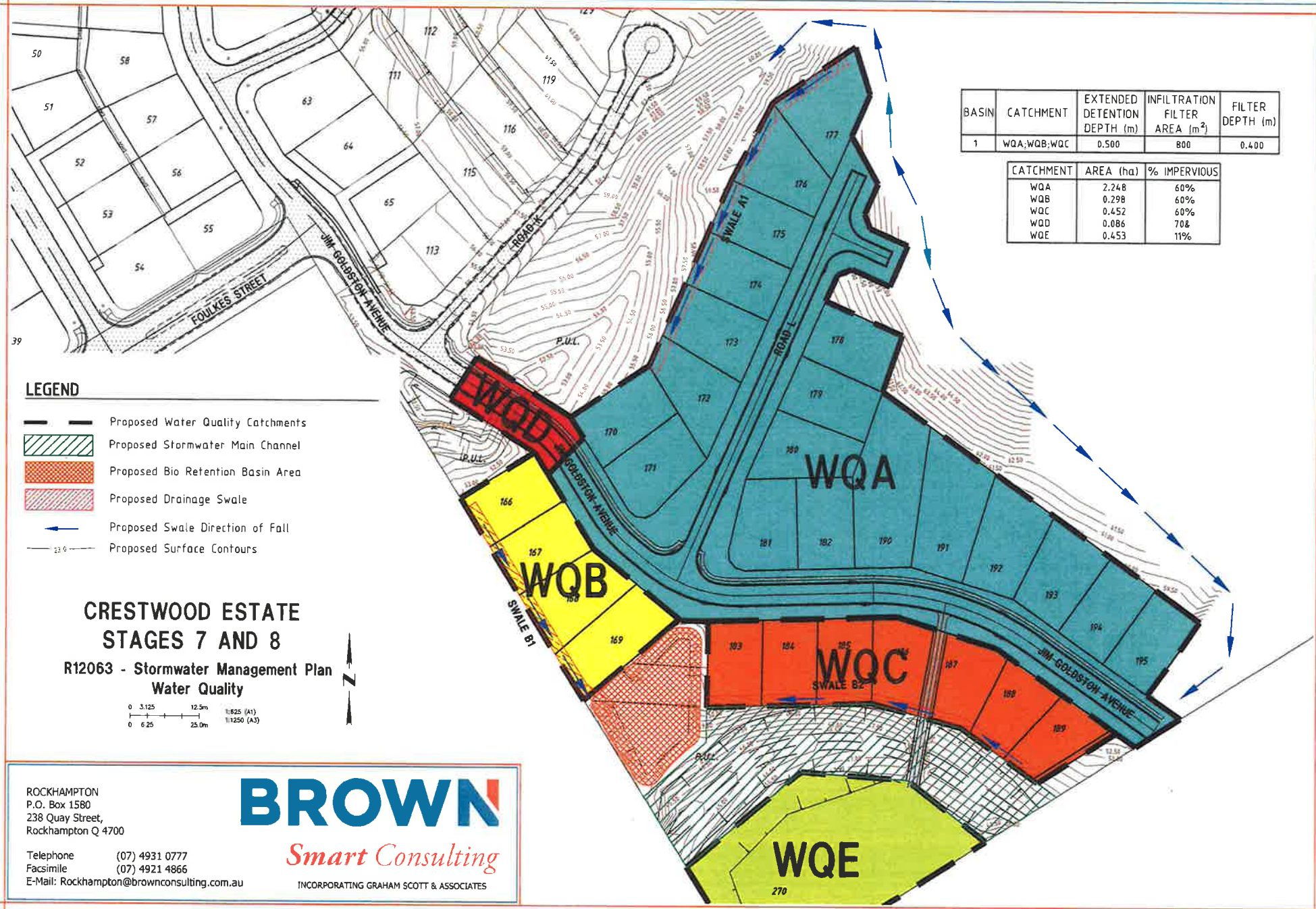

BASIN	CATCHMENT	EXTENDED DETENTION DEPTH (m)	INFILTRATION FILTER AREA (m^2)	FILTER DEPTH (m)
1	WQA;WQB;WQC	0.500	800	0.400

CATCHMENT	AREA (ha)	% IMPERVIOUS
WQA	2.248	60%
WQB	0.298	60%
WQC	0.452	60%
WQD	0.086	70&
WQE	0.453	11%

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DENLEY ENVIRONMENTAL
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Bushfire Hazard Assessment and Management Plan

Crestwood Estate

Lot 300 on SP216105. Crn Yeppoon Road and Norman Road

Norman Gardens, Rockhampton Regional Council

For Crestwood Land Unit Trust
Prepared by Denley Environmental

Publication Details

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Contract Number: 40708

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Version	Author	Reviewed	Distribution type
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Table of Contents

1 Bushfire Hazard Assessment

1.1 Purpose

The purpose of the Bushfire Hazard Assessment is to determine the level of bushfire hazard associated with the proposed Crestwood Estate located on Lot 300 on SP216105 at Norman Gardens, Rockhampton Regional Council (RRC).

Bushfire hazard was assessed with reference to the State Planning Policy 1/03 (SPP 1/03) Guideline and the Rockhampton Regional Council Policy number 12 *Assessment of Bushfire Hazard and Preparation of Bushfire Management Plans*.

The results of this hazard assessment will determine the specific bushfire management requirements with reference to the SPP 1/03 guideline, the Rockhampton Regional Council bushfire management policies and advice from local fire authorities.

1.2 Location

Lot 300 on SP216105 (the subject land) is located at the corner of Yeppoon Road and Norman Road. Figure 1 shows sections of the proposed Crestwood Estate allotments adjacent to the vegetation hazard. All potentially hazardous vegetation is located uphill from the proposed allotments.

Figure 1. An aerial view of the subject land (in yellow) showing that part of the proposed Crestwood Estate (in white) adjacent to the bushfire hazard. Patches of vegetation to the west of the white lines have been removed since the aerial image was taken.

1.3 Development Proposal

The development is for residential allotments. A layout of the proposed development is provided in Figure 2.

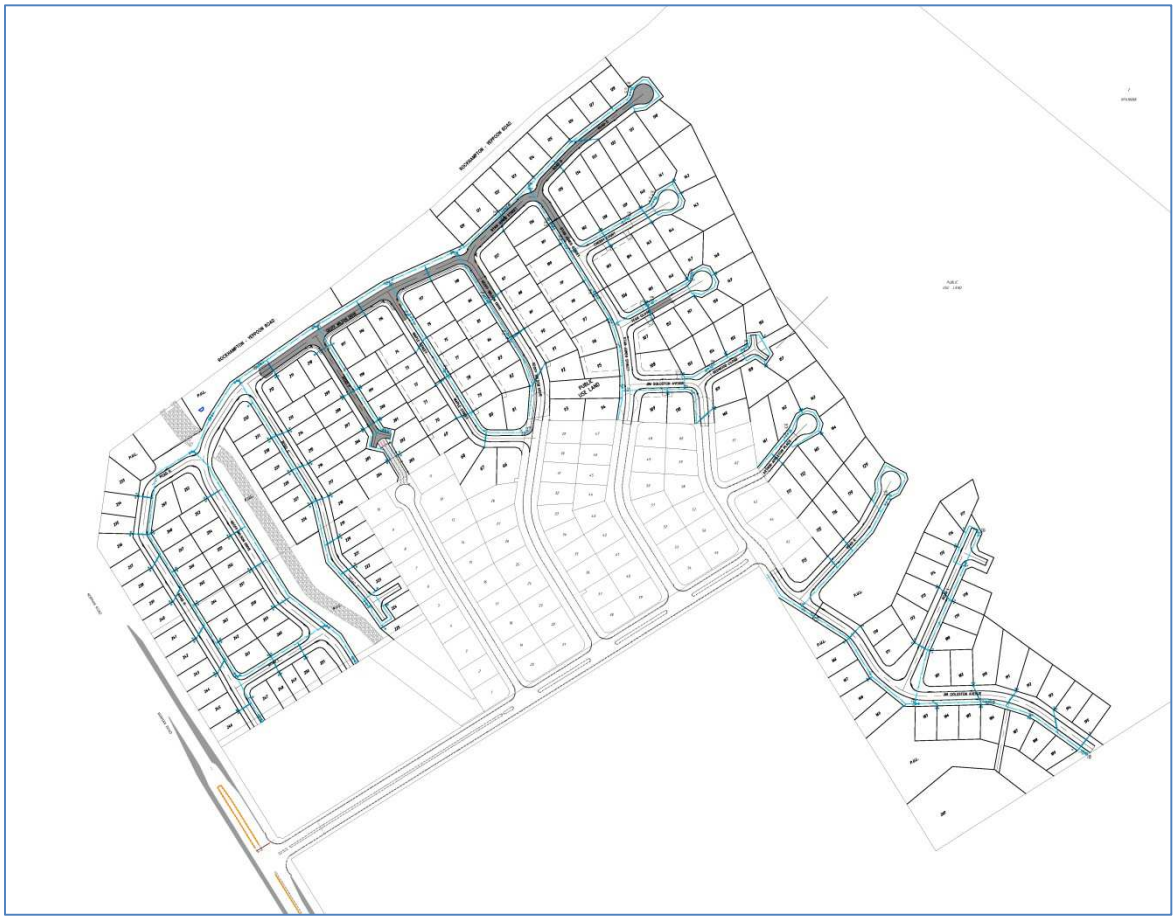

Figure 2. A plan of the development area (raw data provided by Brown Consulting, Rockhampton). The hazard area is located in the top right of the drawing.

1.4 Surrounding Landscape and Land Use.

North: Yeppoon Road then grassy woodland on hills approximately 80 to 90 metres from the boundary of the nearest proposed allotments.

East: Grassy woodland on steep hills adjacent and uphill from proposed allotments.

South: Existing dense residential areas.

West: Existing dense residential areas then Norman Road.

1.5 Vegetation Hazard

1.5.1 Location of the hazard

Potentially hazardous vegetation is located to the north, north east which is up-slope from the development area. See Figure 3 and Figure 4.

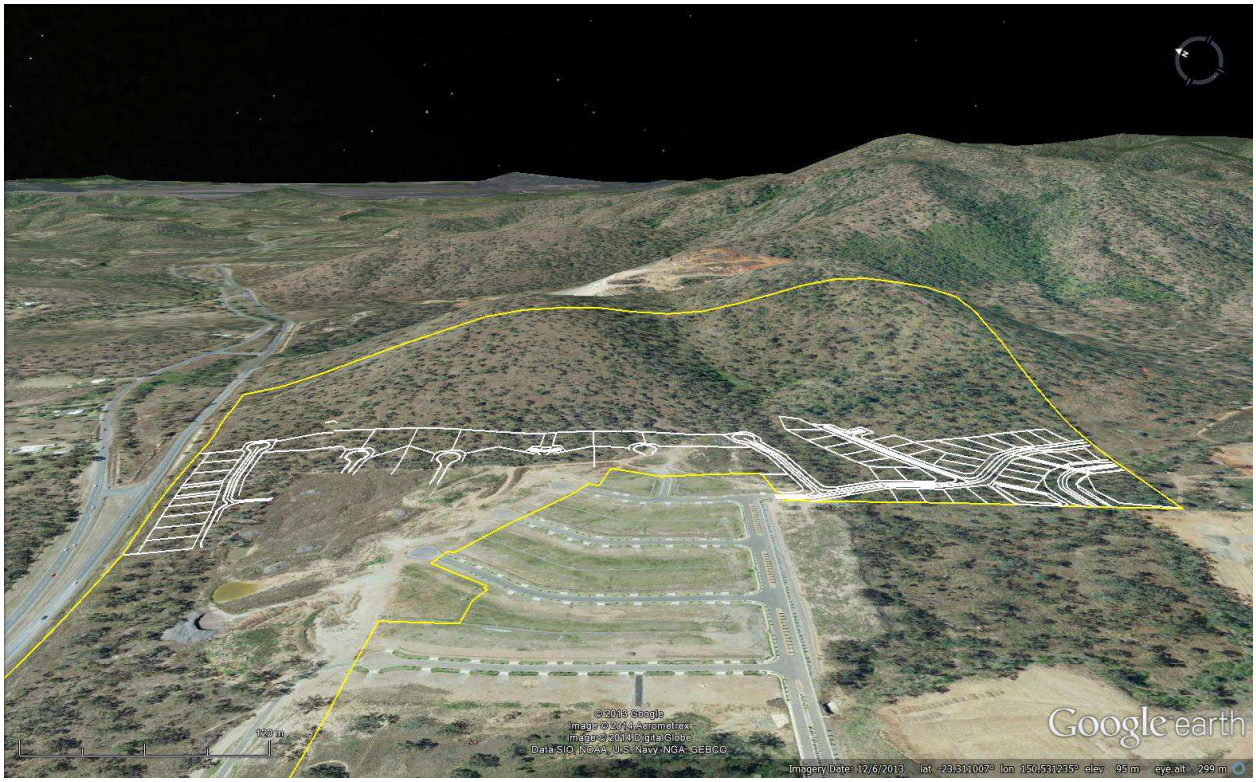

Figure 3. A 3D representation of the proposed allotments in relation to the vegetation. View is from the west southwest.

Figure 4. A view of the site taken from the woodland looking towards the Crestwood Estate development area.

1.6 Vegetation Structure and Hazard

Vegetation types include grassy woodland on steep hills and grassy woodland associated with broad gully lines.

Hill slope vegetation is a woodland to open woodland of iron-bark (*Eucalyptus crebra*) dominant with lemon scented gum (*Corymbia citriodora*) and bloodwood (*C. intermedia*) associated. Tree crowns are separated to well separated.

Mid storey vegetation is very sparse with shrubs including fringed wattle (*Acacia fimbriata*), sally wattle (*Acacia saligna*), unidentified wattle (*Acacia* sp. falcate), pineapple zamia (*Macrozamia* sp.) and dogs balls (*Grewia latifolia*)

Ground layers are primarily dominated by low growing kangaroo grass (*Themeda triandra)* of approximately 40 to 60% cover.

Woodland within broad gullies is dominated by iron bark but includes scattered dead paperbark (*Melaleuca* species) and blue gum (*Eucalyptus tereticornis*). Crowns are separated. The mid storey is very open and similar to upper slope understorey vegetation but includes some dry rainforest species. Grasses are denser than upslope, dominated by kangaroo grass and include some weedy species (guinea grass and red natal).

The vegetation hazard varies between 5 for hill slope vegetation and 6 for gully vegetation

1.7 Slope Hazard

Slopes vary between 11% for gully vegetation on the lower slopes and 30% on upper slopes.

The development area is downslope from the hazard. The RRC Planning Policy Number 12 indicates:

"If the site is downhill from the hazard, the slope effect may be taken as zero as the fire intensity will be less".

Hazard score for slope values is 0.

1.8 Aspect Hazard

Aspect is west southwest. **Aspect hazard score for this aspect is 2**.

1.9 Overall Hazard Score

The overall hazard score is between 7 and 8 for the identified hazard and areas within 50 metres of the hazard. This is within the low range of a Medium Hazard.

1.10 Site considerations

1.10.1 Fuel loads and ladder fuels

The low grassy understory provides a low to medium level of fuel. Flame heights are expected to be relatively low. Shrubs and other ladder fuels are very sparse. Trees are predominately ironbark which have a rough bark capable of carrying flames to tree crowns.

1.10.2 Bushfire Evidence and History

Evidence of bushfire includes burnt lying timber and burns to tree trunks up to 3 to 4 metres. There was no evidence of recent intense burns.

Bushfires have regularly passed through the area approximately annually to bi-annually. These fires have not been severe.

1.10.3 Site Specific Hazards

There is an increased risk of debris rolling downhill into allotments and boundary fences for allotments adjacent to the uphill vegetation.

1.10.4 Factors Reducing Fire Hazards

The location of the development area in relation to the hazard and other landscape features reduces the hazard level presented by upslope vegetation:

1. All dwellings will be located downslope from the hazard;
2. Dwellings will be located to the west southwest of the hazard when seasonally warm north to north west winds are more frequent and therefore will be upwind from the hazard;
3. Yeppoon Rockhampton Road is located to the north northwest of Crestwood Estate. Residential development and Norman Road is located to the west providing substantial fire protection from these directions; and
4. Low biomass for wildfires. Trees are largely separated to well separated, reducing the risk of canopy fires. The shrub layer is very sparse reducing ladder fuels. Ground layers consist of a 50% cover of low growing grasses (primarily kangaroo grass). Low growing grasses will generally have reduced flame height and flame intensity.
5. A broad gully within the southeast of the development area will be retained as a drainage area cleared of shrubs and trees. The retained area will be approximately 40 metres wide and be bounded by seven allotments to the southeast and a road to the northwest. These allotments have a reduced risk of rolling debris and other fire hazards.

1.10.5 Likely Direction of Bushfire Attack

Generally, fires in close proximity to the development will travel uphill, away from the development area. Fires may also move downhill from the northeast.

Likely directions of wildfire are from the northwest, originating from Yeppoon Road and from the southeast where there is a substantial area of woodland.

1.11 Overall Hazard Level

The overall hazard presented to the development area is considered borderline between a LOW and a MEDIUM hazard. Dwellings immediately adjacent to the hazard should be provided with protection from burning debris rolling down the hill and landscaped in a manner that reduces the risk of landscaped trees and shrubs igniting and subsequently presenting a fire hazard to dwellings in those locations.

2 Bushfire Management

2.1 Introduction

This Bushfire Management Plan (BMP) has been developed following the guidelines set out in the Rockhampton Regional Council (Rockhampton City Council) Policy Number 12 and the State Planning Policy 1/03 Guideline "Mitigating the Adverse Impacts of Flood, Bushfire and Landslide".

2.2 Assessed Hazard

Vegetation located on steep slopes to the northeast of Crestwood Estate was assessed as being within an SPP 1/03 **Low to Medium Bushfire Hazard**.

There will be limited ember attack and radiant heat. The most likely risks include grassfires adjacent to fencing, burning debris rolling downhill and ignition of fire prone landscape vegetation within allotments adjacent to the hazard. Fire prone species include popular landscaping plants such as eucalypts, bloodwoods, banksia and grevillea.

Dry rainforest species that occur locally in the gully lines of the Berserker Ranges are ideal to use as fire resistant landscaping species. They are well adapted to dry conditions and require little to no water once established. However, these species can sometimes be difficult to obtain (Livingstone Shire Community Nursery currently stock some of these species).

2.3 Application

This bushfire management plan concerns allotments adjacent to the identified vegetation hazard. These lots are: 128, 130, 142, 143, 148, 149, 156, 157, 163, 164, 129, 171, 178, 190, 191, 192, 193, 194 and 195.

See Figure 5 for the location of these lots within Crestwood Estate.

2.4 Required Bushfire Hazard Mitigation Measures

Mitigation measures to address site specific bushfire hazards are:

1. Fences adjoining the vegetation hazard area must be designed and constructed of materials that will avoid fuelling a fire and making it more hazardous. Materials can include metal, wire, stone and masonry.
   1.1. Surfaces of dwellings within applicable lots which are within 50 metres and directly facing the hazard are to be built to BAL 12.5 (AS3959 Construction of Buildings in Bushfire Prone Areas);
   1.2. Landscaping within applicable lots does not increase the fire hazard within the allotment;
      a) Trees to be located at a sufficient distance away from dwellings so that when fully mature, branches do not overhang the eaves of the house;
      b) Landscape vegetation such as shrubs should remain clear of the building surfaces; and
      c) Landsaped vegetation adjacent to the hazard are to be fire resistant evergreen species.
2. These conditions do not apply to landscaping and building surfaces where subsequent clearing of an adjacent vegetation hazard has occurred for a distance of 50 metres from the boundary of an applicable allotment. Additionally, in the above circumstance, fencing is not restricted to non-combustible materials where changes to topography or another circumstance would prevent burning debris reaching a boundary fence.

   A lot layout plan showing the location of fire hydrants is appended.

Figure 5.

Crestwood Estate showing the location and lot numbers for allotments requiring bushfire management.

Red lines indicate boundaries requiring non-combustible fencing.

3 Appendix

Lot layout plan (Brown Consulting) showing the location of Fire Hydrants. Hydrants are indicated by blue dots with and labeled "FH".

A full size plan is available from Brown Consulting, Rockhampton Office:

238 Quay Street, Rockhampton QLD 4700

Phone: (07) 4931 0777

Fax: (07) 4921 4866

Brown Consulting Drawing numbers are R12063.

Drawing showing the location of fire hydrants indicated by a blue dot and the lettering "FH".
Modified drawing from Brown Consulting Drawing "R12063 xr-Model.pdf