

APPENDIX L

**LONG FORM INFORMATION RESPONSE
AREA 1**

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STRUCTURAL AND CIVIL ENGINEERS
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FILE 5874

13 April 2011

Sekisui House Design Services Pty Ltd
56 Jephson Street
Toowong 4066

Attention: Scott Biggs

Dear Scott,

RE: IR RESPONSE – DEV2010/084 – RIPLEY VALLEY AREA 1

Further to the ULDA Long Form Information Request (LIR) dated 9 December 2010 and pursuant to the meetings held on 2 February 2011 with SHDS, Landpartners and ULDA's nominated technical reviewers, (SKM, Design Flow and Oxbow Environmental) and a second hydraulics specific meeting between MPN, SKM and Design Flow on the 23 March 2011 (email minutes issued as an Hydraulics Information Request (HIR)), MPN is pleased to submit the following responses to the LIR. Included in Appendix A of this report of this report is MPN's HIR response to the meeting held with SKM and Design Flow of 23 March 2011.

Open Space & Recreation

Demonstrate how the Neighbourhood Park will achieve its intended open space functionality and role and meet desired standards of service, whilst containing a stormwater treatment basin.

This is now no longer applicable as the Area 1's Neighbourhood Park does not contain a Bioretention Basin.

Engineering

E2 Services Plan showing the location of services within the road reserves for areas with zero boundary setbacks.

Refer to the attached MPN Drawing No 5874 - PSK70 (Attachment 1) which indicates the locations of Stormwater, Roofwater, Sewerage Reticulation, Water Supply, Gas, Concrete Footpaths etc in the vicinity of zero boundary setbacks.

Stormwater Management Plan

The MPN "Neighbourhood Master Plan Conceptual Stormwater Management Plan – Ripley Valley Urban Core dated June 2010" has been assessed. A Stormwater Management Plan is to be prepared for this site and lodged. In the preparation of the Stormwater Management Plan the following items need to be considered and addressed:

S1 Provide details of the runoff routing program used in the assessment of the proposed basins and provide an assessment of pre and post flows to demonstrate compliance.

Refer to MPNs' Area 1 specific Site Based Stormwater Management Plan (SMP) section 6.4.1 (see Appendix I of the main report by Land Partners) and to the HIR response section 'j' in Appendix A of this report (separate booklet)) which addresses this issue.

S2 Define interaction between the detention system proposed and the coincident flows in Bundamba Creek. Demonstrate that the detention system still achieves the non-worsening of flows with Bundamba Creek coincident flows.

See Appendix S of the main report by Land Partners for the response by Cardno..

S3 Provide evidence of adequate stormwater drainage to accommodate the Q100 flows to avoid overland flows through Lots 305-311, 316-322, 465 and the future attached housing lots.

Refer to the revised POD, MPNs' SMP section 5.2 (see Appendix I of the main report by Land Partners), HIR response in Appendix A of this report (separate booklet) (Drawing No 5874 – RP03 and PSK 42) which demonstrates the conveyance of Q100 flows through Area 1 complying with velocity depth product and freeboard requirements of QUDM.

S4 Provide evidence that the proposed development will have a “non-worsen” effect on all adjoining properties.

Refer to MPNs’ SMP section 6.4.6 (see Appendix I of the main report by Land Partners) and HIR response sections ‘g) & o) in Appendix A of this report (separate booklet)’ for details on outlets of Area 1 which demonstrate a “non-worsening” effect on all adjoining properties.

S5 Provide evidence of how the upgrade of Ripley Road would not adversely affect the drainage patterns of the existing Ripley Township.

Note Ripley Road is no longer part of this application and will be dealt with as part of a future application.

S6 Provide further information regarding the stability of the waterways (also see comments on the geotechnical report).

Refer to MPNs’ SMP section 6.5.1 (see Appendix I of the main report by Land Partners) for demonstration that the proposed stormwater treatments comply with Healthy Waterway stability criteria.

Refer G5 and G6 for responses with respect to the stability of Waterways.

S7 Provide sketches and plans that show locations of all treatment systems; catchments and how stormwater is drained to these treatment systems; size & depth and batters associated with each treatment system to confirm there is space and elevation for the system to operate properly.

Refer to MPNs’ SMP section 7.5 (see Appendix I of the main report by Land Partners and the HIR response section ‘b)’ in Appendix A of this report (separate booklet)) which details proposed Bioretention Basins and Attenuation systems.

S8 Demonstrate the effectiveness of the proposed bio-retention pods (referred to in the report as rain gardens) recognizing the topography on the site. Plans and sketches must be provided for all systems.

MPNs’ SMP no longer proposes the use of rain gardens / Bio-retention pods in the treatment train for Area 1. Hence no details are provided.

S9 Provide conceptual sketches of “at source” bio-retention pods, to demonstrate how adequate space has been provided and how these will interact with road drainage, services and verge widths.

MPNs’ SMP no longer proposes the use of “at source” Bio-retention pods in the treatment train for Area 1. Hence no details are provided

S10 Provide a revised strategy which shows filter area not less than 50% the total surface area of the bio-retention, and filter media areas is minimum 0.8% of catchment area.

Refer to the table below which details filter area as a percentage of catchment.

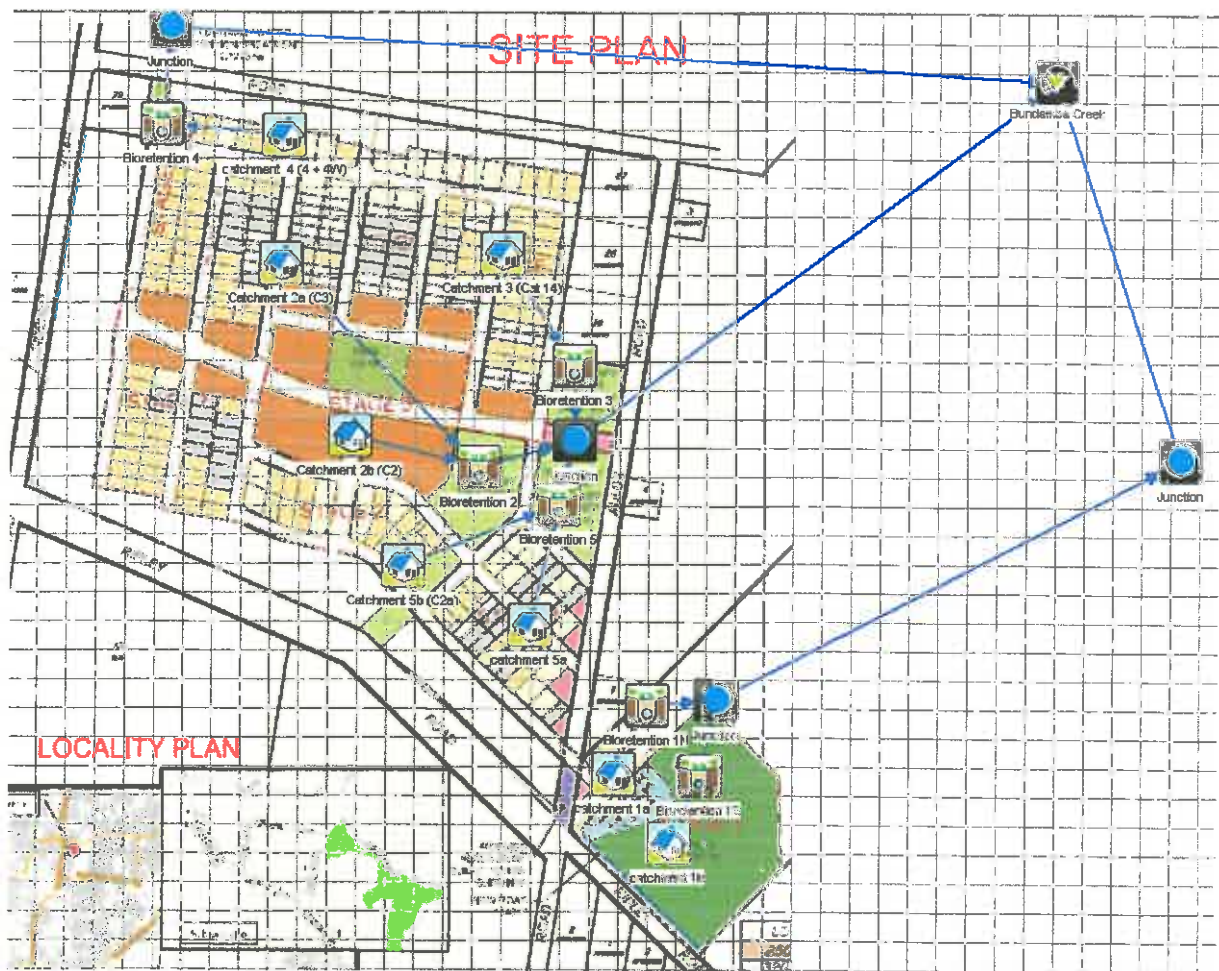
A Catchment No	B Bioretention Basin No	C Bioretention Basin Surface Area	D Filter Media Surface Area	E Filter Media % of Bioretention Basin Surface Area	F Filter Media % of Catchment Area
1N	1N	100m ²	80 m ²	80%	1.3%
1S	1S	110 m ²	75 m ²	68%	1.8%
2	2	2,718m ²	2,442m ²	90%	1.4%
3	3	852m ²	683m ²	80%	1.9%
4	4	172m ²	111m ²	65%	3.7%
5	5	1,342m ²	1,060m ²	79%	1.6%

Table 1 : Bioretention filter area as a percentage of catchment area

In all cases it can be seen that in column E the percentages are greater than 50% of Bioretention Basin area and in column F are greater than 0.8% of catchment area, therefore complying with the Healthy Waterways criteria.

S11 Show how the MUSIC Model for the site should include parklands and demonstrate that the Water Quality Objective (WQO) is achieved at the site outlet.

Refer to MPNs’ SMP section 7.5 (see Appendix I of the main report by Land Partners) and below modified Figure 7-1 that the Neighbourhood Park has been incorporated into the MUSIC model as a node and that the proposed treatment train achieves the pollution and nutrient removal targets set by Healthy Waterways.



S12 Revise MUSIC modelling in accordance with the MUSIC Modelling guidelines for SEQ (Healthy Waterways partnership) and provide all relevant reporting of parameters plus the model file to ULDA for review.

Refer to MPNs' SMP section 7.0 (see Appendix I of the main report by Land Partners) which details compliance with guidelines set by the Healthy Waterways Partnership. Attached is a compact disk that contains a "pdf" of the MPNs' SMP report and the Area 1 MUSIC model for ULDA reviewers.

S13 A catchment plan is requested describing the sub-catchments used for the development of the MUSIC model for the site.

Refer to HIR section 'b)' in Appendix A of this report (separate booklet) (Drawing No 5874 - RP03) for the current POD MUSIC model sub catchments used for the stormwater quality analysis.

S14 Buffers are to be removed from the MUSIC model as they have not been properly modeled.

Vegetated buffers are now no longer utilised in the treatment train for Area 1.

S15 Detailed concept plans are requested for all proposed end-of-line water quality elements and typical concepts for “at source” bioretention pods, to demonstrate how these will interact with road drainage, services and verge widths.

Refer to the HIR response section ‘b)’ in Appendix A of this report (separate booklet) which provides details of stormwater treatment and storage devices within the POD for Area 1.

Geotechnical including Erosion / Sediment control / Dispersive soils

G1 MPN Engineering & Infrastructure Development Application Report dated 1st November 2010” and Butler Partners “Preliminary Geotechnical Investigation Urban Core and Town centre, Ripley Road Ripley Valley – dated 5th February 2008” have been assessed.

Acknowledged.

G2 An Earthworks Management Plan shall be prepared and lodged for the site. In the preparation of the Earthworks Management Plan the following items need to be considered and addressed:

Refer (Attachment 2).

G3 Provide an assessment of the risk of disturbing acid sulfate soils and its impact on the environment should be addressed prior to detailed design and construction.

Refer to the attached Butler Partners (BP) report titled “ULDA Information Request” dated the 9 March 2011 (Attachment 4) wherein under response number 3 they report in paragraph 2 that the site soils are “not acid sulfate soils and an Acid Sulphate Soils Management Plan will not be required for site development.”

G4 Please confirm that no development is proposed in the area constrained by past mining activities or that more detailed mining related assessments are to be undertaken to determine potential subsidence impact prior to detailed design and construction in these areas.

Refer Attachment 11 for a report by Moreton Geotechnical Services where it is demonstrated that past mining activities do not influence the application over Area 1.

G5 Please confirm the risk posed by saline and dispersive soils to the basis of this assessment. What measures will be incorporated within the detailed design and construction of the development to mitigate against the site specific risk posed by saline and dispersive soils.

Refer to attached BP's report dated 23 March 2011 (Attachment 5) and Environmental Soil Solutions Australia Pty Ltd (ESSA) report of January 2011 (Attachment 6) for advice on soil salinity and dispersive soils. To summarise, the salinity of Area 1s' site soils' are low and no treatment is proposed to manage this low risk issue. ESSA however report that site soils are dispersive and have recommended treatments in Table 6 of their report. The treatment recommendations of their report will be incorporated into construction issue drawings and it is also proposed to include ESSA as a drawing reviewer and in the preparation of Operational Works drawings. Furthermore it is proposed that ESSA also oversee the management of earthworks activities during the construction of Area 1.

G6 Provide plans describing the proposed earthworks and details on the stability of existing and re-contoured sloping ground and batters for review. The plans shall show the finished contour levels of the site, including details of all retaining walls.

Refer to attached MPN Drawing No 5874 - PSK44 (Attachment 3) for preliminary earthworks surface contours, MPN Drawing No 5874 – RP13 (Attachment 3) for dispersive soils treatment and to BP's ULDA Information Request response of 9 March 2011 (Attachment 4) and BP's report number 010-218B Table 8 of 23 March 2011 (Attachment 5) for details on which batter slopes are considered to have a stable geometry. Review of these parameters against the preliminary earthwork drawings confirm proposed slopes are less than the maximum slopes recorded in the BP report and are therefore stable.

G7 Demonstrate that the treatment of soils during the construction and operational phases will result in a stable, and sustainable landform.

Refer to ESSA's report summary (Attachment 7) which states "that provided the treatment of dispersive soils are implemented in the earthworks management for Area 1 then the result will be a stable landscape".

G8 Demonstrate that the changes to the hydrological conditions resulting from the development will not result in instability of the downstream receiving environment, particularly the potential for bank instability and/or incision of the stream channel. The latter has the potential to lower the groundwater table and impact riparian vegetation in particular.

For the open drainage channels between Area 1 and Bundamba Creek refer to MPNs' SMP section 6.5.1 (see Appendix I of the main report by Land Partners) Stability of these areas is demonstrated by compliance with Healthy Waterways' "Waterway Stability Criteria".

Cardno to respond on the impacts for Bundamba Creek.

Refer to BP's report summary of the 9 March 2011 (Attachment 4) which states "Groundwater was generally not encountered to between 1m and 3m depth approximately in the test pits/bores undertaken (refer Section 4.3 of Butler Partners' Report No 010-218B, 23 March 2011) (Attachment 5) and it is considered that stream channel erosion (should it occur) will not adversely impact (lower) the groundwater regime."

G9 Show that the soils – both topsoils and subsoils have suitable agronomic qualities for re-establishing a stable vegetation cover across the area.

Refer to ESSA's report of January 2011 (Attachment 6) which recommends treatment of site topsoils so that their agronomic qualities will support the re-vegetation of disturbed areas.

G10 A report needs to be prepared by a suitably qualified soil scientist to adequately map and characterize the site soils for construction and re-vegetation (landscaping) perspectives. It should provide site-specific detail on topsoil re-use and stockpiling, high-risk soils and their required treatment during the construction phase and amelioration for the proposed landscape outcomes. The report should demonstrate that the topsoils are suitable for re-use, and that the existing seed-bank will not compromise the proposed vegetative outcomes.

Refer to ESSA's Dr Dennis Bakers' "Information Report" of the 6 March 2011 (Attachment 7) and their detailed report of January 2011 (Attachment 6) for soil mapping and characterisation.

G11 A report needs to be prepared by a suitably qualified soil scientist to adequately map and characterize the site soils for construction and re-vegetation (landscaping) perspectives.

Refer to ESSA's Dr Dennis Bakers' "Information Report" of the 6 March 2011 (Attachment 7) and their detailed report of January 2011 (Attachment 6) for soil mapping and characterisation.

G12 Prepare an Erosion and Sediment Control Plan that considers the relevant aspects of soil type, hydrology, the types of erosion and sediment control devices required on the site and the space opportunities for these, and link the soil treatment to the proposed landscape outcomes. It should be noted that the highly dispersive nature of the clay component of the soils, combined with the unstable sands make the site HIGH RISK from an erosion perspective.

Refer to attached MPNs' Drawing No 5874 - PSK80 (Attachment 8) for the locations of Temporary Sediment Basins. The notes on this plan incorporate the ESSA treatments of topsoils and dispersive subsoils and the process associated with flocculation, discharge of clean water and the cleaning out of settled sediment. The Erosion and Sediment Control Plan utilises the temporary Bioretention Basin and Attenuation areas adjacent to Auld's Road during the earthworks disturbance phases of stages 1, 2 and 8 prior to being completed to perform their Bioretention role in the permanent treatment train for Area 1. Upstream stages 4 to 7 & 9 will require their own Temporary Sediment Basins which will revert to allotments once there is sufficient grass strike to disturbed areas.

Refer to BPs' report of 23 March 2011 (Attachment 5) table 2 for details on the management of unstable soils.

Traffic

T12 Perform sight distance assessment at the proposed access points in Fischer road and Ripley Road and provide recommendations on mitigation measures (if required).

- i. Refer to Landpartners revised POD, access from Fischer Road is not proposed for Area 1.
- ii. Refer to attached MPNs' Drawing No 5874 - PSK82 (Attachment 9) which details the layout of the Ripley and Aulds Road's intersection. The site lines demonstrate compliance of this intersection to Austroads Design Guidelines.

TransLink

Amend the Reconfiguration Plan to provide:

B1 Bus indent bays along Ripley Road in the location identified on the attached plan.

Note Ripley Road is no longer part of this application and will be dealt with as part of a future application.

Queensland Urban Utilities (QUU)

We are awaiting advice from QUU and will forward such to you shortly.

Please refer to the attached Information Request from QUU (Attachment 10) and MPNs' corresponding response dated 17 March 2011 (Attachment 10). QUU have verbally advised that they are satisfied with MPNs' response and that they will be issuing an acceptance letter in the near future.

We trust that this response is sufficient for your purposes, if there is anything further we can assist you with please don't hesitate to call the undersigned.

Yours faithfully

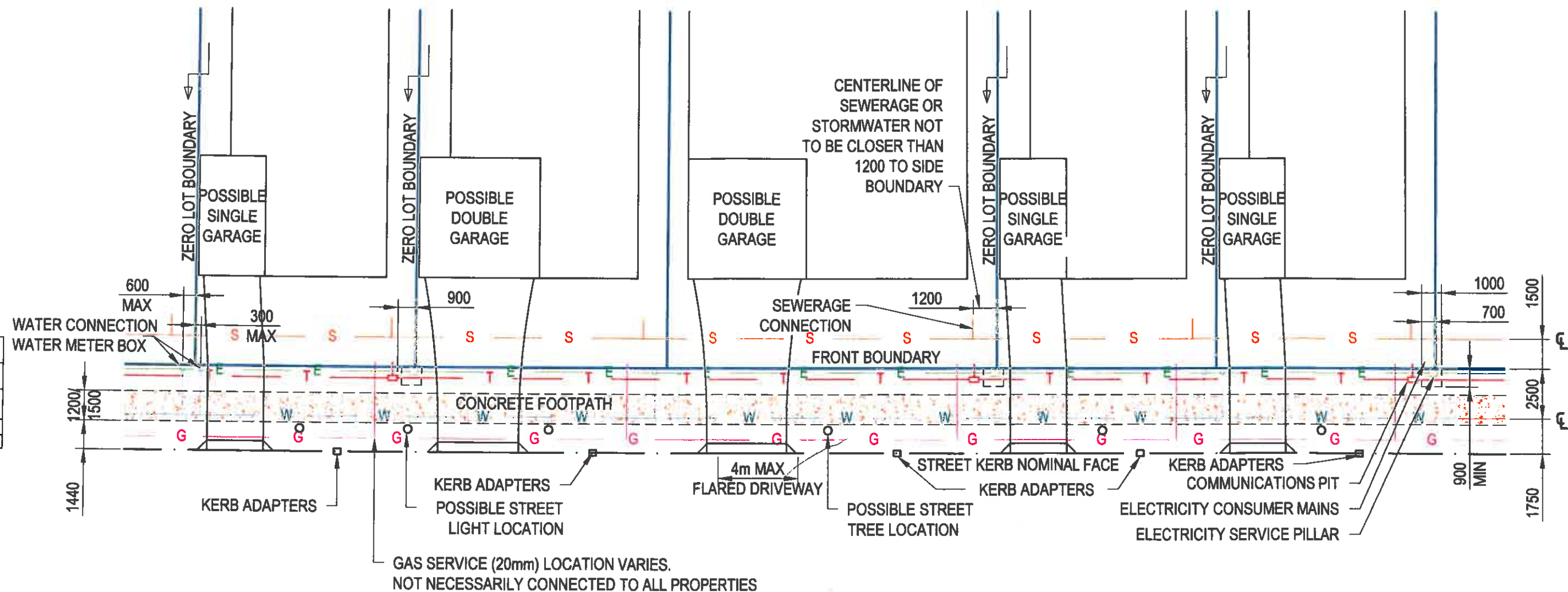


**DEAN PAYNE (RPEQ 4802)
FOR AND ON BEHALF OF
MPN CONSULTING PTY LIMITED**

dp:tt

ATTACHMENT 1
MPN Drawing 5874-PSK70

SERVICE CORRIDORS	
ELECTRICITY & COMMUNICATIONS	1300
POLES/TREES	600
GAS	400



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PROJECT

**RIPLEY VALLEY
 RESIDENTIAL AREA ONE**

DWG TITLE

**LOT SERVICES
 TYPICAL LOCATION PLAN**

SCALE 1:200
 DRAWN JP
 APPRD DG
 DATE MAR 2011

JOB No. **5874**
 DWG No. **PSK70**

ATTACHMENT 2
Earthworks Management Plan

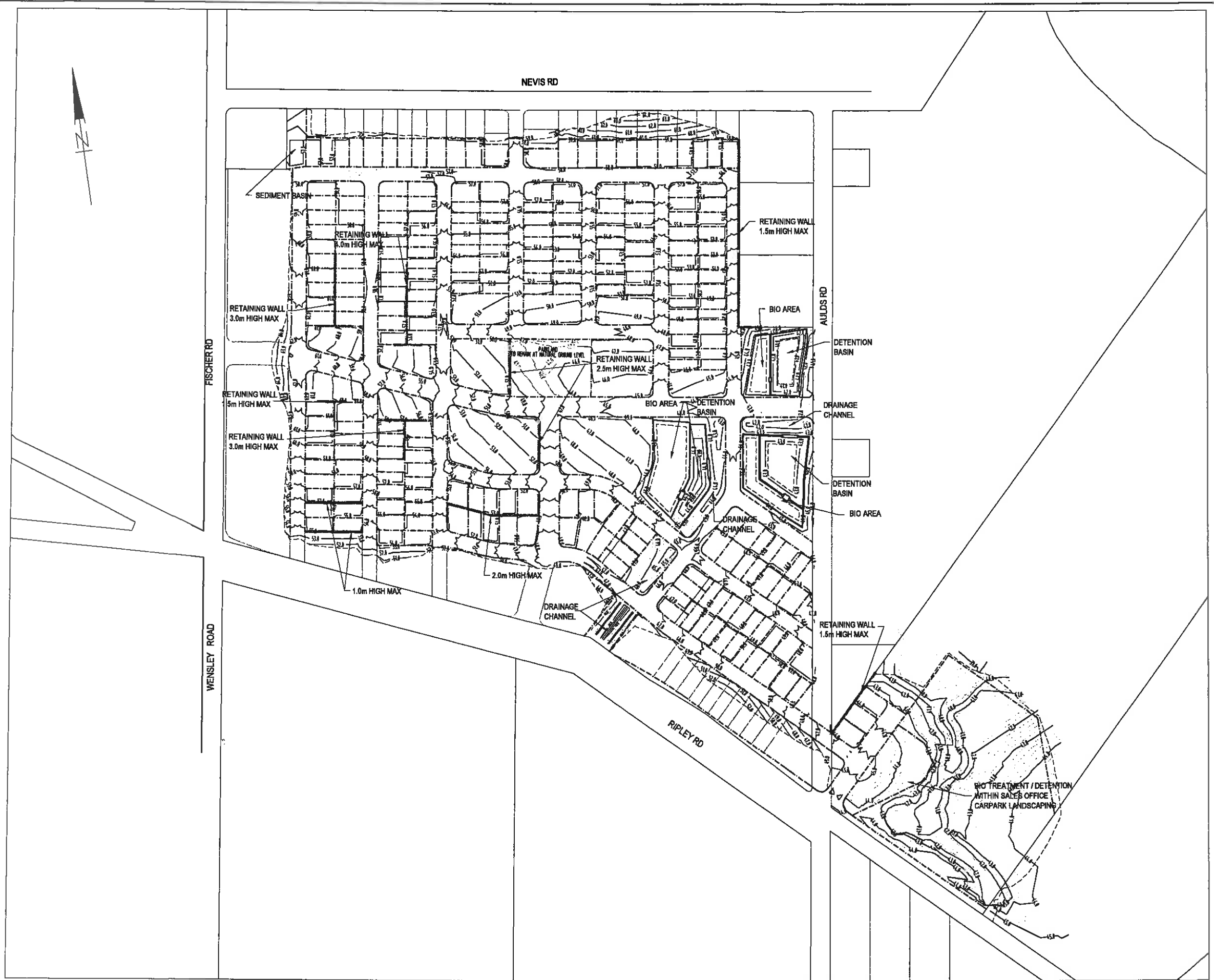
EARTHWORKS MANAGEMENT PLAN
AREA 1 RIPLEY VALLEY
FOR SEKISUI HOUSE DEVELOPMENT SERVICES

These instructions relate to the earthworking of soils (subsoil structural fill and topsoils) on the above project.

Prior to filling any areas the contractor will ensure that;

- Topsoil and organic matter has been stripped from the approved plan areas to depth that removes grasses, roots and deleterious materials, areas to be approved for fill by the nominated geotechnical authority.
- Uncontrolled fill areas identified by the superintendent or by the nominated geotechnical authority will further stripped so that the uncontrolled material is brought back to a natural surface suitable for structural filling.
- The surface prepared for filling must be inspected by the nominated geotechnical authority and proof rolled prior to the commencement the placement of fill.
- If necessary, the fill material will be moisture conditioned to a moisture range suitable for placement and compaction. As the material is laid out it is to be picked any sticks and rubbish to provide a consistent earthworks form.
- Placed layers are not to excess 200mm in thickness, the layer thickness maybe increased if compaction equipment is more effective.
- Field Densities are to be taken in accordance with the local authorities testing regimes.
- Where fill abuts sloping ground benches shall be cut into the natural material in 300mm steps.
- Fill will be placed in uniformly thick layers across the site.
- The maximum particle size is not to exceed 2/3 of the layer thickness.
- Fill areas are to be re-inspected by the geotechnical authority after significant rainfall events and if required, unsuitable material excavated to a sounds surface.
- Geotechnical compliance testing of the fill areas shall be in a accordance with AS 1289 Sections 5.1.1 to 5.8.1
- The contractor will ensure that the equipment selected for the compaction operation can handle the delivery rates of spoiled material.
- The Area 1 Geotechnical report undertaken by Butler and Partners 23.3.2011 has identified that the placement of fill shall be undertaken at controlled moisture contents so that “wetting up” is minimized (minimizing post earthworks heave)
- Area 1 site soils have been identified as “dispersive”, the treatment of the top 200mm of subsoils, top 500mm of cut batters and 2.0 m of fill batter soils is recommended in ESSA’s January 2011 soils investigate Table No 6. ESSA’s recommendations will be incorporated into the Operational Works documentation.
- The Topsoil at this site has been identified as acidic by ESSAs’ Dr Dennis Baker, refer to Table No 6 of their January 2011 report for the appropriate conditioning of this material, this treatment is to provide agronomic qualities to support re-vegetation.
- Rock material encountered within cut works will be removed by the appropriate methods and assessed for suitability for filling in accordance with layer thickness and grading.
- Earthworks within this site will be undertaken in accordance with “AS3798-Guidelines on earthworks for commercial and residential development”
- No Acid Sulfate Soils Management Plan is necessary for the site as the soils are not Acid Sulfate Soils.

ATTACHMENT 3
MPN Drawings PSK44B and RP13A

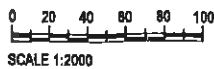


NOTE:

ANY OTHER RETAINING WALLS REQUIRED OVER SITE THAT HAVE NOT BEEN SHOWN WILL BE LESS THAN 1.0m IN HEIGHT OR WILL BE TAKEN UP IN THE BUILDING SLAB FOR LOTS THAT HAVE ZERO LOT BOUNDARIES

ALL RETAINING WALLS WILL BE CONCRETE SLEEPER WALLS OR OF A SIMILAR STRUCTURAL STANDARD

LEGEND	
EXISTING CONTOURS	22.5
TOE OF BATTER	
PROPERTY BOUNDARY	
PROPOSED RETAINING WALL	

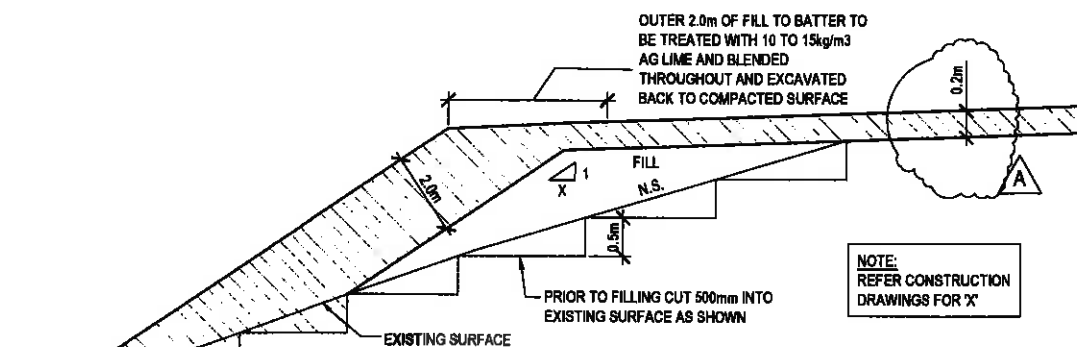


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			DRAWN: D.G.
			CREATED: MAR 2011
B	7.04.11	FOR REVIEW	DG DG CHD:
A	5.04.11	FOR INFORMATION	DG DG APPR:
ISSUE	DATE	AMENDMENT	BY APP DATE:

SEKISUI HOUSE
IPSWICH
RIPLEY VALLEY
RESIDENTIAL AREA ONE
PRELIMINARY GRADING
PLAN

MPH Consulting Pty Ltd
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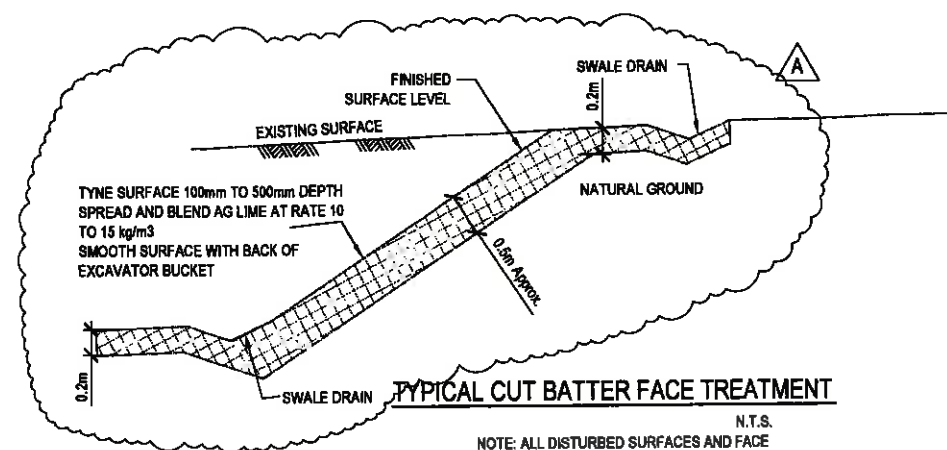
mpn JOB
5874
DRAWING No. REV
PSK44 B



TYPICAL FILL BATTER FACE TREATMENT
N.T.S.

DISPERSIVE SOILS

1. MOST OF THE SOILS TO BE ENCOUNTERED DURING THE BULK EARTHWORKS OPERATIONS ARE EXPECTED TO BE DISPERSIVE.
2. PRIOR TO THE COMMENCEMENT OF BULK EARTHWORKS OPERATIONS THE CONTRACTOR IS TO ARRANGE FOR A SOIL SCIENTIST FROM ENVIRONMENTAL SOIL SOLUTIONS AUSTRALIA (ESSA) TO ATTEND A PRE-START MEETING ON SITE TO ADDRESS DISPERSIVE SOILS.
3. GENERALLY ALL EXPOSED CUT AND FILL BATTERS ARE TO BE TREATED WITH AG LIME IN ACCORDANCE WITH DETAILS ON THIS DRAWING.
4. CUT OFF SWALES AND DIVERSION BUNDS ARE TO BE TREATED WITH AG LIME IN ACCORDANCE WITH DETAILS ON THIS DRAWING.
5. A SOIL SCIENTIST FROM ESSA IS TO INSPECT THE SITE DURING AND AT THE COMPLETION OF WORKS AND TO CONFIRM IN WRITING THAT ALL BULK EARTHWORKS HAVE BEEN CARRIED OUT IN ACCORDANCE WITH ESSA RECOMMENDATIONS AND THAT THE SITE IS STABLE IN RESPECT OF EROSION
6. TOPSOIL MODIFIED IN ACCORDANCE WITH ESSA'S TREATMENT SCHEDULE TO BE SPREAD OVER THE ABOVE SURFACES BY OTHERS



TYPICAL CUT BATTER FACE TREATMENT
N.T.S.

0 2 4 6 8 10
SCALE 1:200

ISSUE	DATE	AMENDMENT	BY	APP
A	21-3-11	TREATMENT THICKNESS AMENDED	LW	DP

RIPLEY VALLEY
RESIDENTIAL DEVELOPMENT
RIPLEY ROAD
IPSWICH

SCALE: 1:200 @ A1
DESIGN: DG
DRAWING: DG
CREATED: FEB 2011
CHD: DL
APPROD: DP
DATE: 18-3-11

RIPLEY VALLEY
IPSWICH
LOT BATTER FACE
TREATMENT DETAILS

mpn consulting
NPN Consulting Pty Ltd
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5874
DRAWING No. 12/7
RP.13
A

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ATTACHMENT 4
Butlers Partners “ULDA Information Request” response dated 9 March 2011

Butler Partners Pty Ltd
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Newstead, Queensland 4006
P.O. Box 2267
Fortitude Valley BC
Queensland 4006

www.butlerpartners.com.au

Ph: 61 7 3852 3800
Fx: 61 7 3852 3808
enquiries@butlerpartners.com.au

Project No. 010-218B

19 April 2011

SHD Services Pty Ltd
c/- MPN Consulting Pty Ltd
Level 5
39 Sherwood Road
TOOWONG QLD 4066

Attention: Mr D Payne

Dear Dean

**RE: ULDA INFORMATION REQUEST
RECONFIGURATION OF LOTS 1 TO 11
RESIDENTIAL SUBDIVISION
CNR RIPLEY AND FISCHER ROADS, RIPLEY VALLEY**

We refer to Urban Land Development Authority's (ULDA) Information Request of 9 December 2010 (ULDA Ref No: DEV2010/084) and provide responses below to the ULDA's twelve (12) notes/questions under the heading *Geotechnical including Erosion/sediment control/dispersive soils*. Our responses do not include reference to 'soil science' issues, which have been addressed separately by Environmental Soil Solutions Australia Pty Ltd (ESSA).

1. MPN Engineering & Infrastructure Development Application Report dated 1 November 2010 and Butler Partners Preliminary Geotechnical Investigation Urban Core and Town Centre, Ripley Road Ripley Valley — dated 5 February 2008 have been assessed.

Noted.

2. An Earthworks Management Plan shall be prepared and lodged for the site. In the preparation of the Earthworks Management Plan the following items need to be considered and addressed.

See below.

Reconfiguration of Lots 1 to 11
Residential Subdivision
Cnr Ripley and Fischer Roads, Ripley Valley
Project No.: 010-218B
19 April 2011

3. Provide an assessment of the risk of disturbing acid sulfate soils and its impact on the environment should be addressed prior to detailed design and construction.

Refer to Butler Partners Pty Ltd's (Butler Partners) Report No.: 010-218B of 23 March 2011, Section 5.3.12 Acid Sulfate Soils. The report notes as follows:

"The Chromium Suite test results confirm that the soil samples tested contained existing acid, but that negligible potential exists for the future oxidation of sulfur. Based on the results of the Chromium Suite test results (refer Section 4.4.6), the site location and the ground surface levels, it is considered that whilst some of the site soils may be acidic because of the site geology, they have been derived from the in-place weathering of rock.

It is considered that whilst the site soils are acidic because of the site geology, they were derived from the in-place weathering of rock and are therefore not acid sulfate soils and an Acid Sulfate Soil Management Plan will not be required for site development.

Because the 'clayey' site soils are of relatively low permeability, all cut to fill that is uniformly compacted in accordance with an appropriate engineering specification, would be essentially impermeable and 'acid leachate' would be negligible."

4. Please confirm that no development is proposed in the area constrained by past mining activities or that more detailed mining related assessments are to be undertaken to determine potential subsidence impact prior to detailed design and construction in these areas.

By others.

5. Please confirm the risk posed by saline and dispersive soils to the basis of this assessment. What measures will be incorporated within the detailed design and construction of the development to mitigate against the site specific risk posed by saline and dispersive soils.

Saline soils are addressed by ESSA.

Dispersive soils (including fill) will be treated as appropriate by use of one or a combination of the following standard 'treatments':

- minimise temporary and permanent exposure of disturbed dispersive soils;
- all fill to be uniformly compacted, including around services etc.;
- grade and drain site to minimise run-off over exposed dispersive soils;
- protect exposed dispersive soils with mechanical erosion protection and/or re-vegetation; and
- treat dispersive cut and fill soil surfaces by lime stabilisation, in a manner consistent with ecologically sustainable practice.

Reconfiguration of Lots 1 to 11
Residential Subdivision
Cnr Ripley and Fischer Roads, Ripley Valley
Project No.: 010-218B
19 April 2011

6. Provide plans describing the proposed earthworks and details on the stability of existing and re-contoured sloping ground and batters for review. The plans shall show the finished contour levels of the site, including details of all retaining walls.

Plans by others. Maximum stable cut and fill batter slope angles are given in Section 5.3.4 of Butler Partners' Report No.: 010-28B, 23 March 2011.

7. Demonstrate that that treatment of soils during the construction and operational phases will result in a stable, and sustainable landform.

Erosion of site soils will be prevented by use of one or more of the methods nominated in Item 5 above.

Use of the techniques nominated in Item 5 has been used successfully in past projects located in the general vicinity of the site, in the same geological conditions, to give stable and sustainable landforms.

8. Demonstrate that the changes to the hydrological conditions resulting from the development will not result in instability of the downstream receiving environment, particularly the potential for bank instability and for incision of the stream channel. The latter has the potential to lower the groundwater table and impact riparian vegetation in particular.

- Hydrology assessment by others.
- Dispersion (and erosion) control – refer Item 5 above.
- Groundwater was generally not encountered to between 1m and 3m depth approximately in the test pits/bores undertaken (refer Section 4.3 of Butler Partners' Report No. 010-218B, 23 March 2011) and it is considered that stream channel erosion (should it occur) will not adversely impact (lower) the groundwater regime.

9. Show that the soils — both topsoils and subsoils have suitable agronomic qualities for re-establishing a stable vegetation cover across the area.

By ESSA.

10. A report needs to be prepared by a suitably qualified soil scientist to adequately map and characterise the site soils for construction and revegetation (landscaping) perspectives. It should provide site specific detail on topsoil re-use and stockpiling, high-risk soils and their required treatment during the construction phase and amelioration for the proposed landscape outcomes. The report should demonstrate that the topsoils are suitable for re-use, and that the existing seed-bank will not compromise the proposed vegetative outcomes.

By ESSA.

11. A report needs to be prepared by a suitably qualified soil scientist to adequately map and characterise the site soils for construction and revegetation (landscaping) perspectives.

By ESSA.

Reconfiguration of Lots 1 to 11
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19 April 2011

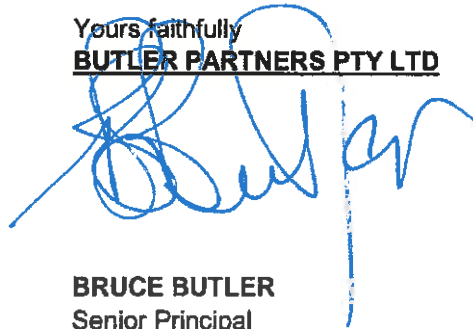
12. Prepare a Erosion and Sediment Control Plan that considers the relevant aspects of soil type, hydrology, the types of erosion and sediment control devices required on the site and the space opportunities for these, and link the soil treatment to the proposed landscape outcomes. It should be noted that the highly dispersive nature of the clay component of the soils, combined with the unstable sands make the site HIGH RISK from an erosion perspective.

By MPN Consulting Pty Ltd. Parameters for use in the preparation of an Erosion and Sediment Control Plan are given in Table 2 of Butler Partners' Report No.: 010-218B, 23 March 2011.

Please let us know if you require any additional information.

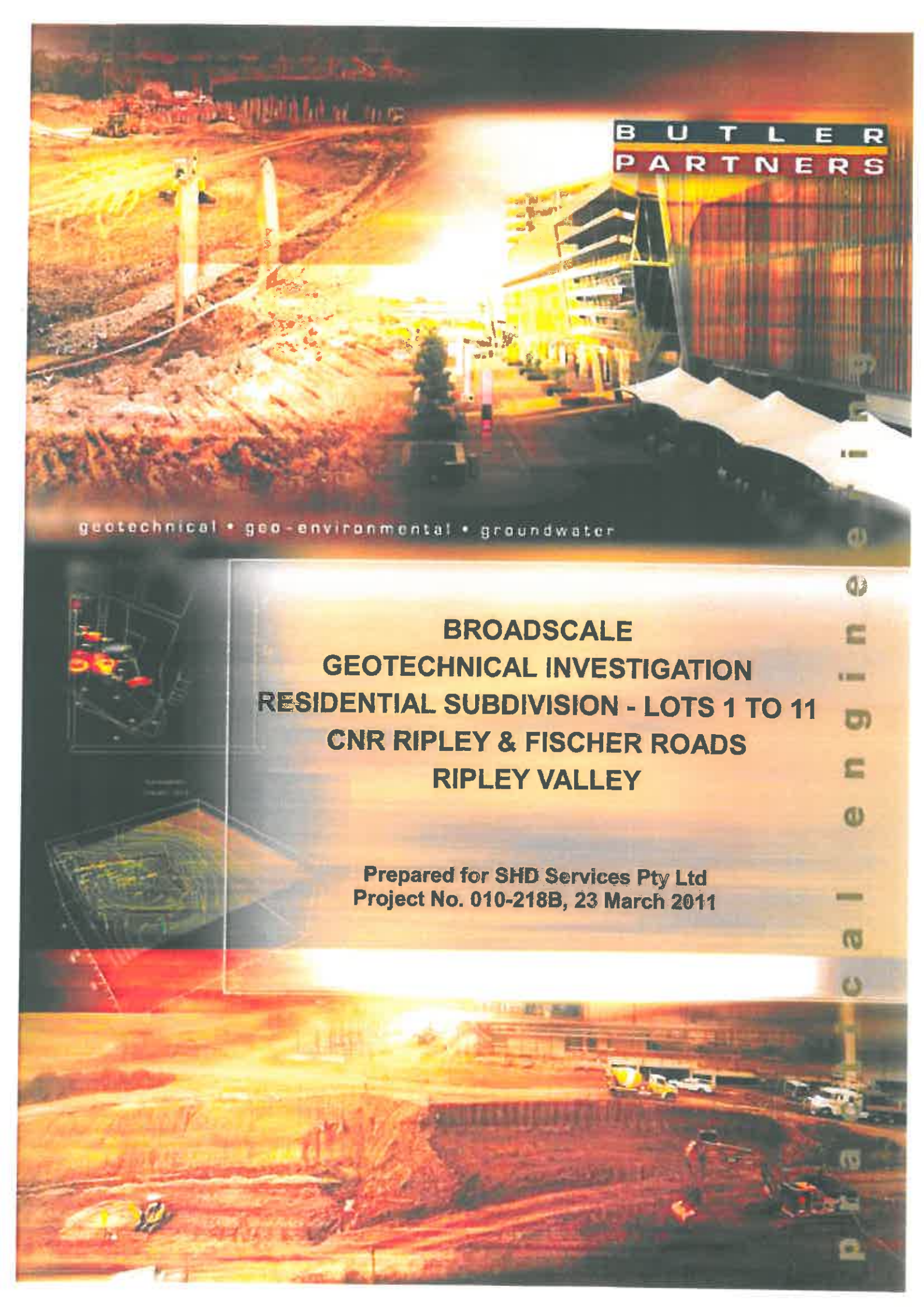
Yours faithfully

BUTLER PARTNERS PTY LTD



BRUCE BUTLER
Senior Principal

ATTACHMENT 5
Butlers Partners “Geotechnical Investigation” 23 March 2011



**BUTLER
PARTNERS**

geotechnical • geo-environmental • groundwater

**BROADSCALE
GEOTECHNICAL INVESTIGATION
RESIDENTIAL SUBDIVISION - LOTS 1 TO 11
CNR RIPLEY & FISCHER ROADS
RIPLEY VALLEY**

**Prepared for SHD Services Pty Ltd
Project No. 010-218B, 23 March 2011**

g e o t e c h n i c a l e n g i n e e r i n g p r a c t i c e

Residential Subdivision - Lots 1 to 11
Cnr Ripley & Fischer Roads, Ripley Valley
Project No. 010-218B
23 March 2011

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Important Information about your Geotechnical Engineering Report (2 pages)

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Drawing No. 1 Locality Plan & Test Locations

Appendix A Bore Report Sheets with Explanatory Notes
 Appendix B Laboratory Test Results Sheets

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SECTION 1 - INTRODUCTION

1.1 Project

It is understood that it is proposed to develop the site as a residential subdivision (excluding Auld's land) and that broadscale geotechnical investigation is required to enable civil and earthworks design. It is further understood that the site is to be developed using cut to fill earthworks, with maximum cut and fill depths of approximately 7m and 4m respectively. The location and extent of the development are shown approximately on Drawing No. 1.

1.2 Proposed Scope of Work

Based on a visit to site and prior knowledge of the area, it was anticipated that the site ground conditions may generally comprise high plasticity clays, overlying variably weathered, variable strength rock, generally at relatively shallow depth. Shallow groundwater was not anticipated.

Based on the scope of the proposed development, the anticipated ground conditions and discussion with MPN Consulting Pty Ltd (MPN), it was proposed to geotechnically investigate the site by:

- excavation and sampling of thirty-seven test pits to 2m to 3m depth (or prior refusal) across the site;
- core drilling two rock bores to 1m depth below proposed formation level in deep cut areas; and
- laboratory testing of selected topsoil, soil and rock samples for civil and earthworks design assessment.

Using the results of the fieldwork and laboratory testing outcomes, it was proposed that a report would be produced that would provide geotechnical design information on each of the following topics:

• subsurface conditions;	• suitable alternate foundation types;
• topsoil depth and properties/potential for re-use;	• working bearing pressures;
• earthworks and site preparation;	• anticipated footing settlements;
• rock excavatability;	• stable batter slopes;
• use of cut for fill;	• fill embankment settlements;
• bulking factors;	• pavement subgrade parameters;
• erosion and sediment control parameters;	• potential for acid sulfate soils; and
• reactive soil movement/indicative site classification;	• anticipated construction aspects.
• retaining wall pressures;	

1.3 Commission

Based on the proposed nature of the development, the anticipated subsurface conditions and the scope of work, a fee to undertake a broadscale geotechnical investigation was presented in a proposal of 30 November 2010. Butler Partners Pty Ltd was subsequently commissioned by SHD Services Pty Ltd (on behalf of Henlia No. 9 Pty Ltd) to conduct the geotechnical investigation as proposed, which was undertaken in consultation with MPN, consulting engineers for the development. This report was issued in draft on 28 February 2011.

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SECTION 2 - THE SITE

2.1 Site Description

The proposed residential subdivision (Lots 1 to 11) is located at the intersection of Ripley and Fischer Roads in an area of gently rolling hills. Site ground levels generally sloped non-uniformly downwards to the east from a high of approximately RL65m on Fischer Road to a low of approximately RL40m to the east of Aulds Road. A dry gully runs in an approximate south-easterly direction through the central section of the site. At the time of the investigation the ground surface was generally grassed, with areas of light to moderate tree growth and existing 'farm' dams were located over the site at the approximate locations indicated on Drawing No. 1. Four views of selected sections of the site are given in Photograph 1 to Photograph 4.



Photograph 1: Partial view of site looking north to east from near Test Pit 1



Photograph 2: Partial view of site looking north to north-west from near Bore 39

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Photograph 3: Partial view of site looking north-east to south-east from near Bore 38



Photograph 4: Panoramic view of site looking north-west to south-west from Aulds Road

2.2 Geology

Reference to the Geological Survey of Australia's 1:100 000 geological series Ipswich map indicates that the site is mapped in an area of Marburg Formation (consisting of lithic or feldspathic, labile to sublabile sandstone, siltstone, shale and coal).

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SECTION 3 - FIELDWORK

3.1 Test Pits

The investigation included the excavation of thirty-seven test pits (Test Pits 1 to 37), using a rubber tyred, tractor mounted Case 580 backhoe using a 0.6m wide bucket. Strata identification was from the inspection of spoil recovered in the bucket, together with the inspection (at shallow depth) of the test pit walls. Hand 'pocket' penetrometer readings were taken, where possible, in cohesive strata to assist with soil strength classification and samples of rock were recovered for testing to assist with the determination of rock strength.

Following completion, the test pits were backfilled and wheel-rolled to surface compact the backfill.

3.2 Bores

The investigation also included the drilling and sampling of two bores (Bores 38 and 39) using a truck mounted Jacro 350 drilling rig. The bores were drilled to between approximately 0.5m and 1.25m using solid flight augers and were advanced below auger refusal depth using wash boring and NMLC coring techniques (to recover 50mm diameter core samples of rock), utilising 'mud' circulation for cuttings removal.

Strata identification in the bores was based on inspection of cuttings recovered on the auger and in the 'mud' circulation, supplemented with inspection of disturbed/undisturbed soil samples and rock core samples.

On completion of drilling, both bores were backfilled with drill spoil.

3.3 Test Locations and Supervision

Test pit and bore locations were set out by direct measurement from existing site features and are shown approximately on Drawing No. 1, attached. Ground surface levels at the bore locations were determined by interpolation from an unreferenced Drawing No. 364900AS *Proposal Plan Ext2.dwg*, received on 19 January 2011, from MPN.

A senior geotechnician set out the test locations, logged the subsurface profiles, determined the in-situ sampling and testing program and supervised the fieldwork.

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SECTION 4 – INVESTIGATION RESULTS

4.1 Results

The subsurface conditions encountered at the bore and test pits locations are given on Bore and Test Pit Report sheets included in Appendix A, using classification and descriptive terms defined in accompanying notes. Laboratory test result sheets are included in Appendix B.

4.2 Subsurface Conditions

4.2.1 Stratigraphy

For a description of the subsurface conditions encountered at the bore and test pit locations, the Bore and Test Pit Report sheets should be consulted. However, a broad summary of the relatively variable subsurface conditions encountered at the test locations is given in Table 1.

Table 1: Summary of Subsurface Conditions at Bore Locations

Depth to Base of Layer (m)	Stratigraphy
0.2	FILL – A discontinuous surface layer of fill comprising a mixture of clay and sand. Only encountered in Test Pit 30.
0.2 to 0.5	SILTY SAND (TOPSOIL) – Generally loose and encountered either from ground surface or below the surface fill layer in Test Pit 30.
0.3 to >3.0	SANDY/SILTY CLAY – Generally stiff to hard. Not encountered in Test Pit 25. The clays contain bands (zones) of clayey sand.
	SANDSTONE – Extremely low to medium strength in general, but with very high strength zones (e.g. Bore 38). Not encountered to the depths excavated in Test Pits 7, 9, 32 and 36. Strength inversions ('weak' rock underlying 'strong' rock) were noted in Bores 38 and 39 (e.g. medium strength rock underlying high strength rock at 7.2m in Bore 38 and low to medium strength rock underlying high strength rock at 7.0m depth in Bore 39).

Where weathered sandstone was encountered in the test pits, 'refusal' to excavation was encountered in all test pits (except Test Pits 16 and 23) at depths generally in the range 0.9m to 2.9m. It should be noted that 'stronger' rock may exist close below the base of the test pits and at shallower depth elsewhere on the site.

4.2.2 Rock Defects

In general, two sets of rock joints/discontinuities were intersected in Bores 38 and 39 which dipped at approximately 10° to 20° and 40° to 80° and were generally clean and tight at approximately 1mm to 10mm thickness, but some were clay infilled and/or crushed zones up to approximately 40mm thickness. A 100mm clay filled joint was noted in Bore 39 at approximately 2.5m depth.

4.3 Groundwater

No free groundwater was encountered during the excavation of any test pits. Free groundwater was also not encountered during the auger drilling of either bore and could not be observed below the depth of auger drilling, due to the use of drilling fluid.

Groundwater levels can change over time with season, prevailing weather and vegetation effects and should be rechecked close to the time of construction.

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4.4 Laboratory Testing

Selected samples from the bores and test pits were tested in geotechnical testing laboratories to determine erosion and sediment control parameters, particle size distribution, plasticity, California bearing ratio (CBR), acid sulfate soil potential, topsoil properties and rock strength and the results are summarised and discussed in the following sections.

4.4.1 Erosion and Sediment Control Parameters

Five selected samples recovered from the bores were tested to determine Emerson Class Number, pH and electrical conductivity and a summary of the reported test results is presented in Table 2.

Table 2: Summary of Emerson Class, pH and Conductivity Test Results

Test Pit	Depth (m)	Sample Description	Emerson Class No.	pH	Electrical Conductivity (mS/cm)
1	0.0 – 0.2	Silty Sand	3	5.6	0.04
	0.4 – 0.6	Sandy Clay	2	7.2	0.37
11	0.0 – 0.2	Silty Sand	3	5.4	0.04
	0.5 – 0.7	Sandy Clay	2	4.7	0.20
18	0.4 – 0.6	Sandy Clay	2	4.9	0.14

The results of the Emerson Class Number testing indicate that all samples tested had a high potential for dispersion, using distilled water.

4.4.2 Particle Size Distribution

Four samples of soils were tested for measurement of particle size distribution using wash sieve grading techniques, and the reported results are summarised in Table 3.

Table 3: Summary of Particle Size Distribution Test Results

Test Pit	Depth (m)	Sample Description	Moisture Content (%)	Gravel Fraction ⁽¹⁾ (%)	Sand Fraction ⁽²⁾ (%)	Silt and Clay Fraction ⁽³⁾ (%)
1	0.0 – 0.2	Silty Sand	11.9	–	70	30
	0.4 – 0.6	Clayey Sand/Sandy Clay	10.1	3	51	46
11	0.5 – 0.7	Clayey Sand	16.8	–	73	27
18	0.4 – 0.6	Clayey Sand/Sandy Clay	14.9	–	52	48

⁽¹⁾ Particle size <60 mm, >2 mm; ⁽²⁾ Particle size (approximately) <2 mm, >0.75 mm; ⁽³⁾ Particle size (approximately) <0.75 mm

4.4.3 Plasticity

Two samples of soils recovered from the test pits were tested for measurement of plasticity using Atterberg limits and linear shrinkage test methods. The reported test results are summarised in Table 4 and indicate that the samples tested are generally of medium plasticity.

Table 4: Summary of Plasticity Test Results

Test Pit	Depth (m)	Sample Description	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Linear Shrinkage (%)	Classification *
2	0.4 – 0.5	Sandy Clay	12.1	41	13	28	14.0	CI
6	0.4 – 0.6	Sandy Clay	13.8	40	14	26	11.0	CI

* Australian Standard AS1726 – 1993 Geotechnical site investigation

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4.4.4 Shrink-Swell

Five 'undisturbed' tube samples of soils recovered from selected test pits/bores were tested to assess reactivity using shrink-swell index (I_{ss}) test methods given in Australian Standard AS1289.7.1.1 – 1992, and a summary of the reported test results is presented in Table 5.

Table 5: Summary of Reported Shrink-Swell Index Test Results

Location	Depth (m)	Sample Description	Moisture Content (%)	Shrinkage (%)	Swell (%)	I_{ss} (% per pF)
Test Pit 13	0.4 – 0.6	Sandy Clay	19.5	4.1	0.7	2.5
Test Pit 21	0.6 – 0.8	Sandy Clay	13.6	2.0	0.1	1.1
Test Pit 22	0.5 – 0.7	Sandy Clay	17.5	2.9	1.0	1.9
Test Pit 30	0.6 – 0.8	Sandy Clay	11.8	2.1	0.4	1.3
Bore 39	0.5 – 0.7	Sandy Clay	11.1	2.8	0.6	1.7

The test results indicate that the samples tested have a low to moderate potential to change volume with change in moisture content/suction.

4.4.5 California Bearing Ratio

Five samples recovered from selected test pits were tested for measurement of soaked CBR using the test method given in Australian Standard AS1289.6.1.1-1998. The samples were recompact using Standard compactive effort at approximately optimum moisture content, then soaked under a surcharge loading of 4.5kg for four days. A summary of the reported results is presented in Table 6.

Table 6: Summary of California Bearing Ratio Test Results

Test Pit	Depth (m)	Sample Description	Sample Moisture Content (%)	Sample Preparation		Swell (%)	CBR (%)
				Dry Density (t/m^3)	Moisture Content (%)		
5	0.5 – 0.7	Sandy Clay	14.1	1.76	13.3	3.5	2.0
8	0.2 – 0.5	Sandy Clay	13.5	1.81	14.4	2.5	2.0
16	0.5 – 0.8	Sandy Clay	25.4	1.63	22.0	2.0	4.5
28	0.2 – 0.8	Sandy Clay	14.4	1.83	11.6	3.5	2.0
37	0.3 – 0.6	Sandy Clay	20.7	1.67	20.6	2.0	3.0

4.4.6 Acid Sulfate Soil Testing

Five samples of soils recovered from selected test pits were selected for Chromium Suite analysis and were kept on ice until transported to Australian Laboratory Services Pty Ltd (ALS) under standard chain of custody protocol. A summary of the test results is given in Table 7.

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Table 7: Summary of Chromium Suite Test Results

Test Pit	Depth (m)	Sample Description	pH _{KCL}	Titrateable Actual Acidity % S	Chromium Reducible Sulfur - (S _{CR}) %S	Net Acidity %S
1	0.0 – 0.2	Silty Sand	4.7	0.02	<0.005	0.02
	0.4 – 0.6	Sandy Clay	6.0	<0.02	<0.005	<0.02
5	0.0 – 0.2	Silty Sand	4.6	<0.02	0.007	0.02
	0.5 – 0.7	Sandy Clay	4.0	0.10	0.005	0.10
18	0.4 – 0.6	Sandy Clay	4.1	0.09	<0.005	0.09

It is considered that the test results indicate that the samples tested are generally neutral to acidic and that negligible potential exists for the generation of additional acidity due to the oxidation of pyrite.

4.4.7 Topsoil

Topsoil tests on three combined samples recovered from 0.0m to 0.2m depth in Test Pits 5 and 6, Test Pits 11 and 18 and Test Pits 19 and 39 were undertaken by Sydney Environmental and Soil Laboratory Pty Ltd and a test report is included in Appendix B.

4.4.8 Rock Strength

Selected rock core samples recovered from Bores 38 and 39 and 'lump' samples of rock recovered generally one each from the majority of the test pits, were tested for measurement of rock strength, using Point Load Test [Is(50)] methods. The test results are given on the relevant Bore and Test Pit Report sheets and a table of results is included in Appendix B.

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SECTION 5 - GEOTECHNICAL COMMENTS

5.1 Ground Model

The results of the investigation indicate that the site is underlain (at the bore and test pit locations) by a surface layer of silty sand (topsoil) to 0.2m to 0.5m depth, with an 0.2m depth of overlying fill in one location. The topsoil was underlain in turn by generally stiff to hard sandy/silty clay with bands (zones) of clayey sand to 0.3m to 3.0m depth, underlain in turn by variably weathered, sandstone that varied in strength between extremely low strength and very high strength. In these ground conditions, design will need to consider at least (but not exclusively) the following key issues:

- presence and quality of existing fill;
- site preparation, earthworks and material variability along the alignment;
- excavatability of rock;
- suitability of cut for soil/fill;
- treatment of soft soils in existing dams;
- the potential for shrink-swell movement in reactive fill;
- slope stability;
- embankment stability in 'soft' subgrade areas;
- the performance of proposed subgrade materials for pavement design;
- groundwater control;
- retaining wall pressures;
- suitable foundation types;
- appropriate founding depths and bearing pressures;
- slab and pavement subgrade properties; and
- possible construction difficulties.

5.2 Existing Fill

It is not known whether the existing fill material at the site is 'controlled' (i.e. it is not known whether the fill has been placed and uniformly compacted to an appropriate engineering specification). If the existing fill is required to support on-ground slabs or pavements, supporting documentation should be obtained and checked to confirm that the fill has been placed in a controlled manner to a specification that is appropriate for the proposed development. If documentation does not exist (or the specification used for filling is not appropriate for the proposed development) then it is suggested that the existing fill be assumed to be uncontrolled, which would be consistent with the general appearance of the fill encountered in Test Pit 30.

If the fill cannot be shown to be controlled, then consideration should be given to the potential for adverse variation to exist in both the composition and degree of compaction of the fill. The presence of voids within uncontrolled fill as well as potential soft/loose zones or inclusions of deleterious materials may lead to potentially significant future total and differential settlements, occurring possibly over relatively short distances.

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To minimise the risk of potentially adverse settlement occurring, it is recommended that all uncontrolled fill present in settlement sensitive areas be either removed and replaced/recompacted with controlled fill of low 'reactivity' or the structure should be supported on foundations extending through the fill and founding in suitable materials.

5.3 Earthworks

5.3.1 *Site Preparation*

Site preparation should involve the stripping of weeds and grass, and removal of trees (as far in advance of construction as possible – see Section 5.5), followed by stripping of any organic near surface soils, 'silts' etc. It is strongly recommended that all uncontrolled fill should also be removed and replaced with controlled fill in areas of settlement sensitivity.

The materials present in the walls/base of existing ponds/dams (refer Drawing No. 1) have the potential to be significantly 'softened' due to moisture, which would have a detrimental influence on the placement and performance of any new fill to be placed over. Site preparation should therefore also include removal of soft soils, ('soft spots'). Soft spots over the general site could be extensive, particularly after rain. Identification of softened materials that need to be removed would need to be confirmed by engineering inspection.

5.3.2 *Excavation*

5.3.2.1 *Bulk*

Soils and extremely low to low strength rock should be readily removed in bulk and confined excavation by large hydraulic excavators. Supplementary use of hydraulic rock breakers will be required in medium strength rock. It is considered that in high strength (or stronger) rock (e.g. Bores 38 and 39), heavy rock breakers and/or blasting will be required and that low productivity and high plant wear should be allowed for.

For scraper excavation of soils, allowance is suggested in costing for 'dozer-push' assistance, comparatively 'slow' rates of excavation and 'pre-ripping'.

5.3.2.2 *Bored Piles*

For the construction of bored pile foundations/solider piles, heavy drilling plant would be required to drill medium strength (or stronger) rock and slow drilling progress and high bit wear is likely. Possible drilling refusal for 'light' rigs would be expected in medium strength (or stronger) rock. Bored pile construction could be adversely affected by the presence of groundwater and sands.

5.3.3 *Suitability of Excavated Materials for Reuse as Fill*

Except for soils that are organic, over-wet or contain over-size (i.e. >75mm) particles, materials recovered in excavations should be suitable for re-use as fill, provided expansive behaviour can be tolerated or designed for where reactive materials are used and near surface 'silty sands' and any 'clean' sands are blended with clay soils to improve their compaction properties.

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It is strongly suggested that any 'silt' materials (including the silty sands encountered at the test locations) not be used as structural fill without removal of organic matter and thorough mixing with bulk excavated clay soils and/or weathered rock. 'Silts' (and fine silty sands etc.) are very moisture sensitive, will be very difficult to compact (and to compact over) without 'very tight' moisture control and will lose considerable strength when 'over-wet'. However, it is anticipated that once all organic material is removed from silts, the organic free soil could be used for non-structural fill (without blending) provided that the potential compaction difficulties nominated can be accepted/tolerated.

The results of the laboratory testing indicate that the samples tested have a high potential for dispersion (Emerson Class No. of 2 and 3), and design and construction methods will need to be adopted to ensure that these materials do not readily disperse e.g.:

- treating dispersive soils to reduce the dispersiveness; or
- placing dispersive materials in areas that cannot be affected by weathering/erosion (e.g. in the centre of fill embankments, etc); or
- treating dispersive materials by mixing them with materials with a lower dispersibility; or
- adopting suitable surface/erosion protection measures that do not allow dispersive materials to be exposed; and/or
- ensuring that those materials are properly and uniformly compacted (particularly around penetrations).

5.3.4 Batter Slopes

5.3.4.1 'Soft' Soils

In areas of 'soft' soils (e.g. existing dams) and the thickness of these soils does not exceed 1m, it would be prudent (at this thickness) for the 'soft' clays to be removed prior to the placement of embankment fill (or pavement) over them.

In areas of 'deep', 'soft' clays where it is impractical to remove the 'soft' soils, location by location design will be required to prevent the presence of 'soft' clays from adversely affecting pavement and/or embankment performance.

5.3.4.2 'Stiff' Soils

Unsurcharged, batter slopes up to 3m to 4m high could be formed at the angles given in Table 8 below, subject to confirmation by inspection during construction. Excavations greater than 4m depth in soils, fill and extremely weathered rock may require benching (by approximately 1m to 2m) at mid-height. At the batter slopes nominated, some movements at and behind the slope crest would be anticipated.

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Table 8: Maximum Unsurcharged Temporary Batter Slopes for Non Water Retaining Structures

Material	Strength	Temporary Batter ⁺⁺	Permanent Batter ⁺⁺
Controlled Fill/Soil	cohesive (stiff) ^{**}	1V:1H	1V:2.5H
	non-cohesive (medium dense)	1V:2H ⁺	1V:3H ⁺
Rock	extremely low	1V:1H	1V:2H
	very low to low	1V:1H	1V:1.5H
	medium or stronger [*]	1V:0.75H	1V:1H

* Depends on jointing and must be checked during excavation. Allowance should be made to flatten batters or to install anchors or dowels if adverse jointing is encountered

++ Not underlain by 'weaker' materials

** Flatter if fissured

+ Not affected by groundwater

At the batter angles nominated in Table 8 there may be some localised slumping of batter slopes and it will be necessary to ensure that the faces are protected from any surface water or groundwater seepage effects (e.g. by grading sites away from slopes and/or the use of surface and subsurface drainage lines). It is also suggested that an allowance be made in project costing for the installation of soil nails/rock dowels and shotcrete over mesh 'as required', to support localised zones of unstable material and for support of batters that are cut steeper than the angles given in Table 8. The amount of mechanical support required will depend on the required batter slope angle, the batter height and the batter materials etc.

All excavated and fill batters should be protected from weathering and erosion and be inspected by an experienced engineer during excavation to confirm stability and revise batter slopes, if required.

Fill batters should be formed by over-filling by a minimum distance of 1m, followed by and cutting back to profile, to assist with the achievement of adequate compaction of batter faces.

5.3.5 Batter Erosion Protection

It is anticipated that cut and fill batters at the site will erode and require ongoing maintenance. All exposed fill should be protected from weathering, erosion and groundwater seepage.

It is suggested that consideration be given to concrete lining of collector drains to minimise erosion.

5.3.6 Subgrade and Fill Compaction

Following site stripping, the exposed subgrade in areas to be filled should be uniformly compacted to a (Standard) dry density ratio of not less than 98%. Any 'soft spots' encountered should be either tyned, dried then recompacted, or excavated and replaced with compacted select fill. Based on the results of the bores and test pits, it is anticipated that 'soft' spots, and possibly 'springs', may be encountered in areas of cut across the site.

In any areas of deep 'firm' clays (refer Section 5.3.4.1) the clays may be too deep to excavate and replace and the use of a coarse granular 'bridging layer' may be required to enable a 'stable' subgrade to be developed, over which compacted fill can be placed. Careful control will be required over bridging layer and fill compaction to avoid further softening of the underlying clays. The placement of the bridging layer should be undertaken under close engineering supervision, with the acceptance of the layer being based on proof rolling.

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All fill which is to support structure loads and/or movement sensitive pavement/slabs, should be 'controlled', i.e. placed in layers having a loose thickness of not more than 300mm and uniformly compacted to an appropriate engineering specification. It is suggested that a minimum dry density ratio of 98% be adopted for fill compaction, and that this be increased to 100% within 0.4m of design platform level in pavement subgrade areas.

All fill should be placed at a moisture content greater than OMC (Standard compaction), to ensure adequate fill compaction is achieved and to minimise the potential for future soil shrink-swell movements associated with changes in moisture content. Soil moisture should not be allowed to change during or following construction.

The silty/sandy clays and extremely low to very low strength, weathered rock encountered on the site have a low to moderate potential for soil shrink-swell movements associated with change in moisture content, especially (but not only) if recompacted. It should be noted that over compacting reactive fill (particularly at a moisture content below Standard optimum) should be avoided as potentially significant expansion could occur on 'wetting up'.

To assist with the achievement of adequate control over fill placement, geotechnical testing as set out in Section 8 of Australian Standard AS3798 – 2007 *Guidelines on earthworks for commercial and residential developments* would be required. It is recommended that the earthworks be undertaken under 'Level 1' geotechnical supervision and testing.

5.3.7 Bulking Factors

Based on past experience with similar materials at other site locations, it is considered that the average 'bulking factor' (ratio of compacted fill density to insitu density) may be within the range 0.9 to 1.0, for materials placed using Standard compactive effort. It will be necessary to conduct extensive insitu and laboratory density testing for confirmation of the average bulking factor.

5.3.8 Traffickability

Site traffickability over the majority of the site was very poor to impossible to rubber tyred plant as a result of rainfall during December 2010 and January 2011.

Prior to general site excavation it will be necessary to traffick the site to remove trees and strip topsoil etc. It is considered likely that this process will result in a significant depth of soils being disturbed and softened, especially (but not only), if the soils are 'wet'. All such soils may require removal to spoil as it would be difficult to 'dry-back' softened materials in an economic time frame.

Following excavation, the exposed subgrade is expected to comprise a combination of clays, sands/clayey sands and weathered rock. Site traffickability will be difficult to impossible in clays, sands/silts and extremely low strength rock if 'wet', and subgrades comprising very low to low strength rock may also be difficult to traffic following wet weather if the rock 'breaks down' under construction traffic.

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To assist with site traffickability, consideration should be given to the placement of a coarse granular working surface over the base of the excavation. The required layer thickness will depend on the type of plant proposed to traffic the site and should be determined on a case by case basis however, a layer thickness of approximately 0.15m would be anticipated for 'light' equipment. Such a layer would also help seal the exposed subgrade from moisture loss and reduce potential subgrade swell movements on 'wetting up'.

5.3.9 Site Drainage

During construction, the site should be graded such that water does not collect and pond over the site, otherwise softening of the subgrade could result, especially under trafficking of construction plant and heavy vehicles.

5.3.10 Topsoil

Silty sand type materials ('topsoils') were encountered to between 0.2m to 0.5m thickness in all bores/test pits, both exposed at ground surface or located beneath a surface fill layer.

The 'silty sands' are very moisture sensitive, will be very difficult to impossible to compact (and to compact over) without 'very tight' moisture control, will lose considerable strength when 'over-wet', and are expected to be dispersive.

It is strongly suggested that any 'silt' materials not be used as structural fill without removal of the organic matter and thorough mixing with bulk excavated 'clay' soils. However, it is anticipated that once all organic materials are removed from 'silts', the organic free soil could be used for non-structural fill (without blending) provided that the potential compaction difficulties nominated can be accepted/tolerated.

5.3.11 Existing Dams

Existing dams are located on the site (refer Drawing No. 1). If any existing dams are located close to (or below) proposed road pavement and/or fill embankments and/or building pad level etc., it will be necessary to undertake specific design on a location by location basis to ensure that the influence of any retained water is taken into account in pavement design and embankment stability.

If existing dams or parts of dams are to be incorporated into or below pavement/embankment areas it may be necessary to remove all softened soils/collected silts down to a suitable strength subgrade (to be approved by engineering inspection), prior to backfilling.

5.3.12 Acid Sulfate Soils

The Chromium Suite test results confirm that the soil samples tested contained existing acid, but that negligible potential exists for the future oxidation of sulfur. It is considered that whilst the site soils are acidic because of the site geology, they were derived from the in-place weathering of rock and are therefore not acid sulfate soils and an Acid Sulfate Soil Management Plan will not be required for site development.

Because the 'clayey' site soils are of relatively low permeability, all cut to fill that is uniformly compacted in accordance with an appropriate engineering specification, would be essentially impermeable and 'acid leachate' would be negligible. However, if the soils are placed in loose stockpiles and exposed to the weather, they may leach acid and may therefore require the construction of a containment bund such that run-off can be collected and tested prior to leaving the site.

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As a general precaution, all stormwater collected during earthworks should be checked for pH prior to off-site discharge; if the pH is outside the range 6.5pH to 8.5pH units, it should be treated to bring it within this range, prior to discharge.

It is suggested that all earthworks be inspected by an experienced engineer to ensure that if any (currently unidentified) zones of ASS do exist, they are identified and the soils appropriately treated.

5.4 Groundwater Control

Based on the results of the fieldwork, it is considered that free groundwater seepage could occur in cut areas, and around the cut-fill line(s) and that the ground water level has the potential to rise with rainfall. Excavation at the site will need to be properly drained so that groundwater does not cause wetting up and softening of subgrade soils and/or uplift of pavements/ slabs etc.

It is strongly suggested that costing provisions be made for the groundwater control measures indicated below, and careful assessment at the time of construction should be undertaken in order to finalise drainage and groundwater control design.

Temporary groundwater control measures should include open graded drains across the site. The number, location and depth of open drains would be dependent on the season and prevailing weather conditions at the time of earthworks.

Permanent control of groundwater will require detailed analysis and design on a location by location basis, but would be expected to require at least the installation of a 'deep' drain at the toe of cut slopes. It would also be expected that drain design would probably incorporate slotted PVC pipe and free draining backfill, and an impermeable seal (either clay, or concrete) at the top of the drain. Grading the crest of cuts back from the slope, or alternatively, provision of a lined crest 'spoon' drain, is recommended to minimise erosion caused by up-slope run-off down exposed batter faces.

5.5 Reactive Ground Movement

5.5.1 Estimated Magnitude

The potential order of characteristic surface movements (y_s) that could occur at the site has been assessed based on the information and methods presented in AS2870 (which assumes soil shrinking and swelling due to change in soil moisture content through 'normal' seasonal moisture variations). Potential characteristic surface movements have been estimated based on the method described in AS2870 using the following equation:

$$y_s = \int_0^{H_s} \alpha I_{ss} \Delta u \, dh$$

where	H_s	maximum depth of seasonal moisture variation (estimated as 2.3m at Ripley);
	α	ratio of laterally restrained to laterally unrestrained movement;
	I_{ss}	shrink-swell index; and
	Δu	soil suction change (taken as 1.3pF maximum at Ripley).

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As a guide to the potential order of magnitude of reactive soil movement at the site, characteristic surface movement (y_s) values have been calculated at three test pit locations (Test Pits 9, 16 and 35) which generally represent a range of reactive clay depths as encountered in the test pits. The calculations have been undertaken using the estimated shrink swell index values given in Table 9, and the results are presented in Table 10.

Table 9: Estimated Shrink Swell Index Values Used for y_s Calculations

Material	Adopted Shrink-Swell Index - I_{ss} (%/pF)
Clayey/Sandy Silt	1.0 – 2.0
Silty Sand	0.1
Silty Clay	3.0 – 6.0
Sandy Clay	2.0 – 3.0
Extremely low strength Sandstone	0.5 – 1.0
Very low strength (and stronger) Sandstone	0.0

The characteristic surface movements (y_s) given in Table 10 have been calculated using the methods and parameters discussed above, assuming normal seasonal moisture/suction variations and the ground surface conditions encountered in each nominated bore. If reactive materials are used to fill the site, then the calculated characteristic surface movement values would increase significantly above those given in Table 10. It is considered essential that the estimated characteristic surface movement values given above for the site be recalculated once site earthworks are completed. It should be carefully noted that the calculated surface movement values given above do not include any allowance for 'abnormal' influences such as vegetation effects, poor site drainage etc.

Table 10: Estimated Characteristic Surface Movements

Test Pits	Stratigraphy	Calculated Characteristic Surface Movement y_s (mm)
9	Silty Sand to 0.3m, then Sandy Clay to >3.0m	35 – 65
16	Silty Sand to 0.4m, Sandy Clay to 1.9m, then very low strength Sandstone	25 – 35
35	Silty Sand to 0.4m, Sandy Clay to 1.1m, then Sandstone	10 – 20

In fill materials the characteristic surface movements could vary significantly from the estimated values given in Table 10 and the reactivity of any fill (and shrink-swell movements) should be assessed once sources are known, if control of reactive fill movement is required. It is also strongly suggested that reactive soils be tested following completion of earthworks, if confirmation of the estimated shrink-swell movements is required.

5.5.2 Design Considerations

The clays (and some clayey sands) and extremely low to low strength sandstone, encountered on the site are expected to generally have moderate potential for shrink-swell movements associated with change in moisture content. If recompacted, the reactivity of these materials may significantly increase, which will need to be allowed for in the estimation of future shrink-swell movement. It should be noted that heavily compacting reactive fill (particularly at a moisture content below standard optimum), should be avoided, as potentially significant expansion could occur on 'wetting up'.

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The natural soil (and extremely low strength rock) profiles encountered in the bores have potential for reactive movement under normal seasonal effects, **if moisture content/suction change can occur**. However, existing or future vegetation, fill, earthworks or 'abnormal' moisture conditions could potentially result in very significant changes (increases) to site reactivity and the following issues should be very carefully considered in design as a consequence:

- Where controlled fill is placed over a natural soil subgrade, higher characteristic movements than those nominated in Table 10 could potentially apply (as AS2870 indicates that the ratio of lateral restrained to unrestrained movement will increase), unless fill reactivity is significantly less than that of the existing site soils. If filling of the site is proposed, a revised site classification will be required, taking into account the actual reactivity, compaction and depth of fill used.
- Vegetation (particularly, but not only, medium to large trees) has the potential to significantly increase soil suction change magnitude and depth (Δu and H_s respectively in the equation above), which leads to a significant increase in potential reactive soil movements adjacent to existing (or proposed) tree locations. Unless the existing trees at the site are removed well in advance of construction (i.e. one year in normal seasons and longer in drought) or trees are prevented from adversely affecting movement sensitive areas (e.g. by the construction of root barriers around the trees) footing design must allow for significantly higher reactive soil movements than are nominated above.
- Abnormal subgrade moisture variations could potentially result in adverse, non-uniform reactive movements that are significantly greater than those nominated above for 'normal' seasonal moisture changes. The risk of 'abnormal' movement occurring could be reduced by ensuring that over-watering of gardens, ponding water, broken/leaking pipes, planting trees/shrubs 'close' to structures, etc. do not occur.

As the materials underlying the site are reactive, 'usual good engineering practices' should be adopted for design and detailing in movement sensitive areas if soil moisture content/suction changes can occur and control of reactive ground movement is desired. In particular, the following are recommended:

- trees/shrubs should not be planted or be allowed to remain closer than 1.5 times their mature height to movement sensitive features (unless significantly greater reactive movements than those nominated in Table 10 are designed for);
- subgrade moisture should not be allowed to change during or following construction;
- site grades should be designed to readily shed water and prevent ponding around footings and other movement sensitive areas. Gradients should be confirmed as part of detailed earthworks design, however, a gradient of not less than 1:20 is suggested to prevent local ponding; and
- services should be designed to be flexible, to prevent any leakage and to rapidly remove any leakage, if it should occur.

5.6 Retaining Walls

Permanent retaining wall pressures can be obtained for 'flexible' and 'rigid' walls under drained, unsaturated conditions, with horizontal backfill, using a triangular pressure distribution in conjunction with the following parameters:

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- **Total Weight:**
 - 1.9t/m³ (soil/fill)
 - 2.3t/m³ (rock)
- **Flexible Walls: 'Active' Pressure Coefficient (k_a):**
 - 0.45 (soils and fill)
 - 0.40 (extremely low strength rock)
 - 0.35 (very low to low strength rock)
- **Rigid Walls: 'At Rest' Pressure Coefficient (k_o):**
 - 0.60 (soils and fill)
 - 0.55 (extremely low strength rock)
 - 0.50 (very low to low strength rock)

Due allowance must also be included in the calculation of wall pressure for groundwater pressure, back fill compaction, surcharge effects from adjacent structures and/or construction loading, the effects of sloping retained materials, reactive soil/fill pressures etc.

Even if a drainage system is installed behind retaining walls, consideration should be given to the potential for water pressures to act on the wall as elevated groundwater levels may occur during or following prolonged 'wet' weather, or from blocked drainage etc. Drain design should incorporate free draining backfill and slotted pipe discharging into a sealed disposal system.

Where retaining walls are located on or close behind slopes, global stability of the overall slope must also be checked (i.e. check for potential instability of materials occurring beneath the wall footing).

Careful consideration will need to be given to wall and/or structure detailing where settlement sensitive structures/features are located situated 'close' to the top of 'flexible' retaining walls.

5.7 Embankment Settlements

For the stiff to hard clays generally encountered in the test pits and bores, the majority of any settlement of any fill placed over such subgrades would generally be expected to comprise fill settlement under 'self-weight'. Actual fill settlement should be determined by analysis as part of bulk earthworks design, however as a preliminary guide fill settlement under self-weight would not be expected to exceed 0.5% to 1.0% of the thickness of the fill, for fill depths to 3m to 4m maximum.

The preliminary settlement estimate given above does not include any allowance for settlement within any existing 'uncontrolled' fill due to poorly compacted zones or inclusions of deleterious materials, as such settlements cannot be accurately predicted and can vary significantly over short distances and it was assumed that all uncontrolled fill would be removed as part of site development. The settlement estimates are also based on no 'soft' clays being present in fill subgrade areas.

The estimated settlements do not include any allowance for structural load or movement due to reactive soil/fill behaviour.

It would be expected that approximately 60% to 80% of the estimated fill settlements should have occurred at the completion of earthworks.

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5.8 Foundations

Foundation selection will be dependent upon structural loadings, the tolerance of structure to movements (including settlements under loads and shrink-swell movements) and groundwater conditions at the time of construction etc. It will be essential to 'cut-off' from structures the effects of adjacent trees, otherwise significant adverse affects could be experienced due to large and non uniform reactive soil movements, of a magnitude significantly greater than estimated in Section 5.5.

It is suggested that the proposed structures be designed to be as 'flexible' as possible, including construction joints, to allow for potentially significant differential movement due to reactive soil behaviour.

Local variations in soil and rock strength and depth could be expected to occur over the site, and it is suggested that a 'flexible' approach be adopted for foundation design, construction methodology and costing so that foundation sizes and founding depths can be readily adjusted as required during construction without incurring significant construction cost/time penalties.

It is suggested that an experienced geotechnical engineer inspect all footing excavations prior to casting to ensure bearing capacity at foundation level is adequate and to confirm final foundation dimensions. All footing excavations should be clean, dry and free of loose/softened materials immediately prior to casting.

Design of strip and pad footings for minor structures could be based on the maximum working bearing pressures nominated in Table 11. It will be necessary to allow for the use of 'mass concrete' to extend footings to found in rock.

Table 11: Working Bearing Pressure for Strip & Pad Footings

Material	Strength	Maximum Bearing Pressure (kPa)*
Controlled Fill - Level 1 (placed and compacted to Section 5.3)		100
Silty/Sandy Clay	firm	Not recommended
	stiff	100
	very stiff	150
	hard	250
Sandstone	extremely low	350
	very low	500

* Not underlain by any 'softer' material

At the values of stress nominated in Table 11 approximate individual footing settlements (due to structural loads only) would not be expected to exceed 1.0% to 1.5% of footing width for properly constructed pad footings, or 2.0% to 2.5% of footing width for properly constructed strip footings. Actual foundation settlements should be checked by analysis once footing sizes and loads are confirmed.

5.9 On-Ground Slabs and Pavements

Subgrade properties are likely to vary across the site following earthworks, and detailed assessment/testing will be required at the time of construction in order to confirm design values. For the purposes of initial costing and preliminary design, design of on-ground slabs and pavements, cast over a natural soil or rock, or controlled fill subgrade, could be based on the parameters presented in Table 12.

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Table 12: Subgrade Design Parameters

Subgrade Type	CBR (%)	Modulus of Subgrade Reaction * (kPa/mm)
Silty Clay (natural or controlled fill)	2 – 4	20 – 30
Sandy Clay (natural or controlled fill)	3 – 8	25 – 40
Clayey Sand (natural or controlled fill)	5 – 10	30 – 50
Silty Sand (natural or controlled fill)	8 – 10	40 – 50
Sandstone (natural or controlled fill) *	20 – 30	50 – 80

* For transient loading only; * May break down under compaction, leading to degraded properties

The values presented in Table 12 are based on the assumption that the subgrade is prepared in accordance with Section 5.2.

On-ground slabs should be fully dowelled and joints between slabs sealed to control differential movements and minimise under-slab moisture changes. It is suggested that floor slabs be tied into shallow footings to prevent relative movement. However, if slabs are not tied in, they should be detailed to enable movement, independent of foundations, fixtures, etc.

BUTLER PARTNERS PTY LTD

BRUCE BUTLER
 Senior Principal

Reviewed by:
MIKE NEIGHBOUR
 Principal

Important Information about Your Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply the report for any purpose or project except the one originally contemplated.*

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse.

- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.*

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that

have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely on Your ASFE-Member Geotechnical Engineer for Additional Assistance

Membership in ASFE/THE BEST PEOPLE ON EARTH exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.



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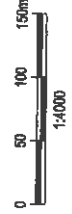
LOTS 1-11
 CORNER RIPLEY AND FISCHER ROADS, RIPLEY VALLEY

LOCALITY PLAN AND TEST LOCATIONS

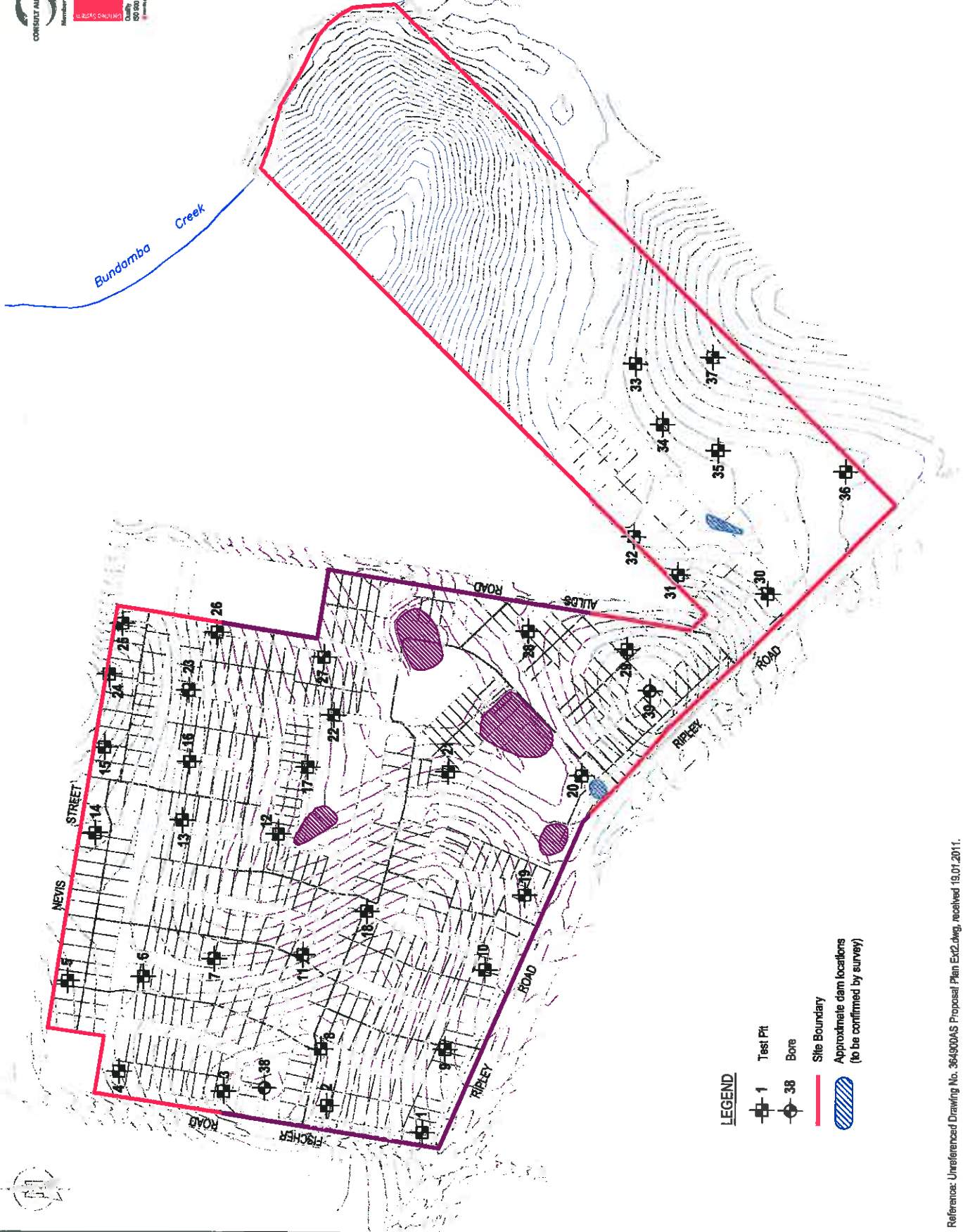
CLIENT:

SHD SERVICES PTY LTD

SCALE AT A3:



DATE:	MARCH 2011
DRAWN:	FD
APPROVED:	
PROJECT No:	D16-218B
DRAWING No:	1 REV: A



LEGEND

- Test Pt 1
- Bore 38
- Site Boundary
- Approximate dam locations (to be confirmed by survey)

*Residential Subdivision - Lots 1 to 11
Cnr Ripley & Fischer Roads, Ripley Valley
Project No. 010-218B
23 March 2011*

APPENDIX A

BORE REPORT SHEETS WITH EXPLANATORY NOTES

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 1

Page No: 1 of 1

Date: 24 January 2011

Ground Surface Level: RL54.7m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	54.7		D	0.0	pp>500
	SANDY CLAY (CL)/CLAYEY SAND (SC) - very stiff, grey, yellow and orange, fine to medium grained sand with bands of clayey sand			D	0.2	
				D	0.4	
		54.0			0.6	
1						Is(50)=0.9(i)
	SANDSTONE (DW) - low to medium strength, grey and yellow, fine to medium grained			D	1.5	
		53.0			1.55	
2	End of Test Pit at 1.55 m (Refusal)					
3		52.0				
4		51.0				
5		50.0				

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 2

Page No: 1 of 1

Date: 24 January 2011

Ground Surface Level: RL62.2m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	62.2		D	0.0	pp=400
	SANDY CLAY (CI) - very stiff, grey, yellow and orange, fine to medium grained sand			D	0.2	
				D	0.4	
				D	0.5	
1						
	SANDSTONE (XW/DW) - very low to low strength, grey and yellow, fine to medium grained	61.0		D	1.2	Is(50)=0.1(i)
					1.3	
2	SANDSTONE (DW) - low strength, grey-brown, grey and yellow, fine to medium grained			D	1.9	Is(50)=0.1(i)
					2.0	
	End of Test Pit at 2 m (Refusal)	60.0				
3						
		59.0				
4						
		58.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rlg: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19.01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 3

Page No: 1 of 1

Date: 24 January 2011

Ground Surface Level: RL64.0m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	64.0		D	0.0	pp=300
	SANDY CLAY (CI) - stiff to very stiff, grey, yellow and orange, fine to medium grained sand			D	0.2	
				D	0.4	
				D	0.6	
1	SANDSTONE (DW) - very low to low strength, dark grey, grey and yellow, fine to medium grained	63.0		D	0.9	Is(50)=0.1(i)
					1.0	
	End of Test Pit at 1 m (Refusal)					
2		62.0				
3		61.0				
4		60.0				
5		59.0				

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected) kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 4

Page No: 1 of 1

Date: 24 January 2011

Ground Surface Level: RL58.0m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	58.0		D	0.0	pp=300
					0.2	
	SANDY CLAY (CI) - stiff to very stiff, grey, yellow and orange, fine to medium grained sand			D	0.4	
					0.6	
1	SANDSTONE (DW) - very low to low strength, grey and yellow, fine to medium grained	57.0		D	1.0	Is(50)=0.1(l)
					1.1	
	End of Test Pit at 1.2 m (Refusal)					
2		56.0				
3		55.0				
4		54.0				
5		53.0				

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19.01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 5

Page No: 1 of 1

Date: 24 January 2011

Ground Surface Level: RL56.2m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand - light grey	56.2		D	0.0	pp=350 Is(50)=0.1(i)
					0.2	
	SANDY CLAY (CI) - very stiff, grey, yellow and orange, fine to medium grained sand			B/D	0.5	
					0.7	
1	SANDSTONE (DW) - very low to low strength, grey and yellow, fine to medium grained			D	1.0	
					1.1	
	End of Test Pit at 1.2 m (Refusal)	55.0				
2						
		54.0				
3						
		53.0				
4						
		52.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 6

Page No: 1 of 1

Date: 24 January 2011

Ground Surface Level: RL57.5m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	57.5			0.0	pp=250
	SANDY CLAY (CI) - stiff, grey, yellow and orange, fine to medium grained sand			D	0.2	
		57.0		D	0.4	
					0.6	
1	- very stiff					Is(50)=0.2(i)
	SANDSTONE (DW) - low strength, grey and yellow, fine to medium grained	56.0		D	1.3	
					1.4	
2	End of Test Pit at 1.7 m (Refusal)					
		55.0				
3		54.0				
4		53.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-2188

TEST PIT 7

Page No: 1 of 1

Date: 17 February 2011

Ground Surface Level: RL55.2m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand - light grey	55.2		D	0.0	pp=400 pp=500
					0.2	
	SANDY CLAY (CI) - very stiff, grey, yellow and orange, fine to medium grained sand			D	0.5	
					0.7	
1		54.0				
2	- very stiff to hard	53.0			2.5	pp>500
3	End of Test Pit at 3 m	52.0				
4		51.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 8

Page No: 1 of 1

Date: 24 January 2011

Ground Surface Level: RL63.3m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	63.3		D	0.0	pp=400
	SANDY CLAY (CI) - very stiff, grey, yellow and orange, fine to medium grained sand	63.0		D/B	0.1 0.2	
	SANDSTONE (DW) - low strength, dark grey, grey and yellow, fine to medium grained				0.5	
1	- medium to high strength			D	0.9 1.0	Is(50)=1.1(i)
	End of Test Pit at 1 m (Refusal)	62.0				
2						
		61.0				
3						
		60.0				
4						
		59.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19.01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 9

Page No: 1 of 1

Date: 24 January 2011

Ground Surface Level: RL52.7m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	52.7			0.0	
				D	0.2	
	SANDY CLAY (CI) - very stiff, grey, yellow and orange, fine to medium grained sand	52.0			0.8	
1				D	1.0	pp=350
	- very stiff to hard, grey and yellow	51.0				
2					2.0	pp>500
	- with (XW) sandstone bands	50.0				
3	End of Test Pit at 3 m					
		49.0				
4						
		48.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2' dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 10

Page No: 1 of 1

Date: 24 January 2011

Ground Surface Level: RL51.0m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	51.0		D	0.0	
					0.2	
	SANDY CLAY (CI) - stiff to very stiff, grey and yellow, fine to medium grained sand				0.8	pp=300
1	- very stiff	50.0			1.0	pp>500
	SANDSTONE (DW) - low strength, grey and yellow, fine to medium grained			D	1.3	Is(50)=0.2(i)
	- low to medium strength			D	1.4	
2	End of Test Pit at 1.8 m (Refusal)	49.0			1.7	Is(50)=0.3(i)
					1.8	
3		48.0				
4		47.0				
5		46.0				

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19.01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 11

Page No: 1 of 1

Date: 24 January 2011

Ground Surface Level: RL56.5m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	56.5		D	0.0	pp=400 Is(50)=0.4(i)
	CLAYEY SAND (SC) - very stiff, grey, yellow and orange, fine to medium grained sand with bands of sandy clay	56.0		D	0.2	
					0.5	
				D	0.7	
				D	0.8	
1	SANDSTONE (DW) - low to medium strength, dark grey, grey and yellow, fine to medium grained				0.9	
	End of Test Pit at 0.9 m (Refusal)					
		55.0				
2						
		54.0				
3						
		53.0				
4						
		52.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 12

Page No: 1 of 1

Date: 17 February 2011

Ground Surface Level: RL48.8m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand - light grey	48.8		D	0.0	pp=220 Is(50)=0.1(i)
					0.2	
	SANDY CLAY (CI) - stiff, grey, yellow and orange, fine to medium grained sand			D	0.5	
		48.0			0.7	
1	SANDSTONE (DW) - very low to low strength, grey and yellow, fine to medium grained			D	0.9	
					1.0	
	End of Test Pit at 1.2 m (Refusal)					
2		47.0				
3		46.0				
4		45.0				
5		44.0				

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 13

Page No: 1 of 1

Date: 17 February 2011

Ground Surface Level: RL55.6m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand - light grey	55.6		D	0.0	pp>500 Is(50)=0.01(i)
					0.2	
					0.4	
	SANDY CLAY (CI) - very stiff, grey, yellow and orange, fine to medium grained sand	55.0		U	0.6	
					0.7	
	SANDSTONE (XW) - extremely low strength, grey and yellow, fine to coarse grained			D	0.8	
1	End of Test Pit at 1.1 m (Refusal)					
		54.0				
2						
		53.0				
3						
		52.0				
4						
		51.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19.01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 14

Page No: 1 of 1

Date: 17 February 2011

Ground Surface Level: RL59.5m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand - light grey	59.5		D	0.0	pp=200 Is(50)=0.01(i)
				D	0.2	
				D	0.4	
				D	0.6	
				D	0.8	
1	SANDY CLAY (CI) - stiff, grey, yellow and orange, fine to medium grained sand	59.0			0.9	
	SANDSTONE (XW) - extremely low strength, grey and yellow, fine to medium grained					
	End of Test Pit at 1 m (Refusal)					
		58.0				
2						
		57.0				
3						
		56.0				
4						
		55.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 15

Page No: 1 of 1

Date: 17 February 2011

Ground Surface Level: RL62.1m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand - light grey	62.1			0.0	pp=250
				D	0.2	
				D	0.4	
				D	0.6	
	SANDY CLAY (CI) - stiff, grey, yellow and orange, fine to medium grained sand					
1	SANDSTONE (DW) - very low to low strength, grey and yellow, fine to medium grained	61.0		D	1.0	Is(50)=0.1(f)
					1.1	
	End of Test Pit at 1.3 m (Refusal)					
2		60.0				
3		59.0				
4		58.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected) kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**ENTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 16

Page No: 1 of 1

Date: 17 February 2011

Ground Surface Level: RL55.7m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand - light grey	55.7		D	0.0	
					0.2	
	SANDY CLAY (CI) - stiff, grey, yellow and orange, fine to medium grained sand	55.0		B/D	0.5	
1					0.8	pp=250
	- very stiff				1.3	pp=500
		54.0				
2	SANDSTONE (XW/DW) - very low to low strength, grey and yellow, fine to medium grained			D	1.9	Is(50)=0.2(i)
					2.0	
		53.0				
3	End of Test Pit at 3 m					
		52.0				
4						
		51.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19.01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 17

Page No: 1 of 1

Date: 17 February 2011

Ground Surface Level: RL47.7m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	47.7		D	0.0	pp=200 pp=400
	- light grey				0.2	
	SANDY CLAY (CI) - stiff, grey, yellow and orange, fine to medium grained sand	47.0		D	0.5	
	- very stiff				0.7	
1						
2	- hard	46.0				
	SANDSTONE (DW) - very low to low strength, grey and yellow, fine to medium grained	45.0		D	2.4	Is(50)=0.1(i)
					2.5	
3	End of Test Pit at 2.6 m (Refusal)					
4		44.0				
5		43.0				

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19.01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 18

Page No: 1 of 1

Date: 24 January 2011

Ground Surface Level: RL55.6m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	55.6		D	0.0	
	SANDY CLAY (CI) - very stiff, grey, yellow and orange, fine to medium grained sand, with clayey sand bands	55.0		D	0.2	
					0.4	
					0.6	pp=500
1	SANDSTONE (DW) - low strength, grey and yellow, fine to medium grained			D	1.2	Is(50)=0.1(i)
					1.3	
		54.0		D	1.5	Is(50)=0.2(i)
					1.6	
2	End of Test Pit at 1.6 m (Refusal)					
		53.0				
3						
		52.0				
4						
		51.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 19

Page No: 1 of 1

Date: 24 January 2011

Ground Surface Level: RL48.6m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	48.6		D	0.0	pp=240
					0.2	
	SANDY CLAY (CI) - stiff, grey, yellow and orange, fine to medium grained sand	48.0		D	0.5	
					0.7	
1						
	- very stiff, grey and yellow, with thin interbedded clayey sand bands	47.0		D	1.6	pp=300
					1.8	
2						
	SANDSTONE (XW) - extremely low strength, grey and yellow, fine to medium grained				2.4	Is(50)=0.1(i)
	SANDSTONE (DW) - low strength, grey and yellow, fine to medium grained	46.0		D	2.5	
3	End of Test Pit at 2.65 m (Refusal)					
4		45.0				
5		44.0				

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 20

Page No: 1 of 1

Date: 16 February 2011

Ground Surface Level: RL45.3m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	45.3			0.0	pp=450 Is(50)=0.2(i)
	SANDY CLAY (CI) - very stiff, grey, yellow and orange, fine to medium grained sand	45.0		D	0.2	
					0.5	
				D	0.7	
					0.9	
1	SANDSTONE (DW) - low strength, grey-brown and red, fine to medium grained			D	1.0	
	End of Test Pit at 1.1 m (Refusal)	44.0				
2						
		43.0				
3						
		42.0				
4						
		41.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 21

Page No: 1 of 1

Date: 16 February 2011

Ground Surface Level: RL46.2m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	46.2		D	0.0	pp=400 pp>500
					0.2	
	SANDY CLAY (CI) - very stiff, grey, yellow and orange, fine to medium grained sand			D	0.4	
				U	0.6	
					0.8	
1	SANDSTONE (DW) - very low to low strength, grey and yellow, fine to medium grained	45.0		D	1.2	Is(50)=0.1(i)
					1.3	
	End of Test Pit at 1.6 m (Refusal)					
2		44.0				
3		43.0				
4		42.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 22

Page No: 1 of 1

Date: 17 February 2011

Ground Surface Level: RL45.8m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand - light grey-brown	45.8		D	0.0	
				D	0.2	
				D	0.3	
	SANDY CLAY (CI/CH) - very stiff, grey, yellow and orange, fine to medium grained sand			U	0.5	pp=400
					0.7	pp>500
1	SANDY CLAY (CI) - hard, grey and yellow, fine to medium grained sand	45.0				
	SANDSTONE (DW) - low strength, grey and yellow, fine to medium grained			D	1.2	Is(50)=0.3(i)
					1.3	
2		44.0				
				D	2.0	Is(50)=0.3(i)
					2.1	
	End of Test Pit at 2.3 m (Refusal)					
3		43.0				
4		42.0				
5		41.0				

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19.01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 23

Page No: 1 of 1

Date: 17 February 2011

Ground Surface Level: RL56.4m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand - light grey-brown	56.4		D	0.0	
					0.2	
	SANDY CLAY (CI/CH) - very stiff, grey, yellow and orange, fine to medium grained sand	56.0		D	0.5	
					0.7	pp=340
1		55.0				
2	- hard, grey and yellow	54.0			1.9	pp>500
	SANDSTONE (DW) - very low to low strength, grey and yellow, fine to medium grained			D	2.7	
3					2.8	Is(50)=0.1(i)
	End of Test Pit at 3 m					
		53.0				
4						
		52.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 24

Page No: 1 of 1

Date: 17 February 2011

Ground Surface Level: RL63.8m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	63.8		D	0.0	pp=350 Is(50)=0.3(i)
	SANDY CLAY (CI) - very stiff, grey, yellow and orange, fine to medium grained sand			D	0.2	
				D	0.3	
	SANDSTONE (DW) - low strength, grey and yellow, fine to medium grained			D	0.5	
				D	0.6	
				D	0.7	
1	End of Test Pit at 0.7 m (Refusal)	63.0				
2		62.0				
3		61.0				
4		60.0				
5		59.0				

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19.01.11

TEST PIT REPORT



Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-2188

TEST PIT 25

Page No: 1 of 1

Date: 17 February 2011

Ground Surface Level: RL59.2m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand - grey-brown, yellow and orange	59.2		D	0.0	
					0.2	
	SANDSTONE (XW) - extremely low to low strength, grey and yellow, fine to medium grained			D	0.5	Is(50)=0.01(i)
					0.6	
1	SANDSTONE (DW) - low strength, grey and yellow, fine to medium grained			D	0.9	Is(50)=0.1(i)
					1.0	
	End of Test Pit at 1 m (Refusal)	58.0				
2						
		57.0				
3						
		56.0				
4						
		55.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 26

Page No: 1 of 1

Date: 17 February 2011

Ground Surface Level: RL53.2m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	53.2		D	0.0	pp=230
	SANDY CLAY (CI) - stiff, grey, yellow and orange, fine to medium grained sand				0.2	
				D	0.5	
					0.7	
1	SANDSTONE (DW) - low strength, grey, yellow, fine to medium grained	52.0		D	1.2	Is(50)=0.1(n)
					1.3	
	End of Test Pit at 1.4 m (Refusal)					
2		51.0				
3		50.0				
4		49.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 27

Page No: 1 of 1

Date: 17 February 2011

Ground Surface Level: RL46.0m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand - light grey	46.0		D	0.0	pp=220 pp=300 Is(50)=0.1(i)
					0.2	
	SANDY CLAY (CI) - stiff, grey, yellow and orange, fine to medium grained sand			D	0.5	
					0.6	
				D	0.7	
1	SANDSTONE (XW) - very low to low strength, grey and yellow, fine to medium grained	45.0			0.8	
	End of Test Pit at 1.2 m (Refusal)					
2		44.0				
3		43.0				
4		42.0				
5		41.0				

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 28

Page No: 1 of 1

Date: 16 February 2011

Ground Surface Level: RL46.3m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	46.3		D	0.0	pp=400 Is(50)=0.1(i)
	SANDY CLAY (CI) - very stiff, grey, yellow and orange, fine to medium grained sand	46.0		D/B	0.2 0.3	
1	SANDSTONE (XW/DW) - very low to low strength, grey and yellow, fine to medium grained			D	0.8 1.0 1.2	
		45.0				
2						Is(50)=0.2(i)
	SANDSTONE (DW) - low strength, grey-brown, grey and yellow, fine to medium grained	44.0		D	2.4 2.5	
3	End of Test Pit at 2.5 m (Refusal)					
		43.0				
4						
		42.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT



Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 29

Page No: 1 of 1

Date: 16 February 2011

Ground Surface Level: RL51.0m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	51.0		D	0.0	
	SANDY CLAY (CI) - very stiff, grey, yellow and orange, fine to medium grained sand			D	0.2	
					0.4	
					0.6	pp=500
1	- hard, grey and yellow	50.0			1.4	pp>500
	- with (XW) sandstone bands				1.8	
2	SANDSTONE (DW) - low strength, grey and yellow, fine to medium grained	49.0		D	1.9	Is(50)=0.2(i)
	End of Test Pit at 2.4 m (Refusal)					
3		48.0				
4		47.0				
5		46.0				

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 30

Page No: 1 of 1

Date: 16 February 2011

Ground Surface Level: RL41.0m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	FILL - grey-brown and yellow, sandy clay, fine to medium grained sand	41.0		D	0.0	
	SILTY SAND (SM) - grey-brown, fine to medium grained sand				0.2	
	SANDY CLAY (CI) - stiff to very stiff, grey-brown and yellow, fine to medium grained sand			U	0.6	
1		40.0			0.8	pp=400
2	- very stiff, grey, yellow and orange	39.0			1.9	pp=500
	SANDSTONE (XW) - very low to low strength, grey and yellow, fine to medium grained sand			D	2.6	Is(50)=0.1(i)
3	End of Test Pit at 2.9 m (Refusal)	38.0			2.7	
4		37.0				
5		36.0				

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'. dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 31

Page No: 1 of 1

Date: 16 February 2011

Ground Surface Level: RL42.6m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	42.6			0.0	
				D	0.2	
	SANDY CLAY (CI/CH) - stiff, grey, yellow and orange, fine to medium grained sand				0.5	pp=200
		42.0		D	0.7	pp=250
1	SANDY CLAY (CI) - very stiff, grey and yellow, fine to medium grained sand				1.2	pp=400
		41.0				
2	SANDSTONE (XW) - very low to low strength, grey and yellow, fine to medium grained			D	1.8	Is(50)=0.1(i)
					1.9	
	SANDSTONE (DW) - low strength, grey and yellow, fine to medium grained			D	2.1	Is(50)=0.2(i)
					2.2	
	End of Test Pit at 2.2 m (Refusal)					
3		40.0				
4		39.0				
5		38.0				

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 32

Page No: 1 of 1

Date: 16 February 2011

Ground Surface Level: RL39.4m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	39.4		D	0.0	
					0.2	
	SANDY CLAY (CH) - stiff, grey and yellow, fine to medium grained sand	39.0		D	0.5	
					0.7	pp=160
1	SILTY CLAY (CH) - stiff, grey and yellow, fine grained sand				1.2	pp=210
		38.0				
	SANDY CLAY (CI) - stiff to very stiff, grey-brown, grey and yellow, fine to medium grained sand, with clayey sand bands					
2		37.0				
3	SILTY CLAY (CH) - stiff, dark grey, fine grained sand				3.0	pp=160
	End of Test Pit at 3 m	36.0				
		35.0				
4						
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 33

Page No: 1 of 1

Date: 16 February 2011

Ground Surface Level: RL40.0m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	40.0		D	0.0	pp=300 Is(50)=0.2(i)
	SANDY CLAY (CI) - stiff to very stiff, yellow and orange, fine to medium grained sand			D	0.4	
					0.6	
					0.8	
1	SANDSTONE (DW) - low strength, pale grey, fine to coarse grained	39.0		D	1.0	
					1.2	
	End of Test Pit at 1.5 m (Refusal)					
2		38.0				
3		37.0				
4		36.0				
5		35.0				

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19.01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 34

Page No: 1 of 1

Date: 16 February 2011

Ground Surface Level: RL40.0m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - brown, fine to medium grained sand	40.0			0.0	Is(50)=0.1(i)
				D	0.4	
	SANDY CLAY (CI) - very stiff, grey, yellow and orange, fine to medium grained sand				0.6	
				D	0.8	
1		39.0			1.0	
	SANDSTONE (DW) - very low to low strength, grey and yellow, fine to medium grained			D	1.2	Is(50)=0.1(i)
	End of Test Pit at 1.3 m (Refusal)					
2		38.0				
3		37.0				
4		36.0				
5		35.0				

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19 .01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 35

Page No: 1 of 1

Date: 16 February 2011

Ground Surface Level: RL40.5m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	40.5				
				D	0.1	
					0.3	
	SANDY CLAY (CI) - very stiff, grey and orange, fine to medium grained sand	40.0		D	0.6	
					0.8	pp=500
1	SANDSTONE (DW) - very low to low strength, grey and yellow, fine to medium grained			D	1.1	Is(50)=0.1(i)
					1.2	
	End of Test Pit at 1.4 m (Refusal)	39.0				
2						
		38.0				
3						
		37.0				
4						
		36.0				
5						

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19.01.11

TEST PIT REPORT



Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 36

Page No: 1 of 1

Date: 16 February 2011

Ground Surface Level: RL41.7m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	41.7			0.1	
				D	0.4	
					0.5	
	SILTY CLAY (CH) - stiff, grey and orange, fine grained sand	41.0		D	0.7	pp=250
1						
	SANDY CLAY (CI) - very stiff, grey and orange, fine to medium grained sand	40.0		D	1.5	
2					1.8	pp=350
3		39.0				
	End of Test Pit at 3.2 m					
4		38.0				
5		37.0				

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19.01.11

TEST PIT REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

TEST PIT 37

Page No: 1 of 1

Date: 16 February 2011

Ground Surface Level: RL46.0m*

Depth (m)	Description	RL (m)	Lithology	Sample Type	Depth (m)	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	46.0			0.0	pp=200 Is(50)=0.3(i)
	SANDY CLAY (CI) - stiff, yellow and orange, fine to medium grained sand			D	0.3	
	SANDSTONE (DW) - low to medium strength, grey and yellow, fine to medium grained			D/B	0.6	
					0.7	
1		45.0		D	0.9	
	End of Test Pit at 1.3 m (Refusal)					
2		44.0				
3		43.0				
4		42.0				
5		41.0				

D Disturbed Sample

E Environmental Sample

pp Pocket Penetrometer Test (kPa)

B Bulk Sample

U Undisturbed Tube (50mm diameter)

Is(50) Point Load Test Result (MPa)

V Vane Shear Strength (Uncorrected)kPa

Rig: Case 580

Bucket Size: 600mm

Groundwater: No free groundwater encountered during excavation

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19.01.11

BORE REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

BORE 38

Page No: 1 of 1

Date: 2 February 2011

Ground Surface Level: RL65.2m*

Depth (m)	Description	RL (m)	Lithology	Structures	Average Number of Defects/m	Sample Type	Sample Depth (m)	Is(50) (MPa)	Core Recovery (%)	RQD (%)	Sample ID	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	65.2				D	0.0					
	SANDY CLAY (CI) - very stiff, grey, yellow, fine to medium grained sand			0.6m, J, 40, vil, Cl, 2mm 0.8m to 1.4m, B, 10, vil, Cl, 5-7mm 0.9m, J, 50, vil, Cl, 2mm			0.15					
	SANDSTONE (DI) - low strength, grey-brown, grey and yellow, fine to medium grained - very high strength	64.0		1.7m, J, 40, vil, Cl, 4mm 1.9m, J, 40, vil, clean, 2mm 2.14m, B, 20, vil, Cl, 10mm 2.3m, B, 20, vil, clean, 2mm 2.55m, B, 30, vil, clean, 2mm 2.64m, J, 50, vil, Cl, 10mm	8	C	0.8	4.4(d) 3.0(a)	100	40		
2		63.0			4	C	1.7 1.8	4.6(d) 4.5(a)				
3		62.0		3.15m, B, 30, vil, Cl, 4mm 3.2m to 8.2m, B, 10-20, vil, clean, 1-2mm			2.95	4.4(d) 4.0(a)	100	75		
4	- high strength, with interbedded conglomerate bands	61.0		3.7m, J, 50, vil, Cl, 1mm	4	C	3.6	3.4(d) 3.1(a)	100	77		
5		60.0		5.1m, crush zone, 10mm 5.4m, crush zone, 10mm	5	C	4.7 4.8	2.4(d) 2.0(a)				
6		59.0					5.2	1.1(d) 1.9(a)	100	53		
7		58.0			1	C	6.2					
	SANDSTONE (SW) - medium strength, grey and yellow, fine to medium grained - grey	57.0		7.37m, B, 10, vil, clean, <1mm			6.95	0.9(d) 0.7(d)	100	99		
8	End of Bore at 8 m				0	C	7.7 7.8 8.0	1.0(d) 0.8(a)	100	100		

U Undisturbed Tube Sample (50mm dia)	S Standard Penetration Test (SPT)	E Environmental Sample	Is(50) Point Load Test Result (MPa)
D Disturbed Sample	HB SPT Hammer Bouncing	Up Push tube Sample	(d) Diametral Test
B Bulk Sample	() No Sample Recovery	C NMLC Coring	(a) Axial Test
pp Pocket Penetrometer Test (kPa)	V Vane Shear Strength, Uncorrected (kPa)		(l) Lump Test

Rig: Jacro 350

Drilling Method: Auger to 0.5m, casing to 0.5m, then NMLC core to 8.0m

Groundwater: No free groundwater encountered during auger drilling

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19.01.11

BORE REPORT

**BUTLER
PARTNERS**

Client: SHD Services Pty Ltd

Project: Residential Subdivision - Lots 1 to 11

Location: Cnr Ripley & Fischer Roads, Ripley Valley

Project No: 010-218B

BORE 39

Page No: 1 of 1

Date: 1 February 2011

Ground Surface Level: RL53.6m*

Depth (m)	Description	RL (m)	Lithology	Structures	Average Number of Defects/m	Sample Type	Sample Depth (m)	Is(50) (MPa)	Core Recovery (%)	RQD (%)	Sample ID	Test Results
0	SILTY SAND (SM) - grey-brown, fine to medium grained sand	53.6					0.0					pp>500
						D	0.2					
							0.5					
						U	0.7					
1	SANDY CLAY (CI) - very stiff, grey, yellow and orange, fine to medium grained sand	53.0										pp>500
	- hard, grey-brown, grey and yellow, fine to medium grained sand, with (XW) sandstone bands											
	SANDSTONE (DW) - low strength, grey and yellow, fine to medium grained											
2		52.0										
2				2.05m,B,10,vii,(XW) rock,4mm			2.0					pp>500
				2.35m,B,10,vii,(XW) rock,5mm			2.2	0.2(d) 0.1(a)				
				2.45m,B,10,vii,Ci,100mm								
		51.0			3	C			100	76		
				2.88m,B,10,vii,Ci,40mm								
3	- low to medium strength											pp>500
							3.1	0.8(d) 0.6(a)				
	- medium strength, grey-brown, grey and yellow, with interbedded conglomerate bands						3.3					
		50.0		3.58m,B,10,vii,clear,2mm								
				3.85m to 3.94m,J,80,vii,Ci,2mm			3.7	0.4(d) 0.3(a)	100	80		
4				4.09m,B,10,vii,clear,2mm	3	C						pp>500
				4.47m,B,10,vii,clear,2mm			4.4	0.6(d)				
		49.0		4.9m,B,10,vii,clear,2mm			4.8	0.1(a)				
5	- medium to high strength			5.3m,B,10,vii,Ci,10mm			5.4	1.0(d) 0.5(a)	100	93		
		48.0		5.63m,B,10,vii,Ci,10mm	2	C						
6	SANDSTONE (SW) - high strength, grey and yellow, fine to medium grained						6.3					pp>500
							6.6	1.3(d)				
		47.0					6.85	1.3(a)				
7	- low to medium strength, grey-brown, grey and yellow			7.3m,B,15,vii,clear,1mm	1	C			100	94		
		46.0		7.7m,B,10,vii,clear,1mm			7.65 7.7 7.9	0.6(d) 0.2(a)				
8	End of Bore at 7.9 m											pp>500
		45.0										

U	Undisturbed Tube Sample (50mm dia)	S	Standard Penetration Test (SPT)	E	Environmental Sample	Is(50)	Point Load Test Result (MPa)
D	Disturbed Sample	HB	SPT Hammer Bouncing	Up	Push tube Sample	(d)	Diametral Test
B	Bulk Sample	()	No Sample Recovery	C	NMLC Coring	(a)	Axial Test
pp	Pocket Penetrometer Test (kPa)	V	Vane Shear Strength, Uncorrected (kPa)			(i)	Lump Test

Rig: Jacro 350

Drilling Method: Auger to 1.25m, casing to 1.25m, rock roller to 2.0m, then NMLC core to 7.9m

Groundwater: No free groundwater encountered during auger drilling

Remarks: *Approximate reduced level interpolated from unreferenced Drawing No. 364900AS 'Proposal Plan Ext2'.dwg, received on 19.01.11

Notes on Description and Classification of Soil

The methods of description and classification of soils used in this report are generally based on Australian Standard AS1726-1993 *Geotechnical Site Investigations*.

Soil description is based on an assessment of disturbed samples, as recovered from bores and excavations, or from undisturbed materials as seen in excavations and exposures or in undisturbed samples. Descriptions given on report sheets are an interpretation of the conditions encountered at the time of investigation.

In the case of cone or piezocone penetrometer tests, actual soil samples are not recovered and soil description is inferred based on published correlations, past experience and comparison with bore and/or test pit data (if available).

Soil classification is based on the particle size distribution of the soil and the plasticity of the portion of the material finer than 0.425mm. The description of particle size distribution and plasticity is based on the results of visual field estimation, laboratory testing or both. When assessed in the field, the properties of the soil are estimated; precise description will always require laboratory testing to define soil properties.

Where soil can be clearly identified as FILL this will be noted as the main soil type followed by a description of the composition of the fill (e.g. FILL – yellow-brown, fine to coarse grained gravelly clay fill with concrete rubble). If the soil is assessed as possibly being fill this will be noted as an additional observation.

Soils are generally described using the following sequence of terms. In certain instances, not all of the terms will be included in the soil description.

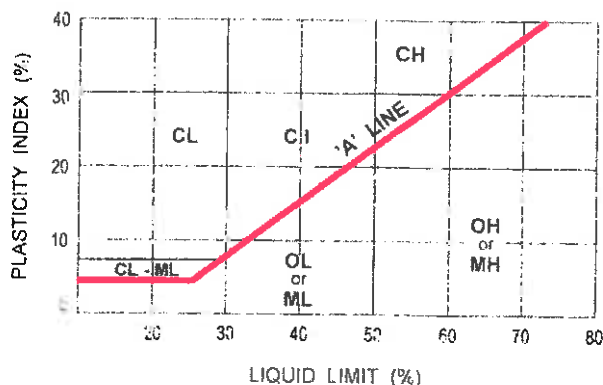
MAIN SOIL TYPE (CLASSIFICATION GROUP SYMBOL)

- strength/density, colour, structure/grain size, secondary and minor components, additional observations

Information on the definition of descriptive and classification terms follows.

SOIL TYPE and CLASSIFICATION GROUP SYMBOLS

	Major Divisions	Particle Size	Classification Group Symbol	Typical Names
COARSE GRAINED SOILS (more than half of material is larger than 0.075 mm)	BOULDERS	> 200mm		
	COBBLES	63 – 200mm		
	GRAVELS (more than half of coarse fraction is larger than 2.36mm)	Coarse: 20 – 63mm Medium: 6 – 20mm Fine: 2.36 – 6mm	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines, uniform gravels.
			GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (more than half of coarse fraction is smaller than 2.36mm)	Coarse: 0.6 – 2.36mm Medium: 0.2 – 0.6mm Fine: 0.075 – 0.2mm	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands.
			SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS (more than half of material is smaller than 0.075 mm)	SILTS & CLAYS (liquid limit <50%)		ML	Inorganic silts and very fine sands, silty/clayey fine sands or clayey silts with low plasticity.
			CL and CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS & CLAYS (liquid limit >50%)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils.
			CH	Inorganic clays of high plasticity.
			OH	Organic clays of medium to high plasticity, organic silts.
	HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.

PLASTICITY CHART FOR CLASSIFICATION OF FINE GRAINED SOILS

(Reference: Australian Standard AS1726-1993 *Geotechnical site investigations*)

DESCRIPTIVE TERMS FOR MATERIAL PROPORTIONS

Coarse Grained Soils		Fine Grained Soils	
% Fines	Modifier	% Coarse	Modifier
< 5	Omit, or use 'trace'	< 15	Omit, or use trace.
5 – 12	Describe as 'with clay/silt' as applicable.	15 – 30	Describe as 'with sand/gravel' as applicable.
> 12	Prefix soil as 'silty/clayey' as applicable	> 30	Prefix soil as 'sandy/gravelly' as applicable.

STRENGTH TERMS – COHESIVE SOILS

Strength Term	Undrained Shear Strength	Field Guide to Strength
Very soft	< 12kPa	Exudes between the fingers when squeezed in hand.
Soft	12 – 25kPa	Can be moulded by light finger pressure.
Firm	25 – 50kPa	Can be moulded by strong finger pressure.
Stiff	50 – 100kPa	Cannot be moulded by fingers, can be indented by thumb.
Very stiff	100 – 200kPa	Can be indented by thumb nail.
Hard	> 200kPa	Can be indented with difficulty by thumb nail.

DENSITY TERMS – NON COHESIVE SOILS

Density Term	Density Index	SPT 'N'	CPT Cone Resistance
Very loose	< 15%	0 – 5	0 – 2MPa
Loose	15 – 35%	5 – 10	2 – 5MPa
Medium dense	35 – 65%	10 – 30	5 – 15MPa
Dense	65 – 85%	30 – 50	15 – 25MPa
Very dense	> 85%	> 50	> 25MPa

COLOUR

The colour of a soil will generally be described in a 'moist' condition using simple colour terms (eg. black, grey, red, brown etc.) modified as necessary by "pale", "dark", "light" or "mottled". Borderline colours will be described as a combination of colours (eg. grey-brown).

EXAMPLE

e.g. CLAYEY SAND (SC) – medium dense, grey-brown, fine to medium grained with silt.

Indicates a medium dense, grey-brown, fine to medium grained clayey sand with silt.

Notes on Description and Classification of Rock

The methods of description and classification of rock used in this report are generally based on Australian Standard AS1726-1993 *Geotechnical site investigations*.

Rock description is based on an assessment of disturbed samples, as recovered from bores and excavations, or from undisturbed materials as seen in excavations and exposures, or in core samples. Descriptions given on report sheets are an interpretation of the conditions encountered at the time of investigation.

Notes outlining the method and terminology adopted for the description of rock defects are given below, however, detailed information on defects can generally only be determined where rock core is taken, or excavations or exposures allow detailed observation and measurement.

Rocks are generally described using the following sequence of terms. In certain instances not all of the terms will be included in the rock description.

ROCK TYPE (WEATHERING SYMBOL), strength, colour, grain size, defect frequency

Information on the definition of descriptive and classification terms follows.

ROCK TYPE

In general, simple rock names are used rather than precise geological classifications.

ROCK MATERIALS WEATHERING CLASSIFICATION

Term	Weathering Symbol	Definition
Residual soil	RS	Soil developed from extremely weathered rock; the mass structure and substance fabrics are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely weathered	XW	Rock is weathered to such an extent that it has 'soil' properties, i.e. it either disintegrates or can be remoulded in water.
Distinctly weathered *	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
- Highly weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock, usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
- Moderately weathered	MW	Rock substance affected by weathering to the extent that staining extends throughout the whole of the rock substance and the original colour of the fresh rock may be no longer recognisable.
Slightly weathered	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh	FR	Rock shows no sign of decomposition or staining.

* Subdivision of this weathering grade into highly and moderately may be used where applicable.

STRENGTH OF ROCK MATERIAL

Term	Symbol	Point Load Index I_p (50)	Field Guide To Strength
Extremely low	EL	<0.03MPa	Easily remoulded by hand to a material with soil properties.
Very low	VL	0.03 – 0.1MPa	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30mm thick can be broken by finger pressure.
Low	L	0.1 – 0.3MPa	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	M	0.3 – 1.0MPa	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High	H	1.0 – 3.0MPa	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very high	VH	3.0 – 10.0MPa	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely high	EH	>10MPa	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Notes:

- These terms refer to the strength of the rock material and not to the strength of the rock mass which may be considerably weaker due to the effect of rock defects.
- The field guide visual assessment for rock strength may be used for preliminary assessment or when point load testing is not available.
- Anisotropy of rock may affect the field assessment of strength.

COLOUR

The colour of a rock will generally be described in a 'moist' condition using simple colour terms (e.g. black, grey, red, brown, etc) modified as necessary by 'pale', 'dark', 'light' or 'mottled'. Borderline colours will be described as a combination of colours (e.g. grey-brown).

GRAIN SIZE

Descriptive Term	Particle Size Range
Coarse grained	0.6 – 2.0mm
Medium grained	0.2 – 0.6mm
Fine grained	0.06 – 0.2mm

DEFECT FREQUENCY

Where appropriate, a defect frequency may be recorded as part of the rock description and will be expressed as the number of natural (or interpreted natural) defects present in an equivalent one metre length of core; by use of the following defect frequency descriptive terms; or both. The descriptive terms refer to the spacing of all types of natural defects along which the rock is discontinuous and include, bedding plane partings, joints and other rock defects, but excludes known artificial fractures such as drilling breaks.

Defect Frequency	Description
Fragmented	Rock core is comprised primarily of fragments of length less than 20mm, and mostly of width less than the core diameter.
Highly Fractured	Core lengths are generally less than 20mm to 40mm with occasional fragments.
Fractured	Core lengths are mainly 30mm to 100mm with occasional shorter and longer sections.
Fractured to Slightly Fractured	Core lengths are mainly 100mm to 300mm with occasional shorter to longer sections.
Slightly Fractured	Core lengths are generally 300mm to 1,000mm with occasional longer sections and occasional sections of 100mm to 300mm.
Unbroken	The core does not contain any fractures.

EXAMPLE

e.g. SANDSTONE (XW) – low strength, pale brown, fine to coarse grained, slightly fractured.

ROCK DEFECT LOGGING

Defects are discontinuities in the rock mass and include joints, sheared zones, cleavages and bedding partings. The ability to observe and log defects will depend on the investigation methodology. Defects logged in core are described using the abbreviations noted in the following tables.

The *depth* noted in the description is measured in metres from the ground surface, the *defect angle* is measured in degrees from horizontal, and the defect *thickness* is measured normal to the plane of the defect and is in millimetres (unless otherwise noted).

Defects are generally described using the following sequence of terms:

Depth, Defect Type, Defect Angle (dip), Surface Roughness, Infill, Thickness

DEFECT TYPE

B	– Bedding
J	– Joint
S	– Shear Zone
C	– Crushed Zone

SURFACE ROUGHNESS

i	- rough or irregular, stepped
ii	- smooth, stepped
iii	- slickensided, stepped
iv	- rough or irregular, undulating
v	- smooth, undulating
vi	- slickensided, undulating
vii	- rough or irregular, planar
viii	- smooth planar
ix	- slickensided, planar

INFILL

Infill refers to secondary minerals or other materials formed on the surface of the defect and some common descriptions are given in the following table together with their abbreviations.

Ls	- limonite staining
Fe	- iron staining
Cl	- clay
Mn	- manganese staining
Qtz	- quartz
Ca	- calcite
Clean	- no visible infill

EXAMPLE

3.59m, J, 90, vii, Ls, 1mm

indicates a joint at 3.59m depth that is at 90° to horizontal (i.e. vertical), is rough or irregular and planar, limonite stained and 1mm thick.

*Residential Subdivision - Lots 1 to 11
Cnr Ripley & Fischer Roads, Ripley Valley
Project No. 010-218B
23 March 2011*

APPENDIX B

LABORATORY TEST RESULTS SHEETS

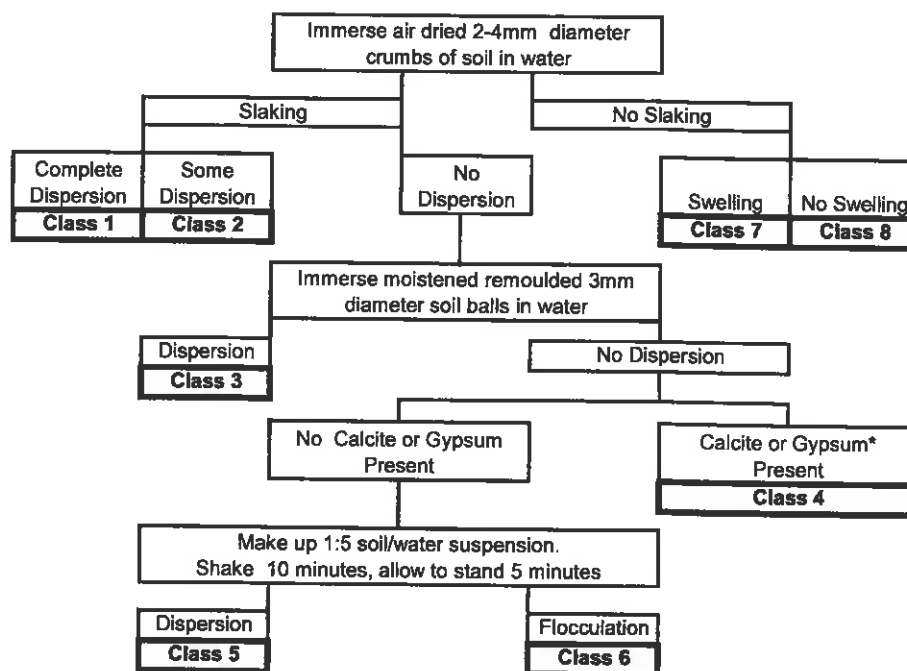
**EMERSON CLASS NUMBER,**

Test Procedure: AS1289.3.8.1 - 2006

**CONDUCTIVITY and
pH TEST REPORT**

Test Procedure: AS1289.4.3.1 - 1997

Client:	SHD Services Pty Ltd	Tested by:	JR/MH
Project:	Residential Subdivision - Lots 1 to 11	Date:	14/02/11
Location:	Cnr Ripley & Fischer Roads, Ripley Valley	Checked by:	MH
Project No.:	010-218B	Date:	15/02/11
		Report No.:	010-218B_EC_N TP1_1

Determination of Emerson Class Number

Test Number	TP1_1	TP1_2	TP11_1	TP11_2	TP18_1
Test Pit Number and Depth	TP1 0.0-0.2m	TP2 0.4-0.5m	TP11 0.0-0.2m	TP11 0.5-0.7m	TP18 0.4-0.6m
Source	In Situ	In Situ	In Situ	In Situ	In Situ
Date Sampled	24/01/11	24/01/11	24/01/11	24/01/11	24/01/11
Material Description	Silty Sand (SM) grey brown	Sandy Clay (CI) grey, yellow & orange	Silty Sand (SM) grey brown	Clayey Sand (SC) grey, yellow & orange	Sandy Clay (CI) grey, yellow & orange
Water Type (distilled, potable, site)	Distilled	Distilled	Distilled	Distilled	Distilled
Water Temperature (°C)	22	22	22	22	22
Emerson Class Number	3	2	3	2	2
Conductivity (mS/cm)	0.04	0.37	0.04	0.20	0.14
pH	5.6	7.2	5.4	4.7	4.9

**PARTICLE SIZE DISTRIBUTION TEST REPORT**

Test Procedure: AS1289.3.6.1 – 2009

Test Procedure: AS1289.2.1.1 – 2005

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Client:	SHD Services Pty Ltd	Tested by:	JR
Project:	Residential Subdivision – Lots 1 to 11	Date:	11/02/11
Location:	Cnr Ripley & Fischer Roads, Ripley Valley	Checked by:	MH
Project No.:	010-218B	Date:	15/02/11
		Report No.:	010-218B PSD_TP1_1

Sample No.:	010-218B_TP1_1
Test Pit:	1
Depth (m):	0.0-0.2
Sample Moisture Content (%):	11.9

AS SIEVE SIZE (mm)	PERCENT PASSING
75.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	100
1.18	98
0.600	96
0.425	91
0.300	76
0.150	42
0.075	30

Sample No.:	010-218B_TP1_2
Test Pit:	1
Depth (m):	0.4-0.6
Sample Moisture Content (%):	10.1

AS SIEVE SIZE (mm)	PERCENT PASSING
75.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	100
1.18	97
0.600	94
0.425	88
0.300	82
0.150	71
0.075	53
	46

**PARTICLE SIZE DISTRIBUTION TEST REPORT**

Test Procedure: AS1289.3.6.1 – 2009

Test Procedure: AS1289.2.1.1 – 2005

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Client:	SHD Services Pty Ltd	Tested by:	JR
Project:	Residential Subdivision – Lots 1 to 11	Date:	11/02/11
Location:	Cnr Ripley & Fischer Roads, Ripley Valley	Checked by:	MH
Project No:	010-218B	Date:	15/02/11
		Report No.:	010-218B_PSD_TP11_2

Sample No.:	010-218B_TP11_2
Test Pit:	11
Depth (m):	0.5-0.7
Sample Moisture Content (%):	16.8

AS SIEVE SIZE (mm)	PERCENT PASSING
75.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	100
1.18	99
0.600	96
0.425	90
0.300	72
0.150	39
0.075	27

Sample No.:	010-218B_TP18_1
Test Pit:	18
Depth (m):	0.4-0.6
Sample Moisture Content (%):	14.9

AS SIEVE SIZE (mm)	PERCENT PASSING
75.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	
1.18	100
0.600	98
0.425	95
0.300	86
0.150	57
0.075	48

ATTERBERG LIMITS TEST REPORT

Test Procedure: AS1289.2.1.1 - 2005

Test Procedure: AS1289.3.1.2 - 2009

Test Procedure: AS1289.3.2.1 - 2009

Test Procedure: AS1289.3.3.1 - 2009

Test Procedure: AS1289.3.4.1 - 2008

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Client:	SHD Services Pty Ltd	Tested by:	MH
Project:	Residential Subdivision - Lots 1 to 11	Date:	14/02/11
Location:	Cnr Ripley & Fischer Roads, Ripley Valley	Checked by:	MH
Project No.:	010-218B	Date:	15/02/11
		Report No.:	010-218B_ATL_TP2_1

Sample No.:	010-218B_TP2_1
Test Pit:	2
Depth (m):	0.4-0.5

Liquid Limit (%)	41
Plastic Limit (%)	13
Plasticity Index (%)	28
Linear Shrinkage (%)	14.0+
Sample Moisture Content (%)	12.1

Remarks: The sample was tested, oven dried, dry sieved and tested in a 249mm mould.

* Crumbling occurred

+ Curling occurred

Sample No.:	010-218B_TP6_1
Test Pit:	6
Depth (m):	0.4-0.6

Liquid Limit (%)	40
Plastic Limit (%)	14
Plasticity Index (%)	26
Linear Shrinkage (%)	11.0+
Sample Moisture Content (%)	13.8

Remarks: The sample was tested, oven dried, dry sieved and tested in a 249mm mould.

* Crumbling occurred

+ Curling occurred

**SHRINK-SWELL INDEX TEST REPORT**

Test Procedure: AS1289.7.1.1 – 2003

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Client:	SHD Services Pty Ltd	Tested by:	MH
Project:	Residential Subdivision – Lots 1 to 11	Date:	03/02/01
Location:	Cnr Ripley & Fischer Roads,	Checked by:	MH
	Ripley Valley	Date:	15/02/11
Project No.:	010-218B	Report No.:	010-218B_SSI_39_1

Sample No.:	010-218B_39_1
Bore:	39
Depth (m):	0.5-0.7
Specimen Description	Sandy Clay (CI)
Specimen Shrinkage (%) ϵ_{sh}	2.8
Specimen Swell (%) ϵ_{sw}	0.6
Estimated Inert inclusions (%)	0
Initial Moisture content of swell specimen (%)	11.1
Final moisture content of swell specimen (%)	14.3
Initial moisture content of shrinkage specimen (%)	11.6
Extent of cracking of shrinkage specimen	Slight
 Shrink-Swell Index (% per pF) I_{ss}	 1.7

**SHRINK-SWELL INDEX TEST REPORT**

Test Procedure: AS1289.7.1.1 – 2003

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Client:	SHD Services Pty Ltd	Tested by:	MH
Project:	Residential Subdivision – Lots 1 to 11	Date:	22/02/01
Location:	Cnr Ripley & Fischer Roads, Ripley Valley	Checked by:	MH
Project No.:	010-218B	Date:	24/02/11
		Report No.:	010-218B_SSI_TP13_1

Sample No.:	010-218B_TP13_1
Test Pit:	13
Depth (m):	0.4-0.6
Specimen Description	Sandy Clay (CI)
Specimen Shrinkage (%) ϵ_{sh}	4.1
Specimen Swell (%) ϵ_{sw}	0.7
Estimated Inert inclusions (%)	0
Initial Moisture content of swell specimen (%)	19.5
Final moisture content of swell specimen (%)	24.8
Initial moisture content of shrinkage specimen (%)	22.5
Extent of cracking of shrinkage specimen	Slight
Shrink-Swell Index (% per pF) I_{ss}	2.5

**SHRINK-SWELL INDEX TEST REPORT**

Test Procedure: AS1289.7.1.1 – 2003

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Client:	SHD Services Pty Ltd	Tested by:	MH
Project:	Residential Subdivision – Lots 1 to 11	Date:	22/02/01
Location:	Cnr Ripley & Fischer Roads, Ripley Valley	Checked by:	MH
Project No.:	010-218B	Date:	24/02/11
		Report No.:	010-218B_SSI_TP21_1

Sample No.:	010-218B_TP21_1
Test Pit:	21
Depth (m):	0.6-0.8
Specimen Description	Sandy Clay (CI)
Specimen Shrinkage (%) ϵ_{sh}	2.0
Specimen Swell (%) ϵ_{sw}	0.1
Estimated Inert inclusions (%)	0
Initial Moisture content of swell specimen (%)	13.6
Final moisture content of swell specimen (%)	14.5
Initial moisture content of shrinkage specimen (%)	14.4
Extent of cracking of shrinkage specimen	Slight
 Shrink-Swell Index (% per pF) I_{ss}	 1.1

**SHRINK-SWELL INDEX TEST REPORT**

Test Procedure: AS1289.7.1.1 – 2003

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Client:	SHD Services Pty Ltd	Tested by:	MH
Project:	Residential Subdivision – Lots 1 to 11	Date:	22/02/01
Location:	Cnr Ripley & Fischer Roads, Ripley Valley	Checked by:	MH
Project No.:	010-218B	Date:	24/02/11
		Report No.:	010-218B_SSI_TP22_1

Sample No.:	010-218B_TP22_1
Test Pit:	22
Depth (m):	0.5-0.7
Specimen Description	Sandy Clay (Cl)
Specimen Shrinkage (%) ϵ_{sh}	2.9
Specimen Swell (%) ϵ_{sw}	1.0
Estimated Inert inclusions (%)	0
Initial Moisture content of swell specimen (%)	17.5
Final moisture content of swell specimen (%)	20.3
Initial moisture content of shrinkage specimen (%)	18.5
Extent of cracking of shrinkage specimen	Slight
Shrink-Swell Index (% per pF) I_{ss}	1.9

**SHRINK-SWELL INDEX TEST REPORT**

Test Procedure: AS1289.7.1.1 – 2003

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Client:	SHD Services Pty Ltd	Tested by:	MH
Project:	Residential Subdivision – Lots 1 to 11	Date:	22/02/01
Location:	Cnr Ripley & Fischer Roads,	Checked by:	MH
	Ripley Valley	Date:	24/02/11
Project No.:	010-218B	Report No.:	010-218B_SSI_TP30_1

Sample No.:	010-218B_TP30_1
Test Pit:	30
Depth (m):	0.6-0.8
Specimen Description	Sandy Clay (Cl)
Specimen Shrinkage (%) ϵ_{sh}	2.1
Specimen Swell (%) ϵ_{sw}	0.4
Estimated Inert inclusions (%)	0
Initial Moisture content of swell specimen (%)	11.8
Final moisture content of swell specimen (%)	14.5
Initial moisture content of shrinkage specimen (%)	12.1
Extent of cracking of shrinkage specimen	Slight
Shrink-Swell Index (% per pF) I_{ss}	1.3



Quality
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California Bearing Ratio Test Report

Report No: 010-218B-GC/11/1 - CBR
Issue No.: 1
Lab No: 010-218B-GC/11/1

Client: SHD Services Pty Ltd
Project: Residential Subdivision - Lots1 to 11
Location: Cnr Ripley & Fischer Roads, Ripley Valley
Project No: 010-218B
Test Pit: 5
Depth: 0.5m - 0.7m

Date of Issue: 07/02/11

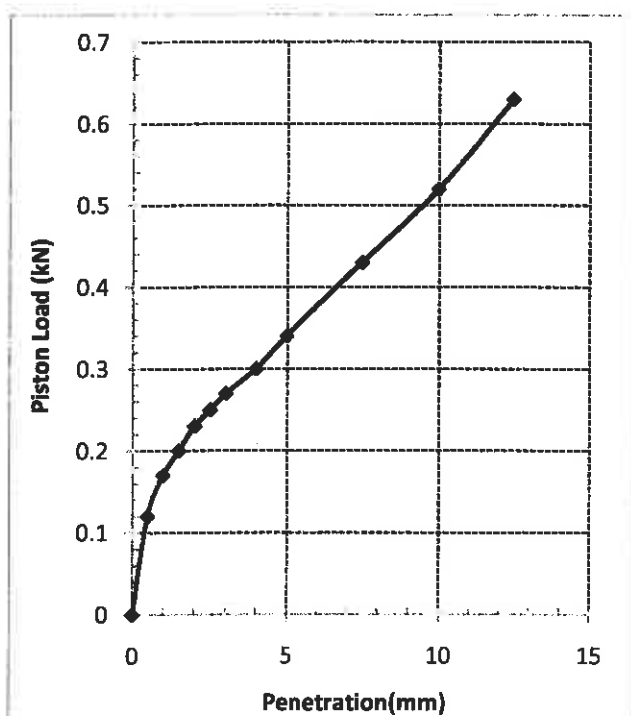
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Sample Details

Sampled by: MH
Sampling Method: AS1289.1.2.1-1998 Clause 6.5.4
Source: Insitu
Date Sampled: 24/01/11

Material: Sandy Clay
Tested by: IM
Date Tested: 01/02/11
Test Method: AS1289.6.1.1 -1998

Load vs Penetration



Test Results

SOAKED CBR (at 2.5mm): 2.0%

Maximum Dry Density (t/m^3): -
Optimum Moisture Content (%): -
Dry Density Before Soaking (t/m^3): 1.76
Dry Density Ratio Before Soaking (%): -
Moisture Content Before Soaking (%): 13.3
Moisture Ratio Before Soaking (%): -
Compactive Effort: Standard
Period of Soaking (Days): 4
Swell During Soaking (%): 3.5
Moisture Content of Top 30mm After Soaking (%): 21.1
Moisture Content of Remaining Depth After Soaking (%): 15.9
Surcharge Mass (kg): 4.5

Oversize Materials

Retained 19mm Sieve (wet mass) (%): 0
Oversize Material Excluded/Replaced: N/A

Comments

Sample compacted at estimated optimum moisture content (13.3%) using Standard compactive effort.

Moisture content of sample at time of sampling was 14.1%.



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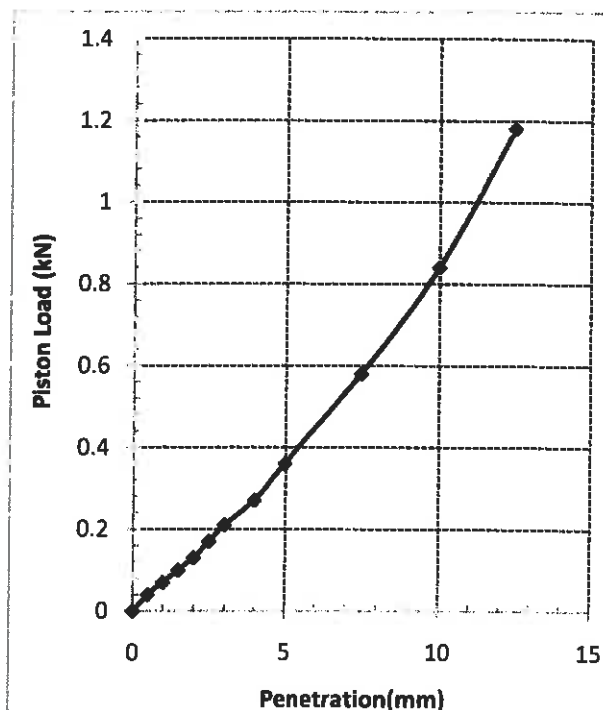
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California Bearing Ratio Test Report		Report No:	010-218B-GC/11/2 - CBR
		Issue No.:	1
		Lab No:	010-218B-GC/11/2
Client:	SHD Services Pty Ltd	Date of Issue: 07/02/11	
Project:	Residential Subdivision - Lots 1 to 11		
Location:	Cnr Ripley & Fischer Roads, Ripley Valley		
Project No:	010-218B		
Test Pit:	8	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL	
Depth:	0.2m - 0.5m		

Sample Details

Sampled by:	MH	Material:	Sandy Clay
Sampling Method:	AS1289.1.2.1-1998 Clause 6.5.4	Tested by:	IM
Source:	Insitu	Date Tested:	01/02/11
Date Sampled:	24/01/11	Test Method:	AS1289.6.1.1 -1998

Load vs Penetration



Test Results

SOAKED CBR (at 5.0mm): **2.0%**

Maximum Dry Density (t/m^3):	-
Optimum Moisture Content (%):	-
Dry Density Before Soaking (t/m^3):	1.81
Dry Density Ratio Before Soaking (%):	-
Moisture Content Before Soaking (%):	14.4
Moisture Ratio Before Soaking (%):	-
Compactive Effort:	Standard
Period of Soaking (Days):	4
Swell During Soaking (%):	2.5
Moisture Content of Top 30mm After Soaking (%):	22.6
Moisture Content of Remaining Depth After Soaking (%):	15.4
Surcharge Mass (kg):	4.5

Oversize Materials

Retained 19mm Sieve (wet mass) (%):	0
Oversize Material Excluded/Replaced:	N/A

Comments

Sample compacted at estimated optimum moisture content (14.4%) using Standard compactive effort.

Moisture content of sample at time of sampling was 13.5%.



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California Bearing Ratio Test Report		Report No:	010-218B-GC/11/3 - CBR
		Issue No.:	1
		Lab No:	010-218B-GC/11/3
Client:	SHD Services Pty Ltd	Date of Issue: 10/03/11	
Project:	Residential Subdivision - Lots 1 to 11		
Location:	Cnr Ripley & Fischer Roads, Ripley Valley		
Project No:	010-218B		
Test Pit:	16	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL	
Depth:	0.5m to 0.8m		

Sample Details			
Sampled by:	MH	Material:	Sandy Clay
Sampling Method:	AS1289.1.2.1-1998 Clause 6.5.4	Tested by:	JR
Source:	Insitu	Date Tested:	04/03/11
Date Sampled:	17/02/11	Test Method:	AS1289.6.1.1 -1998

Load vs Penetration		Test Results	
		SOAKED CBR (at 2.5mm):	
		4.5%	
		Maximum Dry Density (t/m^3):	-
		Optimum Moisture Content (%):	-
		Dry Density Before Soaking (t/m^3):	1.63
		Dry Density Ratio Before Soaking (%):	-
		Moisture Content Before Soaking (%):	22.0
		Moisture Ratio Before Soaking (%):	-
		Compactive Effort:	Standard
		Period of Soaking (Days):	4
		Swell During Soaking (%):	2.0
		Moisture Content of Top 30mm After Soaking (%):	28.2
		Moisture Content of Remaining Depth After Soaking (%):	23.7
		Surcharge Mass (kg):	4.5
		Upsize Materials	
		Retained 19mm Sieve (wet mass) (%):	0
		Upsize Material Excluded/Replaced:	N/A

Comments

Sample compacted at estimated optimum moisture content (22.0%) using Standard compactive effort.

Moisture content of sample at time of sampling was 25.4%.



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California Bearing Ratio Test Report

Report No: 010-218B-GC/11/4 - CBR
Issue No.: 1
Lab No: 010-218B-GC/11/4

Client: SHD Services Pty Ltd
Project: Residential Subdivision - Lots 1 to 11
Location: Cnr Ripley & Fischer Roads, Ripley Valley
Project No: 010-218B
Test Pit: 28
Depth: 0.2m to 0.8m

Date of Issue: 10/03/11

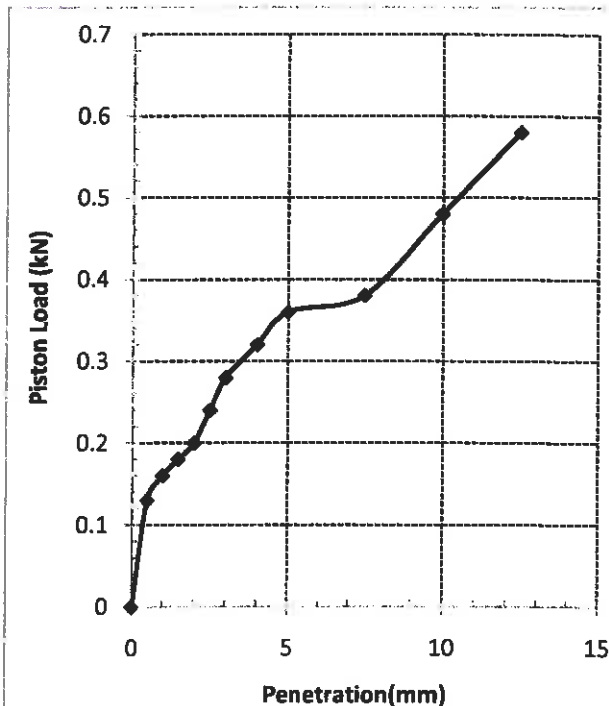
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Sample Details

Sampled by: MH
Sampling Method: AS1289.1.2.1-1998 Clause 6.5.4
Source: Insitu
Date Sampled: 16/02/11

Material: Sandy Clay
Tested by: JR
Date Tested: 04/03/11
Test Method: AS1289.6.1.1 -1998

Load vs Penetration



Test Results

SOAKED CBR (at 5mm): 2.0%

Maximum Dry Density (t/m^3):	-
Optimum Moisture Content (%):	-
Dry Density Before Soaking (t/m^3):	1.83
Dry Density Ratio Before Soaking (%):	-
Moisture Content Before Soaking (%):	11.6
Moisture Ratio Before Soaking (%):	-
Compactive Effort:	Standard
Period of Soaking (Days):	4
Swell During Soaking (%):	3.5
Moisture Content of Top 30mm After Soaking (%):	21.1
Moisture Content of Remaining Depth After Soaking (%):	16.1
Surcharge Mass (kg):	4.5

Override Materials

Retained 19mm Sieve (wet mass) (%):	0
Override Material Excluded/Replaced:	N/A

Comments

Sample compacted at estimated optimum moisture content (11.6%) using Standard compactive effort.

Moisture content of sample at time of sampling was 14.4%.



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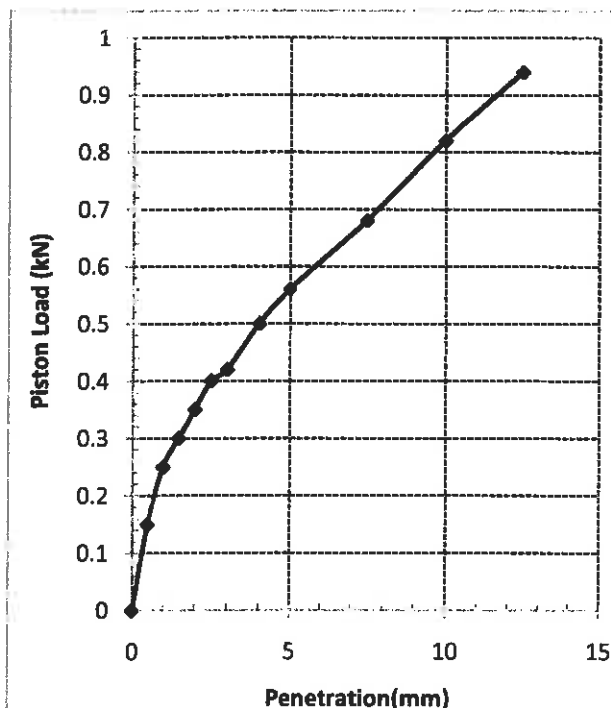
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California Bearing Ratio Test Report		Report No:	010-218B-GC/11/5 - CBR
		Issue No.:	1
		Lab No:	010-218B-GC/11/5
Client:	SHD Services Pty Ltd	Date of Issue: 10/03/11	
Project:	Residential Subdivision - Lots 1 to 11		
Location:	Cnr Ripley & Fischer Roads, Ripley Valley		
Project No:	010-218B		
Test Pit:	37	THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL	
Depth:	0.3m to 0.6m		

Sample Details

Sampled by:	MH	Material:	Sandy Clay
Sampling Method:	AS1289.1.2.1-1998 Clause 6.5.4	Tested by:	JR
Source:	Insitu	Date Tested:	04/03/11
Date Sampled:	16/02/11	Test Method:	AS1289.6.1.1 -1998

Load vs Penetration



Test Results

SOAKED CBR (at 2.5mm):	3.0%
Maximum Dry Density (t/m^3):	-
Optimum Moisture Content (%):	-
Dry Density Before Soaking (t/m^3):	1.67
Dry Density Ratio Before Soaking (%):	-
Moisture Content Before Soaking (%):	20.6
Moisture Ratio Before Soaking (%):	-
Compactive Effort:	Standard
Period of Soaking (Days):	4
Swell During Soaking (%):	2.0
Moisture Content of Top 30mm After Soaking (%):	26.0
Moisture Content of Remaining Depth After Soaking (%):	22.0
Surcharge Mass (kg):	4.5
Upsize Materials	
Retained 19mm Sieve (wet mass) (%):	0
Upsize Material Excluded/Replaced:	N/A

Comments

Sample compacted at estimated optimum moisture content (20.6%) using Standard compactive effort.

Moisture content of sample at time of sampling was 20.7%.



Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	EB1102324	Page	1 of 3
Client	BUTLER PARTNERS PTY LTD	Laboratory	Environmental Division Brisbane
Contact	MR BRUCE BUTLER	Contact	Customer Services
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Telephone	+61 38523800	Telephone	+61 7 3243 7222
Facsimile	+61 07 38523808	Facsimile	+61 7 3243 7218
Project	010-218B	QC Level	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	1683	Date Samples Received	09-FEB-2011
C-O-C number	—	Issue Date	16-FEB-2011
Sampler	Mick Havana	No. of samples received	5
Site	Ripley Valley	No. of samples analysed	5
Quote number	BN/329/10		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results



NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Kim McCabe	Senior Inorganic Chemist	Bne Acid Sulphate Soils



Page : 2 of 3
Work Order : EB1102324
Client : BUTLER PARTNERS PTY LTD
Project : 010-218B

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting

A = This result is computed from individual analyte detections at or above the level of reporting

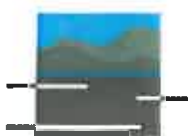
- ANC not required because pH KCl less than 6.5
- Limiting rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO₃) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m³ in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m³'.



Analytical Results

Sub-Matrix: SOIL

Sub-Matrix: SOIL		Client sample ID									
		TP 1		TP 5		TP 1		TP 5		TP 18	
		0.0-0.2m		0.0-0.2m		0.4-0.6m		0.0-0.2m		0.4-0.6m	
		24-FEB-2011 15:00		24-FEB-2011 15:00		24-FEB-2011 15:00		24-FEB-2011 15:00		24-FEB-2011 15:00	
Compound		EB1102324-001		EB1102324-002		EB1102324-003		EB1102324-004		EB1102324-005	
CAS Number	LOR	Unit									
EA033-A: Actual Acidity											
pH KCl (23A)	—	0.1	pH Unit	4.7	6.0	4.5	4.0	4.1			
Titration Actual Acidity (23F)	—	2	mole H+ / t	14	4	12	60	59			
sulfidic - Titration Actual Acidity (a-23F)	—	0.02	% pyrite S	0.02	<0.02	<0.02	0.10	0.09			
EA033-B: Potential Acidity											
Chromium Reducible Sulfur (22B)	—	0.005	% S	<0.005	<0.005	0.007	0.006	<0.005			
acidity - Chromium Reducible Sulfur (a-22B)	—	10	mole H+ / t	<10	<10	<10	<10	<10			
EA033-D: Retained Acidity											
KCl Extractable Sulfur (23Ce)	—	0.02	% S	—	—	—	<0.02	<0.02			
HCl Extractable Sulfur (20Be)	—	0.02	% S	—	—	—	<0.02	<0.02			
Net Acid Soluble Sulfur (20Je)	—	0.02	% S	—	—	—	<0.02	<0.02			
acidity - Net Acid Soluble Sulfur (a-20J)	—	10	mole H+ / t	—	—	—	<10	<10			
sulfidic - Net Acid Soluble Sulfur (a-20J)	—	0.02	% pyrite S	—	—	—	<0.02	<0.02			
EA033-E: Acid Base Accounting											
ANC Fineness Factor	—	0.5	—	1.5	1.5	1.5	1.5	1.5			
Net Acidity (sulfur units)	—	0.02	% S	0.02	<0.02	0.02	0.10	0.09			
Net Acidity (acidity units)	—	10	mole H+ / t	14	<10	16	63	59			
Liming Rate	—	1	kg CaCO3/t	1	<1	1	5	4			



**Sydney
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Specimens in Soil Chemistry, Agronomy,
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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 106 810 708

Sample Drop Off:
16 Chivers Road
Thornleigh NSW 2120
Australia

Mailing Address:
PO Box 357
Pennant Hills NSW 1715

Tel: 02 9980 6554
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Web: www.sesl.com.au



Batch N°: **17205** Sample N°: **1**

Report Status: ☐ Draft ☒ Final

Client Name: **Butler Partners Pty Ltd**

Client Contact: **Mick Havana**

Client Job N°:

Client Order N°:

Address: **PO Box 2267
FORTITUDE VALLEY BC QLD 4006**

Project Name: **Topsoil Testing (0.0 - 0.2M)**

Location: **Ripley Valley**

SESL Quote N°:

Sample Name: **Combination TP5 & TP6**

Description: **Soil**

Test Type: **FSC (M3), OC-DC**

Date Received: **4/2/11**

RECOMMENDATIONS

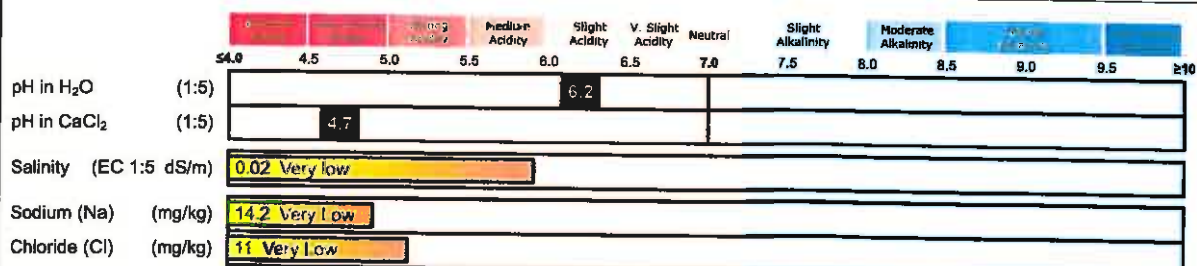
The material was analysed to determine its nutrient status. The pH is slight to very strongly acidic with a high exchangeable acidity (hydrogen + aluminium). Salinity is low which is consistent with a nutrient poor soil. The very low eCEC indicates that this soil has a very poor nutrient retention capacity. Typical of sandy soils. The exchangeable cation percentage shows a dominance of sodium, magnesium and aluminium. Lime and organic matter will help to build the cation exchange capacity of the soil.

Incorporate a recycled organic compost at 20% by volume to the top 150mm. To neutralise the acidity, displace sodium and help address the low calcium levels apply **lime at 150g/sqm (1.5 tone/ha)** and **gypsum at 150g/sqm (1.5 tones/ha)**. To improve nutrients for phosphorus tolerant plant species apply a general purpose NPK fertiliser e.g. **NPK (11:8:15) at 50g/sqm**. For native plant species select a low P NPK fertiliser. Micronutrients are low and can be improved with the addition of a complete trace fertiliser at the manufactures recommended rate. Future maintenance application should consist of a slow release NPK fertiliser due to the low nutrient holding capacity.

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200

FERTILITY RATING: ☐ Low ☒ Moderate ☐ High

pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 5.0
Al only determined if pH in CaCl₂ is ≤ 5.2

Na 15%
High sodicity

Ca 32.5%
Low

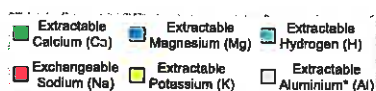
Al 12.5%
High

ACTUAL

Mg 40%
High, magnesian

K 10%
Normal

IDEAL



Na < 5%

Mg 12 - 18%

K 3 - 11%

H < 10%

Al < 1%

Ca 57 - 78%

CATION RATIOS

Ratio	Result	Target Range

Ca:Mg	0.8	4.1 - 6.0

Comment: Potential Calcium deficiency

Mg:K	4	2.6 - 5.0

Comment: Balanced

K/(Ca+Mg)	0.14	< 0.07

Comment: High

K:Na	0.7	N/A

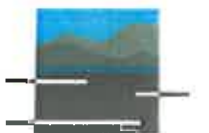
Sodium Absorption Ratio: D.N.T.

Electrochemical Stability Index (ESI):

0 High potential for dispersion and soil structure collapse

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:



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Batch N°: **17205** Sample N°: **1**

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS									
Major Nutrients	Result (mg/kg)	☐ Very Low	☐ Low	☐ Marginal	☐ Adequate	☐ High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	1.5						0.3	4.2	3.9
Phosphate-P (PO ₄)	2.5						0.5	12.6	12.1
Potassium (K)	13.7						2.7	35.5	32.8
Sulphate-S (SO ₄)	4.2						0.8	13.6	12.8
Calcium (Ca)	26.6						5.3	252.8	247.5
Magnesium (Mg)	18.9						3.8	26.7	22.9
Iron (Fe)	340						67.8	110.1	42.3
Manganese (Mn)	0.8						0.2	8.8	8.6
Zinc (Zn)	<0.65						0.1	1	.9
Copper (Cu)	<0.64						0.1	1.3	1.2
Boron (B)	1.4						0.3	0.5	.2

Explanation of graph ranges:

☐ Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

☐ Low

Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

☐ Marginal

Supply of this nutrient is barely adequate for the plant, and build-up still recommended. Potential response to nutrient addition is 30 to 60%.

☐ Adequate

Supply of this nutrient is adequate for the plant, and end only maintenance applications are recommended. Potential response to nutrient addition is 5 to 30%.

☐ High

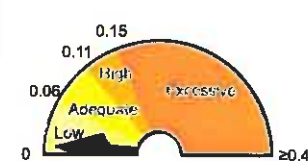
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the Adequate band, which maximises growth/field, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels are Adequate.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): **7.9**
Sum of Base Cations (meq/100g⁻¹): **0.4**
Eff. Cation Exch. Capacity (eCEC): **0.4**
Base Saturation (%): **100**
Exchangeable Acidity (meq/100g⁻¹): **-**
Exchangeable Acidity (%): **-**

Lime Application Rate

- to achieve pH 6.0 (g/sqm): **0**
- to neutralise AI (g/sqm): **7**

Gypsum Application Rate

- to achieve 67.5% exch. Ca (g/sqm): **24**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: **Did not test**
Typical clay content: **Did not test**
Size: **Did not test**
Gravel content: **Did not test**
Aggregate strength: **Did not test**
Structural unit: **Did not test**
Potential infiltration rate: **Did not test**
Permeability (mm/hr): **Did not test**
Calculated EC_{se} (dS/m): **-**

Requires EC and Soil Texture result.

Organic Carbon (OC%): **0.4 - Very low**
Organic Matter (OM%): **0.7**
Additional comments:

Consultant:
Gabriella Navarrete

Authorised Signatory:
Simon Leake

Date of Report:
10 Feb 2011

Disclaimer: Tests are performed under a quality system complying with ISO 9001:2000. Results are based on the analysis of the sample taken or received by SEBL. Due to the variability of sampling procedures, environmental conditions and managerial factors, SEBL does not accept any liability for a lack of performance based on its interpretation and recommendations. This document must not be reproduced except in full.

METHOD REFERENCES:
pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3.v1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SEBL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)

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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sydney Environmental & Soil Laboratory Pty Ltd ABN 70 106 810 708

Sample Drop Off:
16 Chivers Road
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Mailing Address:
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Batch N°: 17205 Sample N°: 2

Report Status: ☐ Draft ☒ Final

Client Name: Butler Partners Pty Ltd
Client Contact: Mick Havana
Client Job N°:
Client Order N°:
Address: PO Box 2267
FORTITUDE VALLEY BC QLD 4006

Project Name: Topsoil Testing (0.0 - 0.2M)
Location: Ripley Valley
SESL Quote N°:
Sample Name: Combination TP11 & TP18
Description: Soil
Test Type: FSC (M3), OC-DC

Date Received: 4/2/11

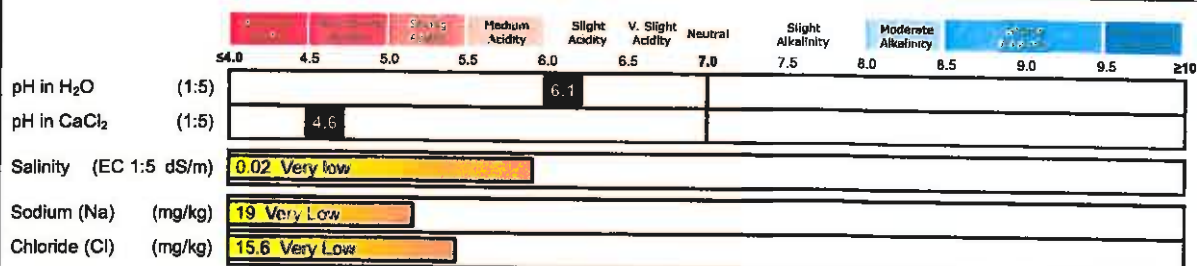
RECOMMENDATIONS

The pH of the combined material has a slight to very strong acidity. As the pH is just above 6.0 hydrogen was not measured, however from the very strong acidity and previous analysis we can predict that exchangeable hydrogen is high. The effective cation exchange capacity of the material is low. Nutrient analysis indicates low fertility with very low levels of nitrogen, phosphorus and potassium. Please refer to sample 1 for amelioration recommendations.

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200

FERTILITY RATING: ☐ Low ☒ Moderate ☐ High

pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ ≤ 5.2

Na 7.3%
Moderate sodicity

Ca 33.6%
Low

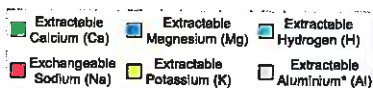
Al 8.2% High

ACTUAL

Mg 47.3%
High, magnesian

K 10.9%
Normal

IDEAL



Ca
57 - 78%

Na < 5%

Mg 12 - 18%

K 3 - 11%

H < 10%

Al < 1%

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	0.7	4.1 - 6.0
Comment: Potential Calcium deficiency		
Mg:K	4.3	2.6 - 5.0
Comment: Balanced		
K/(Ca+Mg)	0.13	< 0.07
Comment: High		
K:Na	1.5	N/A
Sodium Absorption Ratio: D.N.T.		
Electrochemical Stability Index (ESI): 0 High potential for dispersion and soil structure collapse		
SOLUBLE CATIONS (meq/100g)		
Na:	K:	Ca: Mg:



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Batch N°: **17205** Sample N°: **2**

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS									
Major Nutrients	Result (mg/kg)	☐ Very Low	☐ Low	☐ Marginal	☐ Adequate	☐ High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	1.7						0.3	4.2	3.9
Phosphate-P (PO ₄)	0						0	12.6	12.6
Potassium (K)	47.1						9.4	35.5	26.1
Sulphate-S (SO ₄)	4.8						1	13.6	12.6
Calcium (Ca)	73.5						14.7	252.8	238.1
Magnesium (Mg)	63.3						12.6	26.7	14.1
Iron (Fe)	410						81.8	110.1	28.3
Manganese (Mn)	16						3.2	8.8	5.6
Zinc (Zn)	<0.65						0.1	1	.9
Copper (Cu)	<0.64						0.1	1.3	1.2
Boron (B)	1.5						0.3	0.5	.2

Explanation of graph ranges:

☐ **Very Low**
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

☐ **Low**
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

☐ **Marginal**
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

☐ **Adequate**
Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

☐ **High**
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the Adequate band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed Adequate.

* g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

Phosphorus Saturation Index Low. Plant response to applied P is likely.	Exchangeable Acidity Adams-Evans Buffer pH (BpH): 7.8 Sum of Base Cations (meq/100g⁻¹): 1.1 Eff. Cation Exch. Capacity (eCEC): 1.1 Base Saturation (%): 100 Exchangeable Acidity (meq/100g⁻¹): - Exchangeable Acidity (%): - Lime Application Rate - to achieve pH 6.0 (g/sqm): 0 - to neutralise Al (g/sqm): 13 Gypsum Application Rate - to achieve 67.5% exch. Ca (g/sqm): 64 The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.	Physical Description Texture: Did not test Typical clay content: Did not test Size: Did not test Gravel content: Did not test Aggregate strength: Did not test Structural unit: Did not test Potential infiltration rate: Did not test Permeability (mm/hr): Did not test Calculated EC_{se} (dS/m): - Requires EC and Soil Texture result. Organic Carbon (OC%): 0.7 - Low Organic Matter (OM%): 1.1 Additional comments:

Consultant:
Gabriella Navarrete

Authorised Signatory:
Simon Leake

Date of Report:
10 Feb 2011

Disclaimer: Tests are performed under a quality system complying with ISO 9001:2000. Results are based on the analysis of the sample taken or received by SESL. Due to the variability of sampling procedures, environmental conditions and managerial factors, SESL does not accept any liability for a lack of performance based on its interpretation and recommendations. This document must not be reproduced except in full.

METHOD REFERENCES:
pH (1:3 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4J1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)

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Page 2 of 2



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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

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Batch N°: **17205** Sample N°: **3**

Report Status: ☐ Draft ☒ Final

Client Name: **Butler Partners Pty Ltd**

Client Contact: **Mick Havana**

Client Job N°:

Client Order N°:

Address: **PO Box 2267
FORTITUDE VALLEY BC QLD 4006**

Project Name: **Topsoil Testing (0.0 - 0.2M)**

Location: **Ripley Valley**

SESL Quote N°:

Sample Name: **Combination TP19 & BH39**

Description: **Soil**

Test Type: **FSC (M3), OC-DC**

Date Received: **4/2/11**

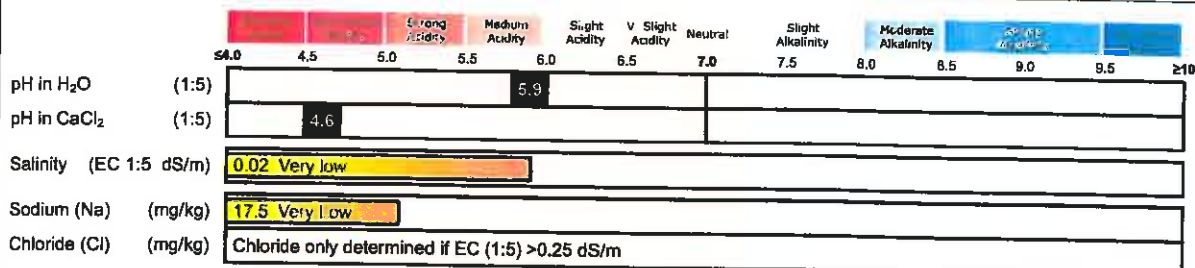
RECOMMENDATIONS

The pH of the combined material has a moderate to very strong acidity. As the pH was just under 6.0 hydrogen was measured indicating a high acidity content (aluminium + hydrogen). The effective cation exchange capacity of the material is low. Nutrient analysis indicates low fertility with very low levels of nitrogen, phosphorus and potassium. The soil requires a similar amelioration approach as sample 1.

SOIL SAMPLE DEPTH (mm): ☐ 100 ☒ 150 ☐ 200

FERTILITY RATING: ☐ Low ☒ Moderate ☐ High

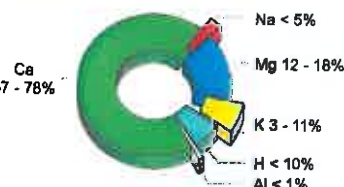
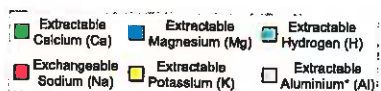
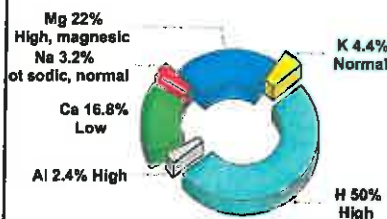
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

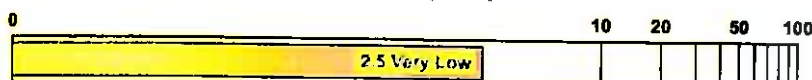
Note: Hydrogen only determined when pH in H₂O < 6.0
Al only determined if pH in CaCl₂ ≤ 5.2



ACTUAL

IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	0.8	4.1 - 6.0
Comment: Potential Calcium deficiency		
Mg:K	5	2.6 - 5.0
Comment: Balanced		
K/(Ca+Mg)	0.11	< 0.07
Comment: High		
K:Na	1.4	N/A
Sodium Absorption Ratio: D.N.T.		
Electrochemical Stability Index (ESI):		
0.01 High potential for dispersion and soil structure collapse		

SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:



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Batch N°: **17205** Sample N°: **3**

Report Status: ☐ Draft ☒ Final

PLANT AVAILABLE NUTRIENTS									
Major Nutrients	Result (mg/kg)	☐ Very Low	☐ Low	☐ Marginal	☐ Adequate	☐ High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO ₃)	<0.05						<0.3	4.2	3.9
Phosphate-P (PO ₄)	.7						0.1	12.6	12.5
Potassium (K)	42.3						8.4	35.5	27.1
Sulphate-S (SO ₄)	6.3						1.3	13.6	12.3
Calcium (Ca)	83.9						16.7	252.8	236.1
Magnesium (Mg)	66.1						13.2	26.7	13.5
Iron (Fe)	351						70	110.1	40.1
Manganese (Mn)	64						12.8	8.8	Drawdown
Zinc (Zn)	<0.65						0.1	1	.9
Copper (Cu)	<0.64						0.1	1.3	1.2
Boron (B)	1.5						0.3	0.5	.2

Explanation of graph ranges:

☐ Very Low

Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

☐ Low

Potential 'hidden hunger', or sub-clinical deficiency. Potential response to nutrient addition is 80 to 90%.

☐ Marginal

Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

☐ Adequate

Supply of this nutrient is adequate for the plant, and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

☐ High

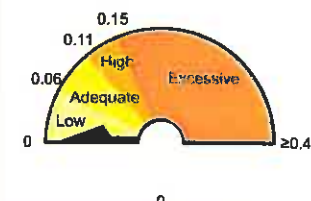
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the Adequate band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed Adequate.

* g/sqm measurements are based on soil bulk density of 1.33 tonnes/m³ and selected soil depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH): **7.8**
Sum of Base Cations (meq/100g⁻¹): **1.2**
Eff. Cation Exch. Capacity (eCEC): **2.5**
Base Saturation (%): **48**
Exchangeable Acidity (meq/100g⁻¹): **1.25**
Exchangeable Acidity (%): **50**

Lime Application Rate

- to achieve pH 6.0 (g/sqm): **80**
- to neutralise Al (g/sqm): **9**

Gypsum Application Rate

- to achieve 67.5% exch. Ca (g/sqm): **80**
The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

Physical Description

Texture: **Did not test**
Typical clay content: **Did not test**
Size:
Gravel content:
Aggregate strength: **Did not test**
Structural unit: **Did not test**
Potential infiltration rate: **Did not test**
Permeability (mm/hr): **Did not test**
Calculated EC_{se} (dS/m): -

Requires EC and Soil Texture result.

Organic Carbon (OC%): **0.6 - Very low**
Organic Matter (OM%): **1.1**
Additional comments:

Consultant:

Gabriella Navarrete

Authorised Signatory:

Simon Leake

Date of Report:

10 Feb 2011

Disclaimer: Tests are performed under a quality system complying with ISO 9001: 2000. Results are based on the analysis of the sample taken or received by SESL. Due to the variability of sampling procedures, environmental conditions and managerial factors, SESL does not accept any liability for a lack of performance based on its interpretation and recommendations. This document must not be reproduced except in full.

METHOD REFERENCES:

pH (1:5 H₂O) - Rayment & Higginson (1992) 4A1,
pH (1:5 CaCl₂) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 5A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
PO₄, K, SO₄, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydroxide - Adams-Evans (1972)

Tests are performed under a quality system certified as complying with ISO 9001: 2000. Results and conclusions assume that sampling is representative. This document shall not be reproduced except in full.

Page 2 of 2

**POINT LOAD STRENGTH INDEX TEST REPORT**Australian Standard AS1726-1993 *Geotechnical site investigation*

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Client:	SHD Services Pty Ltd
Project:	Residential Subdivision – Lots 1 to 11
Location:	Cnr Ripley & Fischer Road, Ripley Valley
Project No.:	010-218B
Tested by:	
Date:	February 2011

Location	Depth (m)	Test Type	Sample Description	Point Load Strength [Is(50)] (MPa)	Rock Strength Category*
38	0.80	Diametral	Sandstone	4.4	Very high
		Axial	Sandstone	3.0	Very high
	1.80	Diametral	Sandstone	4.6	Very high
		Axial	Sandstone	4.5	Very high
	2.95	Diametral	Sandstone	4.4	Very high
		Axial	Sandstone	4.0	Very high
	3.60	Diametral	Sandstone	3.4	Very high
		Axial	Sandstone	3.1	Very high
	4.80	Diametral	Sandstone	2.4	High
		Axial	Sandstone	2.0	High
	5.20	Diametral	Sandstone	1.1	High
		Axial	Sandstone	1.9	High
	6.95	Diametral	Sandstone	0.9	Medium
		Axial	Sandstone	0.7	Medium
39	2.20	Diametral	Sandstone	1.0	Medium
		Axial	Sandstone	0.8	Medium
	3.10	Diametral	Sandstone	0.2	Low
		Axial	Sandstone	0.1	Low
	3.70	Diametral	Sandstone	0.8	Medium
		Axial	Sandstone	0.6	Medium
	4.40	Diametral	Sandstone/Conglomerate	0.4	Medium
		Axial	Sandstone/Conglomerate	0.3	Medium
	4.80	Diametral	Sandstone/Conglomerate	0.6	Medium
		Axial	Sandstone/Conglomerate	<0.1	Very low
	5.40	Diametral	Sandstone	1.0	High
		Axial	Sandstone	0.5	Medium
	6.60	Diametral	Sandstone	1.3	High
		Axial	Sandstone	1.3	High
TP	1.5 – 1.55	Diametral	Sandstone	1.3	High
		Axial	Sandstone	0.6	Medium
	1.2 – 1.3	Diametral	Sandstone	0.6	Medium
		Axial	Sandstone	0.2	Low
	1.9 – 2.0	Diametral	Sandstone	0.9	Medium
		Axial	Sandstone	0.1	Low
	0.9 – 1.0	Diametral	Sandstone	0.1	Low
		Axial	Sandstone	<0.1	Very Low
	1.0 – 1.1	Diametral	Sandstone	<0.1	Very Low
		Axial	Sandstone	<0.1	Very Low
	1.0 – 1.1	Diametral	Sandstone	<0.1	Very Low
		Axial	Sandstone	<0.1	Very Low
	1.3 – 1.4	Diametral	Sandstone	0.2	Low
		Axial	Sandstone	0.2	Low
	0.9 – 1.0	Diametral	Sandstone	1.1	High
		Axial	Sandstone	0.2	Low
	1.3 – 1.4	Diametral	Sandstone	0.2	Low
		Axial	Sandstone	0.3	Low
	1.7 – 1.8	Diametral	Sandstone	0.4	Medium
		Axial	Sandstone	<0.1	Very Low
	0.8 – 0.9	Diametral	Sandstone	<0.1	Very Low
		Axial	Sandstone	0.01	Extremely Low
	0.9 – 1.0	Diametral	Sandstone	0.01	Extremely Low
		Axial	Sandstone	0.01	Extremely Low
	0.7 – 0.8	Diametral	Sandstone	<0.1	Very Low
		Axial	Sandstone	<0.1	Very Low
	0.8 – 0.9	Diametral	Sandstone	0.2	Low
		Axial	Sandstone	<0.1	Very Low
	1.0 – 1.1	Diametral	Sandstone	<0.1	Very Low
		Axial	Sandstone	<0.1	Very Low
	1.9 – 2.0	Diametral	Sandstone	0.2	Low
		Axial	Sandstone	<0.1	Very Low
	2.4 – 2.5	Diametral	Sandstone	<0.1	Very Low
		Axial	Sandstone	<0.1	Very Low

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Project No. 010-218B

9 March 2011

SHD Services Pty Ltd
c/- MPN Consulting Pty Ltd
Level 5
39 Sherwood Road
TOOWONG QLD 4066

Attention: Mr D Payne

Dear Dean

**RE: ULDA INFORMATION REQUEST
RECONFIGURATION OF LOTS 1 TO 11
RESIDENTIAL SUBDIVISION
CNR RIPLEY AND FISCHER ROADS, RIPLEY VALLEY**

We refer to Urban Land Development Authority's (ULDA) Information Request of 9 December 2010 (ULDA Ref No: DEV2010/084) and provide responses below to the ULDA's twelve (12) notes/questions under the heading *Geotechnical including Erosion/sediment control/dispersive soils*. Our responses do not include reference to 'soil science' issues, which have been addressed separately by Environmental Soil Solutions Australia Pty Ltd (ESSA).

1. MPN Engineering & Infrastructure Development Application Report dated 1 November 2010 and Butler Partners Preliminary Geotechnical Investigation Urban Core and Town Centre, Ripley Road Ripley Valley — dated 5 February 2008 have been assessed.

Noted.

2. An Earthworks Management Plan shall be prepared and lodged for the site. In the preparation of the Earthworks Management Plan the following items need to be considered and addressed.

See below.

Reconfiguration of Lots 1 to 11
Residential Subdivision
Cnr Ripley and Fischer Roads, Ripley Valley
Project No.: 010-218B
9 March 2011

3. Provide an assessment of the risk of disturbing acid sulfate soils and its impact on the environment should be addressed prior to detailed design and construction.

Refer to Butler Partners Pty Ltd's (Butler Partners) Report No.: 010-218B of 28 February 2011, Section 5.3.12 Acid Sulfate Soils. The report notes as follows:

23-3-2011

"The Chromium Suite test results confirm that the soil samples tested contained existing acid, but that negligible potential exists for the future oxidation of sulfur. Based on the results of the Chromium Suite test results (refer Section 4.4.6), the site location and the ground surface levels, it is considered that whilst some of the site soils may be acidic because of the site geology, they have been derived from the in-place weathering of rock.

It is considered that whilst the site soils are acidic because of the site geology, they were derived from the in-place weathering of rock and are therefore not acid sulfate soils and an Acid Sulfate Soil Management Plan will not be required for site development.

Because the 'clayey' site soils are of relatively low permeability, all cut to fill that is uniformly compacted in accordance with an appropriate engineering specification, would be essentially impermeable and 'acid leachate' would be negligible."

4. Please confirm that no development is proposed in the area constrained by past mining activities or that more detailed mining related assessments are to be undertaken to determine potential subsidence impact prior to detailed design and construction in these areas.

By others.

5. Please confirm the risk posed by saline and dispersive soils to the basis of this assessment. What measures will be incorporated within the detailed design and construction of the development to mitigate against the site specific risk posed by saline and dispersive soils.

Saline soils are addressed by ESSA.

Dispersive soils (including fill) will be treated as appropriate by use of one or a combination of the following standard 'treatments':

- minimise temporary and permanent exposure of disturbed dispersive soils;
- all fill to be uniformly compacted, including around services etc.;
- grade and drain site to minimise run-off over exposed dispersive soils;
- protect exposed dispersive soils with mechanical erosion protection and/or re-vegetation; and
- treat dispersive cut and fill soil surfaces by lime stabilisation, in a manner consistent with ecologically sustainable practice.

Reconfiguration of Lots 1 to 11
Residential Subdivision
Cnr Ripley and Fischer Roads, Ripley Valley
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9 March 2011

6. Provide plans describing the proposed earthworks and details on the stability of existing and re-contoured sloping ground and batters for review. The plans shall show the finished contour levels of the site, including details of all retaining walls.

Plans by others. Maximum stable cut and fill batter slope angles are given in Section 5.3.4 of Butler Partners' Report No.: 010-28B, 28 February 2011. 23.3.2011

7. Demonstrate that that treatment of soils during the construction and operational phases will result in a stable, and sustainable landform.

Erosion of site soils will be prevented by use of one or more of the methods nominated in Item 5 above.

Use of the techniques nominated in Item 5 has been used successfully in past projects located in the general vicinity of the site, in the same geological conditions, to give stable and sustainable landforms.

8. Demonstrate that the changes to the hydrological conditions resulting from the development will not result in instability of the downstream receiving environment, particularly the potential for bank instability and for incision of the stream channel. The latter has the potential to lower the groundwater table and impact riparian vegetation in particular.

- Hydrology assessment by others.
- Dispersion (and erosion) control – refer Item 5 above.
- Groundwater was generally not encountered to between 1m and 3m depth approximately in the test pits/boreholes undertaken (refer Section 4.3 of Butler Partners' Report No. 010-218B, 28 February 2011) and it is considered that stream channel erosion (should it occur) will not adversely impact (lower) the groundwater regime.

9. Show that the soils — both topsoils and subsoils have suitable agronomic qualities for re-establishing a stable vegetation cover across the area.

By ESSA.

10. A report needs to be prepared by a suitably qualified soil scientist to adequately map and characterise the site soils for construction and revegetation (landscaping) perspectives. It should provide site specific detail on topsoil re-use and stockpiling, high-risk soils and their required treatment during the construction phase and amelioration for the proposed landscape outcomes. The report should demonstrate that the topsoils are suitable for re-use, and that the existing seed-bank will not compromise the proposed vegetative outcomes.

By ESSA.

11. A report needs to be prepared by a suitably qualified soil scientist to adequately map and characterise the site soils for construction and revegetation (landscaping) perspectives.

By ESSA.

Reconfiguration of Lots 1 to 11
Residential Subdivision
Cnr Ripley and Fischer Roads, Ripley Valley
Project No.: 010-218B
9 March 2011

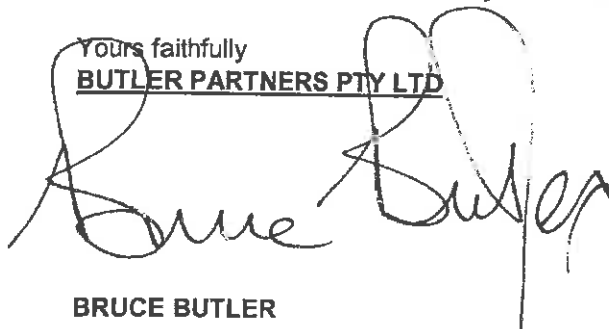
12. Prepare a Erosion and Sediment Control Plan that considers the relevant aspects of soil type, hydrology, the types of erosion and sediment control devices required on the site and the space opportunities for these, and link the soil treatment to the proposed landscape outcomes. It should be noted that the highly dispersive nature of the clay component of the soils, combined with the unstable sands make the site HIGH RISK from an erosion perspective.

By MPN Consulting Pty Ltd. Parameters for use in the preparation of an Erosion and Sediment Control Plan are given in Table 2 of Butler Partners' Report No.: 010-218B, 28 February 2011.

Please let us know if you require any additional information.

23.3.2011

Yours faithfully
BUTLER PARTNERS PTY LTD



BRUCE BUTLER
Senior Principal

ATTACHMENT 6
Environmental Soil solutions Australia Pty Limited
“Soil Assessment Report : Factors Affecting Soil Use, Planting Media and Subsoil
Management for Landscaping” dated January 2011
ESSA Report

Environmental Soil Solutions Australia Pty Ltd
ABN 51 090 697 331

PO Box 442 Sunnybank Q 4109; e.s.s.a@bigpond.net.au
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Ripley Urban Core: Area 1 & Ripley Rd

**Soil Assessment Report: Factors Affecting Soil Use,
Planting Media & Subsoil Management for Landscaping**

D E Baker BSc

January 2011

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Attachments:

- **Soil Map - Ripley Urban Core Area 1**
- **Soil Morphological Descriptions**
- **Full Testing Proformas, Planting Media (Full , Subsuite) , Organic Soil Conditioner**
- **Audit Sample requirements (Subsuite) And Organic Soil Conditioner Requirements**
- **PDF Attached File – Soil Laboratory Analytical Data**

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Summary

This report presents the results of a soil survey along part of the Ripley Road Corridor between Centenary Highway and Fischer Road. SHD Services is developing an area (Area 1) within this location as residential subdivision called Ripley Urban Core.

As part of the development, SHD Services Pty Ltd on behalf of Henlia No 9 Pty Ltd commissioned Environmental Soil Solutions Australia Pty Ltd to undertake a Soil Assessment for Area 1.

Information is required by the client on the range of soils, their distribution and characteristics to assist engineering and environmental staff with planning and implementing landscaping and revegetation works and ensuring erosion control occurs both during and after construction.

A survey of the top 1 m of soil was undertaken to map the soil distribution within Area 1 & road corridor in the section. A very high-intensity mapping scale of around 1: 5,000 was used. Each identified soil was given a name that is unique to this assessment and is shown in *italics*. Soil profile features are described for any surface layers, subsurface layers and subsoil. Surface layers are equivalent to "topsoil". This Definition is as defined by Transport and Main Roads. Subsurface layers and subsoil, as used in this report, represent part of the Transport and Main Roads definition of "subsoil".

A combination of field evidence and analytical results has been used to classify the soils using the Australian Soil Classification and soil groups described in the Transport and Main Roads Road Drainage Design Manual (RDDM).

Inherent soil erodibility ratings defined in the Road Drainage Design Manual have been assigned to each soil using site and soil profile conditions observed during field inspection, soil texture and four dispersion indicators:

- Exchangeable Sodium Percentage;
- Exchangeable Calcium : Exchangeable Magnesium Ratio;
- Emerson Dispersion Test; and
- Soil Dispersion Indicator field test.

Other soil laboratory data have been used to ascertain soil chemical properties that affect plant growth during landscaping and revegetation.

The soil survey element of the study information collected was used to determine:

- soil erodibility and permeability;
- recommended clearing and grubbing operations;
- recommendations for erosion and sediment control works;
- Soil Erosion Potential for exposed subsoils and
- Suitability of soil layers for landscaping and revegetation.

In addition, the laboratory soil testing element combined with the soil survey element has been used to provide soil amelioration recommendations for the "topsoil as defined by Transport and Main Roads as well as Subsurface layers and subsoil where exposed or used as landscape areas.

Recommendations are given in Tables 6 & 6a while Top Soil (Planting Media) management is given in Table 9.

1. Introduction

1.1 Background

This report presents the results of a soil survey and Soil Assessment Report along part of the proposed development in Area 1 of the Ripley Urban Core (RUC).

Sekisui House (Henlia No 9) via Hassell asked Environmental Soil Solutions Australia Pty Ltd to:

1. Investigate the Soils in Area 1 for site located off Fischer Road especially;
2. Open Space Areas & Area 1 Park and
3. Ripley Road Corridor

As part of the design development Sekisui House requires the soil assessment and Soil Assessment Report & recommendations for the areas nominated.

Information therefore is required on:

1. the range of soils,
2. the soil distribution and characteristics

to assist engineering and environmental and landscape architect teams with planning and implementing landscaping and revegetation works and with erosion control both during and after construction.

Therefore, a soil survey along this section to assist in deciding the limitations of the existing soils and indicate what amelioration of the soils is required as well as indicating what further soil studies, sampling and testing may be required.

A very high-intensity (1:5,000 to 1:10,000) soil survey is recommended for site planning in the Australian Soil and Land Survey Handbook: Guidelines for Conducting Surveys (Reid 1992). With increasing intensity there will be greater accuracy in boundary location between different mapped soil units and greater reliability on describing the actual soil properties within each mapping unit.

1.2 Purpose of the soil survey, soil assessment and management

Specific aims of the soil survey were to:

- identify and describe the range of soils within Area 1 and Ripley Road;
- classify these soils according to the Australian Soil Classification (Isbell 2002) and the Road Drainage Design Manual (Transport and Main Roads 2002);
- map the distribution of individual soils at a scale of 1:5,000;
- analyse representative soil samples for a range of attributes that affect construction, landscape and rehabilitation;
- use the field descriptions of site characteristics and soil profile morphology in conjunction with laboratory analytical data to objectively assess soil erodibility and drainage; and
- Provide advice on suitability for use as planting media (topsoil) for revegetation and supply recommendations for soil amelioration and management, where necessary.

2. Study methodology

The soil survey and Soil Site assessments (Soil Assessment Report or SAR) was undertaken in four stages.

2.1 Field work

Field inspection was designed to cover the area at required intensity. This approach has been chosen to include the required areas the Ripley Road Corridor and as much as possible all areas where site soil is exposed especially the subsoils.

Sites were chosen using a free survey technique so that each landscape unit was adequately represented. This means that the most appropriate location for ground observations was chosen whilst in the field on the basis of local landscape features. Observation sites were chosen to represent crest, upper slopes, mid-slopes and lower slopes of the hard rock geological units and to cover all alluvial landform components. As far as practicable, sites were also spaced within the study areas.

At 10 observation sites detailed soil profile descriptions were undertaken to a depth of at least 1 m or to bedrock, whichever came first. Soil profiles were mainly exposed with a hand held auger drilling a 75 mm diameter bore hole though some existing cuttings were used as well. Other observation points were check sites where only sufficient information was collected to reliably determine the soil type.

Landscape position, land surface features, substrate material and indicative vegetation were also recorded at each site to assist in soil classification and mapping.

All site descriptions used standard terminology of the Australian Soil and Land Survey Field Handbook (McDonald et al 1990). Site location was recorded with a hand-held GPS receiver which has an accuracy of $\pm 5-10$ m.

Adequate soil survey accuracy and reliability was achieved during this current survey with the sites recommended in the proposal. In addition, the proportion of detailed soil profile descriptions exceeds the recommended 10-30% of all observations (Reid 1988).

2.2 Soil sampling for laboratory analysis

In total, 17 soil samples were submitted for laboratory analysis. These samples were collected from 10 profiles described as part of the detailed site inspections. An additional sample at Ripley Rd roundabout has been included for another study for TMR. Details are S18 & S42 from TMR Survey.

The samples collected at each site were mainly taken from the surface layer, subsurface layer or from part of the subsoil layer which, based on field evidence, is likely to represent the greatest constraint to stability, landscaping, and site sustainability. However, 1- 2 samples were taken from weathered bedrock and from deep subsoil merging into weathered rock.

Of the 17 samples, all 17 were analysed using a sub-suite of analyses recommended in Standard Specification MRS11.16B – Vegetation Ground Works (Transport and Main Roads 2008). The MRS11.16B sub-suite includes:

- Soil pH;
- Electrical Conductivity (EC), as a measure of salinity;
- Exchangeable Cations (Calcium, Magnesium, Sodium, Potassium and Aluminium);
- Cation Exchange Capacity (CEC);
- ESP (Exchangeable sodium as a % of CEC); and
- Exchangeable Calcium: Exchangeable Magnesium ratio.

In addition, 4 of these 17 samples near the ground surface were also tested for:

- Macronutrient fertility – Nitrogen (N), Phosphorus (P) and Potassium (K);
- Organic Matter (derived from a laboratory measurement of Organic Carbon);
- Trace Elements – Copper (Cu), Zinc (Zn), Manganese (Mn) and Iron (Fe);
- Sulfate; and
- Boron (B).

Texture was recorded for each sample during site inspection.

Analytical methods for pH, EC, exchangeable cations, CEC, macronutrients and trace elements and Organic Carbon were performed according to the relevant Australian laboratory handbook (Rayment and Higginson 1992).

2.3 Soil mapping and classification

Site and soil profile data collected during field inspection were used to identify the range of soil “types” present within the area. Each soil “type” (referred to simply as a soil in this report) has a suite of features that distinguish it from other soils and the variation in these features is less within each soil than between soils.

Each identified soil was given a name that is unique to this assessment. The distribution of these soils was then mapped at a (very high-intensity survey) scale of 1:5,000 using available contour data.

At 1:5,000 scale mapping, individual soils cannot necessarily be mapped on their own as pure units. Rather, the delineated mapping units represent soil associations in which there is a dominant soil covering most of the unit and small inclusions of other soils. For this area, it is estimated that the dominant soil represents at least 70% of the mapping units.

Mapping scale also affects the positional accuracy of boundaries between mapping units. At 1:5,000 scale, the accuracy of mapping unit boundaries is a minimum ± 10 -30 m. While information collected is at 1:5,000 scale the map of soils is supplied at 1:10,000 scale as it is no different for practical purposes for the project soils management.

Each identified soil was classified according to:

- Transport and Main Roads soil groups described in the Road Drainage Design Manual (Transport and Main Roads 2002); and
- The Australian Soil Classification: Revised Edition (Isbell 2002).

2.4 Suitability assessment and reporting

Each soil mapping unit was assessed for:

1. erosion potential,
2. permeability,
3. recommended depth to remove organic matter and
4. Depth of suitable landscaping material for stripping and stockpiling.

The comprehensive Soil Assessment Report produced provides for the soils mapped:

- descriptions and classification of the soils present;
- maps the soil distribution;
- **assesses** the soil erodibility, drainage condition and the suitability of soil layers for landscape and vegetation works;
- recommends clearing and grubbing operations and strategies for land management during construction and revegetation;
- provides soil chemical interpretations of soils;
- provides soil amelioration recommendations for soils/soil layers

3. Assessment of site soils

3.1 Soil terminology

All soil descriptions in this report use standard terminology of the Australian Soil and Land Survey Field Handbook (McDonald et al 1990). Descriptions of field pH measurements (such as medium acid) are from Interpreting Soil Analyses – for Agricultural Land Use in Queensland (Baker and Eldershaw 1993).

The report describes the numerous soil layers that may occur through a soil profile as being either:

- **surface layers** which extend down from the ground surface and are generally darkened (compared to any underlying layers) due to the accumulation of organic matter;
- **subsurface layers** which occur below, and are very similar to, the surface layer in texture and structure but are usually paler in colour (due to much less organic matter); or
- **subsoil**, which refers to any layer below the subsurface layer (or below the surface layer if there is no subsurface layer) which has much higher clay content, brighter colours or markedly different structure.

The term "topsoil" is generally avoided in soil survey reports because its common usage covers a wide range of soil material that may be sourced from any part of the soil profile, though usually not clay. The term has also been applied to any natural soil (and artificial planting) material that is used for top or final planting layer.

The term "topsoil", can be defined as the top layer of existing soil that supports vegetation. There is no indication of what distinguishes this layer from any underlying layers. The definition of "topsoil" is refined to being the upper part of the soil profile that is enriched with organic matter. "Subsoil" is defined to include both the subsurface layer and any layer below in which there is much higher clay content, brighter colours or markedly different structure.

Thus, natural surface layers in this report are equivalent to "topsoil" as defined whereas subsurface layers and subsoil, as used in this report, represent different parts of the defined "subsoil".

3.2 Soil description and distribution

Two soils Units (Texture Contrast Soils) have been identified along the Ripley Road corridor and Area 1.

Both soil units are briefly described in Table 1 whilst their distribution is shown at 1:10,000 scale in Figure 1.

The mapping units in Figure 1 represent soil associations which are named after the dominant soil in each unit. The dominant soil represents at least 70% of the mapping unit with small inclusions of other soils in the remaining area. The accuracy of the mapping unit boundaries is a minimum $\pm$ 20-50 m at this scale of mapping.

Soils

Soil distribution is related to landform shape.

Two "sandy TC soils" occupy the area. The term sandy refers to the sandy texture grade of their surface and subsurface layers whereas "TC" refers to the texture contrast nature of their profiles. In sandy TC soils the sandy surface or subsurface layer abruptly overlies a much heavier, usually clay, subsoil. The change into the subsoil occurs over less than 20 mm.

Sandy red yellow & yellow grey TC soils (dispersive) are texture contrast soils with sandy loam surface layers that abruptly overlie sandy clay subsoil. These soils dominate the crests and upper convex slopes.

The grey sandy loam surface layer is 70-90 mm thick with massive structure (few if any natural soil aggregates) changes into a bleached (almost white) subsurface layer of similar texture and structure. At 150 -250 mm depth, the bleached subsurface layer overlies a sandy medium clay to sandy medium heavy clay subsoil with a mainly red colour though more than 20% of the layer may contain grey blotches (referred to as mottles).

The clay subsoil does not exhibit any obvious dispersive properties when field texturing though laboratory analyses will verify its tendency for dispersion.

A few cobbles and stones occur on the ground surface.

The clay subsoil changes into weathered rock between 500 and 900 mm depth.

Field tests reveal an acid pH throughout the soil profile with some clay subsoil layers being < 5, a level at which aluminium can occur at toxic levels. Laboratory analyses will confirm the pH and presence of aluminium saturation.

Sandy gleyed TC soils (dispersive) are similar texture contrast soils that dominate the concave mid to lower slopes.

These only differ from the *Sandy red-yellow TC soils* in having:

- a thicker grey surface layer (100-250 mm);
- clay subsoil at 300 to 400 mm depth;

- mainly light grey subsoil with varying amounts of red-brown mottles; and
- weathered rock is generally at more than 900 mm depth.

The clay subsoil colours indicate repeated waterlogging for reasonable periods of time and the subsoil exhibits a tendency for dispersion when textured.

Field tests reveal an acid pH throughout the soil profile though no levels below 5 were recorded.

Sandy gleyed TC soils (dispersive) occupy the valley flats at the bottom of the landscape.

These profiles are the same as occur on the mid-lower slopes except for the clay subsoil contains:

- medium to large pebbles; and
- nodules of iron-manganese segregations.

The presence of iron-manganese segregations also indicate repeated waterlogging for substantial periods of time. The subsoil did not exhibit any marked tendency for dispersion when textured but laboratory testing is required for confirmation.

Table 1. Brief description and classification of soils

Soil name	Landform	Brief profile description	RDDM soil group ¹	Australian Soil Classification ²
Sandy red yellow / yellow grey TC soils	Convex Upper Slopes 3-8%	Thin grey, sandy loam over a conspicuously bleached subsurface layer of similar thickness but slightly heavier texture that abruptly overlies mottled red, grey and yellow sandy medium clay subsoil; profile depth usually < 1 m	Texture contrast soils (dispersive)	Magnesian-Natric Red and Yellow Kurosols & Yellow and Grey Sodosols
Sandy gleyed TC soils	Mid Lower Slopes 4 – 10%	Thicker, dark grey to grey, sandy loam over a bleached subsurface layer of similar thickness and texture that abruptly overlies mottled red and brown medium clay subsoil; weathered rock may occur below 900 mm depth	Texture contrast soils (mainly dispersive)	Yellow and Grey Sodosols
Sandy gleyed TC soils	Valley Flats 3-6%	Thicker, grey sandy clay loam, sandy abruptly overlying mottled grey, yellow and often red, light medium clay to medium clay subsoil; profile depth usually > 1 m	Texture contrast soils (non dispersive)	Magnesian-Natric Yellow and Grey Kurosols

Notes:

1. Soil groups identified in the Transport and Main Roads Road Drainage Design Manual (Transport and Main Roads 2002).
2. Suborders from the Australian Soil Classification Revised Edition (Isbell 2002).

3.3 Soil classification

A combination of field evidence and analytical results has been used to classify the soils into suborders of the Australian Soil Classification: Revised Edition (Isbell 2002) and into soil groups described in the Road Drainage Design Manual (RDDM) of Transport and Main Roads (Transport and Main Roads 2002). Results of these classifications are displayed in Table 1.

Table 1 shows via field and analytical evidence and indicates that the *Sandy red-yellow & yellow grey TC soils* and *Sandy gleyed TC soils, mid slopes*) and have dispersive clay subsoil and thus belong in the Transport and Main Roads soil group of "Texture contrast soils (dispersive)".

Areas mapped as *Sandy gleyed TC soils (non dispersive)* occupy the valley flats belong in the Transport and Main Roads soil group of "Texture contrast soils (non dispersive)".

4. Potential risks and soil limitations to re-use in landscaping and revegetation

4.1 Physical limitations

Physical limitations refer to soil related attributes that affect the capacity to re-use soil material for landscaping and revegetation.

Dispersion, overall soil erodibility and soil permeability are soil related attributes that affect re-use for landscape and revegetation and also affect performance & sustainability of landscape stability. These attributes are discussed separately in concluding sections 6.3, 6.4 and 6.5 of this report.

4.2 Chemical limitations affecting plant growth

Soil samples were collected from 10 soil profiles described within the Area 1 and road corridor. Samples representing the surface layer, subsurface layer, part of the subsoil and weathered rock were submitted for a range of chemical analyses.

Chemical properties that directly affect plant growth are summarised for each soil in Table 2. Table 2 also lists the number of samples within each soil layer that was submitted for analysis. These attributes are discussed separately in sections 4.3, 4.4 and 4.5 of this report.

Terms used in this report to describe pH (such as medium acid) are from Interpreting Soil Analyses – for Agricultural Land Use in Queensland (Baker and Eldershaw 1993). Salinity ratings are from the Salinity Management Handbook (DNR 1997).

Table 2. Soil chemical properties affecting plant growth

Soil name	Soil layer ¹	Samples	pH ²	EC ^{2,3} (dS/m)	CEC ^{2,4} (meq%)	Extr P ^{2,5,6} (mg/kg)
Sandy red-yellow TC soils	Surface:	1	4.7-5.7	0.03-0.05	<2-6	6
	Subsurface:	4	4.9-5.3	0.04-0.07	<2-3	Nd
	Subsurface:	1	(6.2 Rd	0.12	18	Nd
	Weathered rock:	1	Cut) 5.1	0.11	3	Nd
Sandy gleyed TC soils	Surface:	2	5.3-5.6	0.04-0.08	3-11	7
	Subsurface:	3	5.1-5.6	0.02- 0.03	<2-3	Nd
Sandy gleyed TC soils flats	Surface:	1	6.3	0.03	<2	5
	Surface +	1	5.1	0.03	4	Nd
	subsurface:	1	5.6	0.17	9	Nd
	Subsoil:					

Notes:

1. Samples designated as "Surface + subsurface" have been combined from both the surface and subsurface layers.
2. Where more than 1 sample was analysed for each soil layer a range of values is given.
3. EC represents Electrical Conductivity which is a measure of soil salinity.
4. CEC represents Cation Exchange Capacity and is a measure of the soil ability to retain positively charged nutrients (such as calcium, magnesium, potassium, ammonium) for use by plant roots, as well as sodium and aluminium; CEC is measured in milli equivalents per 100g soil (meq %).
5. Extr P represents the amount of phosphorus that is available for plant growth and is usually only measured in the soil surface layer.
6. Nd = Not determined
7. Extra samples from TMR survey Ripley Roundabout S 18,42 generally confirm results in this survey except for higher EC

4.2a Soil pH

The level of pH strongly influences the ability of plants to establish and to take up nutrients from a soil and the ability of the vegetation to be sustainable. Soil pH for the sample sites for both horizons (topsoil) and the mostly B horizons (subsoil) are all rated as strongly acid (pH < 5.5) and are not ideal for plant growth other than for insitu adapted plants & grasses which are poorly performing at best.

All sites (both surface and subsoils but especially the exposed subsoils & if reused) would benefit from the addition of agricultural limestone / dolomite incorporated into the soil to reduce acidity and high available Aluminium (See Table 3 for Soil parameters) and achieve a soil pH closer to the ideal range of at least > pH 5.5 preferably pH 6.5 – 7.5.

Rates of limestone /dolomite incorporation into these soils recommended are based on MRS11.16B specification and associated guidelines and need to take into account the soil type & chemical conditions.

The following recommended soil pH amelioration rates have been extracted from *general guidelines*:

- (a) **Apply agricultural lime with a NV of 95 generally at the following rates to increase soil pH by 0.5 units -**
- 2.5 t/ha for a clay soil;
 - 1.7 t/ha for a silty clay loam;
 - 1.3 t/ha for a sandy clay loam; and
 - 1.0 t/ha for a sandy loam;

Soils with pH > 6.5 (of which no soil samples were found, all samples <pH 5.5) are not present. However where soils are pH <5.5 and are sodic to strongly sodic (ESP > 6 for sands and sandy loam and ESP > 15 for sandy loams to clay loams to clays) will not require any agricultural gypsum but will require limestone or dolomite.

Comment: However all these soils are <pH 5.5 and low to very low calcium and magnesium top sandy layers with increasing subsoil magnesium and would benefit from applications of Agricultural Lime / Agricultural Dolomite.

For discussion of soil Aluminium concentration in strongly acidic soils (pH < 5.5) - refer to soil exchangeable cations section below.

For the very deep subsoils this may change. For instance Ripley road Roundabout (RO site8) >1m sample were alkaline. If excavations beyond 1.0 m is anticipated then subsoil testing for Subsuite to determine where change occurs will be needed. See Appendix for Sub Suite Soil Testing criteria requirements.

Table 3 - Organic Carbon/ Organic Matter, Slaking, Clouding & Emerson rating for Ripley Urban Core surface soil samples

Sample No/ Depth Layer	Organic Matter%	ESP	Est. Emerson Class Number	Slaking	Clouding
SITE 2	1.8	2.7	5	None	None
SITE 3	0.8	3.5	5	None	Slow
SITE 6	1.1	2.6	5	None	None
SITE 1	1.2	4.2	5	None	None

4.3 Soil Texture and Dispersion Characteristics

Soil texture gives an indication of the sand, silt and clay content of a soil. The dispersive (erosive) characteristic of a soil is related to the clay content. Refer to Table 2 for an explanation of the soil texture abbreviations. Each soil layer per site was assessed for texture see Table 4. The results are listed in Table 1 and show that the project soils generally Sandy loam (SL) surface (grassed top layer , pasture) to medium clays (MC) especially subsoils with a few subsoils reaching MHC (medium heavy clay) texture.

Evidence of soil dispersion is investigated in the field by carrying out slaking and clouding tests, See Table 3 for ratings. A soil that forms a cloud of soil particles and/or slakes (falls apart) when placed in a dish of distilled water is likely to have some dispersive characteristics. The test results for these characteristics are tabulated. However, as there is high aluminium in many very acid subsoils this test may cause it to be unreliable in the majority of the samples causing soils with these properties to rate on the slaking & clouding assessment as non dispersive.

Please note: no laboratory assessment of soil texture or particle size was part of the project brief (but texture was field assessed and has been provided by ESSA in Table 1a).

4.4 Soil Salts (EC)

For sites sampled, all sites have no significant concentration of soluble salts present in soil. However there are small salt accumulations in Site 8 deep subsoils soils with concentrations

rated as low. Very low / low salt levels are rated as of no concern with respect to soluble salt content.

Soluble salts in soils from Sites rated as Medium (>0.45dS/m) and high (0.9dS/m) are not present in this study area, even in the deeper samples tested.

On that basis, on a general areas basis soil soluble salts are not a problem in areas studied.

Table 5 summarises (EC) – Total Salts of the soil properties from the selected representative soil samples from the series of samples both by ESSA and profile auguring.

Table 4. Soil Test Parameters, RUC Project – Ripley.

Sample No.	Sample Depth	Soil pH	EC dS/m	ESP	Ca Meq/100g	Mg Meq/100g	Ca/Mg	Al %
Crests and upper slopes on elevated hills Sandy red-yellow TC soils (dispersive) Magnesian-Natric Red and Yellow Kurosols								
Site 2 TS	0-200mm	5.7	0.03	2.7	1.76	1.23	1.4	9
Site 2 SS	300-450mm	5.3	0.07	13.6	0.39	5.88	0.1	22
Site 2 SS	500-600mm	5.1	0.11	17	0.14	5.87	<0.1	24
Site 5 SS	200-350mm	4.7	0.05	4.5	0.4	4.25	0.1	21
Site 5 SS	400 - 900mm	4.9	0.06	7	0.14	4.55	<0.1	26
Site 10 SS	700-900mm	5.3	0.04	9.3	0.41	6.24	0.1	22
Crests and upper slopes on low hills Sandy yellow-grey TC soils (dispersive) Yellow and Grey Sodosols								
Site 8 SS	Deeper > 1m	8.9	0.16	21.5	2.41	5.85	0.4	3
Site 8 SS	Deeper >1m	9.1	0.18	27.7	2.0	5.02	0.4	2
Site 18 TMR	0-300	5.3-6.0	0.05-0.15	7-13.5	2.6-3.24	1.71-6.15	0.5-1.5	<5
Site 42	0-1100	6.3-4.2	0.11-1.4	9-17	2.95-4.0	3.73-19.9	0.2-0.9	3-7
Mid-lower slopes Sandy gleyed TC soils (dispersive) Yellow and Grey Sodosols								
Site 3 TS	0-200mm	5.1	0.03	3.5	0.15	0.22	0.7	49
Site 3 SS	500 - 700mm	5.6	0.04	15.8	0.05	1.97	<0.1	49
Site 6 TS	0-200mm	5.2	0.03	2.6	0.5	0.44	1.1	29
Site 6 SS Bleach	200-400mm	5.6	0.02	10.3	0.24	1.17	0.2	42
Site 6 SS	450-700mm	5.3	0.08	15.8	0.2	4.05	0.1	40
S9 Road	Crest							
S9 SS	500 - 600mm	6.2	0.12	13.4	2.85	12.0	0.2	2
Valley flats Sandy gleyed TC soils (dispersive) Magnesian-Natric Yellow and Grey Kurosols								
Site 1 TS	0-200mm	5.6	0.05	4.2	0.76	0.44	1.7	15
Site 1 Bleach	250-400mm	6.3	0.03	16.1	0.3	2.24	0.1	13
Site 1 SS	450-700m	5.1	0.17	28	0.12	4.94	<0.1	15

Soil Groups:

Sites 1, 7	Sandy gleyed TC soils in valley flats	- dispersive
Sites 2, 5, 10	Sandy red-yellow TC soils on convex upper slopes	- dispersive
Sites 3, 4, 6, 9	Sandy gleyed TC soils on mid-lower slopes	- dispersive
S 8 RO (>1m)	Sandy yellow-grey TC soils on convex upper slopes	- dispersive

RO = Roundabout Centenary Highway / Ripley Rd

4.5 Soil Exchangeable Cations (Ca, Mg, ESP and Ca/Mg Ratio)

A soil's ability to supply nutrients to plants is determined by its cation retention properties measured as ECEC. Soil exchangeable cations assessed in this project were Ca, Mg, Na, K and Al.

While results show that the soils of the project site are highly leached texture contrast soils they are generally low in Cation Exchange Capacity with majority containing moderate to high saturation of Aluminium in the subsoils and most likely contain 'variable charge' properties.

It is highly likely that these soils contain proportion of positive charge and net positive charge especially. While this is significant soil property, as far as the reuse of the soils when used goes except in batters, will not be an issue when recommending reuse as planting media or subsoil fill in constructed landscape (grassed batter or planted areas). However for plant establishment in the soil due to properties introduced revegetation will be very difficult to establish in unamended soils & subsoils. This applies to any exposed batters (cuts) if left exposed which will actively be erosive.

Soil data collected from the sites in this survey have very low to extremely low exchangeable Ca and while higher levels of Mg are present (especially in subsoils) they vary from low to moderate to occasionally high Mg in the subsoil of the soil profiles sampled. In addition, the Exchangeable Magnesium (Mg) increases to high levels in lower subsoils, and are a significant issue for the overall soil dispersion assessment. The exchangeable cation soil content values are below 2meq/100g for Ca (very low, except for 1 sample 7 deeper RO soils), but do not exceed 0.41meq/100g (the highest) & low of 0.05meq/100g of all 17 samples tested.

Exchangeable Magnesium on the other hand is in equal proportions to Calcium OR exceeds it with concentrations in the range of <1 meq/100g for Mg generally for sandy topsoil with some subsoils up to >6 meq/100g (moderate to high). Calcium to magnesium ratios for the series of samples rarely exceed 1 with (in fact 9 samples are 0.1 or <0.1) indicating that the low Calcium concentrations and low Ca to Mg ratios are providing low nutrient availability. These properties also indicate soil would have higher tendency to disperse (erode).

Calcium concentrations must be boosted while Mg levels, in both the topsoils and subsoils, will need to be maintained or boosted but not to exceed Calcium. In addition, the Ca to Mg ratios will need also to be improved. Examples of sites where this scenario applies are ALL Sites no exception even in some site 'A' horizon samples which contain some organic matter.

Incorporation of agricultural lime or dolomite will increase the dominance of the desirable Ca cation required for plant growth and also help negate the effects of high Mg compared to Calcium (low Ca/Mg ratios) and soil dispersion. However, as both calcium & magnesium levels are generally low for plant exploitation agricultural lime /dolomite should be considered as the preferred ameliorants (soil conditioner).

Soil exchangeable K is rated moderate in subsoil layers of Crest soils or Sandy red-yellow TC soils. The soils K levels will need to be maintained for successful plant growth & sustainable. For the other 2 soils delineated in this survey assessment the 2 Sandy gleyed TC soils Mid slopes & flats K is low to very low and will need boosting.

Assessment of data for soil sodicity (also referred to as ESP) has been provided and ESP data is presented in Table 1. ESP is calculated by dividing the exchangeable Na by the

effective cation exchange capacity expressed as %. The soils in the current study are rated generally non sodic in the surface but not subsoil using this measure. Soils with an ESP > 6 are rated sodic and > 15 strongly sodic,

Sodicity is a soil property associated with soil dispersion when ESP exceeds 6. The subsoils analysed indicated in general with the highly leached nature of the soils low sodicity (non sodic) and a tendency to be low dispersive. Non dispersive (low ESP) were found for most of the samples and is probably due to the stabilising influence of the organic matter present.

Soils which are Very strongly sodic are the Nos sub soils while all soils are sodic subsoils with highest being 28 ESP for Sandy gleyed TC soils on flats. Range is generally in subsoils <1m 9.6 to 28. For Site 8 Ripley Roundabout (RO) the deeper subsoils are strongly sodic with ESP 21.5 to 27.7.

For the Soils Summarised in Table 4a (soils from this study) the data indicates for the samples deeper than 200mm (subsoil) that soil properties do change from the properties existing in the upper (top) layer.

The data Table 3 shows that the soils can become strongly sodic and dispersive. For example Site 6 soils are very strongly sodic, dominated by magnesium and will be highly dispersive (ESP > 15) combined with Ca/Mg ratios of 0.1), again indicating high soil dispersion.

As the subsoils are sodic to strongly sodic as discussed and are magnesian (dominated by Magnesium cation) ***dispersion of the subsoils will not actively occur if the soil is not treated due to the high free Aluminium contents, which have some stabilising effect.***

However, it is of note that the soils as a planting media or as subsoil for establishment plantings & maintenance of sustainable plantings will not support vegetation establishment other than for adapted plants.

For rapid sustainable & desirable revegetation purposes the soils will need to be ameliorated as per recommendations section of this report.

Potassium (K) is moderate to Very low.

4.6 Soil Exchangeable Aluminium (Al)

A deleterious soil characteristic of some very acid soil horizons (as these are, with the least acid rated as medium to strongly acid) is the presence of high exchangeable Al. Higher proportions of Al, as found in subsoil layers of all Sites laboratory samples 8 of the 17 that is the vast majority of the sub soil layers examined across the site.

When the %Al of the CEC is >25% it may be toxic to most plants but will be when exceeding 40 especially, which 4 samples do with the highest 49 for Site 3 subsoils. Any Aluminium concentration needs to be treated if exposed and or plantings or use of the subsoil for revegetation works is proposed. Simple agricultural lime / dolomite application as required in this area (to correct soil pH) will also correct the Al toxicity problem.

Application of the proposed agricultural lime /dolomite will address this problem by increasing the soil pH and thereby reduce any effects of plant toxic Al present in these soil planting materials. As well agricultural lime /dolomite will increase the desirable Calcium & Magnesium available for plant growth & clay property amelioration.

4.7 Emerson Class Number

The Emerson Class Number (ECN) is sometimes used as indicator of dispersion. ECN 1 and 2 denotes dispersive soils. ECNs of 5 are rated non dispersive.

The non dispersive Emerson estimates for soils from this RUC project are affected by the presence of high soluble aluminium. The presence of the free aluminium (which is in soil solution due to acid conditions) has a flocculating effect and negates the soils tendency to disperse in this assessment method. The property is of no use & therefore not determined.

Table 5. Soil Test Parameters, P, K, S RUC Project – Ripley.

Site	Depth	pH H2O	EC dS/m	Chloride mg/kg	Al meq/100g	P mg/kg	S mg/kg	OM%	K meq/100g
TC Upper <i>Sandy red-yellow TC soils</i>									
Site 2 TS	0-200mm	5.7	0.03	21	0.34	6	4	1.8	0.25
Site 2 SS	300-450mm	5.3	0.07	nd	2.27	nd	nd	nd	0.27
Site 2 SS	500-600mm	5.1	0.11	nd	2.5	nd	nd	nd	0.18
Site 5 SS	200-350mm	4.7	0.05	nd	2.48	nd	nd	nd	0.43
Site 5 SS	400 - 900mm	4.9	0.06	nd	3.22	nd	nd	nd	0.36
Site 10 SS	700-900mm	5.3	0.04	nd	3.76	nd	nd	nd	0.35
S9 Road	Crest								
S9TS	500 - 600mm	6.2	0.12	nd	0.34	nd	3	nd	0.34
TC Mid <i>Sandy gleyed TC soils</i>									
Site 3 TS	0-200mm	5.1	0.03	27	0.42	7	nd	0.8	0.04
Site 3 SS	500 - 700mm	5.6	0.04	nd	2.98	nd	nd	nd	0.12
Site 6 TS	0-200mm	5.2	0.03	15	0.44	7	4	1.1	0.10
Site 6 SS Bleach	200-400mm	5.6	0.02	nd	1.32	nd	nd	nd	0.07

Site	Depth	pH H ₂ O	EC dS/m	Chloride mg/kg	Al meq/100g	P mg/kg	S mg/kg	OM%	K meq/100g
Site 6 SS	450-700mm	5.3	0.08	nd	4.09	nd	nd	nd	0.21
Site RO S 8	Ripley Rd (Eroding)								
Site 8 SS	Deeper > 1m	8.9	0.16	nd	0.30*	nd	4	nd	0.17
Site 8 SS	Deeper >1m	9.1	0.18	nd	0.21*	nd	nd	nd	0.21
TC Lower <i>Sandy gleyed TC soils flats</i>									
Site 1 TS	0-200mm	5.6	0.05	32	0.24	nd	6	1.2	0.15
Site 1 Bleach	250-400mm	6.3	0.03	nd	0.48	nd	nd	nd	0.11
Site 1 SS	450-700m	5.1	0.17	nd	1.35	nd	nd	nd	0.17

- High Aluminium not associated with pH < 5.5

4.8 Organic Carbon / Organic Matter

The *Sandy red-yellow / yellow grey TC soils* Organic Carbon / Organic Matter data was assessed on a top layer of soil Sites 1, 2, 3 & 6 samples topsoil (TS layers) from this study. Organic Carbon concentrations found, as expected, a rapid decline in organic carbon with depth. Compared to the surface layer 0 -50 mm, the 50 – 200 mm depth decreases by more than 50%. It was considered unnecessary to continue testing beyond this depth due to low levels present and the rapid decline of organic carbon found with depth as is most common soil types.

Highest organic carbon contents of surface soil was 0.8% (Organic Matter 1.8 %) which is rated as unsatisfactory & low with the levels below 3% organic matter being rated as unsuitable for planting media use unless ameliorated. In all sites in the exposed subsoils subsoil layers the OM levels would be < 1%. Stripping/mixing/stockpiling of these soils will result in low soil organic carbon contents if mixed.

However, the top layer (generally <100mm to 200mm) would benefit from incorporation of composted organics with a NDI > 0.5 into the top stripped layer of exposed soil. Use of this organic amendment will increase the soil water holding, soil drainage (leaching) increased nutrient retention and help stabilise the topsoil to resist erosion and promote healthy plant growth.

If controlled or slow release fertilisers are applied the composted organics will ensure nutrients are not leached from the root zone. A suggested rate of incorporation of conforming soil organic conditioner (see Appendix for requirements) is 20% by volume of compost to soil.

Please note Organic Matter is simply a derived property from Organic Carbon.

4.9 Soil Fertility Factors

Soil Nitrogen (N), Phosphorus (P) and Potassium (K) & Trace Elements (Copper(Cu) , Zinc (Zn), Boron (B) etc) for topsoil layers have been assessed.

In summary the samples for N, P, and K are from low to Very low,

- N is low and will need to be applied as fertiliser
- Phosphorus is *low for all soil types* – Top soil will suit P sensitive native plants but additional P will be need to be added for the soil for general plantings and turf grass. If hydro mulch applied seed species or ecoblanket if applied, additional P will be need to be added
- *K is needed* and for *Sandy TC* Gleyed groups must be added as fertiliser & increased further for healthy plants especially plants & turf grass

Trace Elements

Trace elements were assessed for these top soil layers soils and in summary the results are:

- Zinc (Zn) is *low to very low* and will need to be added as fertiliser
- Copper (Cu) is generally rated *low to very low* and will need addition as fertiliser
- Manganese (Mn) is rated *low*
- Iron (Fe) is rated *low to moderate*
- Boron (B) is *low to very low*

Any fertiliser amendment would need to contain trace elements, as additional fertiliser amounts, and also needs to contain Nitrogen (N), Phosphorus (P) (Not for P sensitive plants) and Potassium (K) added for most plants & turf grass to establish. Zinc, Boron & copper will need to be added as well.

4.10 Soil Laboratory Methods

For the areas from which the soil samples taken by ESSA at request of Client, laboratory subsamples were taken, described & mixed by ESSA and extracted to give an overall assessment of the soil conditions via a representative bulk sample at each location.

Methods used for the assessment followed *Australian Laboratory Handbook of Soil and Water Chemical Methods (1992) by Rayment & Higginson*. The methods used are recognised Australia wide as consistent methods and procedures that are used for diagnostic and research purposes.

5. Recommendations

5.1 Soil Assessment

The characteristics of the soils of the site studied show that the site soils are in 3 management groups and have:

- Strongly acid pH,
- very low to low salt levels,
- low to extremely low exchangeable calcium (Ca),
- low to very low calcium to magnesium ratios (Ca/Mg ratio),
- generally moderate to high magnesium & high when compared to calcium
- high aluminium levels (%Alsat)
- sodic to strongly sodic soils

All the above will need to be addressed to reduce the risk of failure of any site revegetation works and dispersion effects of any disturbed subsoils used or left as cut batters or reused for advanced tree pit plantings.

For the very acidic, low exchangeable cations (Ca/Mg) ratio, magnesian, sodic, high aluminium soils it is suggested to add agricultural lime (preferred) /dolomite at suggested rates based on the pH section of the report and detailed in Table 8 & Table 8a.

All ameliorants suggested will need to be incorporated by effective mixing with the soil to have maximum effect.

In addition, some soils especially the subsoil from existing surface textured as clays in this case will require incorporation of well composted organic matter with NDI (Nitrogen Draw Down) of > 0.5, as well as the agricultural dolomite to treat the acidic conditions and cation imbalances as described in the report.

As per MRS11.16B (Interim) generally, all soil amelioration agents should be free of contaminants and specifically:

- agricultural lime and if dolomite substituted shall be agricultural dolomite consisting of ground limestone (calcium carbonate - CaCO_3) with a neutralising value (NV) of 95 or above; or
- Agricultural dolomite shall be agricultural dolomite (CaMgCO_3) with NV of 90 - Preferred.

PRODUCTS NOT RECOMMENDED

- agricultural gypsum (calcium sulfate $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) shall be a natural agricultural grade material; Not Required

5.2 Recommended soil treatments – Ripley Urban Core Area 1 & Ripley Road Corridor.

The Tables 6 & 6a below give recommended Amelioration & Management for Surface (Topsoil Layers) & Subsoil to be revegetated or planted & landscaped . Details of Table 6 & 6a content is given below

Table 6 – RUC Project – Ripley soil use and or amelioration recommendations for landscape treatments – Site Planting Media & Subsoil Management

Table 6a - RUC Project – Ripley soil use and or amelioration recommendations for landscape treatments – Imported Planting Media & Planting Recommendations

Table 6 Site Planting Media & Subsoil Management

Site Requirement Description	Agricultural Lime/ Agricultural Dolomite*	Agricultural Gypsum	Fertiliser	Soil Organic Conditioner NDI >0.5
Stripped Site Soil (Top soil Layer) To conforming Planting Media	Top soil Layer -5kg/m3. Ag. Dolomite incorporate	NIL required	Per Plantings Use Appropriate Scotts Fertiliser products	Estimate require 20% minimum Conforming Organic soil conditioner
Site exposed soils – In the site subsoil areas to reveg. subsoil in exposed sloping surfaces for general cover & rehabilitation	1-Subsoils Estimate 10-15kg/m3, Ag. lime incorporate or (1.5-2 kg/m2/200mm depth incorporated). Ag. Lime Preferred	NIL required	Yes, CRF* appropriate to plantings. For Turfgrass add Scott's Lawn Builder @ 2.5kg/100m2 General Plantings Scotts Sierra Blen at 350kg/ha or 40-50g/m2	Recommend Apply Groundworks Ecoblanket**™ At manufacturers recommendation <u>NOTE: No Planting Media need for this option Or apply Hydromulch (Planting Media needed for this option.)</u>
Site exposed soils – Earthworks in the subsoil areas to smooth out exposed sloping surfaces to be landscaped	1-Subsoils Estimate 10-15kg/m3, Ag. lime incorporate or (1.5-2 kg/m2/200mm depth incorporated). Ag. Lime Preferred 2-Add as surface (Top)Planting Media layer at minimum 50mm conforming MRS11.16B Planting Media or ameliorated site stripped soil conforming to MRS11.16B	NIL required	Yes, CRF* appropriate to plantings. For Turfgrass add Scott's Lawn Builder @ 2.5kg/100m2 General Plantings Scotts Sierra Blen at 350kg/ha or 40-50g/m2	For stripped Site topsoil to MRS11.16b add 20% minimum Conforming Organic soil conditioner
All subsoils used in batter / cut /fill areas where in exposed areas in the project	Subsoils - Estimate 10-15 kg/m3, incorporate (1-2 kg/m2/200mm depth incorporated). Ag. Lime Preferred Leave Roughed surface add 50mm conforming MRS11.16B Planting Media	NIL required	Yes, CRF* appropriate to planting as appropriate suggest e g	None

Table 6a Imported Planting Media & Planting Recommendations

Site Requirement Description	Agricultural Lime/ Agricultural Dolomite*	Agricultural Gypsum	Fertiliser	Soil Organic Conditioner NDI >0.5
If Imported Planting Media applied after subsoil amelioration	Add 50mm conforming MRS11.16B Imported Planting Media	NIL required	Yes, CRF* appropriate to planting	Per Full Suite MRS Specification in Appendix
Larger plantings Shrubs Trees	Mix backfill soil with 15 kg/m3, Ag. dolomite incorporate or Ag. Dolomite (1-2 kg/m2/200mm depth incorporated). Coat excavated planting holes with 1mm thick blanket Ag. Dolomite	Nil	Yes , CRF appropriate to planting	Recommend Incorp @ 10% by Volume

Site Requirement Description	Agricultural Lime/ Agricultural Dolomite*	Agricultural Gypsum	Fertiliser	Soil Organic Conditioner NDI >0.5
Tree Pits	15 - kg/m3, Ag. Dolomite incorporate & mix well Lime excavated tree pit with 1-2mm ag. Lime to exposed surface (Coat excavated planting holes with 1-2mm thick blanket Ag.Dolomite	Nil	Yes, CRF appropriate to planting	Suggest 10% Soil conditioner well mixed with backfill soil
If Ecoblanket (compost) blanket applied after Earthworks & subsoil amelioration in cut batters as erosion control & reveg. method. RECOMMENDED	Incorporate all ameliorants into Eco blanket	NIL required	Yes, CRF* appropriate to planting incorporated in application	Recommend Apply Groundworks Ecoblanket™ At manufacturers recommendation. <u>No Planting Media need for this option</u>
All Layers	Suggest all watering containing wetting agent (Hydroflo II)			

5.3 Organic Fertiliser alternative for Tree Pits

As fertiliser alternative for tree pit planting as substitute for inorganic fertiliser is the following recycled organic products –

Tree Pits:

Apply per cubic metre volume of tree pit:

- 1 to 2 bags of “Multi –Pro” (Organic compost fertiliser & Soil Conditioner).AND
- 1 to 1.5 Kg of “Hydra TerraPlex “ per cu metre mixed in with backfill soil around and next to root ball. Hydra- TerraPlex is an Organic based Long term Fertiliser with wetting agents and beneficial soil inoculants. It is a plant establisher, used in Street tree, fruit tree crops and Landcare plantings & where environmentally sensitive riparian soil treatment is required .

5.4 Limitations of Soil Data

Accuracy of soil properties assessed:

- the representative soil sampled is accurate and reliable at the scale of the project and the representative soil analyses information has been extrapolated to other soils examined from the field sampled sites and observations for these areas; and

Level of confidence of the Lab data being representative of the site:

- High level of confidence. Refer to *Further Soil Sampling and Testing* below for recommended actions.

Details of the variation of soil levels expected per soil type and location and depth.

- There are many layers / types of soils ,mostly hard & soft clays over decomposing parent materials

5.5 Further Soil Sampling and Testing

It is considered that further sampling and MRS11.16B modified sub suite testing of particular locations be undertaken where vegetative changes and or soil treatments (amelioration) proposed. *Other than the above recommendations no other sampling / testing* is required at this stage unless changes to the landscaping or new features are added to the project areas.

Extra soil testing is especially recommended if landscape rehabilitation changes occur (Deeper excavations for example) to establish whether dispersive and soil pH conditions (and associated soil properties) occur. See report for the changes in soil properties expected.

It is recommended that MRS11.16B and consistent laboratory methods form part of the soil test monitoring and a Planting Media Management Plan (PMMP) be produced to ensure that valid and necessary soil comparison information is provided during the contract period to optimise the management of the soils used in this project.

Any imported planting media should conform to MRS11.16B full suite specification and the soil conditioner (stabilised compost) used as an ameliorant should conform to pH, EC Wettability and NDI specifications as Detailed in MRS11.16B. Note this should apply to the soil organic matter used as an additive to any manufactured soil imported into the project. Soil Testing Proformas for Laboratory Requirements is given in Appendix.

Laboratory Methods strongly recommended are Methods used for the assessment of soil properties by following the Australian Laboratory Handbook of Soil and Water Chemical Methods (1992) by Rayment & Higgenson. The methods used are recognized Australia wide as consistent methods and procedures that are used for diagnostic and research purposes.

It is recommended that MRS11.16B form part of the contract documents so as to ensure the necessary soil information is provided by the Contractor during construction to optimise the management of the soils used in this project.

5.6 Auditing of ameliorated soil / Rehabilitation

It is considered that further sampling and MRS11.16B modified sub suite testing of particular ameliorated soil (after Ag Lime & organics incorporated) be undertaken to ensure appropriate soil treatments (amelioration) is applied.

5.7 Soil Testing & Soil Organic Conditioner Requirements

As a minimum suite of testing the contractor to ensure:

- Soil Organic Conditioner complies with attached specification for 'Soil Organic Conditioner' in appendix
- For ameliorated stripped soil top layer or subsoils ameliorated with Soil Organic Conditioner & or Ag Lime that sub suite test is supplied.
- If topsoil applied must conform to MRS11.16B attached in Appendix
- Soil Analysis report must be provided with each audit analysis of :

- 1) Ameliorated stripped soil

- 2) Any imported topsoil (if used) &
- 3) Soil Organic Conditioner.

See Appendix to report for minimum testing requirement by contractor.

5.8 Other Site Issues Swales & Drains

The top of batters need to have grassed swale drains to ensure overland runoff onto the batter surfaces is minimised. An alternate may be an organic berm or soil berm installed at top of batter to achieve similar result. For Drains need cleaning out Turfing & for high flows consider Vetiver Grass hedges (across flow path) & planted every 20m lineal of flow path (detail can be provided if this option selected). In any case all soils under Swales & Drains must be ameliorated per Table 6.

6. Conclusions

As detailed in the above report the soils studied in this report indicate poor soil conditions exist in the Ripley Urban Core areas studied in the upper 0.9m of the profile. Some data for deeper sample layers are presented by ESSA and this soils data indicates similar soil conditions exist >0.9m with possibility of some areas saline and as recommended excavations below 0.9m from top of ground surface be checked.

In any event the soils insitu for revegetation present particular problems.

For establishment of vegetation and thereby stabilising the soils and preventing soil erosion & production of erosion and sediment control the soil properties for stripped topsoil and within any of the exposed subsoil layers need to be treated as recommended.

Suggested treatments & alternates are recommended and are contained in Tables 6 & 6a in the report. If subsoil treatment & 50mm Planting Media applied (media per full suite specification in appendix A), Planting Media used must not be sand or clay (see Full Suite specification for details). For the conclusion Primary Soil Attributes are summarised.

6.1 Dispersion

Table 3 presents four commonly used indicators of potential for clay dispersion. Dispersion of clay particles can damage soil structure by destroying large flocculated aggregates and filling the voids between these aggregates with much finer, dispersed material. Thus, the porosity and permeability of the soil declines and the erodibility increases as the small dispersed particles are easily moved in water.

The Exchangeable Sodium Percentage (ESP), Exchangeable Calcium : Exchangeable Magnesium (Ca:Mg) ratio, Soil Dispersion Indicator field test (SDI) and Emerson Dispersion Test (EDT) are used as independent estimates of soil dispersion.

The tendency for dispersion usually increases with increasing ESP and decreasing Ca:Mg ratio. Sodic soil layers (ESP ≥ 6) may disperse and strongly sodic soils (ESP ≥ 15) usually do. Soils with Ca:Mg ratios of 0.5 or less often exhibit dispersion.

ESP and Ca:Mg ratio are derived from chemical analyses and must be interpreted with care. When the actual exchangeable cation levels are very low, any small change in one value can

cause a disproportionate change in the percentage or ratio calculation and thus alter the dispersion rating.

Another complicating factor that must be considered for soils within the development area studied is the aluminium saturation. Soil layers with high aluminium saturation may not disperse despite many of the soil indicators suggesting that they should. This is due to the effects of aluminium in causing clay particles to flocculate (aggregate) together, thus resisting their tendency to disperse.

However, the results for the dispersion indicators have been interpreted and modified where necessary to allow for soil texture (low CEC), aluminium saturation and site and profile conditions observed during field inspection.

The overall interpretation is provided in Table 7 for all sampled soil layers.

Table 3 indicates that the surface and subsurface layers of the *all* are mainly non sodic (ESP <6) though they have a Ca:Mg ratio of 1.0 or less. However, the EDT tests indicate a tendency to disperse in only a few samples and overall these two layers are considered unlikely to be dispersive.

All subsoil samples from the *TC soils* have at least one indicator designating dispersion and a substantial proportion have three indicators. Most subsoil samples have high aluminium saturation suggesting dispersion may be unlikely but significant subsoil erosion was observed nearby

Table 7. Dispersion indicators for each mapped soil type

Soil name (Site) ¹	Soil layer ¹	Samples	Texture ^{2,3}	ESP ≥ 6 ^{2,4}	Ca:Mg ≤ 0.5 ^{2,4}	ECN ≤ 2 ^{2,5}	SDI ^{2,6} Slaking, Clouding	Al sat'n $\geq 25\%$ ²	Dispersive ⁶
Sandy red-yellow/ yellow grey TC soils	Surface:	1	SL	<6	1.4	Nil	low, Nil	No	Unlikely
	Subsurface:	4	MC	7-13.6	0.1	Nil	low, Nil	yes	Unlikely
	Subsurface:	1	MC	9-17	<0.1	Nil	low, mod	yes	Possibly
	Weathered rock:	1	SL	nil	<0.1	Nil	low, mod	yes	Possibly
Sandy gleyed TC soils	Surface:	2	LS	<6	20%	10%	Nil, Nil	Yes >40	Unlikely
	Subsurface:	3	MHC	>15	Nil	Nil	low, mod	Yes >40	Unlikely
Sandy gleyed TC soils flats	Surface:	1	SL	<6	Nil	Nil	Nil, Nil	No	Non
	Surface + subsurface:	1	SL	16	Nil	Nil	Nil, Nil	No	Unlikely
	Subsoil:	1	MC	28	100%	Nil	low, Nil	No	Possibly
					100%	50%	low, Mod	-	Possibly

Notes:

1. Samples designated as "Surface + subsurface" have been combined from both the surface and subsurface layers.
2. > = samples that exceed the threshold limit ; < = samples that do not exceed the threshold limit >6 ; Sodic >15 Strong Sodic.
3. Texture codes are:
SL Sandy loam
FSCL Fine sandy clay loam
SCL Sandy clay loam
CLS Clay loam, sandy
Some surface and subsurface samples with poor ESP or Ca:Mg ratio have a CEC of 2 or less and the results are subject to high computational error.
4. ECN is the Emerson Class Number assigned to each soil sample as a result of the laboratory-based Emerson Dispersion Test. Classes 1 and 2 are dispersive but Classes 5 and 6 are non dispersive.
5. SDI is the Soil Dispersion Indicator field test and any sample which exhibits "Slow" to "Fast" slaking or with "Slight" to "High" clouding indicates some degree of soil instability.
6. Soil layers labelled as "probably" dispersive have more indexes suggesting dispersion than those that don't. Soils labelled as "possibly" dispersive have fewer indexes suggesting dispersion than those that don't. Soils labelled as "unlikely" to be dispersive are generally non sodic and have much fewer indexes suggesting dispersion than those that don't.

6.3 Erodibility

Five soil erodibility ratings have been defined in the Transport and Main Roads RDDM (Transport and Main Roads 2002). All soils identified within the corridor have been assigned to these erodibility ratings which are presented in Table 5.

All subsoil layers of the TC are likely to be dispersive and have inherent erodibility. This especially applies to the clay subsoil which is dispersive giving the entire subsoils a moderate to high erodibility rating.

6.4 Permeability

Soil permeability refers to the ability of the soil to transmit water through its profile in situ and is controlled by the transmission potential of the least permeable layer. Soil permeability is a function of texture, structure, capacity to crack open when dry and soil dispersion. The Australian Soil and Land Survey Field Handbook (McDonald et al 1990) defines four permeability classes:

- very slowly permeable;
- slowly permeable;
- moderately permeable; and
- highly permeable.

These soil permeability ratings have been assigned to each soil based on field evidence and soil analytical results. The ratings are listed in Table 8.

Table 8. Soil erodibility and permeability ratings

Soil name	Erodibility ¹	Permeability ²	Indicative hydraulic conductivity ²
<i>Sandy red-yellow/ yellow grey TC soils</i>	moderate	Moderate-slow	≈50 mm/day
<i>Sandy gleyed TC soils</i>	Moderate - high	Moderate-slow	≈50 mm/day
<i>Sandy gleyed TC soils flats</i>	Moderate - high	Slow-very slow	<5-50 mm/day

Notes:

1. From the Transport and Main Roads Road Drainage Design Manual (Transport and Main Roads 2002).
2. From the Australian Soil and Land Survey Field Handbook (McDonald et al 1990).

Overall, these profiles would have slow to very slow permeability with an indicative hydraulic conductivity varying from less than 5 up to 50 mm/day.

7. Site soil suitability for re-use in landscaping and revegetation

7.1 Suitable soils

Provided appropriate amelioration strategies (per Table 6) are implemented the surface layers of the TC are suitable for re-use in landscaping and revegetation as detailed below.

Table 9 – Soil Group Stripping Depths for Planting Media, Ripley Urban Core

Soil	Landform	Modal slopes	Stripping depth (mm)	Area (ha)
<i>Sandy red-yellow/ Yellow grey TC soils (dispersive)</i>	Convex upper slopes	3-8%	0	5.1
<i>Sandy gleyed TC soils (dispersive)</i>	Mid-lower slopes	4-10%	200	20.6
<i>Sandy gleyed TC soils (dispersive)</i>	Valley flats	3-6%	250	5.1

7.2 Unsuitable soils

Because of their hilly terrain and thin cover of surface layer overlying clay subsoil that is probably dispersive, the *Sandy red-yellow/ yellow grey TC soils (dispersive) on crests* are unsuitable for any re-use in landscaping and revegetation as planting media. The whole soil profile however must be ameliorated per Table 6 & 6a before landscape treatments applied.

Disturbance of these soils should be limited to removal of organic matter from surface that is grubbing.

8. Site soil stripping

This report arranges soil profiles into surface layers, subsurface layers and subsoil to facilitate description of profile features (see section 3.1). However, MRS11.16 General Requirements Landscape and Revegetation Works uses the terms "topsoil" and "subsoil" (Transport and Main Roads 2009). Natural surface layers are equivalent to "topsoil" as defined by Transport and Main Roads whereas subsurface layers and subsoil as used in this report are part of the Transport and Main Roads definition of "subsoil".

Where necessary, the term "topsoil" is used in sections of this report to provide direct correlation with Transport and Main Roads specifications but is applied strictly according to the Transport and Main Roads definition.

8.1 Removal of organic matter

During construction, "topsoil" is partly or fully stripped to remove as much organic matter as possible from the disturbed site areas.

8.2 Depth of suitable soil for re-use in landscaping and revegetation - RUC

The limited chemical analyses performed on soil samples for this survey indicate the chemical barriers to using any of the surface and subsurface layers for revegetation can be overcome with acceptable amelioration strategies.

Therefore, the thickness of soil material suitable for stripping, stockpiling and subsequent revegetation has been determined by the depth to heavier clay subsoil in the three soil groups.

However, the maximum depth recommended for stripping has been decreased by 50 mm to leave some suitable material within the landscape so that the dispersive subsoil is not mixed with the desirable top layers to be ameliorated for use as planting media.

Table 9 presents the calculated depth of soil material in each soil that is suitable for stripping and re-use in landscaping and revegetation. It includes all suitable surface and subsurface layers. Only the surface layer is equivalent to "topsoil" as defined in MRS11.16 General Requirements Landscape and Revegetation Works (Transport and Main Roads 2009).

Thus, the maximum depth that is recommended for stripping is not restricted to "topsoil" alone (as defined by Transport and Main Roads 2005). It may also include any part of the Transport and Main Roads defined "subsoil" that is non dispersive, friable and readily breaks down to create a fine seed bed. Medium and heavy clays are usually not recommended as they tend to be difficult to work, have very slow permeability and have coarse structure which will not readily break down.

A proposed topsoil stripping schedule is provided in Table 9.

9. Risk management strategies

9.1 Clearing and grubbing operations

On sloping land where slopes exceed 2% (1:50), clearing and grubbing operations should not leave tyne lines or rills aligned down the slope. Working along contours is recommended.

Erosion control measures as outlined in section 10.2 should be implemented on all sloping land as soon as clearing and grubbing operations are completed.

9.2 Erosion control works and any sedimentation basins

Temporary runoff control structures should be installed in disturbed areas of sloping land where slope length exceeds 100 m. The runoff control structures should be placed across the slope at regular intervals (down the slope) within any disturbed area as soon as is practicable. The placement of these structures should divert runoff water along the contour and then spread it across the slope outside the disturbed area.

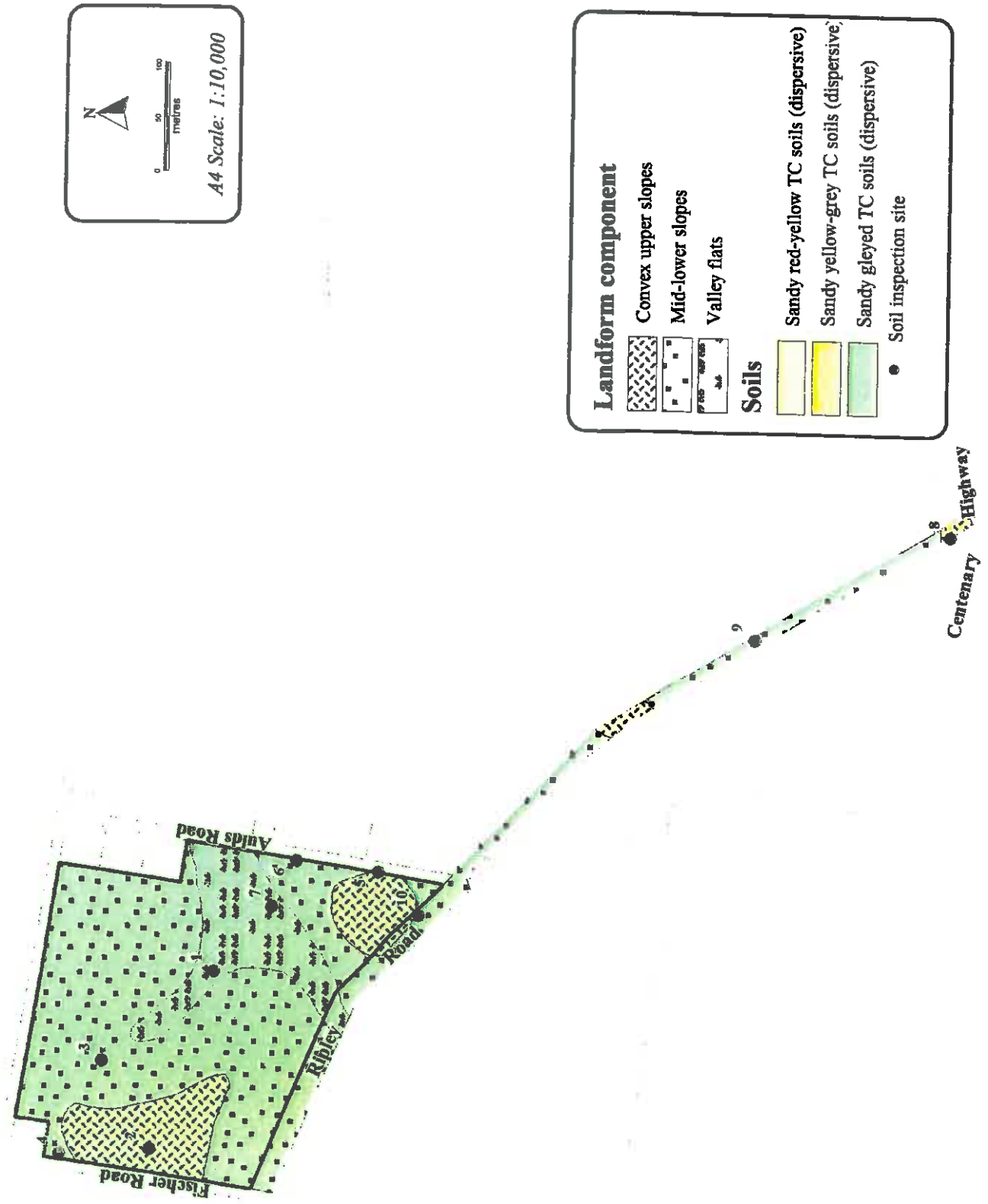
The *Red-brown clays* have low to moderate inherent erodibility but usually occur on quite steep slopes and a number of specific precautions should be implemented in addition to those described above and in section 7:

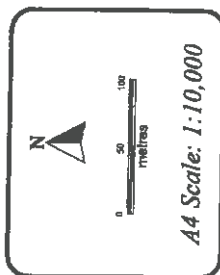
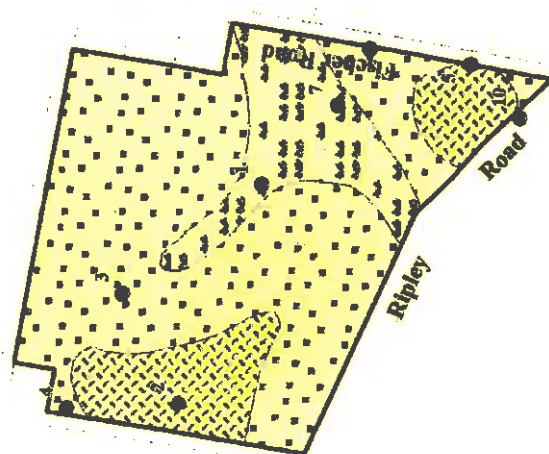
- Wherever possible, grubbing operations outside new the road footprint should leave at least 100 mm of undisturbed soil material (surface and/or subsurface layers) on top of the subsoil.
- The land surface outside the new road footprint should be levelled as soon as possible after any clearing and grubbing operations are finished. The levelling should create a slight convex shape that spreads runoff water away from the disturbed area rather than allowing it to concentrate.
- In particular, any holes should be filled with soil material from the surface and/or subsurface layers. If necessary, complying topsoil should be brought in from elsewhere to ensure no subsoil remains exposed. The levelled surface may have to be lightly compacted to ensure it is not easily moved by raindrop splash and running water.
- Sedimentation basins that expose the subsoil to runoff water should be compacted to ensure minimal water penetration into the soil material.

Works across the valley flats are usually built on top of the existing land surface, rather than excavating into it, and will thus minimise any erosion risk. However, the *TC* will be the dominant soil on bank slopes and any disturbance of these banks will involve a high erosion risk. If disturbance is necessary, these slopes should be restabilised as soon as possible as directed.

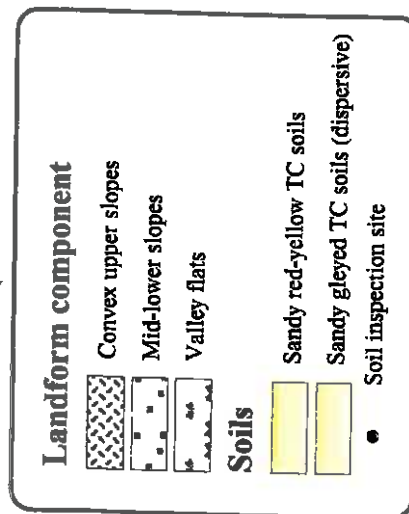
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Aulds Road



Centenary Highway

Soil 1

C – Full-Suite Analysis Schedule

Site Sample Identification	
Project Name:	Sample Location:
Job / Contract No:	Site / Stockpile No:
Date Tested:	Layer and Depth (from surface in mm):

Testing Laboratory Sample Identification	
Laboratory No:	Sample No:

Soil Test Parameter	Test Method	Soil Test Parameter Requirements	Soil Test Results
Refer AS 4419 – Soils for landscaping and garden use NOTE MODIFIED REQUIREMENTS			
Bulk density (BD)	Clause 5.2	> 0.7 kg/L	
Organic matter (OM) (relevant to the organic carbon concentration)	Clause 5.3	3 to 10%	
Wettability	Clause 5.4	> 5 mm/min.	
pH (H ₂ O, 1:5) – a) General range b) Naturally occurring acid soils c) Naturally occurring alkaline soils	Clause 5.5	> 5.5 and < 7.5 > 5.5 and < 6.5 > 7.0 and < 8.5	
Electrical conductivity (EC)	Clause 5.6	< 1.2 dS/m	
Extractable phosphorous content (Extr. P) Very P sensitive plants Moderately P sensitive plants	Clause 5.8	< 5 mg/kg < 20 mg/kg	
Permeability	Clause 5.12	2 – 100 cm/hr	
Texture	Clause 5.13	Refer to Table AS 4419, Table 11 Soil texture Classification	
Large particles – planting media to – a) Turfed or grass seeded areas to be mown or slashed b) Batters to be mulched or hydraulic seeded and hydraulically mulched c) Broad acre areas to be seeded with native species	Clause 5.14	100% by weight to pass a 20 mm sieve 100% by weight to pass a 50 mm sieve 100% by weight to pass a 75 mm sieve	
Refer Appendix Table 1 – Method for Determination of Water Repellency of a Soil (Hydrophobicity)			
Water Repellence Rating (for sands to clay loams)	Appendix Table 1	Class 0 or 1	
Refer AS 1289.3.8.1 – Methods of testing soils for engineering purposes			
Dispersion – Emerson class number	Clause 3.8.1	Class 3 to 8	

Schedule continued over page.

C – Full-Suite Analysis Schedule – (continued)

Schedule continued from previous page.

Soil Test Parameter	Test Method	Soil Test Parameters Requirements	Soil Test Results
Refer ALHS (Australian Laboratory Handbook of Soil and Water Methods)			
Exchangeable calcium (Ca) a) Sands and loamy sands b) Sandy loams to clay loams	Clause 15B3	≥ 2 meq/100g ≥ 5 meq/100g	
Exchangeable magnesium (Mg) a) Sands and loamy sands b) Sandy loams to clay loams	Clause 15B3	> 0.6 meq/100g > 1.0 meq/100g	
Calcium magnesium ratio (Ca:Mg) Exchangeable form for sands and loamy sands and sandy loams to clay loams	Clause 15B3	2 – 10	
Exchangeable sodium percentage (ESP) (Na base saturation % = % Na of total cations) a) Sands and loamy sands b) Sandy loams to clay loams	Clause 15B3	< 6 < 15	
Exchangeable potassium (K) a) Sands and loamy sands b) Sandy loams to clay loams	Clause 15B3	> 0.2 meq/100g > 0.4 meq/100g	
Exchangeable aluminium percentage (Al base saturation % = % Al of total cations) a) Sands and loamy sands b) Sandy loams to clay loams	Clause 15G1	< 25 < 40	
Effective cation exchange capacity (ECEC) (ECEC = sum of exchangeable cations) a) Sands and loamy sands b) Sandy loams to clay loams	Clause 15J1	> 5 meq/100g > 10 meq/100g	

Sub-Suite Analysis Schedule

Site Sample Identification			
Project Name:		Sample Location:	
Job / Contract No:		Site / Stockpile No:	
Date Tested:		Layer and Depth (from surface in mm):	
Laboratory Sample Identification - Laboratory No:		Sample No:	
Soil Test Parameter	Test Method	Soil Test Parameter Requirements	Soil Test Results
Refer AS 4419 – Soils for landscaping and garden use NOTE MODIFIED REQUIREMENTS			
Organic matter (OM) (relevant to the organic carbon concentration)	Clause 5.3	3 to 10%	
pH (H ₂ O, 1:5) – a) General range b) Naturally occurring acid soils c) Naturally occurring alkaline soils	Clause 5.5	> 5.5 and < 7.5 > 5.5 and < 6.5 > 7.0 and < 8.5	
Electrical conductivity (EC)	Clause 5.6	< 1.2 dS/m	
Refer Appendix Table 1 – Method for Determination of Water Repellency of a Soil (Hydrophobicity)			
Water Repellence Rating (for sands to clay loams)	Appendix Table 1	Class 0 or 1	
Refer AS 1289.3.8.1 – Methods of testing soils for engineering purposes			
Dispersion – Emerson class number	Clause 3.8.1	Class 3 to 8	
Refer ALHS (Australian Laboratory Handbook of Soil and Water Methods)			
Exchangeable calcium (Ca) a) Sands and loamy sands b) Sandy loams to clay loams	Clause 15B3	≥ 2 meq/100g ≥ 5 meq/100g	
Exchangeable magnesium (Mg) a) Sands and loamy sands b) Sandy loams to clay loams	Clause 15B3	> 0.6 meq/100g > 1.0 meq/100g	
Calcium magnesium ratio (Ca:Mg) Exchangeable form for sands and loamy sands and sandy loams to clay loams	Clause 15B3	2 – 10	
Exchangeable sodium percentage (ESP) (Na base saturation % = % Na of total cations) a) Sands and loamy sands b) Sandy loams to clay loams	Clause 15B3	< 6 < 15	
Exchangeable potassium (K) a) Sands and loamy sands b) Sandy loams to clay loams	Clause 15B3	> 0.2 meq/100g > 0.4 meq/100g	
Exchangeable aluminium percentage (Al base saturation % = % Al of total cations) a) Sands and loamy sands b) Sandy loams to clay loams	Clause 15G1	< 25 < 40	
Effective cation exchange capacity (ECEC) (ECEC = sum of exchangeable cations) a) Sands and loamy sands b) Sandy loams to clay loams	Clause 15J1	> 5 meq/100g > 10 meq/100g	

Soil Assessment Report

Site Sample Identification	
Project Name:	Sample Location (general):
Job / Contract No:	Site No's:
Date Tested:	Soil Layers (topsoil and / or subsoil):
Testing Laboratory Sample Identification	
Laboratory No:	Sample No's:

The Soil Assessment Report shall include –

- a completed test suite analysis schedule per sample;
- written assessment and interpretation of test results relevant to the intended use of planting media; including –
 - an erodibility and dispersion risk assessment; and
 - recommendations for the best use of a particular soil type, where applicable,
- clearly defined non-conforming soil properties;
- where amelioration is required, the type of ameliorant material together with rates and methods of incorporation; and
- where required, provide a Soil Assessment Report on the material to be used for the construction of drainage devices as outlined above.

Organic Soil Conditioner Requirements

Site Sample Identification			
Project Name:		Sample Location:	
Job / Contract No:		Site / Stockpile / Windrow No:	
Date Tested:		Depth (from surface in mm):	
Testing Laboratory Sample Identification			
Laboratory No:		Sample No:	
Organic Soil Conditioner Parameter	Test Method	Organic Soil Conditioner Test Parameter Requirements	Organic Soil Conditioner Test Results
Refer AS 4454 – Composts, soil conditioners and mulches			
National health standards	Clause 2.1.1	Complies with standards	
Visible extraneous material (% dry matter) –		0.5%	
a) glass, metal, rigid plastics > 2 mm	Appendix H	0.05%	
b) plastics-light, flexible or film > 5 mm		≤ 5%	
c) stones and lumps of clay ≥ 5 mm			
United States Environmental Protection Agency (USEPA)			
Soil Conditioner Quality USEPAA/625/R – 92/013	Thermophilic	Turning and temperature	
Refer AS 4419 – Soils for landscaping and garden use – NOTE MODIFIED REQUIREMENTS			
*pH (H ₂ O, 1:5) –			
a) General range	Clause 5.5	> 5.5 and < 7.5	
b) Naturally occurring acid soils		> 5.5 and < 6.5	
c) Naturally occurring alkaline soils		> 7.0 and < 8.5	
NDI (Nitrogen Drawdown Index)	Clause 5.9	> 0.5	
*Wettability	Clause 5.4	> 5 mm/min.	
*EC (Electrical Conductivity)	Clause 5.6	< 2.5 dS/m	
Particle size of soil conditioner –			
a) to pass a 10 mm sieve	Clause 5.14	90% by weight	
b) to pass a 20 mm sieve		8% by weight	
c) not to pass a 20 mm sieve		2% by weight	
Refer Appendix Table 1 – Method for Determination of Water Repellency of a Soil (Hydrophobicity)			
Water Repellence Rating (for sands to clay loams)	Appendix Table 1	Class 0 or 1	
Refer ALHS (Australian Laboratory Handbook of Soil and Water Methods)			
Moisture content	2 B1 Rayment & Higginson	> 25% and < 35%	
Refer Draft Guidelines for the Assessment & Management of Contaminated Land in Qld – EPA			
Heavy metals and organic chemicals contaminants	Appendix 9 Table 9.1	Not to exceed EIL thresholds	

* Test requirements that have been modified from those in AS 4419.

Recorded - 21 January 2011

Ripley Urban Core

Site 1, WP 1. 2 site photos, 2 soil photos. Valley flat, extensively cleared. Blue gums, Site in gully 1%, side slopes 3-5%. Wet surface. No gravel. Stripping depth 250cm max.

0 – 80	SL; 10 YR 4/1 (M) with 2-10% 1db mottles; massive; W ₁ ; no gravel; no segs; clear to pH 6.
80 – 250	SL; 10 YR 5/1→5/2 (M) with 10-20% 1db mottles; massive; W ₂ ; no gravel; no segs; clear to pH 6.
250 – 400	SL; 7-5 YR 7/2 (M); massive; W; no gravel; no segs; pH 6.5; abrupt to -
400 – 600	MC; 7.5 YR 5/8 (M) with 10-20% 1 dg mottles (10 YR 5/1 (M)); structure mod.; W; 20-50% 6-60mm sa gravel; 2-10% 2 nn; pH 6→5.5.
600 – 750	MHC; 10 YR 8/1 (M) with 20-50% 2 db mottles (10 YR 5/8 (M)); structured; W; pH 4.5; 0-2% gravel as above; no segs; abrupt to -. NOTE; Perched water table on top of clay.
800	Too hard to dig CS; weathered sandstone.
	Samples 0 - 200, 250 – 400; 450 – 700mm.

Site 2, WP 2, Ridge top. Partially cleared. Ironbark. Spotted gum. Acacia understorey. Wet surface. 2-10% 60-600+mm sa gravel. Slopes 2-5%. Stripping depth 100 max.

0 – 80	SL; 7.5 YR 4/2 (M); massive; W ₁ ; no gravel, no segs; pH 6.5; clear/gradual to -
80 – 200	SL; 7.5 YR 6/4 (M) with 20-50% 1 dg mottles (10 YR 5/1 (MM)); massive; W ₁ ; no gravel; no segs; pH 5.5, clear to -
200 - 250	SL; as above but with water table; pH 5.5 clear to -
250 - 500	MC/MHC; 5 YR 5/8 (M) with 20-50% 7.5 YR 6/3 (M); structured; M ₃ , no gravel; no segs; pH 5; clear to -
500 – 600+	Weathered rock; SCL; 7.5 YR 5/8 (M); T; 10-20% 6-20mm sa gravel; no segs; pH 5.
	Samples: 0 - 200; 300 - 450; 500 - 600+
	NOTE: (1) Within 5m of Geotech BH 38 – Not dug yet. (2) Perched watertable 200-250.

Site 3, WP 3, 2 site photos; 1 soil; slopes 2-4%; lower slope. Partially cleared. Wet surface. Acacia regrowth. Swamp mahogany. Moreton Bay Ash. Spotted Gum. Stripping Depth 300 max.

0 – 120	LS; 7.5 YR 4/2 (M); massive; W ₁ ; no gravel; no segs; pH 6; gradual to -
120 - 300	LS; 7.5 YR 4/2 (M); massive; W ₁ ; no gravel, no segs; pH 5.5; clear to -
300 – 400/450	LS/SL; 7.5 YR 6/2 & 6/3 (M) with 2-10% 2db mottles; massive; W ₁ ; no gravel; no segs; abrupt to -
400/450 - 700	MHC (Sodic); 10 YR 7/1 (M) and 20-50% 2 do mottles; 10 YR 5/8 (M); structured; W ₄ ; 10-20% 2-20mm sa gravel; pH 5.5; clear to -; 1 nn 2
700 – 900+	MC; 2.5Y 8/0 (M) with 10-20% 2 dr mottles; (2.5 YR 4/8 (MM)); structured; W ₄ ; no gravel; no segs; 650 pH 5; 800 pH 5.
	Samples 0 - 200, 500 – 700; 700 – 900. NOTES: Overland Flow. Perched water table on top of B horizon.

Site 4, WP 4, Mid slope on ridge. Partially cleared. Spotted gum acacia. Wet surface. 250mm of SL; bleach in bottom 20mm over grey and yellow-brown clay (abrupt boundary). (Possibly sodic).

Same as Site 3.

Sample 0 – 200.

Stripping Depth 100 Max.

No Photos.

Site 5, WP 5. Upper slope. Mostly cleared. Spotted gum. Bloodwood. Moreton Bah Ash. Acacia. Soap Bush. Slopes 8%. Soil stripping depth nil (0 mm).

0 – 80	SL; 7.5 YR 3/2 (M); massive-weak; 2SB; M; no gravel; no segs; pH 5, clear to -
80 – 150	SL; 7.5 YR 5/3 (M); massive; M ₁ ; no gravel; no segs; clear to -
150 - 350	MC (sodic); 5 YR 5/6 (M) with 2-10% 1 dg mottles; (7.5 YR 6/2 (M)); structured (mod-strong); pH 5; M _{3/4} ; no gravel; no segs; gradual to -
350 - 900	MC; 5 YR 5/8 (M); 7.5 YR 6/8 (M) and 2-10% 2 dg (7.5 YR 5/3 (M)); mottles; structured; W ₄ ; no gravel; pH 4.5; no segs; abrupt to -
900 – 950+	Weathered rock; MC; mottled red and yellow; pH 4.5
	Samples: 0 - 100; 200 - 350; 400 - 900
	NOTE: Same as Site 2.

Site Photos 2

Site 6, WP 6, Mid slope cleared. Blue gums. Slope 2-4%. Stripping depth 250 Max.

0 – 250/300	LS/SL; 10 YR 4/1 (M): massive; W ₁ ; no gravel; no segs; pH 6.5; clear to -
250/300 - 400	LS/SL; 10 YR 6/3 (M) with 2-10% 2 dg mottles; (10 YR 4/1 (M)); massive W ₁ ; no gravel; pH 6; no segs; abrupt to -
400 - 750	MHC (Sodic); 10 YR 6/1 and 5/8 (M); structured; W _{3/4} ; no gravel; no segs; pH 5.5; clear to -
750 – 900+	MHC (Sodic); 10 YR 7/1 (M) and 2.5 YR 4/6 (M) with 2-10% 1 db mottles; (10 YR 5/8 (M)); pH 5.5; structured; M ₄ ; no gravel; no segs; clear to -
900 – 950+	MHC; 10 YR 7/1 (M) and 5/6 (M); structured; M _{4/5} ; no gravel; no segs/ pH 5.5
	Samples: 0 -200; 200 - 400; 450 – 700; 900 - 950
	NOTES: Maybe 0-2% 2-6mm sandstone gravel in bottom two layers.

Site 7, WP 7. Valley flat below dam. Completely cleared. Blue gums.

450mm of SL over mottled grey and yellow brown clay with sa to sr fine gravel and ironstone. Mn modules. Same as Site. 1.

Site 8, WP 8, Ripley Road Roundabout MR site on NW of Ripley Road.

Samples 350 – 400. 600 – 800.

Site 9, WP 9, Mid slope on Ripley Road. SL over mottled grey and yellow clay over weathered sandstone n/m. Same as sites 3, 4, 6.

Sample 500 – 600.

NOTE: Shallow stony ridge SE of site 10 with old sheds has shallow stony loams on southern side. TC soils on northern slopes. (Lot 182?).

Site 10, WP 10, Lot 180 on Ripley Road. Redder soils similar to Site 2 on upper slope with remnant spotted gum ironbark.

Yellower soil like site 3 only 5m downslope in cutting.

Samples 300 – 400. 800 – 900 (on top of decomposing rock).

Recorded 2005

Site 42, WP 3, Cutting on Ripley Road. Northern photos. Run-on to Ripley Road interchange.

0 – 20	SL; 7.5 YR 4/2 (M) 4/3 (D); massive; moist; no gravel; no segs; probably bleached when dry; abrupt to -
20 – 60	SMC; 7.5 YR 6/3 (M) with 20-50% 2 db (7.5 YR 6/6/5/6 (M)) mottles; 5 AB, moist; 23 sr sa gravel; gradual to -
60 - 100	FSLC; 7.5 YR 6/3 (M) and 10 YR 6/6 (M); moist; M ₄ AB; no gravel; no segs; clear to
100+	CLFS/FSLC; weathered rock; 10 YR 6/6 (M); 20% 2 dg (10 YR 6/2 (M) mottles;
	Samples: 0 - 10; 20 - 30; 50 – 60; 100 – 110; Photos: 12, 13, 10-11.

Site 43, WP 5, Other side of Ripley Road . Midslope in road reserve. Photos.

0 – 20	CLS; 7.5 YR 3/2 (M) 4/2 (D); moderate moist; 3 6-20mm sa ba gravel; clear; charcoal; W/M 2-5m SB; no segs
20 – 55	MC; 7.5 YR 5/4 and 4/2 (M); moderate to strong; moist; 2-10% gravel as above; 2mn 1; 2-10% dark grey mottles; gradual -
55 – 70	HC; 10 YR 5/4 (M); 2-10% 2 dg mottles; no grave; 3 mn 1; 2 Ks 2; moderate; clear -
70 – 100+	MC; 10 YR 6/2 (M) and 5 YR 5/6 (M); moderate; moist; no gravel; 2 mn 2; 2 Ks 2
	All subsoil layers are sodic. Samples: 0 – 10; 20 – 30; 50 – 60; Photos 14, 15.

WP 17, Site 17. Undulating plains/rises. Beside Bundamba Creek. Completely cleared. Old bore? Slope → 2%. 0-2% 20-60mm sub-rescinded gravel; firm (moderate moist).

0 – 35	SL; 10 YR 3/2 (M); massive; T ₁ ; no gravel; pH 5.5; clear to -
35 – 45	LS/SL; 10 YR 5/2 (M); SP BL; massive M ₁ ; no gravel; no segs; pH 7; abrupt to -
45 – 70	SLC; 10 YR 4/1 and 5/6 (M) with BL on top; weak to moderate; D ₆ ; no gravel; no segs; pH 7; gradual to -
70 – 100+	SLMC (Sodic); 10 YR 7/1 and 5/6 (M); weak; D ₆ ; no gravel; no segs; pH 7
	Samples: 0 - 30; 40 – 70.

WP 18, Site 18, Midslope of undulating rises. Completely cleared slopes 5%. Surface hard setting (dry). 0-2% rock outcrop and 2-10% 200-600mm (sa) cobbled.

0 – 15	SCL; 7.5 YR 4/2 (M); massive; T ₂ ; no gravel; no segs; pH 6.5; clear to -
15 – 20	SCL; 7.5 YR 5/2 (M); 2-10% 5-15 mm DY mottles (10 YR 5/6 (M)); massive; T ₂ ; 0-2%; 6-20mm sr pH 6; gravel; no segs; abrupt to -
20 – 30	SMC (Sodic); 10 YR 5 & 5/6 (M); moderate; D ₆ ; no gravel; no segs; pH 6; clear to -
30 – 35	SLC; Weathered sandstone at 35cm. pH 7
	Samples: 0 - 20; 20 – 30.

ATTACHMENT 7
Environmental Soil solutions Australia Pty Limited
“Response to Information Requests” dated 6 March 2011

Environmental Soil Solutions Australia Pty Ltd

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Information Report

**Response to Information Requests,
Under Heading Geotechnical
Ripley Urban Core, Ripley Road**

For MPN

By D E Baker BSc, MASSSI

March 6, 2011

**Ripley Urban Core & Road Widening
RE: "Soil Science" & Site Soils Issues**

ULDA Ref No: DEV2010/84

Background

1- Request for further information re the Development and Ripley Road widening was request by ULDA, Queensland Government.

Method

The specific response items dealt with in this response are soil science issues and are requested under: Geotechnical heading as items 5, 9, 10 & 11.

On further reading, additional information will be provided re items 7 & 12

**Responses to items
Supporting Information**

The information requested in the 9 December 2010 document is addressed below:

Item 5 – Environmental Soil Solutions Australia Pty Ltd (ESSA) January 2011 report entitled RUC Area 1 & Ripley Road provides the answers.

Re Soil Salinity (Item 5)

Risk from Salinity is low see below.

For sites sampled in the Area 1 & Ripley Road, all sites have no significant concentration of soluble salts present in soil (See ESSA Table 5 extract). However, ere are small salt accumulations in Site 8 deep subsoils soils with concentrations still rated as low. Very low / low **salt levels are rated as of no concern with respect to soluble salt content.**

Soluble salts in soils from Sites studied in Area 1 & Ripley Road rated as Medium = ($>0.45\text{dS/m}$) and high (0.9dS/m) **are not present in this study area**, even in the deeper samples tested.

On that basis, on a general area basis soil, soluble salts are not a problem in areas studied.

Table 5 summarises (EC) – Total Salts of the soil properties from the selected representative soil samples from the series of samples by ESSA and profile auguring.

No salts were found with highest EC 0.18dS/m (Very low)

Additional soil salt measurements by Butler Partners in their **Broadscale Geotechnical Report No 010 -218B** with no sample exceeding 0.37dS/m with range 0.04 to 0.37 dS/m (salinity rating low).

Further additional soil salt measurements by Butler Partners in their **Ripley Road Widening Geotechnical Report No 010 -218A** data showed that no sample exceeding 0.68dS/m (1 sample) with range 0.04 to 0.68 dS/m (0.68dS/m rated moderate) with next highest sample 0.47 dS/m (salinity rating low). Of 14 samples from 14 boreholes to 0.95m the average salinity (EC) is 0.20dS/m (low to very low).

Table 5. ESSA Soil Test Parameters, EC, Soluble Chloride P, K, S

RUC Project – Ripley.

Site	Depth	pH H ₂ O	EC dS/m	Chloride mg/kg	Al meq/100g	P mg/kg	S mg/kg	OM%	K meq/100g
TC Upper <i>Sandy red-yellow TC soils</i>									
Site 2 TS	0-200mm	5.7	0.03	21	0.34	6	4	1.8	0.25
Site 2 SS	300-450mm	5.3	0.07	nd	2.27	nd	nd	nd	0.27
Site 2 SS	500-600mm	5.1	0.11	nd	2.5	nd	nd	nd	0.18
Site 5 SS	200-350mm	4.7	0.05	nd	2.48	nd	nd	nd	0.43
Site 5 SS	400 - 900mm	4.9	0.06	nd	3.22	nd	nd	nd	0.36
Site 10 SS	700-900mm	5.3	0.04	nd	3.76	nd	nd	nd	0.35
S9 Road	Crest								
S9TS	500 - 600mm	6.2	0.12	nd	0.34	nd	3	nd	0.34
TC Mid <i>Sandy gleyed TC soils</i>									
Site 3 TS	0-200mm	5.1	0.03	27	0.42	7	nd	0.8	0.04

Site	Depth	pH H ₂ O	EC dS/m	Chloride mg/kg	Al meq/100g	P mg/kg	S mg/kg	OM%	K meq/100g
Site 3 SS	500 - 700mm	5.6	0.04	nd	2.98	nd	nd	nd	0.12
Site 6 TS	0-200mm	5.2	0.03	15	0.44	7	4	1.1	0.10
Site 6 SS Bleach	200-400mm	5.6	0.02	nd	1.32	nd	nd	nd	0.07
Site 6 SS	450-700mm	5.3	0.08	nd	4.09	nd	nd	nd	0.21
Site RO S 8	Ripley Rd (Eroding)								
Site 8 SS	Deeper > 1m	8.9	0.16	nd	0.30*	nd	4	nd	0.17
Site 8 SS	Deeper > 1m	9.1	0.18	nd	0.21*	nd	nd	nd	0.21
TC Lower <i>Sandy gleyed TC soils flats</i>									
Site 1 TS	0-200mm	5.6	0.05	32	0.24	nd	6	1.2	0.15
Site 1 Bleach	250-400mm	6.3	0.03	nd	0.48	nd	nd	nd	0.11
Site 1 SS	450-700m	5.1	0.17	nd	1.36	nd	nd	nd	0.17

- High Aluminium not associated with pH < 5.5

RE Soil Dispersion (Item 5)

The Exchangeable Sodium Percentage (ESP), Exchangeable Calcium: Exchangeable Magnesium (Ca:Mg) ratio, Soil Dispersion Indicator field test (SDI) and Emerson Dispersion Test (EDT) are used as independent estimates of soil dispersion.

The tendency for dispersion usually increases with increasing ESP and decreasing Ca:Mg ratio. Sodic soil layers (ESP ≥ 6) may disperse and strongly sodic soils (ESP ≥ 15) usually do. Soils with Ca:Mg ratios of 0.5 or less often exhibit dispersion.

ESP and Ca:Mg ratio are derived from chemical analyses and must be interpreted with care. When the actual exchangeable cation levels are very low, any small change in one value can cause a disproportionate change in the percentage or ratio calculation and thus alter the dispersion rating.

All subsoil layers of the *TC (Texture Contrast Soils) studied for Area 1 & Ripley Road* are likely & will most probably be dispersive and have inherent erodibility from the dispersive soil properties. This especially applies to the clay subsoil which is dispersive giving the entire subsoils of the study a moderate to high erodibility rating. Note erodibility caused by High Risk Dispersive Soils.

Table 4 shows that ESP in subsoils is sodic to strongly sodic and this combined with the exchangeable cation profile content especially Ca/Mg ratio confirms this assessment.

The Butler Partners reports mentioned in Item 5 confirm soils are dispersive.

Table 4. Soil Test Parameters, RUC Project – Ripley.

Sample No.	Sample Depth	Soil pH	EC dS/m	ESP	Ca Meq/100g	Mg Meq/100g	Ca/Mg	Al %
<i>Crests and upper slopes on elevated hills</i> <i>Sandy red-yellow TC soils (dispersive)</i> <i>Magnesian-Natric Red and Yellow Kurosols</i>								
Site 2 TS	0-200mm	5.7	0.03	2.7	1.76	1.23	1.4	9
Site 2 SS	300-450mm	5.3	0.07	13.6	0.39	5.88	0.1	22
Site 2 SS	500-600mm	5.1	0.11	17	0.14	5.87	<0.1	24
Site 5 SS	200-350mm	4.7	0.05	4.5	0.4	4.25	0.1	31
Site 5 SS	400 - 900mm	4.9	0.06	7	0.14	4.55	<0.1	36
Site 10 SS	700-900mm	5.3	0.04	9.3	0.41	6.24	0.1	32
<i>Crests and upper slopes on low hills</i> <i>Sandy yellow-grey TC soils (dispersive)</i> <i>Yellow and Grey Sodosols</i>								
Site 8 SS	Deeper > 1m	8.9	0.16	21.5	2.41	5.85	0.4	3
Site 8 SS	Deeper >1m	9.1	0.18	27.7	2.0	5.02	0.4	2
Site 18 TMR	0-300	5.3-6.0	0.05-0.15	7-13.5	2.6-3.24	1.71-6.15	0.5-1.5	<5
Site 42	0-1100	6.3-4.2	0.11-1.4	9-17	2.95-4.0	3.73-19.9	0.2-0.9	3-7
<i>Mid-lower slopes</i> <i>Sandy gleyed TC soils (dispersive)</i> <i>Yellow and Grey Sodosols</i>								
Site 3 TS	0-200mm	5.1	0.03	3.5	0.15	0.22	0.7	49
Site 3 SS	500 - 700mm	5.6	0.04	15.8	0.05	1.97	<0.1	49
Site 6 TS	0-200mm	5.2	0.03	2.6	0.5	0.44	1.1	29
Site 6 SS Bleach	200-400mm	5.6	0.02	10.3	0.24	1.17	0.2	42
Site 6 SS	450-700mm	5.3	0.08	15.8	0.2	4.05	0.1	40
S9 Road	Crest							
S9 SS	500 - 600mm	6.2	0.12	13.4	2.85	12.0	0.2	2
<i>Valley flats</i> <i>Sandy gleyed TC soils (dispersive)</i> <i>Magnesian-Natric Yellow and Grey Kurosols</i>								
Site 1 TS	0-200mm	5.6	0.05	4.2	0.76	0.44	1.7	15
Site 1 Bleach	250-400mm	6.3	0.03	16.1	0.3	2.24	0.1	13
Site 1 SS	450-700m	5.1	0.17	28	0.12	4.94	<0.1	15

Soil Groups:

Sites 1, 7 Sandy gleyed TC soils in valley flats
 Sites 2, 5, 10 Sandy red-yellow TC soils on convex upper slopes
 Sites 3, 4, 6, 9 Sandy gleyed TC soils on mid-lower slopes
 S 8 RO (>1m) Sandy yellow-grey TC soils on convex upper slopes
 RO = Roundabout Centenary Highway / Ripley Rd

- dispersive
 - dispersive
 - dispersive
 - dispersive

Item 9 – Re Topsoil & Subsoil

Topsoil & Subsoil as suitable Planting media for revegetation

ESSA, January 2011 soil report Section 6 gives soil amelioration requirements that must be followed to ensure topsoils & subsoils can be ameliorated to ensure stable sustainable vegetation can be produced across the area.

In short the ESSA January 2011 soil report provides

- 1) Soil Types & Soil Chemical properties
- 2) Soil Stripping depths for Topsoil (Planting Media)
- 3) Required amelioration for both topsoil & subsoils
- 4) All soil areas are included including fill & cut batters for the development

This method of assessment was used by ESSA for TMR in the fill batters and rehabilitation areas of the Centenary highway upgrade (e.g. the Highly erodible Deebling Creek). In addition, for this Development Area additional treatments for increasing the urban visual amenity have been recommended.

Item 10 – Soil Mapping & Soil Characterisation (Landscaping)

ESSA, January 2011 soil report has been completed for this development.

It provides:

- 1) Soil Map is included in report Page 32 & maps the soils according to Reuse & Types & based on ASC, Isbell 1994 See section 3 of ESSA report
- 2) Provides Top soil layer stripping depth stockpiling reuse & amelioration see Sections 9&8 in particular of ESSA report
- 3) It provides site specific details see sections 4&5 of ESSA report
- 4) It provides site soil risk & provides details re high risk soils see sections 6 & 7.2 of ESSA report
- 5) It provides details re construction phase as well as landscape soil uses See sections 9 & 5 of ESSA report
- 6) It provides details to achieve required outcomes for landscaping See especially sections 5.2 & 5.6& 5.7 and appropriate appendices for testing schedules

Additional detail is provided here re Fill embankments.

For general fill embankments the outer embankment to be treated per Table 6 for both site topsoil & subsoil.

In particular for fill embankments preferred that the outer 0.5m of soil to be ameliorated. For site subsoil used in the road core construction this is not included.

For the cut embankments add appropriate ameliorants per Table 6 as described to 200mm.

Requirements for imported Planting Medias & Soil Organic Conditioners appropriate to the site outcomes are also provided.

Item 11 – Soil Mapping & Soil Characterisation (Landscaping)

ESSA, January 2011 soil report provides a detailed response to Item 11.

Further comments are provided for following items:

Item 7 – Soil treatment during construction & final stable landform

ESSA, January 2011 soil report provides a detailed response for the site soils and the recommended incorporation, amelioration for stripping, stockpiling and exposing site soils both Topsoil & Subsoils.

Soil Assessment & Amelioration

From the RUC ESSA report Baker (2011) the characteristics of the soils studied on the development site studied show that the site soils are in 3 management groups and have:

- Strongly acid pH,
- very low to low salt levels,
- low to extremely low exchangeable calcium (Ca),
- to strongly sodic soils

All the above will need to be addressed to reduce the risk of failure of any site revegetation works and dispersion effects of any disturbed subsoils used or left as cut batters or reused for advanced tree pit plantings.

For the very acidic, low exchangeable cations (Ca/Mg) ratio, magnesian, sodic, high aluminium soils it is recommended to add agricultural lime (preferred) /dolomite at

suggested rates based on the pH section of the report and detailed in Table 6 & Table 6a of Baker 2011.

All ameliorants suggested will need to be incorporated by effective mixing with the soil to have maximum effect.

In addition, some soils especially the subsoil from existing surface textured as clays in this case will require incorporation of well composted organic matter with NDI (Nitrogen Draw Down) of > 0.5, as well as the agricultural dolomite to treat the acidic conditions and cation imbalances as described in the report.

As per MRS11.16B (Interim) generally, all soil amelioration agents should be free of contaminants and specifically:

- agricultural lime and if dolomite substituted shall be agricultural dolomite consisting of ground limestone (calcium carbonate - CaCO_3) with a neutralising value (NV) of 95 or above; or
- Agricultural dolomite shall be agricultural dolomite (CaMgCO_3) with NV of 90 - Preferred.

By following the recommended rates of amelioration & soil incorporation recommendations in Tables 6 & Section 5.2 and 5.3 in particular and incorporating this into the civil construction works the result will be stable, sustainable soils and resultant healthy landscape. By ensuring all materials used (Ameliorants, Imported Soils, Organics & Fertilisers) conform to and are supplied with Analysis Schedules as fully documented in proformas in Baker 2011 report appendix this will result in stable landscape.

In the Conclusions to Baker 2011 report the report states "For establishment of vegetation and thereby stabilising the soils and preventing soil erosion & production of erosion and sediment control the soil properties for stripped topsoil and within any of the exposed subsoil layers need to be treated as recommended."

Further the report States: "Suggested treatments & alternates are recommended and are contained in Tables 6 & 6a in the report. If subsoil treatment & 50mm Planting Media applied (media per full suite specification in appendix A), Planting Media used must not be sand or clay (see Full Suite specification for details)."

Of course, soil compaction, ESC control plans (by others) must take cognizance of the Soil Science report and soil properties & incorporate into the construction plans & process.

Additional Note – Adequate quantities of recommended primary beneficial ameliorants namely Agricultural Lime & Dolomite are available onsite at all times and civil construction staff involved in the required incorporation of these are aware of the importance of the correct dosing & incorporation via toolbox meetings.

**D E Baker BSc
MASSI**

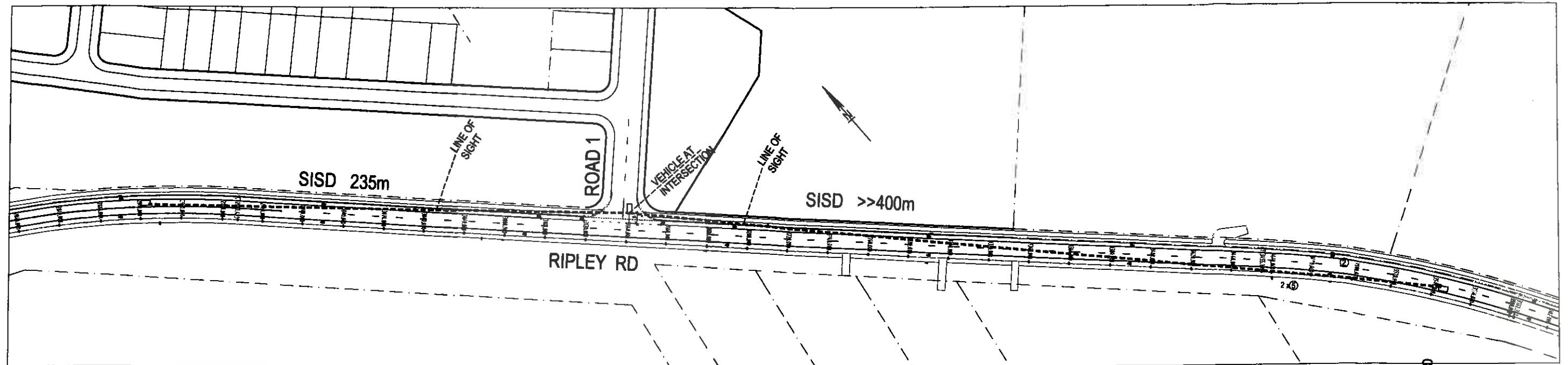
March 6, 2011

13 APRIL 2011



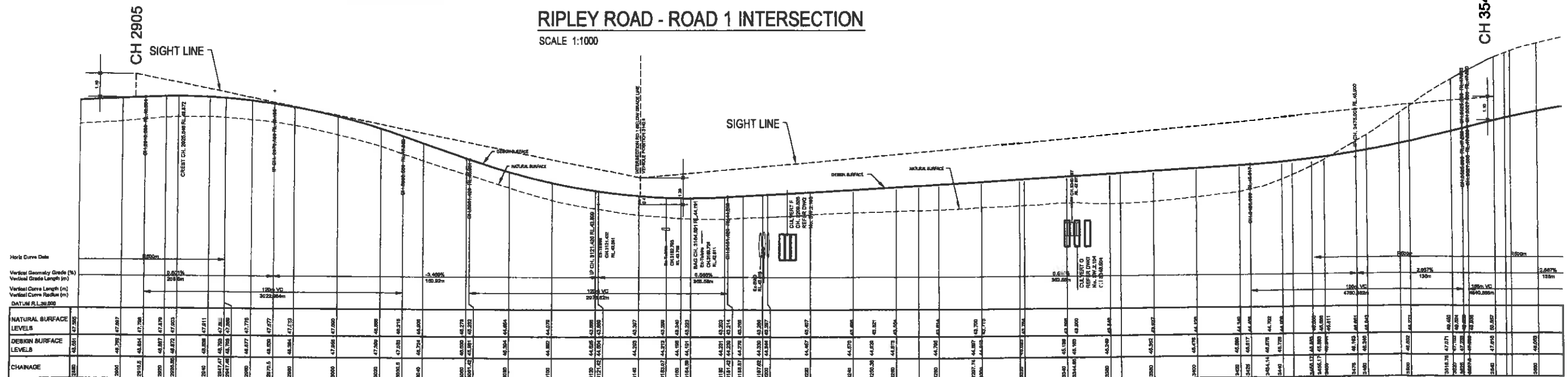
ATTACHMENT 8
MPN Drawing 5874-PSK80

ATTACHMENT 9
MPN Drawing 5784-PSK82



RIPLEY ROAD - ROAD 1 INTERSECTION

SCALE 1:1000



RIPLEY ROAD GRADELINE

SCALE HOR 1:1000
SCALE VERT 1:100

REFERENCE

AUSTROADS 2009
PART 4A UNSIGNALISED AND SIGNALISED INTERSECTIONS
CLAUSE 3.2.2
TABLE 3.2

PRELIMINARY

ISSUE	DATE	AMENDMENT	BY	APP	DATE

SCALE: AS SHOWN	DESIGN: LW	DRAWN: LW	CREATED: APRIL 2011	CHD: LS	APPROD: DP	DATE: 14-11
RIPLEY VALLEY IPSWICH RESIDENTIAL SITE - AREA 1 INTERSECTION SIGHT LINES						

 MPN Consulting Pty Ltd 20 Sherwood Road, Toowoomba QLD 4300 P: 01 7 3371 0077 F: 01 7 3371 3186 E: info@mpnconsulting.com.au	5874 DRAWING No. PSK 82	KEY -

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ATTACHMENT 10

- 1. Queensland Urban Utilities Information Requested dated 15 December 2010**
- 2. MPN's Information Request Response dated 17 March 2011**

Dean Payne

From: Dean Payne
Sent: Wednesday, 13 April 2011 12:38 PM
To: Dean Payne
Subject: FW: Ripley Valley - Area 1 RFI Water and Sewer

The Urban Land Development Authority will be closed from Thursday, 23rd December 2010 and will reopen on Tuesday 4th January 2011

From: Janet Downie [mailto:Janet.Downie@urbanutilities.com.au]
Sent: Wednesday, 15 December 2010 8:13 AM
To: Con De Groot
Subject: Re: Ripley Valley

Hi Con,

Water,

Limited detail available to create conditions. Developer has proposed construction of a pressure reduction valve off the existing trunk main currently feeding the Ripley low level reservoir. Additional information surrounding the control and function of the PRV is required to support the application. This may include additional hydraulic assessment of the proposed Area 1 to demonstrate how pressures will be controlled within the specific area whilst maintaining the desired standards of service.

There are 3 connection points proposed to the existing system as outlined in the Engineering report layout plan 5874-DA06. Pending on the control of the PRV over Area 1 and, location of the PRV, the connection points may need to be isolated. These details must be submitted on a general layout plan for the estate.

General layout of proposed trunk infrastructure is consistent with the Neighborhood master planning report prepared by Cardno. Current layout plans only identify trunk main alignments. Detailed reticulation plans will be required before any OW approval.

Sewerage,

Developer has proposed 2 phases to role out the interim sewerage service arrangements for Area 1. The initial stage includes 2 temporary holding tanks for tankering. The holding tank along Aulds road would be replaced with a pump station through phase 2 construction. This is inconsistent with the agreed service strategy outlined in the latest planning report - Ripley Valley Bundamba Sewerage Planning - Interim stages.

The agreed strategy highlights the conveyance of sewage to a single point of collection at a location which would ultimately contribute to emergency storage for the interim pumpstation for Urban Core development. This strategy will reduce the complexity of operation and redundancy of infrastructure. Any alternative method of service to convey sewage to the interim pump out facility will need further supporting information to substantiate the proposal.

Additional conceptual planning will be required to ensure that the design of the temporary pump out facility can be incorporated as emergency storage for the future Urban Core pump station. This will require confirmation of design levels of sewerage trunk main outlined as RPT1_07 from the Ripley Valley Bundamba Sewerage Planning - Interim stages, and all trunk gravity mains conveying sewage to the interim pump out facility. Further information should include long sections of all trunk gravity mains.

DA Submission 'Localised review of stormwater and sewer', 5874 DA07-2, and 5874 DA07-1, all show the alignment of sewerage mains within the road easement. Where possible, sewerage mains should be kept within the property, generally at a 1.5m offset from the property boundary.

Cheers

Janet

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**MPN CONSULTING PTY LTD
STRUCTURAL AND CIVIL ENGINEERS**

ABN 39 062 191 799
39 Sherwood Road, Toowong, Qld, 4066
P O Box 328, Toowong, Qld, 4066
Tel: 61 7 3371 6677
Fax: 61 7 3371 3196
Email: solutions@mpnc.net.au
Web: www.mpnc.net.au



17 March 2011

FILE 5874

Sekisui House Design Services Pty. Ltd
Level 3, 349 Coronation Drive
MILTON Qld 4064

Attention: Paul Jenkins

Dear Paul

RE: QUU RFI RESPONSE - DEV2010/084 - RIPLEY VALLEY AREA 1

In reference to the ULDA information request of 9 December 2010 and pursuant to the meetings held on 14 December 2010 and 28 February 2011 with SHDS and Queensland Urban Utilities' MPN is pleased to submit the following comments.

QUEENSLAND URBAN UTILITIES - RFI QUERIES

Water

Limited detail available to create conditions. Developer has proposed construction of a pressure reduction valve off the existing trunk main currently feeding the Ripley low level reservoir. Additional information surrounding the control and function of the PRV is required to support the application. This may include additional hydraulic assessment of the proposed Area 1 to demonstrate how pressures will be controlled within the specific area whilst maintaining the desired standards of service.

There are 3 connection points proposed to the existing system as outlined in the Engineering report layout plan 5874-DA06. Pending on the control of the PRV over Area 1 and, location of the PRV, the connection points may need to be isolated. These details must be submitted on a general layout plan for the estate.

EXCELLENCE WITH ECONOMY IN ENGINEERING

Date: 17 March February 2011

General layout of proposed trunk infrastructure is consistent with the Neighbourhood master planning report prepared by Cardno. Current layout plans only identify trunk main alignments. Detailed reticulation plans will be required before any OW approval.

The water supply mains layout plan shown on MPN drawing 5874-DA06 for the DA is based on the Neighbourhood Masterplan Water Supply and Sewerage Report by Cardno. The Water Supply and Sewerage Supplementary Report by Cardno is still in draft form and has not been finalised with Queensland Urban Utilities (QUU). MPN met with Brett Carruthers of QUU on Wednesday 21 December 2010 to discuss and clarify their concerns with respect to the DA. MPN tabled aspects of the Cardno Reports and the DA plans with respect to providing background for QUU at the meeting.

After briefing Brett Carruthers on the background of the water supply aspects for the DA based on the Cardno reports, the main issue of concern was how the PRV would be controlled and function to achieve the minimum standard level of service – i.e. 22 m head minimum head, 80 m maximum head, residual head during fire flow operations etc..

From the layout prepared QUU requires that each connection point (3 off) to the supply main in Fischer Road would also require a PRV with suitable control and function. QUU requested that the water supply network (including reticulation mains) would require modelling to demonstrate that the service supply performance standards can be achieved for operational works approval. MPN can undertake the water supply modelling to demonstrate compliance with QUU's service standards for Area 1. (As a further comment, QUU advised that for the remainder of the Urban Core water supply layout in Cardno's report, additional supply connections are proposed in Wensley Road and QUU advise that these also would require PRVs at each connection to the supply main in Wensley Road).

Sewerage,

Developer has proposed 2 phases to role out the interim sewerage service arrangements for Area 1. The initial stage includes 2 temporary holding tanks for tankering. The holding tank along Aulds road would be replaced with a pump station through phase 2 construction. This is inconsistent with the agreed service strategy outlined in the latest planning report - Ripley Valley Bundamba Sewerage Planning - Interim stages.

The agreed strategy highlights the conveyance of sewage to a single point of collection at a location which would ultimately contribute to emergency storage for the interim pump station for Urban Core development. This strategy will reduce the complexity of operation and redundancy of infrastructure. Any alternative method of service to convey

Date: 13 March February 2011

sewage to the interim pump out facility will need further supporting information to substantiate the proposal.

At the meeting with QUU on 21 December 2010, MPN explained that whilst the agreed service strategy indicates a single point of collection in the Masterplan, the Area 1 proposal does not include lands owned by others and therefore access to some of the land required to provide certain infrastructure works outlined in the service strategy as indicated in the Water Supply and Sewerage Report is not available. MPN drawing 5874-DA07-2 indicates two options to service Area 1. Option 1 is a sewer trunk main extension through the Auld's land being Lot 281 RP234462 to the Proposed Pumping Station and Holding Tank near Bundamba Creek. Option 2, is for a Sewage Pumping Station next to Aulds Road as well as a Rising Main along Aulds Road and a carrier main down the extension of Nevis Road to the Proposed Pumping Station and Holding Tank near Bundamba Creek. Option 2 is required if access to the Auld's land is not possible to provide a suitable connection point for Area 1, and is an interim solution until such time as access to the land is available to build the ultimate sewer carrier.

Additional conceptual planning will be required to ensure that the design of the temporary pump out facility can be incorporated as emergency storage for the future Urban Core pump station. This will require confirmation of design levels of sewerage trunk main outlined as RPT1_07 from the Ripley Valley Bundamba Sewerage Planning - Interim stages and all trunk gravity mains conveying sewage to the interim pump out facility. Further information should include long sections of all trunk gravity mains.

At the meeting with QUU on 21 December 2010, MPN explained that location of the Proposed Pumping Station was indicative of the location shown in the Cardno Water Supply and Sewerage Report. From further discussions with QUU, it was conveyed to MPN that the Proposed Pumping Station must be documented in sufficient detail to demonstrate performance of the sewerage system. QUU advised that in order to undertake this design MPN will need to incorporate the requirements and recommendations for the trunk sewer RPT1_07 as indicated in the Ripley Valley Bundamba Sewerage Planning - Interim Stages report dated October 2010 by MWH. MPN has now reviewed the report and acknowledge that the design of the Area 1 sewerage reticulation system is ultimately intended to be connected to the trunk sewer designated RPT_07 in Figure 6.1 Option A of the report. Due to access restrictions onto the Auld's land (Lot 2 RP229319) the construction of the carrier main is not possible and therefore that interim holding tanks for pump out facilities are proposed generally as indicated on MPN drawings 5874 DA07-2, and 5874 DA07-1. The design of the holding tanks will be such that the tanks can be incorporated within the emergency storage when the proposed future Urban Core pumping station TPS01 (H) is constructed.

Date: 17 March February 2011

DA Submission 'Localised review of stormwater and sewer', 5874 DA07-2, and 5874 DA07-1, all show the alignment of sewerage mains within the road easement. Where possible, sewerage mains should be kept within the property, generally at a 1.5m offset from the property boundary.

This will be accommodated subject to the layout of specific lots which are small or have zero setbacks to the sides of lots within the Plan of Development and is subject to the final design grades for the estate. For example when the lots fall to the road the sewer main can be located at a 1.5m offset from the property boundary, therefore the main should be located inside the lot (not in the road reserve), but in some instances, such as for rear access lots, the earthworks batters at the front may make maintenance of the sewer difficult if the sewer is within the lot and therefore the sewers may best be located in the street.

QUEENSLAND URBAN UTILITIES ADDITIONAL QUERIES RAISED AT MEETING OF 28 FEBRUARY 2011

This meeting was attended by Paul Jenkins of SHDS, Daniel Lee of MPN and Daniel O'Brien, Brett Carruthers and Peter Hall of QUU. The water design drawings for the Ripley Road (South Package) were handed to QUU for approval.

QUU requested a copy of the Ripley Road cross sections and proposed service allocations.

Attached is MPN drawing 5873S-ER.2.101(E) showing the typical details for Ripley Road.

QUU requested the design to consider the network connection arrangement for the future developments without the need to shut down the main feeds to the subdivision.

SHDS agreed that this has been considered in light of the Masterplan Water Supply Report by Cardno with crossings already designed into the Ripley Road design proposed for approval.



Date: 17 March February 2011

Please do not hesitate to contact the undersigned if you have any queries.

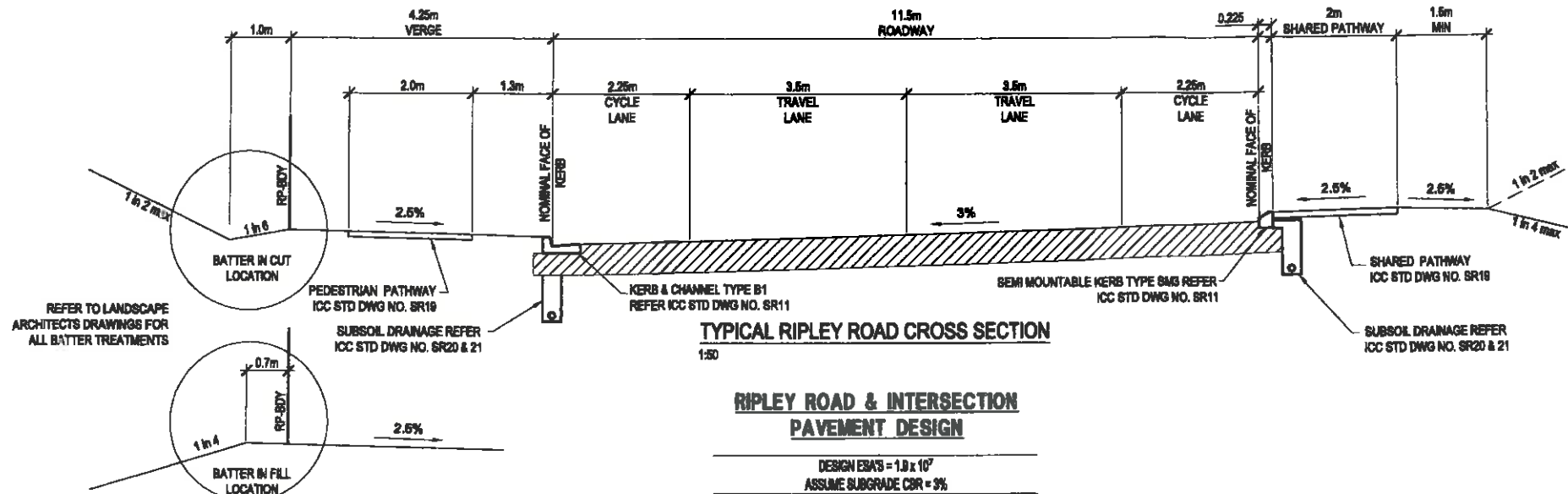
Yours faithfully

A handwritten signature in blue ink, appearing to read 'Daniel Lee'.

DANIEL LEE RPEQ 7709
FOR AND ON BEHALF OF
MPN CONSULTING PTY LIMITED

dl: dl

Att: MPN Drawings 5873S ER.2.101(F), 5874 DA06, 5874 DA07(1), 5874 DA07(2) and
5874 PSK43.

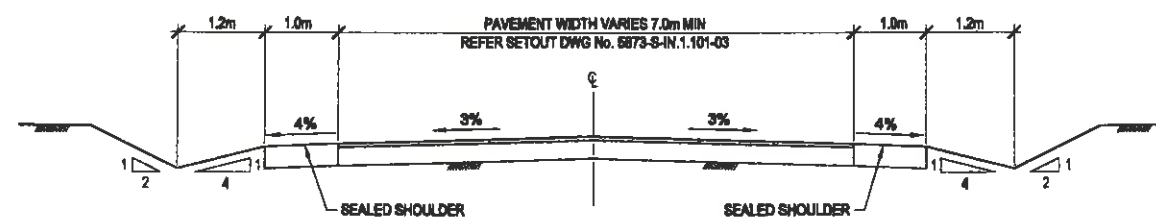


TYPICAL RIPLEY ROAD CROSS SECTION
1:50

**RIPLEY ROAD & INTERSECTION
PAVEMENT DESIGN**

DESIGN EBAS = 1.0×10^7
ASSUME SUBGRADE CBR = 3%

OPTION 1	OPTION 2
125mm ASPHALT	200mm ASPHALT
100mm High Density Granular CBR23	240mm CTB CATEGORY 2
250mm CTB CATEGORY 1	

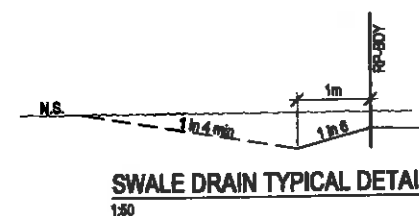


TYPICAL SIDE ROAD CROSS SECTION
1:50

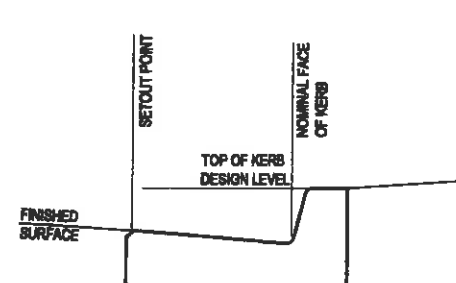
**SIDE ROAD
PAVEMENT DESIGN**

DESIGN EBAS = 1×10^6
ASSUME SUBGRADE CBR = 3%
(TRUNK COLLECTOR)

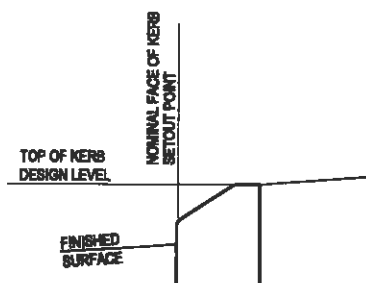
50mm AC
150mm BASE COURSE TYPE 2.1 (Min CBR 80)
150mm UPPER SUB BASE TYPE 2.3 (Min CBR 45)
250mm LOWER SUB BASE TYPE 2.5 (Min CBR 15)



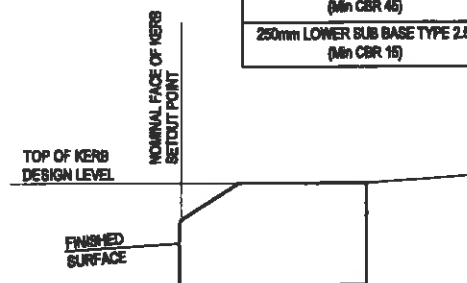
SWALE DRAIN TYPICAL DETAIL
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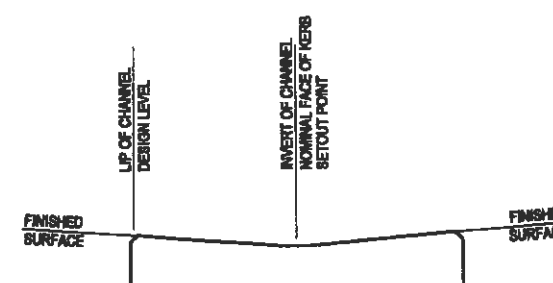
KERB & CHANNEL TYPE B1 SETOUT
REFER ICC STD DWG NO. SR.11 SCALE 1:10



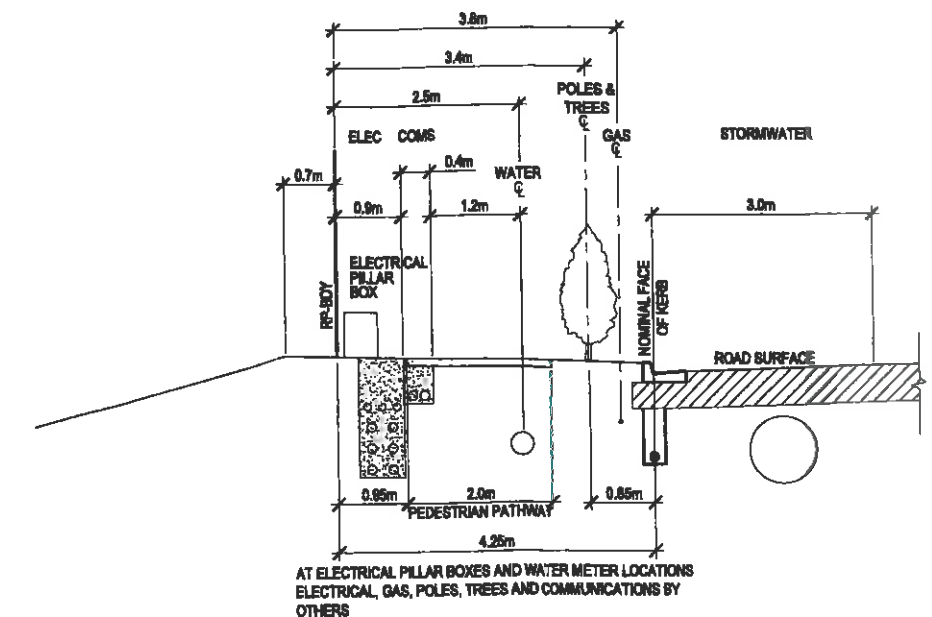
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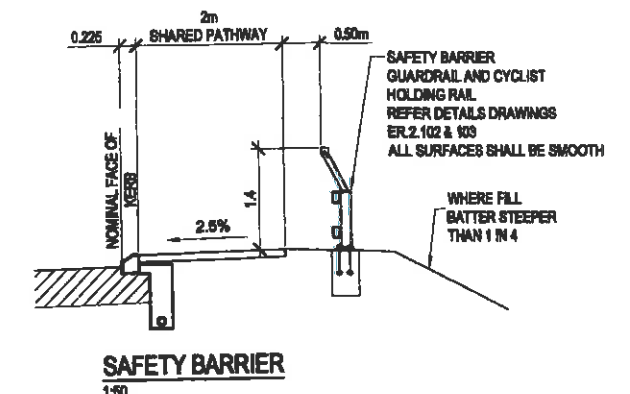
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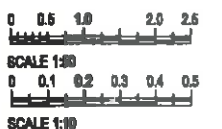
INVERT
REFER ICC STD DWG NO. SR.11 SCALE 1:10



SERVICE CONDUIT TYPICAL SECTION
1:50



SAFETY BARRIER
1:50



CONSULTANT: MPN CONSULTING PTY LTD
CONTACT: GREGG TYQUIN (RPEQ 1528)
TELEPHONE: (07) 3371 6677

DATE 18.02.11

NO	DATE	DESCRIPTION	BY	APP
F	18.02.11	ISSUE	ND	GT
E	18.02.11	FIGURED FOR APPROVAL	JP	GT
D	18.02.11	BIKE PATH AMENDED TO SHARED PATHWAY	JP	GT
C	21.01.11	BIKE PATH AMENDED TO SHARED PATHWAY	LDW	LDW
B	21.01.11	DETAILS AMENDED TO ADD DETAIL	JP	GT
A	21.01.11	ISSUED FOR REVIEW	JP	GT
NO	DATE	DESCRIPTION	BY	APP

**RIPLEY ROAD
FISCHER ROAD
TO
CENTENARY HIGHWAY**

SCALE: AS SHOWN
DESIGN: LW
DRAWN: LW
CREATED: 18.02.11
CNO: GT
APPRO: GT
DATE: DEC 2010

**RIPLEY VALLEY
IPSWICH**
**ROADWORKS
TYPICAL DETAILS**

mpn consulting
MPN Consulting Pty Ltd
ABN: 50 002 151 707
30 Sharnford Rd, Ipswich, QLD 4700
P: 07 3371 6677
F: 07 3371 6688
E: info@mpnconsulting.com.au

5873 S
ER.2.101 F

EXISTING

PROPOSED

LEGEND

PROPERTY BOUNDARY

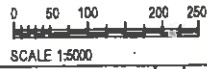
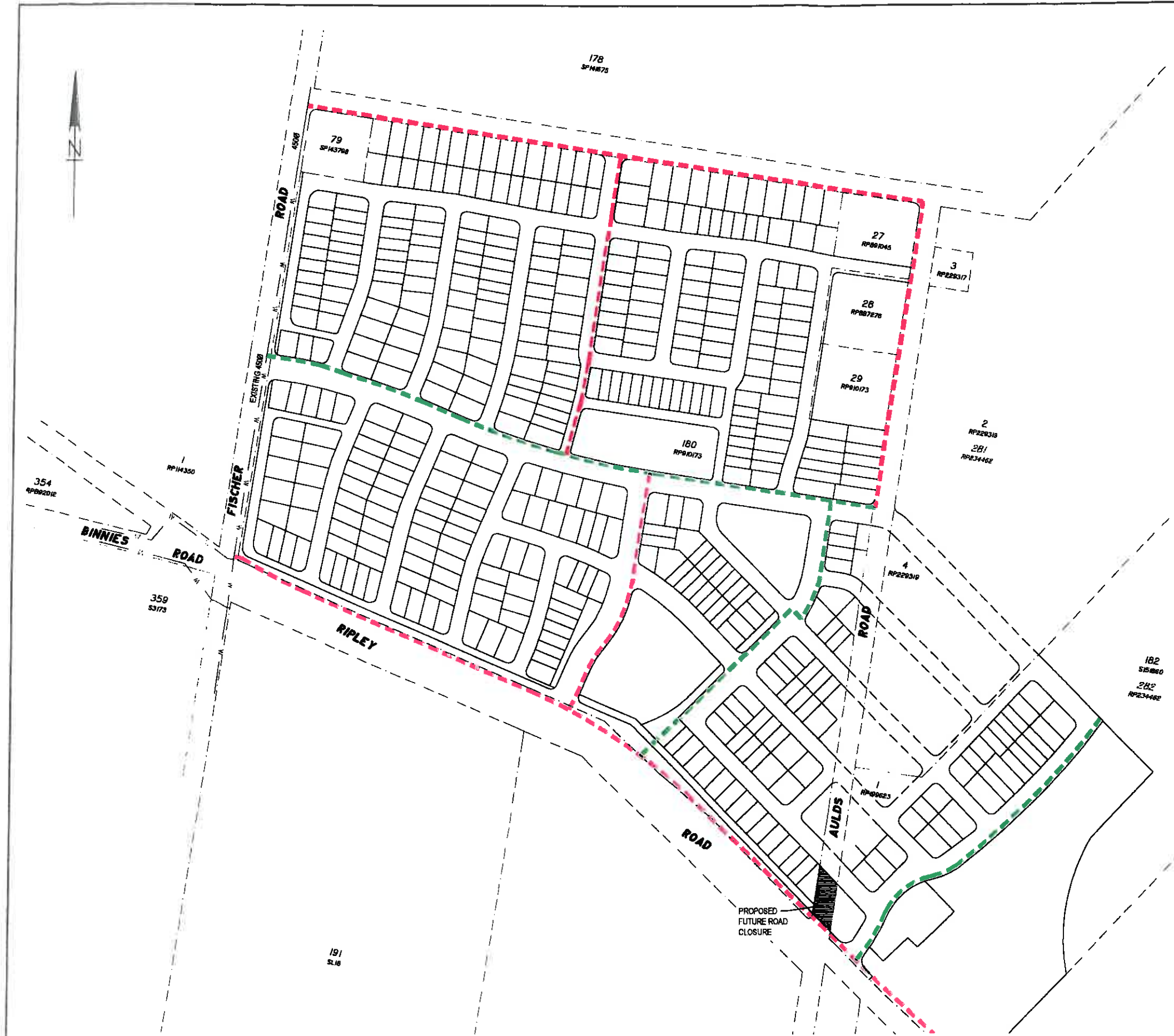
WATER MAIN

1500 WATER MAIN

2000 WATER MAIN

3000 WATER MAIN

NOTE: ALL MINOR PIPES TO BE 1000 (NOT SHOWN)



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DESIGN: DL

DRAWN: JP

CREATED: 08.08.10

CHW:

NO

DL

APPD:

DATE:

SEKISUI HOUSE

IPSWICH

RESIDENTIAL SITE

WATER MAINS PLAN

mpn consulting

MPN Consulting Pty Ltd

ABN 30 662 181 700

30 Sherwood Road, Taringa, QLD 4068

P 61 7 337 1 0077

F 61 7 337 1 0105

E ash@mpn.com.au

DA06

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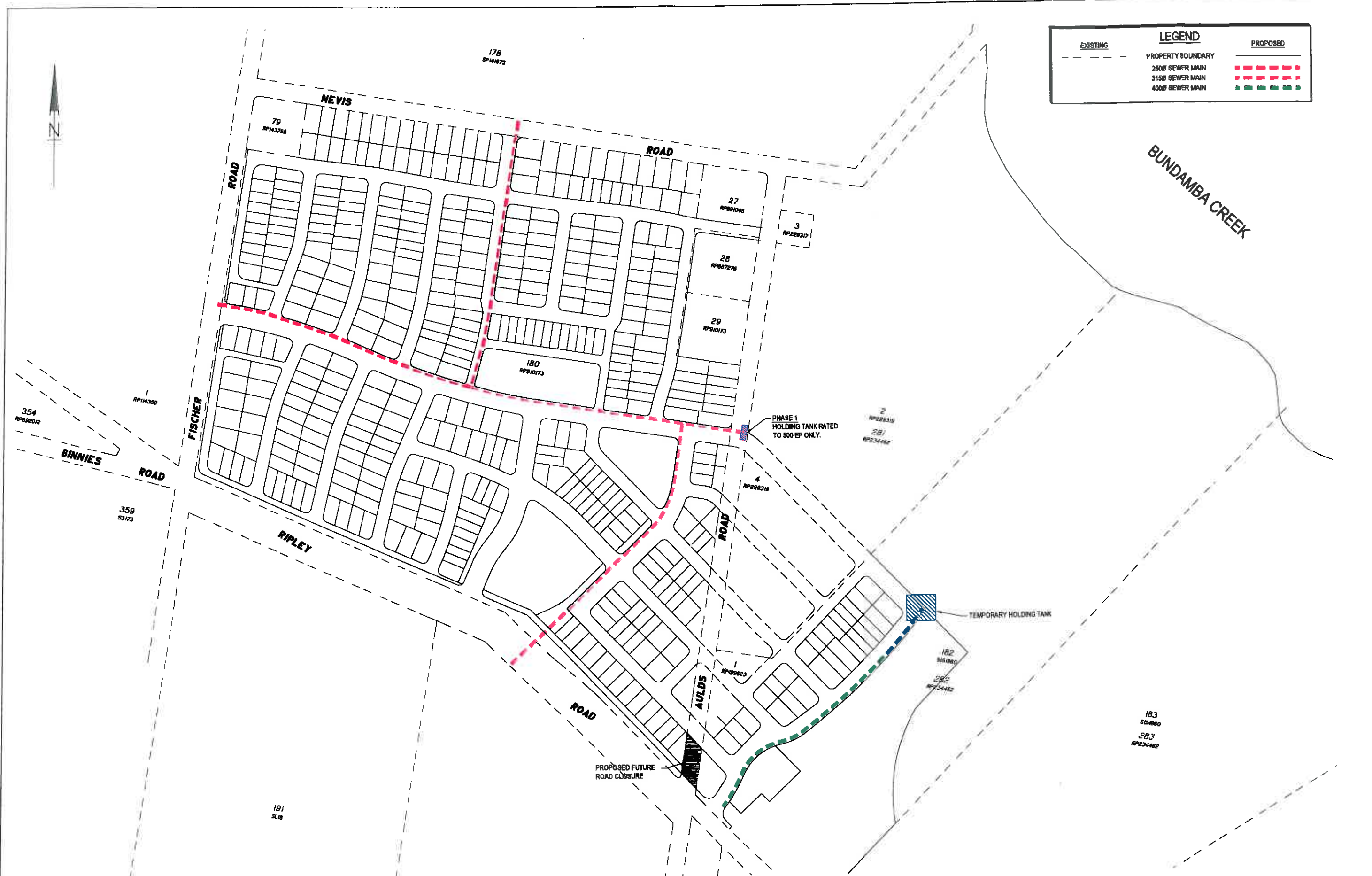
PROPERTY BOUNDARY

250Ø SEWER MAIN

315Ø SEWER MAIN

400Ø SEWER MAIN

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2		AMENDMENT		

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DESIGN: DL

DRAWN: JP

CREATED: 20.06.18

CHECKED:

APPROVED:

5874

DA07-1

MPN Consulting Pty Ltd

ABN: 38 082 181 756

38 Sharwood Road, Tewinong Qld 4068

P 61 7 3371 8877

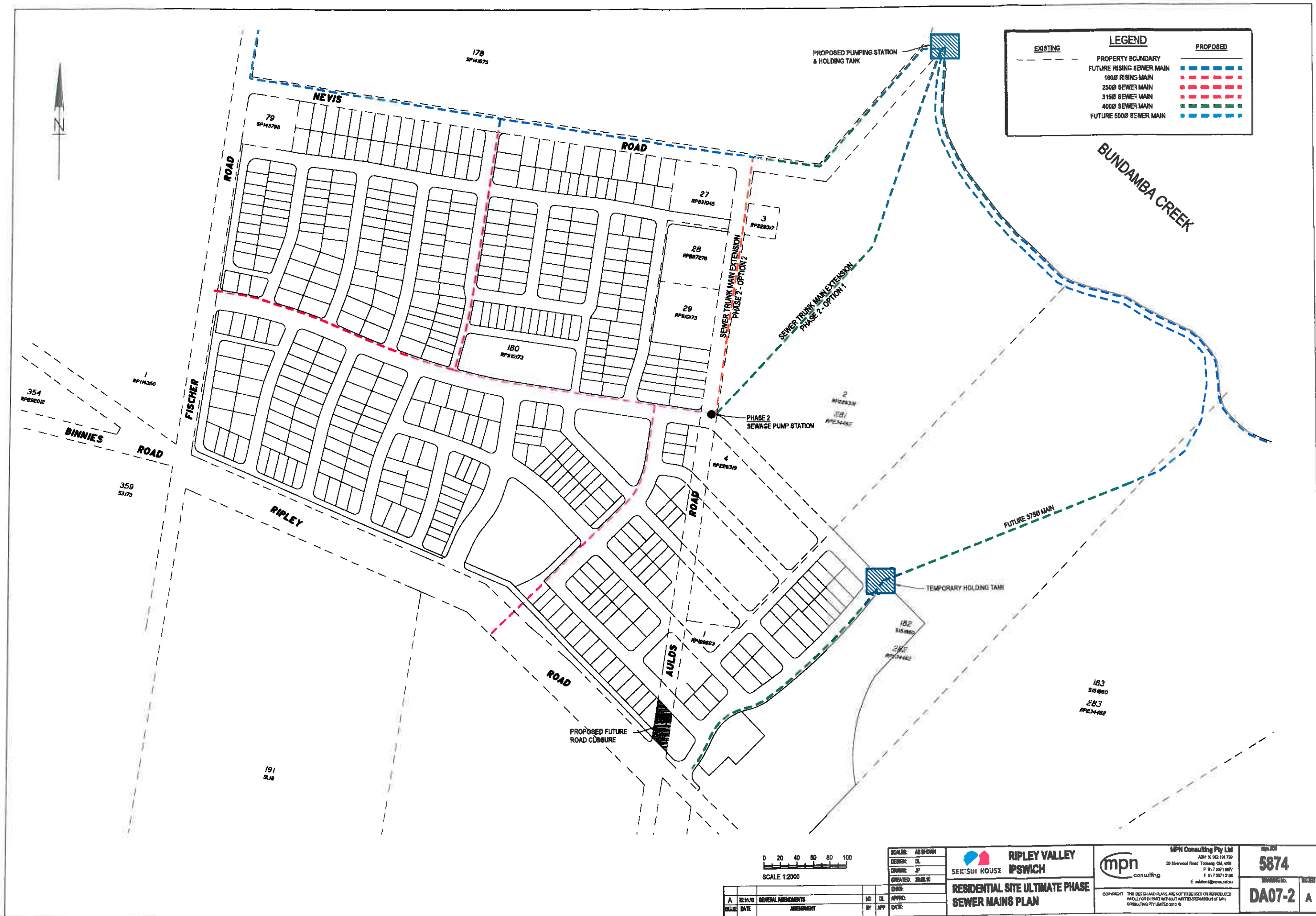
F 61 7 3371 8158

E info@mpnconsulting.com.au

5874

DA07-1

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SCALE: AS SHOWN

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SCALE 1:2000

SEK'SUI HOUSE

RIPLEY VALLEY IPSWICH

RESIDENTIAL SITE ULTIMATE PHASE SEWER MAINS PLAN

MPN Consulting Pty Ltd

ABN 36 063 101 739

30 Sherwood Road, Toowoomba, QLD, 4369

P 01 7 357 1 0077

F 01 7 357 1 51 96

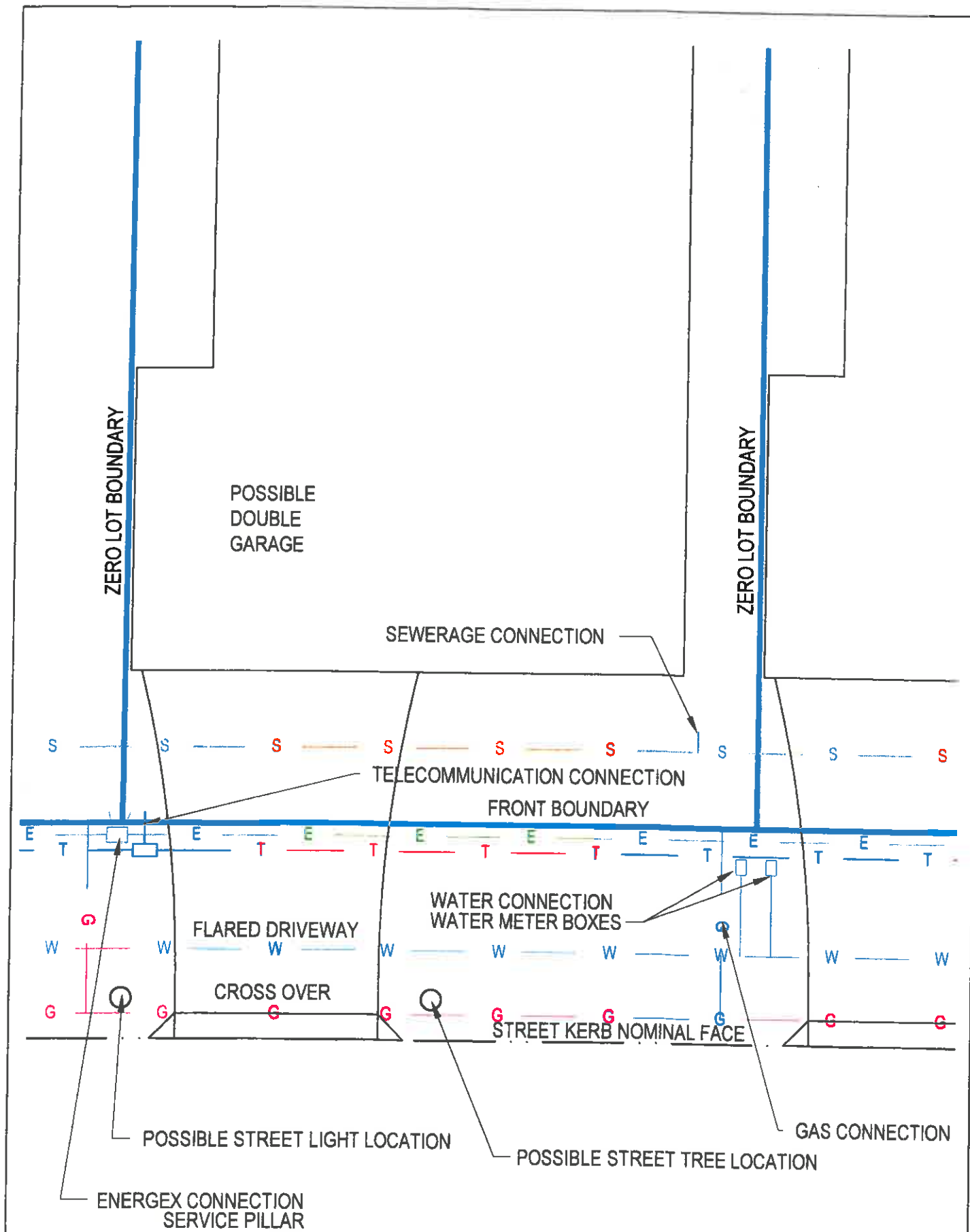
E info@mpn.com.au

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DA07-2

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NO.	DATE	BY	APP.	DATE
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 MPN Consulting Pty Ltd ABN: 39 082 191 799 39 Sherwood Road, Toowong, Qld, 4066 P: 617 3371 5677 F: 617 3371 3196 E: solutions@mpn.net.au	Project RIPLEY VALLEY RESIDENTIAL AREA ONE		Scale 1:100	JOB No. 5874
	Dwg Title LOT SERVICES LOCATION PLAN		Drawn	
			Appr'd	DWG No. PSK43
			Date MARCH 11	

ATTACHMENT 11
Moreton Geotechnical Services
“Desktop Coal Mining Study for the proposed Ripley Valley Urban Core and Town
Centre” dated 9 December 2007

MORETON GEOTECHNICAL SERVICES PTY. LTD.

PO Box 915 Ipswich 4305

Telephone (07) 3294 6988
Facsimile (07) 3294 6988
Email mgs@jill.com.au

A.C.N. 055 813 129
A.B.N. 24 635 813 129

Ref. 2007/104
09 December 2007

Ripley Town Holdings P/L
c/o Butler Partners P/L
P.O. Box 2267
Fortitude Valley BC
4006

Att. Mr. Bruce Butler

Re: **DESK-TOP COAL MINING STUDY FOR THE PROPOSED
RIPLEY VALLEY URBAN COVE AND TOWN CENTRE**

1.0 INTRODUCTION

The work in this report was carried out at your request (letter of 12th November 2007) and in general accordance with the details in our letter of 2nd October 2007 to Ripley Town Holdings P/L.

It is understood that Ripley Town Holdings P/L and BCove 4 P/L control 169.83 hectares of land within the proposed Ripley township area. It is also understood that this mining study is required to establish any constraints to planning and development from past underground coal mining activities exist on this site.

Work in this report has included a roadside inspection, researching available sources of information and reporting by the undersigned Engineering Geologist. Our Associates at Taylor Mining Services P/L have assisted in the study.

The following plans are attached to this report:

1. a 1:7,500 scale site plan
2. a 1:10,300 approximate scale contour plan
3. a 1:15,500 approximate scale transport corridor plan
4. a 1:7,500 scale underground mining and mine constraints plan

2.0 INVESTIGATION RESULTS

2.1 SITE

Plan 1 attached shows the site location and the lot numbers of interest including Lots 182, 183, 184, 185 and 192 on S151860, Lots 3 and 4 on RP229320 and Lot 195 on RP868799. From the plan it can be seen that Bundamba Creek forms the eastern boundary of the site, whereas Ripley Road currently forms the main access route through the site. Plans 1 and 3 attached also show that the site will also be serviced by the South West Transport Corridor which will divide separately into the road and rail corridor in the area of interest.

Plan 2 attached shows the topography of the site.

The site inspection revealed that the area typically comprises rolling grassland with low hills, scattered clusters of native trees and occasional residences and farm buildings. The construction of the road component of the South West Corridor was also noted to be well advanced.

2.2 GEOLOGY

The 1:100,000 Ipswich geology map shows that the bedrock geology under this site for most part comprises the Marburg Formation including sandstone, shale and coal. Ripley Road Sandstone by comparison underlies the eastern half of Lots 182 to 185 on S151860. North west to south east trending faults are also indicated across the general area of the site.

The productive Blackstone Stage of the Ipswich Coal Measures (sandstone, shale and coal) underlies the abovenoted formations. The coal of past economic importance in the coal measures includes, in increasing age and increasing depth, the Aberdare, Bluff, Four Foot, Bergin's, Striped Bacon and Rob Roy Seams.

Quaternary alluvium exists along and adjacent to Bundamba Creek.

2.3 MINING

Mining by bord and pillar methods, including pillar extraction, has occurred extensively in the past on the east side of Bundamba Creek. Mining closest to

this site previously took place along the Four Foot and Bergin's Seams, which were locally known as the 'Wright' and 'Lagoon' Seams respectively. Mining was from the abandoned Box Flat No. 8 and No. 8 Extended Collieries as well as from the Southern Cross No. 9 Colliery.

Plan 4 attached shows the western limit of the Four Foot and Bergins Seam workings as well as two very small areas where the workings extended under Bundamba Creek into this site.

Coal mining leases no longer cover the site area. Notwithstanding this, a full mining tenure search should be carried out at the Department of Natural Resources & Mines to check whether exploration permits or other licenses (e.g. extractive resource permits) have been provided to petroleum or other companies.

3.0 COMMENT

In summary, the work in this report has revealed that underground bord and pillar mining has entered this site very locally at two locations under Lot 184 S151860, also that mining leases no longer cover the area. Part of this site however also falls within the influence of the adjoining workings, on the basis of an assumed 26.5 degree draw angle, as shown on Plan 4 attached.

In conclusion, the work in this report has found that only a small part of this site, i.e. the eastern ends of Lots 183 and 184 on S151880, is undermined or falls within the influence of past underground coal mining activities. The bulk of the site is therefore unconstrained from past coal mining activities. A more detailed study will however be required to establish potential subsidence impacts before any development proceeds in the constrained area.

4.0 LIMITATIONS

This report, which may contain attachments in the form of plans, borehole record sheets, laboratory test results etc, must be read in its entirety.

The work in this report was produced for Butler Partners and their Client Ripley Town Holdings on the basis of information available at the time of writing. This report will not contain sufficient information for other parties and purposes.

While care has been taken in producing this report, it needs to be said that there will always be some risk associated with developing in these settings. Recommendations put forward in this report are aimed at minimising the risk.

This company accepts no responsibility for works which do not fully comply with the recommendations in this report.

MORETON GEOTECHNICAL SERVICES PTY LTD

A handwritten signature in blue ink, appearing to read 'K. B. Grubb', enclosed within a circular scribble.

K. B. GRUBB
M.App.Sc., MIE Aust., CP Eng., RPEQ 2811

CLIENT

RIPLY TOWN HOLDINGS

PROJECT

Pipley Town Holdings
Concessions

PARTIAL

PARISH

COUNTY

STANLEY

LOCAL AUTHORITY

PERMITS CITY COUNCIL

DATA SOURCES

0008 - Department of Natural Resources
and Mines - Aug. 1977

LEGEND

Ripley Town Holdings Concessions

Permit and Mining Rights

Ripley Town Holdings

Permit and Mining Rights

Permit and Mining Rights

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Date: November 2007

Sheet: 1 of 1

Drawing No: 070025

Taylor Mining Services Pty Ltd

Redbank Plains Road

Blackburn, VIC 3116

Phone: (07) 3116 2311

Fax: (07) 3116 2377

Desktop Mining Study

Ripley Township Area

Plan 3 - Transport Corridor Plan

Moreton Geotechnical Services Pty Ltd

Po Box 915 Ipswich QLD 4305

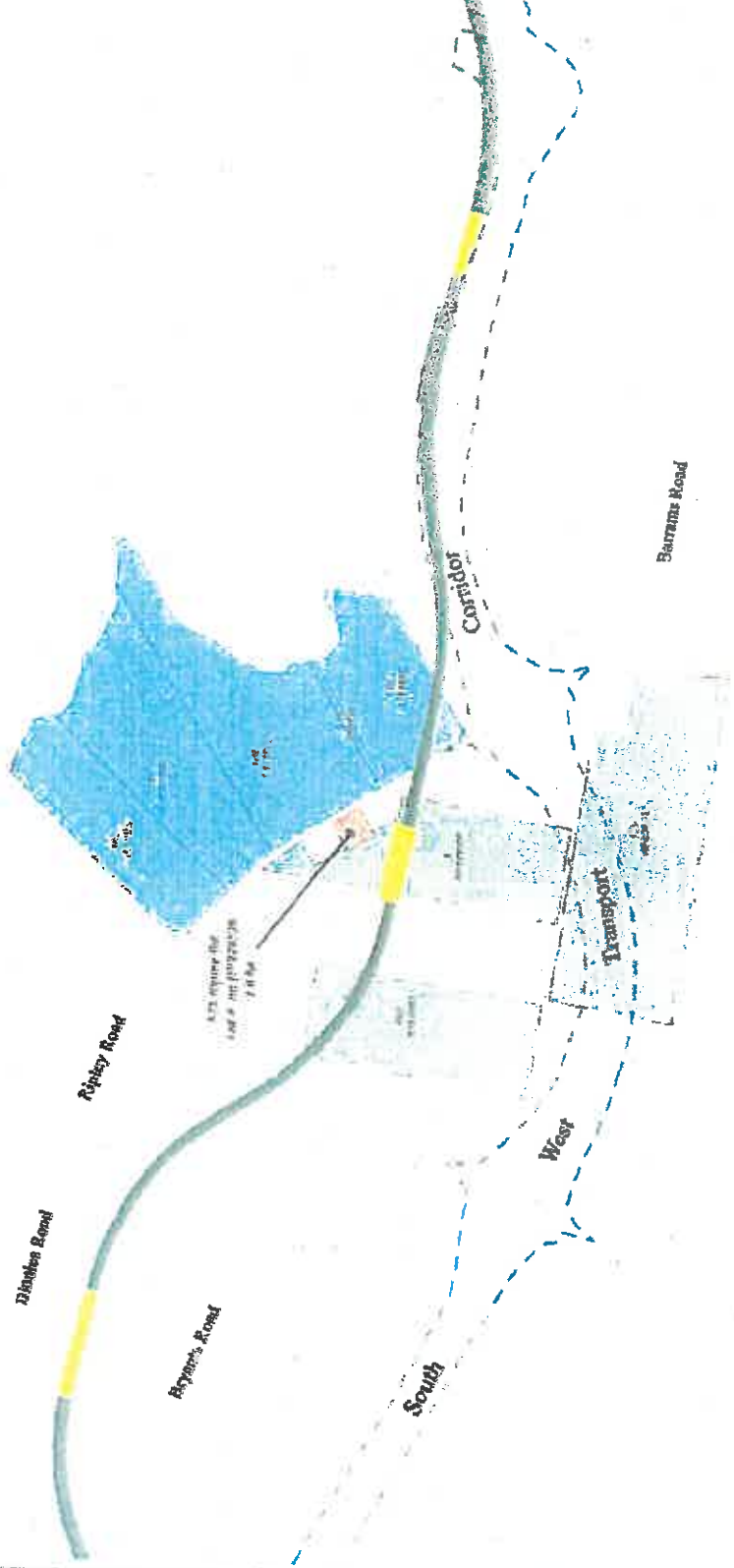
Ref: 2007/104

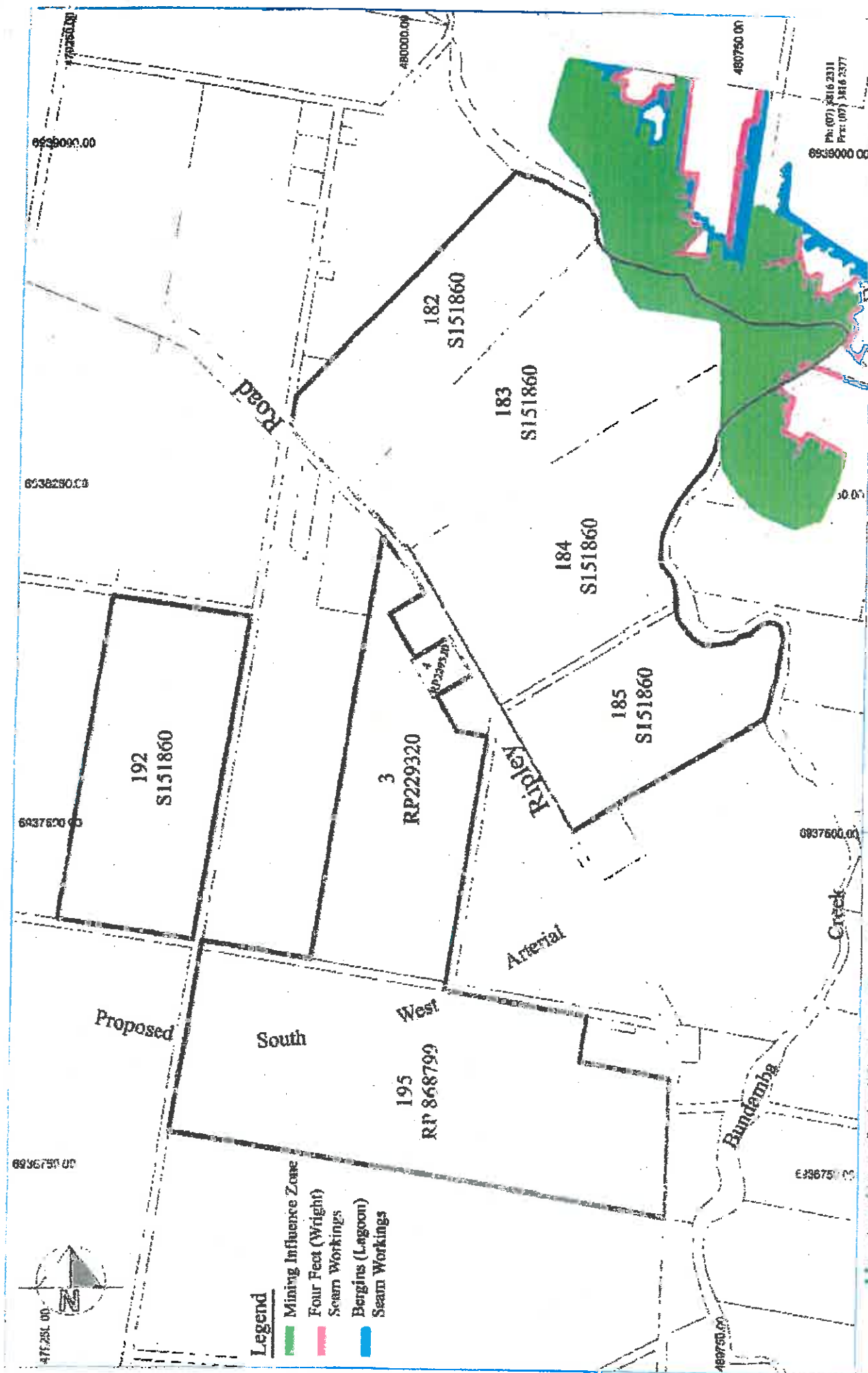
ACIN 055 833 120

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Legend

- Mining Influence Zone
- Four Feet (Wright) Seam Workings
- Bergins (Lagoon) Seam Workings

**Desktop Mining Study -
Ripley Township
Plan 4 - U/G Mining & Contralints Plan**

Mapcon Geotechnical Services Pty Ltd
 PO Box 915 Ipswich QLD 4305
 Tel/Fax: 3794 6988
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 Ref: 2007172
 ACN 055 833 120
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 Taylor Mining Services Pty Ltd
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APPENDIX A

TO

**MPN LONG FORM INFORMATION RESPONSE
AREA 1**

MPN CONSULTING PTY LTD
STRUCTURAL AND CIVIL ENGINEERS
ABN 39 062 191 799
39 Sherwood Road, Toowong, Qld, 4066
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Email: solutions@mpnc.net.au
Web: www.mpnc.net.au



FILE 5874

13 April 2011

Sekisui House Development Services Pty Ltd
56 Jephson Street
Toowong Qld 4066

Attention: SCOTT BIGGS

Dear Scott

**RE: RIPLEY ROAD – ADDITIONAL INFORMATION REQUEST RESPONSES
TO STORMWATER MANAGEMENT PLAN FOR AREA 1**

Further to the meeting held on 23 March 2011 with ULDA consultant Sinclair Knight Merrz, please find MPN's response to Sinclair Knight Merrz's request for additional information as outlined in the email received on 25 March 2011 at 4.55pm.

a) Plan showing pre-developed contour and site catchment details

Drawings 5874-HEC12 and HEC13 attached in Annexure A shows predevelopment contours and site catchment details used for the Urban Core modelling. Drawing 5874-HEC14 in Annexure A shows in greater detail the sub catchments and flow paths used to estimate the times of concentration for Area 1.

The times of concentration for each sub catchment were estimated using Friend's equation (4.06) as per QUDM with a maximum path length of 100m for medium gradient grassland for the pervious fractions, and 5 minutes was adopted for the impervious fractions.

b) Plan showing post development contours, catchments, pipe locations, outfalls to treatments / flood detention and external catchment pathways.

The Area 1 drawings 5874-RP02, RP03, RP15 and RP16 in Annexure B show the development contours, catchments, pipe locations and outlets to bioretention basins, detention storages, and overland flow paths for internal and external catchments.

- c) *Update of the overland flow path plan including sections showing low flow culvert and any changes in swale profile and assumed vegetation types (e.g. $n = 0.08$ to suit a landscaped treatment rather than just a grassed swale).*

The overland flow swale through the neighbourhood centre is detailed in the cross section on drawing 5874-PSK42 in Annexure C. A sensitivity analysis of the swale was performed for manning roughness of 0.035 as a grassed swale, and manning roughness of 0.08 as a landscaped swale (or otherwise to represent an unmaintained swale scenario with long reeds and debris as requested by SKM).

The results of this assessment are tabulated below and as can be seen from Table 1 of results, the flow regime is not very sensitive to a higher “n” value and no significant change occurs to the flow regime in the channel.

Channel Roughness "n"	Q1			Q2			Q10			Q20			Q100		
	Channel velocity (m/s)	Channel depth (m)	Channel d*v (m ² /s)	Channel velocity (m/s)	Channel depth (m)	Channel d*v (m ² /s)	Channel velocity (m/s)	Channel depth (m)	Channel d*v (m ² /s)	Channel velocity (m/s)	Channel depth (m)	Channel d*v (m ² /s)	Channel velocity (m/s)	Channel depth (m)	Channel d*v (m ² /s)
0.035	0.4	0.5	0.14	0.4	0.6	0.17	0.3	1.11	0.25	0.2	1.448	0.2	0.2	1.719	0.37
0.08	0.3	0.461	0.12	0.3	0.565	0.15	0.2	1.119	0.24	0.2	1.455	0.2	0.2	1.718	0.37

Table 1: Main Swale Flow Sensitivity Result

- d) *Plans of each bioretention and flood storage showing 0.1m – 0.2m contours, bioretention details including levels and pit locations, maintenance access, weirs and flood detention details including levels, pits details, weir details, stage-storage, stage discharge etc. Water level and flow hydrographs from DRAINS for say 1yr, 2yr, 10yr, 20yr and 100yr ARI for each flood storage (inflow and outflow). Water level pits for the flood storage needs to illustrate the time of inundation under these events.*

Details of each bioretention basin and detention storage are set out on drawings 5874-PSK71, 85, 86 and 88 in Annexure D.

The flow hydrographs for each storage are attached in Annexure D for the relevant critical duration storm as identified in the response item “o)” below.

- e) *Details of the post development impervious assumptions (if not provided already).*

The post development impervious fractions are based on 60% impervious for the residential areas as calculated from Residential 30 Guideline. Specific road catchments are based on 90% imperviousness as a minimum. The carpark to the sales area has been assumed to be 100% impervious.

- f) *Plan showing interface between DRAINS and HECRAS.*

Drawing 5874-HEC15 in Annexure E shows the catchments, Drains Flow Points and HECRAS cross sections for the existing configuration. The sub catchment times of concentration are shown on 5874-HEC13 in Annexure A.

- g) *Clarification of the pre and post flow reporting locations (boundary of site and downstream) and provide all pre and post development flow results at these locations.*

Attached in Annexure F please find the hydrographs for each outlet location in the pre and post development scenarios for each of the three locations shown in 5874-HEC16:

- Fischer and Nevis Road outlet
- Aulds Road outlet
- Sales Office outlet

The storms analysed and presented are for 1 in 1, 1 in 2, 1 in 10, 1 in 20 and 1 in 100 year ARI and for durations of 5, 10, 20, 45, 90 and 180 minutes. These durations encompass the critical durations storm event and for each ARI event series the post development flows do not exceed the predevelopment peak flow thereby meeting the peak flow retardation objective.

These results also demonstrate the critical storm duration discussed in the response to item “o”).

- h) Is Ripley Valley road to be treated or not? Decision with ULDA and ICC but required discussion.*

This has been referred to ULDA for a decision.

- i) Verification of hydrological model to Rational Method must be provided that relate directly to this development application (realise this has been completed previously which is fine, just need to relate this to this development ... i.e. rational method for a few locations).*

A Rational Method Assessment has been prepared in spreadsheet form for the existing Area 1 which is attached in Annexure G. The catchments and outlet locations are shown in 5874.HEC16 in Annexure F.

The existing peak flows from DRAINS for each outlet correlates to the Rational Flows as follows:

Storm ARI Event	Drains			Rational		
	Aulds Road	Fischer Road	Sales Office	Aulds Road	Fisher Road	Sales Office
Q1	2.23	0.27	0.25	3.60	0.21	0.23
Q2	3.80	0.39	0.35	4.97	0.29	0.32
Q10	8.72	0.72	0.63	8.66	0.51	0.55
Q20	11.0	0.90	0.78	10.62	0.62	0.68
Q100	17.2	1.36	1.17	16.41	0.96	1.04

Table 2: Outlet Flows – DRAINS and Rational Calibration

The total catchment areas contributing to each outlet area:

- 53.70 ha at Aulds Road Outlet
- 3.139 ha at Fischer Road Outlet
- 2.664 ha at the sales office outlet

- j) Sensitivity testing of DRAINS model routing parameters relating to performance of flood storages in mitigating peak flows (more advice to come on Tuesday 29/3 once further review of DRAINS model carried out).*

Awaiting clarification of requirements from SKM, however MPN herewith clarify the hydraulic modelling and calibration of the DRAINS routing procedures.

MPN has prepared a DRAINS model of the Urban Core catchment which drains into Bundamba Creek including a portion of Bundamba Creek downstream of the Centenary Highway Interchange. The modelling program DRAINS is supplied by Watercom Pty. Ltd.

DRAINS uses the Time-Area Method of Catchment Analysis which is a form of catchment routing model in which a hyetograph of rainfall is combined with a time-area diagram to produce a flow hydrograph. The procedure effectively divides a catchment into a number of strips of land, and superimposes the individual flows from these sub-areas, allowing for time lags depending on their distance from the outlet. Hydrological routing is the process of converting a hydrograph that passes through some part of a flow system to allow for the changes that occur during its passage. DRAINS incorporates catchment routing in the time-area calculations and non-linear storage routing calculations. This methodology is more accurate than the QUDM Rational Method and caters for volumetric analysis.

QUDM requires calibration of all mathematical models to ensure consistency. Recommendations in QUDM are that in the absence of “real event” flow data, that the peak flows for the models must at least be calibrated to the peak flows calculated using the Rational Method. DRAINS incorporates an “extended rational method” which allows peak flows and hydrographs to be developed using runoff coefficients determined from QUDM.

To calibrate the model, the Urban Core site has been divided into 47 sub-catchments covering an area of 385 ha for the purpose of flow modelling and these are indicated on drawing 5874-HEC12 in Annexure A.

MPN has calibrated the hydrologic parameters used in the DRAINS model to replicate the flow and level results Cardno has reported in their study of Bundamba Creek, and this negates the necessity for a sensitivity analysis.

The calibration required the setting of the DRAINS parameters as follows:

- Impervious Runoff Coefficient $C_{10} = 0.90$
- Pervious Runoff Coefficient $C_{10} = 0.58$ (range 0.32 to 0.70)
- Antecedent Moisture Condition $AMC = 4$ (range 1 to 4)
- Impervious Storage Depth = 1 mm (range 1 to 10 mm)
- Supplementary Impervious Area Storage Depth = 1 mm (range 1 to 10 mm)

- Pervious Area Storage Depth = 5 mm (range 1 to 10 mm)

The Intensity Frequency Duration parameters used for the Rational Method Calculations were:

Parameter	Notation	mm/hr
1 hour duration, 2 year ARI intensity read from map 1 for catchment area of interest	${}^2i_1$	45.20
12 hour duration, 2 year ARI intensity read from map 2 for catchment area of interest	${}^2i_{12}$	6.90
72 hour duration, 2 year ARI intensity read from map 3 for catchment area of interest	${}^2i_{72}$	1.95
1 hour duration, 50 year ARI intensity read from map 4 for catchment area of interest	${}^{50}i_1$	91.00
12 hour duration, 50 year ARI intensity read from map 5 for catchment area of interest	${}^{50}i_{12}$	14.00
12 hour duration, 50 year ARI intensity read from map 6 for catchment area of interest	${}^{50}i_{72}$	3.95
Skewness factors read from map 7 for catchment of interest	G	0.23
6 minute duration geographical factor for 2 year ARI read from map 8 for catchment of interest	F_2	4.39
6 minute duration geographical factor for 50 year ARI read from map 9 for catchment of interest	F_{50}	17.20

Table 3: IFD Parameters from AR & R.

The model having been calibrated has been used with Australian Rainfall and Runoff (ARR) temporal pattern storms to assess the impact of the post-development flows compared to the pre-developed flows.

For any part of the Urban Core such as Area 1, the DRAINS model results for the post- development case are compared with the flows calculated for the existing case using ARR storm events to assess achievement of flow retardation that does not result in increased runoff. ICC requires flooding to be assessed up to the 1 in 100 year ARI. The storm modelling included the 1 in 1, 1 in 2, 1 in 10, 1 in 20, 1 in 50 and 1 in 100 years average rainfall intensities (ARI) with durations of 5, 10, 20 , 30 , 60, 90, 120 and 180 minutes in DRAINS.

- k) *Demonstration of adequacy of spillways to alleviate upstream flooding of properties in case where piped outlets are blocked.*

Attached in Annexure C is the swale cross section drawing 5874-PSK42 with adjacent road reserve and green space. Marked on the cross section are the 1 in 100 year ARI flow levels for “normal” operation of the swale. Abnormal operation caused by a blockage of any of the adjoining culverts where the roads cross the swale are shown as drawing 5874-PSK93 in Annexure C.

The flow parameters in each case for 1 in 100 ARI are:

Refer 5874-PSK/93 for Blocked Culvert Scenario		
Locations	Road $v \cdot d$ (m²/s)	Depth over road (m)
Ripley road	0.02	0.032
Swale culvert A	0.56	0.244
Swale culvert B	0.58	0.236
Swale culvert C	0.47	0.221

The results indicate no adverse safety risk is created on the roadways should a blockage occur to the culverts.

- l) *Sensitivity of hydraulic modelling to choice of n values, specifically the 0.035 value used in the main drain and Town Park watercourse.*

The HECRAS table in Annexure H shows the results of modelling of the town park channels and sensitivity to Mannings Roughness Values $n = 0.035, 0.08$ and 0.10 . Details for the swale drain through the future neighbourhood centre are addressed in item “c)” above.

- m) *Provide flows, levels and velocities under 1yr, 2yr, 10yr and 100yr from HECRAS.*

Attached in Annexure I please find the drawings showing the Townpark inundation depths, flows and velocities assessed in HECRAS and the tabulated results for each ARI (1, 2, 10, 100 year) for the critical event duration of 60 minutes.

As expected the velocities in the lower portion of the channels near Bundamba Creek increase when the “no-tailwater” is set for the downstream boundary condition. However, no works are proposed in this lower reach of the channel and the flow velocities are no worse than existing flows.

- n) *Redo the HECRAS / DRAINS modelling for the parkland waterway to simulate the changed terrain and changes to Ripley Road (height and cross-drainage) in the DRAINS model. This is to simulate the changes to the hydrology and the hydraulics cumulatively.*

Assessment of the town park channelization in DRAINS on downstream flows does not adversely affect the peak flows in Bundamba Creek as shown on drawings 5874-PSK92 and PSK94 and the hydrographs in Annexure J.

- o) *Provide proof of critical storm for pre, post and mitigated i.e. run a series of durations through each of these to confirm critical storm. Particularly interested in seeing numerous durations run through the flood storage systems.*

Attached in Annexure E are hydrographs generated from DRAINS which demonstrate for a wide range of durations sufficient incorporation of the peak flow duration. In summary the critical durations for each outlet by event is tabulated below:

Predevelopment:

	Q1	Q2	Q10	Q20	Q100
Aulds	90 min	60 min	45 min	45 min	45 min
Fischer	30 min	20 mins	20 mins	20 mins	10 mins
Sales	45 mins	20 mins	45 mins	45 mins	45 mins

Post development:

	Q1	Q2	Q10	Q20	Q100
Aulds	90 mins	60 mins	90 mins	90 mins	90 mins
Fischer	20 mins	60 mins	60 mins	60 mins	45 mins
Sales	90 mins	90 mins	45 mins	90 mins	90 mins

In all other cases the post development peak flow is less than the predevelopment peak flow.

Yours faithfully



DANIEL LEE
FOR AND ON BEHALF OF
MPN CONSULTING PTY LIMITED
dl: tt

ANNEXURE A
MPN Drawing Numbers:
5874-HEC.12
5874-HEC.13
5874-HEC.14

Catchment Name	Area ha	Impervious Portion %	ARI=> Time of Concentration min	1 2 10 20 100					1 2 10 20 100					1 2 10 20 100				
				Runoff Co-efficient					Intensity					Flows				
				-	-	-	-	-	mm/hr	mm/hr	mm/hr	mm/hr	mm/hr	cum/s	cum/s	cum/s	cum/s	cum/s
BUND US SWTC	5171.000	0	180.0	0.37	0.39	0.46	0.49	0.56	15.0	19.5	29.6	34.9	47.9	79.74	110.70	197.61	244.08	382.71
Cat 1	14.248	0	14.6	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	1.08	1.49	2.58	3.16	4.87
Cat 10	21.992	0	14.6	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	1.66	2.29	3.98	4.87	7.51
Cat 11	14.932	0	14.4	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	1.13	1.56	2.70	3.31	5.10
Cat 12	15.374	0	18.8	0.37	0.39	0.46	0.49	0.56	65.0	84.5	125.1	146.1	197.5	1.03	1.42	2.48	3.04	4.70
Cat 13	6.511	0	15.6	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	0.48	0.66	1.14	1.40	2.16
Cat 14	8.275	0	16.4	0.37	0.39	0.46	0.49	0.56	68.9	89.5	132.2	154.3	208.4	0.59	0.81	1.41	1.73	2.67
Cat 15	6.208	0	15.1	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	0.46	0.63	1.09	1.33	2.06
Cat 16	3.133	0	15.1	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	0.23	0.32	0.55	0.67	1.04
Cat 17	28.934	0	15.1	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	2.12	2.92	5.08	6.22	9.60
Cat 18	15.252	0	14.4	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	1.15	1.59	2.76	3.38	5.21
Cat 19	6.437	0	16.0	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	0.47	0.65	1.13	1.38	2.13
Cat 2	8.043	0	16.4	0.37	0.39	0.46	0.49	0.56	68.9	89.5	132.2	154.3	208.4	0.57	0.79	1.37	1.68	2.59
Cat 20	18.065	0	16.4	0.37	0.39	0.46	0.49	0.56	68.9	89.5	132.2	154.3	208.4	1.28	1.77	3.08	3.77	5.82
Cat 21	11.583	0	17.3	0.37	0.39	0.46	0.49	0.56	66.9	86.9	128.5	150.1	202.8	0.80	1.10	1.92	2.35	3.63
Cat 22	18.424	0	13.2	0.37	0.39	0.46	0.49	0.56	75.8	98.3	144.8	168.9	227.7	1.44	1.98	3.44	4.21	6.49
Cat 23	11.065	0	13.2	0.37	0.39	0.46	0.49	0.56	75.8	98.3	144.8	168.9	227.7	0.87	1.19	2.07	2.53	3.90
Cat 24	11.204	0	14.8	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	0.85	1.17	2.03	2.48	3.83
Cat 25	13.702	0	15.6	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	1.00	1.38	2.40	2.95	4.54
Cat 26	11.135	0	14.8	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	0.84	1.16	2.01	2.47	3.80
Cat 27	13.824	0	14.8	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	1.05	1.44	2.50	3.06	4.72
Cat 28	10.334	0	15.3	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	0.76	1.04	1.81	2.22	3.43
Cat 29	9.944	0	14.6	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	0.75	1.04	1.80	2.20	3.40
Cat 30	15.097	0	15.6	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	1.11	1.53	2.65	3.25	5.01
Cat 31	12.535	0	15.1	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	0.92	1.27	2.20	2.69	4.16
Cat 32	10.517	0	14.4	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	0.80	1.10	1.90	2.33	3.59
CAT 33	7.829	0	14.8	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	0.59	0.82	1.42	1.73	2.67
CAT 34	1.840	0	15.3	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	0.13	0.19	0.32	0.40	0.61
Cat 35	17.009	0	14.6	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	1.29	1.77	3.08	3.77	5.81
Cat 36	15.097	0	13.0	0.37	0.39	0.46	0.49	0.56	75.8	98.3	144.8	168.9	227.7	1.18	1.63	2.82	3.45	5.32
Cat 37	15.251	0	13.0	0.37	0.39	0.46	0.49	0.56	75.8	98.3	144.8	168.9	227.7	1.19	1.64	2.85	3.49	5.37
Cat 38	12.202	0	13.5	0.37	0.39	0.46	0.49	0.56	75.8	98.3	144.8	168.9	227.7	0.95	1.31	2.28	2.79	4.30
Cat 39	7.686	0	16.8	0.37	0.39	0.46	0.49	0.56	68.9	89.5	132.2	154.3	208.4	0.55	0.75	1.31	1.61	2.48
Cat 40	8.808	0	15.1	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	0.65	0.89	1.55	1.89	2.92
Cat 41	6.363	0	14.6	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	0.48	0.66	1.15	1.41	2.17
Cat 42	14.655	0	14.8	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	1.11	1.53	2.65	3.25	5.01
Cat 4e	3.140	0	17.3	0.37	0.39	0.46	0.49	0.56	66.9	86.9	128.5	150.1	202.8	0.22	0.30	0.52	0.64	0.99
Cat 4W	26.024	1	18.0	0.58	0.61	0.72	0.76	0.86	66.9	86.9	128.5	150.1	202.8	2.79	3.84	6.69	8.20	12.67
Cat 5	13.338	0	16.8	0.37	0.39	0.46	0.49	0.56	68.9	89.5	132.2	154.3	208.4	0.95	1.31	2.27	2.79	4.30
Cat 6	22.446	0	16.4	0.37	0.39	0.46	0.49	0.56	68.9	89.5	132.2	154.3	208.4	1.60	2.20	3.83	4.69	7.24
Cat 7	15.076	0	15.6	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	1.11	1.52	2.65	3.24	5.00
Cat 8	24.360	0	15.8	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	1.79	2.46	4.27	5.24	8.08
Cat 9	18.035	0	14.8	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	1.36	1.88	3.26	3.99	6.16
CAT D2E	2.729	0	14.4	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	0.21	0.28	0.49	0.60	0.93
CAT D2W	4.094	0	15.1	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	0.30	0.41	0.72	0.88	1.36
CAT D3E	5.011	0	14.8	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	0.38	0.52	0.91	1.11	1.71
CAT D3W	5.011	0	14.8	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	0.38	0.52	0.91	1.11	1.71

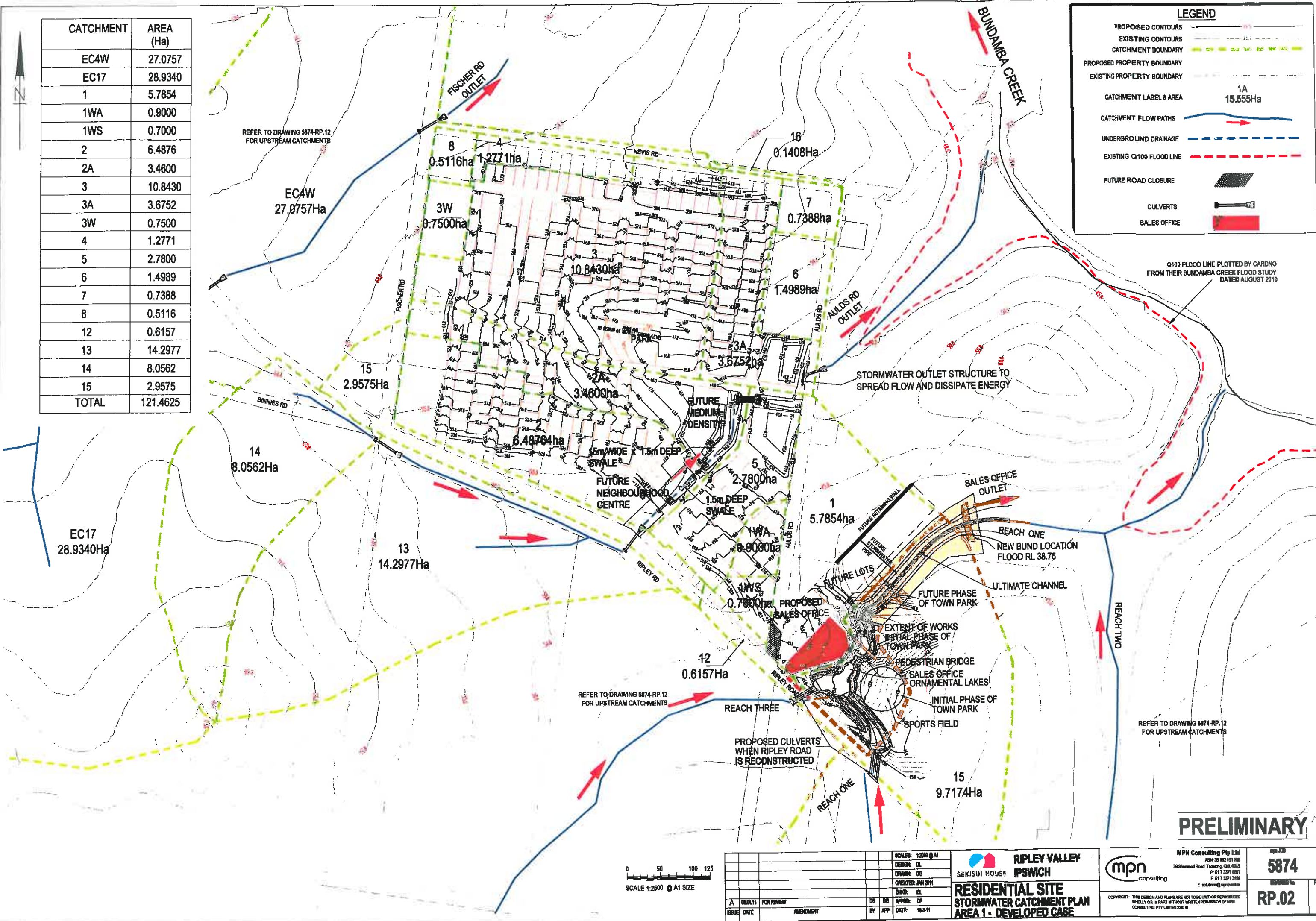
CATCHMENT HYDROLOGY TABLE

ISSUED FOR INFORMATION

RIPLEY VALLEY RESIDENTIAL DEVELOPMENT RIPLEY ROAD IPSWICH		SCALE: 1:500 @ A1 DESIGN: CR DRAWING: CR CREATED: MARCH 2011 CHECKED: DL APPROVED: DATE:	RIPLEY VALLEY IPSWICH CATCHMENT TABLE UNDEVELOPED FLOWS	mpn consulting 30 Sherwood Road, Toowoomba, Qld, 4300 P: 01 7 3391 0877 F: 01 7 3391 0185 E: info@mpn.net.au	5874 DRAWING No. HEC.13 REV A

ANNEXURE B
MPN Drawings 5874-RP02, RP03, RP15 and RP16

CATCHMENT	AREA (Ha)
EC4W	27.0757
EC17	28.9340
1	5.7854
1WA	0.9000
1WS	0.7000
2	6.4876
2A	3.4600
3	10.8430
3A	3.6752
3W	0.7500
4	1.2771
5	2.7800
6	1.4989
7	0.7388
8	0.5116
12	0.6157
13	14.2977
14	8.0562
15	2.9575
TOTAL	121.4625



LEGEND

PROPOSED CONTOURS

EXISTING CONTOURS

CATCHMENT BOUNDARY

PROPOSED PROPERTY BOUNDARY

EXISTING PROPERTY BOUNDARY

CATCHMENT LABEL & AREA

1A 15.555Ha

CATCHMENT FLOW PATHS

UNDERGROUND DRAINAGE

EXISTING Q100 FLOOD LINE

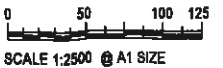
FUTURE ROAD CLOSURE

CULVERTS

SALES OFFICE

Q100 FLOOD LINE PLOTTED BY CARDNO FROM THEIR BUNDAMBA CREEK FLOOD STUDY DATED AUGUST 2010

PRELIMINARY



SCALE: 1:2500 @ A1	DESIGN: DL	DATE: 10-11
CREATED: JAN 2011	APPD: DP	
BY: APP	DATE: 10-11	
A 004/11 FOR REVIEW		
ISSUE DATE	AMENDMENT	

SEKISUI HOUSE

RIPLEY VALLEY PSWICH

RESIDENTIAL SITE STORMWATER CATCHMENT PLAN
AREA 1 - DEVELOPED CASE

MPN CONSULTING

MPN Consulting Pty Ltd
ABN 39 021 911 788
39 Shawwood Road, Traralgon, VIC 3840
P 51 73391887 F 51 73391386
E info@mpnconsulting.com.au

5874

RP.02

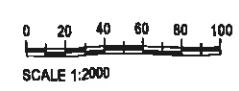
A



LEGEND

- PROPERTY CONTOURS 22.5
- EXISTING PROPERTY BOUNDARY
- PROPOSED PROPERTY BOUNDARY
- OVERLAND FLOW PATHS
- EXISTING Q100 FLOOD LINE
- DRAINAGE SWALE
- CATCHMENT BOUNDARY

PRELIMINARY



SCALE: 1:2000 @ A1	DESIGN: DL	DATE: 10/01/11
DRAWN: LW	CREATED: JAN 2011	CHD: DL
DO: DG	APPRO: DP	DATE: 10/01/11
BY: APP		
ISSUE DATE	AMENDMENT	

SEKISUI HOUSE
RIPLEY VALLEY IPSWICH
RESIDENTIAL SITE OVERLAND FLOW PATHS

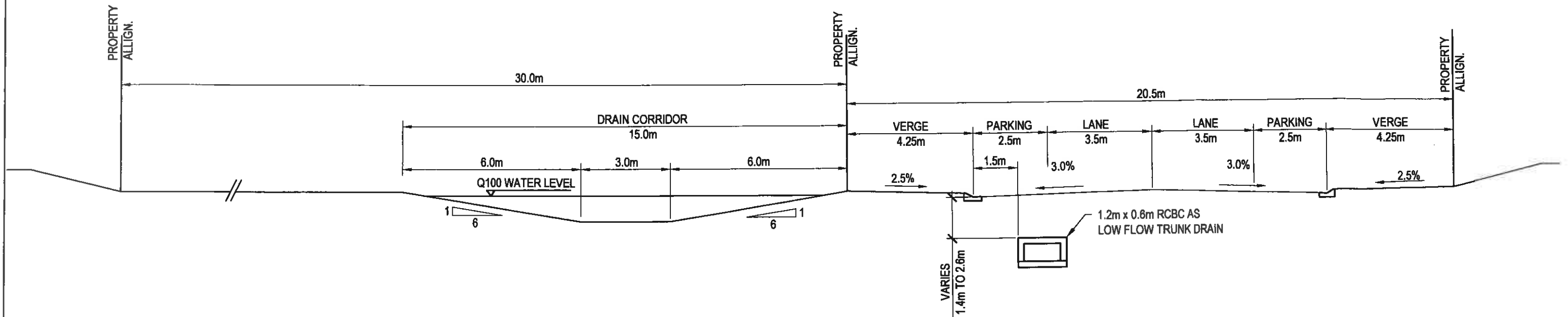
MPN Consulting Pty Ltd
20 Sherwood Road, Toowoomba, QLD 4360
P 61 7 3371 0077
F 61 7 3371 3108
E. solutions@mpn.com.au

mpn consulting

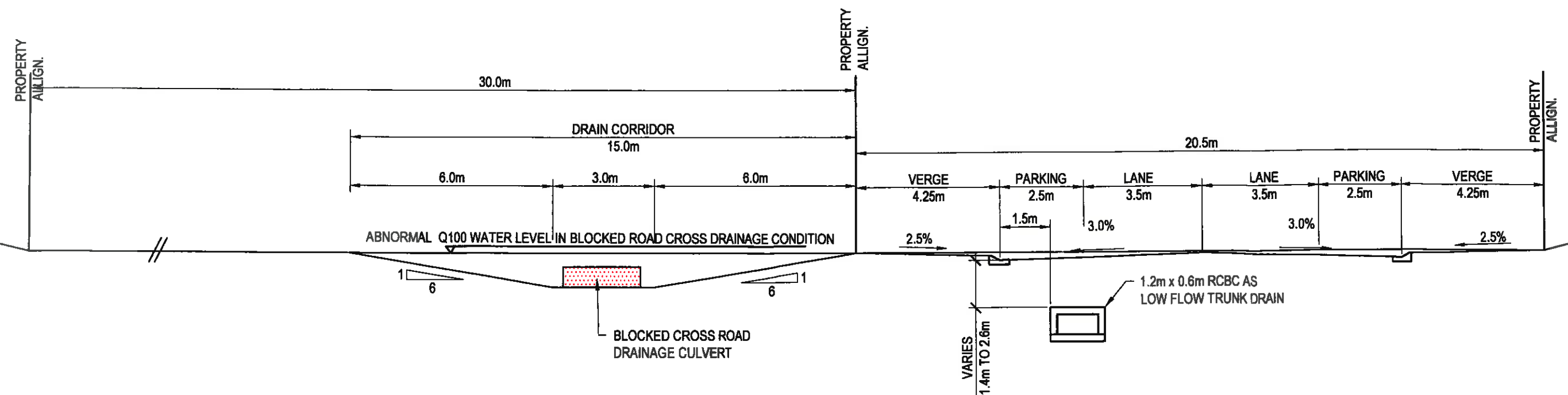
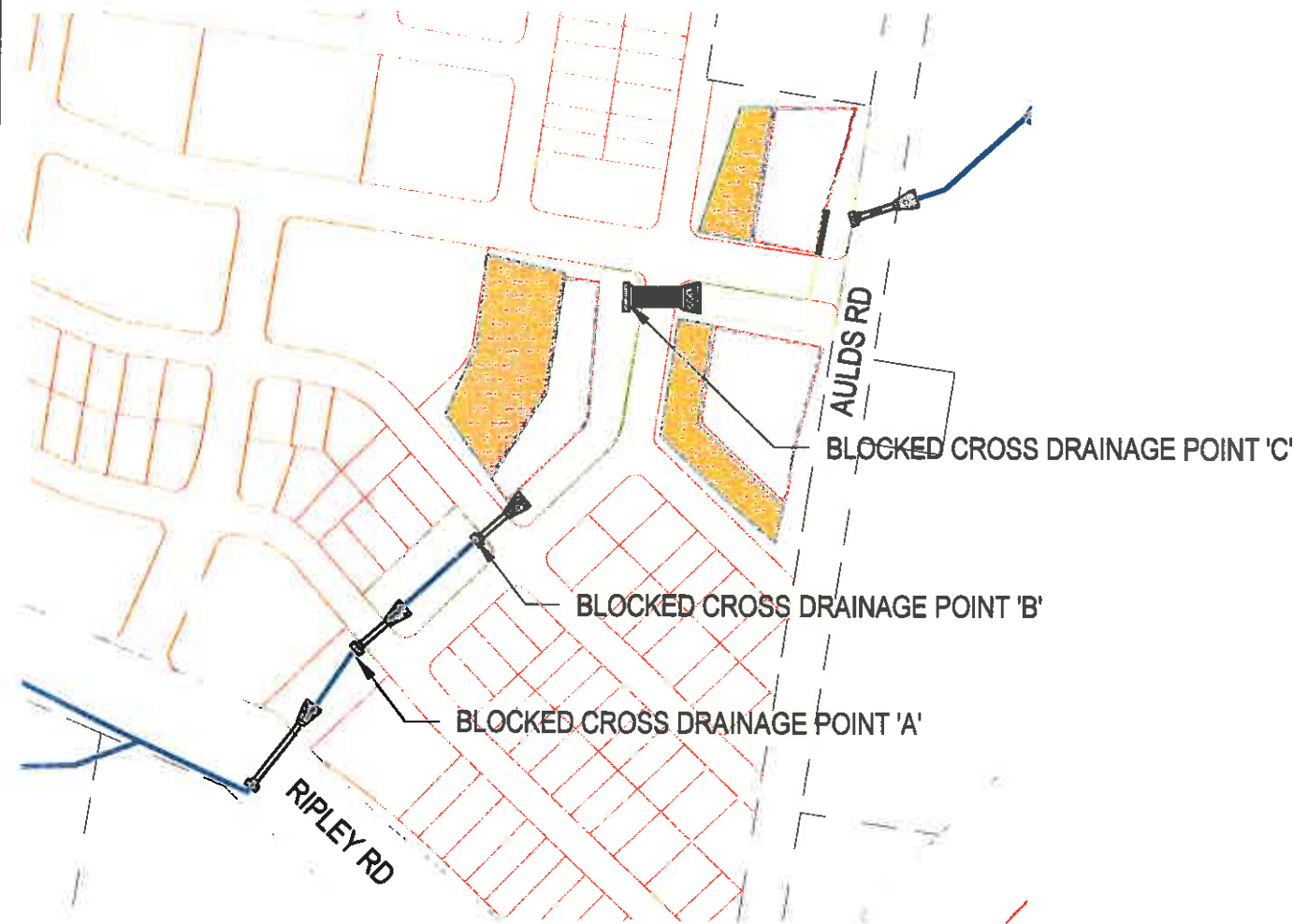
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5874
DRAWING NO. **RP.15** KEY **A**

ANNEXURE C
MPN Drawing Number 5874-PSK42 and 5874-PSK93

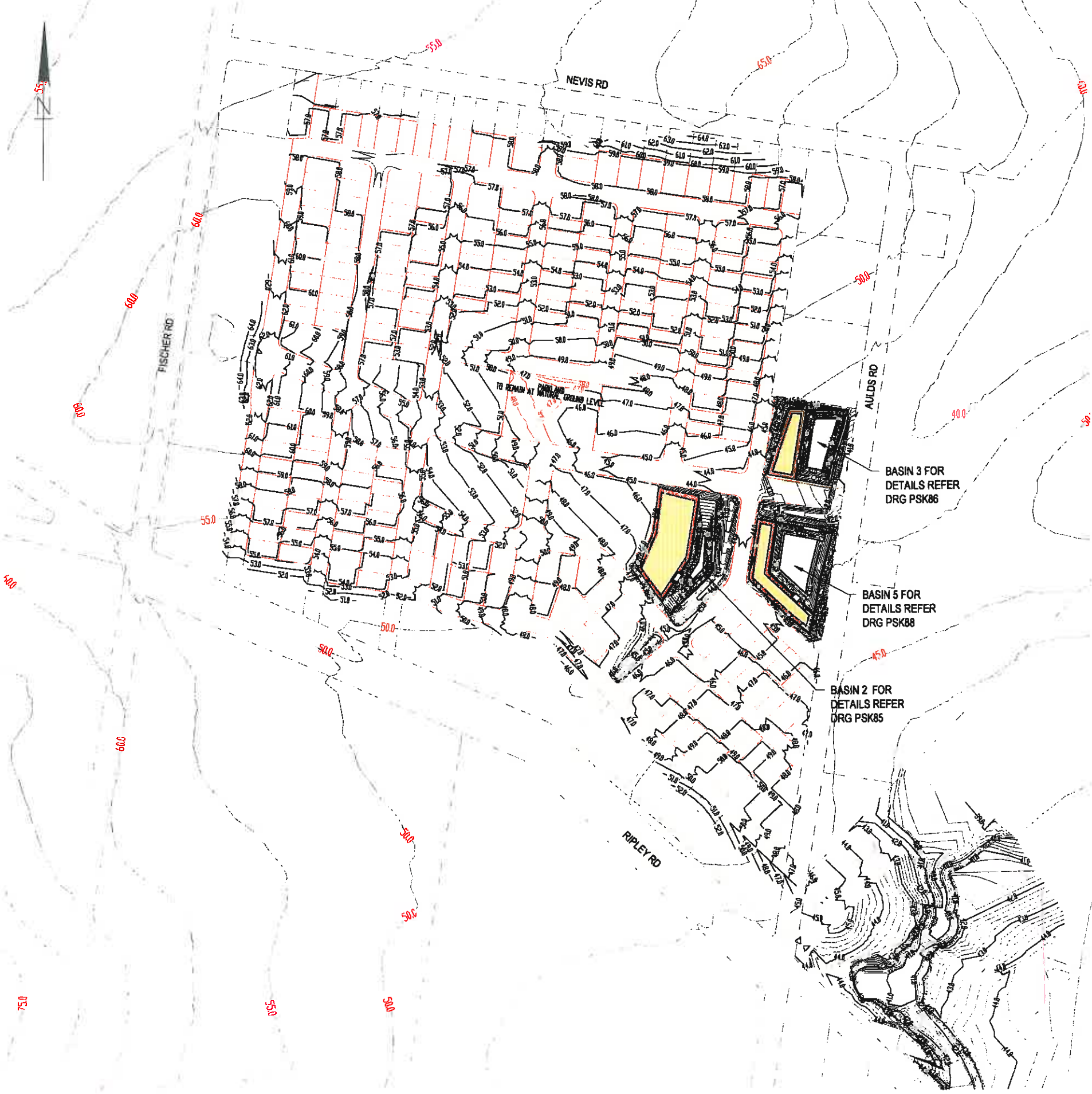


MINOR NEIGHBOURHOOD LINK 20.5m + SWALE 1 in 6 BATTER FACE
SCALE NTS



MINOR NEIGHBOURHOOD LINK 20.5m + SWALE 1 in 6 BATTER FACE
SCALE NTS

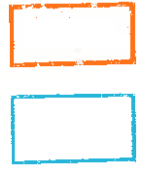
ANNEXURE D
MPN Drawings PSK71, 85, 86 and 88
Storage Inflow and Outflow Hydrographs
(For Critical Storm Durations)



LEGEND

PROPERTY CONTOURS
EXISTING PROPERTY BOUNDARY
PROPOSED PROPERTY BOUNDARY

BIO-RETENTION BASIN
STORMWATER DETENTION BASIN



FOR DETAILS REFER
DRG PSK85
PSK86 AND PSK88



REV	DATE	AMENDMENT	BY	APP	DATE

5ERISIV HOUSE

RIPLEY VALLEY IPSWICH

**RESIDENTIAL AREA ONE
BASIN AND BIO AREA SITE PLAN**

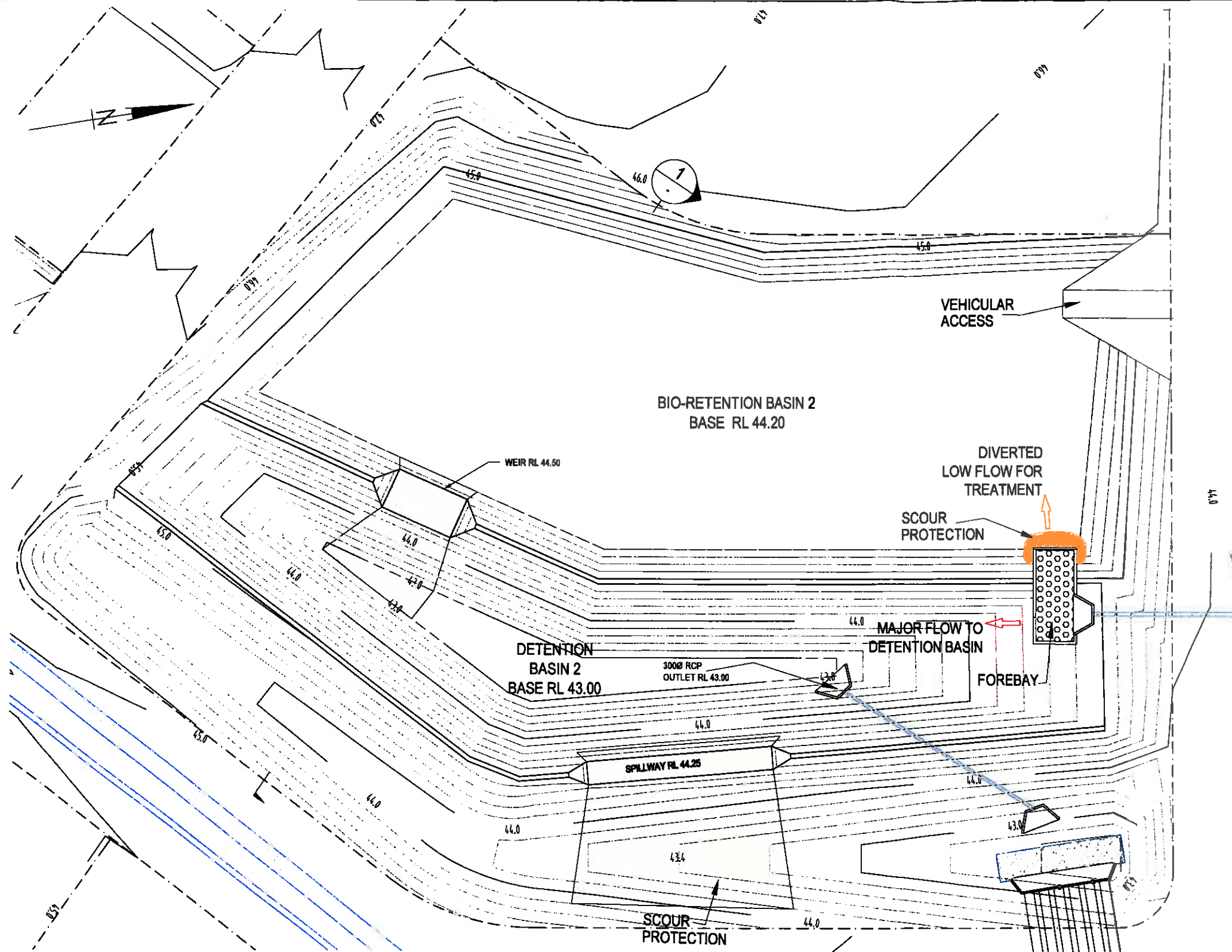
MPN Consulting Pty Ltd
AEN 28 002 101 700
39 Sherwood Road, Toowoomba, QLD 4300
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E solutions@mpn.com.au

mpn consulting

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5874

PSK71

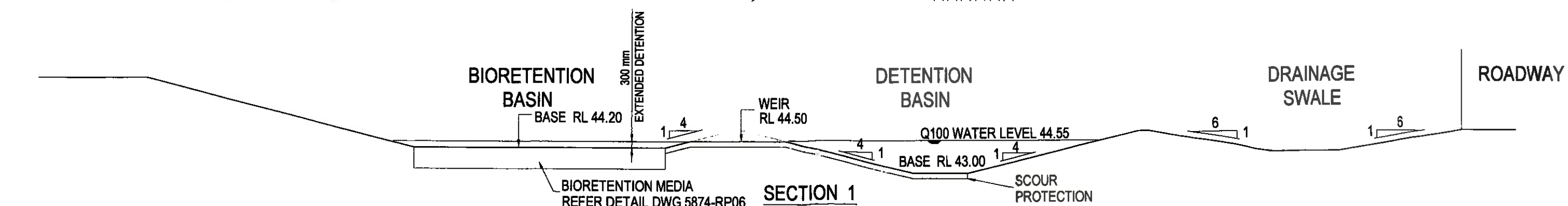


BIO-RETENTION BASIN 3 DETAILS

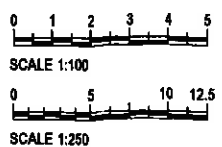
AREA BASE (m²)	2442
FILTER MEDIA DEPTH (m)	1
BASE RL	44.20
WEIR LEVEL / LENGTH	44.50 / 4m
OUTFALL PIPE SIZE	375Ø

DETENTION BASIN DETAILS

	LEVEL	AREA m2	VOLUME m3
STORAGE	43.00	82	0
	44.70	1255	1136
	44.75	3655	1259
	45.00	3655	2173
WEIR LENGTH	20m AT RL 44.25		
Q100 WATER LEVEL	RL 44.55		



SECTION 1
SCALE 1:100

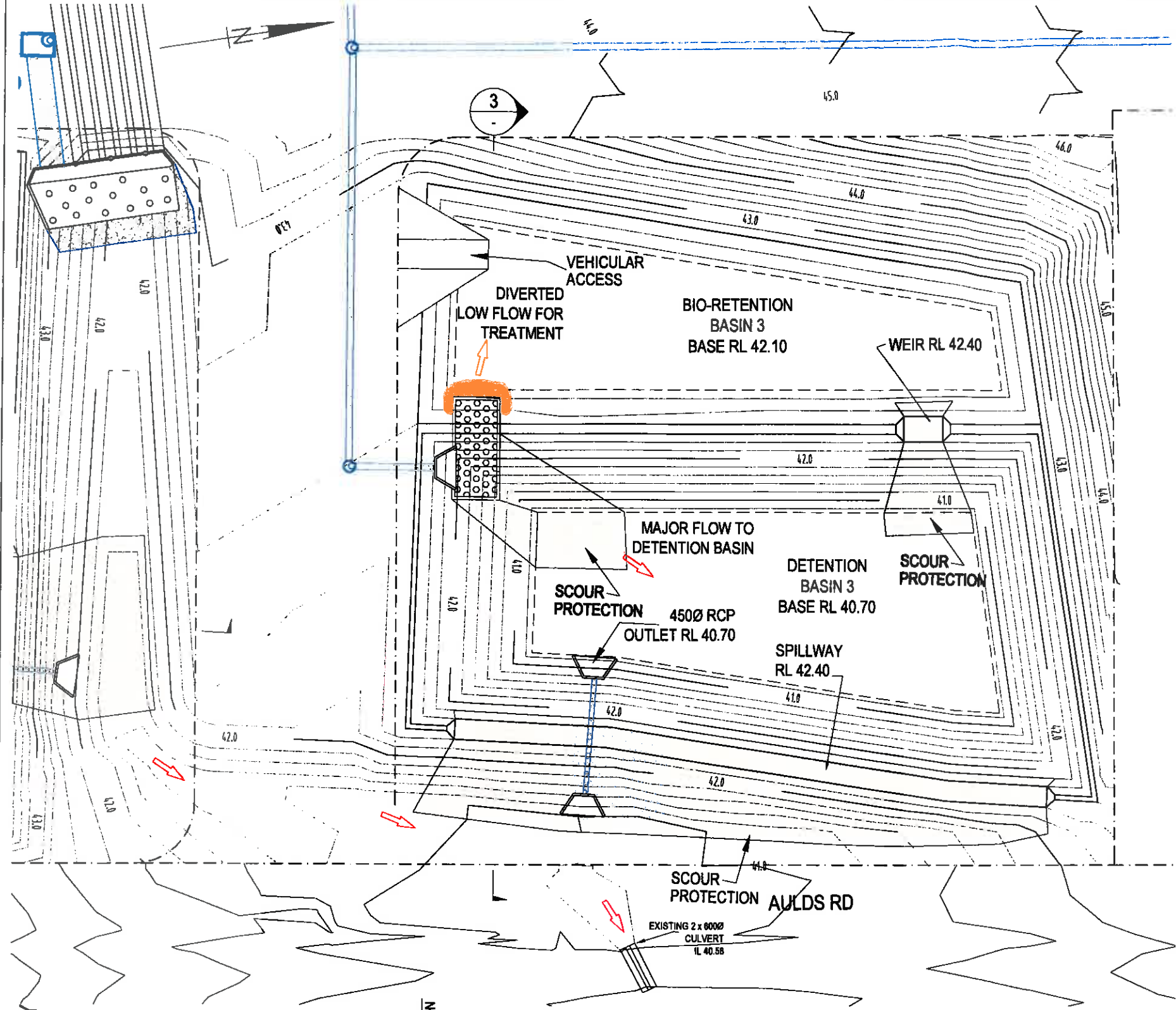


DATE	AMENDMENT	BY	APP	DATE

SEKISUI HOUSE
RIPLEY VALLEY - IPSWICH
RESIDENTIAL AREA ONE
BIORETENTION & DETENTION BASINS
PLAN AND DETAILS - BASIN 2

MPN Consulting Pty Ltd
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F: 017 3371 1186
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mpn consulting
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5874
DRAWING NO. PSK85
REV A

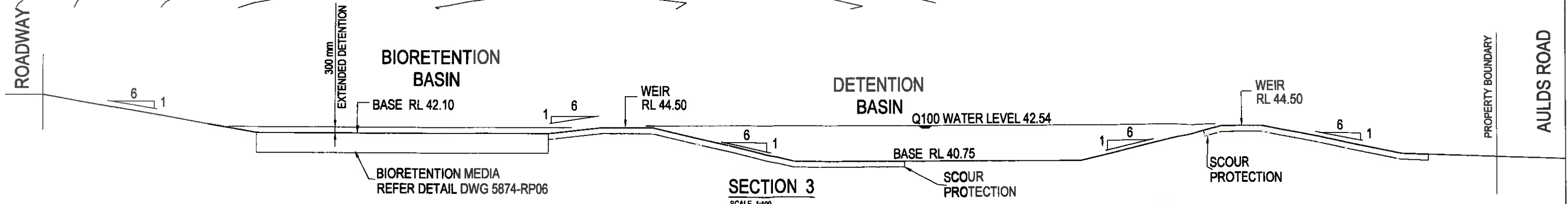


BIO-RETENTION BASIN 3 DETAILS

AREA BASE (m²)	683
FILTER MEDIA DEPTH (m)	1
BASE RL	42.10
WEIR LEVEL / LENGTH	42.40 / 10m
OUTFALL PIPE SIZE	2250

DETENTION BASIN DETAILS

	LEVEL	AREA m2	VOLUME m3
STORAGE	40.70	620	0
	42.30	2170	2232
	42.35	2770	2355
	42.60	2770	3048
WEIR LENGTH	60m AT RL 42.40		
Q100 WATER LEVEL	RL 42.54		

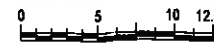


SECTION 3

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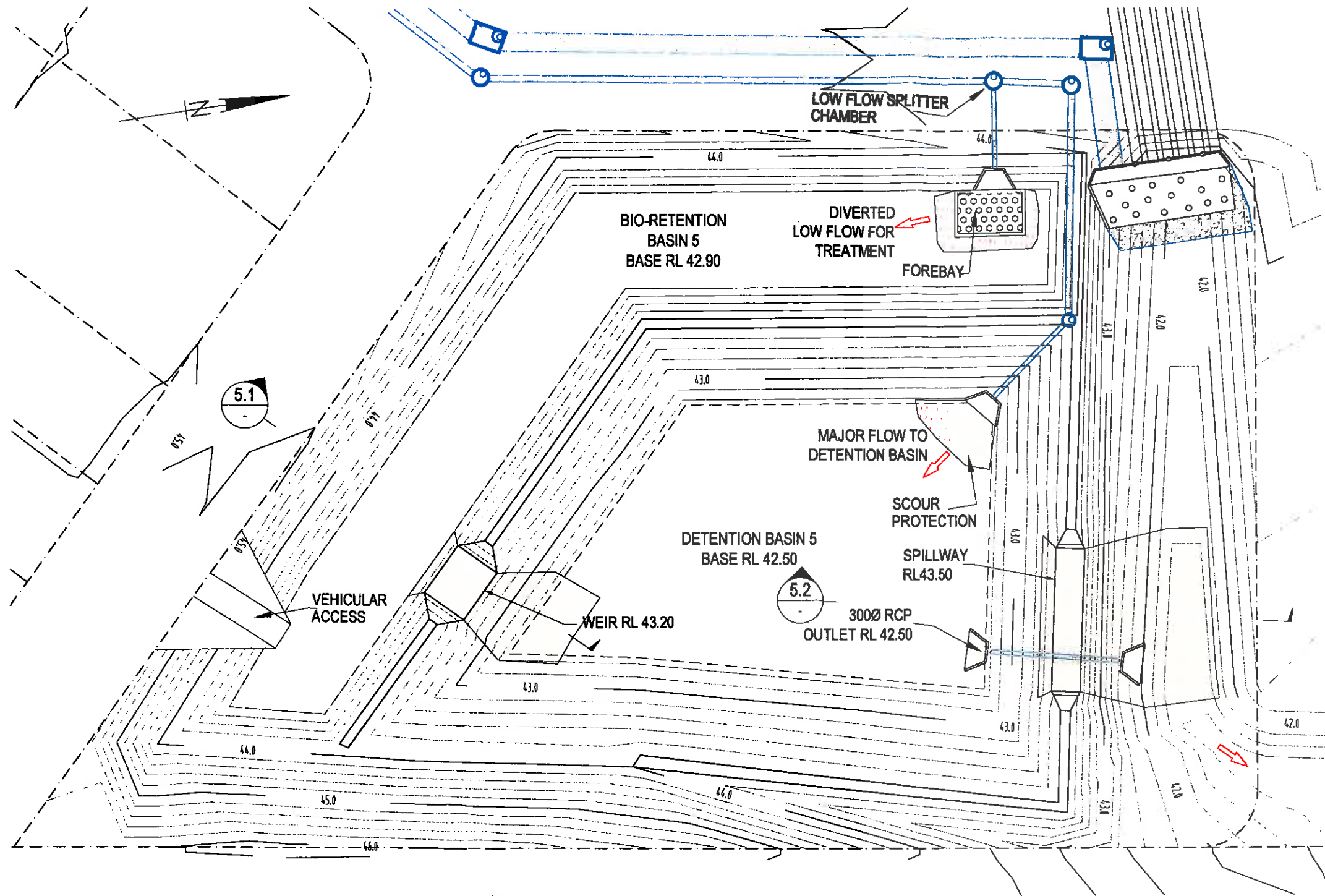


SCALE 1:100



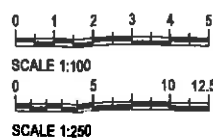
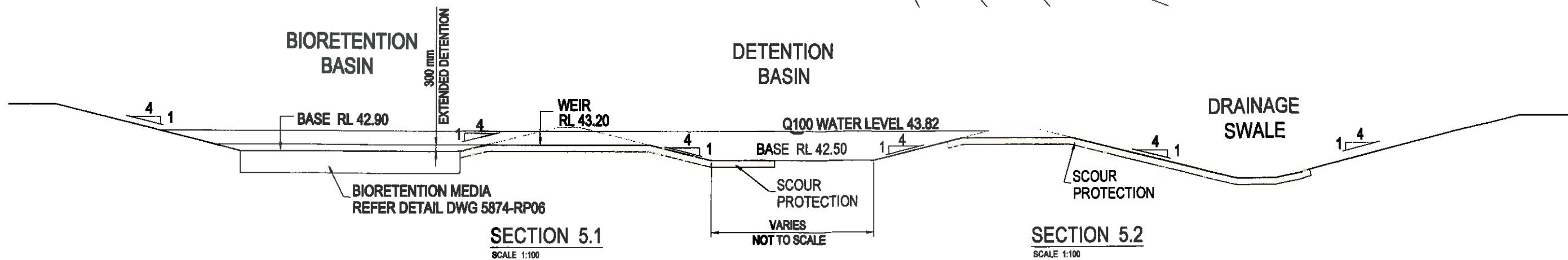
SCALE 1:250

SEKISUI HOUSE RIPLEY VALLEY IPSWICH RESIDENTIAL AREA ONE BIORETENTION & DETENTION BASINS PLAN AND DETAILS - BASIN 3		MPN Consulting Pty Ltd ABN 58 052 161 730 30 Sherwood Road, Topping, Qld, 4086 P 61 7 3371 6577 F 61 7 3371 3186 E info@mpn.com.au	5874 PSK86 A
SCALE: 1:250 @ A1 DESIGN: LW DRAWING: LW CREATED: MAR 2011 CHKD: APPD: DATE:	ISSUE DATE AMENDMENT BY APP DATE:	COPYRIGHT: THIS DESIGN AND PLANS ARE NOT TO BE USED OR REPRODUCED WHOLLY OR IN PART WITHOUT WRITTEN PERMISSION OF MPN CONSULTING PTY LIMITED 2010 ©	



BIO-RETENTION BASIN 5 DETAILS	
AREA BASE (m²)	1060
FILTER MEDIA DEPTH (m)	1
BASE RL	43.20
WEIR LEVEL / LENGTH	6.0 / 4m
OUTFALL PIPE SIZE	225Ø

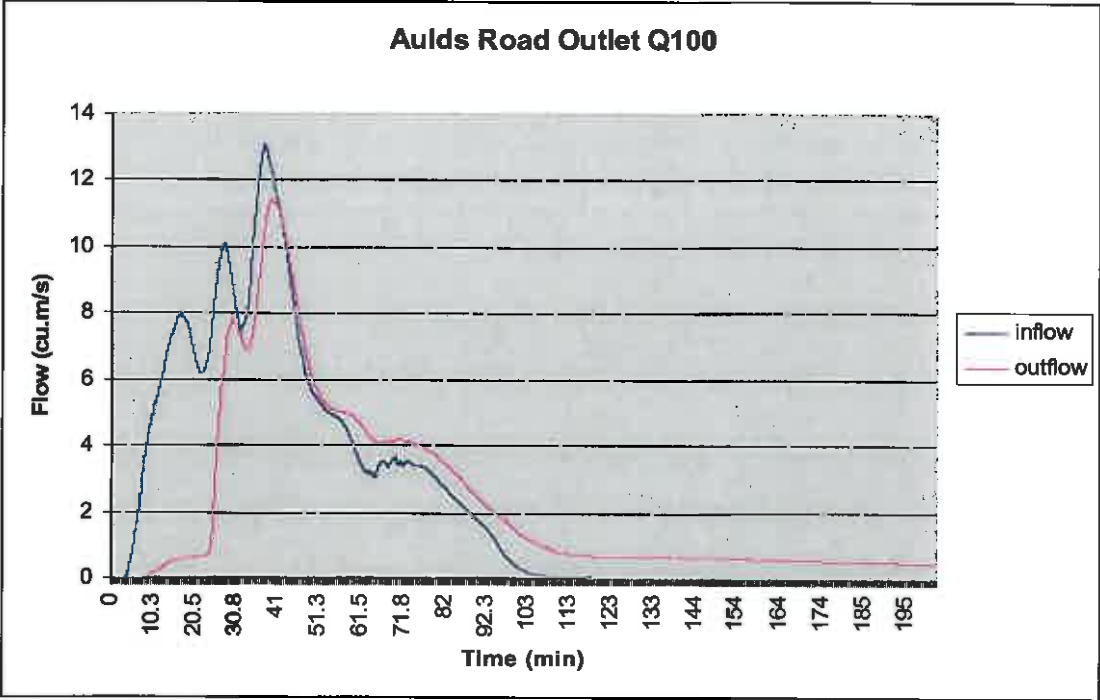
DETENTION BASIN DETAILS			
	LEVEL	AREA m2	VOLUME m3
STORAGE	42.50	980	0
	43.70	2500	2088
	43.75	3500	2238
	44.00	3500	3113
WEIR LENGTH	15m AT RL 43.50		
Q100 WATER LEVEL	RL 43.82		



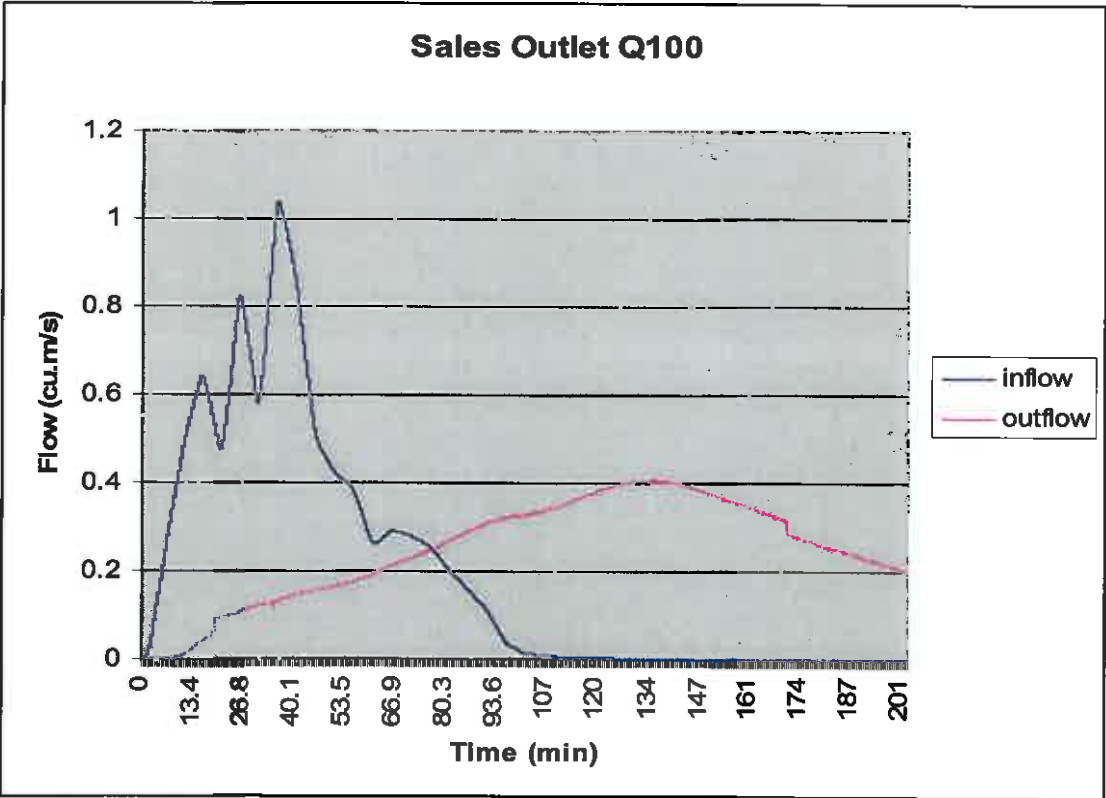
SAKISUI HOUSE 38 KILISUI HOUSE 38 Shawwood Road, Toowoomba, QLD, 4300 P: 01 7 3371 8877 F: 01 7 3371 5168 E: solutions@ripleyvalley.com.au		RIPLEY VALLEY IPSWICH 38 Shawwood Road, Toowoomba, QLD, 4300 P: 01 7 3371 8877 F: 01 7 3371 5168 E: solutions@ripleyvalley.com.au		MPN Consulting Pty Ltd ABN: 38 052 101 719 38 Shawwood Road, Toowoomba, QLD, 4300 P: 01 7 3371 8877 F: 01 7 3371 5168 E: solutions@ripleyvalley.com.au
RESIDENTIAL AREA ONE BIORETENTION & DETENTION BASINS PLAN AND DETAILS - BASIN 5		COPYRIGHT: THIS DESIGN AND PLANS ARE NOT TO BE USED OR REPRODUCED WHOLLY OR IN PART WITHOUT WRITTEN PERMISSION OF MPN CONSULTING PTY LIMITED 2010 ©		

DATE	AMENDMENT	BY	APP	DATE

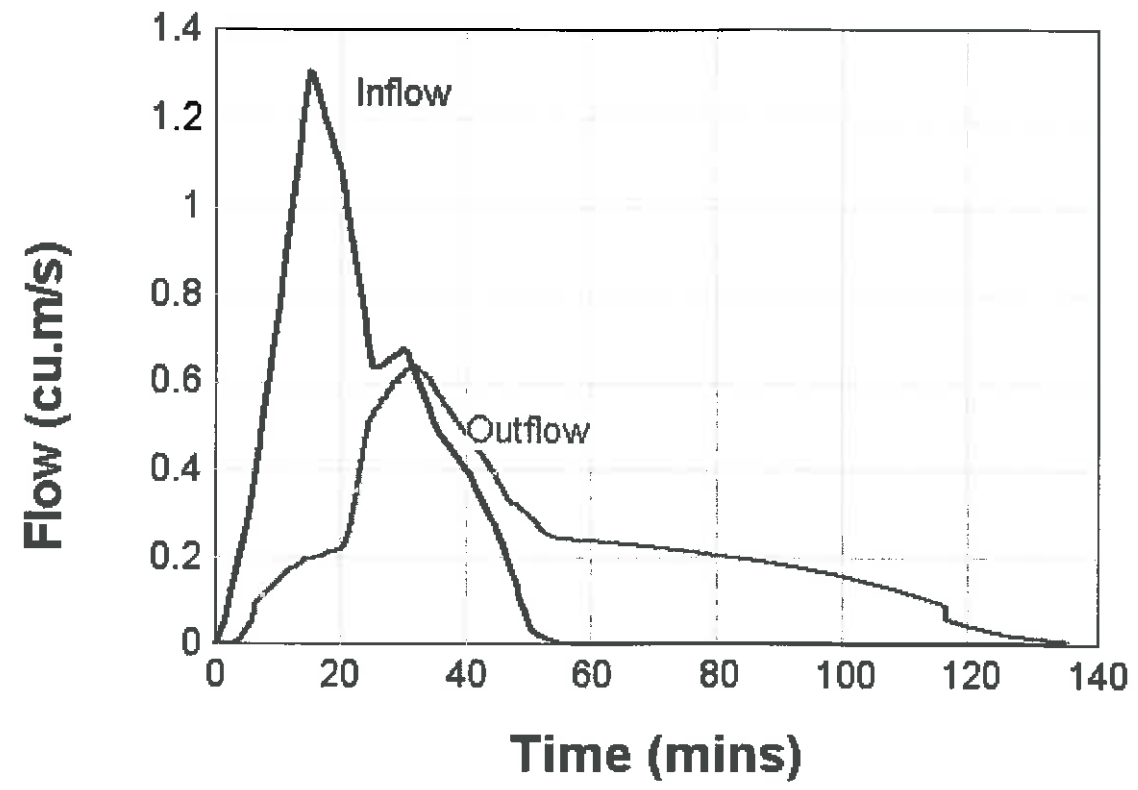
5874	PSK88	A



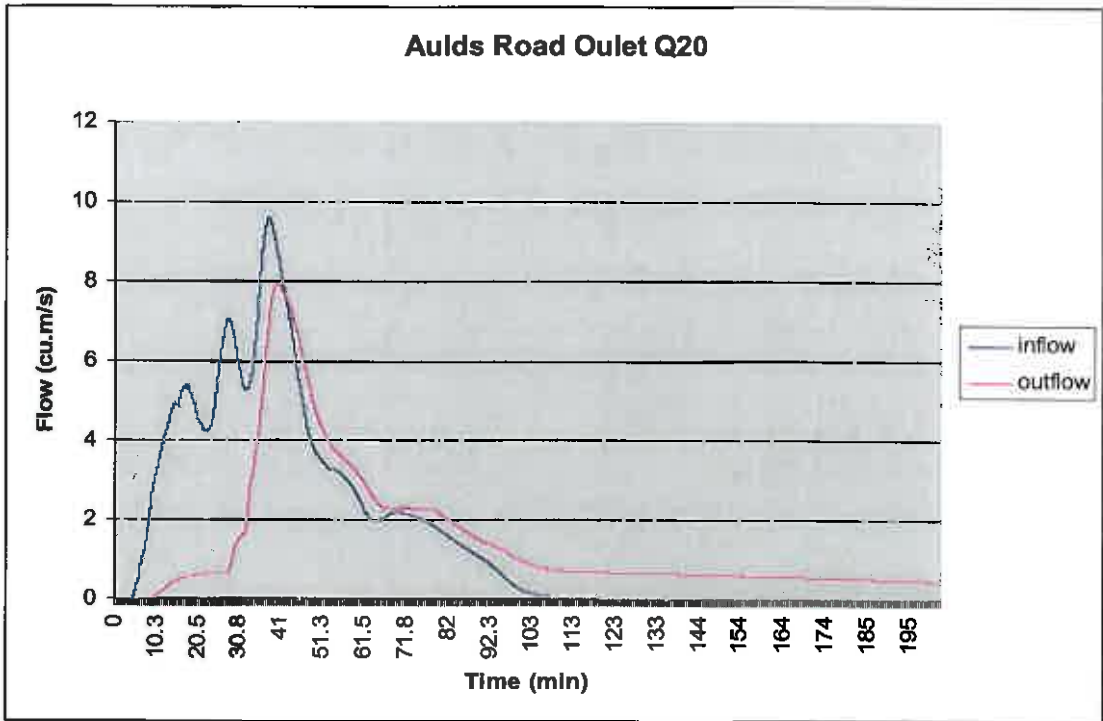
*Critical Storm Duration = 90 Minutes



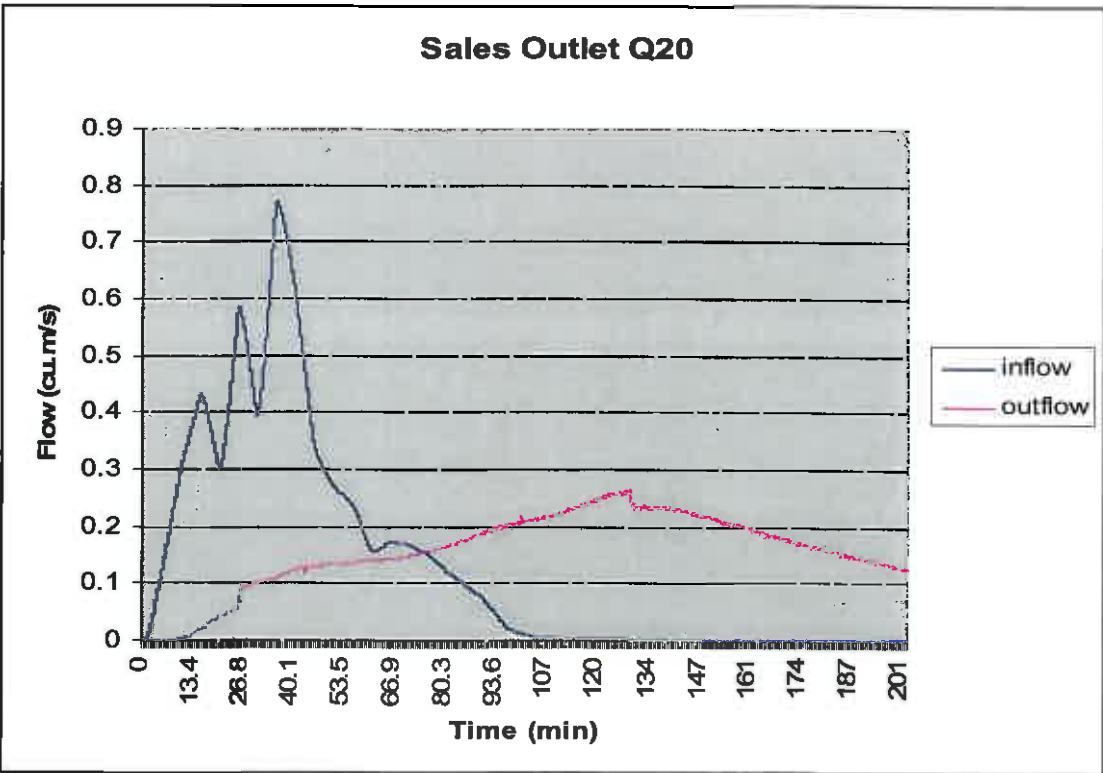
*Critical Storm Duration = 90 Minutes

Fischer Road Outlet Q100

*Critical Storm Duration = 45 Minutes

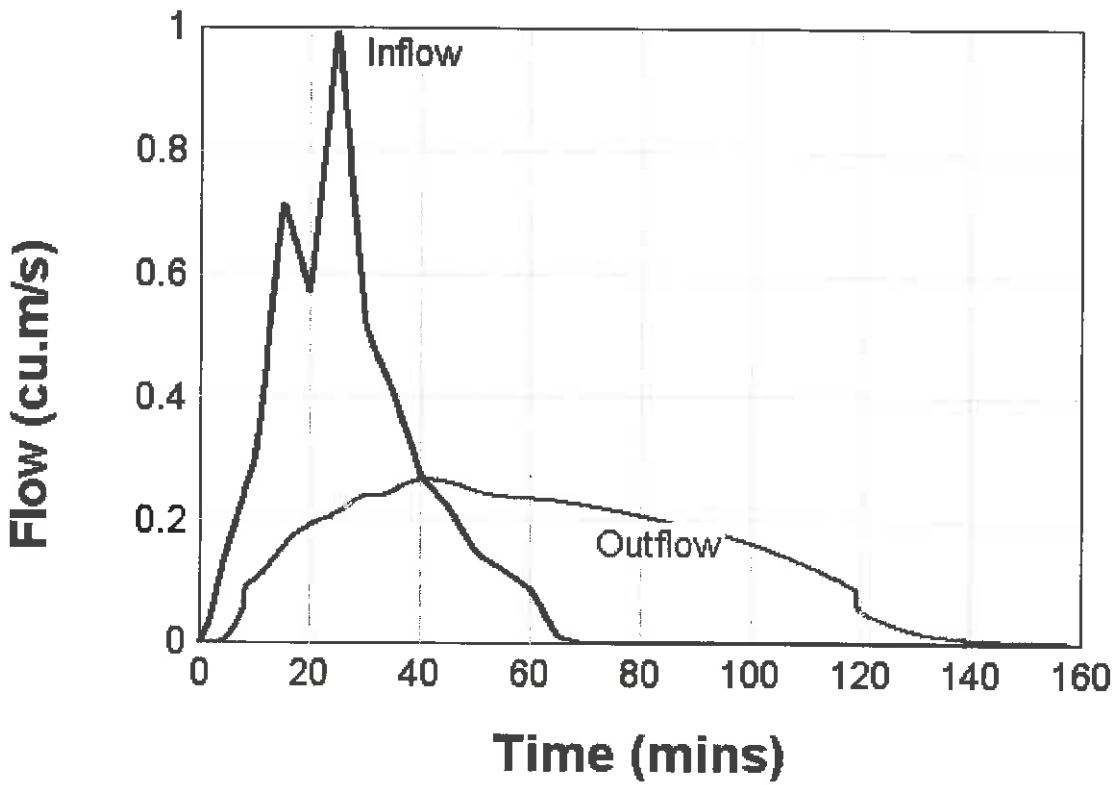


*Critical Storm Duration = 90 Minutes

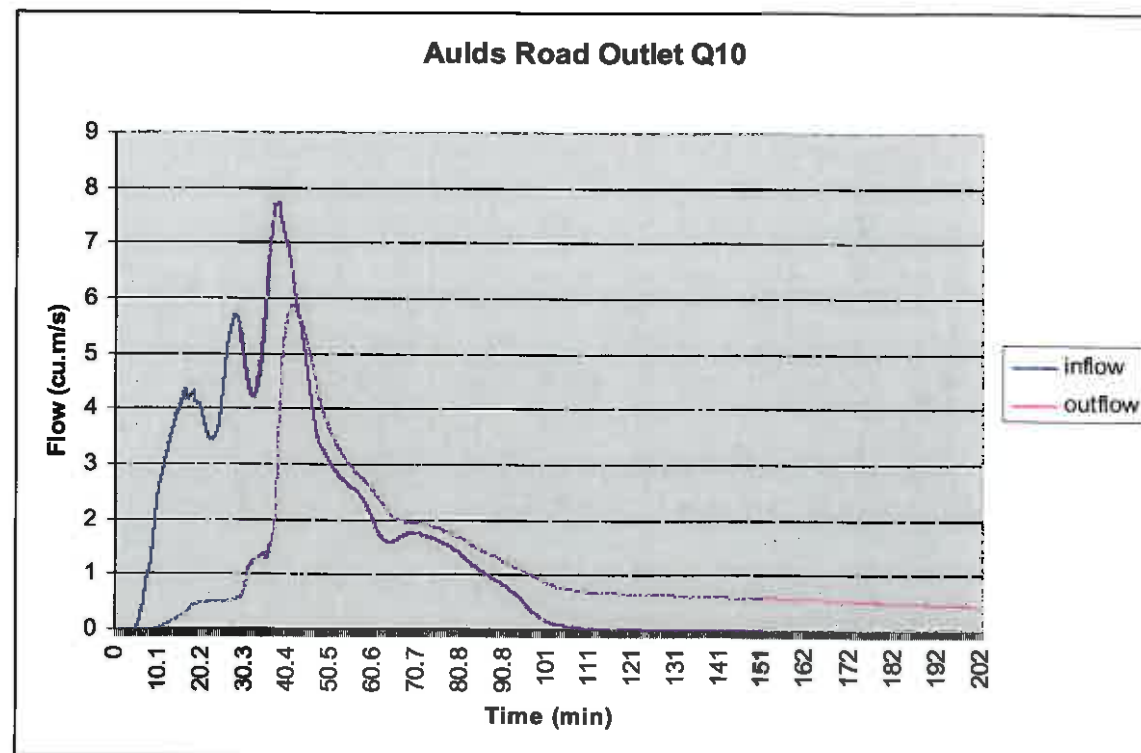


*Critical Storm Duration = 90 Minutes

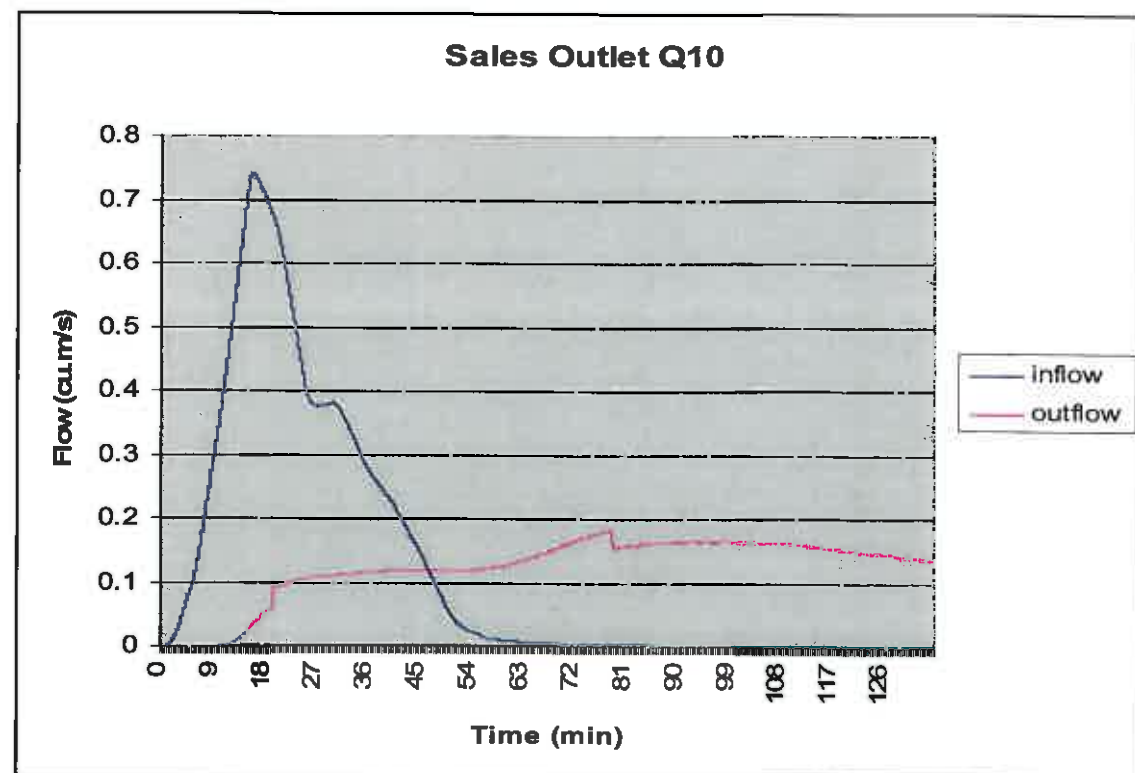
Fischer Road Outlet Q20



*Critical Storm Duration = 60 Minutes

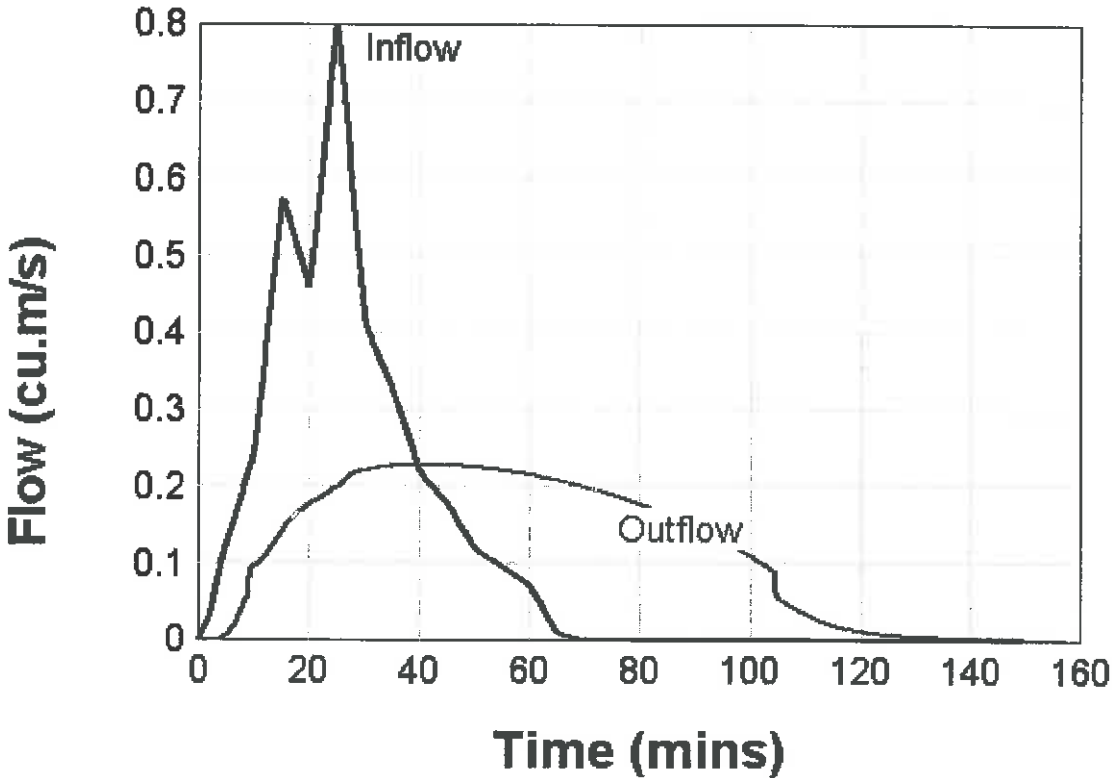


*Critical Storm Duration = 90 Minutes

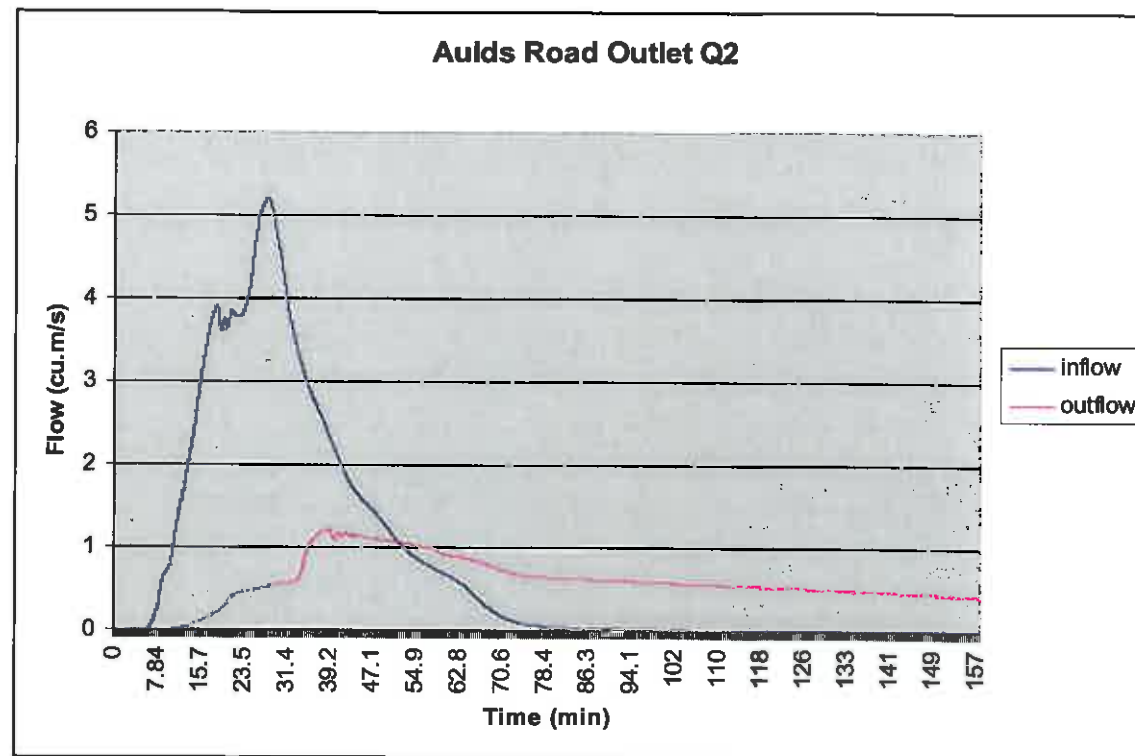


*Critical Storm Duration = 45 Minutes

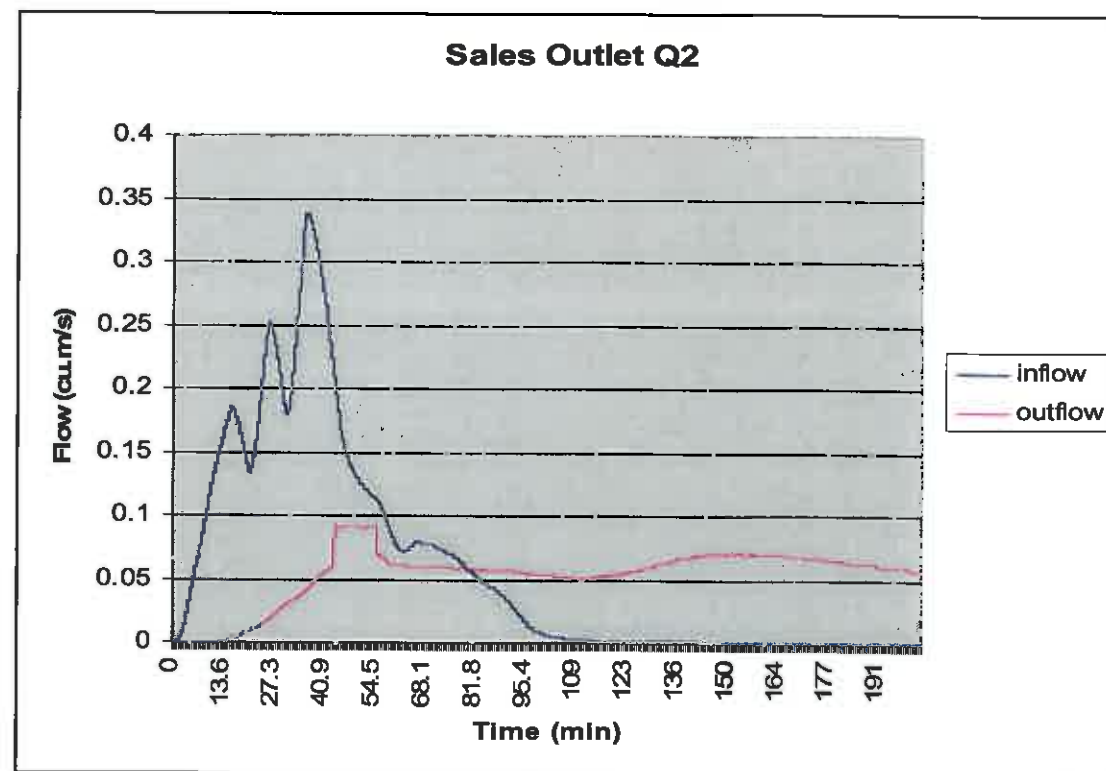
Fischer Road Outlet Q10



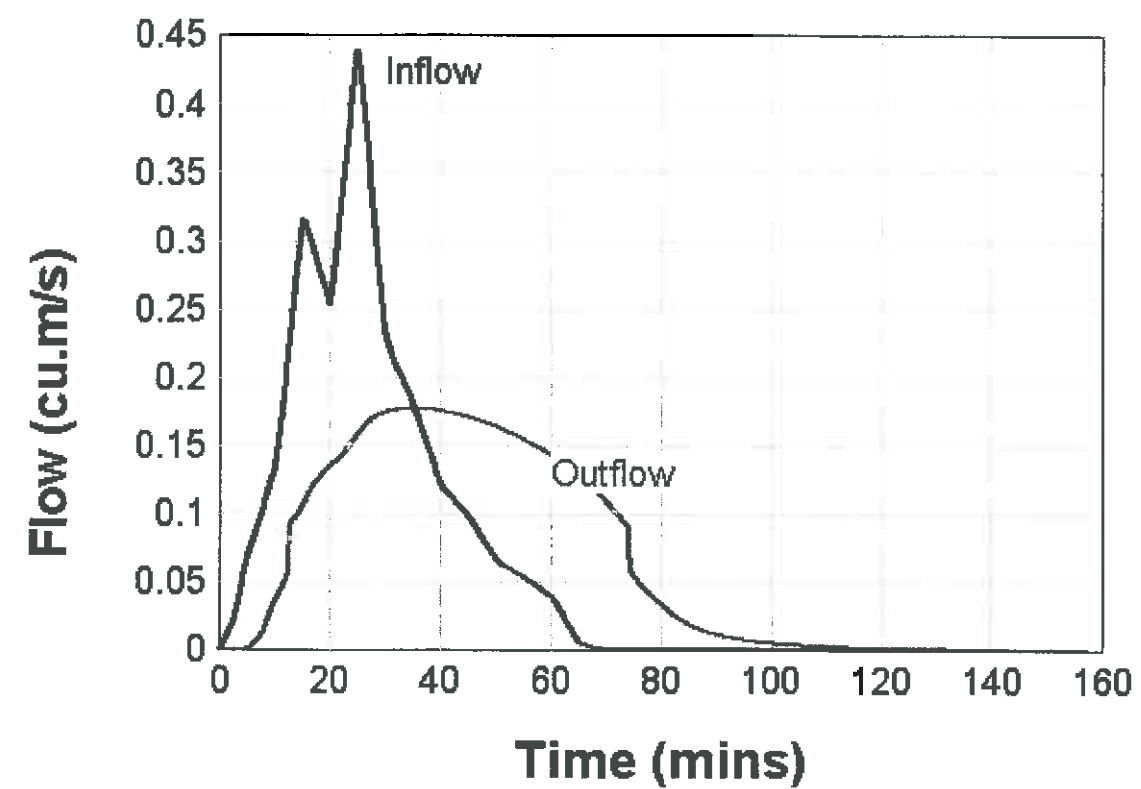
*Critical Storm Duration = 60 Minutes



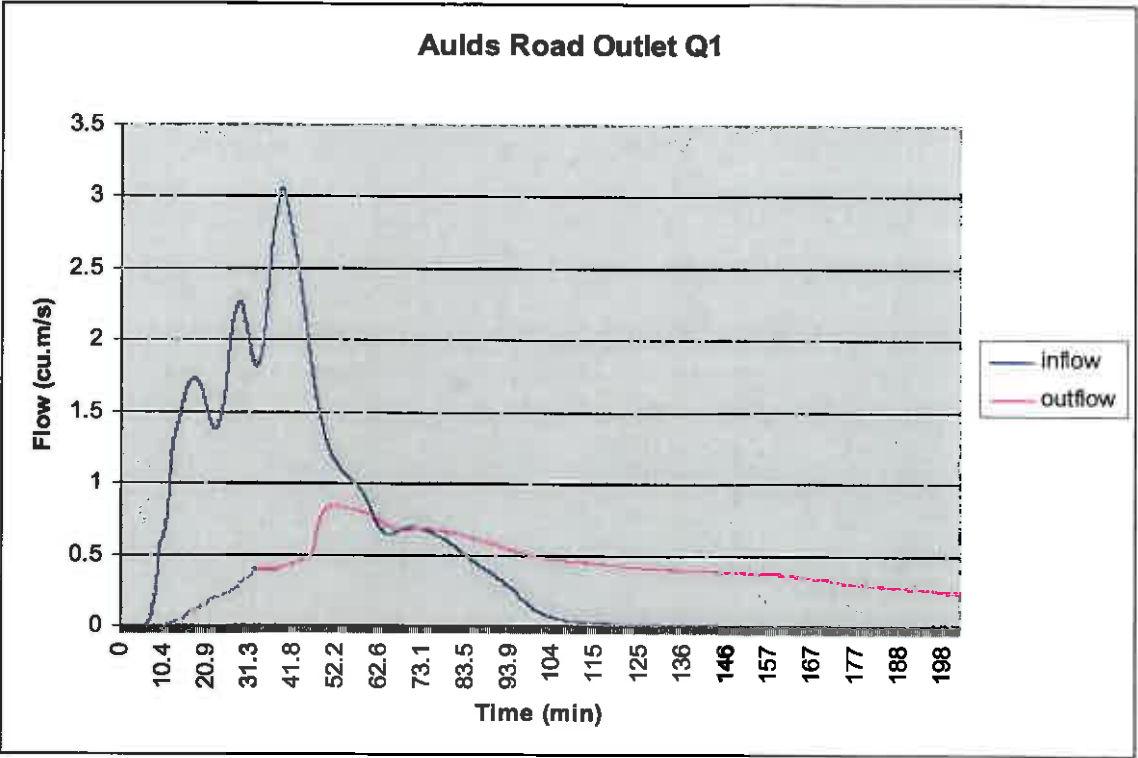
*Critical Storm Duration = 60 Minutes



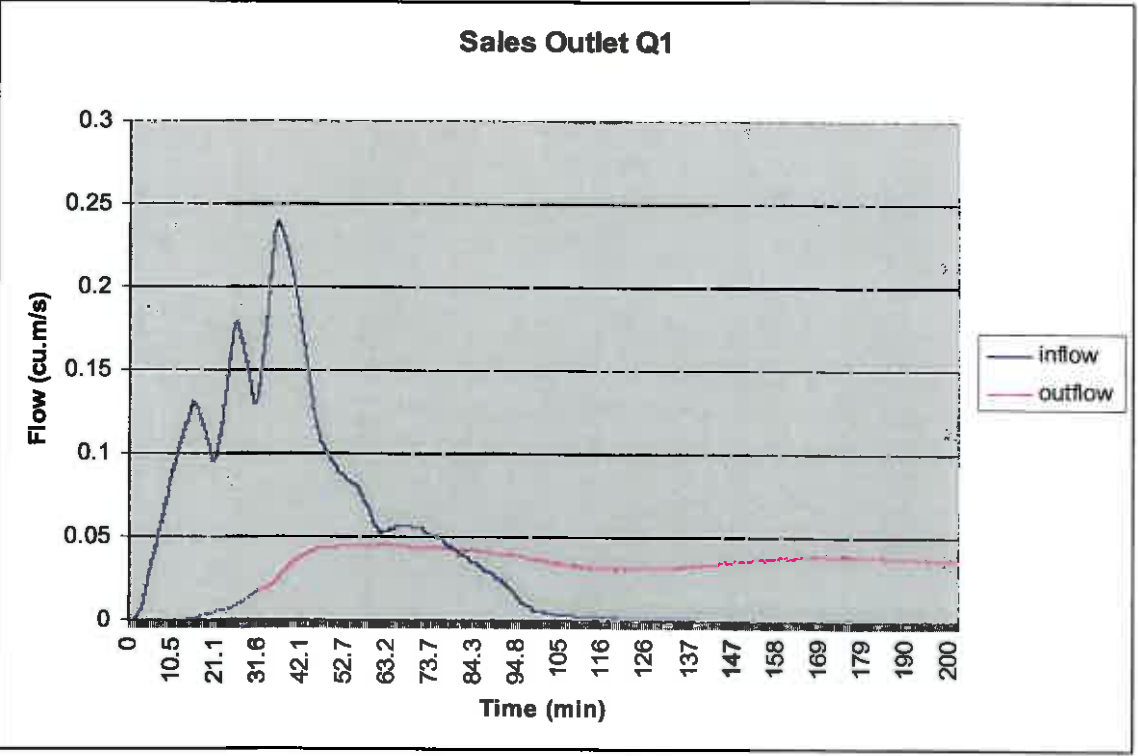
*Critical Storm Duration = 90 Minutes

Fischer Road Outlet Q2

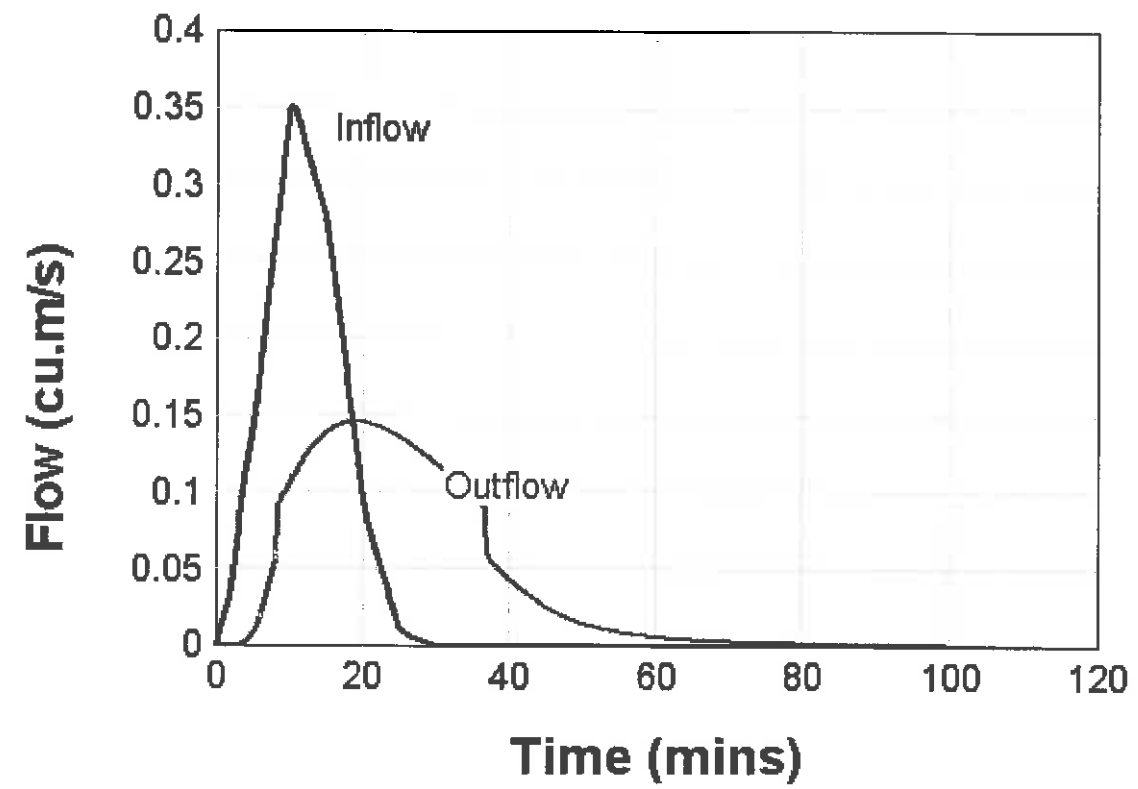
*Critical Storm Duration = 60 Minutes



*Critical Storm Duration = 90 Minutes

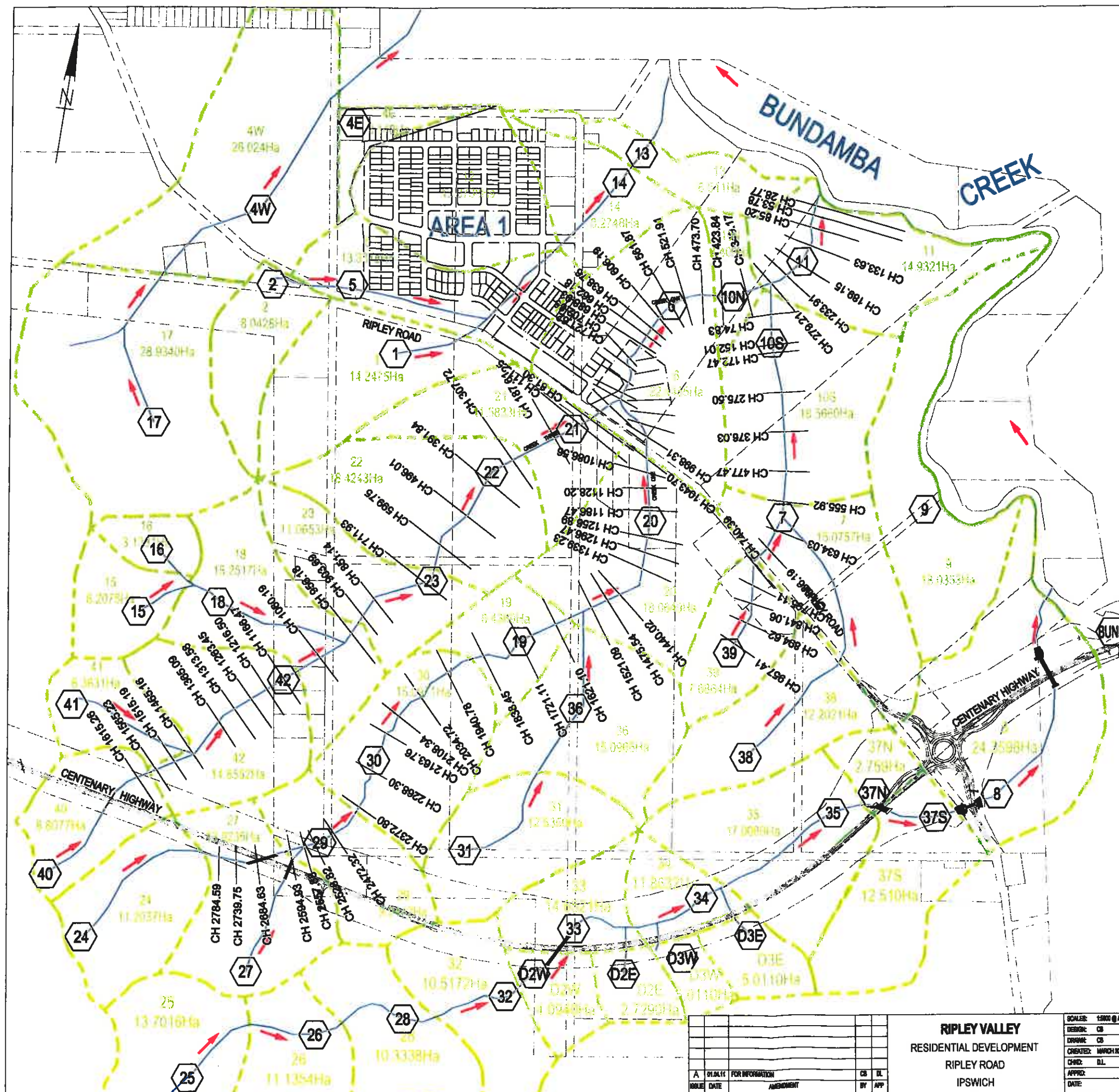


*Critical Storm Duration = 90 Minutes

Fischer Road Outlet Q1

*Critical Storm Duration = 90 Minutes

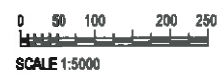
ANNEXURE E
Drawing 5874 –HEC15



LEGEND

- CATCHMENT BOUNDARY
- 18**
15.2517Ha CATCHMENT NAME
CATCHMENT AREA
- FLOW DIRECTION
- DRAINS CATCHMENT
GATHERING POINT FOR
Tc CALCULATION

NOTE:
FOR CATCHMENT HYDROLOGY DETAILS
REFER DWG No. 5874-HEC.13

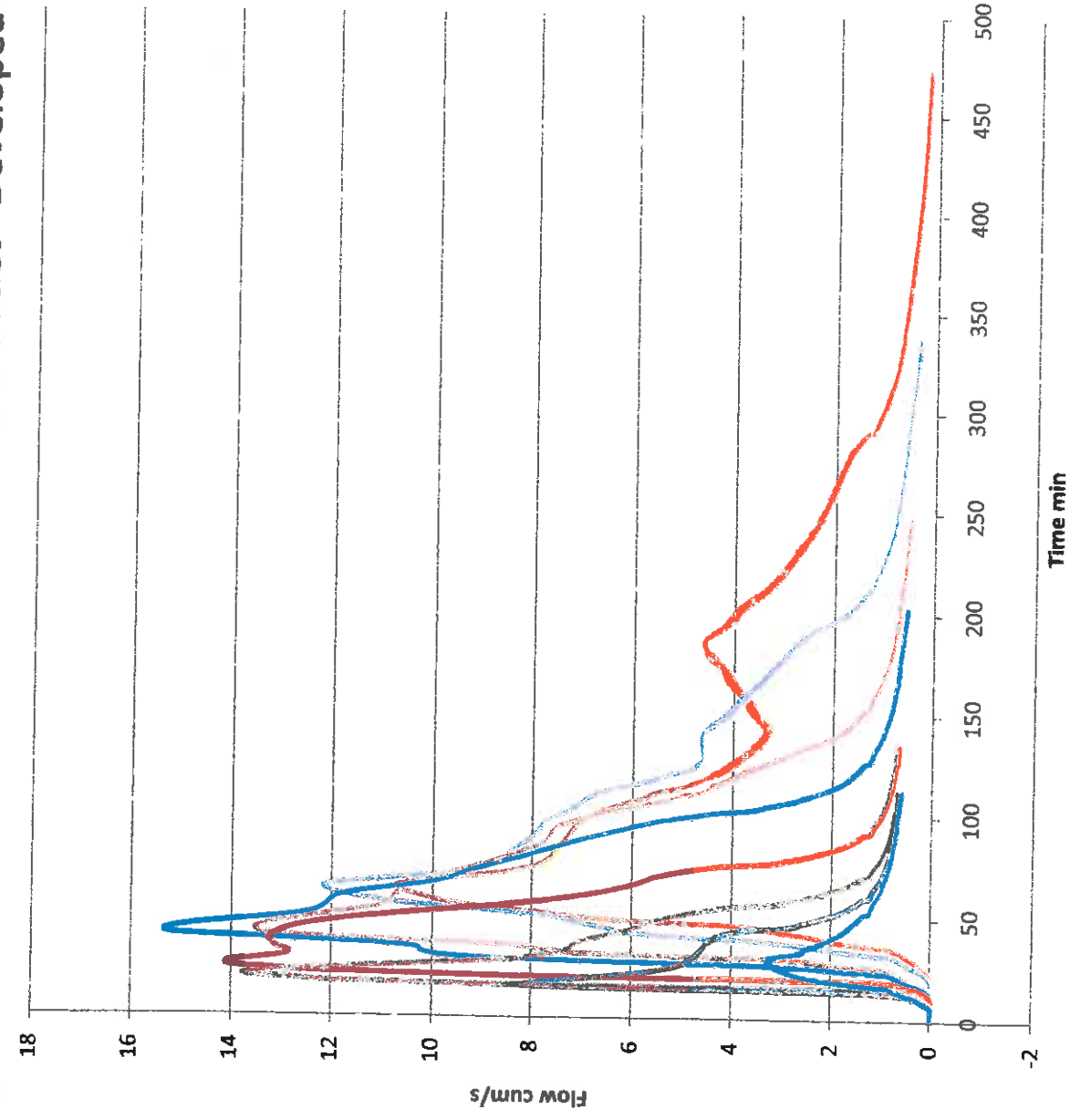


ISSUED FOR INFORMATION

RIPLY VALLEY RESIDENTIAL DEVELOPMENT RIPLY ROAD IPSWICH		SCALE: 1:500 @ A1 DESIGN: CB DRAWN: CB CHECKED: MARCH 2011 CHD: DL APPRO: DATE:	RIPLY VALLEY IPSWICH DRAINS CATCHMENT NODES AND HECRAS SECTIONS	MPN Consulting Pty Ltd ABN: 38 082 191 786 30 Sherwood Road, Trowang, Qld, 4008 P: 017 3371 6877 F: 017 3371 3186 E: solutions@mpn.net.au	5874 DRAWING NO. HEC.15 REV A

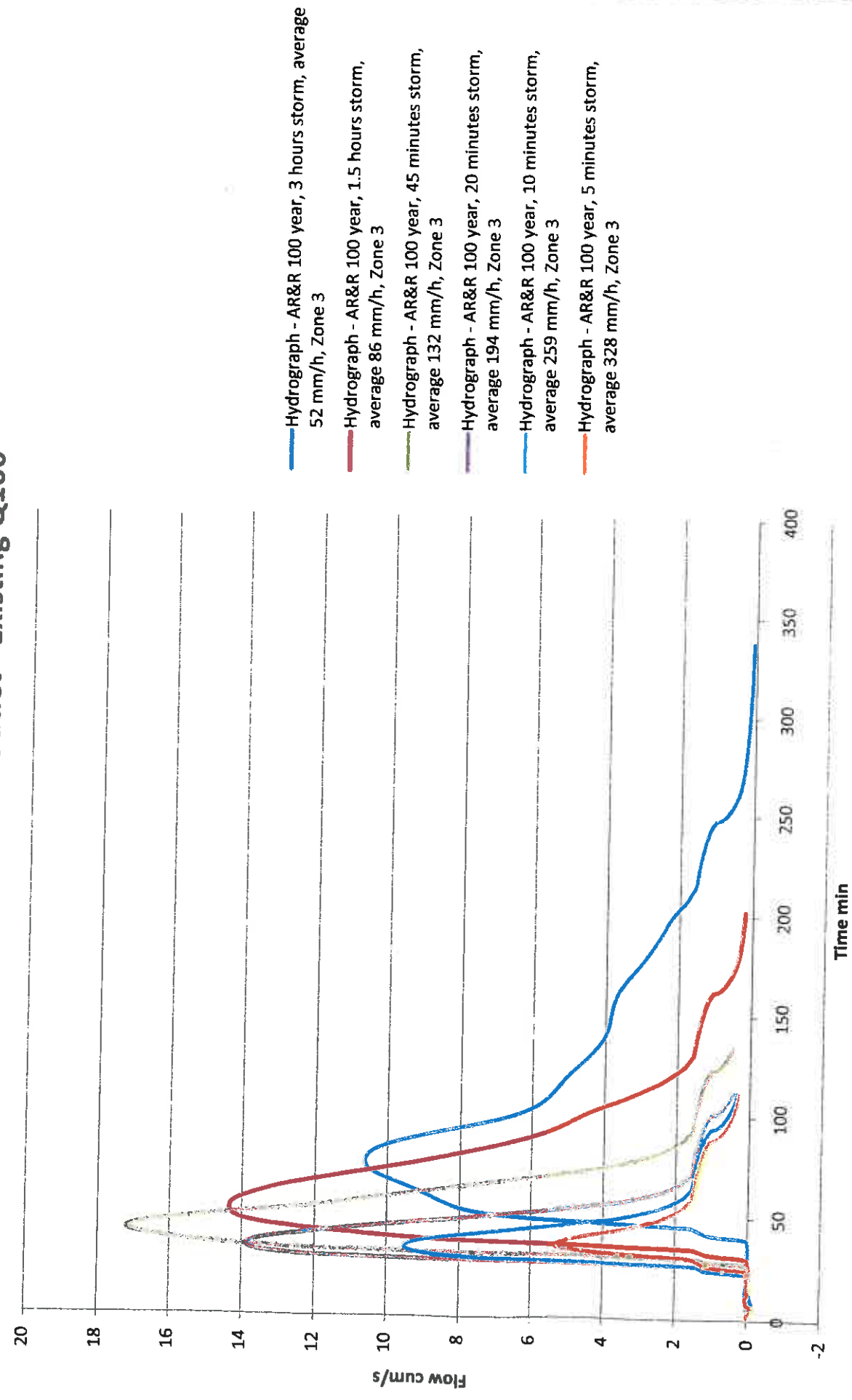
ANNEXURE F
Outlet Hydrographs for Pre and Post Development Conditions
and Drawing 5874 HEC16

Aulds Road Outlet - Developed Q100

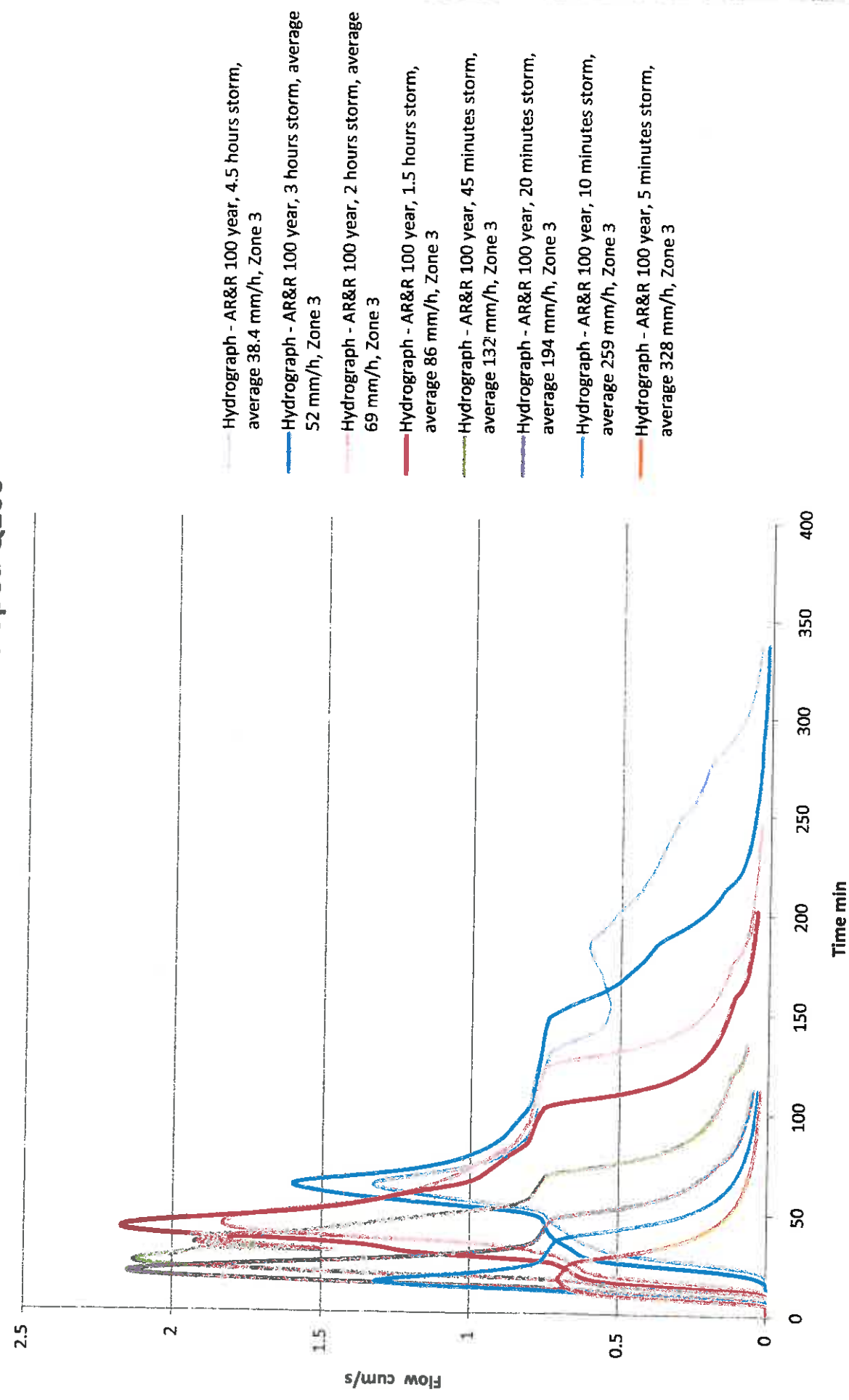


- Hydrograph - AR&R 100 year, 4.5 hours storm, average 38.4 mm/h, Zone 3
- Hydrograph - AR&R 100 year, 3 hours storm, average 52 mm/h, Zone 3
- Hydrograph - AR&R 100 year, 2 hours storm, average 69 mm/h, Zone 3
- Hydrograph - AR&R 100 year, 1.5 hours storm, average 86 mm/h, Zone 3
- Hydrograph - AR&R 100 year, 45 minutes storm, average 132 mm/h, Zone 3
- Hydrograph - AR&R 100 year, 20 minutes storm, average 194 mm/h, Zone 3
- Hydrograph - AR&R 100 year, 10 minutes storm, average 259 mm/h, Zone 3
- Hydrograph - AR&R 100 year, 5 minutes storm, average 328 mm/h, Zone 3

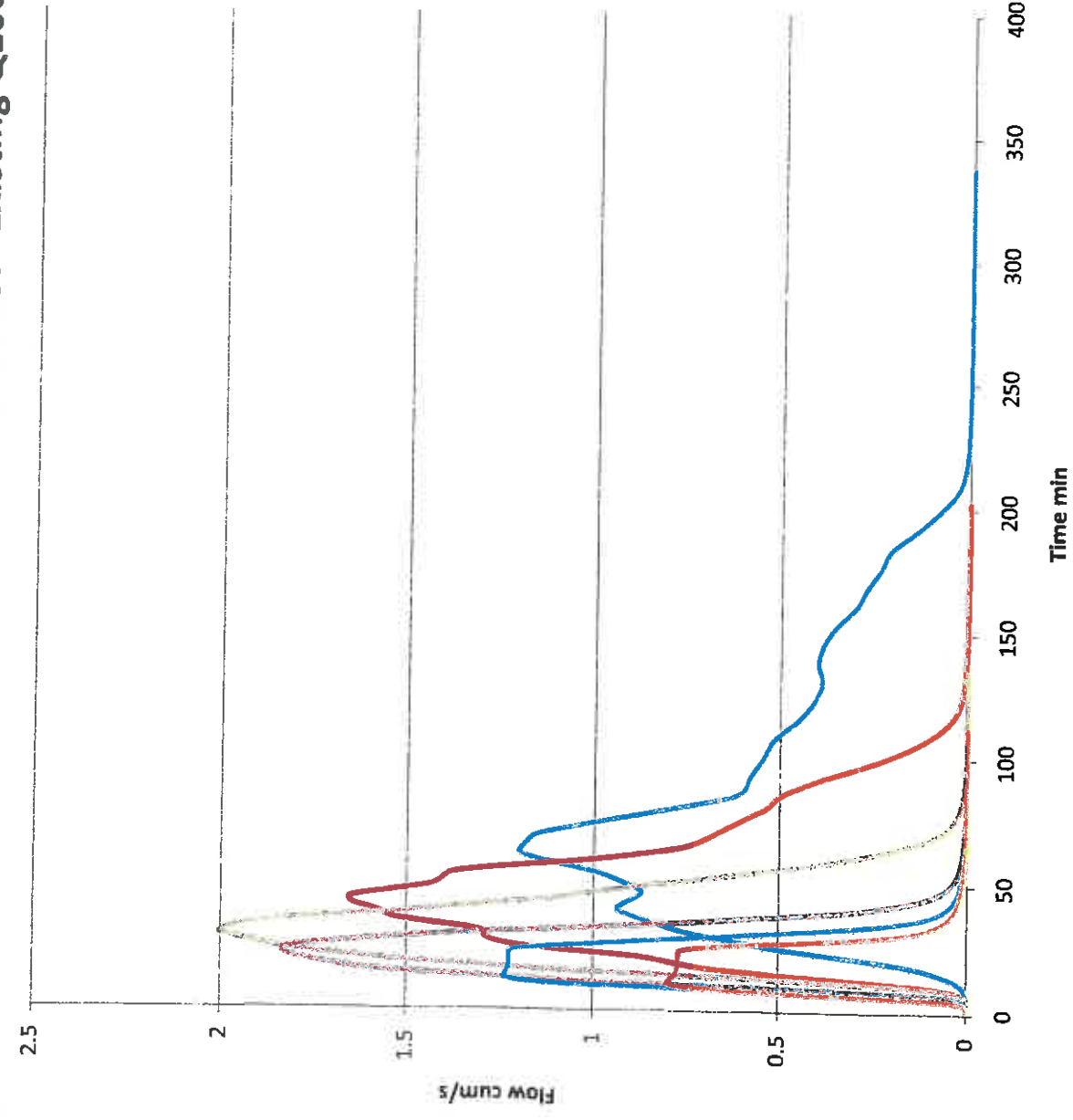
Aulds Road Outlet - Existing Q100



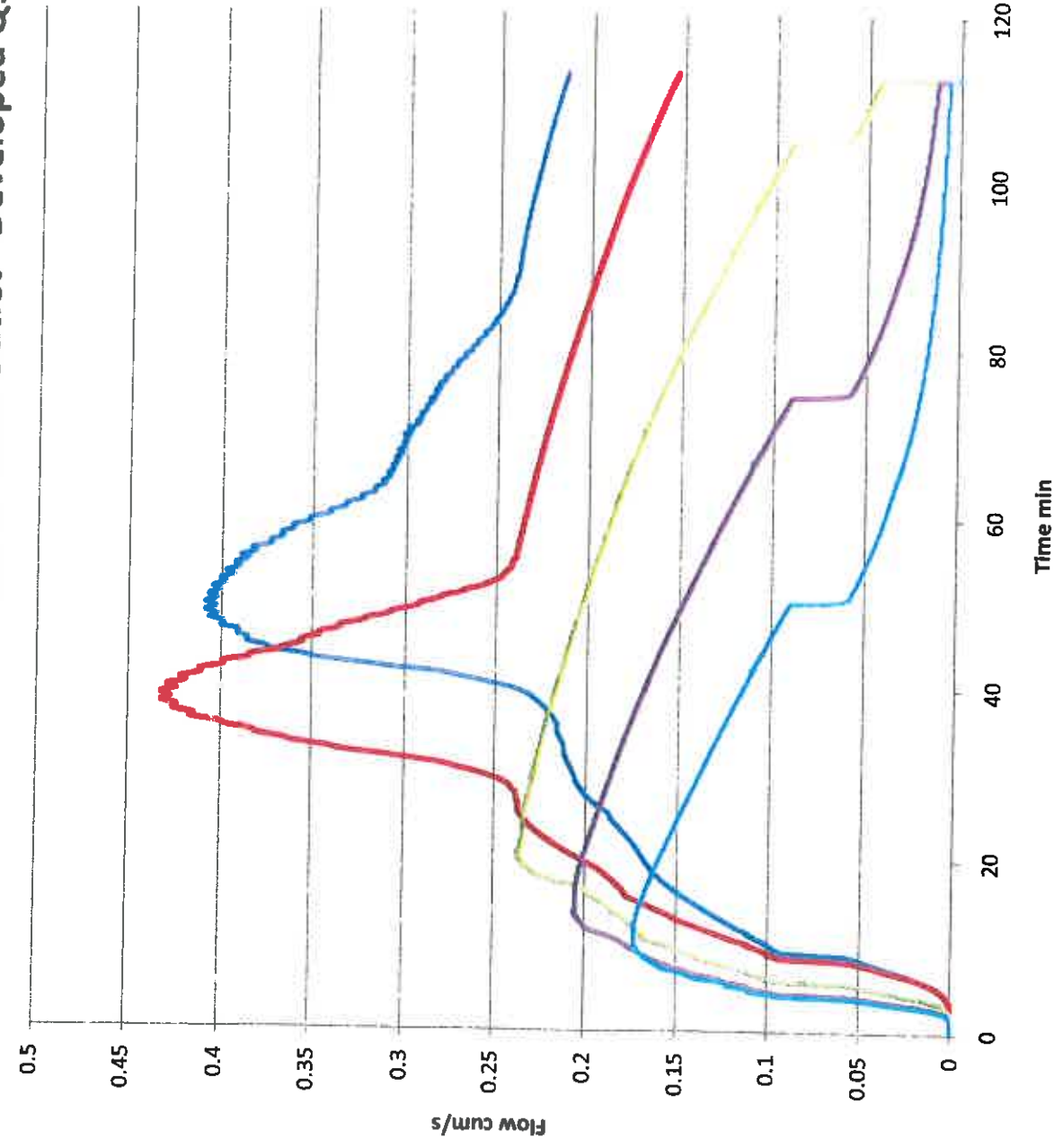
Sales Outlet - Developed Q100



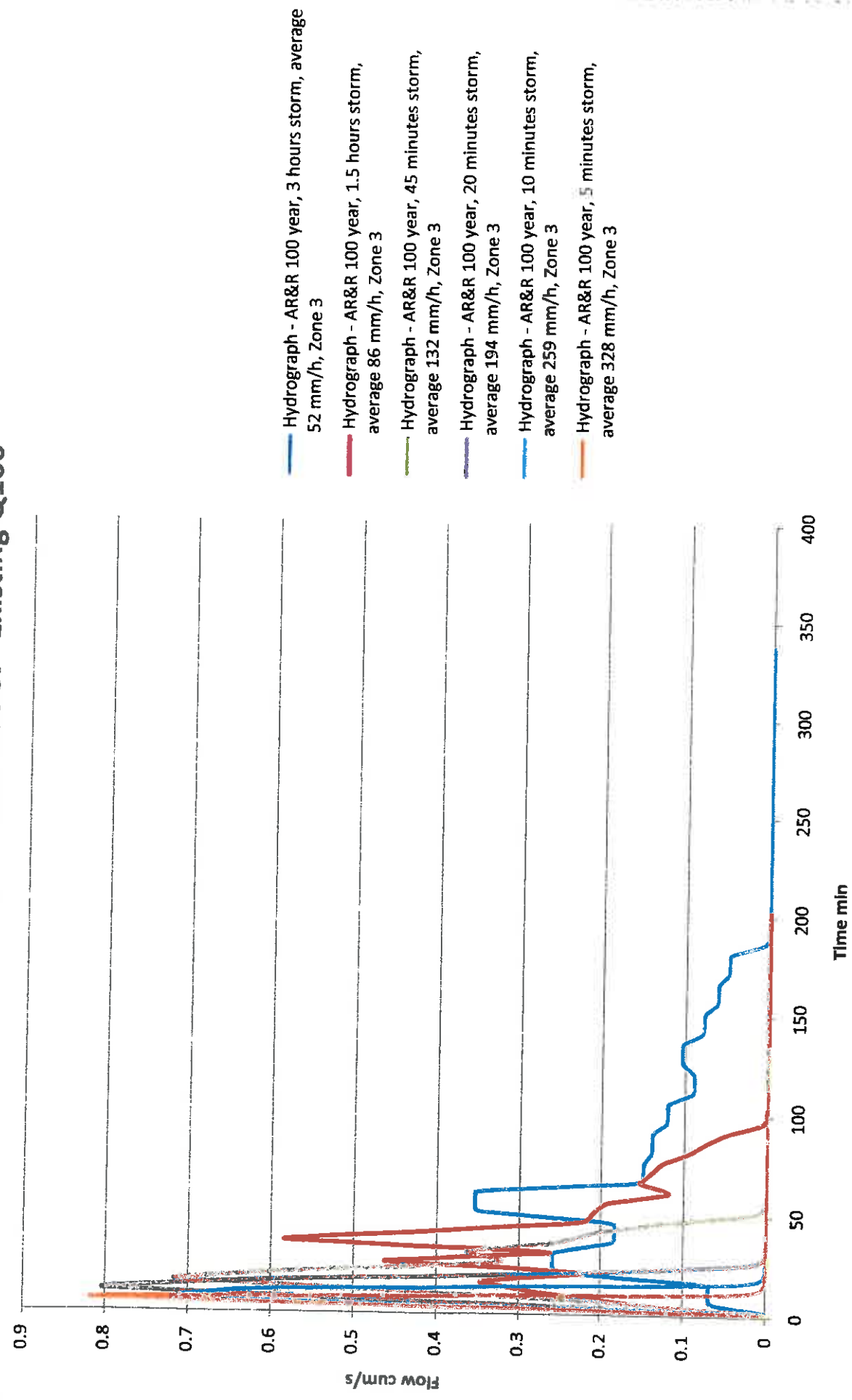
Sales Outlet - Existing Q100



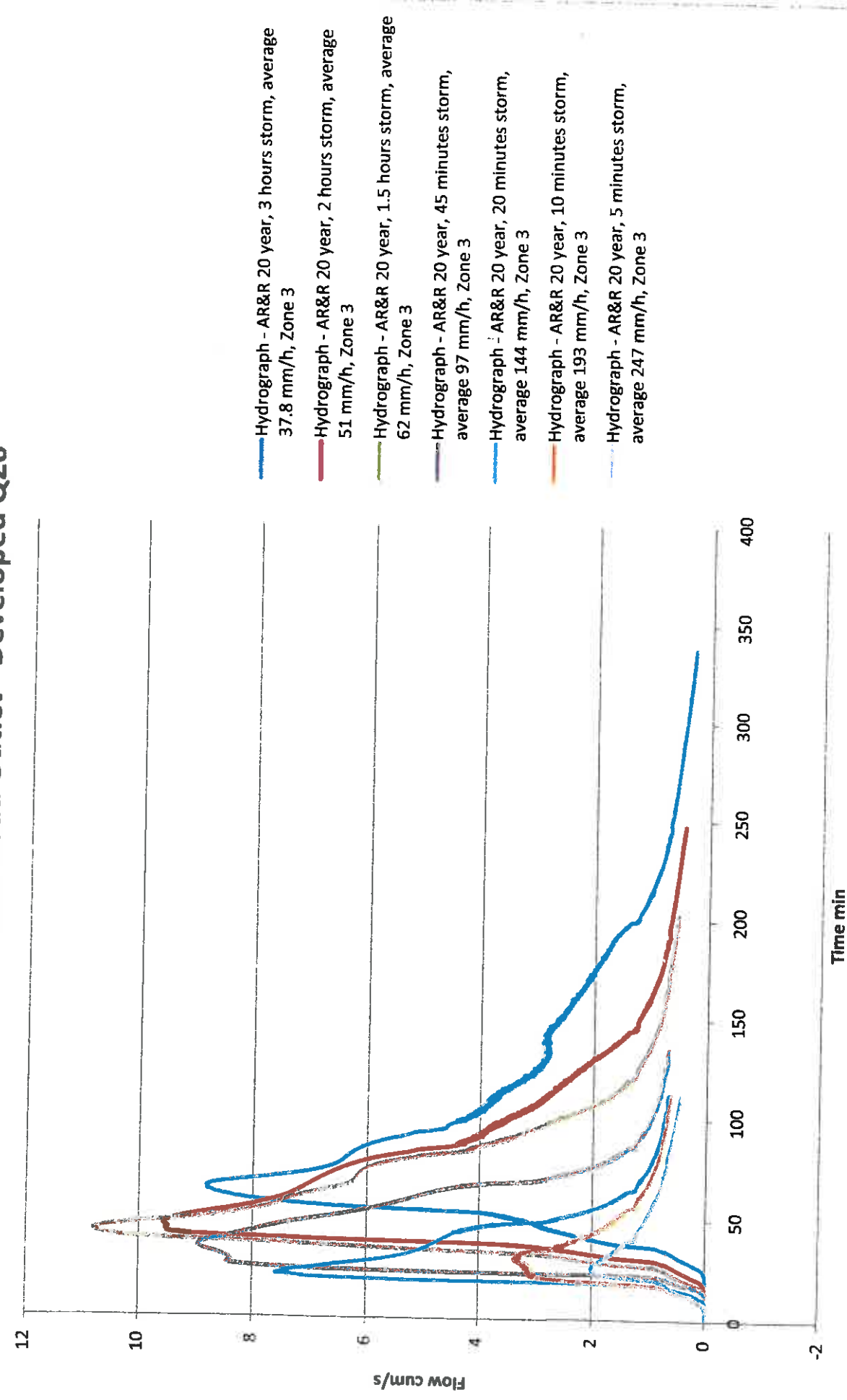
Fischer Road Outlet - Developed Q100



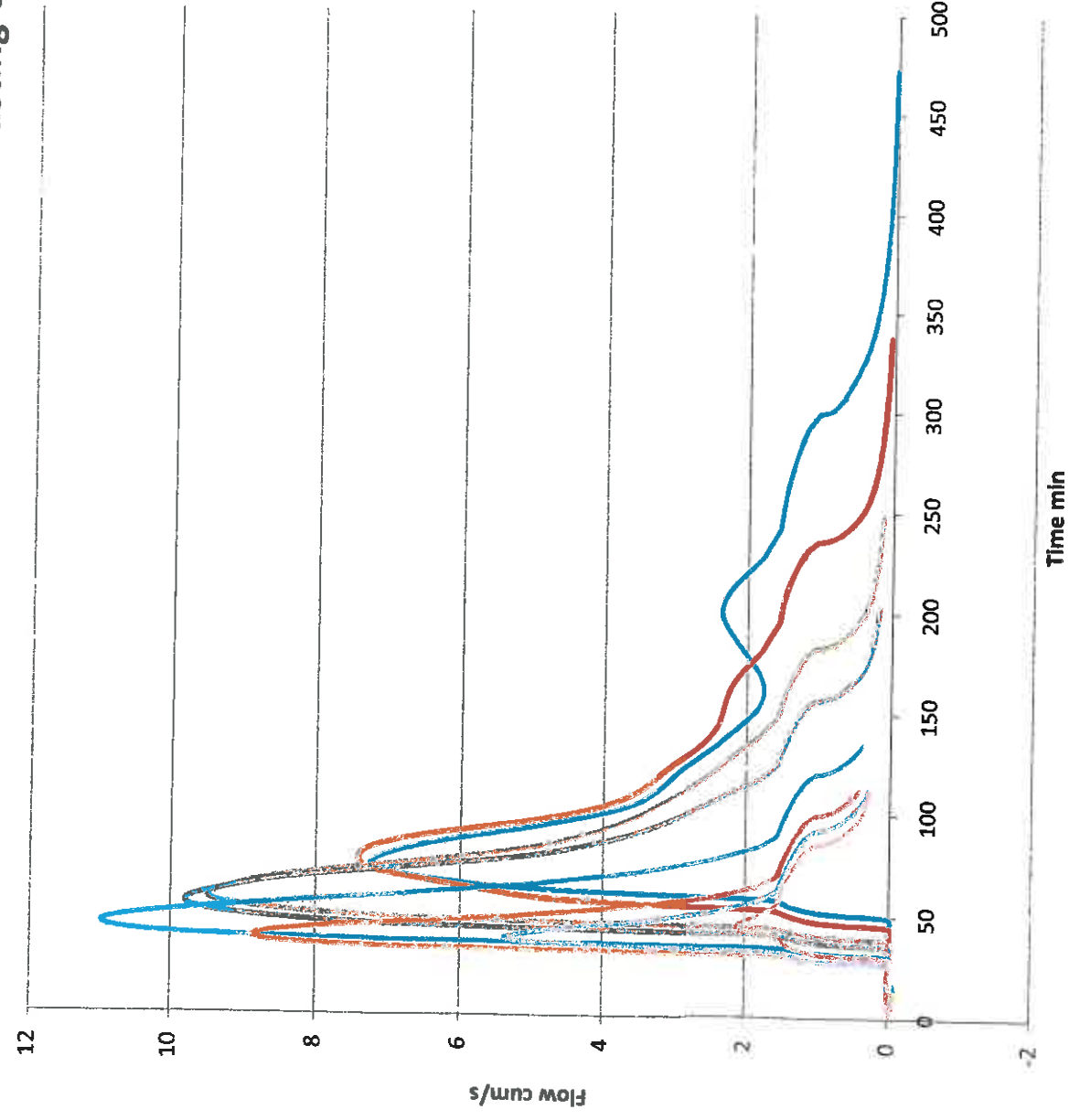
Fischer Road Outlet - Existing Q100



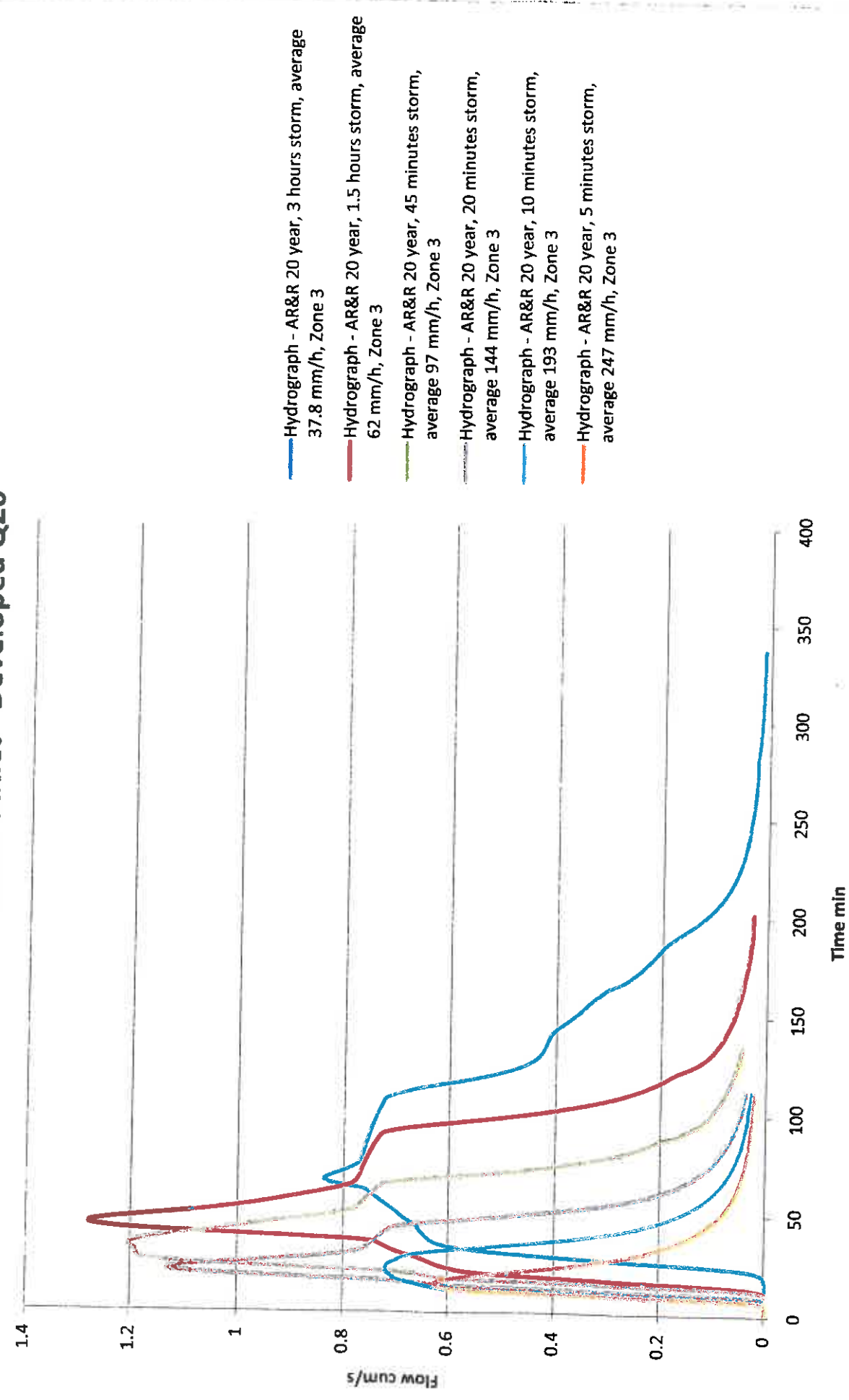
Aulds Road Outlet - Developed Q20



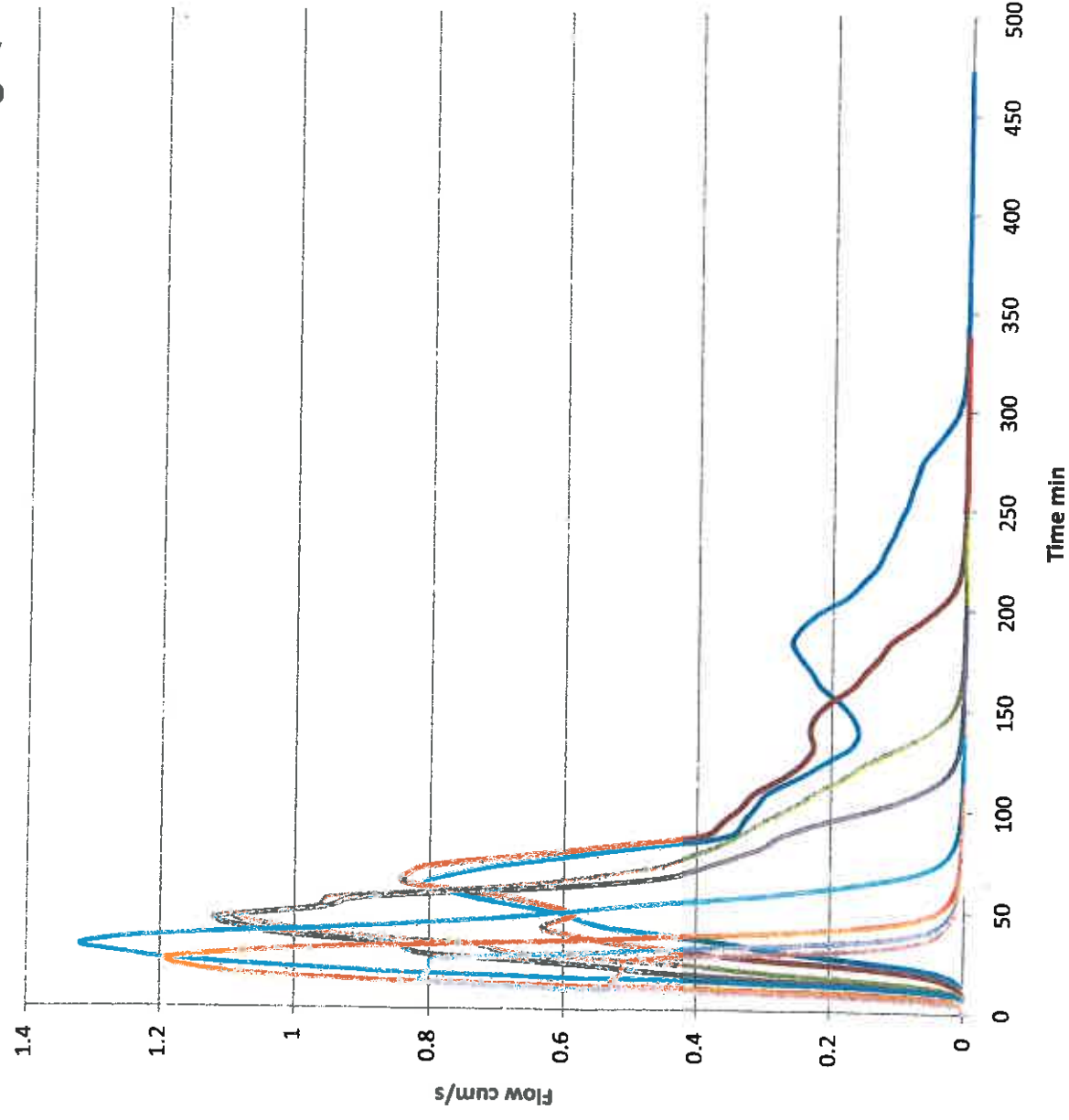
Aulds Road Outlet - Existing Q20



Sales Outlet - Developed Q20

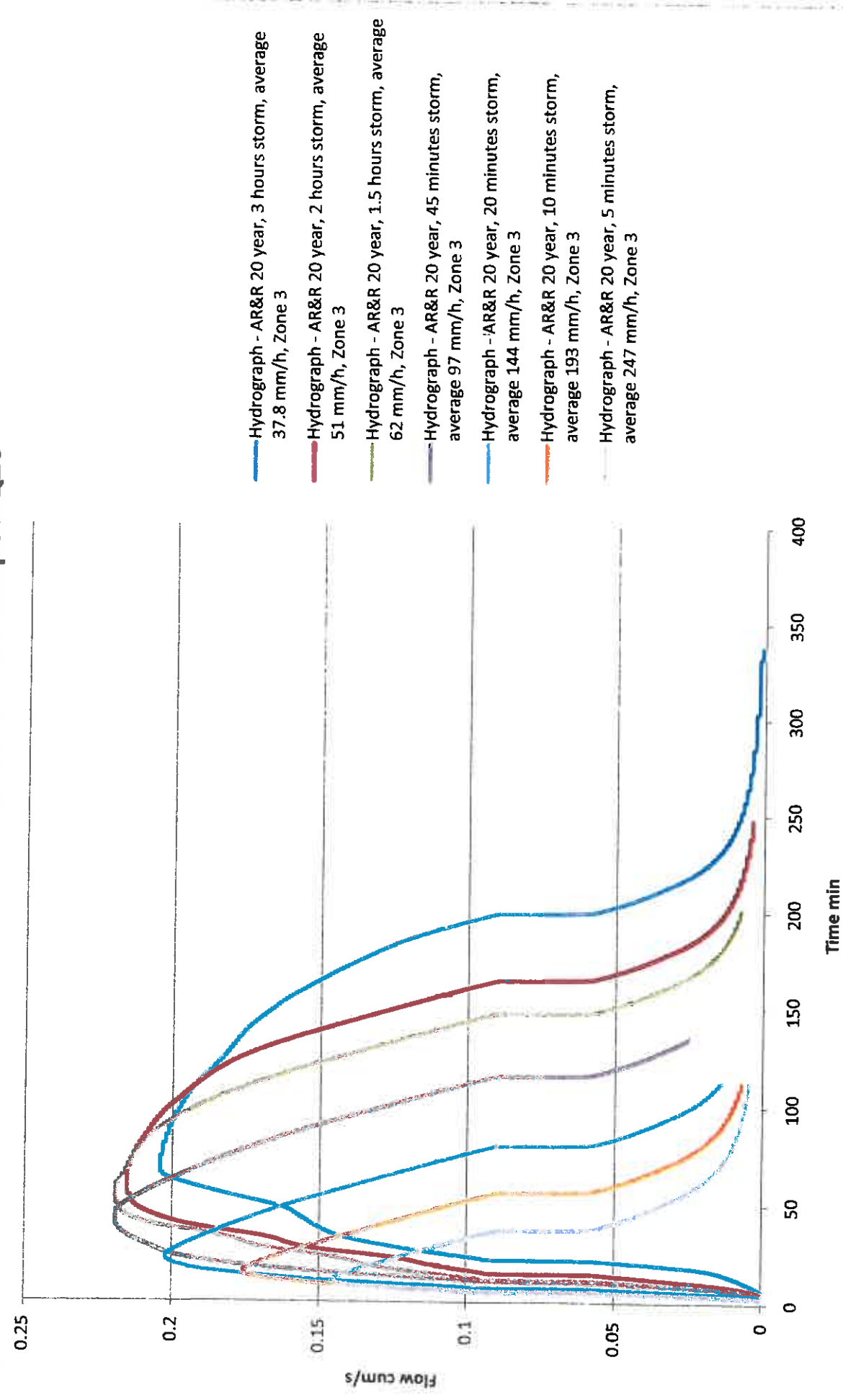


Sales Outlet - Existing Q20

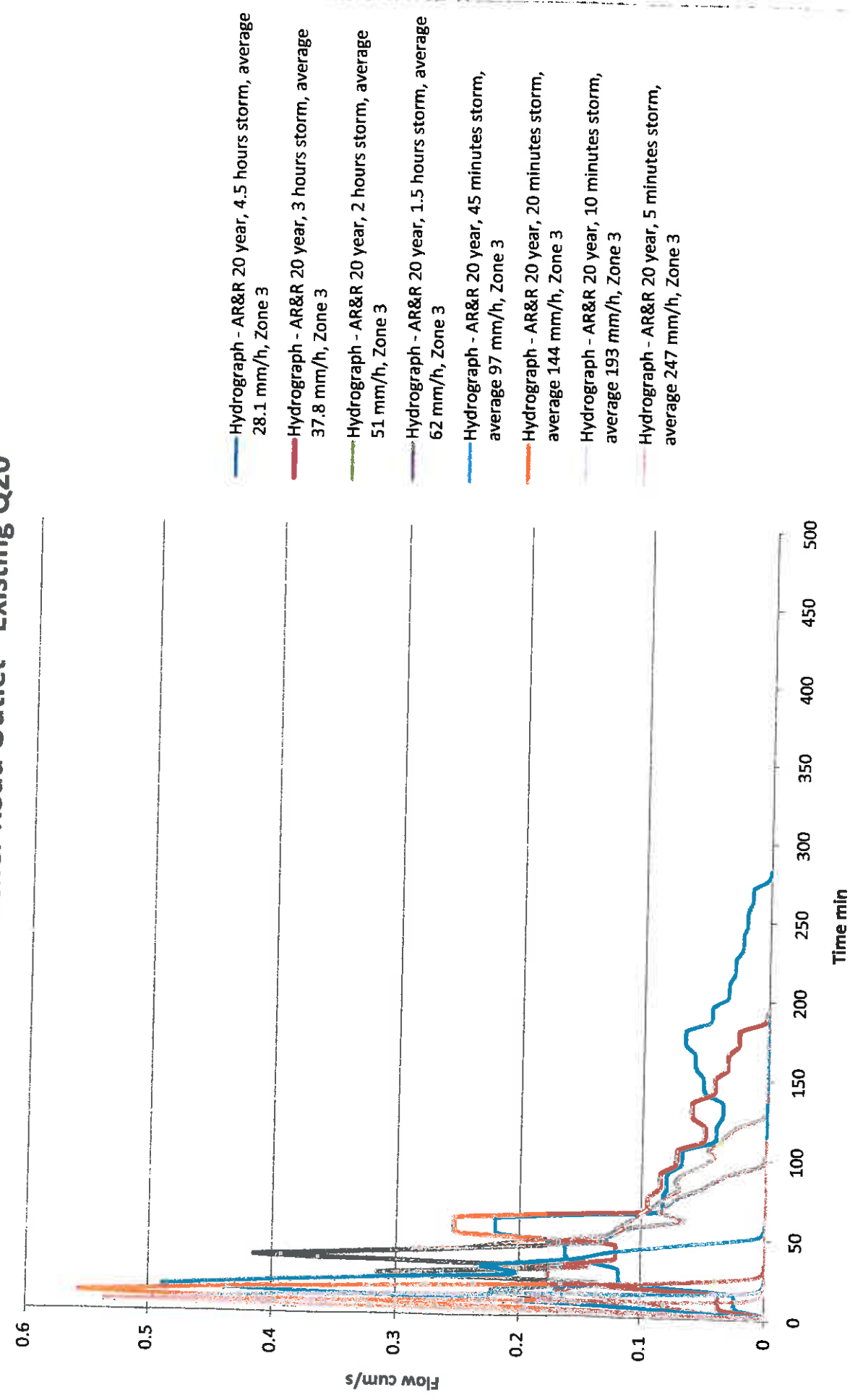


- Hydrograph - AR&R 20 year, 4.5 hours storm, average 28.1 mm/h, Zone 3
- Hydrograph - AR&R 20 year, 3 hours storm, average 37.8 mm/h, Zone 3
- Hydrograph - AR&R 20 year, 2 hours storm, average 51 mm/h, Zone 3
- Hydrograph - AR&R 20 year, 1.5 hours storm, average 62 mm/h, Zone 3
- Hydrograph - AR&R 20 year, 45 minutes storm, average 97 mm/h, Zone 3
- Hydrograph - AR&R 20 year, 20 minutes storm, average 144 mm/h, Zone 3
- Hydrograph - AR&R 20 year, 10 minutes storm, average 193 mm/h, Zone 3
- Hydrograph - AR&R 20 year, 5 minutes storm, average 247 mm/h, Zone 3

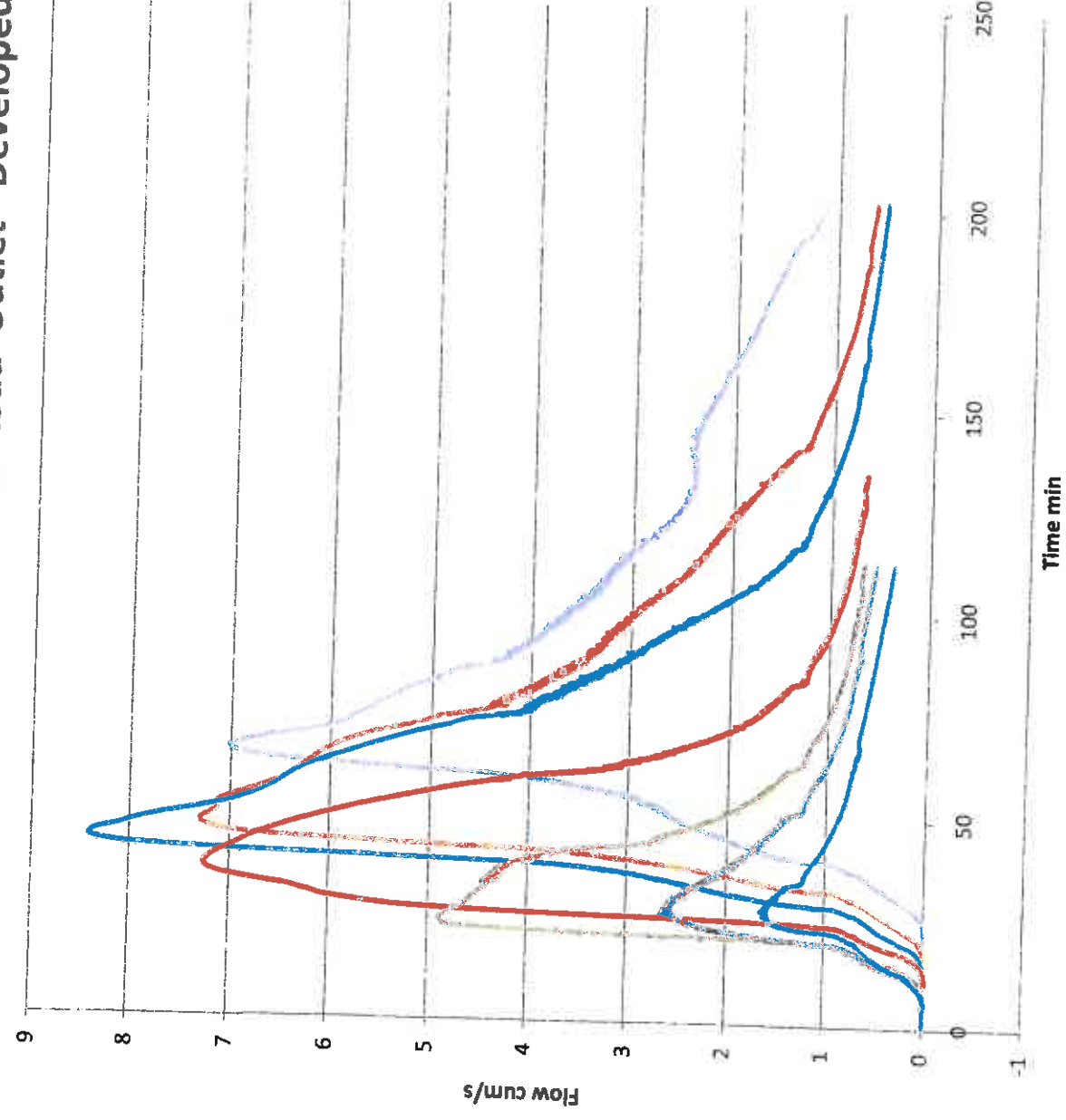
Fisher Road Outlet - Developed Q20



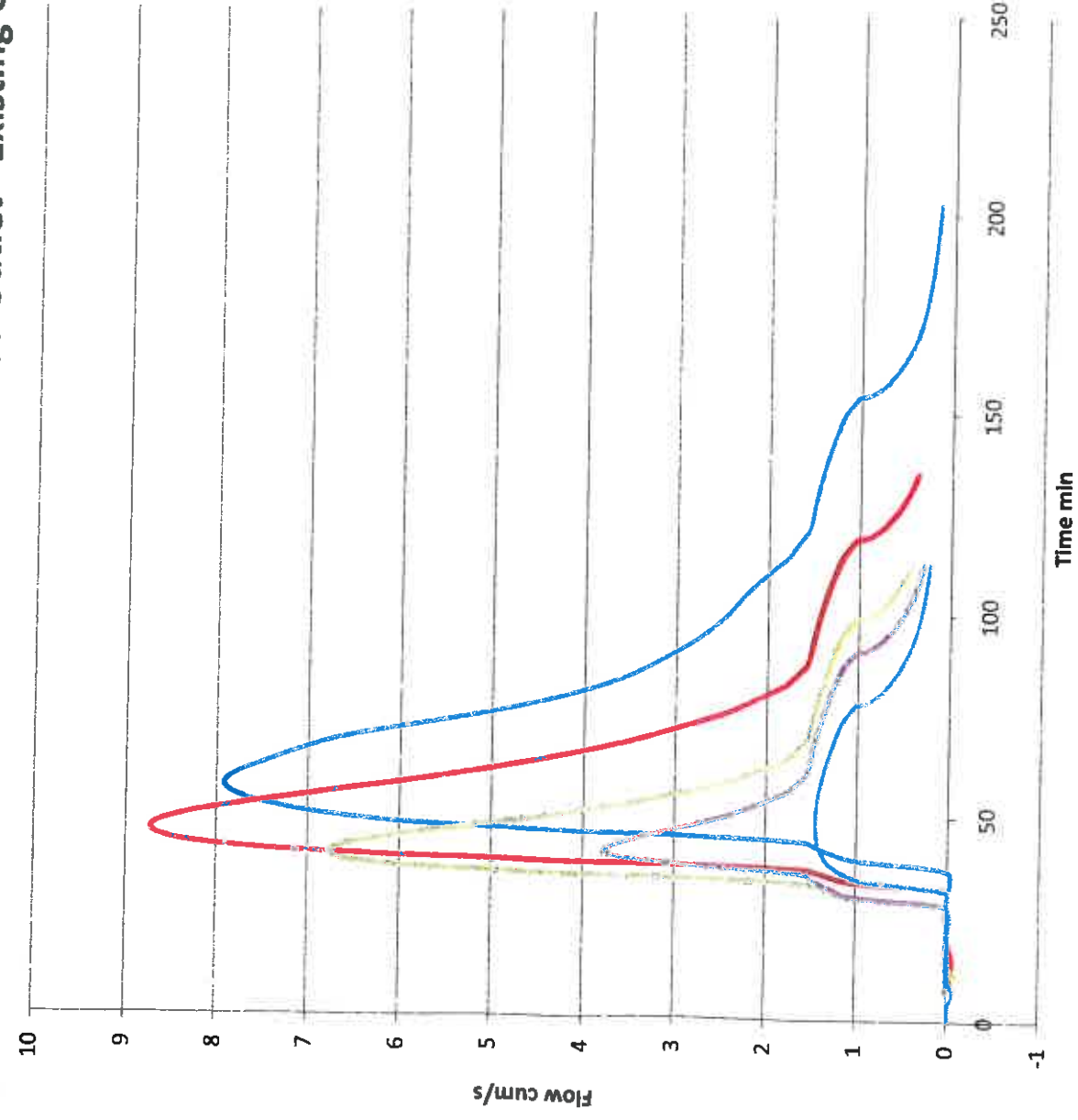
Fischer Road Outlet - Existing Q20



Aulds Road Outlet - Developed Q10



Aulds Road Outlet - Existing Q10



— Hydrograph - AR&R 10 year, 1.5 hours storm, average 53 mm/h, Zone 3

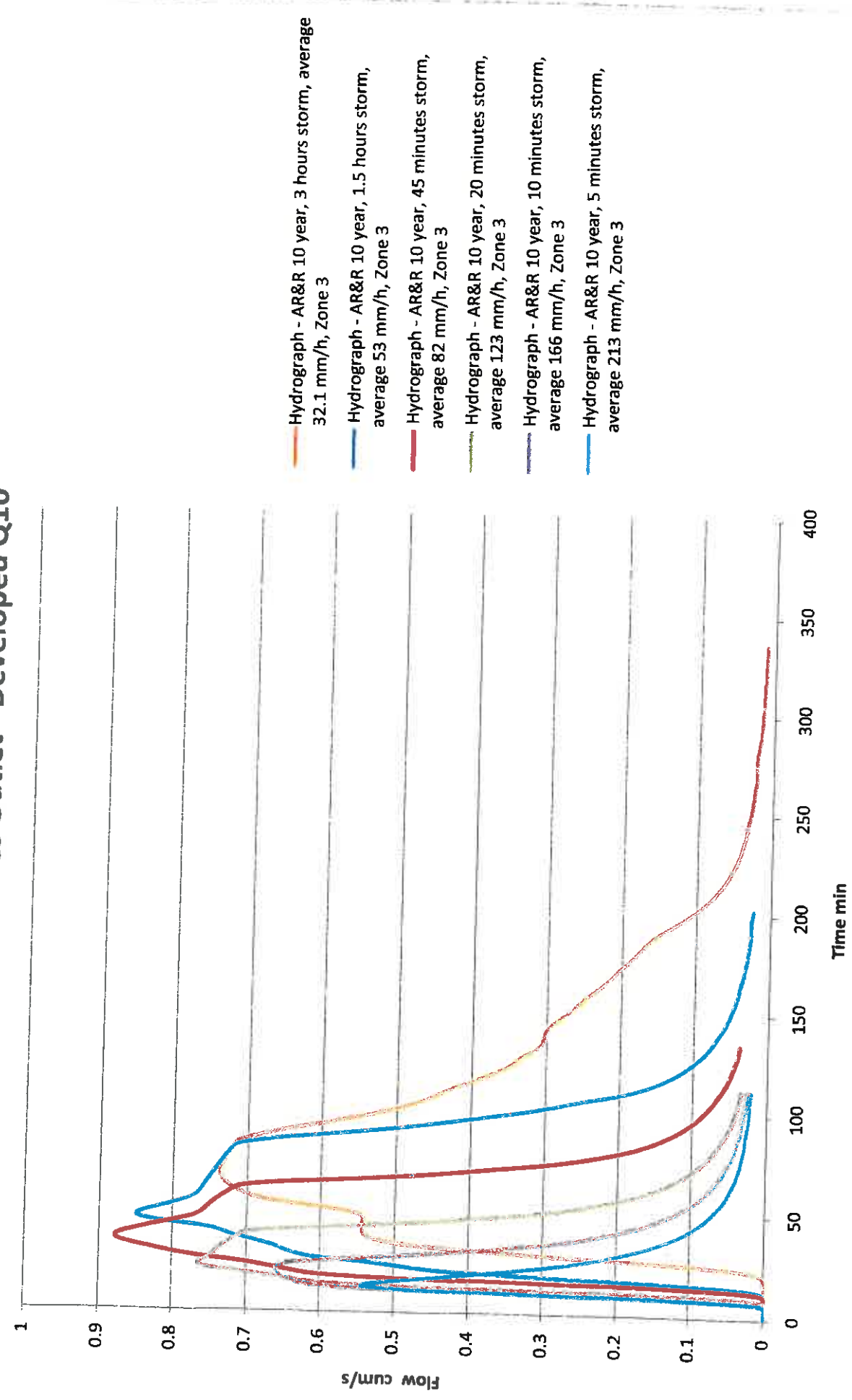
— Hydrograph - AR&R 10 year, 45 minutes storm, average 82 mm/h, Zone 3

- - - Hydrograph - AR&R 10 year, 20 minutes storm, average 123 mm/h, Zone 3

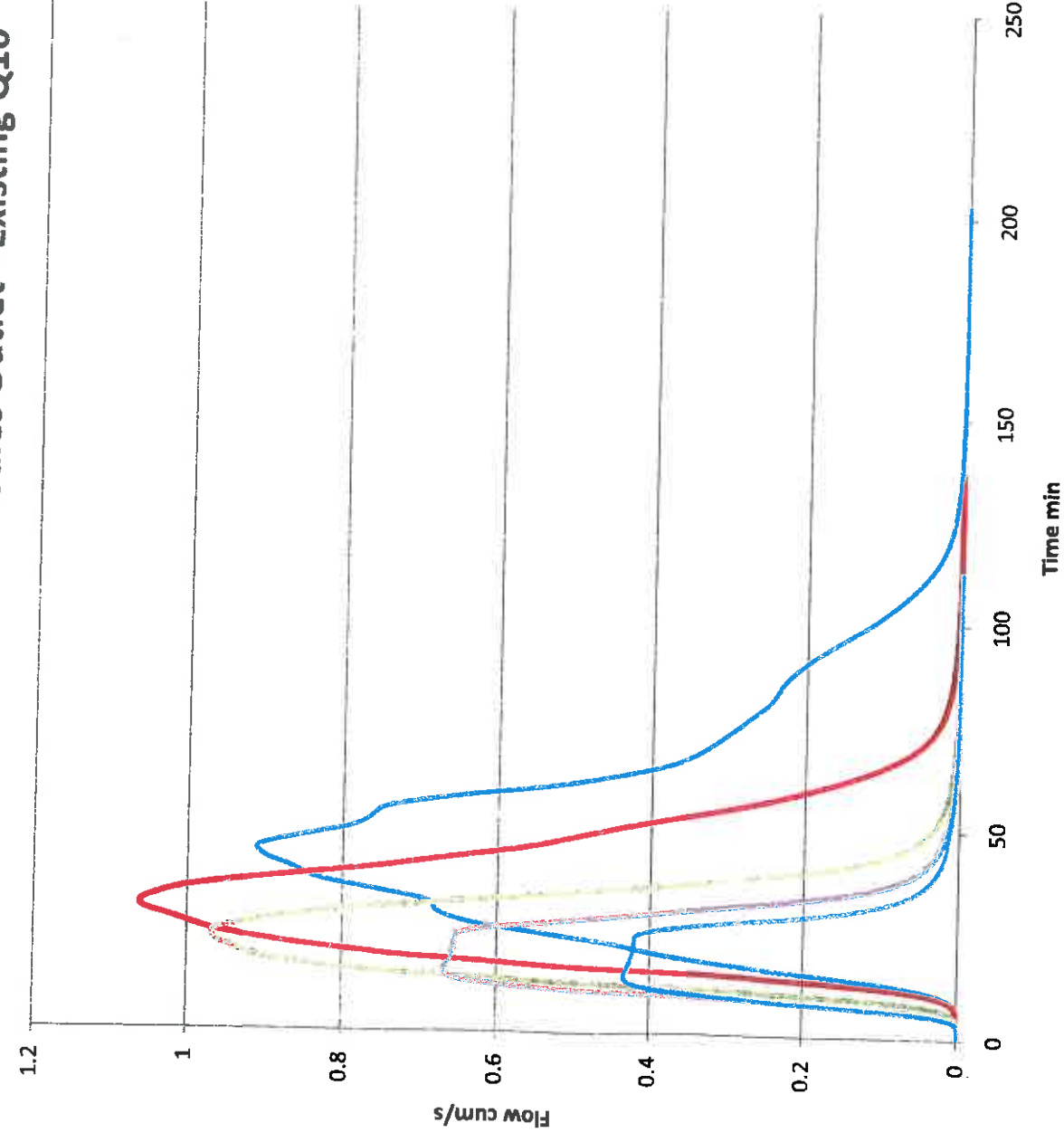
— Hydrograph - AR&R 10 year, 10 minutes storm, average 166 mm/h, Zone 3

— Hydrograph - AR&R 10 year, 5 minutes storm, average 213 mm/h, Zone 3

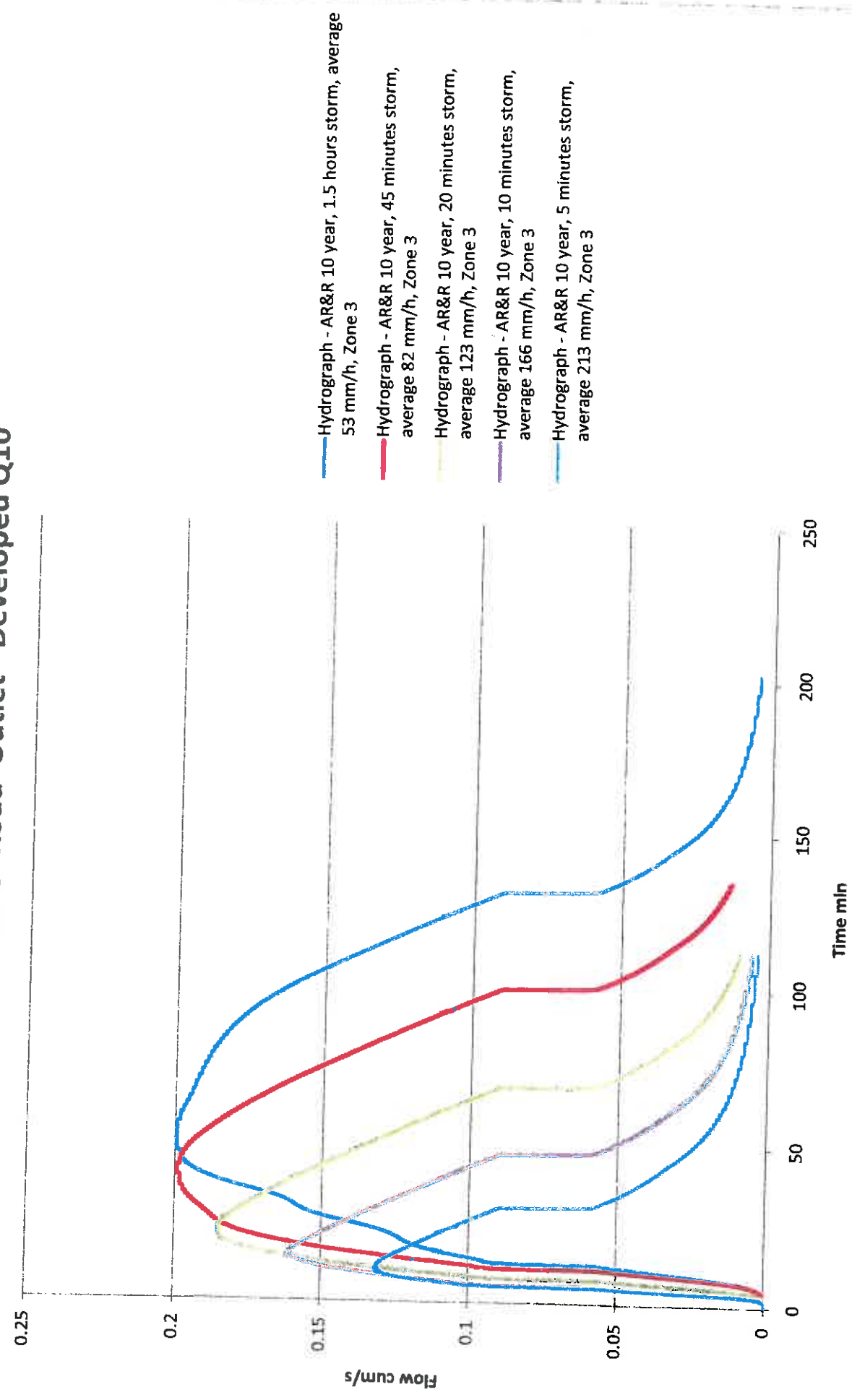
Sales Outlet - Developed Q10



Sales Outlet - Existing Q10



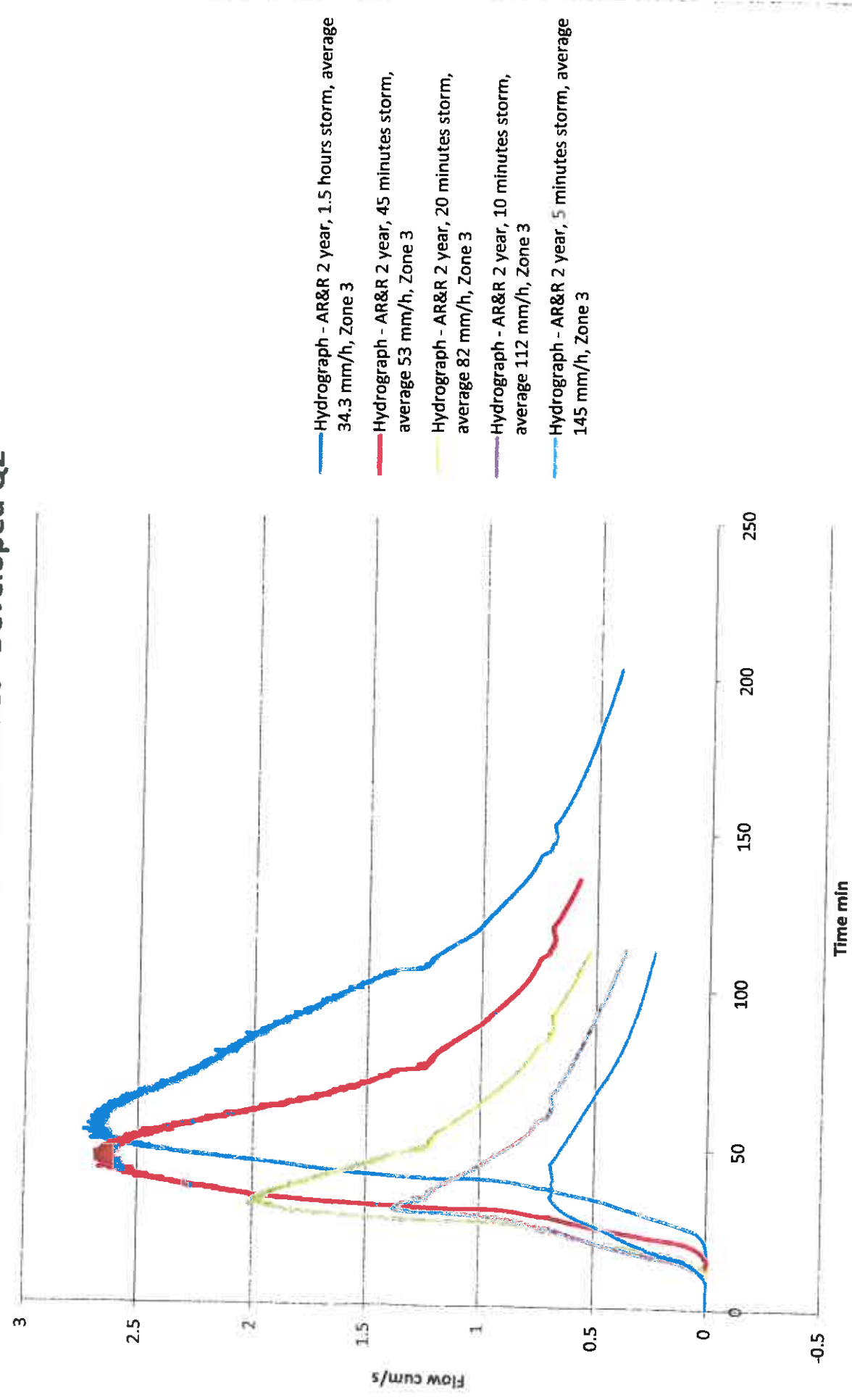
Fischer Road Outlet - Developed Q10



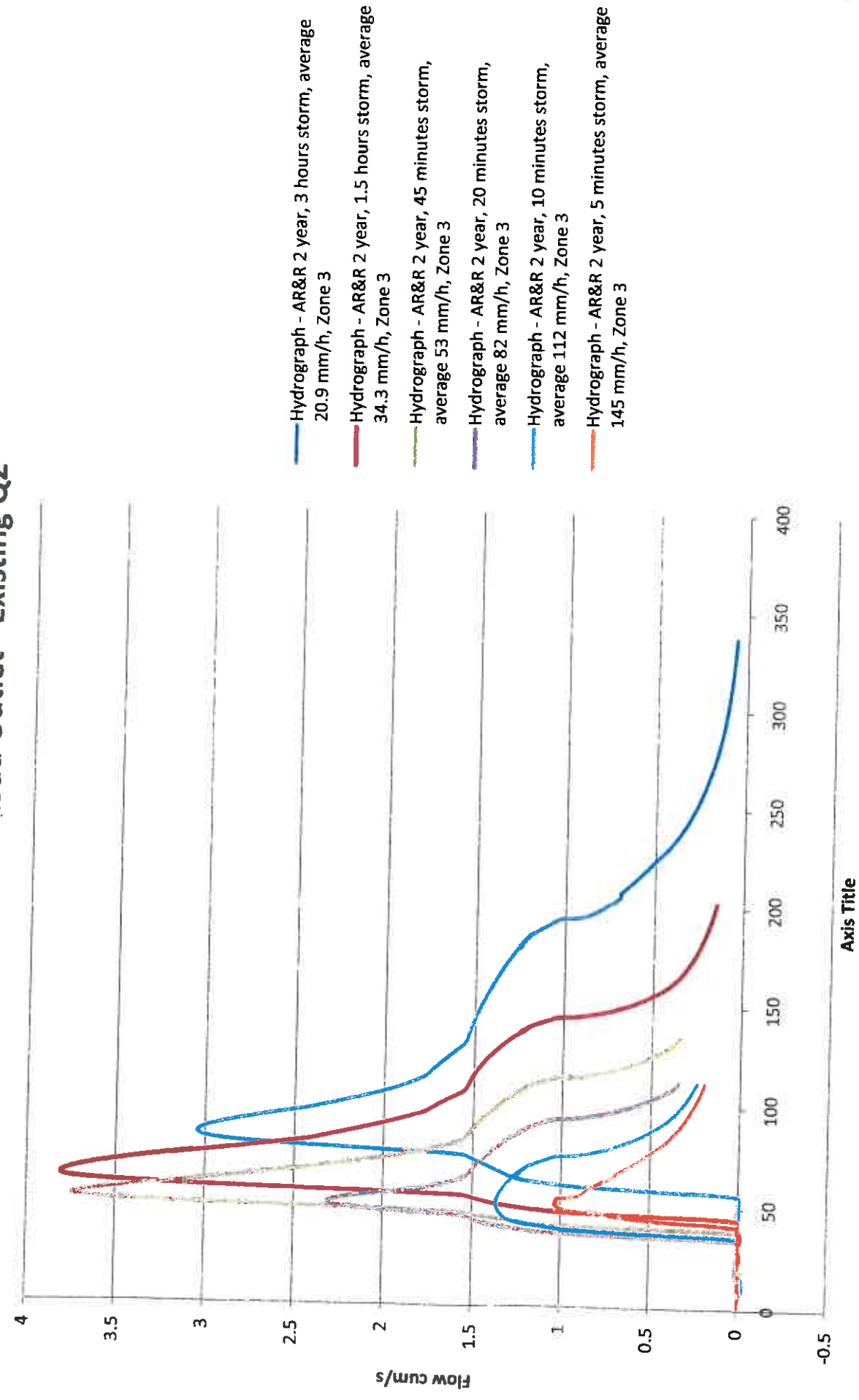
Fischer Road - Existing Q10



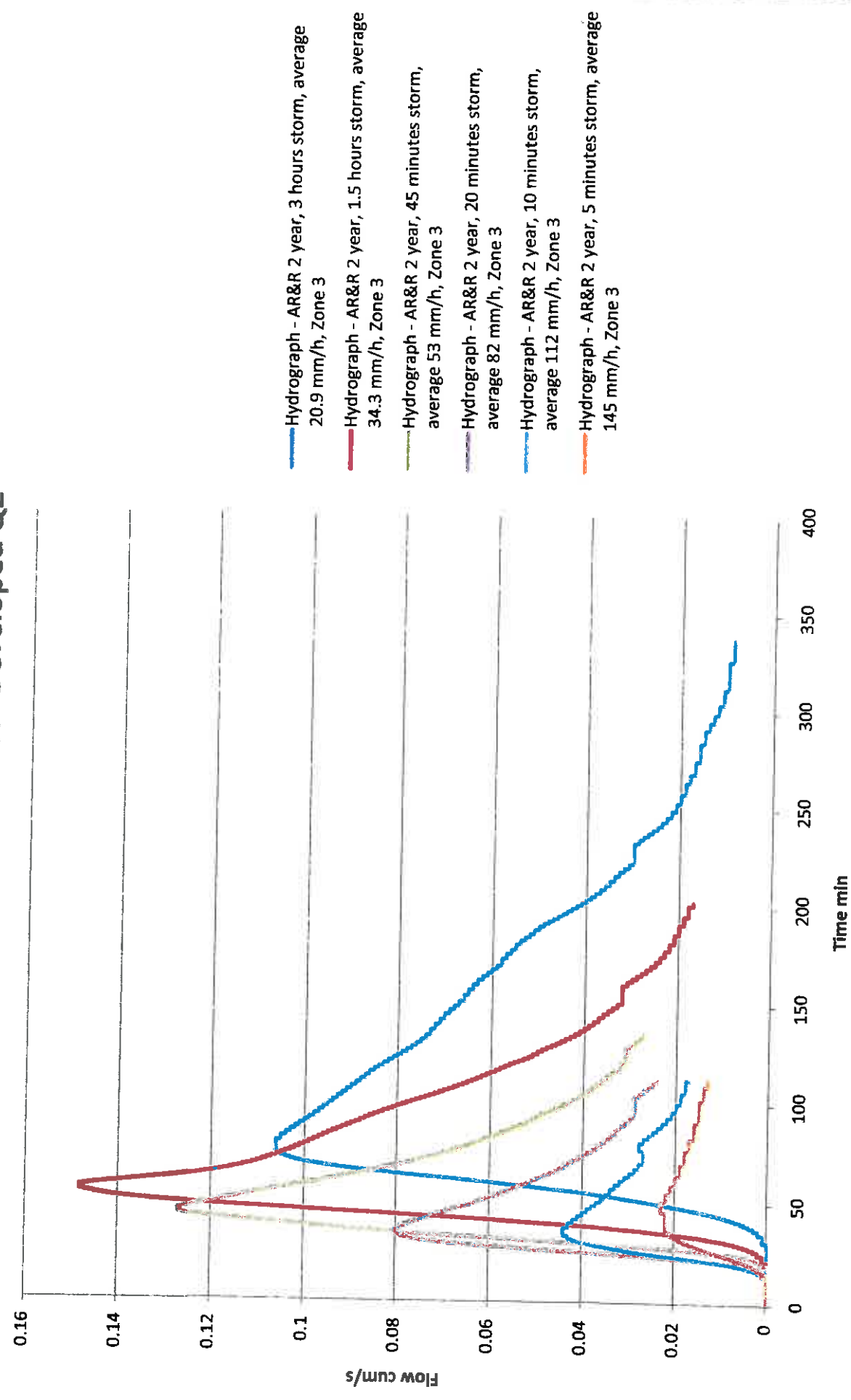
Aulds Road Outlet - Developed Q2



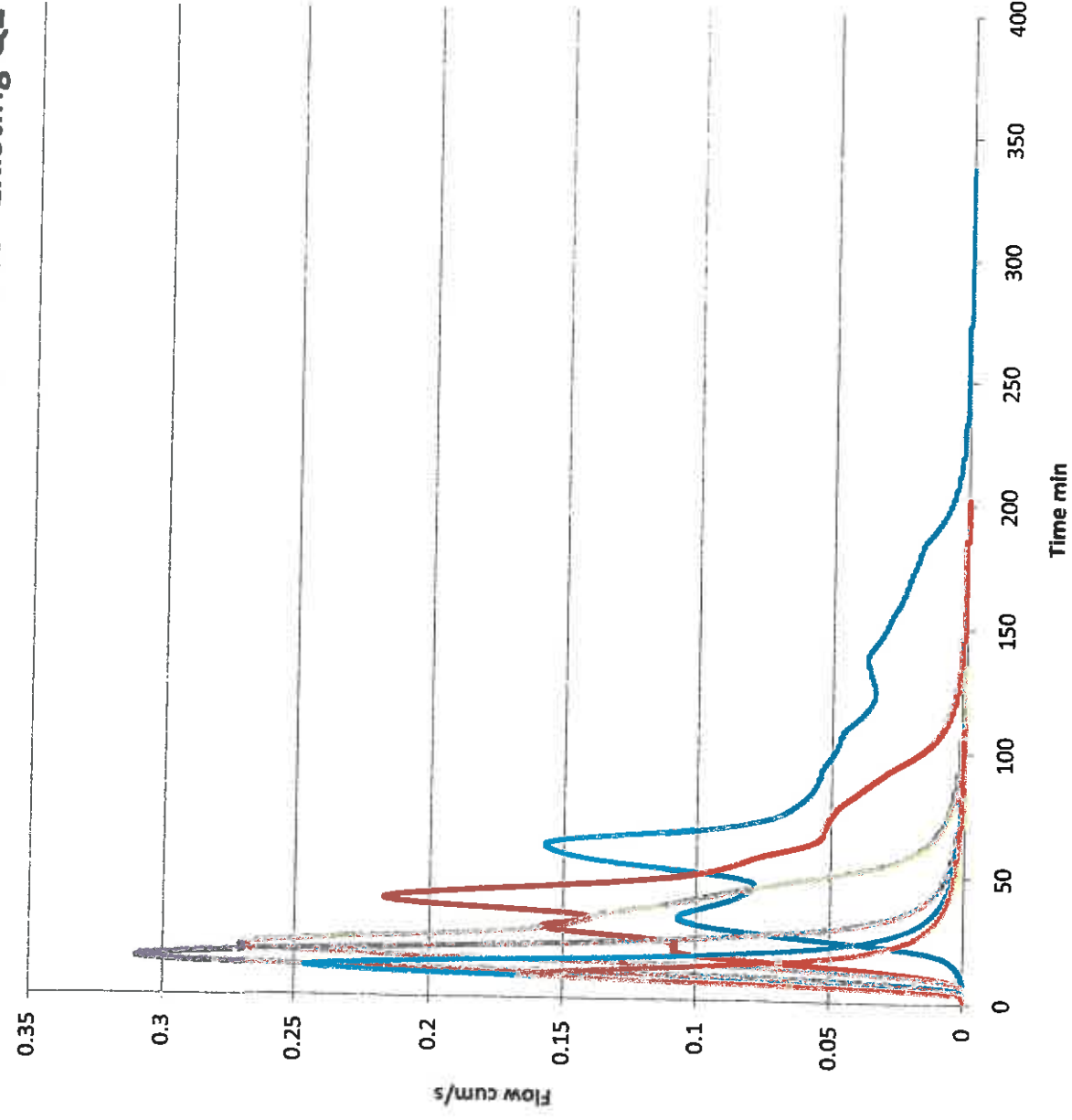
Aulds Road Outlet - Existing Q2



Sales Outlet - Developed Q2

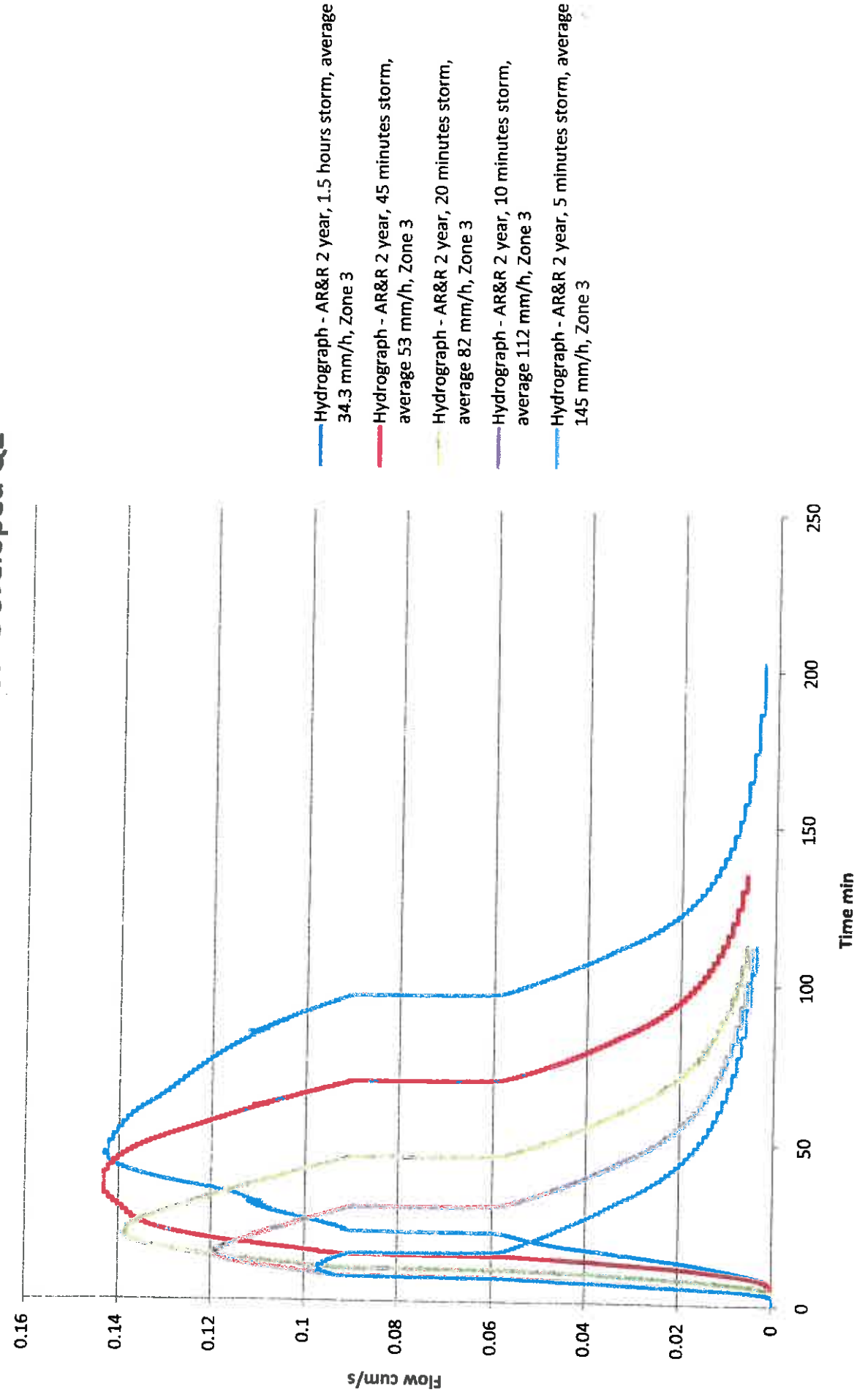


Sales Outlet - Existing Q2

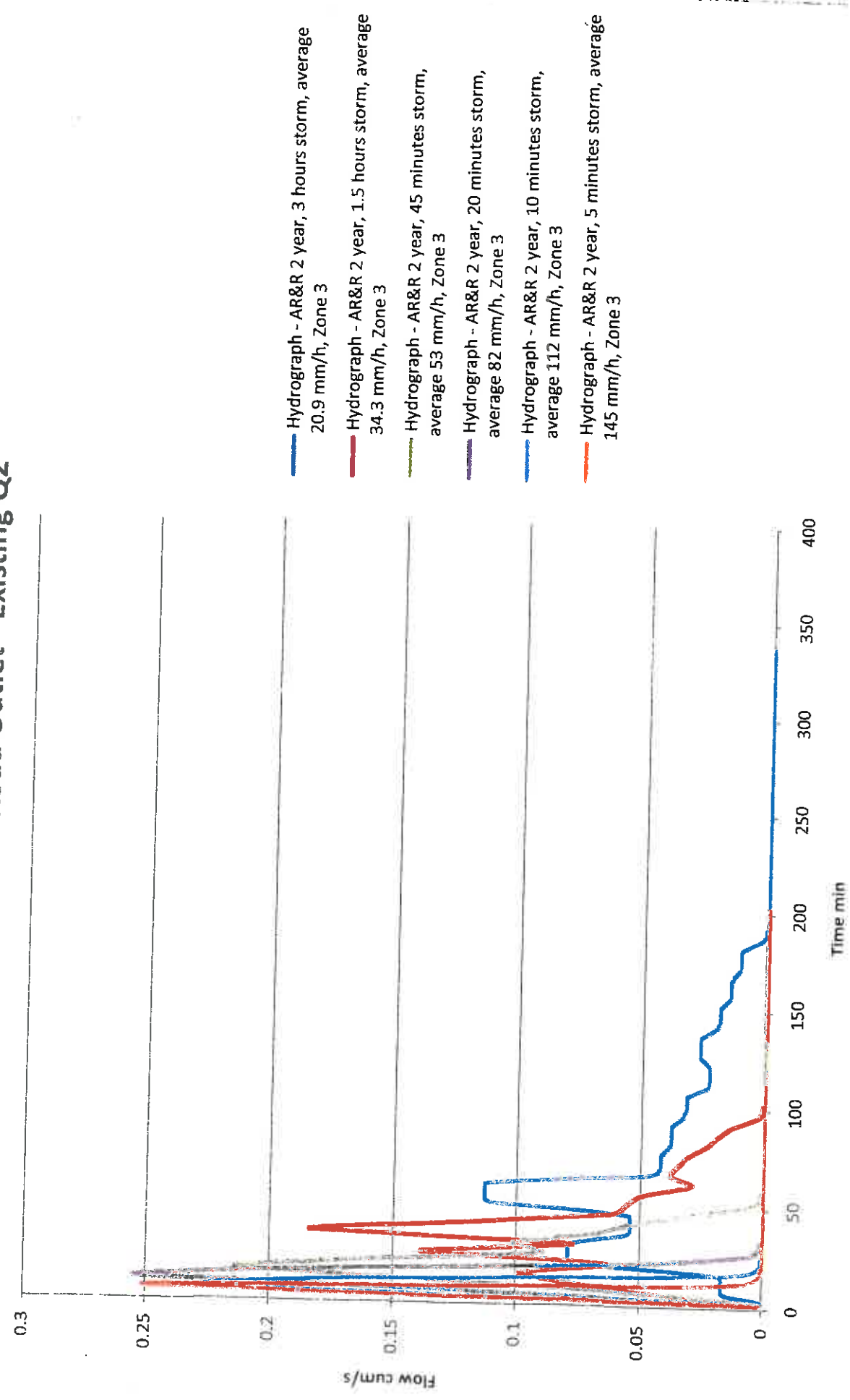


- Hydrograph - AR&R 2 year, 3 hours storm, average 20.9 mm/h, Zone 3
- Hydrograph - AR&R 2 year, 1.5 hours storm, average 34.3 mm/h, Zone 3
- Hydrograph - AR&R 2 year, 45 minutes storm, average 53 mm/h, Zone 3
- Hydrograph - AR&R 2 year, 20 minutes storm, average 82 mm/h, Zone 3
- Hydrograph - AR&R 2 year, 10 minutes storm, average 112 mm/h, Zone 3
- Hydrograph - AR&R 2 year, 5 minutes storm, average 145 mm/h, Zone 3

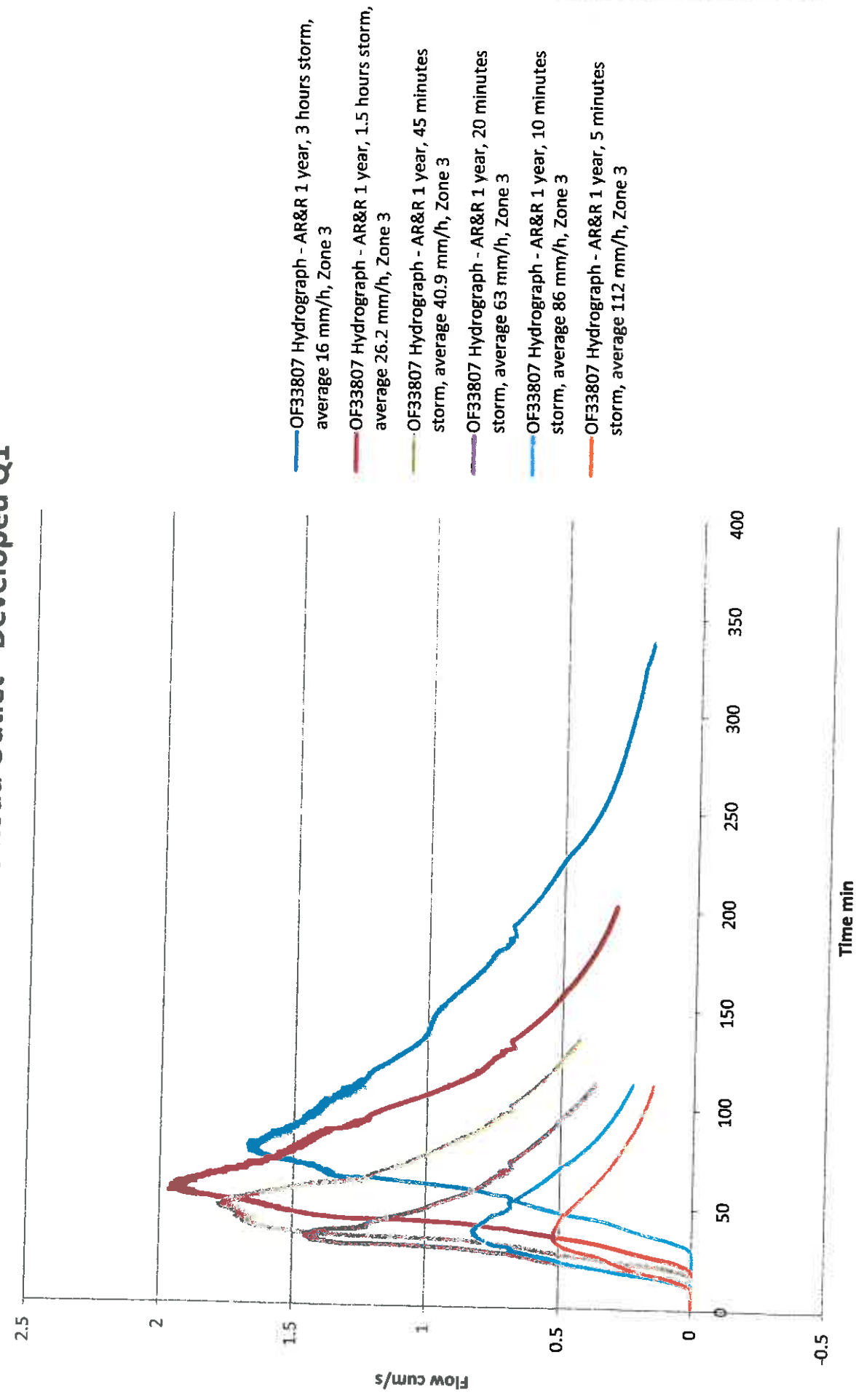
Fischer Road Outlet - Developed Q2



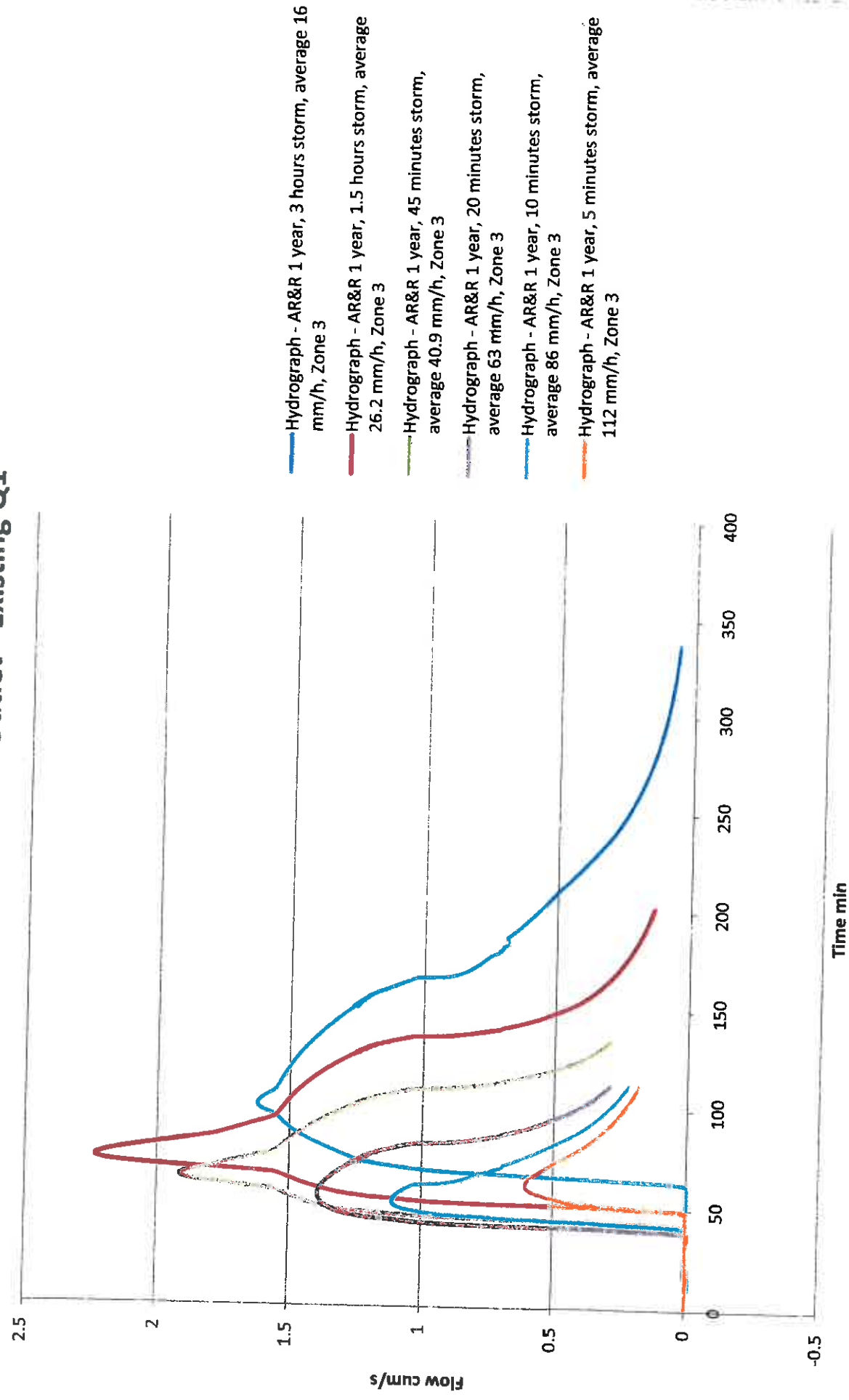
Fischer Road Outlet - Existing Q2



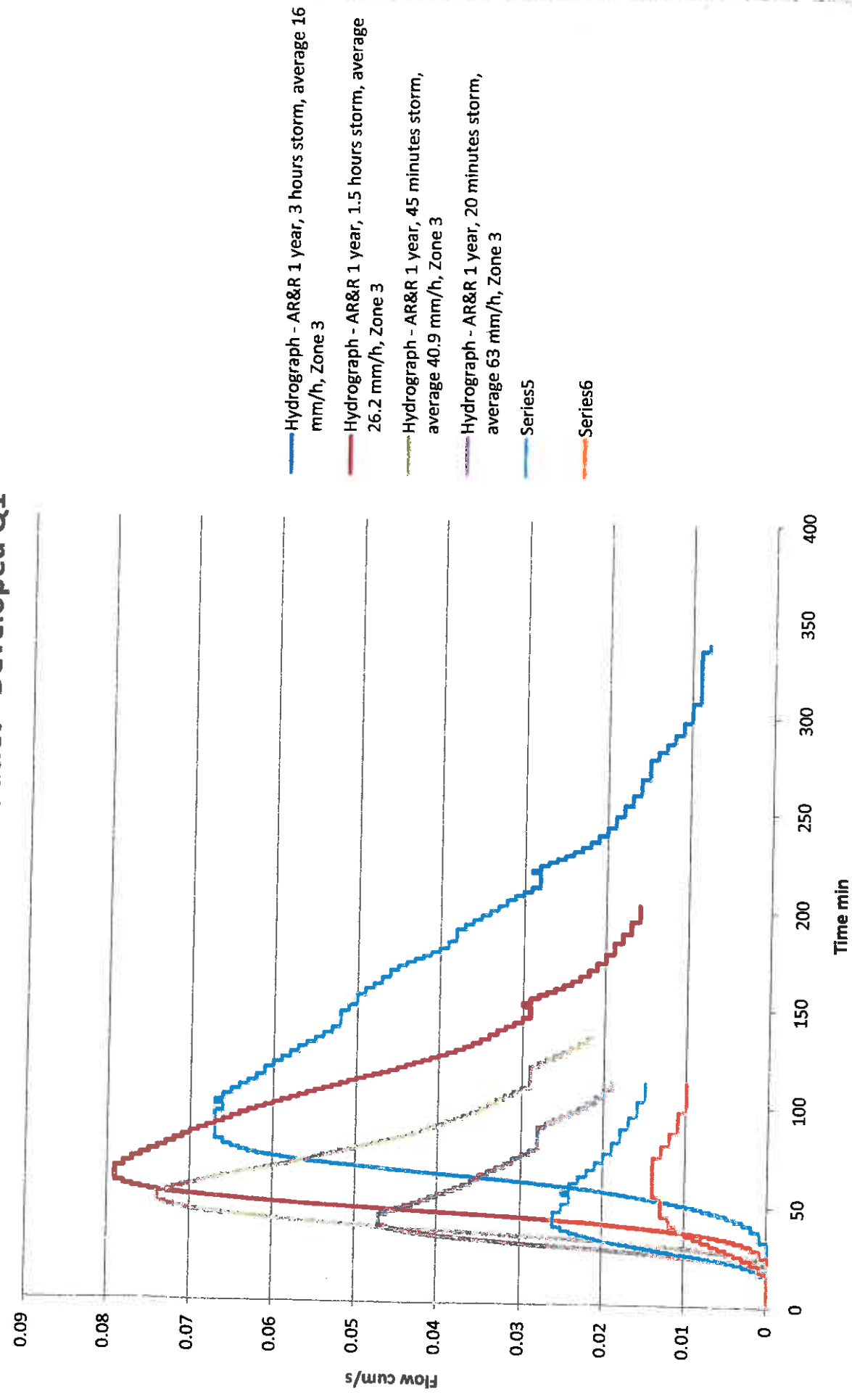
Aulds Road Outlet - Developed Q1



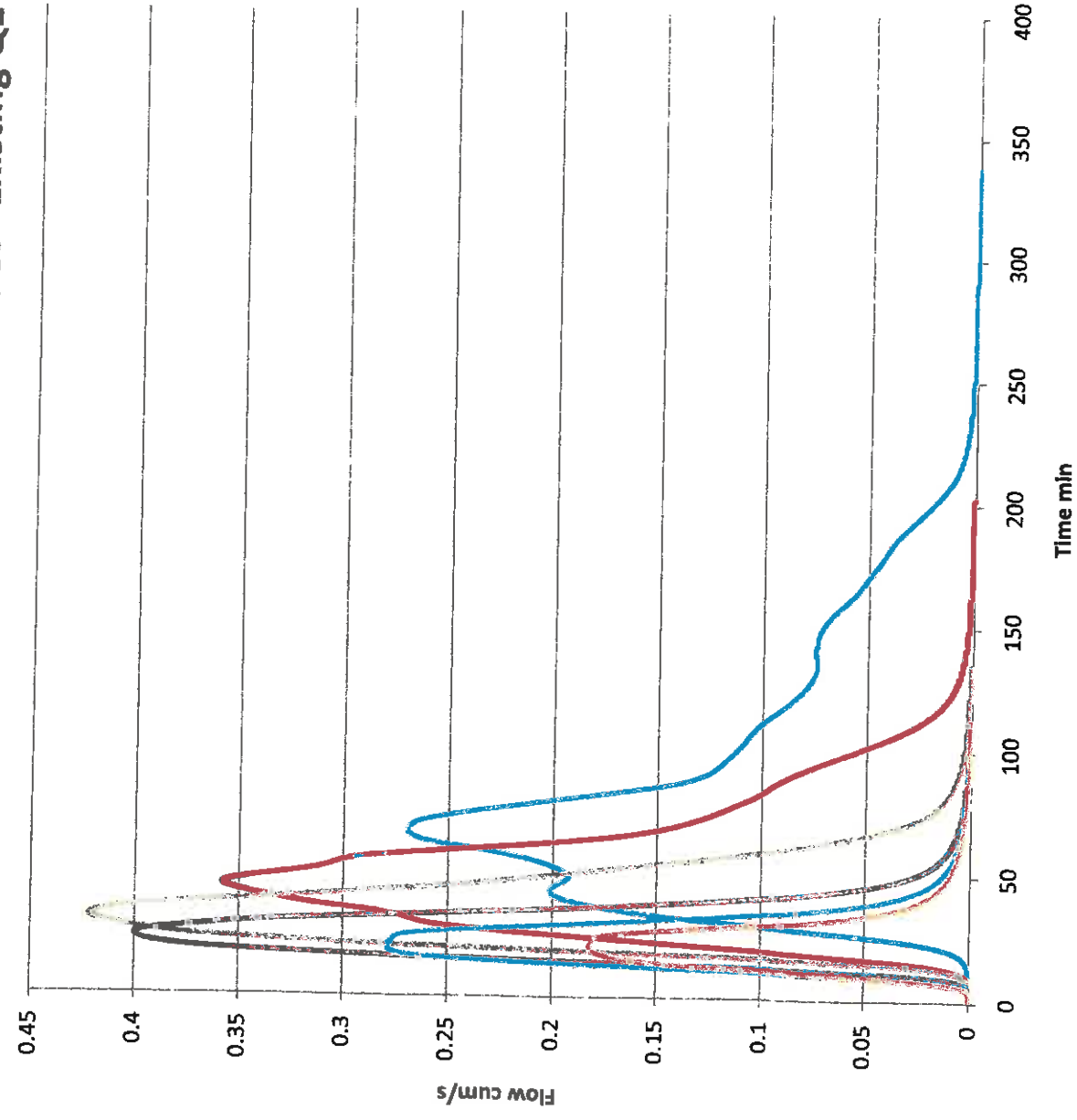
Aulds Road Outlet - Existing Q1



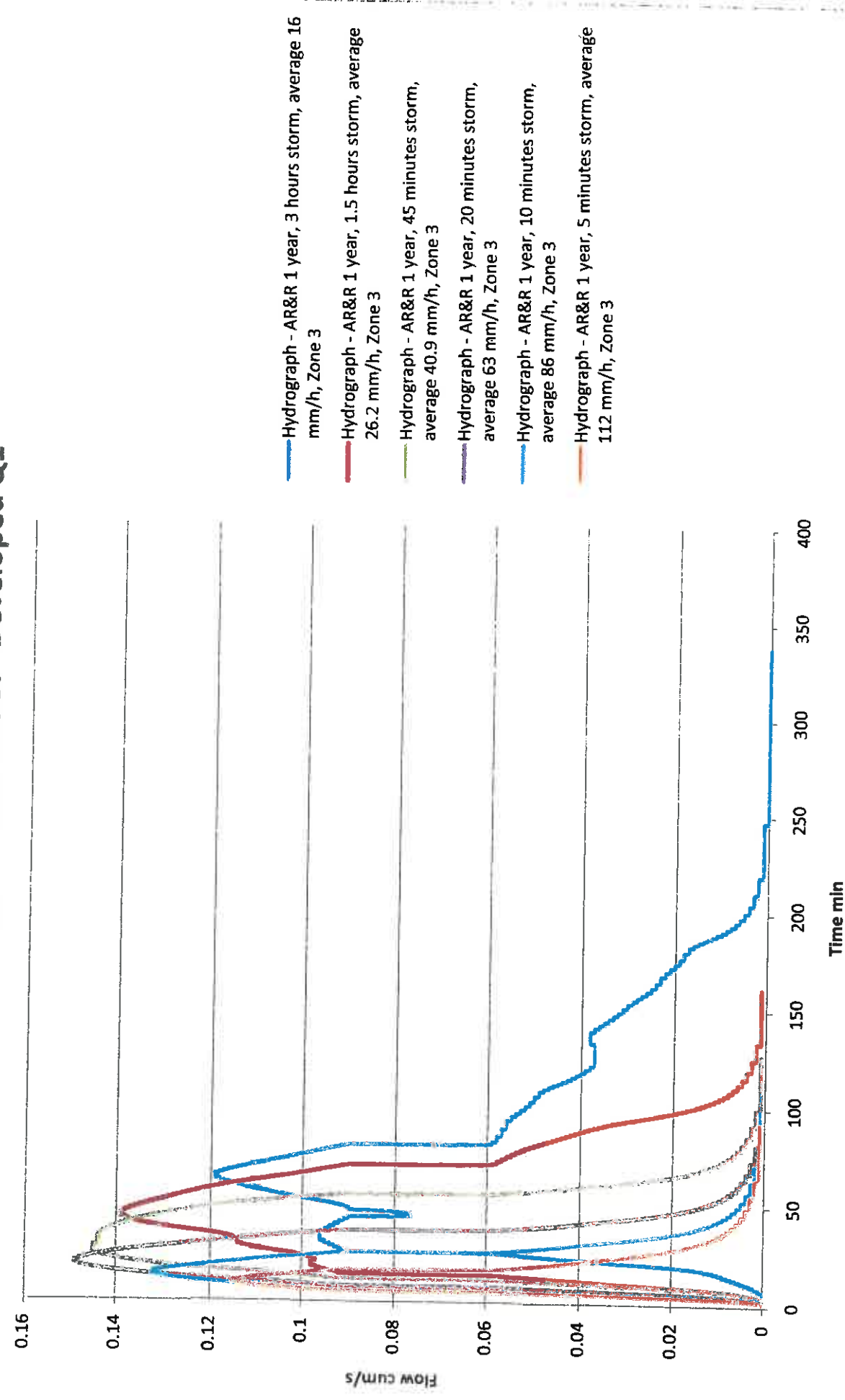
Sales Outlet - Developed Q1



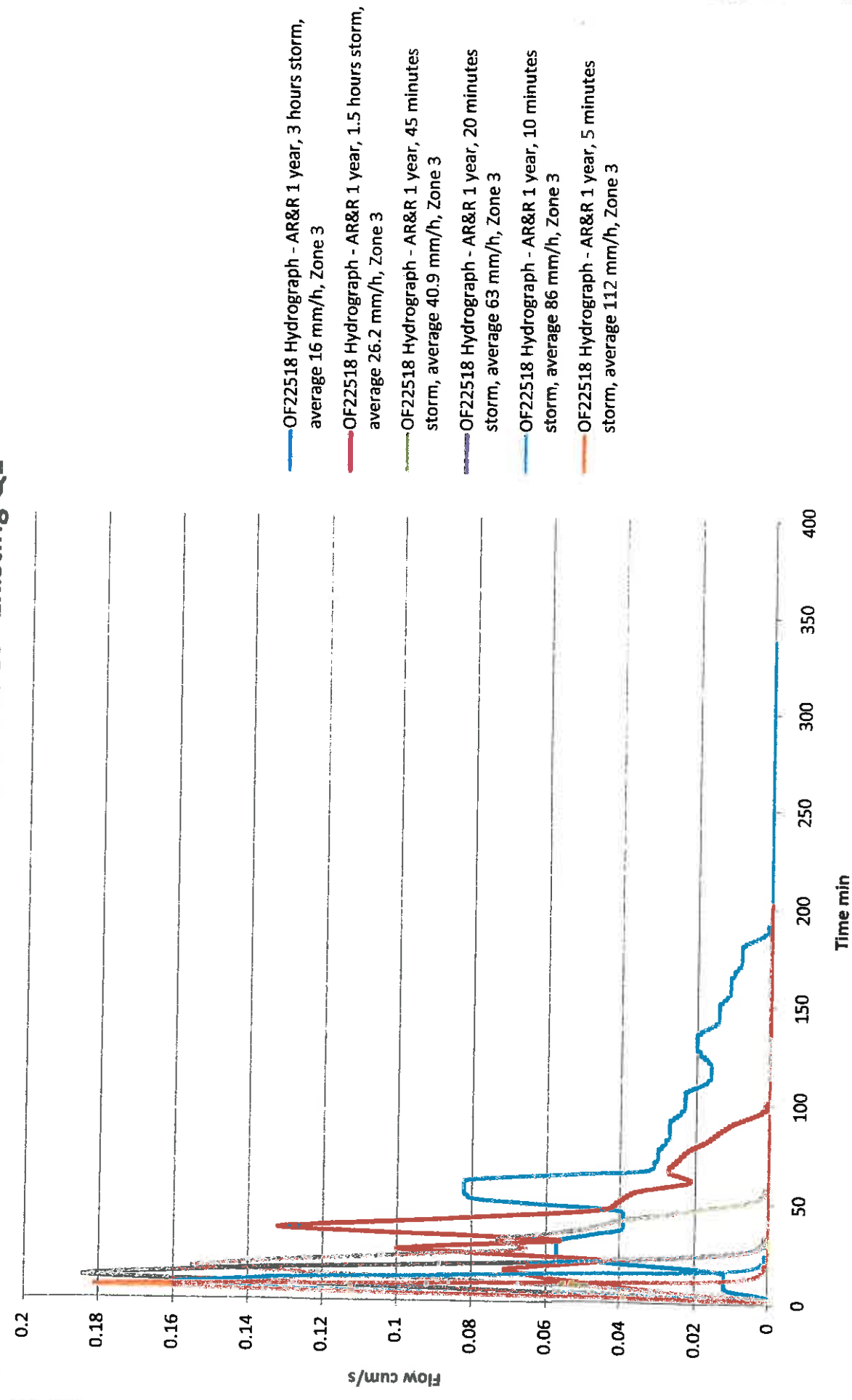
Sales Outlet - Existing Q1



Fischer Road Outlet - Developed Q1



Fischer Road Outlet - Existing Q1



ANNEXURE G

Rational Method Assessment

5874 Ripley Area 1																		
Catchment	Area ha	Impervious Portion %	ARI=> Time of Concentration min	Runoff Co-efficient					Intensity					Flows				
				mm/hr					mm/hr					cum/s				
				1	2	10	20	100	1	2	10	20	100	1	2	10	20	100
Aulds	53.709	0	18.0	0.37	0.39	0.46	0.49	0.56	65.0	84.5	125.1	146.1	197.5	3.60	4.97	8.66	10.62	16.41
Fischer	3.139	0	18.0	0.37	0.39	0.46	0.49	0.56	65.0	84.5	125.1	146.1	197.5	0.21	0.29	0.51	0.62	0.96
Sales	2.665	0	10.0	0.37	0.39	0.46	0.49	0.56	84.5	109.5	160.8	187.3	252.0	0.23	0.32	0.55	0.68	1.04

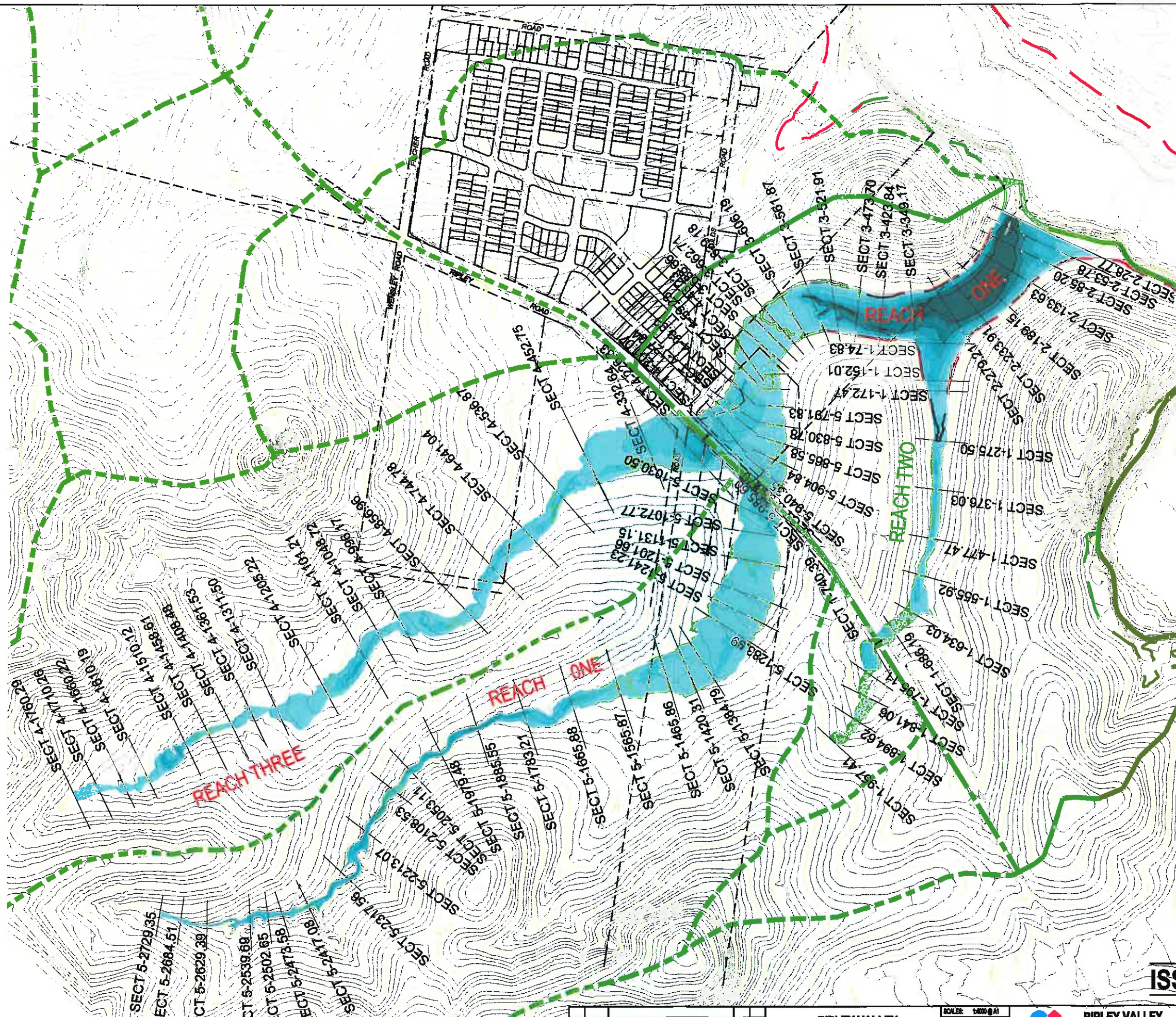
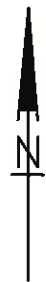
ANNEXURE H
Town Park HECRAS Roughness Sensitivity Results

Q100 FLOW ULTIMATE CHANNEL & BUND MANNINGS "n" SENSITIVITY CHECK

River	Reach	River Station	Q Total (m ³ /s)	Channel "n" = 0.035				Channel "n" = 0.08				Channel "n" = 0.1			
				W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	dV	W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	dV	W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	dV
Reach One	906	1046	Culvert												
Reach One	906	999.33	28.6	42.95	0.95	1.13	1.07	43.30	0.69	1.48	1.02	43.44	0.62	1.62	1.00
Reach One	906	980.95	28.6	42.91	1.17	1.24	1.45	43.27	0.83	1.60	1.33	43.41	0.74	1.74	1.29
Reach One	906	955.98	28.6	42.67	2.02	1.22	2.46	43.08	1.24	1.63	2.02	43.22	1.09	1.77	1.93
Reach One	906	931.01	28.6	42.55	1.76	1.33	2.34	42.78	1.34	1.56	2.09	42.89	1.20	1.67	2.00
Reach One	906	906.07	28.6	42.61	0.68	1.61	1.09	42.74	0.61	1.74	1.06	42.81	0.58	1.81	1.05
Reach One	349	838.46	39.9	42.60	0.63	1.60	1.01	42.71	0.58	1.71	0.99	42.76	0.55	1.76	0.97
Reach One	349	814.49	39.9	42.18	2.71	1.25	3.39	42.18	2.71	1.25	3.39	42.18	2.71	1.25	3.39
Reach One	349	787.03	39.9	41.62	0.99	1.62	1.60	42.02	0.73	2.02	1.47	42.17	0.66	2.17	1.43
Reach One	349	786.00	Bridge												
Reach One	349	782.02	39.9	41.61	0.90	1.61	1.45	42.02	0.66	2.02	1.33	42.17	0.60	2.17	1.30
Reach One	349	764.55	39.9	41.29	2.43	1.33	3.23	41.90	1.31	1.94	2.54	42.05	1.14	2.09	2.38
Reach One	349	739.67	39.9	41.08	2.31	1.38	3.19	41.72	1.18	2.02	2.38	41.89	0.99	2.19	2.17
Reach One	349	690.05	39.9	40.95	1.57	1.73	2.72	41.49	1.01	2.27	2.29	41.65	0.88	2.43	2.14
Reach One	349	665.05	39.9	40.88	1.58	1.73	2.73	41.39	1.03	2.24	2.31	41.55	0.91	2.40	2.18
Reach One	349	615.04	39.9	40.71	1.66	1.68	2.79	41.14	1.14	2.11	2.41	41.28	1.02	2.25	2.30
Reach One	349	565.08	39.9	40.48	1.83	1.58	2.89	40.65	1.55	1.75	2.71	40.70	1.48	1.80	2.66

HECRAS Output for Town Park Channel Flows (1 in 100 ARI)

ANNEXURE I
Drawing Numbers 5874-HEC01 to HEC14
Town Park HECRAS Flow Results



LEGEND

DEPTH OF Q100 FLOW				Colour
0.00	to	0.50	m	
0.50	to	1.00	m	
1.00	to	1.50	m	
1.50	to	2.00	m	
2.00	to	2.50	m	
2.50	to	5.00	m	

Q100 WATER DEPTHS
EXISTING CONDITIONS

CH 745.63	HECRAS SECTION
	EXISTING CULVERT
	PROPOSED CULVERT
	CATCHMENT BOUNDARY
	EXISTING Q100 FLOOD LINE

NOTE:
PROPOSED CULVERT LOCATIONS ARE PROVISIONAL AND
SUBJECT TO AMENDMENT.
REFER TO DRAWING 5874-HEC.10 FOR FLOW DATA.

ISSUED FOR INFORMATION

ISSUE	DATE	AMENDMENT	BY	APP
B	12.04.11	CR003 SECTIONS REVERSED	CB	DL
A	10.03.11	FOR INFORMATION	CB	DL

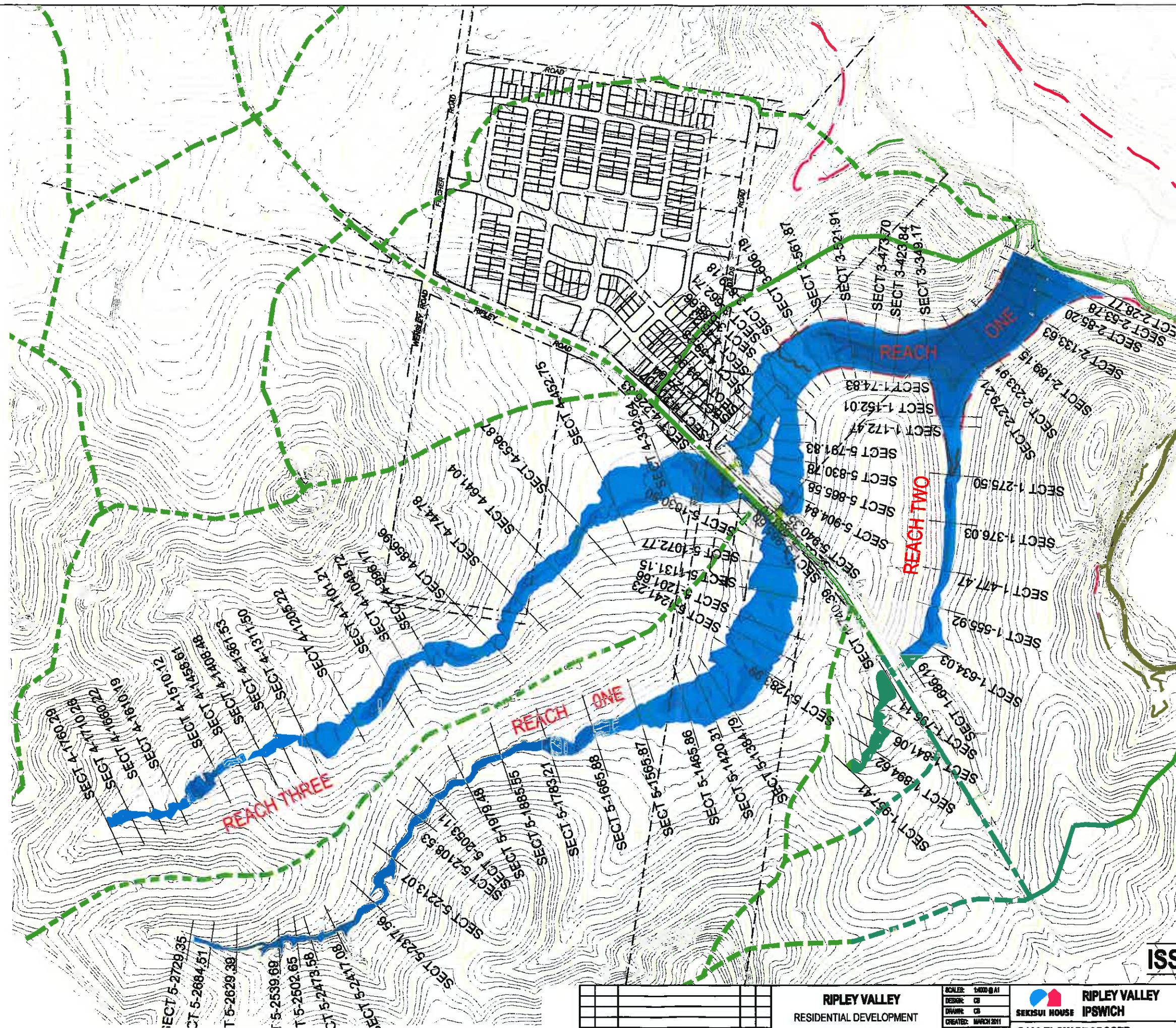
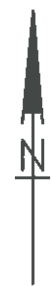
RIPLEY VALLEY
RESIDENTIAL DEVELOPMENT
RIPLEY ROAD
IPSWICH

SCALE: 1:600 @ A1
DESIGN: CB
DRAWN: CB
CREATED: MARCH 2011
CHECK: DL
APPROV: D.P.
DATE: 10.03.11

RIPLEY VALLEY
SEXISUI HOUSE
IPSWICH
Q100 FLOW EXISTING
CONDITION RIPLEY RD

mpn consulting
MPN Consulting Pty Ltd
ABN: 59 082 191 789
28 Sherwood Road, Toowoomba, Qld, 4308
P: 08 7 3371 9677
F: 08 7 3371 9158
E: solutions@mpn.net.au

5874
DRAWING NO.
HEC.01
REV
B



LEGEND

DEPTH OF Q100 FLOW				Colour
0.00	to	0.50	m	
0.50	to	1.00	m	
1.00	to	1.50	m	
1.50	to	2.00	m	
2.00	to	2.50	m	
2.50	to	5.00	m	

Q100 WATER DEPTHS
PROPOSED RIPLEY RD UPGRADE & NEW CULVERTS

CH 745.63	HECRAS SECTION
	EXISTING CULVERT
	PROPOSED CULVERT
	CATCHMENT BOUNDARY
	EXISTING Q100 FLOOD LINE

NOTE:
PROPOSED CULVERT LOCATIONS ARE PROVISIONAL AND
SUBJECT TO AMENDMENT.

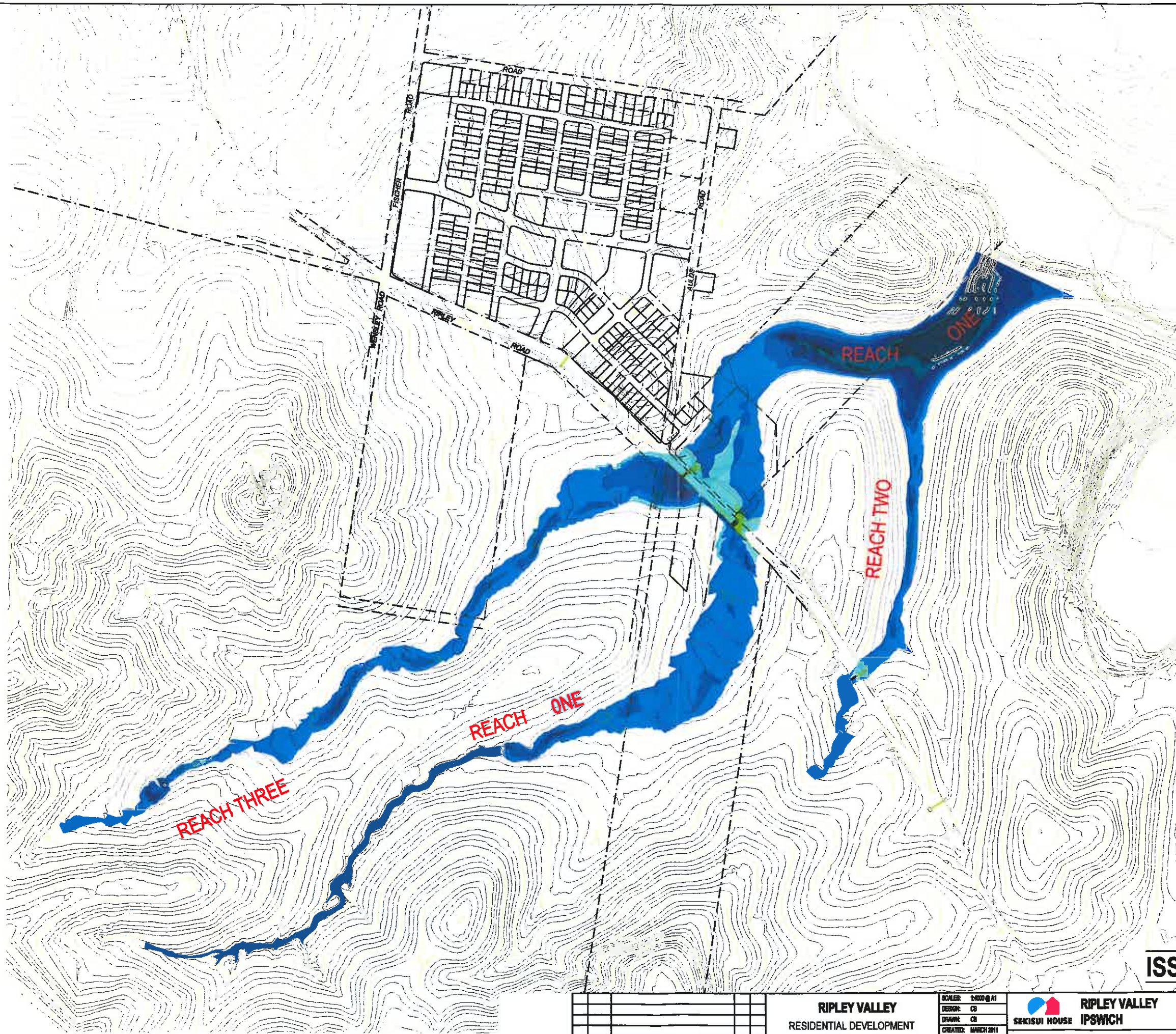
ISSUED FOR INFORMATION

REV	DATE	AMENDMENT	BY	APP
B	12.04.11	CROSS SECTIONS & WATER SURFACE REVISED	CS	DL
A	10.06.12	FOR INFORMATION	CS	DL

RIPLEY VALLEY RESIDENTIAL DEVELOPMENT RIPLEY ROAD IPSWICH	
SCALE: 1:1000 @ A1	DESIGN: CS
DRAWN: CS	CREATED: MARCH 2011
CHWD: DL	APPRO: D.P.
DATE: 10.06.11	

	RIPLEY VALLEY IPSWICH
Q100 FLOW PROPOSED RIPLEY RD ALIGNMENT	

	MPN Consulting Pty Ltd ABN: 20 082 191 759 30 Sherwood Road, Toowoomba, QLD 4300 P: 07 73371 6677 F: 07 73371 2166 E: waldron@mpn.net.au
5874	HEC.02
REV	B



LEGEND



Q100 WATER SURFACE EXISTING
CULVERTS & EXISTING RIPLEY RD

Q100 WATER SURFACE PROPOSED
CULVERTS & RIPLEY RD RAISED



EXISTING CULVERT
PROPOSED CULVERT

NOTE:
PROPOSED CULVERT LOCATIONS ARE PROVISIONAL AND
SUBJECT TO AMENDMENT.

ISSUED FOR INFORMATION

ISSUE	DATE	AMENDMENT	BY	APP
B	12.04.11	WATER SURFACES REWIDENED	CB	DL
A	18.03.11	FOR INFORMATION	CB	DL

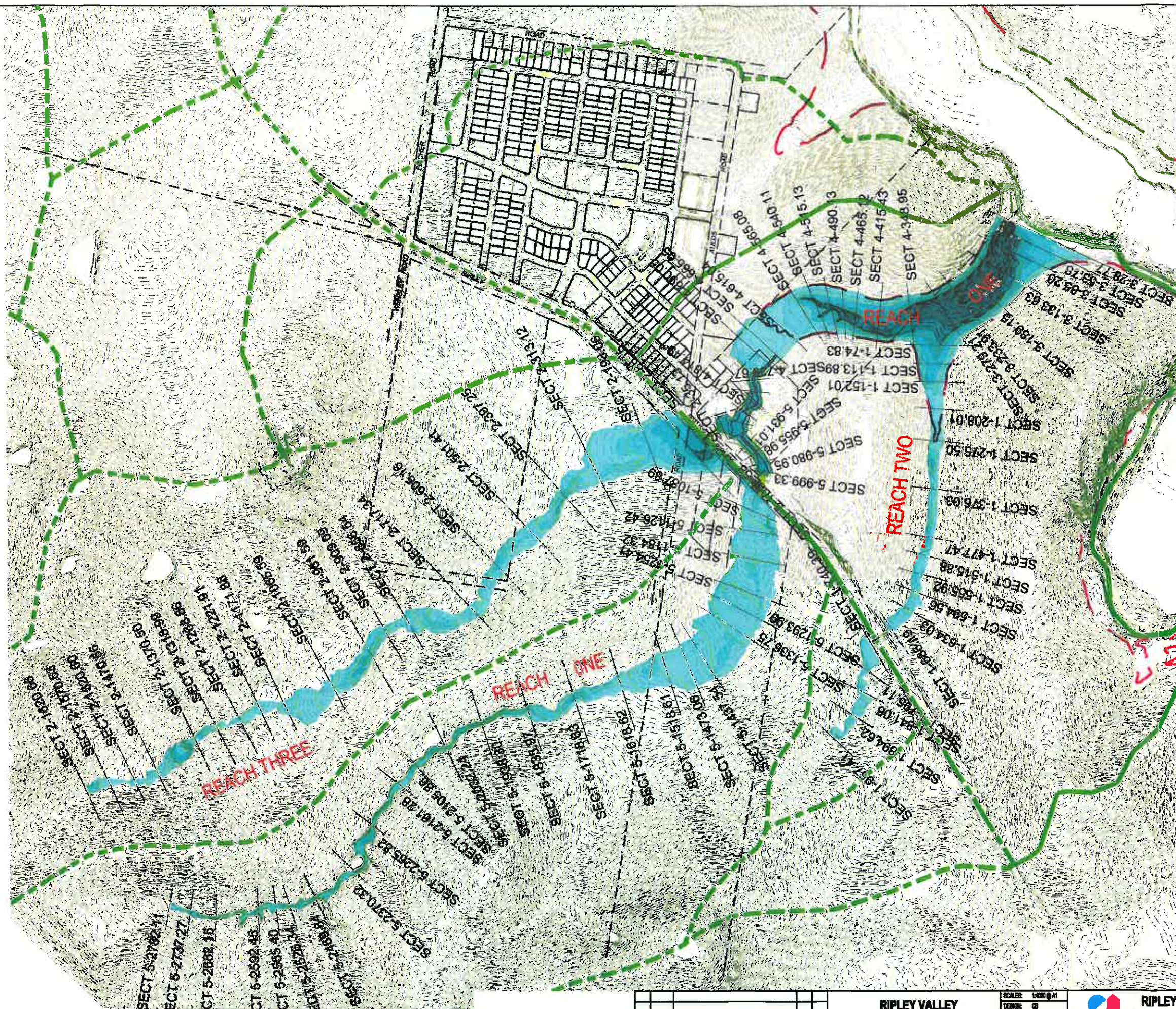
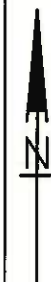
RIPLEY VALLEY
RESIDENTIAL DEVELOPMENT
RIPLEY ROAD
IPSWICH

SCALE:	1:500 @ A1
DESIGN:	CB
DRAWN:	CB
CREATED:	MARCH 2011
CHKD:	DL
APPRD:	DL
DATE:	18.03.11

SEKISUI HOUSE
RIPLEY VALLEY
IPSWICH
EXISTING SURFACE V. RIPLEY RD
REALIGNMENT SURFACE

mpn consulting
MPN Consulting Pty Ltd
ABN: 28 052 191 759
38 Sherwood Road, Toowoomba, QLD, 4369
P: 01 7 3371 0277
F: 01 7 3371 3166
E: solutions@mpn.net.au

mpn JOB
5874
DRAWING No.
HEC.03
REV
B



LEGEND

DEPTH OF Q100 FLOW				Colour
0.00	to	0.50	m	
0.50	to	1.00	m	
1.00	to	1.50	m	
1.50	to	2.00	m	
2.00	to	2.50	m	
2.50	to	5.00	m	

Q100 WATER DEPTHS
PROPOSED RIPLEY RD UPGRADE, PART CHANNEL & NO BUND

CH 745.63	HECRAS SECTION
	EXISTING CULVERT
	PROPOSED CULVERT
	CATCHMENT BOUNDARY
	EXISTING Q100 FLOOD LINE

NOTE:
PROPOSED CULVERT LOCATIONS ARE PROVISIONAL AND
SUBJECT TO AMENDMENT.
REFER TO DRAWING 5874-HEC.10 FOR FLOW DATA.

ISSUED FOR INFORMATION

ISSUE	DATE	AMENDMENT	BY	APP
A	10/03/11	FOR INFORMATION	CB	DL

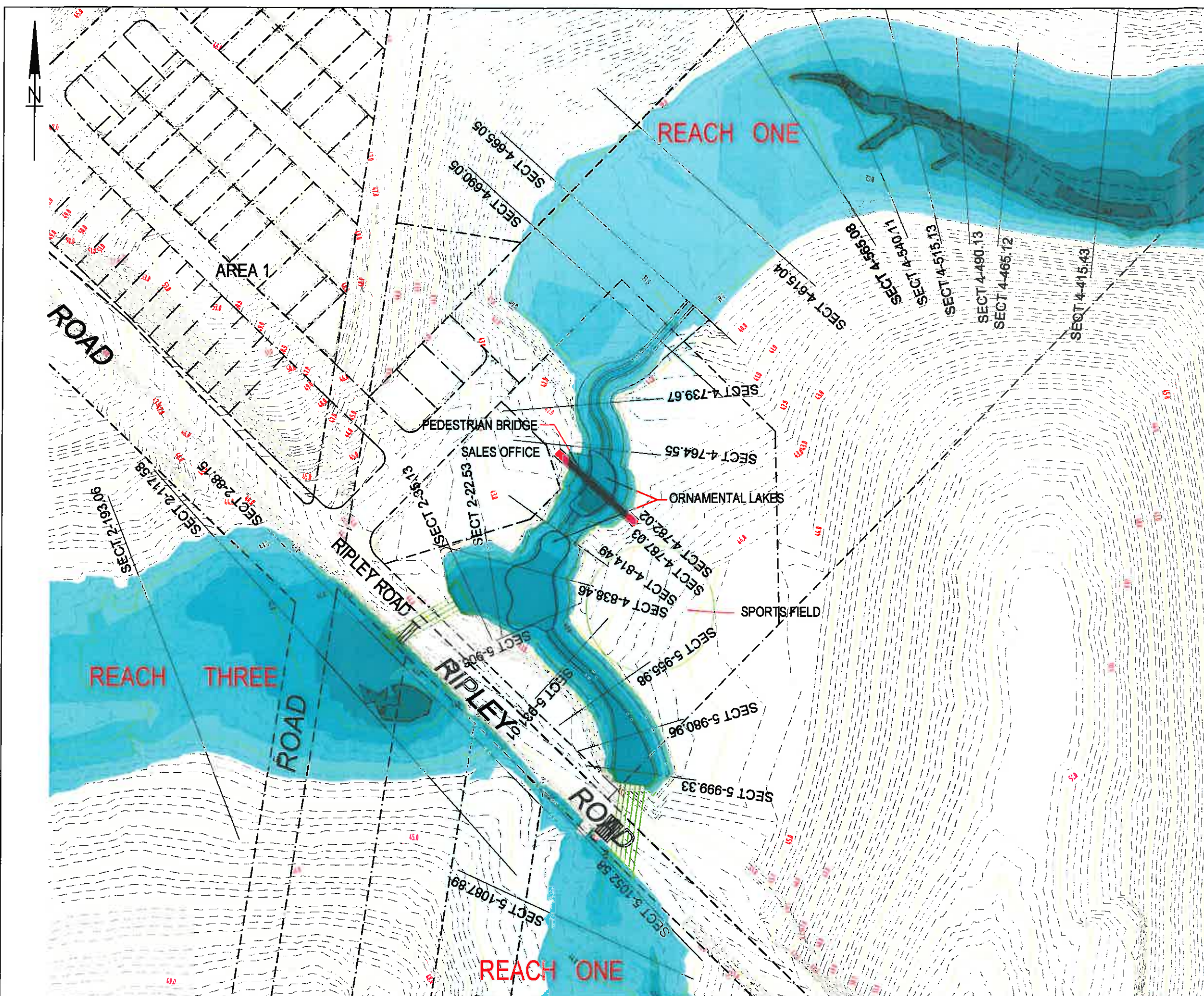
RIPLEY VALLEY
RESIDENTIAL DEVELOPMENT
RIPLEY ROAD
IPSWICH

SCALE:	1:500 @ A1
DESIGN:	CB
DRAWN:	CB
CREATED:	MARCH 2011
CHD:	DL
APPROV:	CB
DATE:	10/03/11

RIPLEY VALLEY
IPSWICH
Q100 FLOW, PARTIAL
CHANNEL WITH NO BUND

MPN Consulting Pty Ltd
20 Sherwood Road, Toowoomba, QLD 4305
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E: solutions@mpn.net.au

5874
DRAWING No. REV
HEC.04 A



LEGEND

DEPTH OF Q100 FLOW				Colour
0.00	to	0.50	m	
0.50	to	1.00	m	
1.00	to	1.50	m	
1.50	to	2.00	m	
2.00	to	2.50	m	
2.50	to	5.00	m	

Q100 WATER DEPTHS

PROPOSED RIPLEY RD UPGRADE, PART CHANNEL & NO BUND

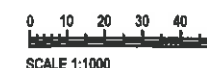
CH 745.63

HECRAS SECTION

EXISTING CULVERT

PROPOSED CULVERT

NOTE:
PROPOSED CULVERT LOCATIONS ARE PROVISIONAL AND
SUBJECT TO AMENDMENT.
REFER TO DRAWING 5874-HEC.10 FOR FLOW DATA.



ISSUED FOR INFORMATION

A	18JUL11	FOR INFORMATION		CS	D
REUSE	DATE	AMENDMENT		BY	AP

RIPLEY VALLEY
RESIDENTIAL DEVELOPMENT
RIPLEY ROAD
IPSWICH

SCALE:	1:1000 @ A1
DESIGN:	CB
DRAWN:	CB
CREATED:	MARCH 2011
CHD:	D.L.
APPRO:	D.P.
DATE:	10.05.11

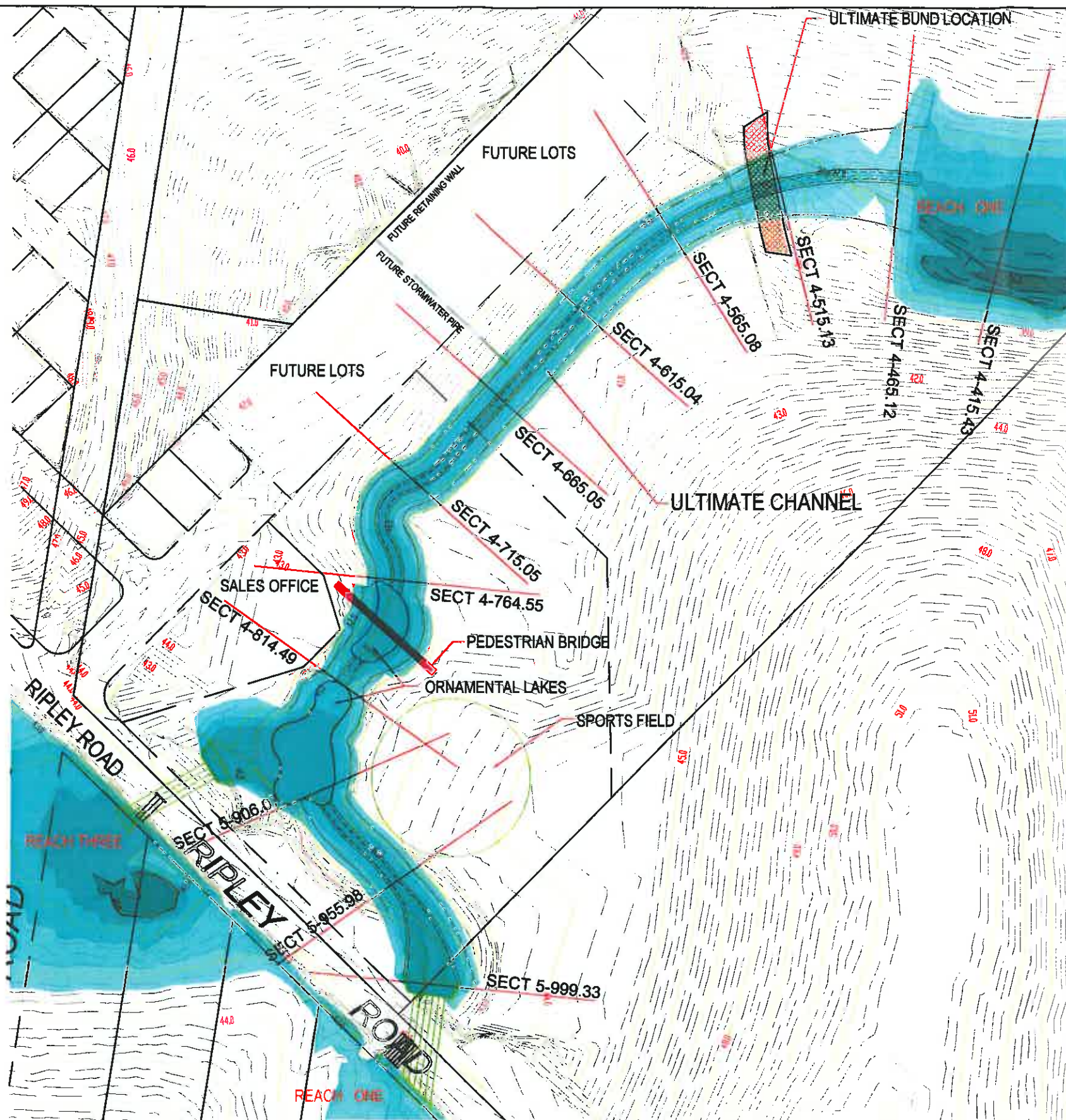
SEKISUI HOUSE
RIPLEY VALLEY
IPSWICH
PARTIAL CHANNEL WITH NO
BUND, PLAN & DETAILS

 **MPN Consulting Pty Ltd**
ABN 39 062 191
36 Sherwood Road, Tooting, Qld 40
P: 01 7 3371 6
F: 01 7 3371 5
E: solutions@mpncn.com

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5874

DESIGN No.	REV
HEC.05	A



LEGEND

DEPTH OF Q100 FLOW				Colour
0.00	to	0.50	m	
0.50	to	1.00	m	
1.00	to	1.50	m	
1.50	to	2.00	m	
2.00	to	2.50	m	
2.50	to	5.00	m	

Q100 WATER DEPTHS
PROPOSED RIPLEY RD UPGRADE, ULTIMATE CHANNEL AND BUND

SECT 4-814.49 WATER LEVEL CROSS SECTION



EXISTING CULVERT

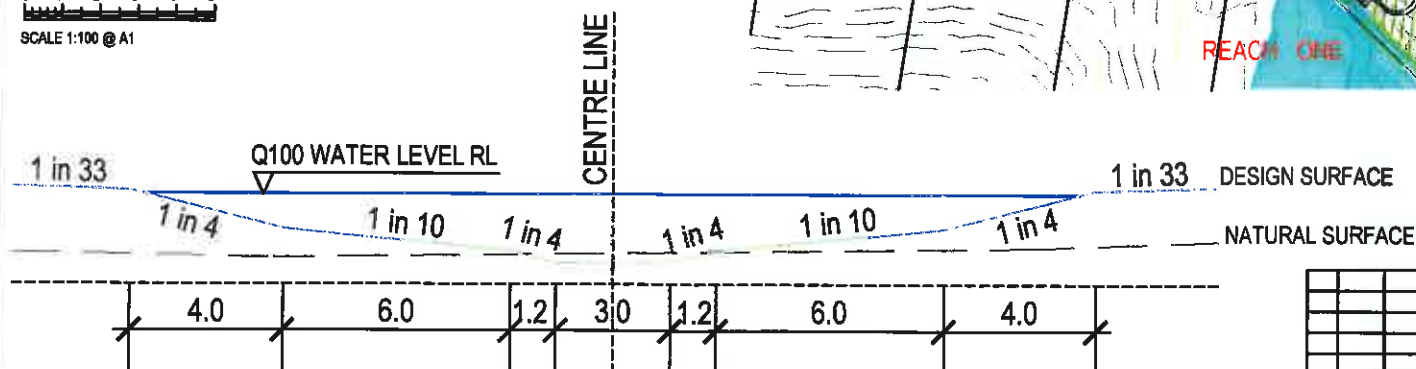


PROPOSED CULVERT

NOTE:
PROPOSED CULVERT LOCATIONS ARE PROVISIONAL AND
SUBJECT TO AMENDMENT.
REFER TO DRAWINGS 5874-HEC.07 & 08 FOR CROSS SECTIONS.
REFER TO DRAWING 5874-HEC.10 FOR FLOW DATA.

TYPICAL CHANNEL CROSS SECTION

0 1 2 3 4 5
SCALE 1:100 @ A1



0 10 20 30 40 50
SCALE 1:1000 @ A1

ISSUED FOR INFORMATION

ISSUE	DATE	AMENDMENT	BY	APP
A	18.03.11	FOR INFORMATION	CB	DL

RIPLEY VALLEY
RESIDENTIAL DEVELOPMENT
RIPLEY ROAD
IPSWICH

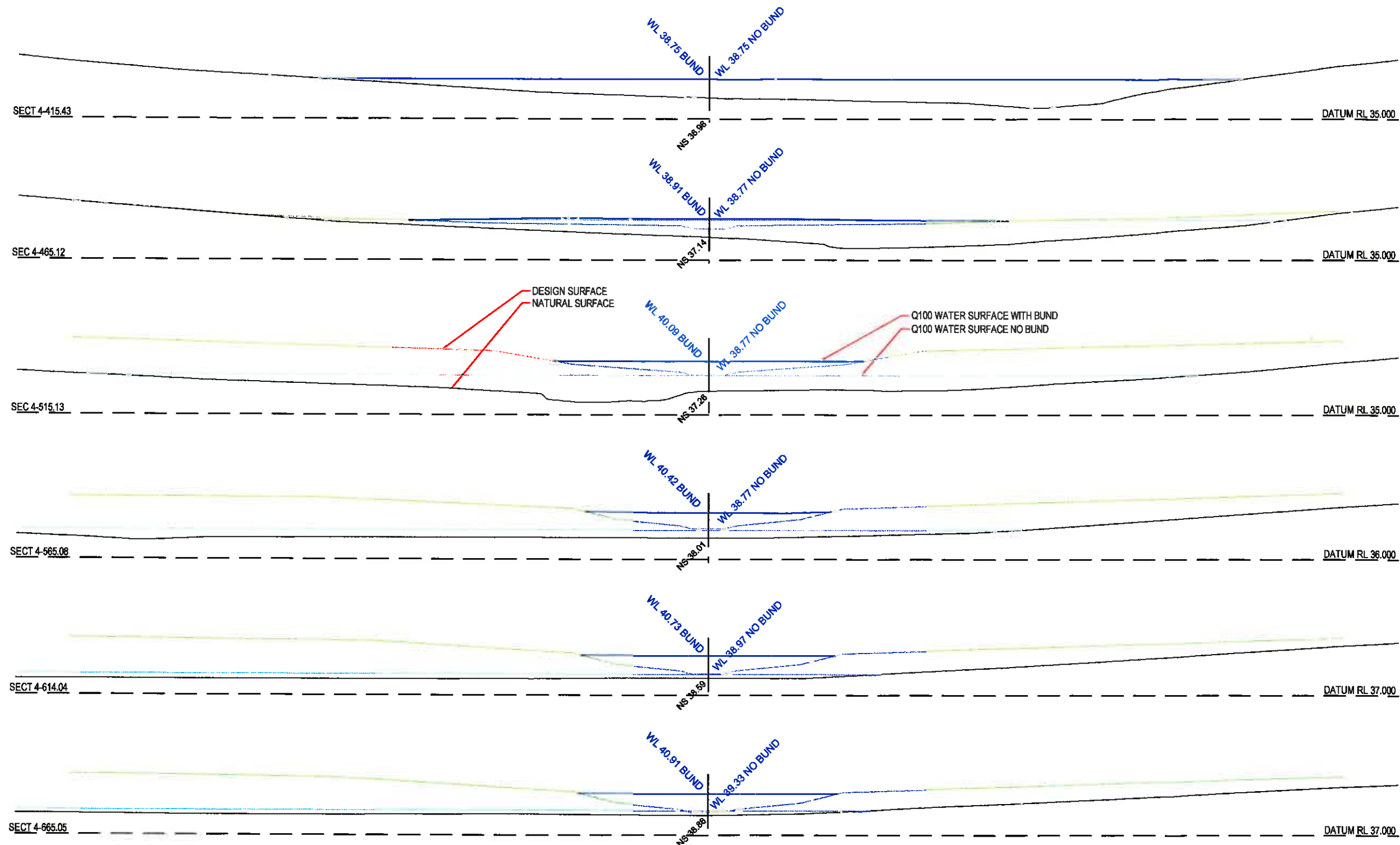
SCALE: AS SHOWN
DESIGN: CB
DRAWN: CB
CREATED: MARCH 2011
CHKD: D.L.
APPRD: D.P.
DATE: 18.03.11

RIPLEY VALLEY
SEKISUI HOUSE
IPSWICH
ULTIMATE CHANNEL WITH BUND
PLAN AND DETAILS

MPN Consulting Pty Ltd
ABN: 28 092 161 798
39 Sherwood Road, Toowoomba, QLD 4368
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E: solutions@mpn.net.au

5874
DRAWING NO.
HEC.06
REV
A

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0 2 4 6 8 10
SCALE 1:200

A	18/03/11	FOR INFORMATION		CS	DL
ISSUE	DATE	AMENDMENT		BY	APP

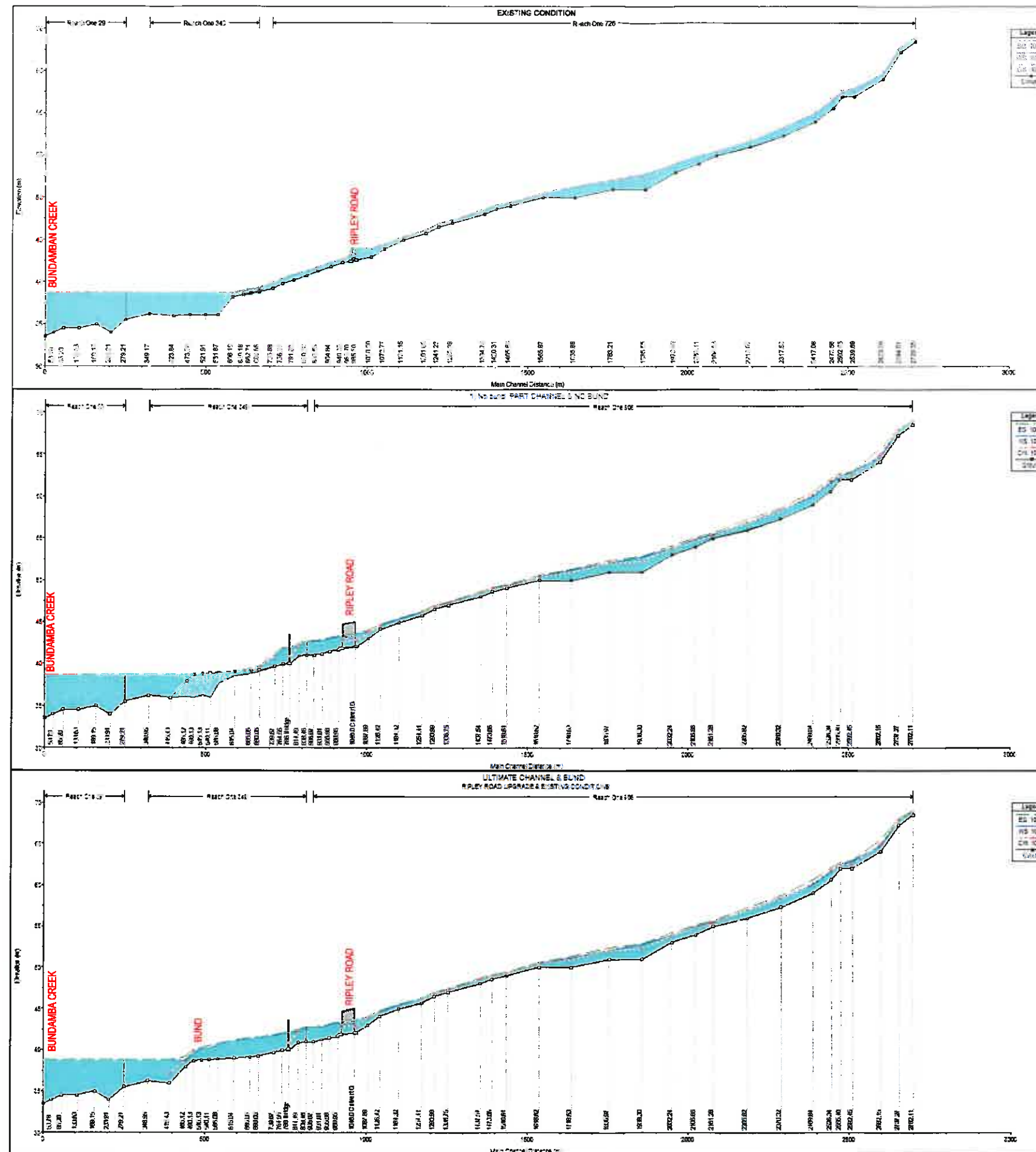
RIPLY VALLEY
RESIDENTIAL DEVELOPMENT
RIPLY ROAD
IPSWICH

SCALE: 1:500 @ A1
DESIGN: CS
DRAWING: CS
CREATED: 18/03/2011
CHD: DL
APPRO: D.P.
DATE: 18/03/11

RIPLY VALLEY
RESIDENTIAL DEVELOPMENT
IPSWICH
Q100 FLOW ULTIMATE CHANNEL
CROSS SECTIONS, SHT 2 OF 2

MPN Consulting Pty Ltd
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5874
DRAWING NO.
HEC.08
REV
A



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REV	DATE	DESCRIPTION	BY	APP
B	12/04/11	LONGITUDINAL SECTIONS UPDATED	CB	DL
A	16/03/11	FOR INFORMATION	CB	DL
		AMENDMENT	BY	APP

RIPLEY VALLEY
RESIDENTIAL DEVELOPMENT
RIPLEY ROAD
IPSWICH

SCALE:	N.T.S.
DESIGN:	CB
DRAWN:	CB
CREATED:	MARCH 2011
CHECK:	DL
APPROV:	D.P.
DATE:	16/03/11

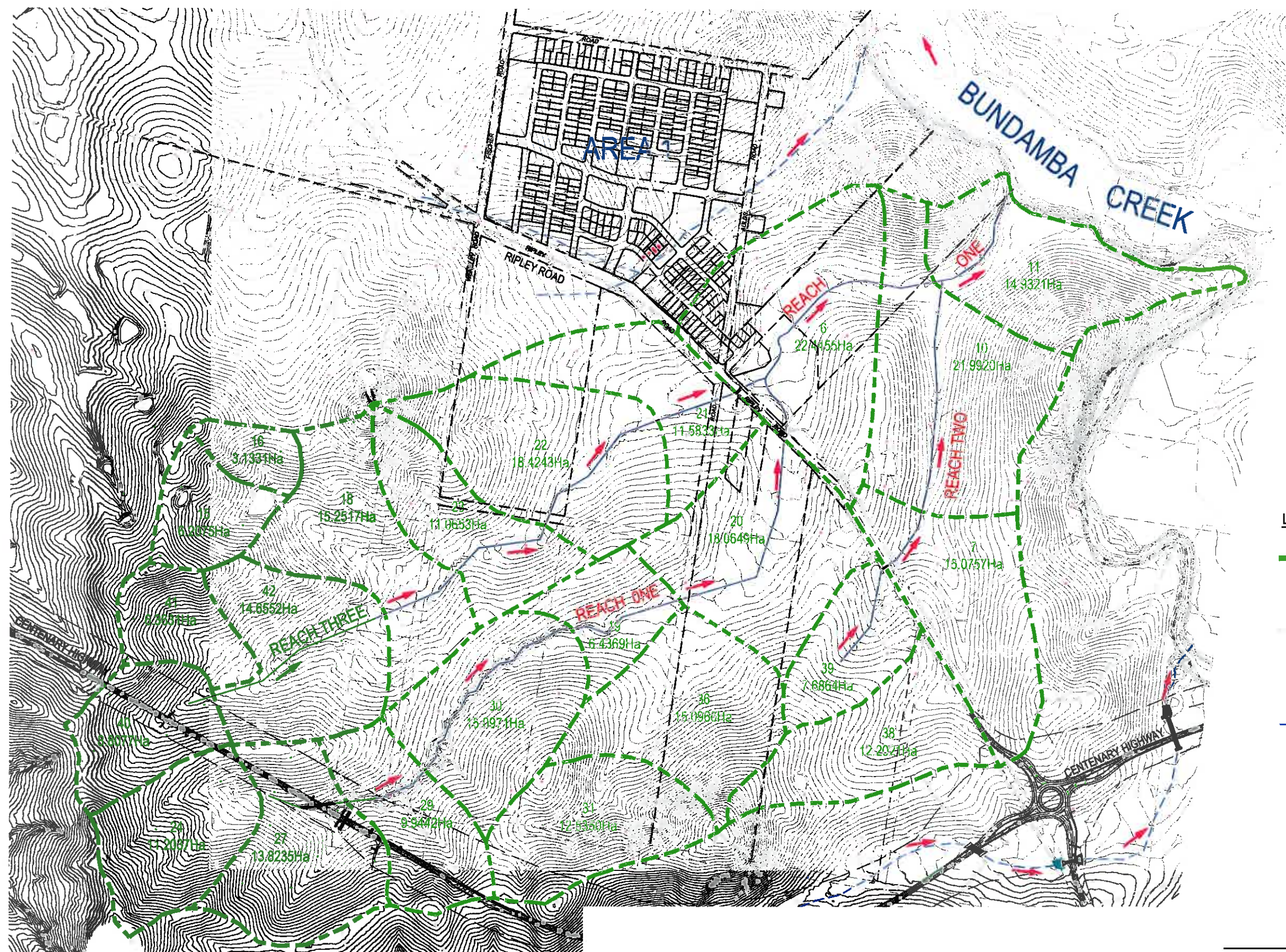
RIPLEY VALLEY
RESIDENTIAL DEVELOPMENT
RIPLEY ROAD
IPSWICH
LONGITUDINAL SECTIONS
REACH ONE

mpn consulting
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mpn 5874
DRAWING No. HEC.09
REV B

REACH 1 - VELOCITY DEPTH COMPARISON:- ULTIMATE CHANNEL & BUND/PART CHANNEL & NO BUND/UNDEVELOPED FLOW

River	Reach	River Station	ARI Event	Q Total (m³/s)	ULTIMATE CHANNEL & BUND					PART CHANNEL & NO BUND					UNDEVELOPED CONDITION				
					W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	dV	Froude No	W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	dV	Froude No	W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	dV	Froude No
Reach Three	23	193.06	100 yr	18.80	43.25	0.58	0.74	0.43	0.24	43.25	0.58	0.74	0.43	0.24	43.12	0.56	0.61	0.34	0.29
Reach Three	23	193.06	10 yr	7.69	42.77	1.16	0.26	0.30	0.97	42.77	1.18	0.26	0.31	0.99	42.97	0.37	0.46	0.17	0.23
Reach Three	23	193.06	2 yr	3.14	42.67	1.09	0.16	0.17	1.09	42.67	1.03	0.16	0.16	1.01	42.67	1.03	0.16	0.16	1.02
Reach Three	23	193.06	1 yr	2.07	42.63	1.03	0.12	0.12	1.14	42.64	0.94	0.13	0.12	1.01	42.64	0.94	0.13	0.12	1.01
Reach Three	23	117.58	100 yr	18.80	43.25	0.23	1.90	0.44	0.06	43.25	0.23	1.90	0.44	0.06	43.13	0.11	1.78	0.20	0.03
Reach Three	23	117.58	10 yr	7.69	42.35	0.26	1.00	0.26	0.09	42.35	0.26	1.00	0.26	0.09	42.57	0.05	1.62	0.08	0.02
Reach Three	23	117.58	2 yr	3.14	41.99	0.23	0.64	0.15	0.10	41.99	0.23	0.64	0.15	0.10	42.34	0.05	0.99	0.05	0.02
Reach Three	23	117.58	1 yr	2.07	41.80	0.27	0.45	0.12	0.17	41.80	0.27	0.45	0.12	0.17	42.15	0.05	0.80	0.04	0.03
Reach Three	23	88.15	100 yr	18.80	43.25	0.13	2.02	0.26	0.03	43.25	0.13	2.02	0.26	0.03	43.13	0.13	1.67	0.22	0.04
Reach Three	23	88.15	10 yr	7.69	42.35	0.14	1.12	0.16	0.05	42.35	0.14	1.12	0.16	0.05	42.97	0.06	1.51	0.09	0.02
Reach Three	23	88.15	2 yr	3.14	41.99	0.12	0.76	0.09	0.06	41.99	0.12	0.76	0.09	0.06	42.33	0.07	0.87	0.06	0.03
Reach Three	23	88.15	1 yr	2.07	41.79	0.16	0.56	0.09	0.10	41.79	0.16	0.56	0.09	0.10	42.15	0.07	0.69	0.05	0.04
Reach Three	23	35.13	100 yr	18.80	42.75	0.39	1.64	0.64	0.11	42.75	0.39	1.64	0.64	0.11	41.80	1.42	0.52	0.74	1.03
Reach Three	23	35.13	10 yr	7.69	42.26	0.25	1.15	0.29	0.08	42.26	0.25	1.15	0.29	0.08	41.68	1.20	0.40	0.48	1.04
Reach Three	23	35.13	2 yr	3.14	41.96	0.14	0.85	0.12	0.05	41.96	0.14	0.85	0.12	0.05	41.59	1.07	0.31	0.33	1.02
Reach Three	23	35.13	1 yr	2.07	41.77	0.13	0.66	0.09	0.05	41.77	0.13	0.66	0.09	0.05	41.53	1.09	0.25	0.27	0.97
Reach Three	23	22.53	100 yr	18.80	42.75	0.33	1.72	0.57	0.09	42.74	0.33	1.71	0.56	0.09	40.94	1.60	0.33	0.53	1.15
Reach Three	23	22.53	10 yr	7.69	42.26	0.21	1.23	0.26	0.07	42.26	0.21	1.23	0.26	0.07	40.85	1.14	0.24	0.27	0.99
Reach Three	23	22.53	2 yr	3.14	41.96	0.12	0.93	0.11	0.04	41.96	0.12	0.93	0.11	0.04	40.77	0.92	0.16	0.15	0.96
Reach Three	23	22.53	1 yr	2.07	41.77	0.10	0.74	0.07	0.04	41.77	0.10	0.74	0.07	0.04	40.75	0.83	0.14	0.12	0.94
Reach One	906	1126.42	100 yr	28.60	44.59	2.01	0.49	0.98	0.98	44.59	2.00	0.49	0.98	0.98	44.47	1.56	0.56	0.87	1.01
Reach One	906	1126.42	10 yr	15.00	44.48	1.54	0.38	0.59	0.88	44.46	1.61	0.36	0.58	0.94	44.37	1.32	0.46	0.61	1.04
Reach One	906	1126.42	2 yr	6.95	44.37	1.20	0.27	0.32	0.86	44.37	1.19	0.27	0.32	0.85	44.30	1.06	0.39	0.41	1.04
Reach One	906	1126.42	1 yr	4.10	44.32	1.01	0.22	0.22	0.83	44.32	0.99	0.22	0.22	0.82	44.30	0.85	0.39	0.25	0.64
Reach One	906	1087.89	100 yr	28.60	43.85	2.07	0.85	1.76	1.11	43.85	2.06	0.85	1.75	1.11	44.09	0.71	1.09	0.77	0.34
Reach One	906	1087.89	10 yr	15.00	43.79	1.68	0.73	1.23	1.10	43.74	1.60	0.74	1.18	1.03	44.01	0.45	1.01	0.45	0.27
Reach One	906	1087.89	2 yr	6.95	43.65	1.23	0.65	0.80	0.99	43.65	1.24	0.65	0.81	1.00	43.90	0.29	0.90	0.26	0.17
Reach One	906	1087.89	1 yr	4.10	43.59	1.10	0.59	0.65	0.95	43.59	1.12	0.59	0.66	0.97	43.58	1.03	0.58	0.60	1.03
Reach One	906	1052.58	100 yr	28.60	43.67	0.64	1.63	1.04	0.24	43.67	0.64	1.63	1.04	0.25	44.09	0.26	1.42	0.37	0.10
Reach One	906	1052.58	10 yr	15.00	43.00	0.96	0.96	0.92	0.35	43.00	0.96	0.96	0.92	0.35	44.01	0.16	1.34	0.21	0.06
Reach One	906	1052.58	2 yr	6.95	42.61	0.83	0.57	0.47	0.37	42.61	0.83	0.57	0.47	0.38	43.90	0.09	1.23	0.11	0.04
Reach One	906	1052.58	1 yr	4.10	42.41	0.79	0.37	0.29	0.43	42.41	0.79	0.37	0.29	0.43	43.60	0.10	0.93	0.09	0.05
Reach One	906	1046	100 yr	28.60	43.30	0.69	1.48	1.02	0.20	43.30	0.69	1.48	1.02	0.20	43.15	1.55	0.65	1.01	1.00
Reach One	906	999.33	10 yr	15.00	42.89	0.53	1.07	0.57	0.18	42.89	0.53	1.07	0.57	0.18	43.06	1.30	0.56	0.73	1.01
Reach One	906	999.33	2 yr	6.95	42.55	0.39	0.73	0.28	0.16	42.55	0.39	0.73	0.28	0.16	42.93	1.30	0.43	0.56	0.91
Reach One	906	999.33	1 yr	4.10	42.37	0.32	0.55	0.18	0.15	42.37	0.32	0.55	0.18	0.15	42.83	1.23	0.33	0.41	0.76
Reach One	906	980.95	100 yr	28.60	43.27	0.83	1.60	1.33	0.25	43.27	0.83	1.60	1.33	0.25	42.72	1.25	0.38	0.48	0.84
Reach One	906	980.95	10 yr	15.00	42.87	0.64	1.20	0.77	0.22	42.87	0.65	1.20	0.78	0.22	42.64	1.02	0.30	0.31	0.84
Reach One	906	980.95	2 yr	6.95	42.54	0.46	0.87	0.40	0.19	42.54	0.46	0.87	0.40	0.19	42.58	0.77	0.24	0.18	0.79
Reach One	906	980.95	1 yr	4.10	42.35	0.37	0.68	0.25	0.16	42.35	0.37	0.68	0.25	0.16	42.55	0.66	0.21	0.14	0.79
Reach One	906	955.98	100 yr	28.60	43.08	1.24	1.63	2.02	0.40	43.08	1.25	1.63	2.04	0.40	42.31	1.23	0.44	0.54	0.72
Reach One	906	955.98	10 yr	15.00	42.71	1.01	1.26	1.27	0.38	42.70	1.02	1.25	1.28	0.38	42.22	0.96	0.35	0.34	0.68
Reach One	906	955.98	2 yr	6.95	42.41	0.76	0.96	0.73	0.34	42.41	0.76	0.96	0.73	0.34	42.14	0.72	0.27	0.19	0.64
Reach One	906	955.98	1 yr	4.10	42.25	0.64	0.80	0.51	0.32	42.25	0.64	0.80	0.51	0.32	42.09	0.61	0.22	0.13	0.61
Reach One	906	931.01	100 yr	28.60	42.78	1.34	1.56	2.09	0.44	42.78	1.34	1.56	2.09	0.44	41.77	1.61	0.42	0.68	0.96
Reach One	906	931.01	10 yr	15.00	42.31	1.29	1.09	1.41	0.53	42.31	1.29	1.09	1.41	0.53	41.66	1.32	0.31	0.41	0.96
Reach One	906	931.01	2 yr	6.95	42.00	1.12	0.78	0.87	0.56	42.00	1.12	0.78	0.87	0.56	41.58	1.00	0.23	0.30	0.90
Reach One	906	931.01	1 yr	4.10	41.80	1.15	0.58	0.67	0.64	41.80	1.15	0.58	0.67	0.65	41.55	0.82	0.20	0.16	0.86
Reach One	906	906.07	100 yr	28.60	42.74	0.61	1.74	1.06	0.17	42.74	0.61	1.74	1.06	0.17	41.32	1.42	0.47	0.67	0.79
Reach One	906	906.07	10 yr	15.00	42.26	0.49	1.26	0.62	0.16	42.26	0.49	1.26	0.62	0.16	41.21	1.10	0.36	0.40	0.72
Reach One	906	906.07	2 yr	6.95	41.97	0.33	0.97	0.32	0.12	41.97	0.33	0.97	0.32	0.12	41.11	0.83	0.26	0.22	0.68
Reach One	906	906.07	1 yr	4.10	41.77	0.26	0.77	0.20	0.11	41.78	0.26	0.78	0.20	0.11	41.06	0.70	0.21	0.15	0.65
Reach One	349	838.46	100 yr	39.90	42.71	0.58	1.71	0.99	0.17	42.70	0.58	1.70	0.99	0.17	40.89	1.46	0.57	0.83	0.79
Reach One	349	838.46	10 yr	18.30	42.23	0.44	1.23	0.54	0.16	42.23	0.44	1.23	0.54	0.16	40.74	1.26	0.42	0.53	0.81
Reach One	349	838.46	2 yr	9.67	41.94	0.35	0.94	0.33	0.14	41.94	0.35	0.94	0.33	0.14	40.61	1.09	0.29	0.32	0.83
Reach One	349	838.46	1 yr	5.81	41.75	0.29	0.75	0.22	0.13	41.75	0.29	0.75	0.22	0.13	40.55	0.93	0.23	0.21	0.81
Reach One	349	814.49	100 yr	39.90	42.18	2.71	1.25	3.39	1.01	42.19	2.68	1.26	3.38	1.00	40.89	1.46	0.57	0.83	0.79
Reach One	349	814.49	10 yr	18.30	41.84	2.19	0.91	1.99	1.01	41.84	2.19	0.91	1.99	1.01	40.74	1.26	0.42	0.53	0.81
Reach One	349	814.49	2 yr	9.67	41.63	1.92	0.70	1.34	1.01	41.63	1.93	0.70	1.35	1.01	40.61	1.09	0.29	0.32	0.83
Reach One	349	814.49	1 yr	5.81	41.49	1.76	0.56	0.99	1.00	41.48	1.77	0.55	0.97	1.01	40.55	0.93	0.23	0.21	0.81
Reach One	349	787.03	100 yr	39.90	42.02	0.73	2.02	1.47	0.19	41.96	0.76	1.96	1.49	0.20	40.89	1.46	0.57	0.83	0.79
Reach One	349	787.03	10 yr	18.30	41.45	0.53	1.45	0.77	0.17	41.44	0.54	1.44	0.78	0.17	40.74	1.26	0.42	0.53	0.81
Reach One	349	787.03	2 yr	9.67	41.10	0.41	1.10	0.45	0.15	41.13	0.40	1.13	0.45	0.14	40.61	1.09	0.29	0.32	0.83
Reach One	349	787.03	1 yr	5.81	40.91	0.32	0.91	0.29	0.13	40.92	0.32	0.92	0.29						



The diagram shows a catchment area with several labeled features:

- CATCHMENT BOUNDARY**: Indicated by a green dashed line at the top.
- CATCHMENT NAME**: The number "18" in black text.
- CATCHMENT AREA**: The value "15.2517Ha" in green text.
- ADJACENT CATCHMENT BODY**: A light blue area to the left of the main catchment.
- ADJACENT CATCHMENT NAME**: The number "19" in black text.
- ADJACENT CATCHMENT AREA**: The value "1.000000Ha" in blue text.
- FLOW DIRECTION**: Indicated by a red arrow pointing right.
- REACH CENTRELINE**: A blue line at the bottom.

0 50 100 200 250
SCALE 1:5000

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				RIPLEY VALLEY RESIDENTIAL DEVELOPMENT RIPLEY ROAD IPSWICH				SEKOSUI HOUSE RIPLEY VALLEY IPSWICH CATCHMENT PLAN FOR Q100 FLOWS				 copyright: THIS DESIGN AND PLANS ARE NOT TO BE USED OR REPRODUCED UNLESS IN WRITING WITHOUT WRITTEN PERMISSION OF MPN CONSULTING PTY LIMITED 2010 ©				 mpn Consulting Pty Ltd 38 Sherwood Road, Tennyson, Qld 4088 P: 61 7 3371 0577 F: 61 7 3371 3198 E: info@mpn.net.au				spn JOB 5874 DRAWING NO. HEC.11				REV A	
A 16.03.11 FOR INFORMATION																									
ISSUE		DATE		AMENDMENT		BY		APP																	

Catchment Name	Area ha	Impervious Portion %	ARI=> Time of Concentration min	Runoff Co-efficient					Intensity					Flows				
				1	2	10	20	100	1	2	10	20	100	1	2	10	20	100
				-	-	-	-	-	mm/hr	mm/hr	mm/hr	mm/hr	mm/hr	cum/s	cum/s	cum/s	cum/s	cum/s
BUND US SWTC	5171.000	0	180.0	0.37	0.39	0.46	0.49	0.56	15.0	19.5	29.6	34.9	47.9	79.74	110.70	197.61	244.08	382.71
Cat 1	14.248	0	14.6	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	1.08	1.49	2.58	3.16	4.87
Cat 10	21.992	0	14.6	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	1.66	2.29	3.98	4.87	7.51
Cat 11	14.932	0	14.4	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	1.13	1.56	2.70	3.31	5.10
Cat 12	15.374	0	18.8	0.37	0.39	0.46	0.49	0.56	65.0	84.5	125.1	146.1	197.5	1.03	1.42	2.48	3.04	4.70
Cat 13	6.511	0	15.6	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	0.48	0.66	1.14	1.40	2.16
Cat 14	8.275	0	16.4	0.37	0.39	0.46	0.49	0.56	68.9	89.5	132.2	154.3	208.4	0.59	0.81	1.41	1.73	2.67
Cat 15	6.208	0	15.1	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	0.46	0.63	1.09	1.33	2.06
Cat 16	3.133	0	15.1	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	0.23	0.32	0.55	0.67	1.04
Cat 17	28.934	0	15.1	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	2.12	2.92	5.08	6.22	9.60
Cat 18	15.252	0	14.4	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	1.15	1.59	2.76	3.38	5.21
Cat 19	6.437	0	16.0	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	0.47	0.65	1.13	1.38	2.13
Cat 2	8.043	0	16.4	0.37	0.39	0.46	0.49	0.56	68.9	89.5	132.2	154.3	208.4	0.57	0.79	1.37	1.68	2.59
Cat 20	18.065	0	16.4	0.37	0.39	0.46	0.49	0.56	68.9	89.5	132.2	154.3	208.4	1.28	1.77	3.08	3.77	5.82
Cat 21	11.583	0	17.3	0.37	0.39	0.46	0.49	0.56	66.9	86.9	128.5	150.1	202.8	0.80	1.10	1.92	2.35	3.63
Cat 22	18.424	0	13.2	0.37	0.39	0.46	0.49	0.56	75.8	98.3	144.8	168.9	227.7	1.44	1.98	3.44	4.21	6.49
Cat 23	11.065	0	13.2	0.37	0.39	0.46	0.49	0.56	75.8	98.3	144.8	168.9	227.7	0.87	1.19	2.07	2.53	3.90
Cat 24	11.204	0	14.8	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	0.85	1.17	2.03	2.48	3.83
Cat 25	13.702	0	15.6	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	1.00	1.38	2.40	2.95	4.54
Cat 26	11.135	0	14.8	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	0.84	1.16	2.01	2.47	3.80
Cat 27	13.824	0	14.8	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	1.05	1.44	2.50	3.06	4.72
Cat 28	10.334	0	15.3	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	0.76	1.04	1.81	2.22	3.43
Cat 29	9.944	0	14.6	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	0.75	1.04	1.80	2.20	3.40
Cat 30	15.097	0	15.6	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	1.11	1.53	2.65	3.25	5.01
Cat 31	12.535	0	15.1	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	0.92	1.27	2.20	2.69	4.16
Cat 32	10.517	0	14.4	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	0.80	1.10	1.90	2.33	3.59
CAT 33	7.829	0	14.8	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	0.59	0.82	1.42	1.73	2.67
CAT 34	1.840	0	15.3	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	0.13	0.19	0.32	0.40	0.61
Cat 35	17.009	0	14.6	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	1.29	1.77	3.08	3.77	5.81
Cat 36	15.097	0	13.0	0.37	0.39	0.46	0.49	0.56	75.8	98.3	144.8	168.9	227.7	1.18	1.63	2.82	3.45	5.32
Cat 37	15.251	0	13.0	0.37	0.39	0.46	0.49	0.56	75.8	98.3	144.8	168.9	227.7	1.19	1.64	2.85	3.49	5.37
Cat 38	12.202	0	13.5	0.37	0.39	0.46	0.49	0.56	75.8	98.3	144.8	168.9	227.7	0.95	1.31	2.28	2.79	4.30
Cat 39	7.686	0	16.8	0.37	0.39	0.46	0.49	0.56	68.9	89.5	132.2	154.3	208.4	0.55	0.75	1.31	1.61	2.48
Cat 40	8.808	0	15.1	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	0.65	0.89	1.55	1.89	2.92
Cat 41	6.363	0	14.6	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	0.48	0.66	1.15	1.41	2.17
Cat 42	14.655	0	14.8	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	1.11	1.53	2.65	3.25	5.01
Cat 4e	3.140	0	17.3	0.37	0.39	0.46	0.49	0.56	66.9	86.9	128.5	150.1	202.8	0.22	0.30	0.52	0.64	0.99
Cat 4W	26.024	1	18.0	0.58	0.61	0.72	0.76	0.86	66.9	86.9	128.5	150.1	202.8	2.79	3.84	6.69	8.20	12.67
Cat 5	13.338	0	16.8	0.37	0.39	0.46	0.49	0.56	68.9	89.5	132.2	154.3	208.4	0.95	1.31	2.27	2.79	4.30
Cat 6	22.446	0	16.4	0.37	0.39	0.46	0.49	0.56	68.9	89.5	132.2	154.3	208.4	1.60	2.20	3.83	4.69	7.24
Cat 7	15.076	0	15.6	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	1.11	1.52	2.65	3.24	5.00
Cat 8	24.360	0	15.8	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	1.79	2.46	4.27	5.24	8.08
Cat 9	18.035	0	14.8	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	1.36	1.88	3.26	3.99	6.16
CAT D2E	2.729	0	14.4	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	0.21	0.28	0.49	0.60	0.93
CAT D2W	4.094	0	15.1	0.37	0.39	0.46	0.49	0.56	71.1	92.2	136.2	158.8	214.4	0.30	0.41	0.72	0.88	1.36
CAT D3E	5.011	0	14.8	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	0.38	0.52	0.91	1.11	1.71
CAT D3W	5.011	0	14.8	0.37	0.39	0.46	0.49	0.56	73.4	95.2	140.3	163.7	220.8	0.38	0.52	0.91	1.11	1.71

CATCHMENT HYDROLOGY TABLE

ISSUED FOR INFORMATION

RIPLEY VALLEY RESIDENTIAL DEVELOPMENT RIPLEY ROAD IPSWICH		SCALE: 1:500 @ A1 DESIGN: CD DRAWN: CD CREATED: MARCH 2011 CHECK: DL APPROVED: DATE:	RIPLEY VALLEY IPSWICH CATCHMENT TABLE UNDEVELOPED FLOWS	MPN Consulting Pty Ltd ABN: 30 082 191 789 39 Shawwood Road, Toowoomba, Qld 4330 P: 81 7 3371 8877 F: 81 7 3371 3158 E: solutions@mpn.net.au	mpn JOB 5874 DRAWING No. HEC.13 REV A



Revision: B
Date Revised: 7/04/2011

AREA 1 TOWN PARK

HEC RAS SUMMARY & RESULTS

RIPLEY ROAD, RIPLEY

BY

MPN CONSULTING PTY LTD

FOR SEKISUI HOUSE

Issue	Revision Description	Date
A	For information	31/03/2011
B	Flows revised & data updated	13/04/2011

Q100 FLOW

Ultimate Channel & Bund

				No tailwater set		Ultimate Channel Tailwater set		Existing Conditions No tailwater set	
River	Reach	River Station	Q Total (m3/s)	Vel Chnl (m/s)	Max Chl Dpth (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	Vel Chnl (m/s)	Max Chl Dpth (m)
Reach One	906	2782.11	4.71	1.68	0.37	1.68	0.37	1.68	0.37
Reach One	906	2737.27	4.71	1.95	0.61	1.95	0.61	1.67	0.65
Reach One	906	2682.15	4.71	3.77	0.67	3.77	0.67	4.49	0.61
Reach One	906	2592.45	13.90	1.06	0.91	1.06	0.91	1.06	0.91
Reach One	906	2555.40	13.90	2.07	0.54	2.07	0.54	2.08	0.54
Reach One	906	2526.34	13.90	3.00	1.03	3.00	1.03	3.01	1.03
Reach One	906	2469.84	13.90	3.29	1.00	3.29	1.00	3.28	1.00
Reach One	906	2370.32	13.90	2.36	1.06	2.36	1.06	2.36	1.06
Reach One	906	2265.82	13.90	2.48	0.91	2.48	0.91	2.47	0.91
Reach One	906	2161.28	13.90	1.52	0.52	1.52	0.52	1.64	0.49
Reach One	906	2105.86	13.90	2.06	0.89	2.06	0.89	1.77	0.98
Reach One	906	2032.24	13.90	2.35	0.88	2.35	0.88	2.51	1.04
Reach One	906	1938.30	13.90	1.40	1.79	1.40	1.79	1.84	1.86
Reach One	906	1835.97	19.40	2.30	1.11	2.30	1.11	1.76	1.10
Reach One	906	1718.63	19.40	1.42	1.22	1.42	1.22	1.18	1.28
Reach One	906	1618.62	19.40	1.70	0.48	1.70	0.48	1.69	0.47
Reach One	906	1518.61	18.90	0.84	0.38	0.84	0.38	1.01	0.42
Reach One	906	1473.06	18.90	1.31	0.42	1.31	0.42	1.07	0.48
Reach One	906	1437.54	18.90	1.80	0.54	1.80	0.54	1.46	0.53
Reach One	906	1336.75	26.00	0.93	0.34	0.93	0.34	0.84	0.35
Reach One	906	1293.99	26.00	1.52	0.40	1.52	0.40	1.41	0.37
Reach One	906	1254.41	26.00	1.70	0.48	1.70	0.48	1.21	0.43
Reach One	906	1184.32	28.60	1.58	0.45	1.58	0.45	1.14	0.39
Reach One	906	1126.42	28.60	2.01	0.49	2.01	0.49	1.56	0.56
Reach One	906	1087.89	28.60	2.07	0.85	2.07	0.85	0.71	1.09
Reach One	906	1052.58	28.60	0.64	1.63	0.64	1.63	0.26	1.42
Reach One	906	1046.00	Culvert						
Reach One	906	999.33	28.60	0.69	1.48	0.69	1.48	1.55	0.65
Reach One	906	980.95	28.60	0.83	1.60	0.83	1.60		
Reach One	906	955.98	28.60	1.24	1.63	1.24	1.63	1.27	0.46
Reach One	906	931.01	28.60	1.34	1.56	1.34	1.56	1.66	0.44
Reach One	906	906.07	28.60	0.61	1.74	0.61	1.74		
Reach One	349	838.46	39.90	0.58	1.71	0.58	1.71	1.48	0.49
Reach One	349	814.49	39.90	2.71	1.25	2.71	1.25	1.85	0.56
Reach One	349	787.03	39.90	0.73	2.02	0.73	2.02		
Reach One	349	786.00	Bridge						
Reach One	349	782.02	39.90	0.66	2.02	0.66	2.02		
Reach One	349	764.55	39.90	1.31	1.94	1.31	1.94		
Reach One	349	739.67	39.90	1.18	2.02	1.18	2.02		
Reach One	349	690.05	39.90	1.01	2.27	1.01	2.27	1.18	0.42
Reach One	349	665.05	39.90	1.03	2.24	1.03	2.24	1.07	0.47
Reach One	349	615.04	39.90	1.14	2.11	1.14	2.11		
Reach One	349 (Bund)	565.08	39.90	1.55	1.75	1.55	1.75	0.40	2.67
Reach One	349	540.11	39.90	2.24	1.40	2.24	1.40		
Reach One	349	515.13	39.90	1.94	1.31	1.94	1.31		
Reach One	349	490.13	39.90	2.22	1.05	2.22	1.05	0.30	2.64
Reach One	349	465.12	39.30	3.39	0.63	3.39	0.63	0.30	2.76
Reach One	349	415.43	39.30	1.23	1.33	0.31	2.76		
Reach One	349	348.95	39.30	1.72	0.63	0.25	2.53	0.22	2.53
Reach One	29	279.21	43.90	1.44	0.79	0.22	3.26	0.22	3.26
Reach One	29	233.91	43.90	0.92	2.28	0.30	4.75	0.30	4.75
Reach One	29	189.15	43.90	0.91	1.25	0.23	3.76	0.23	3.76
Reach One	29	133.63	43.90	0.99	1.68	0.25	4.25	0.25	4.25
Reach One	29	85.20	43.90	1.51	1.55	0.35	4.25	0.35	4.25
Reach One	29	53.78	43.90	2.13	1.83	0.32	4.75	0.32	4.75
Reach One	29	28.77	43.90	3.11	1.81	0.31	5.23	0.31	5.23

River	Reach	River Station	Q Total (m3/s)
Reach One	349	782.02	39.90
Reach One	349	764.55	39.90
Reach One	349	739.67	39.90
Reach One	349	690.05	39.90
Reach One	349	665.05	39.90
Reach One	349	615.04	39.90
Reach One	349	565.08	39.90
Reach One	349	540.11	39.90
Reach One	349	515.13	39.90
Reach One	349	490.13	39.90
Reach One	349	465.12	39.30
Reach One	349	415.43	39.30
Reach One	349	348.95	39.30
Reach One	29	279.21	43.90
Reach One	29	233.91	43.90
Reach One	29	189.15	43.90
Reach One	29	133.63	43.90
Reach One	29	85.20	43.90
Reach One	29	53.78	43.90
Reach One	29	28.77	43.90

"n"	Vel Chnl (m/s)	Max Chl Dpth (m)	dV
	0.66	2.02	1.33
	1.31	1.94	2.54
	1.18	2.02	2.38
	1.01	2.27	2.29
	1.03	2.24	2.31
	1.14	2.11	2.41
	1.55	1.75	2.71
	2.24	1.40	3.14
	1.94	1.31	2.54
	2.22	1.05	2.33
	3.39	0.63	2.14
	0.31	2.76	0.86
	0.25	2.53	0.63
	0.22	3.26	0.72
	0.30	4.75	1.43
	0.23	3.76	0.86
	0.25	4.25	1.06
	0.35	4.25	1.49
	0.32	4.75	1.52
	0.31	5.23	1.62

"n" + 10%	Vel Chnl (m/s)	Max Chl Dpth (m)	dV
	0.64	2.09	1.34
	1.23	2.01	2.47
	1.10	2.09	2.30
	0.95	2.34	2.22
	0.98	2.31	2.26
	1.08	2.17	2.34
	1.49	1.79	2.67
	2.11	1.45	3.06
	1.82	1.36	2.48
	2.22	1.05	2.33
	3.07	0.66	2.03
	0.31	2.76	0.86
	0.25	2.53	0.63
	0.22	3.26	0.72
	0.30	4.76	1.43
	0.23	3.76	0.86
	0.25	4.25	1.06
	0.35	4.25	1.49
	0.32	4.75	1.52
	0.31	5.23	1.62

"n" - 10%	Vel Chnl (m/s)	Max Chl Dpth (m)	dV
	0.69	1.96	1.35
	1.40	1.86	2.60
	1.29	1.94	2.50
	1.07	2.20	2.35
	1.09	2.17	2.37
	1.20	2.05	2.46
	1.61	1.71	2.75
	2.40	1.34	3.22
	2.10	1.26	2.65
	2.22	1.05	2.33
	3.73	0.61	2.28
	0.31	2.76	0.86
	0.25	2.53	0.63
	0.22	3.26	0.72
	0.30	4.75	1.43
	0.23	3.75	0.86
	0.25	4.25	1.06
	0.35	4.25	1.49
	0.32	4.75	1.52
	0.31	5.23	1.62

REACH 1 - VELOCITY DEPTH COMPARISON:- ULTIMATE CHANNEL & BUND/PART CHANNEL & NO BUND/UNDEVELOPED FLOW

River	Reach	River Station	ARI Event	Q Total (m3/s)	ULTIMATE CHANNEL & BUND					PART CHANNEL & NO BUND					UNDEVELOPED CONDITION				
					W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	dV	Froude No	W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	dV	Froude No	W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	dV	Froude No
Reach Three	23	193.06	100 yr	18.80	43.25	0.58	0.74	0.43	0.24	43.25	0.58	0.74	0.43	0.24	43.12	0.56	0.61	0.34	0.29
Reach Three	23	193.06	10 yr	7.69	42.77	1.16	0.26	0.30	0.97	42.77	1.18	0.26	0.31	0.99	42.97	0.37	0.46	0.17	0.23
Reach Three	23	193.06	2 yr	3.14	42.67	1.09	0.16	0.17	1.09	42.67	1.03	0.16	0.16	1.01	42.67	1.03	0.16	0.16	1.02
Reach Three	23	193.06	1 yr	2.07	42.63	1.03	0.12	0.12	1.14	42.64	0.94	0.13	0.12	1.01	42.64	0.94	0.13	0.12	1.01
Reach Three	23	117.58	100 yr	18.80	43.25	0.23	1.90	0.44	0.06	43.25	0.23	1.90	0.44	0.06	43.13	0.11	1.78	0.20	0.03
Reach Three	23	117.58	10 yr	7.69	42.35	0.26	1.00	0.26	0.09	42.35	0.26	1.00	0.26	0.09	42.97	0.05	1.62	0.08	0.02
Reach Three	23	117.58	2 yr	3.14	41.99	0.23	0.64	0.15	0.10	41.99	0.23	0.64	0.15	0.10	42.34	0.05	0.99	0.05	0.02
Reach Three	23	117.58	1 yr	2.07	41.80	0.27	0.45	0.12	0.17	41.80	0.27	0.45	0.12	0.17	42.15	0.05	0.80	0.04	0.03
Reach Three	23	88.15	100 yr	18.80	43.25	0.13	2.02	0.26	0.03	43.25	0.13	2.02	0.26	0.03	43.13	0.13	1.67	0.22	0.04
Reach Three	23	88.15	10 yr	7.69	42.35	0.14	1.12	0.16	0.05	42.35	0.14	1.12	0.16	0.05	42.97	0.06	1.51	0.09	0.02
Reach Three	23	88.15	2 yr	3.14	41.99	0.12	0.76	0.09	0.06	41.99	0.12	0.76	0.09	0.06	42.33	0.07	0.87	0.06	0.03
Reach Three	23	88.15	1 yr	2.07	41.79	0.16	0.56	0.09	0.10	41.79	0.16	0.56	0.09	0.10	42.15	0.07	0.69	0.05	0.04
Reach Three	23	35.13	100 yr	18.80	42.75	0.39	1.64	0.64	0.11	42.75	0.39	1.64	0.64	0.11	41.80	1.42	Culvert	0.74	1.03
Reach Three	23	35.13	10 yr	7.69	42.26	0.25	1.15	0.29	0.08	42.26	0.25	1.15	0.29	0.08	41.68	1.20	0.40	0.48	1.04
Reach Three	23	35.13	2 yr	3.14	41.96	0.14	0.85	0.12	0.05	41.96	0.14	0.85	0.12	0.05	41.59	1.07	0.31	0.33	1.02
Reach Three	23	35.13	1 yr	2.07	41.77	0.13	0.66	0.09	0.05	41.77	0.13	0.66	0.09	0.05	41.53	1.09	0.25	0.27	0.97
Reach Three	23	22.53	100 yr	18.80	42.75	0.33	1.72	0.57	0.09	42.74	0.33	1.71	0.56	0.09	40.94	1.60	0.33	0.53	1.15
Reach Three	23	22.53	10 yr	7.69	42.26	0.21	1.23	0.26	0.07	42.26	0.21	1.23	0.26	0.07	40.85	1.14	0.24	0.27	0.99
Reach Three	23	22.53	2 yr	3.14	41.96	0.12	0.93	0.11	0.04	41.96	0.12	0.93	0.11	0.04	40.77	0.92	0.16	0.15	0.96
Reach Three	23	22.53	1 yr	2.07	41.77	0.10	0.74	0.07	0.04	41.77	0.10	0.74	0.07	0.04	40.75	0.83	0.14	0.12	0.94
Reach One	906	1126.42	100 yr	28.60	44.59	2.01	0.49	0.98	0.98	44.59	2.00	0.49	0.98	0.98	44.47	1.56	0.56	0.87	1.01
Reach One	906	1126.42	10 yr	15.00	44.48	1.54	0.38	0.59	0.88	44.46	1.61	0.36	0.58	0.94	44.37	1.32	0.46	0.61	1.04
Reach One	906	1126.42	2 yr	6.95	44.37	1.20	0.27	0.32	0.86	44.37	1.19	0.27	0.32	0.85	44.30	1.06	0.39	0.41	1.04
Reach One	906	1126.42	1 yr	4.10	44.32	1.01	0.22	0.22	0.83	44.32	0.99	0.22	0.22	0.82	44.30	0.65	0.39	0.25	0.64
Reach One	906	1087.89	100 yr	28.60	43.85	2.07	0.85	1.76	1.11	43.85	2.06	0.85	1.75	1.11	44.09	0.71	1.09	0.77	0.34
Reach One	906	1087.89	10 yr	15.00	43.73	1.68	0.73	1.23	1.10	43.74	1.60	0.74	1.18	1.03	44.01	0.45	1.01	0.45	0.24
Reach One	906	1087.89	2 yr	6.95	43.65	1.23	0.65	0.80	0.99	43.65	1.24	0.65	0.81	1.00	43.90	0.29	0.90	0.26	0.17
Reach One	906	1087.89	1 yr	4.10	43.59	1.10	0.59	0.65	0.95	43.59	1.12	0.59	0.66	0.97	43.58	1.03	0.58	0.60	1.03
Reach One	906	1052.58	100 yr	28.60	43.67	0.64	1.63	1.04	0.24	43.67	0.64	1.63	1.04	0.25	44.09	0.26	1.42	0.37	0.10
Reach One	906	1052.58	10 yr	15.00	43.00	0.96	0.96	0.92	0.35	43.00	0.96	0.96	0.92	0.35	44.01	0.16	1.34	0.21	0.06
Reach One	906	1052.58	2 yr	6.95	42.61	0.83	0.57	0.47	0.37	42.61	0.83	0.57	0.47	0.38	43.90	0.09	1.23	0.11	0.04
Reach One	906	1052.58	1 yr	4.10	42.41	0.79	0.37	0.29	0.43	42.41	0.79	0.37	0.29	0.43	43.60	0.10	0.93	0.09	0.05
Reach One	906	1046	100 yr	28.60	43.30	0.69	1.48	1.02	0.20	43.30	0.69	1.48	1.02	0.20	43.15	1.55	Culvert	1.01	1.00
Reach One	906	999.33	100 yr	15.00	42.89	0.53	1.07	0.57	0.18	42.89	0.53	1.07	0.57	0.18	43.06	1.30	0.56	0.73	1.01
Reach One	906	999.33	10 yr	6.95	42.55	0.39	0.73	0.28	0.16	42.55	0.39	0.73	0.28	0.16	42.93	1.30	0.43	0.56	0.91
Reach One	906	999.33	1 yr	4.10	42.37	0.32	0.55	0.18	0.15	42.37	0.32	0.55	0.18	0.15	42.83	1.23	0.33	0.41	0.76
Reach One	906	980.95	100 yr	28.60	43.27	0.83	1.60	1.33	0.25	43.27	0.83	1.60	1.33	0.25	42.72	1.25	0.38	0.48	0.84
Reach One	906	980.95	10 yr	15.00	42.87	0.64	1.20	0.77	0.22	42.87	0.65	1.20	0.78	0.22	42.64	1.02	0.30	0.31	0.84
Reach One	906	980.95	2 yr	6.95	42.54	0.46	0.87	0.40	0.18	42.54	0.46	0.87	0.40	0.19	42.58	0.77	0.24	0.18	0.79
Reach One	906	980.95	1 yr	4.10	42.35	0.37	0.68	0.25	0.16	42.35	0.37	0.68	0.25	0.16	42.55	0.66	0.21	0.14	0.79

ULTIMATE CHANNEL & BUND					PART CHANNEL & NO BUND					UNDEVELOPED CONDITION				
River	Reach	River Station	ARI Event	Q Total (m3/s)	W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	dV	Froude No	W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	dV	Froude No
Reach One	906	955.98	100 yr	28.60	43.08	1.24	1.63	2.02	0.40	43.08	1.25	1.63	2.04	0.40
	906	955.98	10 yr	15.00	42.71	1.01	1.26	1.27	0.38	42.70	1.02	1.25	1.28	0.38
	906	955.98	2 yr	6.95	42.41	0.76	0.96	0.73	0.34	42.41	0.76	0.96	0.73	0.34
	906	955.98	1 yr	4.10	42.25	0.64	0.80	0.51	0.32	42.25	0.64	0.80	0.51	0.32
Reach One	906	931.01	100 yr	28.60	42.78	1.34	1.56	2.09	0.44	42.78	1.34	1.56	2.09	0.44
	906	931.01	10 yr	15.00	42.31	1.29	1.09	1.41	0.53	42.31	1.29	1.09	1.41	0.53
	906	931.01	2 yr	6.95	42.00	1.12	0.78	0.87	0.56	42.00	1.12	0.78	0.87	0.56
	906	931.01	1 yr	4.10	41.80	1.15	0.58	0.67	0.64	41.80	1.15	0.58	0.67	0.65
Reach One	906	906.07	100 yr	28.60	42.74	0.61	1.74	1.06	0.17	42.74	0.61	1.74	1.06	0.17
	906	906.07	10 yr	15.00	42.26	0.49	1.26	0.62	0.16	42.26	0.49	1.26	0.62	0.16
	906	906.07	2 yr	6.95	41.97	0.33	0.97	0.32	0.12	41.97	0.33	0.97	0.32	0.12
	906	906.07	1 yr	4.10	41.77	0.26	0.77	0.20	0.11	41.78	0.26	0.78	0.20	0.11
Reach One	349	838.46	100 yr	39.90	42.71	0.58	1.71	0.99	0.17	42.70	0.58	1.70	0.99	0.17
	349	838.46	10 yr	18.30	42.23	0.44	1.23	0.54	0.16	42.23	0.44	1.23	0.54	0.16
	349	838.46	2 yr	9.67	41.94	0.35	0.94	0.33	0.14	41.94	0.35	0.94	0.33	0.14
	349	838.46	1 yr	5.81	41.75	0.29	0.75	0.22	0.13	41.75	0.29	0.75	0.22	0.13
Reach One	349	814.49	100 yr	39.90	42.18	2.71	1.25	3.39	1.01	42.19	2.68	1.26	3.38	1.00
	349	814.49	10 yr	18.30	41.84	2.19	0.91	1.99	1.01	41.84	2.19	0.91	1.99	1.01
	349	814.49	2 yr	9.67	41.63	1.92	0.70	1.34	1.00	41.63	1.93	0.70	1.35	1.01
	349	814.49	1 yr	5.81	41.49	1.76	0.56	0.99	1.00	41.48	1.77	0.55	0.97	1.01
Reach One	349	787.03	100 yr	39.90	42.02	0.73	2.02	1.47	0.19	41.96	0.76	1.96	1.49	0.20
	349	787.03	10 yr	18.30	41.45	0.53	1.45	0.77	0.17	41.44	0.54	1.44	0.78	0.17
	349	787.03	2 yr	9.67	41.10	0.41	1.10	0.45	0.15	41.13	0.40	1.13	0.45	0.14
	349	787.03	1 yr	5.81	40.91	0.32	0.91	0.29	0.13	40.92	0.32	0.92	0.29	0.13
Reach One	349	786					Bridge					Bridge		
	349	782.02	100 yr	39.90	42.02	0.66	2.02	1.33	0.17	41.96	0.69	1.96	1.35	0.18
	349	782.02	10 yr	18.30	41.45	0.48	1.45	0.70	0.15	41.44	0.49	1.44	0.71	0.15
	349	782.02	2 yr	9.67	41.10	0.37	1.10	0.41	0.13	41.13	0.36	1.13	0.41	0.13
Reach One	349	782.02	1 yr	5.81	40.91	0.29	0.91	0.26	0.12	40.92	0.29	0.92	0.27	0.11
	349	764.55	100 yr	39.90	41.90	1.31	1.94	2.54	0.38	41.81	1.42	1.85	2.63	0.43
	349	764.55	10 yr	18.30	41.35	1.04	1.39	1.45	0.37	41.34	1.06	1.38	1.46	0.37
	349	764.55	2 yr	9.67	41.02	0.88	1.06	0.93	0.36	41.05	0.83	1.09	0.90	0.34
Reach One	349	764.55	1 yr	5.81	40.84	0.75	0.88	0.66	0.36	40.85	0.73	0.89	0.65	0.34
	349	739.67	100 yr	39.90	41.72	1.18	2.02	2.38	0.33	40.94	2.71	1.26	3.41	1.01
	349	739.67	10 yr	18.30	41.15	0.98	1.45	1.42	0.34	40.59	2.20	0.91	2.00	1.02
	349	739.67	2 yr	9.67	40.79	0.85	1.09	0.93	0.35	40.38	1.93	0.70	1.35	1.01
Reach One	349	739.67	1 yr	5.81	40.57	0.77	0.87	0.67	0.37	40.32	1.38	0.64	0.88	0.75
	349	690.05	100 yr	39.90	41.49	1.01	2.27	2.29	0.26	39.67	1.17	0.54	0.63	0.60
	349	690.05	10 yr	18.30	40.92	0.75	1.70	1.28	0.23	39.52	0.89	0.39	0.35	0.58
	349	690.05	2 yr	9.67	40.55	0.59	1.33	0.78	0.21	39.43	0.74	0.30	0.22	0.61
Reach One	349	690.05	1 yr	5.81	40.33	0.49	1.11	0.54	0.20	39.37	0.70	0.24	0.17	0.66

River	Reach	River Station	ARI Event	Q Total (m3/s)	ULTIMATE CHANNEL & BUND					PART CHANNEL & NO BUND					UNDEVELOPED CONDITION				
					W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	dV	Froude No	W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	dV	Froude No	W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	dV	Froude No
Reach One	349	665.05	100 yr	39.90	41.39	1.03	2.24	2.31	0.27	39.32	2.21	0.46	1.02	1.10	39.17	1.07	0.47	0.50	0.58
Reach One	349	665.05	10 yr	18.30	40.83	0.76	1.68	1.28	0.24	39.18	1.67	0.32	0.53	1.03	39.00	0.91	0.30	0.27	0.63
Reach One	349	665.05	2 yr	9.67	40.47	0.60	1.32	0.79	0.22	39.12	1.23	0.26	0.32	0.86	38.91	0.79	0.21	0.17	0.66
Reach One	349	665.05	1 yr	5.81	40.25	0.49	1.10	0.54	0.20	39.09	0.94	0.23	0.22	0.72	38.86	0.70	0.16	0.11	0.71
Reach One	349	615.04	100 yr	39.90	41.14	1.14	2.11	2.41	0.31	38.96	1.14	0.46	0.52	0.55					
Reach One	349	615.04	10 yr	18.30	40.61	0.84	1.58	1.33	0.28	38.80	0.83	0.30	0.25	0.51					
Reach One	349	615.04	2 yr	9.67	40.28	0.65	1.25	0.81	0.24	38.70	0.69	0.20	0.14	0.52					
Reach One	349	615.04	1 yr	5.81	40.09	0.53	1.06	0.56	0.22	38.65	0.60	0.15	0.09	0.55					
Reach One	349	565.08	100 yr	39.90	40.65	1.55	1.75	2.71	0.48	38.76	1.59	1.01	1.61	0.53	38.77	0.40	2.67	1.07	0.13
Reach One	349	565.08	10 yr	18.30	40.20	1.16	1.30	1.51	0.42	38.29	2.10	0.54	1.13	1.02	37.66	1.50	1.56	2.34	0.88
Reach One	349	565.08	2 yr	9.67	39.95	0.90	1.05	0.95	0.38	38.20	1.65	0.45	0.74	0.91	37.03	2.74	0.93	2.55	1.17
Reach One	349	565.08	1 yr	5.81	39.78	0.75	0.88	0.66	0.35	38.14	1.34	0.39	0.52	0.81	36.79	2.65	0.69	1.83	1.30
Reach One	349	540.11	100 yr	39.90	40.24	2.24	1.40	3.14	0.78	38.79	0.47	2.79	1.31	0.11					
Reach One	349	540.11	10 yr	18.30	39.96	1.51	1.12	1.69	0.61	37.40	0.97	1.40	1.36	0.35					
Reach One	349	540.11	2 yr	9.67	39.76	1.14	0.92	1.05	0.52	37.12	0.77	1.12	0.86	0.32					
Reach One	349	540.11	1 yr	5.81	39.62	0.95	0.78	0.74	0.47	36.94	0.64	0.94	0.60	0.29					
Reach One	349	515.13	100 yr	39.90	40.09	1.94	1.31	2.54	0.74	38.77	0.86	2.57	2.21	0.17					
Reach One	349	515.13	10 yr	18.30	39.85	1.33	1.07	1.42	0.59	37.25	1.64	1.05	1.72	0.54					
Reach One	349	515.13	2 yr	9.67	39.66	1.05	0.88	0.92	0.52	37.04	1.13	0.84	0.95	0.42					
Reach One	349	515.13	1 yr	5.81	39.53	0.89	0.75	0.67	0.47	36.89	0.84	0.69	0.58	0.35					
Reach One	349	490.13	100 yr	39.90	39.77	2.22	1.05	2.33	1.01	38.76	0.78	2.76	2.15	0.16					
Reach One	349	490.13	10 yr	18.30	39.54	1.83	0.82	1.50	1.01	37.21	1.37	1.21	1.66	0.45					
Reach One	349	490.13	2 yr	9.67	39.37	1.67	0.65	1.09	1.01	37.00	0.97	1.00	0.97	0.36					
Reach One	349	490.13	1 yr	5.81	39.26	1.55	0.54	0.84	1.01	36.86	0.74	0.86	0.64	0.31					
Reach One	349	465.12	100 yr	39.30	38.59	3.39	0.63	2.14	2.24	38.76	0.64	2.65	1.70	0.13	37.51	1.07	1.39	1.49	0.40
Reach One	349	465.12	10 yr	17.50	38.49	2.57	0.53	1.36	2.05	37.19	1.01	1.08	1.09	0.34	37.19	0.80	1.07	0.86	0.33
Reach One	349	465.12	2 yr	9.62	38.43	2.10	0.47	0.99	1.82	36.98	0.74	0.87	0.64	0.28	37.00	0.61	0.88	0.54	0.27
Reach One	349	465.12	1 yr	5.82	38.38	1.82	0.42	0.76	1.65	36.84	0.57	0.73	0.42	0.24	36.88	0.49	0.76	0.37	0.23
Reach One	349	415.43	100 yr	39.30	38.76	0.31	2.76	0.86	0.07	38.75	0.71	2.75	1.95	0.14	37.37	1.19	1.37	1.63	0.47
Reach One	349	415.43	10 yr	17.50	37.04	0.95	1.04	0.99	0.45	37.02	1.52	1.02	1.55	0.55	37.07	0.93	1.07	1.00	0.43
Reach One	349	415.43	2 yr	9.62	36.89	0.75	0.89	0.67	0.39	36.87	1.08	0.87	0.94	0.43	36.92	0.73	0.92	0.67	0.38
Reach One	349	415.43	1 yr	5.82	36.79	0.61	0.79	0.48	0.34	36.77	0.80	0.77	0.62	0.35	36.81	0.60	0.81	0.49	0.33
Reach One	349	348.95	100 yr	39.30	38.76	0.25	2.53	0.63	0.05	38.76	0.31	2.53	0.78	0.06	38.76	0.22	2.53	0.56	0.05
Reach One	349	348.95	10 yr	17.50	36.76	1.00	0.53	0.53	0.55	36.76	1.04	0.53	0.55	0.56	36.77	1.00	0.54	0.54	0.55
Reach One	349	348.95	2 yr	9.62	36.66	0.79	0.43	0.34	0.50	36.66	0.79	0.43	0.34	0.50	36.66	0.78	0.43	0.34	0.50
Reach One	349	348.95	1 yr	5.82	36.59	0.65	0.36	0.23	0.48	36.59	0.65	0.36	0.23	0.47	36.59	0.64	0.36	0.23	0.47
Reach One	29	279.21	100 yr	43.90	38.76	0.22	3.26	0.72	0.04	38.76	0.22	3.26	0.72	0.04	38.76	0.22	3.26	0.72	0.04
Reach One	29	279.21	10 yr	19.20	35.98	1.51	0.48	0.72	1.01	35.99	1.57	0.49	0.77	1.00	35.98	1.51	0.48	0.72	1.01
Reach One	29	279.21	2 yr	11.10	35.90	1.31	0.40	0.52	0.99	35.90	1.37	0.40	0.55	1.01	35.90	1.34	0.40	0.54	1.02
Reach One	29	279.21	1 yr	6.65	35.84	1.16	0.34	0.39	0.99	35.84	1.20	0.34	0.41	1.03	35.84	1.19	0.34	0.40	1.03
Reach One	29	233.91	100 yr	43.90	38.75	0.30	4.75	1.43	0.05	38.75	0.32	4.75	1.52	0.05	38.75	0.30	4.75	1.43	0.05

River	Reach	River Station	ARI Event	Q Total (m3/s)
Reach One	29	233.91	10 yr	19.20
Reach One	29	233.91	2 yr	11.10
Reach One	29	233.91	1 yr	6.65
Reach One	29	189.15	100 yr	43.90
Reach One	29	189.15	10 yr	19.20
Reach One	29	189.15	2 yr	11.10
Reach One	29	189.15	1 yr	6.65
Reach One	29	133.63	100 yr	43.90
Reach One	29	133.63	10 yr	19.20
Reach One	29	133.63	2 yr	11.10
Reach One	29	133.63	1 yr	6.65
Reach One	29	85.2	100 yr	43.90
Reach One	29	85.2	10 yr	19.20
Reach One	29	85.2	2 yr	11.10
Reach One	29	85.2	1 yr	6.65
Reach One	29	53.78	100 yr	43.90
Reach One	29	53.78	10 yr	19.20
Reach One	29	53.78	2 yr	11.10
Reach One	29	53.78	1 yr	6.65
Reach One	29	28.77	100 yr	43.90
Reach One	29	28.77	10 yr	19.20
Reach One	29	28.77	2 yr	11.10
Reach One	29	28.77	1 yr	6.65

ULTIMATE CHANNEL & BUND				
W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	dV	Froude No
35.77	0.60	1.77	1.06	0.17
35.58	0.42	1.58	0.66	0.13
35.45	0.29	1.45	0.42	0.09
38.75	0.23	3.76	0.86	0.04
35.72	0.82	0.72	0.59	0.36
35.54	0.73	0.54	0.39	0.40
35.41	0.68	0.41	0.28	0.43
38.75	0.25	4.25	1.06	0.04
35.60	0.93	1.10	1.02	0.40
35.36	0.88	0.86	0.76	0.44
35.22	0.78	0.72	0.56	0.42
38.75	0.35	4.25	1.49	0.06
35.43	1.27	0.93	1.18	0.46
35.16	1.14	0.66	0.75	0.51
34.99	1.04	0.49	0.51	0.57
38.75	0.32	4.75	1.52	0.05
35.20	1.87	1.20	2.24	0.68
34.93	1.61	0.93	1.50	0.68
34.74	1.41	0.74	1.04	0.68
38.75	0.31	5.23	1.62	0.05
34.77	2.64	1.25	3.30	1.02
34.54	2.26	1.02	2.31	1.02
34.33	2.08	0.81	1.68	1.02

PART CHANNEL & NO BUND				
W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	dV	Froude No
35.77	0.64	1.77	1.13	0.17
35.58	0.44	1.58	0.70	0.13
35.45	0.30	1.45	0.44	0.09
38.75	0.23	3.75	0.86	0.04
35.73	0.81	0.73	0.59	0.36
35.54	0.73	0.54	0.39	0.40
35.41	0.68	0.41	0.28	0.43
38.75	0.24	4.25	1.02	0.04
35.60	0.92	1.10	1.01	0.40
35.37	0.86	0.87	0.75	0.43
35.22	0.78	0.72	0.56	0.42
38.75	0.28	4.25	1.19	0.05
35.45	1.09	0.95	1.04	0.45
35.18	1.08	0.68	0.73	0.52
34.99	1.04	0.49	0.51	0.57
38.75	0.32	4.75	1.52	0.05
35.19	1.88	1.19	2.24	0.69
34.93	1.62	0.93	1.51	0.68
34.74	1.41	0.74	1.04	0.68
38.75	0.30	5.23	1.57	0.05
34.77	2.61	1.25	3.26	1.00
34.54	2.23	1.02	2.27	1.00
34.33	2.08	0.81	1.68	1.01

UNDEVELOPED CONDITION				
W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	dV	Froude No
35.77	0.60	1.77	1.06	0.17
35.58	0.42	1.58	0.66	0.13
35.45	0.29	1.45	0.42	0.09
38.75	0.23	3.76	0.86	0.04
35.72	0.82	0.72	0.59	0.36
35.54	0.73	0.54	0.39	0.40
35.41	0.68	0.41	0.28	0.43
38.75	0.25	4.25	1.06	0.04
35.60	0.92	1.10	1.01	0.40
35.37	0.88	0.87	0.77	0.44
35.22	0.78	0.72	0.56	0.42
38.75	0.35	4.25	1.49	0.06
35.43	1.27	0.93	1.18	0.46
35.16	1.14	0.66	0.75	0.51
34.99	1.04	0.49	0.51	0.57
38.75	0.32	4.75	1.52	0.05
35.19	1.88	1.19	2.24	0.69
34.93	1.62	0.93	1.51	0.68
34.74	1.42	0.74	1.05	0.69
38.75	0.31	5.23	1.62	0.05
34.77	2.61	1.25	3.26	1.00
34.54	2.23	1.02	2.27	1.00
34.34	2.06	0.82	1.69	1.00

REACHES 1 & 2 - FLOW COMPARISON:- RIPLEY ROAD AT EXISTING LEVELS AND CULVERTS/RIPLEY ROAD AT PROPOSED DESIGN AND NEW CULVERTS

REACH 1

River	Reach	River Station	Alt Event	EXISTING CONDITIONS					RIPLEY RD - DESIGN & CULVERTS				
				W.S. Elev [m]	Vel Chnl [m/s]	Max Chl Depth [m]	Provide No.	Q Total [m³/s]	W.S. Elev [m]	Vel Chnl [m/s]	Max Chl Depth [m]	Provide No.	
Reach One	726	2728.35	100 Yr	68.68	1.68	0.37	1.20	4.71	68.23	1.68	0.37	1.20	
Reach One	726	2728.35	10 Yr	68.61	1.35	0.30	1.14	2.49	68.61	1.35	0.30	1.14	
Reach One	726	2728.35	2 Yr	68.76	1.12	0.25	1.09	1.39	68.76	1.12	0.25	1.09	
Reach One	726	2728.35	1 Yr	68.73	1.01	0.22	1.06	0.96	68.73	1.01	0.22	1.06	
Reach One	726	2694.51	100 Yr	67.87	1.67	0.65	1.02	4.71	67.87	1.67	0.65	1.02	
Reach One	726	2694.51	10 Yr	67.75	1.49	0.53	1.02	2.49	67.75	1.49	0.53	1.02	
Reach One	726	2694.51	2 Yr	67.65	1.34	0.43	1.02	1.39	67.65	1.34	0.43	1.02	
Reach One	726	2694.51	1 Yr	67.60	1.26	0.38	1.02	0.96	67.60	1.26	0.38	1.02	
Reach One	726	2629.39	100 Yr	64.68	4.49	0.61	2.57	4.71	64.68	4.49	0.61	2.57	
Reach One	726	2629.39	10 Yr	64.54	3.99	0.47	2.61	2.49	64.54	3.99	0.47	2.61	
Reach One	726	2629.39	2 Yr	64.44	3.51	0.37	2.60	1.39	64.44	3.51	0.37	2.60	
Reach One	726	2629.39	1 Yr	64.39	3.25	0.32	2.61	0.96	64.39	3.25	0.32	2.61	
Reach One	726	2539.69	100 Yr	62.91	1.06	0.91	0.42	13.90	62.91	1.06	0.91	0.42	
Reach One	726	2539.69	10 Yr	62.64	0.80	0.64	0.36	6.59	62.64	0.80	0.64	0.36	
Reach One	726	2539.69	2 Yr	62.43	0.56	0.48	0.30	2.82	62.43	0.56	0.48	0.30	
Reach One	726	2539.69	1 Yr	62.35	0.48	0.35	0.28	1.93	62.35	0.48	0.35	0.28	
Reach One	726	2502.65	100 Yr	62.54	2.06	0.54	1.01	13.90	62.54	2.06	0.54	1.01	
Reach One	726	2502.65	10 Yr	62.34	1.71	0.34	1.01	6.59	62.34	1.71	0.34	1.01	
Reach One	726	2502.65	2 Yr	62.20	1.34	0.20	1.00	2.82	62.20	1.34	0.20	1.00	
Reach One	726	2502.65	1 Yr	62.16	1.19	0.16	1.00	1.93	62.16	1.19	0.16	1.00	
Reach One	726	2473.58	100 Yr	61.68	3.01	1.03	1.32	13.90	61.68	3.01	1.03	1.32	
Reach One	726	2473.58	10 Yr	61.38	2.72	0.73	1.40	6.59	61.38	2.72	0.73	1.40	
Reach One	726	2473.58	2 Yr	61.16	2.35	0.51	1.45	2.82	61.16	2.35	0.51	1.45	
Reach One	726	2473.58	1 Yr	61.08	2.18	0.43	1.46	1.93	61.08	2.18	0.43	1.46	
Reach One	726	2417.08	100 Yr	60.00	3.28	1.00	1.38	13.90	60.00	3.29	1.00	1.38	
Reach One	726	2417.08	10 Yr	59.74	2.60	0.74	1.25	6.59	59.74	2.60	0.74	1.25	
Reach One	726	2417.08	2 Yr	59.52	2.00	0.52	1.12	2.82	59.52	2.00	0.52	1.12	
Reach One	726	2417.08	1 Yr	59.47	1.59	0.47	0.92	1.93	59.47	1.59	0.47	0.92	
Reach One	726	2317.56	100 Yr	58.39	2.35	1.06	0.93	13.90	58.39	2.36	1.06	0.93	
Reach One	726	2317.56	10 Yr	58.03	2.12	0.70	0.96	6.59	58.03	2.11	0.70	0.97	
Reach One	726	2317.56	2 Yr	57.76	1.79	0.43	1.01	2.82	57.76	1.79	0.43	1.01	
Reach One	726	2317.56	1 Yr	57.67	1.65	0.34	1.00	1.93	57.67	1.65	0.34	1.00	
Reach One	726	2213.07	100 Yr	56.91	2.47	0.91	1.00	13.90	56.91	2.48	0.91	1.01	
Reach One	726	2213.07	10 Yr	56.66	1.85	0.66	0.85	6.59	56.66	1.85	0.66	0.85	
Reach One	726	2213.07	2 Yr	56.47	1.26	0.47	0.67	2.82	56.46	1.27	0.46	0.67	
Reach One	726	2213.07	1 Yr	56.39	1.09	0.39	0.82	1.93	56.39	1.09	0.39	0.82	
Reach One	726	2108.53	100 Yr	55.49	1.64	0.49	0.81	13.90	55.48	1.67	0.48	0.81	
Reach One	726	2108.53	10 Yr	55.28	1.46	0.28	0.92	6.59	55.28	1.45	0.28	0.92	
Reach One	726	2108.53	2 Yr	55.15	1.20	0.15	1.01	2.82	55.15	1.19	0.15	1.00	
Reach One	726	2108.53	1 Yr	55.12	1.06	0.12	1.01	1.93	55.12	1.06	0.12	1.00	
Reach One	726	2053.11	100 Yr	54.98	1.77	0.98	0.71	13.90	54.98	1.78	0.98	0.71	
Reach One	726	2053.11	10 Yr	54.67	1.50	0.67	0.70	6.59	54.67	1.50	0.67	0.71	
Reach One	726	2053.11	2 Yr	54.45	1.12	0.45	0.62	2.82	54.45	1.12	0.45	0.62	
Reach One	726	2053.11	1 Yr	54.37	1.00	0.37	0.60	1.93	54.37	1.00	0.37	0.60	
Reach One	726	1979.48	100 Yr	54.04	2.51	1.04	1.00	13.90	54.04	2.51	1.04	1.00	
Reach One	726	1979.48	10 Yr	53.69	2.12	0.69	1.01	6.59	53.69	2.12	0.69	1.00	
Reach One	726	1979.48	2 Yr	53.48	1.82	0.48	1.01	4.33	53.48	1.82	0.48	1.01	
Reach One	726	1979.48	1 Yr	53.39	1.67	0.39	1.01	3.00	53.39	1.67	0.39	1.01	
Reach One	726	1885.55	100 Yr	52.86	1.84	1.86	0.57	13.90	52.84	1.87	1.84	0.58	
Reach One	726	1885.55	10 Yr	52.45	1.27	1.45	0.44	8.69	52.45	1.27	1.45	0.44	
Reach One	726	1885.55	2 Yr	52.11	0.99	1.11	0.39	4.33	52.11	0.99	1.11	0.39	
Reach One	726	1885.55	1 Yr	51.97	0.86	0.97	0.36	3.00	51.97	0.86	0.97	0.36	

REACH 2

River	Reach	River Station	ARI Event	Q Total (m³/s)	EXISTING CONDITIONS				RIPLEY RD - DESIGN & CULVERTS			
					W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Depth (m)	Provide No.	W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Depth (m)	Provide No.
Reach Two	75	957.41	100 Yr	3.20	54.22	1.15	0.18	1.10	54.22	1.15	0.18	1.10
	75	957.41	10 Yr	1.72	54.17	0.97	0.13	1.05	54.17	0.97	0.13	1.05
	75	957.41	2 Yr	0.95	54.14	0.83	0.10	1.01	54.14	0.83	0.10	1.01
	75	957.41	1 Yr	0.68	54.12	0.76	0.08	1.01	54.12	0.76	0.08	1.01
Reach Two	75	894.62	100 Yr	3.20	50.91	1.92	0.17	1.98	50.91	1.92	0.17	1.98
	75	894.62	10 Yr	1.72	50.87	1.58	0.13	1.91	50.87	1.58	0.13	1.91
	75	894.62	2 Yr	0.95	50.85	1.30	0.11	1.83	50.85	1.30	0.11	1.83
	75	894.62	1 Yr	0.68	50.84	1.14	0.10	1.75	50.84	1.14	0.10	1.75
Reach Two	75	841.06	100 Yr	3.20	49.00	1.07	0.35	0.91	49.00	1.07	0.35	0.91
	75	841.06	10 Yr	1.72	48.93	1.01	0.29	1.05	48.93	1.01	0.29	1.05
	75	841.06	2 Yr	0.95	48.90	0.83	0.26	1.00	48.90	0.83	0.26	1.00
	75	841.06	1 Yr	0.68	48.88	0.76	0.24	1.02	48.88	0.76	0.24	1.02
Reach Two	75	795.11	100 Yr	3.20	47.23	1.90	0.18	1.85	47.23	1.90	0.18	1.85
	75	795.11	10 Yr	1.72	47.21	1.26	0.16	1.34	47.21	1.26	0.16	1.34
	75	795.11	2 Yr	0.95	47.18	1.03	0.13	1.28	47.18	1.03	0.13	1.28
	75	795.11	1 Yr	0.68	47.16	0.88	0.11	1.17	47.16	0.88	0.11	1.17
Reach Two	75	740.39	100 Yr	3.20	47.30	0.13	1.10	0.06	46.67	0.25	1.07	0.10
	75	740.39	10 Yr	1.72	47.24	0.08	1.04	0.03	46.25	0.33	0.65	0.17
	75	740.39	2 Yr	0.95	47.02	0.07	0.82	0.04	46.04	0.35	0.44	0.21
	75	740.39	1 Yr	0.68	46.78	0.09	0.58	0.05	45.95	0.36	0.35	0.24
Reach Two	75	740.00	100 Yr	3.20	44.62	1.04	0.20	1.00	44.68	1.32	0.26	1.01
	75	686.19	10 Yr	1.72	44.57	0.92	0.15	1.00	44.51	0.94	0.19	1.00
	75	686.19	2 Yr	0.95	44.54	0.80	0.12	1.00	44.56	0.98	0.14	1.01
	75	686.19	1 Yr	0.68	44.52	0.75	0.10	1.01	44.54	0.90	0.12	1.01
Reach Two	75	634.03	100 Yr	3.20	43.07	0.69	0.22	0.57	43.07	0.69	0.22	0.57
	75	634.03	10 Yr	1.72	43.01	0.60	0.16	0.61	43.01	0.60	0.16	0.61
	75	634.03	2 Yr	0.95	42.98	0.46	0.13	0.53	42.98	0.46	0.13	0.53
	75	634.03	1 Yr	0.68	42.97	0.40	0.12	0.50	42.97	0.40	0.12	0.50
Reach Two	75	555.92	100 Yr	8.34	41.85	1.59	0.35	1.01	41.85	1.59	0.35	1.01
	75	555.92	10 Yr	3.15	41.70	1.25	0.20	1.01	41.70	1.25	0.20	1.01
	75	555.92	2 Yr	2.38	41.67	1.16	0.17	1.00	41.67	1.16	0.17	1.00
	75	555.92	1 Yr	1.69	41.64	1.07	0.14	1.01	41.64	1.07	0.14	1.01
Reach Two	75	477.47	100 Yr	8.34	40.88	1.25	0.60	0.68	40.88	1.25	0.60	0.68
	75	477.47	10 Yr	3.15	40.74	0.74	0.46	0.45	40.74	0.74	0.46	0.45
	75	477.47	2 Yr	2.38	40.69	0.68	0.41	0.44	40.69	0.68	0.41	0.44
	75	477.47	1 Yr	1.69	40.64	0.62	0.36	0.42	40.64	0.62	0.36	0.42
Reach Two	75	376.03	100 Yr	8.34	40.22	1.07	0.63	0.58	40.22	1.08	0.63	0.58
	75	376.03	10 Yr	3.15	39.90	1.37	0.31	1.01	39.90	1.37	0.31	1.01
	75	376.03	2 Yr	2.38	39.87	1.27	0.28	1.01	39.87	1.27	0.28	1.01
	75	376.03	1 Yr	1.69	39.83	1.17	0.24	1.01	39.83	1.17	0.24	1.01
Reach Two	75	275.50	100 Yr	8.34	39.23	1.37	0.23	0.94	39.23	1.37	0.23	0.94
	75	275.50	10 Yr	3.15	39.27	0.45	0.27	0.39	39.27	0.45	0.27	0.39
	75	275.50	2 Yr	2.38	39.21	0.44	0.21	0.32	39.21	0.44	0.21	0.32
	75	275.50	1 Yr	1.69	39.17	0.39	0.17	0.31	39.17	0.39	0.17	0.31
Reach Two	75	172.47	100 Yr	13.70	38.75	0.86	0.66	0.44	38.75	0.87	0.66	0.44
	75	172.47	10 Yr	7.70	38.46	1.37	0.37	1.02	38.46	1.37	0.37	1.02
	75	172.47	2 Yr	4.67	38.39	1.27	0.30	1.02	38.39	1.27	0.30	1.02
	75	172.47	1 Yr	3.31	38.35	1.18	0.26	1.01	38.35	1.18	0.26	1.01
Reach Two	75	152.01	100 Yr	13.70	38.76	0.39	0.10	0.15	38.76	0.39	0.10	0.15
	75	152.01	10 Yr	7.70	38.03	1.30	0.37	0.70	38.02	1.11	0.36	0.70
	75	152.01	2 Yr	4.67	37.94	0.88	0.28	0.69	37.94	0.87	0.28	0.69
	75	152.01	1 Yr	3.31	37.90	0.87	0.24	0.68	37.90	0.88	0.24	0.68

River	Reach	River Station	ARI Event	EXISTING CONDITIONS				RIPLEY RD - DESIGN & CULVERTS			
				W.S. Elev [m]	Vel Chnl [m/s]	Max Chl Depth [m]	Froude No	W.S. Elev [m]	Vel Chnl [m/s]	Max Chl Depth [m]	Froude No
Reach One	726	1783.21	100 Yr	52.10	1.76	1.10	0.99	52.11	2.29	1.11	0.85
Reach One	726	1783.21	10 Yr	51.70	2.19	0.70	1.01	51.70	2.19	0.70	1.01
Reach One	726	1783.21	2 Yr	51.46	1.91	0.46	1.01	51.46	1.91	0.46	1.01
Reach One	726	1783.21	1 Yr	51.37	1.74	0.37	1.01	51.37	1.74	0.37	1.01
Reach One	726	1665.88	100 Yr	51.30	1.18	1.28	0.52	51.24	1.43	1.22	0.53
Reach One	726	1665.88	10 Yr	51.01	0.94	0.99	0.43	51.00	0.94	0.98	0.43
Reach One	726	1665.88	2 Yr	50.82	0.71	0.80	0.35	50.82	0.71	0.80	0.35
Reach One	726	1665.88	1 Yr	50.73	0.62	0.71	0.33	50.73	0.62	0.71	0.33
Reach One	726	1565.87	100 Yr	50.47	1.69	0.47	1.01	50.47	1.69	0.47	1.01
Reach One	726	1565.87	10 Yr	50.33	1.44	0.33	1.01	50.33	1.44	0.33	1.01
Reach One	726	1565.87	2 Yr	50.24	1.25	0.24	1.01	50.24	1.25	0.24	1.01
Reach One	726	1565.87	1 Yr	50.20	1.15	0.20	1.01	50.20	1.15	0.20	1.01
Reach One	726	1465.86	100 Yr	49.42	1.01	0.42	0.56	49.45	0.93	0.45	0.51
Reach One	726	1465.86	10 Yr	49.30	0.79	0.30	0.48	49.31	0.77	0.31	0.48
Reach One	726	1465.86	2 Yr	49.20	0.61	0.20	0.47	49.20	0.62	0.20	0.48
Reach One	726	1465.86	1 Yr	49.15	0.54	0.15	0.47	49.15	0.54	0.15	0.47
Reach One	726	49.09	100 Yr	49.09	1.07	0.46	0.70	49.08	1.51	0.47	0.80
Reach One	726	49.09	10 Yr	48.99	0.93	0.38	0.67	48.98	1.17	0.37	0.74
Reach One	726	49.09	2 Yr	48.90	0.76	0.29	0.63	48.88	0.89	0.27	0.65
Reach One	726	49.09	1 Yr	48.83	0.75	0.22	0.61	48.83	0.75	0.22	0.61
Reach One	726	48.56	100 Yr	48.56	1.46	0.33	1.01	48.57	1.80	0.54	0.88
Reach One	726	48.56	10 Yr	48.46	1.33	0.43	1.03	48.45	1.47	0.42	0.88
Reach One	726	48.56	2 Yr	48.36	1.17	0.33	1.02	48.36	1.18	0.33	1.02
Reach One	726	48.31	1 Yr	48.31	1.05	0.28	1.00	48.31	1.05	0.28	1.00
Reach One	726	47.35	100 Yr	47.35	0.84	0.35	0.49	47.37	0.79	0.37	0.45
Reach One	726	47.35	10 Yr	47.24	0.66	0.24	0.46	47.25	0.65	0.25	0.44
Reach One	726	47.16	2 Yr	47.16	0.51	0.16	0.44	47.16	0.50	0.16	0.42
Reach One	726	47.12	1 Yr	47.12	0.43	0.12	0.41	47.12	0.43	0.12	0.41
Reach One	726	46.90	100 Yr	46.90	1.41	0.37	1.02	46.92	1.69	0.39	1.13
Reach One	726	46.82	10 Yr	46.82	1.23	0.29	1.01	46.85	1.30	0.32	1.00
Reach One	726	46.73	2 Yr	46.73	0.97	0.22	0.94	46.75	1.14	0.22	1.01
Reach One	726	46.71	1 Yr	46.71	0.89	0.18	1.00	46.71	0.98	0.18	0.97
Reach One	726	46.15	100 Yr	46.15	1.21	0.43	0.83	46.18	1.23	0.46	0.74
Reach One	726	46.07	10 Yr	46.07	1.02	0.35	0.83	46.09	0.96	0.37	0.69
Reach One	726	45.98	2 Yr	45.98	0.91	0.26	0.84	46.01	0.72	0.29	0.61
Reach One	726	45.97	1 Yr	45.97	0.61	0.25	0.59	45.97	0.61	0.25	0.59
Reach One	726	45.33	100 Yr	45.33	1.14	0.39	0.73	45.29	1.39	0.35	0.80
Reach One	726	45.24	10 Yr	45.24	0.93	0.30	0.67	45.20	1.12	0.28	0.86
Reach One	726	45.16	2 Yr	45.16	0.69	0.22	0.60	45.13	0.88	0.19	0.86
Reach One	726	45.09	1 Yr	45.09	0.79	0.15	0.83	45.09	0.79	0.15	0.83
Reach One	726	44.47	100 Yr	44.47	1.56	0.56	1.01	44.51	1.34	0.60	0.80
Reach One	726	44.37	10 Yr	44.37	1.32	0.46	1.04	44.42	1.06	0.50	0.75
Reach One	726	44.30	2 Yr	44.30	1.06	0.39	1.04	44.34	0.77	0.43	0.67
Reach One	726	44.30	1 Yr	44.30	0.65	0.39	0.64	44.30	0.65	0.39	0.64
Reach One	726	44.08	100 Yr	44.08	0.71	1.09	0.34	43.82	1.62	0.42	1.04
Reach One	726	44.01	10 Yr	44.01	0.45	1.01	0.24	43.72	1.36	0.72	1.01
Reach One	726	43.90	2 Yr	43.90	0.29	0.90	0.17	43.63	1.13	0.63	1.04
Reach One	726	43.58	1 Yr	43.58	1.03	0.58	1.03	43.58	1.09	0.58	1.03
Reach One	726	44.09	100 Yr	44.09	0.26	1.42	0.10	43.46	0.81	1.42	0.37
Reach One	726	44.01	10 Yr	44.01	0.16	1.34	0.06	42.93	1.12	0.88	0.40
Reach One	726	985.6	2 Yr	985.6	0.09	1.23	0.04	42.56	0.91	0.52	0.42
Reach One	726	985.6	1 Yr	985.6	0.10	0.93	0.05	42.41	0.78	0.37	0.42
Reach One	726	984	100 Yr	984	1.55	0.65	1.00	New Culvert			
Reach One	726	983.7	10 Yr	983.7	1.30	0.56	1.01				

River	Reach	River Station	ARI Event	Q Total [m³/s]
Reach Two	75	74.83	100 Yr	13.70
Reach Two	75	74.83	10 Yr	7.70
Reach Two	75	74.83	2 Yr	4.67
Reach Two	75	74.83	1 Yr	3.31

REACH 3

EXISTING CONDITIONS					RIPLEY RD - DESIGN & CULVERTS		
W.S. Elev [m]	Vel Chnl [m/s]	Max Chl Depth [m]	Froude No		W.S. Elev [m]	Vel Chnl [m/s]	Froude No
38.76	0.12	2.01	0.03		38.76	0.12	2.01
37.19	1.15	0.44	0.79		37.19	1.14	0.44
37.13	0.96	0.38	0.73		37.13	0.96	0.38
37.08	0.87	0.33	0.71		37.08	0.87	0.33
		Junction				Junction	
		Reach One				Reach One	

W.S. Elev [m]	Vel Chnl [m/s]	Max Chl Depth [m]	Froude No
38.76	0.12	2.01	0.03
37.19	1.14	0.44	0.79
37.13	0.96	0.38	0.73
37.08	0.87	0.33	0.71
		Junction	
		Reach One	

EXISTING CONDITIONS					RIPLEY RD - DESIGN & CULVERTS		
W.S. Elev [m]	Vel Chnl [m/s]	Max Chl Depth [m]	Froude No		W.S. Elev [m]	Vel Chnl [m/s]	Froude No
69.34	1.47	0.32	1.17		69.34	1.47	1.17
69.28	1.27	0.26	1.12		69.28	1.27	1.12
69.22	1.10	0.20	1.08		69.22	1.10	1.08
69.20	1.02	0.18	1.06		69.20	1.02	1.06
67.83	1.40	0.20	1.16		67.82	1.46	1.16
67.79	0.95	0.16	0.85		67.79	0.96	0.85
67.75	0.76	0.12	0.80		67.75	0.76	0.80
67.73	0.67	0.10	0.76		67.73	0.67	0.76
66.77	1.16	0.26	1.00		66.76	1.19	1.00
66.71	0.96	0.20	1.02		66.71	0.99	1.02
66.67	0.89	0.16	1.00		66.67	0.89	1.00
66.65	0.84	0.14	1.01		66.65	0.84	1.01
65.02	1.79	0.23	1.47		65.02	1.76	1.50
64.97	1.34	0.18	1.30		64.97	1.34	1.30
64.93	1.09	0.14	1.24		64.93	1.09	1.24
64.92	0.96	0.13	1.16		64.92	0.96	1.16
61.10	1.15	0.38	0.78		61.09	1.74	1.23
61.08	0.91	0.31	0.91		61.02	1.01	0.90
60.95	0.85	0.23	0.69		60.95	0.85	0.69
60.91	0.77	0.19	0.65		60.91	0.77	0.65
60.25	1.41	0.25	1.01		60.25	1.41	1.01
60.17	1.19	0.17	1.01		60.17	1.19	1.01
60.11	1.00	0.12	1.00		60.11	1.00	1.00
60.09	0.92	0.09	1.01		60.09	0.92	1.01
59.48	1.05	0.45	0.68		59.48	1.10	0.68
59.39	0.85	0.36	0.61		59.39	0.86	0.61
59.32	0.69	0.29	0.55		59.32	0.69	0.55
59.29	0.61	0.26	0.52		59.29	0.61	0.52
58.90	0.99	0.31	0.89		58.88	1.19	0.98
58.83	0.93	0.24	0.90		58.83	0.96	0.90
58.78	0.85	0.19	0.92		58.78	0.85	0.91
58.76	0.79	0.17	0.94		58.76	0.79	0.94
57.80	1.22	0.26	1.01		57.80	1.30	0.99
57.73	1.01	0.19	0.96		57.73	1.02	0.97
57.68	0.83	0.14	0.89		57.68	0.83	0.89
57.65	0.71	0.11	0.83		57.65	0.71	0.83
55.35	1.40	0.37	1.08		55.33	1.70	1.10
55.23	1.24	0.25	1.02		55.23	1.23	1.01
55.17	1.05	0.19	1.00		55.17	1.05	1.00
55.14	0.98	0.16	1.00		55.14	0.98	1.00
53.95	0.89	0.95	0.40		53.95	0.90	0.39
53.69	0.70	0.68	0.36		53.68	0.70	0.36
53.48	0.53	0.48	0.32		53.48	0.53	0.32
53.40	0.45	0.40	0.29		53.40	0.45	0.29
53.55	1.79	0.55	1.88		53.54	1.88	1.01

RIPLEY RD - DESIGN & CULVERTS				
W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Depth (m)	Froude No	
69.34	1.47	0.32	1.17	
69.28	1.27	0.26	1.12	
69.22	1.10	0.20	1.08	
69.20	1.02	0.18	1.06	
67.82	1.46	0.19	1.18	
67.79	0.96	0.16	0.85	
67.75	0.76	0.12	0.80	
67.73	0.67	0.10	0.76	
66.76	1.19	0.25	1.00	
66.71	0.99	0.20	1.02	
66.67	0.89	0.16	1.00	
66.65	0.84	0.14	1.01	
65.02	1.76	0.23	1.50	
64.97	1.34	0.18	1.30	
64.93	1.09	0.14	1.24	
64.92	0.96	0.13	1.16	
61.09	1.74	0.31	1.23	
61.02	1.01	0.30	0.74	
60.95	0.85	0.23	0.69	
60.91	0.77	0.19	0.65	
60.25	1.41	0.25	1.01	
60.17	1.19	0.17	1.01	
60.11	1.00	0.12	1.00	
60.09	0.92	0.09	1.01	
59.48	1.10	0.45	0.66	
59.39	0.86	0.36	0.61	
59.32	0.69	0.29	0.55	
59.29	0.61	0.26	0.52	
58.88	1.19	0.29	0.98	
58.83	0.96	0.24	0.90	
58.78	0.85	0.19	0.91	
58.76	0.79	0.17	0.94	
57.80	1.30	0.26	0.99	
57.73	1.02	0.19	0.97	
57.68	0.83	0.14	0.89	
57.65	0.71	0.11	0.83	
55.33	1.70	0.35	1.10	
55.23	1.23	0.25	1.01	
55.17	1.05	0.19	1.00	
55.14	0.98	0.16	1.00	
53.95	0.90	0.95	0.39	
53.68	0.70	0.68	0.36	
53.48	0.53	0.48	0.32	
53.40	0.45	0.40	0.29	
33.94	1.88	0.54	1.01	

River	Reach	River Station	ARI Event	Q Total (m³/s)	EXISTING CONDITIONS					RIPLEY RD - DESIGN & CULVERTS				
					W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	Froude No		W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Dpth (m)	Froude No	
Reach One	726	963.7	2 Yr	6.95	42.93	1.30	0.43	0.91		53.38	1.33	0.38	0.82	
Reach One	726	963.7	1 Yr	4.10	42.83	1.23	0.33	0.76		53.25	0.99	0.25	0.73	
Reach One	726	940.35	100 Yr	28.60	42.72	1.35	0.38	0.84		53.19	0.85	0.19	0.70	
Reach One	726	940.35	2 Yr	15.00	42.64	1.02	0.30	0.84		52.66	1.68			
Reach One	726	940.35	2 Yr	6.95	42.58	0.77	0.24	0.79		52.53	1.32	0.32	1.01	
Reach One	726	940.35	1 Yr	4.10	42.55	0.68	0.21	0.79		52.44	0.98	0.23	0.95	
Reach One	726	904.84	100 Yr	28.60	42.31	1.23	0.44	0.72		52.41	0.83	0.20	0.90	
Reach One	726	904.84	10 Yr	15.00	42.22	0.86	0.35	0.68		49.45	2.10	0.45	1.29	
Reach One	726	904.84	2 Yr	6.95	42.14	0.72	0.27	0.64		49.34	1.48	0.34	1.06	
Reach One	726	904.84	1 Yr	4.10	42.09	0.61	0.22	0.61		49.22	1.20	0.22	1.01	
Reach One	726	865.58	100 Yr	28.60	41.77	1.61	0.42	0.96		49.17	1.08	0.17	1.00	
Reach One	726	865.58	10 Yr	15.00	41.66	1.32	0.31	0.90		48.04	1.40	0.59	0.99	
Reach One	726	865.58	2 Yr	6.95	41.58	1.00	0.23	0.86		47.88	1.03	0.43	0.65	
Reach One	726	865.58	1 Yr	4.10	41.55	0.82	0.20	0.86		47.75	0.78	0.30	0.60	
Reach One	726	830.78	100 Yr	28.60	41.32	1.42	0.47	0.79		47.70	0.67	0.25	0.56	
Reach One	726	830.78	10 Yr	15.00	41.21	1.10	0.36	0.72		46.68	1.72	0.51	1.00	
Reach One	726	830.78	2 Yr	6.95	41.11	0.83	0.26	0.68		46.53	1.39	0.36	1.01	
Reach One	726	830.78	1 Yr	4.10	41.06	0.70	0.21	0.65		46.41	1.12	0.24	1.01	
Reach One	726	791.83	100 Yr	28.60	40.89	1.46	0.57	0.79		46.37	1.02	0.20	1.01	
Reach One	726	791.83	10 Yr	15.00	40.74	1.26	0.42	0.81		44.89	1.73	0.89	0.82	
Reach One	726	791.83	2 Yr	6.95	40.61	1.09	0.29	0.82		44.67	1.29	0.67	0.71	
Reach One	726	791.83	1 Yr	4.10	40.55	0.93	0.23	0.81		44.48	0.94	0.48	0.61	
Reach One	726	756.37	100 Yr	28.60	40.40	1.79	0.53	0.90		44.40	0.85	0.40	0.60	
Reach One	726	756.37	10 Yr	15.00	40.25	1.46	0.38	0.86		44.24	1.27	0.57	0.64	
Reach One	726	756.37	2 Yr	6.95	40.13	1.11	0.28	0.79		44.09	0.89	0.42	0.56	
Reach One	726	756.37	1 Yr	4.10	40.07	0.91	0.20	0.74		43.97	0.63	0.30	0.50	
Reach One	726	725.68	100 Yr	28.60	39.89	2.03	0.55	1.01		43.91	0.60	0.24	0.48	
Reach One	726	725.68	10 Yr	15.00	39.72	1.71	0.38	1.01		42.87	1.43	0.36	1.01	
Reach One	726	725.68	2 Yr	6.95	39.59	1.38	0.25	1.01		42.77	1.11	0.26	1.02	
Reach One	726	725.68	1 Yr	4.10	39.53	1.17	0.19	1.00		42.67	1.08	0.16	1.02	
Reach One	349	688.66	100 Yr	39.90	39.33	1.18	0.42	0.67		41.73	0.44	0.13	1.01	
Reach One	349	688.66	10 Yr	18.30	39.20	0.88	0.29	0.61		42.76	0.28		0.07	
Reach One	349	688.66	2 Yr	9.67	39.14	0.67	0.23	0.55		42.08	0.23	0.73	0.13	
Reach One	349	688.66	1 Yr	5.81	39.10	0.53	0.19	0.50		41.73	0.44	0.38	0.35	
Reach One	349	662.71	100 Yr	39.90	39.16	1.12	0.46	0.58		41.66	0.49	0.31	0.48	
Reach One	349	662.71	10 Yr	18.30	39.00	0.91	0.30	0.63		42.76	0.19	1.53	0.07	
Reach One	349	662.71	2 Yr	9.67	38.91	0.79	0.21	0.66		42.07	0.29	0.84	0.16	
Reach One	349	662.71	1 Yr	5.81	38.86	0.70	0.16	0.71		41.69	0.38	0.46	0.23	
Reach One	349	639.18	100 Yr	39.90	38.92	1.47	0.42	0.85		41.57	0.42	0.34	0.31	
Reach One	349	639.18	10 Yr	18.30	38.84	0.90	0.34	0.57						
Reach One	349	639.18	2 Yr	9.67	38.75	0.68	0.26	0.49						
Reach One	349	639.18	1 Yr	5.81	38.70	0.56	0.20	0.46						
Reach One	349	606.19	100 Yr	39.90	38.77	0.96	0.56	0.46						
Reach One	349	606.19	10 Yr	18.30	38.46	1.29	0.25	1.00		41.30	1.80	0.46	1.01	
Reach One	349	606.19	2 Yr	9.67	38.40	1.07	0.19	1.01		40.94	1.40	0.30	1.01	
Reach One	349	606.19	1 Yr	5.81	38.36	0.93	0.15	1.01		40.83	1.10	0.19	1.01	
Reach One	349	561.87	100 Yr	39.90	38.77	0.40	2.67	0.13		40.80	0.99	0.16	1.00	
Reach One	349	561.87	10 Yr	18.30	37.66	1.50	1.56	0.88		40.53	1.76	0.36	1.21	
Reach One	349	561.87	2 Yr	9.67	37.03	2.74	0.93	1.17		40.48	0.95	0.31	0.79	
Reach One	349	561.87	1 Yr	5.81	36.79	2.65	0.69	1.30		40.38	0.75	0.21	0.69	
Reach One	349	521.91	100 Yr	39.30	38.77	0.33	2.65	0.10		40.35	0.67	0.18	0.67	
Reach One	349	521.91	10 Yr	17.60	37.29	1.21	1.17	0.66		40.46	1.05	0.56	0.60	
Reach One	349	521.91	2 Yr	9.62	37.04	1.17	0.92	0.46		40.21	1.30	0.31	1.01	
Reach One	349	521.91	1 Yr	5.82	36.90	0.88	0.78	0.36		40.11	1.07	0.21	1.01	
Reach One										40.08	0.97	0.18	1.00	

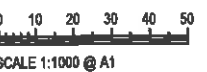
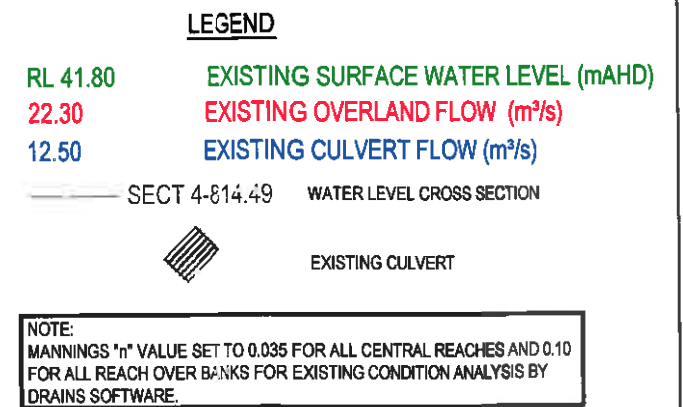
River	Reach	River Station	ARI Event	EXISTING CONDITIONS					RIPLEY RD - DESIGN & CULVERTS				
				W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Depth (m)	Froutde No	Q Total (m3/s)	W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Depth (m)	Froutde No	
Reach One	349	473.7	100 Yr	38.76	0.30	2.64	0.08	38.30	38.76	0.50	2.64	0.10	
Reach One	349	473.7	10 Yr	37.18	0.79	1.06	0.33	17.60	37.15	0.86	1.09	0.32	
Reach One	349	473.7	2 Yr	36.99	0.60	0.87	0.27	9.62	36.99	0.61	0.87	0.26	
Reach One	349	473.7	1 Yr	36.87	0.47	0.75	0.23	5.82	36.86	0.48	0.74	0.22	
Reach One	349	423.84	100 Yr	38.76	0.30	2.76	0.08	38.30	38.76	0.44	2.76	0.09	
Reach One	349	423.84	10 Yr	37.06	0.92	1.06	0.43	17.60	37.05	0.96	1.05	0.43	
Reach One	349	423.84	2 Yr	36.91	0.72	0.91	0.37	9.62	36.91	0.73	0.91	0.37	
Reach One	349	423.84	1 Yr	36.80	0.59	0.80	0.32	5.82	36.80	0.59	0.80	0.32	
Reach One	349	349.17	100 Yr	38.76	0.22	2.53	0.05	38.30	38.76	0.32	2.59	0.07	
Reach One	349	349.17	10 Yr	36.77	1.00	0.54	0.55	17.60	36.76	1.06	0.53	0.56	
Reach One	349	349.17	2 Yr	36.66	0.78	0.43	0.50	9.62	36.66	0.81	0.43	0.50	
Reach One	349	349.17	1 Yr	36.59	0.64	0.36	0.47	5.82	36.59	0.66	0.36	0.47	
Reach One	29	279.21	100 Yr	38.76	0.22	3.26	0.04	43.90	38.76	0.21	3.26	0.04	
Reach One	29	279.21	10 Yr	35.96	1.51	0.48	1.01	15.20	35.96	1.51	0.48	1.01	
Reach One	29	279.21	2 Yr	35.90	1.34	0.40	1.02	11.10	35.90	1.34	0.40	1.02	
Reach One	29	279.21	1 Yr	35.84	1.19	0.34	1.03	6.65	35.84	1.19	0.34	1.03	
Reach One	29	233.91	100 Yr	38.75	0.30	4.75	0.05	43.90	38.75	0.30	4.75	0.05	
Reach One	29	233.91	10 Yr	35.77	0.60	1.77	0.17	15.20	35.77	0.60	1.77	0.17	
Reach One	29	233.91	2 Yr	35.58	0.42	1.38	0.13	11.10	35.58	0.41	1.38	0.12	
Reach One	29	233.91	1 Yr	35.45	0.29	1.45	0.09	6.65	35.45	0.29	1.45	0.09	
Reach One	29	189.15	100 Yr	38.75	0.23	3.76	0.04	43.90	38.75	0.23	3.75	0.04	
Reach One	29	189.15	10 Yr	35.72	0.82	0.72	0.36	15.20	35.72	0.81	0.72	0.36	
Reach One	29	189.15	2 Yr	35.54	0.73	0.54	0.40	11.10	35.54	0.72	0.54	0.40	
Reach One	29	189.15	1 Yr	35.41	0.68	0.41	0.43	6.65	35.41	0.68	0.41	0.43	
Reach One	29	133.63	100 Yr	38.75	0.25	4.25	0.04	43.90	38.75	0.26	4.25	0.04	
Reach One	29	133.63	10 Yr	35.60	0.92	1.10	0.40	15.20	35.60	0.92	1.10	0.39	
Reach One	29	133.63	2 Yr	35.37	0.88	0.87	0.44	11.10	35.37	0.86	0.87	0.43	
Reach One	29	133.63	1 Yr	35.22	0.78	0.72	0.42	6.65	35.22	0.78	0.72	0.42	
Reach One	29	85.2	100 Yr	38.75	0.35	4.25	0.06	43.90	38.75	0.22	4.25	0.04	
Reach One	29	85.2	10 Yr	35.43	1.27	0.93	0.46	15.20	35.46	1.09	0.96	0.45	
Reach One	29	85.2	2 Yr	35.16	1.14	0.66	0.51	11.10	35.18	1.08	0.68	0.52	
Reach One	29	85.2	1 Yr	34.99	1.04	0.49	0.57	6.65	34.99	1.04	0.49	0.57	
Reach One	29	53.78	100 Yr	38.75	0.32	4.75	0.05	43.90	38.75	0.32	4.75	0.05	
Reach One	29	53.78	10 Yr	35.19	1.63	1.19	0.69	15.20	35.19	1.88	1.19	0.69	
Reach One	29	53.78	2 Yr	34.93	1.62	0.93	0.68	11.10	34.93	1.62	0.93	0.68	
Reach One	29	53.78	1 Yr	34.74	1.42	0.74	0.69	6.65	34.74	1.41	0.74	0.68	
Reach One	29	28.77	100 Yr	38.75	0.31	5.23	0.05	43.90	38.75	0.30	5.23	0.05	
Reach One	29	28.77	10 Yr	34.77	2.61	1.25	1.00	15.20	34.77	2.61	1.25	1.00	
Reach One	29	28.77	2 Yr	34.54	2.23	1.02	1.00	11.10	34.54	2.23	1.02	1.00	
Reach One	29	28.77	1 Yr	34.38	2.06	0.82	1.00	6.65	34.33	2.08	0.81	1.01	

River	Reach	River Station	ARI Event	EXISTING CONDITIONS					RIPLEY RD - DESIGN & CULVERTS				
				W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Depth (m)	Froutde No	Q Total (m3/s)	W.S. Elev (m)	Vel Chnl (m/s)	Max Chl Depth (m)	Froutde No	
Reach Three	349	93.90	100 Yr	40.10	0.90	1.10	0.47	18.80	40.13	2.17	1.13	0.72	
Reach Three	349	93.90	10 Yr	39.91	0.65	0.91	0.38	7.69	39.92	1.38	0.92	0.52	
Reach Three	349	93.90	2 Yr	39.78	0.45	0.78	0.30	3.14	39.76	0.82	0.76	0.35	
Reach Three	349	93.90	1 Yr	39.73	0.37	0.73	0.26	2.07	39.71	0.62	0.71	0.28	
Reach Three	349	58.23	100 Yr	39.78	1.41	0.78	1.01	18.80	39.79	1.40	0.79	1.01	
Reach Three	349	58.23	10 Yr	39.70	0.94	0.20	0.79	7.69	39.70	0.94	0.20	0.80	
Reach Three	349	58.23	2 Yr	39.65	0.58	0.15	0.58	3.14	39.65	0.58	0.15	0.58	
Reach Three	349	58.23	1 Yr	39.63	0.48	0.13	0.52	2.07	39.63	0.48	0.13	0.52	
Reach Three	349	43.23	100 Yr	39.61	0.91	0.33	0.63	18.80	39.60	0.97	0.32	0.64	
Reach Three	349	43.23	10 Yr	39.49	0.79	0.21	0.74	7.69	39.48	0.79	0.21	0.74	
Reach Three	349	43.23	2 Yr	39.42	0.75	0.14	0.94	3.14	39.42	0.75	0.14	0.94	
Reach Three	349	43.23	1 Yr	39.39	0.75	0.11	1.03	2.07	39.39	0.75	0.11	1.03	

Q100 FLOW ULTIMATE CHANNEL & BUND
MANNINGS "n" SENSITIVITY CHECK

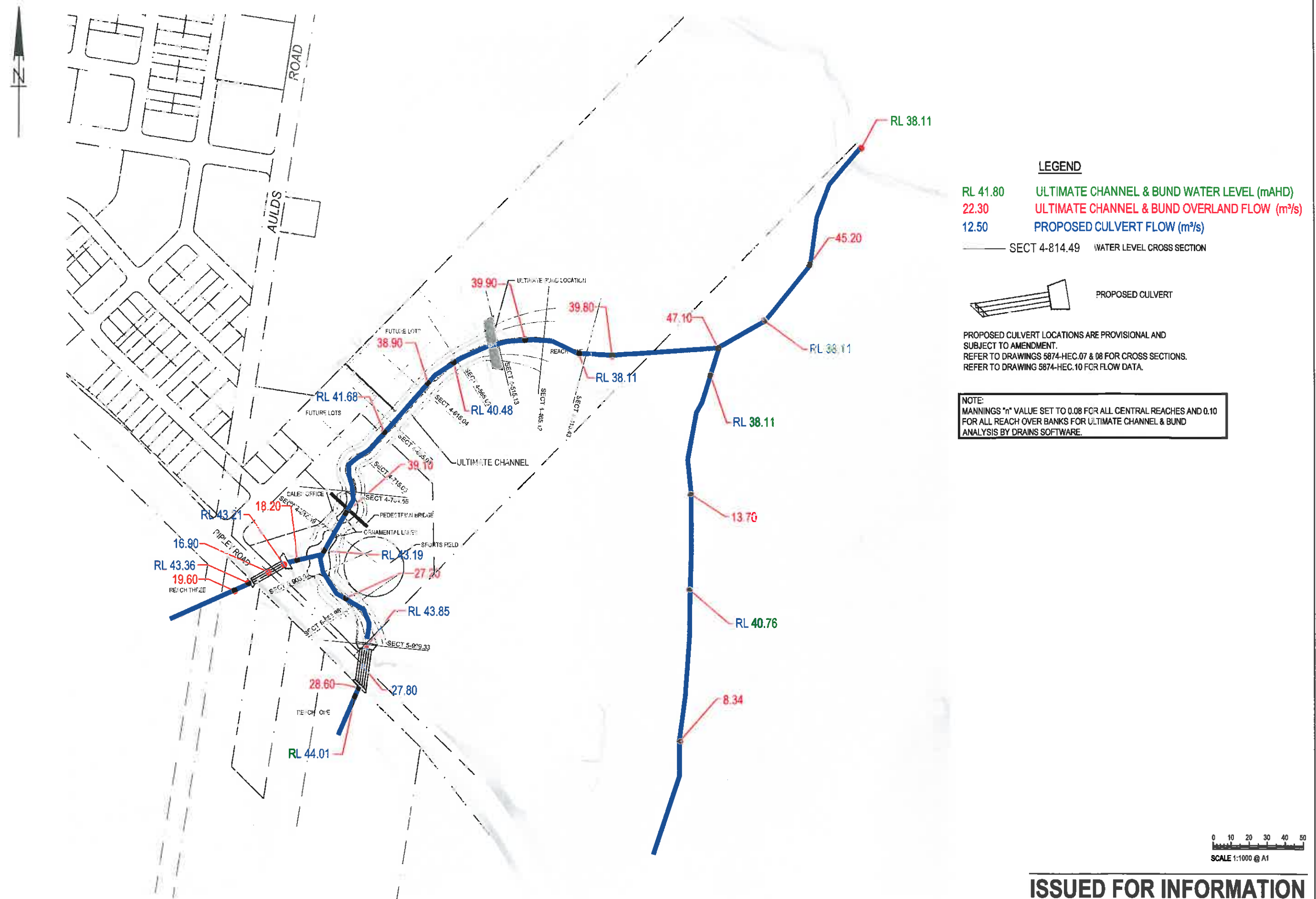
River	Reach	River Station	Q Total (m3/s)	Channel "n" = 0.035				Channel "n" = 0.08				Channel "n" = 0.1			
				W.S. Elev (m)	Vel Chnl (m/s)	Max Chi Dpth (m)	dV	W.S. Elev (m)	Vel Chnl (m/s)	Max Chi Dpth (m)	dV	W.S. Elev (m)	Vel Chnl (m/s)	Max Chi Dpth (m)	dV
Reach One	906	1046	Culvert	42.95	0.95	1.13	1.07	43.30	0.69	1.48	1.02	43.44	0.62	1.62	1.00
Reach One	906	999.33	28.6	42.91	1.17	1.24	1.45	43.27	0.83	1.60	1.33	43.41	0.74	1.74	1.29
Reach One	906	980.95	28.6	42.67	2.02	1.22	2.46	43.08	1.24	1.63	2.02	43.22	1.09	1.77	1.93
Reach One	906	955.98	28.6	42.55	1.76	1.33	2.34	42.78	1.34	1.56	2.09	42.89	1.20	1.67	2.00
Reach One	906	931.01	28.6	42.61	0.88	1.61	1.09	42.74	0.61	1.74	1.06	42.81	0.58	1.81	1.05
Reach One	906	906.07	28.6	42.60	0.63	1.60	1.01	42.71	0.58	1.71	0.99	42.76	0.55	1.76	0.97
Reach One	349	838.46	39.9	42.18	2.71	1.25	3.39	42.18	2.71	1.25	3.39	42.18	2.71	1.25	3.39
Reach One	349	814.49	39.9	41.62	0.99	1.62	1.60	42.02	0.73	2.02	1.47	42.17	0.66	2.17	1.43
Reach One	349	787.03	39.9												
Reach One	349	786.00	Bridge												
Reach One	349	782.02	39.9	41.61	0.90	1.61	1.45	42.02	0.66	2.02	1.33	42.17	0.60	2.17	1.30
Reach One	349	764.55	39.9	41.29	2.43	1.33	3.23	41.90	1.31	1.94	2.54	42.05	1.14	2.09	2.38
Reach One	349	739.67	39.9	41.08	2.31	1.38	3.19	41.72	1.18	2.02	2.38	41.89	0.99	2.19	2.17
Reach One	349	690.05	39.9	40.95	1.57	1.73	2.72	41.49	1.01	2.27	2.29	41.65	0.88	2.43	2.14
Reach One	349	665.05	39.9	40.88	1.58	1.73	2.73	41.39	1.03	2.24	2.31	41.55	0.91	2.40	2.18
Reach One	349	615.04	39.9	40.71	1.66	1.68	2.79	41.14	1.14	2.11	2.41	41.28	1.02	2.25	2.30
Reach One	349	565.08	39.9	40.48	1.83	1.58	2.89	40.65	1.55	1.75	2.71	40.70	1.48	1.80	2.66

ANNEXURE J
Drawing Number 5874-PSK92 and 5874-PSK94
Townpark Downstream Flow Hydrograph at Bundamba Creek Comparison
Of Pre and Post Development Conditions



ISSUED FOR INFORMATION

[illegible]



ISSUED FOR INFORMATION

				RIPLEY VALLEY				SCALE: AS SHOWN								RIPLEY VALLEY															
				RESIDENTIAL DEVELOPMENT				DESIGN: CS				SEKISU HOUSE				IPSWICH				AKR 30002 151 710				30 Sherwood Road, TOWSONG Q4 4068				DRAWING NO.		REV	
				RIPLEY ROAD				DRAWN: CS												P: 61 7 3371 9877				E: solutions@mpn.net.au				PSK94		A	
				IPSWICH				CREATED: MARCH 2011												F: 61 7 3371 3198											
								CHRG: DL																							
								APPRD: D.P.																							
								DATE: 16.05.11																							
A				16.05.11				CS				DL																			
FOR INFORMATION																															
DATE																															
AMENDMENT																															
BY																															
APP																															

Bundamba Creek Hydrographs Pre-and Post Town Park Channelisation

