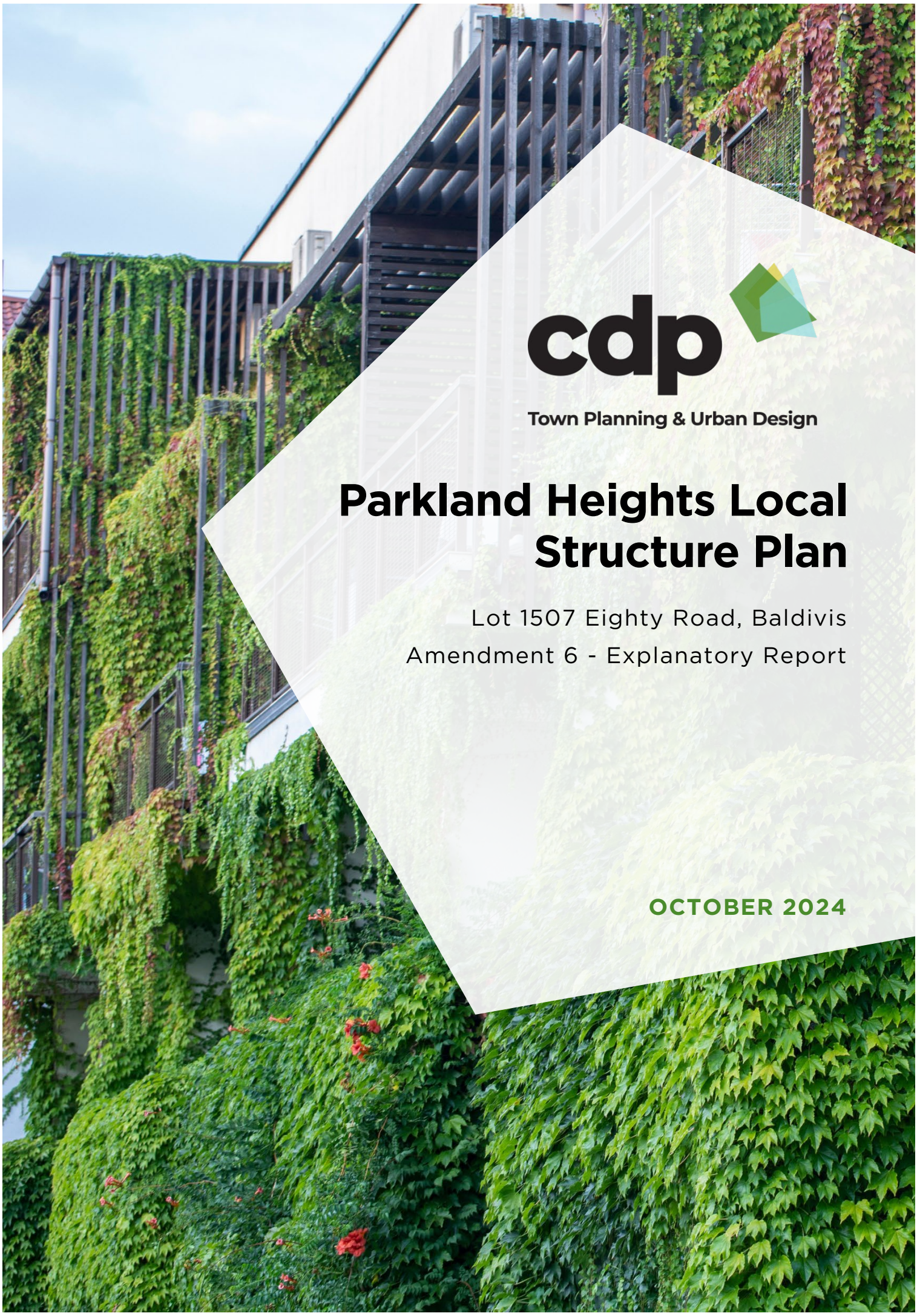


cdp

Town Planning & Urban Design

Parkland Heights Local Structure Plan

Lot 1507 Eighty Road, Baldivis

Amendment 6 - Explanatory Report

OCTOBER 2024

Parkland Heights Local Structure Plan.

AMENDMENT 6 – EXPLANATORY REPORT

OCTOBER 2024

Prepared by. CDP Town Planning & Urban Design
2/464 Murray Street
PERTH WA 6000

p. +61 8 6333 1888
e. info@cdpaus.com.au
w. www.cdpaus.com.au

Prepared for. Rockingham Park Pty Ltd

In Collaboration with.
Transcore
Pritchard Francis
Pentium Water

DOCUMENT STATUS

Version	Comment	Prepared	Reviewed	Issued
1	Lodgement	CH	KB	8/10/2024

Contents.

1 Introduction & Purpose

The purpose of this Amendment to the approved Structure Plan for the Parkland Heights Estate is to update the design of Stage 9, and portions of Stage 10 and 11, and update the layout to reflect approved subdivisions in other stages of previously approved stages.

2 Proposed Amendment

The proposed land-uses, urban structure and general design within Stage 9, and portions of Stage 10 and 11, is generally consistent with structure and land use intent of the approved Structure Plan. The current approved Structure Plan is included at **Figure 1**.

The amendment proposes only the following changes:

- Removal of 8 x R40 grouped housing sites.
- Removal of the majority of the R40 rear loaded laneway product.
- Introduction of additional R30 and R40 single residential lot product.
- Minor re-alignment and re-design of the road structure to respond to the change in lot products.
- Minor re-alignment of lot boundaries within existing cell boundaries.

The proposed Structure Plan is included at **Figure 2**.

Figure 3 shows a comparison of the current LSP to the proposed LSP as per this amendment.

2.1 Dwelling Yield

Across the area subject to this LSP Amendment, the current LSP provides for in the order of 274 dwellings. This is made up of 188 single residential lots and an estimated 86 dwellings within the R40 grouped housing sites. The estimated dwelling yield for the grouped housing sites was calculate using the minimum average lot size for R40 (220m2) and less one dwelling to account for common property and inefficiencies in design.

The proposed LSP Amendment provides for 238 single residential lots (no grouped housing sites) within the area subject to the amendment. Thus, the estimated dwelling yield is reduced by 36 dwellings across the LSP amendment area.

Figure 4 shows the lot and dwelling yield estimates as per the above.

Referencing back to the overall estimate dwelling yield across the estate of 1,580 dwellings pursuant to the structure plan, a reduction by 36 dwellings resulting from this Structure Plan amendment represents only a 2.3% variation the ultimate dwelling yield across the whole estate. In addition, the estimate dwelling yields across the current grouped housing sites are likely to be less than that anticipated by the above calculations given the desired housing product in this area and inevitable design inefficiencies to accommodate access driveways, visitor parking and landscaping. Thus, the reduction in actual dwelling yield resulting from this Structure Plan Amendment is likely to be even less.

LEGEND

ZONES/RESERVES

- RESIDENTIAL R15
- RESIDENTIAL R20
- RESIDENTIAL R25
- RESIDENTIAL R30
- RESIDENTIAL R40
- RESIDENTIAL R60
- COMMERCIAL
- SPECIAL USE
- EDUCATION
- PUBLIC OPEN SPACE

OTHER

- LOCAL STRUCTURE PLAN BOUNDARY
- 400m NEIGHBOURHOOD WALKABLE CATCHMENT
- PUMP STATION ODOUR BUFFER
- POWERLINE EASEMENT
- ROAD WIDENING (SIXTY EIGHT ROAD)
- PLANNED BUS ROUTE
- VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
- SEWER PUMP STATION (900m² - 1220m²)

NOTES

1. The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boundary.
2. The access street and associated lot layout shown on the plan is indicative only and subject to refinement as part of the detailed subdivision process.
3. POS Areas are indicative only and subject to further detailed design and drainage considerations.
4. All road carriageway detail depicted on the Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on the Plan are subject to pre-cal and final survey and may vary from figures shown.
5. Bushfire attack level to be reviewed prior to creation of titles. Development may require construction in accordance with AS3959 - Construction in Bushfire Prone Areas.
6. Sixty-Eight Road widening to accomodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.

LOCAL STRUCTURE PLAN MAP

Lot 1507 Eighty Road, BALDIVIS

A Rockingham Park Project

NORTH

Scale: 1:6000 @ A3

0 60 120 180m

PLAN: RHPPH-2-001 REVISION:
DATE: 20/11/2018 DRAWN: JP
PROJECTION: PCG 94 PLANNER: BK
DATUM: AHD CHECK: TV

Creative DESIGN+PLANNING

A 28 Brown Street, East Perth WA 6004
P (08) 9325 0200
E info@creativedp.com.au
W creativedp.com.au

LEGEND

- AREA SUBJECT TO LSP AMENDMENT

ZONES/RESERVES

- RESIDENTIAL R15
- RESIDENTIAL R20
- RESIDENTIAL R25
- RESIDENTIAL R30
- RESIDENTIAL R40
- RESIDENTIAL R60
- COMMERCIAL
- SPECIAL USE
- EDUCATION
- PUBLIC OPEN SPACE

OTHER

- LOCAL STRUCTURE PLAN BOUNDARY
- 400m NEIGHBOURHOOD WALKABLE CATCHMENT
- PUMP STATION ODOUR BUFFER
- POWERLINE EASEMENT
- ROAD WIDENING (SIXTY EIGHT ROAD)
- PLANNED BUS ROUTE
- VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
- SEWER PUMP STATION (900m² - 1220m²)

NOTES

1. The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boundary.
2. The access street and associated lot layout shown on the plan is indicative only and subject to refinement as part of the detailed subdivision process.
3. POS Areas are indicative only and subject to further detailed design and drainage considerations.
4. All road carriageway detail depicted on the Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on the Plan are subject to pre-cal and final survey and may vary from figures shown.
5. Bushfire attack level to be reviewed prior to creation of titles. Development may require construction in accordance with AS3959 - Construction in Bushfire Prone Areas.
6. Sixty-Eight Road widening to accomodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.

PROPOSED LOCAL STRUCTURE PLAN AMENDMENT

Lot 1507 Eighty Road, BALDIVIS

A Rockingham Park Project

NORTH

Scale: 1:6000 @ A3

0 60 120 180m

PLAN: RHPPH-5-018 REVISION: A

DATE: 24/09/2024 DRAWN: JP

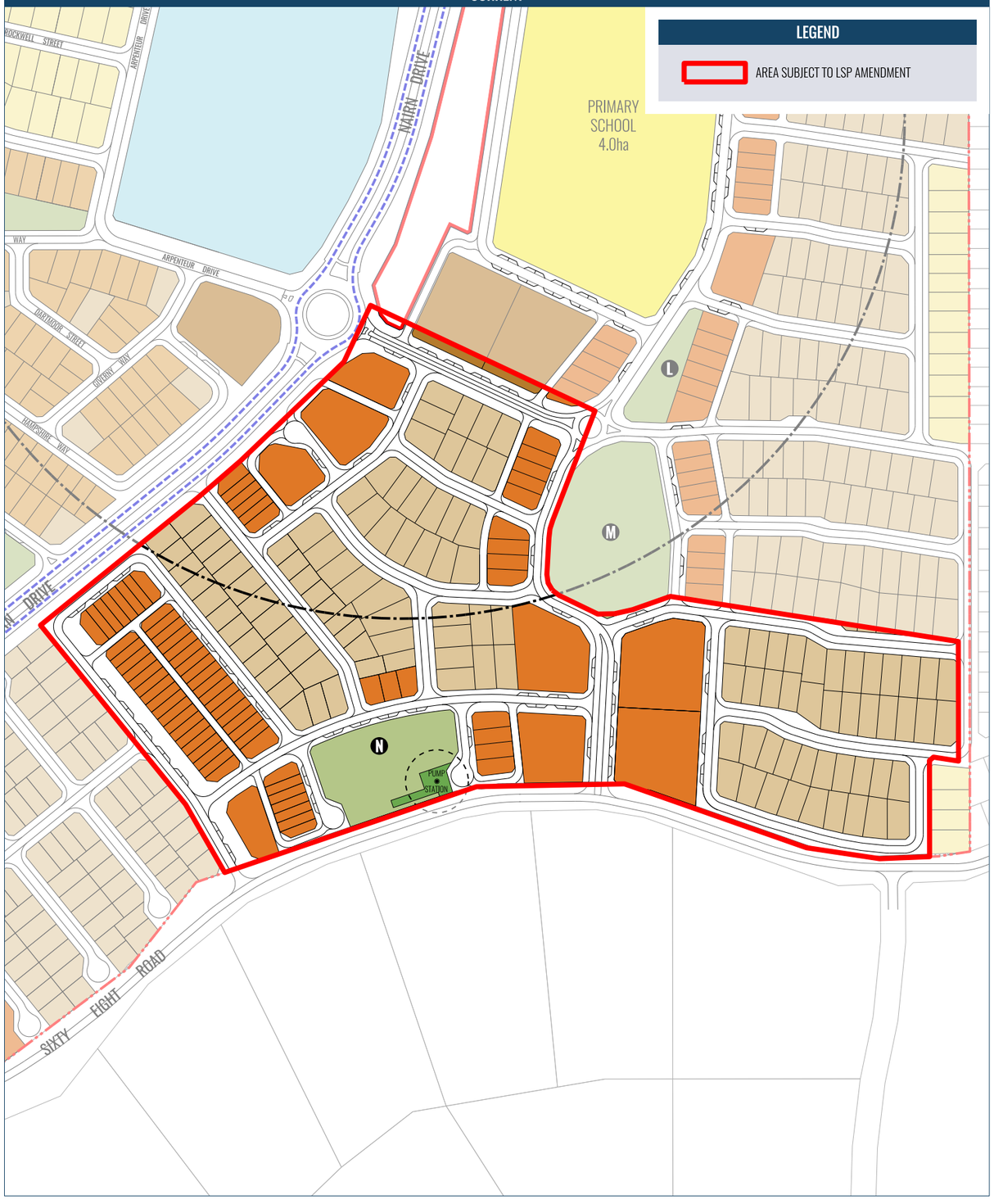
PROJECTION: PCG 94 PLANNER: CH

DATUM: AHD CHECK: KB

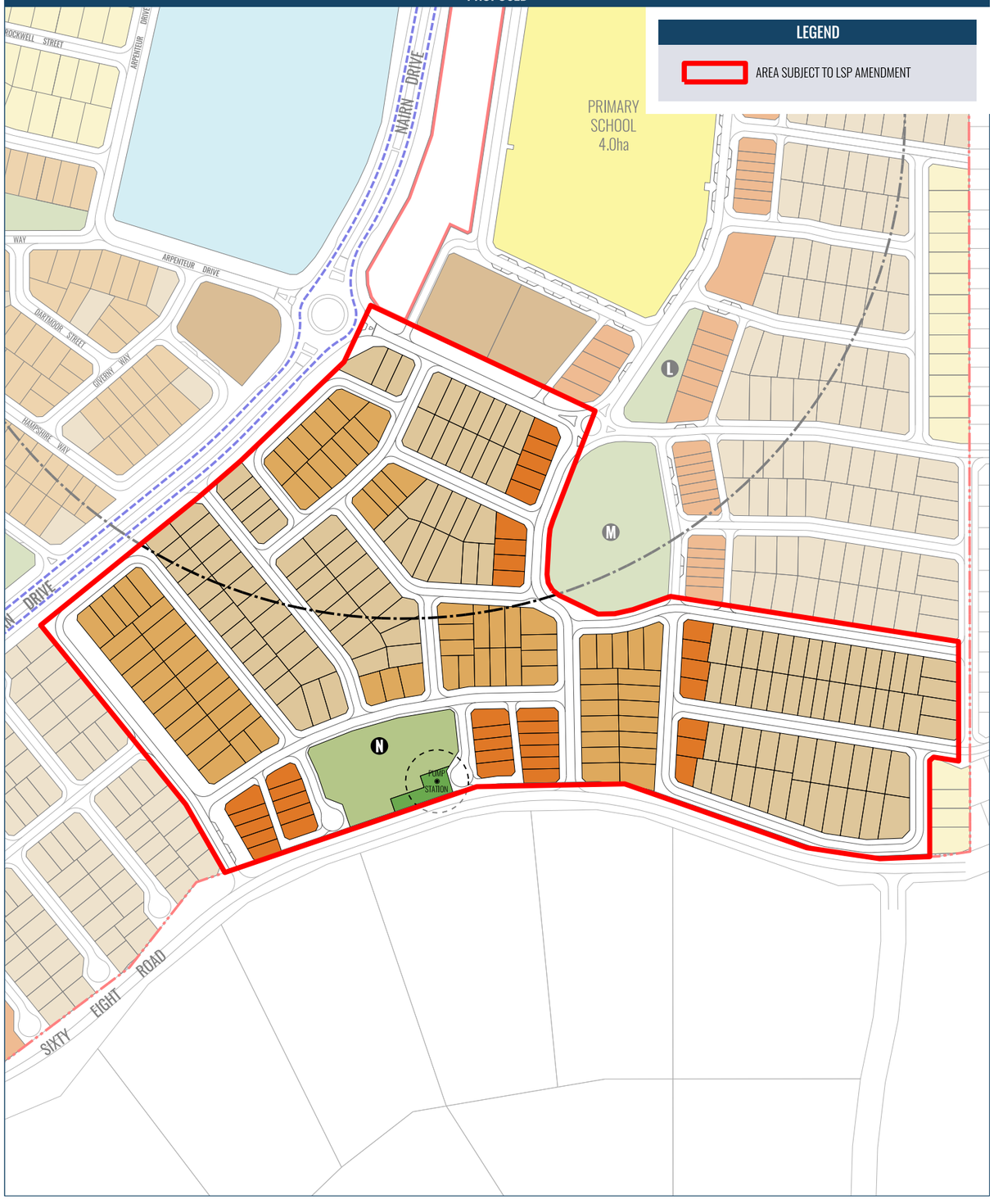
cdp Town Planning & Urban Design

Unit 2, 464 Murray Street
Perth WA 6000
(08) 6333 1888
info@cdpaus.com.au
www.cdpaus.com.au

CURRENT



PROPOSED



LOCAL STRUCTURE PLAN AMENDMENT

Lot 1507 Eighty Road, BALDIVIS

A Rockingham Park Project

NORTH

Scale: 1:4000 @ A3

0 40 80 120m

PLAN: RHPPH-5-018 REVISION:

DATE: 10/07/2024 DRAWN: JP

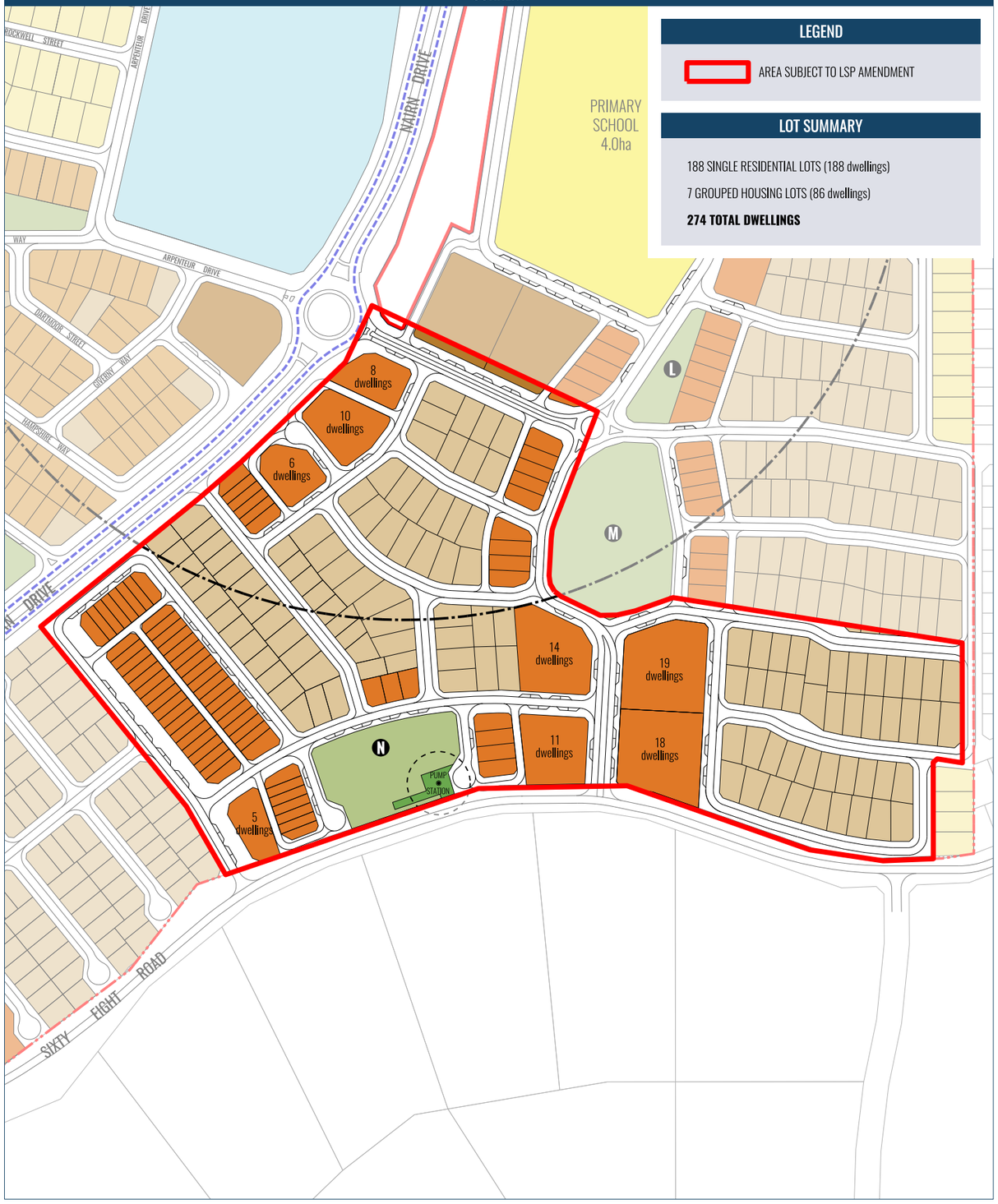
PROJECTION: PCG 94 PLANNER: CH

DATUM: AHD CHECK: KB

cdp Town Planning & Urban Design

Unit 2, 464 Murray Street
Perth WA 6000
(08) 6333 1888
info@cdpaus.com.au
www.cdpaus.com.au

CURRENT



LEGEND

AREA SUBJECT TO LSP AMENDMENT

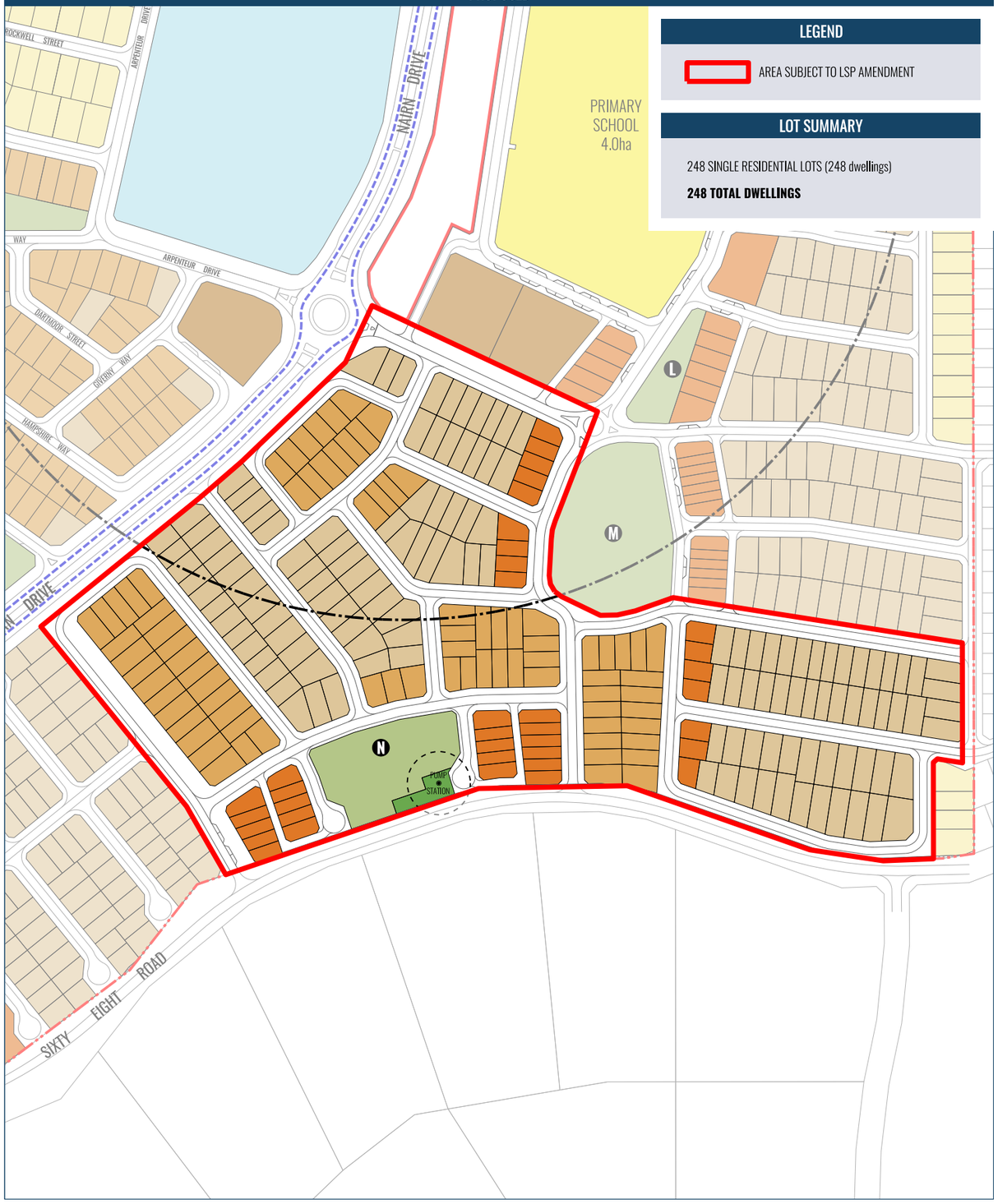
LOT SUMMARY

188 SINGLE RESIDENTIAL LOTS (188 dwellings)

7 GROUPED HOUSING LOTS (86 dwellings)

274 TOTAL DWELLINGS

PROPOSED



LEGEND

AREA SUBJECT TO LSP AMENDMENT

LOT SUMMARY

248 SINGLE RESIDENTIAL LOTS (248 dwellings)

248 TOTAL DWELLINGS

LOCAL STRUCTURE PLAN AMENDMENT

Lot 1507 Eighty Road, BALDIVIS

A Rockingham Park Project

NORTH

Scale: 1:4000 @ A3

0 40 80 120m

PLAN: RHPPH-5-018 REVISION:

DATE: 10/07/2024 DRAWN: JP

PROJECTION: PCG 94 PLANNER: CH

DATUM: AHD CHECK: KB

cdp Town Planning & Urban Design

Unit 2, 464 Murray Street
Perth WA 6000
(08) 6333 1888
info@cdpaus.com.au
www.cdpaus.com.au

2.2 R40 Laneway Lots

The current Structure Plan provides for 64 rear loaded R40 lots. This is considered to be a large proportion of small rear loaded lots within one stage area. The majority of these were serviced by a T-style laneway in the order of 70 metres x 150 metres in length. Laneways are also provided to service some of the grouped housing sites. A comprehensive review of the subdivision demonstrated clear design inefficiencies in regard to the amount of laneway required. The review also highlighted an oversupply of rear loaded small lot product which is against the current market preference trends for front loaded single residential product. In response, this LSP Amendment proposes to reduce the number of R40 rear loaded lots to 21 lots located directly adjacent to Public Open Space N (POS N) at Sixty Eight Road frontage of the Estate.

2.3 R40 Grouped Housing Sites

The current Structure Plan provides for 24 grouped housing sites within Parkland Heights Estate. Of these, 8 are located within the LSP Amendment area. This is considered to be a large proportion of grouped housing within one stage area and within the Estate overall. A design review highlighted an oversupply of grouped housing product which is against the current market preference trends for front loaded single residential product. Comparable approved structure plans through Baldivis require either nil or significantly less grouped housing development sites. Refer table below.

Approved Structure Plans in Baldivis	**No. of Grouped Housing Sites in LSP**
Parklands Heights	24
Baldivis South East	0
The Rivergum's East	0
Highbury Park	0
Paramount Estate	7
Brightwood Estate	0
Lot 19 Sixty Eight Road	0
Banksia Grove	0
Heritage Park	0
Paradiso Estate	3
The Spires	2
Lot 306 McDonald Road	0
Baldivis Parks	0
Greenlea	0
Millars Landing	0

In response, this LSP Amendment proposes to remove 8 grouped housing sites from the structure plan and alternatively provide for single residential product. There are still 16 x grouped housing sites within the estate which is significantly more than any other estate in Baldivis.

In addition, the majority of the grouped housing sites in this LSP Amendment area have dual road frontage. A comprehensive review of the subdivision demonstrated clear design inefficiencies in regard to the amount of road required to service these grouped housing sites.

2.4 Additional Single Residential Lot Product (R30)

As a direct consequence of the removal of the grouped housing sites and laneway products, it is proposed to introduce R30 single residential product into this area. The LSP Amendment area is now consisting of a diverse mix of R25 – R40 single residential product, ranging from ~ 280m2 to 700m2 in area.

2.5 Roads & Road Structure

A Transport Impact Assessment Addendum has been proposed by Transcore to support this LSP Amendment and review the minor changes proposed to the roads and road structure. Refer **Appendix 1**.

The road pattern and road hierarchy of the approved Structure Plan has been generally maintained. The majority of the laneways have been removed, however the local access street alignment and structure is generally consistent with the approved Structure Plan. The alignment of the north-south roads, including the Neighbourhood Connector B, located to the south of POS M has shifted westwards slightly. This is a direct result of removal of the grouped housing sites and the creation of residential cell depths that are adequate to accommodate and provide for front loaded single residential lot products in this area.

The width of roads has generally been maintained as per the current LSP, with the exception of the north-south Neighbourhood Connector B which has been reduced in width from 25 metres to 18 metres. This reduction in width is due to the removal of on street parking that was previously provided to service the grouped housing sites. The median has also been removed as it is deemed unnecessary. The proposed 18m width is consistent with the minimum required for Neighbourhood Connector B roads under Liveable Neighbourhoods. Importantly, this width is consistent with that approved for the section of the Neighbourhood Connector B abutting POS M pursuant to subdivision approval for Stage 11 of the Estate (WAPC 163429).

This Neighbourhood Connector B, which intersects with Sixty Eight Road, accommodates traffic volumes significantly less than 5,000vpd (which is the upper volume for unrestricted driveway access). Thus, no restriction on driveway access to this road is required. Accordingly, the LSP Amendment proposes single residential lots with direct frontage to this road.

The LSP Amendment proposes the removal of widened verge spaces in the east west roads at the south eastern corner of the amendment area. This is consistent with the approach required by the City, and approved by the WAPC, for the subdivision of Stage 11 to the north (WAPC 163429). The proposed LSP also shows the east west roads in Stage 11 without the widened verges as per the subdivision approval.

3 Public Open Space

There are no changes to the provision of POS proposed by this Structure Plan amendment. However, an updated POS schedule that reflects subdivisions and Urban Water Management Plans approved to date has been prepared and included below. A surplus of POS, above the 10% requirement, is being provided in the Parkland Heights Estate.

Table 1a: POS Schedule

PUBLIC OPEN SPACE SCHEDULE PARKLAND HEIGHTS STRUCTURE PLAN		
Gross Site Area		120.825
Deductions		
Nairn Drive Regional Road Reservation	6.399	
Sixty Eight Road Widening	0.127	
Primary School	4.032	
Commerical/Special Use	6.292	
Pump Stations	0.181	
1:1 Drainage	1.330	
Surplus Restricted Open Space	0.000	
Total Deductions		18.362
Gross Subdivisable Area		102.464
Maximum 2% Restricted POS Permitted	2.049	
Minimum 8% Unrestricted POS Required	8.197	
10% POS Requirement		10.246
POS Provision		
Restricted POS Provision		
>1:1 - 1:5yr Drainage	0.425	
Powerline Easement	1.129	
Creditable Restricted POS Provision		1.554
Unrestricted POS Provision		
Credited POS (inclusive >1:5 - 1:100yr drainage)	9.805	
Creditable Unrestricted POS Provision		9.805
TOTAL POS PROVISION	11.09%	11.359
OVER/UNDER PROVISION OF POS		1.113

Table 1b: Detailed POS Breakdown

POS AND DRAINAGE PROVISION - DETAILED BREAKDOWN							
All Figures in hectares (ha)		Uncredited Green Space (Deduction)		Credited 'Restricted' Public Open Space		Credited 'Unrestricted' Public Open Space	Total Credited Public Open Space
POS/Easement Reference	Land Area	Pump Station	1:1yr drainage	Powerline Easement	>1:1 - 1:5yr Drainage	*Inclusive >1:5 - 1:100yr drainage*	
A	0.4823		0.0775	0.0652	0.0155	0.3241	0.4048
B	0.1463		0.0000	0.1463	0.0000	0.0000	0.1463
C	1.1240		0.2080		0.0732	0.8428	0.9160
D	0.2283		0.0000		0.0000	0.2283	0.2283
E	0.5681		0.0370		0.0213	0.5098	0.5311
F	5.7711	0.1200	0.3322	0.5562	0.1046	4.6581	5.3189
G	0.5129		0.0461		0.0279	0.4389	0.4668
H	0.2747		0.0000		0.0000	0.2747	0.2747
I	0.3235		0.0000		0.0000	0.3235	0.3235
K	0.5289		0.0700		0.1390	0.3199	0.4589
L	0.2328		0.0000		0.0000	0.2328	0.2328
M	1.0935		0.3045		0.0028	0.7862	0.7890
N	0.7366	0.0609	0.1508		0.0247	0.5002	0.5249
O	0.8475		0.1043	0.3610	0.0163	0.3659	0.7432
TOTAL	12.8705	0.181	1.330	1.129	0.425	9.805	11.359

4 Transport Assessment

An assessment of the proposed Structure Plan amendment has been undertaken by Transcore and included as **Appendix 1**. The assessment by Transcore provides updated plans responding to the proposed LSP Amendment to illustrate road hierarchy, pedestrian and cyclist facilities, traffic volumes and intersection treatments.

5 Water Management

Pentium Water have prepared technical memo supporting the proposed Structure Plan amendment, refer **Appendix 2**. The memo demonstrates that adequate flood management provisions will be provided in line with the approved Local Water Management Strategy (LWMS). The memo provides updated stormwater modelling details to address the proposed changes to the approved LSP. Changes proposed by the LSP Amendment are considered relatively minor and the stormwater management will be largely consistent with the approved LSP and LWMS.

All runoff in the 1% AEP event from Stages 9, 10 and 11 are being managed within basins located in POS N or POS M. Stormwater modelling was undertaken to inform the Parkland Heights Stage 11 UWMP and demonstrated that sufficient flood storage will be provided in the POS M basin to cater for the 1% AEP event.

Allocated drainage area in POS N is specified at 2,227 m2 basin top area as detailed in the LWMS. The catchment area draining into POS N basin will be significantly smaller than the catchment area proposed in the LWMS as the size of the catchment for the POS M basin has increased. This is as per the Stage 11 UWMP. Given the above, the required size of POS N basin is expected to be smaller than the 2,227 m2 estimated in the LWMS.

In summary, the proposed changes to LSP Amendment will have negligible impact on total runoff to the basins and will result in relatively minor changes to the stormwater management strategy detailed in the

approved LWMS. This technical memo prepared by Pentium Water demonstrates that all run-off generated in the 1% AEP event will be adequately managed and infiltrated within POS N and POS M basins consistent with the LWMS.

6 Civil Engineering and Services

Pritchard Francis has prepared a Civil Engineering Services Report to support the proposed Stricture Plan amendment, refer **Appendix 3**. The report outlines the capacity of existing utilities to service the development. The subject area has planning carried out by all service authorities with all services within the existing development front.

7 Grounds for Amendment

The Structure Plan amendment is being pursued to remove the grouped housing sites and large extent of laneway product from this stage, whilst still aiming to generally maintain the intention around density and dwelling yields in this area. The local road layout is only modified very slightly and as required to service single residential lot product.

The changes to the lot products is being sought to meet market demand and a preference for front loaded single residential product. Specifically, the amendment is in response to:

- the LSP, and this stage in particular, currently being quite "heavy" with grouped housing sites and rear loaded laneway lot product;
- financial challenges associated with holding costs, building timeframes and resources associated with the development of these grouped housing sites; and
- market movement away from rear loaded laneway product.

7.1 Minor Amendment

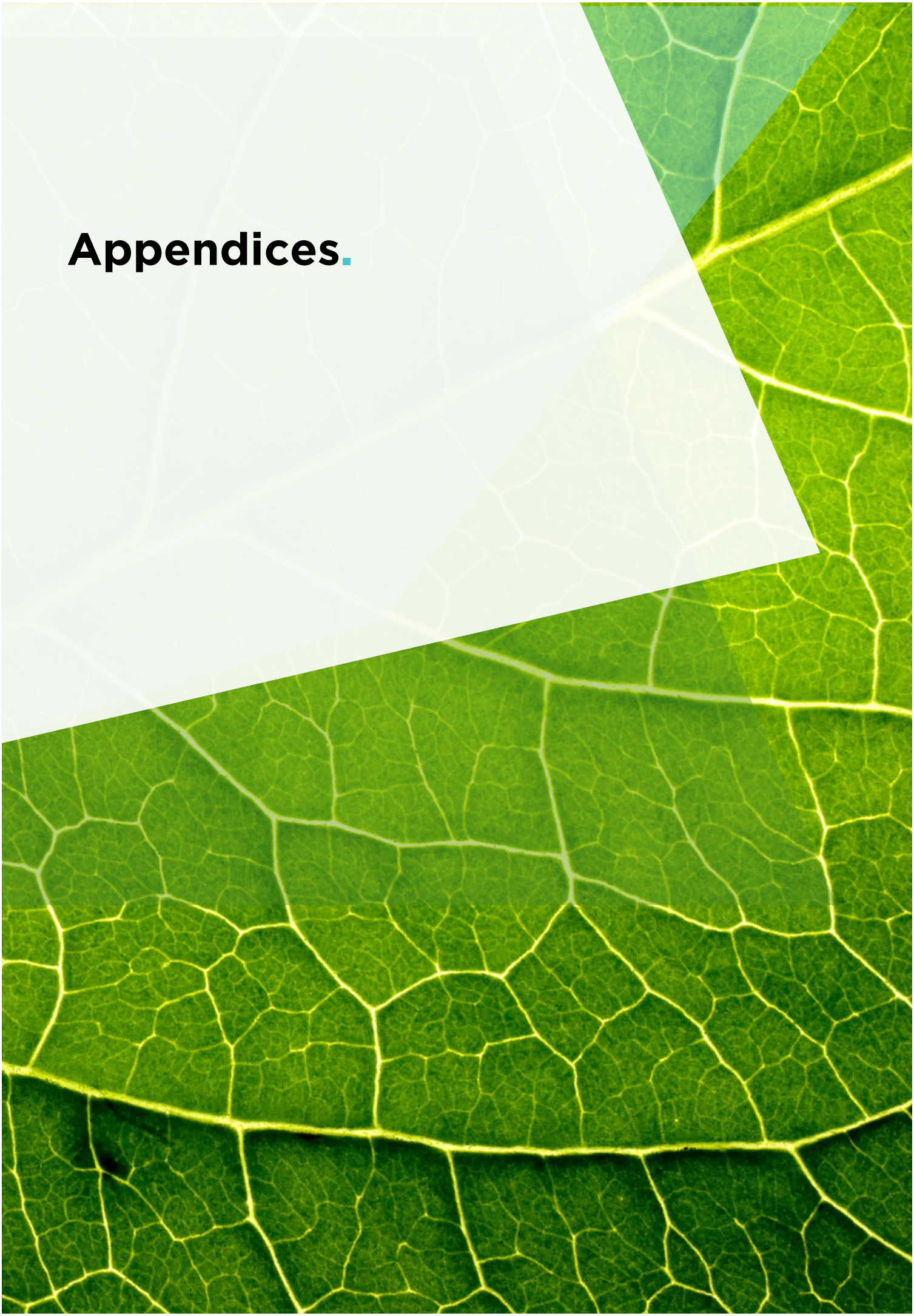
Section 7.1.1 of the WAPC's Planning Manual 'Guidance for Structure Plans' states that an amendment to a Structure Plan can be considered minor if the proposed changes do not impact on the purpose, objectives, or the overall design response of the plan, and in addition the changes:

- are required to give effect to a State Planning Policy; or
- do not have a consequential impact on the land, landowners, or occupiers in and around the structure plan area; or
- are administrative in nature, for example, where required to remove redundant provisions or requirements); and
- the proposed changes do not impact on the infrastructure provision or the environment.

It is submitted that this Structure Plan amendment does not involve any changes that substantially alter the intent of the Structure Plan and/or would affect adjoining landowners /developers in a manner that would warrant public advertising. The proposed amendment has no consequential impact on the land, landowners, neighbours, infrastructure provision or the environment.

On this basis, we request that this amendment is assessed as a minor Structure Plan amendment.

Appendices.



Appendix 1
Traffic Impact Assessment Addendum

Technical Note: No 1 **Date:** 8/07/2024
Project No: t24.146
Project: Parkland Heights, Baldivis – LSP Amendment
Subject: Transport Impact Assessment Addendum

1 Introduction

Transcore has prepared a number of traffic reports in relation to the Local Structure Plan for Lot 1507 Eighty Road, Baldivis, known as Parkland Heights, on behalf of Rockingham Park Pty Ltd since the original preparation and approval of that LSP.

Relevant reports have included the following:

- *Parkland Heights Local Structure Plan, Lot 1507 Eighty Road, Baldivis Transport Assessment* (July 2011);
- *Parkland Heights Neighbourhood Centre LSP Amendment Transport Impact Assessment* (December 2018);
- *Parkland Heights, Baldivis - Neighbourhood Centre - Local Development Plan Transport Impact Assessment* (November 2022)
- *Parkland Heights Neighbourhood Centre, Baldivis – Local Development Plan Transport Impact Assessment Addendum* (March 2024).

The 2018 TIA provided a comprehensive update of the 2011 LSP Transport Assessment report to address a substantial revision of planning for the Neighbourhood Centre to approximately 10,000m^2 NLA retail area. That December 2018 LSP TIA report is the most recent Transport Impact Assessment covering the whole LSP area.

The November 2022 TIA for the Neighbourhood Centre LDP and subsequent March 2024 LDP TIA Addendum addressed further changes with the Neighbourhood Centre now planned for a total of approximately 12,800m^2 NLA.

Other minor changes have occurred within the overall LSP area as subdivision stages have been approved and developed. Proposed subdivision stage 9 now proposes further refinement of the local road network and lot layout in the southernmost section of the LSP area.

Accordingly, this Technical Note is intended to update key figures from the 2018 TIA report to include the current LSP Amendment proposal and other approved changes already incorporated in the current approved LSP plan. This Technical Note may be considered as an Addendum to that 2018 LSP TIA report.

Address: 61 York Street, Subiaco WA 6008. P.O.Box 42 Subiaco WA 6904
Phone: +61 (08) 9382 4199
Fax: +61 (08) 9382 4177
Email: admin@transcore.net.au
Transcore Pty Ltd ACN 094 951 318 ABN 19 094 951 318
www.transcore.net.au
www.linkedin.com/company/transcore/
instagram: @transcoreaustralia

2 Current Local Structure Plan

The current approved Local Structure Plan is shown at **Appendix A**.

The LSP area is anticipated to accommodate approximately 1,580 dwellings, one primary school and a neighbourhood centre. The neighbourhood centre comprises a commercial zone on the western side of Nairn Drive and a special use zone on the eastern side of Nairn Drive.

According to the Parkland Heights Structure Plan Report Part One Implementation (Dec 2020) the estimated commercial floorspace was 10,000m^2 NLA of retail/shop and 4,500m^2 GFA of other non-residential floorspace.

The recently approved Parkland Heights Neighbourhood Centre Local Development Plan (June 2024) is shown at **Appendix C**. The March 2024 TIA Addendum for that LDP is based on approximately 12,800m^2 NLA on the commercial zoned site on the western side of Nairn Drive, and no change to future land use in special use zone on the eastern side of Nairn Drive.

3 Proposed LSP Amendment

The proposed Amended Local Structure Plan is shown at **Appendix B**.

The main changes between the current approved LSP plan and the Proposed Amended LSP plan relates to the local road network and lot layout in the Stage 9 Subdivision area in the southernmost section of the LSP area. The Proposed Stage 9 Subdivision plan is shown at **Appendix D**.

The main changes relate to the road alignment of the north-south neighbourhood connector northward from Sixty Eight Road towards the primary school. Previously planned R40 grouped dwelling sites either side of this road (north of Sixty Eight Road) have been replaced with single residential lots, with some now having frontage access from this road. The future traffic volumes on this north south neighbourhood connector will be significantly less than 5,000vpd (which is the upper volume for unrestricted driveway access) so no restriction on driveway access to this road is required.

4 Road Hierarchy

The December 2018 LSP TIA report included a plan showing the proposed road hierarchy within the LSP area as Figure 6 of that TIA report. An updated version of the road hierarchy plan is shown in **Figure 1** in this Technical Note.

Some of the local roads have been realigned in this latest plan but the road hierarchy remains relatively consistent with that proposed in the 2018 TIA report.

Figure 1: Road hierarchy

The only significant change in the road hierarchy is that all of Nairn Drive is now shown as an Integrator A, whereas the two sections of Nairn Drive through the centre of the LSP area (adjacent to the neighbourhood centre and the next section to the south) were previously shown as Integrator B because of lower traffic volumes on those sections. It is understood that the planning authorities consider it prudent to plan this section of Nairn Drive as the higher standard Integrator A (which has two traffic lanes each way and therefore higher capacity than an Integrator B) to ensure this important district distributor road has sufficient capacity for potential higher future traffic demands as the areas further south are developed in future. The subdivision plan at **Appendix D** reflects this Integrator A classification.

5 Public Transport

Future bus routes in Baldivis are shown in Figure 7 of the December 2018 LSP TIA report. The current approved LSP plan at **Appendix A** of this Technical Note and the proposed Amended LSP plan at **Appendix C** both show the planned future bus route (dark blue dashed lines) along Arpenteur Drive and Furnivall Parade (north of the neighbourhood centre) and along Nairn Drive from Furnivall Parade to Sixty Eight Road through the LSP area. The proposed LSP Amendment does not change this planned bus route at all.

6 Pedestrian and Cyclist Facilities

Planned path networks within the LSP area were shown in Figure 8 of the December 2018 LSP TIA report. An updated version of the path networks plan is shown in **Figure 2** in this Technical Note.

Some additional 2m paths are shown in the southern part of the LSP area based on those shown on the subdivision plan at **Appendix D**.

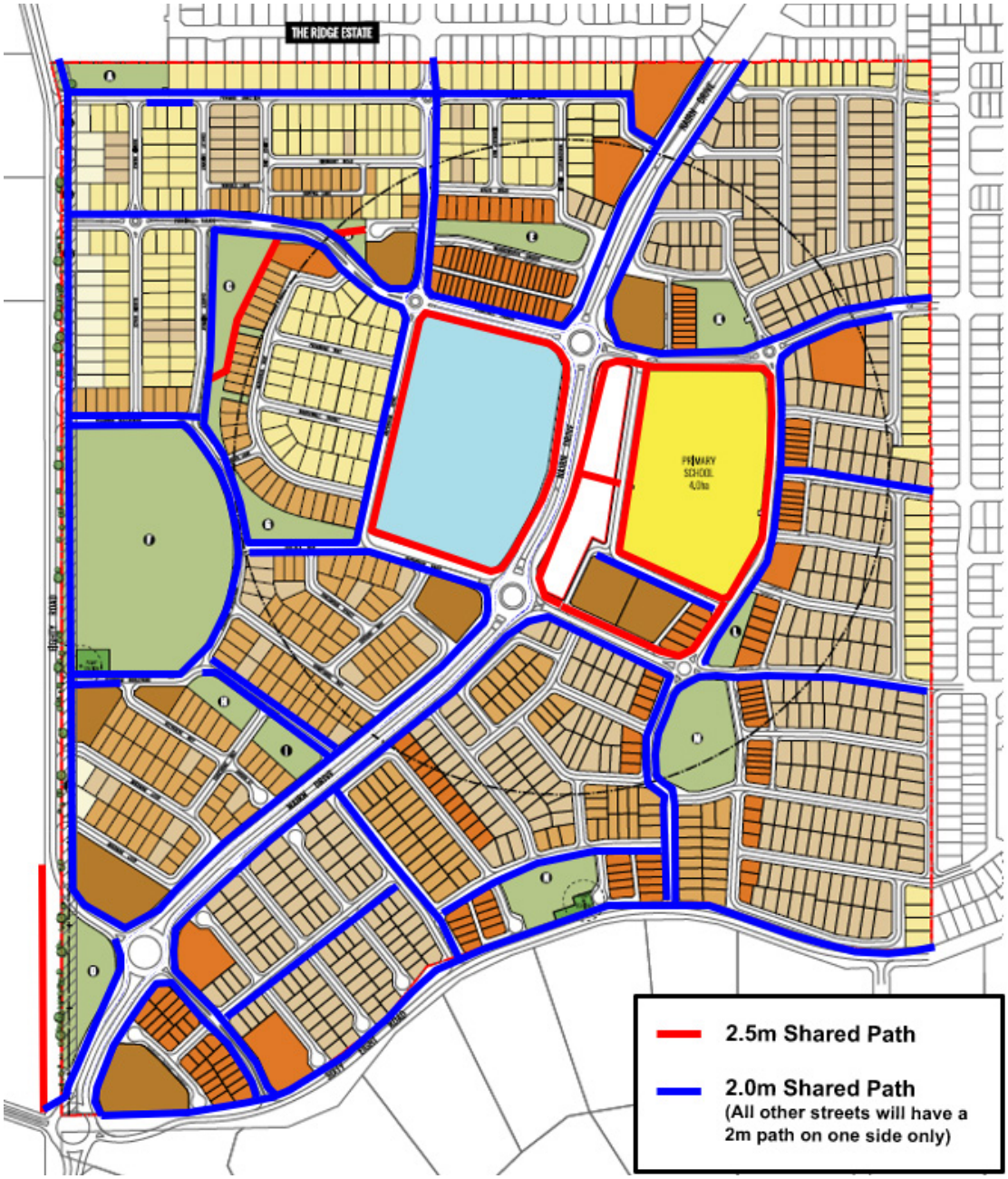


Figure 2: Pedestrian and cyclist facilities

7 Future Traffic Flows

Future daily traffic flows on the LSP area road network were shown in Figure 9 of the December 2018 LSP TIA report. An updated version of the future daily traffic flows is shown in **Figure 3** in this Technical Note.

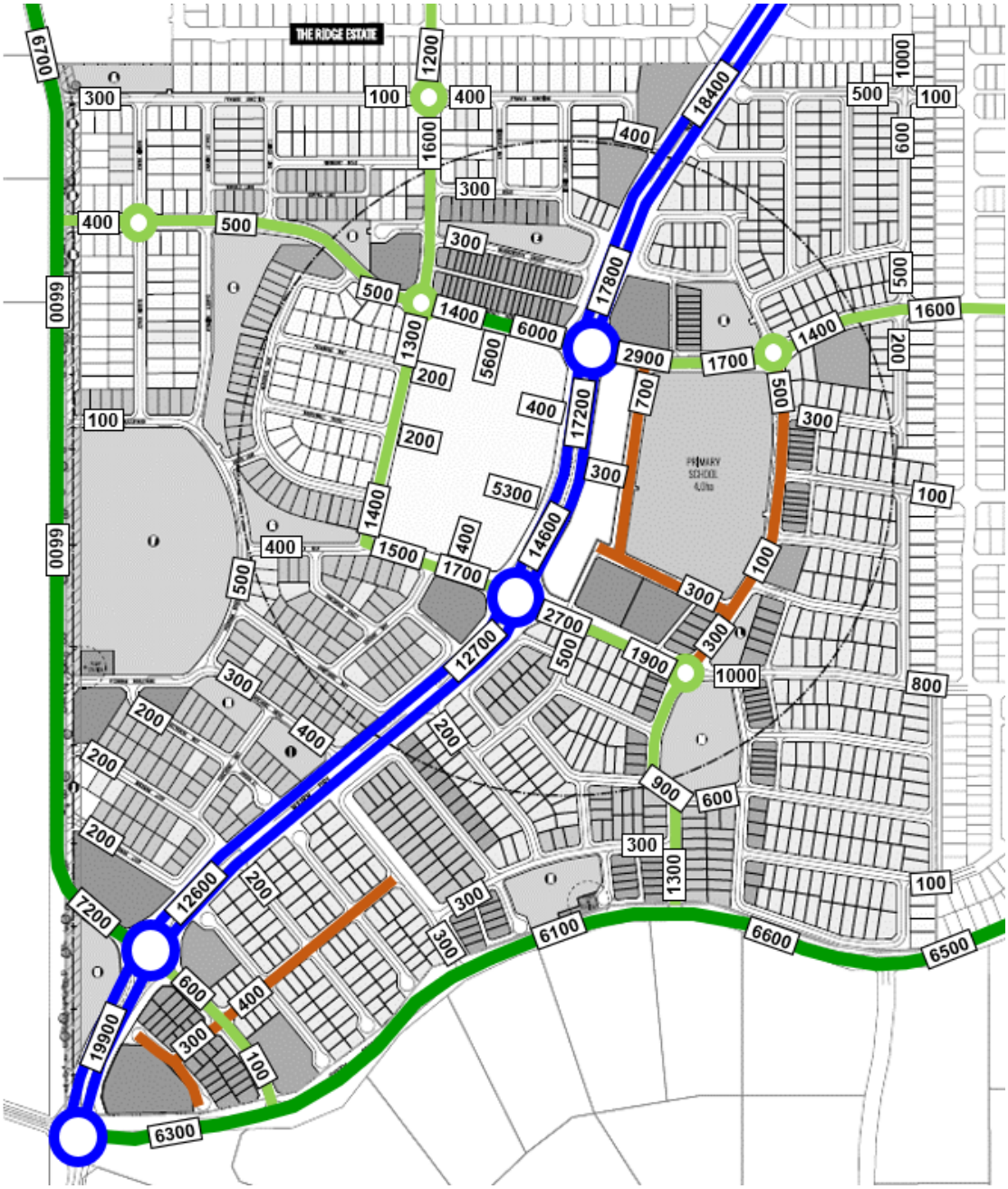


Figure 3: Future daily traffic volumes

The future daily traffic volumes shown in **Figure 3** are based on the 2018 TIA traffic volumes with adjustment for the neighbourhood centre traffic flows and the changes in the southern subdivision area.

Traffic volumes around the neighbourhood centre were documented in the *Parkland Heights Neighbourhood Centre, Baldivis – Local Development Plan Transport Impact Assessment Addendum* (March 2024), for future weekday AM and PM peak hour traffic flows. Shopping centre weekday daily traffic generation rates are typically approximately ten times the equivalent weekday PM peak hour trip rates, and the same factor applies for residential trip rates as well. Accordingly, the daily traffic flows shown around the neighbourhood centre in **Figure 3** have

been estimated as ten times the PM peak hour traffic flows in the 2024 LDP TIA Addendum.

8 Intersection Treatments

Planned intersection treatments on the LSP area road network were shown in Figure 9 of the December 2018 LSP TIA report. An updated version of the intersection treatments plan is shown in **Figure 4** in this Technical Note.

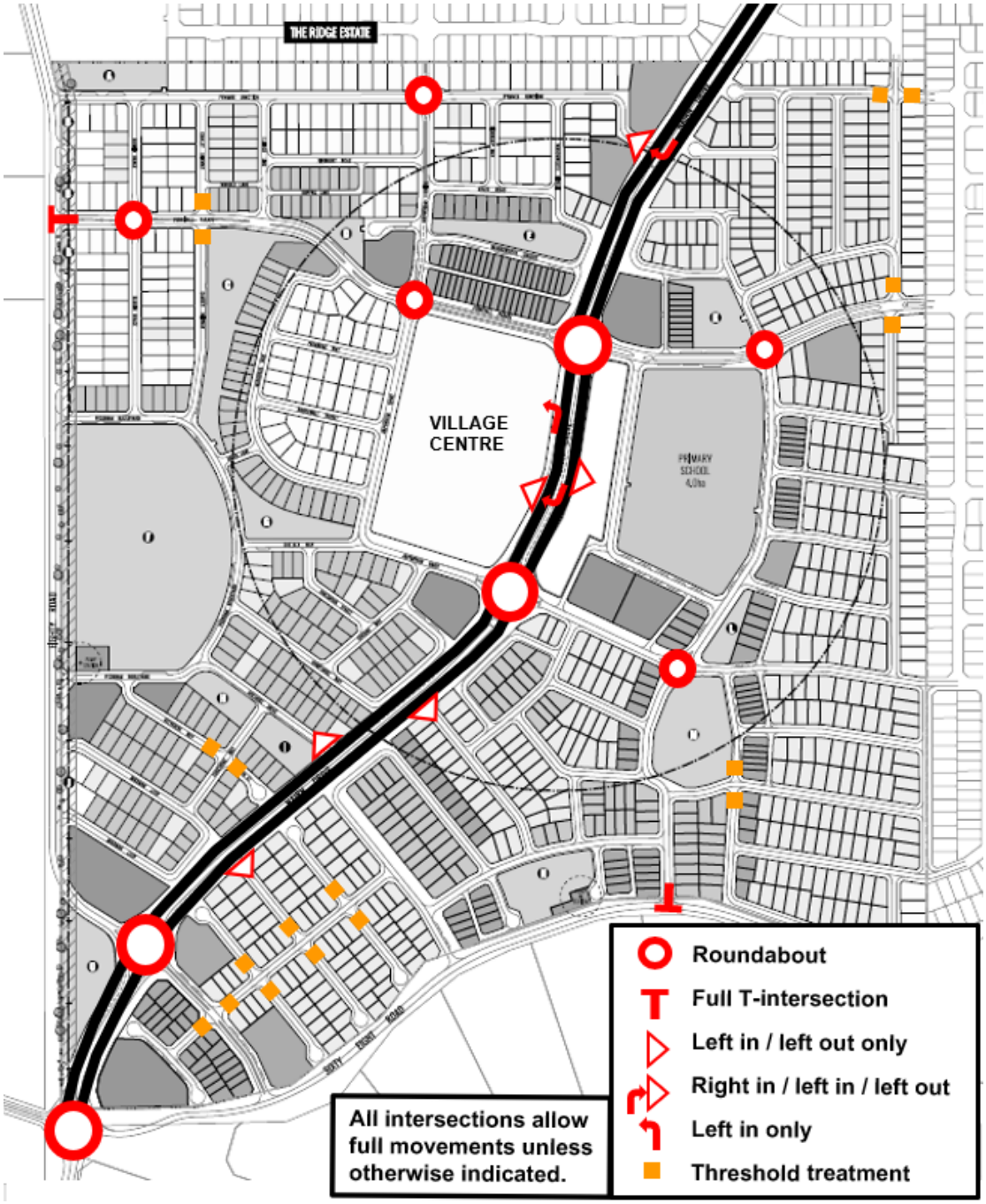


Figure 4: Intersection treatments

Most of the changes in **Figure 4** relate to the access arrangements for the neighbourhood centre and are consistent with the approved Neighbourhood Centre Local Development Plan shown at **Appendix C** of this Technical Note.

9 Conclusions

This Technical Note addresses a proposed Amendment to the Local Structure Plan for Lot 1507 Eighty Road, Baldivis, which is known as Parkland Heights. The proposed Amendment relates to proposed subdivision stage 9 which proposes further refinement of the local road network and lot layout in the southernmost section of the LSP area.

The *Parkland Heights Neighbourhood Centre LSP Amendment Transport Impact Assessment* (December 2018) is the most recent Transport Impact Assessment report covering the whole LSP area.

This Technical Note updates key figures from the 2018 TIA report to include the current proposed LSP Amendment and other approved changes already incorporated in the current approved LSP plan since 2018, including the recently approved Parkland Heights Neighbourhood Centre Local Development Plan.

Therefore, this Technical Note may be considered as an Addendum to that 2018 LSP TIA report as well as providing updated assessment in support of the current proposed LSP Amendment.

APPENDIX A

APPROVED LOCAL STRUCTURE PLAN

LEGEND

ZONES/RESERVES

- RESIDENTIAL R15
- RESIDENTIAL R20
- RESIDENTIAL R25
- RESIDENTIAL R30
- RESIDENTIAL R40
- RESIDENTIAL R60
- COMMERCIAL
- SPECIAL USE
- EDUCATION
- PUBLIC OPEN SPACE

OTHER

- LOCAL STRUCTURE PLAN BOUNDARY
- 400m NEIGHBOURHOOD WALKABLE CATCHMENT
- PUMP STATION ODOUR BUFFER
- POWERLINE EASEMENT
- ROAD WIDENING (SIXTY EIGHT ROAD)
- PLANNED BUS ROUTE
- VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
- SEWER PUMP STATION (900m² - 1220m²)

NOTES

1. The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boundary.
2. The access street and associated lot layout shown on the plan is indicative only and subject to refinement as part of the detailed subdivision process.
3. POS Areas are indicative only and subject to further detailed design and drainage considerations.
4. All road carriageway detail depicted on the Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on the Plan are subject to pre-cal and final survey and may vary from figures shown.
5. Bushfire attack level to be reviewed prior to creation of titles. Development may require construction in accordance with AS3959 - Construction in Bushfire Prone Areas.
6. Sixty-Eight Road widening to accomodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.

LOCAL STRUCTURE PLAN MAP

Lot 1507 Eighty Road, BALDIVIS

A Rockingham Park Project

NORTH

Scale: 1:6000 @ A3

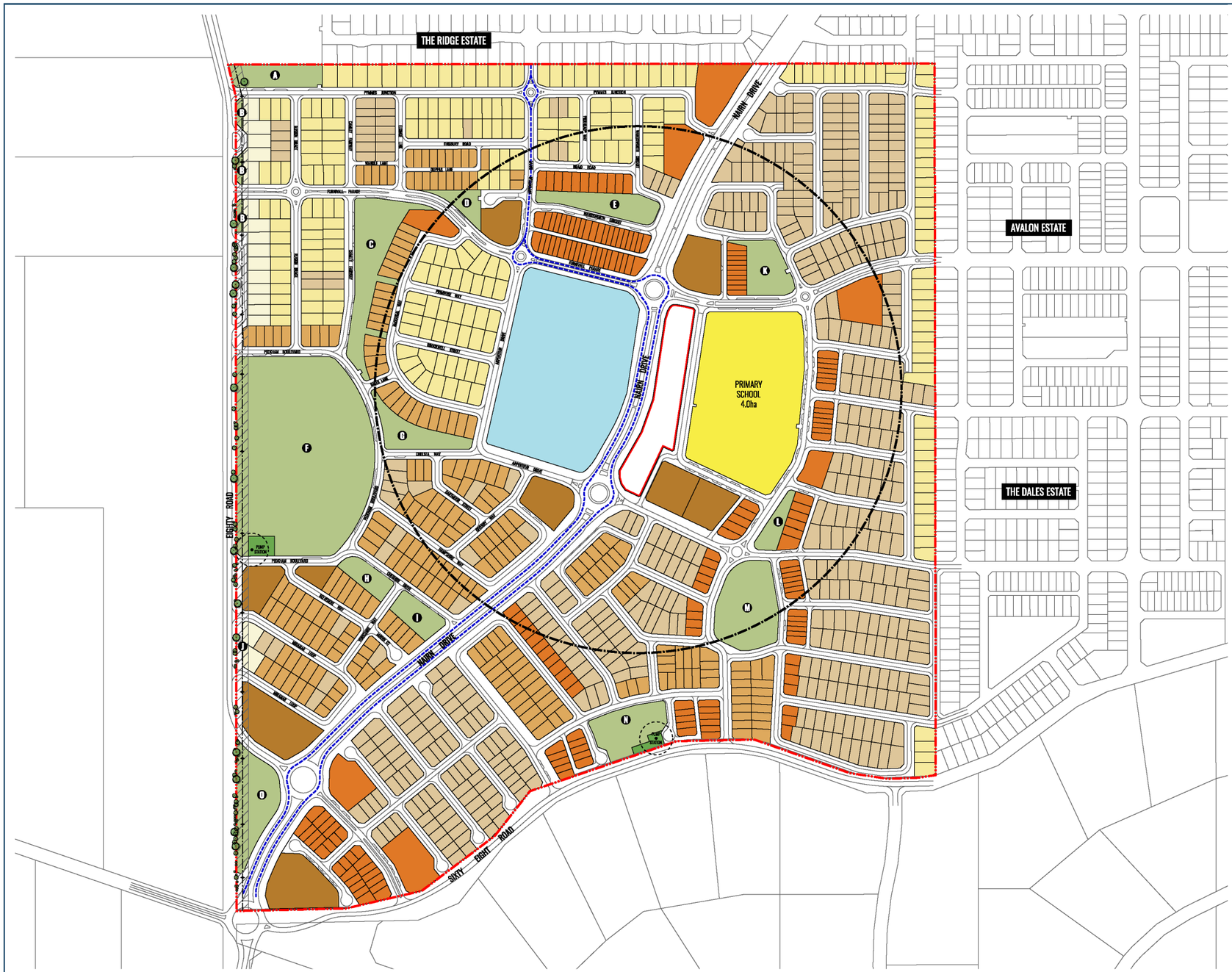
0 60 120 180m

PLAN: RHPPH-2-001 REVISION:
DATE: 20/11/2018 DRAWN: JP
PROJECTION: PCG 94 PLANNER: BK
DATUM: AHD CHECK: TV

Creative DESIGN+PLANNING
A 28 Brown Street, East Perth WA 6004
P (08) 9325 0200
E info@creativedp.com.au
W creativedp.com.au

APPENDIX B

PROPOSED AMENDED LOCAL STRUCTURE PLAN



LEGEND

ZONES/RESERVES

- RESIDENTIAL R15
- RESIDENTIAL R20
- RESIDENTIAL R25
- RESIDENTIAL R30
- RESIDENTIAL R40
- RESIDENTIAL R60
- COMMERCIAL
- SPECIAL USE
- EDUCATION
- PUBLIC OPEN SPACE

OTHER

- LOCAL STRUCTURE PLAN BOUNDARY
- 400m NEIGHBOURHOOD WALKABLE CATCHMENT
- PUMP STATION ODOUR BUFFER
- POWERLINE EASEMENT
- ROAD WIDENING (SIXTY EIGHT ROAD)
- PLANNED BUS ROUTE
- VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
- SEWER PUMP STATION (900m² - 1220m²)

NOTES

1. The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boundary.
2. The access street and associated lot layout shown on the plan is indicative only and subject to refinement as part of the detailed subdivision process.
3. POS Areas are indicative only and subject to further detailed design and drainage considerations.
4. All road carriageway detail depicted on the Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on the Plan are subject to pre-cal and final survey and may vary from figures shown.
5. Bushfire attack level to be reviewed prior to creation of titles. Development may require construction in accordance with AS3959 - Construction In Bushfire Prone Areas.
6. Sixty-Eight Road widening to accomodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.

LOCAL STRUCTURE PLAN MAP

Lot 1507 Eighty Road, BALDIVIS

A Rockingham Park Project

NORTH

Scale: 1:6000 @ A3

0 60 120 180m

PLAN: RHPPH-2-001 REVISION: A
DATE: 08/05/2024 DRAWN: JP
PROJECTION: PCG 94 PLANNER: CH
DATUM: AHD CHECK: KB

cdp Town Planning & Urban Design

Unit 2, 464 Murray Street
Perth WA 6000
(08) 6333 1888
info@cdpaus.com.au
www.cdpaus.com.au

APPENDIX C

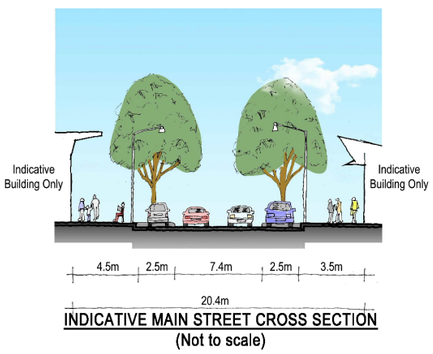
PARKLAND HEIGHTS NEIGHBOURHOOD CENTRE LOCAL DEVELOPMENT PLAN

PARKLAND HEIGHTS NEIGHBOURHOOD CENTRE

LOCAL DEVELOPMENT PLAN 1

LEGEND

- LDP Boundary
- Neighbourhood Centre Main Street
- Potential Residential Precinct
- Indicative Car Park and Aisle Location
- Service / Delivery Route
- Town Square
- Loading Area
- Screen Wall
- Landscaping
- Active Building Edge
- Secondary Building Edge
- Key Pedestrian Link
- Supermarket *'Click & Collect'*
- Indicative Building Location (notional building footprint only and subject to review at detailed design)
- Fuel Canopy
- Drive-thru
- Pedestrian Crossing
- Entry Statement
- Full Movement Intersection
- Full Movement Intersection - Service / Delivery & Staff Vehicles Only
- Left In / Left Out / Right In Intersection
- Left In Intersection



INDICATIVE MAIN STREET CROSS SECTION
(Not to scale)

APPLICATION OF LOCAL DEVELOPMENT PLAN

The provisions of this Local Development Plan (LDP) are in addition to any requirements under Local Planning Scheme No.2 (LPS No.2) and any development control provisions prescribed under a Local Structure Plan.

DEVELOPMENT STANDARDS

Main Street

1. The main street shall be designed as a low-speed traffic environment that prioritises pedestrian movement over vehicles. Traffic-calming measures should be incorporated into the design with pedestrian crossings provided that generally align with entrance points to buildings.
2. The main street shall accommodate on-street parking as well as loading zones for service vehicles on each side of the main street where practical and safe.
3. The main street shall be designed for a high-level of pedestrian amenity and incorporate features such as street furniture, low planting, street trees and lighting where practicable and safe.

Active Building Edges

Where identified, active building edges shall:

4. Have a nil setback to the footpath.
5. Have a continuous frontage with a minimum building façade height of 5.5m.
6. Comprise a minimum of 60% glazing for the length of the ground floor facade.
7. Provide continuous pedestrian shelter that extends over the width of the adjoining footpath to the extent that they do not pose a hazard for passing vehicles (eg. delivery and service trucks).
8. Comprise 'preferred' uses with the exception of where entry points are required for access to internal shopping centre pedestrian malls and buildings denoted with a # symbol. 'Preferred' uses include 'fast food outlet', 'market', 'restaurant', 'small bar', 'tavern', and 'shop'. Other uses may be considered in accordance with Clause 4.1 of the Parkland Heights Local Structure Plan and Table No.1 - Zoning Table of LPS No.2.

Other Building Facades

9. With the exception of 'Active Building Edges' and walls adjoining loading areas, building facades should avoid blank walls to enhance visual presentation through the use of features such as glazing (where conducive to the floor plan and use), alternative colours, finishes and textures and/or intrusions and extrusions in the wall.
10. In addition to the above, 'Secondary Building Edges' are to be designed to provide visual relief through an architectural response.

Vehicle Access

11. Intersection treatments for vehicle access points to the Neighbourhood Centre are to be provided in accordance with the LDP.
12. Alternative intersection treatments may be considered where a Traffic Impact Assessment is provided to the satisfaction of the City of Rockingham.

Pedestrian Access

13. Footpaths adjacent 'Active Building Edges' are to have a minimum width of 4.5m in order to accommodate alfresco dining opportunities and pedestrian movement. A reduction to 3.5m wide may be considered where alfresco dining is not proposed or contemplated by the specific land use.
14. For buildings abutting the main street, primary pedestrian access to building entries is to be provided from the main street.

Landscaping

15. Landscaping strips a minimum of 2.0m wide are to be provided within the property boundary in the general locations depicted on the LDP. Timing for the installation of the landscaping is to coincide with the construction of the adjoining car park to provide screening.
16. Where landscaping strips adjoin car parking areas, loading areas and buildings facades, the Landscape Plan that accompanies the Development Application is to provide details that demonstrate screening of these areas through the use of shrubs and tree planting.
17. A minimum of 10% of the site area should be provided as landscaping. This may include shade trees and landscaping areas within car parks.
18. Car parking areas are to include shade trees at a minimum rate of 1 tree per 6 car bays. Where shade structures are proposed over parking areas, the requisite number of trees may be provided on the periphery of, or adjacent to, the covered area.

Potential Residential Precinct

19. The north-west corner of the site identified as a 'Potential Residential Precinct' may be developed for residential purposes where it can be demonstrated that the land is not necessary to satisfy the parking requirements for the Neighbourhood Centre.
20. Should residential development be proposed within the 'Potential Residential Precinct' at a future stage, a separate LDP will be required in order to coordinate vehicle access and built form outcomes.
21. A separate LDP for the 'Potential Residential Precinct' shall consider and respond to potential sources of noise emanating from the Neighbourhood Centre. The LDP should be accompanied by an Acoustic Assessment prepared by a suitably qualified Acoustic Consultant that identifies potential sources of noise and outlines strategies to mitigate and manage the potential impact of noise on dwellings.

Noise Management

22. A Development Application that includes a 'Loading Area' depicted on the LDP is to be accompanied by an Acoustic Assessment prepared by a suitably qualified Acoustic Consultant that outlines strategies to mitigate and manage the potential impacts of noise from delivery vehicles and activities on surrounding sensitive land uses.
23. The screen wall is to be articulated and finished in materials and colours that match the overall development and seek to minimise the potential impact of bulk and form on the streetscape.

NOTES

- The LDP depicts indicative building and intersection locations only for the purpose of spatial planning. The building and intersection locations are subject to more detailed design which will be refined as part of the Development Application but shall be generally consistent with the LDP.
- The car park designs and locations depicted on the LDP are indicative only for the purpose of spatial site planning. The exact configuration and location of car parks is to be refined as part of the Development Application but shall be generally consistent with the LDP.
- The indicative 'Main Street Cross Section' depicted on the LDP has been prepared for illustrative purposes only and is subject to refinement at the Development Application stage. Widths and dimensions may vary from those shown on the indicative cross section as part of the detailed design process.
- Building truncations that maintain appropriate visual sightlines at the corners of intersections are to be demonstrated at the Development Application stage.
- The location and number of on-street parking bays is indicative only and subject to more detailed design at the Development Application stage.
- The location and alignment of pedestrian crossings are indicative only and subject to change at the detailed Development Application stage.
- Stormwater management on the site is to be in accordance with the approved addendum to the Parkland Heights Local Water Management Strategy dated 22 February 2018 in accordance with WSUD principles.
- Design details for intersection treatments are to be provided at the development application stage.
- Landscape drawings submitted with development applications are to include details of landscaping within verge areas.
- Trees along the perimeter of the site as depicted on the LDP are to be planted at a rate of one tree every 10 metres where vehicle access, parking and sightlines permit.

THIS LDP HAS BEEN APPROVED BY THE CITY UNDER SCHEDULE 2, CLAUSE 52(1)(A) OF THE PLANNING AND DEVELOPMENT (LOCAL PLANNING SCHEMES) REGULATIONS 2015.

21 June 2024

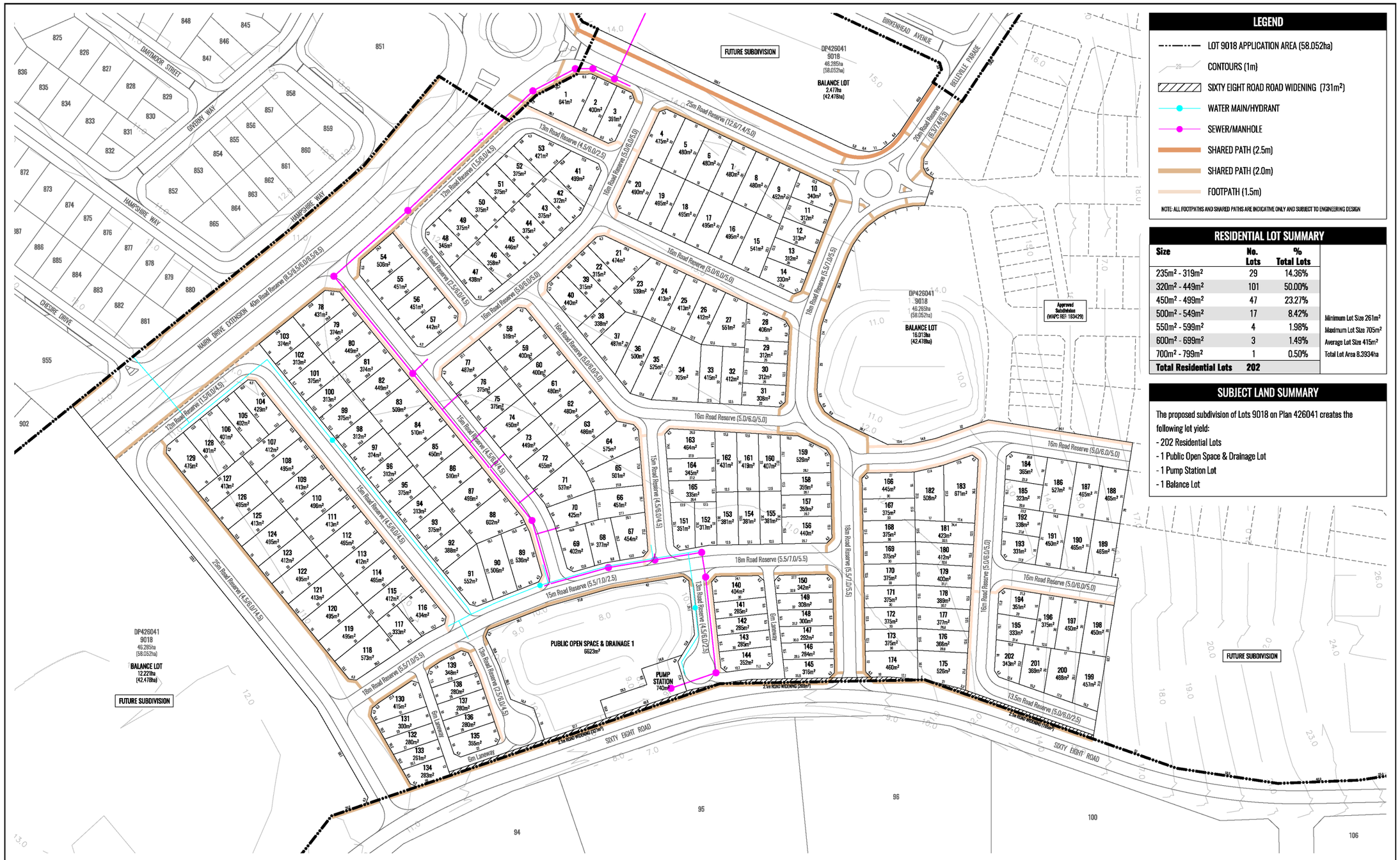
MANAGER, STATUTORY PLANNING — DATE

CLE Town Planning + Design

3039-46J-01 (20.03.2024) NTS

APPENDIX D

STAGE 9 SUBDIVISION PLAN



LEGEND

- LOT 9018 APPLICATION AREA (58.052ha)
- CONTOURS (1m)
- SIXTY EIGHT ROAD ROAD WIDENING (731m²)
- WATER MAIN/HYDRANT
- SEWER/MANHOLE
- SHARED PATH (2.5m)
- SHARED PATH (2.0m)
- FOOTPATH (1.5m)

NOTE: ALL FOOTPATHS AND SHARED PATHS ARE INDICATIVE ONLY AND SUBJECT TO ENGINEERING DESIGN

RESIDENTIAL LOT SUMMARY

Size	No. Lots	% Total Lots	
235m² - 319m²	29	14.36%	
320m² - 449m²	101	50.00%	
450m² - 499m²	47	23.27%	
500m² - 549m²	17	8.42%	Minimum Lot Size 261m²
550m² - 599m²	4	1.98%	Maximum Lot Size 705m²
600m² - 699m²	3	1.49%	Average Lot Size 415m²
700m² - 799m²	1	0.50%	Total Lot Area 8.3934ha
Total Residential Lots	**202**		

SUBJECT LAND SUMMARY

The proposed subdivision of Lots 9018 on Plan 426041 creates the following lot yield:

- 202 Residential Lots
- 1 Public Open Space & Drainage Lot
- 1 Pump Station Lot
- 1 Balance Lot

PROPOSED FREEHOLD SUBDIVISION

Lot 9018 Nairn Drive, PARKLANDS HEIGHTS Page 1 of 2

A Rockingham Park Project

NORTH

Scale: 1:2000 @ A3

0 20 40 60m

PLAN: RHPPH-3-012 REVISION: B
DATE: 12/03/2024 DRAWN: JP
PROJECTION: PCG 94 PLANNER: BK
DATUM: AHD CHECK: CH

cdp
Town Planning & Urban Design

Unit 2, 464 Murray Street
Perth WA 6000
(08) 6333 1888
info@cdpaus.com.au
www.cdpaus.com.au

Appendix 2
Stormwater Technical Memo

Level 1, 640 Murray Street
West Perth WA, 6005
P 08 6182 1790

2 July 2024

City of Rockingham
PO Box 2142
Rockingham DC WA 6967

Dear Sir/Madam,

Parkland Heights Lot 1507 Eighty Road, Baldivis LSP amendment – Stormwater Technical Memorandum

Introduction

This letter has been prepared as a technical memorandum to support the proposed amendment to the Parkland Heights Lot 1507 Eighty Road, Baldivis approved Local Structure Plan (LSP) (herein referred to as 'the site').

This memorandum details the changes proposed in the LSP amendment and demonstrates that adequate flood management provisions will be provided in line with the approved Local Water Management Strategy (LWMS) (ENV Australia 2011).

This letter should be read in conjunction with the following documents:

- Proposed - *Local Structure Plan, Lot 1507 Eighty Road, Baldivis* (Creative Design and Planning 2024) (Attachment A)
- Proposed - *Indicative Staging Plan, Parkland Heights, Baldivis* (Creative Design and Planning 2024) (Attachment B)
- Proposed - *Freehold Subdivision, Lot 9018 Nairn Drive, Parkland Heights* (Creative Design and Planning 2024) (Attachment C)
- Approved - *Freehold Subdivision Lot 9015 Nairn Drive, Parkland Heights Approval Subject to Conditions* (Western Australian Planning Commission 2023) (Attachment D)
- Approved - *Local Structure Plan, Lot 1507 Eighty Road, Baldivis* (Creative Design and Planning 2018) (Attachment E),
- Approved - *Addendum to the Parkland Heights Lot 1507 Eighty Road, Baldivis Local Water Management Strategy* (RPS Group 2020) (Attachment F).

Background

The purpose of this LWMS addendum is to provide updated stormwater modelling details to address the proposed changes to the approved LSP. The project history is summarised below:

- A LWMS for Parkland Heights was prepared by ENV Australia in 2011 to support the submission of the original LSP for Lot 1507 Eighty Road, Baldivis. The LWMS was approved by the City of Rockingham (CoR) and Department of Water and Environmental Regulation (DWER).
- A Stormwater Management Plan was prepared by Mortons Urban Solutions (2018) to assess the impact to downstream infrastructure of the proposed Neighbourhood Centre, located west of Nairn Drive and found that change to the LWMS overall drainage strategy was required.
- A revised LSP was prepared by Creative Design and Planning in 2018 (Attachment E) with modifications to the layout within Stages 13 and 14.

- An LWMS addendum was prepared by RPS Group in 2020 to address the changes proposed in the LSP 2018 amendment in Stages 13 and 14 and to demonstrate that stormwater would be adequately managed (Attachment F).
- The LSP was amended again in 2024 by Creative Design and Planning (Attachment A). The changes include realignment of lots and roads, and lot densities within Stages 9, 10 and 11. The main changes are presented in Figure 1. The corresponding Lot 9018 proposed freehold subdivision is provided as Attachment C. And the 2024 indicative staging plan is provided as Attachment B.
- Parkland Heights Stage 11 Urban Water Management Plan (UWMP) was prepared by Pentium Water in 2024 based on the amended 2024 LSP and demonstrates that sufficient flood storage will be provided in POS M basin to manage the 1% Annual exceedance probability (AEP) event.

Technical memo

Changes proposed in the amended 2024 LSP are summarized in Figure 1 and are considered relatively minor. The stormwater management will be largely consistent with the approved LSP and LWMS with all runoff in the 1% AEP event from Stages 9, 10 and 11 draining being managed within basins located in POS N or POS M. The proposed stormwater management in POS N and POS M is summarised in the subsections below.

POS M - Flood Management

Stormwater modelling was undertaken to inform the Parkland Heights Stage 11 UWMP and demonstrated that sufficient flood storage will be provided in POS M basin to cater for the 1% AEP event. The stormwater modelling adopted the amended 2024 LSP layout and land use type, as well as an increased catchment area relative to the approved LWMS. The stormwater management plan for POS M basin is presented in Figure 3.

POS N – Flood Management

In the amended 2024 LSP the:

- Allocated POS and drainage area in POS N is 6623 m^2 which is almost three times larger than the specified 2227 m^2 basin top area detailed in the LWMS (Figure 4)
- The catchment area draining into POS N basin will be significantly smaller than the catchment area proposed in the LWMS as presented in Figure 2, and
- The proposed changes to the LSP presented in Figure 1 will have negligible impact on total runoff to the basins.

Given the above, the required size of POS N basin is expected to be smaller than the 2227 m^2 estimated in the LWMS and significantly smaller than the allocated size of POS N.

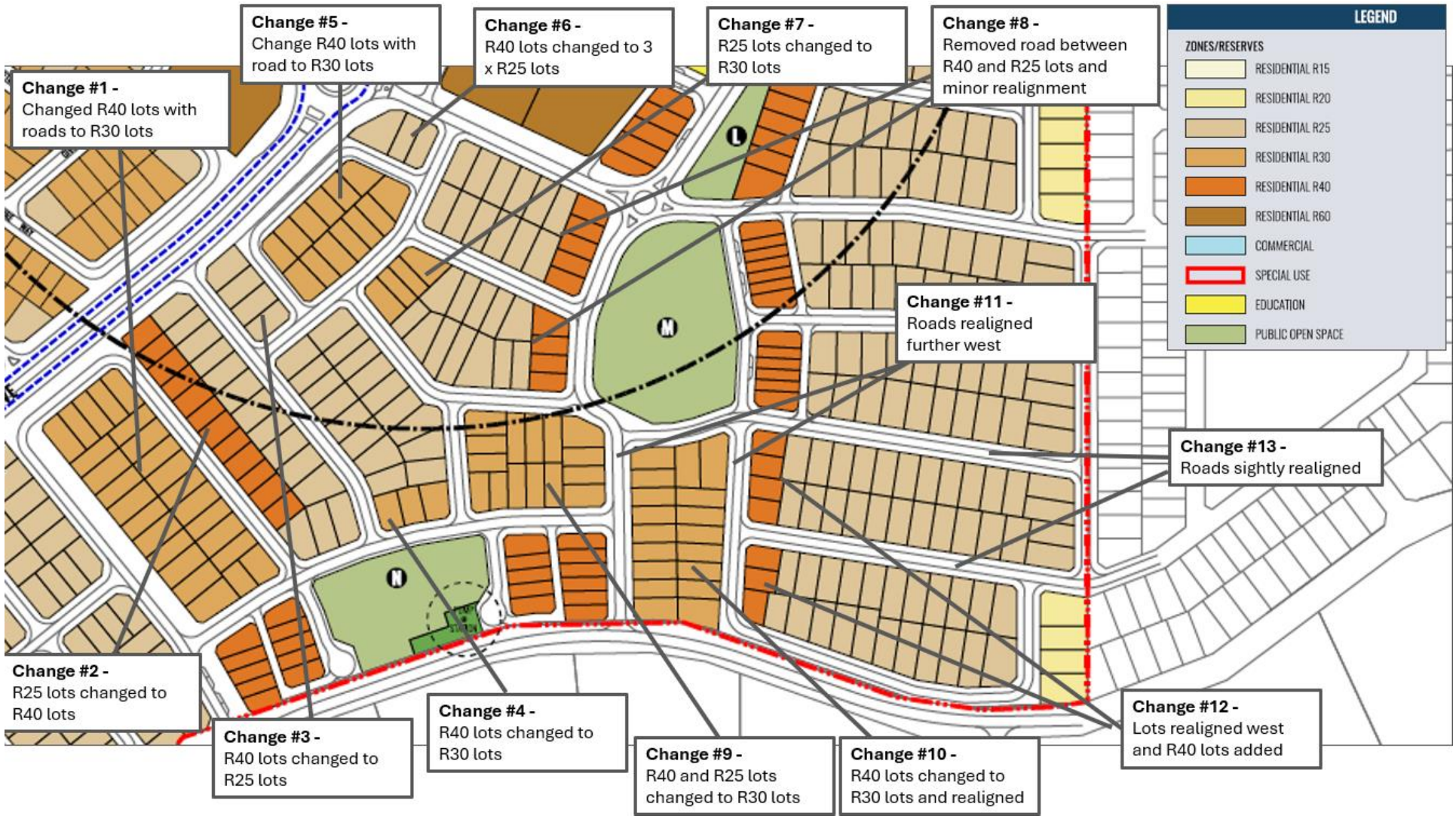


Figure 1: Main changes to 2024 LSP amendment

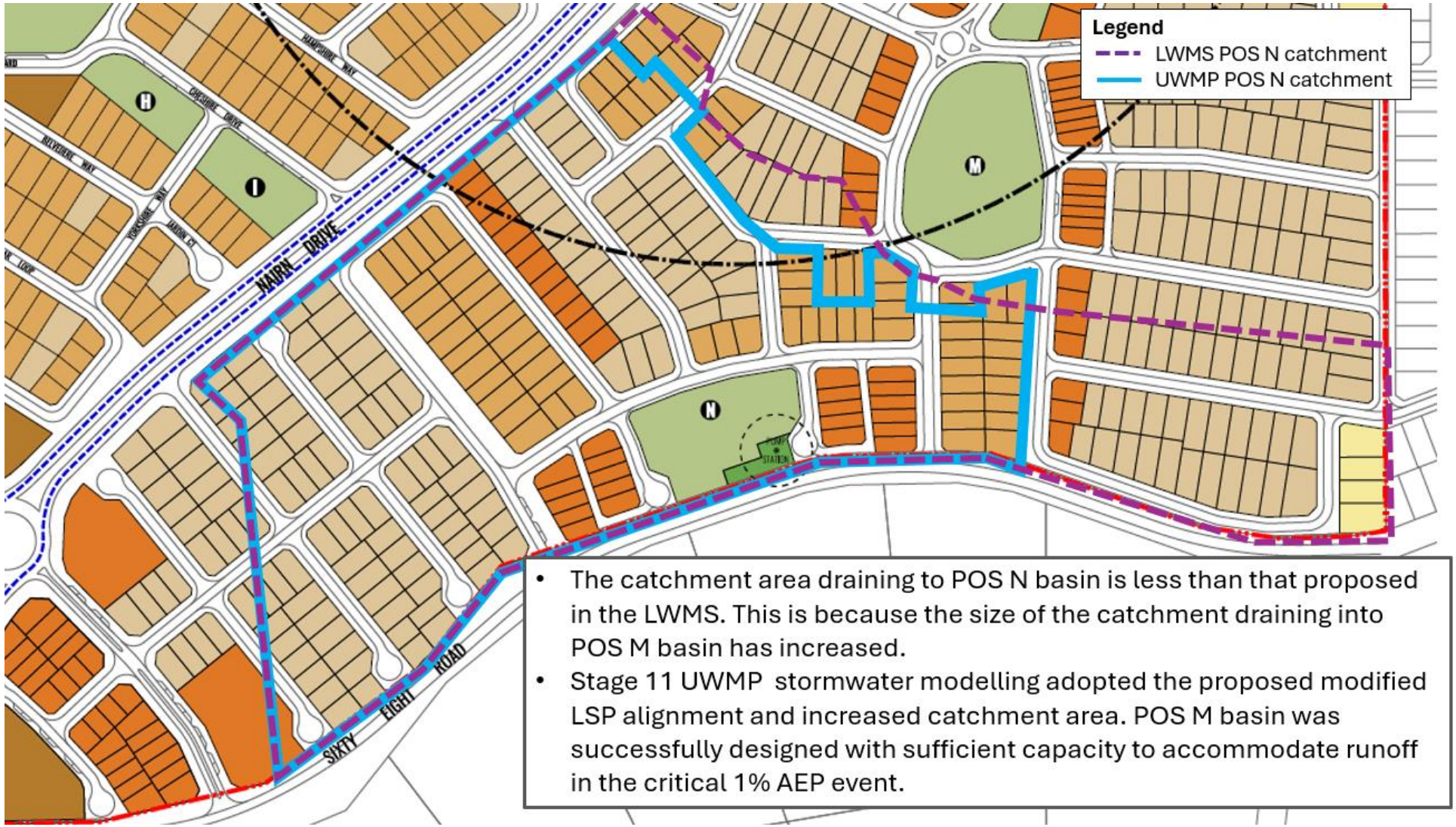


Figure 2: POS N basin catchment boundary

Pentium Water Pty Ltd | ACN: 655 914 015 | Level 1, 640 Murray St West Perth WA
T +61 (0) 8 6182 1790| **E** info@pentiumwater.com.au | **pentiumwater.com.au**

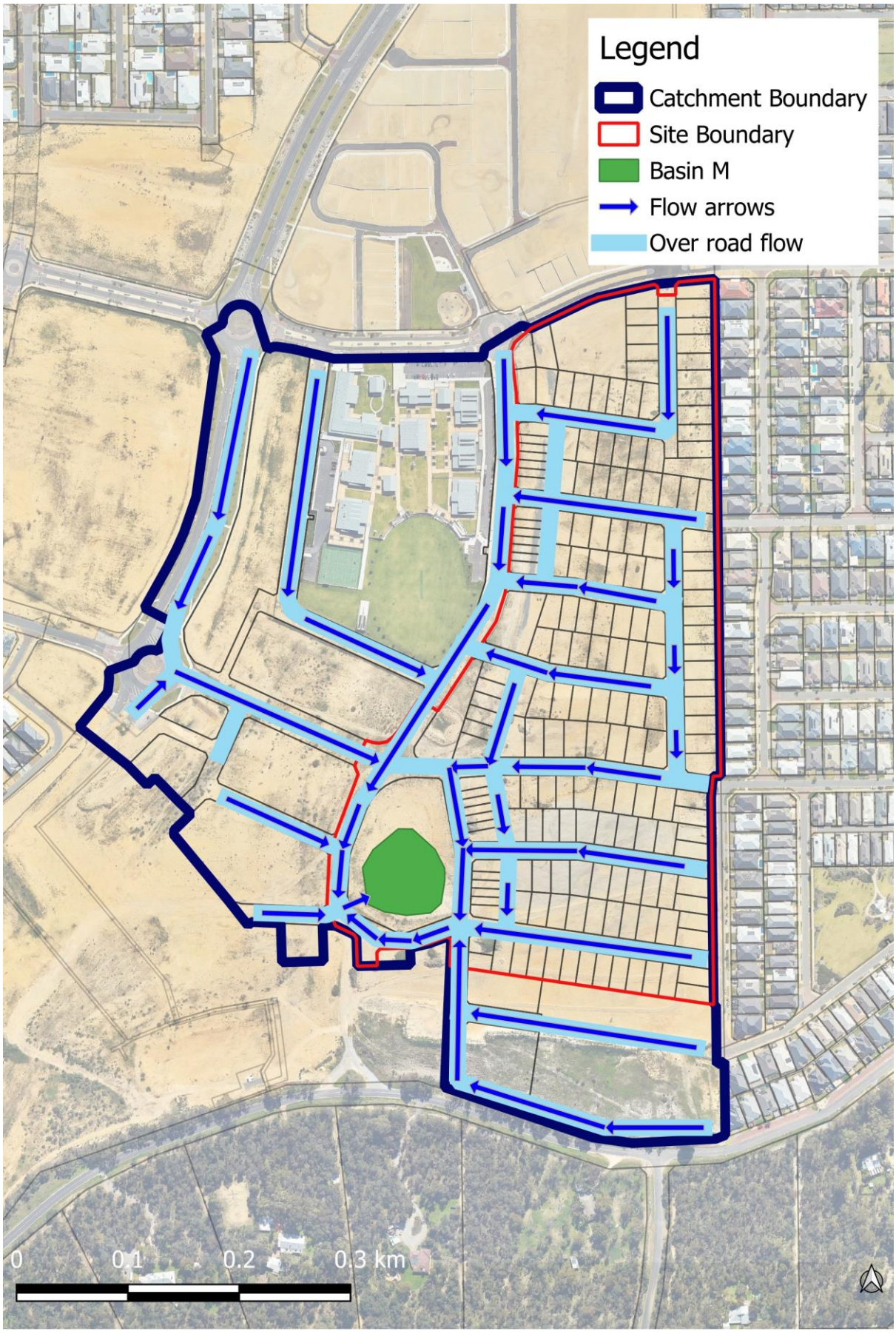


Figure 3: POS M Stage 11 UWMP stormwater management

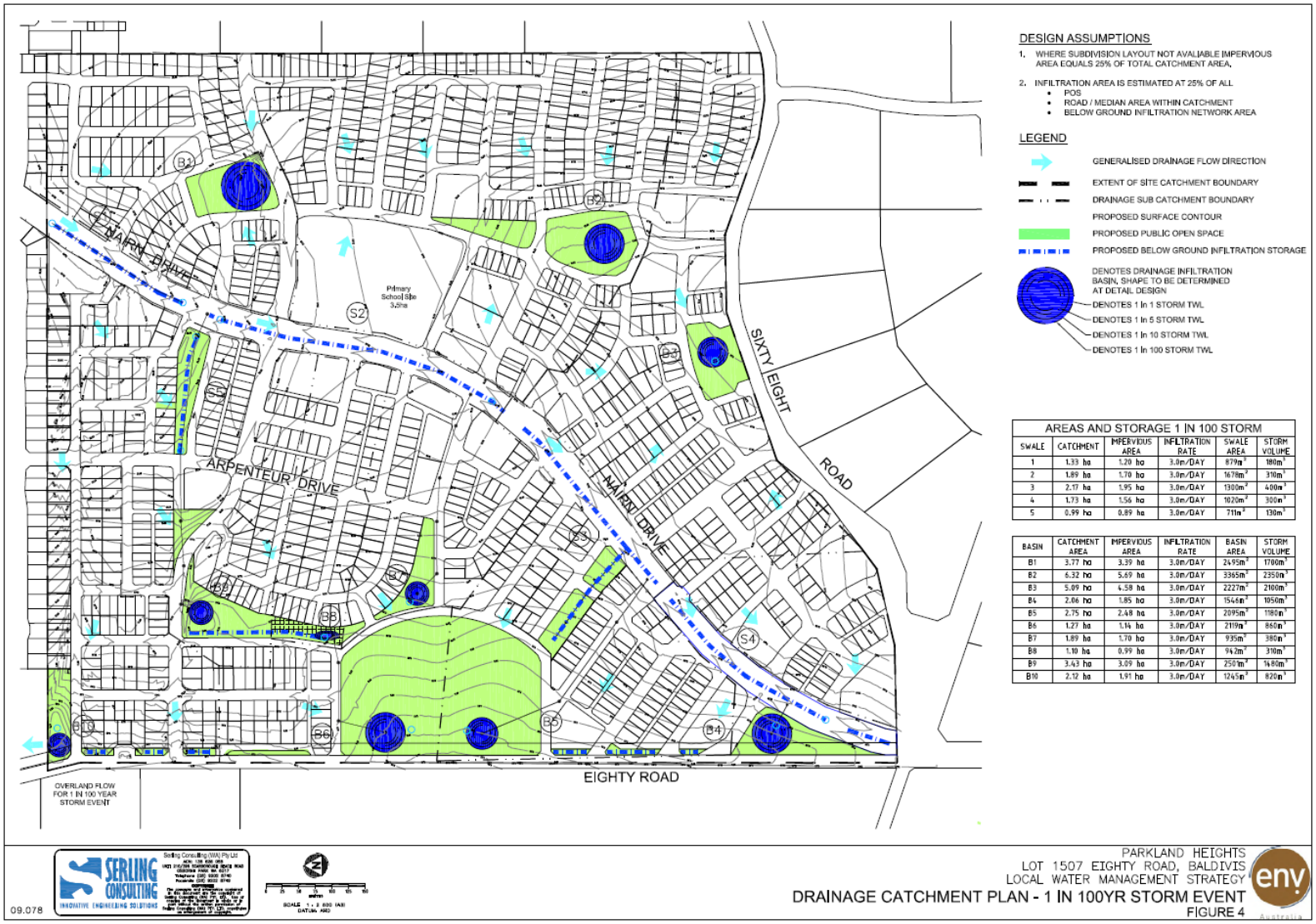


Figure 4: Stormwater plan proposed in the LWMS (ENV Australia 2011)

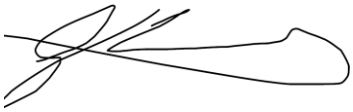
Conclusion

The changes to the layout and land use types proposed within stages 8, 9 and 10 of the amended 2024 LSP will result in relatively minor changes to the stormwater management strategy detailed in the approved LWMS. This technical memorandum demonstrates that all run-off generated in the 1% AEP event will be adequately managed and infiltrated within POS N and POS M basins consistent with the LWMS.

Further water management details will be provided at detailed design stage and documented in the future UWMPs to support subdivision application.

Yours sincerely,

for Pentium Water



Gerard Edwards
Principal Hydrologist
Urban Water Management
gedwards@pentiumwater.com.au
+61 8 6182 1790

Enc:

Attachment A: *Proposed Local Structure Plan, Lot 1507 Eighty Road*, Baldivis (Creative Design and Planning 2024)
Attachment B: *Indicative Staging Plan, Parkland Heights, Baldivis* (Creative Design and Planning 2024)
Attachment C: *Proposed Freehold Subdivision, Lot 9018 Nairn Drive, Parkland Heights* (Creative Design and Planning 2024)
Attachment D: *Proposed Freehold Subdivision Lot 9015 Nairn Drive, Parkland Heights Approval Subject to Conditions* (Western Australian Planning Commission 2023)
Attachment E: *Local Structure Plan, Lot 1507 Eighty Road, Baldivis* (Creative Design and Planning 2018)
Attachment F: *Addendum to the Parkland Heights Lot 1507 Eighty Road, Baldivis Local Water Management Strategy Local Water Management Strategy* (RPS Group 2020)

LEGEND

ZONES/RESERVES

- RESIDENTIAL R15
- RESIDENTIAL R20
- RESIDENTIAL R25
- RESIDENTIAL R30
- RESIDENTIAL R40
- RESIDENTIAL R60
- COMMERCIAL
- SPECIAL USE
- EDUCATION
- PUBLIC OPEN SPACE

OTHER

- LOCAL STRUCTURE PLAN BOUNDARY
- 400m NEIGHBOURHOOD WALKABLE CATCHMENT
- PUMP STATION ODOUR BUFFER
- POWERLINE EASEMENT
- ROAD WIDENING (SIXTY EIGHT ROAD)
- PLANNED BUS ROUTE
- VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
- SEWER PUMP STATION (900m^2 - 1220m^2)

NOTES

1. The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boundary.
2. The access street and associated lot layout shown on the plan is indicative only and subject to refinement as part of the detailed subdivision process.
3. POS Areas are indicative only and subject to further detailed design and drainage considerations.
4. All road carriageway detail depicted on the Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on the Plan are subject to pre-cal and final survey and may vary from figures shown.
5. Bushfire attack level to be reviewed prior to creation of titles. Development may require construction in accordance with AS3959 - Construction in Bushfire Prone Areas.
6. Sixty-Eight Road widening to accomodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.

LOCAL STRUCTURE PLAN MAP

Lot 1507 Eighty Road, BALDIVIS

A Rockingham Park Project

NORTH

Scale: 1:6000 @ A3

0 60 120 180m

PLAN: RHPPH-2-001 REVISION: A
DATE: 08/05/2024 DRAWN: JP
PROJECTION: PCG 94 PLANNER: CH
DATUM: AHD CHECK: KB

cdp
Town Planning & Urban Design
Unit 2, 464 Murray Street
Perth WA 6000
(08) 6333 1888
info@cdpaus.com.au
www.cdpaus.com.au

STAGE LOT SUMMARY

STAGE 1	
TYPE	LOTS
SINGLE RESIDENTIAL	108
GROUPED HOUSING	-
Total	108

STAGE 2A & 2B	
TYPE	LOTS
SINGLE RESIDENTIAL	65
GROUPED HOUSING	-
Total	65

STAGE 3	
TYPE	LOTS
SINGLE RESIDENTIAL	91
GROUPED HOUSING	1
Total	92

STAGE 4	
TYPE	LOTS
SINGLE RESIDENTIAL	73
GROUPED HOUSING	1
Total	74

STAGE 5	
TYPE	LOTS
SINGLE RESIDENTIAL	60
GROUPED HOUSING	3
Total	63

STAGE 6 & 6B	
TYPE	LOTS
SINGLE RESIDENTIAL	61
GROUPED HOUSING	3
Total	64

STAGE 7	
TYPE	LOTS
SINGLE RESIDENTIAL	27
GROUPED HOUSING	1
Total	28

STAGE 8	
TYPE	LOTS
SINGLE RESIDENTIAL	83
GROUPED HOUSING	2
Total	85

STAGE 9	
TYPE	LOTS
SINGLE RESIDENTIAL	210
GROUPED HOUSING	2
Total	212

STAGE 10	
TYPE	LOTS
SINGLE RESIDENTIAL	39
GROUPED HOUSING	-
Total	39

STAGE 11A	
TYPE	LOTS
SINGLE RESIDENTIAL	54
GROUPED HOUSING	1
Total	55

STAGE 11B	
TYPE	LOTS
SINGLE RESIDENTIAL	46
GROUPED HOUSING	1
Total	47

STAGE 11C	
TYPE	LOTS
SINGLE RESIDENTIAL	56
GROUPED HOUSING	-
Total	56

STAGE 11D	
TYPE	LOTS
SINGLE RESIDENTIAL	30
GROUPED HOUSING	-
Total	30

STAGE 13	
TYPE	LOTS
SINGLE RESIDENTIAL	79
GROUPED HOUSING	-
Total	79

STAGE 15/16	
TYPE	LOTS
SINGLE RESIDENTIAL	15
GROUPED HOUSING	0
Total	15

STAGE 14	
TYPE	LOTS
SINGLE RESIDENTIAL	83
GROUPED HOUSING	1
Total	84

OVERALL	
TYPE	LOTS
SINGLE RESIDENTIAL	1180
GROUPED HOUSING	16
Total	1196

LEGEND

ZONES/RESERVES

- RESIDENTIAL R15
- RESIDENTIAL R20
- RESIDENTIAL R25
- RESIDENTIAL R30
- RESIDENTIAL R40
- RESIDENTIAL R60
- COMMERCIAL
- EDUCATION
- PUBLIC OPEN SPACE

OTHER

- LOCAL STRUCTURE PLAN BOUNDARY
- STAGING BOUNDARY (APPROVED SUBDIVISION)
- STAGING BOUNDARY (FUTURE INDICATIVE SUBDIVISION - SUBJECT TO CHANGE)
- SEWER PUMP STATION
- POWERLINE EASEMENT
- ROAD WIDENING (SIXTY EIGHT ROAD)
- WATER
- SEWER

PUBLIC OPEN SPACE TABLE

NOTES	AREA (ha)	NOTES	CREDITABLE AREA (ha)
A	0.4823	I	0.3235
B	0.1463	J	CONVERTED TO ROAD RESERVE
C	1.1240	K	0.5256
D	0.2283	L	0.2328
E	0.5575	M	1.0983
F	5.7711	N	0.7364
G	0.5129	O	0.8475
H	0.2747		
TOTAL AREA OF POS & DRAINAGE			12.8566ha
% OF GROSS LANDHOLDING			10.62%

INDICATIVE STAGING PLAN

Parkland Heights, BALDIVIS

A Rockingham Park Project

NORTH

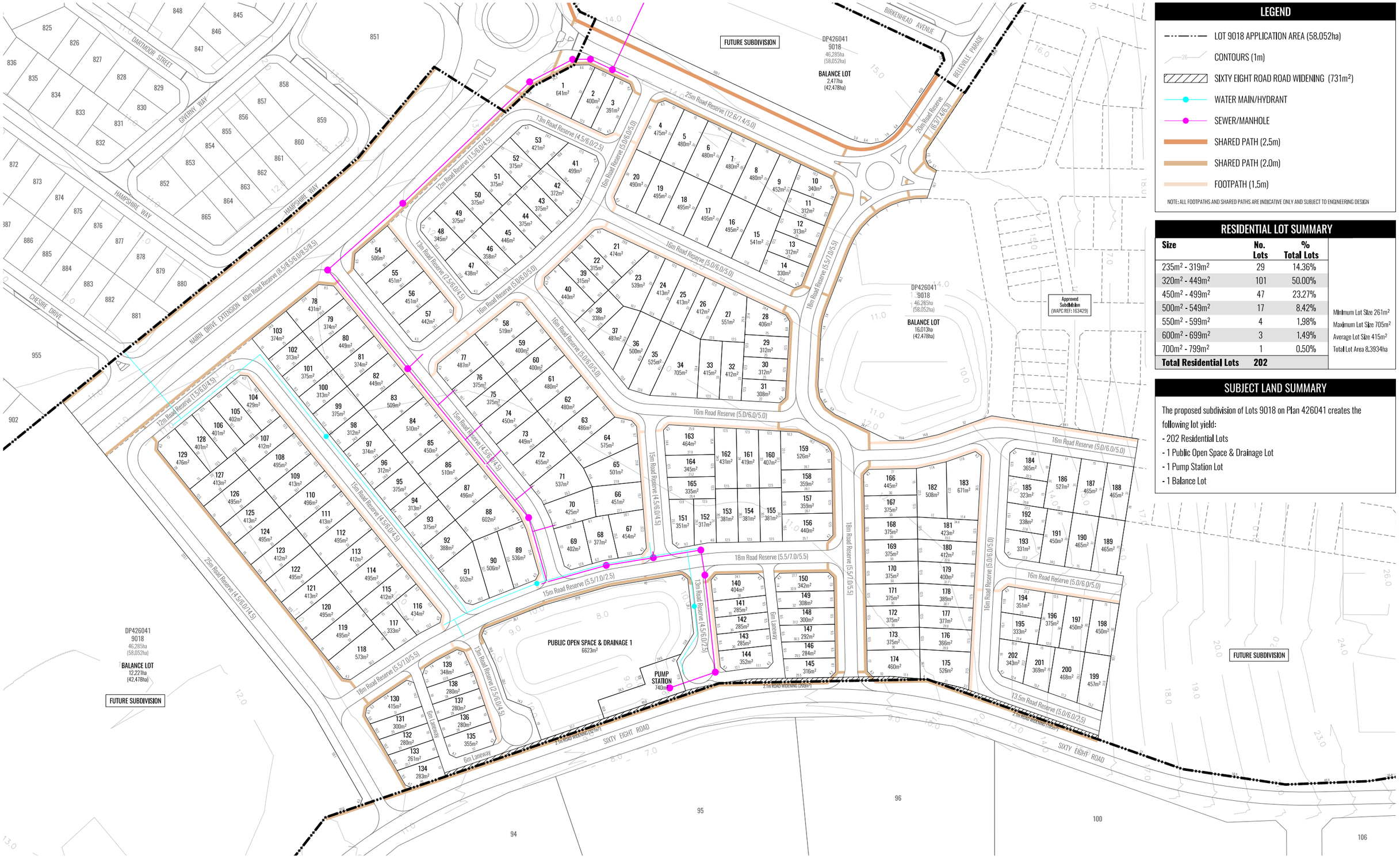
Scale: 1:6000 @ A3

0 60 120 180m

PLAN: RHPPH-1-018 REVISION: G
DATE: 27/02/2024 DRAWN: JP
PROJECTION: PCG 94 PLANNER: CH
DATUM: AHD CHECK: KB

cdp Town Planning & Urban Design

Unit 2, 464 Murray Street
Perth WA 6000
(08) 6333 1888
info@cdpaus.com.au
www.cdpaus.com.au



LEGEND

- LOT 9018 APPLICATION AREA (58.052ha)
- CONTOURS (1m)
- SIXTY EIGHT ROAD ROAD WIDENING (731m²)
- WATER MAIN/HYDRANT
- SEWER/MANHOLE
- SHARED PATH (2.5m)
- SHARED PATH (2.0m)
- FOOTPATH (1.5m)

NOTE: ALL FOOTPATHS AND SHARED PATHS ARE INDICATIVE ONLY AND SUBJECT TO ENGINEERING DESIGN

RESIDENTIAL LOT SUMMARY

Size	No. Lots	% Total Lots
235m² - 319m²	29	14.36%
320m² - 449m²	101	50.00%
450m² - 499m²	47	23.27%
500m² - 549m²	17	8.42%
550m² - 599m²	4	1.98%
600m² - 699m²	3	1.49%
700m² - 799m²	1	0.50%
Total Residential Lots	**202**	

Minimum Lot Size 261m²
Maximum Lot Size 705m²
Average Lot Size 415m²
Total Lot Area 8.3934ha

SUBJECT LAND SUMMARY

The proposed subdivision of Lots 9018 on Plan 426041 creates the following lot yield:

- 202 Residential Lots
- 1 Public Open Space & Drainage Lot
- 1 Pump Station Lot
- 1 Balance Lot

PROPOSED FREEHOLD SUBDIVISION

Lot 9018 Nairn Drive, PARKLANDS HEIGHTS Page 1 of 2

A Rockingham Park Project

NORTH

Scale: 1:2000 @ A3

0 20 40 60m

PLAN: RHPPH-3-012 REVISION: B
DATE: 12/03/2024 DRAWN: JP
PROJECTION: PCG 94 PLANNER: BK
DATUM: AHD CHECK: CH

cdp
Town Planning & Urban Design

Unit 2, 464 Murray Street
Perth WA 6000
(08) 6333 1888
info@cdpaus.com.au
www.cdpaus.com.au

Western Australian Planning Commission

Your Ref : RHPPHSUB

Cdp Town Planning & Urban Design
2/464 Murray Street
PERTH WA 6000

Approval Subject To Condition(s)
Freehold (Green Title) Subdivision

Application No : 163429

Planning and Development Act 2005

Applicant	:	Cdp Town Planning & Urban Design 2/464 Murray Street PERTH WA 6000
Owner	:	Rockingham Park Pty Ltd 242 Leach Highway Myaree MYAREE WA 6154
Application Receipt	:	28 March 2023

Lot Number	:	
Diagram / Plan	:	423718
Location	:	
C/T Volume/Folio	:	4029/667
Street Address	:	Lot 9015 Regency Av, Baldivis
Local Government	:	City of Rockingham

The Western Australian Planning Commission has considered the application referred to and is prepared to endorse a deposited plan in accordance with the plan date-stamped **28 March 2023** once the condition(s) set out have been fulfilled.

This decision is valid for **four years** from the date of this advice, which includes the lodgement of the deposited plan within this period.

The deposited plan for this approval and all required written advice confirming that the requirement(s) outlined in the condition(s) have been fulfilled must be submitted by **24 July 2027** or this approval no longer will remain valid.

140 William Street, Perth, Western Australia 6000, Locked Bag 2506 Perth, 6001
Tel: (08) 6551 8002; Fax: (08) 6551 9001; Infoline: 1800 626 477
e-mail: info@dplh.wa.gov.au; web address http://www. dplh.wa.gov.au
ABN 35 482 341 493

Reconsideration - 28 days

Under section 151(1) of the *Planning and Development Act 2005*, the applicant/owner may, within 28 days from the date of this decision, make a written request to the WAPC to reconsider any condition(s) imposed in its decision. One of the matters to which the WAPC will have regard in reconsideration of its decision is whether there is compelling evidence by way of additional information or justification from the applicant/owner to warrant a reconsideration of the decision. A request for reconsideration is to be submitted to the WAPC on a Form 3A with appropriate fees. An application for reconsideration may be submitted to the WAPC prior to submission of an application for review. Form 3A and a schedule of fees are available on the WAPC website: http://www.dplh.wa.gov.au

Right to apply for a review - 28 days

Should the applicant/owner be aggrieved by this decision, there is a right to apply for a review under Part 14 section 251 of the *Planning and Development Act 2005*. The application for review must be submitted in accordance with part 2 of the *State Administrative Tribunal Rules 2004* and should be lodged within 28 days of the date of this decision to: the State Administrative Tribunal, Level 6, State Administrative Tribunal Building, 565 Hay Street, PERTH, WA 6000. It is recommended that you contact the tribunal for further details: telephone 9219 3111 or go to its website: http://www.sat.justice.wa.gov.au

Deposited plan

The deposited plan is to be submitted to the Western Australian Land Information Authority (Landgate) for certification. Once certified, Landgate will forward it to the WAPC. In addition, the applicant/owner is responsible for submission of a Form 1C with appropriate fees to the WAPC requesting endorsement of the deposited plan. A copy of the deposited plan with confirmation of submission to Landgate is to be submitted with all required written advice confirming compliance with any condition(s) from the nominated agency/authority or local government. Form 1C and a schedule of fees are available on the WAPC website: http://www.dplh.wa.gov.au

Condition(s)

The WAPC is prepared to endorse a deposited plan in accordance with the plan submitted once the condition(s) set out have been fulfilled.

The condition(s) of this approval are to be fulfilled to the satisfaction of the WAPC.

The condition(s) must be fulfilled before submission of a copy of the deposited plan for endorsement.

The agency/authority or local government noted in brackets at the end of the condition(s) identify the body responsible for providing written advice confirming that the WAPC's requirement(s) outlined in the condition(s) have been fulfilled. The written advice of the agency/authority or local government is to be obtained by the applicant/owner. When the

written advice of each identified agency/authority or local government has been obtained, it should be submitted to the WAPC with a Form 1C and appropriate fees and a copy of the deposited plan.

If there is no agency/authority or local government noted in brackets at the end of the condition(s), a written request for confirmation that the requirement(s) outlined in the condition(s) have been fulfilled should be submitted to the WAPC, prior to lodgement of the deposited plan for endorsement.

Prior to the commencement of any subdivision works or the implementation of any condition(s) in any other way, the applicant/owner is to liaise with the nominated agency/authority or local government on the requirement(s) it considers necessary to fulfil the condition(s).

The applicant/owner is to make reasonable enquiry to the nominated agency/authority or local government to obtain confirmation that the requirement(s) of the condition(s) have been fulfilled. This may include the provision of supplementary information. In the event that the nominated agency/authority or local government will not provide its written confirmation following reasonable enquiry, the applicant/owner then may approach the WAPC for confirmation that the condition(s) have been fulfilled.

In approaching the WAPC, the applicant/owner is to provide all necessary information, including proof of reasonable enquiry to the nominated agency/authority or local government.

The condition(s) of this approval, with accompanying advice, are:

CONDITIONS

Administrative

1. The plan of subdivision is to be modified in accordance with the attached plan (Attachment A) dated 29 June 2023. (Western Australian Planning Commission)

2. The landowner/applicant contributing towards development infrastructure provisions pursuant to the City of Rockingham Local Planning Scheme No.2. (Local Government)

Drainage and site works

3. Uniform fencing being constructed along the boundaries of lots abutting public open space. (Local Government)

4. Engineering drawings and specifications are to be submitted, approved, and works undertaken in accordance with the approved engineering drawings, specifications and approved plan of subdivision, for grading and/or stabilisation of the site to ensure that:

(a) lots can accommodate their intended use; and
(b) finished ground levels at the boundaries of the lot(s) the subject of this approval match or otherwise coordinate with the existing and/or proposed finished ground levels of the land abutting. (Local Government)

5. Prior to the commencement of subdivisional works, an urban water management plan is to be prepared and approved, in consultation with the Department of Water and Environmental Regulation, consistent with any approved local water management strategy. (Local Government)

6. Engineering drawings and specifications are to be submitted and approved, and works undertaken in accordance with the approved engineering drawings and specifications and approved plan of subdivision, for the filing and/or draining of the land, including ensuring that stormwater is contained on-site, or appropriately treated and connected to the local drainage system. Engineering drawings and specifications are to be in accordance with an approved urban water management plan for the site, or where no urban water management plan exists, to the satisfaction of the Western Australian Planning Commission. (Local Government)

7. Prior to the commencement of subdivisional works, the landowner/applicant is to provide a pre-works geotechnical report certifying that the land is physically capable of development or advising how the land is to be remediated and compacted to ensure it is capable of development; and in the event that remediation works are required, the landowner/applicant is to provide a post geotechnical report certifying that all subdivisional works have been carried out in accordance with the pre-works geotechnical report. (Local Government)

8. Suitable arrangements being made for connection of the land to the comprehensive district drainage system at the landowner/applicant's cost. (Local Government)

9. Drainage easements and reserved as may be required by the local government for drainage infrastructure being shown on the diagram or plan of survey (deposited plan) as such, granted free of cost, and vested in that local government under Sections 152 and 167 of the *Planning and Development Act 2005*. (Local Government)

Lot design

10. Local development plan(s) being prepared and approved for lots that are accessed via a laneway and/or with direct frontage to public open space as shown on the plan dated 29 June 2023 (attached) that address the following:

    (a) lots to be elevated a minimum 500mm above public open space, with open style front fencing;
    (b) provision of a footpath at least 1.5 metres-wide between lots and public open space, with sufficient lighting to access the front of the property;
    (c) access and parking arrangements; and
    (d) garage locations.

    (Local Government)

11. The landowner/applicant shall make arrangements to ensure that prospective purchasers of lots subject of a local development plan are advised in writing that local development plan provisions apply. (Local Government)

Transport, roads and access

12. Engineering drawings and specifications are to be submitted, approved and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications, to ensure that those lots not fronting an existing road are provided with frontage to a constructed road(s) connected by a constructed road(s) to the local road system and such road(s) are constructed and drained at the landowner/applicant's cost.

    As an alternative, and subject to the agreement of the local government the Western Australian Planning Commission is prepared to accept the landowner/applicant paying to the local government the cost of such road works as estimated by the local government and the local government providing formal assurance to the Western Australian Planning Commission confirming that the works will be completed within a reasonable period as agreed by the Western Australian Planning Commission. (Local Government)

13. Engineering drawings and specifications are to be submitted and approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications to ensure that:

    (a) street lighting in accordance with dark sky principles is installed on all new subdivisional roads to the standards of the relevant licensed service provider;
    (b) roads that have been designed to connect with existing or proposed roads abutting the subject land are coordinated so the road reserve location and width connect seamlessly;
    (c) temporary turning areas are provided to those subdivisional roads that are subject to future extension; and
    (d) embayment parking is provided abutting the proposed public open space reserves, Grouped Housing Site 69 and lots subject to an R40 residential density code.

    (Local Government)

14. Engineering drawings and specifications are to be submitted, approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications, for the provision of shared paths through and connecting to the application area. The approved shared paths are to be constructed by the landowner/applicant. (Local Government)

15. All local streets within the subdivision being truncated in accordance with Western Australian Planning Commission's *Liveable Neighbourhoods* policy. (Local Government)

140 William Street, Perth, Western Australia 6000, Locked Bag 2506 Perth, 6001
Tel: (08) 6551 8002; Fax: (08) 6551 9001; Infoline: 1800 626 477
e-mail: info@dplh.wa.gov.au; web address http://www. dplh.wa.gov.au
ABN 35 482 341 493

Reserves

16. The proposed reserve(s) shown on the approved plan of subdivision being shown on the diagram or plan of survey (deposited plan) as reserve(s) for public open space and drainage (as applicable) and vested in the Crown under Section 152 of the *Planning and Development Act 2005*, such land to be ceded free of cost and without any payment of compensation by the Crown. (Local Government)

17. Arrangements being made for the proposed public open space to be developed by the landowner/applicant to a minimum standard and maintained for two summers through the implementation of an approved landscape plan providing for the development and maintenance of the proposed public open space in accordance with the requirements of Liveable Neighbourhoods and/or dark sky principles and to the specifications of the local government. (Local Government)

Servicing

18. Arrangements being made with a licensed electricity network operator for the provision of an underground electricity distribution system that can supply electricity to each lot shown on the approved plan of subdivision. (Western Power)

19. The transfer of land as a Crown reserve free of cost to Western Power for the provision of electricity supply infrastructure. (Western Power)

20. Suitable arrangements being made with the Water Corporation so that provision of a suitable water supply service will be available to lot(s) shown on the approved plan of subdivision. (Water Corporation)

21. Suitable arrangements being made with the Water Corporation so that provision of a sewerage service will be available to the lot(s) shown on the approved plan of subdivision. (Water Corporation)

Notifications

22. A notification, pursuant to Section 165 of the *Planning and Development Act 2005* is to be placed on the certificates of title of the proposed lot(s) advising of the existence of a hazard or other factor. Notice of this notification is to be included on the diagram or plan of survey (deposited plan). The notification is to state as follows:

    "This lot is in close proximity to known mosquito breeding areas. The predominant mosquito species is known to carry viruses and other diseases."
    (Western Australian Planning Commission)

140 William Street, Perth, Western Australia 6000, Locked Bag 2506 Perth, 6001
Tel: (08) 6551 8002; Fax: (08) 6551 9001; Infoline: 1800 626 477
e-mail: info@dplh.wa.gov.au; web address http://www. dplh.wa.gov.au
ABN 35 482 341 493

ADVICE:

1. Condition 5 has been imposed in accordance with *Better Urban Water Management Guidelines (WAPC 2008).* Further guidance on the contents of urban water management plans is provided in *'Urban Water Management Plans: Guidelines for preparing and complying with subdivision conditions' (Published by the then Department of Water 2008).*

2. The landowner/applicant and the local government are advised to refer to the Institute of Public Works Engineering Australasia's *Local Government Guidelines for Subdivisional Development* (current edition). The guidelines set out the minimum best practice requirements recommended for subdivision construction and granting clearance of engineering conditions imposed.

3. The landowner/applicant is advised that the Department of Water and Environmental Regulation has prepared dust control guidelines for development sites, which, outline the procedures for the preparation of dust management plans.

   The dust management plans are generally approved, and their implementation overseen, by the Local Government. Further information on the guidelines can be obtained from the Department of Water and Environmental Regulation's website www.dwer.wa.gov.au under air quality publications.

4. With regard to Conditions 12 to 15, the landowner/applicant is advised that the road reserves, including the constructed carriageways, laneways, truncations, footpaths/dual use paths and car embayment's, are to be generally consistent with the approved plan of subdivision.

5. With regard to Condition 13, the landowner/applicant is advised that to achieve the dark sky principles, new street lighting is to comply with a correlated colour temperature of 3,000 kelvins or less, shielded luminaires and in accordance with *AS4282:2010 - control of the obtrusive effects of lighting.*

6. With regard to Condition 17, the development is to include full earthworks, reticulation, grassing of key areas, and pathways that form part of the overall pedestrian and/or cycle network. The works are to be seamless with abutting public open space.
   Any lighting within the public open space shall comply with the dark sky principles and AS4282:2010 - control of the obtrusive effects of lighting. Smart lighting should also be installed to ensure that lighting infrastructure is capable of remote operation and/or timing.

7. With regard to Condition 18, Western Power provides only one point of electricity supply per freehold (green title) lot.

8. With regard to Conditions 20 to 21, the landowner/applicant shall make arrangements with the Water Corporation for the provision of the necessary services. On receipt of a request from the landowner/ applicant, a Land Development Agreement under Section 83 of the *Water Services Act 2012* will be prepared by the Water Corporation to document the specific requirements for the proposed subdivision.

9. The applicant/landowner is advised that pursuant to the *Commonwealth Telecommunications Act 1997* there will generally be a requirement for the installation of fibre-ready telecommunications infrastructure. Exemptions can be sought for certain types of development. Further information is available from the Australian Government Department of Infrastructure, Transport, Regional Development and Communications website at www.infrastructure.gov.au.

10. Prior to the commencement of subdivisional works, the landowner/applicant needs to be aware of their obligations under the *Aboriginal Cultural Heritage Act 2021*. The Aboriginal Cultural Heritage Management Code sets out the process for meeting those obligations.

Ms Sam Fagan
Secretary
Western Australian Planning Commission
24 July 2023

Enquiries : Lisa Hall (Ph 9586 4690)

140 William Street, Perth, Western Australia 6000, Locked Bag 2506 Perth, 6001
Tel: (08) 6551 8002; Fax: (08) 6551 9001; Infoline: 1800 626 477
e-mail: info@dplh.wa.gov.au; web address http://www. dplh.wa.gov.au
ABN 35 482 341 493

LEGEND

LOT 9015 APPLICATION AREA (62.359ha)

CONTOURS (1m)

NOTE: ALL FOOTPATHS AND SHARED PATHS ARE INDICATIVE ONLY AND SUBJECT TO ENGINEERING DESIGN

RESIDENTIAL LOT SUMMARY

Size	No. Lots	% Total Lots
180m² - 234m²	18	9.73%
235m² - 319m²	3	1.62%
320m² - 449m²	13	7.03%
450m² - 499m²	46	24.86%
500m² - 549m²	70	37.84%
550m² - 599m²	22	11.89%
600m² - 699m²	11	5.95%
700m² - 799m²	1	0.54%
800m² - 899m²	1	0.54%
Total Residential Lots	**185**	
Grouped Housing Lots	2	
Total Lots	**187**	

Minimum Lot Size 225m²
Maximum Lot Size 829m²
Average Lot Size 483m²
Total Lot Area 8.9530ha

SUBJECT LAND SUMMARY

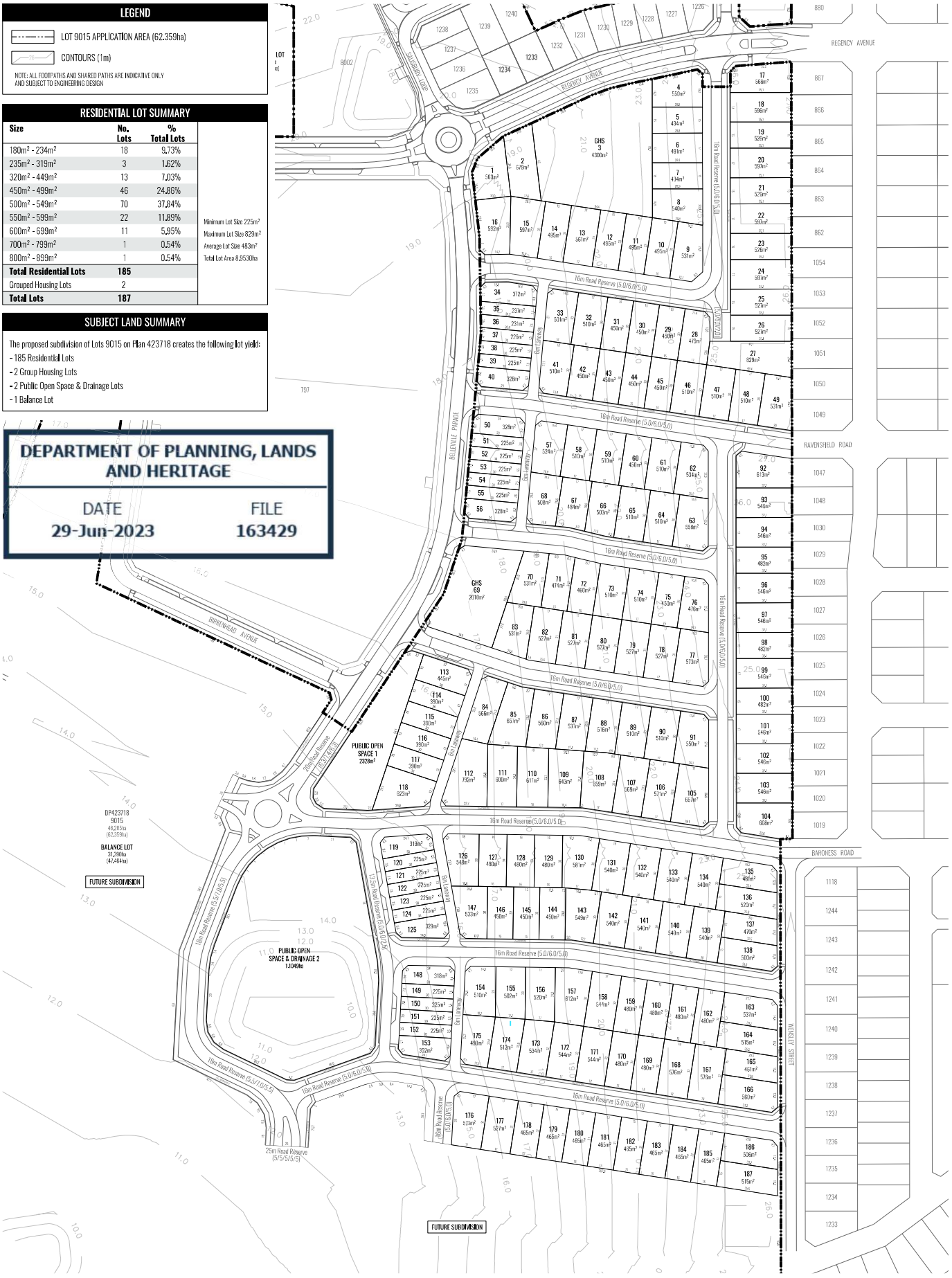
The proposed subdivision of Lots 9015 on Plan 423718 creates the following lot yield:

- 185 Residential Lots
- 2 Group Housing Lots
- 2 Public Open Space & Drainage Lots
- 1 Balance Lot

DEPARTMENT OF PLANNING, LANDS AND HERITAGE

DATE 29-Jun-2023

FILE 163429



PROPOSED FREEHOLD SUBDIVISION

Lot 9015 Nairn Drive, PARKLANDS HEIGHTS Page 1 of 2

A Rockingham Park Project

NORTH

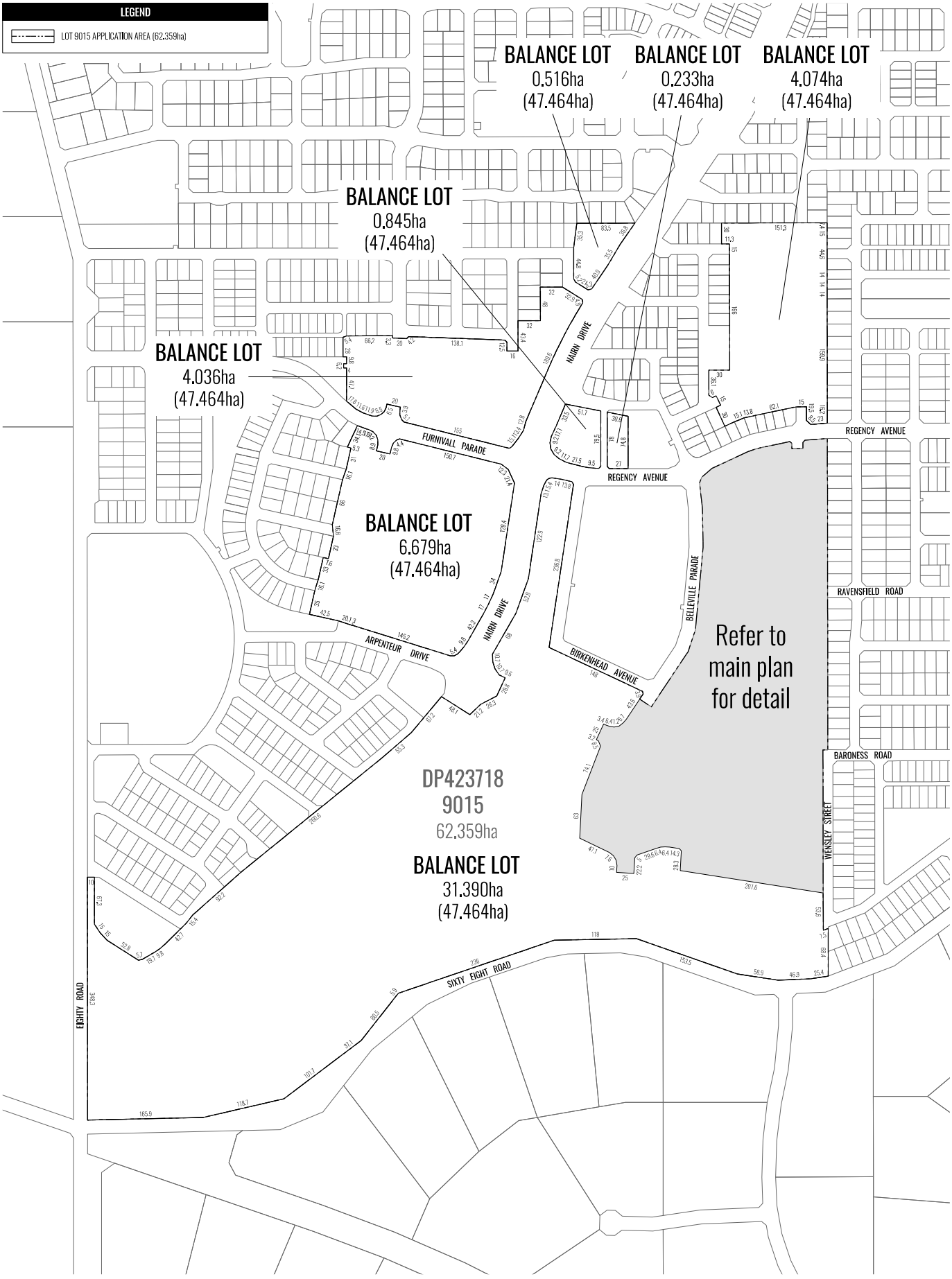
Scale: 1:2000 @ A3

0 20 40 60m

PLAN: RIPPH-3-011 REVISION: E
DATE: 09/03/2023 DRAWN: JP
PROJECTION: PCG 94 PLANNER: CH
DATUM: AHD CHECK: KB

cdp Town Planning & Urban Design

Unit 2, 464 Murray Street
Perth WA 6000
(08) 6333 1888
info@cdpaus.com.au
www.cdpaus.com.au



BALANCE LOT DETAIL

Lot 9015 Nairn Drive, PARKLANDS HEIGHTS

A Rockingham Park Project

NORTH

Scale: 1:5000 @ A3

0 50 100 150m

PLAN: RIPPH-3-011 REVISION: E
DATE: 09/03/2023 DRAWN: JP
PROJECTION: PCG 94 PLANNER: CH
DATUM: AHD CHECK: KB

cdp
Town Planning & Urban Design

Unit 2, 464 Murray Street
Perth WA 6000
(08) 6333 1888
info@cdpaus.com.au
www.cdpaus.com.au

LEGEND

ZONES/RESERVES

- RESIDENTIAL R15
- RESIDENTIAL R20
- RESIDENTIAL R25
- RESIDENTIAL R30
- RESIDENTIAL R40
- RESIDENTIAL R60
- COMMERCIAL
- SPECIAL USE
- EDUCATION
- PUBLIC OPEN SPACE

OTHER

- LOCAL STRUCTURE PLAN BOUNDARY
- 400m NEIGHBOURHOOD WALKABLE CATCHMENT
- PUMP STATION ODOUR BUFFER
- POWERLINE EASEMENT
- ROAD WIDENING (SIXTY EIGHT ROAD)
- PLANNED BUS ROUTE
- VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
- SEWER PUMP STATION (900m² - 1220m²)

NOTES

1. The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boundary.
2. The access street and associated lot layout shown on the plan is indicative only and subject to refinement as part of the detailed subdivision process.
3. POS Areas are indicative only and subject to further detailed design and drainage considerations.
4. All road carriageway detail depicted on the Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on the Plan are subject to pre-cal and final survey and may vary from figures shown.
5. Bushfire attack level to be reviewed prior to creation of titles. Development may require construction in accordance with AS3959 - Construction in Bushfire Prone Areas.
6. Sixty-Eight Road widening to accomodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.

LOCAL STRUCTURE PLAN MAP

Lot 1507 Eighty Road, BALDIVIS

A Rockingham Park Project

NORTH

Scale: 1:6000 @ A3

0 60 120 180m

PLAN: RHPPH-2-001 REVISION:
DATE: 20/11/2018 DRAWN: JP
PROJECTION: PCG 94 PLANNER: BK
DATUM: AHD CHECK: TV

Creative DESIGN+PLANNING

A 28 Brown Street, East Perth WA 6004
P (08) 9325 0200
E info@creativedp.com.au
W creativedp.com.au

Our ref: EWP20132.001

Level 2, 27-31 Troode Street
West Perth WA 6005
T +61 8 9211 1111

Date: 12 November 2020

City of Rockingham
PO Box 2142
Rockingham DC WA 6967

Dear Sir/Madam,

Parkland Heights Lot 1507 Eighty Road Baldivis - addendum to the Local Water Management Strategy

This letter has been prepared as an addendum to the Parkland Heights Lot 1507 Eighty Road Baldivis Local Water Management Strategy (LWMS) (ENV Australia 2011) to support the submitted revised Local Structure Plan (LSP) (herein referred to as 'the site').

This addendum provides updated stormwater management to support the revised LSP and demonstrates that adequate flood management provisions will be provided. This addendum should be read in conjunction with the following documents:

- Proposed Local Structure Plan, Lot 1507 Eighty Road (Creative Design and Planning 2018) (Appendix A)
- Draft Subdivision Plan, Lot 9010 Nairn Drive (Creative Design and Planning 2019) (Appendix B)
- Amendment advice, Parklands Height Structure Plan (Western Australian Planning Commission 2019) (Appendix C)
- Approved Local Structure Plan, Lot 1507 Eighty Road (Creative Design and Planning 2017) (Appendix D)
- Local Water Management Strategy Parkland Heights Lot 1507 Eighty Road, Baldivis (ENV Australia 2011) (Appendix E)
- POS K Landscape Concept Plan, Parkland Height Lot 1507 Eighty Road, Baldivis (LD Total 2020) (Appendix F)
- Irrigation Schedule, Parkland Heights Lot 1507 Eighty Road, Baldivis (LD Total 2020) (Appendix G)
- Licence to take water (Department of Water and Environmental Regulation 2018) (Appendix H)
- Stormwater Management Plan – Nairn Drive Extension (Eco Logical Australia 2020) (Appendix I)
- Lot 9009 Sixty Eight Road Drainage Management Plan (Mortons Urban Solutions 2019) (Appendix J)
- Permeability Assessment of POS Areas and Median Strip, Parklands Heights Private Estate (Galt Geotechnics Solutions 2019) (Appendix K)
- Testing of Proposed Bio Retention Soil Filter Media, Parklands Heights Private Estate (Galt Geotechnics Solutions 2019) (Appendix L).

1 Background

The purpose of this LWMS addendum is to provide updated stormwater modelling details to address the proposed changes to the approved LSP, consistent with recommendations provided by the Western Australian Planning Commission (WAPC) and comments provided by the City of Rockingham (CoR) (Appendix C).

A LWMS for Parkland Heights was prepared by ENV Australia in 2011 (Appendix E) to support the submission of the original LSP for Lot 1507 Eighty Road, Baldivis (Appendix D). The LWMS received approval by the CoR and Department of Water and Environmental Regulation (DWER). A LWMS addendum report was prepared by Mortons Urban Solutions (2018) to assess the impact to downstream infrastructure of the proposed Neighbourhood Centre, located west of Nairn Drive. No change to the LWMS' overall drainage strategy was required.

A revised LSP was prepared by Creative Design and Planning in 2018 (Appendix A) with modifications to the layout within stages 13 and 14 (refer to Figure 1 and Figure 2). A draft subdivision plan for stages 13 and 14 has also been included as Appendix B and provides a breakdown of lot sizes.

The revised LSP shows land use types proposed within stages 13 and 14 will largely remain consistent with the approved LSP with the predominant land use consisting of R25, R15 and R40 residential lots, road reserve and a relatively large Public Open Space (POS) area which provides a drainage function. In addition to this, a group home (residential R60) is now proposed in the southwestern corner of stage 14 which was previously R40 residential lots.

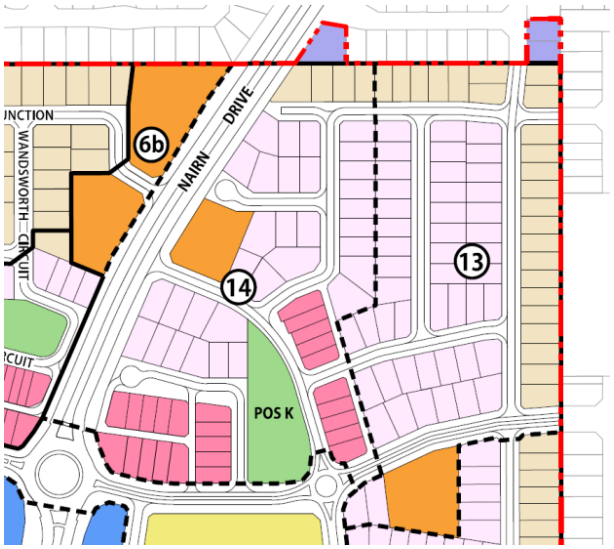


Figure 1: Stages 13 and 14 of the approved LSP (Creative Design and Planning 2017)

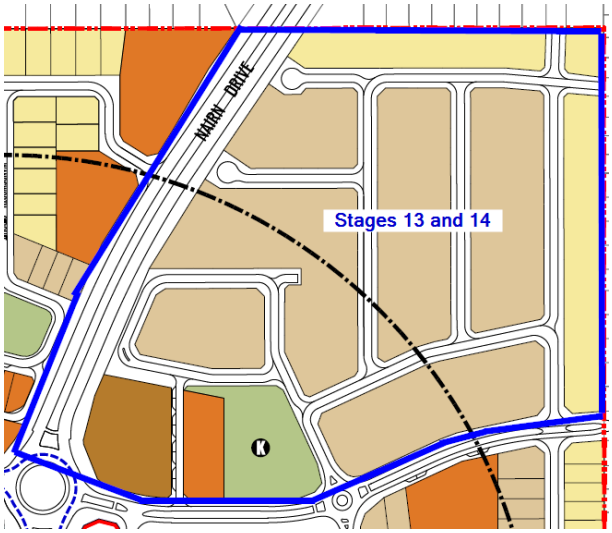


Figure 2: Stages 13 and 14 of the revised LSP (Creative Design and Planning 2018)

2 Approved LWMS

2.1 Stormwater management summary

In the approved LWMS, all run-off generated on the eastern side of Nairn Drive drains into the Basin B1 within POS K where it is infiltrated (Figure 3). Run-off was assumed to only occur from road reserve areas and was calculated using the Rational method. The infiltration areas were estimated as 25% of POS and total road verge areas, with an infiltration rate of 3 m/day. Basin B1 design as detailed in the LWMS are provided in Table 1.

Figure 3: Approved LWMS catchment plan for stages 13 and 14 (ENV Australia 2011)

Table 1: LWMS Basin B1 design (ENV Australia 2011)

Storm event (ARI)	Inundation area (m^2)	Volume (m^3)
1 year	1,878	300
5 year	2,085	740
10 year	2,159	910
100 year	2,495	1,700

3 LWMS addendum

The stormwater drainage strategy for the revised LSP is proposed to be consistent with the approved LSP and LWMS with all run-off to be drained and infiltrated in Basin B1 located within POS K. The main changes to the revised LSP is the alignment of lots and roads, as well as a slight change in land use type (i.e. lot densities) within stages 13 and 14.

The following sub-sections provide context on the similarities and differences to the approved LWMS and results from recent investigations.

3.1 Water sustainability

3.1.1 Landscaping and irrigation strategy

The landscape concept plan and cross-section for POS K was prepared by LD Total in 2020 (Appendix F). Note that the landscape plan will be subject to further detailed design at the UWMP stage. All proposed turf and planting will be irrigated, and the dense tree planting will be temporarily irrigated.

The water use and irrigation schedule for POS K and all stages is shown in Appendix G. The Groundwater Licence (GWL164680(11)) was issued by the DWER for an annual water entitlement of 86,320 kL for dust suppression and irrigation of up to 5.8 ha of POS (Appendix H).

3.2 Stormwater management strategy for adjacent sites

3.2.1 Lot 9009 Sixty Eight Road, Baldivis

Stormwater management for Lot 9009 Sixty Eight Road, Baldivis (Primary School Site, stage 12) immediately south of the stages 13 and 14 is detailed in the Lot 9009 Sixty Eight Road Drainage Management Plan (Appendix J). The Primary School Site has four sub-catchments; Furnivall Parade, proposed Regency Avenue, Road 1 & 2, and School Site (Mortons Urban Solutions 2019).

Within the School Site, stormwater run-off will be captured, retained, and infiltrated for up to the critical 1% AEP storm event, whereby allowing stormwater to overflow and infiltrate through the school oval during major storm events.

Within the road reserves, stormwater run-off will be captured via a pit and pipe system, with 0.6 m traps and open bases to prompt at source infiltration. These systems will be designed to convey the 20% AEP storm event, with 0.3 m freeboard to the pit inlet levels. Furnivall Parade's run-off will be directed towards the existing pit and pipe system in stage 3, while run-off from Regency Avenue and Road 1 & 2 will be directed to temporary basins within the future POS K and POS L, respectively. Once Stage 9 is developed, this run-off will be connected to the POS M.

The temporary storage requirements in POS K from Regency Avenue for the 1% AEP storm event will be a volume of 115 m^3. This will not significantly impact the POS K basin as at 1.2 m depth it will have greater than 115 m^3 additional capacity in the 1% AEP event.

3.2.2 Nairn Drive extension

Stormwater management along Nairn Drive immediately west of the stages 13 and 14 is detailed in the Stormwater Management Plan - Nairn Drive Extension by Eco Logical Australia in 2020 (Appendix I). This includes the drainage sump located on Songlark Ct, which will be retained.

Run-off from Section 1 of Nairn Drive will discharge into swales which are designed to capture flows up to the 1% AEP, with a total catchment area of 1.43 ha. The swales will be 'V' shaped with side slopes designed at 1 in 6 batters with a maximum depth of 300 mm, providing a total storage capacity of 302 m^3. The swales will be 6 m wide and will be located between the carriageway (including the bike lane) and the footpath, on both sides of Section 1. Stormwater will street flow from the road to the swale. No stormwater will be directed towards the median of Nairn Drive.

XPSWMM modelling of Section 1 Nairn Drive showed relatively minor run-off will discharge into Furnivall Parade. This flow will be conveyed via the roadside drainage network and discharged into Basin B1 and has been accounted for in the revised modelling for the site.

3.3 Stormwater management strategy for the site

3.3.1 Stormwater management

A summary of the stormwater management strategies for the site including modelling methodology and assumptions for sizing Basin B1 is detailed in the subsections below.

The layout and land use types proposed within stages 13 and 14 of the revised LSP were remodelled by RPS using XPSWMM. Additional run-off from lots greater than 300 m^2 in size was accounted for, as was run-off from the Cottonwood Drive Northern Catchment and minor overflow from Nairn Drive via Furnivall Parade. The infiltration rate within Basin B1 was increased from 3 m/day to 8 m/day, as advised by the City of Rockingham (S. Main pers. Comms. 09 August 2020). Basin B1 located within POS K was sized to accommodate the 1% AEP storm event.

The top area of Basin B1 was found to be approximately 2% larger than the size documented in the approved LWMS. As such the revised LSP has resulted in relatively minor changes to the approved LWMS' stormwater management strategy as all run-off from the site will still be contained and infiltrated within Basin B1.

3.3.2 Infiltration rate

A permeability assessment of the site's POS areas and median strip was undertaken by Galt Geotechnics in 2019 (Appendix K). To a depth of 0.9 m, the infiltration test results for POS K ranged from 3.4 m/day to >15 m/day. Based on these findings, the CoR advised to adopt a maximum infiltration rate under Basin B1 of 8 m/day (S Main 2019, personal communication, 9 August).

3.3.3 Phosphorus retention index

Testing of the in-situ soil in POS and a median strip within Parkland Heights was undertaken by Galt Geotechnics in 2019 (Appendix L). Soil samples were collected from POS K from a depth of 0 to 0.5 m below surface level and were found to have a phosphorus retention index of 6.8. Based on this finding, the CoR advised that the use of in-situ soils in POS K is suitable for use within Basin B1 in providing adequate water quality treatment and that bioretention treatment media is not required to be provided (S Main 2019, personal communication, 17 October).

3.3.4 Catchment plan

For the northern catchment two drainage sumps were constructed in 2006 in Lot 334 Songlark Court and Lot 309 Cottonwood Drive. Drainage modelling and assessment of the Songlark Court catchment was detailed in the Stormwater Management Plan - Nairn Drive Extension to support a subdivision application along Nairn Drive (Eco Logical Australia 2020). Run-off from the northern external catchment was proposed to be directly connected to the Songlark Court sump via Nairn Drive at the site boundary, as such run-off from this area was treated as being isolated from the site. Similarly, run-off from the Cottonwood Drive catchment was previously assumed to be contained within the sump and not considered to be draining into the site prior to this LWMS addendum.

The CoR have advised that these drainage sumps are temporary and that this LWMS addendum is required to integrate the run-off generated from the Songlark Court and Cottonwood Drive catchments (T. Fernandes 2020, personal communication, 28 August 2020). However, CoR have since advised in their response to comments on the LWMS addendum that as the Nairn Drive Stormwater Management plan incorporated the sump on Songlark Ct, this basin would be retained. A minor upgrade of the Nairn Drive drainage system has ensured that no run-off from up to and including the 1% AEP will enter Parkland Heights, No changes have been made to the Songlark Ct basin since the Eco Logical Australia report (2020). This sump has now been handed over to the CoR as Drainage Reserve.

Revised modelling of Basin B1 has assumed removal of the Cotton Wood Drive sump and has accounted for run-off from the northern catchment area including Cottonwood Drive catchment (Figure 4 and Figure 5).

The catchment and land use areas considered in the stormwater modelling are summarised in Table 2.

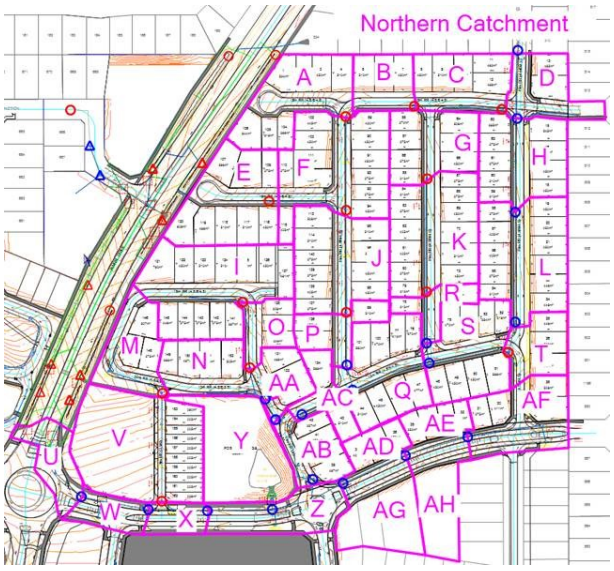


Figure 4: LWMS addendum catchment plan

Figure 5: Northern catchment

Table 2: Catchment and land use areas

Catchment ID	Land use areas included in the XPSWMM modelling						Additional 90% of >300 m² lots not included in the model (ha)	Total area (ha)
	Road verge (ha)	Road impervious (ha)	10% of >300 m² lot (ha)	<300 m² lot (ha)	Group home (ha)	POS (ha)		
A	0.073	0.073	0.032	0	0	0	0.288	0.466
B	0.035	0.035	0.014	0	0	0	0.127	0.211
C	0.053	0.053	0.024	0	0	0	0.212	0.342
D	0.085	0.085	0.01	0	0	0	0.092	0.272
E	0.062	0.062	0.042	0	0	0	0.376	0.542
F	0.085	0.085	0.051	0	0	0	0.461	0.682
G	0.041	0.041	0.028	0	0	0	0.256	0.366
H	0.048	0.048	0.037	0	0	0	0.329	0.462
I	0.061	0.061	0.042	0	0	0	0.376	0.54
J	0.085	0.085	0.051	0	0	0	0.461	0.682
K	0.064	0.064	0.049	0	0	0	0.441	0.618
L	0.071	0.071	0.046	0	0	0	0.415	0.603
M	0.095	0.095	0.013	0	0	0	0.113	0.316
N	0.07	0.07	0.027	0	0	0	0.247	0.414
O	0.038	0.038	0.01	0	0	0	0.085	0.171
P	0.032	0.032	0.013	0	0	0	0.118	0.195
Q	0.058	0.058	0.038	0	0	0	0.337	0.491
R	0.032	0.032	0.008	0	0	0	0.068	0.14
S	0.053	0.053	0.035	0	0	0	0.316	0.457
T	0.037	0.037	0.015	0	0	0	0.132	0.221
U	0.103	0.103	0	0	0	0	0	0.206
V	0.037	0.037	0	0.233	0.503	0	0	0.81

Catchment ID	Land use areas included in the XPSWMM modelling						Additional 90% of >300 m² lots not included in the model (ha)	Total area (ha)
	Road verge (ha)	Road impervious (ha)	10% of >300 m² lot (ha)	<300 m² lot (ha)	Group home (ha)	POS (ha)		
W	0.075	0.075	0	0	0	0	0	0.15
X	0.059	0.059	0	0	0	0	0	0.118
Y	0	0	0	0	0	0.529	0	0.529
Z	0.157	0.157	0	0	0	0	0	0.314
AA	0.013	0.013	0.005	0	0	0	0.041	0.072
AB	0.046	0.046	0.016	0	0	0	0.141	0.249
AC	0.033	0.033	0.011	0	0	0	0.099	0.176
AD	0.064	0.064	0.04	0	0	0	0.363	0.531
AE	0.058	0.058	0.035	0	0	0	0.315	0.466
AF	0.113	0.113	0.018	0	0	0	0.167	0.411
Northern Catchment	0.6	0.6	0.324	0	0	0	2.912	4.436

3.3.5 Modelling assumptions

Revised XPSWMM modelling was undertaken based on the revised LSP to determine the required flood storage area within Basin B1. The design assumptions of Basin B1 were kept generally consistent with the LWMS including 1 in 6 side slopes and a maximum depth of up to 1.2 m in the 1% AEP storm event.

An infiltration rate of 8 m/day was adopted within Basin B1 in line with advice received from the CoR (Section 3.3.2). This is supported by infiltration testing at the site which measured infiltration rates in excess of 15 m/day.

Additional inflows from the Northern Catchment and Nairn Drive via Furnivall Parade has also been accounted for in the modelling.

The modelling simulated current (Australian Rainfall and Run-off 2016) rainfall intensity-frequency-duration data and temporal patterns in line with best practice.

The run-off assumptions for all land uses are summarised below and in Table 3:

- Lots greater than 300 m² in size are assumed to have an effective impervious area of 10%, with run-off from this area assumed to discharge directly into the roadside drainage system. The remaining 90% of the lot area is assumed to be contained within the lot for infiltration via soak wells and garden areas.
- Lots less than 300 m² in size are assumed to be 100% effective impervious with all run-off discharging directly into the roadside drainage system as these lots are higher density and will not have soak wells.
- Group lots are assumed to retain the first 15 mm on site in soak wells with a 5 mm/ hour continuing loss. In large storm events excess run-off will drain into the roadside drainage.
- POS is provided as POS K. An initial loss of 20 mm and continuing loss of 5 mm/hour was initially adopted for this land use type, with additional 8 m/day infiltration occurring within Basin B1. This was further revised so that the initial and continuing loses only apply to the POS area outside of Basin B1. Basin B1 has been modelled to have an infiltration rate of 8 m/d with no initial or continuing loses.

Table 3: Run-off assumptions for different land use types

	Road verge	Road impervious area	10% of >300 m² lots[1]	<300 m² lot	Group home	POS[2]
Impervious %	0	100	100	100	0	0
Initial loss (mm)	12	0	0	0	15	20
Continuing loss (mm/hour)	6	0	0	0	5	5

[1] Assumed lots over 300 m² have 10% effective impervious area.

[2] Excludes basin B1. This has been modelled has having an infiltration rate of 8 m/d as requested by CoR

The modelling results are summarised in Table 4 with a basin top area in the 1% AEP event of 2,550 m^2, which is approximately 2% larger than that reported in the LWMS of 2,495 m^2.

Table 4: Basin B1 design based on RPS modelling of the revised LSP

	Depth (m)	Top Area (m^2)	Volume (m^3)	Peak storm duration (hrs)	Time to empty (hrs)
1 EY	0.17	1,580	254	0.5	3
20% AEP	0.40	1,180	636	1	4
10% AEP	0.57	1,950	960	3	5
1% AEP	1.12	2,580	2180	2	8

Basin B1's plan and cross-section of the 1 Exceedances per Year (EY), 20%, 10% and 1% AEP ponding extents and depths are shown in Figure 6 and 7.

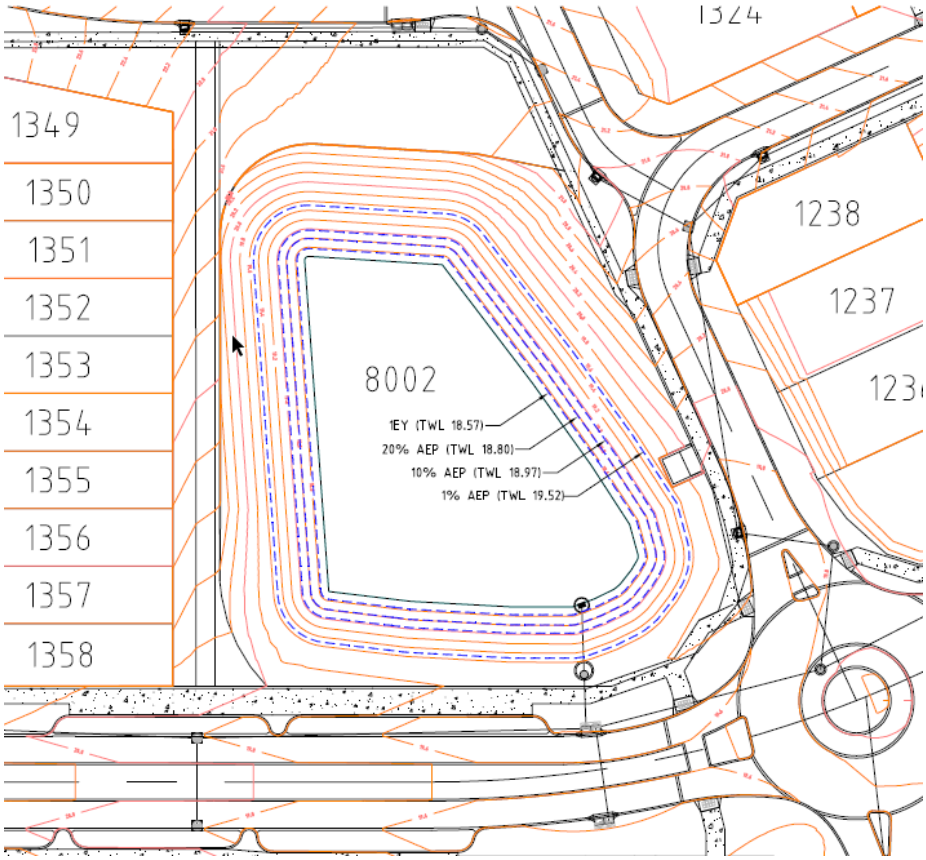


Figure 6: Basin B1 ponding extents and top water levels

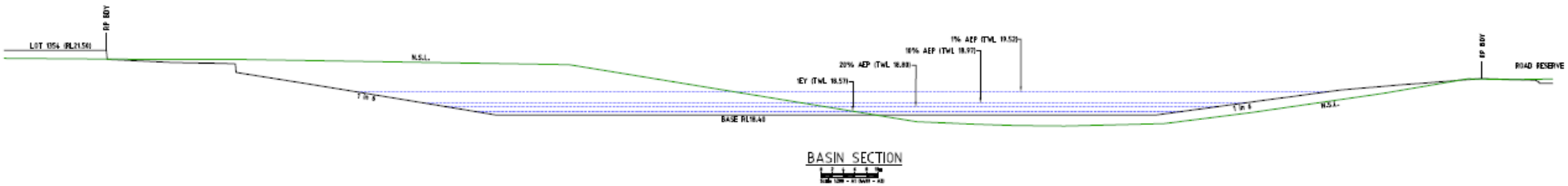


Figure 7: Basin B1 indicative cross-section and top water levels

4 Conclusion

The layout and land use types proposed within stages 13 and 14 of the revised LSP were remodelled using XPSWMM. Additional run-off from lots greater than 300 m^2 in size was accounted for, as was run-off from the Northern Catchment and inflow from Nairn Drive via Furnivall Parade. The infiltration rate within Basin B1 was increased from 3 m/day to 8 m/day. Basin B1 located within POS K was sized to accommodate the 1% AEP storm event.

The top area of Basin B1 was found to be approximately 2% larger than the size documented in the approved LWMS. As such the revised LSP has resulted in relatively minor changes to the approved LWMS' stormwater management strategy as all run-off from the site will still be contained and infiltrated within Basin B1.

Further water management details will be provided at detailed design stage and documented in the future Urban Water Management Plan to support subdivision application.

Yours sincerely,
for RPS Australia West Pty Ltd

Gerard Edwards
Senior Hydrologist
gerard.edwards@rpsgroup.com.au
+61 8 6315 0341

enc:
Appendix A: Proposed Local Structure Plan, Lot 1507 Eighty Road (Creative Design and Planning 2018)
Appendix B: Draft Subdivision Plan, Lot 9010 Nairn Drive (Creative Design and Planning 2019)
Appendix C: Amendment advice, Parklands Height Structure Plan (Western Australian Planning Commission 2019)
Appendix D: Approved Local Structure Plan, Lot 1507 Eighty Road (Creative Design and Planning 2017)
Appendix E: Local Water Management Strategy Parkland Heights Lot 1507 Eighty Road, Baldivis (ENV Australia 2011)
Appendix F: Parkland Heights Baldivis Landscape Concept Plan Amendment POS K (LD Total and Mortons Urban Solutions 2020)
Appendix G: Staged water use and irrigation schedule for POS K and Parkland Heights (LD Total 2020)
Appendix H: Licence to take water (Department of Water and Environmental Regulation 2018)
Appendix I: Stormwater Management Plan - Nairn Drive Extension (Eco Logical Australia 2020)
Appendix J: Lot 9009 Sixty Eight Road Drainage Management Plan (Mortons Urban Solutions 2019)
Appendix K: Permeability Assessment of POS Areas and Median Strip, Parklands Heights Private Estate Baldivis (Galt Geotechnics 2019)
Appendix L: Testing of Proposed Bio Retention Soil Filter Media, Parklands Heights Private Estate Baldivis (Galt Geotechnics 2019)

cc:
Brett Dunn, Department of Water and Environmental Regulation
Jo Kempton, Western Australian Planning Commission

Our ref: EWP20132.001

Appendix A
Proposed local structure plan, Lot 1507 Eighty Road

LEGEND

ZONES/RESERVES

- RESIDENTIAL R15
- RESIDENTIAL R20
- RESIDENTIAL R25
- RESIDENTIAL R30
- RESIDENTIAL R40
- RESIDENTIAL R60
- COMMERCIAL
- SPECIAL USE
- EDUCATION
- PUBLIC OPEN SPACE

OTHER

- LOCAL STRUCTURE PLAN BOUNDARY
- 400m NEIGHBOURHOOD WALKABLE CATCHMENT
- PUMP STATION ODOUR BUFFER
- POWERLINE EASEMENT
- ROAD WIDENING (SIXTY EIGHT ROAD)
- PLANNED BUS ROUTE
- VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
- SEWER PUMP STATION (900m^2 - 1220m^2)

NOTES

1. The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boundary.
2. The access street and associated lot layout shown on the plan is indicative only and subject to refinement as part of the detailed subdivision process.
3. POS Areas are indicative only and subject to further detailed design and drainage considerations.
4. All road carriageway detail depicted on the Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on the Plan are subject to pre-cal and final survey and may vary from figures shown.
5. Bushfire attack level to be reviewed prior to creation of titles. Development may require construction in accordance with AS3959 - Construction in Bushfire Prone Areas.
6. Sixty-Eight Road widening to accomodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.

LOCAL STRUCTURE PLAN MAP

Lot 1507 Eighty Road, BALDIVIS

A Rockingham Park Project

NORTH

Scale: 1:6000 @ A3

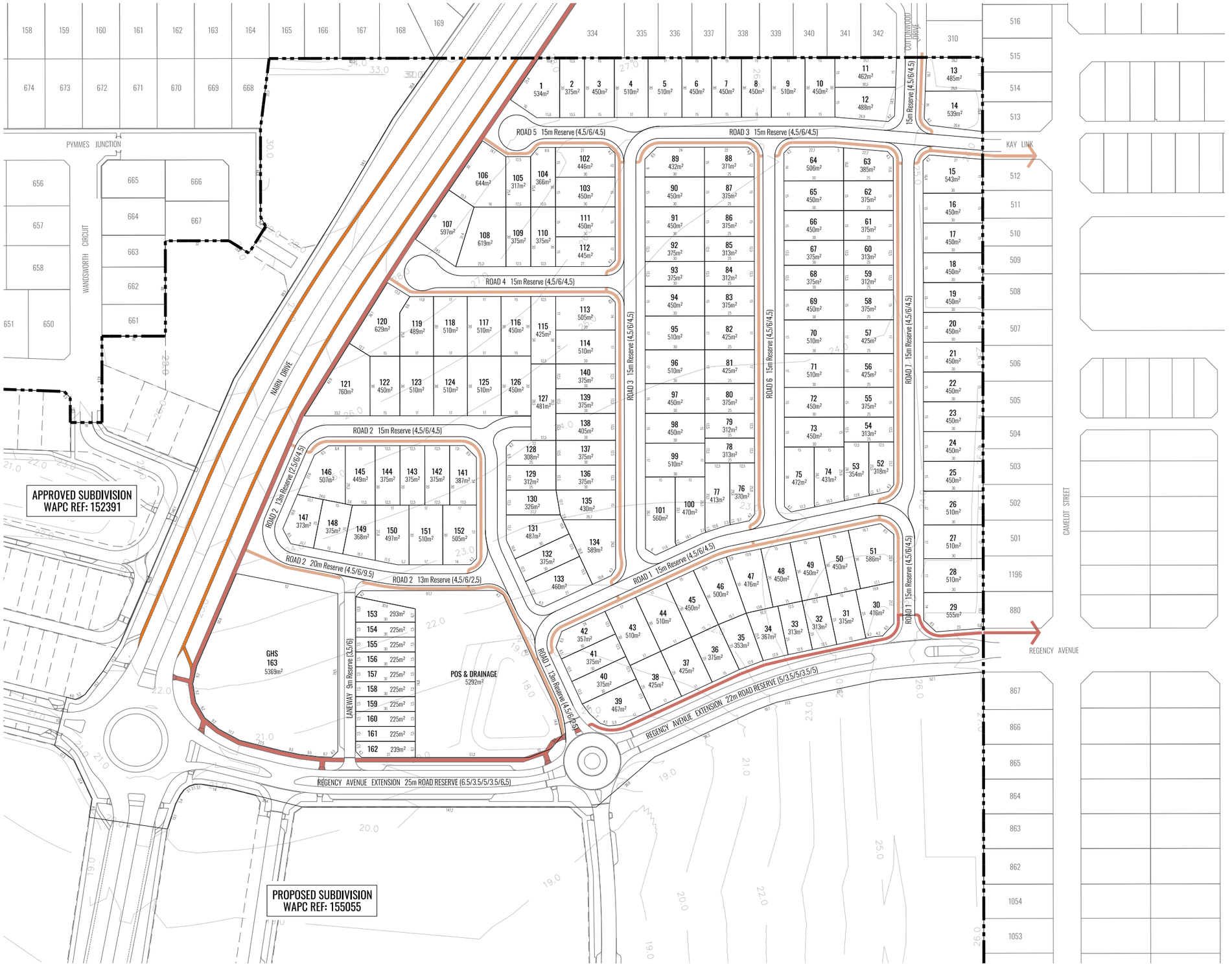
0 60 120 180m

PLAN: RHPPH-2-001 REVISION:
DATE: 20/11/2018 DRAWN: JP
PROJECTION: PCG 94 PLANNER: BK
DATUM: AHD CHECK: TV

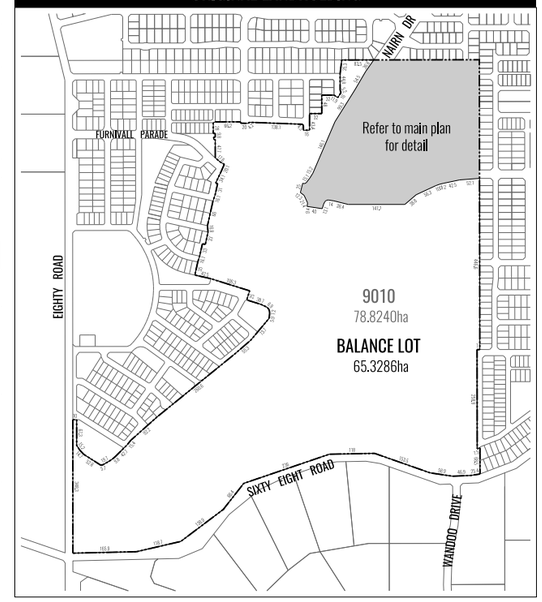
Creative DESIGN+PLANNING

A 28 Brown Street, East Perth WA 6004
P (08) 9325 0200
E info@creativedp.com.au
W creativedp.com.au

Appendix B
Draft subdivision plan, Lot 9010 Nairn Drive



ORIGINAL LANDHOLDING



LOT SUMMARY

Size	No. Lots	% Total Lots
180m² - 234m²	8	4.94%
235m² - 319m²	15	9.26%
320m² - 449m²	55	33.95%
450m² - 499m²	47	29.01%
500m² - 549m²	28	17.28%
550m² - 599m²	5	3.09%
600m² - 699m²	3	1.85%
700m² - 799m²	1	0.62%
Total Residential Lots	**162**	
Group Housing Lots	1	
Balance Lots	1	
Total Lots	**164**	

Minimum Lot Size 225m²
Maximum Lot Size 760m²
Average Lot Size 426m²
Total Lot Area 6.9032ha

SUBJECT LAND SUMMARY

The proposed subdivision of Lots 9010 on Plan 407830 creates the following lot yield:

- 162 Residential Lots
- 1 Group Housing Site
- 1 Public Open Space Lot
- 1 Balance Lot

LEGEND

- APPLICATION AREA (118.9071ha)
- CONTOUR (1.0m)
- FOOTPATH
- DEDICATED CYCLE LANE
- SHARED PATH

NOTE: ALL FOOTPATHS AND SHARED PATHS ARE INDICATIVE ONLY AND SUBJECT TO ENGINEERING DESIGN

PROPOSED SUBDIVISION

Lot 9010 Nairn Drive, BALDIVIS

A Rockingham Park Project

NORTH

Scale: 1:2000 @ A3

0 20 40 60m

PLAN: RPHPH-3-004A
DATE: 26/03/2019
PROJECTION: PCG 94
DATUM: AHD
REVISION: A
DRAWN: JP
PLANNER: BK
CHECK: TV

A 28 Brown Street, East Perth WA 6004
P (08) 9325 0200
E info@creativedp.com.au
W creativedp.com.au

Our ref: EWP20132.001

Appendix C
Amendment advice, Parklands Height structure plan

Western Australian Planning Commission

Your ref: LUP/866
Our ref: SPN/0423M-3
Enquiries: Kempton, Jo (Jo.Kempton@planning.wa.gov.au)

City of Rockingham
P O Box 2142
Rockingham Dc 6967 WA

transmission via electronic mail to: customer@rockingham.wa.gov.au; tamarav@creativedp.com.au

Dear Sir/Madam

Request To Modify – Amendment 5 to Parkland Heights Structure Plan SPN/0423M-3 Lodgement ID: 2019-213916

Pursuant to Schedule 2, Clause 22(1)(b) of the *Planning and Development (Local Planning Schemes) Regulations 2015* (Regulations), the Western Australian Planning Commission (WAPC), requires Creative Design and Planning to modify and resubmit Amendment 5 to Parkland Heights Structure Plan in accordance with the attached Schedule of Modifications.

You are requested to undertake the required modifications to the Structure Plan and provide an updated copy of the Structure Plan to the WAPC. When submitting the modified document, please provide a complete modified Structure Plan (including spatial data in the format and manner specified in the Structure Plan Framework) as well as a separate document containing the updated Parts 1 and 2 only, to the WAPC for endorsement and publication in accordance with Schedule 2, Clause 26 of the Regulations.

The modified document can be lodged via the Department of Planning's online eLodgement portal by selecting the 'Modification' option and inputting the lodgement ID into the drop-down menu which will link to the following reference number: SPN/0423M-3. The portal can be accessed at the Department's website, or at: https://elodgement.planning.wa.gov.au/.

Yours sincerely,

Ms Sam Fagan
Secretary
Western Australian Planning Commission

22/05/2019

Attachment 4 - Track change document April 2019

Parkland Heights Structure Plans*- Schedule of Modifications*

1. Require Amendment 5 to the Parkland Heights Structure Plan be modified as follows:

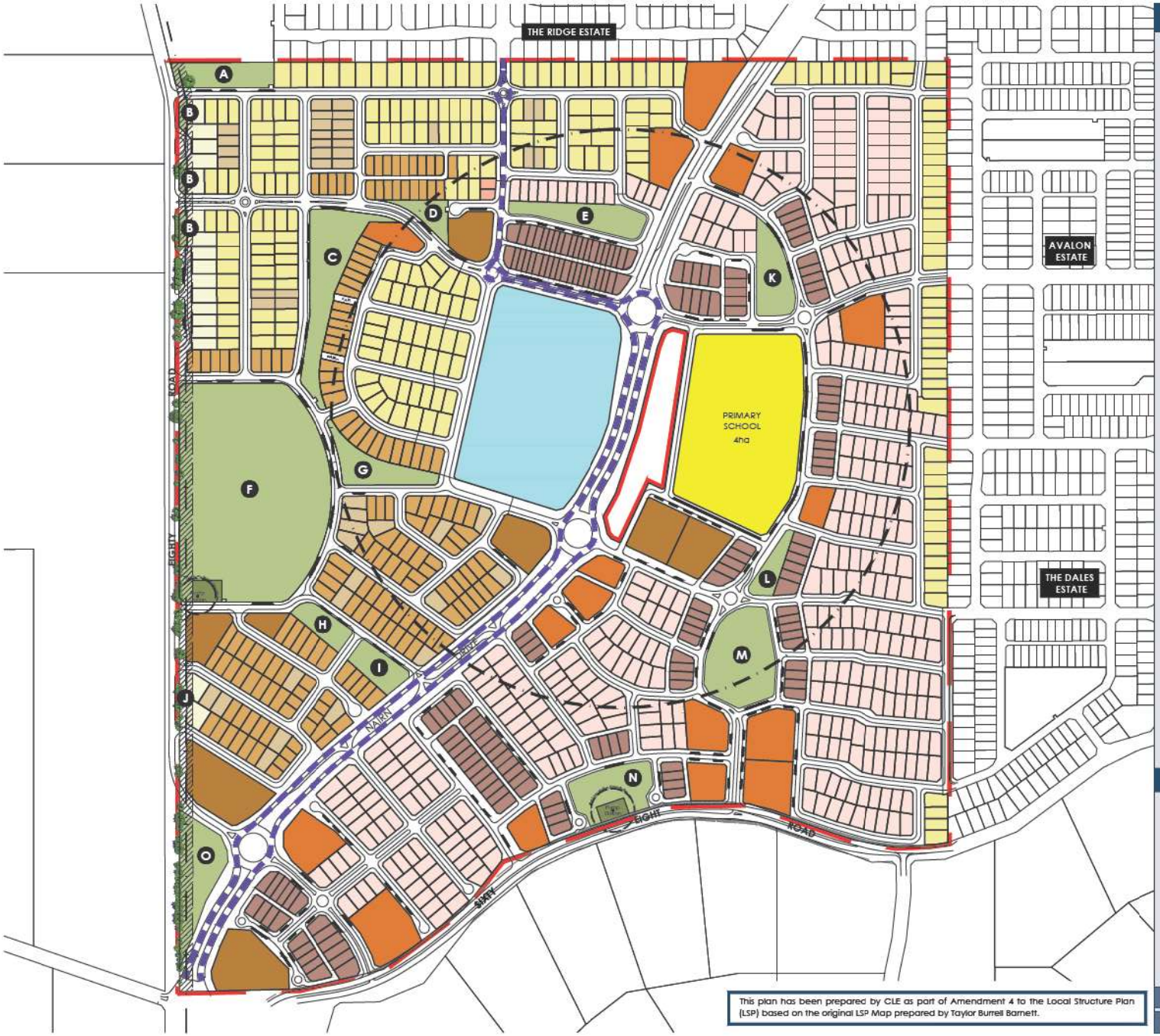
   (a) Update Part 1 in accordance with Attachment 4 – Track change document April 2019;

   (b) Update the Local Water Management Strategy addendum in Part 2 to the specifications of the Local Government in consultation with the Department of Water and Environment Regulation

2. Require the modified structure plan to be resubmitted to the Western Australian Planning Commission for determination

Our ref: EWP20132.001

Appendix D
Approved local structure plan, Lot 1507 Eighty Road



LEGEND

ZONES / RESERVES

- RESIDENTIAL R60
- RESIDENTIAL R40
- RESIDENTIAL R30
- RESIDENTIAL R25
- RESIDENTIAL R20
- RESIDENTIAL R15
- COMMERCIAL
- SPECIAL USE
- EDUCATION
- PUBLIC OPEN SPACE
- RMD R40
- RMD R30
- RMD R25

OTHER

- LOCAL STRUCTURE PLAN BOUNDARY
- 400m NEIGHBOURHOOD WALKABLE CATCHMENT
- PUMP STATION ODOUR BUFFER
- POWERLINE EASEMENT
- ROAD WIDENING (SIXTY EIGHT ROAD)
- PLANNED BUS ROUTE
- VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
- SEWER PUMP STATION (900m²-1200m²)

NOTES

1. The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boudary.
2. The access street and associated lot layout shown on the Plan is indicative only and subject to refinement as part of the detailed subdivision process.
3. POS areas are indicative only and subject to further detailed design and drainage considerations.
4. All road carriageway detail depicted on this Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on this Plan are subject to pre-cal and final survey and may vary from figures shown.
5. Bushfire attack level to be reviewed prior to creation of titles. Development may require construction in accordance with AS3959 - Construction in Bushfire Prone Areas.
6. Sixty-Eight Road widening to accomodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.

PUBLIC OPEN SPACE TABLE

NOTES	CREDITABLE AREA (ha)	NOTES	CREDITABLE AREA (ha)
A	0.4009	I	0.3235
B	0.1463	J	CONVERTED TO ROAD RESERVE
C	0.8566	K	0.3439
D	0.2283	L	0.2328
E	0.5220	M	0.8281
F	5.3214	N	0.4755
G	0.4668	O	0.7076
H	0.2747		
TOTAL AREA OF POS & DRAINAGE			11.1284
% OF GROSS LANDHOLDING			10.90%

This plan has been prepared by CLE as part of Amendment 4 to the Local Structure Plan (LSP) based on the original LSP Map prepared by Taylor Burrell Barnett.

PLAN A: LOCAL STRUCTURE PLAN MAP

Lot 1507 Eighty Road, Baldivis

A Rockingham Park Project

plan no: **3039-24A-01**

date: 24 August 2017

scale: Not to scale

Our ref: EWP20132.001

Appendix E
Local water management strategy Parkland Heights Lot 1507 Eighty Road, Baldivis

APPENDIX J
LOCAL WATER MANAGEMENT STRATEGY

PARKLAND HEIGHTS

LOT 1507 EIGHTY ROAD BALDIVIS

LOCAL WATER MANAGEMENT STRATEGY

PARKLAND HEIGHTS

LOT 1507 EIGHTY ROAD BALDIVIS

LOCAL WATER MANAGEMENT STRATEGY

Prepared for:

Rockingham Park Pty Ltd

Prepared by:

ENV Australia Pty Ltd
Level 1, 503 Murray Street, Perth
PERTH WA 6000
Phone: (08) 9214 6100
Fax: (08) 9266 4109
Email: env@env.net.au

Job Number:	*J100378*
Report Number:	*10/174*
Prepared by:	*Halinka Lamparski & John Hunt*
Status:	*Final*
QA Review:	*Paul Zahra*
Technical Review:	*Karen Lane*
Content Review:	*Karen Lane*
Date:	*14 December 2011*

TABLE OF CONTENTS

FIGURES

APPENDICES

STATEMENT OF LIMITATIONS

Scope of Services

This environmental site assessment report ("the report") has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and ENV. Australia Pty Ltd (ENV) ("scope of services"). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

Reliance on Data

In preparing the report, ENV has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise stated in the report, ENV has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. ENV will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to ENV.

Environmental Conclusions

In accordance with the scope of services, ENV has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

On all sites, varying degrees of non-uniformity of the vertical and horizontal soil or groundwater conditions are encountered. Hence no monitoring, common testing or sampling technique can eliminate the possibility that monitoring or testing results/samples are not totally representative of soil and/or groundwater conditions encountered. The conclusions are based upon the data and the environmental field monitoring and/or testing and are therefore merely indicative of the environmental condition of the site at the time of preparing the report, including the presence or otherwise of contaminants or emissions. Also it should be recognised that site conditions, including the extent and concentration of contaminants, can change with time.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

Report for Benefit of Client

The report has been prepared for the benefit of the Client and no other party. ENV assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of ENV or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

Other Limitations

ENV will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

The scope of services did not include any assessment of the title to or ownership of the properties, buildings and structures referred to in the report nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

EXECUTIVE SUMMARY

This report has been prepared by ENV. Australia Pty Ltd to support the submission of a revised version of a Local Structure Plan for the land located in Lot 1507 Eighty Rd, Baldivis. This site is owned by Rockingham Park Pty Ltd and is also known as Parkland Heights.

Under *Better Urban Water Management (BUWM)* (WAPC 2008a), a Local Water Management Strategy (LWMS) is required to support the Local Structure Plan prior to subdivision and development of land zoned Urban. The BUWM sets out the requirements for a LWMS, which must be approved by the Western Australian Planning Commission on advice of the Department of Water as part of the Local Structure Plan Approval.

The objective of the Local Water Management Strategy (LWMS) is to ensure that sustainable management of the total water cycle at Parkland Heights, Lot 1507 Eighty Rd, Baldivis occurs through Water Sensitive Urban Design. This includes water conservation, stormwater management and groundwater management. Rockingham Park Pty Ltd aims to manage these issues at the site through the following initiatives:

Water Conservation

- Participating in the Urban Development Institute of Australia's EnviroDevelopment program to achieve a maximum potable water usage of 80 kL/person/year and meet the EnviroDevelopment target of a 20% reduction in scheme water use;

    1. Behaviour change of householders, encouraging water conservation through education packages and the construction of a Waterwise Display Village (The Behaviour Change Program).

    2. Providing waterwise front gardens to all homes in Parkland Heights

- Providing Waterwise landscaping for Public Open Space (POS) that includes waterwise plants, soil amendments to improve water and nutrient retention, minimising turf areas and water efficient irrigation; and

- Using groundwater to irrigate POS.

Stormwater Management

- Implementing a drainage design that ensures pre-development discharge rates in the event of a 1 in 100 year ARI event will be maintained through storage and infiltration on site; and

- Maximising infiltration by developing swales and rain gardens in road reserves where possible, planted with native vegetation to encourage nutrient and

suspended solids uptake and removal prior to infiltration. Open based manholes will also be used to maximise infiltration. Infiltration basins in Public Open Space will manage larger events.

Groundwater Management

- Recognising the issue of groundwater availability and planning low water use POS.

This LWMS demonstrates that Parkland Heights, Lot 1507 Eighty Rd, Baldivis can be developed without significant constraints. The outstanding issues can be resolved at the Urban Water Management Plan stage to create a development that meets the goals and ideals of *Better Urban Water Management*.

1 INTRODUCTION

This report has been prepared to support the submission of a Local Structure Plan for Lot 1507 Eighty Road, Baldivis. The study area is approximately 40 km kilometres south of Perth in the City of Rockingham (Figure 1). The site is situated on the Spearwood Dunes system on the Swan Coastal Plain. It was cleared in the 1960's and has since been operated as an agroforestry plantation (Figure 1). It is bound by existing and approved residential housing to the north and east of the site respectively, Eighty Road to the west and Sixty-Eight Road immediately south. The total area of the site is approximately 120 hectares.

Under *Better Urban Water Management* (BUWM) (WAPC, 2008a) and *Planning Bulletin 92* (WAPC, 2008b) a Local Water Management Strategy (LWMS) is required to support a Local Structure Plan (LSP). An amended LSP is being prepared to expand the area within the existing LSP at Lot 1507 Eighty Road to include land on the east side of Nairn Drive (Figure 2). The LWMS provides strategic information regarding the management of water in the development while outlining and demonstrating the feasibility of the proposed drainage design. This work is then refined and details confirmed at the Subdivision Stage through Urban Water Management Plans for each subdivision application area. *BUWM* and the document *Interim: Developing a Local Water Management Strategy* (DoW, 2008) set out the requirements for a LWMS. The agency responsible for the approval of the LWMS is the Western Australian Planning Commission (WAPC) on advice of the Department of Water (WAPC, 2008b).

1.1 Total Water Cycle Management – Principles and Objectives

The process of managing the total water cycle in an urban scenario is referred to as Water Sensitive Urban Design (WSUD). A Local Water Management Strategy seeks to support WSUD by assisting to design, develop and maintain urban water systems that are sensitive to the total water cycle. The principles of WSUD as outlined in the *Better Urban Water Management* (BUWM) (WAPC, 2008a) have been used here. These principles are to:

- Protect natural systems – protect and enhance natural water systems and their hydrological regimes in urban developments;
- Integrate stormwater treatment into the landscape – use stormwater in the landscape by incorporating multiple use corridors that maximise the visual and recreational amenity of developments;
- Protect water quality – protect the water quality draining from urban development and minimise outputs of phosphorus and nitrogen and other pollutants;
- Manage run-off and peak flows – reduce peak flows from urban developments by using local detention measures and minimising impervious areas; and

- Add value while minimising development costs – minimise the drainage infrastructure cost of development.

1.2 Planning Background

1.2.1 Metropolitan Region Scheme

The site is situated in the South-West Corridor of the Perth Metropolitan Region. The land is zoned Urban under the Metropolitan Region Scheme (MRS) and is included within Category A1 of the South West Corridors Structure Plan, being land assessed as having no constraints to urban development.

1.2.2 City of Rockingham District Zoning Scheme (Town Planning Scheme No. 2)

Under the City of Rockingham District Zoning Scheme (Town Planning Scheme No. 2) the site is zoned Development.

1.2.3 Baldivis South District Structure Plan

The Baldivis South District Structure Plan (DSP) was prepared for the site by the City of Rockingham in 2004. A District Water Management Strategy (DWMS) was not developed as part of the DSP.

1.3 Previous Studies

Previous studies into land and water management at the subject site include:

- Lot 1507 Eighty Road Baldivis, Geotechnical Investigation Report, Prepared for Summit Homes Group (Sinclair Knight Merz, 2009);
- Preliminary Acid Sulphate Soils Investigation Lot 1507 Sixty Eight Road, Baldivis WA, Prepared for Rockingham Park Pty Ltd (ENV, 2009a);
- Environmental Preliminary Site Investigation Lot 1507 Sixty Eight Road, Baldivis WA, Prepared for Rockingham Park Pty Ltd (ENV, 2009b);
- Flora and Vegetation of Lot 1507 Sixty-Eight and Eighty Roads, Baldivis, Prepared for Rockingham Park Pty Ltd (ENV, 2009c);
- Lot 1507 Sixty-Eight Road, Baldivis Black Cockatoo Assessment, Prepared for Rockingham Park Pty Ltd (ENV, 2010);
- Parkland Heights, Lot 1507 Sixty-Eight Road Baldivis, Environmental Assessment, Prepared for Rockingham Park Pty Ltd (ENV, 2011a); and
- Parkland Heights Acid Sulfate Soils Dewatering Management Plan, Prepared for Rockingham Park Pty Ltd (ENV, 2011b).

2 PROPOSED DEVELOPMENT

2.1 KEY POINTS OF STRUCTURE PLAN

The Local Structure Plan (LSP) presents a predominantly low and medium residential development forming a community with a range of densities (R15 – R60) including single and grouped dwellings. The site is divided east and west by Nairn Drive, a major road in the South Baldivis traffic network (Figure 2).

Within the residential areas, provisions have been made for 20 areas of Public Open Space (POS) for both drainage and amenity purposes. Provision has also been made for a primary school located in the area east of Nairn Drive. Community and recreation facilities and a local centre are also included within the LSP to enhance community amenity within the development (Figure 2). A staging plan is provided in Figure 7.

A focus on preserving and reinforcing existing positive site characteristics will be implemented through the proposed landscape treatment of the site. POS have been planned to incorporate significant existing trees along Eighty Road both pines and eucalypts) where possible. The existing vegetation will provide the foundation and structure for new tree planting, which will include eucalypts and pines, as well as deciduous trees in key areas to reference the semi-rural character of the area.

2.2 ENVIRONMENTAL REPORT AND MANAGEMENT PLAN

An Environmental Assessment of Lot 1507 Eighty Road, Baldivis was undertaken by ENV Australia and included in the Local Structure Plan (ENV, 2011a). The report is based on work done for the site in the preparation of the Local Structure Plan, including a desktop study, a flora and vegetation survey and an acid sulfate soils investigation, carried out by ENV Australia. The report presents opportunities and constraints for development of the site and recommendations for environmental management of the site related to the proposed development (ENV, 2011a).

3 DESIGN CRITERIA

The principles, design objectives and criteria shown here are from *Better Urban Water Management (BUWM)* (WAPC, 2008a). Quotes from BUWM are shown in italics.

3.1 WATER CONSERVATION - AND EFFICIENCY

Principle

No potable water should be used outside of homes and buildings with the use of water to be as efficient as possible (WAPC, 2008a).

Design Objectives

Consumption target of 100 kL/person/year (State Water Plan Target).

Site Response

The development will aim to achieve the target of a maximum scheme water usage of 80 kL/person/year through Rockingham Park's participation in the UDIA EnviroDevelopment program and the expected uptake of groundwater for POS and residential irrigation. The Water Corporation's latest potable water use study 'Perth's Residential Water Use Study 2008/2009' (Water Corporation, 2010) found that the average potable water consumption rate was 106 kL/person/year. Water efficiency programs will be developed to target behaviour change of householders and promote the use of non-potable water sources to minimise potable water use both in-house and ex-house. This will be modelled in the display village. All homes will have water wise front garden landscapes in order to assist in meeting the EnviroDevelopment target of a 20% reduction in potable water use.

3.2 WATER QUANTITY MANAGEMENT

Principle

Post-development annual discharge volume and peak flows will be maintained relative to pre-development conditions, unless otherwise established through determination of Ecological Water Requirements for sensitive environments (WAPC, 2008a).

Criteria

<u>Ecological Protection</u> - For the critical one-year average recurrence interval (ARI) event, the post-development discharge volume and peak flow rates shall be maintained relative to pre-development conditions in all parts of the catchment. Where there are identified impacts on significant ecosystems, maintain or restore desirable environmental flows and/or hydrological cycles as specified by the DoW.

<u>Flood Management</u> - Manage the catchment run-off for up to the 1 in 100 year ARI event in the development area to pre-development peak flows, unless otherwise indicated in

an approved strategy or as negotiated with the relevant drainage service provider (WAPC 2008a).

Site Response

The drainage strategy for the site is based on detention of stormwater on-site to maintain pre-development discharge rates in events up to the 1 in 100 year ARI. Run-off from 1 in 1 year ARI events will be infiltrated on site.

3.3 WATER QUALITY MANAGEMENT

These are intended to apply to run-off from impervious areas and should be met in addition to the groundwater design objectives.

Principle

Maintain surface and groundwater quality at pre-development levels (winter concentrations) and, if possible, improve the quality of water leaving the development area to maintain and restore ecological systems in the sub-catchment in which the development is located (WAPC, 2008a).

Criteria

Contaminated Sites – To be managed in accordance with the Contaminated Sites Act 2003.

All other Land – If the pollutant outputs from the development (measured or modelled concentrations) exceed catchment ambient conditions, the proponent shall achieve water quality improvements in the development area or, alternatively, arrange equivalent water quality improvement offsets inside the catchment. If these conditions have not been determined, the development should meet relevant water quality guidelines stipulated in the National Water Quality Management Strategy (ARMCANZ & ANZECC, 2000) (WAPC, 2008a).

Site Response/Commitment

The development proposes to use Best Management Practices in line with the Stormwater Management Manual (DoW, 2004-2007) to manage water quality on the site, predominantly nutrients. The site is considered to be unlikely to be contaminated based on the land use history of being largely vegetated (ENV, 2008b). As such, contaminated sites guidelines do not apply.

Bio-retention structures with an area equivalent to 2% of the directly connected constructed impervious area will be provided as close to source as possible and practical.

3.4 STORMWATER MODELLING CRITERIA

Principle

If it is proposed to use a stormwater modelling tool to demonstrate compliance with design objectives, the following design modelling parameters are recommended.

As compared to a development that does not actively manage stormwater quality:

- *At least 80% reduction in the average annual load of total suspended solids;*
- *At least 60% reduction in the average annual load of total phosphorus;*
- *At least 45% reduction in the average annual load of total nitrogen; and*
- *At least 70% reduction in the average annual load of gross pollutants* (WAPC, 2008a).

Site Response/Commitment

Stormwater quality modelling is not proposed for the site at this stage because currently there is no commercially available tool in Western Australia approved by the DoW to undertake such modelling.

3.5 DISEASE VECTOR AND NUISANCE INSECT MANAGEMENT

Principle:

To reduce health risks from mosquitoes, retention and detention treatments should be designed to ensure that between the months of November and May, detained immobile stormwater is fully infiltrated in a time period not exceeding 96 hours.

*Permanent water bodies are discouraged, but where accepted by DoW, must be designed to maximise predation of mosquito larvae by native fauna to the satisfaction of the local government on advice of the Departments of Water and Health (*WAPC, 2008a).

Site Response/Commitment

The system has been designed to ensure that detained immobile stormwater is fully infiltrated in a time period not exceeding 96 hours.

Permanent water bodies are not proposed for this site.

4 PRE-DEVELOPMENT ENVIRONMENT

4.1 TOPOGRAPHY

The site is composed of remnant bushland and pine plantation and is situated at an elevation of 4 - 42 m AHD (Figure 3). The site is undulating, but generally slopes overall from the south-east to north-west, with the lowest point of the site on the western border. There are also two lower points in the centre of the site with heights of 10 – 11 m AHD (Figure 3).

4.2 SOILS AND GEOLOGY

Regional geological information was obtained from the Geological Survey of WA 1:50,000 Environmental Geology Series which describes the geology at and surrounding the site (Gozzard, 1986) (Figure 4). Only one geological unit was identified at the site:

- S7 SAND – (Sand derived from Tamala limestone) pale yellowish brown, medium to coarse-grained, sub-angular to well-rounded quartz, trace of feldspar, shell debris, variably lithified, surface kankar, of eolian origin.

This soil unit is also known as 'Spearwood Sand'. This classification is generally consistent with the geotechnical work undertaken by SKM (2009). ENV (2009a) also recorded the presence of a layer of clayey sand at a depth of 1.7 m at groundwater bore MW1 located in the north-western corner of the site (Figure 8, Appendix C of ENV, 2009a). As this layer was not reported in any other surveys, it is assumed that this layer is isolated to a small area near this bore only.

The physical properties of the site geology are described as follows (GSWA, 1980):

- High permeability;
- Low to medium slope stability; and
- Moderate ease of excavation.

A geotechnical report of the site (SKM, 2009) summaries permeability testing and geological results obtained at three test pits across the site (Figure 3). Soils within the site were found to consist predominantly of sand with a hydraulic conductivity between 4.3 – 5.9 m/day and of moderate to good drainage characteristics (SKM, 2009).

4.2.1 Acid Sulfate Soils

An Acid Sulfate Soils (ASS) Investigation was undertaken on the site by ENV in 2009 (ENV, 2009a). The investigation indicated that the site was generally at a low risk of ASS, in line with the ASS risk mapping of the site (Figure 4). Only one soil sample showed evidence of ASS. This was found at MW1 in the north-west of the site at a

depth of 2.25 m (Figure 8, Appendix C of ENV, 2009a). This may be due to its proximity to a high risk ASS area associated with an adjacent wetland (identified in Section 4.3).

Should future excavation works involve the disturbance of soil at or near the water table and groundwater in the north-western vicinity of the site, further localised investigation is recommended and it may trigger some management specific to this corner of the site.

4.2.2 Phosphorus Retention Index

Phosphorus Retention Index (PRI) was measured at four groundwater bores at the site during installation. The PRI results are presented in Table 1 below.

Table 1: Phosphorus Retention Index Test Results

Location	PRI
MW1	0
MW2	4.2
MW4	1.1
MW5	6

According to Allen and Jeffery (1990), soils with PRIs of less than 2 may be classified as very weakly adsorbing or desorbing of phosphorus and PRIs between 2-5 as weakly adsorbing of phosphorus. This indicates that the soils at the site have a low natural nutrient retention property with respect to phosphorus.

With the exception of soil at bore MW5 (PRI = 6), the PRI results are generally below the usual range expected for a Spearwood Sand of 5 -20 (Allen and Jeffrey, 1990). This may be due in part to the use of the site as a pine plantation, which may have enhanced leaching of the surface soils. Observations of adjacent sites indicate that the soils become a darker yellow or orange colour at depth, suggesting that more iron oxides are present at depth. This may imply an increase in PRI with depth (Bolland, Allen and Barrow, 2003).

4.2.3 Contaminated Sites Assessment

ENV has undertaken an Environmental Preliminary Site Investigation (PSI) of the site (ENV, 2009b). Searches indicated that the site was not subject to any specific land use prior to 1963 (ENV, 2009b). Aerial photographs of the site before 1963 confirm this and show surrounding areas consist entirely of bushland (ENV, 2009b). Early stages of land cultivation to the east and west of the site are observable in aerial photographs taken in

1963 (ENV, 2009b). The site was cultivated for forestry product purposes at some stage between 1963 and 1974 (ENV, 2009b). There is no indication that the site was utilised for any other land use between 1973 and 2000 (ENV, 2009b). The Forest Products Commission began harvesting the pine trees at the site between 2001 and 2004 (ENV, 2009b).

No record of the site was found on the Department of Environment and Conservation Contaminated Sites Database at the time of the investigation (ENV, 2009b). It was therefore considered that a Detailed Site Investigation (DSI) was not required (ENV, 2009b).

4.3 SURFACE WATER QUANTITY AND QUALITY

The site is located within the Peel-Harvey catchment. There are no ephemeral or permanent surface water bodies located within the site. The nearest wetlands to the site are Outridge Swamp, located 80 m west of the site and Lake Walyungup, located 1.7 km north-west of the site.

There are no drainage lines within the site due to the high permeability of the Spearwood Sands at the site, as described in Section 3.2. The site is therefore dominated by infiltration with little to no surface run-off except during extreme storm events.

4.4 GROUNDWATER QUANTITY AND QUALITY

ENV installed five groundwater monitoring bores at the site using air and mud rotary methods in October 2009 (Appendix A). Four Department of Water (DoW) groundwater bores have also been included in the groundwater monitoring program at the site (Table 2). ENV undertook pre-development groundwater level and quality monitoring for the period of October 2009 to March 2011. Groundwater levels have currently been measured during 12 events and five sets of water samples have been collected and analysed.

4.4.1 Groundwater Levels

The five ENV bores and four DoW bores located on or near the site have been monitored monthly since 28 October 2009 until most recently on 11 November 2010 (Figure 6). The groundwater levels measured in the DoW bores since installation in 1975 were also reviewed to provide maximum and minimum groundwater levels (Appendix B). Groundwater levels have been measured for at least two winters in 2009 and 2010.

The Annual Average Maximum Groundwater Levels (AAMGLs) on the site were calculated from levels measured in October 2009 and varied from 2.41 mAHD in MW1 in the north-west to 1.50 mAHD at MW5 in the south. Depth to AAMGLs varied between

8.65 m Below Ground Level (BGL) at MW4 in the south-west, to 1.67 mBGL at MW3 in the west (Table 2). MW3 is located in one of the lowest areas of the site. On many areas of the site the depth to AAMGLs exceeds 20 m (Figure 6). Groundwater contour mapping is presented in Figure 6.

The minimum groundwater levels measured on-site varied from 1.6 mAHD (January 2010) at MW1 in the north-east to 0.35 mAHD (May 2010) at MW5 in the south of the site. Full monitoring records may be found in Appendix C.

The regional flow direction shown in the Second Edition of the Perth Groundwater Atlas (DoE, 2004) is south-west towards Lake Walyungup. This direction is consistent with groundwater levels measured by ENV, which indicate a clear south-westerly flow direction towards Lake Walyungup, as well as a general southerly direction (Figure 6).

Table 2: AAMGLs at or near Lot 1507 Eighty Rd, Baldivis Groundwater Bores

Bore	Annual Average Maximum Groundwater Levels (mAHD)	Depth to AAMGLs (mBGL)
MW1	2.41	1.87
MW2	2.38	5.81
MW3	2.35	1.67
MW4	2.34	8.65
MW5	1.50	5.46
DoW 3011	2.25	4.51
DoW 3012	2.23	4.53
DoW 3033	2.35	8.37
DoW 3034	2.35	11.51

Figure 6 also shows bores F and G. These bores were initially installed to record upstream groundwater levels and quality at the site. These bores however were dry at 21m and advise from the DoW in 2009 was that they therefore did not need to be monitored.

4.4.2 Groundwater Quality

The groundwater quality monitoring program included the measurements of physical parameters of acidity and electrical conductivity, measurements of total and components of nitrogen and phosphorus and a suite of heavy metals, detailed below. No groundwater quality data is available for bore MW2 because it has been blocked since October 2009, thus not allowing bailers to reach groundwater for sampling. The

thinner water level probes were still able to move freely through the bore however, and measure water levels at MW2.

Physical parameter measurements were taken using hand-held water quality meters in collected groundwater samples. Groundwater samples were purged and collected using bailers and analysed at National Association of Testing Authorities (NATA)-accredited laboratory MPL Laboratories, Myaree.

Physical Parameters

pH was found to be generally stable and neutral in all bores located within the site (Table 3 and Figure 6). Electrical conductivity (EC) levels measured in groundwater were found to be similar and of freshwater quality in all bores. Full physical parameter results may be found in Appendix C.

Table 3: Groundwater Physical Parameter Results

Bore	pH			Mean EC (mS/cm)	Calculated TDS (mg/L)[1]
	Mean	Minimum	Maximum		
MW1	5.53	5.35	5.7	0.67	335
MW3	6.37	6.16	6.68	0.45	227
MW4	7.52	7.39	7.66	0.75	377
MW5	6.43	6.13	6.82	0.58	288

[1]TDS (Total Dissolved Solids) calculated from EC assuming pure NaC and conversion factor of 500

Nutrient Concentrations

Groundwater at the site was generally found to have levels of Total Phosphorus (TP) exceeding the Long Term Swan-Canning Cleanup Program (SCCP) target of 0.1 mg/L (SRT, 1999) with mean TP concentrations varying between 0.11 and 0.48 mg/L (Table 4 and Figure 6). However, PO_4 concentrations at all bores were negligible and only bore MW4 was found to minimally exceed detection limits, which suggests that phosphorus in groundwater at the site exists predominantly in a particulate form.

Total Nitrogen (TN) concentrations exceeded the long-term SCCP target of 1 mg/L at all bores except for MW5. TN concentrations in MW1 were also found to equal or exceed the ANZECC Fresh Water Quality guidelines level of 1.2 mg/L (Table 4 and Figure 6). Full nutrient results may be found in Appendix C. Given a breakdown of nitrogen in groundwater in Table 4, the predominant form is organic (Kjeldahl) nitrogen (TKN).

Table 4: Mean Groundwater Nutrient Results

Monitoring Location	Total P mg/L	PO4 mg/L	Total N mg/L	NO3-N mg/L	NH3-N mg/L	TKN mg/L
MW1	0.22	<0.005	3.35	0.13	0.46	3.25
MW3	0.48	<0.005	1.09	0.01	0.16	1.09
MW4	0.24	0.0058	1.00	0.20	0.04	0.79
MW5	0.11	<0.005	0.93	0.13	0.05	0.79
SCCP long-term Target[1]	0.1	-	1	-	-	-
ANZECC Guidelines[2]	0.065	0.04	1.2	0.15	-	-

[1]SRT (2003)

[2]ANZECC & ARMCANZ (2000). Guidelines are for slightly disturbed ecosystems in south-west Australia.

Heavy Metal Concentrations

Groundwater samples were analysed for a suite of heavy metals listed in Table 5 below. Mean Chromium (Cr), Copper (Cu) and Zinc (Zn) concentrations exceeded ANZECC Fresh Water Quality guidelines levels (95% level of protection) in bores. Mean Cadmium (Cd) concentrations exceeded ANZECC Fresh Water Quality guidelines (95% level of protection) in all bores except MW1, however, MW1 was also the only bore where mean Arsenic (As) and Nickel (Ni) concentrations did exceed the guidelines. Mean Lead (Pb) concentrations exceeded ANZECC Fresh Water Quality guidelines (95% level of protection) in two of the four bores sampled, MW1 and MW5.

Given that the detection limit for Mercury (Hg) analysis (<0.0001 mg/L) was greater than the ANZECC guideline level (0.00006 mg/L), it is not possible to determine whether the ANZECC guideline level (95% level of protection) was exceeded. However, Hg mean concentrations were found to be below detection limits in all bores sampled.

Table 5: Mean Groundwater Metals Results

Bore	As (mg/L)	Cd (mg/L	Cr (mg/L)	Cu (mg/L)	Pb (mg/L)	Ni (mg/L)	Zn (mg/L)	Hg (mg/L)
MW1	0.024	0.0001	0.046	0.01	0.01	0.02	0.07	<0.0001
MW3	0.015	0.00086	0.024	0.003	0.0026	0.0032	0.032	<0.0001
MW4	0.002	0.00086	0.003	0.0046	0.0016	0.0042	0.024	<0.0001
MW5	0.01	0.00086	0.038	0.006	0.0078	0.0042	0.13	<0.0001
ANZECC Guideline[1] (mg/L)	0.024	0.0002	0.001	0.0014	0.0034	0.011	0.008	0.00006

[1]ANZECC & ARMCANZ (2000). Guidelines are trigger values for freshwater with 95% level of protection.

4.5 ENVIRONMENTAL ASSETS

This section represents a brief summary of the environmental assets and water dependent ecosystems on the site. Further information on the species and management of flora and fauna on the site can be found in *Flora and Vegetation of Lot 1507 Sixty-Eight and Eighty Roads, Baldivis* (ENV, 2009c), which also accompanies the Local Structure Plan.

4.5.1 Vegetation Type and Condition

The site does not appear to be constrained in terms of floristic attributes. The vegetation over most of the site is cleared with no good quality remnant vegetation of significance.

Twenty-two families, 35 genera and 40 taxa (18 of which were introduced) were found during the survey. None of these are listed as significant species.

The site contains one main vegetation unit - Open Woodland of *Eucalyptus gomphocephala, Eucalyptus marginata* and **Pinus pinaster* over *Acacia saligna, Jacksonia furcellata* and *Xanthorrhoea preissii* over weeds. There are no flora species or vegetation communities of significance on the site. There are no areas of vegetation or particular trees that should be retained in planning urban development for the site and no particular requirements for management have been identified.

4.5.2 Water Dependant Ecosystems

There are no wetlands, springs or other water dependant ecosystems located within the site. A Conservation Category Wetland (CCW) and Multiple Use Wetland (UFI 6394),

Outridge Swamp, is located approximately 80 m to the west of the site (Figure 5). Another CCW Wetland (UFI 13083), Stakehill Swamp, is located further west, approximately 600 m of the site. The local groundwater flow direction at the site is partially south-west and may have some influence on the wetlands located directly west of the site.

5 WATER SUSTAINABILITY

5.1 INTRODUCTION

This section provides a summary of water conservation measures that will be undertaken at Lot 1507 Eighty Road, Baldivis. Water conservation criteria for Water Sensitive Urban Design (WSUD) in BUWM (WAPC, 2008) provide a consumption target of 100 kL/person/year. At a minimum, the development at Lot 1507 Eighty Road, Baldivis aims to meet the State Water Plan target of 100 kL/person/year. However, a greater goal of achieving a 20% reduction in potable water use will be implemented through Rockingham Park's participation in the UDIA EnviroDevelopment program. Additional savings will be achieved through use of residential bores for garden irrigation and commercial bores for POS irrigation.

The Water Corporation's latest potable water use study 'Perth's Residential Water Use Study 2008/2009' (Water Corporation, 2010) found that the average potable water consumption rate was 106 kL/person/year whereas the State Water Plan states a target of 100kL/p/a. Therefore, to meet the EnviroDevelopment potable water reduction target of 20%, a maximum usage of 80 kL/person/year of potable water is required. The water sustainability initiatives to meet this target are addressed below.

This section also addresses the provision of water for the irrigation within the development of areas of Public Open Space (POS), the proposed primary school and the servicing of potable water and wastewater supplies and sources. Water conservation issues are summarised and matters to be addressed at subdivision are presented.

5.2 WATER CONSERVATION STRATEGY

Rockingham Park Pty Ltd is seeking certification of sustainability initiatives undertaken at its Lot 1507 Eighty Rd development through the UDIA EnviroDevelopment program, including those specifically targeting water conservation under the Water Element of the program.

The EnviroDevelopment program seeks to raise the level of sustainable urban land development in WA and provides awards across six elements where it can be verified that sustainability benchmarks will be achieved. These elements include water conservation through the reduction of potable water consumption, as well as protecting ecosystems, reducing waste and increasing recycling, reducing energy use, using environmentally responsible materials in development and encouraging sustainable community amenities and behaviour.

To achieve water conservation at Lot 1507 Eighty Rd, the following EnviroDevelopment principles will be implemented:

- Reduction of overall potable water use by more than 20% through water efficiency measures; and

- Use of alternate water sources.

Support will also be provided to residents to educate them on how to minimise their water use. Sustainability Information Packages (SIPs) will be provided by Rockingham Park to homeowners as an educational tool on water conservation, reducing fertiliser use and other sustainability initiatives, as well as stipulating requirements on the built form of each lot. Education will also be promoted through the construction of a Waterwise Display Village designed to display and endorse waterwise practices both inside and outside the house. In addition to participating in the EnviroDevelopment program, Rockingham Park Pty Ltd is also investigating a Waterwise Land Development accreditation from the Water Corporation to demonstrate their commitment to water conservation.

The Water Corporation Waterwise criteria to be investigated for Lot 1507 Eighty Rd include:

- Addressing water efficiency and water conservation within the Entry Statement and Public Open Spaces;
- Addressing water efficiency and water conservation through innovation in all major buildings within the development;
- Including specific clauses that reflect water efficiency and water conservation within the general conditions of sale, in relation to both private and public buildings and building of display villages; and
- Educating the community on water efficiency and water conservation.

5.2.1 Water Efficiency Measures

Approximately half of all household water use is for maintaining gardens, therefore minimising water demand for landscFaping is an essential water conservation measure for residential areas (Water Corporation, 2010). Ex-house irrigation controls can be easily implemented through the developer provided landscaping packages.

Rockingham Park will commit to implementing its goal of reducing overall potable water use by more than 20% through offering waterwise front garden landscaping to all homes in the development. In addition programs will be implemented to support residents to use less water through behavioural changes.

Note that residential bore water use has not been included in these calculations and the uptake off this alternate water source would reduce the scheme water use significantly further.

In addition to these options, it will be incentivised through the associated rebate packages to plumb homes for provisional connection to rainwater and grey water reuse schemes (as per the earlier proposed Five Star Plus Stage Two program).

It is intended that waterwise landscaping packages through Waterwise landscaping incentive packages by Planet Landscapes will be provided by Rockingham Park as part of each lot sale. These packages will include the use of soil amendments (such as mulch or clayey/loamy soils to improve water and nutrient retention), waterwise plants (with native options), paving or mulched surfaces and minimising turf areas, based upon individual garden requirements of the landowner.

In addition to these water efficiency measures aimed at the household scale, waterwise landscape design will also be undertaken for all POS and streetscapes. POS and streetscape design will also include the use of soil amendments, waterwise plants with native options, paving or mulched surfaces and minimal turf areas where practical.

5.2.2 Potential Alternate Water Sources

Rockingham Park will also commit to implementing its goal of reducing overall potable water use through the provision of a combination of the following water efficiency measures implemented in POS, as well as in-house and ex-house in individual houses:

- The use of **groundwater** for irrigation of POS and streetscapes.
- Consideration of the use of **grey water**: home grey water reuse systems on all 'traditional' lots (R20 and R40) and group housing lots (from bathrooms only) for irrigation of perennial garden beds, where garden areas are large enough to meet Department of Health standards.
- Consideration of the use of **rainwater**: rainwater harvesting tanks (minimum of 2000L) on all houses where roof areas are large enough to be plumbed in to supplement toilets and laundry water use. These systems will be promoted for use from the Stage 1 Display Village.

A preliminary water balance (Appendix F) has been completed for each of these individual options to determine how much water will be saved at the development if any of these are implemented. The cost-benefit aspects of these alternative water source options will also be considered at the subdivision stage of the development.

5.2.3 Education Strategies

Marketing and educational tools are important in encouraging the behaviour change of future landowners. The installation of waterwise fittings by landowners, further to those required for Stage 1 of the Five Star Plus scheme, may reduce water usage by up to 25% (Water Corporation, 2008). Sustainability Information Packages (SIPs) provided by Rockingham Park will be designed to ensure that landowners are aware of all

possible water conservation measures and how best to apply them. The packages will be distributed individually and will be supported by free community workshops and householder consultations on waterwise design.

SIPs will comprise information on, but will not be limited to, advice on the following:

- Changing personal and family water use behaviour, both in-house and ex-house;
- Using Water Efficiency Labelling and Standards (WELS) to choose fixtures with greater than four stars for tap fittings and three stars for shower heads, as well as advice about choosing flow regulators, low flow dual flush toilet, washing machines and relevant rebates available from the State Government;
- Water efficiency measures for ex-house use, including how to operate waterwise irrigation systems, frequency and timing of irrigation, landscaping packages and timing and the use of pool covers;
- Rainwater tanks, requirements, information about installation of tanks, switching systems and plumbing to toilets and/or laundry and relevant rebates; and
- Greywater systems, including requirements, approved products, regulatory approvals, installation of infrastructure for irrigation and relevant rebates.

Rockingham Park Pty Ltd plans to build a Waterwise Display Village that meets Water Corporation standard (Water Corporation, 2007) for viewing by potential and new landowners. The Display Village will be designed to display and promote waterwise practices both inside and outside the house. Sustainability Information Packages (SIP) and tours of the Display Village will be provided to explain waterwise measures, such as waterwise fittings, appliances, landscaping and irrigation. Features are expected to include rainwater tanks and connections, water efficient taps and shower heads in kitchens and bathrooms and mulching, waterwise plants, turf, soil amendments and irrigation controllers in the garden.

Rockingham Park Pty Ltd is investigating obtaining a Waterwise Land Development accreditation from the Water Corporation to demonstrate their commitment to water conservation. This accreditation is obtained by submitting an application to the Water Corporation specifying that water conservation targets have been met for POS, water efficient methods have been addressed in public and private buildings (including the display village) and that the community will be educated on water conservation via methods such as literature (SIPs).

5.3 PROJECTED POTABLE WATER CONSUMPTION

- The 80 kL/person/year EnviroDevelopment target (Section 5.1) can be achieved as shown in Appendix F. These calculations are determined from the current water yields calculated from given lot yields, based on Water Corporation Waterwise

Calculator assumptions, take-up rates of water efficiency packages and dwelling statistics. It is estimated that a typical resident living in Lot 1507 Eight Road, Baldivis will potentially use less than 80 kL/year on average of scheme water.

The water sustainability initiatives will save 26% volume of scheme water, based on current Water Corporation figures, and meet BUWM design criteria. It will also meet EnviroDevelopment criteria for the Water Element of a 20% reduction of potable water. Full potable demand calculations may be found in Appendix F.

5.4 PUBLIC OPEN SPACE (POS) IRRIGATION

Rockingham Park Pty Ltd has been issued groundwater allocations by the Department of Water (DoW) to irrigate POS and verge streetscapes at a rate of 7,500 kL/ha/year, as required by the DoW (WAWA, 1990). This irrigation rate requires a total allocation of 97 ML/year. A licence for 37 ML/year from the Leederville aquifer and 60 ML/year from the superficial aquifer has been acquired by Rockingham Park (Appendix G) and comes from an 80ML/year allocation that is shared with Lot 1507 Eighty Rd and another site owned by Rockingham Park. This will need to be amended in the future.

Rockingham Park Pty Ltd recognises the importance of conserving groundwater resources in the Jandakot area and has planned for the use of a water minimising landscape design. The groundwater allocation will be sufficient to ensure the irrigation of POS within the Lot 1507 Eighty Rd, Baldivis development through the use of minimal turf, soil amendments, waterwise plants and water-efficient irrigation. Appendix D contains information demonstrating the breakdown of water use for the POS areas until 2025.

5.5 PRIMARY SCHOOL IRRIGATION

A site for a primary school has been identified in the Local Structure Plan (Figure 2) with an approximate area of 4Ha. Of this area 1Ha will be used as a sports oval requiring non-potable water for irrigation of the turf. The DoW's recommended irrigation application rate for active POS is 10000 kL/Ha/a. Therefore the required water to irrigate just the oval is 10000 kL/a. Additional irrigable areas of the school grounds will require additional water. As the ground water in this sub area is fully allocated, a groundwater licence to irrigate the primary school grounds cannot be given at this time. Options to source the required irrigation water for the Primary School shall be investigated as part of the Urban Water Management Plan (UWMP) and will include:

- Purchasing or leasing of a ground water allocation from a third party if available. This may be a private or public entity;
- Applying for a groundwater allocation from the DoW that may become available from recouped water entitlements;

- Using recycled water whether it be an onsite system, sewer mining, grey water reuse or a combination of these;
- Supplementing of any of the above systems with rainwater or stormwater harvesting;
- A combination of the above.

The UWMP shall present a feasibility study of the proposed options and identify the proposed supply option or options.

5.6 WATER BALANCE

An increase in recharge volume of approximately 270% is estimated post-development as shown in Appendix E. The pre-development recharge is estimated at 113 ML/year. Water balance calculations indicate that approximately 306 ML/yr additional recharge will occur on site once developed (Appendix E).

5.7 POTABLE WATER SERVICING

The site falls within the Tamworth tank water reticulation area. Water supply to the eastern part of the site is currently limited until the existing DN500 water distribution main in Nairn Drive has been extended south to the existing DN250 reticulation main at The Ridge Boulevard. This work is currently under way. The DN400 water main is proposed to be progressively extended southwards along Nairn Drive as a Water Corporation pre-funded capital works item as the development front moves southwards along Nairn Drive.

There is an existing DN300 water main located on the eastern side of Eighty Road that will also need to be extended southwards as a Water Corporation pre-funded capital works item along the front of the site to service the site from the west. The distribution mains in Nairn Drive and Eighty Road will be linked by reticulation-sized mains through the development road network as the development front moves ahead.

The Water Corporation has advised that land above the 30 metre contour is unable to be supplied by the Corporation and local boosting of water supply may be required. As shown in the Preliminary Earthworks Plan (Appendix H), none of the landholding will fall above the RL30 contour.

5.8 WASTEWATER SERVICING

Water Corporation waste water planning shows two future Waste Water Pump Stations (WWPSs) and Pressure Mains (PMs) located within the site: Baldivis WWPS “K” and Baldivis South WWPS “N”.

The initial stages of the development are proposed in the north-west corner of the site fronting Eighty Road. The Baldivis South WWPS “K” would need to be constructed as

part of any first stage of development for the landholding as the Water Corporation policy is not to allow tankering. No details of the sewerage outfall could be confirmed at the time of writing this report. It is expected that the outfall would be, at least in the short-term, into an existing 225 mm gravity sewer located to the north, near the intersection of Nairn Drive and Territory Crescent.

The Water Corporation waste water planning shows 2 Waste Water Pumping Stations (WWPS) and Pressure Mains (PMs), being Baldivis South WWPS "K" and Baldivis South WWPS "N" located within the landholding.

The initial stages of the development are proposed in the northwest corner of the landholding fronting Eighty Road. The Baldivis South WWPS "K" would need to be constructed as part of any first stage of development for the landholding as the Water Corporation policy is not to allow tankering. The WWPS is a Type 40 permanent station and will be located on the eastern side of Eighty Road next to a future POS area. The outfall is to be as per Option B (Refer Appendix J) and eventually moving into the ultimate as Option C.

The WWPS, and the ultimate pressure main (PM) if it forms part of the ultimate sewerage infrastructure, are capital works items for the Water Corporation, and as such the costs are funded by the developer and reimbursed by the Water Corporation according to a formula based on the number of lots titled compared to the number of lots calculated by the Water Corporation to justify the capital works expenditure. The agreement is formalised through a Customer Constructed Works Agreement (CCWA). Only permanent infrastructure falls within the CCWA as being reimbursable by the Water Corporation to the Developer.

It is expected that the initial pressure main construction (Option B and C) will not be capital works items.

If the WWPS and the PM form part of the ultimate sewerage infrastructure, then they will be capital works items owned by the Water Corporation. In this case the costs are funded by the developer and reimbursed by the Water Corporation according to a formula based on the number of lots titled compared to the number of lots calculated by the Water Corporation to justify the capital works expenditure. The agreement is formalised through a Customer Constructed Works Agreement (CCWA). Only permanent infrastructure falls within the CCWA as being reimbursable by the Water Corporation to the developer.

It is recommended that the CCWA takes into account an agreed discharge factor from an agreed percentage of individual household grey water reuse systems to be permanently implemented and operated. It is expected that this will be less than the actual number installed due to a lack of maintenance, shutdown and failure to replace systems by some householders at the end of their useful life.

5.9 MATTERS TO BE ADDRESSED AT THE SUBDIVISION STAGE

Matters to be addressed at the subdivision stage in the Urban Water Management Plan(s) (UWMPs) where relevant are:

- Finalise details of landscaping design in terms of confirmed groundwater allocation;
- Undertake subdivision level water balances based on the groundwater allocation;
- Final decision on water sustainability initiatives to be implemented at the site based on current investigations;
- Refine expected percentage uptake of rainwater and greywater reuse systems to be implemented and include at UWMP level water balance calculations;
- Finalise details to be included in the Sustainability Information Package; and
- Provide relevant design detail for the primary school irrigation water source including demonstration that any required licences for groundwater supply (if this is the preferred option) are substantially progressed.

6 STORMWATER MANAGEMENT STRATEGY

The stormwater management strategy for the site is based on infiltration of stormwater to maintain pre-development flows, while maintaining water quality. A variety of structural and non-structural Best Management Practices (BMPs) are proposed to achieve this, including swales and rain gardens in road reserves and POS, side entry and other drainage pits with open bases and infiltration basins. Swales, rather than pipes, may be used for conveyance where possible.

A Drainage Concept Plan for the site developed by Serling Consulting engineers is included in Appendix I.

6.1 STORMWATER QUANTITY

6.1.1 Stormwater Management in Road Reserves

Stormwater within road reserves will be collected via swales or conventional gully pits depending on the steepness of the landform and adjacent land uses. The pits will have open bases to increase soakage from the system. Swales, rain gardens and underground soakage systems will be used where feasible to manage more frequent rainfall events and increase infiltration through the drainage network.

Swales and road reserve rain gardens will be installed in median strips on the major road, Nairn Drive, and in road reserves adjacent to Public Open Space where space is available, as shown in the Drainage Concept Plans in Appendix I. These structures will generally contain native vegetation, although grass may be used on the edges of Public Open Space where this is more appropriate to the development. Where feasible, the use of swales rather than pipes for conveyance will be considered.

Swales are generally only suitable for areas where the slope is less than about 4% (Engineers Australia, 2006). Road reserve widths are also a potential constraint for the use of swales and rain gardens. Road reserves that may be appropriate for the use of swales have been identified and are shown on the Drainage Concept Plan (Appendix I).

Intermittent rain gardens within the widened road reserve of Nairn Drive may also be utilised. These will be designed to retain nutrients while infiltrating stormwater and use appropriate native vegetation. An example of a rain garden is shown in Plate 1. Potential rain garden locations are presented in Appendix I.

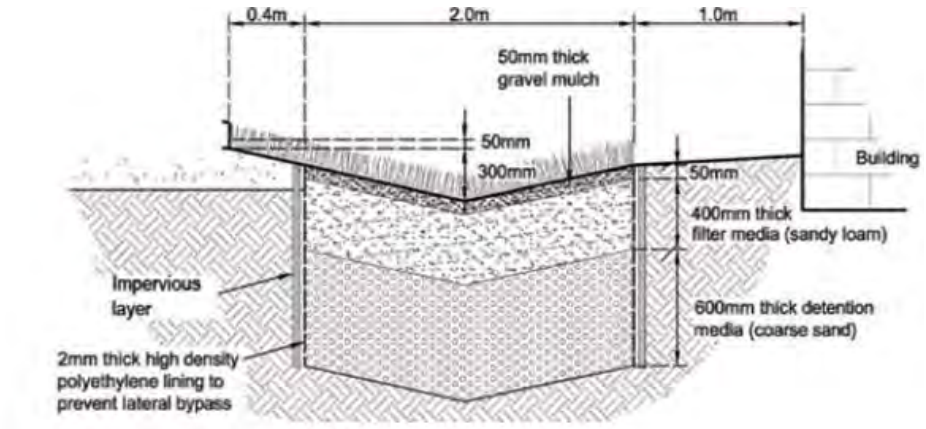


Plate 1: Example of a rain garden design (from DoW, 2008). Note that the rain gardens will not be located adjacent to buildings.

The site will utilise open-based drainage pits to increase infiltration throughout the drainage network. Soakage pits may be used in road verges where road reserve widths and service alignments permit.

The use of permeable paving will be considered for rear lane access in addition to parking areas and within the activity centres. The City of Rockingham will be consulted to determine suitability of permeable paving. Consideration will be given to non-central road alignments for better facilitation of swales and rain gardens, and to appropriate road reserve widths for infiltration within road reserves at a UWMP stage.

Major flow paths will be provided along road reserves for the 1 in 100 year flow (Appendix I). Peak flows for the 1 in 100 year ARI event will discharge the site by overland flow in the north-western corner of the site.

6.1.2 Flood Management in Public Open Space

The development has been divided into ten catchments for flood management purposes (Appendix I and Table 6) based on approximate topographic catchments. The catchment areas vary from 1.10 ha to 6.32 ha (Table 6). Areas of Public Open Space have been allocated for drainage in each catchment. The basins have been designed to cater for the 1 in 100 year ARI events and to allow approximately 12340m^3 of storage in all of the ten catchments. The basin areas have been designed upon the basis that a maximum area of 25% of POS is inundated during a 1 in 10 year ARI storm event, as per City of Rockingham standards. The infiltration rate upon which the drainage concept plan is based is 3 m/day.

Table 6: Catchment areas for 1 in 100 year ARI peak volumes and approximate basin areas for each catchment at Parkland Heights

Catchment No.	Catchment Area (ha)	Impervious Area (ha)	1 in 100 year ARI Peak Volume (m^3)	Basin Area (m^2) (based on the base area requirement for 1 in 100 Year ARI event)			
				1 in 100 Year ARI	1 in 10 Year ARI	1 in 5 Year ARI	1 in 1 Year ARI
B1	3.77	3.39	1,700	2,495	2,159	2,085	1,878
B2	6.32	5.69	2,350	3,365	2,977	2,893	2,654
B3	5.09	4.58	2,100	2,227	1,839	1,755	1,508
B4	2.06	1.85	1,050	1,546	1,265	1,206	1,043
B5	3.03	2.48	1,290	2,095	1759	1,673	1,414
B6	1.27	1.14	860	2,119	1,840	1,795	1,732
B7	1.89	1.7	380	935	902	878	798
B8	1.1	0.99	310	942	836	810	750
B9	3.43	3.09	1,480	2,501	2,180	2,112	1,924
B10	2.12	1.91	820	1,245	1,012	961	814

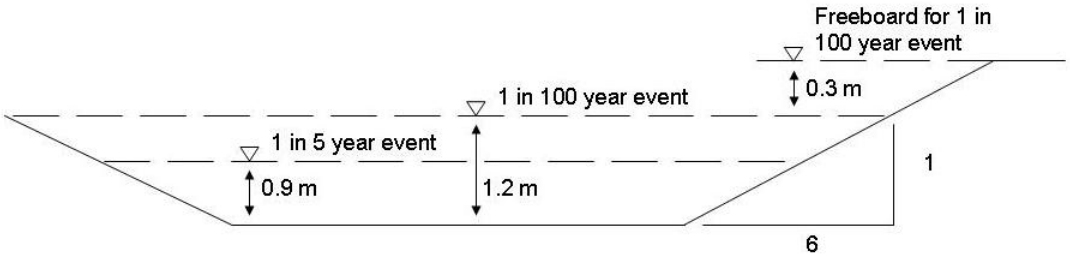


Plate 2: Conceptual design of drainage structure. Design will be optimised and improved at subdivision stage to decrease area of inundation in smaller events and maximise POS useability. Base area will depend on volume required.

The total area of inundation in a 1 in 5 year ARI event is 1.62 ha within Public Open Space. This area represents the storage for the whole 1 in 5 year event, without allowances for losses through drainage pits and swales. This is seen as a maximum allowable area for inundation and efforts will be made to reduce this area by maximising infiltration within the road reserve.

The area of inundation in a 1 in 100 year ARI event is estimated at 1.95 ha. This area is outlined in Appendix I. The areas are shown to indicate the total area of inundation. The basins themselves shall be shaped and located to maximise the useability of the Public Open Space while maintaining acceptable depths of inundation.

6.1.3 Lot Stormwater Management

The drainage from lots will be managed on the lots through the use of soakwells or similar structures. Soils within the site consist predominantly of sand with a given hydraulic conductivity between 4.3 – 5.9 m/day and of moderate to good drainage characteristics (SKM, 2009), which is considered suitable.

Lots will not be provided with a direct connection to the road drainage system.

A minimum freeboard of 0.3 m will be provided between the 1 in 100 year water level and minimum habitable floor levels.

6.2 STORMWATER QUALITY

The development will use a mixture of structural and non-structural controls to manage stormwater quality, in line with the DoW's *Stormwater Management Manual* (2004-7).

Stormwater quality on the site will be maintained through the use of Best Management Practices including swales, rain gardens and infiltrating basins to remove nutrients and sediments. These structures will be planted with native vegetation to encourage nutrient and suspended solids uptake and removal prior to infiltration. The structures will be sized to meet the DoW requirement that an equivalent of 2% of the effective impervious area will be bioretention structures to maintain water quality (DoW, 2008c). Gross pollutant traps will also be used prior to discharge to basins or Public Open Space.

A package of information provided to landowners at settlement of their property will include information on reducing fertiliser use and other water conservation and environmental management measures.

6.3 IMPACT ON WATER DEPENDANT ECOSYSTEMS

There are no water dependant ecosystems (WDEs) within the site. The closest wetland, Outridge Swamp, is 80 m to the west of the site and the associated 50 m buffer zone is still 30 m away from the site.

6.4 MATTERS TO BE ADDRESSED AT THE SUBDIVISION STAGE

Matters to be addressed at the subdivision stage in the Urban Water Management Plan(s) (UWMPs) are:

- Provision of a detailed drainage design and planning for the subdivision area including underground soakage systems, swales and rain gardens and confirmation of sizing and location of structures, road alignments and road reserves; and
- Details of landscaping for swales, rain gardens and basins.

7 GROUNDWATER MANAGEMENT STRATEGY

7.1 GROUNDWATER QUANTITY

Because of the significant depth to groundwater over the site, depth to groundwater is not considered to be a significant constraint to development on this site. Subsoil drainage is not proposed on this site.

Fill will not be required on this site to manage groundwater levels, except possibly in isolated areas around POS and other low points.

7.2 IMPACT ON WATER DEPENDANT ECOSYSTEMS

There are no wetlands or groundwater dependent vegetation within the site as outlined in Section 4.5.2. The closest wetland, Outridge Swamp, is 80 m to the west of the site. Groundwater flow direction at the site is partially due south-west and not directly in the path of the wetland. Any changes to the groundwater regime will be managed to ensure there is minimal impact upon this wetland.

7.3 GROUNDWATER QUALITY

Nutrient concentrations entering groundwater will be reduced through the use of a mixture of structural and non-structural Best Management Practices including:

- Swales, rain gardens and basins with native vegetation in frequently inundated areas and amended fill to strip nutrients prior to infiltration;
- Soil amendments in all POS and landscaping packages to retain phosphorus and water;
- Limiting the use of fertilisers in POS through householder education and control of POS; and
- Provision of education to householders on fertilise wise gardening through Sustainability Information Packages.

7.4 MATTERS TO BE ADDRESSED AT THE SUBDIVISION STAGE

Matters to be addressed at the subdivision stage in the Urban Water Management Plan(s) (UWMPs) are:

- Confirmation of finished lot levels; and
- Further details of landscaping and Sustainability Information Packages to be provided to householders.

8 MATTERS TO BE ADDRESSED AT THE SUBDIVISION STAGE

The following section summarises all matters presented in this report that have to be addressed at the subdivision stage in the Urban Water Management Plan(s) (UWMPs).

These are:

- Finalise details of landscaping design in terms of confirmed groundwater allocation;
- Undertake subdivision level water balances based on the groundwater allocation;
- Finalise decisions on water sustainability initiatives to be implemented at the site based on current investigations;
- Undertake cost-benefit analyses of alternate water source options;
- Determine expected percentage uptake of rainwater and greywater reuse systems to be implemented and include at UWMP level water balance calculations;
- Provision of a detailed drainage design and planning for the subdivision area including underground soakage systems, swales and rain gardens and confirmation of sizing and location of structures, road alignments and road reserves;
- Provision of details of landscaping for swales, rain gardens and basins;
- Confirmation of finished lot levels; and
- Finalise details of landscaping and Sustainability Information Packages to be provided to householders.

9 MONITORING

9.1 PROGRAM FOR UWMP PREPARATION

Eighteen months of groundwater monitoring has been completed at Lot 1507 Eighty Rd, Baldivis. The full set of monitoring data acquired will be used to provide a baseline for post-development groundwater quality and levels.

This information will be provided as part of the first UWMP.

9.2 POST-DEVELOPMENT MONITORING

A detailed post-development monitoring program and contingency plan should be developed for the subdivision by the developer and submitted to the City of Rockingham before any works are commenced. These programs should be inline with the LWMS.

Post-development monitoring for each stage will include monthly measurements of ground water and surface water levels (where surface water is present) and quarterly sampling for pH, electrical conductivity, redox potential, total nitrogen, ammonia, heavy metals, Kjeldahl nitrogen, nitrate/nitrite, total phosphorus and phosphate in groundwater for which trigger levels and resulting actions are outlined in Table 7. This monitoring will be undertaken for two years following the practical completion of each stage.

Monitoring shall be undertaken at the pre-development bores (Figure 6) excepting bores F and G. Where pre-development bores are destroyed during construction, replacement bores of a similar depth shall be installed and monitored after development.

Table 7: Parameters, Tests and Actions Associated with Monitoring

Parameter	Test	Trigger	Action
Groundwater Levels and Quality	Groundwater level and water quality from pre-development bores, sampled quarterly	Increase in Total Phosphorus and Total Nitrogen concentration compared to pre-development baseline for two successive events (refer Table 1). Increase in groundwater level over two successive winters from predevelopment levels.	Responsible body to investigate reasons for any change. If intervention is required, this shall be undertaken prior to the following winter.

The contingency response to the monitoring program will be detailed in each UWMP. It will likely include trigger levels and action levels in the groundwater levels and wetlands that will require investigation and responsive actions. There will also be water quality criteria to be addressed.

10 IMPLEMENTATION

10.1 ROLES AND RESPONSIBILITIES

Item	Scheme Development	Interim Maintenance (Minimum of two years)	Long-term Maintenance
Waterwise Efficiency Packages	Developer	Residents and strata companies.	Residents and strata companies.
Sustainability Information packages	Developer	Developer	Council
Swales, raingardens and drainage system	Developer	Developer for at least 2 years as per Council requirements	Council
Public Open Space	Developer	Developer for at least 2 years as per Council requirements	Council
Monitoring of the development	Developer	Developer for three years post-development, including one year following the completion of the majority (80%) of the development	Developer for monitoring in compliance with groundwater licensing conditions. Council for other items.

10.2 FUNDING

No external funding is being sought for this project.

10.3 REVIEW

Rockingham Park Pty Ltd expects that development of Lot 1507 Eighty Rd, Baldivis will occur over a number of years. Water management 'best practice' procedures will likely vary during the development timeframe. If there is a need to change, then proposed practices may need to be modified in the future to comply with improvements in understanding or design. Rockingham Park Pty Ltd proposes to address any identified and agreed modifications through the preparation and implementation of UWMPs.

11 CONCLUSIONS

The objective of the Local Water Management Strategy (LWMS) is to ensure that sustainable management of the total water cycle at Parkland Heights, Lot 1507 Eighty Rd, Baldivis occurs through Water Sensitive Urban Design. This includes water conservation, stormwater management and groundwater management. Rockingham Park Pty Ltd aims to manage these issues at the site through the following initiatives:

Water Conservation

- Participating in the EnviroDevelopment program to achieve a maximum potable water usage of 80 kL/per/year and meet both the State Water Target and EnviroDevelopment target of a 20% reduction in scheme water use;
- Providing Waterwise landscaping for Public Open Space (POS) that includes waterwise plants, soil amendments to improve water and nutrient retention, minimising turf areas and water efficient irrigation;
- Investigating the possibility of using an alternative water source to irrigate POS;

Stormwater Management

- Implementing a drainage design that ensures pre-development discharge rates in the event of a 1 in 100 year ARI event will be maintained through storage and infiltration on site; and
- Maximising infiltration by developing swales and rain gardens in road reserves where possible, planted with native vegetation to encourage nutrient and suspended solids uptake and removal prior to infiltration. Open based manholes will also be used to maximise infiltration. Infiltration basins in Public Open Space will manage larger events.

Groundwater Management

- Recognising the issue of groundwater availability and planning low water use POS.

This LWMS demonstrates that Parkland Heights, Lot 1507 Eighty Rd, Baldivis can be developed without significant constraints. The outstanding issues can be resolved at the Urban Water Management Plan stage to create a development that meets the goals and ideals of *Better Urban Water Management*.

12 REFERENCES

Allen, DG and Jeffery, RC 1990, *Methods for Analysis of Phosphorus in Western Australian Soils, Report on Investigation No. 37*, Chemistry Centre, Perth, Western Australia.

Bolland, M. D. A., Allen, D. G. and Barrow, N. J. (2003) *Sorption of Phosphorus by Soils – how it is measured in Western Australia*, Department of Agriculture, Perth, Western Australia.

Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC & ARMCANZ) 2000, *National Water Quality Management Strategy - Australian and New Zealand Guidelines for Fresh and Marine Water Quality*.

Coghlan, P and Loh, M 2003, *Domestic Water Use Study in Perth, Western Australia*, Water Corporation, Perth.

Department of Environment (DoE) 2004, *Perth Groundwater Atlas Second Edition,* Department of Environment, Perth.

Department of Health (DoH) 2005, *Code of Practice for Reuse of Greywater in Western Australia* Department of Health, Perth.

Department of Water (DoW) 2004-2007, *Stormwater Management Manual for Western Australia,* Department of Water, Perth.

Department of Water (DoW) 2008, *Urban Water Management Plans*, Department of Water, Perth.

Department of Water (DoW) 2009, *Jandakot structure plan area drainage and water management plan,* Department of Water, Perth.

Department of Water (DoW) 2011, *Water monitoring guidelines for better urban water management strategies/plans* Department of Water, Perth.

Engineers Australia 2006, *Australian Runoff Quality: A guide to Water Sensitive Urban Design.*

ENV Australia 2009a, *Lot 1507 Sixty Eight Road Baldivis – Preliminary Acid Sulfate Soils Investigation*, ENV Australia, Perth.

ENV Australia 2009b, *Environmental Preliminary Site Investigation – Lot 1507 Sixty Eight Road, Baldivis, WA,* ENV Australia, Perth.

ENV Australia 2009c, *Flora and Vegetation of Lot 1507 Sixty-Eight and Eighty Roads, Baldivis*, ENV Australia, Perth.

ENV Australia 2010, *Lot 1507 Sixty Eight Road, Baldivis Black Cockatoo Assessment,* ENV Australia, Perth.

ENV Australia 2011a, *Parkland Heights, Lot 1507 Sixty Eight Road Baldivis, Environmental Assessment,* ENV Australia, Perth.

ENV Australia 2011b, *Parkland Heights Acid Sulfate Soils Dewatering Management Plan,* ENV Australia, Perth.

Geological Survey of Western Australia (GSWA) (1980), *Pinjarra 1:250,000 Geological Series Map, Sheet S150-2 and Sheet S150-1*, Geological Survey of Western Australia

Government of Western Australia 1981, *Metropolitan Water Supply, Sewerage and Drainage By-laws,* Perth, Western Australia.

Government of Western Australia 2007, *State Water Plan*, Department of Premier and Cabinet, Perth, Western Australia.

Sinclair Knight Merz (SKM) 2009, *Lot 1507 Eighty Road, Geotechnical Investigation Report*, Sinclair Knight Merz, Perth.

Swan River Trust (SRT) 2003, *Developing targets for the Swan-Canning Cleanup Program (SCCP), River Science Issue 7*, Government of Western Australia, Perth, Western Australia.

Water and Rivers Commission (WRC) 1997, *Perth Groundwater Atlas (First Edition),* Water and Rivers Commission, Perth.

Water Authority of Western Australian (WAWA) 1990, *General principles and policy for groundwater licensing in Western Australia*, Water Authority of Western Australian, Perth, Western Australia.

Water Corporation 2007, *Waterwise Display Village Criteria,* Water Corporation Perth, Western Australia.

Water Corporation 2008, *Waterwise Calculator*, Water Corporation. Available from: <http://www.watercorporation.com.au/W/waterwise_calculator.cfm> [17 September 2009].

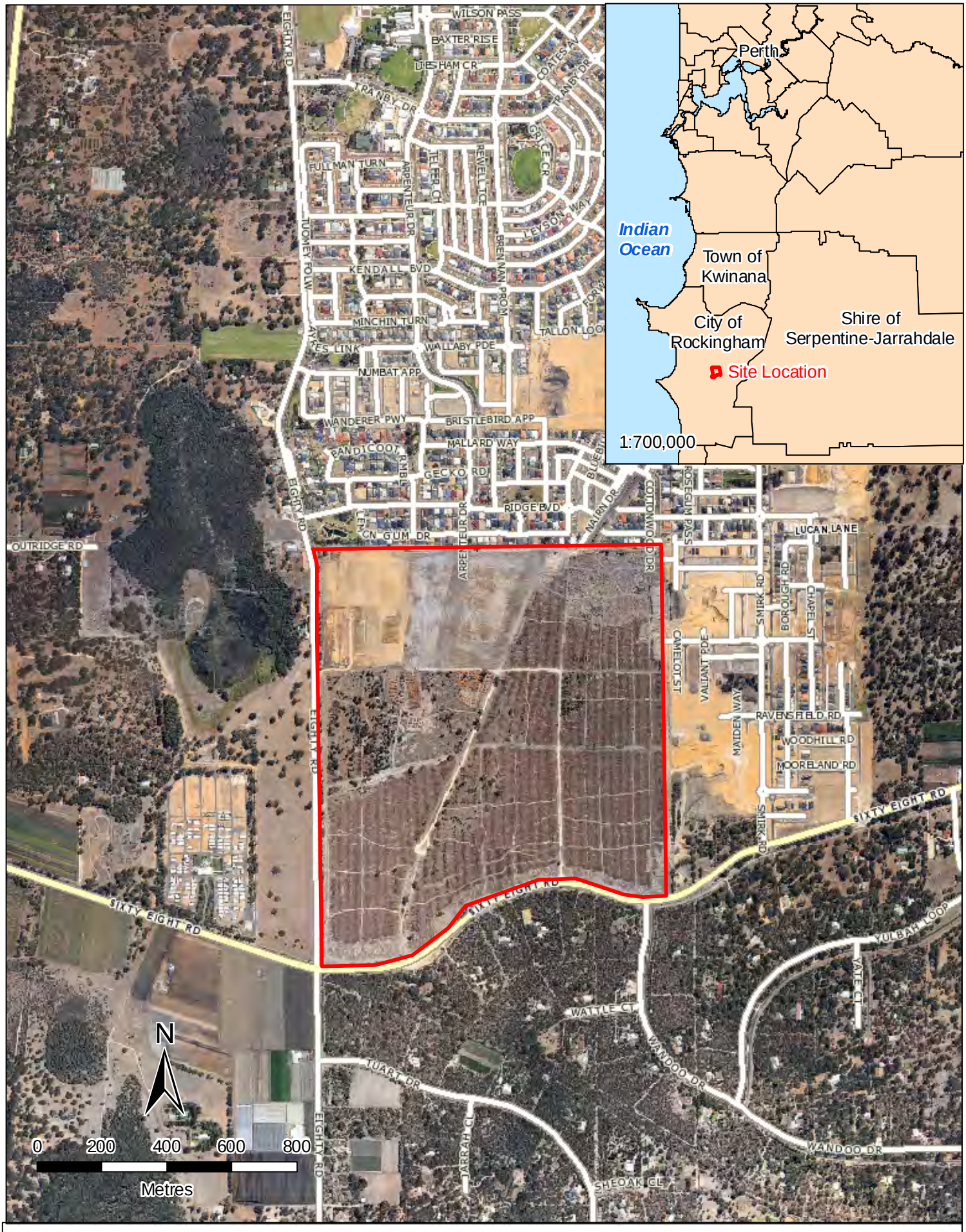
Water Corporation 2009, Water Balance Tool, Water Corporation. Available from: http://www.watercorporation.com.au/_files/H2Options_Annexure_F.pdf [20 September 2011].

Water Corporation 2010, *Perth's Residential Water Use Study 2008/2009*, Water Corporation Perth, Western Australia

Western Australian Planning Commission (WAPC) 2008, *Better Urban Water Management,* Western Australian Planning Commission, Perth, Western Australia.

Western Australian Planning Commission (WAPC) 2009, *Acid Sulfate Soils, Planning Bulletin 64/2009*, Western Australian Planning Commission, Perth, Western Australia.

FIGURES



CLIENT: Rockingham Park		JOB NO.: J100378	
AUTHOR: J Hunt	DRAWN: T Ellis	DATE: 6-12-2011	
SCALE: 1:15,000@ A4	PROJECTION: GDA94 MGA50		

Site Context Plan

Lot 1507 Eighty Road, Baldivis
Local Water
Mangement Strategy

FIGURE 1

Source: Taylor Burrell Barnett, 14-11-2011

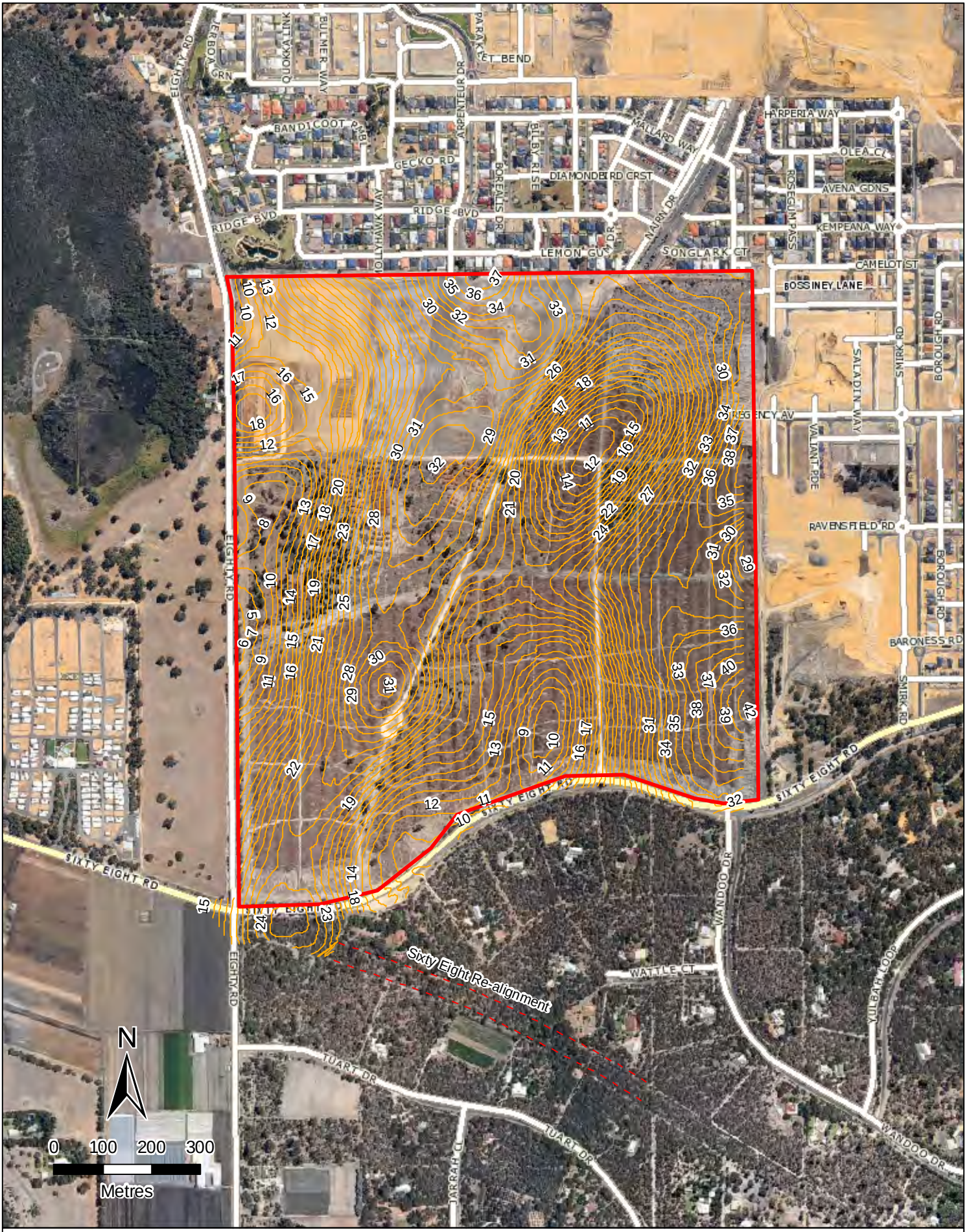
env Australia

CLIENT	JOB NO.
Rockingham Park	J100378
AUTHOR:	DRAWN	DATE
J Hunt	T Ellis	6-12-2011
SCALE	PROJECTION
1:7000 @ A4	N/A

Site Structure Plan

Lot 1507 Eighty Road, Baldivis
Local Water
Mangement Strategy

FIGURE 2



env Australia

CLIENT	JOB NO.
Rockingham Park	J100378

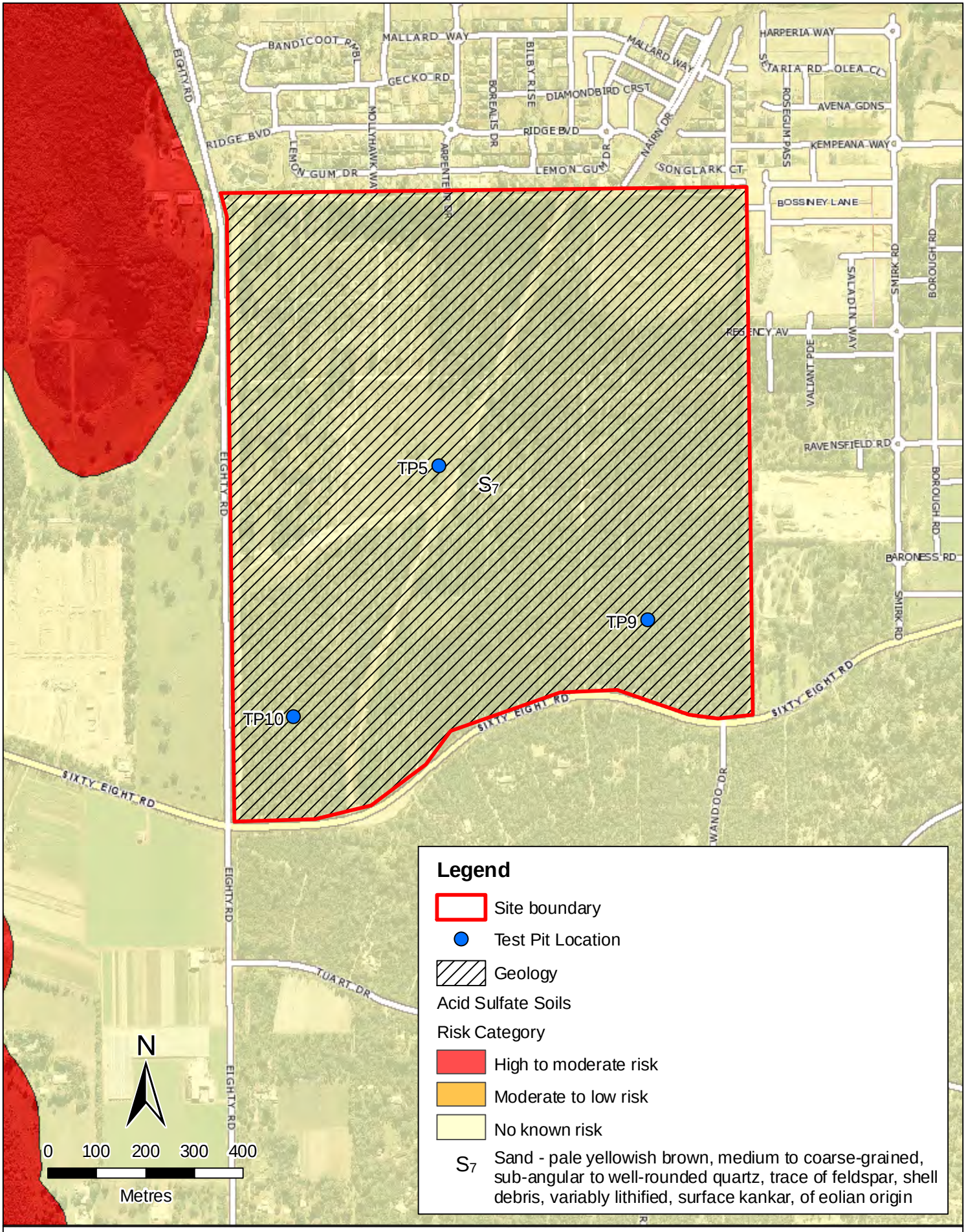
AUTHOR:	DRAWN	DATE
J Hunt	T Ellis	6-12-2011

SCALE	PROJECTION
1:10,000@ A4	GDA 94 MGA 50

Site Condition Plan

Lot 1507 Eighty Road, Baldivis
Local Water
Mangement Strategy

FIGURE 3

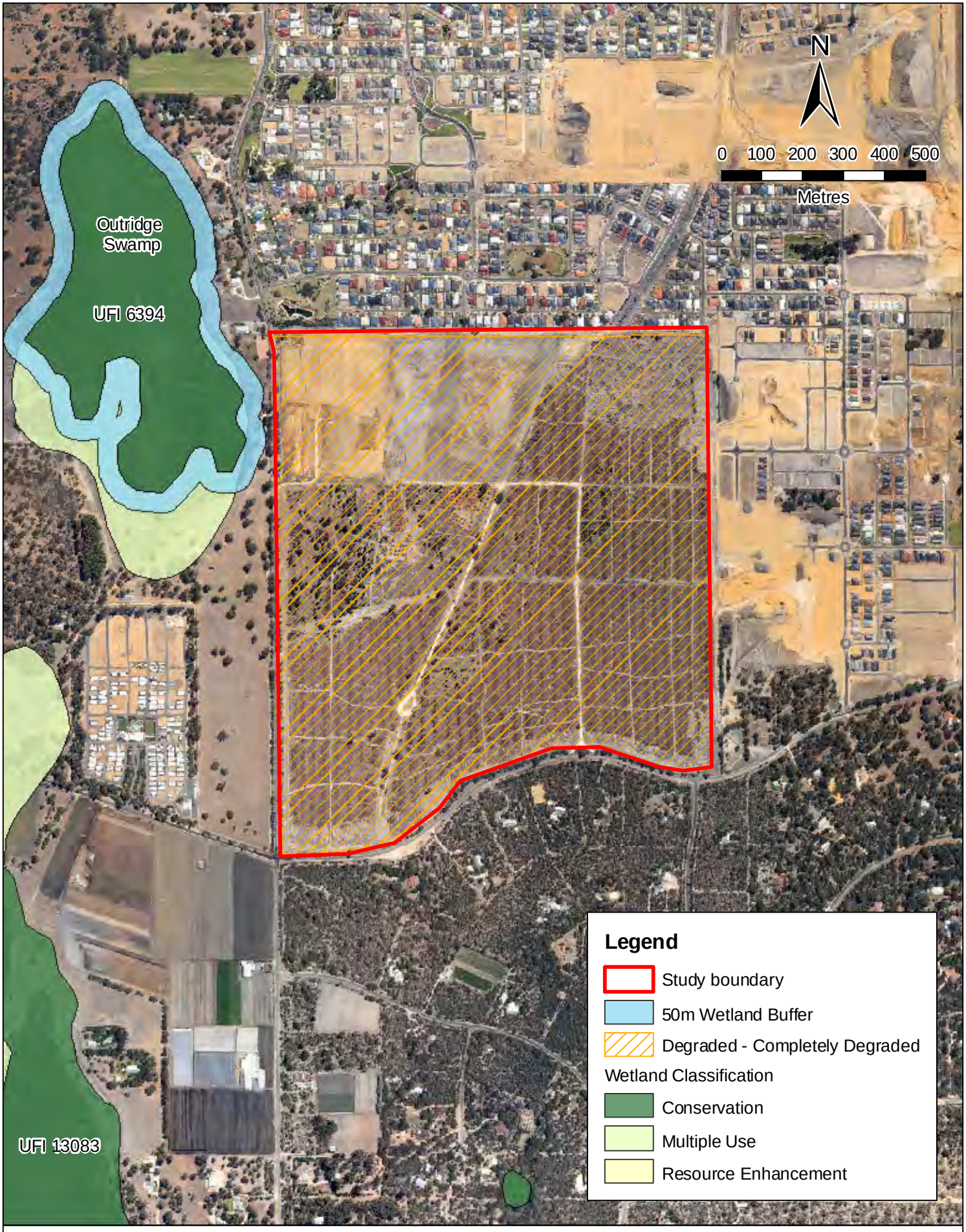


CLIENT: Rockingham Park
JOB NO.: J100378
AUTHOR: J Hunt
DRAWN: T Ellis
DATE: 6-12-2011
SCALE: 1:10,000@ A4
PROJECTION: GDA 94 MGA 50

Geotechnical Plan

Lot 1507 Eighty Road, Baldivis
Local Water
Mangement Strategy

FIGURE 4



CLIENT
Rockingham Park

JOB NO.
J100378

AUTHOR:
J Hunt

DRAWN
T Ellis

DATE
6-12-2011

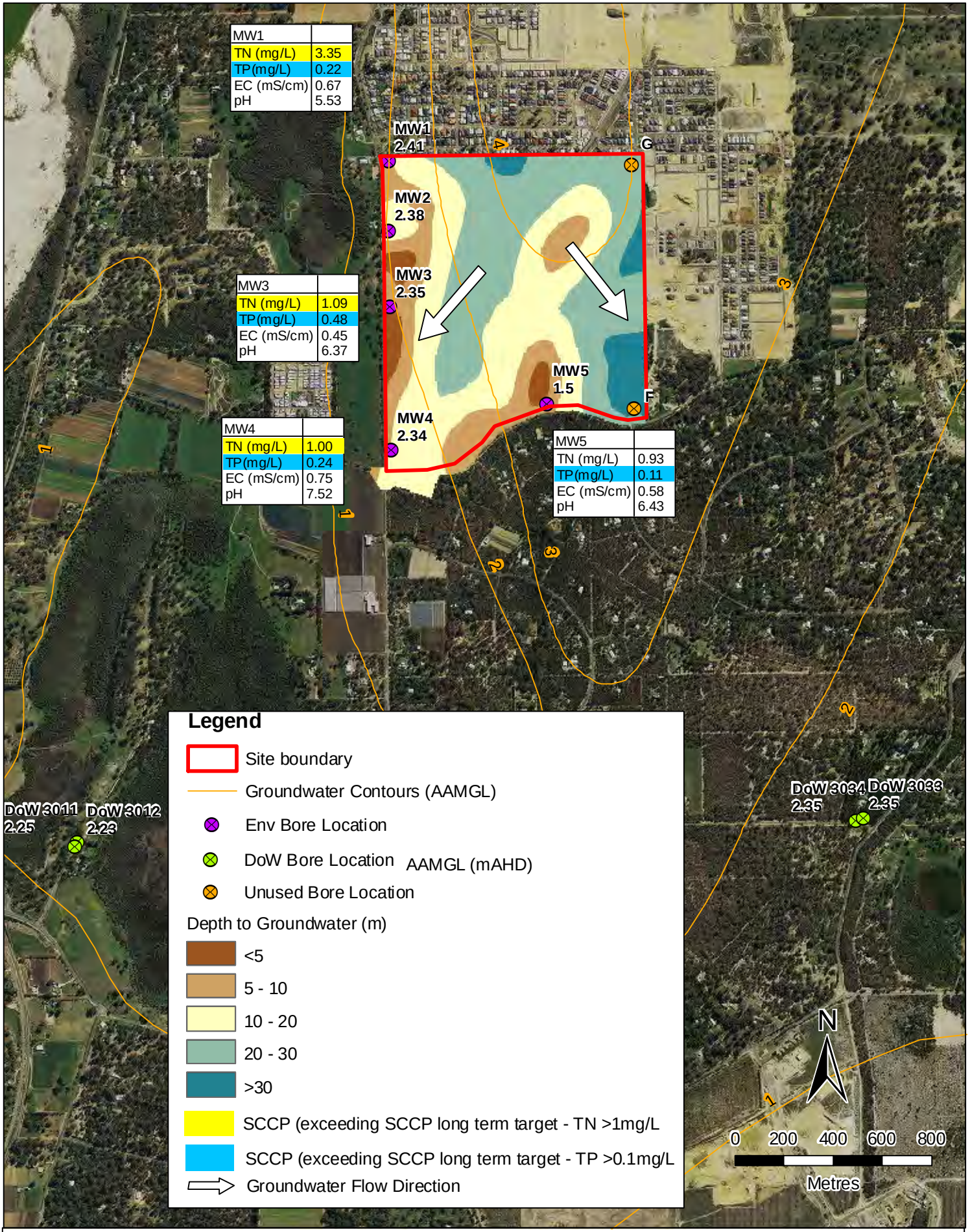
SCALE
1:12,000@ A4

PROJECTION
GDA 94 MGA 50

Environmental Plan

Lot 1507 Eighty Road, Baldivis
Local Water
Mangement Strategy

FIGURE 5



CLIENT
Rockingham Park

JOB NO.
J100378

AUTHOR:
J Hunt

DRAWN
T Ellis

DATE
6-12-2011

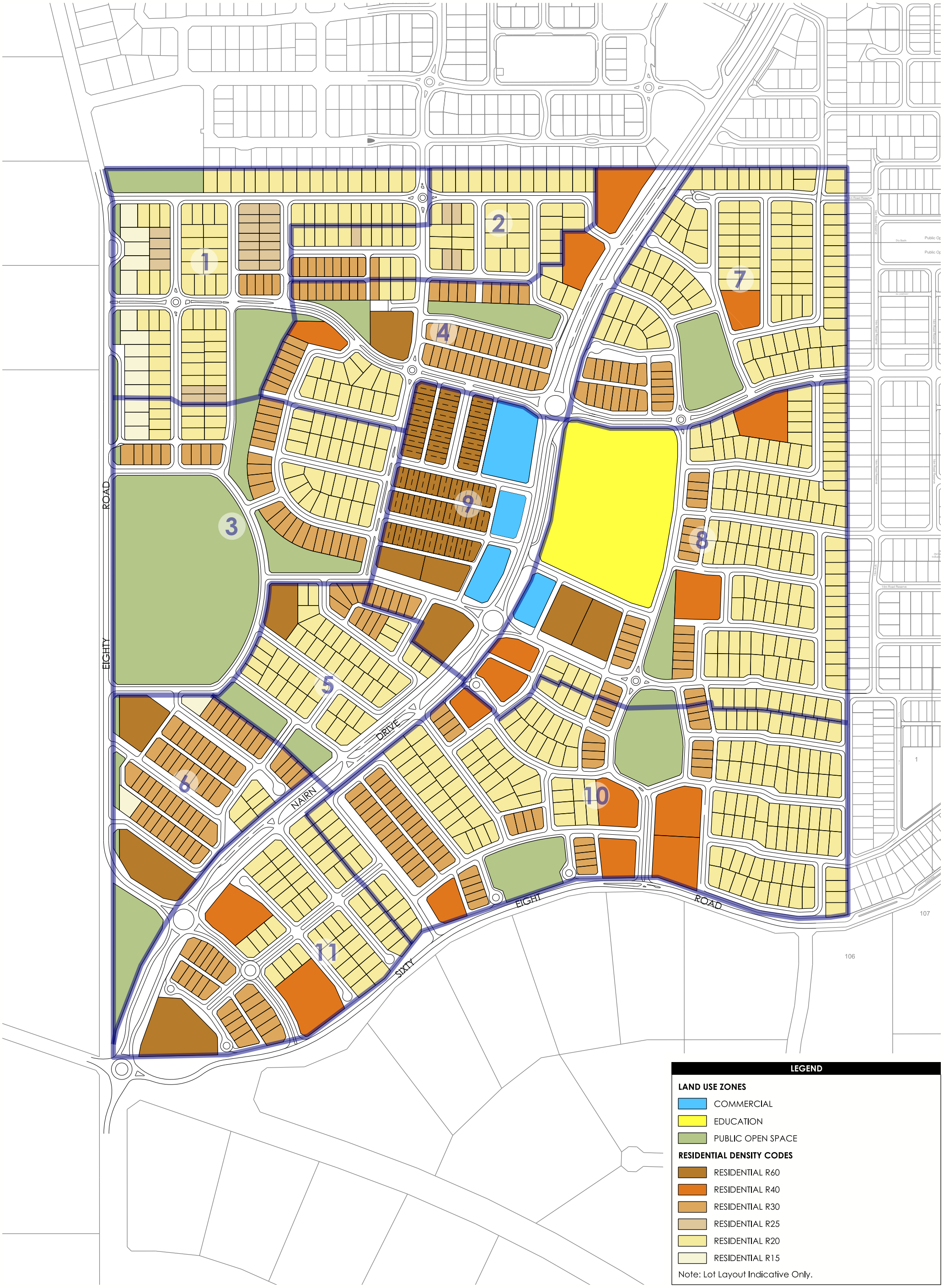
SCALE
1:20,000@ A4

PROJECTION
GDA94 MGA50

Groundwater Plan

Lot 1507 Eighty Road, Baldivis
Local Water
Mangement Strategy

FIGURE 6



Indicative Staging Plan

LOT 1507, BALDIVIS

A ROCKINGHAM PARK PTY LTD PROJECT

plan: 00/075/032B
date: 22/11/2011
projection: PCG 94
designed: DR
checked: BDM
drawn: BR
scale: 1:2500@A1 | 1:2000@A0
0 50 100m

Taylor Burrell Barnett Town Planning & Design
187 Roberts Road Subiaco Western Australia 6008
p: (08) 9382 2911 f: (08) 9382 4586 e: admin@tbbplanning.com.au

APPENDIX A
BORE LOGS

Client: Rockingham Park
Logged By: PA
Drilled By: Landcare Drilling
Monitoring Bore No: MW1

Project: Parkland Heights
Job No: 09.207
Date Logged: 21-Oct-09
Installation Method: Air Rotary

386986E, 6419561N

Depth BGL (m)	Sample Taken	Monitor Well Log	Profile	Lithology	Field Rank	Observations (PID in ppm$_v$ VOC)
				Blue riser		
			0 - 0.25	SAND & ORGANIC MATTER, brown/grey, medium grain size, poorly sorted, dry		
			0.25 - 0.7	SAND, brown, medium grain size, moderately sorted, dry		Quartz sand, limestone fragments
						elements
			0.7 - 0.75	SAND, cream/grey, medium grain size, moderately sorted dry		
1.0			0.75 - 1.25	SAND, brown/cream/grey, medium grain size, moderately sorted, dry		
			1.25 - 1.7	SAND, cream/grey, medium grain size, moderately sorted		damp uniform colour all the way down, tan speckles
		▽	1.7 - 2.25	CLAYEY SAND, brown, medium grain size, moderately sorted,		Saturated WL: 1.75mbgl
2.0						
			2.25 - 2.75	CLAYEY SAND, brown/grey, medium grain size moderately sorted		Saturated Quartz sand
			2.75 - 5	CLAYEY SAND, dark brown/grey, medium grain size, moderately sorted, saturated		becoming darker with depth
3.0						
4.0						
5.0				EoH @ 5 mbgl		

NOTE:

- Monitor Well Screen
- Gravel Pack
- Bentonite Layer
- Sand Fill
- Cement Grout

Initial water table at time drilling ▽

ENV. Australia
Level 7
182 St Georges Terrace
Perth, WA, 6000.

Client: Rockingham Park
Logged By: PA
Drilled By: Landcare Drilling
Monitoring Bore No: MB2

Project: Parkland Heights
Job No: 09.207
Date Logged: 21-Oct-09
Installation Method: Air Core

386985E, 6419281N

Depth BGL (m)	Sample Taken	Monitor Well Log	Profile	Lithology	Field Rank	Observations (PID in ppm_v VOC)
				blue riser		
			0 - 0.25	TOPSOIL - SAND, black		organic matter
			0.25 - 0.5	SAND, tan brown, medium grain size,		
				poorly sorted		dry
			05. - 1	SAND, brown, medium grain size,		dry
				moderately sorted		quartz sand light tan parts
1.0			1 - 2.5	SAND, yellow/orange, medium grain size,		dry
				moderately sorted		white quartz elements,
						very orange colour
2.0						
			2.5 - 6	SAND, yellow/orange, medium grain size,		damp
				modertately sorted		very slight clay stain
3.0						
4.0						
5.0						
						slightly lighter at 5.4 mbgl

NOTE:

- Monitor Well Screen
- Gravel Pack
- Bentonite Layer
- Sand Fill
- Cement Grout

Initial water table at time drilling ▽

ENV. Australia
Level 7
182 St Georges Terrace
Perth, WA, 6000.

Client: Rockingham Park
Logged By: PA
Drilled By: Landcare Drilling
Monitoring Bore No: MB2

Project: Parkland Heights
Job No: 09.207
Date Logged: 21-Oct-09
Installation Method: Air Core

386985E, 6419281N

Depth BGL (m)	Sample Taken	Monitor Well Log	Profile	Lithology	Field Rank	Observations (PID in ppm_v VOC)
			6 - 9	SAND, yellow/orange/ white, medium to coarse grained.		saturated
						white mottles
						WL: 6.5 mbgl
6.0			6 - 9	SAND, yellow/orange/ white, medium to coarse grained.		saturated
						white mottles
						WL: 6.5 mbgl
7.0						
8.0						
9.0						
				EOH @ 9 mbgl		3m casing
						6m slotted casing
10.0						

NOTE:

- Monitor Well Screen
- Gravel Pack
- Bentonite Layer
- Sand Fill
- Cement Grout

Initial water table at time drilling ▽

ENV. Australia
Level 7
182 St Georges Terrace
Perth, WA, 6000.

Client: Rockingham Park
Logged By: PA
Drilled By: Landcare Drilling
Monitoring Bore No: MB3

Project: Parkland Heights
Job No: 09.207
Date Logged: 21-Oct-09
Installation Method: Air core, mud rotary

386998E, 6418987N

Depth BGL (m)	Sample Taken	Monitor Well Log	Profile	Lithology	Field Rank	Observations (PID in ppm_v VOC)
				Steel riser		
	0-0.15		0-0.25	TOPSOIL - SAND, black		
			0.25 - 1.5	SAND, cream/tan, medium grain size, poorly sorted		dry
1.0						
			1.5 - 5.5	SAND, yellow/orange, medium grain size, poorly sorted		saturated
						WL: 2.5 mbgl
2.0						
3.0						
4.0						
5.0						
				EOH @ 5.5 mbgl		

NOTE:

- Monitor Well Screen
- Gravel Pack
- Bentonite Layer
- Sand Fill
- Cement Grout

Initial water table at time drilling ▽

ENV. Australia
Level 7
182 St Georges Terrace
Perth, WA, 6000.

Client: Rockingham Park
Logged By: PA
Drilled By: Landcare Drilling
Monitoring Bore No: MB4

Project: Parkland Heights
Job No: 09.207
Date Logged: 22/10/09
Installation Method: Mud Rotary

386994E, 6418389N

Depth BGL (m)	Sample Taken	Monitor Well Log	Profile	Lithology	Field Rank	Observations (PID in ppm_v VOC)
				Steel riser		
			0 - 0.35	Topsoil: SAND, black, organic		
			0.35-4.5	SAND, yellow/grey, medium grain size, moderately sorted		dry
						predomiately yellow with grey
						mottles
3.0						
			4.5 - 14.5	SAND, yellow/orange medium grain size, moderately sorted		becoming more orange with depth
6.0						
9.0						
12.0						
						WL: 13.3 mbgl
				EOH: 14.5 mbgl		
15.0						

NOTE:

- Monitor Well Screen
- Gravel Pack
- Bentonite Layer
- Sand Fill
- Cement Grout

Initial water table at time drilling

ENV. Australia
Level 7
182 St Georges Terrace
Perth, WA, 6000.

Client: Rockingham Park
Logged By: PA
Drilled By: Landcare Drilling
Monitoring Bore No: MB5

Project: Parkland Heights
Job No: 09.207
Date Logged: 22/10/09
Installation Method: Air and Mud rotary

387632E, 6418582N

Depth BGL (m)	Sample Taken	Monitor Well Log	Profile	Lithology	Field Rank	Observations (PID in ppm$_v$ VOC)
			0-0.5	TOPSOIL - SAND, grey		organic matter
			0.5 - 1	SAND, yellow/grey		some grey and orange particles
1.0			1 - 6	SAND, yellow/orange, medium grain size, moderately sorted		looks like "clean fill"
2.0						
3.0						
4.0						
5.0						

NOTE:
- Monitor Well Screen
- Gravel Pack
- Bentonite Layer
- Sand Fill
- Cement Grout

Initial water table at time drilling ▽

ENV. Australia
Level 7
182 St Georges Terrace
Perth, WA, 6000.

Client: Rockingham Park
Logged By: PA
Drilled By: Landcare Drilling
Monitoring Bore No: MB5

Project: Parkland Heights
Job No: 09.207
Date Logged: 22/10/09
Installation Method: Air and Mud rotary

387632E, 6418582N

Depth BGL (m)	Sample Taken	Monitor Well Log	Profile	Lithology	Field Rank	Observations (PID in ppm$_v$ VOC)
			0-0.5	TOPSOIL - SAND, grey		organic matter
			0.5 - 1	SAND, yellow/grey		some grey and orange particles
6.0			1 - 6	SAND, yellow/orange, medium grain size, moderately sorted		looks like "clean fill"
		▽				WL: 6.5 mbgl
7.0						
8.0						
9.0				EOH @ 9 mbgl		
10.0						

NOTE:
- Monitor Well Screen
- Gravel Pack
- Bentonite Layer
- Sand Fill
- Cement Grout

Initial water table at time drilling ▽

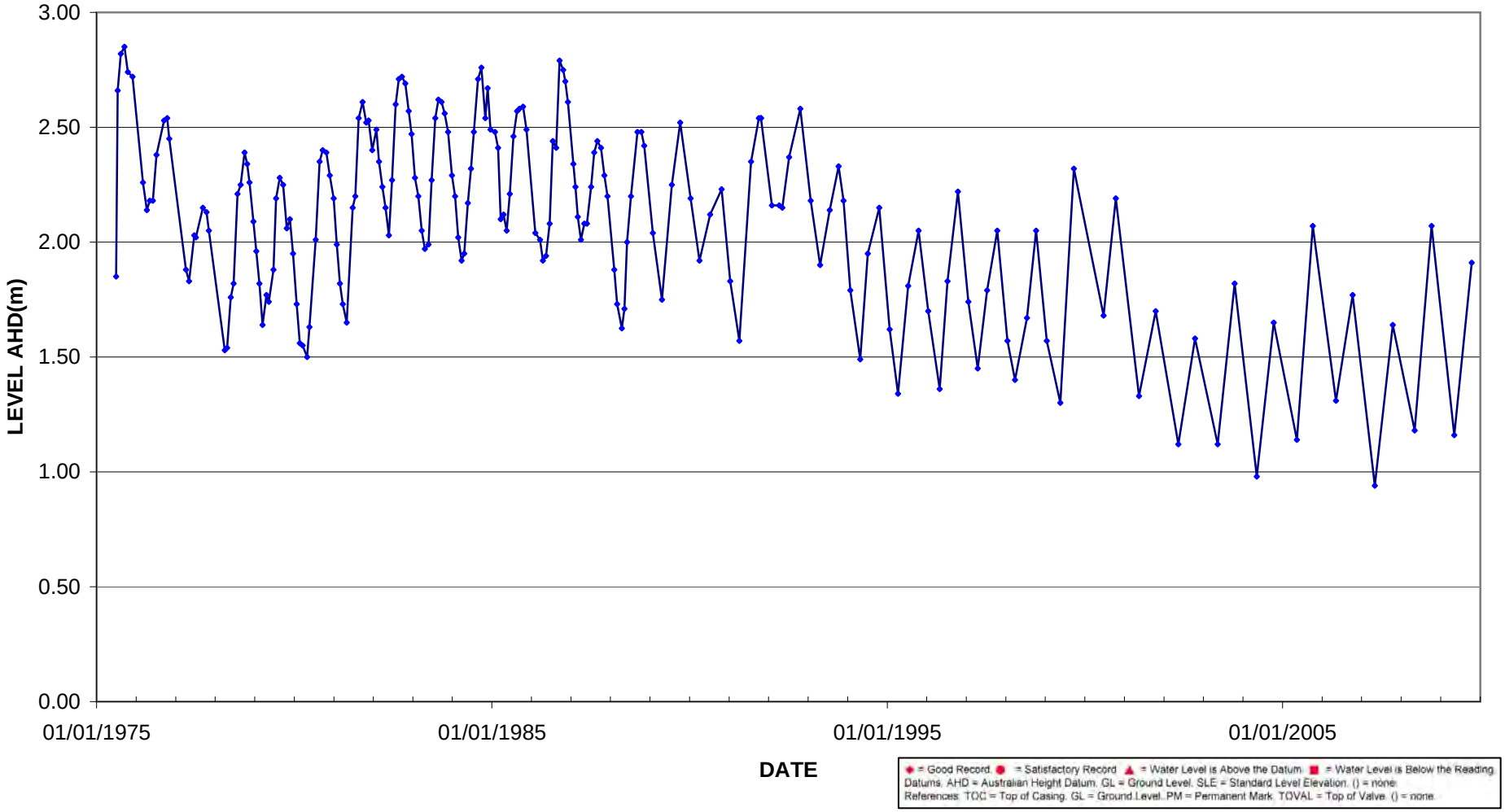
ENV. Australia
Level 7
182 St Georges Terrace
Perth, WA, 6000.

APPENDIX B
DOW GROUNDWATER DATA

Government of Western Australia
Department of Water

61410049 LAKE THOMSON T430 (O)

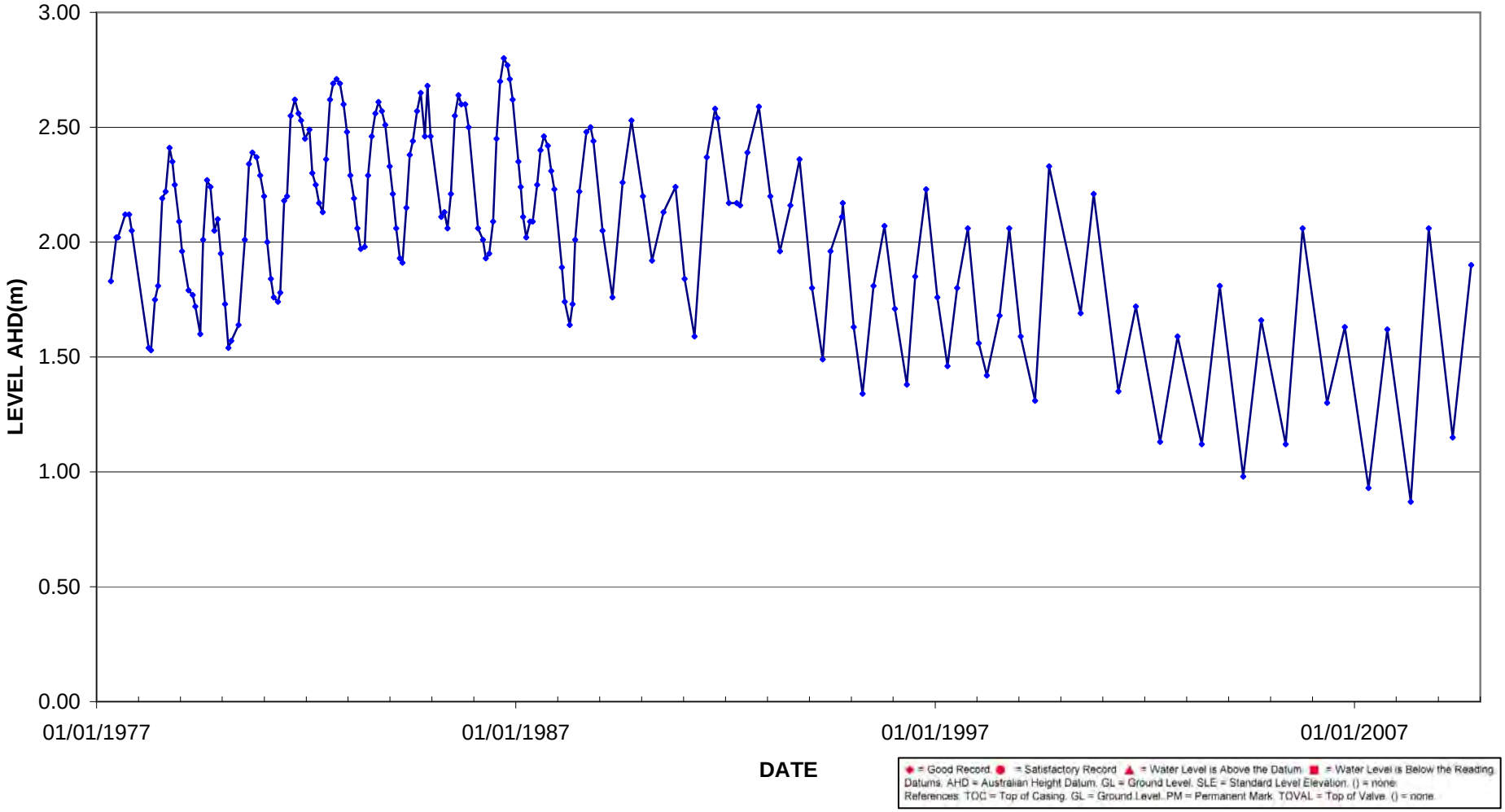
Easting = 385714.00 Northing = 6416781.00 Zone = 50 TOC = 7.17mAHD WIN SITE ID = 3011



Government of Western Australia
Department of Water

61410050 LAKE THOMSON T430 (I)

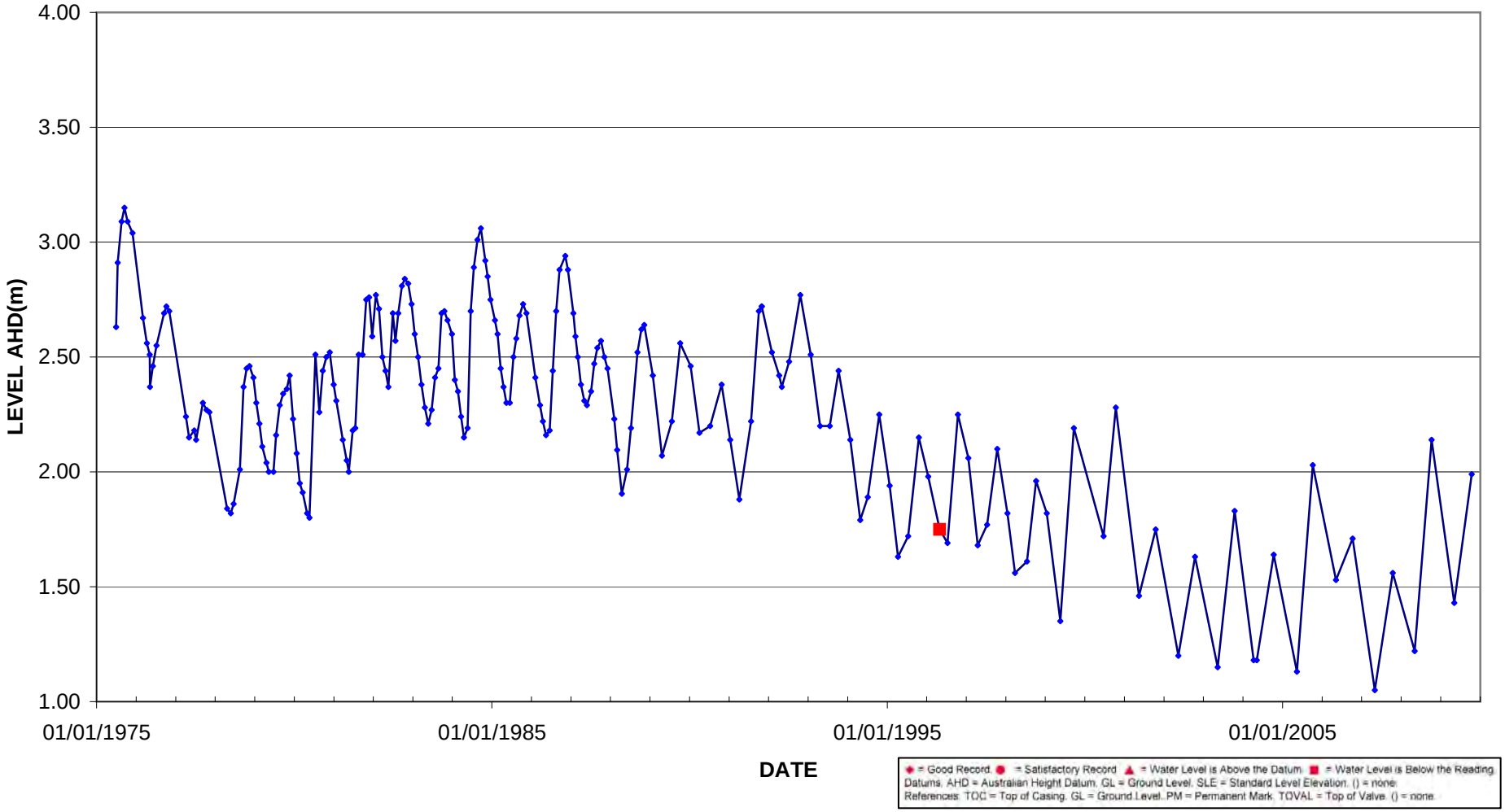
Easting = 385704.00 Northing = 6416765.00 Zone = 50 TOC = 7.46mAHD WIN SITE ID = 3012



Government of Western Australia
Department of Water

61410071 LAKE THOMSON T440

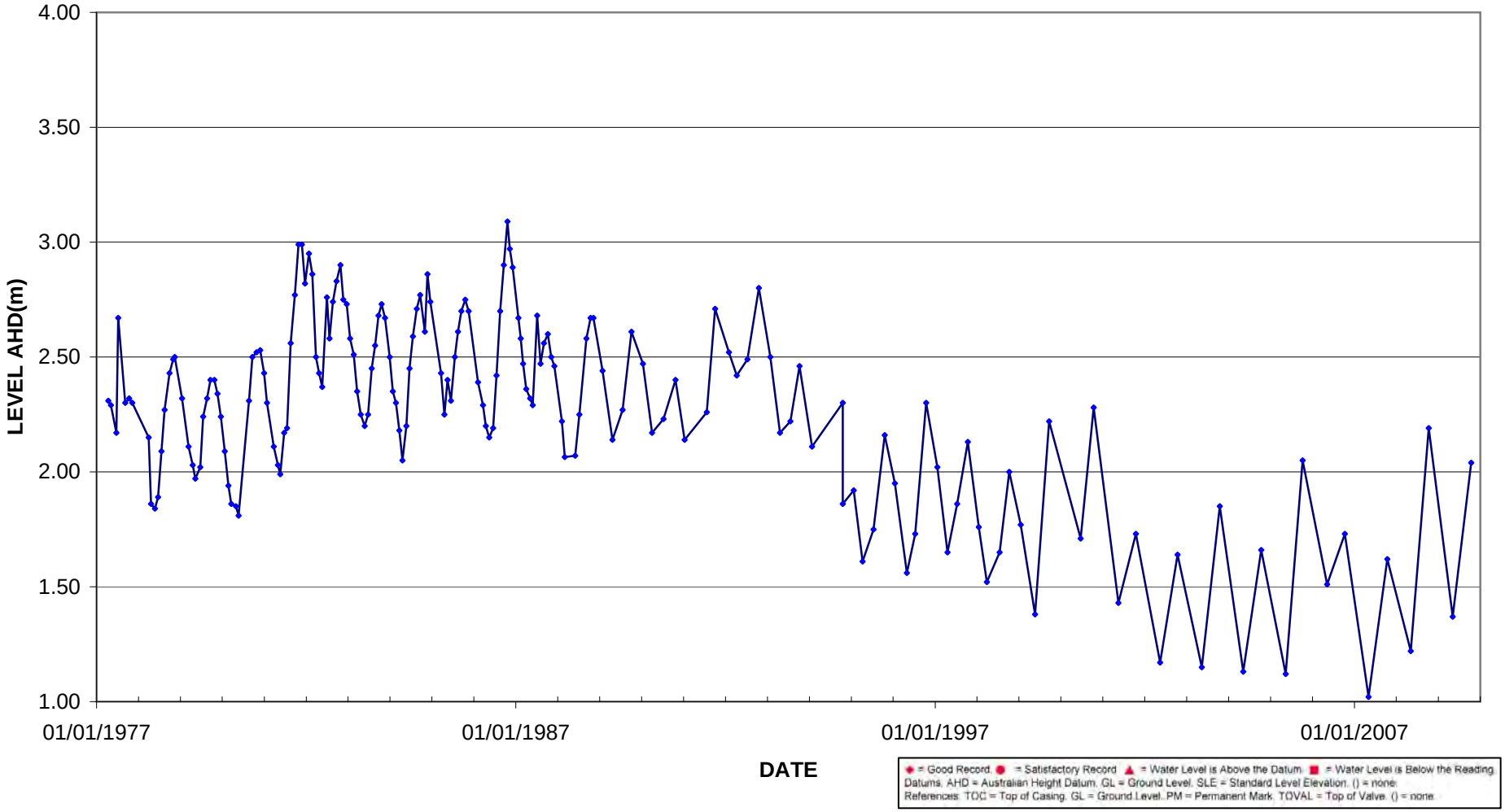
Easting = 388918.00 Northing = 6416879.00 Zone = 50 TOC = 10.9mAHD WIN SITE ID = 3033



Government of Western Australia
Department of Water

61410072 LAKE THOMSON T441

Easting = 388889.00 Northing = 6416870.00 Zone = 50 TOC = 14.15mAHD WIN SITE ID = 3034



APPENDIX C
MONITORING RECORDS

Parkland Heights - Lot 1507 Eighty Road - Baldivis

pH						
	28/10/2009	**21/01/2010**	**21/04/2010**	**7/07/2010**	**11/10/2010**	MEAN
MB1	5.7	5.35	dry	dry	dry	5.53
MB2	blocked					
MB3	6.68	6.5	6.16	6.29	6.22	6.37
MB4	7.66	7.5	7.5	7.39	7.56	7.52
MB5	6.82	6.16	6.13	6.61	6.45	6.43

EC (mS)						
	28/10/2009	**21/01/2010**	**21/04/2010**	**7/07/2010**	**11/10/2010**	MEAN
MB1	0.71	0.63	dry	dry	dry	0.67
MB2	Blocked					
MB3	0.47	0.46	0.47	0.45	0.42	0.45
MB4	1.13	0.73	0.67	0.71	0.53	0.75
MB5	0.61	0.52	0.61	0.69	0.45	0.58

Parkland Heights - Lot 1507 Eighty Road - Baldivis

Date	Bore ID	pH	EC mS/cm	Total P mg/L	PO4-P mg/L	Total N mg/L	NOX-N mg/L	NH3-N mg/L	TKN mg/L	Dissolved Metals							
										Arsenic mg/L	Cadmium mg/L	Chromium mg/L	Copper mg/L	Lead mg/L	Nickel mg/L	Zinc mg/L	Mercury mg/L
28/10/2009	MB1	4.55	0.77	0.32	<0.005	3.4	0.24	0.55	3.2	<0.001	0.0001	<0.001	0.006	0.004	0.028	0.042	<0.0001
21/01/2010		5.4	0.6	0.11	<0.005	3.3	0.011	0.37	3.3	0.047	<0.0001	0.09	0.004	0.016	0.007	0.092	<0.0001
AVERAGE		4.98	0.69	0.22	<0.005	3.35	0.13	0.46	3.25	0.024	0.0001	0.0455	0.01	0.01	0.02	0.07	<0.0001
28/10/2009	MB3	6.9	0.45	0.08	<0.005	0.86	0.008	0.1	0.85	<0.001	<0.0001	<0.001	0.002	<0.001	0.002	0.008	<0.0001
21/01/2010		6.55	0.45	<0.01	<0.005	1.5	<0.005	0.15	1.5	0.029	<0.0001	0.11	0.002	0.009	0.003	0.094	<0.0001
21/04/2010		6.9	0.47	2	<0.005	0.71	<0.005	0.23	0.71	0.017	<0.0001	0.001	0.001	<0.001	<0.001	0.037	<0.0001
7/07/2010		7.6	0.44	0.21	<0.005	1.4	0.005	0.21	1.4	0.013	<0.002	<0.005	<0.005	<0.001	<0.005	<0.01	<0.0001
11/10/2010		8.3	0.44	0.08	<0.005	1	0.03	0.093	0.97	0.014	<0.002	<0.005	<0.005	<0.001	<0.005	<0.01	<0.0001
AVERAGE		7.25	0.45	0.48	<0.005	1.09	0.01	0.16	1.09	0.0148	0.00086	0.0244	0.003	0.0026	0.0032	0.0318	<0.0001
28/10/2009	MB4	7.8	1.2	<0.01	<0.005	0.88	0.78	0.01	0.1	0.002	<0.0001	<0.001	0.002	<0.001	0.004	0.027	<0.0001
21/01/2010		7.65	0.74	<0.01	<0.005	0.4	0.026	0.037	0.37	0.003	0.0001	0.003	0.004	0.004	0.005	0.067	<0.0001
21/04/2010		7.7	0.69	0.55	<0.005	0.5	0.015	0.089	0.48	0.003	<0.0001	0.001	0.005	0.001	0.002	0.007	<0.0001
7/07/2010		8	0.61	0.17	<0.005	1.8	0.11	0.047	1.7	0.002	<0.002	<0.005	<0.005	<0.001	<0.005	<0.01	<0.0001
11/10/2010		8.1	0.6	0.46	0.009	1.4	0.084	0.025	1.3	0.001	<0.002	<0.005	0.007	<0.001	<0.005	<0.01	<0.0001
AVERAGE		7.85	0.768	0.24	0.0058	1.00	0.20	0.04	0.79	0.002	0.00086	0.003	0.0046	0.0016	0.0042	0.0242	<0.0001
28/10/2009	MB5	7.1	0.64	0.1	<0.005	1.1	0.22	<0.005	0.85	0.002	<0.0001	<0.001	0.002	<0.001	0.001	0.016	<0.0001
21/01/2010		6.55	0.51	<0.01	<0.005	0.92	0.16	0.056	0.76	0.005	<0.0001	0.14	0.017	0.035	0.009	0.47	<0.0001
21/04/2010		6.5	0.57	0.12	<0.005	0.5	0.14	0.12	0.36	0.017	<0.0001	nt	0.001	<0.001	<0.001	nt	nt
7/07/2010		8.2	0.54	0.16	<0.005	0.75	0.07	0.031	0.68	0.002	<0.002	<0.005	<0.005	<0.001	<0.005	0.02	<0.0001
11/10/2010		8.1	0.48	0.17	<0.005	1.4	0.065	0.057	1.3	0.004	<0.002	<0.005	<0.005	<0.001	<0.005	<0.01	<0.0001
AVERAGE		7.29	0.55	0.11	<0.005	0.93	0.13	0.05	0.79	0.01	0.00086	0.03775	0.006	0.0078	0.0042	0.129	<0.0001
SCCP Long Term				0.1		1					0.0002	0.001	0.0014	0.0034	0.011	0.008	0.00006
SCCP Short Term Target				0.2		2				Fresh Waters Guideline (Concentrations given as Dissolved; only indicative comparison)							
ANZECC Drinking							11.3										

DoW Bore 3012

Levels in mAHD

12:00:00 05/05/1977	1.830	
12:00:00 21/06/1977	2.020	
12:00:00 06/07/1977	2.020	
12:00:00 08/09/1977	2.120	
12:00:00 12/10/1977	2.120	
12:00:00 04/11/1977	2.050	2.120
12:00:00 30/03/1978	1.540	
12:00:00 20/04/1978	1.530	
12:00:00 24/05/1978	1.750	
12:00:00 19/06/1978	1.810	
12:00:00 26/07/1978	2.190	
12:00:00 24/08/1978	2.220	
12:00:00 29/09/1978	2.410	
12:00:00 23/10/1978	2.350	
12:00:00 13/11/1978	2.250	
12:00:00 20/12/1978	2.090	2.410
12:00:00 15/01/1979	1.960	
12:00:00 13/03/1979	1.790	
12:00:00 18/04/1979	1.770	
12:00:00 10/05/1979	1.720	
12:00:00 22/06/1979	1.600	
12:00:00 17/07/1979	2.010	
12:00:00 21/08/1979	2.270	
12:00:00 19/09/1979	2.240	
12:00:00 23/10/1979	2.050	
12:00:00 22/11/1979	2.100	
12:00:00 20/12/1979	1.950	2.270
12:00:00 24/01/1980	1.730	
12:00:00 22/02/1980	1.540	
12:00:00 19/03/1980	1.570	
12:00:00 21/05/1980	1.640	
12:00:00 16/07/1980	2.010	
12:00:00 21/08/1980	2.340	
12:00:00 19/09/1980	2.390	
12:00:00 24/10/1980	2.370	
12:00:00 25/11/1980	2.290	
12:00:00 29/12/1980	2.200	2.390
12:00:00 27/01/1981	2.000	
12:00:00 26/02/1981	1.840	
12:00:00 24/03/1981	1.760	
12:00:00 30/04/1981	1.740	
12:00:00 19/05/1981	1.780	
12:00:00 23/06/1981	2.180	
12:00:00 17/07/1981	2.200	
12:00:00 19/08/1981	2.550	
12:00:00 24/09/1981	2.620	
12:00:00 26/10/1981	2.560	
12:00:00 17/11/1981	2.530	
12:00:00 21/12/1981	2.450	2.620
12:00:00 29/01/1982	2.490	
12:00:00 23/02/1982	2.300	
12:00:00 25/03/1982	2.250	
12:00:00 22/04/1982	2.170	
12:00:00 24/05/1982	2.130	
12:00:00 23/06/1982	2.360	
12:00:00 27/07/1982	2.620	
12:00:00 23/08/1982	2.690	
12:00:00 22/09/1982	2.710	
12:00:00 22/10/1982	2.690	
12:00:00 23/11/1982	2.600	
12:00:00 21/12/1982	2.480	2.710
12:00:00 20/01/1983	2.290	
12:00:00 21/02/1983	2.190	
12:00:00 23/03/1983	2.060	

	observed WL (mAHD)	calculated AAMGL (mAHD)	GL (mAHD)	GL - AAMGL (m)
	28/10/2009			
MW1	2.009	2.412	4.281	1.869
MW2	1.98	2.383	8.195	5.812
MW3	1.942	2.345	4.012	1.667
MW4	1.938	2.341	10.988	8.647
MW5	1.094	1.497	6.954	5.457
DoW 3011	1.845	2.248	6.76	4.512
DoW 3033				
DoW 3034				
DoW 3012	**1.83**	**2.233**	**6.76**	**4.527**

Max	2.412
Min	1.497

0.403

difference between observed & calculated

12:00:00 22/04/1983	1.970	
12:00:00 25/05/1983	1.980	
12:00:00 24/06/1983	2.290	
12:00:00 26/07/1983	2.460	
12:00:00 25/08/1983	2.560	
12:00:00 23/09/1983	2.610	
12:00:00 21/10/1983	2.570	
12:00:00 21/11/1983	2.510	
12:00:00 29/12/1983	2.330	2.610
12:00:00 25/01/1984	2.210	
12:00:00 23/02/1984	2.060	
12:00:00 26/03/1984	1.930	
12:00:00 18/04/1984	1.910	
12:00:00 22/05/1984	2.150	
12:00:00 20/06/1984	2.380	
12:00:00 18/07/1984	2.440	
12:00:00 24/08/1984	2.570	
12:00:00 24/09/1984	2.650	
12:00:00 31/10/1984	2.460	
12:00:00 21/11/1984	2.680	
12:00:00 19/12/1984	2.460	2.680
12:00:00 22/03/1985	2.110	
12:00:00 18/04/1985	2.130	
12:00:00 16/05/1985	2.060	
12:00:00 14/06/1985	2.210	
12:00:00 18/07/1985	2.550	
12:00:00 20/08/1985	2.640	
12:00:00 12/09/1985	2.600	
12:00:00 16/10/1985	2.600	
12:00:00 15/11/1985	2.500	2.640
15:06:00 05/02/1986	2.060	
10:44:00 20/03/1986	2.010	
10:31:00 15/04/1986	1.930	
10:12:00 14/05/1986	1.950	
11:07:00 18/06/1986	2.090	
10:23:00 16/07/1986	2.450	
10:41:00 18/08/1986	2.700	
10:03:00 18/09/1986	2.800	
10:24:00 20/10/1986	2.770	
09:27:00 10/11/1986	2.710	
09:35:00 03/12/1986	2.620	2.800
09:18:00 23/01/1987	2.350	
09:47:00 12/02/1987	2.240	
10:26:00 04/03/1987	2.110	
09:36:00 02/04/1987	2.020	
09:21:00 05/05/1987	2.090	
09:43:00 28/05/1987	2.090	
08:58:00 06/07/1987	2.250	
09:38:00 04/08/1987	2.400	
09:11:00 02/09/1987	2.460	
13:24:00 06/10/1987	2.420	
09:15:00 05/11/1987	2.310	
11:13:00 03/12/1987	2.230	2.460
09:34:00 05/02/1988	1.890	
09:40:00 03/03/1988	1.740	
10:01:00 15/04/1988	1.640	
09:27:00 09/05/1988	1.730	
09:06:00 01/06/1988	2.010	
09:40:00 07/07/1988	2.220	
09:33:00 06/09/1988	2.480	
09:41:00 12/10/1988	2.500	
09:47:00 07/11/1988	2.440	2.500
09:36:00 25/01/1989	2.050	
09:59:00 21/04/1989	1.760	
11:32:00 20/07/1989	2.260	
10:00:00 05/10/1989	2.530	2.530
13:04:00 11/01/1990	2.200	
10:49:00 02/04/1990	1.920	
13:01:00 10/07/1990	2.130	
11:46:00 23/10/1990	2.240	2.240

10:52:00 10/01/1991	1.840	
10:24:00 06/04/1991	1.590	
10:01:00 23/07/1991	2.370	
10:41:00 02/10/1991	2.580	
14:43:00 23/10/1991	2.540	2.580
14:34:00 31/01/1992	2.170	
10:17:00 07/04/1992	2.170	
14:07:00 07/05/1992	2.160	
12:12:00 09/07/1992	2.390	
12:13:00 19/10/1992	2.590	2.590
11:30:00 25/01/1993	2.200	
11:28:00 20/04/1993	1.960	
09:27:00 19/07/1993	2.160	
10:15:00 08/10/1993	2.360	2.360
10:33:00 24/01/1994	1.800	
12:39:00 27/04/1994	1.490	
10:16:00 05/07/1994	1.960	
15:45:00 11/10/1994	2.110	
12:37:00 18/10/1994	2.170	2.170
11:22:00 23/01/1995	1.630	
09:50:00 10/04/1995	1.340	
13:15:00 14/07/1995	1.810	
11:47:00 17/10/1995	2.070	2.070
09:17:00 15/01/1996	1.710	
10:17:00 30/04/1996	1.380	
11:17:00 11/07/1996	1.850	
09:57:00 14/10/1996	2.230	2.230
10:50:00 20/01/1997	1.760	
08:49:00 17/04/1997	1.460	
09:23:00 11/07/1997	1.800	
09:35:00 13/10/1997	2.060	2.060
09:22:00 15/01/1998	1.560	
09:10:00 26/03/1998	1.420	
11:14:00 15/07/1998	1.680	
10:53:00 07/10/1998	2.060	2.060
09:30:00 15/01/1999	1.590	
10:19:00 20/05/1999	1.310	
09:37:00 21/09/1999	2.330	2.330
10:18:00 21/06/2000	1.690	
09:33:00 12/10/2000	2.210	2.210
09:22:00 16/05/2001	1.350	
09:06:00 16/10/2001	1.720	1.720
09:17:00 13/05/2002	1.130	
09:13:00 14/10/2002	1.590	1.590
09:06:00 13/05/2003	1.120	
13:15:00 15/10/2003	1.810	1.810
10:44:00 07/05/2004	0.980	
09:53:00 11/10/2004	1.660	1.660
10:22:00 13/05/2005	1.120	
09:18:00 06/10/2005	2.060	2.060
09:35:00 08/05/2006	1.300	
09:29:00 09/10/2006	1.630	1.630
08:59:00 03/05/2007	0.930	
09:14:00 15/10/2007	1.620	1.620
10:24:00 06/05/2008	0.870	
09:12:00 09/10/2008	2.060	2.060
09:49:00 06/05/2009	1.150	
12:27:00 15/10/2009	1.900	1.900

Average = 2.233

DoW Bore 3011

Levels in mAHD

00:00:00 30/06/1975	1.850	
12:00:00 14/07/1975	2.660	
12:00:00 13/08/1975	2.820	
12:00:00 15/09/1975	2.850	
12:00:00 17/10/1975	2.740	
12:00:00 28/11/1975	2.720	2.850
12:00:00 05/03/1976	2.260	
12:00:00 08/04/1976	2.140	
12:00:00 05/05/1976	2.180	
12:00:00 04/06/1976	2.180	
12:00:00 07/07/1976	2.380	
12:00:00 15/09/1976	2.530	
12:00:00 13/10/1976	2.540	
12:00:00 02/11/1976	2.450	2.540
12:00:00 05/04/1977	1.880	
12:00:00 05/05/1977	1.830	
12:00:00 21/06/1977	2.030	
12:00:00 06/07/1977	2.020	
12:00:00 08/09/1977	2.150	
12:00:00 12/10/1977	2.130	
12:00:00 04/11/1977	2.050	2.150
12:00:00 30/03/1978	1.530	
12:00:00 20/04/1978	1.540	
12:00:00 24/05/1978	1.760	
12:00:00 19/06/1978	1.820	
12:00:00 26/07/1978	2.210	
12:00:00 24/08/1978	2.250	
12:00:00 29/09/1978	2.390	
12:00:00 23/10/1978	2.340	
12:00:00 13/11/1978	2.260	
12:00:00 20/12/1978	2.090	2.390
12:00:00 15/01/1979	1.960	
12:00:00 14/02/1979	1.820	
12:00:00 13/03/1979	1.640	
12:00:00 18/04/1979	1.770	
12:00:00 10/05/1979	1.740	
12:00:00 22/06/1979	1.880	
12:00:00 17/07/1979	2.190	
12:00:00 21/08/1979	2.280	
12:00:00 19/09/1979	2.250	
12:00:00 23/10/1979	2.060	
12:00:00 22/11/1979	2.100	
12:00:00 20/12/1979	1.950	2.280
12:00:00 24/01/1980	1.730	
12:00:00 22/02/1980	1.560	
12:00:00 19/03/1980	1.550	
12:00:00 28/04/1980	1.500	
12:00:00 21/05/1980	1.630	
12:00:00 16/07/1980	2.010	
12:00:00 21/08/1980	2.350	
12:00:00 19/09/1980	2.400	
12:00:00 24/10/1980	2.390	
12:00:00 25/11/1980	2.290	
12:00:00 29/12/1980	2.190	2.400
12:00:00 27/01/1981	1.990	
12:00:00 26/02/1981	1.820	
12:00:00 24/03/1981	1.730	
12:00:00 30/04/1981	1.650	
12:00:00 23/06/1981	2.150	
12:00:00 17/07/1981	2.200	
12:00:00 19/08/1981	2.540	
12:00:00 24/09/1981	2.610	
12:00:00 26/10/1981	2.520	
12:00:00 17/11/1981	2.530	
12:00:00 21/12/1981	2.400	2.610
12:00:00 29/01/1982	2.490	
12:00:00 23/02/1982	2.350	
12:00:00 25/03/1982	2.240	

	observed WL (mAHD)	calculated AAMGL (mAHD)	GL (mAHD)	GL - AAMGL (m)
	28/10/2009			
MW1	2.009	2.423	4.281	1.858
MW2	1.98	2.394	8.195	5.801
MW3	1.942	2.356	4.012	1.656
MW4	1.938	2.352	10.988	8.636
MW5	1.094	1.508	6.954	5.446
DoW 3011	1.845	**2.259**	6.76	4.501

Max	2.423
Min	1.508

0.414

difference between observed & calculated

12:00:00 22/04/1982	2.150	
12:00:00 24/05/1982	2.030	
12:00:00 23/06/1982	2.270	
12:00:00 27/07/1982	2.600	
12:00:00 23/08/1982	2.710	
12:00:00 22/09/1982	2.720	
12:00:00 22/10/1982	2.690	
12:00:00 23/11/1982	2.570	
12:00:00 21/12/1982	2.470	2.720
12:00:00 20/01/1983	2.280	
12:00:00 21/02/1983	2.200	
12:00:00 23/03/1983	2.050	
12:00:00 22/04/1983	1.970	
12:00:00 25/05/1983	1.990	
12:00:00 24/06/1983	2.270	
12:00:00 26/07/1983	2.540	
12:00:00 25/08/1983	2.620	
12:00:00 23/09/1983	2.610	
12:00:00 21/10/1983	2.560	
12:00:00 21/11/1983	2.480	
12:00:00 29/12/1983	2.290	2.620
12:00:00 25/01/1984	2.200	
12:00:00 23/02/1984	2.020	
12:00:00 26/03/1984	1.920	
12:00:00 18/04/1984	1.950	
12:00:00 22/05/1984	2.170	
12:00:00 20/06/1984	2.320	
12:00:00 18/07/1984	2.480	
12:00:00 24/08/1984	2.710	
12:00:00 24/09/1984	2.760	
12:00:00 31/10/1984	2.540	
12:00:00 21/11/1984	2.670	
12:00:00 19/12/1984	2.490	2.760
12:00:00 29/01/1985	2.480	
12:00:00 25/02/1985	2.410	
12:00:00 22/03/1985	2.100	
12:00:00 18/04/1985	2.120	
12:00:00 16/05/1985	2.050	
12:00:00 14/06/1985	2.210	
12:00:00 18/07/1985	2.460	
12:00:00 20/08/1985	2.570	
12:00:00 12/09/1985	2.580	
12:00:00 16/10/1985	2.590	
12:00:00 15/11/1985	2.490	2.590
15:09:00 05/02/1986	2.040	
10:47:00 20/03/1986	2.010	
10:38:00 15/04/1986	1.920	
10:16:00 14/05/1986	1.940	
11:13:00 18/06/1986	2.080	
10:27:00 16/07/1986	2.440	
10:36:00 18/08/1986	2.410	
10:08:00 18/09/1986	2.790	
10:28:00 20/10/1986	2.750	
09:31:00 10/11/1986	2.700	
09:38:00 03/12/1986	2.610	2.790
09:20:00 23/01/1987	2.340	
09:45:00 12/02/1987	2.240	
10:30:00 04/03/1987	2.110	
09:39:00 02/04/1987	2.010	
09:23:00 05/05/1987	2.080	
09:55:00 28/05/1987	2.080	
09:01:00 06/07/1987	2.240	
09:41:00 04/08/1987	2.390	
09:13:00 02/09/1987	2.440	
13:28:00 06/10/1987	2.410	
09:18:00 05/11/1987	2.290	
11:09:00 03/12/1987	2.200	2.440
09:37:00 05/02/1988	1.880	
09:42:00 03/03/1988	1.730	
10:04:00 15/04/1988	1.625	
09:30:00 09/05/1988	1.710	
09:08:00 01/06/1988	2.000	
09:42:00 07/07/1988	2.200	
09:36:00 06/09/1988	2.480	

09:48:00 12/10/1988	2.480	
09:50:00 07/11/1988	2.420	2.480
09:38:00 25/01/1989	2.040	
10:01:00 21/04/1989	1.750	
11:34:00 20/07/1989	2.250	
10:08:00 05/10/1989	2.520	2.520
12:50:00 11/01/1990	2.190	
10:46:00 02/04/1990	1.920	
13:06:00 10/07/1990	2.120	
11:23:00 23/10/1990	2.230	2.230
10:56:00 10/01/1991	1.830	
10:27:00 06/04/1991	1.570	
09:59:00 23/07/1991	2.350	
10:32:00 02/10/1991	2.540	
12:33:00 23/10/1991	2.540	
13:10:00 23/10/1991	2.540	2.540
14:28:00 31/01/1992	2.160	
10:14:00 07/04/1992	2.160	
14:42:00 07/05/1992	2.150	
12:17:00 09/07/1992	2.370	
12:08:00 19/10/1992	2.580	2.580
11:24:00 25/01/1993	2.180	
11:26:00 20/04/1993	1.900	
09:32:00 19/07/1993	2.140	
10:18:00 08/10/1993	2.330	
00:00:00 24/11/1993	2.180	2.330
10:35:00 24/01/1994	1.790	
12:44:00 27/04/1994	1.490	
10:19:00 05/07/1994	1.950	
12:35:00 18/10/1994	2.150	2.150
11:20:00 23/01/1995	1.620	
09:45:00 10/04/1995	1.340	
13:10:00 14/07/1995	1.810	
11:45:00 17/10/1995	2.050	2.050
09:15:00 15/01/1996	1.700	
10:15:00 30/04/1996	1.360	
11:15:00 11/07/1996	1.830	
09:55:00 14/10/1996	2.220	2.220
10:52:00 20/01/1997	1.740	
08:45:00 17/04/1997	1.450	
09:20:00 11/07/1997	1.790	
09:30:00 13/10/1997	2.050	2.050
09:20:00 15/01/1998	1.570	
09:08:00 26/03/1998	1.400	
11:12:00 15/07/1998	1.670	
10:51:00 07/10/1998	2.050	2.050
09:28:00 15/01/1999	1.570	
10:17:00 20/05/1999	1.300	
09:34:00 21/09/1999	2.320	2.320
10:16:00 21/06/2000	1.680	
09:31:00 12/10/2000	2.190	2.190
09:20:00 16/05/2001	1.330	
09:03:00 16/10/2001	1.700	1.700
09:15:00 13/05/2002	1.120	
09:11:00 14/10/2002	1.580	1.580
09:04:00 13/05/2003	1.120	
13:11:00 15/10/2003	1.820	1.820
10:42:00 07/05/2004	0.980	
09:51:00 11/10/2004	1.650	1.650
10:20:00 13/05/2005	1.140	
09:16:00 06/10/2005	2.070	2.070
09:33:00 08/05/2006	1.310	
09:27:00 09/10/2006	1.770	1.770
08:57:00 03/05/2007	0.940	
09:11:00 15/10/2007	1.640	1.640
10:21:00 06/05/2008	1.180	
09:09:00 09/10/2008	2.070	2.070
08:47:00 06/05/2009	1.160	
12:22:00 15/10/2009	1.910	1.910

Average = 2.259

DoW Bore 3033

Levels in mAHD

00:00:00 30/06/1975	2.630	
12:00:00 14/07/1975	2.910	
12:00:00 19/08/1975	3.090	
12:00:00 15/09/1975	3.150	
12:00:00 15/10/1975	3.090	
12:00:00 28/11/1975	3.040	3.150
12:00:00 05/03/1976	2.670	
12:00:00 08/04/1976	2.560	
12:00:00 05/05/1976	2.510	
12:00:00 07/05/1976	2.370	
12:00:00 04/06/1976	2.460	
12:00:00 08/07/1976	2.550	
12:00:00 15/09/1976	2.690	
12:00:00 06/10/1976	2.720	
12:00:00 02/11/1976	2.700	2.720
12:00:00 05/04/1977	2.240	
12:00:00 05/05/1977	2.150	
12:00:00 21/06/1977	2.180	
12:00:00 07/07/1977	2.140	
12:00:00 08/09/1977	2.300	
12:00:00 12/10/1977	2.270	
12:00:00 07/11/1977	2.260	2.300
12:00:00 20/04/1978	1.840	
12:00:00 24/05/1978	1.820	
12:00:00 19/06/1978	1.860	
12:00:00 16/08/1978	2.010	
12:00:00 19/09/1978	2.370	
12:00:00 19/10/1978	2.450	
12:00:00 13/11/1978	2.460	
12:00:00 20/12/1978	2.410	2.460
12:00:00 15/01/1979	2.300	
12:00:00 14/02/1979	2.210	
12:00:00 12/03/1979	2.110	
12:00:00 18/04/1979	2.040	
12:00:00 11/05/1979	2.000	
12:00:00 22/06/1979	2.000	
12:00:00 17/07/1979	2.160	
12:00:00 21/08/1979	2.290	
12:00:00 19/09/1979	2.340	
12:00:00 23/10/1979	2.360	
12:00:00 19/11/1979	2.420	
12:00:00 20/12/1979	2.230	2.420
12:00:00 23/01/1980	2.080	
12:00:00 22/02/1980	1.950	
12:00:00 19/03/1980	1.910	
12:00:00 28/04/1980	1.820	
12:00:00 21/05/1980	1.800	
12:00:00 15/07/1980	2.510	
12:00:00 20/08/1980	2.260	
12:00:00 19/09/1980	2.440	
12:00:00 24/10/1980	2.500	
12:00:00 25/11/1980	2.520	
12:00:00 29/12/1980	2.380	2.520
12:00:00 23/01/1981	2.310	
12:00:00 24/03/1981	2.140	
12:00:00 30/04/1981	2.050	
12:00:00 19/05/1981	2.000	
12:00:00 23/06/1981	2.180	
12:00:00 17/07/1981	2.190	
12:00:00 19/08/1981	2.510	
12:00:00 23/09/1981	2.510	
12:00:00 26/10/1981	2.750	
12:00:00 23/11/1981	2.760	
12:00:00 21/12/1981	2.590	2.760
12:00:00 25/01/1982	2.770	
12:00:00 22/02/1982	2.710	
12:00:00 26/03/1982	2.500	

	observed WL (mAHD)	calculated AAMGL (mAHD)	GL (mAHD)	GL - AAMGL (m)
	25/11/2009			
MW1	1.941	2.335	4.281	1.946
MW2	1.895	2.289	8.195	5.906
MW3	1.87	2.264	4.012	1.748
MW4	1.85	2.244	10.988	8.744
MW5	1.036	1.430	6.954	5.524
DoW 3033	1.95	**2.344**	6.76	4.416

Max	2.335
Min	1.430

0.394

difference between observed & calculated

12:00:00 22/04/1982	2.440	
12:00:00 20/05/1982	2.370	
12:00:00 30/06/1982	2.690	
12:00:00 23/07/1982	2.570	
12:00:00 19/08/1982	2.690	
12:00:00 21/09/1982	2.810	
12:00:00 19/10/1982	2.840	
12:00:00 19/11/1982	2.820	
12:00:00 20/12/1982	2.730	2.840
12:00:00 17/01/1983	2.600	
12:00:00 18/02/1983	2.500	
12:00:00 21/03/1983	2.380	
12:00:00 21/04/1983	2.280	
12:00:00 24/05/1983	2.210	
12:00:00 23/06/1983	2.270	
12:00:00 25/07/1983	2.410	
12:00:00 24/08/1983	2.450	
12:00:00 22/09/1983	2.690	
12:00:00 20/10/1983	2.700	
12:00:00 18/11/1983	2.660	
12:00:00 28/12/1983	2.600	2.700
12:00:00 24/01/1984	2.400	
12:00:00 22/02/1984	2.350	
12:00:00 22/03/1984	2.240	
12:00:00 17/04/1984	2.150	
12:00:00 21/05/1984	2.190	
12:00:00 19/06/1984	2.700	
12:00:00 17/07/1984	2.890	
12:00:00 21/08/1984	3.010	
12:00:00 20/09/1984	3.060	
12:00:00 31/10/1984	2.920	
12:00:00 21/11/1984	2.850	
12:00:00 18/12/1984	2.750	3.060
12:00:00 29/01/1985	2.660	
12:00:00 21/02/1985	2.600	
12:00:00 21/03/1985	2.450	
12:00:00 18/04/1985	2.370	
12:00:00 15/05/1985	2.300	
12:00:00 14/06/1985	2.300	
12:00:00 18/07/1985	2.500	
12:00:00 14/08/1985	2.580	
12:00:00 12/09/1985	2.680	
12:00:00 16/10/1985	2.730	
12:00:00 15/11/1985	2.690	2.730
14:47:00 05/02/1986	2.410	
11:22:00 20/03/1986	2.290	
11:42:00 15/04/1986	2.220	
10:59:00 14/05/1986	2.160	
12:32:00 18/06/1986	2.180	
11:06:00 16/07/1986	2.440	
11:20:00 18/08/1986	2.700	
10:54:00 18/09/1986	2.880	
10:35:00 10/11/1986	2.940	
10:11:00 03/12/1986	2.880	2.940
09:57:00 23/01/1987	2.690	
10:20:00 12/02/1987	2.590	
11:13:00 04/03/1987	2.500	
10:17:00 02/04/1987	2.380	
10:00:00 05/05/1987	2.310	
10:28:00 28/05/1987	2.290	
10:15:00 06/07/1987	2.350	
10:16:00 04/08/1987	2.470	
09:44:00 02/09/1987	2.540	
14:06:00 06/10/1987	2.570	
10:05:00 05/11/1987	2.500	
13:30:00 03/12/1987	2.450	2.690
10:09:00 05/02/1988	2.230	
10:20:00 03/03/1988	2.095	
10:49:00 15/04/1988	1.905	
09:51:00 01/06/1988	2.010	
10:28:00 07/07/1988	2.190	
10:22:00 06/09/1988	2.520	
10:42:00 12/10/1988	2.620	

10:22:00 07/11/1988	2.640	2.640
10:09:00 25/01/1989	2.420	
10:42:00 21/04/1989	2.070	
12:05:00 20/07/1989	2.220	
11:05:00 05/10/1989	2.560	2.560
13:58:00 11/01/1990	2.460	
11:33:00 02/04/1990	2.170	
13:51:00 10/07/1990	2.200	
12:48:00 23/10/1990	2.380	2.460
11:29:00 10/01/1991	2.140	
11:03:00 06/04/1991	1.880	
10:56:00 23/07/1991	2.220	
11:15:00 02/10/1991	2.700	
12:21:00 29/10/1991	2.720	
13:29:00 29/10/1991	2.720	
13:36:00 31/01/1992	2.520	
11:30:00 08/04/1992	2.420	
14:05:00 01/05/1992	2.370	
13:42:00 09/07/1992	2.480	
12:53:00 19/10/1992	2.770	2.770
12:55:00 25/01/1993	2.510	
12:12:00 20/04/1993	2.200	
10:30:00 19/07/1993	2.200	
10:57:00 08/10/1993	2.440	2.510
11:15:00 24/01/1994	2.140	
13:24:00 27/04/1994	1.790	
11:40:00 05/07/1994	1.890	
13:08:00 18/10/1994	2.250	2.250
12:43:00 23/01/1995	1.940	
11:00:00 10/04/1995	1.630	
14:10:00 14/07/1995	1.720	
09:22:00 19/10/1995	2.150	2.150
09:55:00 15/01/1996	1.980	
10:52:00 30/04/1996	1.750	
11:50:00 11/07/1996	1.690	
10:37:00 14/10/1996	2.250	2.250
11:20:00 20/01/1997	2.060	
09:50:00 17/04/1997	1.680	
09:50:00 11/07/1997	1.770	
10:30:00 13/10/1997	2.100	2.100
09:55:00 15/01/1998	1.820	
09:53:00 26/03/1998	1.560	
11:42:00 15/07/1998	1.610	
10:27:00 07/10/1998	1.960	1.960
10:00:00 15/01/1999	1.820	
11:05:00 20/05/1999	1.350	
10:30:00 21/09/1999	2.190	2.190
10:54:00 21/06/2000	1.720	
10:00:00 12/10/2000	2.280	2.280
10:00:00 16/05/2001	1.460	
09:44:00 16/10/2001	1.750	1.750
09:50:00 13/05/2002	1.200	
09:43:00 14/10/2002	1.630	1.630
09:40:00 13/05/2003	1.150	
13:54:00 15/10/2003	1.830	1.830
09:24:00 07/04/2004	1.180	
11:22:00 07/05/2004	1.180	
10:43:00 11/10/2004	1.640	1.640
10:53:00 13/05/2005	1.130	
09:50:00 06/10/2005	2.030	2.030
10:22:00 08/05/2006	1.530	
10:16:00 09/10/2006	1.710	1.710
09:28:00 03/05/2007	1.050	
09:40:00 15/10/2007	1.560	1.560
10:46:00 06/05/2008	1.220	
09:37:00 09/10/2008	2.140	2.140
09:12:00 06/05/2009	1.430	
13:01:00 15/10/2009	1.990	1.990

Average = 2.344

DoW Bore 3034

Levels in mAHD

12:00:00 13/04/1977	2.310	
12:00:00 05/05/1977	2.290	
12:00:00 21/06/1977	2.170	
12:00:00 07/07/1977	2.670	
12:00:00 08/09/1977	2.300	
12:00:00 12/10/1977	2.320	
12:00:00 07/11/1977	2.300	2.670
12:00:00 30/03/1978	2.150	
12:00:00 20/04/1978	1.860	
12:00:00 24/05/1978	1.840	
12:00:00 19/06/1978	1.890	
12:00:00 20/07/1978	2.090	
12:00:00 16/08/1978	2.270	
12:00:00 29/09/1978	2.430	
12:00:00 29/10/1978	2.490	
12:00:00 13/11/1978	2.500	2.500
12:00:00 15/01/1979	2.320	
12:00:00 13/03/1979	2.110	
12:00:00 18/04/1979	2.030	
12:00:00 11/05/1979	1.970	
12:00:00 22/06/1979	2.020	
12:00:00 17/07/1979	2.240	
12:00:00 21/08/1979	2.320	
12:00:00 19/09/1979	2.400	
12:00:00 23/10/1979	2.400	
12:00:00 19/11/1979	2.340	
12:00:00 20/12/1979	2.240	2.400
12:00:00 23/01/1980	2.090	
12:00:00 22/02/1980	1.940	
12:00:00 19/03/1980	1.860	
12:00:00 28/04/1980	1.850	
12:00:00 21/05/1980	1.810	
12:00:00 20/08/1980	2.310	
12:00:00 19/09/1980	2.500	
12:00:00 24/10/1980	2.520	
12:00:00 25/11/1980	2.530	
12:00:00 29/12/1980	2.430	2.530
12:00:00 23/01/1981	2.300	
12:00:00 24/03/1981	2.110	
12:00:00 30/04/1981	2.030	
12:00:00 19/05/1981	1.990	
12:00:00 23/06/1981	2.170	
12:00:00 17/07/1981	2.190	
12:00:00 19/08/1981	2.560	
12:00:00 23/09/1981	2.770	
12:00:00 26/10/1981	2.990	
12:00:00 23/11/1981	2.990	
12:00:00 21/12/1981	2.820	2.990
12:00:00 25/01/1982	2.950	
12:00:00 22/02/1982	2.860	
12:00:00 26/03/1982	2.500	
12:00:00 22/04/1982	2.430	
12:00:00 20/05/1982	2.370	
12:00:00 30/06/1982	2.760	
12:00:00 23/07/1982	2.580	
12:00:00 20/08/1982	2.740	
12:00:00 21/09/1982	2.830	
12:00:00 25/10/1982	2.900	
12:00:00 19/11/1982	2.750	
12:00:00 20/12/1982	2.730	2.950
12:00:00 17/01/1983	2.580	
12:00:00 18/02/1983	2.510	
12:00:00 21/03/1983	2.350	
12:00:00 21/04/1983	2.250	
12:00:00 24/05/1983	2.200	
12:00:00 23/06/1983	2.250	

	observed WL (mAHD)	calculated AAMGL (mAHD)	GL (mAHD)	GL - AAMGL (m)
	25/11/2009			
MW1	1.941	2.354	4.281	1.927
MW2	1.895	2.308	8.195	5.887
MW3	1.87	2.283	4.012	1.729
MW4	1.85	2.263	10.988	8.725
MW5	1.036	1.449	6.954	5.505
DoW 3034	1.945	**2.358**	6.76	4.402

Max	2.354
Min	1.449

0.413

difference between observed & calculated

12:00:00 25/07/1983	2.450	
12:00:00 24/08/1983	2.550	
12:00:00 22/09/1983	2.680	
12:00:00 20/10/1983	2.730	
12:00:00 18/11/1983	2.670	
12:00:00 28/12/1983	2.500	2.730
12:00:00 24/01/1984	2.350	
12:00:00 22/02/1984	2.300	
12:00:00 22/03/1984	2.180	
12:00:00 17/04/1984	2.050	
12:00:00 21/05/1984	2.200	
12:00:00 19/06/1984	2.450	
12:00:00 17/07/1984	2.590	
12:00:00 21/08/1984	2.710	
12:00:00 20/09/1984	2.770	
12:00:00 31/10/1984	2.610	
12:00:00 21/11/1984	2.860	
12:00:00 18/12/1984	2.740	2.860
12:00:00 21/03/1985	2.430	
12:00:00 18/04/1985	2.250	
12:00:00 15/05/1985	2.400	
12:00:00 14/06/1985	2.310	
12:00:00 18/07/1985	2.500	
12:00:00 14/08/1985	2.610	
12:00:00 12/09/1985	2.700	
12:00:00 16/10/1985	2.750	
12:00:00 15/11/1985	2.700	2.750
14:45:00 05/02/1986	2.390	
11:18:00 20/03/1986	2.290	
11:52:00 15/04/1986	2.200	
10:55:00 14/05/1986	2.150	
12:44:00 18/06/1986	2.190	
11:11:00 16/07/1986	2.420	
11:27:00 18/08/1986	2.700	
10:50:00 18/09/1986	2.900	
10:54:00 20/10/1986	3.090	
10:30:00 10/11/1986	2.970	
10:08:00 03/12/1986	2.890	3.090
09:54:00 23/01/1987	2.670	
10:18:00 12/02/1987	2.580	
11:16:00 04/03/1987	2.470	
10:20:00 02/04/1987	2.360	
10:05:00 05/05/1987	2.320	
10:31:00 28/05/1987	2.290	
10:18:00 06/07/1987	2.680	
10:19:00 04/08/1987	2.470	
09:46:00 02/09/1987	2.560	
14:12:00 06/10/1987	2.600	
10:09:00 05/11/1987	2.500	
13:33:00 03/12/1987	2.460	2.680
10:11:00 05/02/1988	2.220	
10:15:00 03/03/1988	2.065	
09:59:00 01/06/1988	2.070	
10:23:00 07/07/1988	2.250	
10:20:00 06/09/1988	2.580	
10:49:00 12/10/1988	2.670	
10:26:00 07/11/1988	2.670	2.670
10:13:00 25/01/1989	2.440	
10:45:00 21/04/1989	2.140	
12:09:00 20/07/1989	2.270	
11:14:00 05/10/1989	2.610	2.610
13:40:00 11/01/1990	2.470	
11:29:00 02/04/1990	2.170	
13:55:00 10/07/1990	2.230	
12:41:00 23/10/1990	2.400	2.470
11:43:00 10/01/1991	2.140	
10:51:00 23/07/1991	2.260	
11:17:00 02/10/1991	2.710	2.710
13:27:00 31/01/1992	2.520	
11:34:00 08/04/1992	2.420	
13:48:00 09/07/1992	2.490	
12:47:00 19/10/1992	2.800	2.800

13:00:00 25/01/1993	2.500	
12:15:00 20/04/1993	2.170	
10:23:00 19/07/1993	2.220	
10:53:00 08/10/1993	2.460	2.500
11:17:00 24/01/1994	2.110	
13:04:00 18/10/1994	2.300	
15:30:00 19/10/1994	1.860	2.300
12:45:00 23/01/1995	1.920	
10:55:00 10/04/1995	1.610	
14:05:00 14/07/1995	1.750	
09:20:00 19/10/1995	2.160	2.160
09:50:00 15/01/1996	1.950	
10:50:00 30/04/1996	1.560	
11:52:00 11/07/1996	1.730	
10:35:00 14/10/1996	2.300	2.300
11:15:00 20/01/1997	2.020	
09:35:00 17/04/1997	1.650	
09:55:00 11/07/1997	1.860	
10:25:00 13/10/1997	2.130	2.130
09:50:00 15/01/1998	1.760	
09:50:00 26/03/1998	1.520	
11:40:00 15/07/1998	1.650	
10:25:00 07/10/1998	2.000	2.000
09:58:00 15/01/1999	1.770	
10:59:00 20/05/1999	1.380	
10:26:00 21/09/1999	2.220	2.220
10:50:00 21/06/2000	1.710	
09:58:00 12/10/2000	2.280	2.280
09:57:00 16/05/2001	1.430	
09:40:00 16/10/2001	1.730	1.730
09:47:00 13/05/2002	1.170	
09:49:00 14/10/2002	1.640	1.640
09:37:00 13/05/2003	1.150	
13:57:00 15/10/2003	1.850	1.850
11:25:00 07/05/2004	1.130	
10:39:00 11/10/2004	1.660	1.660
10:50:00 13/05/2005	1.120	
09:48:00 06/10/2005	2.050	2.050
10:19:00 08/05/2006	1.510	
10:13:00 09/10/2006	1.730	1.730
09:25:00 03/05/2007	1.020	
09:45:00 15/10/2007	1.620	1.620
10:49:00 06/05/2008	1.220	
09:35:00 09/10/2008	2.190	2.190
09:09:00 06/05/2009	1.370	
13:01:00 15/10/2009	2.040	2.040

Average = 2.358

APPENDIX D
GROUND WATER USAGE

Project: HERITAGE PARK IRRIGATION REQUIREMENTS per STAGE AND YEAR

PRELIMINARY MAY 2011

7500kL/hect/ann

Includes: *- POS incl. verges associated with POS*

Does not include: *- Verges*

POS not completed within this stage

Assume 70% irrigation requirements following completion of 2 year maintenance period (with exception of POS F - full irrigation requirements

POS within 2 year maintenance period (assume full irrigation requirements during this time)

POS Partially completed within Stage (assume full irrigation requirements for completed POS)

POS Fully completed within Stage (assume full irrigation requirements)

						STAGE NUMBER AND COMPLETION DATE (APPROXIMATE)																											
					YEAR	*2011*	*2011*	*2012*		*2013*		*2014*		*2015*		*2016*		*2017*		*2018*		*2019*		*2020*		*2021*		*2022*		*2023*		*2024*		*2025*
						First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half
		POS Area	*Water/year kL*	*Water/yr in maintenance*	*Water/yr ongoing*																											
STAGE				100% usage	70% usage (excl POS F)																											
5A	1ST HALF 2011	7,825	*4,049*	*4,049*	*2,835*	2,025	2,025	2,025	2,025	2,025	1,417	1,417	1,417	1,417	1,417	1,417	1,417	1,417	1,417	1,417	1,417	1,417	1,417	1,417	1,417	1,417	1,417	1,417	1,417	1,417	1,417	1,417
5B	1ST HALF 2012	0	*0*	*0*	*0*																											
1B	1ST HALF 2012	960	*612*	*612*	*428*			306	306	306	306	306	214	214	214	214	214	214	214	214	214	214	214	214	214	214	214	214	214	214	214	214
HERITAGE PARK					TOTAL WATER (kL) PER YEAR		4,049		4,661		4,054		3,355		3,263		3,263		3,263		3,263		3,263		3,263		3,263		3,263		3,263	1,632

Project: PARKLAND HEIGHTS - IRRIGATION REQUIREMENTS per STAGE AND YEAR
PRELIMINARY MAY 2011

7500kL/hect/ann

Includes: - POS incl. verges associated with POS
- Greenlinks

Does not include: - Verges

POS not completed within this stage

Assume 70% irrigation requirements following completion of 2 year maintenance period (with exception of POS F - full irrigation requirements
POS within 2 year maintenance period (assume full irrigation requirements during this time)
POS Partially completed within Stage (assume full irrigation requirements for completed POS)
POS Fully completed within Stage (assume full irrigation requirements)

						YEAR	2011	2012		2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023		2024		2025
							2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half	2nd Half	First Half
STAGE		*POS Area*	*Water/year kL*	*Water/yr in maintenance*	*Water/yr ongoing*		*ONE*	*TWO*		*THREE*				*FOUR*		*FIVE*		*SIX*		*SEVEN*				*EIGHT*		*NINE A*		*NINE B*		*TEN A*		*TEN B*		*ELEVEN*
POS				100% usage	70% usage (excl POS F)																													
A	2ND HALF 2011	8,300	*4,295*	*4,295*	*3,007*		2,148	2,148	2,148	2,148	2,148	1,503	1,503	1,503	1,503	1,503	1,503	1,503	1,503	1,503	1,503	1,503	1,503	1,503	1,503	1,503	1,503	1,503	1,503	1,503	1,503	1,503	1,503
B	2ND HALF 2011 + 1ST HALF 2013	5,750	*3,666*	*3,666*	*2,566*		1,375	1,375	1,375	1,833	1,833	1,420	1,420	1,420	1,283	1,283	1,283	1,283	1,283	1,283	1,283	1,283	1,283	1,283	1,283	1,283	1,283	1,283	1,283	1,283	1,283	1,283	1,283
C	2ND HALF 2011 + 1ST HALF 2013	13,268	*6,269*	*6,269*	*4,388*		1,567	1,567	1,567	3,135	3,135	3,135	3,135	3,135	2,194	2,194	2,194	2,194	2,194	2,194	2,194	2,194	2,194	2,194	2,194	2,194	2,194	2,194	2,194	2,194	2,194	2,194	2,194
D	1ST HALF 2015	2,033	*1,296*	*1,296*	*907*									648	648	648	648	648	454	454	454	454	454	454	454	454	454	454	454	454	454	454	454	454
E	1ST HALF 2015	6,420	*4,093*	*4,093*	*2,865*									2,046	2,046	2,046	2,046	2,046	1,432	1,432	1,432	1,432	1,432	1,432	1,432	1,432	1,432	1,432	1,432	1,432	1,432	1,432	1,432	1,432
F	1ST HALF 2013	60,562	*35,429*	*35,429*	*35,429*					17,714	17,714	17,714	17,714	17,714	17,714	17,714	17,714	17,714	17,714	17,714	17,714	17,714	17,714	17,714	17,714	17,714	17,714	17,714	17,714	17,714	17,714	17,714	17,714	17,714
G	1ST HALF 2013	5,564	*2,796*	*2,796*	*1,957*					1,398	1,398	1,398	1,398	1,398	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979
H	1ST HALF 2018	1,926	*1,228*	*1,228*	*859*															614	614	614	614	614	430	430	430	430	430	430	430	430	430	430
I	1ST HALF 2018	2,729	*1,739*	*1,739*	*1,218*															870	870	870	870	870	609	609	609	609	609	609	609	609	609	609
J	1ST HALF 2018	2,622	*1,671*	*1,671*	*1,170*															836	836	836	836	836	585	585	585	585	585	585	585	585	585	585
K	1ST HALF 2018	428	*273*	*273*	*191*															136	136	136	136	136	95	95	95	95	95	95	95	95	95	95
L	1ST HALF 2020	11,235	*5,477*	*5,477*	*3,834*																			2,739	2,739	2,739	2,739	2,739	1,917	1,917	1,917	1,917	1,917	1,917
M	1ST HALF 2021 + 2023	15,408	*7,396*	*7,396*	*5,177*																					1,849	1,849	1,849	1,849	3,698	3,143	3,143	3,143	3,143
N	1ST HALF 2023	8,346	*3,943*	*3,943*	*2,760*																										1,972	1,972	1,972	1,972
O	1ST HALF 2018	8,774	*4,738*	*4,738*	*3,317*															2,369	2,369	2,369	2,369	2,369	1,658	1,658	1,658	1,658	1,658	1,658	1,658	1,658	1,658	1,658
GREENLINKS i	STAGE 8	780	*468*	*468*	*328*																			234	234	234	234	234	164	164	164	164	164	164
GREENLINKS ii	STAGE 9	2,195	*1,317*	*1,317*	*922*																					659	659	659	659	659	461	461	461	461
GREENLINKS iii	STAGE 5	2,035	*1,221*	*1,221*	*855*											611	611	611	611	611	427	427	427	427	427	427	427				427	427	427	427	427
GREENLINKS iv	STAGE 10	3,300	*1,980*	*1,980*	*1,386*																									990	990	990	990	990
TEMP ENTRY	2ND HALF 2011	3,000	*2,250*	*2,250*	*1,575*		1,125	1,125	1,125	1,125	1,125	788	788	788	788	788	788																	
		164,674	84,309			TOTAL WATER (kL) PER YEAR	6,215	12,429		54,705		51,916		55,808		55,532		53,148		61,806		61,623		66,121		69,688		68,796		74,802		76,022		38,011

	ONE	*TWO*	*THREE*	*FOUR*	*FIVE*	*SIX*	*SEVEN*	*EIGHT*	*NINE A*	*NINE B*	*TEN A*	*TEN B*	*ELEVEN*
TOTAL WATER (kL) PER STAGE	6,215	6,215	33,567	107,921	54,921	54,744	57,165	126,219	67,181	69,688	70,744	76,022	76,022

Project: HERITAGE PARK AND PARKLAND HEIGHTS IRRIGATION REQUIREMENTS per STAGE AND YEAR

PRELIMINARY MAY 2011

7500kL/hect/ann

Includes: *- POS incl. verges associated with POS*

- Greenlinks

Does not include: *- Verges*

POS not completed within this stage

Assume 70% irrigation requirements following completion of 2 year maintenance period (with exception of POS F - full irrigation requirements

POS within 2 year maintenance period (assume full irrigation requirements during this time)

POS Partially completed within Stage (assume full irrigation requirements for completed POS)

POS Fully completed within Stage (assume full irrigation requirements)

	YEAR	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*	*2025*
PARKLAND HEIGHTS + HERITAGE PARK	TOTAL WATER (kL) PER YEAR	10,264	17,090	58,759	55,271	59,071	58,795	56,411	65,069	64,886	69,384	72,951	72,059	78,065	79,285	39,642

Date: 15/06/2011

Project: **Lot 1507 Parkland Heights**

Year	Construction Stage	Approximate Stage Finish Date	Water Useage	Required Construction Water (kL)	Required Irrigation Water (kL)
2011	1	September	Construction Water/ Irrigation	30,000	6,500
2012	2	August	Construction Water/ Irrigation	30,000	13,000
2013	3	August	Construction Water/ Irrigation	40,000	55,000
2014	Sand Mining	Continuous	Construction Water/ Irrigation	40,000	55,000
2015	4	February	Construction Water/ Irrigation	40,000	56,000
2016	5	February	Construction Water/ Irrigation	60,000	56,000
2017	6	June	Construction Water/ Irrigation	60,000	56,000
2018	7	June	Construction Water/ Irrigation	40,000	62,000
2019	Sand Mining	Continuous	Construction Water/ Irrigation	40,000	62,000
2020	8	June	Construction Water/ Irrigation	40,000	67,000
2021	9A	June	Construction Water/ Irrigation	50,000	70,000
2022	9B	June	Construction Water/ Irrigation	50,000	70,000
2023	10A	June	Construction Water/ Irrigation	50,000	75,000
2024	10B	June	Construction Water/ Irrigation	50,000	77,000
2025	11	June	Construction Water/ Irrigation	30,000	77,000

Project: **Heritage Park**

Year	Construction Stage	Approximate Stage Finish Date	Water Useage	Required Construction Water (kL)	Required Irrigation Water (kL)
2011	5A	July	Construction Water/ Irrigation	20000	23,000
2012	5B & 1B	July	Construction Water/ Irrigation	25000	23,000
2013	POS Only		Irrigation	-	23,000
2014	POS Only		Irrigation	-	23,000
2015	POS Only		Irrigation	-	23,000
2016	POS Only		Irrigation	-	23,000
2017	POS Only		Irrigation	-	23,000
2018	POS Only		Irrigation	-	23,000
2019	POS Only		Irrigation	-	23,000
2020	POS Only		Irrigation	-	23,000
2021	POS Only		Irrigation	-	23,000
2022	POS Only		Irrigation	-	23,000
2023	POS Only		Irrigation	-	23,000
2024	POS Only		Irrigation	-	23,000
2025	POS Only		Irrigation	-	23,000

Summary: **Parkland Heights & Heritage Park**

Year	Total Required Construction Water (kL)	Total Required Irrigation Water (kL)
2011	50,000	29,500
2012	55,000	36,000
2013	40,000	78,000
2014	40,000	78,000
2015	40,000	79,000
2016	60,000	79,000
2017	60,000	79,000
2018	40,000	85,000
2019	40,000	85,000
2020	40,000	90,000
2021	50,000	93,000
2022	50,000	93,000
2023	50,000	98,000
2024	50,000	100,000

APPENDIX E

WATER BALANCE CALCULATIONS

Parkland Heights LWMS

Pre-Development	Drainage and Infiltration (ML/yr)
Pre Development	**112.83**

Post-Development	Drainage and Infiltration (ML/yr)
Groundwater Input	
R15 Houses	5.71
R20 Houses	191.64
R25 Houses	6.94
R30 Houses	55.91
R40 Houses	26.34
R50 Houses	0.00
R60 Houses	19.27
Non Residential recharge from rainfall &irrigation	48.60
POS recharge from rainfall &irrigation	19.36
Drainage areas and roads	164.54
Total Input	**538.31**
Groundwater Extraction	
R15 Houses	-1.20
R20 Houses	-46.36
R25 Houses	-1.19
R30 Houses	-12.37
R40 Houses	0.00
R50 Houses	0.00
R60 Houses	0.00
Groundwater for non-residential irrigation	-14.70
Groundwater for POS irrigation	-44.39
Total Extraction	**-120.21**

Total recharge to groundwater and drainage leaving site	**418.10**

Extra volume recharge/outlfow	**305.28**

% increase of recharge/outflow	**271%**

APPENDIX F
POTABLE DEMAND CALCULATIONS

Appendix F - Potable Calculator

Standard Water Use data		R15	R20	R25	R30	R40	R60	Total
Number of dwellings		19	696	27	302	170	190	1404
Number of people/hh		4	3	3	2	1.5	1.5	2.41
Number of people		76	2088	81	604	255	285	3389
Irragable area/ lot	m2	280	208	208	110	50	35	
Irrigation rates	kL/ha/a	7500	7500	7500	7500	7500	7500	
Irrigation rates	kL/m2/a	0.75	0.75	0.75	0.75	0.75	0.75	
Indoor	kL/hh/a	224	168	168	112	84	84	
Outdoor	kL/hh/a	210	156	156	82.5	37.5	26.3	
Total Water use	kL/hh/a	434	324	324	194.5	121.5	110	244
Total Water use	kL/zone/a	8246	225504	8748	58739	20655	20948	342840
Total Water use	kL/p/a	109	108	108	97	81	74	101

								Total Savings		
Residential bore takeup rate	%	20%	20%	20%	0%	0%	0%	kL/dev/a	kL/hh/a	%
P1 **Eco water saver- Rainwater indoors**										
Package takeup rate		1%	1%	1%	0%	0%	0%			
Savings	kL/hh/a	26	21	21	16	15	15			
Total package savings	kL/zone/a	4.94	146.16	5.67	0	0	0	157	0.1	0%
P2 **Eco water recycler - Greywater + ww garden (backyard)**										
Package takeup rate (not including those in P3)		0%	0%	0%	0%	0%	0%			
% of total homes with both bore and package		0%	0%	0%	0%					
Greywater										
Greywater produced	kL/hh/a	0	0	0	0	0	0			
Required Greywater area (35mm/wk)	m2	0.0	0.0	0.0	0.0	0.0	0.0			
Scheme water saved	kL/hh/a	0.0	0.0	0.0	0.0	0.0	0.0			
Scheme water saved	kL/zone/a	0	0	0	0	0	0			
Waterwise garden usage										
Waterwise garden savings	kL/hh/a	42.0	31.2	31.2	16.5	7.5	5.3			
Waterwise garden savings	kL/zone/a	0.0	0.0	0.0	0.0	0.0	0.0			
Total package savings	kL/zone/a	0	0	0	0	0	0	0	0.0	0.0%
Savings from bore	kL/zone/a	798	21715	842	0	0	0	23356	17	6.8%
Savings from bore & package	kL/zone/a	798	21715	842	0	0	0	23356	16.6	6.8%
P3 **Eco waterwise landscape (frontyard)**										
Package takeup rate (not including those with P2)		100%	100%	100%	100%	0%	0%			
% of total homes with both bore and package		0%	0%	0%	0%	0%	0%			
Scheme water savings	kL/hh/a	42	31.2	31.2	16.5	7.5	5.25			
Total package scheme water savings	kL/zone/a	798	21715	842	4983	0	0	28339	20.2	8.3%
Savings from bore	kL/zone/a	798	21715	842	0	0	0	23356	16.6	6.8%
Savings from bore & package	kL/zone/a	1596	43430	1685	4983	0	0	51694	36.8	15.1%
P4 **Indoor Eco water saver (Internal appliance upgrade)**										
Package takeup rate		0%	0%	0%	0%	0%	0%			
Savings	kL/hh/a	46.6	35.0	35.0	23.3	17.5	17.5			
Total package savings	kL/zone/a	0	0	0	0	0	0	0	0.0	0.0%
P5 **Behaviour change program**										
Package takeup rate		30%	30%	30%	30%	30%	30%			
Savings	kL/hh/a	65.1	48.6	48.6	29.2	18.2	16.5			
Total package savings	kL/zone/a	371	10148	394	2643	929	943	15428	11.0	4.5%
Total packages savings	**kL/zone/a**	**1174**	**32009**	**1242**	**7626**	**929**	**943**	**43923**	**31.3**	**12.8%**
Total Residential Bore savings	**kL/zone/a**	**1596**	**43430**	**1685**	**0**	**0**	**0**	**46711**	**33.3**	**13.6%**

	kL/hh/a	L/hh/d	kL/p/a	L/p/d
Standard Total Water Use	247	677	102.3	280
Estimated Total Water Savings from Packages	31.3	86	13.0	36
Estimated Total Water Savings from Bore	33.3	91	13.8	38
Expected Total Water Scheme Water Use	182	500	75.6	207
% reduction	26%	26%	26%	26%

Packages Summary (averaged over whole development)

	Total saving			
	kL/hh/a	kL/p/a	%	
Eco water saver- Rainwater indoors	0.1	0.0	0%	toilet and w/m only assuming a 3star w/m
Eco water recycler - Greywater + ww garden	0.0	0.0	0%	assumes WW garden saves 40% of rear garden use
Eco waterwise landscape	20.2	8.4	8%	assumes WW garden saves 40% of front garden use
Indoor Eco water saver (Internal appliance upgrade)	0.0	0.0	0%	4.5/3 toilet, 7.5L/min shower, tap restrictors
Behaviour change program	11.0	4.6	5%	Assumes 15% reduction
Residential bore water savings	33.3	4.6	14%	
Total	**31**	**13**	**26%**	

APPENDIX G
GROUNDWATER LICENCES

Government of **Western Australia**
Department of **Water**

looking after all our water needs

Your ref: GWL 169700 (3)
Our ref: RF 7769
Enquiries: Lorna Aylward 9550 4217

Rockingham Park Pty Ltd
PO Box 7197
CLOISTERS SQUARE WA 6850

Dear Licensee

Re: Issue of a Licence to Take Water – GWL 169700 (3)
Property: Lot 9002 on Plan 61888-Volume/Folio 2715/142- Lot 9002 Baldivis-Heritage Park
Lot 182 on Plan 55259 on Plan 55259-Volume/Folio Lr3147/627-Lot 182 Baldivis-Heritage Park

Please find enclosed your *Licence to Take Water*, issued under section 5C of the *Rights in Water and Irrigation Act 1914.* This licence entitles you to take water, subject to certain terms, conditions or restrictions. It does not absolve the licensee from responsibility for compliance with the requirements of all Commonwealth and State legislation.

It is important that you read the conditions of your licence carefully. If you do not understand your licence, please contact the Department as soon as possible, as there are penalties for failing to comply with all of your licence conditions.

Under Section 26GG(2) of the *Rights in Water and Irrigation Act 1914*, you have a right to apply to the State Administrative Tribunal to request a written statement of reasons for the period for which the licence is granted or for a review of any term, condition or restriction included in the licence. You have 28 days from the date you received this letter to request that the decision be reviewed

For further information please contact the State Administrative Tribunal:

State Administrative Tribunal
12 St Georges Terrace
PERTH WA 6000

GPO Box U1991
PERTH WA 6845

Telephone: (08) 9219 3111
Toll-free: 1300 306 017
Facsimile: (08) 9325 5099
www.sat.justice.wa.gov.au

Kwinana Peel Region
107 Breakwater Parade Mandurah Ocean Marina Mandurah Western Australia 6210
PO Box 332 Mandurah Western Australia 6210
Telephone (08) 9550 4222 Facsimile (08) 9581 4560
www.water.wa.gov.au
wa.gov.au

If you wish to continue taking water after this *Licence to Take Water* expires, it is your responsibility to apply to the Department of Water for its renewal. If this licence expires and you have not applied to renew it, then the taking of water must cease, or you will be in breach of *the Rights in Water and Irrigation Act 1914*. It is suggested that an application for renewal be made at least one month in advance of the *Licence to Take Water* expiry date.

Should legal access to the land cease, for example you decide to sell your property, before the Licence to Take Water expiry date, you are required to inform the Department using Form 6 - Notice that Licence Holder is not or may not be Eligible to Hold a Licence and return the enclosed licence within 30 days. Failure to comply is a breach of the *Rights in Water and Irrigation Act 1914.*

You may apply to amend or transfer the *Licence to Take Water* at any time. The Department may also amend, suspend or cancel this licence in certain circumstances. For further information, please refer to the Frequently Asked Questions (FAQ's) on the Departments website http://www.water.wa.gov.au

Please note that the Department maintains a 'Water Register' containing information on Western Australia's water availability and licensing details. An extract of this licence has been placed on the register and can be viewed online at; http://www.water.wa.gov.au.

If you have any queries relating to the above matter, please contact me on 9550 4217

Yours faithfully

Lorna Aylward
Natural Resource Management Officer
Department of Water
Kwinana Peel Regional office

24 August 2011

Encl. GWL 169700 (3)

File No: RF7769

Government of Western Australia
Department of Water

Instrument No. GWL169700(3)

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Rockingham Park Pty Ltd		
Description of Water Resource	Stakehill Perth - Superficial Swan	**Annual Water Entitlement**	27450 kL
Location of Water Source	Lot 182 On Plan 55259 - Volume/Folio Lr3147/627 - Lot 182 Baldivis - Heritage Park		

	Taking of water for	**Location of Activity**
Authorised Activities	Irrigation of up to 0 ha of public open space	Lot 9002 On Plan 61888 - Volume/Folio 2715/142 - Lot 9002 Baldivis - Heritage Park
	Irrigation of up to 6.87 ha of public open space	Lot 182 On Plan 55259 - Volume/Folio Lr3147/627 - Lot 182 Baldivis - Heritage Park

Duration of Licence	From 18 August 2011 to 18 July 2013

This Licence is subject to the following terms, conditions and restrictions:

1 Approval by the Department of Water is to be obtained prior to the construction of additional and replacement wells and the modification or refurbishment of existing wells.

2 That should the licensee's draw adversely affect the aquifer or other users in the area, the Department of Water may reduce the amount that may be drawn.

3 The licensee shall not use water for public open space between 9 am and 6 pm except for the establishment of newly planted areas. For newly planted areas water may be used within these hours for a period of up to 28 consecutive days, commencing from the date of planting.

4 The annual water year for water taken under this licence is defined as 12:00 pm at 1 July to 12:00 pm at 1 July twelve months later.

5 The licensee must take and record the reading from each meter required under this licence at the beginning and another at the end of the water year defined on this licence.

6 In addition to taking and recording the reading(s) at the beginning and the end of the water year, the licensee must, as close as practicable to the end of each month (other than the month in which the water year ends), take and record the reading from each meter required under this licence.

7 All meter readings must be recorded on the "Meter Water Use Card".

8 The completed Meter Water Use Card must be returned to the Department of Water by 14 July.

9 The licensee must not, in any water year, take more water than the annual water entitlement specified in this licence.

10 The licensee must notify the Department of Water in writing of any water meter malfunction within seven days of the malfunction being noticed.

11 That the licensee shall have the irrigation project completed by 27 August 2011.

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

This Licence is subject to the following terms, conditions and restrictions:

12 The licensee must obtain authorisation from the Department of Water before removing, replacing or interfering with any meter required under this licence.

13 The licensee must ensure the installed meter(s) accuracy is maintained to within plus or minus 5% of the volume metered, in field conditions.

14 Between 1 June and 31 August in any year, the licence-holder must not water a lawn, garden, or grass-covered area ("turf") by reticulation, provided always that this restriction shall not apply to watering with a hand held hose; or watering, by way of reticulation: newly planted areas for a period of up to 28 days from the date of planting; for renovating turf; or for maintenance of reticulation systems.

End of terms, conditions and restrictions

Government of **Western Australia**
Department of **Water**

looking after all our water needs

Your ref: GWL 164680 (4)
Our ref: RF7769

Enquiries: Lorna Aylward (08) 9550 4217

Neil Teo
Dynamic Planning & Developments
PO Box 525
NORTH PERTH WA 6906

On behalf of Rockingham Park Pty Ltd

Dear Mr Teo

Re: Issue of a Licence to Take Water – GWL 164680 (4)
Property: Lot 1507 on Plan 194627-Volume/Folio Lr3115/948-Lot 1507 Baldivis-Parkland Estate
Lot 9003 on Plan 61899-Volume/Folio 2748/284-Lot 9003 Baldivis –Heritage Park

Please find enclosed your *Licence to Take Water*, issued under section 5C of the *Rights in Water and Irrigation Act 1914*. This licence entitles you to take water, subject to certain terms, conditions or restrictions. It does not absolve the licensee from responsibility for compliance with the requirements of all Commonwealth and State legislation.

It is important that you read the conditions of your licence carefully. If you do not understand your licence, please contact the Department as soon as possible, as there are penalties for failing to comply with all of your licence conditions.

Under Section 26GG(2) of the *Rights in Water and Irrigation Act 1914*, you have a right to apply to the State Administrative Tribunal to request a written statement of reasons for the period for which the licence is granted or for a review of any term, condition or restriction included in the licence. You have 28 days from the date you received this letter to request that the decision be reviewed

For further information please contact the State Administrative Tribunal:

State Administrative Tribunal
12 St Georges Terrace
PERTH WA 6000

GPO Box U1991
PERTH WA 6845

Telephone: (08) 9219 3111
Toll-free: 1300 306 017
Facsimile: (08) 9325 5099
www.sat.justice.wa.gov.au

Kwinana Peel Region
107 Breakwater Parade Mandurah Ocean Marina Mandurah Western Australia 6210
PO Box 332 Mandurah Western Australia 6210
Telephone (08) 9550 4222 Facsimile (08) 9581 4560
www.water.wa.gov.au
wa.gov.au

This licence is due to expire on 25 August 2013. If you wish to continue taking water after this *Licence to Take Water* expires, it is your responsibility to apply to the Department of Water for its renewal. If this licence expires and you have not applied to renew it, then the taking of water must cease, or you will be in breach of *the Rights in Water and Irrigation Act 1914*. It is suggested that an application for renewal be made at least one month in advance of the *Licence to Take Water* expiry date.

Should legal access to the land cease, for example you decide to sell your property, before the Licence to Take Water expiry date, you are required to inform the Department using Form 6 - Notice that Licence Holder is not or may not be Eligible to Hold a Licence and return the enclosed licence within 30 days. Failure to comply is a breach of the *Rights in Water and Irrigation Act 1914*.

You may apply to amend or transfer the *Licence to Take Water* at any time. The Department may also amend, suspend or cancel this licence in certain circumstances. For further information, please refer to the Frequently Asked Questions (FAQ's) on the Departments website http://www.water.wa.gov.au

The Department of Water would like to inform you that your licence has been re-issued for a 1 year period only, it includes a development condition stating that you must have at least 50% of the irrigation project completed within the term of the licence otherwise the water entitlement will be reduced in line with the Department of Water's Statewide policy on unused water entitlements.

Please note that the Department maintains a 'Water Register' containing information on Western Australia's water availability and licensing details. An extract of this licence has been placed on the register and can be viewed online at; http://www.water.wa.gov.au.

If you have any queries relating to the above matter, please contact me on (08) 9550 4217

Yours sincerely

Lorna Aylward
Natural Resource Management Officer
Department of Water
Kwinana Peel Region

31 August 2011

Encl. GWL 164680 (4)

Government of Western Australia
Department of Water

Instrument No. GWL164680(4)

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Rockingham Park Pty Ltd		
Description of Water Resource	Stakehill Perth - Superficial Swan	**Annual Water Entitlement**	80000 kL
Location of Water Source	Lot 1507 On Plan 194627 - Volume/Folio Lr3115/948 - Lot 1507 Baldivis - Parkland Heights Lot 9003 On Plan 61899 - Volume/Folio 2748/284 - Lot 9003 Baldivis - Heritage Park		

Authorised Activities	**Taking of water for**	**Location of Activity**
	Dust suppression for earthworks and construction purposes Earthwork and construction purposes	Lot 1507 On Plan 194627 - Volume/Folio Lr3115/948 - Lot 1507 Baldivis - Parkland Heights
	Dust suppression for earthworks and construction purposes Earthwork and construction purposes	Lot 9003 On Plan 61899 - Volume/Folio 2748/284 - Lot 9003 Baldivis - Heritage Park
Duration of Licence	From 26 August 2011 to 25 August 2013	

This Licence is subject to the following terms, conditions and restrictions:

1 That should the licensee's draw adversely affect the aquifer or other users in the area, the Department of Water may reduce the amount that may be drawn.

2 Approval by the Department of Water is to be obtained prior to the construction of additional and replacement wells and the modification or refurbishment of existing wells.

3 The annual water year for water taken under this licence is defined as 12:00 pm at 1 July to 12:00 pm at 30 June twelve months later.

4 The licensee must take and record the reading from each meter required under this licence at the beginning and another at the end of the water year defined on this licence.

5 In addition to taking and recording the reading(s) at the beginning and the end of the water year, the licensee must, as close as practicable to the end of each month (other than the month in which the water year ends), take and record the reading from each meter required under this licence.

6 All meter readings must be recorded on the "Meter Water Use Card".

7 The licensee must not, in any water year, take more water than the annual water entitlement specified in this licence.

8 The licensee must ensure the installed meter(s) accuracy is maintained to within plus or minus 5% of the volume metered, in field conditions.

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

This Licence is subject to the following terms, conditions and restrictions:

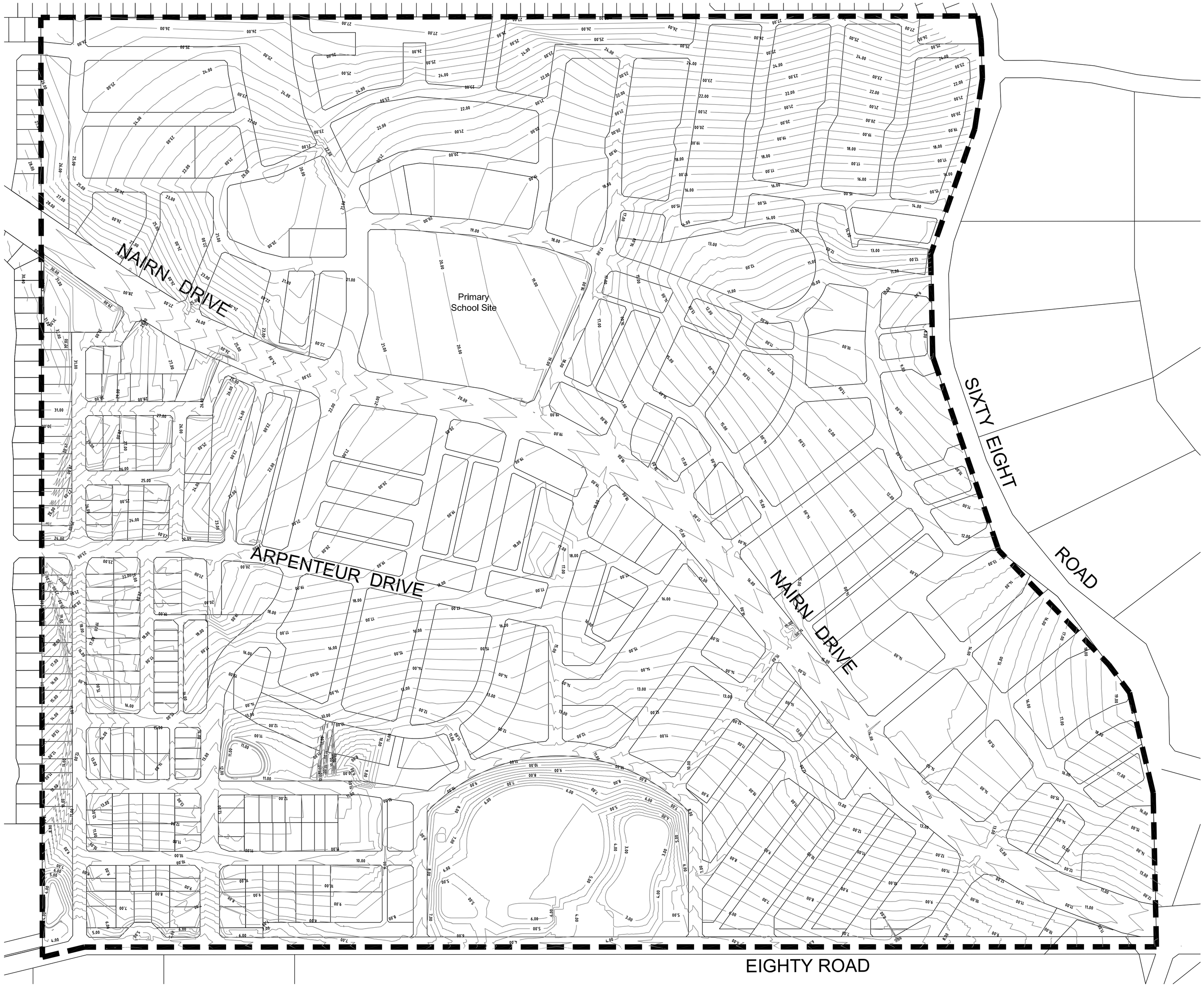
9 The licensee must notify the Department of Water in writing of any water meter malfunction within seven days of the malfunction being noticed.

10 The licensee must submit to the Department of Water the recorded meter readings and the volume of water taken within the water year by 14 July.

11 The licensee must install a cumulative water meter of a type approved under the Rights in Water and Irrigation (Approved Meters) Order 2009 to each water draw point under this licence.

End of terms, conditions and restrictions

APPENDIX H
PRELIMINARY EARTHWORKS PLAN



NOTES

1. DRAWING FOR INFORMATION ONLY. FOR DETAILED DESIGN INFORMATION REFER TO STAGE SPECIFIC DRAWINGS AND SPECIFICATION.

LEGEND

- PRELIMINARY DESIGN FINISHED SURFACE CONTOUR (1.0m INTERVAL)
- LIMIT OF WORKS BOUNDARY

PRELIMINARY AND UNCHECKED

CHECK PRINT Apr 20, 2011

- ☐ DRAFTING CHECK
- ☐ DESIGN CHECK
- ☐ CLIENT REVIEW
- ☐ APPROVED BY ENGINEER

REV No.	DATE	DRAFTING CHECK	DESIGN REVIEW	REV'D P.ENG.	APP'D P.MGR	AMENDMENT
B	25/05/11					CONTOURS UPDATED RE ISSUED FOR INFORMATION
A	20/04/11					ISSUED FOR INFORMATION ONLY

REV No.	DATE	DRAFTING CHECK	DESIGN REVIEW	REV'D P.ENG.	APP'D P.MGR	AMENDMENT

SERLING CONSULTING
INNOVATIVE ENGINEERING SOLUTIONS

Serling Consulting (WA) Pty Ltd
ACN: 136 628 058
UNIT 210/396 SCARBOROUGH BEACH ROAD
OSBORNE PARK WA 6017
Telephone (08) 9202 8740
Facsimile (08) 9202 8749

CLIENT: ROCKINGHAM PARK

PROJECT: LOT 1507 - BALDIVIS - PARKLAND HEIGHTS

DRAFTER	DRAFTING CHECK	REVIEWED PROJECT MANAGER	APPROVED PROJECT DIRECTOR
R.DE JONG			
DESIGNED	DESIGN REVIEW		
R.DE JONG			

TITLE: PRELIMINARY OVERALL EARTHWORKS PLAN

SHEET	DATUM	WAPC No.	PROJECT No.	DRAWING No.	REVISION
A1	A.H.D.	SCALE 1:1000	SC00102.010	C010	B

'*' INDICATES A COPY OF AN ORIGINAL SIGNED DRAWING

Q:\Projects\SC00102.010 - Stage 1 Lot 1507 Eighty Road -Parkland Heights\Deliverables\DWG - STAGE 1\C010 - Preliminary Overall Earthworks Plan 25/05/2011 10:30:31 AM Russell De Jong

APPENDIX I
DRAINAGE CONCEPT PLANS

DESIGN ASSUMPTIONS

1. WHERE SUBDIVISION LAYOUT NOT AVALIABLE IMPERVIOUS AREA EQUALS 25% OF TOTAL CATCHMENT AREA.

2. INFILTRATION AREA IS ESTIMATED AT 25% OF ALL
   - POS
   - ROAD / MEDIAN AREA WITHIN CATCHMENT
   - BELOW GROUND INFILTRATION NETWORK AREA

LEGEND

- GENERALISED DRAINAGE FLOW DIRECTION
- EXTENT OF SITE CATCHMENT BOUNDARY
- DRAINAGE SUB CATCHMENT BOUNDARY
- PROPOSED SURFACE CONTOUR
- PROPOSED PUBLIC OPEN SPACE
- PROPOSED SWALES / BELOW GROUND INFILTRATION SYSTEM
- DENOTES DRAINAGE INFILTRATION BASIN. SHAPE TO BE DETERMINED AT DETAIL DESIGN
- DENOTES 1 in 1 STORM TWL
- DENOTES 1 in 5 STORM TWL
- DENOTES 1 in 10 STORM TWL
- DENOTES 1 in 100 STORM TWL

AREAS AND STORAGE 1 IN 1 STORM

SWALE	CATCHMENT	IMPERVIOUS AREA	INFILTRATION RATE	SWALE AREA	STORM VOLUME
1	1.33 ha	1.20 ha	3.0m/DAY	546m^2	70m^3
2	1.89 ha	1.70 ha	3.0m/DAY	902m^2	110m^3
3	2.17 ha	1.95 ha	3.0m/DAY	800m^2	150m^3
4	1.73 ha	1.56 ha	3.0m/DAY	551m^2	100m^3
5	0.99 ha	0.89 ha	3.0m/DAY	462m^2	50m^3

BASIN	CATCHMENT AREA	IMPERVIOUS AREA	INFILTRATION RATE	BASIN AREA	STORM VOLUME
B1	3.77 ha	3.39 ha	3.0m/DAY	1878m^2	300m^3
B2	6.32 ha	5.69 ha	3.0m/DAY	2654m^2	470m^3
B3	5.09 ha	4.58 ha	3.0m/DAY	1508m^2	560m^3
B4	2.06 ha	1.85 ha	3.0m/DAY	1043m^2	170m^3
B5	2.75 ha	2.48 ha	3.0m/DAY	1414m^2	140m^3
B6	1.27 ha	1.14 ha	3.0m/DAY	1732m^2	10m^3
B7	1.89 ha	1.70 ha	3.0m/DAY	798m^2	140m^3
B8	1.10 ha	0.99 ha	3.0m/DAY	750m^2	60m^3
B9	3.43 ha	3.09 ha	3.0m/DAY	1924m^2	260m^3
B10	2.12 ha	1.91 ha	3.0m/DAY	814m^2	200m^3

SERLING CONSULTING
INNOVATIVE ENGINEERING SOLUTIONS
Serling Consulting (WA) Pty Ltd
ACN: 136 628 058
UNIT 210/396 SCARBOROUGH BEACH ROAD
OSBORNE PARK WA 6017
Telephone (08) 9202 8740
Facsimile (08) 9202 8749

0 25 50 75 100 125 150 metres

SCALE 1 : 2 500 (A3)
DATUM: AHD

09.078

PARKLAND HEIGHTS
LOT 1507 EIGHTY ROAD, BALDIVIS
LOCAL WATER MANAGEMENT STRATEGY

DRAINAGE CATCHMENT PLAN - 1 IN 1YR STORM EVENT

FIGURE 1

env Australia

DESIGN ASSUMPTIONS

1. WHERE SUBDIVISION LAYOUT NOT AVALIABLE IMPERVIOUS AREA EQUALS 25% OF TOTAL CATCHMENT AREA.

2. INFILTRATION AREA IS ESTIMATED AT 25% OF ALL
   - POS
   - ROAD / MEDIAN AREA WITHIN CATCHMENT
   - BELOW GROUND INFILTRATION NETWORK AREA

LEGEND

- GENERALISED DRAINAGE FLOW DIRECTION
- EXTENT OF SITE CATCHMENT BOUNDARY
- DRAINAGE SUB CATCHMENT BOUNDARY
- PROPOSED SURFACE CONTOUR
- PROPOSED PUBLIC OPEN SPACE
- PROPOSED BELOW GROUND INFILTRATION STORAGE
- DENOTES DRAINAGE INFILTRATION BASIN. SHAPE TO BE DETERMINED AT DETAIL DESIGN
- DENOTES 1 in 1 STORM TWL
- DENOTES 1 in 5 STORM TWL
- DENOTES 1 in 10 STORM TWL
- DENOTES 1 in 100 STORM TWL

AREAS AND STORAGE 1 IN 5 STORM

SWALE	CATCHMENT	IMPERVIOUS AREA	INFILTRATION RATE	SWALE AREA	STORM VOLUME
1	1.33 ha	1.20 ha	3.0m/DAY	691m^2	120m^3
2	1.89 ha	1.70 ha	3.0m/DAY	1232m^2	190m^3
3	2.17 ha	1.95 ha	3.0m/DAY	1000m^2	250m^3
4	1.73 ha	1.56 ha	3.0m/DAY	755m^2	180m^3
5	0.99 ha	0.89 ha	3.0m/DAY	573m^2	80m^3

BASIN	CATCHMENT AREA	IMPERVIOUS AREA	INFILTRATION RATE	BASIN AREA	STORM VOLUME
B1	3.77 ha	3.39 ha	3.0m/DAY	2085m^2	740m^3
B2	6.32 ha	5.69 ha	3.0m/DAY	2893m^2	1070m^3
B3	5.09 ha	4.58 ha	3.0m/DAY	1755m^2	1050m^3
B4	2.06 ha	1.85 ha	3.0m/DAY	1206m^2	430m^3
B5	2.75 ha	2.48 ha	3.0m/DAY	1673m^2	440m^3
B6	1.27 ha	1.14 ha	3.0m/DAY	1795m^2	140m^3
B7	1.89 ha	1.70 ha	3.0m/DAY	878m^2	270m^3
B8	1.10 ha	0.99 ha	3.0m/DAY	810m^2	130m^3
B9	3.43 ha	3.09 ha	3.0m/DAY	2112m^2	650m^3
B10	2.12 ha	1.91 ha	3.0m/DAY	961m^2	400m^3

SERLING CONSULTING
INNOVATIVE ENGINEERING SOLUTIONS
Serling Consulting (WA) Pty Ltd
ACN: 136 628 058
UNIT 210/396 SCARBOROUGH BEACH ROAD
OSBORNE PARK WA 6017
Telephone (08) 9202 8740
Facsimile (08) 9202 8749

0 25 50 75 100 125 150 metres
SCALE 1 : 2 500 (A3)
DATUM: AHD

09.078

PARKLAND HEIGHTS
LOT 1507 EIGHTY ROAD, BALDIVIS
LOCAL WATER MANAGEMENT STRATEGY

DRAINAGE CATCHMENT PLAN - 1 IN 5YR STORM EVENT

FIGURE 2

env Australia

DESIGN ASSUMPTIONS

1. WHERE SUBDIVISION LAYOUT NOT AVALIABLE IMPERVIOUS AREA EQUALS 25% OF TOTAL CATCHMENT AREA.

2. INFILTRATION AREA IS ESTIMATED AT 25% OF ALL
   - POS
   - ROAD / MEDIAN AREA WITHIN CATCHMENT
   - BELOW GROUND INFILTRATION NETWORK AREA

LEGEND

- GENERALISED DRAINAGE FLOW DIRECTION
- EXTENT OF SITE CATCHMENT BOUNDARY
- DRAINAGE SUB CATCHMENT BOUNDARY
- PROPOSED SURFACE CONTOUR
- PROPOSED PUBLIC OPEN SPACE
- PROPOSED BELOW GROUND INFILTRATION STORAGE
- DENOTES DRAINAGE INFILTRATION BASIN. SHAPE TO BE DETERMINED AT DETAIL DESIGN
- DENOTES 1 in 1 STORM TWL
- DENOTES 1 in 5 STORM TWL
- DENOTES 1 in 10 STORM TWL
- DENOTES 1 in 100 STORM TWL

AREAS AND STORAGE 1 IN 10 STORM

SWALE	CATCHMENT	IMPERVIOUS AREA	INFILTRATION RATE	SWALE AREA	STORM VOLUME
1	1.33 ha	1.20 ha	3.0m/DAY	737m^2	130m^3
2	1.89 ha	1.70 ha	3.0m/DAY	1335m^2	220m^3
3	2.17 ha	1.95 ha	3.0m/DAY	1060m^2	280m^3
4	1.73 ha	1.56 ha	3.0m/DAY	819m^2	210m^3
5	0.99 ha	0.89 ha	3.0m/DAY	607m^2	90m^3

BASIN	CATCHMENT AREA	IMPERVIOUS AREA	INFILTRATION RATE	BASIN AREA	STORM VOLUME
B1	3.77 ha	3.39 ha	3.0m/DAY	2159m^2	910m^3
B2	6.32 ha	5.69 ha	3.0m/DAY	2977m^2	1290m^3
B3	5.09 ha	4.58 ha	3.0m/DAY	1839m^2	1230m^3
B4	2.06 ha	1.85 ha	3.0m/DAY	1265m^2	530m^3
B5	2.75 ha	2.48 ha	3.0m/DAY	1759m^2	570m^3
B6	1.27 ha	1.14 ha	3.0m/DAY	1840m^2	230m^3
B7	1.89 ha	1.70 ha	3.0m/DAY	902m^2	320m^3
B8	1.10 ha	0.99 ha	3.0m/DAY	836m^2	170m^3
B9	3.43 ha	3.09 ha	3.0m/DAY	2180m^2	790m^3
B10	2.12 ha	1.91 ha	3.0m/DAY	1012m^2	480m^3

SERLING CONSULTING
INNOVATIVE ENGINEERING SOLUTIONS
Serling Consulting (WA) Pty Ltd
ACN: 136 628 058
UNIT 210/396 SCARBOROUGH BEACH ROAD
OSBORNE PARK WA 6017
Telephone (08) 9202 8740
Facsimile (08) 9202 8749

09.078

0 25 50 75 100 125 150 metres

SCALE 1 : 2 500 (A3)
DATUM: AHD

PARKLAND HEIGHTS
LOT 1507 EIGHTY ROAD, BALDIVIS
LOCAL WATER MANAGEMENT STRATEGY

DRAINAGE CATCHMENT PLAN - 1 IN 10YR STORM EVENT

FIGURE 3

env Australia

DESIGN ASSUMPTIONS

1. WHERE SUBDIVISION LAYOUT NOT AVALIABLE IMPERVIOUS AREA EQUALS 25% OF TOTAL CATCHMENT AREA.

2. INFILTRATION AREA IS ESTIMATED AT 25% OF ALL
   - POS
   - ROAD / MEDIAN AREA WITHIN CATCHMENT
   - BELOW GROUND INFILTRATION NETWORK AREA

LEGEND

- GENERALISED DRAINAGE FLOW DIRECTION
- EXTENT OF SITE CATCHMENT BOUNDARY
- DRAINAGE SUB CATCHMENT BOUNDARY
- PROPOSED SURFACE CONTOUR
- PROPOSED PUBLIC OPEN SPACE
- PROPOSED BELOW GROUND INFILTRATION STORAGE
- DENOTES DRAINAGE INFILTRATION BASIN. SHAPE TO BE DETERMINED AT DETAIL DESIGN
- DENOTES 1 in 1 STORM TWL
- DENOTES 1 in 5 STORM TWL
- DENOTES 1 in 10 STORM TWL
- DENOTES 1 in 100 STORM TWL

AREAS AND STORAGE 1 IN 100 STORM

SWALE	CATCHMENT	IMPERVIOUS AREA	INFILTRATION RATE	SWALE AREA	STORM VOLUME
1	1.33 ha	1.20 ha	3.0m/DAY	879m^2	180m^3
2	1.89 ha	1.70 ha	3.0m/DAY	1678m^2	310m^3
3	2.17 ha	1.95 ha	3.0m/DAY	1300m^2	400m^3
4	1.73 ha	1.56 ha	3.0m/DAY	1020m^2	300m^3
5	0.99 ha	0.89 ha	3.0m/DAY	711m^2	130m^3

BASIN	CATCHMENT AREA	IMPERVIOUS AREA	INFILTRATION RATE	BASIN AREA	STORM VOLUME
B1	3.77 ha	3.39 ha	3.0m/DAY	2495m^2	1700m^3
B2	6.32 ha	5.69 ha	3.0m/DAY	3365m^2	2350m^3
B3	5.09 ha	4.58 ha	3.0m/DAY	2227m^2	2100m^3
B4	2.06 ha	1.85 ha	3.0m/DAY	1546m^2	1050m^3
B5	2.75 ha	2.48 ha	3.0m/DAY	2095m^2	1180m^3
B6	1.27 ha	1.14 ha	3.0m/DAY	2119m^2	860m^3
B7	1.89 ha	1.70 ha	3.0m/DAY	935m^2	380m^3
B8	1.10 ha	0.99 ha	3.0m/DAY	942m^2	310m^3
B9	3.43 ha	3.09 ha	3.0m/DAY	2501m^2	1480m^3
B10	2.12 ha	1.91 ha	3.0m/DAY	1245m^2	820m^3

Serling Consulting (WA) Pty Ltd
ACN: 136 628 058
UNIT 210/396 SCARBOROUGH BEACH ROAD
OSBORNE PARK WA 6017
Telephone (08) 9202 8740
Facsimile (08) 9202 8749

0 25 50 75 100 125 150 metres

SCALE 1 : 2 500 (A3)
DATUM: AHD

09.078

PARKLAND HEIGHTS
LOT 1507 EIGHTY ROAD, BALDIVIS
LOCAL WATER MANAGEMENT STRATEGY

DRAINAGE CATCHMENT PLAN - 1 IN 100YR STORM EVENT

FIGURE 4

APPENDIX J
SEWER SERVICING OPTION

Serling Consulting (WA) Pty Ltd
Unit 210 Westpoint Centre
396 Scarborough Beach Road
Osborne Park WA 6017 Australia

Tel: +61 8 9202 8740
Fax: +61 8 92028749
Email: admin@serling.coau
Web: www.serlingconsulting.com.au

Mr John Giacchetta
Development Services Branch
Water Corporation
PO Box 100
LEEDERVILLE, WA 6902

L01 WdT WaterCorporation WWPS options 110203
SC00102.011

3 February 2011

Dear John,

LOT 1507: BALDIVIS SOUTH WWPS K
WAPC No.: 143012 / 139379

WWPS Pressure Main Options Evaluation

Following a number of meetings towards the end of last year, we would like to confirm the status of our assessment for the proposed Type 40 Wastewater Pumping Station (WWPS) requirements and investigation of the proposed options for the temporary pressure main discharge path and location.

Background

Serling Consulting (WA) Pty Ltd (Serling) has used current Water Corporation Sewer planning and current development structure plan for the project to investigate options for the WWPS and pressure main.

The WWPS is a Type 40 permanent station with catchment as discussed below. It will be located on the eastern side of Eighty Road next to a future POS area.

Previous meetings confirmed that the pressure main options for this WWPS are all temporary and our assessment indicates that there are significant hydraulic, operations and construction cost differences between the possible options.We have evaluated these options for comments and direction before we can finalise the actual pumping station report. Pump duties and details for example will vary significantly depending on the option taken.

This options evaluation includes detail calculations for every option and these will be discussed in the following sections.

Catchment Plan

The catchment plan is attached as Annexure 1, Plan 1-1.

Calculations for the temporary pressure main have been based on an initial gross catchment area of 38 ha (19.1 + 4.75 + 14.7) which will cover the first 4 – 5 stages of the proposed Parkland Heights development (equal to at least 4 – 5 years construction timeframe depending on the number of lots developed per year) and it also includes the existing aged care group housing site , that is currently is discharging into AC 5638 via a private pressure main.

The 38 ha is about 30% of the ultimate catchment area for this WWPS.

WWPS Site Layout

The proposed pumping station is located within a future POS, south of stage 1, with the access road to the station being constructed off a future internal road within the development. The attached site plan,see Annexure 2, demonstrates the turning movement and site boundary required to cater for the Type 40 arrangement and 3hours of emergency storage pipe network.

The total area of the pump station site is approximately 40.5m x 22.5m and consideration for a combination of lot & easement boundaries are being reviewed.

Option A: Discharge into existing AC 5638 in Eighty Road – Preferred

Plan 1-2 showing the proposed layout and long section, as well as detail calculations, are included in Annexure 3.

This option will result in cutting into the existing 70mm private sewer pressure main in Eighty Road and redirect into a new discharge that gravity feeds into the proposed WWPS. The proposed pressure main from the pump station will then be installed along Eighty Road (915m) to discharge into the existing discharge chamber AC 5638 with the pipework between AC5638 & AB4398 to be upgraded to DN225. Key issues to note about this option are the following: (Refer to the calculation table in Annexure 3 for details)

1. In principle it will increase an existing discharge arrangement currently with the private pumping station from existing pumping rate of 3 l/sec to 11 l/sec (approximately peak flow of 8.3l/s)
2. Minimum temporary infrastructure required.
3. Much lower pump head requirements when compared to the other options, resulting in a more efficient and lower maintenance pump system.
4. Pressure main can be 100P-12 and further reduction in Duty Head Required if approval to use PE pipe. (Refer calculations for both the PVC and PE options in Annexure 3)
5. Construction along existing road reserve within the design parameters of 1.0m to 2.5m cover as specified in the Manual.
6. Redirects existing private station flows into the ultimate pumping station minimising future works in upgrades.

Option B: Discharge into existing pressure main at existing AC 5694

Plan 1-3 showing the proposed layout and long section, as well as detail calculations, are included in Annexure 4.

For this option, sewer will be pumped from the proposed pumping station through a 1,360m pressure main to an existing Water Corporation pressure main in the Nairn Drive area that discharges into existing access chamber AB5694. The pumping system will have to be synchronised with the Cottonwood Drive temporary pumping station. Key issues to note about this option are the following: (Refer to the calculation table in Annexure 4 for details)

1. Pump head requirements are relatively high as a result of the static head requirements.
2. Most of the route not subdivided or earthworked, so risk with alignment and levels. Excavations of over 6.0m for a pressure main to accommodate the ultimate future design levels.
3. A 150mm pressure main is required to reduce the pump head requirements and the minimum pumping rate required is 15l/s to provide the minimum velocity acceptable.
4. Due to the higher pumping rate and the low initial expected peak flows from the catchment, septic sewer is likely to occur within the station and the pressure main not being turned sufficiently.

Option C: Discharge into existing AC5237 – DN300 gravity main

Plan 1-4 showing the proposed layout, as well as detail calculations, are included in Annexure 5.

This option is along the same route as Option B, but discharges 2,150m from the pumping station into an existing DN300 (AC 5237) gravity main. Key issues to note about this option are the following: (Also refer to the calculation table in Annexure 5).

1. Pump head requirements are relatively high as a result of the static head requirements.
2. Most of the route not subdivided or earthworked, so risk with alignment and levels. Excavations of over 6.0m for a pressure main to accommodate the ultimate future design levels.
3. The pressure main & gravity main route also crosses unplanned private land with uncertainty about approvals and conditions or finished surface levels.
4. A significant section is along an existing, recently constructed road, which will require to be bored in order to not impact on the road and footpaths.
5. A 150mm pressure main is required to reduce the pump head requirements, and the minimum pumping rate required is 15l/s to provide the minimum velocity acceptable.
6. This option involves the construction of over 2km of temporary sewer pressure main and 350m of DN225 gravity main installed at steep grades (approximately 1 in 20) in order to connect into the existing DN300 invert levels.
7. Due to the higher **pumping** rate and the low initial expected peak flows from the catchment, septic sewer is likely to occur within the station and the pressure main not being turned sufficiently

Further important issues are the following:

- The Developer will install the permanent rising main as stages develop, so there will be no issue with installation of sewer in new subdivision areas.
- Should the temporary system down Eighty Road be used (Option A) and in the event that the permanent pumping outlet to the East along Sixty Eight Road is not avaliablewhen the temporary system reaches capacity, there is still the option to construct Options B or C with less risk, as the road reserves and levels will be established by that time.

Based on the comparison of options, we propose to use Option A as the most efficient and cost effective solution when considering maintenance and capital cost. It also provides flexibility should the permanent solution not be in place 5 or more years in the future. It will be appreciated if Water Corporation can investigate the downstream capacities and alternatives for Option A.

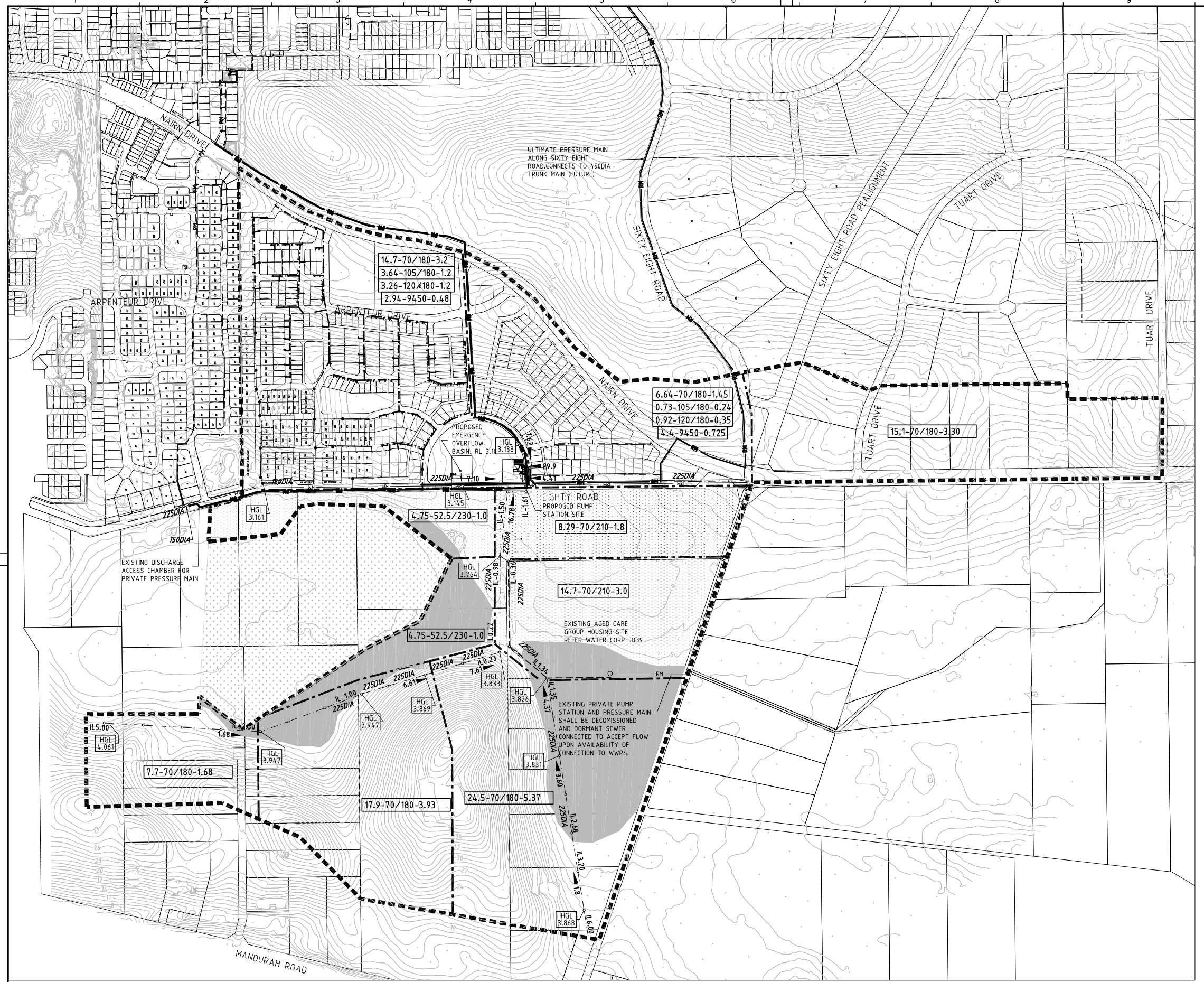
Your earliest attention to this application would be appreciated. Should you have any queries, please contact the undersigned.

Yours sincerely

WILLEM DU TOIT
Executive Engineer
Phone: 08 9202 8743
Fax: 08 9202 8701
Mobile: 0438 966 086
E-mail: wdutoit@serling.com.au

ANNEXURE 1

Catchment Plan



1 100 50 0 100 200 300 350m

(HORIZONTAL SCALE 1:5000 - A1 SHEET)

NOTES

1. LOCAL AUTHORITY : CITY OF ROCKINGHAM
2. ESTIMATED GROUND WATER LEVEL: REFER AAMGL CONTOURS
3. THIS RETICULATION AREA IS CLASSIFIED 'WET & DRY' IN ACCORDANCE WITH THE WATER CORPORATION WASTEWATER MANUAL VOL. 1 UNLESS NOTED OTHERWISE.
4. EXISTING SURFACE LEVELS DETERMINED FROM MAPS AERIAL AND GROUND SURVEYS.
5. ALL PIPE SIZES IN MILLIMETRES (DIA 150 U.N.O.). ALL DISTANCES AND LEVELS IN METRES.
6. CADASTRAL BOUNDARIES DERIVED FROM MAPS PRECAL, EXISTING BOUNDARIES AND PLANNERS INFORMATION WHICH MAY BE SUBJECT TO FURTHER CHANGES.

DESIGN DATA NOTATION

RESIDENTIAL

NET AREA (Ha) — FLOW LITRES/PERSON/DAY

1.120 - 52.5 / 180 - 0.170

PERSONS PER NET HECTARE — PEAK FLOW (L/s)

NON RESIDENTIAL

NET AREA (Ha) — PEAK FLOW (L/s)

0.850 - 14976 - 0.220

FLOW LITRES/NET HECTARE/DAY

LEGEND

- PROPOSED GRAVITY SEWER AND ACCESS CHAMBERS
- EXISTING GRAVITY SEWER AND ACCESS CHAMBERS
- FUTURE GRAVITY SEWER AND ACCESS CHAMBERS
- RM — EXISTING PRIVATE PRESSURE MAIN
- PM — PROPOSED DN200 PRESSURE MAIN
- RETICULATION AREA BOUNDARY
- CATCHMENT AREA BOUNDARY
- 1.78 — FLOW IN LITRES PER SECOND
- AREA CLASSIFIED AS 'WET'
- FILL REQUIRED TO MIN RL 4.5
- RECREATION/WETLAND AREA , NOT INCLUDED IN CATCHMENT CALCULATIONS
- GW 21.5 — GROUND WATER CONTOURS
- HGL 99.99 — RL OF CRITICAL ROUTE LOCATION OF THE EMERGENCY OVERFLOW HYDRAULIC GRADE LINE (HGL)

PARAMETER	INITIAL	ULTIMATE
GROSS CATCHMENT AREA:	39.2	134.9
MAXIMUM INFLOW TO PUMPING STATION:	6.1	29.9
EXTERNAL CATCHMENTS (PEAK):	3	..
PUMPING RATE REQUIRED	11.1	39.77
DESIGN PUMPS OPERATIONAL PUMPING FLOW	.	.
STORAGE VOLUME OF WET WELL BETWEEN CUT OUT–AT LEVEL (R.L.–4.05) AND ULTIMATE DUTY CUT–IN LEVEL (R.L.–2.25)	CUT–IN RL –3.55 2000	CUT–IN RL –2.25 7158
TOTAL 3HR STORAGE VOLUME REQUIRED	98.280m³	322.920m³
TOTAL STORAGE VOLUME IN THE SYSTEM (PIPEWORK, ACCESS CHAMBERS, MAINTENANCE SHAFTS & WET WELL)	46.129m³	111.948m³
TOTAL STORAGE VOLUME IN THE STORAGE TANKS.	55.881m³ Therefore we require 9 tanks.	223.526m³ Therefore we require 36 tanks.
STORAGE TIME IN SEWERAGE SYSTEM AT ULTIMATE GRAVITY SEWER DESIGN CONDITIONING BETWEEN HIGH LEVEL ALARM LEVEL AND INVERT LEVEL (R.L. 3.10) OF EMERGENCY OVERFLOW PIPE (OVERFLOW TO ENVIRONMENT)	HIGH LEVEL ALARM LEVEL RL –3.25 3.1 hrs	HIGH LEVEL ALARM LEVEL RL –1.95 3.1 hrs

SC - REVISION RECORD — SC DRG No. WC090004-PS-1-2

No	DATE	DRAFTING CHECK	DESIGN REVIEW	REV'D P.MGR	APP'D P.DIR	AMENDMENT
A1						

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD

SURVEY BOOKS: NONE

VERTICAL DATUM AHD	DES CALC P.ALEBAKIS
COORDINATE SYS MGA94–50	DES CHD N.SHAH
DES REF	DRN S.MEWS
	Q.C. CHD N.SHAH

NORTH POINT

SERLING CONSULTING — INNOVATIVE ENGINEERING SOLUTIONS

Serling Consulting (WA) Pty Ltd
ACN: 136 628 058
UNIT 210/396 SCARBOROUGH BEACH ROAD
OSBORNE PARK WA 6017
Telephone (08) 9202 8740
Facsimile (08) 9202 8749

RECOMMENDED
CONSULTANT PROJECT MANAGER
APPROVED
CONSULTANT PROJECT DIRECTOR

WATER CORPORATION

METROPOLITAN WASTEWATER – WAPC .
BALDIVIS SOUTH PUMPING STATION "K"
DESIGN DATA AND CATCHMENT PLAN

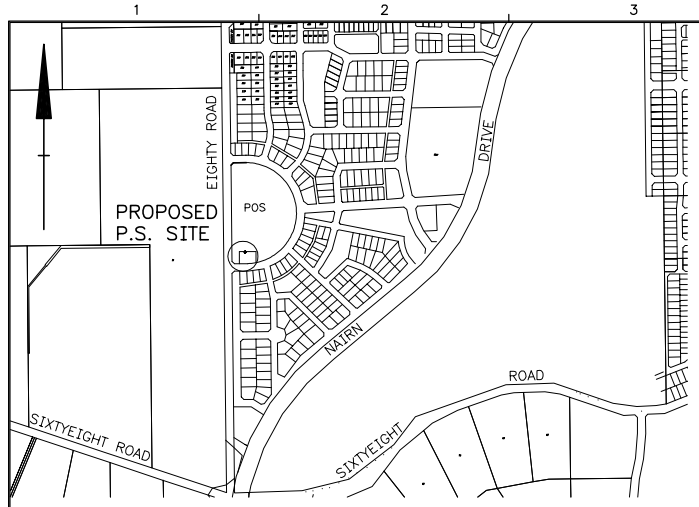
FILE . | PROJECT . | PLAN 1–1 | CAD | ISSUE A

ORIGINAL SHEET SIZE A1 MF

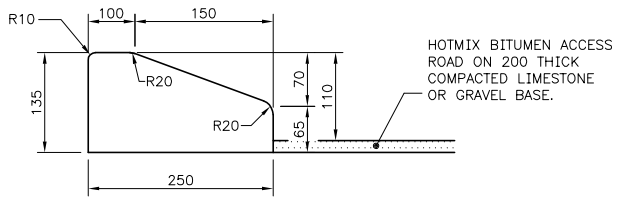
566 810

ANNEXURE 2

Preliminary Site Plan



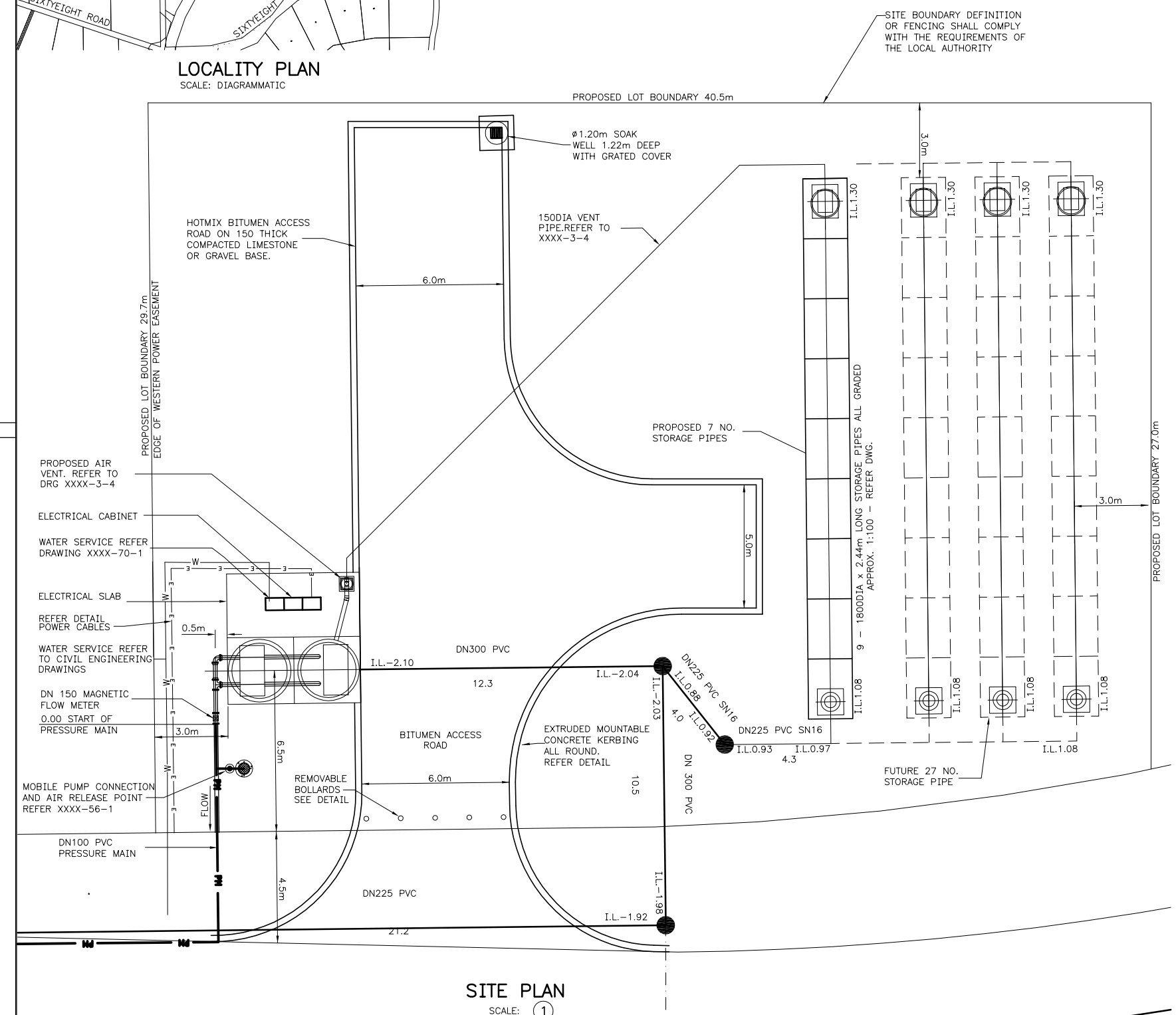
LOCALITY PLAN
SCALE: DIAGRAMMATIC



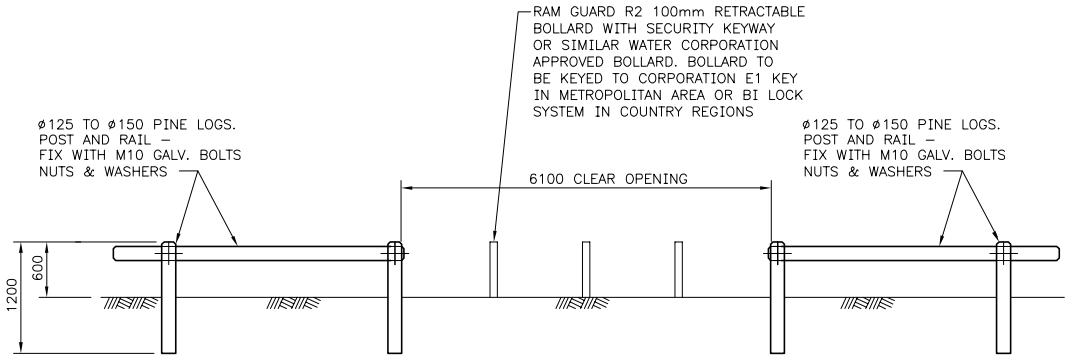
KERB DETAIL
SCALE: (2)

CAUTION:

COMMUNICATION–	CABLES MAY HAVE BEEN RECENTLY INSTALLED. PHONE *'Input'* FOR ON SITE LOCATION.
POWER–	EXISTING POWER SERVICES MAY BE AFFECTED ON *'Input'* SIDE OF *'Input'* AVE./ST./RD. CONTACT *'Input'* ON *'Input'* PRIOR TO WORK COMMENCEMENT.
GAS–	EXISTING GAS SERVICES MAY BE AFFECTED ON *'Input'* SIDE OF *'Input'* AVE./ST./RD. CONTACT *'Input'* ON *'Input'* PRIOR TO WORK COMMENCEMENT.



SITE PLAN
SCALE: (1)



RETRACTABLE BOLLARDS AND PINE POST AND RAIL BARRIER
SCALE: DIAGRAMMATIC

GENERAL NOTES
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS SHOWN OTHERWISE.
2. SIGNAGE TO BE PROVIDED ACORDINGTO SECTION 4 CLAUSE 4.4.9 OF THE WASTEWATER STANDARD DS 51. SIGNAGE TO BE ATTACHED TO R.P.Z BACKFLOW PREVENTION CABINET UNLESS IT CANNOT BE VIEWED FROM ROAD. IN THIS CASE IT SHOULD BE ATTACHED TO THE MOST APPROPRIATE CABINET.

LEGEND
WATER CORPORATION FREEHOLD LAND OR RESERVE SHOWN:

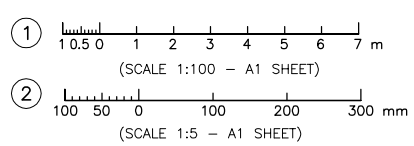
Pumping Station Site Area, Location And Arangements For Title Transfer To Water Corporation Shall Be Subject To Agreement Prior To Commencement Of Detailed Design Work

EXISTING SURFACE LEVEL SHOWN 9.99

PROPOSED SURFACE LEVEL SHOWN 99.99

REFERENCE DRAWINGS
Example Drawing List Only – Modify to Suit Pump Station Type.

EMERGENCY STORAGE TANK DETAILS	XXXX–5–1
EMERGENCY OVERFLOW DETAILS	XXXX–5–3
GENERAL ARRANGEMENT NO.S 1 & 2	XXXX–10–1,2
STRUCTURAL DETAILS – PRECAST COMPONENTS	XXXX–10–5
PRECAST SLABS AND COVERS	XXXX–10–6
ELECTRICAL SLAB DETAILS	XXXX–10–7
VALVE, CONTROL AND ALARM HOLE COVERS	XXXX–10–9
MISCELLANEOUS STEEL FABRICATION DETAILS	XXXX–10–10
LADDER, PUMP RAIL & PIPE SUPPORT DETAIL – WET WELL	XXXX–10–11
LIFTING CHAIN HOOK, VALVE PIT DRAIN	
INLET PIPE & LANYARD DETAILS	XXXX–10–12
RPZ BACKFLOW PREVENTION DEVICE	XXXX–70–1



ISSUE	DATE	GRID	REVISION	DRN	REC	APPD

SURVEY BOOKS

VERTICAL DATUM AHD	DES CALC P. ALEBAKIS
COORDINATE SYS NONE	DES CHD N/A
DES REF N/A	DRN S.MEWS
	Q.C. CHD P.R.M.

NORTH POINT

SERLING CONSULTING INNOVATIVE ENGINEERING SOLUTIONS

Serling Consulting (WA) Pty Ltd
ACN: 136 628 058
UNIT 210/396 SCARBOROUGH BEACH ROAD
OSBORNE PARK WA 6017
Telephone (08) 9202 8740
Facsimile (08) 9202 8749

RECOMMENDED

SUPERVISING ENGINEER

APPROVED

MANAGER I.D. BRANCH

WATER CORPORATION

WASTEWATER – EXAMPLE DRAWING
BALDIVIS SOUTH PUMPING STATION K EIGHTY ROAD
TYPE 40 PUMPING STATION – WITH VALVE PIT
SITE PLAN

ORIGINAL SHEET SIZE A1

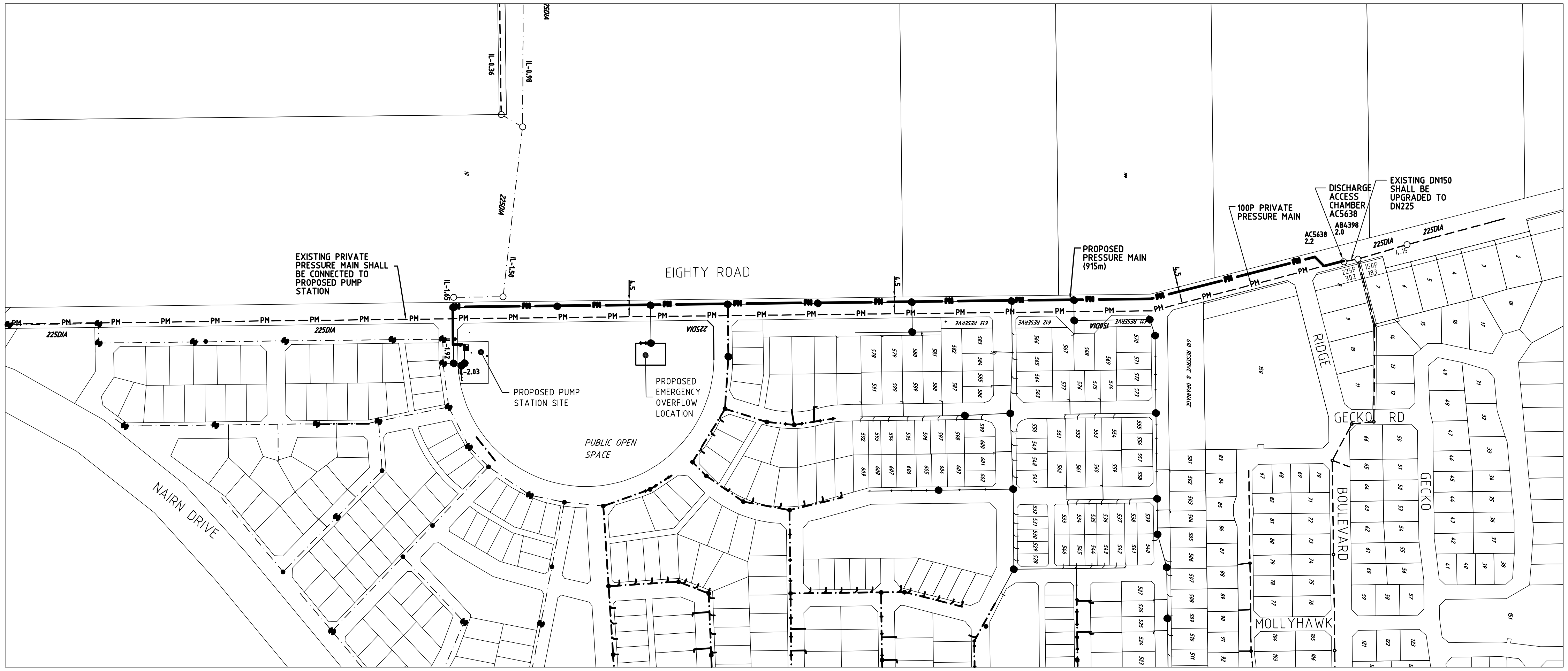
FILE	'Input'	PLAN	CAD	ISSUE
PROJECT	'Input'	–3–1	C	MF

566
810

WWCS\MANUALS\STANDARD DRAWINGS\PUMP STATIONS\DRAFT – PROGRESSING\XXXX00300101C 15:33 04/12/2003 schneiw0/WS11260

ANNEXURE 3

Option A Layout and calculations



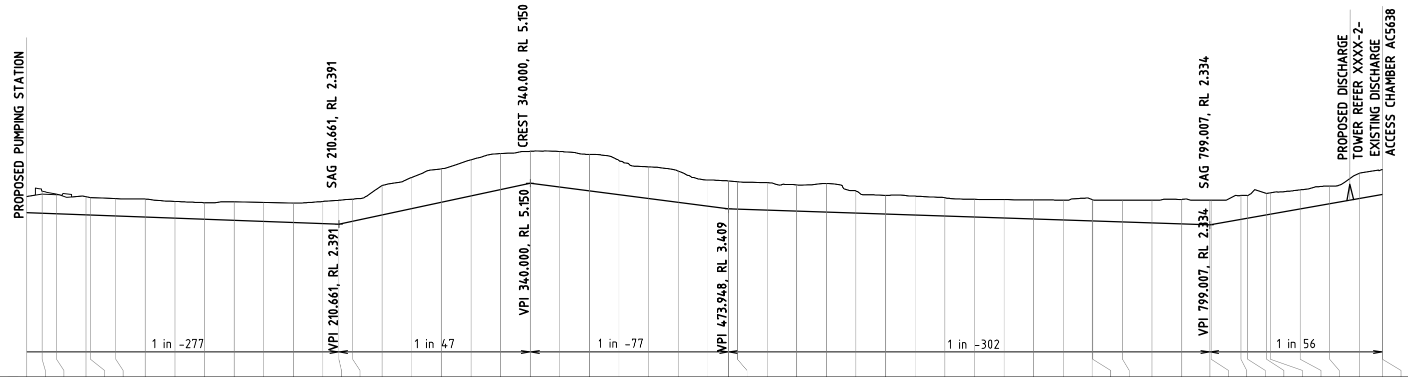
SITE PLAN

NOTES

1. LOCAL AUTHORITY : CITY OF ROCKINGHAM
2. ESTIMATED GROUND WATER LEVEL: REFER AAMGL CONTOURS
3. THIS RETICULATION AREA IS CLASSIFIED 'WET & DRY' IN ACCORDANCE WITH THE WATER CORPORATION WASTEWATER MANUAL VOL. 1 UNLESS NOTED OTHERWISE.
4. EXISTING SURFACE LEVELS DETERMINED FROM MAPS AERIAL AND GROUND SURVEYS.
5. ALL PIPE SIZES IN MILLIMETRES (DIA 150 U.N.O.). ALL DISTANCES AND LEVELS IN METRES.
6. CADASTRAL BOUNDARIES DERIVED FROM MAPS PRECAL, EXISTING BOUNDARIES AND PLANNERS INFORMATION WHICH MAY BE SUBJECT TO FURTHER CHANGES.

LEGEND

- PROPOSED GRAVITY SEWER AND ACCESS CHAMBERS
- EXISTING GRAVITY SEWER AND ACCESS CHAMBERS
- FUTURE GRAVITY SEWER AND ACCESS CHAMBERS
- EXISTING PRIVATE PRESSURE MAIN
- PROPOSED PRESSURE MAIN
- GROUND WATER CONTOURS (GW 21.5)



PIPE GRADE
DATUM R.L. -8.0

PRESSURE MAIN CHAINAGE	PRESSURE MAIN PIPE INVERT	DEPTH TO PIPE INVERT	FINISHED SURFACE LEVEL
0.000	3.150	-1.098	4.249
10.232	3.114	-1.492	4.605
20.000	3.078	-1.331	4.409
40.000	3.006	-1.236	4.242
43.029	2.995	-1.184	4.179
60.000	2.934	-1.177	4.111
80.000	2.862	-1.217	4.079
100.000	2.790	-1.126	3.915
120.000	2.718	-1.119	3.837
140.000	2.646	-1.243	3.889
160.000	2.574	-1.271	3.844
180.000	2.502	-1.299	3.800
200.000	2.429	-1.490	3.919
210.661	2.391	-1.603	3.994
220.000	2.590	-1.472	4.062
240.000	3.017	-1.985	5.002
260.000	3.443	-2.102	5.545
280.000	3.870	-2.251	6.121
300.000	4.297	-2.434	6.731
320.000	4.723	-2.434	7.157
340.000	5.150	-2.152	7.302
360.000	4.890	-2.403	7.293
380.000	4.630	-2.468	7.098
400.000	4.370	-2.304	6.674
420.000	4.110	-2.148	6.259
440.000	3.850	-2.121	5.971
460.000	3.590	-1.779	5.369
473.948	3.409	-1.895	5.304
480.000	3.389	-1.858	5.247
500.000	3.323	-1.865	5.188
520.000	3.257	-1.778	5.035
540.000	3.191	-1.934	5.125
560.000	3.125	-1.501	4.625
580.000	3.058	-1.268	4.326
600.000	2.992	-1.283	4.275
620.000	2.926	-1.251	4.177
640.000	2.860	-1.199	4.059
660.000	2.794	-1.251	4.045
680.000	2.728	-1.290	4.018
700.000	2.662	-1.338	4.000
719.526	2.597	-1.450	4.047
720.000	2.596	-1.433	4.028
740.000	2.529	-1.471	4.000
760.000	2.463	-1.537	4.000
780.000	2.397	-1.659	4.056
799.007	2.334	-1.666	4.000
800.000	2.352	-1.648	4.000
820.000	2.706	-1.610	4.316
824.526	2.786	-1.527	4.314
837.357	3.013	-1.453	4.467
840.000	3.060	-1.443	4.503
860.000	3.414	-1.289	4.704
880.000	3.769	-1.181	4.950
900.000	4.123	-1.695	5.818
915.650	4.400	-1.675	6.075
915.652			6.075

PRESSURE MAIN PROFILE - OPTION A

SCALE HORIZ 1 : 2500 metres
VERT 1 : 250 metres

(1) 50 25 0 50 100 150 175m
(HORIZONTAL SCALE 1:2500 - A1 SHEET)

SC - REVISION RECORD SC DRG No. WC090004-PS-1-2

No	DATE	DRAFTING CHECK	DESIGN REVIEW	REV'D P.MGR	APP'D P.DIR	AMENDMENT
A1						

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD

SURVEY BOOKS: NONE
VERTICAL DATUM: AHD
COORDINATE SYS: MGA94-50
DES REF
DES CALC: P.ALEBAKIS
DES CHD: N.SHAH
DRN: S.MEWS
Q.C. CHD: N.SHAH
NORTH POINT

SERLING CONSULTING
INNOVATIVE ENGINEERING SOLUTIONS

Serling Consulting (WA) Pty Ltd
ACN: 136 628 058
UNIT 210/396 SCARBOROUGH BEACH ROAD
OSBORNE PARK WA 6017
Telephone (08) 9202 8740
Facsimile (08) 9202 8749

RECOMMENDED
CONSULTANT PROJECT MANAGER
APPROVED
CONSULTANT PROJECT DIRECTOR

WATER CORPORATION

METROPOLITAN WASTEWATER - WAPC .
BALDIVIS SOUTH PUMPING STATION "K"
PRELIMINARY PRESSURE MAIN ALIGNMENT - OPTION A

FILE .
PROJECT .
PLAN 1-2
CAD
ISSUE A
ORIGINAL SHEET SIZE A1
MF

566
810

Option A - Eighty Road Existing AC 5638 - PVC Pressure Main

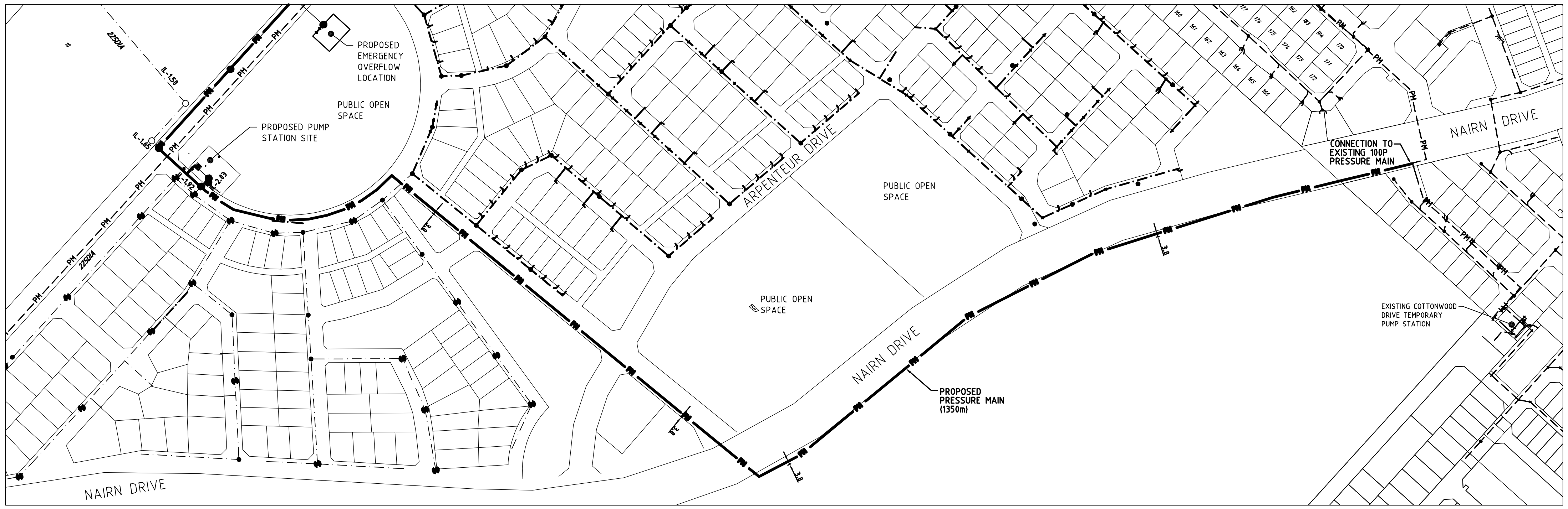
		Initial	*Ultimate*	
Max PUMP HEAD		**29.8**	**44.5**	**m**
PIPE DIAMETER		**100**	**225**	**mm**
Friction Head		***20.0***	***11.4***	**m**
Pumping Rate		11.1	39.8	L/s
Start of Pressure Main Level		3.15	3.15	RL
Internal Pump Station Pipework Diameter		200	200	mm
Internal Pump Station Pipework Length		62	62	m
Internal Pump Equivalent length Factor		0.0	2.5	
Pressure Main Nominal Diameter		100	225	mm
• Pipe Class to AS1477		12	12	
• Pipe Internal Diameter		108.5	233.7	mm
• Pipe Length Actual		915	2200	m
• Pipe Velocity		1.20	0.93	m/s
Equivalent Length		915.0	2354.4	m
Colebrook-White k =	0.6 , f	0.0322	0.0259	
Hydraulic Gradient		0.022	0.005	m/m
Max Static Head		***9.8***	***33.1***	m
Min Static Head		***2.6***	***25.9***	m
Pump Duty Cut-out Level		-4.05	-4.05	RL
IL Discharge / Pressure Main Highest Point		5.65	29.00	RL
Emergency Overflow Level		3.10	3.10	RL

Option A - Eighty Road Existing AC 5638 - PE Pressure Main

		PE140	*PE160*	
Max PUMP HEAD		**22.9**	**16.3**	**m**
PIPE DIAMETER		**140**	**160**	**mm**
Friction Head		***13.1***	***6.5***	**m**
Pumping Rate		11.1	11.1	L/s
Start of Pressure Main Level		3.15	3.15	RL
Internal Pump Station Pipework Diameter		200	200	mm
Internal Pump Station Pipework Length		62	62	m
Internal Pump Equivalent length Factor		1.0	1.0	
Pressure Main Nominal Diameter		140	160	mm
• Pipe Class		12.5	12.5	
• Pipe Internal Diameter		119	136	mm
• Pipe Length Actual		915	915	m
• Pipe Velocity		1.00	0.77	m/s
Equivalent Length		976.8	976.8	m
Colebrook-White k =	0.6 , f	0.0315	0.0305	
Hydraulic Gradient		0.013	0.007	m/m
Max Static Head		***9.8***	***9.8***	m
Min Static Head		***2.6***	***2.6***	m
Pump Duty Cut-out Level		-4.05	-4.05	RL
IL Discharge / Pressure Main Highest Point		5.65	5.65	RL
Emergency Overflow Level		3.10	3.10	RL

ANNEXURE 4

Option B Layout and calculations



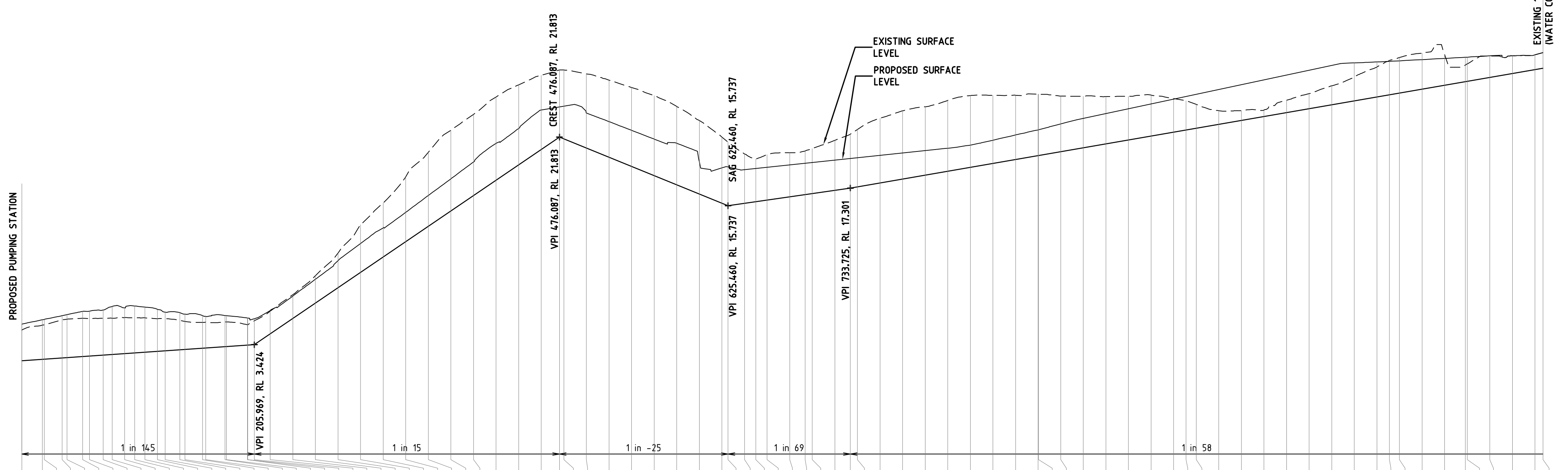
SITE PLAN
SCALE 1:2500

NOTES

1. LOCAL AUTHORITY : CITY OF ROCKINGHAM
2. ESTIMATED GROUND WATER LEVEL: REFER AAMGL CONTOURS
3. THIS RETICULATION AREA IS CLASSIFIED 'WET & DRY' IN ACCORDANCE WITH THE WATER CORPORATION WASTEWATER MANUAL VOL. 1 UNLESS NOTED OTHERWISE.
4. EXISTING SURFACE LEVELS DETERMINED FROM MAPS AERIAL AND GROUND SURVEYS.
5. ALL PIPE SIZES IN MILLIMETRES (DIA 150 U.N.O.). ALL DISTANCES AND LEVELS IN METRES.
6. CADASTRAL BOUNDARIES DERIVED FROM MAPS PRECAL, EXISTING BOUNDARIES AND PLANNERS INFORMATION WHICH MAY BE SUBJECT TO FURTHER CHANGES.

LEGEND

- PROPOSED GRAVITY SEWER AND ACCESS CHAMBERS
- EXISTING GRAVITY SEWER AND ACCESS CHAMBERS
- FUTURE GRAVITY SEWER AND ACCESS CHAMBERS
- EXISTING PRIVATE PRESSURE MAIN
- PROPOSED PRESSURE MAIN
- GROUND WATER CONTOURS (GW 21.5)



PIPE GRADE
DATUM R.L. -8.0

PRESSURE MAIN CHAINAGE	PRESSURE MAIN PIPE INVERT	DEPTH TO PIPE INVERT	FINISHED SURFACE LEVEL
0.000	2.000	-3.242	5.242
18.180	2.126	-3.505	5.631
20.000	2.138	-3.532	5.671
35.788	2.247	-3.752	6.000
40.000	2.277	-3.816	6.092
53.949	2.373	-4.007	6.380
60.000	2.415	-3.990	6.405
71.988	2.498	-4.005	6.503
80.000	2.553	-4.262	6.815
91.058	2.630	-4.058	6.688
100.000	2.692	-4.164	6.856
109.050	2.754	-4.001	6.755
120.000	2.830	-3.730	6.560
126.956	2.878	-3.434	6.312
140.000	2.968	-3.292	6.260
144.598	3.000	-3.127	6.127
160.000	3.106	-2.900	6.006
162.796	3.126	-2.810	5.936
180.000	3.245	-2.768	6.013
181.153	3.253	-2.747	6.000
199.947	3.383	-2.419	5.802
200.000	3.383	-2.417	5.800
205.969	3.424	-2.301	5.726
220.000	4.380	-2.084	6.464
240.000	5.741	-1.996	7.737
260.000	7.103	-2.118	9.220
280.000	8.464	-2.405	10.869
300.000	9.826	-2.563	12.388
320.000	11.187	-2.584	13.771
340.000	12.549	-2.606	15.155
360.000	13.910	-2.727	16.638
380.000	15.272	-2.849	18.121
400.000	16.634	-2.970	19.604
420.000	17.995	-3.251	21.246
440.000	19.357	-3.221	22.577
460.000	20.718	-2.580	23.298
476.087	21.813	2.187	19.626
480.000	21.654	-0.412	22.066
500.000	20.841	-3.110	23.951
520.000	20.027	-3.153	23.181
540.000	19.214	-3.196	22.410
560.000	18.400	-3.240	21.640
580.000	17.586	-3.678	21.265
600.000	16.773	-2.837	19.610
620.000	15.959	-3.134	19.094
625.460	15.737	-3.427	19.164
640.000	15.947	-3.166	19.114
649.922	16.090	-3.774	19.864
660.000	16.236	-4.013	20.249
680.000	16.525	-3.906	20.431
693.637	16.722	-3.865	20.587
700.000	16.814	-3.983	20.797
720.000	17.102	-4.426	21.528
733.725	17.301	-4.774	22.075
740.000	17.409	-5.076	22.485
760.000	17.756	-5.721	23.476
780.000	18.102	-6.035	24.137
800.000	18.448	-6.051	24.499
820.000	18.794	-2.030	20.824
840.000	19.141	-1.968	21.109
860.000	19.487	-2.049	21.536
880.000	19.833	-2.167	22.000
900.000	20.179	-2.270	22.449
900.434	20.187	-2.272	22.459
920.000	20.526	-2.448	22.974
940.000	20.872	-4.560	25.432
960.000	21.218	-4.185	25.404
980.000	21.565	-3.863	25.427
1000.000	21.911	-3.620	25.530
1020.000	22.257	-2.967	25.224
1030.904	22.446	-2.587	25.033
1040.000	22.603	-2.107	24.710
1060.000	22.950	-1.208	24.157
1080.000	23.296	-0.862	24.158
1100.000	23.642	-0.559	24.201
1120.000	23.988	-1.091	25.080
1140.000	24.335	-1.328	25.663
1160.000	24.681	-1.672	26.353
1180.000	25.027	-3.354	28.382
1200.000	25.373	-3.092	28.466
1211.207	25.568	-2.946	28.513
1220.000	25.720	-2.842	28.562
1240.000	26.066	-2.606	28.672
1260.000	26.412	-2.370	28.782
1278.286	26.729	-2.154	28.883
1280.000	26.759	-2.134	28.893
1300.000	27.105	-1.900	29.005
1320.000	27.451	-1.556	29.007
1340.000	27.797	-1.293	29.090
1347.084	27.920	-1.380	29.300

PRESSURE MAIN PROFILE - OPTION B
SCALE HORIZ 1 : 2500 metres
VERT 1 : 250 metres

(1) 50 25 0 50 100 150 175m
(HORIZONTAL SCALE 1:2500 - A1 SHEET)

SC - REVISION RECORD | SC DRG No. WC090004-PS-1-2

No	DATE	DRAFTING CHECK	DESIGN REVIEW	REV'D P.MGR	APP'D P.DIR	AMENDMENT
A1						

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD

SURVEY BOOKS: NONE
VERTICAL DATUM: AHD
COORDINATE SYS: MGA94-50
DES REF
DES CALC: P.ALEBAKIS
DES CHD: N.SHAH
DRN: S.MEWS
Q.C. CHD: N.SHAH
NORTH POINT

SERLING CONSULTING
INNOVATIVE ENGINEERING SOLUTIONS
Serling Consulting (WA) Pty Ltd
ACN: 136 628 058
UNIT 210/396 SCARBOROUGH BEACH ROAD
OSBORNE PARK WA 6017
Telephone (08) 9202 8740
Facsimile (08) 9202 8749

RECOMMENDED
CONSULTANT PROJECT MANAGER
APPROVED
CONSULTANT PROJECT DIRECTOR

WATER CORPORATION

METROPOLITAN WASTEWATER - WAPC . BALDIVIS SOUTH PUMPING STATION "K" PRELIMINARY PRESSURE MAIN ALIGNMENT - OPTION B

FILE . | PLAN 1-3 | CAD | ISSUE A | ORIGINAL SHEET SIZE A1
PROJECT . | MF

566
810

Option B - Discharge into existing PM & Existing AB5694

		Initial	*Ultimate*	
Max PUMP HEAD		**59.1**	**44.5**	**m**
PIPE DIAMETER		**150**	**225**	**mm**
Friction Head		***20.0***	***11.4***	**m**
Pumping Rate % Ratio			100.00%	
Pumping Rate		15.1	39.8	L/s
Start of Pressure Main Level		3.15	3.15	RL
Internal Pump Station Pipework Diameter		200	200	mm
Internal Pump Station Pipework Length		62	62	m
Internal Pump Equivalent length Factor		1.0	2.5	
Pressure Main Nominal Diameter		150	225	mm
• Pipe Class to AS1477		12	12	
• Pipe Internal Diameter		158	234	mm
• Pipe Length Actual		1360	2200	m
• Pipe Velocity		0.77	0.93	m/s
Equivalent Length		1421.8	2354.4	m
Colebrook-White k =	0.6 , f	0.0291	0.0259	
Hydraulic Gradient		0.006	0.005	m/m
Pressure Main Nominal Diameter - Existing		100		mm
• Pipe Class to AS1477		12		
• Pipe Internal Diameter		108.5		mm
• Pipe Length Actual		300		m
• Pipe Velocity		1.63		m/s
Colebrook-White k =	0.6 , f	0.0320		
Hydraulic Gradient		0.040		m/m
Max Static Head		***39.1***	***33.1***	m
Min Static Head		***31.9***	***25.9***	m
Pump Duty Cut-out Level		-4.05	-4.05	RL
IL Discharge / Pressure Main Highest Point		35.00	29.00	RL
Emergency Overflow Level		3.10	3.10	RL

ANNEXURE 5

Option C Layout and calculations

PRESSURE MAIN PROFILE - OPTION C

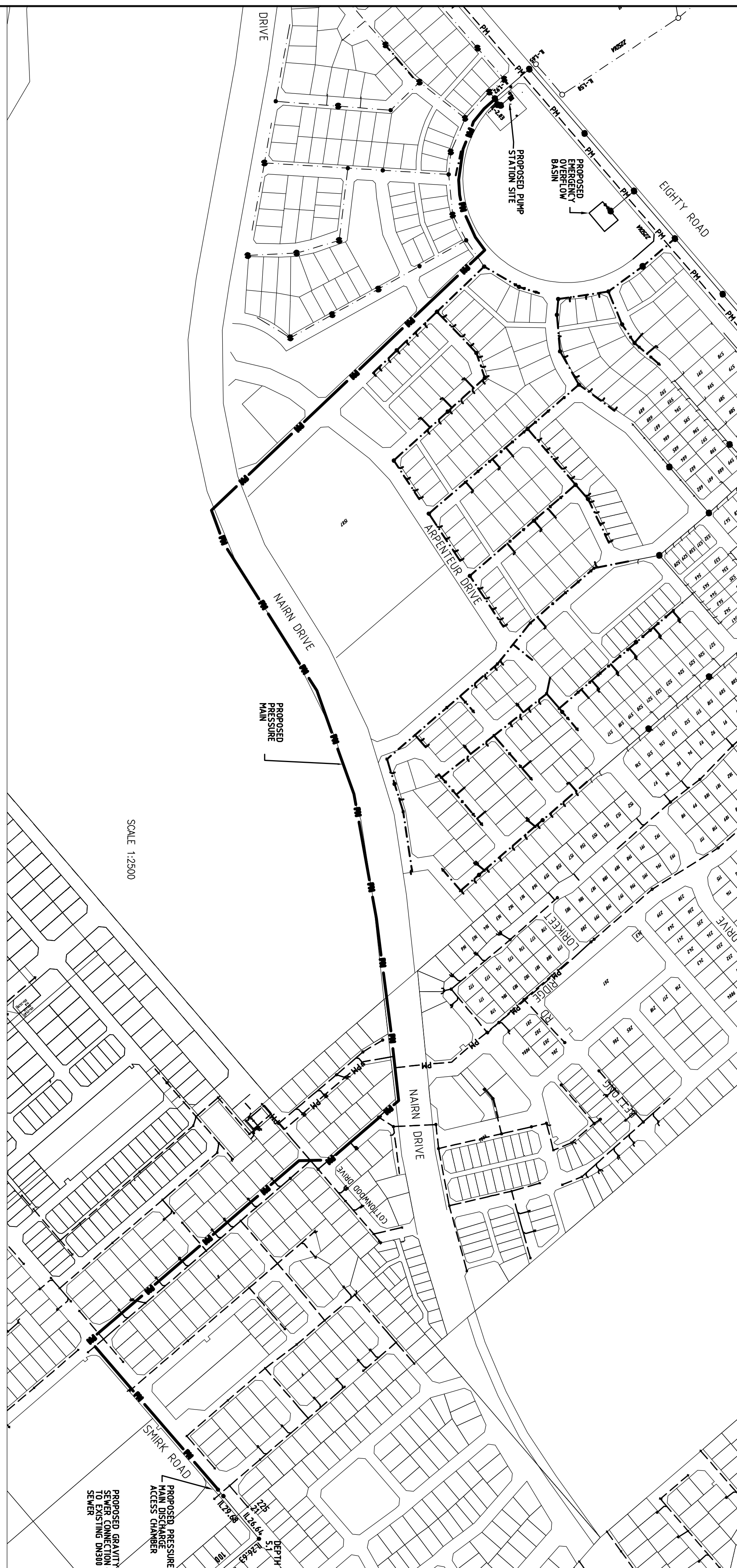
SCALE HORIZ 1 : 3000 metres
VERT 1 : 300 metres

PIPE GRADE
DATUM R.L. -10.0

PRESSURE MAIN CHAINAGE	PRESSURE MAIN PIPE INVERT	DEPTH TO PIPE INVERT	FINISHED SURFACE LEVEL
0.000	2.000	-2.605	4.605
20.000	2.138	-3.052	5.190
39.448	2.273	-3.318	5.590
40.000	2.277	-3.326	5.602
59.494	2.411	-3.436	5.848
60.000	2.415	-3.451	5.866
80.000	2.553	-3.824	6.377
94.336	2.652	-3.851	6.503
100.000	2.691	-4.084	6.775
120.000	2.830	-4.066	6.896
131.300	2.908	-3.848	6.755
140.000	2.968	-3.685	6.653
149.205	3.031	-3.281	6.312
160.000	3.106	-3.205	6.311
166.848	3.153	-2.973	6.127
180.000	3.244	-2.910	6.154
200.000	3.383	-2.660	6.043
203.308	3.405	-2.594	6.000
206.000	3.424	-2.551	5.975
220.000	4.381	-1.446	5.826
222.102	4.525	-1.277	5.802
240.000	5.748	-0.560	6.308
260.000	7.115	-0.418	7.533
280.000	8.482	-0.516	8.998
300.000	9.849	-0.814	10.663
320.000	11.216	-1.008	12.224
340.000	12.583	-1.061	13.644
360.000	13.950	-0.986	14.936
380.000	15.317	-1.103	16.420
400.000	16.684	-1.221	17.904
420.000	18.051	-1.338	19.389
440.000	19.418	-1.687	21.104
460.000	20.785	-1.573	22.358
475.000	21.810	-1.912	23.722
480.000	21.608	-2.485	24.093
500.000	20.798	-0.134	20.932
520.000	19.988	-4.298	24.286
540.000	19.178	-4.104	23.282
560.000	18.369	-4.144	22.513
580.000	17.559	-4.185	21.744
594.395	16.976	-4.214	21.190
600.000	16.749	-4.583	21.332
620.000	15.939	-4.625	20.564
625.000	15.737	-3.319	19.056
640.000	15.950	-3.072	19.023
660.000	16.234	-2.832	19.066
671.711	16.401	-3.517	19.918
680.000	16.519	-3.725	20.243
700.000	16.803	-3.658	20.460
714.589	17.010	-3.605	20.615
720.000	17.087	-3.699	20.786
735.000	17.300	-4.007	21.307
740.000	17.376	-4.122	21.498
760.000	17.678	-4.760	22.439
780.000	17.981	-2.254	20.234
800.000	18.283	-2.137	20.421
820.000	18.586	-2.023	20.609
840.000	18.888	-1.911	20.799
860.000	19.191	-1.886	21.077
880.000	19.494	-2.007	21.500
900.000	19.796	-2.168	21.964
920.000	20.099	-2.315	22.414
921.391	20.120	-2.325	22.445
940.000	20.401	-2.533	22.934
960.000	20.704	-2.746	23.450
980.000	21.006	-4.457	25.464
1000.000	21.309	-4.188	25.497
1020.000	21.612	-4.049	25.660
1040.000	21.914	-3.436	25.350
1052.003	22.096	-3.591	25.686
1060.000	22.217	-2.621	24.838
1080.000	22.519	-1.735	24.254
1100.000	22.822	-1.443	24.264
1120.000	23.124	-1.174	24.299
1140.000	23.427	-1.681	25.108
1160.000	23.729	-1.983	25.712
1180.000	24.032	-4.245	28.277
1200.000	24.335	-4.027	28.362
1202.757	24.376	-3.997	28.373
1220.000	24.637	-3.827	28.464
1240.000	24.940	-3.630	28.570
1260.000	25.242	-3.433	28.675
1280.000	25.545	-3.236	28.781
1300.000	25.847	-3.039	28.887
1320.000	26.150	-2.842	28.992
1340.000	26.453	-2.554	29.007
1341.361	26.473	-2.536	29.009
1360.000	26.755	-2.304	29.059
1380.000	27.058	-2.501	29.559
1400.000	27.360	-2.294	29.654
1420.000	27.663	-2.069	29.731
1421.262	27.682	-2.064	29.746
1437.000	27.920	-1.917	29.837
1440.000	27.890	-1.814	29.704
1460.000	27.691	-2.033	29.724
1480.000	27.492	-1.622	29.115
1500.000	27.293	-1.720	29.013
1520.000	27.094	-1.798	28.892
1531.209	26.983	-1.662	28.644
1540.000	26.895	-1.628	28.523
1541.073	26.884	-1.662	28.546
1560.000	26.696	-1.784	28.480
1566.819	26.628	-1.807	28.435
1568.186	26.615	-1.827	28.442
1580.000	26.824	-1.967	28.791
1600.000	27.178	-1.844	29.022
1620.000	27.533	-2.250	29.783
1639.564	27.879	-2.087	29.967
1640.000	27.881	-2.087	29.968
1660.000	27.955	-3.051	31.005
1680.000	28.028	-2.972	31.000
1700.000	28.102	-2.831	30.933
1720.000	28.175	-2.745	30.920
1740.000	28.249	-2.837	31.086
1760.000	28.322	-2.894	31.217
1780.000	28.396	-2.951	31.347
1800.000	28.470	-3.009	31.478
1820.000	28.543	-2.937	31.480
1840.000	28.617		
1860.000	28.690		
1860.614	28.692		
1880.000	28.764		
1895.335	28.820		
1900.000	28.837	-2.993	31.830
1917.641	28.902		
1920.000	28.911		
1940.000	28.984		
1960.000	29.058		
1980.000	29.132		
2000.000	29.205		
2020.000	29.279		
2040.000	29.352		
2060.000	29.426	-1.704	31.130
2080.000	29.499		
2100.000	29.573		
2120.000	29.646		
2129.128	29.680		

(HORIZONTAL SCALE DIAGRAMMATIC - A1 SHEET)

SITE PLAN



NOTES

1. LOCAL AUTHORITY : CITY OF ROCKINGHAM
2. ESTIMATED GROUND WATER LEVEL: REFER AAMGL CONTOURS
3. THIS RETICULATION AREA IS CLASSIFIED 'WET & DRY' IN ACCORDANCE WITH THE WATER CORPORATION WASTEWATER MANUAL VOL. 1 UNLESS NOTED OTHERWISE.
4. EXISTING SURFACE LEVELS DETERMINED FROM MAPS AERIAL AND GROUND SURVEYS.
5. ALL PIPE SIZES IN MILLIMETRES (DIA 150 U.N.O.). ALL DISTANCES AND LEVELS IN METRES.
6. CADASTRAL BOUNDARIES DERIVED FROM MAPS PRECAL. EXISTING BOUNDARIES AND PLANNERS INFORMATION WHICH MAY BE SUBJECT TO FURTHER CHANGES.

LEGEND

- PROPOSED GRAVITY SEWER AND ACCESS CHAMBERS
- EXISTING GRAVITY SEWER AND ACCESS CHAMBERS
- FUTURE GRAVITY SEWER AND ACCESS CHAMBERS
- EXISTING PRIVATE PRESSURE MAIN
- PROPOSED PRESSURE MAIN
- GW 21.5 GROUND WATER CONTOURS

SC - REVISION RECORD

No	DATE	DRAFTING CHECK	DESIGN REVIEW	REV'D P.MGR	APP'D P.DIR	AMENDMENT
A1						

SC DRG No. WC090004-PS-1-2

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD

566
810

SURVEY BOOKS: NONE

VERTICAL DATUM AHD
COORDINATE SYS MGA94-50
DES REF

DES CALC P.ALEBAKIS
DES CHD N.SHAH
DRN S.MEWS
Q.C. CHD N.SHAH

NORTH POINT

SERLING CONSULTING
INNOVATIVE ENGINEERING SOLUTIONS
Serling Consulting (WA) Pty Ltd
ACN: 136 628 058
UNIT 210/396 SCARBOROUGH BEACH ROAD
OSBORNE PARK WA 6017
Telephone (08) 9202 8740
Facsimile (08) 9202 8749

RECOMMENDED
CONSULTANT PROJECT MANAGER
APPROVED
CONSULTANT PROJECT DIRECTOR

WATER CORPORATION

METROPOLITAN WASTEWATER - WAPC .
BALDIVIS SOUTH PUMPING STATION "K"
PRELIMINARY PRESSURE MAIN LAYOUT - OPTION C

FILE .
PROJECT .
PLAN 1-4
CAD
ISSUE A
MF
ORIGINAL SHEET SIZE A1

1 2 3 4 5 6 7 8 9 10 11 12
A B C D E F G H

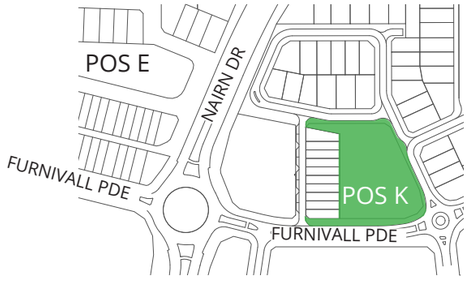
Option C - Discharge into Existing AC5237 - DN300 Gravity Main

		Initial	*Ultimate*	
Max PUMP HEAD		**60.0**	**44.5**	**m**
PIPE DIAMETER		**150**	**225**	**mm**
Friction Head		***24.4***	***11.4***	**m**
Pumping Rate % Ratio			100.00%	
Pumping Rate		15.1	39.8	L/s
Start of Pressure Main Level		3.15	3.15	RL
Internal Pump Station Pipework Diameter		200	200	mm
Internal Pump Station Pipework Length		62	62	m
Internal Pump Equivalent length Factor		1.0	2.5	
Pressure Main Nominal Diameter		150	225	mm
• Pipe Class to AS1477		12	12	
• Pipe Internal Diameter		158	234	mm
• Pipe Length Actual		2150	2200	m
• Pipe Velocity		0.77	0.93	m/s
Equivalent Length		2211.8	2354.4	m
Colebrook-White k =	0.6 , f	0.0291	0.0259	
Hydraulic Gradient		0.006	0.005	m/m
Pressure Main Nominal Diameter - Existing		100		mm
• Pipe Class to AS1477		12		
• Pipe Internal Diameter		108.5		mm
• Pipe Length Actual		300		m
• Pipe Velocity		1.63		m/s
Colebrook-White k =	0.6 , f	0.0320		
Hydraulic Gradient		0.040		m/m
Max Static Head		***35.6***	***33.1***	m
Min Static Head		***28.4***	***25.9***	m
Pump Duty Cut-out Level		-4.05	-4.05	RL
IL Discharge / Pressure Main Highest Point		31.50	29.00	RL
Emergency Overflow Level		3.10	3.10	RL

Our ref: EWP20132.001

Appendix F
Parkland Heights Baldivis landscape concept plan amendment POS K

PLAN



LOCATION PLAN NTS

TO POS L

THIS IS A CONCEPT DESIGN ONLY AND SUBJECT TO FUTURE DETAIL DESIGN AT URBAN WATER MANAGEMENT PLAN PHASE.

LEGEND

1. Dense tree planting with planted understory
2. Open grass area
3. Retaining wall
4. 2.5m Share path
5. 2.0m Pedestrian circuit pathway
6. Small playground with picnic facilities

CONCEPT
- POS to be a passive neighbourhood park
- Take into consideration impact on adjacent residents when locating amenity
- Connect into the pedestrian network
- Barrier around playground

FUNCTIONS/MATERIALS
- Provide drainage via a vegetated basin
- Informal active use grassed area
- Small playground with seating and picnic facilities
- Informal clumps of native trees
- Native shrub planting
- Fully irrigated
- All hard and soft landscape to comply with the City of Rockingham's landscape criteria

PLANTING STRATEGY
- One tree species planted along pedestrian circuit
- POS planting to be predominantly native species
- Trees planted informally
- Ensure tree species selected have clear trunks for optimal passive surveillance
- Plants will be water wise
- Planting design to be zoned according to their water requirements

ENVIRONMENTAL RESPONSE
- Waterwise plant strategy
- Water zoning
- Controlled fertilisation

IRRIGATION STRATEGY
- All proposed turf and planting to be irrigated
- Proposed irrigation to dense tree planting

PARKLAND HEIGHTS Baldivis

Landscape Concept Plan | Amendment POS K | November 2020

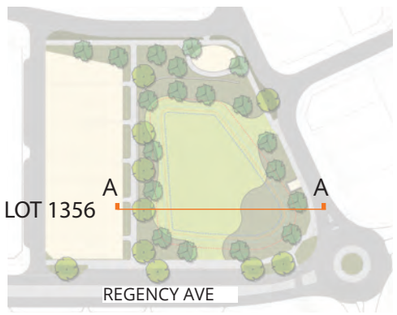
0 5 10m

NORTH

MORTONS urbansolutions
Civil Engineering | Town Planning | Project Coordination

LD TOTAL
LEADERS IN LANDSCAPING

indicative SECTION A A



KEY PLAN

THIS IS A CONCEPT DESIGN ONLY AND SUBJECT TO FUTURE DETAIL DESIGN AT URBAN WATER MANAGEMENT PLAN PHASE.

DRAINAGE BASIN

1EY	Area 1,580m2	Depth 0.17m
20% AEP	Area 1,800m2	Depth 0.40m
10% AEP	Area 1,950m2	Depth 0.57m
1% AEP	Area 2,580m2	Depth 1.12m

PARKLAND HEIGHTS Baldivis

Landscape Concept Plan | Amendment POS K | November 2020

0 5 10m

MORTONS urbansolutions
Civil Engineering | Town Planning | Project Coordination

LD TOTAL
LEADERS IN LANDSCAPING

Our ref: EWP20132.001

Appendix G
Staged water use and irrigation schedule for POS K and Parkland Heights

GWL164680(11) -INSTRUMENT REPOR~al-Rockingham Park Pty Ltd

Annual Water Entitlement 86,320kL

PARKLAND HEIGHTS

STAGED WATER USE AND IRRIGATION SCHEDULE

27th Oct 2020

LD TOTAL
LEADERS IN LANDSCAPING

7,500kL/ha/a 9,000kL/ha/a - DOS	Total POS & Streetscape area m2	Irrigated Area (m2)	Irrigated turf area %	Irrigated Turf area (m²)	Volume - Turf (kL/yr)	Irrigated Planting %	Irrigated Planting area (m2)	Volume - Planting (kL/yr)	Non - Irrigated Areas (m2)	TOTAL VOLUME Volume - Planting & Turf (kL/yr)
Stage 3										
POS Part B	0	0	0	0	0	0	0	0	0	0
POS C	11,920	8,702	33%	3,934	2,950	40%	4,768	3,576	3,218	6,526
POS D	2,754	2,010	33%	909	682	40%	1,102	826	744	1,508
Total for Stage	14,674									
Stage 4 - Feb 16 - June 16										
POS G - Feb 16 - Jun 16	6,105	5,709	75%	4,608	3,456	18%	1,101	826	0	4,282
DOS F - Jul 15 - Nov 15	57,736	49,059	84%	48,549	43,694	1%	510	459	545	44,153
Total for Stage	63,841									48,435
Stage 5 - Jan 18 - April 18										
POS H - Jan 18 - April 18	3,131	2,586	53%	1,650	1,238	30%	936	702	545	1,940
POS I - Jan 18 - April 18	3,784	3,256	60%	2,277	1,708	26%	979	734	528	2,442
Total for Stage	6,915			3,927	2,945		1,915	1,436	1,073	4,382
Stage 6										
POS E	5,680	5,570	**67%**	3,809	2,857	**31%**	1,761	1,321	110	**4,178**
Furnivall Parade - Median & RAB	515	515	**0%**	0	0	**100%**	515	386	0	**386**
Total for Stage	6,195			3,809	2,857		2,276	1,707	110	**4,564**
Nairn Drive										
Section 1 + 2	13,320	13,010	**66%**	8,780	6,585	**32%**	4,230	3,173	310	**9,758**
Section 3	11,283	10,155	**40%**	4,513	3,385	**50%**	5,642	4,231	1,128	**7,616**
Total for Stage	24,603			13,293	9,970		9,872	7,404	1,438	**17,374**
Stage 7 & 7a - BORE										
POS O	11,054	9,396	**50%**	5,527	4,145	**35%**	3,869	2,902	1,658	**7,047**
Greenlinks - Median	155	155	**0%**	0	0	**100%**	155	116	1,658	**116**
Total for Stage	11,209			5,527	4,145		4,024	3,018	3,316	**7,163**
Stage 8										
POS N	7,508	6,382	**50%**	3,754	2,816	**35%**	2,628	1,971	1,126	**4,786**
Greenlinks - Verge	950	950	**0%**	0	0	**100%**	950	713	0	**713**
Total for Stage	8,458			3,754	2,816		3,578	2,683	1,126	**5,499**
Stage 9										
POS M	12,354	10,501	**50%**	6,177	4,633	**35%**	4,324	3,243	1,853	**7,876**
Greenlinks - Median + RAB	950	950	**0%**	0	0	**100%**	950	713	0	**713**
Total for Stage	13,304			6,177	4,633		5,274	3,955	1,853	**8,588**
Stage 11										
POS L	2,863	2,290	**50%**	1,432	1,074	**30%**	859	644	573	**1,718**
Main Streets - Median + RAB	2,942	2,942	**0%**	0	0	**100%**	2,942	2,207	0	**2,207**
Total for Stage	5,805			1,432	1,074		3,801	2,851	573	**3,924**
Stage 12										
Regency Avenue - Median + RAB	710	710	**0%**	0	0	**100%**	710	533	0	**533**
Total for Stage	710			0	0		2,942	2,207	0	**533**
Stage 13										
Regency Avenue - Median	455	455	**0%**	0	0	**100%**	455	341	0	**341**
Total for Stage	455			0	0		710	533	0	**341**
Stage 14 - BORE										
POS K	5,950	4,750	**54%**	3,200	2,400	**26%**	1,550	1,163	1,200	**3,563**
Total for Stage	5,950			3,200	2,400		1,550	1,163	1,200	**3,563**
Sixty Eight Rd Upgrade										
Sixty Eight Rd - Verge + RAB	11,500	8,050	**40%**	4,600	3,450	**30%**	3,450	2,588	3,450	**6,038**
Total for Stage	11,500			4,600	3,450		3,450	2,588	3,450	**6,038**
TOTALS FOR ESTATE										**57,586**

PH + HP TOTAL PROPOSED IRR	**75,222**
PH + HP REMAINING ALLOCATION FOR IRR	**11,098**

Appendix H
Licence to take groundwater

Government of **Western Australia**
Department of **Water and Environmental Regulation**

Your Ref:
Our Ref: RF7311-03
Enquiries: Oliver Krumholz
Phone: 9550 4210

Rockingham Park Pty Ltd
PO BOX 4376
MYAREE BUSINESS CENTRE WA 6960

Dear Licensee

Issue of a licence under the *Rights in Water and Irrigation Act 1914*

Properties: Parkland Heights and Heritage Park, Baldivis

Thank you for your application, dated 12/08/2020 for the transfer of a portion (15,000 kilolitres) of the annual water entitlement from your licence to take water GWL164680 to the Department of Education. Your application has been approved and your new annual water entitlement is now 86,320 kilolitres.

Please find enclosed the following:

- Your licence to take water **GWL164680(11)**
- Brochure *Your licence to take water*
- Brochure *Metering your water use*
- *Metering Regulations* – fact sheet

Take time to read these documents as they contain important information about your rights and responsibilities.

The *Rights in Water and Irrigation Regulations 2000* apply to this licence. We have removed the conditions on your licence that require you to meter your water use and submit meter readings, as these requirements are now statutory. Please note you must report meter readings to the department within 30 days after the end of your water year referred to in **Condition 1** of your licence.

Please read the enclosed information. If you are unsure if you meet the requirements of the new Regulations, you should review your current licence(s) and the requirements of the new legislation to work out if there is anything you need to do.

You can find out more about how the changes affect you by accessing the FAQs on our website at www.dwer.wa.gov.au Go to Water > Licensing > Metering and measurement, where you can also access a copy of the measurement policy.

Peel Region
107 Breakwater Parade Mandurah Western Australia 6210
Telephone (08) 9550 4222 Fax (08) 9581 4560
www.dwer.wa.gov.au

Furthermore, the department has no records on the submission of the monthly meter readings for this licence for the 2019 water year which were due on 31 January 2020. **Meter readings must be submitted via the department's Water Online** portal, unless otherwise approved by the department.

Please be advised, that failure to comply with these requirements is an offence and attracts a penalty of $2000 and daily penalty of $200 under prosecution. The department may elect to deal with the offence by way of a modified penalty (i.e. issue an infringement) of $400.

In addition, please update the drawpoints and meters registered in the Water Online portal, as some may have been handed over to the City of Rockingham.

Under provisions of the *Rights in Water and Irrigation Act 1914*, you have a right to apply to the State Administrative Tribunal for a review of our decision within 28 days from the date of this letter.

For further information please contact the State Administrative Tribunal:

In person:	State Administrative Tribunal Level 6, 565 Hay Street PERTH WA 6000
In writing:	State Administrative Tribunal GPO Box U1991 PERTH WA 6845
By telephone:	Metro: (08) 9219 3111 Regional: 1300 306 017 (for the cost of a local call)
By fax:	(08) 9325 5099
Website:	http://www.sat.justice.wa.gov.au/

You can now use online services to manage all of your licensing and metering needs. Water Online provides the easiest, fastest and most efficient way to:

- Apply for a new licence or permit
- Apply to amend, renew or transfer an existing licence
- Submit meter readings in accordance with a licence; and
- Manage your account details.

Register for Water Online at www.water.wa.gov.auby clicking on the Water Online Login icon.

The instructions for registering, checking your details and updating them where required can be found by selecting the Quick Reference Guides link on the water online home page.

Please check your details to ensure that they are correct. If they are not correct **please contact the department's online business support unit on 1800 508 885** (select option 2).

Peel Region
107 Breakwater Parade Mandurah Western Australia 6210
Telephone (08) 9550 4222 Fax (08) 9581 4560
www.dwer.wa.gov.au

If you have any queries about this or any other water licensing matter please contact Oliver Krumholz by telephone on 9550 4210 or email oliver.krumholz@dwer.wa.gov.au

Yours faithfully,

Carlie Slodecki
District/Program Manager
Peel Region
09 September 2020

Peel Region
107 Breakwater Parade Mandurah Western Australia 6210
Telephone (08) 9550 4222 Fax (08) 9581 4560
www.dwer.wa.gov.au

Government of **Western Australia**
Department of **Water and Environmental Regulation**

Instrument No. GWL164680(11)

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Rockingham Park Pty Ltd		
Description of Water Resource	Stakehill Perth - Superficial Swan	**Annual Water Entitlement**	86,320kL
Location of Water Source	LOT 954 ON PLAN 407830 - Lot 954 BALDIVIS - POS H - Parkland Heights		

Authorised Activities	**Taking of water for**	**Location of Activity**
	Dust suppression for earthworks and construction purposes	LOT 9011 ON PLAN 417866 - Volume/Folio 2982/250 - Lot 9011 Lot 986 On Plan 202758 - Volume/Folio 2128/381 - Lot 986 Baldivis Rd Baldivis - Heritage Park Lot 993 On Plan 202758 - Volume/Folio 2125/382 - Lot 993 Baldivis Rd Baldivis - Heritage Park Road Reserve - PIN11754540 - Heritage Park
	Irrigation of up to 5.8 ha of public open space	LOT 9011 ON PLAN 417866 - Volume/Folio 2982/250 - Lot 9011 Lot 986 On Plan 202758 - Volume/Folio 2128/381 - Lot 986 Baldivis Rd Baldivis - Heritage Park Lot 993 On Plan 202758 - Volume/Folio 2125/382 - Lot 993 Baldivis Rd Baldivis - Heritage Park Road Reserve - PIN11754540 - Heritage Park
Duration of Licence	From 9 September 2020 to 3 February 2024	

This Licence is subject to the following terms, conditions and restrictions:

1. The annual water year for water taken under this licence is defined as 1 Jan to 31 Dec.
2. The licensee shall not use water for sprinkler irrigation between 9 am and 6 pm except for the establishment of newly planted areas. For newly planted areas water may be used within these hours for a period of up to 28 consecutive days, commencing from the date of planting.
3. Between 1 June and 31 August in any year, the licence-holder must not water a lawn, garden, or grass-covered area ("turf") by reticulation, provided always that this restriction shall not apply to watering with a hand held hose; or watering, by way of reticulation: newly planted areas for a period of up to 28 days from the date of planting; for renovating turf; or for maintenance of reticulation systems.

End of terms, conditions and restrictions

Government of **Western Australia**
Department of **Water and Environmental Regulation**

Your licence to take water

Important information. Please read.

Please carefully read this information. It explains your licence and responsibilities as a licensee.

Carefully read your licence. You may commit an offence if you take or use water in any way that is not authorised.

Keep your licence in a safe place.

You must inform the department if

- the details on your licence seem in any way incorrect
- you do not understand your licence terms, conditions and restrictions
- you believe you may not be able to comply with your licence terms, conditions and restrictions
- for any reason you no longer have lawful access to the part of the property from which you take water e.g. you sell or lease your property or your lease expires. You must tell the department **within 30 days** if this occurs
- you want to use some or all of your water entitlement on a different property
- someone else is using the water, either temporarily or permanently, or you are planning to lease your property to somebody else and they plan to use water
- you plan to drill new wells, excavate new soaks or construct new dams, or alter existing infrastructure. You may need to apply for a licence or permit to do this
- you plan to change your water-use activities.

Your licence

File and instrument numbers

The file number (top left) refers to the department's records of your licence(s) and the applications you have made. The instrument number (top right) is your licence number. You may be asked to quote these numbers if you make an enquiry about your licence.

Licensee(s)

The licensee(s) is responsible for the use of water as authorised by the licence. If there is more than one name on the licence, all named parties share joint responsibility.

Water resource

This is the name of the groundwater area and aquifer, or the surface water area and branch/tributary, you are authorised to take water from, based on the information you have given the department in your application about the depth and location of your bores, wells, dams, soaks or pumps.

Annual water entitlement

This is how much water you can take within a 12 month period, in kilolitres (kL).

Location of water source

This is the only property from which water is to be taken.

Authorised activities

This part of your licence lists what activities you can use the water for. Using water for other purposes or at any other location may be an offence. If your water use is not measured with a meter, your 'authorised activities' are an important way for the department to calculate your water-use.

Duration of licence

The licence is valid for this period.

Terms, conditions and restrictions

This section lists any other terms, conditions or restrictions that apply to your licence. It is a breach of the Rights in Water and Irrigation Act 1914 if you do not comply with these conditions.

Other things you should know

Annual water entitlement

There is no guarantee this volume of water is available at all times or is of a suitable quality for your purposes.

Licence expiry

You should apply to renew your licence before your licence expires. It is an offence if you continue to take water after the expiry date, unless you have applied to renew the licence. The department recommends you submit an application at least one month before the expiry date. You can apply online at **www.online.water.wa.gov.au**.

Copy of licence

You may request a certified copy of your licence. A fee applies.

Water year

On some licences, the water year is defined in the terms, conditions and restrictions. If the water year is not defined on your licence, the water year begins on the date your licence is issued (see duration of licence). For example, if the licence was issued on 15 May 2012, the water year would be from 15 May to 14 May the following year. Unused water in any year does not carry over to the next water year.

Licence transfer

If you are planning to move premises and would like to be able to use your current water entitlement on a new property, you can apply to transfer the water entitlement.

If the property is sold or leased, the new owner or tenant does not automatically have rights to take water under this licence, **even if the water entitlement has been included in the contract of sale or lease agreement**. Contact the department for more information.

Water efficiency

Water in WA is a precious resource. All water users are encouraged to keep up with new technologies and operate the most efficient systems possible.

Other laws

This licence does not give you any rights except to take and use water from a given point(s). You must still comply with Commonwealth and state legislation, and local by-laws.

Our rights

The Department of Water and Environmental Regulation (on behalf of the Minister for Water), can take action it believes is necessary to manage and protect the state's water resources, and to protect the rights of other water users. The department may, for example:

- require you to fit a water meter
- access your property for routine inspection purposes
- access your property to determine if an offence has been committed (under the *Rights in Water and Irrigation Act 1914*)
- direct you to reduce the amount of water you take or change the rate at which water is pumped, or direct the purpose for which it is taken
- direct you to close a well, if water is being wasted or improperly used
- refuse to renew your licence if it believes you will not comply with licence conditions
- cancel or suspend your licence
- add, remove or change the terms, conditions and restrictions of your licence. This includes reducing your water entitlement if you cannot demonstrate that you are legitimately using water for the purpose for which it was intended.

In all but an exceptional circumstance, you would be given notice of these actions and, in some cases, you would have a right to comment or apply for a review of the decision.

The Water Register

The general public has access to a register which contains some of the details of your licence, including the licensee name(s) and postal address, annual water entitlement and duration of licence.

The Water Register is available at the department's website, www.dwer.wa.gov.au.

Definitions

Well Any opening in the ground made or used to obtain access to underground water. This includes bores and 'soaks' or other excavations that intercept groundwater.

Water year The 12 month period during which you can use your annual water entitlement.

Ha *(hectare)* A measure of land area. One hectare is equal to 10 000 square metres, which is approximately 2.5 acres.

kL *(kilolitre)* A measure of water volume. One kilolitre is 1000 litres or one cubic metre (m^3).

Take water To remove or reduce the flow of water in a watercourse, wetland or from underground. This includes pumping or siphoning water; stopping, impeding or diverting the flow of water; releasing water from a wetland; allowing water to flow under natural pressure from a well; or allowing stock to drink from a watercourse or wetland. It also includes storing water that has been drawn by these means.

For further information

Please refer to 'Responsibilities of licence and permit holders' at the department's website

www.dwer.wa.gov.au

or contact your local regional office.

Government of **Western Australia**
Department of **Water and Environmental Regulation**

Important information. Please read.

Metering your water use

For online licensees

Please carefully read this information. It will help you to understand your responsibilities as a licensee. You may commit an offence if you do not correctly meter your water use.

As a metered water user you must:

• Install an approved meter (or meters). This is a meter that complies with the Rights in Water and Irrigation (Approved Meters) Order 2009.

• Maintain your meter and take all reasonable steps, including regular servicing, to ensure it is accurately measuring all water use.

• Record and report readings, as required by your licence conditions. If you cannot read the meter at the required time, you will need to arrange for someone else to do this for you.

• Not deliberately damage or alter a meter, or associated fittings or pipework, such that the meter does not accurately measure all of the water being taken.

Failure to comply with these requirements may attract a penalty

To ensure you are compliant with your obligations you should:

• Inform the Department of Water and Environmental Regulation in writing within 30 days of installing the meter, the date of installation, meter location, make, size, type and serial number of the meter, and the meter reading after installation.

• Provide the department with a photograph(s) and/or diagram(s) of the meter, shown fitted to the pipe work.

• Familiarise yourself with your meter and how to read the instrument. Not all meters are the same. See the department's *Reading your meter* fact sheet and ask your installer for a demonstration.

You need to contact the department immediately if:

• You think you may not be able to fit a meter within the timeframe specified in your licence (notify the department **before** the installation deadline).
• You are unable to read your meter or report the meter readings by the due date, for any reason.

• You think your meter may not be accurately recording water use. For example, if the meter is not registering water flow when the pump is switched on, or if water use is higher or lower than expected.

• A meter is damaged, or if for any reason you think that your meter may have malfunctioned.

• A meter must be removed for a period of time for maintenance or repair or any other reason.

• A meter is replaced for any reason.

Installation

You should ask your local irrigation systems supplier to recommend a fit-for-purpose water meter that complies with the Rights in Water and Irrigation (Approved Meters) Order 2009. The supplier may also be able to recommend a competent installer.

The department's *Guidelines for water meter installation 2009* provides you with details of the technical, maintenance and installation requirements for new water meters, and the upgrade or replacement of existing water meters. If a meter installation does not comply with the department's requirements, you will be required to ensure alterations are made to the meter or the pipework to address this issue. The department will advise you in writing of the required changes or it may elect to issue you with a formal direction. Failure to comply with a direction is also an offence and may attract a penalty.

Maintenance

Over time, a meter may lose accuracy and incorrectly measure water use. The accuracy of a meter is affected by its age, and by the volume and quality of the water passing through the instrument. Corrosion, iron bacteria, exposure to coarse sediment and intermittent patterns of water use may affect meter performance and longevity.

Meters must therefore be maintained properly to ensure they continue to accurately measure water use over time. The department accepts a margin of error of up to five per cent, on an installed meter.

The department may inspect a meter at any time and may require a meter be tested if the department believes the instrument is not accurate. The department may estimate your water use if it believes your water use has not been measured accurately, because the meter was not installed

correctly, was removed for maintenance or repair, or the meter was tested and found to be inaccurate. For more information about meter-testing please refer to the department's *Guidelines for water meter installation 2009*.

Records

Taking regular meter readings will help you manage your water use and ensure you comply with your annual licensed entitlement, and may be a condition of your water licence.

For monthly readings, you should set aside a specific day during the last week of each month to read your meter. It may be useful to set yourself a reminder in your diary, calendar or on your mobile phone. If a reading is required for the beginning of your water year, it should be taken during the first week of that year. A reading required to be taken at the end of your water year should be taken during the last week of that year.

If your licence requires you to record readings on a *Meter water use card*, readings submitted electronically through Water Online at www.online.water.wa.gov.au will be accepted as completed *Meter water use cards*.

Meter removal

If a meter that is required under your licence must be replaced or removed for any reason, you should notify the department as soon as possible, by providing the following information:

- your name and/or the licensee's name and licence details
- location of the draw-point
- serial number of the meter
- date and time of removal and replacement
- meter reading at the time of removal
- details of the new meter fitted, if applicable
- reasons for meter removal.

Servicing

Servicing should be carried out by an irrigation specialist, ideally during a period of low water use. Regular servicing helps maintain meter accuracy and reduces the risk of a malfunction which may affect your water supply. Meters should be serviced more frequently if the water in your area has high levels of iron or sediment. Brown stains on hard surfaces and build-ups of deposits on sprinkler heads are common signs of high iron levels. In some cases it may be more economical to schedule regular meter replacement. You should consult your irrigation specialist about your meter maintenance options.

You can expect a routine service to include:

- **inspection** of the outer casing of the meter and the register (dial), and the removal and examination of the internal parts. The technician may identify corrosion or iron build-up, or structural damage to the turbine, paddle or impeller caused by exposure to coarse sediment
- **servicing** which may include cleaning and restoration of the internal measurement elements, cleaning of the meter register housing, repair of any obvious damage or faults and the application of a bore-cleaning solution
- **testing** of the meter once reassembled. A service certificate should be provided for your records.

Why meter water use?

The state's water resources are under increasing pressure. Precise information about how much water is being used in a particular area helps the department to understand the real impacts of our water use.

The information supports sustainable water resource management and planning by helping us to set allocation limits, improve modelling and forecasting for the future, and improving equity for all water users by ensuring licensees' take no more water than they are entitled to.

Metering also benefits water users, for example, by helping you to understand your water needs to support business planning and development, optimising water efficiency, allowing you to monitor the performance of pump and irrigation systems, identifying opportunities to trade surplus entitlements.

Definitions

Draw-point a point at which water is accessed and drawn.

Rights in Water and Irrigation (Approved Meters) Order 2009 legislation published in the *Western Australian Government Gazette* on 5 May 2009. It requires that a meter complies with the Australian standard, or is tested and verified to be accurate by an accredited laboratory and installed according to manufacturer's specifications. Refer to the department's *Guidelines for water meter installation 2009*.

For further information

For more information about your responsibilities as a licence holder, please see the department's brochure *Your licence to take water*, contact your local regional office or see Responsibilities of Licence and Permit holders at the department's website.

www.dwer.wa.gov.au

The department's *Guidelines for water meter installation 2009* are available from your local regional office or from the department's website.

Metering regulations

The *Rights in Water and Irrigation Amendment Regulations 2018*, enacted on 18 February 2018, relate primarily to the Rights in Water and Irrigation Regulations 2000 Part 4A – Meters.

The regulations

Under the new regulations, certain licensees must:

- Install a meter on each water draw-point.
- Ensure the meter and installation complies with the Rights in Water and Irrigation (Approved meters) Order 2009.
- Provide the following details of the installation (within 30 days):
  - Coordinate references relating to the location of the meter or another approved description of its location
  - Date of installation
  - Meter reading at the time of installation
  - Make, size, type and serial number of the meter.

After the meter is installed drawings or annotated photographs of the meter should be taken and must show:

- the length of pipe connecting the draw-point to the upstream flange of the meter
- the length of pipe between the downstream flange of the meter and the first-bend or take-off
- the direction of the water flow through the meter.

A copy of the manufacturer's specifications for installation of the meter or written advice from the person who installed the meter that it complies with the manufacturer's specifications for installation must also be provided.

Licensees are to ensure the meter is maintained, in good working order and operating within a range of plus or minus five per cent of the quantity of water that actually passes through it, when tested in field conditions.

Under the Rights in Water and Irrigation Regulations 2000 it is an offence to damage a meter; or install, or alter, a meter or any associated fittings so that the meter does not accurately measure the quantity of water being taken from a well.

Licensees are required to:

- Record the meter reading at the end of each month
- Report meter readings to the department within 30 days after the end of the relevant water year (unless approved to provide an annual abstraction volume)
- Notify the department within seven days of detecting a malfunction of the meter.

Meter readings must be submitted via the department's Water Online metering portal, unless otherwise approved by the department. To enable the online submission of meter readings, meters must first be registered in the metering portal against the relevant water licence by entering some key meter installation details.

When do the requirements apply?

The new metering regulations will affect licences issued under Section 5C of the *Rights in Water and Irrigation Act 1914*, with an annual water entitlement of -

500,000 kL or more	from 31 March 2018
50,000 kL to 499,000 kL	from 31 December 2018
10,000 kL to 49,999 kL in the Gnangara groundwater plan area	from 31 December 2019
10,000 kL to 49,999 kL In all other areas	from 31 December 2020

The regulations **do not** apply if

- the licence is issued for less than 12 months
- the licence relates to a single user dam
- the department has approved an alternative method for measuring the take of water, or
- the licence is exempt from all forms of measurement.

Alternative measurement

The department may approve alternative forms of measurement, for example, for in-stream dams (where metering may not be practical) and in situations where the licensed water take requires more comprehensive monitoring (most likely in addition to metering). This will be assessed on a case by case basis.

Alternative forms of measurement approved for surface water may include but not be limited to dam surveys, installation of staff gauges, or monitoring of water levels.

Exemptions

In some cases, where measurement will provide minimal benefit to water resource management, licensees may be exempt from measuring their water take. A licensee may be exempt from the requirement to measure the quantity of water taken under a licence if the department is satisfied on reasonable grounds that it is impracticable to fit a meter and it is also inappropriate to use an alternative measurement method for measuring the quantity of water taken.

Penalties

Failure to comply with these requirements is an offence and attracts a penalty of $2000 and daily penalty of $200 under prosecution. The department may elect to deal with the offence by way of a modified penalty (i.e. issue an infringement) of $400.

If a licensee fails to comply with the regulations, the department also may formally direct a licensee to comply. The licensee commits an offence if they do not comply with the direction within the specified time-frame and the department may do all or part of whatever the direction requires to be done (such as fitting a meter), and recover the costs from the licensee.

More information

For more information about your responsibilities see our brochure 'Metering your water use' and answers to Frequently Asked Questions on our website at www.dwer.wa.gov.au. Go to Water > Licensing > Metering and measurement.

You can see a full transcript of the regulations and the *Rights in Water and Irrigation Act 1914* at the State Law Publisher's website at www.slp.wa.gov.au/legislation/statutes.

You can use our online services to manage all of your licensing and metering needs. Register for water online at www.dwer.wa.gov.au >Water> Home > Water Online.

Our ref: EWP20132.001

Appendix I
Stormwater management plan - Nairn Drive extension

STORMWATER MANAGEMENT PLAN - NAIRN DRIVE EXTENSION

BACKGROUND AND AREA COVERED BY THIS PLAN

The intention of this Stormwater Management Plan (SMP) is to support the progression of a subdivision application to create a portion of road reserve, being the extension of Nairn Drive within the Parkland Heights Estate (the site). This subdivision will enable the construction of Nairn Drive from the northern boundary of the site to just south of the proposed roundabout to be constructed at the intersection of Arpenteur Drive and Nairn Drive.

This SMP covers Section 1 and 2 of Nairn Drive and a small unconstructed section of Pymmes Junction, as illustrated in Attachment A (the subdivision area) and Attachment B (drainage catchment extents). The Pymmes Junction catchment is included on 28601-NAIRN- SK008(D) of Attachment B.

This SMP responds to a request from the City of Rockingham (CoR) for the purpose of demonstrating the drainage requirements and proposed water management of Section 1 and 2 of Nairn Drive plus a small section of Pymmes Junction. This statement will clarify the stormwater volumes generated by Sections 1 and 2 Nairn Drive and the small section of Pymmes Junction. It will also demonstrate the proposed engineering design and treatment of this stormwater to be implemented within the Nairn Drive road reserve Section 1 and Pymmes Junction and provision of a temporary basin for Section 2.

Parts of the subdivision area drain to Furnivall Parade and Arpenteur Drive (see Attachment B 28601-NAIRN-SK008 and 28601-NAIRN-SK009). These sub-catchment areas are in accordance with the approved Stage 4, 5 and 6 Urban Water Management Plan and are not discussed further.

An indicative staging plan for the site is provided as Attachment C and illustrates the location of each stage. This staging plan should be considered indicative as this a working document which is subject to change but is useful to provide overall context of the development.

Construction of Nairn Drive is a project priority. Therefore, approvals (planning, engineering and landscaping) are being progressed to facilitate civil construction commencing mid 2020. This SMP forms part of this work and is consistent with the currently approved Parkland Heights LWMS.

An LWMS Addendum update will also be developed, relating to the Structure Plan amendment resulting from minor changes to the Stage 13 & 14 subdivision layout. As agreed with the city, this LWMS Addendum will be limited to, and address (1) upstream catchment (2) runoff from lots within Stage 13 & 14 to POSK; and (3) limited commentary on Nairn Drive Section 1 and 2, consistent with this SMP.

DESIGN DETAIL

The following assumptions were used to inform stormwater infrastructure design.

- The *Laurenson Routing Method* was used for modelling runoff of each sub-catchment.
- The XPSWMM Hydraulic model was used for modelling of pit and pipes, swales, basins, and surface conveyance (eg kerb side).

Table 1 Impervious area assumptions

Post-development land use	Percentage as impervious area
Road Reserve	80%
Pymmes Junction Catchment	70%

Table 2 Loss model assumptions

	Initial Loss*	Continuing Loss
Impervious Area	2 mm	Nil
Pervious Area	30 mm	7 mm per hour*

*Pervious area continuing loss as accepted by CoR.

The initial and continuing loss values adopted are based on other sandy sites and are recommended by the CoR for Nairn Drive As agreed with the CoR in recent meetings, these values shall be re-assessed for future Parkland Heights stages, including POSK in Stage 14.

The Pymmes Junction catchment was modelled as 1.31 ha in size, with approximately 70% impervious and 30% pervious areas. The initial and continuing loss rates adopted for pervious areas are consistent with the rates used along Nairn Drive.

Table 3 Mean-Max Design Storms for Nairn Drive sub-catchments

Design Storm	Nairn Drive Sub-Catchments
1% AEP	30min Storm 6
10% AEP	1 hour Storm 3
20% AEP	30min Storm 3
63% AEP (Bio Retention)	1 hour Storm 5

GROUNDWATER LEVELS AND QUALITY

Based on the recent geotechnical investigation of the Parkland Heights Estate, no groundwater was observed within boreholes drilled to depths of up to 2.5 m below surface level.

In addition, as part of Parkland Heights Draft Stage 6 UWMP, the estimated AAMGL underlying Nairn Drive is 4.5 m to 4.95 m AHD. The main proposed levels and the estimated depth to AAMGL is summarised in Table 4 below. Given the significant depth to groundwater, ranging from 10 m to 25 m, groundwater does not present as a constraint to the management of drainage within the Nairn Drive road reserve or surrounding development.

Table 4 Proposed development levels separation to AAMGL

	Proposed Levels (m AHD)	Estimated Depth to AAMGL (m)	Estimated AAMGL (m)
Section 1	22.5 to 29	17.5 to 24	5
Section 2	14.5 to 20	10 to 15.5	4.5
Section 3	29 to 30	24 to 25	5

INFRASTRUCTURE OVERVIEW- UPSTREAM CATCHMENT

The main external catchment from the Ridge Estate to the north is illustrated in 28601-NAIRN-SK007 (C) of Attachment B. It has an area of 9.3 ha and is directed to a storage basin in Lot 334 currently owned by

Rockingham Park Pty Ltd. It was agreed that this site would remain the storage basin for this catchment and that ownership would be transferred to the CoR. The basin has been surveyed and it has a storage volume of 1,852 m3 which is more than adequate to store the 1% AEP of 1,748 m3.

To ensure runoff is diverted to this basin, side entry pits adequate for the 1% AEP and 525/750 diameter pipes directly connected to this basin at the Nairn Drive boundary of Parkland Heights have been incorporated into the design. The upstream Ridge Estate runoff is therefore isolated from Nairn Drive within Parkland Heights.

Additional detailed information relating to this upstream catchment will be included in the Parkland Heights Local Water Management Strategy Addendum (LWMS) as discussed above. This LWMS is currently being updated as part of the Parkland Heights Structure Plan amendment (minor) resulting from minor design changes to proposed Stages 13 and 14.

INFRASTRUCTURE OVERVIEW - SECTION 1 NAIRN DRIVE

Catchment details of Section 1 of Nairn Drive are shown in 28601-NAIRN-008 (D). Drainage generated by Section 1 of Nairn Drive will be managed through a roadside drainage swale that will be located within both the eastern and western verges of the northern portion of Nairn Drive. The location and size of the swales are detailed in 28601-NAIRN-100 (D), 101 (D),-102 (C), with typical cross sections detailed in 28601-NAIRN-128 (B), Attachment D.

The swales are designed to capture all flows up to the 1% AEP, with a total catchment area of 1.43 ha. The swales will be 'V' shaped with side slopes designed at 1 in 6 batters with a maximum depth of 300 mm, providing a total storage capacity of 302 m^3. The swales will be 6 m wide and will be located between the carriageway (including the bike lane) and the footpath, on both sides of Section 1. Stormwater will streetflow from the road to the swale. No stormwater will be directed towards the median of Nairn Drive.

INFRASTRUCTURE OVERVIEW - SECTION 2 NAIRN DRIVE

Stormwater runoff for Section 2 of Nairn Drive adjoining the Neighbourhood Centre will be captured via a pit and pipe system which will ultimately connect and discharge to the future POS M via the future Arpenteur Drive (east of Nairn Drive). Catchment details of the Section 2 system are illustrated in 28601-NAIRN-SK009 (C) of Attachment B. Detailed design of the pit and pipe system was included in the amended engineering package previously provided to the CoR on the 28 April 2020.

As an interim measure, the Section 2 of Nairn Drive pit and pipe system will discharge into a temporary basin located to the south east of the Nairn Drive /Arpenteur Drive roundabout (refer 28601-NAIRN-SK009(C) and 28601-NAIRN-603 (B) of Attachment B for the temporary basin location and design details. The temporary basin allows for 1% AEP / 1:100 year event.

Temporary basin design details, a cross-section details were included in the amended engineering package previously provided to the CoR on the 28 April 2020. The basin will include side batters at a slope of no more than 1:4 and the temporary basin will be fenced to ensure access is restricted. No landscaping of the temporary basin is proposed to be undertaken as the basin will be relocated when future Stage 9 is developed, and POS M is installed.

INFRASTUCTURE OVERVIEW - PYMMES JUNCTION

The Pymmes Junction catchment contains an area of 1.31 ha and will be constructed as part of the Nairn Drive extension works. Details of this catchment and runoff are included in 28601-NAIRN-SK008(D) of Attachment B. Runoff from Pymmes Junction catchment has been included as part of Nairn Drive Section 1 catchment calculations, and will be managed within the series of roadside swales provided within Section 1 of Nairn Drive as indicated in Attachment B.

RESPONSIBILITIES AND MANAGEMENT ARRANGEMENTS

Construction and management of all infrastructure described will be the responsibility of the developer until such time as handover to the CoR. Prior to handover of the temporary basin, on implementation of subdivision for adjacent Stage 9, the temporary basin described for Section 2 will be decommissioned and completely removed.

LANDSCAPING

A preliminary landscape design concept for Nairn Drive is detailed in Attachment E.

Attachment E illustrates a combination of planted and turfed swales for the extent of the Section 1 design. Please note this Landscape Plan is conceptual only and detailed design and documentation will be finalised for City of Rockingham approval following approval of the engineering drawings.

The proposed treatments for Section 1 of Nairn Drive for the verge and median will include two specifications detailed below:

- Verges, 600 mm mulch only offset and planting with native trees at 10 m spacings to drainage swale area and footpath; or
- Verges, turf with native trees at 10 m spacings to drainage swale area and footpath.
- Median will be kerbed with turf with *Eucalyptus gomphocephala* (Tuart) trees at 15 m spacings.

The proposed treatments for Section 2 of Nairn Drive for the verge and median will include:

- Verges with a kerb, turf with native trees at 10m spacings and footpath
- Median with a kerb, 600mm paving offset with mulch and planting including *Araucaria heterophylla* (Norfolk Pine) at 15m spacings

The proposed tree species to be utilised in the verges of Nairn Drive (both Section 1 and 2) will be confirmed by CoR, as per suggestions in Concept Document Attachment D and issued on 18th Dec 2019 by LD Total.

WATER RESOURCING

Groundwater Licence GWL164680(10) (Attachment F) applies to both Parkland Heights and Heritage Park and provides for a total annual allocation of 101,320 kL from the Stakehill Perth-Superficial Swan aquifer. A balance of 52,579 kL/annum is available for the Parkland Heights estate; of this it is estimated the entire Nairn Drive area will require approximately 10,000 - 15,000 kL (max) per annum for irrigation purposes. Table 5 below illustrates the use of the of the allocation within the estate more broadly and demonstrates the availability of this volume for use in the Nairn Drive sections.

Table 5: Nairn Drive Section 1 and 2 water use and irrigation schedule

Groundwater will be supplied from a bore to be constructed in future POS K, within Stage 13 and 14 and was approved for construction by the DWER on 10 December 2019.

PARKLAND HEIGHTS STAGED WATER USE AND IRRIGATION SCHEDULE 4th Jan 2020										
7,500kL/ha/a 9,000kL/ha/a - DOS	**Total POS & Streetscape area m2**	**Irrigated Area (m2)**	**Irrigated turf area %**	**Irrigated Turf area (m²)**	**Volume - Turf (kL/yr)**	**Irrigated Planting %**	**Irrigated Planting area (m2)**	**Volume - Planting (kL/yr)**	**Non - Irrigated Areas (m2)**	**TOTAL VOLUME Volume - Planting & Turf (kL/yr)**
Nairn Drive										
Section 1 + 2	15,301	12,472	**70.0%**	10,711	8,033	**20%**	1,761	2,295	2,829	**10,328**
Section 3	11,283	10,155	**40.0%**	4,513	3,385	**50%**	5,642	4,231	1,128	**7,616**
TOTALS FOR ESTATE										**52,579**

ATTACHMENT A

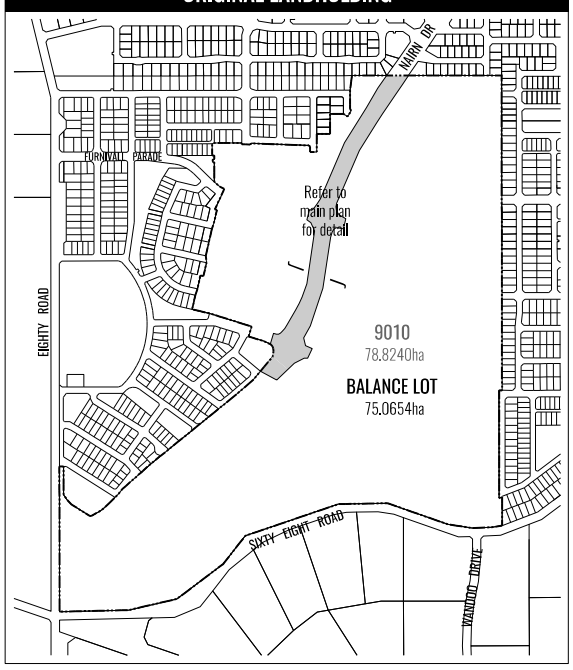
Proposed subdivision

LEGEND

- APPLICATION AREA (78.8240ha)
- CONTOUR (1.0m)
- DEDICATED CYCLE LANE
- SHARED PATH

NOTE: ALL FOOTPATHS AND SHARED PATHS ARE INDICATIVE ONLY AND SUBJECT TO ENGINEERING DESIGN

ORIGINAL LANDHOLDING



APPROVED SUBDIVISION
WAPC REF: 152391

APPROVED SUBDIVISION
WAPC REF: 155055

APPROVED SUBDIVISION
WAPC REF: 156276

PROPOSED SUBDIVISION

Lot 9010 Nairn Drive, BALDIVIS

A Rockingham Park Project

NORTH

Scale: 1:2500 @ A3

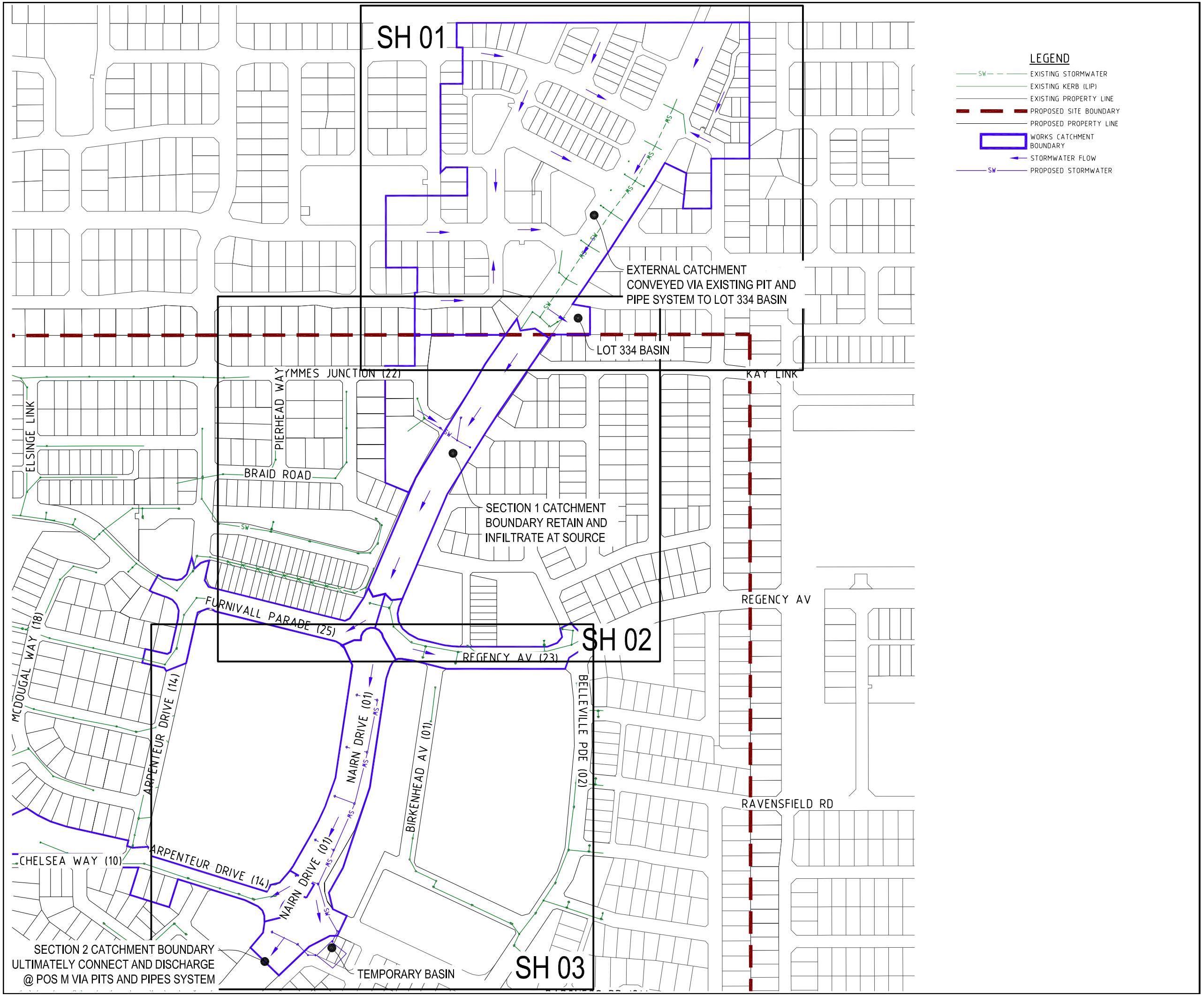
0 25 50 75m

PLAN: RHPPH-3-005B REVISION: B
DATE: 03/10/2019 DRAWN: RW
PROJECTION: PCG 94 PLANNER: TV
DATUM: AHD CHECK: TV

A 28 Brown Street, East Perth WA 6004
P (08) 9325 0200
E info@creativedp.com.au
W creativedp.com.au

ATTACHMENT B

Drainage catchment extents



PROJECT NAME

PARKLAND HEIGHTS

NAIRN DRIVE

CLIENT

Rockingham Park Pty Ltd

NORTH

0 20 40 60 80 100m

Scale 1:2000 - A1 (1:4000 - A3)

ISSUES	DATE	
TENDER		
COUNCIL		
WATER CORPORATION		
CONSTRUCTION		

PRE	DATE	AMENDMENT
B	04-02-20	MINOR UPDATES
A	04-11-19	PRELIMINARY ISSUE

ASSOCIATED CONSULTANTS

DRAWING TITLE

NAIRN DRIVE
DRAINAGE CATCHMENTS
KEYPLAN

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

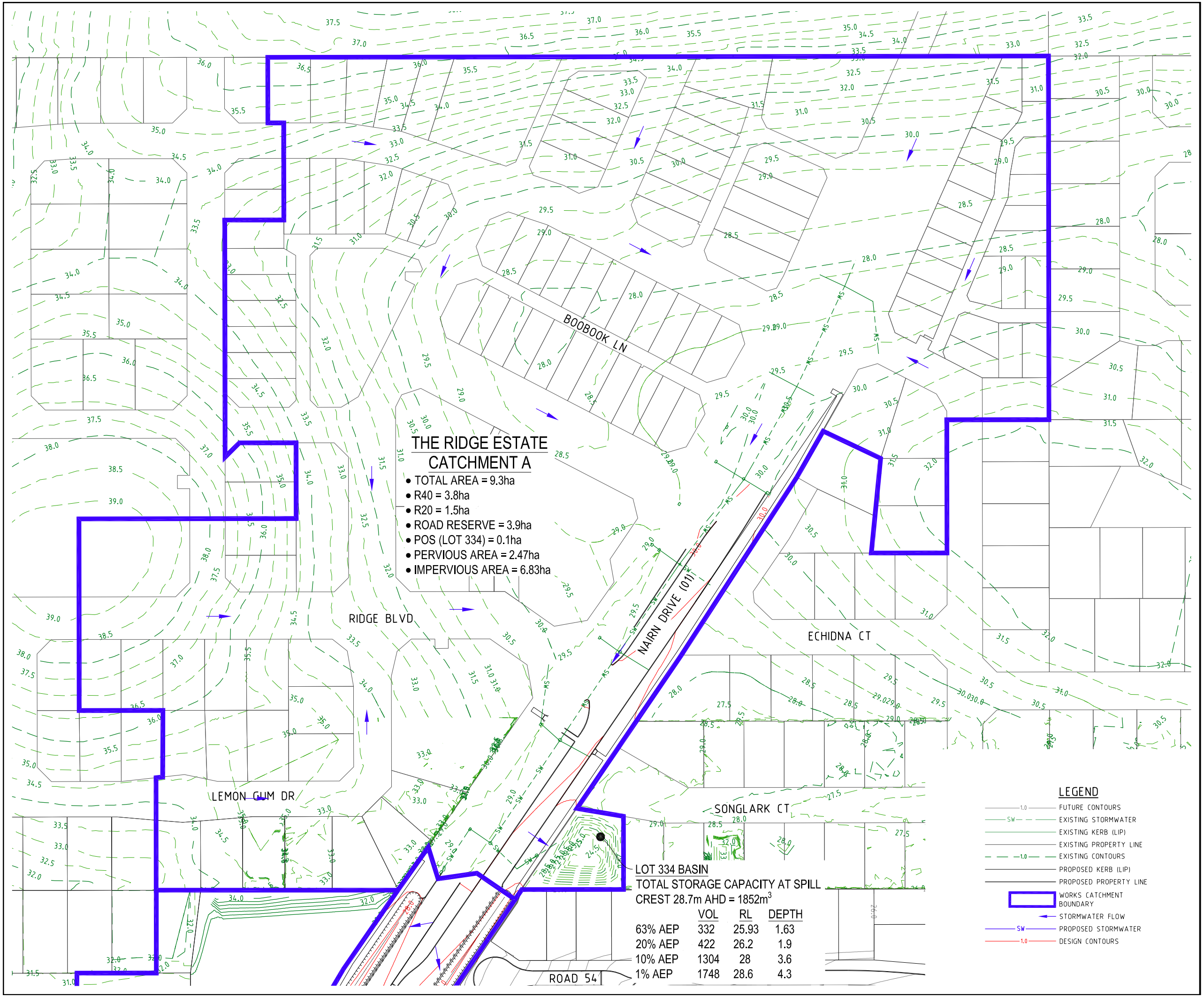
Postal Address
U4 100 Railway Road
Subiaco 6008

Email: mortons@urbansolutions.net.au
Website www.urbansolutions.net.au
Tel 08 9380 9700

Perth Office
U4 100 Railway Road
Subiaco 6008

DESIGNED	CL	DRAWN	CB
APPROVED		DATE	04-11-19

DRAWING NUMBER	AMEND.
28601-NAIRN-SK006	B



PROJECT NAME

PARKLAND HEIGHTS

NAIRN DRIVE

CLIENT

Rockingham Park Pty Ltd

NORTH

0 7.5 15 22.5 30 37.5m

Scale 1:750 - A1 (1:1500 - A3)

ISSUES	DATE	
TENDER		
COUNCIL		
WATER CORPORATION		
CONSTRUCTION		

C	03-06-20	DESIGN UPDATES
B	04-02-20	MINOR UPDATES
A	04-11-19	PRELIMINARY ISSUE
PRE	DATE	AMENDMENT

ASSOCIATED CONSULTANTS

DRAWING TITLE

NAIRN DRIVE
DRAINAGE CATCHMENTS
SHEET 01

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As
Mortons-Urban Solutions
ABN 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

Email mortons@urbansolutions.net.au
Website www.urbansolutions.net.au
Tel 08 9380 9700

Perth Office
U4 100 Railway Road
Subiaco 6008

DESIGNED	CL	DRAWN	CB
APPROVED		DATE	04-11-19

DRAWING NUMBER	AMEND.
28601-NAIRN-SK007	C

LEMON GUM DR

SONGLARK CT

PYMMES JUNCTION (22)

PYMMES JUNCTION CATCHMENT
• CATCHMENT AREA = 1.314ha

PIERHEAD

WONDSWORTH CCT

BRAID ROAD

NAIRN DRIVE (01)

SECTION 1 CATCHMENT
• CATCHMENT AREA = 1.43ha

ROAD 54

ROAD 52

ROAD 53

ROAD 55

ROAD 51

ROAD 59

ROAD 50

WONDSWORTH CCT (28)

ROAD (30)

FURNIVALL PARADE (25)

IN ACCORDANCE WITH
STAGE 6 UWMP AND LWMS

ROAD 58

IN ACCORDANCE WITH STAGE 12 DMP

REGENCY AV (23)

LEGEND

- FUTURE CONTOURS
- EXISTING STORMWATER
- EXISTING KERB (LIP)
- EXISTING PROPERTY LINE
- EXISTING CONTOURS
- PROPOSED KERB (LIP)
- PROPOSED PROPERTY LINE
- WORKS CATCHMENT BOUNDARY
- STORMWATER FLOW
- PROPOSED STORMWATER
- DESIGN CONTOURS

PROJECT NAME

PARKLAND HEIGHTS

NAIRN DRIVE

CLIENT

Rockingham Park Pty Ltd

NORTH

0 7.5 15 22.5 30 37.5m

Scale 1:750 - A1 (1:1500 - A3)

ISSUES	DATE	
TENDER		
COUNCIL		
WATER CORPORATION		
CONSTRUCTION		

PRE	DATE	AMENDMENT
D	03-06-20	DESIGN UPDATES
C	10-03-20	MINOR UPDATES TO SUIT CoR
B	04-02-20	MINOR UPDATES
A	04-11-19	PRELIMINARY ISSUE

ASSOCIATED CONSULTANTS

DRAWING TITLE

NAIRN DRIVE
DRAINAGE CATCHMENTS
SHEET 02

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

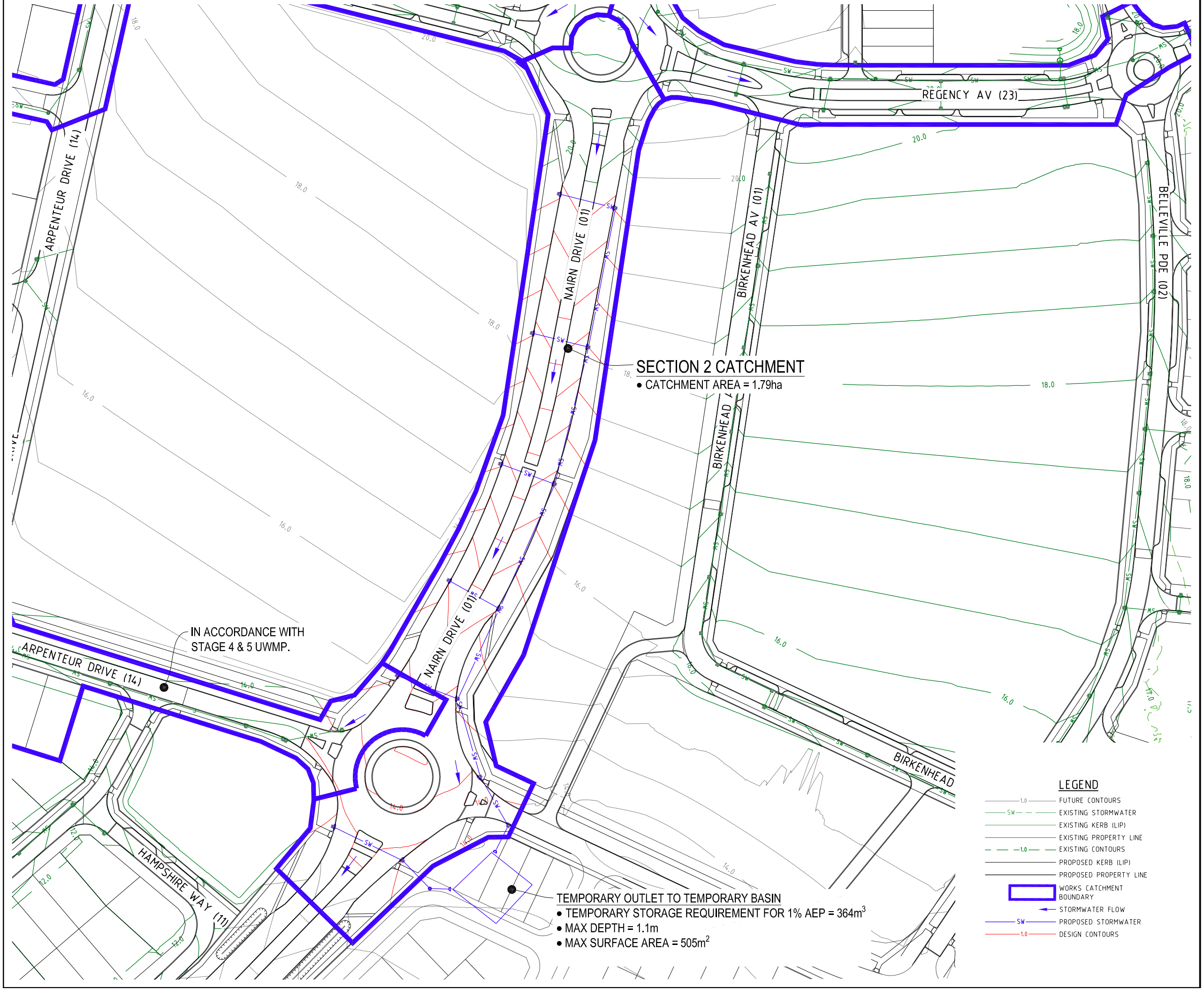
Postal Address
U4 100 Railway Road
Subiaco 6008

Email: mortons@urbansolutions.net.au
Website: www.urbansolutions.net.au
Tel 08 9380 9700

Perth Office
U4 100 Railway Road
Subiaco 6008

DESIGNED	CL	DRAWN	CB
APPROVED		DATE	04-11-19

DRAWING NUMBER	AMEND.
28601-NAIRN-SK008	D



PROJECT NAME

PARKLAND HEIGHTS

NAIRN DRIVE

CLIENT

Rockingham Park Pty Ltd

NORTH

0 7.5 15 22.5 30 37.5m

Scale 1:750 - A1 (1:1500 - A3)

ISSUES	DATE	
TENDER		
COUNCIL		
WATER CORPORATION		
CONSTRUCTION		

PRE	DATE	AMENDMENT
C	13-05-20	MINOR UPDATES
B	04-02-20	MINOR UPDATES
A	04-11-19	PRELIMINARY ISSUE

ASSOCIATED CONSULTANTS

DRAWING TITLE

NAIRN DRIVE
DRAINAGE CATCHMENTS
SHEET 03

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

Email: mortons@urbansolutions.net.au
Website: www.urbansolutions.net.au
Tel 08 9380 9700

Perth Office
U4 100 Railway Road
Subiaco 6008

DESIGNED	CL	DRAWN	CB
APPROVED		DATE	04-11-19

DRAWING NUMBER	AMEND.
28601-NAIRN-SK009	C

DRAINAGE BUILT UNDER ARPENTEUR DRIVE EXTENSION, 28601-RDEXT (WAPC REF: 158684)

ADJOINS SHEET 3

ARPENTEUR DRIVE (14)

ARPENTEUR DRIVE (24)

NAIRN DRIVE (01)

GIVERNY AV (12)

HAMPSHIRE WAY (11)

03/002 SEP
U/S=11.35
375/200
D=27.1
D/S=11.22

06/001 GRATED PIT
D/S 11.38

05/001 SEP
U/S 11.44
D/S 11.66

04/001 SEP TRAPPED
Ø 375 / 200.0
D=52.1
U/S 11.97
D=60.2

03/001 (SAG) SEP TRAPPED
U/S 12.16
Ø 300/200
D= 1.3
D/S 12.15

02/001 (SAG) SEP TRAPPED

01/001 SEP TRAPPED
U/S 12.12
Ø 300/200
D= 16.6
D/S 12.04

U/S 12.31
Ø 300/200
D= 24.3
D/S 12.19

01/021 SEP TRAPPED
U/S 13.50
Ø 300/182.3
D= 24.7
D/S 13.37

01/022 SEP TRAPPED
U/S 12.85
Ø 300/200
D= 27.6
D/S 12.71

04/020 SEP TRAPPED
U/S 14.69
Ø 300 / 43.6
D=57.7
D/S 13.37

05/020 SEP TRAPPED

06/020 SEP TRAPPED
U/S 13.22
Ø 450/63.7
D= 41.9
D/S 12.56

U/S 12.48
Ø 525/200
D= 34.2
D/S 12.31

07/020 SEP TRAPPED
U/S 12.28
Ø 525/93.7
D= 23.9
D/S 12.03

08/020 SEP TRAPPED 1200Ø
U/S 11.95
Ø 600/243.3
D= 11.8
D/S 11.90

09/020 STD HEADWALL

01/154 SEP TRAPPED
U/S 12.03
Ø 300/200
D=32.9
D/S 11.86

02/154 SEP TRAPPED

04/154 STD HEADWALL

03/154 JUNCTION PIT
U/S 11.83
Ø 300/200
D=16.4
D/S 11.75

U/S 11.72
Ø 300/200
D=8.2
D/S 11.68

4m² OF 320mm THICK GROUTED ROCK.
d50 = 200mm

PROVIDE TEMPORARY BASIN. 500m² BASE AT RL11.9 AND 1:3 BATTER SLOPES TO NATURAL. BASIN TO BE ENCAPSULATED BY A TEMPORARY 1.8m HIGH PVC COATED CHAIN LINK FENCE WITH ACCESS GATE.

U/S 15.28
Ø 300/47.7
D= 27.0
D/S 14.72

U/S 14.69
Ø 300/88.8
D= 24.1
D/S 14.41

07/17 GRATED TRAPPE

U/S 14.38
Ø 300/186.6
D= 15.0
D/S 14.30

08/171 GRATED PI TRAPPED

FUTURE DRAINAGE IS INDICATIVE ONLY AND SUBJECT TO CHANGE DURING DETAILED DESIGN.

SHEET LAYOUT
SH 1
SH 2
SH 3
SH 4

PROJECT NAME

PARKLAND HEIGHTS

NAIRN DRIVE, SECTIONS 1, 2 & 3

CLIENT

Rockingham Park Pty Ltd

NORTH

0 5 10 15 20 25m

Scale 1:500 - A1 (1:1000 - A3)

ISSUES	DATE	
TENDER	30-04-20	
COUNCIL	24-01-20	
CONSTRUCTION		

PRE	DATE	AMENDMENT
B	16-03-20	DETAILS AMENDED
A	24-01-20	COUNCIL ISSUE

WAPC REF: 158551

ASSOCIATED CONSULTANTS

3 CONSULTING ENGINEERS PTY LTD
Electrical Engineering Excellence

DRAWING TITLE

DRAINAGE PLAN
SHEET 04

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As
Mortons-Urban Solutions
ABN 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

Email mortons@urbansolutions.net.au
Website www.urbansolutions.net.au
Tel 08 9380 9700

Perth Office
U4 100 Railway Road
Subiaco 6008

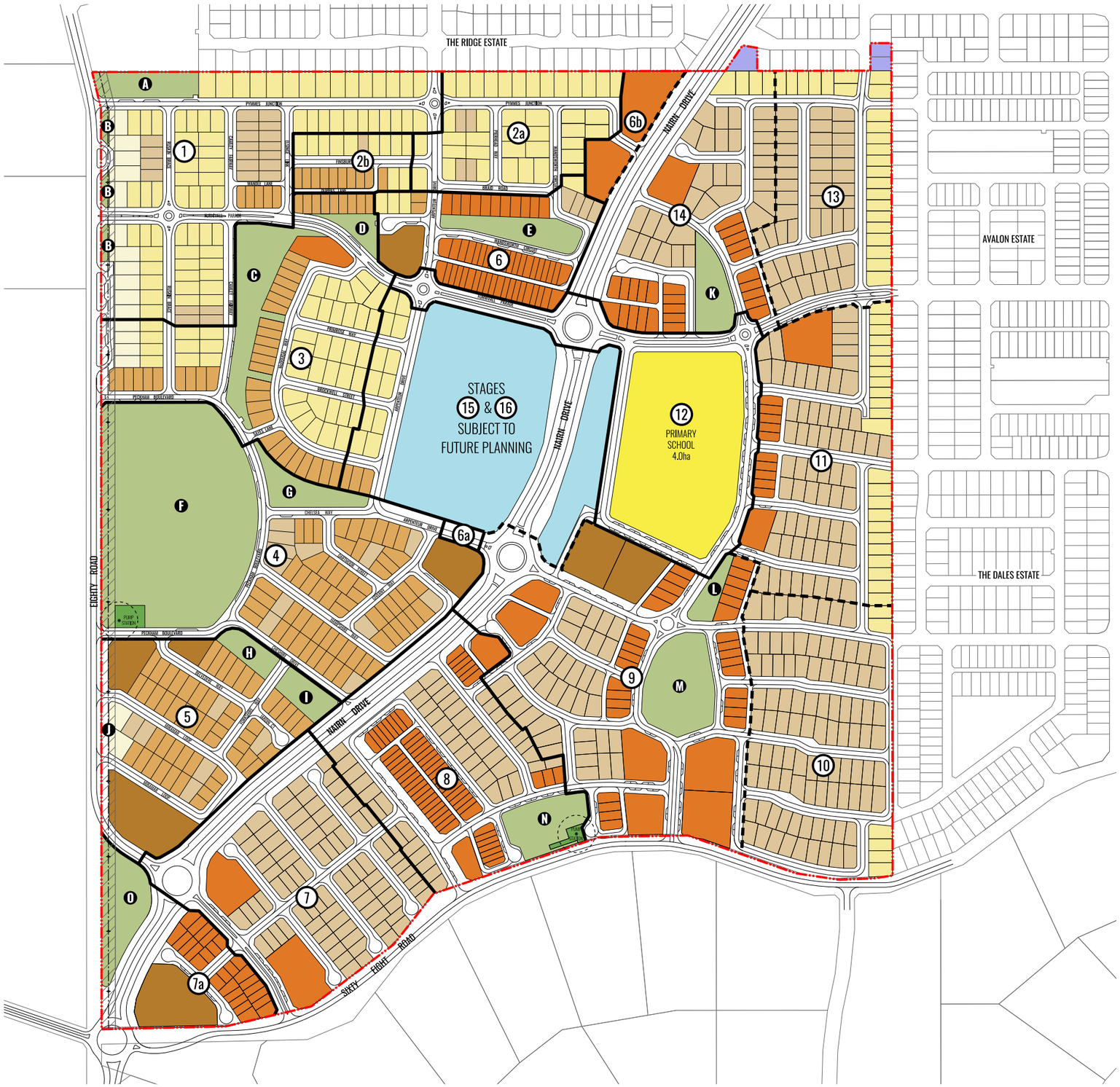
DESIGNED	GW	DRAWN	CB
APPROVED		RPEQ	DATE 24-01-20

DRAWING NUMBER: 28601-NAIRN-603

AMEND.: B

ATTACHMENT C

Indicative staging plan



STAGE 1				
TYPE	AREA	LOTS	GH DWELLINGS	AVE. LOT SIZE
RESIDENTIAL R15	8445m²	11	-	767m²
RESIDENTIAL R20	4.0120ha	70	-	573m²
RESIDENTIAL R25	9376m²	22	-	426m²
RESIDENTIAL R30	1787m²	5	-	357m²
Total	**5.9731ha**	**108**	**-**	

STAGE 2A & 2B				
TYPE	AREA	LOTS	GH DWELLINGS	AVE. LOT SIZE
RESIDENTIAL R20	3.001ha	50	-	600m²
RESIDENTIAL R25	2115m²	5	-	423m²
RESIDENTIAL R30	3407m²	10	-	340m²
Total	**3.553ha**	**65**	**-**	

STAGE 3				
TYPE	AREA	LOTS	GH DWELLINGS	AVE. LOT SIZE
RESIDENTIAL R15	2278m²	4	-	569m²
RESIDENTIAL R20	2.535ha	44	-	576m²
RESIDENTIAL R30	1.836ha	43	-	426m²
RESIDENTIAL R40	2317m²	1 GH	10	231m²
Total	**4.830ha**	**92**	**10**	

STAGE 4				
TYPE	AREA	LOTS	GH DWELLINGS	AVE. LOT SIZE
RESIDENTIAL R25	7360m²	12	-	613m²
RESIDENTIAL R30	2.766ha	61	-	453m²
RESIDENTIAL R60	4235m²	1 GH	28	151m²
Total	**3.925ha**	**74**	**28**	

STAGE 5				
TYPE	AREA	LOTS	GH DWELLINGS	AVE. LOT SIZE
RESIDENTIAL R15	1837m²	2	-	918m²
RESIDENTIAL R25	3657m²	6	-	609m²
RESIDENTIAL R30	2.342ha	52	-	450m²
RESIDENTIAL R60	1.257ha	3 GH	83	151m²
Total	**4.148ha**	**63**	**83**	

STAGE 6, 6A & 6B				
TYPE	AREA	LOTS	GH DWELLINGS	AVE. LOT SIZE
RESIDENTIAL R20	2125m²	4	-	531m²
RESIDENTIAL R25	1719m²	4	-	429m²
RESIDENTIAL R30	632m²	2	-	316m²
RESIDENTIAL R40	2.3731ha	53 (2 GH)	40	260m²
RESIDENTIAL R60	3449m²	1 GH	22	156m²
Total	**3.165ha**	**64**	**62**	

STAGE 7				
TYPE	AREA	LOTS	GH DWELLINGS	AVE. LOT SIZE
RESIDENTIAL R25	3.403ha	83	-	410m²
RESIDENTIAL R40	8582m²	2 GH	39	220m²
Total	**4.261ha**	**85**	**39**	

STAGE 7A				
TYPE	AREA	LOTS	GH DWELLINGS	AVE. LOT SIZE
RESIDENTIAL R40	8847m²	27	-	327m²
RESIDENTIAL R60	7013m²	1 GH	46	152m²
Total	**1.5860ha**	**28**	**46**	

STAGE 8				
TYPE	AREA	LOTS	GH DWELLINGS	AVE. LOT SIZE
RESIDENTIAL R25	2.0372ha	49	-	415m²
RESIDENTIAL R40	1.7411ha	62 (2 GH)	14	235m²
Total	**3.7783ha**	**111**	**14**	

STAGE 9				
TYPE	AREA	LOTS	GH DWELLINGS	AVE. LOT SIZE
RESIDENTIAL R25	2.0871ha	37	-	564m²
RESIDENTIAL R40	3.2467ha	39 (6 GH)	88	268m²
RESIDENTIAL R60	8905m²	2 GH	59	151m²
Total	**6.2243ha**	**78**	**147**	

STAGE 10				
TYPE	AREA	LOTS	GH DWELLINGS	AVE. LOT SIZE
RESIDENTIAL R20	3358m²	6	-	560m²
RESIDENTIAL R25	4.9551ha	95	-	521m²
Total	**5.2909ha**	**101**	**-**	

STAGE 11				
TYPE	AREA	LOTS	GH DWELLINGS	AVE. LOT SIZE
RESIDENTIAL R20	1.1376ha	23	-	495m²
RESIDENTIAL R25	3.3748ha	65	-	519m²
RESIDENTIAL R40	0.9892ha	12 (2 GH)	27	265m²
Total	**5.5015ha**	**100**	**27**	

STAGE 13				
TYPE	AREA	LOTS	GH DWELLINGS	AVE. LOT SIZE
RESIDENTIAL R20	1.2709ha	24	-	529m²
RESIDENTIAL R25	2.4068ha	46	-	523m²
Total	**3.6777ha**	**70**	**-**	

STAGE 14				
TYPE	AREA	LOTS	GH DWELLINGS	AVE. LOT SIZE
RESIDENTIAL R20	2497m²	4	-	624m²
RESIDENTIAL R25	1.9749ha	32	-	617m²
RESIDENTIAL R40	1.3356ha	26 (1 GH)	13	351m²
Total	**3.5603ha**	**62**	**13**	

LEGEND

ZONES/RESERVES

- RESIDENTIAL R15
- RESIDENTIAL R20
- RESIDENTIAL R25
- RESIDENTIAL R30
- RESIDENTIAL R40
- RESIDENTIAL R60
- COMMERCIAL
- EDUCATION
- PUBLIC OPEN SPACE

OTHER

- LOCAL STRUCTURE PLAN BOUNDARY
- STAGING BOUNDARY (APPROVED SUBDIVISION)
- STAGING BOUNDARY (FUTURE INDICATIVE SUBDIVISION - SUBJECT TO CHANGE)
- SEWER PUMP STATION
- PUMP STATION ODOUR BUFFER
- POWERLINE EASEMENT
- ROAD WIDENING (SIXTY EIGHT ROAD)
- FUTURE LOTS TO BE DEVELOPED - OWNED BY RP

OVERALL LOT YIELD

SINGLE RESIDENTIAL LOTS (not including stages 15&16)	1077
GROUPED HOUSING LOTS	24
GROUPED HOUSING DWELLINGS	469
OVERALL DWELLINGS	**1546**

PUBLIC OPEN SPACE TABLE

NOTES	AREA (ha)	NOTES	CREDITABLE AREA (ha)
A	0.4823	I	0.3235
B	0.1463	J	CONVERTED TO ROAD RESERVE
C	1.1240	K	0.5316
D	0.2283	L	0.2328
E	0.5681	M	1.0935
F	5.7736	N	0.6745
G	0.5129	O	0.8475
H	0.2747		
TOTAL AREA OF POS & DRAINAGE	**12.8136ha**		
% OF GROSS LANDHOLDING	**10.59%**		

INDICATIVE STAGING PLAN

Lot 1507 Eighty Road, BALDIVIS

A Rockingham Park Project

NORTH

Scale: 1:6000 @ A3

0 60 120 180m

PLAN: RHPPH-5-001K REVISION: K
DATE: 28/10/2019 DRAWN: JP
PROJECTION: PCG 94 PLANNER: BK
DATUM: AHD CHECK: TV

A 28 Brown Street, East Perth WA 6004
P (08) 9325 0200
E info@creativedp.com.au
W creativedp.com.au

ATTACHMENT D

Swale design detail

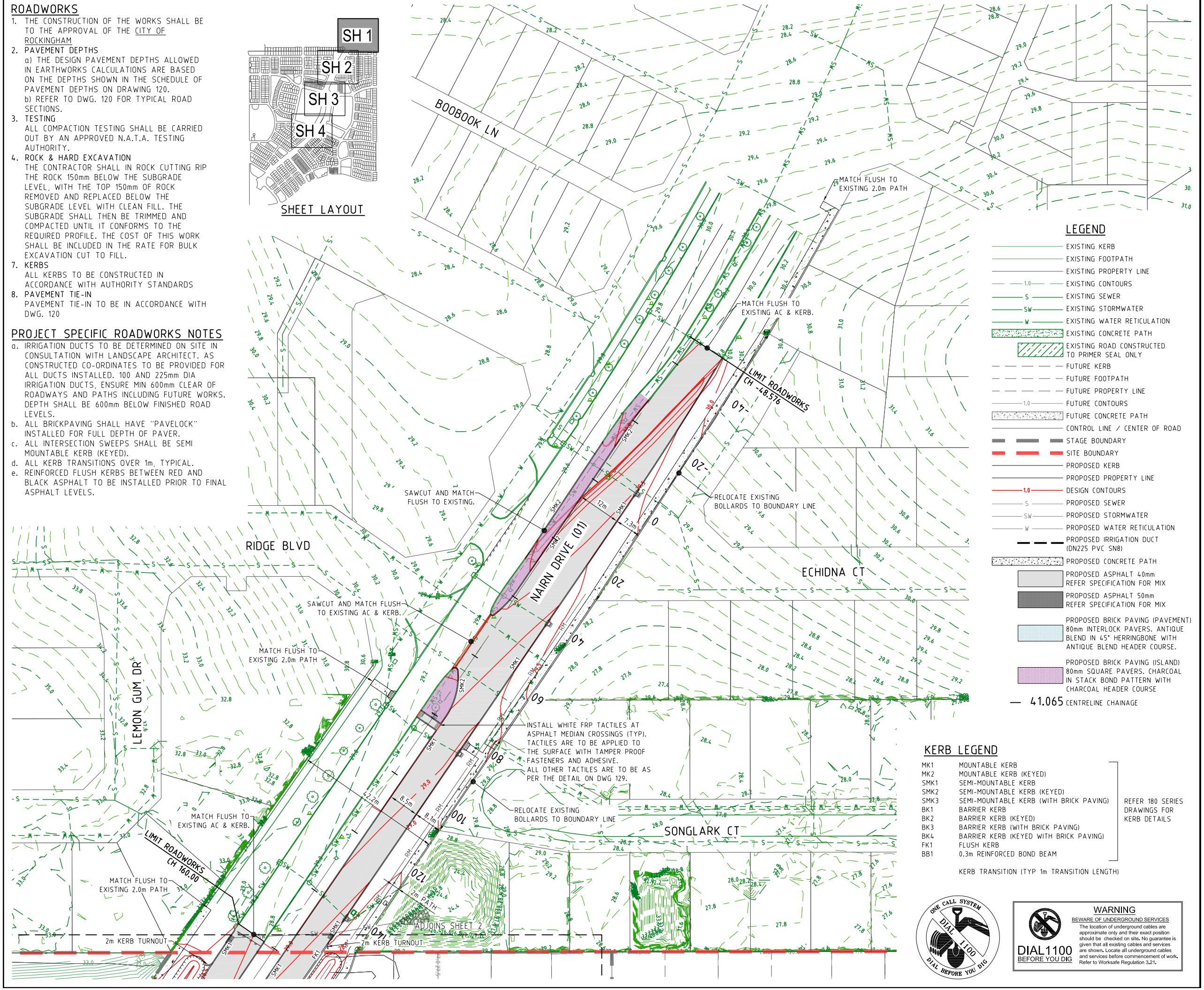
ROADWORKS

1. THE CONSTRUCTION OF THE WORKS SHALL BE TO THE APPROVAL OF THE CITY OF ROCKINGHAM
2. PAVEMENT DEPTHS
   a) THE DESIGN PAVEMENT DEPTHS ALLOWED IN EARTHWORKS CALCULATIONS ARE BASED ON THE DEPTHS SHOWN IN THE SCHEDULE OF PAVEMENT DEPTHS ON DRAWING 120.
   b) REFER TO DWG. 120 FOR TYPICAL ROAD SECTIONS.
3. TESTING
   ALL COMPACTION TESTING SHALL BE CARRIED OUT BY AN APPROVED N.A.T.A. TESTING AUTHORITY.
4. ROCK & HARD EXCAVATION
   THE CONTRACTOR SHALL IN ROCK CUTTING RIP THE ROCK 150mm BELOW THE SUBGRADE LEVEL, WITH THE TOP 150mm OF ROCK REMOVED AND REPLACED BELOW THE SUBGRADE LEVEL WITH CLEAN FILL. THE SUBGRADE SHALL THEN BE TRIMMED AND COMPACTED UNTIL IT CONFORMS TO THE REQUIRED PROFILE. THE COST OF THIS WORK SHALL BE INCLUDED IN THE RATE FOR BULK EXCAVATION CUT TO FILL.
7. KERBS
   ALL KERBS TO BE CONSTRUCTED IN ACCORDANCE WITH AUTHORITY STANDARDS
8. PAVEMENT TIE-IN
   PAVEMENT TIE-IN TO BE IN ACCORDANCE WITH DWG. 120

PROJECT SPECIFIC ROADWORKS NOTES

a. IRRIGATION DUCTS TO BE DETERMINED ON SITE IN CONSULTATION WITH LANDSCAPE ARCHITECT. AS CONSTRUCTED CO-ORDINATES TO BE PROVIDED FOR ALL DUCTS INSTALLED. 100 AND 225mm DIA IRRIGATION DUCTS, ENSURE MIN 600mm CLEAR OF ROADWAYS AND PATHS INCLUDING FUTURE WORKS. DEPTH SHALL BE 600mm BELOW FINISHED ROAD LEVELS.
b. ALL BRICKPAVING SHALL HAVE "PAVELOCK" INSTALLED FOR FULL DEPTH OF PAVER.
c. ALL INTERSECTION SWEEPS SHALL BE SEMI MOUNTABLE KERB (KEYED).
d. ALL KERB TRANSITIONS OVER 1m, TYPICAL.
e. REINFORCED FLUSH KERBS BETWEEN RED AND BLACK ASPHALT TO BE INSTALLED PRIOR TO FINAL ASPHALT LEVELS.

SHEET LAYOUT



LEGEND

- EXISTING KERB
- EXISTING FOOTPATH
- EXISTING PROPERTY LINE
- 1.0 EXISTING CONTOURS
- S EXISTING SEWER
- SW EXISTING STORMWATER
- W EXISTING WATER RETICULATION
- EXISTING CONCRETE PATH
- EXISTING ROAD CONSTRUCTED TO PRIMER SEAL ONLY
- FUTURE KERB
- FUTURE FOOTPATH
- FUTURE PROPERTY LINE
- 1.0 FUTURE CONTOURS
- FUTURE CONCRETE PATH
- CONTROL LINE / CENTER OF ROAD
- STAGE BOUNDARY
- SITE BOUNDARY
- PROPOSED KERB
- PROPOSED PROPERTY LINE
- 1.0 DESIGN CONTOURS
- S PROPOSED SEWER
- SW PROPOSED STORMWATER
- W PROPOSED WATER RETICULATION
- PROPOSED IRRIGATION DUCT (DN225 PVC SN8)
- PROPOSED CONCRETE PATH
- PROPOSED ASPHALT 40mm REFER SPECIFICATION FOR MIX
- PROPOSED ASPHALT 50mm REFER SPECIFICATION FOR MIX
- PROPOSED BRICK PAVING (PAVEMENT) 80mm INTERLOCK PAVERS. ANTIQUE BLEND IN 45° HERRINGBONE WITH ANTIQUE BLEND HEADER COURSE.
- PROPOSED BRICK PAVING (ISLAND) 80mm SQUARE PAVERS. CHARCOAL IN STACK BOND PATTERN WITH CHARCOAL HEADER COURSE
- 41.065 CENTRELINE CHAINAGE

KERB LEGEND

MK1	MOUNTABLE KERB
MK2	MOUNTABLE KERB (KEYED)
SMK1	SEMI-MOUNTABLE KERB
SMK2	SEMI-MOUNTABLE KERB (KEYED)
SMK3	SEMI-MOUNTABLE KERB (WITH BRICK PAVING)
BK1	BARRIER KERB
BK2	BARRIER KERB (KEYED)
BK3	BARRIER KERB (WITH BRICK PAVING)
BK4	BARRIER KERB (KEYED WITH BRICK PAVING)
FK1	FLUSH KERB
BB1	0.3m REINFORCED BOND BEAM

REFER 180 SERIES DRAWINGS FOR KERB DETAILS

KERB TRANSITION (TYP 1m TRANSITION LENGTH)

ONE CALL SYSTEM DIAL 1100 DIAL BEFORE YOU DIG

DIAL1100 BEFORE YOU DIG

WARNING

BEWARE OF UNDERGROUND SERVICES

The location of underground cables are approximate only and their exact position should be checked on site. No guarantee is given that all existing cables and services are shown. Locate all underground cables and services before commencement of work. Refer to Worksafe Regulation 3.21.

PROJECT NAME

PARKLAND HEIGHTS

NAIRN DRIVE, SECTIONS 1, 2 & 3

CLIENT

Rockingham Park Pty Ltd

NORTH

0 5 10 15 20 25m

Scale 1:500 - A1 (1:1000 - A3)

ISSUES	DATE	
TENDER	30-04-20	
COUNCIL	24-01-20	
CONSTRUCTION		

D	01-06-20	HATCH, IRRIGATION DUCT & NOTATION TO BOLLARDS
C	14-05-20	LEGEND REVISED
B	16-03-20	DETAILS REVISED
A	24-01-20	COUNCIL ISSUE
PRE	DATE	AMENDMENT

WAPC REF: 158551

ASSOCIATED CONSULTANTS

3 CONSULTING ENGINEERS PTY LTD

Electrical Engineering Excellence

DRAWING TITLE

ROADWORKS PLAN
SHEET 01

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

Email: mortons@urbansolutions.net.au
Website: www.urbansolutions.net.au
Tel 08 9380 9700

Perth Office
U4 100 Railway Road
Subiaco 6008

DESIGNED	GW	DRAWN	CB
APPROVED		RPEQ	DATE 24-01-20

DRAWING NUMBER 28601-NAIRN-100

AMEND. D

PYMMES JUNCTION (22)

WONDSWORTH CCT (28)

BRAID ROAD

TH CCT (28)

NAIRN DRIVE (01)

ADJOINS SHEET 1

ADJOINS SHEET 3

ROAD 54

ROAD 53

ROAD 52

ROAD 51

ROAD 59

STAGE 06B

STAGE 14

02A

WALL BUILT UNDER PYMMES JUNCTION EXTENSION, 28601-RDEXT1 (WAPC REF: 158748)

WALL BUILT UNDER PYMMES JUNCTION EXTENSION, 28601-RDEXT1 (WAPC REF: 158748)

2m KERB TURNOUT

2m KERB TURNOUT

2.3m PATH

2.3m PATH

2m PATH

MATCH FLUSH TO 2.0m PATH BUILT UNDER PYMMES JUNCTION EXTENSION, 28601-RDEXT1 (WAPC REF: 158748)

MATCH FLUSH TO AC & KERB BUILT UNDER PYMMES JUNCTION EXTENSION, 28601-RDEXT1 (WAPC REF: 158748)

INSTALL WHITE FRP TACTILES AT ASPHALT MEDIAN CROSSINGS (TYP). TACTILES ARE TO BE APPLIED TO THE SURFACE WITH TAMPER PROOF FASTENERS AND ADHESIVE. ALL OTHER TACTILES ARE TO BE AS PER THE DETAIL ON DWG 129.

234.843

106.610

374.686

24.820

SHEET LAYOUT

SH 1

SH 2

SH 3

SH 4

PROJECT NAME

PARKLAND HEIGHTS

NAIRN DRIVE, SECTIONS 1, 2 & 3

CLIENT

Rockingham Park Pty Ltd

NORTH

0 5 10 15 20 25m

Scale 1:500 - A1 (1:1000 - A3)

ISSUES	DATE	
TENDER	30-04-20	
COUNCIL	24-01-20	
CONSTRUCTION		

D	01-06-20	HATCH EDITED AND IRRIGATION DUCT ADDED
C	13-05-20	LEVELS REVISED
B	16-03-20	DETAILS REVISED
A	24-01-20	COUNCIL ISSUE
PRE	DATE	AMENDMENT

WAPC REF: 158551

ASSOCIATED CONSULTANTS

3 CONSULTING ENGINEERS PTY LTD

Electrical Engineering Excellence

DRAWING TITLE

ROADWORKS PLAN
SHEET 02

MORTONS urbansolutions

Civil Engineering
Project Coordination

MUS Pty Ltd T/As
Mortons-Urban Solutions
ABN 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

Email: mortons@urbansolutions.net.au
Website: www.urbansolutions.net.au
Tel 08 9380 9700

Perth Office
U4 100 Railway Road
Subiaco 6008

DESIGNED	GW	DRAWN	CB
APPROVED		RPEQ	DATE 24-01-20

DRAWING NUMBER 28601-NAIRN-101

AMEND. D

ROAD (30)

FURNIVALL PARADE (25)

ADJOINS SHEET 2

LIMIT ROADWORKS CH 504.385

MATCH FLUSH TO EXISTING 2.0m PATH (BOTH SIDES)

ROAD FINISHED TO PRIME STAGE UNDER PREVIOUS WORKS. ROAD TO BE FINISHED TO SURFACE LEVEL WITH PROPOSED WORKS. MATCH FLUSH TO EXISTING AC & KERB.

ROAD 58

REGENCY AV (23)

MATCH FLUSH TO EXISTING 2.5m PATH

MATCH FLUSH TO EXISTING 2.5m PATH

ROAD FINISHED TO PRIME STAGE UNDER PREVIOUS WORKS. ROAD TO BE FINISHED TO SURFACE LEVEL WITH PROPOSED WORKS. MATCH FLUSH TO EXISTING AC & KERB.

LIMIT ROADWORKS CH 593.800

INSTALL CONCRETE CYCLE RAMP WHERE INDICATED, IN ACCORDANCE WITH DETAIL ON DWG 128 AND MRWA STANDARD DWG 200331-196-3.

NAIRN DRIVE (01)

BIRKENHEAD AV (01)

HEAD AV (01)

2.5m PATH

2.5m PATH

7.3m 8.5m 6m 8.5m 9.7m

40m

INSTALL WHITE FRP TACTILES AT ASPHALT MEDIAN CROSSINGS (TYP). TACTILES ARE TO BE APPLIED TO THE SURFACE WITH TAMPER PROOF FASTENERS AND ADHESIVE. ALL OTHER TACTILES ARE TO BE AS PER THE DETAIL ON DWG 129.

ADJOINS SHEET 4

SHEET LAYOUT

SH 1
SH 2
SH 3
SH 4

PROJECT NAME

PARKLAND HEIGHTS

NAIRN DRIVE, SECTIONS 1, 2 & 3

CLIENT

Rockingham Park Pty Ltd

NORTH

0 5 10 15 20 25m

Scale 1:500 - A1 (1:1000 - A3)

ISSUES	DATE	
TENDER	30-04-20	
COUNCIL	24-01-20	
CONSTRUCTION		

C	01-06-20	MATCH EDITED AND IRRIGATION DUCT ADDED
B	16-03-20	DETAILS REVISED
A	24-01-20	COUNCIL ISSUE
PRE	DATE	AMENDMENT

WAPC REF: 158551

ASSOCIATED CONSULTANTS

3 CONSULTING ENGINEERS PTY LTD
Electrical Engineering Excellence

DRAWING TITLE

ROADWORKS PLAN
SHEET 03

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

Email: mortons@urbansolutions.net.au
Website: www.urbansolutions.net.au
Tel 08 9380 9700

Perth Office
U4 100 Railway Road
Subiaco 6008

DESIGNED	GW	DRAWN	CB
APPROVED		RPEQ	DATE 24-01-20

DRAWING NUMBER 28601-NAIRN-102

AMEND. C

ADJOINS SHEET 3

STAGE 06A

ARPENTEUR DRIVE (14)

NAIRN DRIVE (01)

ARPENTEUR DRIVE (24)

HAMPSHIRE WAY (11)

GIVERNY AV (12)

LIMIT ROADWORKS CH 742.275

LIMIT ROADWORKS CH 925.850

LIMIT ROADWORKS CH 55.900

LIMIT PATH

2.5m PATH

2m PATH

INSTALL CONCRETE CYCLE RAMP WHERE INDICATED, IN ACCORDANCE WITH DETAIL ON DWG 128 AND MRWA STANDARD DWG 200331-196-3.

INSTALL WHITE FRP TACTILES AT ASPHALT MEDIAN CROSSINGS (TYP). TACTILES ARE TO BE APPLIED TO THE SURFACE WITH TAMPER PROOF FASTENERS AND ADHESIVE. ALL OTHER TACTILES ARE TO BE AS PER THE DETAIL ON DWG 129.

MATCH FLUSH TO AC & KERB BUILT UNDER ARPENTEUR DRIVE EXTENSION, 28601-RDEXT (WAPC REF: 158684)

MATCH FLUSH TO 2.0m PATH BUILT UNDER ARPENTEUR DRIVE EXTENSION, 28601-RDEXT (WAPC REF: 158684)

SHEET LAYOUT

SH 1
SH 2
SH 3
SH 4

PROJECT NAME

PARKLAND HEIGHTS

NAIRN DRIVE, SECTIONS 1, 2 & 3

CLIENT

Rockingham Park Pty Ltd

NORTH

0 5 10 15 20 25m

Scale 1:500 - A1 (1:1000 - A3)

ISSUES	DATE	
TENDER	30-04-20	
COUNCIL	24-01-20	
CONSTRUCTION		

C	01-06-20	MATCH EDITED AND IRRIGATION DUCT ADDED
B	16-03-20	DETAILS REVISED
A	24-01-20	COUNCIL ISSUE
PRE	DATE	AMENDMENT

WAPC REF: 158551

ASSOCIATED CONSULTANTS

3 CONSULTING ENGINEERS PTY LTD
Electrical Engineering Excellence

DRAWING TITLE

ROADWORKS PLAN
SHEET 04

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

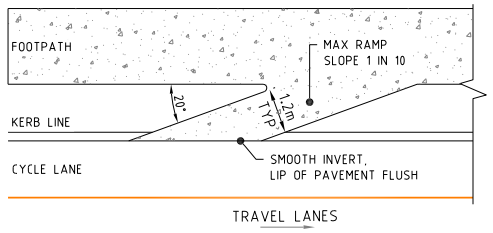
Postal Address
U4 100 Railway Road
Subiaco 6008

Email: mortons@urbansolutions.net.au
Website: www.urbansolutions.net.au
Tel 08 9380 9700

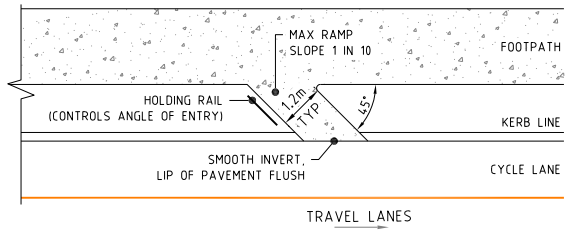
Perth Office
U4 100 Railway Road
Subiaco 6008

DESIGNED	GW	DRAWN	CB
APPROVED		RPEQ	DATE 24-01-20

DRAWING NUMBER	AMEND.
28601-NAIRN-103	C



EXIT RAMP



ENTRY RAMP

LOW SPEED CYCLE RAMPS

NOT TO SCALE

GENERALLY IN ACCORDANCE WITH AUSTROADS 2016 GUIDE TO ROAD DESIGN PART 3: GEOMETRIC DESIGN

C

TYPICAL CROSS-SECTION (CH150 - CH500)

SCALE 1:100

PATH TO EXTEND 300mm TO THE PROPERTY BOUNDARY WHERE THE PATH IS ADJACENT TO A RETAINING WALL

PROJECT NAME

PARKLAND HEIGHTS

NAIRN DRIVE, SECTIONS 1, 2 & 3

CLIENT

Rockingham Park Pty Ltd

0 0.2 0.4 0.6 0.8 1.0m

Scale 1:20 - A1 (1:40 - A3)

ISSUES	DATE	
TENDER	30-04-20	
COUNCIL	24-01-20	
CONSTRUCTION		

PRE	DATE	AMENDMENT
C	01-06-20	SECTION AMENDED
B	16-03-20	REVISED FOR CONSISTENCY
A	16-03-20	REVISED FOR CONSISTENCY

WAPC REF: 158551

ASSOCIATED CONSULTANTS

3 CONSULTING ENGINEERS PTY LTD
Electrical Engineering Excellence

DRAWING TITLE

ROADWORKS & DRAINAGE DETAILS SHEET 09

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

Email: mortons@urbansolutions.net.au
Website: www.urbansolutions.net.au
Tel 08 9380 9700

Perth Office
U4 100 Railway Road
Subiaco 6008

DESIGNED	GW	DRAWN	CB
APPROVED		RPEQ	DATE 16-03-20

DRAWING NUMBER: 28601-NAIRN-128

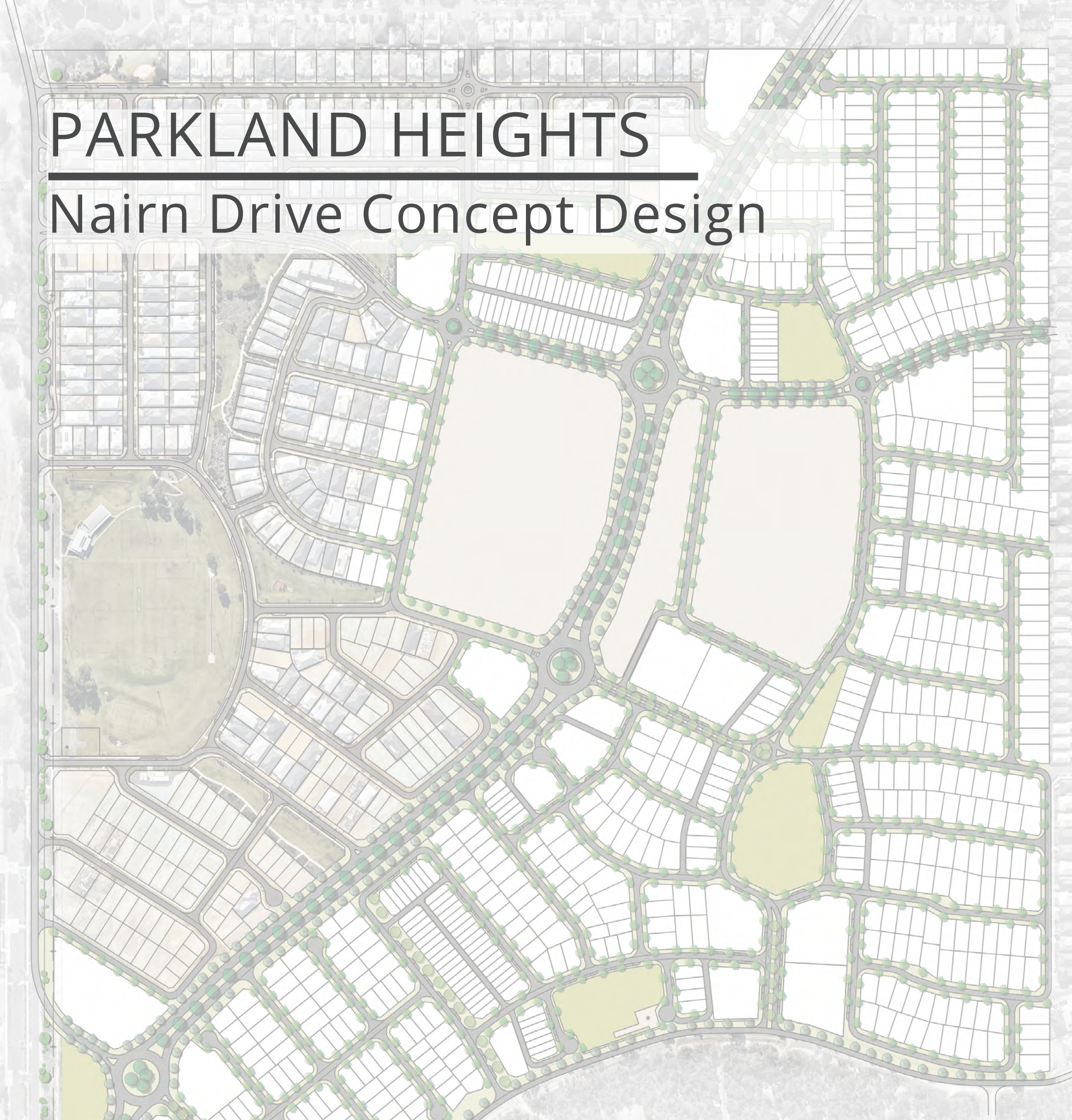
AMEND.: B

ATTACHMENT E

Landscape design concept plan

PARKLAND HEIGHTS

Nairn Drive Concept Design



9th Jan 2020 - Rev C

LD TOTAL
LEADERS IN LANDSCAPING

PARKLAND HEIGHTS

MORTONS urbansolutions
Engineering | Town Planning | Project Coordination

NAIRN DRIVE - PARKLAND HEIGHTS
CONCEPT PLAN

Note:
Design is subject to detailed design, budget and water allocation. LDT reserve Copy Rights over this work and the right to change the design. Road reserve boundary and design to follow approved civil drawings.

NAIRN DRIVE CoR upgrade

NAIRN DRIVE SECTION 1
(EXCL ROUNDABOUT)

NAIRN DRIVE SECTION 2
(INC ROUNDABOUT)

NAIRN DRIVE

ARPENTEUR DRIVE

PYMMES JUNCTION

FURNIVALL PARADE

FURNIVALL PARADE

NEIGHBOURHOOD CENTRE

NEIGHBOURHOOD CENTRE

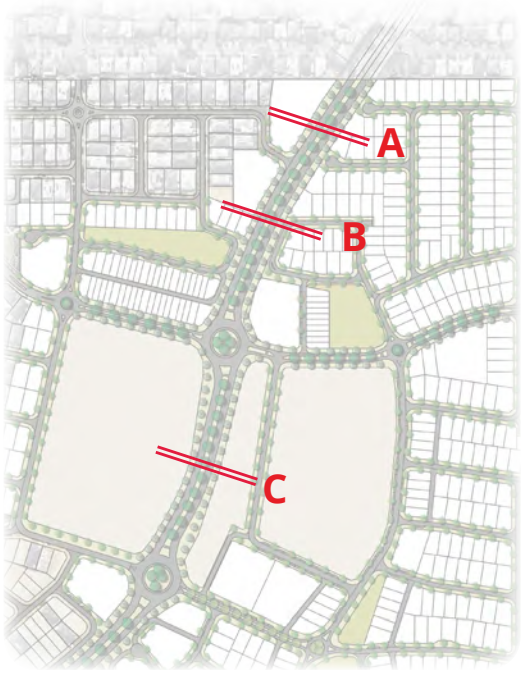
LEGEND

- MEDIAN TREES @15M SPACINGS
- VERGE TREES - @10M SPACINGS
- TURF AREAS
- PLANTING AREAS
- 1A — TREE WITH MEDIAN TURF - 600MM HARD EDGE BY CIVIL
- 1B — TREE WITH MEDIAN PLANTING - 600MM HARD EDGE BY CIVIL
- 2 — FOOTPATH TO VERGES BY CIVIL
- 3 — PLANTED SWALE TO VERGE SECTION 1 AREA
- 4 — TURF SWALE TO VERGE - SECTION 1 AREA
- 5 — TURF WITH NO SWALE TO VERGE - SECTION 2 AREA
- 6 — ROUNDABOUT FEATURE SCULPTURE
- NAIRN DRIVE SECTION 1 AREA
- NAIRN DRIVE SECTION 2 AREA - NEIGHBOURHOOD CENTRE

NAIRN DRIVE - PARKLAND HEIGHTS
LANDSCAPE TREE SPECIES SECTION AND CROSS-SECTIONS

Note:
Design is subject to detailed design, budget and water allocation. LDT reserve Copy Rights over this work and the right to change the design. Road reserve boundary and design to follow approved civil drawings.

Angophora costata



LOCATION KEY sections NTS

TREE TO MEDIANS
SECTION 1


Eucalyptus gomphocephala

SECTION 2


Araucaria heterophylla

NATIVE TREES TO VERGE AREAS


Cupaniopsis anacardioides


Eucalyptus leucoxylon


Eucalyptus sideroxylon

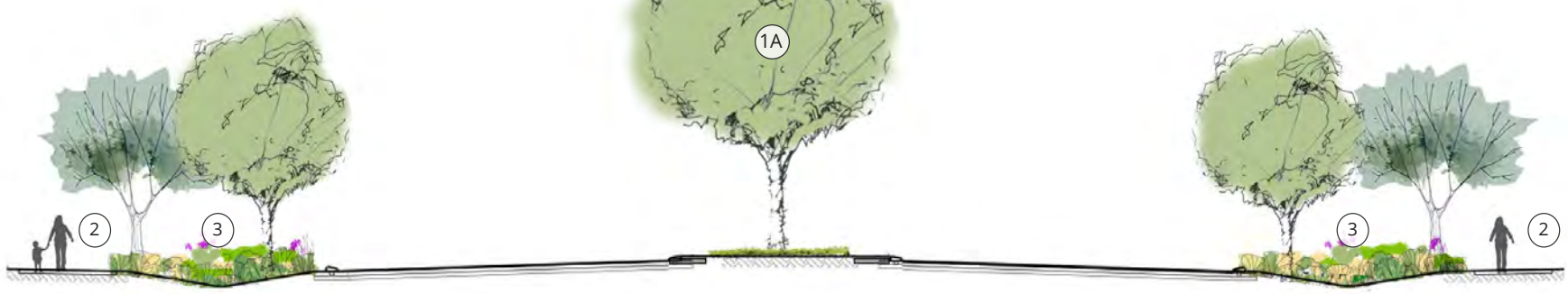
ROUNDABOUT SCULPTURES - INDICATIVE IMAGERY ONLY

LEGEND FOR SECTIONS

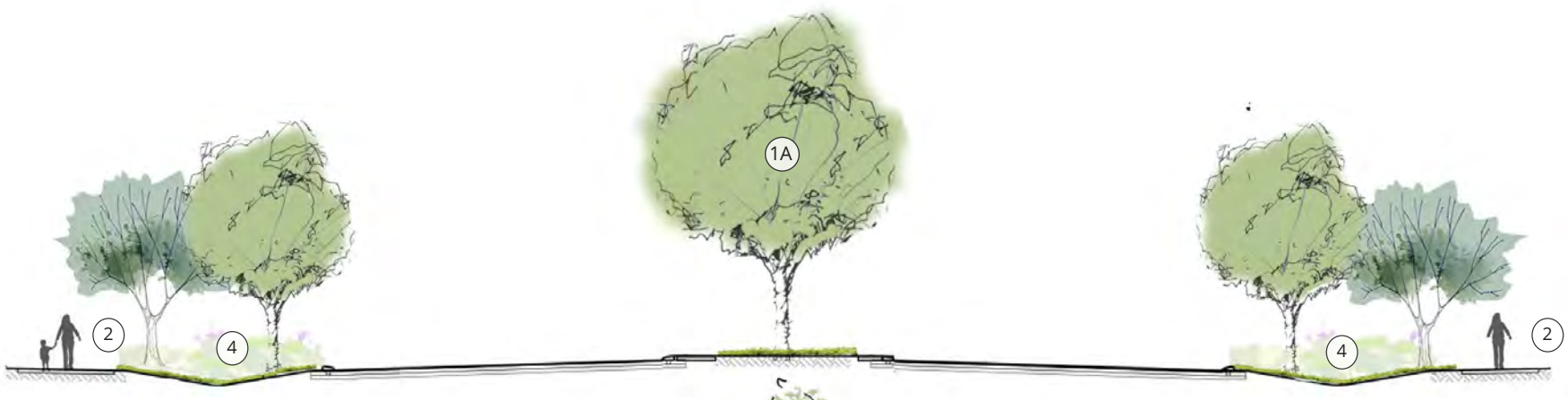
1A	TREE AND TURF - 600MM HARD EDGE BY CIVIL
1B	TREE AND PLANTING - 600MM HARD EDGE BY CIVIL
2	FOOTPATH TO VERGES BY CIVIL
3	PLANTED SWALE TO VERGE - SECTION 1 AREA
4	TURF SWALE TO VERGE - SECTION 1 AREA
5	TURF WITH NO SWALE TO VERGE - SECTION 2 AREA

NOTE: ALL SPECIES AND UNDERSTOREY PLANTING TO MEDIAN AND SWALES WILL BE CONFIRMED IN DETAILED DESIGN WITH REFERENCE TO CITY OF ROCKINGHAM ADVICE PROVIDED TO DATE.

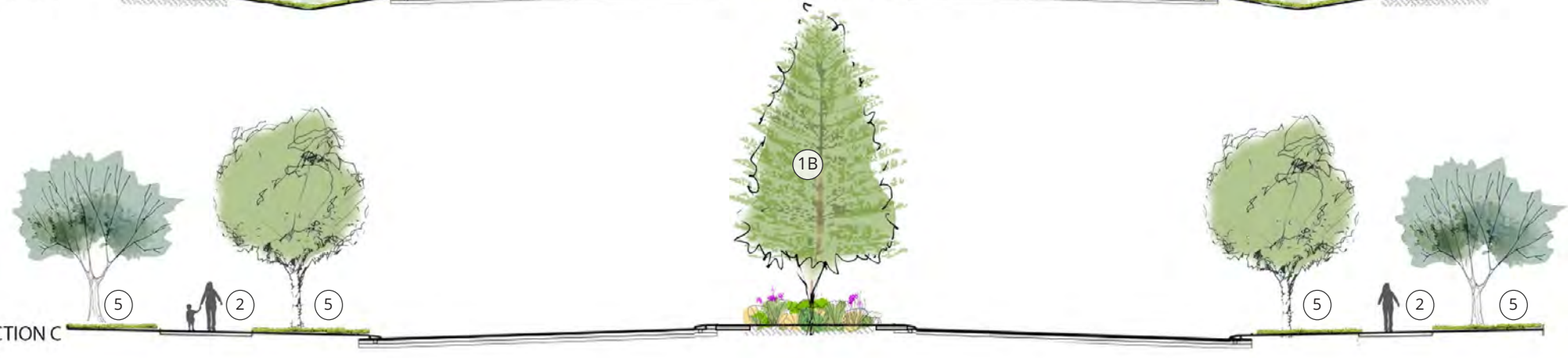
SECTION A



SECTION B



SECTION C



NAIRN DRIVE - PARKLAND HEIGHTS

CONCEPT PLAN - TREE SPECIES

NATIVE TREES TO ALL VERGE
- 10M SPACING
SPECIES SUGGESTIONS

Angophora costata known as smooth-barked apple, rose gum, etc

Eucalyptus leucoxylon known as Yellow gum

Eucalyptus sideroxylon known as mugga, red ironbark or mugga

MEDIAN TREE
~15M SPACING
SECTION 1

Eucalyptus gomphocephala, known as tuart

MEDIAN
WILL BE TURF
VERGE
WILL BE PLANTING + TURF

MEDIAN TREE
~15M SPACING
NEIGHBOURHOOD CENTRE

Araucaria heterophylla known as Norfolk Pine

MEDIAN
WILL BE PLANTING
VERGE
WILL BE TURF

LD TOTAL
LEADERS IN LANDSCAPING

MUS/RP	10.1720	C	18.12.19
CLIENT	PROJECT NO	REVISION	DATE

ATTACHMENT F

Groundwater Licence

Government of **Western Australia**
Department of **Water and Environmental Regulation**

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Rockingham Park Pty Ltd		
Description of Water Resource	Stakehill Perth - Superficial Swan	**Annual Water Entitlement**	101,320kL
Location of Water Source	LOT 9010 ON PLAN 407830 - Lot 9010 BALDIVIS - Parkland Heights LOT 954 ON PLAN 407830 - Lot 954 BALDIVIS - POS H - Parkland Heights		

Authorised Activities	**Taking of water for**	**Location of Activity**
	Dust suppression for earthworks and construction purposes	LOT 9010 ON PLAN 407830 - Lot 9010 BALDIVIS - Parkland Heights Lot 986 On Plan 202758 - Volume/Folio 2128/381 - Lot 986 Baldivis Rd Baldivis - Heritage Park Lot 993 On Plan 202758 - Volume/Folio 2125/382 - Lot 993 Baldivis Rd Baldivis - Heritage Park Road Reserve - PIN11754540 - Heritage Park
	Irrigation of up to 2ha ovals and playing fields	LOT 9010 ON PLAN 407830 - Lot 9010 BALDIVIS - Parkland Heights
	Irrigation of up to 5.8 ha of public open space	LOT 9010 ON PLAN 407830 - Lot 9010 BALDIVIS - Parkland Heights LOT 954 ON PLAN 407830 - Lot 954 BALDIVIS - POS H - Parkland Heights LOT 955 ON PLAN 407830 - Lot 955 BALDIVIS - POS I - Parkland Heights Lot 986 On Plan 202758 - Volume/Folio 2128/381 - Lot 986 Baldivis Rd Baldivis - Heritage Park Lot 993 On Plan 202758 - Volume/Folio 2125/382 - Lot 993 Baldivis Rd Baldivis - Heritage Park Road Reserve - PIN11754540 - Heritage Park
Duration of Licence	From 18 October 2018 to 4 February 2024	

This Licence is subject to the following terms, conditions and restrictions:

1. The licensee shall not use water for sprinkler irrigation between 9 am and 6 pm except for the establishment of newly planted areas. For newly planted areas water may be used within these hours for a period of up to 28 consecutive days, commencing from the date of planting.

2. Between 1 June and 31 August in any year, the licence-holder must not water a lawn, garden, or grass-covered area ("turf") by reticulation, provided always that this restriction shall not apply to watering with a hand held hose; or watering, by way of reticulation: newly planted areas for a period of up to 28 days from the date of planting; for renovating turf; or for maintenance of reticulation systems.

3. The volume of all water taken under this licence must be metered using an approved meter fitted to each drawpoint.

4. The annual water year for water taken under this licence is defined as 1 January to 31 December.

5. Unless otherwise approved by the Department of Water and Environmental Regulation, all meter readings must be recorded monthly via the Department of Water and Environmental Regulation's 'Water Online Portal' or on an approved Department of Water and Environmental Regulation 'Meter Water Use Card'. The meter readings must be reported via the 'Water Online Portal' or submitted via a completed 'Meter Water Use Card' to the Department of Water and Environmental Regulation every 12 Months, commencing 30/01/2019.

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000.

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

This Licence is subject to the following terms, conditions and restrictions:

6. The licensee must ensure the installed meter(s) accuracy is maintained to within plus or minus 5% of the volume metered, in field conditions.

7. The licensee must notify the Department of Water and Environmental Regulation in writing of any water meter malfunction within seven days of the malfunction being noticed.

8. The licensee must obtain authorisation from the Department of Water and Environmental Regulation before removing, replacing or interfering with any meter required under this licence.

End of terms, conditions and restrictions

Our ref: EWP20132.001

Appendix J
Lot 9009 Sixty Eight Road drainage management plan

MORTONS urbansolutions

Innovative Solutions. Sustainable Outcomes.

PARKLAND HEIGHTS ESTATE

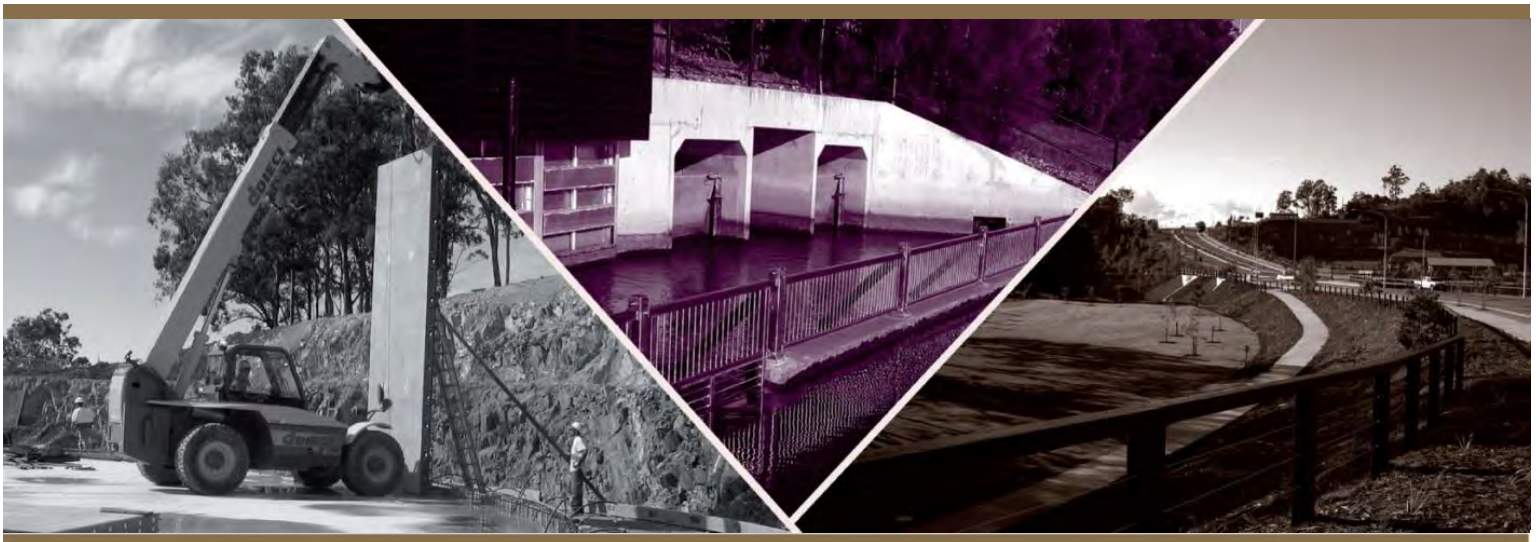
Lot 9009 Sixty Eight Road

Drainage Management Plan

Lot 9009 Sixty Eight Road
DRAINAGE MANAGEMENT PLAN

Address:	Furnivall Parade, Baldivis
Lot & RP Description:	(part) of Lot 9010 DP407830
Local Government:	City of Rockingham
Prepared for:	Rockingham Park Pty Ltd
Prepared by:	**Mortons – Urban Solutions** Unit 4 / 100 Railway Road SUBIACO WA 6008 Ph: (08) 9380 9700 Email: mortons@urbansolutions.net.au

DATE: JULY 2019



CIVIL ENGINEERING TOWN PLANNING PROJECT COORDINATION

MORTONS
urbansolutions

4/100 Railway Road,
SUBIACO WA 6008

P: (08) 9380 9700
www.urbansolutions.net.au

Prepared for:

PARKLAND HEIGHTS

Property Address:
Furnivall Parade, Baldivis

Real Property Description/s:
(part) Lot 9010 DP407830

DOCUMENT CONTROL

Report Summary	
Document Details	
Project Reference:	28601-SS [ID 731678]
Document Title:	Drainage Management Plan Parkland Heights Estate

Distribution

Revision	Date	Author	Reviewed		Distributed To
A	22/05/2019	CL			Council
B	16/07/2019	CL			Council
C	23/07/2019	CL			Council

CONTENTS PAGE

List of Figures

List of Appendices

1.0 INTRODUCTION

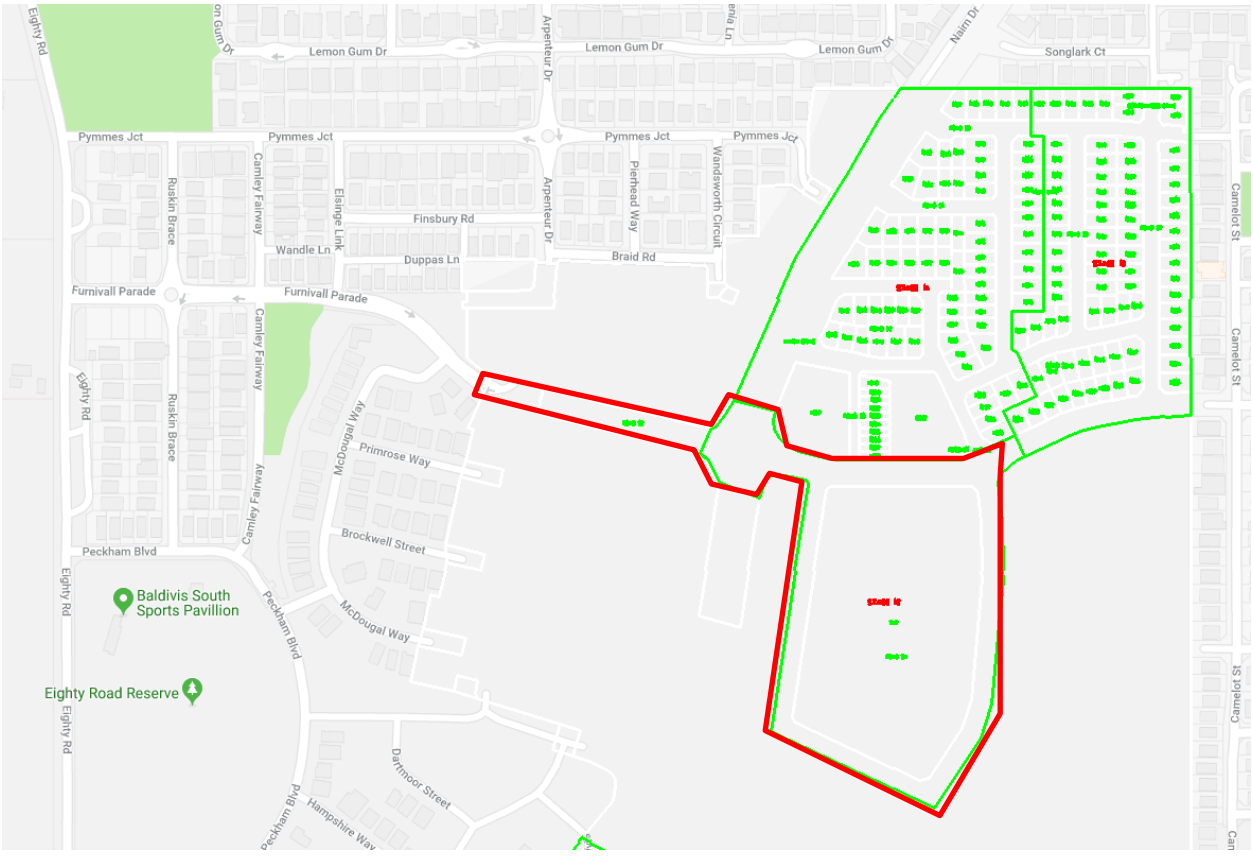
This report has been prepared to comply with Condition 2, Western Australian Planning Commission (WAPC) application number 155055, which applies to Parkland Heights Estate Stage 12 (Primary School Site). The site is located adjacent to the proposed intersection of Furnivall Parade, Nairn Drive, and Regency Avenue.

As per WAPC Advice Note 2, to facilitate Department of Education's proposed school opening date of January 2021, City of Rockingham is supportive of a Drainage Management Plan and agrees that a full UWMP is not required for this proposed subdivision application. Future UWMP's for the adjacent subdivisional stages will include the respective catchment areas of the School Site and the surrounding roads.

2.0 THE SITE AND ITS CONTEXT

The total subdividable area is approximately 7.03ha, comprising 1 Primary School Site (4.0316ha) and the essential access roads. The site is located approximately 40km south of Perth in the City of Rockingham. Preliminary bulk earthworks have been completed over this area.

Figure 1.0: Locality Plan



Source: www.mngaccess.com.au

3.0 DESIGN OBJECTIVES

The principles design objectives and criteria shown here are from BUWM (WAPC 2008).

3.1 Water Conservation and Efficiency

The Parkland Heights development will aim to achieve a maximum 100kL/person/year scheme water usage through a range of water efficiency measures, as per the LWMS and previously approved UWMP (e.g. Stage 1 to 6).

3.2 Stormwater Quantity Management

Stormwater quantity management has been designed and modelled in accordance with AR&R 2016 and CoR's Planning Policy 3.4.3.

The drainage strategy for Parkland Heights Estate is based on infiltration of stormwater onsite, furthermore, at source infiltration are prompted. Therefore, the school site shall retain up to the critical 1% AEP Median Maximum event, whereby allowing stormwater to overflow and infiltrate through the school oval during major storm events. This strategy is also in accordance with DoE's School Design Guidelines.

For stormwater runoff within road reserve areas, all drainage pits (where possible) have been designed with a 600mm deep trap and an oversized weephole which allows at source stormwater retention and infiltration.

A total of 360 storm ensembles were modelled for the 63%, 20%, 10% and 1% AEP Storm Events, and the Median Max Flow Storm Ensembles have been utilised in our calculation and hydraulic modelling and design.

3.3 Stormwater Quality Management

Bio-retention systems (swales, tree pits, rain gardens) designed to contain the first 15mm of runoff from the connected impervious catchment area will be implemented. This is the design criteria outlined in the DWER's Decision Process for Stormwater Management in WA (2017) which the City of Rockingham has adopted in Planning Policy 3.4.3.

Prior to the development of POS areas and the designated basins, the stormwater pit and pipe system have been designed to discharge into temporary drainage basins, which are sized to capture up to the 10% AEP Median Max storm event. For greater storm events above the 10% AEP, stormwater can overflow to the adjacent undeveloped area (within the developer's site) and infiltrate through the sandy soil. This is consistent with the previous approved strategy and management practise in previous stages and nearby subdivisional developments.

3.4 Stormwater Quality Modelling Criteria

Stormwater quality modelling is not proposed for this estate at this stage as currently there is no commercially available tool in Western Australia approved by the DWER to undertake such modelling.

3.5 Disease Vector and Nuisance Insect Management

The stormwater retention system has been designed to ensure that stormwater is fully infiltrated in a time period not exceeding 96 hours. The basin's emptying time is reported as part of MUS' calculation.

4.0 SITE CHARACTERISTICS

4.1 Site Conditions

The site has been cleared in preparation for construction. The pre-development elevation of the site ranges from approximately 16 m Australian Height Datum (AHD) along the western boundary to 32.7 m AHD towards the northeast area of the site.

4.2 Geotechnical Characteristics

The Rockingham 1:50,000 Environmental Geology sheet suggests that natural subsurface conditions at the site comprise of sand derived from Tamala Limestone (Spearwood Sand).

The Perth Groundwater Atlas (2004) indicates that the groundwater level was approximately between RL 3 m and 4 m AHD, i.e. more than 15 m below the surface levels at the site.

Acid sulphate soil risk mapping indicates that the Sand derived from Tamala Limestone in the area has no known risk of acid sulphate soil occurring within the top 3 m. It should be noted that bulk earthworks have occurred within this area over the past 10 years, comprising of cuts ranging between 0.5m to 7m.

The most recent geotechnical field works were undertaken by Douglas Partners in April 2019, and provided the following summary of the ground conditions encountered:

- **FILL (SAND, SP and SP-SM)** – well compacted, brown and grey sand with silt or trace silt, was observed at each test location except for Bore 13, from the surface to depths of between 0.05 m and borehole termination depth of 1.5 m.

- **SAND (SM)** – generally dense, yellow-brown and orange-brown, fine to medium grained sand with trace silt, underlying the fill and from the surface at Bore 13 to borehole termination depths of up to 2.5 m.

4.3 Contaminated Sites Assessment

As accepted in the approved LWMS, a Detailed Site Investigation (DSI) for this site is not required, as there was no record of any development according to the Department of Environment Regulation (DER) Contaminated Sites Database, besides from some evidence of forestry use at some stage between 1963 and 1974 by the Forest Products Commission.

4.4 Water Dependant Ecosystem

There are no wetlands, springs or other water-dependent ecosystems located within 'the site'.

4.5 Surface Water Quantity and Quality

There are no ephemeral or permanent surface water bodies located within the site. There are no drainage lines within the site due to the high permeability of the Spearwood Sands present as described in Section 4.2. 'The site' is therefore dominated by infiltration with little to no surface run-off except during extreme storm events.

4.6 Groundwater Levels and Quality

Based on the recent investigation by Douglas Partners, no groundwater was observed within boreholes drilled to depths of up to 2.5 m below surface level.

According to ENV investigation as part of Parkland Heights Stage 6 UWMP, the estimated AAMGL underlying Stage 12 School Site Development is 4.9m AHD. The main proposed levels and the estimated depth to AAMGL are summarised in **Table 1** below. Given the significant depth to groundwater, ranging from 5.1m to 15.1m, groundwater does not present as a constraint to the development of the site.

Table 1 - Proposed development levels separation to AAMGL

	Proposed Levels (m AHD)	Estimated Depth to AAMGL (m)
School Site Lot	15.5 to 20	10.6 to 15.1
POS K Temporary Basin	18	13.1
Road 1 & 2 Temporary Basin	13	8.1
POS M Future Basin	10	5.1

4.7 Landscape Design

Landscape Design for POS K and POS M will be designed and submitted as part of Stage 13 & 14 UWMP, and Stage 9 to 11 UWMP, respectively.

The School Site Landscaping including the adjacent verge treatment will be designed and lodged as part of the Development Application for the School Site's built-form works.

The Parkland Heights development shares a licence with the Heritage Park development by the same developer, located approximately 2 km away. Both developments are located in the same proclaimed groundwater area (Stakehill). Irrigation of the POS areas is from groundwater licence GWL164680(10).

It is estimated that Heritage Park will require approximately 22,239 kL/yr for long term irrigation. The total for both Heritage Park and Parkland Heights is therefore estimated to be 59,226 kL/yr with the approved licence being 101,320kL/annum as of 19 October 2018. The updated water licence takes into account transfers associated with POS: B, C, D & G at Parkland Heights, and POS 5 at Heritage Park. The District Open Space at Parkland Heights (POS F) was a separate Water Licence which has been transferred to the CoR. The water licence on 2 January 2018 was 83,030kL and being reduced to 71,795kL following the handover of POS B, C, D – Parkland Heights – 1.498 ha of 11,235 kL. Additional water was secured resulting in the current allocation for the School Site and Dust Suppression.

Therefore sufficient groundwater is available within the groundwater licences to meet the long term irrigation demands and with sufficient remaining to meet short term irrigation and construction demands for both developments.

The Groundwater Licence includes 15,000kL allocation to irrigate 2Ha of ovals and playing fields for the proposed school. This water allocation is to be transferred to the DoE when construction of the proposed primary school is due to commence.

Appendix E contains the latest Irrigation Schedule dated 15 July 2019, and the latest Groundwater Licence, this is also reflected in the water register website.

5.0 WATER SUSTAINABILITY INITIATIVES

The Water Corporation's latest potable water use study 'Perth's Residential Water Use Study 2008/2009' (Water Corporation, 2010) found that the average potable water consumption rate was 106 kL/person/year whereas the State Water Plan states a target of 100 kL/person/year. The water sustainability initiatives to meet this target are addressed below.

This section also addresses the servicing of potable water and wastewater supplies including water conservation measures and sources.

The School Site Water Sensitive Urban Design (WSUD) initiatives will be as per the Department of Education's (DoE) typical development criteria for a primary school site and the City of Rockingham's inputs, typically detailed at the Development Application phase for the School Site's internal works.

The following Water Sensitive Urban Design (WSUD) initiatives are proposed for the adjacent residential lots:

- Free water-wise landscaping for all residential front yards including drought-tolerant lawn areas with improved soils, efficient drip irrigation system (where applicable);
- Access to free, voluntary information sessions about how to be Water Smart to reduce water bills; and
- Behaviour change of households, encouraging water conservation through sustainability information packages.

6.0 STORMWATER MANAGEMENT STRATEGY

The stormwater management strategy for the site is based on infiltration of stormwater to maintain predevelopment flows, while maintaining water quality.

A variety of structural and non-structural BMPs are proposed to achieve this.

As part of the Stage 12 School Site Development, the following will be constructed:

- Trapped Stormwater Drainage Pits, with 600mm traps and open bases;

- Gross Pollutant Trap (GPT) prior to discharge into future POS K; and
- Temporary Sandy Drainage Basins at future POS K and L, which are commonly accepted as interim measures in this area.

Ultimately, as part of Stage 9 and 14 development, vegetated bio-retention swales and grass-lined infiltration basin will be constructed in accordance with the approved UWMP and Landscape Plan.

Stormwater Drainage Plans including a Catchment Plan for 'the site', developed by Mortons Urban Solutions, are included in **Appendix B and Figures 2 to 6**.

6.1 Stormwater Quantity

6.1.1 Stormwater Management in School Site

Stormwater runoff within the School Site shall be captured, retained, and infiltrated on site for all events up to and including the Median Maximum 1% AEP storm event.

For minor events, stormwater can be collected via conventional pits and pipes and infiltrated via soak-wells or underground drainage cells.

For major events, stormwater should be allowed to overflow and infiltrate, through the School's ovals or other low-lying open space areas.

As per Department of Education's Consultant Brief for the Primary School Site (Document No. 5.4, November 2018), an internal stormwater management plan will be prepared and must be approved by the local authority as part of the built form development application (DA).

6.1.2 Stormwater Management in Road Reserve and POS

Stormwater within road reserves will be collected via conventional pits and pipes system. The pits will have 600mm traps and have open bases to increase soakage from the system and prompt at source infiltration.

Pit and pipe networks have been designed to convey the Median Max 20% AEP event with 300mm freeboard from pit inlet levels, with the exception for pit and pipe network within Nairn Drive. MUS has designed this system to convey the Median Max 10% AEP storm event. Although this was not specified in the LWMS, we believe this is desirable considering that Nairn Drive higher order in term of road hierarchy.

The proposed pit and pipe system has been designed to convey runoff from all future upstream catchment areas within the approved Structure Plan.

Runoff from Furnivall Parade, west of the Nairn Drive roundabout, will be connected into the existing Parkland Heights Stage 3 pit and pipe system, in accordance with the approved Stage 6 UWMP. Runoff from Regency Avenue will discharge into a temporary drainage basin within the future POS K area. Runoff from Road 1 & 2, south of Regency Ave, will discharge into a temporary basin located approximately within the future POS L area. Ultimately, this drainage will be extended to discharge into POS M in accordance with the LWMS.

In accordance with the City of Rockingham Planning Policy 3.4.1 – Public Open Space, MUS' modelling has checked for compliance with the following conditions at the ultimate discharge location for the proposed pit and pipe system:

- A maximum of 25% site area of any parcel of POS may be covered by any body of water, not exceeding a frequency of inundation of 1 in 10 years.
- The base of the detention basin shall be a minimum of 0.5m above the post-development groundwater level.
- A flood depth of 1.2m maximum for storms up to the critical 100-Year event.

6.1.3 Lot Stormwater Management

Development of residential Lots is not proposed as part of this development.

6.2 Stormwater Quality

Gross pollutant traps (GPTs) will be used prior to discharge to basins or Public Open Space and will remove rubbish, hydrocarbons through traps and some nutrients. This forms a treatment train of GPTs and infiltration structures, in line with the concepts of the Stormwater Management Manual (DoW, 2004-2007) and BUWM (WAPC, 2008).

The bio-retention swale will be sized to handle storm events up to Median Max 63% AEP 1 hour Storm Event (formerly referred to as 1 Year 1 Hour ARI). The bio-retention basin design will be included on the landscape drawings submitted separately for approval. The Bio-Filter composition will be as per City of Rockingham standard specification.

The City of Rockingham has expressed the desire to incorporate Bio-Retention Swale in the Central Median of Nairn Drive. The design of the proposed central bio-retention swale shall be investigated at the UWMP Phase for Stage 13 & 14 and will be subject to the City's review and approval.

7.0 MANAGING SUBDIVISION WORKS

There is no requirement for ASS and Dewatering Management for this site.

Water required for dust suppression during subdivision works will be sourced from an existing bore in POS N.

Semi-Permanent Wind Fencing will be constructed around the entire Limit of Works boundary as shown on the engineering drawings. Dust Management within the proposed Stage 12 School Site Subdivision will be managed by the successful contractor, and the balance bulk earthworks area will continue to be managed by Urban Resources under the extension of the existing Bulk Earthworks contract and approval.

8.0 MONITORING & MAINTENANCE PROGRAM

The developer will be responsible for monitoring and maintaining all temporary drainage basins, including cleaning and removal of Gross Pollutant, Erosion Control, and general maintenance.

The developer recognises that this is only an interim arrangement, the final POS & Basin Design is still subjected to Engineering, Landscaping, and UWMP Approval.

9.0 IMPLEMENTATION PLAN

9.1 Roles and Responsibility

Roles and responsibilities for Stage 12 Primary School Site are outlined in **Table 2**.

Table 2 - Roles and responsibilities for Stage 12 Primary School Site

Item	Scheme Development	Interim Maintenance	Long-Term Maintenance
Best Management Practices	Developer	Maintain all BMP's to ensure effective operation.	City of Rockingham
Lot 797 (School Site) - Drainage Management & System	Developer	Department of Education	Department of Education
Interim Drainage System	Developer	Developer until the ultimate drainage system is completed.	Not Applicable
Ultimate Drainage System	Developer	Developer for 12months as per City of Rockingham standard defects liability period for civil works.	City of Rockingham
Monitoring of the development	Developer	Developer for three years post-development, including one year following the completion of the majority (80%) of the development.	Developer for monitoring in compliance with groundwater licensing conditions. City of Rockingham for other items.
Public Open Spaces	Developer/ Developer's Contractor	Establishment of POS areas including landscaping, irrigation and maintenance by the developer's contractor for a period of 2 years. Handover to City of Rockingham subject to satisfactory practical completion.	City of Rockingham

9.2 Management of the stormwater system

The stormwater system will be maintained by the developer until handover to the City of Rockingham as per the City of Rockingham's standard defects liability period for civil works. Until this time, the developer will maintain the stormwater system to ensure it is operating effectively. The following recommended maintenance practices are adapted from the Stormwater Management Manual (DoW, 2007).

- Identify pollutant 'hot spots', where relatively large quantities of pollutants of concern regularly accumulate in the drainage system.
- Focus on those parts of the stormwater drainage network with relatively flat grades or low flows, as pollutants tend to accumulate in these areas.
- Undertake regular inspections of 'hot spots' to assess whether pollutants are accumulating.
- Inspect all stormwater drains and detention basins at least once a year, preferably immediately prior to the wet season. Typical maintenance frequencies for assets in Perth are defined in the Water Corporation's Drainage Maintenance Standards (2004).
- Adjust the maintenance frequency of the drainage network to suit pollutant accumulation rates and seasonal conditions (flexibility of the maintenance regime is required given the uncertainty with accumulation rates and rainfall patterns).
- Prepare an inspection program, if required, that assigns inspection tasks, frequencies and responsibilities.
- All Best Management Practices will be maintained by the developer to ensure effective operation until handover to the City of Rockingham. The stormwater system will be inspected and cleaned as necessary, including flushing of pipes and sucking of pits before handover to the City of Rockingham.

9.3 Funding

No external funding is being sought for this project.

10.0 DRAINAGE CALCULATIONS & MODELLING

Detailed surface water modelling of the temporary and ultimate drainage system was undertaken using the stormwater modelling software XPSWMM to provide details of the required retention volumes for all interconnecting sub-catchment areas east of and including Nairn Drive. Design storms are 63% AEP, 20% AEP, 10% AEP, and 1% AEP, and the storm durations investigated varied between 10 minutes and 168 hours.

A total of 320 storm ensembles were assessed as part of MUS' modelling to determine critical design Median Max Storm for each catchment and design storm.

The detailed modelling also considers the conveyance system, and information such as water level, flow, velocity, and velocity depth factor, typical to that of UWMP level of assessment.

10.1 Design Rainfall Data System (2016)

In accordance with AR&R 2019, Design Rainfall Data System 2016 and AR&R Storm Ensembles were used as part of MUS' calculation and modelling, instead of the outgoing ARR 87 IFDs.
Links to the source of this information are detailed below:

http://www.bom.gov.au/water/designRainfalls/revised-ifd/
http://data.arr-software.org/

A copy of the design rainfall data system is attached in **Appendix C**.

10.2 Catchment Areas

Stage 12 Primary School Site is divided into 4 sub-catchments, as described in Section 6.1.2.

- Sub-catchment 1: Furnivall Parade, west of Nairn Drive, draining west towards Stage 3's POS C as per the approved LWMS and Stage 6 UWMP.
- Sub-catchment 2: Proposed Regency Ave, drains towards future POS K, in accordance with the approved LWMS and LWMS addendum report.
- Sub-catchment 3: Road 1 & 2, drains south towards POS M, in accordance with the approved LWMS.
- Sub-catchment 4: School Site, stormwater will be managed and infiltrate at source.

All future contributing catchment areas have also been considered in our calculations and modelling, in accordance with the current approved Structure Plan and Subdivision Plans.

10.3 Runoff

The following assumptions are in accordance with the approved LWMS Addendum Report, dated February 2018.

To convert the region's rainfall pattern and the tabled rainfall intensity into a runoff hydrograph for proposed post development catchments, the following assumptions were made. The runoff models were determined based on the following assumptions of impervious area percentage for 5 types of Land-use.

Table 3 – Post Development Land-use, Percentage of Impervious Area	
Road Reserve	80%
POS	20%
School Site	35%*

**Indicative only, this based on MUS estimate from other established school sites. This is to be determined as detailed in Section 6.1.1.*

Based on our estimates, we believe the Road Reserve percentage of impervious area is approximately 64% to 70%. However, an impervious percentage of 80% has been adopted as this is commonly used within the industry, stemming from the Rational Method Runoff Coefficient for Road Reserves.

The lot percentage of impervious area is based on measurements of the constructed lots through Parkland Heights. It is recognized that the Impervious Area within Lots is connected to other pervious and soakage areas, such as soakwells and garden beds. Therefore, a separate loss model was created for lot impervious areas, as it is different to all other impervious areas which are assumed to be directly connected to the street storm-water conveyance system.

In accordance with the latest AR&R Guidelines, we've assumed that the catchment area has been receiving rainfall throughout the winter period, prior to the arrival of the storm event of interest. Therefore, 20% of the POS area was assumed to be impervious which consists of 10% wetted area, and 10% for paved or hardstand area within the POS.

With regards to the Neighbourhood Centre (commercial area), as the development planning is still conceptual, we have conservatively assumed 90% impervious in our modelling for the purpose of this report. It is recommended that this percentage of impervious be refined at UWMP and detailed design stage.

The above assumptions are considered conservative, and refinement of these assumptions can be reviewed and approved at the detailed design phase, which could highlight additional drainage capacity within the downstream infrastructure.

10.4 Loss Model

The following assumptions are in accordance with the approved LWMS Addendum Report, dated February 2018.

The following Uniform Loss Model was applied to all Impervious, and Pervious Areas. The use of 3m/day continuing loss is based on permeability test results for the sandy fill materials that will be sourced from Parkland Heights. In 2009, geotechnical testing undertaken by SKM found the sandy material at Parkland Heights to have an infiltration rate from 4.3m/day to 5.8m/day. Furthermore, these sandy materials have recently been placed over the Guildford Formation at the North Baldivis Development Area and initial infiltration tests carried out over North Baldivis Bulk Earthwork areas have shown an average infiltration rate of 5m/day prior to installation of subsoil drainage. Mortons Urban Solutions (MUS) believes 3m/day continuing loss is conservative and suitable for this development with the consideration for clogging over time.

Table 4 – Loss Model Assumptions

	Initial Loss	Continuing Loss
Impervious Area	Nil.	Nil.
Pervious Area	9mm	3m per day

It is recognised that ARR 2016 recommends using 60% to 80% of the pre-development storm initial loss, which is supplied by ARR Data Hub (data.arr-software.org/). This would equate a Pervious Area's Initial Loss of 18mm to 24mm for this proposed urban catchment. However, we have proceeded with caution for sites such as this, where there is no measurable surface runoff that would enable us to calibrate our Hydrological Model. As a result, we have assumed 9mm initial loss for all Pervious Areas.

For pits and drainage basins infiltration model, refer to Section 10.6.

10.5 Hydrology

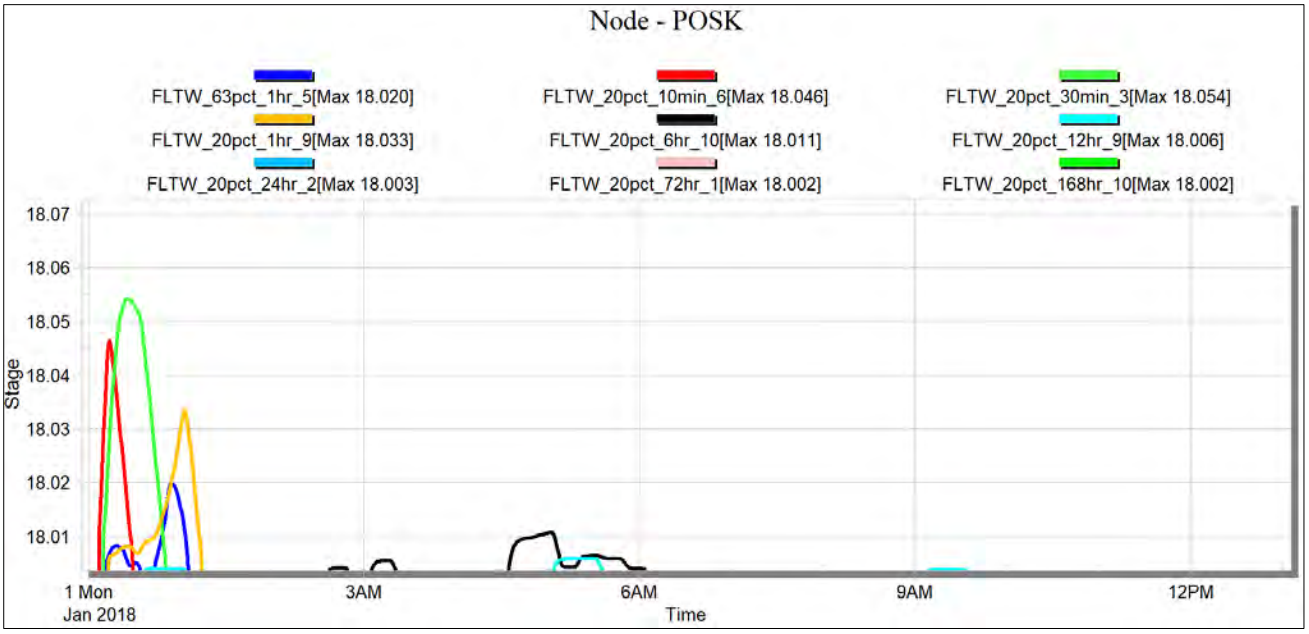
To determine the critical (Median-Max) design storm for each sub-catchment and for the following Annual Exceedance Probability (AEP); 63% AEP, 20% AEP, 10% AEP, and 1% AEP, a total of 320 storm ensembles were modelled.

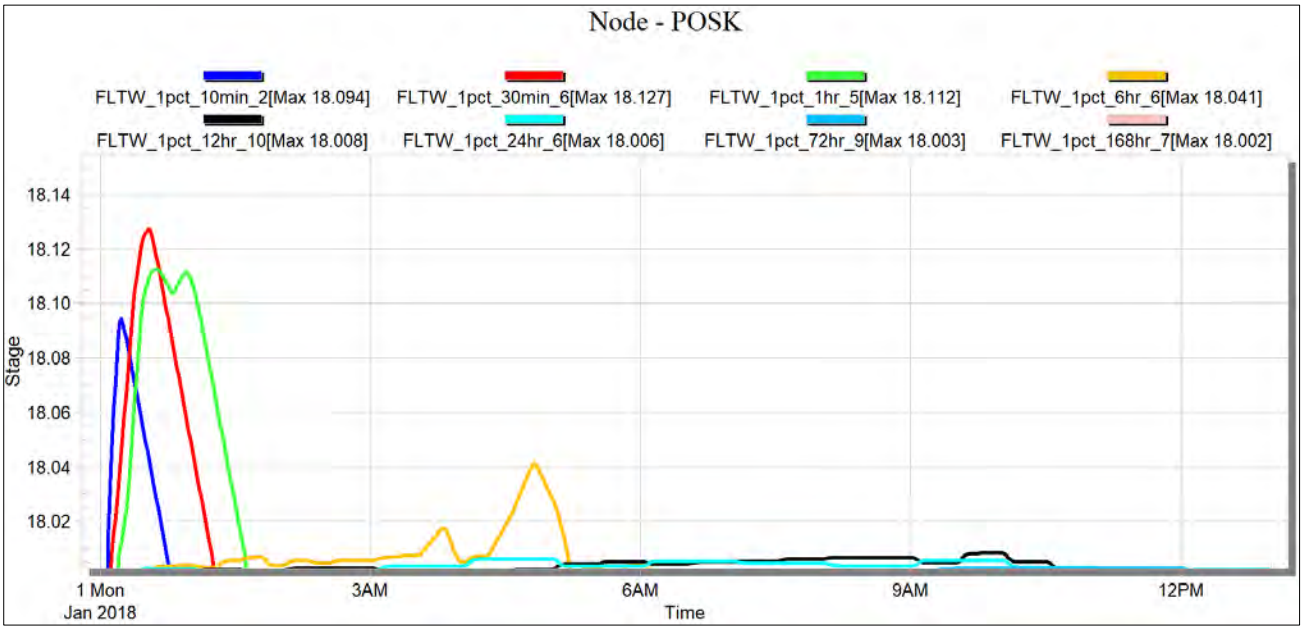
10.5.1 POS K, Temporary Storage Requirement (using existing basin)

The combined hydrology and hydraulic modelling results and critical storms for POS K, when receiving runoff from Stage 12 contributing catchment areas only, are summarised in this section. POS K Temporary Basin has been pre-earthwork to allow for a much greater catchment area of 5.95 ha, therefore, runoff from Stage 12 northern catchment area will make little impact to this temporary basin.

Table 6 – POS K Temporary Storage Requirement (Stage 12 Only)

Critical Storm	Volume (m^3)	Surface Area (m^2)	Depth (m)	Max Water Level (m AHD)
63% AEP 1hr Storm 5	12	909	0.02	18.02
20% AEP 30min Storm 3	44	944	0.05	18.05
1% AEP 30min Storm 6	115	1019	0.12	18.13

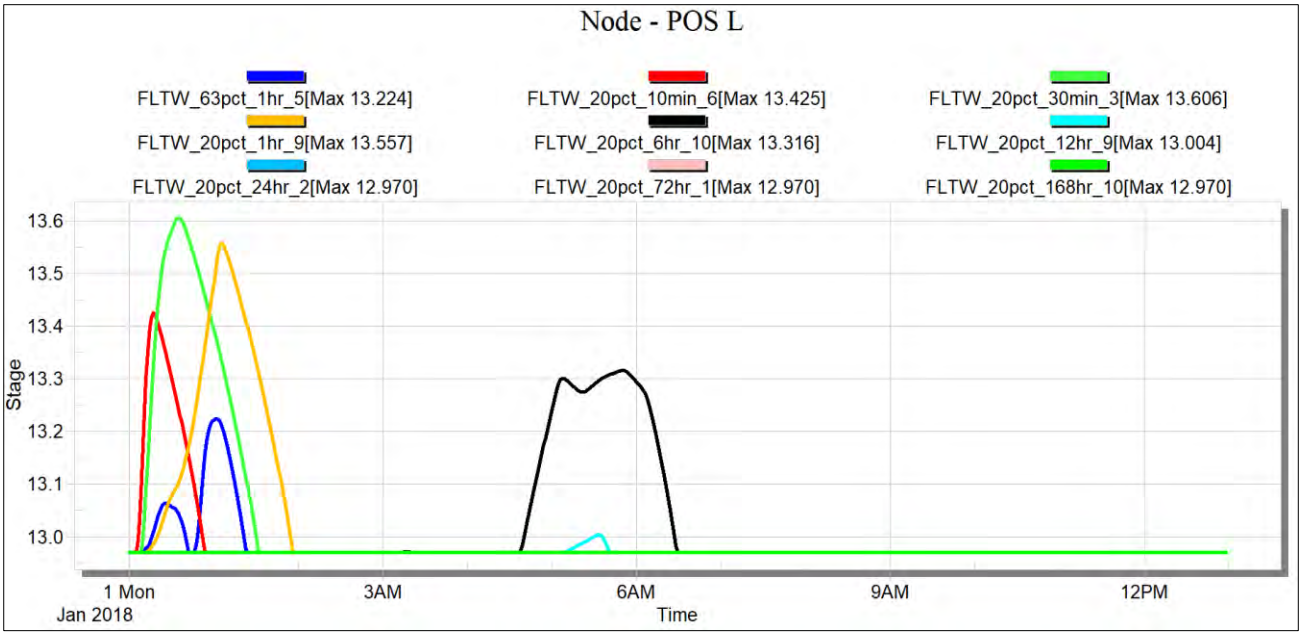


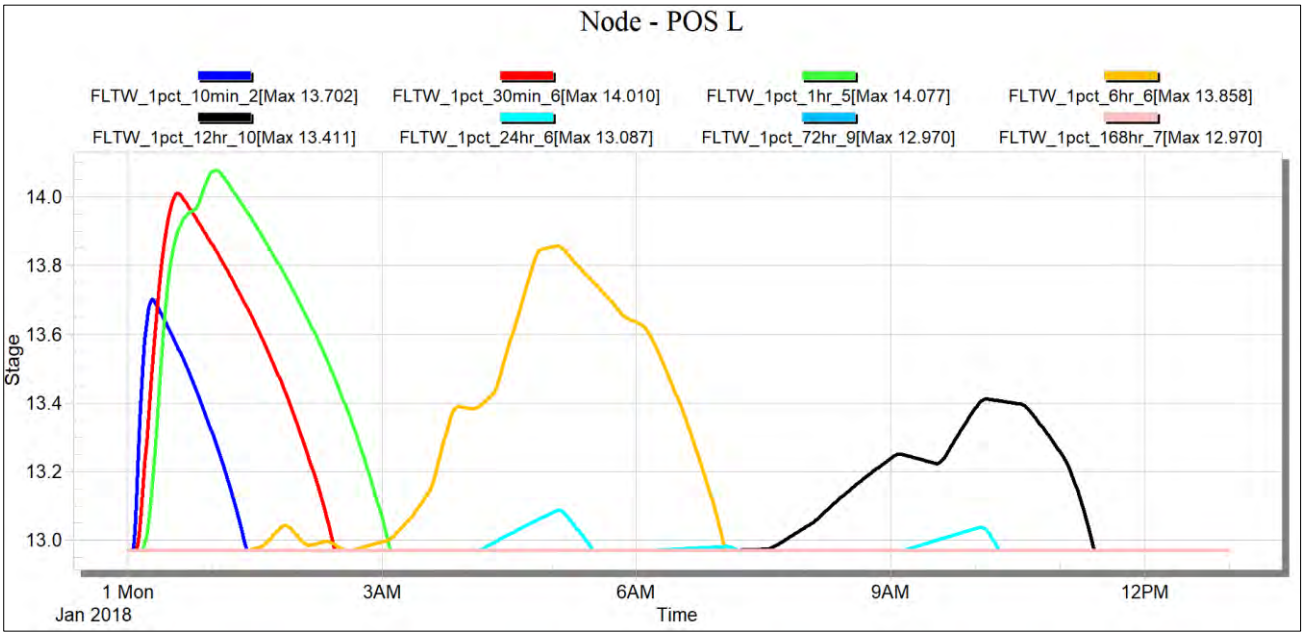


10.5.2 POS L, Temporary Storage Requirement

The combined hydrology and hydraulic modelling results and critical storms for POS L, when receiving runoff from Stage 12 contributing catchment areas only, are summarised in this section.

Table 7 – POS L Temporary Storage Requirement (Stage 12 Only)				
Storm	**Volume (m^3)**	**Surface Area (m^2)**	**Depth (m)**	**Max Water Level (m AHD)**
63% AEP 1hr Storm 5	44	166	0.3	13.30
20% AEP 30min Storm 3	137	289	0.6	13.60
1% AEP 1hr Storm 5*	303	420	1.1	14.08





10.6 Infiltration Model

Infiltration Model is based on Deep Water Table Model and Clogged Base Model. Design checks were also undertaken for Unclogged Base Model, which use Green Ampt model for the initial soakage until the wetted front reaches the water table, then the Shallow Water Table model is then used for the later part of the soakage period. It was established that the Unclogged Base Model is not applicable to this site, due to the significant separation from groundwater.

All trapped drainage pits have been modelled with 600mm storage trap, with infiltration through the pit's base only. Drainage basins' infiltration area model is a stepwise linear model constructed using the temporary basin design contours.
The geotechnical recommended hydraulic conductivity of 4.3m/day was used as the base for these infiltration models.

10.7 Hydraulic

Results from MUS' Hydraulic Modelling are presented in **Appendix D**

The hydraulic system has been designed for ultimate flow scenario, and checked against the critical 10% & 20% AEP, in accordance with the Stormwater Management Strategy detailed in Section 6.1.2.

Ultimate Discharge into POS K Basin will be 0.68 m^3/s at a velocity of 1.26 m/s, during the critical 10% AEP storm event, via a DN900 pipe.

Ultimate Discharge into POS K GPT will be 0.68m^3/s at a velocity of 1.54m/s, therefore an ecoBITE 2100 has been selected, capable of treating flows up to 0.736m^3/s and capable of conveying the maximum flow of 0.95 m^3/s (FOS of 1.4).

Ultimate Discharge into POS L temporary basin will be 0.383 m^3/s at a velocity of 1.92 m/s, during the critical 10% AEP storm event, via a DN450 pipe. This proposed temporary drainage basin in POS L will be removed in conjunction with Stage 9 and POS M development.

Ultimate Discharge into POS M will be 1.077 m^3/s at a velocity of 2 m/s, during the critical 10% AEP storm event, via a DN900 pipe. It is likely that an eco-BITE 3000 will be required at this location.

11.0 CONCLUSION

Parkland Heights Stage 12, including all future contributing catchment areas, have been designed and modelled in accordance with the latest Subdivision Plans, Approved Structure Plans, LWMS Strategy, City of Rockingham's Guidelines and Policy, IPWEA Guidelines, and AR&R 2016.

This Drainage Management Plan Report has been prepared to support the submission of a subdivision application for land located in Stage 12, Parkland Heights, Baldivis, and to comply with Condition 2 and Advice Note 2, of the WAPC Subdivision Application Number 155055. Rockingham

Park Pty Ltd, The developer of Stage 12, will ensure WSUD occurs at the site and will meet the BUWM (WAPC, 2008) design objectives.

FIGURE 2

Parkland Heights Estate Stormwater Catchment Plan

(drawing no. XPSWMM Runoff Model 1, dated 24/05/2019)
Prepared by C. Le

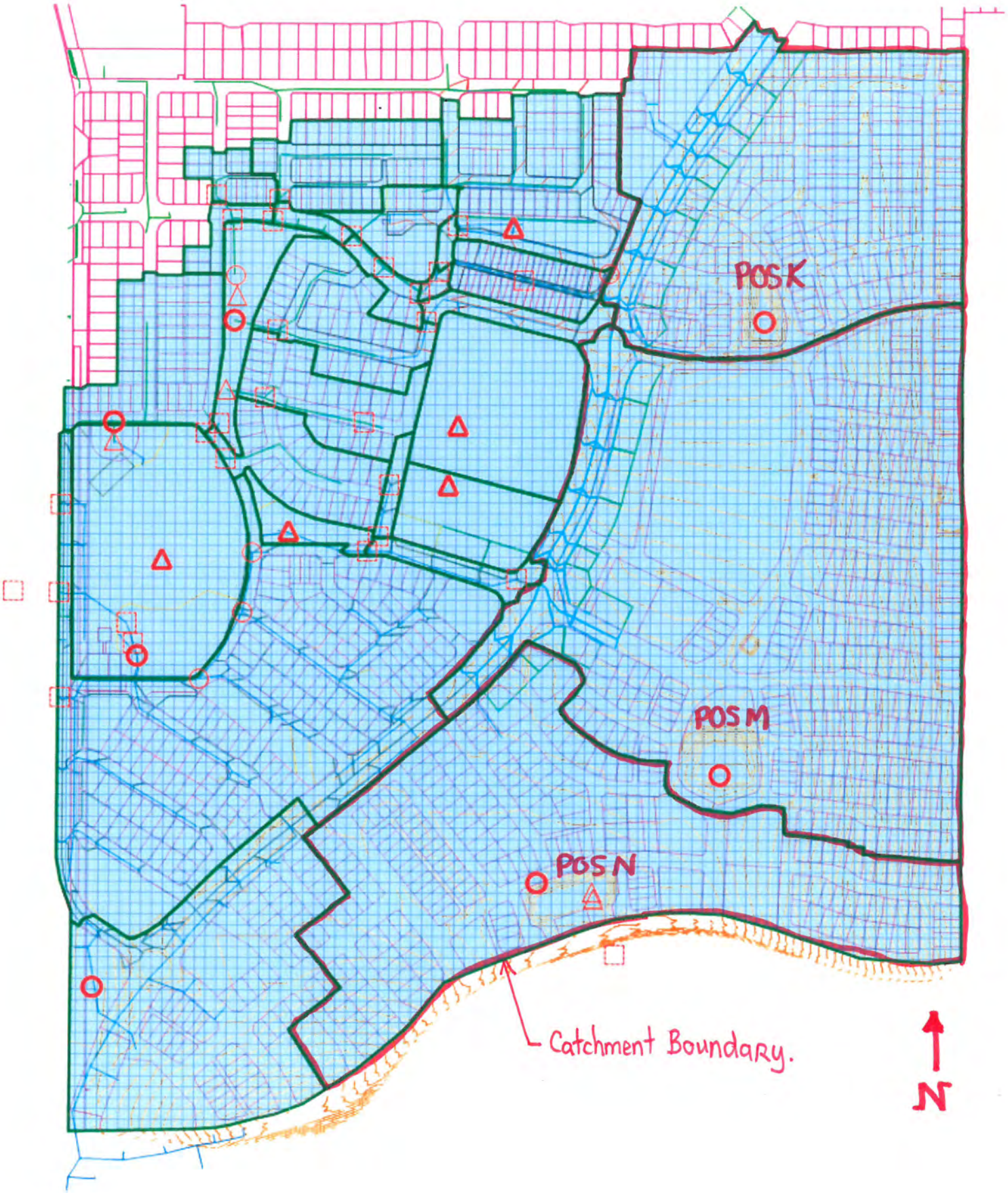

POS K
POS M
POS N
Catchment Boundary.
N

FIGURE 3

Furnivall Parade Catchment Boundary

(drawing no. XPSWMM Runoff Model 2, dated 24/05/2019)
Prepared by C. Le

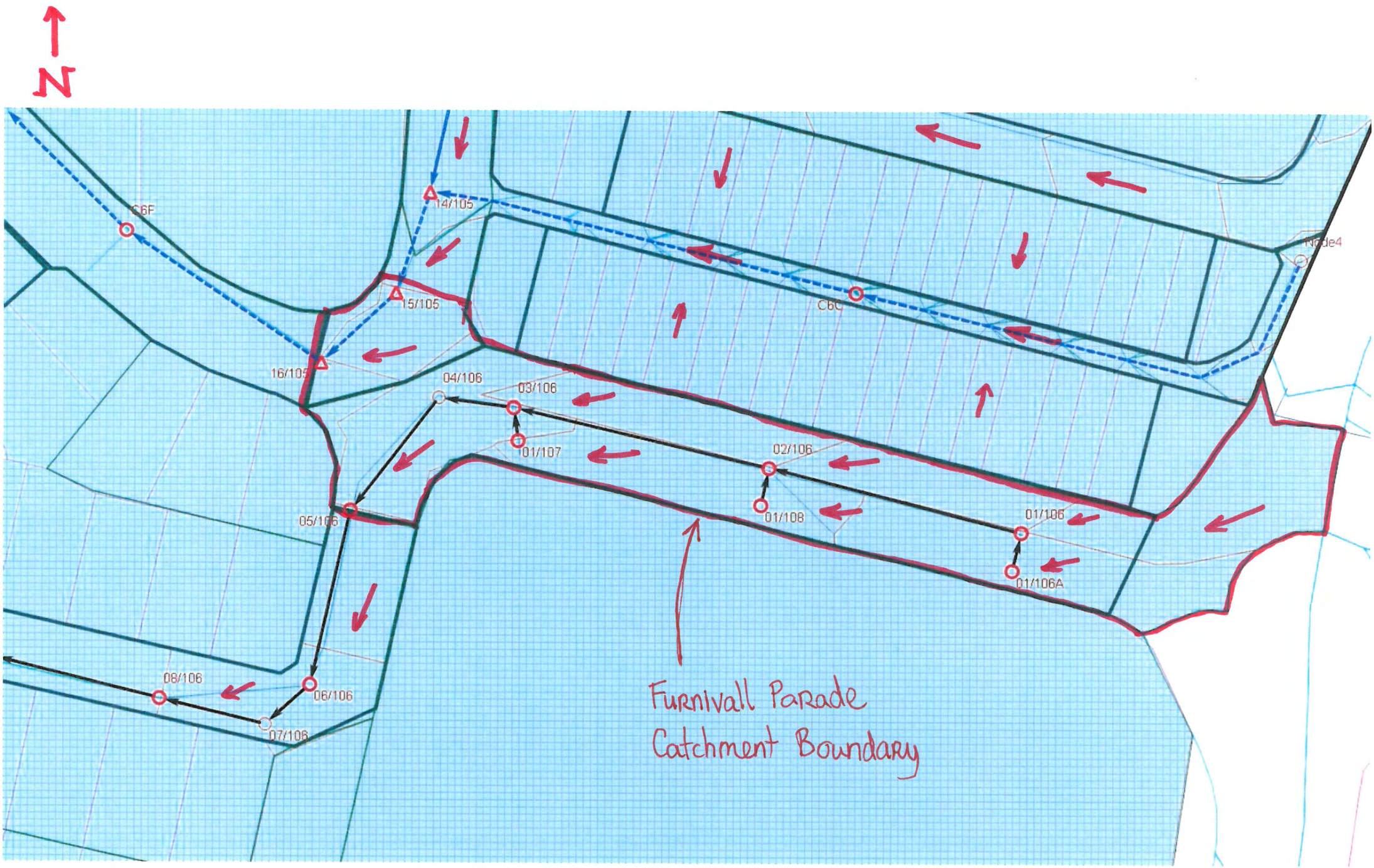

N
C6F
14/105
15/105
16/105
C6C
Node4
04/106
03/106
01/107
02/106
01/108
01/106
01/106A
05/106
08/106
06/106
07/106
Furnivall Parade
Catchment Boundary

FIGURE 4

POS K Pits and Pipes Sub-Catchment Boundaries

(drawing no. XPSWMM Runoff Model 3, dated 24/05/2019)
Prepared by C. Le

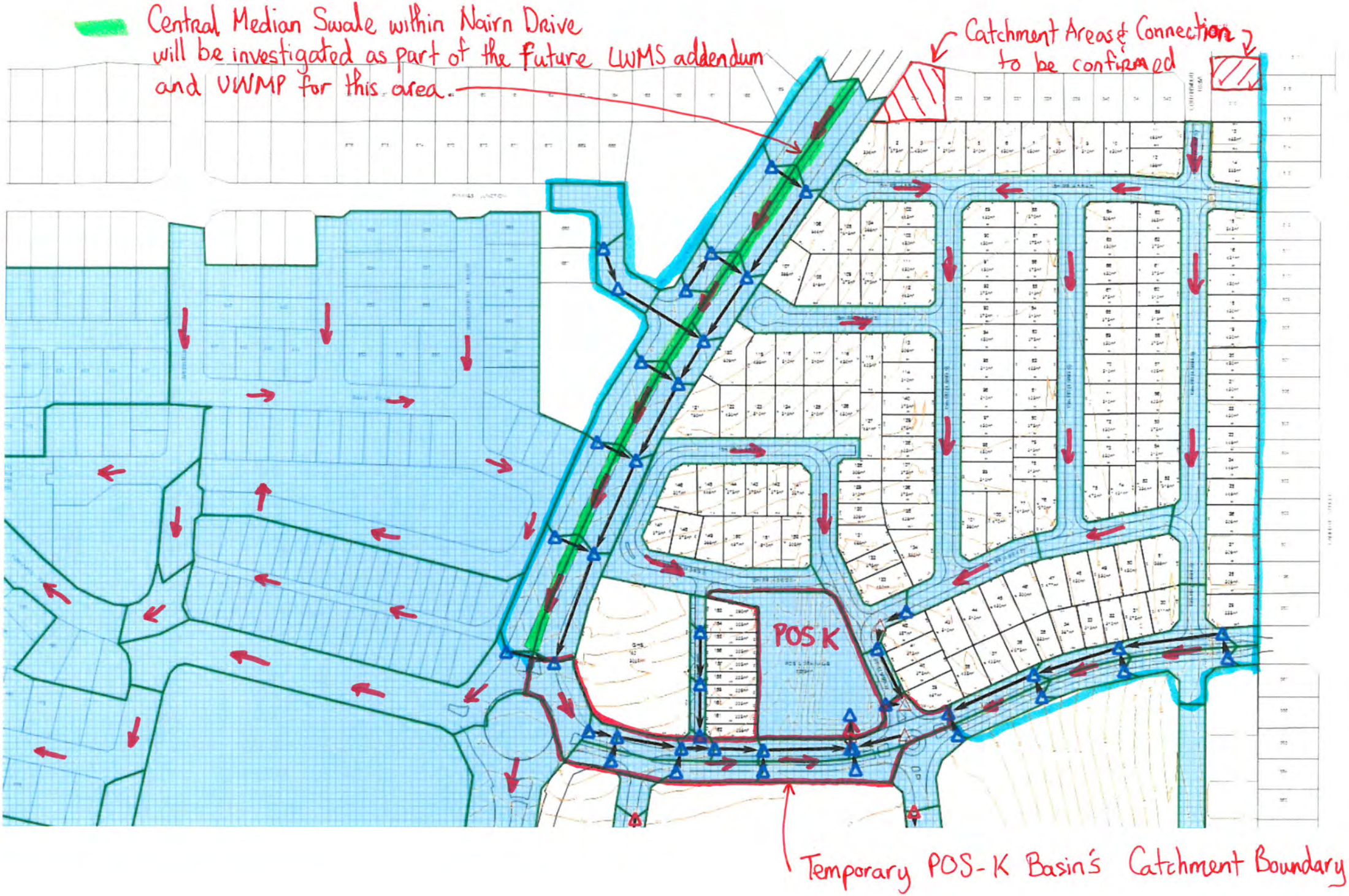

Central Median Swale within Nairn Drive will be investigated as part of the future LWMS addendum and UWMP for this area.
Catchment Areas & Connection to be confirmed
POS K
Temporary POS-K Basin's Catchment Boundary

FIGURE 5

POS L Sub-Catchment Boundaries for Temporary Basin

(drawing no. XPSWMM Runoff Model 4, dated 24/05/2019)
Prepared by C. Le

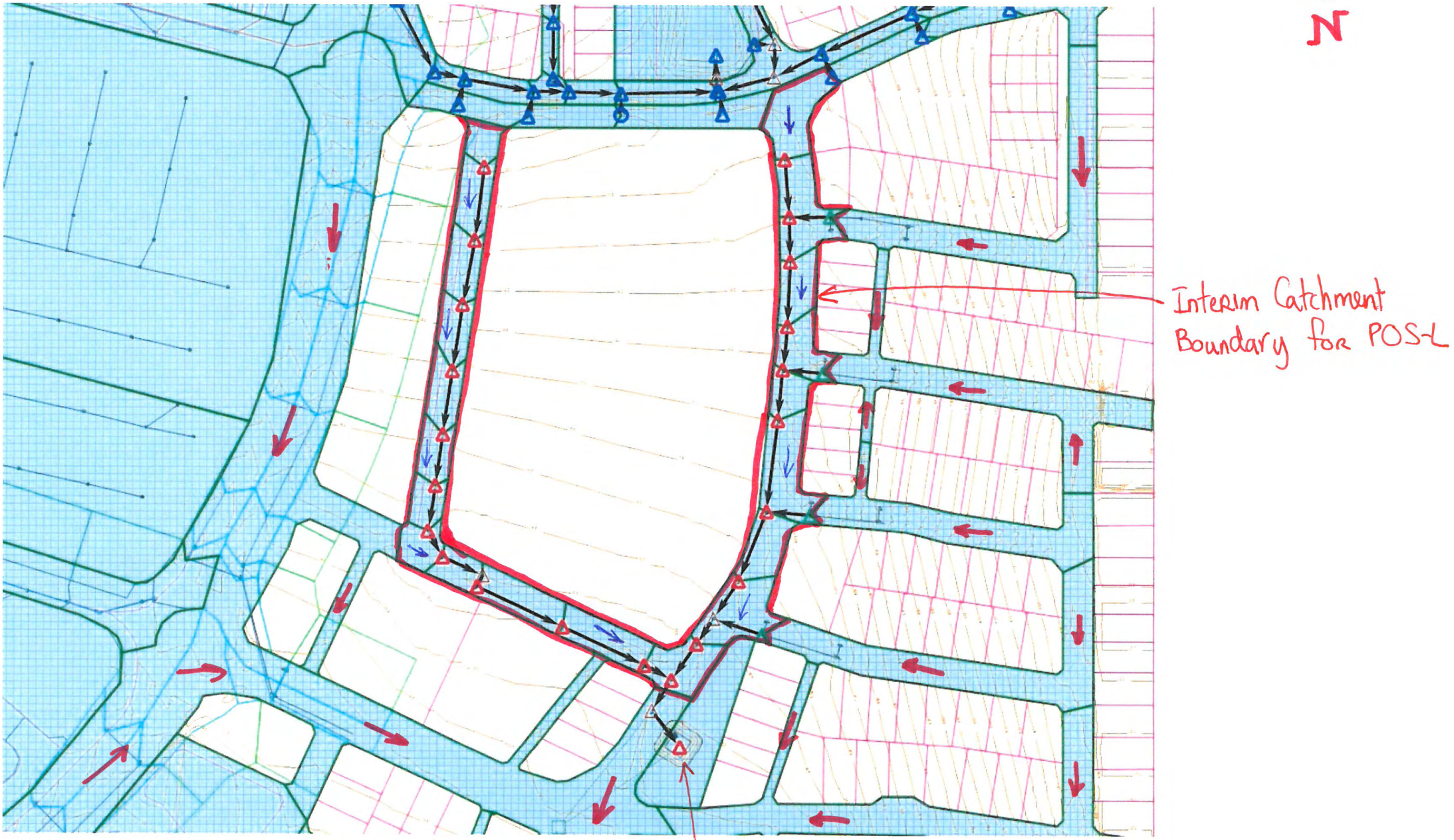
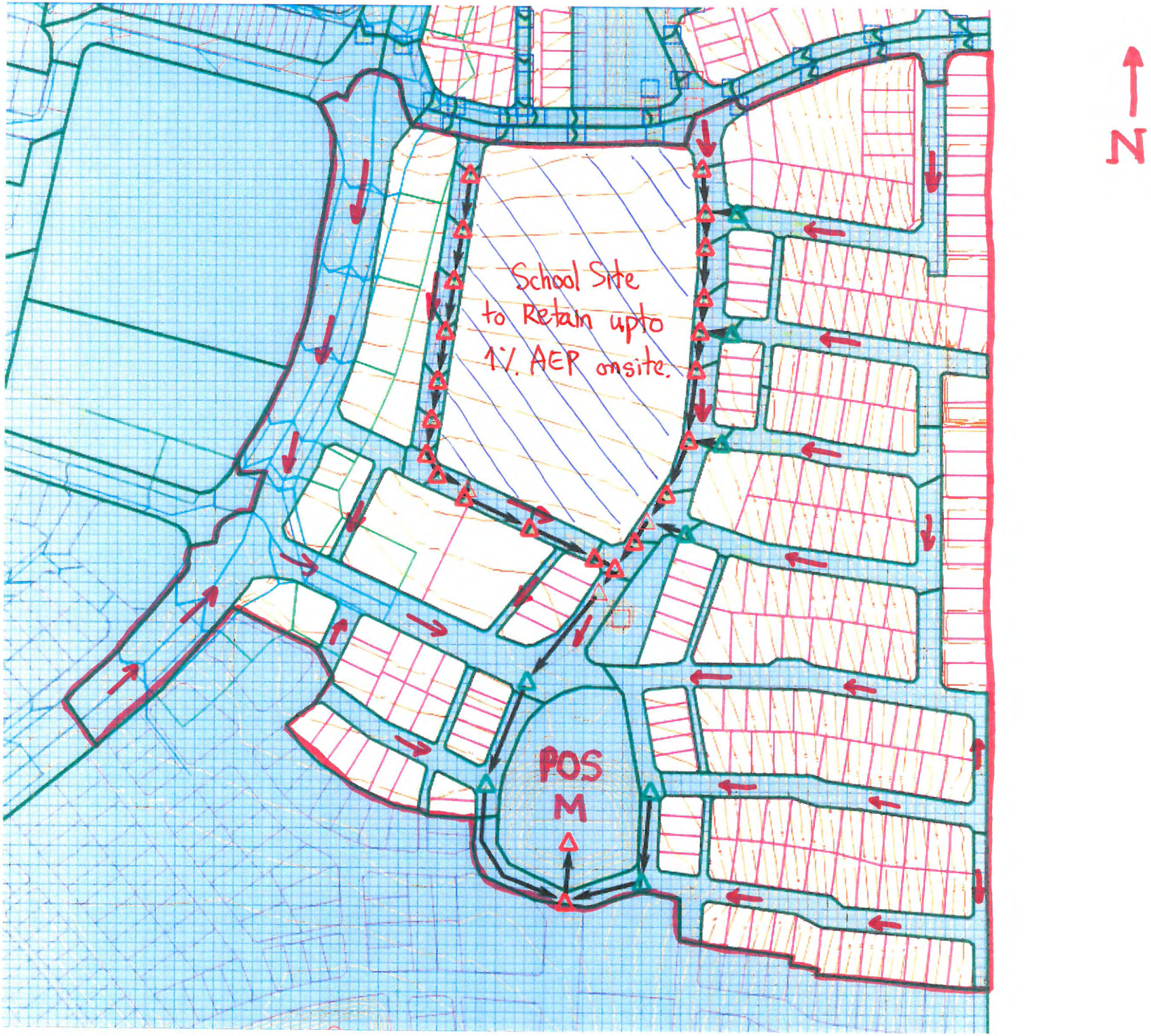

N
Interim Catchment Boundary for POS-L
POS-L Temporary Basin.

FIGURE 6

POS M Pits & Pipes Sub-Catchment Boundaries

(drawing no. XPSWMM Runoff Model 5, dated 24/05/2019)
Prepared by C. Le


School Site
to Retain upto
1% AEP onsite.
POS
M
N

APPENDIX A

WAPC Subdivision Approval Conditions and Plan

(WAPC no. 155055, dated 11 April 2017)
Prepared by Creative Planning & Design

Western Australian Planning Commission

Your Ref : PCG 94
Enquiries : Regan Douglas (Ph 6551 9289)

Creative Design + Planning
P O Box 7655
CLOISTERS SQUARE WA 6850

Approval Subject To Condition(s)
Freehold (Green Title) Subdivision

Application No : 155055

Planning and Development Act 2005

Applicant	:	Creative Design + Planning P O Box 7655, CLOISTERS SQUARE WA 6850
Owner	:	Rockingham Park Pty Ltd P O Box 907, CLAREMONT WA 6910
Application Receipt	:	11 April 2017

Lot Number	:	9009
Diagram / Plan	:	406823
Location	:	-
C/T Volume/Folio	:	2891/11
Street Address	:	Sixty Eight Road, Baldivis
Local Government	:	City of Rockingham

The Western Australian Planning Commission has considered the application referred to and is prepared to endorse a deposited plan in accordance with the plan date-stamped **11 April 2017** once the condition(s) set out have been fulfilled.

This decision is valid for **three years** from the date of this advice, which includes the lodgement of the deposited plan within this period.

The deposited plan for this approval and all required written advice confirming that the requirement(s) outlined in the condition(s) have been fulfilled must be submitted by **04 July 2020** or this approval no longer will remain valid.

140 William Street, Perth, Western Australia 6000, Locked Bag 2506 Perth, 6001
Tel: (08) 6551 8002; Fax: (08) 6551 9001; Infoline: 1800 626 477
e-mail: info@dplh.wa.gov.au; web address http://www. planning.wa.gov.au
ABN 35 482 341 493

Reconsideration - 28 days

Under section 151(1) of the *Planning and Development Act 2005*, the applicant/owner may, within 28 days from the date of this decision, make a written request to the WAPC to reconsider any condition(s) imposed in its decision. One of the matters to which the WAPC will have regard in reconsideration of its decision is whether there is compelling evidence by way of additional information or justification from the applicant/owner to warrant a reconsideration of the decision. A request for reconsideration is to be submitted to the WAPC on a Form 3A with appropriate fees. An application for reconsideration may be submitted to the WAPC prior to submission of an application for review. Form 3A and a schedule of fees are available on the WAPC website: http://www.planning.wa.gov.au

Right to apply for a review - 28 days

Should the applicant/owner be aggrieved by this decision, there is a right to apply for a review under Part 14 section 251 of the *Planning and Development Act 2005*. The application for review must be submitted in accordance with part 2 of the *State Administrative Tribunal Rules 2004* and should be lodged within 28 days of the date of this decision to: the State Administrative Tribunal, Level 6, State Administrative Tribunal Building, 565 Hay Street, PERTH, WA 6000. It is recommended that you contact the tribunal for further details: telephone 9219 3111 or go to its website: http://www.sat.justice.wa.gov.au

Deposited plan

The deposited plan is to be submitted to the Western Australian Land Information Authority (Landgate) for certification. Once certified, Landgate will forward it to the WAPC. In addition, the applicant/owner is responsible for submission of a Form 1C with appropriate fees to the WAPC requesting endorsement of the deposited plan. A copy of the deposited plan with confirmation of submission to Landgate is to be submitted with all required written advice confirming compliance with any condition(s) from the nominated agency/authority or local government. Form 1C and a schedule of fees are available on the WAPC website: http://www.planning.wa.gov.au

Condition(s)

The WAPC is prepared to endorse a deposited plan in accordance with the plan submitted once the condition(s) set out have been fulfilled.

The condition(s) of this approval are to be fulfilled to the satisfaction of the WAPC.

The condition(s) must be fulfilled before submission of a copy of the deposited plan for endorsement.

The agency/authority or local government noted in brackets at the end of the condition(s) identify the body responsible for providing written advice confirming that the WAPC's requirement(s) outlined in the condition(s) have been fulfilled. The written advice of the agency/authority or local government is to be obtained by the applicant/owner. When the written advice of each identified agency/authority or local government has been obtained, it

140 William Street, Perth, Western Australia 6000, Locked Bag 2506 Perth, 6001
Tel: (08) 6551 8002; Fax: (08) 6551 9001; Infoline: 1800 626 477
e-mail: info@dplh.wa.gov.au; web address http://www. planning.wa.gov.au
ABN 35 482 341 493

should be submitted to the WAPC with a Form 1C and appropriate fees and a copy of the deposited plan.

If there is no agency/authority or local government noted in brackets at the end of the condition(s), a written request for confirmation that the requirement(s) outlined in the condition(s) have been fulfilled should be submitted to the WAPC, prior to lodgement of the deposited plan for endorsement.

Prior to the commencement of any subdivision works or the implementation of any condition(s) in any other way, the applicant/owner is to liaise with the nominated agency/authority or local government on the requirement(s) it considers necessary to fulfil the condition(s).

The applicant/owner is to make reasonable enquiry to the nominated agency/authority or local government to obtain confirmation that the requirement(s) of the condition(s) have been fulfilled. This may include the provision of supplementary information. In the event that the nominated agency/authority or local government will not provide its written confirmation following reasonable enquiry, the applicant/owner then may approach the WAPC for confirmation that the condition(s) have been fulfilled.

In approaching the WAPC, the applicant/owner is to provide all necessary information, including proof of reasonable enquiry to the nominated agency/authority or local government.

The condition(s) of this approval, with accompanying advice, are:

CONDITIONS:

Drainage and site works

1. Engineering drawings and specifications are to be submitted, approved, and works undertaken in accordance with the approved engineering drawings, specifications and approved plan of subdivision, for grading and/or stabilisation of the site to ensure that:

    a) lots can accommodate their intended use; and

    b) finished ground levels at the boundaries of the lot(s) the subject of this approval match or otherwise coordinate with the existing and/or proposed finished ground levels of the land abutting. (Local Government)

2. Prior to the commencement of subdivisional works, an urban water management plan is to be prepared and approved, in consultation with the Department of Water, consistent with any approved local water management strategy. (Local Government)

3. Engineering drawings and specifications are to be submitted and approved, and works undertaken in accordance with the approved engineering drawings and specifications and approved plan of subdivision, for the filling and/or draining of the land, including ensuring that stormwater is contained on-site, or appropriately

treated and connected to the local drainage system. Engineering drawings and specifications are to be in accordance with an approved urban water management plan for the site. (Local Government)

4. Prior to the commencement of subdivisional works, the landowner/applicant is to provide a pre-works geotechnical report certifying that the land is physically capable of development or advising how the land is to be remediated and compacted to ensure it is capable of development; and in the event that remediation works are required, the landowner/applicant is to provide a post geotechnical report certifying that all subdivisional works have been carried out in accordance with the pre-works geotechnical report. (Local Government).

Schools

5. The land denoted as proposed primary school site on the approved plan of subdivision is to be set aside as a separate lot, pending the acquisition of the land by the Department of Education. (Department of Education)

Transport

6. Engineering drawings and specifications are to be submitted, approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications, to ensure that those lots not fronting an existing road are provided with frontage to a constructed road(s) connected by a constructed road(s) to the local road system and such road(s) are constructed and drained at the landowner/applicant's cost. As an alternative, and subject to the agreement of the Local Government the Western Australian Planning Commission (WAPC) is prepared to accept the landowner/applicant paying to the local government the cost of such road works as estimated by the local government and the local government providing formal assurance to the WAPC confirming that the works will be completed within a reasonable period as agreed by the WAPC. (Local Government)
7. Engineering drawings and specifications are to be submitted and approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications to ensure that:

    a) street lighting is installed on all new subdivisional roads to the standards of the relevant licensed service provider;

    b) roads that have been designed to connect with existing or proposed roads abutting the subject land are coordinated so the road reserve location and width connect seamlessly; and

    d) embayment parking is provided within all of the proposed streets.

    to the satisfaction of the Western Australian Planning Commission. (Local Government)

8. Engineering drawings and specifications are to be submitted, approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications, for the provision of shared paths through and connecting to the application area in accordance with the approved Parkland Heights Local Structure Plan.

   The approved shared paths are to be constructed by the landowner/applicant. (Local Government)

9. All local streets within the subdivision being truncated in accordance with the Western Australian Planning Commission's *Liveable Neighbourhoods* policy.(Local Government)

10. The western road reserve abutting the school site to be increased to 18 metres width. (Local Government)

Water and sewer

11. Arrangements being made with the Water Corporation so that provision of a suitable water supply service will be available to the lot shown on the approved plan of subdivision. (Water Corporation)

12. Arrangements being made with the Water Corporation so that provision of a sewerage service will be available to the lot shown on the approved plan of subdivision. (Water Corporation)

ADVICE:

1. The landowner/applicant should contact 'Dial Before You Dig' on '1100' prior to the commencement of development works to determine the location of buried gas infrastructure.

2. In regard to Condition 2, it is understood that the City of Rockingham will accept a drainage management plan to fulfil this condition.

3. In regard to Conditions 11 and 12, the landowner/applicant shall make arrangements with the Water Corporation for the provision of the necessary services. On receipt of a request from the landowner/applicant, a Land Development Agreement under Section 83 of the *Water Services Act 2012* will be prepared by the Water Corporation to document the specific requirements for the proposed subdivision.

4. In regard to Condition 10, the increase in the width of the western road reserve to 18 metres is advocated by Transcore's transport assessments for subject land dated July 2011 and March 2017. Further, it is also warranted by the increase in traffic associated with the proposed amendment to the Lot 1507 Eighty Road, Baldivis

Local Structure Plan which will increase the scale of the Village Centre from a 'Local' centre to a 'Neighbourhood' centre.

5. The Department of Planning's Infrastructure and Land Use Coordination Division recommends that the intersection of the road on the western site of the school site with Furnivall Parade be restricted to left-in/left-out vehicular movements.

Kerrine Blenkinsop
Secretary
Western Australian Planning Commission

4 July 2017

140 William Street, Perth, Western Australia 6000, Locked Bag 2506 Perth, 6001
Tel: (08) 6551 8002; Fax: (08) 6551 9001; Infoline: 1800 626 477
e-mail: info@dplh.wa.gov.au; web address http://www. planning.wa.gov.au
ABN 35 482 341 493

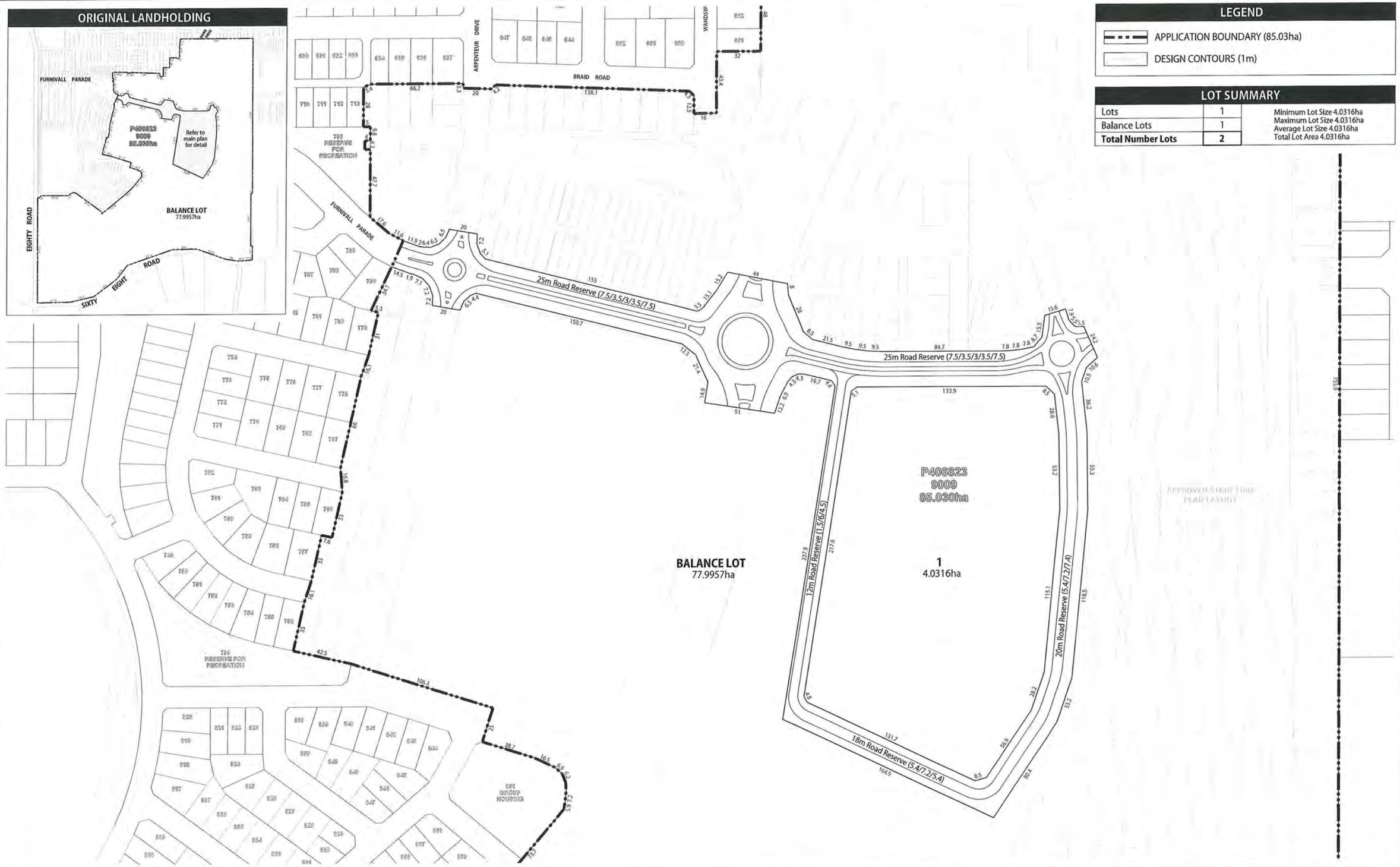
ORIGINAL LANDHOLDING

LEGEND

- APPLICATION BOUNDARY (85.03ha)
- DESIGN CONTOURS (1m)

LOT SUMMARY

Lots	1	Minimum Lot Size 4.0316ha Maximum Lot Size 4.0316ha Average Lot Size 4.0316ha Total Lot Area 4.0316ha
Balance Lots	1	
Total Number Lots	**2**	



PROPOSED SUBDIVISION

Lot 9009 Sixty Eight Road, BALDIVIS

A Rockingham Park Pty Ltd Project

DEPARTMENT OF PLANNING

DATE	FILE
11-Apr-2017	**155055**

NORTH

Scale 1:2500 @ A3

0 25 50 75 100 125m

DATE:	10/02/2017	DRAFTEE:	JP
REVISED:		PLANNER:	TV
PROJECTION:	PCG 94	CHECK:	BK
DATUM:	AHD	PLAN NUMBER:	RHPPH-3-002

A 28 Brown St, East Perth WA 6004
P (08) 9325 0200
E info@creativedp.au
W creativedp.au

Creative DESIGN+PLANNING

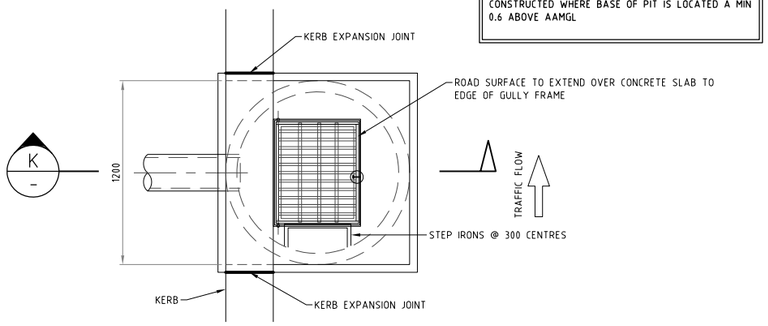
APPENDIX B

Stormwater Drainage Design Drawing(s)

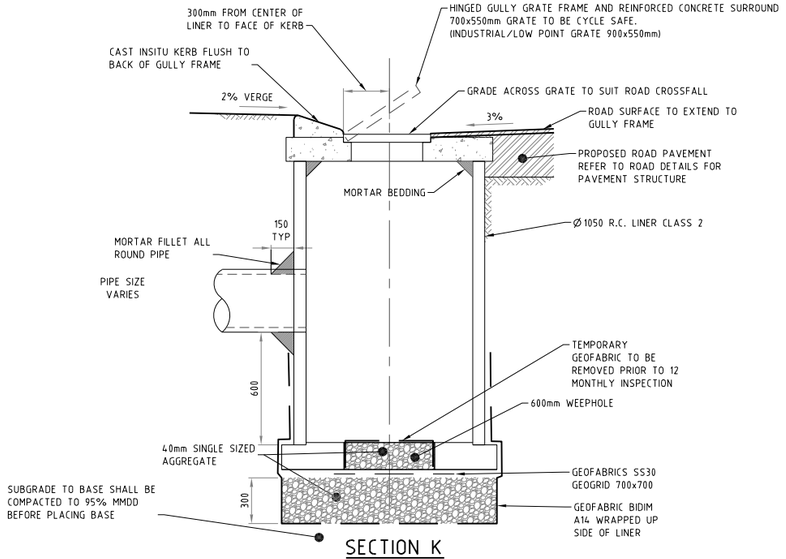
Prepared by Mortons Urban Solutions

NOTE:

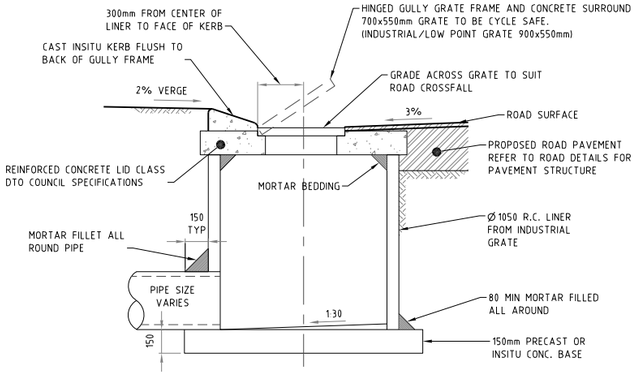
WEEP HOLE/SAND TRAP SHALL ONLY BE CONSTRUCTED WHERE BASE OF PIT IS LOCATED A MIN 0.6 ABOVE AAMGL



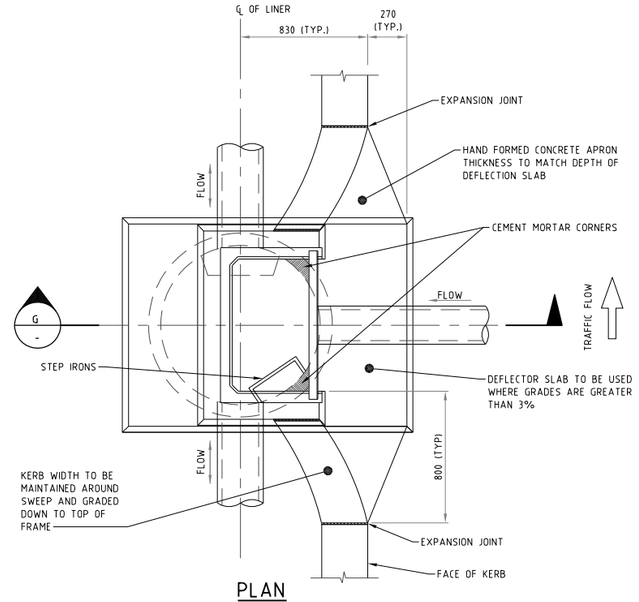
PLAN



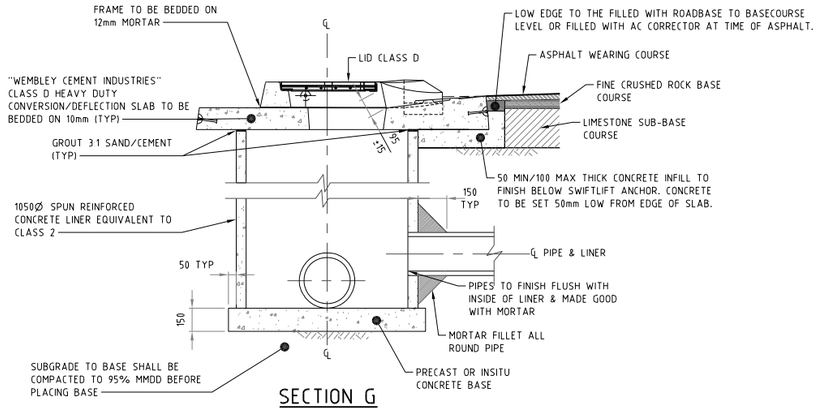
SECTION K
STANDARD GULLY GRATE DETAIL (TRAPPED)
SCALE 1:20 - A1 (1:40 - A3)



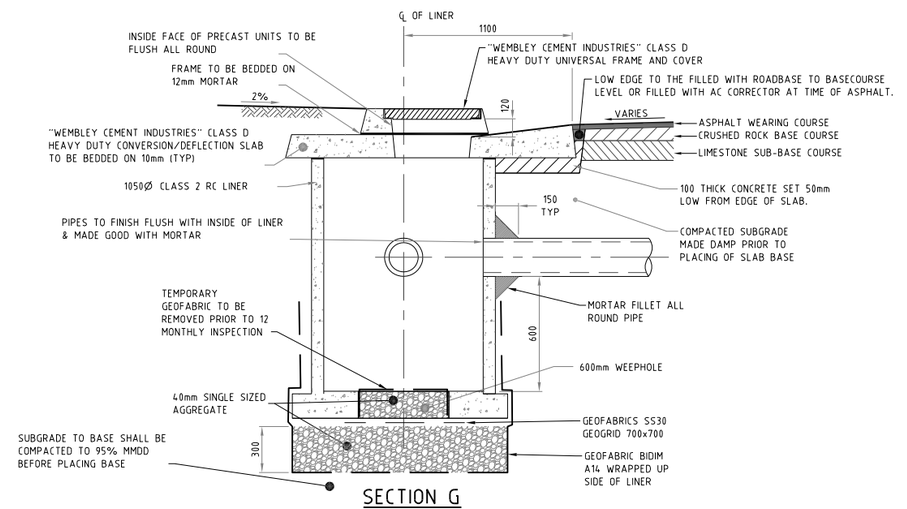
SECTION K
STANDARD GULLY GRATE DETAIL
SCALE 1:20 - A1 (1:40 - A3)



PLAN



SECTION G
SIDE ENTRY PIT DETAIL
SCALE 1:20 - A1 (1:40 - A3)



SECTION G
SIDE ENTRY PIT DETAIL (TRAPPED)
SCALE 1:20 - A1 (1:40 - A3)

PROJECT NAME

PARKLAND HEIGHTS

SCHOOL SITE

CLIENT

Rockingham Park Pty Ltd

0 0.2 0.4 0.6 0.8 1.0m

Scale 1:20 - A1 (1:40 - A3)

ISSUES	DATE	
TENDER	25-06-18	
COUNCIL		
CONSTRUCTION		

B	19-03-19	DESIGN REVISION
A	25-06-18	COUNCIL ISSUE
PRE	DATE	AMENDMENT

WAPC REF: 155055

ASSOCIATED CONSULTANTS

3 CONSULTING ENGINEERS PTY LTD
Electrical Engineering Excellence

DRAWING TITLE

ROADWORKS & DRAINAGE DETAILS SHEET 03

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

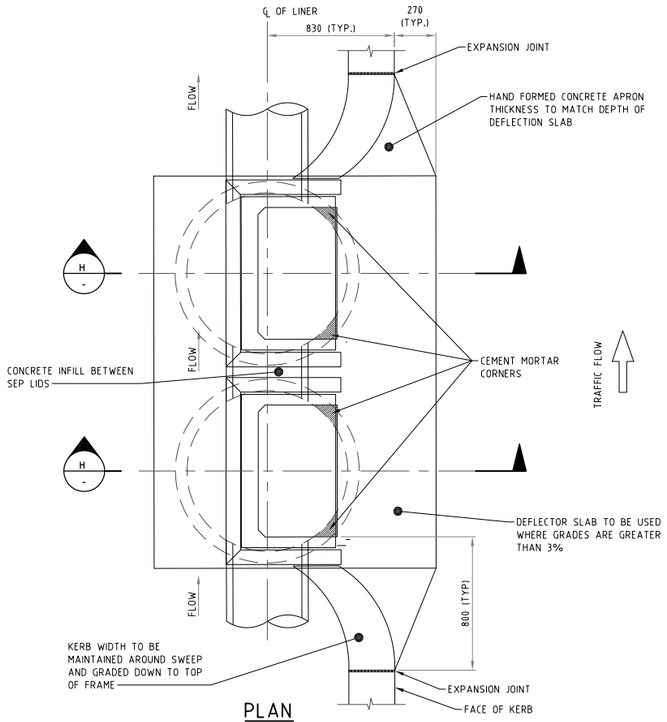
Postal Address
U4 100 Railway Road
Subiaco 6008

Email: mortons@urbansolutions.net.au
Website: www.urbansolutions.net.au
Tel 08 9380 9700

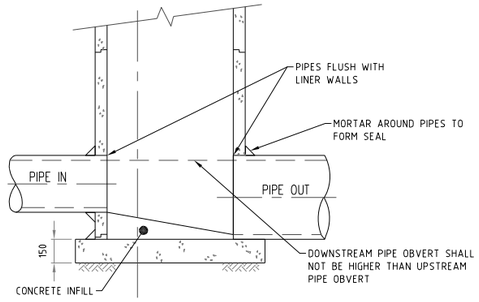
Perth Office
U4 100 Railway Road
Subiaco 6008

DESIGNED	SM	DRAWN	SM
APPROVED		RPEQ 4706	DATE 26-02-18

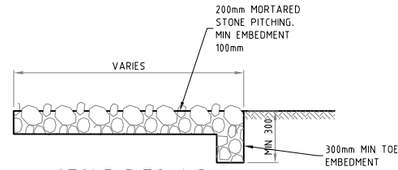
DRAWING NUMBER	AMEND.
28601-SS-182	B



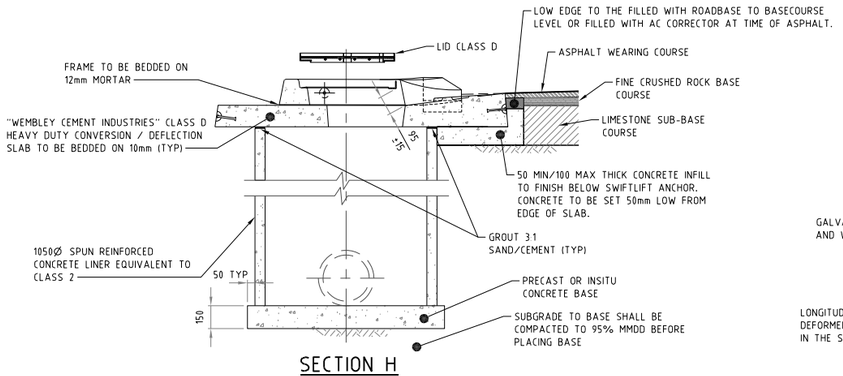
PLAN



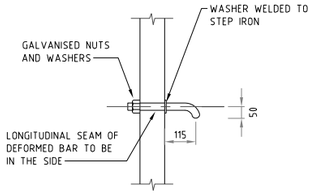
TYPICAL SECTION
SMALLER PIPE TO LARGER PIPE



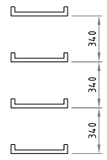
STONE PITCHING
DETAIL



SECTION H
DOUBLE SIDE ENTRY PIT DETAIL
SCALE 1:20 - A1 (1:40 - A3)

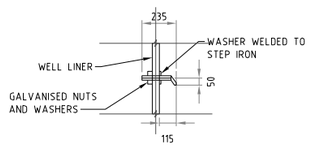


SECTION THROUGH WALL



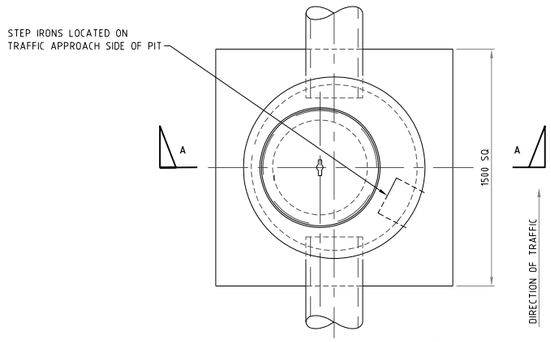
VERTICAL SPACING

STEP IRON DETAILS FOR SIDE ENTRY PIT
NOT TO SCALE

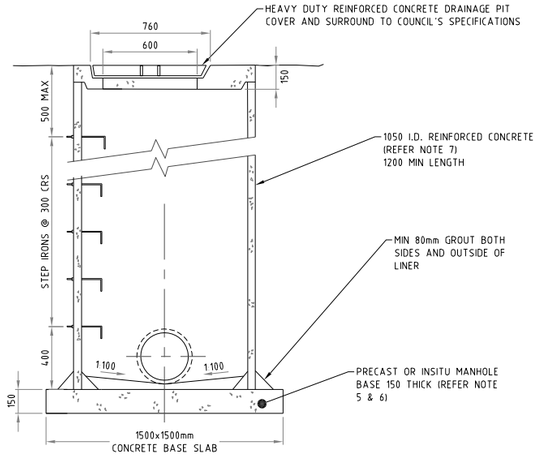


STEP IRONS TO BE 24 DIA HOT DIPPED GALVANISED DEFORMED BARS TO BE INSTALLED ON ALL ACCESSIBLE PITS ON SIDE OF ONCOMING TRAFFIC IN ALL PITS

STEP IRON DETAIL
NOT TO SCALE

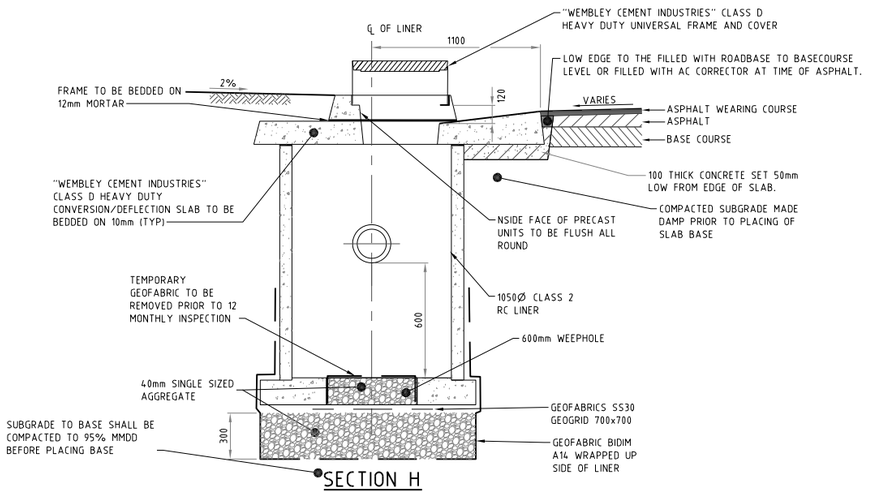


PLAN PREFERRED LAYOUT
SCALE 1:20 - A1 (1:40 - A3)



SECTION A-A

JUNCTION DETAILS
PIPES 300 - 750mm
SCALE 1:20 - A1 (1:40 - A3)



SECTION H
DOUBLE SIDE ENTRY PIT DETAIL (TRAPPED)
SCALE 1:20 - A1 (1:40 - A3)

NOTES:

1. STEP IRONS NOT REQUIRED IN GULLIES/PITS WITH A DEPTH OF 1000mm OR LESS.
2. ALL STEP IRONS TO BE HOT DIPPED GALVANISED AFTER FABRICATION.
3. ALL BASES TO BE BEDDED ON FIRM NATURAL OR COMPACTED SAND.
4. MORTAR TO BE 3:1 SAND-CEMENT MIXTURE.
5. INSITU CONCRETE TO HAVE MINIMUM STRENGTH OF 20 MPa AT 28 DAYS.
6. ALL ACCESS PITS SHALL BE INTERLOCKING JOINT, EQUIVALENT TO 'CLASS 2' PIPE.
7. ALL REINFORCEMENT AND STEEL TO BE CLEAN AND FREE FROM OIL, RUST AND OTHER DELETERIOUS SURFACE COATINGS.
8. ALL PIPE JOINT CONNECTIONS ARE TO BE CLOSED JOINTED CONNECTIONS CONTAINING RUBBER RINGS.
9. SIDE ENTRY DEFLECTION SLABS ARE ONLY REQUIRED WHERE GRADE IS 3% OR GREATER.
10. ANY REMEDIAL WORKS TO ADJUSTED STRUCTURES IN THE PAVEMENT SHALL BE BACKFILLED WITH INSITU ROAD MATERIAL AND THE USE OF CONCRETE SURROUND IS TO BE MINIMIZED AT ALL TIMES.

PROJECT NAME

PARKLAND HEIGHTS

SCHOOL SITE

CLIENT

Rockingham Park Pty Ltd

0 0.2 0.4 0.6 0.8 1.0m
Scale 1:20 - A1 (1:40 - A3)

ISSUES	DATE	
TENDER	25-06-18	
COUNCIL		
CONSTRUCTION		

PRE	DATE	AMENDMENT
B	19-03-19	DESIGN REVISION
A	25-06-18	COUNCIL ISSUE

WAPC REF: 155055

ASSOCIATED CONSULTANTS

3 CONSULTING ENGINEERS PTY LTD
Electrical Engineering Excellence

DRAWING TITLE

ROADWORKS & DRAINAGE DETAILS SHEET 04

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

Email mortons@urbansolutions.net.au
Website www.urbansolutions.net.au
Tel 08 9380 9700

Perth Office
U4 100 Railway Road
Subiaco 6008

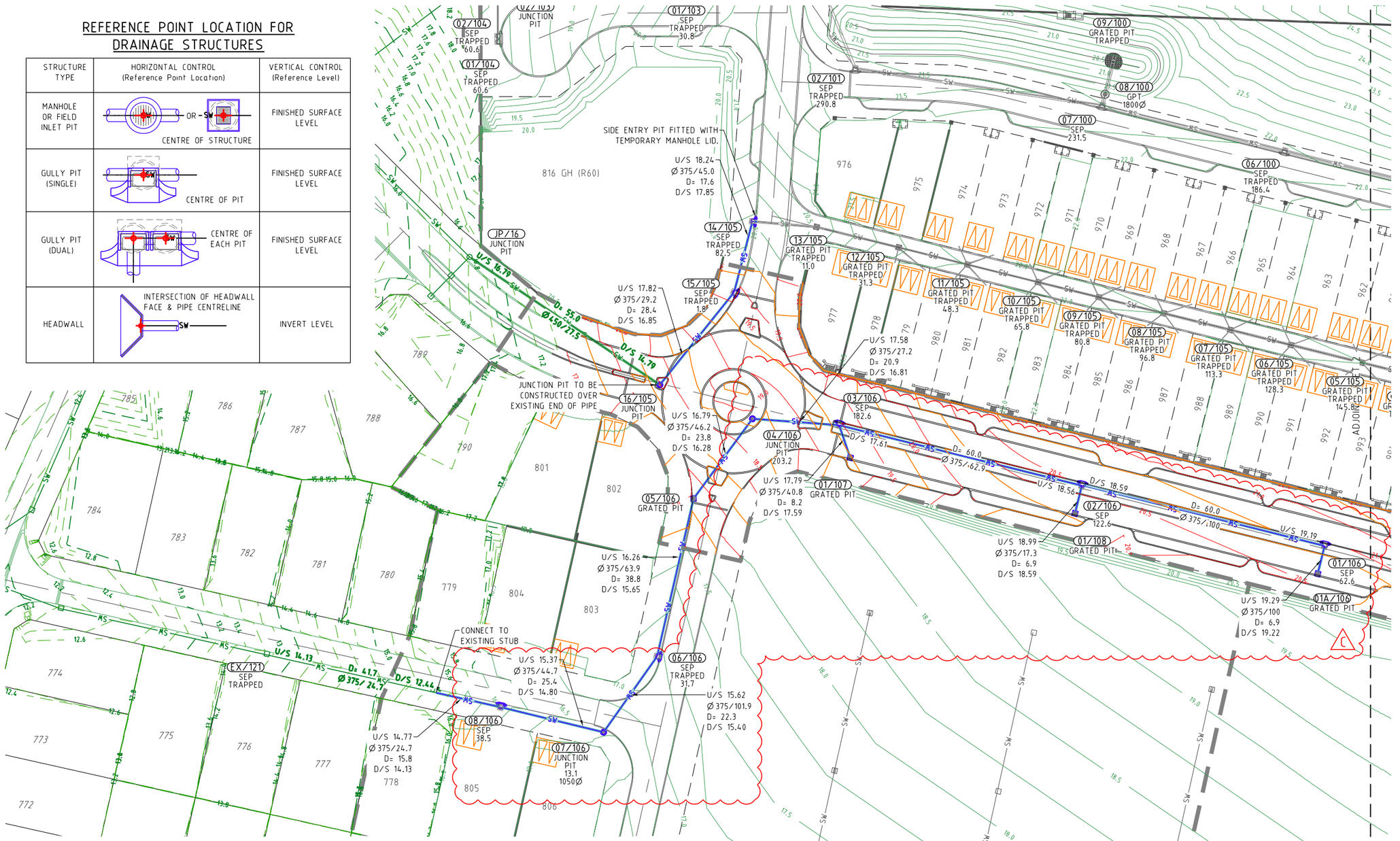
DESIGNED	SM	DRAWN	SM
APPROVED		RPEQ 4706	DATE 26-02-18

DRAWING NUMBER 28601-SS-183

AMEND. B

REFERENCE POINT LOCATION FOR DRAINAGE STRUCTURES

STRUCTURE TYPE	HORIZONTAL CONTROL (Reference Point Location)	VERTICAL CONTROL (Reference Level)
MANHOLE OR FIELD INLET PIT	SW OR SW — CENTRE OF STRUCTURE	FINISHED SURFACE LEVEL
GULLY PIT (SINGLE)	SW — CENTRE OF PIT	FINISHED SURFACE LEVEL
GULLY PIT (DUAL)	SW SW — CENTRE OF EACH PIT	FINISHED SURFACE LEVEL
HEADWALL	INTERSECTION OF HEADWALL FACE & PIPE CENTRELINE — SW	INVERT LEVEL



PROJECT SPECIFIC STORMWATER NOTES

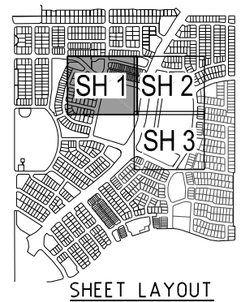
a. DRAINAGE PIPE SHALL BE RC CLASS 2 UNO.
b. ALL TRENCHING, PIPE BEDDING AND BACKFILLING SHALL BE IN ACCORDANCE WITH AS3725.
c. ALL DRAINAGE PIPE CONNECTIONS TO BE CLOSED JOINTED WITH RUBBER RINGS.
d. CENTERLINES OF DRAINAGE MANHOLES SHALL BE ALIGNED 3.0m FROM THE ROAD RESERVE BOUNDARY UNO.
e. ALL JUNCTION PITS AND ENTRY PITS SHALL BE LOCATED AS SHOWN, IRRESPECTIVE OF PIPE LENGTHS SHOWN ON THE DRAWINGS.
f. ALL SAG TYPE ENTRY PITS SHALL BE LOCATED AT THE LOW POINT OF THE ROAD PAVEMENT.
g. THE JUNCTION PIT AND ENTRY PIT LIDS SHALL BE SET TO SUIT TOP VERGE SLOPE, NOMINALLY 2% UPWARDS FROM THE TOP OF BACK OF KERB.
h. IN STANCES WHERE THE SEWER LINE INTERSECTS WITH A STORMWATER DRAINAGE LINE IN THIS DRAWINGS SET, AND THE SEWER PASSES OVER THE DRAINAGE, THEN THE SEWER SHALL HAVE A TIMBER PILE AND KEEL PROVIDED FOR THE FULL EXTENT NECESSARY TO SUPPORT THE SEWER DURING EXCAVATION OF THE DRAINAGE.
i. THE CONTRACTOR SHALL LOCATE EXPOSE AND CONFIRM LEVELS OF EXISTING DRAINAGE AT THE CONNECTION POINTS PRIOR TO COMMENCEMENT OF WORKS.
j. THE CONTRACTOR SHALL IMMEDIATELY REPORT ANY DISCREPANCY OR CLASH WITH OTHER SERVICES TO THE SUPERINTENDENT.
k. NO TREES SHALL BE REMOVED WITHOUT THE SUPERINTENDENT'S WRITTEN INSTRUCTIONS. REFER TO SPECIFICATIONS.
l. IRRIGATION DUCTS TO BE DETERMINED ON SITE WITH SUPERINTENDENT.
m. ALL GROSS POLLUTANT TRAPS SHALL BE SMARTSTREAM ECO-BITE OR SIMILAR APPROVED PRODUCT.
n. 200mm DIA PVC IRRIGATION DUCTS ENSURE ENDS MIN 600mm CLEAR OF ROADWAY AND PATH, DEPTH SHALL BE 600mm BELOW FINISHED ROAD LEVEL. AS CONSTRUCTED CO-ORDINATES SHALL BE PROVIDED TO THE SUPERINTENDENT.

LEGEND

- EXISTING KERB
- EXISTING PROPERTY LINE
- EXISTING RETAINING WALL
- SW EXISTING STORMWATER
- 1.0 EXISTING CONTOURS
- FUTURE KERB
- FUTURE PROPERTY LINE
- FUTURE RETAINING WALL
- SW FUTURE STORMWATER
- STAGE BOUNDARY
- CONTROL LINE / CENTER OF ROAD
- PROPOSED KERB
- PROPOSED PROPERTY LINE
- 1.0 DESIGN CONTOURS
- INDICATIVE DRIVEWAY LOCATION
- SW PROPOSED STORMWATER
- SCOUR PROTECTION
- 10/001 DRAINAGE PIT & LINE NO.

ONE CALL SYSTEM DIAL 1100 DIAL BEFORE YOU DIG

WARNING
BEWARE OF UNDERGROUND SERVICES
The location of underground cables are approximate only and their exact position should be checked on site. No guarantee is given that all existing cables and services are shown. Locate all underground cables and services before commencement of work. Refer to Worksafe Regulation 3.21.
DIAL1100 BEFORE YOU DIG



SHEET LAYOUT

PROJECT NAME
PARKLAND HEIGHTS
SCHOOL SITE

CLIENT
Rockingham Park Pty Ltd

NORTH
0 5 10 15 20 25m
Scale 1:500 - A1 (1:1000 - A3)

ISSUES	DATE	
TENDER	28-06-18	
COUNCIL		
CONSTRUCTION		

C	03-07-19	DESIGN REVISED
B	19-03-19	DESIGN REVISION
A	28-06-18	COUNCIL ISSUE
PRE	DATE	AMENDMENT

WAPC REF: 155055

ASSOCIATED CONSULTANTS
3 CONSULTING ENGINEERS PTY LTD
Electrical Engineering Excellence

DRAWING TITLE
DRAINAGE PLAN
SHEET 01

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

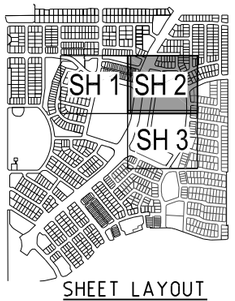
Postal Address
U4 100 Railway Road
Subiaco 6008

Email mortons@urbansolutions.net.au
Website www.urbansolutions.net.au
Tel 08 9380 9700

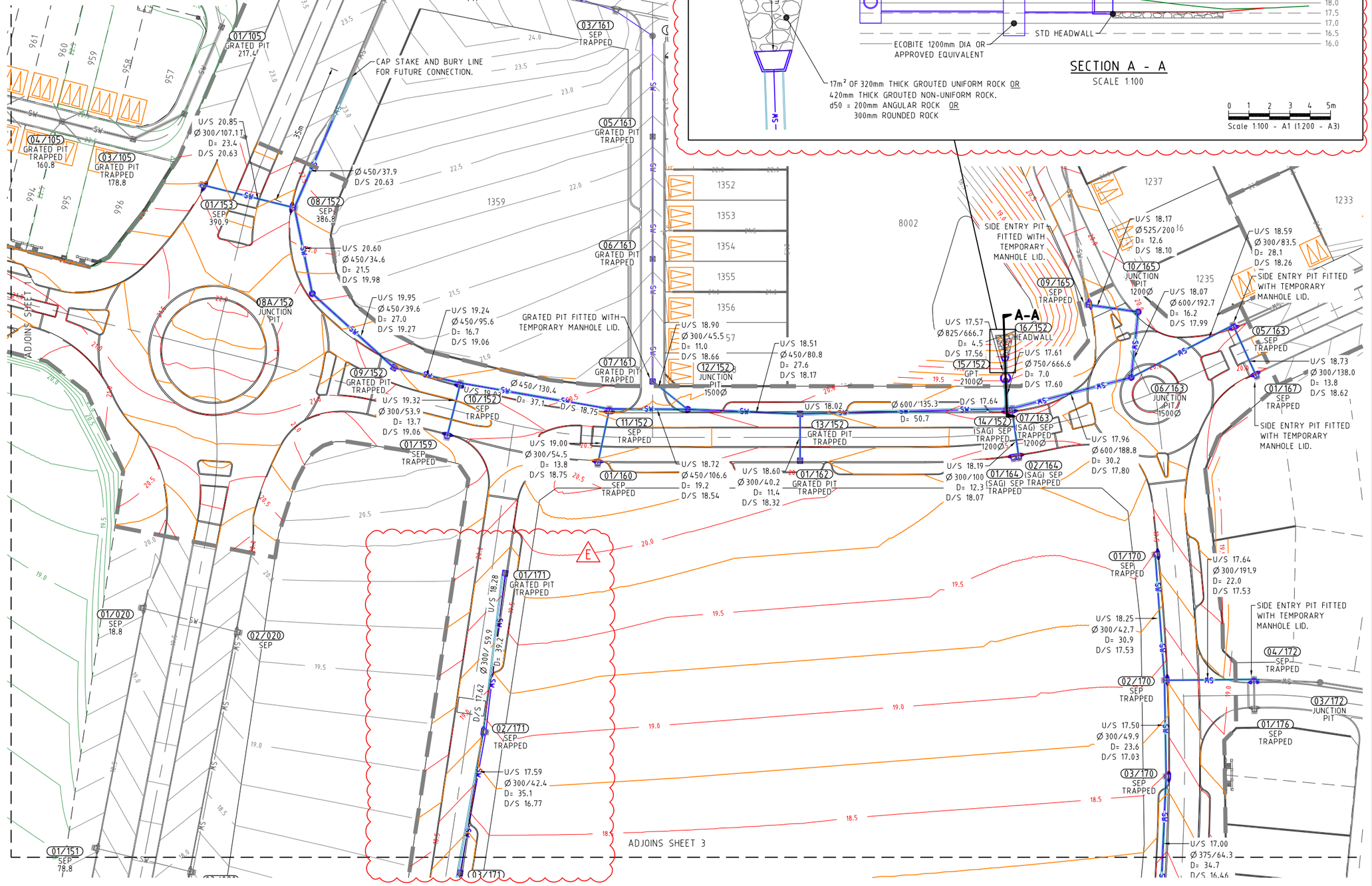
Perth Office
U4 100 Railway Road
Subiaco 6008

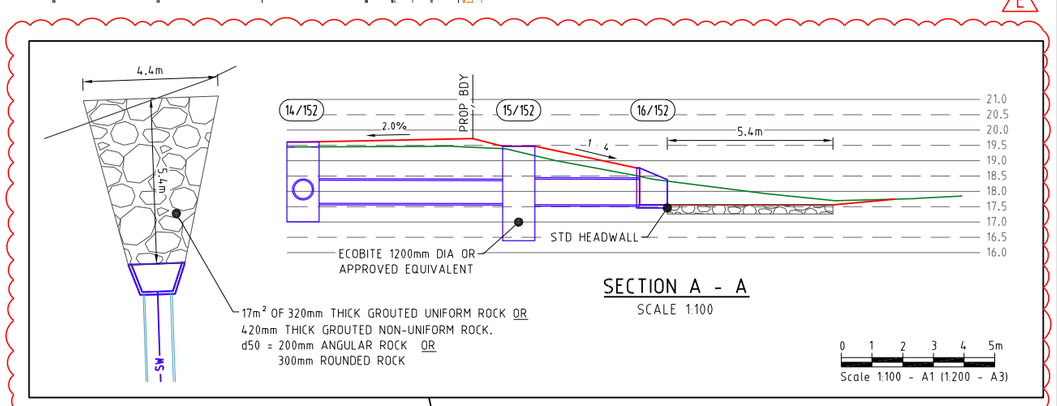
DESIGNED	SM	DRAWN	SM
APPROVED		RPEQ 4706	DATE 26-02-18

DRAWING NUMBER	AMEND.
28601-SS-600	C



SHEET LAYOUT





SECTION A - A
SCALE 1:100

0 1 2 3 4 5m
Scale 1:100 - A1 (1:200 - A3)

A-A

E

ONE CALL SYSTEM DIAL 1100 DIAL BEFORE YOU DIG

DIAL1100 BEFORE YOU DIG

WARNING

BEWARE OF UNDERGROUND SERVICES

The location of underground cables are approximate only and their exact position should be checked on site. No guarantee is given that all existing cables and services are shown. Locate all underground cables and services before commencement of work. Refer to Worksafe Regulation 3.21.

PROJECT NAME

PARKLAND HEIGHTS

SCHOOL SITE

CLIENT

Rockingham Park Pty Ltd

NORTH

0 5 10 15 20 25m
Scale 1:500 - A1 (1:1000 - A3)

ISSUES	DATE	
TENDER	28-06-18	
COUNCIL		
CONSTRUCTION		

D	29-05-19	DRAINAGE DESIGN UPDATED
C	07-05-19	DETAIL ADDED
B	19-03-19	DESIGN REVISION
A	28-06-18	COUNCIL ISSUE
PRE	DATE	AMENDMENT

WAPC REF: 155055

ASSOCIATED CONSULTANTS

3 CONSULTING ENGINEERS PTY LTD
Electrical Engineering Excellence

DRAWING TITLE

DRAINAGE PLAN
SHEET 02

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN. 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

Email. mortons@urbansolutions.net.au
Website www.urbansolutions.net.au
Tel 08 9380 9700

Perth Office
U4 100 Railway Road
Subiaco 6008

DESIGNED	SM	DRAWN	SM
APPROVED		RPEQ 4706	DATE 26-02-18

DRAWING NUMBER 28601-SS-601

AMEND. E

ADJOINS SHEET 2

797

01/151 SEP 78.8
03/020 SEP 82.7
01/150 SEP 137.0
04/020 SEP 141.1
05/020 SEP 199.1
06/020 (SAG) SEP TRAPPED
07/020 (SAG) SEP TRAPPED
08/020 (SAG) SEP TRAPPED
09/020 (SAG) SEP TRAPPED

03/171 GRATED PIT TRAPPED
U/S 16.74
Ø 300/53.4
D= 35.9
D/S 16.06

04/171 GRATED PIT TRAPPED
U/S 16.03
Ø 300/48.6
D= 35.1
D/S 15.31

05/171 GRATED PIT TRAPPED
U/S 15.28
Ø 300/47.7
D= 27.0
D/S 14.72

06/171 GRATED PIT TRAPPED
U/S 14.69
Ø 300/88.8
D= 24.1
D/S 14.41

07/171 GRATED PIT TRAPPED
U/S 14.38
Ø 300/186.6
D= 15.0
D/S 14.30

U/S 14.27
Ø 300/200
D= 25.5
D/S 14.15

08/171 GRATED PIT TRAPPED

09/171 GRATED PIT TRAPPED

U/S 14.12
Ø 300/198.8
D= 7.8
D/S 14.08

10/171 SEP TRAPPED

U/S 14.05
Ø 300 / 200.0
D= 48.2
D/S 13.81

11/171 SEP TRAPPED

U/S 13.78
Ø 300 / 200.0
D= 48.4
D/S 13.54

12/171 (SAG) SEP TRAPPED

13/171 (SAG) SEP TRAPPED

U/S 13.18
Ø 450/201.6
D= 14.1
D/S 13.11

12/170 SEP TRAPPED

13/170 TEMP HEADWALL

U/S 13.08
Ø 450/201.6
D= 21.9
D/S 12.97

U/S 13.60
Ø 450/77.2
D= 30.0
D/S 13.21

11/170 JUNCTION PIT

U/S 13.47
Ø 450/53.8
D= 14.1
D/S 13.21

10/170 SEP TRAPPED

U/S 13.83
Ø 450/83.3
D= 16.7
D/S 13.63

09/170 JUNCTION PIT

U/S 14.57
Ø 450/33.3
D= 23.9
D/S 13.86

08/170 SEP TRAPPED

U/S 15.12
Ø 450/77.6
D= 40.0
D/S 14.60

07/170 SEP TRAPPED

U/S 15.15
Ø 375/85.0
D= 48.9
D/S 15.72

06/170 SEP TRAPPED

U/S 16.08
Ø 375/83.1
D= 27.1
D/S 15.75

05/170 SEP TRAPPED

U/S 16.43
Ø 375/74.1
D= 23.5
D/S 16.11

04/170 SEP TRAPPED

U/S 17.00
Ø 375/64.3
D= 34.7
D/S 16.46

01/178 SEP TRAPPED

SIDE ENTRY PIT FITTED WITH TEMPORARY MANHOLE LID.

03/173 SEP TRAPPED

U/S 16.92
Ø 375/28.7
D= 21.8
D/S 16.15

01/180 SEP TRAPPED

SIDE ENTRY PIT FITTED WITH TEMPORARY MANHOLE LID.

03/174 SEP TRAPPED

U/S 15.87
Ø 300/32.4
D= 23.4
D/S 15.15

01/182 SEP TRAPPED

U/S 15.39
Ø 300/19.5
D= 27.6
D/S 13.98

03/175 SEP TRAPPED

SIDE ENTRY PIT FITTED WITH TEMPORARY MANHOLE LID.

01/183 SEP TRAPPED

02/175 SEP TRAPPED

4m² OF 320mm THICK GROUTED ROCK. d50 = 200mm

1.8m
2.4m

0 1 2 3 4 5m
Scale 1:100 - A1 (1:200 - A3)

SH 1 SH 2 SH 3

SHEET LAYOUT

ONE CALL SYSTEM DIAL 1100 DIAL BEFORE YOU DIG

DIAL1100 BEFORE YOU DIG

WARNING

BEWARE OF UNDERGROUND SERVICES

The location of underground cables are approximate only and their exact position should be checked on site. No guarantee is given that all existing cables and services are shown. Locate all underground cables and services before commencement of work. Refer to Worksafe Regulation 3.21.

PROJECT NAME

PARKLAND HEIGHTS

SCHOOL SITE

CLIENT

Rockingham Park Pty Ltd

NORTH

0 5 10 15 20 25m
Scale 1:500 - A1 (1:1000 - A3)

ISSUES	DATE
TENDER	28-06-18
COUNCIL	
CONSTRUCTION	

D	03-07-19	DESIGN REVISED
C	07-05-19	DETAIL ADDED
B	19-03-19	DESIGN REVISION
A	28-06-18	COUNCIL ISSUE
PRE	DATE	AMENDMENT

WAPC REF: 155055

ASSOCIATED CONSULTANTS

3 CONSULTING ENGINEERS PTY LTD
Electrical Engineering Excellence

DRAWING TITLE

DRAINAGE PLAN
SHEET 03

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As
Mortons-Urban Solutions
ABN: 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

Email: mortons@urbansolutions.net.au
Website: www.urbansolutions.net.au
Tel 08 9380 9700

Perth Office
U4 100 Railway Road
Subiaco 6008

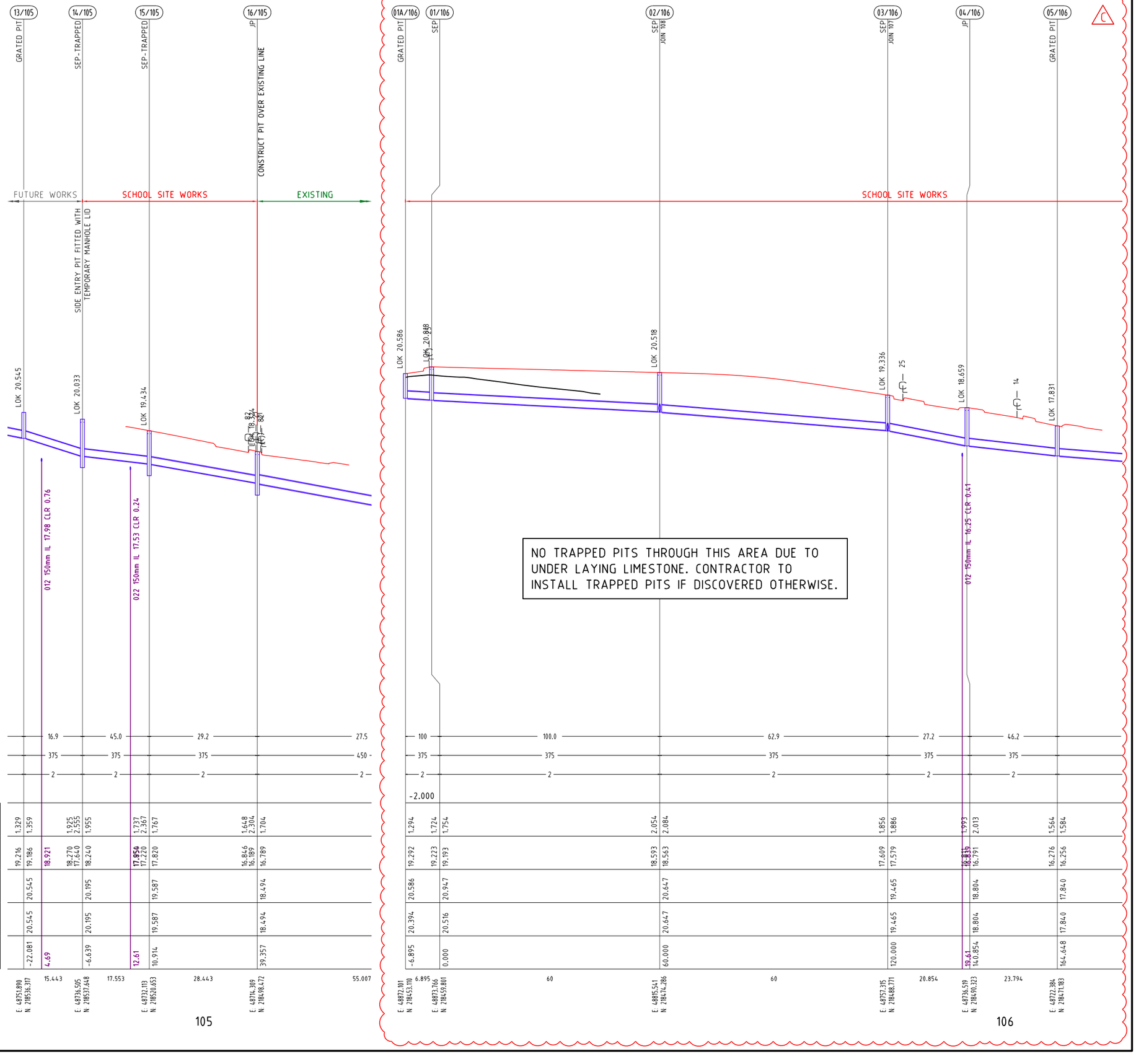
DESIGNED	SM	DRAWN	SM
APPROVED		RPEQ 4706	DATE 26-02-18

DRAWING NUMBER 28601-SS-602

AMEND. D

STRUCTURE NAME

STRUCTURE DESCRIPTION



DRAINAGE LINE

PROJECT NAME

PARKLAND HEIGHTS

SCHOOL SITE

CLIENT

Rockingham Park Pty Ltd

0 5 10 15 20 25m

Horiz. Scale 1:500 - A1 (1:1000 - A3)

0 1 2 3 4 5m

Vert. Scale 1:100 - A1 (1:200 - A3)

ISSUES	DATE	
TENDER	25-06-18	
COUNCIL		
CONSTRUCTION		

C	05-07-19	DESIGN REVISED
B	19-03-19	DESIGN REVISION
A	25-06-18	COUNCIL ISSUE
PRE	DATE	AMENDMENT

WAPC REF: 155055

ASSOCIATED CONSULTANTS

3E CONSULTING ENGINEERS PTY LTD

Electrical Engineering Excellence

DRAWING TITLE

STORMWATER PROFILES
SHEET 01

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

Email: mortons@urbansolutions.net.au
Website: www.urbansolutions.net.au
Tel 08 9380 9700

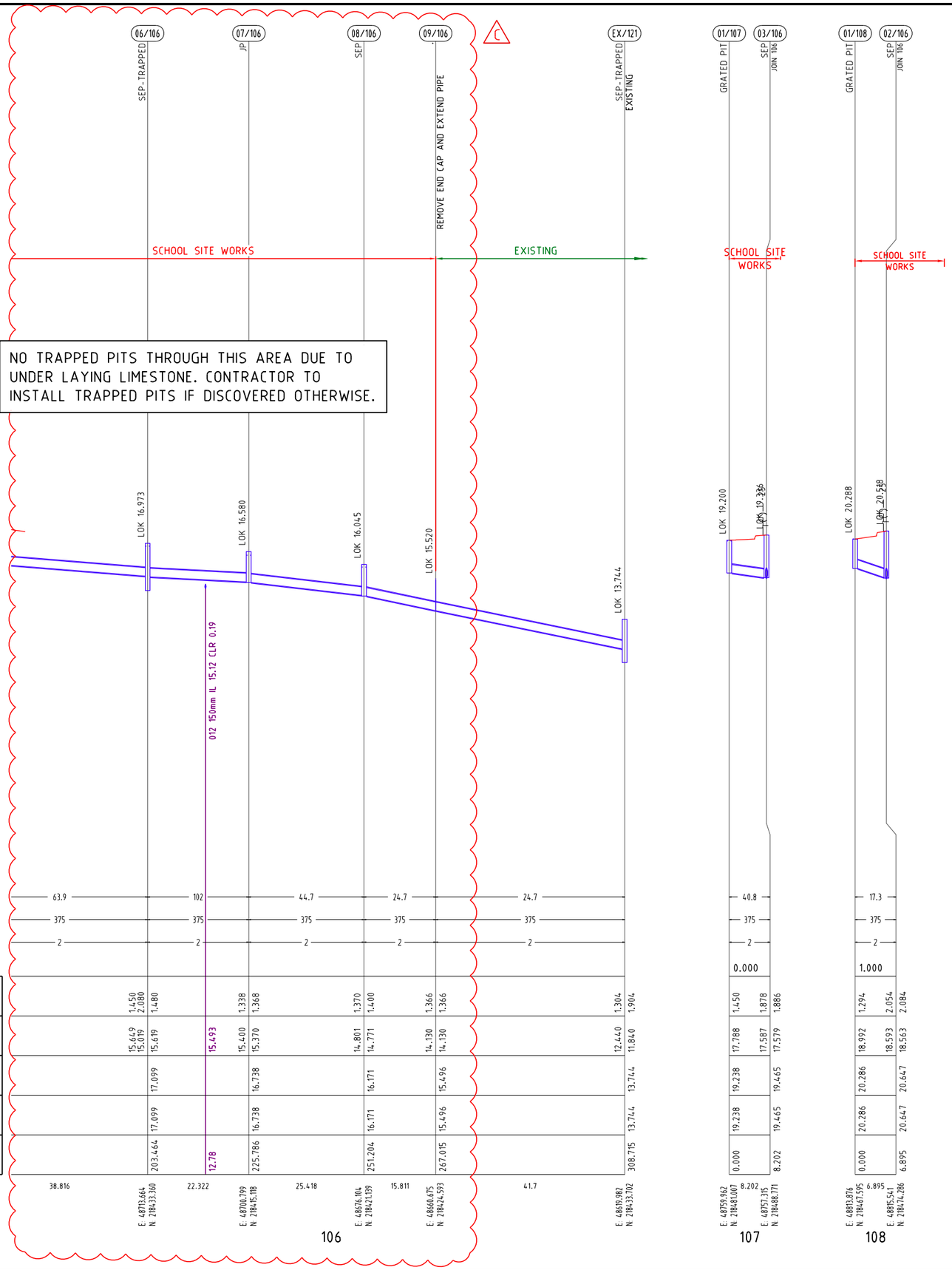
Perth Office
U4 100 Railway Road
Subiaco 6008

DESIGNED	SM	DRAWN	SM
APPROVED		RPEQ 4706	DATE 26-02-18

DRAWING NUMBER	AMEND.
28601-SS-620	C

STRUCTURE NAME

STRUCTURE DESCRIPTION



PROJECT NAME

PARKLAND HEIGHTS

SCHOOL SITE

CLIENT

Rockingham Park Pty Ltd

0 5 10 15 20 25m

Horiz. Scale 1:500 - A1 (1:1000 - A3)

0 1 2 3 4 5m

Vert. Scale 1:100 - A1 (1:200 - A3)

ISSUES	DATE	
TENDER	25-06-18	
COUNCIL		
CONSTRUCTION		

PRE	DATE	AMENDMENT
C	03-07-19	DESIGN REVISED
B	19-03-19	DESIGN REVISION
A	25-06-18	COUNCIL ISSUE

WAPC REF: 155055

ASSOCIATED CONSULTANTS

3E CONSULTING ENGINEERS PTY LTD
Electrical Engineering Excellence

DRAWING TITLE

STORMWATER PROFILES
SHEET 02

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

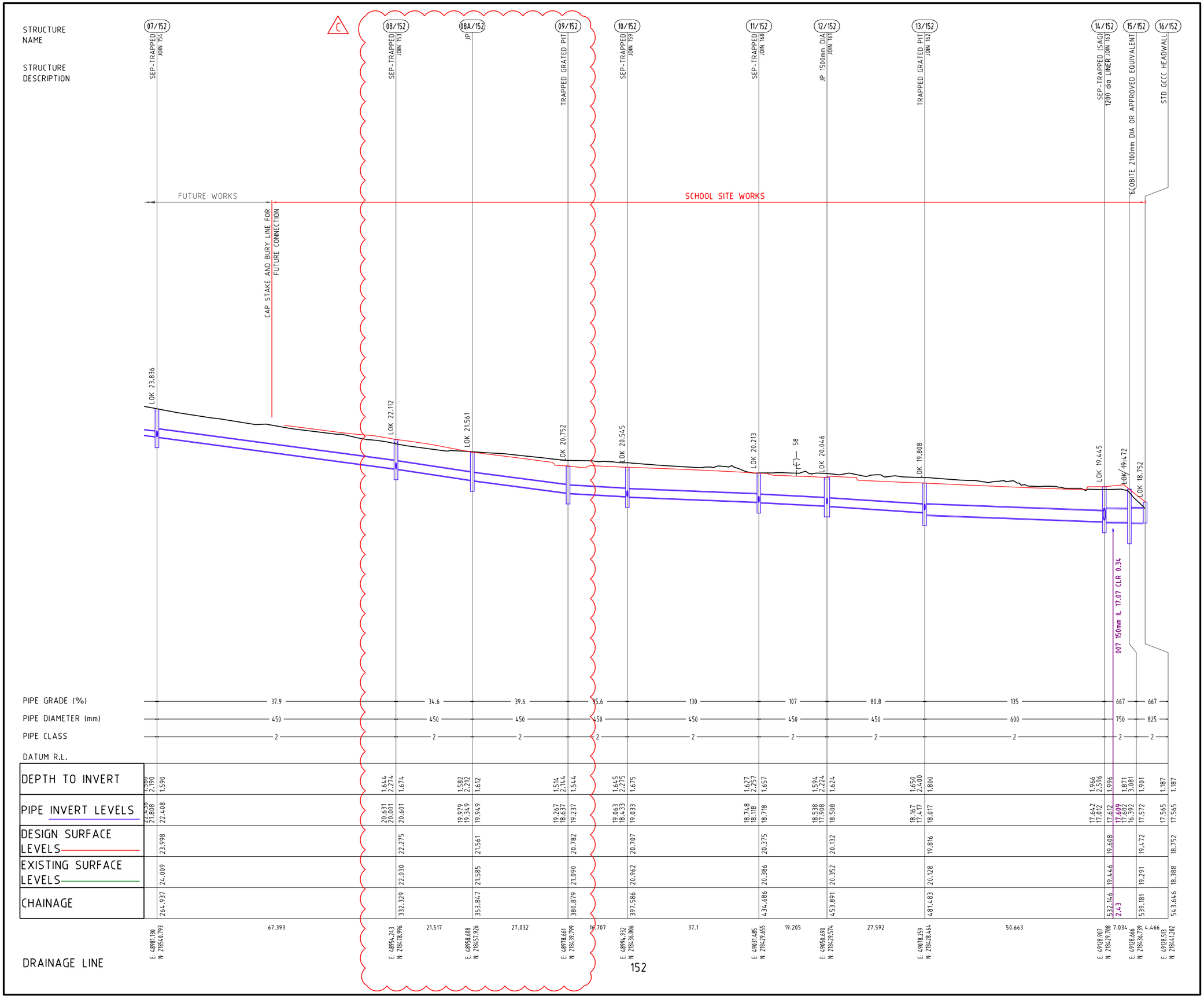
Email mortons@urbansolutions.net.au
Website www.urbansolutions.net.au
Tel 08 9380 9700

Perth Office
U4 100 Railway Road
Subiaco 6008

DESIGNED	SM	DRAWN	SM
APPROVED		RPEQ 4706	DATE 26-02-18

DRAWING NUMBER 28601-SS-621

AMEND. C



PROJECT NAME

PARKLAND HEIGHTS

SCHOOL SITE

CLIENT

Rockingham Park Pty Ltd

0 5 10 15 20 25m
Horiz. Scale 1:500 - A1 (1:1000 - A3)

0 1 2 3 4 5m
Vert. Scale 1:100 - A1 (1:200 - A3)

ISSUES	DATE	
TENDER	25-06-18	
COUNCIL		
CONSTRUCTION		

PRE	DATE	AMENDMENT
C	29-05-19	DRAINAGE DESIGN UPDATED
B	19-03-19	DESIGN REVISION
A	25-06-18	COUNCIL ISSUE

WAPC REF: 155055

ASSOCIATED CONSULTANTS

3E CONSULTING ENGINEERS PTY LTD
Electrical Engineering Excellence

DRAWING TITLE

STORMWATER PROFILES
SHEET 03

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

Email: mortons@urbansolutions.net.au
Website: www.urbansolutions.net.au
Tel: 08 9380 9700

Perth Office
U4 100 Railway Road
Subiaco 6008

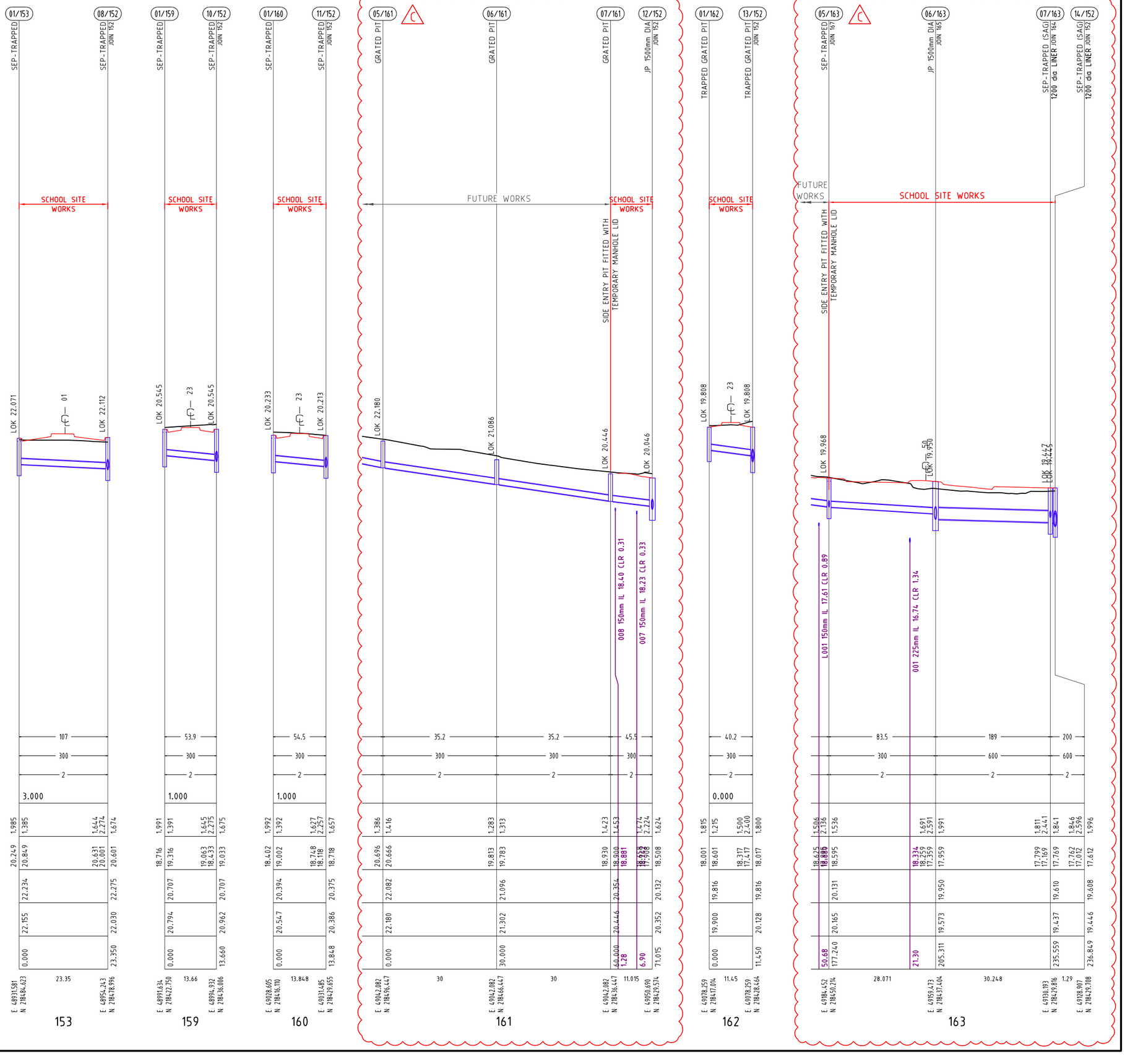
DESIGNED	SM	DRAWN	SM
APPROVED	RPEQ 4706	DATE	26-02-18

DRAWING NUMBER 28601-SS-622

AMEND. C

STRUCTURE NAME

STRUCTURE DESCRIPTION



PROJECT NAME

PARKLAND HEIGHTS

SCHOOL SITE

CLIENT

Rockingham Park Pty Ltd

0 5 10 15 20 25m

Horiz. Scale 1:500 - A1 (1:1000 - A3)

0 1 2 3 4 5m

Vert. Scale 1:100 - A1 (1:200 - A3)

ISSUES	DATE	
TENDER	25-06-18	
COUNCIL		
CONSTRUCTION		

PRE	DATE	AMENDMENT
C	03-07-19	DESIGN REVISED
B	19-03-19	DESIGN REVISION
A	25-06-18	COUNCIL ISSUE

WAPC REF: 155055

ASSOCIATED CONSULTANTS

3 CONSULTING ENGINEERS PTY LTD

Electrical Engineering Excellence

DRAWING TITLE

STORMWATER PROFILES
SHEET 04

MORTONS urbansolutions

Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

Email: mortons@urbansolutions.net.au
Website: www.urbansolutions.net.au
Tel 08 9380 9700

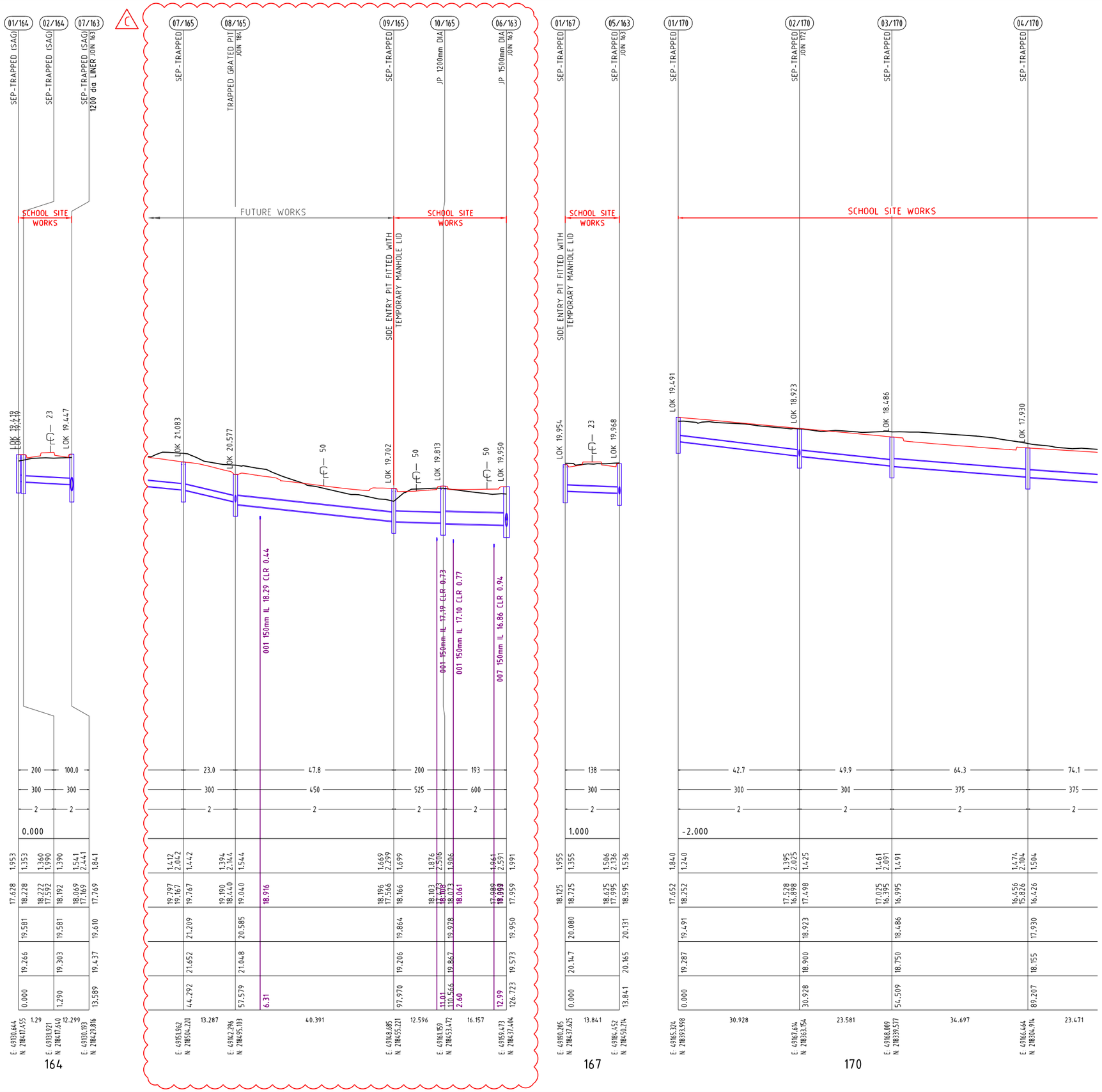
Perth Office
U4 100 Railway Road
Subiaco 6008

DESIGNED	SM	DRAWN	SM
APPROVED	RPEQ 4706	DATE	26-02-18

DRAWING NUMBER	AMEND.
28601-SS-623	C

STRUCTURE NAME

STRUCTURE DESCRIPTION



PROJECT NAME

PARKLAND HEIGHTS

SCHOOL SITE

CLIENT

Rockingham Park Pty Ltd

0 5 10 15 20 25m
Horiz. Scale 1:500 - A1 (1:1000 - A3)

0 1 2 3 4 5m
Vert. Scale 1:100 - A1 (1:200 - A3)

ISSUES	DATE	
TENDER	25-06-18	
COUNCIL		
CONSTRUCTION		

PRE	DATE	AMENDMENT
C	03-07-19	DESIGN REVISED
B	19-03-19	DESIGN REVISION
A	25-06-18	COUNCIL ISSUE

WAPC REF: 155055

ASSOCIATED CONSULTANTS

3E CONSULTING ENGINEERS PTY LTD
Electrical Engineering Excellence

DRAWING TITLE

STORMWATER PROFILES
SHEET 05

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

Email: mortons@urbansolutions.net.au
Website: www.urbansolutions.net.au
Tel 08 9380 9700

Perth Office
U4 100 Railway Road
Subiaco 6008

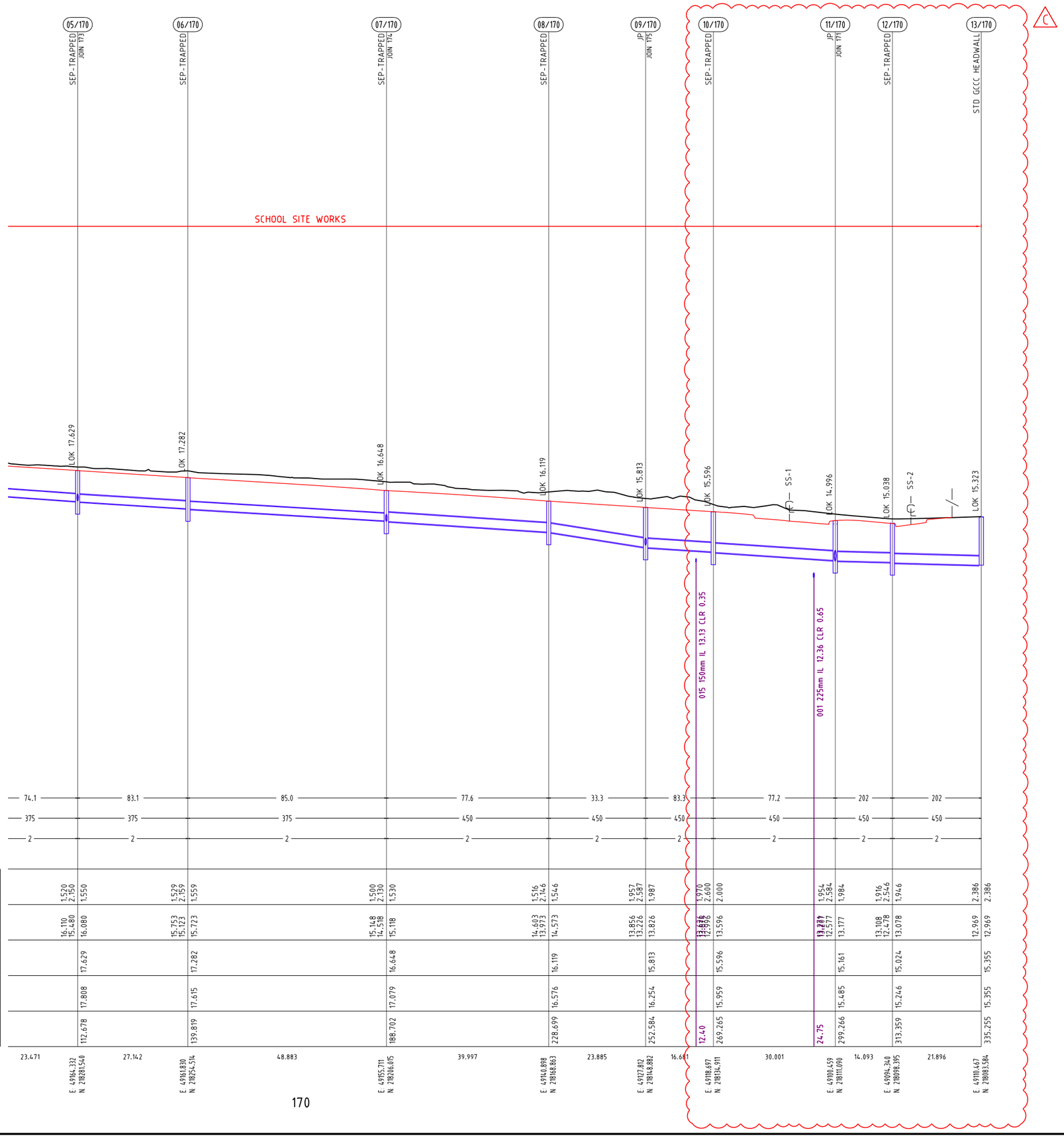
DESIGNED	SM	DRAWN	SM
APPROVED		RPEQ 4706	DATE 26-02-18

DRAWING NUMBER 28601-SS-624

AMEND. C

STRUCTURE NAME

STRUCTURE DESCRIPTION



DRAINAGE LINE

170

PROJECT NAME

PARKLAND HEIGHTS

SCHOOL SITE

CLIENT

Rockingham Park Pty Ltd

0 5 10 15 20 25m

Horiz. Scale 1:500 - A1 (1:1000 - A3)

0 1 2 3 4 5m

Vert. Scale 1:100 - A1 (1:200 - A3)

ISSUES	DATE	
TENDER	25-06-18	
COUNCIL		
CONSTRUCTION		

PRE	DATE	AMENDMENT
C	03-07-19	DESIGN REVISED
B	19-03-19	DESIGN REVISION
A	25-06-18	COUNCIL ISSUE

WAPC REF: 155055

ASSOCIATED CONSULTANTS

3E CONSULTING ENGINEERS PTY LTD

Electrical Engineering Excellence

DRAWING TITLE

STORMWATER PROFILES
SHEET 06

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

Email: mortons@urbansolutions.net.au
Website: www.urbansolutions.net.au
Tel 08 9380 9700

Perth Office
U4 100 Railway Road
Subiaco 6008

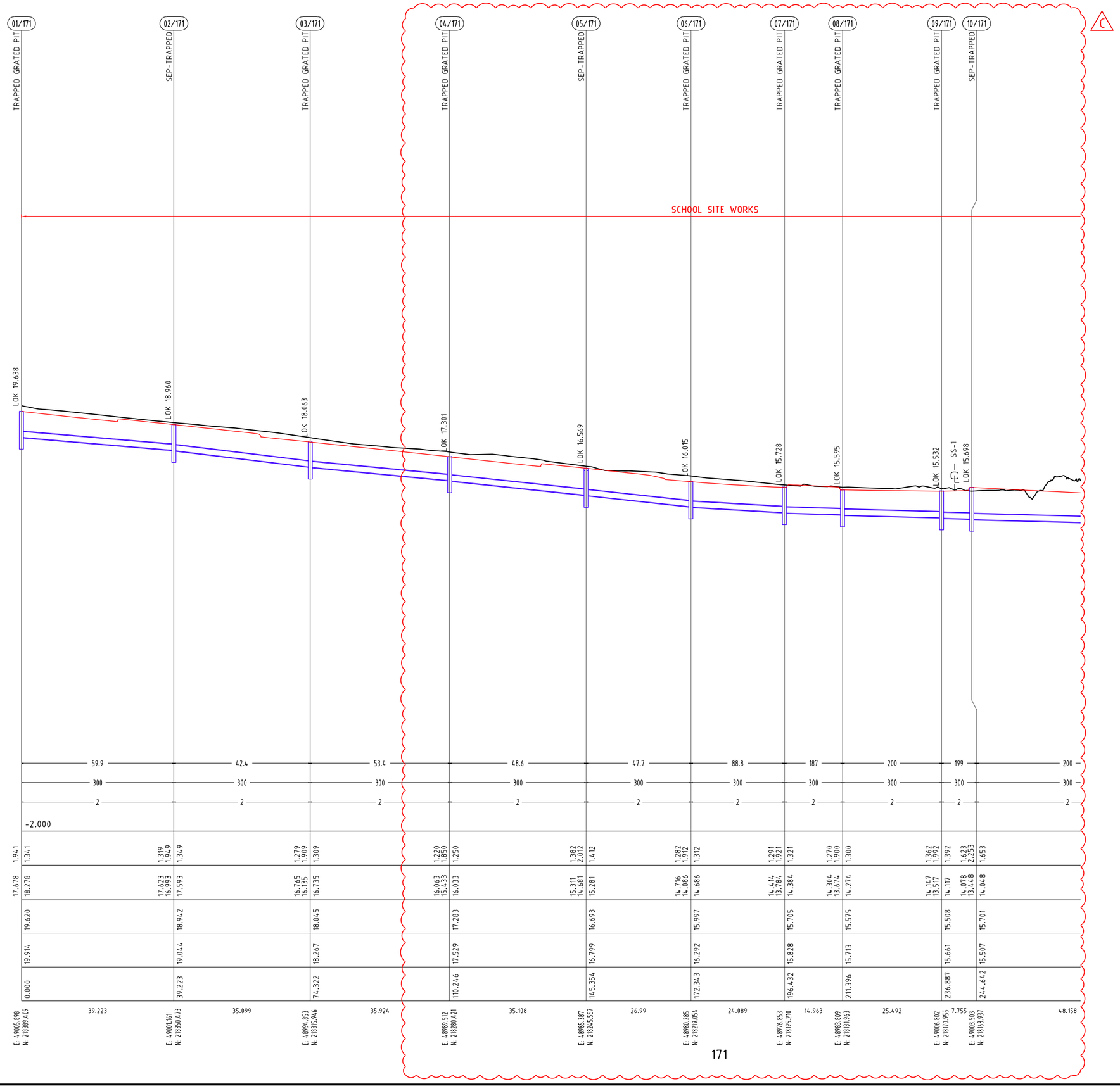
DESIGNED	SM	DRAWN	SM
APPROVED		RPEQ 4706	DATE 26-02-18

DRAWING NUMBER 28601-SS-625

AMEND. C

STRUCTURE NAME

STRUCTURE DESCRIPTION



DRAINAGE LINE

PROJECT NAME

PARKLAND HEIGHTS

SCHOOL SITE

CLIENT

Rockingham Park Pty Ltd

0 5 10 15 20 25m

Horiz. Scale 1:500 - A1 (1:1000 - A3)

0 1 2 3 4 5m

Vert. Scale 1:100 - A1 (1:200 - A3)

ISSUES	DATE	
TENDER	25-06-18	
COUNCIL		
CONSTRUCTION		

PRE	DATE	AMENDMENT
C	03-07-19	DESIGN REVISED
B	19-03-19	DESIGN REVISION
A	25-06-18	COUNCIL ISSUE

WAPC REF: 155055

ASSOCIATED CONSULTANTS

3E CONSULTING ENGINEERS PTY LTD
Electrical Engineering Excellence

DRAWING TITLE

STORMWATER PROFILES
SHEET 07

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

Email: mortons@urbansolutions.net.au
Website: www.urbansolutions.net.au
Tel 08 9380 9700

Perth Office
U4 100 Railway Road
Subiaco 6008

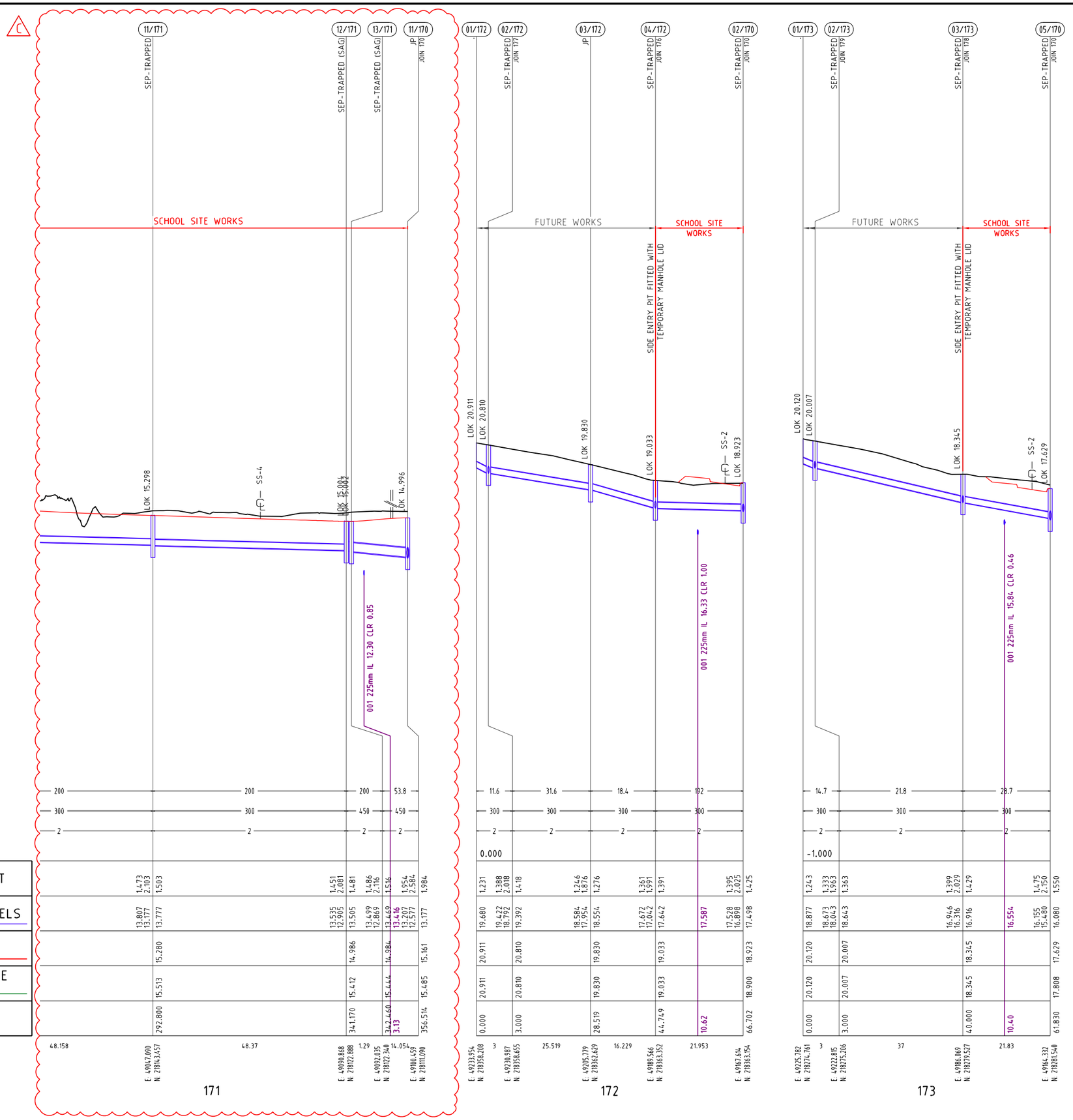
DESIGNED	SM	DRAWN	SM
APPROVED	RPEQ 4706	DATE	26-02-18

DRAWING NUMBER 28601-SS-626

AMEND. C

STRUCTURE NAME

STRUCTURE DESCRIPTION



PROJECT NAME

PARKLAND HEIGHTS

SCHOOL SITE

CLIENT

Rockingham Park Pty Ltd

0 5 10 15 20 25m
Horiz. Scale 1:500 - A1 (1:1000 - A3)

0 1 2 3 4 5m
Vert. Scale 1:100 - A1 (1:200 - A3)

ISSUES	DATE	
TENDER	25-06-18	
COUNCIL		
CONSTRUCTION		

C	03-07-19	DESIGN REVISED
B	19-03-19	DESIGN REVISION
A	25-06-18	COUNCIL ISSUE
PRE	DATE	AMENDMENT

WAPC REF: 155055

ASSOCIATED CONSULTANTS

3 CONSULTING ENGINEERS PTY LTD
Electrical Engineering Excellence

DRAWING TITLE

STORMWATER PROFILES
SHEET 08

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

Email mortons@urbansolutions.net.au
Website www.urbansolutions.net.au
Tel 08 9380 9700

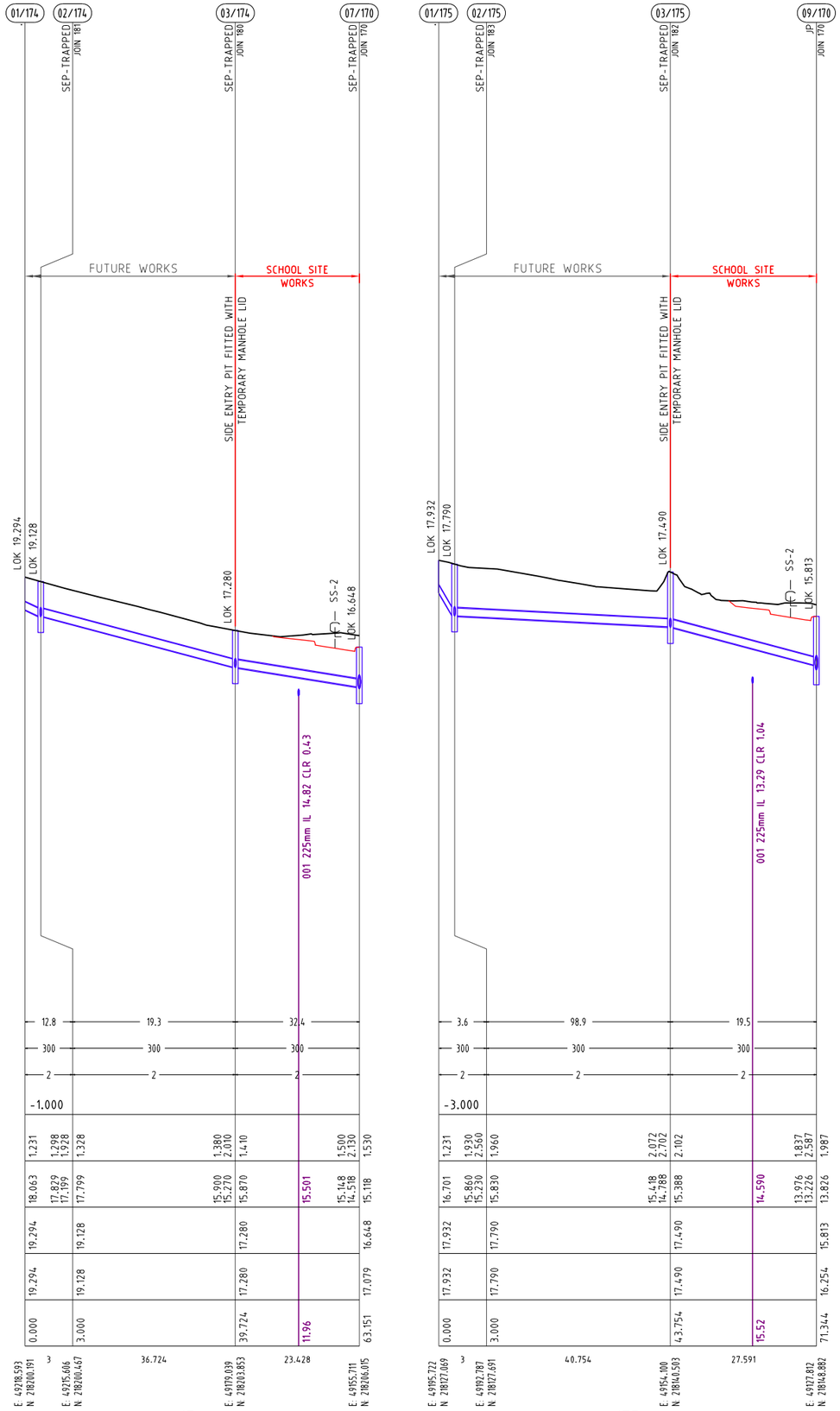
Perth Office
U4 100 Railway Road
Subiaco 6008

DESIGNED	SM	DRAWN	SM
APPROVED		RPEQ 4706	DATE 26-02-18

DRAWING NUMBER	AMEND.
28601-SS-627	C

STRUCTURE NAME

STRUCTURE DESCRIPTION



DRAINAGE LINE

PROJECT NAME

PARKLAND HEIGHTS

SCHOOL SITE

CLIENT

Rockingham Park Pty Ltd

0 5 10 15 20 25m
Horiz. Scale 1:500 - A1 (1:1000 - A3)

0 1 2 3 4 5m
Vert. Scale 1:100 - A1 (1:200 - A3)

ISSUES	DATE	
TENDER	19-03-19	
COUNCIL		
CONSTRUCTION		

PRE	DATE	AMENDMENT
A	19-03-19	DESIGN REVISION

WAPC REF: 155055

ASSOCIATED CONSULTANTS

3 CONSULTING ENGINEERS PTY LTD
Electrical Engineering Excellence

DRAWING TITLE

STORMWATER PROFILES
SHEET 09

MORTONS urbansolutions
Civil Engineering
Project Coordination

MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN 39 116 375 065

Postal Address
U4 100 Railway Road
Subiaco 6008

Email: mortons@urbansolutions.net.au
Website www.urbansolutions.net.au
Tel 08 9380 9700

Perth Office
U4 100 Railway Road
Subiaco 6008

DESIGNED	SM	DRAWN	CB
APPROVED		RPEQ 4706	DATE 19-03-19

DRAWING NUMBER	AMEND.
28601-SS-628	A

APPENDIX C

Design Rainfall Data System (2016)

(dated May 2019)
Prepared by BOM and AR&R

Location

Label: Parkland Heights

Latitude: -32.361 [Nearest grid cell: 32.3625 (S)]

Longitude: 115.806 [Nearest grid cell: 115.8125 (E)]

IFD Design Rainfall Depth (mm)

Issued: 21 May 2019

Rainfall depth for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).
FAQ for New ARR probability terminology

Unit: mm

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	1.90	2.09	2.70	3.13	3.55	4.13	4.58
2 min	3.34	3.64	4.58	5.23	5.87	6.71	7.36
3 min	4.47	4.88	6.18	7.08	7.98	9.16	10.1
4 min	5.38	5.90	7.53	8.66	9.79	11.3	12.5
5 min	6.16	6.76	8.69	10.0	11.4	13.2	14.6
10 min	8.89	9.81	12.8	14.8	16.9	19.6	21.8
15 min	10.7	11.8	15.4	17.9	20.3	23.7	26.3
20 min	12.1	13.4	17.3	20.1	22.9	26.6	29.5
25 min	13.3	14.6	18.9	21.9	24.9	29.0	32.1
30 min	14.3	15.7	20.3	23.5	26.6	30.9	34.3
45 min	16.7	18.3	23.5	27.1	30.7	35.6	39.4
1 hour	18.6	20.3	26.0	29.9	33.9	39.3	43.6
1.5 hour	21.6	23.5	29.9	34.5	39.1	45.5	50.5
2 hour	23.9	26.1	33.1	38.2	43.4	50.6	56.4
3 hour	27.7	30.1	38.3	44.3	50.5	59.2	66.4
4.5 hour	31.8	34.7	44.3	51.5	58.9	69.7	78.6
6 hour	35.1	38.3	49.1	57.2	65.8	78.3	88.7
9 hour	40.0	43.7	56.5	66.2	76.5	91.6	104
12 hour	43.7	47.8	62.1	73.0	84.6	102	116
18 hour	49.1	53.9	70.4	82.9	96.3	116	132
24 hour	53.1	58.4	76.3	89.9	104	125	143
30 hour	56.4	61.9	80.9	95.2	110	132	150
36 hour	59.1	64.9	84.7	99.4	115	137	155
48 hour	63.8	70.0	90.8	106	122	144	161
72 hour	71.6	78.4	100	116	132	153	170
96 hour	78.8	86.0	109	125	141	162	178
120 hour	85.9	93.6	118	134	150	171	187

144 hour	93.3	102	127	144	160	182	199
168 hour	101	110	137	155	171	195	214

Note:
The 50% AEP IFD **does not** correspond to the 2 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 1.44 ARI.
* The 20% AEP IFD **does not** correspond to the 5 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 4.48 ARI.

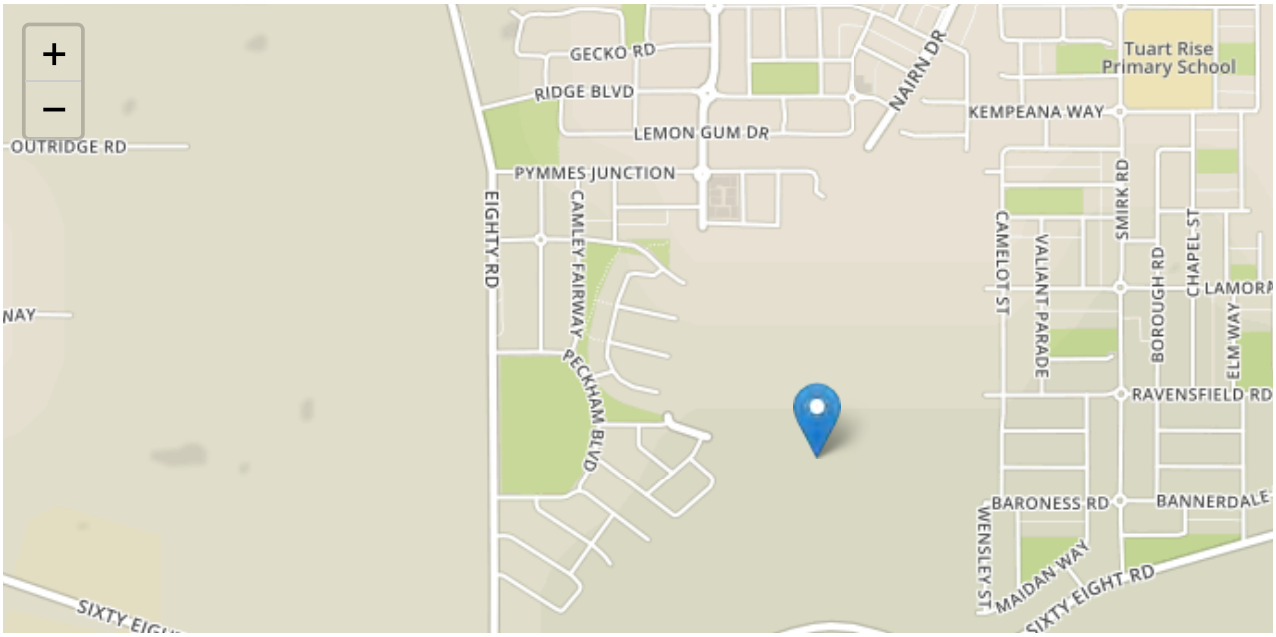
This page was created at **18:34 on Tuesday 21 May 2019 (AWST)**

ATTENTION: This site was updated recently, changing some of the functionality. Please see the changelog (./changelog) for further information

Australian Rainfall & Runoff Data Hub - Results

Input Data

Longitude	115.806
Latitude	-32.361
Selected Regions (clear)	
River Region	show
ARF Parameters	show
Storm Losses	show
Temporal Patterns	show
Areal Temporal Patterns	show
BOM IFDs	show
Median Preburst Depths and Ratios	show
10% Preburst Depths	show
25% Preburst Depths	show
75% Preburst Depths	show
90% Preburst Depths	show
Interim Climate Change Factors	show
Baseflow Factors	show



Data

River Region

Division	South West Coast
River Number	12
River Name	Murray River (Wa)

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2016_v1

ARF Parameters

$$ARF = Min\left\{1, \left[1 - a\left(Area^{b} - c\log_{10}Duration\right)Duration^{-d} + eArea^{f}Duration^{g}\left(0.3 + \log_{10}AEP\right) + h10^{iArea\frac{Duration}{1440}}\left(0.3 + \log_{10}AEP\right)\right]\right\}$$

Zone	a	b	c	d	e	f	g	h	i
SW WA	0.183	0.259	0.271	0.33	3.85e-06	0.41	0.55	0.00817	-0.00045

Short Duration ARF

$$ARF = Min\left[1, 1 - 0.287\left(Area^{0.265} - 0.439\log_{10}(Duration)\right).Duration^{-0.36} + 2.26\ \text{x}\ 10^{-3}\ \text{x}\ Area^{0.226}.Duration^{0.125}\left(0.3 + \log_{10}(AEP)\right) + 0.0141\ \text{x}\ Area^{0.213}\ \text{x}\ 10^{-0.021\frac{(Duration-180)^{2}}{1440}}\left(0.3 + \log_{10}(AEP)\right)\right]$$

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2016_v1

Storm Losses

Note: Burst Loss = Storm Loss - Preburst

Note: These losses are only for rural use and are **NOT FOR DIRECT USE** in urban areas

ID	1973.0
Storm Initial Losses (mm)	30.0
Storm Continuing Losses (mm/h)	2.9

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2016_v1

Temporal Patterns | Download (.zip) (static/temporal_patterns/TP/FLTwest.zip)

code	FLTwest
Label	Southern and South Western Flatlands (West)

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2016_v2

Areal Temporal Patterns | Download (.zip) (./static/temporal_patterns/Areal/Areal_FLTwest.zip)

code	FLTwest
arealabel	Southern and South Western Flatlands (West)

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2016_v2

BOM IFDs

Click here (http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016&coordinate_type=dd&latitude=-32.361&longitude=115.806&sdmin=true&sdhr=true&sdday=true&user_label=) to obtain the IFD depths for catchment centroid from the BoM website

Layer Info

Time Accessed	21 May 2019 08:37PM

Median Preburst Depths and Ratios

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	5.6 (0.275)	5.9 (0.228)	6.1 (0.205)	6.3 (0.187)	5.6 (0.143)	5.1 (0.116)
90 (1.5)	6.1 (0.257)	6.4 (0.212)	6.6 (0.190)	6.7 (0.172)	6.3 (0.138)	5.9 (0.117)
120 (2.0)	3.9 (0.148)	4.9 (0.148)	5.6 (0.146)	6.3 (0.144)	6.3 (0.124)	6.3 (0.112)
180 (3.0)	4.5 (0.149)	4.7 (0.122)	4.8 (0.109)	4.9 (0.098)	4.8 (0.082)	4.7 (0.072)
360 (6.0)	2.5 (0.065)	2.4 (0.048)	2.3 (0.040)	2.2 (0.034)	2.9 (0.038)	3.5 (0.039)
720 (12.0)	0.4 (0.008)	0.5 (0.009)	0.6 (0.009)	0.7 (0.008)	1.6 (0.016)	2.4 (0.020)
1080 (18.0)	0.0 (0.000)	0.1 (0.001)	0.2 (0.002)	0.2 (0.002)	1.0 (0.009)	1.6 (0.012)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.4 (0.003)	0.6 (0.004)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

10% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
90 (1.5)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
120 (2.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

25% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	1.8 (0.088)	1.2 (0.046)	0.8 (0.027)	0.4 (0.013)	0.2 (0.006)	0.1 (0.001)
90 (1.5)	1.5 (0.064)	1.0 (0.032)	0.6 (0.018)	0.3 (0.007)	0.4 (0.009)	0.5 (0.010)
120 (2.0)	0.4 (0.015)	0.8 (0.025)	1.1 (0.029)	1.4 (0.032)	0.7 (0.014)	0.2 (0.004)
180 (3.0)	0.6 (0.021)	0.9 (0.022)	1.0 (0.023)	1.2 (0.023)	0.5 (0.008)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

75% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	11.4 (0.559)	14.7 (0.565)	16.9 (0.564)	19.0 (0.560)	16.9 (0.430)	15.4 (0.353)
90 (1.5)	15.0 (0.638)	17.6 (0.589)	19.4 (0.561)	21.0 (0.537)	16.2 (0.357)	12.6 (0.250)
120 (2.0)	15.3 (0.585)	17.3 (0.523)	18.7 (0.489)	20.0 (0.461)	18.2 (0.360)	16.9 (0.299)
180 (3.0)	11.8 (0.393)	11.4 (0.298)	11.1 (0.251)	10.8 (0.215)	11.9 (0.201)	12.7 (0.191)
360 (6.0)	8.0 (0.209)	8.4 (0.172)	8.7 (0.152)	9.0 (0.137)	13.1 (0.167)	16.1 (0.182)
720 (12.0)	11.2 (0.235)	9.9 (0.159)	9.0 (0.123)	8.1 (0.095)	11.8 (0.116)	14.6 (0.126)
1080 (18.0)	10.6 (0.196)	8.4 (0.119)	7.0 (0.084)	5.6 (0.058)	11.3 (0.098)	15.6 (0.118)
1440 (24.0)	2.6 (0.044)	3.7 (0.049)	4.5 (0.050)	5.3 (0.051)	9.0 (0.072)	11.9 (0.083)
2160 (36.0)	1.5 (0.023)	2.5 (0.030)	3.2 (0.032)	3.9 (0.034)	6.7 (0.049)	8.9 (0.058)
2880 (48.0)	0.5 (0.007)	4.0 (0.044)	6.4 (0.060)	8.6 (0.071)	6.4 (0.044)	4.7 (0.029)
4320 (72.0)	0.7 (0.009)	1.7 (0.017)	2.3 (0.020)	3.0 (0.023)	2.1 (0.014)	1.5 (0.009)

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

90% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	24.9 (1.225)	31.1 (1.197)	35.2 (1.176)	39.1 (1.153)	35.6 (0.905)	33.0 (0.756)
90 (1.5)	28.5 (1.209)	32.7 (1.093)	35.6 (1.031)	38.3 (0.978)	47.6 (1.046)	54.5 (1.079)
120 (2.0)	27.5 (1.055)	30.6 (0.924)	32.7 (0.855)	34.6 (0.798)	38.6 (0.763)	41.6 (0.738)
180 (3.0)	26.8 (0.890)	30.1 (0.785)	32.2 (0.728)	34.3 (0.679)	39.1 (0.661)	42.8 (0.644)
360 (6.0)	19.4 (0.508)	19.9 (0.406)	20.2 (0.354)	20.6 (0.312)	28.4 (0.363)	34.3 (0.386)
720 (12.0)	31.1 (0.650)	28.2 (0.454)	26.3 (0.360)	24.5 (0.289)	33.2 (0.326)	39.8 (0.342)
1080 (18.0)	33.7 (0.626)	29.0 (0.413)	26.0 (0.313)	23.0 (0.239)	35.6 (0.307)	45.0 (0.340)
1440 (24.0)	24.2 (0.415)	22.9 (0.300)	22.0 (0.245)	21.2 (0.203)	28.3 (0.226)	33.7 (0.236)
2160 (36.0)	18.2 (0.280)	20.7 (0.245)	22.4 (0.226)	24.0 (0.209)	26.1 (0.191)	27.6 (0.178)
2880 (48.0)	11.6 (0.166)	18.6 (0.205)	23.2 (0.218)	27.6 (0.226)	23.0 (0.160)	19.5 (0.121)
4320 (72.0)	18.4 (0.235)	25.9 (0.258)	30.9 (0.266)	35.6 (0.270)	30.5 (0.199)	26.7 (0.157)

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

Interim Climate Change Factors

	RCP 4.5	RCP6	**RCP 8.5**
2030	**0.758 (3.8%)**	0.675 (3.3%)	**0.782 (3.9%)**
2040	**0.970 (4.8%)**	0.868 (4.3%)	**1.132 (5.7%)**
2050	**1.179 (5.9%)**	1.094 (5.5%)	**1.501 (7.6%)**
2060	**1.370 (6.9%)**	1.332 (6.7%)	**1.900 (9.7%)**
2070	**1.526 (7.7%)**	1.564 (7.9%)	**2.342 (12.1%)**
2080	**1.631 (8.3%)**	1.769 (9.0%)	**2.839 (14.9%)**
2090	**1.667 (8.5%)**	1.929 (9.9%)	**3.404 (18.1%)**

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2019_v1
Note	ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values that can be found on the climate change in Australia website.

Baseflow Factors

Downstream	0
Area (km2)	271.542848
Catchment Number	9535
Volume Factor	0.001209
Peak Factor	0.084487

Layer Info

Time Accessed	21 May 2019 08:37PM
Version	2016_v1

Download TXT (downloads/0c49eb35-e76b-4d01-b654-b8bafecc1aaa.txt)

Download JSON (downloads/f5873769-88d0-4253-836d-aef2208a075f.json)

Generating PDF... (downloads/995c302b-336c-488c-aad5-29ee72a2e3fc.pdf)

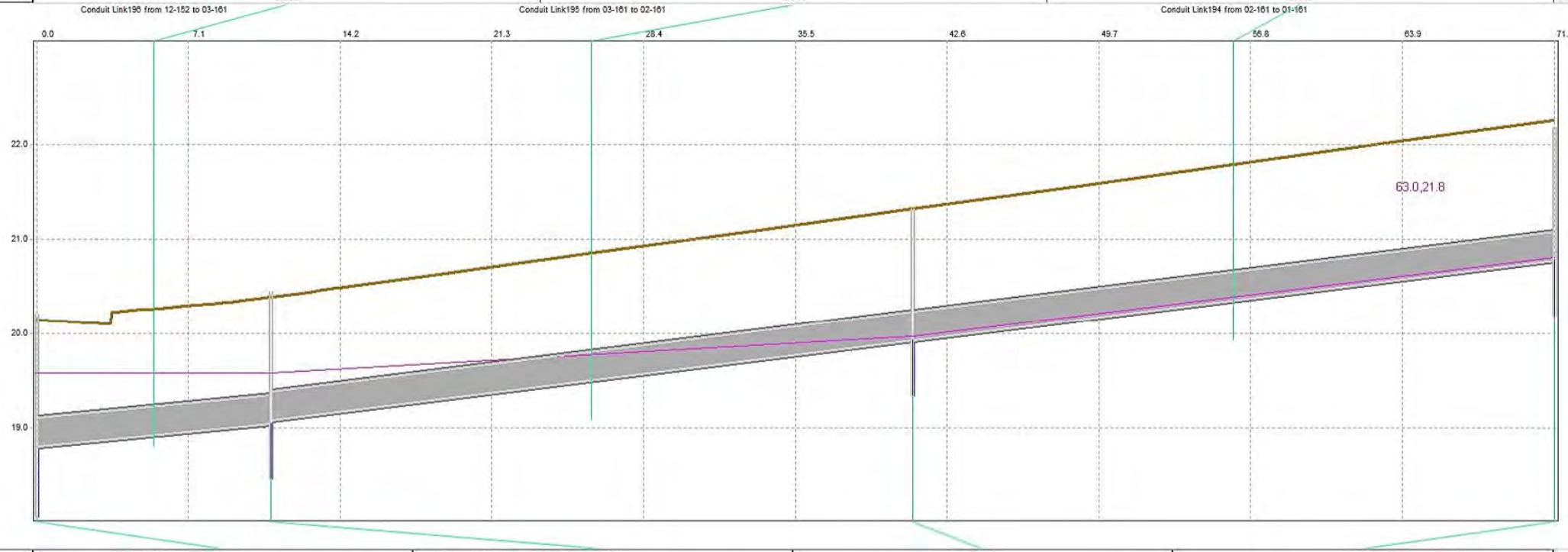
APPENDIX D

Hydraulic Modelling Results

Prepared by Mortons Urban Solutions

Link

	Link196	Link195	Link194
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Flow	0.006	0.004	0.002
Max Velocity	0.770	0.840	0.620
Diameter (Height)	0.300	0.300	0.300
Max Depth	0.772	0.501	0.034
Conduit Slope	2.202	2.841	2.843

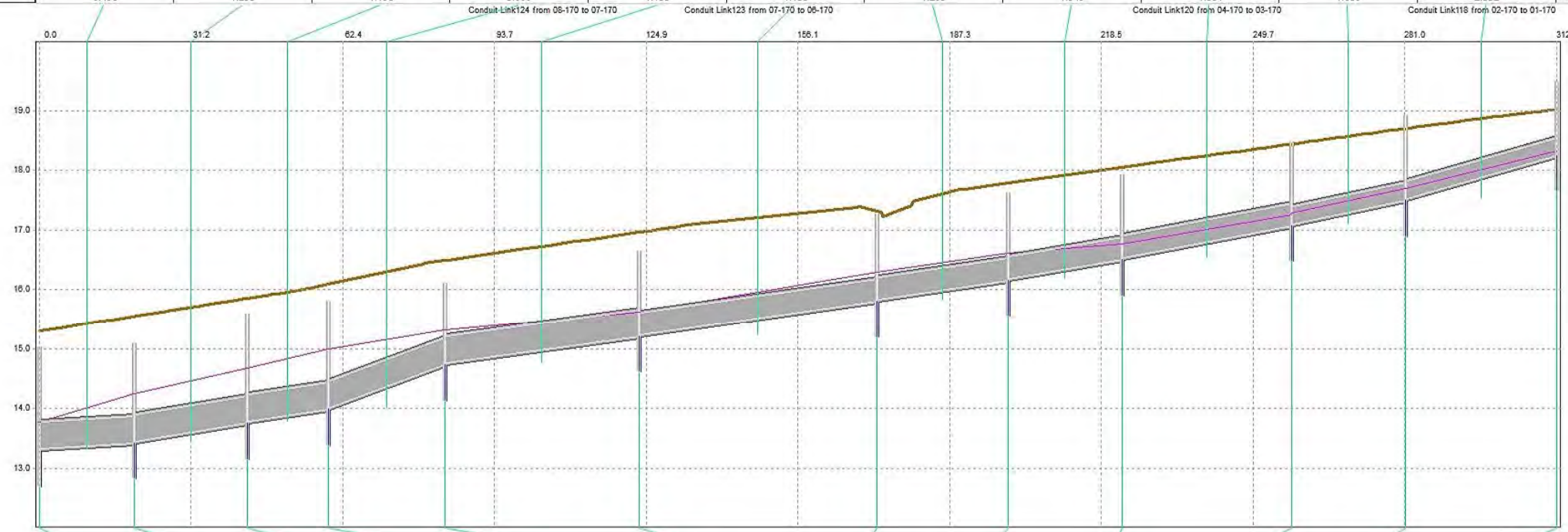


	12-152	03-161	02-161	01-161
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	19.574	19.575	19.966	20.806
Ground Elevation (Spill Crest)	20.206	20.446	21.330	22.180
Freeboard	0.630	0.870	1.360	1.370
Invert Elevation	18.057	18.449	19.332	20.185
Max Water Depth	1.517	1.126	0.634	0.621

Node Runoff

Link

	Link128	Link127	Link126	Link125	Link124	Link123	Link122	Link121	Link120	Link119	Link118
Storm	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1
Max Flow	0.362	0.285	0.270	0.226	0.228	0.169	0.167	0.104	0.094	0.086	0.017
Max Velocity	2.270	1.780	1.690	2.010	1.700	1.520	1.610	1.310	1.680	1.650	1.070
Diameter (Height)	0.450	0.450	0.450	0.450	0.450	0.375	0.375	0.375	0.375	0.300	0.300
Max Depth	0.831	0.922	1.009	0.979	0.555	0.497	0.467	0.423	0.242	0.211	0.181
Conduit Slope	0.496	1.295	1.198	3.000	1.135	1.135	1.203	1.349	1.551	1.680	2.332

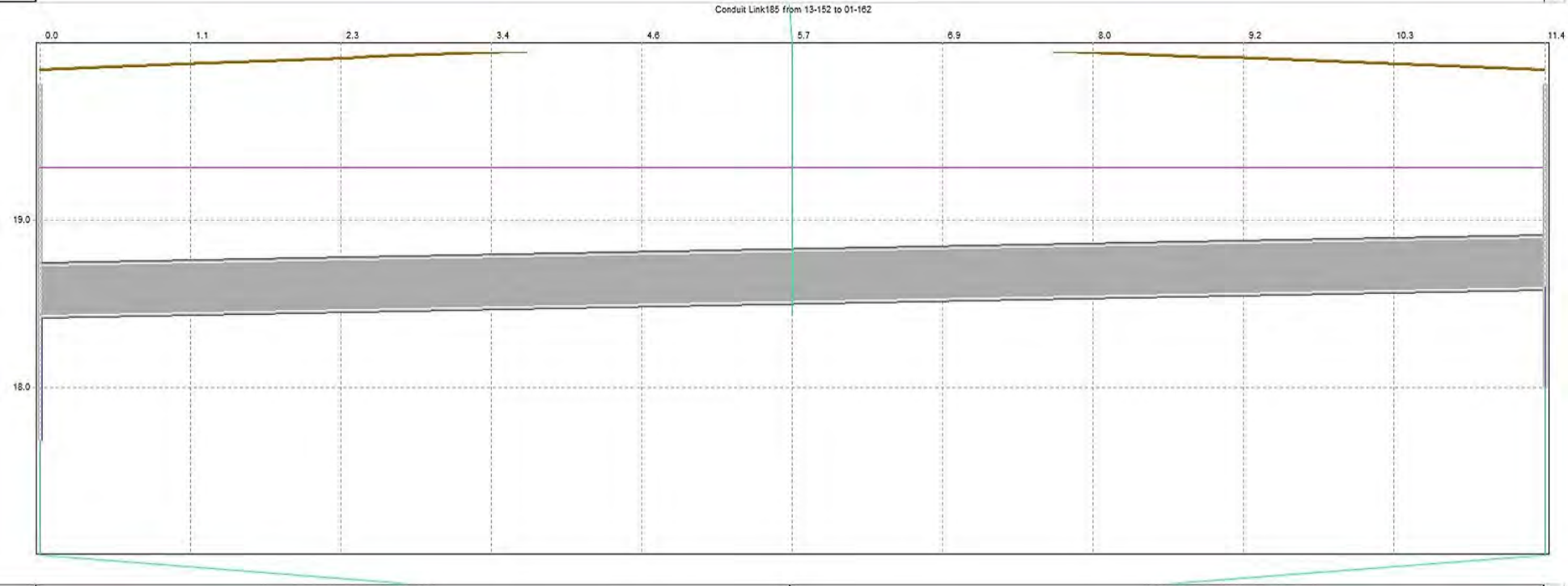


	12-170	11-170	10-170	09-170	08-170	07-170	06-170	05-170	04-170	03-170	02-170	01-170
Storm	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1
Max Water Elevation	13.783	14.256	14.680	14.996	15.316	15.619	16.300	16.607	16.775	17.261	17.708	18.324
Ground Elevation (Spill Crest)	15.038	15.099	15.596	15.813	16.119	16.648	17.282	17.629	17.930	18.486	18.923	19.491
Freeboard	1.250	0.840	0.920	0.820	0.800	1.030	0.980	1.020	1.160	1.220	1.210	1.170
Invert Elevation	12.699	12.826	13.158	13.388	14.134	14.618	15.203	15.559	15.905	16.474	16.898	17.652
Max Water Depth	1.084	1.430	1.522	1.608	1.182	1.001	1.097	1.048	0.870	0.787	0.810	0.672

Node Runoff

Link

	Link185
Storm	FLTW_20pct_1hr_9
Max Flow	0.006
Max Velocity	1.110
Diameter (Height)	0.300
Max Depth	0.880
Conduit Slope	1.450

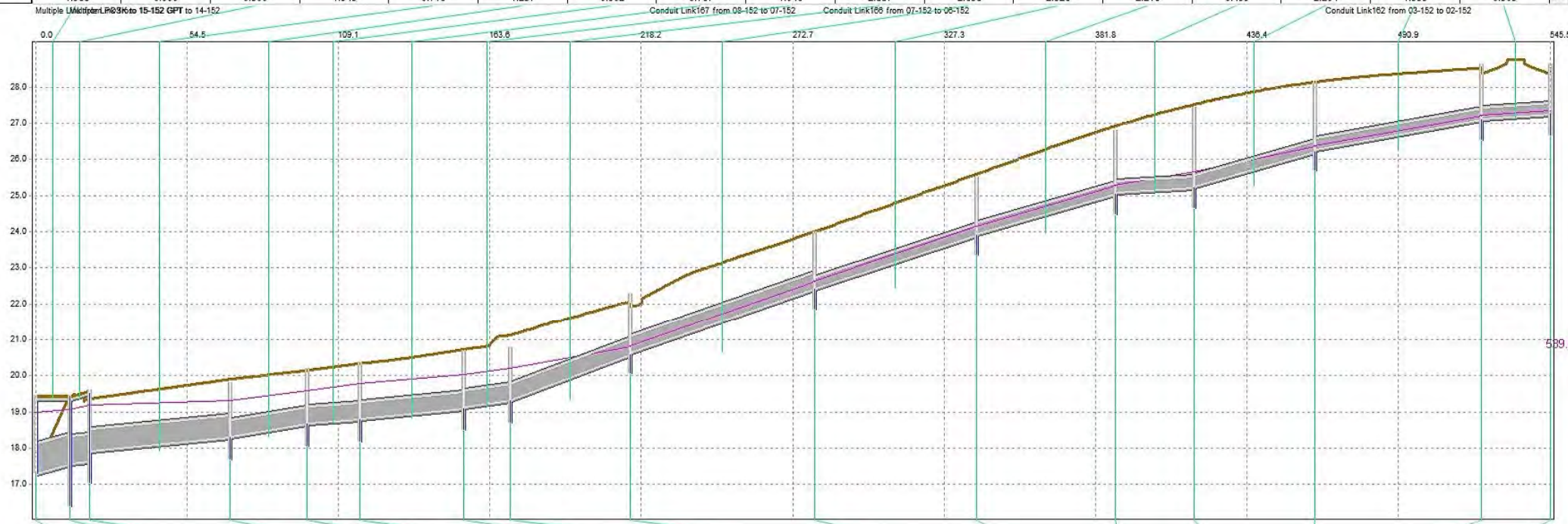


	13-152	01-162
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	19.311	19.312
Ground Elevation (Spill Crest)	19.816	19.816
Freeboard	0.500	0.500
Invert Elevation	17.685	18.001
Max Water Depth	1.626	1.311

Node Runoff

Link

	582.1	582.2	580.1	580.2	Link173	Link172	Link171	Link170	Link169	Link168	Link167	Link166	Link165	Link164	Link163	Link162	Link161
Storm	FLTW_20pct_1hr_	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Flow	0.481	0.000	0.482	0.000	0.203	0.195	0.187	0.179	0.176	0.164	0.138	0.116	0.096	0.080	0.055	0.025	0.013
Max Velocity	0.900	0.000	1.080	0.000	1.000	1.360	1.170	1.190	1.200	2.240	2.090	1.980	1.840	1.150	1.490	1.140	0.610
Diameter (Height)	0.825	0.100	0.750	0.100	0.600	0.450	0.450	0.450	0.450	0.450	0.450	0.300	0.300	0.300	0.300	0.300	0.300
Max Depth	1.691	-0.371	1.576	-9e+99	1.276	1.000	0.995	0.965	0.915	0.874	0.197	0.236	0.208	0.429	0.399	0.105	0.106
Conduit Slope	1.968	0.000	0.500	1.943	0.716	1.237	0.502	0.767	1.046	2.887	2.638	2.526	2.216	0.499	2.204	1.355	0.503

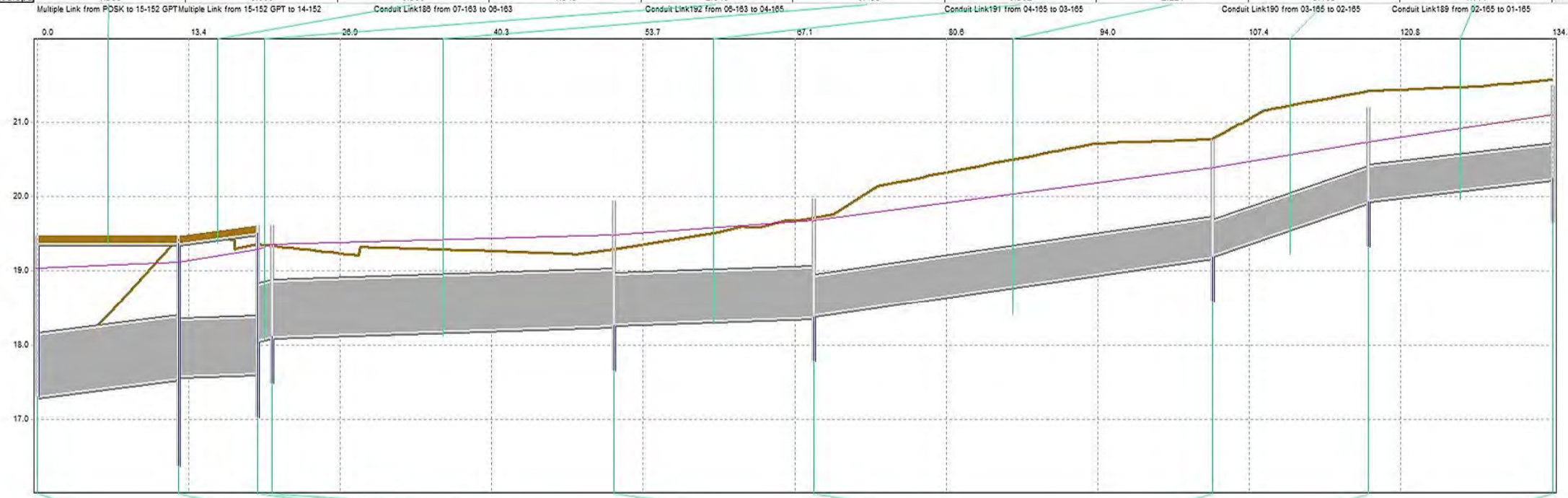


	POSK	15-152 GPT	14-152	13-152	12-152	11-152	10-152	09-152	08-152	07-152	06-152	05-152	04-152	03-152	02-152	01-152
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	19.000	19.059	19.194	19.311	19.574	19.773	20.037	20.202	20.810	22.605	24.150	25.261	25.654	26.355	27.205	27.359
Ground Elevation (Spill Crest)	19.472	19.472	19.608	19.816	20.206	20.375	20.707	20.782	22.277	23.998	25.505	26.802	27.450	28.163	28.645	28.645
Freeboard	0.470	0.410	0.410	0.500	0.630	0.600	0.670	0.580	1.470	1.390	1.360	1.540	1.800	1.810	1.440	1.290
Invert Elevation	17.310	16.377	17.022	17.685	18.057	18.183	18.498	18.703	20.057	21.838	23.344	24.483	24.655	25.687	26.530	26.654
Max Water Depth	1.690	2.682	2.172	1.626	1.517	1.590	1.539	1.499	0.753	0.767	0.806	0.778	0.999	0.668	0.675	0.705

Node Runoff

Link

	582.1	582.2	580.1	580.2	Link187	Link186	Link192	Link191	Link190	Link189
Storm	FLTW_10pct_1hr_3	FLTW_10pct_1hr_3	FLTW_10pct_1hr_3	FLTW_10pct_1hr_3	FLTW_10pct_1hr_3	FLTW_10pct_1hr_3	FLTW_10pct_1hr_3	FLTW_10pct_1hr_3	FLTW_10pct_1hr_3	FLTW_10pct_1hr_3
Max Flow	0.812	0.000	0.814	0.000	0.544	0.519	0.443	0.444	0.341	0.350
Max Velocity	1.520	0.000	1.830	0.000	1.230	1.170	1.240	2.040	2.710	2.230
Diameter (Hei	0.825	0.100	0.750	0.100	0.750	0.750	0.675	0.525	0.450	0.450
Max Depth	1.734	-0.328	1.674	-9e+99	1.248	1.248	1.300	1.270	1.170	0.856
Conduit Slope	1.968	0.000	0.500	1.943	2.846	0.499	0.502	2.221	5.105	1.777

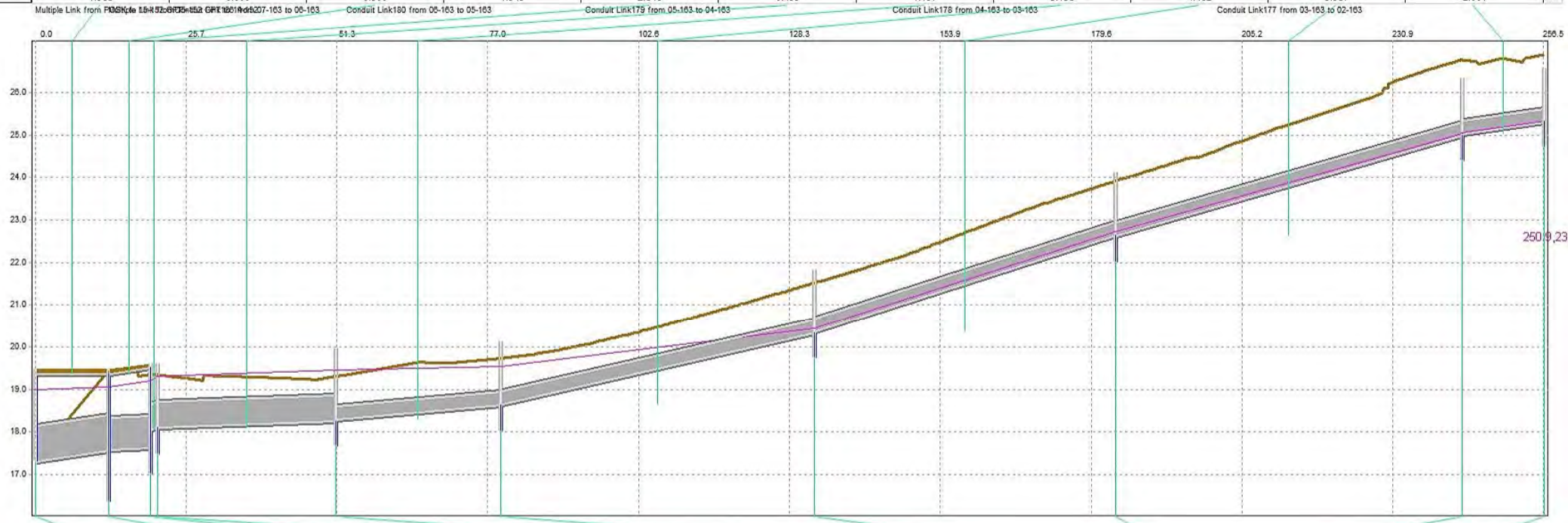


	POSK	15-152 GPT	14-152	07-163	06-163	04-165	03-165	02-165	01-165
Storm	FLTW_10pct_1hr_3	FLTW_10pct_1hr_3	FLTW_10pct_1hr_3	FLTW_10pct_1hr_3	FLTW_10pct_1hr_3	FLTW_10pct_1hr_3	FLTW_10pct_1hr_3	FLTW_10pct_1hr_3	FLTW_10pct_1hr_3
Max Water Ele	19.044	19.119	19.295	19.355	19.461	19.654	20.372	20.712	21.096
Ground Elevati	19.472	19.472	19.608	19.610	19.950	19.964	20.774	21.197	21.488
Freeboard	0.430	0.350	0.310	0.250	0.490	0.310	0.400	0.480	0.390
Invert Elevatio	17.310	16.377	17.022	17.479	17.660	17.779	18.593	19.328	19.648
Max Water De	1.734	2.742	2.273	1.876	1.801	1.875	1.779	1.384	1.448

Node Runoff

Link

	582.1	582.2	580.1	580.2	Link187	Link186	Link180	Link179	Link178	Link177	Link176
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Flow	0.481	0.000	0.482	0.000	0.273	0.254	0.045	0.033	0.023	0.003	0.002
Max Velocity	0.900	0.000	1.080	0.000	0.960	0.890	0.940	1.470	1.720	0.750	0.570
Diameter (Height)	0.825	0.100	0.750	0.100	0.600	0.600	0.300	0.300	0.300	0.300	0.300
Max Depth	1.691	-0.371	1.576	-9e+99	1.205	1.205	1.155	0.889	0.074	0.074	0.024
Conduit Slope	1.968	0.000	0.500	1.943	2.846	0.499	1.197	3.158	4.462	3.987	2.001

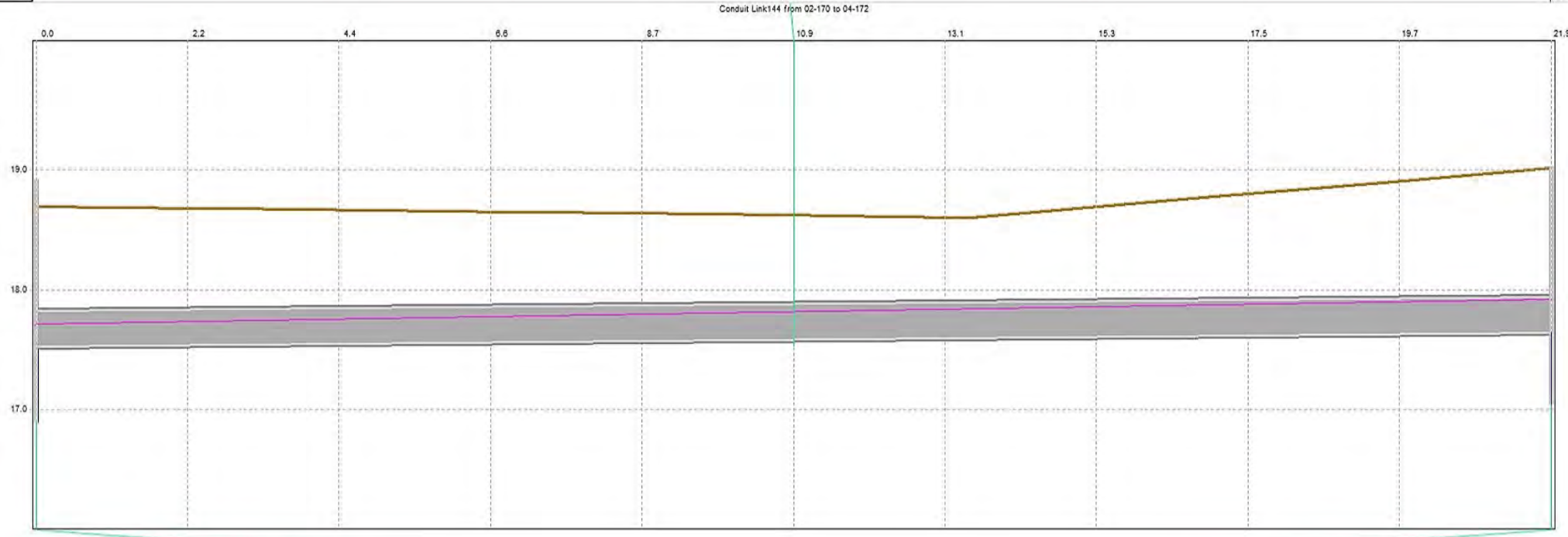


	POSK	15-152 GPT	14-152	07-163	06-163	05-163	04-163	03-163	02-163	01-163
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	19.000	19.059	19.194	19.311	19.442	19.543	20.438	22.727	25.031	25.336
Ground Elevation (Spill Crest)	19.472	19.472	19.608	19.610	19.950	20.131	21.828	24.113	26.343	26.570
Freeboard	0.470	0.410	0.410	0.300	0.510	0.590	1.390	1.390	1.310	1.230
Invert Elevation	17.310	16.377	17.022	17.479	17.660	18.026	19.740	22.023	24.403	24.712
Max Water Depth	1.690	2.682	2.172	1.832	1.782	1.517	0.698	0.704	0.628	0.624

Node Runoff

Link

	Link144
Storm	FLTW_20pct_1hr_1
Max Flow	0.059
Max Velocity	0.880
Diameter (Height)	0.300
Max Depth	0.287
Conduit Slope	0.521

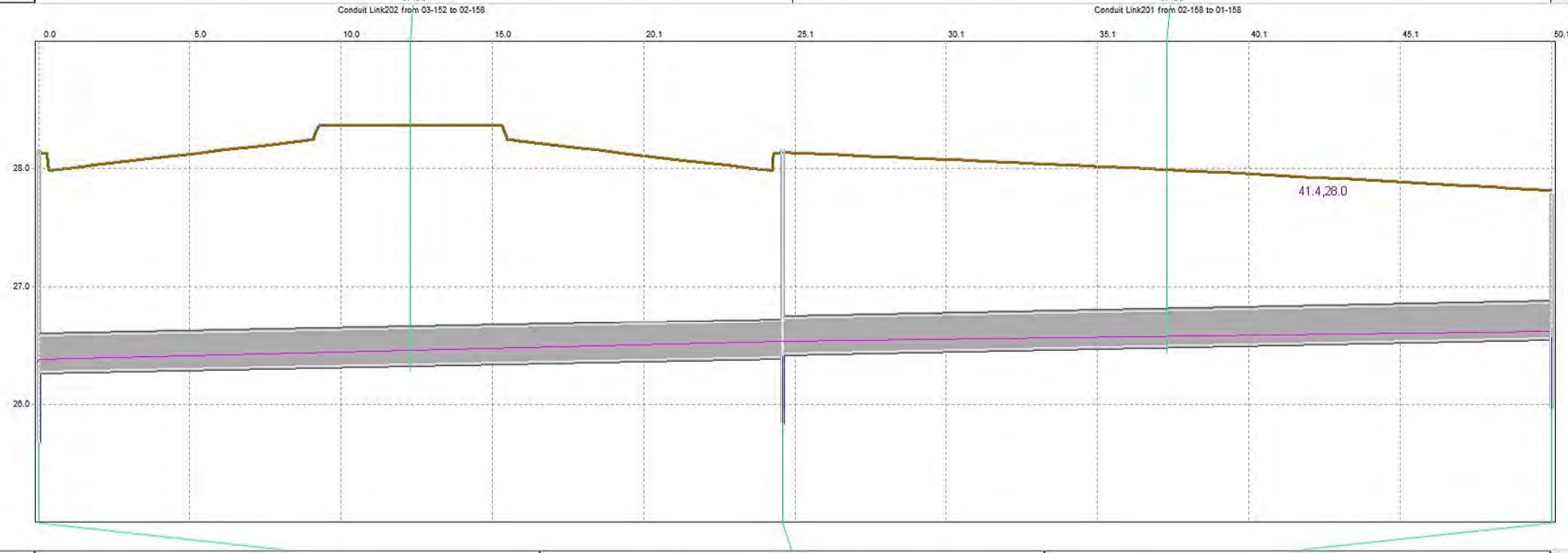


	02-170	04-172
Storm	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1
Max Water Elevation	17.708	17.929
Ground Elevation (Spill Crest)	18.923	19.033
Freeboard	1.210	1.100
Invert Elevation	16.898	17.042
Max Water Depth	0.810	0.887

Node Runoff

Link

	Link202	Link201
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Flow	0.018	0.005
Max Velocity	0.640	0.480
Diameter (Height)	0.300	0.300
Max Depth	0.130	0.100
Conduit Slope	0.498	0.499

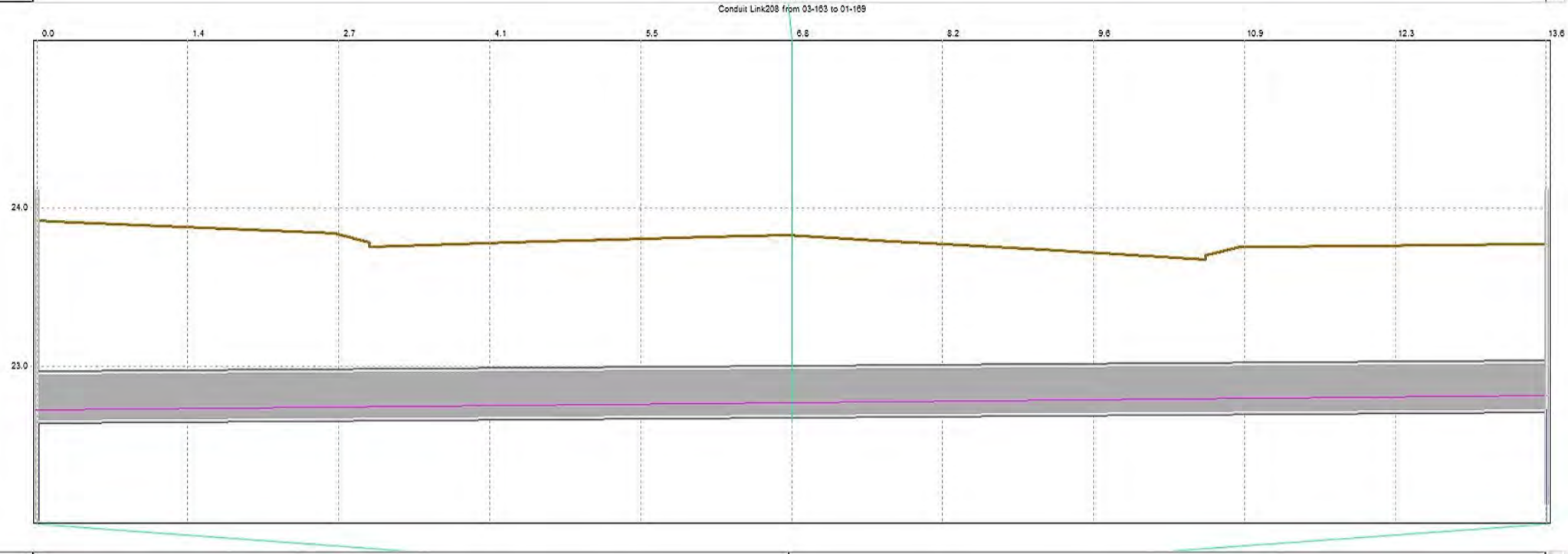


	03-152	02-158	01-158
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	26.355	26.540	26.624
Ground Elevation (Spill Crest)	28.163	28.163	27.790
Freeboard	1.810	1.620	1.170
Invert Elevation	25.687	25.840	25.967
Max Water Depth	0.668	0.700	0.657

Node Runoff

Link

	Link208
Storm	FLTW_20pct_1hr_9
Max Flow	0.010
Max Velocity	0.520
Diameter (Height)	0.300
Max Depth	0.094
Conduit Slope	0.505

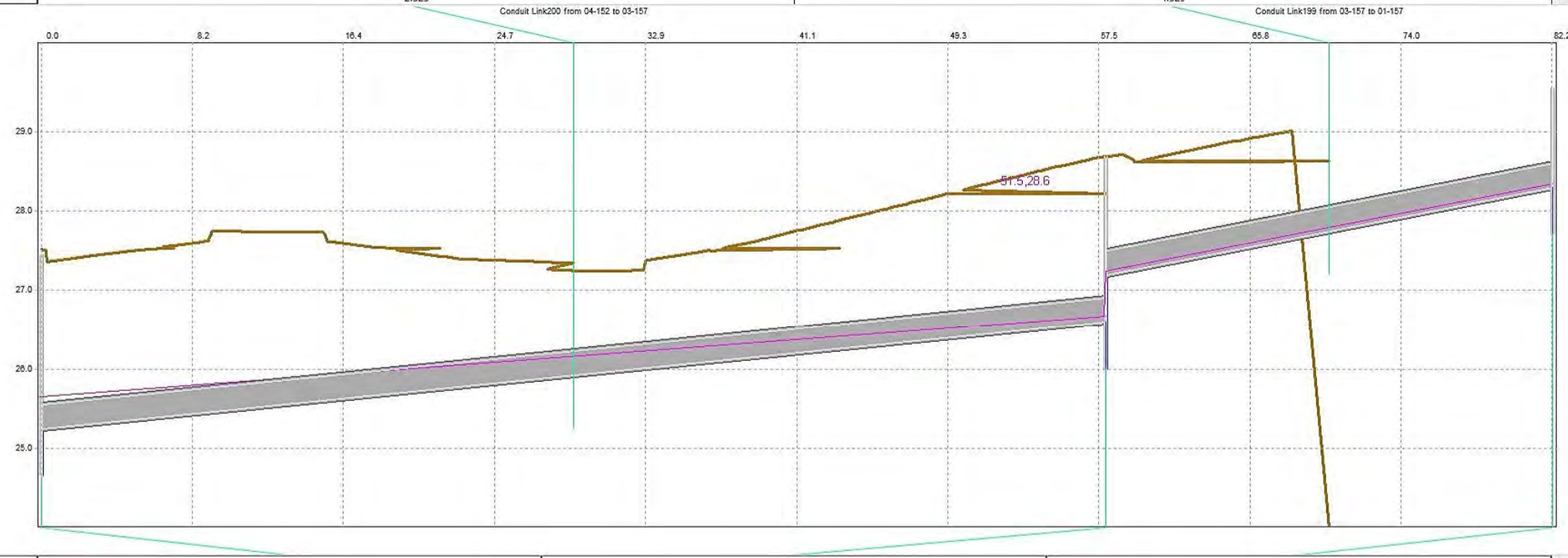


	03-163	01-169
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	22.727	22.815
Ground Elevation (Spill Crest)	24.113	24.113
Freeboard	1.390	1.300
Invert Elevation	22.023	22.122
Max Water Depth	0.704	0.693

Node Runoff

Link

	Link200	Link199
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Flow	0.016	0.009
Max Velocity	0.890	1.340
Diameter (Height)	0.300	0.300
Max Depth	0.399	0.046
Conduit Slope	2.323	4.529

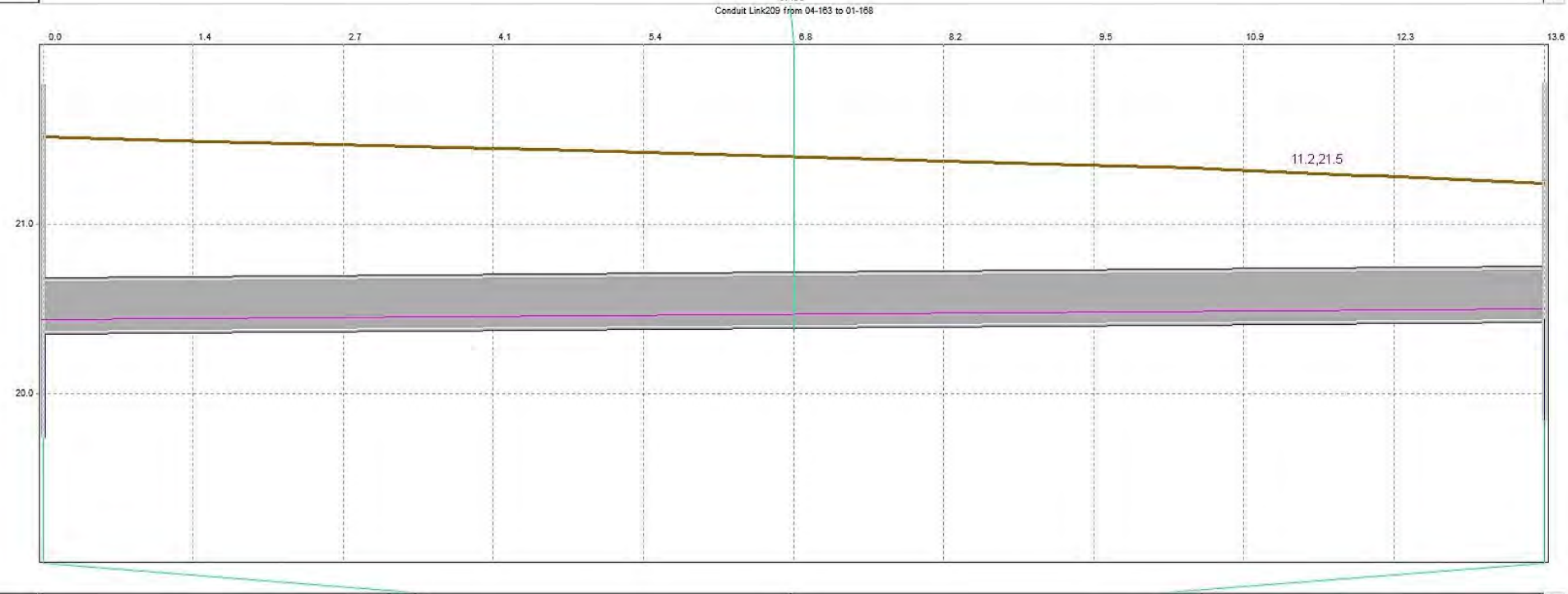


	04-152	03-157	01-157
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	25.654	26.670	28.346
Ground Elevation (Spill Crest)	27.450	28.689	29.553
Freeboard	1.800	2.020	1.210
Invert Elevation	24.655	26.000	27.700
Max Water Depth	0.999	0.670	0.646

Node Runoff

Link

	Link209
Storm	FLTW_20pct_1hr_9
Max Flow	0.005
Max Velocity	0.470
Diameter (Height)	0.300
Max Depth	0.068
Conduit Slope	0.499

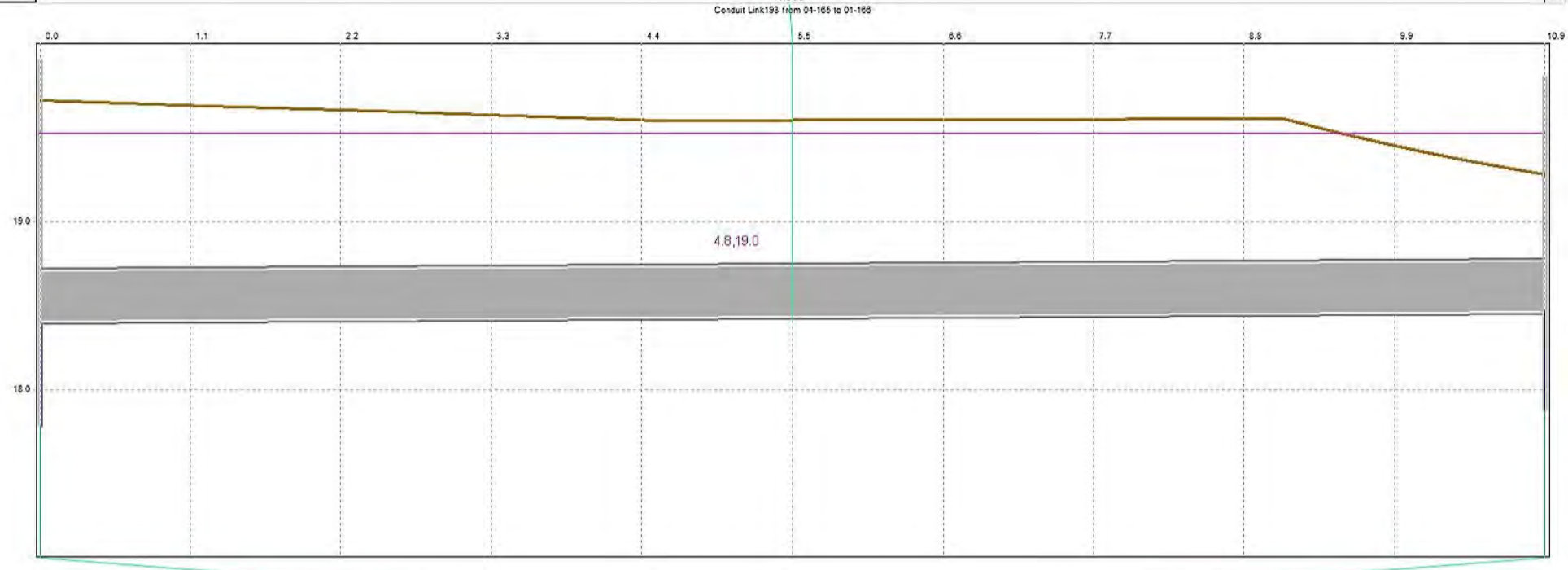


	04-163	01-168
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	20.438	20.502
Ground Elevation (Spill Crest)	21.828	21.830
Freeboard	1.390	1.330
Invert Elevation	19.740	19.838
Max Water Depth	0.698	0.664

Node Runoff

Link

	Link193
Storm	FLTW_20pct_1hr_9
Max Flow	0.004
Max Velocity	0.100
Diameter (Height)	0.300
Max Depth	1.116
Conduit Slope	0.566

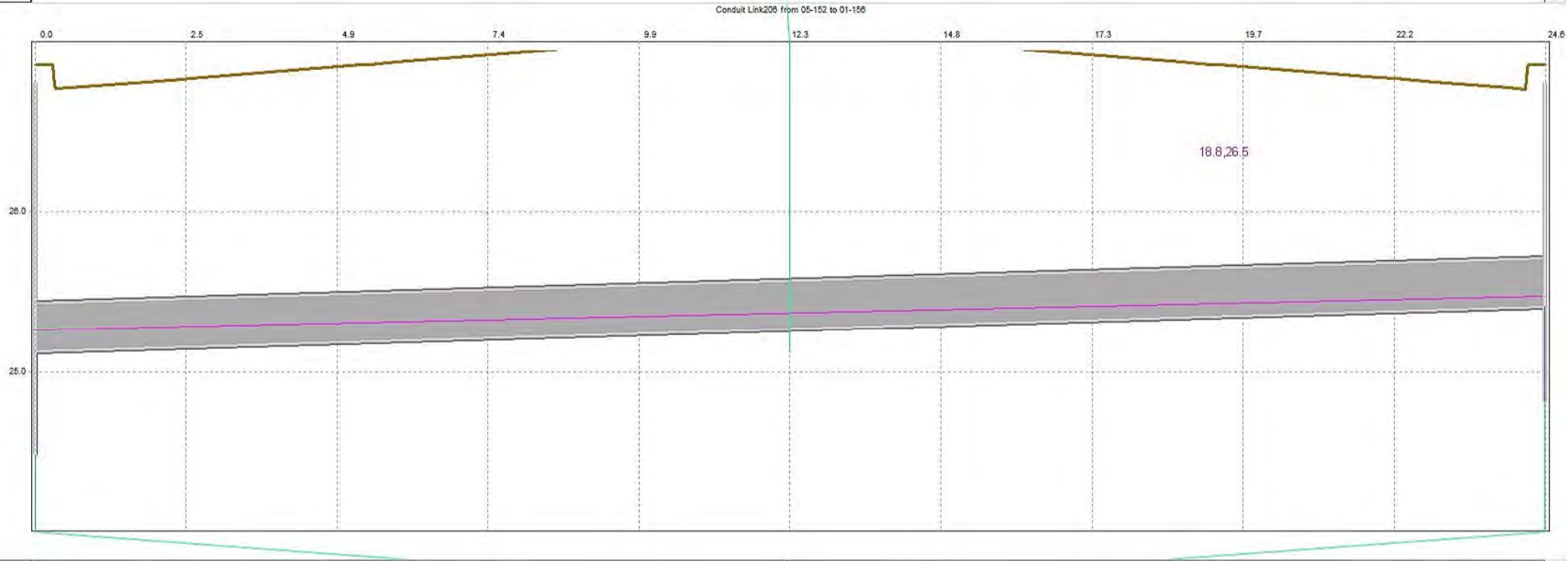


	04-165	01-166
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	19.521	19.522
Ground Elevation (Spill Crest)	19.964	19.864
Freeboard	0.440	0.340
Invert Elevation	17.779	17.871
Max Water Depth	1.742	1.651

Node Runoff

Link

	Link206
Storm	FLTW_20pct_1hr_9
Max Flow	0.010
Max Velocity	0.770
Diameter (Height)	0.300
Max Depth	0.133
Conduit Slope	1.144

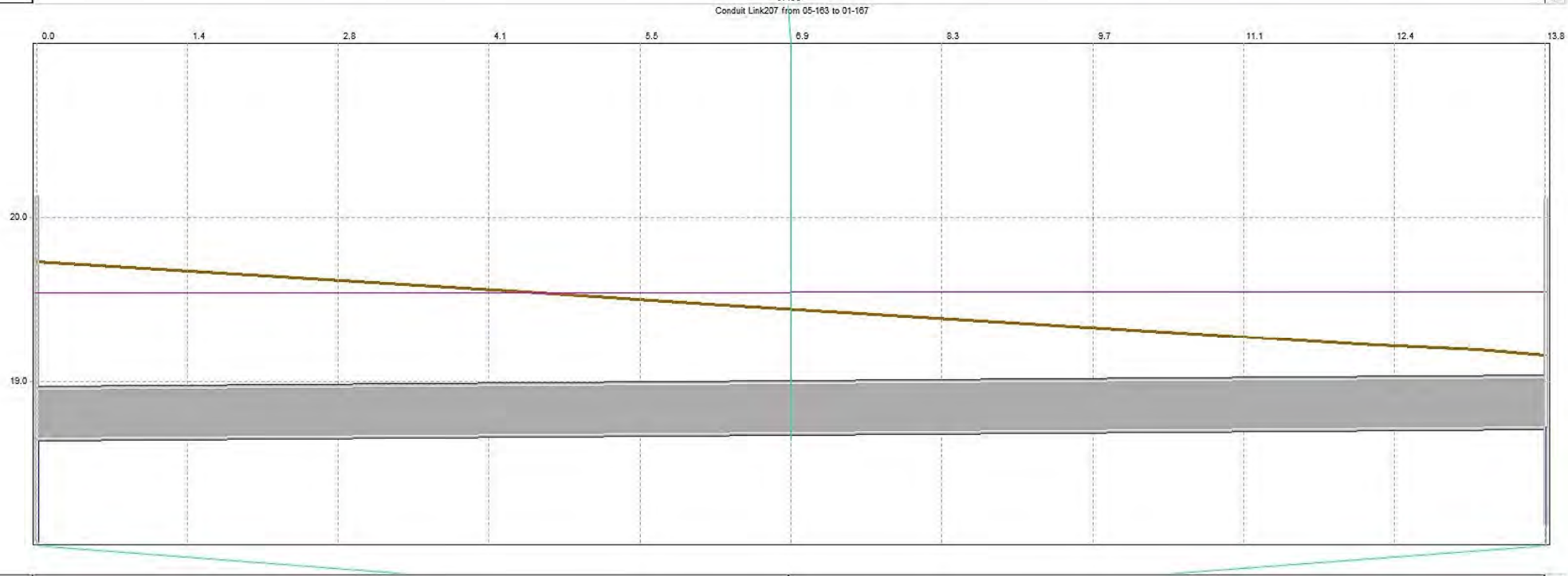


	05-152	01-156
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	25.261	25.476
Ground Elevation (Spill Crest)	26.802	26.802
Freeboard	1.540	1.330
Invert Elevation	24.483	24.810
Max Water Depth	0.778	0.666

Node Runoff

Link

	Link207
Storm	FLTW_20pct_1hr_9
Max Flow	0.006
Max Velocity	0.390
Diameter (Height)	0.300
Max Depth	0.889
Conduit Slope	0.499

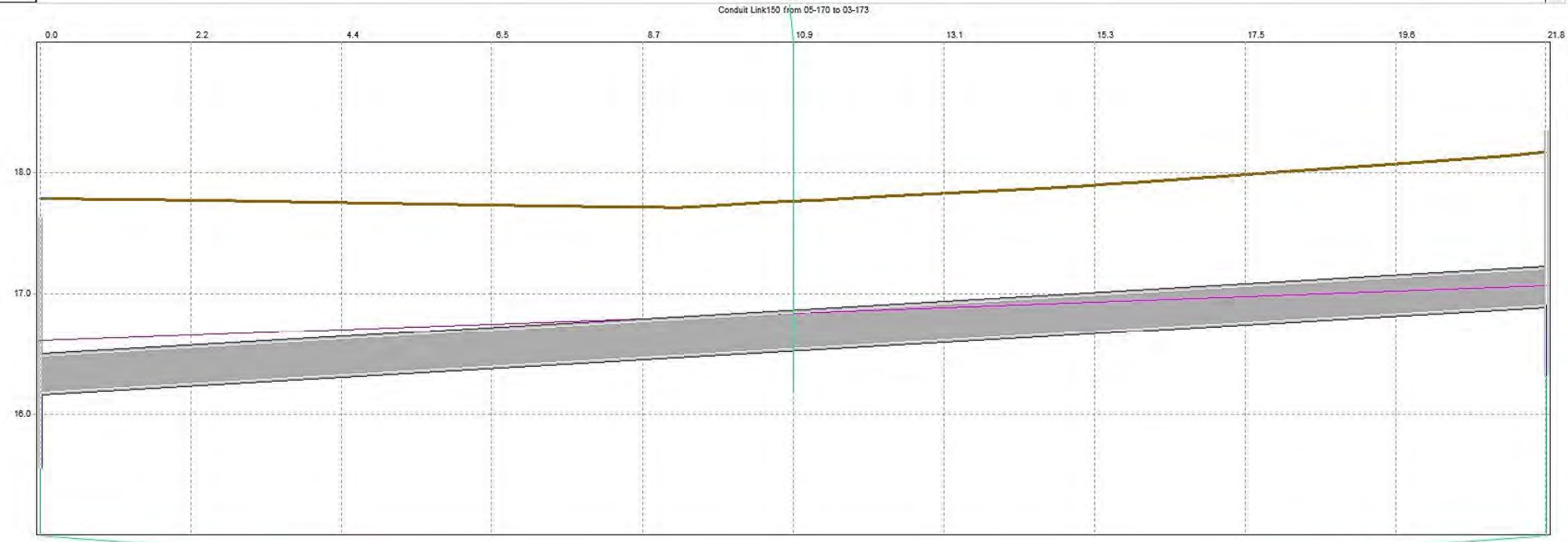


	05-163	01-167
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	19.543	19.544
Ground Elevation (Spill Crest)	20.131	20.116
Freeboard	0.590	0.570
Invert Elevation	18.026	18.125
Max Water Depth	1.517	1.419

Node Runoff

Link

	Link150
Storm	FLTW_20pct_1hr_1
Max Flow	0.063
Max Velocity	1.720
Diameter (Height)	0.300
Max Depth	0.423
Conduit Slope	3.330

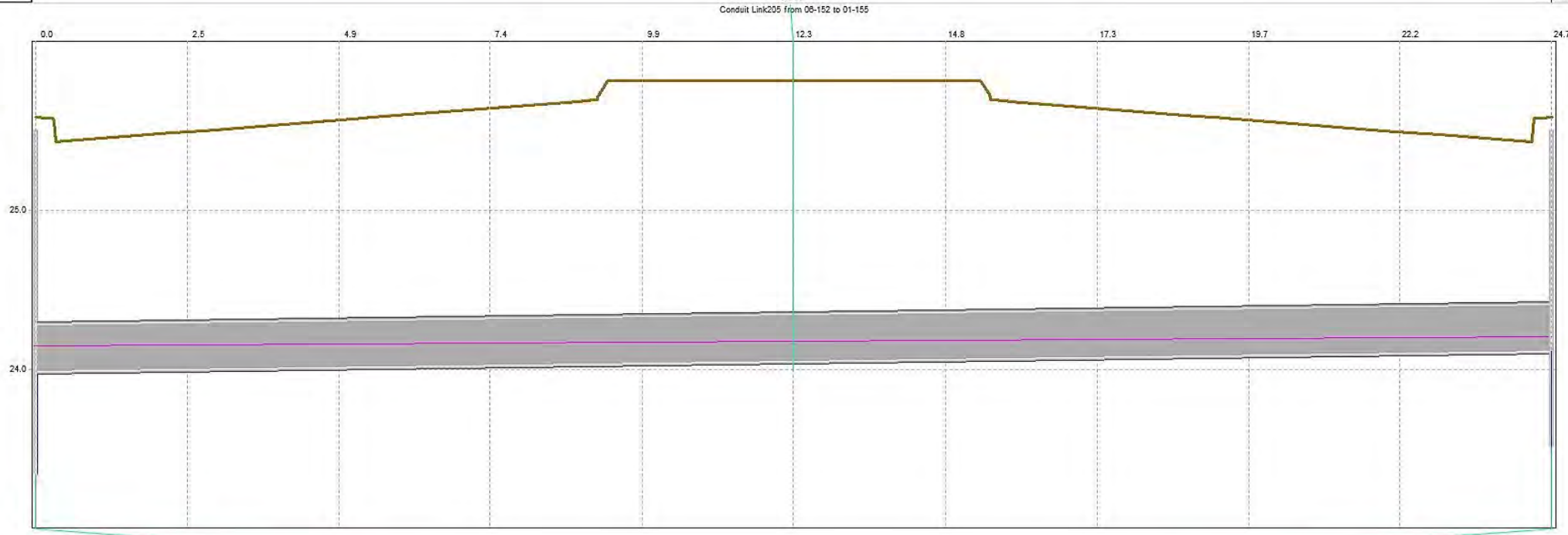


	05-170	03-173
Storm	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1
Max Water Elevation	16.607	17.068
Ground Elevation (Spill Crest)	17.629	18.345
Freeboard	1.020	1.280
Invert Elevation	15.559	16.316
Max Water Depth	1.048	0.752

Node Runoff

Link

	Link205
Storm	FLTW_20pct_1hr_9
Max Flow	0.010
Max Velocity	0.540
Diameter (Height)	0.300
Max Depth	0.161
Conduit Slope	0.503

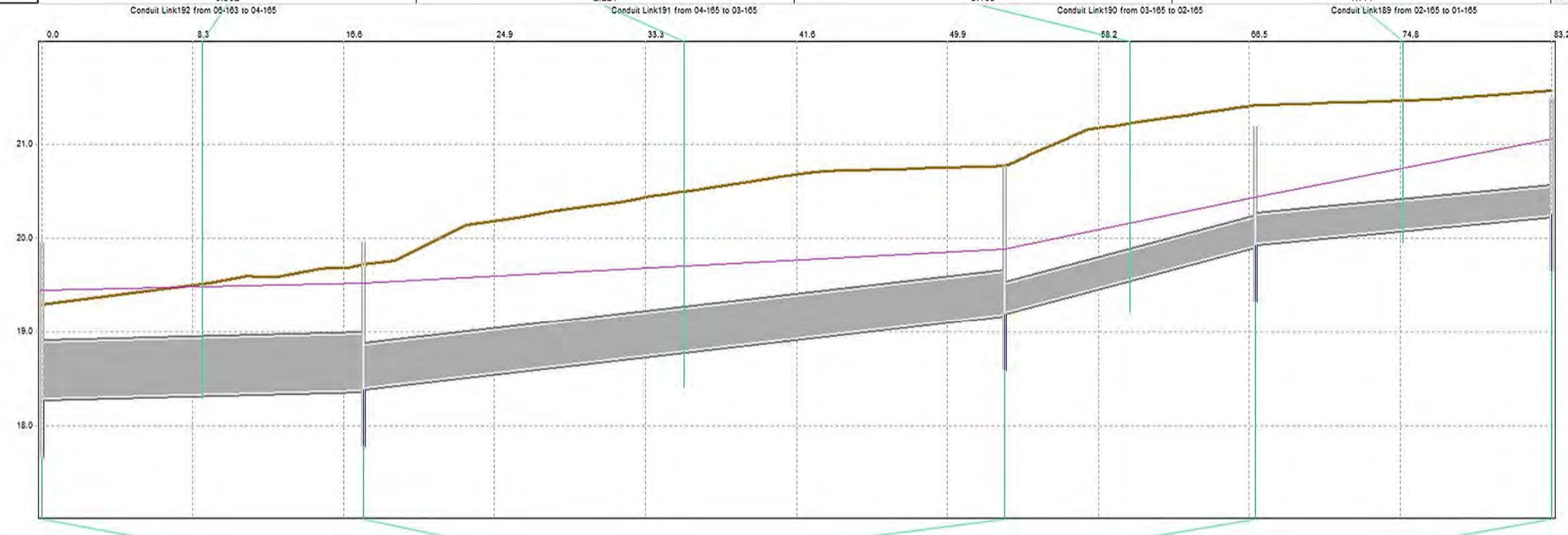


	06-152	01-155
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	24.150	24.206
Ground Elevation (Spill Crest)	25.505	25.504
Freeboard	1.360	1.300
Invert Elevation	23.344	23.513
Max Water Depth	0.806	0.693

Node Runoff

Link

	Link192	Link191	Link190	Link189
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Flow	0.210	0.207	0.154	0.151
Max Velocity	0.810	1.820	2.530	2.110
Diameter (Height)	0.600	0.450	0.300	0.300
Max Depth	1.155	1.116	0.665	0.809
Conduit Slope	0.502	2.221	5.105	1.777

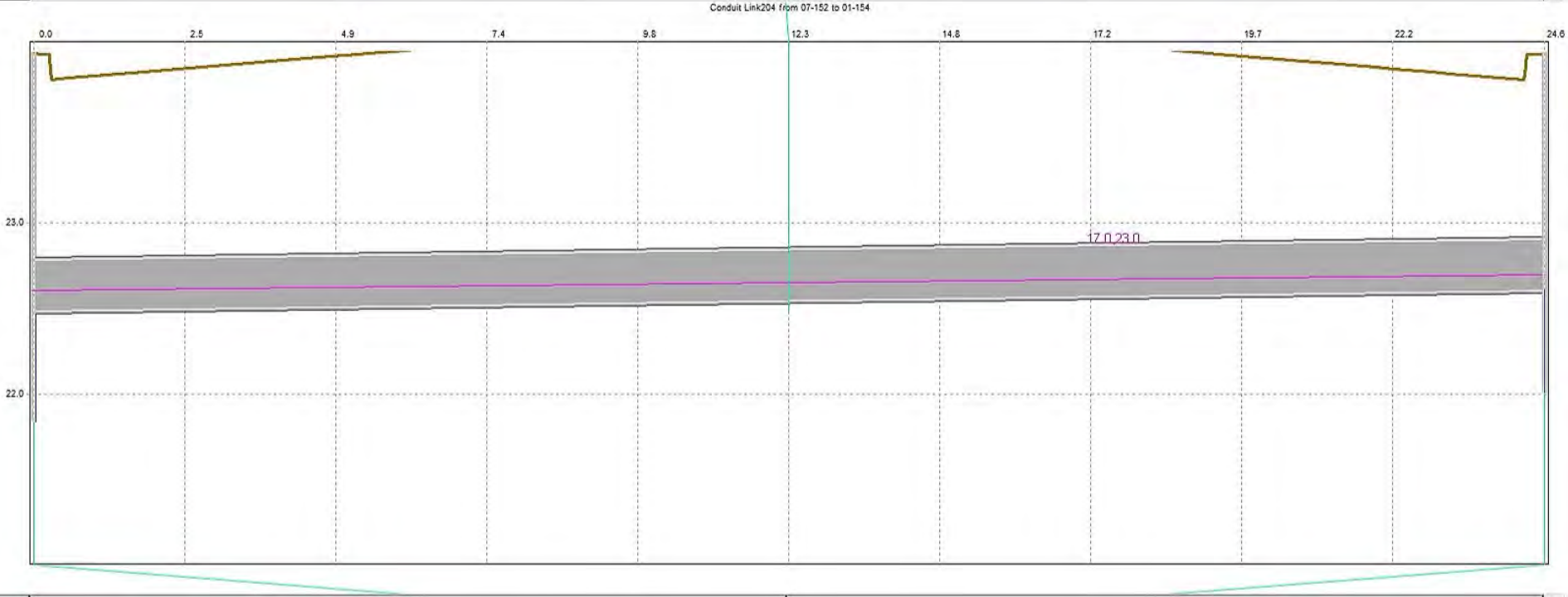


	06-163	04-165	03-165	02-165	01-165
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	19.442	19.521	19.884	20.429	21.044
Ground Elevation (Spill Crest)	19.950	19.964	20.774	21.197	21.488
Freeboard	0.510	0.440	0.890	0.770	0.440
Invert Elevation	17.660	17.779	18.593	19.328	19.648
Max Water Depth	1.782	1.742	1.291	1.101	1.396

Node Runoff

Link

	Link204
Storm	FLTW_20pct_1hr_9
Max Flow	0.011
Max Velocity	0.580
Diameter (Height)	0.300
Max Depth	0.122
Conduit Slope	0.504

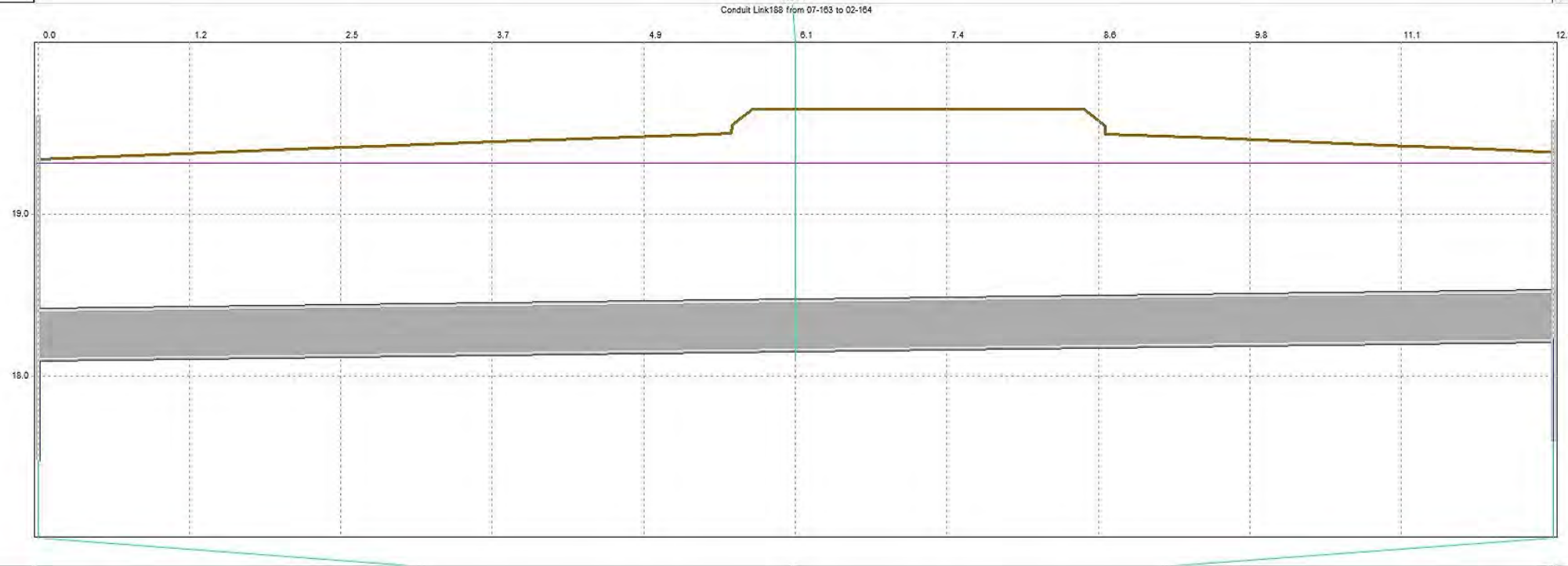


	07-152	01-154
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	22.605	22.699
Ground Elevation (Spill Crest)	23.998	23.998
Freeboard	1.390	1.300
Invert Elevation	21.838	22.007
Max Water Depth	0.767	0.692

Node Runoff

Link

	Link188
Storm	FLTW_20pct_1hr_9
Max Flow	0.010
Max Velocity	0.550
Diameter (Height)	0.300
Max Depth	1.205
Conduit Slope	0.904

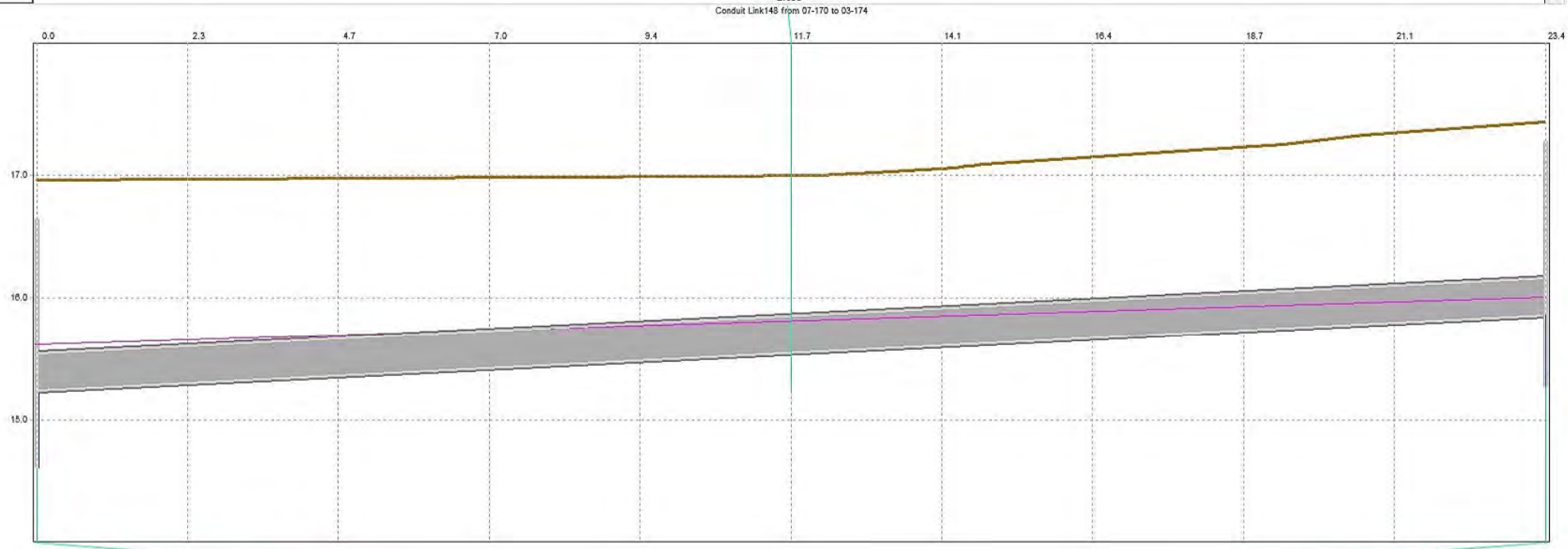


	07-163	02-164
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	19.311	19.315
Ground Elevation (Spill Crest)	19.610	19.581
Freeboard	0.300	0.270
Invert Elevation	17.479	17.590
Max Water Depth	1.832	1.725

Node Runoff

Link

	Link148
Storm	FLTW_20pct_1hr_1
Max Flow	0.047
Max Velocity	1.480
Diameter (Height)	0.300
Max Depth	0.375
Conduit Slope	2.655

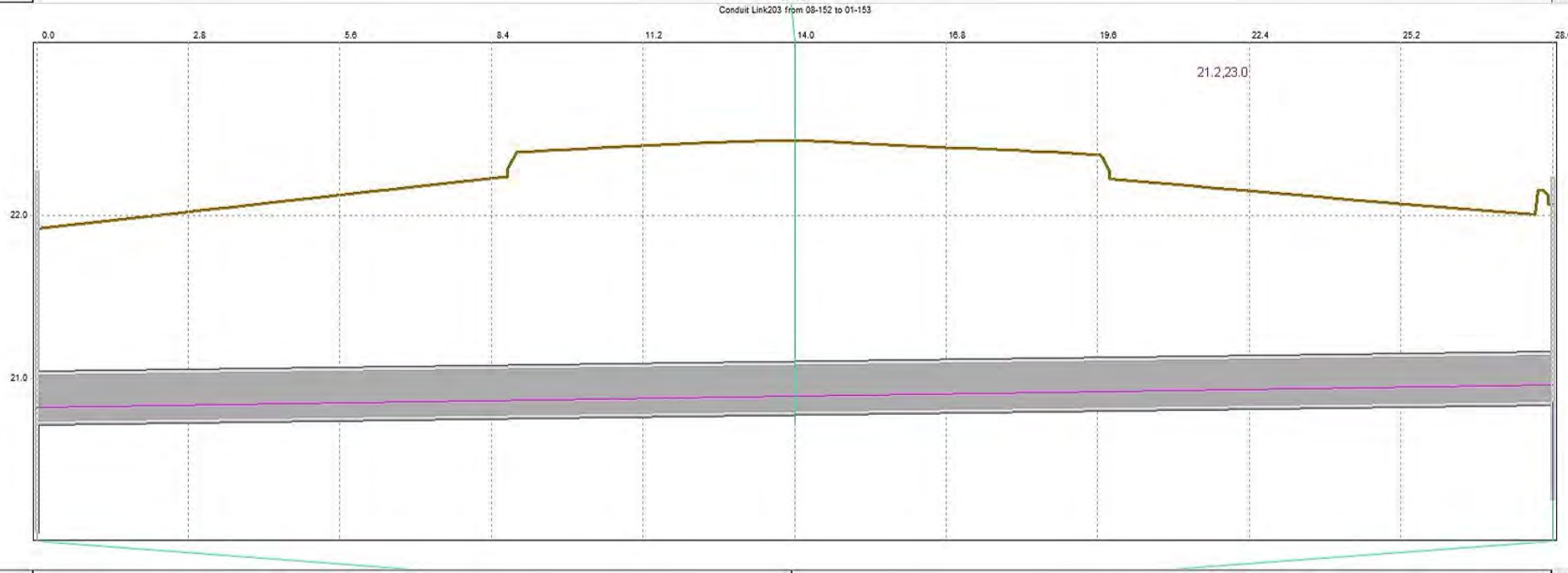


	07-170	03-174
Storm	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1
Max Water Elevation	15.619	16.007
Ground Elevation (Spill Crest)	16.648	17.280
Freeboard	1.030	1.270
Invert Elevation	14.618	15.270
Max Water Depth	1.001	0.737

Node Runoff

Link

	Link203
Storm	FLTW_20pct_1hr_9
Max Flow	0.013
Max Velocity	0.600
Diameter (Height)	0.300
Max Depth	0.109
Conduit Slope	0.418

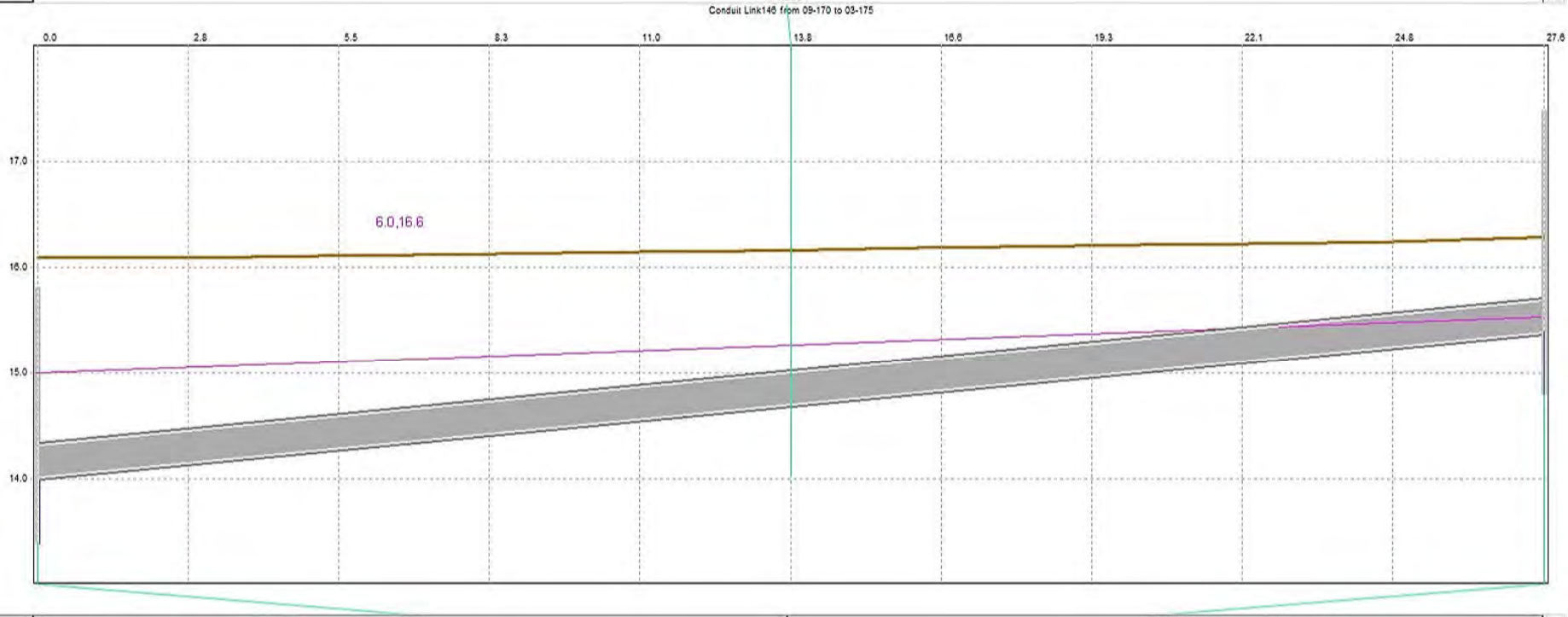


	08-152	01-153
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	20.810	20.958
Ground Elevation (Spill Crest)	22.277	22.234
Freeboard	1.470	1.280
Invert Elevation	20.057	20.249
Max Water Depth	0.753	0.709

Node Runoff

Link

	Link146
Storm	FLTW_20pct_1hr_1
Max Flow	0.062
Max Velocity	2.100
Diameter (Height)	0.300
Max Depth	0.979
Conduit Slope	4.966

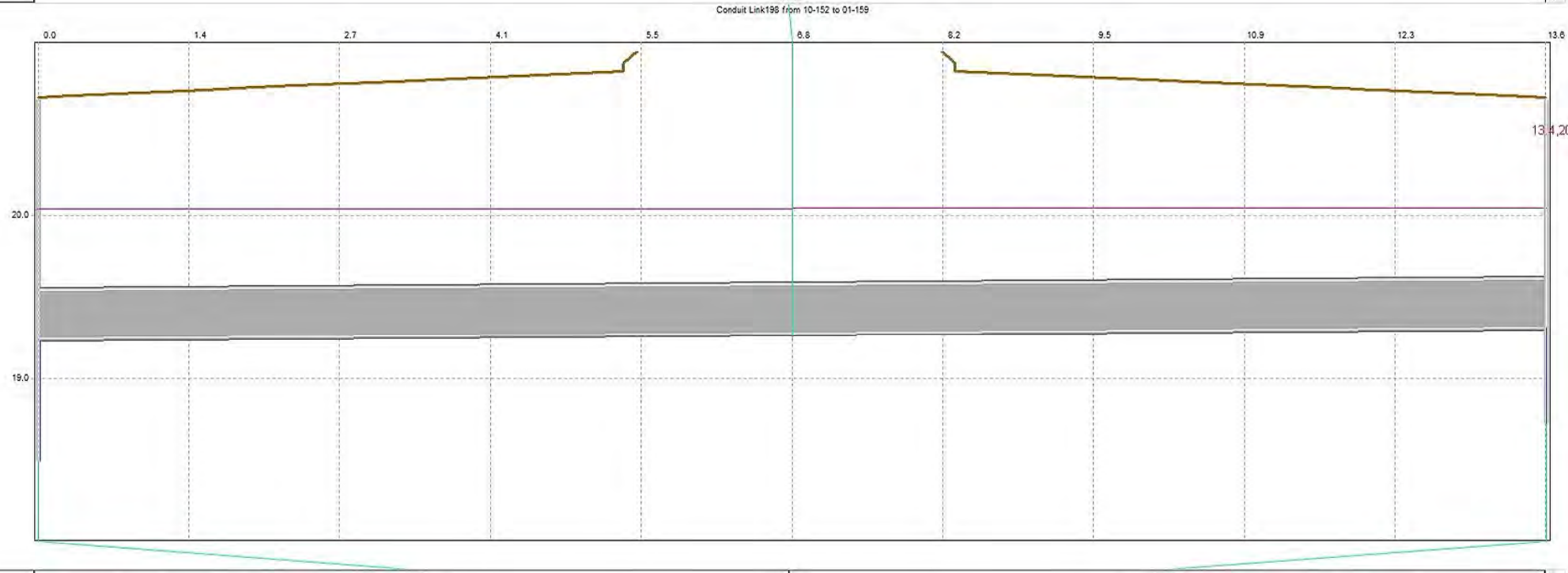


	09-170	03-175
Storm	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1
Max Water Elevation	14.996	15.529
Ground Elevation (Spill Crest)	15.813	17.490
Freeboard	0.820	1.960
Invert Elevation	13.388	14.788
Max Water Depth	1.608	0.741

Node Runoff

Link

	Link198
Storm	FLTW_20pct_1hr_9
Max Flow	0.006
Max Velocity	0.360
Diameter (Height)	0.300
Max Depth	0.795
Conduit Slope	0.499

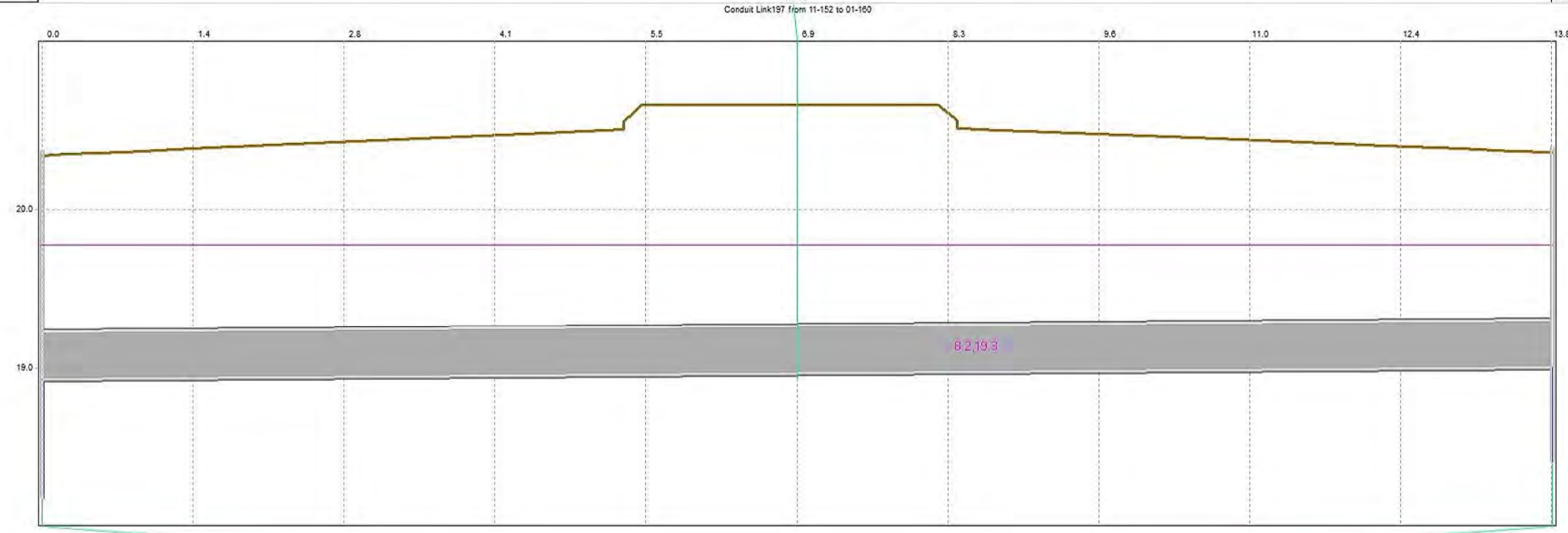


	10-152	01-159
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	20.037	20.037
Ground Elevation (Spill Crest)	20.707	20.707
Freeboard	0.670	0.670
Invert Elevation	18.498	18.716
Max Water Depth	1.539	1.321

Node Runoff

Link

	Link197
Storm	FLTW_20pct_1hr_9
Max Flow	0.006
Max Velocity	0.350
Diameter (Height)	0.300
Max Depth	0.845
Conduit Slope	0.501

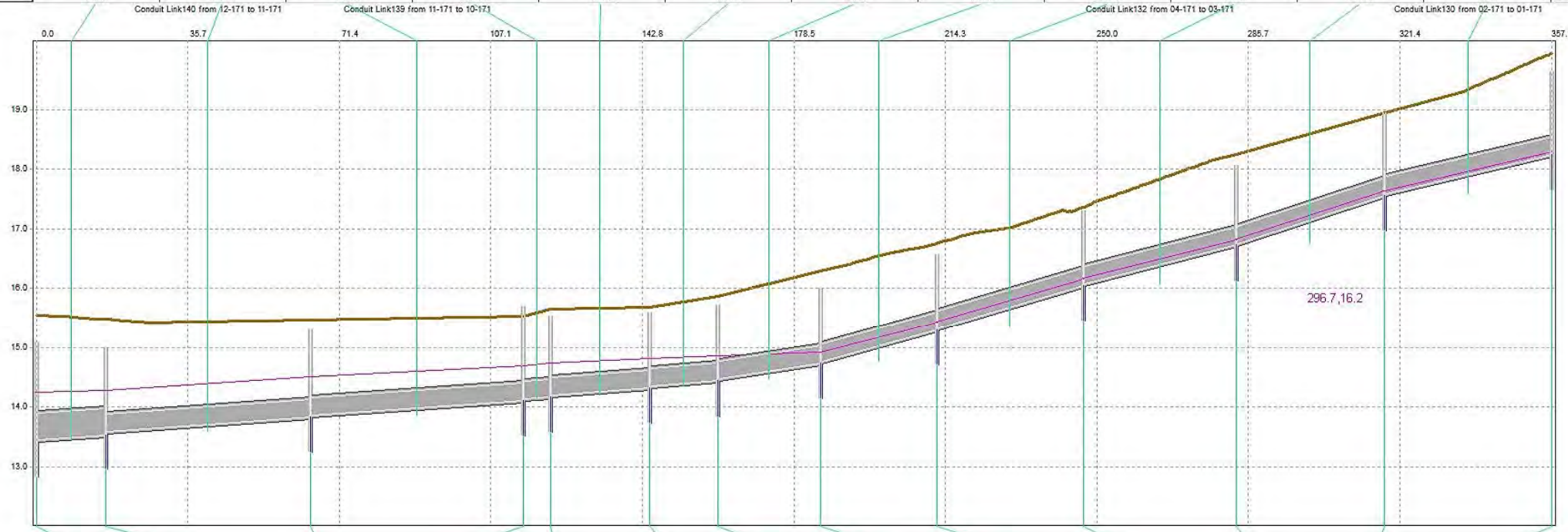


	11-152	01-160
Storm	FLTW_20pct_1hr_9	FLTW_20pct_1hr_9
Max Water Elevation	19.773	19.774
Ground Elevation (Spill Crest)	20.375	20.394
Freeboard	0.600	0.620
Invert Elevation	18.183	18.402
Max Water Depth	1.590	1.372

Node Runoff

Link

	Link141	Link140	Link139	Link138	Link137	Link136	Link135	Link134	Link133	Link132	Link131	Link130
Storm	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1
Max Flow	0.073	0.064	0.056	0.054	0.058	0.053	0.048	0.040	0.031	0.022	0.016	0.006
Max Velocity	0.510	0.930	0.900	0.810	0.890	0.890	1.180	1.500	1.430	1.260	1.250	0.810
Diameter (Height)	0.450	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
Max Depth	0.801	0.689	0.648	0.553	0.523	0.460	0.389	0.143	0.103	0.089	0.071	0.046
Conduit Slope	0.465	0.500	0.500	0.503	0.499	0.536	1.126	1.940	2.056	1.815	2.299	1.670



	11-170	12-171	11-171	10-171	09-171	08-171	07-171	06-171	05-171	04-171	03-171	02-171	01-171
Storm	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1	FLTW_20pct_1hr_1
Max Water Elevation	14.256	14.285	14.516	14.687	14.735	14.816	14.862	14.918	15.431	16.154	16.822	17.641	18.301
Ground Elevation (Spill Crest)	15.099	15.004	15.298	15.698	15.532	15.595	15.728	16.015	16.569	17.301	18.063	18.960	19.638
Freeboard	0.840	0.720	0.780	1.010	0.800	0.780	0.870	1.100	1.140	1.150	1.240	1.320	1.340
Invert Elevation	12.826	12.968	13.240	13.520	13.583	13.729	13.846	14.147	14.711	15.451	16.133	16.970	17.655
Max Water Depth	1.430	1.317	1.276	1.167	1.152	1.087	1.016	0.771	0.720	0.703	0.689	0.671	0.646

Node Runoff

APPENDIX E

Parkland Heights & Heritage Park Irrigation Schedule

(dated July 2019)
Prepared by LD TOTAL

PARKLAND HEIGHTS and HERITAGE PARK

IRRIGATION SCHEDULE

Current Licence 101,320kl
GWL 164680(10)

15th July 2019

7,500kL/ha/a	Pre Cal POS area m2	Irrigated turf area % Long-term	Total Irrigated Turf area (m²) Long-term	Long-term Volume - Turf (kL/yr)	Irrigated Planting % Establishment (2yrs)	Total Irrigated Planting area (m2) - Long Term	Long-term Volume - Planting (kL/yr)	TOTAL VOLUME
PH POS A (under the CoR licence)	4,823							
PH POS B (under the CoR licence)	1,463							
PH POS C (under the CoR licence)	11,240							
PH POS D (under the CoR licence)	2,283							
PH POS E	5,681	as per current design	3,552	2,664	as per design	1,360	1,020	3,684
PH POS F (under the CoR licence)	57,736							
PH POS G	5,129	as per current design	4,452	3,339	as per design	1,090	818	4,157
PH POS H	2,747	as per current design	1,651	1,238	as per design	936	702	1,940
PH POS I	3,235	as per current design	2,043	1,532	as per design	935	701	2,234
PH POS J (Eighty Road)	5,317	as per current design			as per design	2,509	1,882	1,882
PH POS K	5,317	40.0%	2,127	1,595	40%	2,127	1,595	3,190
PH POS L	2,328	40.0%	931	698	40%	931	698	1,397
PH POS M	10,935	40.0%	4,374	3,281	40%	4,374	3,281	6,561
PH POS N	6,934	40.0%	2,774	2,080	40%	2,774	2,080	4,160
PH POS O	8,110	40.0%	3,244	2,433	40%	3,244	2,433	4,866
PH Streetscapes	2,000	50.0%	1,000	750	50%	1,000	750	1,500
PH School Site	20,000	100.0%	20,000	15,000	0%	0	0	15,000
HP POS 1 (under the CoR licence)								
HP POS 2 (under the CoR licence)								
HP POS 3 (under the CoR licence)								
HP POS 4 (under the CoR licence)								
HP POS 5 (upcoming for handover July 18)		as per current design	-	-	-	-	-	9,426
HP P2 POS 1	22,263	40.0%	8,905	6,679	30%	6,679	5,009	11,688
HP Streetscape and Drainage	1,500	50.0%	750	563	50%	750	563	1,125
TOTALS FOR ESTATE								72,809

NOTES: ASSUMPTIONS + EXCLUSIONS:

The curent GWL 164680(10) has an allocation of 101,320kl

80% irrigated areas has been assumed for the POS that have not been designed, this value is based on previous approved POS designs within the CoR

Pre cal areas do not include verge or streetscape sqm

This irrigation schedule does not include construction/dust suppression water management

The school site allocation is to be transferred to the Department of Education when construction of the school is due to commence

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Rockingham Park Pty Ltd		
Description of Water Resource	Stakehill Perth - Superficial Swan	**Annual Water Entitlement**	101,320kL
Location of Water Source	LOT 9010 ON PLAN 407830 - Lot 9010 BALDIVIS - Parkland Heights LOT 954 ON PLAN 407830 - Lot 954 BALDIVIS - POS H - Parkland Heights		

Authorised Activities	**Taking of water for**	**Location of Activity**
	Dust suppression for earthworks and construction purposes	LOT 9010 ON PLAN 407830 - Lot 9010 BALDIVIS - Parkland Heights Lot 986 On Plan 202758 - Volume/Folio 2128/381 - Lot 986 Baldivis Rd Baldivis - Heritage Park Lot 993 On Plan 202758 - Volume/Folio 2125/382 - Lot 993 Baldivis Rd Baldivis - Heritage Park Road Reserve - PIN11754540 - Heritage Park
	Irrigation of up to 2ha ovals and playing fields	LOT 9010 ON PLAN 407830 - Lot 9010 BALDIVIS - Parkland Heights
	Irrigation of up to 5.8 ha of public open space	LOT 9010 ON PLAN 407830 - Lot 9010 BALDIVIS - Parkland Heights LOT 954 ON PLAN 407830 - Lot 954 BALDIVIS - POS H - Parkland Heights LOT 955 ON PLAN 407830 - Lot 955 BALDIVIS - POS I - Parkland Heights Lot 986 On Plan 202758 - Volume/Folio 2128/381 - Lot 986 Baldivis Rd Baldivis - Heritage Park Lot 993 On Plan 202758 - Volume/Folio 2125/382 - Lot 993 Baldivis Rd Baldivis - Heritage Park Road Reserve - PIN11754540 - Heritage Park
Duration of Licence	From 18 October 2018 to 4 February 2024	

This Licence is subject to the following terms, conditions and restrictions:

1. The licensee shall not use water for sprinkler irrigation between 9 am and 6 pm except for the establishment of newly planted areas. For newly planted areas water may be used within these hours for a period of up to 28 consecutive days, commencing from the date of planting.

2. Between 1 June and 31 August in any year, the licence-holder must not water a lawn, garden, or grass-covered area ("turf") by reticulation, provided always that this restriction shall not apply to watering with a hand held hose; or watering, by way of reticulation: newly planted areas for a period of up to 28 days from the date of planting; for renovating turf; or for maintenance of reticulation systems.

3. The volume of all water taken under this licence must be metered using an approved meter fitted to each drawpoint.

4. The annual water year for water taken under this licence is defined as 1 January to 31 December.

5. Unless otherwise approved by the Department of Water and Environmental Regulation, all meter readings must be recorded monthly via the Department of Water and Environmental Regulation's 'Water Online Portal' or on an approved Department of Water and Environmental Regulation 'Meter Water Use Card'. The meter readings must be reported via the 'Water Online Portal' or submitted via a completed 'Meter Water Use Card' to the Department of Water and Environmental Regulation every 12 Months, commencing 30/01/2019.

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000.

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

This Licence is subject to the following terms, conditions and restrictions:

6. The licensee must ensure the installed meter(s) accuracy is maintained to within plus or minus 5% of the volume metered, in field conditions.

7. The licensee must notify the Department of Water and Environmental Regulation in writing of any water meter malfunction within seven days of the malfunction being noticed.

8. The licensee must obtain authorisation from the Department of Water and Environmental Regulation before removing, replacing or interfering with any meter required under this licence.

End of terms, conditions and restrictions

Our ref: EWP20132.001

Appendix K
Permeability assessment of POS areas and median strip

J1901164 002 L Rev0 09 August 2019

Mortons Urban Solutions
Unit 4/100 Railway Road
SUBIACO WA 6008

Attention: Chris Le

PERMEABILITY ASSESSMENT OF POS AREAS AND MEDIAN STRIP
PARKLANDS HEIGHTS PRIVATE ESTATE
BALDIVIS

Dear Chris,

1. INTRODUCTION

This letter presents the outcomes of Galt Geotechnics (Galt's) permeability assessment of public open space (POS) areas and a median strip within the Parklands Heights Private Estate in Baldivis ("the site"). The location of the site relative to the surrounding area is shown on Figure 1, Site and Location Plan.

2. SITE DESCRIPTION

The assessed POS areas are designated K, L, M, N & E. The median strip is along Nairn Drive, extending north from Furnivall Parade. The configuration of the site is shown on the local structure plan presented in Attachment A and superimposed on a recent aerial photograph in Figure 1.

At the time of our investigation (5 & 7 May 2019), the site had been largely earthworked and a number of drainage basins were already formed in the POS areas. Photographs taken during the investigation are presented in Attachment B.

3. PERMEABILITY TESTING

Infiltration testing was conducted at 3 locations at each POS area and along the Nairn Drive median strip (total 18 tests), at a depth of about 0.9 m for each test. The testing was conducted using the inverse auger hole method described by Cocks[1]. The locations of the tests are shown on Figure 1.

The subsurface soils at each site generally comprise:

- SAND (SP): fine to coarse grained, sub-rounded to sub-angular, typically yellow but also varying between grey-brown, grey-white grey and dark grey, trace fines.

The results of the infiltration testing are presented in Attachment C and a summary of the results is presented in Table 1

[1] Cocks, G (2007), "Disposal of Stormwater Runoff by Soakage in Perth Western Australia", Journal and News of the Australian Geomechanics Society, Volume 42 No. 3, pp 101-114

Table 1: Summary of Permeability Test Results

Location	Test Reference	Test Depth (m)	Minimum Unsaturated Permeability, k (m/day)		
			Test 1	Test 2	Test 3
POS K	K1	0.90	> 15	> 15	> 15
	K2	0.90	> 15	> 15	> 15
	K3	0.90	10.4	5.5	3.4
POS L	L1	0.95	> 15	> 15	> 15
	L2	0.89	6.3	3.7	2.6
	L3	0.85	12.1	>15	>15
POS M	M1	0.90	> 15	12.9	7.1
	M2	0.90	> 15	> 15	> 15
	M3	0.90	> 15	> 15	> 15
POS N	N1	0.90	> 15	> 15	> 15
	N2	0.90	> 15	> 15	> 15
	N3	0.90	> 15	> 15	> 15
POS E	E1	0.90	> 15	> 15	> 15
	E2	0.90	> 15	> 15	14.4
	E3	0.95	> 15	> 15	> 15
Nairn Drive median strip	IT1	0.95	> 15	> 15	> 15
	IT2	0.95	> 15	> 15	> 15
	IT3	0.95	> 15	> 15	> 15

Note: Permeabilities greater than 15 m/day are not reported due to the inaccuracies of the test method in highly permeable soils.

4. CLOSURE

We draw your attention to Attachment D of this letter report, "Understanding Your Report". The information provided within is intended to inform you as to what your realistic expectations of this report should be. This information is provided not to reduce the level of responsibility accepted by Galt, but to ensure that all parties who rely on this report are aware of the responsibilities each assumes in so doing.

GALT GEOTECHNICS PTY LTD

Harry Chambers

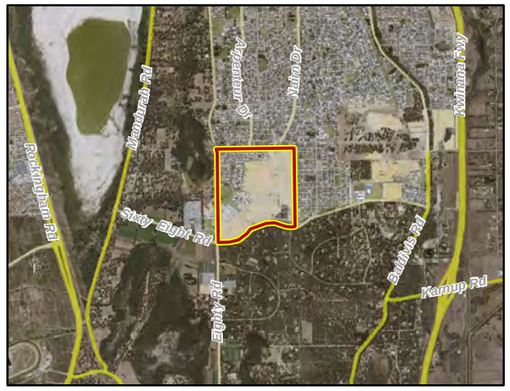
Geotechnical Engineer

Rick Piovesan CPEng

Geotechnical Engineer

Attachments: Figure 1 – Site and Location Plan
A – Supplied Drawings
B – Photographs
C – Infiltration Test Results
D – Understanding Your Report

\\galtgeo.local\OsbornePark\Data\Jobs\2019\J1901164 - Buckby EV Parkland Heights Baldivis\03 Correspondence\J1901164 002 L Rev0.docx



Legend

- Site Boundary
- Infiltration Test

N

0 80 160 240 320 400
Meters

NOTES

Aerial Imagery and Cadastre sourced from Landgate/SLIP

SCALE	1:5,000	(A3)
DRAWN	CED	
DATE DRAWN	9/08/2019	
CHECKED	HWC	
DATE CHECKED	9/08/2019	
PROJECTION	GDA 1994 MGA Zone 50	

Galt Geotechnics Pty Ltd
ACN : 138 490 865
Tel : +61 (0)8 6272-0200
Address : 50 Edward Street
Osborne Park WA 6017

CLIENT	**MORTONS URBAN SOLUTIONS**
PROJECT	PERMEABILITY ASSESSMENT OF POS AREAS
LOCATION	PARKLANDS HEIGHTS PRIVATE ESTATE BALDIVIS
TITLE	SITE & LOCATION PLAN

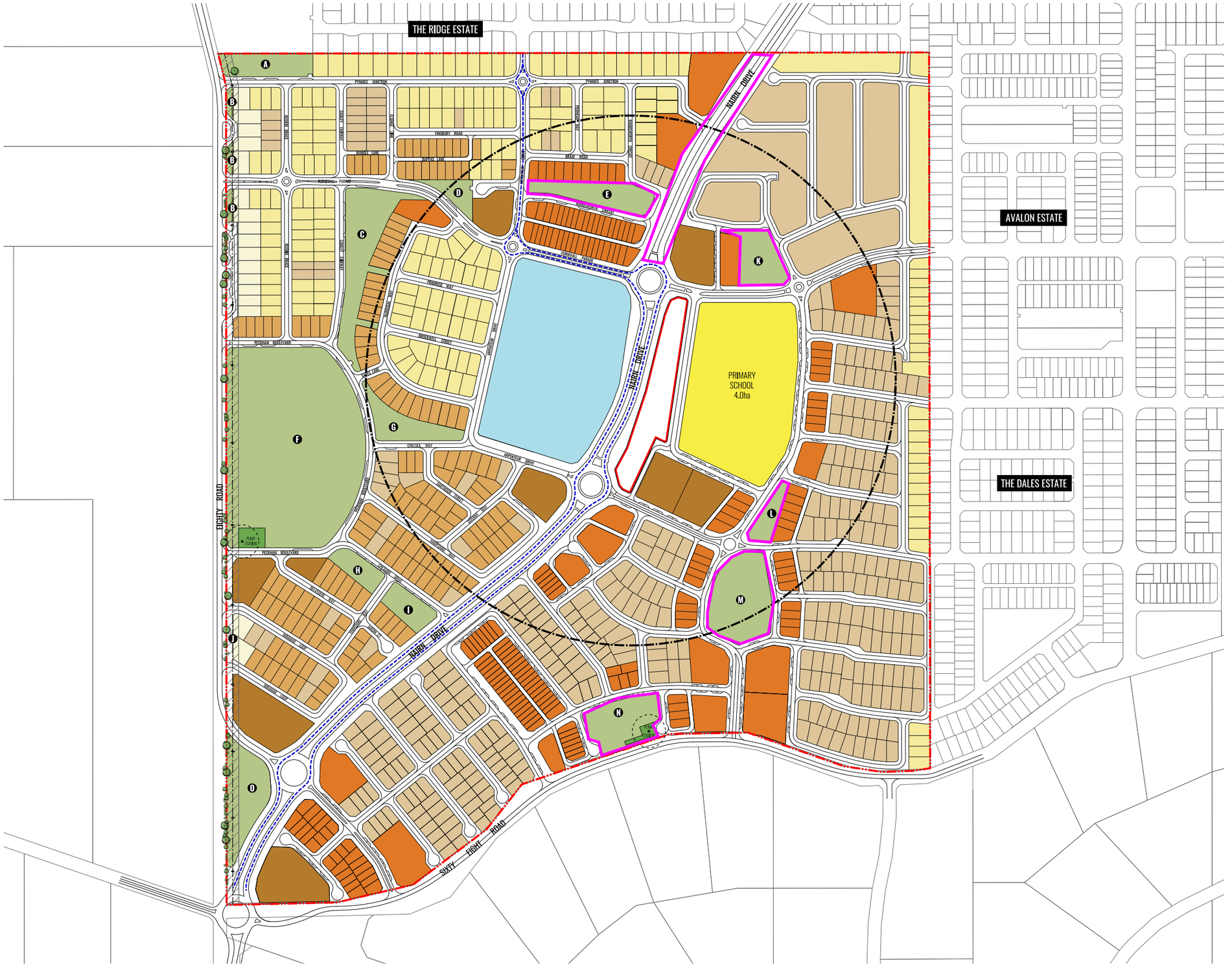
Job No	Fig No	Rev
J1901164	FIGURE 1	**A**

ATTACHMENT A

Supplied Drawing

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017

ABN: 64 625 054 729



LEGEND

ZONES/RESERVES

- RESIDENTIAL R15
- RESIDENTIAL R20
- RESIDENTIAL R25
- RESIDENTIAL R30
- RESIDENTIAL R40
- RESIDENTIAL R60
- COMMERCIAL
- SPECIAL USE
- EDUCATION
- PUBLIC OPEN SPACE

OTHER

- LOCAL STRUCTURE PLAN BOUNDARY
- 400m NEIGHBOURHOOD WALKABLE CATCHMENT
- PUMP STATION ODOUR BUFFER
- POWERLINE EASEMENT
- ROAD WIDENING (SIXTY EIGHT ROAD)
- PLANNED BUS ROUTE
- VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
- SEWER PUMP STATION (900m^2 - 1220m^2)

NOTES

1. The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boundary.
2. The access street and associated lot layout shown on the plan is indicative only and subject to refinement as part of the detailed subdivision process.
3. POS Areas are indicative only and subject to further detailed design and drainage considerations.
4. All road carriageway detail depicted on the Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on the Plan are subject to pre-cal and final survey and may vary from figures shown.
5. Bushfire attack level to be reviewed prior to creation of titles. Development may require construction in accordance with AS3959 - Construction in Bushfire Prone Areas.
6. Sixty-Eight Road widening to accomodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.

LOCAL STRUCTURE PLAN MAP

Lot 1507 Eighty Road, BALDIVIS

A Rockingham Park Project

NORTH

Scale: 1:6000 @ A3

0 60 120 180m

PLAN: RHPPH-2-001 REVISION:
DATE: 20/11/2018 DRAWN: JP
PROJECTION: PCG 94 PLANNER: BK
DATUM: AHD CHECK: TV

A 28 Brown Street, East Perth WA 6004
P (08) 9325 0200
E info@creativedp.com.au
W creativedp.com.au

ATTACHMENT B

Photographs

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017

ABN: 64 625 054 729

Photograph 1: Looking south overlooking POS M basin

Photograph 2: Looking west within POS N basin

Photograph 3: Looking south across POS K

Photograph 4: Looking east across POS K

Photograph 5: Looking north within POS E basin

Photograph 6: Looking south along Nairn Drive median strip

Photograph 7: Looking south from POS L location

Photograph 8: General view of the estate looking south

ATTACHMENT C

Infiltration Test Results

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017

ABN: 64 625 054 729

Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics

Job No:	J1901164
Client:	Mortons.U.S
Project:	Parkland Heights
Location:	Baldivis
Calc by:	HWC
BH Name:	E1
Test Depth:	0.90 m

Spreadsheet author:	ORW	17-Oct-09

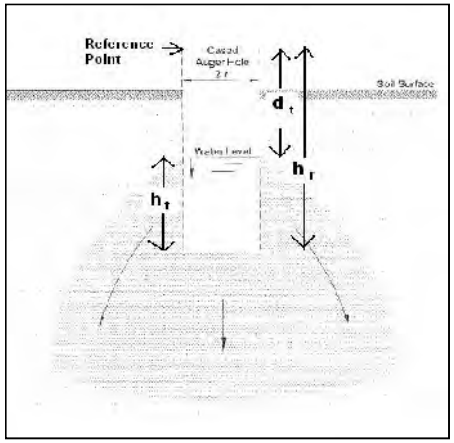
$$K = 1.15r\,\frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

Spreadsheet Legend

	Required input
	Calculated field
	Comment field
	Field not used
	Fixed field

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	1	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m



Test 1

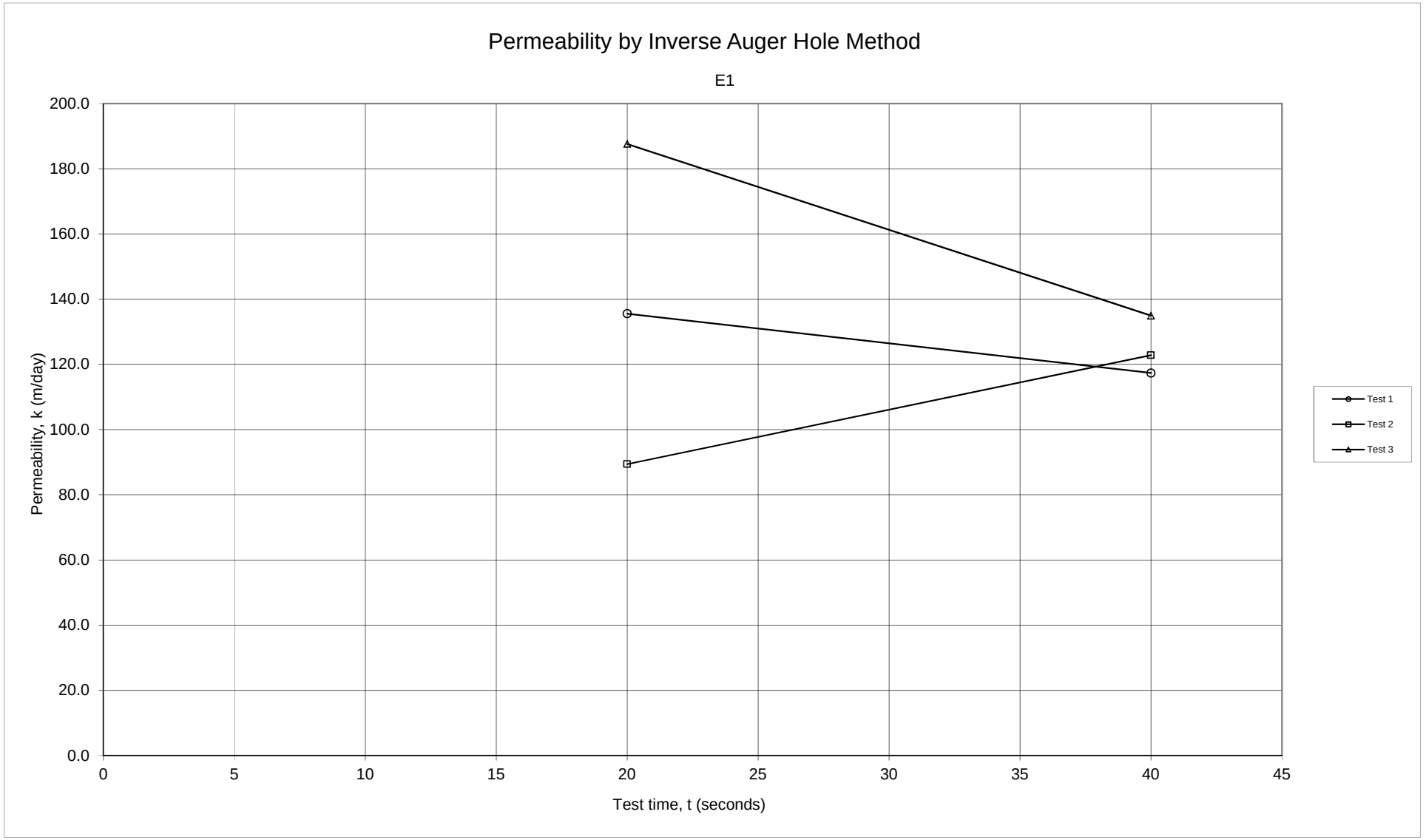
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.77	0.23		
20	0.96	0.04	1.6E-03	135.6
40	1	0	1.4E-03	117.4
		AVERAGE	1.5E-03	126.5

Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.74	0.26		
20	0.91	0.09	1.0E-03	89.4
40	1	0	1.4E-03	122.8
		AVERAGE	1.2E-03	106.1

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.66	0.34		
20	0.97	0.03	2.2E-03	187.6
40	1	0	1.6E-03	134.9
		AVERAGE	1.9E-03	161.3


Permeability by Inverse Auger Hole Method
E1
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Permeability, k (m/day)
0
5
10
15
20
25
30
35
40
45
Test time, t (seconds)
Test 1
Test 2
Test 3

Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics

Job No:	J1901164
Client:	Mortons.U.S
Project:	Parkland Heights
Location:	Baldivis
Calc by:	HWC
BH Name:	E2
Test Depth:	0.90 m

Spreadsheet author:	ORW	17-Oct-09

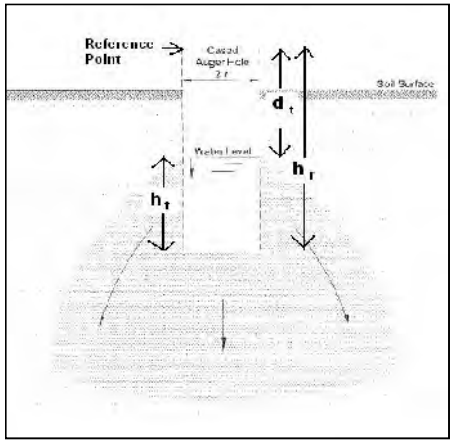
$$K = 1.15r\,\frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

Spreadsheet Legend

	Required input
	Calculated field
	Comment field
	Field not used
	Fixed field

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	1	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m



Test 1

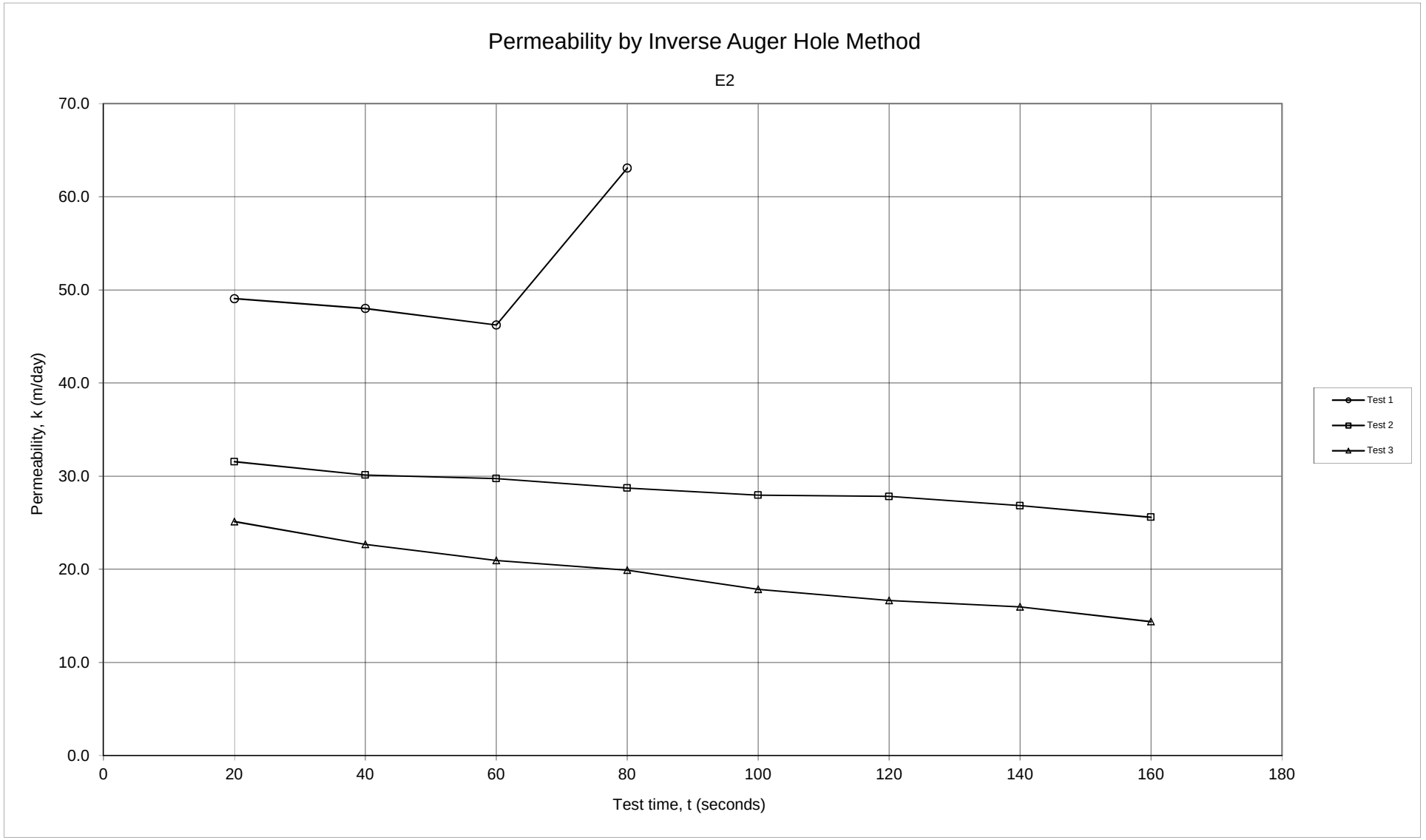
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.72	0.28		
20	0.84	0.16	5.7E-04	49.1
40	0.91	0.09	5.6E-04	48.0
60	0.95	0.05	5.4E-04	46.2
80	1	0	7.3E-04	63.1
		AVERAGE	6.0E-04	51.6

Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.59	0.41		
20	0.71	0.29	3.7E-04	31.6
40	0.79	0.21	3.5E-04	30.1
60	0.85	0.15	3.4E-04	29.7
80	0.89	0.11	3.3E-04	28.7
100	0.92	0.08	3.2E-04	28.0
120	0.945	0.055	3.2E-04	27.8
140	0.96	0.04	3.1E-04	26.8
160	0.97	0.03	3.0E-04	25.6
		AVERAGE	3.3E-04	28.5

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.54	0.46		
20	0.65	0.35	2.9E-04	25.1
40	0.72	0.28	2.6E-04	22.7
60	0.77	0.23	2.4E-04	21.0
80	0.81	0.19	2.3E-04	19.9
100	0.83	0.17	2.1E-04	17.8
120	0.85	0.15	1.9E-04	16.6
140	0.87	0.13	1.8E-04	16.0
160	0.875	0.125	1.7E-04	14.4
		AVERAGE	2.2E-04	19.2


Permeability by Inverse Auger Hole Method
E2
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Permeability, k (m/day)
0
20
40
60
80
100
120
140
160
180
Test time, t (seconds)
Test 1
Test 2
Test 3

Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics

Job No:	J1901164
Client:	Mortons.U.S
Project:	Parkland Heights
Location:	Baldivis
Calc by:	HWC
BH Name:	E3
Test Depth:	0.95 m

Spreadsheet author:	ORW	17-Oct-09

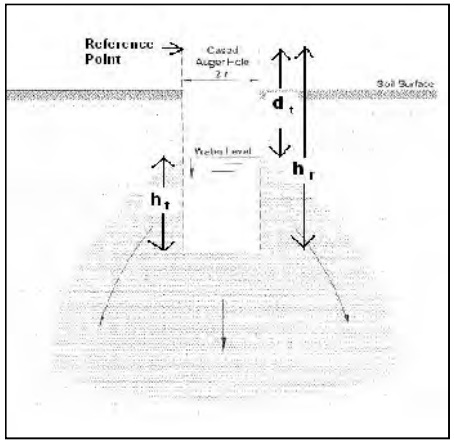
$$K = 1.15r\,\frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

Spreadsheet Legend

	Required input
	Calculated field
	Comment field
	Field not used
	Fixed field

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	0.95	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m



Test 1

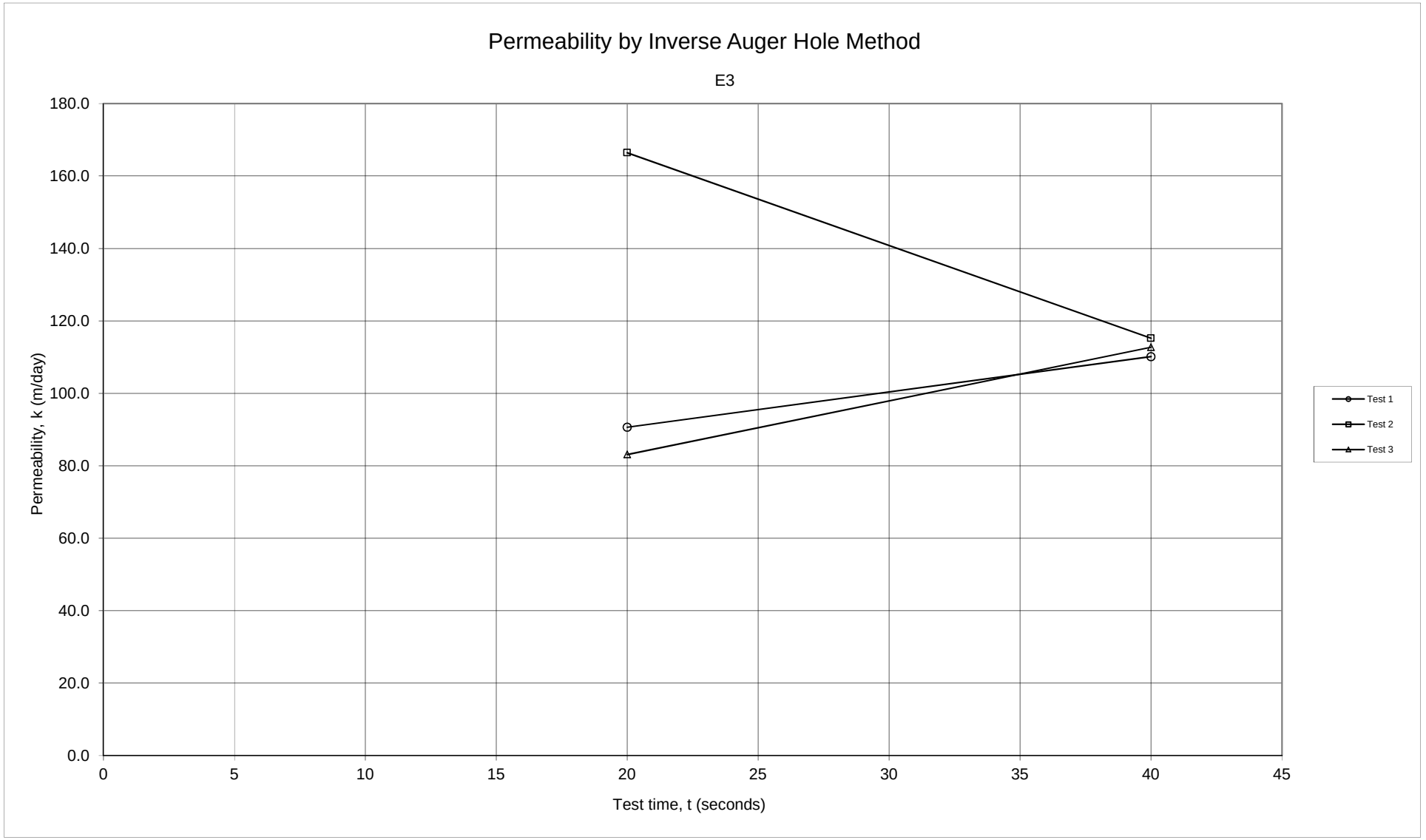
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.61	0.34		
20	0.83	0.12	1.0E-03	90.7
40	0.935	0.015	1.3E-03	110.1
		AVERAGE	1.2E-03	100.4

Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.57	0.38		
20	0.9	0.05	1.9E-03	166.4
40	0.935	0.015	1.3E-03	115.2
		AVERAGE	1.6E-03	140.8

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.59	0.36		
20	0.81	0.14	9.6E-04	83.1
40	0.935	0.015	1.3E-03	112.7
		AVERAGE	1.1E-03	97.9


Permeability by Inverse Auger Hole Method
E3
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Permeability, k (m/day)
0
5
10
15
20
25
30
35
40
45
Test time, t (seconds)
Test 1
Test 2
Test 3

Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics

Job No:	J1901164
Client:	Mortons.U.S
Project:	Parkland Heights
Location:	Baldivis
Calc by:	HWC
BH Name:	K1
Test Depth:	0.90 m

Spreadsheet author:	ORW	17-Oct-09

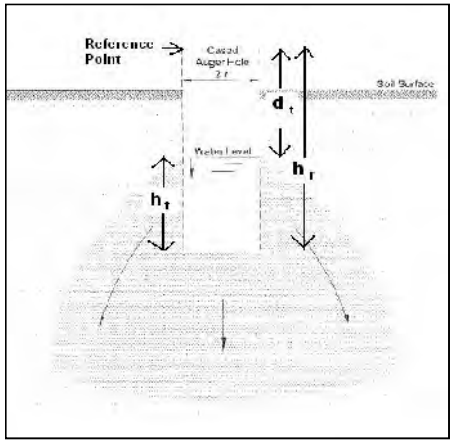
$$K = 1.15r\,\frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

Spreadsheet Legend

	Required input
	Calculated field
	Comment field
	Field not used
	Fixed field

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	1	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m



Test 1

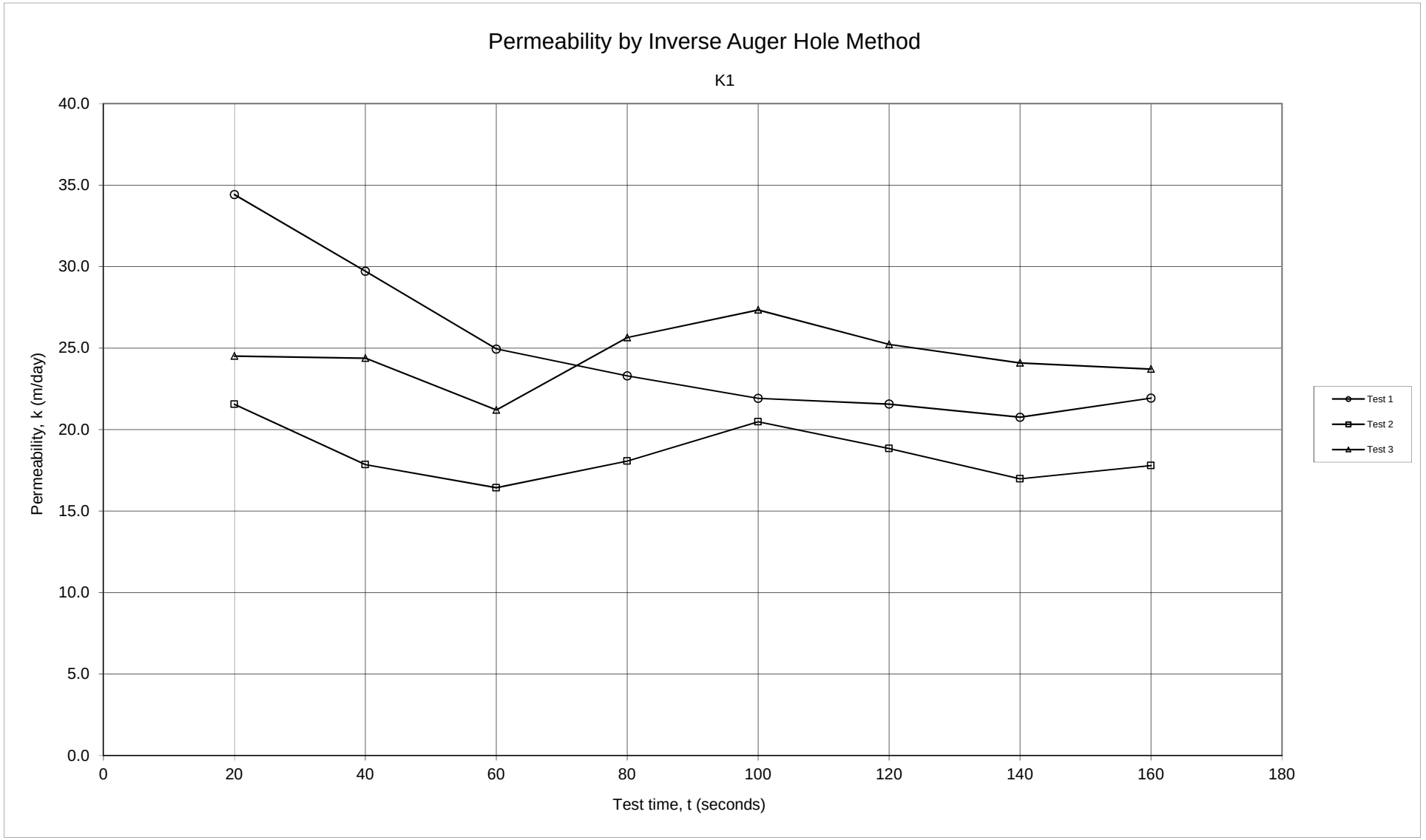
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.52	0.48		
20	0.67	0.33	4.0E-04	34.4
40	0.75	0.25	3.4E-04	29.7
60	0.79	0.21	2.9E-04	24.9
80	0.83	0.17	2.7E-04	23.3
100	0.86	0.14	2.5E-04	21.9
120	0.89	0.11	2.5E-04	21.6
140	0.91	0.09	2.4E-04	20.8
160	0.94	0.06	2.5E-04	21.9
		AVERAGE	2.9E-04	24.8

Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.47	0.53		
20	0.58	0.42	2.5E-04	21.6
40	0.64	0.36	2.1E-04	17.9
60	0.69	0.31	1.9E-04	16.4
80	0.76	0.24	2.1E-04	18.1
100	0.83	0.17	2.4E-04	20.5
120	0.85	0.15	2.2E-04	18.8
140	0.86	0.14	2.0E-04	17.0
160	0.895	0.105	2.1E-04	17.8
		AVERAGE	2.1E-04	18.5

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.44	0.56		
20	0.57	0.43	2.8E-04	24.5
40	0.67	0.33	2.8E-04	24.4
60	0.72	0.28	2.5E-04	21.2
80	0.82	0.18	3.0E-04	25.6
100	0.88	0.12	3.2E-04	27.3
120	0.9	0.1	2.9E-04	25.2
140	0.92	0.08	2.8E-04	24.1
160	0.94	0.06	2.7E-04	23.7
		AVERAGE	2.8E-04	24.5


Permeability by Inverse Auger Hole Method
K1
Permeability, k (m/day)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
20
40
60
80
100
120
140
160
180
Test time, t (seconds)
Test 1
Test 2
Test 3

Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics

Job No:	J1901164
Client:	Mortons.U.S
Project:	Parkland Heights
Location:	Baldivis
Calc by:	HWC
BH Name:	K2
Test Depth:	0.90 m

Spreadsheet author:	ORW	17-Oct-09

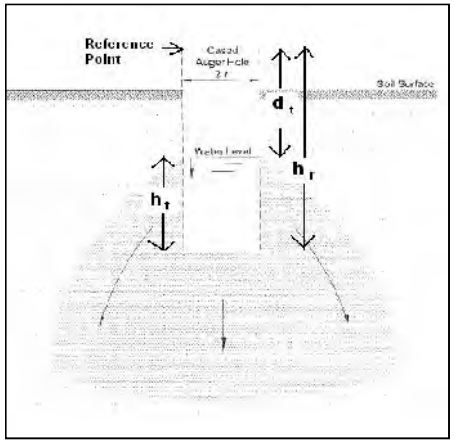
$$K = 1.15r \frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

Spreadsheet Legend

	Required input
	Calculated field
	Comment field
	Field not used
	Fixed field

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	1	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m



Test 1

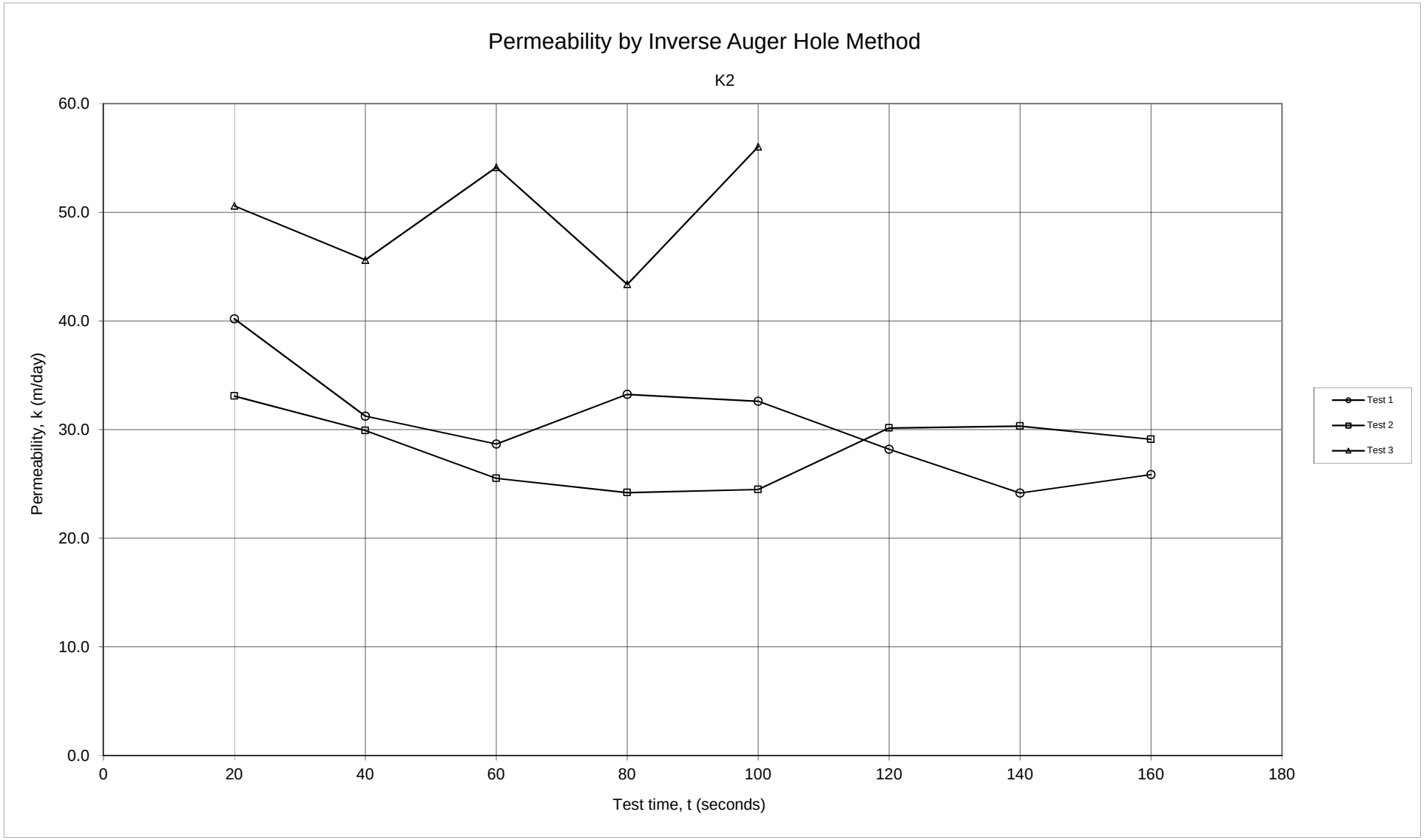
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.58	0.42		
20	0.73	0.27	4.7E-04	40.2
40	0.79	0.21	3.6E-04	31.2
60	0.84	0.16	3.3E-04	28.7
80	0.91	0.09	3.8E-04	33.2
100	0.94	0.06	3.8E-04	32.6
120	0.945	0.055	3.3E-04	28.2
140	0.945	0.055	2.8E-04	24.2
160	0.97	0.03	3.0E-04	25.9
		AVERAGE	3.5E-04	30.5

Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.555	0.445		
20	0.69	0.31	3.8E-04	33.1
40	0.77	0.23	3.5E-04	29.9
60	0.81	0.19	3.0E-04	25.5
80	0.85	0.15	2.8E-04	24.2
100	0.89	0.11	2.8E-04	24.5
120	0.95	0.05	3.5E-04	30.2
140	0.97	0.03	3.5E-04	30.3
160	0.98	0.02	3.4E-04	29.1
		AVERAGE	3.3E-04	28.3

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.53	0.47		
20	0.73	0.27	5.9E-04	50.6
40	0.83	0.17	5.3E-04	45.6
60	0.93	0.07	6.3E-04	54.1
80	0.94	0.06	5.0E-04	43.4
100	0.995	0.005	6.5E-04	56.0
		AVERAGE	5.8E-04	49.9


Permeability by Inverse Auger Hole Method
K2
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Permeability, k (m/day)
0
20
40
60
80
100
120
140
160
180
Test time, t (seconds)
Test 1
Test 2
Test 3

Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics

Job No:	J1901164
Client:	Mortons.U.S
Project:	Parkland Heights
Location:	Baldivis
Calc by:	HWC
BH Name:	K3
Test Depth:	0.90 m

Spreadsheet author:	ORW	17-Oct-09

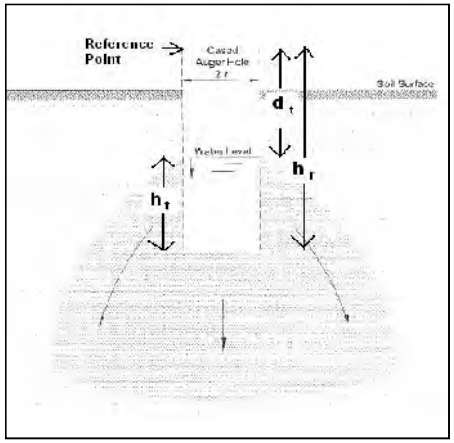
$$K = 1.15r\,\frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

Spreadsheet Legend

	Required input
	Calculated field
	Comment field
	Field not used
	Fixed field

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	1	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m



Test 1

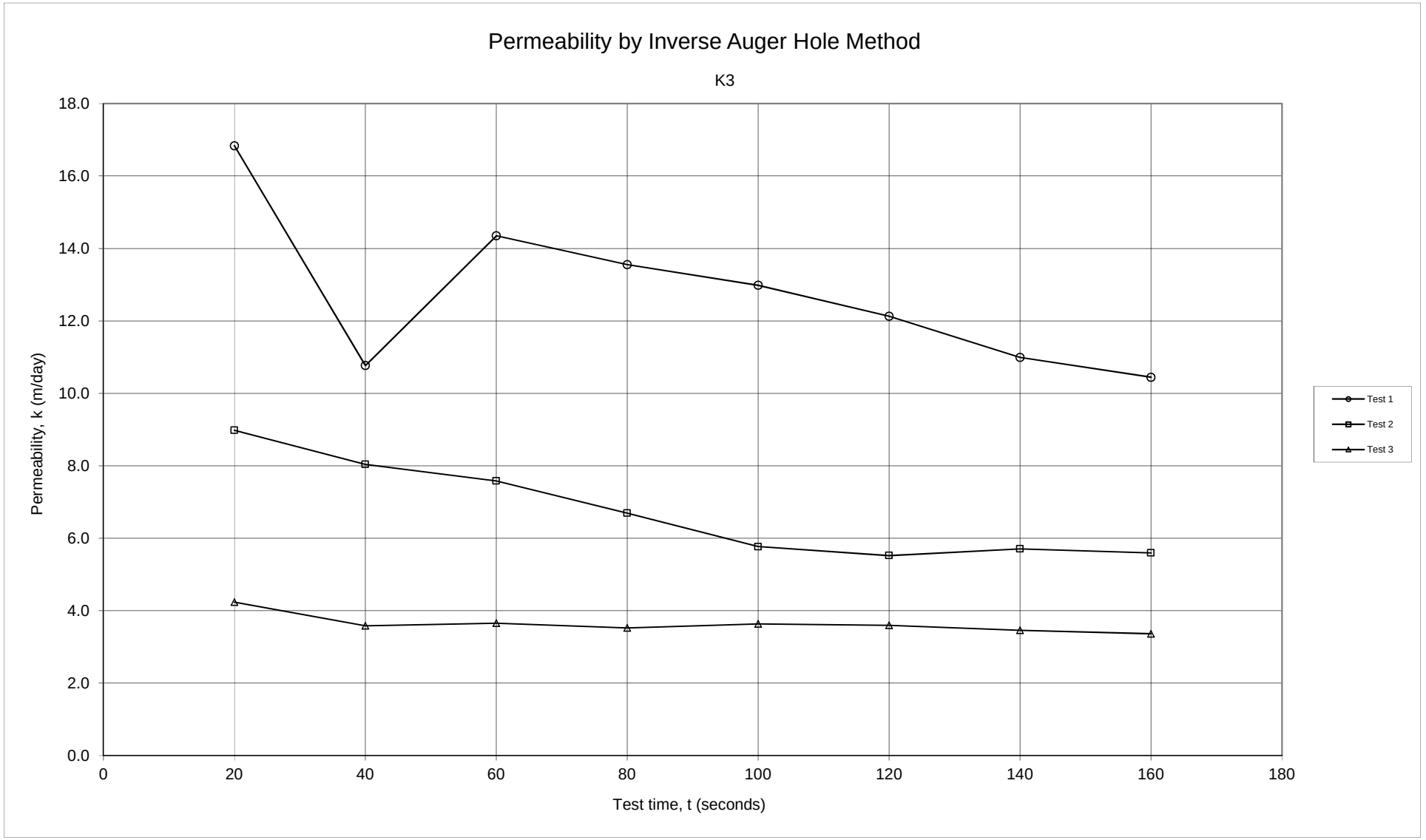
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.52	0.48		
20	0.6	0.4	1.9E-04	16.8
40	0.62	0.38	1.2E-04	10.8
60	0.7	0.3	1.7E-04	14.4
80	0.735	0.265	1.6E-04	13.6
100	0.765	0.235	1.5E-04	13.0
120	0.785	0.215	1.4E-04	12.1
140	0.795	0.205	1.3E-04	11.0
160	0.81	0.19	1.2E-04	10.4
		AVERAGE	1.5E-04	12.8

Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.4	0.6		
20	0.455	0.545	1.0E-04	9.0
40	0.495	0.505	9.3E-05	8.0
60	0.53	0.47	8.8E-05	7.6
80	0.55	0.45	7.7E-05	6.7
100	0.56	0.44	6.7E-05	5.8
120	0.58	0.42	6.4E-05	5.5
140	0.61	0.39	6.6E-05	5.7
160	0.63	0.37	6.5E-05	5.6
		AVERAGE	7.8E-05	6.7

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.32	0.68		
20	0.35	0.65	4.9E-05	4.2
40	0.37	0.63	4.1E-05	3.6
60	0.395	0.605	4.2E-05	3.7
80	0.415	0.585	4.1E-05	3.5
100	0.44	0.56	4.2E-05	3.6
120	0.46	0.54	4.2E-05	3.6
140	0.475	0.525	4.0E-05	3.5
160	0.49	0.51	3.9E-05	3.4
		AVERAGE	4.2E-05	3.6


Permeability by Inverse Auger Hole Method
K3
Permeability, k (m/day)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
20
40
60
80
100
120
140
160
180
Test time, t (seconds)
Test 1
Test 2
Test 3

Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics

Job No:	J1901164
Client:	Mortons.U.S
Project:	Parkland Heights
Location:	Baldivis
Calc by:	HWC
BH Name:	L1
Test Depth:	0.95 m

Spreadsheet author:	ORW	17-Oct-09

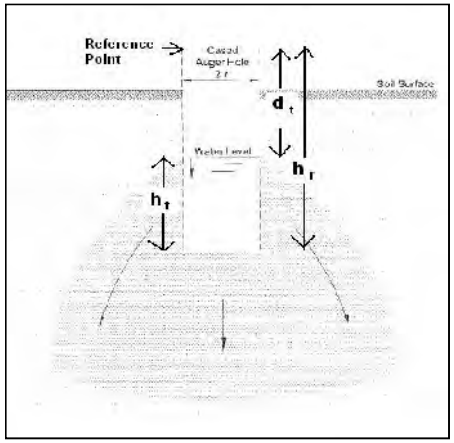
$$K = 1.15r\,\frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

Spreadsheet Legend

	Required input
	Calculated field
	Comment field
	Field not used
	Fixed field

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	0.95	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m



Test 1

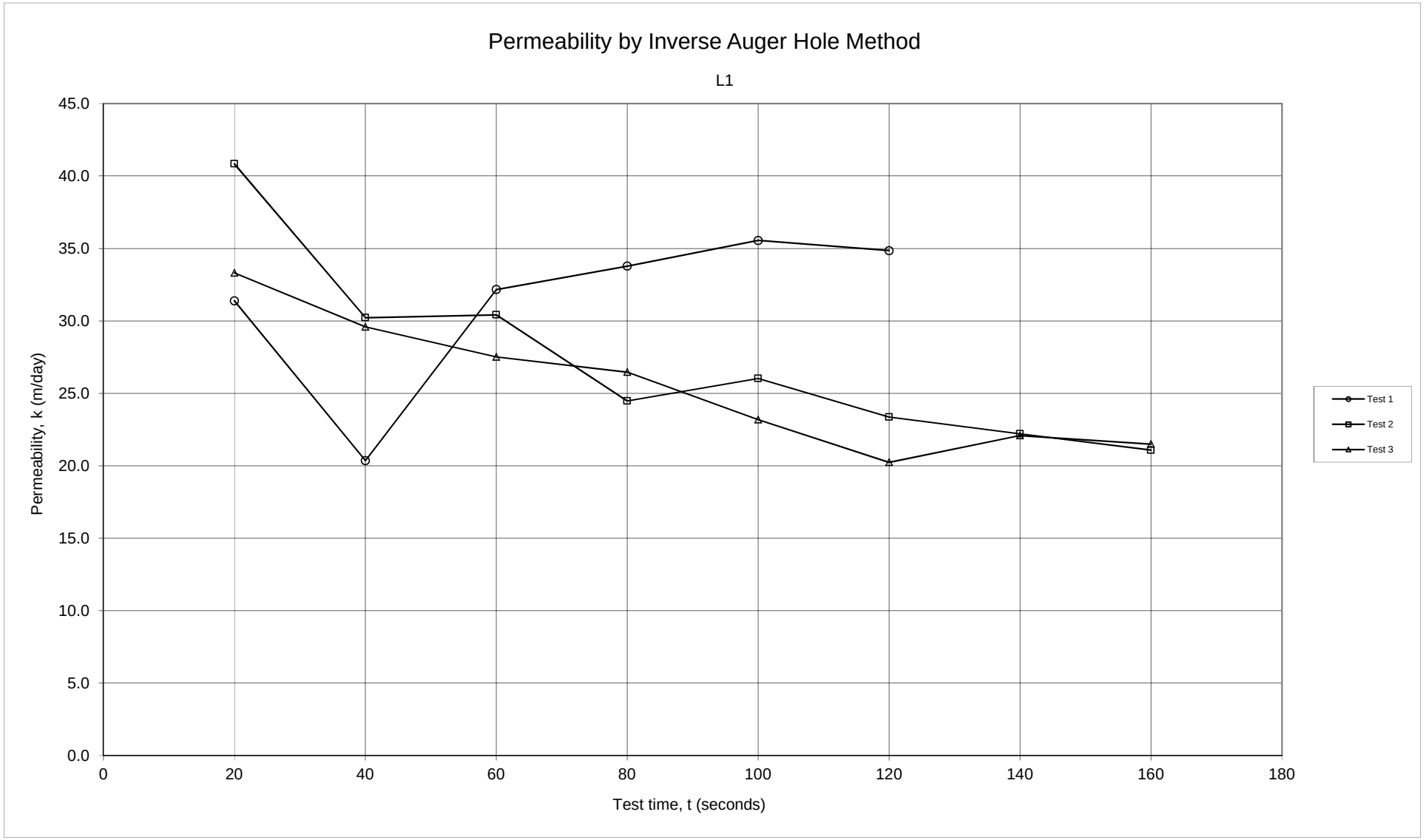
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.52	0.43		
20	0.645	0.305	3.6E-04	31.4
40	0.675	0.275	2.4E-04	20.4
60	0.805	0.145	3.7E-04	32.2
80	0.86	0.09	3.9E-04	33.8
100	0.9	0.05	4.1E-04	35.6
120	0.92	0.03	4.0E-04	34.9
		AVERAGE	3.6E-04	31.4

Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.39	0.56		
20	0.59	0.36	4.7E-04	40.8
40	0.66	0.29	3.5E-04	30.2
60	0.745	0.205	3.5E-04	30.4
80	0.76	0.19	2.8E-04	24.5
100	0.82	0.13	3.0E-04	26.0
120	0.835	0.115	2.7E-04	23.4
140	0.855	0.095	2.6E-04	22.2
160	0.87	0.08	2.4E-04	21.1
		AVERAGE	3.2E-04	27.3

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.37	0.58		
20	0.545	0.405	3.9E-04	33.3
40	0.645	0.305	3.4E-04	29.6
60	0.715	0.235	3.2E-04	27.5
80	0.77	0.18	3.1E-04	26.5
100	0.79	0.16	2.7E-04	23.2
120	0.8	0.15	2.3E-04	20.2
140	0.85	0.1	2.6E-04	22.1
160	0.87	0.08	2.5E-04	21.5
		AVERAGE	3.0E-04	25.5


Permeability by Inverse Auger Hole Method
L1
Permeability, k (m/day)
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
20
40
60
80
100
120
140
160
180
Test time, t (seconds)
Test 1
Test 2
Test 3

Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics

Job No:	J1901164
Client:	Mortons.U.S
Project:	Parkland Heights
Location:	Baldivis
Calc by:	HWC
BH Name:	L2
Test Depth:	0.89 m

Spreadsheet author:	ORW	17-Oct-09

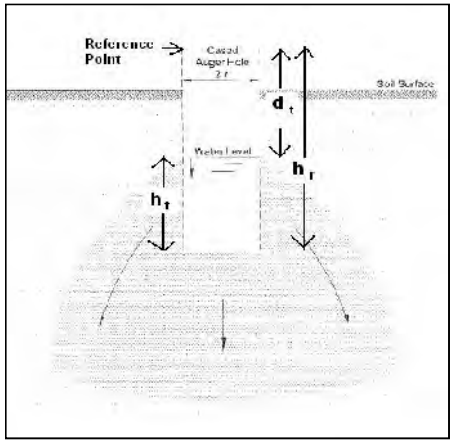
$$K = 1.15r\,\frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

Spreadsheet Legend

	Required input
	Calculated field
	Comment field
	Field not used
	Fixed field

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	0.95	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m



Test 1

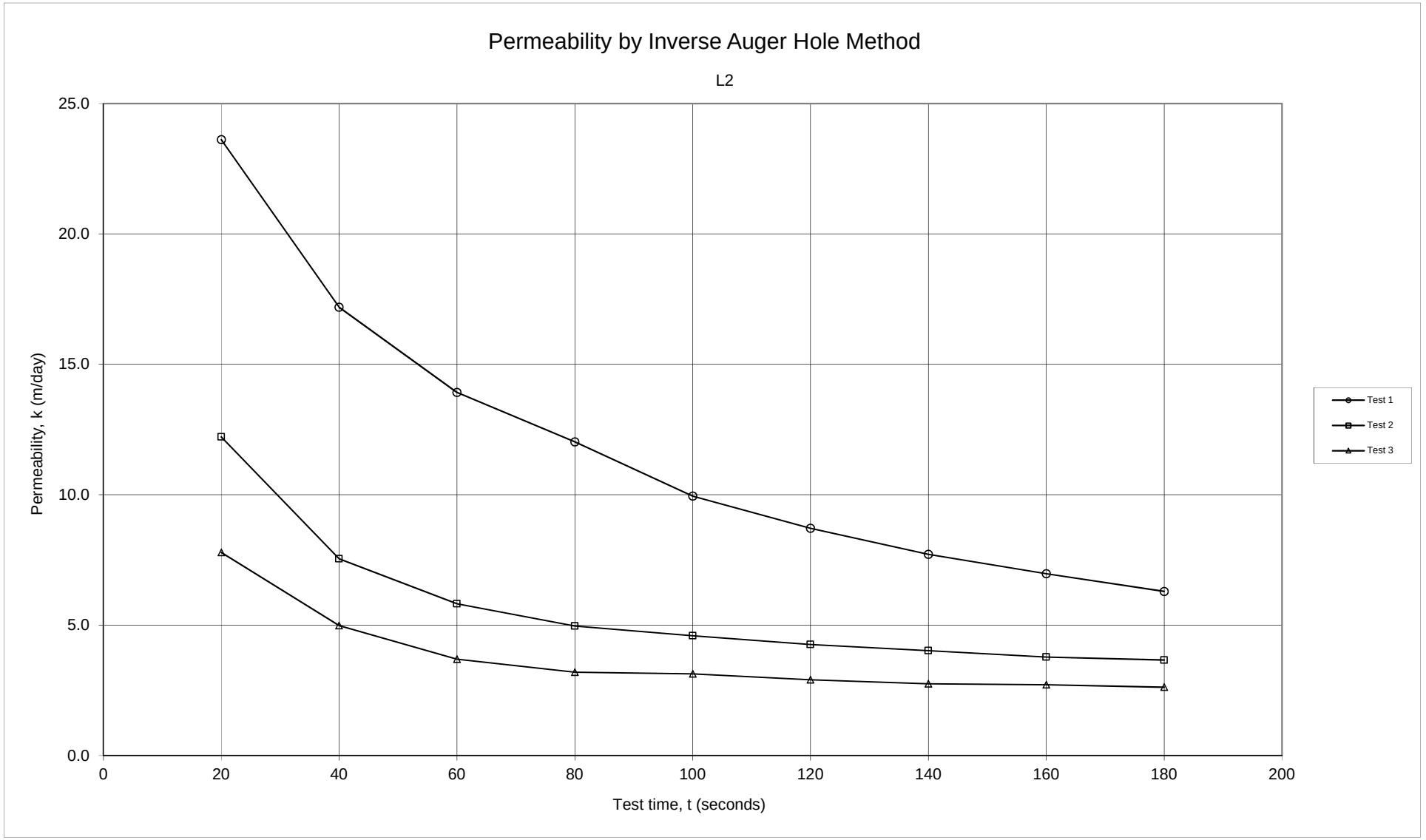
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0	0.95		
20	0.21	0.74	2.7E-04	23.6
40	0.29	0.66	2.0E-04	17.2
60	0.34	0.61	1.6E-04	13.9
80	0.38	0.57	1.4E-04	12.0
100	0.39	0.56	1.2E-04	10.0
120	0.405	0.545	1.0E-04	8.7
140	0.415	0.535	8.9E-05	7.7
160	0.425	0.525	8.1E-05	7.0
180	0.43	0.52	7.3E-05	6.3
		AVERAGE	1.4E-04	11.8

Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0	0.95		
20	0.115	0.835	1.4E-04	12.2
40	0.14	0.81	8.7E-05	7.5
60	0.16	0.79	6.7E-05	5.8
80	0.18	0.77	5.8E-05	5.0
100	0.205	0.745	5.3E-05	4.6
120	0.225	0.725	4.9E-05	4.3
140	0.245	0.705	4.7E-05	4.0
160	0.26	0.69	4.4E-05	3.8
180	0.28	0.67	4.2E-05	3.7
		AVERAGE	6.5E-05	5.7

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0	0.95		
20	0.075	0.875	9.0E-05	7.8
40	0.095	0.855	5.8E-05	5.0
60	0.105	0.845	4.3E-05	3.7
80	0.12	0.83	3.7E-05	3.2
100	0.145	0.805	3.6E-05	3.1
120	0.16	0.79	3.4E-05	2.9
140	0.175	0.775	3.2E-05	2.8
160	0.195	0.755	3.1E-05	2.7
180	0.21	0.74	3.0E-05	2.6
		AVERAGE	4.3E-05	3.8


Permeability by Inverse Auger Hole Method
L2
Permeability, k (m/day)
25.0
20.0
15.0
10.0
5.0
0.0
0
20
40
60
80
100
120
140
160
180
200
Test time, t (seconds)
Test 1
Test 2
Test 3

Permeability Calculation - Inverse Auger Hole Method

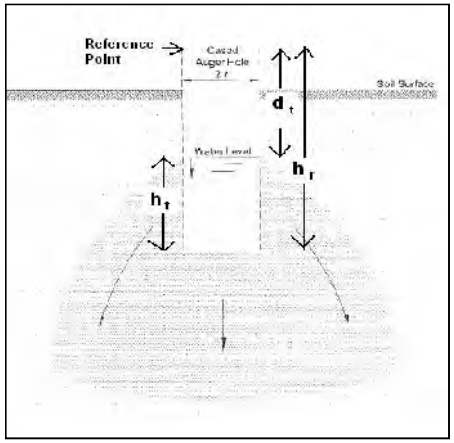
Galt Geotechnics

Spreadsheet author:	ORW	17-Oct-09

Job No:	J1901164
Client:	Mortons.U.S
Project:	Parkland Heights
Location:	Baldivis
Calc by:	HWC
BH Name:	L3
Test Depth:	0.85 m

$$K = 1.15r\,\frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114



Spreadsheet Legend

	Required input
	Calculated field
	Comment field
	Field not used
	Fixed field

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	0.95	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m

Test 1

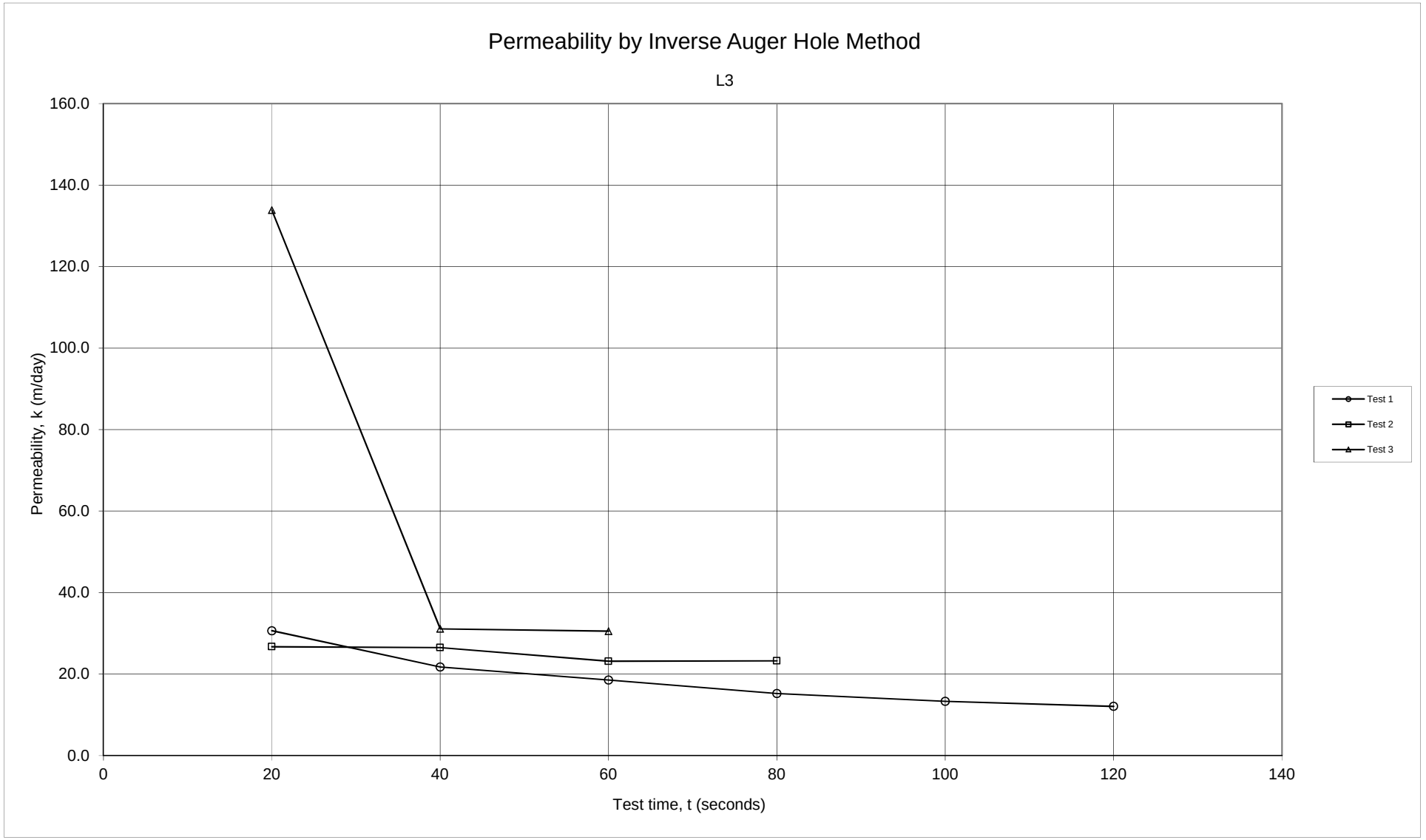
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.64	0.31		
20	0.73	0.22	3.5E-04	30.6
40	0.76	0.19	2.5E-04	21.7
60	0.785	0.165	2.1E-04	18.5
80	0.795	0.155	1.8E-04	15.2
100	0.805	0.145	1.5E-04	13.3
120	0.815	0.135	1.4E-04	12.1
		AVERAGE	2.2E-04	18.6

Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.64	0.31		
20	0.72	0.23	3.1E-04	26.7
40	0.78	0.17	3.1E-04	26.5
60	0.81	0.14	2.7E-04	23.2
80	0.845	0.105	2.7E-04	23.3
		AVERAGE	2.9E-04	24.9

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.645	0.305		
20	0.89	0.06	1.5E-03	133.9
40	0.8	0.15	3.6E-04	31.1
60	0.845	0.105	3.5E-04	30.5
		AVERAGE	7.5E-04	65.2


Permeability by Inverse Auger Hole Method
L3
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Permeability, k (m/day)
0
20
40
60
80
100
120
140
Test time, t (seconds)
Test 1
Test 2
Test 3

Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics

Job No:	J1901164
Client:	Mortons.U.S
Project:	Parkland Heights
Location:	Baldivis
Calc by:	HWC
BH Name:	M1
Test Depth:	0.90 m

Spreadsheet author:	ORW	17-Oct-09

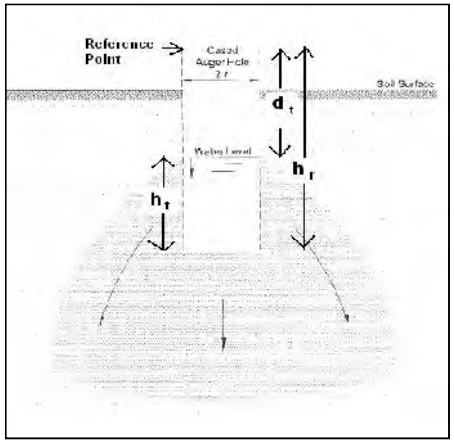
$$K = 1.15r\,\frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

Spreadsheet Legend

	Required input
	Calculated field
	Comment field
	Field not used
	Fixed field

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	1	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m



Test 1

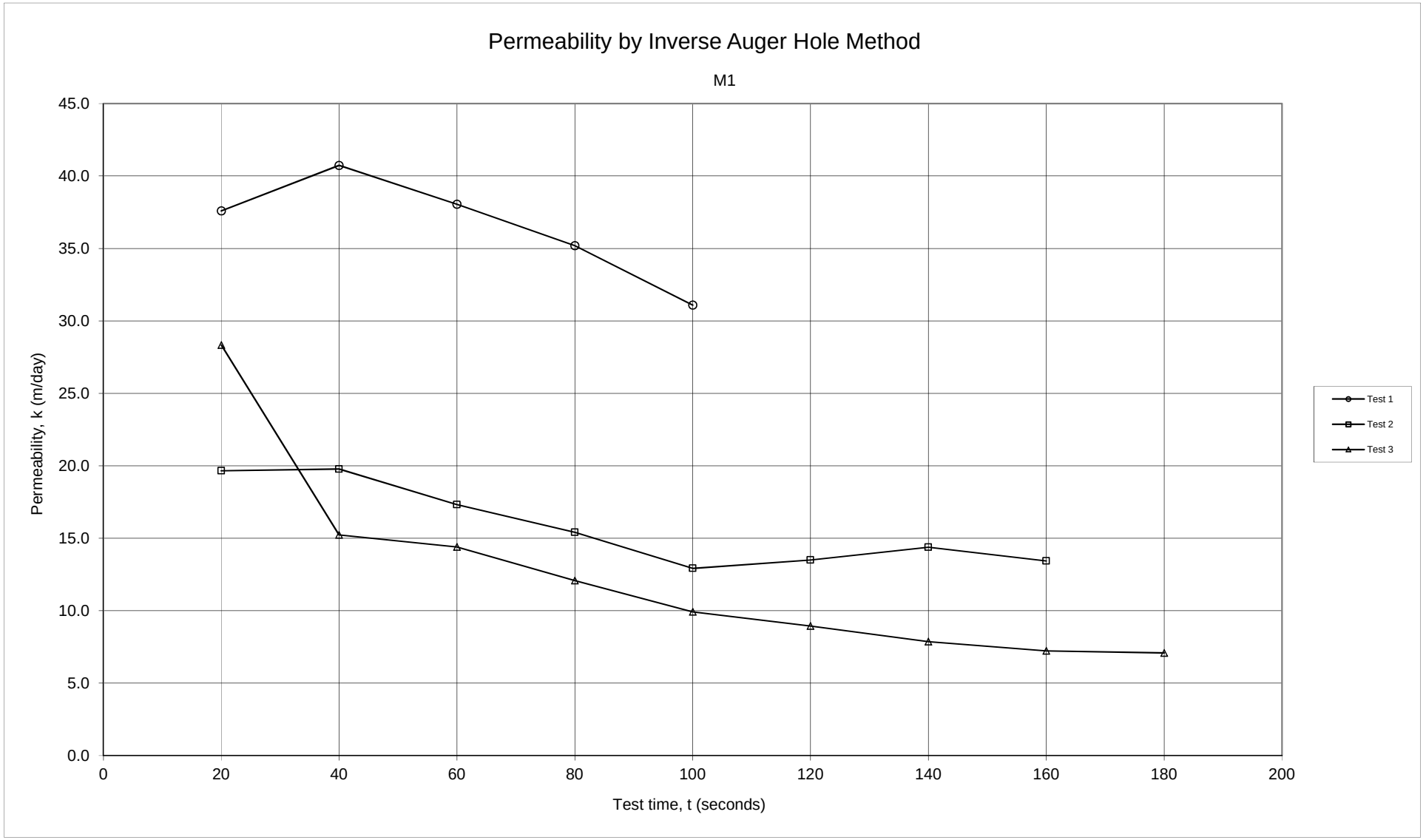
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.415	0.585		
20	0.61	0.39	4.4E-04	37.6
40	0.76	0.24	4.7E-04	40.7
60	0.835	0.165	4.4E-04	38.0
80	0.88	0.12	4.1E-04	35.2
100	0.9	0.1	3.6E-04	31.1
		AVERAGE	4.2E-04	36.5

Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.395	0.605		
20	0.51	0.49	2.3E-04	19.7
40	0.605	0.395	2.3E-04	19.8
60	0.655	0.345	2.0E-04	17.3
80	0.69	0.31	1.8E-04	15.4
100	0.7	0.3	1.5E-04	12.9
120	0.75	0.25	1.6E-04	13.5
140	0.8	0.2	1.7E-04	14.4
160	0.815	0.185	1.6E-04	13.4
		AVERAGE	1.8E-04	15.8

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.41	0.59		
20	0.565	0.435	3.3E-04	28.3
40	0.575	0.425	1.8E-04	15.2
60	0.63	0.37	1.7E-04	14.4
80	0.65	0.35	1.4E-04	12.1
100	0.655	0.345	1.1E-04	9.9
120	0.67	0.33	1.0E-04	8.9
140	0.675	0.325	9.1E-05	7.9
160	0.685	0.315	8.4E-05	7.2
180	0.705	0.295	8.2E-05	7.1
		AVERAGE	1.4E-04	12.3


Permeability by Inverse Auger Hole Method
M1
Permeability, k (m/day)
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
20
40
60
80
100
120
140
160
180
200
Test time, t (seconds)
Test 1
Test 2
Test 3

Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics

Job No:	J1901164
Client:	Mortons.U.S
Project:	Parkland Heights
Location:	Baldivis
Calc by:	HWC
BH Name:	M2
Test Depth:	0.90 m

Spreadsheet author:	ORW	17-Oct-09

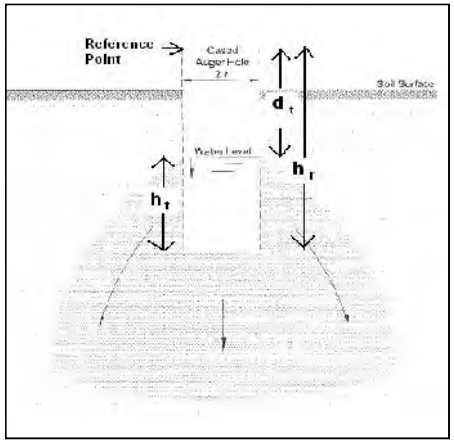
$$K = 1.15r\,\frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

Spreadsheet Legend

	Required input
	Calculated field
	Comment field
	Field not used
	Fixed field

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	1	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m



Test 1

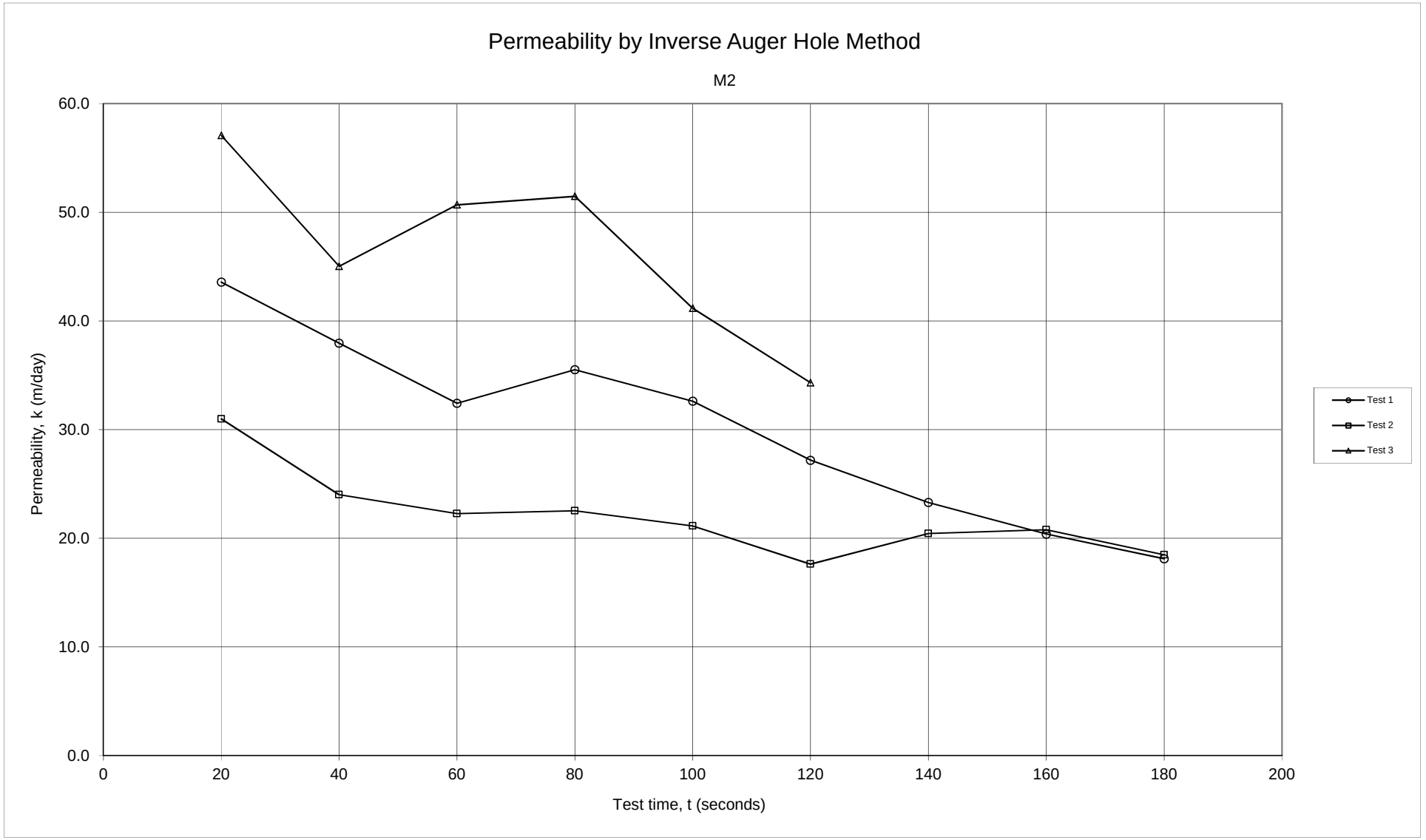
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.58	0.42		
20	0.74	0.26	5.0E-04	43.6
40	0.82	0.18	4.4E-04	37.9
60	0.86	0.14	3.8E-04	32.4
80	0.92	0.08	4.1E-04	35.5
100	0.94	0.06	3.8E-04	32.6
120	0.94	0.06	3.1E-04	27.2
140	0.94	0.06	2.7E-04	23.3
160	0.94	0.06	2.4E-04	20.4
180	0.94	0.06	2.1E-04	18.1
		AVERAGE	3.5E-04	30.1

Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.51	0.49		
20	0.65	0.35	3.6E-04	31.0
40	0.71	0.29	2.8E-04	24.0
60	0.765	0.235	2.6E-04	22.3
80	0.82	0.18	2.6E-04	22.5
100	0.85	0.15	2.4E-04	21.1
120	0.85	0.15	2.0E-04	17.6
140	0.905	0.095	2.4E-04	20.4
160	0.93	0.07	2.4E-04	20.8
180	0.93	0.07	2.1E-04	18.5
		AVERAGE	2.5E-04	22.0

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.46	0.54		
20	0.71	0.29	6.6E-04	57.1
40	0.8	0.2	5.2E-04	45.0
60	0.905	0.095	5.9E-04	50.7
80	0.955	0.045	6.0E-04	51.5
100	0.955	0.045	4.8E-04	41.2
120	0.955	0.045	4.0E-04	34.3
		AVERAGE	5.4E-04	46.6


Permeability by Inverse Auger Hole Method
M2
Permeability, k (m/day)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0
20
40
60
80
100
120
140
160
180
200
Test time, t (seconds)
Test 1
Test 2
Test 3

Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics

Job No:	J1901164
Client:	Mortons.U.S
Project:	Parkland Heights
Location:	Baldivis
Calc by:	HWC
BH Name:	M3
Test Depth:	0.90 m

Spreadsheet author:	ORW	17-Oct-09

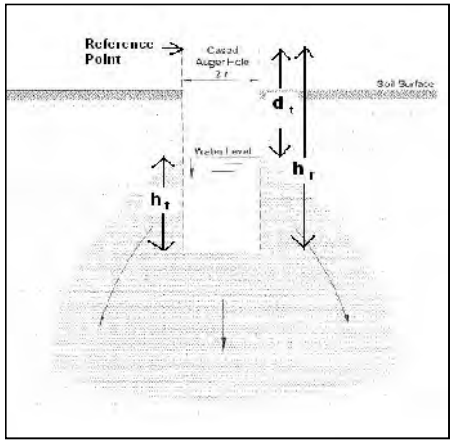
$$K = 1.15r\,\frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

Spreadsheet Legend

	Required input
	Calculated field
	Comment field
	Field not used
	Fixed field

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	1	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m



Test 1

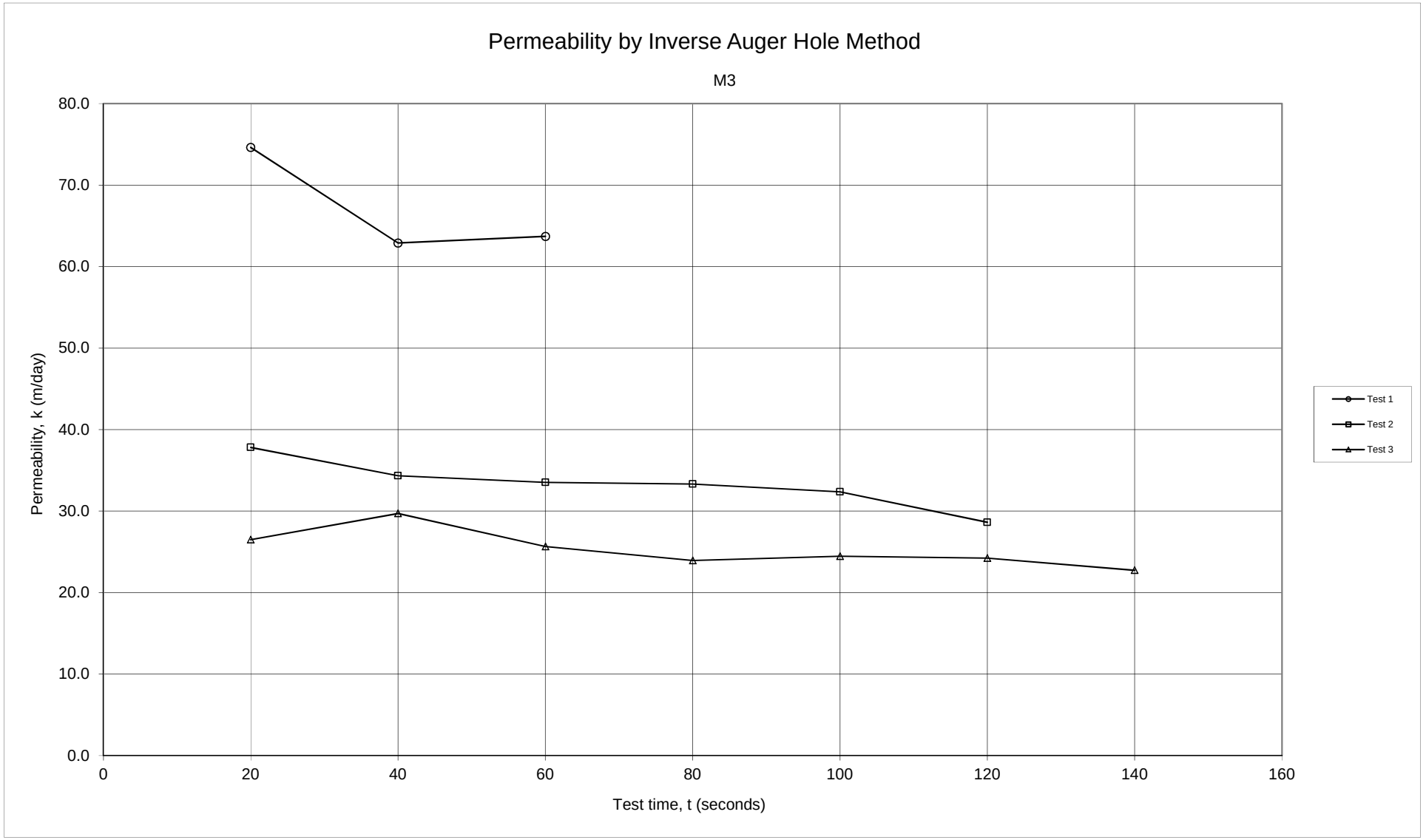
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.575	0.425		
20	0.815	0.185	8.6E-04	74.6
40	0.9	0.1	7.3E-04	62.9
60	0.96	0.04	7.4E-04	63.7
		AVERAGE	7.8E-04	67.1

Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.48	0.52		
20	0.655	0.345	4.4E-04	37.8
40	0.755	0.245	4.0E-04	34.3
60	0.83	0.17	3.9E-04	33.5
80	0.885	0.115	3.9E-04	33.3
100	0.92	0.08	3.7E-04	32.4
120	0.93	0.07	3.3E-04	28.6
		AVERAGE	3.9E-04	33.3

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.52	0.48		
20	0.64	0.36	3.1E-04	26.5
40	0.75	0.25	3.4E-04	29.7
60	0.795	0.205	3.0E-04	25.6
80	0.835	0.165	2.8E-04	23.9
100	0.88	0.12	2.8E-04	24.5
120	0.91	0.09	2.8E-04	24.2
140	0.925	0.075	2.6E-04	22.7
		AVERAGE	2.9E-04	25.3


Permeability by Inverse Auger Hole Method
M3
Permeability, k (m/day)
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0
20
40
60
80
100
120
140
160
Test time, t (seconds)
Test 1
Test 2
Test 3

Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics

Job No:	J1901164
Client:	Mortons.U.S
Project:	Parkland Heights
Location:	Baldivis
Calc by:	HWC
BH Name:	N1
Test Depth:	0.90 m

Spreadsheet author:	ORW	17-Oct-09

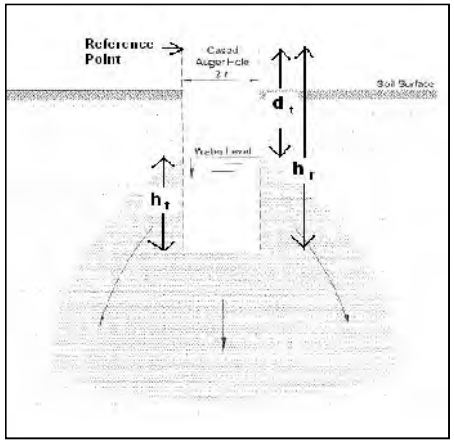
$$K = 1.15r\,\frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

Spreadsheet Legend

	Required input
	Calculated field
	Comment field
	Field not used
	Fixed field

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	1	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m



Test 1

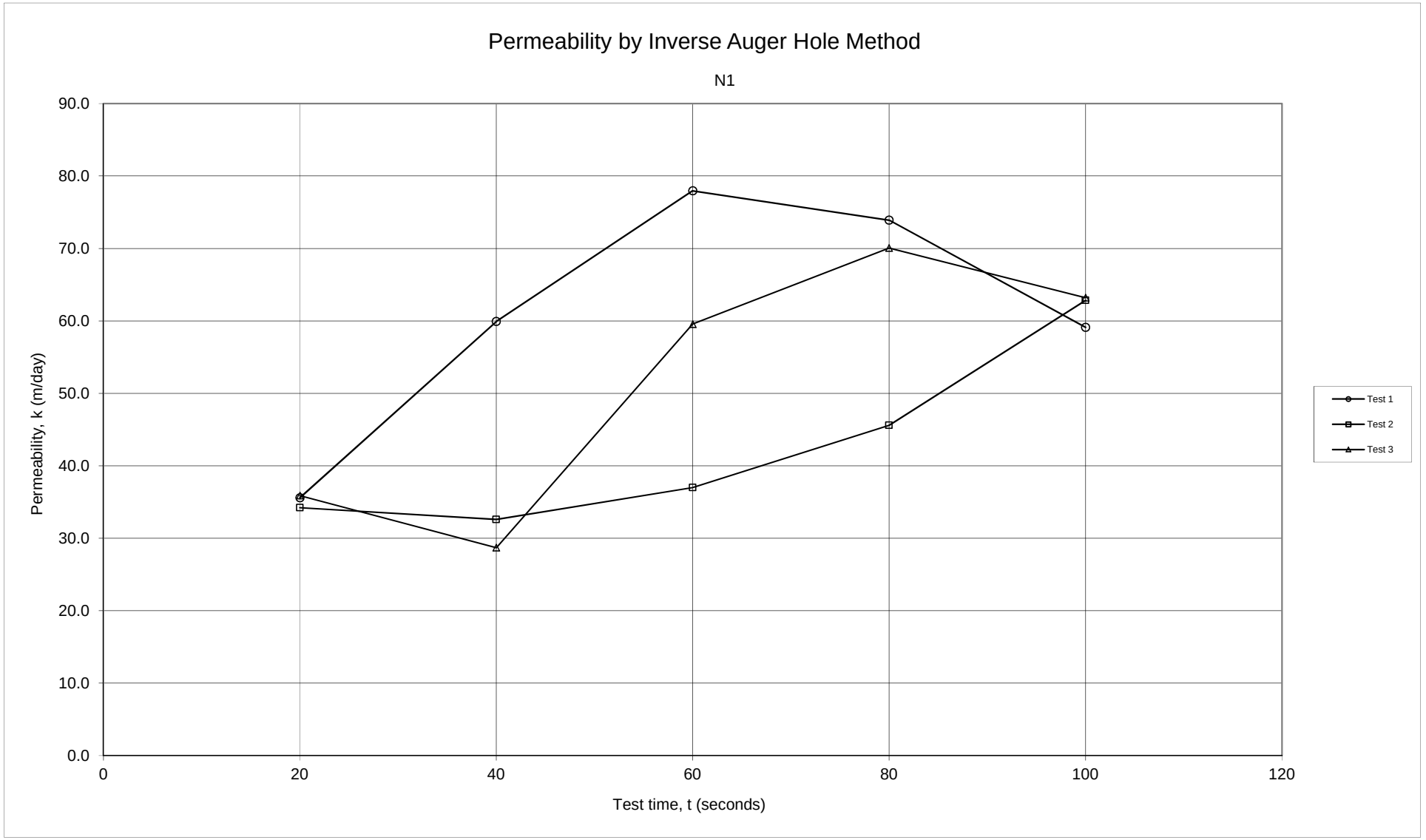
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.55	0.45		
20	0.695	0.305	4.1E-04	35.6
40	0.885	0.115	6.9E-04	59.9
60	0.98	0.02	9.0E-04	77.9
80	1	0	8.6E-04	73.9
100	1	0	6.8E-04	59.1
		AVERAGE	7.1E-04	61.3

Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.45	0.55		
20	0.62	0.38	4.0E-04	34.2
40	0.73	0.27	3.8E-04	32.6
60	0.84	0.16	4.3E-04	37.0
80	0.935	0.065	5.3E-04	45.6
100	1	0	7.3E-04	62.8
		AVERAGE	4.9E-04	42.4

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.44	0.56		
20	0.62	0.38	4.2E-04	35.9
40	0.7	0.3	3.3E-04	28.7
60	0.93	0.07	6.9E-04	59.6
80	0.99	0.01	8.1E-04	70.1
100	1	0	7.3E-04	63.2
		AVERAGE	6.0E-04	51.5


Permeability by Inverse Auger Hole Method
N1
Permeability, k (m/day)
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0
20
40
60
80
100
120
Test time, t (seconds)
Test 1
Test 2
Test 3

Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics

Job No:	J1901164
Client:	Mortons.U.S
Project:	Parkland Heights
Location:	Baldivis
Calc by:	HWC
BH Name:	N2
Test Depth:	0.90 m

Spreadsheet author:	ORW	17-Oct-09

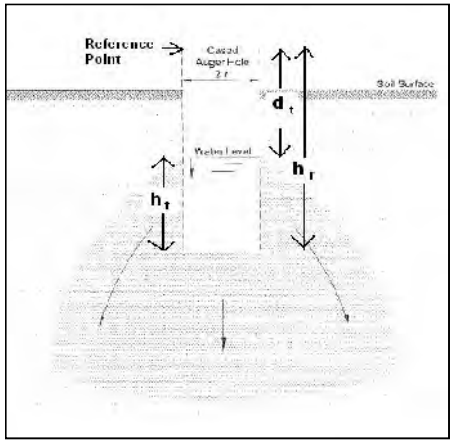
$$K = 1.15r\,\frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

Spreadsheet Legend

	Required input
	Calculated field
	Comment field
	Field not used
	Fixed field

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	1	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m



Test 1

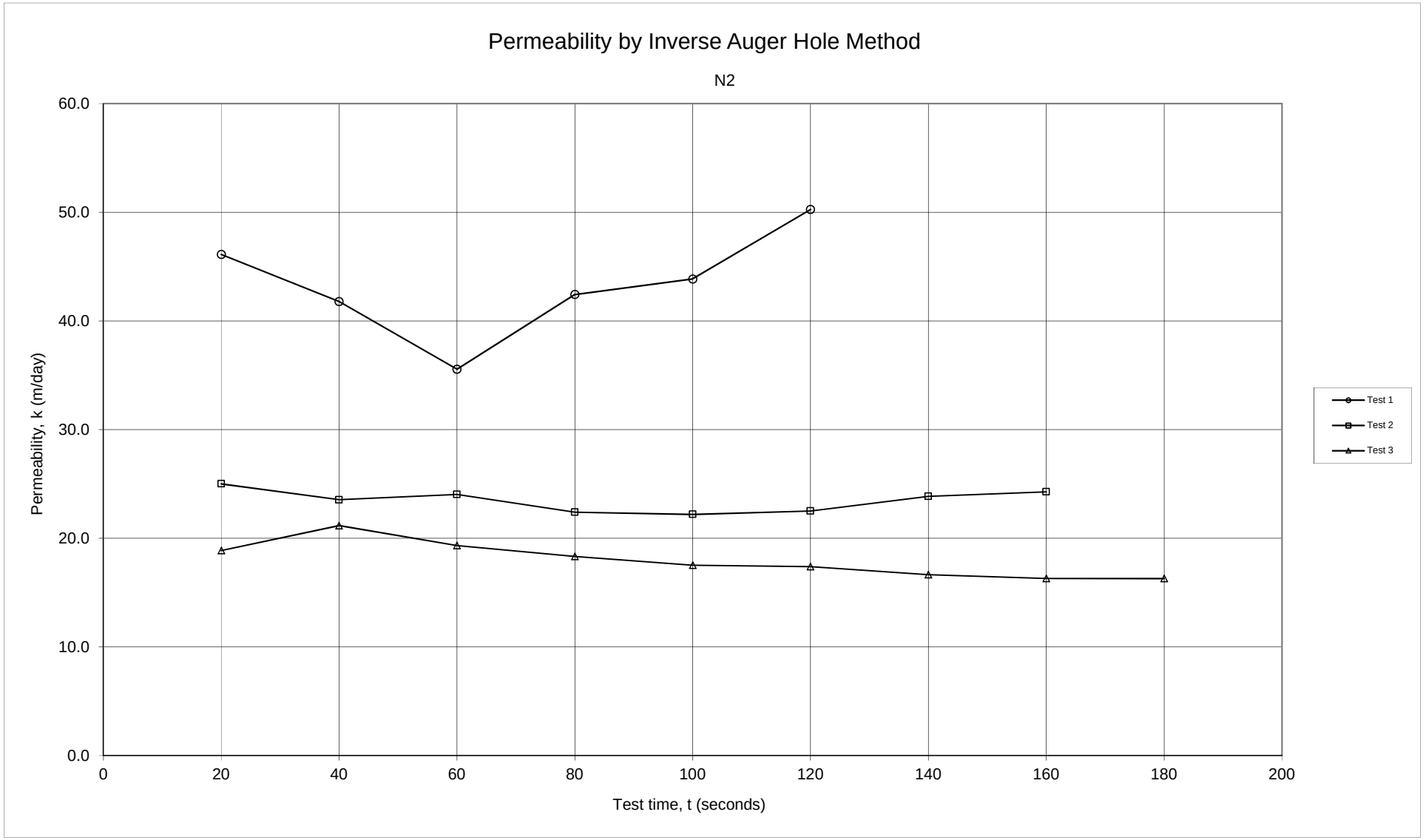
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.52	0.48		
20	0.71	0.29	5.3E-04	46.1
40	0.81	0.19	4.8E-04	41.8
60	0.855	0.145	4.1E-04	35.6
80	0.935	0.065	4.9E-04	42.4
100	0.97	0.03	5.1E-04	43.9
120	1	0	5.8E-04	50.3
		AVERAGE	5.0E-04	43.3

Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.45	0.55		
20	0.58	0.42	2.9E-04	25.0
40	0.67	0.33	2.7E-04	23.5
60	0.75	0.25	2.8E-04	24.0
80	0.795	0.205	2.6E-04	22.4
100	0.84	0.16	2.6E-04	22.2
120	0.88	0.12	2.6E-04	22.5
140	0.92	0.08	2.8E-04	23.9
160	0.945	0.055	2.8E-04	24.3
		AVERAGE	2.7E-04	23.5

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.4	0.6		
20	0.51	0.49	2.2E-04	18.9
40	0.62	0.38	2.5E-04	21.2
60	0.68	0.32	2.2E-04	19.3
80	0.73	0.27	2.1E-04	18.3
100	0.77	0.23	2.0E-04	17.5
120	0.81	0.19	2.0E-04	17.4
140	0.835	0.165	1.9E-04	16.6
160	0.86	0.14	1.9E-04	16.3
180	0.885	0.115	1.9E-04	16.3
		AVERAGE	2.1E-04	18.0


Permeability by Inverse Auger Hole Method
N2
Permeability, k (m/day)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0
20
40
60
80
100
120
140
160
180
200
Test time, t (seconds)
Test 1
Test 2
Test 3

Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics

Job No:	J1901164
Client:	Mortons.U.S
Project:	Parkland Heights
Location:	Baldivis
Calc by:	HWC
BH Name:	N3
Test Depth:	0.90 m

Spreadsheet author:	ORW	17-Oct-09

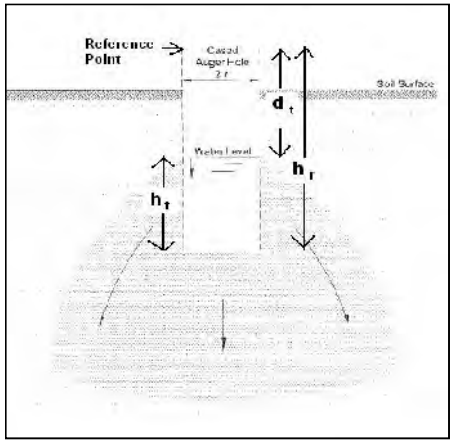
$$K = 1.15r\,\frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

Spreadsheet Legend

	Required input
	Calculated field
	Comment field
	Field not used
	Fixed field

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	1	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m



Test 1

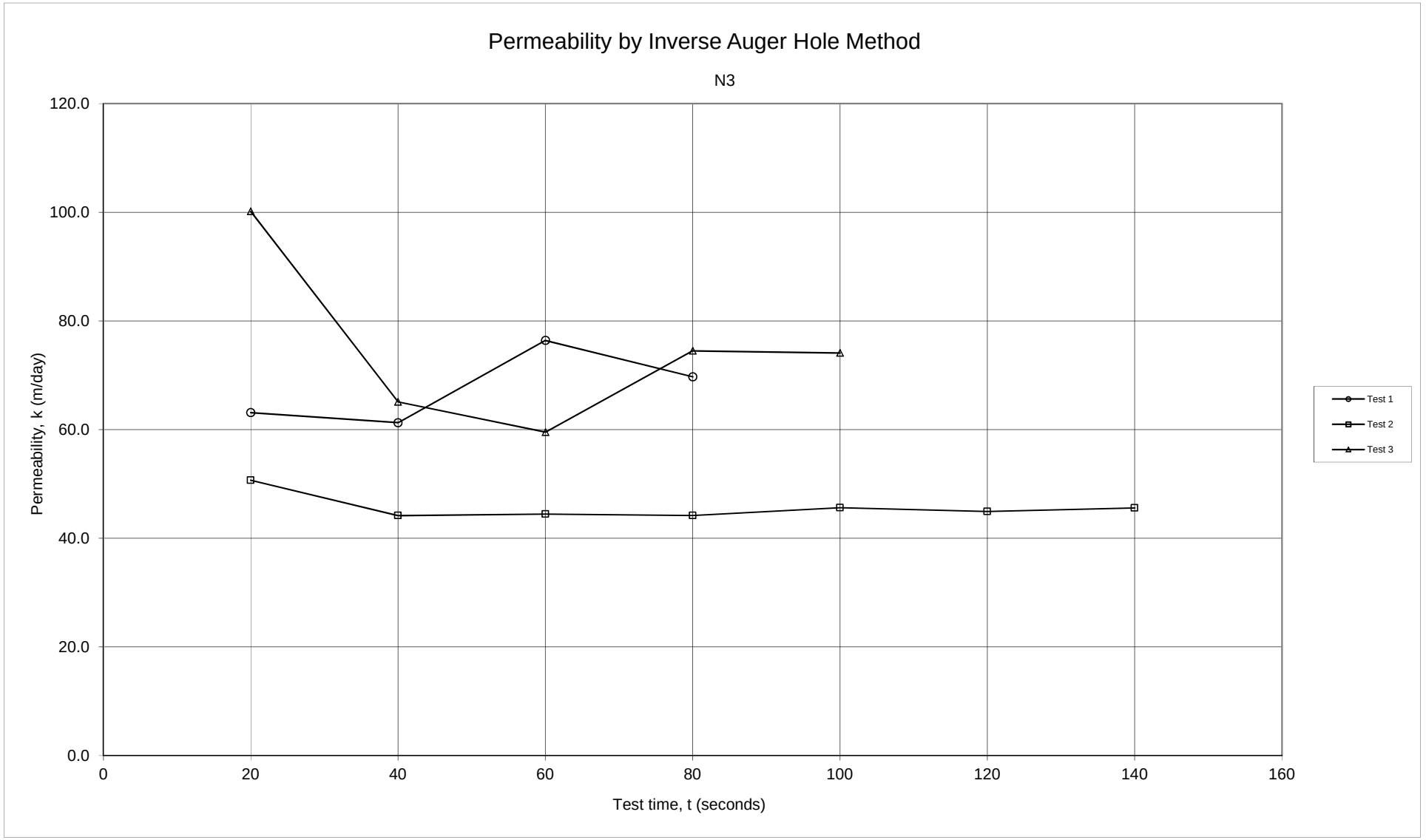
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.625	0.375		
20	0.815	0.185	7.3E-04	63.1
40	0.91	0.09	7.1E-04	61.3
60	0.985	0.015	8.8E-04	76.4
80	1	0	8.1E-04	69.7
		AVERAGE	7.8E-04	67.6

Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.42	0.58		
20	0.665	0.335	5.9E-04	50.7
40	0.78	0.22	5.1E-04	44.2
60	0.87	0.13	5.1E-04	44.5
80	0.925	0.075	5.1E-04	44.2
100	0.965	0.035	5.3E-04	45.6
120	0.985	0.015	5.2E-04	44.9
140	1	0	5.3E-04	45.6
		AVERAGE	5.3E-04	45.7

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0	1		
20	0.658	0.342	1.2E-03	100.1
40	0.755	0.245	7.5E-04	65.1
60	0.86	0.14	6.9E-04	59.5
80	0.975	0.025	8.6E-04	74.5
100	1	0	8.6E-04	74.1
		AVERAGE	8.6E-04	74.7


Permeability by Inverse Auger Hole Method
N3
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Permeability, k (m/day)
0
20
40
60
80
100
120
140
160
Test time, t (seconds)
Test 1
Test 2
Test 3

Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics

Job No:	J1901164
Client:	Mortons.U.S
Project:	Parkland Heights
Location:	Baldivis
Calc by:	HWC
BH Name:	IT1
Test Depth:	0.95 m

Spreadsheet author:	ORW	17-Oct-09

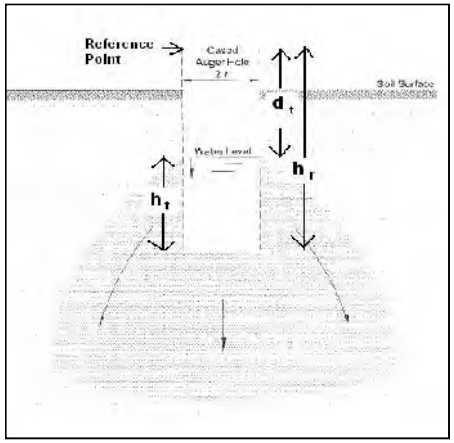
$$K = 1.15r\,\frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

Spreadsheet Legend

	Required input
	Calculated field
	Comment field
	Field not used
	Fixed field

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	0.95	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m



Test 1

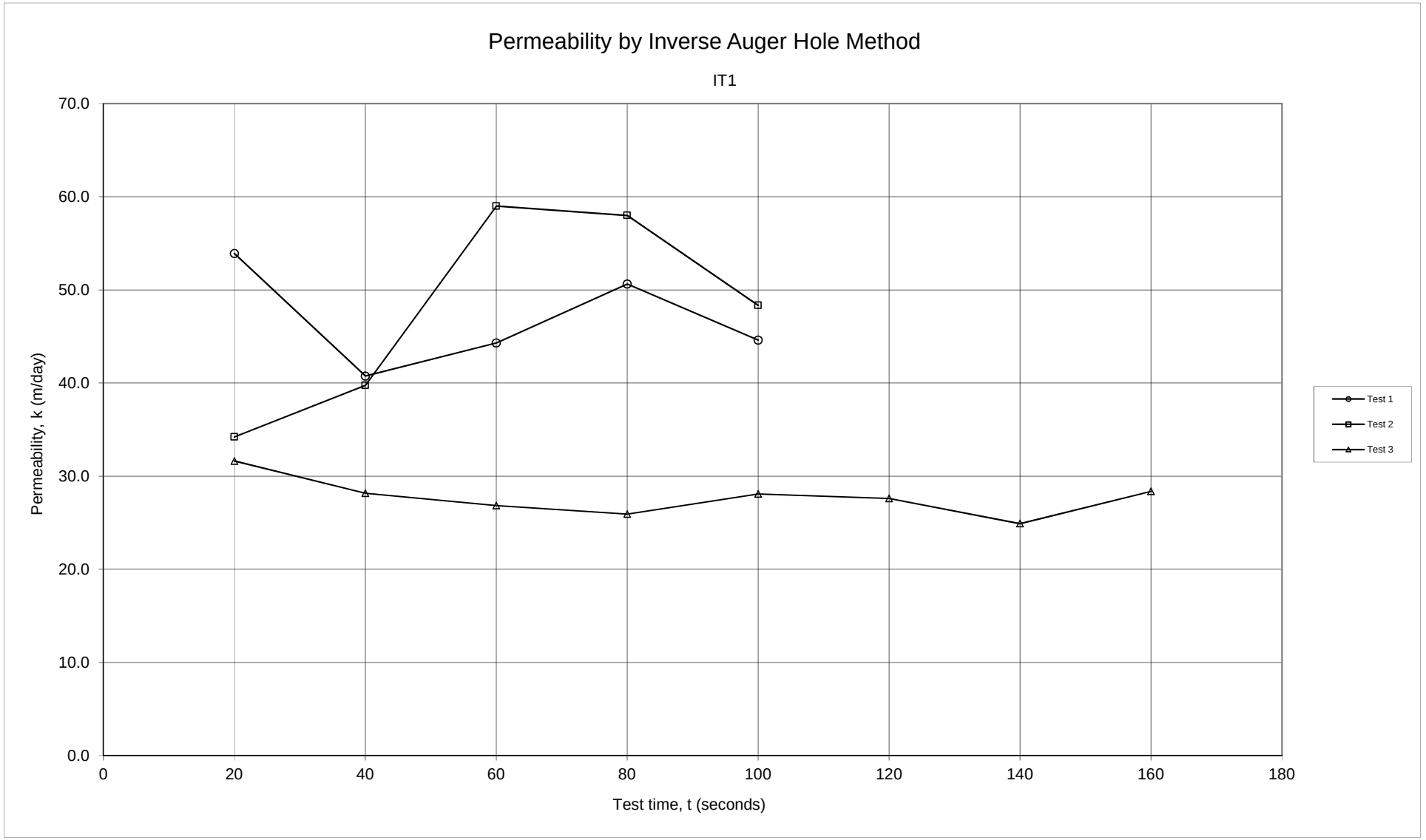
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.55	0.4		
20	0.73	0.22	6.2E-04	53.9
40	0.79	0.16	4.7E-04	40.8
60	0.865	0.085	5.1E-04	44.3
80	0.92	0.03	5.9E-04	50.6
100	0.93	0.02	5.2E-04	44.6
		AVERAGE	5.4E-04	46.8

Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.4	0.55		
20	0.57	0.38	4.0E-04	34.2
40	0.72	0.23	4.6E-04	39.7
60	0.88	0.07	6.8E-04	59.0
80	0.92	0.03	6.7E-04	58.0
100	0.925	0.025	5.6E-04	48.3
		AVERAGE	5.5E-04	47.9

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.325	0.625		
20	0.505	0.445	3.7E-04	31.6
40	0.61	0.34	3.3E-04	28.2
60	0.69	0.26	3.1E-04	26.8
80	0.75	0.2	3.0E-04	25.9
100	0.82	0.13	3.2E-04	28.1
120	0.855	0.095	3.2E-04	27.6
140	0.865	0.085	2.9E-04	24.9
160	0.91	0.04	3.3E-04	28.4
		AVERAGE	3.2E-04	27.7


Permeability by Inverse Auger Hole Method
IT1
Permeability, k (m/day)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0
20
40
60
80
100
120
140
160
180
Test time, t (seconds)
Test 1
Test 2
Test 3

Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics

Job No:	J1901164
Client:	Mortons.U.S
Project:	Parkland Heights
Location:	Baldivis
Calc by:	HWC
BH Name:	IT2
Test Depth:	0.95 m

Spreadsheet author:	ORW	17-Oct-09

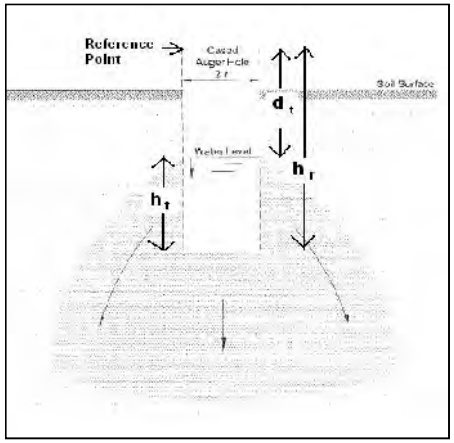
$$K = 1.15r \frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

Spreadsheet Legend

	Required input
	Calculated field
	Comment field
	Field not used
	Fixed field

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	0.95	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m



Test 1

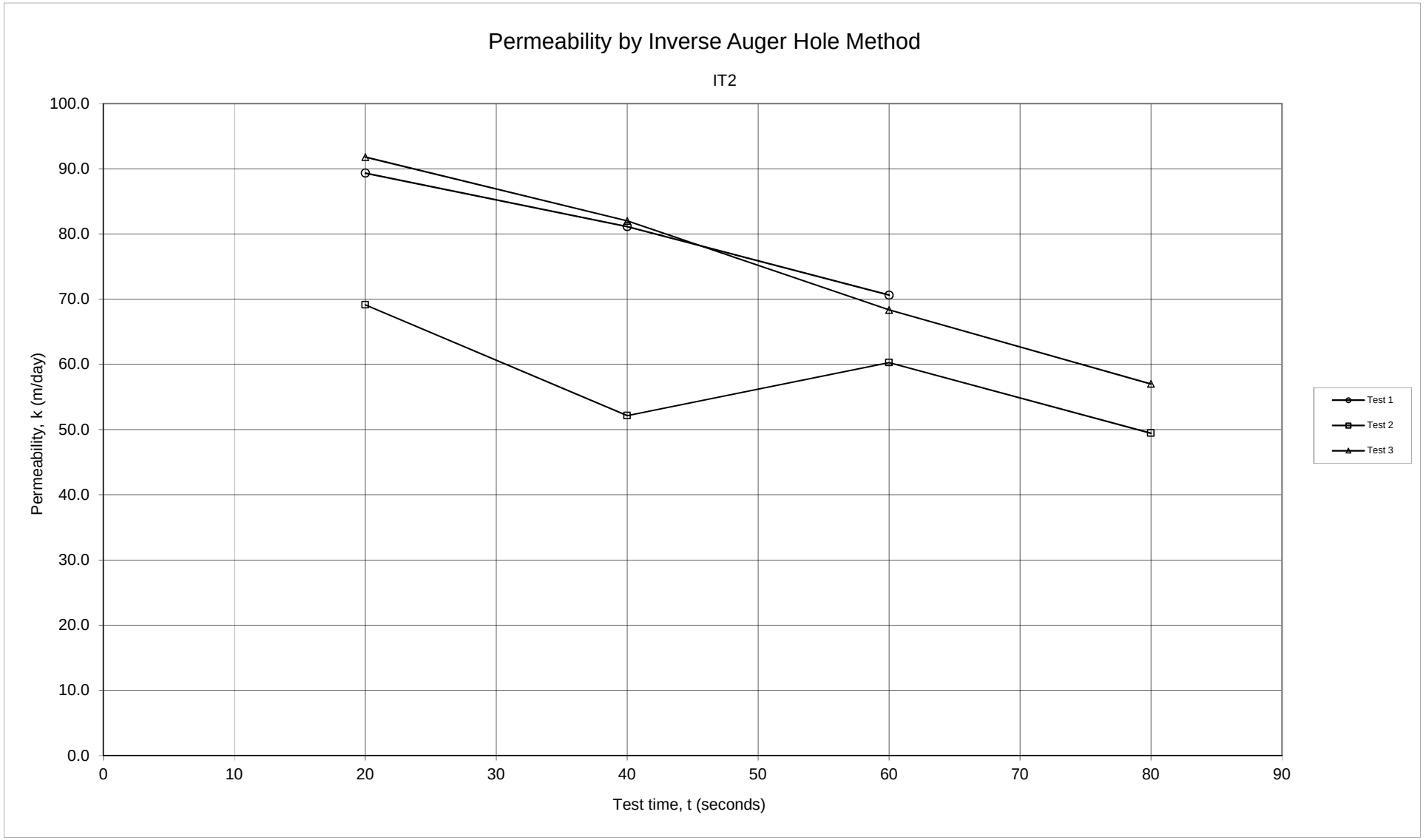
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.64	0.31		
20	0.84	0.11	1.0E-03	89.3
40	0.91	0.04	9.4E-04	81.1
60	0.935	0.015	8.2E-04	70.6
		AVERAGE	9.3E-04	80.4

Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.57	0.38		
20	0.775	0.175	8.0E-04	69.1
40	0.835	0.115	6.0E-04	52.1
60	0.91	0.04	7.0E-04	60.3
80	0.92	0.03	5.7E-04	49.4
		AVERAGE	6.7E-04	57.7

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.58	0.37		
20	0.82	0.13	1.1E-03	91.8
40	0.9	0.05	9.5E-04	82.0
60	0.925	0.025	7.9E-04	68.3
80	0.935	0.015	6.6E-04	57.0
		AVERAGE	8.7E-04	74.8


Permeability by Inverse Auger Hole Method
IT2
Permeability, k (m/day)
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0
10
20
30
40
50
60
70
80
90
Test time, t (seconds)
Test 1
Test 2
Test 3

Permeability Calculation - Inverse Auger Hole Method

Galt Geotechnics

Job No:	J1901164
Client:	Mortons.U.S
Project:	Parkland Heights
Location:	Baldivis
Calc by:	HWC
BH Name:	IT3
Test Depth:	0.95 m

Spreadsheet author:	ORW	17-Oct-09

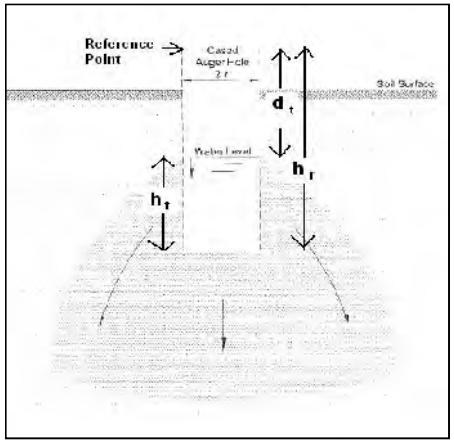
$$K = 1.15r\,\frac{\log_{10}(h_0 + \frac{1}{2}r) - \log_{10}(h_t + \frac{1}{2}r)}{t - t_0}$$

REFERENCE: Cocks, G. *Disposal of Stormwater Runoff by Soakage in Perth Western Australia*, Journal and News of the Australian Geomechanics Society, Volume 42 No 3 September 2007, pp101-114

Spreadsheet Legend

	Required input
	Calculated field
	Comment field
	Field not used
	Fixed field

Parameter	Description	Value	Units
K	Permeability		m/s
r	radius of test hole	0.045	m
t	time since start of measurement		s
h_r	reference point height above base	0.95	m
d_t	depth from reference point to water at time t		m
h_t	Water column height at time t		m
h_0	h_t at t=0		m



Test 1

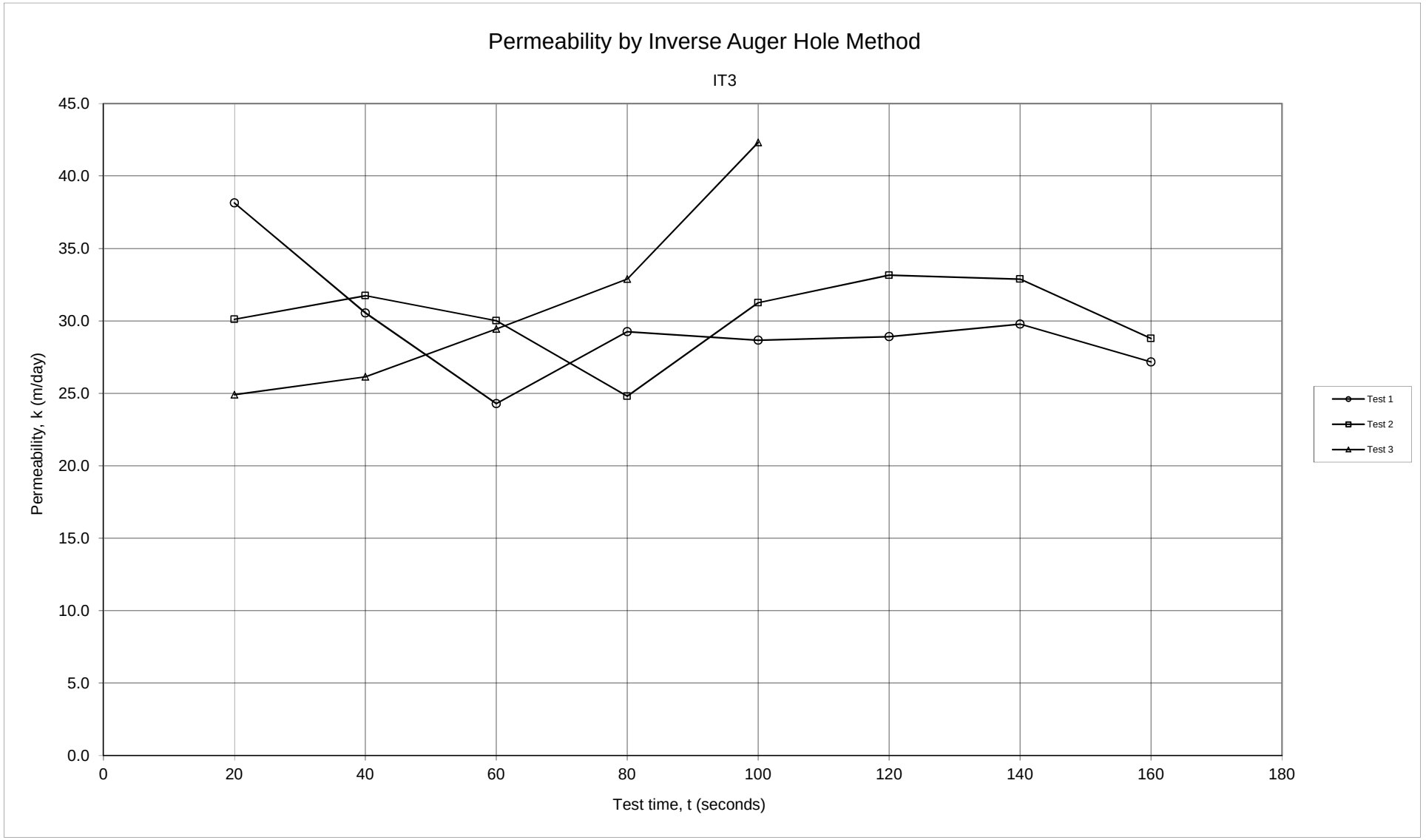
t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.48	0.47		
20	0.64	0.31	4.4E-04	38.1
40	0.71	0.24	3.5E-04	30.5
60	0.74	0.21	2.8E-04	24.3
80	0.825	0.125	3.4E-04	29.3
100	0.86	0.09	3.3E-04	28.7
120	0.89	0.06	3.3E-04	28.9
140	0.915	0.035	3.4E-04	29.8
160	0.92	0.03	3.1E-04	27.2
		AVERAGE	3.4E-04	29.6

Test 2

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.41	0.54		
20	0.56	0.39	3.5E-04	30.1
40	0.68	0.27	3.7E-04	31.7
60	0.75	0.2	3.5E-04	30.0
80	0.77	0.18	2.9E-04	24.8
100	0.86	0.09	3.6E-04	31.3
120	0.9	0.05	3.8E-04	33.2
140	0.92	0.03	3.8E-04	32.9
160	0.92	0.03	3.3E-04	28.8
		AVERAGE	3.5E-04	30.3

Test 3

t (s)	d_w (m)	h_t (m)	K (m/s)	K (m/day)
0	0.42	0.53		
20	0.545	0.405	2.9E-04	24.9
40	0.65	0.3	3.0E-04	26.1
60	0.75	0.2	3.4E-04	29.4
80	0.83	0.12	3.8E-04	32.9
100	0.91	0.04	4.9E-04	42.3
		AVERAGE	3.6E-04	31.1


Permeability by Inverse Auger Hole Method
IT3
Permeability, k (m/day)
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
20
40
60
80
100
120
140
160
180
Test time, t (seconds)
Test 1
Test 2
Test 3

ATTACHMENT D

Understanding Your Report

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017

ABN: 64 625 054 729

UNDERSTANDING YOUR REPORT

GALT FORM PMP11 Rev3

1. EXPECTATIONS OF THE REPORT

This document has been prepared to clarify what is and is not provided in your report. It is intended to inform you of what your realistic expectations of this report should be and how to manage your risks associated with the conditions on site.

Geotechnical engineering and environmental science are less exact than other engineering and scientific disciplines. We include this information to help you understand where our responsibilities begin and end. You should read and understand this information. Please contact us if you do not understand the report or this explanation. We have extensive experience in a wide variety of projects and we can help you to manage your risk.

2. THIS REPORT RELATES TO PROJECT-SPECIFIC CONDITIONS

This report was developed for a unique set of project-specific conditions to meet the needs of the nominated client. It took into account the following:

- the project objectives as we understood them and as described in this report;
- the specific site mentioned in this report; and
- the current and proposed development at the site.

It should not be used for any purpose other than that indicated in the report. You should not rely on this report if any of the following conditions apply:

- the report was not written for you;
- the report was not written for the site specific to your development;
- the report was not written for your project (including a development at the correct site but other than that listed in the report); or
- the report was written before significant changes occurred at the site (such as a development or a change in ground conditions).

You should always inform us of changes in the proposed project (including minor changes) and request an assessment of their impact.

Where we are not informed of developments relevant to your report, we cannot be held responsible or liable for problems that may arise as a consequence.

Where design is to be carried out by others using information provided by us, we recommend that we be involved in the design process by being engaged for consultation with other members of the project team. Furthermore, we recommend that we be able to review work produced by other members of the project team that relies on information provided in our report.

3. SOIL LOGS

Our reports often include logs of intrusive and non-intrusive investigation techniques. These logs are based on our interpretation of field data and laboratory results. The logs should only be read in conjunction with the report they were issued with and should not be re-drawn for inclusion in other documents not prepared by us.

4. THIRD PARTY RELIANCE

We have prepared this report for use by the client. This report must be regarded as confidential to the client and the client's professional advisors. We do not accept any responsibility for contents of this document from any party other than the nominated client. We take no responsibility for any damages suffered by a third party because of any decisions or actions they may make based on this report. Any reliance or decisions made by a third party based on this report are the responsibility of the third party and not of us.

5. CHANGE IN SUBSURFACE CONDITIONS

The recommendations in this report are based on the ground conditions that existed at the time when the study was undertaken. Changes in ground conditions can occur in numerous ways including anthropogenic events (such as construction or contaminating activities on or adjacent to the site) or natural events (such as floods, groundwater fluctuations or earthquakes). We should be consulted prior to use of this report so that we can comment on its reliability. It is important to note that where ground conditions have changed, additional sampling, testing or analysis may be required to fully assess the changed conditions.

6. SUBSURFACE CONDITIONS DURING CONSTRUCTION

Practical constraints mean that we cannot know every minute detail about the subsurface conditions at a particular site. We use professional judgement to form an opinion about the subsurface conditions at the site. Some variation to our evaluated conditions is likely and significant variation is possible. Accordingly, our report should not be considered as final as it is developed from professional judgement and opinion.

The most effective means of dealing with unanticipated ground conditions is to engage us for construction support. We can only finalise our recommendations by observing actual subsurface conditions encountered during construction. We cannot accept liability for a report's recommendations if we cannot observe construction.

7. ENVIRONMENTAL AND GEOTECHNICAL ISSUES

Unless specifically mentioned otherwise in our report, environmental considerations are not addressed in geotechnical reports. Similarly, geotechnical issues are not addressed in environmental reports. The investigation techniques used for geotechnical investigations can differ from those used for environmental investigations. It is the client's responsibility to satisfy themselves that geotechnical and environmental considerations have been taken into account for the site.

Geotechnical advice presented in a Galt Environmental report has been provided by Galt Geotechnics under a sub-contract agreement. Similarly, environmental advice presented in a Galt Geotechnics report has been provided by Galt Environmental under a sub-contract agreement.

Unless specifically noted otherwise, no parties shall draw any inferences about the applicability of the Western Australian state government landfill levy from the contents of this document.

O:\Administration\Standard Forms and Documents\PMP11-Rev3 Understanding your Report.docx

Appendix L
Proposed bio-retention soil filter media

J1901164 005 L Rev0 15 October 2019

Mortons Urban Solutions
Unit 4/100 Railway Road
SUBIACO WA 6008

Attention: Chris Le

TESTING OF PROPOSED BIO RETENTION SOIL FILTER MEDIA
PARKLANDS HEIGHTS PRIVATE ESTATE
BALDIVIS

Dear Chris,

1. INTRODUCTION

This letter presents the results of Galt Geotechnics (Galt's) testing of proposed bio retention soil filter media for the public open space (POS) areas and a median strip within the Parklands Heights Private Estate in Baldivis ("the site"). The location of the site relative to the surrounding area is shown on Figure 1, Site and Location Plan.

2. SITE DESCRIPTION

The assessed POS areas are designated K, L, M, N & E. The median strip is along Nairn Drive, extending north from Furnivall Parade. The configuration of the site is shown on Figure 1.

The site has been largely earthworked and a number of drainage basins are already formed in the POS areas. Photographs taken during the investigation are presented in Attachment A.

3. FIELDWORK

Representative samples were collected from 0-0.5 m depth from each POS area (K, L, M, N & E) and from the north and south ends of the Nairn Drive median strip (total 7 samples). The sample locations are shown on Figure 1. Photographs taken during the sampling are presented in Attachment A.

The subsurface soils at each site generally comprise:

- SAND (SP): fine to coarse grained, sub-rounded to sub-angular, typically yellow but also varying between grey-brown, grey-white grey and dark grey, trace fines.

4. LABORATORY TEST RESULTS AND DISCUSSION

Samples were submitted to the following NATA accredited laboratories for testing:

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017
T: +61 (8) 6272-0200

ABN: 64 625 054 729

- Western Geotechnical & Laboratory Services:
  - Particle size distribution (UGSA sieve sizes).
  - Saturated hydraulic conductivity (Jakobsen & McIntyre Method).
- Envirolab Services (WA) Pty Ltd:
  - pH.
  - Electrical conductivity.
- CSBP:
  - Phosphorous retention index (PRI).

Laboratory test results are presented in Attachment B and are summarised in Table 1. Table 1 also includes the soil parameters required for bio retention soil filter media to compare the test results to the requirements.

Table 1: Summary of Laboratory Test Results and Required Soil Parameters

Soil Parameters	Sample Reference (0.00 – 0.50 m)							Bio Retention Soil Filter Media
	POS K	POS L	POS M	POS N	POS E	Nairn Dr North	Nairn Dr South	
Saturated hydraulic conductivity (mm/hr)	238	720	900	148	432	1476	720	100-300
Clay and silt (< 0.05 mm)	4.0	3.4	1.8	4.4	3.6	2.0	2.2	< 3%
Very fine sand (0.05-0.15 mm)	3.5	2.3	1.1	9.8	1.8	1.8	3.8	5-30%
Fine sand (0.15-0.25 mm)	13.5	13.3	9.6	41.6	15.6	7.3	25.7	10-30%
Medium to coarse sand (0.25-1.00 mm)	78.1	80.2	86.9	43.4	78.2	88.6	68.0	40-60%
Coarse sand (1.00-2.00 mm)	0.7	0.4	0.6	0.8	0.3	0.3	0.3	7-10%
Fine gravel (2.00-3.40 mm)	0.2	0.4	0	0	0.1	0	0	< 3%
pH	8.6	9.2	7.8	7.0	9.4	8.7	8.2	5.5-7.5
Electrical conductivity (dS/m)	0.048	0.055	0.0097	0.0087	0.046	0.027	0.010	< 1.2
Phosphorous retention index (ml/g)	6.8	2.1	3.0	8.7	3.4	1.6	2.6	> 10

Note: red values denote non-conforming parameters

The test results indicate that the sand at the POS areas and Nairn Drive median strip generally does not conform to the criteria provided.

5. CLOSURE

We draw your attention to Attachment C of this letter report, "Understanding Your Report". The information provided within is intended to inform you as to what your realistic expectations of this report should be. This information is provided not to reduce the level of responsibility accepted by Galt, but to ensure that all parties who rely on this report are aware of the responsibilities each assumes in so doing.

GALT GEOTECHNICS PTY LTD

Harry Chambers

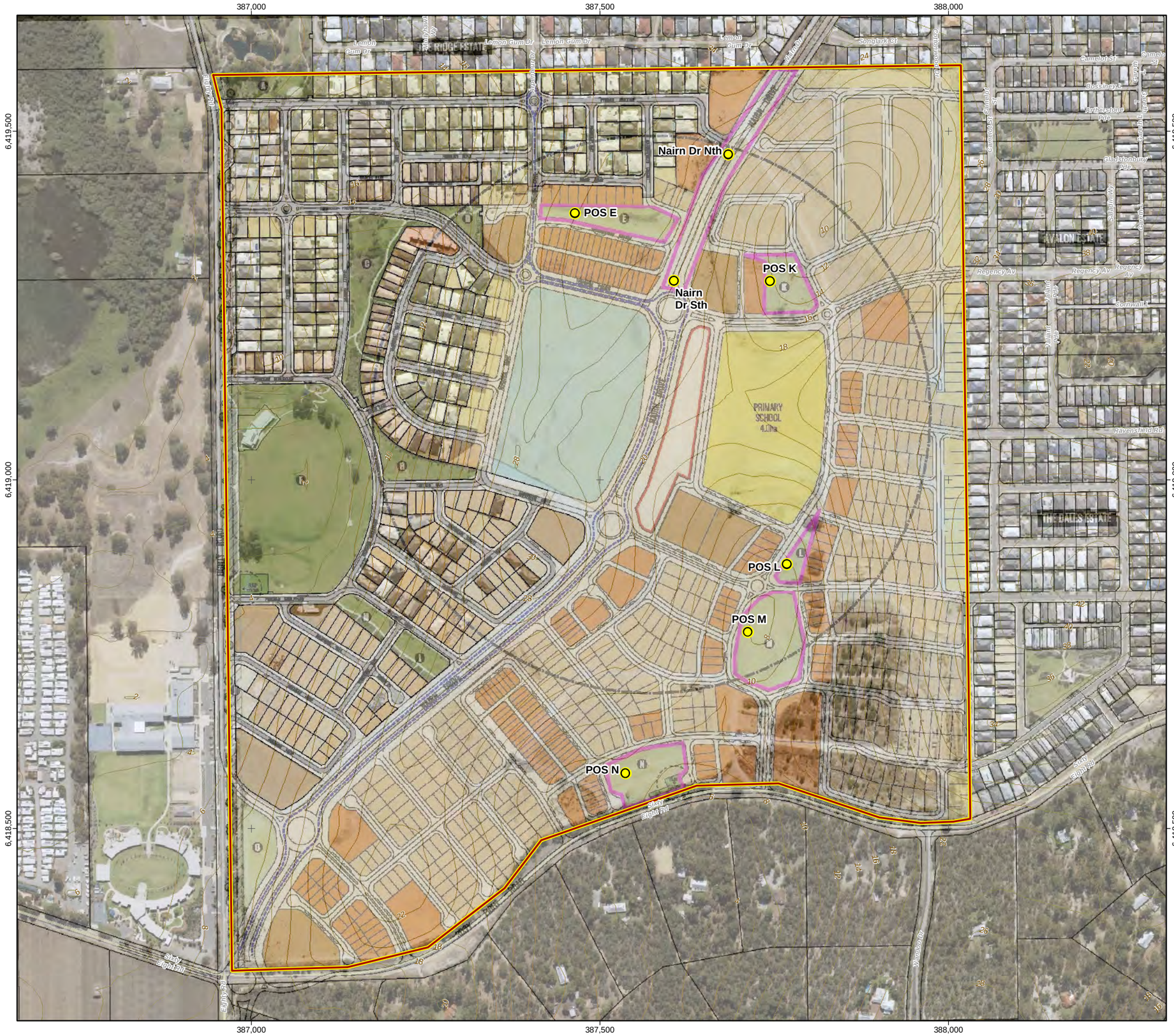
Geotechnical Engineer

Rick Piovesan CPEng

Geotechnical Engineer

Attachments: Figure 1 – Site and Location Plan
A – Photographs
B – Laboratory Test Results
C – Understanding Your Report

\\galtgeo.local\OsbornePark\Data\Jobs\2019\J1901164 - Buckby EV Parkland Heights Baldivis\03 Correspondence\J1901164 005 L Rev0.docx



Legend

- Site Boundary
- Sampling Location

N

0 80 160 240 320 400
Meters

NOTES

Aerial Imagery and Cadastre sourced from Landgate/SLIP

SCALE	1:5,500	(A3)
DRAWN	CED	
DATE DRAWN	15/10/2019	
CHECKED	HWC	
DATE CHECKED	15/10/2019	
PROJECTION	GDA 1994 MGA Zone 50	

Galt Geotechnics Pty Ltd
ACN : 138 490 865
Tel : +61 (0)8 6272-0200
Address : 50 Edward Street
Osborne Park WA 6017

CLIENT	**MORTONS URBAN SOLUTIONS**
PROJECT	TESTING OF BIORETENTION SOIL FILTER MEDIA
LOCATION	PARKLANDS HEIGHTS PRIVATE ESTATE BALDIVIS
TITLE	SITE & LOCATION PLAN

Job No	Fig No	Rev
J1901164	FIGURE 1	**A**

ATTACHMENT A

Photographs

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017

ABN: 64 625 054 729

Photograph 1: General view of POS E

Photograph 2: General view of POS K

Photograph 3: General view of POS L

Photograph 4: General view of POS M

Photograph 5: General view of POS N

Photograph 6: Sample collected from south side of Nairn Drive median strip

Photograph 7: General view of north side of Nairn Drive median strip

ATTACHMENT B

Laboratory Test Results

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017

ABN: 64 625 054 729

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

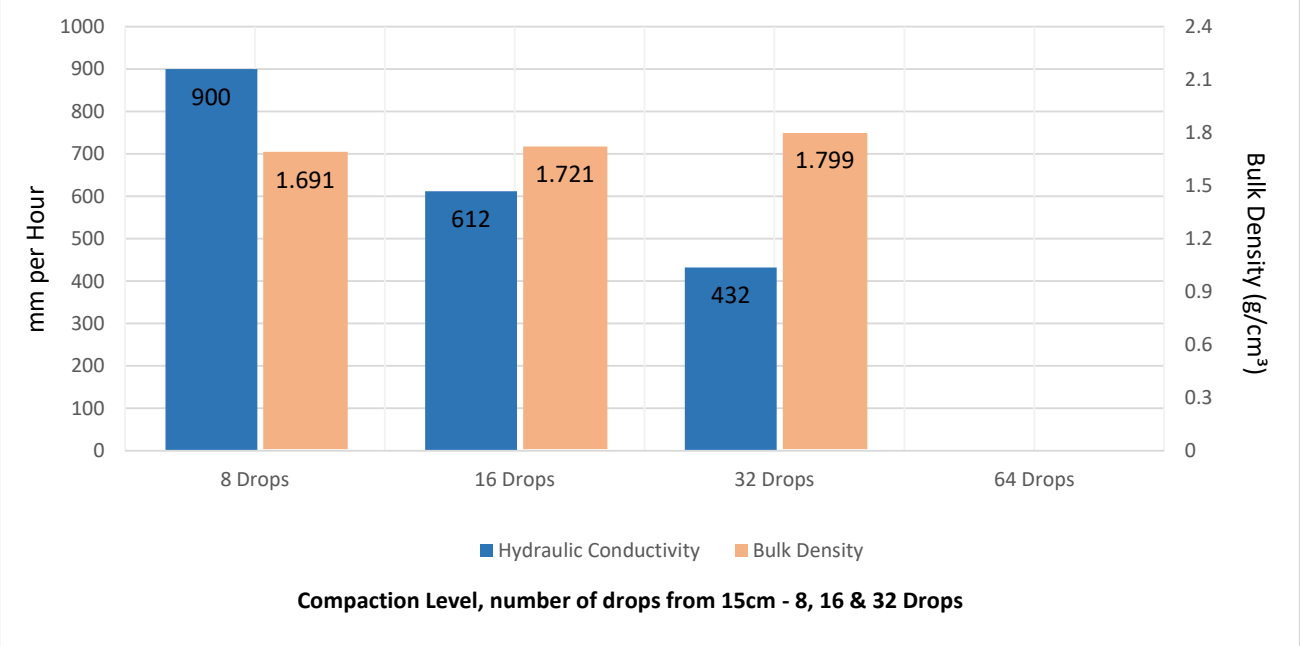
TEST REPORT - HYDRAULIC CONDUCTIVITY - JAKOBSEN & MCINTRYE METHOD

Client:	Mortons Urban Solutions	*Ticket No.*	S408
Client Address:	-	*Report No.*	WG19/3027_1_UGSA
Project:	Proposed Bioretention Media	*Sample No.*	WG19/3027
Location:	Parklands Heights Estate, Baldivis	*Date Sampled:*	Not Specified
Sample Identification:	POS E 0.0-0.5m	*Date Tested:*	8-10-2019

TEST RESULTS - HYDRAULIC CONDUCTIVITY

Sampling Method: **Sampled by Client, Tested as Received**

Saturated Hydraulic Conductivity (Ksat) and Bulk Density



Compaction Level, number of drops from 15cm - 8, 16 & 32 Drops

Comments:

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 10-October-2019

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.6.1 - UGSA

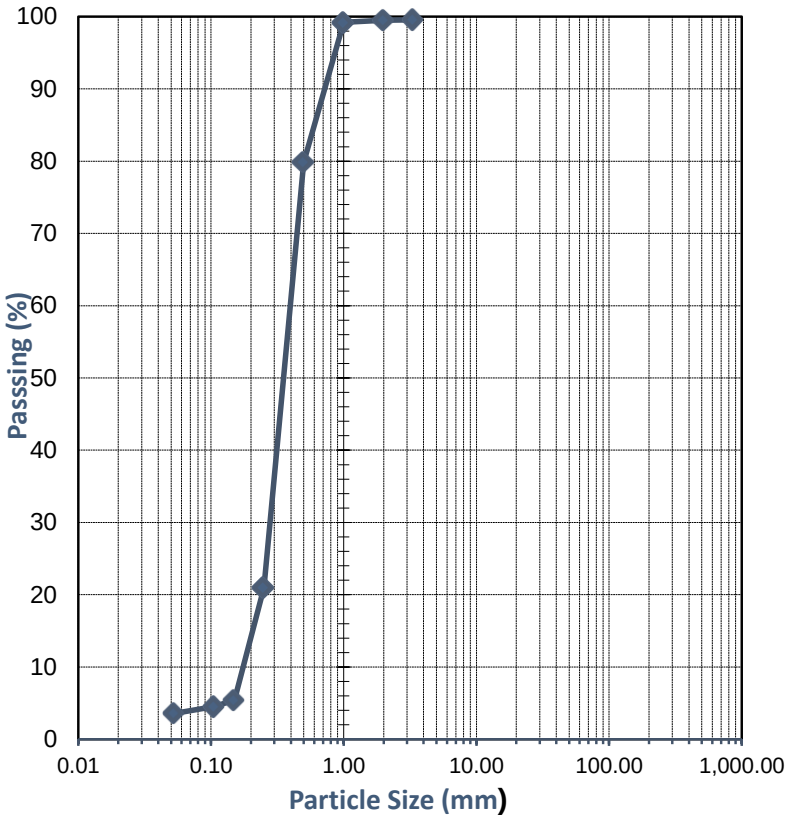
Client:	Mortons Urban Solutions	*Ticket No.*	S408
Client Address:	-	*Report No.*	WG19/3027_1_UGSA
Project:	Proposed Bioretention Media	*Sample No.*	WG19/3027
Location:	Parklands Heights Estate, Baldivis	*Date Sampled:*	Not Specified
Sample Identification:	POS E 0.0-0.5m	*Date Tested:*	3-10-2019

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: **Sampled by Client, Tested as Received**

Sieve Size (mm)	Percent Retained (%)
3.35	0.0
2.00	0.1
1.00	0.3
0.500	19.4
0.250	58.8
0.150	15.6
0.106	0.9
ψ 0.053	0.9

Sieve Size (mm)	Percent Passing (%)
3.35	99.6
2.00	99.5
1.00	99.2
0.500	79.8
0.250	21.0
0.150	5.4
0.106	4.5
ψ 0.053	3.6



Comments: ψ Sieve fraction 0.053 µm does not comply with AS 1289.3.6.1 - NATA accreditation does not cover the performance of this service.

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 09-October-2019

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

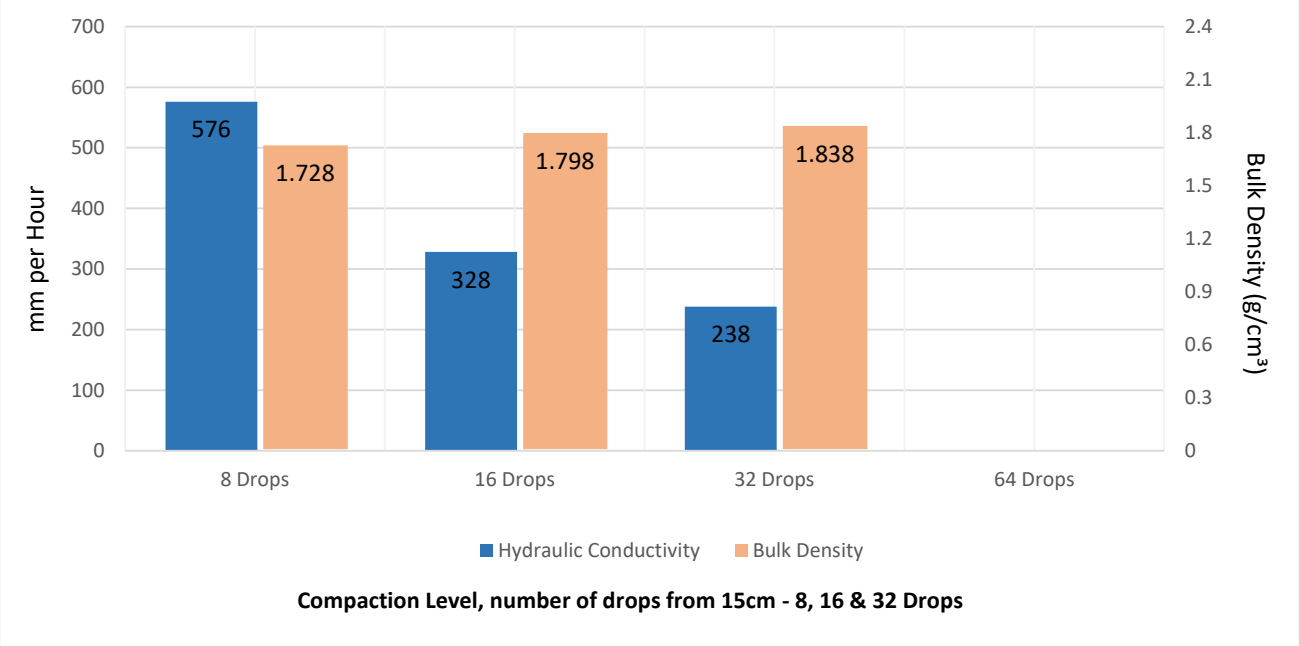
TEST REPORT - HYDRAULIC CONDUCTIVITY - JAKOBSEN & MCINTRYE METHOD

Client:	Mortons Urban Solutions	*Ticket No.*	S408
Client Address:	-	*Report No.*	WG19/3028_1_UGSA
Project:	Proposed Bioretention Media	*Sample No.*	WG19/3028
Location:	Parklands Heights Estate, Baldivis	*Date Sampled:*	Not Specified
Sample Identification:	POS K 0.0-0.5m	*Date Tested:*	8-10-2019

TEST RESULTS - HYDRAULIC CONDUCTIVITY

Sampling Method: **Sampled by Client, Tested as Received**

Saturated Hydraulic Conductivity (Ksat) and Bulk Density



Compaction Level, number of drops from 15cm - 8, 16 & 32 Drops

Comments:

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 10-October-2019

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.6.1 - UGSA

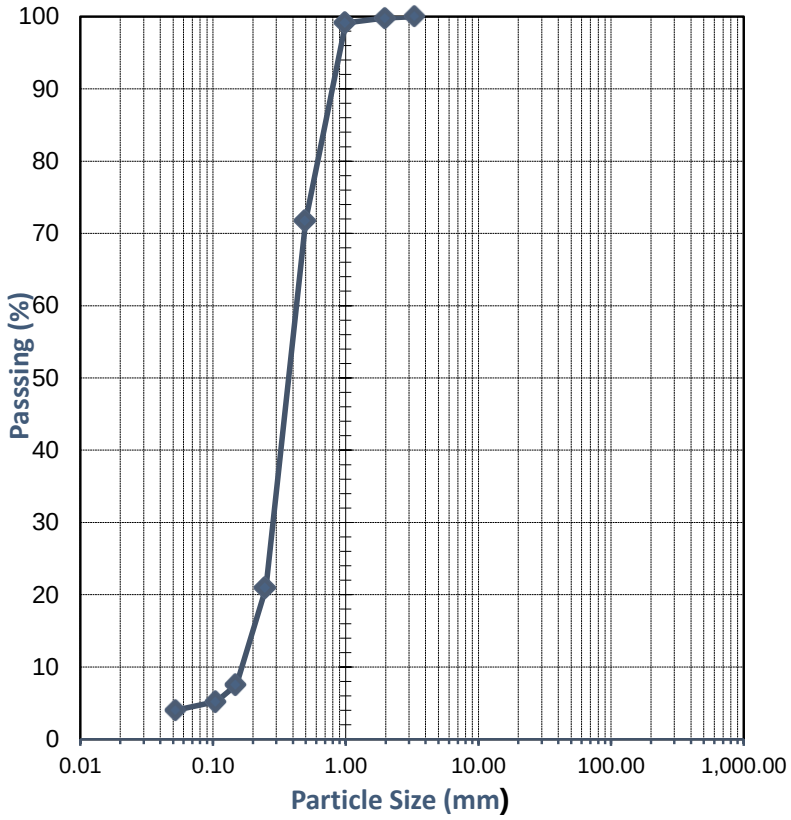
Client:	Mortons Urban Solutions	*Ticket No.*	S408
Client Address:	-	*Report No.*	WG19/3028_1_UGSA
Project:	Proposed Bioretention Media	*Sample No.*	WG19/3028
Location:	Parklands Heights Estate, Baldivis	*Date Sampled:*	Not Specified
Sample Identification:	POS K 0.0-0.5m	*Date Tested:*	3-10-2019

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: **Sampled by Client, Tested as Received**

Sieve Size (mm)	Percent Retained (%)
3.35	0.0
2.00	0.2
1.00	0.7
0.500	27.4
0.250	50.8
0.150	13.4
0.106	2.3
ψ 0.053	1.2

Sieve Size (mm)	Percent Passing (%)
3.35	100.0
2.00	99.8
1.00	99.1
0.500	71.8
0.250	21.0
0.150	7.5
0.106	5.2
ψ 0.053	4.0



Comments: ψ Sieve fraction 0.053 µm does not comply with AS 1289.3.6.1 - NATA accreditation does not cover the performance of this service.

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 09-October-2019

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

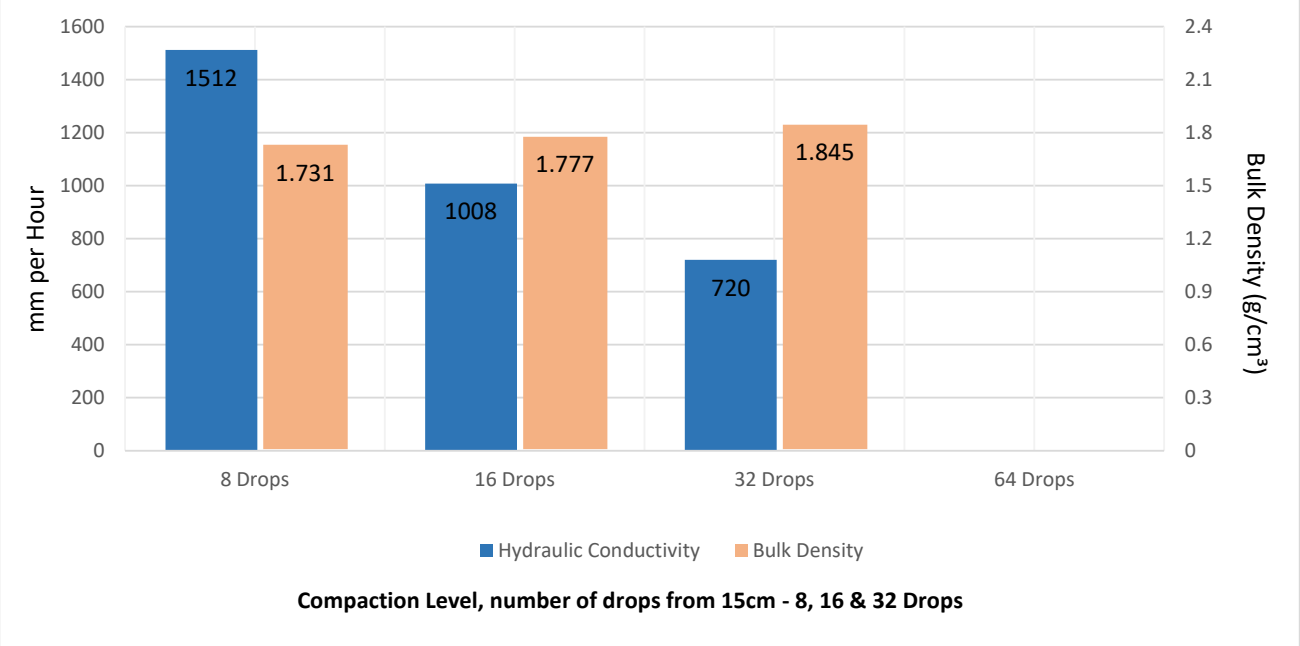
TEST REPORT - HYDRAULIC CONDUCTIVITY - JAKOBSEN & MCINTRYE METHOD

Client:	Mortons Urban Solutions	*Ticket No.*	S408
Client Address:	-	*Report No.*	WG19/3029_1_UGSA
Project:	Proposed Bioretention Media	*Sample No.*	WG19/3029
Location:	Parklands Heights Estate, Baldivis	*Date Sampled:*	Not Specified
Sample Identification:	POS L 0.0-0.5m	*Date Tested:*	8-10-2019

TEST RESULTS - HYDRAULIC CONDUCTIVITY

Sampling Method: **Sampled by Client, Tested as Received**

Saturated Hydraulic Conductivity (Ksat) and Bulk Density



Compaction Level, number of drops from 15cm - 8, 16 & 32 Drops

Comments:

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 10-October-2019

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.6.1 - UGSA

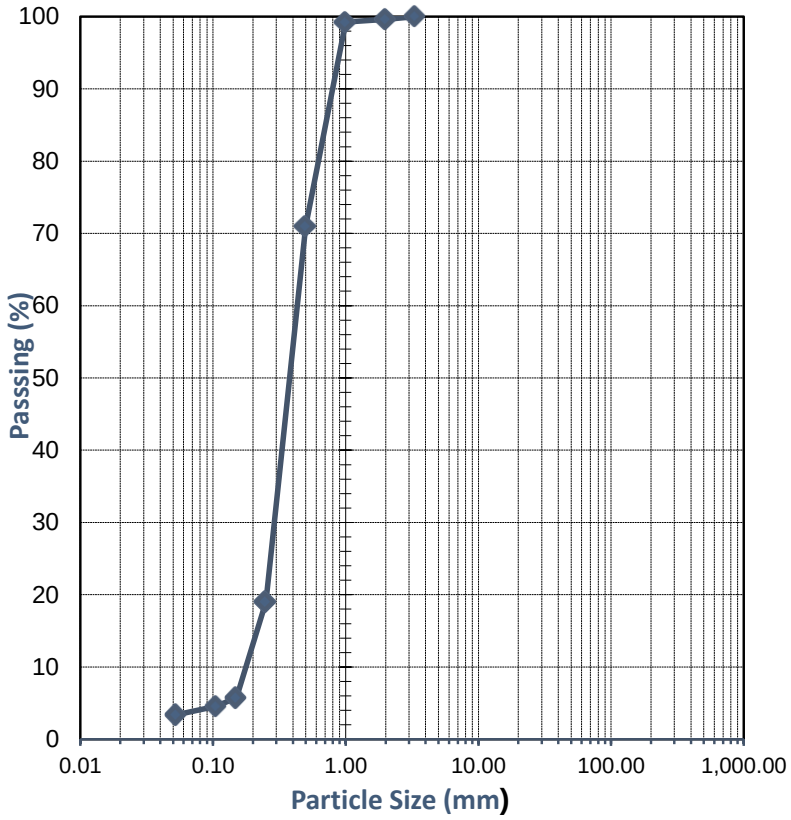
Client:	Mortons Urban Solutions	*Ticket No.*	S408
Client Address:	-	*Report No.*	WG19/3029_1_UGSA
Project:	Proposed Bioretention Media	*Sample No.*	WG19/3029
Location:	Parklands Heights Estate, Baldivis	*Date Sampled:*	Not Specified
Sample Identification:	POS L 0.0-0.5m	*Date Tested:*	3-10-2019

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: **Sampled by Client, Tested as Received**

Sieve Size (mm)	Percent Retained (%)
3.35	0.0
2.00	0.4
1.00	0.4
0.500	28.3
0.250	52.0
0.150	13.3
0.106	1.2
ψ 0.053	1.2

Sieve Size (mm)	Percent Passing (%)
3.35	100.0
2.00	99.6
1.00	99.2
0.500	71.0
0.250	19.0
0.150	5.7
0.106	4.6
ψ 0.053	3.4



Comments: ψ Sieve fraction 0.053 µm does not comply with AS 1289.3.6.1 - NATA accreditation does not cover the performance of this service.

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 09-October-2019

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

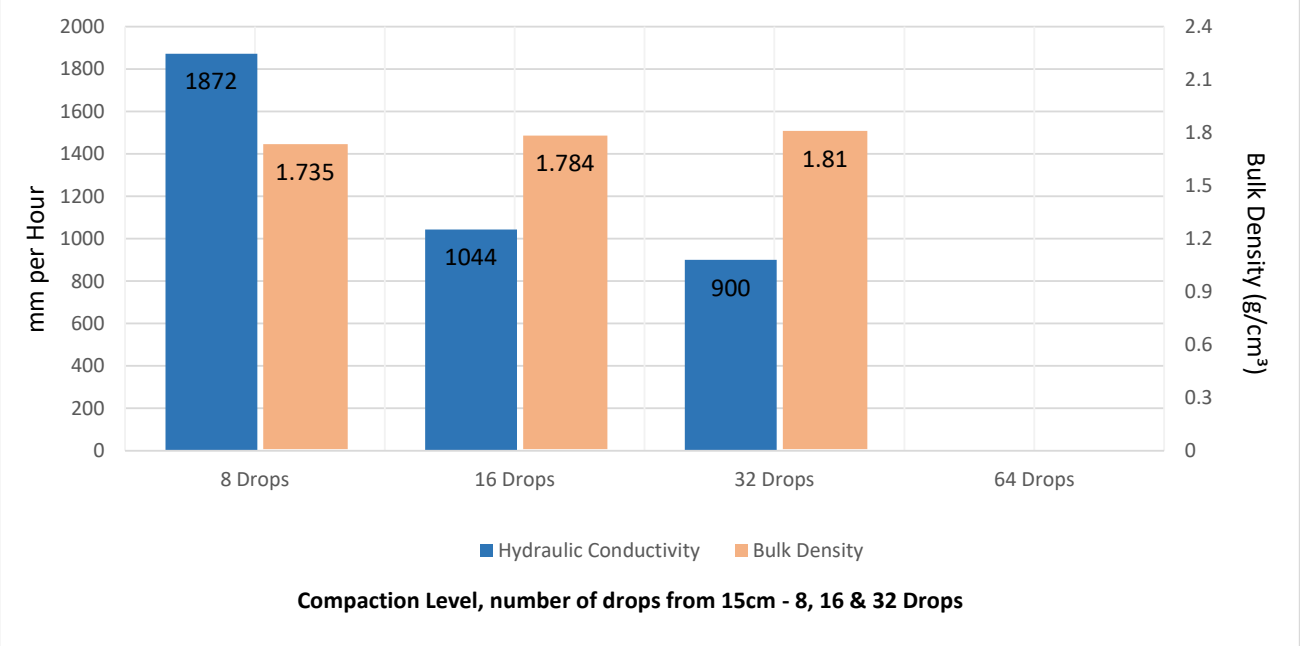
TEST REPORT - HYDRAULIC CONDUCTIVITY - JAKOBSEN & MCINTRYE METHOD

Client:	Mortons Urban Solutions	*Ticket No.*	S408
Client Address:	-	*Report No.*	WG19/3030_1_UGSA
Project:	Proposed Bioretention Media	*Sample No.*	WG19/3030
Location:	Parklands Heights Estate, Baldivis	*Date Sampled:*	Not Specified
Sample Identification:	POS M 0.0-0.5m	*Date Tested:*	8-10-2019

TEST RESULTS - HYDRAULIC CONDUCTIVITY

Sampling Method: **Sampled by Client, Tested as Received**

Saturated Hydraulic Conductivity (Ksat) and Bulk Density



Compaction Level, number of drops from 15cm - 8, 16 & 32 Drops

Comments:

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 10-October-2019

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.6.1 - UGSA

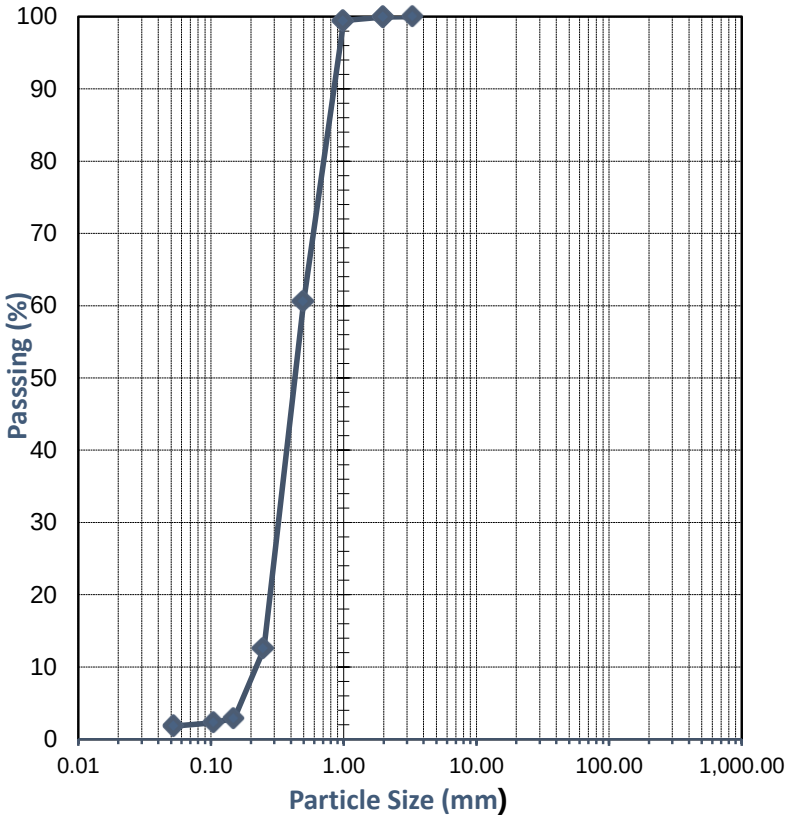
Client:	Mortons Urban Solutions	*Ticket No.*	S408
Client Address:	-	*Report No.*	WG19/3030_1_UGSA
Project:	Proposed Bioretention Media	*Sample No.*	WG19/3030
Location:	Parklands Heights Estate, Baldivis	*Date Sampled:*	Not Specified
Sample Identification:	POS M 0.0-0.5m	*Date Tested:*	3-10-2019

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: **Sampled by Client, Tested as Received**

Sieve Size (mm)	Percent Retained (%)
3.35	0.0
2.00	0.0
1.00	0.5
0.500	38.8
0.250	48.1
0.150	9.6
0.106	0.6
ψ 0.053	0.5

Sieve Size (mm)	Percent Passing (%)
3.35	100.0
2.00	100.0
1.00	99.4
0.500	60.6
0.250	12.5
0.150	2.9
0.106	2.3
ψ 0.053	1.8



Comments: ψ Sieve fraction 0.053 µm does not comply with AS 1289.3.6.1 - NATA accreditation does not cover the performance of this service.

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 09-October-2019

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

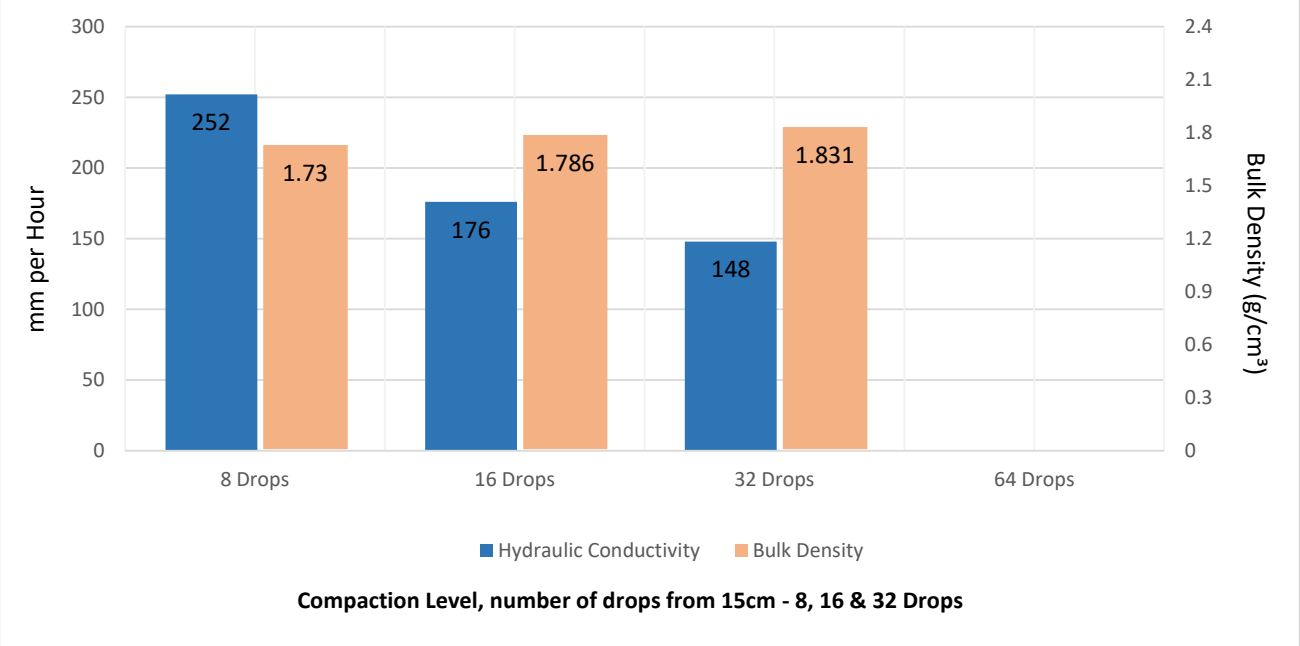
TEST REPORT - HYDRAULIC CONDUCTIVITY - JAKOBSEN & MCINTRYE METHOD

Client:	Mortons Urban Solutions	*Ticket No.*	S408
Client Address:	-	*Report No.*	WG19/3031_1_UGSA
Project:	Proposed Bioretention Media	*Sample No.*	WG19/3031
Location:	Parklands Heights Estate, Baldivis	*Date Sampled:*	Not Specified
Sample Identification:	POS N 0.0-0.5m	*Date Tested:*	8-10-2019

TEST RESULTS - HYDRAULIC CONDUCTIVITY

Sampling Method: **Sampled by Client, Tested as Received**

Saturated Hydraulic Conductivity (Ksat) and Bulk Density



Compaction Level, number of drops from 15cm - 8, 16 & 32 Drops

Comments:

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 10-October-2019

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.6.1 - UGSA

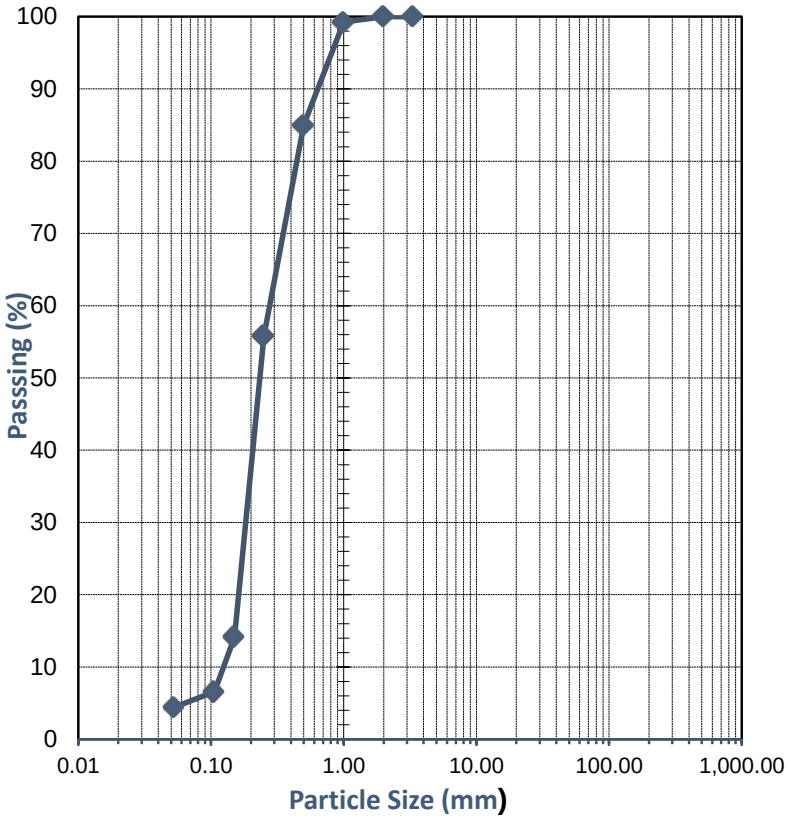
Client:	Mortons Urban Solutions	*Ticket No.*	S408
Client Address:	-	*Report No.*	WG19/3031_1_UGSA
Project:	Proposed Bioretention Media	*Sample No.*	WG19/3031
Location:	Parklands Heights Estate, Baldivis	*Date Sampled:*	Not Specified
Sample Identification:	POS N 0.0-0.5m	*Date Tested:*	3-10-2019

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: **Sampled by Client, Tested as Received**

Sieve Size (mm)	Percent Retained (%)
3.35	0.0
2.00	0.0
1.00	0.8
0.500	14.3
0.250	29.2
0.150	41.6
0.106	7.6
ψ 0.053	2.1

Sieve Size (mm)	Percent Passing (%)
3.35	100.0
2.00	100.0
1.00	99.2
0.500	85.0
0.250	55.8
0.150	14.2
0.106	6.6
ψ 0.053	4.4



Comments: ψ Sieve fraction 0.053 µm does not comply with AS 1289.3.6.1 - NATA accreditation does not cover the performance of this service.

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 09-October-2019

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

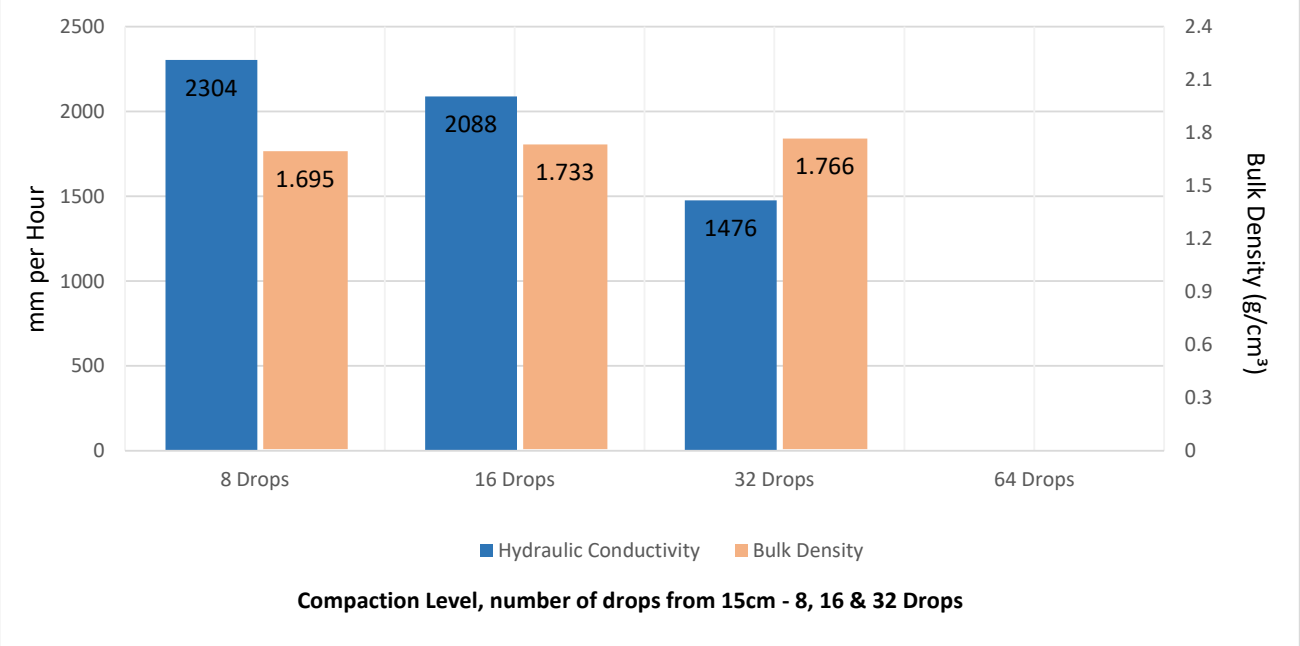
TEST REPORT - HYDRAULIC CONDUCTIVITY - JAKOBSEN & MCINTRYE METHOD

Client:	Mortons Urban Solutions	*Ticket No.*	S408
Client Address:	-	*Report No.*	WG19/3032_1_UGSA
Project:	Proposed Bioretention Media	*Sample No.*	WG19/3032
Location:	Parklands Heights Estate, Baldivis	*Date Sampled:*	Not Specified
Sample Identification:	Nairn - North 0.0-0.5m	*Date Tested:*	8-10-2019

TEST RESULTS - HYDRAULIC CONDUCTIVITY

Sampling Method: **Sampled by Client, Tested as Received**

Saturated Hydraulic Conductivity (Ksat) and Bulk Density



Compaction Level, number of drops from 15cm - 8, 16 & 32 Drops

Comments:

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 10-October-2019

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.6.1 - UGSA

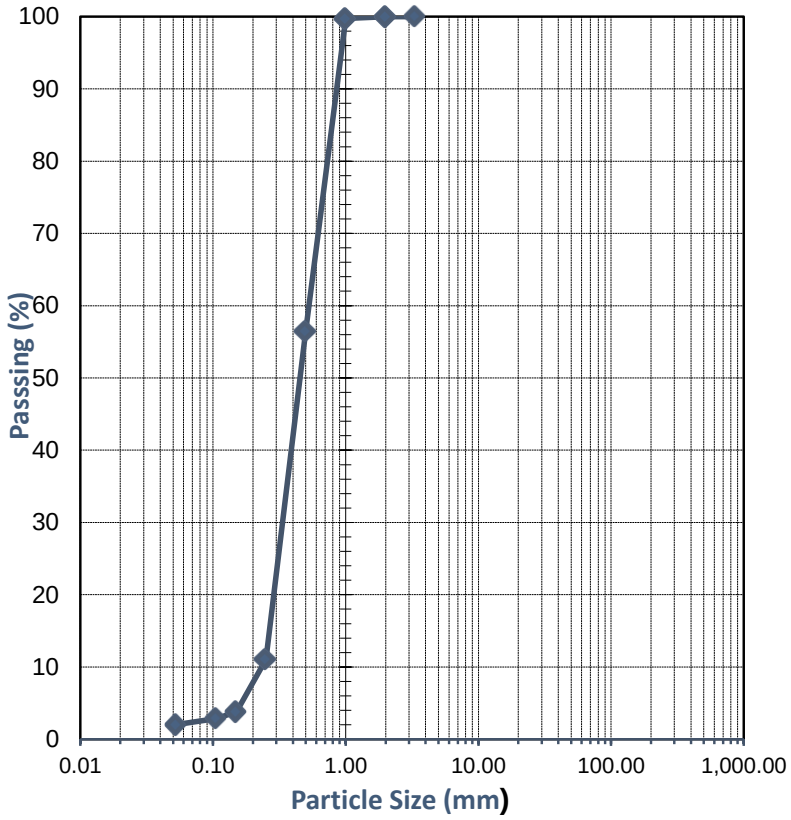
Client:	Mortons Urban Solutions	*Ticket No.*	S408
Client Address:	-	*Report No.*	WG19/3032_1_UGSA
Project:	Proposed Bioretention Media	*Sample No.*	WG19/3032
Location:	Parklands Heights Estate, Baldivis	*Date Sampled:*	Not Specified
Sample Identification:	Nairn - North 0.0-0.5m	*Date Tested:*	3-10-2019

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: **Sampled by Client, Tested as Received**

Sieve Size (mm)	Percent Retained (%)
3.35	0.0
2.00	0.0
1.00	0.2
0.500	43.3
0.250	45.4
0.150	7.2
0.106	0.9
ψ 0.053	0.8

Sieve Size (mm)	Percent Passing (%)
3.35	100.0
2.00	100.0
1.00	99.7
0.500	56.5
0.250	11.1
0.150	3.8
0.106	2.9
ψ 0.053	2.0



Comments: ψ Sieve fraction 0.053 µm does not comply with AS 1289.3.6.1 - NATA accreditation does not cover the performance of this service.

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 09-October-2019

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

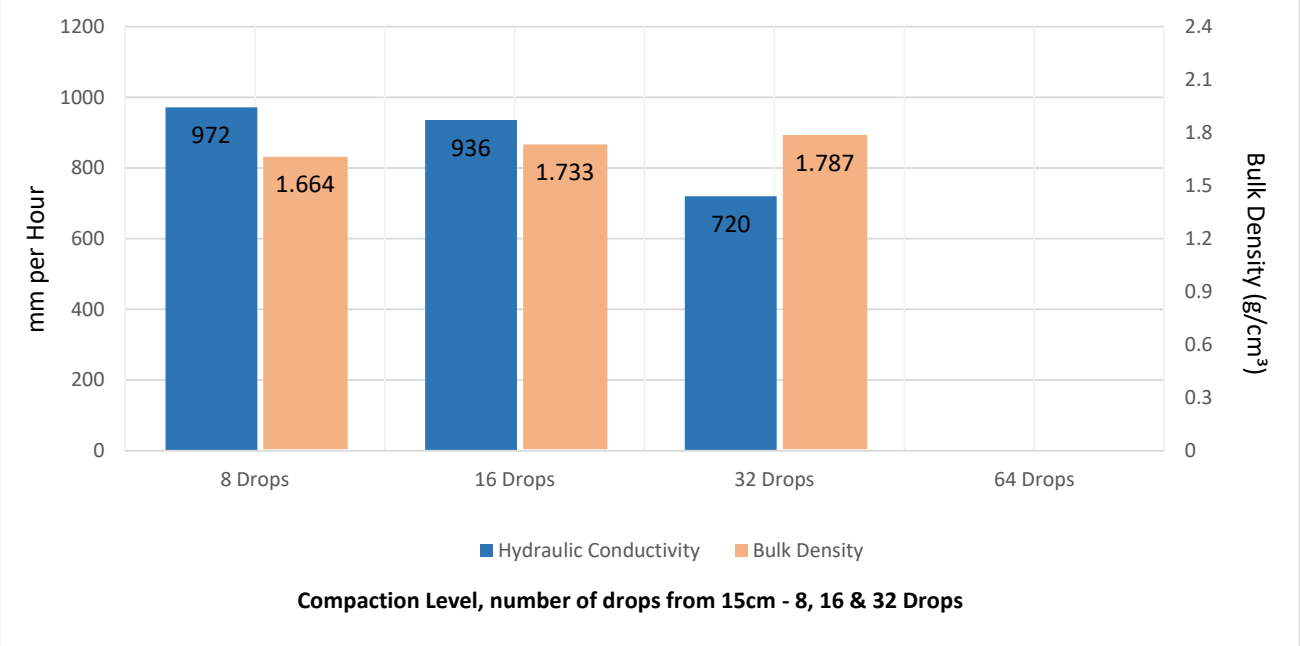
TEST REPORT - HYDRAULIC CONDUCTIVITY - JAKOBSEN & MCINTRYE METHOD

Client:	Mortons Urban Solutions	*Ticket No.*	S408
Client Address:	-	*Report No.*	WG19/3033_1_UGSA
Project:	Proposed Bioretention Media	*Sample No.*	WG19/3033
Location:	Parklands Heights Estate, Baldivis	*Date Sampled:*	Not Specified
Sample Identification:	Nairn - South 0.0-0.5m	*Date Tested:*	8-10-2019

TEST RESULTS - HYDRAULIC CONDUCTIVITY

Sampling Method: **Sampled by Client, Tested as Received**

Saturated Hydraulic Conductivity (Ksat) and Bulk Density



Compaction Level, number of drops from 15cm - 8, 16 & 32 Drops

Comments:

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 10-October-2019

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.6.1 - UGSA

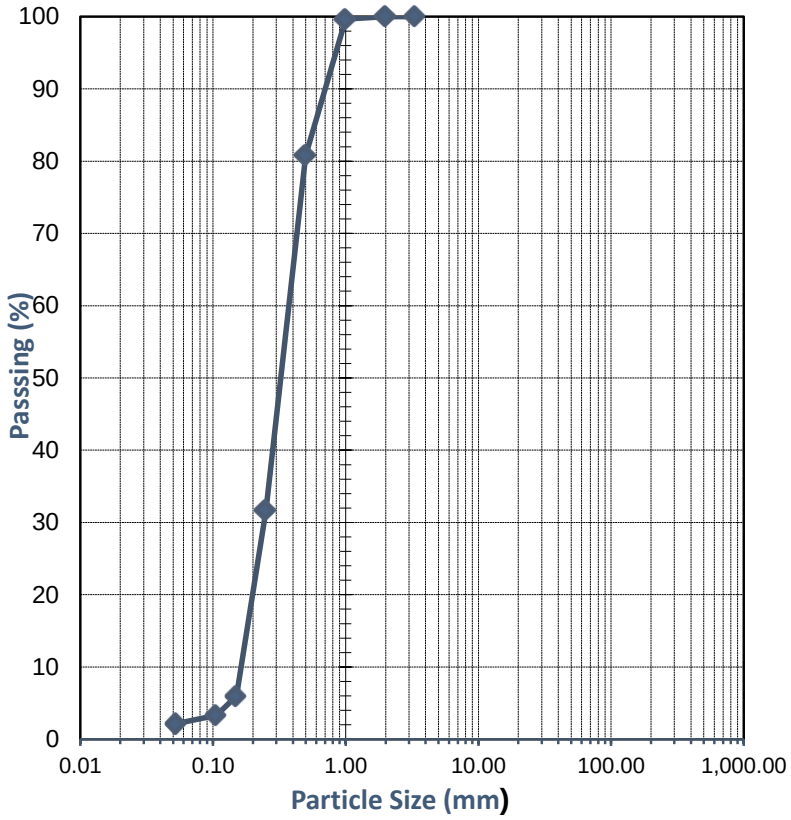
Client:	Mortons Urban Solutions	*Ticket No.*	S408
Client Address:	-	*Report No.*	WG19/3033_1_UGSA
Project:	Proposed Bioretention Media	*Sample No.*	WG19/3033
Location:	Parklands Heights Estate, Baldivis	*Date Sampled:*	Not Specified
Sample Identification:	Nairn - South 0.0-0.5m	*Date Tested:*	3-10-2019

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: **Sampled by Client, Tested as Received**

Sieve Size (mm)	Percent Retained (%)
3.35	0.0
2.00	0.0
1.00	0.3
0.500	18.9
0.250	49.1
0.150	25.7
0.106	2.7
ψ 0.053	1.1

Sieve Size (mm)	Percent Passing (%)
3.35	100.0
2.00	100.0
1.00	99.7
0.500	80.8
0.250	31.7
0.150	6.0
0.106	3.3
ψ 0.053	2.2



Comments: ψ Sieve fraction 0.053 µm does not comply with AS 1289.3.6.1 - NATA accreditation does not cover the performance of this service.

Approved Signatory:

Name: Matt van Herk
Function: General Manager
Date: 09-October-2019

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

Analysis Results

CSBP Soil and Plant Laboratory

95386
Western Geotechnical & Laboratory Servic

Lab No	6ES19089	6ES19090	6ES19091	6ES19092	6ES19093	6ES19094	6ES19095
Depth	0-10	0-10	0-10	0-10	0-10	0-10	0-10
Name	POS E 0.0-0.5M	POS K 0.0-0.5M	POS L 0.0-0.5M	POS M 0.0-0.5M	POS N 0.0-0.5M	NAIRN NORTH 0.0-0.5M	NAIRN SOUTH 0.0-0.5M
Code	WG19/3027	WG19/3028	WG19/3029	WG19/3030	WG19/3031	WG19/3032	WG19/3033
Customer	MORTONS URBAN SOLUTIONS	MORTONS URBAN SOLUTIONS	MORTONS URBAN SOLUTIONS	MORTONS URBAN SOLUTIONS	MORTONS URBAN SOLUTIONS	MORTONS URBAN SOLUTIONS	MORTONS URBAN SOLUTIONS
Phosphorus Retention Index	3.4	6.8	2.1	3.0	8.7	1.6	2.6

CSBP Lab. Extract Value.

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
ABN 53 140 099 207
16-18 Hayden Court Myaree WA 6154
ph 08 9317 2505 fax 08 9317 4163
lab@mpl.com.au
www.mpl.com.au

CERTIFICATE OF ANALYSIS 233854

Client Details

Client	Western Geotechnical & Laboratory Services
Attention	Matt van Herk
Address	235 Bank Street, Welshpool, WA, 6101

Sample Details

Your Reference	**S408/Mortons Urban Solutions/Proposed**
Number of Samples	7 Soil
Date samples received	03/10/2019
Date completed instructions received	03/10/2019
Location	Bioretention Media/Parkland Heights

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	10/10/2019
Date of Issue	10/10/2019

NATA Accreditation Number 2901. This document shall not be reproduced except in full.

Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Heram Halim, Operations Manager

Authorised By

Michael Kubiak, Laboratory Manager

Miscellaneous Inorg - soil						
Our Reference		233854-1	233854-2	233854-3	233854-4	233854-5
Your Reference	UNITS	POS E	POS K	POS L	POS M	POS N
Depth		0.0-0.5m	0.0-0.5m	0.0-0.5m	0.0-0.5m	0.0-0.5m
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	09/10/2019	09/10/2019	09/10/2019	09/10/2019	09/10/2019
Date analysed	-	10/10/2019	10/10/2019	10/10/2019	10/10/2019	10/10/2019
pH	pH Units	9.4	8.6	9.2	7.8	7.0
Electrical Conductivity (EC)	µS/cm	46	48	55	9.7	8.7

Miscellaneous Inorg - soil			
Our Reference		233854-6	233854-7
Your Reference	UNITS	Nairn - North	Nairn - South
Depth		0.0-0.5m	0.0-0.5m
Type of sample		Soil	Soil
Date prepared	-	09/10/2019	09/10/2019
Date analysed	-	10/10/2019	10/10/2019
pH	pH Units	8.7	8.2
Electrical Conductivity (EC)	µS/cm	27	10

Method ID	Methodology Summary
INORG-001	pH - Measured using pH meter and electrode base on APHA latest edition, Method 4500-H+. Please note that the results for water analyses may be indicative only, as analysis can be completed outside of the APHA recommended holding times. Soils are reported from a 1:5 water extract unless otherwise specified.
INORG-002	Conductivity and Salinity - measured using a conductivity cell at 25°C based on APHA latest edition Method 2510. Soils reported from a 1:5 water extract unless otherwise specified.

QUALITY CONTROL: Miscellaneous Inorg - soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			09/10/2019	1	09/10/2019	09/10/2019		09/10/2019	[NT]
Date analysed	-			10/10/2019	1	10/10/2019	10/10/2019		10/10/2019	[NT]
pH	pH Units		INORG-001	[NT]	1	9.4	9.4	0	101	[NT]
Electrical Conductivity (EC)	µS/cm	1	INORG-002	<1	1	46	43	7	108	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available).

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) a

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

ATTACHMENT C

Understanding Your Report

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017

ABN: 64 625 054 729

UNDERSTANDING YOUR REPORT

GALT FORM PMP11 Rev3

1. EXPECTATIONS OF THE REPORT

This document has been prepared to clarify what is and is not provided in your report. It is intended to inform you of what your realistic expectations of this report should be and how to manage your risks associated with the conditions on site.

Geotechnical engineering and environmental science are less exact than other engineering and scientific disciplines. We include this information to help you understand where our responsibilities begin and end. You should read and understand this information. Please contact us if you do not understand the report or this explanation. We have extensive experience in a wide variety of projects and we can help you to manage your risk.

2. THIS REPORT RELATES TO PROJECT-SPECIFIC CONDITIONS

This report was developed for a unique set of project-specific conditions to meet the needs of the nominated client. It took into account the following:

- the project objectives as we understood them and as described in this report;
- the specific site mentioned in this report; and
- the current and proposed development at the site.

It should not be used for any purpose other than that indicated in the report. You should not rely on this report if any of the following conditions apply:

- the report was not written for you;
- the report was not written for the site specific to your development;
- the report was not written for your project (including a development at the correct site but other than that listed in the report); or
- the report was written before significant changes occurred at the site (such as a development or a change in ground conditions).

You should always inform us of changes in the proposed project (including minor changes) and request an assessment of their impact.

Where we are not informed of developments relevant to your report, we cannot be held responsible or liable for problems that may arise as a consequence.

Where design is to be carried out by others using information provided by us, we recommend that we be involved in the design process by being engaged for consultation with other members of the project team. Furthermore, we recommend that we be able to review work produced by other members of the project team that relies on information provided in our report.

3. SOIL LOGS

Our reports often include logs of intrusive and non-intrusive investigation techniques. These logs are based on our interpretation of field data and laboratory results. The logs should only be read in conjunction with the report they were issued with and should not be re-drawn for inclusion in other documents not prepared by us.

4. THIRD PARTY RELIANCE

We have prepared this report for use by the client. This report must be regarded as confidential to the client and the client's professional advisors. We do not accept any responsibility for contents of this document from any party other than the nominated client. We take no responsibility for any damages suffered by a third party because of any decisions or actions they may make based on this report. Any reliance or decisions made by a third party based on this report are the responsibility of the third party and not of us.

5. CHANGE IN SUBSURFACE CONDITIONS

The recommendations in this report are based on the ground conditions that existed at the time when the study was undertaken. Changes in ground conditions can occur in numerous ways including anthropogenic events (such as construction or contaminating activities on or adjacent to the site) or natural events (such as floods, groundwater fluctuations or earthquakes). We should be consulted prior to use of this report so that we can comment on its reliability. It is important to note that where ground conditions have changed, additional sampling, testing or analysis may be required to fully assess the changed conditions.

6. SUBSURFACE CONDITIONS DURING CONSTRUCTION

Practical constraints mean that we cannot know every minute detail about the subsurface conditions at a particular site. We use professional judgement to form an opinion about the subsurface conditions at the site. Some variation to our evaluated conditions is likely and significant variation is possible. Accordingly, our report should not be considered as final as it is developed from professional judgement and opinion.

The most effective means of dealing with unanticipated ground conditions is to engage us for construction support. We can only finalise our recommendations by observing actual subsurface conditions encountered during construction. We cannot accept liability for a report's recommendations if we cannot observe construction.

7. ENVIRONMENTAL AND GEOTECHNICAL ISSUES

Unless specifically mentioned otherwise in our report, environmental considerations are not addressed in geotechnical reports. Similarly, geotechnical issues are not addressed in environmental reports. The investigation techniques used for geotechnical investigations can differ from those used for environmental investigations. It is the client's responsibility to satisfy themselves that geotechnical and environmental considerations have been taken into account for the site.

Geotechnical advice presented in a Galt Environmental report has been provided by Galt Geotechnics under a sub-contract agreement. Similarly, environmental advice presented in a Galt Geotechnics report has been provided by Galt Environmental under a sub-contract agreement.

Unless specifically noted otherwise, no parties shall draw any inferences about the applicability of the Western Australian state government landfill levy from the contents of this document.

O:\Administration\Standard Forms and Documents\PMP11-Rev3 Understanding your Report.docx

Appendix 3
Engineering Report

Parkland Heights, Lot 1507 Eighty Road, Baldivis - Local Structure Plan Amendment

Civil Engineering Services Report

Project No: 22-319

pritchard francis
civil and structural engineering consultants

Table of Contents

Revision	Description	Author	Date
A	Initial Issue	Kyle Johnston	26 June 2024

1 Introduction

1.1 General

Pritchard Francis has been engaged to prepare an engineering services report to support a Local Structure Plan (LSP) amendment for Lot 1507 Eighty Road, Baldivis. The below represents a summary of engineering services, both current and future planned services to facilitate the development of the Proposed Freehold Division (RHPPH-3-012B) found in Appendix One, which is supported by the Local Structure Plan Map (RHPPH-2-001A) found in Appendix Two.

This report outlines the capacity of existing utilities to service the development and is based on infrastructure planning currently available from authorities and infrastructure mapping services online. The services under assessment are:

- Water and Sewer Reticulation (Water Corporation)
- Drainage (City of Armadale)
- Gas (ATCO Gas Australia)
- Power (Western Power)
- Communications (Telstra, NBN)

In addition to a utility service capacity assessment, the report also covers geology and preliminary earthworks advice for the development.

Figure 1 - Aerial Photograph of Proposed Development Site (MetroMap, June 2024)

Figure 2 - Local Structure Plan (LSP) Map, Lot 1507 Eighty Road, Baldivis

1.2 Report Qualifications

In line with this report, Pritchard Francis make the following qualifications:

- This report was prepared exclusively for Rockingham Park Pty Ltd. Unless otherwise stated, the use of this report by third parties is not permitted.
- The information provided in this report may be considered valid for three (3) months from the date of the report.
- The information provided in this report is based upon the information and documentation provided by the client. Pritchard Francis have relied on such information and documents being true. Where we are uninformed of developments outside of this report, Pritchard Francis cannot be held responsible or liable for any problems or issues that may arise consequently.
- Assumptions have been made which, if incorrect, have the potential to impact the recommendations of this report. Major development implications existing through avenues which cannot be assured at the time of this report, including the upgrading and provision of utility services, WAPC Conditions, DA Conditions, Local Authority Scheme Requirements, timing of adjacent developments, etc.
- Unless otherwise stated, the capacities of existing services have not been verified via calculations. Where required, specialist consultants may need to be engaged to provide accurate assessments of existing and future servicing capacities.
- A geotechnical report has not been conducted at present. Pritchard Francis has undertaken a desktop geological assessment and considered the geotechnical findings from geotechnical investigations of nearby sites.
- All cost estimates mentioned in this report represent our best judgment based on information available at the time of providing but Pritchard Francis cannot and does not warrant that it represents the final construction cost. Pritchard Francis is not a Quantity Surveyor and does not employ quantity surveyors.
- The civil designs presented in this report are conceptual in nature, and by no means depict the ultimate design solution. Detail design and documentation will be necessary to validate all design levels and gradients to ensure compliant with the client brief, Australian Standards, Austroads and relevant authority guidelines.
- Where design is carried out by third parties using information provided by Pritchard Francis, it is recommended that Pritchard Francis be engaged or involved in the design process.

2 Information Sources

The table below outlines the background and service information obtained by Pritchard Francis to facilitate this report.

Description of Data	Obtained From	Date
Local Structure Plan Map	CDP-AU PTY LTD	09 June 2024
Proposed Freehold Subdivision	CDP-AU PTY LTD	09 June 2024
LWMS	CDP-AU PTY LTD	09 June 2024
Geotechnical Information	ENV Australia Pty Ltd (2011)	19 June 2024
Water Corporation Data	Water Corporation Esinet	19 June 2024
Aerial Image	MNG Mapping	19 June 2024
Groundwater Data	ENV Australia Pty Ltd (2011)	19 June 2024
Acid Sulphate Soils (ASS)	ENV Australia Pty Ltd (2011)	19 June 2024

3 Codes and Standards

This project will be designed and documented in accordance with all relevant standards and codes of practice. In general, the codes relevant to the civil design will be:

- AS 2890.5-2020 On-Street Parking
- AS 3798-2007 Guidelines on Earthworks for Commercial and Residential Developments.
- Australian Rainfall and Runoff (2016).
- Australian Runoff Quality (2006).
- IPWEA Local Government Guidelines for Subdivisional Development Edition 2.3-2017 or City of Armadale Standards.

All work and materials shall comply with all relevant standards.

4 Site Conditions

4.1 Geology

4.1.1 Geotechnical Conditions

Currently, there is no geotechnical investigation report for the proposed development site. Pritchard Francis recommends a geotechnical investigation to be performed prior to design. Pritchard Francis has undertaken a desktop geological study based on information from a previous report by ENV Australia Pty Ltd.

The desktop study carried out by ENV Australia Pty Ltd in 2011 states that the 1 in 50,000 Environmental Geology Series describes the geology at and surrounding the site as:

- S7 Sand – (Sand derived from Tamala limestone) pale yellowish brown, medium to coarse-grained, sub-angular to well-rounded quartz, trace of feldspar, shell debris, variably lithified, surface kankar, of eolian origin.

This soil unit is also known as “Spearwood Sand’. ENV also recorded the presence of a layer of clayey sand at a depth of 1.7m at groundwater bore however it is believed that this layer was only isolated to a small area in the north-western corner of the Parkland Heights development. The physical properties of the site geology are described as follows:

- High permeability
- Low to medium slope stability; and
- Moderate ease of excavation

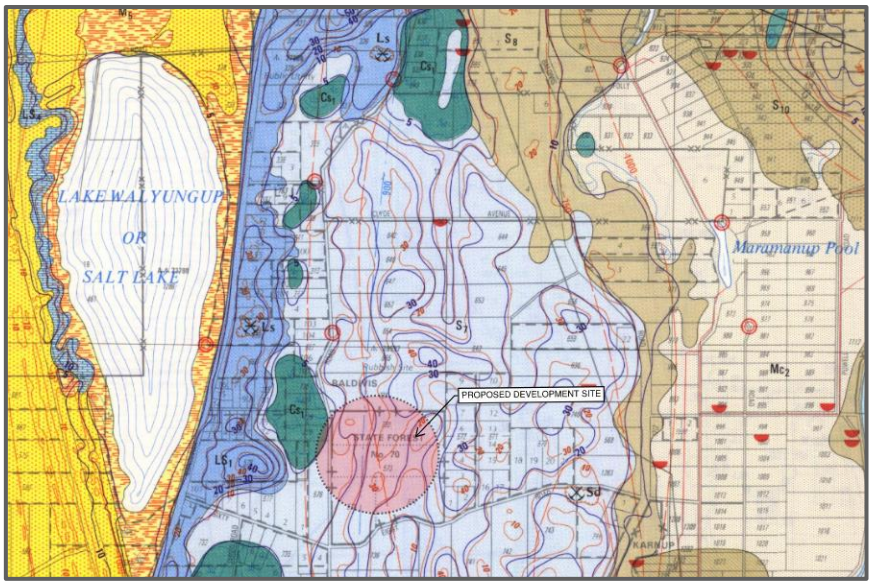


Figure 3 - 1 in 50,000 Environmental Geology Map of Proposed Development Site (City of Rockingham, June 2024)

4.2 Topography and Survey

Prichard Francis has utilised the Water Corporation Esinet Data to extract 1.0m contour intervals and obtain specific heights. Locally, the existing site levels vary throughout the site as noted below:

- RL – 9.00 AHD to RL 15.00 AHD to the north of the proposed development site.
- RL – 24.00 AHD to RL 29.00 AHD to the west of the proposed development site.
- RL – 23.00 AHD to RL 33.00 AHD to the east of the proposed development site.
- RL – 11.00 AHD to RL 8.00 AHD to the south of the proposed development site.

In summary, the land typically falls to the east of the proposed Nairn Drive and rises sharply west again to the boundary of Wensley Street.

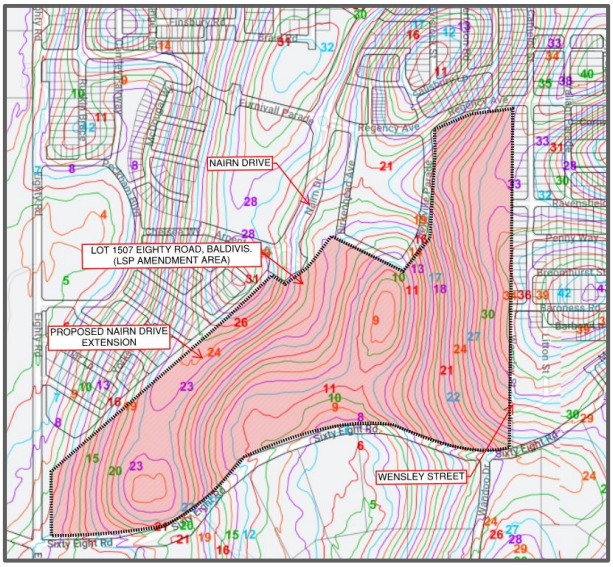


Figure 4 - Existing Topography (Esinet, 2024)

4.3 Groundwater Level

A desktop study carried out by ENV Australia Pty Ltd in 2011 states that the Annual Average Maximum Groundwater Levels (AAMGs) on the site were calculated from levels measured in October 2009. Using the figure found within the report we can anticipate that groundwater levels within the proposed local structure plan area and ranges from < 5m to > 30mAHD. This is noted in Figure 5 below.

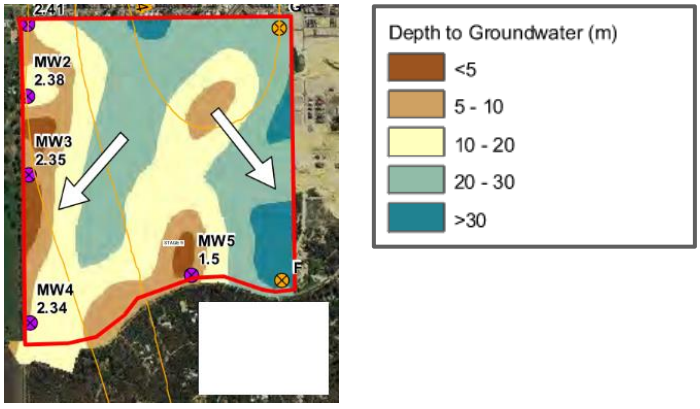


Figure 5 - Existing Groundwater Levels, Lot 1507 Eighty Road, Baldivis (ENV, 2011)

4.4 Earthworks Strategy

The subject site has previously been earth-worked in part for sand extraction in the 2000's which has created some steep grades within the site as outlined in the topography and survey section. These grades are particularly steep adjacent to Wensley Place, east of the site and to the proposed Nairn Drive extension in the west of the site. This will need to be considered in the finished design levels to best integrate the ultimate road and lot levels.

The proposed development isn't expected to require groundwater management with soils suitable for stormwater infiltration (sand with low percentage fines) and appropriate separation to the groundwater table (6 m minimum). Opportunities for cut to fill will be investigated to shape the landform with consideration to the existing vegetation on site and requirements for best practise road design in line with Austroads and IPWEA guidelines.

4.5 Acid Sulphate Soil

A previous report by ENV Australia Pty Ltd indicates that an Acid Sulphate Soils (ASS) investigation was undertake on the site in 2009. The investigation indicates the development was generally at a low risk of ASS, in line with the ASS risk mapping of the site. It is however noted in the report that one soil sample showed evidence of ASS. This was found in the north-west of the site at a depth of 2.25m due to the close proximity to a high-risk ASS area associated with an adjacent wetland. Given the distance from the proposed development, Pritchard Francis anticipate that there will be a low risk of ASS in the proposed development however it is recommended that localised investigation is carried out.

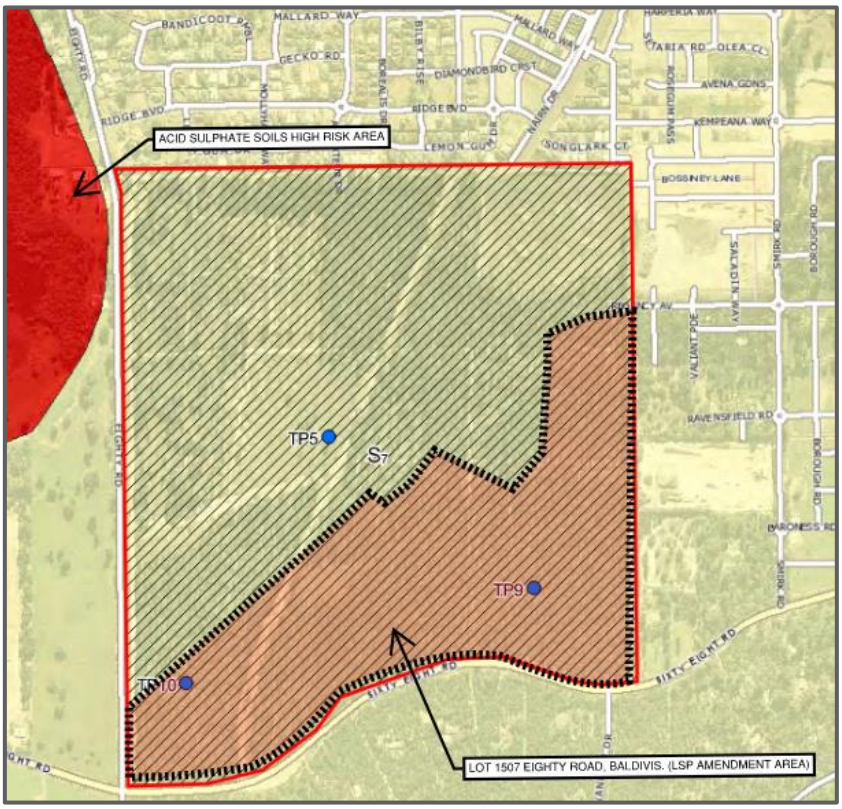


Figure 6 - Acid Sulphate Soils (ASS) Risk (ENV, 2011)

5 Utilities Infrastructure

5.1 Sewerage Reticulation

The proposed development area is located in a sewer license under Water Corporations control. The Water corporation Esinet Data confirms the presence of sewer reticulation infrastructure that travels through the proposed local structure plan area via a Ø225PVC gravity sewer from Regency Avenue to Nairn Drive to a pumping station on Sixty-Eight Road. From the pumping station a Ø250PE sewer pressure main then travels west towards the Brightwood Development.

Pritchard Francis note that all infrastructure is in place to service the proposed development.

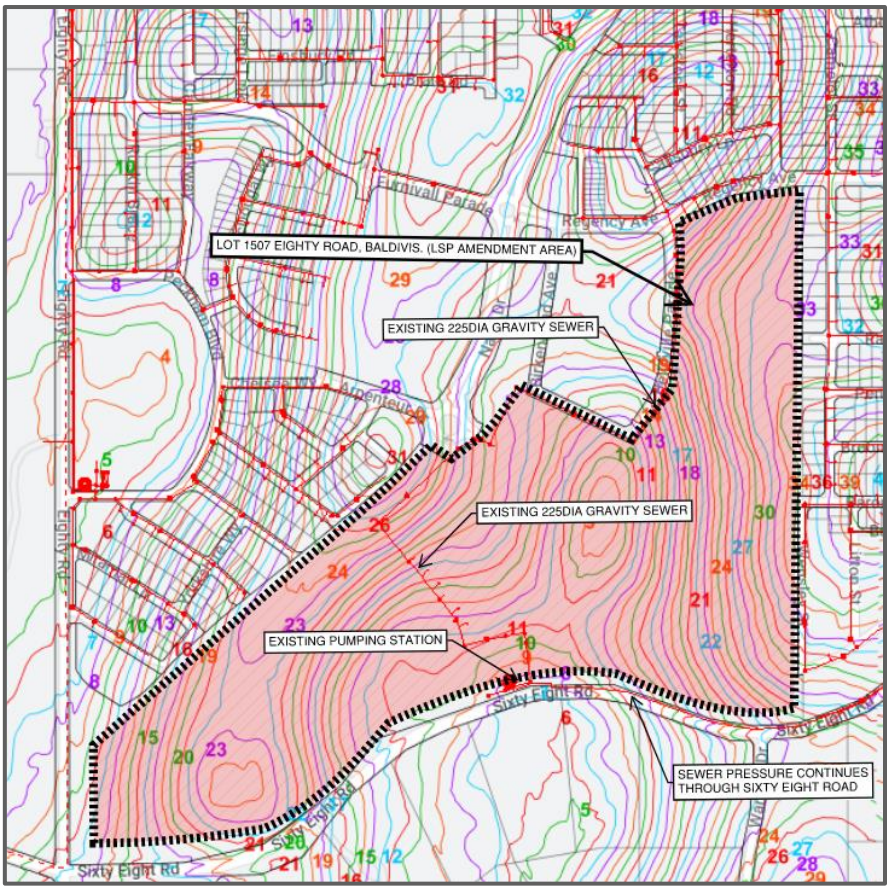


Figure 7 - Existing Sewerage Reticulation (Esinet, June 2024)

5.2 Water Reticulation

The proposed development is located in a potable water license area under Water Corporations control. The Water Corporation Esinet data confirms the presence of water reticulation infrastructure that travels through the proposed local structure plan area via a Ø150P-12 from Regency Avenue through to Nairn Drive and through the site to Sixty-Eight Road. Pritchard Francis note that the extension of water reticulation infrastructure in the adjoining residential development will be sufficient for the proposed development.

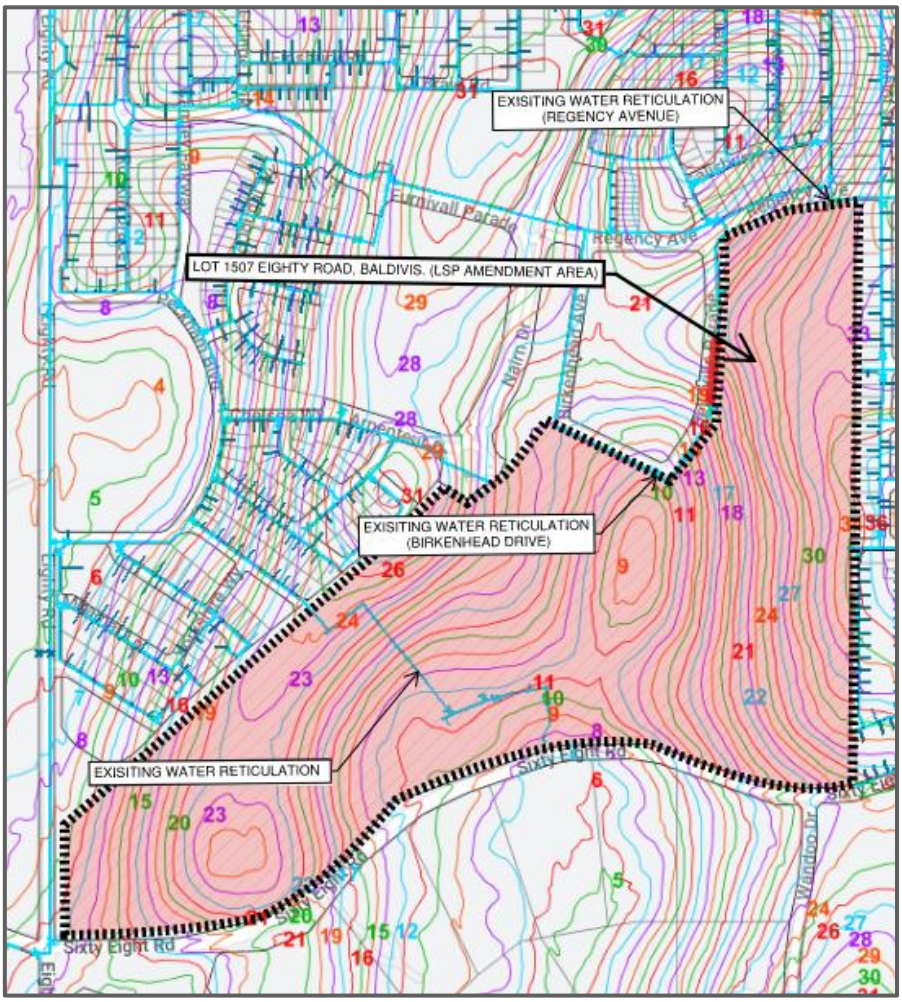


Figure 8 - Existing Water Reticulation (Esinet, June 2024)

5.3 Gas Supply

A desktop investigation indicates that there is existing gas infrastructure within the vicinity of proposed local structure plan area. It is anticipated that the existing gas infrastructure has capacity to service the proposed development.

This will be confirmed by ATCO Gas as regional planning approvals progress.

5.4 Power Supply

5.4.1 Existing UGP Network

MNG Mapping indicates there is existing power infrastructure within the vicinity of the proposed development site, sufficient to service the proposed development. The subject site has existing High Voltage (HV) aerial feeders running in an east west direction along Sixty-Eight Road. As well as this there is an existing overground and underground power network in the Parkland Heights development to the North of the subject road. See Figure 9 below.

Figure 9 - Existing Electrical Infrastructure

5.4.2 Proposed UGP Network

As a standard, network upgrades would be addressed through the HV pool of funds. This infrastructure is capable of servicing the initial stages of the proposed amendment. Network capacity will be further determined at the formal structure planning stage, and this is not an impediment to the normal progression of this MRS amendment request. A high voltage feeder upgrade is likely to be provided by Western Power as part of the development of the urban front and further strengthening of the HV network from the Parkland Heights residential network to the North.

5.5 Communication

5.5.1 Existing NBN Co Network

The subject site is located within an NBN rollout area with infrastructure installed in the adjoining Parkland Heights residential development. A review of this infrastructure to service urban residential development would be undertaken at the formal structure plan stage in the normal manner.

5.5.2 Proposed NBN Co Network

Developers have two obligations in relation to communications. Firstly, to provide fibre ready pit and pipe and secondly to provide telecommunications infrastructure. The Federal government, in its telecommunications policy statement on new developments, has determined that Telstra and NBN Co must function as Infrastructure Providers of Last Resort (IPoLR's), should Developers wish to engage them for telecommunications infrastructure. However, Developers have the choice of engaging the services of competitors, such as Opticomm or LBN, should they wish.

NBN Co charge for telecommunications infrastructure on a partial cost recovery basis, which normally works out at a reasonable cost to Developers, when compared to other alternatives. We are not aware of any reason as to why the Developer should not engage NBN Co for telecommunications infrastructure and recommend such engagement. NBN Co levy two infrastructure charges, a Deployment Charge of $600/premise for single residential services or $400/premise for Multi Dwelling Units and a Backhaul Charge, where there is insufficient infrastructure.

The first development within this precinct will need to negotiate with NBN Co charges for backhaul if any at all. We do not see the proposed NBN Co network being an impediment to the MRS amendment request.

6 Conclusion

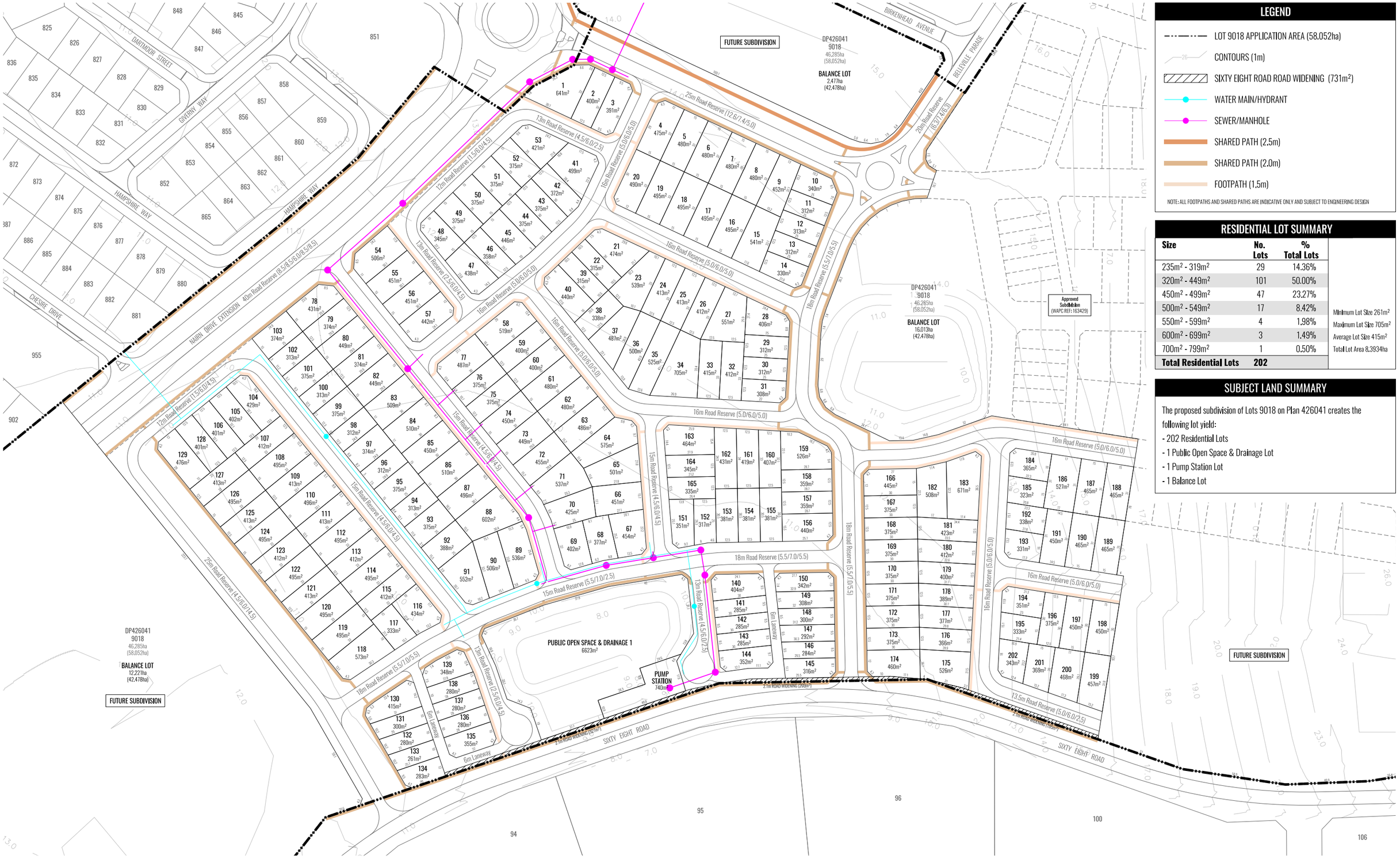
The subject site has planning carried out by all service authorities with all services found within the existing Parkland Heights development. There is no noted shortfall in regional infrastructure or constraints that would prevent development of this land for Urban use.

Appendices

Appendix One: Proposed Freehold Division (RHPPH-3-012B)

Appendix Two: Local Structure Plan Map (RHPPH-2-001A)

Appendix One: Proposed Freehold Division (RHPPH-3-012B)



LEGEND

- LOT 9018 APPLICATION AREA (58.052ha)
- CONTOURS (1m)
- SIXTY EIGHT ROAD ROAD WIDENING (731m²)
- WATER MAIN/HYDRANT
- SEWER/MANHOLE
- SHARED PATH (2.5m)
- SHARED PATH (2.0m)
- FOOTPATH (1.5m)

NOTE: ALL FOOTPATHS AND SHARED PATHS ARE INDICATIVE ONLY AND SUBJECT TO ENGINEERING DESIGN

RESIDENTIAL LOT SUMMARY

Size	No. Lots	% Total Lots
235m² - 319m²	29	14.36%
320m² - 449m²	101	50.00%
450m² - 499m²	47	23.27%
500m² - 549m²	17	8.42%
550m² - 599m²	4	1.98%
600m² - 699m²	3	1.49%
700m² - 799m²	1	0.50%
Total Residential Lots	**202**	

Minimum Lot Size 261m²
Maximum Lot Size 705m²
Average Lot Size 415m²
Total Lot Area 8.3934ha

SUBJECT LAND SUMMARY

The proposed subdivision of Lots 9018 on Plan 426041 creates the following lot yield:

- 202 Residential Lots
- 1 Public Open Space & Drainage Lot
- 1 Pump Station Lot
- 1 Balance Lot

PROPOSED FREEHOLD SUBDIVISION

Lot 9018 Nairn Drive, PARKLANDS HEIGHTS Page 1 of 2

A Rockingham Park Project

NORTH

Scale: 1:2000 @ A3

0 20 40 60m

PLAN: RHPPH-3-012 REVISION: B
DATE: 12/03/2024 DRAWN: JP
PROJECTION: PCG 94 PLANNER: BK
DATUM: AHD CHECK: CH

cdp
Town Planning & Urban Design

Unit 2, 464 Murray Street
Perth WA 6000
(08) 6333 1888
info@cdpaus.com.au
www.cdpaus.com.au

Appendix Two: Local Structure Plan Map (RHPPH-2-001A)

LEGEND

ZONES/RESERVES

- RESIDENTIAL R15
- RESIDENTIAL R20
- RESIDENTIAL R25
- RESIDENTIAL R30
- RESIDENTIAL R40
- RESIDENTIAL R60
- COMMERCIAL
- SPECIAL USE
- EDUCATION
- PUBLIC OPEN SPACE

OTHER

- LOCAL STRUCTURE PLAN BOUNDARY
- 400m NEIGHBOURHOOD WALKABLE CATCHMENT
- PUMP STATION ODOUR BUFFER
- POWERLINE EASEMENT
- ROAD WIDENING (SIXTY EIGHT ROAD)
- PLANNED BUS ROUTE
- VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
- SEWER PUMP STATION (900m^2 - 1220m^2)

NOTES

1. The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boundary.
2. The access street and associated lot layout shown on the plan is indicative only and subject to refinement as part of the detailed subdivision process.
3. POS Areas are indicative only and subject to further detailed design and drainage considerations.
4. All road carriageway detail depicted on the Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on the Plan are subject to pre-cal and final survey and may vary from figures shown.
5. Bushfire attack level to be reviewed prior to creation of titles. Development may require construction in accordance with AS3959 - Construction in Bushfire Prone Areas.
6. Sixty-Eight Road widening to accomodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.

LOCAL STRUCTURE PLAN MAP

Lot 1507 Eighty Road, BALDIVIS

A Rockingham Park Project

NORTH

Scale: 1:6000 @ A3

0 60 120 180m

PLAN: RHPPH-2-001 REVISION: A
DATE: 08/05/2024 DRAWN: JP
PROJECTION: PCG 94 PLANNER: CH
DATUM: AHD CHECK: KB

cdp
Town Planning & Urban Design
Unit 2, 464 Murray Street
Perth WA 6000
(08) 6333 1888
info@cdpaus.com.au
www.cdpaus.com.au

cdp

Town Planning & Urban Design

p. 08 6333 1888

e. info@cdpaus.com.au

a. 2/464 Murray St,
Perth WA 6000

PO Box 8002
Cloisters Square 6850

www.cdpaus.com.au