Cardno LawsonTreloar

Shaping the Future

FLOOD STUDY FOR 17 O'RIORDAN STREET, ALEXANDRIA

Report Prepared for

Goodman International

28 July 2008
W4771

Cardno Lawson Treloar Pty Ltd

ABN 55 001 882 873

Level 2, 910 Pacific Highway

Gordon New South Wales

2072 Australia

Telephone: 02 9499 3000

Facsimile: 02 9499 3033

International: +61 2 9499 3000

cltnsw@cardno.com.au

www.cardno.com.au

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2	Final	28 July 2008	Andrew Reid	AR	Rhys Thomson	RST

EXECUTIVE SUMMARY

This Report assesses the stormwater flood extent and behaviour for the proposed redevelopment of 17 O'Riordan Street, Alexandria. The site is located on O'Riordan Street at the intersection with Johnson Street, Alexandria. The existing site comprises a large two-storey office / warehouse with an open carpark area on the northern side. The proposed redevelopment for the Australian Red Cross Blood Service comprises a multi-storey office and warehousing building.

Hydraulic modelling was undertaken for the 1% Annual Exceedance Probability (AEP) event and the Probable Maximum Flood (PMF) to determine the flood behaviour in the vicinity of the subject site and to assess the impact of the proposed development. Relevant Council development conditions with respect to flooding were also assessed for the proposed development.

The subject site is located within City of Sydney Council's Planning Zone #13 Green Square (excluding Town Centre) which is covered by the South Sydney Local Environmental Plan (LEP) 1998 and South Sydney Development Control Plan 1997.

A hydraulic model of the subject site and adjoining areas was developed in SOBEK, a linked one- and two-dimensional modelling system that models flood flow behaviour. The base model was developed for a previous study, '*Flood Mitigation Options Report Green Square Town Centre*' (Draft, 2008, Connell Wagner and Cardno Lawson Treloar). This model was amended to incorporate the existing site survey and proposed development details received from the Client.

Three scenarios were modelled:

1. Existing site layout for 1% AEP event,
2. Proposed development layout for 1% AEP event,
3. Proposed development layout for PMF event.

The SOBEK flood modelling for the 1% AEP and PMF event demonstrate that the proposed development satisfies Council's Development Conditions. Specifically, the proposed development:

- does not adversely affect flood behaviour upstream or downstream up to the 1% AEP event,
- has floor levels above the Flood Planning Level (adopted as 1% AEP plus 500mm freeboard) and PMF,
- has a basement entry level above the FPL and PMF,
- does not imperil the safety of persons in its immediate vicinity.

Several items are identified to be incorporated into the detailed design phase, including:

- External openings to the basement to be above the 1% AEP + 0.5m freeboard and PMF level,
- Flood compatible materials to be used below the FPL,
- Building to be structurally designed to withstand flood forces up to the PMF level,
- Utility services are to be flood proofed to the FPL or the PMF, whichever is the higher.

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1. BACKGROUND

This Report assesses the stormwater flood extent and behaviour for the proposed redevelopment of 17 O'Riordan Street, Alexandria. The site, shown in Figure 1, is located on O'Riordan Street at the intersection with Johnson Street, Alexandria. Figure 2 is aerial image of the subject site.

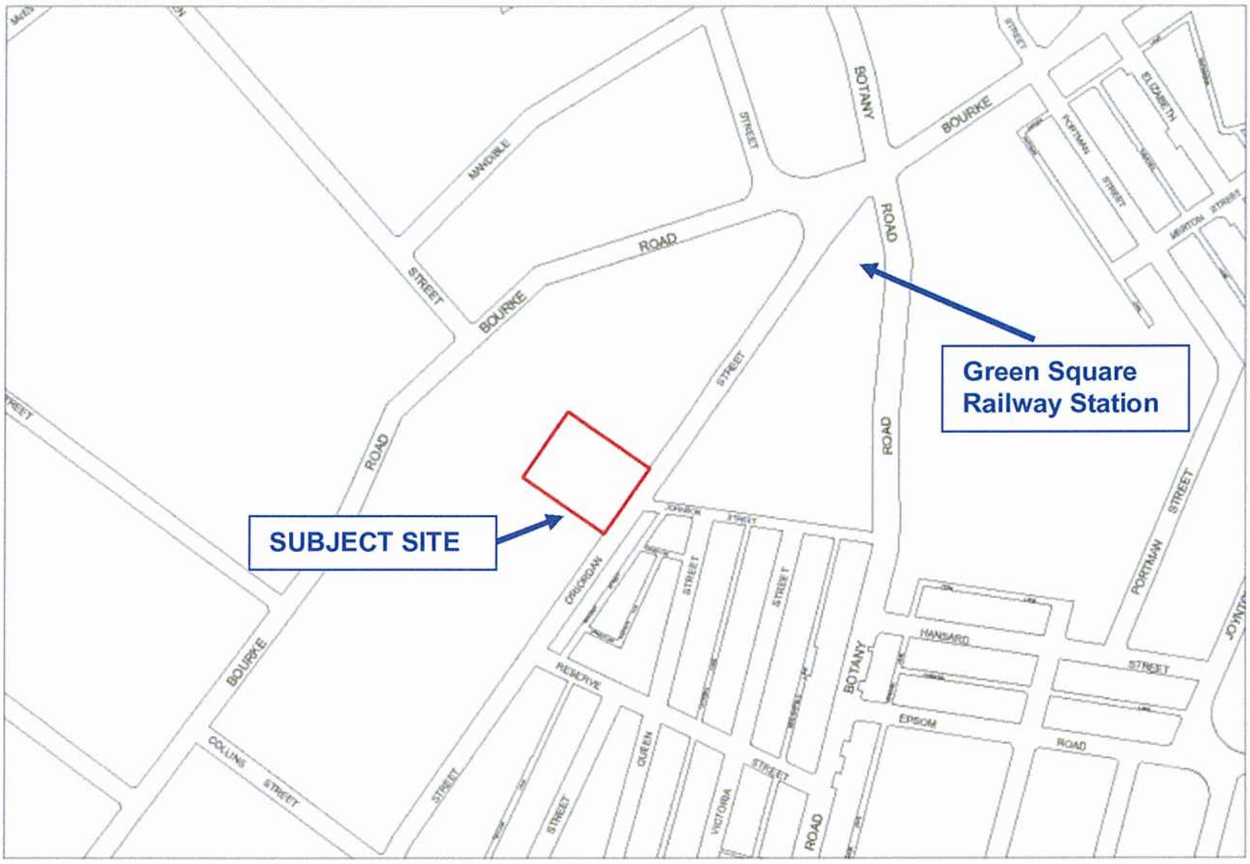


Figure 1 Site Locality

The existing site comprises a large two-storey office / warehouse with an open carpark area on the northern side (shown in Figure 3). The proposed redevelopment for the Australian Red Cross Blood Service comprises a multi-storey office and warehousing building.

Hydraulic modelling was undertaken for the 1% Annual Exceedance Probability (AEP) event and the Probable Maximum Flood (PMF) to determine the flood behaviour in the vicinity of the subject site and to assess the impact of the proposed development. Relevant Council development conditions with respect to flooding were also assessed for the proposed development.

Figure 2 Aerial Image of Site (Source GoogleEarth)

Figure 3 Existing Site (from Johnson Street)

2. DEVELOPMENT CONDITIONS

The subject site is located within City of Sydney Council's Planning Zone #13 Green Square (excluding Town Centre) which is covered by the South Sydney Local Environmental Plan (LEP) 1998 and South Sydney Development Control Plan 1997.

City of Sydney Council indicated in their email correspondence of 10 July 2008 that the proposed development:

> *should not have adverse flood impacts on any developments within the catchment for flood events up to and including the 1 in 100 year event. Outside the development site flood levels shall not be increased more than 10mm.*

The LEP includes Item 38, Flood Liable Land, which provides direction to Council in assessing developments in flood prone areas. This item states that Council must not grant consent to development if:

- *it impedes the flow of floodwaters in its immediate vicinity;*
- *it imperils the safety of persons in its immediate vicinity;*
- *it aggravates the consequences of floodwater in its immediate vicinity with regard to erosion or siltation;*
- *it has an adverse effect on the water table in the immediate vicinity.*

Additional policies were not available on Council's website referring to specific conditions applicable to developments within Zone 13, however more detailed conditions are presented for the Green Square Town Centre area. The document "South Sydney Development Control Plan 1997 Amendment Part H – Green Square Town Centre" details requirements for development within the Green Square Town Centre area. The conditions identified include:

- *Flood Planning Levels:*
  - *Floor level of a small business = 1% AEP;*
  - *Floor level of a large business = merits approach presented by the applicant;*
  - *Above-ground carpark = 1% AEP;*
  - *Underground carpark inundated by mainstream or local overland flooding = 1% AEP + 0.5m freeboard (as a minimum) or a level that is determined based on a review of the Probable Maximum Flood (PMF), whichever is the higher.*
- *Any portion of the building lower than the nominated FPL is to be built from flood compatible materials;*
- *All services associated with the development are to be flood proofed to the nominated FPL or the PMF, whichever is the higher.*
- *All flood sensitive equipment to be located above the FPL, or if in basements protected to the nominated FPL or the PMF, whichever is higher.*
- *A suitably qualified engineer is to certify that the structure can withstand the forces of floodwater, debris and buoyancy in the PMF event (Note this item is beyond the scope of this assessment).*
- *Overland flowpaths and other stormwater management systems must be designed such that personal safety is not compromised. In the event of a PMF flood vertical evacuation procedures must be considered.*

On 31 January 2007, the Minister for Planning issued a revised direction under Section 117 of the Environmental Planning and Assessment Act 1979 (EP&A Act) confirming that, unless there are exceptional circumstances, councils should adopt the 1% AEP flood (plus 0.5m freeboard) as the flood planning level (FPL) for residential development. This directive also specified that local planning instruments, such as an LEP or DCP, should be consistent with this Guideline. Therefore, the FPL adopted is the 1% AEP flood level plus 0.5m freeboard. However, where it is determined

that there is a risk to life, the PMF has been adopted as the FPL for certain elements of infrastructure (eg entry points to below ground areas and underground carparks).

The 1% AEP plus 500mm freeboard is adopted as the Flood Planning Level for floor levels within the proposed building as advised in email correspondence from Council of 5 June 2008.

Note that this assessment is not intended to address conditions related to the internal stormwater drainage of the development. Effects on the water table are also beyond the scope of this assessment.

3. AVAILABLE DATA

A survey of the existing site by Hard & Forester (dated 20/08/2007) was forwarded by the Client on 24 June 2008. This survey drawing is included as Appendix A.

Drawings of the proposed development by Bligh Voller Nield Architecture were received from the Client on 27 June 2008. Issue 08 of drawings SD-003 to SD-015 (dated 26/06/2008) were utilised for this assessment. Appendix B includes Drawings SD-003 and SD-004 of this set which show the basement and ground level floor plans.

The SOBEK model developed for a previous study in the region, '*Flood Mitigation Options Report Green Square Town Centre*' (Draft, 2008, Connell Wagner and Cardno Lawson Treloar), was adapted for this analysis.

4. FLOOD MODELLING

A hydraulic model of the subject site and adjoining areas was developed in SOBEK, a linked one- and two-dimensional modelling system that models flood flow behaviour. The base model was developed for a previous study, '*Flood Mitigation Options Report Green Square Town Centre*' (Draft, 2008, Connell Wagner and Cardno Lawson Treloar). This model was amended to incorporate the existing site survey and proposed development details listed in Section 3. Figure 4 shows the extent of the SOBEK model.

Hydrographs of runoff from catchment areas outside of the extent were incorporated into the model. Flows from local sub-catchments adjacent to the site were developed using the DRAINS program and included in the model. Runoff within the site itself, namely the roof and driveway runoff, are not part of the scope of this analysis.

Trunk drainage lines and channels conveying runoff were detailed in the model. Minor stormwater infrastructure, such as road inlet pits and pipes, immediately adjacent to the subject site were not included in the SOBEK model. These minor systems are generally only designed to convey flow up to the 10% AEP (less in some older systems) and are thus likely to only carry a small proportion of flow in the 1% AEP and PMF events. Additionally, in large storm events such as the 1% AEP, significant blockage of the inlet pits may be expected, further reducing the proportion of flow conveyed in these underground systems. The resultant flows generated are thus conservative estimates of the flood behaviour within the modelled area.

SOBEK elevation and roughness grids at 2m spacing were developed for both the existing and proposed development layout from the drawings supplied (included as Appendices A and B). The model incorporates the existing carpark area, shown in Figure 5, and the depression adjacent to the northern boundary of the site (shown in Figure 6). In the elevation grid, buildings were raised several metres above the surrounding levels to represent impermeable barriers to flow. Roughness parameters used in the model were 0.015 for road / paved areas, 0.03 for property / yard areas, and 0.05 for buildings (noting that the buildings were also raised in the elevation grid).

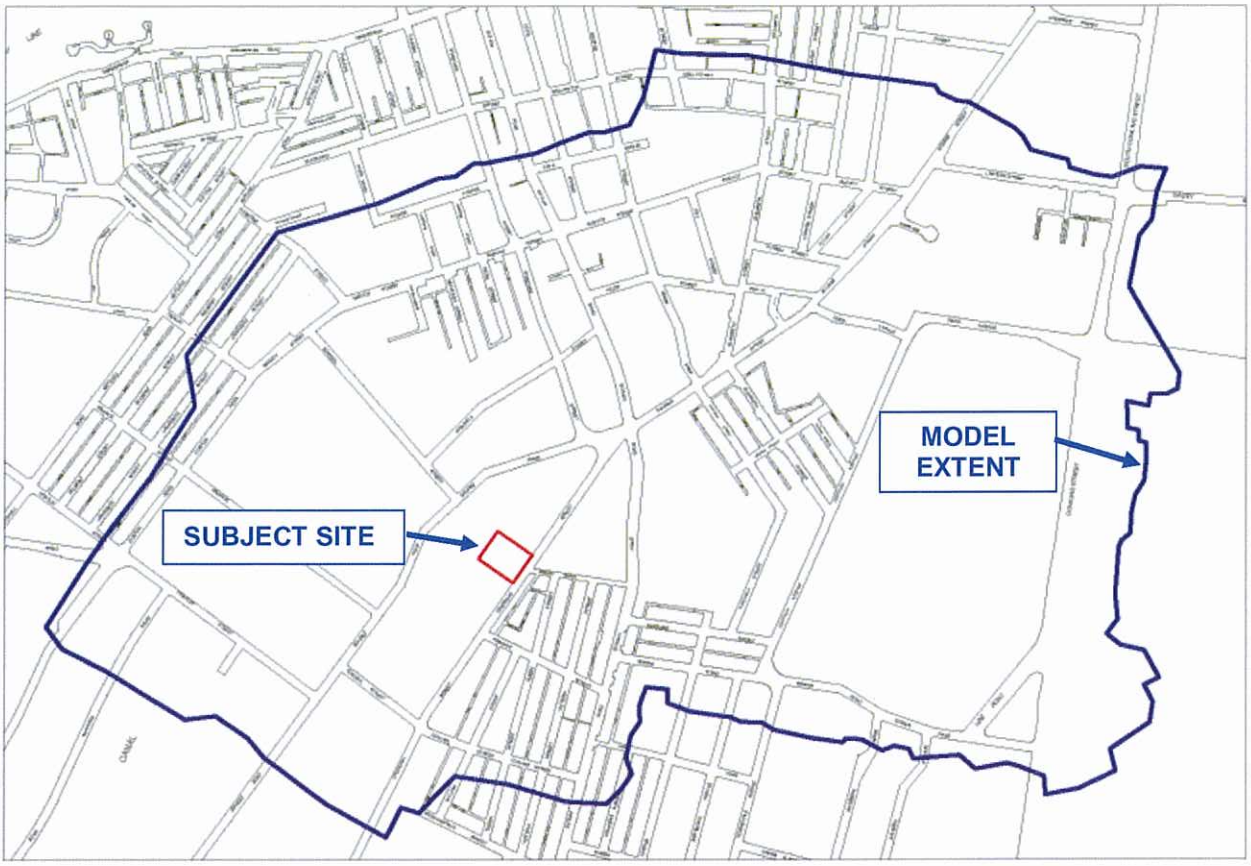


Figure 4 SOBEK Model Extent

Figure 5 Existing Carpark on Northern Side (facing west)

Figure 6 Depression Adjacent to Northern Boundary (facing west)

5. MODEL RESULTS

Three scenarios were modelled:

4. Existing site layout for 1% AEP event,
5. Proposed development layout for 1% AEP event,
6. Proposed development layout for PMF event.

The duration modelled for the 1% AEP event was the 60 minute duration storm (embedded in the 6 hour storm) and the 45 minute duration for the PMF event. These events represent the peak durations presented in previous studies for the region in *'Flood Mitigation Options Report Green Square Town Centre'* (Draft, 2008, Connell Wagner and Cardno Lawson Treloar) and *'Green Square and West Kensington Flood Study'* (Draft, 2008, Webb McKeown & Associates). The embedded storm concept is to incorporate the critical burst to coincide with the peak of the longer duration event. This approach provides a conservative approach whereby the significant storages within the model extent are already active prior to the peak burst. The embedded storm approach was not used for the PMF event, since the available storage in the catchment is not likely to have a significant impact on an extreme event such as the PMF.

Model results were processed using GIS and Appendix C includes figures showing results. These figures are:

- Figure C1 – Peak depth for 1% AEP event with existing site layout,
- Figure C2 – Peak depth for 1% AEP event with proposed development layout,
- Figure C3 – Peak water level difference between proposed layout and existing for 1% AEP event,
- Figure C4 – Flow depth for PMF event with proposed development layout,
- Figure C5 – Flood level locations related to proposed development layout,
- Figure C6 – Provisional hazard for proposed layout in 1% AEP event,
- Figure C7 – Provisional hazard for proposed layout in PMF event.

5.1 Existing Flood Behaviour

Runoff flows to the depression in O'Riordan Street located to the north-east of the subject site. The peak depth of ponding in this location for the 1% AEP event is estimated as up to 1.1m. Water spills from this pond south along O'Riordan Street passing the subject site and combining with local flows. Some inundation of the driveway of the site is shown for the existing site in 1% AEP event.

Figure C1 shows that water also inundates the depression located on the neighbouring property to north of the site (shown in Figure 5). The modelling indicates that the water in this depression does not spill onto the subject site. Similarly, inundation of the neighbouring property to the south does not impact on the subject site.

5.2 Proposed Layout Flood Levels

Figure C2 shows that inundation of the site in the 1% AEP event is limited to inundation along the eastern edge of the building and parts of the driveway fronting O'Riordan Street. The depth of flooding on the site is shown in Figure C3 to not increase above the existing depths. In the PMF event, Figure C4 shows a larger extent of the driveway of the proposed site is inundated due to the increased depth of water on O'Riordan Street. Notably, no flow is shown within the building itself or entering the basement carpark entry on the south-eastern side.

Peak flood levels for the proposed development scenario of the 1% AEP event and PMF event for locations shown on Figure C5 are listed in Table 1.

Table 1 Proposed Development Scenario Peak Flood Levels (m AHD)

Location (Figure C5)	1% AEP	PMF
A	11.8	12.4
B	11.8	12.4
C	11.8	12.4
D	11.8	12.4
E	11.8	12.4
F	11.8	12.4
G	11.8	12.3
H	11.8	12.3
I	11.8	12.3
J	n/a	n/a

5.3 Proposed Layout Provisional Hazard

The provisional hydraulic hazard classification is based on the velocity and depth of floodwaters in accordance with Figure 7 (below) extracted from the NSW Government Floodplain Development Manual (FDM) 2005. The peak velocity and peak depth from the SOBEK models of the proposed development were categorised into provisional high hazard and low/intermediate hazard based on the FDM classification. Resultant provisional hazard mapping for the proposed is shown in Figure C6 for the 1% AEP event and Figure C7 for the PMF event.

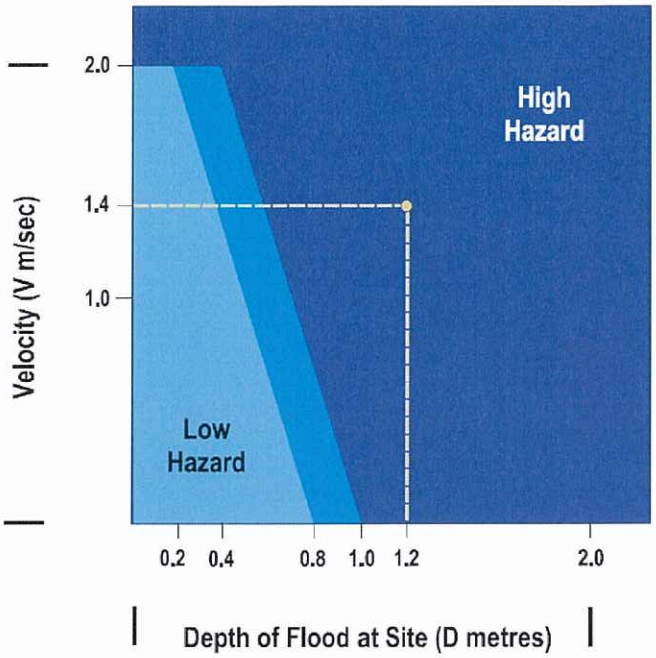


Figure 7 Hazard Categories (Source: Floodplain Development Manual)

In the 1% AEP event, high hazard is shown on O'Riordan Street to the north of the site due to the depth of water ponding at this location. High hazard flow conditions are also noted in the drainage depression of the property to the north of the site and in part of Johnson Street near the O'Riordan Street intersection. As the water levels for the 1% AEP event are unchanged for the proposed scenario (shown on Figure C3), these high hazard locations are considered to be unchanged from the existing case. The inundation on the eastern side of the site is shown as low hazard.

The water level for the PMF event results in additional areas of O'Riordan Street and Johnson Street being categorised as provisional high hazard. High hazard areas are also shown on the eastern side of the site adjacent to the building and on parts of the driveways.

6. CONDITIONS FOR PROPOSED DEVELOPMENT

6.1 Flood Behaviour

The results of the SOBEK modelling demonstrate that the proposed development does not adversely affect flood behaviour upstream or downstream of the site up to the 1% AEP event as required by Council. Specifically, the flood levels outside the development site are not increased by more than 10mm (as shown in Figure C3 in Appendix C).

6.2 Floor Levels

The 1% AEP plus 500mm freeboard is adopted as the Flood Planning Level for floor levels within the proposed building as advised in email correspondence from Council of 5 June 2008.

The peak 1% AEP flood level adjacent to the site was estimated from the SOBEK model as 11.8m AHD. The floor level of the proposed building is 12.60m AHD, which satisfies the requirement for floor level above the Flood Planning Level. It is noted that the proposed level is also above the peak PMF level of 12.4m AHD adjacent to the site.

Flows within the site itself, specifically runoff from the roof and paved areas, are not considered in this analysis. Compliance of the floor level for runoff from these areas would need to be addressed at the detailed design phase when the driveway profile and drainage inlets are confirmed.

6.3 Basement Entry

The proposed development includes an entry to a basement carpark on the south-east corner of the building. The proposed basement carpark has a driveway crest of 12.5m AHD, which is above the adjacent PMF level (namely 12.3m AHD) and the FPL level of 1% AEP+0.5m freeboard (namely 11.8m AHD +0.5m), and thereby complies with Council's conditions.

All openings to the basement, such as vents or doorways, are to be above the PMF and 1% AEP+0.5m freeboard level.

6.4 Personal Safety

Locations of provisional high hazard in the 1% AEP event are not increased in the proposed scenario. High hazard occurs near to the subject site on O'Riordan Street and Johnson Street for the 1% AEP event. Personal safety is not affected by the proposed development as sufficient refuge locations occur in the vicinity. People within the building are safe to remain within the building as it is above the FPL and PMF. Pedestrians outside the building would be able to move to higher ground, namely at the building entry points or at locations on the driveway, which are above the 1% AEP and the PMF events.

Four stairwells are provided in the basement level to allow egress to areas above the FPL and PMF water levels. Signage should be installed to advise of these stairwells as exits from the basement.

6.5 Flood Compatible Materials

Council's conditions include that all parts of the building lower than the FPL are to be built from flood compatible materials. Suitable materials for construction of flood affected walls may comprise a reinforced concrete, solid brickwork or blockwork construction.

Primarily, flood inundation adjacent to the building structure occurs on the eastern side of the site. Additionally, a suitably qualified engineer is to certify that the structure is capable of withstanding floodwater, debris and buoyancy effects up to the PMF level. In the PMF event, velocities adjacent to the eastern side of the building peak at about 0.8 m/s and at the eastern boundary of the site the peak velocity is about 1.4 m/s. Compliance with this condition is not within the scope of this assessment.

6.6 Services

The Green Square Town Centre DCP states that all services and flood sensitive equipment associated with the development are to be flood proofed to the FPL or the PMF, whichever is the higher.

7. CONCLUSION

The SOBEK flood modelling for the 1% AEP and PMF event demonstrate that the proposed development satisfies Council's Development Conditions. Specifically, the proposed development:

- does not adversely affect flood behaviour upstream or downstream up to the 1% AEP event,
- has floor levels above the Flood Planning Level (adopted as 1% AEP plus 500mm freeboard) and PMF,
- has a basement entry level above the FPL and PMF,
- does not imperil the safety of persons in its immediate vicinity.

Several items are identified to be incorporated into the detailed design phase, including:

- External openings to the basement to be above the 1% AEP + 0.5m freeboard and PMF level,
- Flood compatible materials to be used below the FPL,
- Building to be structurally designed to withstand flood forces up to the PMF level,
- Utility services are to be flood proofed to the FPL or the PMF, whichever is the higher.

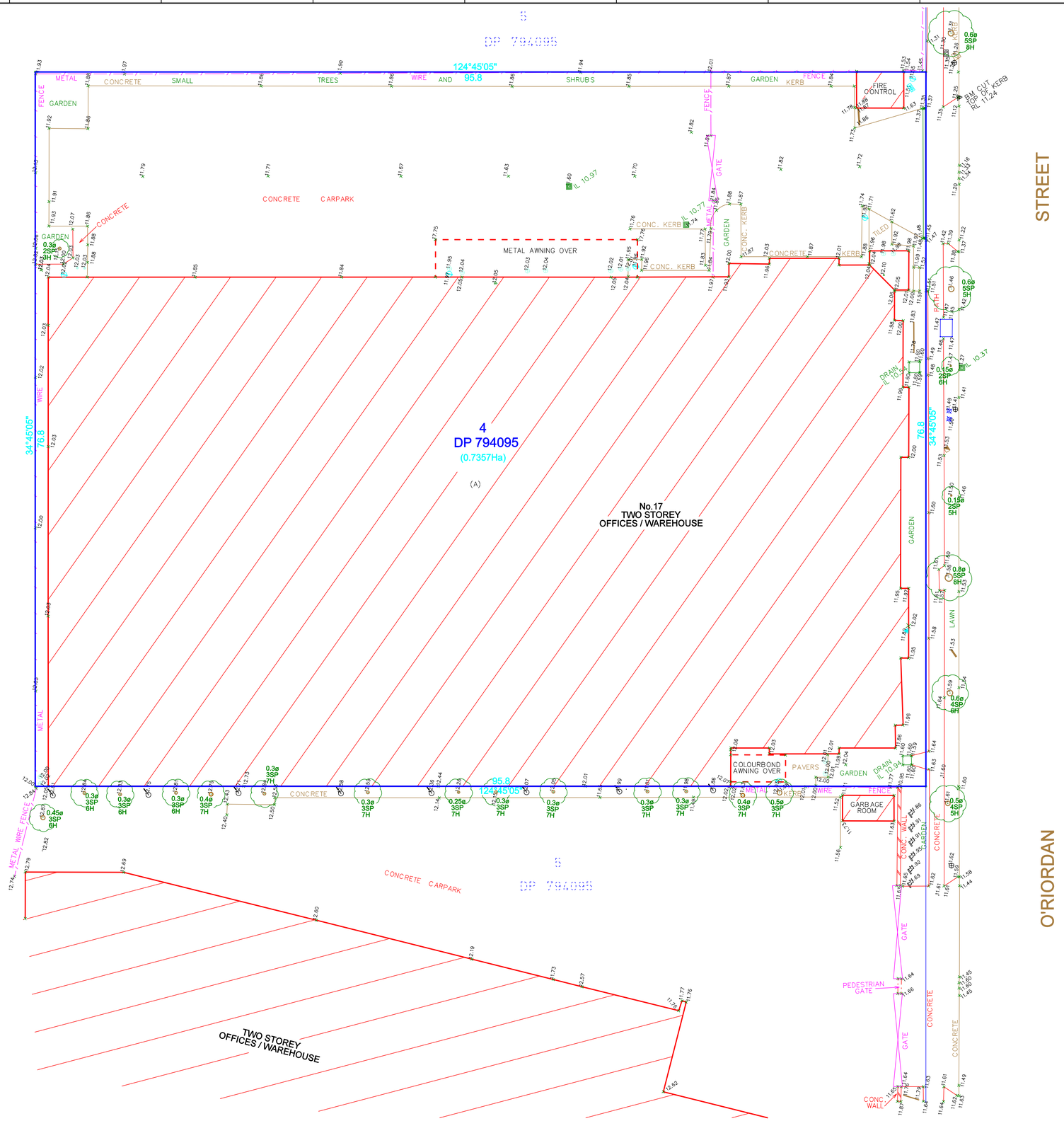
8. QUALIFICATIONS

Flow behaviour of runoff developed within the site itself, from the roof and driveway area, is not within the scope of this Report. These flows are to be considered in the assessment of Council's Development Conditions, and items such as adjacent floor levels may form part of the detailed design phase of the development.

APPENDIX A

Existing Site Survey

By Hard & Forester



(A) RESTRICTION AS TO USER VIDE DP 794095

0.3ø TRUNK DIAMETER
6SP TREE SPREAD
4H TREE HEIGHT

1.BOUNDARIES HAVE NOT BEEN SURVEYED
2.SITE AREA 7357.4m² BY TITLE DIMENSIONS

IMPORTANT NOTE:
This plan is prepared for GOODMAN PROPERTY SERVICES from a combination of field survey and existing records for the purpose of designing new constructions on the land and should not be used for any other purpose.
The title boundaries shown hereon were not marked by the author at the time of survey and have been determined by plan dimensions only and not by field measurement.

A services search of the area surveyed above has not been undertaken.
Visible services shown hereon have been located where possible by field survey. Prior to any demolition, excavation or construction on the site, the relevant authority should be contacted for possible location of further underground services and detailed locations of all services.
This note is an integral part of this plan.

LEGEND:
- SEWER MANHOLE
- UNCLASS SEWER
- SEWER VENT
- SEWER LAMP HOLE
- TELSTRA PIT 1.0x1.0
- UNCLASS TELSTRA
- TWN TELSTRA PIT
- TELSTRA PIT
- SIGN
- UNCLASS ELECTRICITY
- POWER POLE
- LIGHT POLE
- ELECTRICITY PIT
- UNCLASS SERVICE
- UNCLASS WATER
- WATER METER
- STOP VALVE
- TAP
- HYDRANT
- GULLY PIT
- JUNCTION BOX
- GRATED PIT
- DRAINAGE MANHOLE
- STATE SURVEY MARK
- SURVEY MARK
- GAS PIT
- GAS MARKER POST
- UNCLASS GAS
- TRAFFIC CONTROL SIGNAL
- TRAFFIC JUNCTION BOX
- TRAFFIC SIGNAL PIT
- RAILWAY

REVISION	DATE	DESCRIPTION	CCAD REF	APPROVED
00	20.8.07	ORIGINAL ISSUE	112468AA	CWH

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COORDINATES: E 333 752.796 N 6 258 546.020 RL 11.255
VERTICAL DATUM
DATUM: AHD
BM ADOPTED: SSM 53812
RL: 11.255
SURVEYED D.D. | DRAWN B.B. | CHECKED | PASSED

HARD & FORESTER
HARD & FORESTER
52 Frederick Street
PO Box 175
Rockdale NSW 2216
DX11116 Kogarah
t: (02) 9599 4077
f: (02) 9599 2146
e: survey@hardforester.com.au
w: www.hardforester.com.au
Consulting Surveyors
Hard & Forester Pty Ltd ABN 67 003 541 348

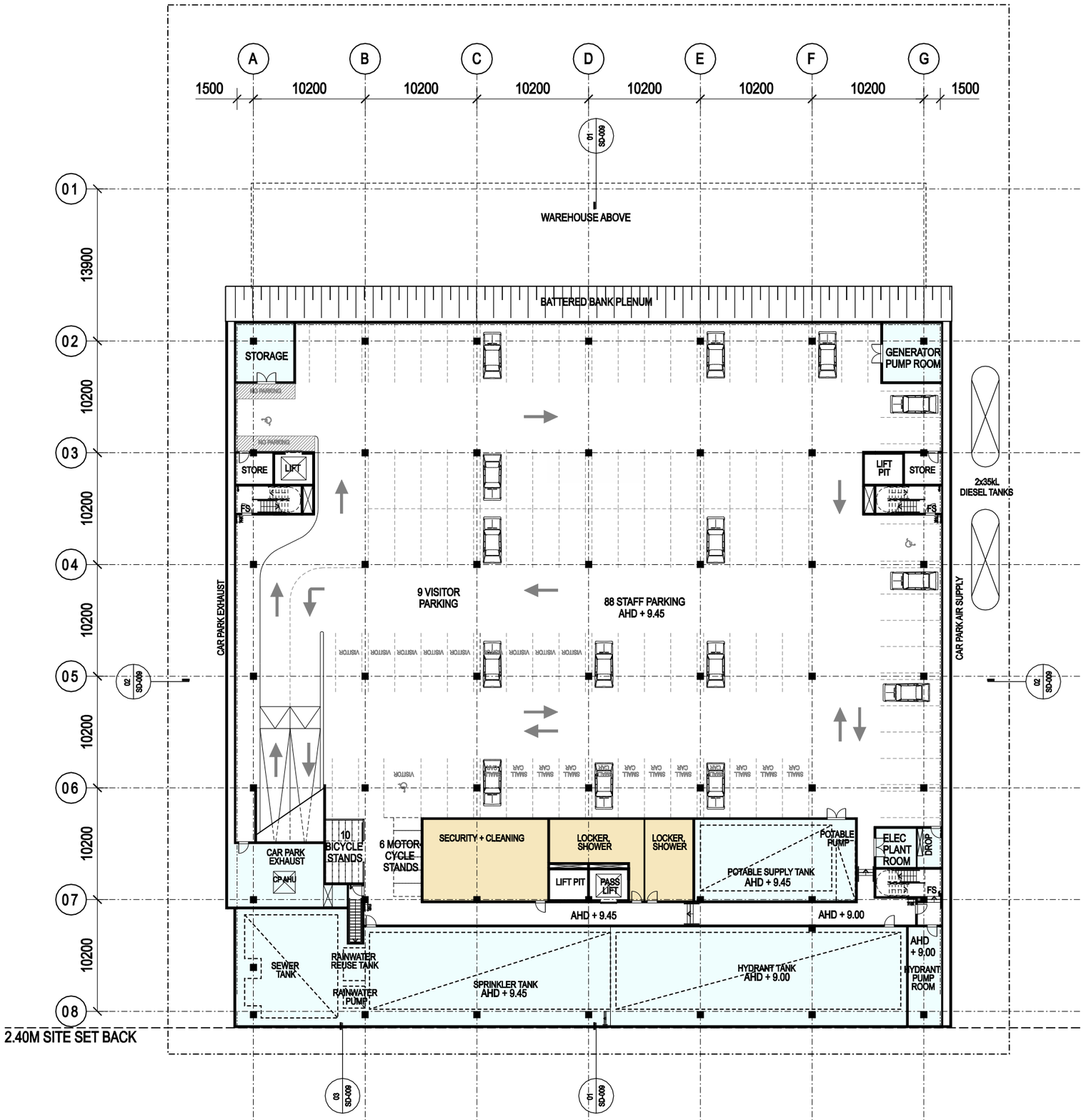
PROJECT: DETAIL AND LEVELS
No.17 O'RIORDAN STREET ALEXANDRIA
CLIENT: GOODMAN PROPERTY SERVICES

SHEET 1 OF 1
DRAWING NUMBER 112468001
REV 00

APPENDIX B

Proposed Development

By Bligh Noller Vield



BVN BlighVollerNieldArchitecture

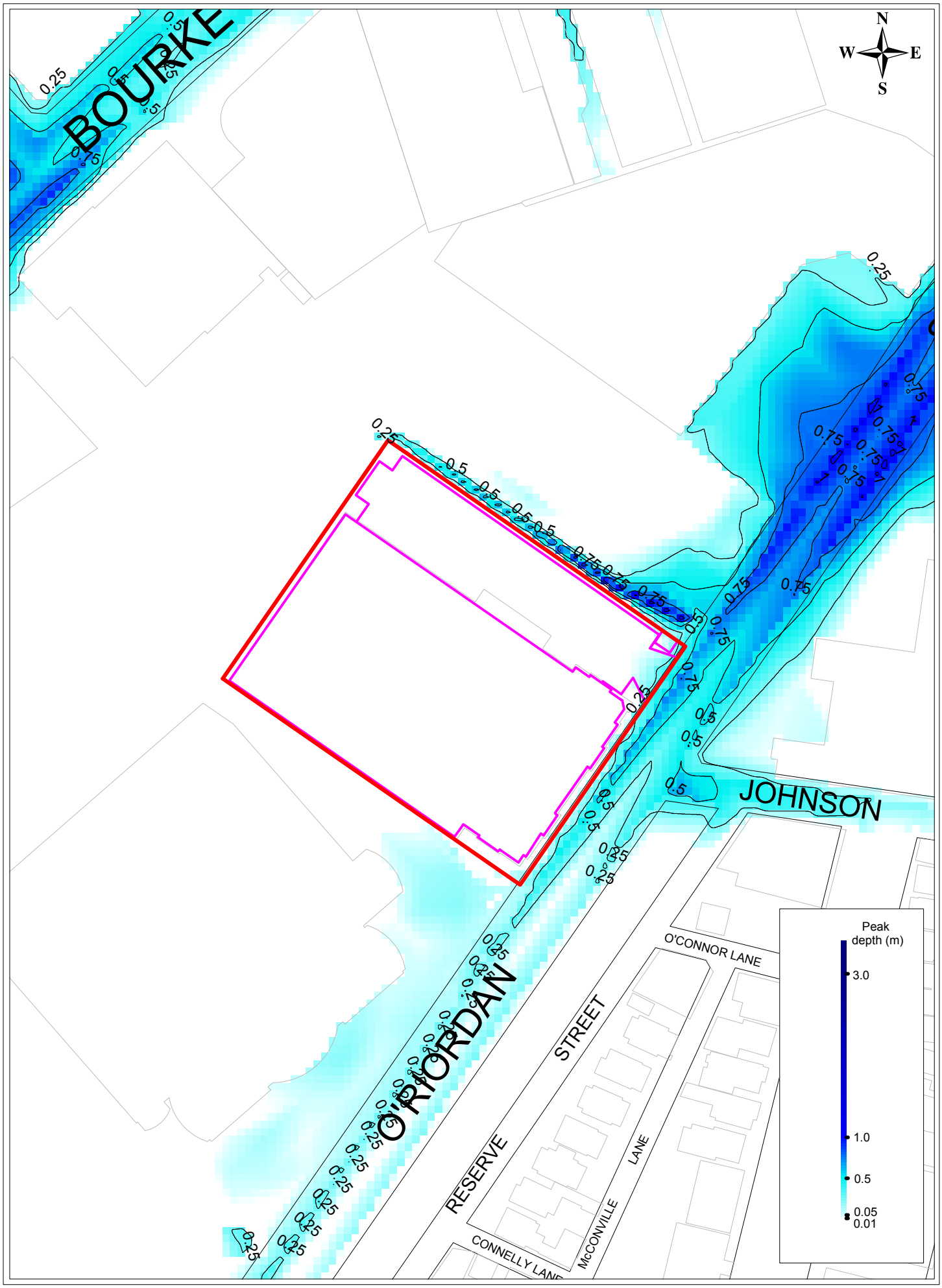
CLIENT	PROJECT	PROJECT NORTH	GRAPHIC SCALE	SCALE	DRAWING	DRAWING NO	DATE	ISSUE
GOODMAN	AUSTRALIAN RED CROSS BLOOD SERVICE		0 4000 10000	1:400 at A3	FLOOR PLAN - BASEMENT	SD-003	26.06.08	08

BVN BlighVollerNieldArchitecture

CLIENT	PROJECT	PROJECT NORTH	GRAPHIC SCALE	SCALE	DRAWING	DRAWING NO	DATE	ISSUE
GOODMAN	AUSTRALIAN RED CROSS BLOOD SERVICE		0 4000 10000	1:400 at A3	FLOOR PLAN - GROUND LEVEL	SD-004	26.06.08	08

APPENDIX C

Figures



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W4771/V2
28 July 2008

17 O'Riordan Street, Alexandria
Flood Study

FIGURE C1
PEAK FLOOD DEPTH - 1% AEP 60m
EXISTING SITE LAYOUT
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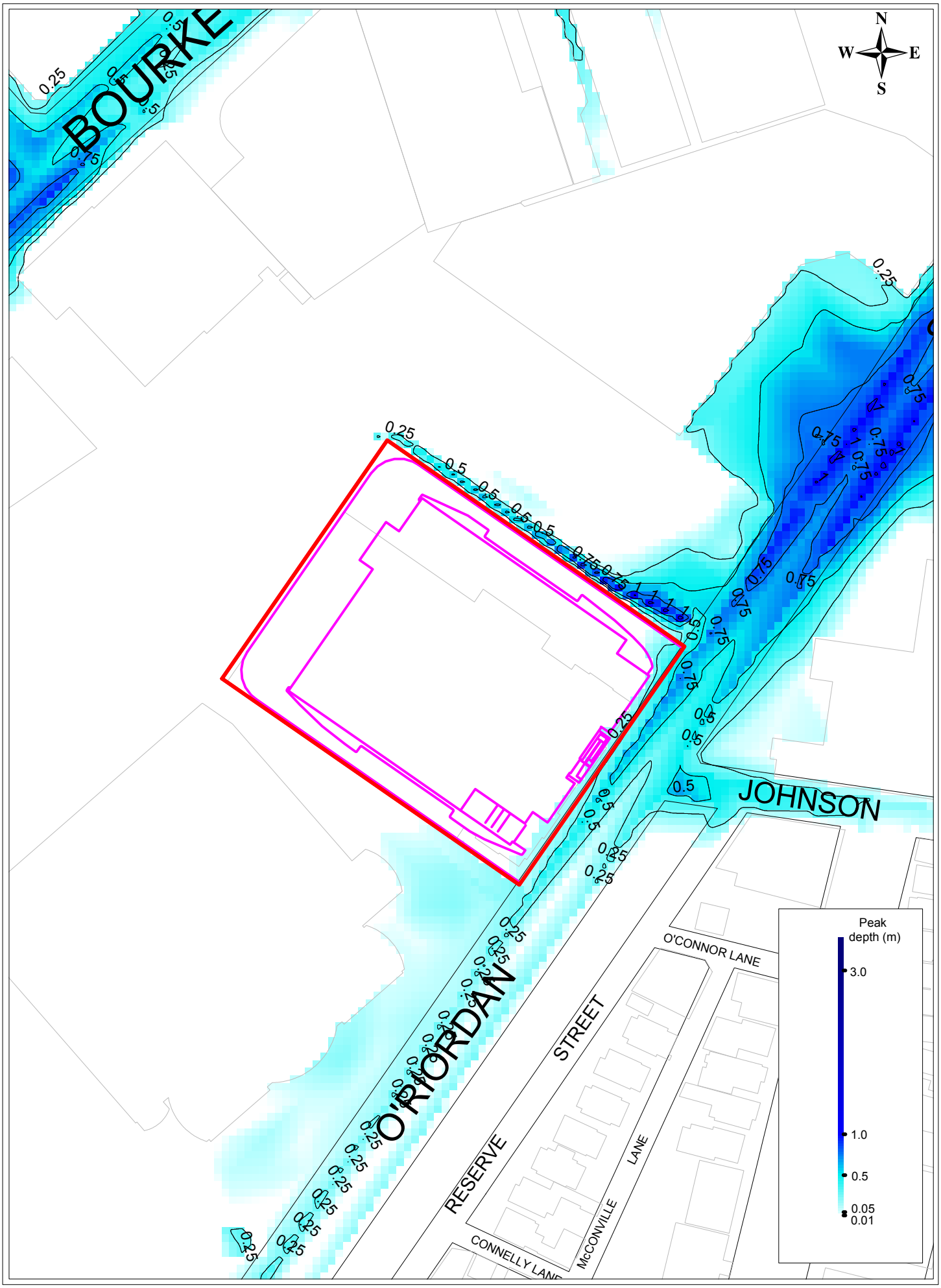

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28 July 2008

17 O'Riordan Street, Alexandria
Flood Study

FIGURE C2
PEAK FLOOD DEPTH - 1% AEP 60m
PROPOSED SITE LAYOUT
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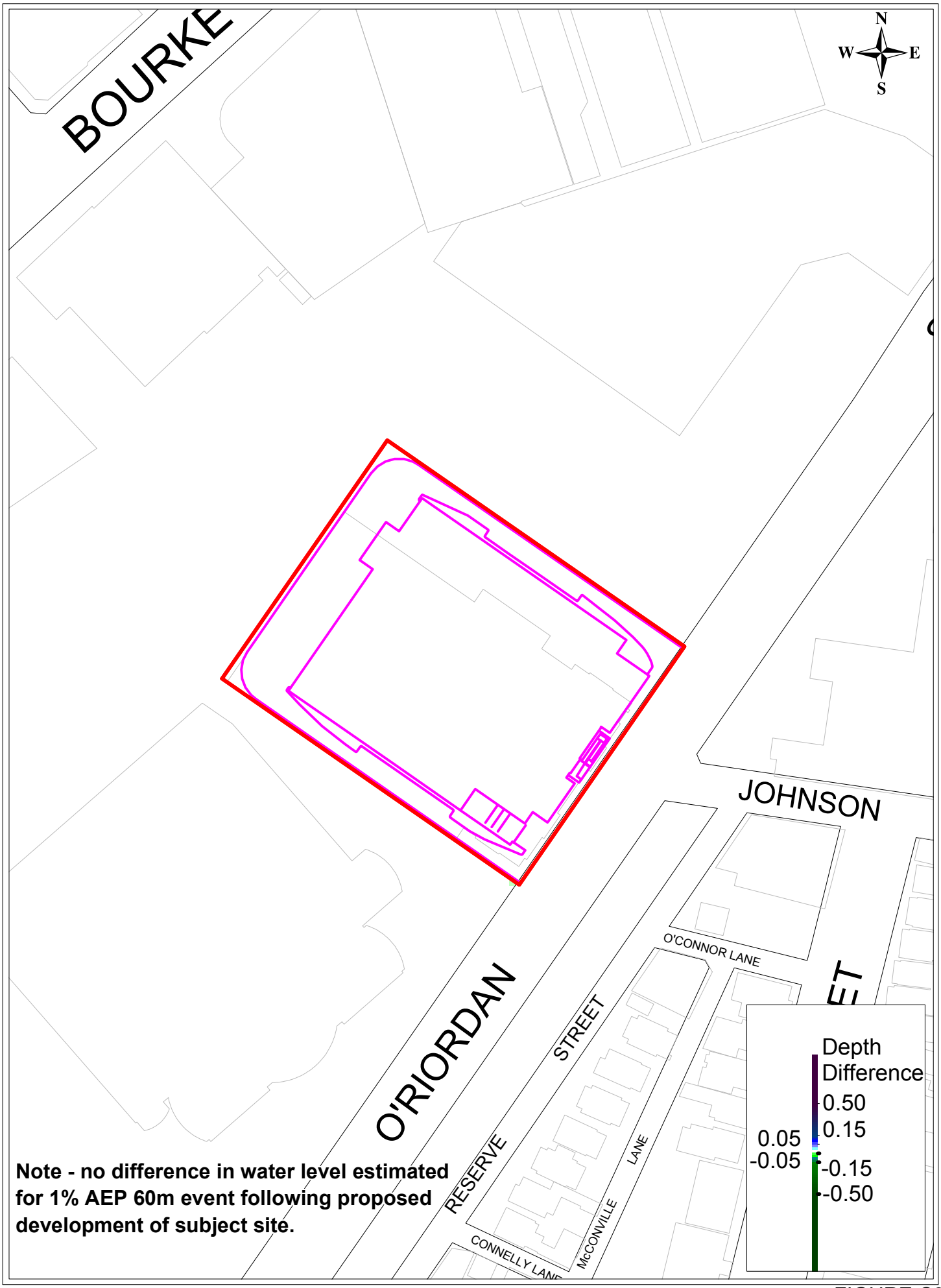

Cardno Lawson Treloar

FIGURE C3
PEAK LEVEL DIFFERENCE- 1% AEP 60m
PROPOSED LAYOUT minus EXISTING

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28 July 2008

17 O'Riordan Street, Alexandria
Flood Study

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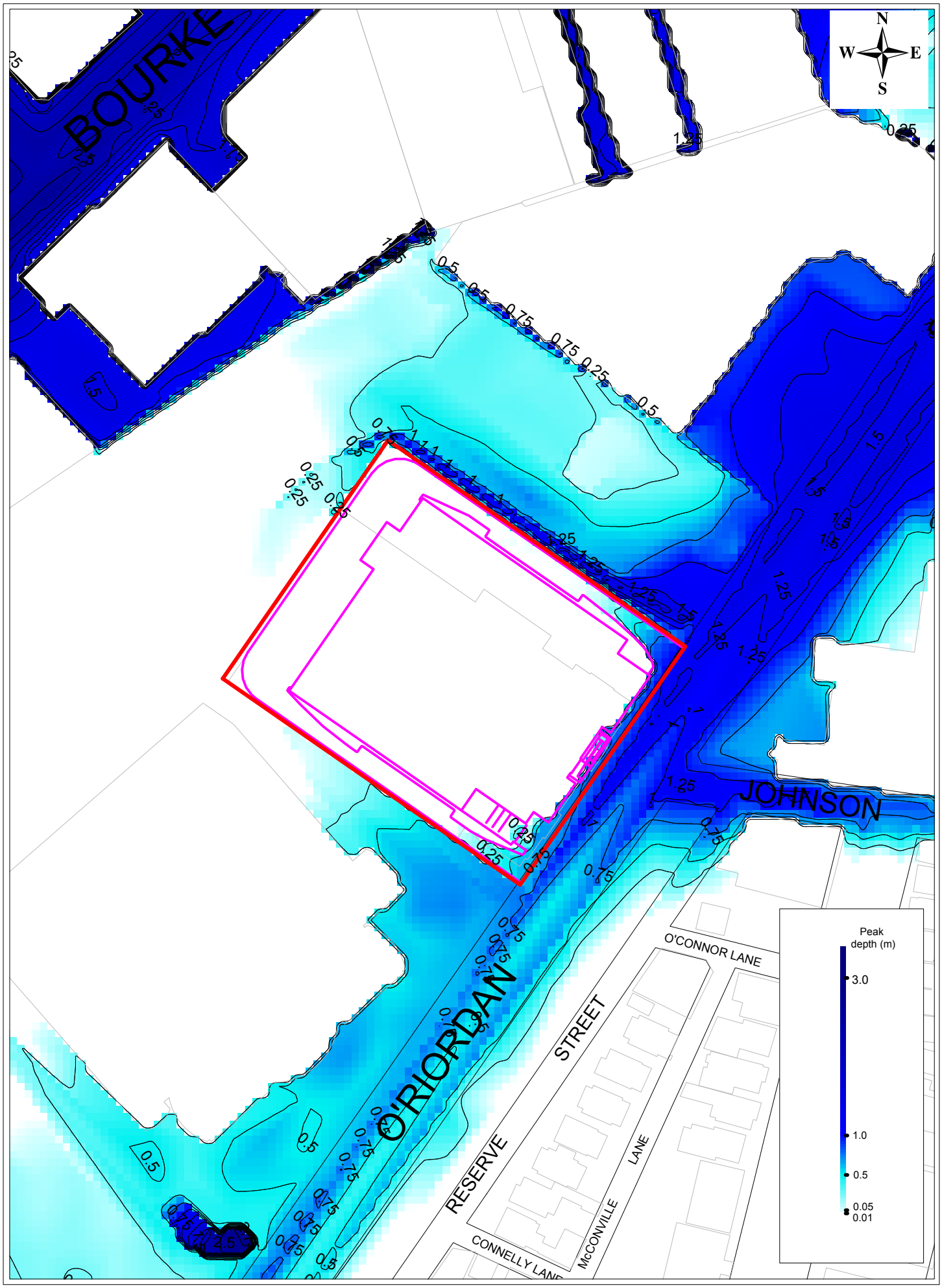

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28 July 2008

17 O'Riordan Street, Alexandria
Flood Study

FIGURE C4
PEAK FLOOD DEPTH - PMF 45m
PROPOSED SITE LAYOUT
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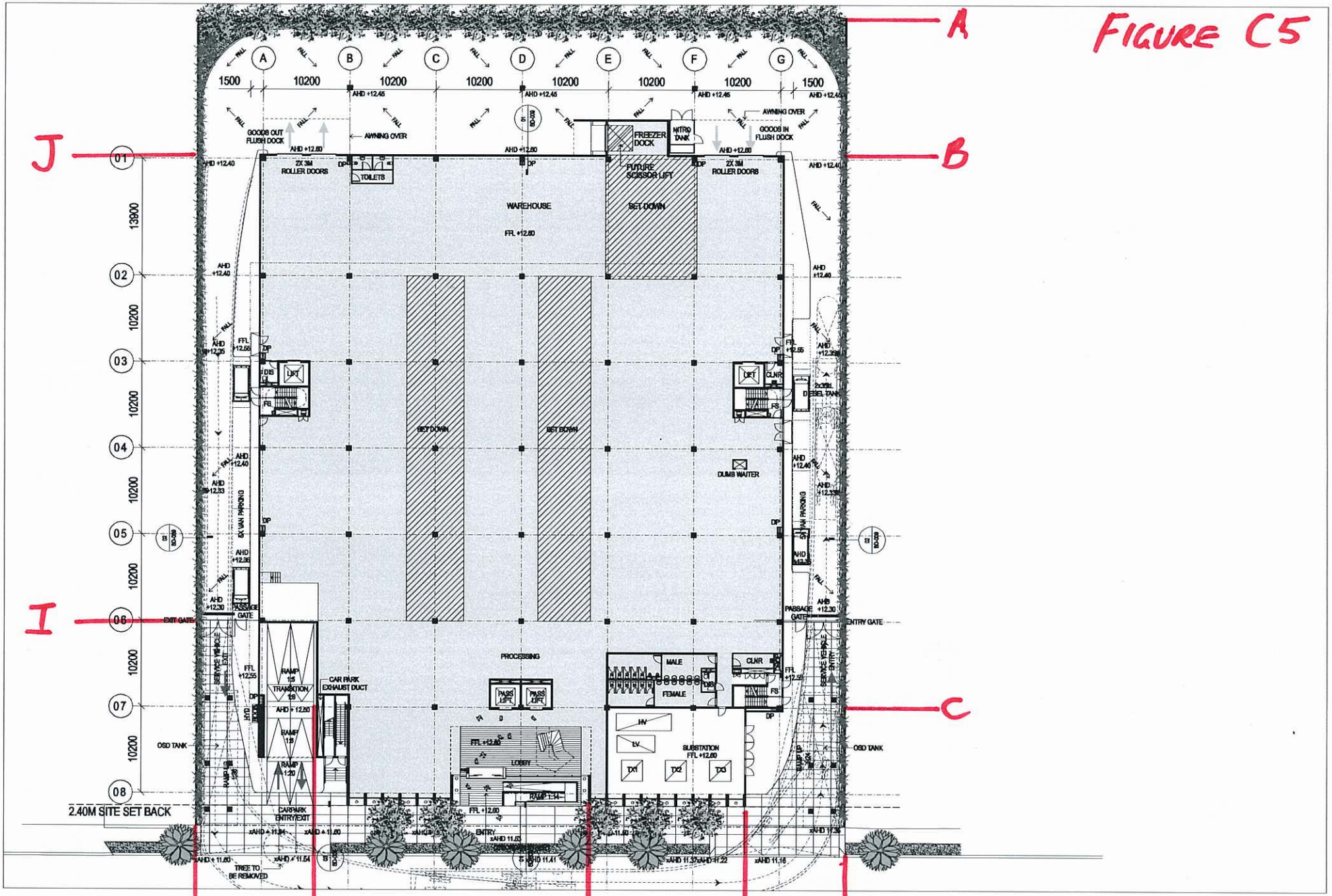
FIGURE C5



BVN BlightVollerNield Architecture

CLIENT: GOODMAN

PROJECT: AUSTRALIAN RED CROSS BLOOD SERVICE

PROJECT NORTH

GRAPHIC SCALE: 0 4000 10000

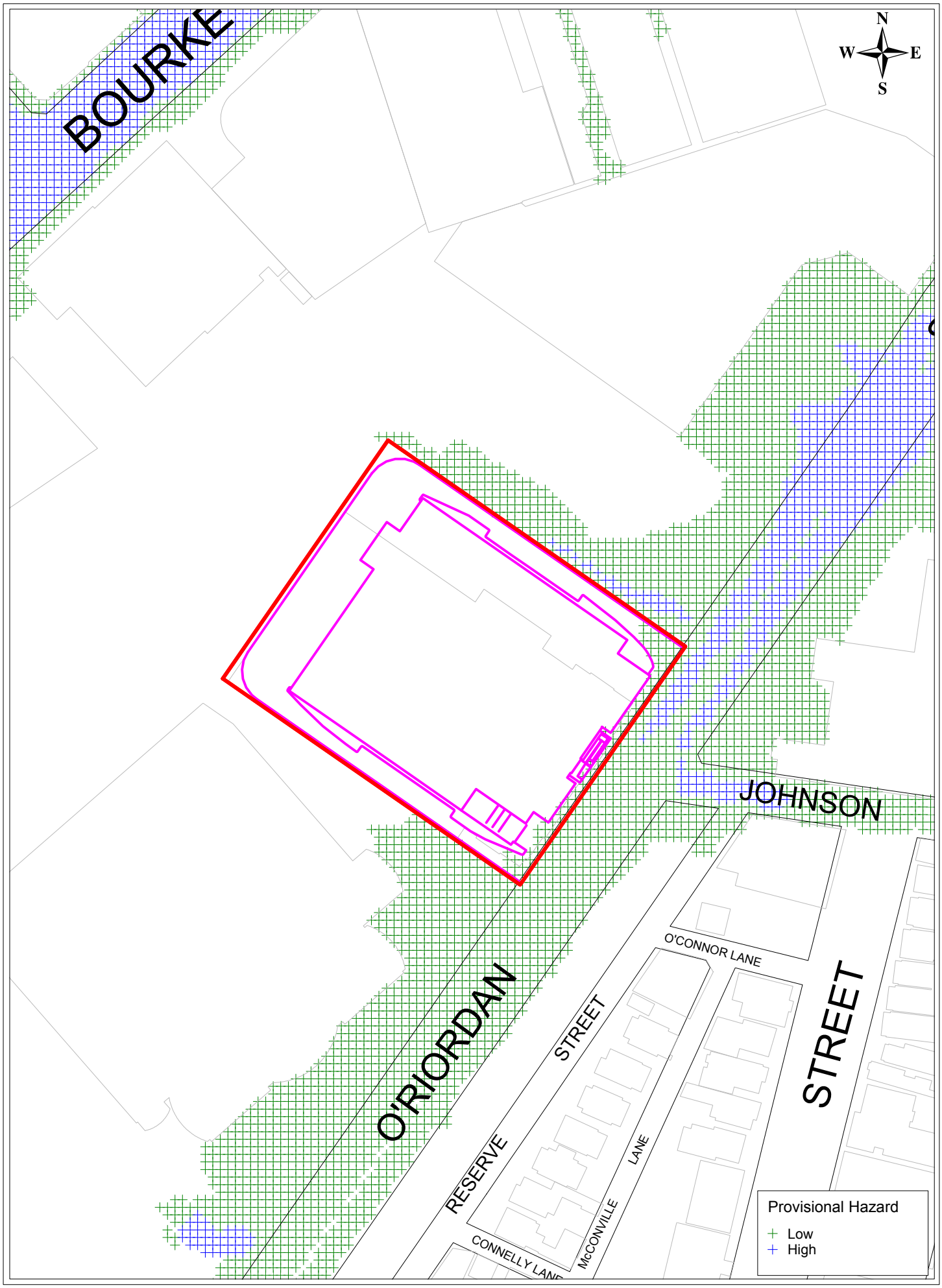
SCALE: 1:400 at A3

DRAWING: FLOOR PLAN - GROUND LEVEL

DRAWING NO: SD-004

DATE: 26.06.06

ISSUE: 08



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W4771/V2
28 July 2008

17 O'Riordan Street, Alexandria
Flood Study

FIGURE C6
PROVISIONAL HAZARD - 1% AEP 60m
PROPOSED SITE LAYOUT
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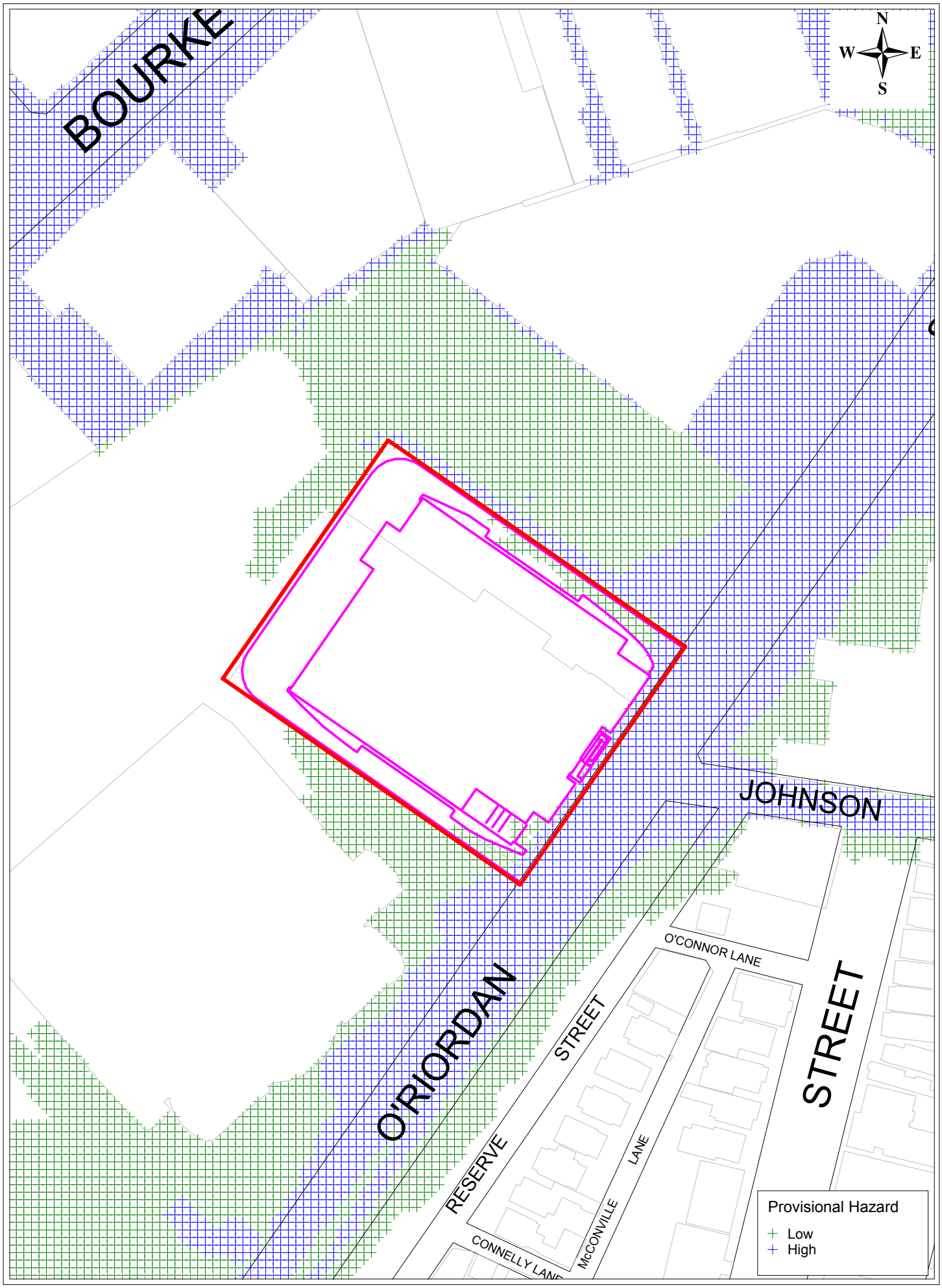

Cardno Lawson Treloar

W4771/V2
28 July 2008

17 O'Riordan Street, Alexandria
Flood Study

FIGURE C7
PROVISIONAL HAZARD - PMF 45m
PROPOSED SITE LAYOUT
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