Flood Study Report

Bunnings Warehouse, Bonnyrigg

NA49913151-016

Prepared for
Bunnings Group Limited

10 July 2015

Cardno
Shaping the Future

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Document Information

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1	10/07/2015	Issue	Sabina Lohani	Andrew Reid

Table of Contents

Appendices

1 Introduction

A development application for a new Bunnings Waterhouse at 1-19 Bonnyrigg Avenue, Bonnyrigg has been lodged with Fairfield City Council (DA 71.1 / 2015). The subject site comprises two lots as shown in Figure 1-1, with one an undeveloped parcel and the other previously used as a bus depot. An existing Bunnings Warehouse on the property to the north (21 Bonnyrigg Avenue) is proposed to cease operation when the subject site is completed.

This Flood Study reviews local overland flood behaviour at the subject site and is supplementary to the previous Flood Impact Assessment report prepared by Cardno on 29 January 2015.

Figure 1-1 Site Locality (Aerial Image Source: Nearmap)

1.1 Flood Impact Assessment Report (January 2015)

Henty Creek, located near the western boundary of the subject site, is a tributary of Clear Paddock Creek which was assessed in the Flood Study for Orphan School Creek, Green Valley Creek and Clear Paddock Creek prepared by Sinclair Knight Merz in October 2008. The Cardno Flood Impact Assessment Report (2015) reviewed the flood inundation defined in the 2008 Study and concluded that the proposed development satisfied the requirements of Chapter 11 – Flood Risk Management of the Fairfield City Wide Development Control Plan 2013 Amendment 7.

2 Council Request for Information

Fairfield City Council reviewed the development application for the subject site and advised in their letter (Reference 71.1 / 2015, dated 15 May 2015) that additional information was required for assessment. Item 4 in relation to flooding stated:

The site is located within a part low and part no flood risk precinct as a result of mainstream flooding and also may be affected by local overland flooding which has not yet been risk mapped by Council. A Flood Impact Assessment has been submitted however it does not address the overland flooding that may affect the site. Accordingly the applicant shall address the following matters raised by Council's engineers:

1. *A copy of the flood information sheets, obtainable via the Section 149 (2) & (5) Planning Certificate process, for all lots in the development shall be submitted to Council.*
2. *Council's records indicate that the sites may be subject to local overland flooding which has not yet been risk mapped by Council. In this regard, a flood study prepared by a suitably qualified civil engineer, competent in flood analysis, to determine the extent, depth and velocity of any overland flow affecting the site shall be submitted to Council.*
3. *Following the flood study, a revision of the flood risk management may be required and any revisions shall be submitted to Council together with the flood study.*

2.1 Flood Information Sheets

Flood Information Sheets for the two subject lots, 1-9 Bonnyrigg Avenue and 11-19 Bonnyrigg Avenue, are attached as Appendix B.

2.2 Local Overland Flooding

The Fairfield City Overland Flood Study, prepared by Sinclair Knight Merz in December 2004, identified potential overland flow flood paths at the southern and northern boundaries of the subject sites. Flow behaviour in these flowpaths is detailed in Section 5 of this Flood Study Report.

2.3 Flood Risk Management

Flow behaviour within the site is identified as of low hazard as detailed in Section 5.

3 Available Data

3.1 Three Tributaries Study

The Flood Study for Orphan School Creek, Green Valley Creek and Clear Paddock Creek (referred to as the three tributaries of Prospect Creek) prepared by Sinclair Knight Merz in October 2008 assessed mainstream flooding along these watercourses. Two road crossings of Henty Creek are located near the subject site and the drainage culverts at these are:

- Elizabeth Drive - 8 x (3.3 m x 0.75 m) and two 1.8 m diameter; and
- Bus Transit Way (LPT Way) - 8 x (3.3 m x 0.75 m).

Peak flood levels were also defined which are reviewed for verification of the overland flow model detailed in Section 4.

3.2 Council Data

Fairfield City Council provided ground elevations in the catchment area of the subject site as Aerial Laser Survey (ALS) ground elevations. Council's GIS of stormwater pit and pipe layout was viewed following a meeting with Council on 27 May 2015.

3.3 Detailed Survey

Detailed ground survey for the existing site by Craig and Rhodes (dated 28/10/2014) is attached as Appendix C.

3.4 Site Visit

A site inspection of the study area 27 May 2015 allowed identification of localised hydraulic controls and catchment characteristics for the establishment of the model. Appendix D includes some photographs from the inspection.

3.5 Proposed Development

The proposed development of the subject site is shown on the drawings by John R. Brogan & Associates (Revision P2, dated 08.07.2015) attached as Appendix E. C&M Consulting Engineers prepared detailed stormwater drainage and on-site detention drawings and driveway grading information for the proposed development.

4 Flood Model Setup

Subcatchments of the two identified flowpaths (at the northern and southern boundary of the subject site) were estimated based on the elevation contours as shown in Figure A1 (in Appendix A). The contributing catchment areas for the southern flowpath (labelled A) is 3.28 ha and for the northern flowpath (labelled B) is 3.23 ha.

4.1 Hydraulic Model

A SOBEK 1D and 2D fully dynamic hydraulic model with direct rainfall was established to estimate overland flow behaviour at the site. Design rainfall intensities for the 100 year Average Recurrence Interval (ARI) event were adopted from the Fairfield City Council Stormwater Drainage Policy (2002) as listed in Table 4.1.

Table 4.1: Design Rainfall Intensities

Event Duration	100 Year ARI (mm/h)
10 min	168.11
30 min	98.87
60 min	67.31
120 min	44.68

The SOBEK model for the assessment covered an area of about 85 ha on a 2 m by 2 m grid cell network. Elevations for the model grid were adopted primarily from the ALS provided by Council. Surface roughness was modelled for the various landuses based on aerial photography, land-use zones and site inspection as shown in Figure A2 with parameters listed in Table 4.2. A downstream boundary water level for the model was estimated as 39 m AHD for the 100 year ARI event based on the peak flood levels from the SKM 2008 Flood Study.

Table 4.2 Surface Roughness Parameters

Landuse	Roughness Parameter
Residential Area	0.06
Grass (maintained)	0.04
Grass (dense)	0.05
Road	0.02
Dense Riparian Vegetation	0.08
Concrete Areas	0.02

4.2 Pits and Pipes

Pit and pipe drainage conveying runoff upstream and across the subject site was input to the model as 1D elements based on data from Council and ground survey by Craig & Rhodes. Culverts crossing Elizabeth Drive and the bus transitway were modelled as listed in Section 3.1.

Council's policy requires a blockage factor to be applied to surface inlet pits – 50% for sag pits and 20% for on-grade pits. In the SOBEK model, pit inlet capacities are restricted to maximum flows as shown in Figure A3, also accounting for some locations where two inlets in close proximity have been modelled as a single pit.

4.3 Proposed Development

Overland flow modelled for the existing scenario (described in Section 5) shows inundation of the subject site near the northern boundary. A model of the proposed development scenario was established by incorporating the design elevations of the northern driveway (by C&M Consulting Engineers) to assess behaviour of the only location where existing overland flow enters the subject site.

5 Flood Model Results

5.1 Model Verification

Results from the SOBEK flood model were reviewed in comparison to peak flood levels presented in the Flood Study for Orphan School Creek, Clear Paddock Creek and Green Valley Creek (SKM 2008). Peak water levels for the 100 year ARI event from the two models are summarised in Table 5.1 for locations shown in Figure A4 (in Appendix A). These results show close agreement between the two models and thus the SOBEK model is considered suitable for the overland flow assessment for the proposed development at the subject site.

Table 5.1 Modelled Peak Water Level Comparison (m AHD)

Reference Location	SOBEK Model	SKM 2008 Flood Study
A (u/s of Elizabeth Dr)	41.03	41
B (d/s of Elizabeth Dr)	40.83	40.8
C (u/s of LPT Way)	40.08	40
D (u/s of Smithfield Rd)	39.08	39

5.2 Existing Scenario Results

A storm event of 30 minutes duration in a 100 year ARI event was found to be the critical duration at the site from the modelled durations of 10 min, 30 min, 60 min and 120 minutes.

Figures A5 and A6 show the modelled 100 year ARI peak depths and peak velocity. These results are filtered to show flow depths greater than 0.1m to highlight the primary flows and exclude minor localised runoff and depths.

In a 100 year ARI event, the modelling shows the two overland flowpaths are independent. On the northern side of the subject site, runoff ponds in the lowpoint of Bonnyrigg Avenue which is conveyed in the pipe drainage system westward to the creek corridor. Some flow spills into the northern corner of the subject site but the majority of excess flow is conveyed overland through the carpark on 21 Bonnyrigg Avenue. At the southern side of the site, some runoff ponds at the pits on Bonnyrigg Avenue at the intersection of Elizabeth Drive but a consistent flowpath (of depth >0.1m) is not shown along Elizabeth Drive westward to the creek.

5.3 Proposed Development Scenario Results

Figures A7 and A8 (in Appendix A) show the modelled 100 year ARI peak depth and velocity results for the proposed development scenario. A 100 year ARI peak water level of 46.21 m AHD is estimated at the Bonnyrigg Avenue lowpoint near the proposed northern driveway. The peak flowrate of overland flow spilling from this location (shown in Figure A10) over the proposed driveway into the site is 0.45 m^3/s. Figure 5.1 shows the flow time-series modelled over the driveway into the site.

When considering pedestrian and vehicular stability, three velocity x depth criteria have been identified historically as follows:

- ≤ 0.4 m^2/s This is typically adopted by Councils as a limit of stability for pedestrians
- 0.4 – 0.6 m^2/s Unsafe for pedestrians but safe for vehicles if overland flood depths do not exceed around 0.3 m
- > 0.6 m^2/s This is typically adopted by Councils as a limit of stability for vehicles

Figure A9 shows the peak velocity x depth modelled for the 100 year ARI event showing low risk surface inundation across the subject site, 21 Bonnyrigg Avenue, and Bonnyrigg Avenue. The peak water depth across the crest of the proposed northern driveway into the site would be less than 0.15m (noting the peak 100 year ARI water level of 46.21 m AHD and minimum crest level of 46.07m AHD).

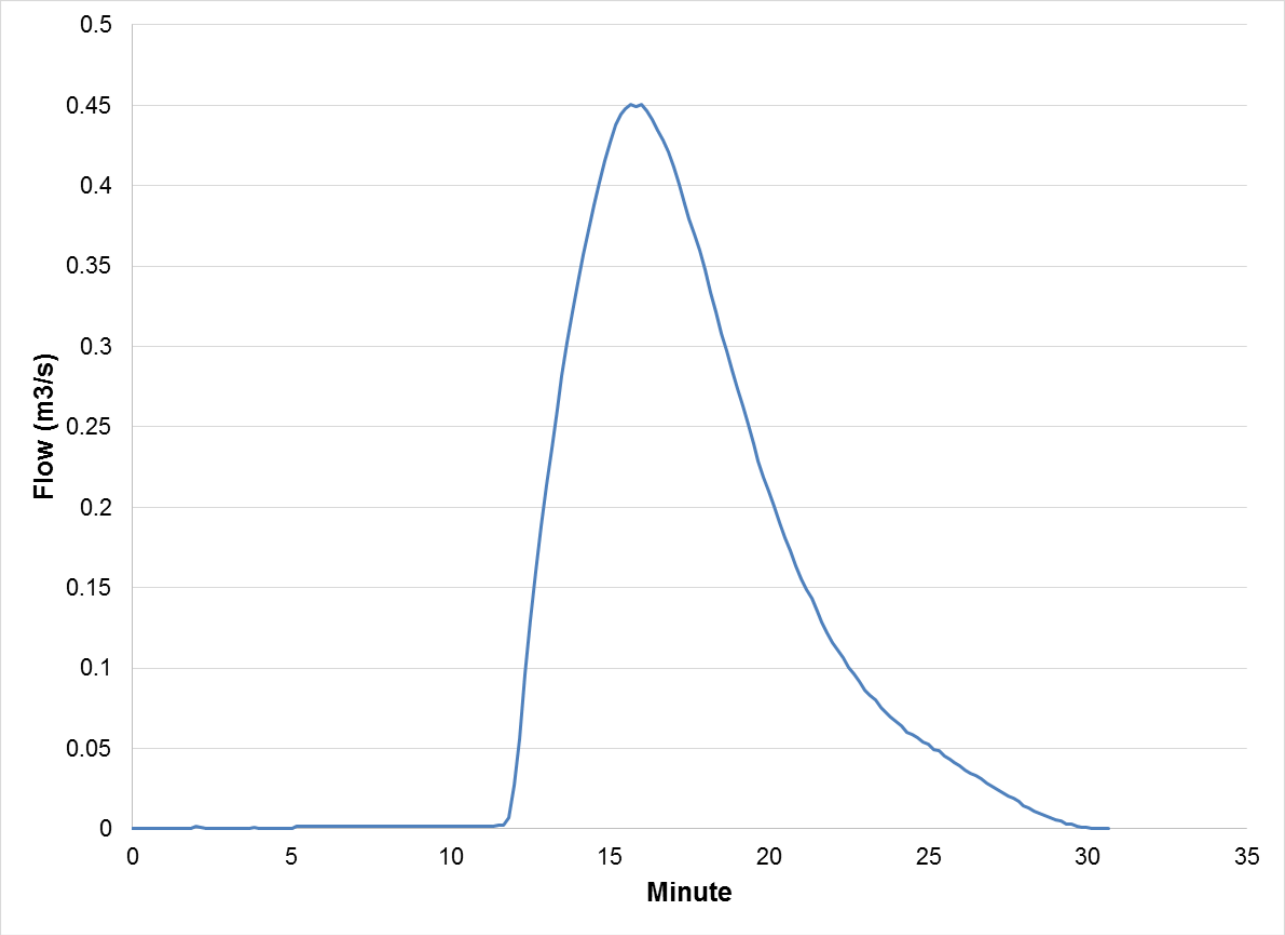

Figure 5.1 Flow from Bonnyrigg Avenue to the Subject Site

A small decrease to peak water levels post-development (shown in Figure A11) occurs at the Bonnyrigg Avenue lowpoint as the proposed driveway allows a higher flowrate of water into the site compared to the existing ground elevations. The increase shown along the southern boundary of 21 Bonnyrigg Avenue is due to the setup of the model and would not be expected to occur. This impact is shown as the increased flow into the subject site post-development is not contained on-site in the model and is discharged onto the adjacent site. However, the stormwater drainage design by C&M Consulting Engineers accommodates all overflow entering the proposed driveway into the on-site detention system, thus there is no overflow from the subject site to 21 Bonnyrigg Avenue.

6 Conclusion

Overland flow modelling using SOBEK estimates that the identified flowpaths on the northern and southern boundaries of the subject site (1-19 Bonnyrigg Avenue, Bonnyrigg) are relatively minor in a 100 year ARI event.

The proposed development does not adversely impact flood behaviour on neighbouring sites as the design by C&M Consulting Engineers manages the overland flow into the site through the on-site detention system. Overflow across the northern driveway from Bonnyrigg Avenue is less than 0.15m deep at the crest in a 100 year ARI event and has a velocity-depth product less than 0.4 m^2/s.

7 References

Fairfield City Council (2002). Stormwater Drainage Policy.

NSW Government Department of Infrastructure, Planning and Natural Resources (now Office of Environment and Heritage) (2005). Floodplain Development Manual.

Sinclair Knight Merz (2008). Orphan School Creek, Clear Paddock Creek and Green Valley Creek Flood Study.

Sinclair Knight Merz (2004). Fairfield City Overland Flood Study.

Bunnings Warehouse, Bonnyrigg

APPENDIX A

FIGURES

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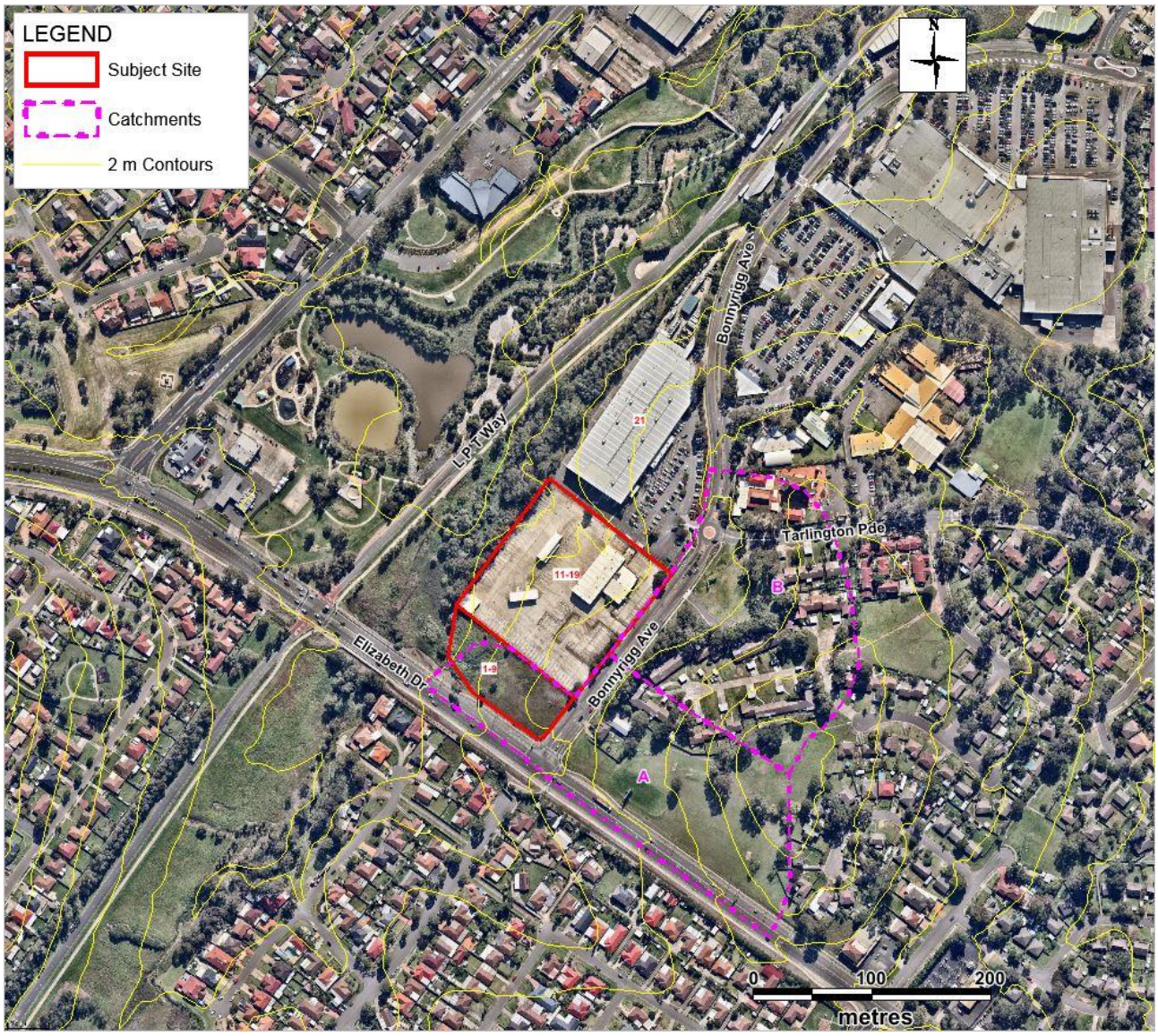

Figure A1 – Overland Flowpath Subcatchments

Figure A2– SOBEK Model Roughness

Figure A3 – Modelled Street Drainage Pits and Pipes

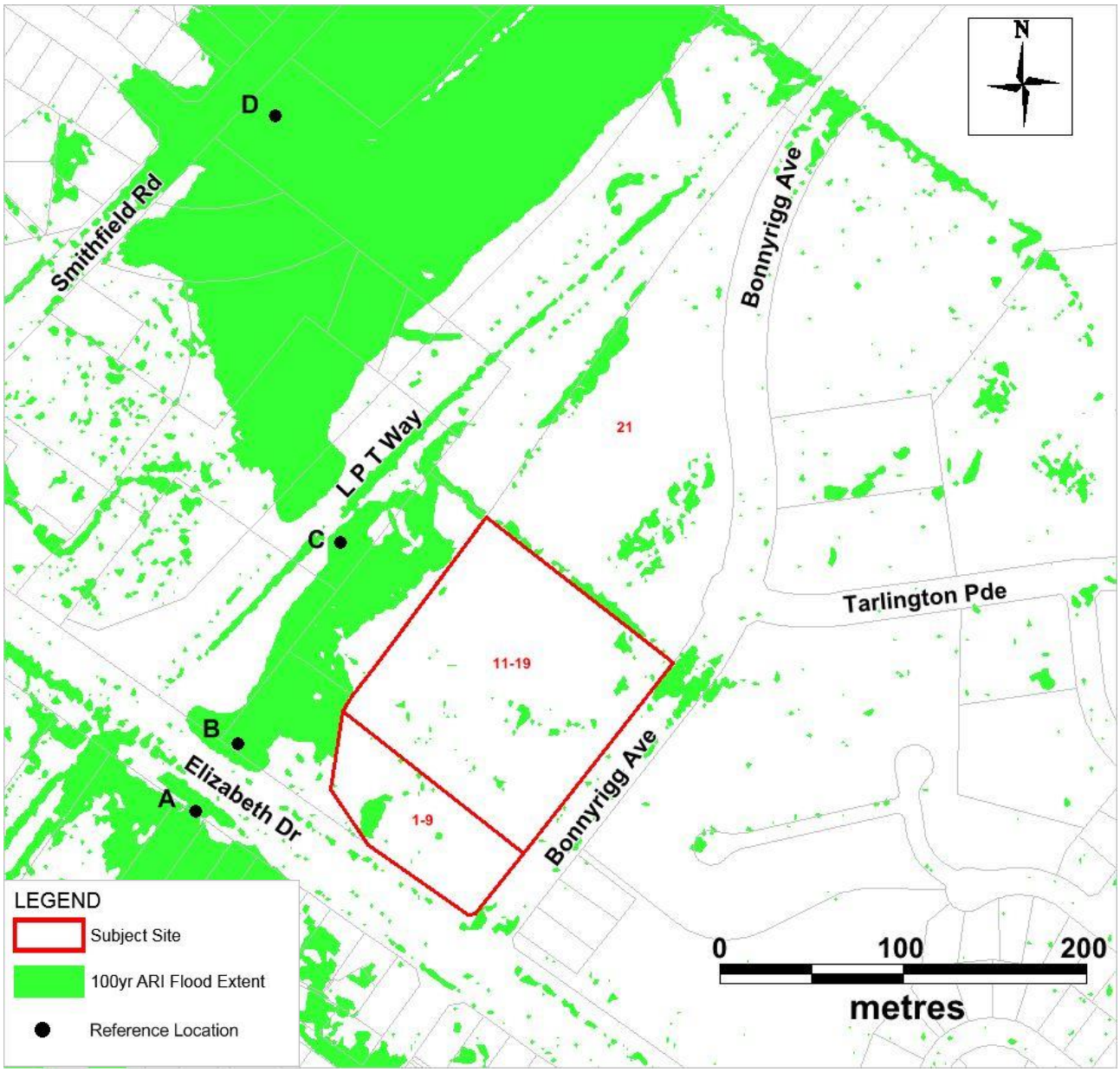

Figure A4 – Model Verification Reference Location

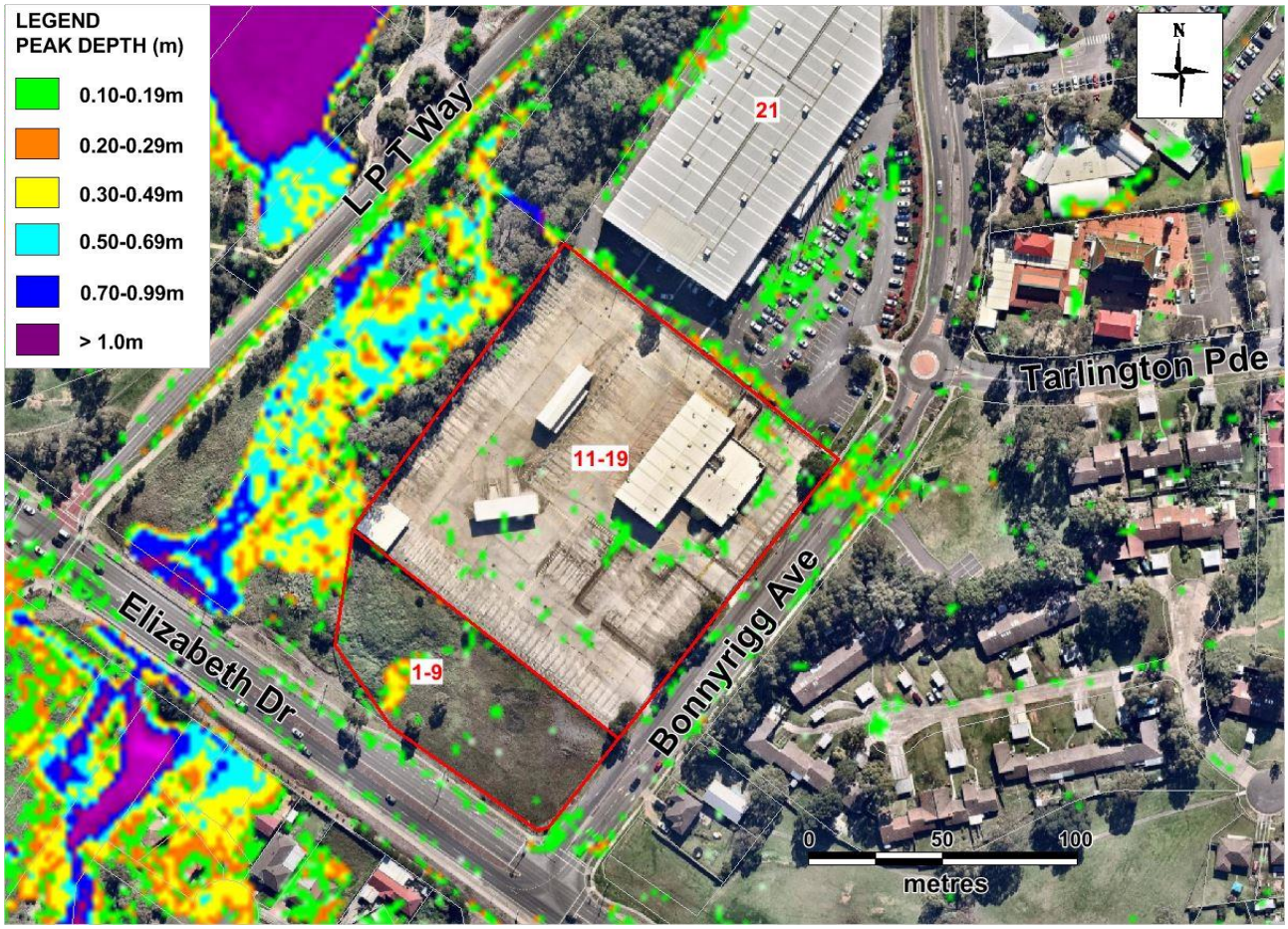

Figure A5 – 100 year ARI Existing Peak Flood Depth

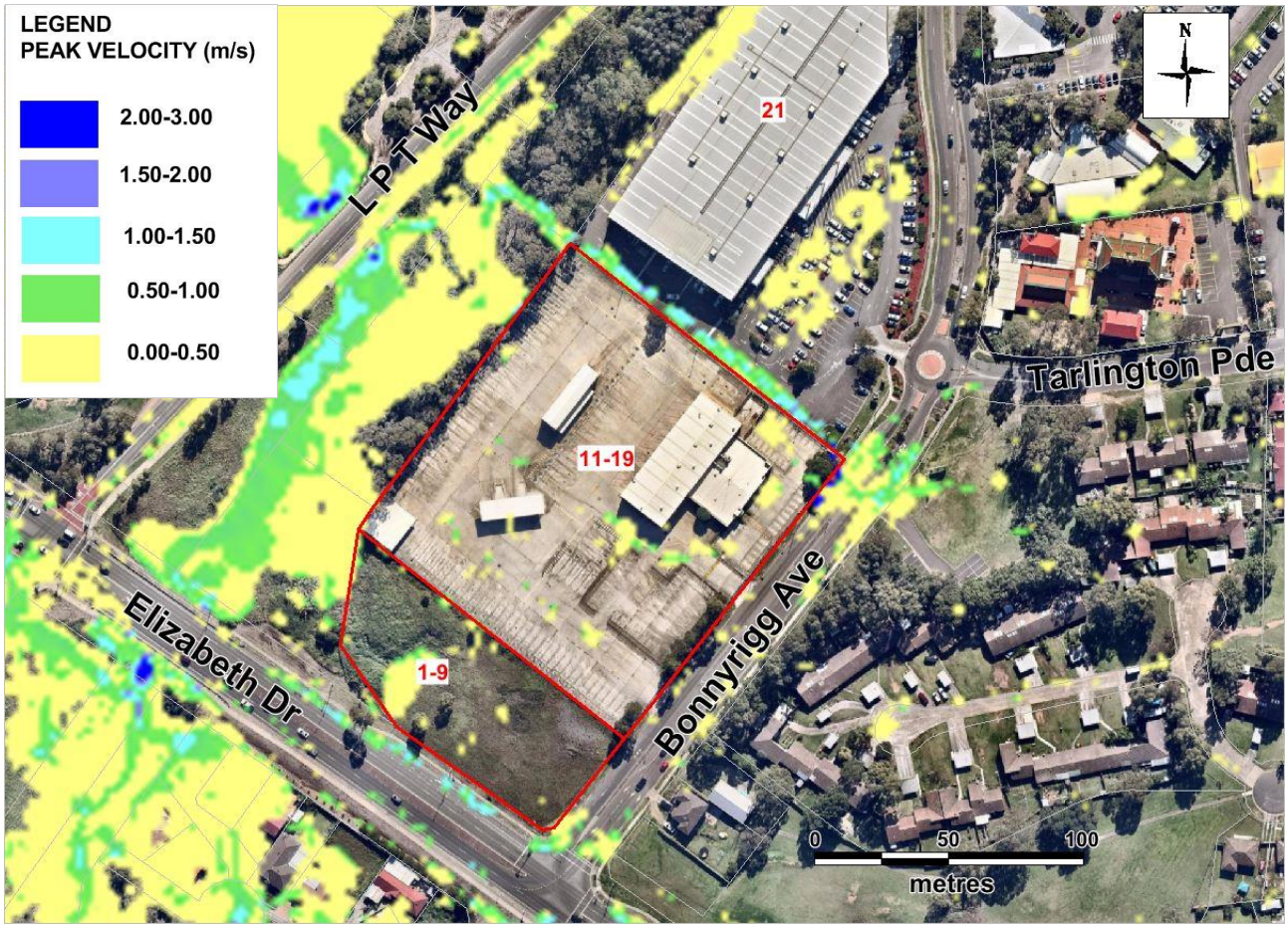

Figure A6 – 100 year ARI Existing Peak Flood Velocity

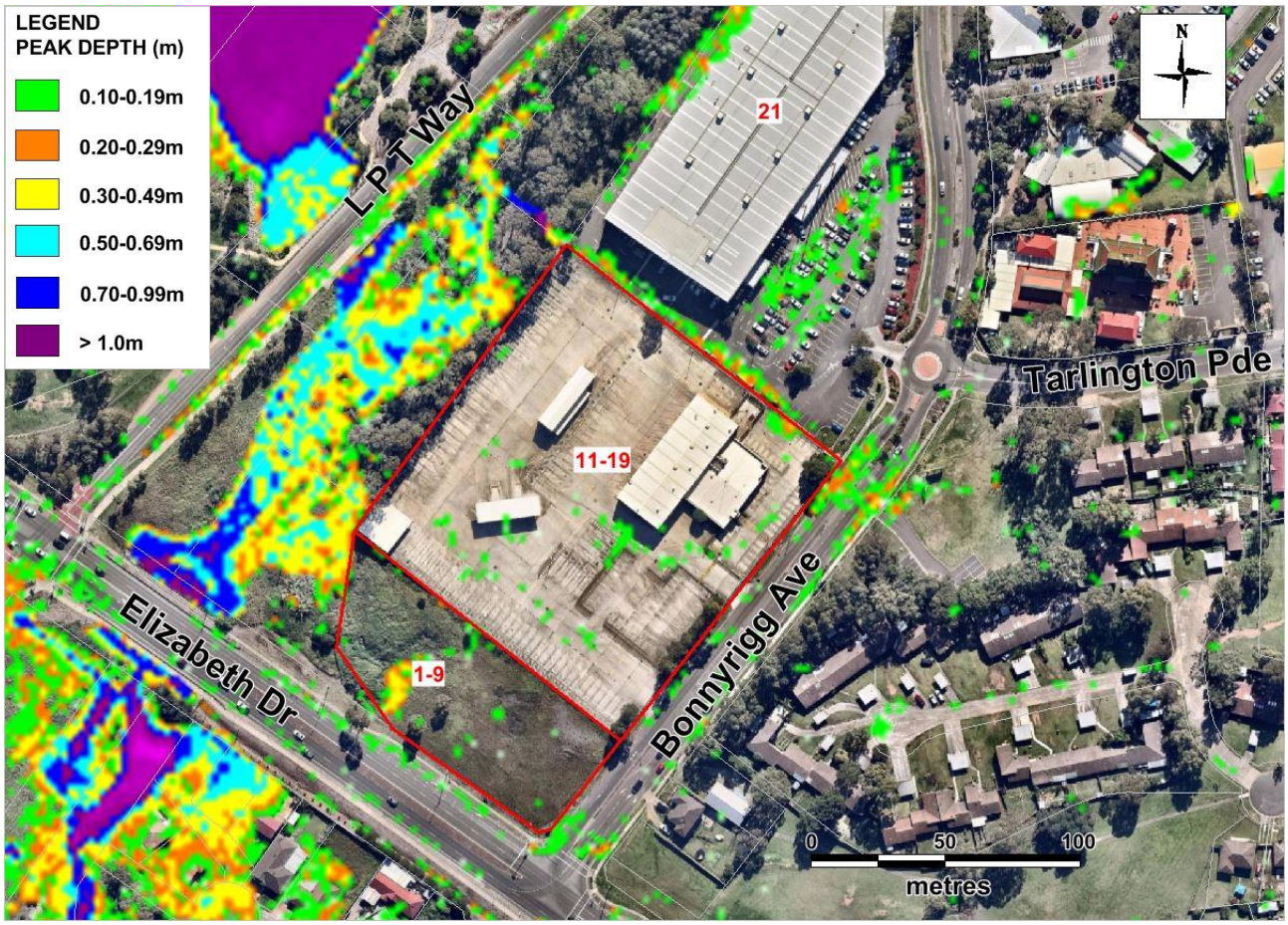

Figure A7 – 100 year ARI Proposed Peak Flood Depth

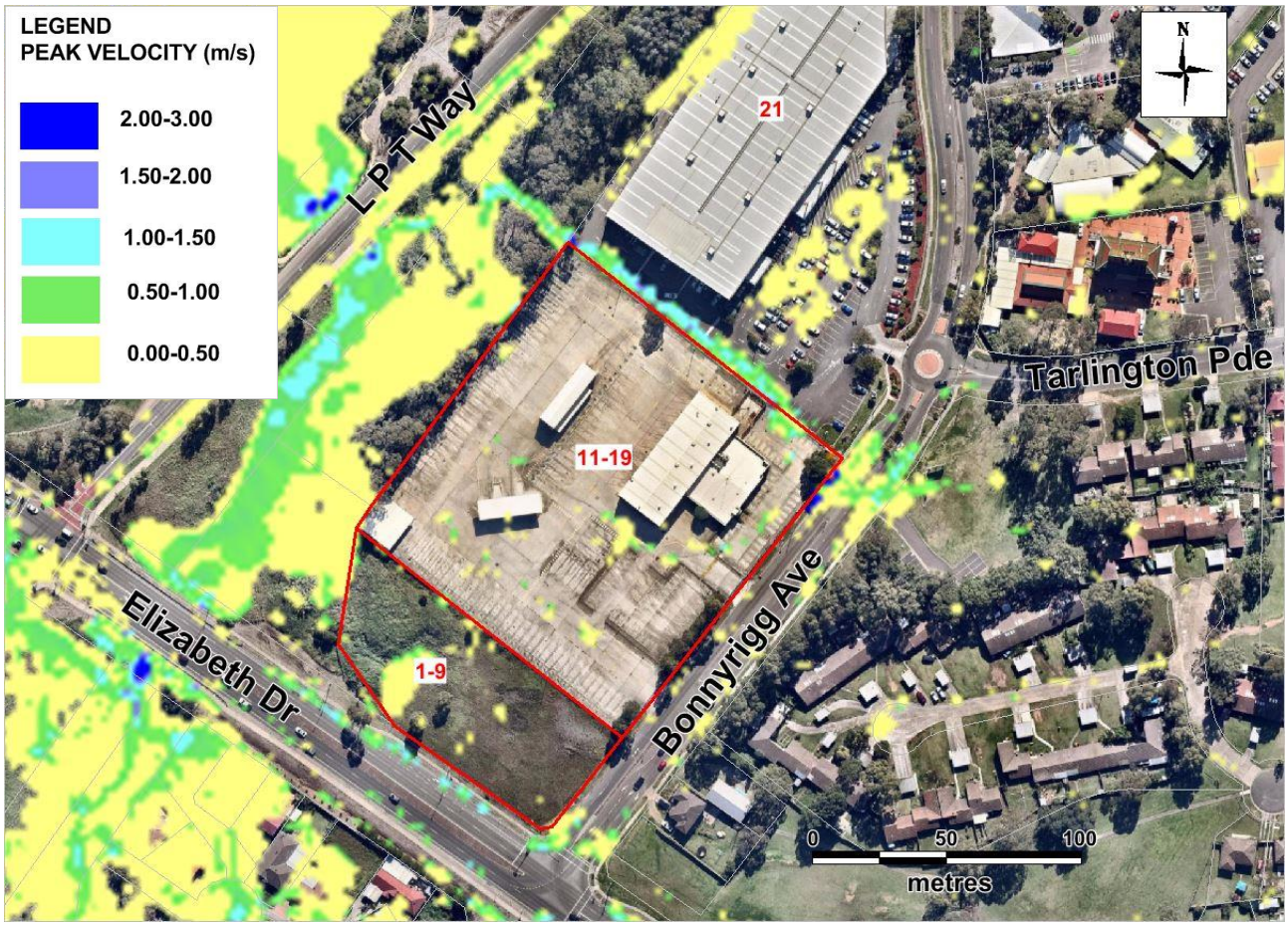

Figure A8 – 100 year ARI Proposed Peak Flood Velocity

Figure A9 – 100 year ARI Proposed Peak Flood Velocity x Depth

Figure A10 – Flow and Water Level Reference Location

Figure A11 – 100 year ARI Water Level Difference Proposed Minus Existing

Bunnings Warehouse, Bonnyrigg

APPENDIX B

FLOOD INFORMATION SHEETS

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Flood Information Sheet

Fairfield City Council
Administration Centre
86 Avoca Road
WAKELEY NSW 2176
PO Box 21
FAIRFIELD NSW 1860
Telephone: (02) 9725 0222
Facsimile: (02) 9609 3257

Applicant's Details:

Applicant's Name	**GlobalX Information Services**
Postal Address	**PO Box A250** **SYDNEY SOUTH NSW 1235**
Phone	
Fax	

Property Particulars:

House No.	**1-9**
Street & Suburb	**Bonnyrigg Avenue** **BONNYRIGG NSW 2177**
Lot Description	**Lot 2** **DP 1071647**

Council has adopted a policy on flooding which may restrict the development of land. The Fairfield City-Wide Development Control Plan 2013 (which includes provisions for flood management) applies to all of the Fairfield Local Government area.

Part or all of this land may be affected by mainstream flooding.

Part or all of this land may be affected by local overland flooding.

MAINSTREAM FLOODING

Description

This parcel is identified as being partly within a **Low** Flood Risk Precinct and partly **not affected** by mainstream flooding.

Mainstream Flood Details

Size of Flood	Flood Level (m AHD)
Probable Maximum Flood (PMF)	42.4-42.6
100 Year ARI	Not Applicable
50 Year ARI	Not Applicable
20 Year ARI	Not Applicable

Flood levels in the vicinity of the above property have been extracted from the Sinclair Knight Merz & Fairfield Consulting Services (2008) *Flood Study for Orphan School Creek, Green Valley Creek and Clear Paddock Creek.*

Note: Existing flood information is currently under review. New flood levels may be available late 2014. Please contact Council late 2014 for any updated information.

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GLOSSARY

m AHD	metres Australian Height Datum (AHD).
Australian Height Datum (AHD)	A common national plane of level approximately equivalent to the height above sea level. All flood levels, floor levels and ground levels are normally provided in metres AHD.
Average Recurrence Interval (ARI)	The long term average number of years between the occurrence of a flood as big as the selected event. For example, floods with a discharge as great as the 20 year ARI event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event.
flood	A relatively high stream flow that overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam. It also includes local overland flooding associated with major drainage before entering a watercourse, or coastal inundation resulting from raised sea levels, or waves overtopping the coastline.
flood risk precinct	An area of land with similar flood risks and where similar development controls may be applied by a Council to manage the flood risk. The flood risk is determined based on the existing development in the precinct or assuming the precinct is developed with normal residential uses. Usually the floodplain is categorised into three flood risk precincts 'low', 'medium' and 'high', although other classifications can sometimes be used. **High Flood Risk:** This has been defined as the area of land below the 100-year flood event that is either subject to a high hydraulic hazard or where there are significant evacuation difficulties. **Medium Flood Risk:** This has been defined as land below the 100-year flood level that is not within a High Flood Risk Precinct. This is land that is not subject to a high hydraulic hazard or where there are no significant evacuation difficulties. **Low Flood Risk:** This has been defined as all land within the floodplain (i.e. within the extent of the probable maximum flood) but not identified within either a High Flood Risk or a Medium Flood Risk Precinct. The Low Flood Risk Precinct is that area above the 100-year flood event.
local overland flooding	The inundation of normally dry land by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam.
mainstream flooding	The inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam.
probable maximum flood (PMF)	The largest flood that could conceivably occur at a particular location.

Fairfield City Council
Administration Centre
86 Avoca Road
WAKELEY NSW 2176
PO Box 21
FAIRFIELD NSW 1860
Telephone: (02) 9725 0222
Facsimile: (02) 9609 3257

Flood Information Sheet

Applicant's Details:

Applicant's Name	**GlobalX Information Services**
Postal Address	**PO Box A250** **SYDNEY SOUTH NSW 1235**
Phone	
Fax	

Property Particulars:

House No.	**11-19**
Street & Suburb	**Bonnyrigg Avenue** **BONNYRIGG NSW 2177**
Lot Description	**Lot 1** **DP 1071647**

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Part or all of this land may be affected by mainstream flooding.

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MAINSTREAM FLOODING

Description

This parcel is identified as being partly within a **Low** Flood Risk Precinct and partly **not affected** by mainstream flooding.

Mainstream Flood Details

Size of Flood	Flood Level (m AHD)
Probable Maximum Flood (PMF)	41.6-42.4
100 Year ARI	Not Applicable
50 Year ARI	Not Applicable
20 Year ARI	Not Applicable

Flood levels in the vicinity of the above property have been extracted from the Sinclair Knight Merz & Fairfield Consulting Services (2008) *Flood Study for Orphan School Creek, Green Valley Creek and Clear Paddock Creek.*

Note: Existing flood information is currently under review. New flood levels may be available late 2014. Please contact Council late 2014 for any updated information.

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GLOSSARY

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flood	A relatively high stream flow that overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam. It also includes local overland flooding associated with major drainage before entering a watercourse, or coastal inundation resulting from raised sea levels, or waves overtopping the coastline.
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probable maximum flood (PMF)	The largest flood that could conceivably occur at a particular location.

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APPENDIX C

GROUND SURVEY

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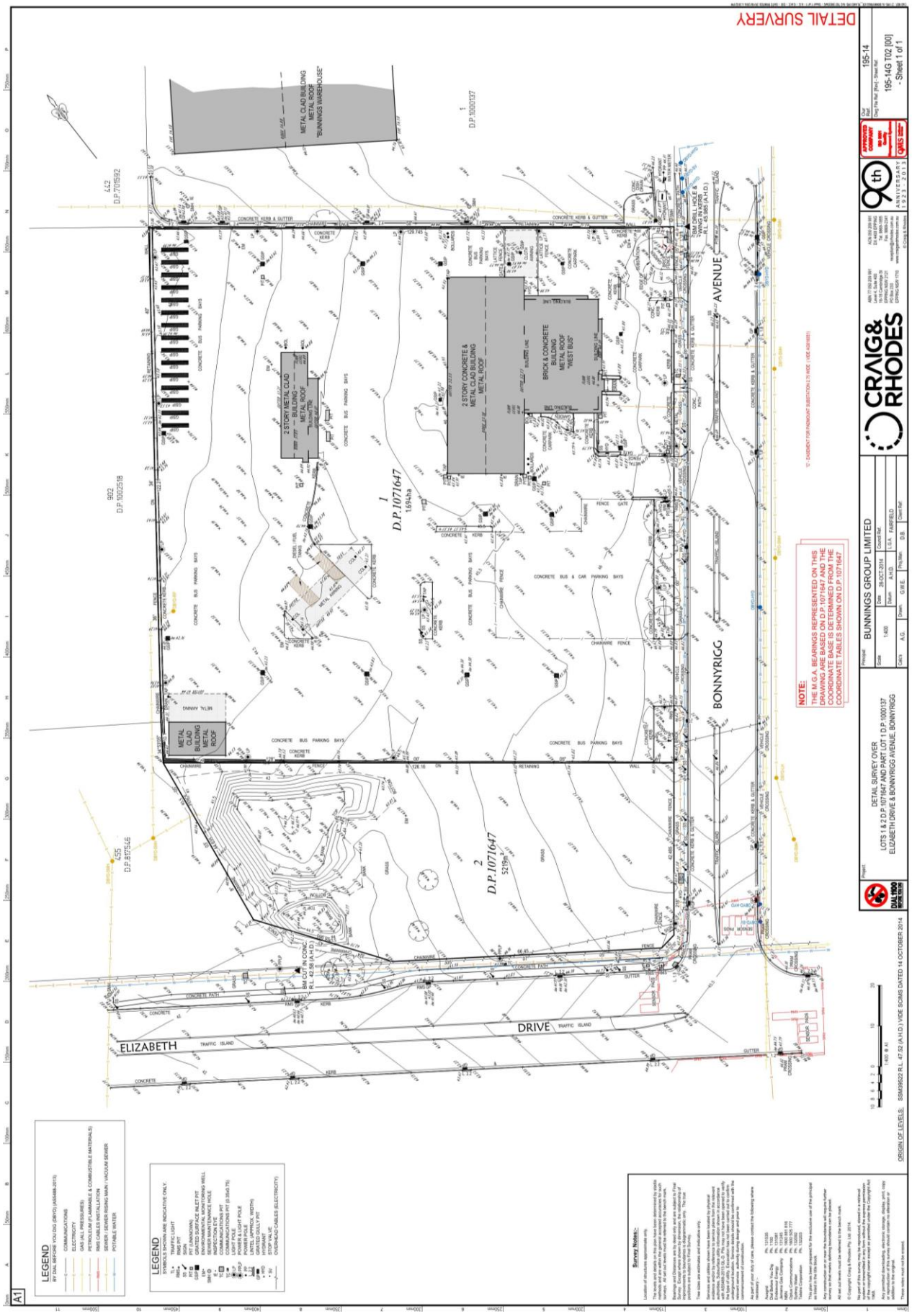
DETAIL SURVEY
BUNNINGS GROUP LIMITED
DETAIL SURVEY OVER
LOTS 1 & 2 D.P.1071647 AND PART LOT 1 D.P.1000137
ELIZABETH DRIVE & BONNYRIGG AVENUE, BONNYRIGG
CRAIG & RHODES
195-14
195-14G T02 [00]
- Sheet 1 of 1
BONNYRIGG AVENUE
ELIZABETH DRIVE
METAL CLAD BUILDING METAL ROOF "BUNNINGS WAREHOUSE"
2 STORY CONCRETE & METAL CLAD BUILDING METAL ROOF
BRICK & CONCRETE BUILDING METAL ROOF "WEST BUS"
3 STORY METAL CLAD BUILDING METAL ROOF
METAL CLAD BUILDING METAL ROOF
D.P.1071647 1.694ha
D.P.1071647 5219m²
D.P.1000137
D.P.705592
D.P.1002518
D.P.575546
NOTE:
THE M.G.A. BEARINGS REPRESENTED ON THIS PLAN ARE BASED ON D.P.1071647 AND THE COORDINATE BASIS IS DERIVED FROM THE COORDINATE TABLES SHOWN ON D.P.1071647
LEGEND
Survey Notes:
ORIGIN OF LEVELS: SSM39522 R.L. 47.52 (A.H.D.) VIDE SCIMS DATED 14 OCTOBER 2014
A1

Bunnings Warehouse, Bonnyrigg

APPENDIX D

SITE PHOTOGRAPHS

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Photo 1 – Boundary of 11-19 and 21 Bonnyrigg Avenue – facing west

Photo 2 – Boundary of 11-19 and 21 Bonnyrigg Avenue – facing south

Photo 3 – Boundary of 11-19 and 21 Bonnyrigg Avenue – facing south-west

Photo 4 – Boundary of 11-19 and 21 Bonnyrigg Avenue – facing east

Photo 5 – Boundary of 11-19 and 21 Bonnyrigg Avenue – frontage to Bonnyrigg Avenue

Photo 6 – Boundary of 1-9 Bonnyrigg Avenue and Elizabeth Drive – facing west

Bunnings Warehouse, Bonnyrigg

APPENDIX E

PROPOSED DEVELOPMENT DRAWINGS

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DA ISSUE
NOT FOR CONSTRUCTION
PROPOSED BUNNINGS WAREHOUSE
BONNYRIGG NSW 2177
SITE PLAN / ROOF PLAN
SCALE : 1:400
DATE : JUL 09
PROJ. NO. 1062
DRG. NO. 030
AMD NO. P2
JOHN R. BROGAN & ASSOCIATES
ARCHITECTS, PLANNERS & COMMERCIAL INTERIOR DESIGNERS
CLIENT
BUNNINGS GROUP LTD
ELIZABETH DRIVE
BONNYRIGG AVENUE
BAGGED GOODS CANOPY
OUTDOOR NURSERY BELOW
GOODS INWARDS CANOPY
ADJOINING SITE
EXISTING ROUNDABOUT
PROPOSED ROUNDABOUT
EXISTING SIGNALISED VEHICULAR CROSSING
DRIVEWAY
SERVICE ROAD
RAMP
10.00 M
9.30 M
8.70 M
9.00 M
7.60 M
9.80 M
6.50 M
6 M
4.50 M


ELIZABETH DRIVE
BONNYRIGG AVENUE
PARKING
PLANT
MAIN ENTRY
LANDSCAPE
DA ISSUE
NOT FOR CONSTRUCTION
PROPOSED BUNNINGS WAREHOUSE
BONNYRIGG NSW 2177
FLOOR PLAN
UNDERCROFT PARKING LEVEL
SCALE: 1:500
DATE: JUL 09
PROJ. NO. 1062
DRG. NO. 100
REV. NO. P3
JOHN R. BROGAN & ASSOCIATES
ARCHITECTS, PLANNERS & COMMERCIAL INTERIOR DESIGNERS
CLIENT
BUNNINGS warehouse
BUNNINGS GROUP LTD