Job Number: *210039*
Date: *5 July 2021*

Mark Tooker
Tooker and Associates

GRC Hydro
Level 9, 233 Castlereagh Street
Sydney NSW 2000

Tel: +61 413 631 447
www.grchydro.com.au

Dear Mark,

Re: 30-46 Auburn Road, Regents Park– Flood Modelling Assessment

Introduction

A planning proposal was submitted for 30-46 Auburn Road, Regents Park (the site). To address 'Section 9.1 Direction 4.3 – Flood Prone Land' requirements, a flood study was undertaken by National Project Consultants (NPC) in August 2017, which concluded that the planning proposal complied with the 'Flood Prone Land' Direction.

An independent review of the flood related aspects of the planning proposal was undertaken by Rhelm (dated 11 April 2021) on behalf of the Department of Planning, Industry and Environment. The Rhelm (2021) review, *'recommended that further flood modelling is undertaken using a finer resolution version of the Duck River TUFLOW model, incorporating all current features in the vicinity of the site that would have an impact on flow behaviour'*.

GRC Hydro have been engaged by Tooker and Associates to review and update the Duck River Stormwater Catchment Study (BMT WBM/Bewsher, 2009) flood model. The model has been amended to include changes in the vicinity of the site and updated 1% AEP and PMF flood model results are presented.

Relevant Studies

The studies listed below have been considered as part of the current study:

- Planning Proposal 30-46 Auburn Road, Regents Park - Flood Study (NPC, 2017)
- Review Of Flood Assessment and Behaviour with Respect to Planning Proposal for 30 – 46 Auburn Road, Regents Park (Rhelm, 2021)
- Duck River Stormwater Catchment Study (BMT WBM/Bewsher, 2009)
- Duck River Floodplain Risk Management Study and Plan (Molino Stewart, 2012)

The TUFLOW flood model developed as part of the Duck River Stormwater Catchment Study (BMT WBM/Bewsher, 2009) has been revised as per the Rhelm recommendations and used as the basis of analysis presented herein.

Model Review and Update

The Duck River Stormwater Catchment Study (BMT WBM/Bewsher, 2009) investigates flood behaviour for the Duck River catchment, within the Canterbury Bankstown Council LGA, for a range of design flood events. The study was completed in 2007, with an addendum added in 2009. A key feature of the addendum was an update of the TUFLOW model. The 2009 TUFLOW model has been endorsed by Council and subsequently used for development of the Duck River Floodplain Risk Management Study and Plan (Molino Stewart, 2012).

The 2009 TUFLOW model is a combined 1D/2D model which applies a 5 m cell resolution in the 2D domain. The base DEM is derived from Airborne Laser Scanning (ALS) survey captured by AAMHATCH in 2003. The 2009 (double precision) version of TUFLOW was used in the analysis.

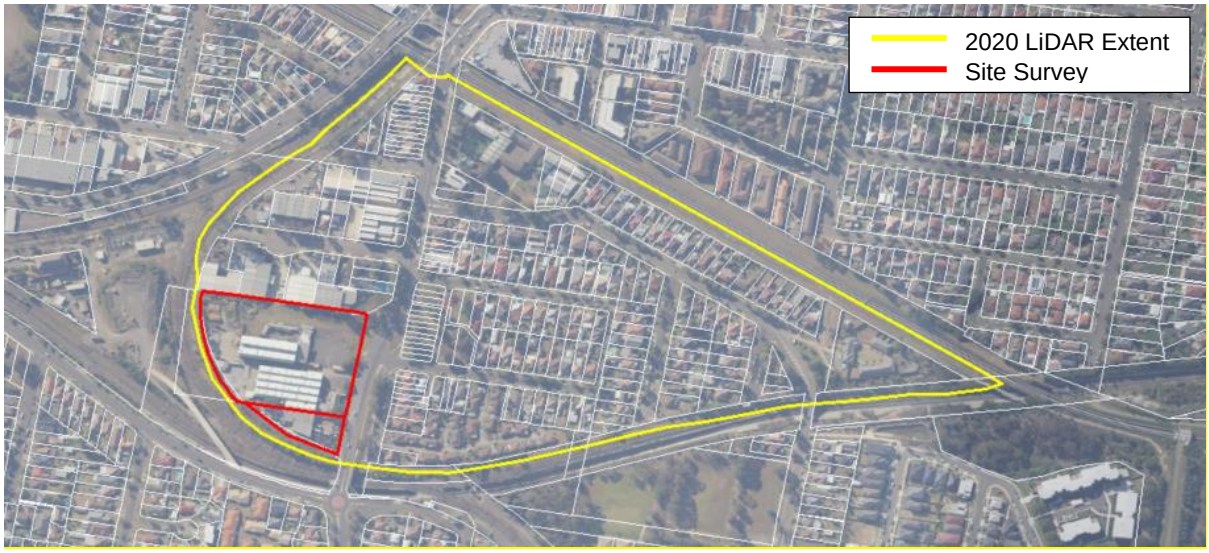
The Rhelm (2021) review of the Duck River Stormwater Catchment Study made the following comments in relation to the model near the site:

- *'the adopted model resolution would not capture finer features which may impact flood behaviour at a local scale';*
- *A '0.5m high blockwork wall along the 28A Auburn Road frontage was identified that extends across the majority of the mapped overland flow path at the Auburn Road low point';*
- *'two buildings have been constructed at 26 Auburn Road since the completion of the Duck River Stormwater Catchment Study'.*

To address these comments, the following model updates have been made:

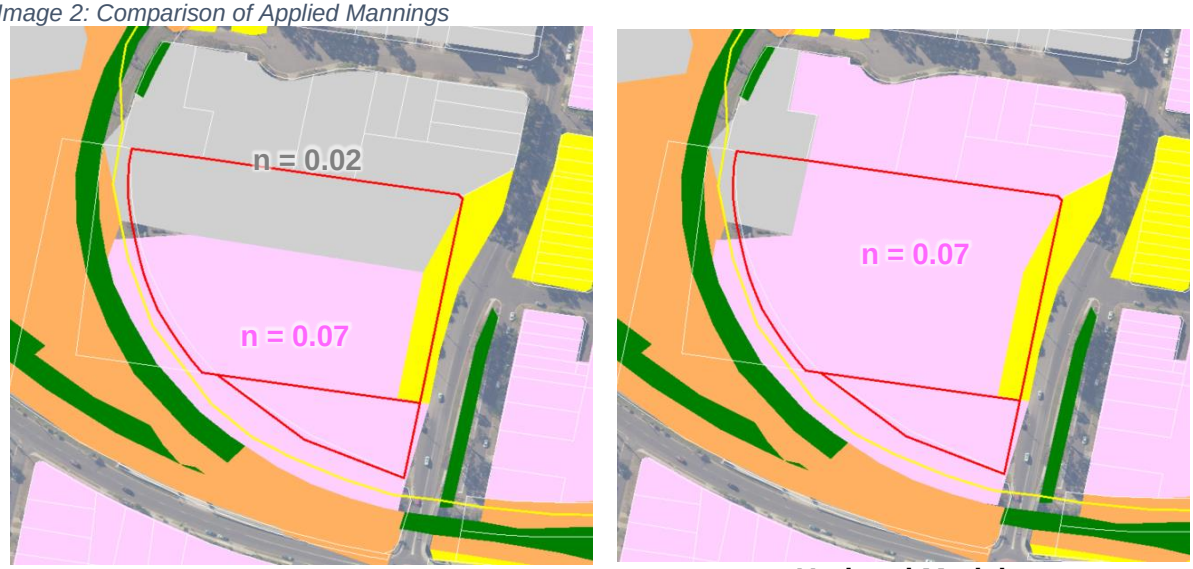
- TUFLOW model version – The TUFLOW model version was updated to 'TUFLOW.2020-10-AA' (single precision with HPC solver) which is the most recent TUFLOW version available at the time of the analysis;
- Model Domain and Grid Size – The hydraulic model domain was reduced by removing areas downstream of the site (the upstream catchment area was not changed). The downstream model boundary was located ~320 m downstream of the rail embankment and at a level ~7 m lower than levels on Auburn Road. The current analysis has increased to model grid resolution to use a 2 m grid;
- Digital Elevation Model (DEM) – The model DEM was developed through combination of three data sources:
    - DEM from the 2009 TUFLOW model was used for areas of the upper catchment to minimise the influence of model changes on hydrology and design flow estimates at the site (which have been endorsed by Council).
    - Areas contained within the rail easements (see Image 1) were updated to use the 'Sydney202005' LiDAR dataset downloaded from the ICSM Elvis website (https://elevation.fsdf.org.au/) which provides more accurate topographical information and a better representation of current ground levels;
    - For areas within the site, survey data provided by Geometra (dated 21 May 2021) was incorporated into the model. The survey details are presented in Attachment A.

Image 1: Areas of 2020 LiDAR and Survey Data



- Breaklines – representation of features finer than the 2D model grid resolution were incorporated as breaklines. These features included road crests and the kerb/gutter and were informed via inspection of the 2020 LiDAR mentioned above.
- Mannings Roughness – Mannings values in the northern portion of the site, and the lots to the north, were increased from 0.02 ('Open Concrete') to 0.07 ('Urban Block') to better suit the site characteristics determined via a site visit and inspection of the aerial imagery. The change in applied Mannings extent is presented in Image 2.

Image 2: Comparison of Applied Mannings

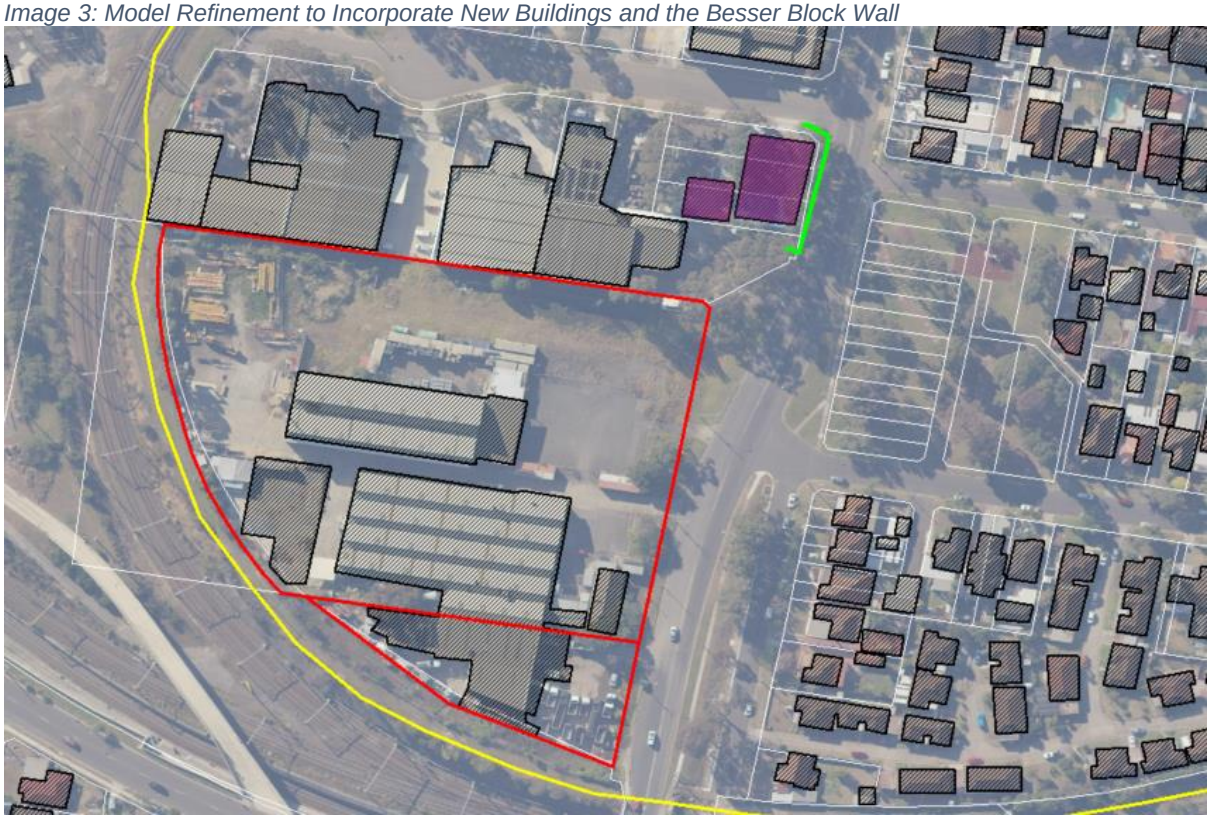


Council Model **Updated Model**

- Buildings and Obstructions – New buildings near the site and the '*blockwork wall*' identified by Rhelm (2021) review have been included in the model. The height of the wall was measured during a site visit undertaken on 25 June 2021 and found to have a crest ~0.65 m above surrounding ground level. The wall was included in the TUFLOW model as a breakline at a height of 0.65 m above the level of the surrounding 2020 LiDAR. Two new buildings were also included in the model near the corner of Auburn Road and Gunya Street. These buildings were modelled as a polygon extent with Mannings of 1.0 to maintain consistency with Council's

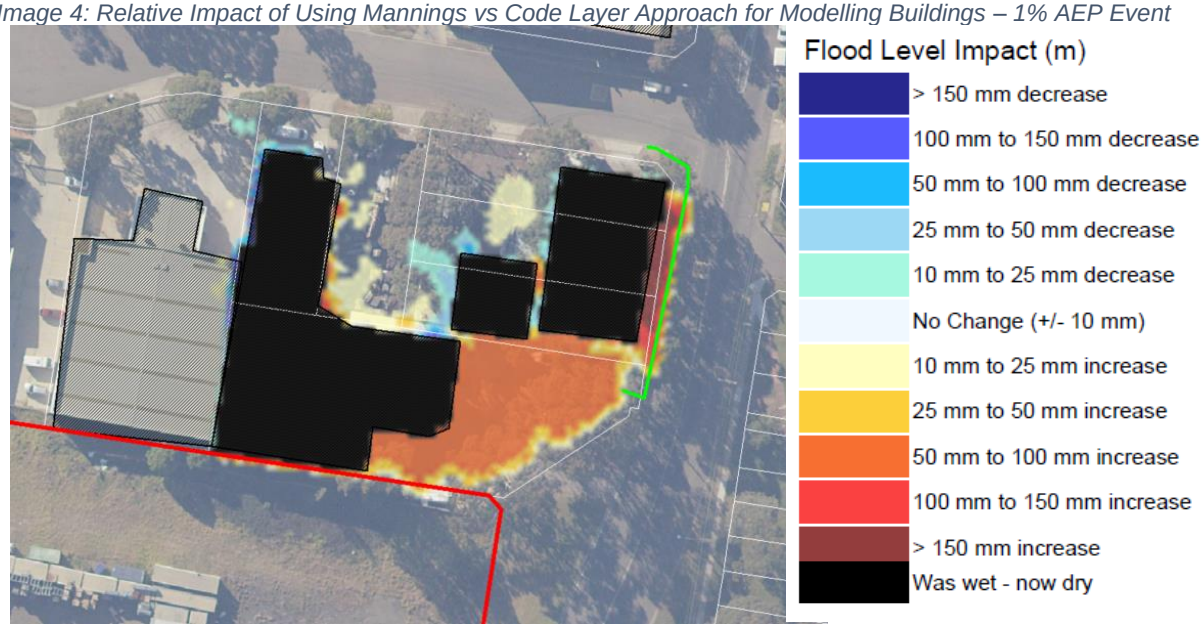
modelling approach. The Besser Block wall (green line) and new buildings (purple polygons) are presented in Image 3.

Image 3: Model Refinement to Incorporate New Buildings and the Besser Block Wall



To test the sensitivity of the Council building modelling approach, a conservative approach was assessed where the buildings were 'coded out' of the model domain to not allow water to enter these buildings. A flood impact map that compares the two approaches is presented in Image 4, and shows an increase in flood level for properties to the north of site if the 'coded out' approach is used, however minimal change in areas relative to the site are noted. The Mannings approach to modelling buildings has been applied to maintain consistency with the endorsed Council model.

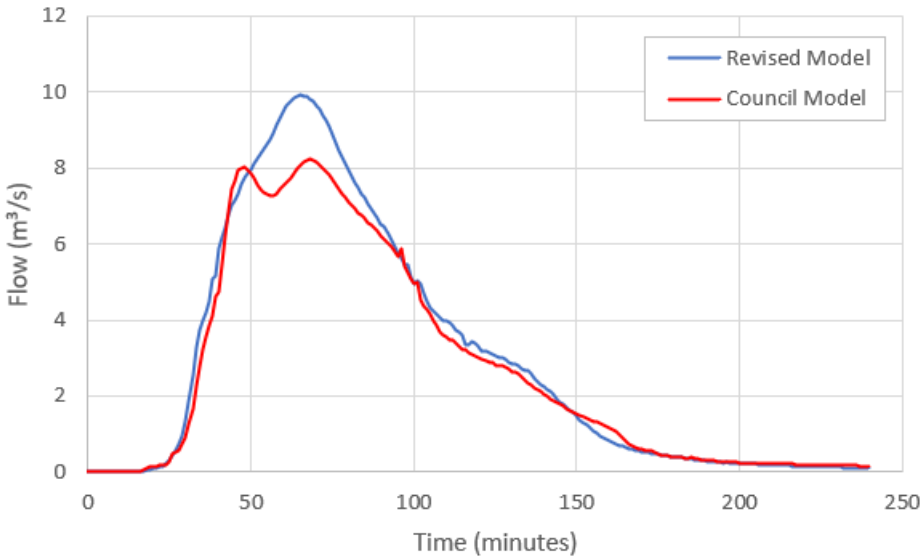
Image 4: Relative Impact of Using Mannings vs Code Layer Approach for Modelling Buildings – 1% AEP Event



Hydrology Validation

The analysis presented herein aims to maintain consistency with the Council endorsed 2009 TUFLOW model, and as such, changes the applied hydrology approach and design flow estimates have aimed to be minimal. Comparison of 1% AEP flows for the 2009 Council TUFLOW model and the current study Revised Model are presented in Image 5 for Auburn Road near the site. The flows are the combined stormwater trunk and overland flows. The comparison shows that the current study Revised Model peak 1% AEP flow at the site is greater than the 2009 TUFLOW model. The increase in flow is due to improved conveyance, during high flows, through buildings in the upper catchment due to use of a finer grid resolution.

Image 5: Relative Impact of Using Mannings vs Code Layer Approach for Modelling Buildings – 1% AEP Event



Whilst the current study flows are different to the 2009 TUFLOW model, they are greater and therefore conservative for use in the current study.

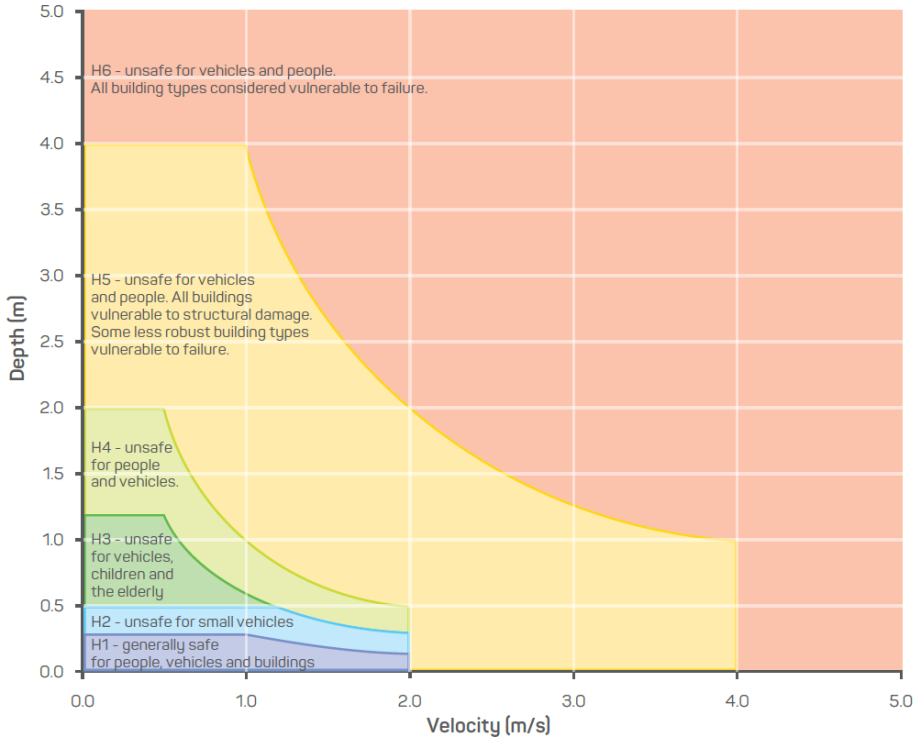
Model Results

The updated TUFLOW model was run for the 1% AEP and PMF events. The following flood maps are presented which can be used to assess the development:

- Figure 1: 1% AEP event - peak flood depths and levels;
- Figure 2: PMF event - peak flood depths and levels;
- Figure 3: 1% AEP event - flood hazard;
- Figure 4: PMF event - flood hazard;
- Figure 5: 1% AEP event - flood function.

Flood hazard is defined as the threat that flooding will pose to human activity. The hazard categories were determined in accordance with the Australian Emergency Management Handbook 7 guideline, which considers the threat to types of people (children, adult) and activity (pedestrian, vehicle and within a building). The flood hazard categories from this guideline are presented in Image 6.

Image 6: Flood Hazard Curves based on AEM Handbook 7



Flood Function (also known as Hydraulic Categories) refers to the classification of floodwaters into three categories: flow conveyance, flood storage and flood fringe. These categories help to describe the nature of flooding across the floodplain and aid planning when assessing developable areas. For the current study, the flood function classifications have been undertaken in accordance with the findings of Howells et al (2003), which defined these categories based on the depth and velocity of flood waters as described below:

- Flow Conveyance/Floodway – areas where:
    - the velocity-depth product > 0.25 m2/s and peak velocity >0.25 m/s; or
    - peak velocity > 1 m/s and peak depth > 0.15 m
- Flood Storage - areas outside the Flow Conveyance where depths exceed 0.5 m
- Flood Fringe – areas outside of Flow Conveyance where depths are less than 0.5 m

Results Discussion

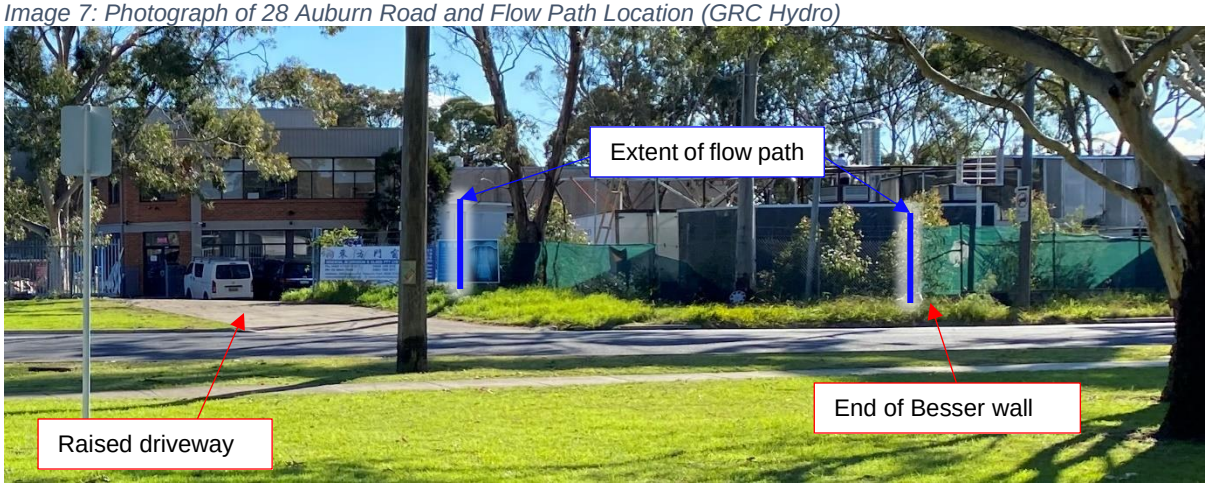
The revised flood modelling shows the following notable findings:

- The 1% AEP flood level at the site is 30.5 mAHD;
- The PMF flood level at the site is 31.0 mAHD;
- The site is largely flood free apart from the north-east corner of the site which is flooded due to external catchment flows. Other flood depths within the site represent ponding in existing depressions (due to the applied direct rainfall method) and are not part of the overland flow flooding;
- The north-east corner of the site is subject to localised ponding with depth of ~0.35 m, H2 hazard classification and a 'flood fringe' classification in the 1% AEP event. There is no 'flow conveyance' on the site during this event;
- In the PMF event, the north-east corner of the site is subject to depth of ~0.9 m with a H3 hazard classification. Modelled water depths within the site for areas away from the north-east

corner of the block are shallow, due to local rainfall, and considered 'local drainage' as opposed to 'flooding' as defined by the Floodplain Development Manual (2005).

- Properties to the north of the site near the corner of Auburn Road and Gunya Street are significantly flooded with depths of up to 0.7 m in the 1% AEP event. The flood liability of these properties is due to the local topography with a sag situated to the west of Auburn Road. Flow enters the sag between the driveway of 28 Auburn Road and the previously mentioned Besser Block wall. Review of the model results agree with that observed at the site.

Image 7: Photograph of 28 Auburn Road and Flow Path Location (GRC Hydro)



Conclusions

A planning proposal was submitted for 30-46 Auburn Road, Regents Park (the site). An independent review of the flood related aspects of the planning proposal was undertaken by Rhelm (dated 11 April 2021) with additional flood modelling analysis requested. GRC Hydro have been engaged by Tooker and Associates to review and update the Duck River Stormwater Catchment Study (BMT WBM/Bewsher, 2009) flood model as recommended in the Rhelm report.

The model has been amended to increase model resolution and incorporate changes near the site. The amendments included the addition of survey and 2020 LiDAR as well as details of new development. Revised 1% AEP and PMF event flood depths, levels, hazard and flood function are presented.

The majority of the site is not flood affected for events up to and including the PMF event. The north-east corner of the site is the only area flooded due to external catchment flows with the area subject to localised ponding with depths of ~0.35 m, H2 hazard and a 'flood fringe' classification in the 1% AEP event. No areas of 'flow conveyance' (floodway) are noted on the site. Due to the flood fringe classification, development of the site could occur without significant adverse impact on flood behaviour on adjacent properties.

A Flood Planning Level of RL 31.0 mAHD applies to the site which is the same level as the PMF. Development of the site in accordance with the Bankstown Development Control Plan 2015 (DCP 2015) could be implemented to manage flood risk. Site stormwater management has not been assessed as part of this assessment.

As requested in the Rhelm (2021) report 'Conclusions and Recommendations' section, consideration has been given to the four dot point recommendations and the following response to each is provided:

- There are no significant flood flows on the site along the property northern boundary. Water ponding in these areas would be collected by the site drainage system and would be resolved at the DA stage;

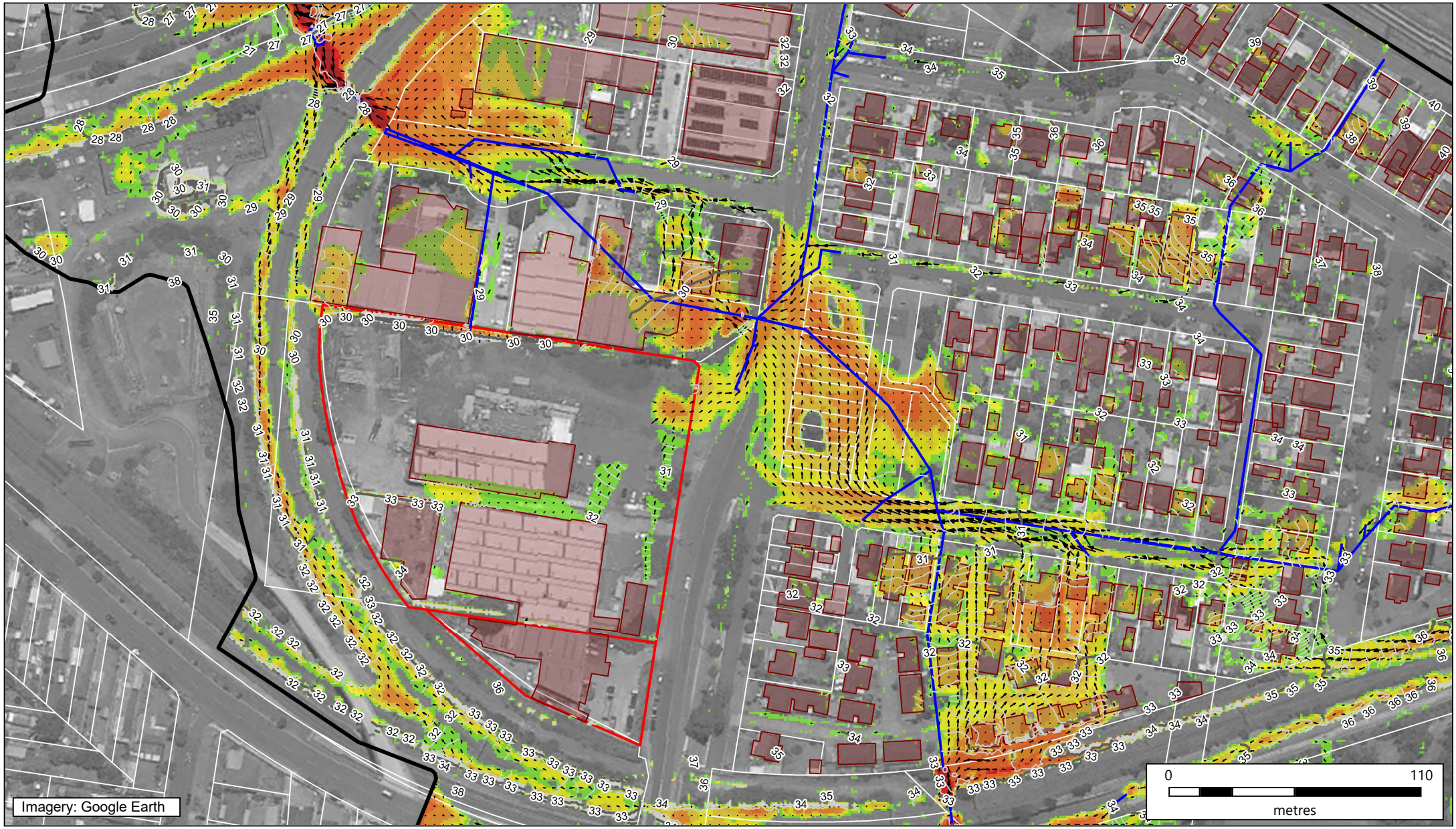
- Basement flooding can be controlled by adopting an appropriate driveway crest level which would be addressed at the DA stage;
- A childcare centre could be accommodated given the flooding conditions at the site. The details of the childcare centre in terms of floor level and access can be resolved at the DA stage;
- The revised flood modelling assessment has demonstrated that the site is subject to shallow 'flood fringe' flow characteristics and as such, development of the site could be undertaken without significantly impacting flood behaviour to the north of the site.

Yours Sincerely

Zac Richards
Director

Email: richrds@grchydro.com.au
Tel: +61 432 477 036

FIGURES



N
W E
S

Flood Depths (m)

- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.3
- 0.30 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- > 1.50

Major Flood Level Contours (1 m spacing)

Minor Flood Level Contours (0.1 m spacing)

Subject Site

Buildings

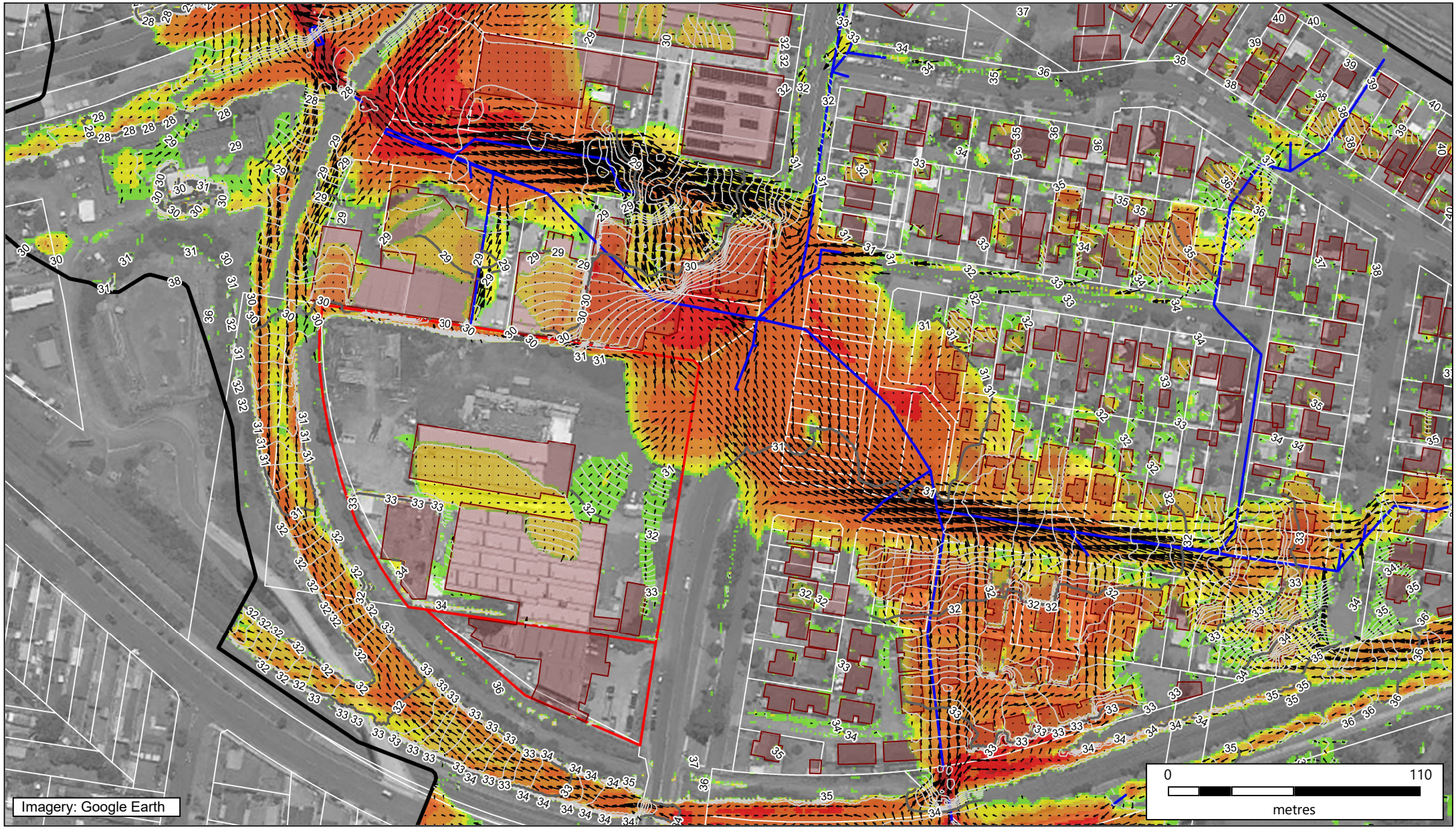
Hydraulic Model Extent

Council Pipe Network

Cadastre

grc HYDRO

TITLE : **1% AEP Peak Flood Depths**	PROJECT: **30-46 Auburn Road, Regents Park**	PROJECT No. **210039**	DATE: **June 2021**	SCALE: **1 : 2,200**	FIGURE No. **01**



N
W E
S

Flood Depths (m)

- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.3
- 0.30 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- > 1.50

Major Flood Level Contours (1 m spacing)

Minor Flood Level Contours (0.1 m spacing)

Subject Site

Buildings

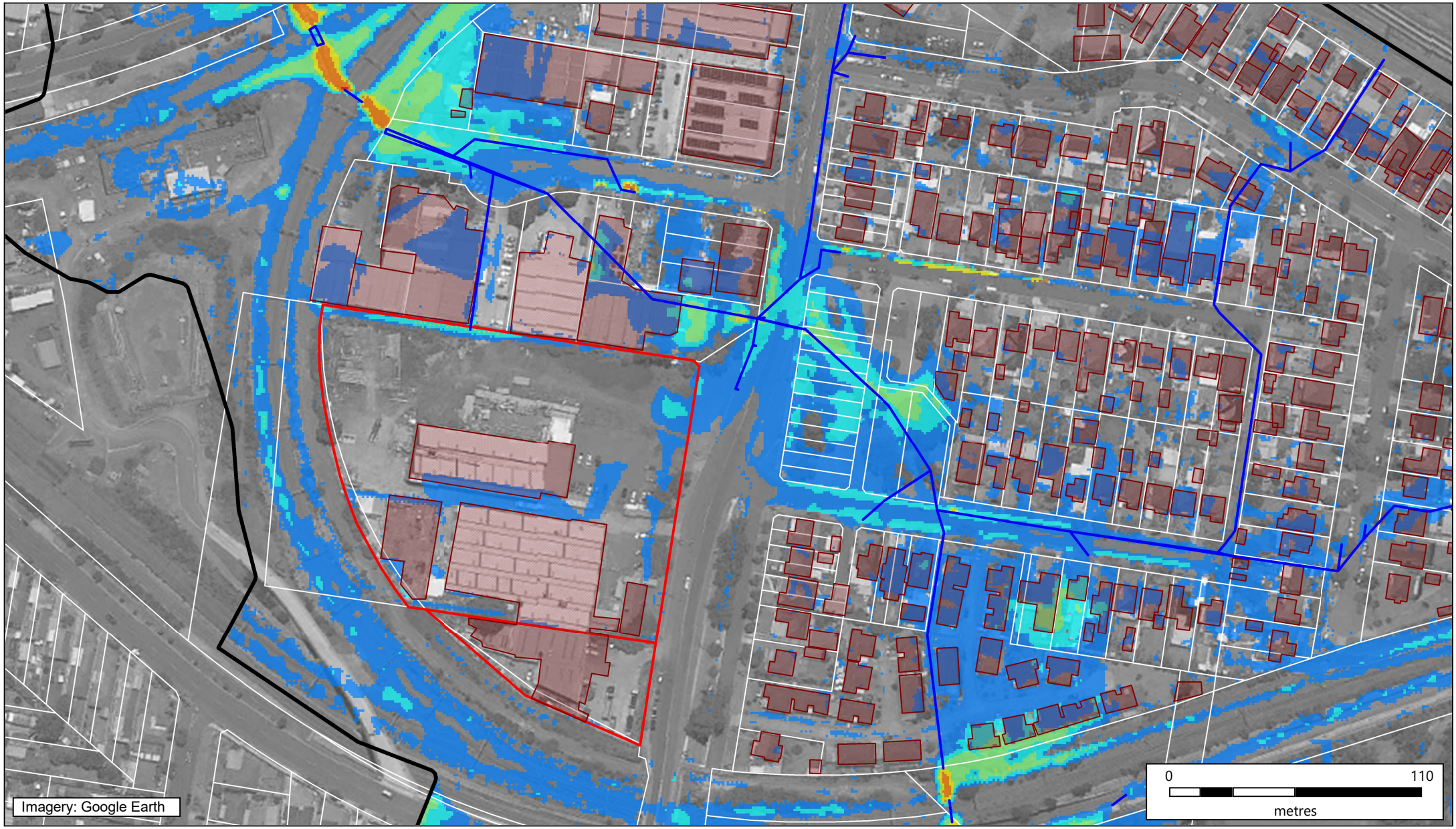
Hydraulic Model Extent

Council Pipe Network

Cadastre

grc HYDRO

TITLE : **PMF Peak Flood Depths**	PROJECT: **30-46 Auburn Road, Regents Park**	PROJECT No. **210039**	DATE: **June 2021**	SCALE: **1 : 2,200**	FIGURE No. **02**



N
W E
S

Flood Hazard

H1
H2
H3
H4
H5
H6

Subject Site

Buildings

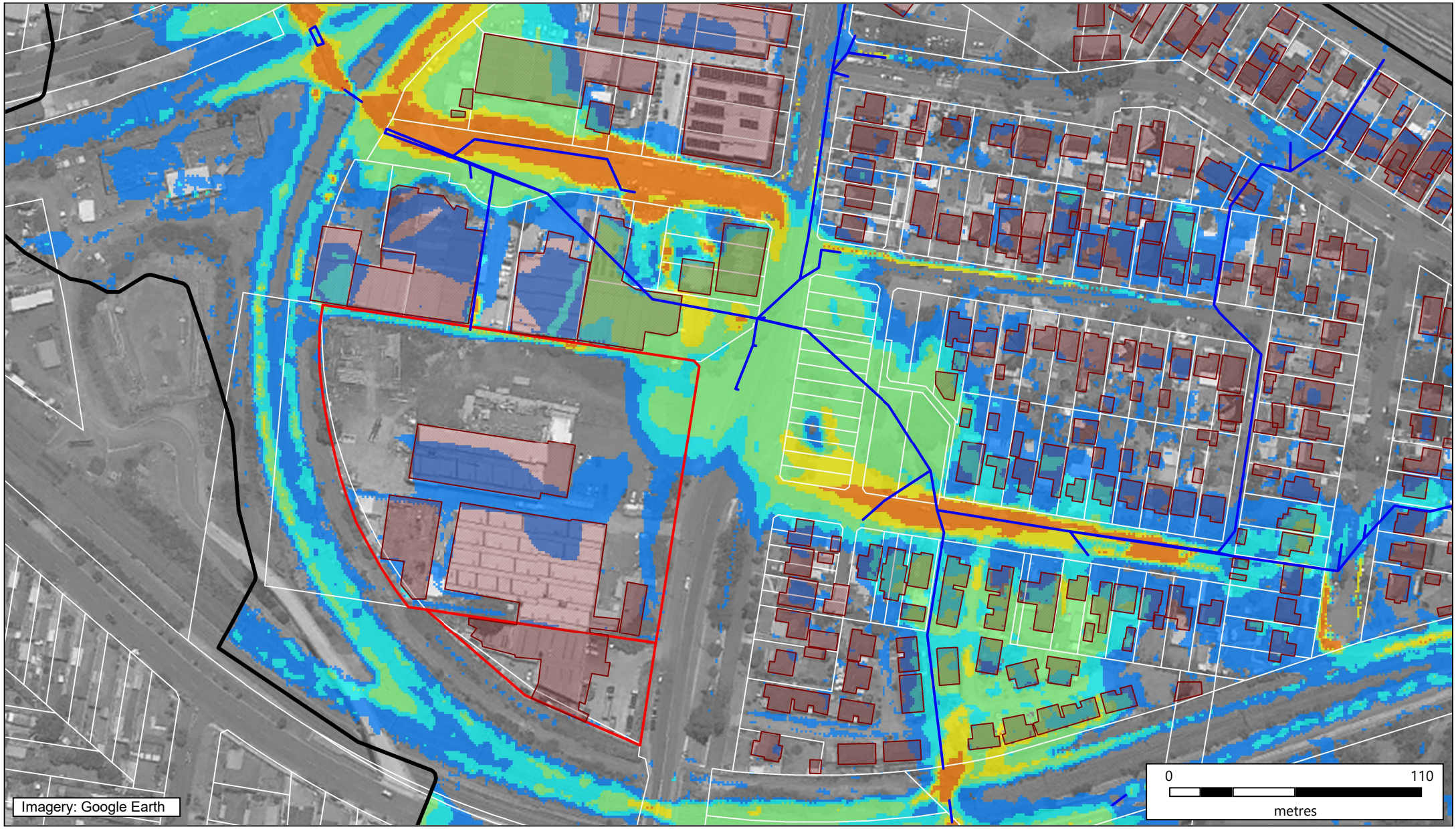
Hydraulic Model Extent

Council Pipe Network

Cadastre

grc HYDRO

TITLE : **1% AEP Peak Flood Hazard**	PROJECT: **30-46 Auburn Road, Regents Park**	PROJECT No. **210039**	DATE: **June 2021**	SCALE: **1 : 2,200**	FIGURE No. **03**



N
W E
S

Flood Hazard

H1 H2 H3 H4 H5 H6

Subject Site

Buildings

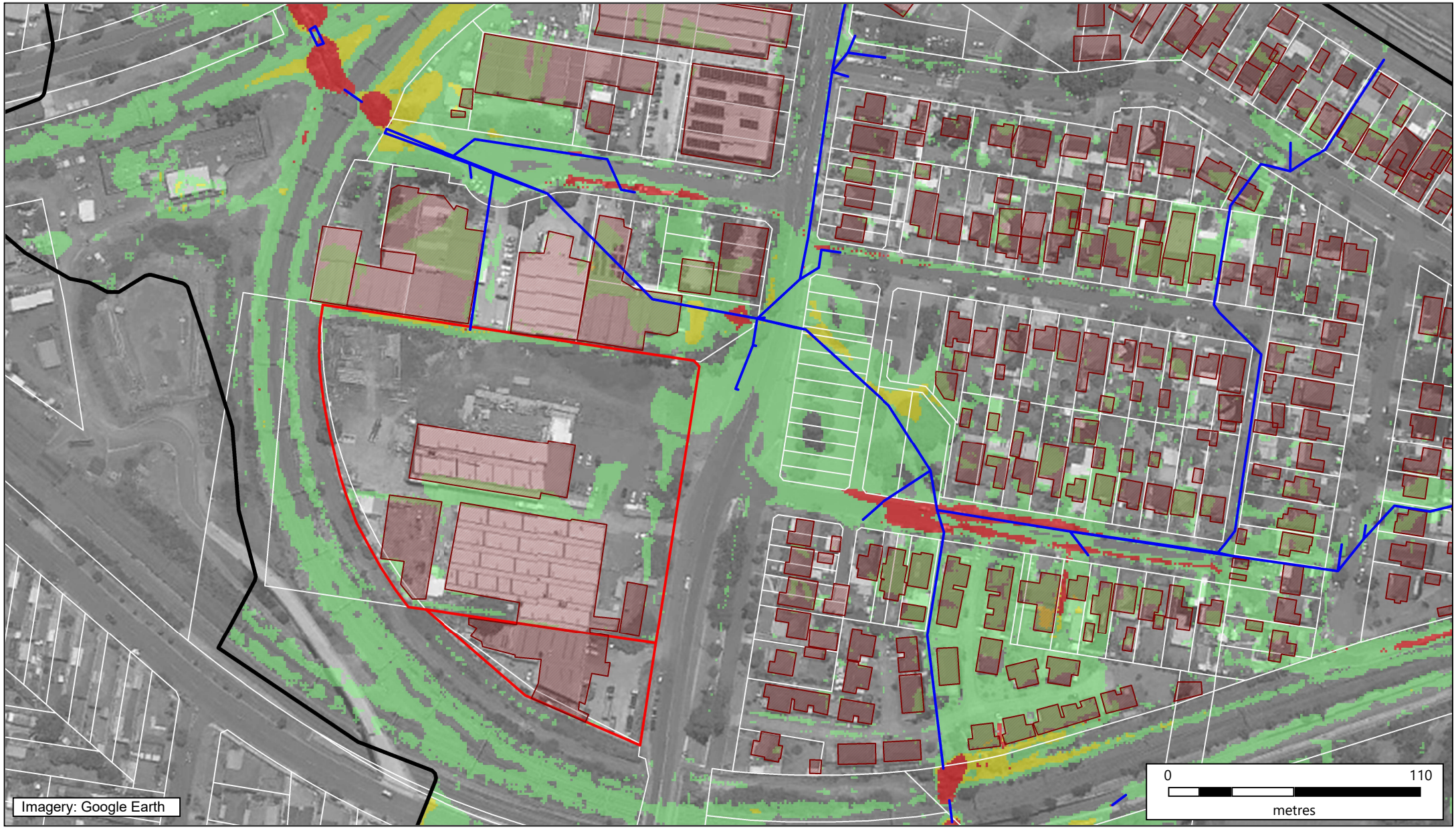
Hydraulic Model Extent

Council Pipe Network

Cadastre

grc HYDRO

TITLE : **PMF Peak Flood Hazard**	PROJECT: **30-46 Auburn Road, Regents Park**	PROJECT No. **210039**	DATE: **June 2021**	SCALE: **1 : 2,200**	FIGURE No. **04**



N
W E
S

Flood Function
Flow Conveyance
Flood Storage
Flood Fringe

Subject Site
Buildings
Hydraulic Model Extent

Council Pipe Network
Cadastre

grc HYDRO

TITLE : **1% AEP Flood Function**	PROJECT: **30-46 Auburn Road, Regents Park**	PROJECT No. **210039**	DATE: **June 2021**	SCALE: **1 : 2,200**	FIGURE No. **05**

ATTACHMENT A

Our Ref : 6042-3

21 May 2021

20/1-5 Jacobs Street
Bankstown NSW 2200

PO Box 3530
Centro Bankstown
NSW 2200

P 02 **9708 5719**

admin@geometra.com.au
www.geometra.com.au

Hallmark Constructions Pty Ltd
2A Gregory Place
HARRIS PARK NSW 2150

Attention : Raymond Raad

RE: **AUTOCAD TRIANGULATION FILE**
PROPERTY: **30 & 46 AUBURN ROAD, REGENTS PARK**

As requested by you we have generated an AutoCad Triangulation File from the previous survey plans that this firm had prepared for this site.

Note the first site detail survey done by this firm was in 2001 and then updated in 2018.

The AutoCad Triangulation File was generated from the information obtained in these two surveys.

A copy of the plan (in .dwg format) has also been emailed to you at raymond@raad.com.au as requested.

The subject property comprises of two lots being Lot 1 in DP 656032 and Lot 2 in DP 433938.

Should you have any further queries on this matter please contact this office.

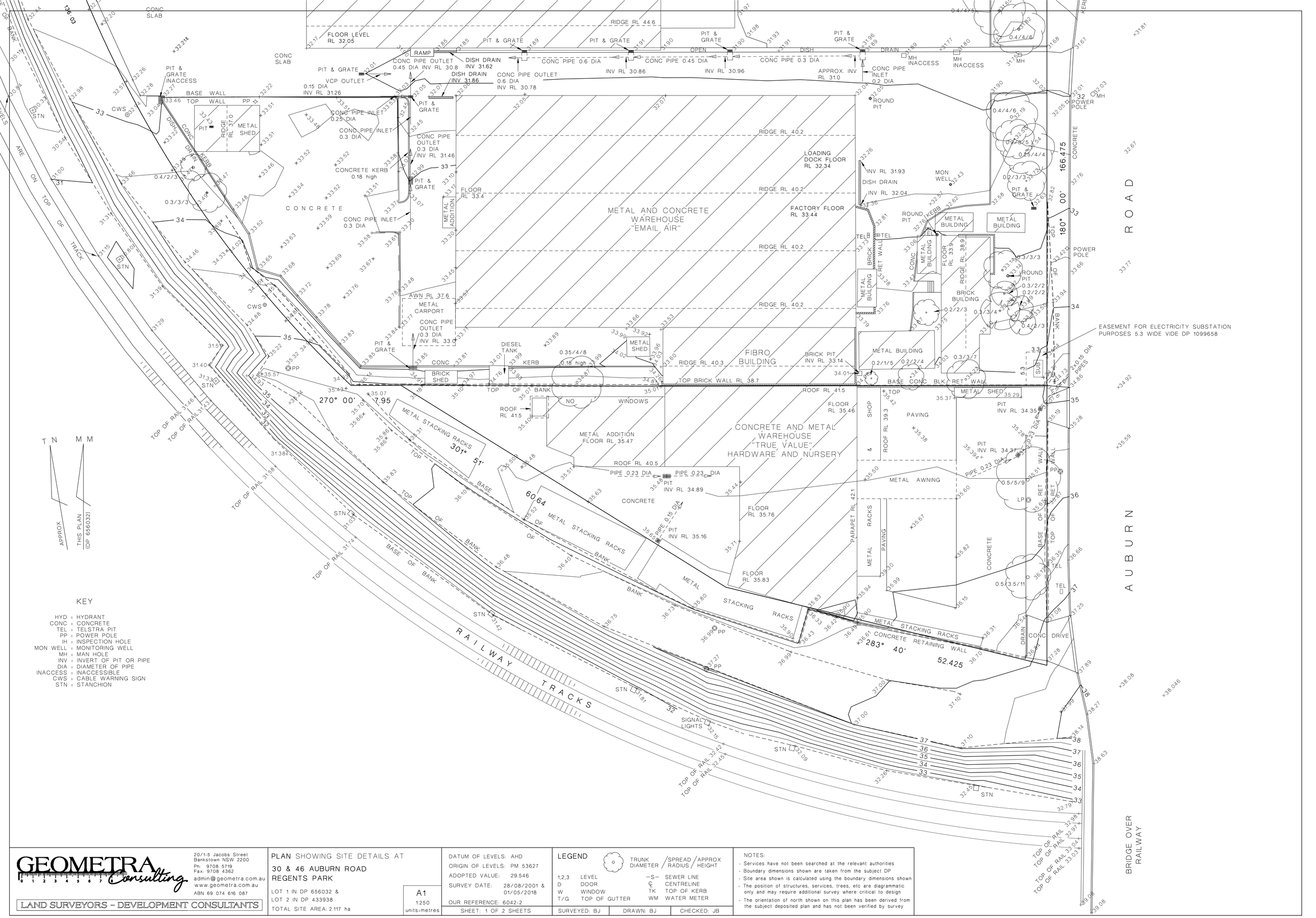
Yours faithfully

John Bottaro
Surveyor Registered Under
Surveying and Spatial Information Act 2002

CONCRETE BLOCK BUILDING
FLOOR RL 29.49
ROOF RL 35.1
NO WINDOWS
CONCRETE BUILDING
FLOOR RL 29.00
ROOF RL 36.4
NO WINDOWS
CONC PIPE OUTLET 0.7 DIA INV RL 27.72
BRICK PIT CONC LID
CONCRETE AND BRICK WAREHOUSE AND OFFICES "RONLAI PLASTIC PTY. LTD." No. 28A
ROOF RL 39.2
FLOOR RL 30.19
NO WINDOWS
89° 51'
163.85
134° 55' 30"
3.26
PVC IH 0.2 DIA
BASE OF BANK
TOP OF BANK
ROUND PIT
CONC PIPE INLET 0.76 DIA INV RL 27.72
POWER POLE
PIT CONC LID INACCESS
CONC PIPE OUTLET 0.3 DIA INV RL 29.06
PIT
PVC IH 0.2 DIA
PIT CONC LID INACCESS INV OF PIT RL 29.15
MH CONC LID INACCESS
CLUMP OF TREES 9×0.2/6/10
CWS
STN
GRASSED AREA
MON WELL
BITUMEN
EDGE OF
LOW CONC BLK RET WALL
CONCRETE
AIR CLEANER
METAL, FIBRO AND BRICK WAREHOUSE "EMAIL AIR"
FLOOR LEVEL RL 32.05
RIDGE RL 44.6
METAL AWNING
BITUMEN CAR PARK
CONC SLAB
RAMP
CONC PIPE OUTLET 0.45 DIA INV RL 30.8
DISH DRAIN INV 31.62
DISH DRAIN INV 31.86
CONC PIPE OUTLET 0.6 DIA INV RL 30.78
CONC PIPE 0.6 DIA
INV RL 30.86
CONC PIPE 0.45 DIA
INV RL 30.96
CONC PIPE 0.3 DIA
APPROX. INV RL 31.0
CONC PIPE INLET 0.2 DIA
PIT & GRATE
OPEN DISH DRAIN
MH INACCESS
MH
PIT & GRATE INACCESS
BASE WALL
TOP WALL
PP
VCP OUTLET 0.15 DIA INV RL 31.26
CONC PIPE INLET 0.23 DIA
CONC PIPE INLET 0.3 DIA
CONC PIPE OUTLET 0.3 DIA INV RL 31.46
METAL SHED
RIDGE RL 40.2
LOADING DOCK FLOOR RL 32.34
INV RL 31.93
DISH DRAIN
INV RL 32.04
ROUND PIT
CONCRETE KERB 0.18 high
METAL AND CONCRETE WAREHOUSE "EMAIL AIR"
FACTORY FLOOR RL 33.44
METAL ADDITION
FLOOR RL 33.4
METAL BUILDING
BRICK WALL
CONC BUILDING
FLOOR RL 33.9
RIDGE RL 38.9
BRICK BUILDING
AWN RL 37.6
METAL CARPORT
CONC PIPE OUTLET 0.3 DIA INV RL 33.0
DIESEL TANK
METAL SHED
FIBRO BUILDING
BRICK PIT INV RL 33.14
BASE CONC BLK RET WALL
TOP BRICK WALL RL 38.7
ROOF RL 41.5
FLOOR RL 35.46
SHOP
ROOF RL 39.3
PAVING
PIT INV RL 34.35
METAL ADDITION FLOOR RL 35.47
CONCRETE AND METAL WAREHOUSE "TRUE VALUE" HARDWARE AND NURSERY
ROOF RL 40.5
PIPE 0.23 DIA
PIT INV RL 34.89
PIT INV RL 35.16
FLOOR RL 35.76
FLOOR RL 35.83
PARAPET RL 42.1
METAL RACKS
METAL PAVING
CONCRETE
METAL STACKING RACKS
CONCRETE RETAINING WALL
CONC DRIVE
SIGNAL LIGHTS
RAILWAY TRACKS
TOP OF RAIL
BASE OF BANK
TOP OF BANK
RAD 181.08
ARC 139.45
CHORD 350° 47' 138.03
270° 00' 7.95
301° 57' 60.64
283° 40' 52.425
180° 00' 166.475
EASEMENT FOR ELECTRICITY SUBSTATION PURPOSES 5.3 WIDE VIDE DP 1099658
AUBURN ROAD
BRIDGE OVER RAILWAY

KEY

HYD = HYDRANT
CONC = CONCRETE
TEL = TELSTRA PIT
PP = POWER POLE
IH = INSPECTION HOLE
MON WELL = MONITORING WELL
MH = MAN HOLE
INV = INVERT OF PIT OR PIPE
DIA = DIAMETER OF PIPE
INACCESS = INACCESSIBLE
CWS = CABLE WARNING SIGN
STN = STANCHION



KEY

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GEOMETRA Consulting
LAND SURVEYORS - DEVELOPMENT CONSULTANTS
20/1-5 Jacobs Street
Bankstown NSW 2200
Ph: 9708 5719
Fax: 9708 4362
admin@geometra.com.au
www.geometra.com.au
ABN 69 074 616 087

PLAN SHOWING SITE DETAILS AT

30 & 46 AUBURN ROAD
REGENTS PARK

LOT 1 IN DP 656032 &
LOT 2 IN DP 433938
TOTAL SITE AREA: 2.117 ha

A1
1:250
units=metres

DATUM OF LEVELS: AHD
ORIGIN OF LEVELS: PM 53627
ADOPTED VALUE: 29.546
SURVEY DATE: 28/08/2001 & 01/05/2018
OUR REFERENCE: 6042-2
SHEET: 1 OF 2 SHEETS

LEGEND

TRUNK DIAMETER / SPREAD / RADIUS / APPROX HEIGHT

1,2,3 LEVEL
D DOOR
W WINDOW
T/G TOP OF GUTTER
-S- SEWER LINE
℄ CENTRELINE
TK TOP OF KERB
WM WATER METER

SURVEYED: BJ | DRAWN: BJ | CHECKED: JB

NOTES:
- Services have not been searched at the relevant authorities
- Boundary dimensions shown are taken from the subject DP
- Site area shown is calculated using the boundary dimensions shown
- The position of structures, services, trees, etc are diagrammatic only and may require additional survey where critical to design
- The orientation of north shown on this plan has been derived from the subject deposited plan and has not been verified by survey

GEOMETRA Consulting
20/1-5 Jacobs Street
Bankstown NSW 2200
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Fax: 9708 4362
admin@geometra.com.au
www.geometra.com.au
ABN 69 074 616 087
LAND SURVEYORS - DEVELOPMENT CONSULTANTS

PLAN SHOWING SITE DETAILS AT
30 & 46 AUBURN ROAD
REGENTS PARK

LOT 1 IN DP 656032 &
LOT 2 IN DP 433938
TOTAL SITE AREA: 2.117 ha

A1
1:250
units=metres

DATUM OF LEVELS: AHD
ORIGIN OF LEVELS: PM 53627
ADOPTED VALUE: 29.546
SURVEY DATE: 28/08/2001 & 01/05/2018
OUR REFERENCE: 6042-2
SHEET: 2 OF 2 SHEETS

LEGEND

TRUNK DIAMETER / SPREAD RADIUS / APPROX HEIGHT

1,2,3 LEVEL
D DOOR
W WINDOW
T/G TOP OF GUTTER
-S- SEWER LINE
℄ CENTRELINE
TK TOP OF KERB
WM WATER METER

SURVEYED: BJ | DRAWN: BJ | CHECKED: JB

NOTES:
- Services have not been searched at the relevant authorities
- Boundary dimensions shown are taken from the subject DP
- Site area shown is calculated using the boundary dimensions shown
- The position of structures, services, trees, etc are diagrammatic only and may require additional survey where critical to design
- The orientation of north shown on this plan has been derived from the subject deposited plan and has not been verified by survey