BMT WBM Pty Ltd
Suite G2, 13-15 Smail Street
Ultimo, Sydney, NSW, 2007
Australia
PO Box 1181, Broadway NSW 2007

Tel: +61 2 8960 7755
Fax: +61 2 8960 7745

ABN 54 010 830 421

www.bmt.org

Our Ref: DJL: L.N21282.001.00_FIA.docx

08 October 2019

Mr Thomas Rozendahl
Henry & Hymas
Level 5, 79 Victoria Avenue
Chatswood NSW 2067,

Attention: Tom Rozendahl

Dear Tom,

RE: OVERLAND FLOW ASSESSMENT FOR PROPOSED DEVELOPMENT AT 1 - 9 NORTH ROCKS ROAD, NORTH ROCKS

This letter report outlines the overland flow assessment undertaken for the proposed commercial development at 1 North Rocks Road, North Rocks (Site). The letter report summarises the analysis including catchment delineation, hydraulic model development, design flood results and mapping.

Specifically, the assessment was undertaken to provide details of overland flooding behaviour at the Site in response to a request for information from Parramatta City Council (Council) including:

Site Location and Catchment Topography

The Site is bounded by James Ruse Drive to the north, Darling Mills Creek to the east, North Rocks Road to the south and Windsor Road to the west as shown in Figure 1.

The catchment topography shown in Figure 1 is based on the NSW Land and Property Information (LPI) LiDAR data set acquired in 2013. A 1m grid resolution Digital Elevation Model (DEM) for the catchment has been accessed from the ELVIS Elevation and Depth data platform (https://elevation.fsdf.org.au/) The Site is relatively low-lying in the local catchment context being located immediately adjacent to the mainstream alignment of Darling Mills Creek.

A catchment delineation and flow path mapping analysis of the LiDAR DEM was undertaken utilising CatchmentSIM software. The catchment area shown in Figure 1 captures the potential overland flow area draining to Darling Mills Creek a short distance upstream and downstream of the Site. The catchment shown is adopted as the model area for the 2D model described further below and is defined to enable identification of the potential overland flood flow contributions to the Site. Given the focus on overland flooding and not mainstream flooding of Darling Mills Creek, the catchment and model area is limited to the overland flow environs on the western side of Darling Mills Creek only.

The major overland flow paths are indicated by the flow path mapping shown in Figure 1. Many of the local overland flow paths are defined by the road network alignment which is typical in an urban flooding environment.

Based on the indicative overland flow paths defined by the topography, the Site has almost no external overland flow catchment area. The Site is protected somewhat on the northern and western boundaries by the elevated embankment/road profiles of James Ruse Drive and Windsor Road respectively. Darling Mills Creek lies at the boundary and mainstream flooding of this watercourse may impact the Site. However, mainstream flooding of Darling Mills Creek does not form part of the current assessment (to be addressed in a separate report to be provided by Henry Hymas).

Accordingly, potential overland flooding at the Site is limited to:

- Runoff generated on-site – site stormwater drainage provisions (not part of this assessment) are expected to manage the local site runoff
- Overflow from James Ruse Drive – the James Ruse Drive Road underpass of Windsor Road represents a trapped low-point in the local topography. Whilst numerous stormwater drainage pits/pipes are incorporated in the road drainage, Council has requested an assessment based on an assumed 100% blockage. Under these conditions, runoff from the local catchment would pond in the low point on James Ruse Drive. If runoff volumes were sufficient to fill this storage, the spill point would be across the westbound exit of James Ruse Drive immediately adjacent to the Site at the northern boundary. This scenario would correspond to a flood depth in James Ruse Drive of approximately 1.5m at the low point beneath Windsor Road.

This overland flow contribution from James Ruse Drive is a very unlikely scenario and not considered a realistic risk to the Site given:

- 100% blockage of the entire stormwater drainage system is unlikely. Even with 90% blockage, the ponding in James Ruse Drive would be able to be drained.
- The overflows may be intercepted by on-site stormwater drainage system.

Notwithstanding this unlikely overland flow condition, the modelling assessment described hereunder has proceeded on a 100% blockage assumption for the stormwater drainage network and accordingly represents a very conservative assessment of overland flood affectation of the Site.

Hydraulic Model Development

The design flood conditions have been established via the development of a two-dimensional (2D) TUFLOW hydraulic model developed for the local overland flow catchment. The model utilises the direct rainfall (rainfall on grid) approach to simulating the rainfall runoff process in the catchment. A summary of the adopted model configuration is provided hereunder:

- Model extent - as shown in Figure 1 and covers the local catchment area contributing to a reach of Darling Mills Creek extending a short distance upstream and downstream of the Site. The model area enables capture of all potential overland flow contributions to the Site (excludes mainstream flooding of Darling Mills Creek).
- Model Topography – The ground surface elevation for the TUFLOW model grid points are sampled directly from the LiDAR DEM. A TUFLOW 2D domain resolution of 2m was adopted for the study area. It should be noted that TUFLOW samples elevation points at cell centres, mid-sides and corners, so a 2m cell size results in elevations being sampled from the underlying DEM every 1m. This resolution provides an appropriate detail to model the distribution of flow in the urban overland flow environment, particular where majority of flows are conveyed within the road network. Modifications to the topography were made where appropriate using 3D break lines (zshapes) to

enforce channel topography along Darling Mills Creek and the Windsor Road overpass of James Ruse Drive. Floor levels for the existing Site building have also been reinforced at 18.1m AHD.

- Hydraulic Roughness – defined by Manning's 'n' values representing different land surface coverage using aerial photography and cadastral data.
- Boundary Conditions – include specification of design rainfall inputs for the rainfall on grid modelling and inflow/outflow boundaries at the upstream and downstream limits of the modelled reach of Darling Mills Creek:
  - Design rainfall and losses- design rainfall intensities established using ARR2016 IFDs and GSDM method for PMP. A single temporal pattern rather than a suite of storm profiles has been simulated. The adopted pattern captures a high intensity rainfall burst likely to provide for peak flow conditions in this small and heavily urbanised catchment which would have a short time of concentration. The use of a single temporal pattern providing a peak flow condition represents a conservative approach to the ensemble approach from a which mean flow condition is adopted for design.
  - Darling Mills Creek – a nominal 5m^3/s constant inflow is provided at the upstream boundary of Darling Mills Creek. This inflow is only provided for establishing an initial low flow condition in the channel, noting that mainstream flooding is not part of this assessment. A free outflow condition applying a stage-discharge relationship adopted at the downstream boundary.
- Drainage Structures – no subsurface stormwater drainage is incorporated in the model given Councils request for a 100% blockage condition to be applied. Cross drainage structures have been included in the model as required:
  - Darling Mills Creek –culverts modelled as 1D elements for the crossings of James Ruse Drive Windsor Road. Note that dimensions are only estimated. These structure details are non-critical to the assessment as they only provide for flow connectivity along the Darling Mills Creek alignment and do not influence the overland flooding.
  - Underpasses – modelled as 1D elements where the overpass road is enforced in the 2D domain at James Ruse Drive /Windsor Road and James Ruse Drive /North Rocks Road.

Overland Flow Flood Mapping

The simulated design overland flood flow conditions (peak flood extent and depth distribution) is shown in Figure 2 for the 1% AEP event. The principal flow paths through the local catchment and vicinity of the Site are evident.

As alluded to in the catchment description, the Site has a limited catchment area with respect to overland flow. The broader catchment area included in the model flows directly into Darling Mills Creek both to the north and south remote from the Site.

The only potentially significant overland flow contribution to the Site is the spilling of ponded water in James Ruse Drive low point at the northern Site boundary. The high depth of floodwater in James Ruse Drive through the Windsor Road underpass is evident in Figure 2, with flood depths exceeding 1.5m at the low point. The ponded floodwater emanates from the local flows conveyed in the connected road network, largely from the catchment area bounded by Hammers Road, Kleins Road, James Ruse Drive and Windsor Road. As noted, the ponded floodwater represents an extremely conservative condition with all of catchment stormwater drainage assumed at 100% blocked.

The outlet or overflow point of the ponded water is at the closest sag point on the westbound exit of James Ruse Drive which occurs adjacent to the Site at the northern boundary. The model simulation therefore provides for an unconfined spilling of floodwater from this location onto the Site. Again, as noted the on-site drainage system has not been modelled (100% blockage assumption), however, it is anticipated that this network would capture and convey some of this overland flow spilling onto the Site.

Nevertheless, the flows spilling onto the Site in this very conservative condition provide a generally low risk. The flood depths remain relatively minor on Site with flow moving around the building to drain into Darling Mills Creek. Figure 3 shows the simulated 1% AEP peak velocity distribution across the modelled area. The overland flows through the Site are relatively low velocity and accordingly coupled with the shallow depth of flow provides for a low flood hazard.

Given the minor Site flood affectation at the 1% AEP design event magnitude, similar mapping has not been provided for the other design events. This can be produced as required, however, it is noted that the flood affectation of the Site would lessen further under lower design event magnitudes. The 100% blockage condition adopted for the assessment is likely even further conservative given a lower propensity for blockage in the smaller events.

The Flood Hazard Guideline 7-3 of the Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (AIDR, 2107) represents the current industry best practice with regards to defining flood hazard. The guideline presents a holistic approach to consider flood hazards to people, vehicles and structures. It recommends a composite six-tiered hazard classification, determined from the predicted flood depth and velocity (reproduced as Chart 1). A high flood depth will cause a hazardous situation while a low depth may only cause an inconvenience. High flood velocities are dangerous and may cause structural damage while low velocities generally have no major threat. The flood depth at the site will drive the hazard classification, as velocities will be negligible due to the nature of backwater flooding. The six hazard classifications are summarised in Table and presented graphically in Chart 1.

Table 1 Best Practice Provisional Flood Hazards (AIDR, 2017)

	Hazard Classification	Description
H1	Depth < 0.3 m and Velocity < 2.0 m/s and Velocity*Depth <0.3	Relatively benign flow conditions. No restrictions for development.
H2	Depth < 0.5 m and Velocity < 2.0 m/s and Velocity*Depth <0.6	Hydraulically unsafe for small vehicles.
H3	Depth < 1.2 m and Velocity < 2.0 m/s and Velocity*Depth <0.6	Hydraulically unsafe for vehicles, children and the elderly.
H4	Depth < 2.0 m and Velocity < 2.0 m/s and Velocity*Depth <1.0	Hydraulically unsafe for people and vehicles.
H5	Depth < 4.0 m and Velocity < 4.0 m/s and Velocity*Depth <4.0	Hydraulically unsafe for people or vehicles. Buildings require special engineering, design and construction to withstand floodwater.
H6	Depth > 4.0 m OR Velocity > 4.0 m/s OR Velocity*Depth >4.0	Hydraulically unsuitable for people, vehicles and buildings. Flow conditions are unconditionally dangerous and are unsuitable for any type of development.

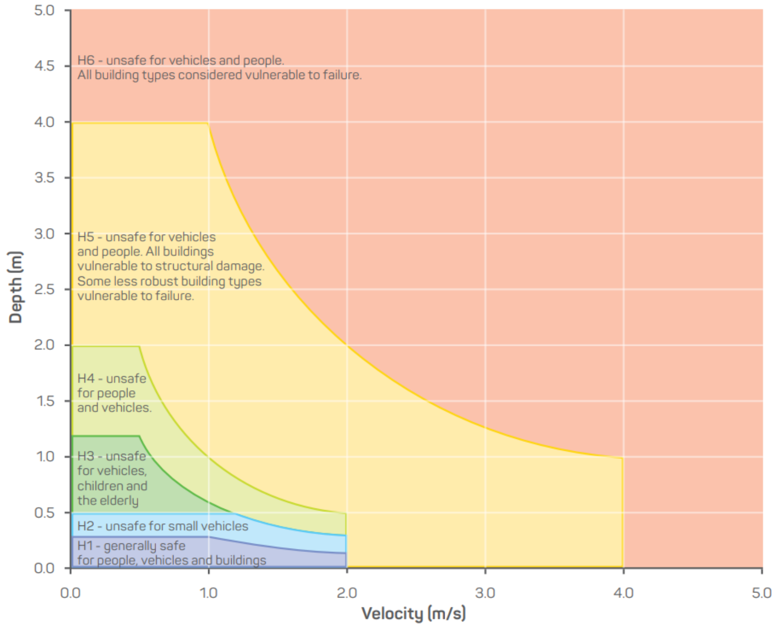


Chart 1 Combined Flood Hazard Curves – Vulnerability Thresholds

Flood hazard mapping of the site has been generated from existing flood conditions for the 1% AEP and PMF design events, presented respectively in Figure 4 and Figure 5.

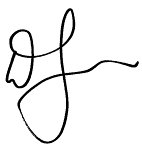
The Site hazard classification is low, limited to the H1 classification for the 1% AEP and H2 for the PMF event. The principal higher hazard class areas in the catchment are limited to the mainstream alignment of Darling Mills Creek, and some small areas of road corridor in particular the depth driven ponding beneath the Windsor Road overpass of James Ruse Drive.

Conclusions

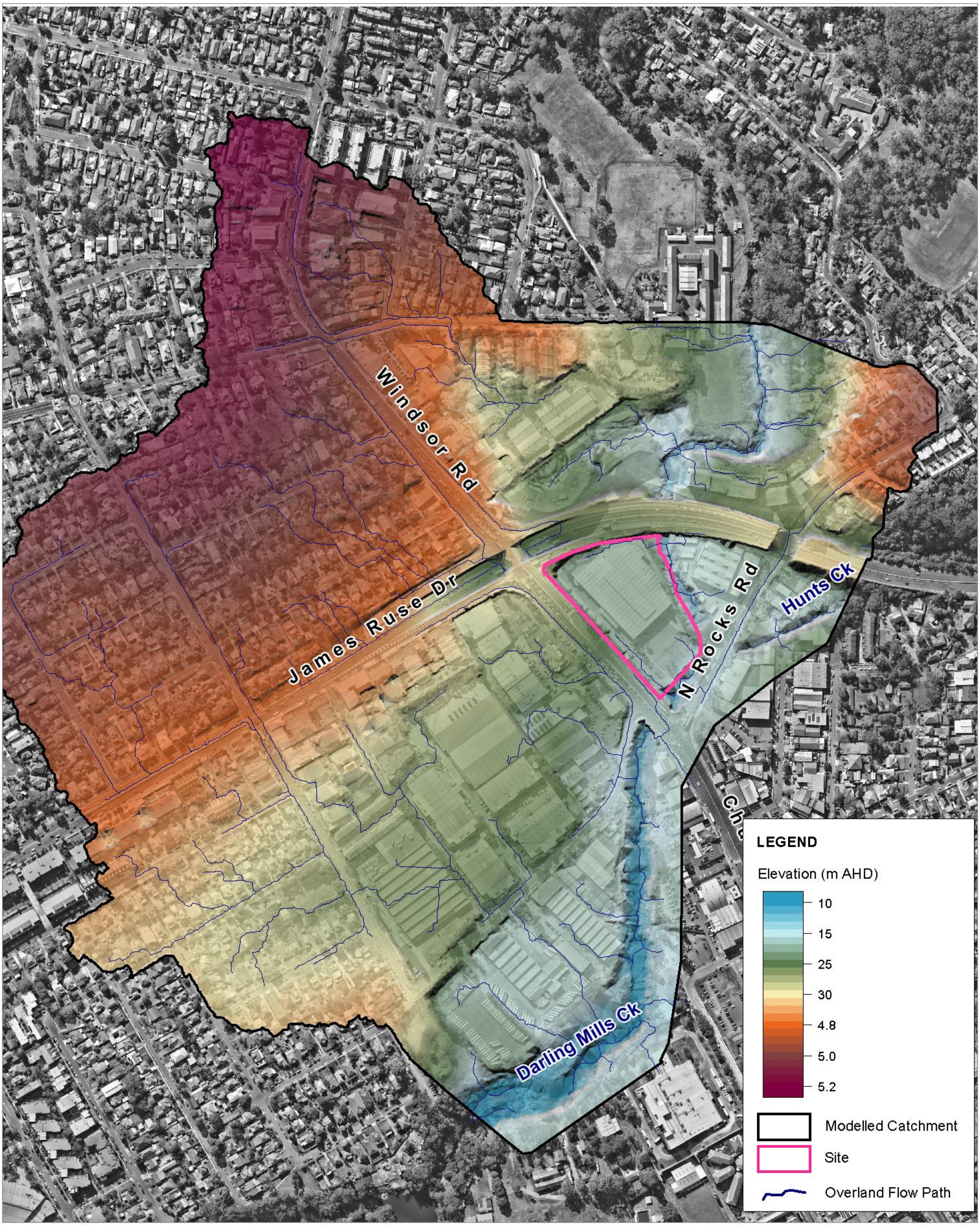
A 2D TUFLOW hydraulic model of the local overland flow catchment was developed to assess the potential impact of overland flow on the proposed development site. The modelling confirms that there is relatively low overland flooding risk to the Site given the limited contributing catchment area. The assessment is very conservative using the assumption of complete blockage (100%) of the local drainage system. Under this scenario, the Site still only receives some overflow from ponded water in the sag point of James Ruse Drive.

We trust the above provides a suitable description of the potential overland flow flooding behaviour at the proposed development site. Please feel free to contact the undersigned to discuss further as required.

Yours Faithfully
BMT



Darren Lyons
NSW & Vic Business Unit Leader
Senior Principal Engineer



Title:

Site Location and Local Topography

Figure: 1

Rev: A

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

N

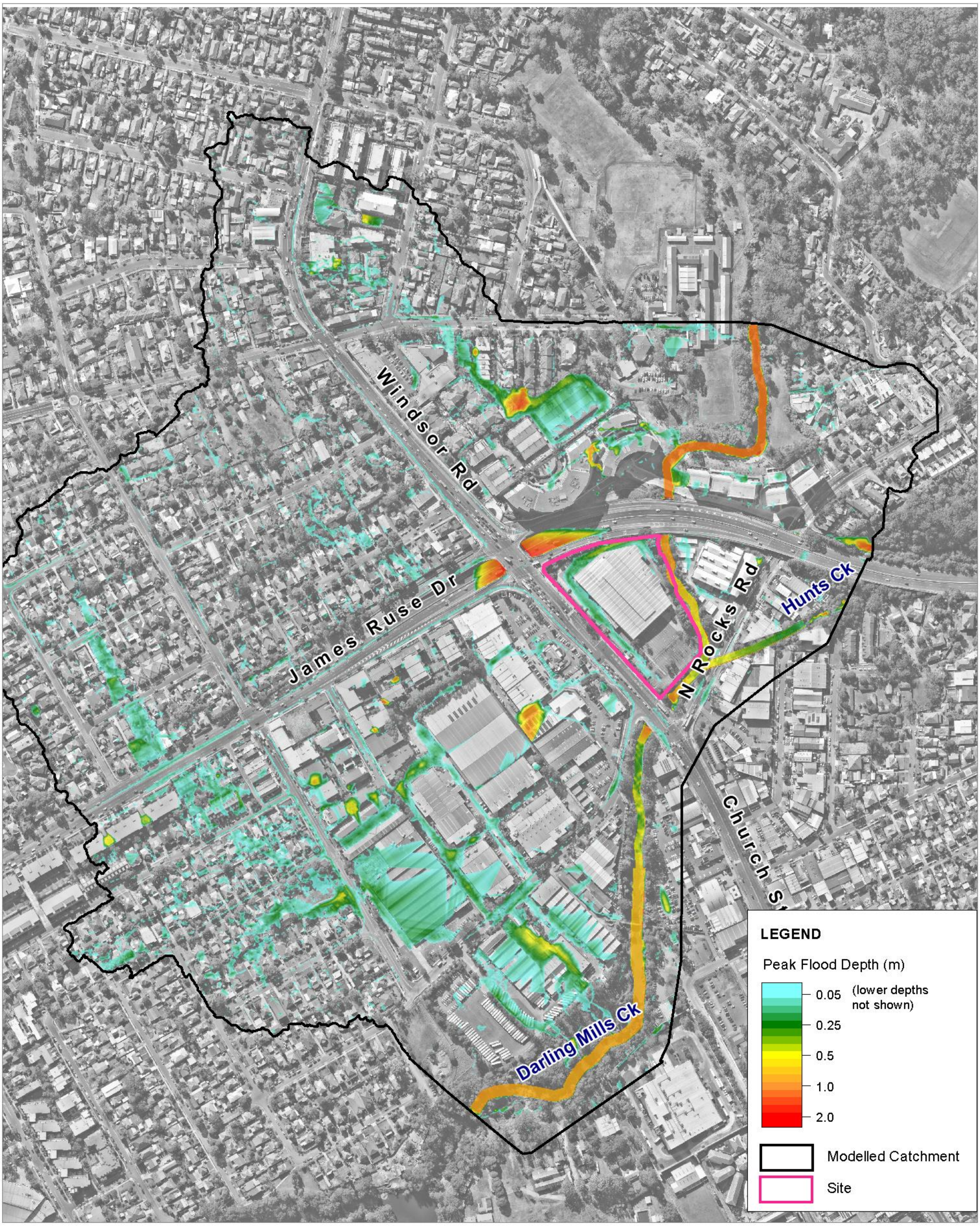
0 100 200m

Approx. Scale

BMT

www.bmt.org

Filepath: "K:\N21282_1-9_North_Rocks_Rd_North_Rocks_FIA\Mapinfo\WOR\DRG_01_Local_Topography.WOR"



Title:

Peak 1% AEP Overland Flood Conditions

Figure: 2

Rev: A

N

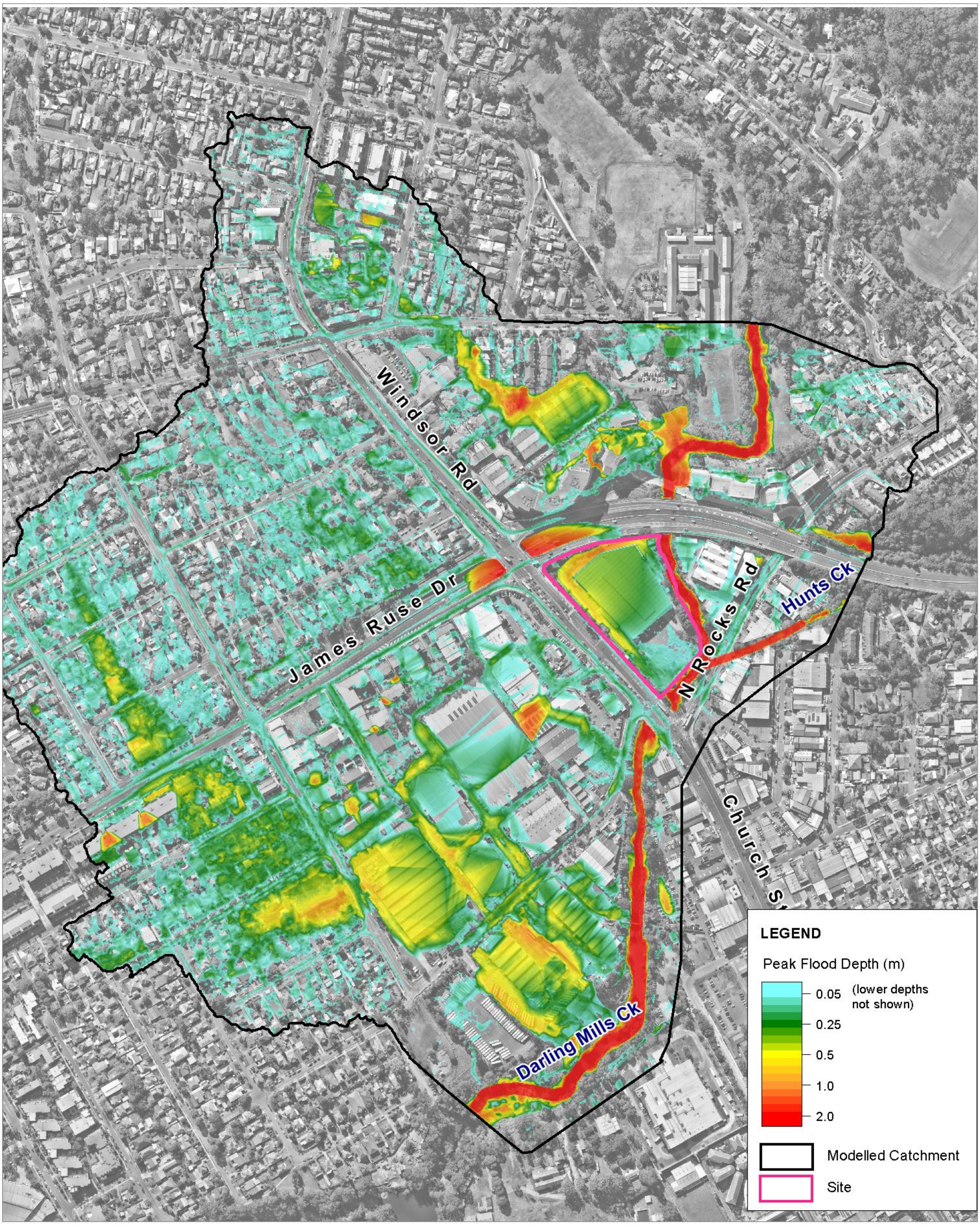
0 100 200m

Approx. Scale

BMT

www.bmt.org

Filepath: "K:\N21282_1-9_North_Rocks_Rd_North_Rocks_FIA\Mapinfo\WOR\DRG_01_1%AEP_Depth.WOR"



Title:

Peak PMF Overland Flood Conditions

Figure: 3

Rev: A

N

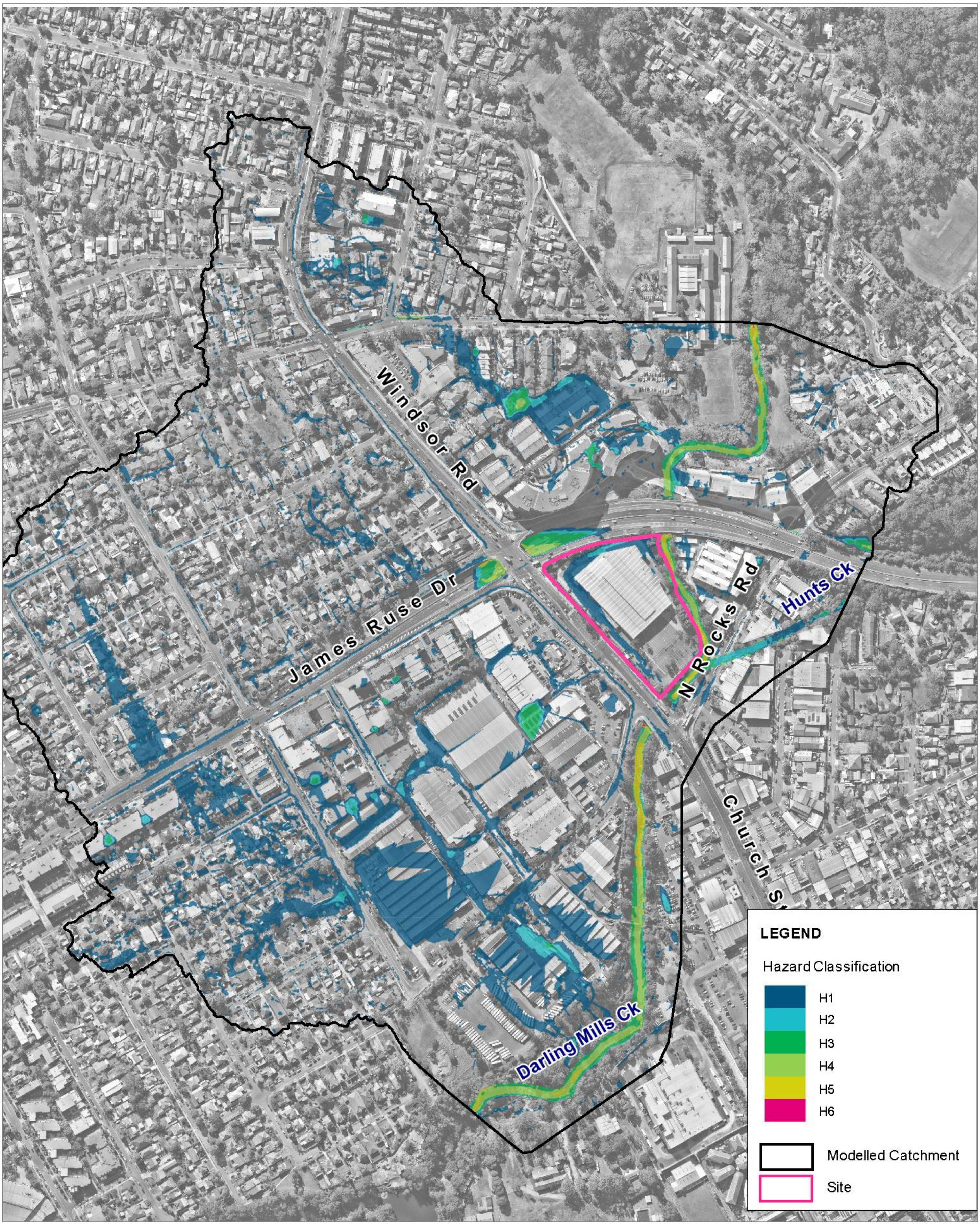
0 100 200m

Approx. Scale

BMT

www.bmt.org

Filepath: "K:\N21282_1-9_North_Rocks_Rd_North_Rocks_FIA\Mapinfo\WOR\DRG_01_1%AEP_Depth.WOR"



Title:

Flood Hazard Vulnerability Classification 1% AEP Overland Flood Conditions

Figure: 4

Rev: A

N

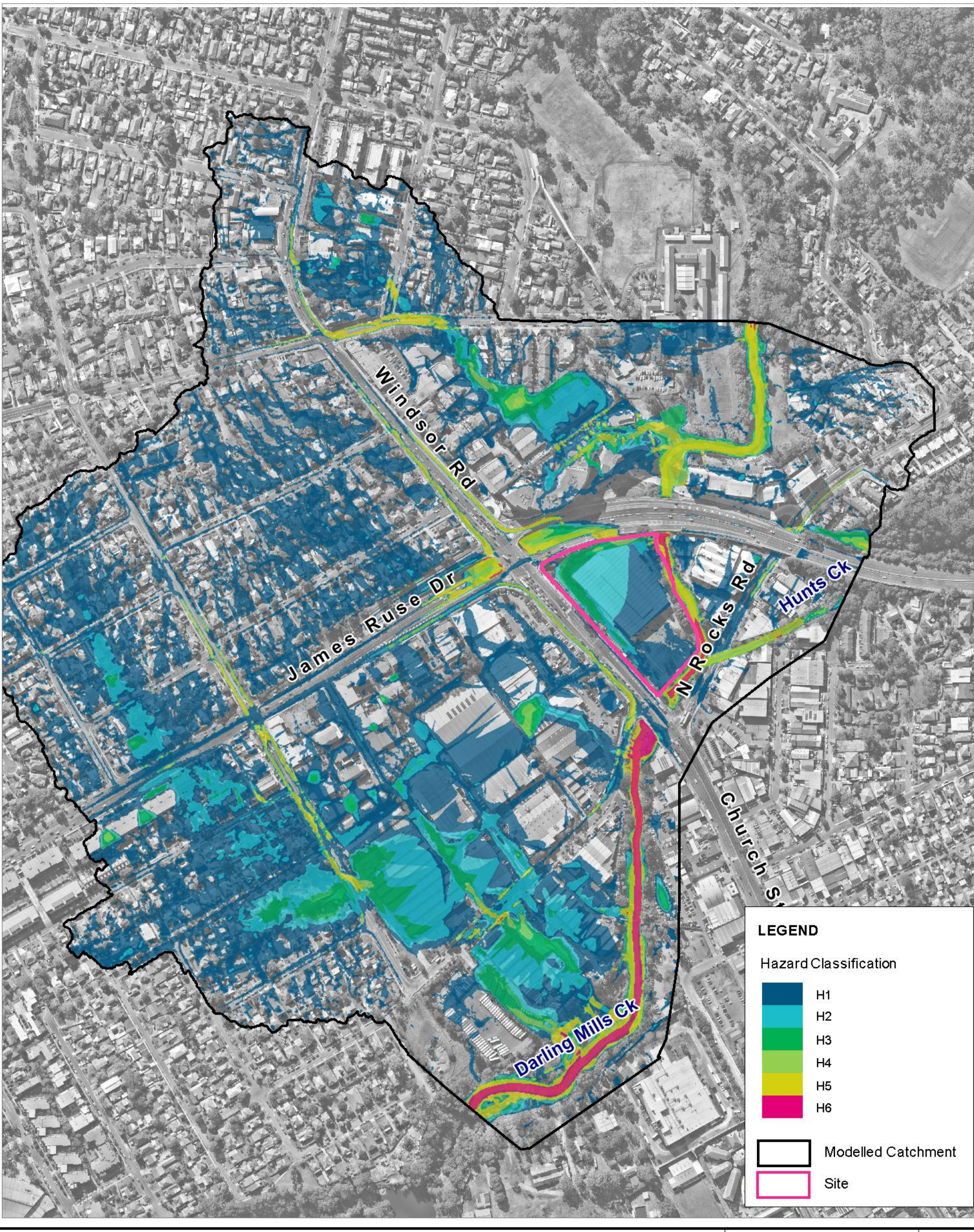
0 100 200m

Approx. Scale

BMT

www.bmt.org

Filepath: "K:\N21282_1-9_North_Rocks_Rd_North_Rocks_FIA\Mapinfo\WOR\DRG_04_1%AEP_Haz.WOR"



Title:

Flood Hazard Vulnerability Classification
PMF Overland Flood Conditions

Figure: 5

Rev: A

N

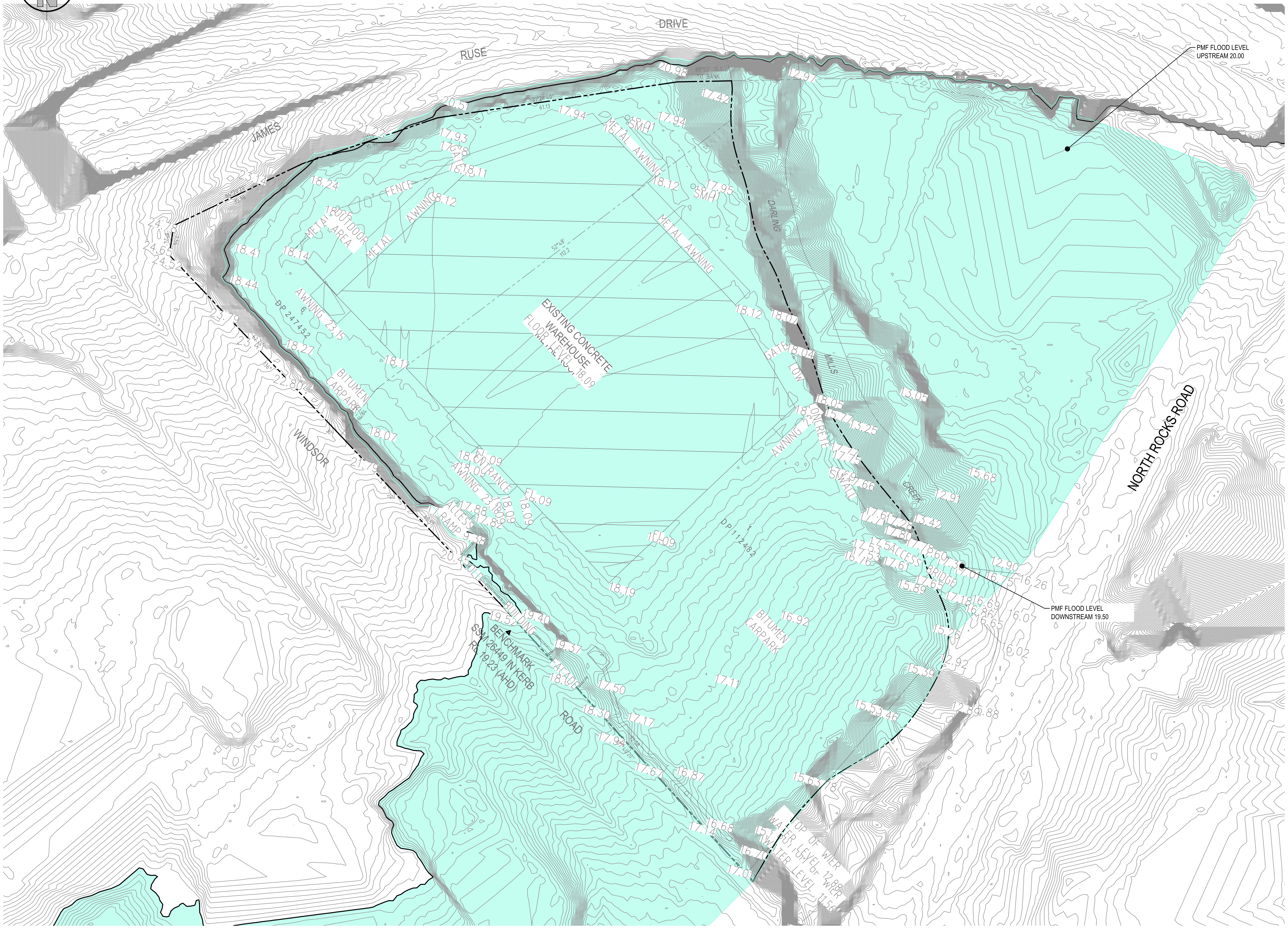
0 100 200m

Approx. Scale

BMT

www.bmt.org

Filepath: "K:\N21282_1-9_North_Rocks_Rd_North_Rocks_FIA\Mapinfo\WOR\DRG_05_PMF_Haz.WOR"



LEGEND

EXISTING BOUNDARY

EXISTING CONTOURS (15.60)

EXISTING LEVEL (15.70 ×)

SCALE 1:500 (0 10 20 30 40 50m)

ISSUED FOR APPROVAL

REVISION	AMENDMENT	DRAWN	DESIGNED	DATE
01	ISSUED FOR APPROVAL	MC	TR	21.10.2019

Client
FABCOT PTY LTD

Surveyor
SURVEYOR LTS

Level 5,
79 Victoria Avenue
Chatswood NSW 2067

Telephone +61 2 9417 8400
Facsimile +61 2 9417 8337
Email email@hhconsult.com.au
Web www.henryandhymas.com.au

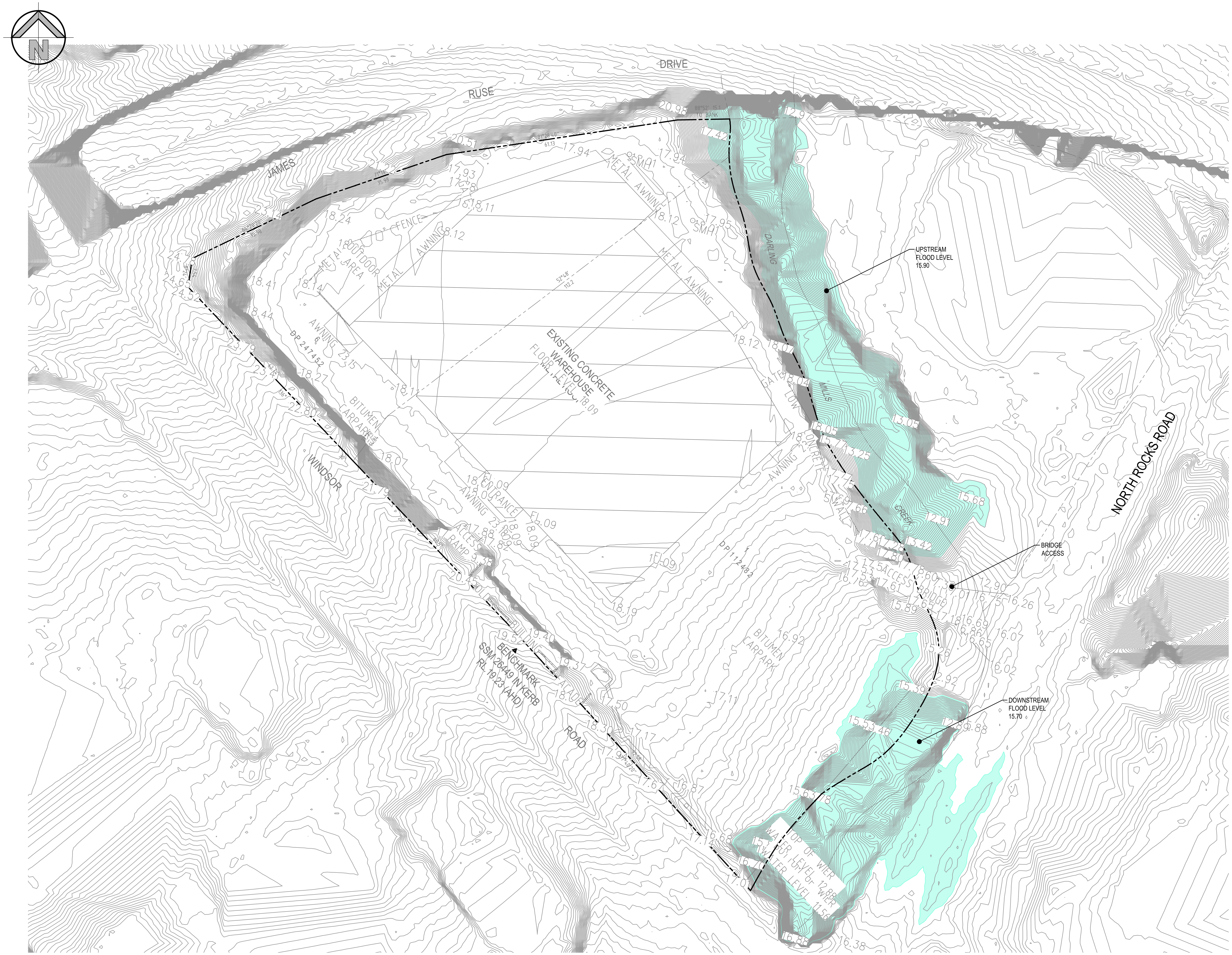
henry&hymas

Project
1-9 NORTHS ROCK ROAD
NORTH ROCKS

Title
PMF

Drawn	Designed	Date
J.Knight	T.Rozehnal	OCT 19
Checked	**Approved**	**Scale @A1**
T.Rozehnal	A.Francis	1:500

Drawing number: 19966_DA_C103 — Revision: 01



LEGEND

- EXISTING BOUNDARY
- EXISTING CONTOURS
- EXISTING LEVEL

SCALE 1:500

ISSUED FOR APPROVAL

REVISION	AMENDMENT	DRAWN	DESIGNED	DATE	REVISION	AMENDMENT	DRAWN	DESIGNED	DATE
01	ISSUED FOR APPROVAL	MC	TR	21.10.2019					

Client: FABCOT PTY LTD

Surveyor: SURVEYOR LTS

Level 5,
79 Victoria Avenue
Chatswood NSW 2067

Telephone +61 2 9417 8400
Facsimile +61 2 9417 8337
Email email@hhconsult.com.au
Web www.henryandhymas.com.au

henry&hymas

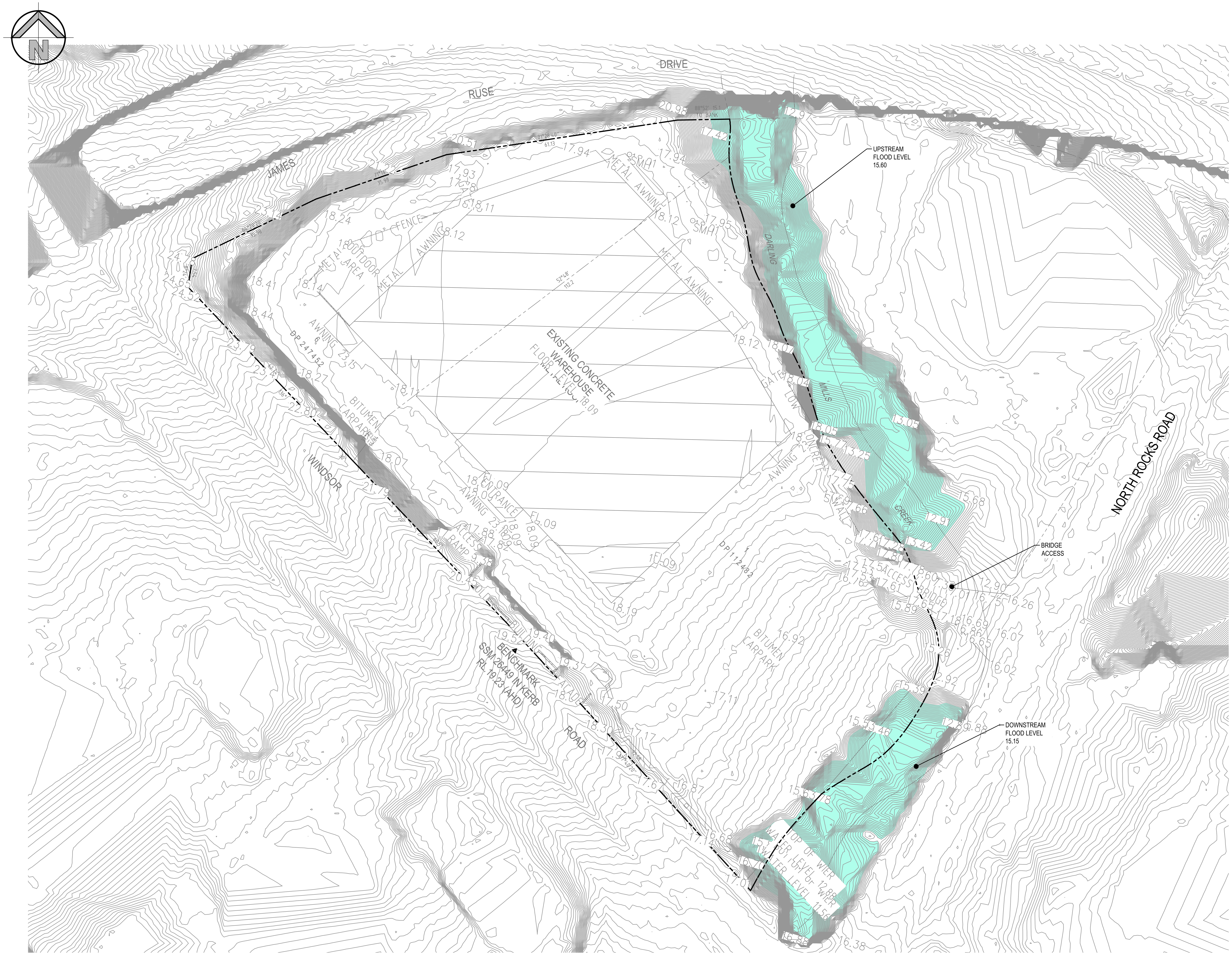
Project: 1-9 NORTHS ROCK ROAD NORTH ROCKS

Title: 1% AEP

Drawn	Designed	Date
J.Knight	T.Rozehnal	OCT 19
Checked	**Approved**	**Scale @A1**
T.Rozehnal	A.Francis	1:500

Drawing number: 19966_DA_C102

Revision: 01



LEGEND

- EXISTING BOUNDARY
- 15.60 EXISTING CONTOURS
- 15.70 × EXISTING LEVEL

0 10 20 30 40 50m

SCALE 1:500

ISSUED FOR APPROVAL

REVISION	AMENDMENT	DRAWN	DESIGNED	DATE	REVISION	AMENDMENT	DRAWN	DESIGNED	DATE
01	ISSUED FOR APPROVAL	MC	TR	21.10.2019					

Client: FABCOT PTY LTD

Architect: SURVEYOR LTS

Level 5, 79 Victoria Avenue Chatswood NSW 2067

Telephone +61 2 9417 8400
Facsimile +61 2 9417 8337
Email email@hhconsult.com.au
Web www.henryandhymas.com.au

henry&hymas

Project: 1-9 NORTHS ROCK ROAD NORTH ROCKS

Title: 5% AEP

Drawn	Designed	Date
J.Knight	T.Rozehnal	OCT 19
Checked	**Approved**	**Scale @A1**
T.Rozehnal	A.Francis	1:500

Drawing number: 19966_DA_C101 Revision: 01