Appendix E – Flood Assessment

MECONE

hkma
ENGINEERS

General Manager
The Hills Shire Council
P O Box 75
CASTLE HILL NSW 1765

February 9, 2012

RE: 27-33 NORTH ROCKS ROAD, NORTH ROCKS

Dear Sir,

I refer to the proposed development at above property and make specific reference to the flood affectation and stormwater drainage requirements relating to the proposal.

In this regard, we have reviewed the proposed overall development scheme and that the overall development scheme to be achieved on the site (resulting from the Planning Proposal) will not generate additional impacts beyond the findings of our original reports from the recently lodged development application.

In terms of stormwater disposal, on-site stormwater detention and water sensitive urban design measures, the basis of the designs are area based and the height of the proposed buildings does not impact on these designs.

With regard to flooding, the key components are the ground floor and basement levels. If these levels are maintained, an increase in height of buildings does not affect or alter the findings of the flood report

I trust explains our position regarding this matter, if you have any queries, please do not hesitate to contact me on (02) 9687-9222

Sincerely Yours,

Steve Arraj
Director – Civil Engineering

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Civil & Structural Consulting Engineers

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FLOOD IMPACT REPORT

FOR THE PROPOSED DEVELOPMENT AT:

27-33 NORTH ROCKS ROAD
NORTH ROCKS

Prepared By: Steve Arraj
Date: December 15, 2011

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INDEX

(1) Site Analysis
- (1.1) Location
- (1.2) Surrounding Area
- (1.3) Adopted Flood Levels
- (1.4) Existing Buildings/Structures within the Site
- (1.5) Easements or any other constraints

(2) Existing Flood Hazard
- (2.1) Existing Flood Regime
- (2.2) Potential Flood Hazard
- (2.3) Risk Expectation
- (2.4) Existing Flood Storage

(3) Proposed Development
- (3.1) Category, Layouts
- (3.2) Any Structures proposed within Flood plain
- (3.3) Proposed Earthworks(Excavation/Filling)
- (3.4) Surrounding Development
- (3.5) Loss of Flood Storage
- (3.6) Impact on Flood Behaviour

(4) Risk Management/Perception
- (4.1) Structural Design Elements
- (4.2) Provisions to Facilitate the Flood Behaviour
- (4.3) Flood Emergency Response and Public Awareness

(5) Design Options to be Considered

(6) Conclusions and Recommendations

(7) Appendices

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(1) Site Analysis

(1.1) Location

The site is located on North Rocks Road, adjacent to James Ruse Drive, North Rocks. The site address is 27-33 North Rocks Road, North Parramatta, Lot 101 DP 617754.

(1.2) Surrounding Area

The site is bounded by Darling Mills Creek to the north and west, James Ruse Drive to the south and North Rocks Road to the south east.

(1.3) Adopted Flood Levels

The flood levels for the site have been determined by the Upper Parramatta River Catchment Trust (UPRCT) as part of the Upper Parramatta River Flood Study which state the following levels:

	North East Boundary	Western Boundary	North Rocks Road
1 in 100 Year A.R.I Flood Level	R.L. 16.54	R.L.15.99	R.L.21.04
P.M.F. Level	R.L. 21.24	R.L. 20.95	R.L.21.97

Refer to appendices for flood contour plan

(1.4) Existing Buildings/Structures within the Site

The site is currently has a large industrial buildings and two single dwellings are located on nos. 31 & 33 North Rocks Road.

(1.5) Easements or any other constraints

Darling Mills Creek traverses the site along the northern and western boundaries. An associated Riparian Corridor exists adjacent to the creek. An easement for an oil pipeline is adjacent to the southern boundary and crosses the site in an east west direction.

An easement for a proposed road and bridge also crosses the site as well as Darling Mills Creek.

(2) Existing Flood Hazard

(2.1) Existing Flood Regime

Darling Mills Creek is subject to mainstream flooding and the site is near the convergence of Hunt's Creek which also contributes to the flooding. The actual building footprint of the proposed development is located away from the constraints previously listed and the entire site is well above the 1% A.E.P. Design Flood Level. The lowest point of the site to be developed is 0.5m above the 1% AEP level.

The PMF level inundates the majority of the site. Approximately 15% of the site is above the PMF level. This area adjoins the North Rocks Road frontage.

(2.2) Potential Flood Hazard - Factors Which Determine The Flood Hazard (Section G6 Floodplain Management Manual)

a) Size of Flood

The site floor levels will need to be designed for the 1% AEP flood. A freeboard of 500mm will be added to this level to provide adequate protection to the design event. For this development, the lowest habitable floor level is R.L. 17.00 which is 0.5m above the 1% AEP Flood Level (Darling Mills Creek). There are only three units set at this level which adjoins basement level 1.

The retaining walls encompassing the open space to these three units provide flood protection to approximately R.L. 21.20 which is equivalent to the PMF level at this location.

The basement car park access will be from the North Rocks Road. The ramp crests to a level of R.L. 22.00 which is 0.96m above the adjacent 1% AEP Flood Level. This level is also set marginally above the PMF level of 21.97m at North Rocks Road.

b) Effective Warning Time

This section of the NSW Floodplain Management Manual relates to the need to assess the effective warning time for people to undertake appropriate actions such as raising pumps, lifting or transporting belongings and/or evacuating the property in the 1% AEP event.

Darling Mills Creek does not break the creek bank adjacent to the development and therefore does not impact.

In the PMF event, evacuation from the site would be possible via the ground floor level across the common open space area and up to North Rocks Road which is all above the PMF event.

Alternatively, vertical evacuation throughout each building is available and a 'shelter in place' scheme may be utilised.

c) Flood Readiness

Flood readiness that is associated with this catchment relates to the structural measures that are in place. Plans for transportation of belongings are not practical due to the relatively short warning time involved. The floor levels will be set at an adequate protection level to mitigate the need for transporting items. This has been done by providing a minimum 500mm freeboard from the habitable floor level to the 1% AEP flood level. Driveway access from the basement to North Rocks Road via the exit driveway is entirely above the PMF level and can be utilised in all storm events.

d) Rate of Rise of Flood Waters

The rate of rise of floodwaters is determined as the difference in time for the creek to break its bank to the time the peak flood level is achieved. In the case of the 1% AEP flood event, the creek does not break its banks at this location.

e) Evacuation Problems

Evacuation in flood events is extremely important and Section G6.7 of the Floodplain Management Manual identifies the following possible difficulties that may arise:

- *Number of people requiring assistance* – Given the potential number of residential dwellings proposed, the total number of people that may need to be evacuated would be in the order of 200-400

- *The depth and velocity of flood waters* – The vehicle egress point at North Rocks Road is above the 1% AEP flood level and is flood free and it is considered safe to evacuate from this point. For the PMF event, the exit driveway at North Rocks Road is entirely above the PMF level. Emergency services vehicles are therefore able to access the site via this driveway in all storm events

- *Wading problems* – The egress point form the site is flood free. The development proposal will need to ensure that occupants are directed to North Rocks Road for evacuation.

- *Mobility of people* - The development will provide access ramps and chair lifts that allow people with mobility problems to evacuate the site in the 1% AEP event. It is possible for people with mobility problems to be assisted to North Rocks Road in all events as the entire pedestrian travel path is protected in the PMF event.

- *The distance to flood free ground* – 100% of the site is flood free from the 1% AEP storm event as well as the access road. In the case of the PMF event, the footpath immediately north of the driveway in North Rocks Road is above the PMF level is flood free ground.

- *The inability to contact emergency services* – Due to the site being in an urbanized catchment, emergency services are fairly easy to contact and the distance to their headquarters are short allowing quick response times.

- *Bottlenecks* – The development proposal creates a large open common open space area on the southern side of the buildings. This area is entirely above the 1% AEP level. Given the total number of people involved, the space available above the 1% AEP flood level and the fact that flood free ground is adjacent to the site in North Rocks Road, bottlenecks are not likely to occur.

- *The time of day and existing weather conditions* – The Street is well lit at night to permit easier evacuation. Proximity lighting on timer switches would be provided for access to the development in the normal course of events regardless. Poor weather conditions would be expected in the event of a flood. The common open space areas as well as the access road on the southern side of the building are above the 1% AEP level. This areas could be used as a congregation point

- *The lack of suitable evacuation equipment such as boats, trucks, helicopters etc* – The necessity for this type of equipment is considered highly unlikely, however the site is located in close proximity to hospitals and medical facilities. Accordingly, ambulances would be used in the case of emergency and their close proximity would enable very short response times.

Evacuation of the site is relatively straightforward and poses minimal problems. The site proposes the majority of dwellings to be elevated by a minimum three to four metres above the 1% AEP Flood Level. In reality, the occupants would be more likely to sit out the duration of the flood rather than evacuate. Regardless of this fact, emergency services are in close proximity to the site and access is from flood free ground.

Effective Flood Access

Flood access is generally divided into two categories, pedestrian and vehicular. Pedestrian access has already been discussed above. Vehicular access to the site can be gained via the entry driveway at North Rocks Road.

Emergency services personnel can access the site via the driveway entrance in all events up to the PMF storm event. The exit driveway from the site as well as the access ramp to the basement car park are entirely above the PMF level

f) Type of Development

The type of development in the floodplain is governed by the following categories

- *The existence of special evacuation needs* – Relates to occupants who require particular assistance to evacuate. Due to the flood free access from North Rocks Road, people with special evacuation needs can be easily evacuated. Alternatively, the relatively short flood duration may mean that these people may not be evacuated and are attended to on-site by emergency services personnel if required.

- *Levels of Occupant awareness* – Residents should be made aware of the flood risk. This can be done by the provision of information in the lift notice boards and by appropriate signage around the site showing flood depth indicators and identifying travel paths to the safest egress point.

- *Isolated Residential Development* – Not applicable to this case

- *Hazardous Industries or Hazardous Storage Establishments* – The development is entirely residential and this is not applicable to this development.

- *Potential for Damage and Danger to Personal* Safety – Given the 1% AEP Flood Level, there is very limited risk involved. The PMF could potentially create horizontal loaded on the lower levels of building (basement car park), however given the maximum possible depth, the structure will be able to sustain such load. Furthermore, the design life of the structure is normally 100yrs.

  Statistically this equates to the 1% AEP storm which has no impact. The PMF relates to frequencies which are significantly higher than the design life of the structure. Nevertheless, our Structural Engineer's have advised that loading from floodwaters will not create a structural problem.

- *Development over Watercourses* – The development will take place over the fringe of the floodplain and as such it is important that there is no detrimental effect to the flood regime. The proposed method of construction is clear of the creek embankment as well as the Riparian Zone. This will allow the conveyance of floodwaters through the site. Overall, there will be no reduction in any component of the flood regime throughout the site.

(2.3) Risk Expectation

The risk expectation of the in its current form would be relatively low as the majority of the site is above the 1% AEP Flood Level.

(2.4) Existing Flood Storage

In relation to the footprint of the proposed development area, there is no flood storage on the site for the 1 % AEP Flood.

(3) Proposed Development

(3.1) Category, Layouts

The proposed development consists of a residential apartment building over a double basement. The ground floor level will be constructed with a minimum freeboard of 3.5m to the 1% AEP Flood Level. Access to the basement will be via a ramp which will slope down from the access road from North Rocks Road. It is proposed to provide a crest at the entry driveway to ensure the driveway and access ramp are above the PMF level.

(3.2) Any Structures proposed within Flood plain

There are no structures within the 1% AEP Flood Plain area.

(3.3) Proposed Earthworks(Excavation/Filling)

There will be no disturbance to the creek embankments or Riparian Zone adjacent to the creek. The proposed development will be constructed within the area above the 1% AEP level

(3.4) Surrounding Development

The properties immediately to the west of the site are approved for high rise residential developments. The proposal is consistent with the adjoining proposed uses.

(3.5) Loss of Flood Storage

There is no loss of flood storage for the proposal. On-site stormwater detention will be provided utilizing below ground detention tanks.

(3.6) Impact on Flood Behaviour

The impact on flood behavior will be a positive impact due to the following reasons:

(a) No loss of flood storage.
(b) No obstructions to the passage of floodwaters are proposed.
(c) The Riparian Zone will be enhanced as part of the landscaping of the site which assists with creek bank stabilization.

(4) Risk Management/Perception

(4.1) Structural Design Elements

The level of the ground floor will be set above the 1% AEP Flood Level to ensure adequate protection to both the inhabitants, possessions and structures. The basement level habitable units will be further protected by a retaining wall around the open space areas which will safeguard against the PMF event/

Access to the basement will be from North Rocks Road. The entire access corridor is greater than the 1%AEp plus 500mm freeboard as required. The crest of the driveway has been set above the PMF flood level.

(4.2) Provisions to Facilitate the Flood Behaviour

There are no obstructions to the passage of floodwaters and the setbacks from the creek ensure there is no development in the Riparian corridor.

(4.3) Flood Emergency Response and Public Awareness

Evacuation of the site is relatively straightforward and poses minimal problems. The site proposes dwellings to be elevated by a minimum of 500mm above the 1% AEP Flood Level. In reality, the occupants would be more likely to sit out the duration of the flood rather than evacuate.

Egress from the site can be directed to North Rocks Road via the access road. Pedestrian evacuation in events up to and including the PMF is available to North Rocks Road.

Alternatively, vertical evacuation throughout each building is available and a 'shelter in place' scheme may be utilised.

The site is located in relatively close proximity to hospital and medical services and emergency response times can be expect to be short

Public awareness can be heightened with the provision of signage marking proposed flood heights and directing pedestrians to the safest egress point.

A Site Emergency Response Plan will be provided at Construction Certificate stage and form part of the Body Corporate by-laws

(5) Design Options to be Considered

In order to prevent any impacts on other properties within the catchment, any proposed development on this particular site would need to ensure that the flood storage available on the site is not reduced in all events up to the 1% AEP Storm.

The architectural plans have set that the ground floor level is set a minimum of 500mm above the 1% AEP Flood Level

Access to the basement will be from North Rocks Road. The crest of the driveway is set above the PMF flood level. The basement will be constructed as a watertight structure and mechanically ventilated.

Appropriate warning signs, flood depth indicators and directional signs will need to be incorporated into the detailed design documentation for the site.

(6) Conclusions and Recommendations

The flooding of the site is due to a combination of flows from several directions. On this basis, in order to prevent any impacts on other properties within the catchment, any proposed development on this particular site would need to ensure that the flood storage available on the site is not reduced and that overland flowpaths are maintained.

The location of the proposed building is entirely outside the 1% AEP flood zone which means the flood behaviour at the site will be consistent with the flood regime for this portion of the catchment.

The proposed setback to the creek and the protection of the Riparian Zone will ensure the flood characteristics are maintained.

The access/egress from the site will need to direct evacuees to travel unobstructed to the point of least ponding and flood waters around all access points need to be determined as Low Hazard with respect to Figure G2 of the Floodplain Management Manual (January 2001).

The vehicle egress point at North Rocks Road as well as the access road to the basement is not only well above the 1% AEP flood level, it is also above the corresponding PMF level. It is considered safe to evacuate from this point.

With these factors in mind, it is recommended that Council approve the development proposal subject to conditions requiring the flood storage and Riparian Zone to be maintained, access and freeboards to be as discussed in this report, appropriate signage and flood indicators being provided and Council's general conditions relating to the disposal of stormwater from development sites.

(7) Appendices

(a) Flood Information issued by BHSC
Based on UPRCT Model (Draft 8, November 2004)

(b) Flood Contour Plan
1% AEP and PMF Events

(c) Pre-development Flood Inundation Plan
1% AEP and PMF Events

(d) Post-development Flood Inundation Plan
1% AEP and PMF Events

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APPENDIX 'A'
Flood Information issued by BHSC
Based on UPRCT Model
(Draft 8, November 2004)

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Baulkham Hills Shire Council

24 September 2008

Project:			
Date RCVD/SENT 26/9/08			
NAME	ACT	INF	NOTE
SA			

Mr Steve Arraj
HKMA Engineers
1/142 James Ruse Drive
ROSEHILL NSW 2142

Dear Mr Arraj

Re: Flood Information – No. 27-29 North Rocks Road, North Rocks
Lot 101, DP 617754

I refer to your enquiry on 19 September 2008 requesting flooding information at the abovementioned property.

With respect to your enquiry, information has been sourced from the "Upper Parramatta River Catchment Trust Web Site-ARCIMS Database-UPRCT Flood Study, Draft 8, November 2004" made available to Council by the Upper Parramatta River Catchment Trust.

That information indicates that the predicted 100 year Average Recurrence Interval (ARI) and Probable Maximum Flood (PMF) levels at the site vary at the cross sections shown on the attached plan, and as described in the table below:

Reference Cross Section	100 year ARI Flood Level (m AHD)	PMF Level (m AHD)
9438	16.54	21.24
9512	16.50	21.21
9589	16.31	21.12
9642	15.94	21.09
9673	15.99	20.95
273.3	N/A	21.12
199.1	N/A	21.81
197.1	21.04	21.97
144.6	21.04	21.97

I trust this information is of assistance.

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129 Showground Road Castle Hill NSW 2154
PO Box 75 Castle Hill NSW 1765

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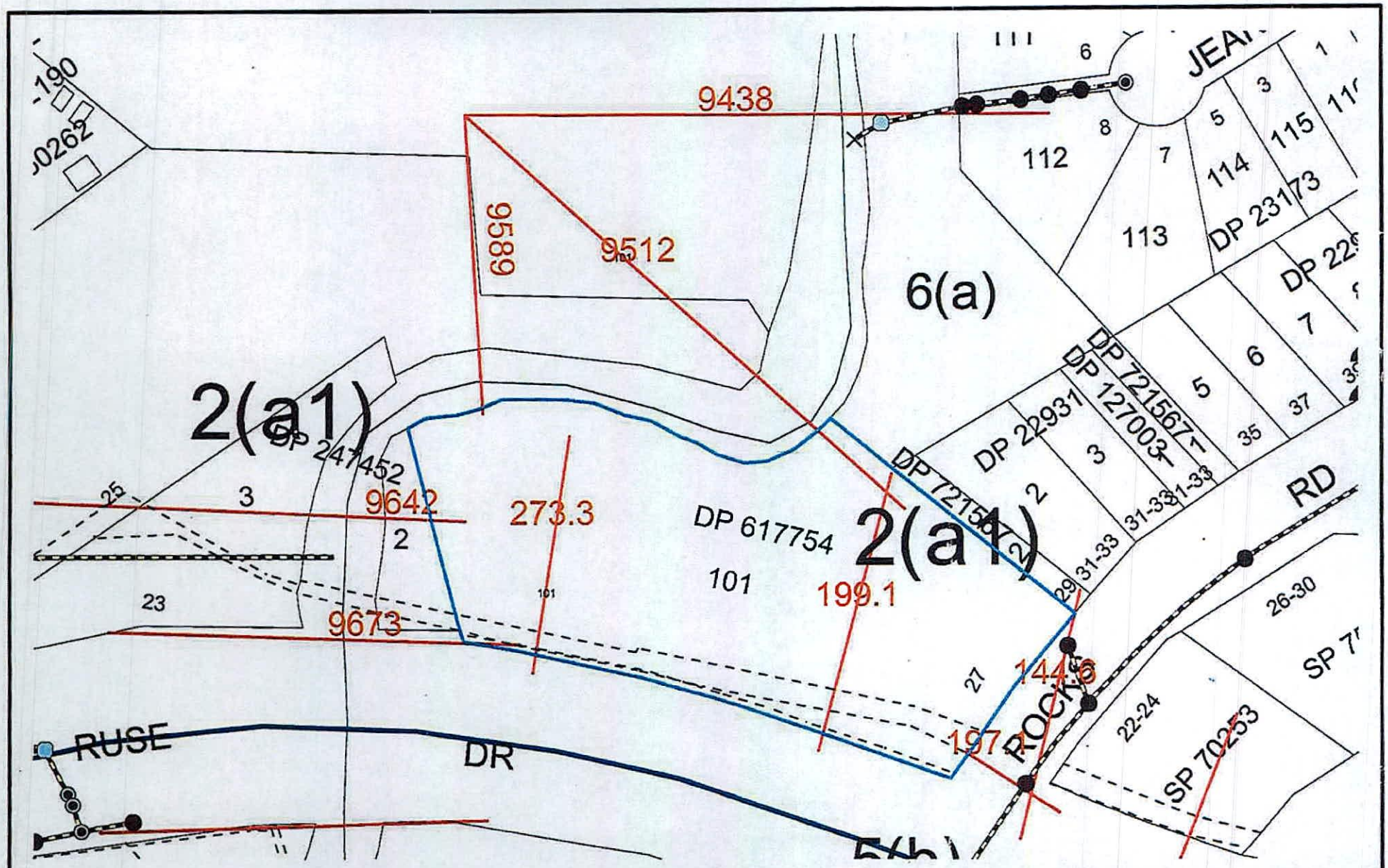
A.B.N. No. 25 034 494 656

Should you require any further information regarding this matter, please contact Council's Stormwater Project Officer, Mr Wimal Rangedera on 9843 0228.

Yours faithfully

Allan Gear
WATERWAYS MANAGER



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Not all pipes and pits are shown. The position of pits and pipes may be different to the position shown on the plan. Contours are a general guide to landform and should not be used to determine levels. Verify all information on site before use.

BAULKHAM HILLS SHIRE COUNCIL

Stormwater Management

Scale 1:1,200

Date

APPENDIX 'B'
Flood Contour Plan
1% AEP and PMF Events

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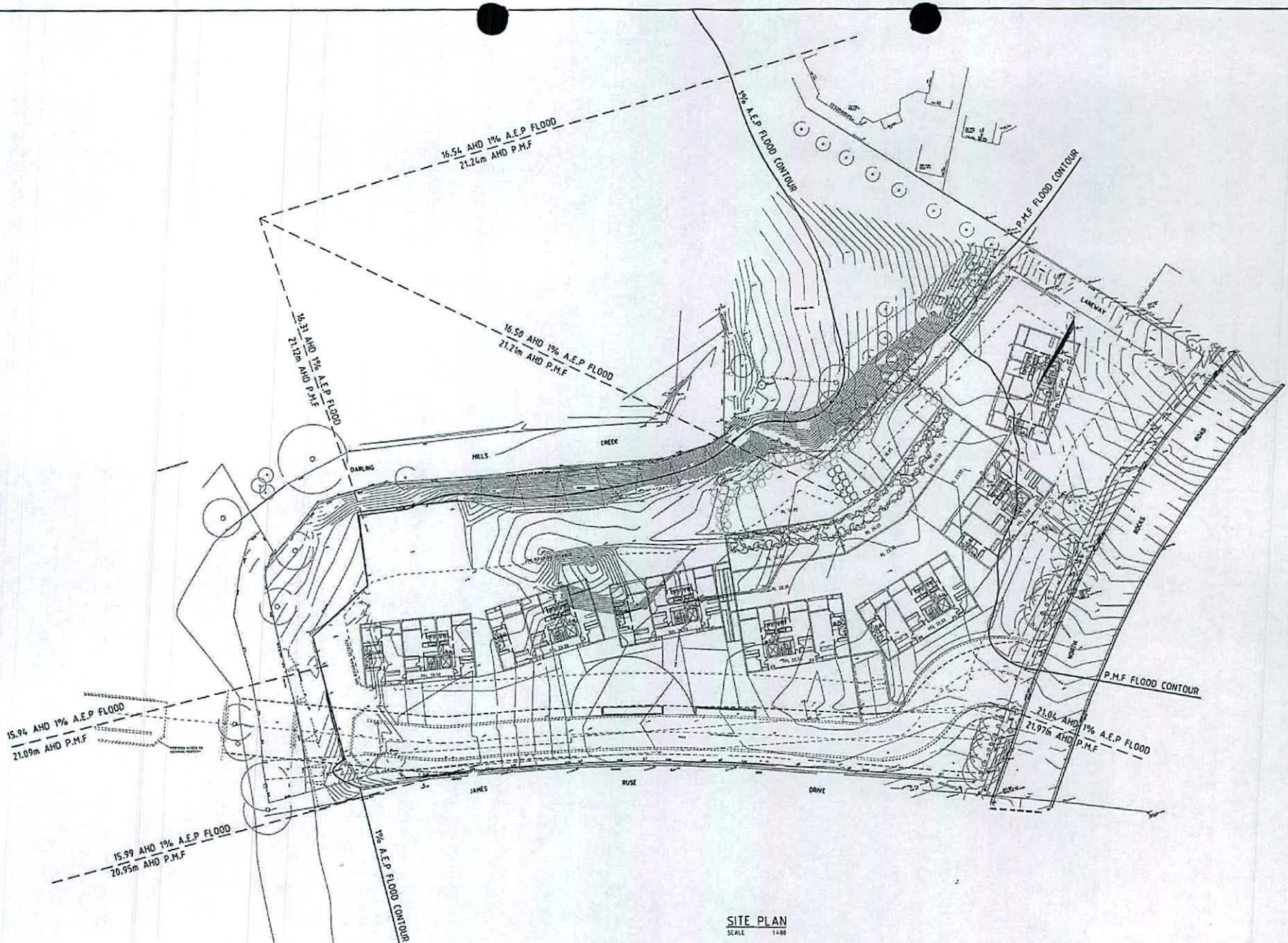

SITE PLAN
SCALE 1:400

ISSUE	DESCRIPTION	BY	DATE
A	ISSUE FOR DEVELOPMENT APPLICATION	CC	19/12/11

FOR COUNCIL / CONSTRUCTION CERTIFICATE ISSUE

CHECKED BY
Signature Date

STEVE ARRAJ B.E.(Civil)

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PROJECT
PROPOSED RESIDENTIAL DEVELOPMENT
27-33 NORTH ROCKS ROAD
NORTH ROCKS

DRAWING TITLE
FLOOD CONTOUR PLAN

DESIGNED	SA
CHECKED	SA
DATUM	AHD
SCALE	1:400
DRAWING NUMBER	1142-FS DA01
ISSUE	A
	A1
SHEET	1

APPENDIX 'C'
Pre-development Flood Inundation Plan
1% AEP and PMF Events

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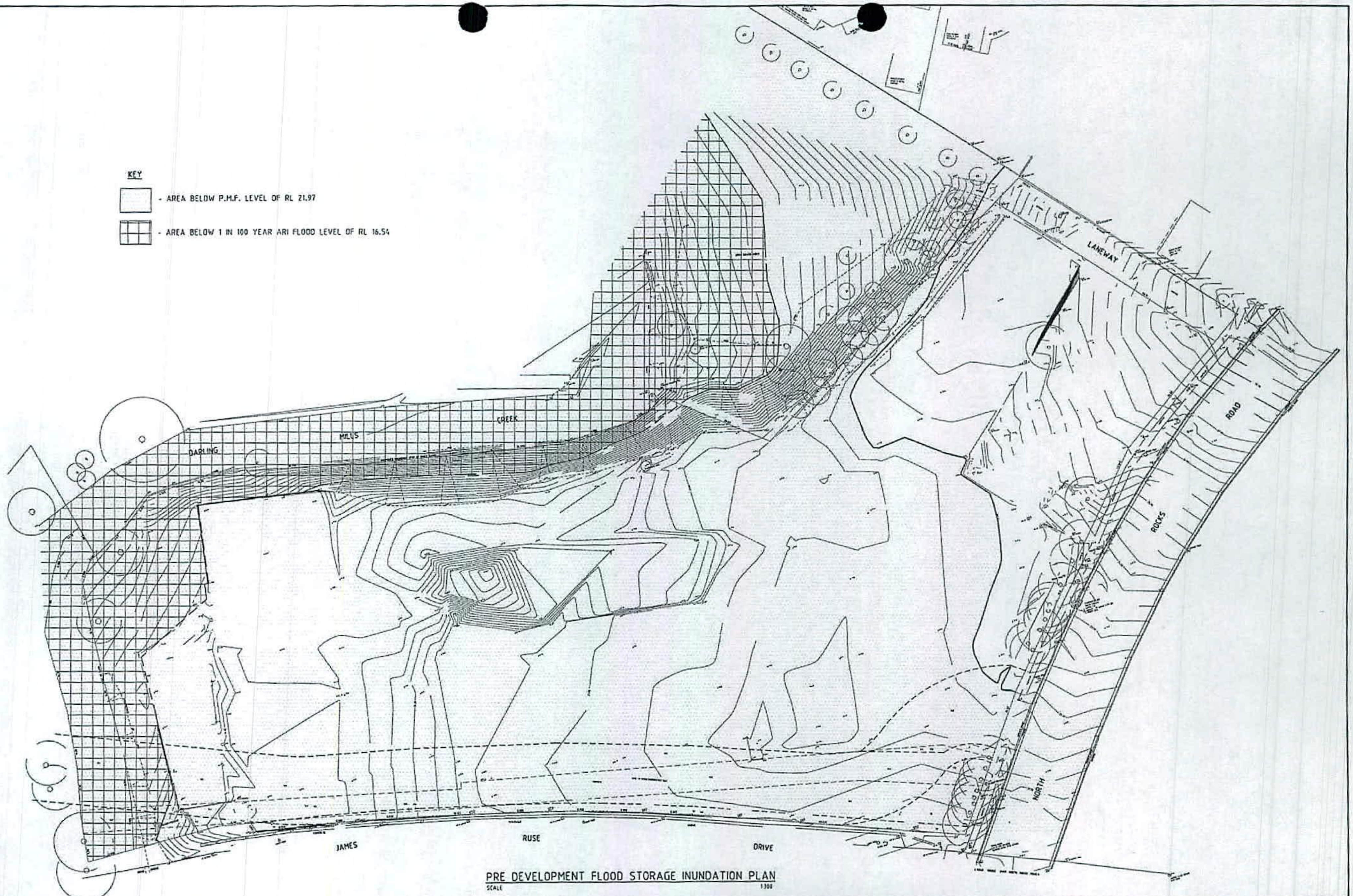

PRE DEVELOPMENT FLOOD STORAGE INUNDATION PLAN
SCALE 1:300

ISSUE	DESCRIPTION	BY	DATE
A	ISSUE FOR DEVELOPMENT APPLICATION	CE	16/12/11

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FOR COUNCIL / CONSTRUCTION CERTIFICATE ISSUE
CHECKED BY
Signature Date
STEVE ARRAJ B.E.(Civil)

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PROJECT
PROPOSED RESIDENTIAL DEVELOPMENT
27-33 NORTH ROCKS ROAD
NORTH ROCKS

DRAWING TITLE
PRE DEVELOPMENT FLOOD
INUNDATION DRAWING

DESIGNED SA	DRAWING NUMBER	ISSUE	
CHECKED SA	1142-FS	A	
DATUM AHD	DA02	A1	
SCALE 1:300		SHEET 2	

APPENDIX 'D'
Post-development Flood Inundation Plan
1% AEP and PMF Events

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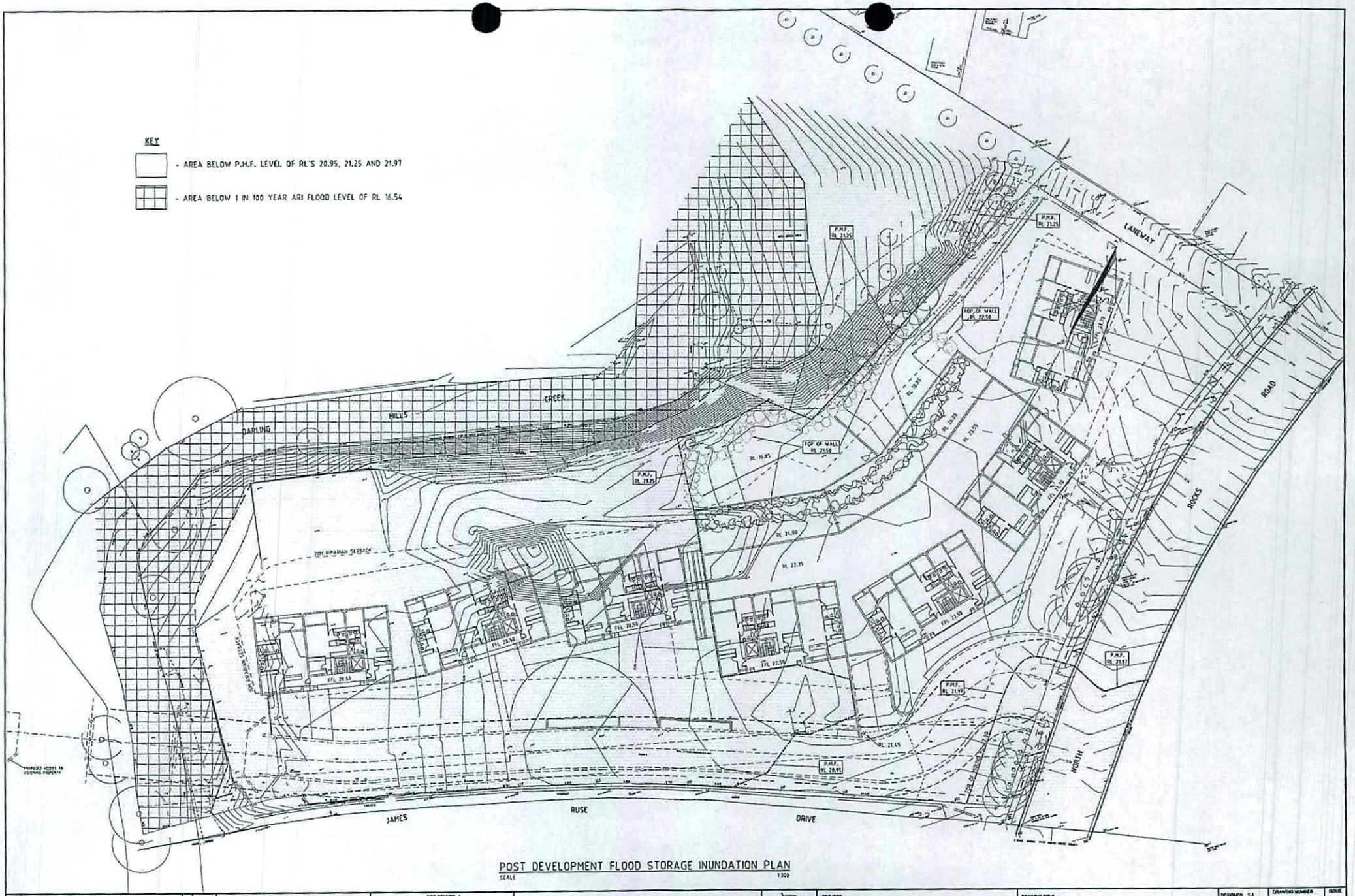

POST DEVELOPMENT FLOOD STORAGE INUNDATION PLAN

SCALE 1:300

ISSUE	DESCRIPTION	BY	DATE
A	ISSUE FOR DEVELOPMENT APPLICATION	CC	19/12/11

FOR COUNCIL / CONSTRUCTION CERTIFICATE ISSUE

CHECKED BY

STEVE ARRAJ B.E.(Civil)

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PROJECT
PROPOSED RESIDENTIAL DEVELOPMENT
27-33 NORTH ROCKS ROAD
NORTH ROCKS

DRAWING TITLE
POST DEVELOPMENT FLOOD
INUNDATION DRAWING

DESIGNED	S.A.	DRAWING NUMBER	ISSUE
CHECKED	S.A.	1142-FS DA03	A
DATUM	A.H.D.		A1
SCALE	1:300	SHEET	3