

# NSW DEPARTMENT OF EDUCATION Blakebrook Public School

Flood Impact Assessment

QC3008\_001-REP-001-0

6 DECEMBER 2023



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Rev	Date	Description	Author	Reviewer	Project Mgr.	Approver
0	6/12/2023	Client Issue	Ramya Srinivasan	Kelsey Mundt	Kelsey Mundt	Mark Page
Signatures:			Ramp	Kelso	Kelsb	Mage



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# 1. INTRODUCTION

Engeny was commissioned by the New South Wales (NSW) Department of Education (DoE) to undertake a flood assessment (the Project) for Blakebrook Public School, located at 417 Rosehill Road, Blakebrook, NSW 2840 (the Site). A complete rebuild of the school is currently proposed, and as such the Project also includes a Flood Impact Assessment (FIA) of the proposed works. Flood behaviour and impacts were assessed for the critical flood event duration at the Site location for a range of flood event AEPs. The scope of works for this assessment and associated findings are outlined in the following sections.

### 1.1 Scope and Objectives

The key objectives of the Project were to:

- Define the Flood Planning Level and provide information to inform the proposed design and assess flood impacts.
- Base Case Assessment:
  - Utilise and modify the hydrologic and hydraulic models previously developed as part of the Lismore Floodplain Risk Management Study (FRMS) (Engeny, 2019) to represent local conditions related to the Site.
  - Produce a trimmed model for the hydraulic analysis of the existing conditions at the Site (with incorporation of existing topography provided by ADCO Constructions, dated 22 November 2023) and simulate the model for the 10%, 5%, 1%, 0.5%, 1:1,000, 1:2,000, 1:10,000, 1:100,000 AEP, and PMF flood events.
  - Provide information on the current flood immunity of the Site.
  - Provide mapping of flood levels, depths, velocity, and hazard at the Site.
- Post-Rebuild Case Assessment:
  - Undertake a hydraulic assessment of the proposed earthworks (supplied by ADCO Constructions, dated 22 November 2023) for the Site by incorporating the proposed design into the trimmed flood model and simulate the model for the 10%, 5%, 1%, 0.5%, 1:1,000, 1:2,000, 1:10,000, 1:100,000 AEP, and PMF events.
  - Define flood levels, depths, velocity, and hazard influencing the Site.
  - Provide information to inform flood evacuation.
  - Identify any flood impacts associated with the proposed development and provide suggestions for design improvement where applicable.
  - Provide mapping of flood levels, depths, velocity, hazard, and flood impacts at the Site.
- Summarise key findings and recommendations in a technical Flood Assessment report.

### 1.2 Site Locality

The Site is located within the floodplains of Terania Creek (to the east of the Site) and Goolmangar Creek (to the west of the Site), which are tributaries to Leycester Creek. The contributing catchment area to the Site is approximately 600 km<sup>2</sup>. Elevations at the Site range from approximately 13.2 m AHD to 16.1 m AHD.

The Site locality is presented in Figure 1.1.





Figure 1.1: Site Locality



# 2. HYDRAULIC MODEL DEVELOPMENT

The TUFLOW hydraulic modelling package was utilised to undertake the hydraulic assessment of the Site, utilising the previously built model for the Lismore Floodplain Risk Management Study (FRMS) (Engeny, 2019). For the purpose of this assessment, and in order to establish the baseline or existing flooding conditions upon which flood impacts for the rebuilt school could be assessed, the model was extended upstream geographically and truncated at the downstream end to approximately 4 km from the Site and simulated for the 10%, 5%, 1%, 0.5%, 1:1,000, 1:2,000, 1:10,000, 1:100,000 AEP, and PMF flood events as specified by LCC. The extent of the base case model is presented in Figure 2.1. The total model area is 28.2 km<sup>2</sup>. The adopted grid cell size is 5 m, which provides suitable definition of the road surface and waterways, without resulting in unreasonable simulation durations.

The following sections outline the hydraulic assessment and results.

### 2.1 Base Case Model Development

The parametrisation of the TUFLOW hydraulic model is summarised below:

- The Digital Elevation Model (DEM) used in the hydraulic model was based on Lismore 1m LiDAR 2010 retrieved from ELVIS Elevations, as well as incorporation of site existing topography provided by ADCO Constructions dated 22 November 2023 (ref. 'CIVIL TIN & EX TIN.dwg').
- The data input for the hydraulic structures are adopted from the data supplied by LCC, as well as asset data retrieved from LCC interactive mapping and Google Streetview. Hydraulic structures were input into TUFLOW, using either:
  - 1D structural elements, which includes upstream and downstream grid connection, invert levels, and size and number of culverts, and/or
  - Bridge layered flow constrictions to represent bridges and to account for two-dimensional flow behaviour and the alignment of the structure and interaction with piers.
- The Manning's 'n' roughness values applied in the model are presented in Table 2.1 below.
- Inflows for the 10%, 5%, 1%, 0.5%, 1:1,000, 1:2,000, 1:10,000, 1:100,000 AEP, and PMF rainfall scenarios from the Engeny URBS model developed for the Lismore Flood Risk Management Study (FRMS) were adjusted for the Site location. Critical durations and temporal patterns for each inflow location were also determined in the URBS model and applied to the hydraulic model. The inflows and the model extent are shown in Figure 2.1.

#### TABLE 2.1: MANNING'S ROUGHNESS VALUES

Land Use	Manning's 'n' Roughness
Pasture	0.05
Dams / Open Water	0.07
Creek Bed	0.025
Lightly Vegetated Creek	0.07
Medium Density Vegetation	0.07
Dense Vegetation	0.12



Land Use	Manning's 'n' Roughness
Sparse Vegetation	0.09
Sparse Urban Block	0.2
Road	0.025
Building	0.8
Cultivated Field	0.06

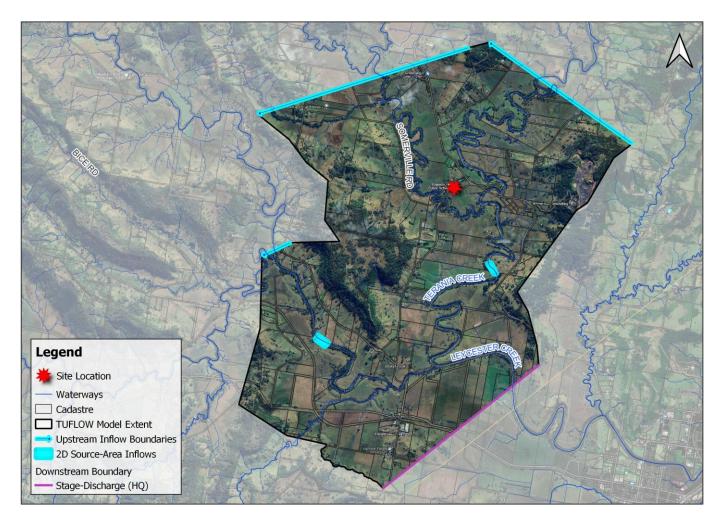


Figure 2.1: Model Extent and Inflow Locations

### 2.2 Post-Rebuild Case Model Development

The post-rebuild case TUFLOW model utilised all the same inputs as the base case, however, it also incorporated a design TIN representing works as supplied by ADCO Constructions dated 22 November 2023 (ref. 'CIVIL TIN & EX TIN.dwg'). The demolition of existing buildings in the post-rebuild case model was represented through adjustment of the Manning's roughness values by lowering the roughness to reflect surrounding land conditions, and the proposed school building was represented as a layered flow constriction in the model, based on the



supplied architectural plans by Pedavoli Architects dated 03/10/2023 (ref. 'BLA-ARC-PP-DWG-200[B]\_ELEVATIONS.pdf' and ref. 'BLA-ARC-PP-DWG-201[B]\_ELEVATIONS.pdf').

The post-rebuild case model setup is presented in Figure 2.2.

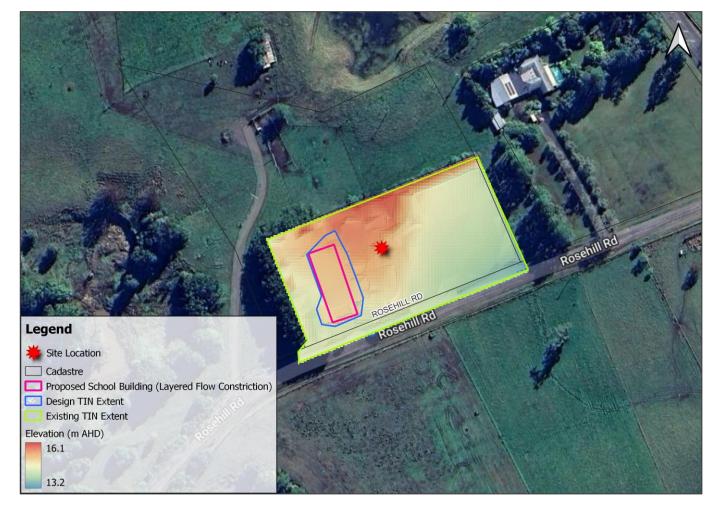


Figure 2.2: Post-Rebuild Case Model Representation



# 3. FLOOD RISK ASSESSMENT

### 3.1 Base Case Flood Risk Assessment

#### 3.1.1 Immunity of Site

The existing flood immunity of the Site is presented in Figure 3.1 below, showing the flood extents for the 10%, 5%, and 1% AEP events. The existing site is generally flood immune in the 10% AEP flood event, with flooding only present at the south-eastern corner of the Site where there were no existing buildings located. The Site becomes partially inundated in the 5% AEP event, and almost completely inundated in the 1% AEP event, as shown in Figure 3.1 below. The 1% AEP flood depths surrounding the Site are presented in Figure 3.2 along with key reporting locations, which have been selected to indicate flood conditions over the roads to inform evacuation from the Site. As shown in Figure 3.2, all the roads surrounding the Site are inundated in the base case, blocking access to and from the Site in the 1% AEP event.

Mapping of the base case flood results for the full range of events from the 10% AEP to the PMF is provided in Appendix A.



Figure 3.1: Base Case Flood Immunity



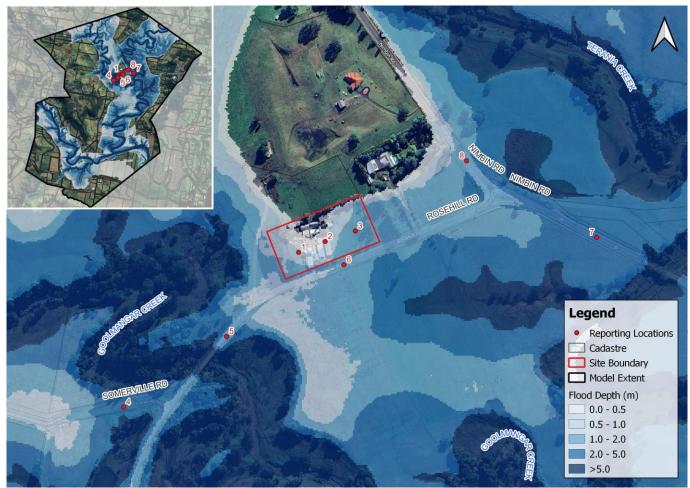


Figure 3.2: Base Case 1% AEP Flood Depth

### 3.2 Post-Rebuild Case Flood Risk Assessment

#### 3.2.1 Proposed School Building Flood Risk Results

The flood depth, level, velocity, and hazard levels at the proposed new school building location for all AEPs are summarized in Table 3.1 below. Mapping of the post-rebuild case flood results for the full range of events from the 10% AEP to the PMF is provided in Appendix B.

#### TABLE 3.1: POST-REBUILD CASE FLOOD RESULTS AT REPORTING LOCATION 1 - ALL AEPS

AEP	Flood Depth (m)	Flood Height (m AHD)	Flood Velocity (m/s)	Flood Hazard (m²/s)	Flood Hazard Classification (ZAEM1)
10 %	0.00	N/A	0.00	0.00	N/A
5 %	0.00	N/A	0.00	0.00	N/A
1%	0.43	15.53	0.30	0.13	H2
0.5 %	0.75	15.84	0.35	0.26	Н3



AEP	Flood Depth (m)	Flood Height (m AHD)	Flood Velocity (m/s)	Flood Hazard (m²/s)	Flood Hazard Classification (ZAEM1)
1 in 1000	0.92	16.02	0.36	0.34	Н3
1 in 2000	1.06	16.16	0.38	0.40	НЗ
1 in 10000	1.19	16.29	0.39	0.46	НЗ
1 in 100000	1.93	17.03	0.46	0.89	Н4
PMF	3.29	18.38	0.58	1.91	Н5

#### 3.2.2 Broader Site Flood Risk Results

The 1% AEP flood depth and key reporting locations for the post-rebuild case are presented in Figure 3.3: below. Reporting locations have been selected within the Site boundary as well as at roads surrounding the Site to inform evacuation conditions.

The flood depth, level, velocity, hazard, and duration of inundation are presented in Table 3.2 below, with the flood hazard classification results and hazard category definitions presented in Figure 3.4 and Figure 3.5, respectively.

The flood hazard classifications presented in Figure 3.4 are in accordance with the Australian Rainfall & Runoff (ARR) 2019 guidelines safety design criteria to categorize hazard levels for pedestrians, vehicles, and buildings, which are based on the depth-velocity product as presented in Figure 3.5. As shown in Table 2.1 above, the lowest hazard classification over the roads surrounding the Site (reporting locations 4 to 8) in the 1% AEP event is H3, which is unsafe for vehicles, children, and the elderly. The duration of inundation above 10 mm over the roads (reporting locations 4 to 8) ranges from 16 hours to 31 hours. As access to and from the Site is via each of these roads, it is unlikely that evacuation from the Site will be possible in the 1% AEP event. However, these hazard levels have not changed in comparison to the base case and are consistent with the existing flooding conditions. The flood immunity of the school has also not altered from the base case as the flood extents are the same in the post-rebuild case. It is recommended that appropriate warning time be given in advance of major flood events to allow sufficient time for people to evacuate prior to the flood occurring.

#### TABLE 3.2: POST-REBUILD CASE 1% AEP FLOOD RESULTS

Reporting Location	Flood Depth (m)	Flood Height (m AHD)	Flood Velocity (m/s)	Flood Hazard (m²/s)	Flood Hazard Classification (ZAEM1)	Duration of Inundation above 10mm (hr)
1 (Site)	0.43	15.53	0.30	0.13	H2	11
2 (Site)	0.45	15.49	0.04	0.02	H2	10
3 (Site)	1.26	15.49	0.03	0.02	H4	17
4 (Somerville Rd)	3.37	15.53	1.96	1.84	Н5	31
5 (Rosehill Rd)	1.49	15.51	1.57	1.10	Н5	21



Reporting Location	Flood Depth (m)	Flood Height (m AHD)	Flood Velocity (m/s)	Flood Hazard (m²/s)	Flood Hazard Classification (ZAEM1)	Duration of Inundation above 10mm (hr)
6 (Rosehill Rd)	1.11	15.49	0.41	0.34	Н3	16
7 (Nimbin Rd)	3.36	15.48	0.48	1.56	Н5	30
8 (Nimbin Rd)	1.30	15.49	0.32	0.42	H4	18

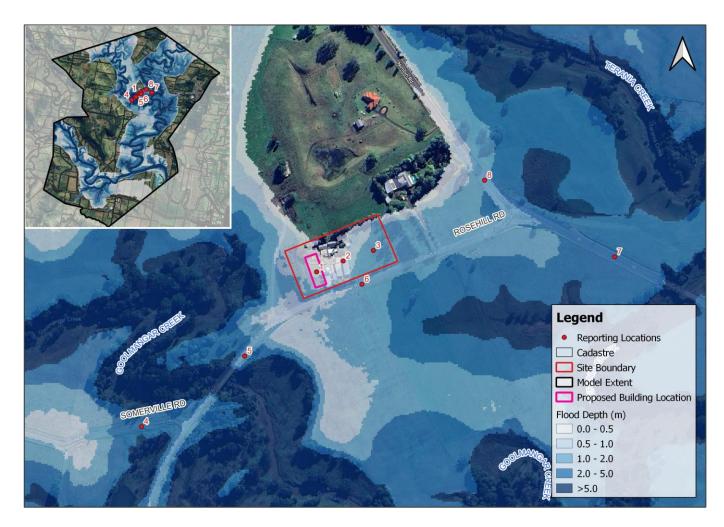


Figure 3.3: Post Rebuild Case 1% AEP Flood Depth



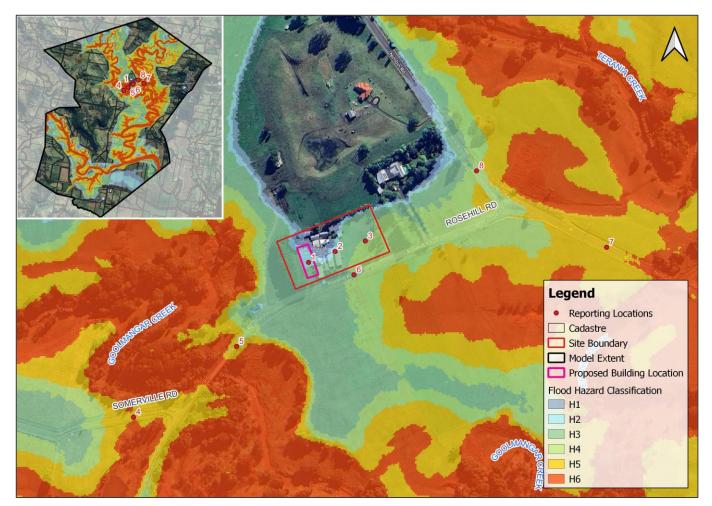


Figure 3.4: Post-Rebuild Case 1% AEP Flood Hazard Classification (ZAEM1)

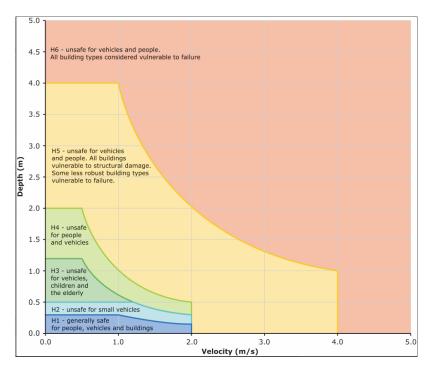


Figure 3.5: Combined Flood Hazard Curves (Smith et al., 2014)



#### 3.2.3 Evacuation and Access

The flood results indicate that there is flooding over all access roads in the immediate vicinity of the Site from the 10% AEP event and higher. The depths in the 10% AEP event range from approximately 100 mm to 300 mm over the roads (Rosehill Rd and Nimbin Rd). However, if evacuation is required, the preferred route would likely be via Rosehill Rd to the south-west of the Site as the road is largely flood free after the Goolmangar Creek crossing approximately 700 m from the entrance to the school. The evacuation route would require travelling down Rosehill Rd to Kyogle Rd and then south-east towards the Lismore CBD. However, it is noted that there is likely to be significant flooding further downstream along the evacuation route at the Lismore CBD. It is advised that appropriate flood warning is given to allow for evacuation prior to any flood event occurring.

#### 3.2.4 Immunity of Proposed School

The Defined Flood Event (DFE) for the Site is the 1% AEP event, plus 500mm freeboard required for the flood planning level (FPL), as per the NSW Government Flood Risk Management Manual (2023) referenced in the Lismore Local Environmental Plan 2012 (LEP 2012). The flood level for the 1% AEP at the proposed building location is 15.53 m AHD. The architectural plans provided by Pedavoli Architects dated 03/10/2023 (ref. 'BLA-ARC-PP-DWG-200[B]\_ELEVATIONS.pdf' and ref. 'BLA-ARC-PP-DWG-201[B]\_ELEVATIONS.pdf') indicate that the finished floor level (FFL) of the proposed building will be at 19.20 m AHD, which indicates that the school will be immune to flooding in this event with sufficient freeboard, noting that there is approximately 500 mm of flood depth over the building undercroft (set at 15 m AHD in the supplied architectural plans) as indicated by the flood depth results summarized in Table 3.1.



# 4. FLOOD IMPACT ASSESSMENT

The flood height impact results for the 10% AEP to the 1% AEP events are provided in Appendix C.

A summary of flood impacts at key reporting locations surrounding the proposed building and along Rosehill Rd at the frontage of the Site (refer Figure 4.1) is presented in Table 4.1 below.



#### Figure 4.1: 1% AEP Flood Height Afflux and Reporting Locations

#### TABLE 4.1: FLOOD HEIGHT IMPACT RESULTS

Reporting Location	10% AEP Flood Height Impact (m)	5% AEP Flood Height Impact (m)	1% AEP Flood Height Impact (m)
1 (Rosehill Rd)	0.00	0.00	0.00
2 (Within Site Boundary)	0.00	0.03	0.00
3 (Rosehill Rd)	0.00	Was Inundated (Wet) Now Immune (Dry)	-0.01
4 (Within Site Boundary)	0.00	-0.02	0.00



Reporting Location	10% AEP	5% AEP	1% AEP
	Flood Height Impact (m)	Flood Height Impact (m)	Flood Height Impact (m)
5 (Rosehill Rd)	0.00	0.00	0.00

As shown in Table 4.1, there are no impacts external to the Site from the 10% AEP to the 1% AEP events as a result of the proposed school rebuild. There is an increase in flood level of 30 mm in the 5% AEP event to the west of the proposed building, which is expected due to the proposed building causing minor blockage of flows from the Goolmangar Creek system from the west that would otherwise flow through the Site.



# 5. SUMMARY AND CONCLUSION

The following is a summary of the flood assessment undertaken for the proposed reconstruction works at the Blakebrook Public School located at 417 Rosehill Road, Blakebrook, NSW 2840:

- Development and simulation of a base case and post-rebuild case hydraulic model for the following events: 10%, 5%, 1%, 0.5%, 1:1000, 1:2000, 1:100,000 AEPs and PMF.
- Flood risk assessment to evaluate the flood immunity and evacuation conditions for the school in the base case and post-rebuild case.
- Flood impact assessment to identify potential impacts resulting from the proposed works at the school.

The assessment has identified the following:

- Flood Risk Assessment:
  - No change in flood immunity of the Site from the base case to the post-rebuild case.
  - Flood immunity for the 1% AEP event is achieved in the post-rebuild case as the proposed FFL (19.20 m AHD) is above the 1% AEP flood level (15.53 m AHD). Depths of up to approximately 500mm are predicted over the undercroft of the proposed building.
  - No change in flood conditions in relation to evacuation between the base case and post-rebuild case. All roads surrounding the Site
    are inundated in both the base case and post-rebuild case, with hazard levels exceeding safe levels for vehicles and pedestrians.
  - The preferred evacuation route would most likely be via Rosehill Rd in the south-west direction, down to Kyogle Rd, and then to the south-east towards the Lismore CBD, however it is noted that there may be significant flooding surrounding the Lismore CBD.
  - It is recommended that appropriate warning time be given in advance of major flood events to allow sufficient time for evacuation prior to the flood occurring.
- Flood Impact Assessment:
  - The proposed works for the Blakebrook Public School are not predicted to result in a material change to the existing flood behaviour from Goolmangar Creek and Terania Creek in the 10% AEP to the PMF events.
  - The model results show a maximum increase in flood level of 30mm adjacent to the proposed building location in the 5% AEP event, however, this is contained within the Site and does not impact any external properties or road.

The above assessment indicates that the proposed works at the Site are predicted to provide sufficient flood immunity for the school and are not expected to cause any adverse impacts external to the Site. It is recommended that appropriate flood warning and emergency response measures be taken to allow for evacuation from the Site to mitigate the risk of isolation in the event of flooding.



## 6. REFERENCES

NSW Government (2012). Lismore Local Environmental Plan 2012 (2013 EPI 66).

NSW Government (2023). Flood Risk Management Manual: The policy and manual for the management of flood liable land.

Smith, G.P., Davey, E.K. and Cox, R.J. (2014), Flood Hazard UNSW Australia Water Research Laboratory Technical Report 2014/07 30 September 2014.



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# APPENDIX A: BASE CASE FLOOD MAPPING



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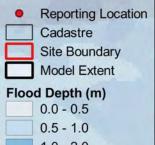
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#### Figure A1

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 10% AEP Flood Depth



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## Reporting Location Cadastre

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### Site Boundary

Model Extent

## Flood Depth (m) 0.0 - 0.5

- 0.5 1.0
- 1.0 2.0
- 2.0 5.0
- >5.0

#### Figure A2

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 5% AEP Flood Depth







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 Reporting Location ] Cadastre Site Boundary Model Extent

### Flood Depth (m) 0.0 - 0.5

- 0.5 1.0 1.0 - 2.0
- 2.0 5.0
- >5.0

#### Figure A3

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 1% AEP Flood Depth









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- 0.5 1.0
- 1.0 2.0
- 2.0 5.0
- >5.0

#### Figure A4

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 0.5% AEP Flood Depth







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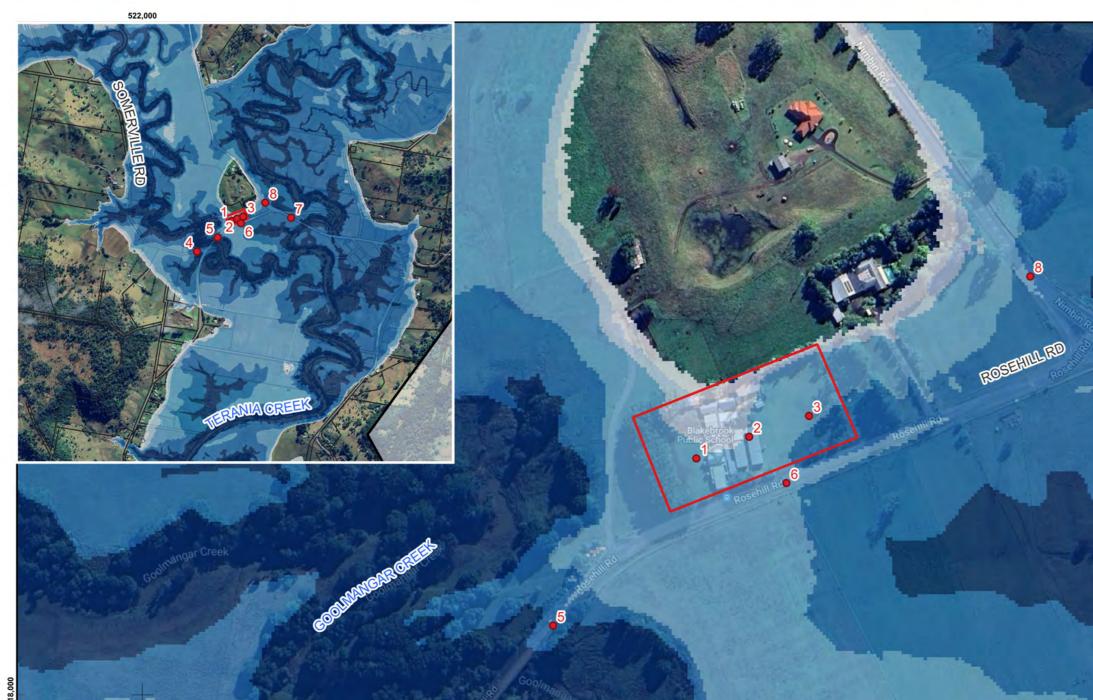
- Reporting Location Cadastre Site Boundary
- Model Extent

### Flood Depth (m) 0.0 - 0.5

- 0.5 1.0
- 1.0 2.0 2.0 - 5.0
- >5.0

#### Figure A5

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 1 in 1000 AEP Flood Depth



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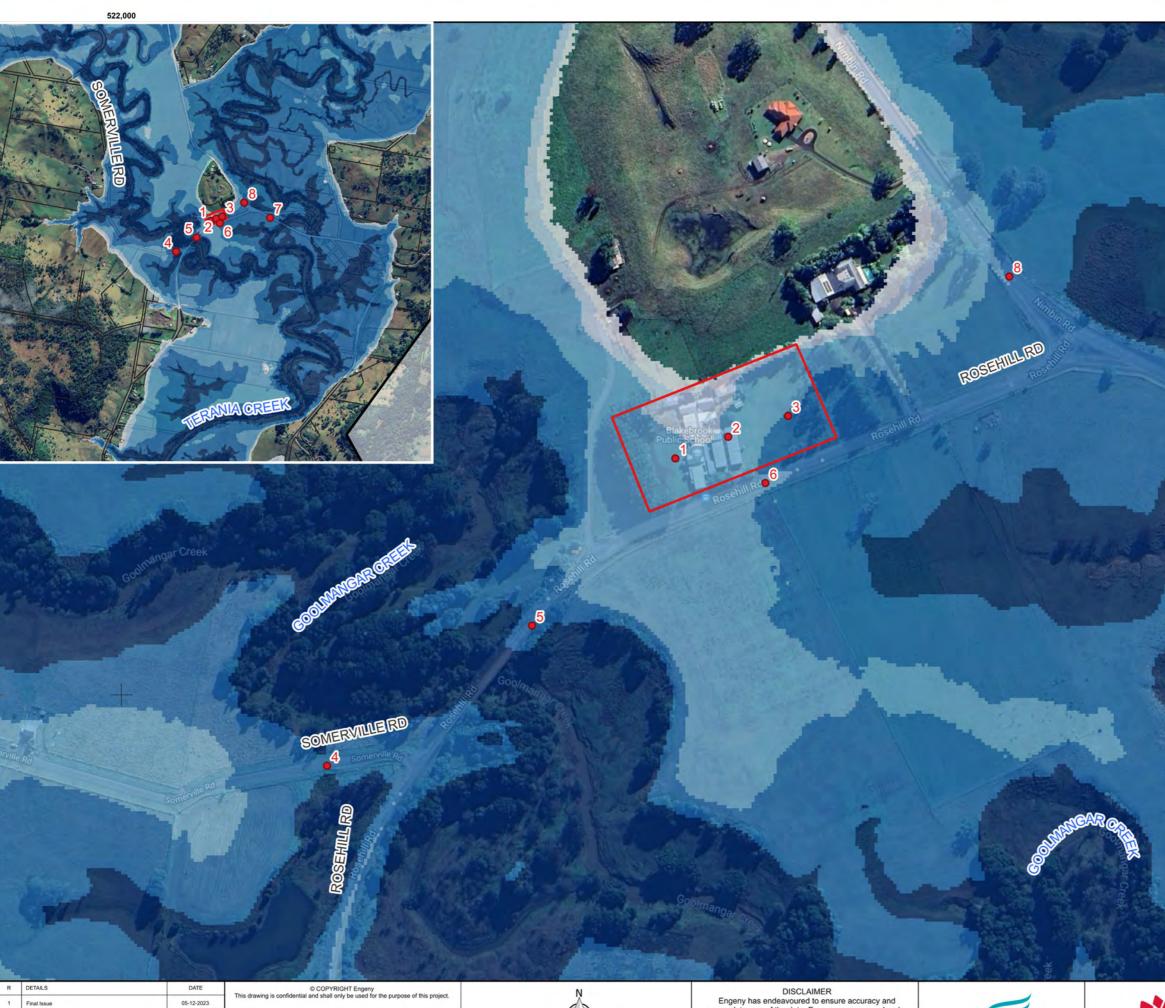
#### Reporting Location Cadastre Site Boundary Model Extent Flood Depth (m) 0.0 - 0.5 0.5 - 1.0 1.0 - 2.0

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#### Figure A6

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 1 in 2000 AEP Flood Depth



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### Reporting Location

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- Cadastre Site Boundary
- Model Extent

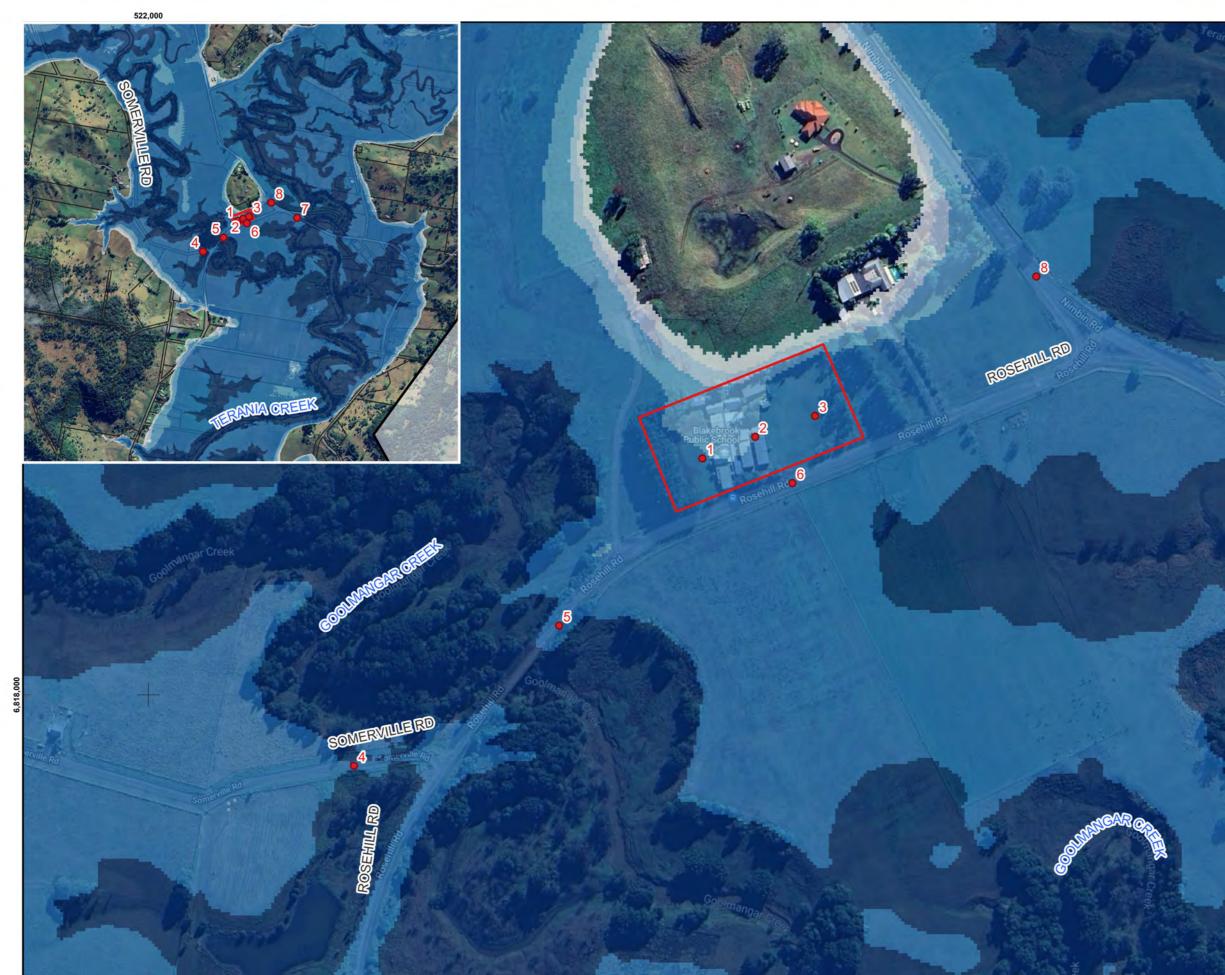
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#### Figure A7

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 1 in 10000 AEP Flood Depth



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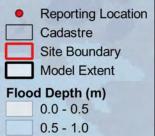
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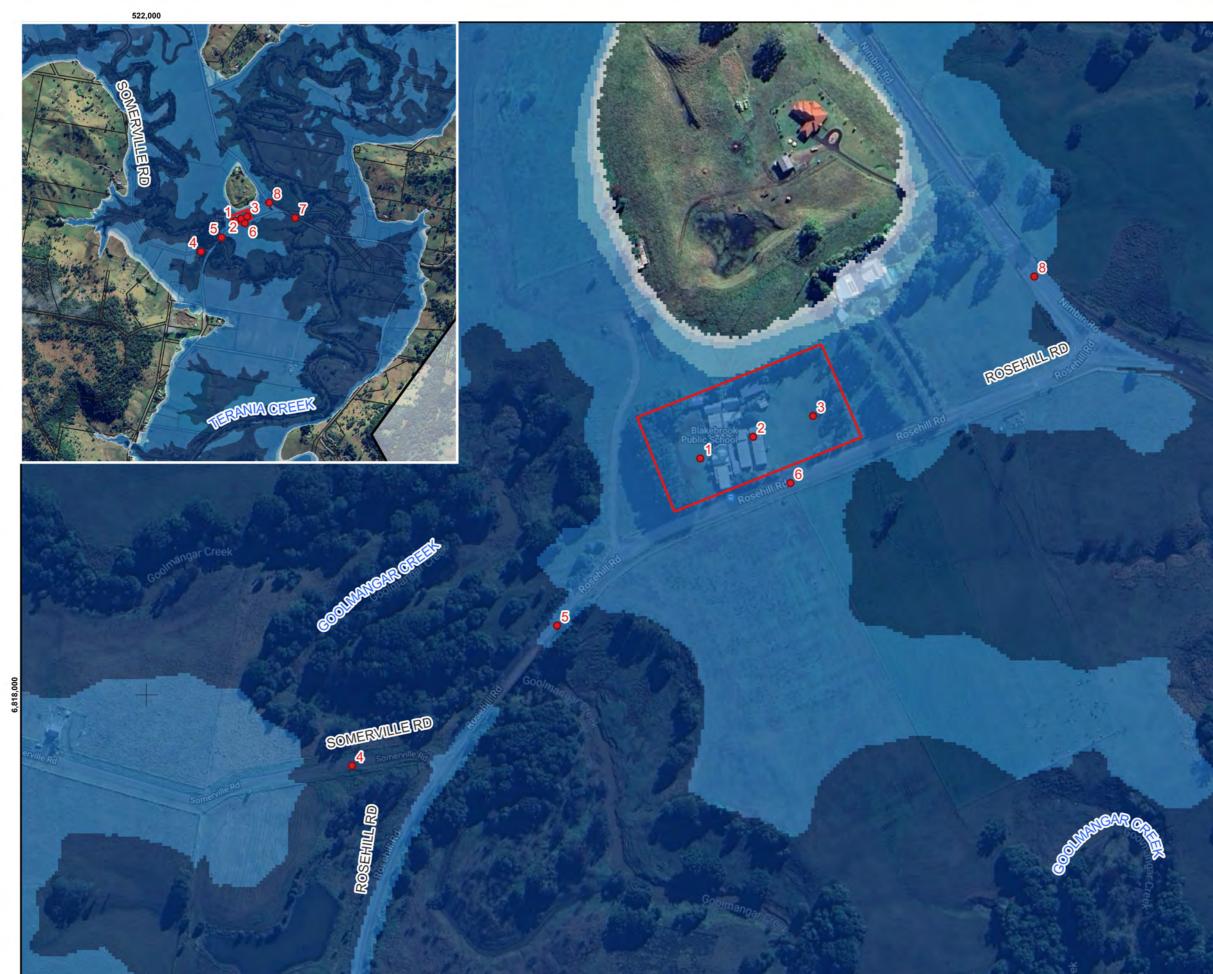
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#### Figure A8

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 1 in 100000 AEP Flood Depth



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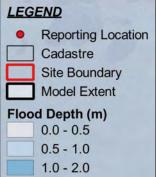
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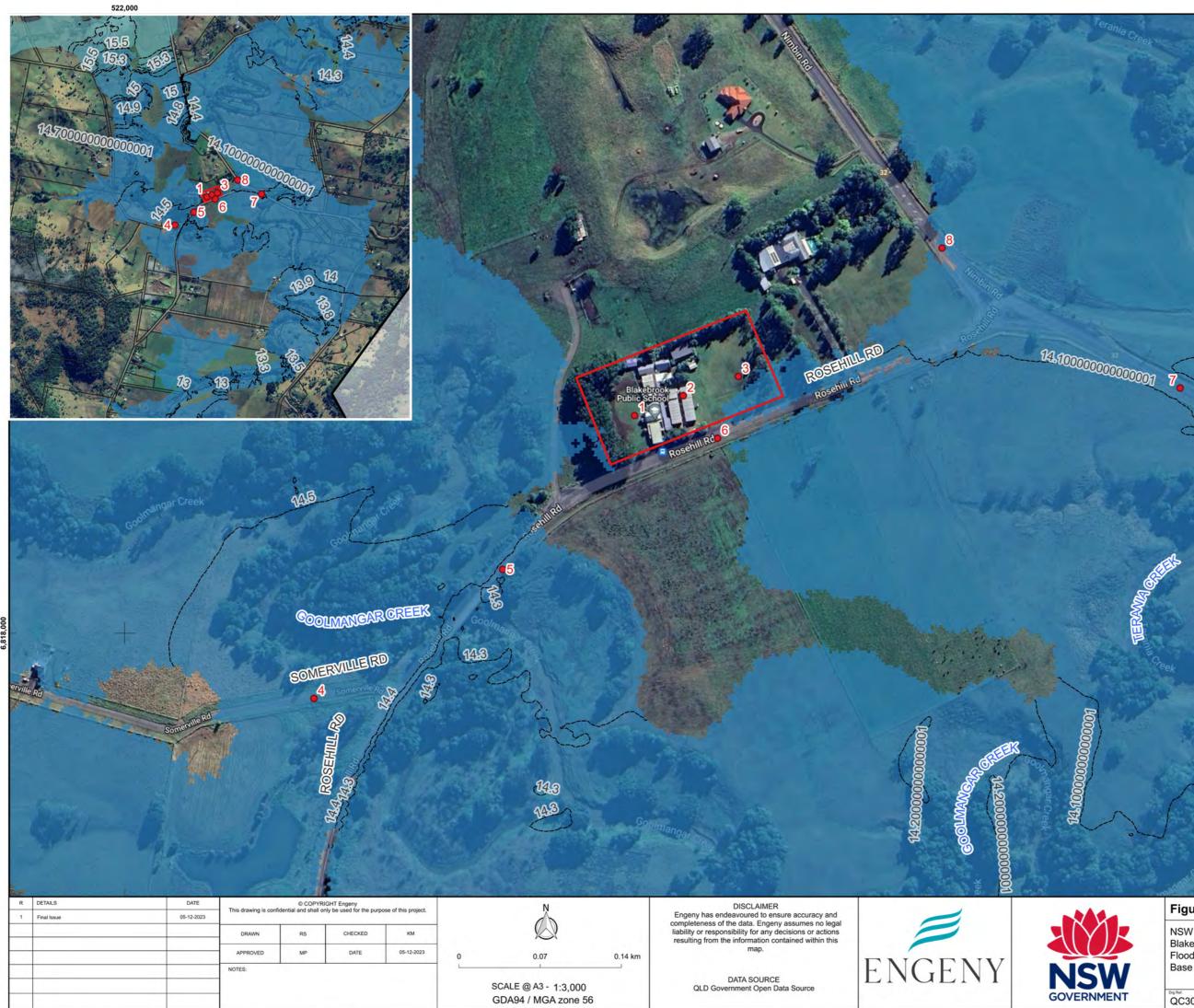


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#### Figure A9

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NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case PMF Flood Depth



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#### Figure A10

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 10% AEP Flood Height

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#### Figure A11

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 5% AEP Flood Height



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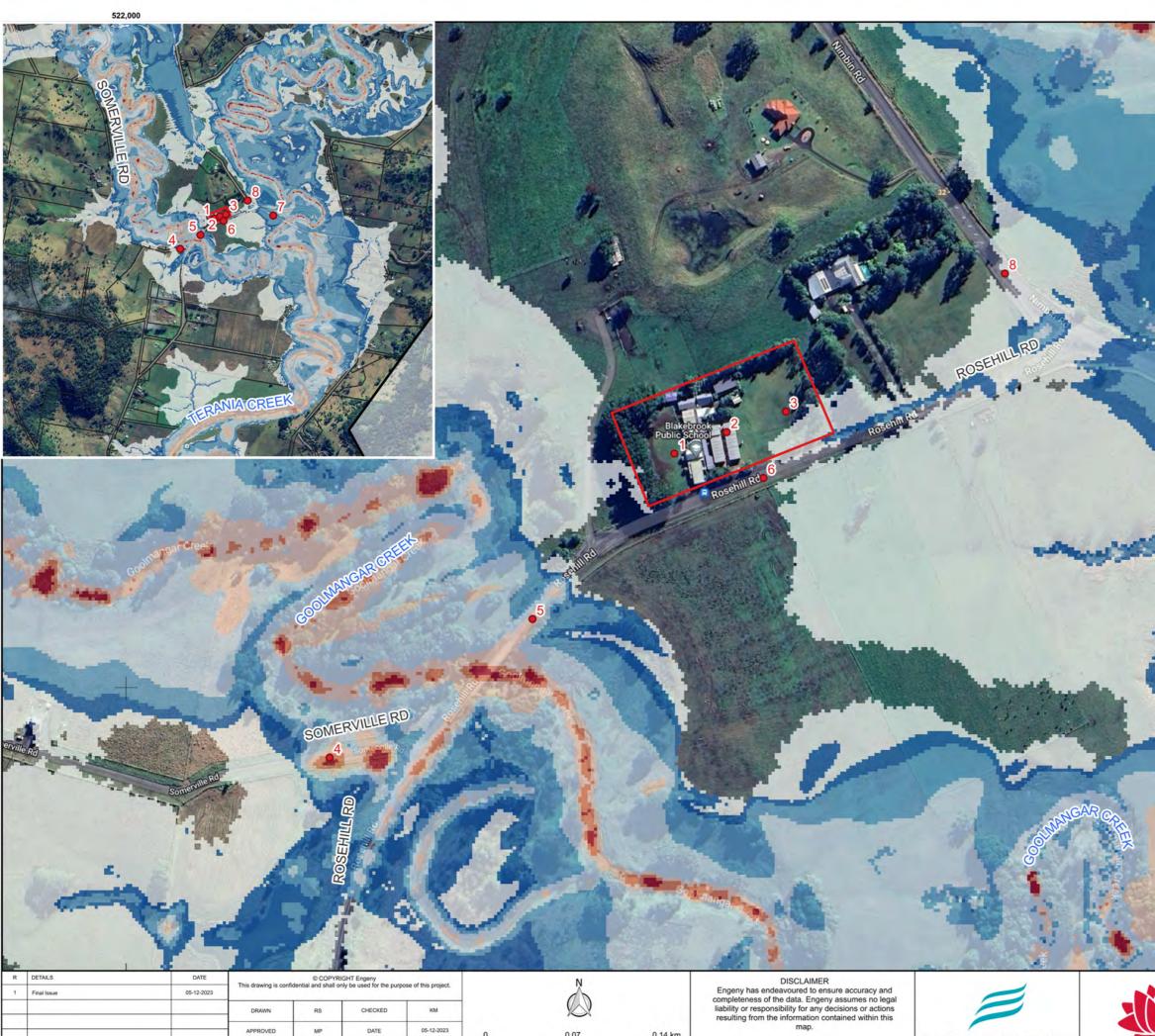


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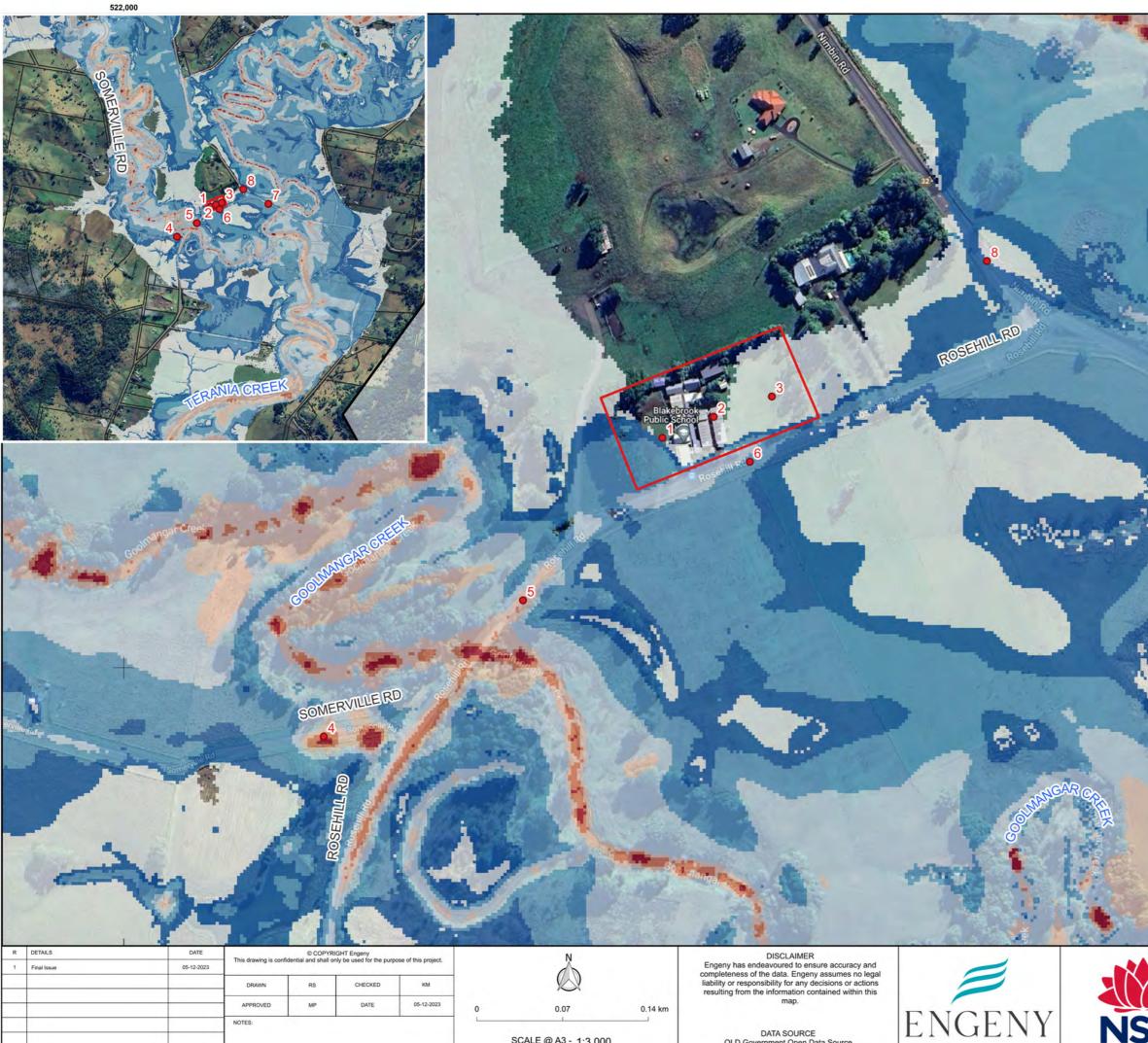
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#### Figure A19

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 10% AEP Flood Velocity



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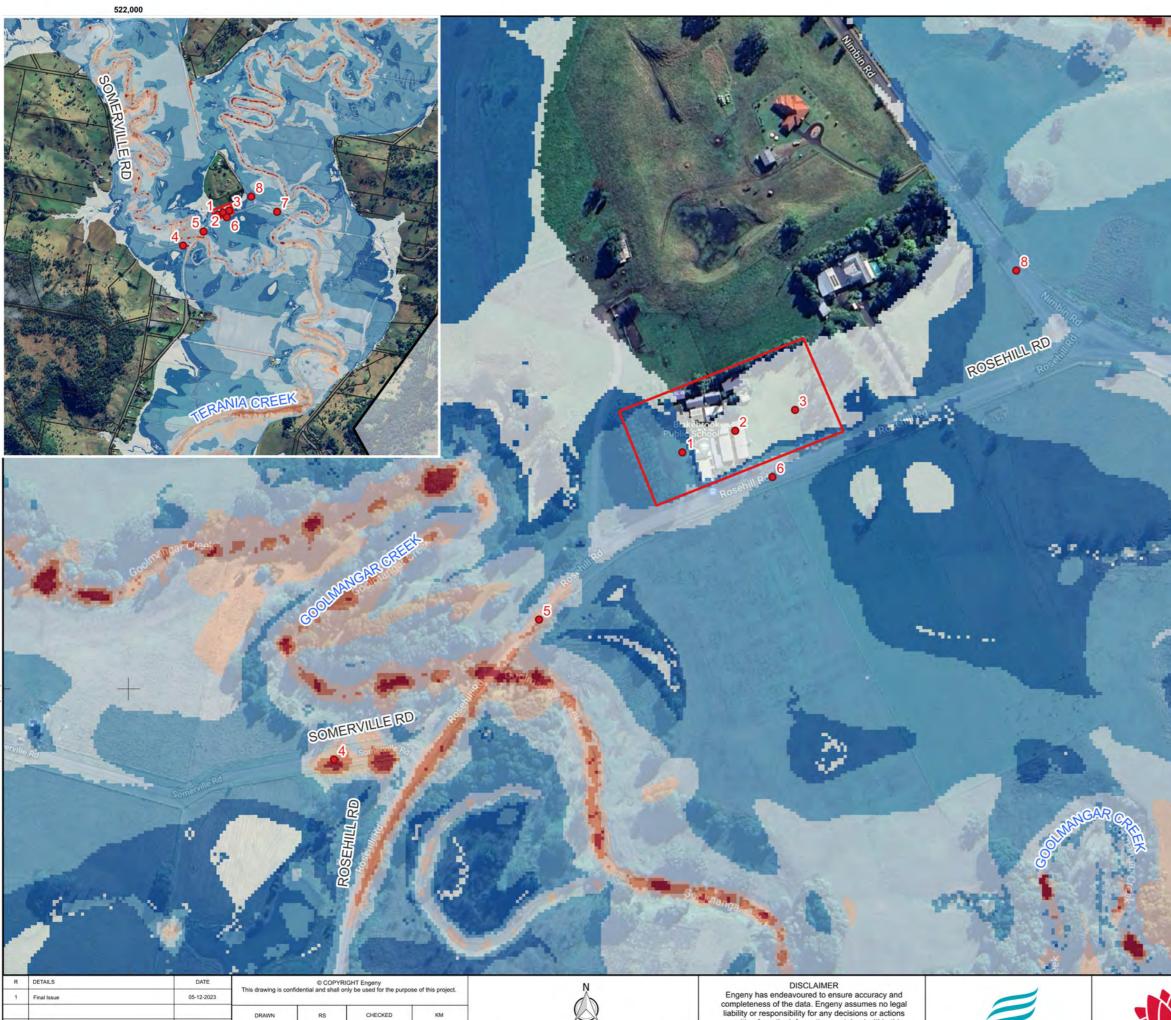
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#### Figure A20

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 5% AEP Flood Velocity



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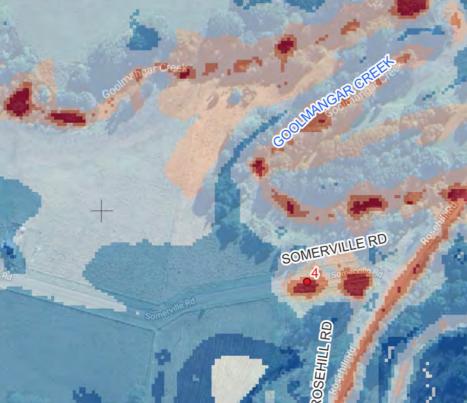
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#### Figure A21

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 1% AEP Flood Velocity

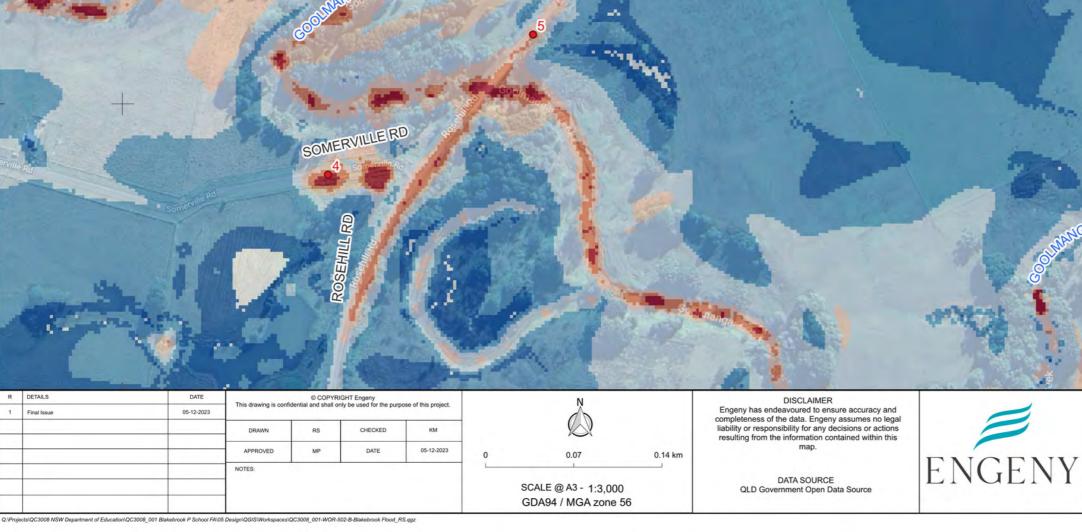






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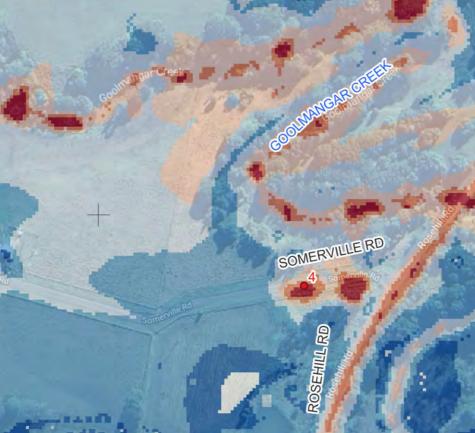
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#### Figure A22

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 0.5% AEP Flood Velocity







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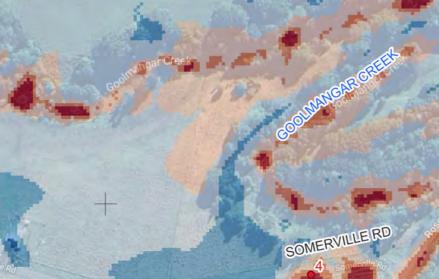
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NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 1 in 1000 AEP Flood Velocity



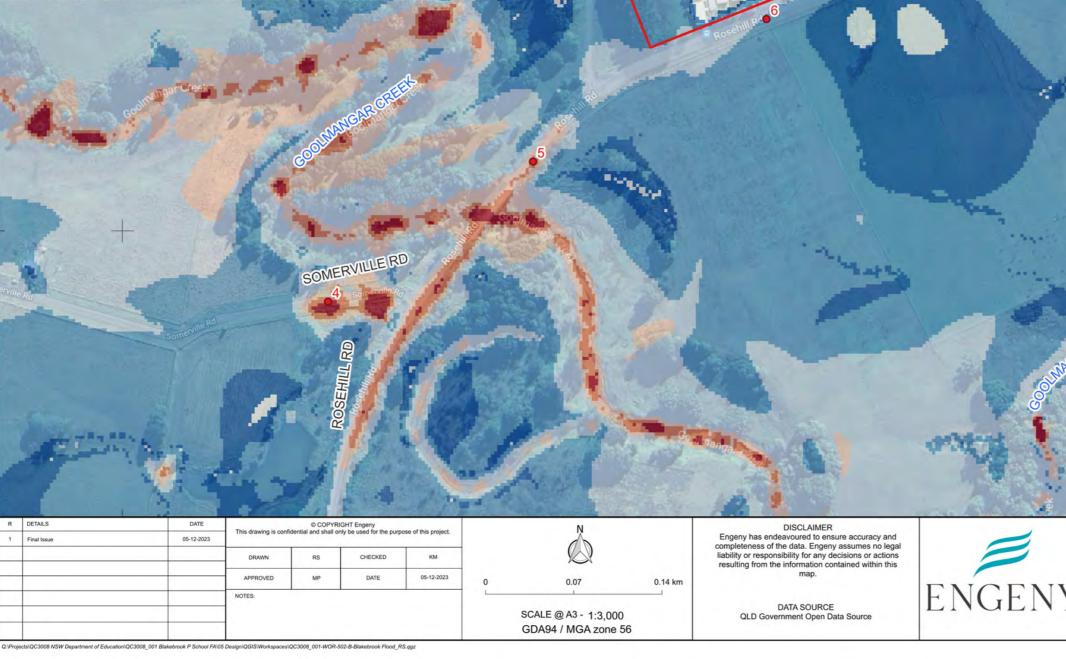




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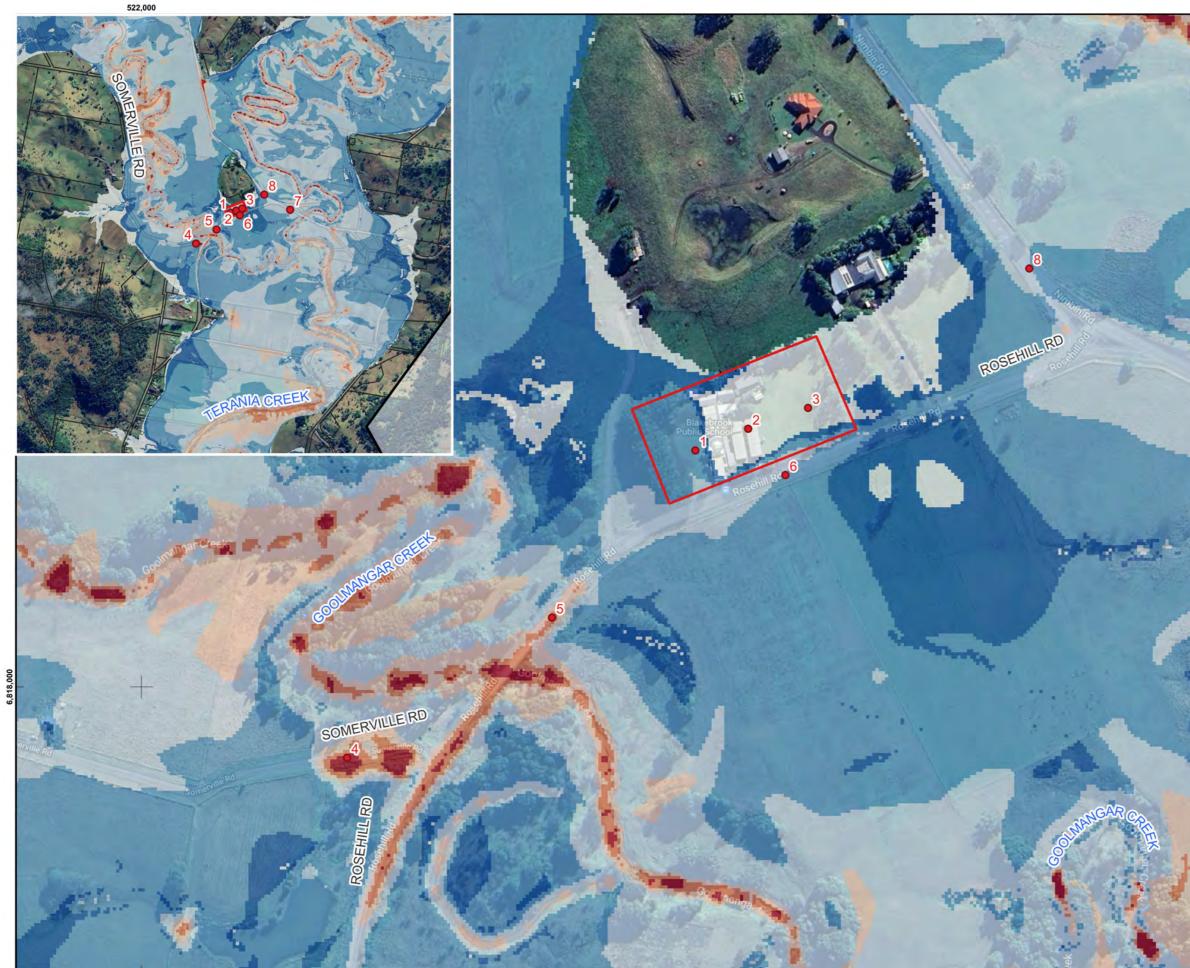
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#### Figure A24

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 1 in 2000 AEP Flood Velocity

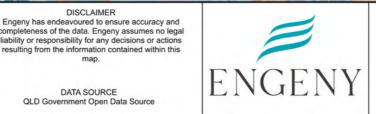


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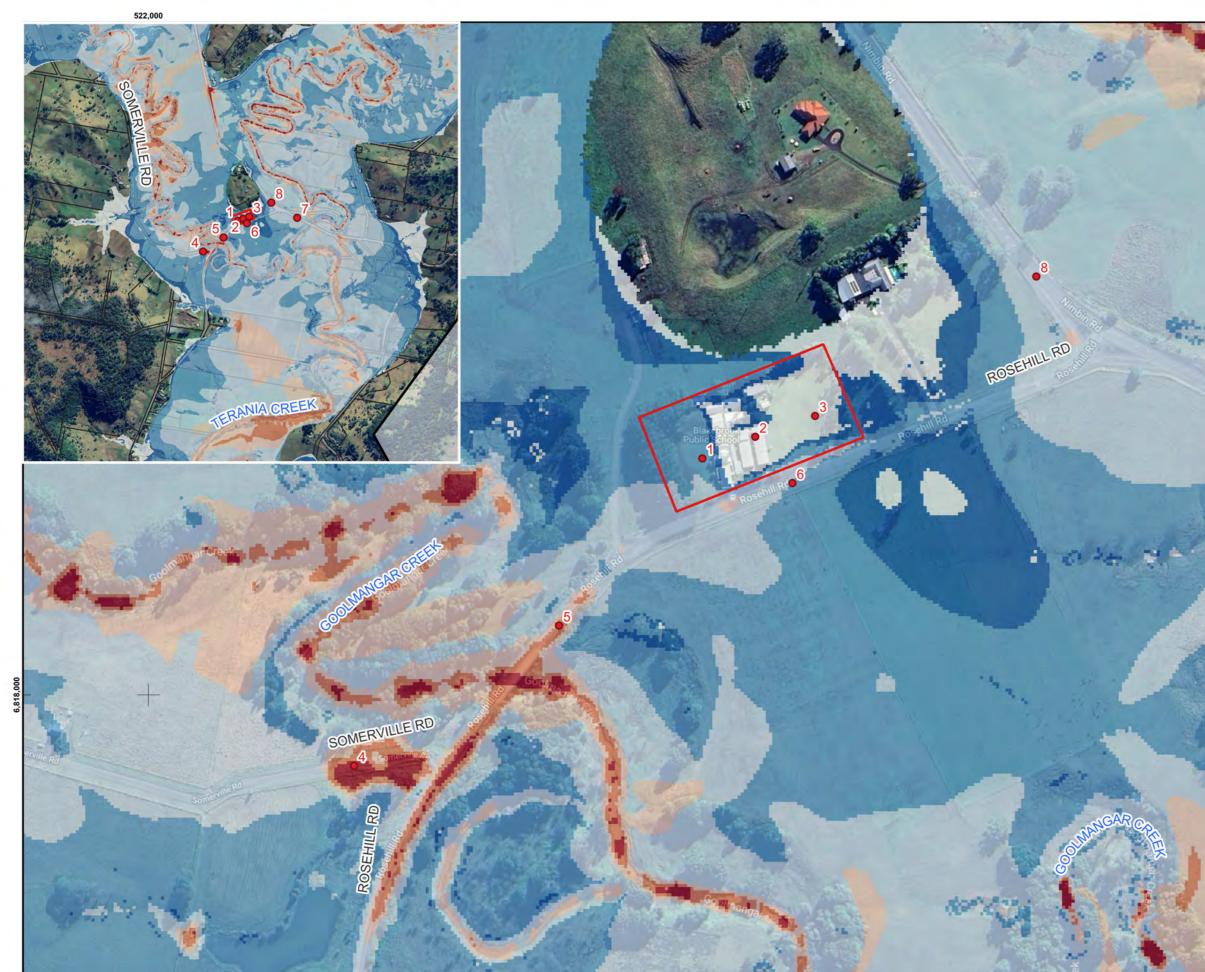
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#### Figure A25

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 1 in 10000 AEP Flood Velocity



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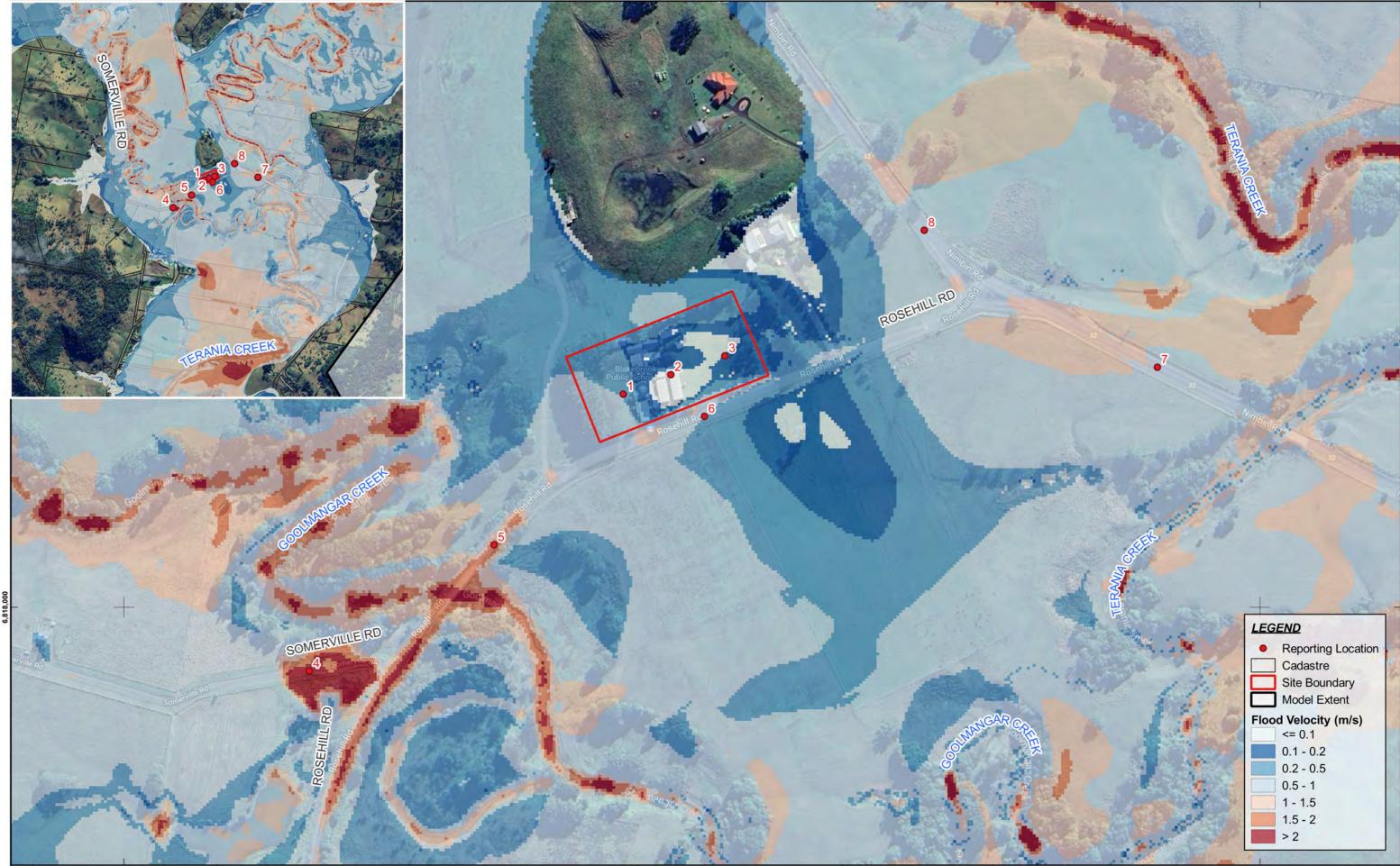
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#### Figure A26

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NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 1 in 100000 AEP Flood Velocity



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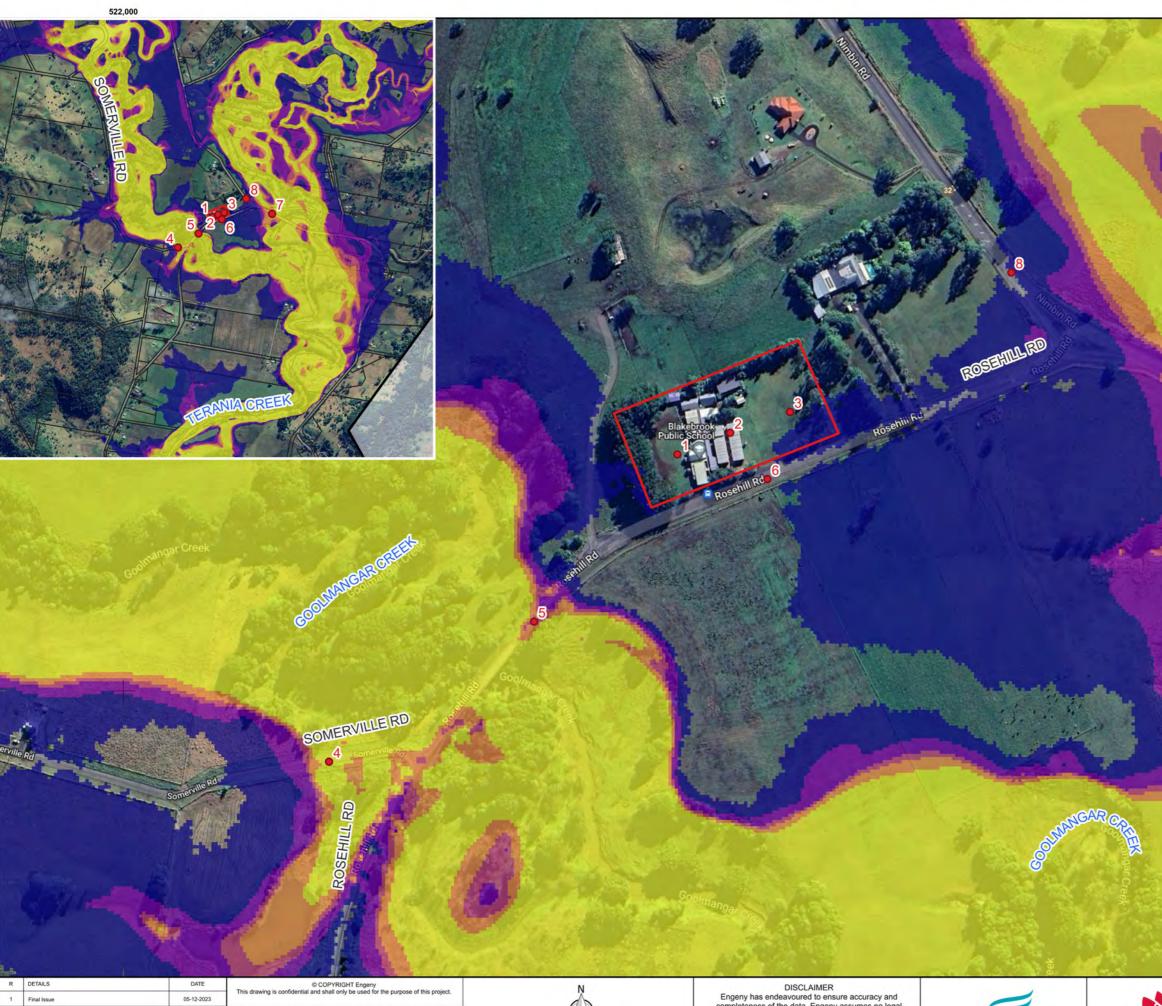
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#### Figure A27

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case PMF Flood Velocity

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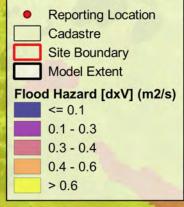
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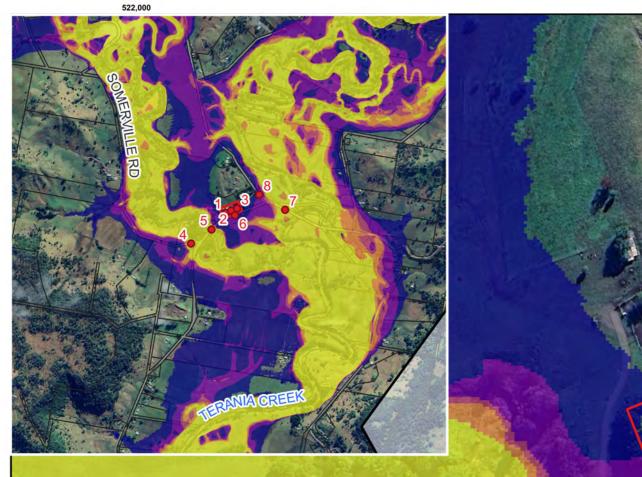
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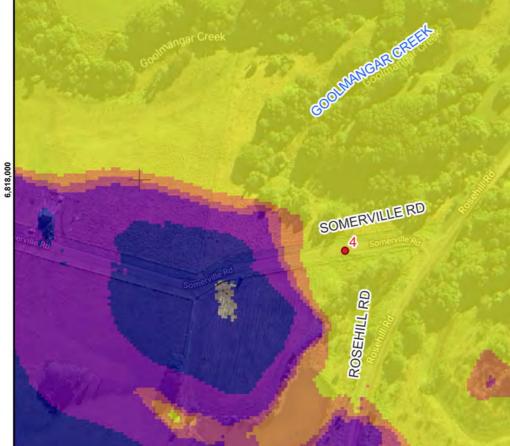
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#### Figure A28

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 10% AEP Flood Hazard (dxV)





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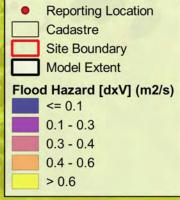
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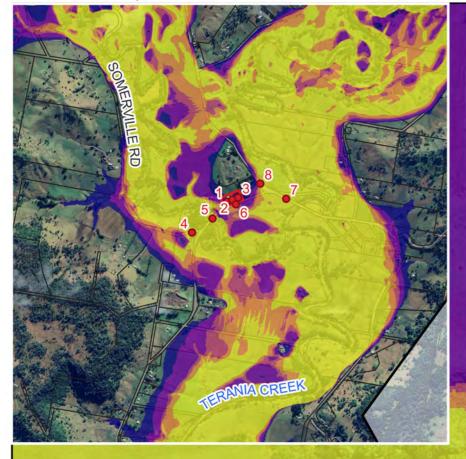
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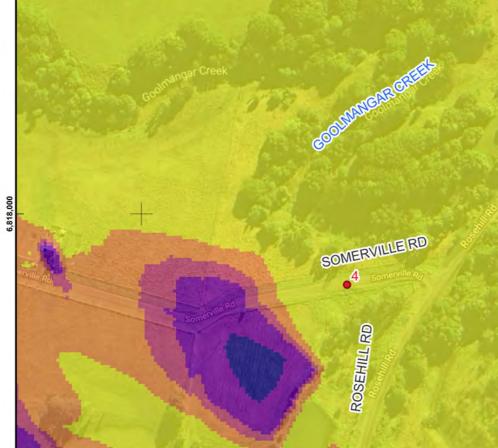


#### Figure A29

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 5% AEP Flood Hazard (dxV)







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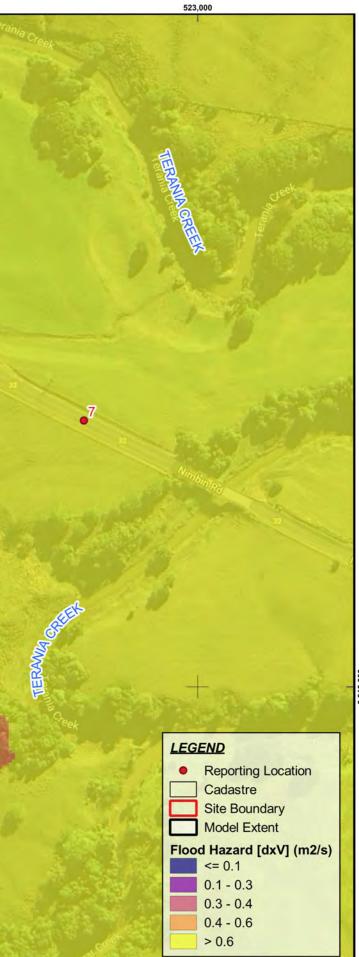
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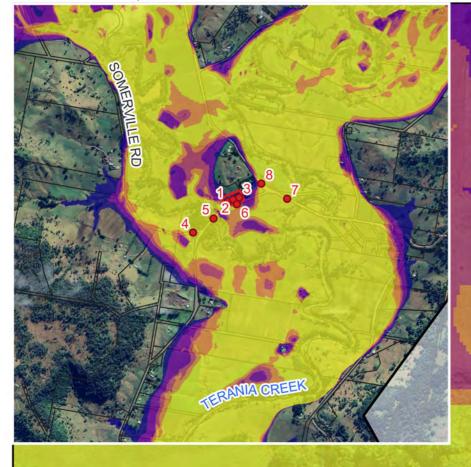


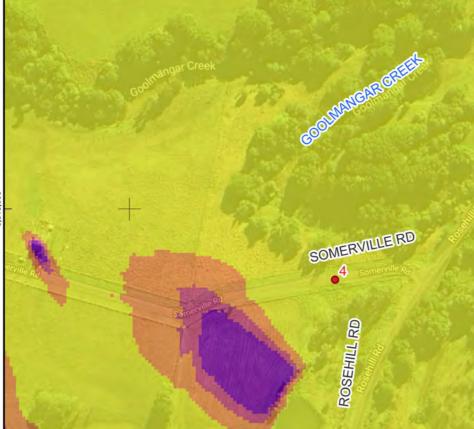


#### Figure A30

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 1% AEP Flood Hazard (dxV)







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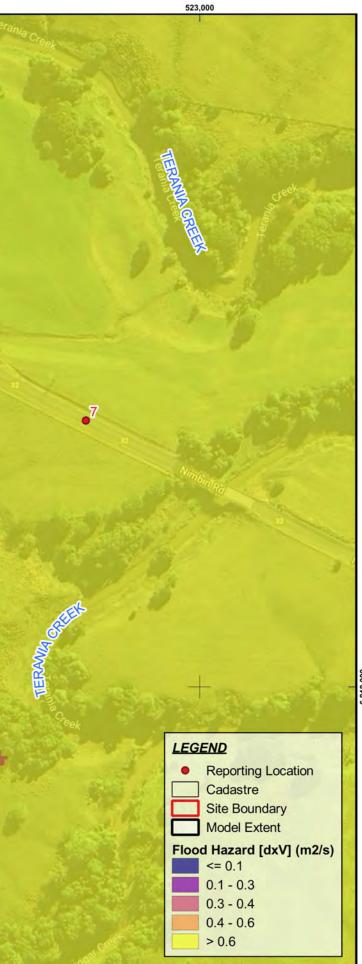


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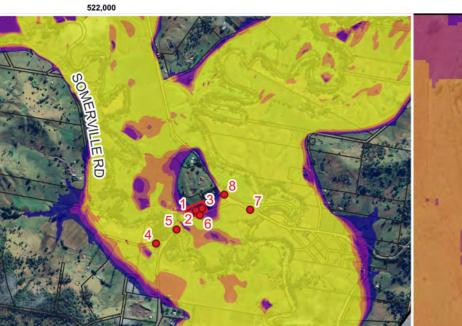
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#### Figure A31

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 0.5% AEP Flood Hazard (dxV)







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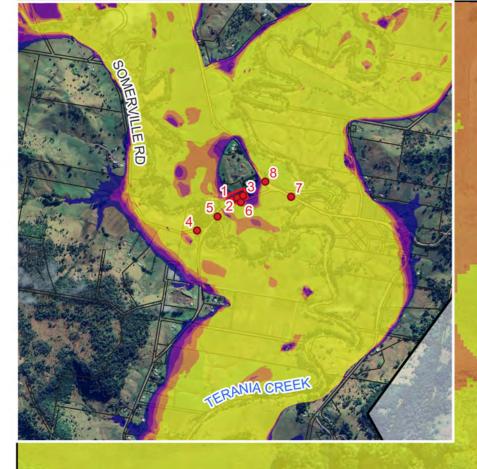




#### Figure A32

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 1 in 1000 AEP Flood Hazard (dxV)







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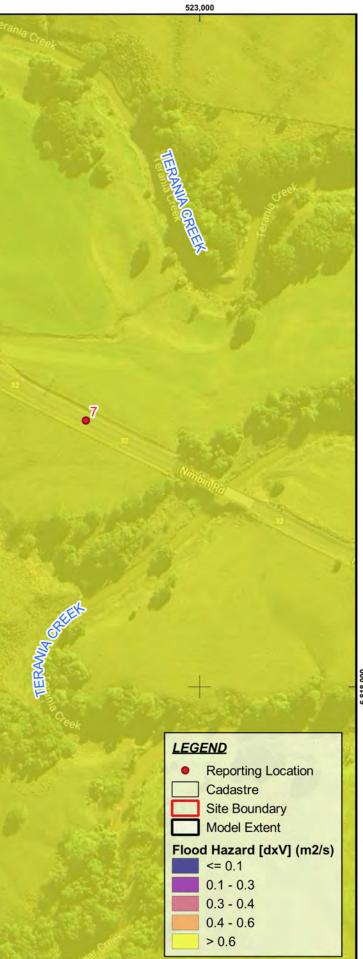


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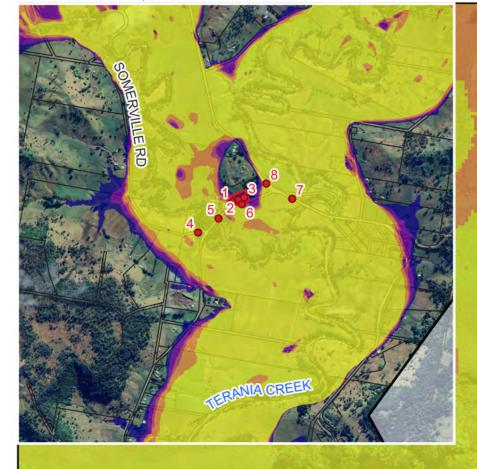




#### Figure A33

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 1 in 2000 AEP Flood Hazard (dxV)







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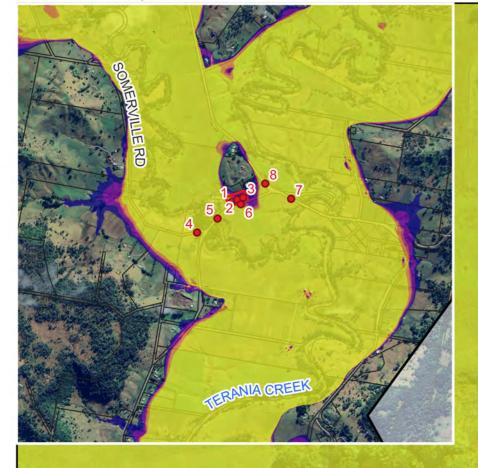




#### Figure A34

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 1 in 10000 AEP Flood Hazard (dxV)





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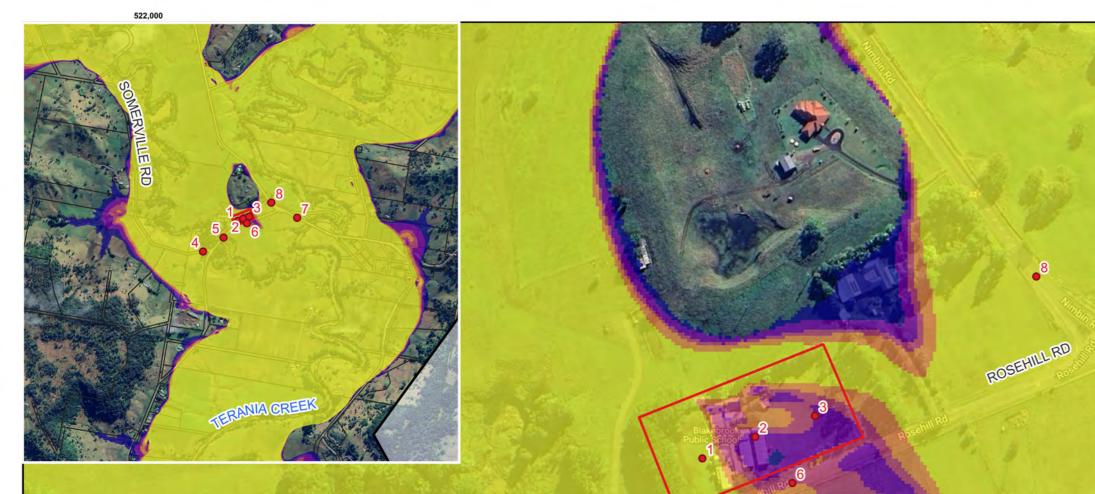
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#### Figure A35

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 1 in 100000 AEP Flood Hazard (dxV)



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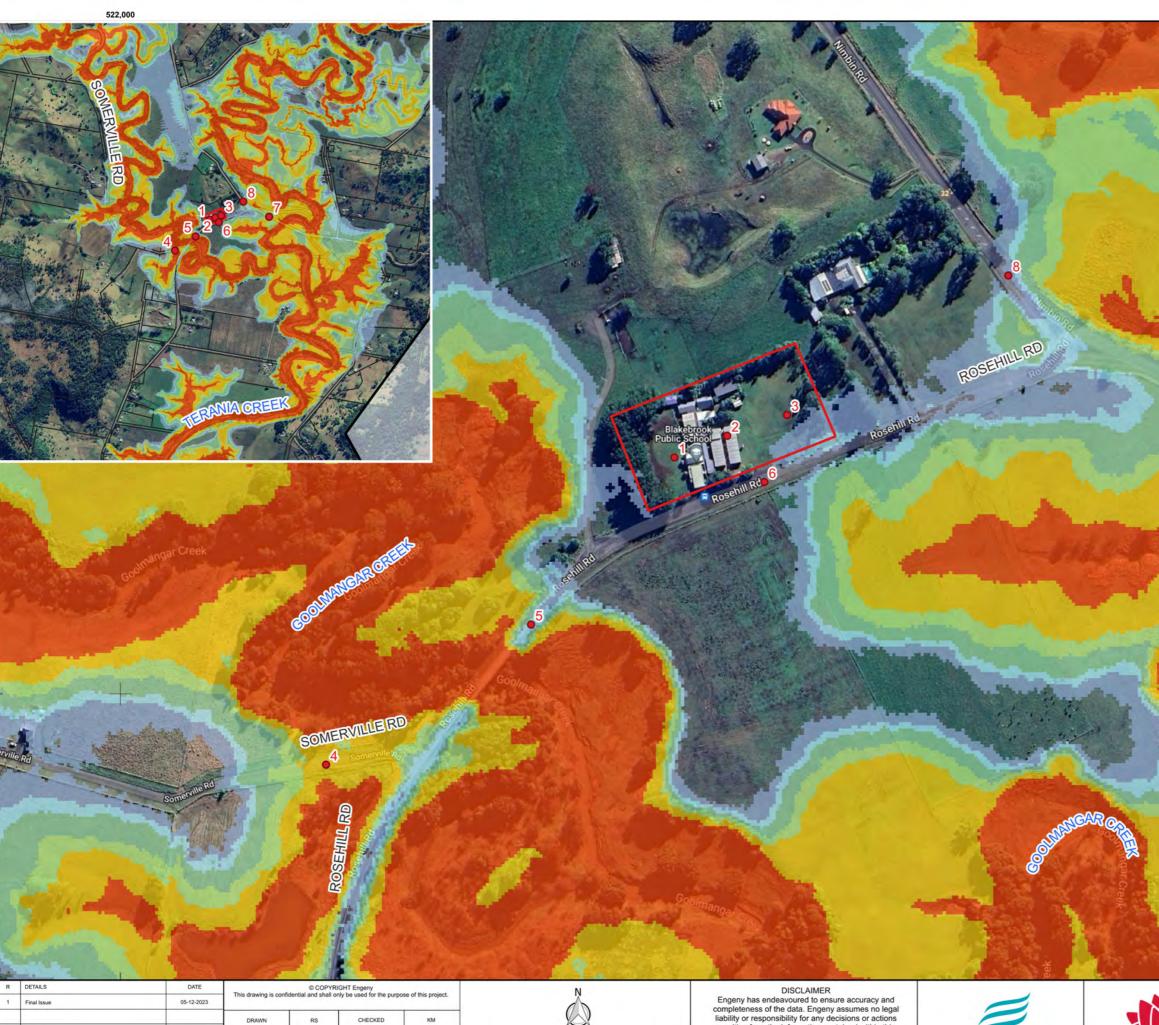


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#### Figure A36

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case PMF Flood Hazard (dxV)



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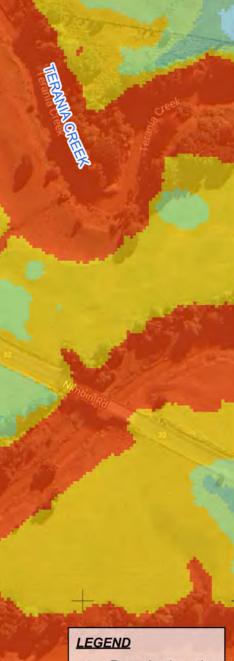
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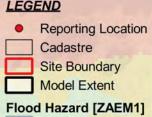
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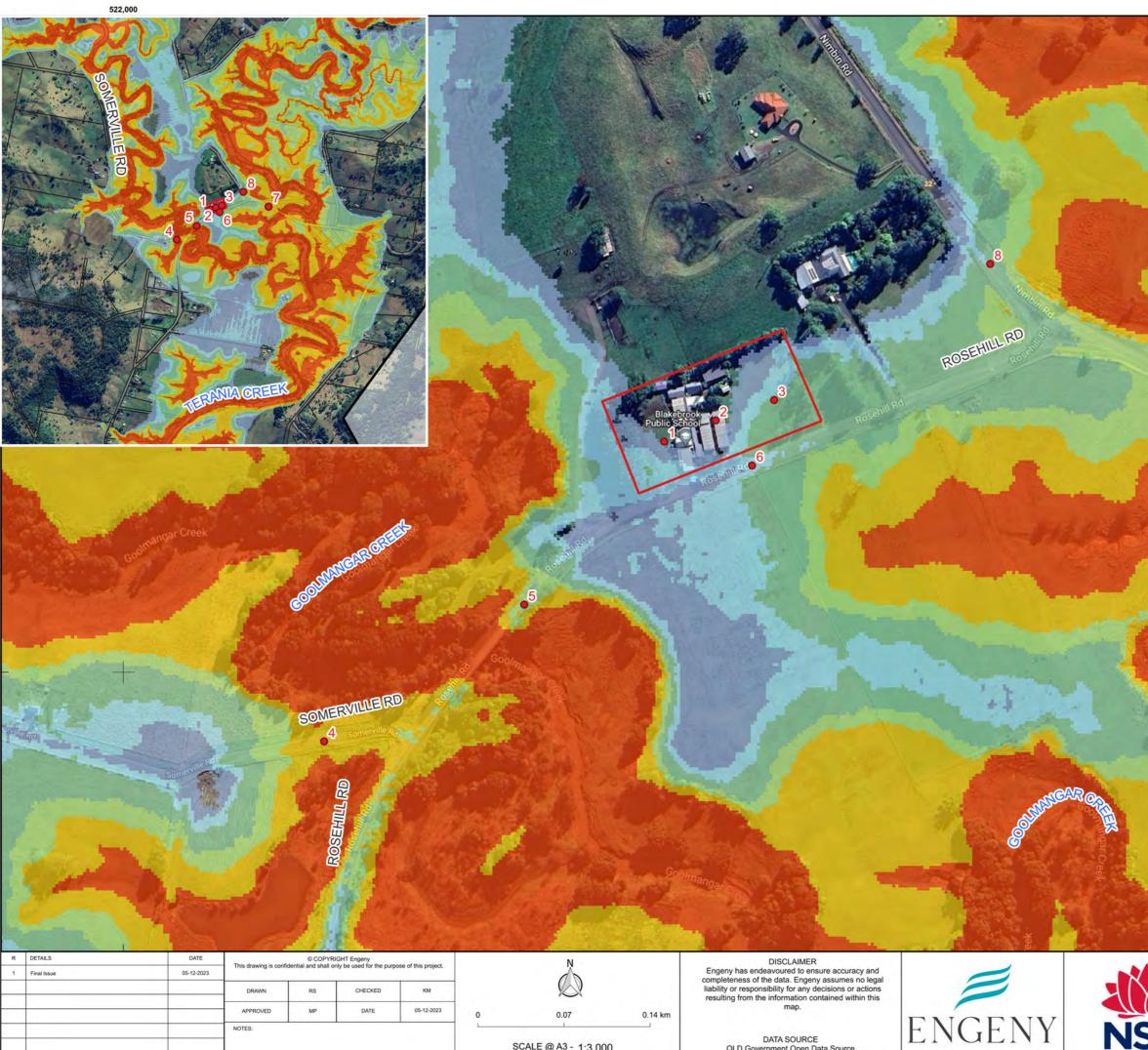




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#### Figure A37

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 10% AEP Flood Hazard (ZAEM1)



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 Reporting Location Cadastre Site Boundary Model Extent

#### Flood Hazard [ZAEM1] H1

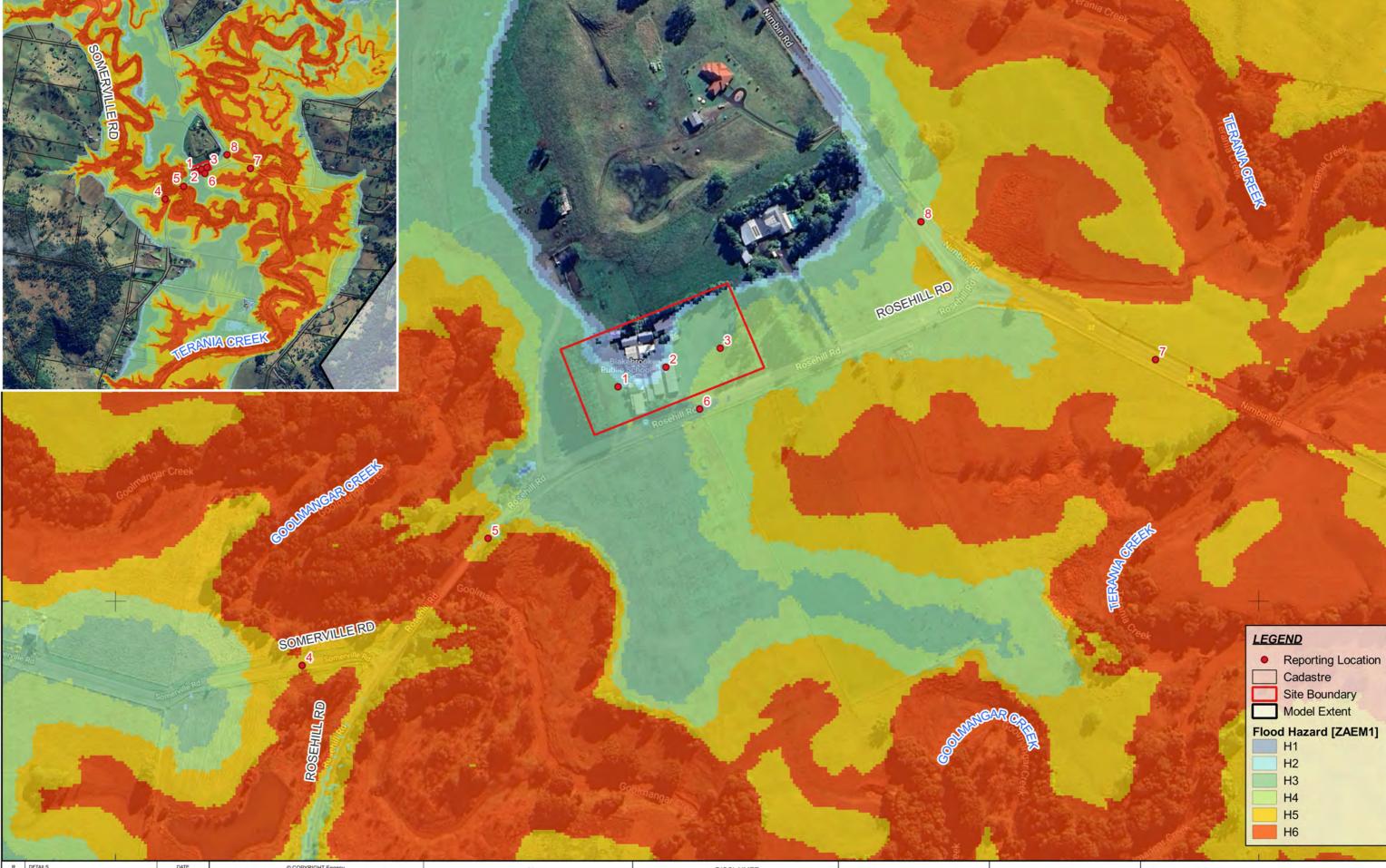
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#### Figure A38

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NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 5% AEP Flood Hazard (ZAEM1)



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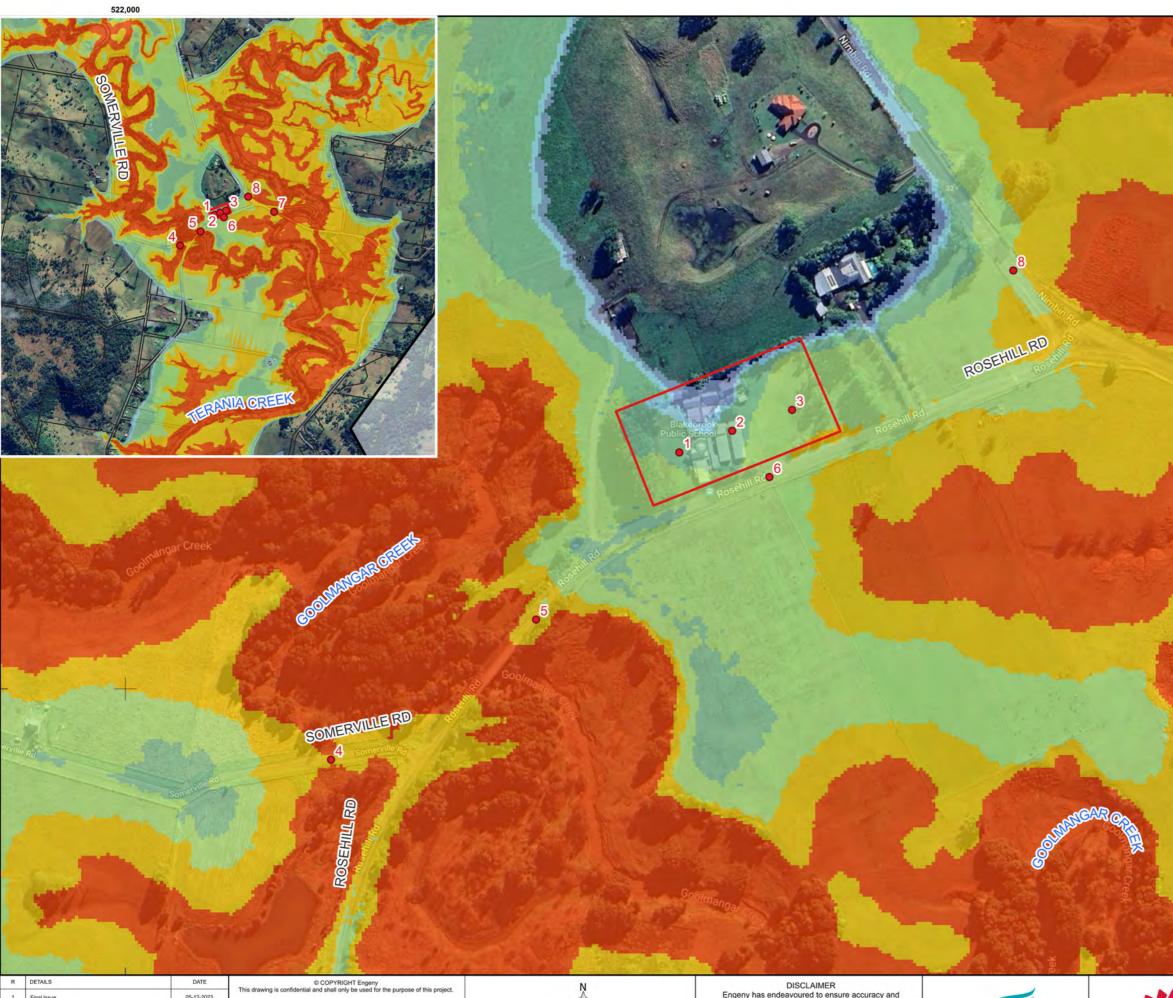
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#### Figure A39

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 1% AEP Flood Hazard (ZAEM1)



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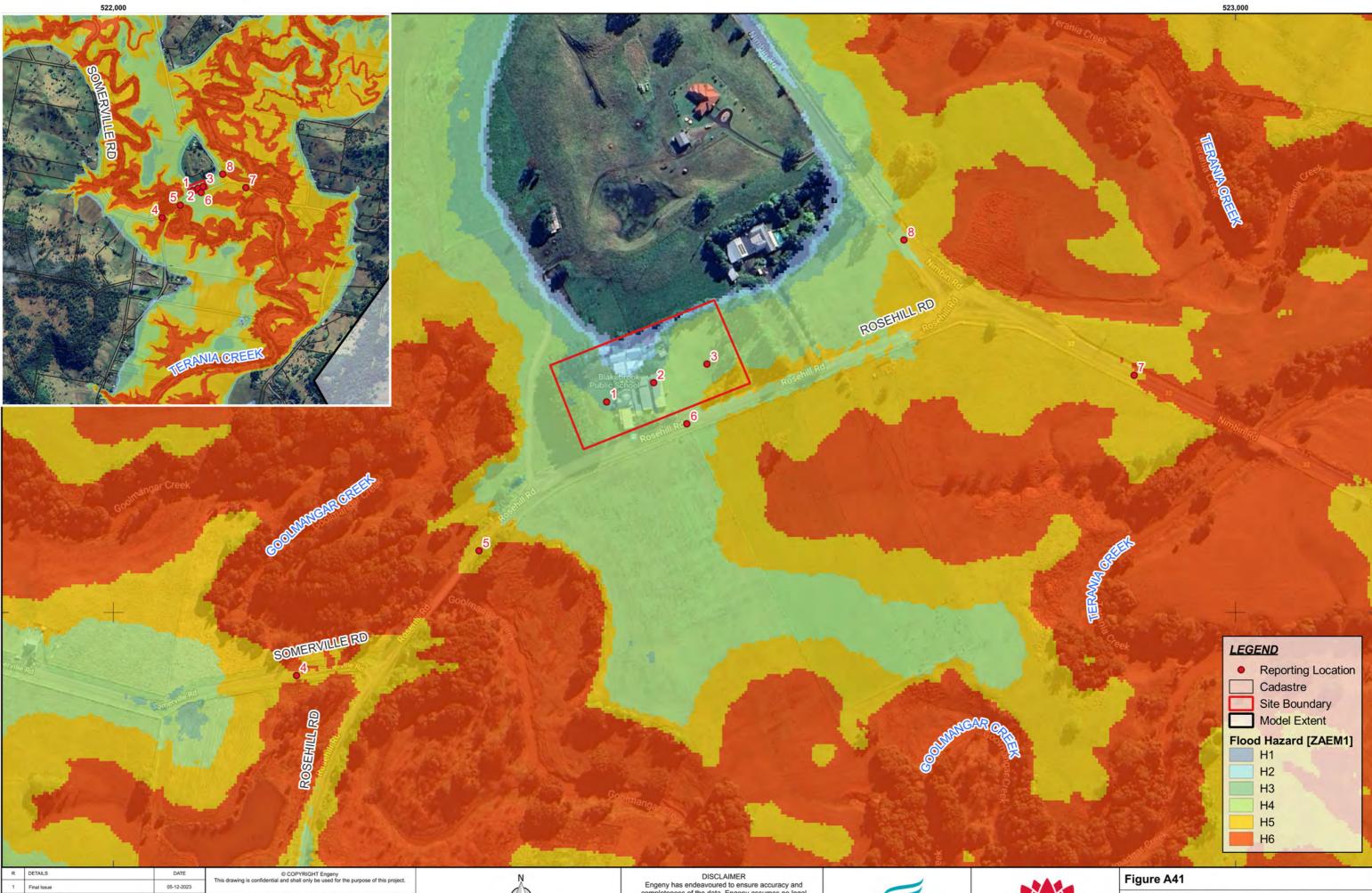
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#### Figure A40

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 0.5% AEP Flood Hazard (ZAEM1)

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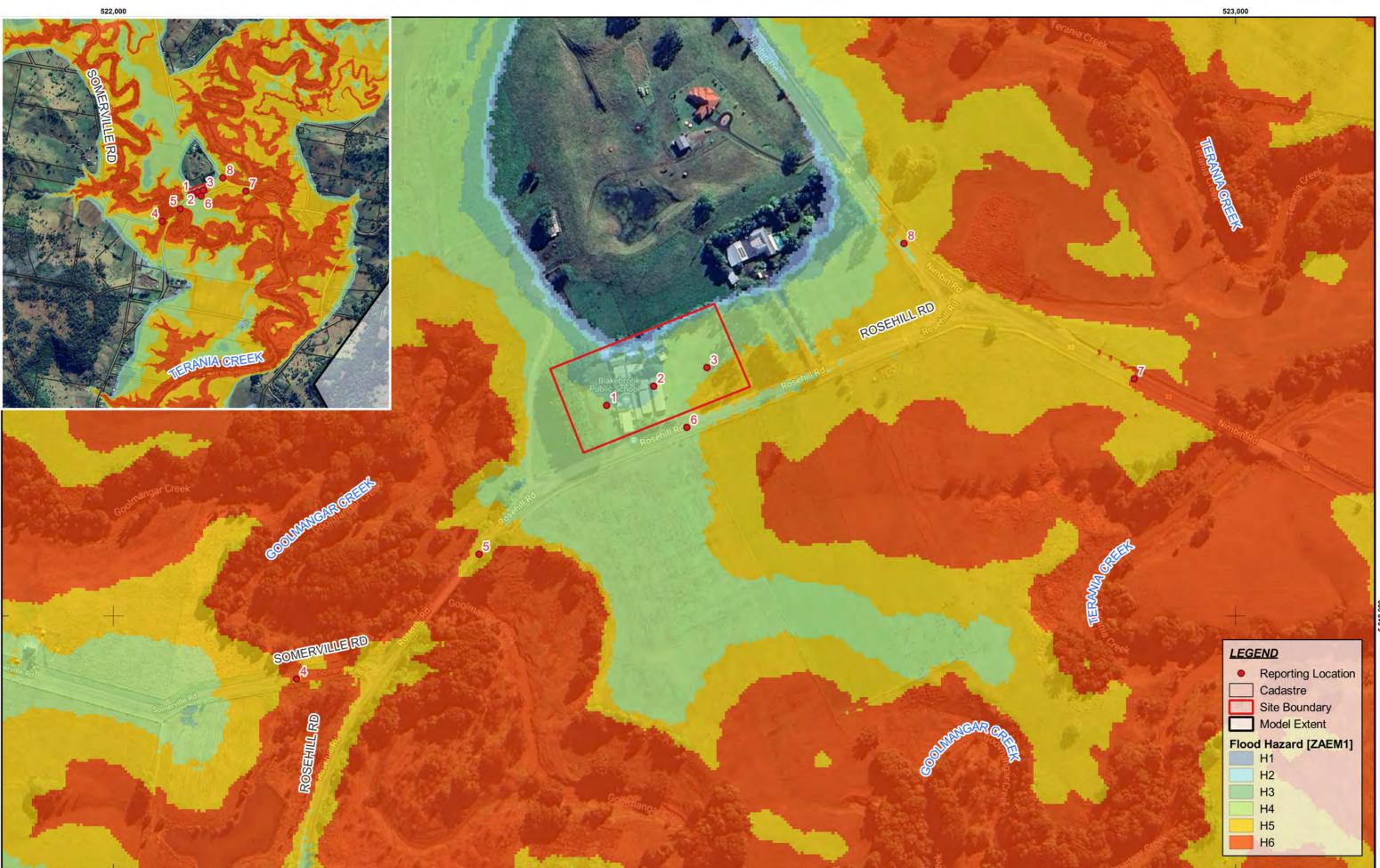


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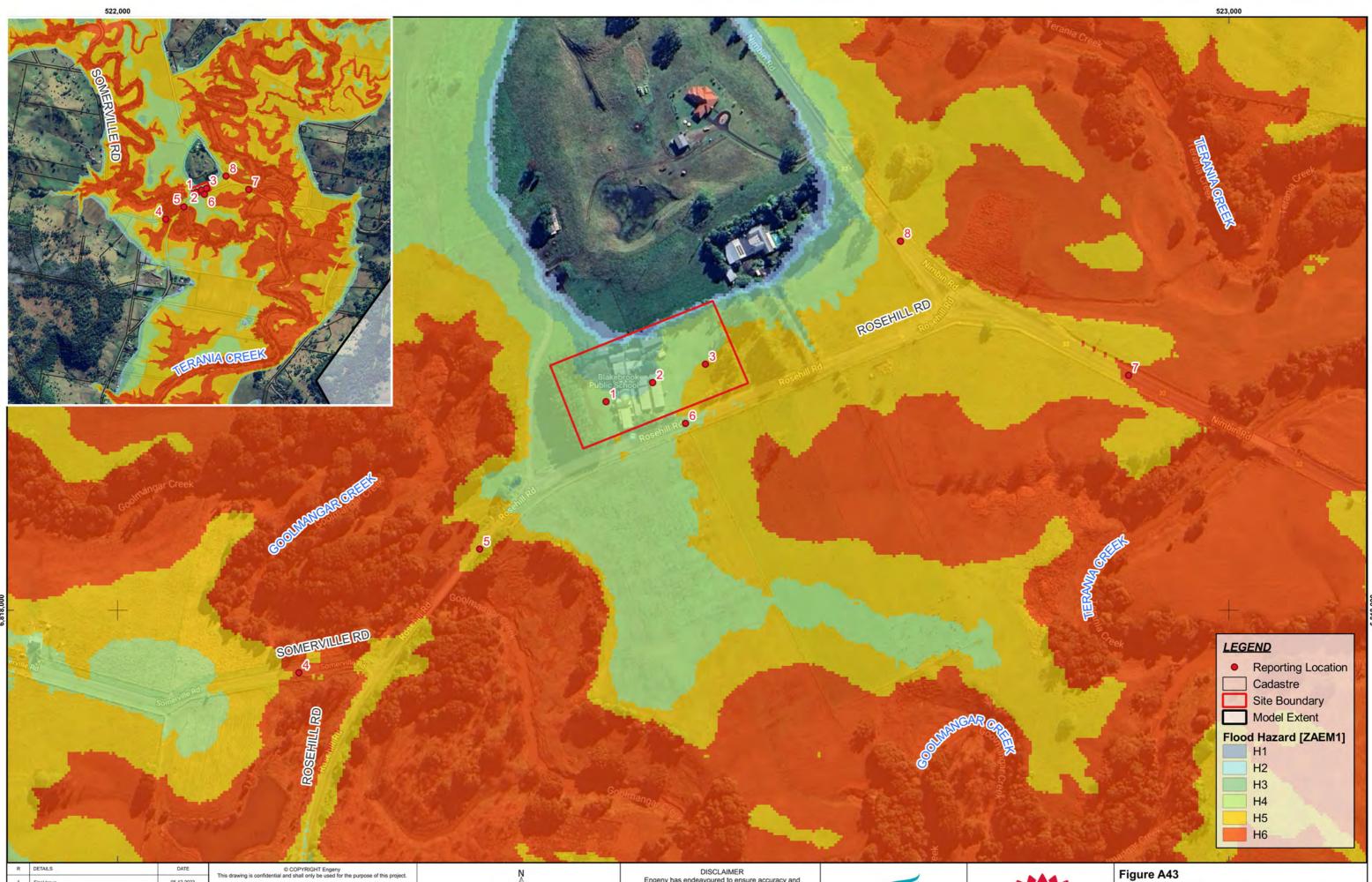


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#### Figure A42

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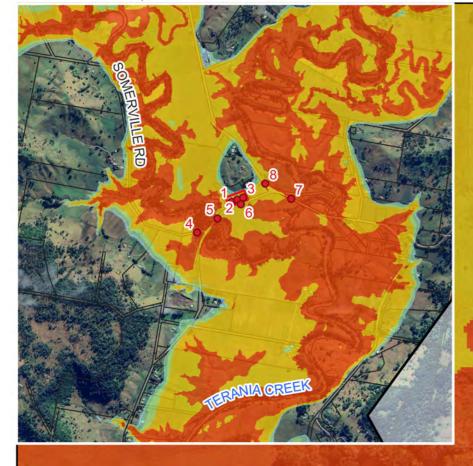


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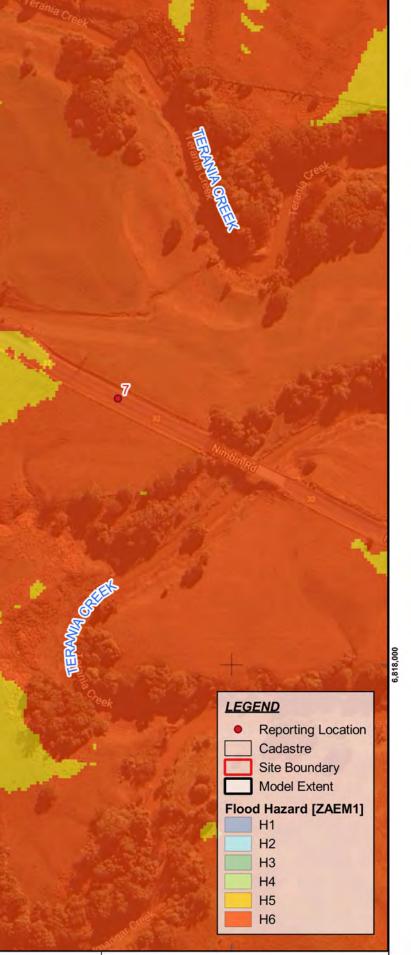


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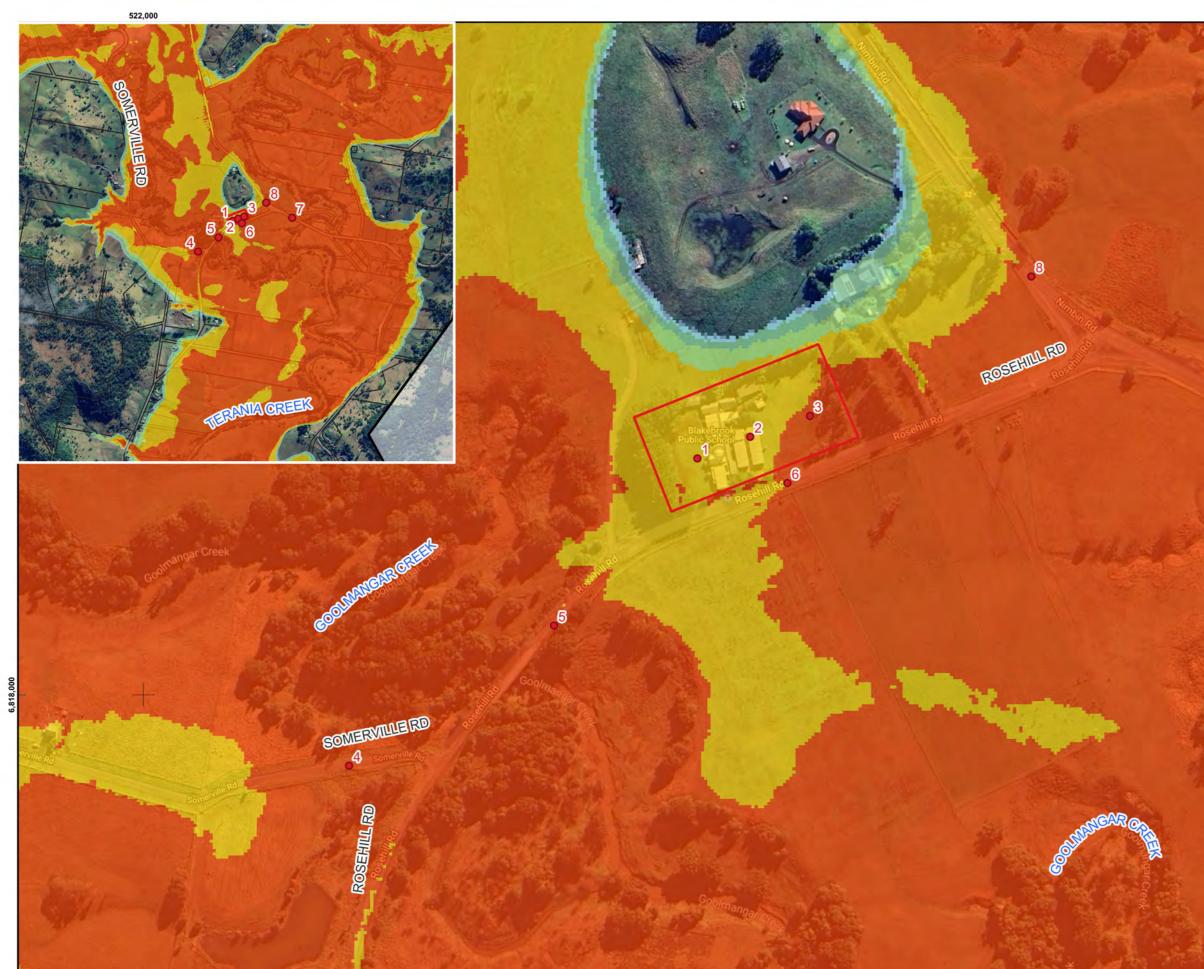






#### Figure A44

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case 1 in 100000 AEP Flood Hazard (ZAEM1)



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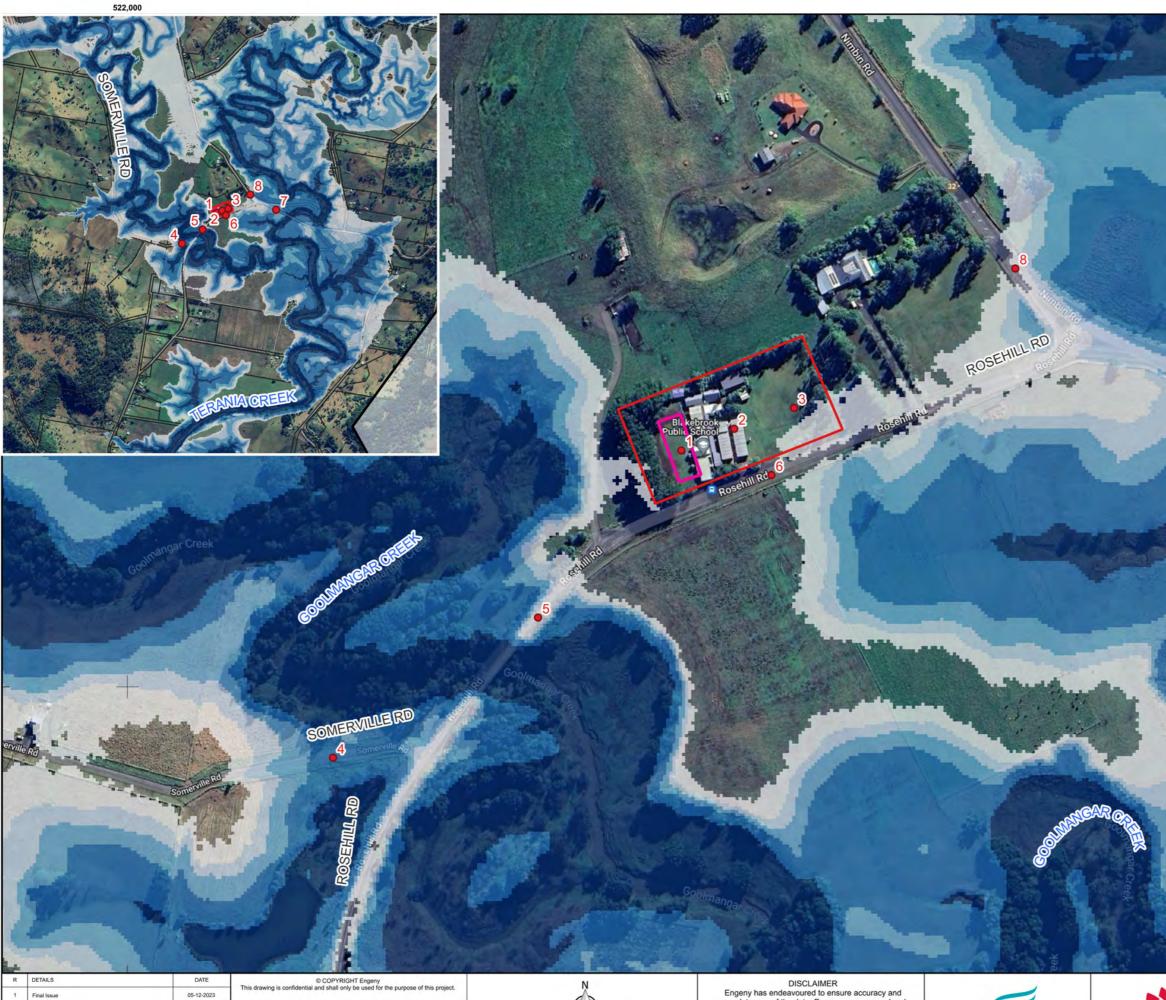
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#### Figure A45

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Base Case PMF Flood Hazard (ZAEM1)

# APPENDIX B: POST-REBUILD CASE FLOOD MAPPING



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# Reporting Location Cadastre

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#### Site Boundary Proposed Building Location Model Extent

# Flood Depth (m) 0.0 - 0.5

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0.5 - 1.0
1.0 - 2.0
2.0 - 5.0
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#### Figure B1

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 10% AEP Flood Depth



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	Cadastre					
	Site Boundary					
	Proposed Building Location					
	Model Extent					
Floo	d Depth (m)					
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	0.5 - 1.0					
	1.0 - 2.0					
	2.0 - 5.0					

#### Figure B2

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 5% AEP Flood Depth

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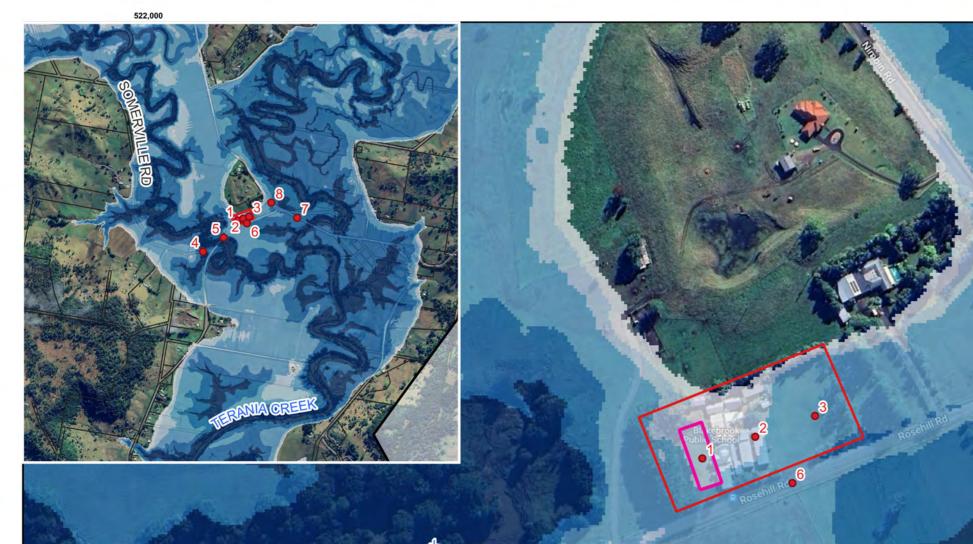
## Flood Depth (m) 0.0 - 0.5

Reporting Location

0.0 - 0.5
0.5 - 1.0
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2.0 - 5.0
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#### Figure B3

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1% AEP Flood Depth

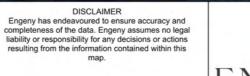




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#### Flood Depth (m) 0.0 - 0.5 0.5 - 1.0 1.0 - 2.0 2.0 - 5.0 >5.0

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#### Figure B4

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 0.5% AEP Flood Depth







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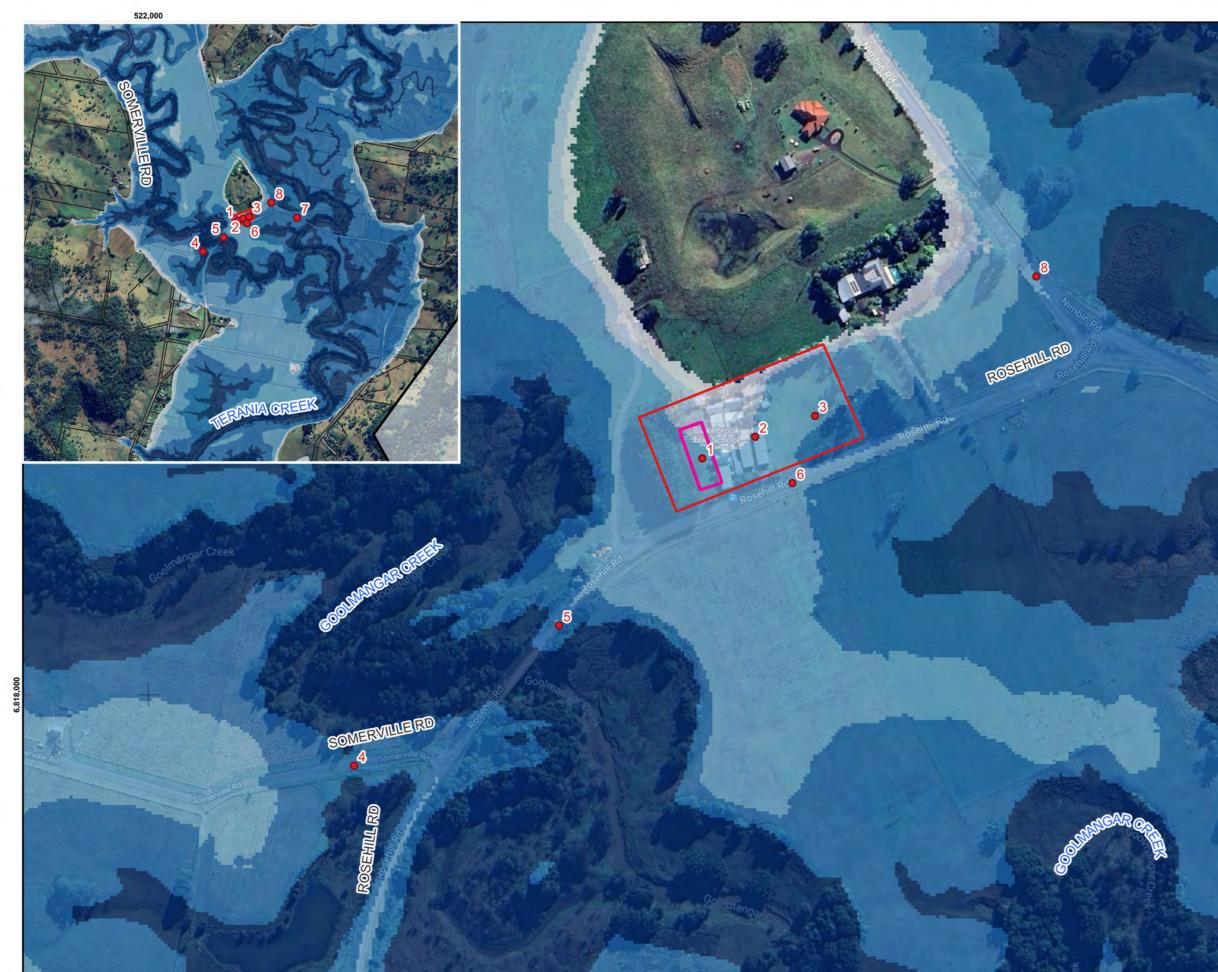


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•	Reporting Location				
	Cadastre				
	Site Boundary				
	Proposed Building Location				
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#### Figure B5

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1 in 1000 AEP Flood Depth



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 Reporting Location Cadastre Site Boundary

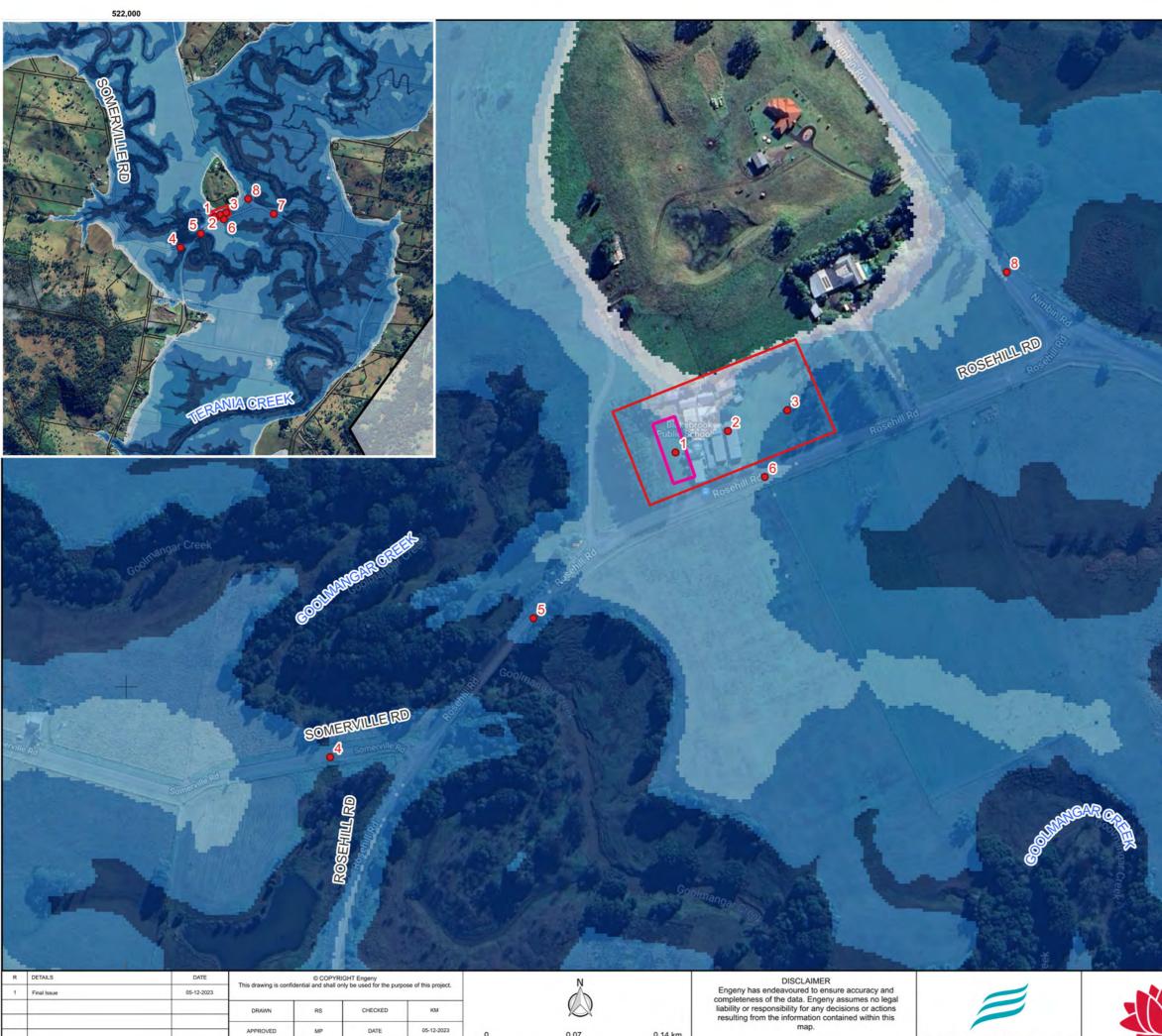
Model Extent

Proposed Building Location



#### Figure B6

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1 in 2000 AEP Flood Depth



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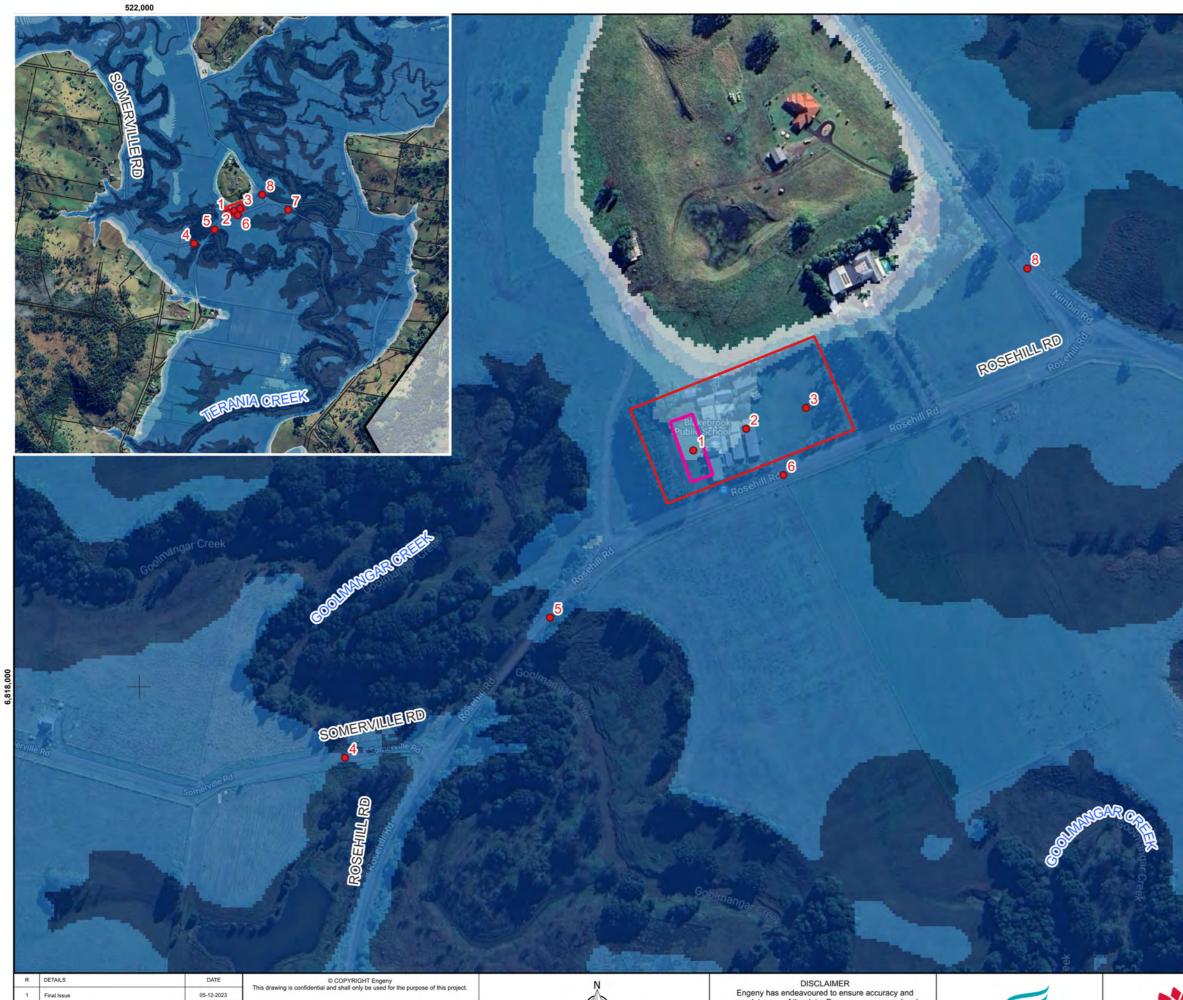
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	Cadastre
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	Model Extent
Floo	d Depth (m)
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0.5 - 1.0
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#### Figure B7

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1 in 10000 AEP Flood Depth



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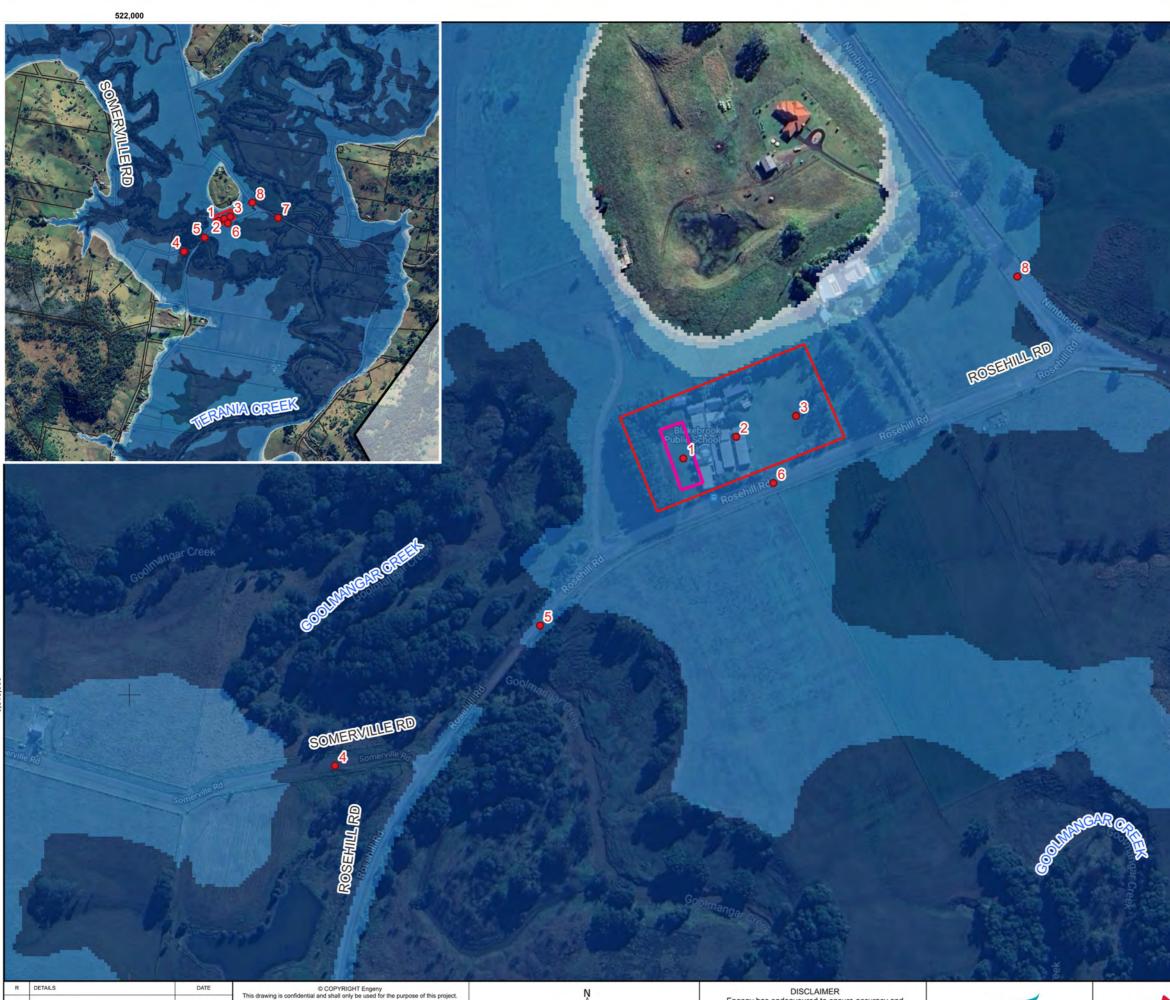
•	Reporting Location	
	Cadastre	
	Site Boundary	
	Proposed Building Location	
Model Extent		
Flood Depth (m)		

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loo	d Depth (m)
	0.0 - 0.5
	0.5 - 1.0
	1.0 - 2.0
	2.0 - 5.0
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#### Figure B8

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1 in 100000 AEP Flood Depth



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•	Reporting Location			
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Flood Depth (m)				
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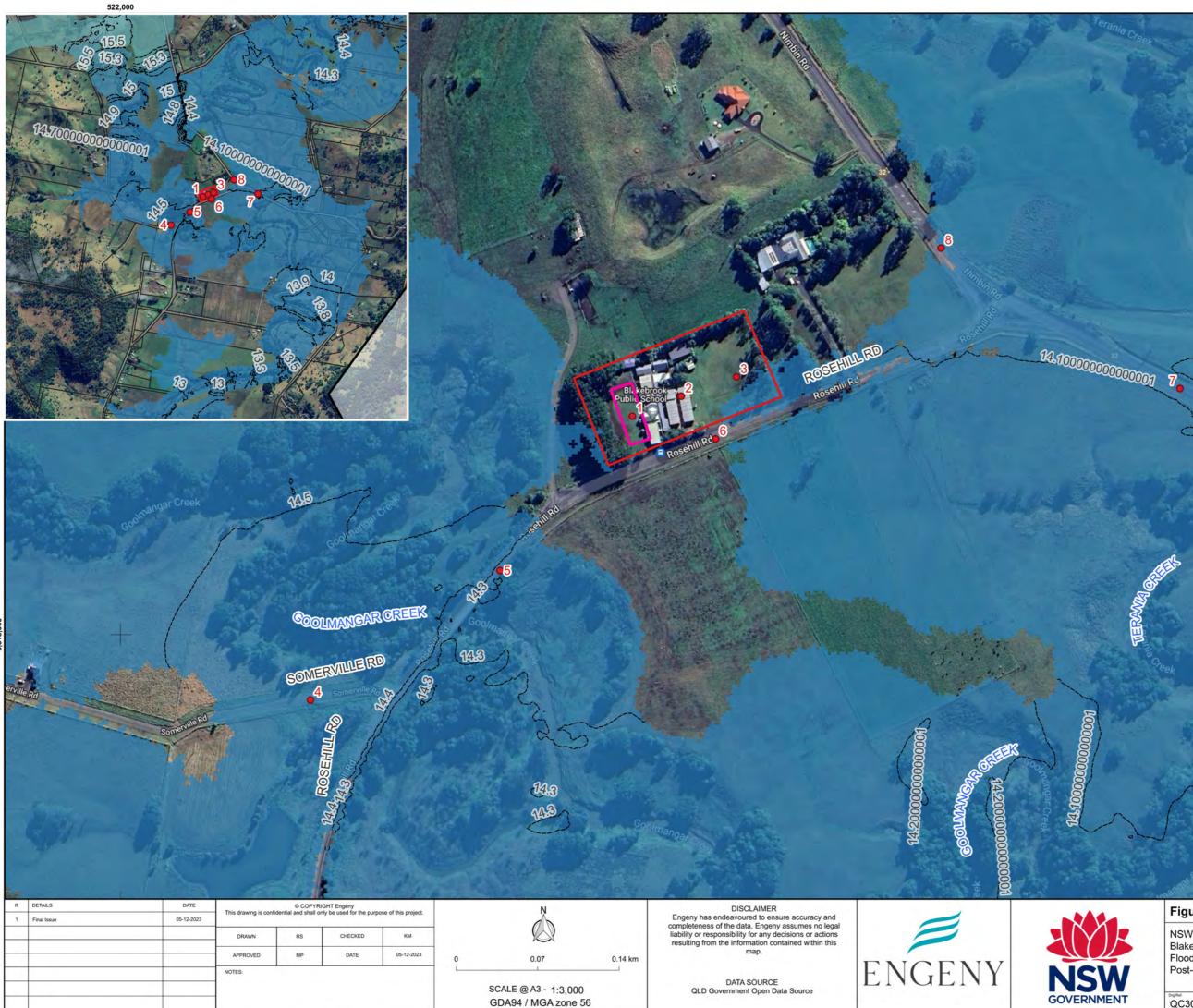


#### Figure B9

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NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case PMF Flood Depth

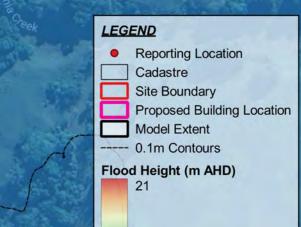
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#### Figure B10

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 10% AEP Flood Height

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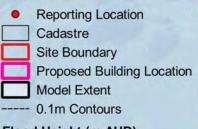
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## Flood Height (m AHD) 21

#### Figure B11

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 5% AEP Flood Height

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#### Figure B12

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1% AEP Flood Height



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#### Figure B13

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 0.5% AEP Flood Height

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#### Figure B14

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1 in 1000 AEP Flood Height



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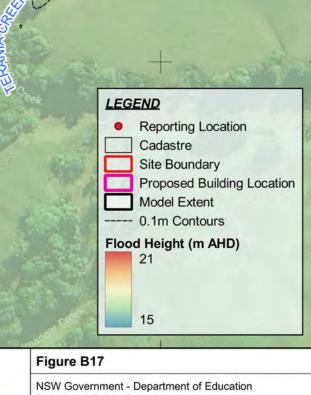
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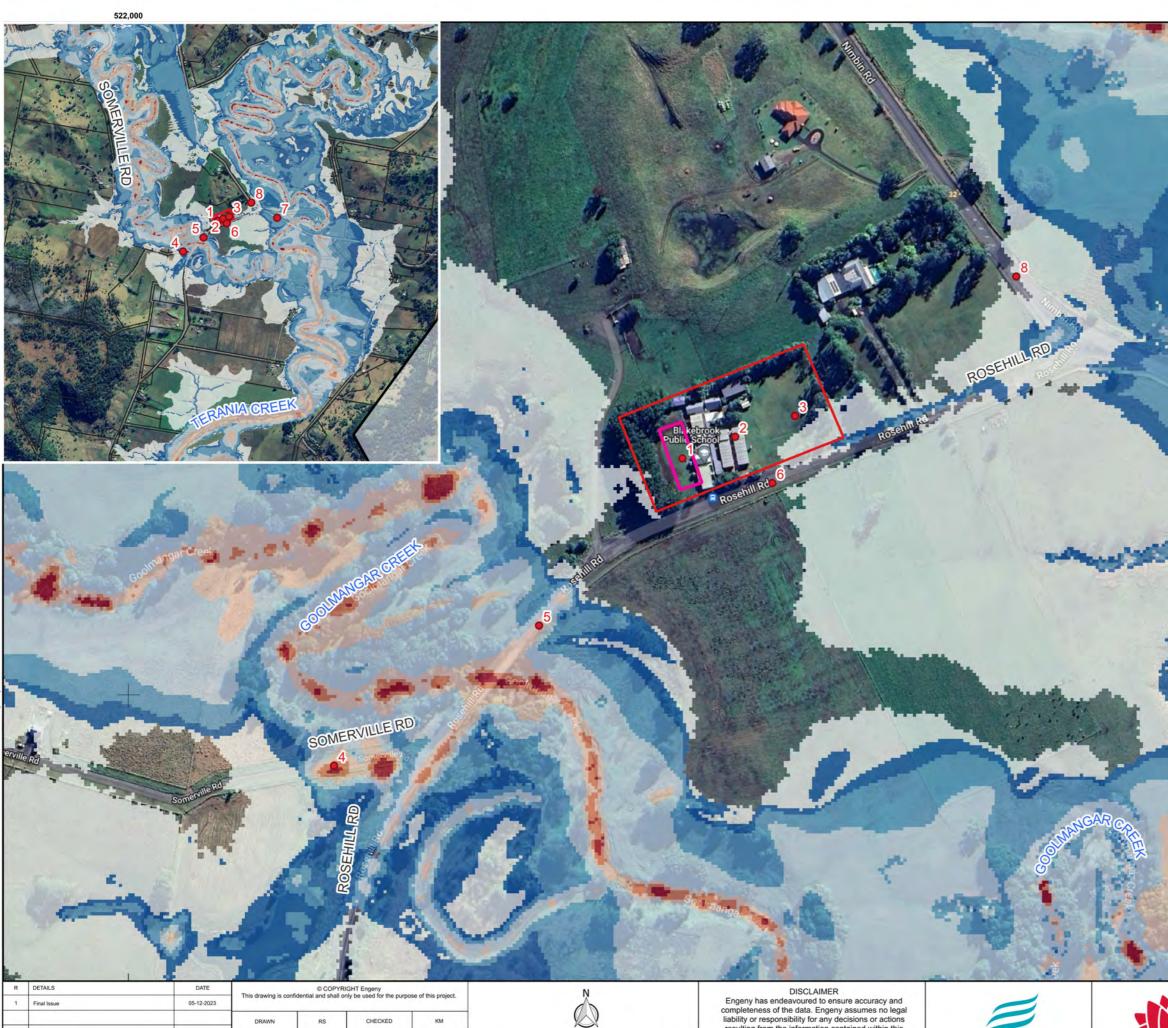








NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case PMF Flood Height



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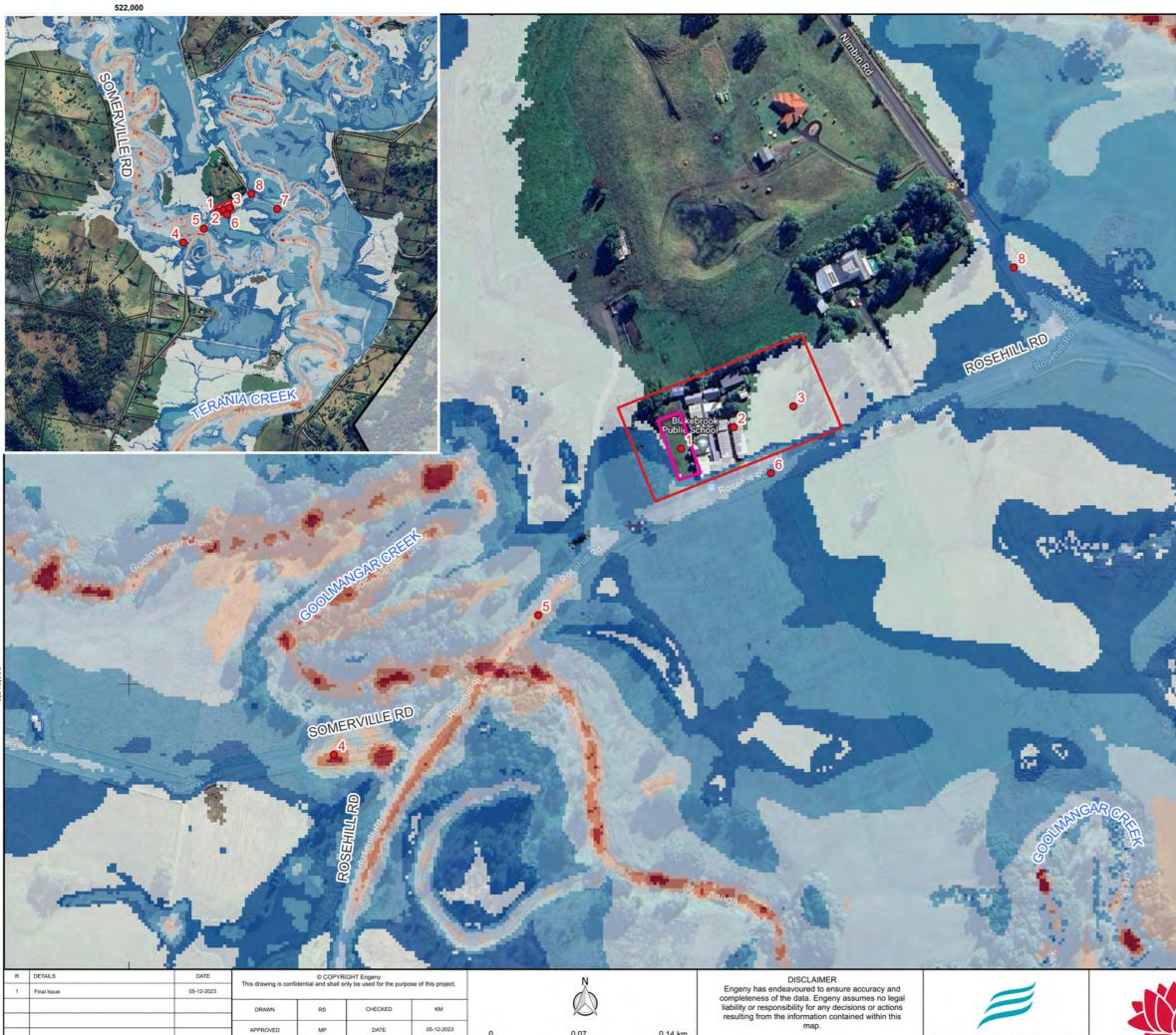


## LEGEND

•	Reporting Location
	Cadastre
	Site Boundary
	Proposed Building Location
	Model Extent
Floo	d Velocity (m/s)
	<= 0.1
	0.1 - 0.2
	0.2 - 0.5
	0.5 - 1
	1 - 1.5
	1.5 - 2
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#### Figure B19

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 10% AEP Flood Velocity



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	] Cadastre
	Site Boundary
	Proposed Building Location
	Model Extent
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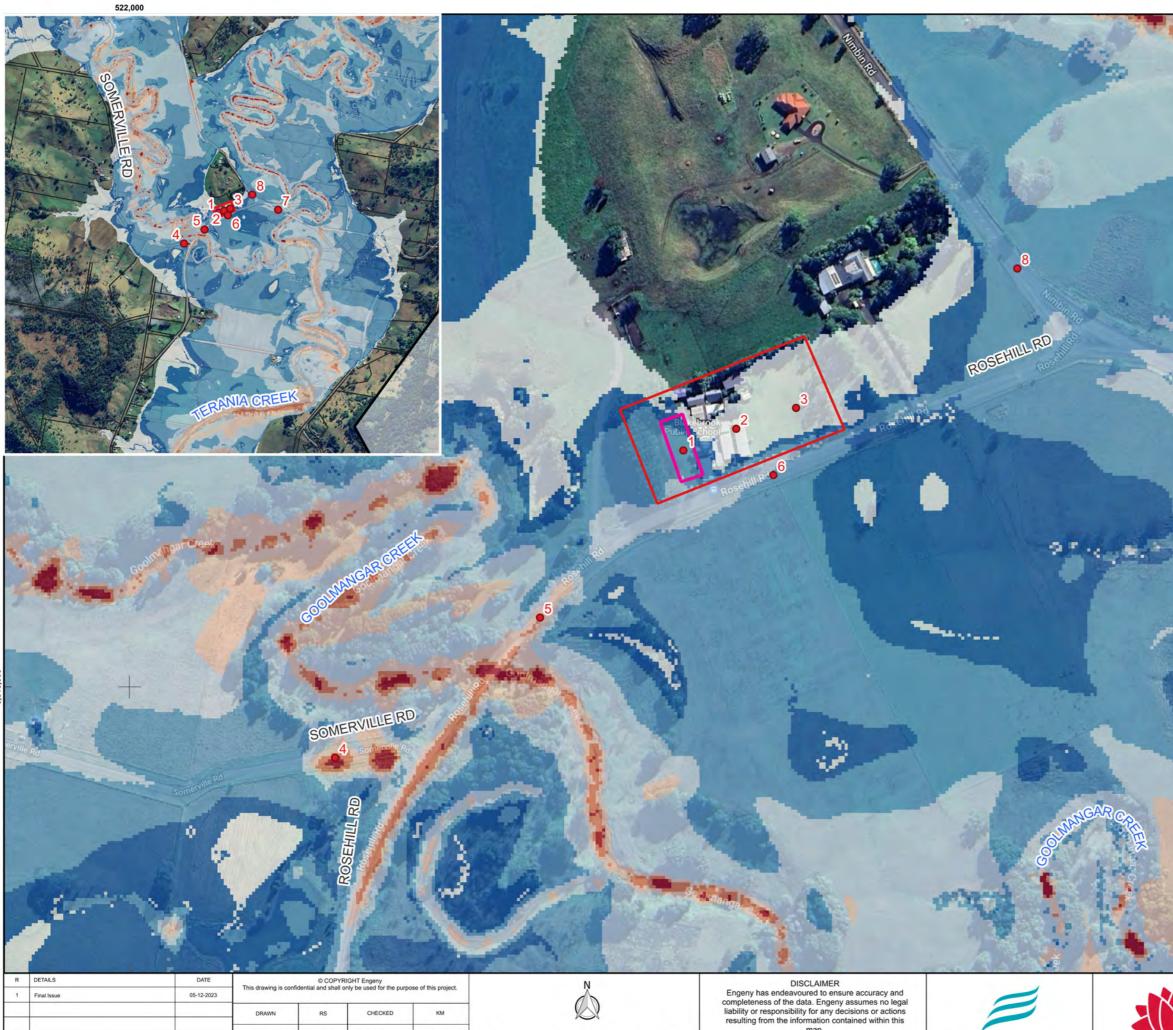
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Flo	od Velocity (m/s)
	<= 0.1
	0.1 - 0.2
	0.2 - 0.5
	0.5 - 1
	1 - 1.5
	1.5 - 2
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#### Figure B20

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 5% AEP Flood Velocity



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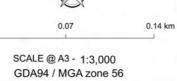
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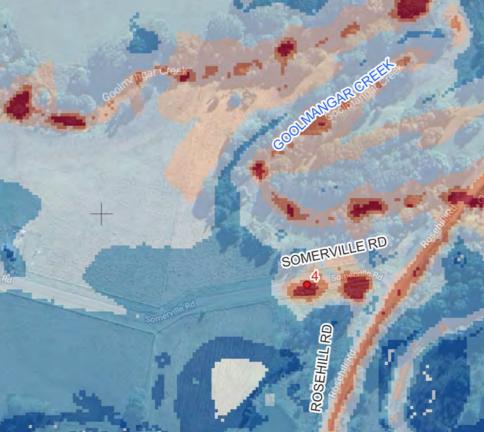
- Reporting Location
   Cadastre Site Boundary Proposed Building Location Model Extent
- Flood Velocity (m/s) <= 0.1 0.1 - 0.2 0.2 - 0.5 0.5 - 1 1 - 1.5 1.5 - 2 >2

#### Figure B21

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1% AEP Flood Velocity







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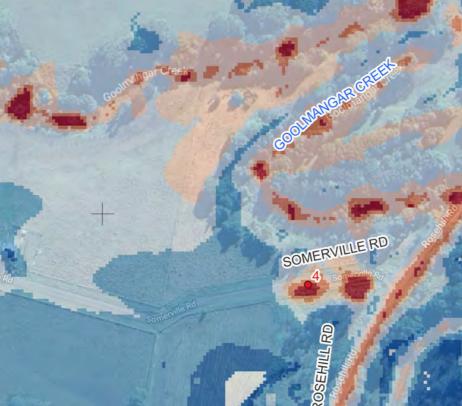


#### Figure B22

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 0.5% AEP Flood Velocity







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	Site Boundary
	Proposed Building Location
	Model Extent
Floo	d Velocity (m/s)

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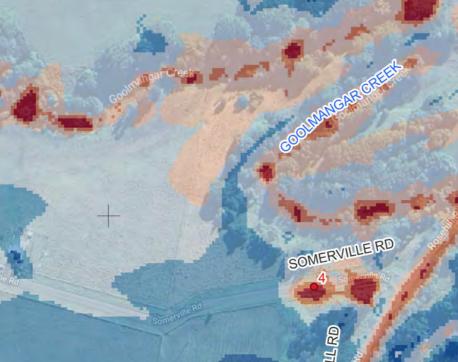
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#### Figure B23

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1 in 1000 AEP Flood Velocity







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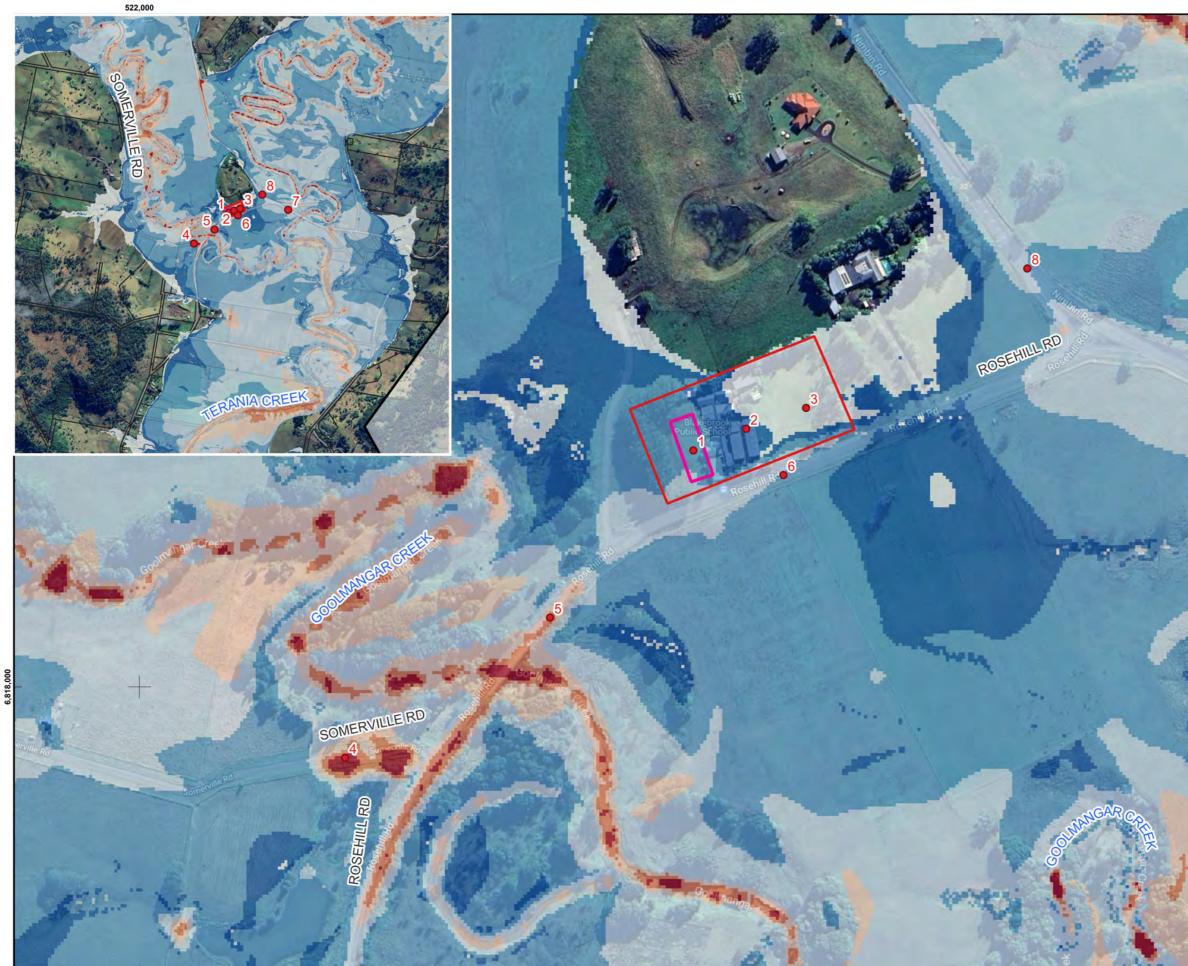
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## LEGEND

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	Cadastre				
	Site Boundary				
	Proposed Building Location				
	Model Extent				
Floo	d Velocity (m/s)				
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	0.1 - 0.2				
	0.2 - 0.5				
	0.5 - 1				
	1 - 1.5				
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#### Figure B24

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1 in 2000 AEP Flood Velocity



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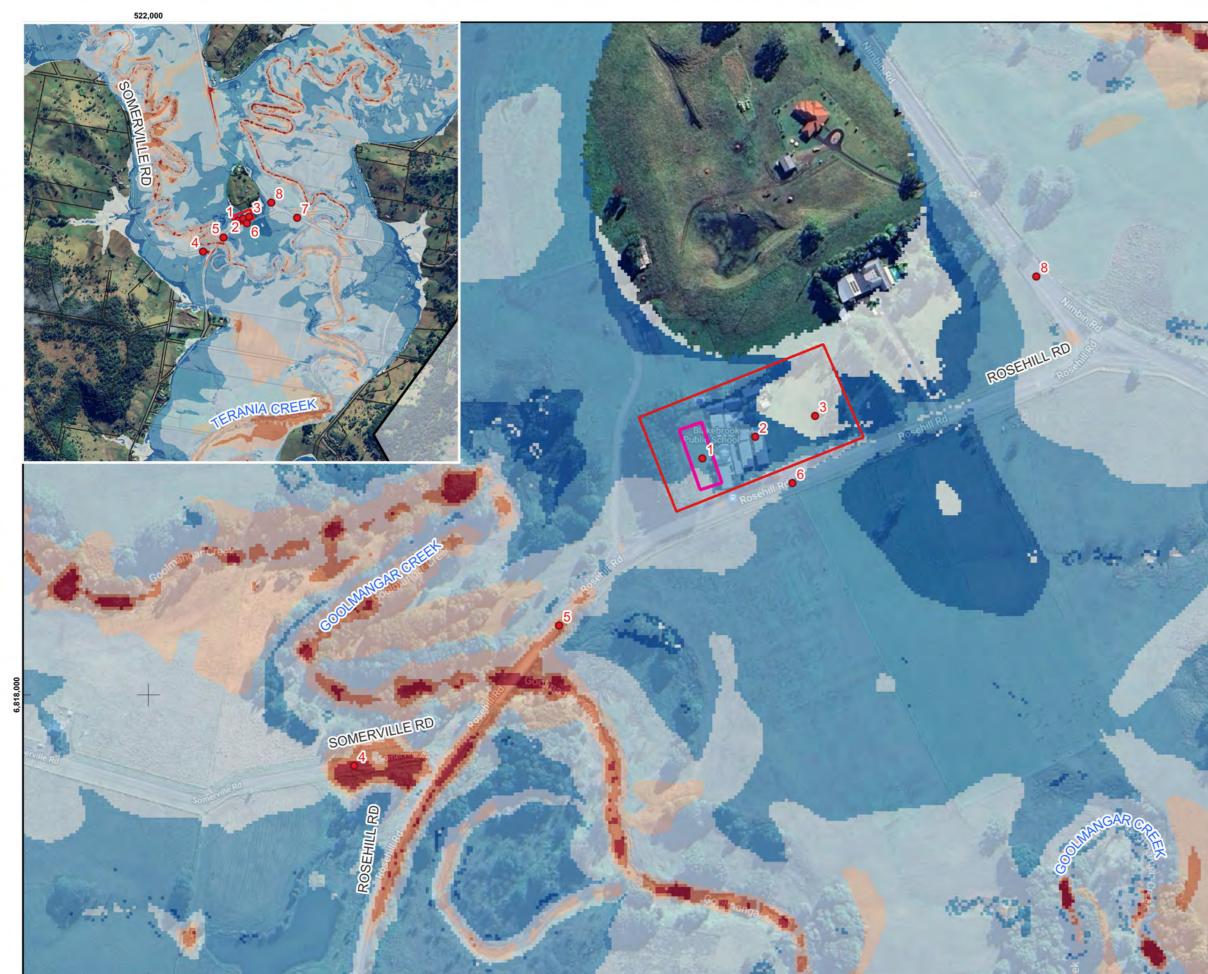
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•	Reporting Location					
	Cadastre					
	Site Boundary					
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Floo	d Velocity (m/s)					
	<= 0.1					
	0.1 - 0.2					
	0.2 - 0.5					
	0.5 - 1					
	1 - 1.5					
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#### Figure B25

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1 in 10000 AEP Flood Velocity



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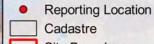
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Cadastre
Site Boundary
Proposed Building Location
Model Extent
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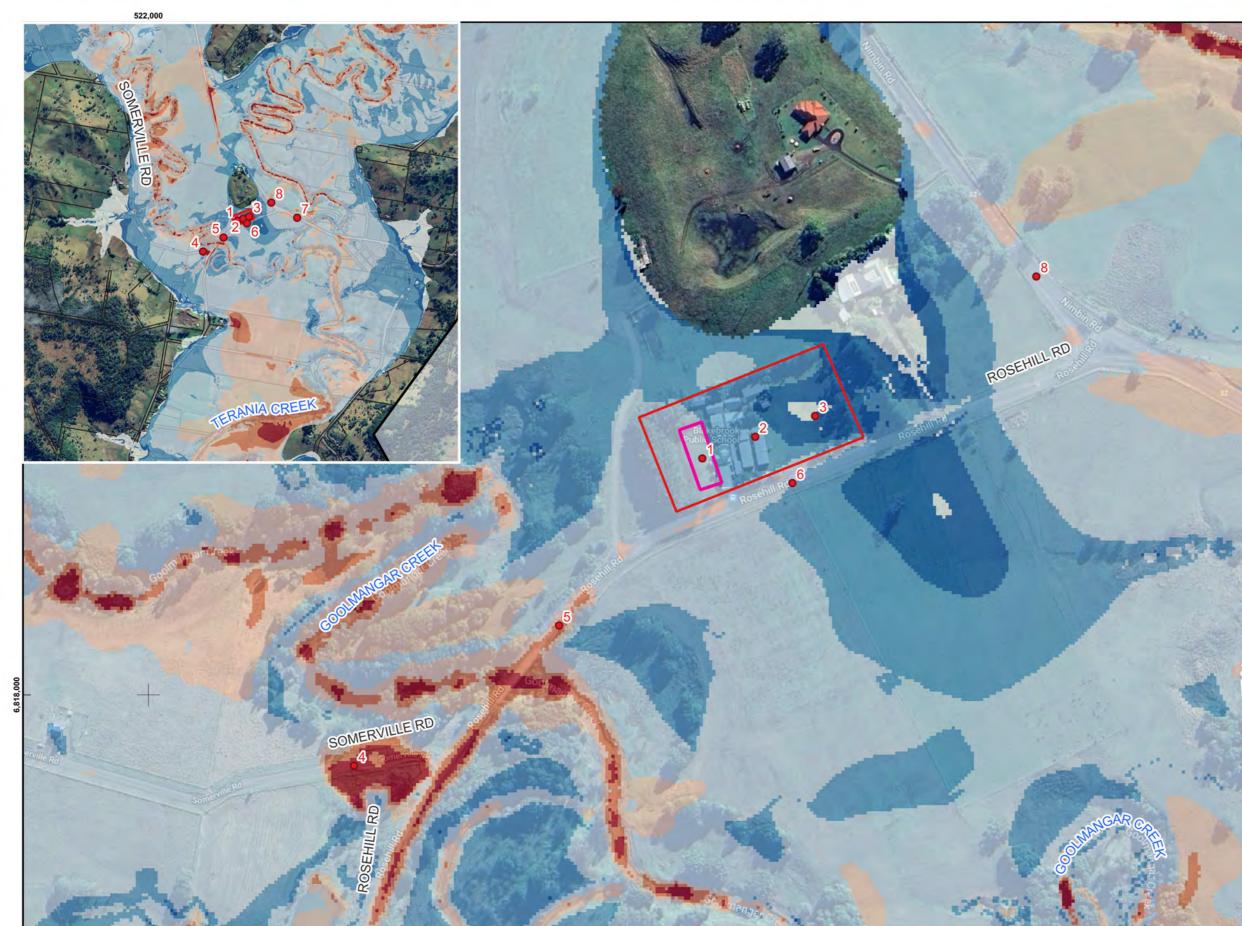
Flo	od Velocity (m/s)
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	0.2 - 0.5
	0.5 - 1
	1 - 1.5
	1.5 - 2

#### Figure B26

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NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1 in 100000 AEP Flood Velocity

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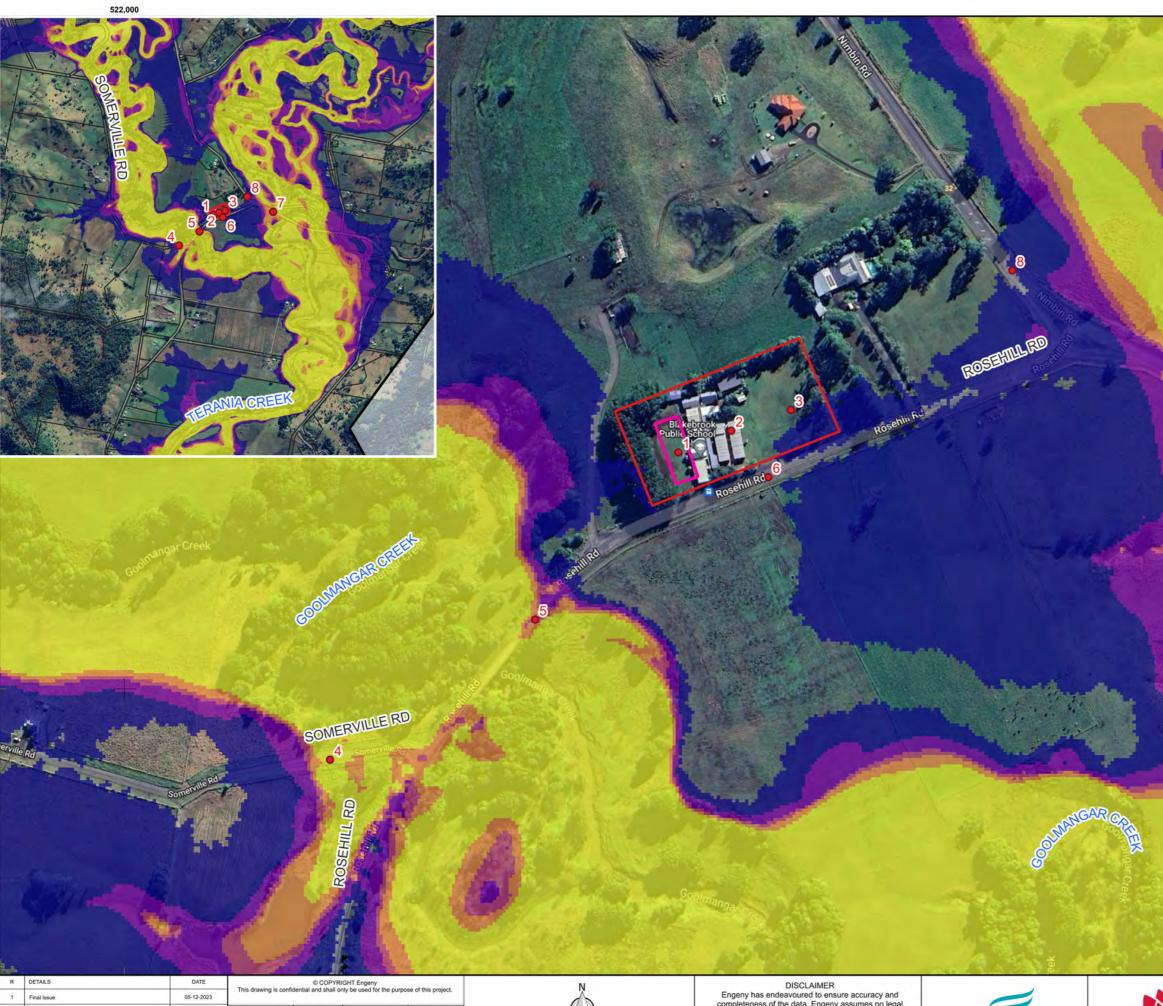
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	Cadastre
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#### Figure B27

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case PMF Flood Velocity

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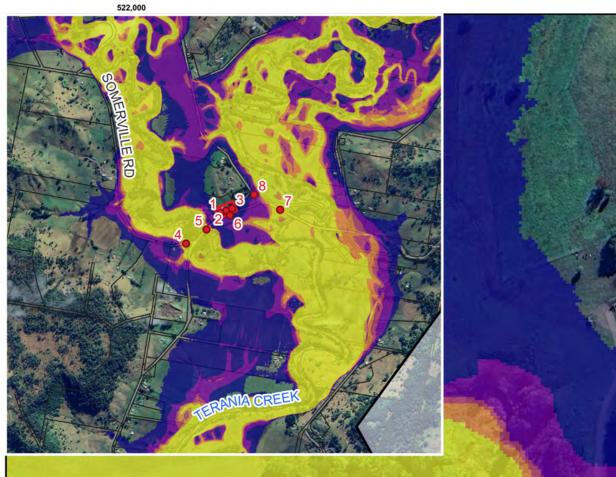
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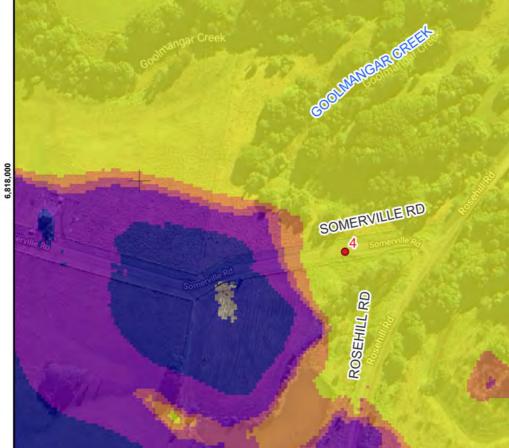
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ed Building Location Extent d [dxV] (m2/s) 0.1 - 0.3 0.3 - 0.4 0.4 - 0.6 > 0.6

#### Figure B28

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 10% AEP Flood Hazard (dxV)





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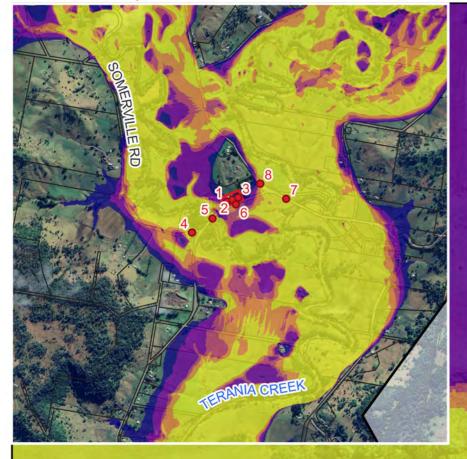
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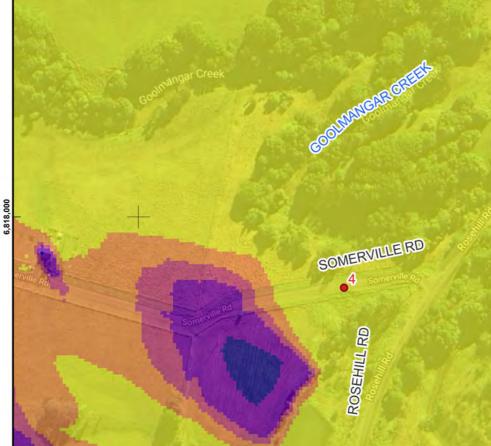
#### Figure B29

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 5% AEP Flood Hazard (dxV)

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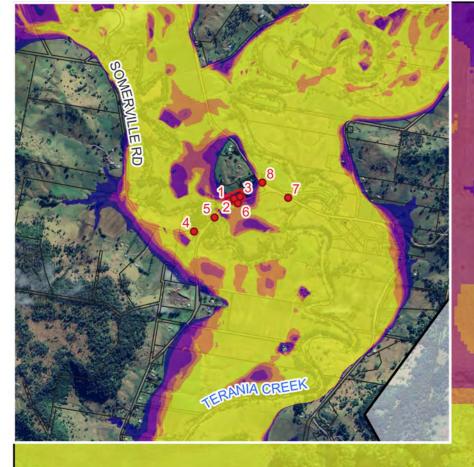


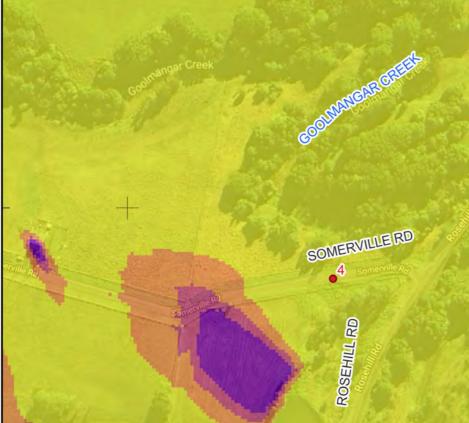
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#### Figure B30

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1% AEP Flood Hazard (dxV)







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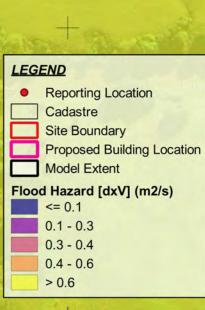


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#### Figure B31

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 0.5% AEP Flood Hazard (dxV)







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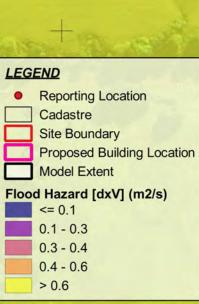


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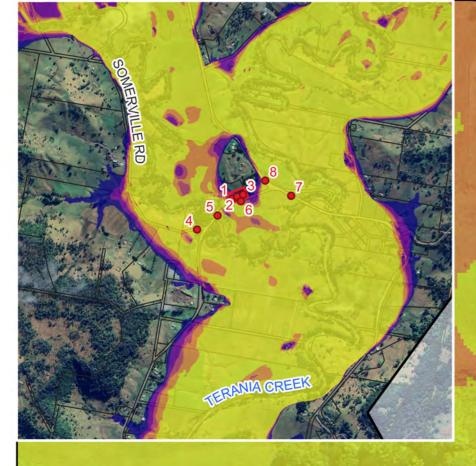


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#### Figure B32

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1 in 1000 AEP Flood Hazard (dxV)







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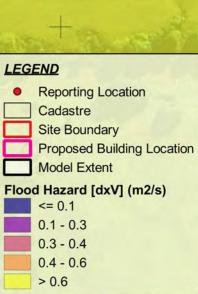


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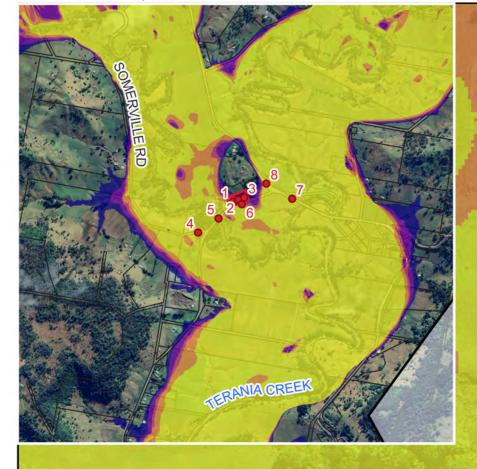
#### Figure B33

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NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1 in 2000 AEP Flood Hazard (dxV)

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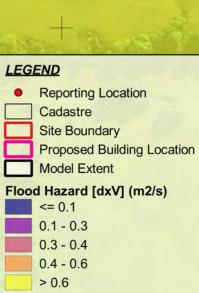


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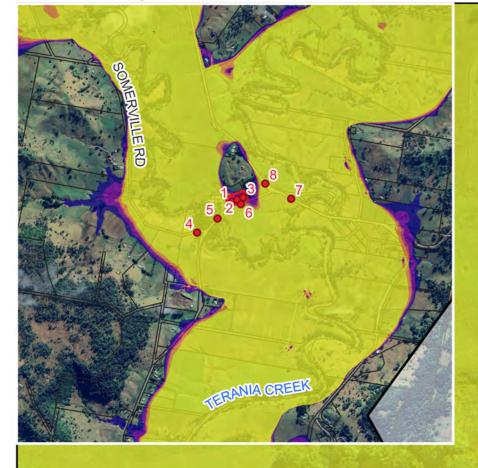


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#### Figure B34

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1 in 10000 AEP Flood Hazard (dxV)





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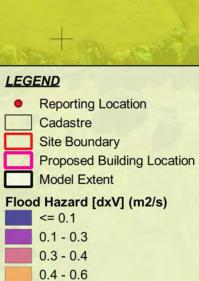


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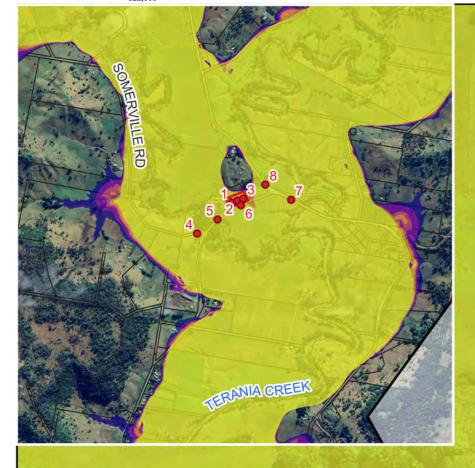
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#### Figure B35

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1 in 100000 AEP Flood Hazard (dxV)

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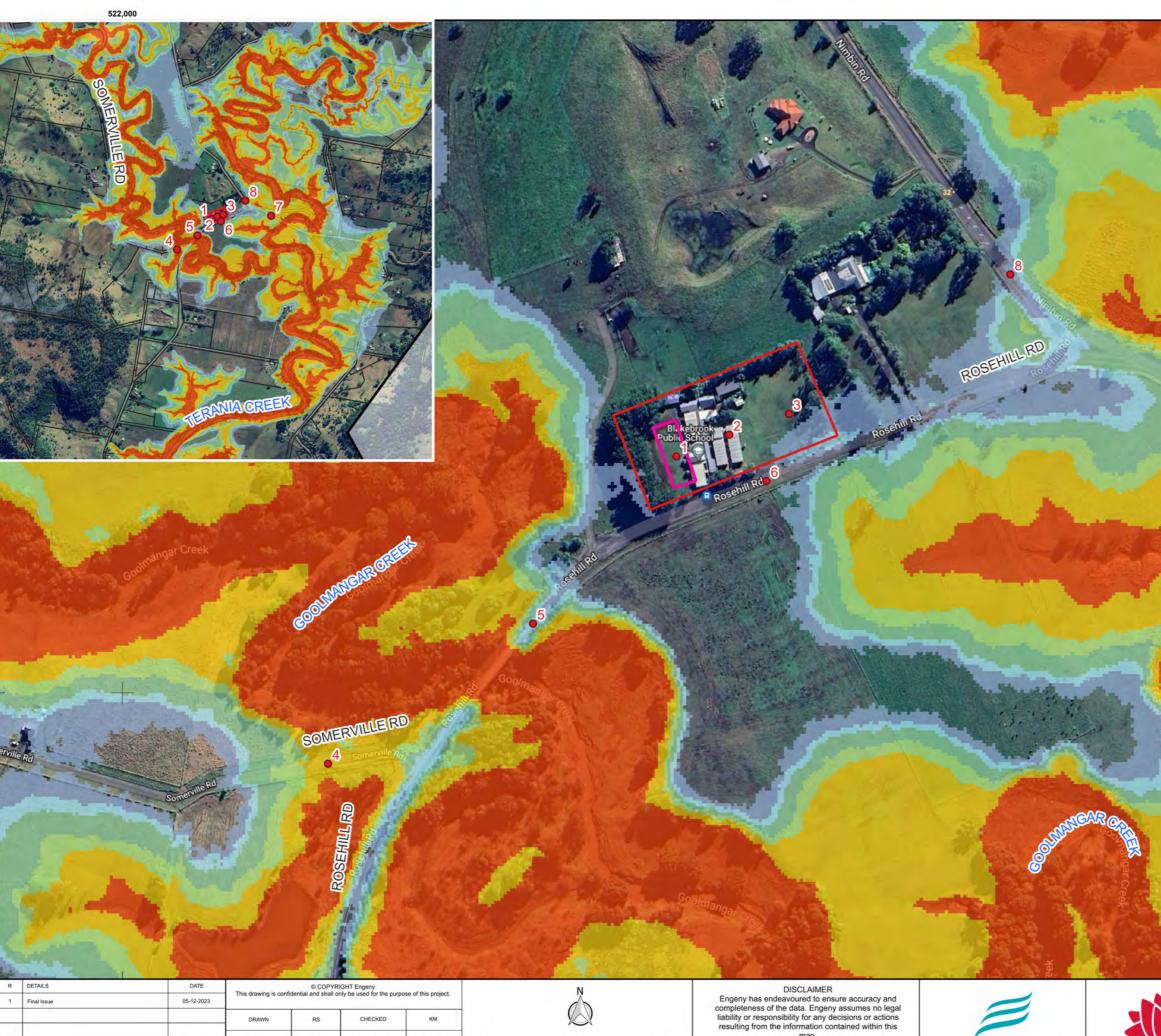


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#### Figure B36

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case PMF Flood Hazard (dxV)

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#### LEGEND Reporting Location

- Cadastre
- Site Boundary
- Proposed Building Location
- Model Extent

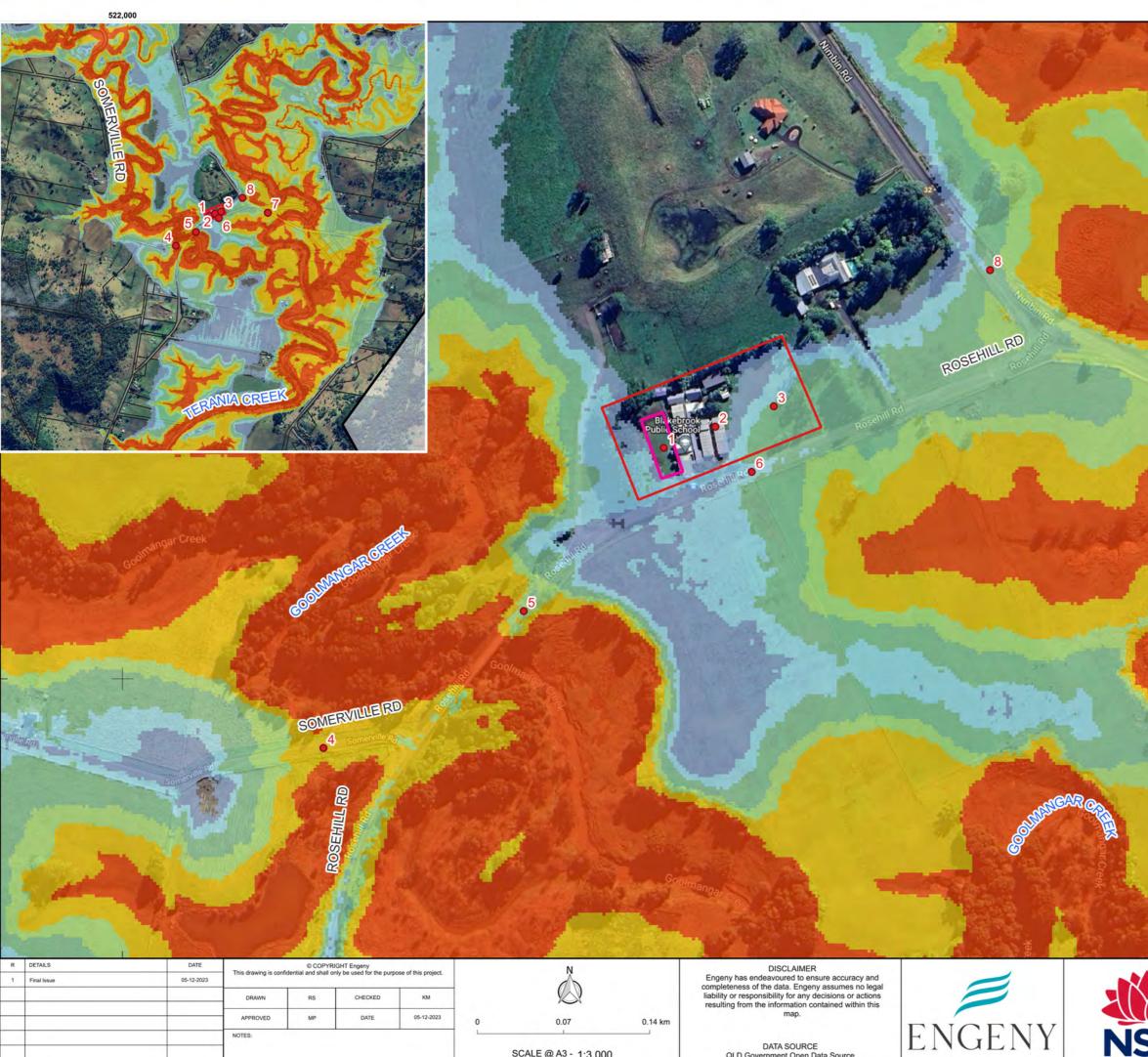
#### Flood Hazard [ZAEM1]

H1 H2 H3 H4 H5

H6

#### Figure B37

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 10% AEP Flood Hazard (ZAEM1)



SCALE @ A3 - 1:3,000 GDA94 / MGA zone 56

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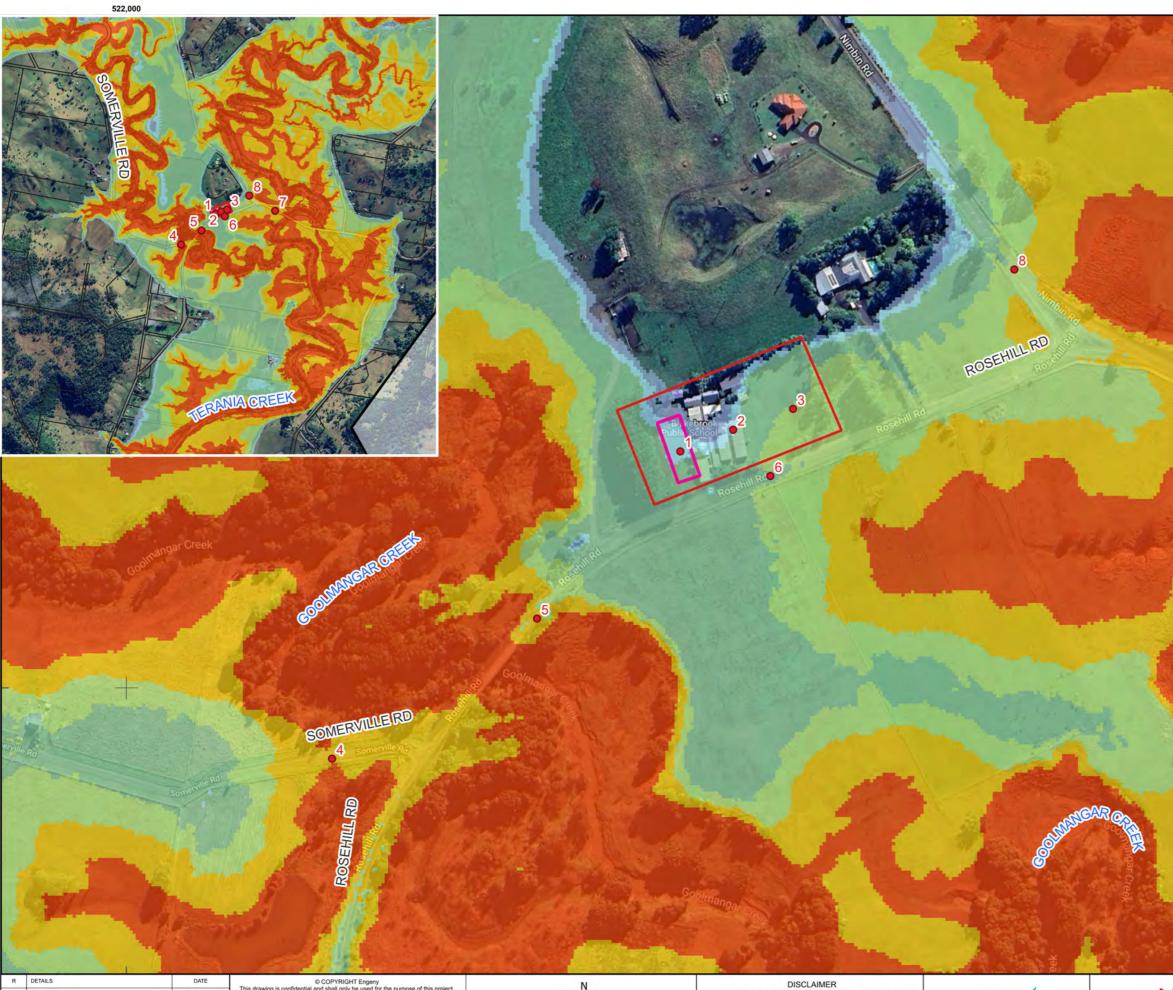


#### Figure B38

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NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 5% AEP Flood Hazard (ZAEM1)

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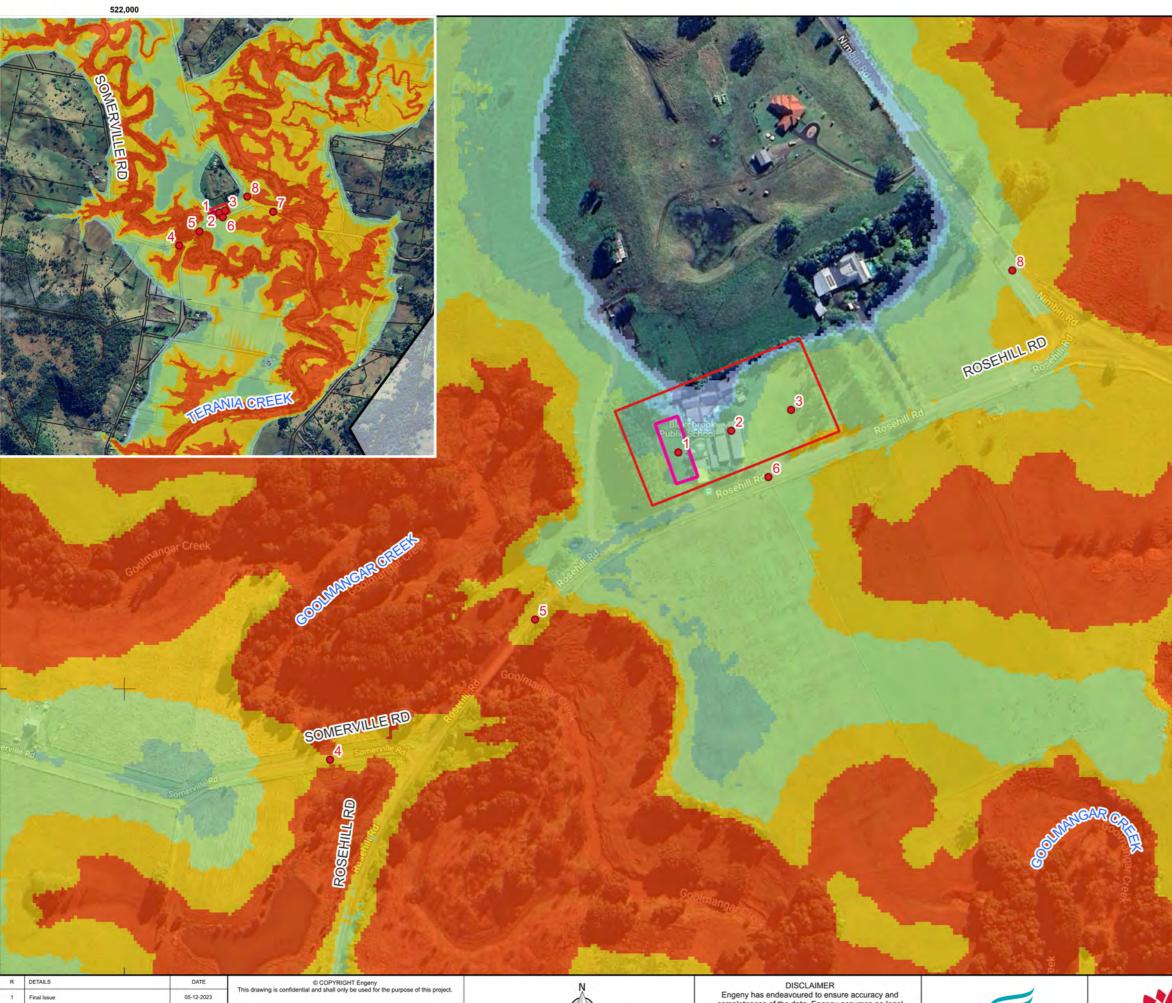
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	H1
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#### Figure B39

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1% AEP Flood Hazard (ZAEM1)



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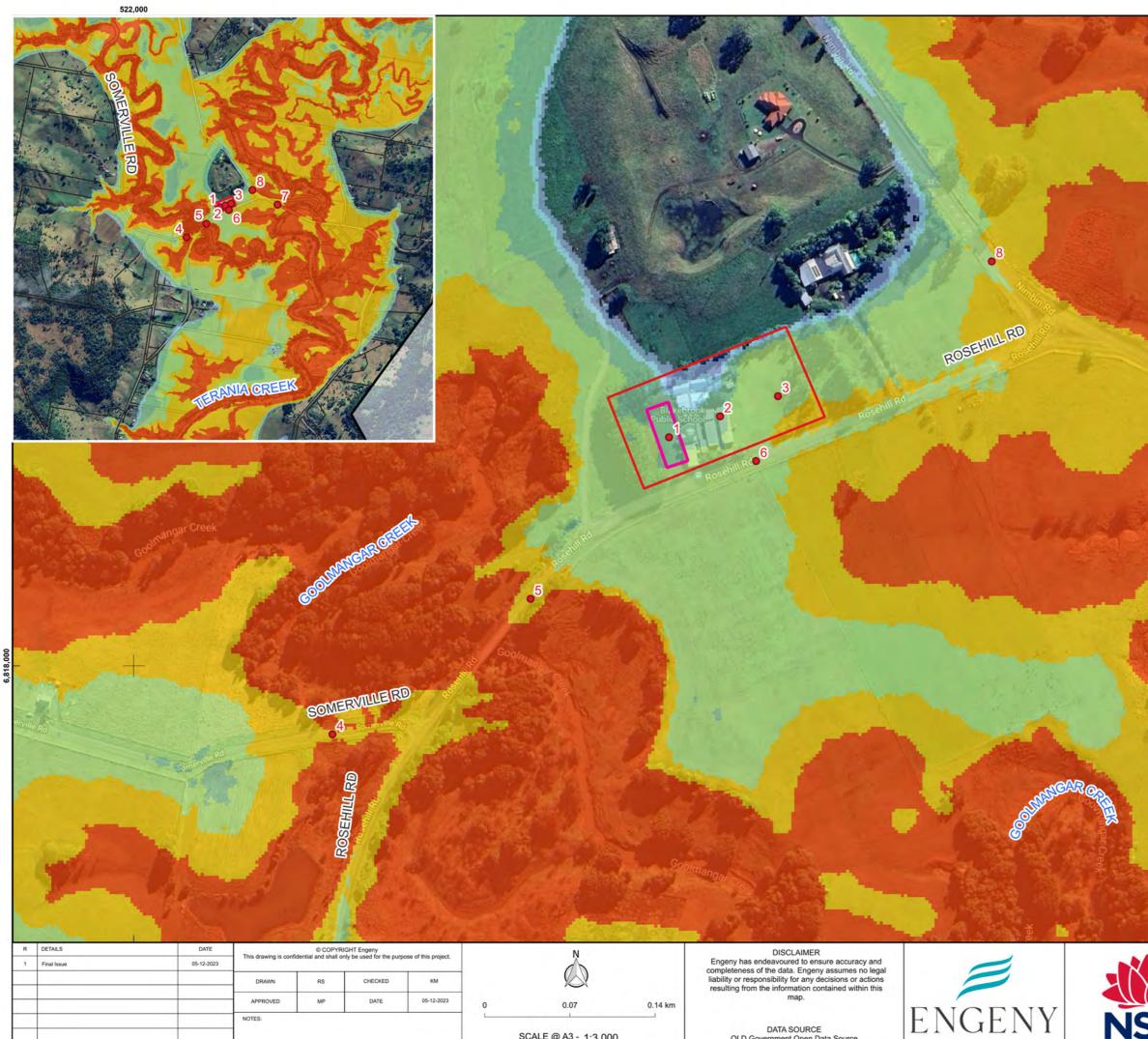
- Site Boundary
- Proposed Building Location
- Model Extent

#### Flood Hazard [ZAEM1] H1

- H1 H2 H3 H4
- H5

#### Figure B40

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 0.5% AEP Flood Hazard (ZAEM1)



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- Cadastre
- Site Boundary
- Proposed Building Location
- Model Extent

#### Flood Hazard [ZAEM1]

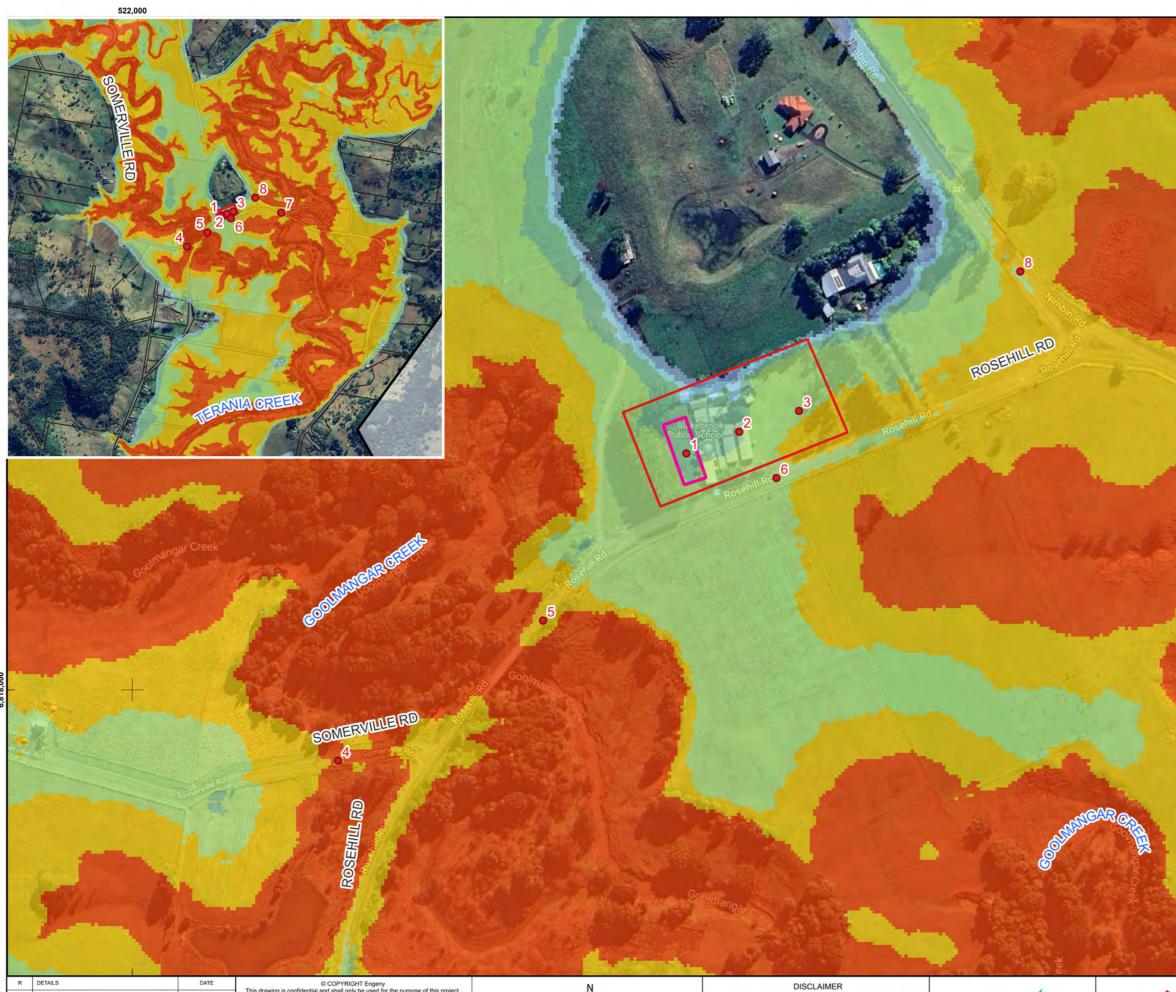
H1 H2 H3 H4 H5

H6



#### Figure B41

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1 in 1000 AEP Flood Hazard (ZAEM1)



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- Reporting Location Cadastre
- Site Boundary
- Proposed Building Location
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## Flood Hazard [ZAEM1] H1

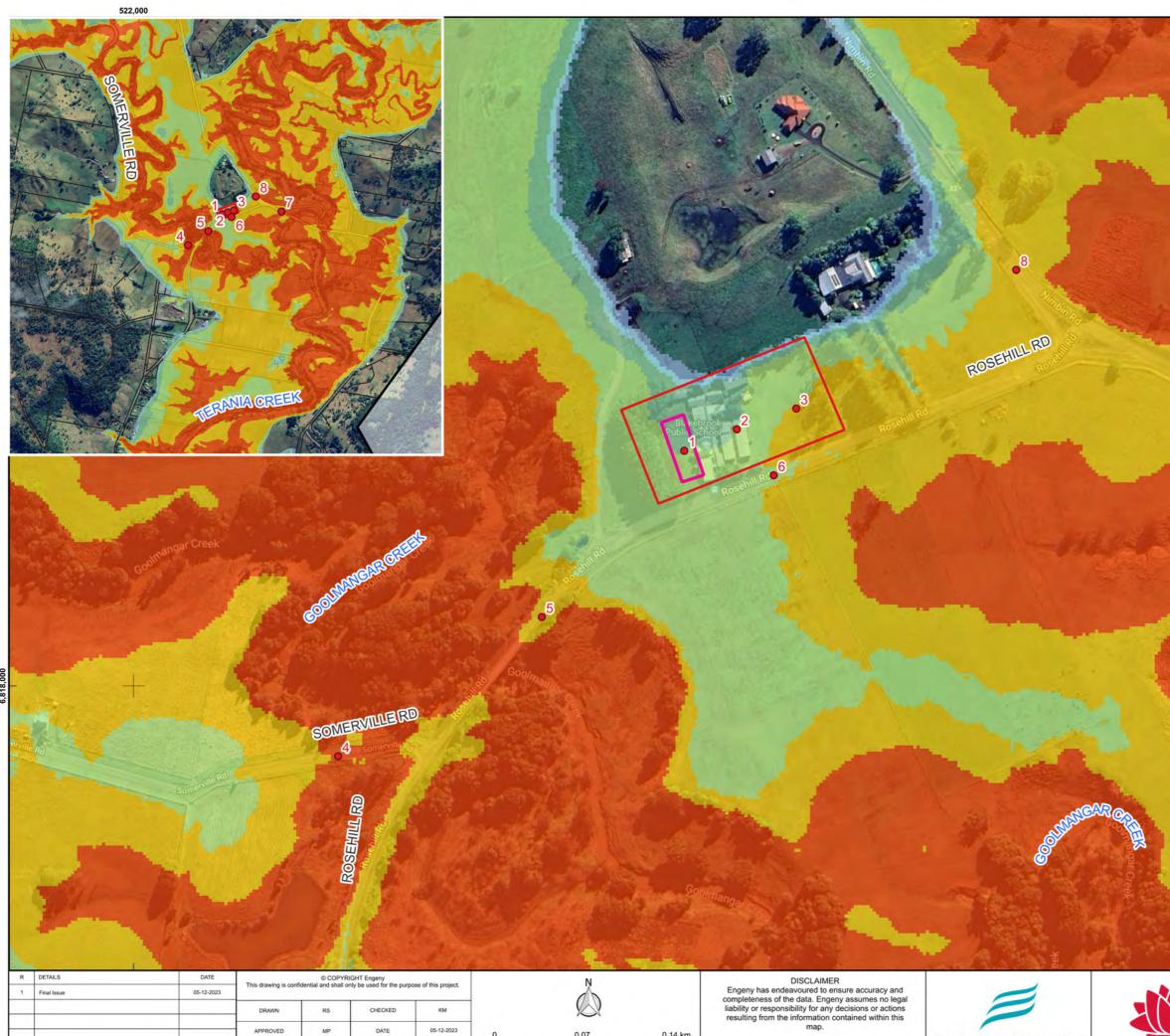
H2 H3 H4 H5

H6



#### Figure B42

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1 in 2000 AEP Flood Hazard (ZAEM1)



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## LEGEND

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- Site Boundary
- Proposed Building Location
- Model Extent

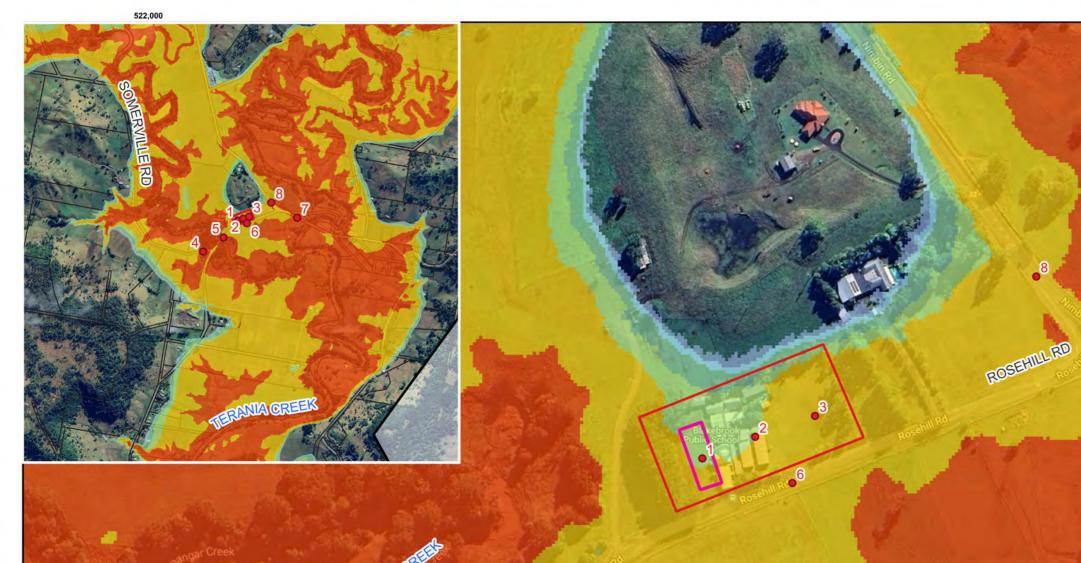
#### Flood Hazard [ZAEM1]

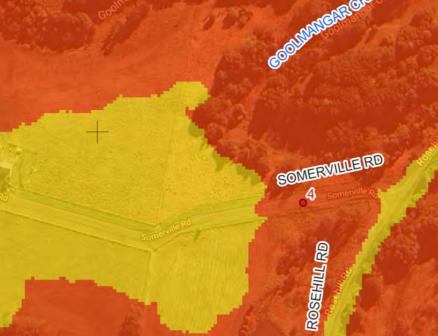
H1 H2 H3 H4 H5

H6

#### Figure B43

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1 in 10000 AEP Flood Hazard (ZAEM1) QC3008\_001-SKE-0001





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#### LEGEND Reporting Location Cadastre

- Site Boundary
- Proposed Building Location
- Model Extent

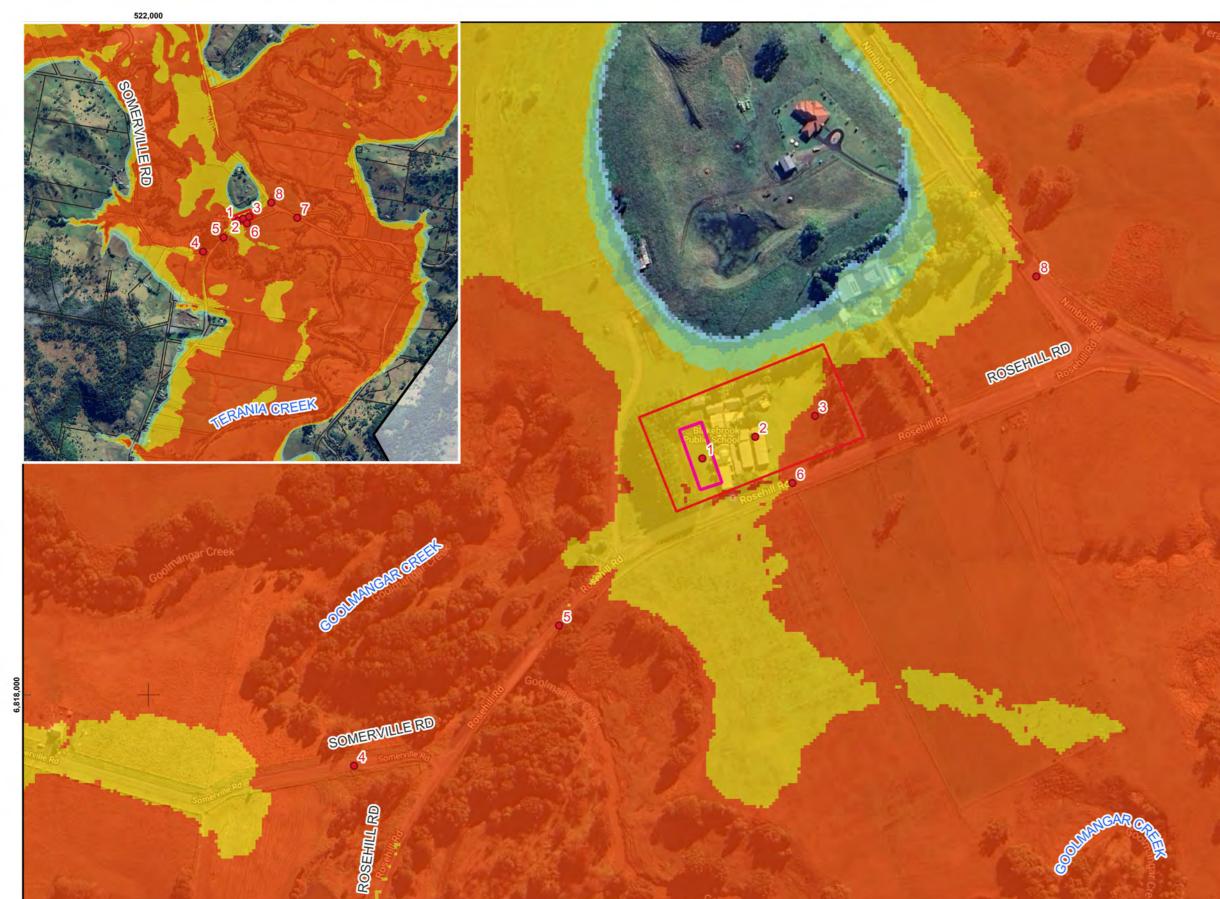
## Flood Hazard [ZAEM1] H1

- H2 H3 H4
- H5
- H6

#### Figure B44

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NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1 in 100000 AEP Flood Hazard (ZAEM1) QC3008\_001-SKE-0001



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## LEGEND Cadastre

- Reporting Location
- Site Boundary
- Proposed Building Location
- Model Extent

#### Flood Hazard [ZAEM1]

- H1 H2 H3 H4
- H5

H6

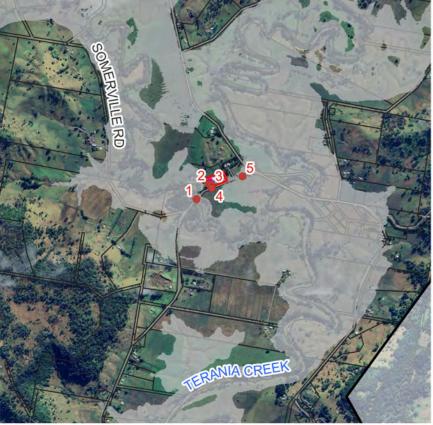
#### Figure B45

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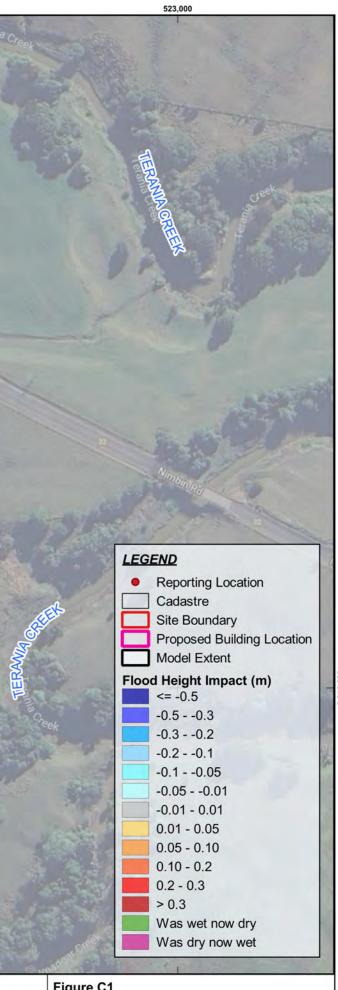
NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case PMF Flood Hazard (ZAEM1)

# APPENDIX C: FLOOD IMPACT MAPPING





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R DETAILS  1 Final issue	DATE 05-12-2023	This drawing is confide DRAWN APPROVED NOTES:	© COPYR ential and shall or RS MP	GHT Engeny ny be used for the purp CHECKED DATE	KM 05-12-2023	0	0.07	0.14 km	DISCLAIMER Engeny has endeavoured to ensure accuracy and completeness of the data. Engeny assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.	ENGENY	
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#### Figure C1

NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 10% AEP Flood Height Impact



R	DETAILS	DATE	COPYRIGHT Engeny This drawing is confidential and shall only be used for the purpose of this proj				
1	Final Issue	05-12-2023	This drawing is contro	ential and shall o	hig be used for the purpo	ose of this proje	
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	0.07	0.14
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	GDA94 / MGA zone	56

0.14 km

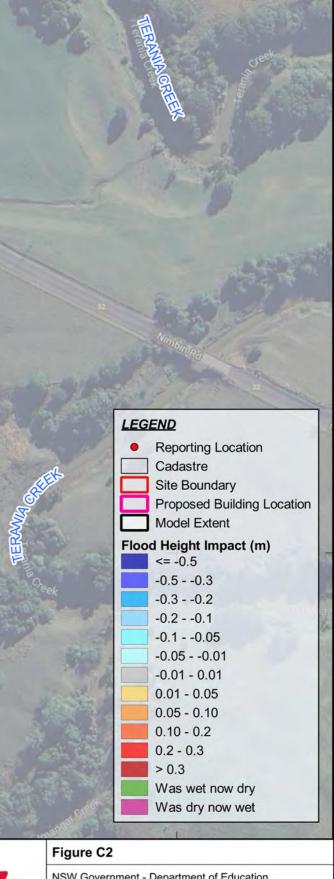
map.

DATA SOURCE QLD Government Open Data Source





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523,000



NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 5% AEP Flood Height Impact



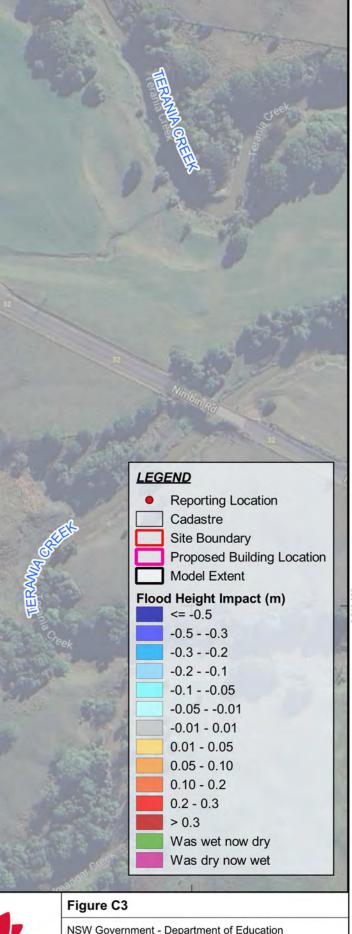
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GDA94 / MGA zone 56

DATA SOURCE QLD Government Open Data Source

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NSW Government - Department of Education Blakebrook Public School Flood Impact Assessment Post-Rebuild Case 1% AEP Flood Height Impact