New High School for Jordan Springs - Flood Impact and Risk Assessment

Customer	
Project	003408
Deliverable	003
Version	01
	18 December 2024

Document Control

Document Identification

Title	New High School for Jordan Springs - Flood Impact and Risk Assessment
Project No	003408
Deliverable No	003
Version No	01
Version Date	18 December 2024
Customer	Department of Education
Classification	OFFICIAL

Author	Nam Nguyen
Checked By	Kieran Smith, Jacquie Hannan
Approved By	Mel Adam
Project Manager	Kieran Smith

Amendment Record

The Amendment Record below records the history and issue status of this document.

Version	Version Date	Distribution	Record
01	15 November 2024	Department of Education, TSA	Draft – For Client Review
02	12 December 2024	Department of Education, TSA	Final – Issued for REF
03	18 December 2024	Department of Education, TSA	Final – Issued for REF

Contents

Tables

Figures

1 Introduction

1.1 Purpose of this Report

This report documents the Flood Impact and Risk Assessment (FIRA) that has been prepared to accompany a Review of Environmental Factors (REF) for the Department of Education (DoE) for the construction and operation of a New High School for Jordan Springs (the activity) under Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act) and State Environmental Planning Policy (Transport and Infrastructure) 2021 (SEPP TI).

This document has been prepared in accordance with the *Guidelines for Division 5.1 assessments – Consideration of environmental factors for health services facilities and schools, October 2024* (the Guidelines) by the Department of Planning, Housing and Infrastructure.

This report examines and takes into account the relevant environmental factors in the Guidelines and *Environmental Planning and Assessment Regulations 2021* under Section 170, Section 171 and Section 171A of the EP&A Regulation as outlined in Table 1.1.

Table 1.1 Summary of Relevant Section of the Part 5 Guidelines and EP&A Regulation

Regulation / Guideline Section	Requirement	Response	Report Section
Division 5.1 Guidelines, Section 3, Table 1, j)	Consider any long-term effects on the environment (including flood)	The proposed activities are not expected to cause any off-site flood impacts. An evaluation of long-term environmental effects and safety risks, including specific consideration of climate change has been conducted. The climate change assessment indicates that the proposed activities are unlikely to alter flood behaviour or increase flood risks over time.	5.2
Division 5.1 Guidelines, Section 3, Table 1, l)	Consider any risk to the safety of the environment (including runoff patterns, flooding regimes)	The analysis shows that runoff and flood behaviour are not expected to be adversely affected, and no significant risks to environmental safety have been identified.	5.2

It is noted that the Flood Emergency Response Plan (FERP) prepared by BMT for proposed the New High School at Jordan Springs is documented in a separate report.

1.2 Documentation Review

The plans and reports identified in Table 1.2 have been reviewed to inform the assessment contained within this report.

Table 1.2 Reviewed Plans and Reports

Discipline	Document name	Revision	Date
Flooding	Wianamatta (South) Creek Catchment Flood Study (INSW)	Rev I	23 May 2022
Flooding	Hawkesbury-Nepean Flood Study (NSWRA)	Rev 07	19 May 2024
Civil Engineering	JORDAN SPRING HIGH SCHOOL (JSHS-TTW-01-00-DR-C)	Rev B	30 October 2024

1.3 Proposed Activity Description

The proposed activity for the construction and operation of the New High School for Jordan Springs (JSHS) is proposed to have a capacity of 1,000 students and 80 staff to meet forecast enrolment demand associated with population growth in Jordan Springs and Ropes Crossing. The school will provide permanent General Learning Spaces (GLS), Support Learning Spaces (SLS), staff facilities and a library across three (3), three storey buildings, a single storey hall, sports field, three (3) outdoor sport courts, 72 operational at grade parking spaces (including two (2) accessible spaces), 100 bicycle spaces and landscaping.

Public domain works and the permanent off-site OSD Basin are to be constructed by others under separate planning pathways.

1.4 Proposed Activity Scenarios

The project scope of works includes two (2) Scenarios, to allow construction and operation of the school, with (Scenario 1 – preferred option) or without (Scenario 2 – Interim Solution) the public domain works and permanent off-site basin being constructed by others under a separate planning pathway.

Scenario 1 – Preferred Option - Road Network completed and permanent OSD Basin Constructed

- External works undertaken by others to facilitate Scenario 1
  - Construction of Park Edge Road;
  - Any adjustments to Infantry Street;
  - Kiss and drop zone along Park Edge Road;
  - Support kiss and drop zone located along Infantry Street; and
  - Construction and operation of permanent OSD Basin off site.

Note – Scenario 1 is not to proceed if external works undertaken by others is not completed.

- Scenario 1
  - Construction and Operation of the New High School for Jordan Springs, including:
    - Decommissioning of existing on-site OSD basin;

    - Demolition of roads and associated services within the site boundary;
    - Tree removal within the site boundary;
    - Earthworks;
    - Three (3) multi-storey classroom buildings;
    - One (1) school hall;
    - Three (3) outdoor sport's courts;
    - One (1) sport's field;
    - 72 at grade car parking spaces, including two (2) accessible parking spaces, and waste services, accessed via Park Edge Road;
    - 100 bicycle parking spaces across the site; and
    - Landscaping.

Scenario 2 - Interim Solution – Road network not completed, Permanent OSD Basin not constructed.

- Scenario 2 - Stage 1
  - Construction and operation of a temporary on-site OSD Basin;
  - Construction and operation of the New High School for Jordan Springs, including;
    - Demolition of roads and associated services within the site boundary;
    - Tree removal within the site boundary;
    - Earthworks;
    - Three (3) multi-storey classroom buildings;
    - One (1) sport's field;
    - Temporary carpark - 72 at grade car parking spaces, including two (2) accessible parking spaces and waste services, located on the north-west corner of the site, accessed off Armoury Road;
    - 100 bicycle parking spaces across;
    - Temporary Kiss and drop facilities on Armoury Road; and
    - Associated landscaping.
- Scenario 2 – Stage 2

  Stage 2 is not to be undertaken until the temporary on-site OSD basin under Stage 1 works is completed and operational.

  - Decommissioning of existing on-site OSD basin, prior to the following works being undertaken:

- 72 at grade car parking spaces, including two (2) accessible parking spaces, and waste services, located on the south-east corner of the site. This car park cannot be constructed until the decommissioning of the existing OSD basin is completed and will be non-operational with no road connection until completion of Scenario 2 – Stage 3;
- One (1) school hall;
- Three (3) outdoor sport's courts; and

External works undertaken by others to facilitate Stage 3

- Construction of Park Edge Road;
- Any adjustments to Infantry Street;
- Kiss and drop zone along Park Edge Road;
- Support kiss and drop zone located along Infantry Street; and
- Construction and operation of OSD Basin off site.

Note – Scenario 2 - Stage 3 is not to proceed until the external works undertaken by others have been completed.

- <u>Scenario 2 – Stage 3</u>
  - Connection of the south-east carpark to Park Edge Road;
  - Rectification works along Armoury Road to remove temporary kiss and drop facilities and cross over for temporary carpark;
  - Demolition of temporary carpark, once permanent car park is operational; and
  - Decommissioning of temporary OSD basin.

1.5 Activity Site

The project site is located on the corner of Armoury Road and Infantry Street in Jordan Springs and is legally described as part of Lots 2 and 3 in DP 1248480.

Figure 1.1 provides an aerial photograph of the project site, outlines the boundaries of the project site (in red) and the boundaries of Lots 2 and 3 in DP 1248480 (in blue).

The project site is within the Central Precinct of the St Mary's Release Area in the Penrith City Local Government Area (LGA).

1.6 Other Approvals

External works and construction of the permanent off-site OSD Basin are to be constructed by others.

Figure 1.1 Aerial Photograph

2 Flood Assessment Overview

2.1 Key Tasks

The following tasks were completed as part of this flood assessment:

- Review of available topographic and flood information for the Site;
- Review of relevant Council flood studies, flood-related planning policies, and flood advice for the Site;
- Identification of on-site flood risk for design flood events, including the 10% AEP, 5% AEP, 1% AEP, 0.2% AEP, the Probable Maximum Flood (PMF), and a climate change scenario (increased rainfall intensity);
- Flood impact assessment comparing post-activity flood behaviour with existing flood conditions across all modelled events.

It is noted that the works completed are not inclusive of a Stormwater Management Plan for the Site (completed by others).

2.2 Site Description and Topography

The proposed activity is planned on an approximately 5 ha lot that is bordered by Armoury Road to the west, Charlie Street to the south, and open, cleared areas to the north and east. The study lot, hereafter referred to as "the Site", encompasses Lots 2 and 3 (DP 1248480) and provides a relatively spacious and undeveloped setting suitable for future activity. Currently, the Site boundary is characterised by cleared grass vegetation and includes several stormwater basins that manage local surface water runoff.

The on-site elevation varies from 18.4 mAHD at the surface of the existing stormwater basin to 23.7 mAHD in the south-west corner, as illustrated in Figure 2.1. It is understood that between 2011 and 2019 at least 3 m of fill (estimated from a comparison of available LiDAR datasets) was imported onto the Site as part of wider construction within the Jordan Springs suburb.

The Site is located within the catchment of the South Creek watercourse, a major tributary of the Hawkesbury River. The Site is also situated within the Central Precinct of the St Mary's Release Area, an area earmarked for growth within the Penrith City LGA.

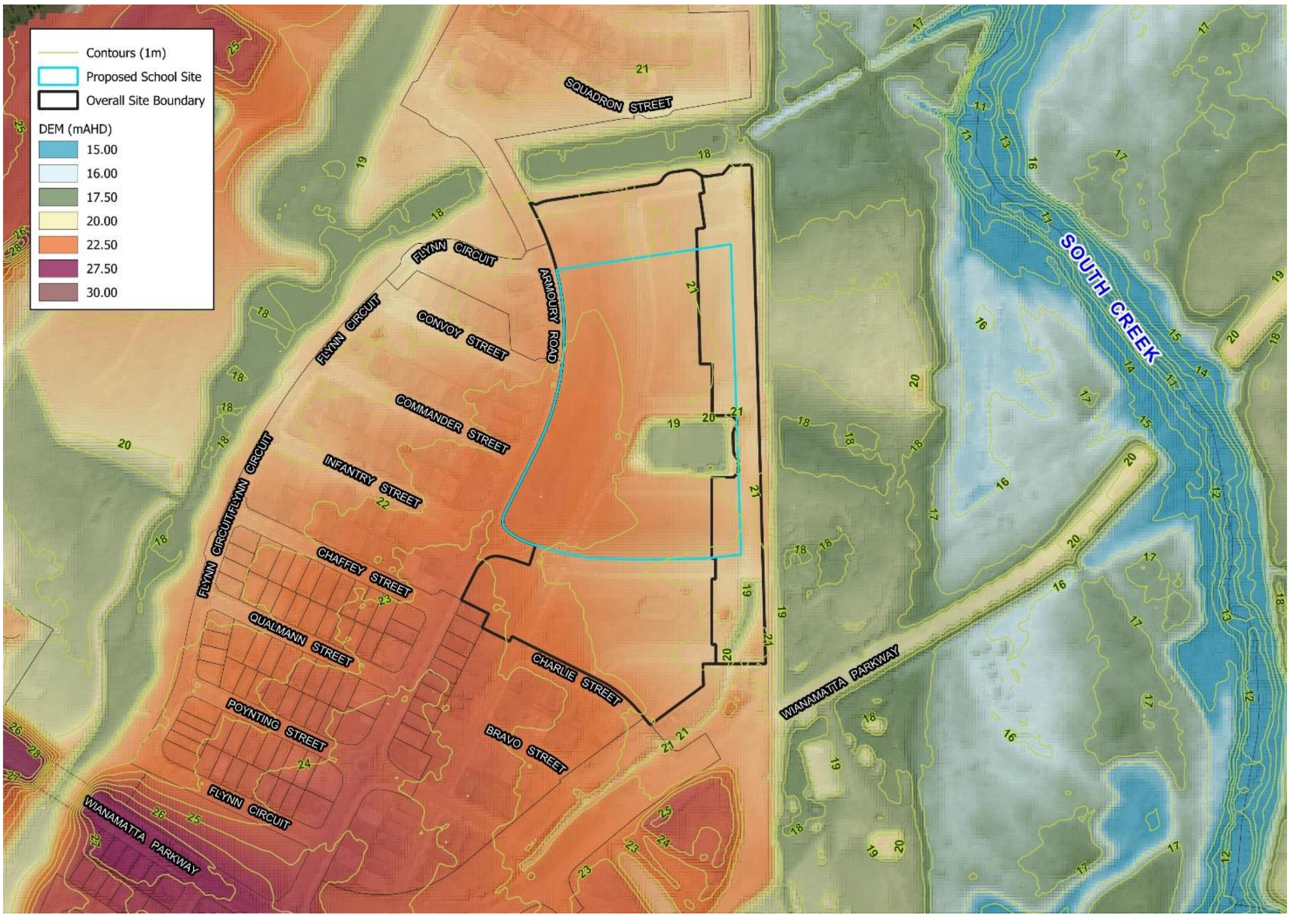


Figure 2.1 Site Location and Topography

2.3 Flood Mechanism and Existing Studies

Flooding at the Site is influenced by its position within the South Creek catchment, a major tributary of the Hawkesbury River, and by its topography. Regional (mainstream) flooding within this part of the catchment has been defined by the following studies:

- ‘Wianamatta South Creek Catchment Flood Study’ (INSW, 2022) prepared by Advisian (herein the “South Creek Flood Study”).
- ‘Hawkesbury-Nepean River Flood Study’ (NSWRA, 2024) (herein the “HN Flood Study”).

These flood studies do not include local catchment and overland flow flooding in the surrounding area of the Site. However, there is potential for flood risk associated with runoff originating from local catchments upstream of the Site. This flood mechanism is accounted for in the modelling undertaken for this assessment.

3 Existing Flood Conditions

3.1 Existing Regional (Mainstream) Flood Conditions

Existing mainstream flood conditions at the Site have been extracted from the South Creek Flood Study and HN Flood Study. Peak flood levels at the Site, as determined by these available studies, are summarised in Table 3.1 below.

Table 3.1 Peak Flood Levels at the Site from the South Creek Flood Study and HN Flood Study)

Design Flood Event	South Creek Flood Study (mAHD)	HN Flood Study (mAHD)
1 in 100 (1%) AEP	19.9	17.3
1 in 500 (0.2%) AEP	20.5	20.2
1 in 1000 (0.1%) AEP	Not Assessed	21.3
1 in 2000 (0.05%) AEP	Not Assessed	22.8
1 in 5000 (0.02%) AEP	Not Assessed	24.4
PMF	26.9	30.6

A comparison of the flood levels across the two studies indicates that for rare events (such as the 1% AEP), higher flood levels at the Site are predicted in the South Creek Flood Study when compared to the HN Flood Study. This indicates for rare events, higher flood levels are driven by flooding from the South Creek watercourse rather than Hawkesbury-Nepean backwater. However, the HN Flood Study predicts a significant increase in the predicted peak PMF flood level at the Site when compared to the South Creek Study, indicating that conditions are backwater dominant for very rare and extreme events.

It is not predicted that the Site will be inundated during events up to and including the 1 in 500 AEP event as a result of flooding from either South Creek or the Hawkesbury River. Mapping provided as part of the HN Flood Study indicates that the Site would be partially inundated from at least a 1 in 1000 AEP event, with several metres of inundation expected in a 1 in 5000 AEP event and significant flood depths expected in a PMF event (likely to be in excess of 6 m deep in some locations).

Annex A provides the regional (mainstream) flood conditions for the Site, extracted from the HN Flood Study.

3.2 Existing Local (Overland) Flood Model

As part of this assessment, BMT has developed a flood model to determine overland flood conditions for the catchment draining to South Creek within which the Site is located based on Australian Rainfall and Runoff 2019 (ARR 2019). This model was developed in line with the modelling methodologies adopted in the South Creek Flood Study.

Hydrologic Model Setup

A direct rainfall or rainfall-on-grid (ROG) hydraulic model was developed for the catchment draining to South Creek within which the Site is located, and has an approximate catchment area of 4km^2. The ROG hydraulic model included 2016 IFD (intensity-frequency-duration) design rainfall estimates developed by the Bureau of Meteorology (BoM).

ARR 2019 recommends the application of an Areal Reduction Factor (ARF) in the determination of the design rainfall estimates for a catchment contributing flows to a point of interest that is larger than 1km^2. The ARF is the ratio between the average rainfall occurring on a specific area and the point rainfall computed for the same duration and AEP. Given that the catchment is relatively small, any areal reduction in rainfall would also be small. A conservative ARF factor of 1 was therefore adopted for the assessment (in other words, no reduction in the rainfall depth was applied).

Rainfall losses for the study area were determined based on the 5-level hierarchical approach of rainfall losses for NSW catchments (as shown in Table 3.2). While using the loss parameters from Council's Flood Study is generally preferred, those values were designed for riverine flooding along South Creek with longer critical durations. Given that the current assessment focuses on local (overland) flooding with shorter durations, more conservative initial loss (IL) and continuing loss (CL) values were adopted based on Approach 5. The IL values used in the model range from 3.60 to 10.75, and CL values range between 0.9 to 1.2.

Table 3.2 Hierarchy of Loss Approach from Most (1) to Least Preferred (5)

Approach	Data to use	Storm Initial Loss	Pre-burst (transformational)	IL Burst	Continuing Loss
1	Current Study	Average Calibration	Not required or back calculated using $IL_{Storm} - IL_{Burst}$	Calculated using Equation 6*	Average Calibration
2	Other Studies within the Catchment	Average Calibration	Not required or back calculated using $IL_{Storm} - IL_{Burst}$	Calculated using Equation 6*	Average Calibration
3	Neighbouring Studies	Average Calibration	Not required or back calculated using $IL_{Storm} - IL_{Burst}$	Calculated using Equation 6*	Average Calibration
4	FFA (Flood Frequency Analysis)	NSW FFA reconciled initial loss	Not required or back calculated using $IL_{Storm} - IL_{Burst}$	Probability Neutral Burst Loss	NSW FFA reconciled continuing losses
5	ARR Data Hub	ARR Data Hub initial loss	Not required or back calculated using $IL_{Storm} - IL_{Burst}$	Probability Neutral Burst Loss	ARR Data Hub continuing losses multiplied x 0.4

*** Equation 6 as found in 'Review of ARR Design Inputs for NSW' (OEH, 2019)**

Hydraulic Model Setup

To facilitate the assessment, the following datasets were provided by others (as listed below) or obtained from publicly available sources:

- Aerial imagery of the study area;
- Reports and flood results from the South Creek Flood Study and the HN Flood Study;
- Existing Site survey prepared by Astrea (ref: "A4307-Topo&Util-A.dwg") in April 2024;

- Proposed layout of the project provided by TTW (ref: “JSHS-DJRD-00-00-DR-A-0101(P03)_SITE PLAN.pdf” issued on 12 November 2024);
- Proposed ground level design provided by TTW (ref: “Design tin.dwg” issued on 29 October 2024);
- Digital Elevation Model (DEM) in 1 m and 5 m resolution tiles based on LiDAR aerial survey obtained in 2019 by the NSW Government, available from the ELVIS webpage (https://elevation.fsdf.org.au/);
- Cadastral information and hydrolines (watercourses) from SIX Maps (https://maps.six.nsw.gov.au/clipnship.html);
- BoM 2016 design rainfalls (http://www.bom.gov.au/water/designRainfalls/revised-ifd/); and
- Storm losses and temporal patterns for design rainfalls from ARR Data Hub (https://data.arrsoftware.org/).

The hydraulic model was developed to cover both upstream catchments draining to the Site and the downstream catchment discharging to South Creek, with the model extent aligning predominantly with the western (upstream) catchment area. The TUFLOW HPC software package was used to run the simulations, with a 5m grid cell size applied to balance representation of topographic features and model simulation time. This setup aimed to provide reasonable run times and enhanced resolution across the model, particularly around the study area.

Hydraulic roughness zones (e.g. urban, forested areas, cleared land or vegetated areas) were informed mainly by inspection of aerial photography. Manning’s ‘n’ values from the South Creek Flood Study were adopted for this assessment. The majority of the catchment is covered by natural grassland interspersed by trees. A hydraulic roughness value of 0.05 was adopted for the main floodplain areas. A summary of the adopted Manning’s ‘n’ hydraulic roughness is provided in Table 3.3.

Table 3.3 Adopted Manning’s ‘n’ Hydraulic Roughness

Catchment Surface Type	Manning’s ‘n’
Grassed Floodplain	0.050
Lightly vegetated creek channel	0.055
Clear creek channel or watercourse	0.035
Moderately vegetated creek channel	0.100
Heavily vegetated creek channel	0.120
Floodplain with moderate coverage of trees	0.080
Floodplain with dense trees	0.120
Urban Floodplain	0.040
Industrial Development	0.090
Roadways	0.015
Buildings	1.000

Model inflows include runoff generated as part of the ROG input. A stage-discharge boundary (denoted as HQ), that is automatically generated by TUFLOW using the bed slope of the watercourse, was applied at the outlet of the model on South Creek, .

Key drainage structures, such as culverts and bridges, were included in the TUFLOW model based on information provided in the South Creek Flood Study, aerial imagery or google street view inspection. The existing on-site and local stormwater system is conservatively not included within the model, and it is assumed that all rainfall will discharge overland. Initial water levels were not specified for waterbodies within the study area, including the lake. Base levels for the lake and other waterbodies were derived from LiDAR data.

The locations of the boundary conditions are shown in Figure 3.1, along with an overview of the hydralic model setup.

Critical Duration Assessment

As per ARR 2019 recommendations, an ensemble of ten temporal patterns for each duration has been modelled for each AEP design flood event as part of the assessment herein. The ten temporal patterns vary in terms of their distribution and variability (comprising front, middle and back loaded storms) and can result in a wide range of flooding behaviour within the catchment.

The procedures for ARR 2019 provide for the selection of the temporal pattern that gives the peak flow closest to the mean of the peak flows from all ten temporal patterns. This method was followed to find the critical temporal pattern for each storm duration. A critical storm duration assessment was then undertaken to establish the critical storm duration that produces the highest mean peak flow at the study area across the modelled storm durations. A summary of the critical storm duration at the Site for each AEP design storm event is presented in Table 3.4.

Local PMF flood conditions were determined based on the procedures outlined in *‘The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method’* (BoM, 2003).

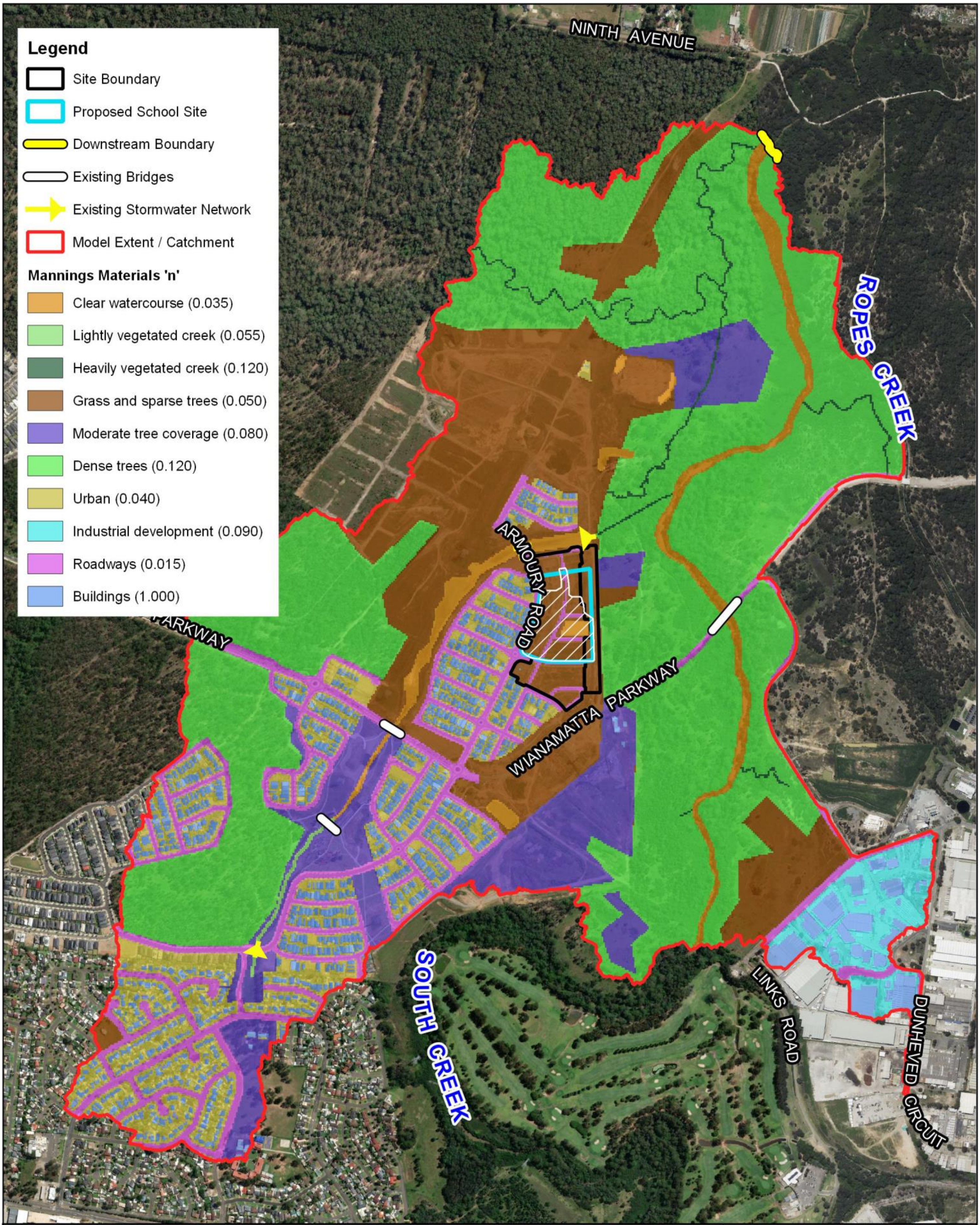
Table 3.4 Critical Storm Duration

Design Event (AEP)	Storm Duration (min)
10%	60-min, TP-4563
5%	60-min, TP-4573
1%	90-min, TP-4395
0.2%	90-min, TP-4395
PMF	15-min

Climate Change Scenario

The ‘Flood Risk Management Manual’ (DPE, 2023) and associated Guideline LU01 (Flood Impact and Risk Assessment) recommend including a climate change assessment to understand and mitigate potential future impacts. This assessment uses the SSP2-4.5 climate scenario, a widely recognised intermediate scenario developed by the Intergovernmental Panel on Climate Change (IPCC). This scenario assumes moderate emissions reductions, projecting a long-term warming trend that assess future flood risks under anticipated climate conditions.

The hydraulic model has been used to simulate existing flood conditions for the 10% AEP, 5% AEP, 1% AEP, 0.2% AEP events, one climate change scenario, and the PMF event. A flood depth filter has been applied to remove flood depths less than 0.015m from all results.



Title:

Local (Overland) - Hydraulic Flood Model Setup

Figure: **3.1**

Rev: **A**

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

0 300 600 m

BMT
www.bmt.org

Filepath: S:\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\Main_Report.qgz

3.3 Existing Local (Overland) Flood Conditions

The existing local flood modelling results for the 10% AEP, 5% AEP, 1% AEP, 0.2% AEP, 1% AEP with Climate Change and PMF events are attached in Annex B and presented as follows:

- Peak flood depths and level contours for existing conditions – Figures B-01 to B-05 (Annex B);
- Peak flood velocities for existing conditions – Figures B-06 to B-10 (Annex B); and
- Peak flood hazard for existing conditions – Figures B-11 to B-15 (Annex B).

The Site is situated on elevated ground, with most of the local catchment draining into tributaries that flow into South Creek, minimising the extent of flow directed toward the Site. As a result, flood conditions are generally minimal across most of the Site. During the 1% AEP event, shallow flood depths of approximately 0.15 m are predicted in limited areas, with peak flood velocities localised and generally less than 0.4 m/s. Some flow concentration occurs in the south-eastern corner of the Site due to a flow path originating from Wianamatta Parkway, which directs runoff south-east towards the road between the Site and open grassland adjacent to South Creek.

4 Post-Activity Flood Conditions

4.1 Proposed Activity

The project scope of works includes two (2) Scenarios, to allow construction and operation of the school, with (Scenario 1 – preferred option) or without (Scenario 2 – Interim Solution) the public domain works and permanent off-site basin being constructed by others under a separate planning pathway.

Scenario 1 – Preferred Option - Road Network completed and permanent OSD Basin Constructed

- External works undertaken by others to facilitate Scenario 1
  - Construction of Park Edge Road;
  - Any adjustments to Infantry Street;
  - Kiss and drop zone along Park Edge Road;
  - Support kiss and drop zone located along Infantry Street; and
  - Construction and operation of permanent OSD Basin off site.

Note – Scenario 1 is not to proceed if external works undertaken by others is not completed.

- Scenario 1
  - Construction and Operation of the New High School for Jordan Springs, including:
    - Decommissioning of existing on-site OSD basin;
    - Demolition of roads and associated services within the site boundary;
    - Tree removal within the site boundary;
    - Earthworks;
    - Three (3) multi-storey classroom buildings;
    - One (1) school hall;
    - Three (3) outdoor sport’s courts;
    - One (1) sport’s field;
    - 72 at grade car parking spaces, including two (2) accessible parking spaces, and waste services, accessed via Park Edge Road;
    - 100 bicycle parking spaces across the site; and
    - Landscaping.

Scenario 2 - Interim Solution – Road network not completed, Permanent OSD Basin not constructed.

- Scenario 2 - Stage 1
  - Construction and operation of a temporary on-site OSD Basin;
  - Construction and operation of the New High School for Jordan Springs, including;
    - Demolition of roads and associated services within the site boundary;
    - Tree removal within the site boundary;
    - Earthworks;
    - Three (3) multi-storey classroom buildings;
    - One (1) sport's field;
    - Temporary carpark - 72 at grade car parking spaces, including two (2) accessible parking spaces and waste services, located on the north-west corner of the site, accessed off Armoury Road;
    - 100 bicycle parking spaces across;
    - Temporary Kiss and drop facilities on Armoury Road; and
    - Associated landscaping.
- Scenario 2 – Stage 2

  Stage 2 is not to be undertaken until the temporary on-site OSD basin under Stage 1 works is completed and operational.

  - Decommissioning of existing on-site OSD basin, prior to the following works being undertaken:
    - 72 at grade car parking spaces, including two (2) accessible parking spaces, and waste services, located on the south-east corner of the site. This car park cannot be constructed until the decommissioning of the existing OSD basin is completed and will be non-operational with no road connection until completion of Scenario 2 – Stage 3;
    - One (1) school hall;
    - Three (3) outdoor sport's courts; and

  External works undertaken by others to facilitate Stage 3

  - Construction of Park Edge Road;
  - Any adjustments to Infantry Street;
  - Kiss and drop zone along Park Edge Road;
  - Support kiss and drop zone located along Infantry Street; and
  - Construction and operation of OSD Basin off site.

Note – Scenario 2 - Stage 3 is not to proceed until the external works undertaken by others have been completed.

- Scenario 2 – Stage 3
  - Connection of the south-east carpark to Park Edge Road;
  - Rectification works along Armoury Road to remove temporary kiss and drop facilities and cross over for temporary carpark;
  - Demolition of temporary carpark, once permanent car park is operational; and
  - Decommissioning of temporary OSD basin.

The proposed activity has been considered under two scenarios:

- Scenario 1 – the Preferred Option, where the road network is completed (as shown in Figure 4.1) and the permanent OSD basin is constructed; and
- Scenario 2 – the Interim Solution (as shown in Figure 4.2), where the road network and permanent OSD basin are not yet completed.

It is noted that flood modelling is based on Scenario 1, since it represents the final, fully developed stage of the project. Scenario 2 differs mainly in the use of a temporary OSD basin and car parking, but by Stage 3, conditions will align with Scenario 1. Therefore, no additional flood modelling is required for Scenario 2, as the flood impact is assessed based on the completed infrastructure in Scenario 1.

The proposed activities were modelled in TUFLOW based on Scenario 1, using the site layout provided by TTW, as shown in Figure 4.1 (ref: “JSHS-DJRD-00-00-DR-A-0101(P03)_SITE PLAN.pdf” issued on 12 November 2024).

4.2 Post-activity Regional (Mainstream) Flood Conditions

Additional modelling for post-activity regional (mainstream) flood conditions has not been assessed at the Site because the proposed activities do not significantly alter the floodplain or affect the flow characteristics of the regional flood conditions for all events up to and including the 1 in 500 AEP flood event for both South Creek and Hawkesbury River flood conditions. The minimum nominated finished floor level of 22 mAHD for the Building D Hall would place it at least 0.5 m above the predicted 1 in 1000 AEP Hawkesbury-Nepean River flood level.

Flood emergency management requirements at the Site for mainstream flood conditions are outlined in Section 7.1.

4.3 Post-activity Local (Overland) Flood Model

The proposed activities were incorporated into the TUFLOW hydraulic model as part of the post-activity scenario modelling whereby:

- The hydraulic roughness and associated rainfall losses were adjusted to match the change in surface.
- Proposed earthworks were incorporated into the post-activity scenario modelling as per the design provided by TTW (ref: “Design tin.dwg” issued on 29 October 2024). The change in ground levels for the activity is shown in **Error! Reference source not found.**.

This hydraulic model has been used to simulate the post-activity flood conditions for the 10% AEP, 5% AEP, 1% AEP, 0.2% AEP events, one climate change scenario, and the PMF event. A flood depth filter of less than 0.015m has been applied to all results. The flood impact assessment results are discussed in the following section.

It is noted that the proposed activity area does not contribute to model inflows for both existing and post-activity scenarios (i.e. it has been removed from the rainfall-on-grid input, and rainfall is excluded within its boundaries). It is assumed that rainfall falling on the proposed activity area will be managed via the site stormwater management plan, whereas the focus of this assessment is on potential local catchment flood impacts associated with the activity works.

A sensitivity was undertaken as part of this flood assessment with the proposed activity areas included in both the existing and post-activity scenarios and an impact assessment undertaken. The sensitivity indicated that the activity would result in minor off-site flood level increases to the area to the east discharging into South Creek, primarily due to the raising of local elevations and flattened areas on Site. However, as noted in Section 3.2, the flood model conservatively does not include on-site or local stormwater systems under either scenario which would likely cater for this minor increase in run-off. If necessary, confirmation of local runoff can be confirmed at a later design stage.

4.4 Post-Activity Local (Overland) Flood Conditions

The post-activity local flood modelling results for the 10% AEP, 5% AEP, 1% AEP, 0.2% AEP, 1% AEP with Climate Change and PMF events are attached in Annex C and presented as follows:

- Peak flood depths and level contours for post-development conditions – Figures C-01 to C-05 (Annex C);
- Peak flood velocities for post-activity conditions – Figures C-06 to C-10 (Annex C); and
- Peak flood hazard for post-activity conditions – Figures C-11 to C-15 (Annex C).

The Site is situated on elevated ground, with most of the local catchment draining into tributaries that flow into South Creek, minimising the extent of flow directed toward the Site. As a result, flood conditions are generally minimal across most of the Site.

DATE PRINTED: 12/11/2024 11:09:58 AM

ISSUE	DATE	SUBJECT	AUTHORISED
P01	25/10/2024	FOR COORDINATION	TD
P02	01/11/2024	FOR COORDINATION	TD
P03	11/11/2024	FOR COORDINATION	TD

LANDSCAPE ARCHITECT: SITE IMAGE

PROJECT MANAGER: TSA Riley

CLIENT: NSW Government Education School Infrastructure

SERVICES: STEENSEN VARMING

STRUCTURE & CIVIL: TTW

ARCHITECT: djrd architects

NOTES

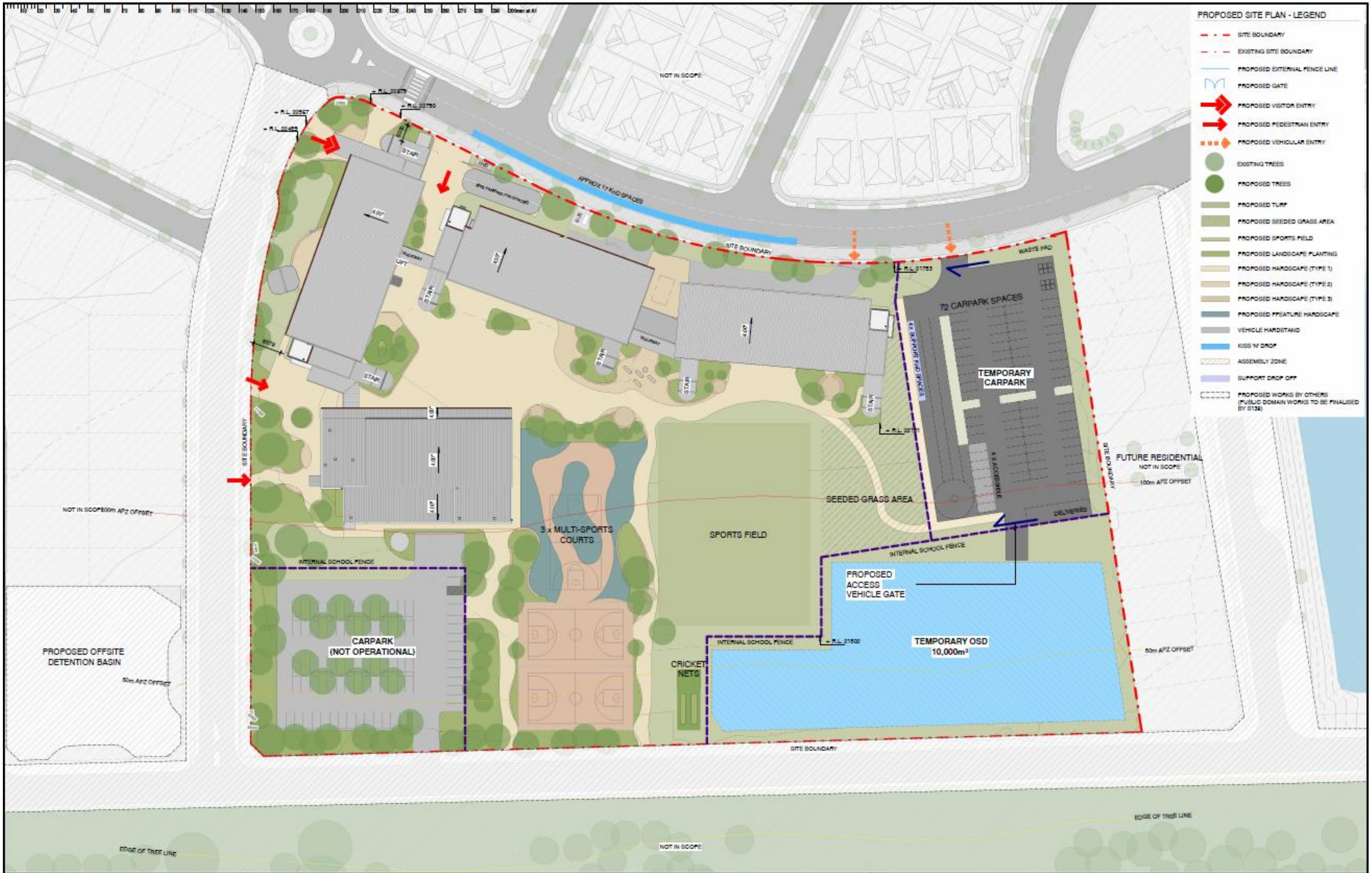
PROJECT: JORDAN SPRINGS HIGH SCHOOL
Armoury Road, Jordan Springs NSW 2747

SCALE: As indicated — 1:100

DESCRIPTION: SITE PLAN

PROJECT No	DRAWING No	REVISION
24 410	JSHS-DJRD-00-00-DR-A-0101	P03

PURPOSE OF ISSUE	STATUS	DRAWN BY	SHEET SIZE	ORIGIN DATE
SCHEMATIC DESIGN	S1	CT	A1	25/10/24



ISSUE	DATE	SUBJECT	AUTHORISED
P01	03/12/2024	REVISED STAGING FOR INFORMATION	TD
P02	03/12/2024	REVISED STAGING FOR INFORMATION	TD
P03	05/12/2024	REVISED STAGING FOR INFORMATION	TD

LANDSCAPE ARCHITECT: SITE IMAGE
PROJECT MANAGER: TSA Riley
CLIENT: NSW Government Education School Infrastructure
SERVICES: STEENSEN VARMING; WSce
STRUCTURE & CIVIL: TTW
ARCHITECT: djrd architects

DISCLAIMER
This drawing should be read in conjunction with all the standard notes & abbreviations in the drawing pack, relevant contracts, specifications and drawings. Dimensions are in millimetres. Levels are metres. Do not scale off drawings. Use figured dimensions only. Check dimensions on Site. Report discrepancies immediately.

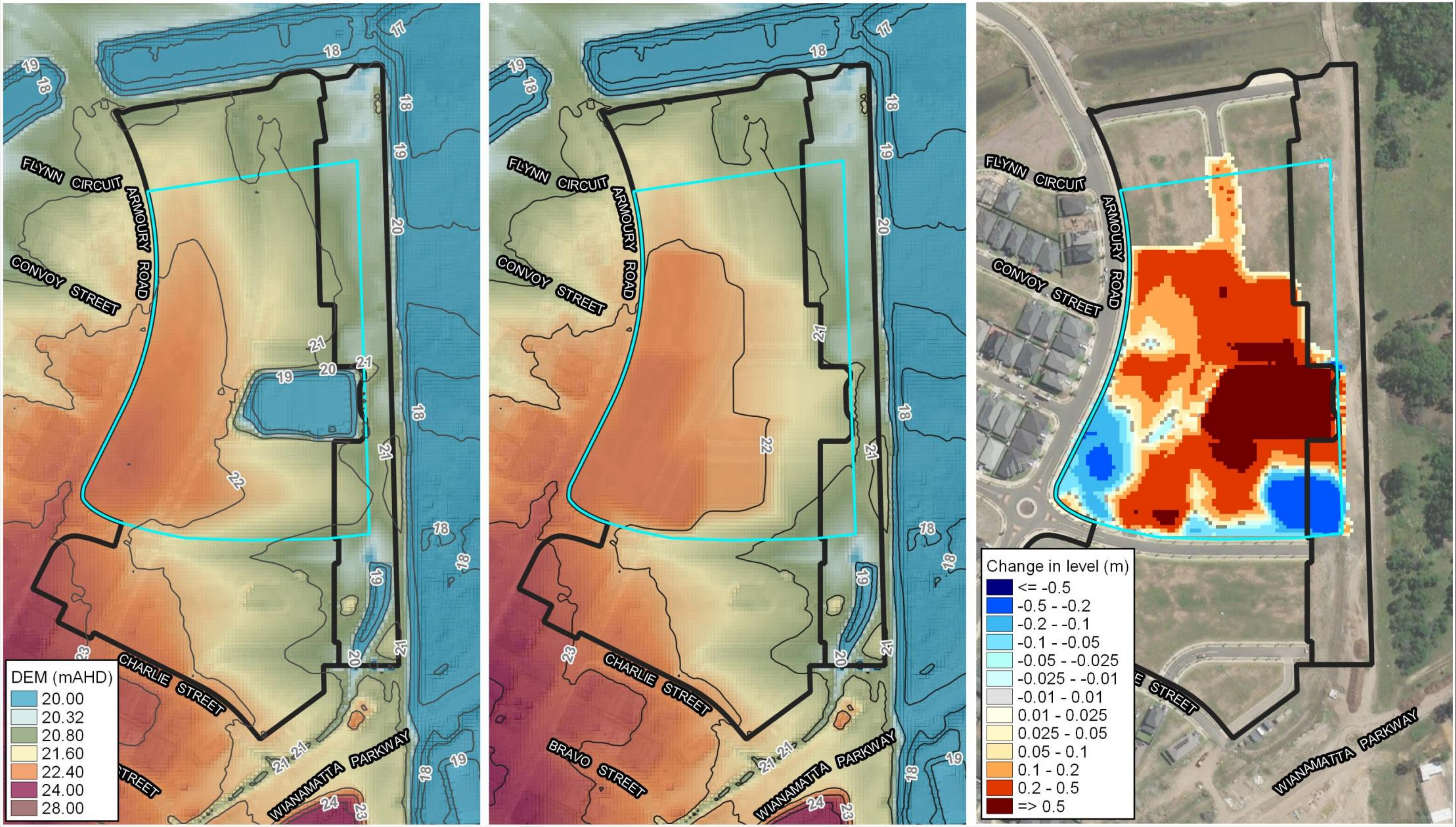
PROJECT
NEW HIGH SCHOOL FOR JORDAN SPRINGS
Armoury Road, Jordan Springs NSW 2747

SCALE: As indicated @ A1 (1:500)
DATE PRINTED: 5/12/2024 5:02:16 PM

DESCRIPTION
SCENARIO 2 STAGE 1 & 2 OPERATIONAL

PROJECT No	DRAWING No	REVISION
24 410	JSHS-DJRD-00-00-DR-A-0506	P03

PURPOSE OF ISSUE	STATUS	DRAWN BY	SHEET SIZE	ORIGIN DATE
FOR INFORMATION	S2	AL		10/02/24



Legend

Proposed School Site

Overall Site Boundary

Title:

Change in Ground Levels between Proposed Activity and Existing Flood Model

Drawing: 4.3

Rev: -

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

0 0.025 0.05 0.075 0.1 km

BMT

www.bmt.org

Filepath: S:\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\Main_Report_FIRA.qgz

5 Predicted Changes in Peak Flood Conditions

5.1 Flood Impact Mapping

The proposed activity has been considered in terms of potential adverse impacts on existing (baseline) local (overland) flood behaviour. Modelling results were used to assess and map the relative flood impacts of the proposed activity (i.e. peak flood levels from the post-activity scenario minus peak flood levels from the existing scenarios). Peak local overland flood impact mapping for the 10% AEP, 5% AEP, 1% AEP, 0.2% AEP, 1% AEP with Climate Change and PMF is shown in Annex D, as follows:

- Peak flood level impacts for post-activity conditions – Figures D-01 to D-05 (Annex D); and
- Peak flood velocity impacts for post-activity conditions – Figure D-06 to D-10 (Annex D).

The maps identify areas where:

- Flooding previously occurred in the existing scenario model but no longer occurs in the post-activity scenario model (referenced “was wet now dry”);
- Flooding now occurs in the post-activity scenario model which was previously not flooded in the existing scenario model (referenced “was dry now wet”); and
- Extent and degree of change in the peak water levels / velocities.

A summary of the impacts are discussed below and are limited to local (overland) flood behaviour.

5.2 Peak Flood Depth and Level Impacts

The existing flood conditions indicate that the Site is affected by shallow overland flooding, with depths under 0.15 m during events up to and including the 1% AEP Climate Change scenario. A local overland flow path influences the southern part of the Site, channelling from the southwest to the north-east and slightly impacting the Site's north-east boundary. In the PMF event, the low point of this flow path reaches depths of up to 0.5 m, causing inundation along the road on the southern portion of the Site.

Under post-activity flood conditions, there are no off-site impacts predicted across all events up to and including the PMF within the local (overland) flood conditions. An increase of up to 0.1 m is noted along the proposed new road adjacent to the eastern boundary, though this remains within the overall Site boundary. Table 5.1 shows the reporting locations and the peak flood levels are shown in Figure 5.1.

Table 5.1 1% AEP Event Post-Activity Peak Flood Conditions at Reporting Locations – Local (Overland) Flooding

Reporting Location	Post-Activity Flood Conditions – 1% AEP Event		
	Peak Depth (m)	Peak Level (mAHD)	Peak Velocity (m/s)
A	0.17	20.93	0.04
B	0.02	21.36	0.44
C (Building C)	0.02	21.97	0.19
D (Building B)	0.02	22.30	0.10

Reporting Location	Post-Activity Flood Conditions – 1% AEP Event		
	Peak Depth (m)	Peak Level (mAHD)	Peak Velocity (m/s)
E	0.02	22.60	0.12
F (Building A)	0.02	22.30	0.22
G (Building D)	0.03	21.45	0.75
H	0.19	20.87	0.10
I	0.98	20.87	0.56
J	0.08	20.87	0.01
K	0.04	20.92	0.03
L	0.09	20.50	0.20
M	0.09	20.64	0.01
N	0.02	21.05	0.14

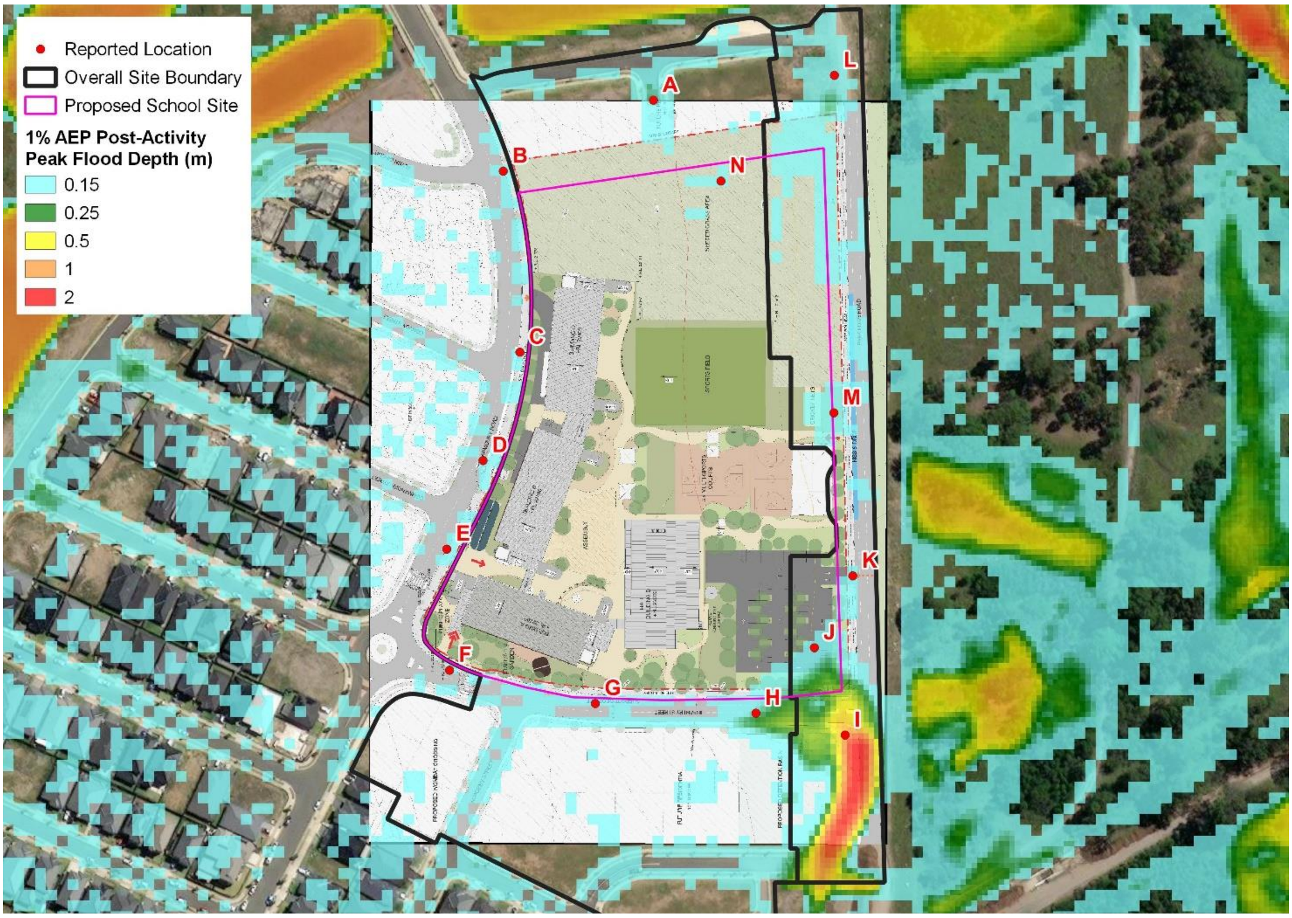


Figure 5.1 Reporting Locations

Table 5.2 provides a comparison of the proposed finished floor levels (FFLs) for the buildings on the Site with planning flood levels, as well as flood levels for the 1% AEP, 1% AEP climate change, and PMF events. All building FFLs are positioned above the local (overland) PMF flood levels.

Table 5.2 Comparison of Proposed Finished Floor Levels and Post-Activity Overland Flood Levels – Local (Overland) Flooding

Location	Proposed FFLs (mAHD)	1% AEP Level (mAHD)	1% AEP with Climate Change Level (mAHD)	PMF Level (mAHD)
Building A	22.7	22.30	22.31	22.38
Building B	22.7	22.30	22.31	22.35
Building C	22.4	21.97	21.98	22.00
Building D	22.0	21.45	21.47	21.59

5.3 Peak Flood Velocity Impacts

The existing flood conditions show that the Site is generally impacted by low flood velocities, with only slight variations observed across the Site. However, higher velocities are present along the internal roads on the southern portion of the overall Site. These higher velocities are limited to the southern section and do not significantly impact the remainder of the Site.

In the post-activity flood conditions, similar low velocities are expected across the Site. An increase in velocity impact is shown in the PMF event, however, these increases are not expected to cause any adverse impacts, as they remain within the overall Site boundary.

5.4 Peak Flood Hazards

The Australian Institute of Disaster Resilience (AIDR) classifies flood hazard into six categories as part of its best practice approach to flood risk management (AIDR, 2017). This method is consistent with the classification in the 'Flood Risk Management Manual' (NSW Government, 2023) and divides the floodplain into six distinct hazard classifications (H1 to H6), as shown in Figure 5.2. These hazard classifications are based on adopted thresholds of flood depth, velocity and depth-velocity product that identify when flood conditions are likely to present a risk to people, vehicles and buildings. A description of each hazard threshold is provided in Table 5.3.

Under both existing and post-activity conditions for local (overland) flooding, the majority of the Site (overall site boundary) falls within H1 hazard classification across all events, up to and including the PMF. This indicates low hazard levels with minimal risk to people and property in most areas of the Site.

Within the proposed school site, the peak flood hazard is H3 which is located within the proposed landscaping area between Infantry Street and the proposed carpark. A minor area of the south-east portion of the proposed carpark is located within an H2 hazard (unsuitable for small cars) whilst the exit location onto Park Edge Road is classified as an H1 hazard.

Within the overall site boundary, there are higher hazards (H4-H5) located along the channel at the south-east corner due to an active flow path during the PMF event. These hazards suggest increased risks in this area, where floodwaters during the PMF may present dangers to safety and stability due to either higher velocities and flood depths (or both). This location sits outside of the proposed school site. It is also noted that this area does not include local drainage features, and in reality ponding of water may be offset by local pit and pipe and culvert systems as part of the wider site stormwater management plan.

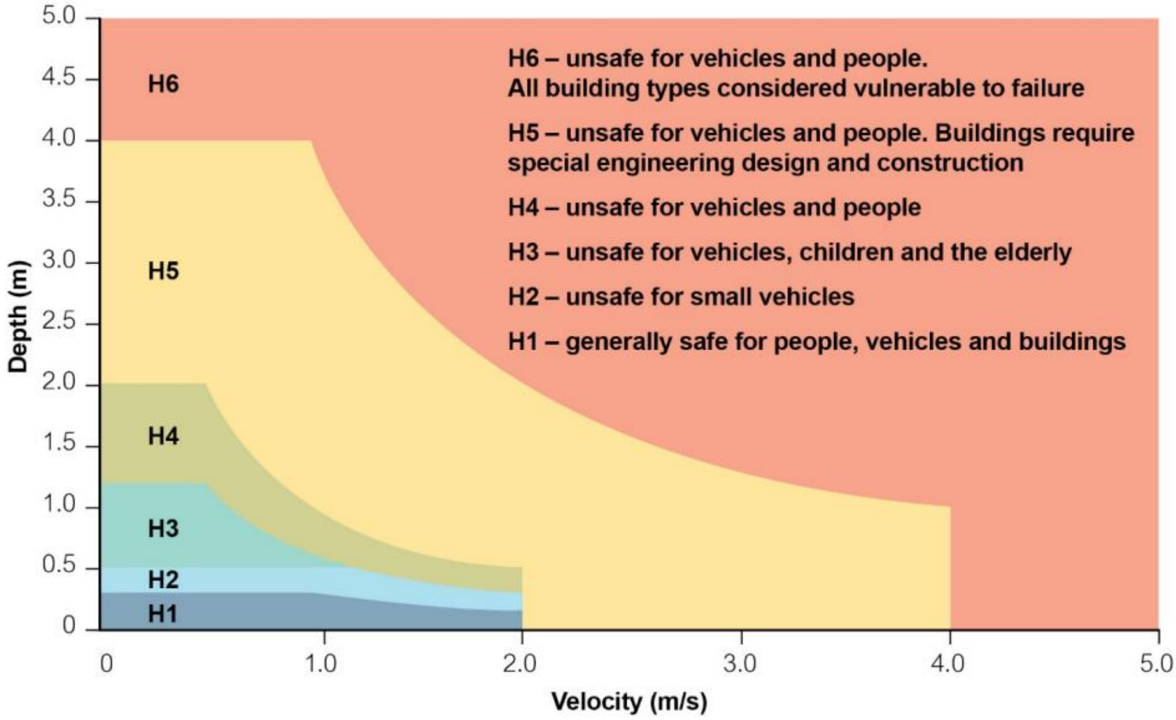


Figure 5.2 AIDR (2017) Flood Hazard Classification System

Table 5.3 Combined Hazard Curves – Vulnerability Threshold Classification Limits (AIDR, 2017)

Hazard Classification	Description	Classification limit (D and V in combination) m^2/s	Limiting still water depth (D) m	Limiting velocity (V) m/s
H1	Generally safe for vehicles, people and buildings	D*V ≤ 0.3	0.3	2.0
H2	Unsafe for small vehicles	D*V ≤ 0.6	0.5	2.0
H3	Unsafe for vehicles, children and the elderly	D*V ≤ 0.6	1.2	2.0
H4	Unsafe for vehicles and people	D*V ≤ 1.0	2.0	2.0
H5	Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure	D*V ≤ 4.0	4.0	4.0
H6	Unsafe for vehicles and people. All building types considered vulnerable to failure	D*V > 4.0	-	-

6 Compliance with Flood Management Guidelines

6.1 Overview

This section provides a review of NSW flood-related development controls and guidelines that have been considered in the preparation of the flood risk and impact assessment.

6.2 Flood Risk Management Manual

The ‘Flood Risk Management Manual’ sets out 10 principles for Flood Risk Management as follows:

- Principle 1 Establish sustainable governance arrangements;
- Principle 2 Think and plan strategically;
- Principle 3 Be consultative;
- Principle 4 Make flood information available;
- Principle 5 Understand flood behaviour and constraints;
- Principle 6 Understand flood risk and how it may change;
- Principle 7 Consider variability and uncertainty;
- Principle 8 Maintain natural flood functions;
- Principle 9 Manage flood risk effectively; and
- Principle 10 Continually improve the management of flood risk.

The undertaking of a detailed flood assessment for the proposed activity contributes towards achieving Principles 1-7.

In regard to Principle 8, the proposed activity area is predominantly affected by low-hazard overland flows. The natural flood function affecting the proposed activity area is broadly low hazard flood fringe. This behaviour will be maintained under post-activity flood conditions.

In regard to Principles 9 and 10, the proposed activity will be located in areas affected by low-hazard overland flooding for all events up to and including the 1% AEP Climate Change scenario. Effective management of current and future flood risk for the proposed activity for all events up to and including the PMF can be achieved through existing flood controls and consideration of Flood Emergency Management Planning. A FERP (a separate document) has been developed for the Site with consideration of flooding for all events up to and including the local overland PMF and mainstream regional PMF.

6.3 Part 5 of the Environmental Planning and Assessment Act 1979

The flood-related risks for proposed activities are assessed in accordance with Part 5 of the Environmental Planning and Assessment Act 1979. Table 6.1 below has been prepared with direct reference to the Guidelines for Division 5.1 Assessments and outlines how the proposed activities comply with these requirements.

Table 6.1 Division 5.1 Requirements

Guideline Requirements	BMT Comment
Consider any long-term effects on the environment (including flood).	These requirements have been addressed as part of this FIRA. The report includes detailed flood modelling and mapping for a range of flood events including the 10% AEP, 5% AEP, 1% AEP, 0.2% AEP, 1% AEP with climate change and PMF event. The flood risk assessment considers the relevant adopted flood studies, addresses the potential impacts of climate change, and aligns with the provisions set out in the Flood Risk Management Manual (DPE, 2023). The results indicate that the proposed activity will be subject to low hazard flooding for all events up to and including the 1% AEP Climate Change scenario.
Consider any risk to the safety of the environment (including runoff patterns, flooding regimes)	Potential flood impacts associated with the activity are discussed in Section 5.2. The proposed activities are not predicted to result in any off-site flood impacts. The hydraulic model assumes that all rainfall within the proposed activity area will be managed on-site through the Site's Stormwater Management Plan (not part of this assessment), preventing any increase in off-site runoff due to the proposed activity

7 Planning Consideration

7.1 Mitigation Measures

A summary of mitigation measures are shown in Table 7.1.

Table 7.1 Flood Risk Mitigation Measures

Mitigation Type	When Mitigation Measure is to be Complied with	Mitigation Measure	Reason for Mitigation Measure
Elevated Finished Floor Levels	During the design and construction phase	Ensure all proposed building floor levels are elevated above the local overland PMF level, as detailed in Table 5.2 of this report.	Minimises the risk of flood damage to the proposed school buildings and ensures the safety of occupants during extreme events.
Flood Emergency Response Plan	Continuously, with updates based on flood risk assessments	Develop and maintain a Flood Emergency Response Plan (FERP) with risk management priorities and coordination with SES.	Ensures a systematic, proactive approach to managing flood risks and minimising impacts on school operations and safety – see Section 7.2.
Stormwater Management Plan (completed by others)	During site design, construction, and operation	Ensure that all rainfall falling on the development area is managed within the boundaries of the Site via a Stormwater Management Plan. This includes treatment and conveyance systems designed to prevent impacts to surrounding areas.	Prevents local overland flooding or adverse impacts to surrounding areas by managing rainfall on-site (excluded from this flood assessment).

7.2 Flood Emergency Response Plan

The Flood Emergency Response Plan (FERP) for the JSHS has been developed with a risk management priority system.

For local (overland) flooding, the proposed buildings will have finished floor levels elevated above the PMF level (as shown in Table 5.2), and in a worst-case extreme event, total site inundation is expected to last less than an hour

For very rare and extreme regional (mainstream) flooding events, where both prolonged warning times and potential extended isolation periods are likely, the recommended emergency response is school closure (Priority 1). This is based on forecast locations and levels of service for the Hawkesbury-Nepean River Valley, specifically monitoring the Windsor Gauge. According to the FERP assessment, there should be sufficient warning time provided by the BoM to close the school before students arrive. It is also recommended that closure of the school be considered in response to the issue of severe thunderstorm or emergency storm warnings in coordination with the NSW State Emergency Service (SES) to offset the possibility of school operation during a local catchment PMF event.

If school closure cannot occur prior to the school day, the secondary emergency management strategy is an off-site evacuation (Priority 2), to be carried out before floodwaters affect evacuation routes or buildings. The recommended evacuation route is along Armoury Road, Wianamatta Parkway, Lakeside Parade, and Jordan Springs Boulevard, leading to The Northern Road and then onto the final nominated evacuation centre.

Further details are provided in the FERP (provided in a separate document).

7.3 Evaluation of Environmental Impacts

The evaluation of environmental impacts considers the potential effects of the proposed activities on the Site and surrounding areas, with a focus on flood behaviour and long-term environmental sustainability. This assessment has considered for both the existing and post-activity conditions, factoring in local overland flooding and potential climate change impacts.

While Scenario 2, which includes a temporary OSD basin and additional car parking, was not modelled, it is expected that the flood impact during the interim stages will be temporary and localised, with conditions aligning closely with those predicted for the ultimate post-activity conditions associated with Scenario 1 (final stage) once the permanent infrastructure is in place.

Based on the findings from Scenario 1, the proposed activities are not expected to significantly alter flood behaviour or lead to adverse flood-related environmental consequences off-site. Overall, the proposed activities align with sustainable environmental management practices, with minimal disruption to existing conditions and flood regimes.

8 Recommendations

This report documents the Flood Impact and Risk Assessment (FIRA) prepared to support the Review of Environmental Factors (REF) for the construction and operation of the new High School for Jordan on behalf of the Department of Education (DoE). The assessment, conducted under Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act) and the State Environmental Planning Policy (Transport and Infrastructure) 2021 (SEPP TI), follows guidelines set forth by the Department of Planning, Housing, and Infrastructure.

For regional (mainstream) flooding, additional modelling for post-activity conditions was not conducted as the proposed works does not alter the regional floodplain or flow characteristics for South Creek and Hawkesbury River events up to and including the 1 in 500 AEP flood event. The finished floor level (FFL) for Building D Hall is set at 22mAHD, providing an additional safety margin of at least 0.5m above the 1 in 1000 AEP flood level for the Hawkesbury-Nepean River.

BMT developed a flood model to assess overland flooding in the catchment draining to South Creek, following the ARR 2019 guidelines and consistent with South Creek Flood Study methodologies. Local (overland) model results show minimal flood impacts across most areas of the Site, with only shallow localised flood depths of approximately 0.15 m occurring in isolated low-lying zones during the 1% AEP event. The majority of the Site falls within H1 hazard classification, indicating low risk to people and property, while the low point adjacent to the south-east corner experiences higher hazard levels (H4-H5) due to an active flow path during the PMF event, though potential risks are mitigated by local stormwater management systems.

Under post-activity flood conditions, no off-site impacts are predicted for all events up to and including the PMF with flood velocities remaining low across the Site. The report also compares the proposed activity with flood management guidelines and outlines relevant planning considerations. The findings indicate that the proposed activity is not expected to significantly alter flood behaviour or cause adverse environmental impacts off-site.

As part of the mitigation measures, a Flood Emergency Response Plan (FERP) (provided in a separate document) has been prepared for the New High School for Jordan Springs, outlining the actions to be taken in the event of flooding. The FERP focusing on minimising risks to the safety of Site occupants and ensuring a timely response to extreme flood events.

References

Australian Institute for Disaster Resilience (AIDR) (2017). *Australian Disaster Resilience Guidelines: Guidelines for the Development of a Flood Emergency Management Plan*, Australian Institute for Disaster Resilience.

Infrastructure NSW (INSW) (2022). *Wianamatta South Creek Catchment Flood Study*, prepared by Advisian.

NSW Department of Planning and Environment (DPE) (2023). *NSW Flood Risk Management Manual – The management of flood liable land*.

NSW Department of Planning and Environment (DPE) (2023). *Secretary's Environmental Assessment Requirements for Schools.*

NSW Reconstruction Authority (NSWRA) (2024). *Hawkesbury-Nepean River Flood Study*, prepared by Rhelm, Catchment Simulation Solutions, WMAwater and Baird.

Annex A Existing Regional (Mainstream) Flood Conditions

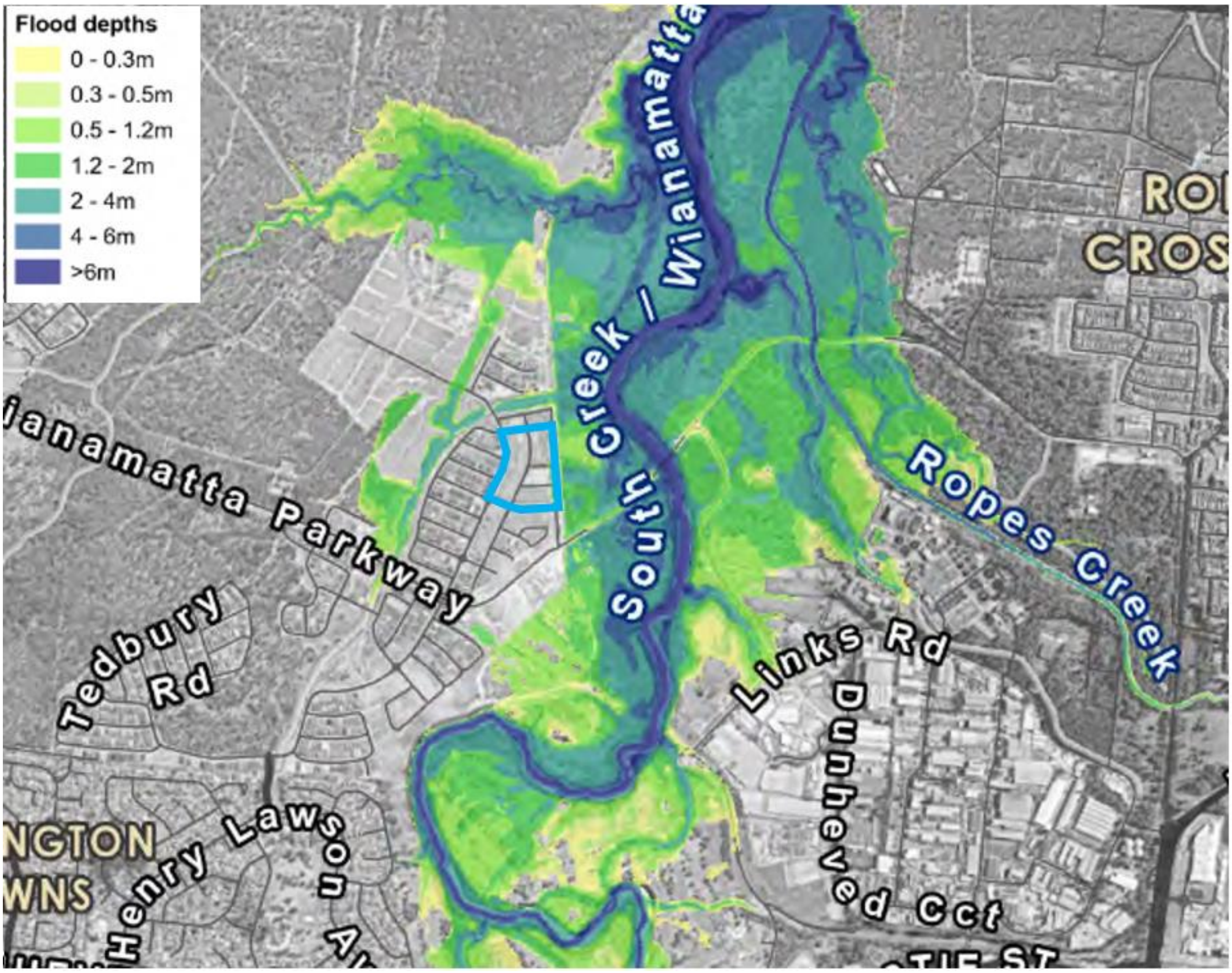


Figure A.1 1 in 500 (0.2%) AEP Flood Depths, Hawkesbury Nepean Flood Study (NSWRA, 2024)

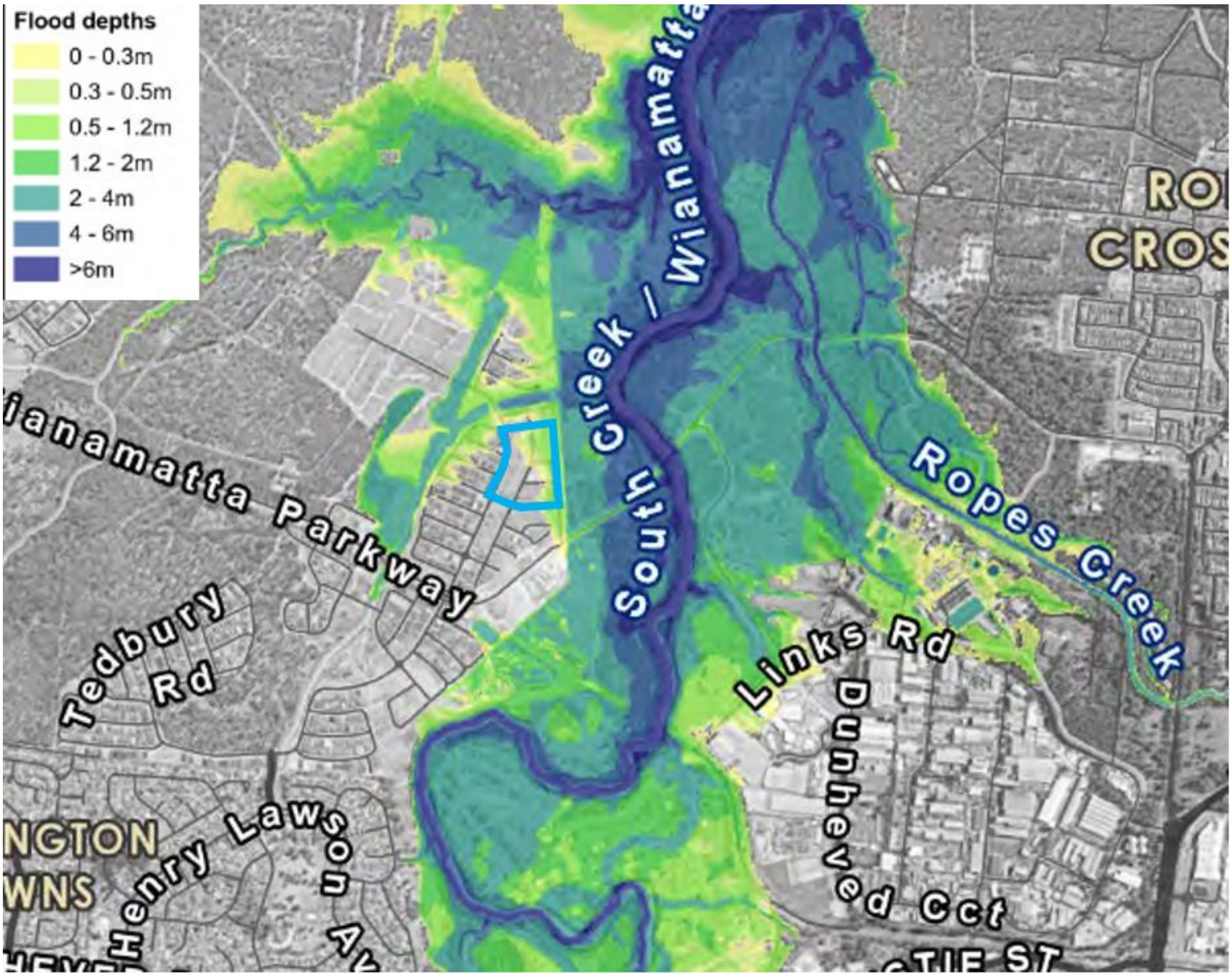


Figure A.2 1 in 1000 (0.1%) AEP Flood Depths, Hawkesbury Nepean Flood Study (NSWRA, 2024)

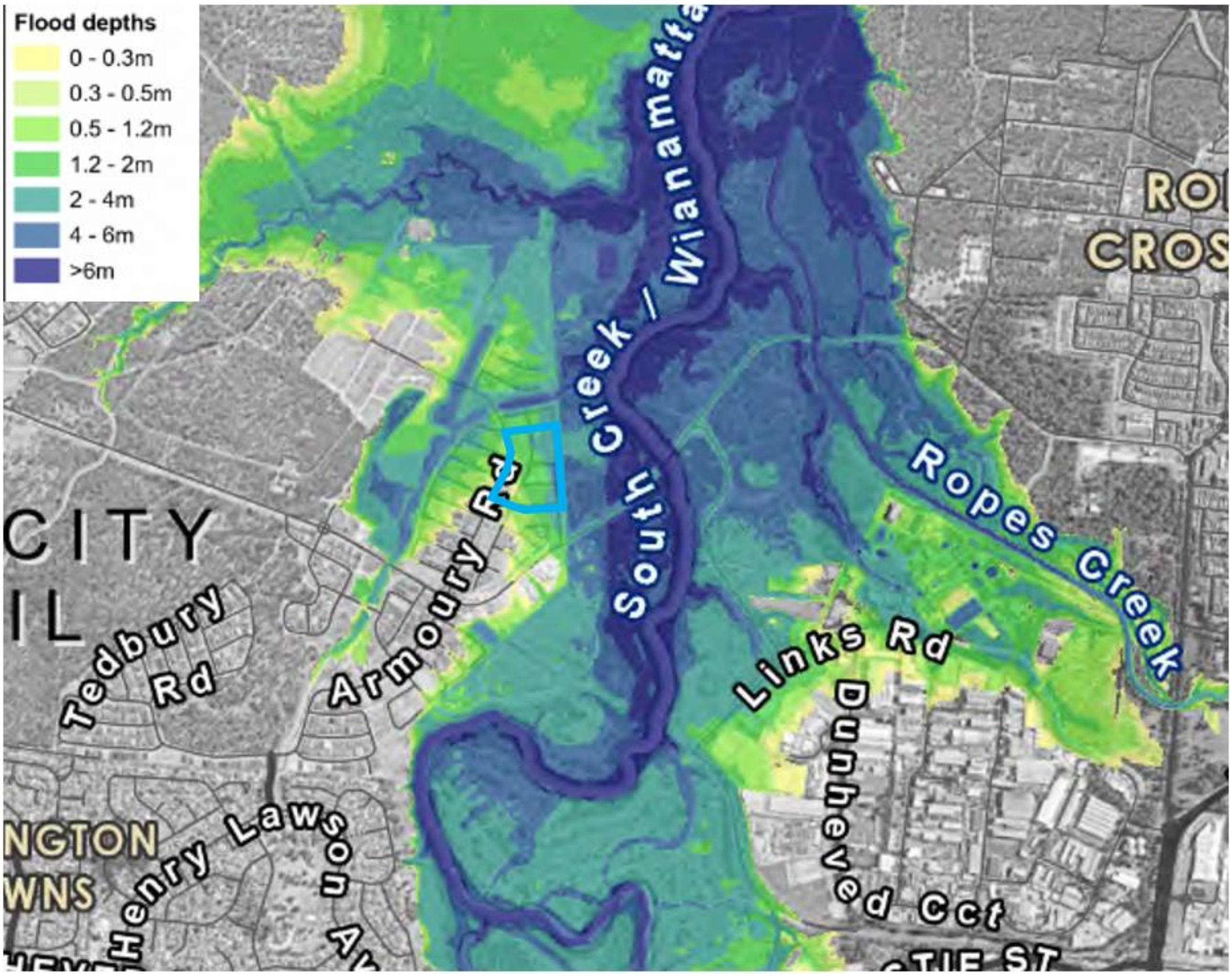


Figure A.3 1 in 2000 (0.05%) AEP Flood Depths, Hawkesbury Nepean Flood Study (NSWRA, 2024)

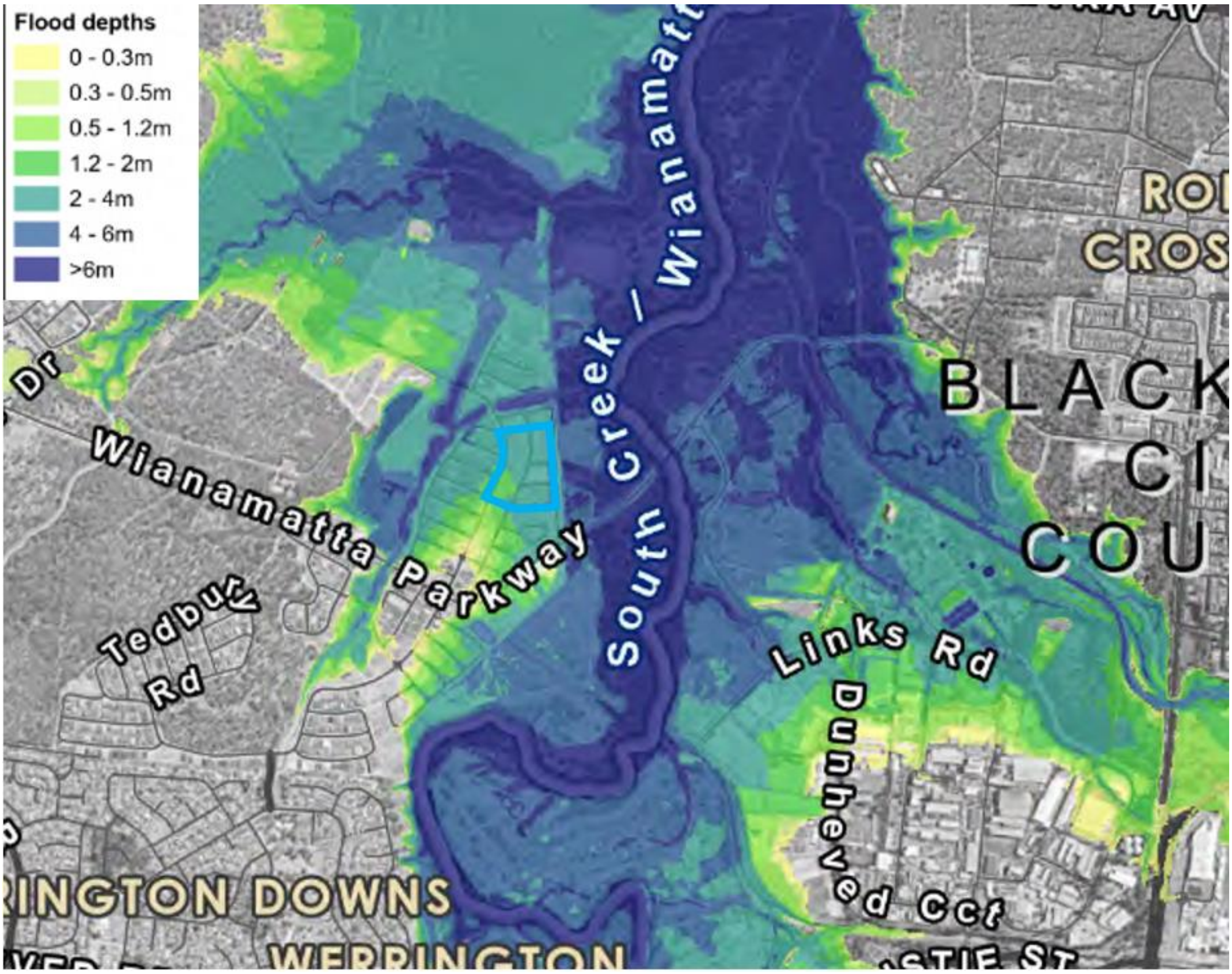


Figure A.4 1 in 5000 (0.02%) AEP Flood Depths, Hawkesbury Nepean Flood Study (NSWRA, 2024)

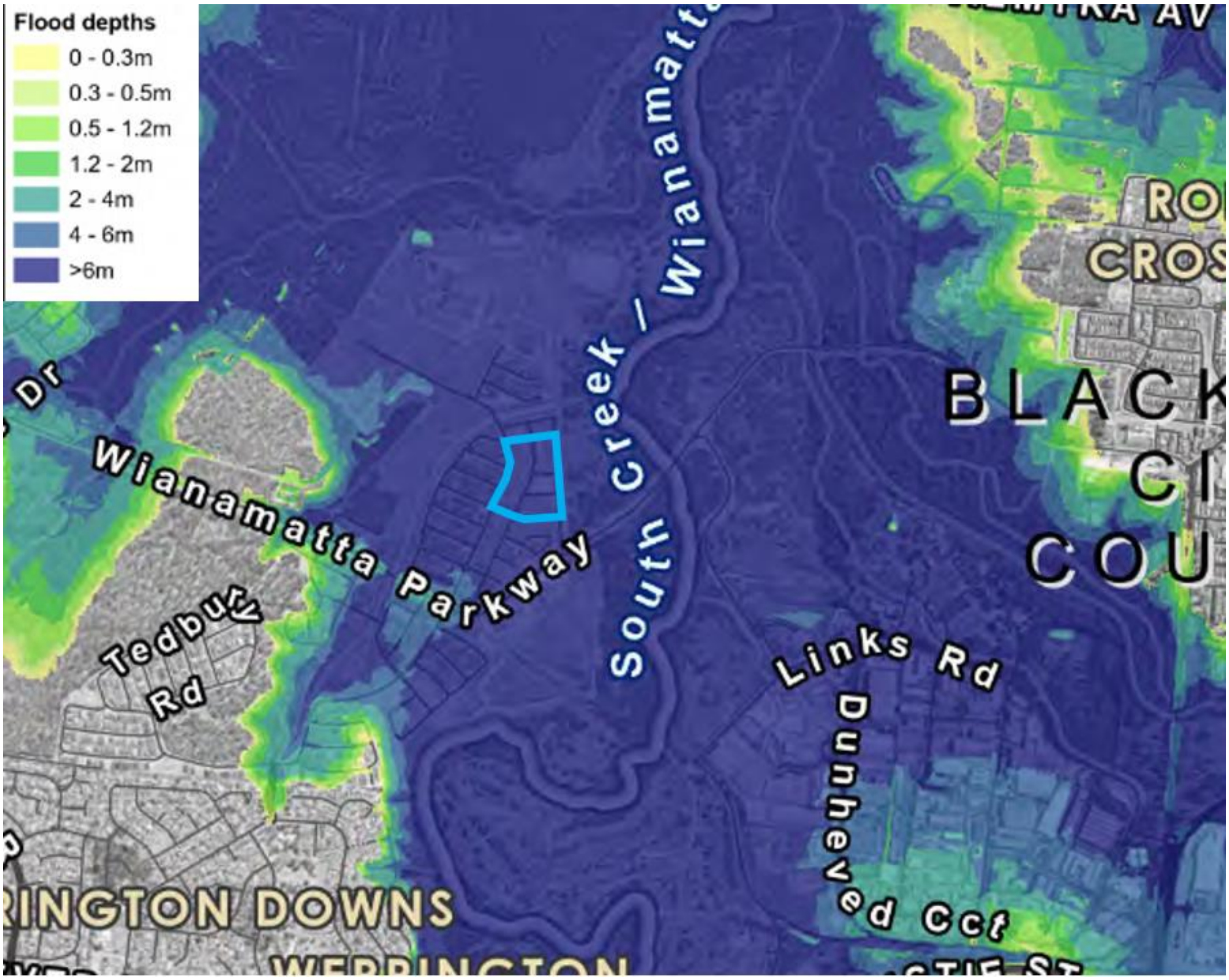
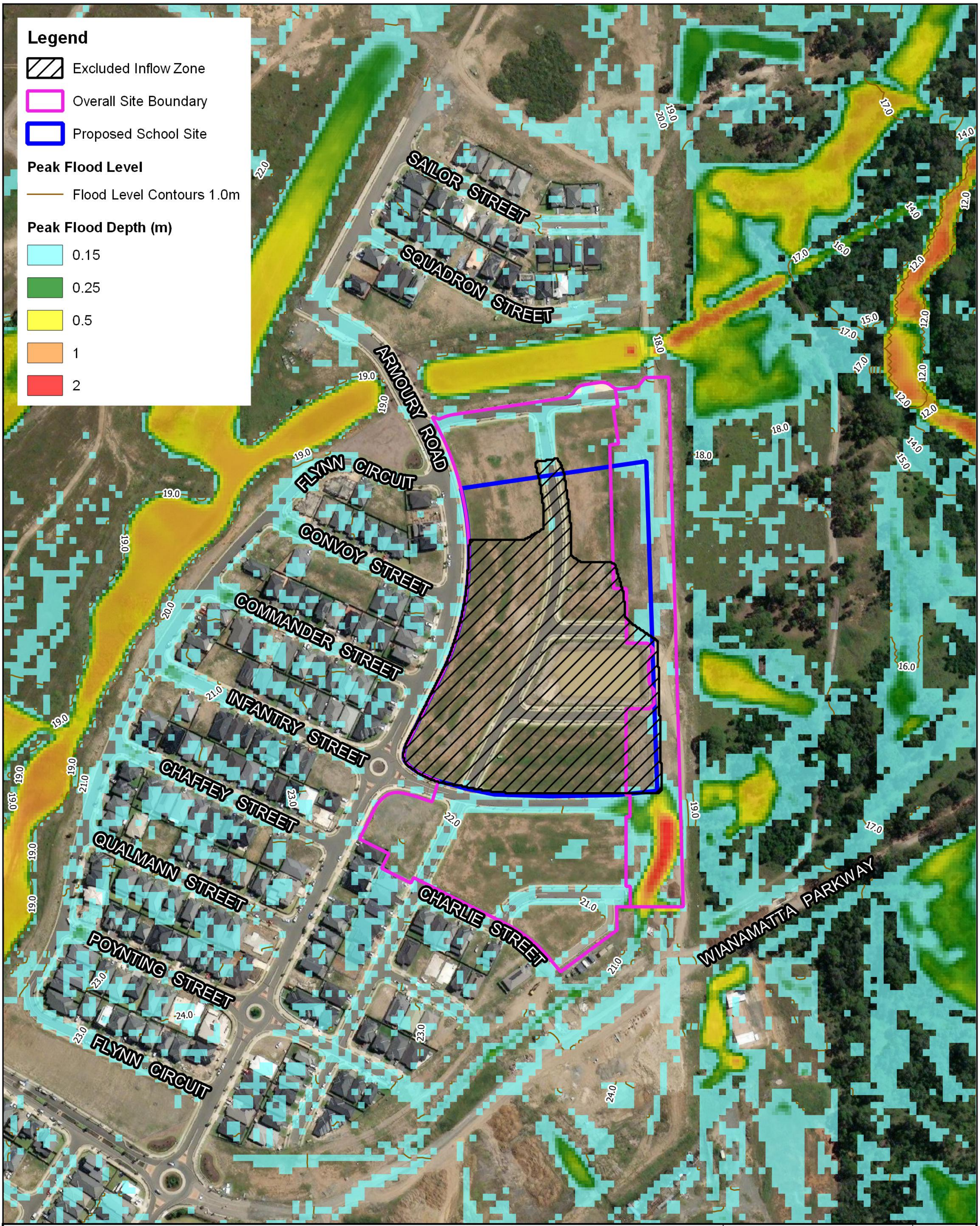


Figure A.5 PMF Flood Depths, Hawkesbury Nepean Flood Study (NSWRA, 2024)

Annex B Existing Local (Overland) Flood Conditions



Title:

Peak Flood Depths and Levels - Existing Conditions - 10% AEP Event

Figure: B-01

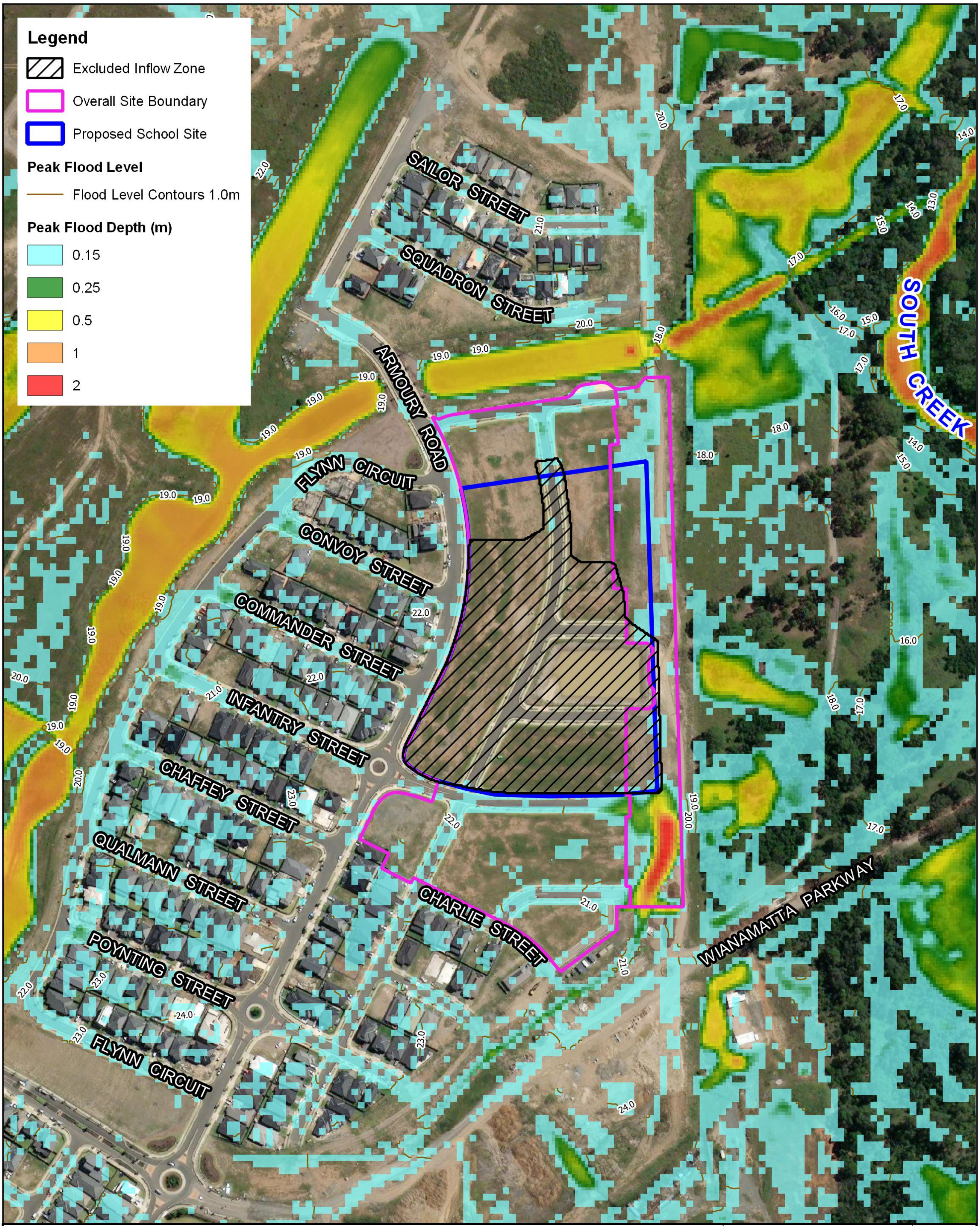
Rev: A

0 90 180 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\01_AnnexB_Existing\01_AnnexB.qgz



Title:

Peak Flood Depths and Levels - Existing Conditions - 5% AEP Event

Figure: B-02

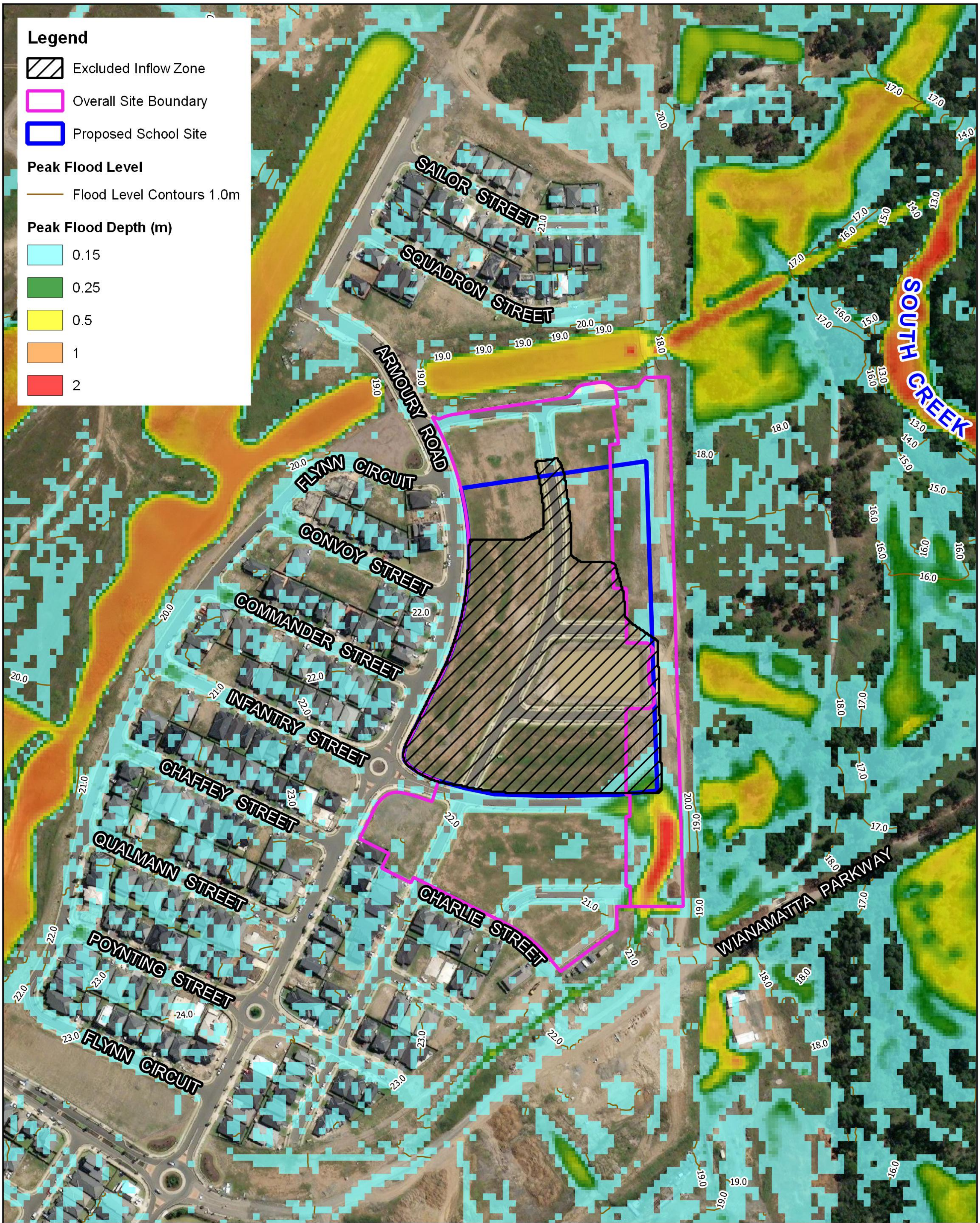
Rev: A

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

0 90 180 m

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\01_AnnexB_Existing\01_AnnexB.qgz



Title:

Peak Flood Depths and Levels - Existing Conditions - 1% AEP Event

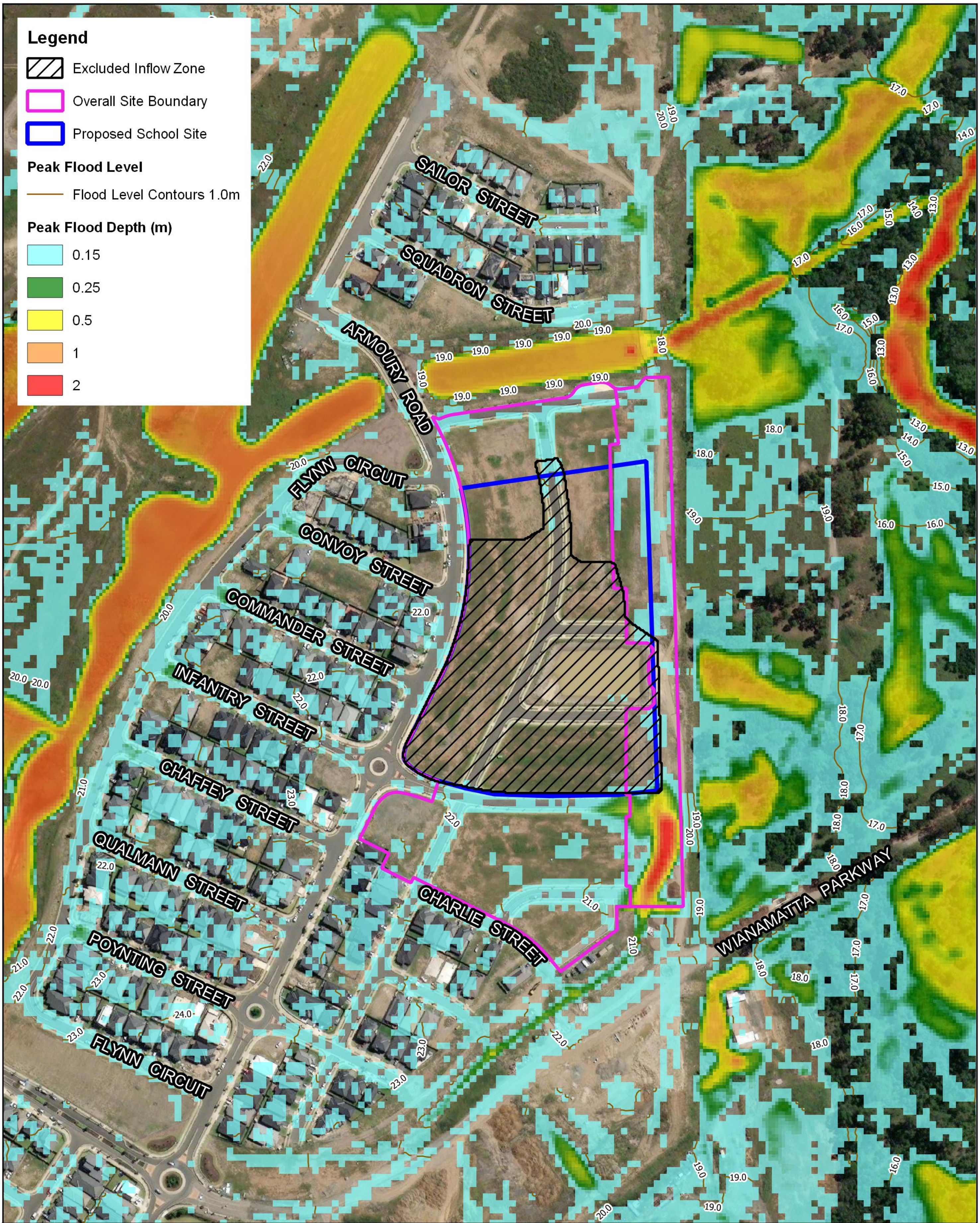
Figure: B-03

Rev: A

0 90 180 m

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\01_AnnexB_Existing\01_AnnexB.qgz



Title:

Peak Flood Depths and Levels - Existing Conditions - 0.2% AEP Event

Figure: **B-04**

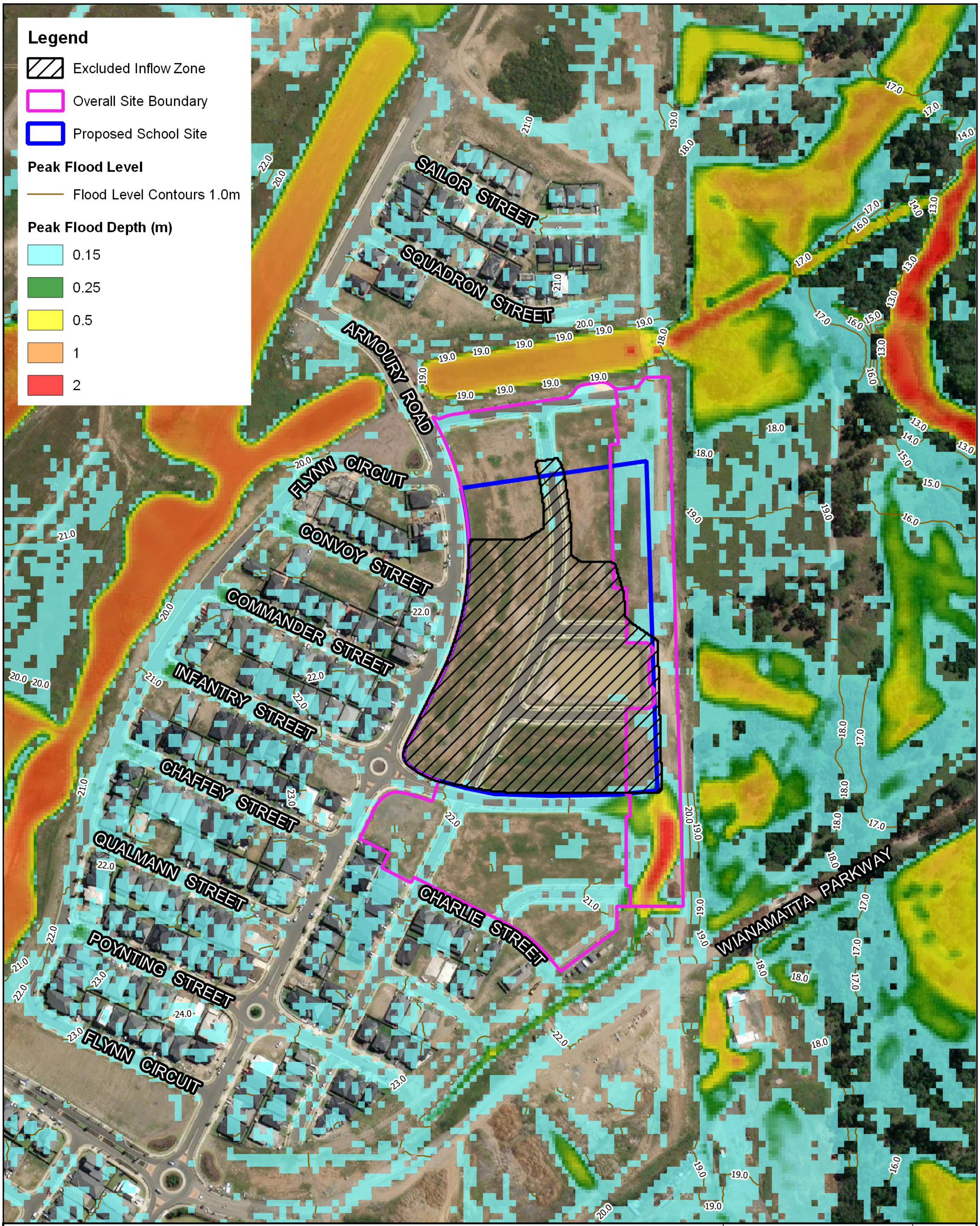
Rev: **A**

0 90 180 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\01_AnnexB_Existing\01_AnnexB.qgz



Title:

Peak Flood Depths and Levels - Existing Conditions - 1% AEP + Climate Change SSP2-4.5 Event

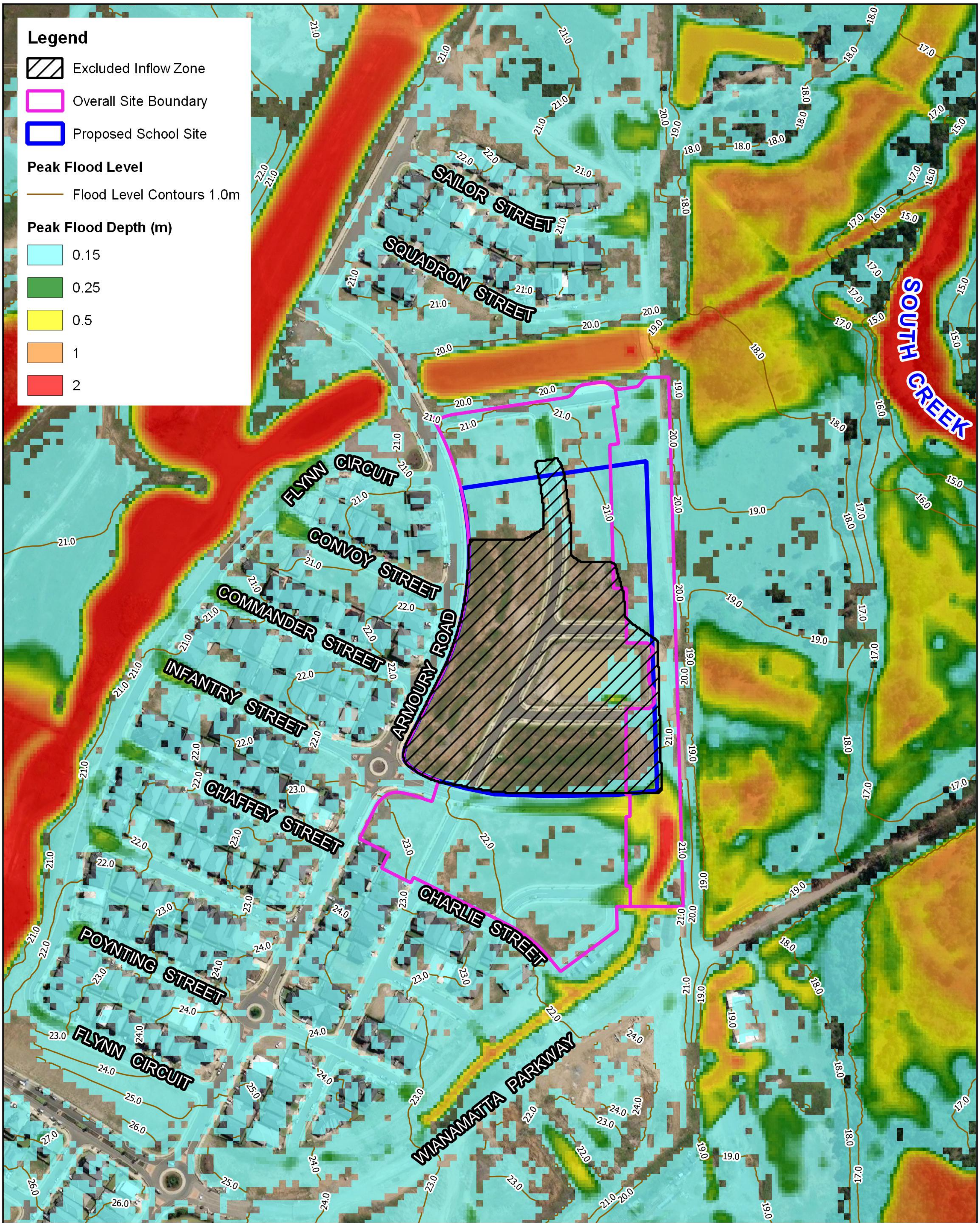
Figure: **B-05**

Rev: **A**

0 90 180 m

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\01_AnnexB_Existing\01_AnnexB.qgz



Title:

Peak Flood Depths and Levels - Existing Conditions - PMF Event

Figure: B-06

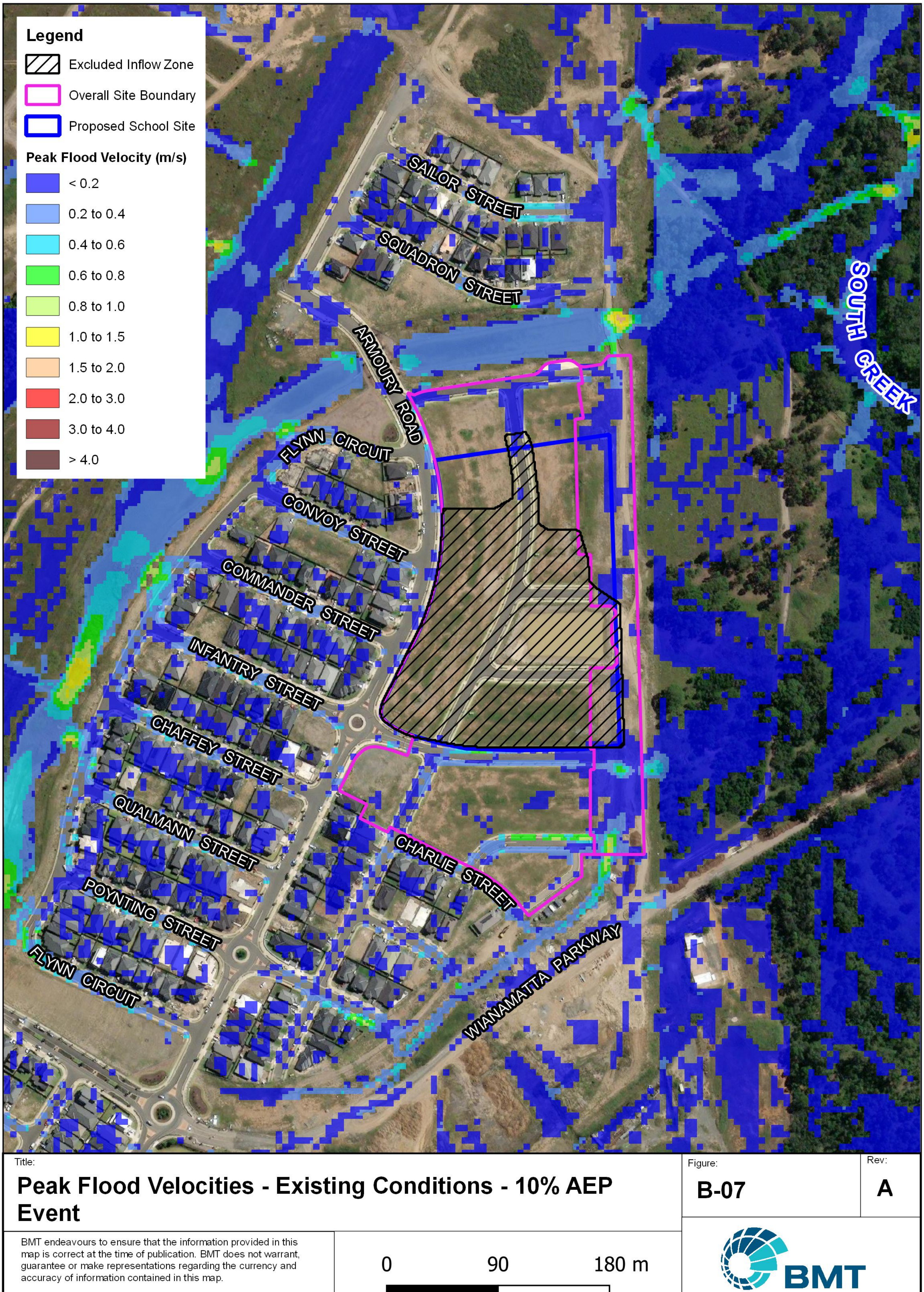
Rev: A

0 90 180 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\01_AnnexB_Existing\01_AnnexB.qgz



Title:

Peak Flood Velocities - Existing Conditions - 10% AEP Event

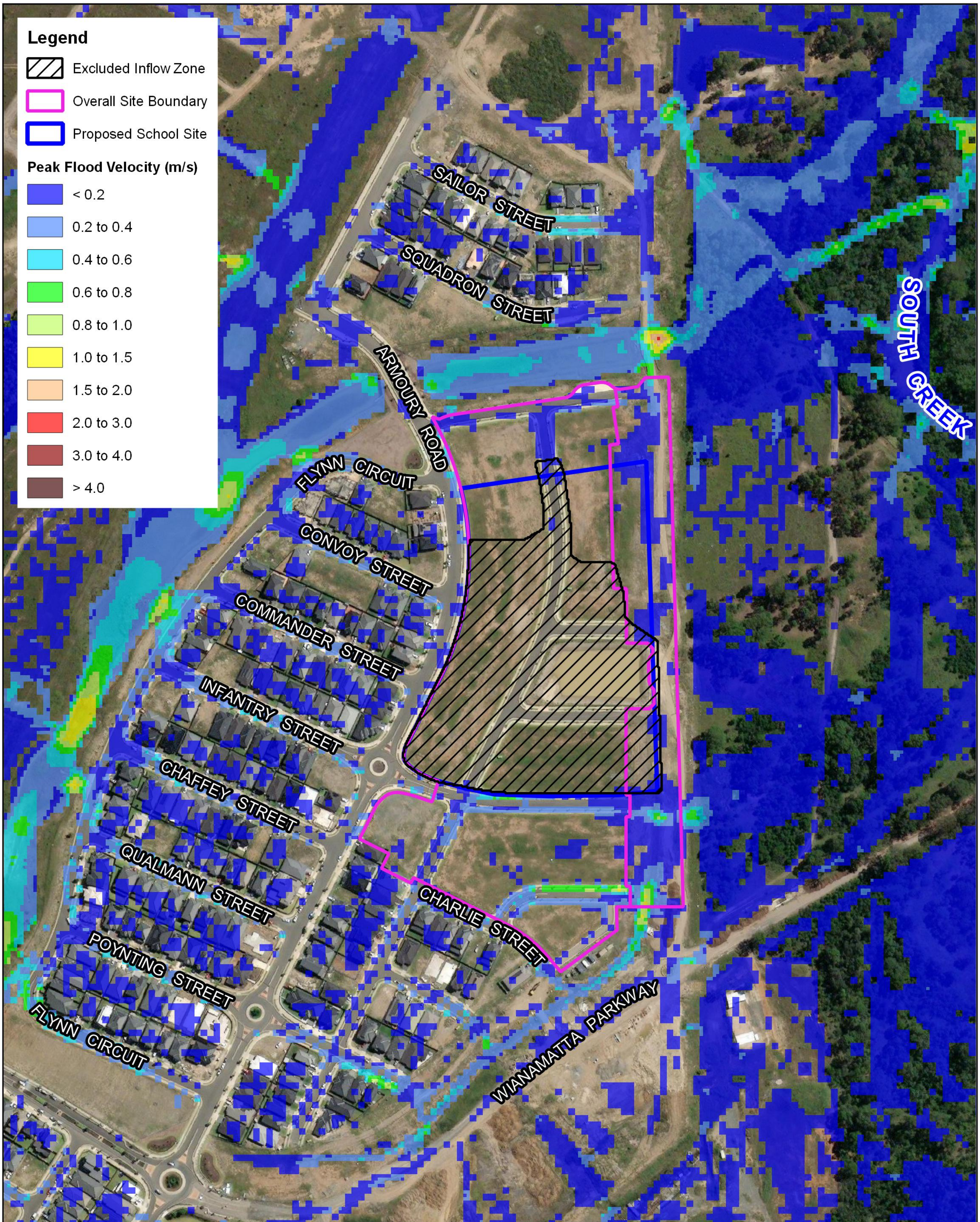
Figure: **B-07**

Rev: **A**

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

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\01_AnnexB_Existing\01_AnnexB.qgz



Title:

Peak Flood Velocities - Existing Conditions - 5% AEP Event

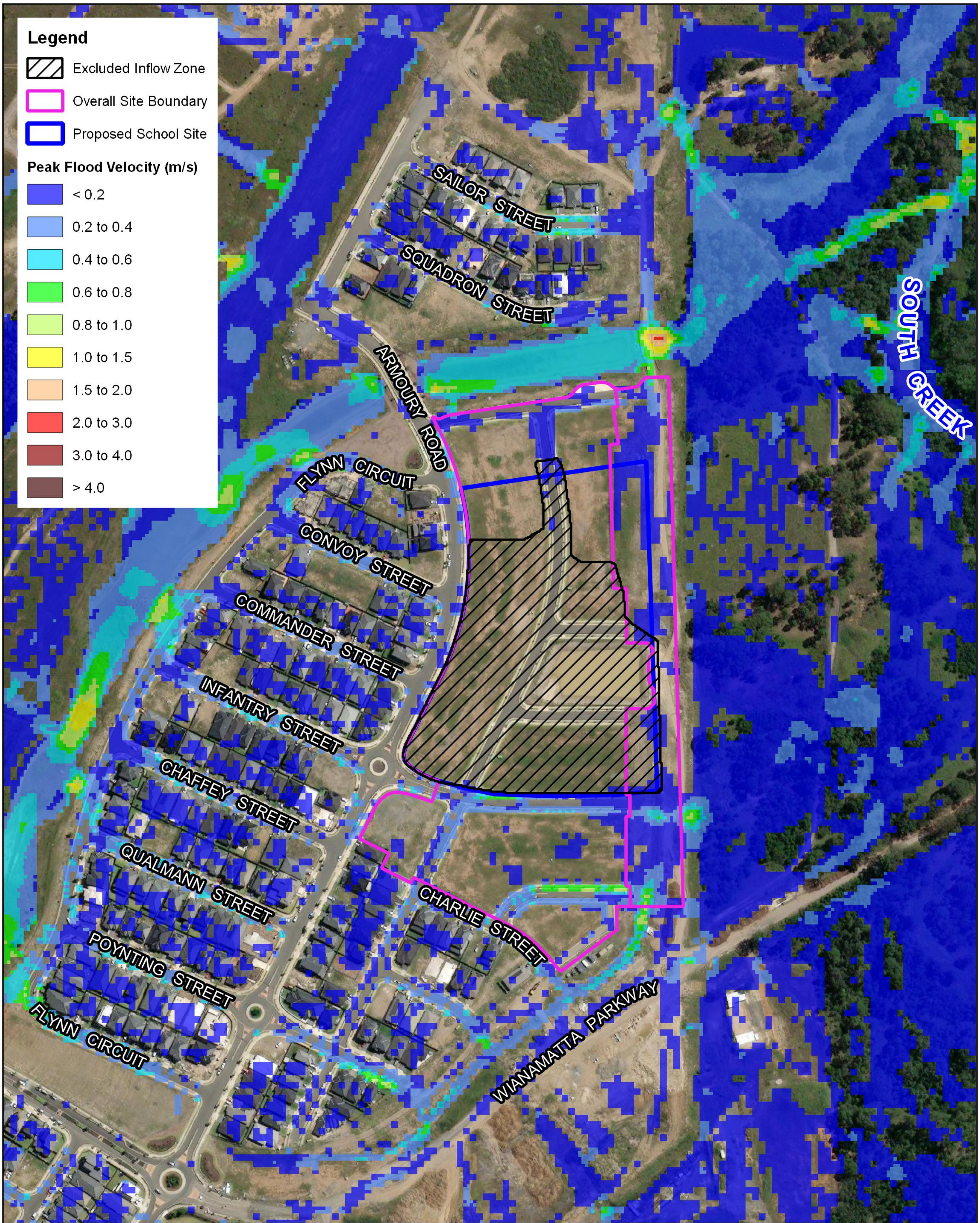
Figure: **B-08**

Rev: **A**

0 90 180 m

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\01_AnnexB_Existing\01_AnnexB.qgz



Title:

Peak Flood Velocities - Existing Conditions - 1% AEP Event

Figure: **B-09**

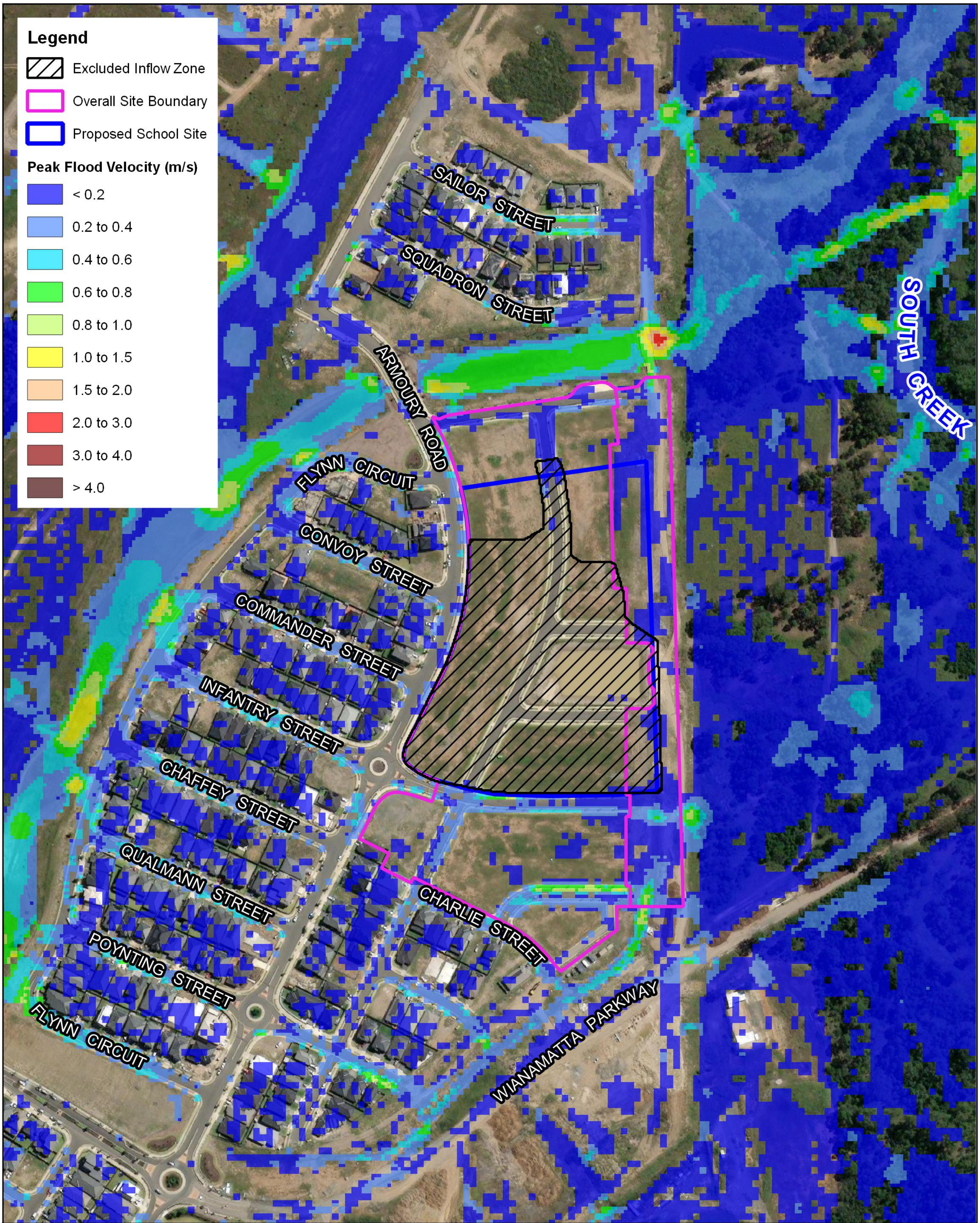
Rev: **A**

0 90 180 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\01_AnnexB_Existing\01_AnnexB.qgz



Title:

Peak Flood Velocities - Existing Conditions - 0.2% AEP Event

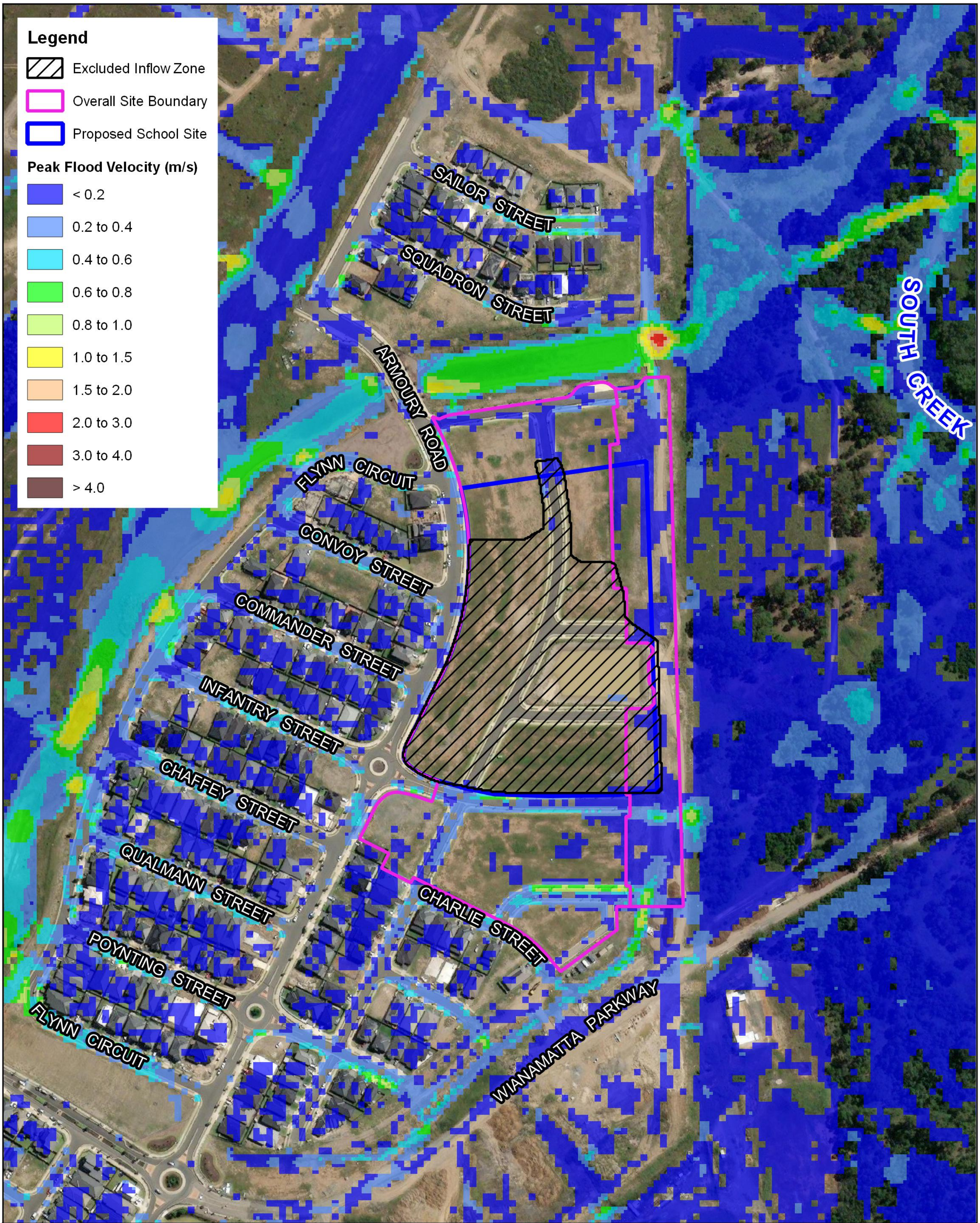
Figure: **B-10**

Rev: **A**

0 90 180 m

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\01_AnnexB_Existing\01_AnnexB.qgz



Title:

Peak Flood Velocities - Existing Conditions - 1% AEP + Climate Change SSP2-4.5 Event

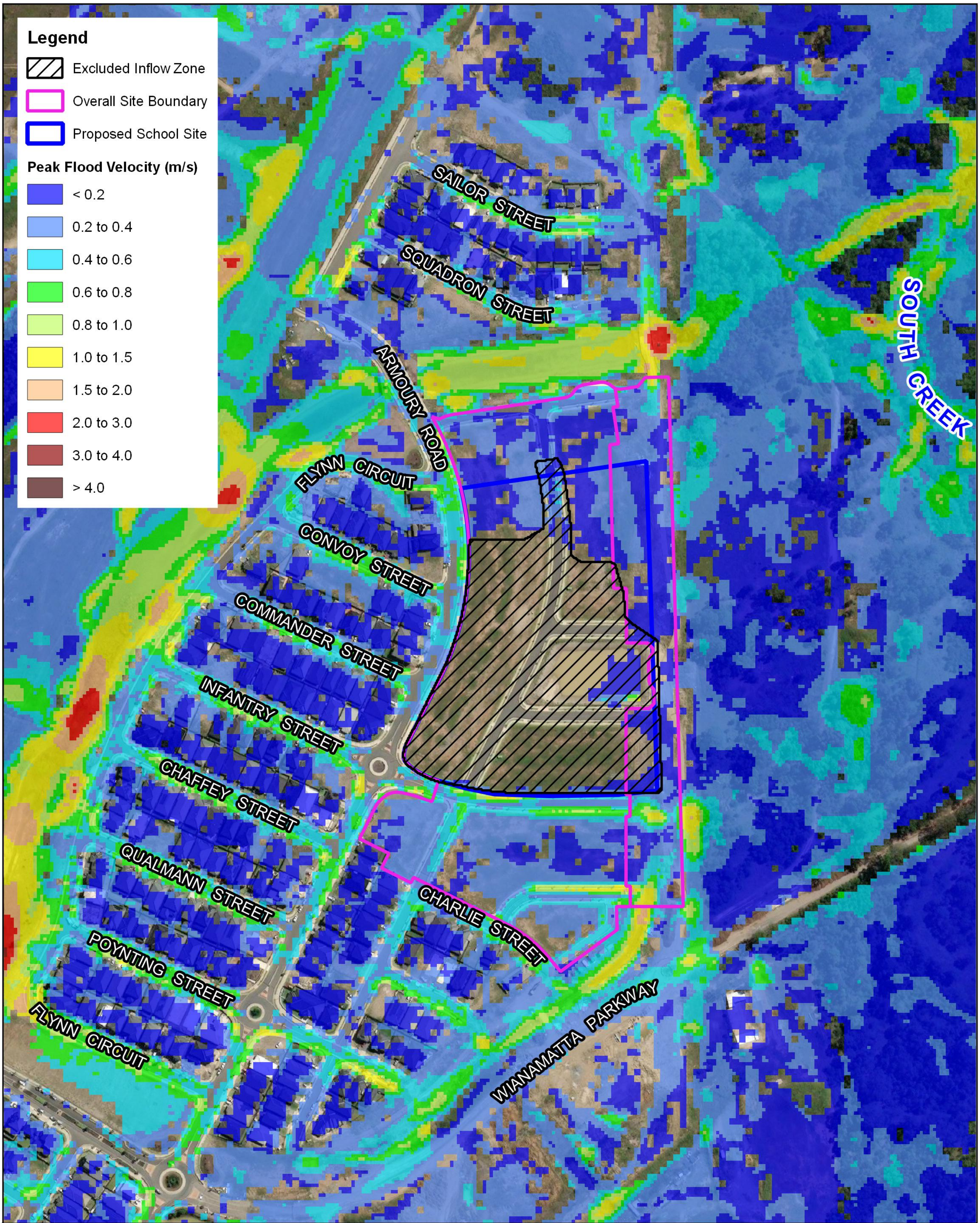
Figure: **B-11**

Rev: **A**

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

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\01_AnnexB_Existing\01_AnnexB.qgz



Title:

Peak Flood Velocities- Existing Conditions - PMF Event

Figure: B-12

Rev: A

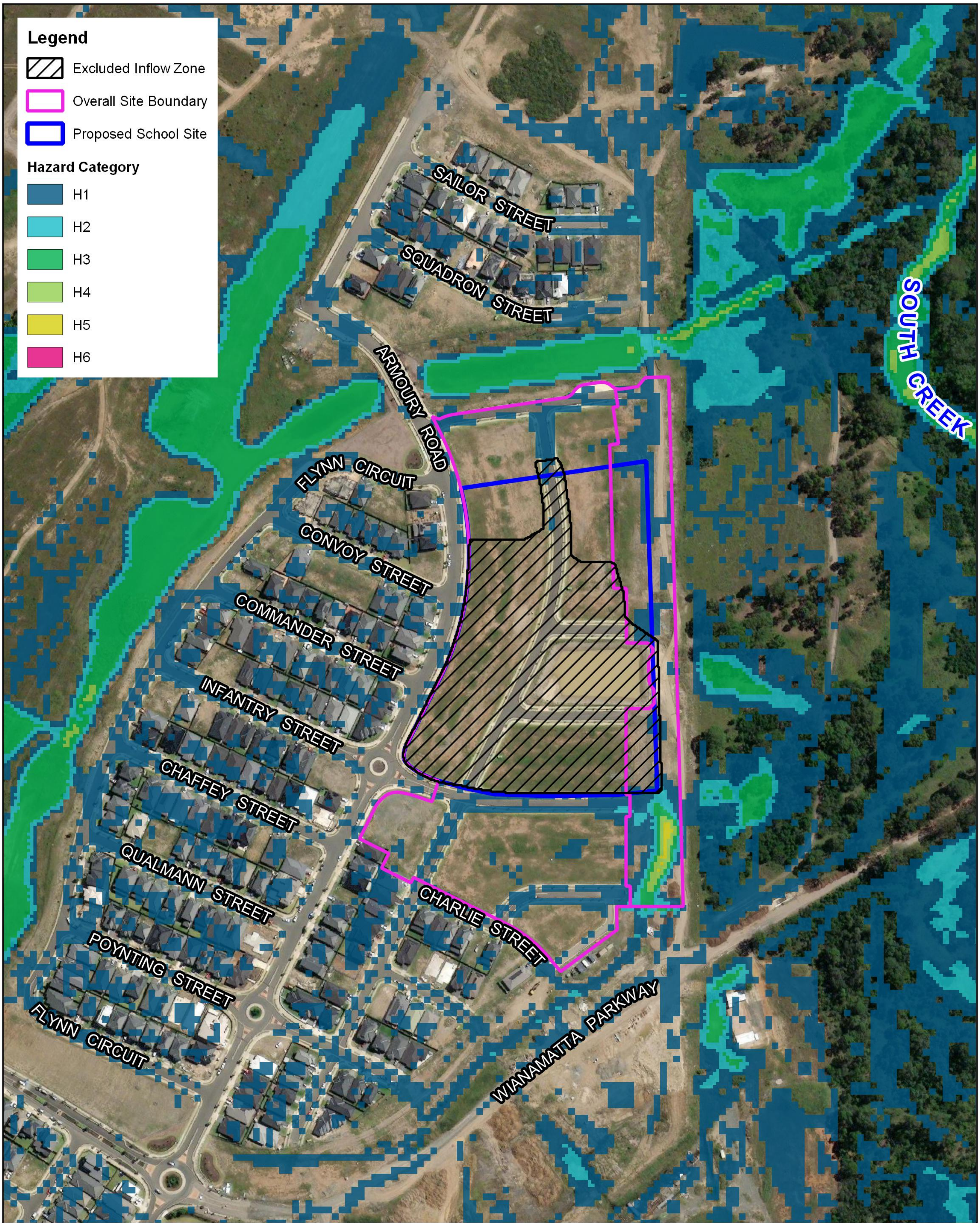
BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

0 90 180 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\01_AnnexB_Existing\01_AnnexB.qgz



Title:

Peak Flood Hazard - Existing Conditions - 10% AEP Event

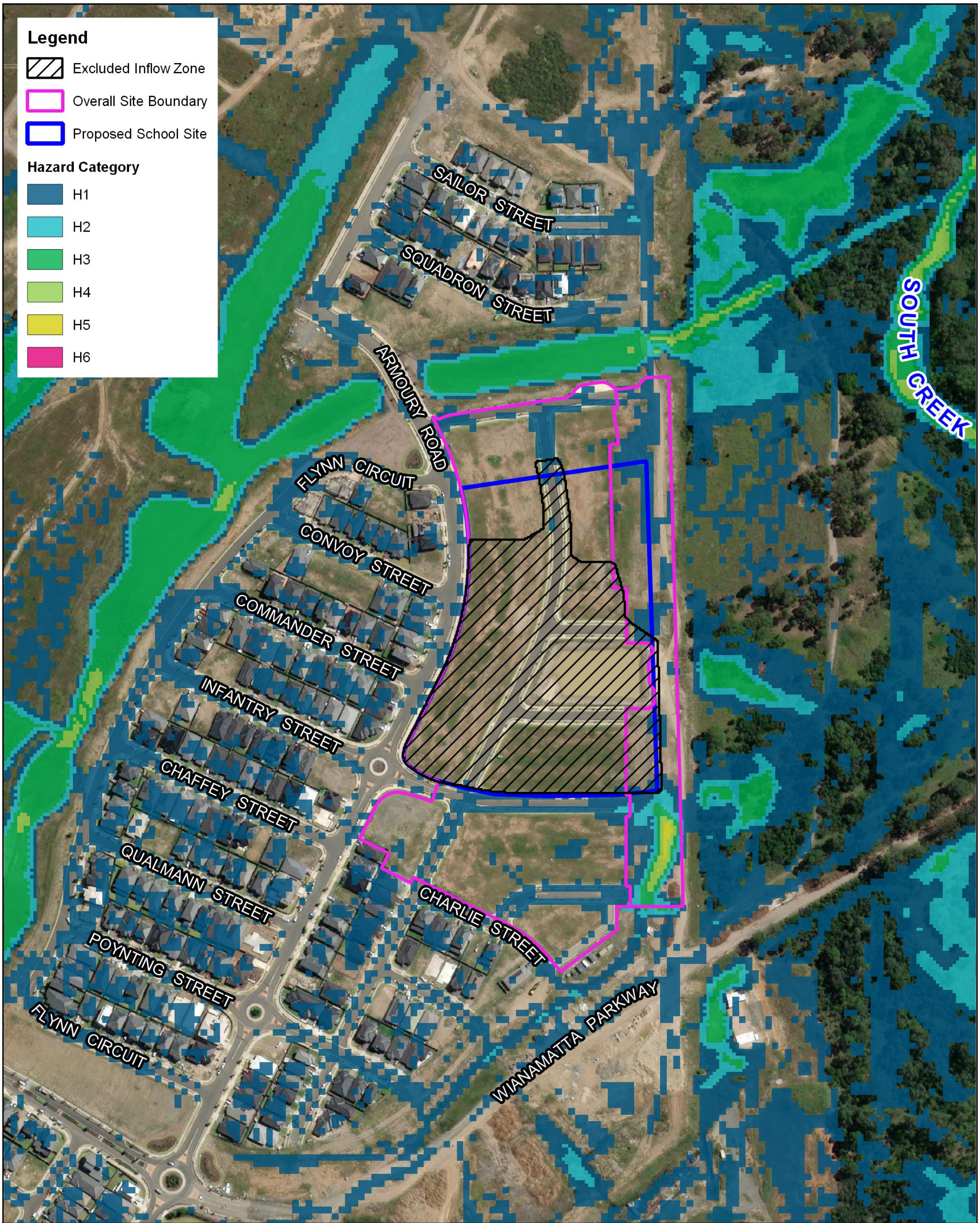
Figure: **B-13**

Rev: **A**

0 90 180 m

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\01_AnnexB_Existing\01_AnnexB.qgz



Title:

Peak Flood Hazard - Existing Conditions - 5% AEP Event

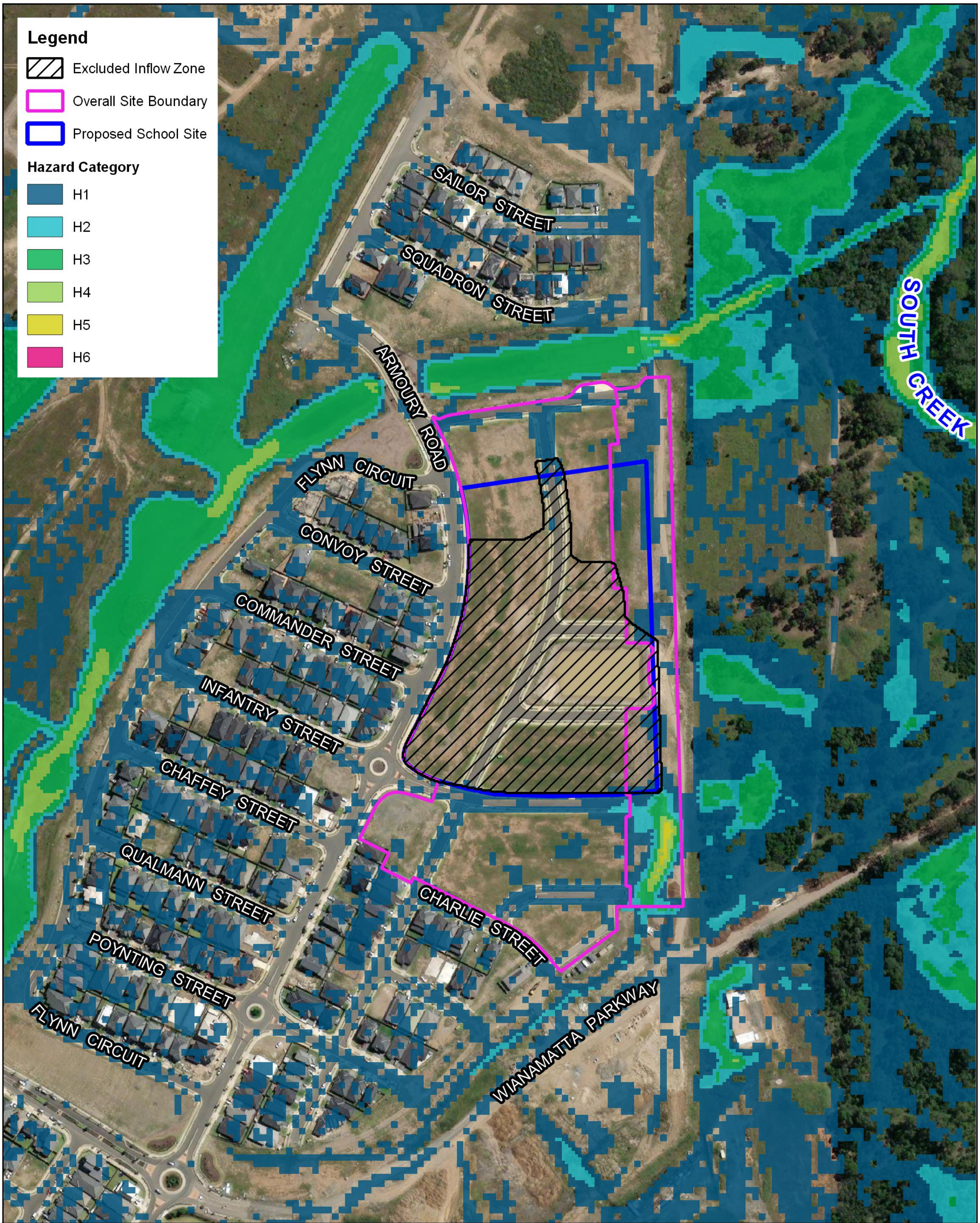
Figure: **B-14**

Rev: **A**

0 90 180 m

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\01_AnnexB_Existing\01_AnnexB.qgz



Title:

Peak Flood Hazard - Existing Conditions - 1% AEP Event

Figure: B-15

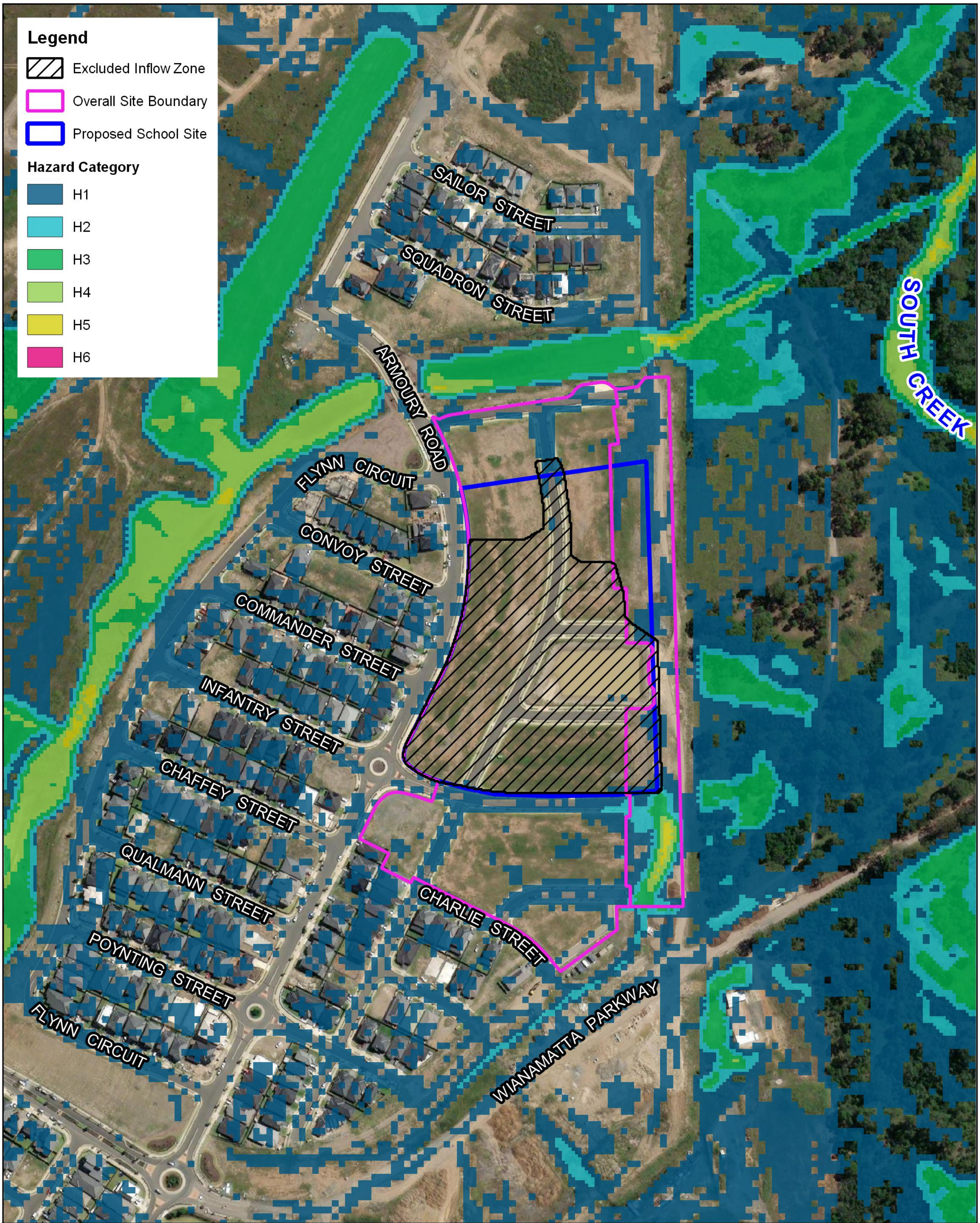
Rev: A

0 90 180 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\01_AnnexB_Existing\01_AnnexB.qgz



Title:

Peak Flood Hazard - Existing Conditions - 0.2% AEP Event

Figure: **B-16**

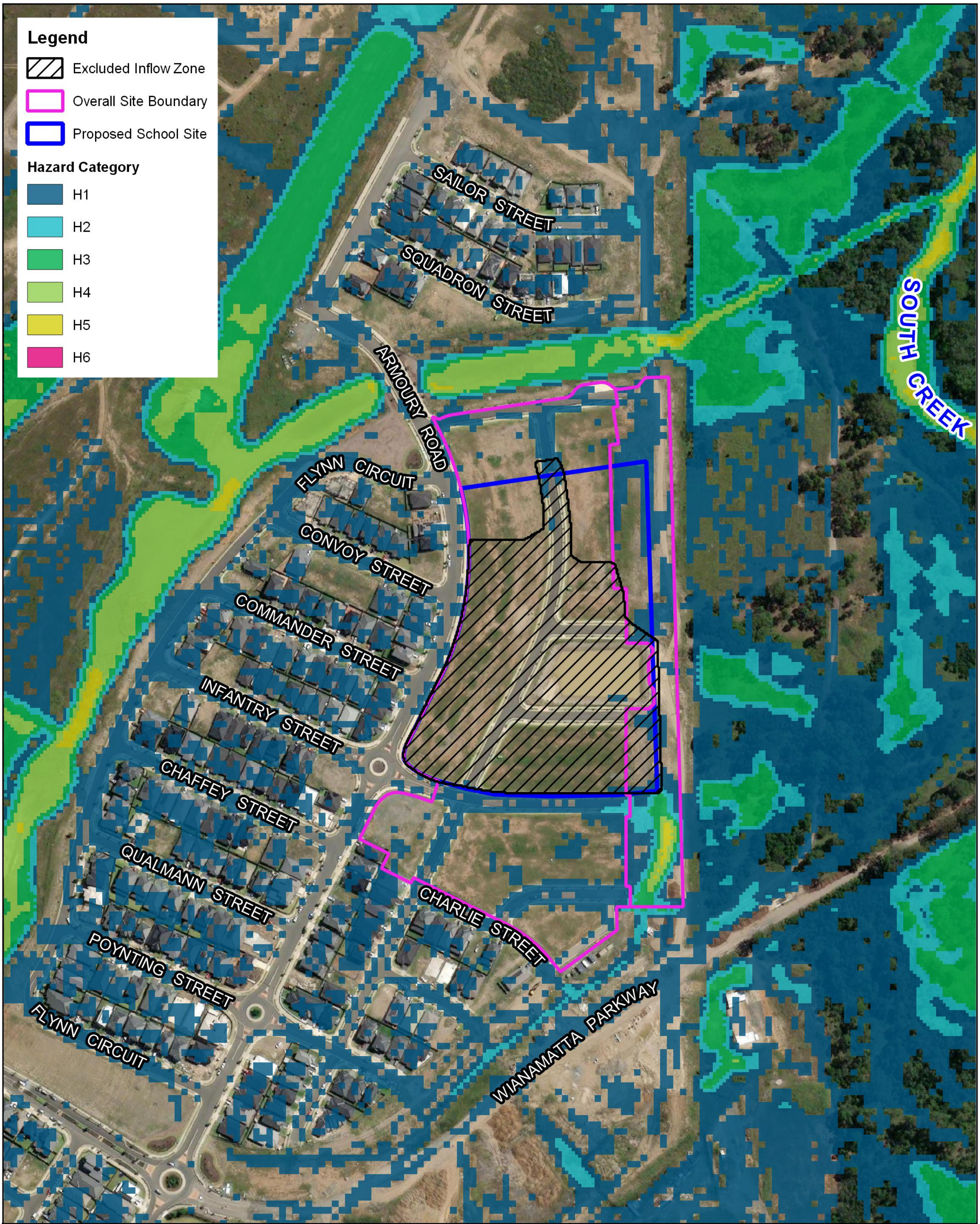
Rev: **A**

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

0 90 180 m

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\01_AnnexB_Existing\01_AnnexB.qgz



Title:

Peak Flood Hazard - Existing Conditions - 1% AEP + Climate Change SSP2-4.5 Event

Figure: **B-17**

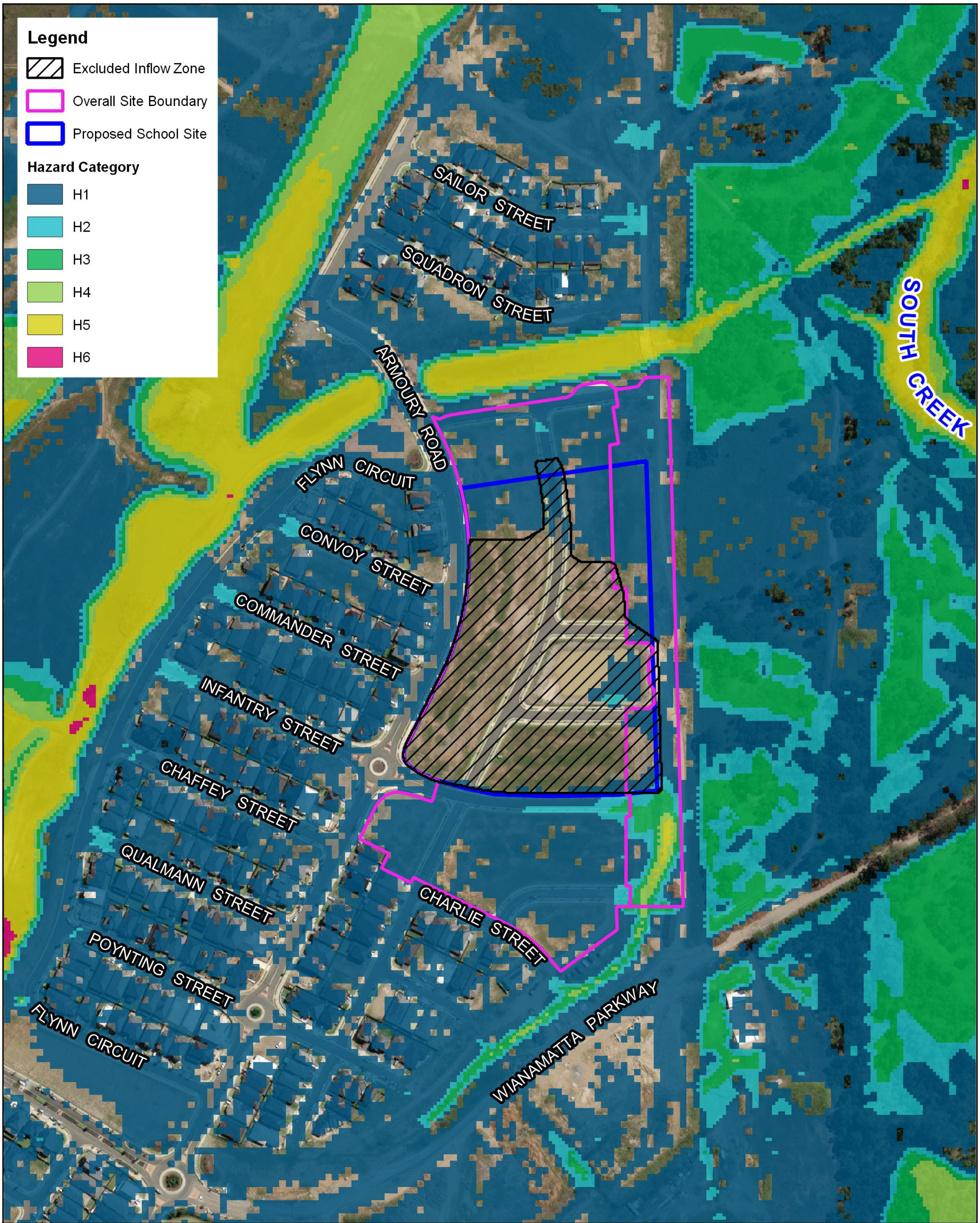
Rev: **A**

0 90 180 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\01_AnnexB_Existing\01_AnnexB.qgz



Title:

Peak Flood Hazard - Existing Conditions - PMF Event

Figure: **B-18**

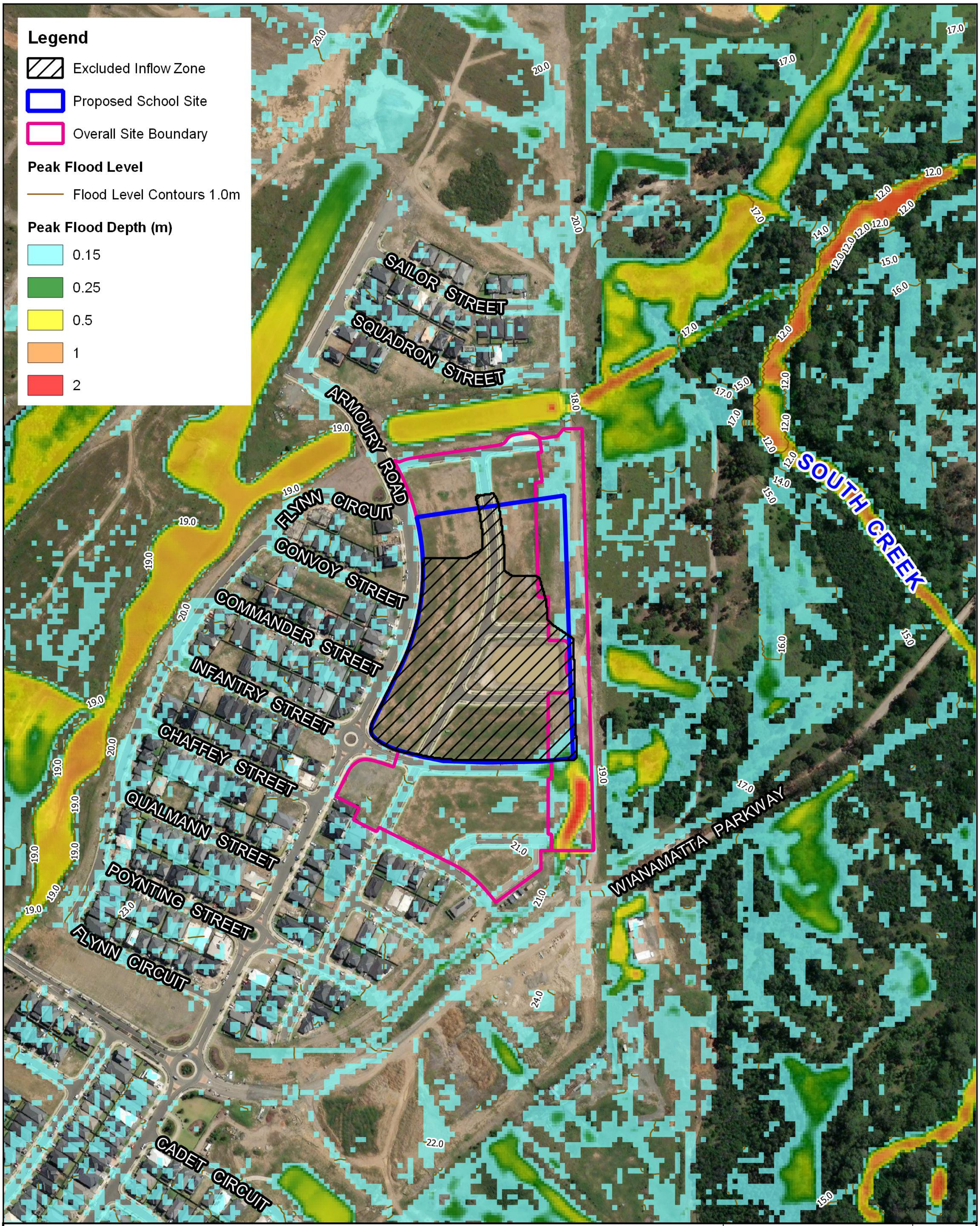
Rev: **A**

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\01_AnnexB_Existing\01_AnnexB.qgz

Annex C Post-Activity Local (Overland) Flood Conditions



Title:

Peak Flood Depths and Levels - Post-Activity Conditions - 10% AEP Event

Figure: C-01

Rev: A

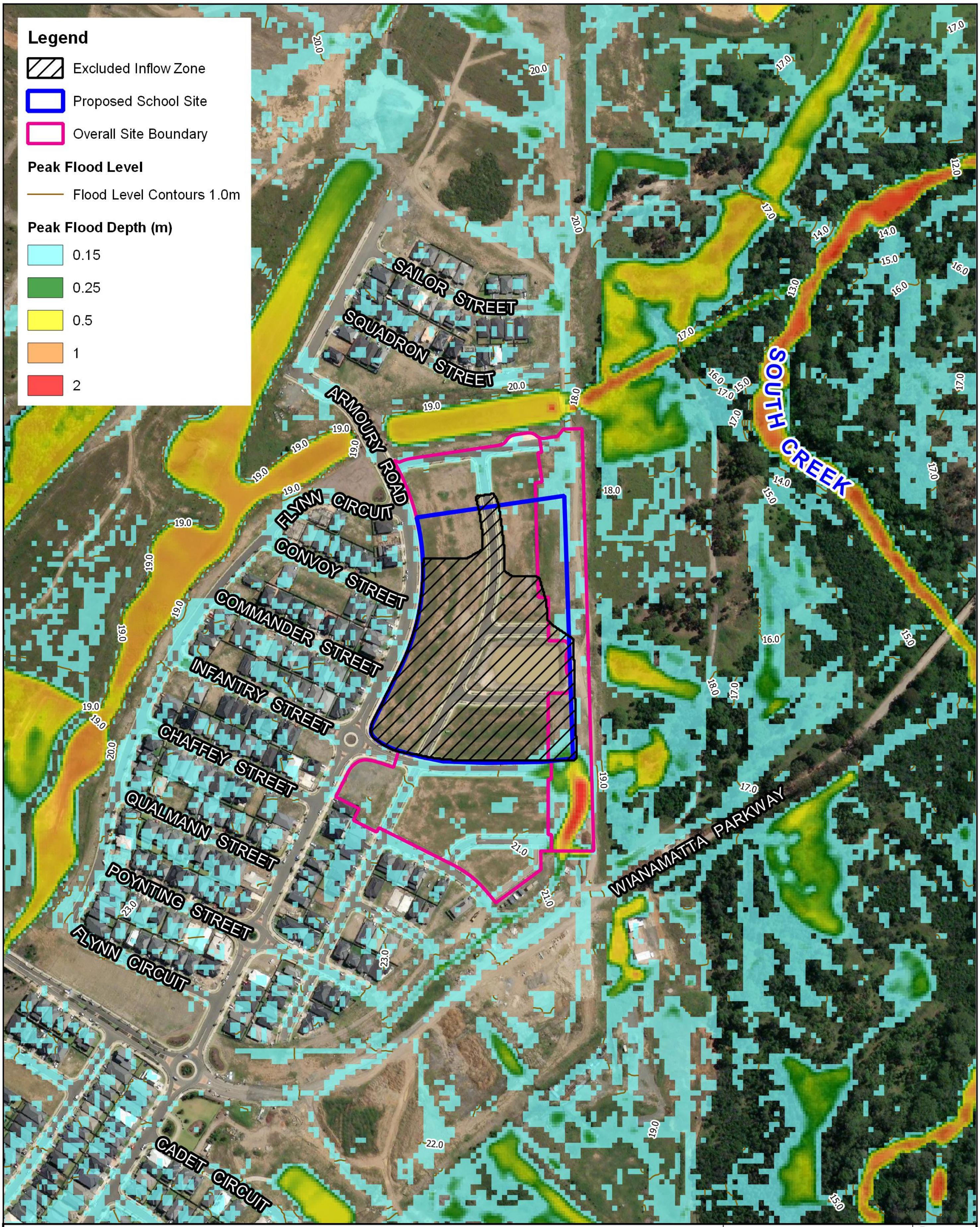
BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

0 100 200 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\02_AnnexC_PostDev\01_AnnexC.qgz



Title:

Peak Flood Depths and Levels - Post-Activity Conditions - 5% AEP Event

Figure: C-02

Rev: A

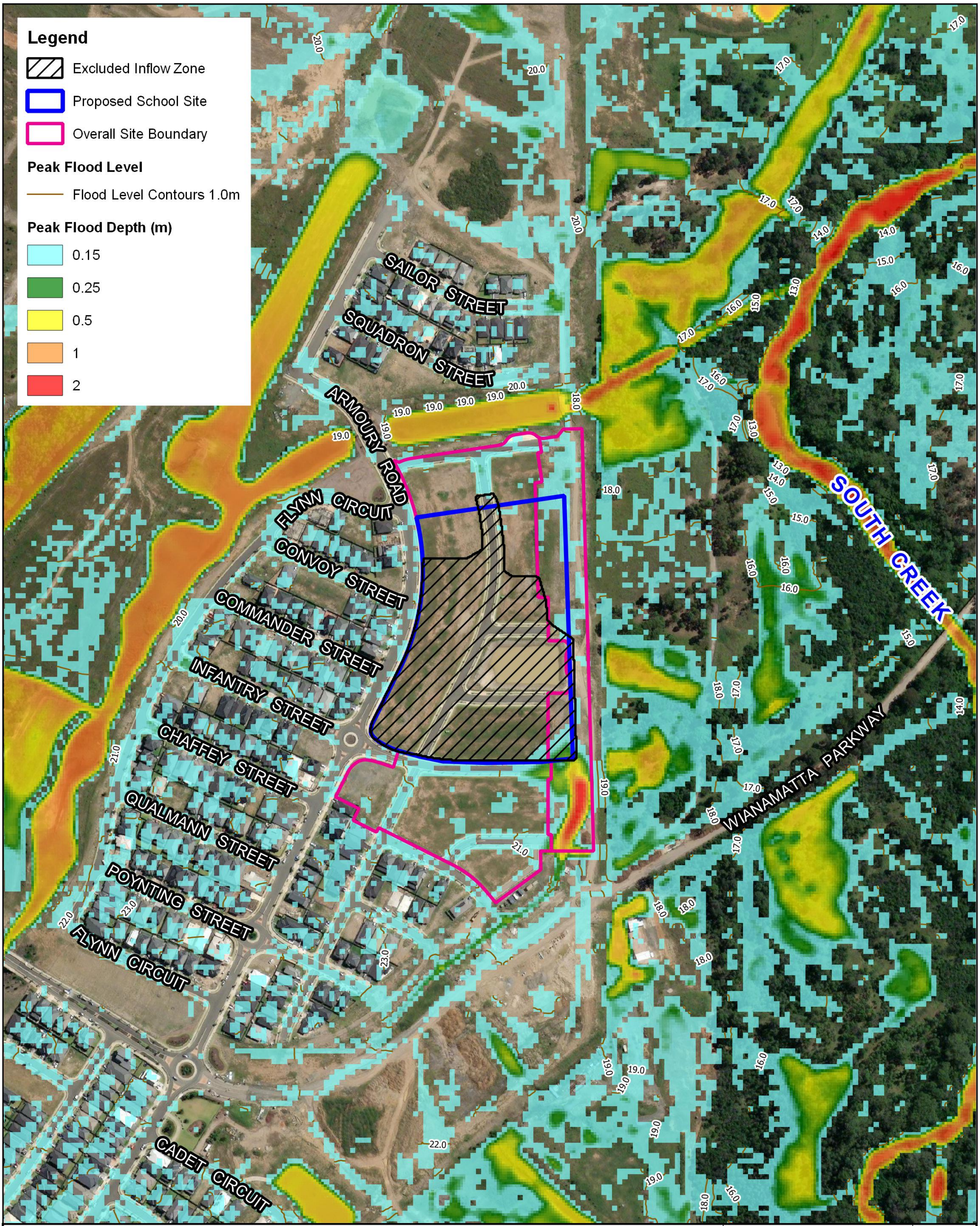
BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

0 100 200 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\02_AnnexC_PostDev\01_AnnexC.qgz



Title:

Peak Flood Depths and Levels - Post-Activity Conditions - 1% AEP Event

Figure: C-03

Rev: A

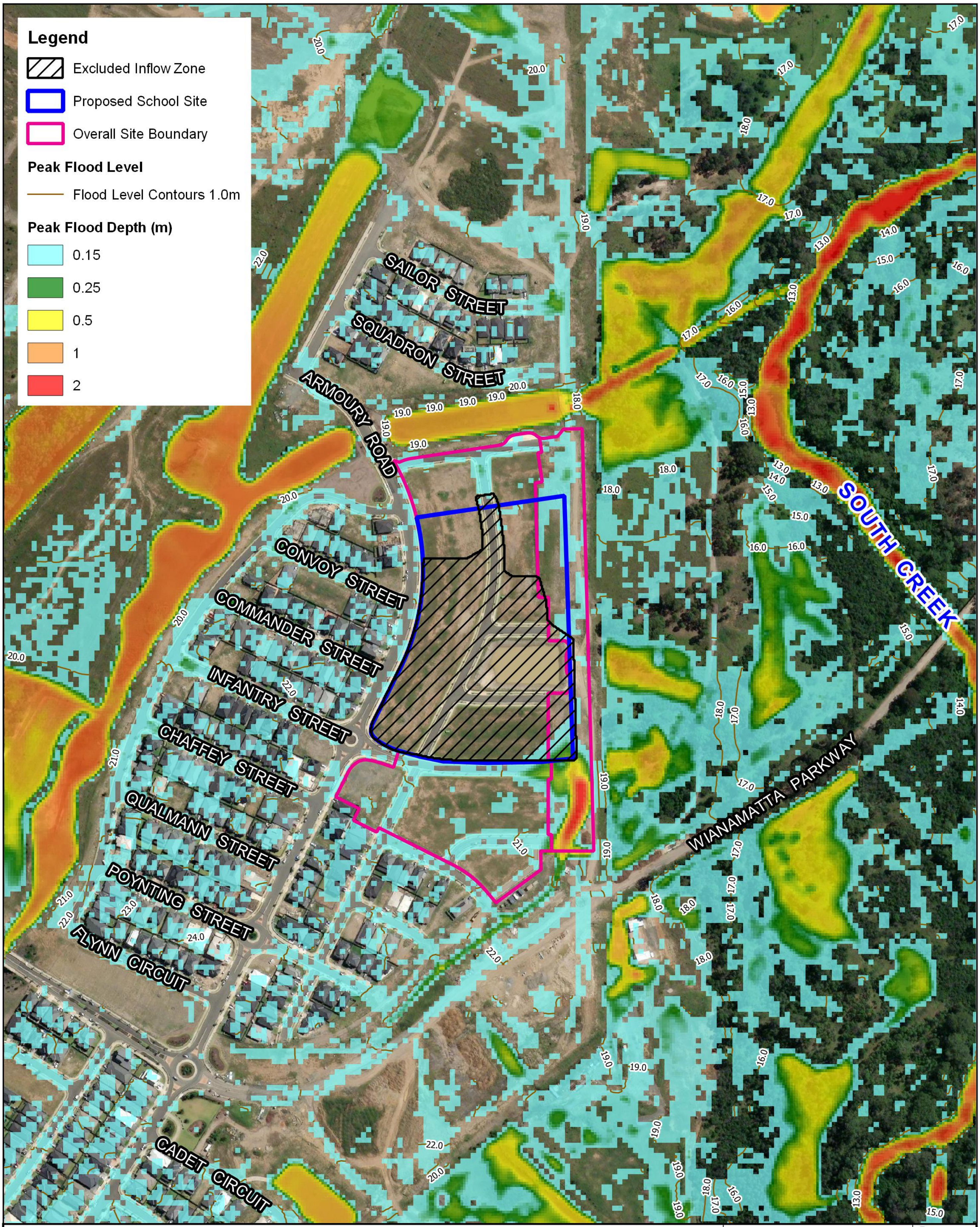
BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

0 100 200 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\02_AnnexC_PostDev\01_AnnexC.qgz



Title:

Peak Flood Depths and Levels - Post-Activity Conditions - 0.2% AEP Event

Figure: **C-04**

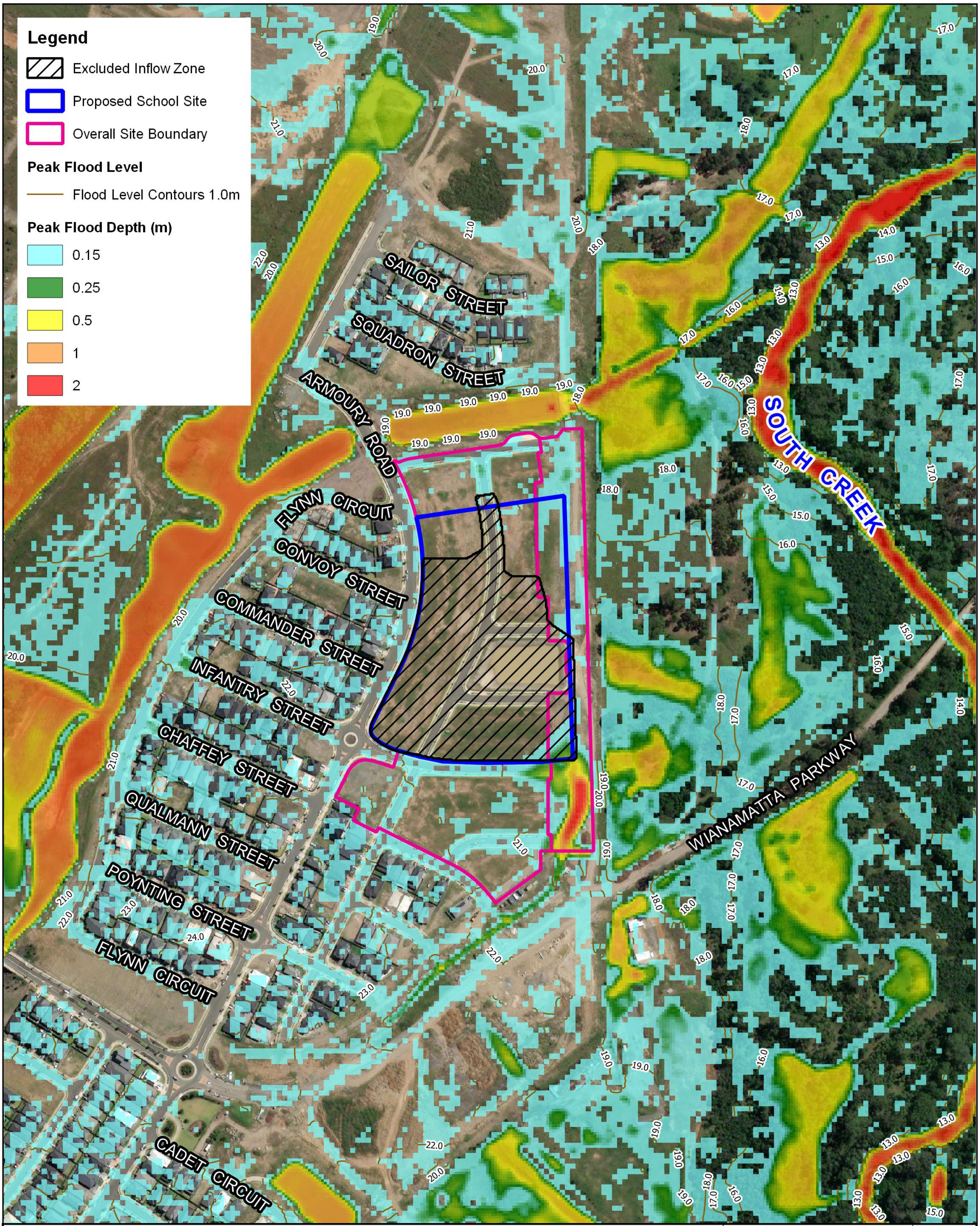
Rev: **A**

0 100 200 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\02_AnnexC_PostDev\01_AnnexC.qgz



Title:

Peak Flood Depths and Levels - Post-Activity Conditions - 1% AEP Event with Climate Change

Figure: C-05

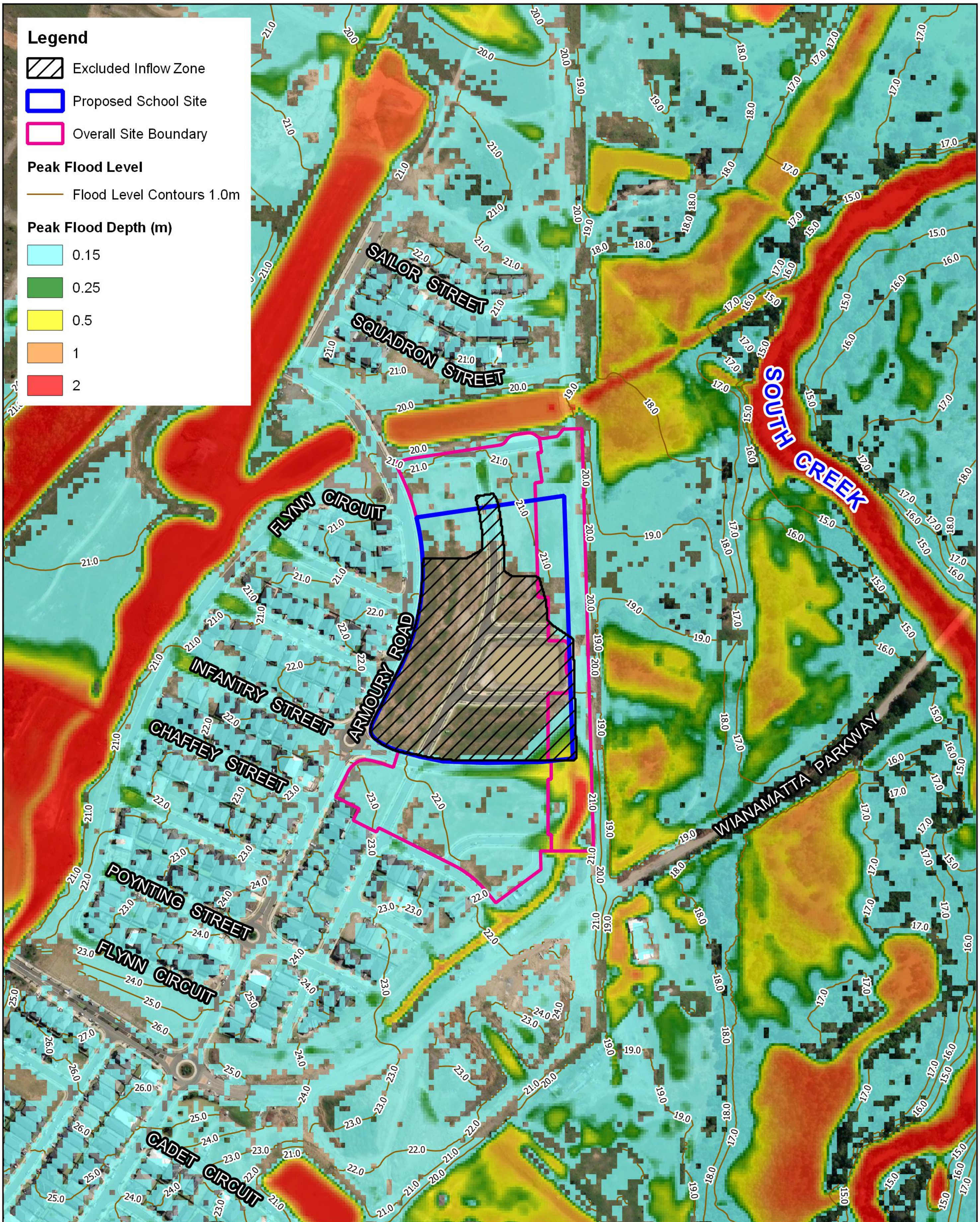
Rev: A

0 100 200 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\02_AnnexC_PostDev\01_AnnexC.qgz



Title:

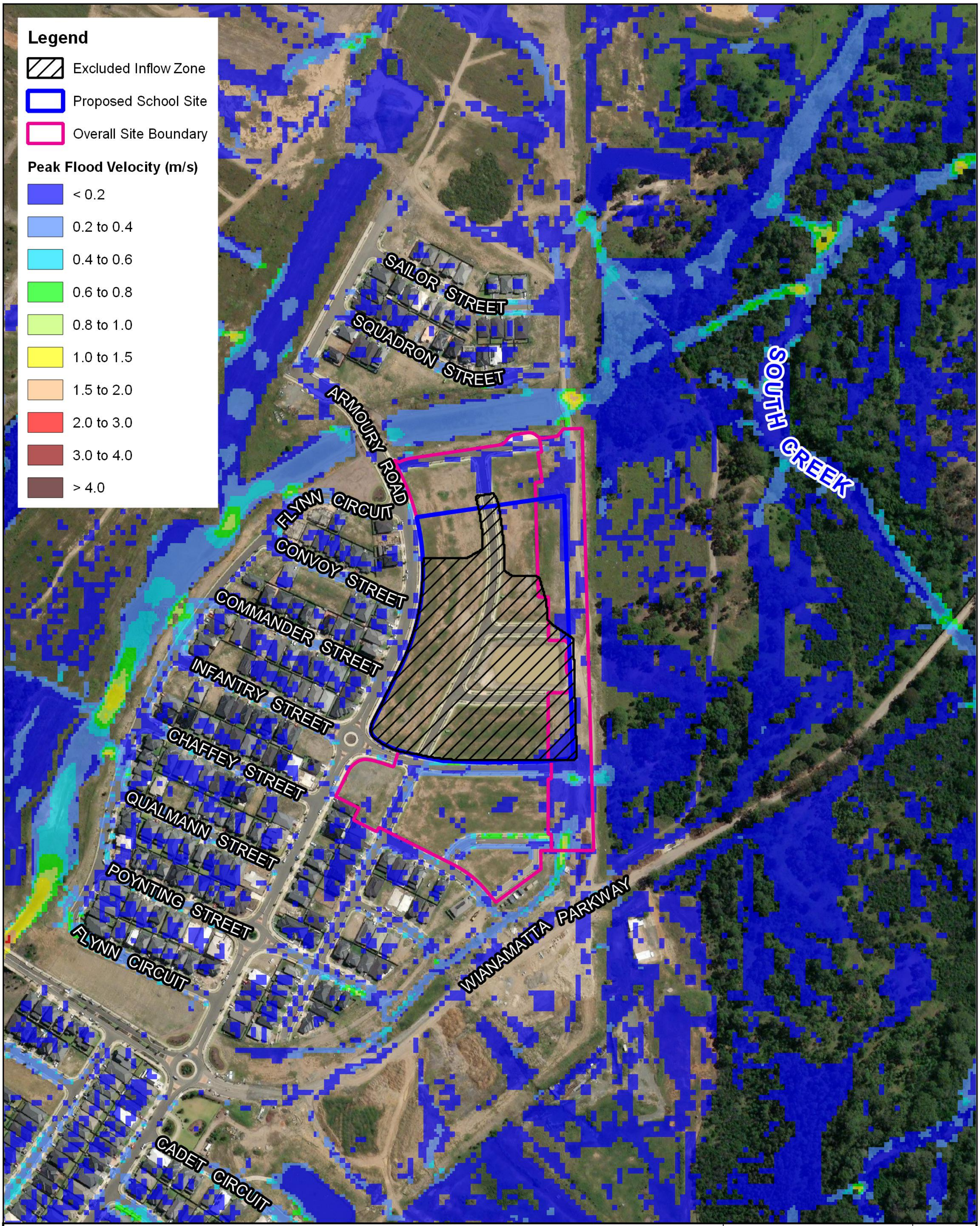
Peak Flood Depths and Levels - Post-Activity Conditions - PMF Event

Figure: **C-06**

Rev: **A**

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\02_AnnexC_PostDev\01_AnnexC.qgz



Title:

Peak Flood Velocities - Post-Activity Conditions - 10% AEP Event

Figure: C-07

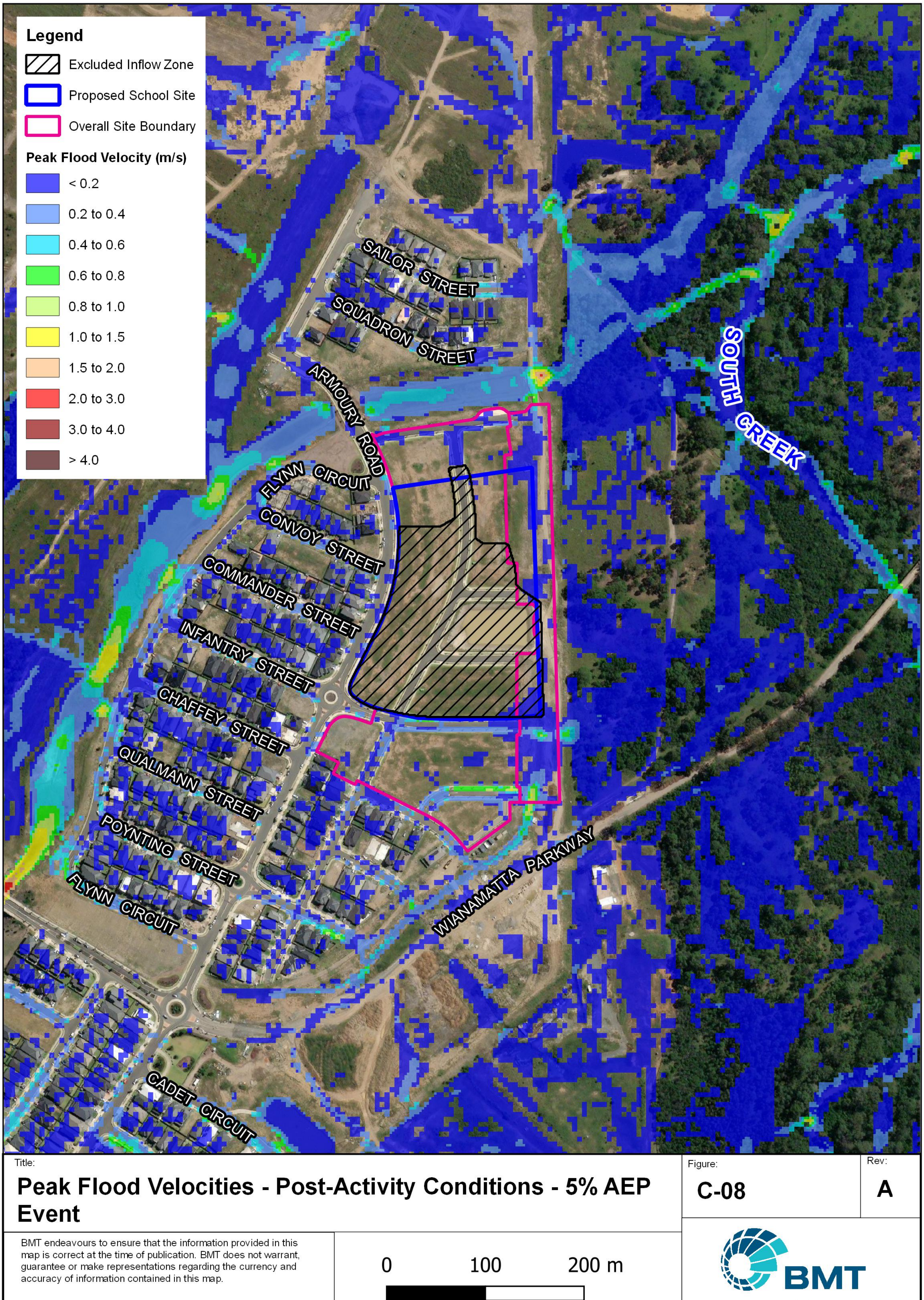
Rev: A

0 100 200 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\02_AnnexC_PostDev\01_AnnexC.qgz



Title:

Peak Flood Velocities - Post-Activity Conditions - 5% AEP Event

Figure: C-08

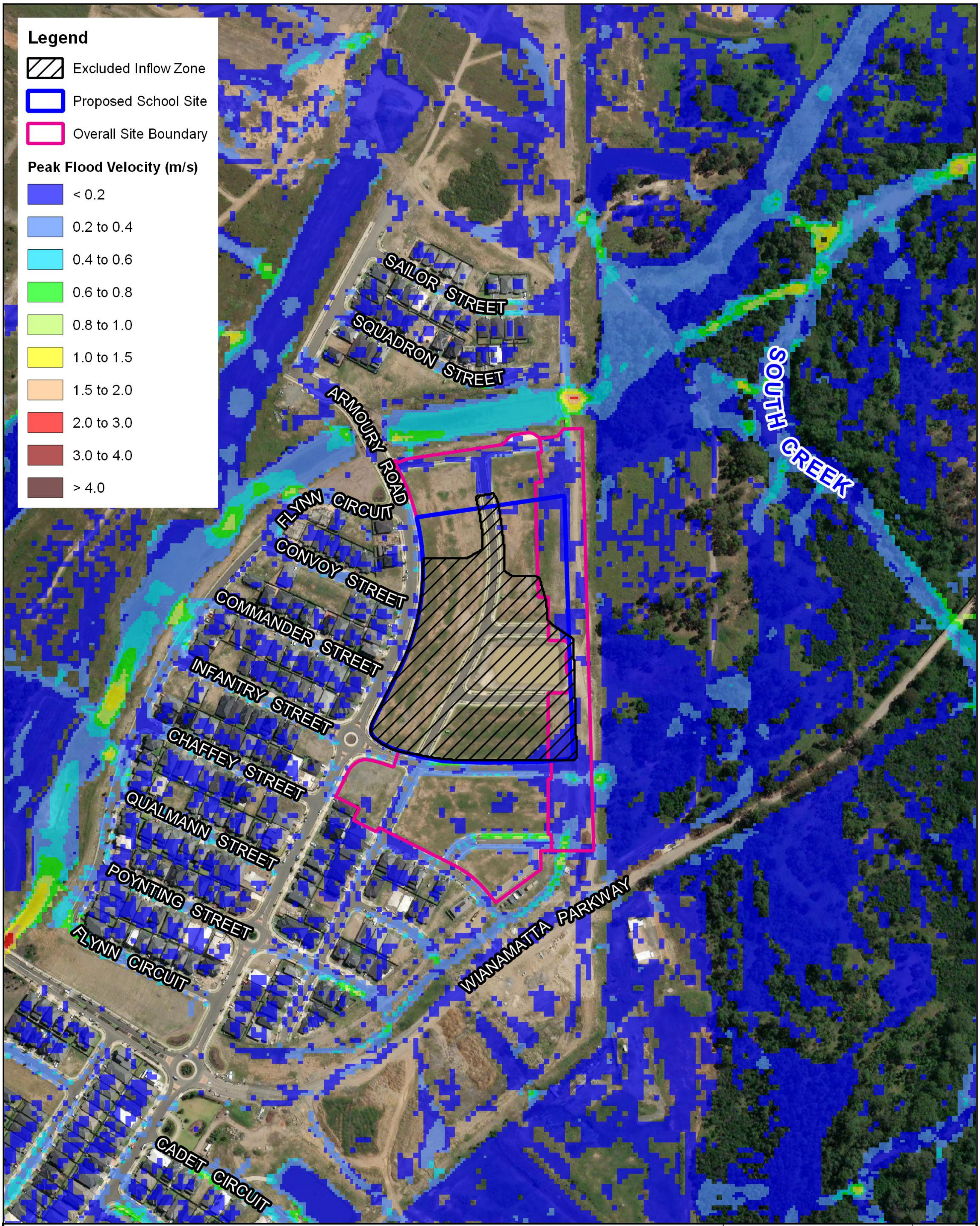
Rev: A

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

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\02_AnnexC_PostDev\01_AnnexC.qgz



Title:

Peak Flood Velocities - Post-Activity Conditions - 1% AEP Event

Figure: C-09

Rev: A

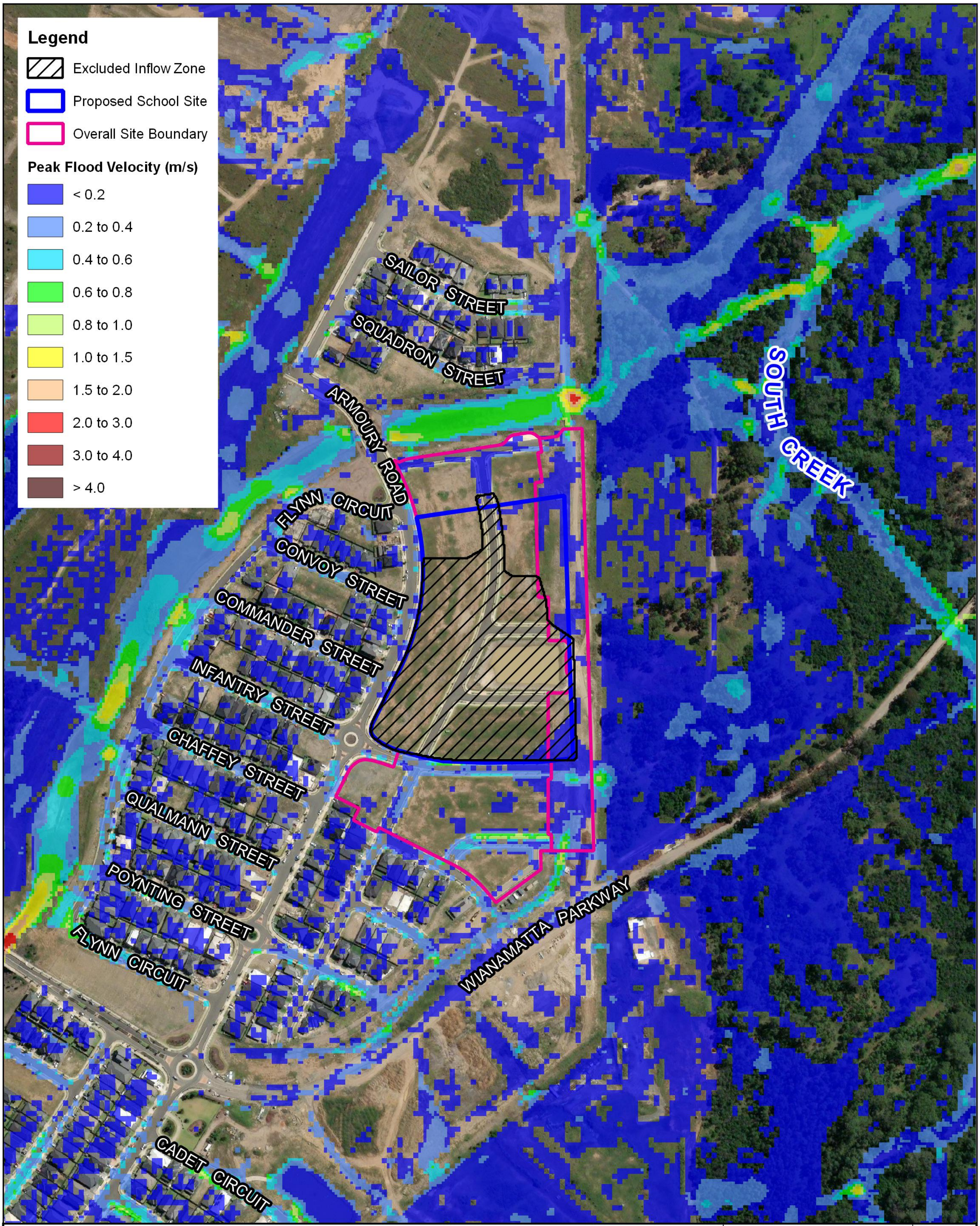
BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

0 100 200 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\02_AnnexC_PostDev\01_AnnexC.qgz



Title:

Peak Flood Velocities - Post-Activity Conditions - 0.2% AEP Event

Figure: C-10

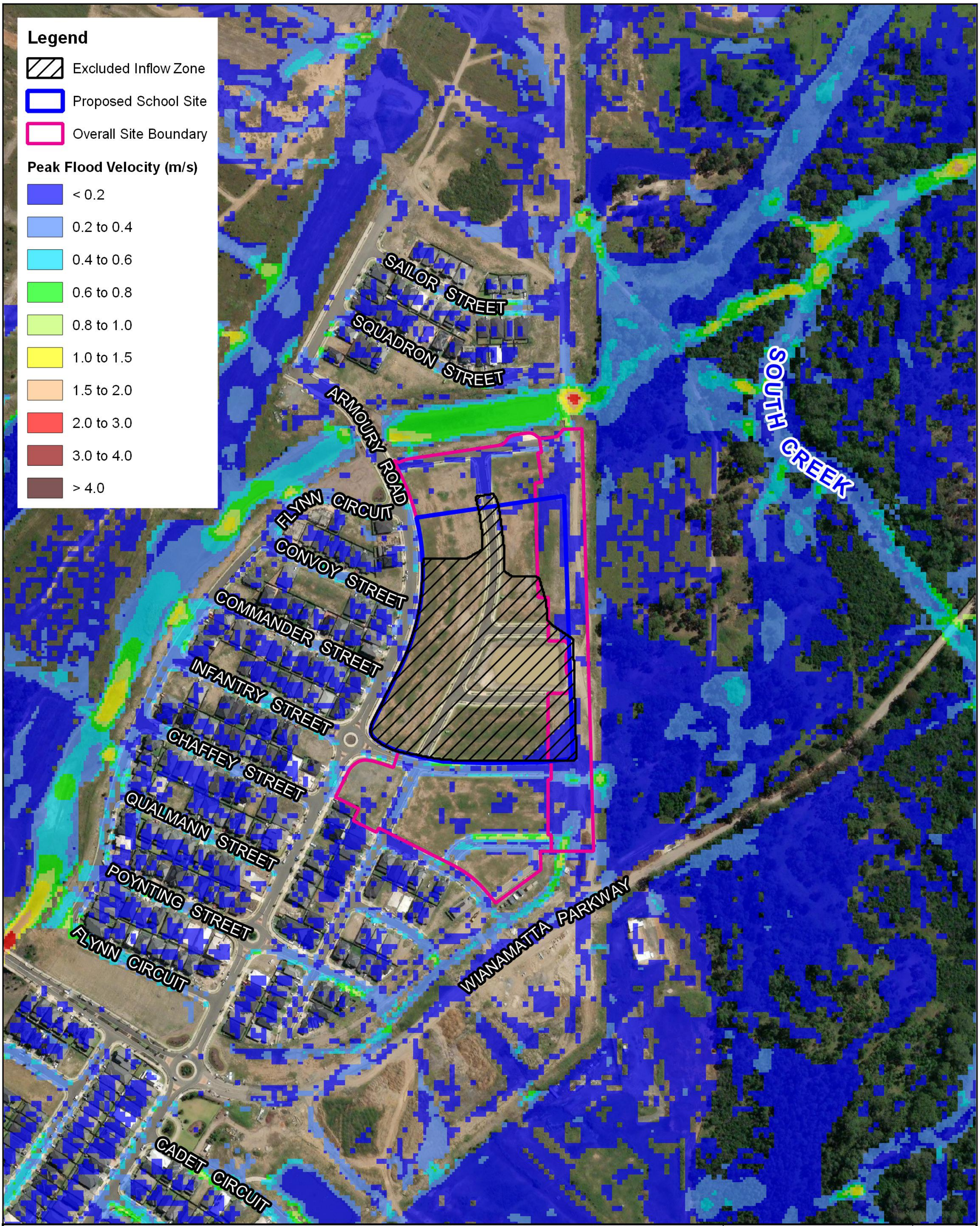
Rev: A

0 100 200 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\02_AnnexC_PostDev\01_AnnexC.qgz



Title:

Peak Flood Velocities - Post-Activity Conditions - 1% AEP Event with Climate Change

Figure: C-11

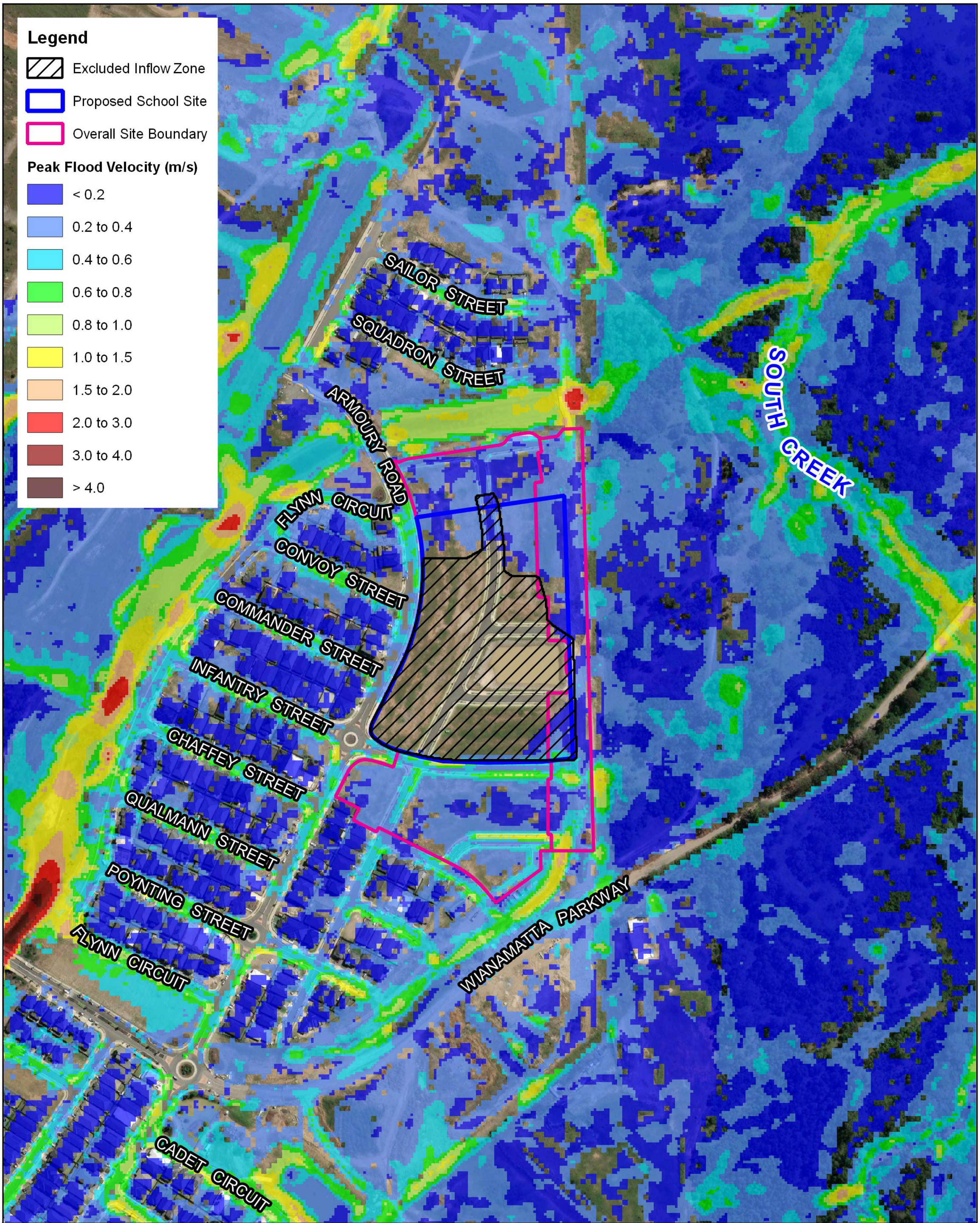
Rev: A

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

0 100 200 m

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\02_AnnexC_PostDev\01_AnnexC.qgz



Title:

Peak Flood Velocities - Post-Activity Conditions - PMF Event

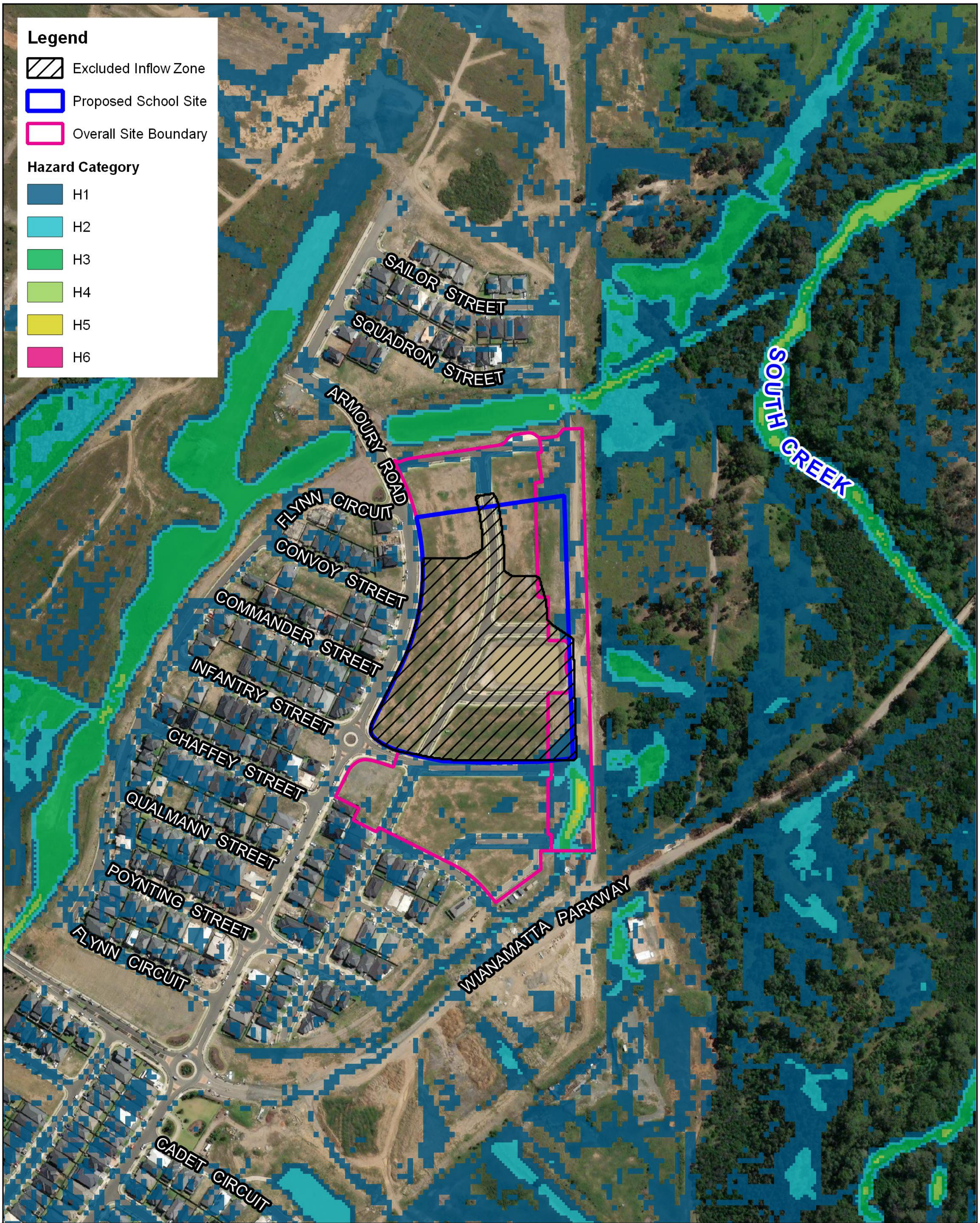
Figure: C-12

Rev: A

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\02_AnnexC_PostDev\01_AnnexC.qgz



Title:

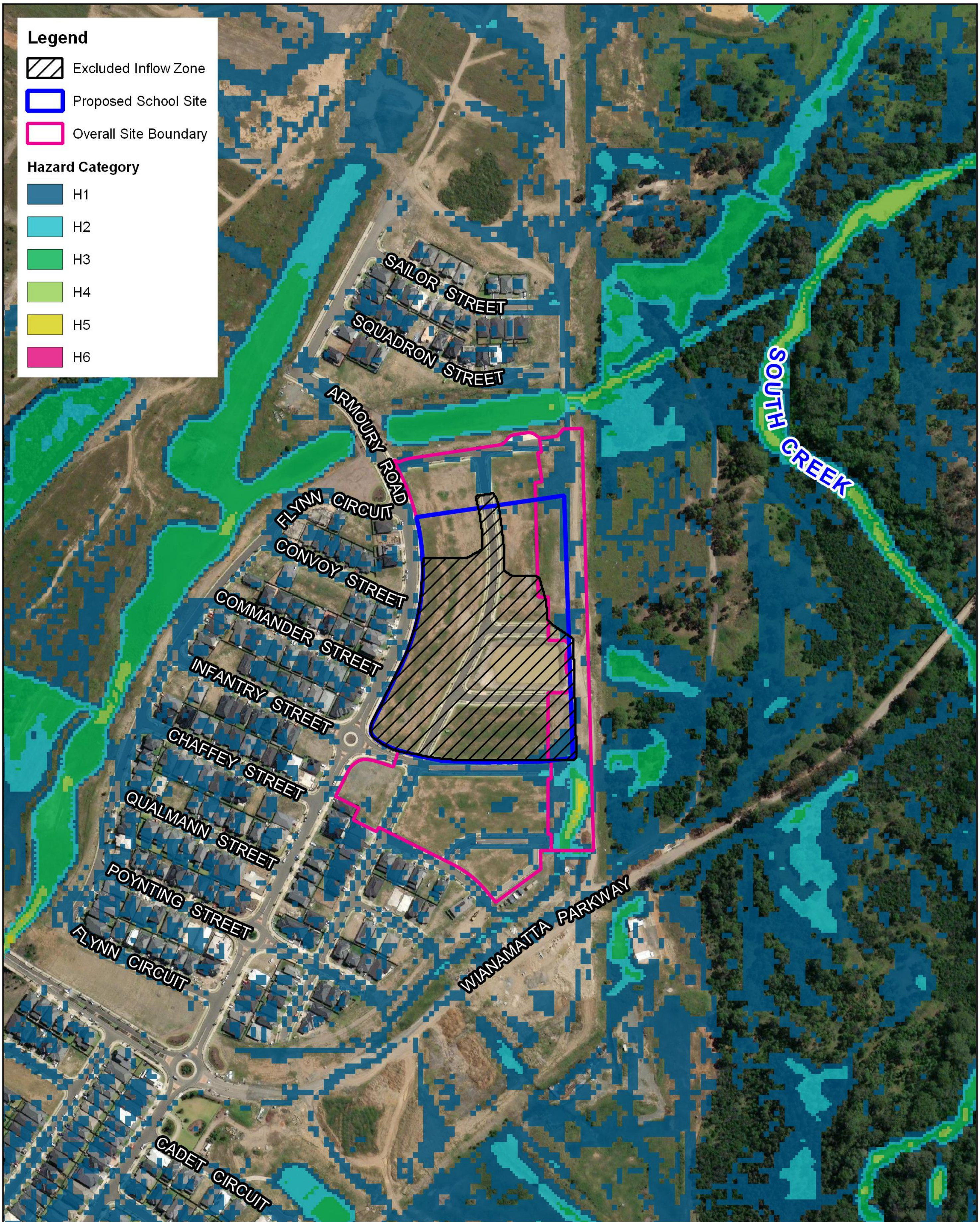
Peak Flood Hazard - Post-Activity Conditions - 10% AEP Event

Figure: C-13

Rev: A

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\02_AnnexC_PostDev\01_AnnexC.qgz



Title:

Peak Flood Hazard - Post-Activity Conditions - 5% AEP Event

Figure: C-14

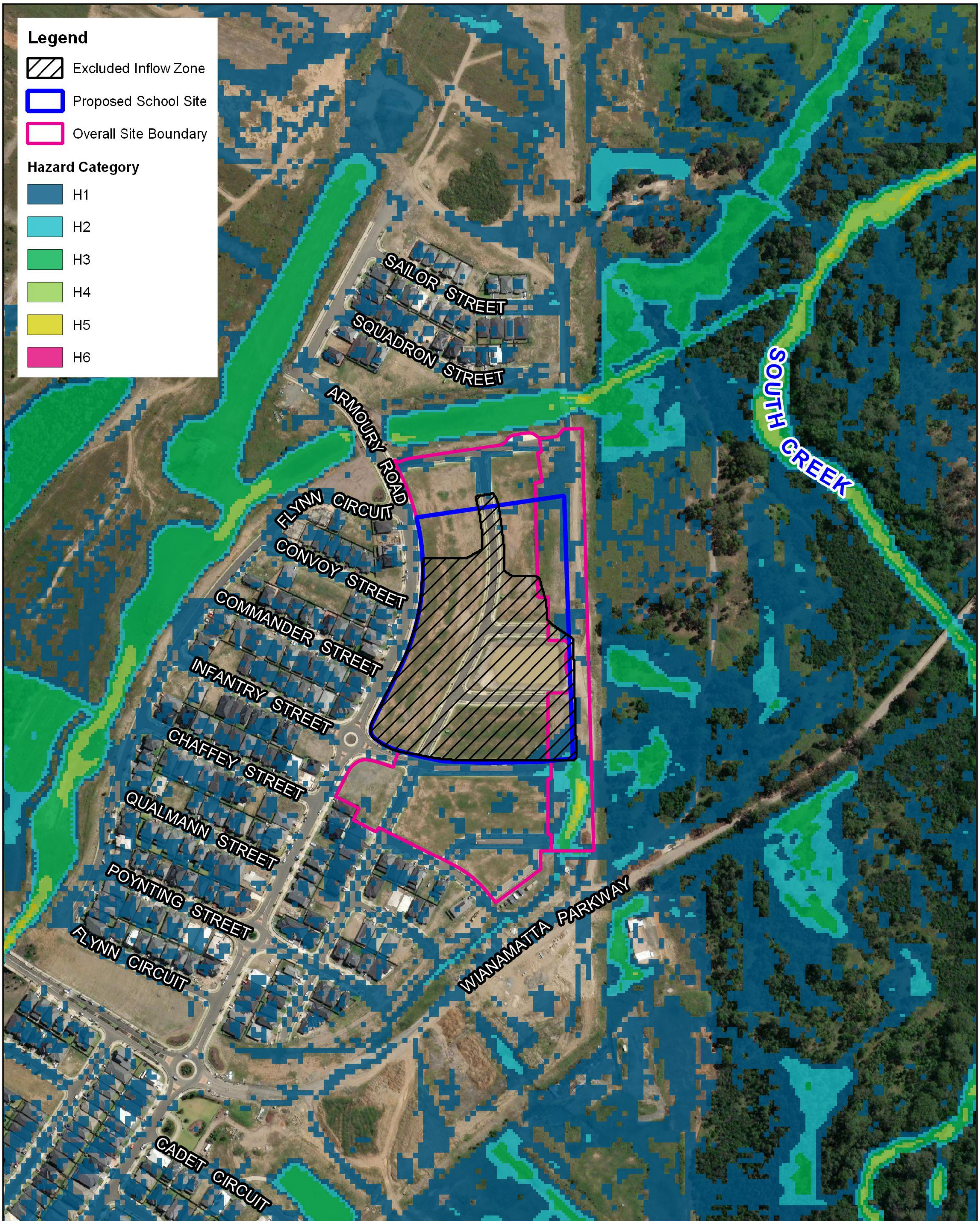
Rev: A

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

0 100 200 m

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\02_AnnexC_PostDev\01_AnnexC.qgz



Title:

Peak Flood Hazard - Post-Activity Conditions - 1% AEP Event

Figure: **C-15**

Rev: **A**

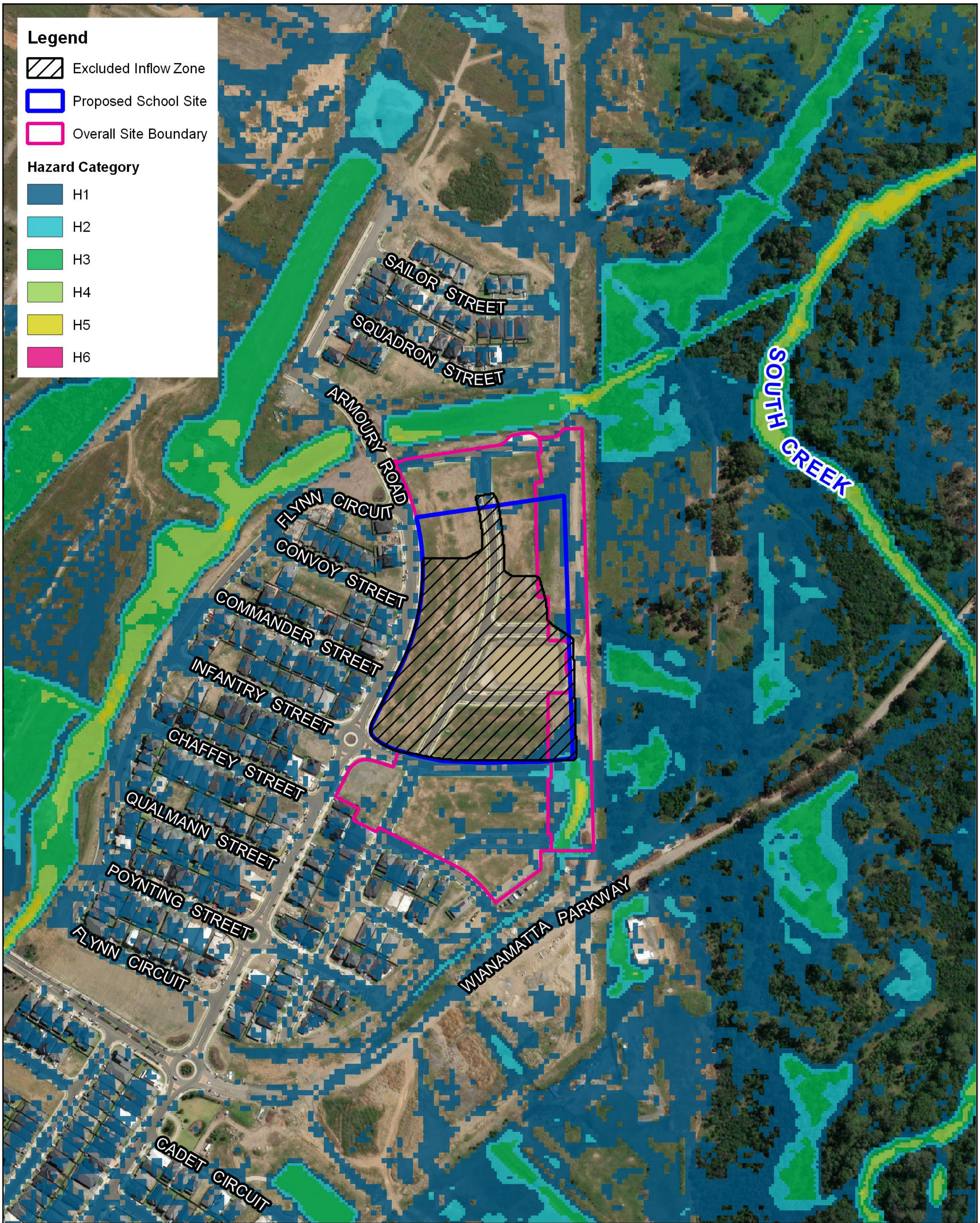
BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

0 100 200 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\02_AnnexC_PostDev\01_AnnexC.qgz



Title:

Peak Flood Hazard - Post-Activity Conditions - 0.2% AEP Event

Figure: C-16

Rev: A

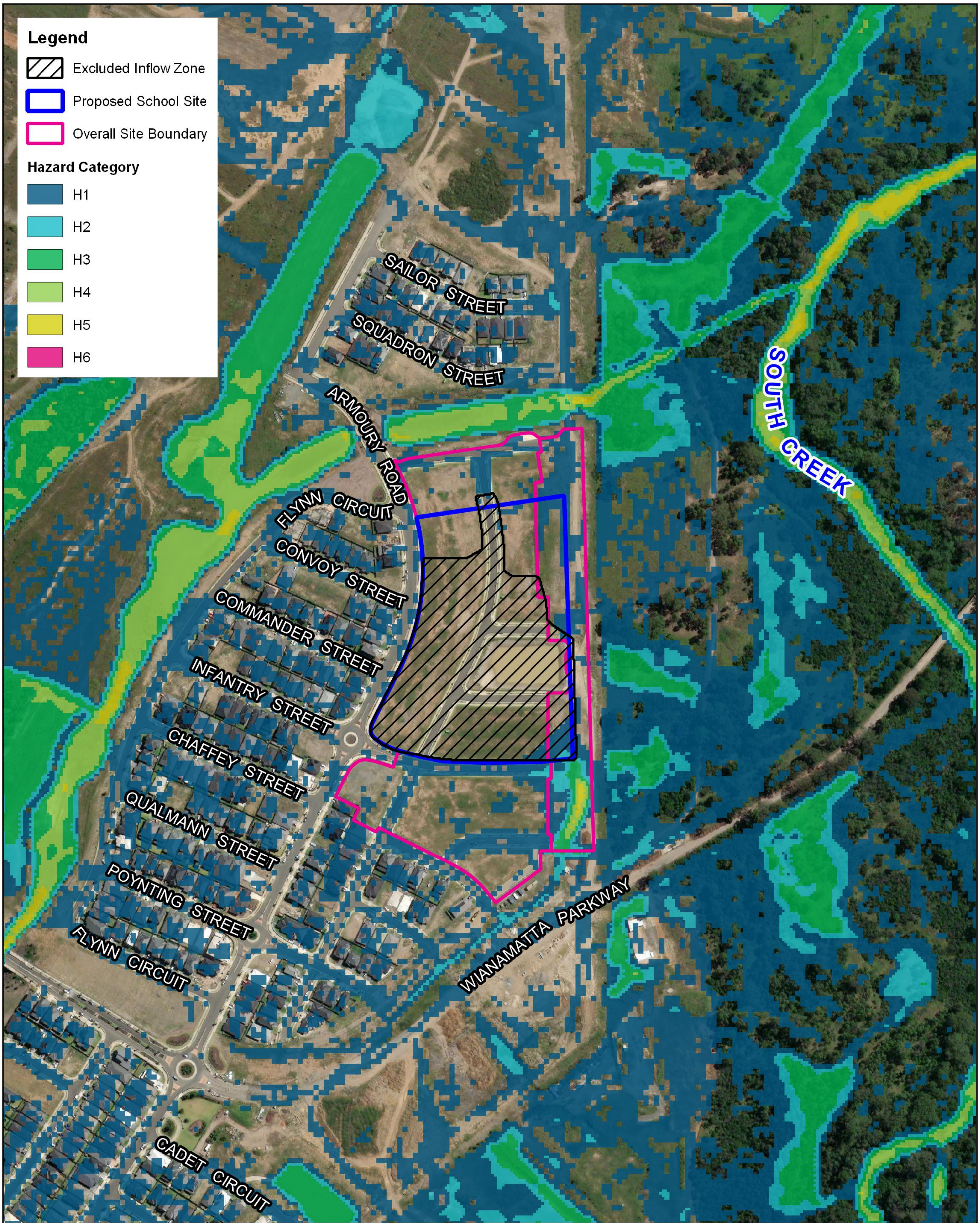
BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

0 100 200 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\02_AnnexC_PostDev\01_AnnexC.qgz



Title:

Peak Flood Hazard - Post-Activity Conditions - 1% AEP Event with Climate Change

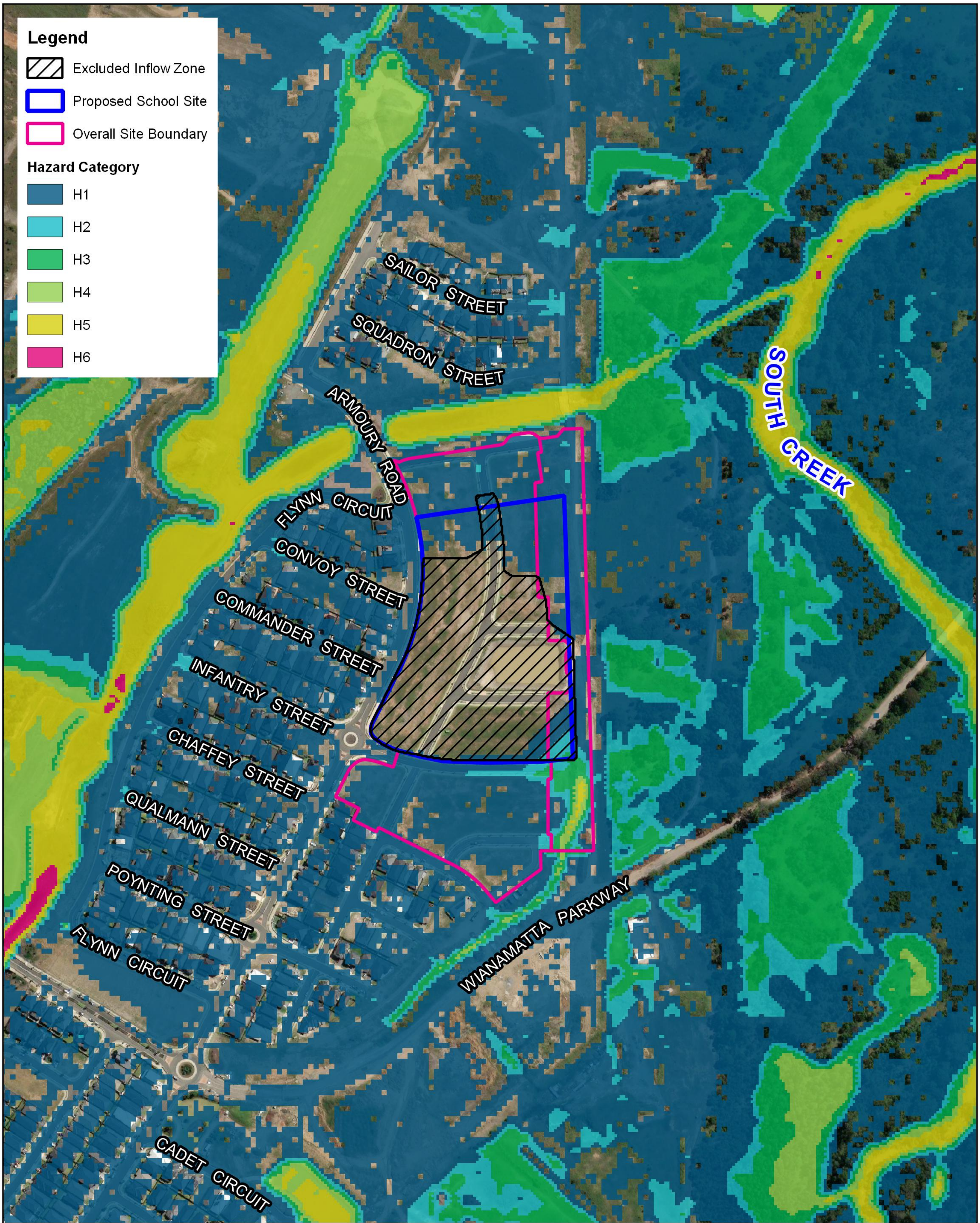
Figure: C-17

Rev: A

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

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\02_AnnexC_PostDev\01_AnnexC.qgz



Title:

Peak Flood Hazard - Post-Activity Conditions - PMF Event

Figure: C-18

Rev: A

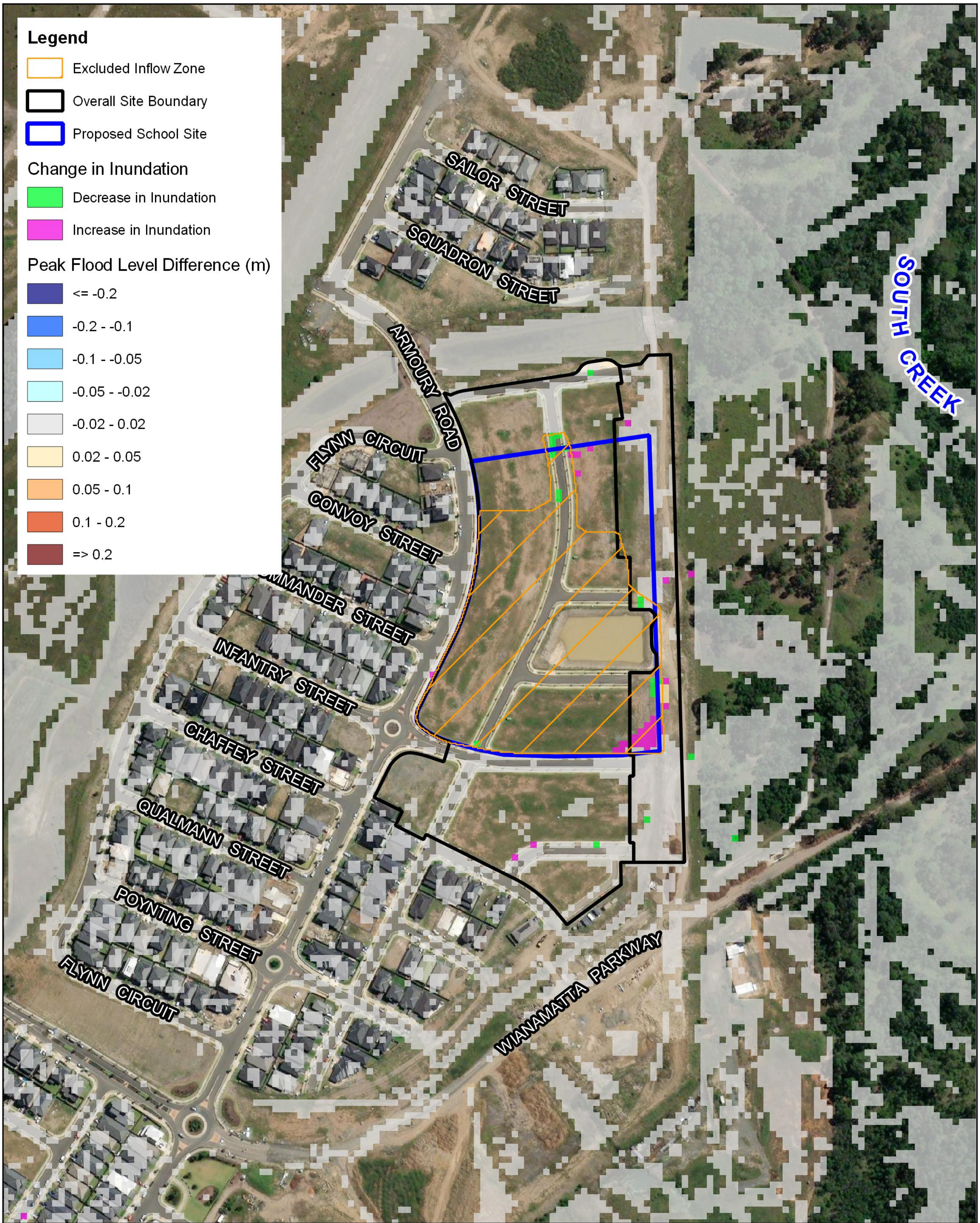
0 100 200 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\02_AnnexC_PostDev\01_AnnexC.qgz

Annex D Predicted Impacts on Local (Overland) Flood Conditions



Title:

Peak Flood Level Impact - 10% AEP Event

Figure: D-01

Rev: A

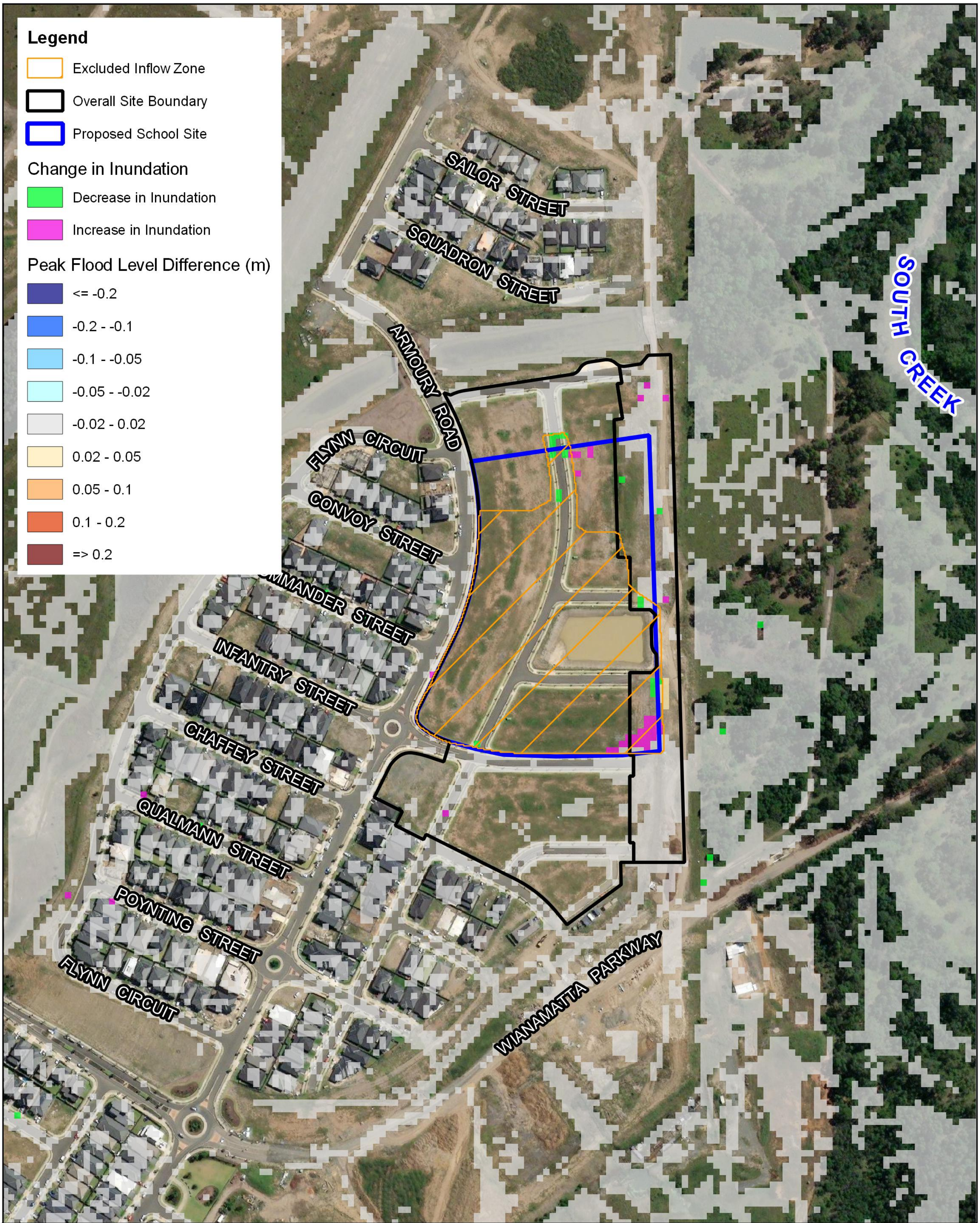
BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

0 90 180 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\03_AnnexD_Impacts\01_AnnexD.qgz



Title:

Peak Flood Level Impact - 5% AEP Event

Figure: **D-02**

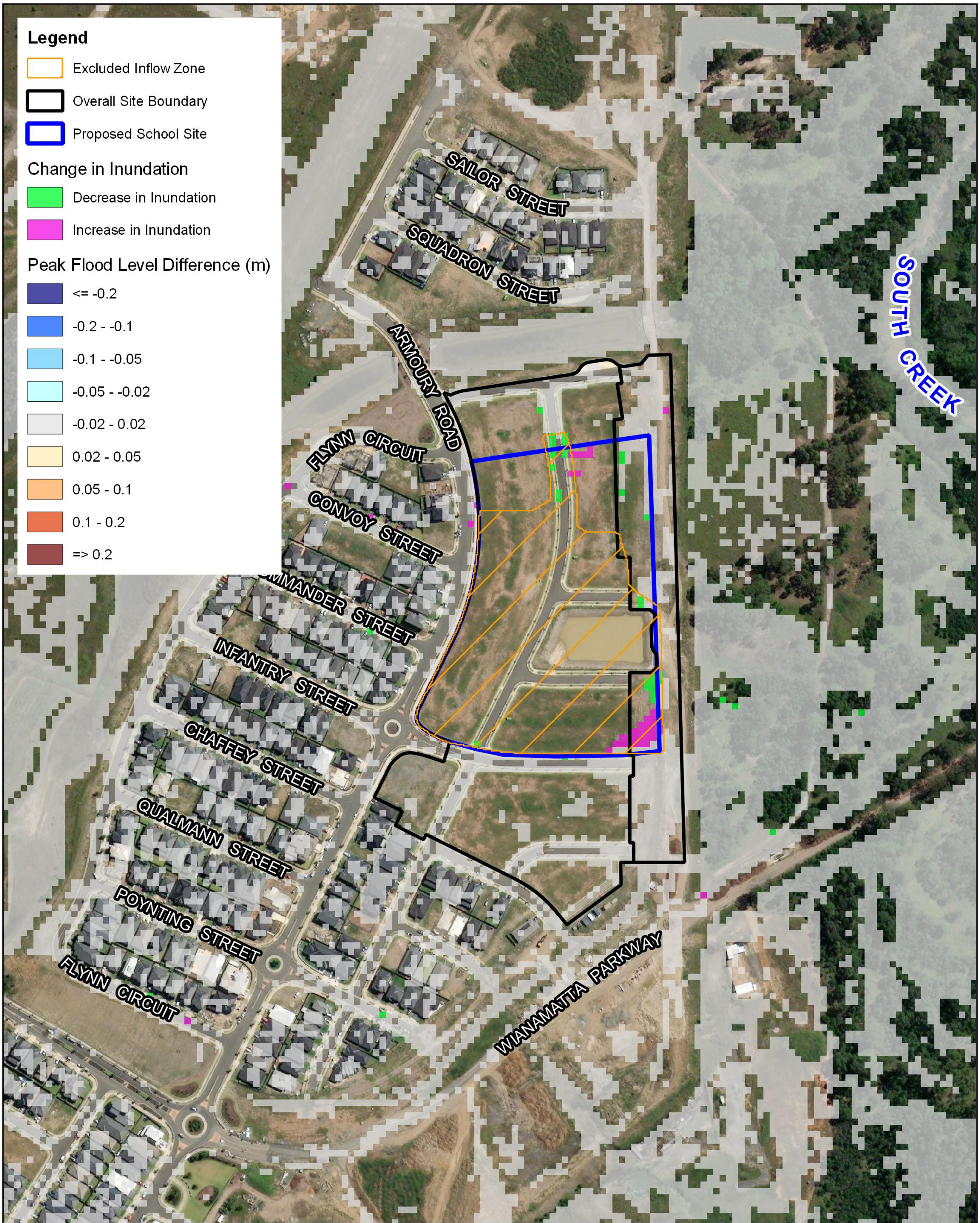
Rev: **A**

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

0 90 180 m

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\03_AnnexD_Impacts\01_AnnexD.qgz



Title:

Peak Flood Level Impact - 1% AEP Event

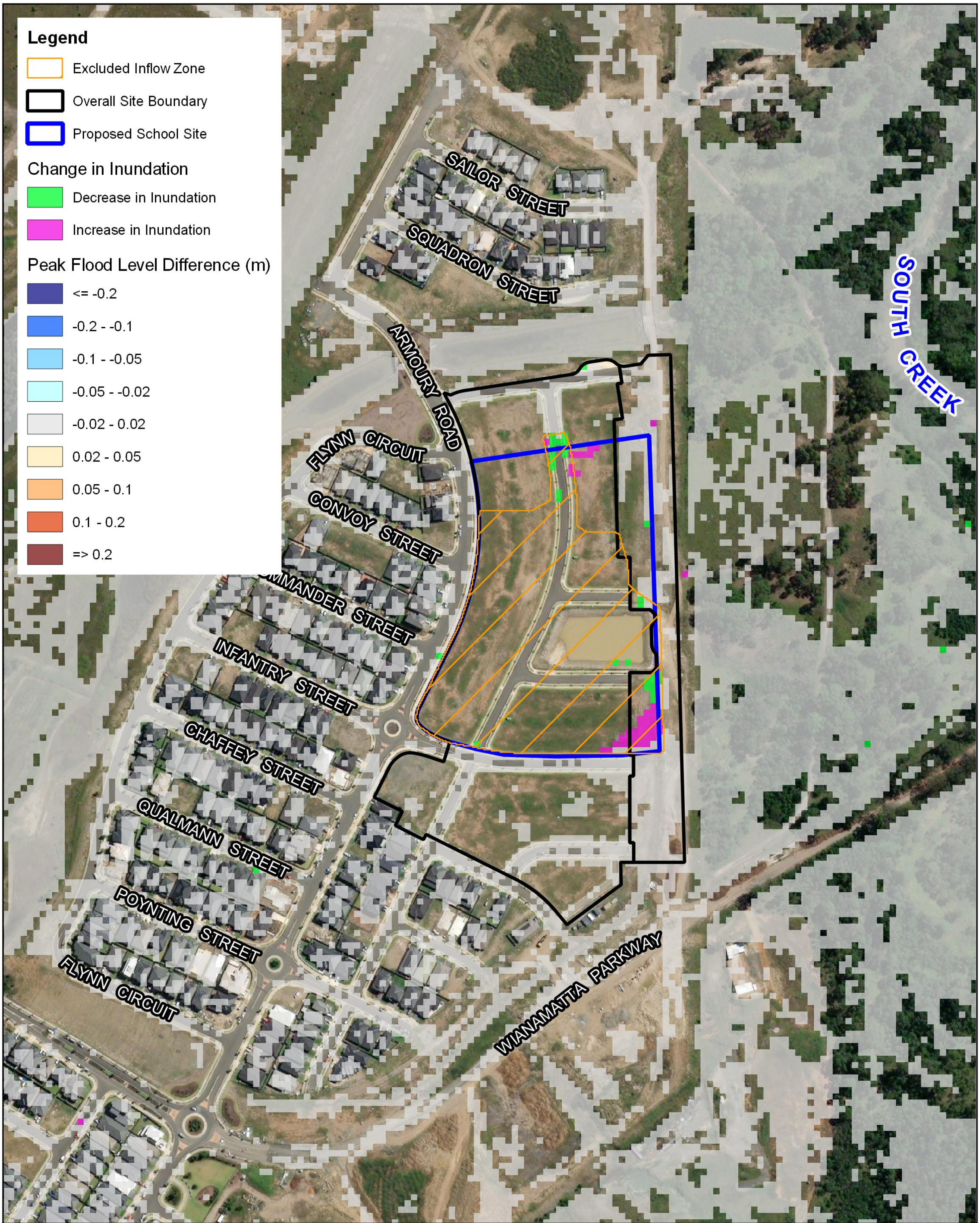
Figure: D-03

Rev: A

0 90 180 m

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\03_AnnexD_Impacts\01_AnnexD.qgz



Title:

Peak Flood Level Impact - 0.2% AEP Event

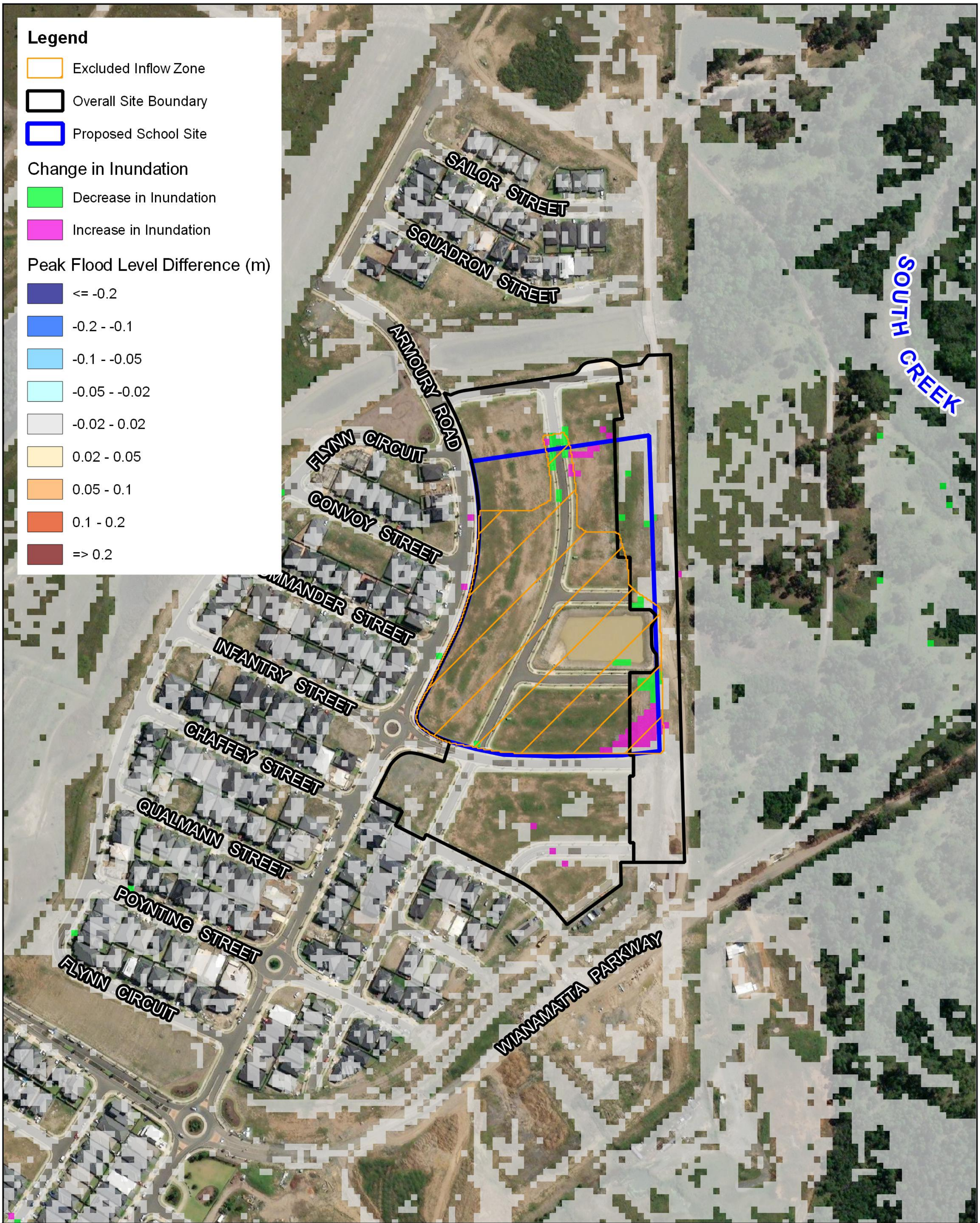
Figure: D-04

Rev: A

0 90 180 m

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\03_AnnexD_Impacts\01_AnnexD.qgz



Title:

Peak Flood Level Impact - 1% AEP Event with Climate Change

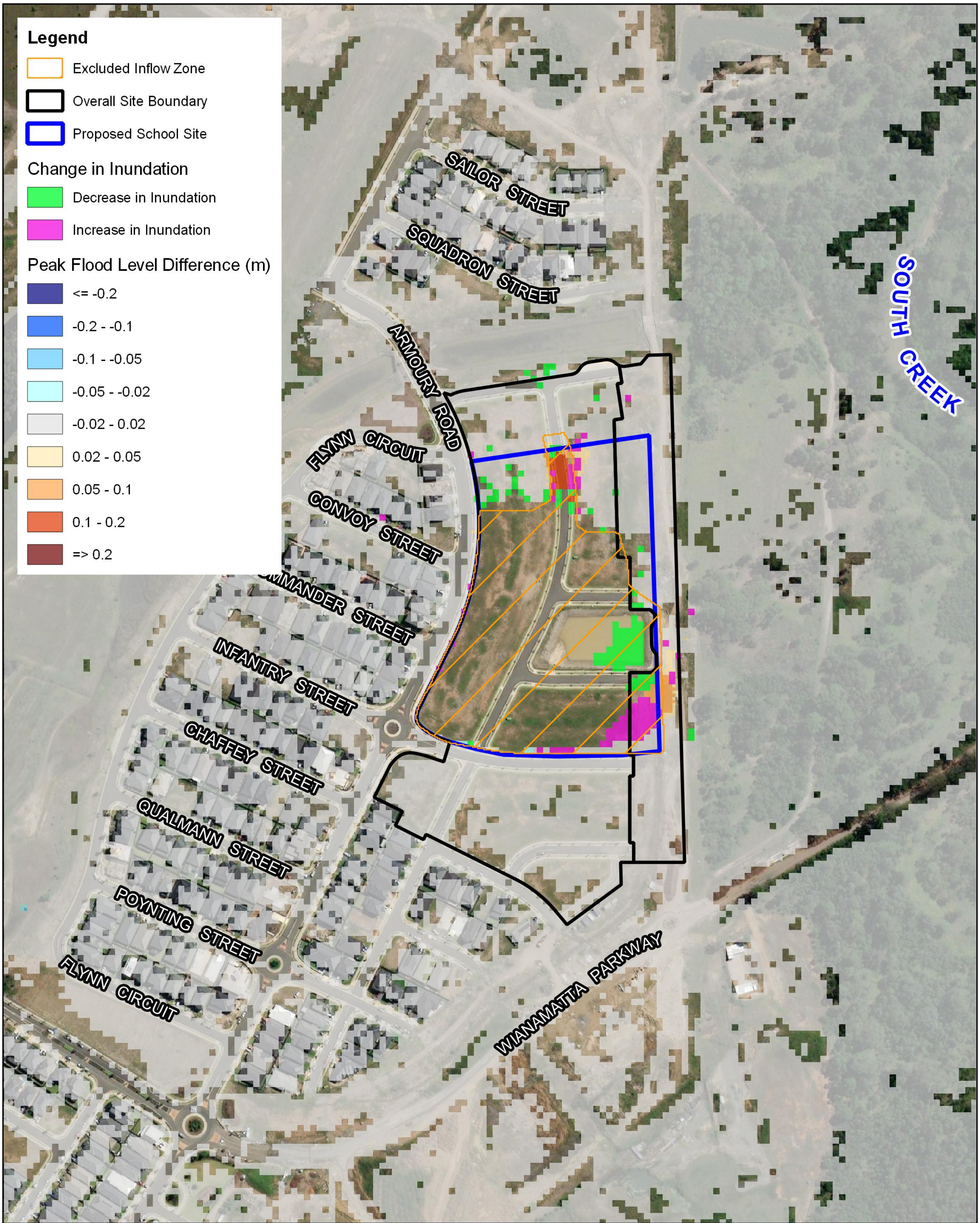
Figure: **D-05**

Rev: **A**

0 90 180 m

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\03_AnnexD_Impacts\01_AnnexD.qgz



Title:

Peak Flood Level Impact - PMF Event

Figure: D-06

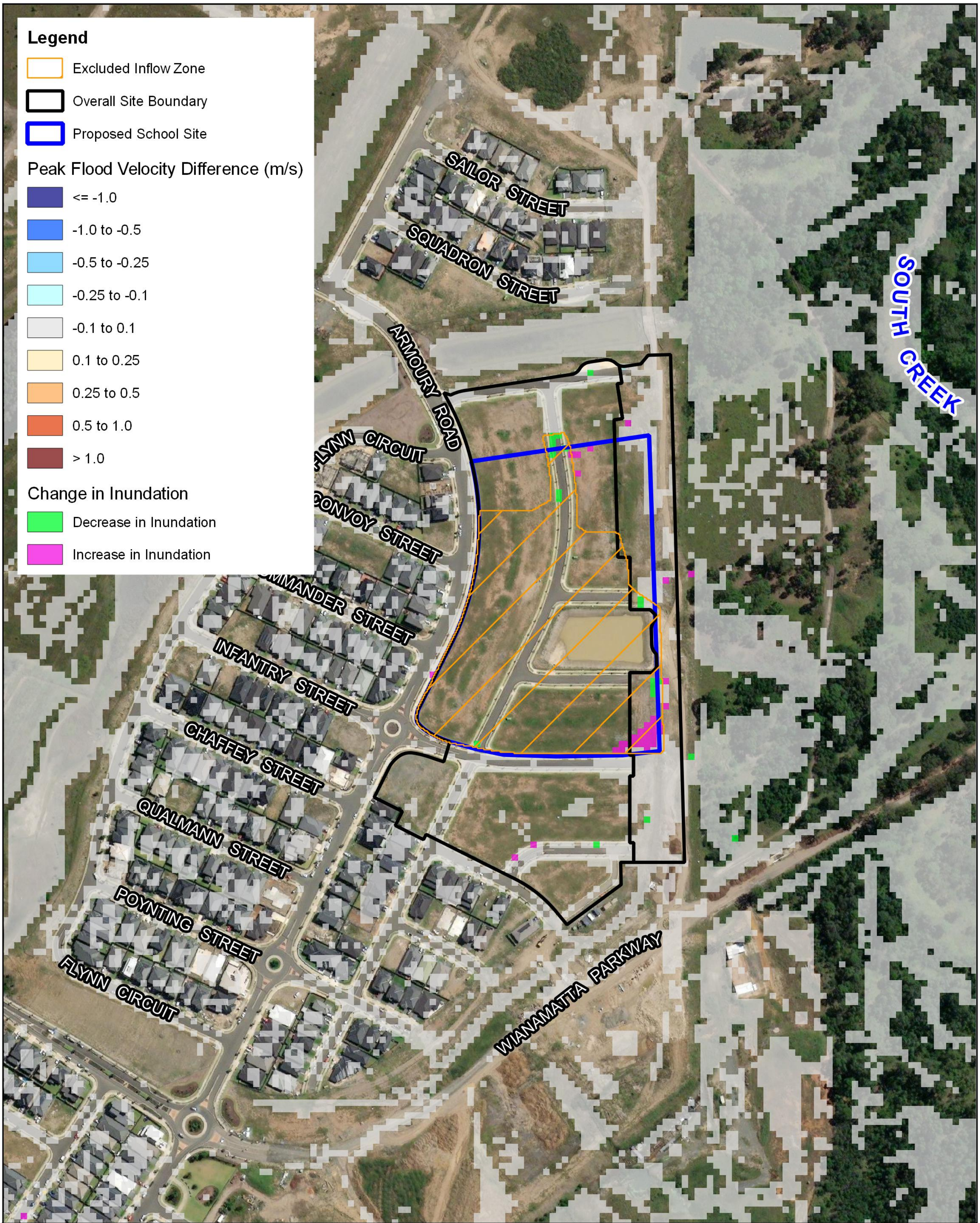
Rev: A

0 90 180 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\03_AnnexD_Impacts\01_AnnexD.qgz



Title:

Peak Flood Velocity Impact - 10% AEP Event

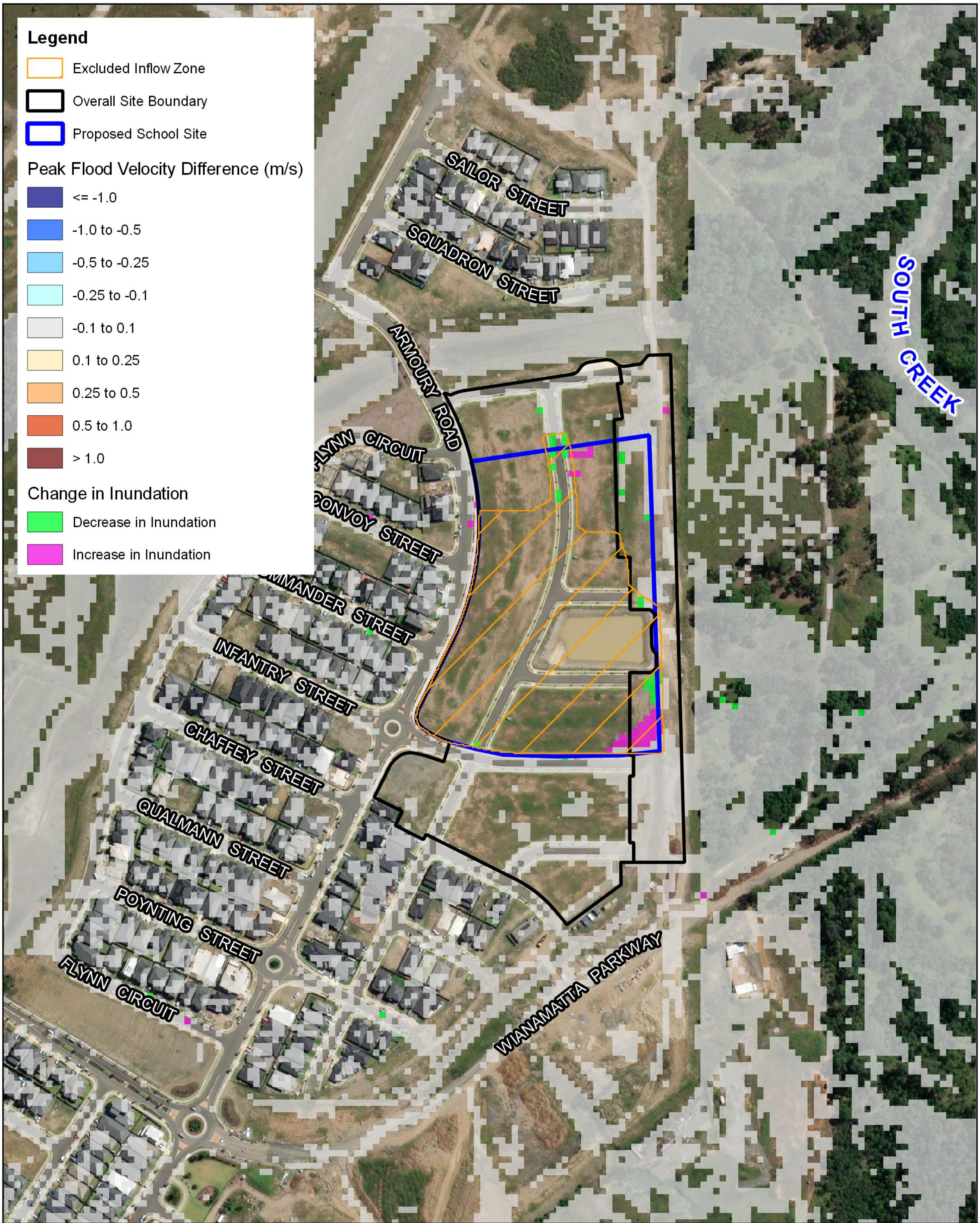
Figure: D-07

Rev: A

0 90 180 m

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\03_AnnexD_Impacts\01_AnnexD.qgz



Title:

Peak Flood Velocity Impact - 1% AEP Event

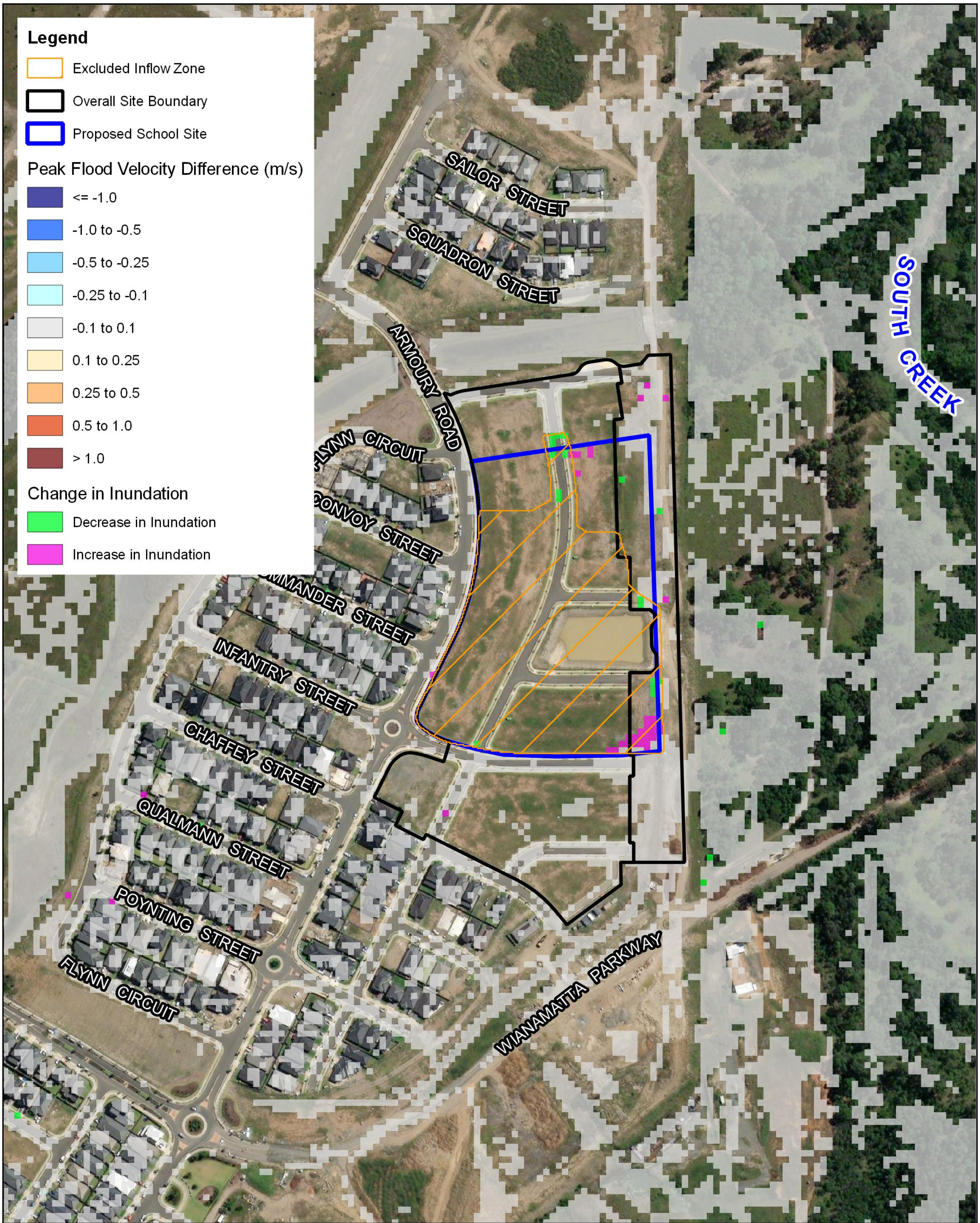
Figure: D-08

Rev: A

0 90 180 m

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\03_AnnexD_Impacts\01_AnnexD.qgz



Title:

Peak Flood Velocity Impact - 5% AEP Event

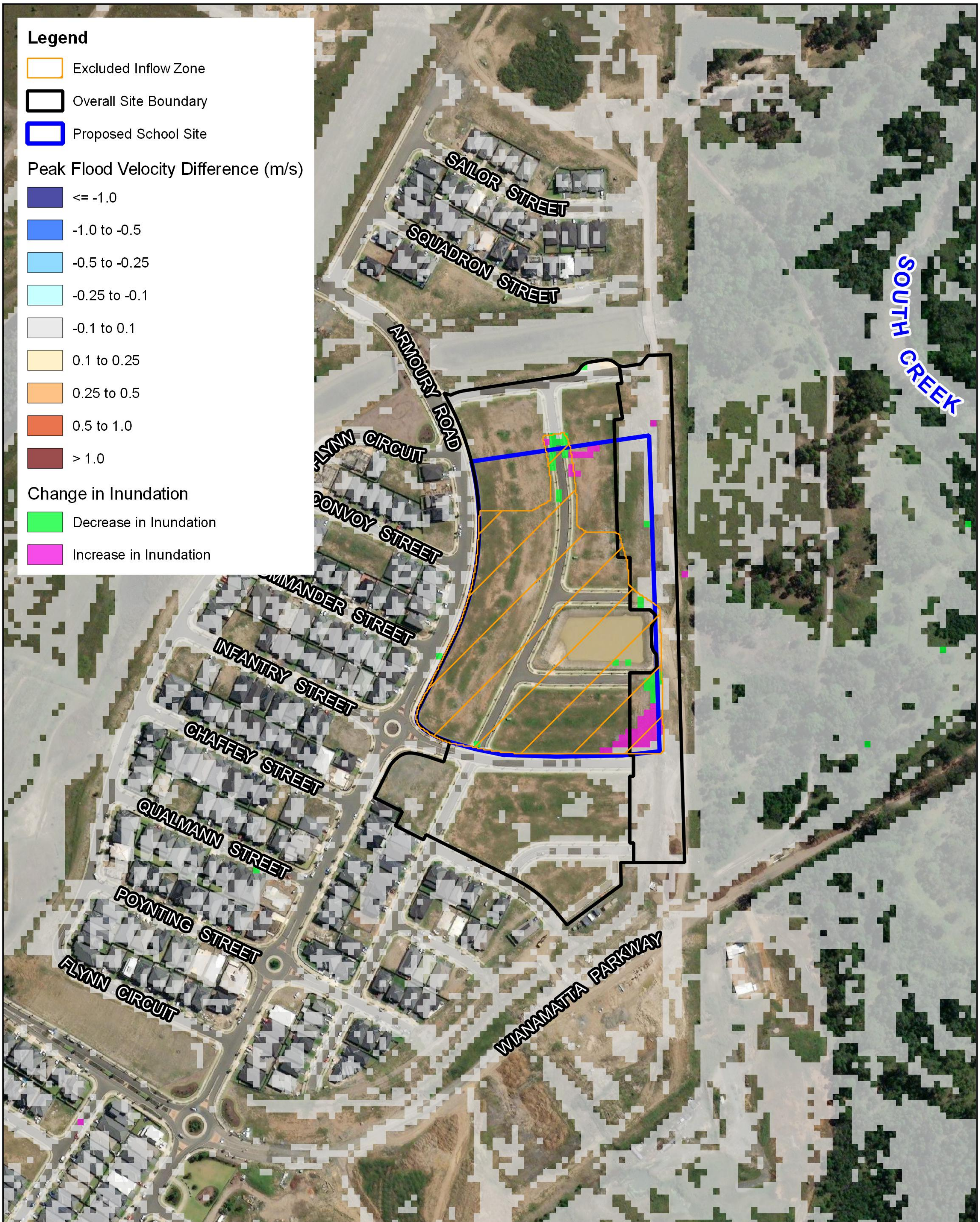
Figure: **D-08**

Rev: **A**

0 90 180 m

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\03_AnnexD_Impacts\01_AnnexD.qgz



Title:

Peak Flood Velocity Impact - 0.2% AEP Event

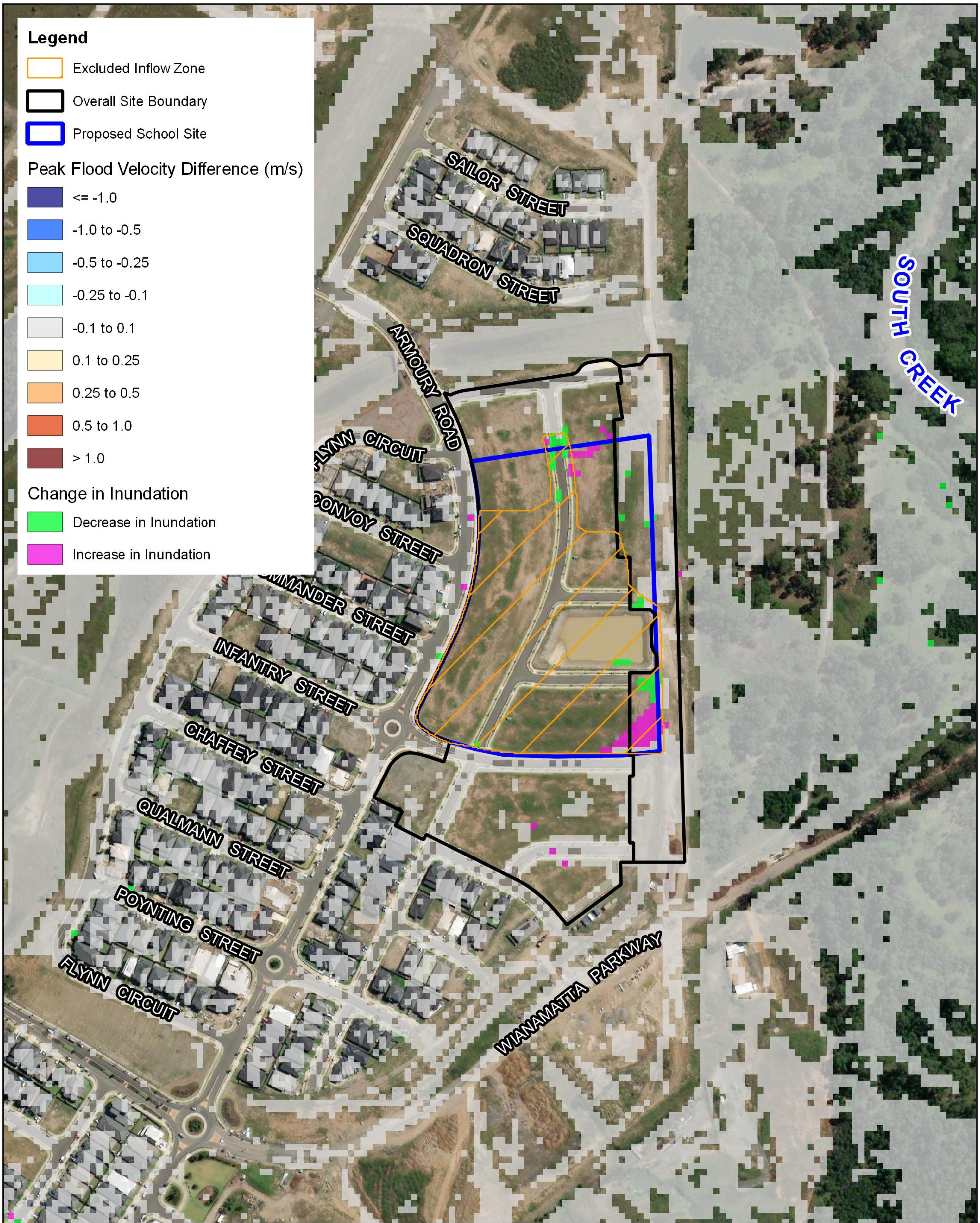
Figure: **D-09**

Rev: **A**

0 90 180 m

BMT
www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\03_AnnexD_Impacts\01_AnnexD.qgz



Title:

Peak Flood Velocity Impact - 1% AEP Event with Climate Change

Figure: **D-10**

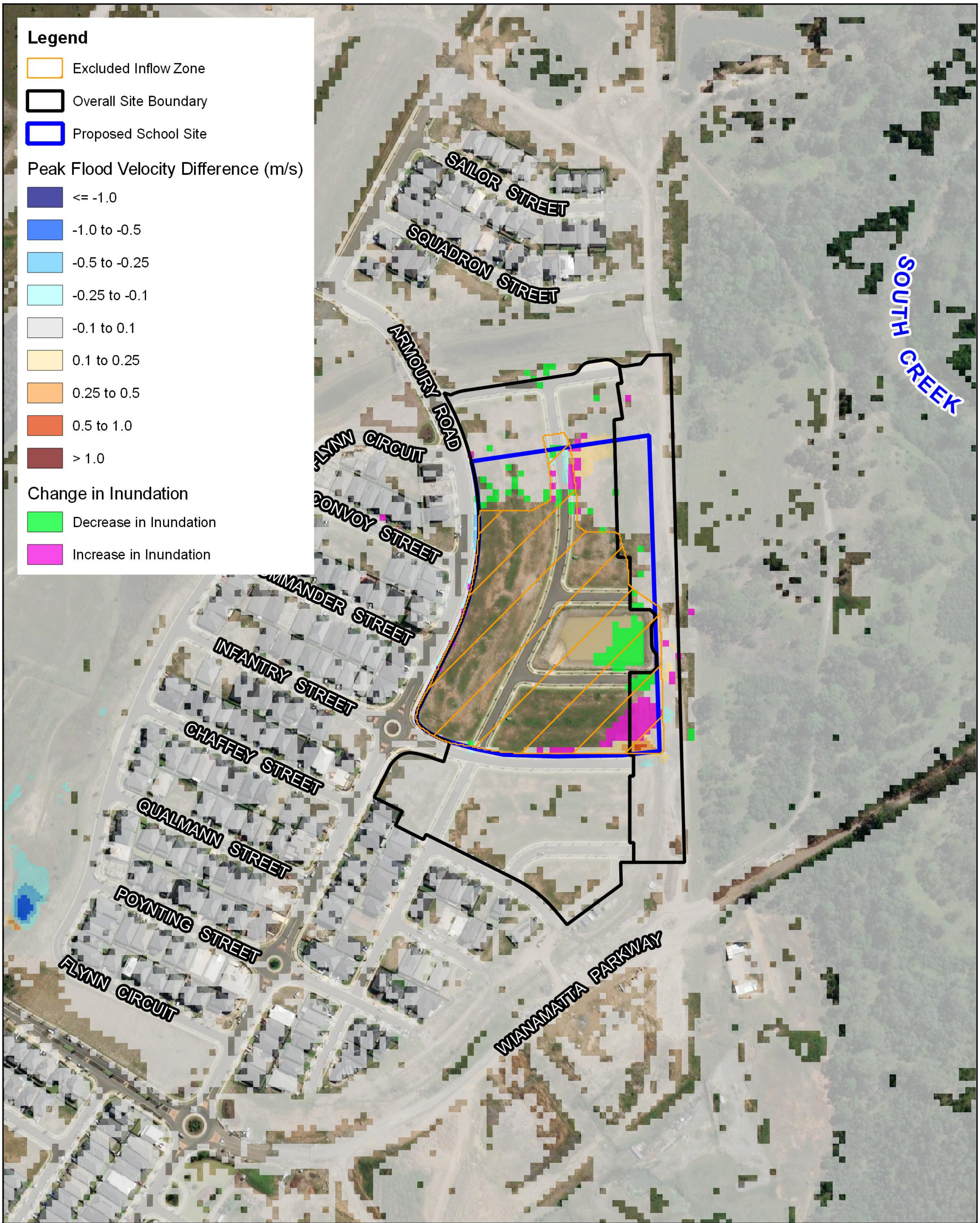
Rev: **A**

0 90 180 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\03_AnnexD_Impacts\01_AnnexD.qgz



Title:

Peak Flood Velocity Impact - PMF Event

Figure: **D-11**

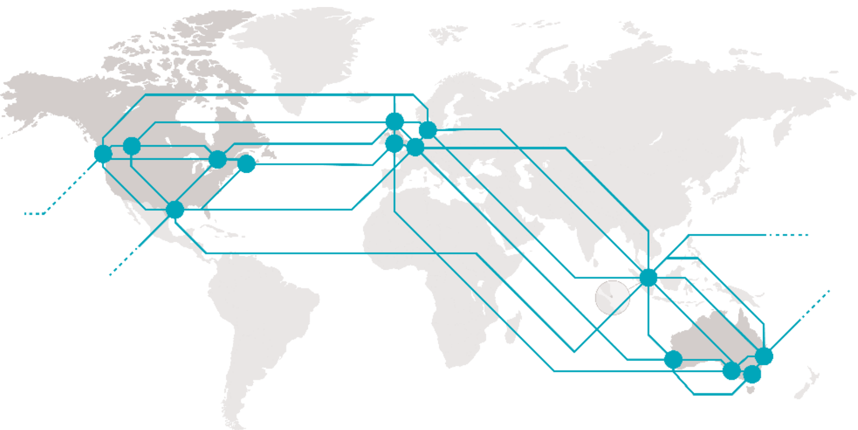
Rev: **A**

0 90 180 m

BMT

www.bmt.org

Filepath: \\bmt-syd-fs01\wbmsyd\WATER\PROJECTS\3408_JordanSprings_SchoolAssessment\GIS\Figure\02_Result_Figures\03_AnnexD_Impacts\01_AnnexD.qgz



BMT is a leading design, engineering, science and management consultancy with a reputation for engineering excellence. We are driven by a belief that things can always be better, safer, faster and more efficient. BMT is an independent organisation held in trust for its employees.

Level 4
4-14 Foster Street
Surry Hills
NSW 2010
Australia
+61 2 8960 7755

Registered in Australia
Registered no. 010 830 421
Registered office
Level 5, 348 Edward Street,
Brisbane QLD 4000 Australia

For your local BMT office visit www.bmt.org

Contact us

enquiries@bmtglobal.com

www.bmt.org

Follow us

www.bmt.org/linkedin

www.bmt.org/youtube

www.bmt.org/twitter

www.bmt.org/facebook