

Supplementary Flooding Report

Parramatta Light Rail Stage 2







Supplementary Flooding Report May 2023 This page left intentionally blank for pagination.

Mott MacDonald 383 Kent Street Sydney NSW 2000 PO Box Q1678 QVB Sydney NSW 1230 Australia

T +61 (0)2 9098 6800 mottmac.com

Transport for NSW Parramatta

Parramatta Light Rail Stage 2

Supplementary Flooding Report

May 2023

Issue and Revision Record

Rev	vision	Date	Originator	Checker	Approver	Description
0		18/05/2023	Tomas Sanchez- Bayo, Tom Gu, David Chick	Jeffrey Mail	Tim Green	Final for issue to DPE

Document reference: 703425724 | 1 | E |

Information class: Standard

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Contents

Glo	ssary	and Abb	reviations	vii			
Exe	ecutive	Summa	ıry	8			
1	Introduction						
			-W-12-14 D-7	12			
	1.1		atta Light Rail	12			
	1.2		al and assessment requirements	13			
		1.2.1 1.2.2	Approval requirements	13 14			
	1.3		Responding to submissions and proposed amendments	15			
	1.3	1.3.1	overview Key features	15			
		1.3.1	Operation	16			
		1.3.3	Timing	16			
	1.4		e of this report	18			
2	Proposed project amendments						
	2.1	Camellia foreshore to Rydalmere alignment and bridge					
	2.2	·					
	2.3	-					
	2.4	Construction compounds					
3	Assessment Methodology						
	3.1	Study Area					
	3.2	Flood Modelling Approach					
	3.3	Flood Management Objectives		28			
		3.3.1	Consistency of FMOs	28			
4	Floo	d impact	ts of project amendments	31			
	4.1	Constru	ction Impacts	31			
		4.1.1	Construction compounds	31			
		4.1.2	Bridge construction and modification	34			
	4.2 Operational Impacts						
		4.2.1	Bridge between Camellia and Rydalmere modelling results	40			
	4.3	Camellia bridge - further design refinement					
		4.3.1	Modelling results	42			
	4.4	.4 Cumulative impacts					
5	Mitic	Mitigation measures					

6 Conclusion		46
7 References		48
Appendix A	Updated Flood Maps	49
Appendix B	Proof of Concept Flood Maps	54
Appendix C	Additional Modelling Configuration	59
Table 3-1 Acceptable in Table 4-1 Summary of (construction compound Table 4-2 Flood potenti Table 4-3 Summary of locations	with relevant Secretary's environmental assessment requirements impacts for major transport infrastructure flood risks and potential impacts from proposed project amendments ds) al impacts during bridge construction changed operational flooding impacts at the project amendment imulative flooding impacts due to the re-alignment of the bridge	14 19 30 32 34 36
Figure 2-2 Melrose Par Figure 2-3 Bridge at Hill Figure 2-4 Construction Figure 2-5 Construction Figure 2-6 Construction Figure 4-1: Layout of the Figure 4-2: Bridge between	s of the project eshore to Rydalmere alignment and bridge k to Wentworth Point bridge amendment	13 17 22 24 25 26 26 27 40 41 42
_	er configuration for the bridge between Camellia and Rydalmere –	43

Glossary and Abbreviations

Term/Acronym	Definition
AEP	Annual Exceedance Probability
CAD	Computer Aided Design
CBD	Central Business District
CEMP	Construction Environmental Management Plan
Cth	Commonwealth legislation
DIPNR	Department of Infrastructure Planning and Natural Resources (now DPE)
DPE	Department of Planning and Environment
EIS	Environmental Impact Statement
EIS Technical Paper 10	Hydrology, Flooding and Water Quality Technical Report
EP&A Act	Environmental Planning and Assessment Act 1979
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999
EY	Exceedances per year
FMO	Flooding Management Objective
Form Loss	Hydraulic losses within modelling representation of river flows
FMO	Flood Management Objectives
HFWQ	Hydrology, Flooding and Water Quality Report
GPOP	Greater Parramatta to Olympic Peninsular
Guide to Road Design Part 5	Austroads (2023) Guide to Road Design Part 5: Drainage-General and Hydrology Considerations
NSW	New South Wales
Project	Parramatta Light Rail Stage 2
PLR	Parramatta Light Rail
PMF	Probable Maximum Flood
SEARS	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SES	NSW State Emergency Service
SSI	State Significant Infrastructure
SWMP	Soil and Water Management Plan
TUFLOW	Water Flow modelling software (www.tuflow.com)

Executive Summary

The project

The Parramatta Light Rail will deliver an integrated light rail service that supports the population and employment growth expected throughout Greater Parramatta and the Olympic Peninsula. It will integrate with existing and future modes of transport, including buses, trains, ferries and active transport (pedestrian and cycle networks), as well as Sydney Metro West services and the existing road network.

Parramatta Light Rail is being delivered in stages to keep pace with development:

- Stage 1 will connect Westmead to Carlingford via the Parramatta central business district (CBD) and Camellia. The construction and operation of Parramatta Light Rail Stage 1 was approved by the NSW Minister for Planning in May 2018. Major construction is underway with the track installation complete and light rail stop construction in progress. Stage 1 is expected to start operating in 2024. Further information on Stage 1 is available at <u>Parramatta</u> Light Rail
- Transport for NSW is now proposing to construct and operate Stage 2 of Parramatta Light Rail ('the project'). Stage 2 would connect the Parramatta CBD and Stage 1 to Camellia, Rydalmere, Ermington, Melrose Park, Wentworth Point and Sydney Olympic Park.

The Stage 2 project comprises two main elements:

- construction of about 10 kilometres of light rail infrastructure between Camellia and the Carter Street precinct adjacent to Sydney Olympic Park
- operation of about 13 kilometres of light rail alignment between the Parramatta CBD and the Carter Street precinct, including a section of infrastructure constructed by Parramatta Light Rail Stage 1 between Camellia and the Parramatta CBD.

Approvals process

The project is critical State significant infrastructure and is subject to approval by the NSW Minister for Planning under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979.*

An environmental impact statement (EIS) was prepared to assess the potential impacts of the project, and to identify the management measures to address those impacts. The EIS was exhibited by the NSW Department of Planning and Environment from 9 November 2022 to 16 December 2022. The EIS was also prepared to support Transport for NSW's application for approval of the project under the EPBC Act.

During the exhibition period, stakeholders and members of the community were able to review the EIS, participate in consultation and engagement activities, and make a written submission to the Department of Planning and Environment for consideration in its assessment of the project.

Transport for NSW has prepared a submissions report to address the Planning Secretary's request to submit a response to the issues raised in submissions to the EIS during public exhibition and DPE's State Significant Infrastructure and State Significant Project Guidelines.

Project amendments

During and following public exhibition of the EIS, Transport for NSW has undertaken further investigations and is proposing a number of design amendments to the project. The aim of these amendments is to address issues raised during consultation and in submissions, and to minimise the potential impacts of the project. The proposed amendments are:

- An amended alignment for the Camellia foreshore to Rydalmere bridge
- An amended alignment for the Melrose Park to Wentworth Point bridge further to the west to avoid direct impacts to residential properties
- Removing the existing bridge at Hill Road and constructing a new bridge to reduce the impact to the Narrawang Wetland.
- refinements are proposed to the location of the substation at Atkins Road, and the cut and fill volumes generated during earthworks.

Purpose of this report

Additional assessments of the potential hydrologic impacts of the project have been undertaken since exhibition of the EIS. These supplementary flooding assessments assist with considering and responding to issues raised in submissions and during consultation with stakeholders, assessing the impacts of the proposed amendments and to further progress commitments made in the EIS.

This supplementary report documents the assessment of the project as amended, it does not repeat existing conditions assessment nor does it assess impacts where there are no project amendments. This report should be read in conjunction with the Hydrology, Flooding and Water Quality (HFWQ) Technical Paper 10, originally prepared to support the EIS.

Assessment method

The overarching approach to the supplementary flooding assessment remains consistent with the methodology in the EIS Technical Paper 10 as it applies to the project amendments. The methodology was developed in line with relevant legislation and guidelines as well as the Department of Planning and Environment Secretary's Environmental Assessment Requirements (SEARs). There have been no changes to any inputs or software, assumptions, calibration and validation, or flood management objectives (FMO) (Refer to Sections 3.1, 3.1.1 & 3.12 of EIS Technical Paper 10).

In accordance with the SEARs, FMO were identified for the project to provide criteria against which potential impacts are assessed and managed in relation to changes in flooding conditions.

The FMO were developed in consultation with, and with input from, key project stakeholders, including the City of Parramatta Council. The objectives were developed to be consistent with accepted industry practice and relevant guidelines, as well as similar objectives for other major infrastructure projects in NSW (including Sydney Metro West, Parramatta Light Rail Stage 1 and Inland Rail (Parkes to Narromine).

Flooding impacts

Other than where impacts of the proposed project amendments have been outlined and discussed in Chapter 4 of this report, the magnitude of impacts on existing flood conditions would not be different from those described in EIS Technical Paper 10 (refer to Sections 5.2.1 and 5.2.2 of EIS Technical Paper 10).

Construction impacts

Consideration of flood risk and potential flood impact as a result of the project amendments during construction has been carried out for:

- Construction compounds
- Bridge construction and modification

Changes to flood risk and potential impacts are only observed for construction compounds 1,2 and 7 (refer to Figure 2.1 & Figure 2.2) and are mostly a result of their altered size and/or location within the amended alignment. These risks to and potential impacts from the compounds are either minor in significance or reduced from the EIS. All other compounds are unchanged or with negligible difference in both aspects to the EIS and are thus excluded from this assessment.

Summary of impacts

Areas of change to flood risk and impact from the EIS due to the project amendments largely remain in compliance with the FMOs and include:

- localised overland flow in Grand Avenue, Camellia
- localised overland flow path through Rydalmere:
 - John Street/Antoine Street adjacent Reid Park (Minor change, compliant with FMOs)
- localised overland flow paths through Melrose Park:
 - Ermington boat Ramp/Archer Park on approach to Wentworth Point bridge (Minor change, compliant with FMOs)

The magnitude of changes is most evident on the upstream side of the Camellia foreshore to Rydalmere bridge where a larger area of the floodplain experiences an increase in flood level. In this area flood level increases in excess of the FMOs, up to a maximum of 47mm are predicted within commercial properties.

Other project amendments only result in immediate impacts to local overland flows within the project boundary which don't increase impacts in adjacent areas.

Minimal changes to flow velocities are attributed to the project, with only minor new impervious areas created by the presence of project infrastructure.

There are no significant changes to the social and economic costs to community, consistency with council floodplain risk management plans, and impacts on existing emergency management arrangements from the EIS (refer to Sections 5.2.3, 5.2.4 & 5.2.5 of Technical Paper 10, Hydrology, Flooding and Water Quality Assessment, Parramatta Light Rail Stage 2 Environmental Impact Statement).

Further design refinement

The initial design for the re-aligned Camellia foreshore to Rydalmere bridge was found to generate an increase in peak 1% AEP water levels that exceeds the proposed FMO for commercial and industrial zones. The spacing and location of the piers was deemed to be the most critical factor influencing these results.

Further bridge design refinements of the re-aligned bridge were developed and modelled to test if the impacts can be improved during detailed design stages to meet the FMOs for the project. This included optimising bridge pier configurations for reduced disturbance to flood flows in Parramatta River.

The design refinement process found a suitable design that had the potential to reduce the degree of afflux to be between 12 and 15mm, within the FMOs for commercial and industrial zones.

Mitigation

The existing mitigation measures for minimising both potential flooding and residual impacts from the EIS Technical Paper 10 are unchanged with this supplementary flooding assessment. Refer to Table 8-1 and Section 8.4 of EIS Technical Paper 10.

Ongoing design development would be undertaken to minimise the localised flooding impacts as far as practicable. This would consider the design of bridges in order to minimise flow disruption, and the capacity of proposed and existing stormwater drainage systems. Optimisation of bridge piers would also be considered to reduce the larger impact of the new proposed design on flood flows in the Parramatta River.

Conclusion

The potential for flood impacts as a result of the project has been identified in the EIS. Subsequent project amendments at the two bridge crossings of Parramatta River, at Camellia and Wentworth Point, and the bridge crossing at Hill Road have a different flood impact potential.

Potential changes to the flood impacts are generally minimal and in compliance with FMOs, with impacts of a similar scale to those identified in the EIS. The most substantial change in flood impacts is a result of the Camellia foreshore to Rydalmere bridge alignment change which increases flood level impacts to areas upstream of the bridge crossing, up to a maximum 47mm in the 1% AEP flood.

To address this a revised bridge design for the amended Camellia crossing has been assessed, with flood impacts brought back within the FMO limits through locating piers in a more favourable configuration for flood impact.

1 Introduction

1.1 Parramatta Light Rail

The NSW Government's Greater Sydney Region Plan *A Metropolis of Three Cities* (Greater Sydney Commission, 2018) outlines a vision for a three-city metropolis. The Central River City covers the four local government areas of the City of Parramatta, Blacktown City, Cumberland City and The Hills Shire. *A Metropolis of Three Cities* highlights Greater Parramatta as the focal point for the Central River City, with employment growth and public transport being of key importance.

The Greater Parramatta and the Olympic Peninsula area (GPOP), which extends from Westmead and Parramatta in the west to Sydney Olympic Park to the east, is fast emerging as the heart of Sydney's Central River City and is set to grow and change significantly over the next 20 years. Forecasts predict that GPOP will accommodate almost 170,000 new residents by 2041. Employment opportunities will also grow, with an additional 100,000 jobs predicted by 2041 (SGS, 2017).

Parramatta Light Rail will deliver an integrated light rail service that supports the population and employment growth expected throughout GPOP. It will integrate with existing and future modes of transport, including buses, trains, ferries and active transport (pedestrian and cycle networks), as well as Sydney Metro West services and the existing road network. Parramatta Light Rail would be delivered in stages to keep pace with development:

- Stage 1 will connect Westmead to Carlingford via the Parramatta central business district (CBD) and Camellia. The construction and operation of Parramatta Light Rail Stage 1 was approved by the NSW Minister for Planning in May 2018. Major construction is underway with the track installation complete and light rail stop construction in progress. Stage 1 is expected to start operating in 2024. Further information on Stage 1 is available at <u>Parramatta</u> Light Rail
- Transport for NSW is now proposing to construct and operate Stage 2 of Parramatta Light Rail ('the project'). Stage 2 would connect the Parramatta CBD and Stage 1 to Camellia, Rydalmere, Ermington, Melrose Park, Wentworth Point and Sydney Olympic Park.

Figure 1-1 provides an overview of Parramatta Light Rail showing both stages.

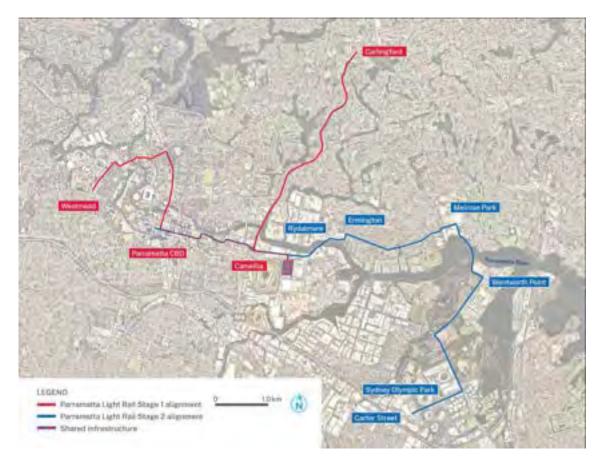


Figure 1-1 Parramatta Light Rail network

1.2 Approval and assessment requirements

1.2.1 Approval requirements

The project is critical State significant infrastructure and is subject to approval by the NSW Minister for Planning under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act).

The project is also determined to be a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) and requires approval from the Australian Minister for the Environment and Water.

An environmental impact statement (EIS) was prepared to assess the potential impacts of the project, and to identify the management measures to address those impacts. The EIS was exhibited by the NSW Department of Planning and Environment from 9 November 2022 to 16 December 2022. The EIS was also prepared to support Transport for NSW's application for approval of the project under the EPBC Act.

The EIS was supported by a range of technical papers, which provided detailed assessments of the potential impacts of the project as they relate to the key environmental issues defined by the Secretary's environmental assessment requirements (SEARs). This included Technical Paper 10 Hydrology, Flooding & Water Quality.

1.2.2 Responding to submissions and proposed amendments

During the exhibition period, stakeholders and members of the community were able to review the EIS, participate in consultation and engagement activities, and make a written submission to the Department of Planning and Environment for consideration in its assessment of the project.

Transport for NSW has prepared a submissions report to address the Planning Secretary's request to submit a response to the issues raised in submissions to the EIS during public exhibition and DPE's State Significant Infrastructure and State Significant Project Guidelines.

During and following public exhibition of the EIS, Transport for NSW has undertaken further investigations and is proposing a number of design amendments to the project. The aim of these amendments is to address issues raised during consultation and in submissions, and to minimise the potential impacts of the project. A summary of the proposed amendments is provided in Table 1-1. Further information is provided in the Amendment Report.

Table 1-1: Summary of amendments

Proposed amendment	Overview
Camellia foreshore to Rydalmere alignment and bridge	As described in section 5.4.2 and Appendix D of the EIS, investigation of an alternative alignment between Camellia and Rydalmere (the 'Camellia foreshore to Rydalmere option') was ongoing in parallel with development of the EIS. It is now proposed to amend the project to incorporate this alternative alignment of the light rail track, active transport link and bridge over the Parramatta River.
	The new alignment extends along the Sandown Line corridor in Camellia; however, instead of crossing south over to Grand Avenue, it continues along the Parramatta River foreshore in Camellia before extending across a new bridge structure and along the boundary of Eric Primrose Reserve in Rydalmere.
	The bridge design has been amended and includes different pier arrangements in the river. It is also proposed to locate the light rail stop at John Street closer to Rydalmere Wharf.
Melrose Park to Wentworth Point bridge	The project as described in the EIS included a bridge located between the southern end of Wharf Road in Melrose Park and the northern end of Wentworth Point. It is proposed to amend the alignment and locate the bridge further to the west to avoid direct impacts to residential properties. The works would also include removing the existing high voltage transmission tower at Melrose Park and relocating the wires to three new poles located to the west of the original tower.
Bridge at Hill Road	The project as described in the EIS included retaining the Hill Road bridge in Sydney Olympic Park and providing a new bridge for light rail vehicles on the western side of the existing bridge.
	It is now proposed to remove the existing bridge at Hill Road and construct a new bridge, which would accommodate road traffic and light rail vehicles in an on-road (segregated) running corridor to reduce the impact to the Narrawang Wetland.

In addition, refinements are proposed to the location of the substation at Atkins Road, and the cut and fill volumes generated during earthworks.

1.3 Project overview

The project comprises two main elements:

- construction of about 10 kilometres of light rail infrastructure between Camellia and the Carter Street precinct adjacent to Sydney Olympic Park
- operation of about 13 kilometres of light rail alignment between the Parramatta CBD and the Carter Street precinct, including a section of infrastructure constructed by Parramatta Light Rail Stage 1 between Camellia and the Parramatta CBD.

Further information on the location of the project, and a description of the project site for the purposes of this document, is provided in the Amendment Report.

1.3.1 Key features

The key features of the project (as amended), which are shown on Figure 1.2, include:

Light rail track and bridges

- a new 10 kilometre long dual light rail track, with 14 stops, between the Parramatta Light Rail
 Stage 1 line in Camellia and the Carter Street precinct adjacent to Sydney Olympic Park
- two bridges over the Parramatta River to allow the light rail line to cross between Camellia and Rydalmere, and between Melrose Park and Wentworth Point
- a bridge over Silverwater Road between Rydalmere and Ermington
- other bridge works in Ken Newman Park and Sydney Olympic Park.

Active and public transport integration

The project would also deliver:

- about 9.5 kilometres of new active transport links between Camellia and the Carter Street precinct, which would connect with the existing cycling and pedestrian network
- interchanges with other forms of public transport, including trains, ferries, buses and Sydney Metro West, with the main interchanges located in the Parramatta CBD, Rydalmere and Sydney Olympic Park
- a light rail and pedestrian zone (no through vehicle access) within Sydney Olympic Park along Dawn Fraser Avenue between Australia Avenue and Olympic Boulevard
- bus access over the proposed bridge between Melrose Park and Wentworth Point.

Other works

Works proposed to support the project's operation:

- turnback facilities, including along part of Macquarie Street in the Parramatta CBD
- adjustments to the Parramatta Light Rail stabling and maintenance facility at Camellia
- five new traction power substations to convert electricity to a form suitable for use by light rail vehicles
- new and improved open spaces and recreation facilities at Eric Primrose Reserve, Ken Newman Park and the Atkins Road stop.

Further information on the project is provided in the updated project description chapters in Appendix A of the Amendment Report.

1.3.2 Operation

The project would operate between the Parramatta CBD and the Carter Street precinct, using a section of the Parramatta Light Rail Stage 1 alignment and the alignment constructed as part of the project.

Between the Parramatta CBD and Camellia, the project would operate along about three kilometres of the Parramatta Light Rail Stage 1 alignment. Parramatta Light Rail Stage 2 services would terminate at the Stage 1 Parramatta Square stop to allow customers direct and convenient access to Parramatta's CBD, and interchange with Stage 1 light rail services, trains, buses and Sydney Metro West.

From Camellia, the project would operate along the light rail infrastructure proposed as part of Stage 2, terminating at the proposed Carter Street stop.

The project would operate as a turn-up-and-go light rail service from 5am to 1am, seven days a week, as for Parramatta Light Rail Stage 1. The project would have travel times of around 29 minutes from the Carter Street stop in Lidcombe to the proposed Sandown Boulevard stop in Camellia, and a further seven minutes from Camellia to the Parramatta Square stop in the Parramatta CBD.

Further information on the project's operation is provided in the Amendment Report.

1.3.3 Timing

It is anticipated that construction would start in 2025, subject to obtaining all necessary approvals, and the first passenger services are proposed to start from 2030/2031.

An indicative construction methodology is provided in the Amendment Report.



Figure 1.2: Key features of the project

1.4 Purpose of this report

Additional assessments of the potential hydrologic impacts of the project have been undertaken since exhibition of the EIS. These supplementary flooding assessments assist with considering and responding to issues raised in submissions and during consultation with stakeholders, assessing the impacts of the proposed amendments and to further progress commitments made in the EIS.

This supplementary report documents the assessment of the project as amended, it does not repeat existing conditions assessment nor does it assess impacts where there are no project amendments. This report should be read in conjunction with the Hydrology, Flooding and Water Quality (HFWQ) Technical Paper 10, originally prepared to support the EIS. This report:

- provides an updated hydrologic assessment of the project (as amended)
- addresses the relevant SEARs listed in Table 1-2
- provides additional information as required to respond to issues raised in submissions and during consultation.

Table 1-2 Compliance with relevant Secretary's environmental assessment requirements

SEARs	Requirement	Where addressed
Ref #		
5	Flooding	
5.1	Changes to flood behaviour during construction and operation for a full range of flood events up to the probable maximum flood (taking into account sea level rise and storm intensity due to climate change) including:	The flooding assessment covers the present day scenarios and scenarios that account for climate change, sea level rise and an increase in storm intensity. Chapter 5 of EIS Technical Paper 10 outlines the changes to flood behaviour during construction and operation relative to the EIS design.
		This supplementary report documents changed impacts resulting from the project amendments in Section 4.1 and 4.2.
		Flood events included are: • 5% annual exceedance probability (AEP) • 1% AEP
		 Probable maximum flood (PMF)
		To address predicted impacts of the bridge between Camellia and Rydalmere further design refinement has been considered in Section 4.3.
5.1(a)	any detrimental increases in the potential flood affectation of other properties, assets and infrastructure	Chapter 5 of EIS Technical Paper 10 considers the impacts relative to the EIS design.
	iiiiastiucture	This report documents changed impacts resulting from the project amendments in Section 4.1 and 4.2.To address predicted impacts of the bridge between Camellia and Rydalmere further design refinement has been considered in Section 4.3.
5.1(b)	consistency (or inconsistency) with applicable Council floodplain risk management plans	Sections 5.2.4, and 5.2.5 of EIS Technical Paper 10 outlines that the risk management plans and development of emergency management approaches relative to the EIS design.
		The source of flow, flood hazard and evacuation strategies are not impacted significantly by the project amendments.
5.1(c)	compatibility with the flood hazard of the land	Section 5.2.5 of EIS Technical Paper 10 discusses compatibility with the flood hazard of the land. These are not impacted significantly by
		the project amendments.

SEARs Ref #	Requirement	Where addressed
5.1(d)	compatibility with the hydraulic functions of flow conveyance in flood ways and storage areas of the land	Section 5.2.1 of EIS Technical Paper 10 provides an assessment of flooding impacts during construction including from construction compounds, light rail alignment, roads and bridge construction in relation to the hydraulic function of water ways and the land. Section 5.2.2 of EIS Technical Paper 10 provides an assessment of flooding impacts during operation, including finished design surface and bridge structure impacts in the relation to the hydraulic function of waterways and the land. This is not impacted significantly by the project amendments.
5.1(e)	downstream velocity and scour potential	Changes in velocity and scour due to the project amendments are described in Table 4-2 (construction) and Table 4-3 (operation) of this report.
5.1 (f)	impacts the development may have upon existing community emergency management arrangements for flooding. These matters must be discussed with the State Emergency Services and Council	Section 3.3.4 of EIS Technical Paper 10 outlines that the risk management plans and the development of emergency management approaches relative to the EIS design. The source of flow, flood hazard and evacuation strategies are not impacted significantly by the project amendments.
5.1 (g)	any impacts the development may have on the social and economic costs to the community as consequence of flooding	Section 5.2.3 of the EIS Technical Paper 10 outlines social and economic costs to the community relative to the EIS design. These are not impacted significantly by the project amendments.
5.2	Flood management objectives and outcomes must be clearly identified and substantiated to address the characteristics of the environment and relevant legislative, management and guidance requirements	Section 3.3 of this report describes the project-specific flood management objectives (FMOs) (which have not changed). Section 3.3.1 outlines the assessment against the FMOs due to the project amendments.

2 Proposed project amendments

It is proposed to amend the following features of the project:

- Camellia foreshore to Rydalmere alignment and bridge
- Bridge between Melrose Park and Wentworth Point
- Bridge at Hill Road

The proposed amendments are described in sections 2.1 to 2.4 and have also resulted in some project site adjustments.

Refinements to the project as described in the EIS have also been made as part of the ongoing development of the project since the EIS was exhibited. Refinements are changes that are consistent with the parameters of the project description in the EIS. The refinements do not result in changes to the project impacts with regard to hydrology. These refinements have been considered in the Amendment Report.

The project with all proposed amendments and project refinements is referred to in this report as the amended project. The project description chapters provided in the EIS (chapters 6 and 7) have been updated taking into account the proposed amendments and refinements. The project description, updated to include the amended design and refinements, is contained within Chapter 4 of the Amendment Report and outlined below.

2.1 Camellia foreshore to Rydalmere alignment and bridge

Figure 2-1 shows the new alignment and bridge compared to the exhibited project.

The proposed infrastructure for the amendment includes:

- light rail track, which would be off-road (separated), along the Sandown Line corridor before
 crossing over the bridge and then through Eric Primrose Reserve on a raised embankment.
 The corridor would then become on-road (segregated) as it extends up John Street turning
 east onto South Street.
- a five-span, concrete bridge about 260 metres long, with the northern abutment now located within the corridor of the Sandown Line and the southern abutment within Eric Primrose Reserve to the south of Park Road
- three bridge piers within the river and a fourth on the riverbank at Park Road
- an active transport pathway located on the western side of the bridge with a separate exit ramp off the bridge to connect with the existing Parramatta Valley Cycleway and local footpaths
- relocation of the John Street stop closer to Rydalmere Wharf
- road network changes to Park Road (adjusted turning circle) and John Street, South Street and Antoine Street (changed traffic lanes and new signalisation)
- relocation of a traction power substation in Rydalmere from the corner of John Street and Antoine Street to the corner of John Street and South Street
- relocation of a traction power substation on Grand Avenue in Camellia slightly east to a property already nominated as part of the land requirements for the project.
- public domain and open space improvements such as landscaped areas at Eric Primrose Reserve, recreational facilities and adjustments to existing active transport links.

Construction of the amended alignment and bridge would generally involve the same activities as described in Chapter 7 of the EIS but with the following changes:

- a construction compound at the eastern end of Grand Avenue would no longer be required
- the location of the John Street construction compound would be revised to be situated in the western section of Eric Primrose Reserve
- partial road closures at Grand Avenue would not be required however the full closure of John Street (between South Street and Antoine Street) and Antoine Street (at the John Street intersection) may be required temporarily to facilitate construction works in this area
- coffer dams in the river would no longer be required
- one closure of three months of the navigational channel would be required (instead of two closures of three months) and ferry services would not be able to operate upstream during this closure
- closure of the Rydalmere Wharf during construction would no longer be required.

Further information on the proposed amendment is provided in the updated project description chapters in the Amendment Report.



Figure 2-1 Camellia foreshore to Rydalmere alignment and bridge

2.2 Bridge between Melrose Park and Wentworth Point

Figure 2-2 shows the new location of the bridge compared to the exhibited project. The proposed infrastructure for the amendment includes:

- light rail track, which would remain as on-road (segregated) along Waratah Street before
 crossing over the proposed bridge along an alignment further west than shown in the EIS,
 and then around Sanctuary Wentworth Point as off-road (separated) before connecting back
 to Hill Road
- a six-span, concrete bridge about 350 metres long, with the northern abutment now located within Archer Park to the north of the Ermington Boat Ramp and the southern abutment remaining to the west of Sanctuary Wentworth Point
- three bridge piers within the river, slightly upstream from their locations in the EIS
- an active transport pathway located on the eastern side of the bridge

relocation of the Waratah Street stop slightly north from the location nominated in the EIS.

To accommodate the amended alignment and bridge the following adjustments are also proposed:

- car park configuration and access changes to Ermington Boat Ramp resulting in a reduction of 10 boat trailer parking spaces and the permanent closure of Waratah Street between Mary Street and Wharf Road (about 110 metres)
- relocating the existing amenities building to a new location within Archer Park
- replacement of an existing transmission tower in Archer Park with the overhead wiring relocated to three new poles of a similar height, in order to maintain the necessary clearances.

Construction of the amended bridge would generally involve the same activities as described in chapter 7 of the EIS but with the following changes:

- Coffer dams in the river would no longer be required.
- The inclusion of works associated with the existing transmission tower in Melrose Park.
- River Walk at Wentworth Point would need to be closed for up to two years to establish a temporary work platform for bridge works. During the closure, a detour of about 515 metres via Hill Road and Louise Sauvage Pathway would be provided for pedestrian and cyclists.

Further information on the proposed amendment is provided in the updated project description chapters in the Amendment Report.



Figure 2-2 Melrose Park to Wentworth Point bridge amendment

2.3 Bridge at Hill Road

Figure 2-3 shows the new bridge compared to exhibited project.

The proposed infrastructure for the amendment includes:

- construction of a new single span, concrete structure, about 20 metres long and 29 metres
- light rail tracks on the western side of the bridge, with two traffic lanes in each direction in the centre of the bridge and an active transport pathway on the eastern side
- a retaining structure on the eastern side of Hill Road to manage the differences between the existing ground level and light rail alignment (up to about 2.7 metres high)
- reinstatement of existing active transport paths and connections

utility relocation and adjustments.

Construction of the new bridge at Hill Road would generally involve the same activities as described in chapter 7 of the EIS but with the following changes:

- removal of the existing Hill Road bridge
- temporary traffic changes to facilitate bridge works (combination of short-term closures and contraflow arrangements).

Further information on the proposed amendment is provided in the updated project description chapters in the Amendment Report.

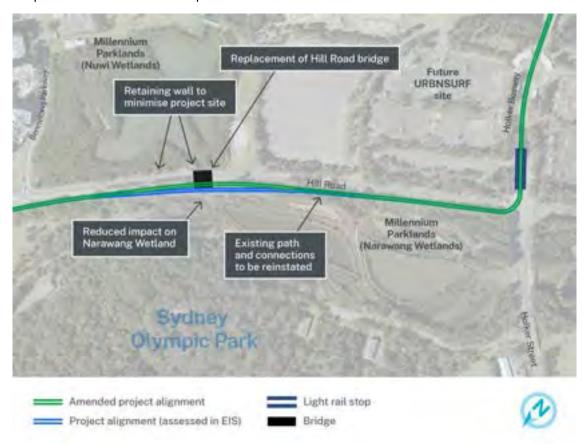


Figure 2-3 Bridge at Hill Road amendment

2.4 Construction compounds

There are some proposed changes to construction compounds as a result of the project amendments. The number of compounds reduce from 15 to 14 across the alignment. The previous EIS compound number 2 within Camellia (on the southern approach to Parramatta River) is no longer required due to the change in alignment along the foreshore.

Compound 7 is reconfigured from the previous EIS compound 8 layout. Figure 2-4, Figure 2-5 & Figure 2-6 shows the change to the locations or layouts of construction compounds for the amended project.



Figure 2-4 Construction compound locations – map 1



Figure 2-5 Construction compound locations – map 2



Figure 2-6 Construction compound locations – map 3

3 Assessment Methodology

3.1 Study Area

The relevant study area for this supplementary assessment remains the same as the EIS (Refer to Section 3 of EIS Technical Paper 10.

3.2 Flood Modelling Approach

The overarching approach to the supplementary flooding assessment remains consistent with the methodology in the EIS Technical Paper 10 as it applies to the project amendments. The methodology was developed in line with relevant legislation and guidelines as well as the SEARs. There have been no changes to any inputs or software, assumptions, calibration and validation, or flood management objectives (Refer to Sections 3.1, 3.1.1 & 3.12 of EIS Technical Paper 10).

Flood maps have been developed with flood hazard categories in accordance with the Australian Institute for Disaster Resilience - Australian Institute of Disaster Resilience Guideline (2017b). Refer to Appendix Appendix A which includes all mapping associated with the supplementary flood assessment.

3.3 Flood Management Objectives

In accordance with the SEARs, flood management objectives (FMO) were identified for the project to provide criteria against which potential impacts are assessed and managed in relation to changes in flooding conditions. As described in section 17.1.3 of the EIS, the following flood management objectives have been defined:

- for operational flood levels in events up to the one per cent AEP there should be no increase in flood levels relative to the existing condition (afflux) greater than:
 - 10 millimetres in residential zoned land
 - 20 millimetres in commercial/industrial zoned land
 - 50 millimetres in public land*
- the potential for soil erosion and scouring is minimised for events up to and including a one per cent AEP flood event
- no change in flood hazard category in residential and commercial/industrial zoned land
- no change to the hazard category for events up to and including the one per cent AEP flood event for dedicated evacuation routes.
- * Sections 25 and 26 *Local Government Act 1993* classify 'public land' as any land (including a public reserve) vested in or under the control of the council.

3.3.1 Consistency of FMOs

In response to a number of submissions Transport, has provided further information regarding how the flood management objectives for the project have been developed.

The flood management objectives were developed in consultation with, and with input from, key project stakeholders, including the City of Parramatta Council. The objectives were developed to be consistent with accepted industry practice and relevant guidelines, as well as similar objectives for other major infrastructure projects in NSW (including Sydney Metro West, Parramatta Light Rail Stage 1 and Inland Rail (Parkes to Narromine).

When developing the flood management objectives consideration was also given to the following:

Floodplain Development Manual (DIPNR, 2005)

Guidance and requirements outlined in Appendix F and Appendix G of the manual.

Parramatta Development Control Plan 2011 (City of Parramatta, 2011)

The following objectives from Section 2.4.2.1:

- the proponents of development are aware of the potential flood hazard and consequent risk and liability associated with the use and development of flood liable land
- manage flood liable land in an economically, environmentally and socially sustainable manner
- ensure that the proposed development does not expose existing development to increased risks associated with flooding
- ensure that developments with high sensitivity to flood risk are sited and designed to provide reliable access and minimise risk from flooding
- minimise the risk to life by ensuring the provision of appropriate access from areas affected by flooding up to extreme events
- minimise the damage to property, including motor vehicles, arising from flooding
- new development should not result in any increased risk to human life.

The State Significant Infrastructure Template Conditions of Approval (Linear Infrastructure) (DPE, 2022)

DPE template Conditions of Approval recommend infrastructure be designed and constructed to limit impacts on flooding characteristics in areas outside the project boundary during any flood event up to and including the one per cent AEP flood event to the following:

- (a) a maximum increase in inundation time of one hour
- (b) a maximum increase of 10 millimetres in above-floor inundation to habitable rooms where floor levels are currently exceeded
- (c) no above-floor inundation of habitable rooms which are currently not inundated
- (d) a maximum increase of 50 millimetres in inundation of land zoned as residential, industrial or commercial
- (e) a maximum increase of 100 millimetres in inundation of land zoned as rural, primary production, environment zone or public recreation
- (f) no significant increase in the flood hazard or risk to life
- (g) maximum relative increase in velocity of 10 per cent, where the resulting velocity is greater than one metres per second, unless adequate scour protection measures are implemented and/or the velocity increases do not exacerbate erosion as demonstrated through site-specific risk of scour or geomorphological assessments

Guide to Road Design Part 5: Drainage-General and Hydrology Considerations (Austroads, 2023) (Guide to Road Design Part 5)

The recommended acceptable impact for industrial and commercial buildings in the Guide to Road Design Part is 50 millimetres in the one per cent AEP event and the acceptable impact for other buildings is 25 millimetres, with 10 millimetres considered acceptable for houses at significant flood risk or for sensitive receivers (e.g. schools) and critical infrastructure. The Guide

to Road Design Part 5 notes that changes of less than 10 millimetres should not be considered relevant as 10 millimetres is typically the limit of accuracy of two-dimensional flood models.

The flood management objectives which have been developed for the project are consistent with the above guidelines and other projects and are stricter than the values recommended by the Guide to Road Design Part 5 (table 6.19, which is replicated in Table 3-1).

Table 3-1 Acceptable impacts for major transport infrastructure

	Residential buildings (mm)	Residential yards (mm)	Industrial and commercial buildings (mm)	Industrial and commercial yard (mm)	Non habitable structures (sheds)	Agricultural (mm)	Open Space/Forest (mm)
Flood levels	25 (general) 10-20 sensitive receivers including hospitals, schools and critical infrastructure	50	50	100	100	200 - 400	400

4 Flood impacts of project amendments

This Chapter documents the potential impacts of the project on existing flooding in the study area, where there are proposed project amendments. This includes impacts to regional flooding from Parramatta River and local stormwater flooding. Impacts are described relative to either the construction or operational phases.

Other than where impacts of the proposed project amendments have been outlined and discussed in this section, the magnitude of impacts on existing flood conditions would not be different from those described in EIS Technical Paper 10 (refer to Sections 5.2.1 and 5.2.2 of EIS Technical Paper 10).

4.1 Construction Impacts

This section provides a qualitative assessment of any new or changed potential flood risks and impacts associated with the project's construction compounds and construction activities that are attributed to the proposed project amendments.

Flooding during construction activities has the potential to result in delays to construction and damage to plant and materials. It may also pose a safety risk to construction personnel. In terms of flood impact, construction activities have the potential to change flood behaviour as a result of changes to site topography and installation of temporary buildings and other structures within the flood plain.

Construction planning and the layout of construction worksites and compounds would be undertaken with consideration of overland flow paths and flood risk, avoiding flood liable land as far as practicable.

Consideration of flood risk and potential flood impact as a result of the project amendments has been carried out for:

- Construction compounds
- Bridge construction and modification

4.1.1 Construction compounds

Table 4-1 summarises the assessed flood risk and potential flood impacts at each new or changed project construction compound only, and also provides a comparison to the EIS impacts.

Changes to flood risk and potential impacts are only observed for construction compounds 1,2 and 7 (refer to Figure 2.1 & Figure 2.2) and are mostly a result of their altered size and/or location within the amended alignment. These risks to and potential impacts from the compounds are either minor in significance or reduced from the EIS. All other compounds are unchanged or with negligible difference in both aspects to the EIS and are thus excluded from this assessment.

It is acknowledged that the number and location of construction compounds is subject to further change with subsequent stages of the design, and re-assessment of flood risk and impact may be required.

Table 4-1 Summary of flood risks and potential impacts from proposed project amendments (construction compounds)

Compound No.	Location	Extent of flood risk at compound	Design amendment flood impact potential	Difference from flood impacts documented in EIS
1	Grand Avenue, Camellia	Compound is located outside the 1% AEP mainstream flood extent, but within the Parramatta River PMF extent. Some local ponding of flood water within site compound for the 1% AEP event. Water depths may reach 0.1m in places.	No change in flooded extent, however localised increases in flood levels are likely within the site. Depending on the proposed structures/storage on the site, limited obstruction of existing flood volume may occur, causing a redistribution of flow. The redistribution is not expected to have a significant impact due to the nature of the existing land use.	Increased localised impacts primarily caused by earthworks and interface works with the amended alignment along foreshore. Greater earthworks at the northern limit of the construction compound.
2	Antoine Street, Rydalmere (previously compound 3 at John Street, Rydalmere in the EIS)	Located within the Parramatta River 1% AEP extent. 1% AEP flood depths exceed 1.5m in places.	Local impacts in ponding within Reid Park, however largely limited to the construction and permanent project boundaries. Depending on the proposed structures/storage on the site obstruction of floodwaters may occur. This has potential to affect private properties on Antoine Street. Transport of sediment/materials into Parramatta River due to proximity to river though not expected to adversely affect the capacity of the river due its large scale.	Similar resulting flood risk, located further west in Reid Park along the river foreshore than in EIS. Reduction in flood impacts associated with the removal of construction compound from the eastern end of Grand Avenue.
7	Archer Park/ Waratah Street/ Ermington Boat Ramp/ Wharf Road, Melrose Park	Typically located outside the 1% AEP mainstream flood extent, but within the Parramatta River PMF. Small portion of the eastern zone is affected by the 1% flood.	Negligible impact anticipated on major flood behaviour, with minor overland flow impacts resulting from disturbed areas and earthworks. Transport of sediment/materials into Parramatta River due to proximity to river	Smaller footprint of impacts through the Ermington Boat Ramp/Archer Park area.

Compound No.	Location	Extent of flood risk at compound		Difference from flood impacts documented in EIS
			though not expected to adversely affect the capacity of the river.	

4.1.2 Bridge construction and modification

Proposed works and potential construction stage flood impacts at each new proposed bridge location are addressed in Table 4-2. A comparison to the EIS impacts is also provided in Table 4-2.

Table 4-2 Flood potential impacts during bridge construction

Bridge	Description	Design amendment flood	Difference from flood
Bridge	Description	impact potential	impacts documented in EIS
Proposed bridge between Camellia and Rydalmere	Construction of supporting piers within the Parramatta River would involve temporary access within the river.	Potential impacts include: • obstruction of the waterway by temporary scaffolding/falsework • obstruction of the waterway through temporary access for pier piling works. These could lead to an increase in flood water levels or localised increases in velocity within Parramatta River in the immediate vicinity of the proposed pier locations.	Increased geographical extent of impacts along proposed alignment, with skewed crossing. Greater pier impact to flow regime where located towards bend in the river alignment. These could lead to an increase in flood water levels or localised increases in velocity within Parramatta River in the immediate vicinity of the proposed pier locations.
Proposed bridge between Wentworth Point and Melrose Park	Construction of supporting piers within the Parramatta River would involve temporary access within the river.	Potential impacts include: • obstruction of the waterway by temporary scaffolding/falsework • obstruction of the waterway through temporary access for pier piling works These could lead to an increase in flood water levels or localised increases in velocity within Parramatta River in the immediate vicinity of the proposed pier locations.	Reduction in flood impact relative to the EIS through removal of cofferdam associated obstructions to flow.
Proposed Bridge at Hill Road	No change from EIS	No change from EIS	N/A

4.2 Operational Impacts

Table 4-3 provides a quantitative assessment of flood risk and potential flood impacts associated with the operation of the design amendments in comparison to the EIS.

The impacts assessed through the flood modelling are presented in mapping attached as Appendix A including the 5% AEP and 1% AEP flood events (with and without climate change).

Table 4-3 Summary of changed operational flooding impacts at the project amendment locations

Location	Design amendment flood impact potential	Difference from flood impacts documented in EIS
Camellia	 In Camellia, flooding impacts may occur in the following locations as a result of the project amendments: Along the alignment at Grand Avenue: this is due to the alignment crossing existing flood flow routes from south to north as they travel towards Parramatta River. Any vertical changes to the topography have the potential to create adverse flood impacts as these flow routes become blocked. Flood impacts of up to 30 millimetres are predicted at the western end of Grand Avenue in commercial land. This would be mitigated during design development when it is expected that as-built drainage details for Parramatta Light Rail Stage 1 are included in the flood modelling. This would enhance the understanding of existing and future flood risk and allow a more suitable mitigation option to be designed if impacts are still prevalent. Flood impact of up to 50mm generally in commercial areas, and 50mm along the bank of the Parramatta River which impacts commercial properties at 15 Grand Avenue due to the change in bridge alignment, primarily a result of the pile group and pile cap. Other than these locations, FMOs are met in Camellia with no predicted impact to residential properties or public land. Any residual impacts after mitigation are anticipated to be minor only and within the target limits of the FMOs. Further assessment and investigation for piped drainage system capacity to relieve overland flow conditions will be undertaken during detailed design. More detailed assessment of the bridge between Camellia and Rydalmere is outlined in Section 4.2.1. 	 Flood impacts up to + 270 millimetres that were predicted at the eastern end of Grand Avenue in commercial land are no longer caused under the design amendment. This was caused by the proposed bridge abutments restricting flow and reducing capacity of the floodplain in this location. Flood impacts to commercial properties to the west of the amended bridge up to approximately 50mm were not evident in the EIS flood impact assessment.
Rydalmere	In Rydalmere, flooding impacts may occur in the following locations as a result of the project amendments:	Changes from EIS impacts are predominantly a result of the new horizontal alignment that adopts a western route through Reid Park

Location	Design amendment flood impact potential	Difference from flood impacts documented in EIS
	 The project proposes to raise the vertical geometry of the road at John Street, and this has potential to alter or block existing flood flow paths, causing impacts to adjacent properties. A commercial unit at 58 John Street may be impacted by up to 30 millimetre increase in water level. Further assessment and investigation for piped drainage system capacity to relieve overland flow conditions would be undertaken during design development, however, it is expected that FMOs would be achieved. Ground level changes and local drainage system modification required for the project has the potential to cause flood impacts to properties within the extent of urban overland flows ponding and then crossing South Street. Mitigation of impacts at South Street / Patricia Street and South Street / Primrose Avenue is expected to achieve the FMOs for residential locations, with no impacts greater than 10 millimetres. Any residual impacts after mitigation are anticipated to be within the target limits of the FMOs and further mitigation in Rydalmere is not required Flood results based on the amended design predict areas with a flood impact of up to 50mm due to the change in bridge alignment, primarily a result of the pile group and pile cap. This increase in water level primarily impacts commercial properties along Pike St and Alan St. Further mitigation such as additional cross culverts through the proposed bridge abutments, or local land reshaping would be considered as part of design development to reduced water levels within the Parramatta River. 	instead of the southern route from John Street on approach to Rydalmere wharf. Flood results based on the amended design predict areas with a flood impact of up to 50mm due to the change in bridge alignment, primarily a result of the pile group and pile cap. This increase in water level primarily impacts commercial properties along Pike St and Alan St. Larger areas of improvement on the northern side of the rail alignment adjacent Antoine Street properties are observed as a result of the changed design whereby the northern bridge abutment and return to existing grade provides bunded protection from the main Parramatta River Floodplain for properties immediately to the north.
Melrose Park	 In Melrose Park, flooding impacts may occur in the following locations as a result of the project amendments: Raised ground levels due to the project at the intersection of Hope Street and Hughes Avenue as well as Hope Street west of Waratah Street may cause adverse flood impacts to residential properties. Mitigation through increasing the capacity of the 	Small changes to the extent of impacts area closely linked to the route of the changed design alignment through the approach to new bridge to Wentworth Point. The afflux flood maps in Appendix A show little to no change in this location. The realignment of the bridge at Wentworth does not alter the impacts already described in the EIS. Smaller

Location	Design amendment flood impact potential	Difference from flood impacts documented in EIS
	 drainage network and providing new cross drainage would achieve the FMO for no increase greater than 10 millimetres on residential properties. Increased surcharge capacity would also be required at the southern verge to maintain flows in the existing overland flows paths. Filling for the alignment along Waratah Street, at the end of Waratah Street, at interface with the shared use path. Existing ground levels are around 5mAHD, with track level being 5.8 / 5.9mAHD. The filling at this point increases flood levels up to 830mm, where flood water ponds temporarily at a sag point against the raised alignment. However, impacts are located entirely within the project site and are not expected to impact commercial or residential properties. Further assessment and investigation for piped drainage system capacity to relieve overland flow conditions would be undertaken during design development. Other than these locations, FMOs are met in Melrose Park. 	footprint of impacts through the Ermington Boat Ramp/Archer Park area.
Wentworth Point (Hill Road Bridge)	 In Wentworth Point, flooding impacts may occur in the following locations as a result of the project amendments: Localised increases in flood levels upstream of the proposed Hill Road bridge extend beyond the project site. Detailed flow transition structures including scour management at the inlet and beneath the bridge would be considered in design development to mitigate these impacts. Residual flood impacts are anticipated in the immediate vicinity of the inlet structure. However, specific mitigation (such as wingwalls or flow control devices) can be used such to reduce any potential flood effects on sensitive communities upstream of the new bridge. These impacts would be further addressed during design development. 	No change from the EIS

Location	Design amendment flood impact potential	Difference from flood impacts documented in EIS
	 Further assessment and investigation for piped drainage system capacity to relieve overland flow conditions would be undertaken during design development. The FMOs are met for residential, commercial and public land in Wentworth Point. 	

4.2.1 Bridge between Camellia and Rydalmere modelling results

The impacts of the realignment of the bridge between Camellia and Rydalmere, outlined in Table 4-3, have flood level differences from existing conditions in excess of 20mm, up to a maximum of 47mm, at commercial properties upstream of the bridge. The bridge location also creates impacts in terms of velocity and scour potential at the bridge substructure locations. Given the extent of impacts further discussion on the detailed assessment is outlined below.

The amended arrangement of the bridge between Camellia and Rydalmere adopted for the flood model is shown in Figure 4-1.



Figure 4-1: Layout of the Bridge between Camellia and Rydalmere

The design of the bridge between Camellia and Rydalmere was tested using the TUFLOW flood model for the 1% AEP and 1% AEP (with climate change) storm events.

The resulting afflux on the 1% AEP storm water level upstream of the structure was found to be between 30 and 40mm within Parramatta River. This results in impacts up to 47mm at commercial/industrial zones on the north side of Parramatta River (Figure 4-2), which exceeds the recommended limits identified by the project FMOs.

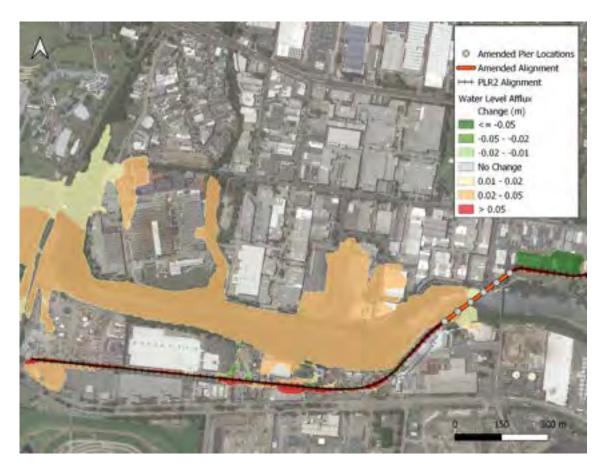


Figure 4-2: Bridge between Camellia and Rydalmere – 1% AEP storm - water level afflux

The increase in water level is typically the result of the size of the pile caps, the spacing of the piers and their associated skewness across the river channel. These factors combine to reduce the overall flow area available to Parramatta River as it flows through the structure.

The bridge piers were also found to be located in an area of flow that is sensitive to changes, primarily due to higher velocities where the Parramatta River channel is confined around a bend. Sensitivity testing of the model determined that piers located in the higher velocity areas were more likely to generate higher upstream water levels. 1% AEP water velocities are shown Figure 4-3

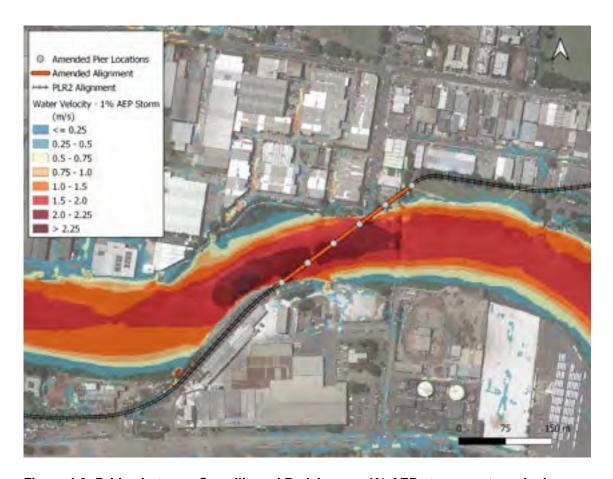


Figure 4-3: Bridge between Camellia and Rydalmere – 1% AEP storm - water velocity

4.3 Camellia bridge - further design refinement

Further bridge design refinements were developed and modelled to test if the impacts can be improved during detailed design stages to meet the FMOs for the project. This included optimising bridge pier configurations for reduced disturbance to flood flows in Parramatta River.

The overall aim of this design refinement was to remove piers from high velocity areas and reduce the total number of piers in the watercourse. The following bridge parameters were identified as been achievable:

- 110 to 120m clear span balanced cantilever
- · Removal of central pier and pile cap
- Move piers and pile caps out of high velocity areas
- Provide 60 to 80m back spans to connect to the landside

These parameters were used to generate a new 2D layered flow constriction element in the flood model. Opening ratios, blockage and form loss factors were calculated in the same manner described in Appendix C.

4.3.1 Modelling results

The water level afflux of the revised bridge pier configuration is shown in Figure 4-4 (1% AEP storm event).

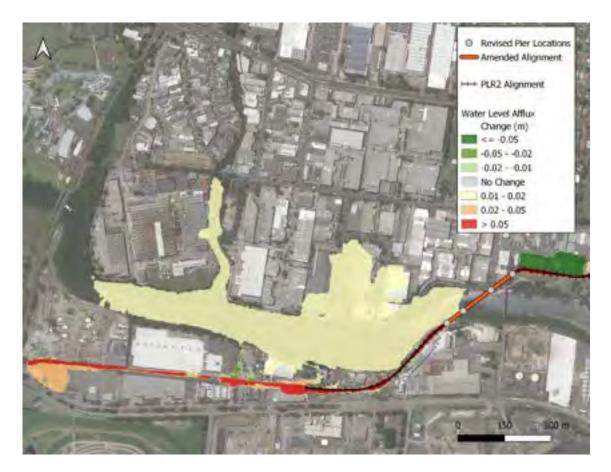


Figure 4-4: Revised pier configuration for the bridge between Camellia and Rydalmere – 1% AEP storm - water level afflux

The revised bridge pier configuration shows an improvement in the magnitude of water level increase in Parramatta River and is predicted to be between 12 and 15mm. This would satisfy the FMO of no greater than 20mm increase in land zoned as industrial or commercial.

Widening the spans and removing the central pier significantly reduces the Form Loss of the structure, which is directly related to the opening ratio of the spans (i.e., the ratio of open space vs. blocked space). Reducing the number of piers generates a lower Form Loss factor which subsequently has less influence on peak water levels.

The impacts assessed for the revised bridge pier configuration through the flood modelling are presented in mapping attached as Appendix B including the 5% AEP and 1% AEP flood events (with and without climate change).

4.4 Cumulative impacts

The only design amendment resulting in a change to the existing cumulative impacts discussed in the EIS is the bridge between Camellia and Rydalmere. As such, only developments in the vicinity of the bridge are described in Table 4-4, which outlines the changes in interaction from the EIS.

Elsewhere the amendments to the alignment are not expected to result in cumulative impacts outside of those outlined in the EIS (refer to Table 7-1 of Technical Paper 10, Hydrology, Flooding and Water Quality Assessment, Parramatta Light Rail Stage 2 Environmental Impact Statement).

Table 4-4 Change in cumulative flooding impacts due to the re-alignment of the bridge between Camellia and Rydalmere

Project and description	Amended Design Cumulative Impact Assessment	Change from EIS
Parramatta Light Rail Stage 1 Connection from Westmead to Carlingford via the Parramatta CBD and Camellia with a two-way track spanning 13 kilometres. The route will link Parramatta's CBD and railway station to the Westmead Health Precinct. Interaction with the project: Part of the current project scope includes modifications to the Parramatta Light Rail Stage 1 stabling and maintenance facility at Camellia.	The Parramatta Light Rail Stage 1 works include surface changes to establish the light rail alignment and stabling and maintenance facility in Camellia adjacent to Grand Avenue. This initial stage of the light rail system would result in minimal changes to flooding behaviour due to the alignment predominantly following existing roads and existing road grades. There is the potential for cumulative local impacts from Stage 2 to be observed in the Grand Avenue location where localised ponding and overland flows are influenced by the stabling and maintenance facility and local alignment.	There is potential for a more widespread impact due to the new bridge alignment, extending project impacts upstream towards James Ruse Drive and potential interaction with Grand Avenue localised flood impacts.
Camellia Waste Facility Materials Recycling Facility located at 37 Grand Avenue. Stage 1 is complete, whilst Stage 2 construction works estimated completion dates are not yet confirmed. Interaction with the project: The site interacts with the project on the southern boundary along Grand Avenue and the eastern boundary of the footprint as it runs across Parramatta River to the project site adjacent to South Street	The potential for cumulative flood impacts are low with significant separation provided between flood impacts of the amended design bridge at Camellia and the Camellia Waste facility.	The project amendment to remove the bridge crossing alignment from this eastern end of Grand Avenue reduces the potential for cumulative flood impacts.

5 Mitigation measures

The existing mitigation measures for minimising both potential flooding and residual impacts from the EIS Technical Paper 10 are unchanged by this supplementary flooding assessment. Refer to Table 8-1 and Section 8.4 of EIS Technical Paper 10. However, the mitigation measures for minimising both potential flooding and residual impacts from the EIS have been changed in response to a submission received from exhibition of the EIS.

Ongoing design development would be undertaken to minimise the localised flooding impacts as far as practicable. This would consider the design of bridges in order to minimise flow disruption, and the capacity of proposed and existing stormwater drainage systems. Optimisation of bridge piers would also be considered to reduce the larger impact of the new proposed design on flood flows in the Parramatta River.

The location and layout of construction work sites and compounds would be prepared with consideration of overland flow paths, avoiding flood liable land and minimising changes to flow paths where practicable to minimise impacts. The presence of temporary structures and work areas within and next to the Parramatta River and other watercourses in the study area, could pose an environmental and safety risk in the event of a flood event. Floodwaters could mobilise pollutants and construction materials from these areas. A construction flood emergency response plan would be prepared that sets out measures which are aimed at mitigating the risks in the event of a flood occurring during construction.

6 Conclusion

The potential for flood impacts as a result of the project has been identified in the EIS. Subsequent project amendments at the two bridge crossings of Parramatta River, at Camellia and Wentworth Point, and the bridge crossing at Hill Road have a different flood impact potential.

Potential changes to the flood impacts are generally minimal and in compliance with FMOs, with impacts of a similar scale to those identified in the EIS. The most substantial change in flood impacts is a result of the bridge between Camellia and Rydalmere realignment change which increases flood level impacts to areas upstream of new position for the bridge crossing.

Construction Stage Impacts

Changes to flood risk and potential impacts are only observed for construction compounds 1, 2 and 7. These risks to and potential impacts from the compounds are either minor in significance or reduced from the EIS, and any localised impacts are largely limited to the construction and project boundaries.

Operational Stage Impacts

Localised overland flow path changes through areas of design amendments at Rydalmere and Melrose Park only result in immediate impacts to local overland flows within the project boundary which don't increase impacts in adjacent areas.

A greater magnitude of flood impact on the upstream side of the Camellia Bridge occurs with the design amendment whereby a larger area of the floodplain experiences an increase in flood level.

Changes in impacts between the exhibited project and the amended project

The change in construction flood impacts from the design amendments are flood level changes in the locations of the new bridge alignment including both piers and abutment positions. Amended pier locations result in velocity and scour potential changes in new locations, predominantly in Rydalmere. These increases in impacts are anticipated within Parramatta River in the immediate vicinity of the proposed pier locations.

Worsening of operational flood levels as a result of the changes to bridge design and crossing location are likely to affect areas between James Ruse Drive and the bridge between Camellia and Rydalmere, with impacts limited to commercial properties adjacent the waterway by increasing 1% AEP flood levels by up to 47mm. The bridge location change also creates impacts in terms of velocity and scour potential at the new bridge substructure locations.

The areas in Camellia towards the eastern end of Grand Avenue that were affected by flooding attributed to the EIS design have reverting back to flood behaviour very similar to the existing conditions where the design amendment moved the Camellia bridge further west.

Changes in impacts due to local drainage and grading design amendments are minimal and are generally limited to areas adjacent to the bridge approaches.

Revised bridge design impacts

The impact to properties immediately upstream of the bridge between Camellia and Rydalmere (by the amended design of up to 47mm) can be reduced through the revised pier configuration for the Camellia bridge. The revised design brings impacts to these upstream properties under 20mm and in line with the project FMOs.

Cumulative Impacts

The potential for cumulative impacts with other projects were identified and considered to be low provided the standard mitigation measures are implemented. These potential impacts are not significantly change by the project amendments.

Mitigation Measures

The existing mitigation measures for minimising both potential flooding and residual impacts from the EIS Technical Paper 10 are unchanged with this supplementary flooding assessment. There are a number of mitigation measures proposed to minimise impacts associated with construction and operation of the project. These include measures to guide future design stages to minimise flood impacts.

Residual impacts can be further mitigated through detailed design stages including the impacts of the bridge crossings. Further mitigation through pier and pile structure optimisation can provide a reduction in the observed flood impacts.

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Appendix A Maps

Updated Flood

Appendix A1 – Flood model figures – 5% AEP

- Design Scenario Flood Conditions 5% AEP Depth
- Design Scenario Flood Conditions 5% AEP Hazard
- Design Scenario Flood Conditions 5% AEP Velocity
- Design Scenario Flood Conditions 5% AEP Climate Change Depth
- Design Scenario Flood Conditions 5% AEP Climate Change Hazard
- Design Scenario Flood Conditions 5% AEP Climate Change Velocity

Appendix A2 – Flood model figures – 1% AEP

- Design Scenario Flood Conditions 1% AEP Depth
- Design Scenario Flood Conditions 1% AEP Hazard
- Design Scenario Flood Conditions 1% AEP Velocity
- Design Scenario Flood Conditions 1% AEP Climate Change Depth
- Design Scenario Flood Conditions 1% AEP Climate Change Hazard
- Design Scenario Flood Conditions 1% AEP Climate Change Velocity

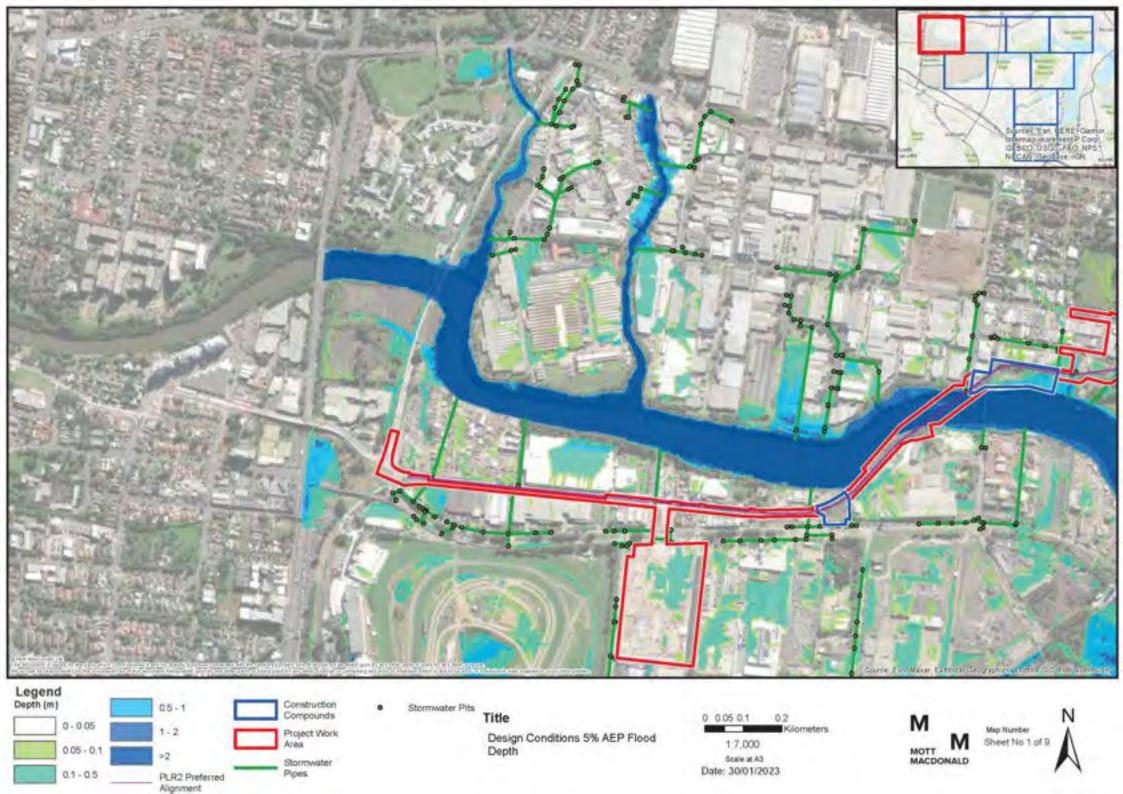
Appendix A3 – Flood model figures – PMF

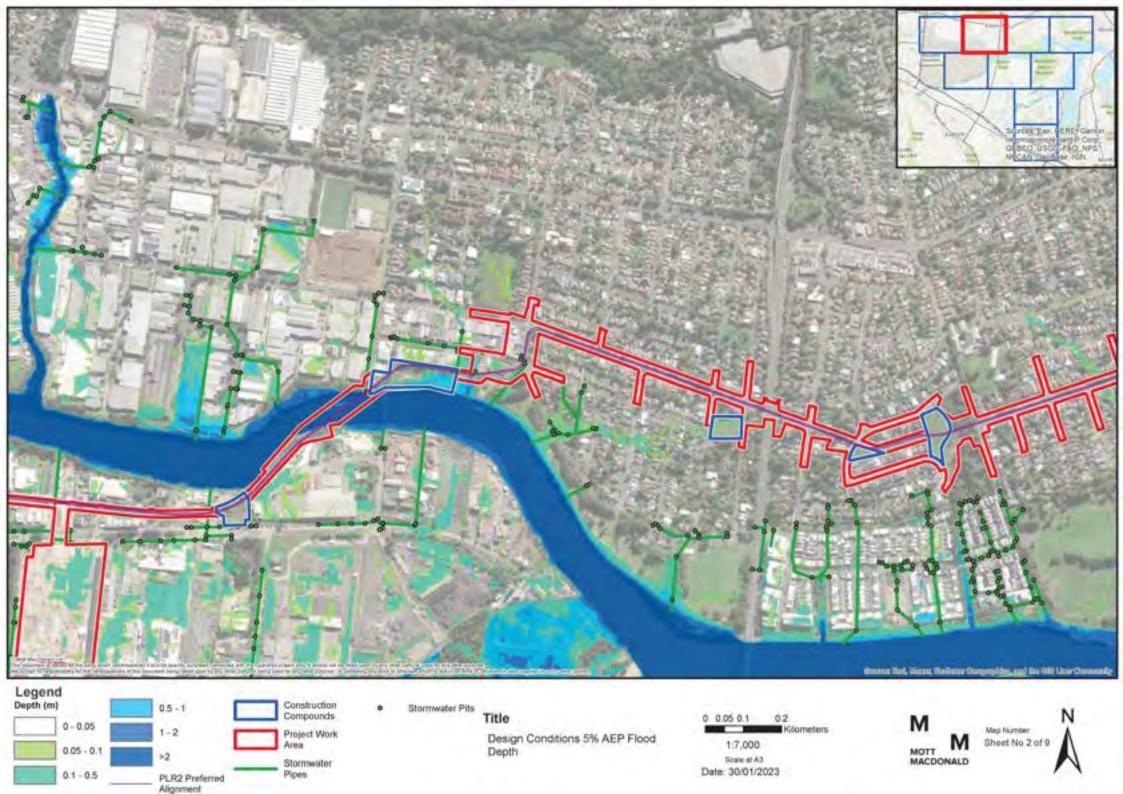
- Design Scenario Flood Conditions PMF Depth
- Design Scenario Flood Conditions PMF Hazard
- Design Scenario Flood Conditions PMF Velocity

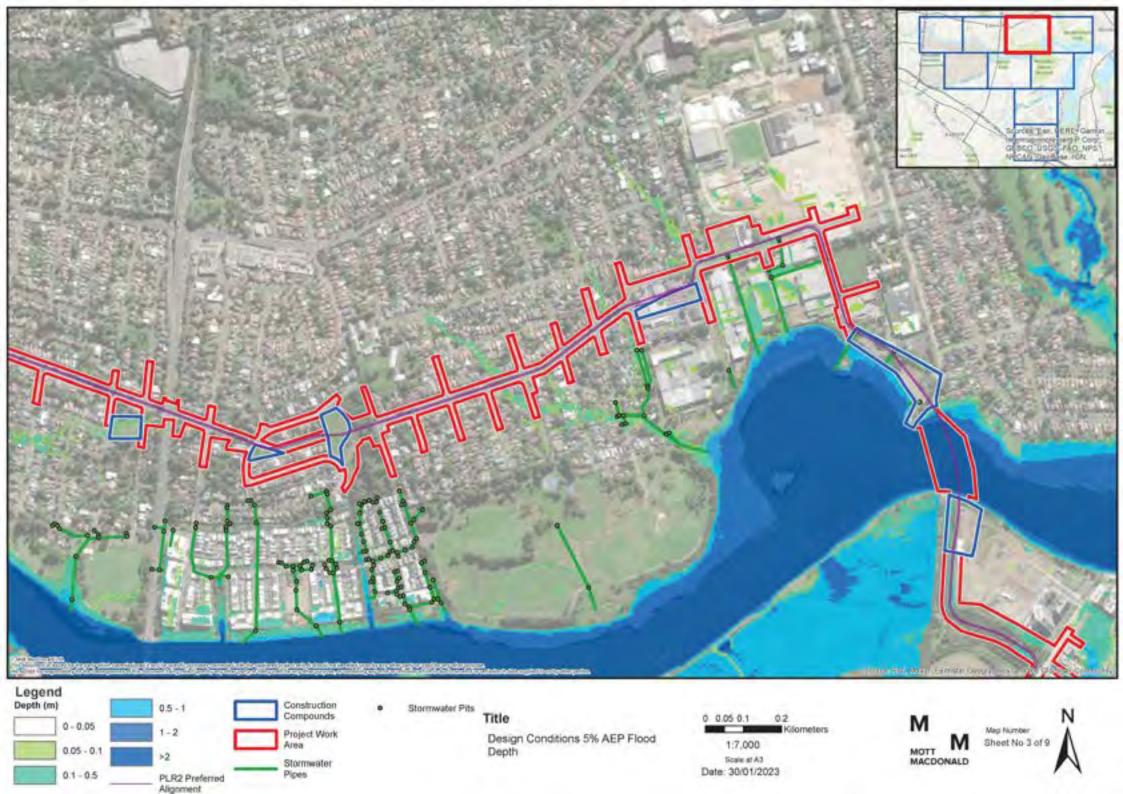
Appendix A4 - Flood model figures - Flood level difference

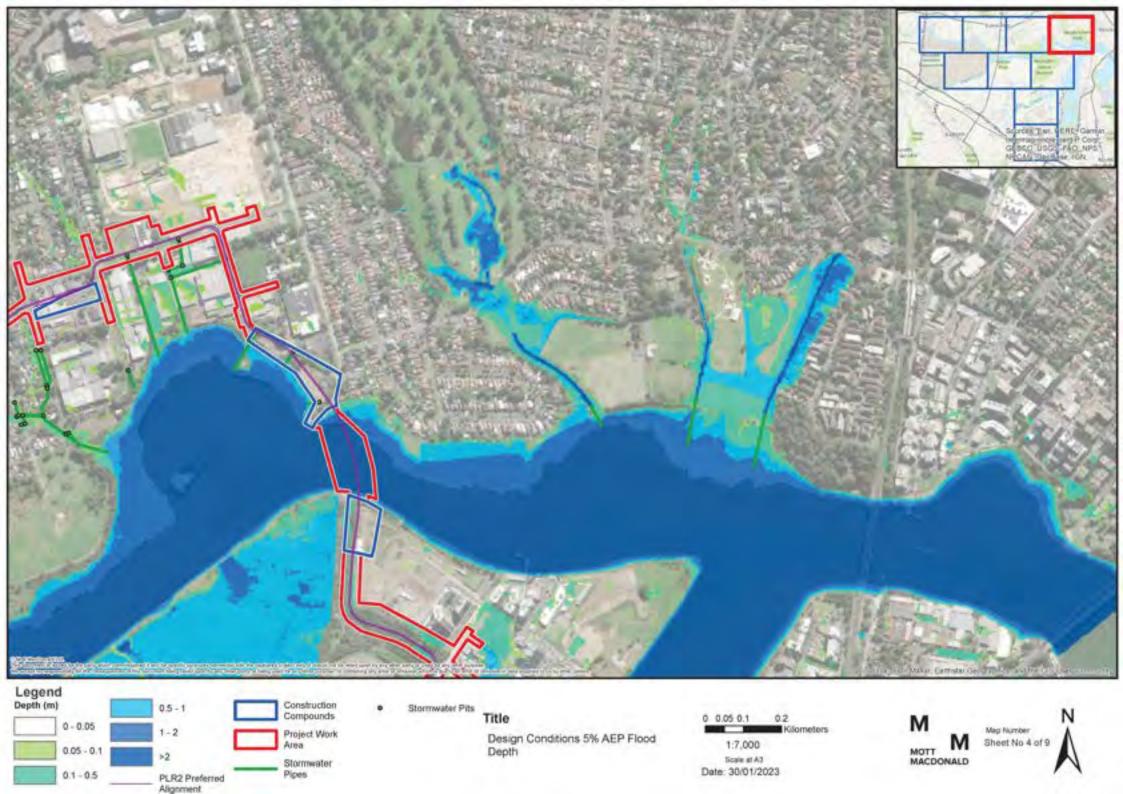
- Design Scenario Flood Afflux 5% AEP
- Design Scenario Flood Afflux 5% AEP Climate Change
- Design Scenario Flood Afflux 1% AEP
- Design Scenario Flood Afflux 1% AEP Climate Change
- Design Scenario Flood Afflux PMF

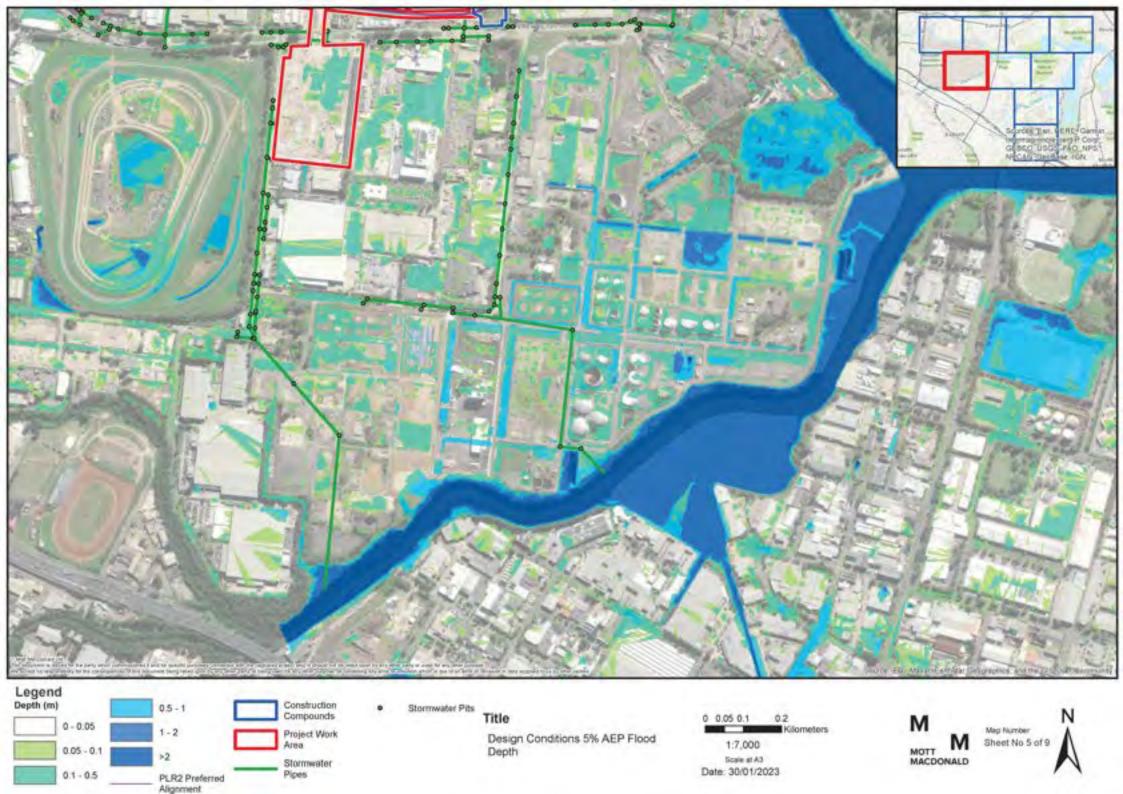
Appendix A1 – Flood model figures – 5% AEP

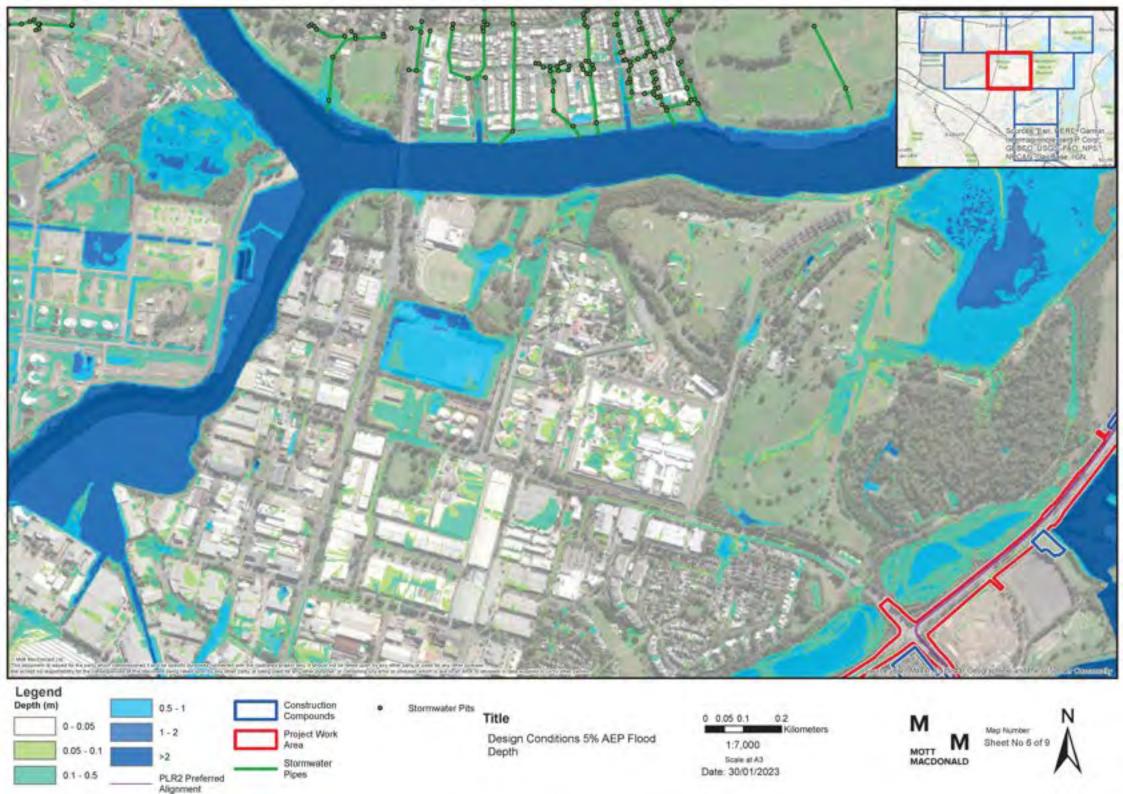


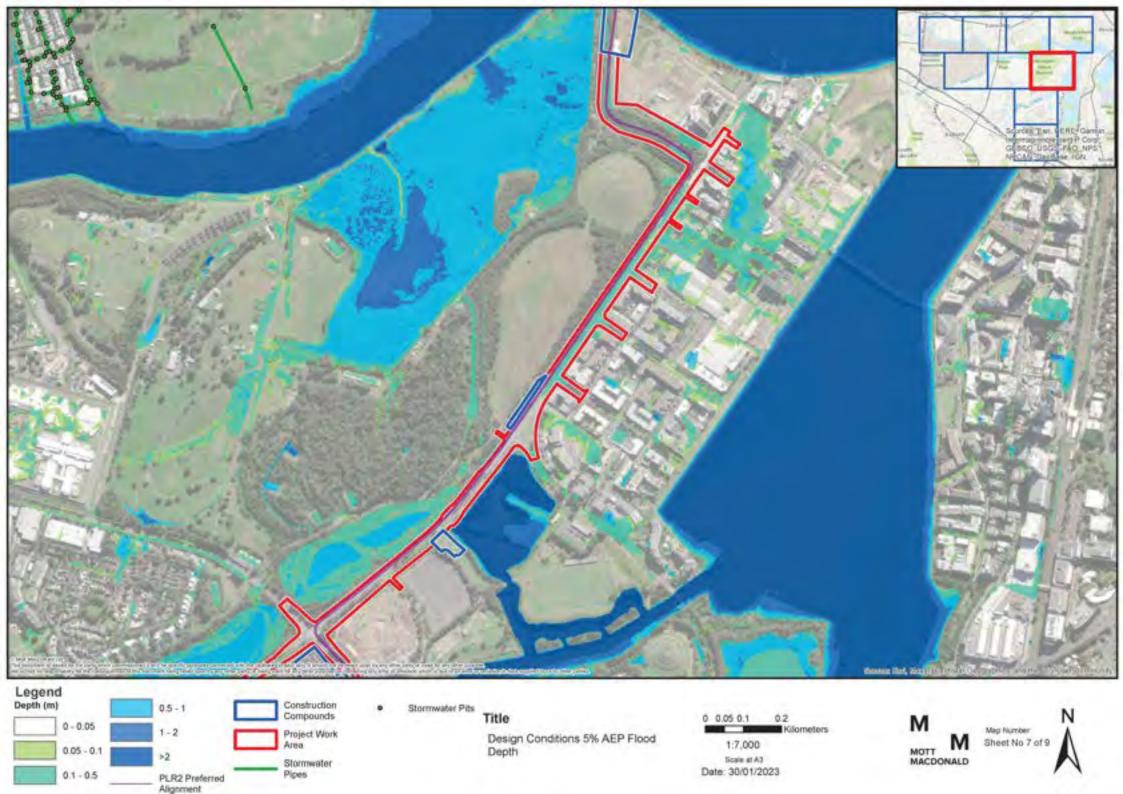


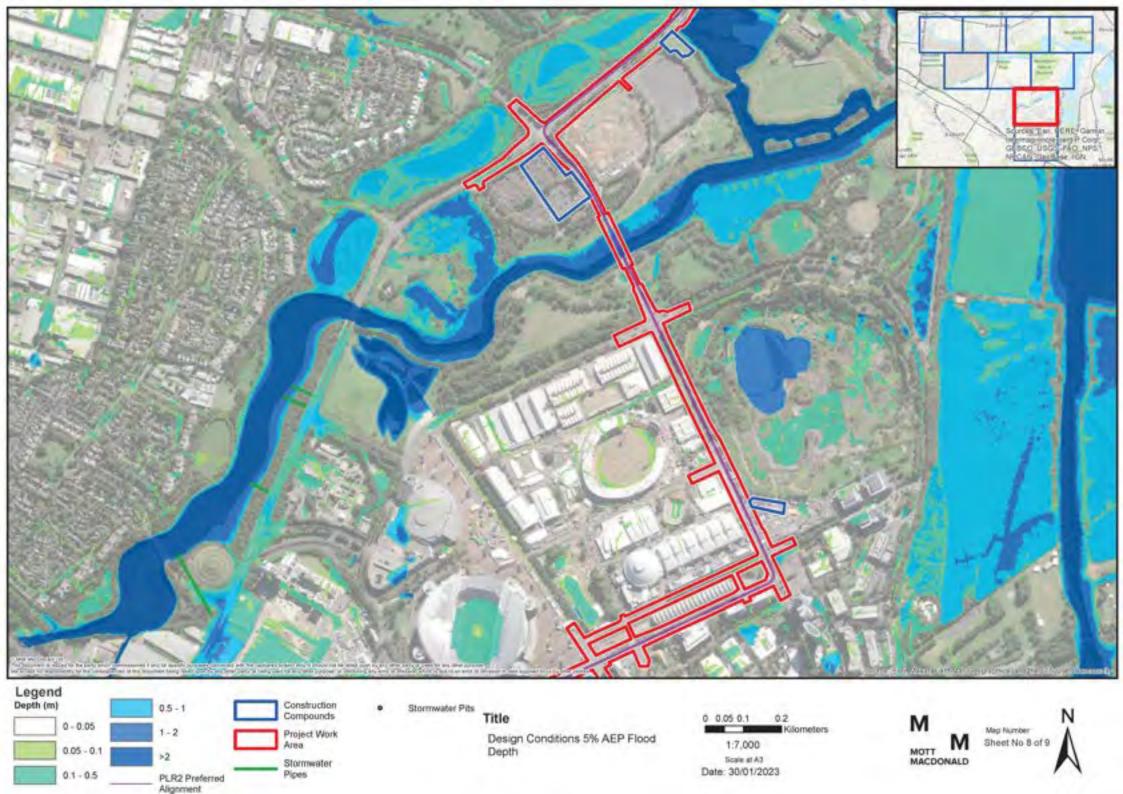


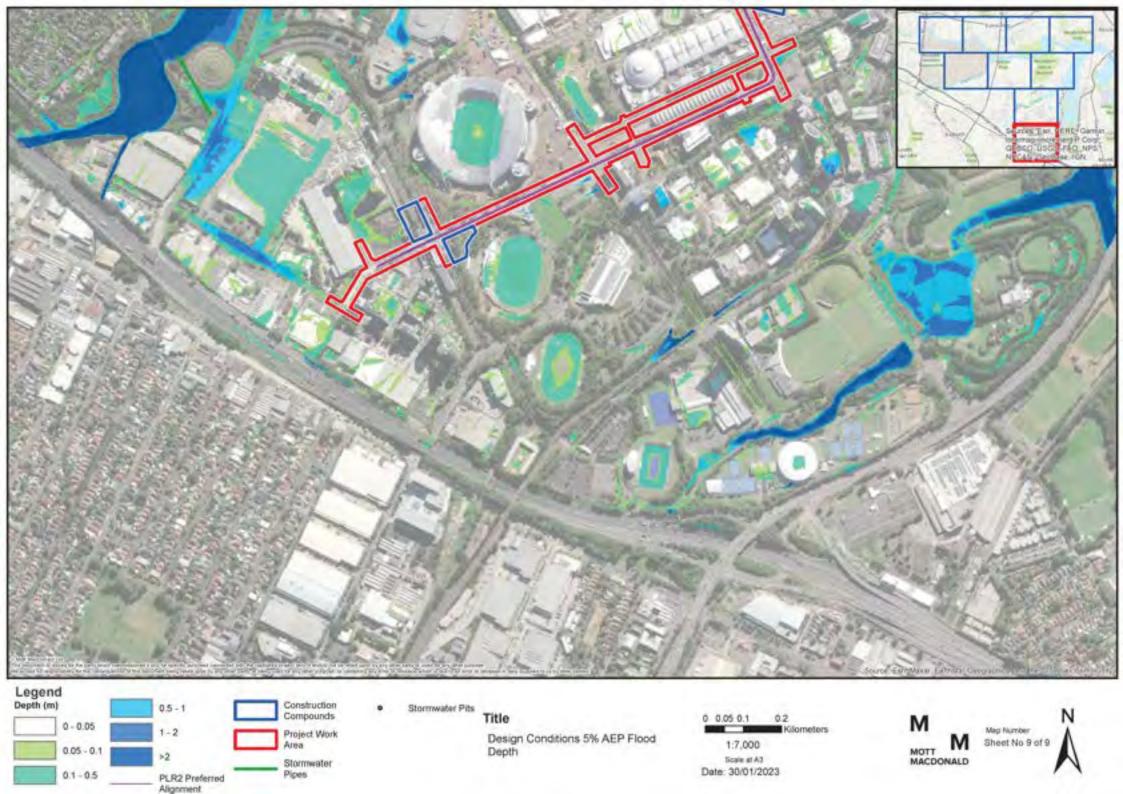


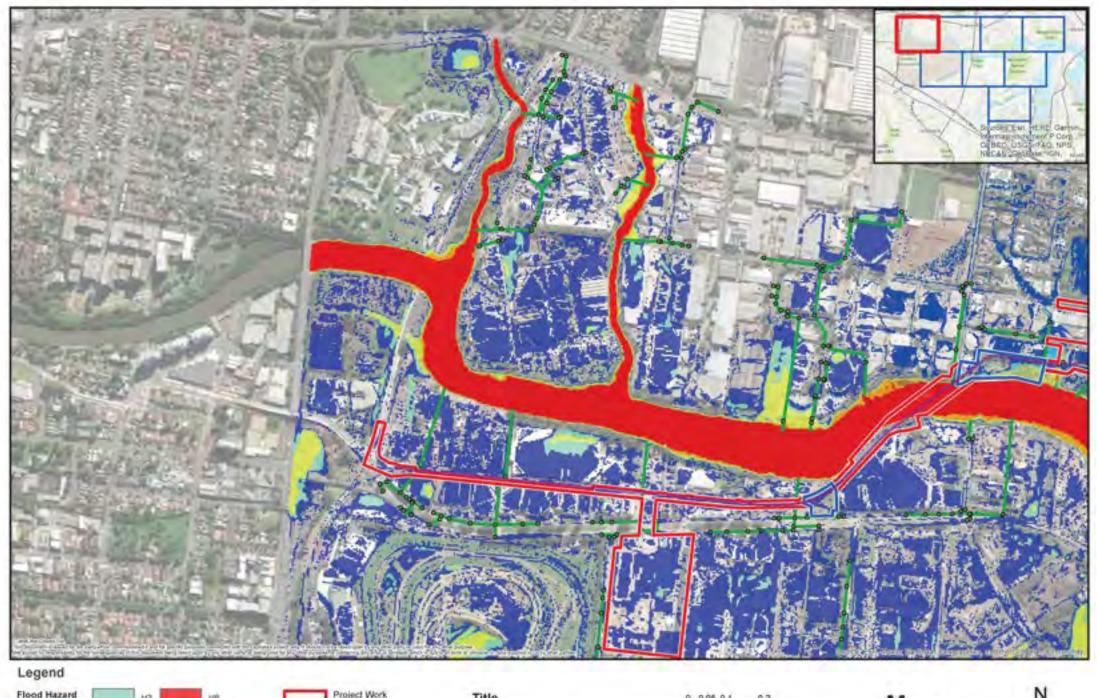








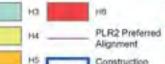














Compounds

Project Work Area

Stormwater Pipes

Stormwater Pits

Title

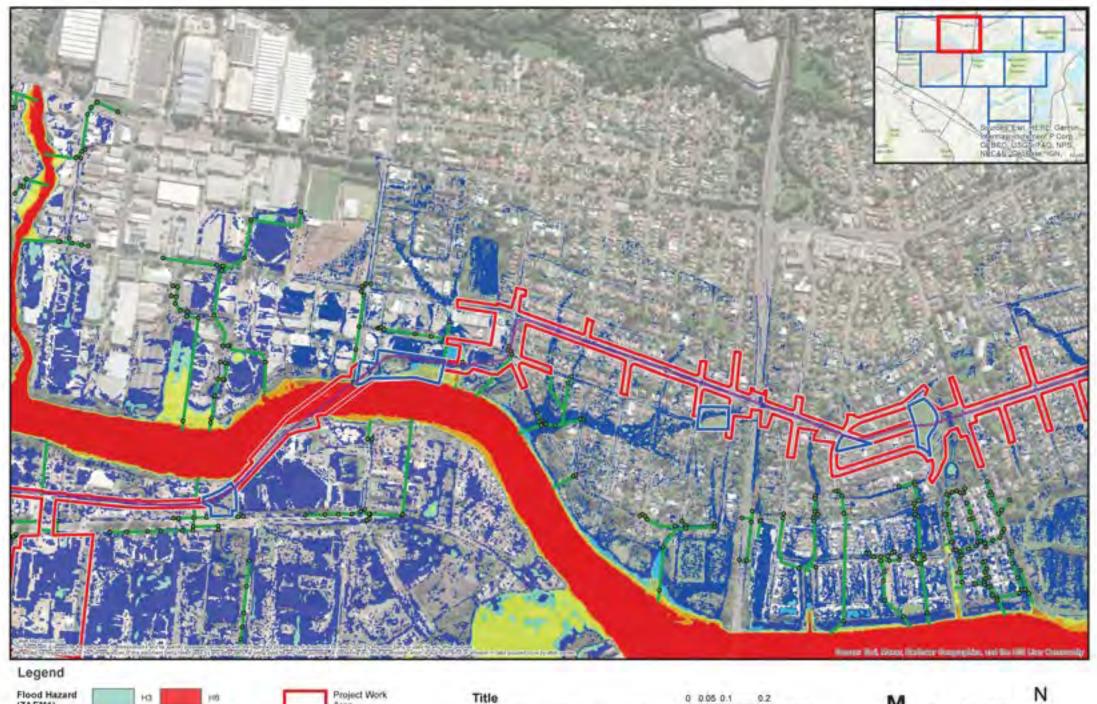
Design Conditions 5% AEP Flood Hazard

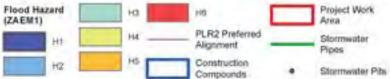


MOTT IVI

Map Number Sheet No 1 at 9







Design Conditions 5% AEP Flood Hazard

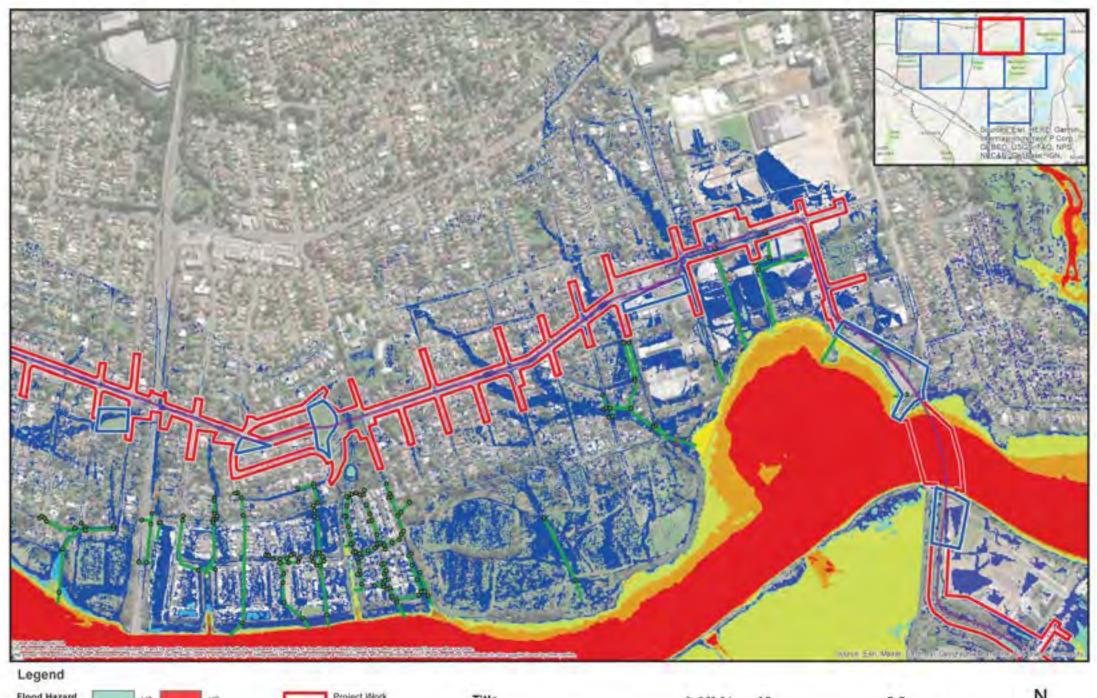


Date: 30/01/2023

MOTT MACDONALD

Map Number Sheet No 2 of 9





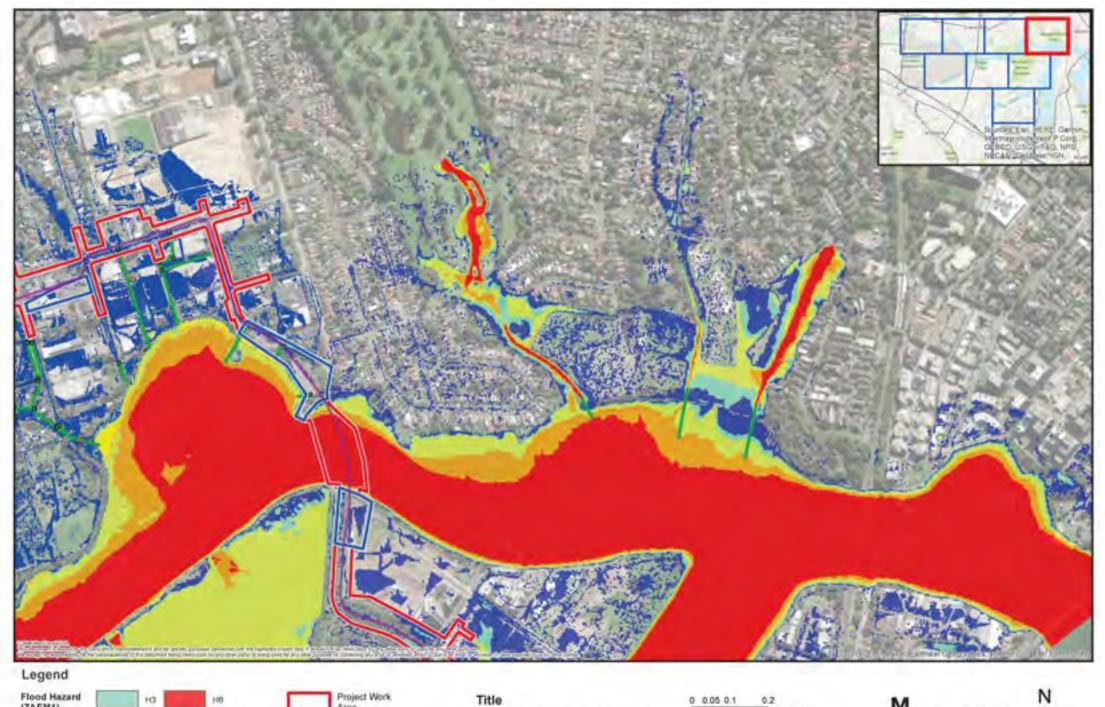


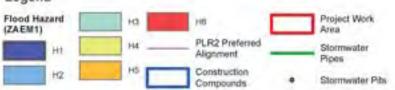
Title
Design Conditions 5% AEP Flood
Hazard



M M







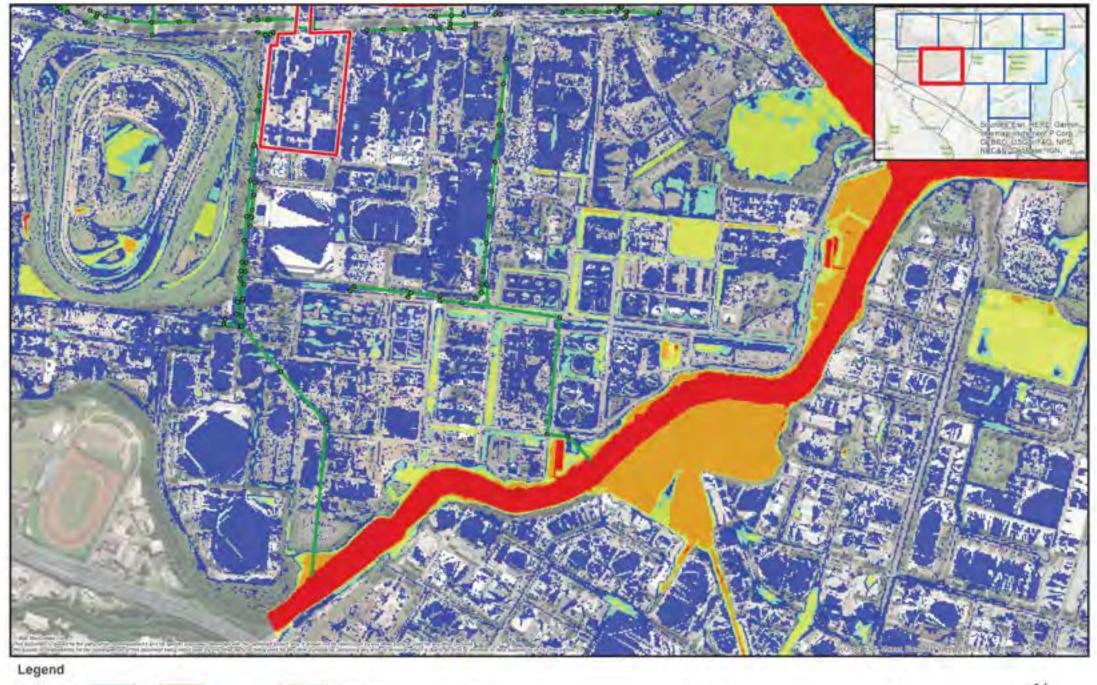
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Date: 30/01/2023

MOTT IVI







Title

Design Conditions 5% AEP Flood Hazard



Date: 30/01/2023

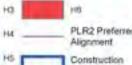
MOTT M MACDONALD Map Number Sheet No 5 of 9













Compounds



Stormwater Pits

Title

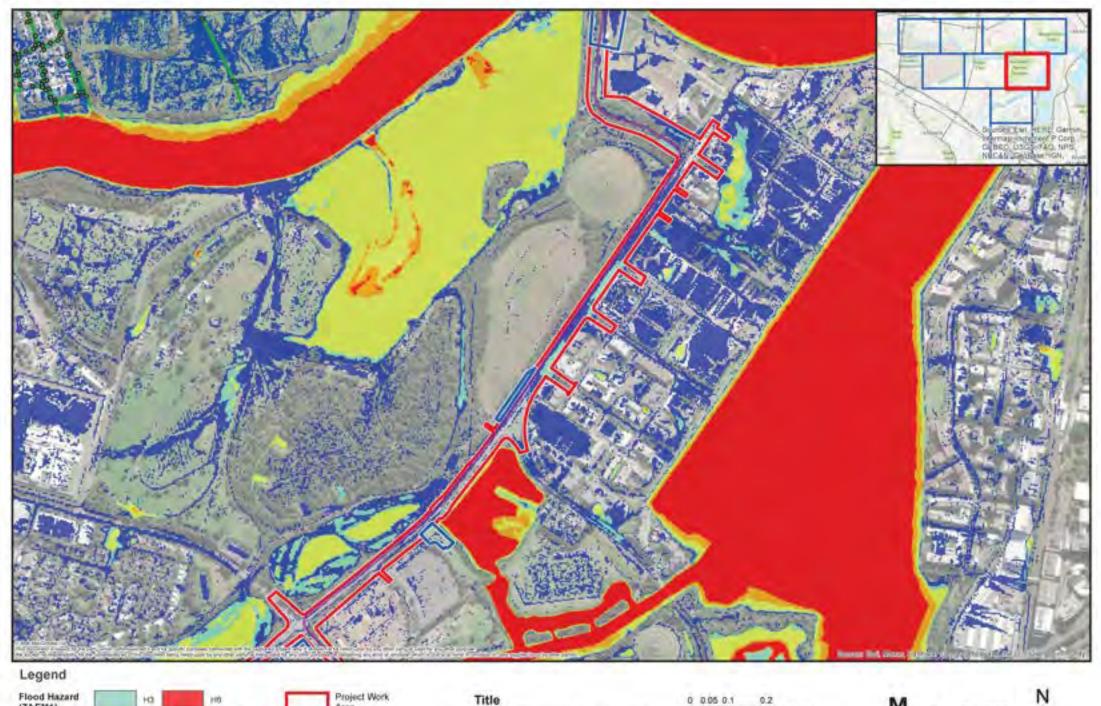
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 Title
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 0.2

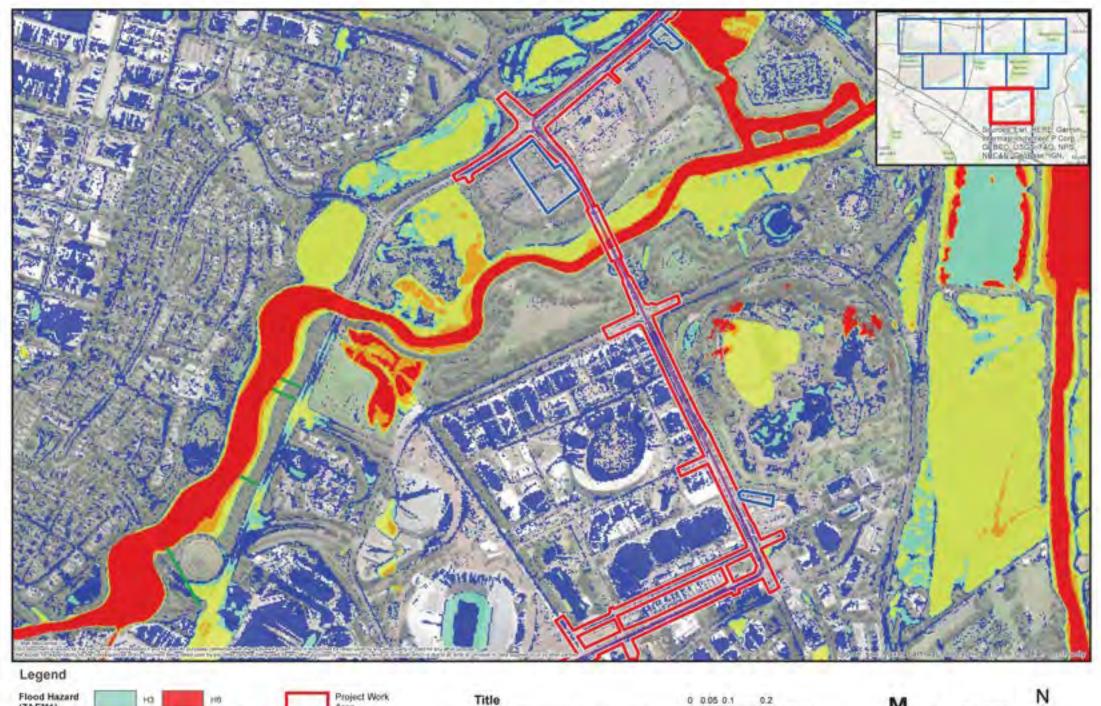
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 1:7,000

 Hazard
 \$346 8143

Date: 30/01/2023

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Map Number Sheet No 7 of 9





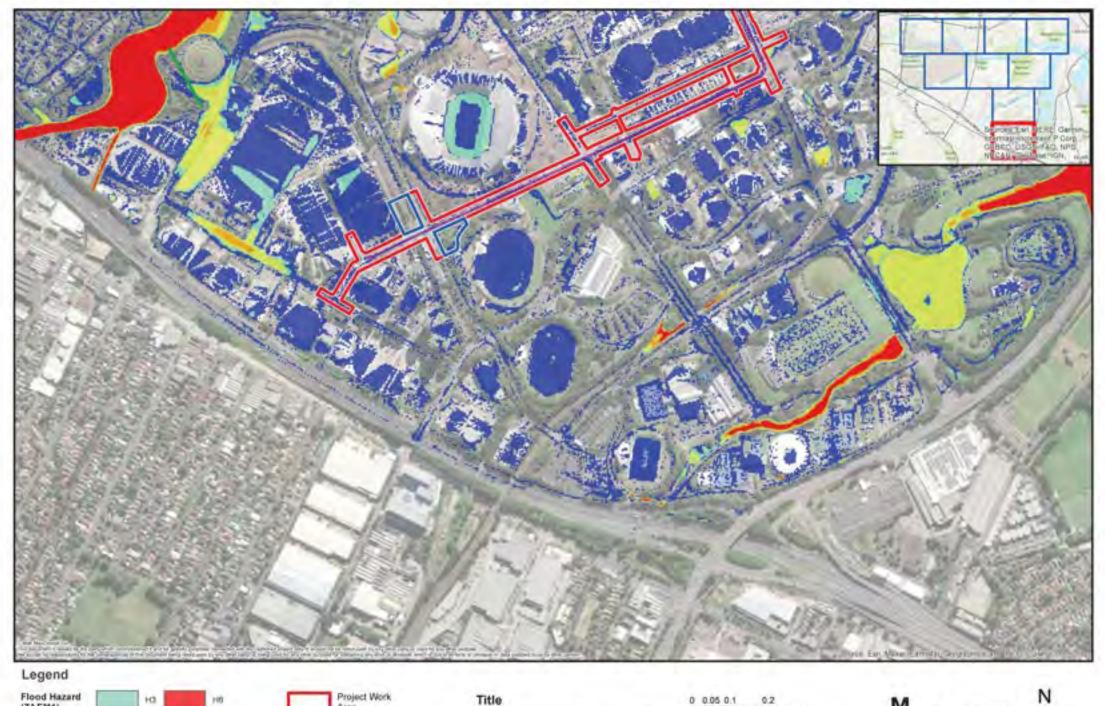
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Design Conditions 5% AEP Flood 1:7,000
Scale at A2

Date: 30/01/2023

M M

Map Number Sheet No 8 of 9



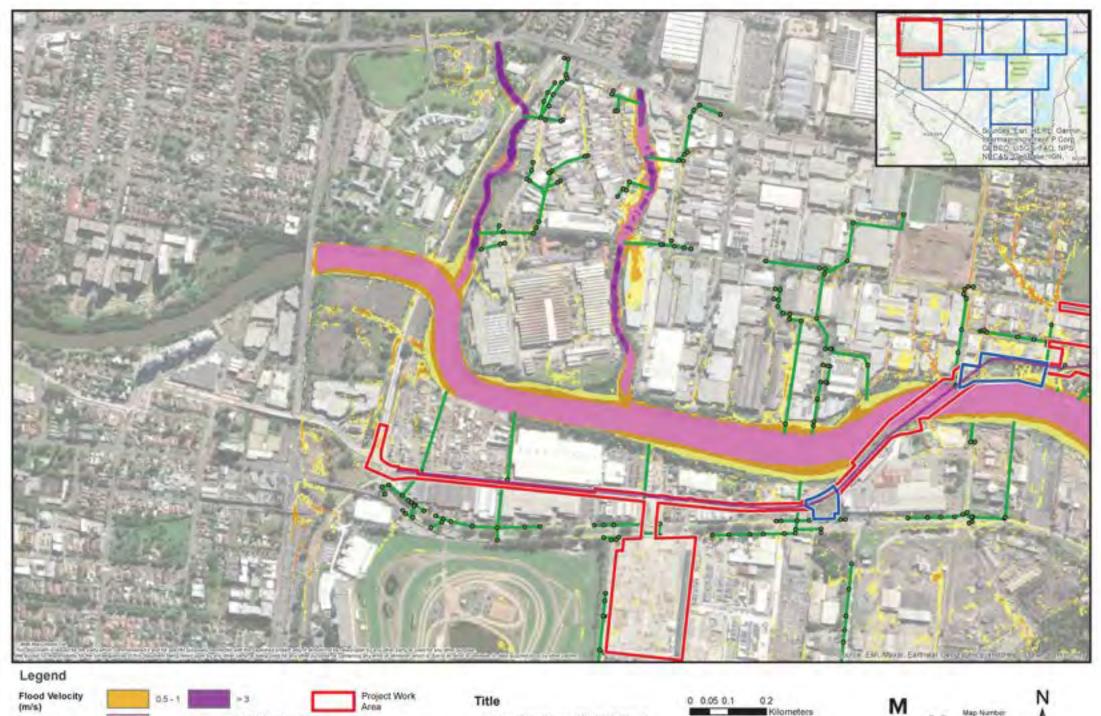


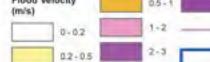
Design Conditions 5% AEP Flood Hazard





Map Number Sheet No 9 of 9





PLR2 Preferred Alignment Stormwater Pipes: Construction Stormwater Pits

Compounds

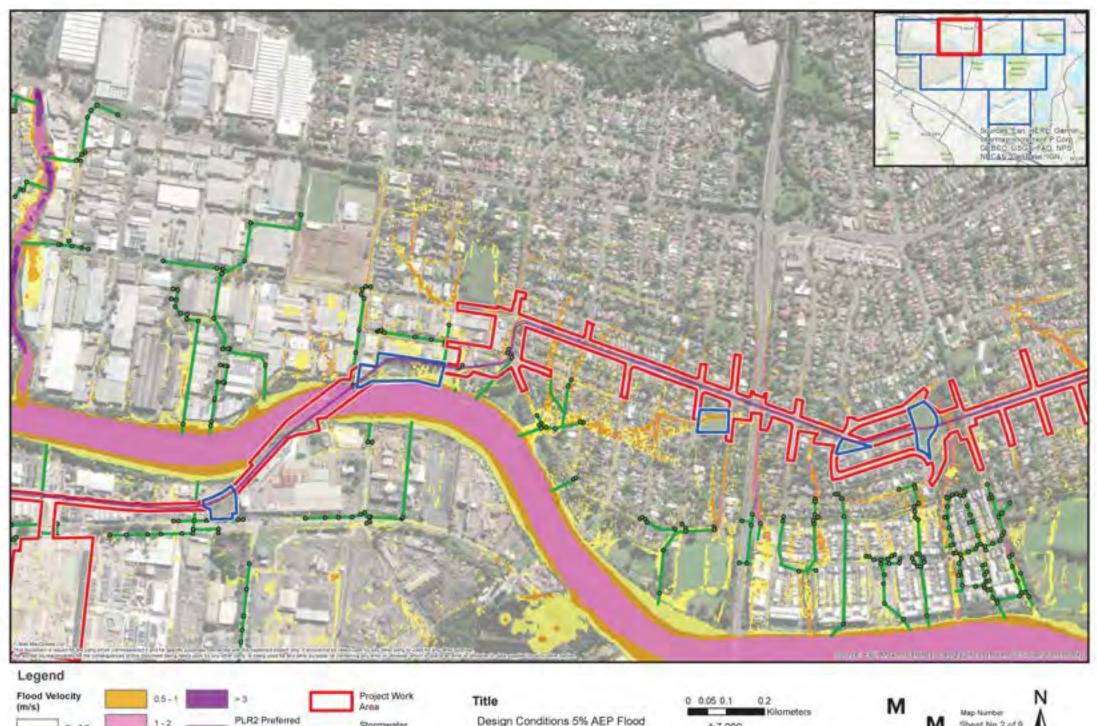
Design Conditions 5% AEP Flood Velocity

1:7,000 Scale vt A3 Date: 30/01/2023

MOTT IVI

Map Number Sheet No 1 of 9





PLR2 Preferred Alignment Stormwater Pipes. Construction Stormwater Pits. Compounds

Design Conditions 5% AEP Flood Velocity

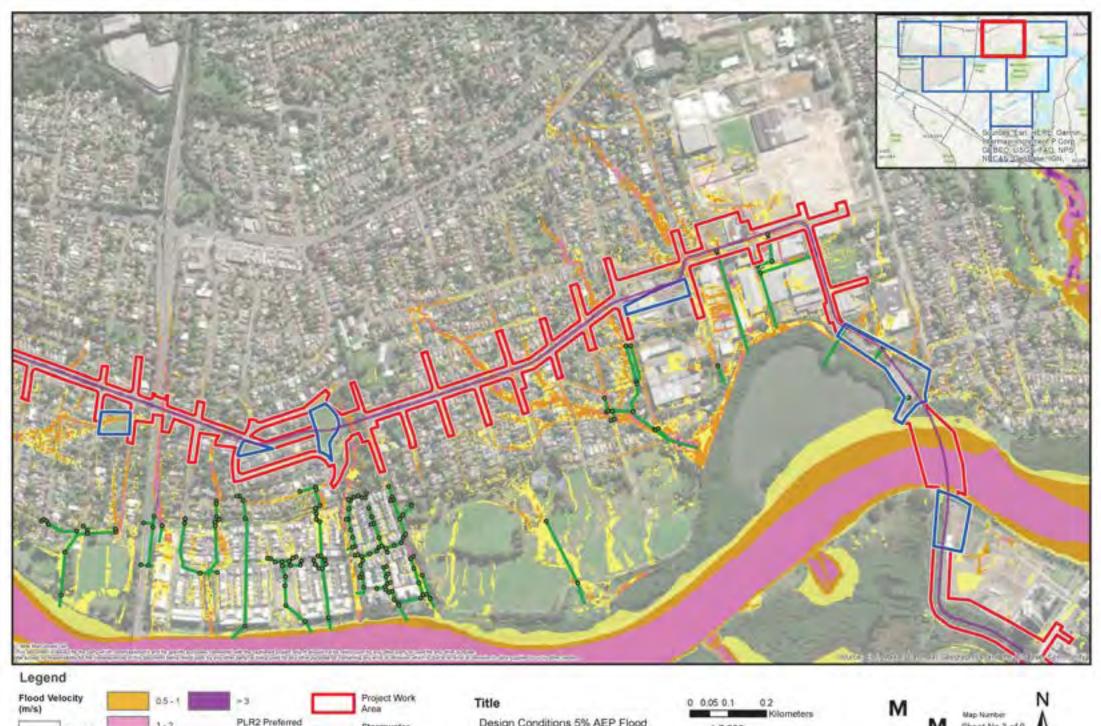
1:7,000 Scale at A3

Date: 30/01/2023

MOTT IVI

Sheet No 2 of 9





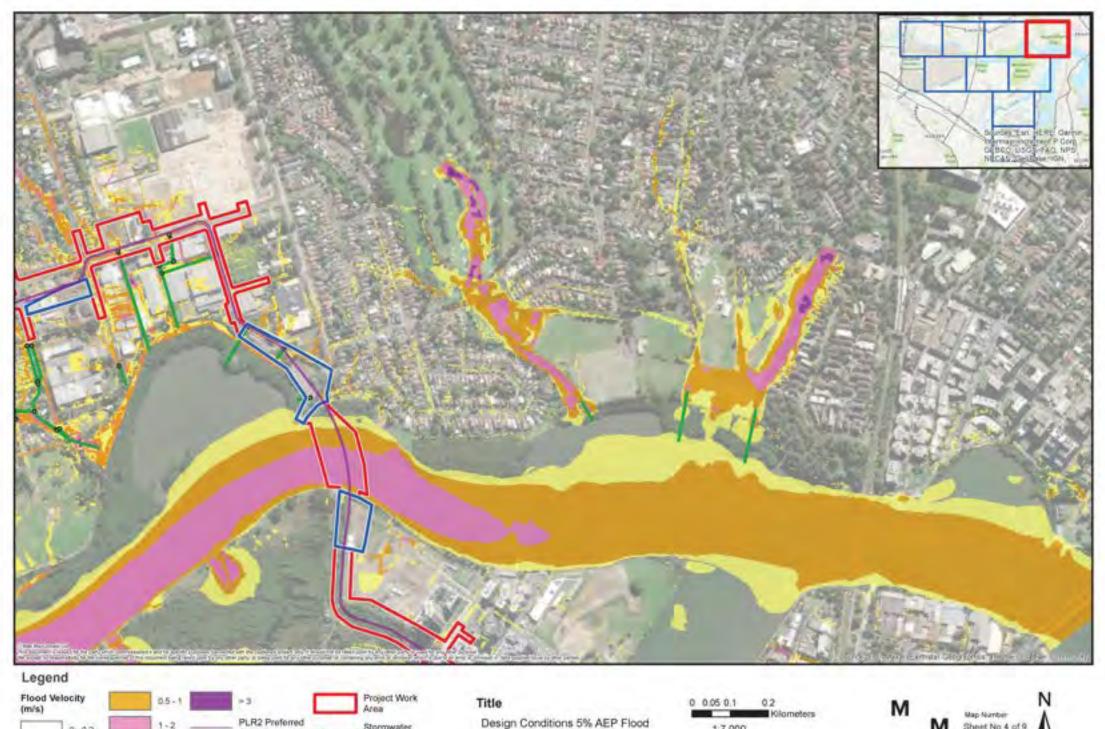
PLR2 Preferred Alignment Stormwater Pipes: Construction Stormwater Pits. Compounds

Design Conditions 5% AEP Flood Velocity

1:7,000 Scale at A3 Date: 30/01/2023

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Sheet No 3 of 9



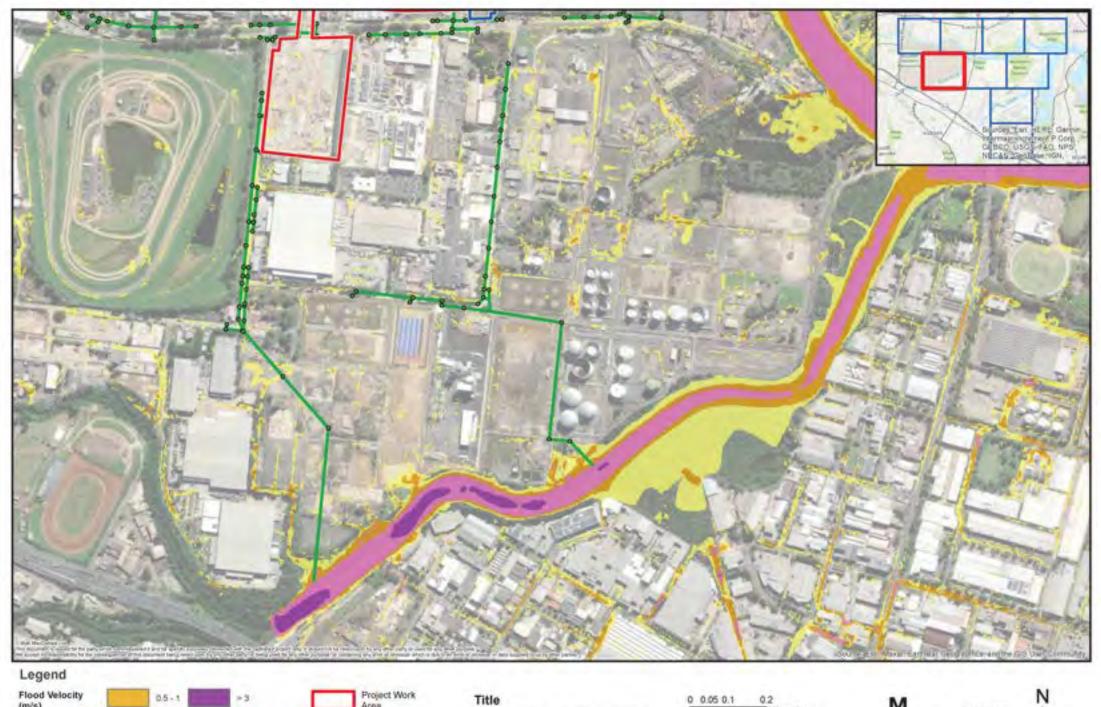


Design Conditions 5% AEP Flood Velocity



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Sheet No 4 of 9





Design Conditions 5% AEP Flood
Velocity

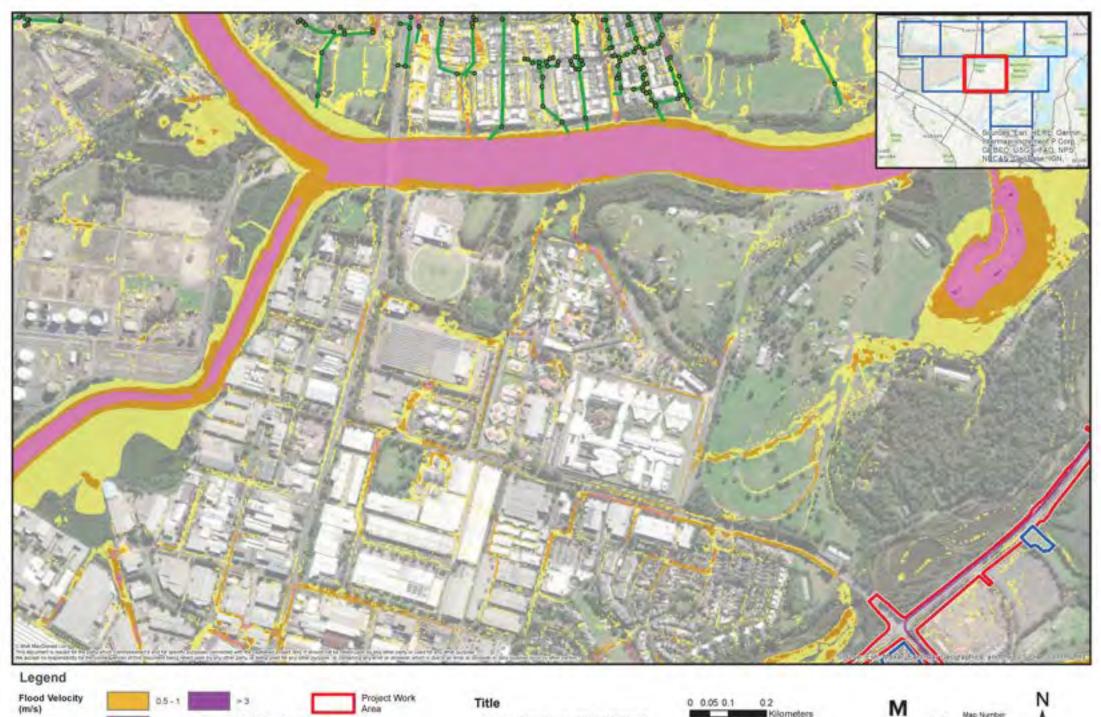
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0 0.05 0.1 0.2 Kilometers 1:7,000 Scale at A3

M M

Map Number Sheet No 5 of 9





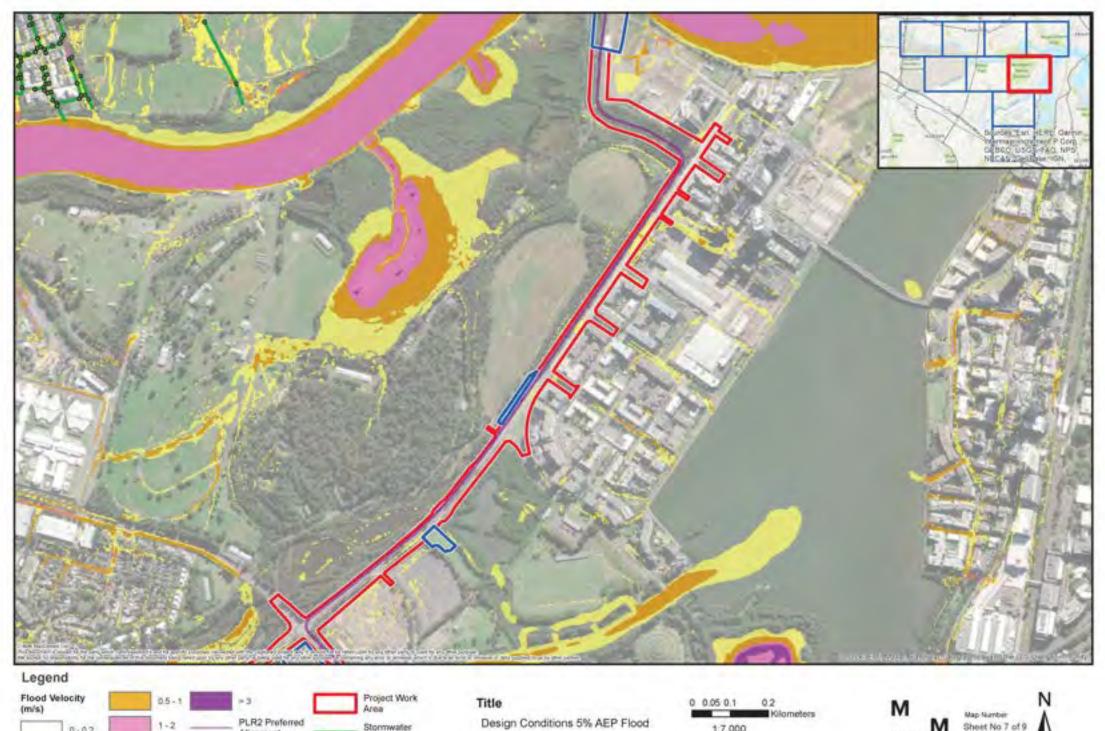


Design Conditions 5% AEP Flood Velocity

0 0.05 0.1 0.2 Holometers 1:7,000 Scale at A3 Date: 30/01/2023

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Map Number Sheet No 6 of 9



PLR2 Preferred Alignment Pipes. Construction Stormwater Pits Compounds

Design Conditions 5% AEP Flood Velocity

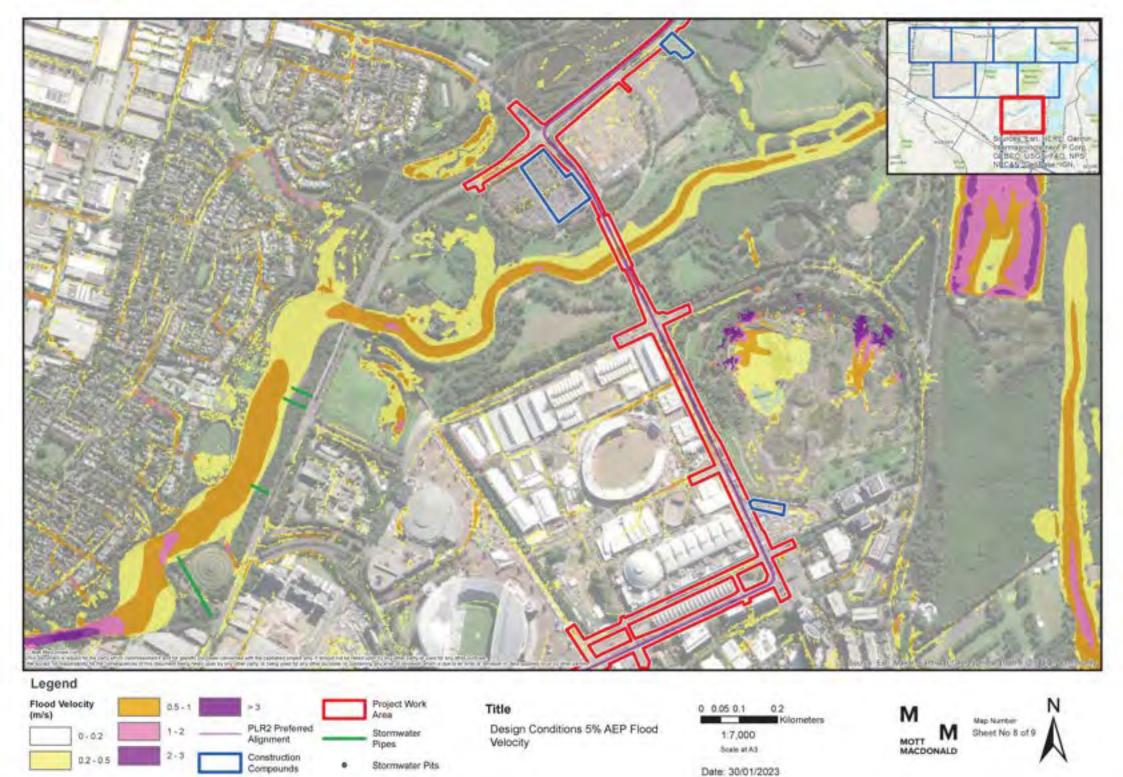
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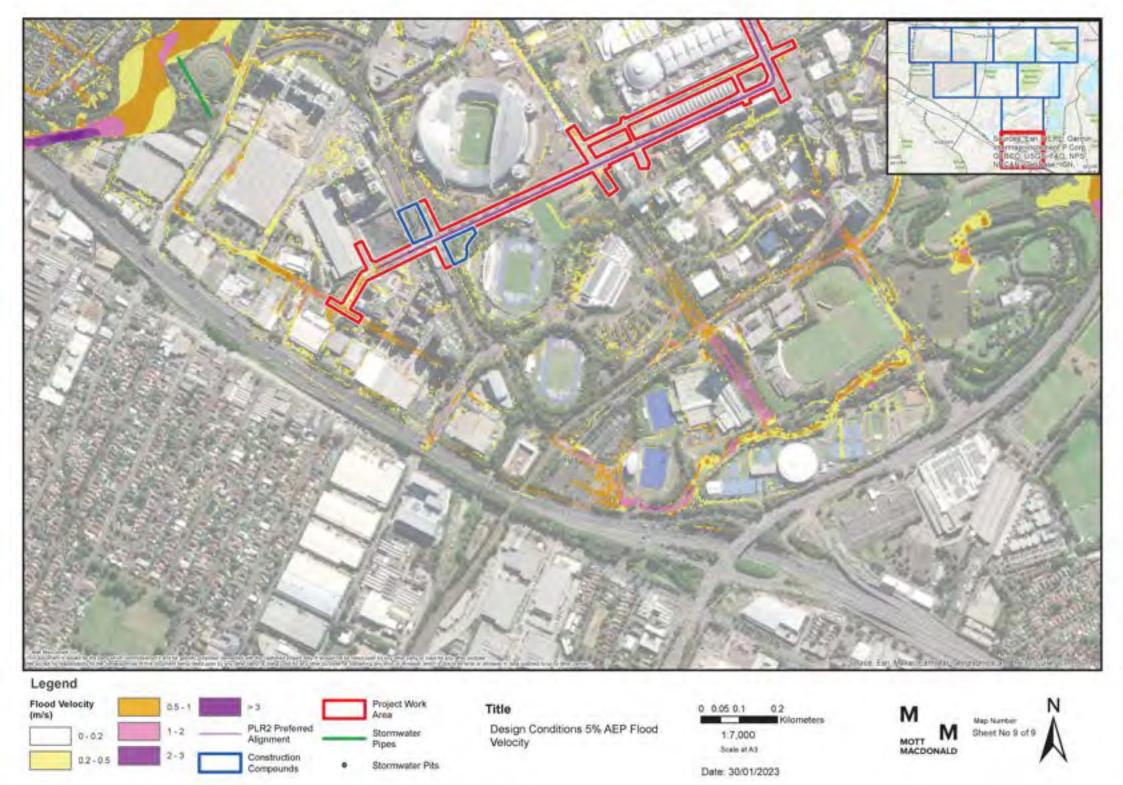
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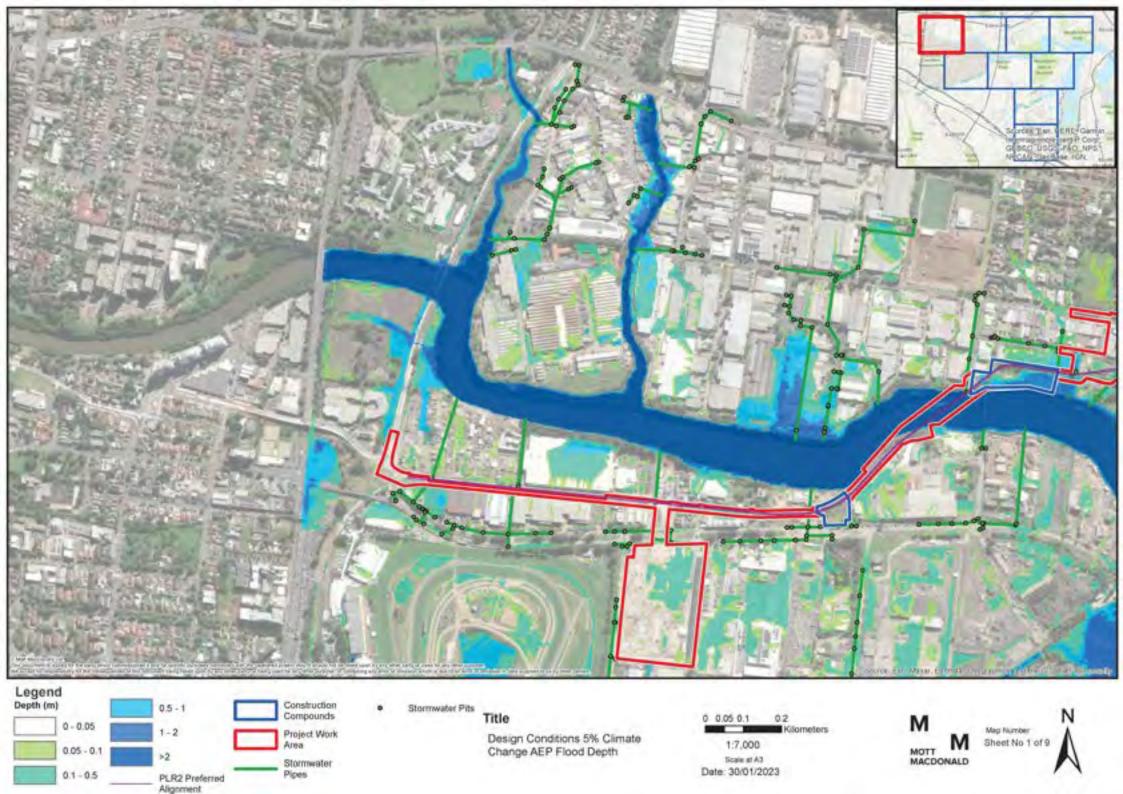
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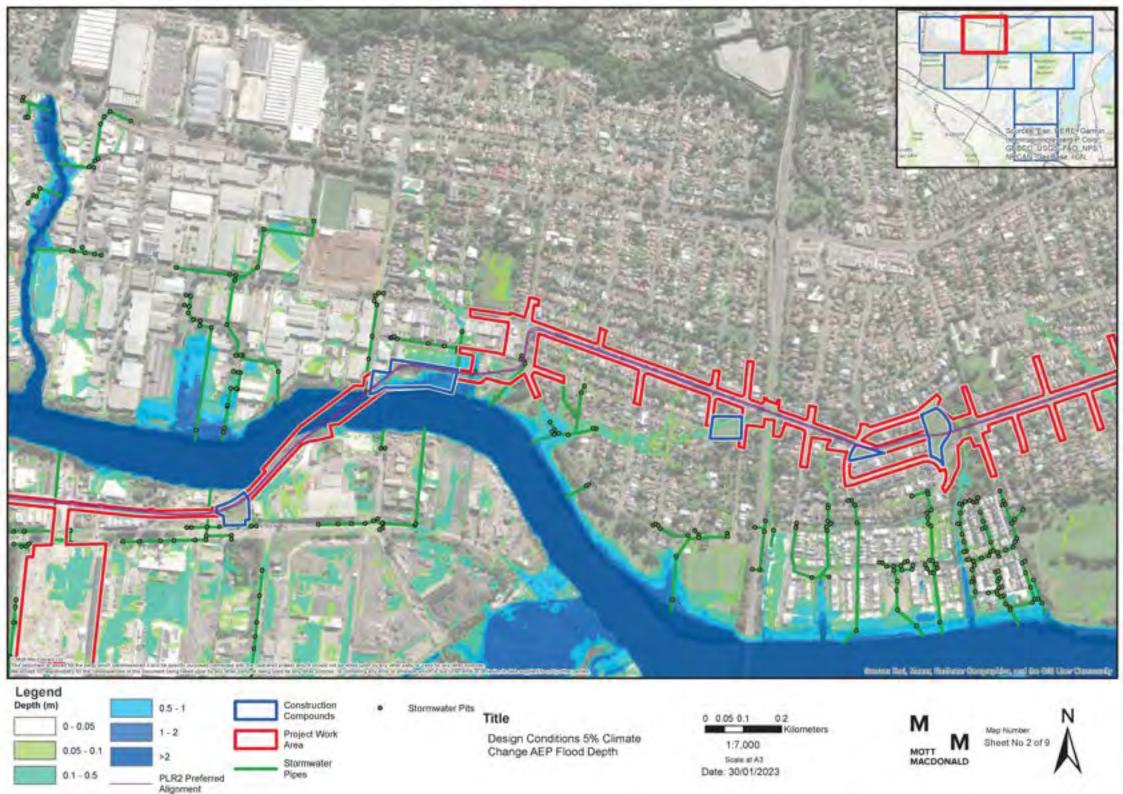
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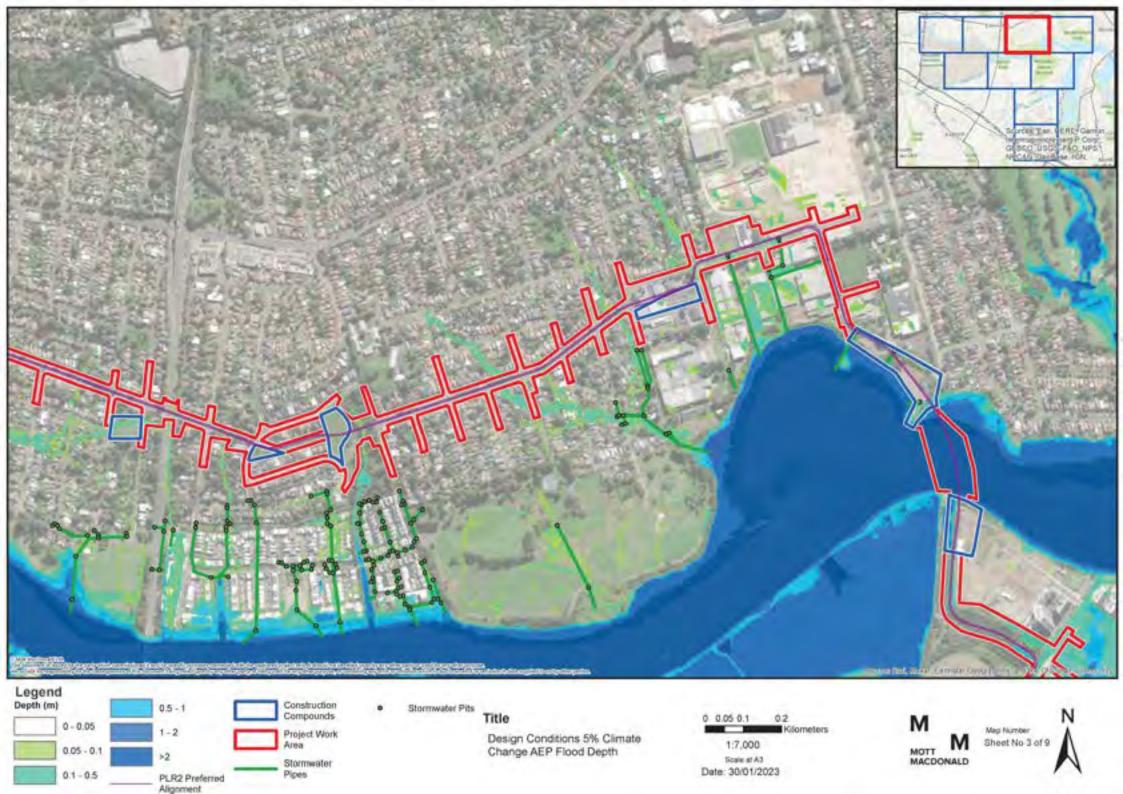


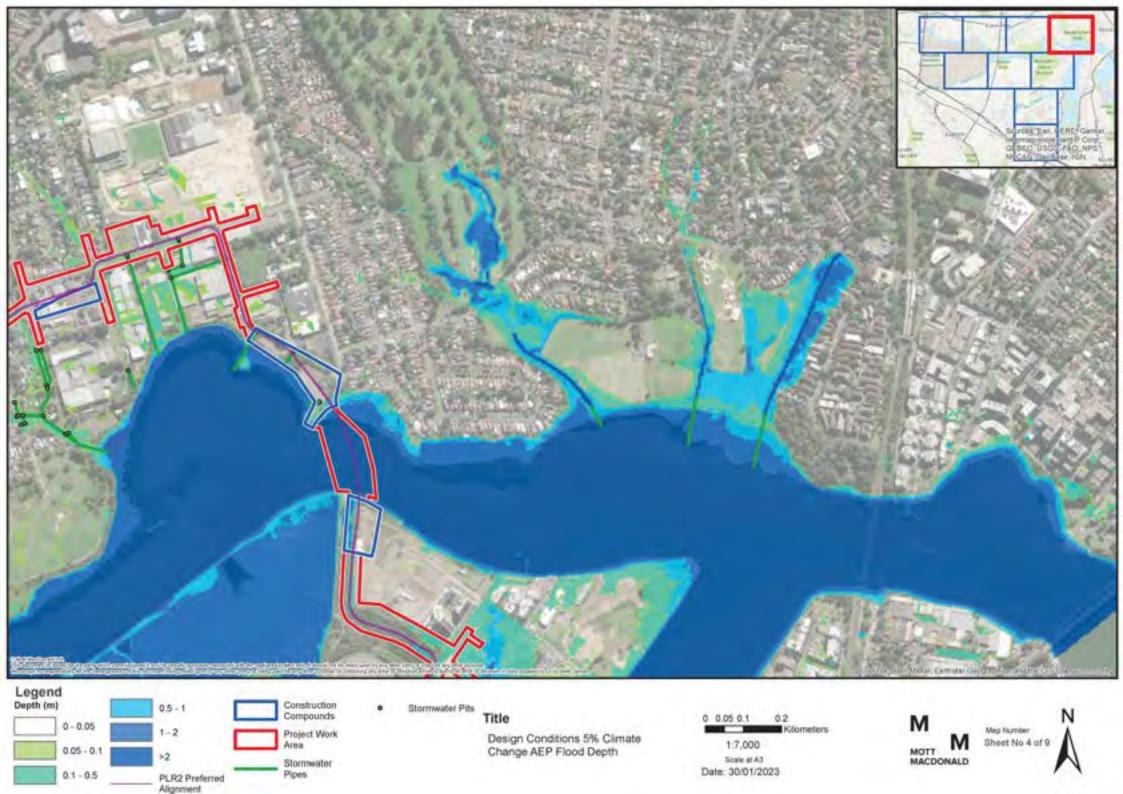


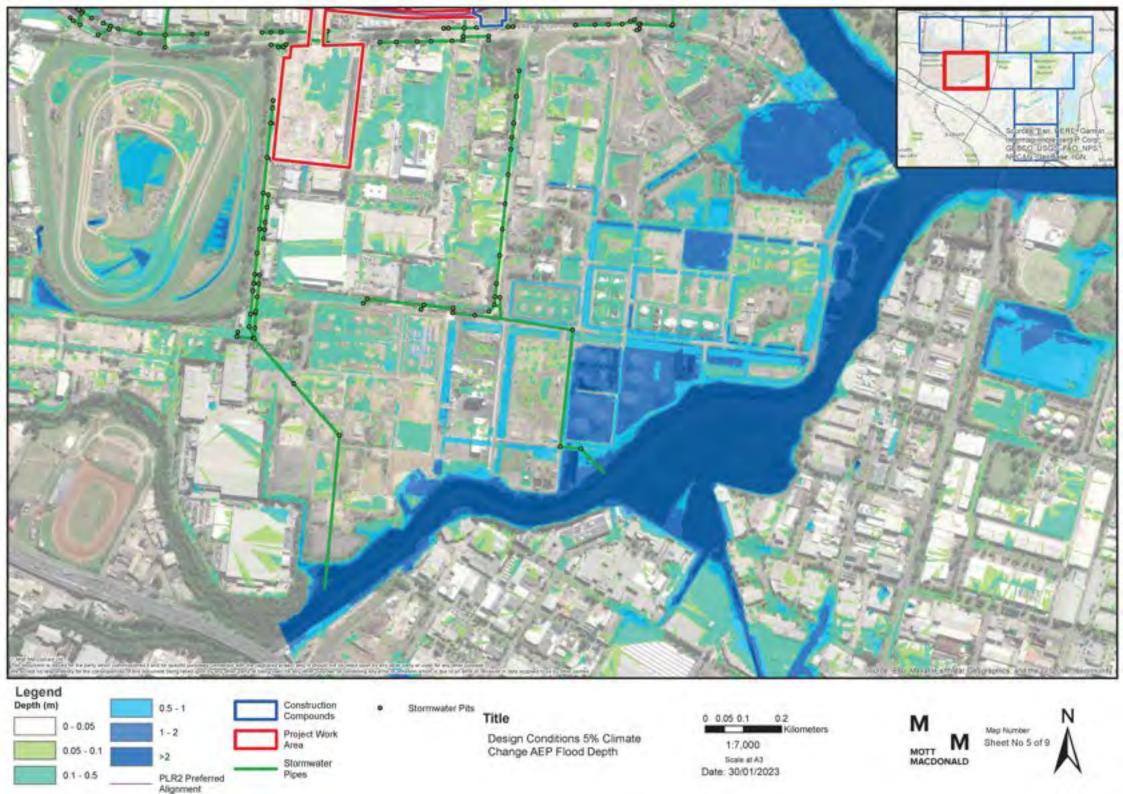


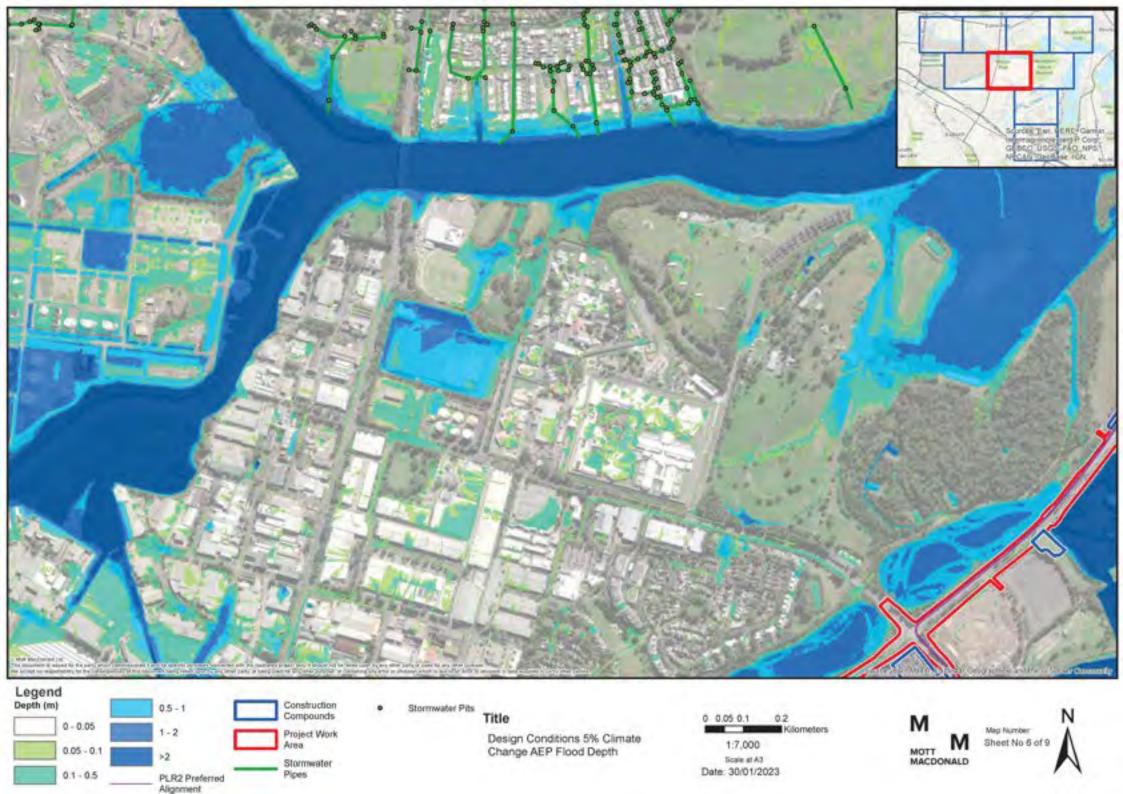


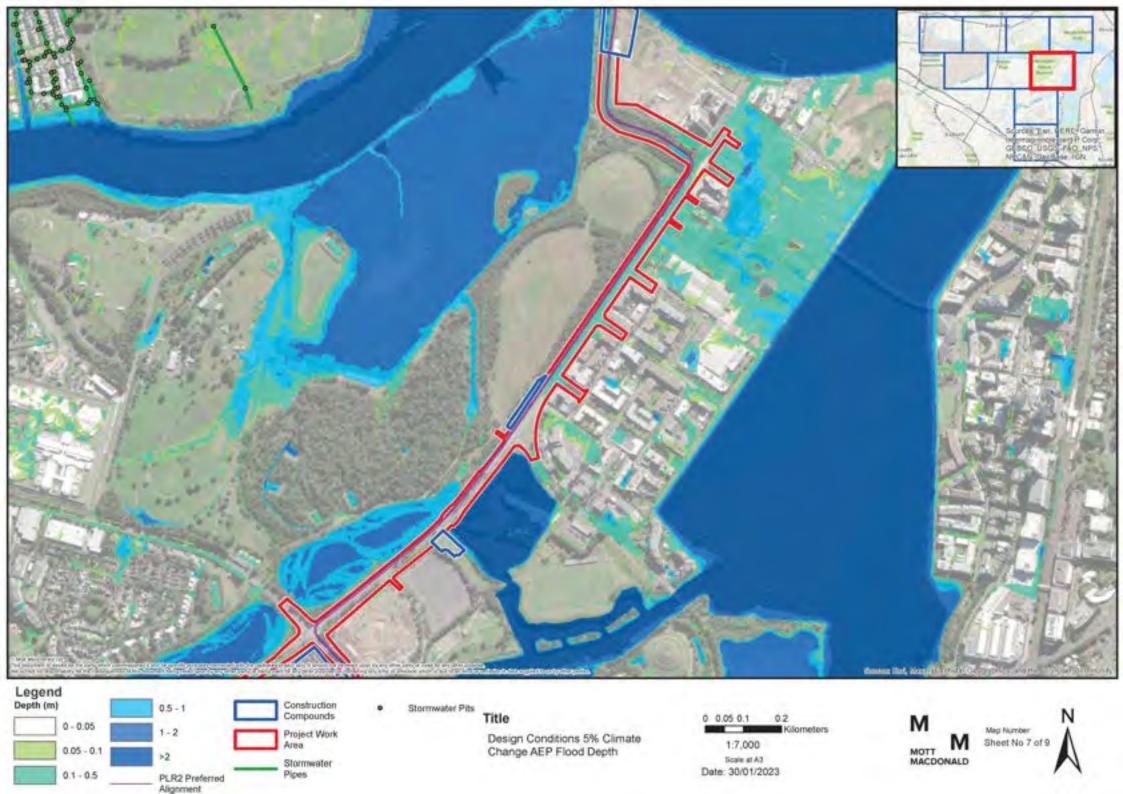


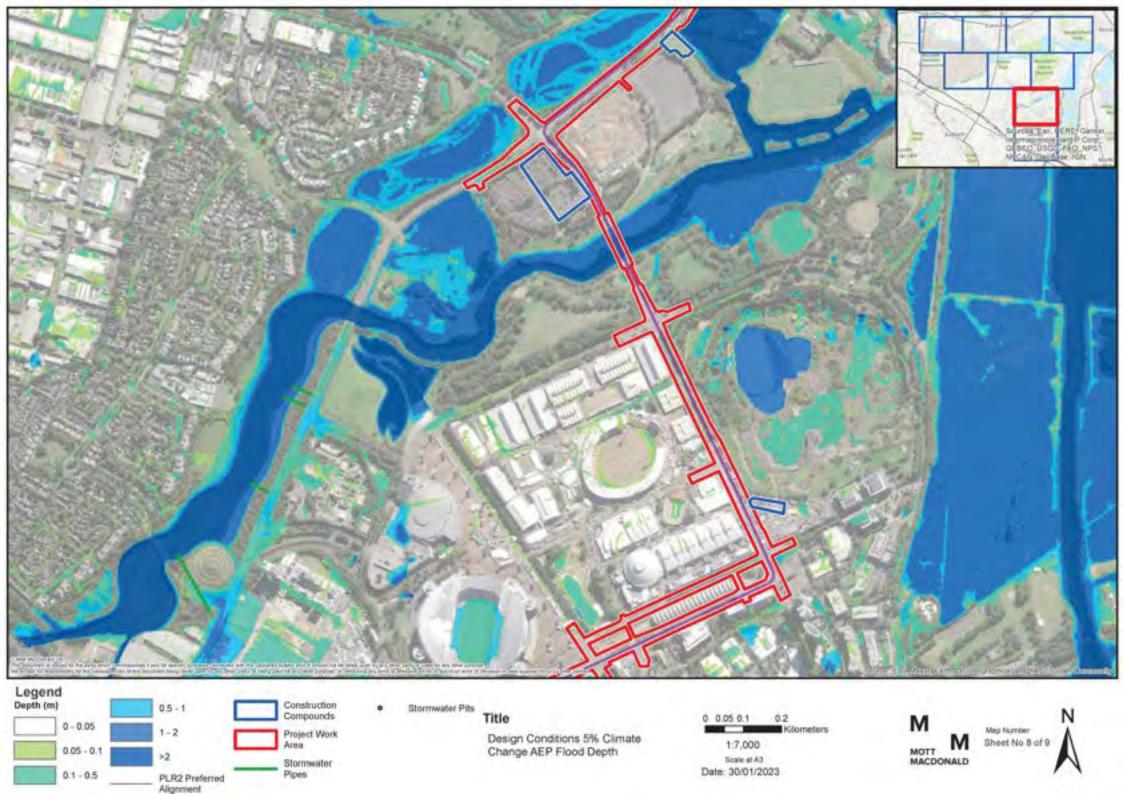


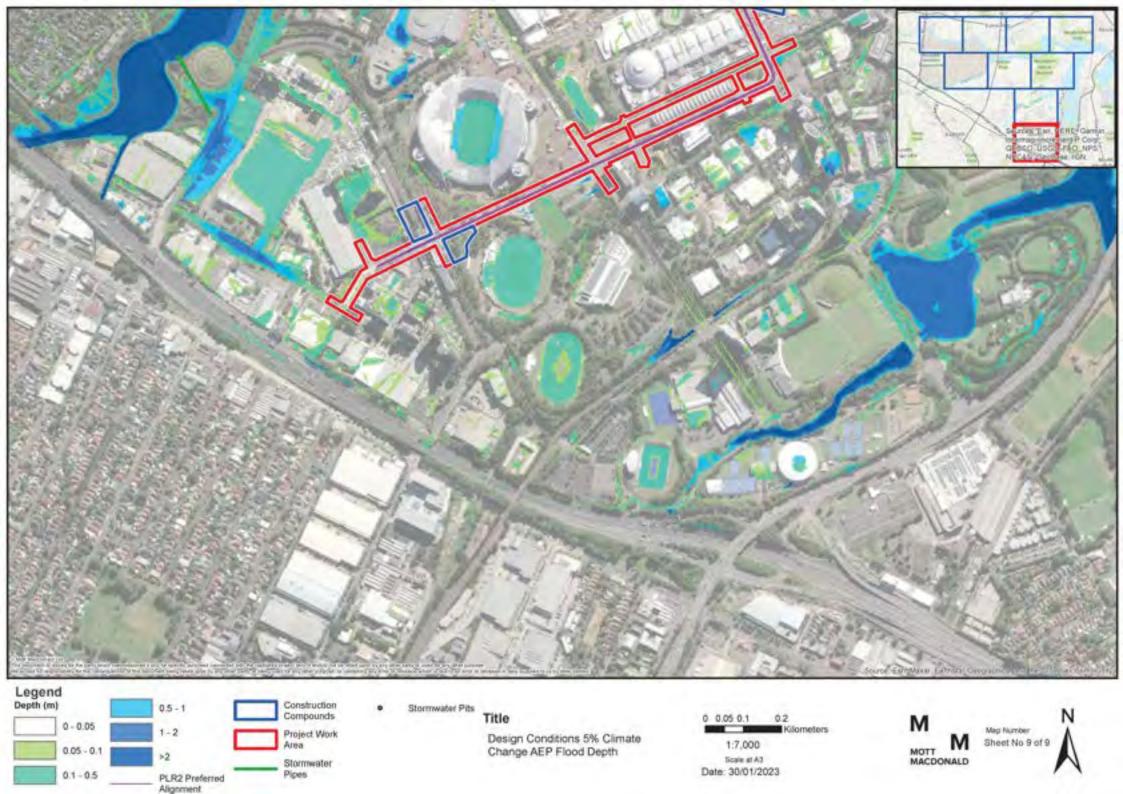


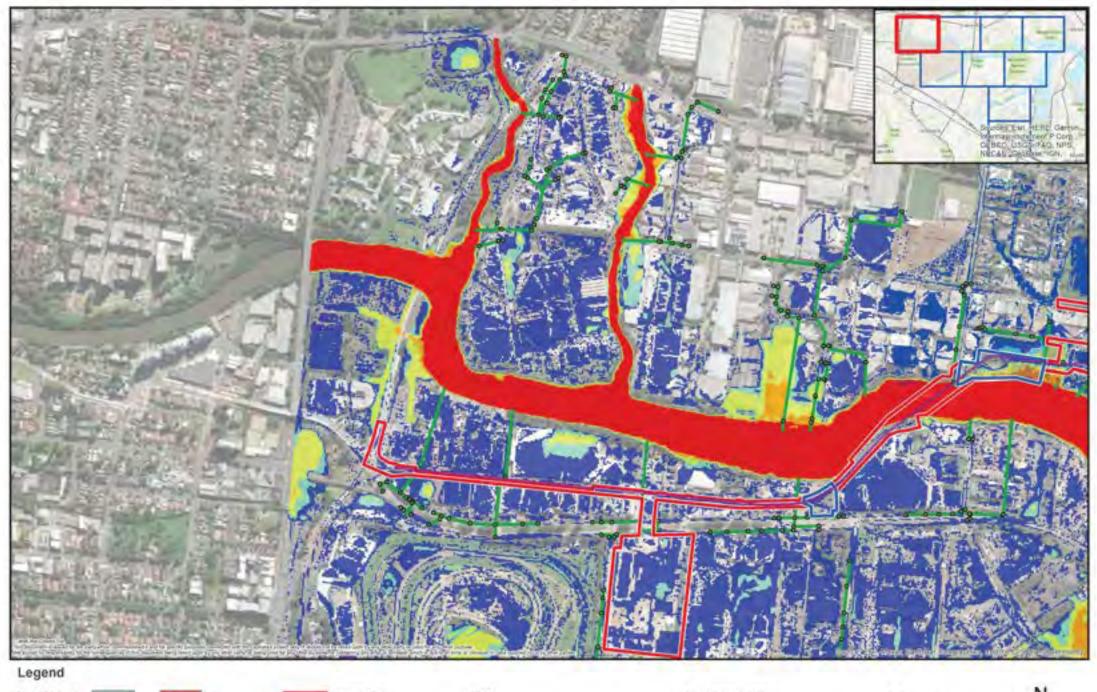














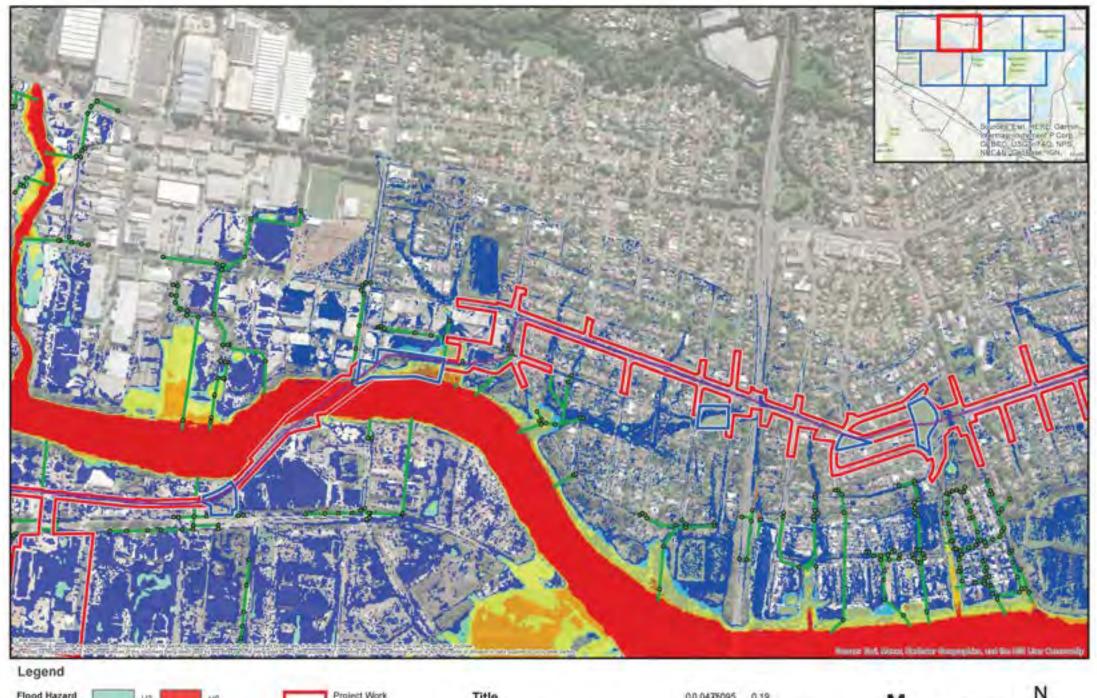
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Date: 30/01/2023

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Map Number Sheet No 1 at 9





Design Conditions 5% AEP Climate Change Flood Hazard

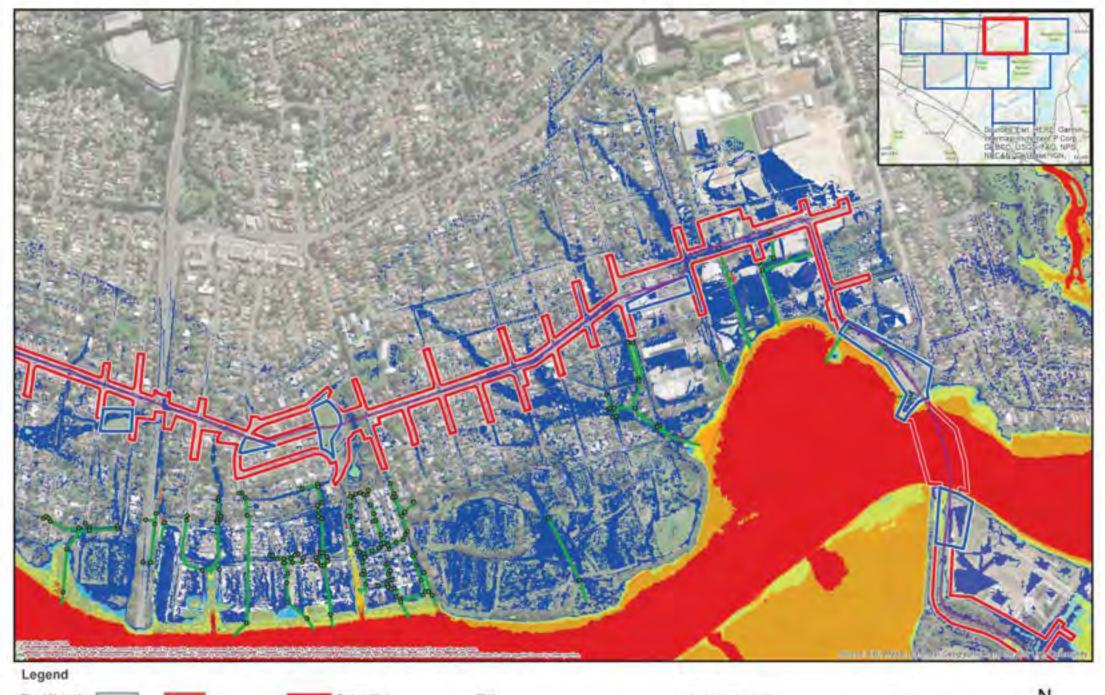
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Date: 30/01/2023

MOTT IVI

Map Number Sheet No 2 of 9





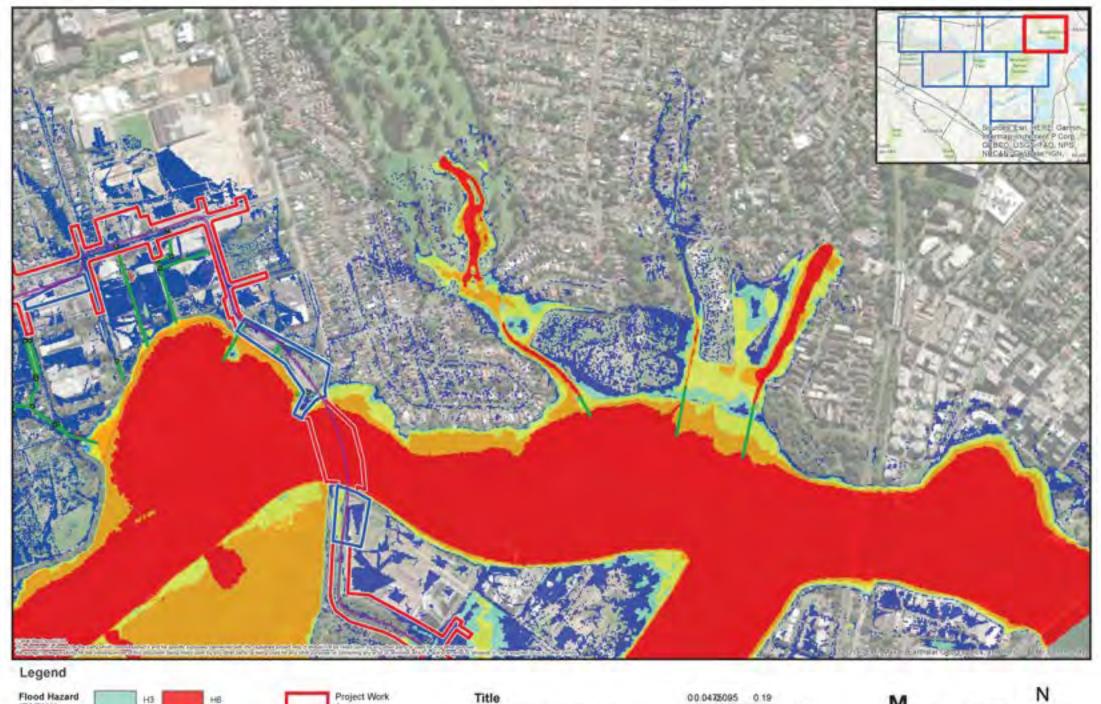
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Title Design Conditions 5% AEP Climate Change Flood Hazard









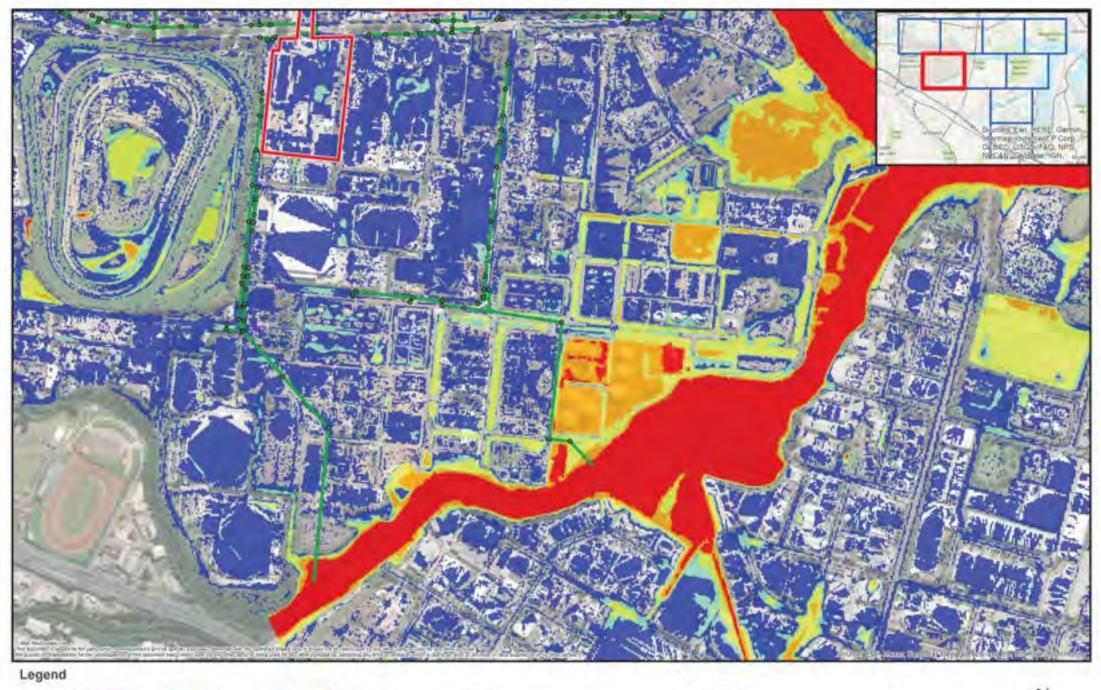
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Design Conditions 5% AEP Climate Change Flood Hazard



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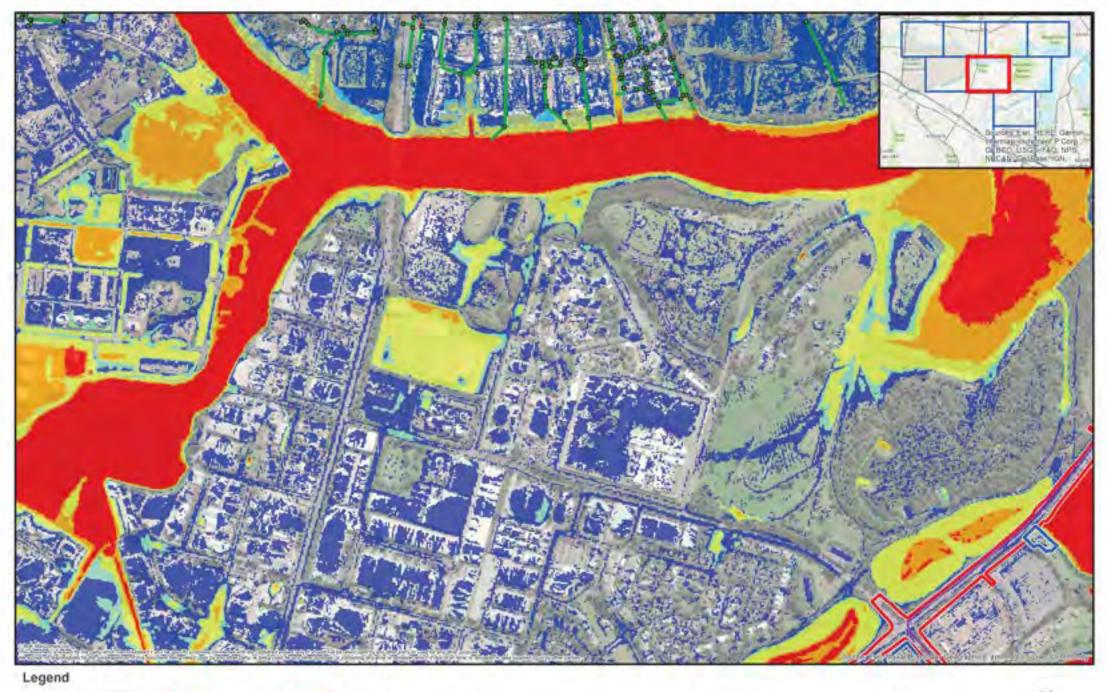
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Date: 30/01/2023

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Map Number Sheet No 5 of 9





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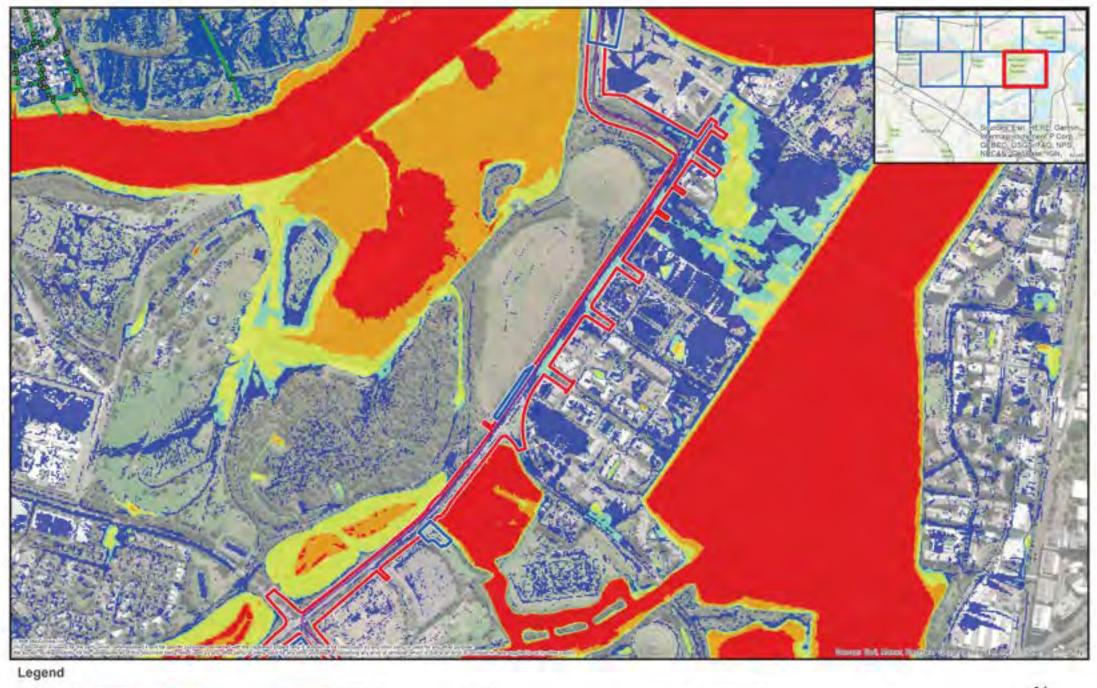


1:7,000 MOTT MACDONALD

Date: 30/01/2023











Design Conditions 5% AEP Climate Change Flood Hazard

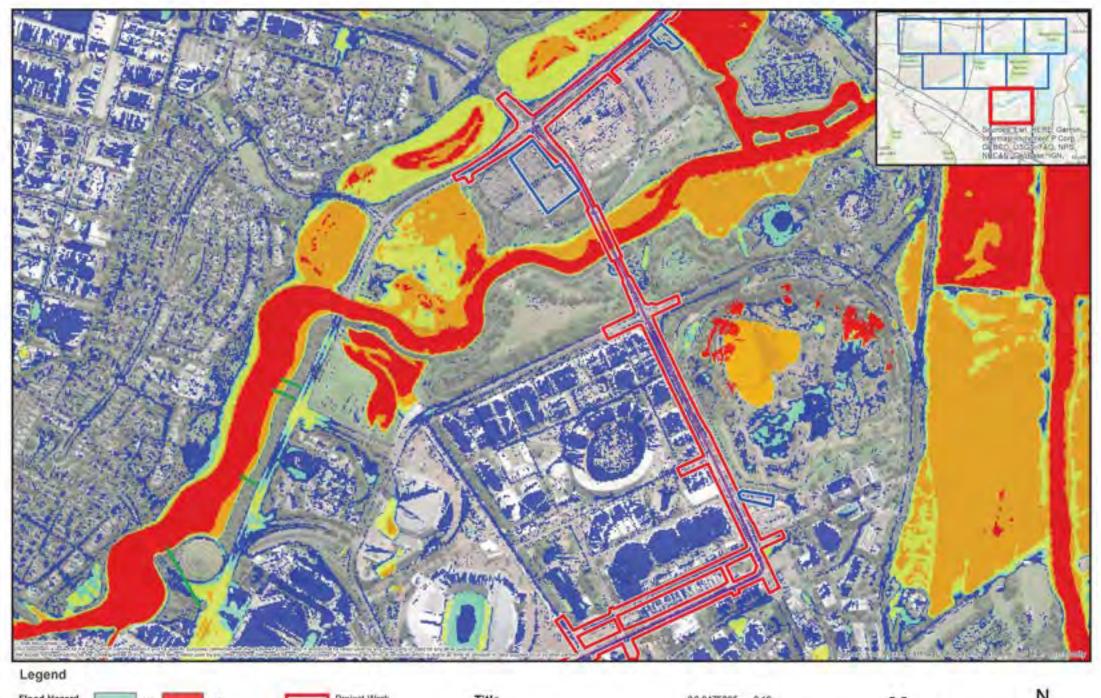


Date: 30/01/2023



Map Number Sheet No 7 of 9







Design Conditions 5% AEP Climate Change Flood Hazard

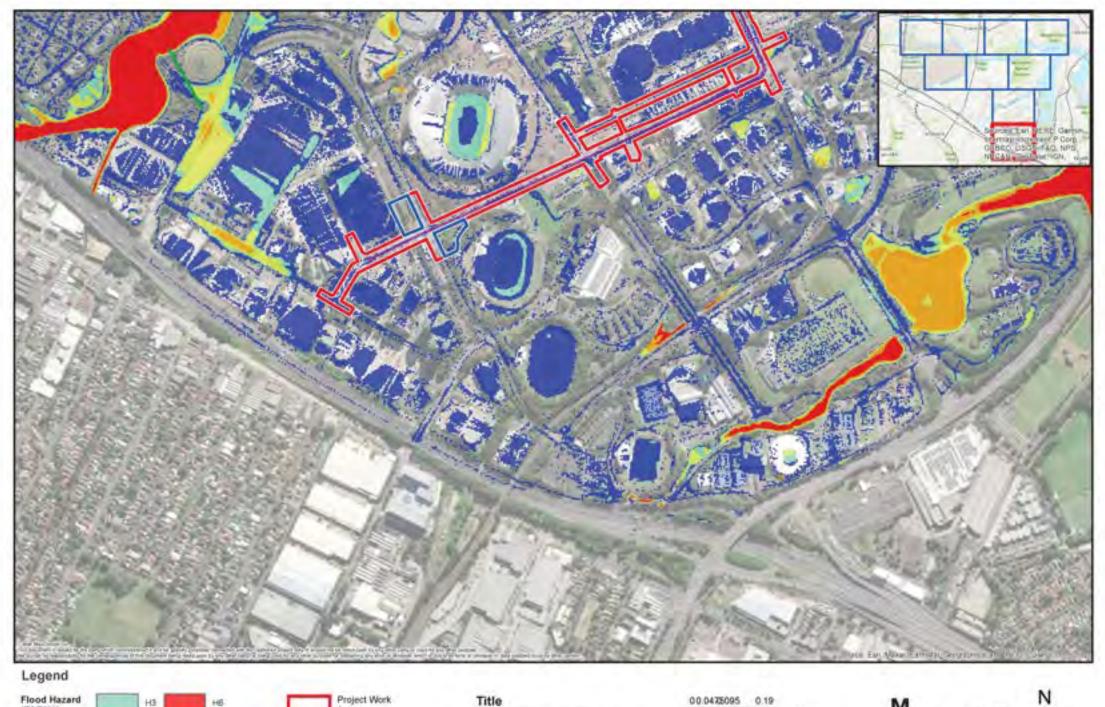


Date: 30/01/2023

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Map Number Sheet No 8 of 9





Flood Hazard (ZAEM1) Project Work Area PLR2 Preferred Alignment Stormwater Pipes. Construction Compounds Stormwater Pits

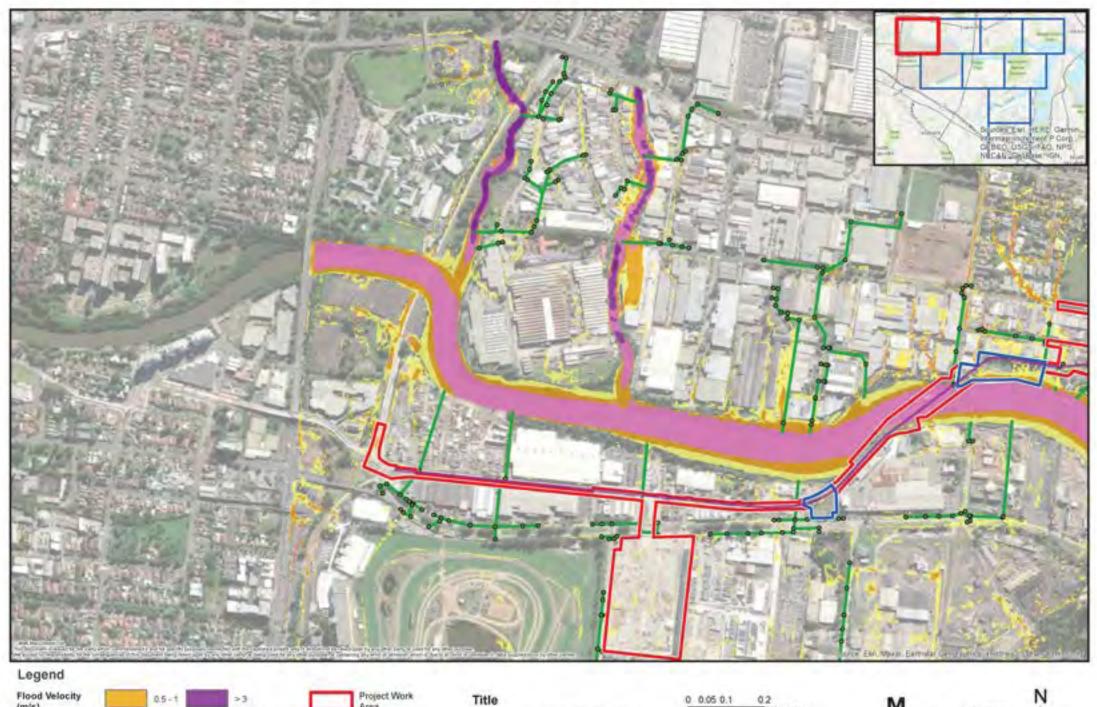
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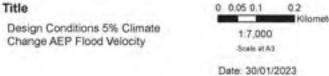


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Map Number Sheet No 9 of 9

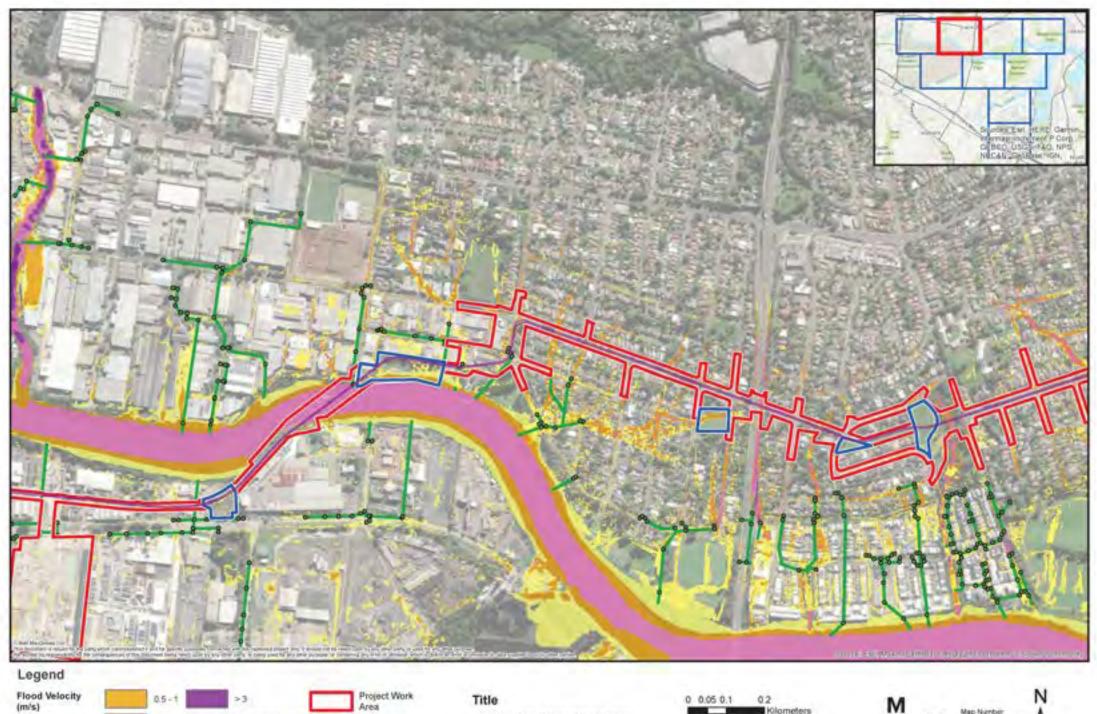






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Map Number Sheet No 1 of 9















Stormwater Pipes

Stormwater Pits

Design Conditions 5% Climate Change AEP Flood Velocity

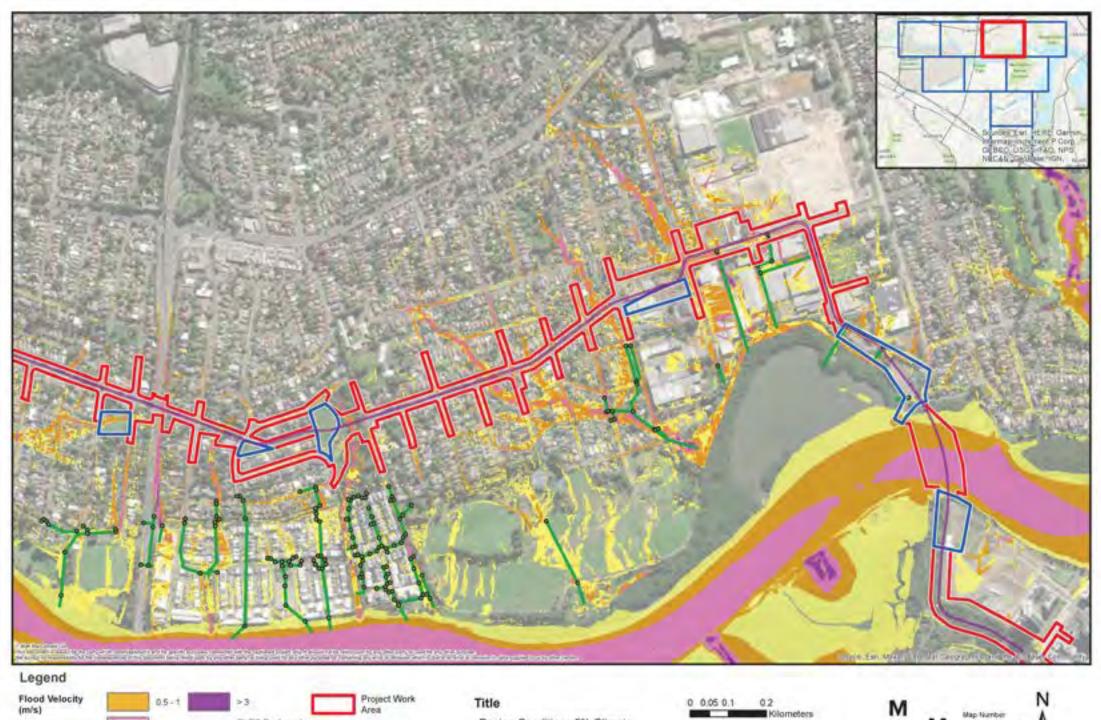


Date: 30/01/2023



Map Number Sheet No 2 of 9





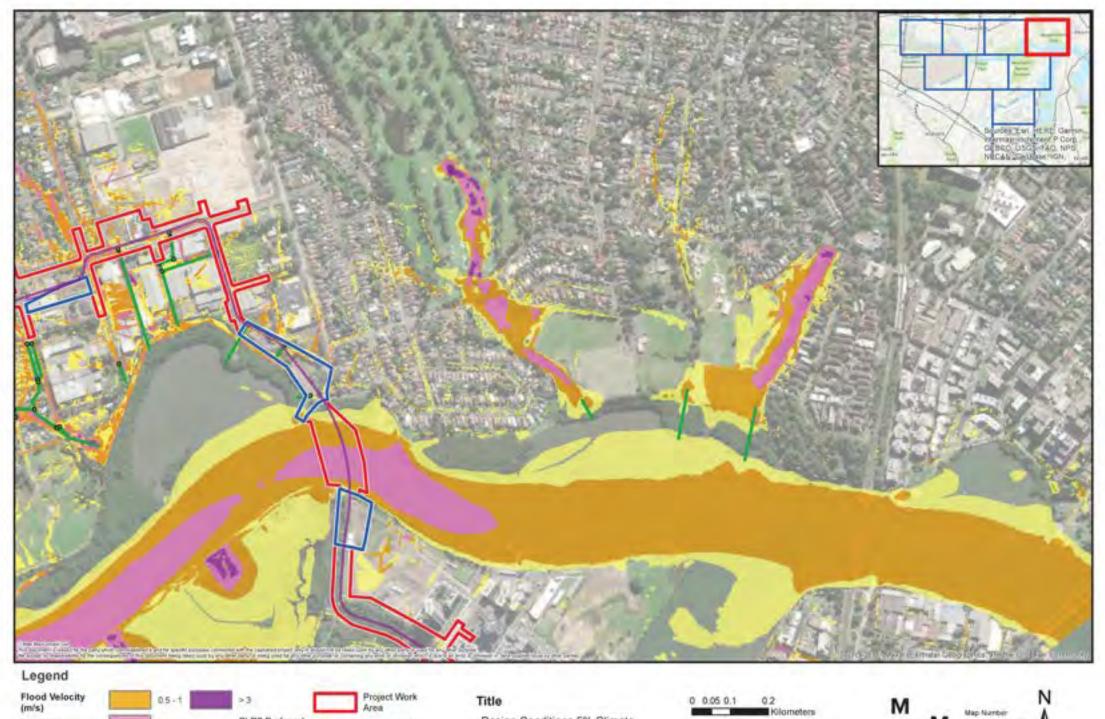


Design Conditions 5% Climate Change AEP Flood Velocity 1:7,000 Scale #143

Date: 30/01/2023

MOTT MACDONALD





PLR2 Preferred Alignment Stormwater Pipes Construction Compounds 02-05 Stormwater Pits Design Conditions 5% Climate Change AEP Flood Velocity

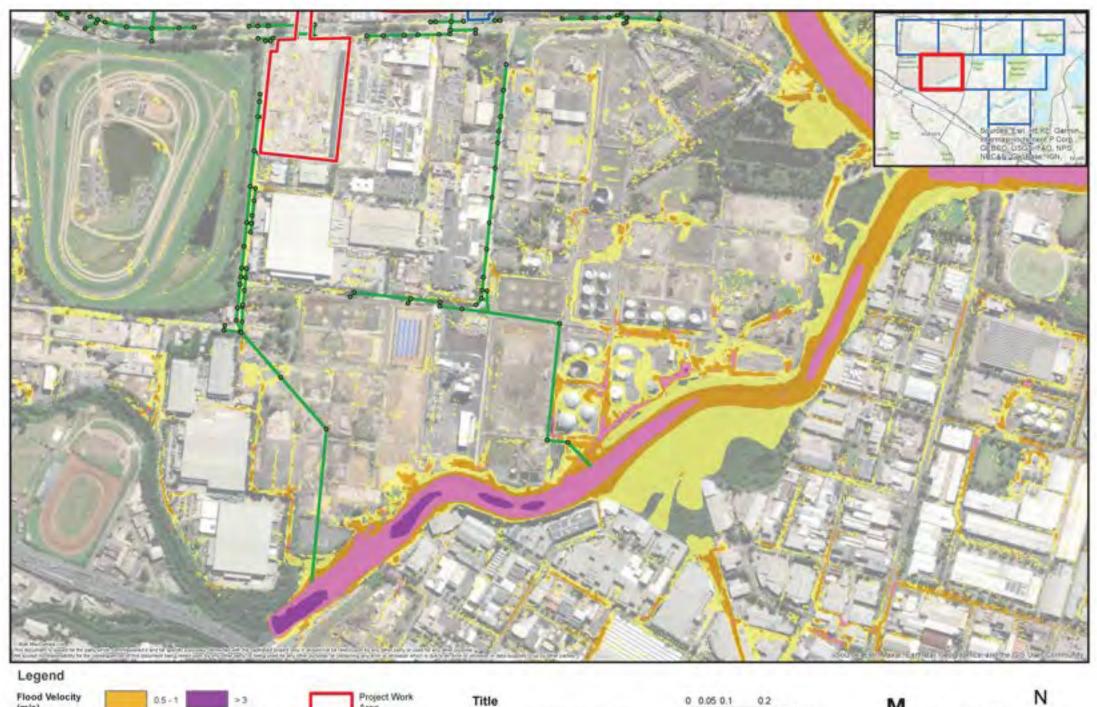
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Date: 30/01/2023

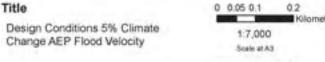
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Sheet No 4 of 9





Project Work Area Flood Velocity (m/s) PLR2 Preferred Alignment Stormwater Pipes Construction Compounds 02-05 Stormwater Pits



Date: 30/01/2023

MOTT IVI

Map Number Sheet No 5 of 9





Design Conditions 5% Climate
Change AEP Flood Velocity

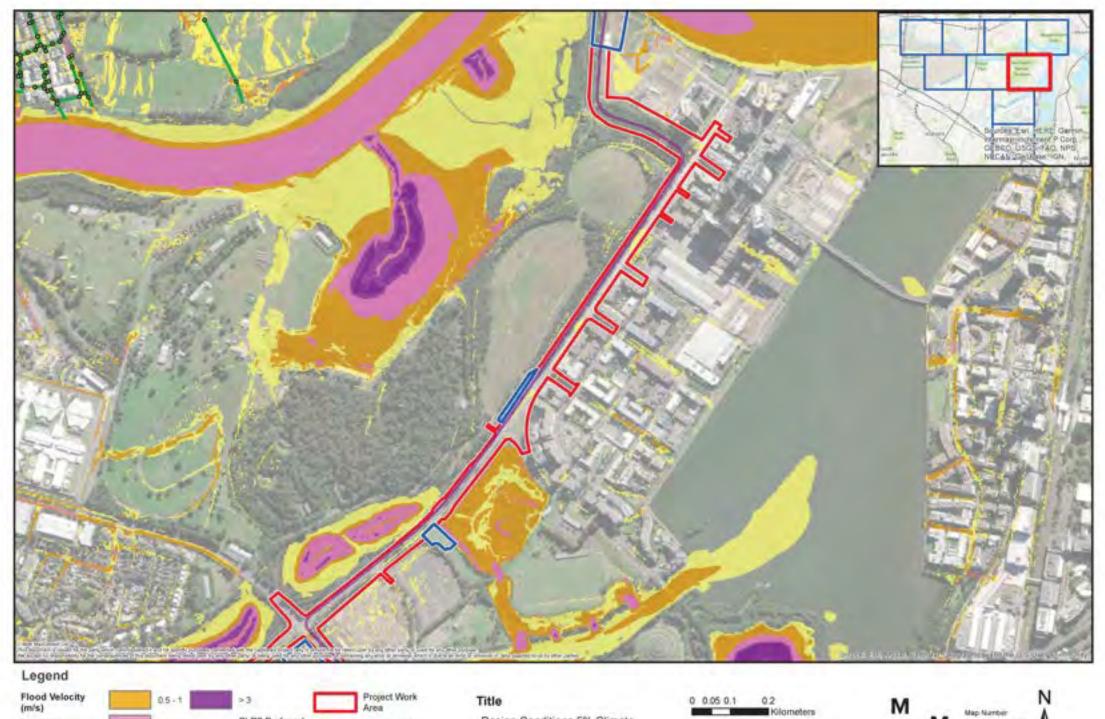
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1:7,00





Map Number Sheet No 6 of 9



0 - 0.2 1 - 2 PLR2 Preferred Stormwater Pipes

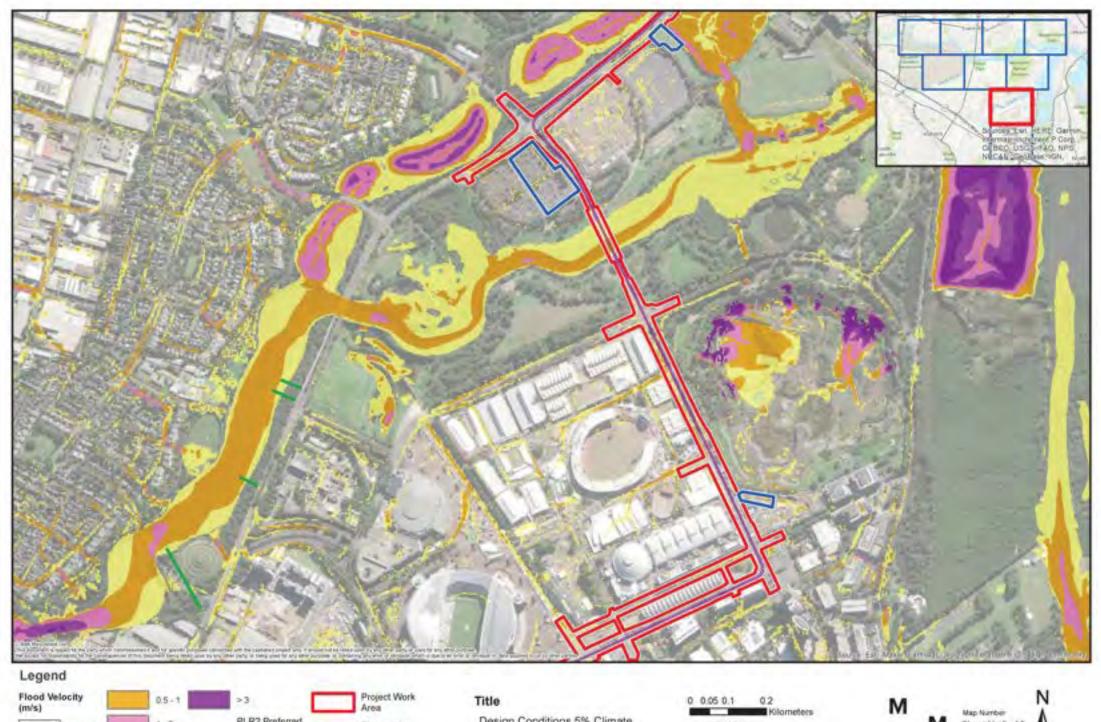
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Design Conditions 5% Climate Change AEP Flood Velocity 1:7,000 Scale at A3

M MOTT M

Map Number Sheet No 7 of 9





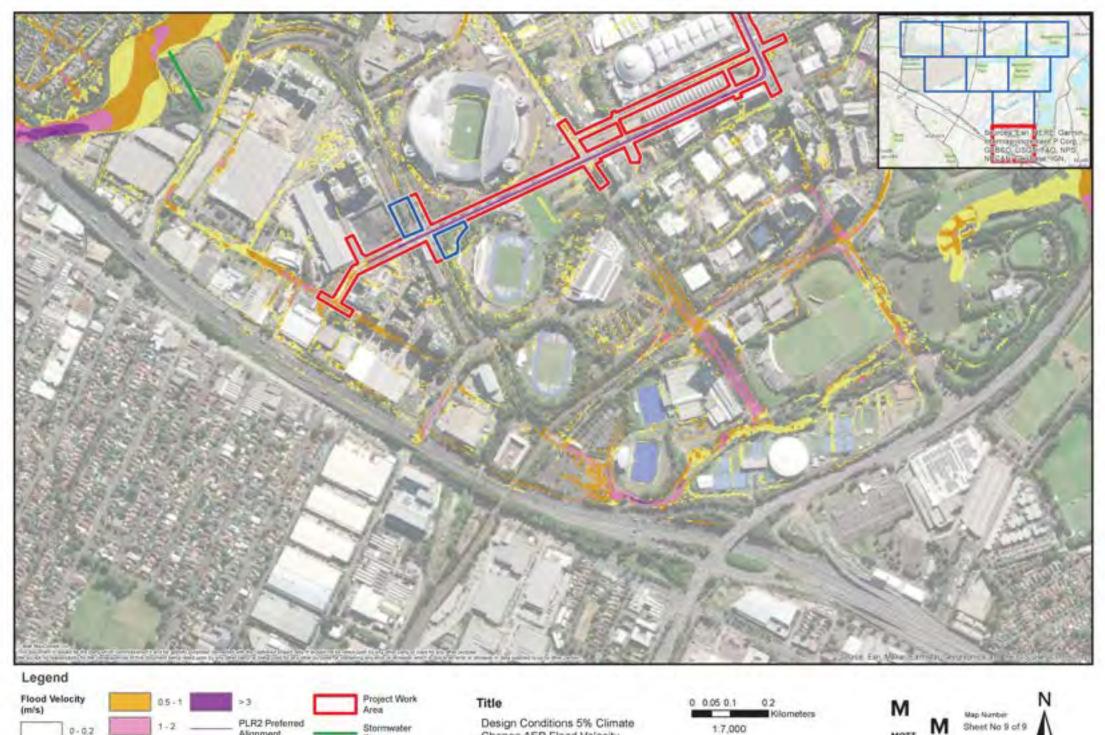
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Design Conditions 5% Climate Change AEP Flood Velocity



MOTT IVI

Sheet No 8 of 9





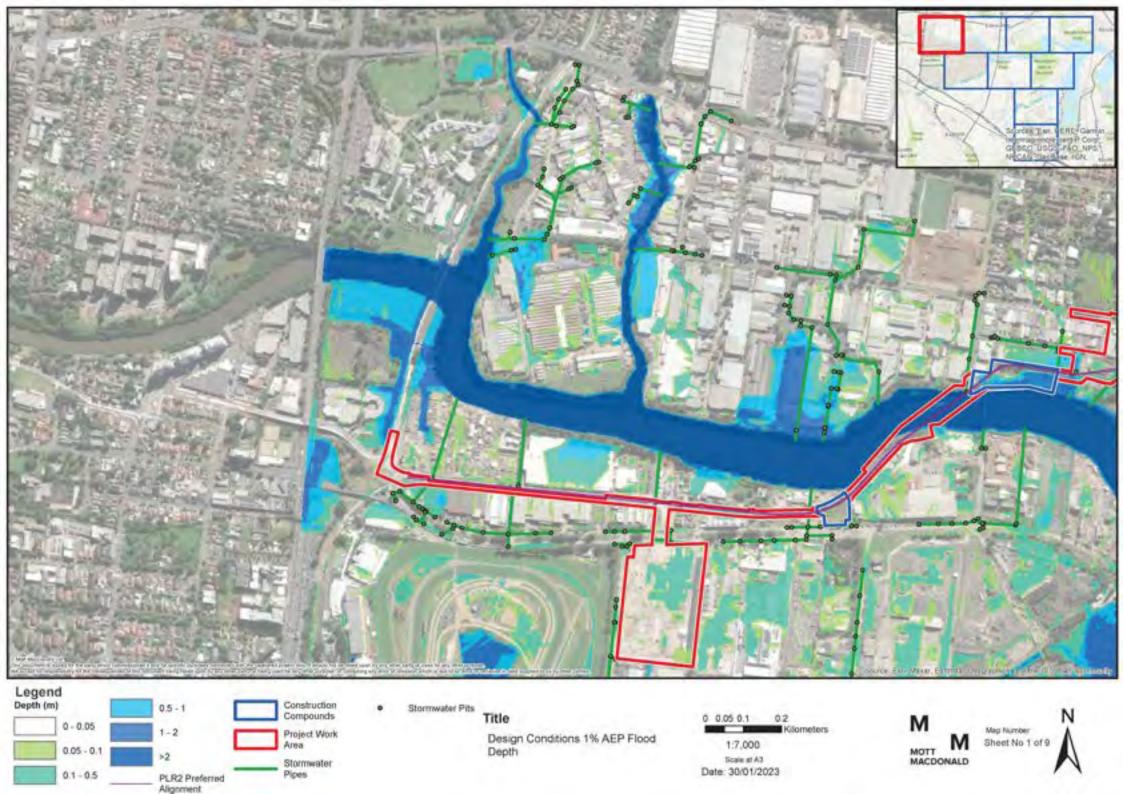
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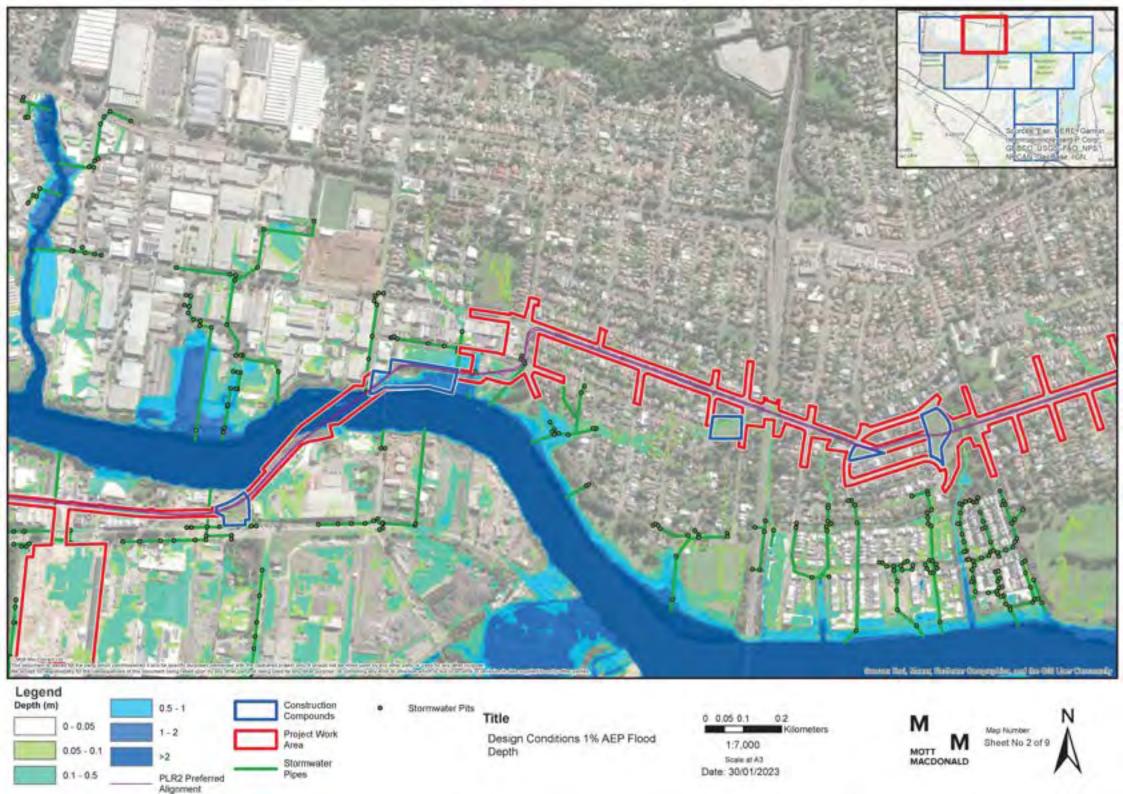
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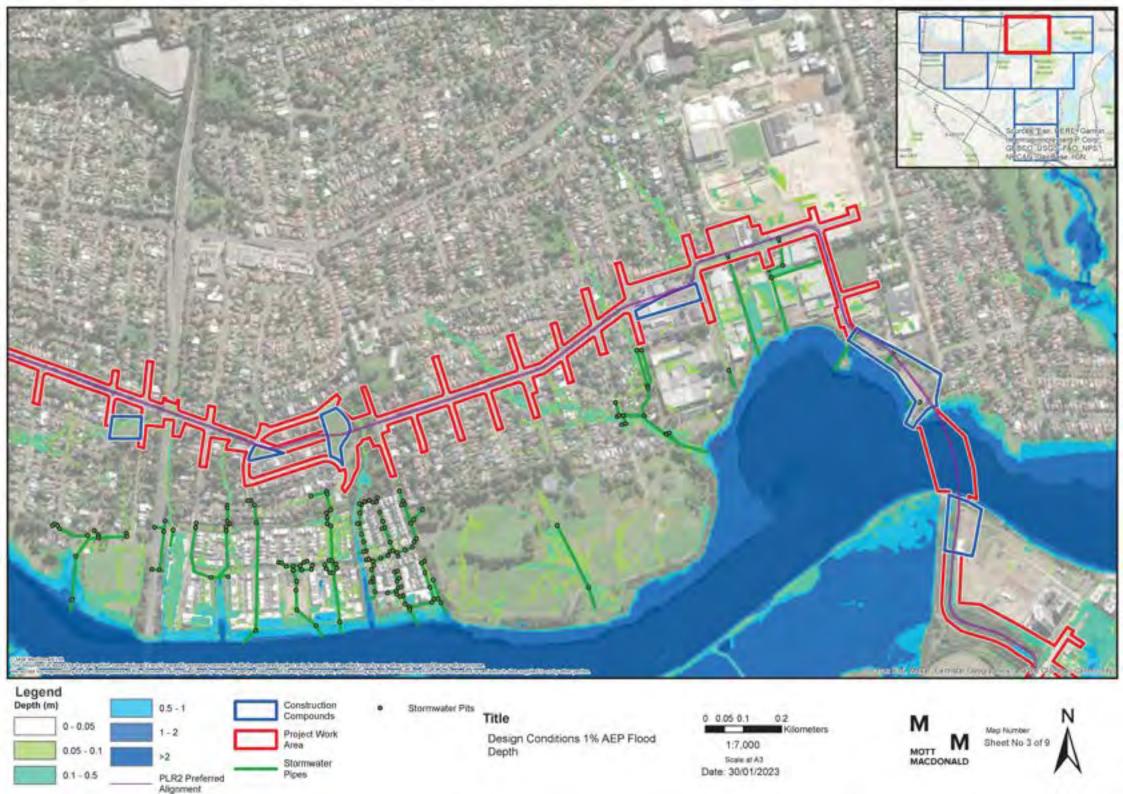
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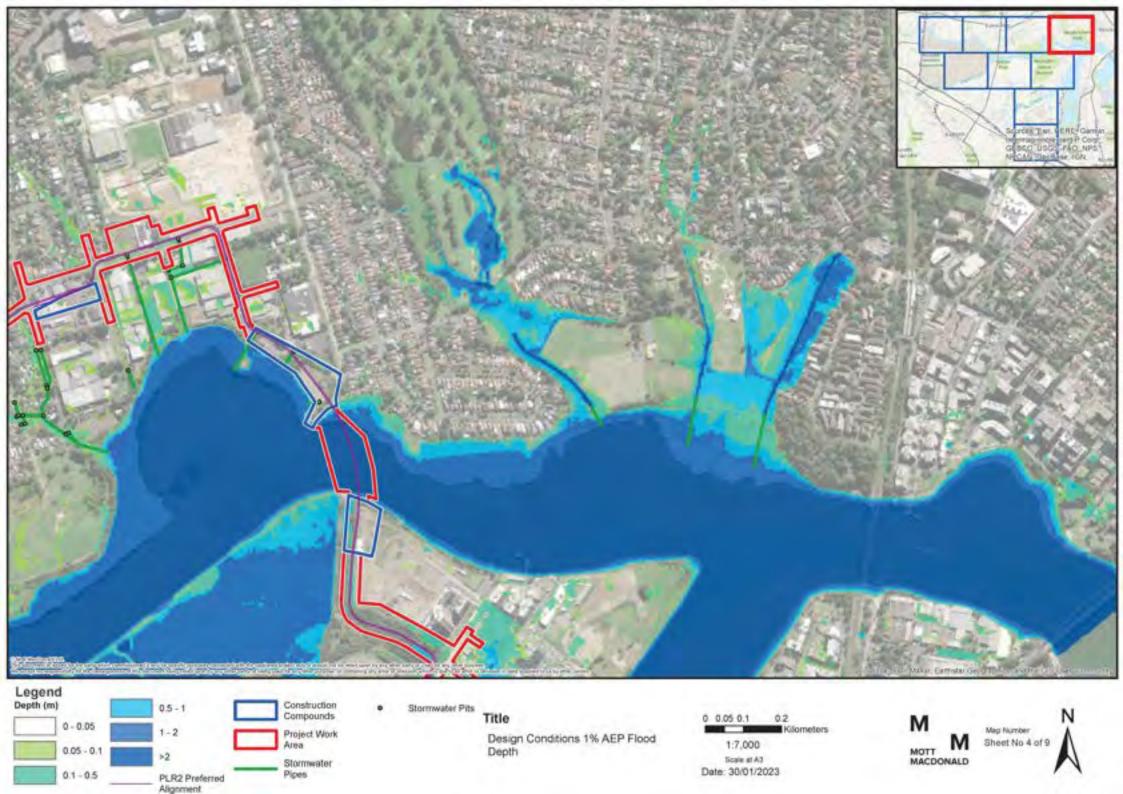


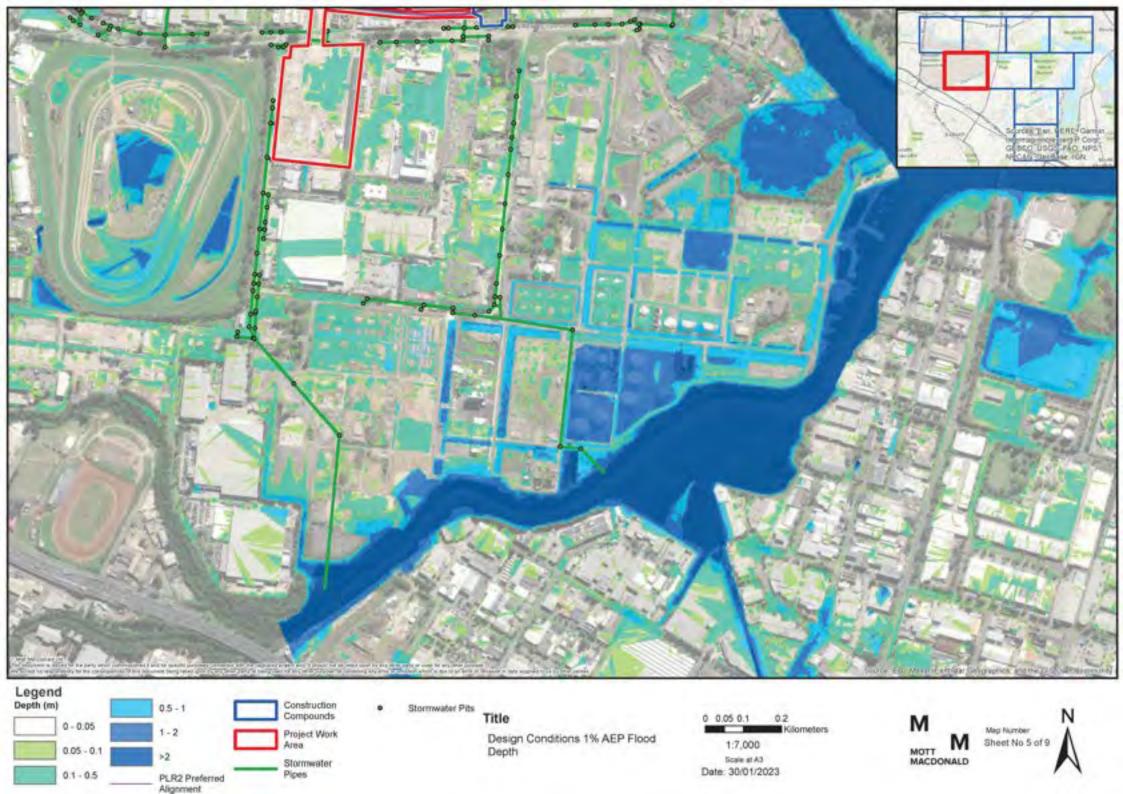
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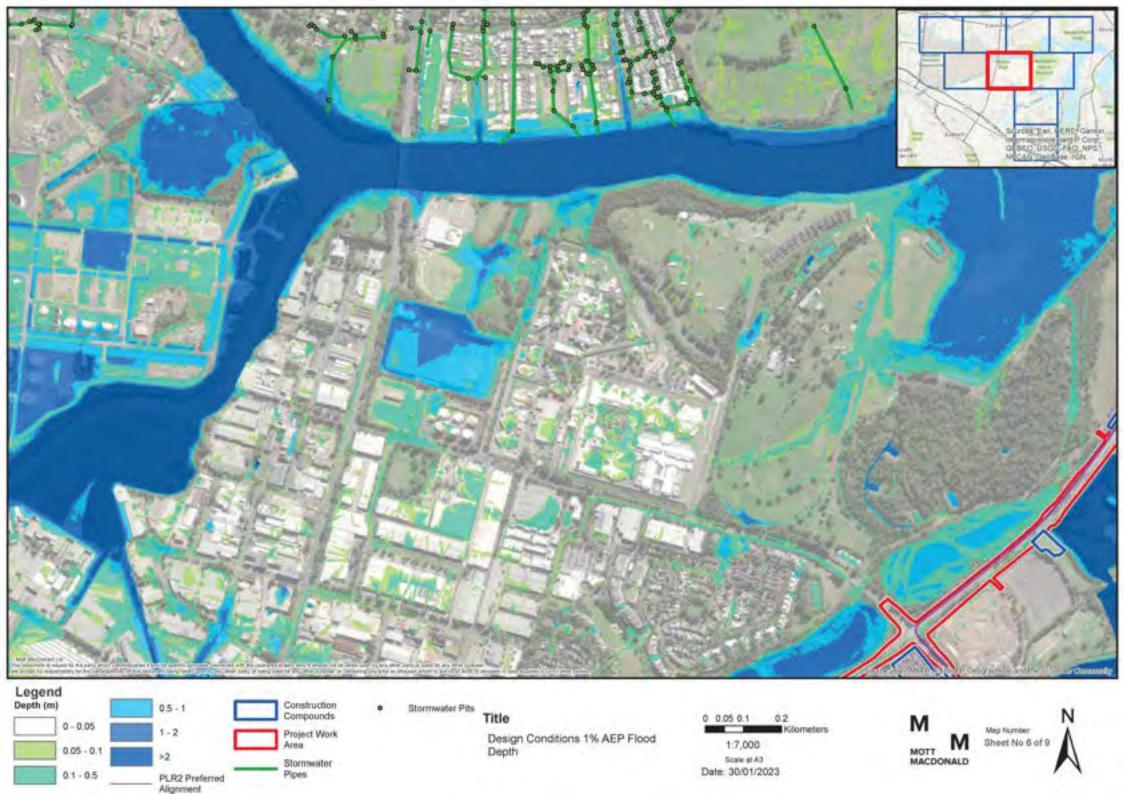


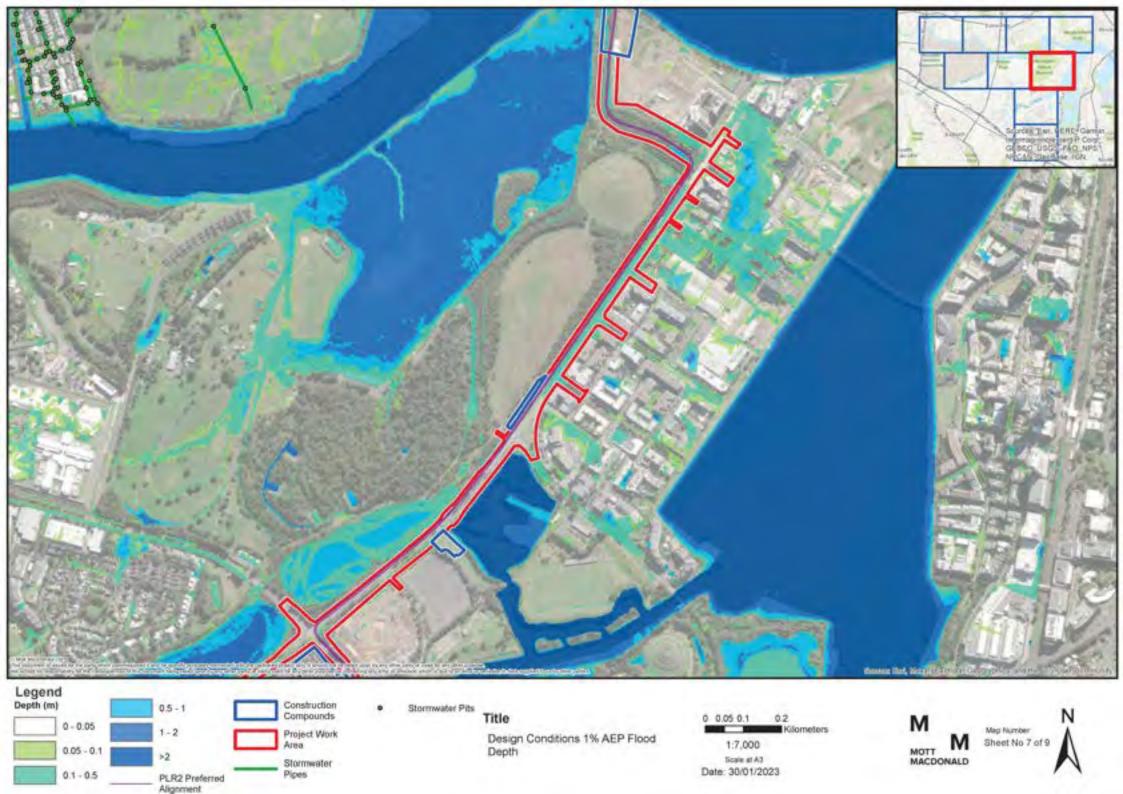


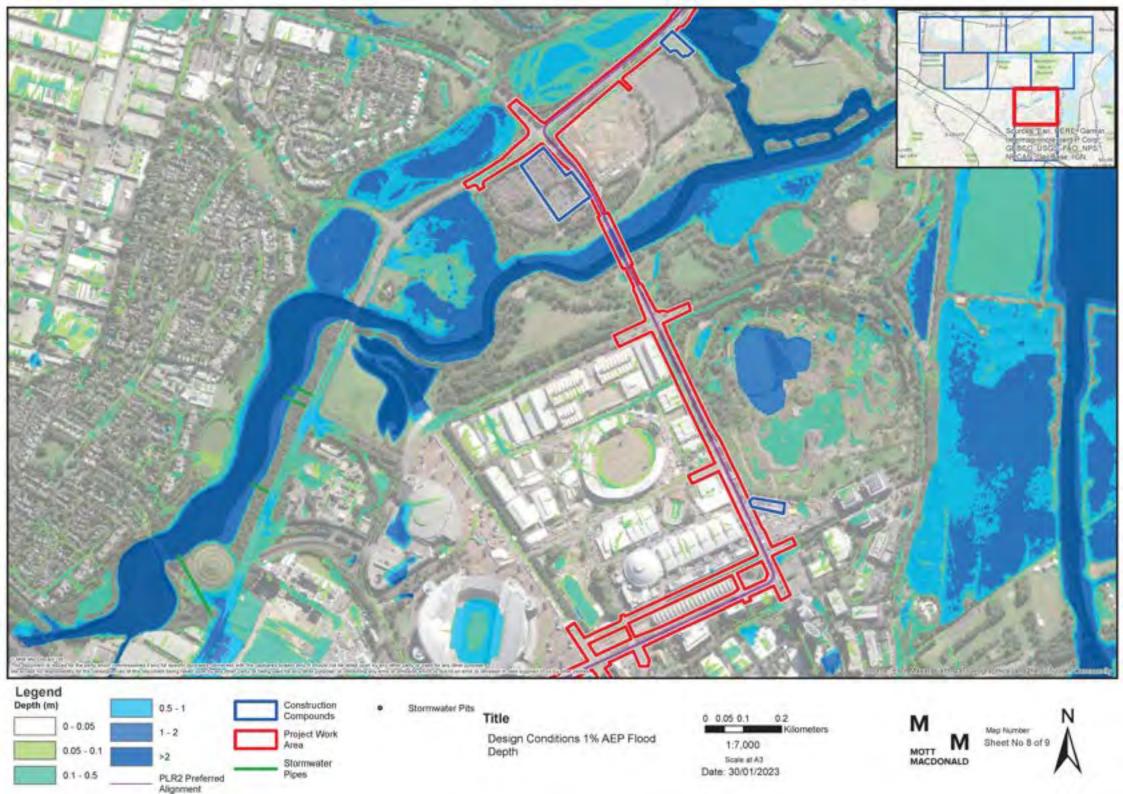


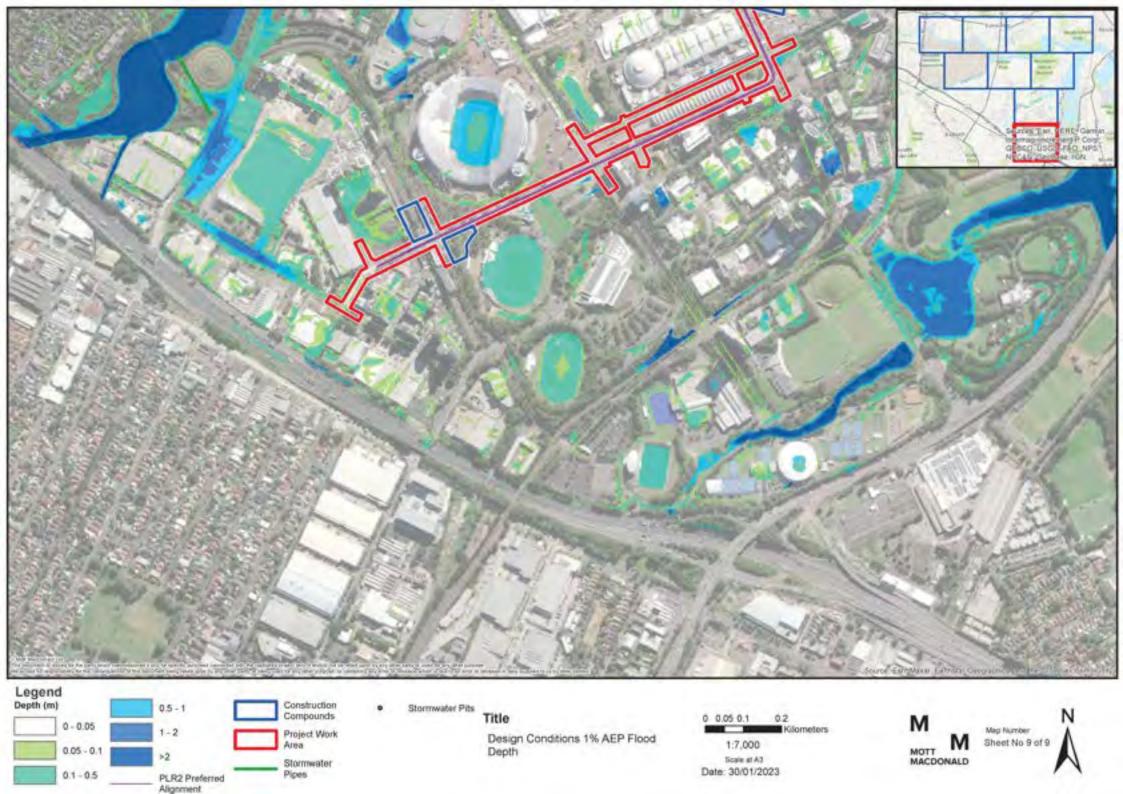


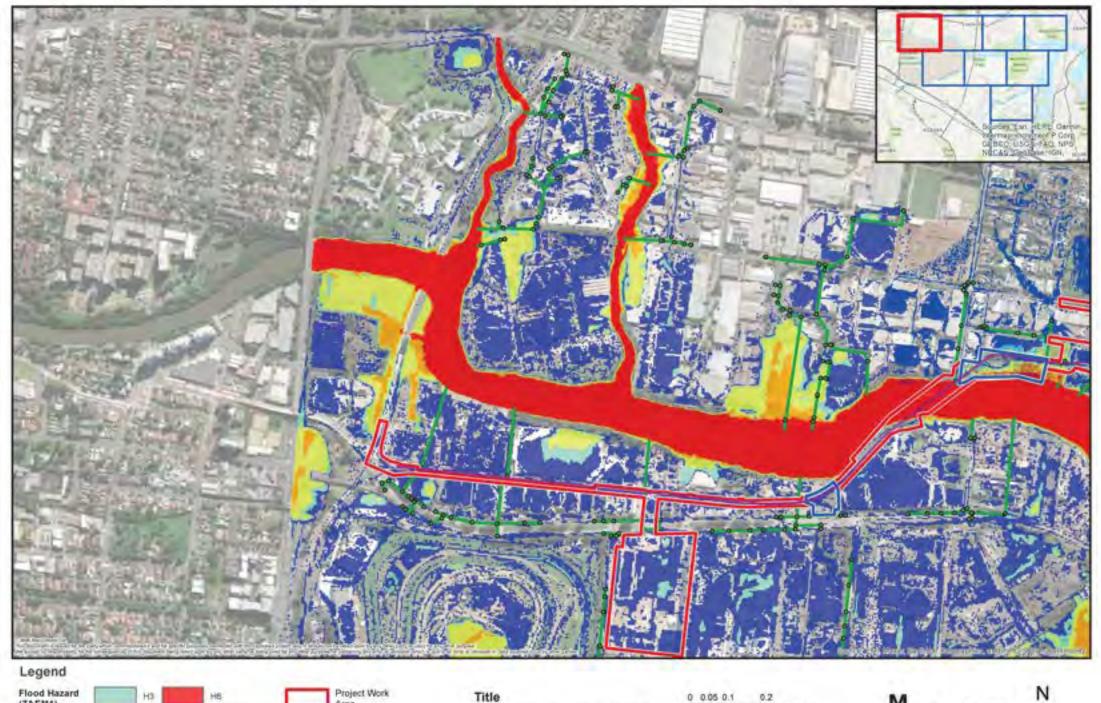














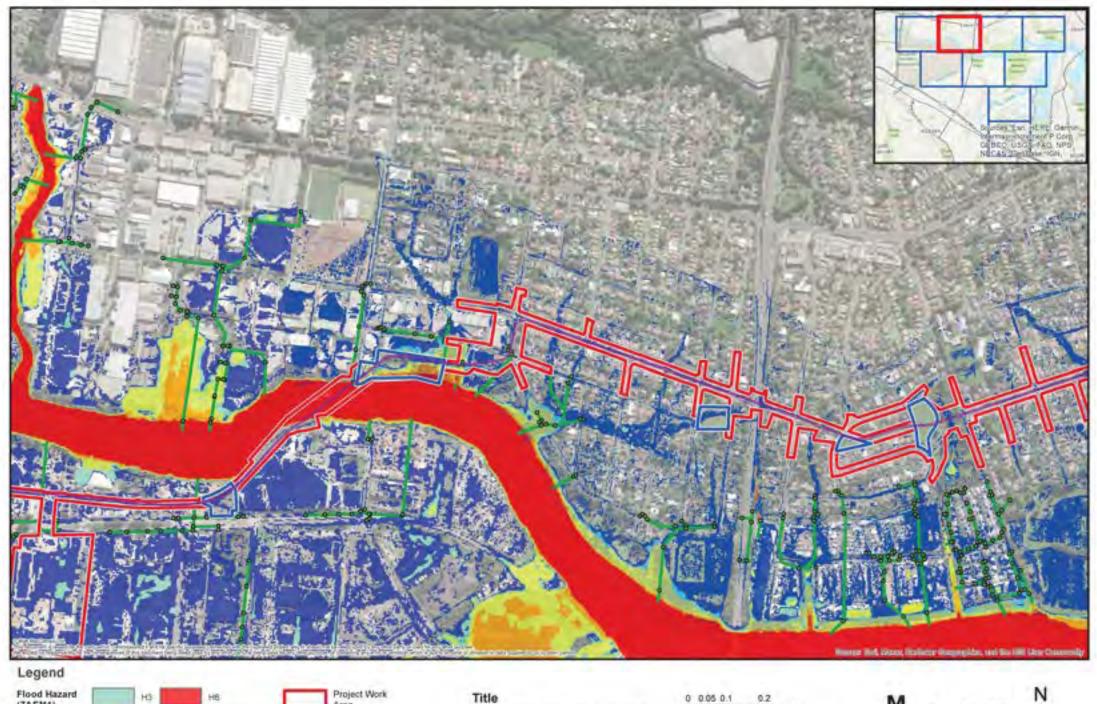
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Date: 30/01/2023

MOTT IVI









Design Conditions 1% AEP Flood Hazard

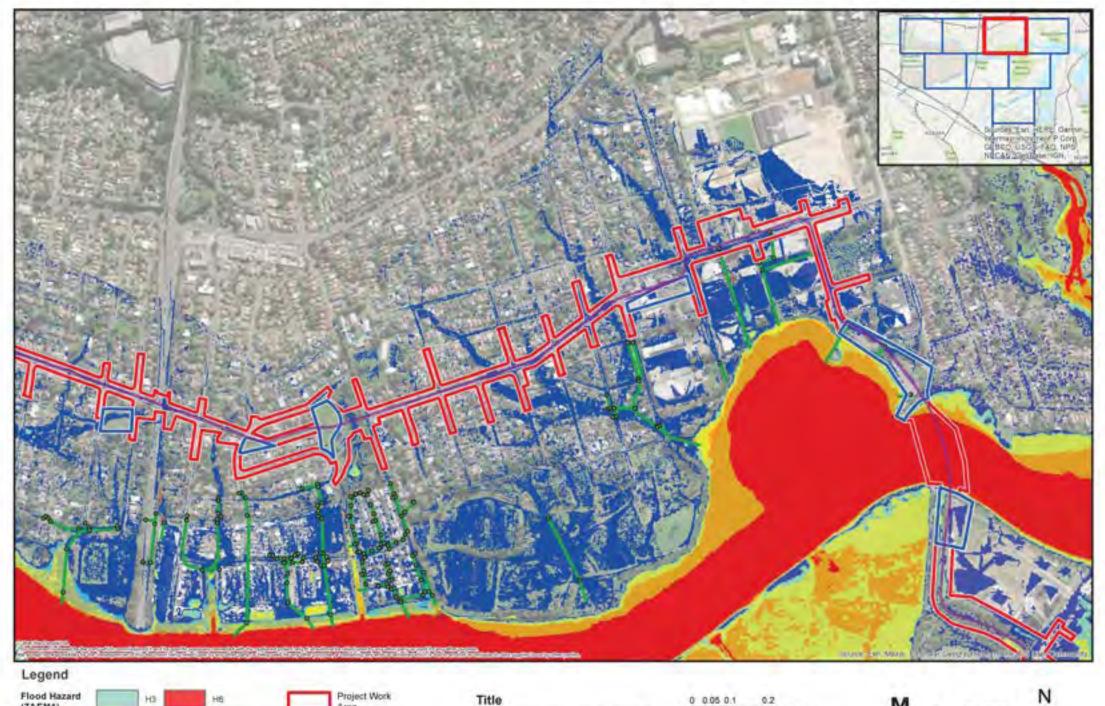


Sole vi A3 MACD Date: 30/01/2023

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Map Number Sheet No 2 of 9







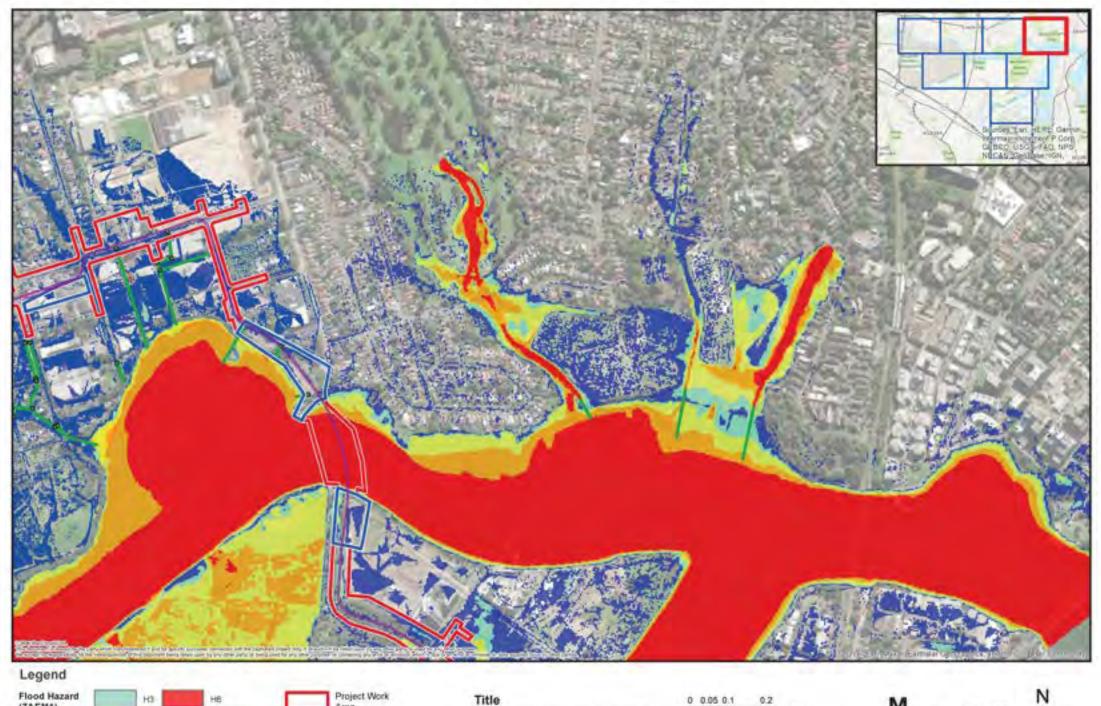
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 1:7,000

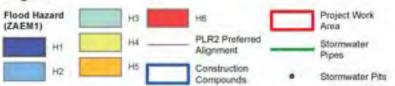
 Hazard
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Date: 30/01/2023

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Map Number Sheet No 3 of 9



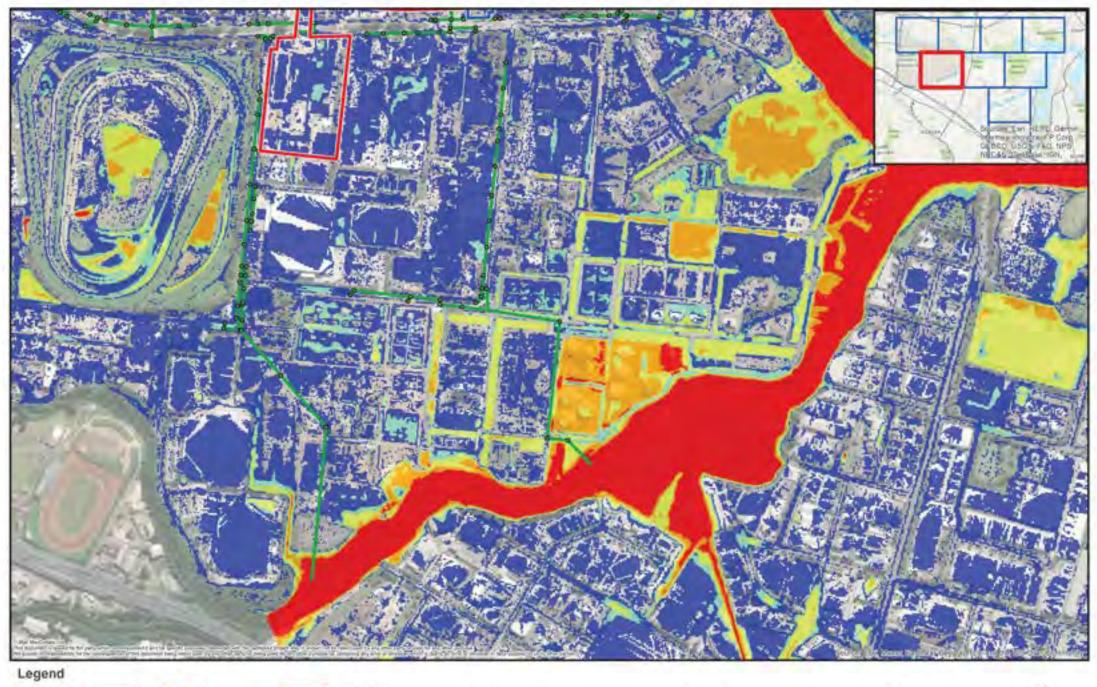


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Date: 30/01/2023









Title

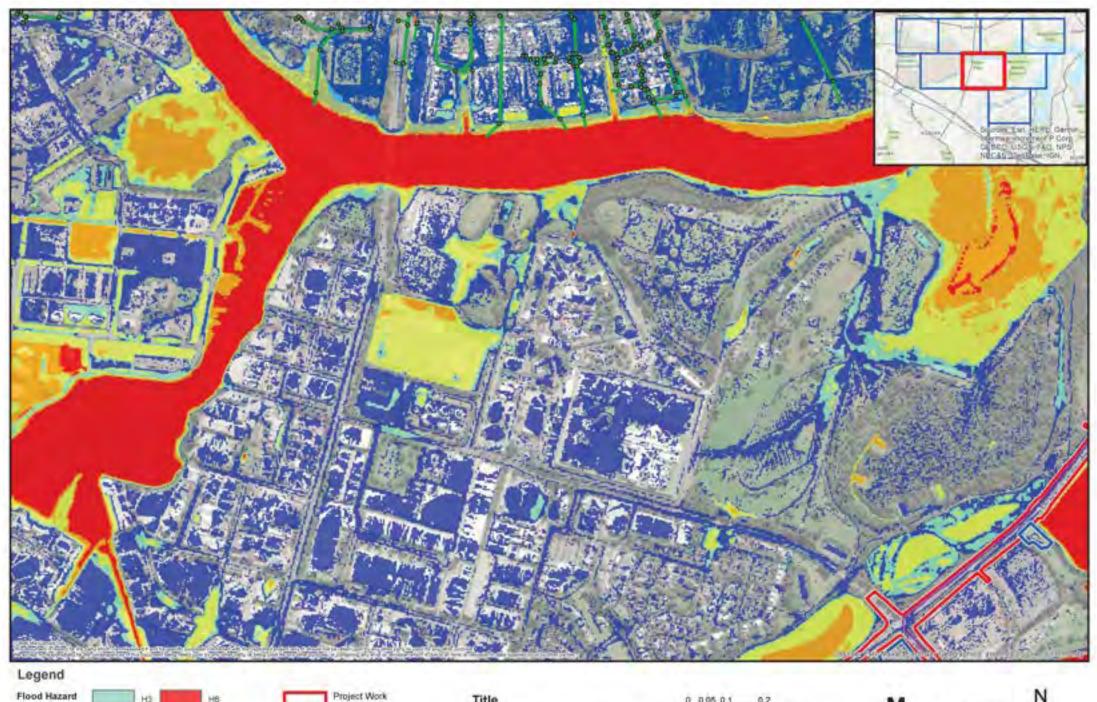
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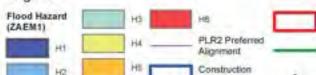


Date: 30/01/2023

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Map Number Sheet No 5 of 9





Compounds

Title

Stormwater

Stormwater Pits

Pipes

Design Conditions 1% AEP Flood Hazard



Date: 30/01/2023

MOTT IVI









Design Conditions 1% AEP Flood Hazard

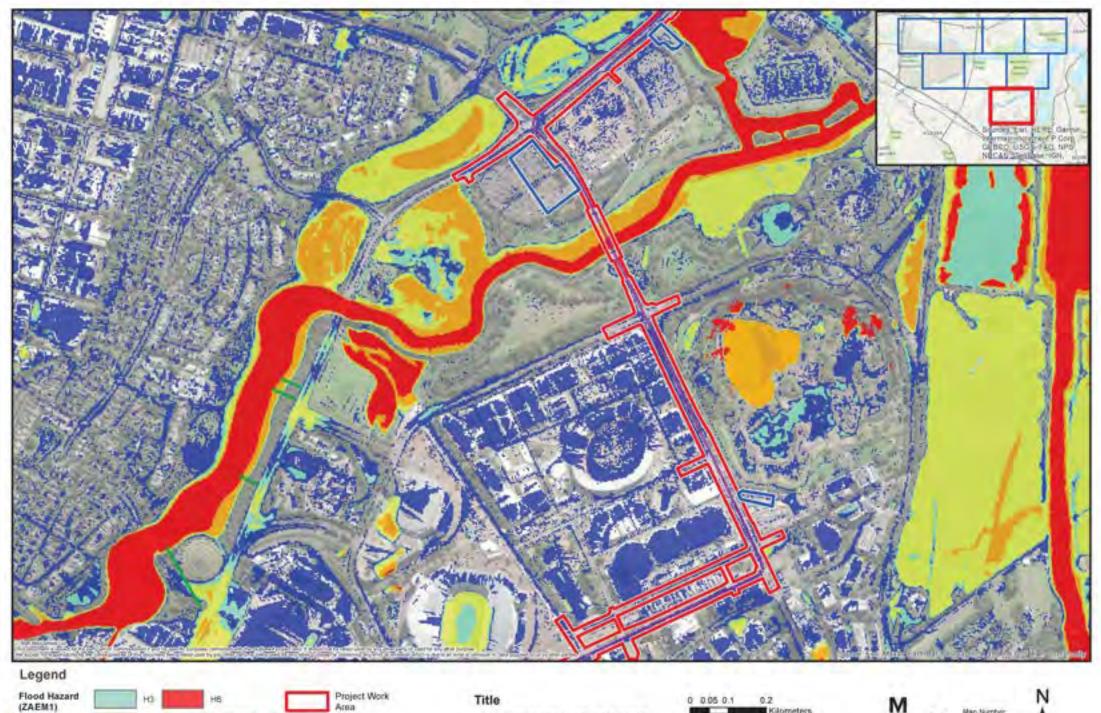
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Date: 30/01/2023

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Map Number Sheet No 7 of 9







Design Conditions 1% AEP Flood 1:7,000
Hazard 5000 014 0.2

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Date: 30/01/2023

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Map Number Sheet No 8 of 9





Design Conditions 1% AEP Flood
Hazard

0 0.05 0.1

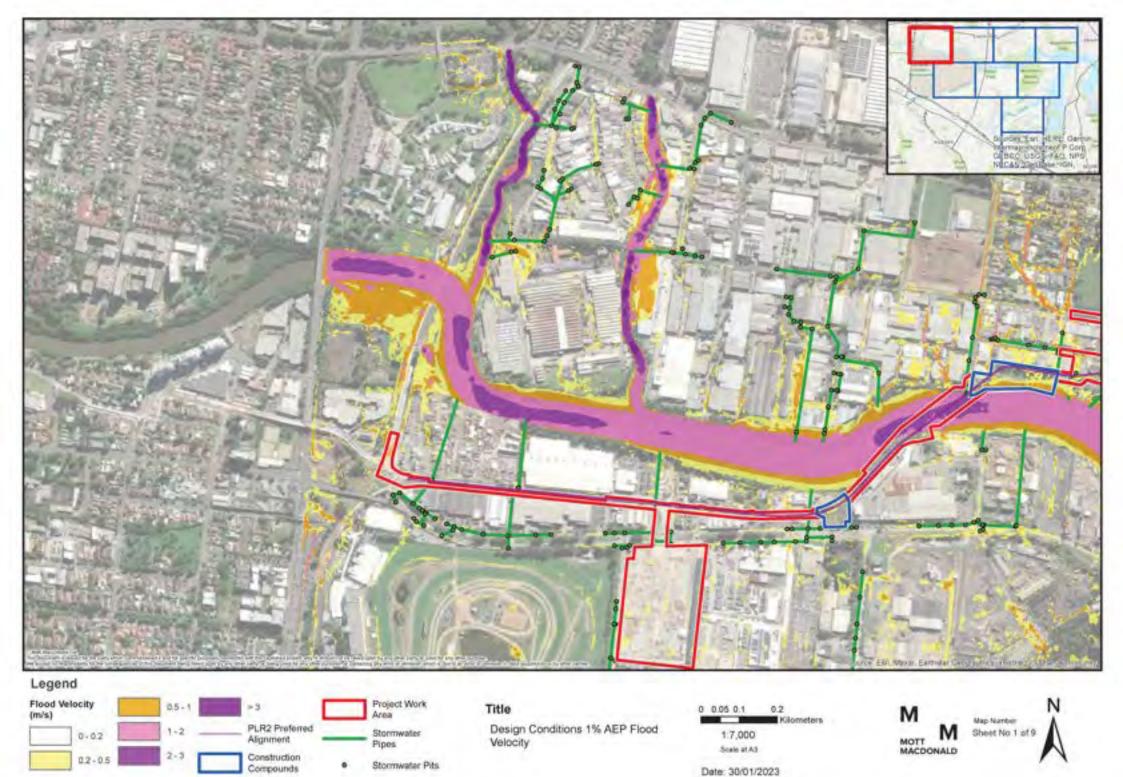
1:7,000

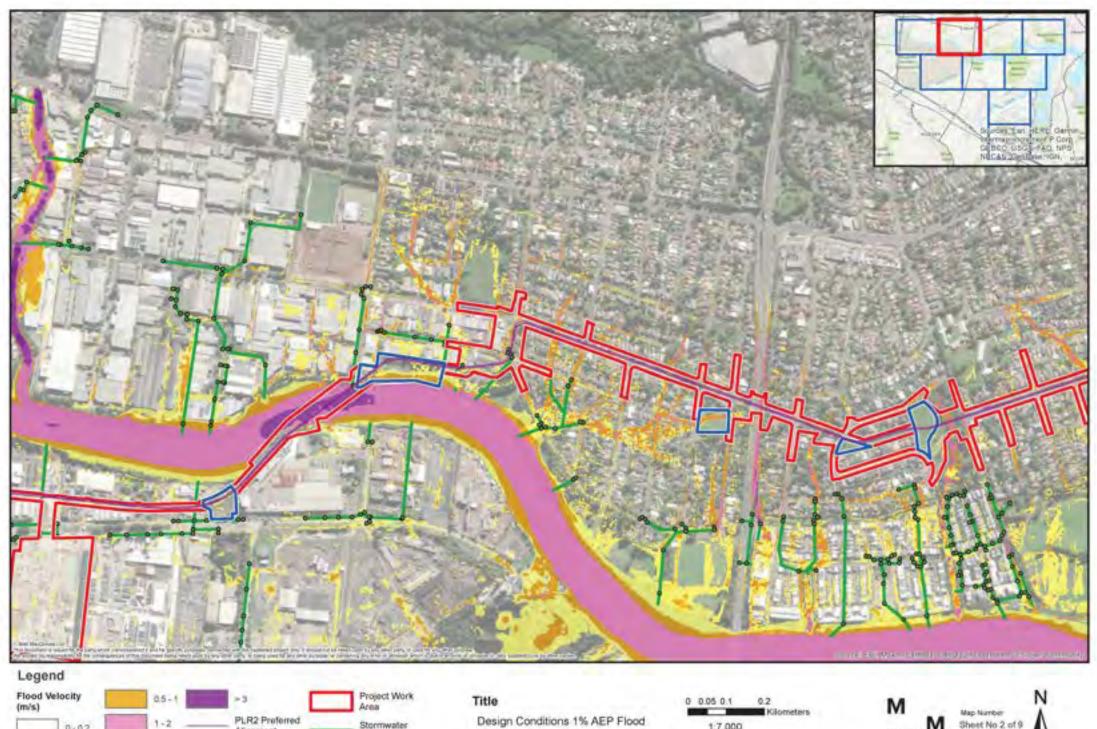
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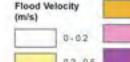
Date: 30/01/2023

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Map Number Sheet No 9 of 9







PLR2 Preferred Alignment Construction Compounds

Design Conditions 1% AEP Flood Velocity

Pipes.

Stormwater Pits.

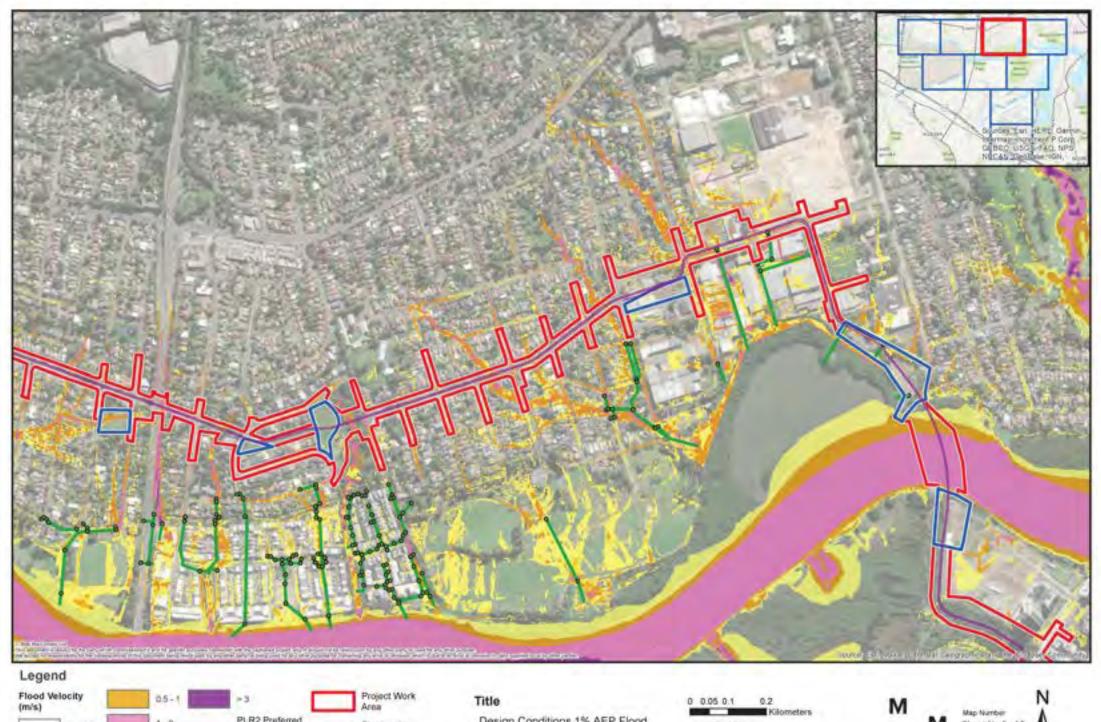
1:7,000 Scale at A3

Date: 30/01/2023

MOTT IVI

Sheet No 2 of 9



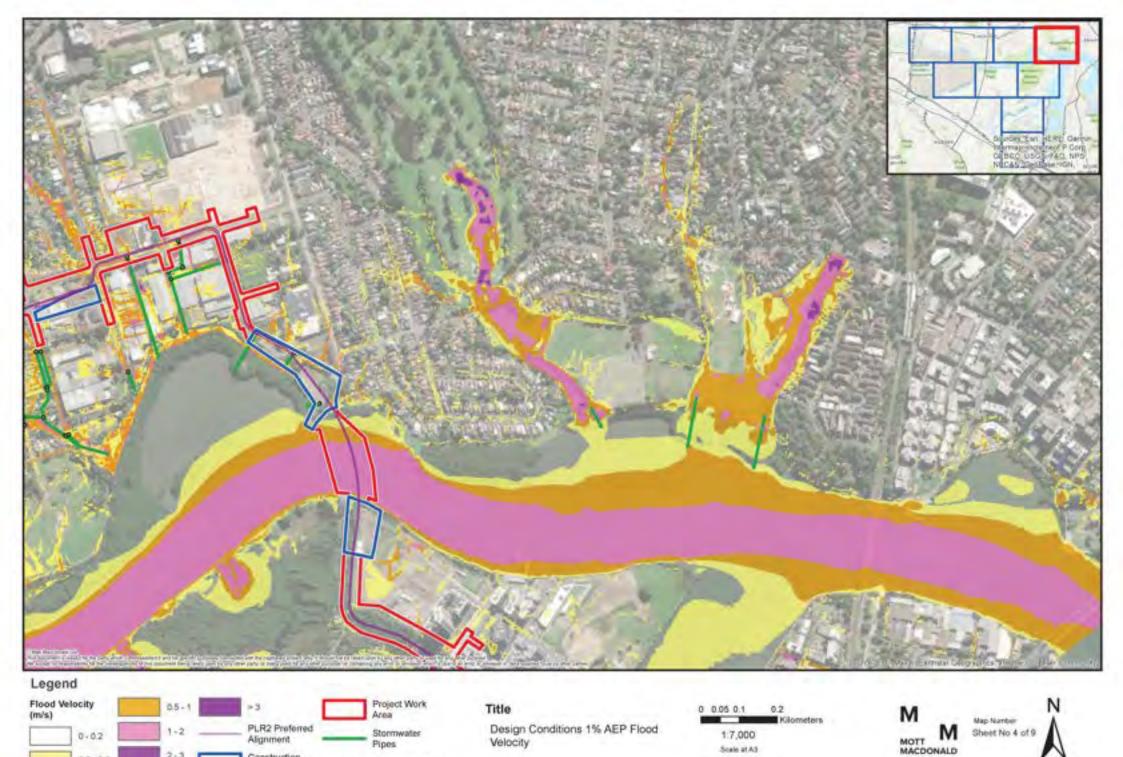




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MOTT IVI

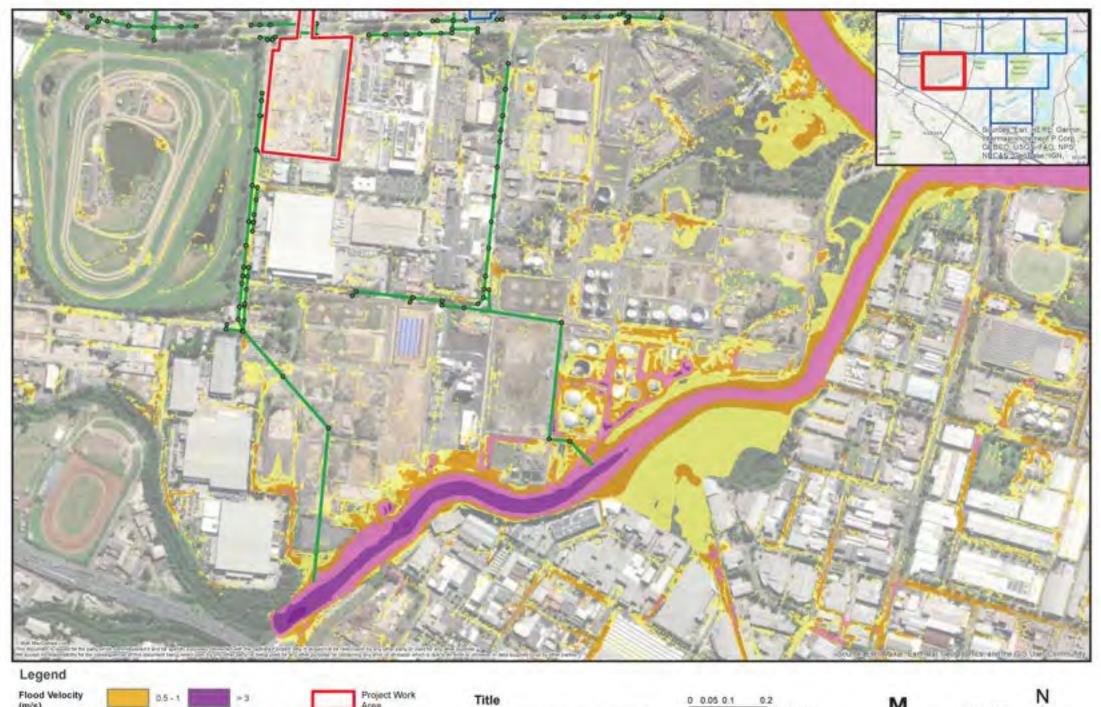
Sheet No 3 of 9



Construction
Compounds

Stormwater Pits

Date: 30/01/2023





Title 0 0.05 0.1 0.2

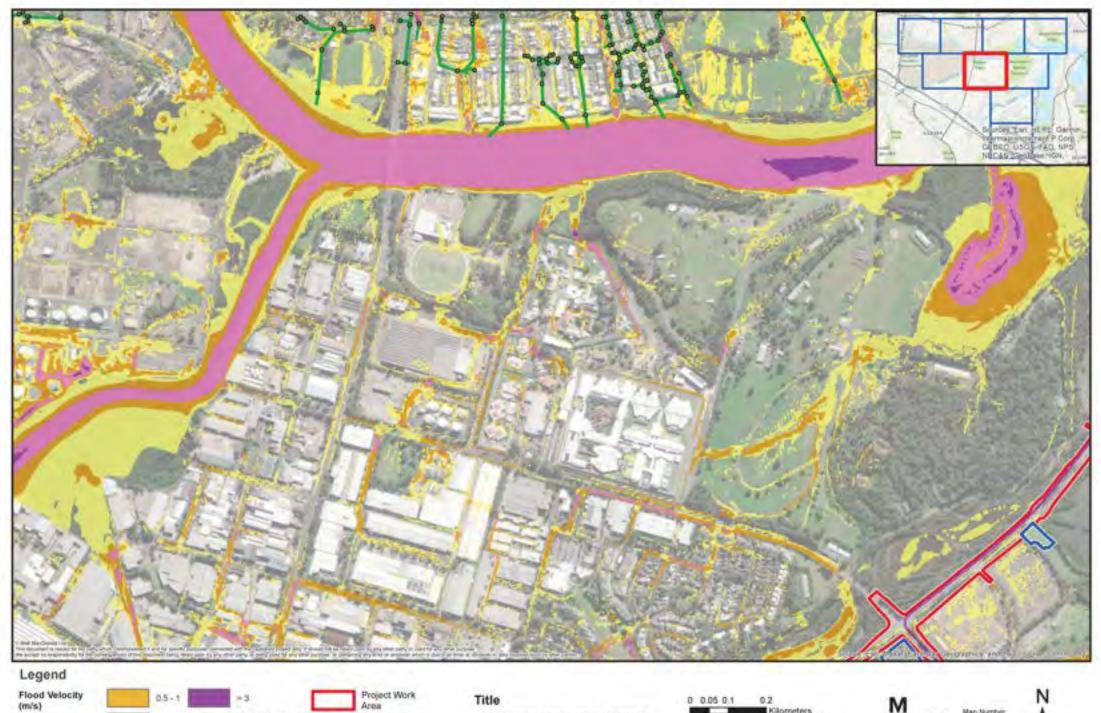
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Scale at A3

Date: 30/01/2023



Map Number Sheet No 5 of 9





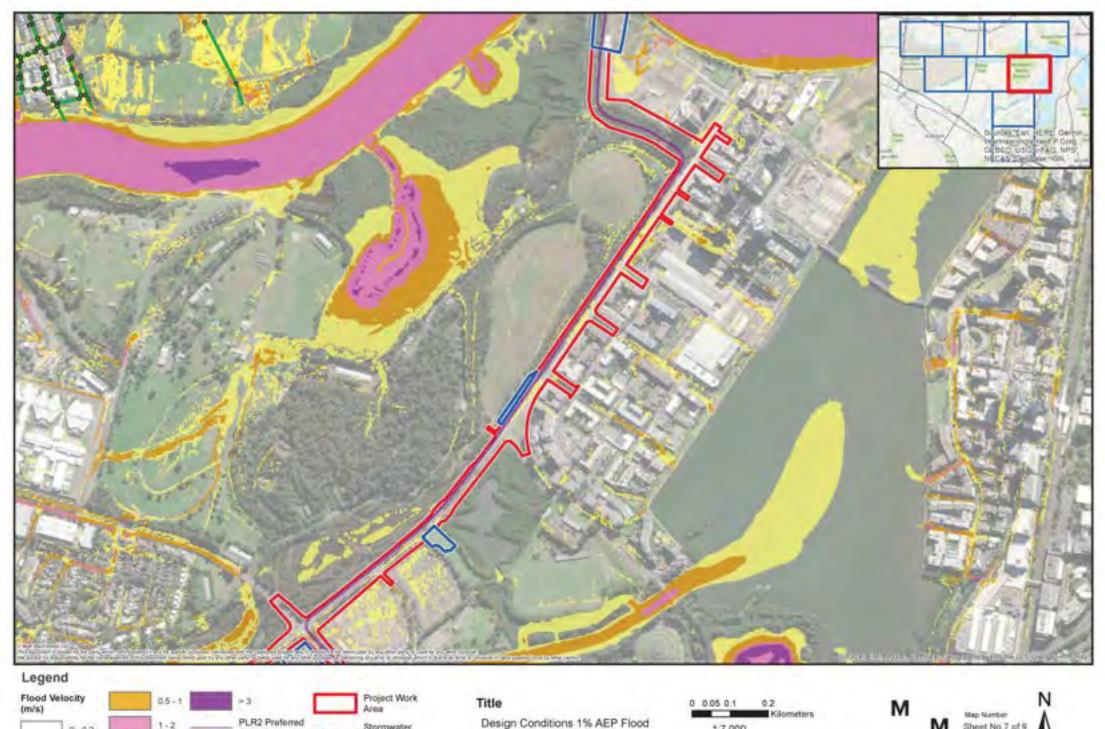
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Date: 30/01/2023

MOTT IVI

Map Number Sheet No 6 of 9







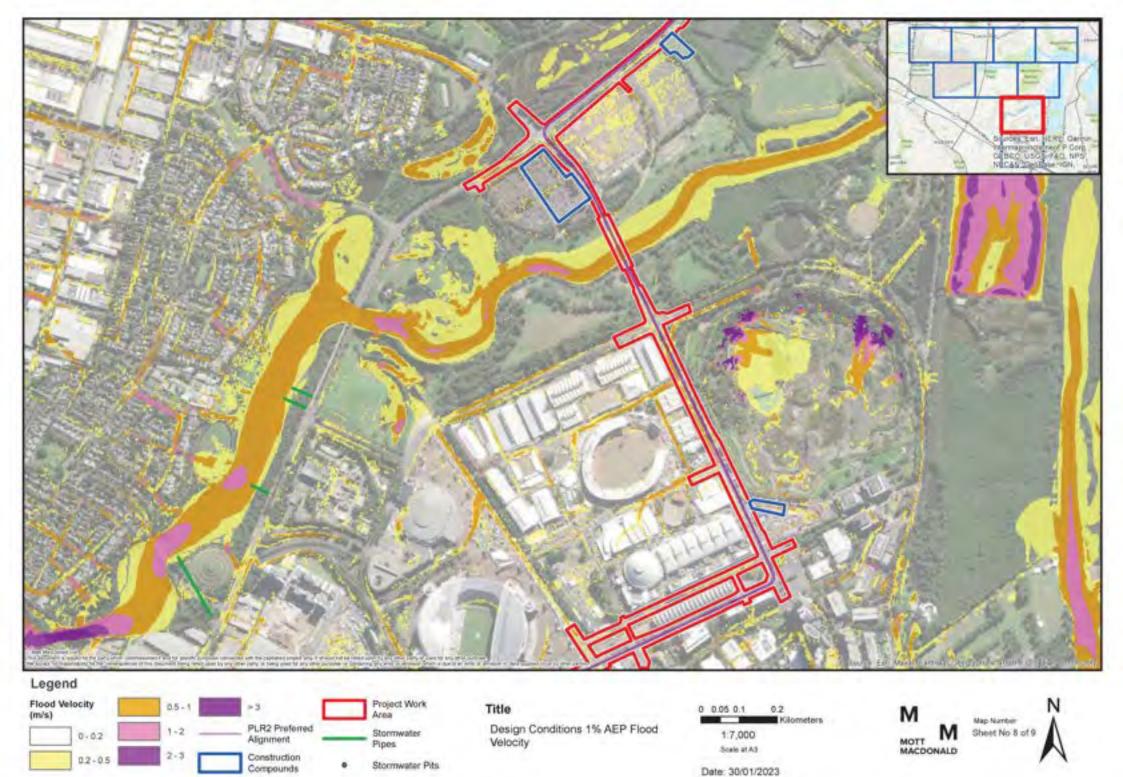
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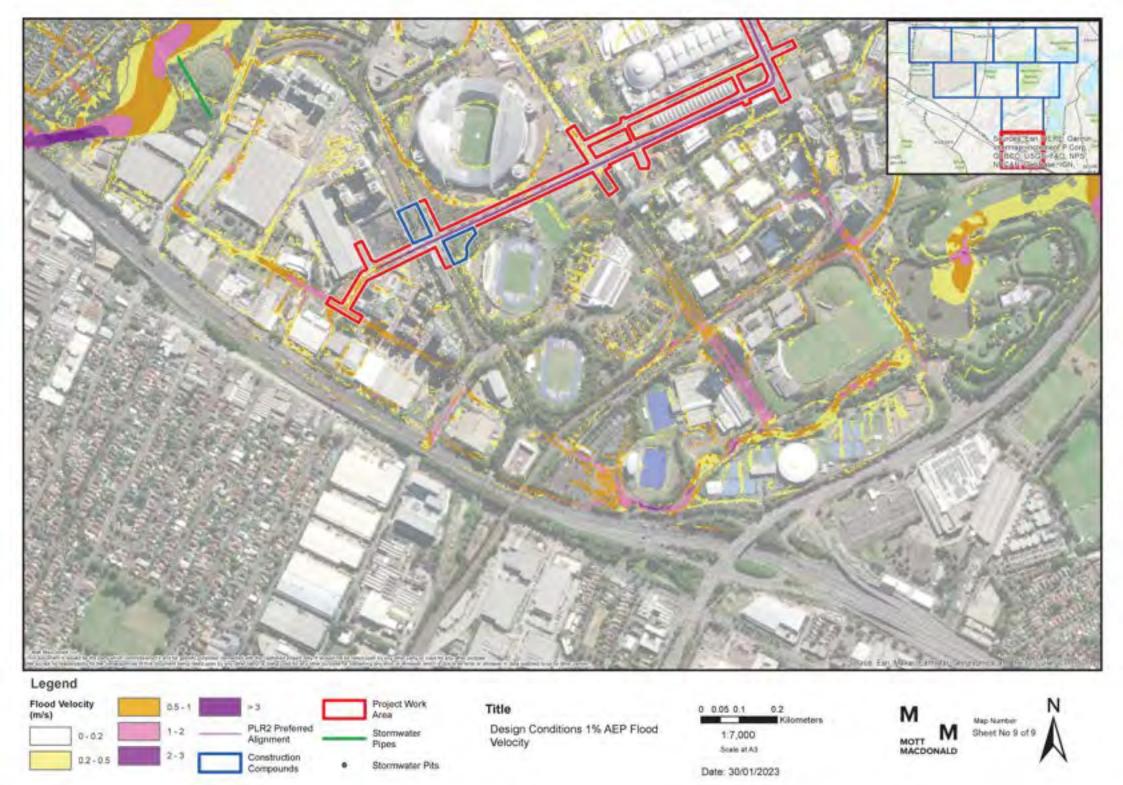


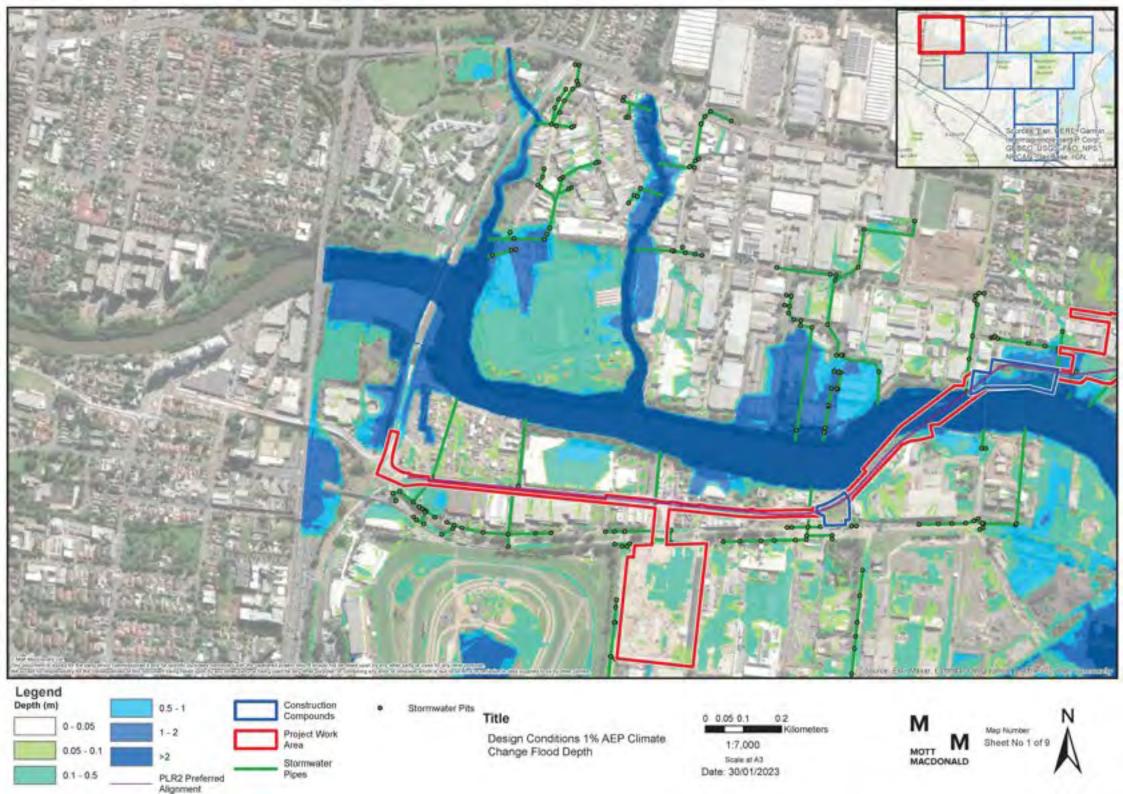
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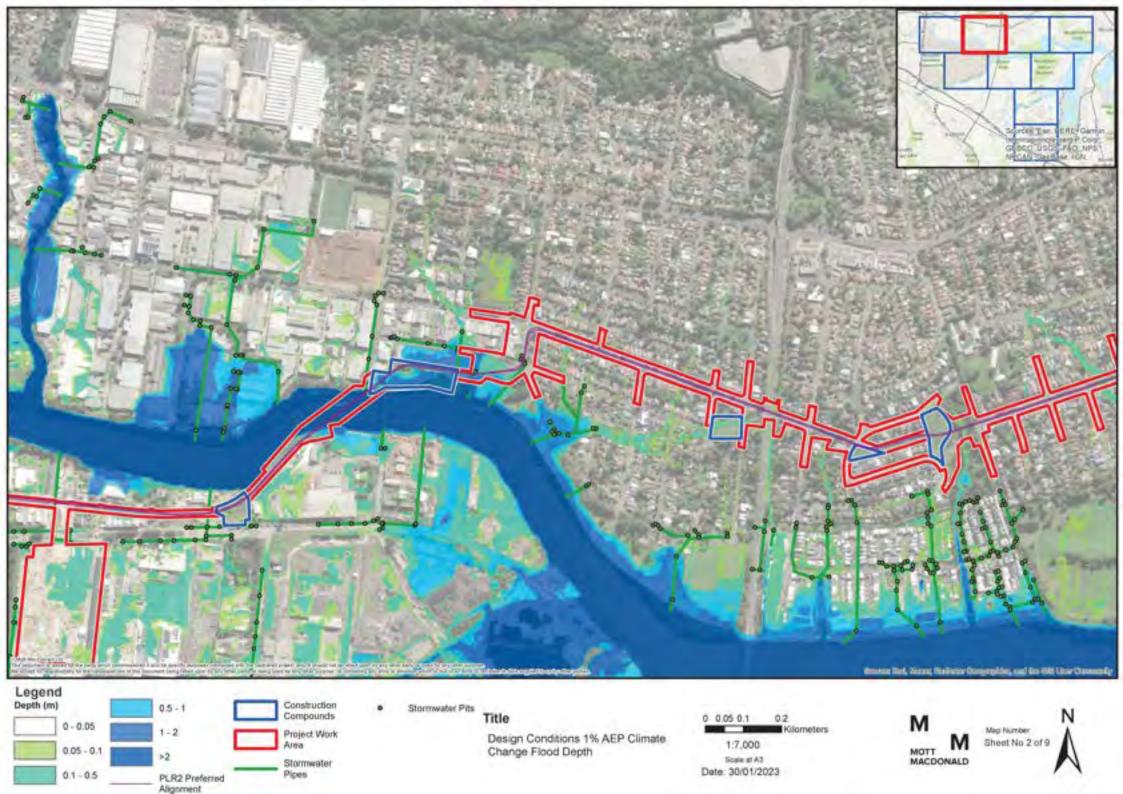
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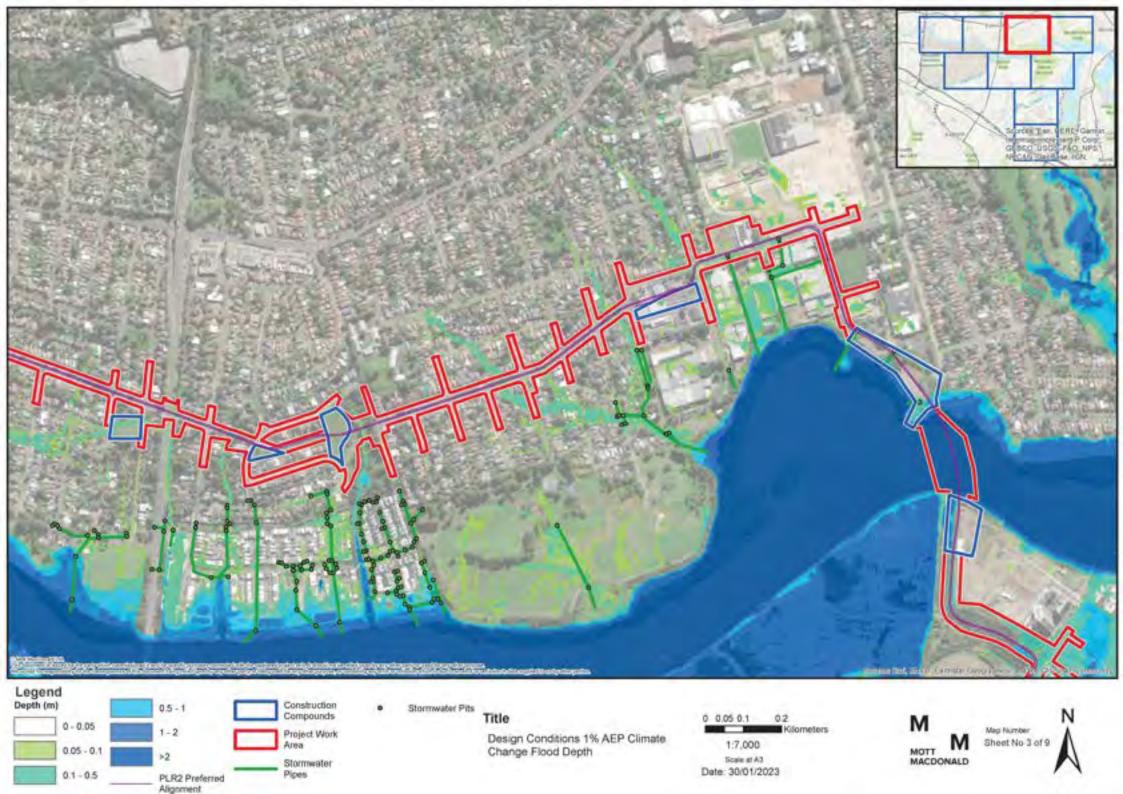


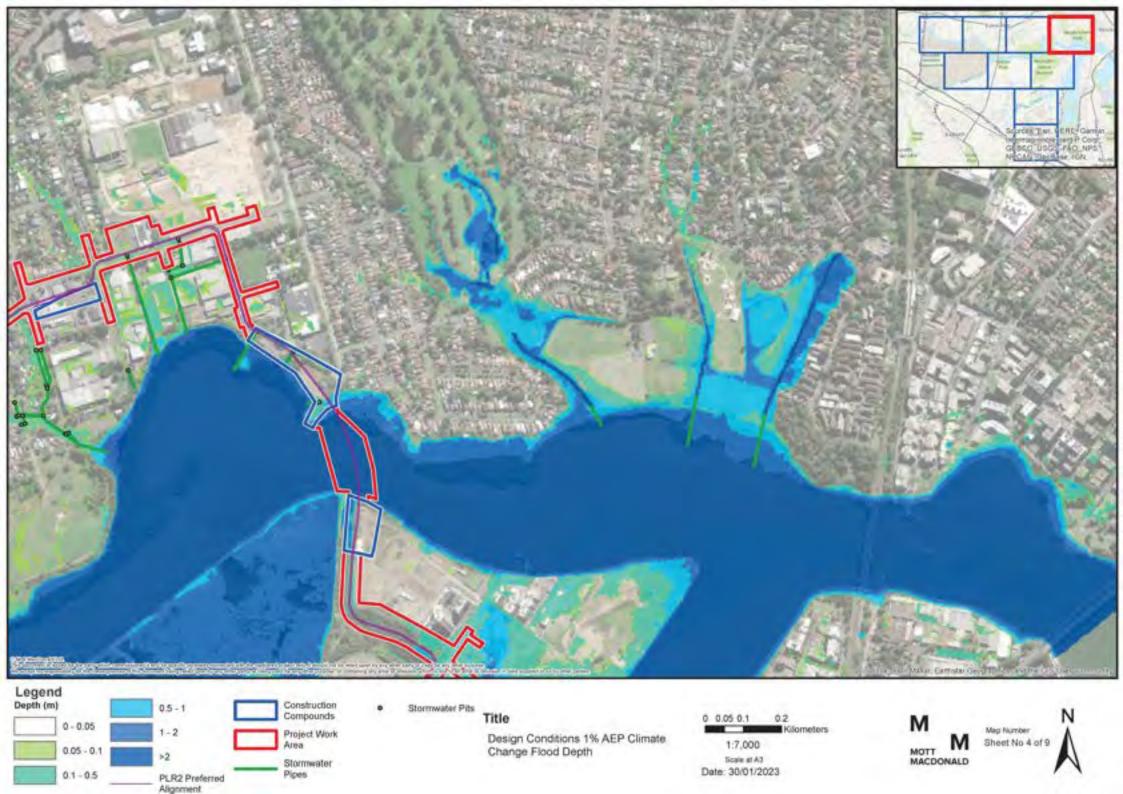


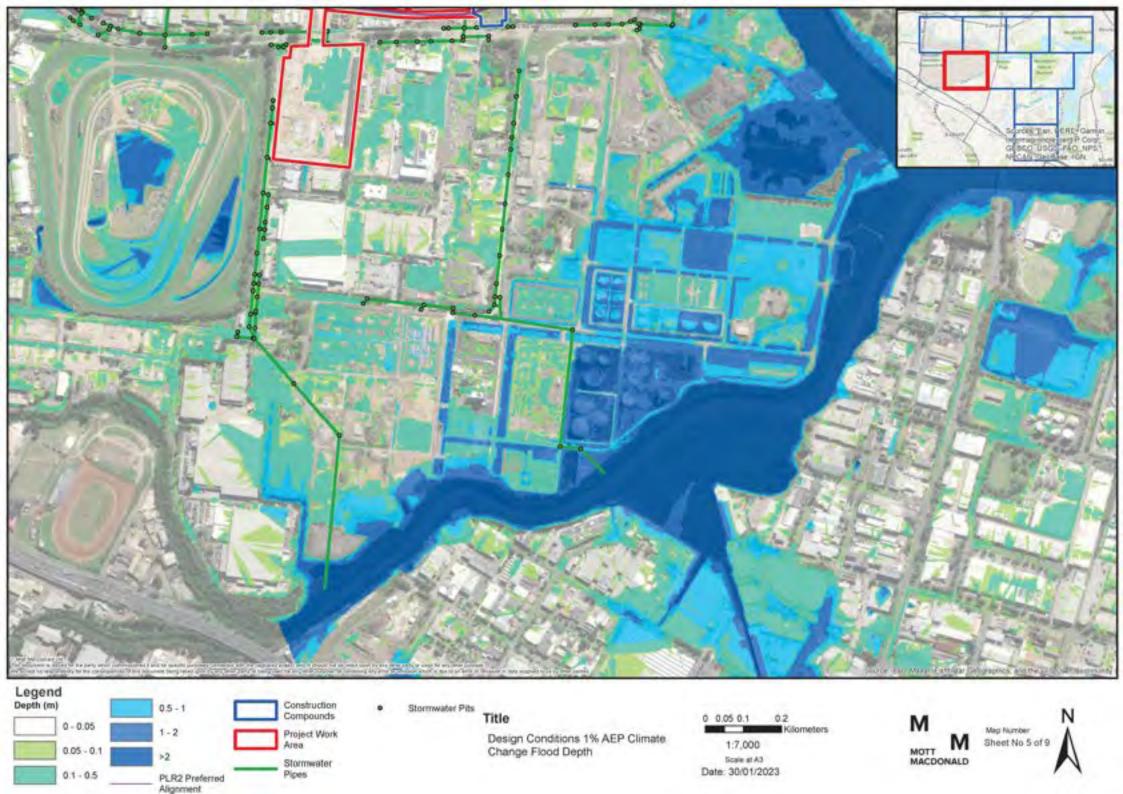


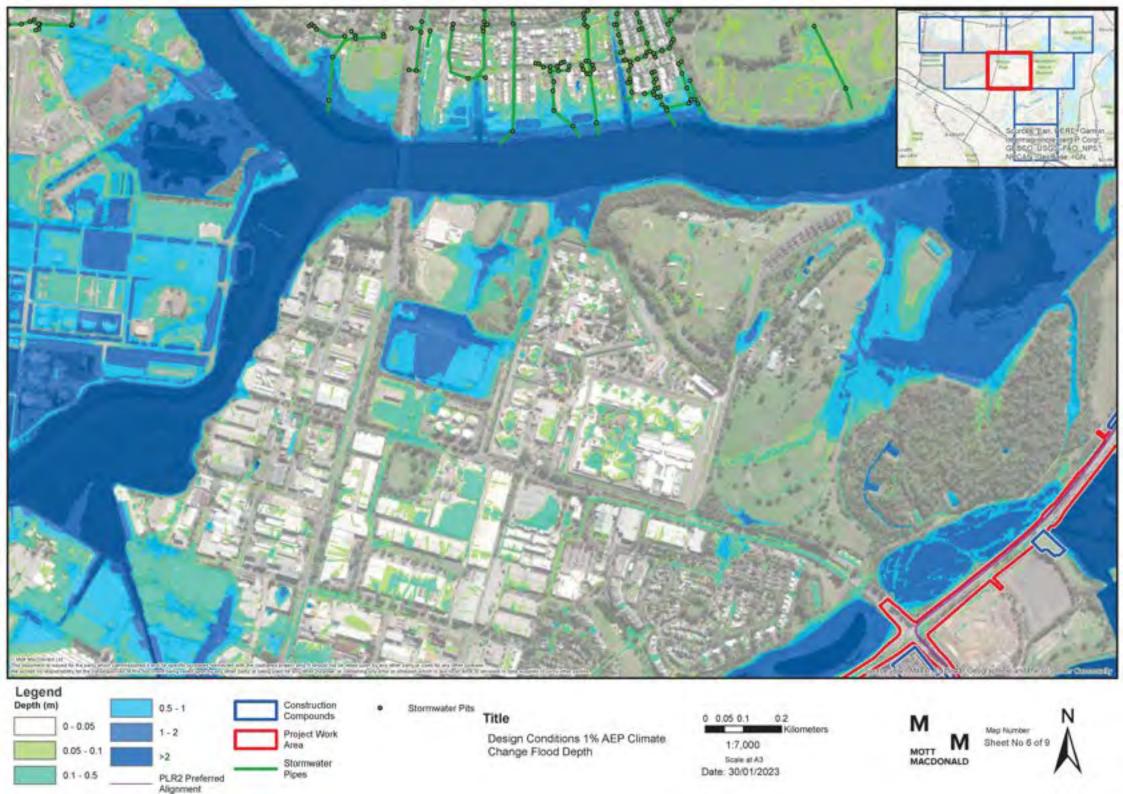


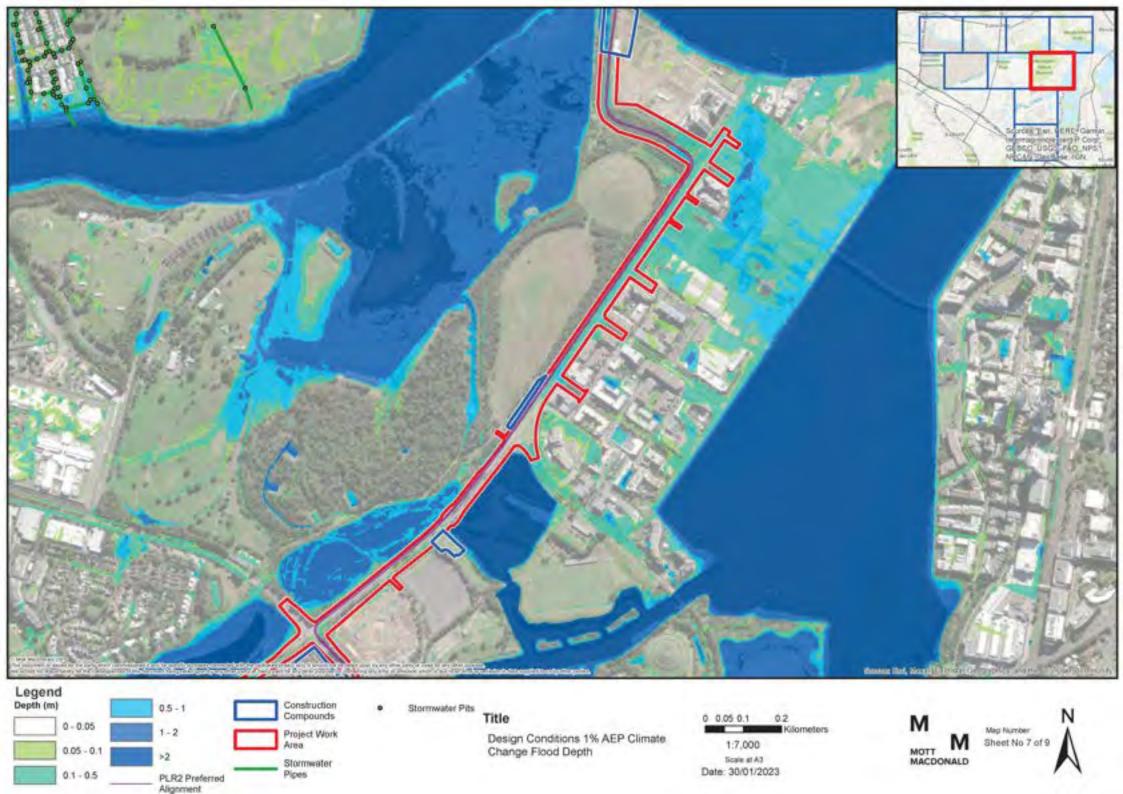


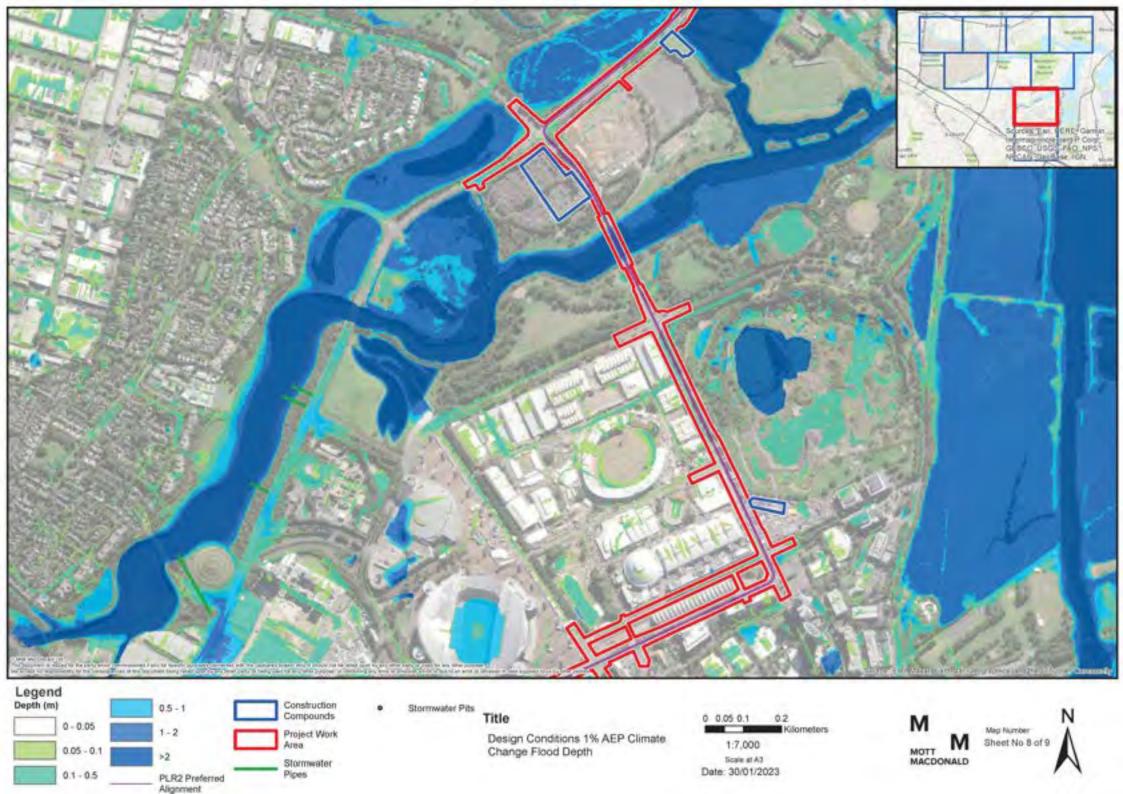


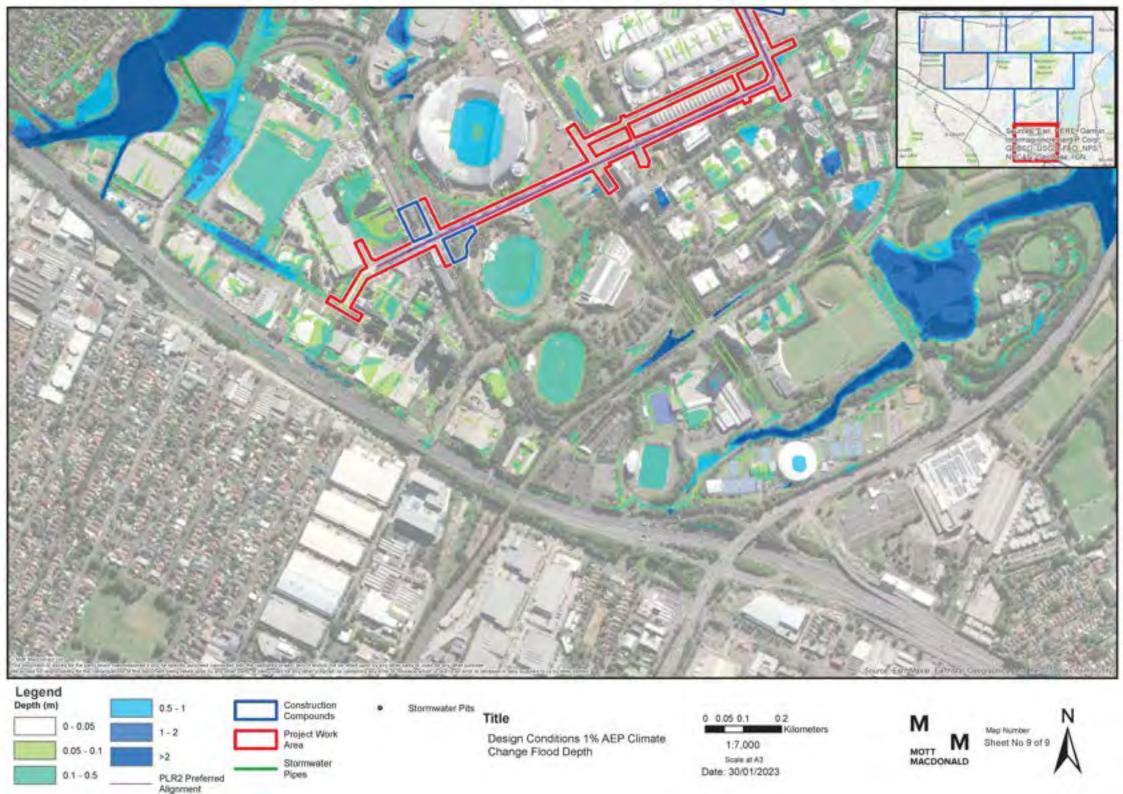


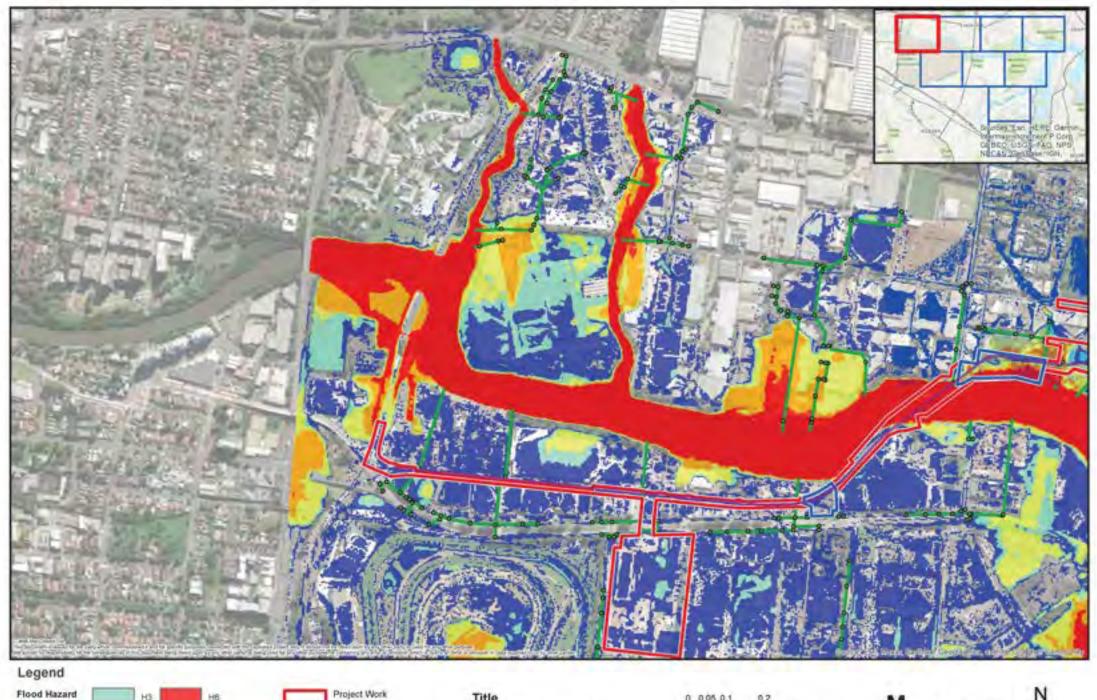












Flood Hazard (ZAEM1)







Compounds

Stormwater Pipes

Stormwater Pits

Title

Design Conditions 1% AEP Climate Change Flood Hazard

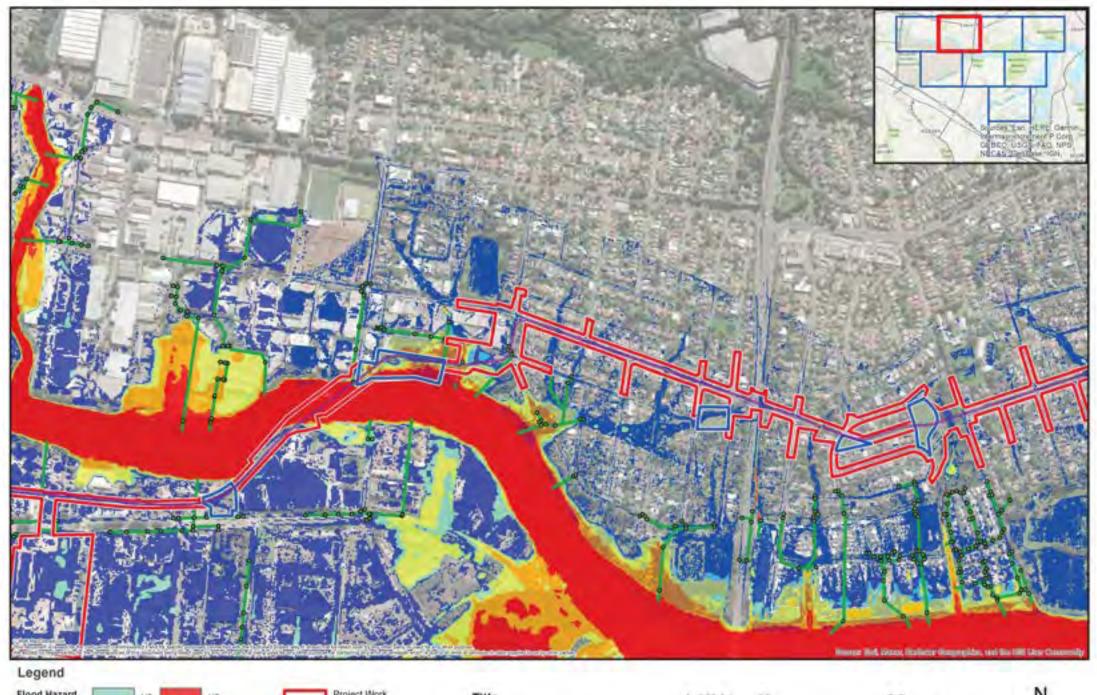
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Date: 30/01/2023

MOTT IVI

Map Number Sheet No 1 at 9







Title

Design Conditions 1% AEP Climate Change Flood Hazard

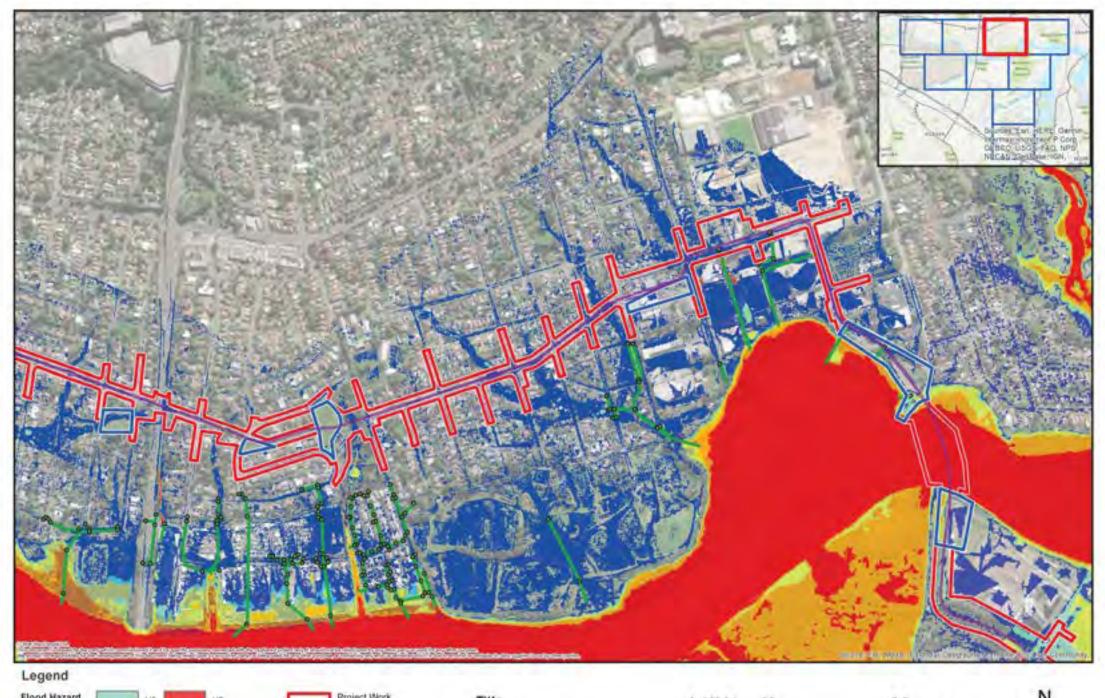


Date: 30/01/2023

MOTT MACDONALD

Map Number Sheet No 2 of 9





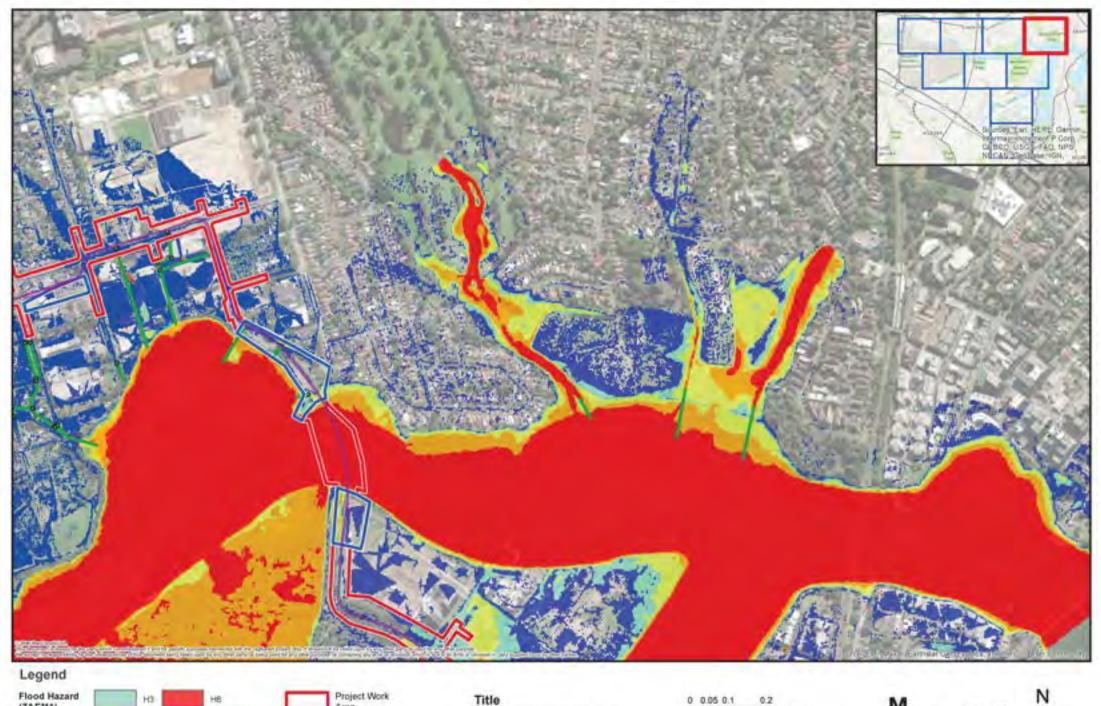


Title Design Conditions 1% AEP Climate Change Flood Hazard



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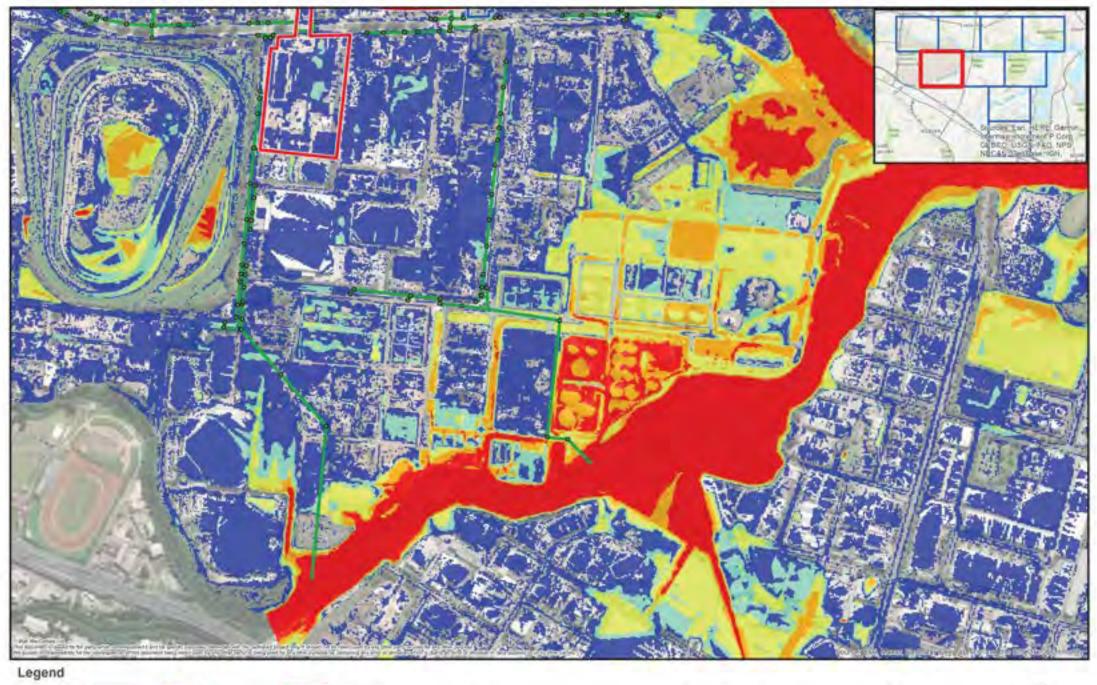
Design Conditions 1% AEP Climate Change Flood Hazard



Date: 30/01/2023

MOTT IVI



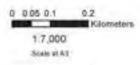






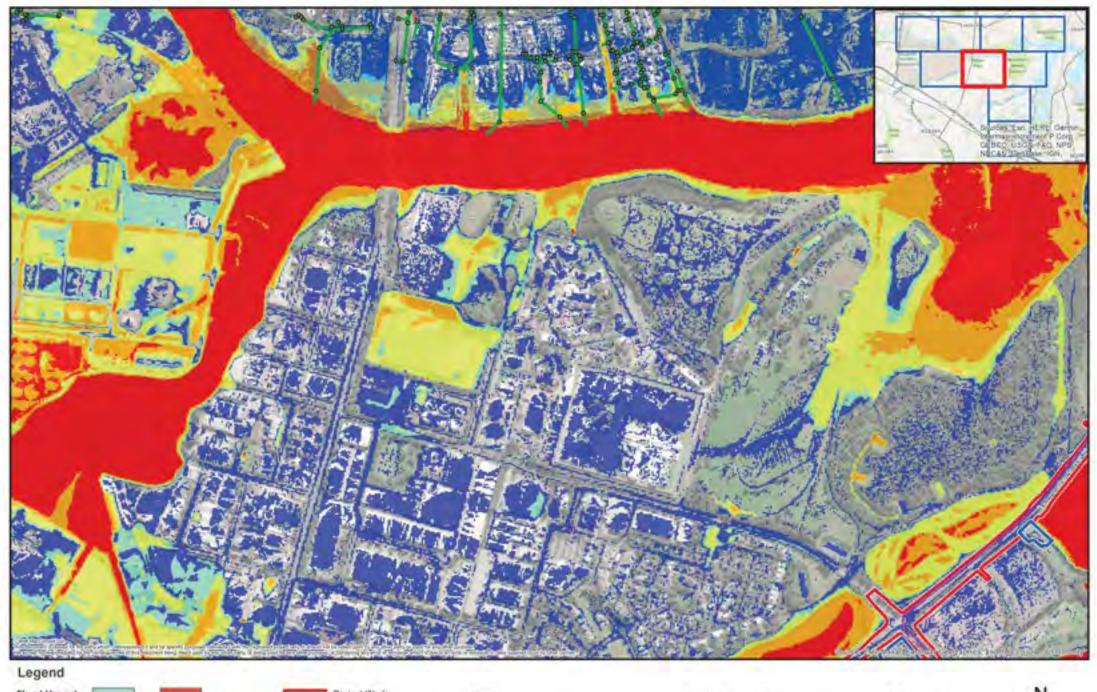
Title

Design Conditions 1% AEP Climate Change Flood Hazard



MOTT IVI















Compounds



Project Work

Stormwater Pipes

Stormwater Pits

Title

Design Conditions 1% AEP Climate Change Flood Hazard

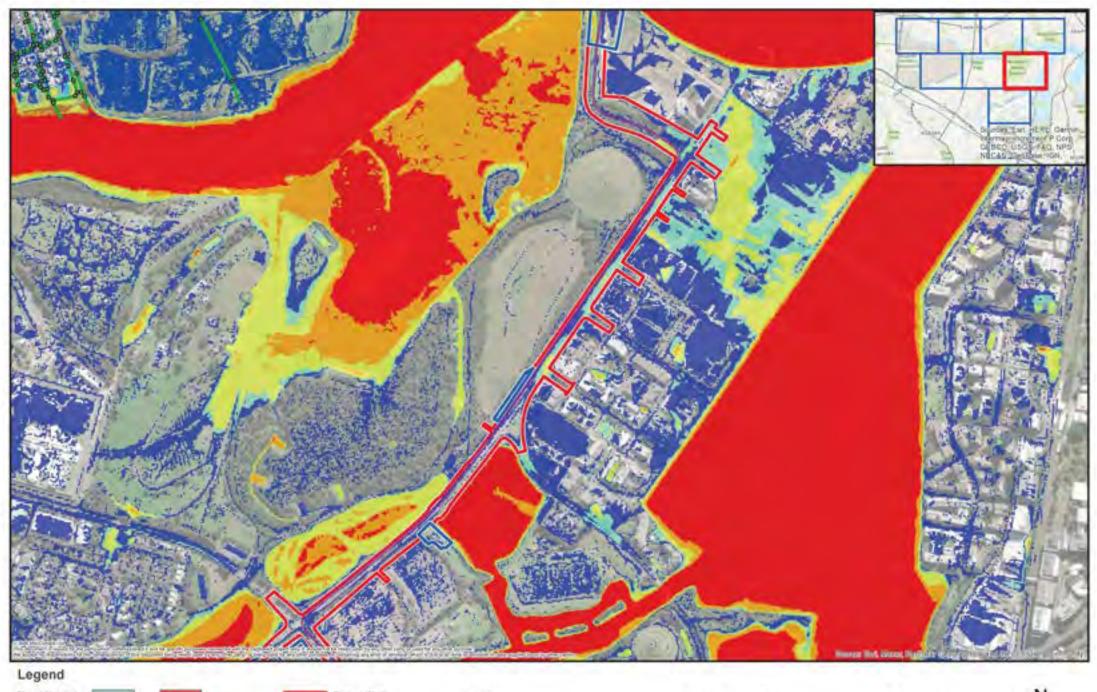


Date: 30/01/2023



Map Number Sheet No 6 of 9











Compounds

Project Work

Stormwater Pipes

Stormwater Pits

Title

Design Conditions 1% AEP Climate Change Flood Hazard

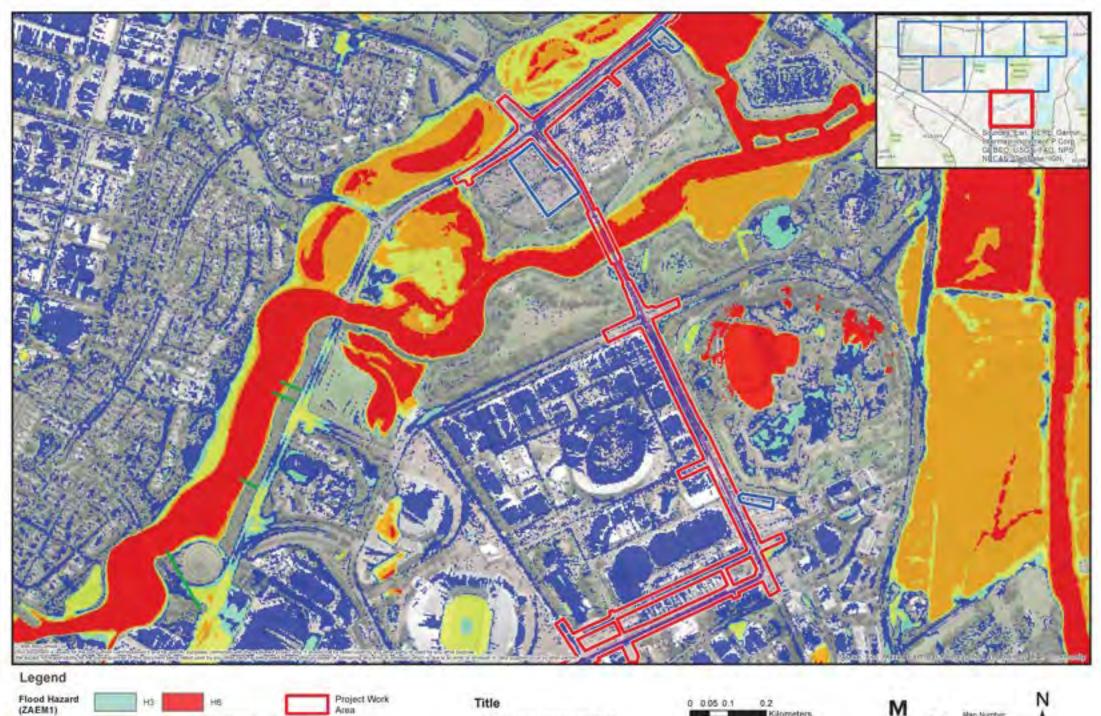
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Date: 30/01/2023



Map Number Sheet No.7 of 9





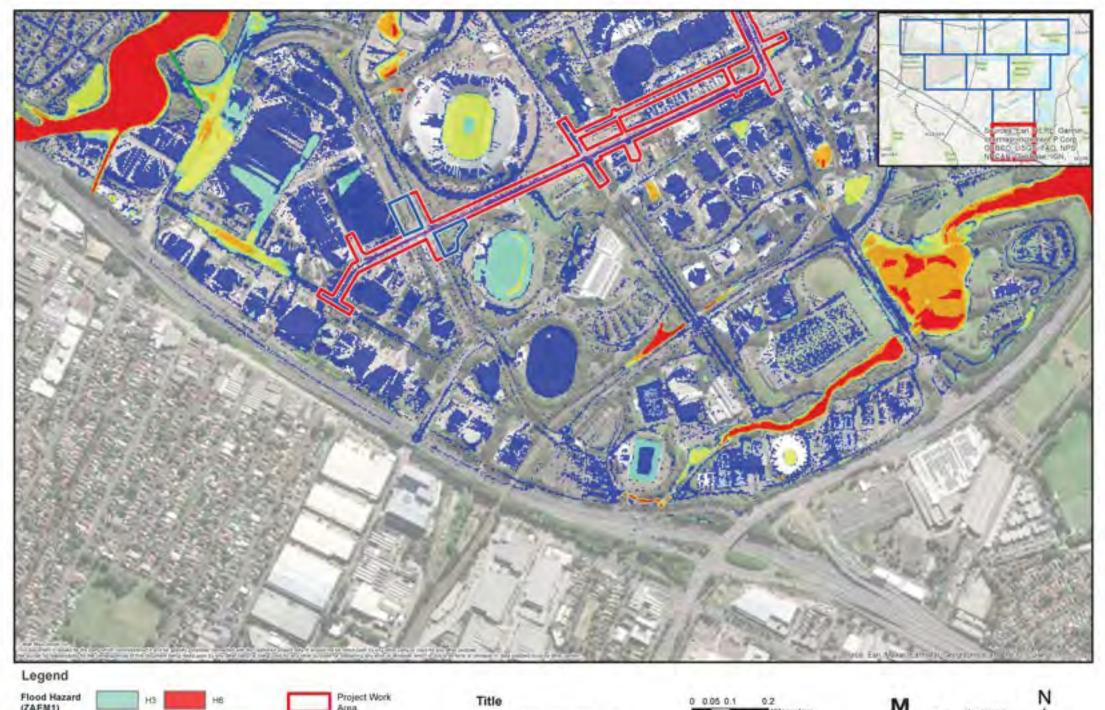


Title 0 0.05 0.1 0.2 Design Conditions 1% AEP 1:7,000 Climate Change Flood Hazard Scale at A7

Date: 30/01/2023

MOTT M





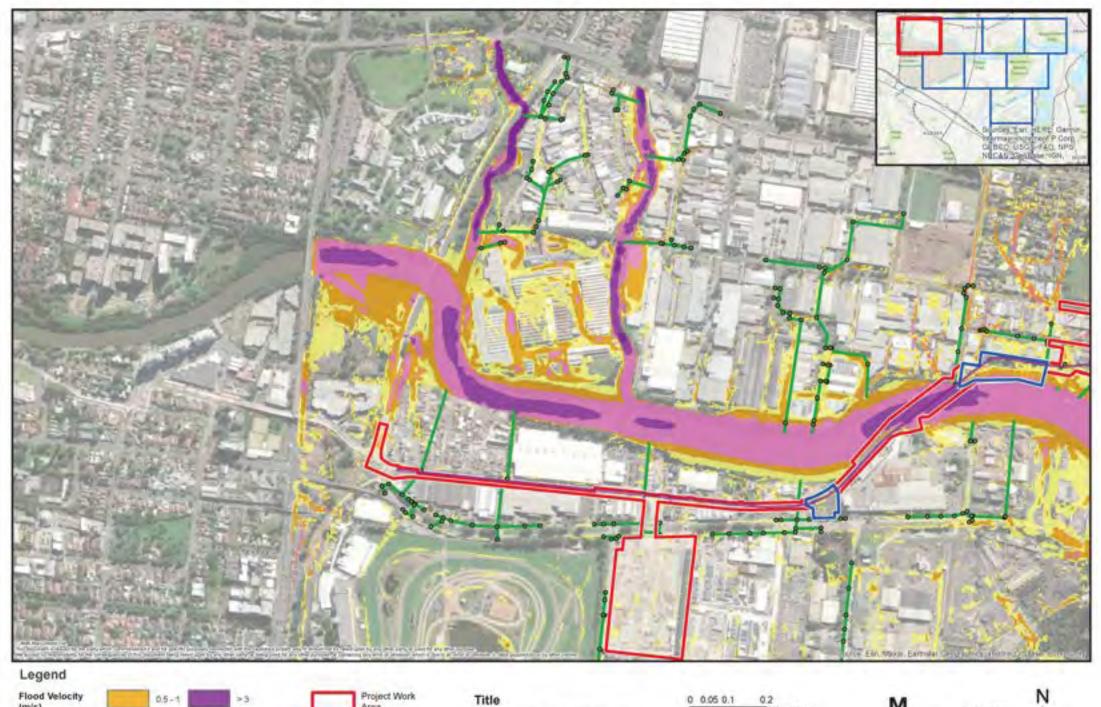


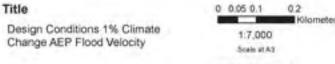
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MOTT IVI

Map Number Sheet No 9 of 9

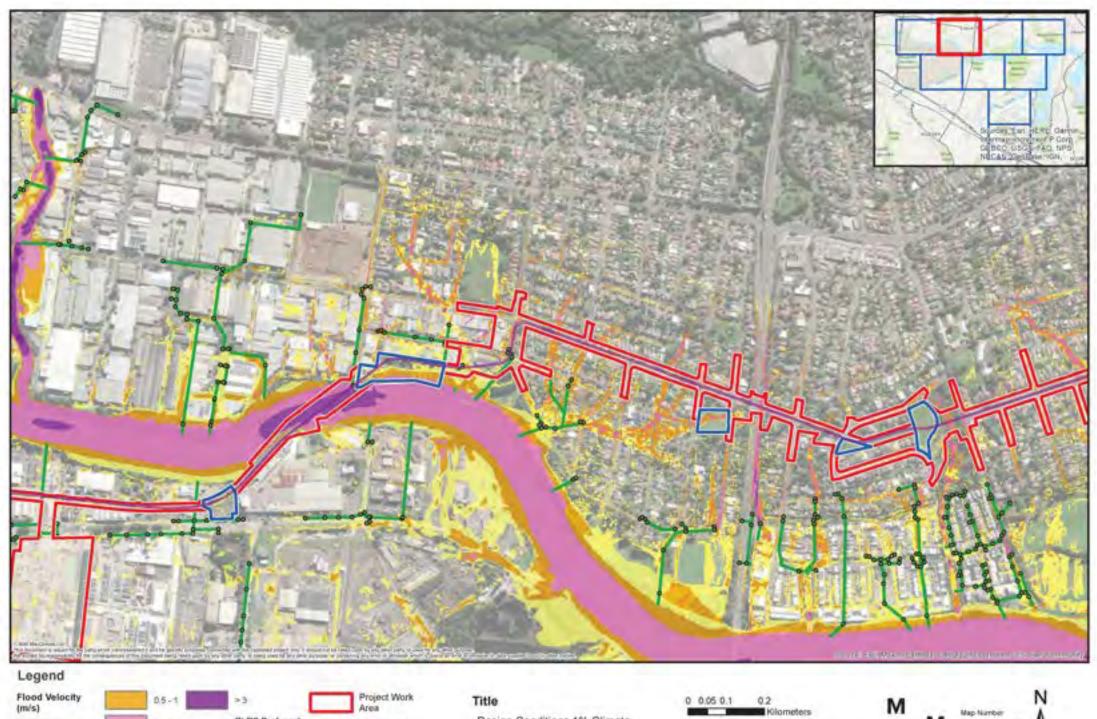




1:7,000 MOTT MACDONALD

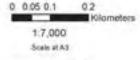
Date: 30/01/2023





0 - 0.2 1 - 2 PLR2 Preferred Stormwater Pipes
0 - 0.2 2 - 3 Construction Compounds Stormwater Pits

Design Conditions 1% Climate Change AEP Flood Velocity

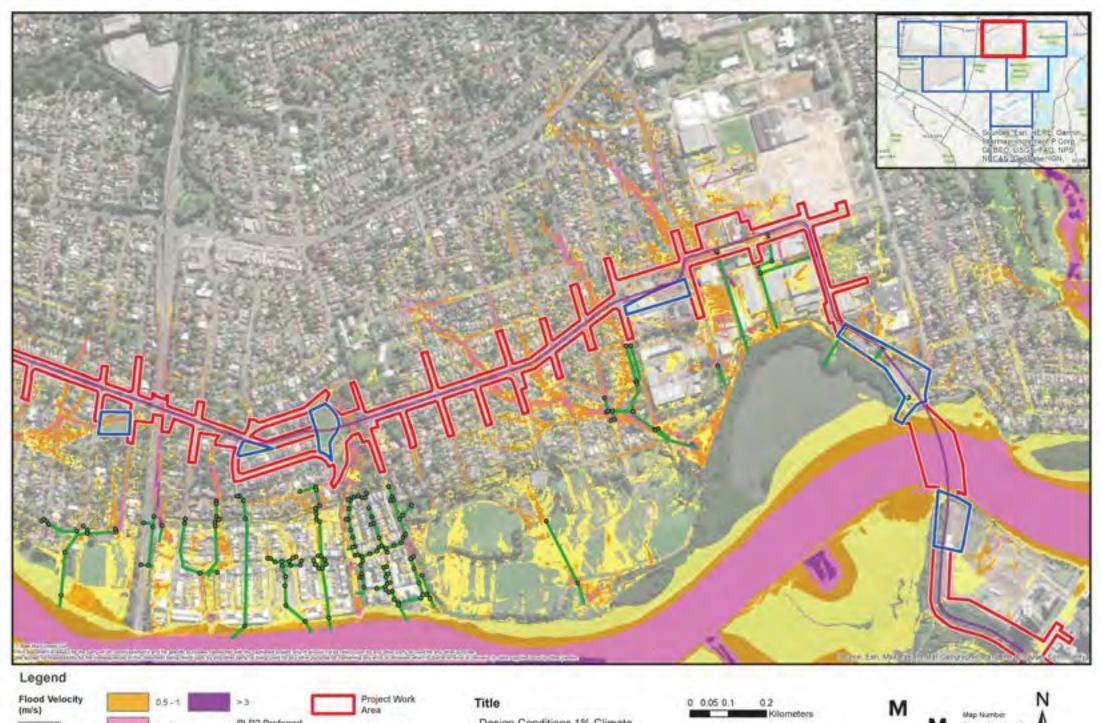


Date: 30/01/2023

MOTT M

Map Number Sheet No 2 of 9



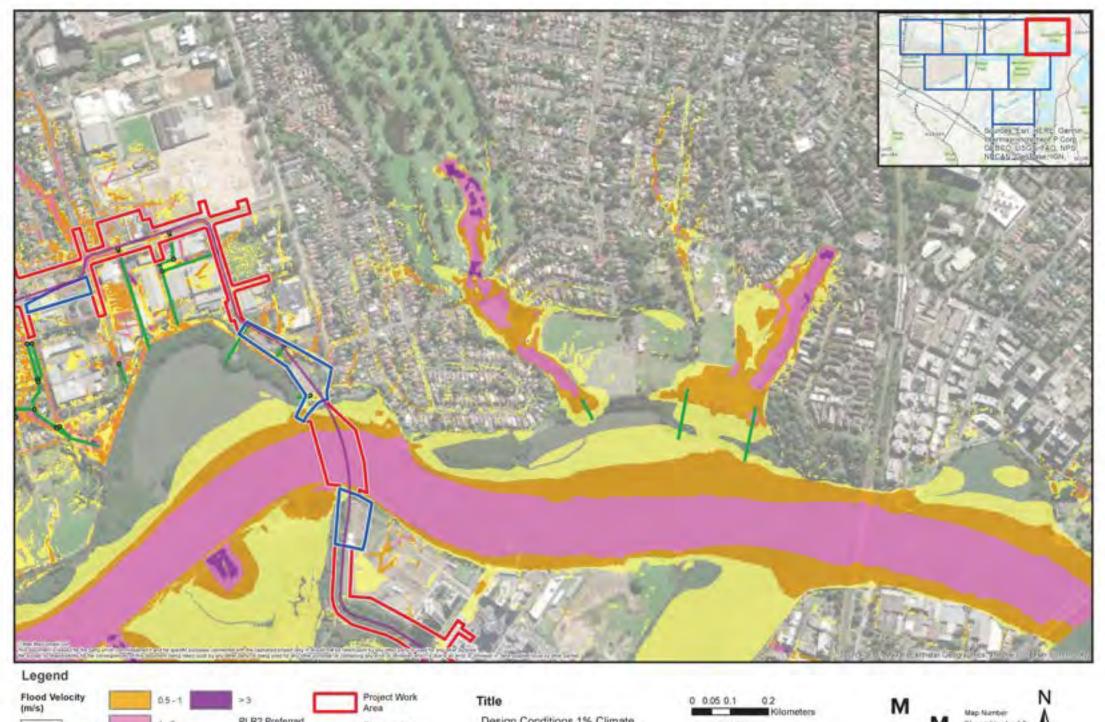


lood Velocity 0.5-1 >3 Project Work Area 0-0.2 1-2 PLR2 Preferred Stormwater Pipes 0.2-0.5 2-3 Construction Compounds Stormwater Pits

Design Conditions 1% Climate Change AEP Flood Velocity 1:7,000 Scale #A3

M M

Map Number Sheet No 3 of 9



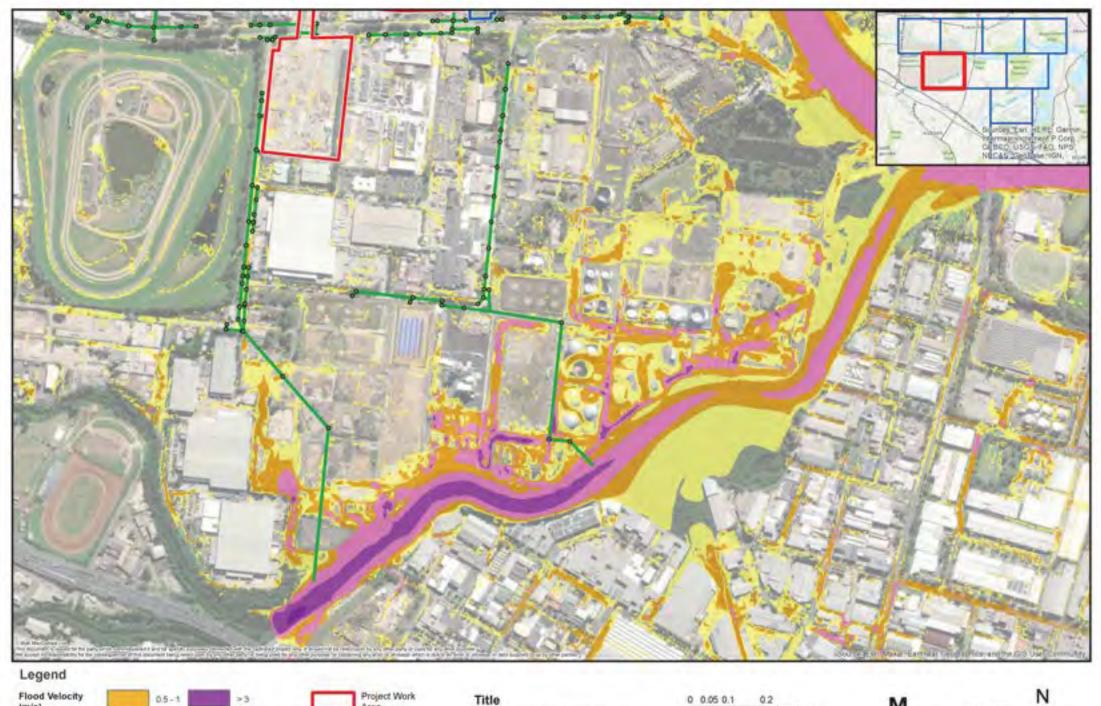


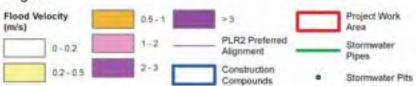
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1:7,000 Scale at A3 Date: 30/01/2023

MOTT IVI

Sheet No 4 of 9





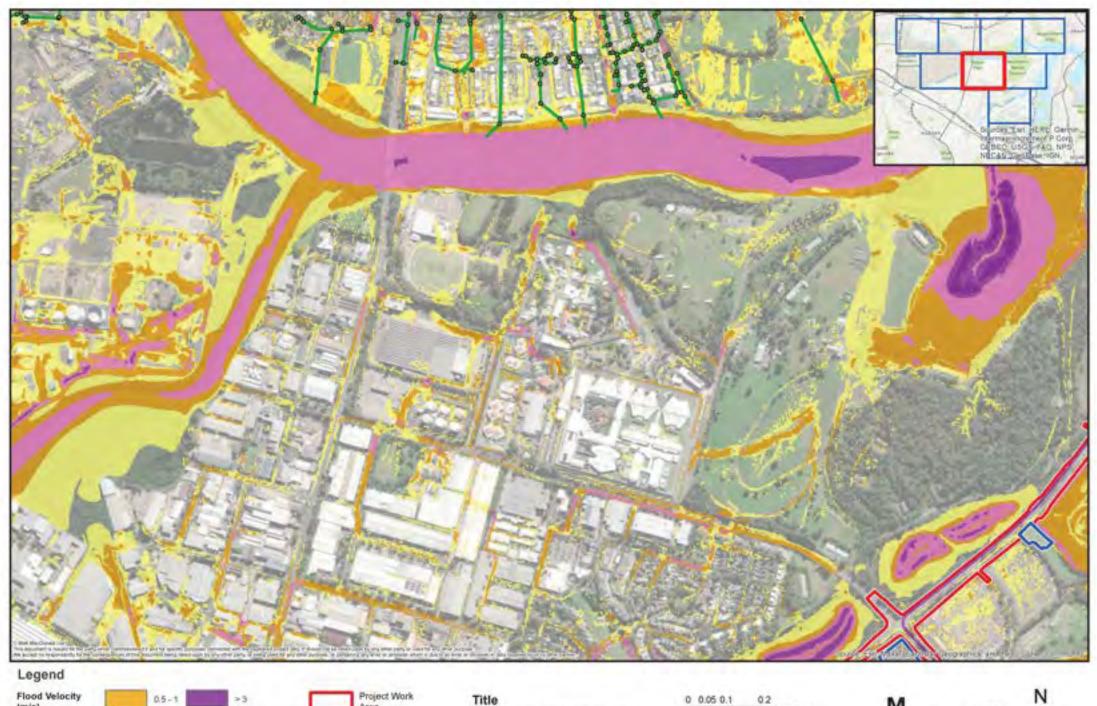
Design Conditions 1% Climate Change AEP Flood Velocity



M M

Map Number Sheet No 5 of 9





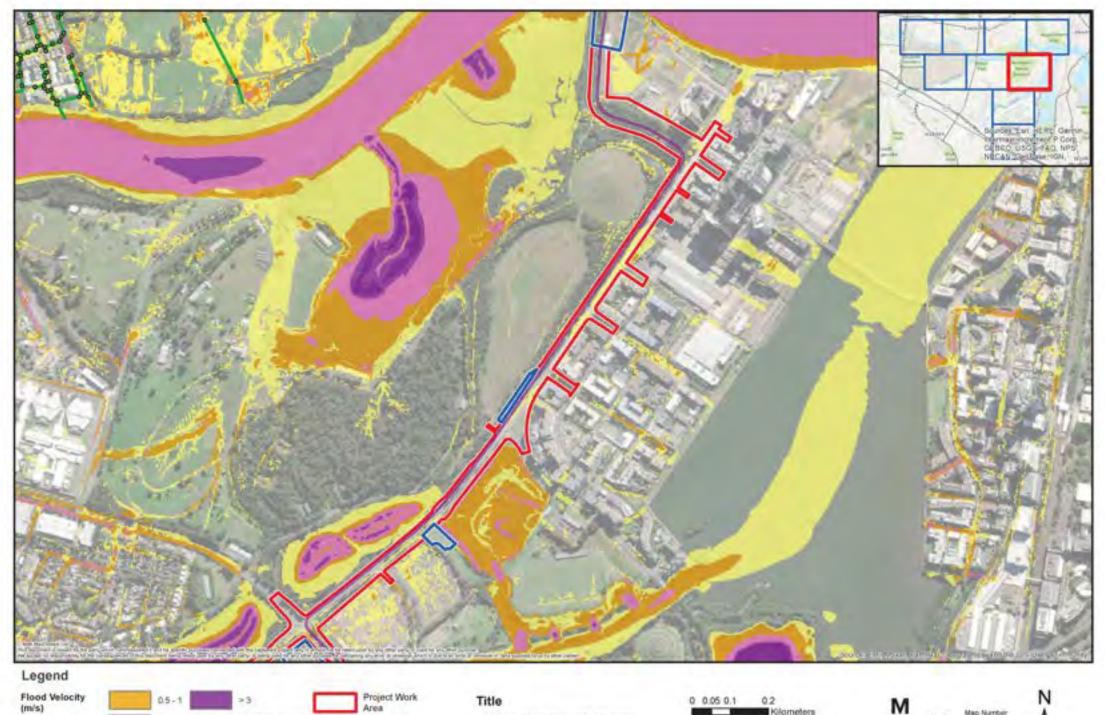
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Date: 30/01/2023

MOTT MACDONALD

Map Number Sheet No 6 of 9





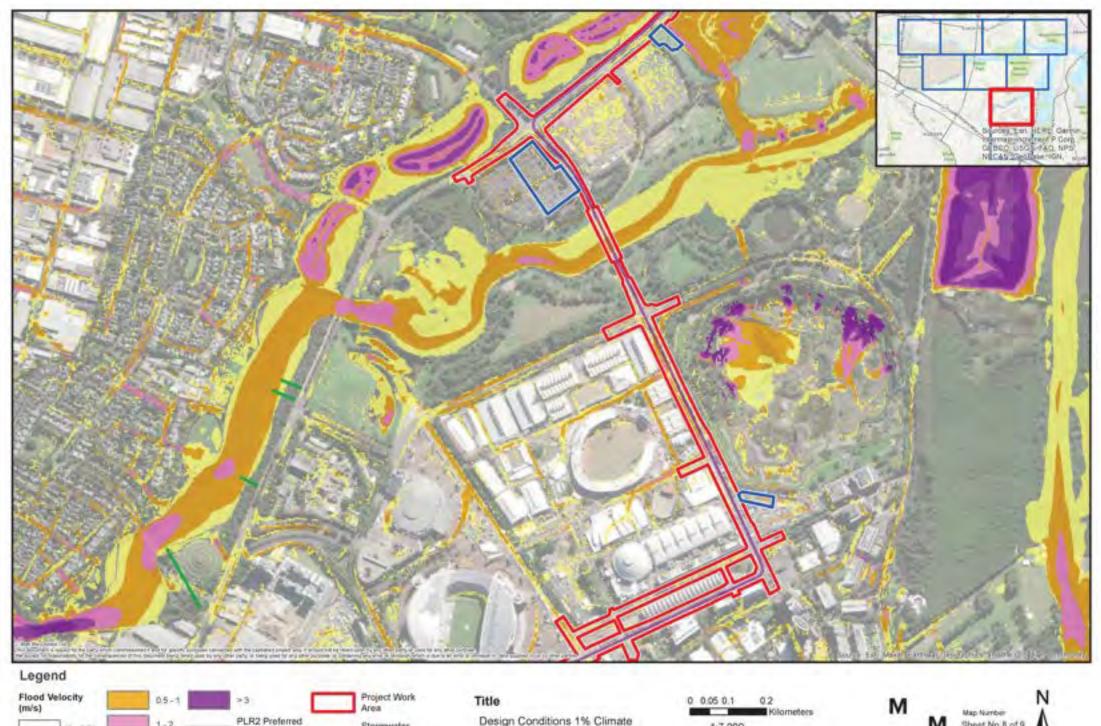
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1:7,000 Scale at A3 Date: 30/01/2023

MOTT IVI

Map Number Sheet No.7 of 9





PLR2 Preferred Alignment Stormwater Pipes Construction 0.7-05 Stormwater Pits Compounds

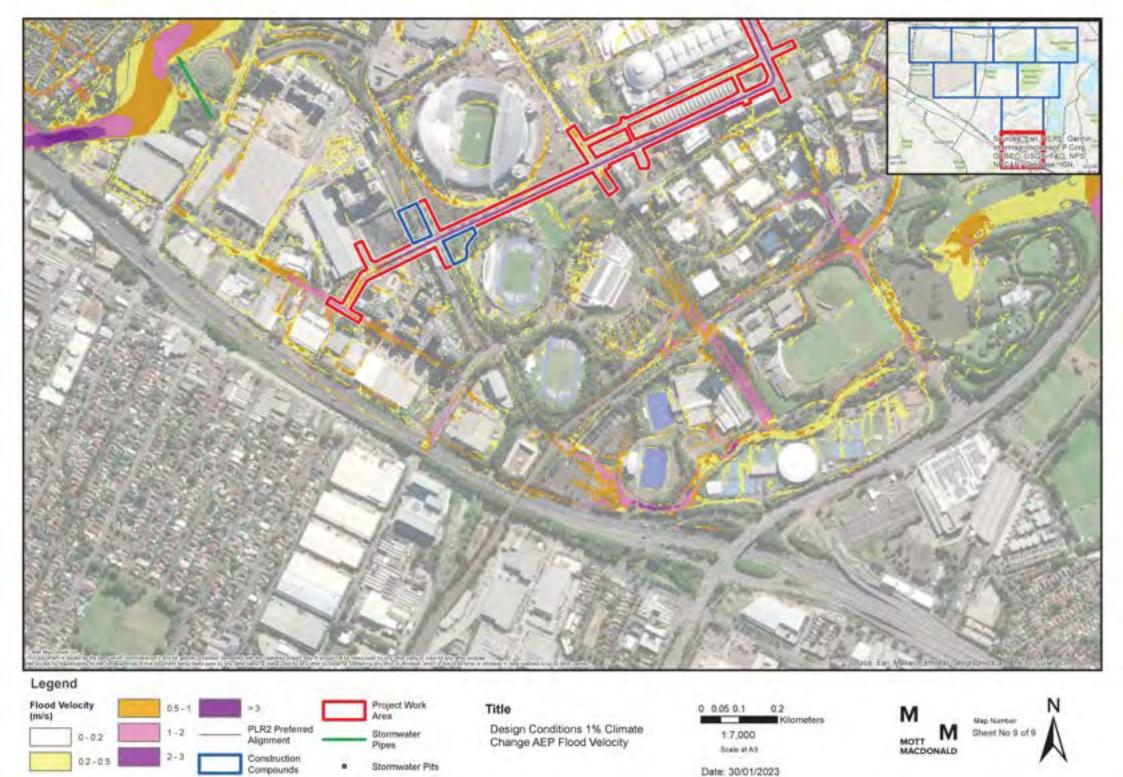
Design Conditions 1% Climate Change AEP Flood Velocity



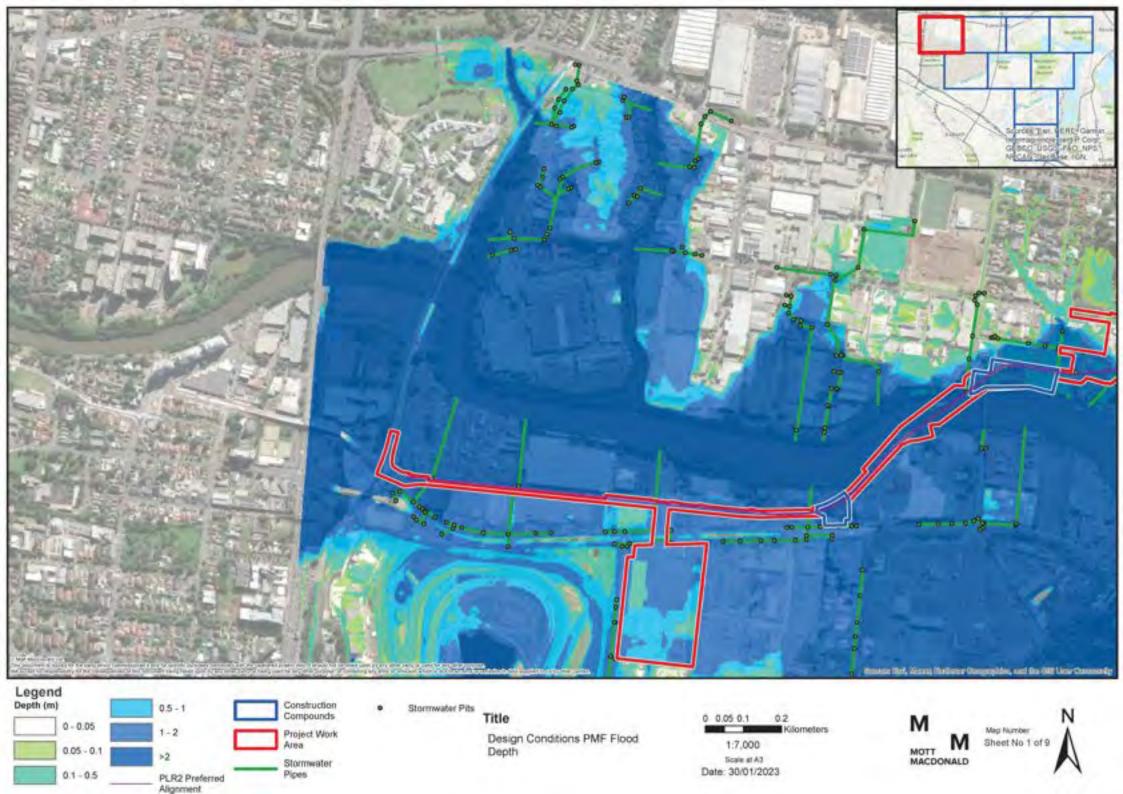
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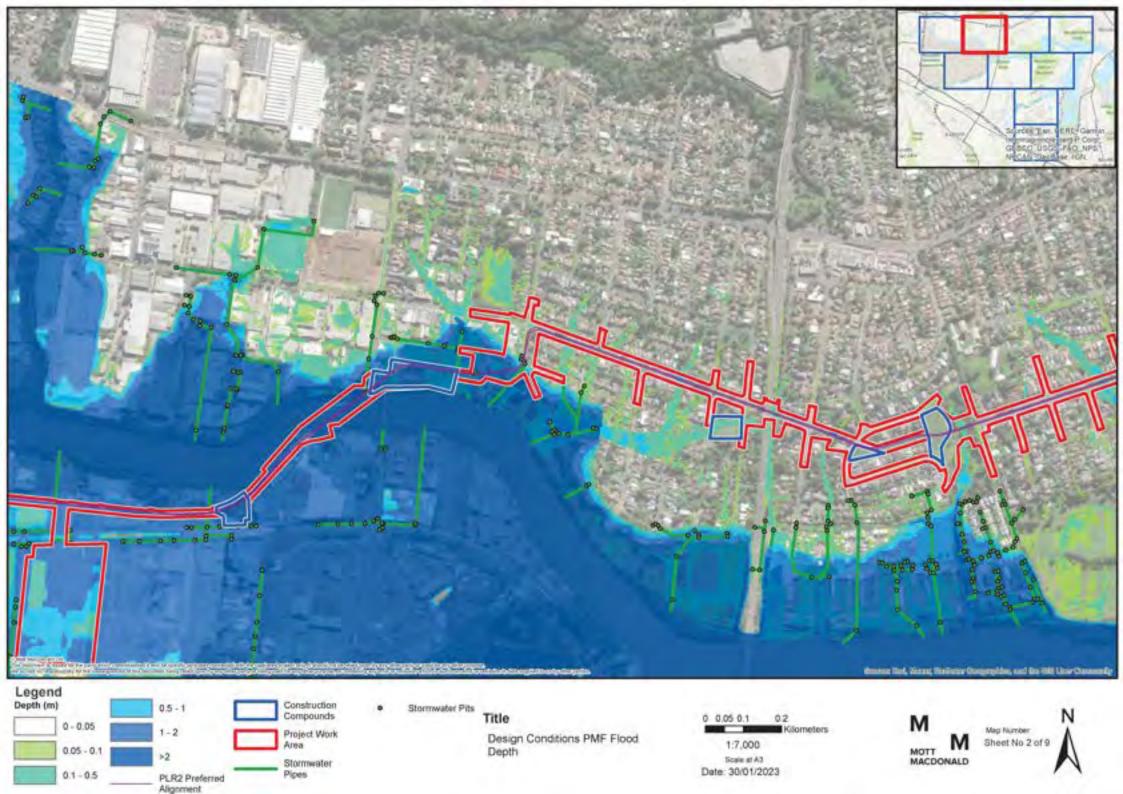
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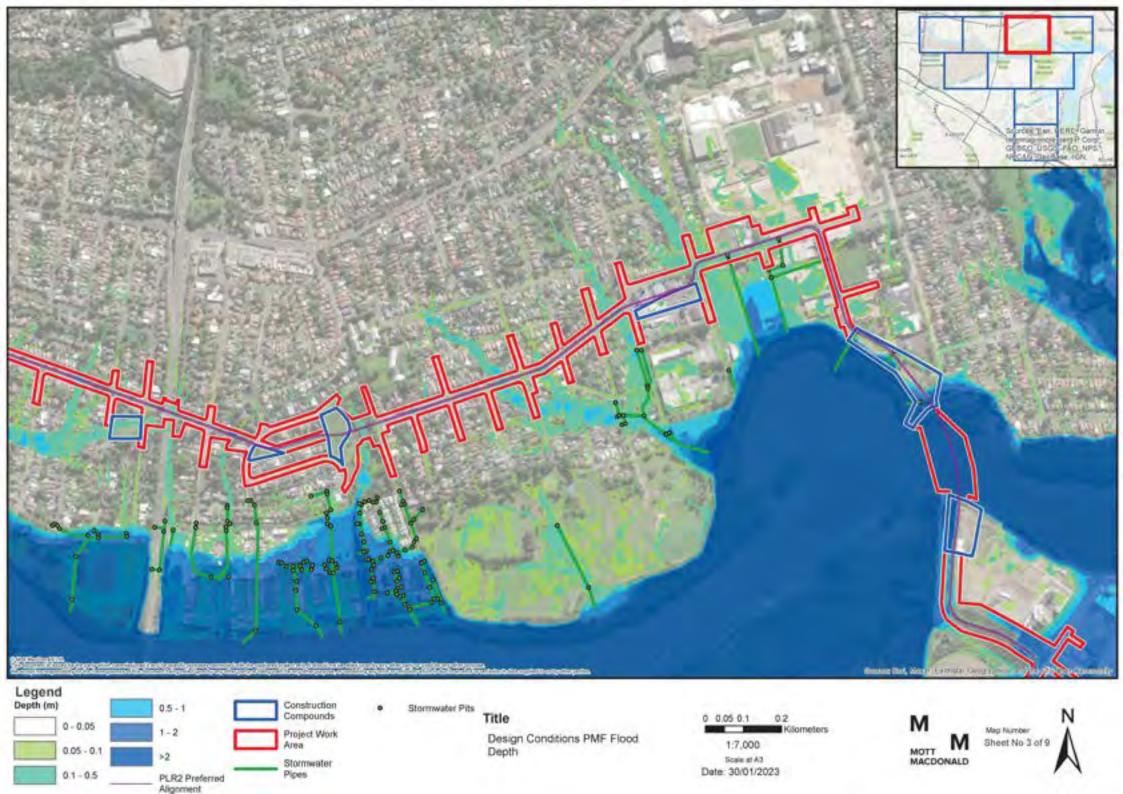


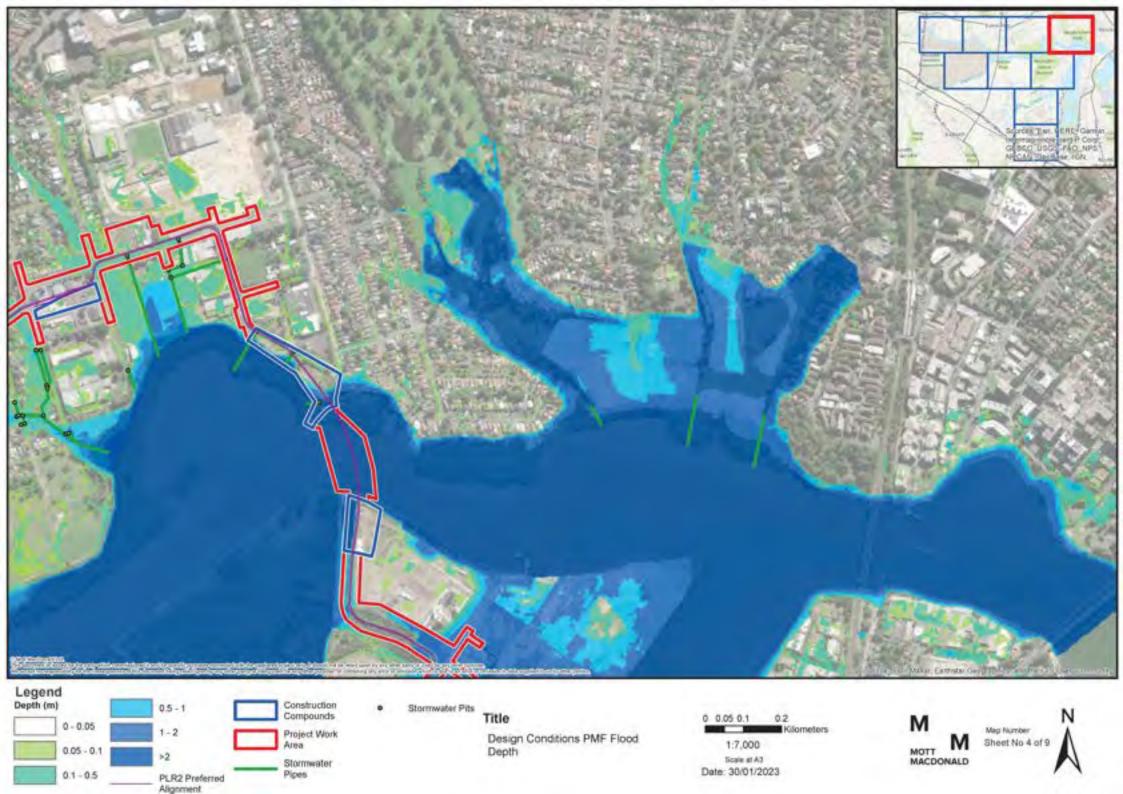


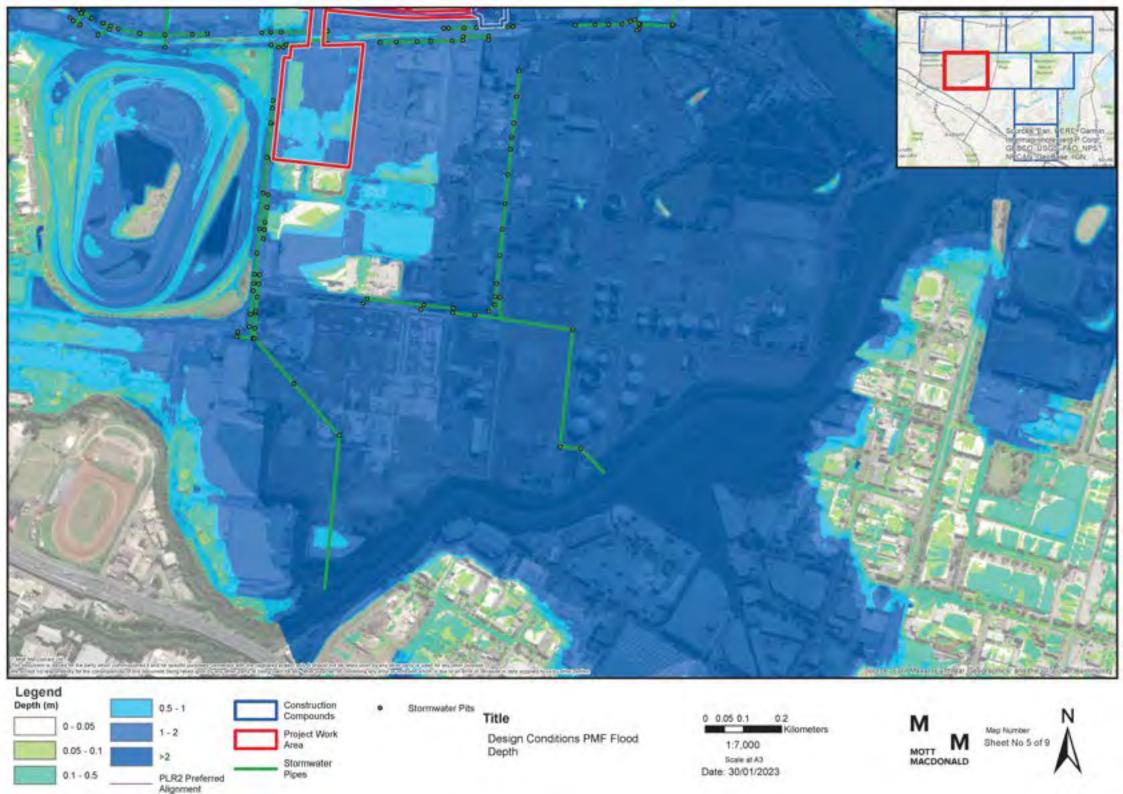
Appendix A3 – Flood model figures – PMF

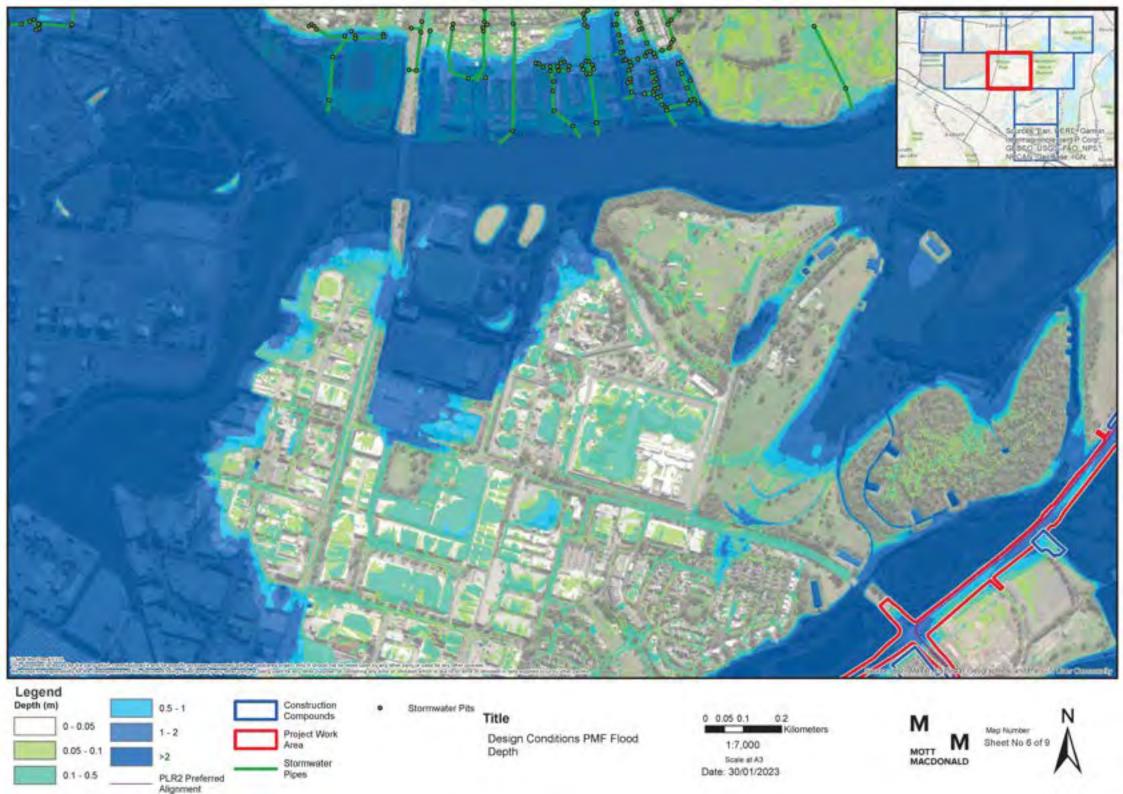


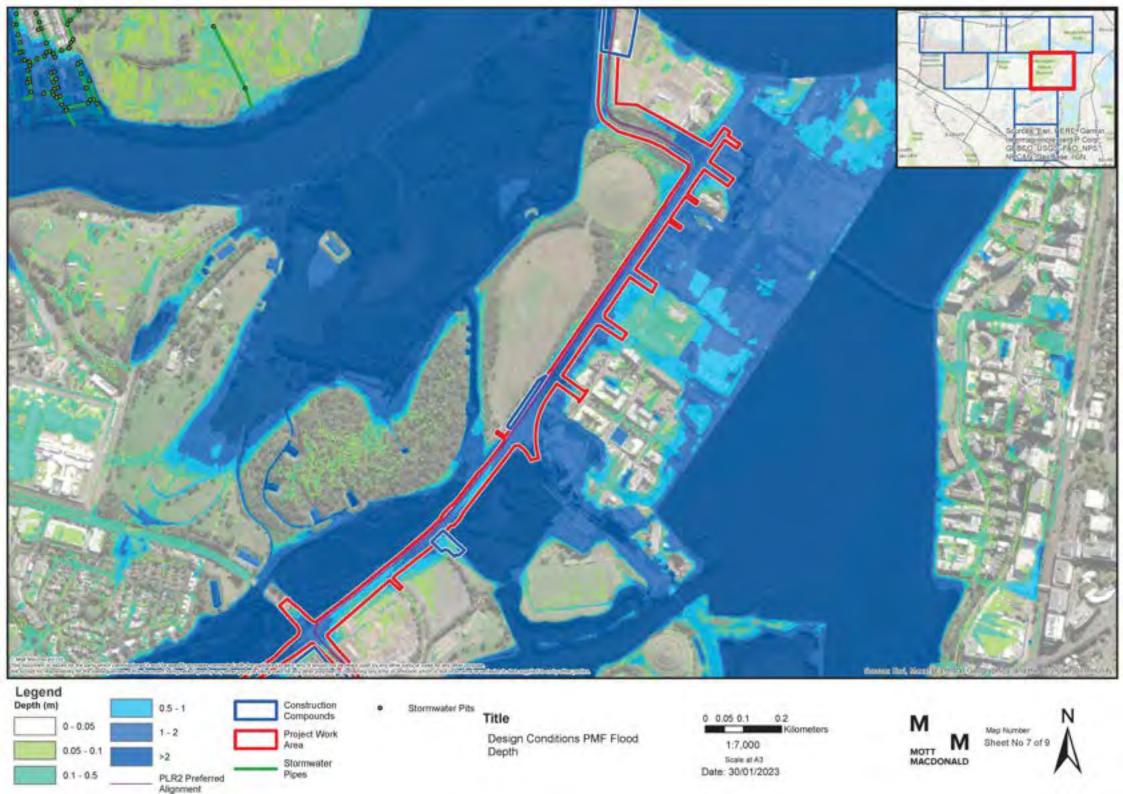


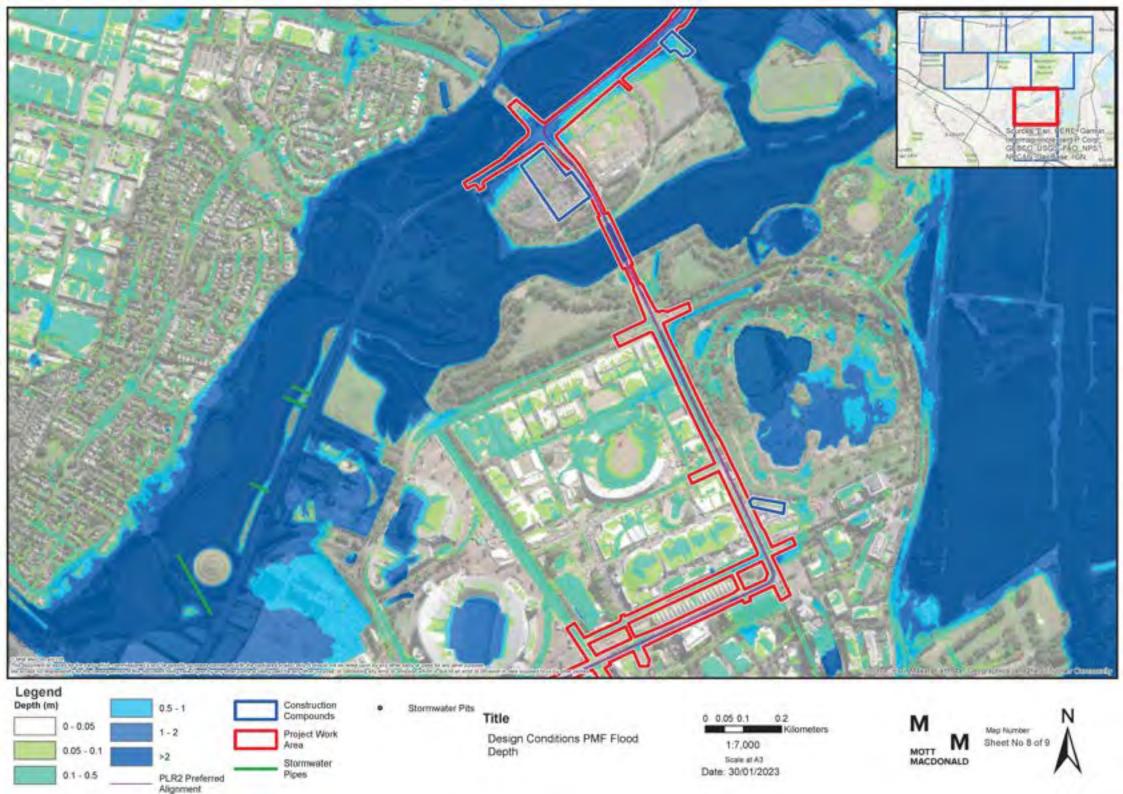


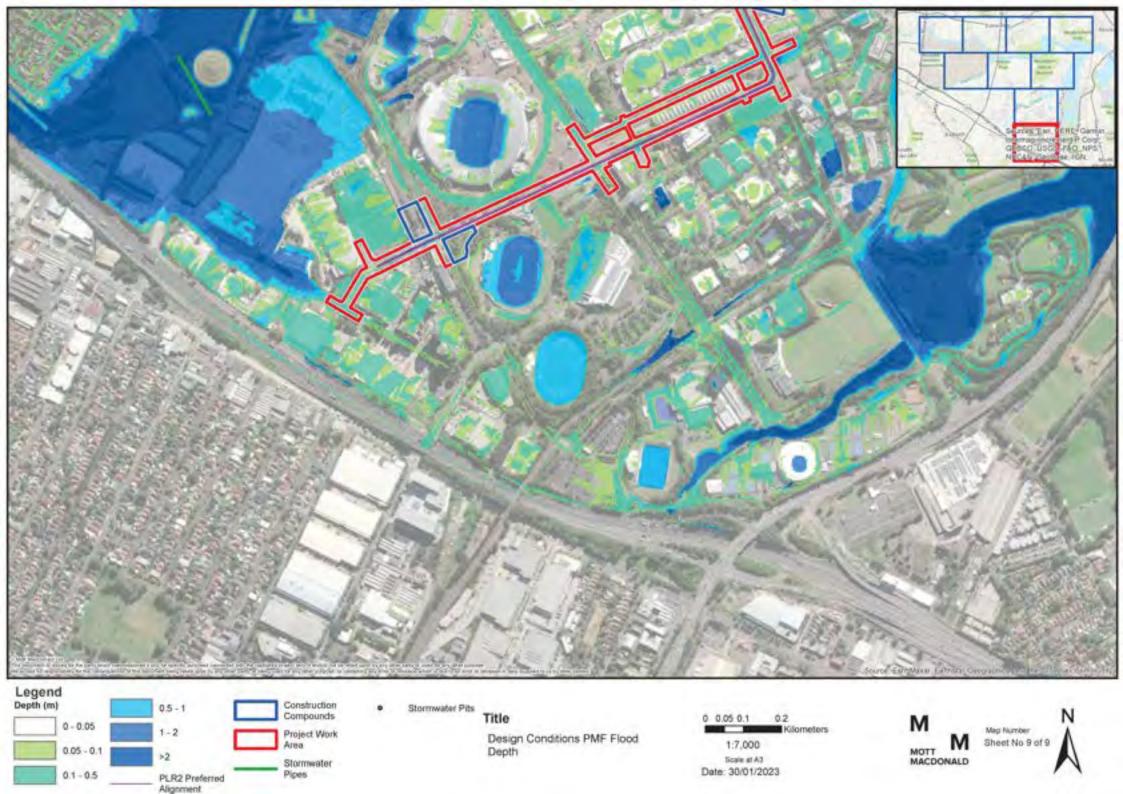


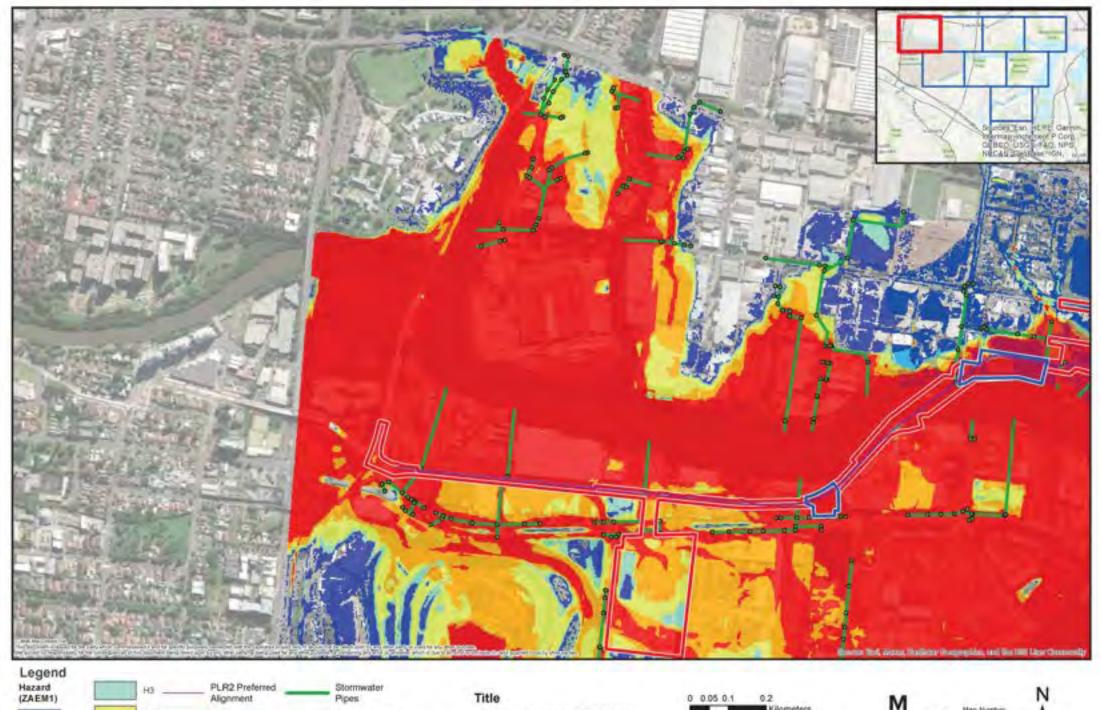














Stormwater Pits

Design Conditions PMF Flood Hazard

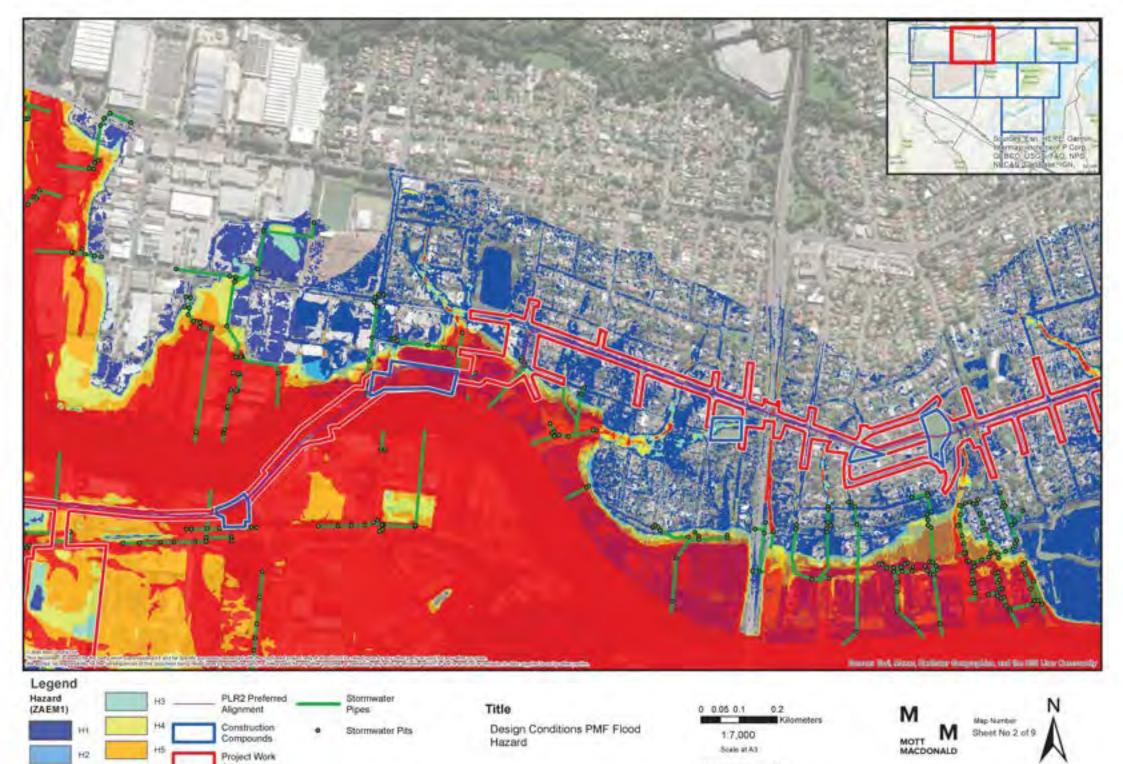
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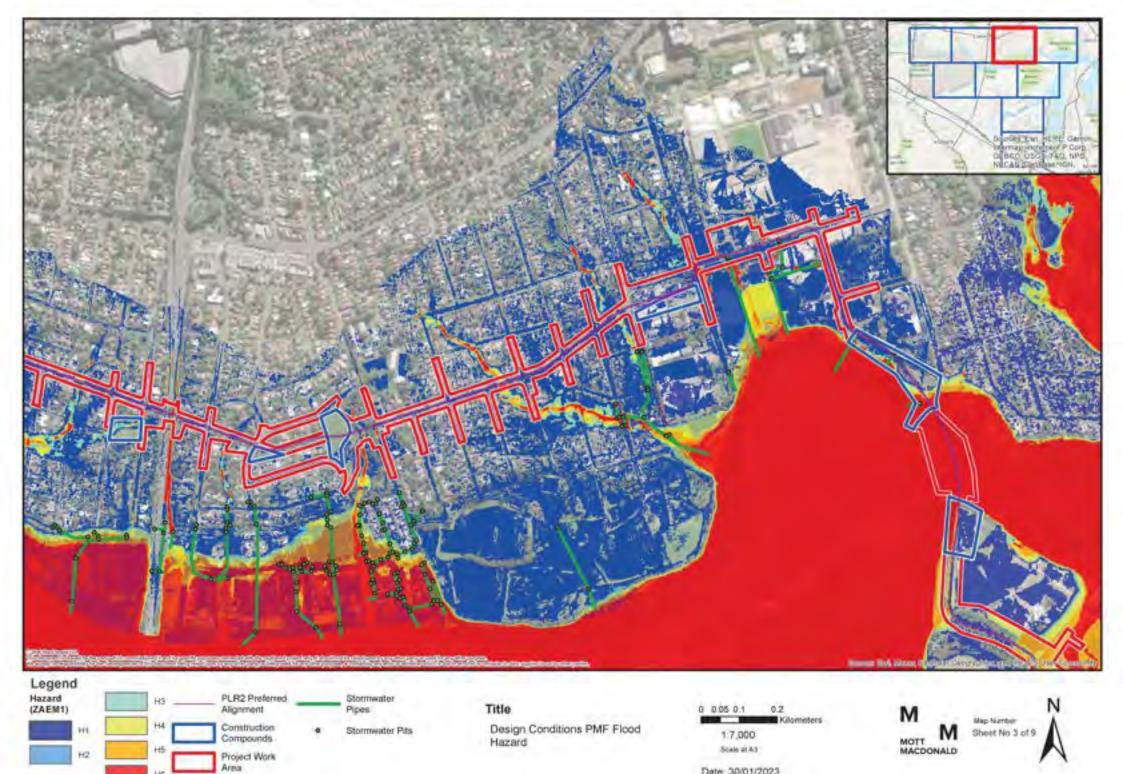
Date: 30/01/2023

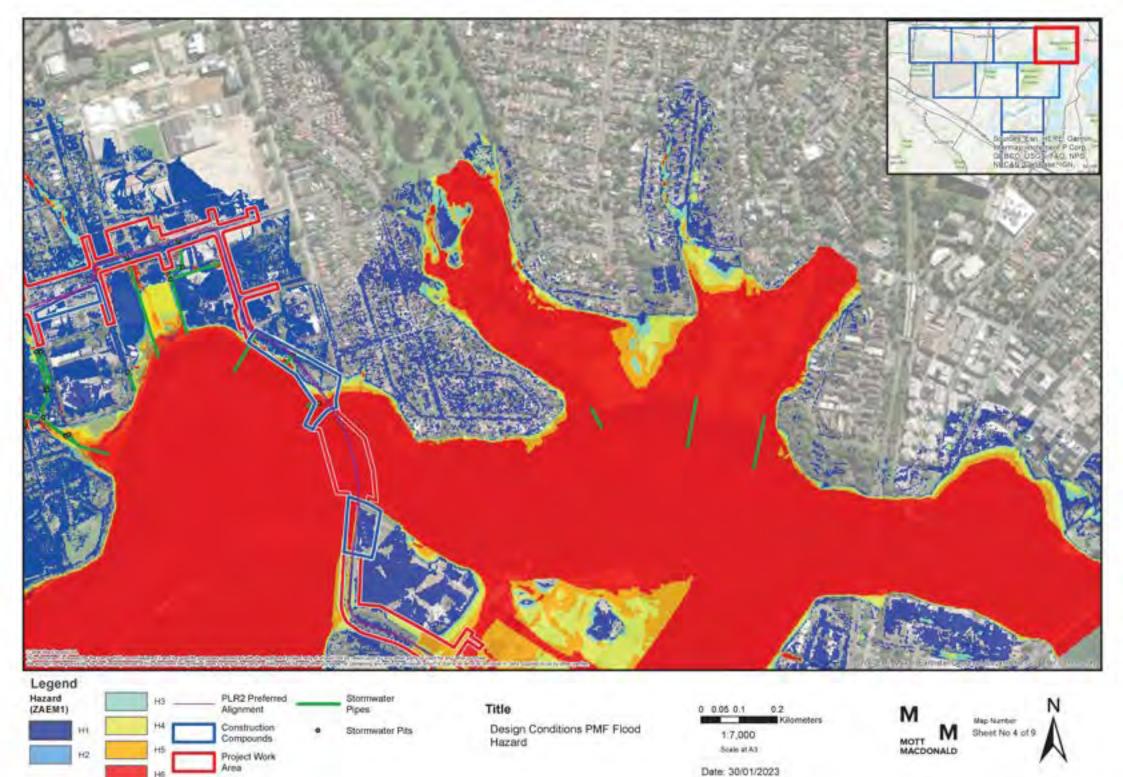
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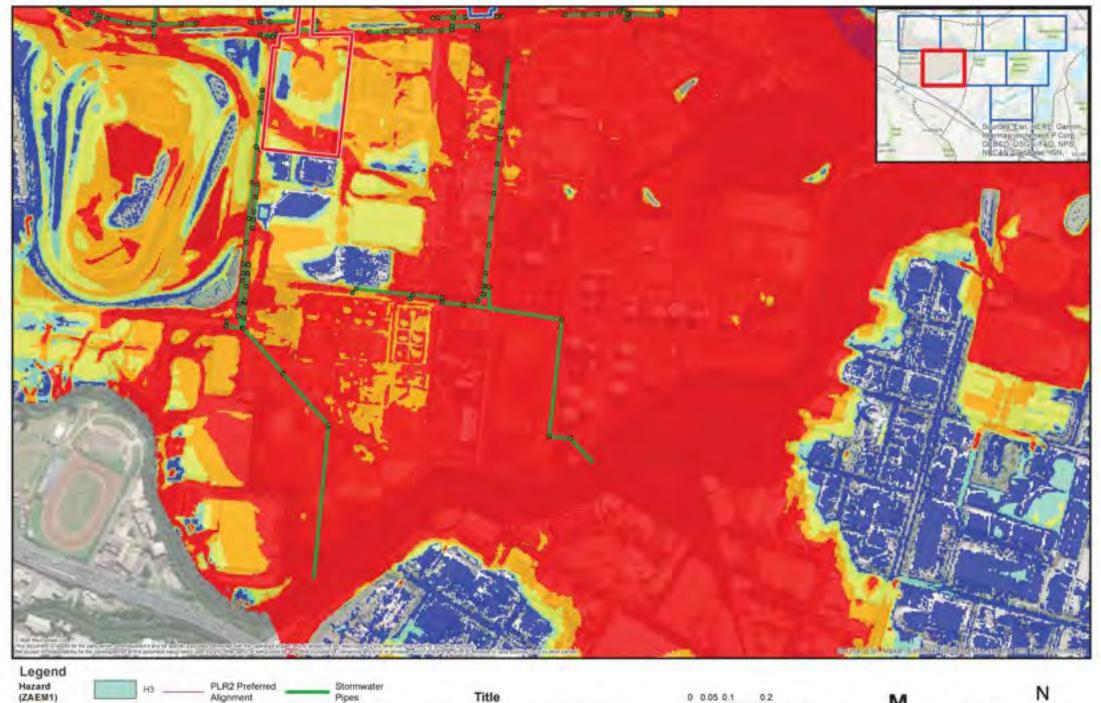
Map Number Sheet No 1 of 9

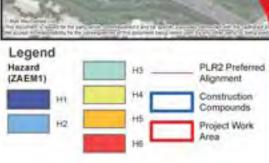












Stormwater Pipes Stormwater Pits

Design Conditions PMF Flood Hazard

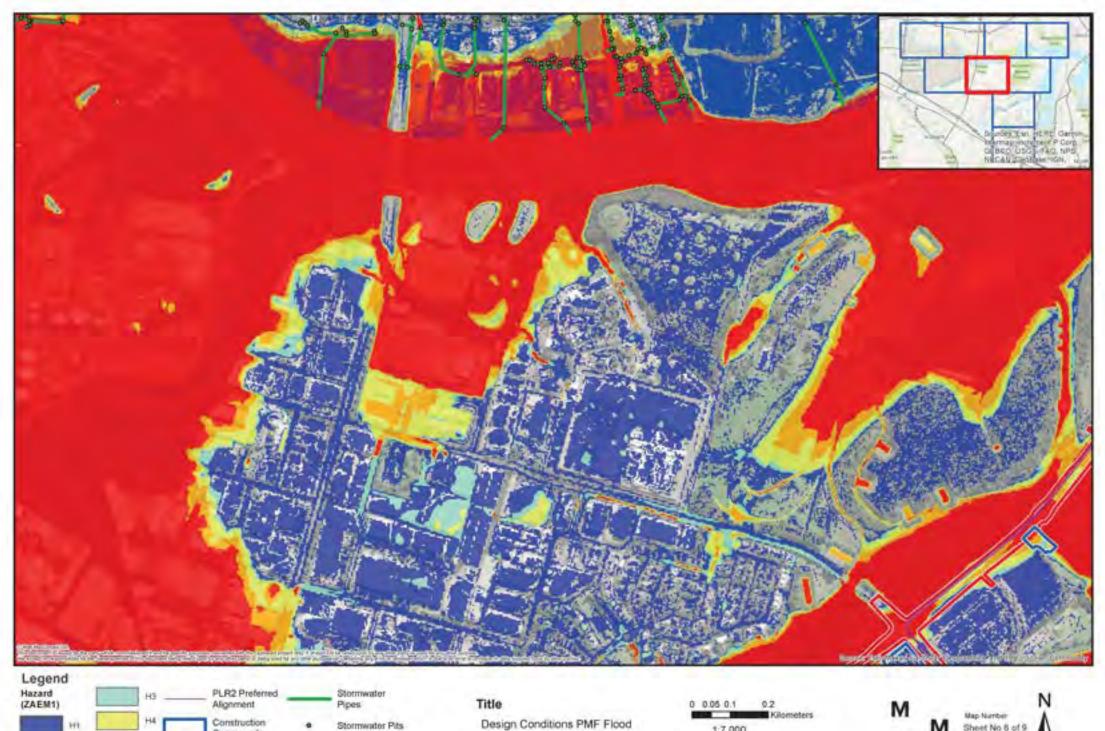
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Date: 30/01/2023

MOTT IVI

Map Number Sheet No 5 of 9







Design Conditions PMF Flood Hazard



Date: 30/01/2023

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Map Number Sheet No 6 of 9



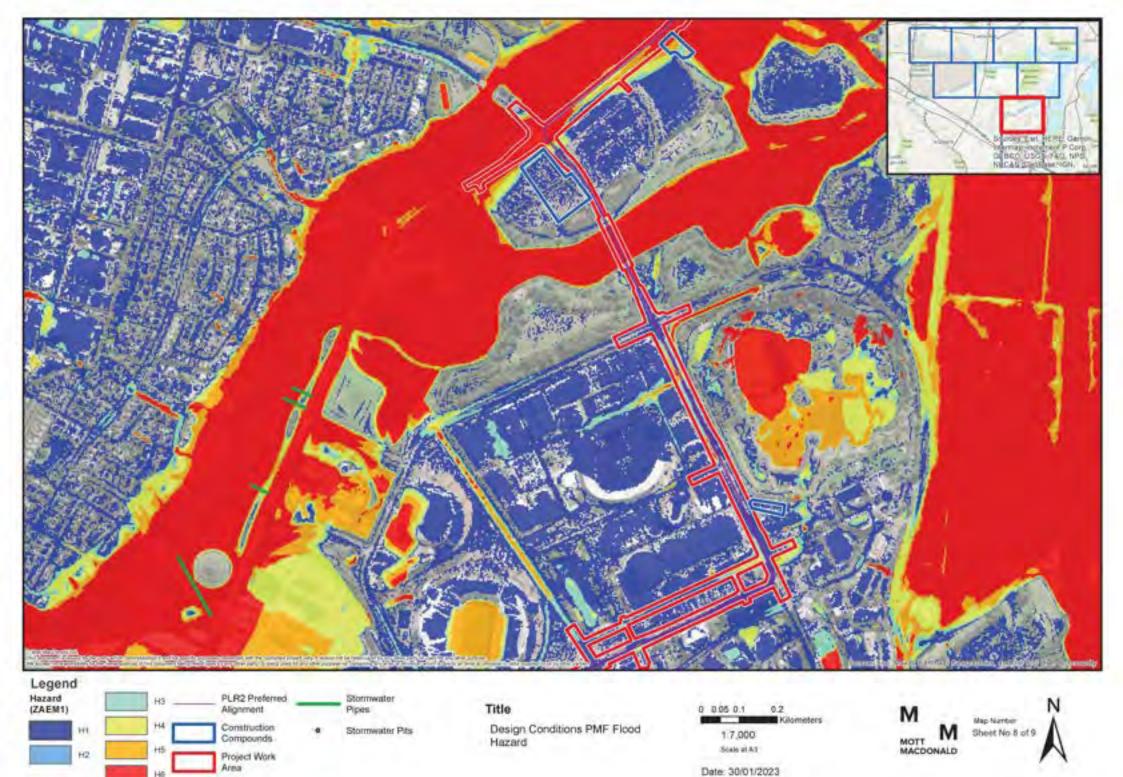


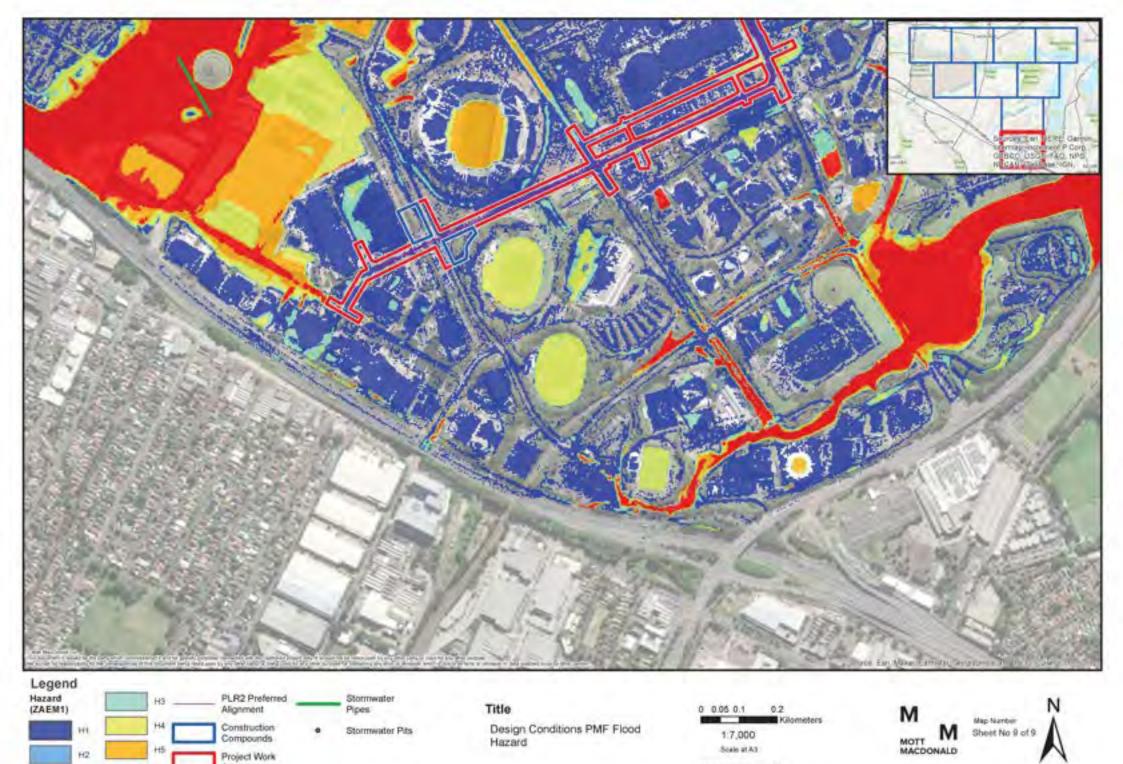
Design Conditions PMF Flood Hazard

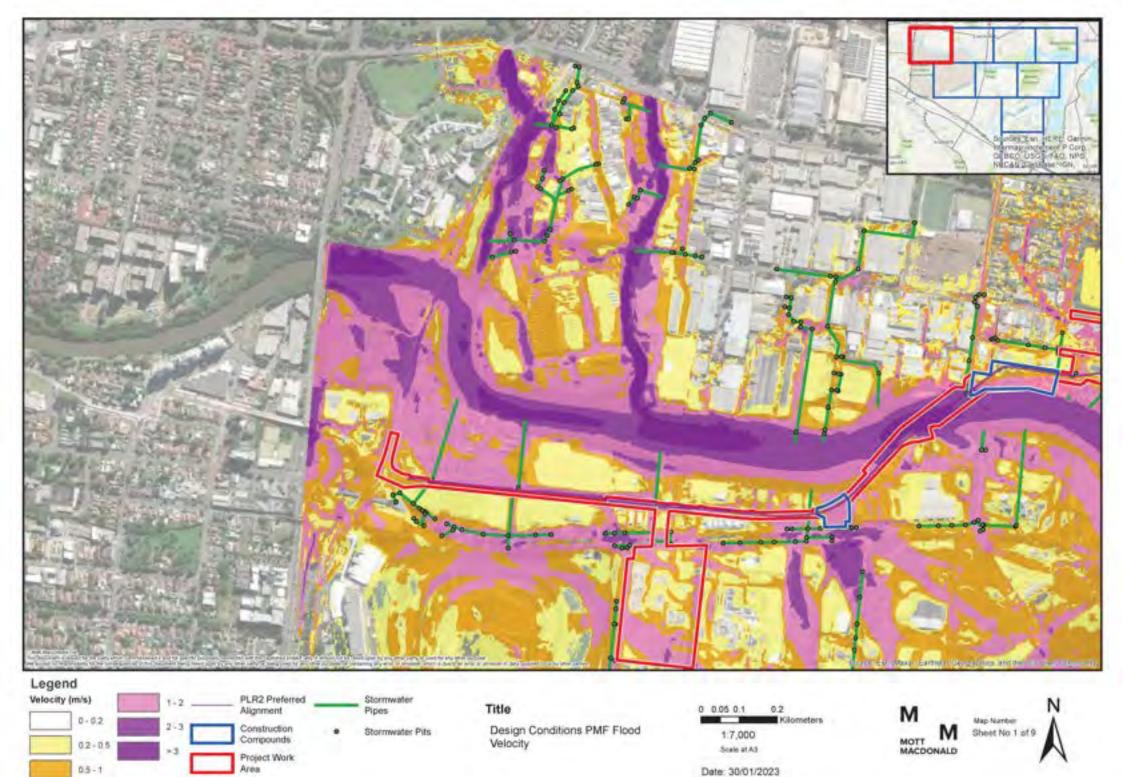


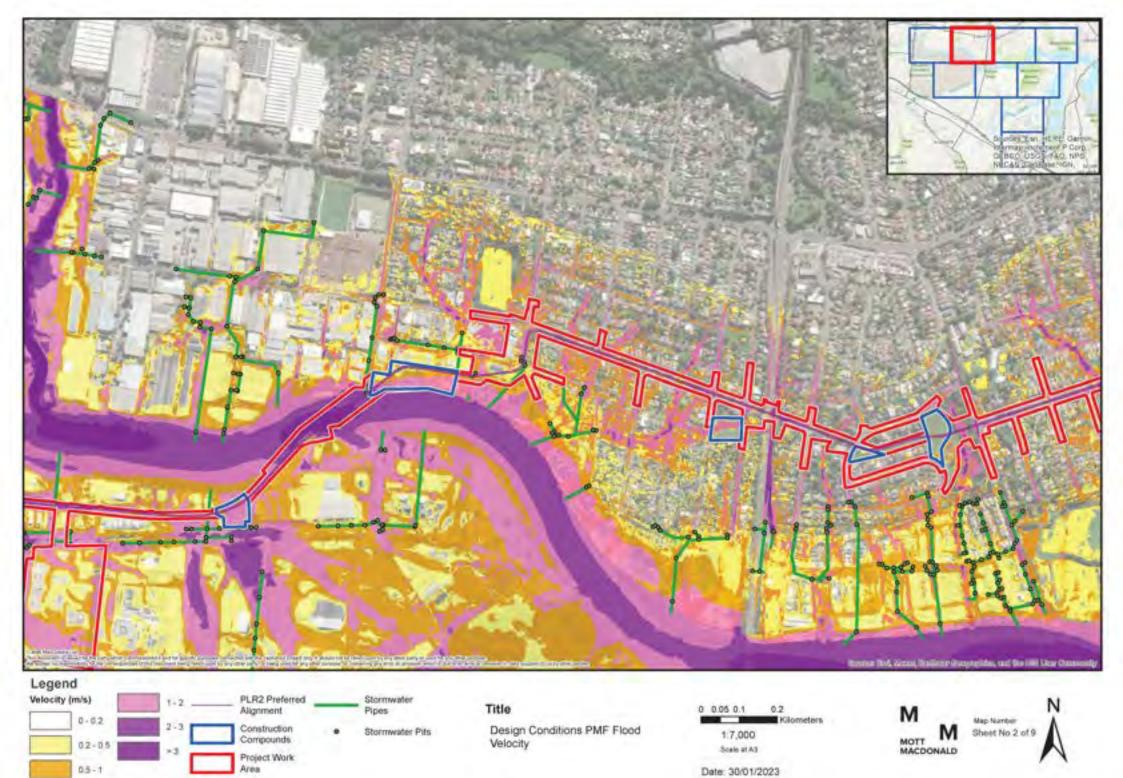
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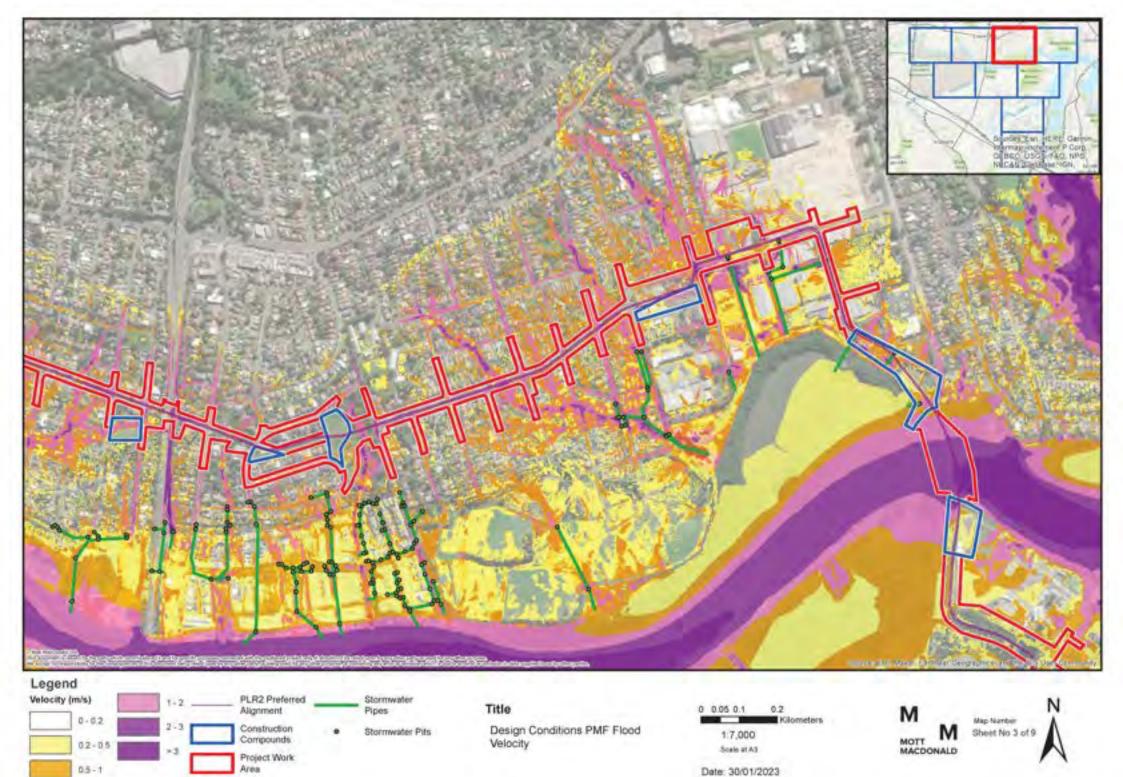


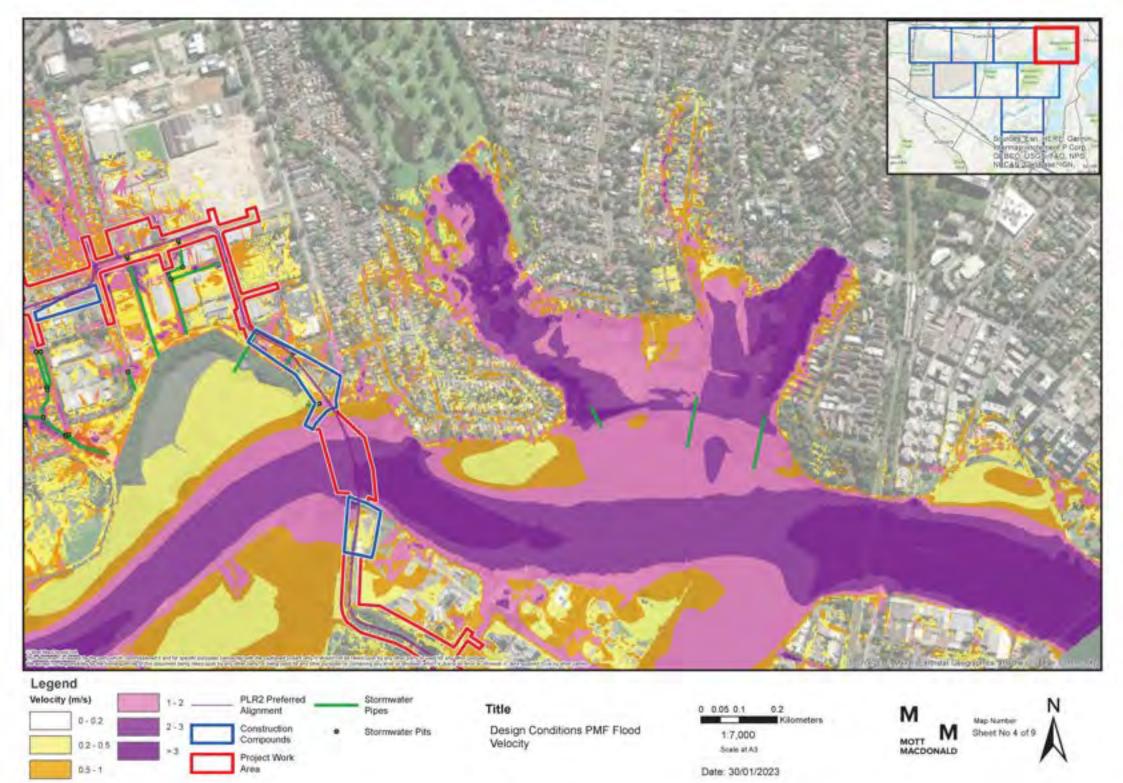


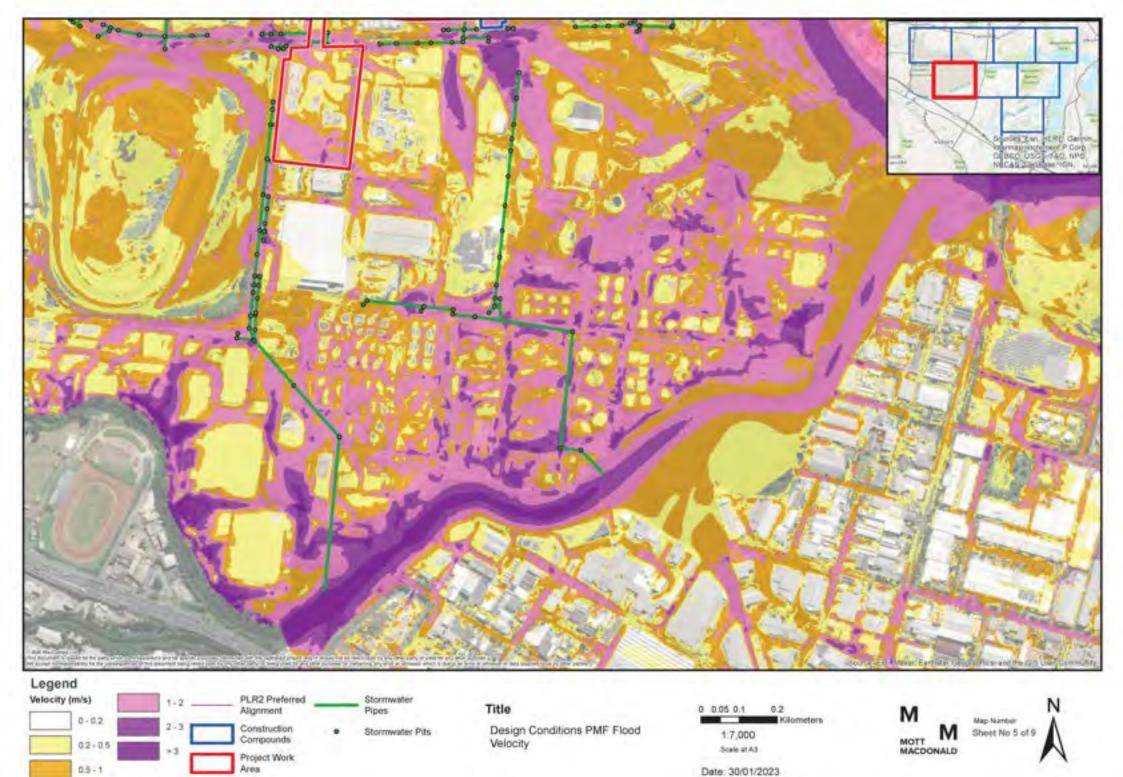
















Stormwater Pits

Design Conditions PMF Flood Velocity

1:7,000 Scale at A3 Date: 30/01/2023

MOTT M

Sheet No 6 of 9

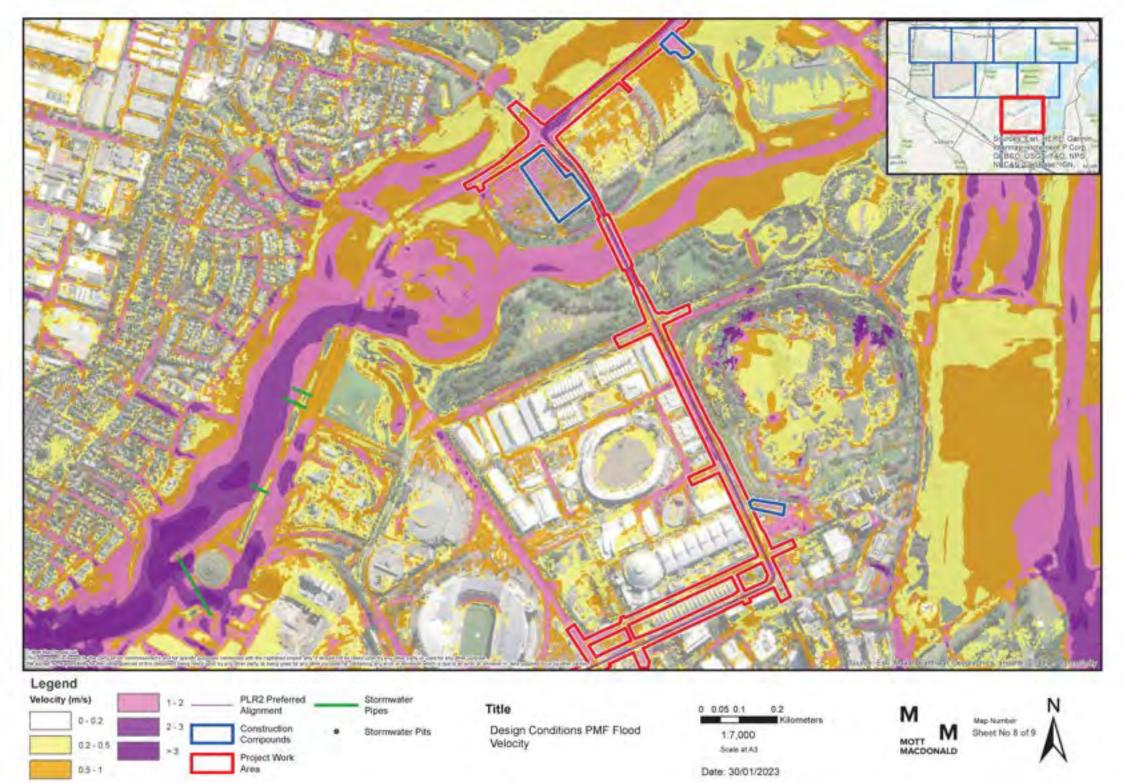


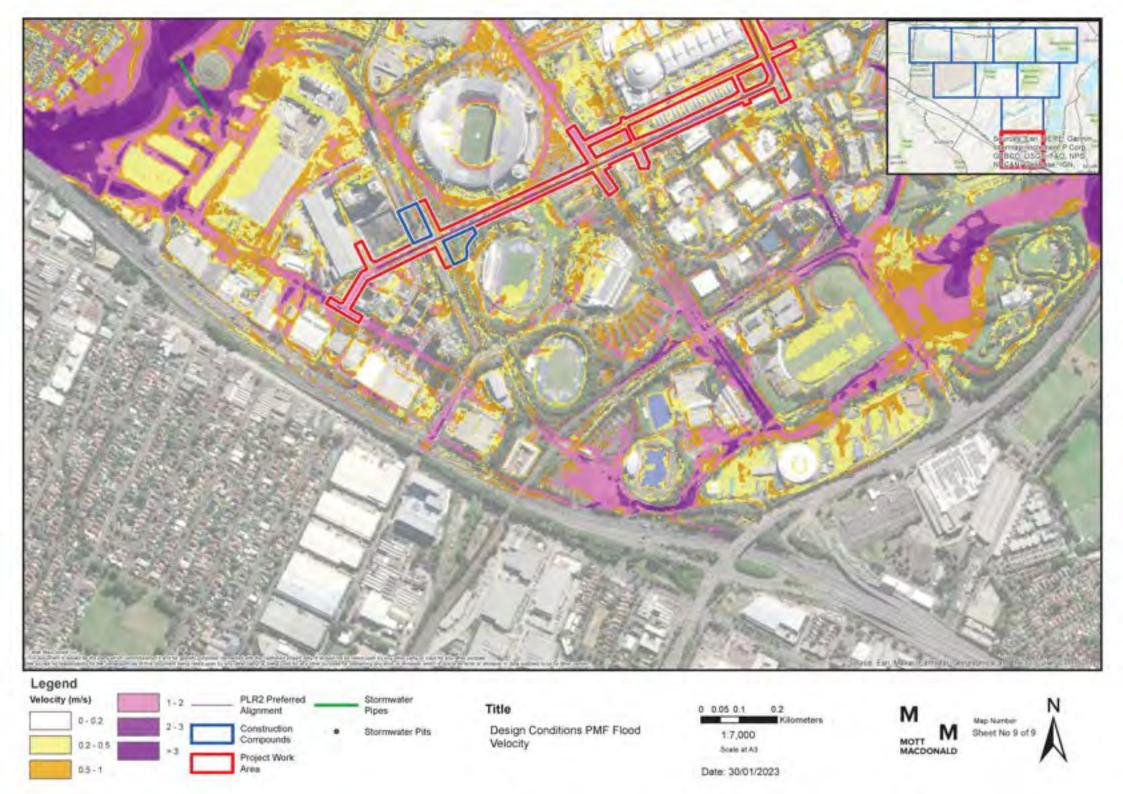




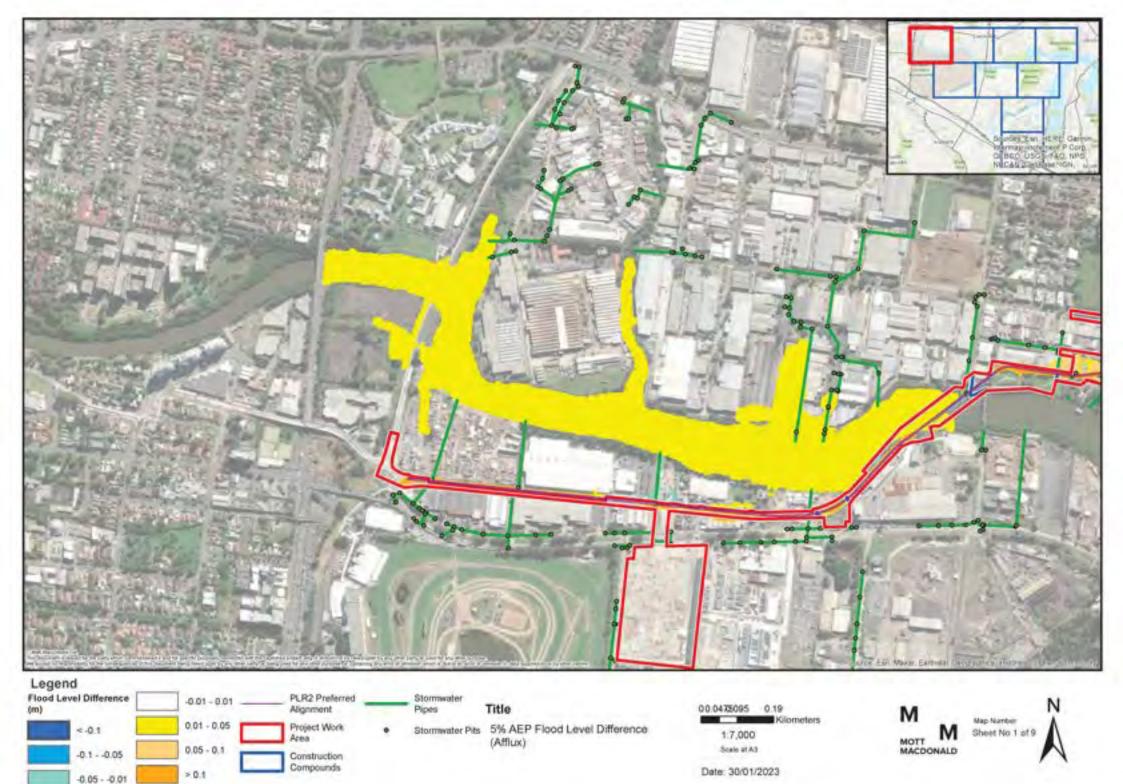
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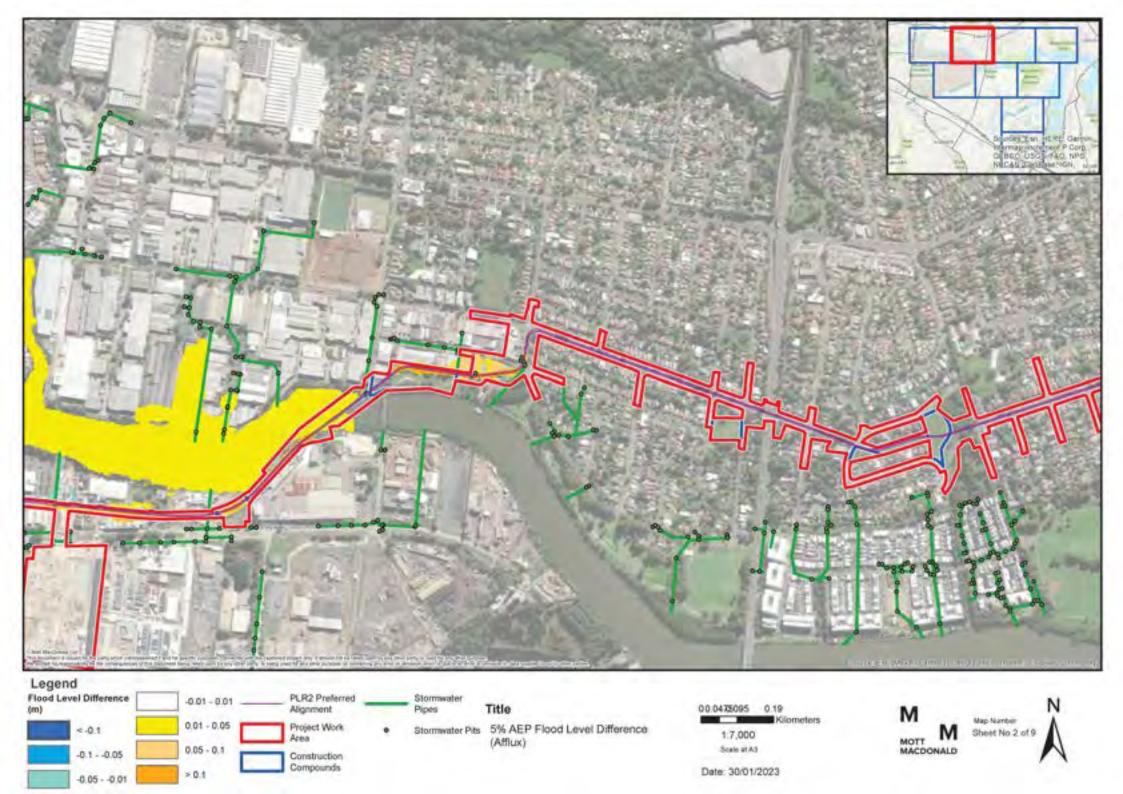
Sheet No 7 of 9

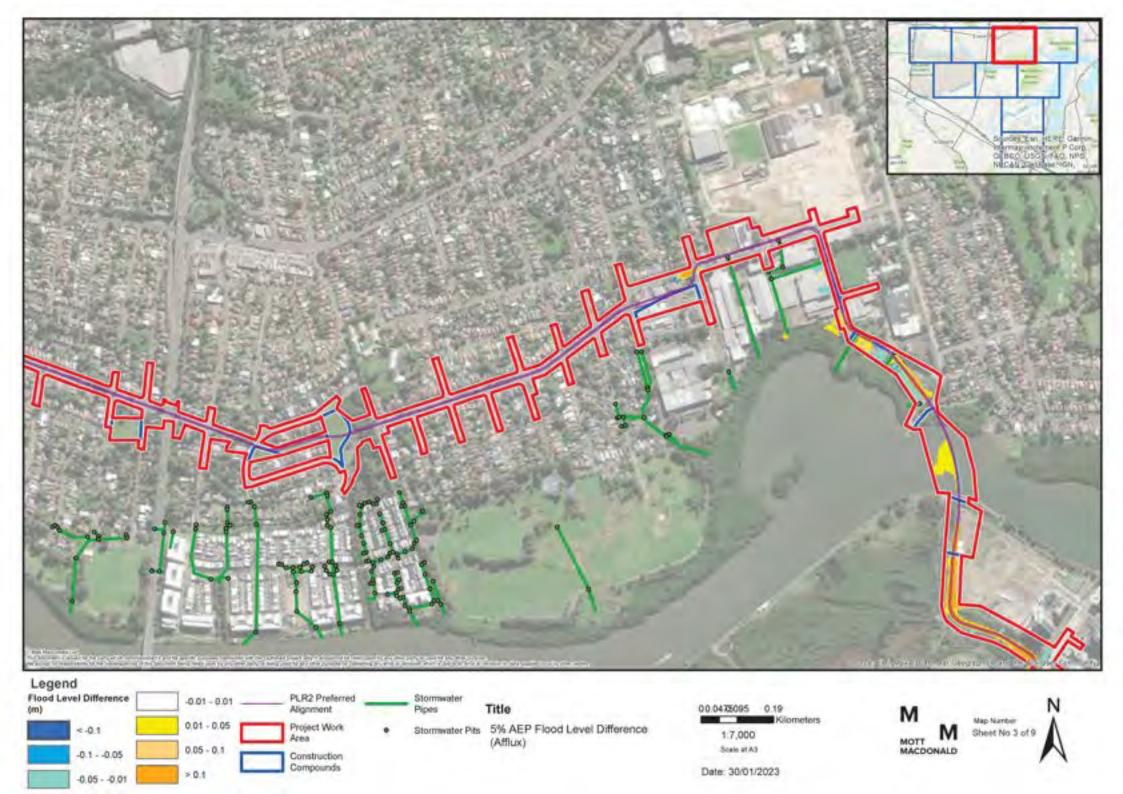


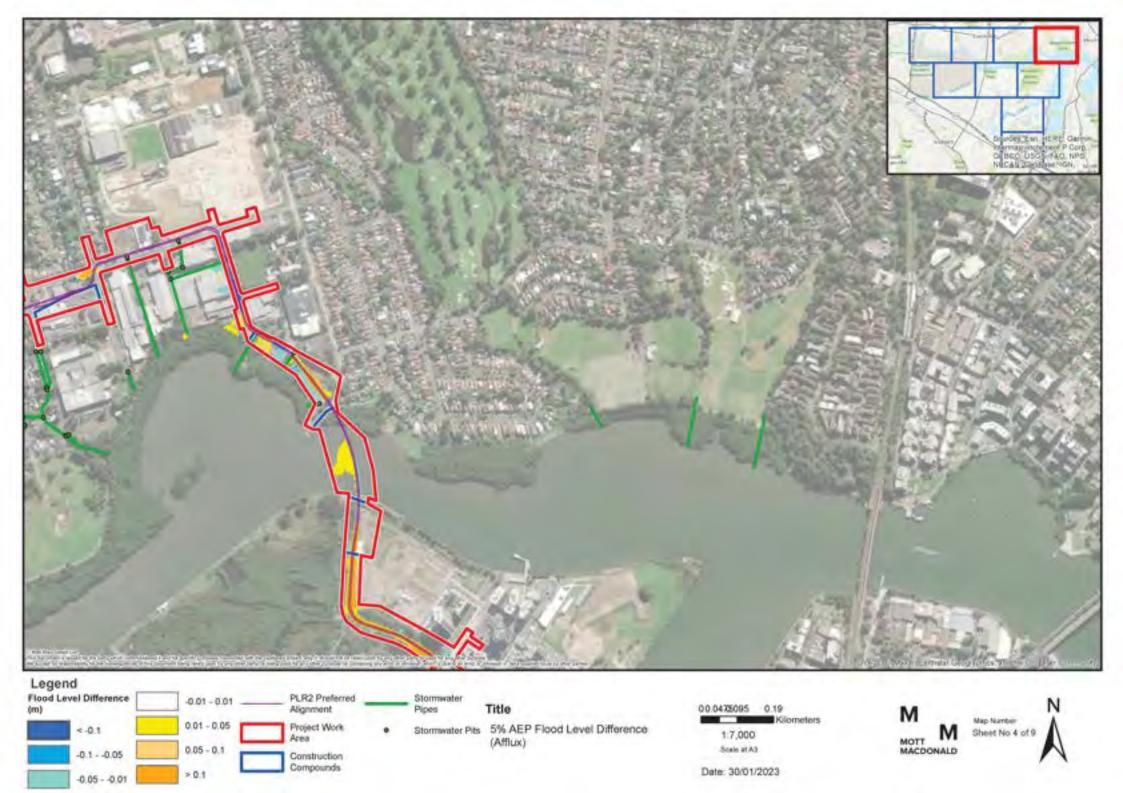


Appendix A4 – Flood model figures – Flood level difference









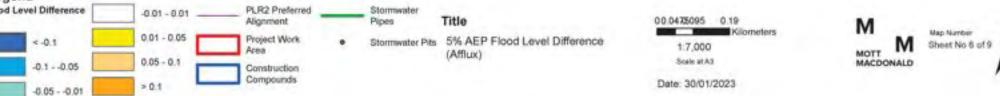


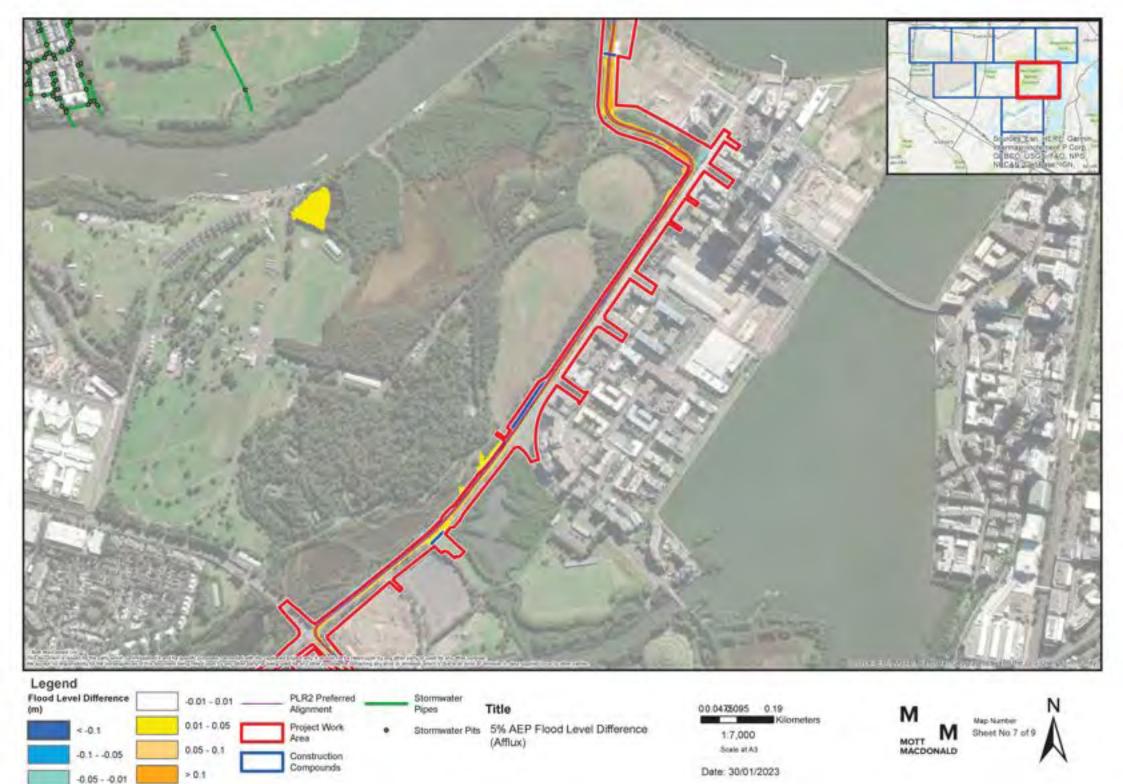


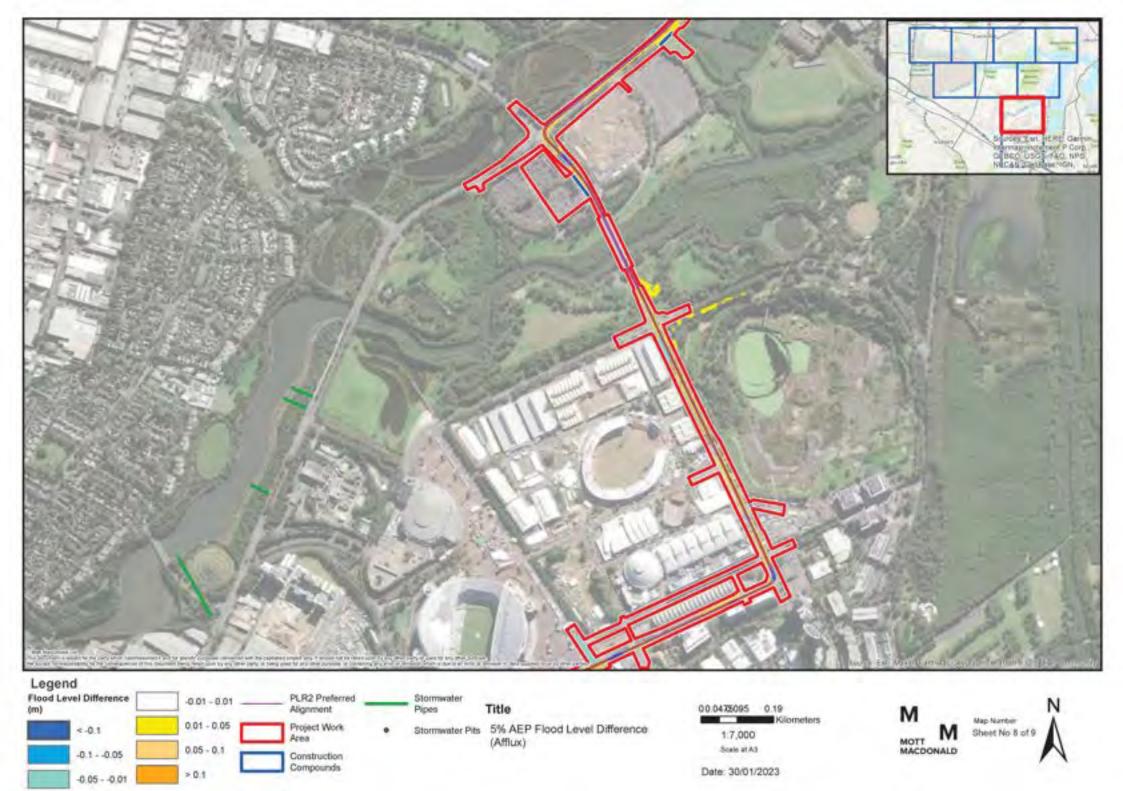
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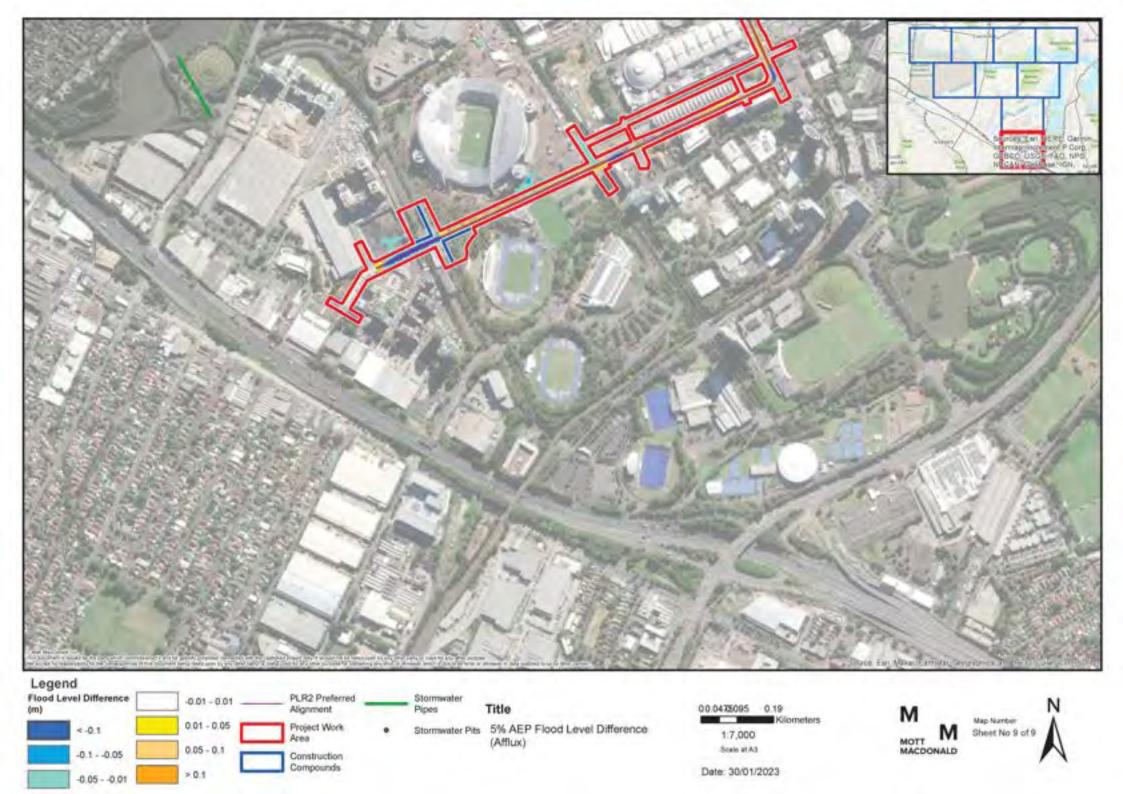
Map Number Sheet No 5 of 9

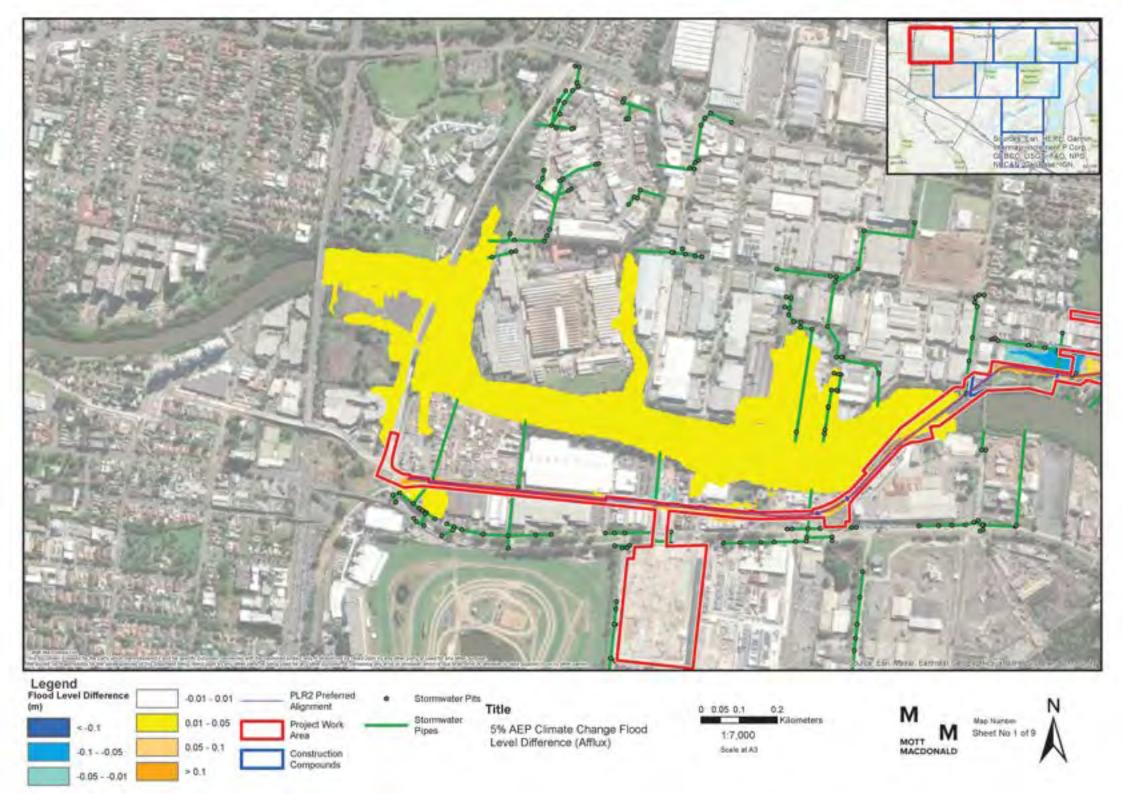


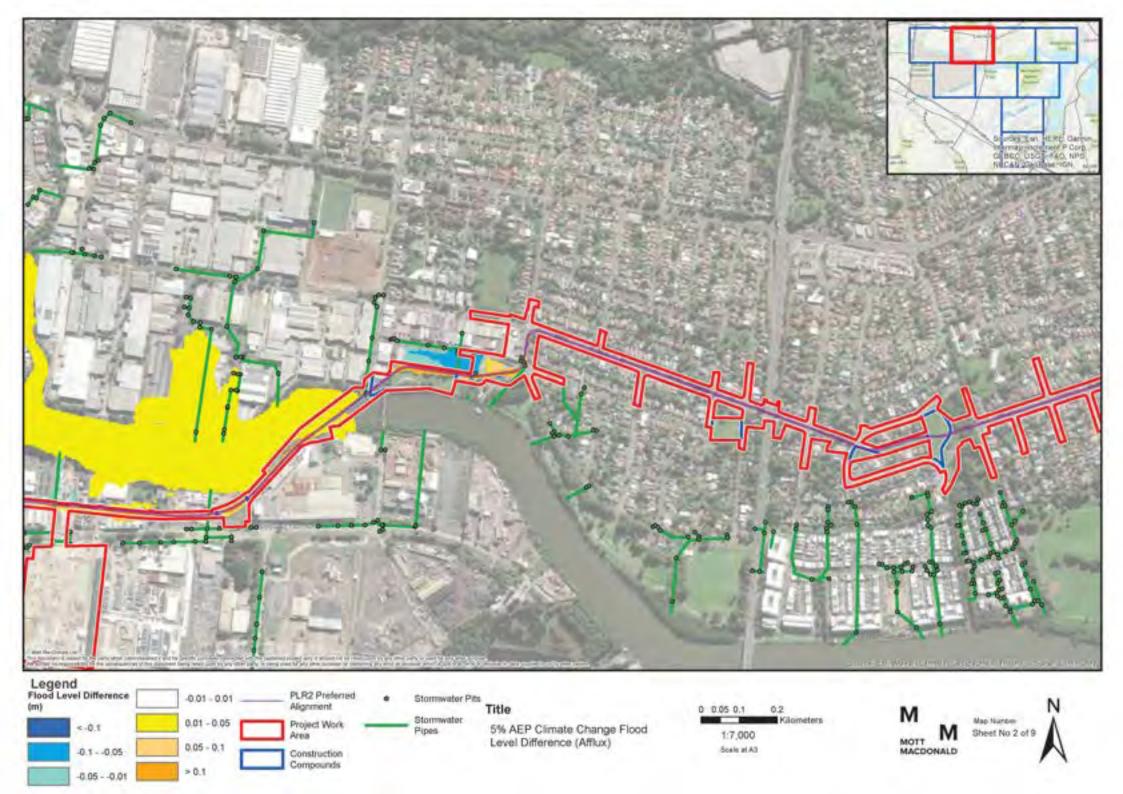


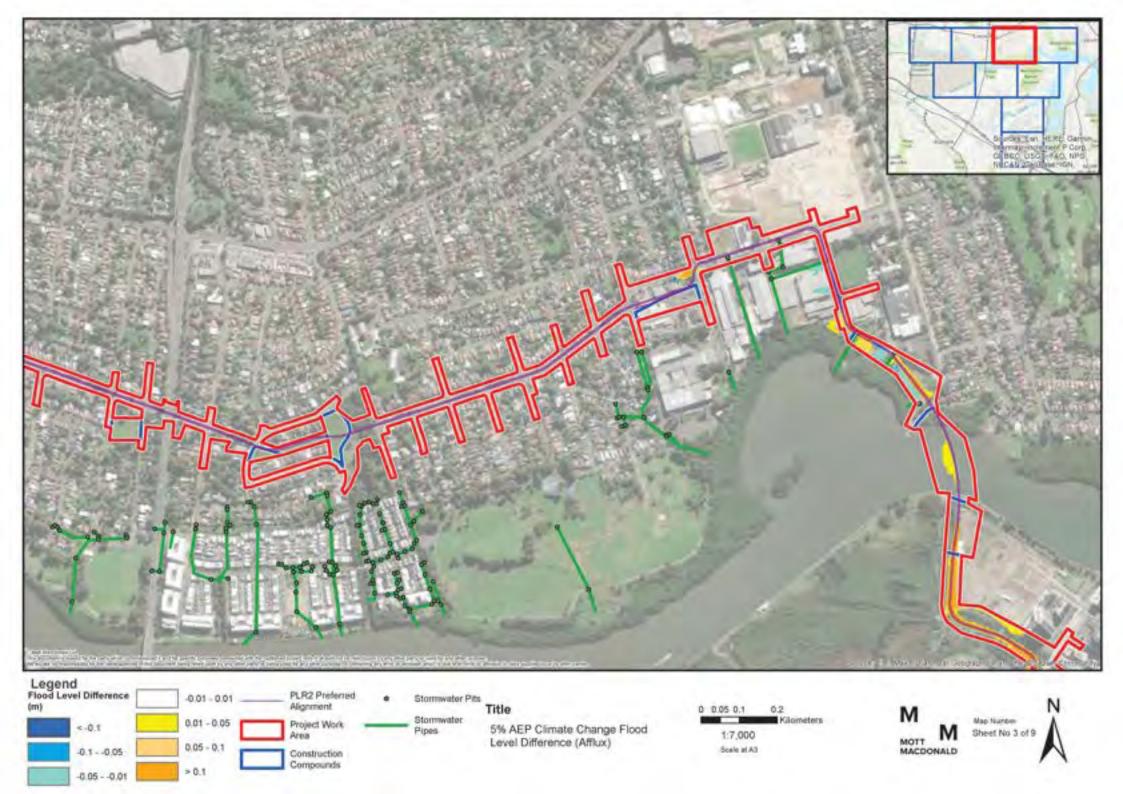


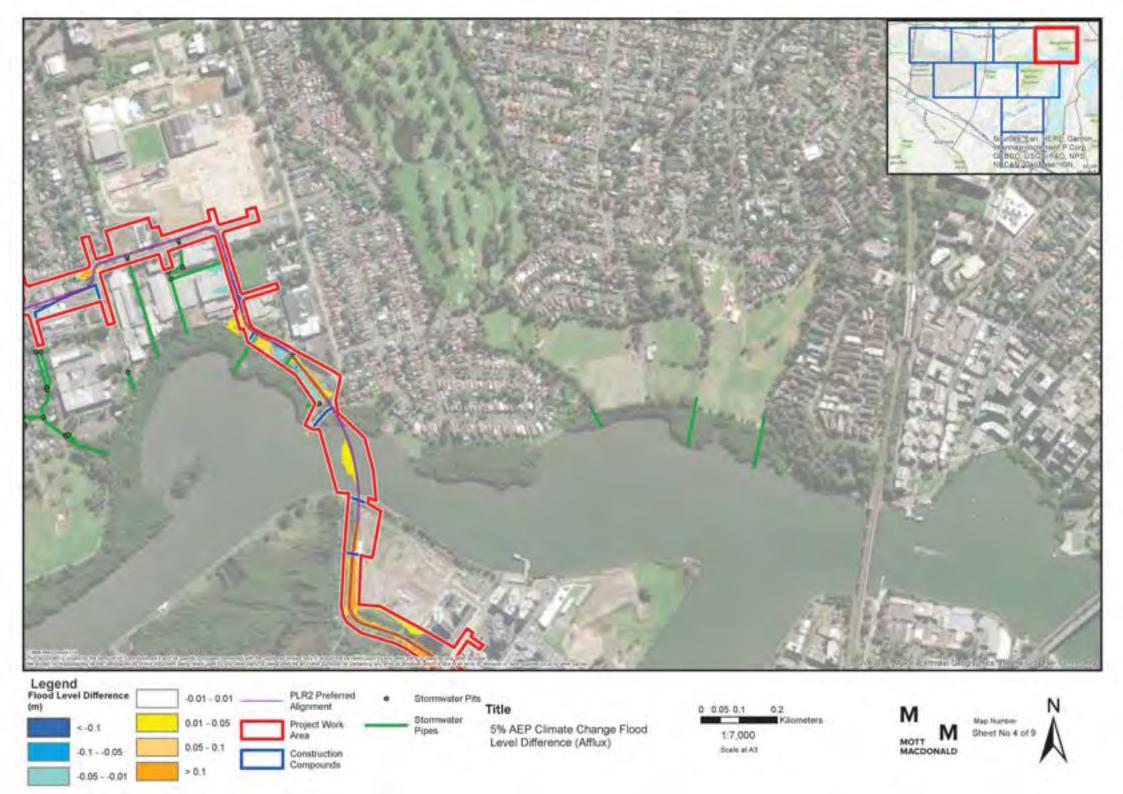


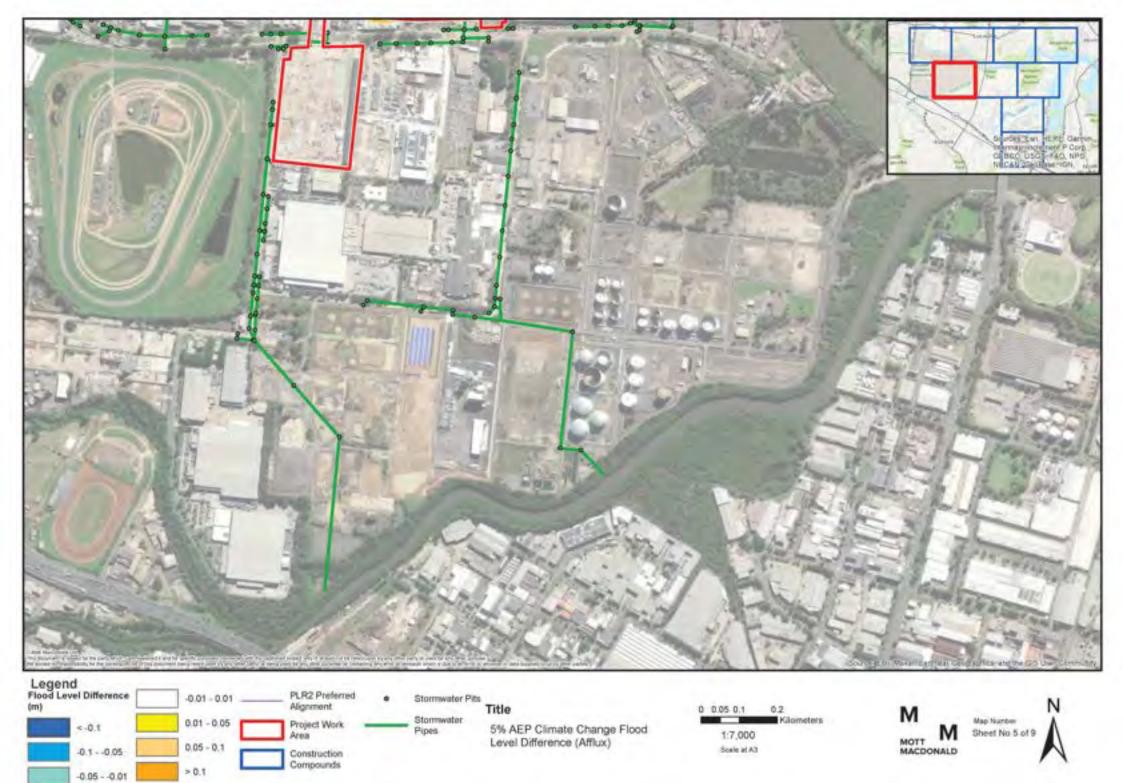




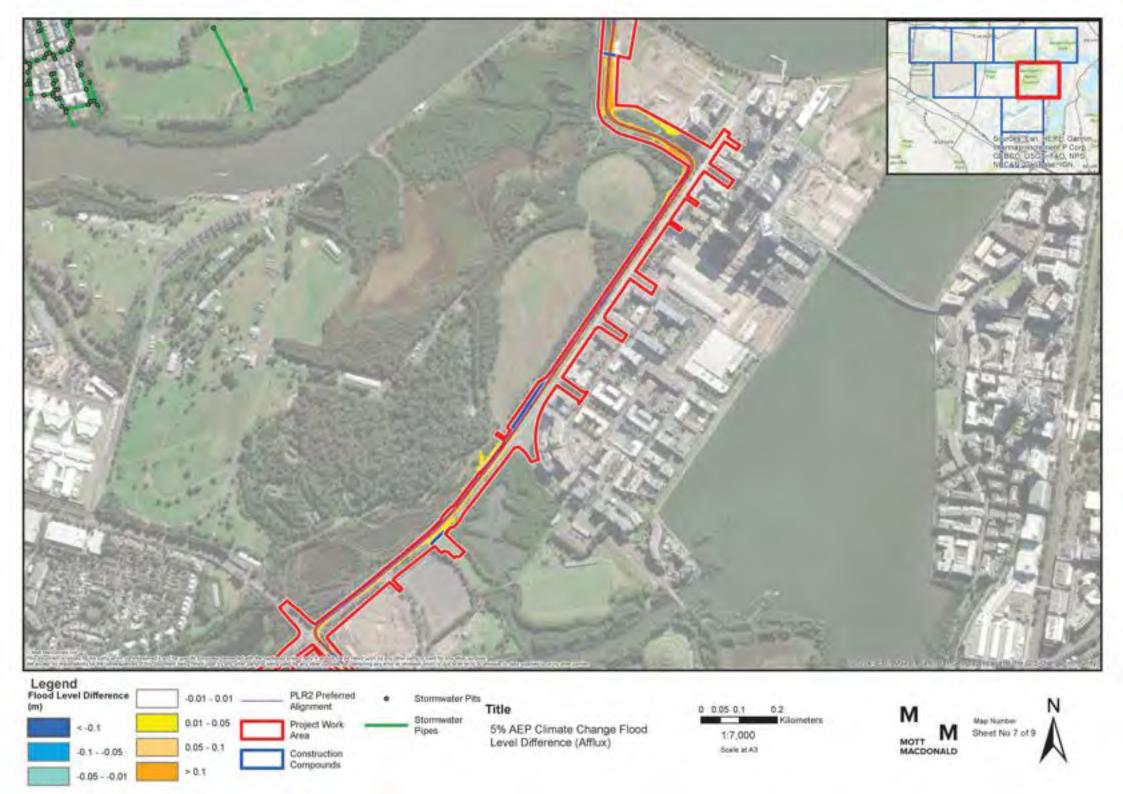


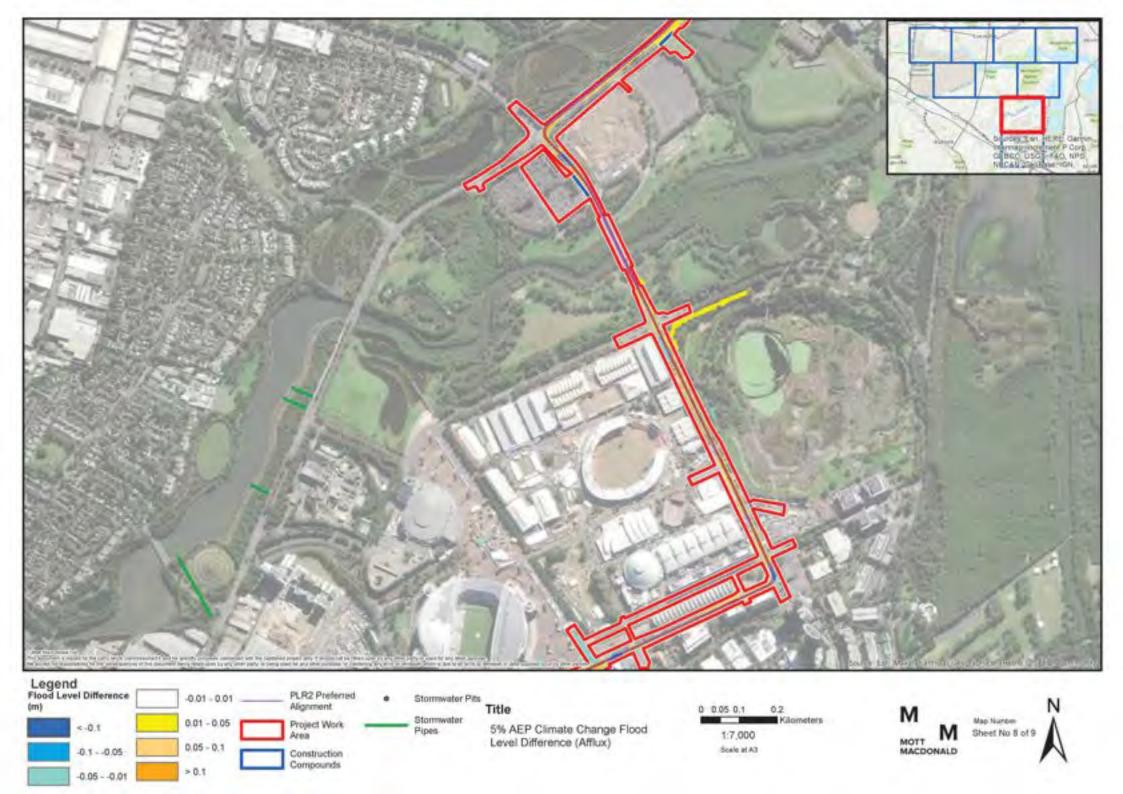


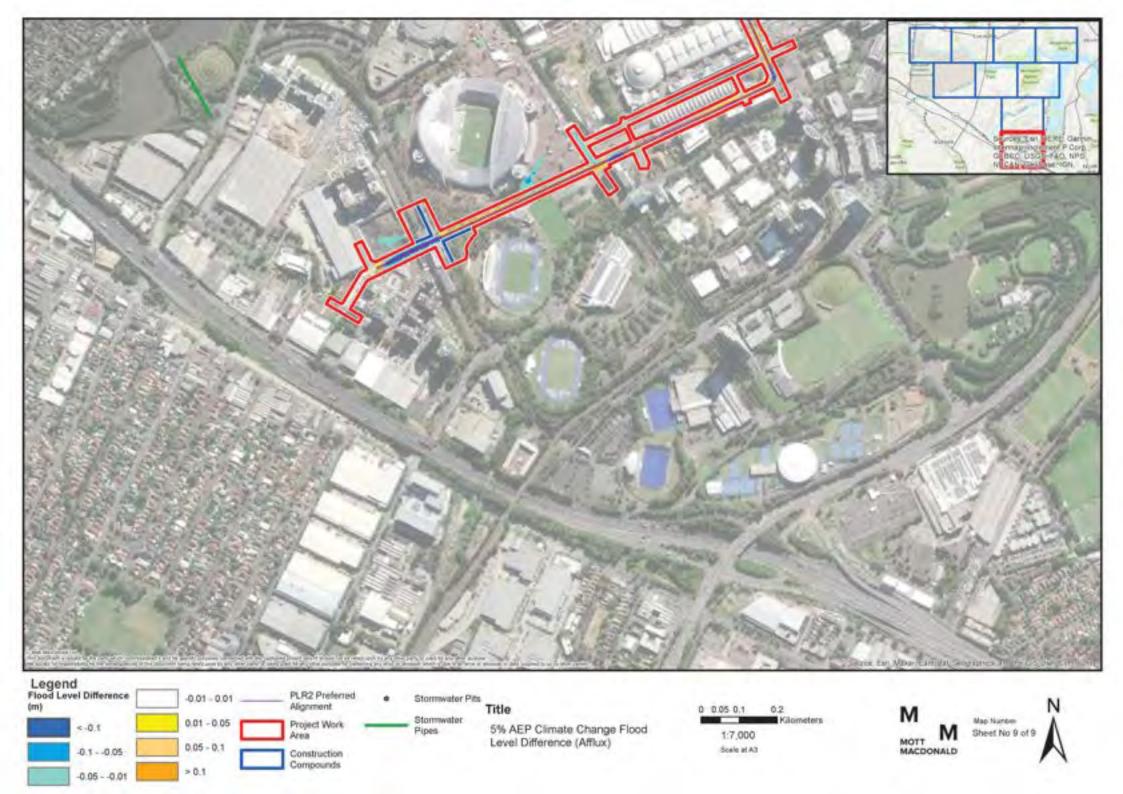


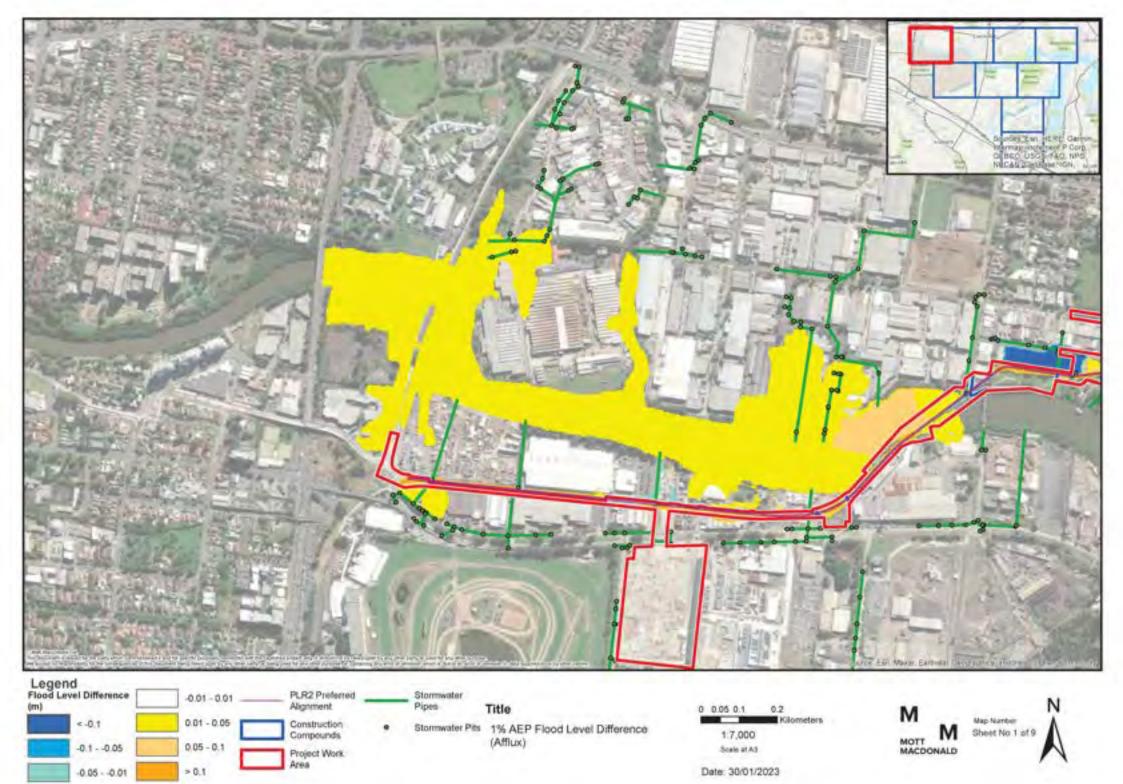


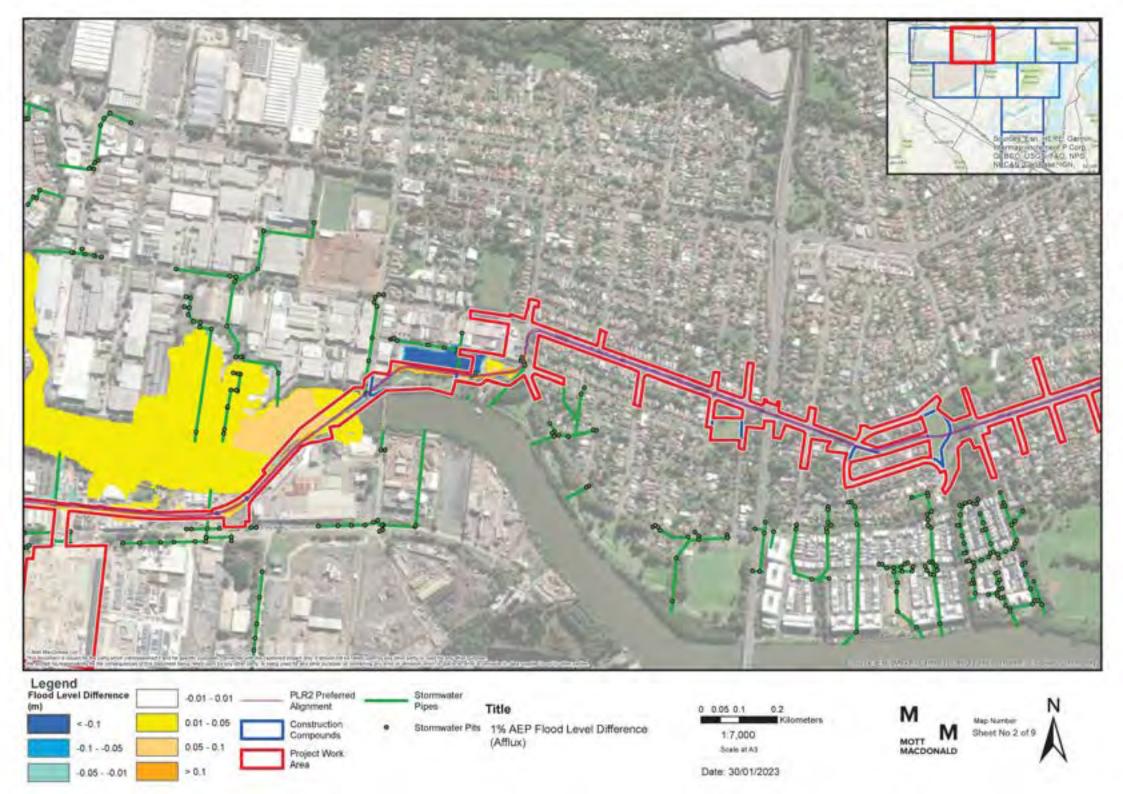


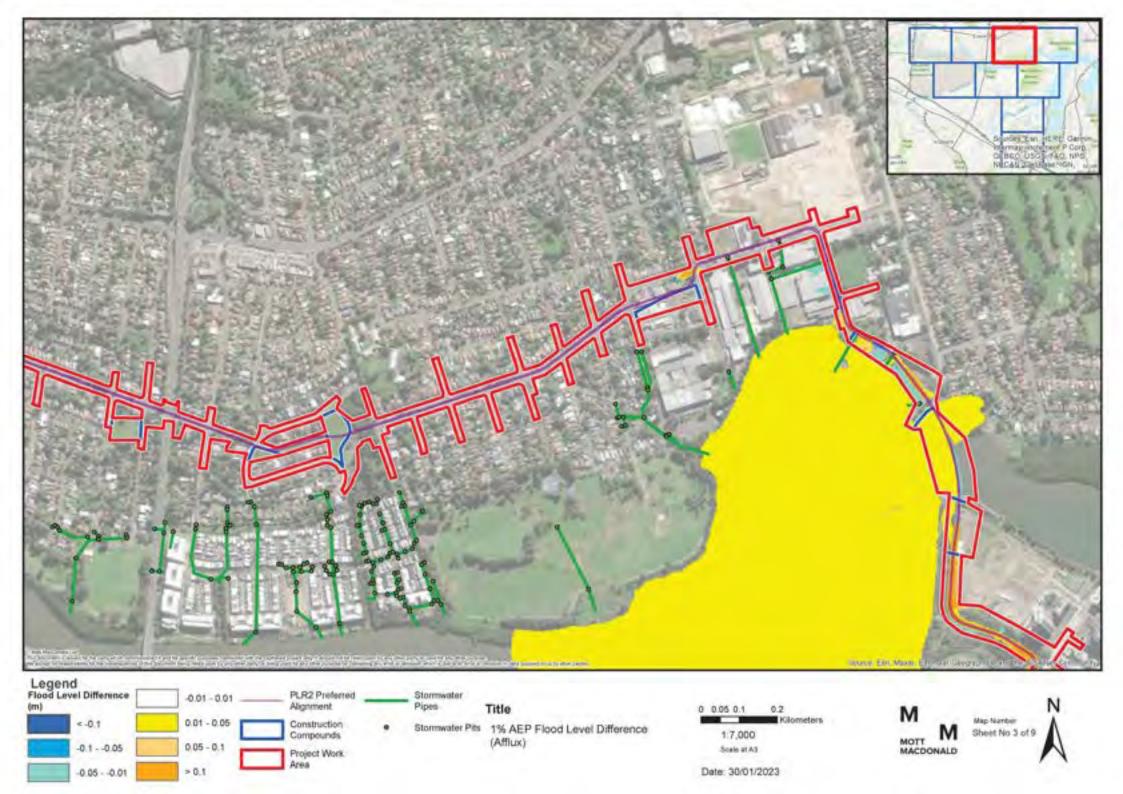


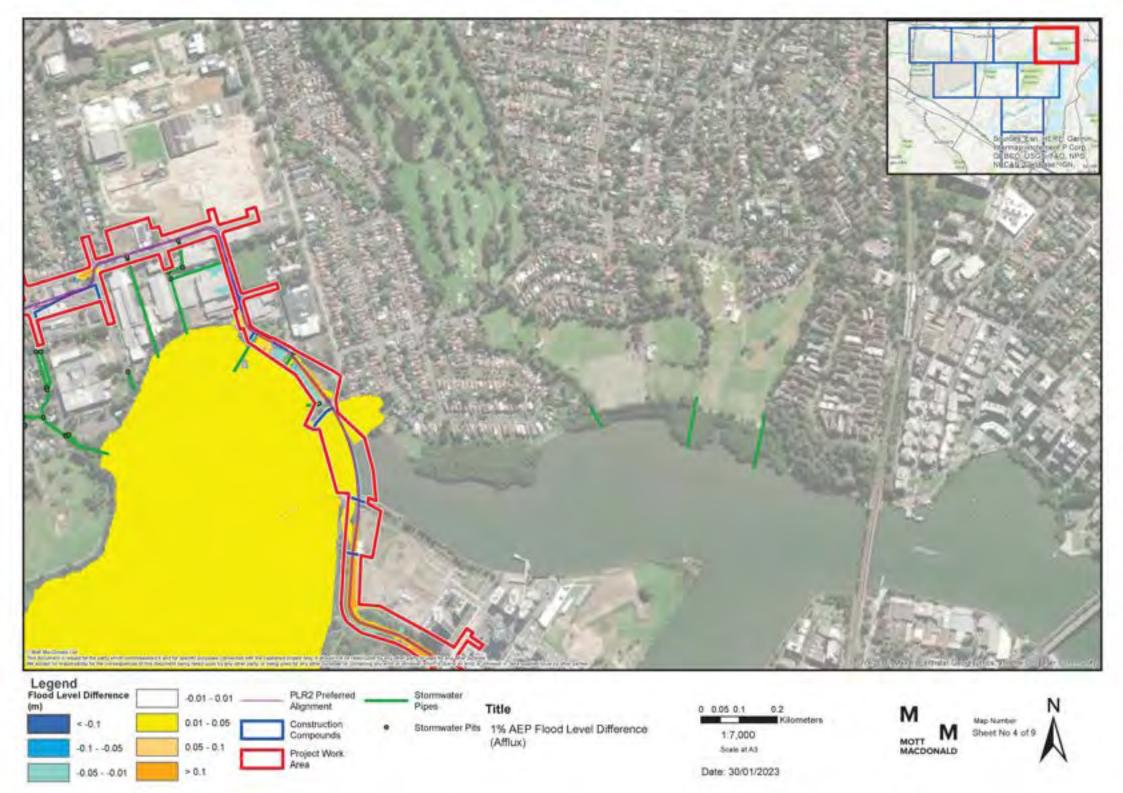












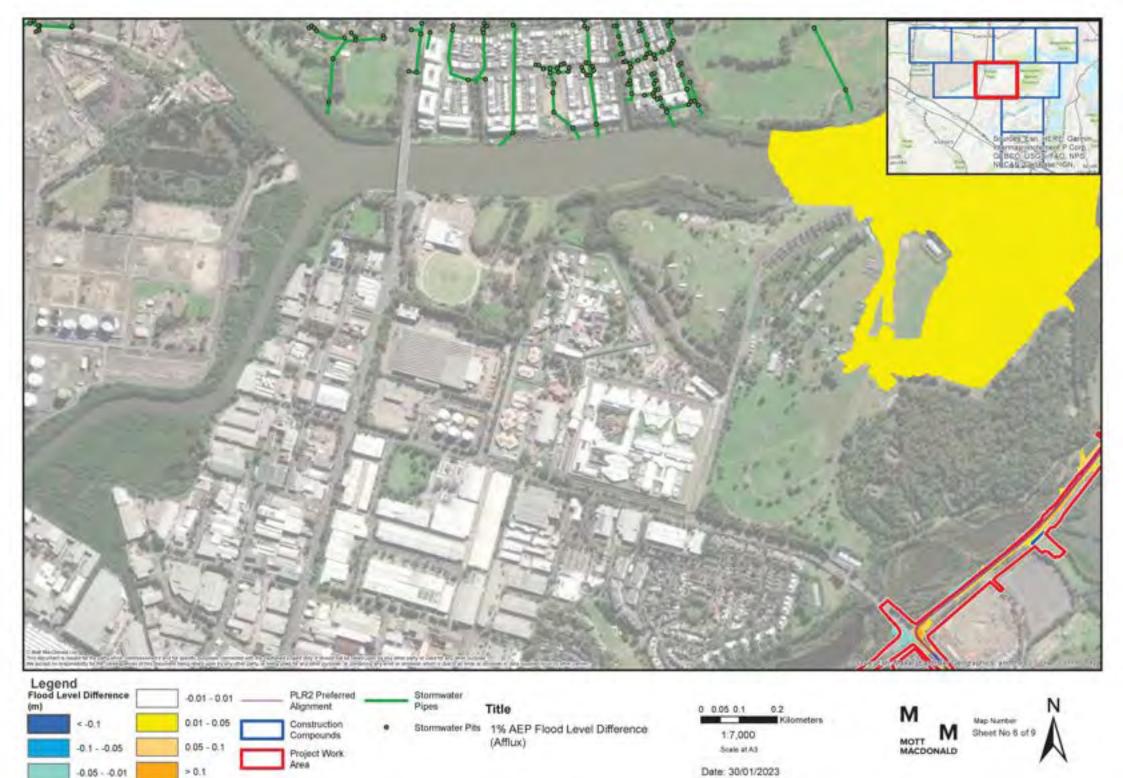


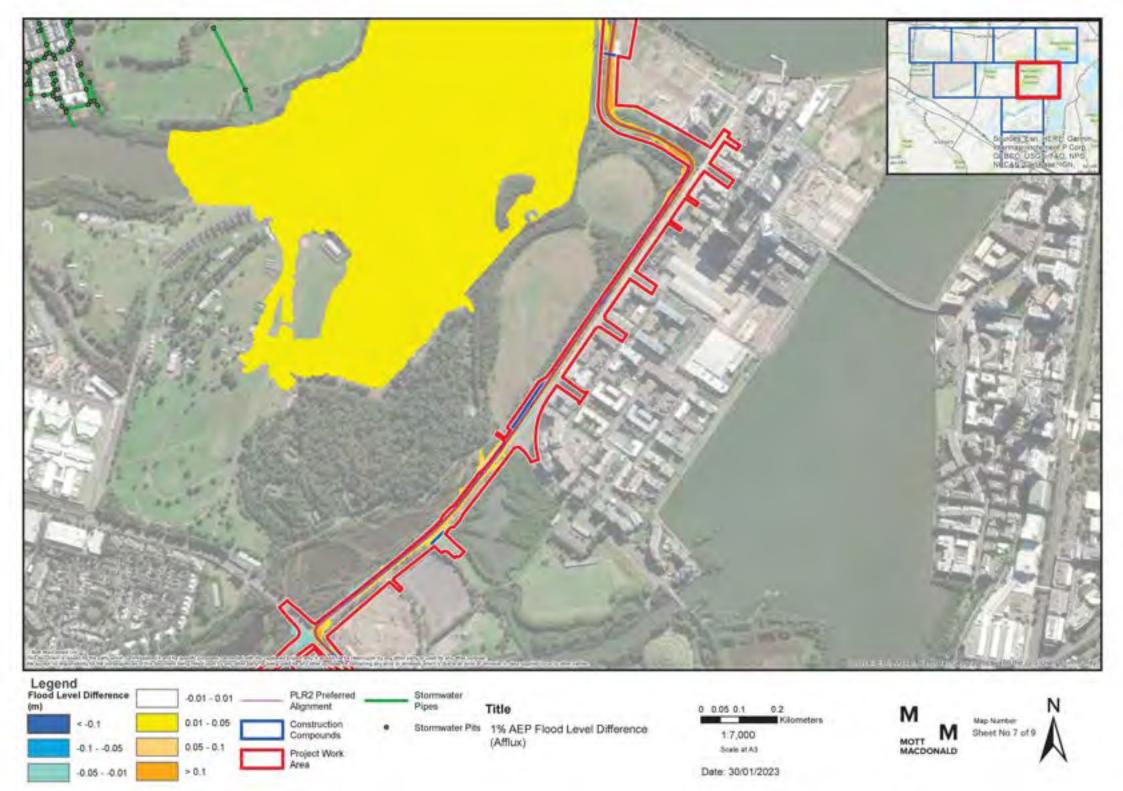


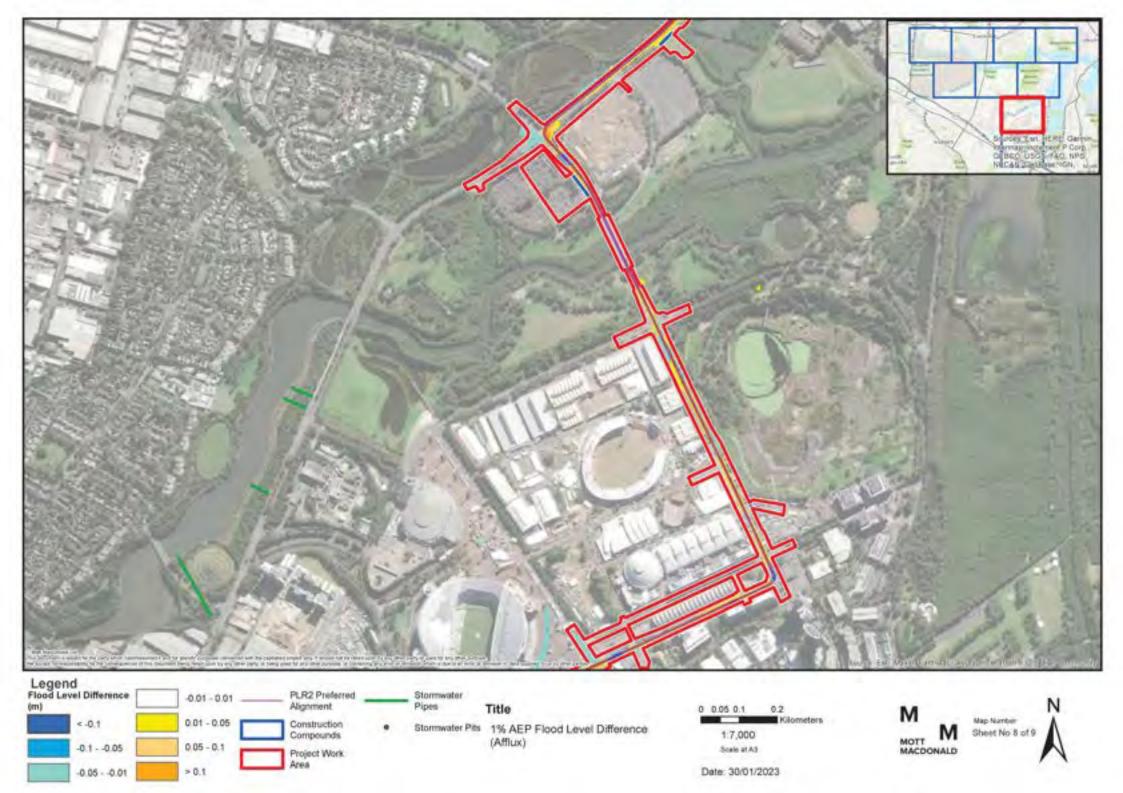
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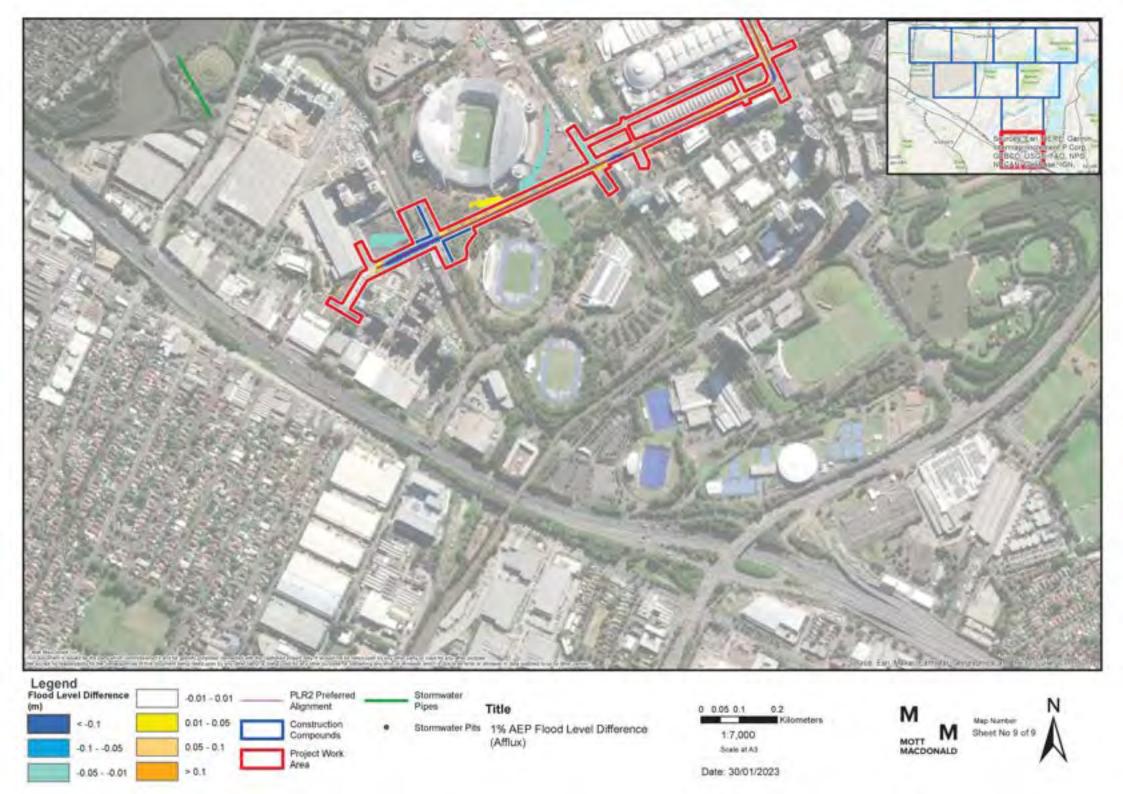
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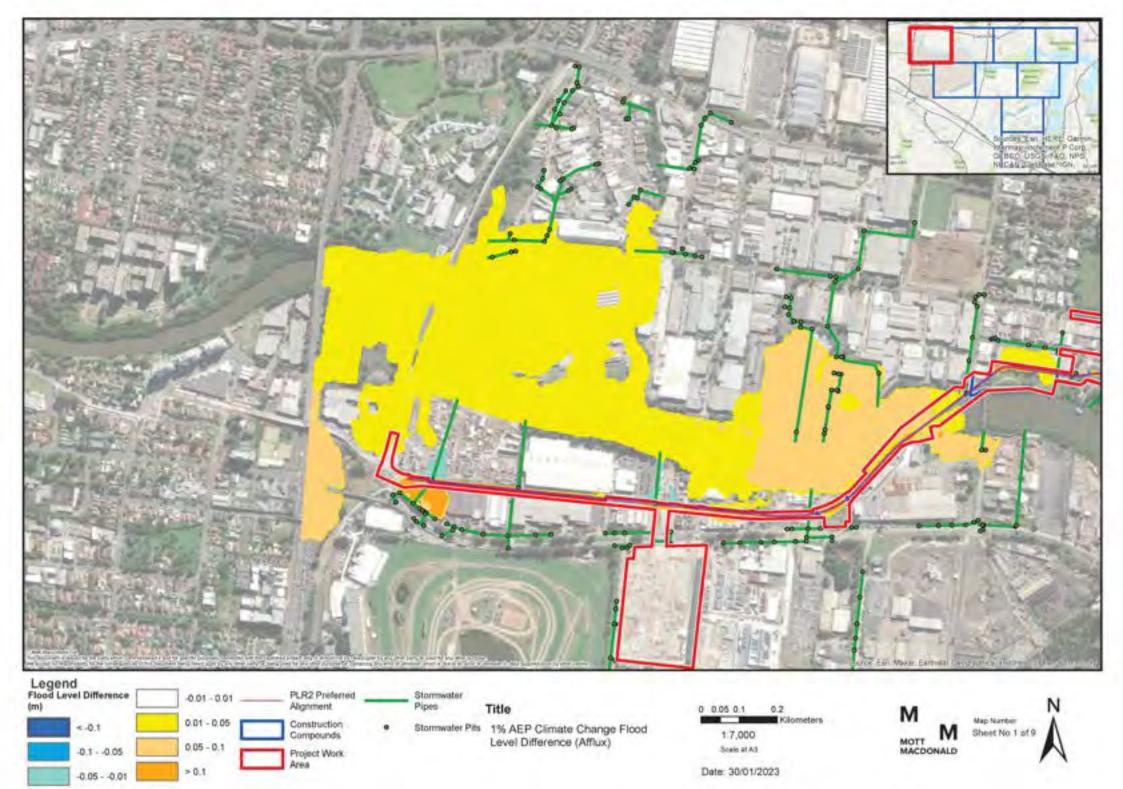


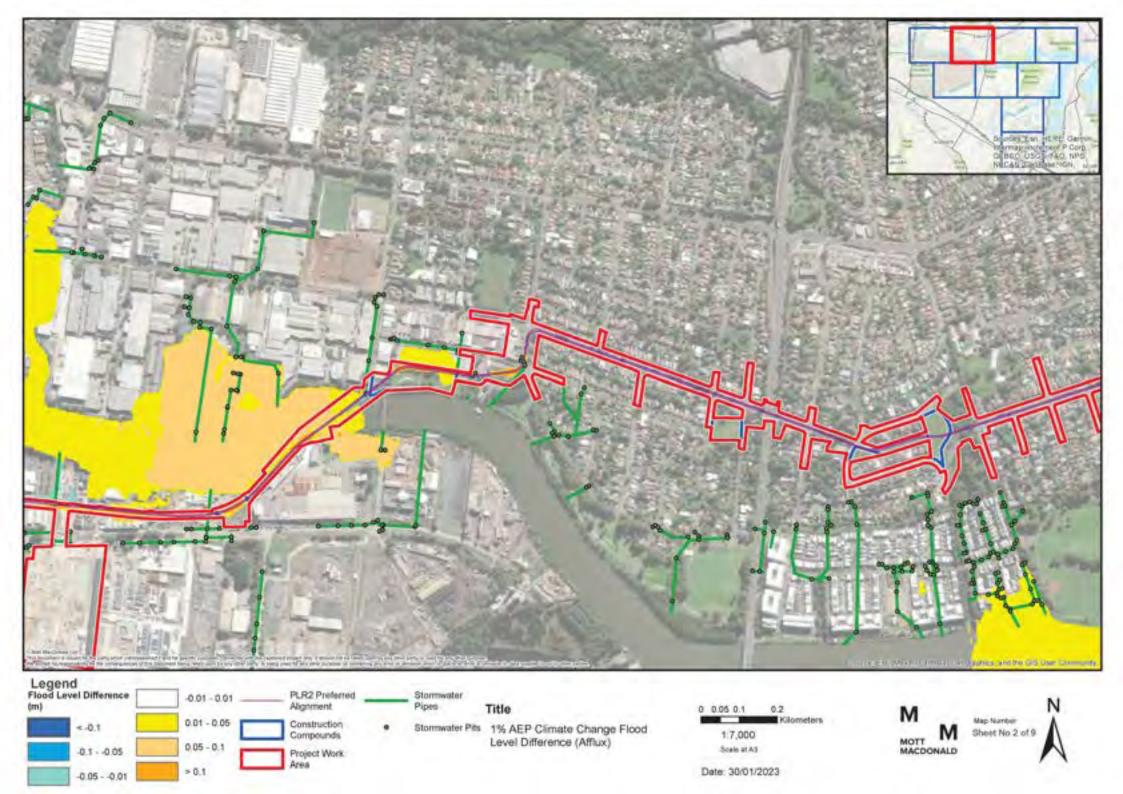


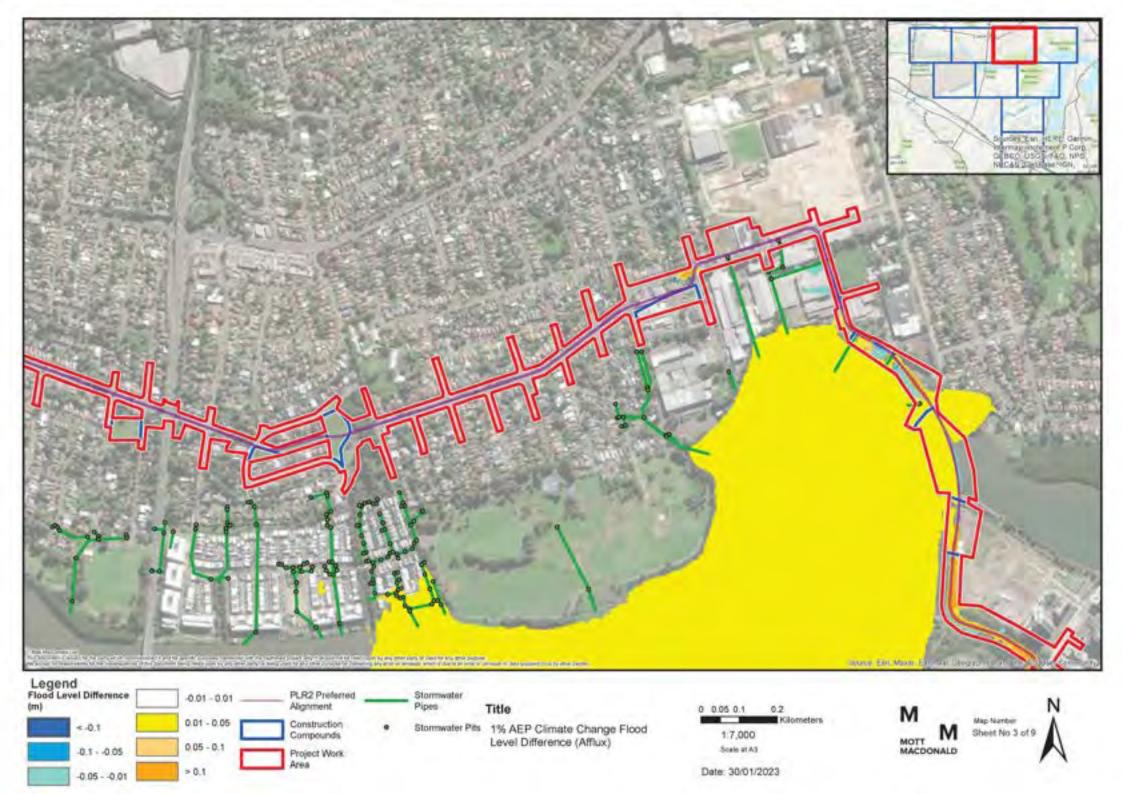


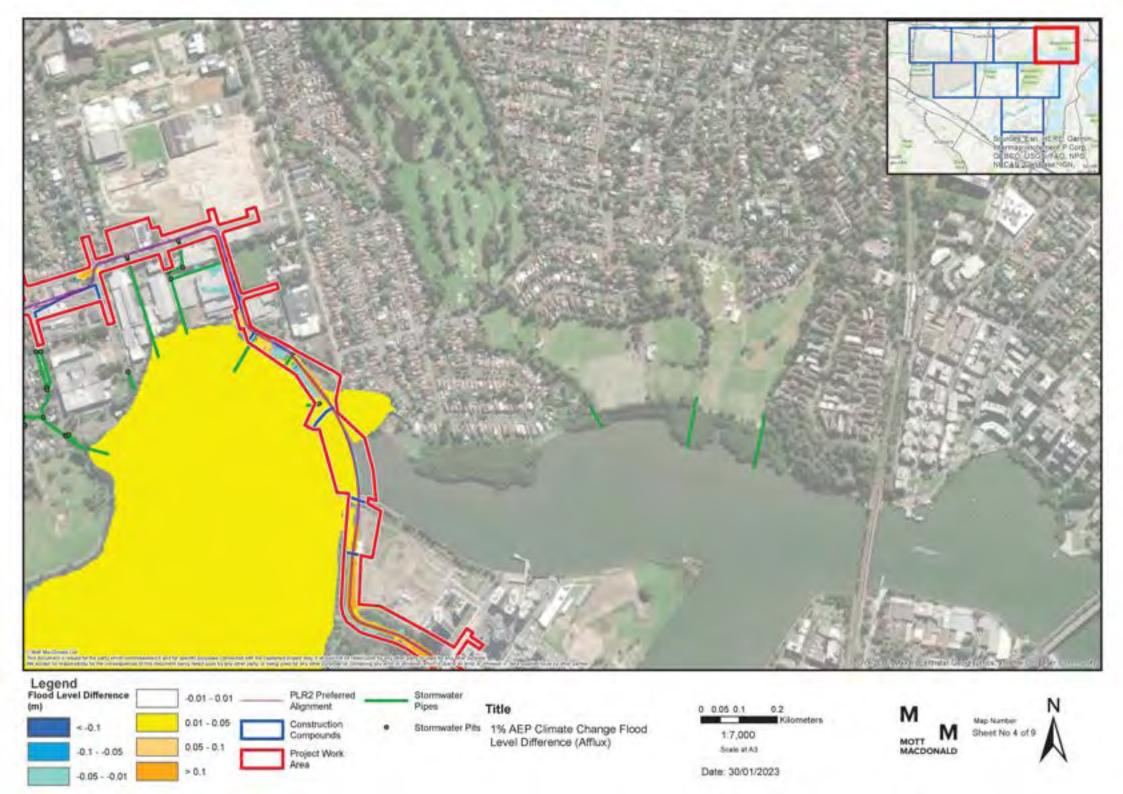




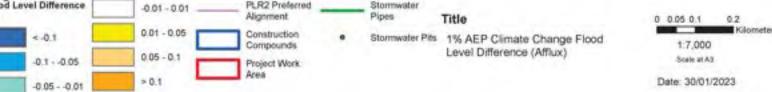








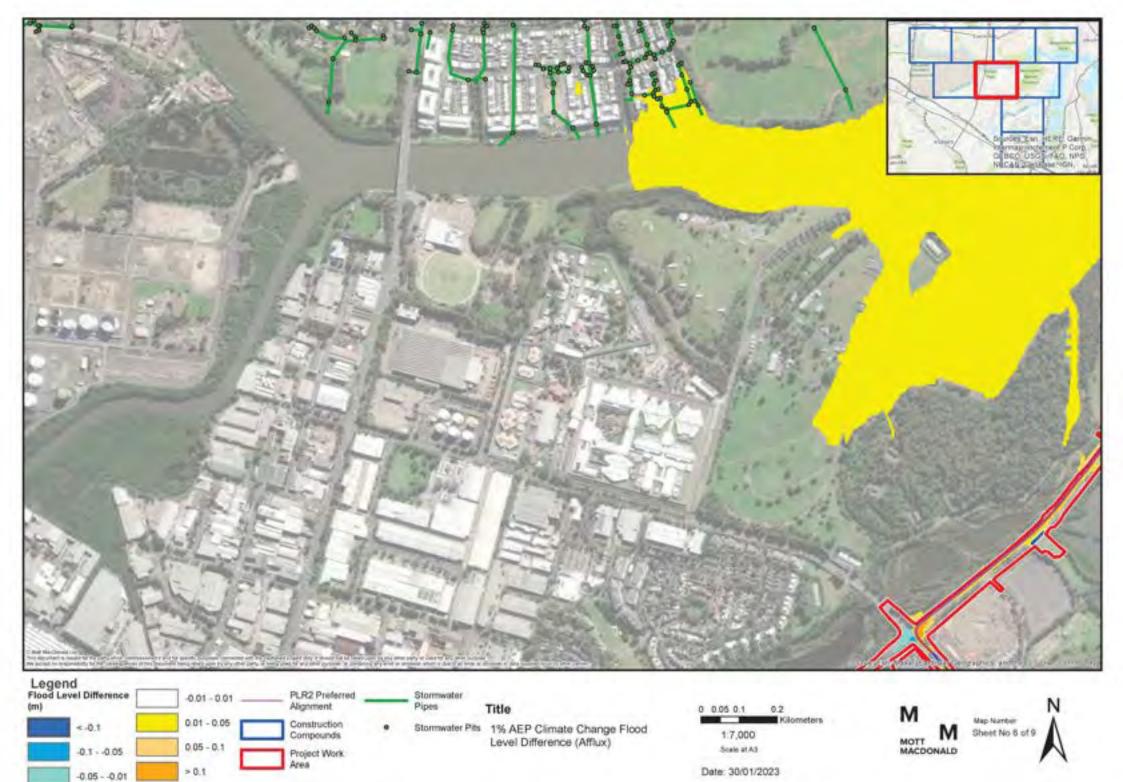


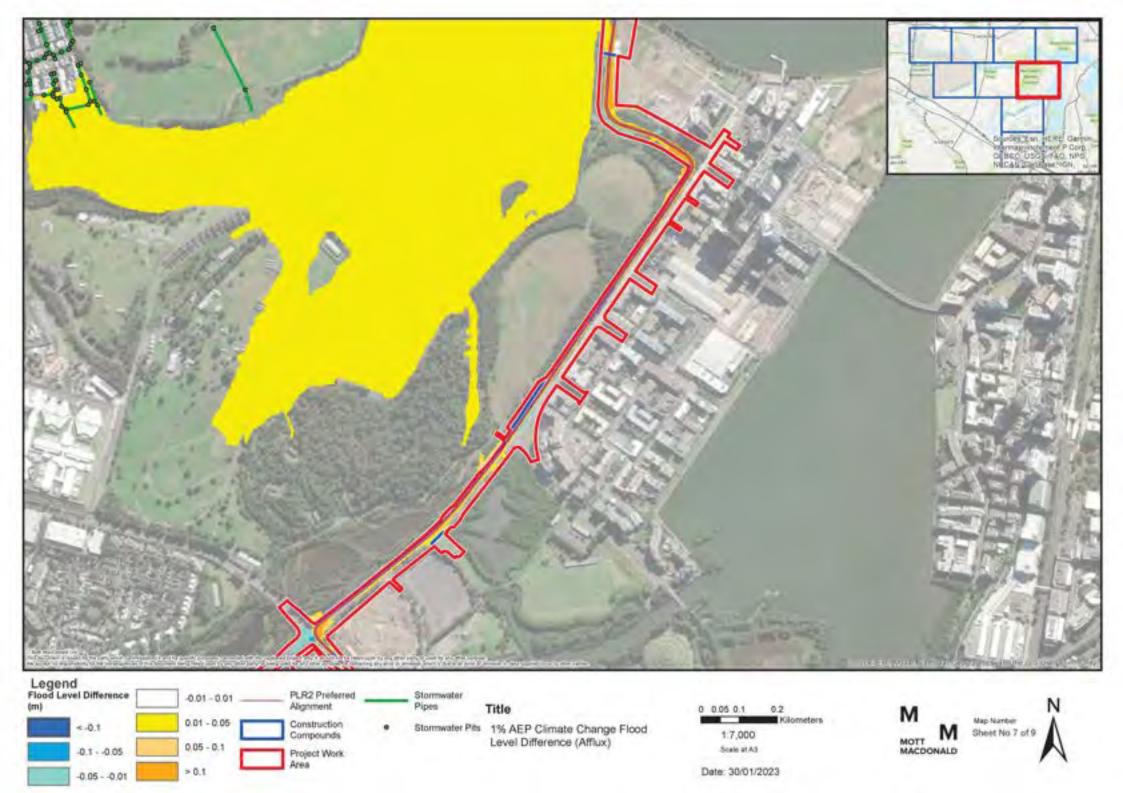


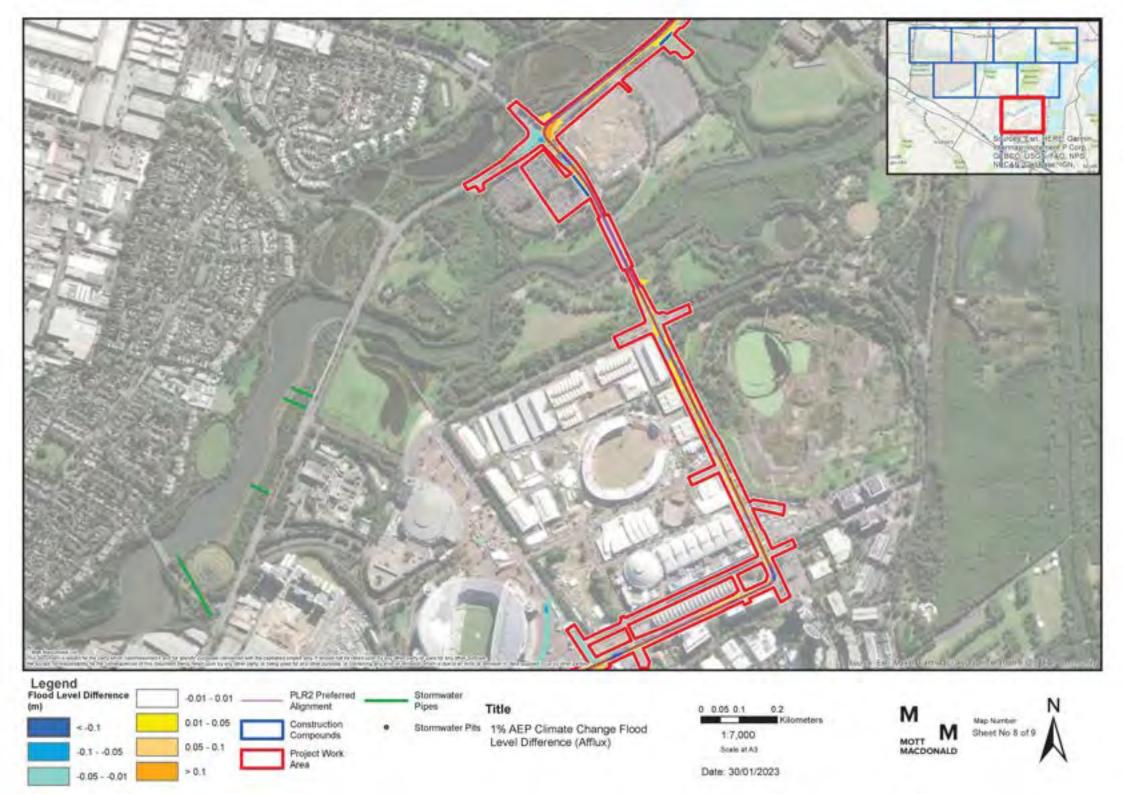
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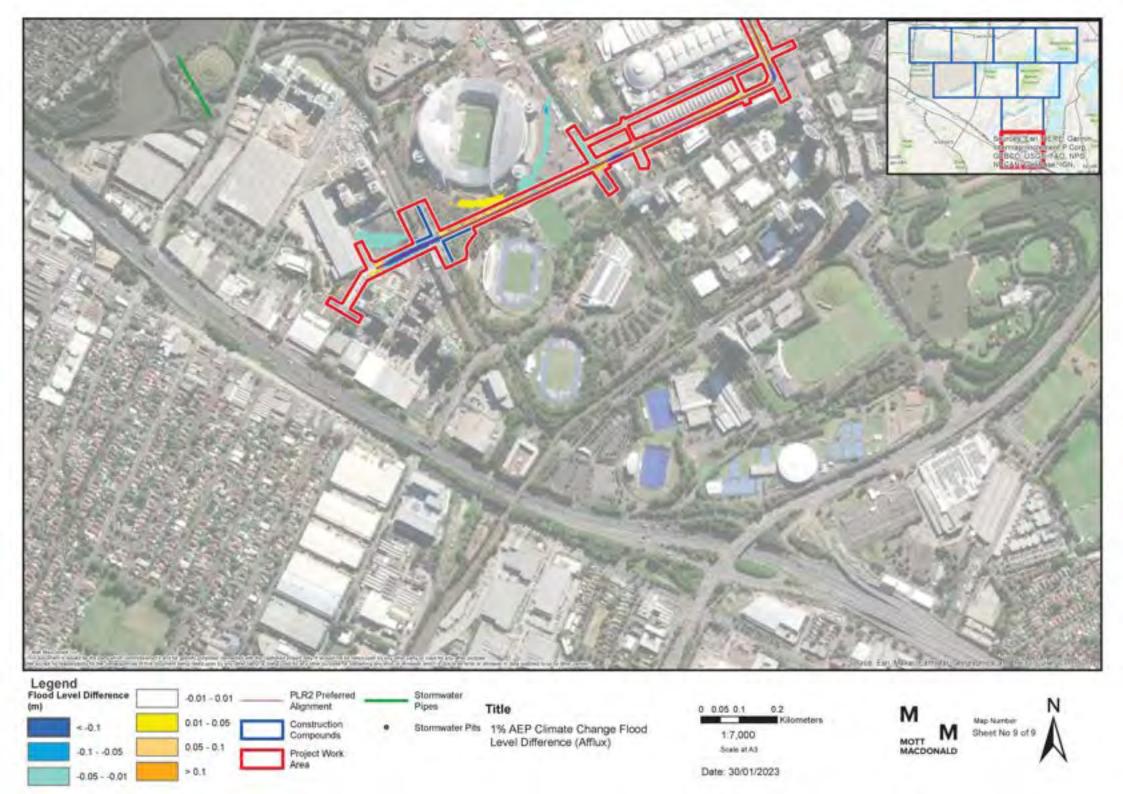
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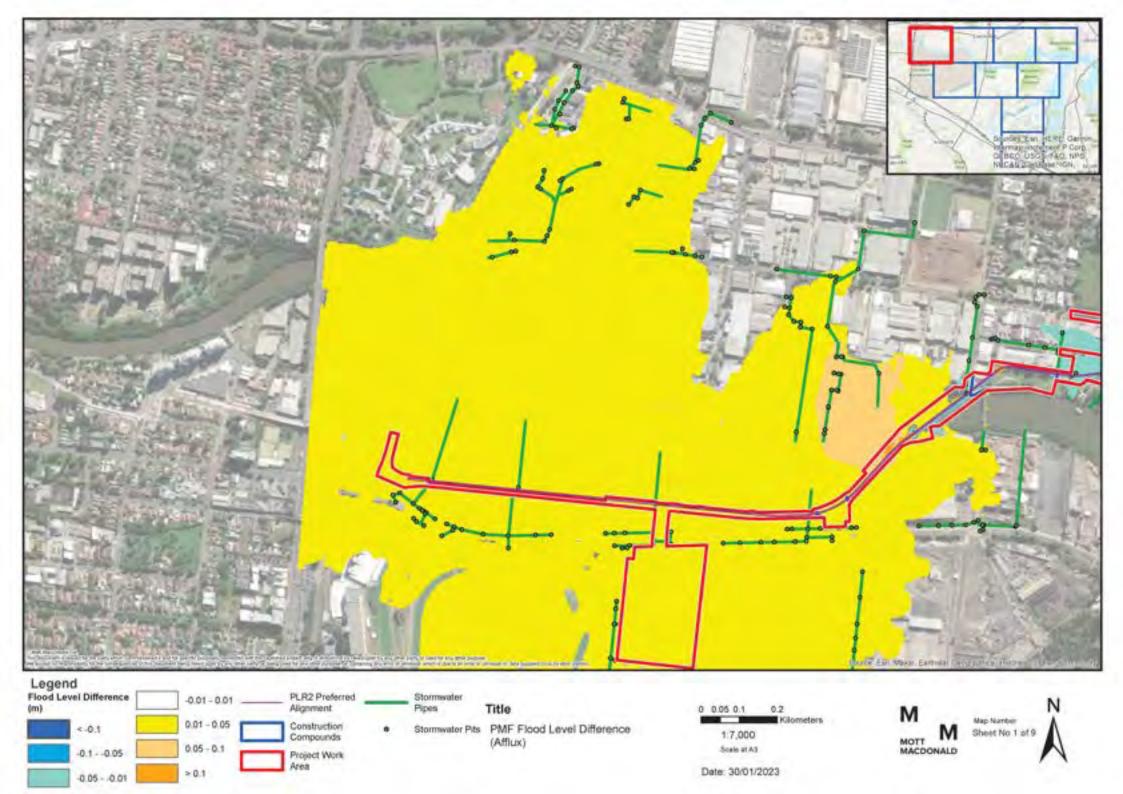


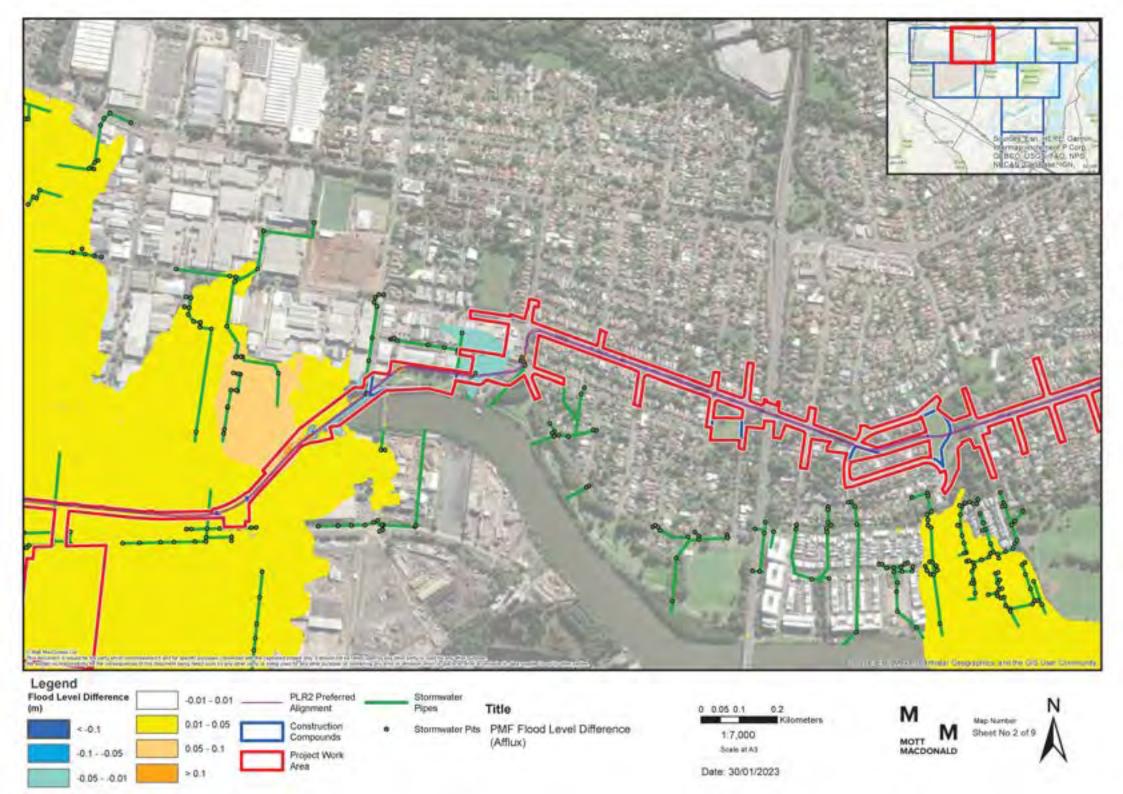


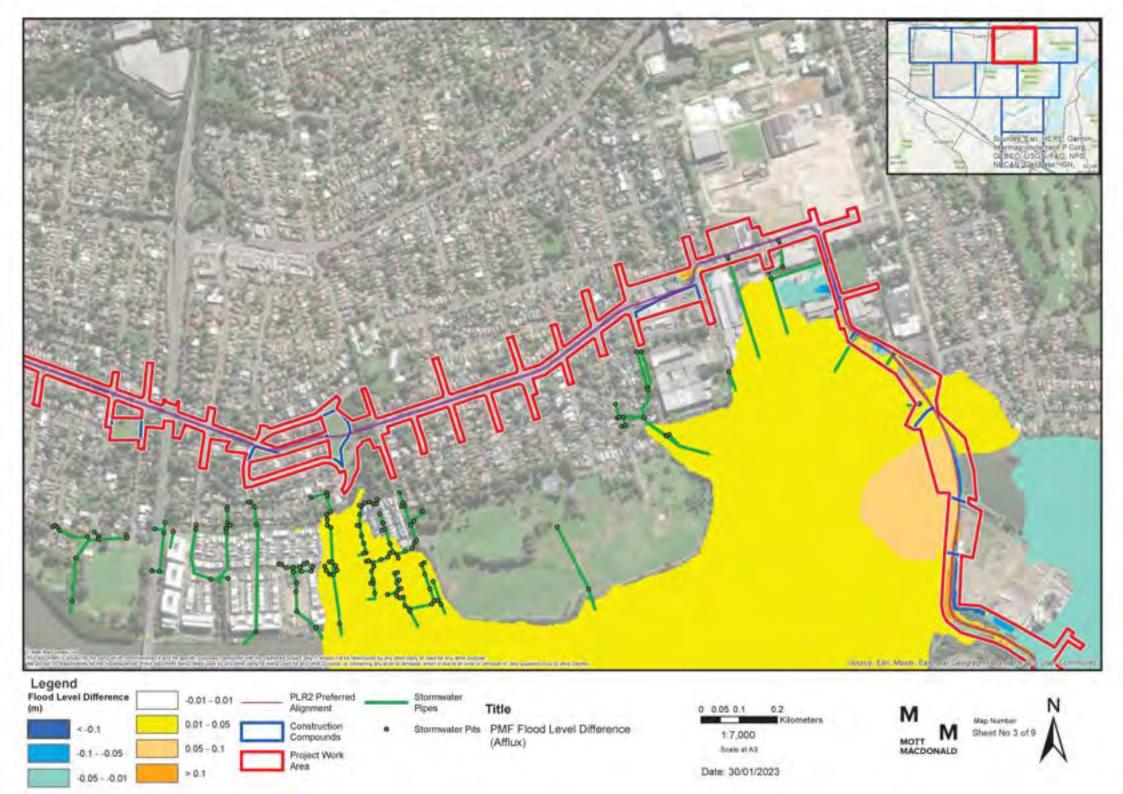


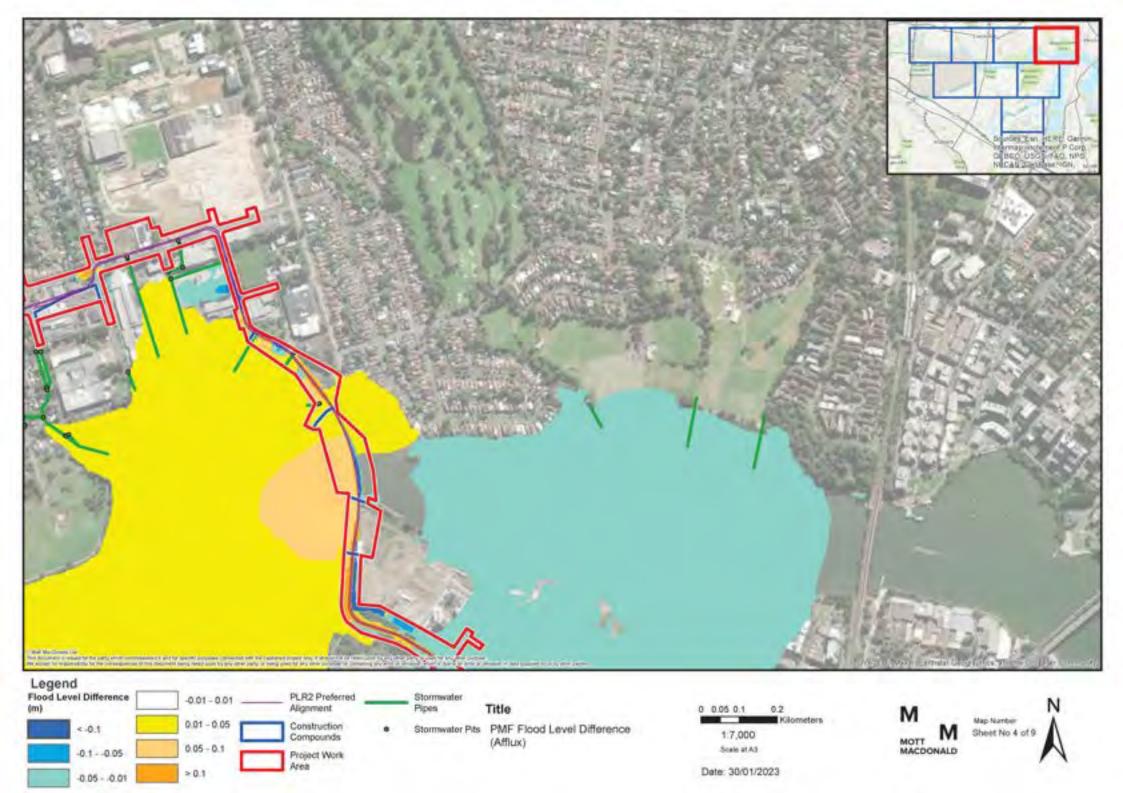


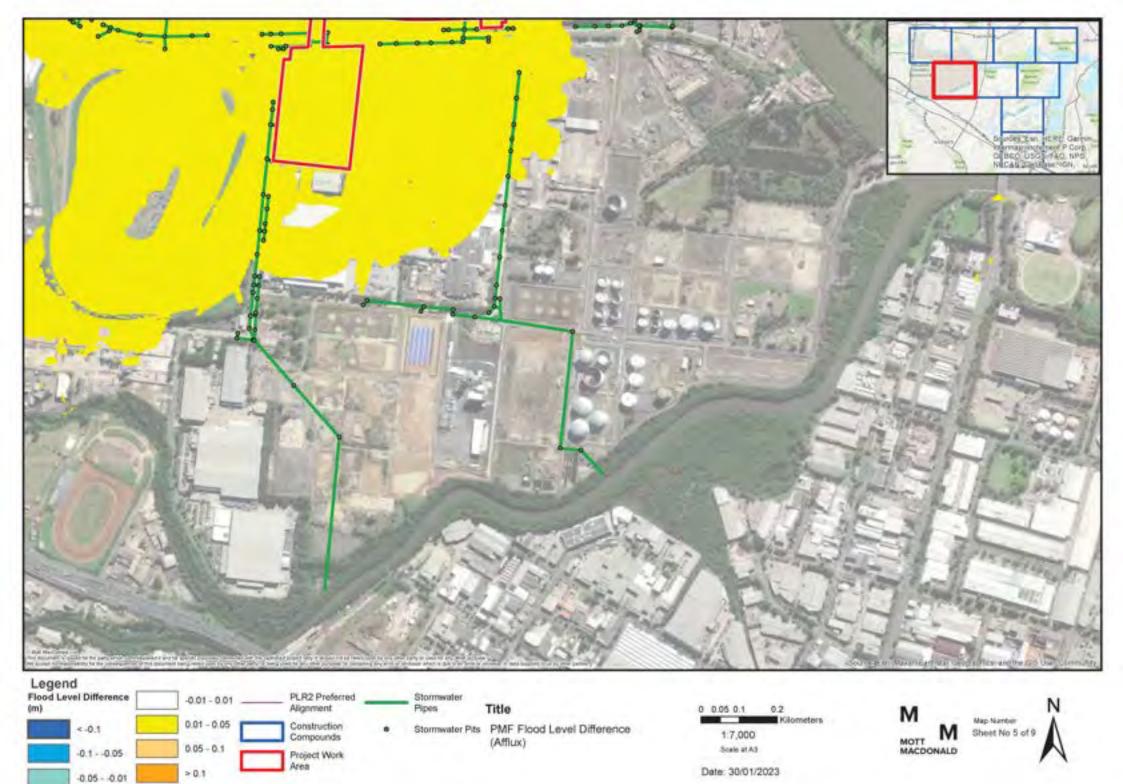


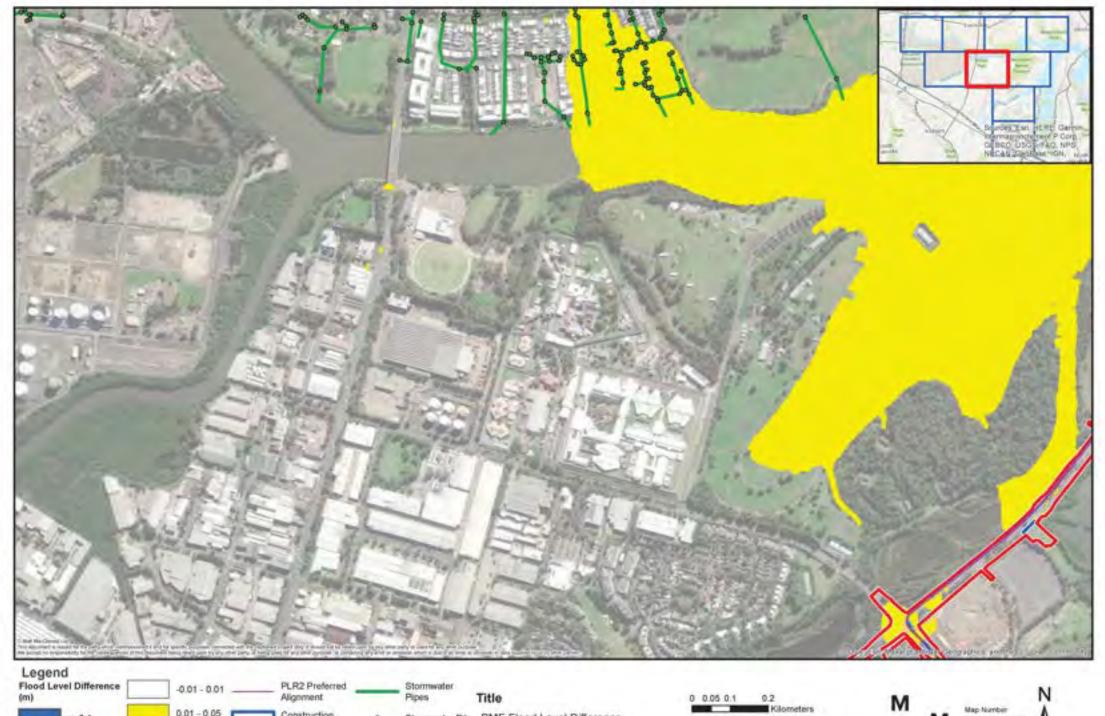


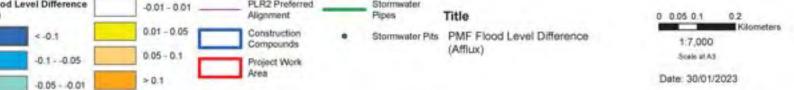






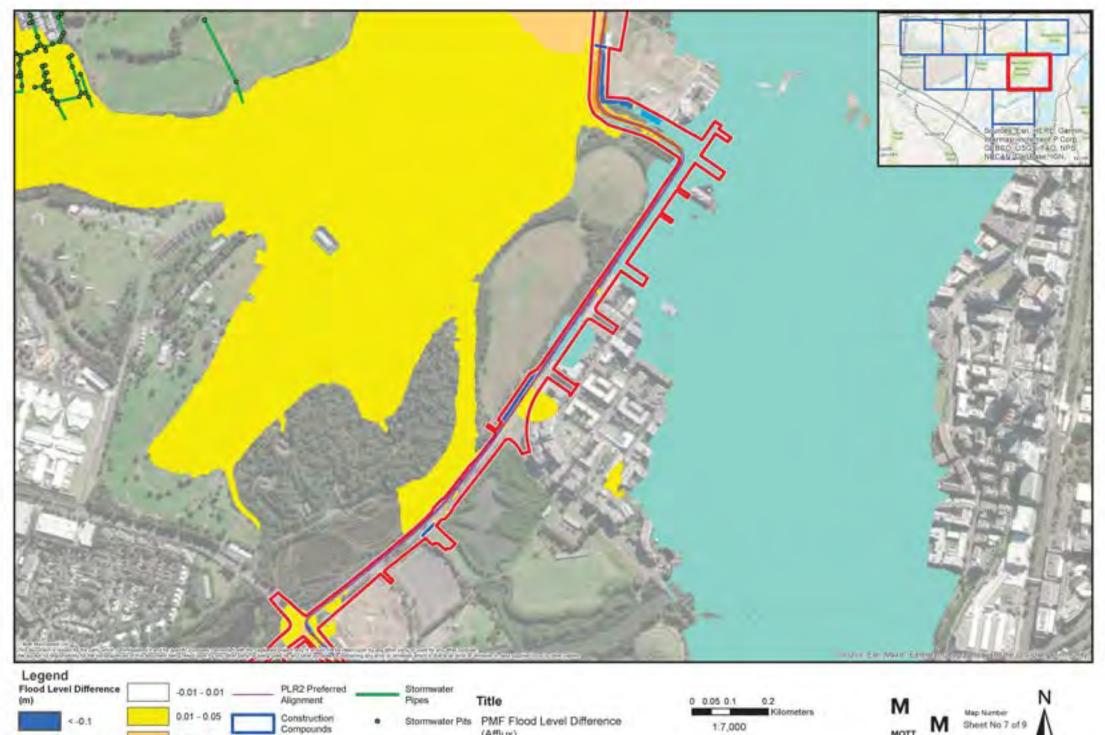






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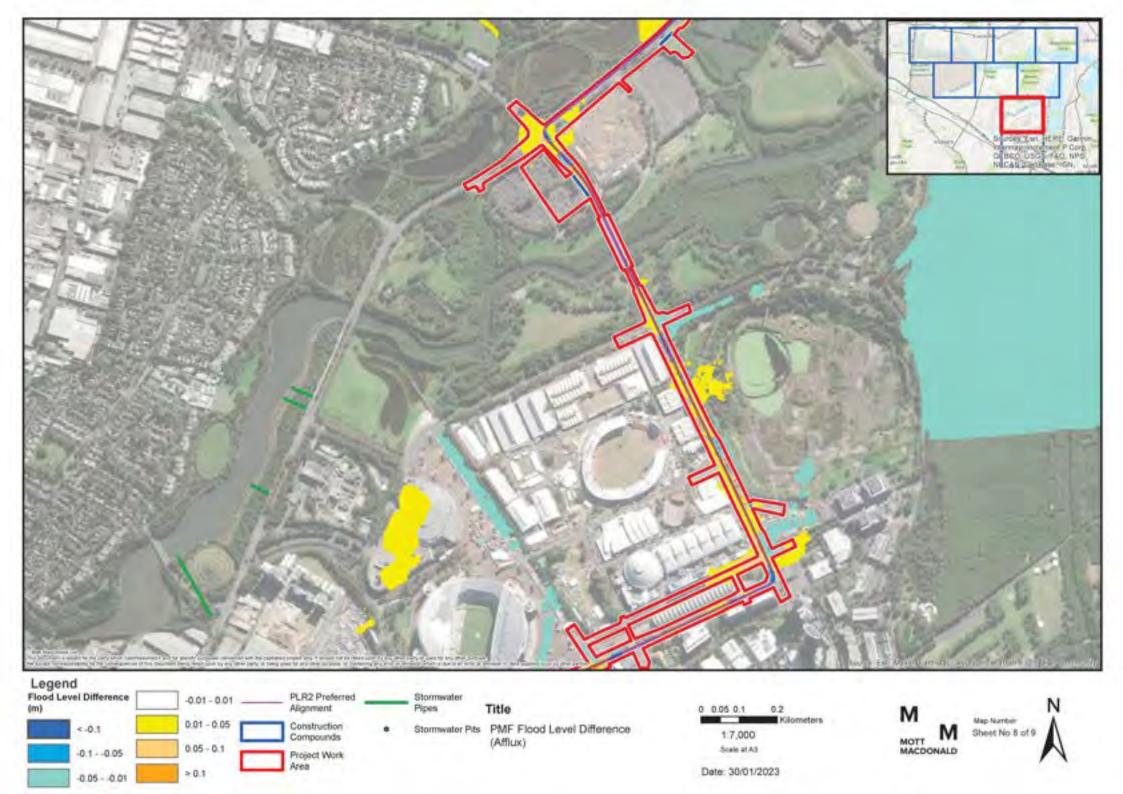
Map Number Sheet No 6 of 9

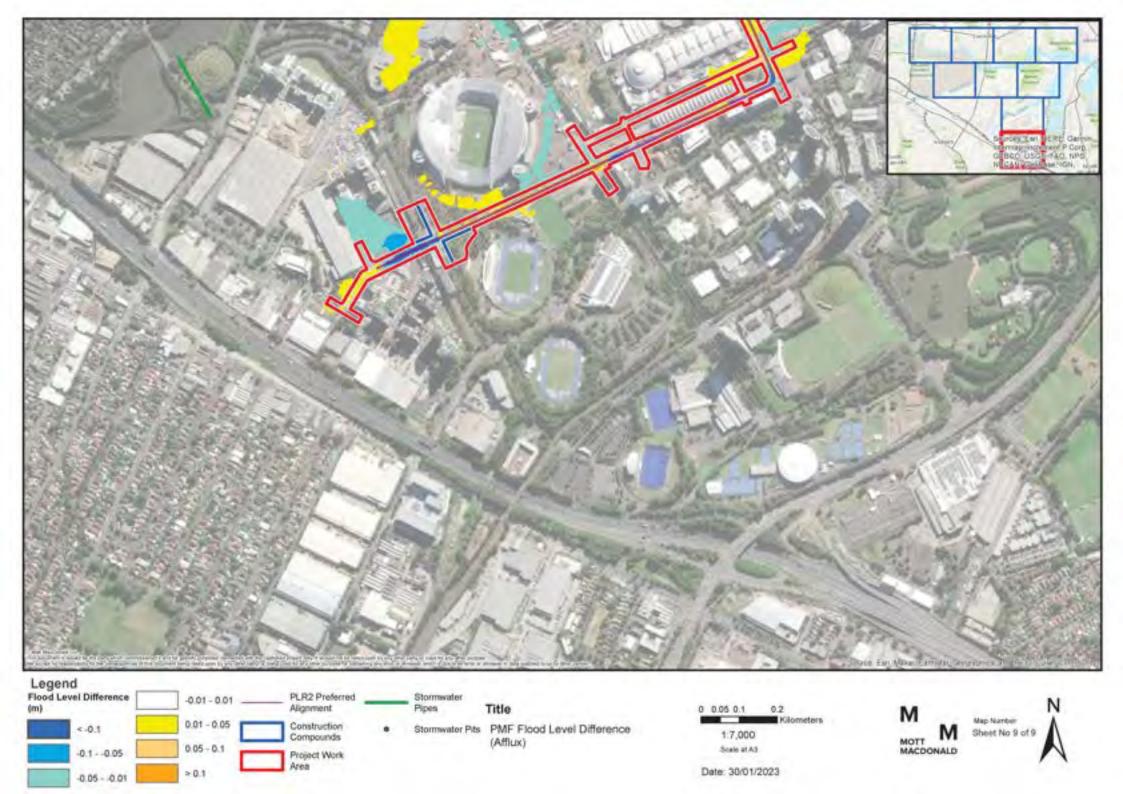


(Afflux) 0.05-0.1 Scale VLAS -0.1 - -0.05 Project Work Area Date: 30/01/2023 > 0.1 -0.05 - 0.01

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Appendix B Proof of Concept Flood Maps

Appendix B1 - Flood model figures (Proof of concept) - 5% AEP

- Proof of concept Flood Conditions 5% AEP Depth
- Proof of concept Flood Conditions 5% AEP Hazard
- Proof of concept Flood Conditions 5% AEP Velocity
- Proof of concept Flood Conditions 5% AEP Climate Change Depth
- Proof of concept Flood Conditions 5% AEP Climate Change Hazard
- Proof of concept Flood Conditions 5% AEP Climate Change Velocity

Appendix B2 – Flood model figures (Proof of concept) – 1% AEP

- Proof of concept Flood Conditions 1% AEP Depth
- Proof of concept Flood Conditions 1% AEP Hazard
- Proof of concept Flood Conditions 1% AEP Velocity
- Proof of concept Flood Conditions 1% AEP Climate Change Depth
- Proof of concept Flood Conditions 1% AEP Climate Change Hazard
- Proof of concept Flood Conditions 1% AEP Climate Change Velocity

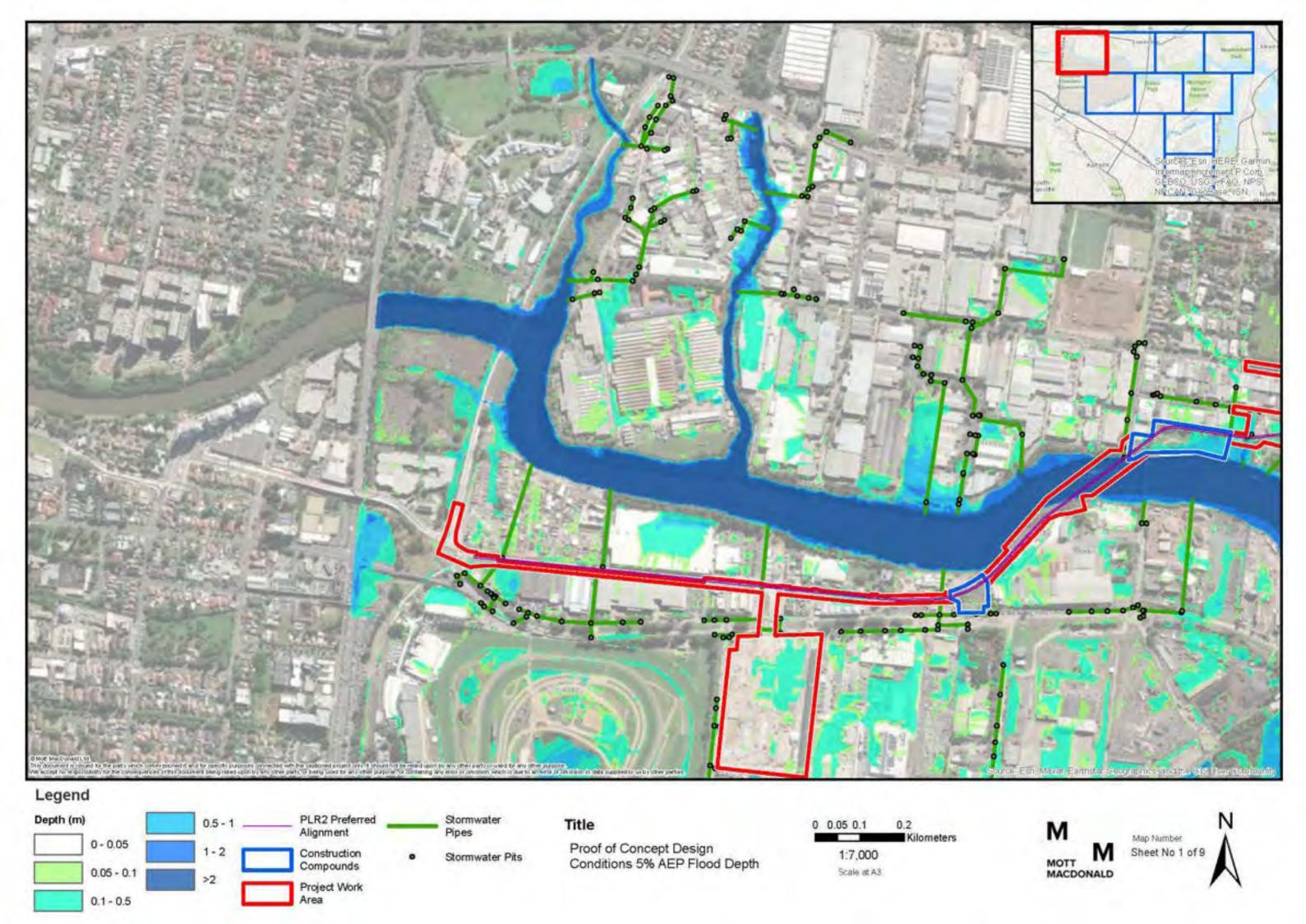
Appendix B3 – Flood model figures (Proof of concept) – PMF

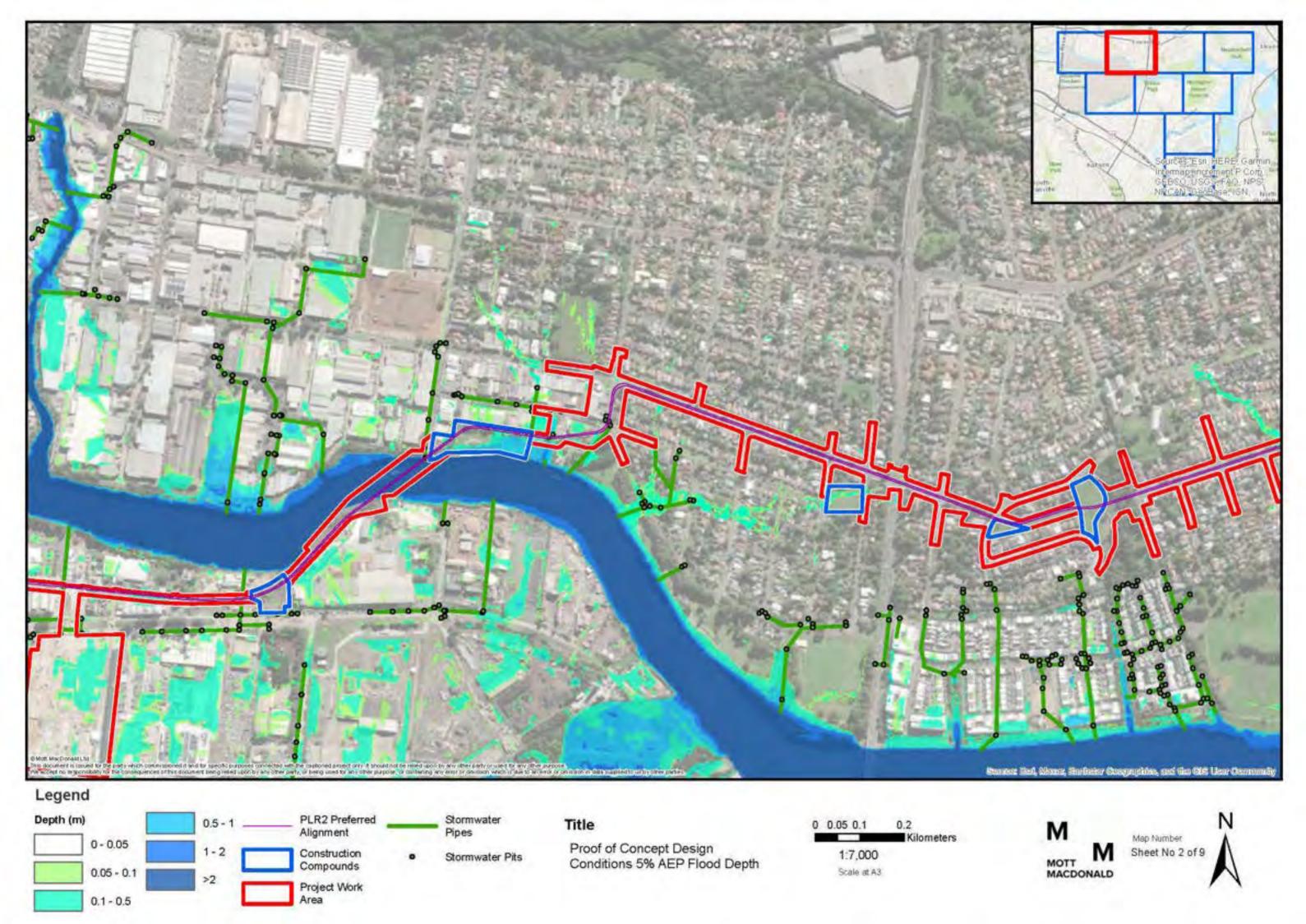
- Proof of concept Flood Conditions PMF Depth
- Proof of concept Flood Conditions PMF Hazard
- Proof of concept Flood Conditions PMF Velocity

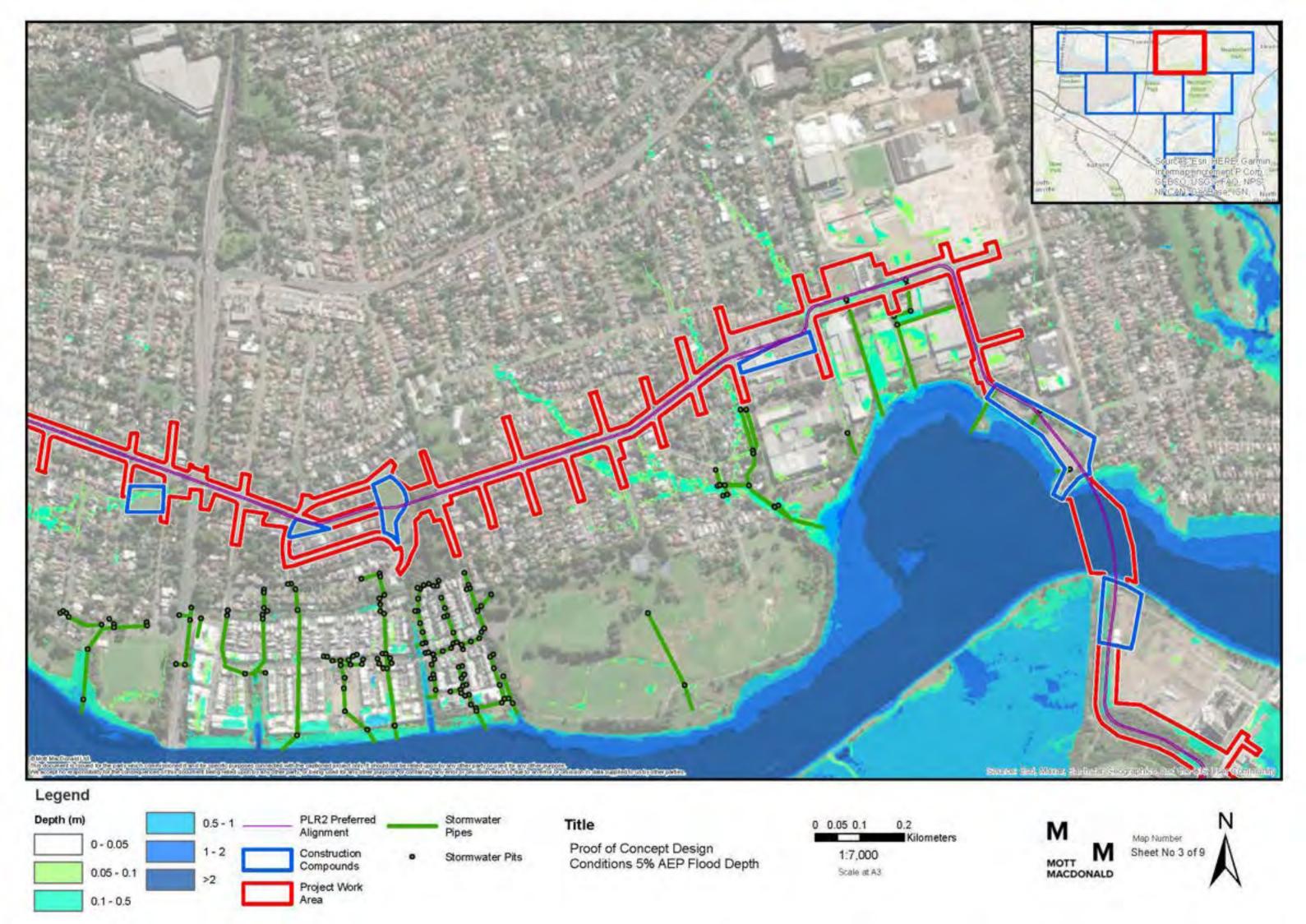
Appendix B4 - Flood model figures (Proof of concept) - Flood level difference

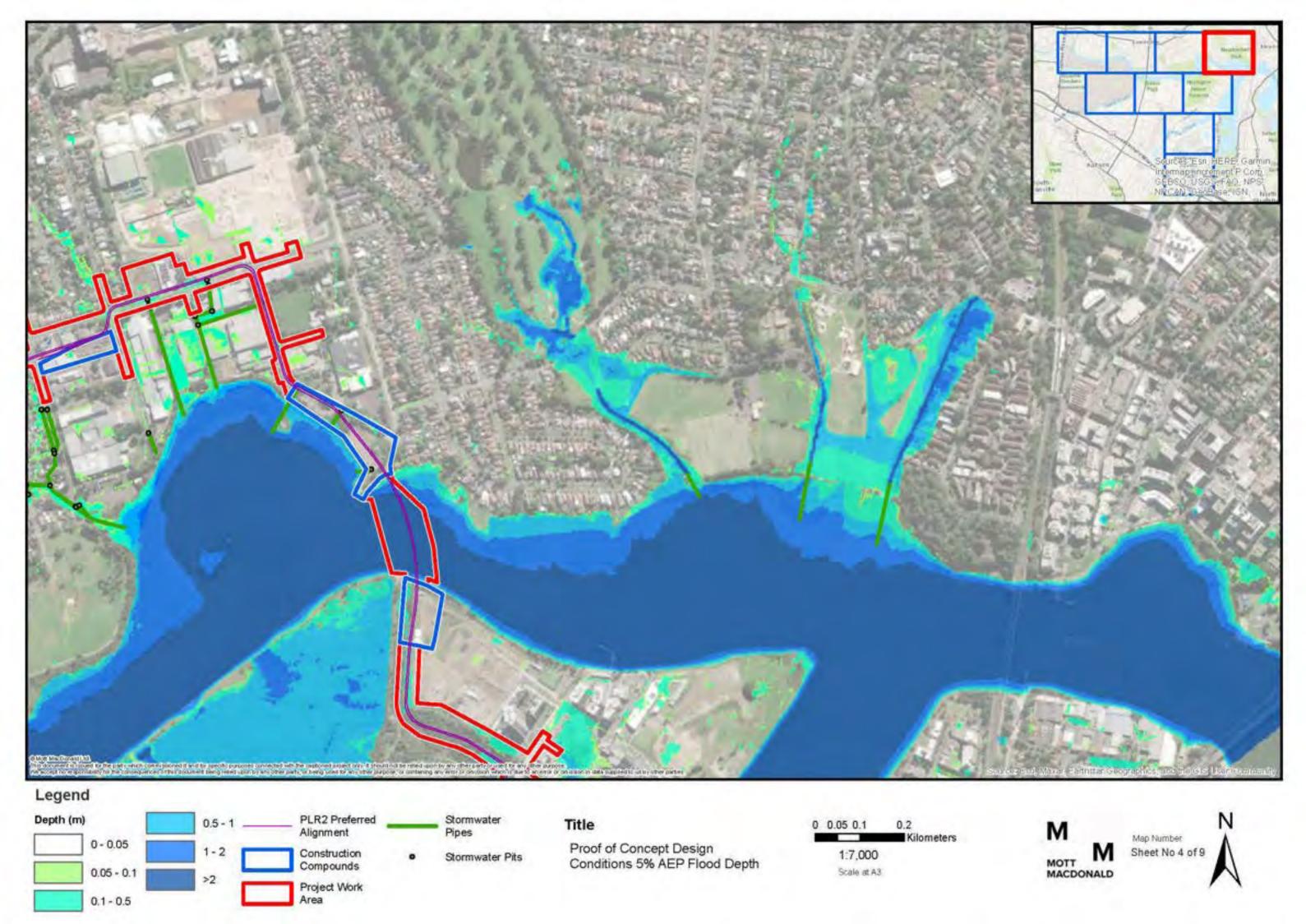
- Proof of concept Flood Afflux 5% AEP
- Proof of concept Flood Afflux 5% AEP Climate Change
- Proof of concept Flood Afflux 1% AEP
- Proof of concept Flood Afflux 1% AEP Climate Change
- Proof of concept Flood Afflux PMF

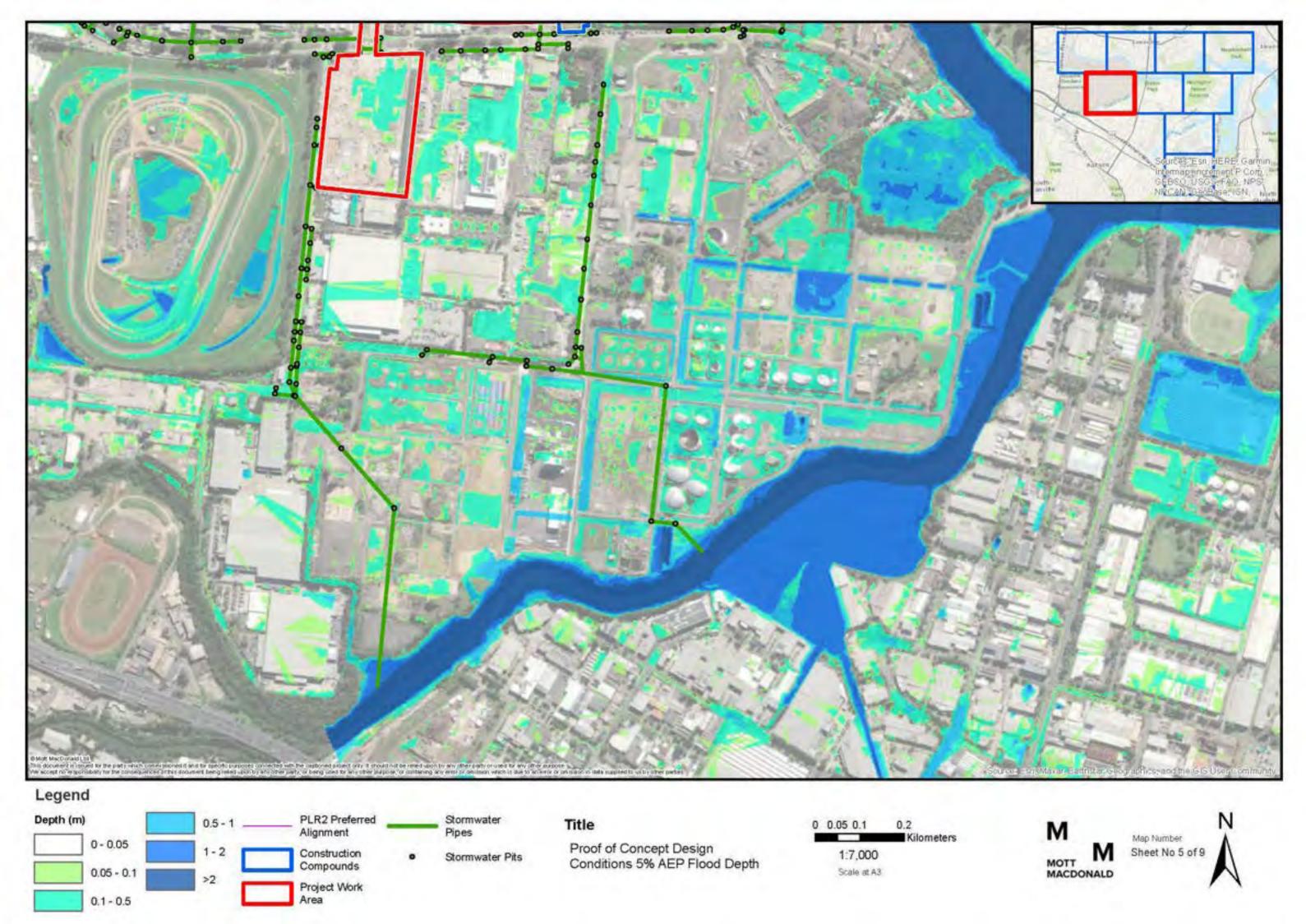
Appendix B1 – Flood model figures (Proof of concept) – 5% AEP

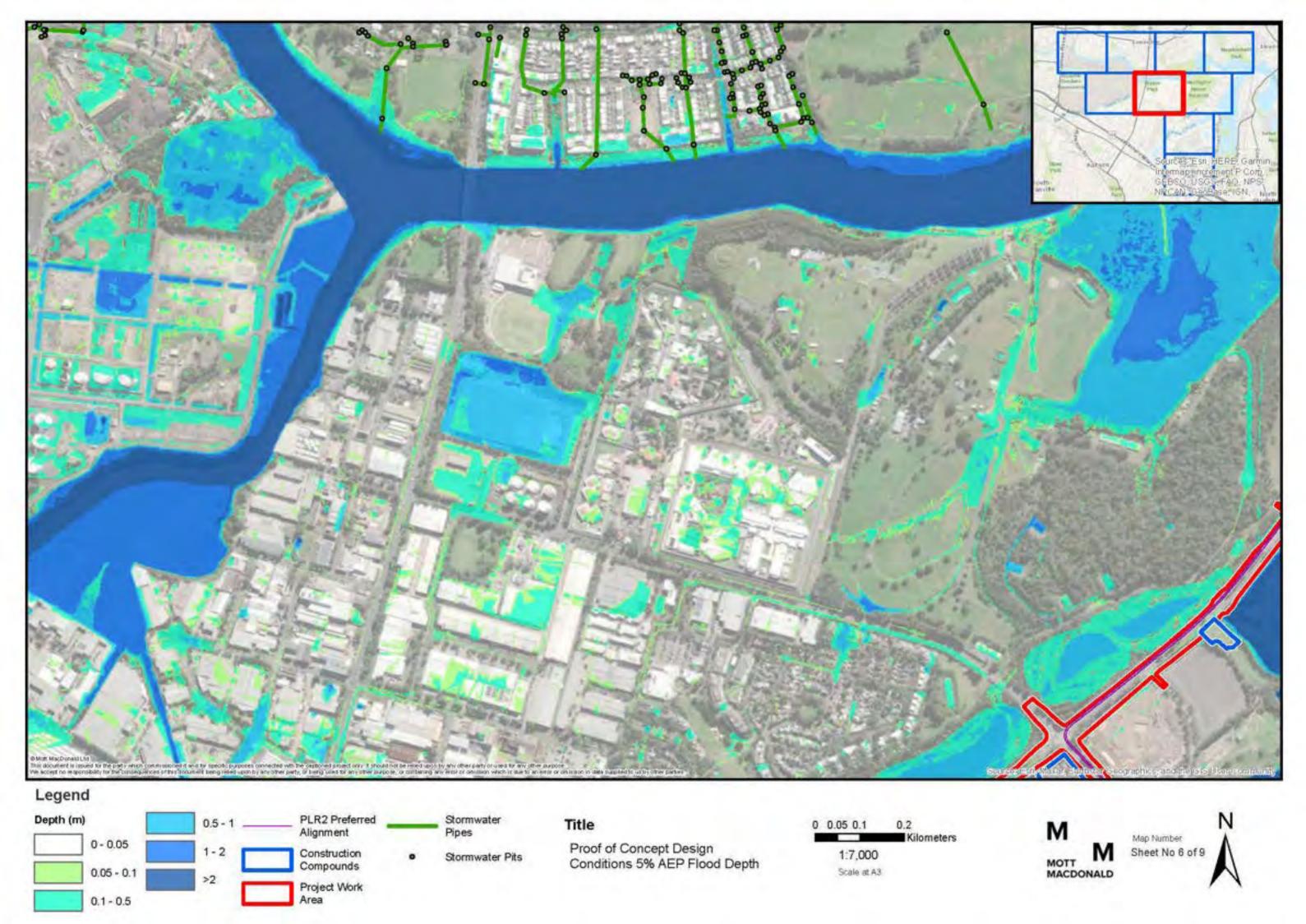


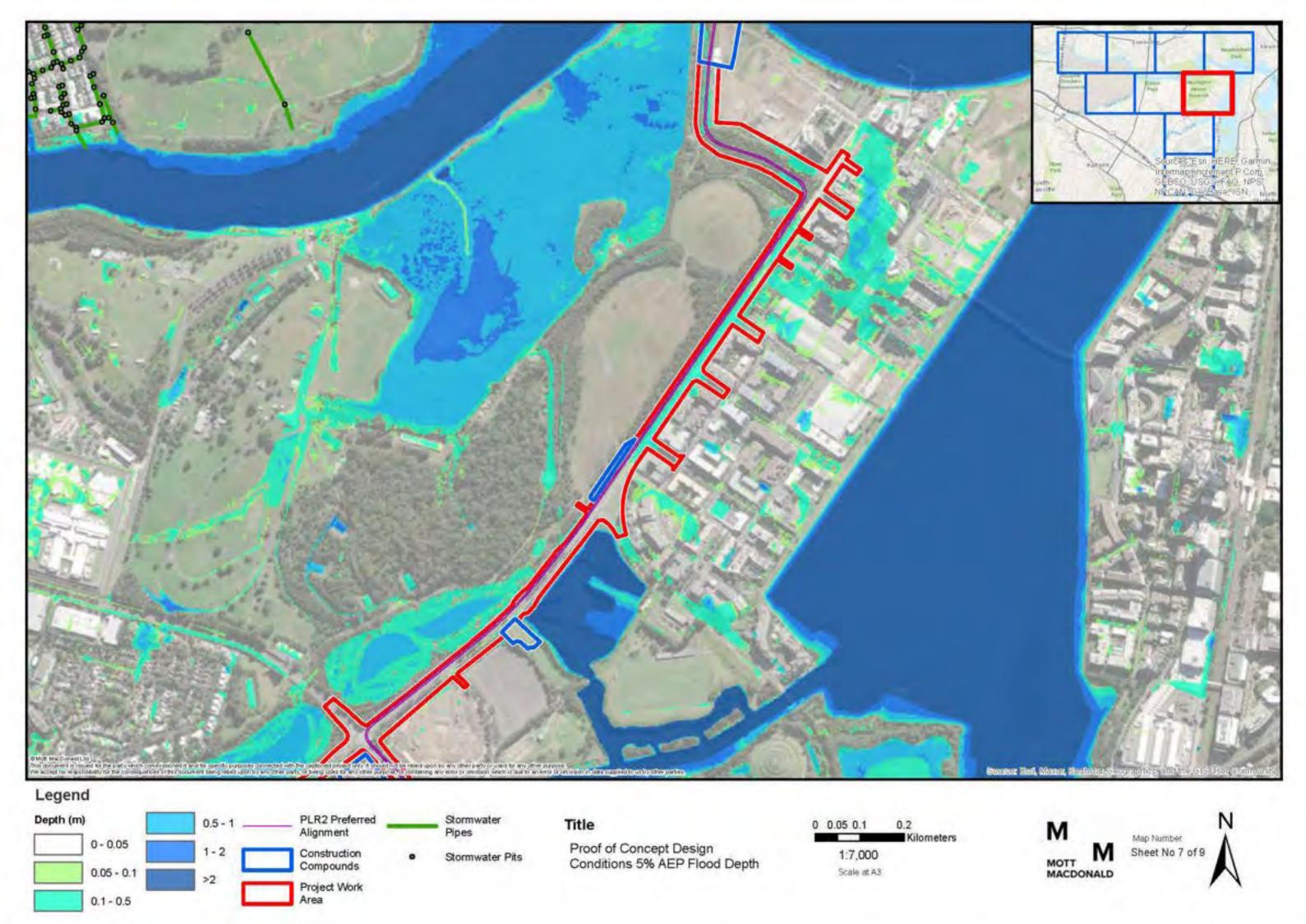


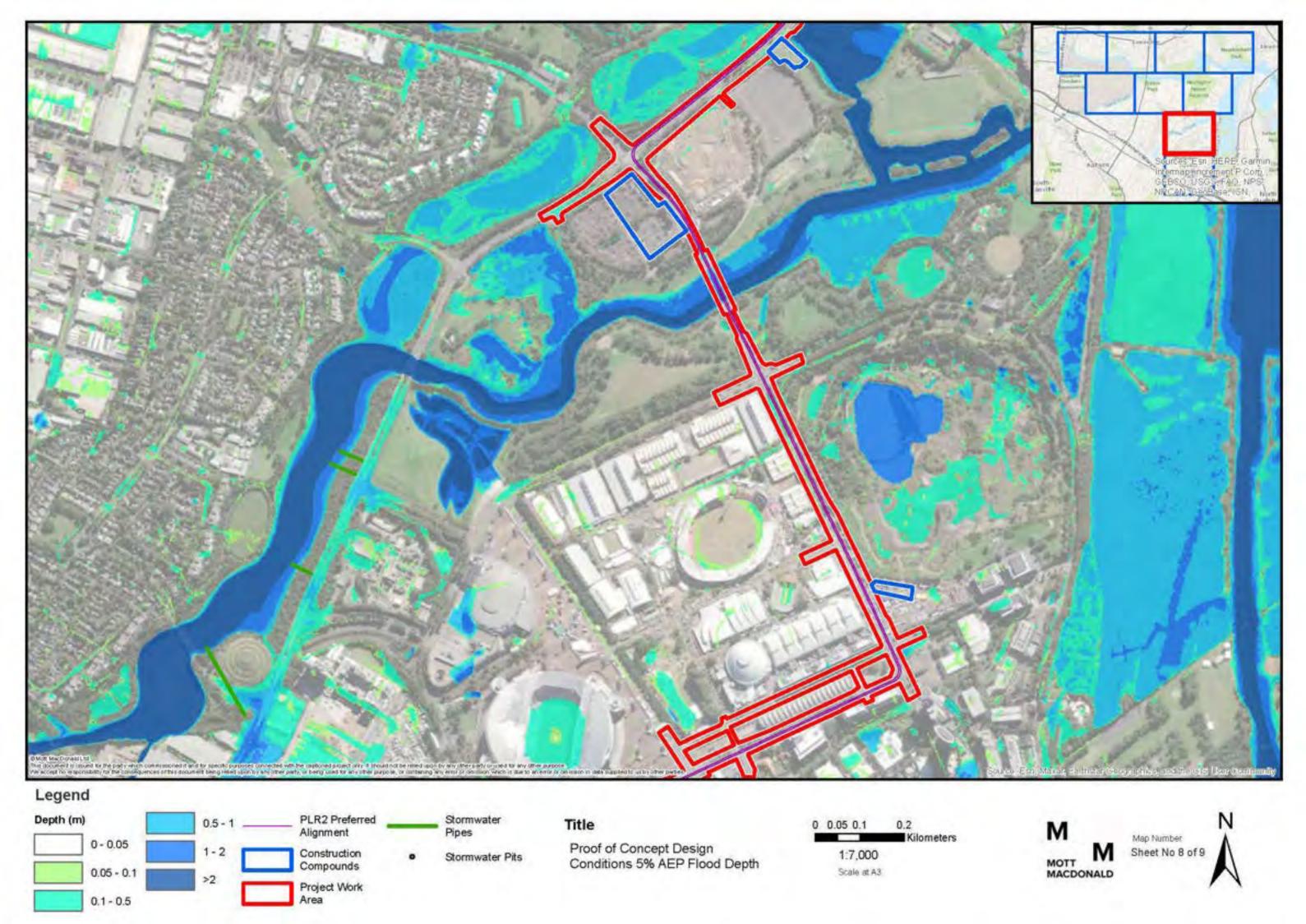


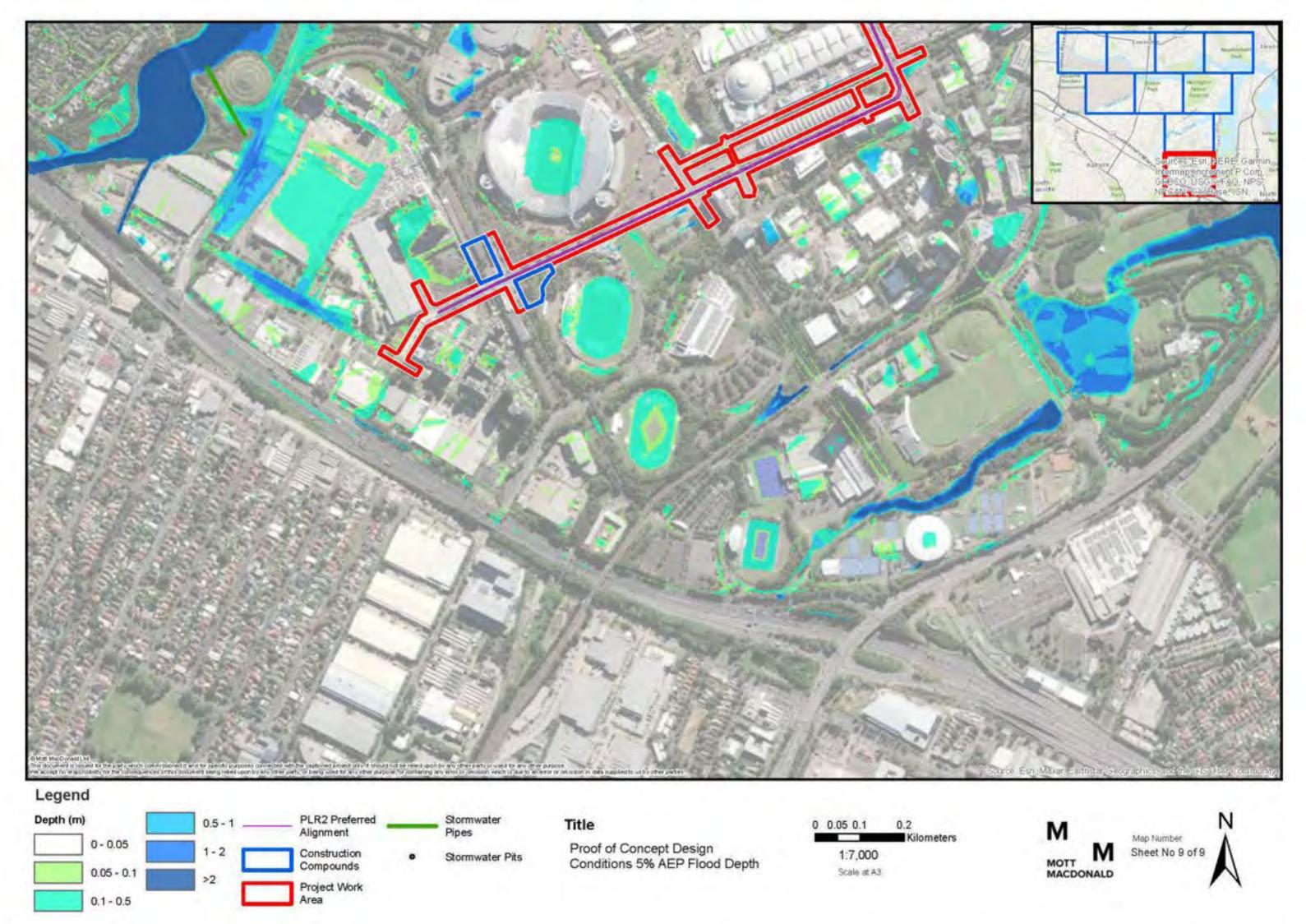


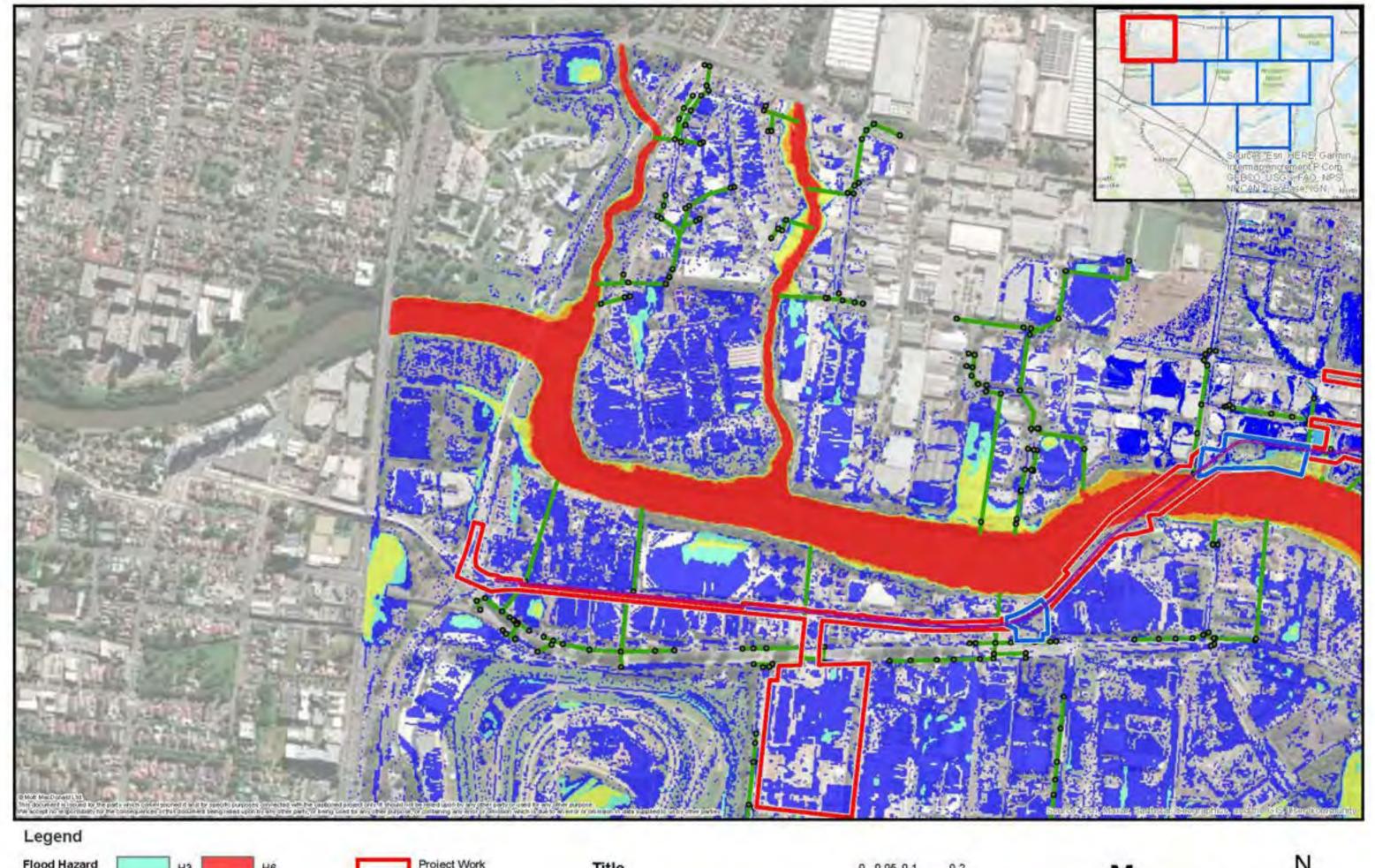


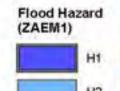












НЗ H5 Compounds



Construction

Project Work Area

Stormwater Pipes

Stormwater Pits

Title

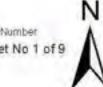
Proof of Concept Design Conditions 5% AEP Flood Hazard

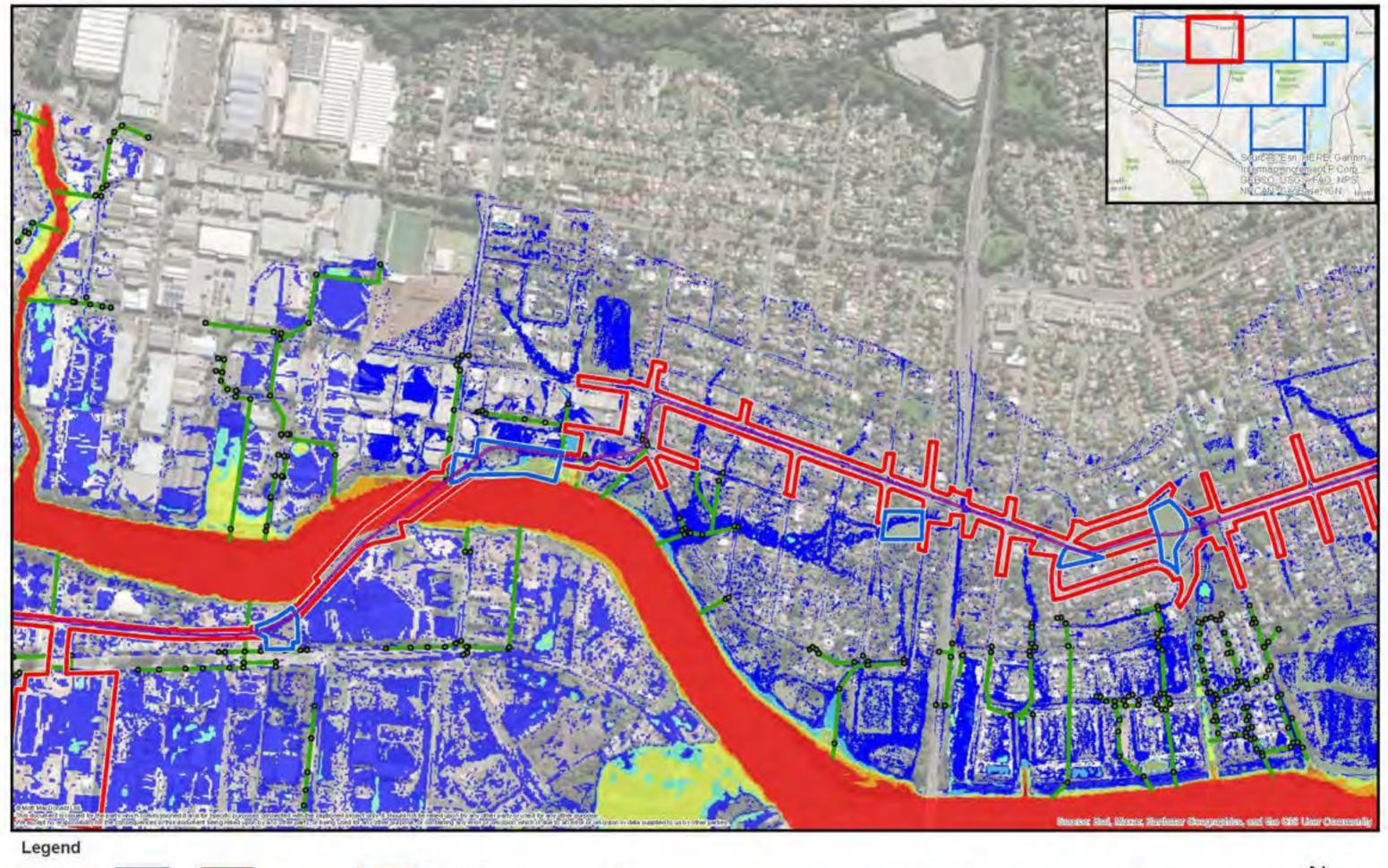
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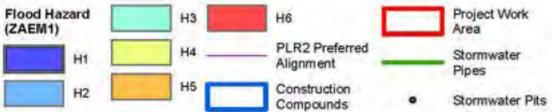
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Map Number Sheet No 1 of 9







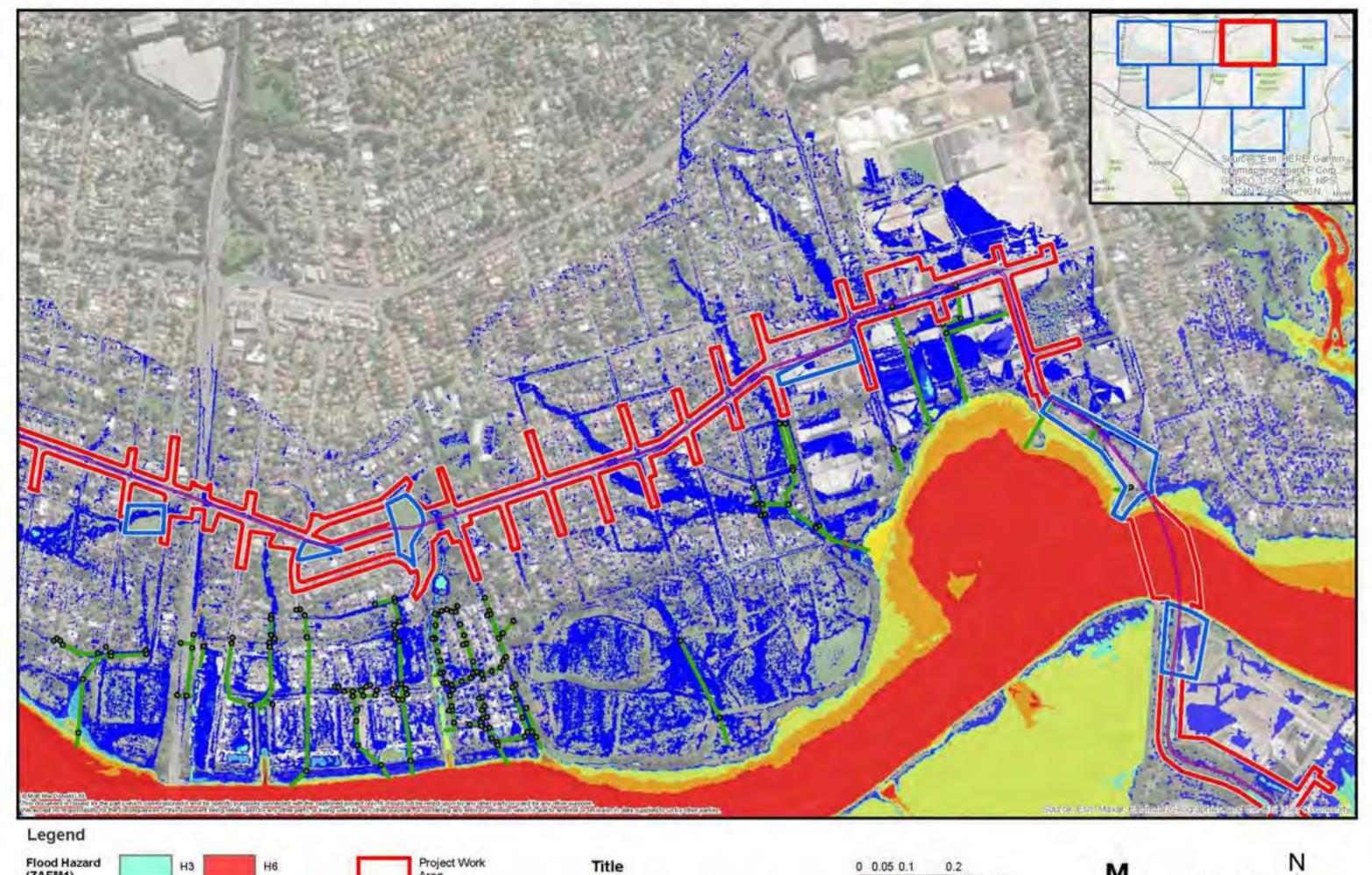
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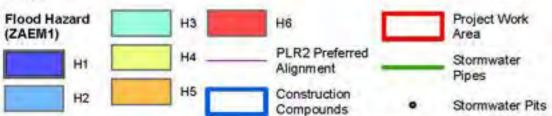
Proof of Concept Design Conditions 5% AEP Flood Hazard



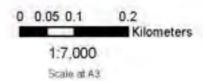


Map Number Sheet No 2 of 9



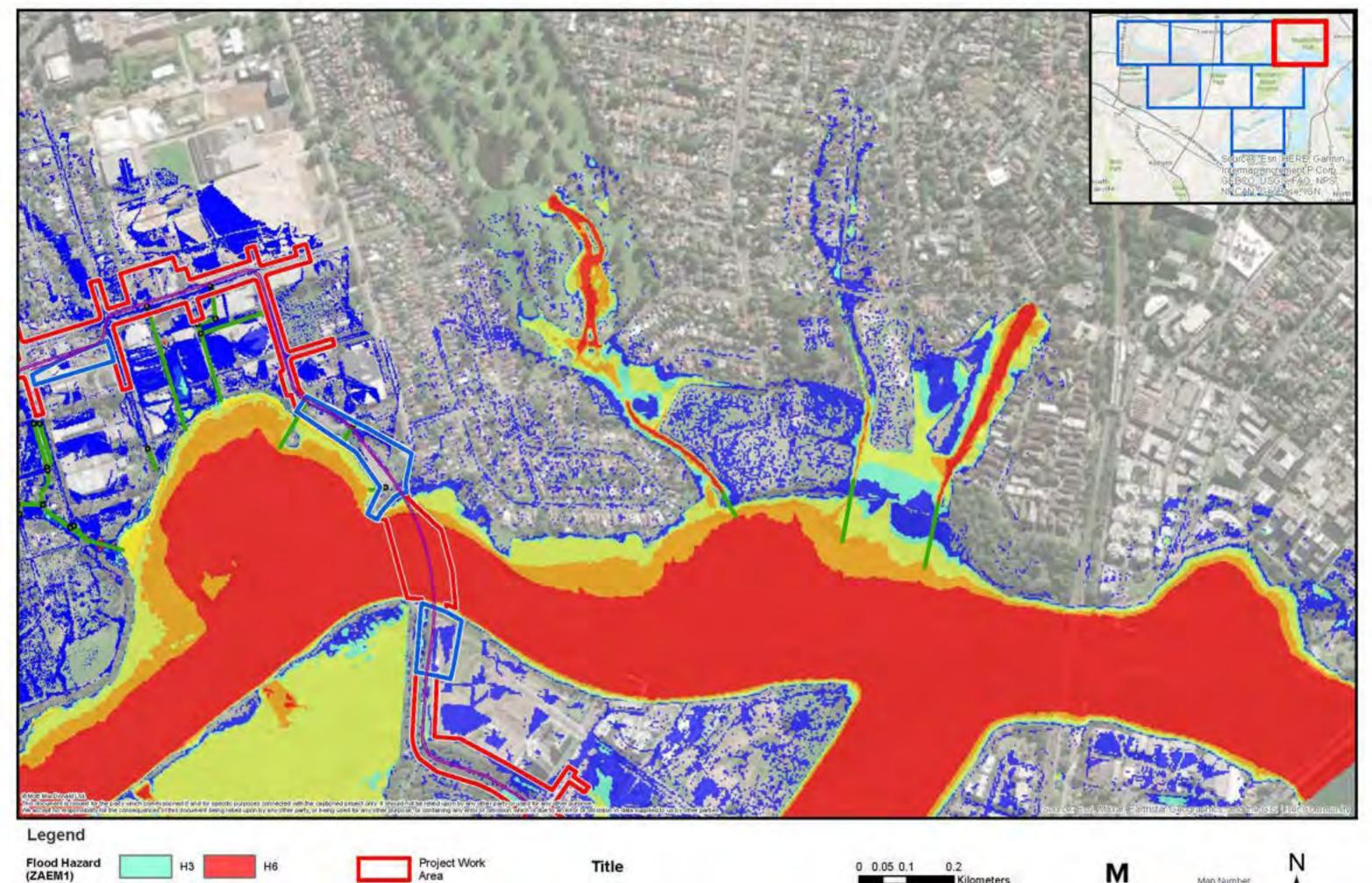


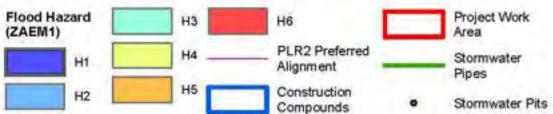




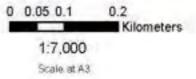


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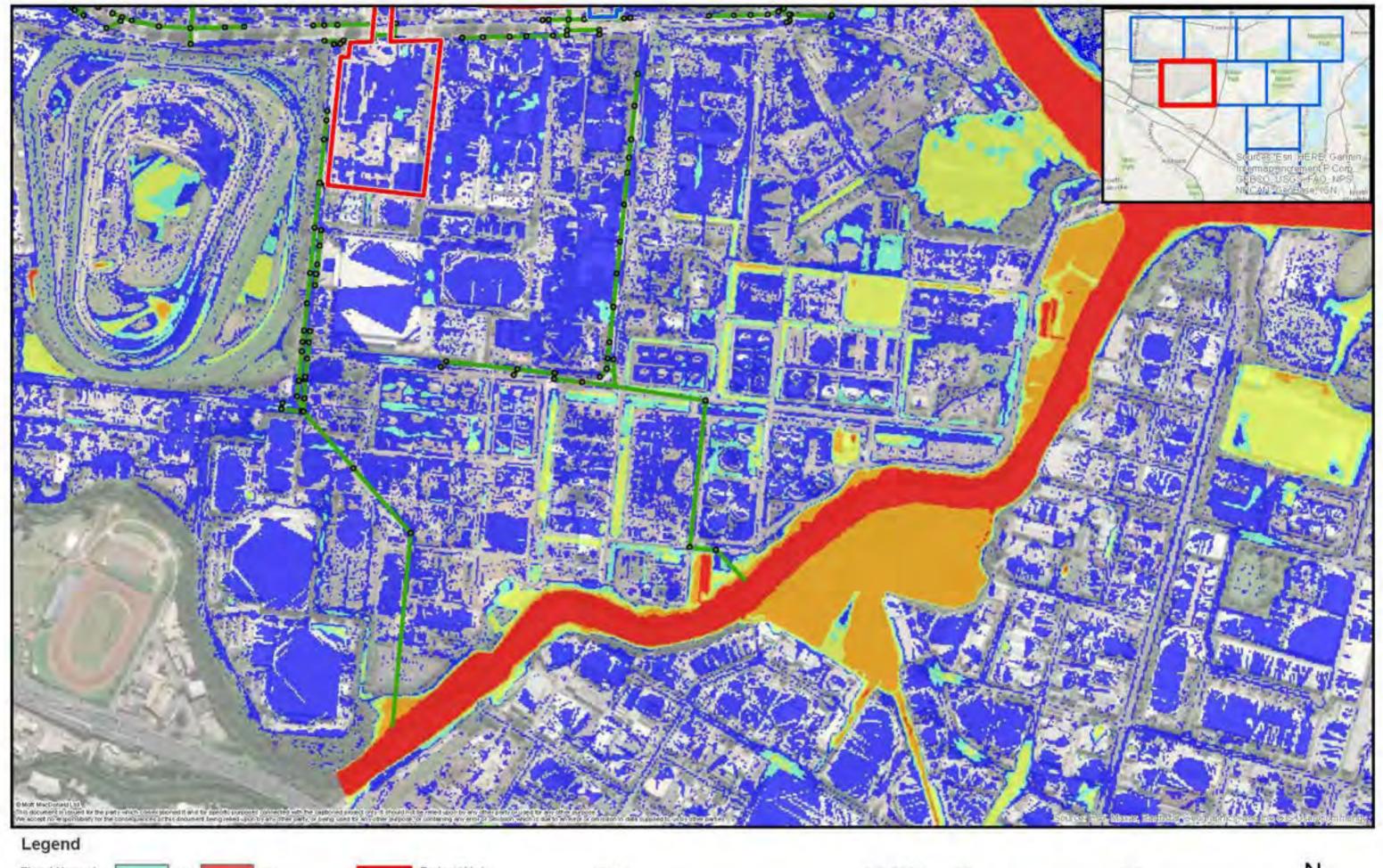


Proof of Concept Design Conditions 5% AEP Flood Hazard

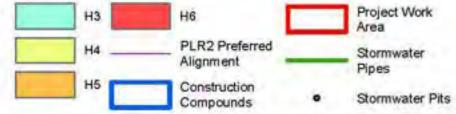




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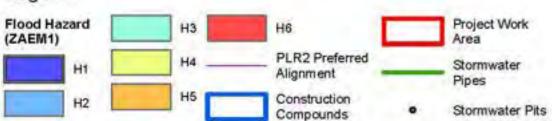
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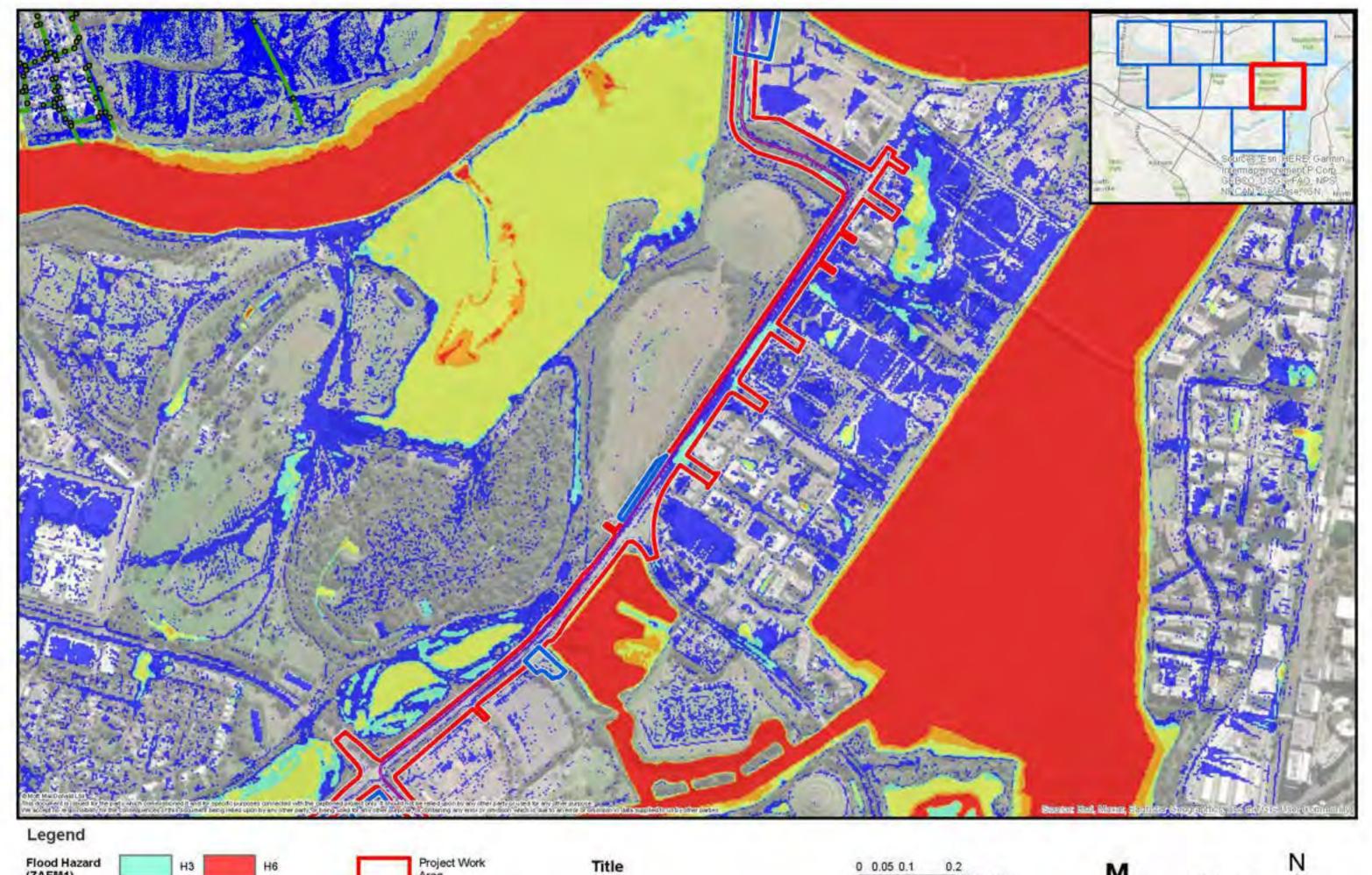


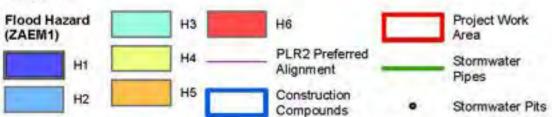
Proof of Concept Design Conditions 5% AEP Flood Hazard





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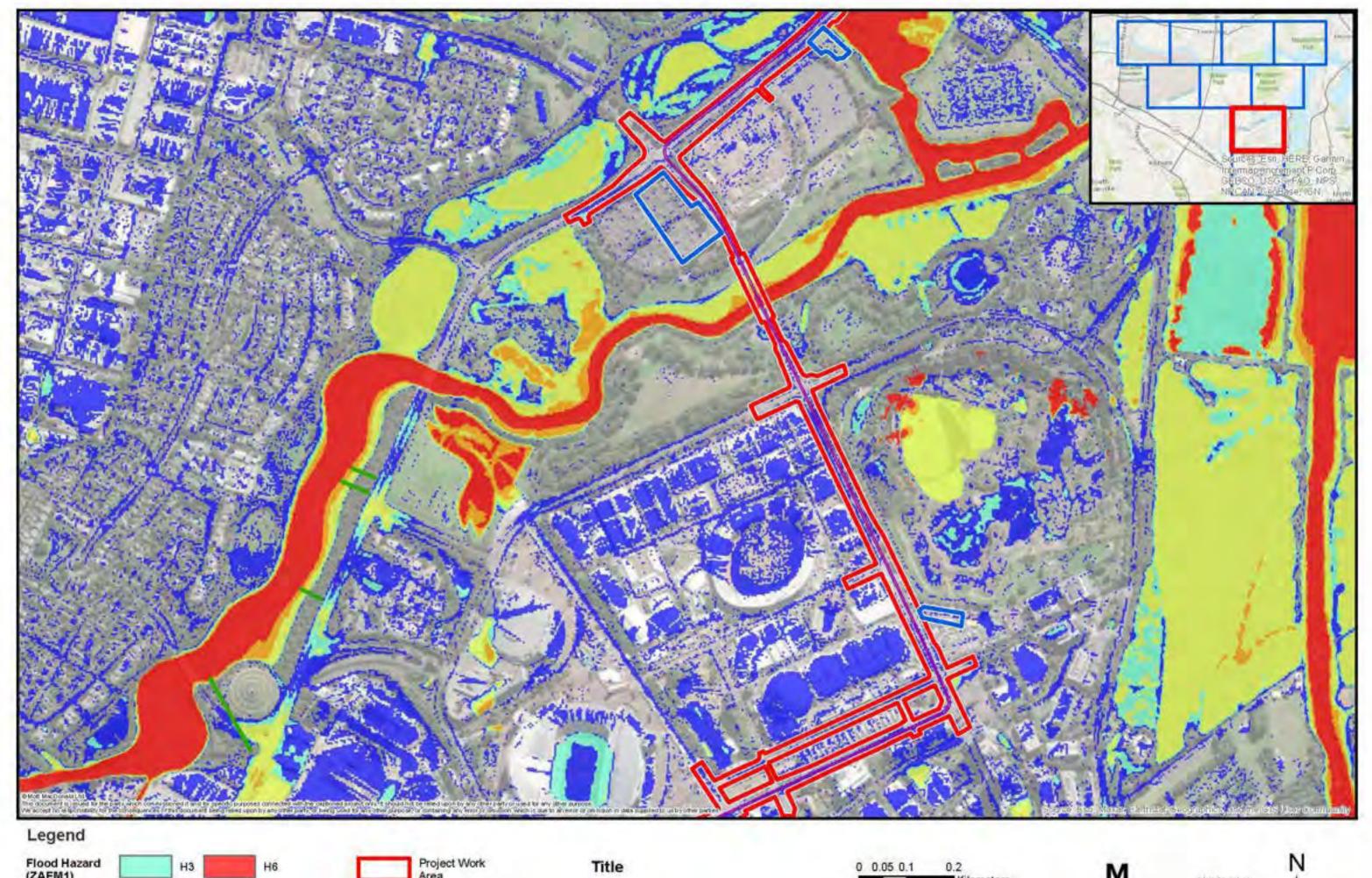


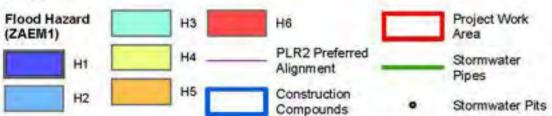
Proof of Concept Design Conditions 5% AEP Flood Hazard





Map Number Sheet No 7 of 9



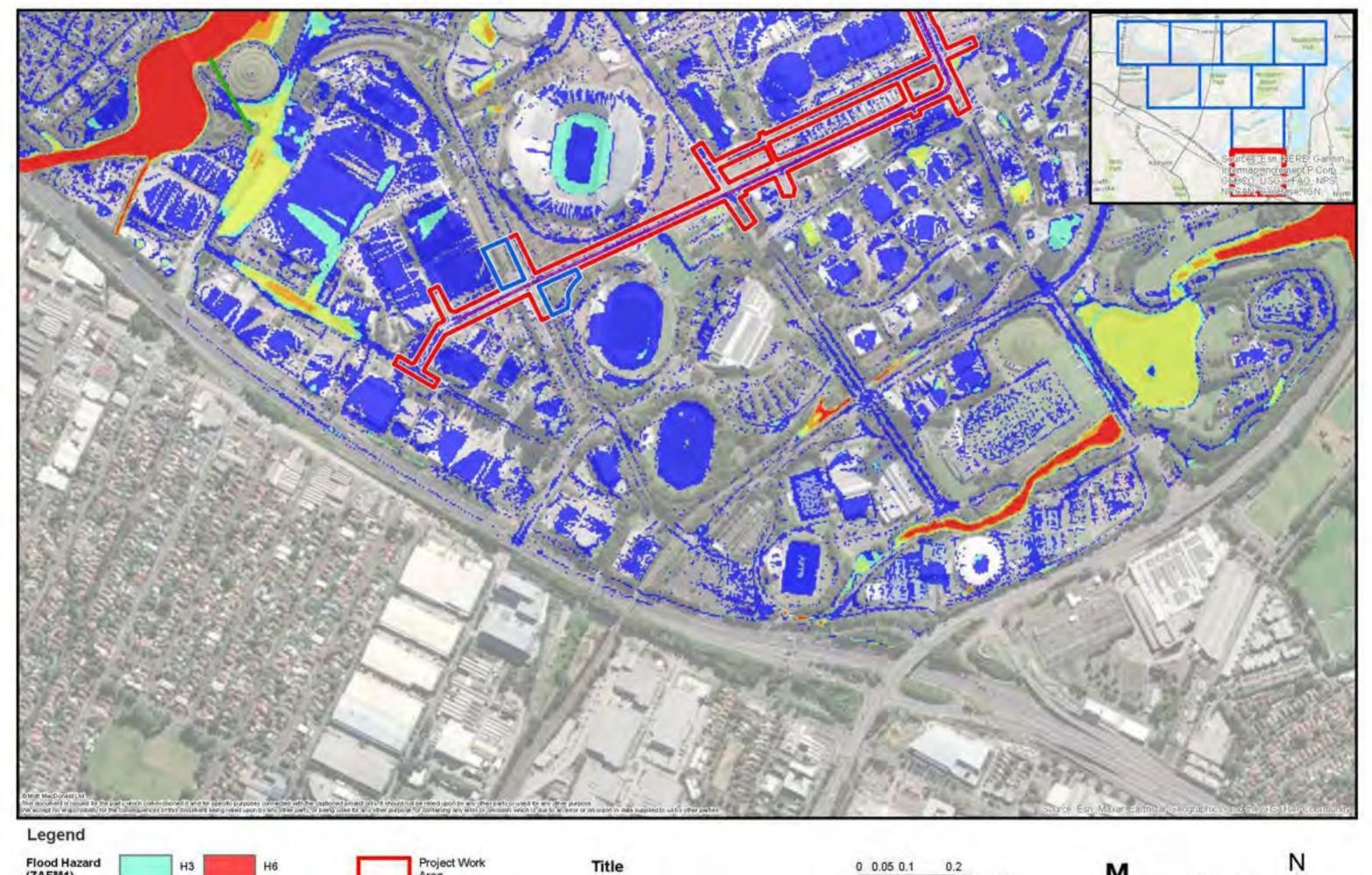


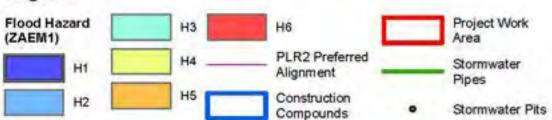
Proof of Concept Design Conditions 5% AEP Flood Hazard





Map Number Sheet No 8 of 9



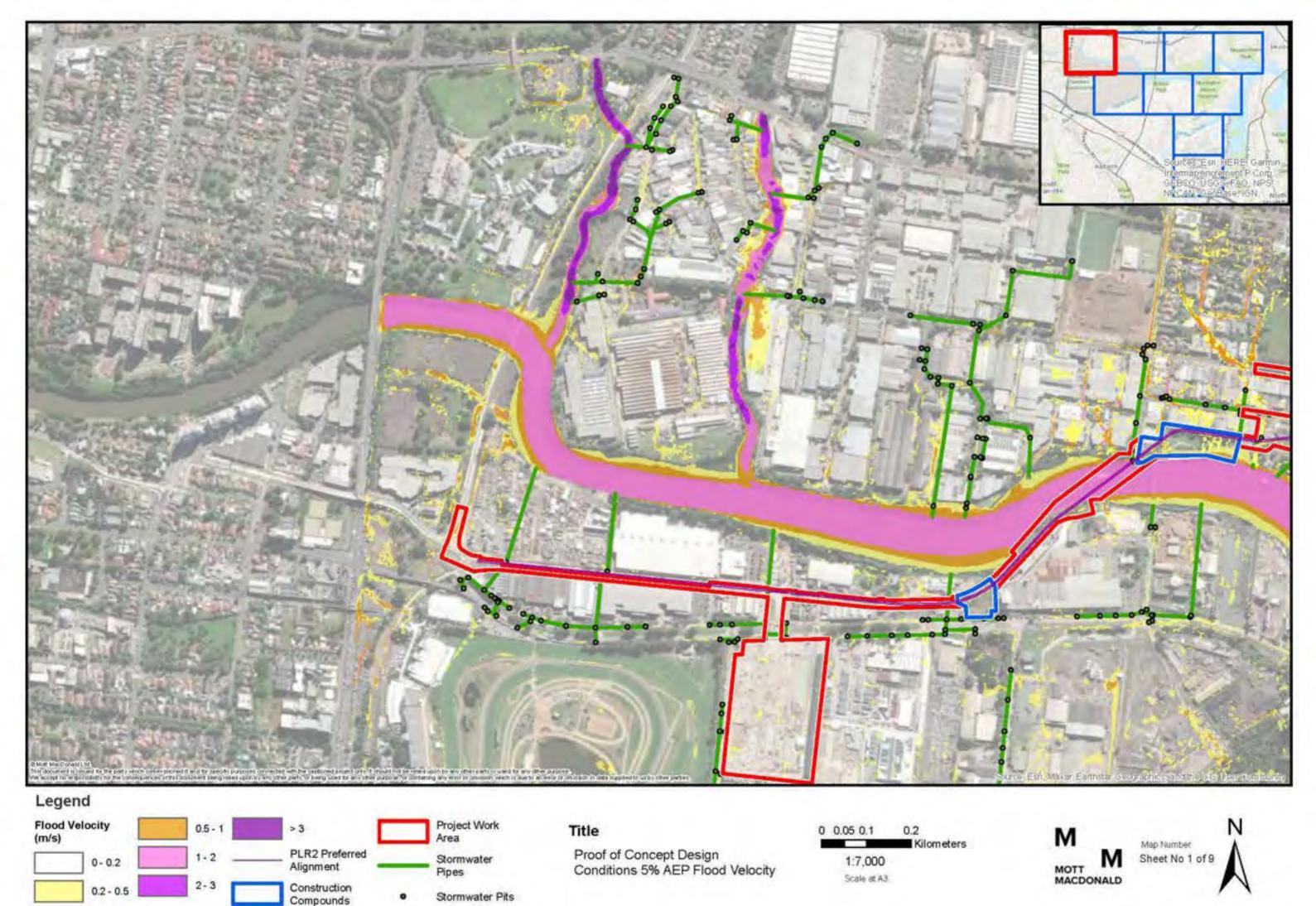


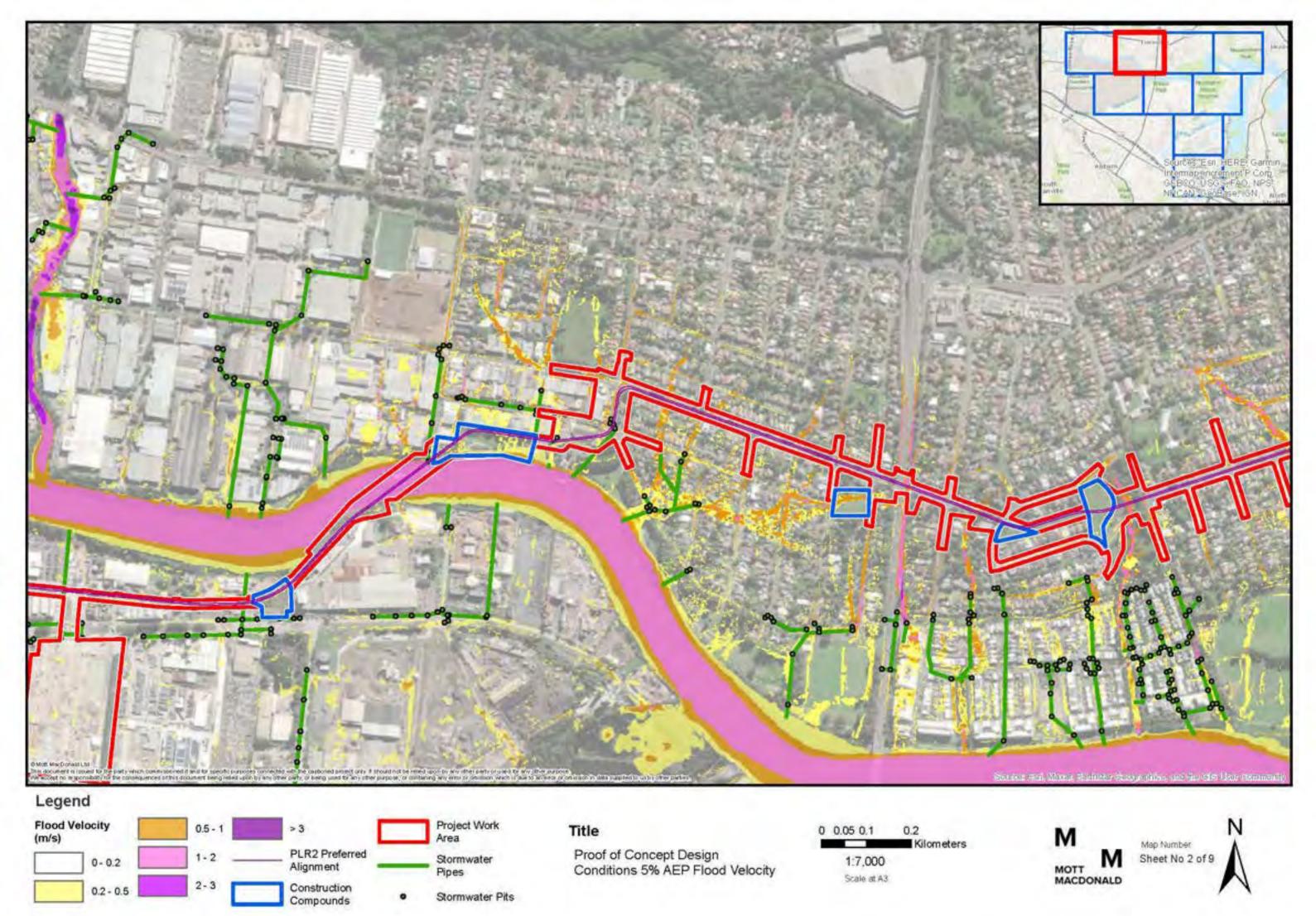
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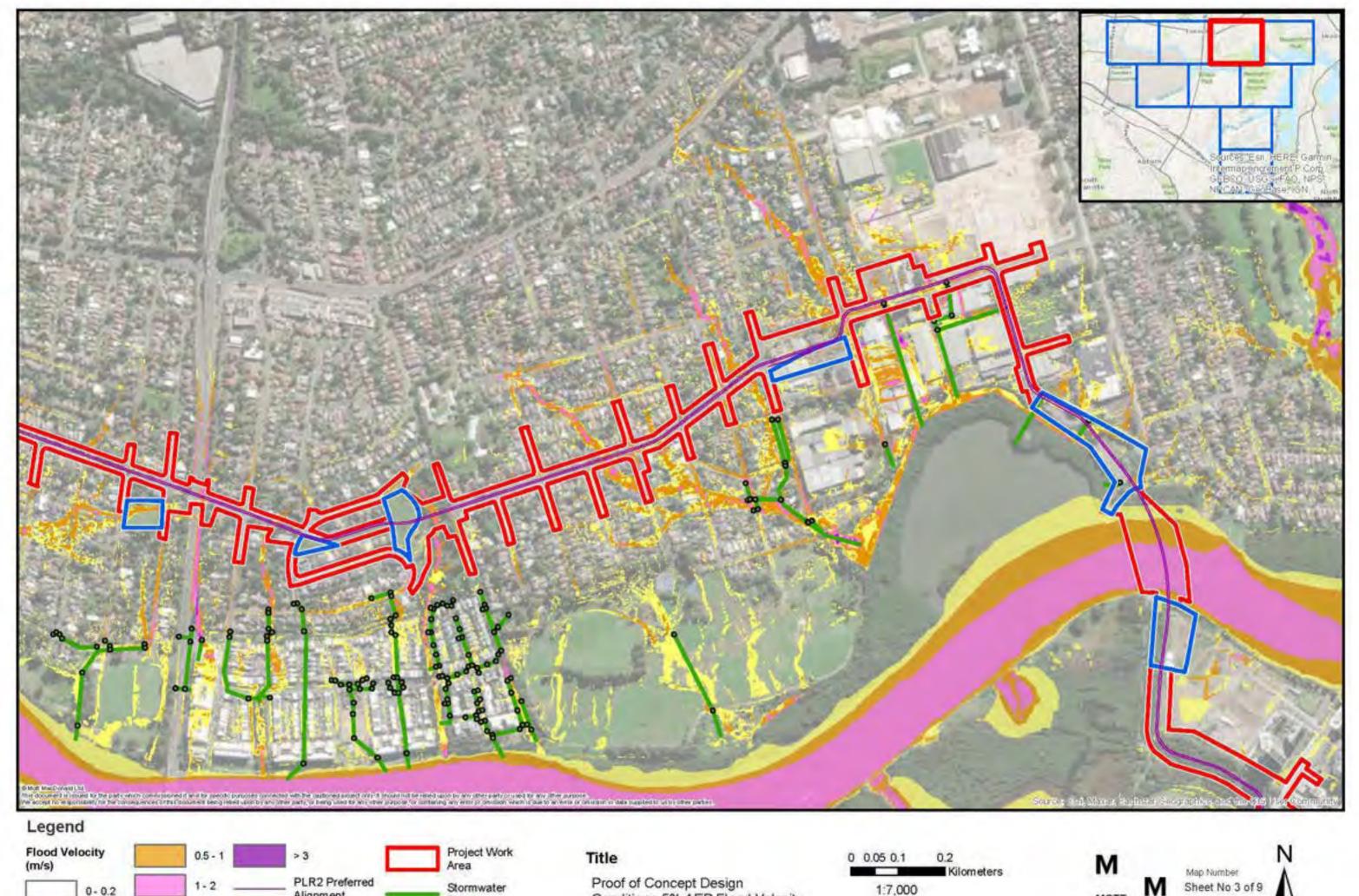


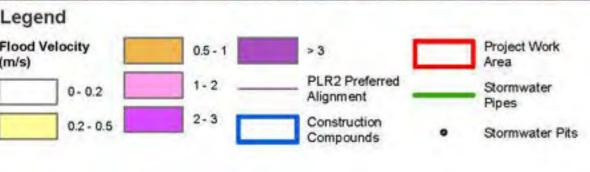


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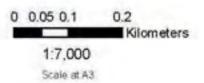




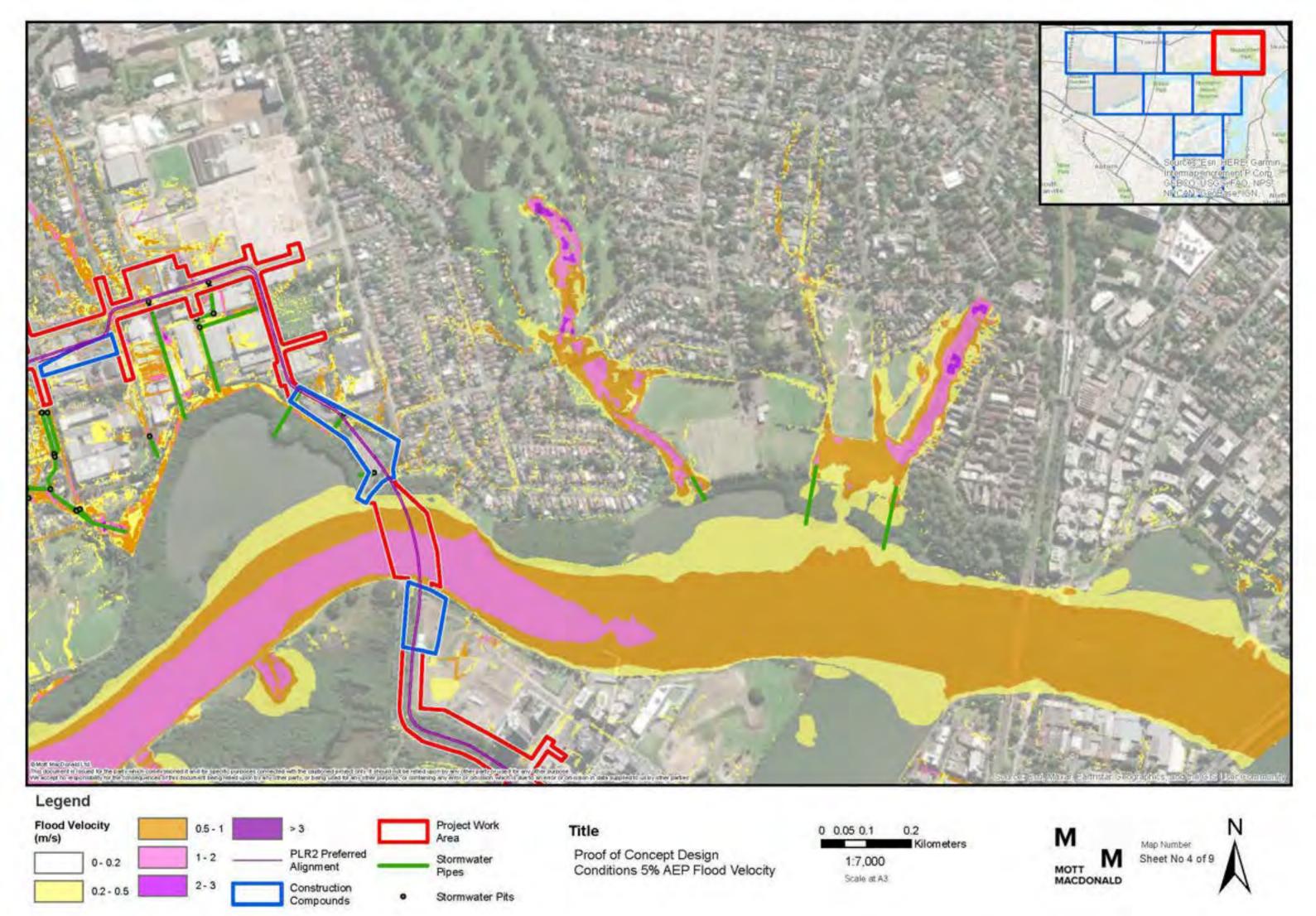


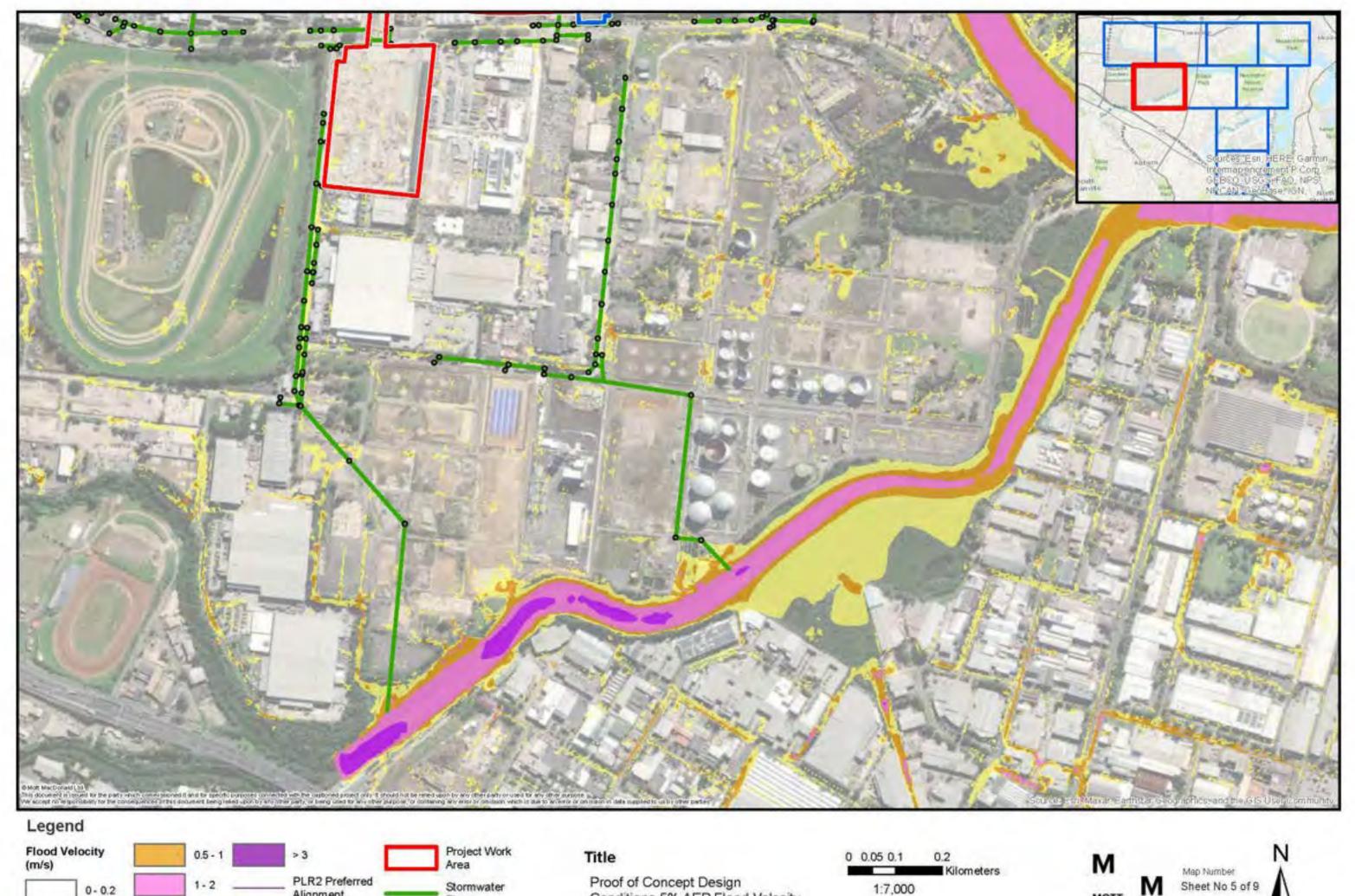


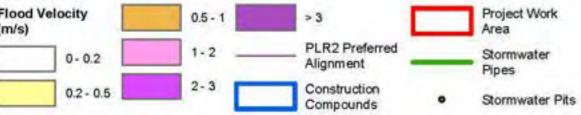






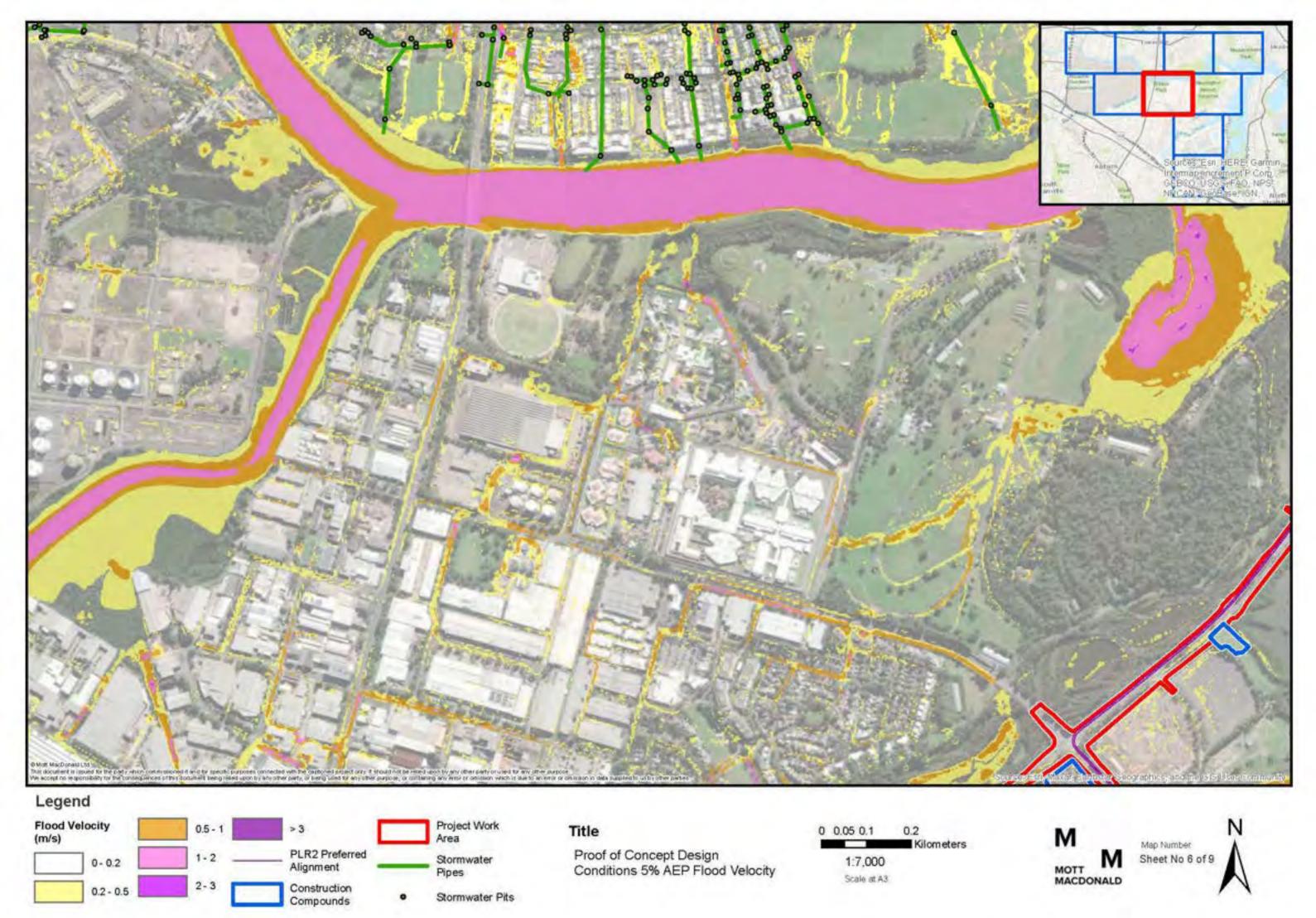


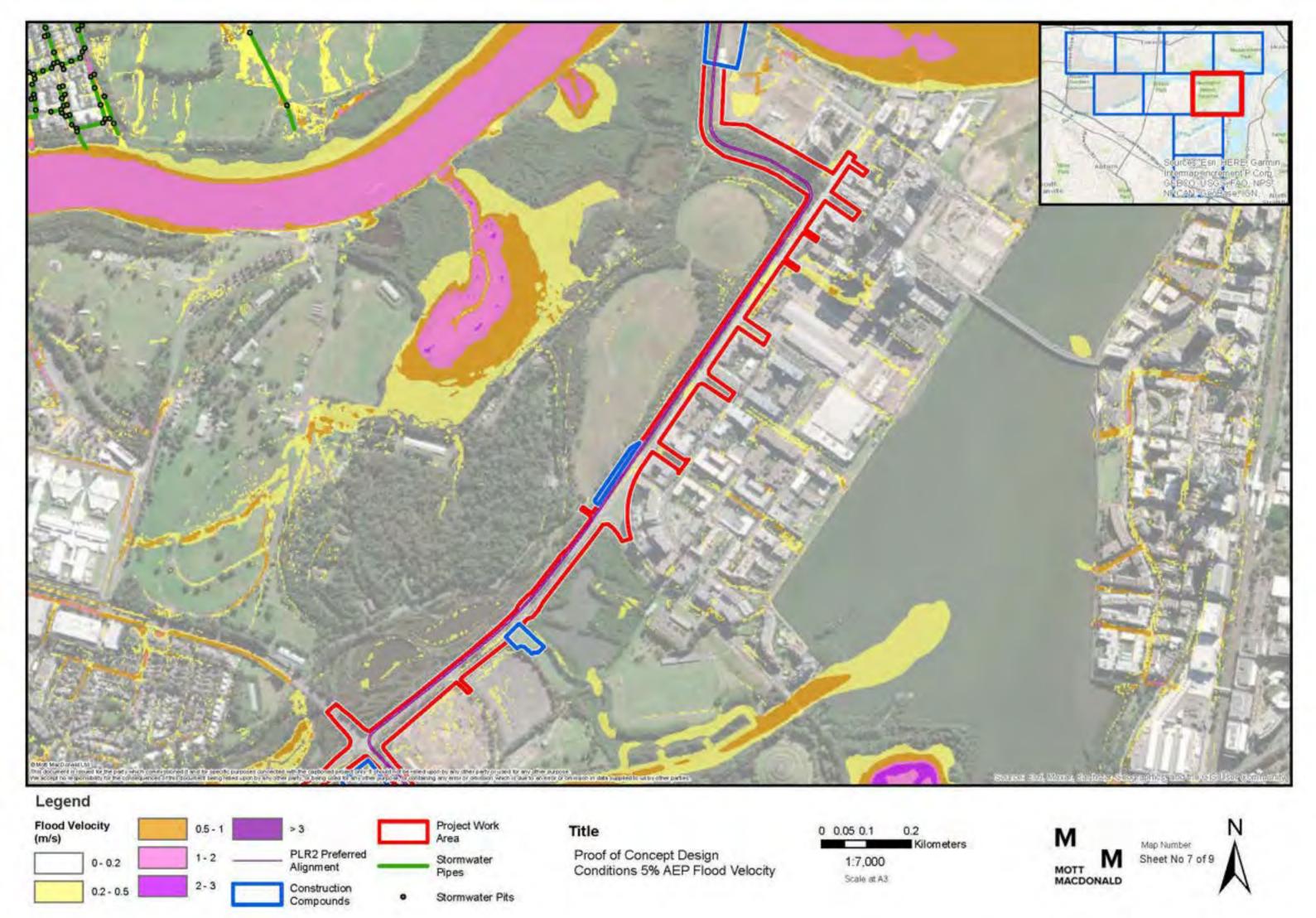


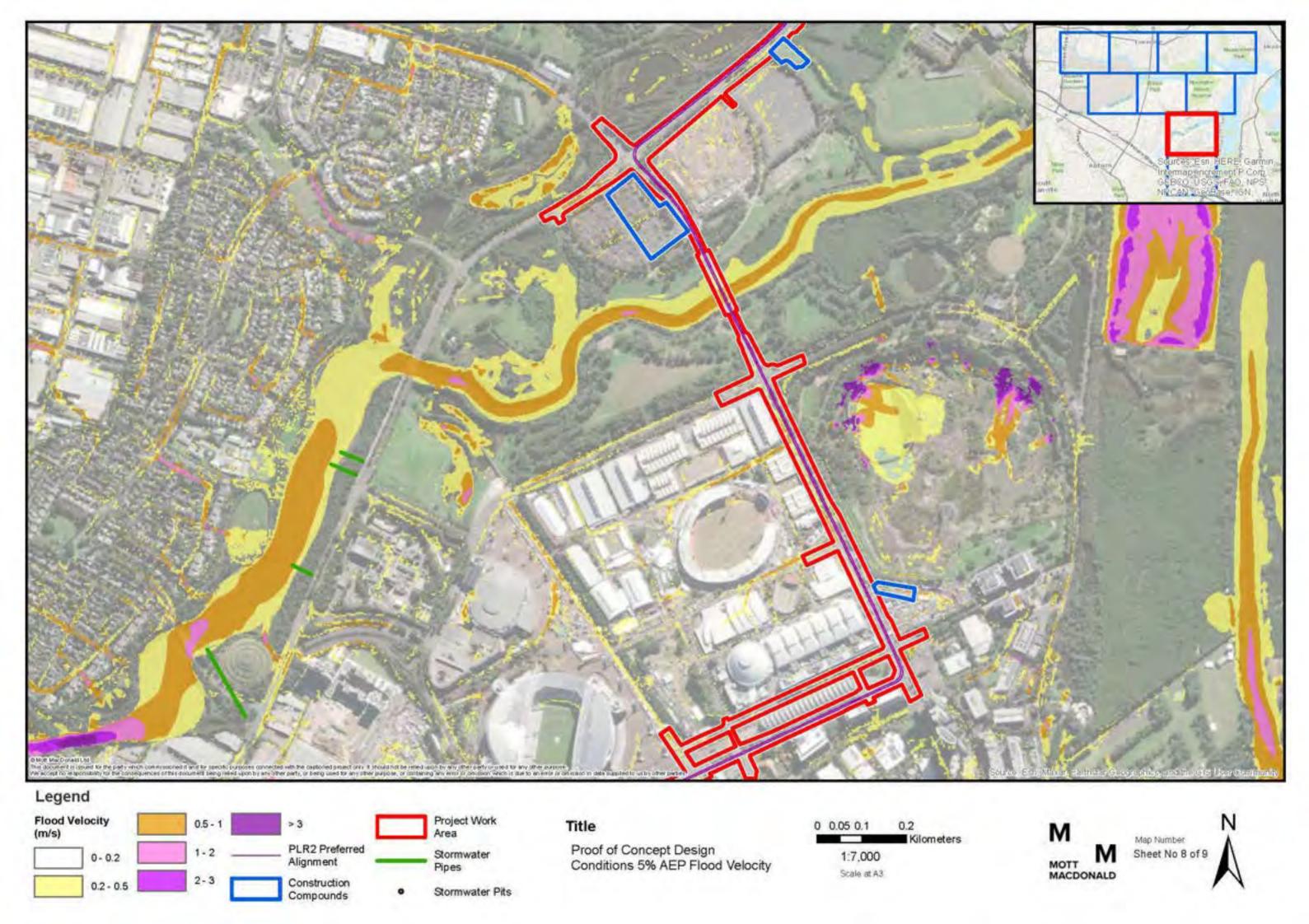


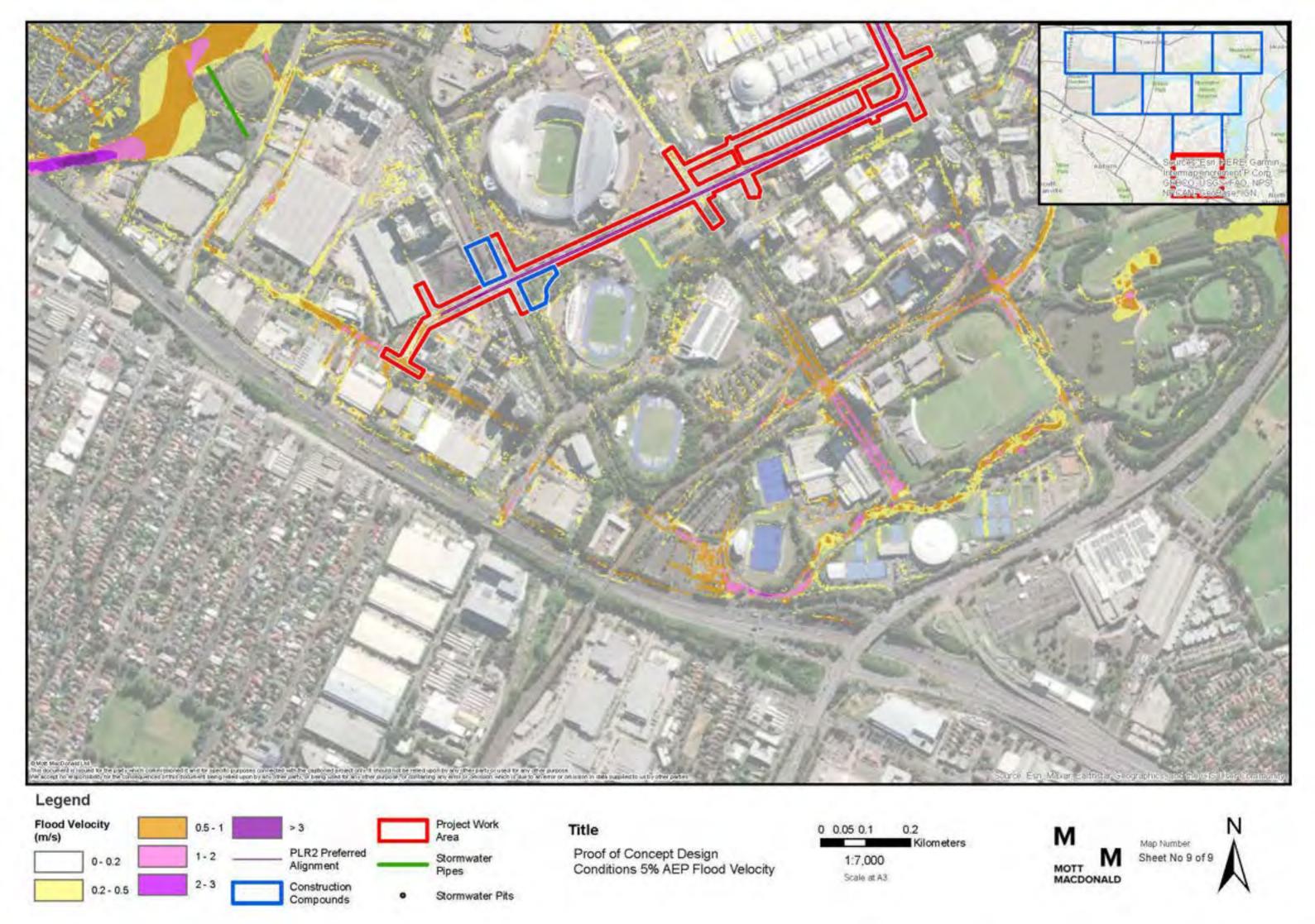


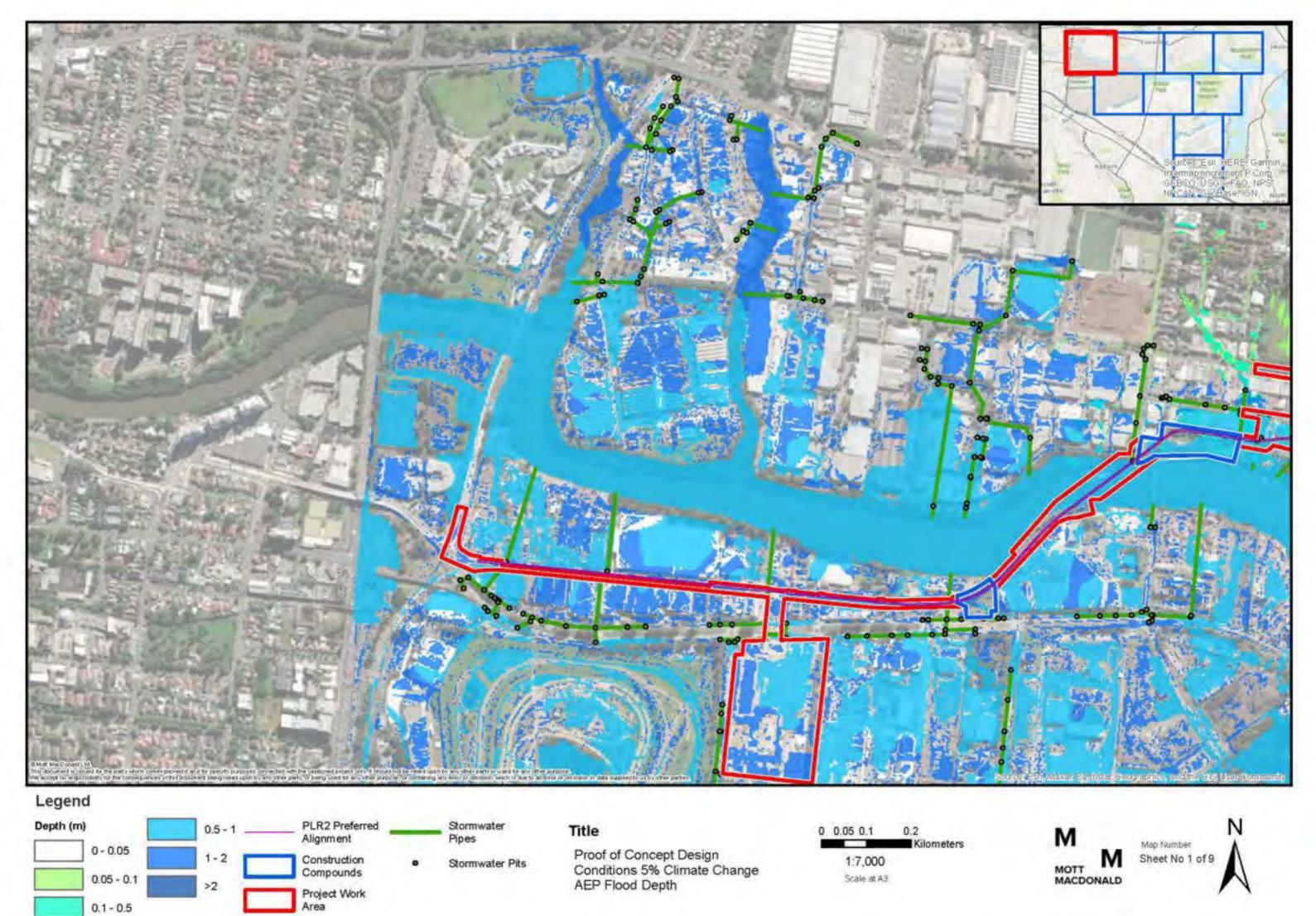


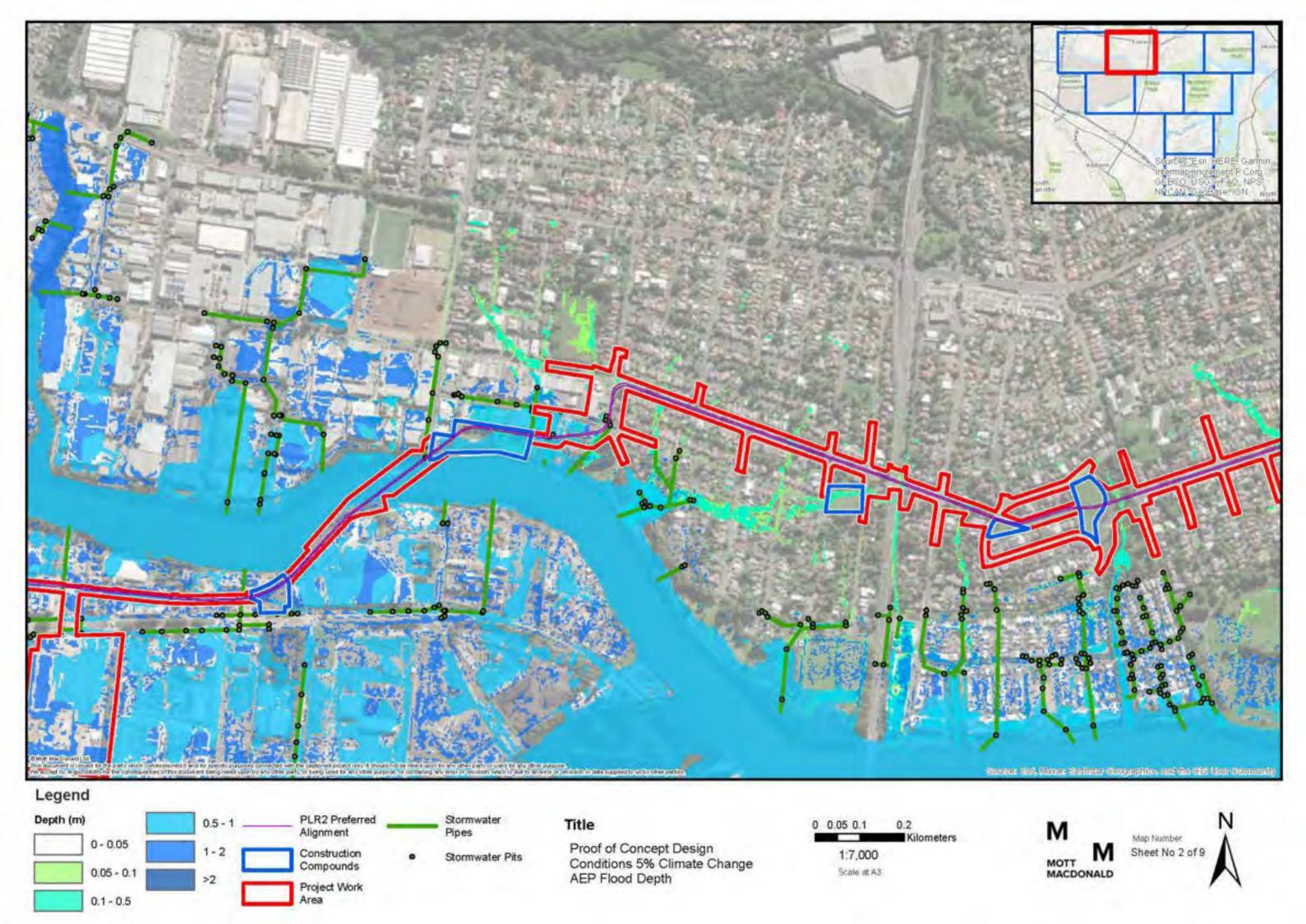


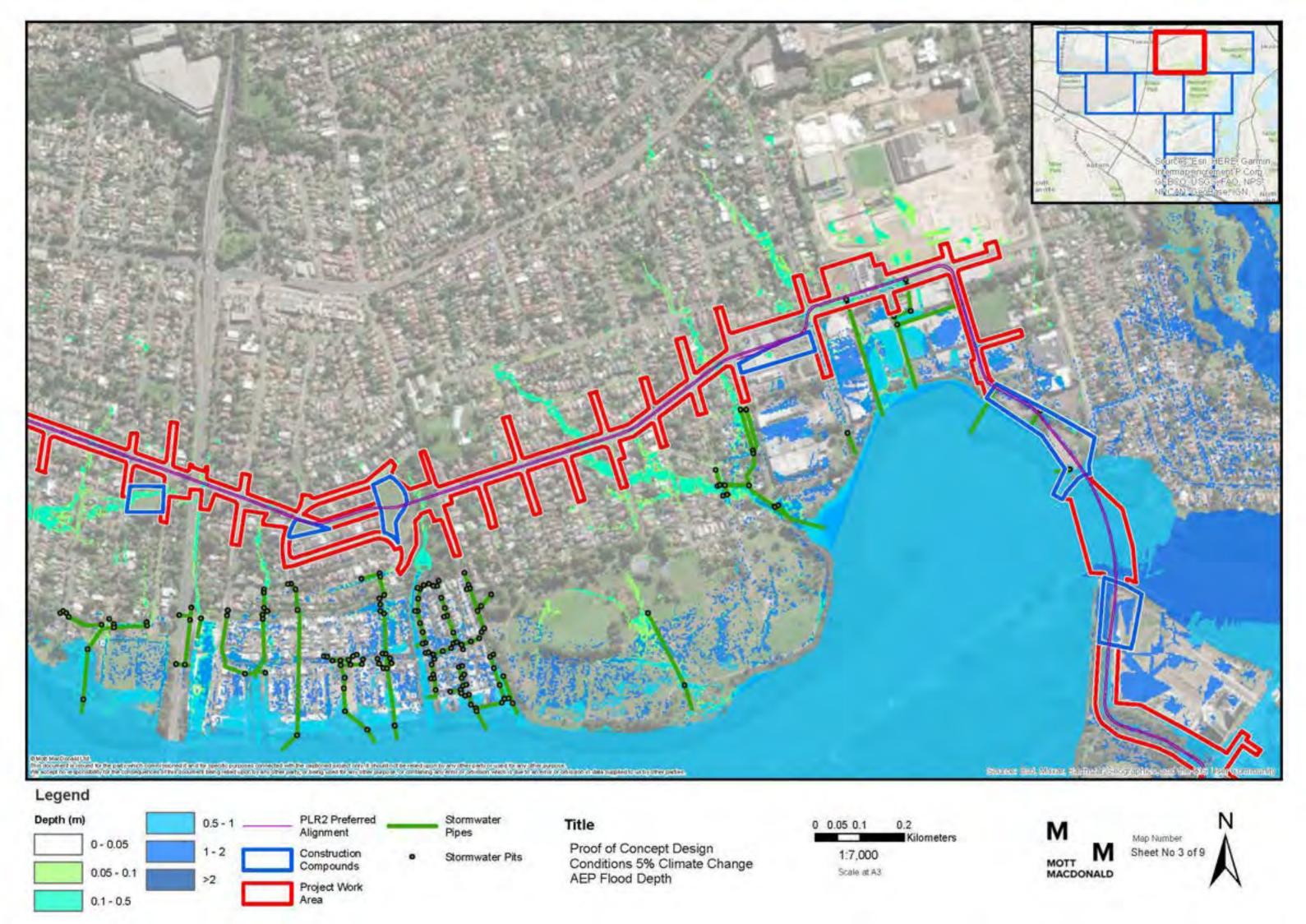


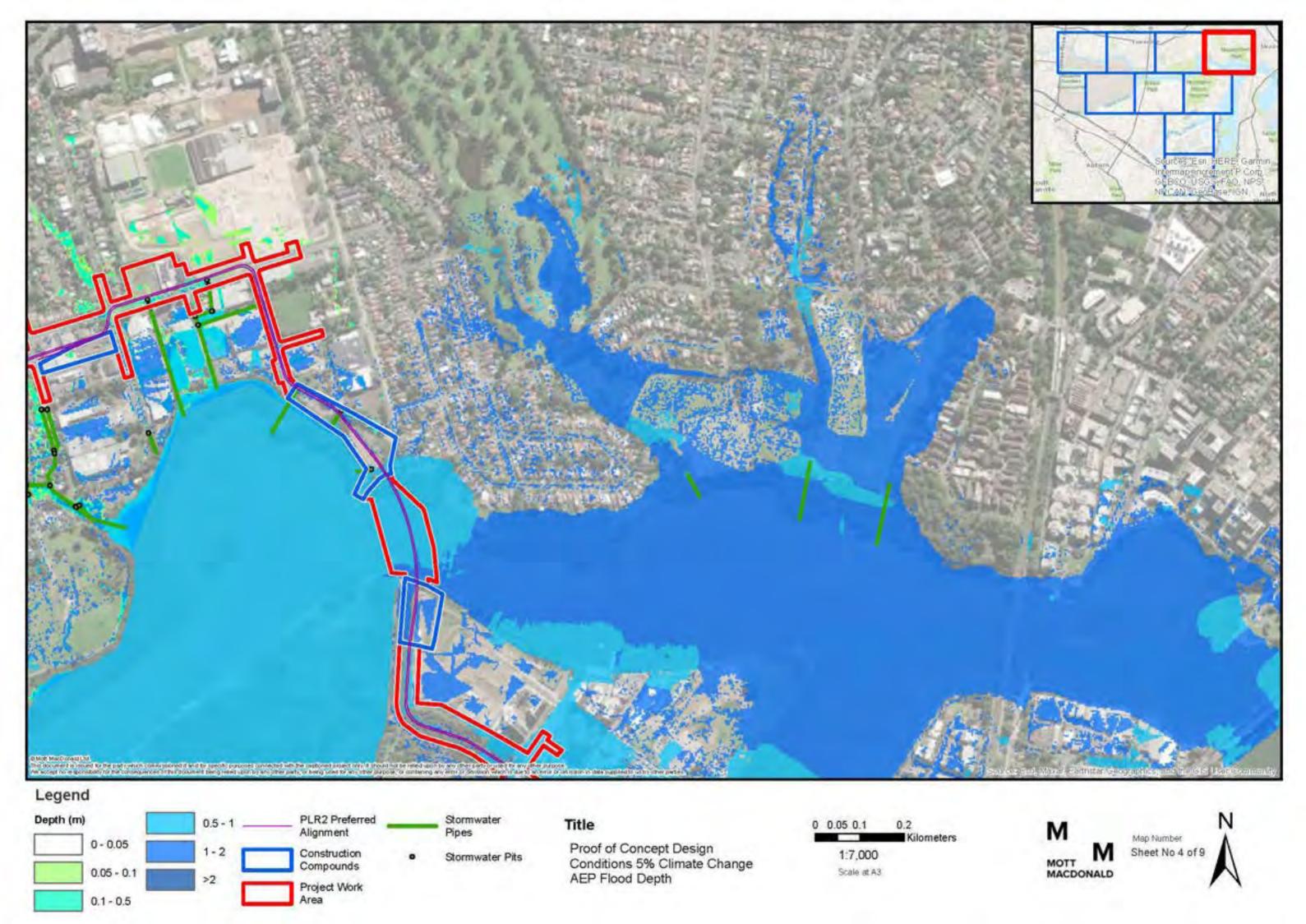


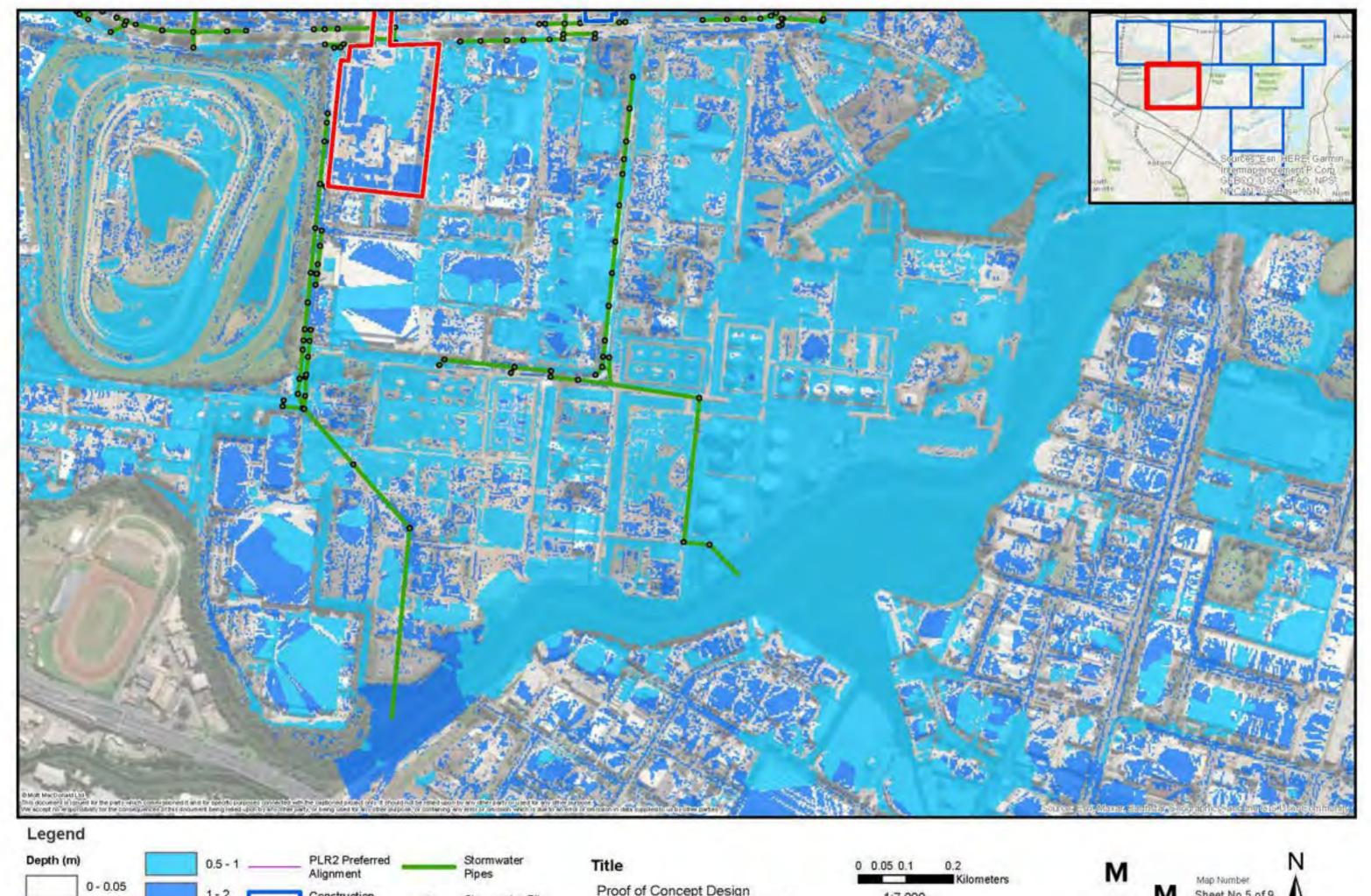


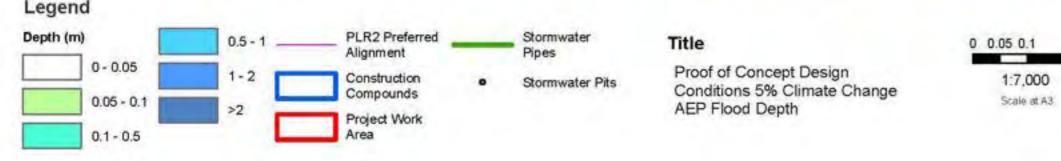






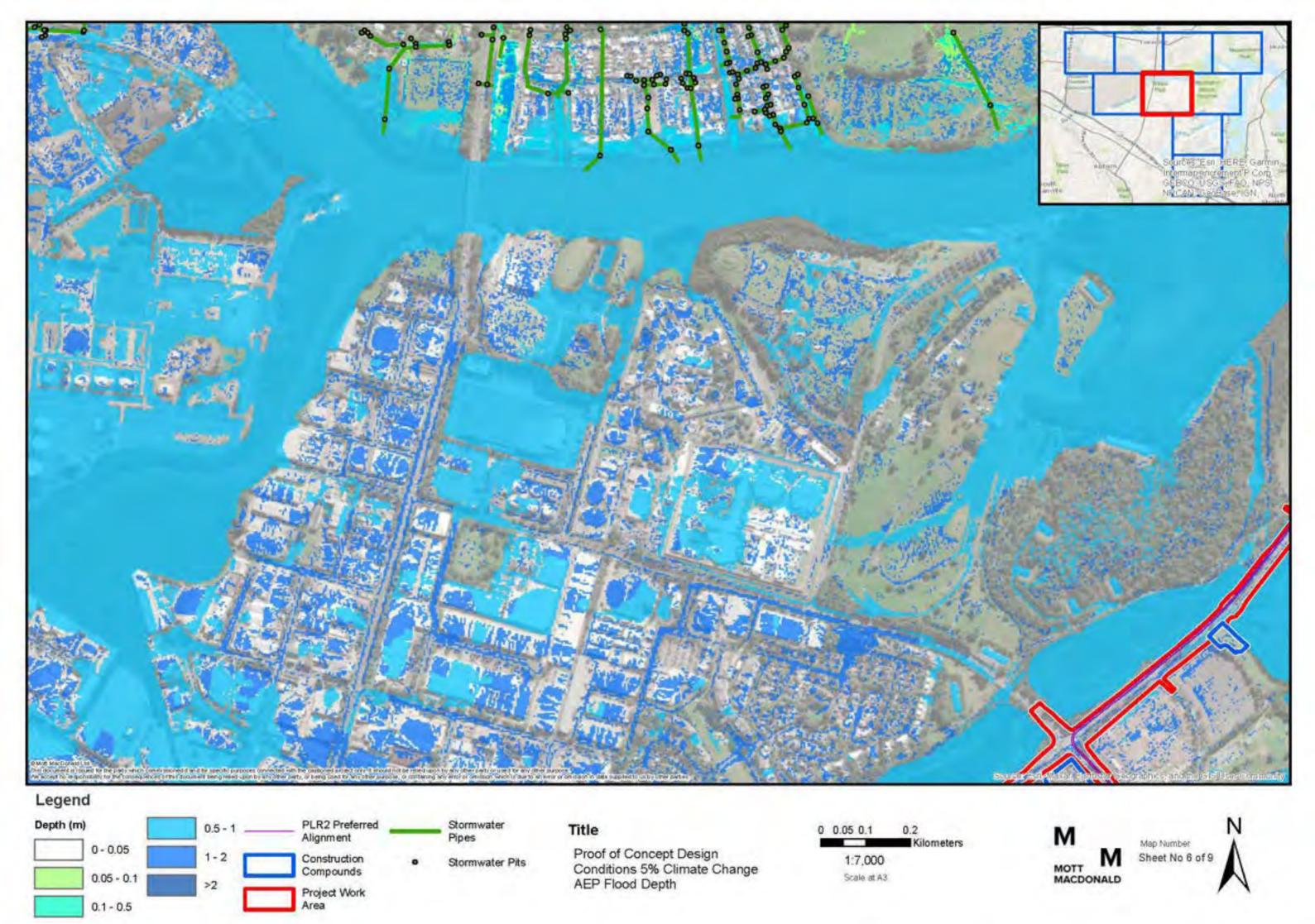


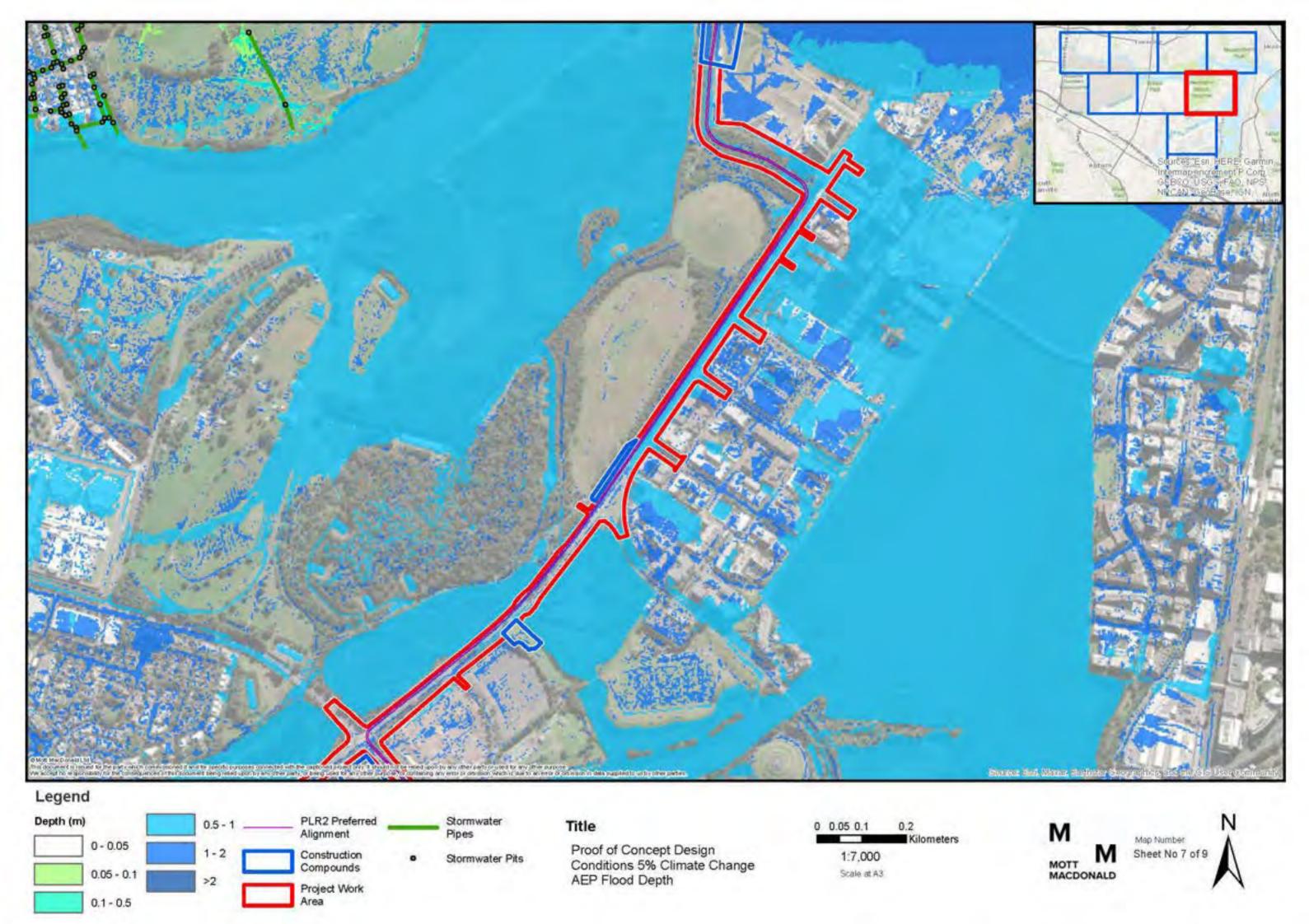


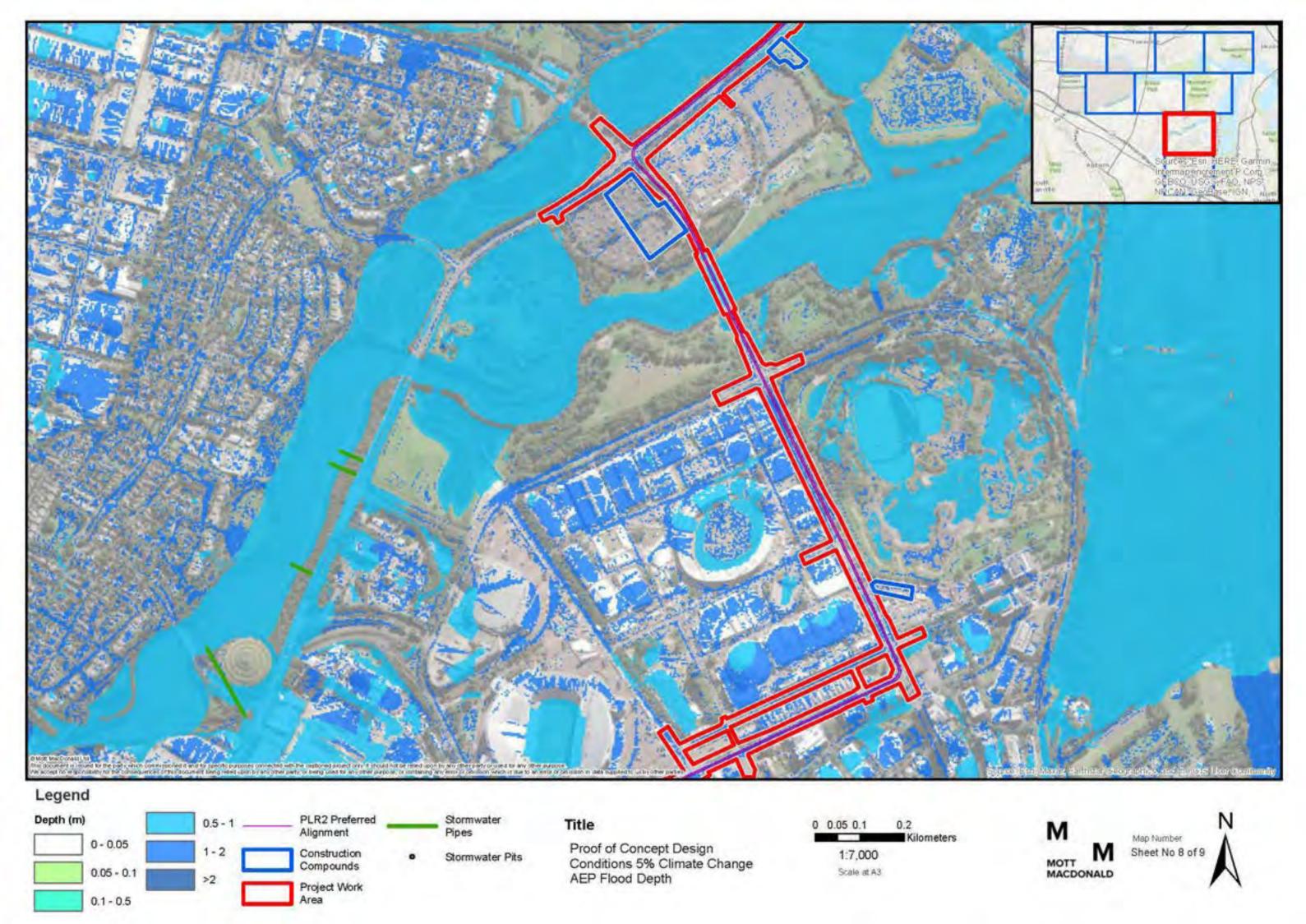


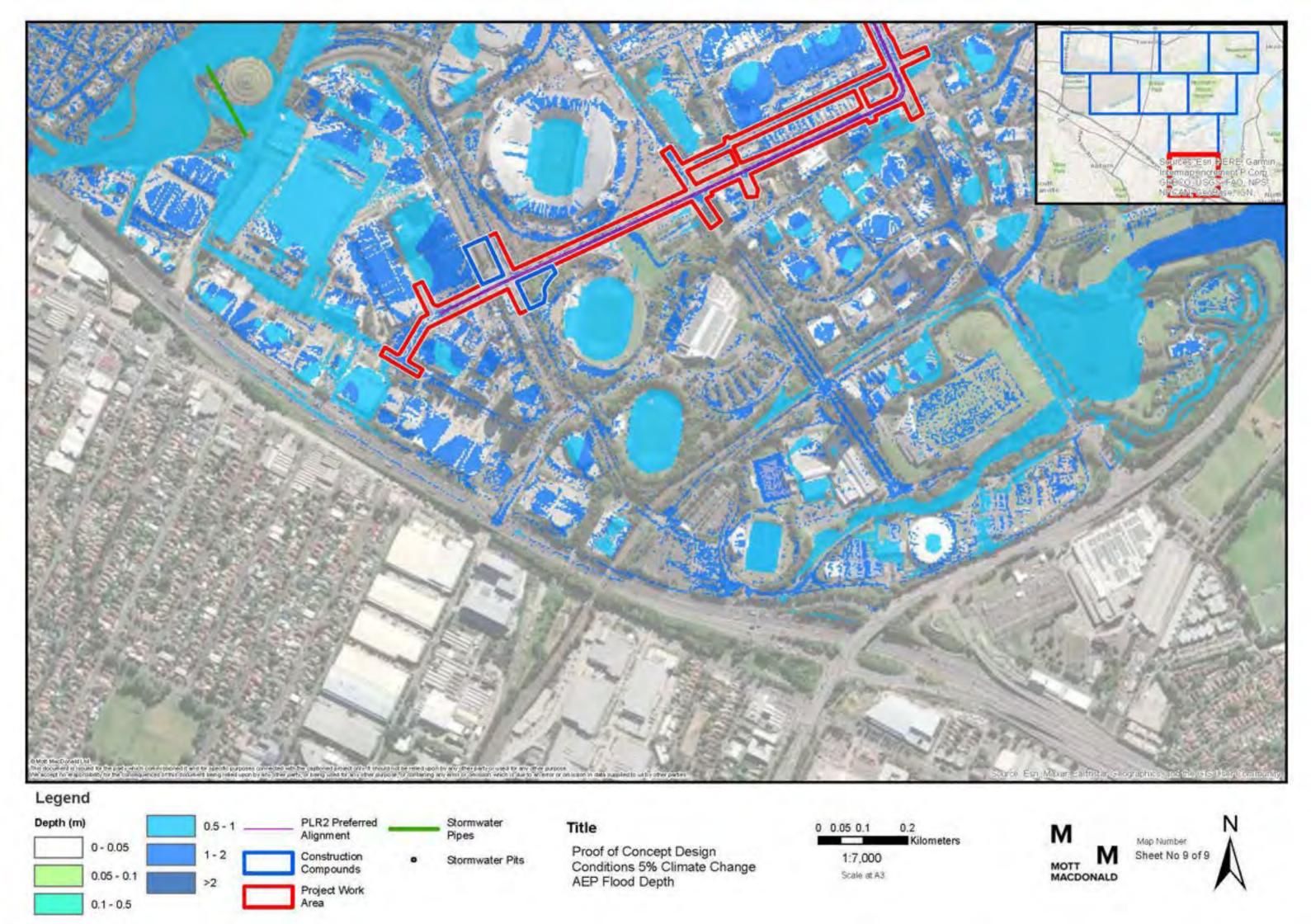


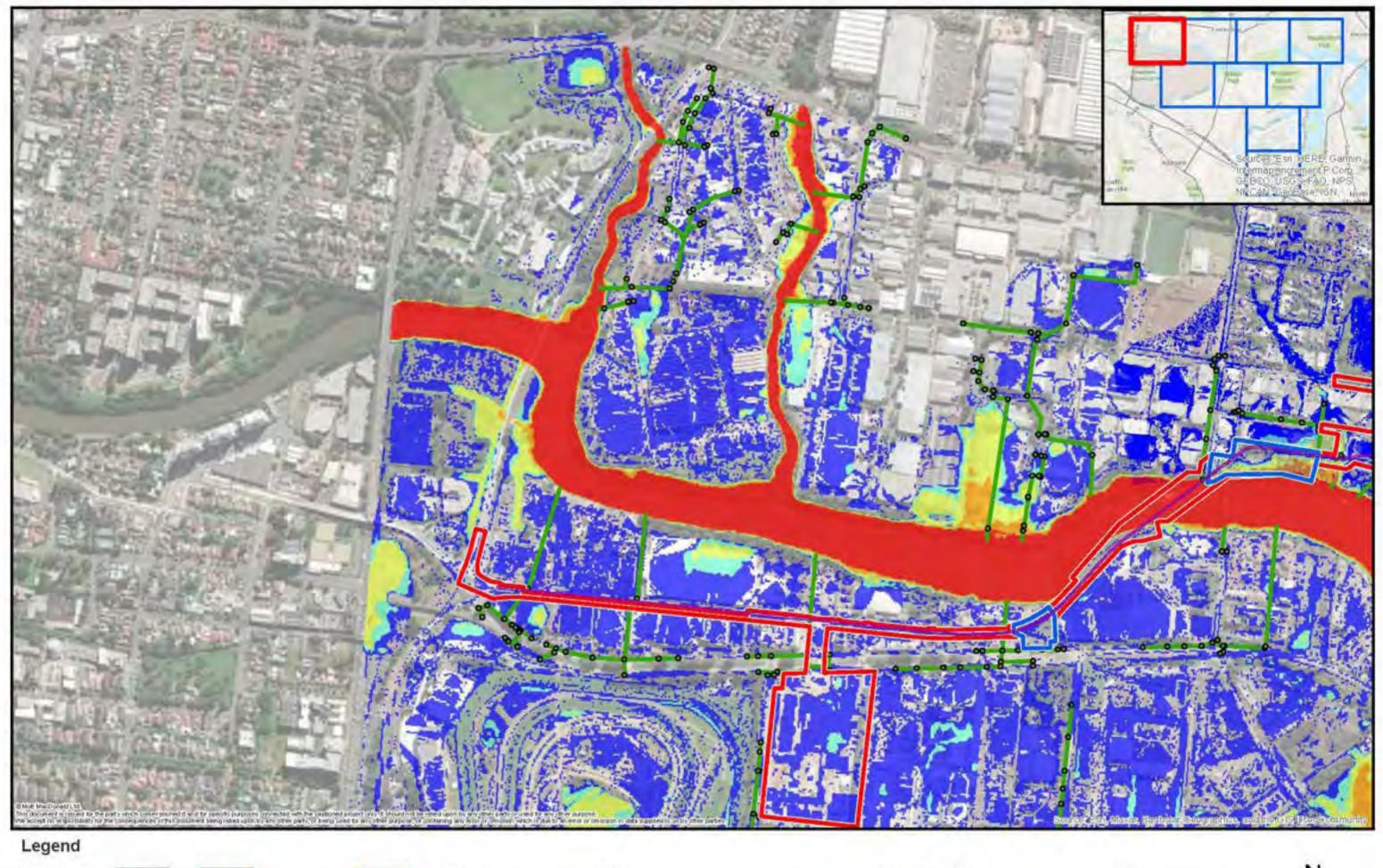


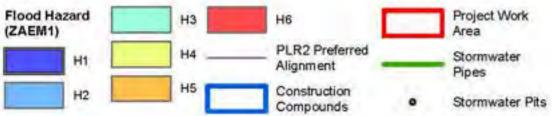












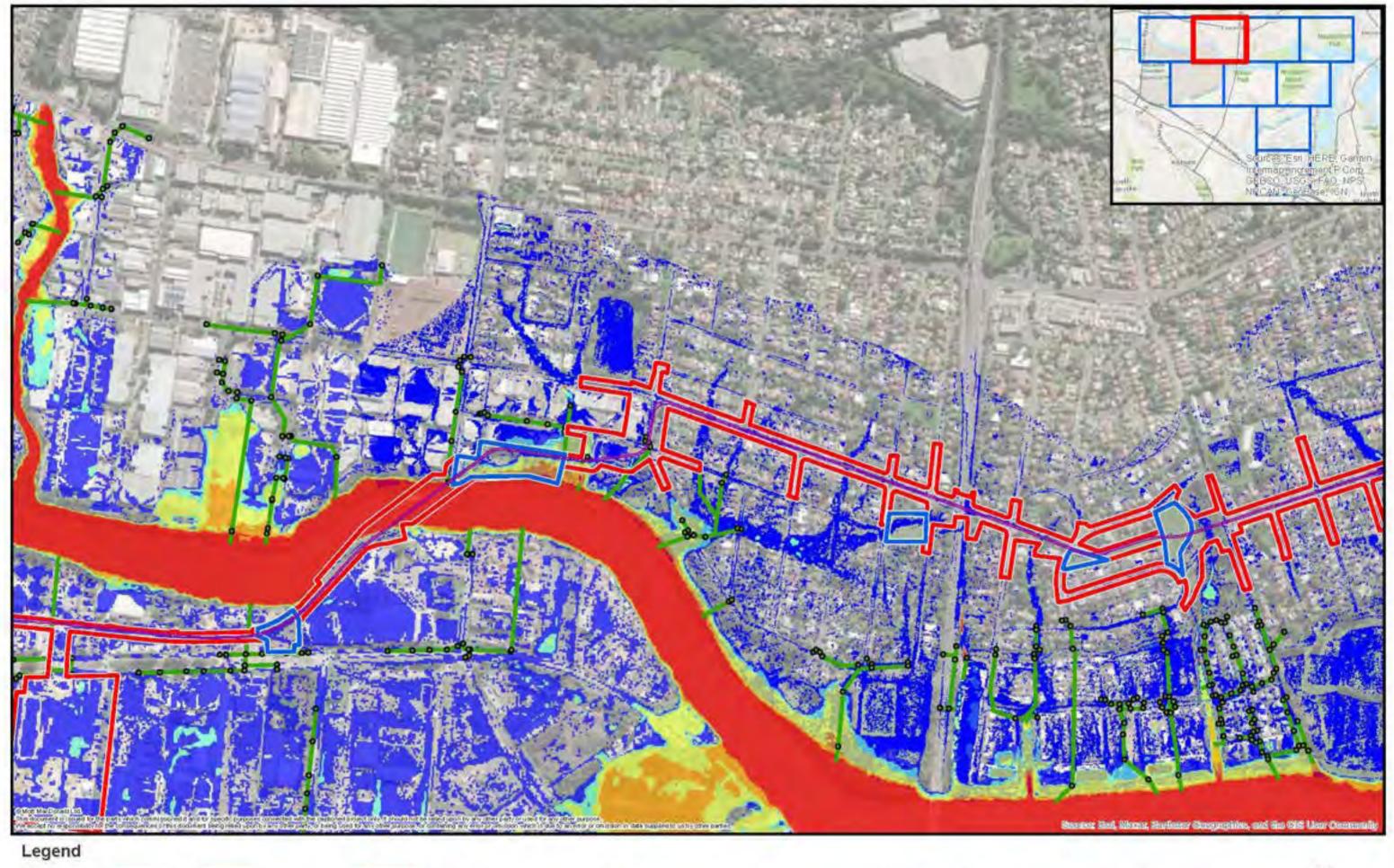
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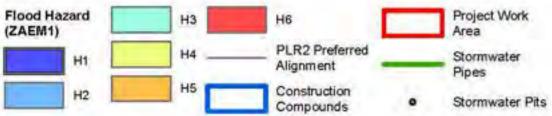




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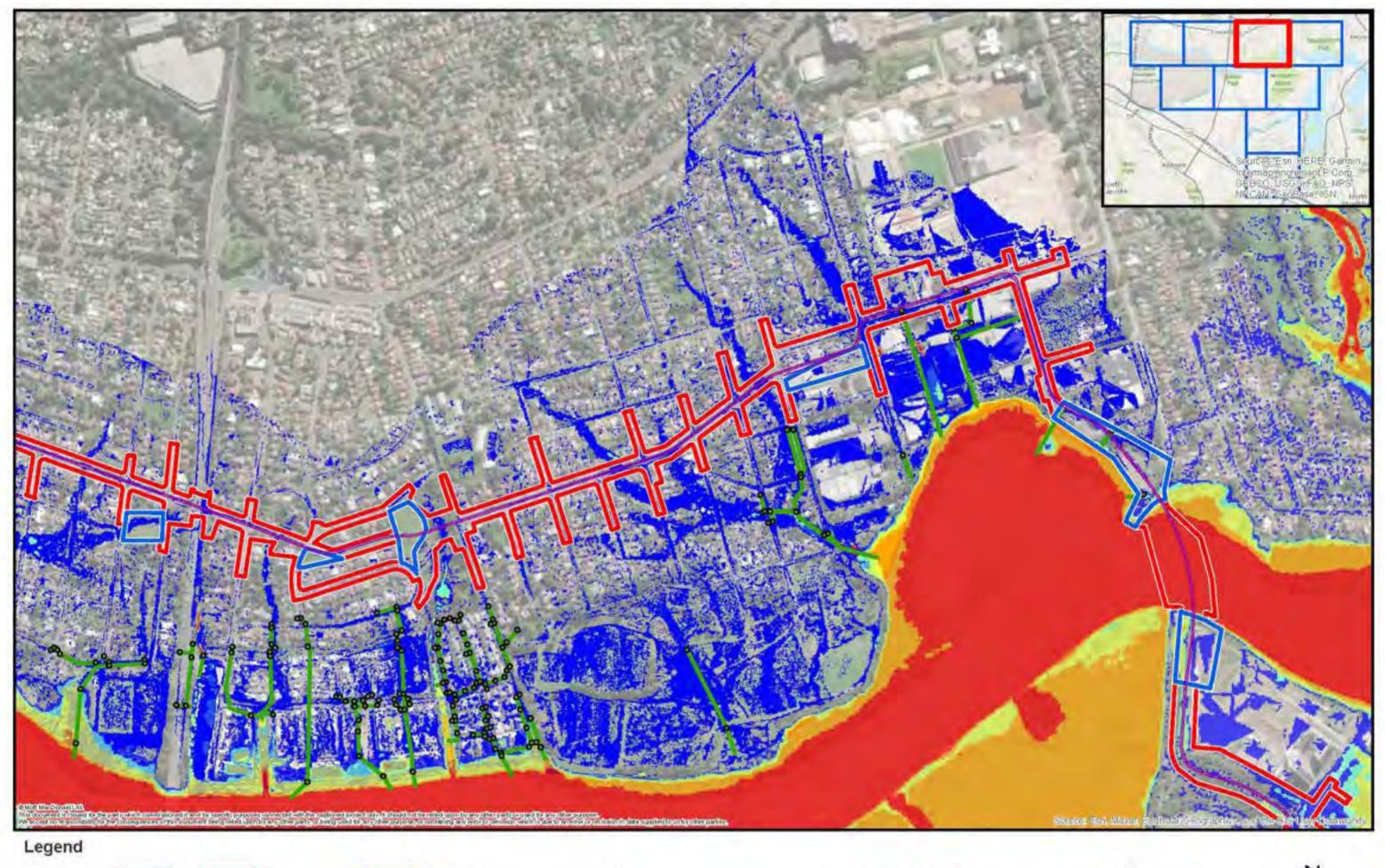
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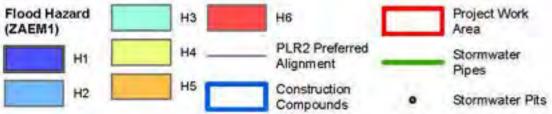




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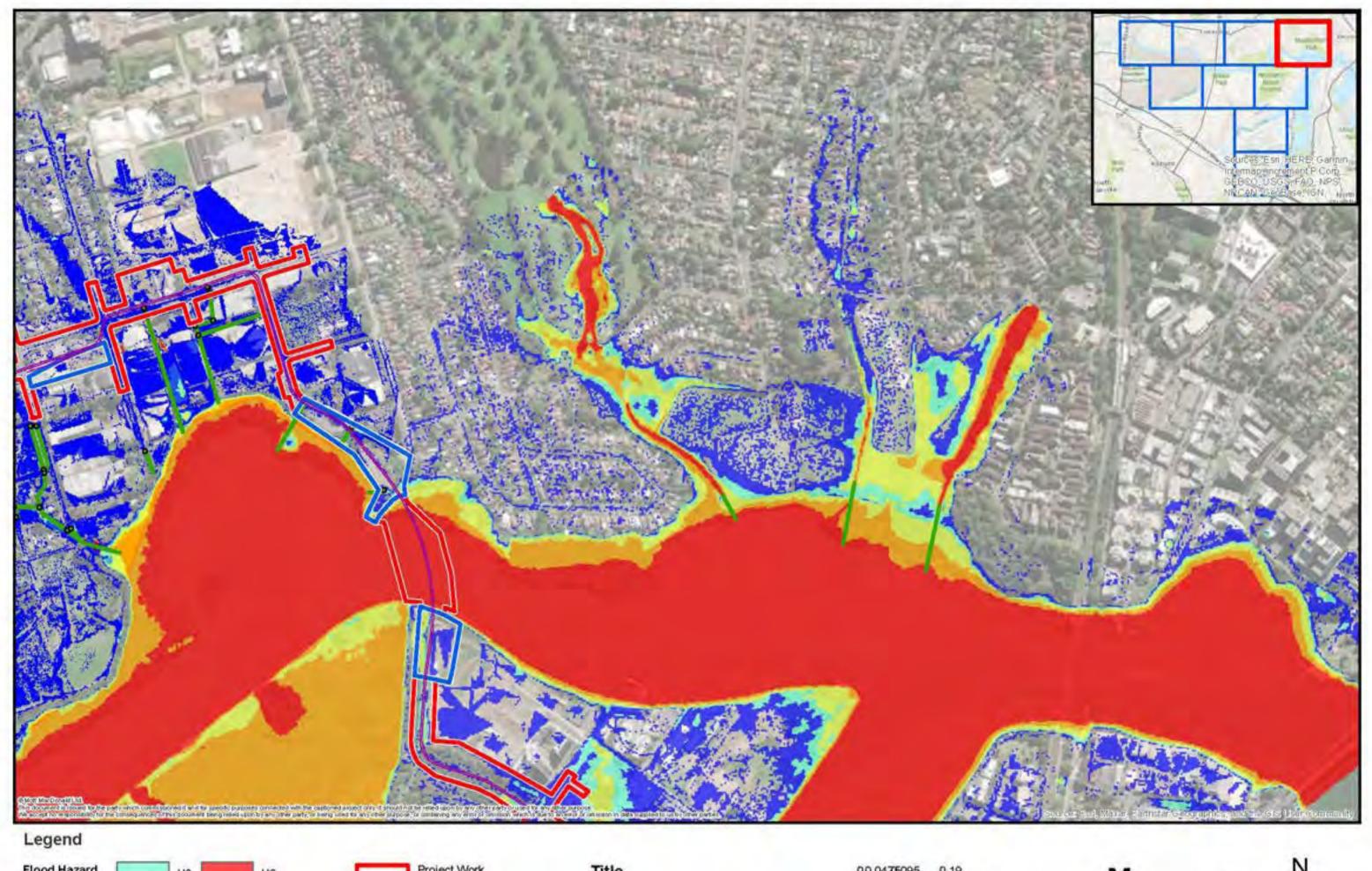


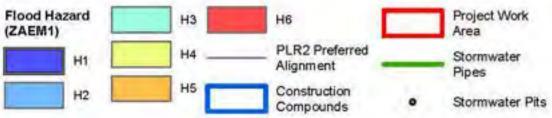
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Map Number Sheet No 3 of 9



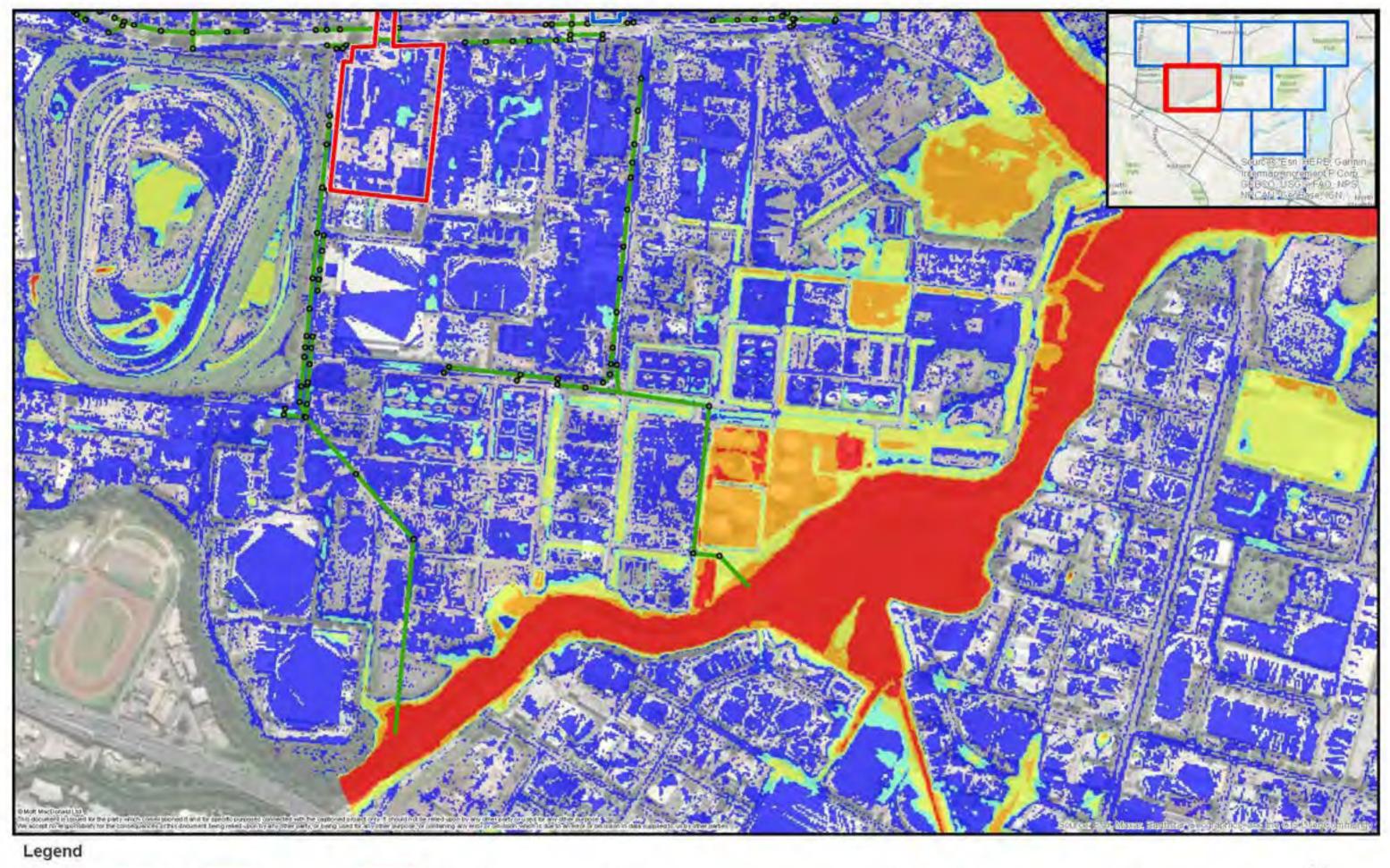


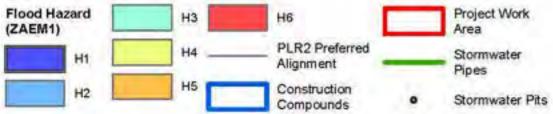
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Map Number Sheet No 4 of 9





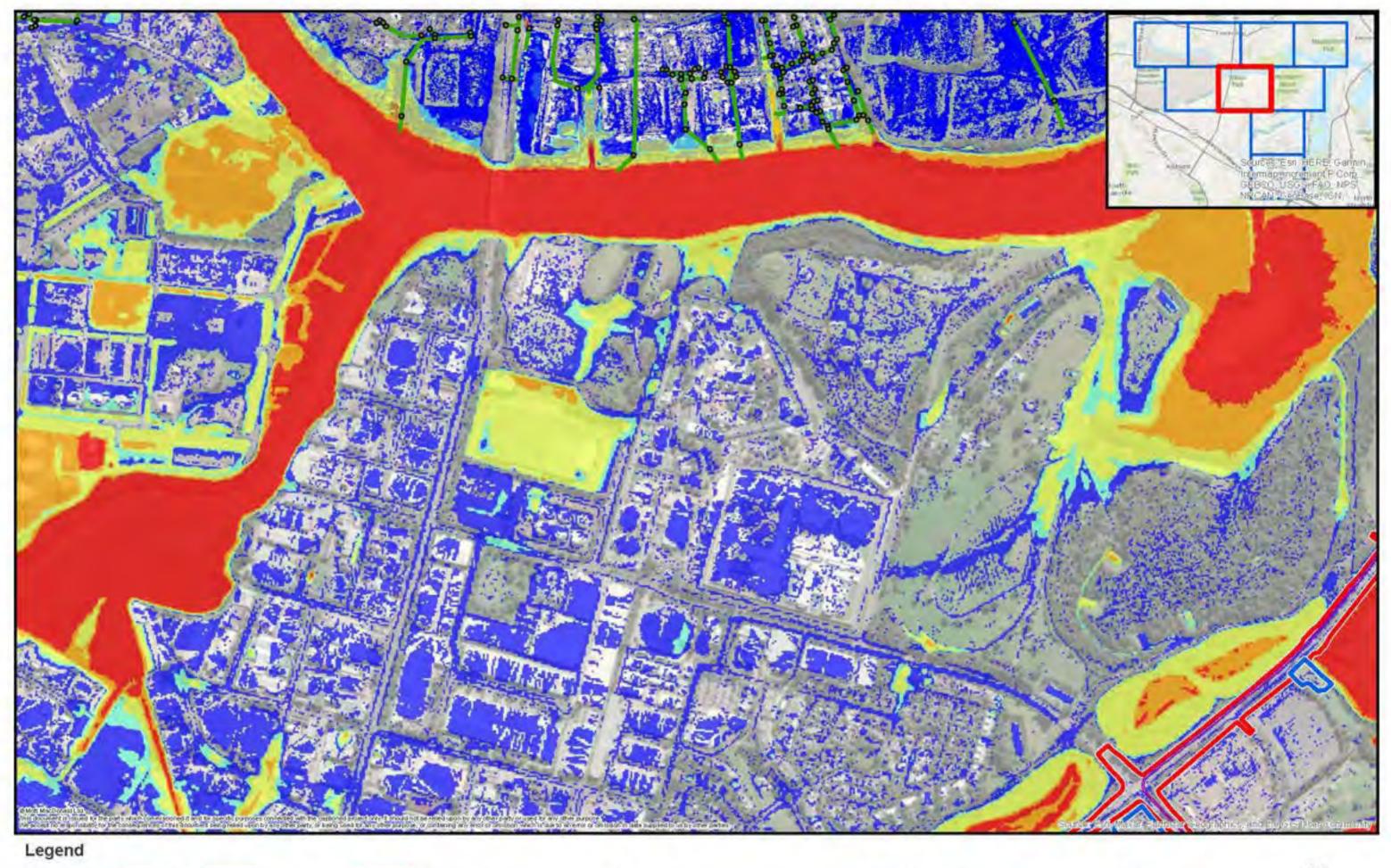
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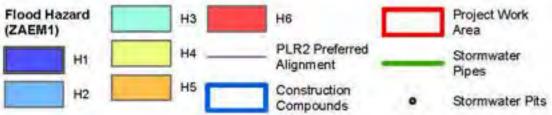


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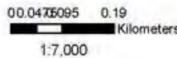
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Proof of Concept Design Conditions 5% AEP Climate Change Flood Hazard

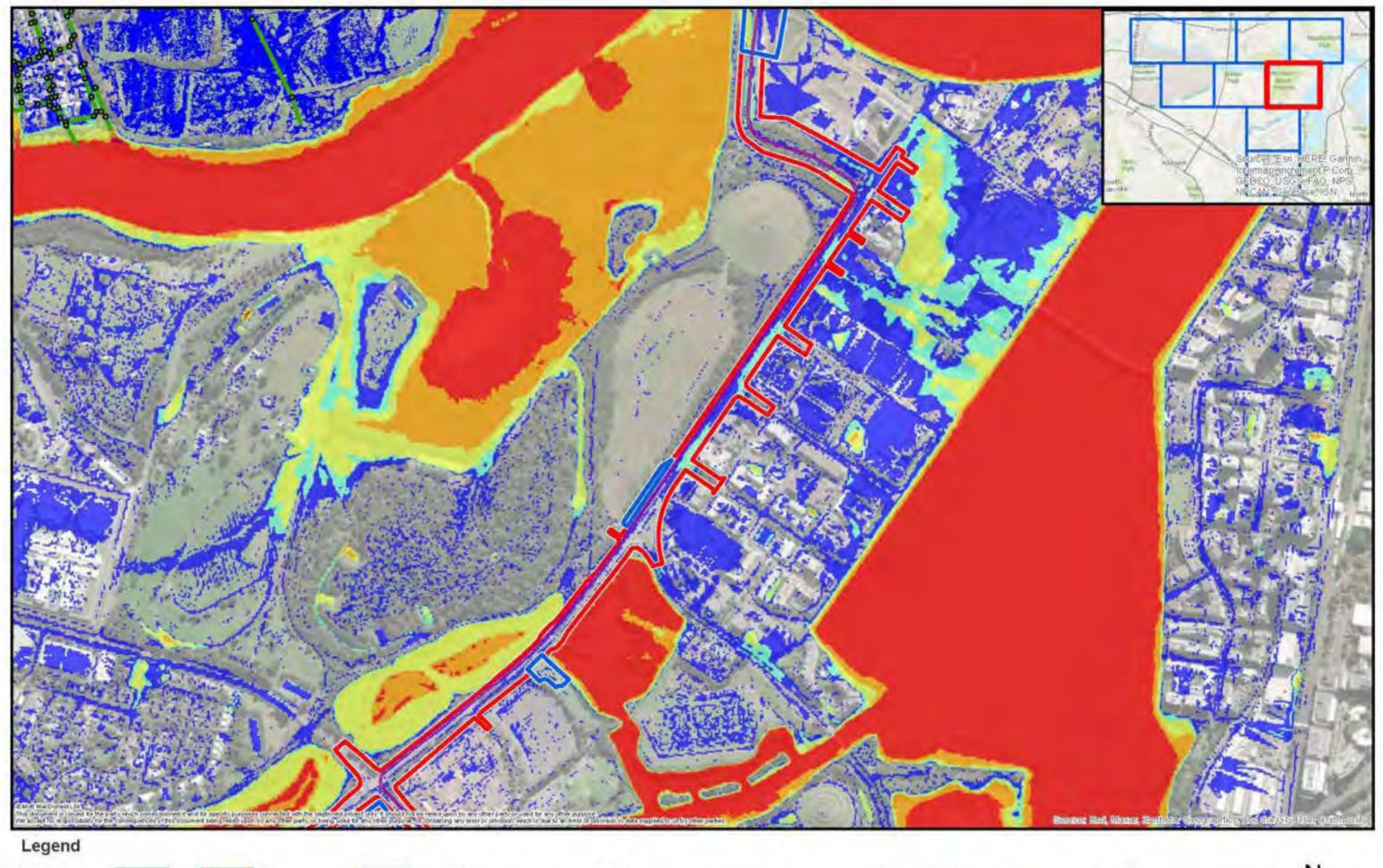


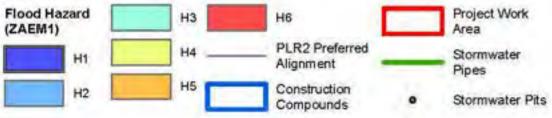
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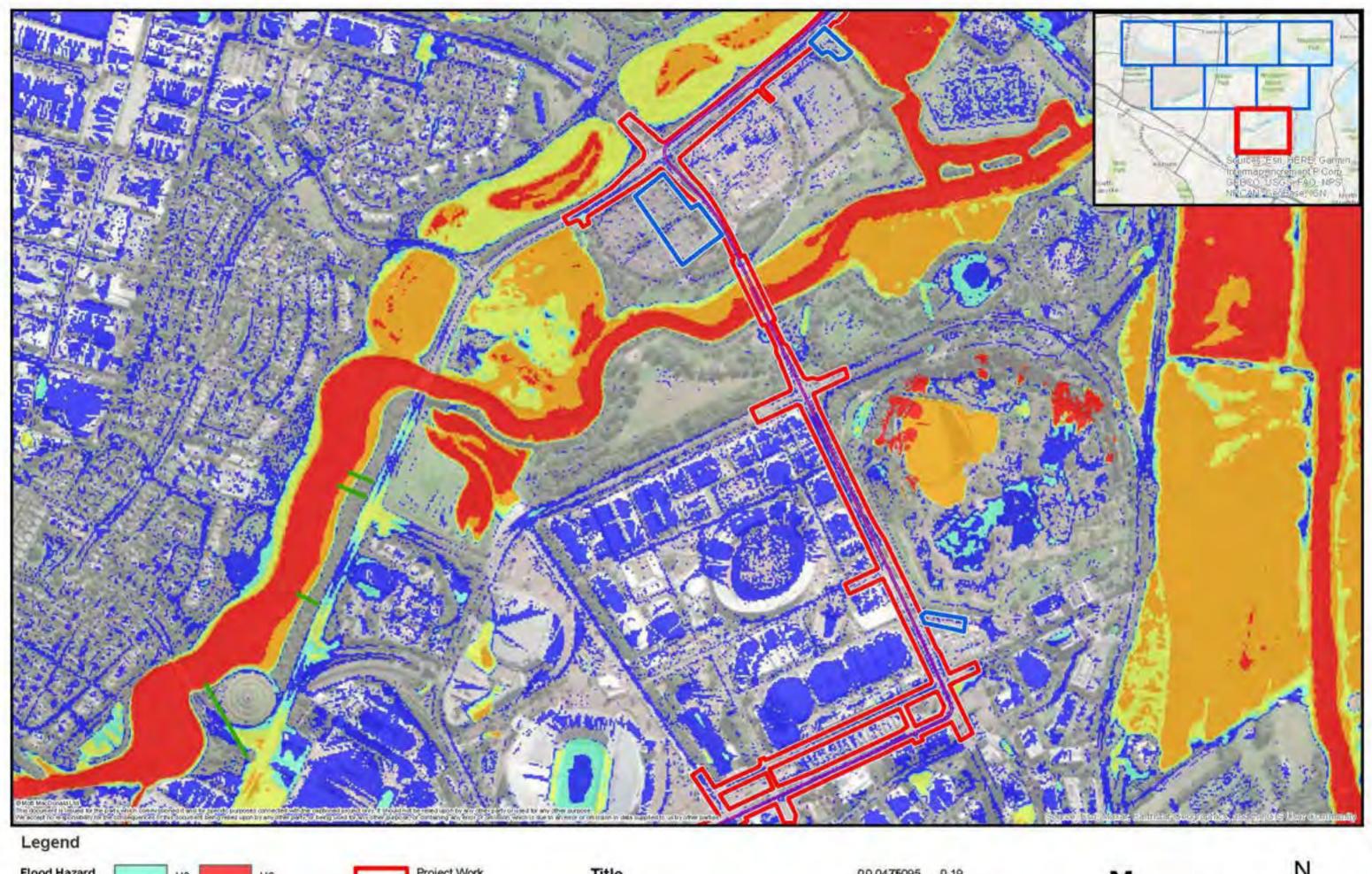
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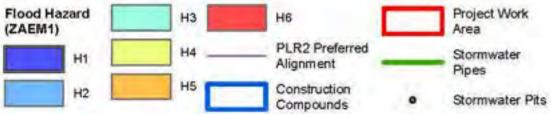




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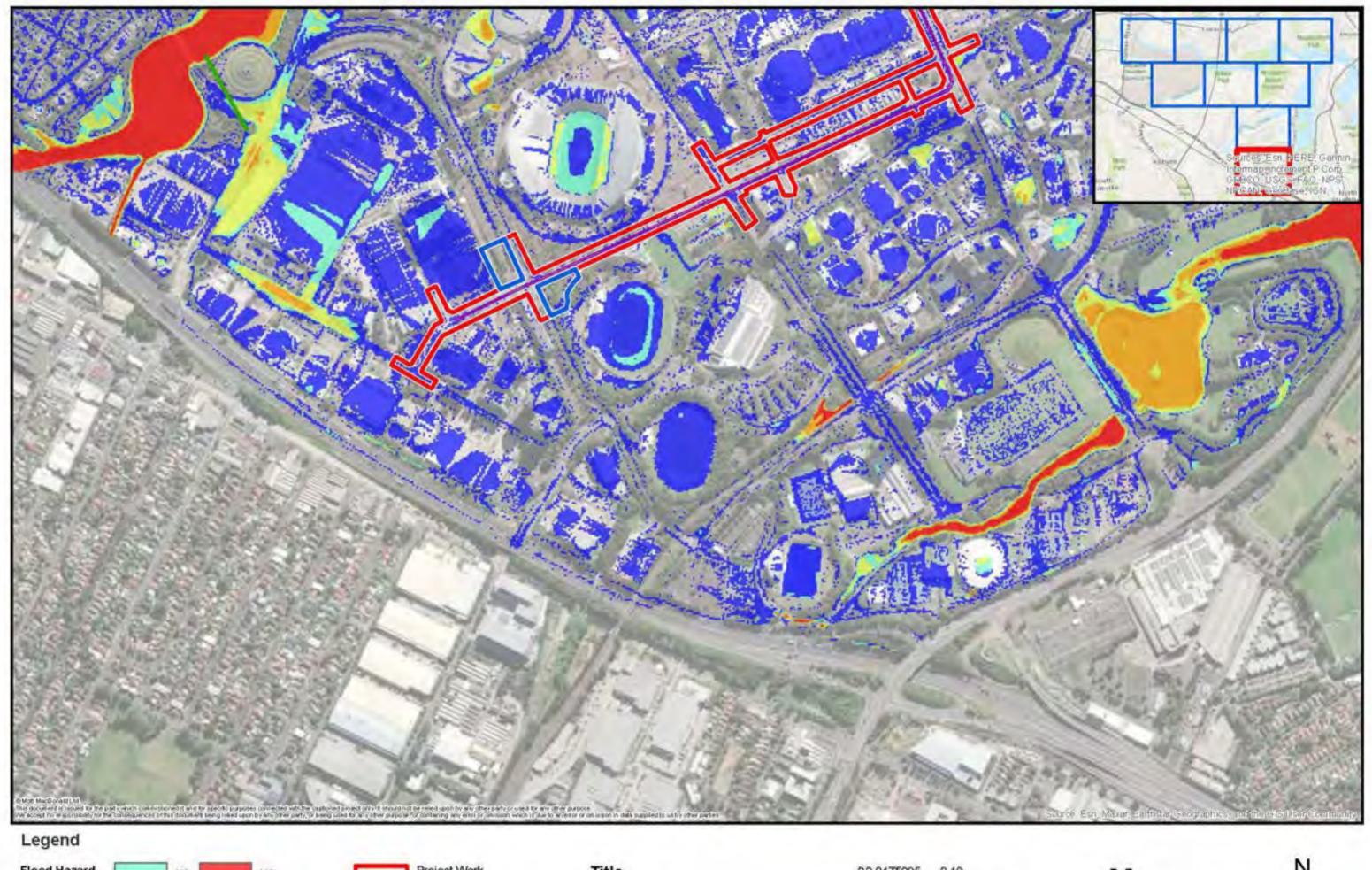


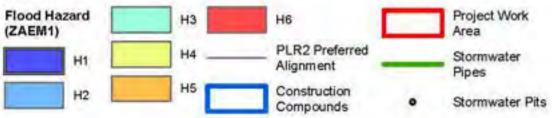
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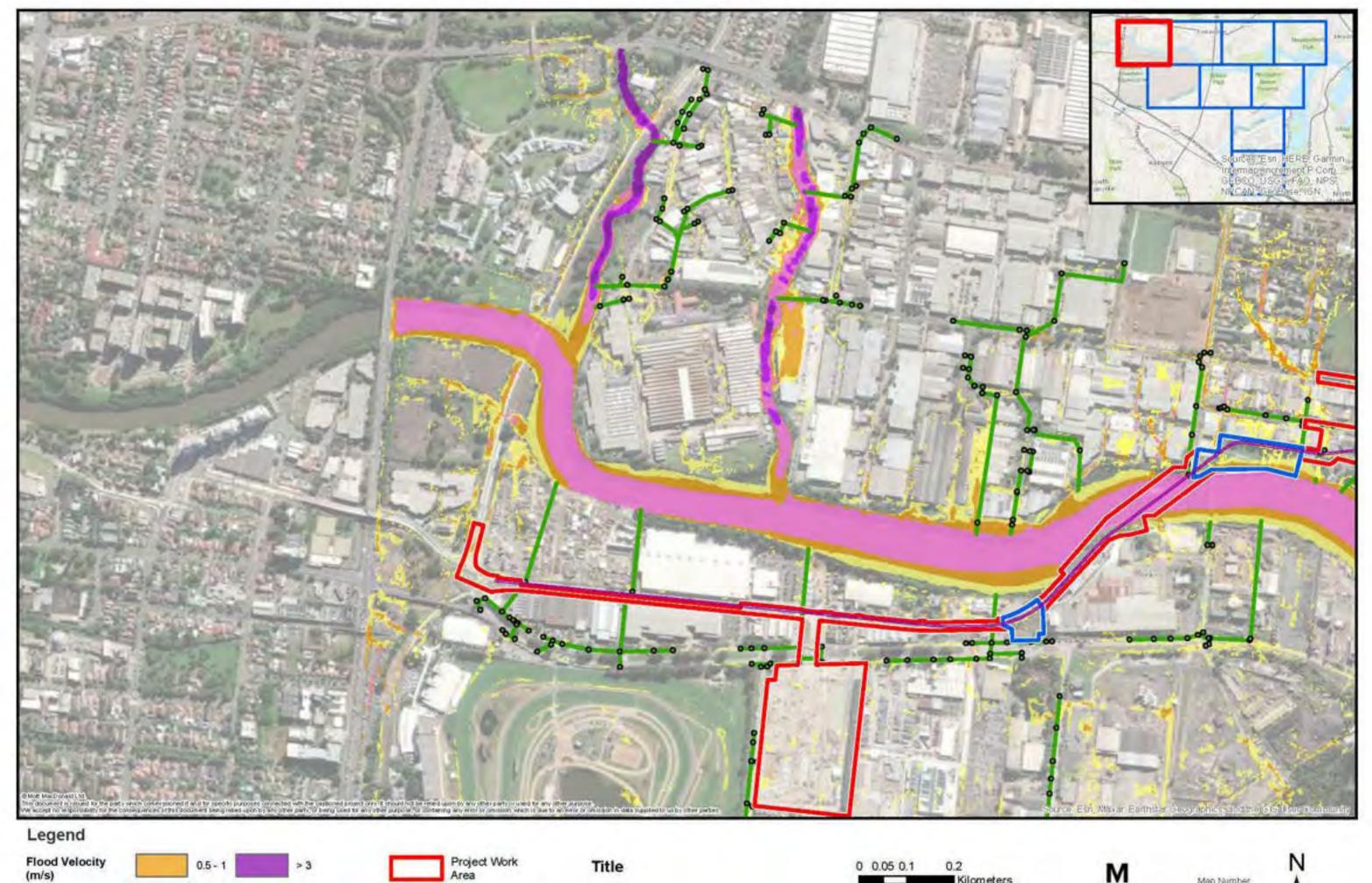
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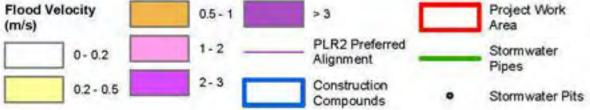


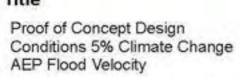


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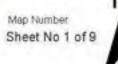


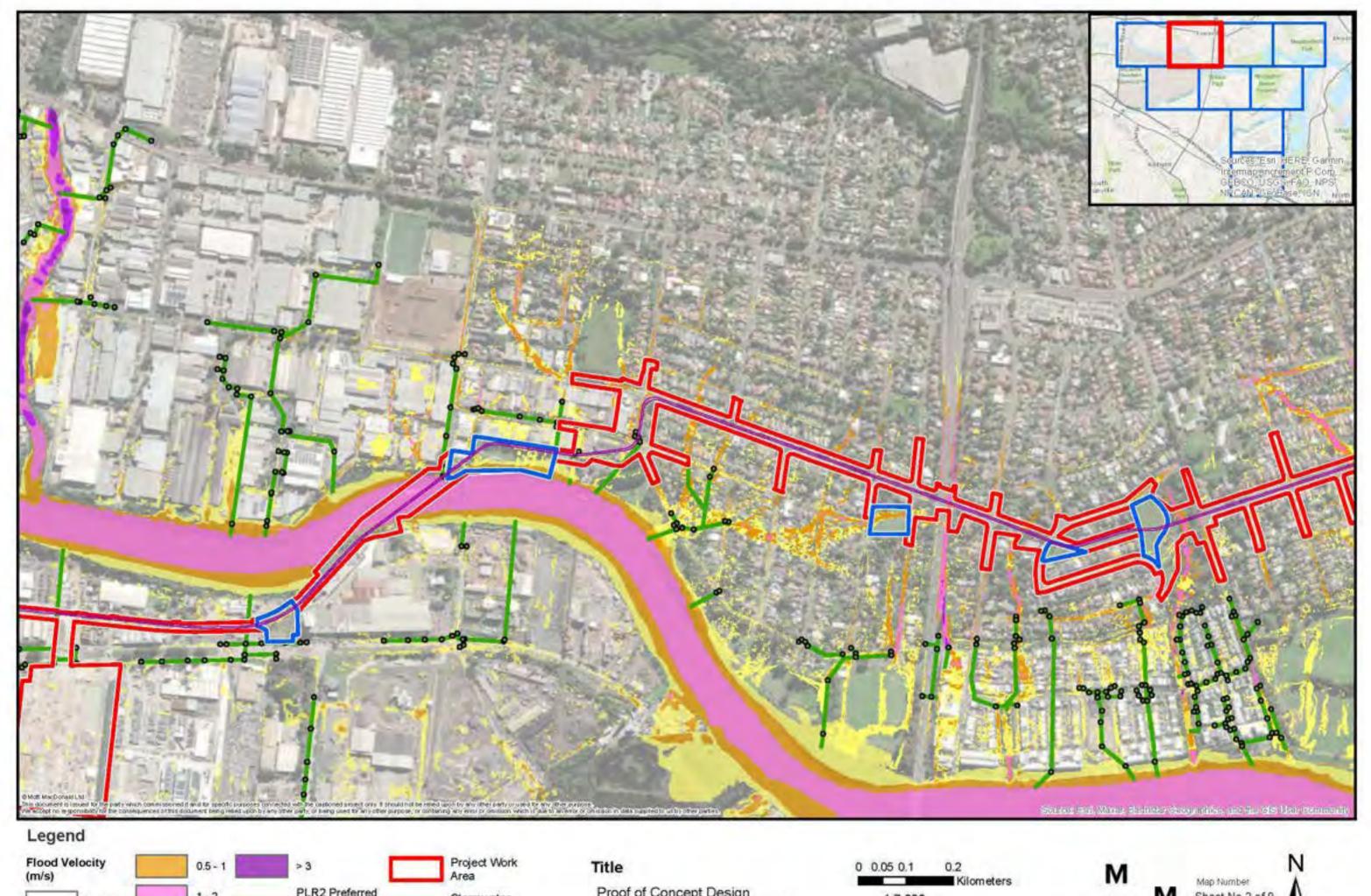


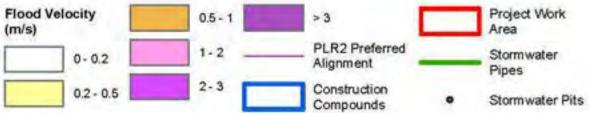




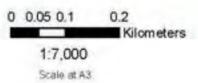




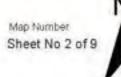


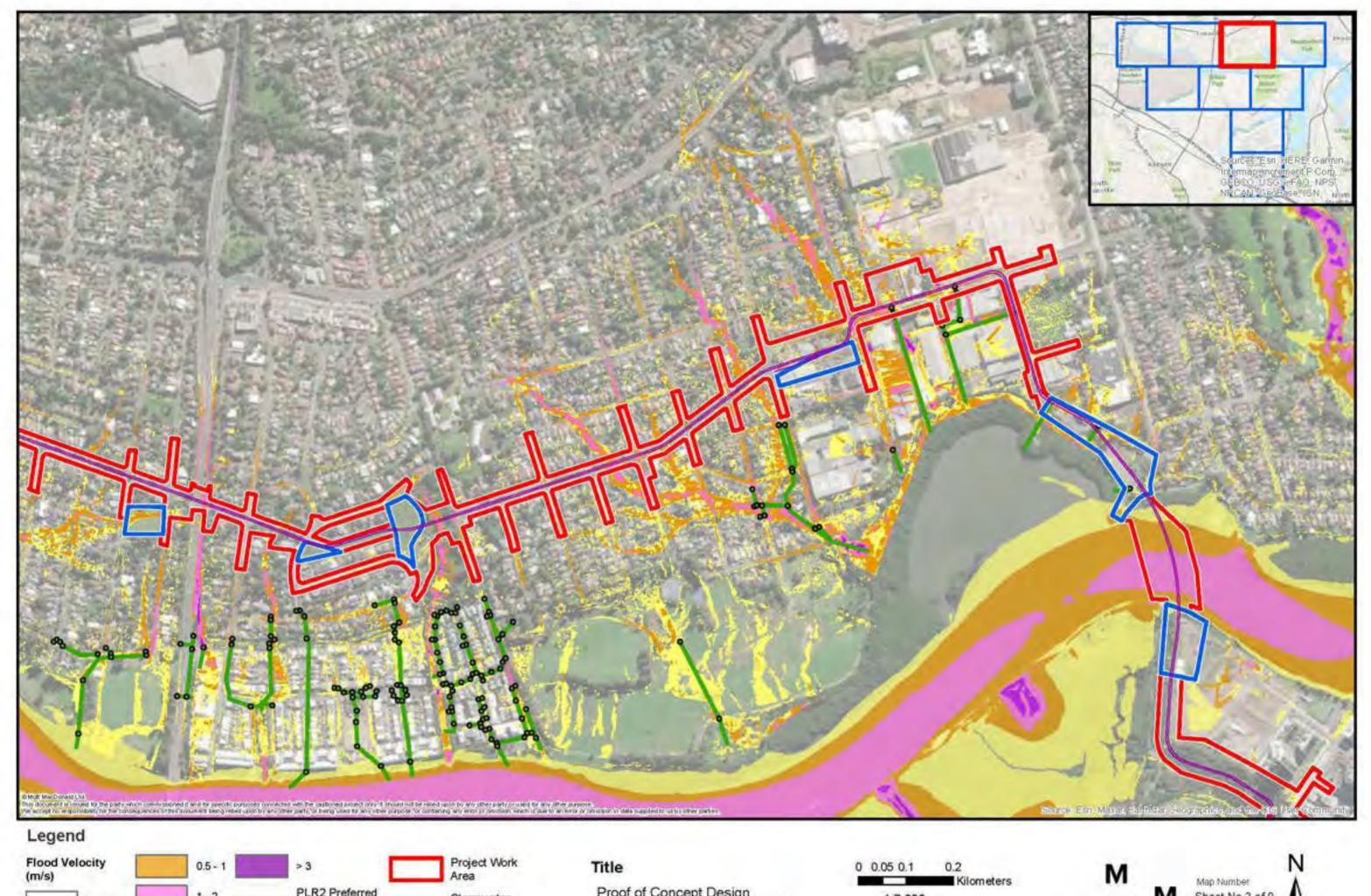


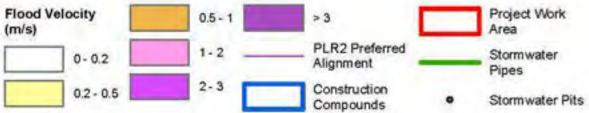
Proof of Concept Design Conditions 5% Climate Change AEP Flood Velocity

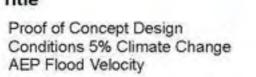


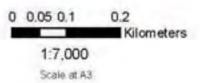
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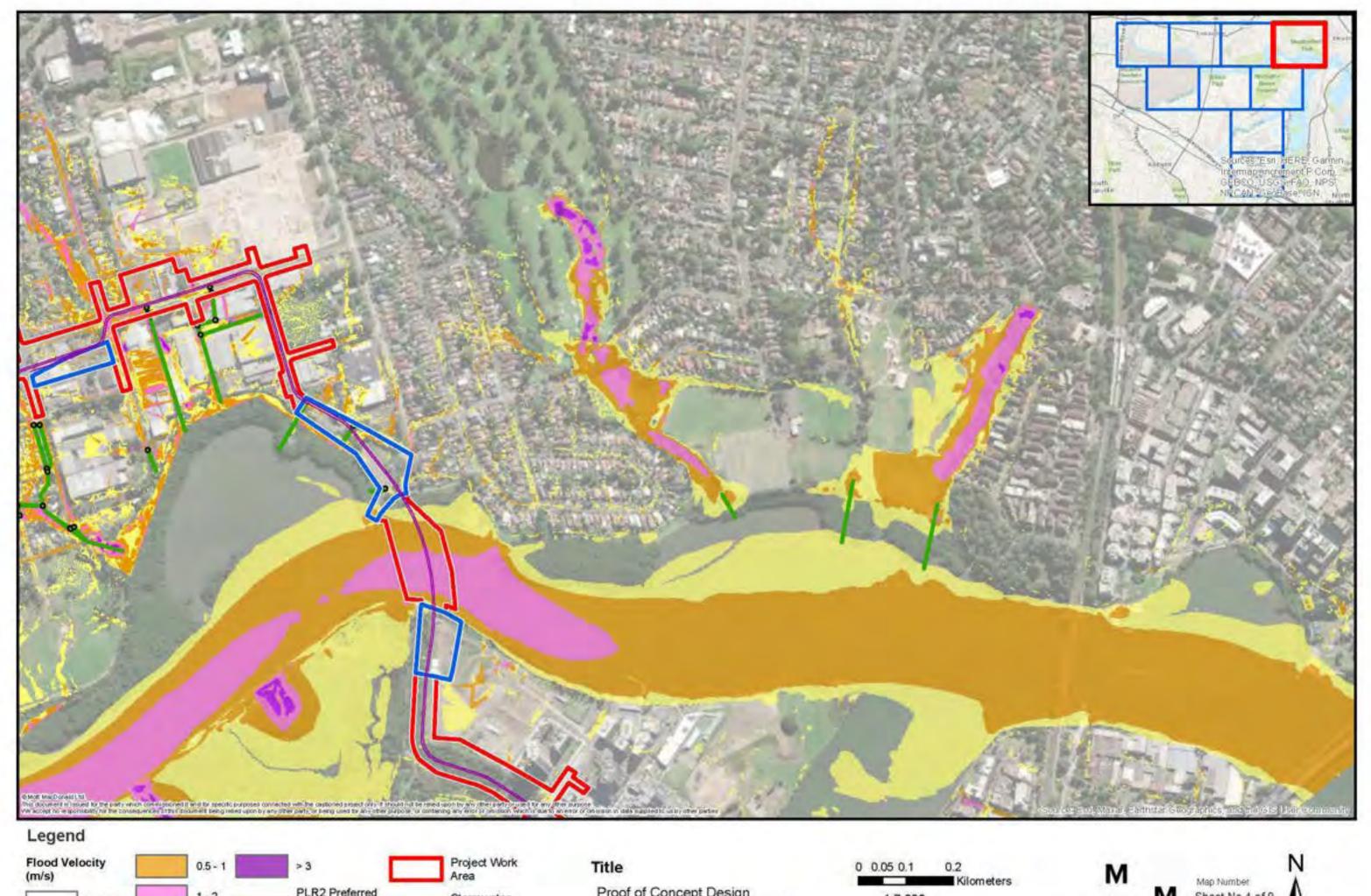


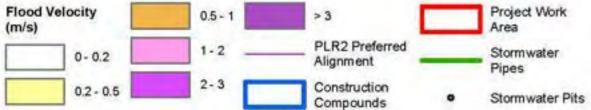




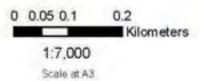


Sheet No 3 of 9



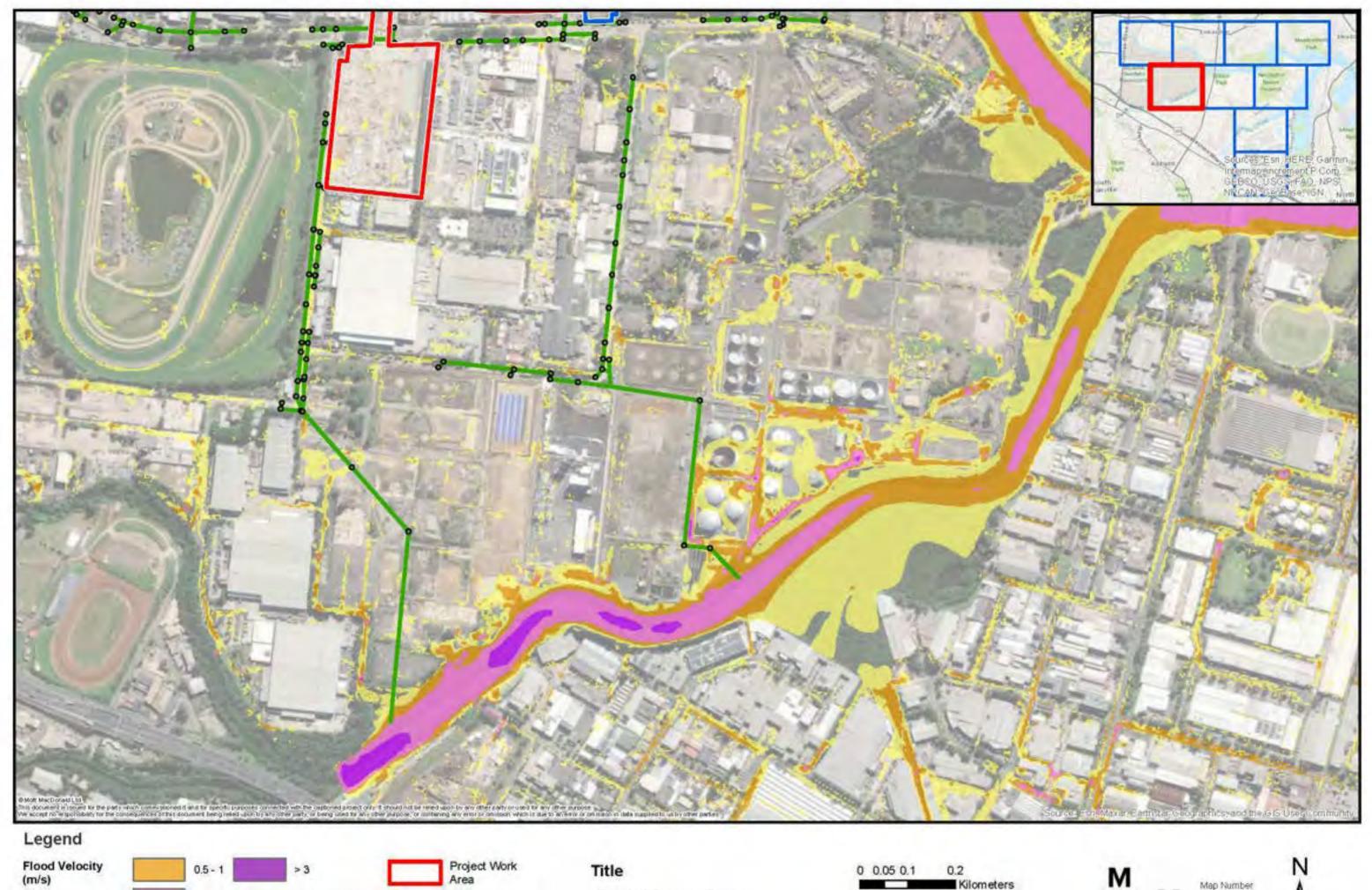


Proof of Concept Design Conditions 5% Climate Change AEP Flood Velocity

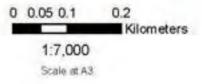




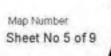
Sheet No 4 of 9

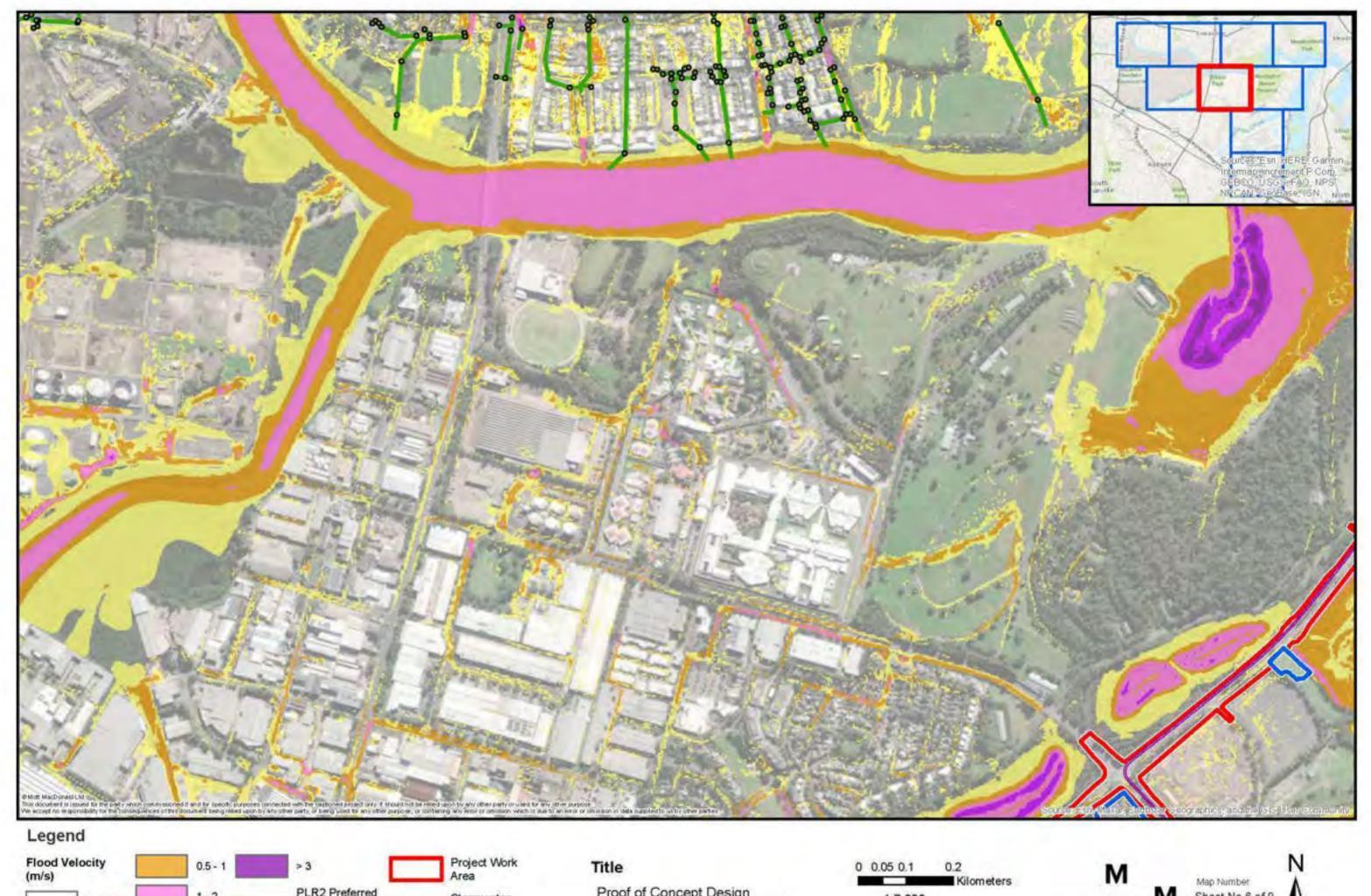


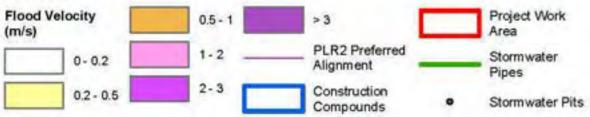










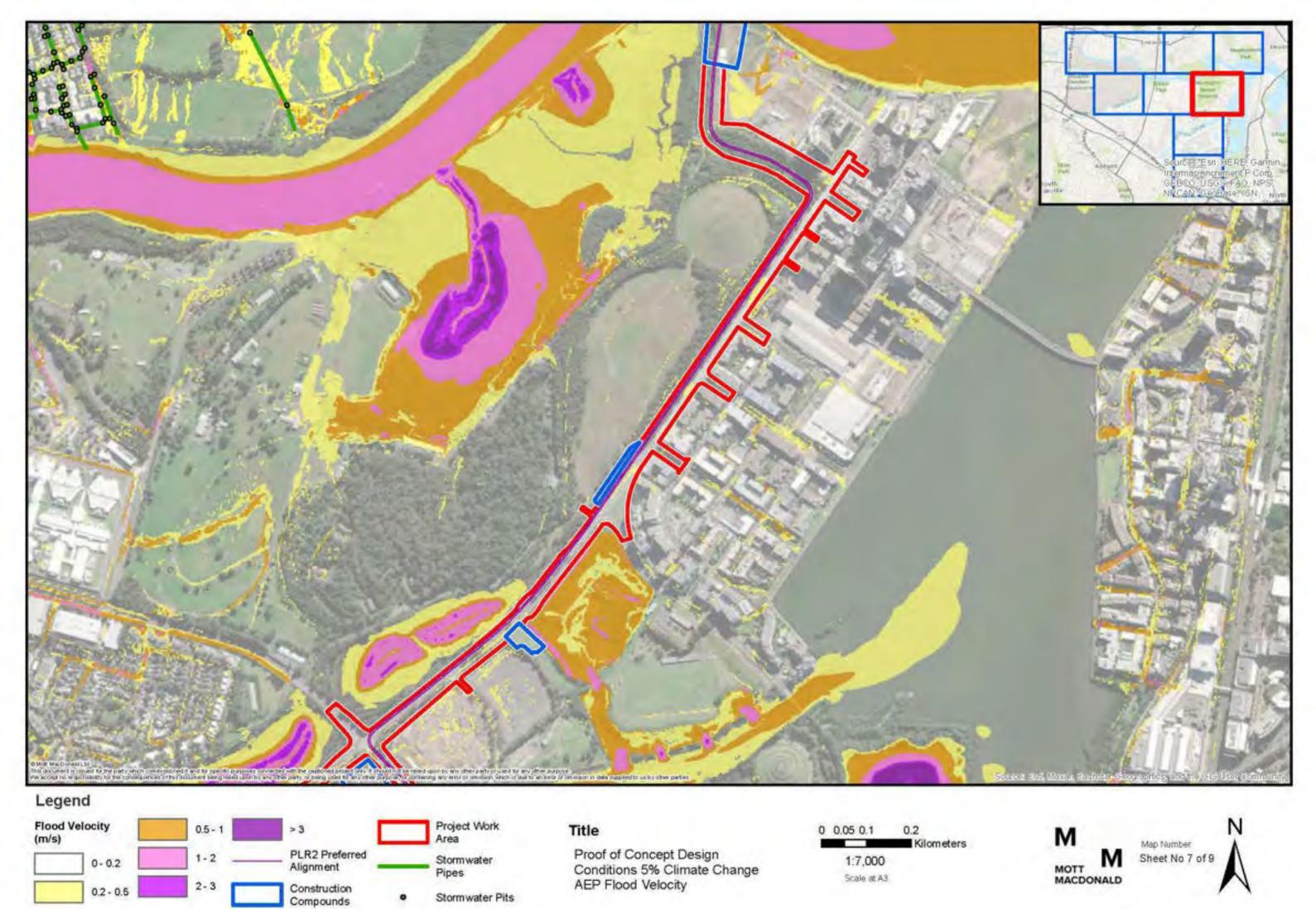


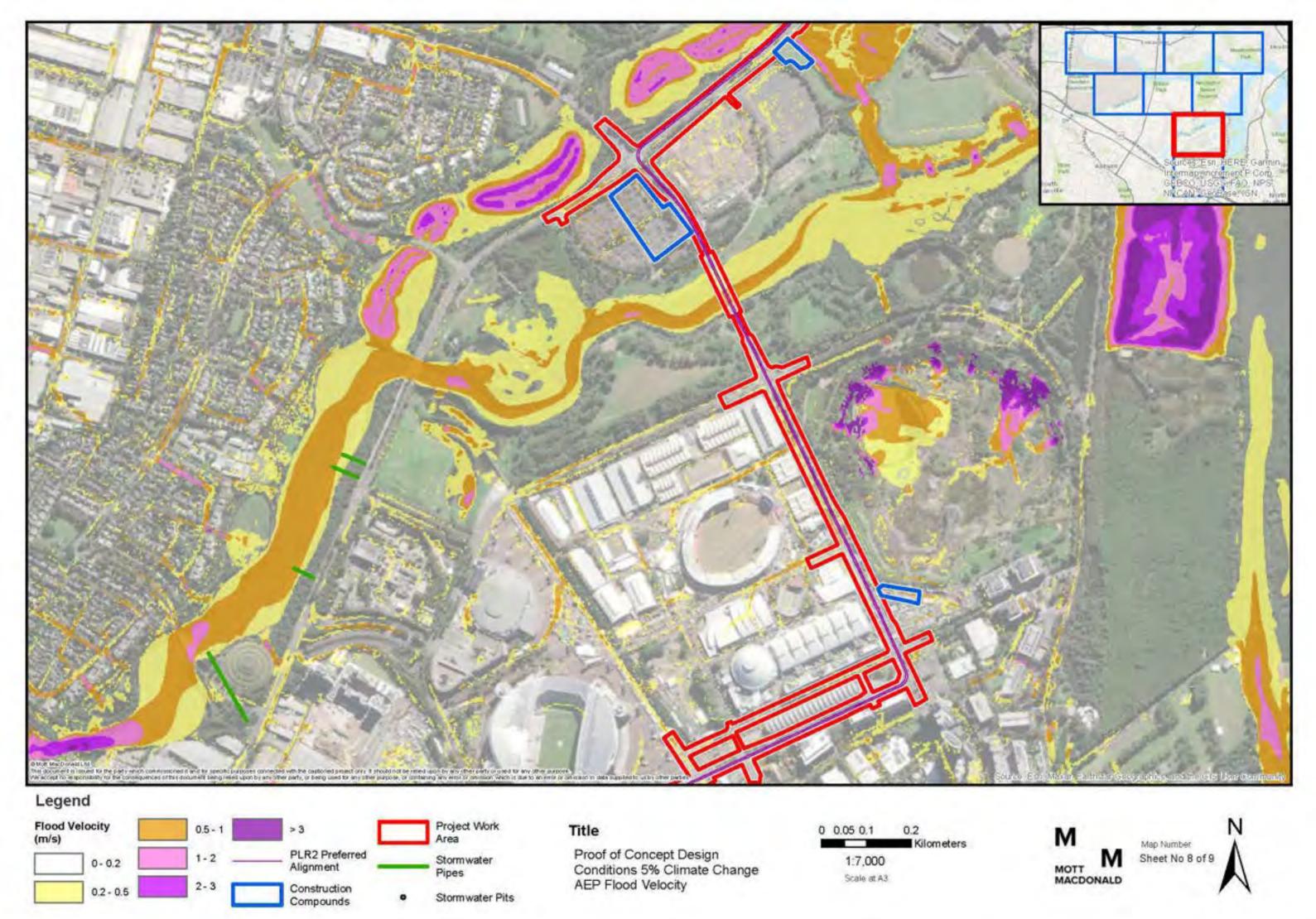
Proof of Concept Design Conditions 5% Climate Change AEP Flood Velocity



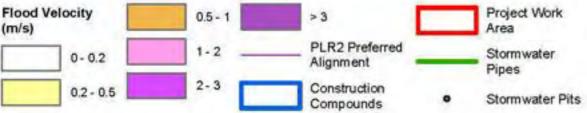




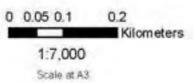








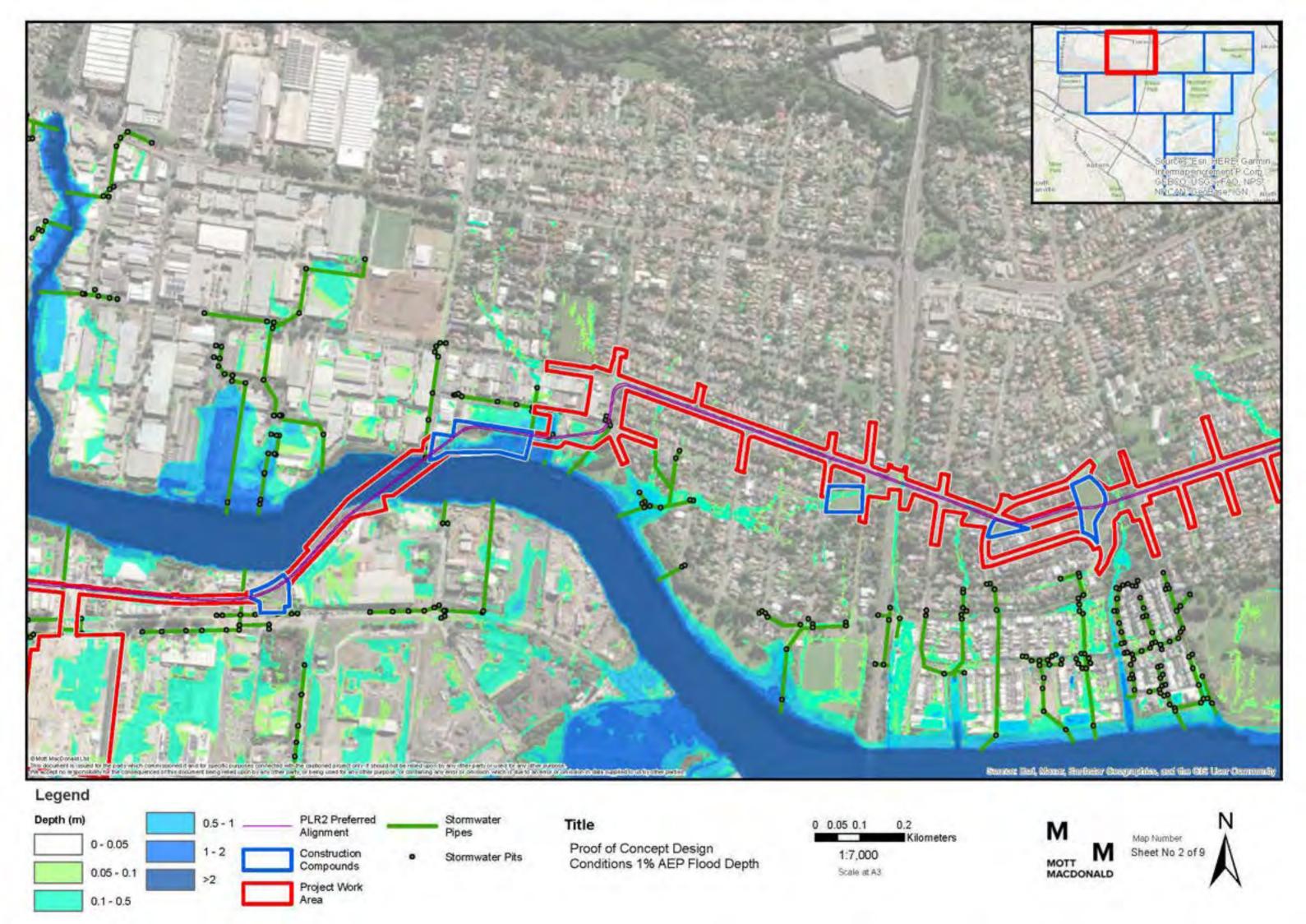
Proof of Concept Design Conditions 5% Climate Change AEP Flood Velocity

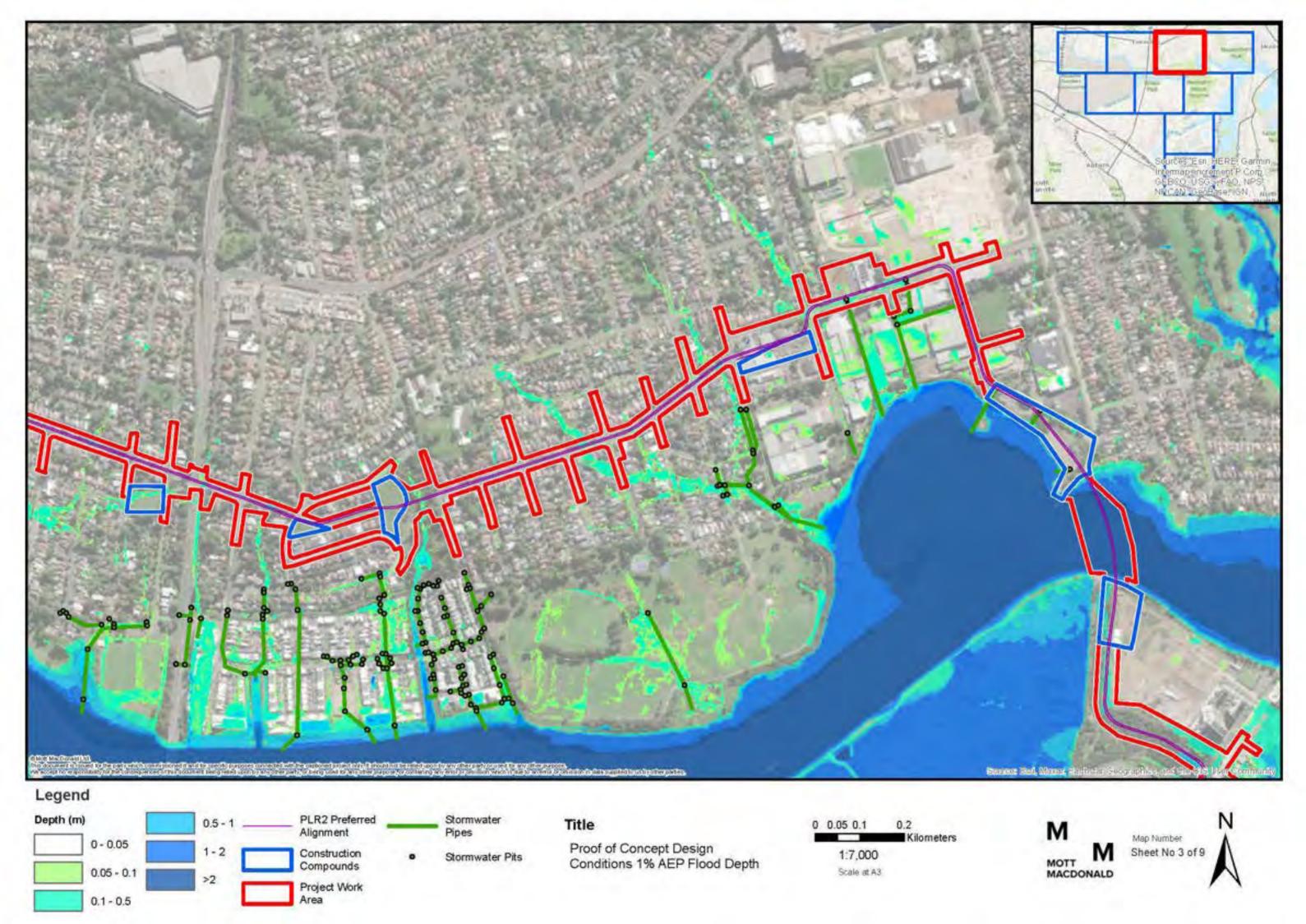


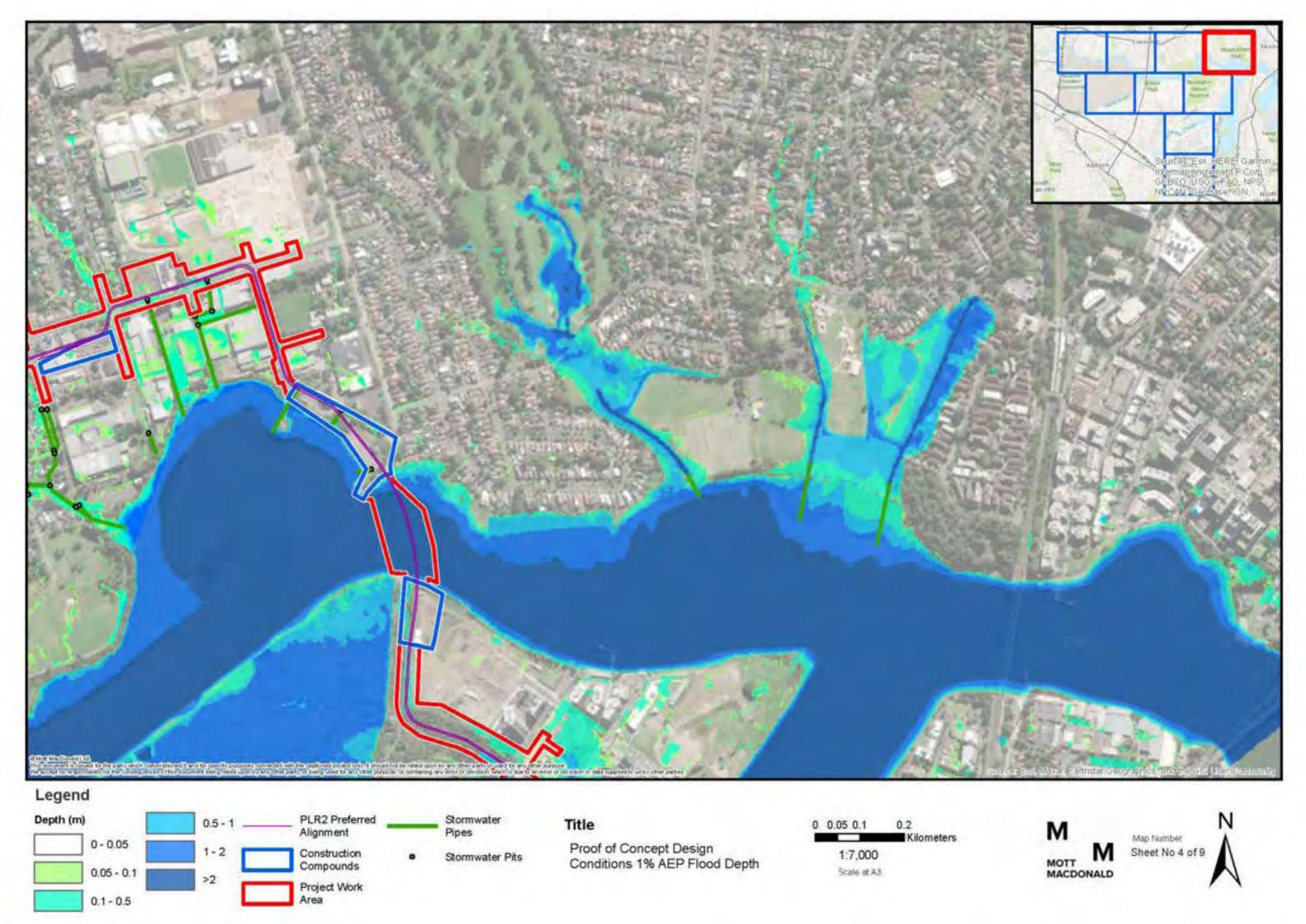
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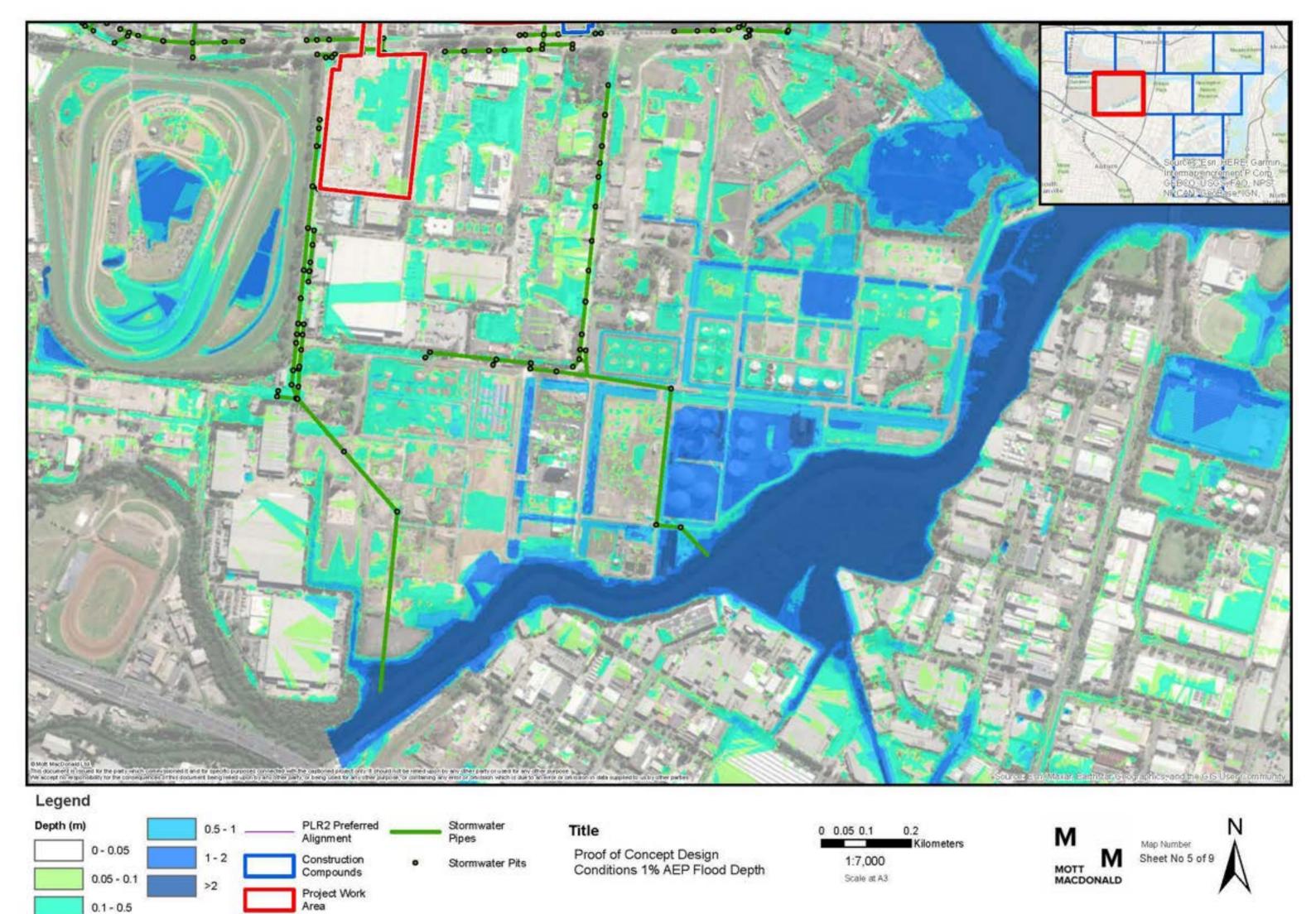


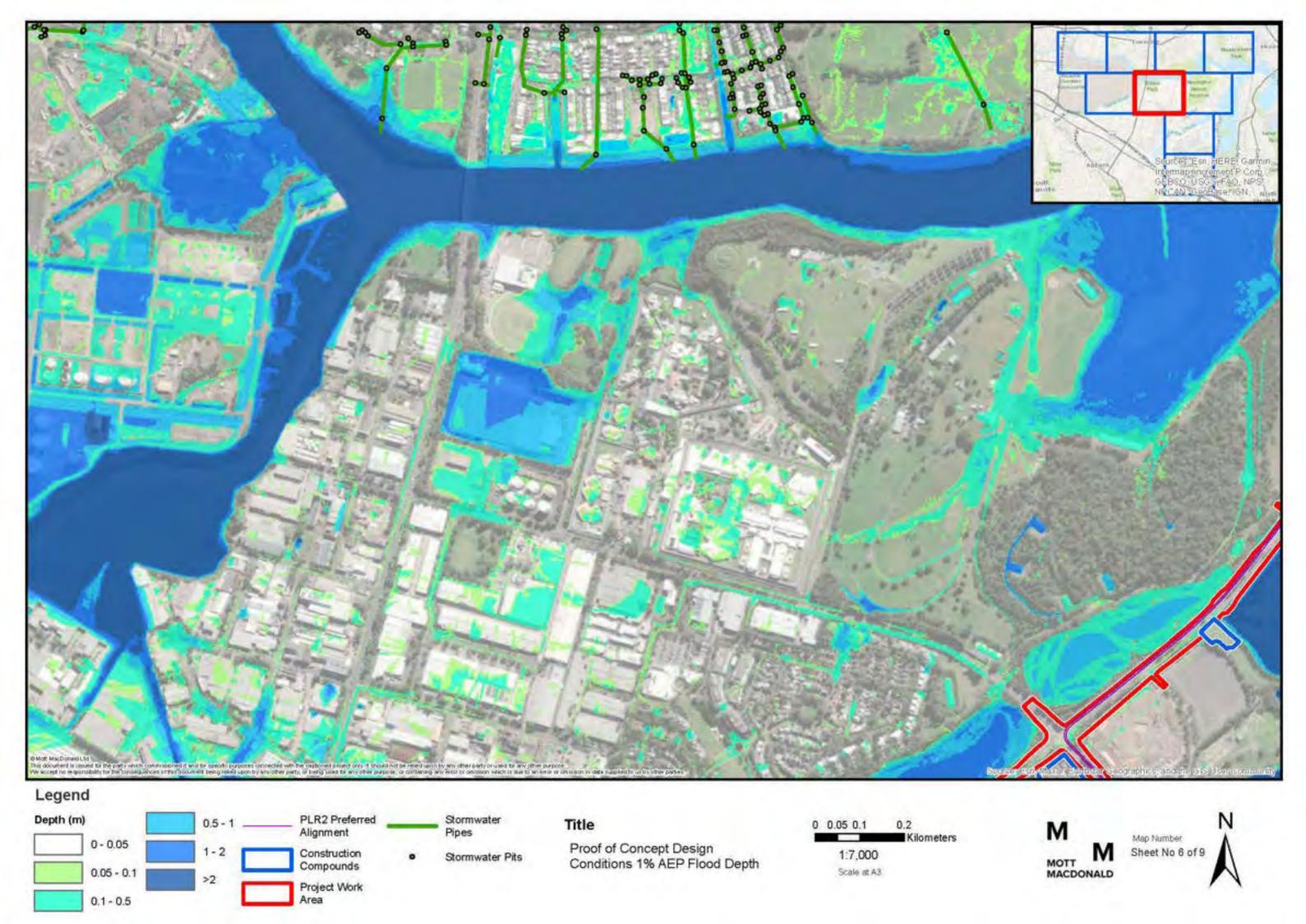
Appendix B2 – Flood model figures (Proof of concept) – 1% AEP

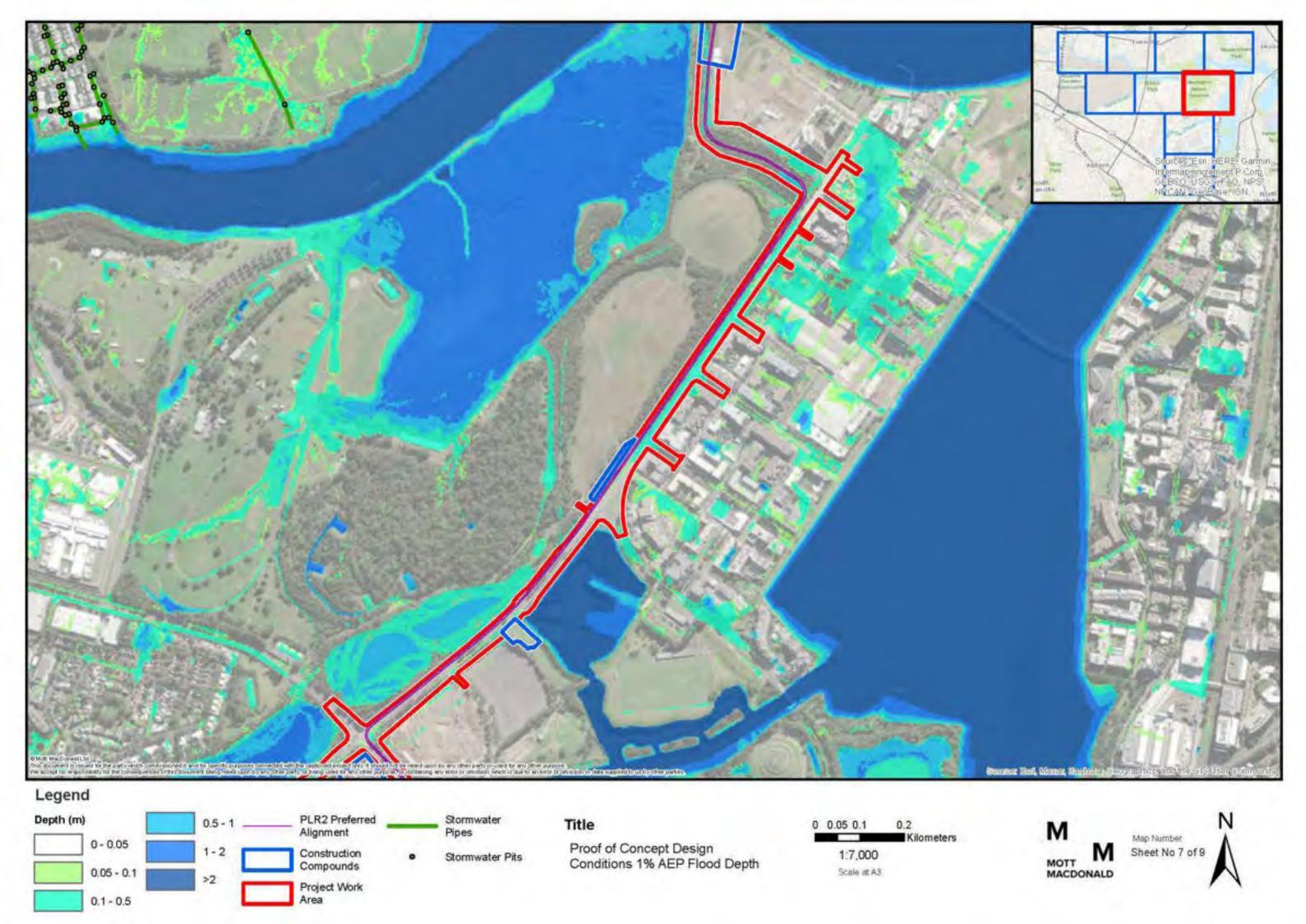


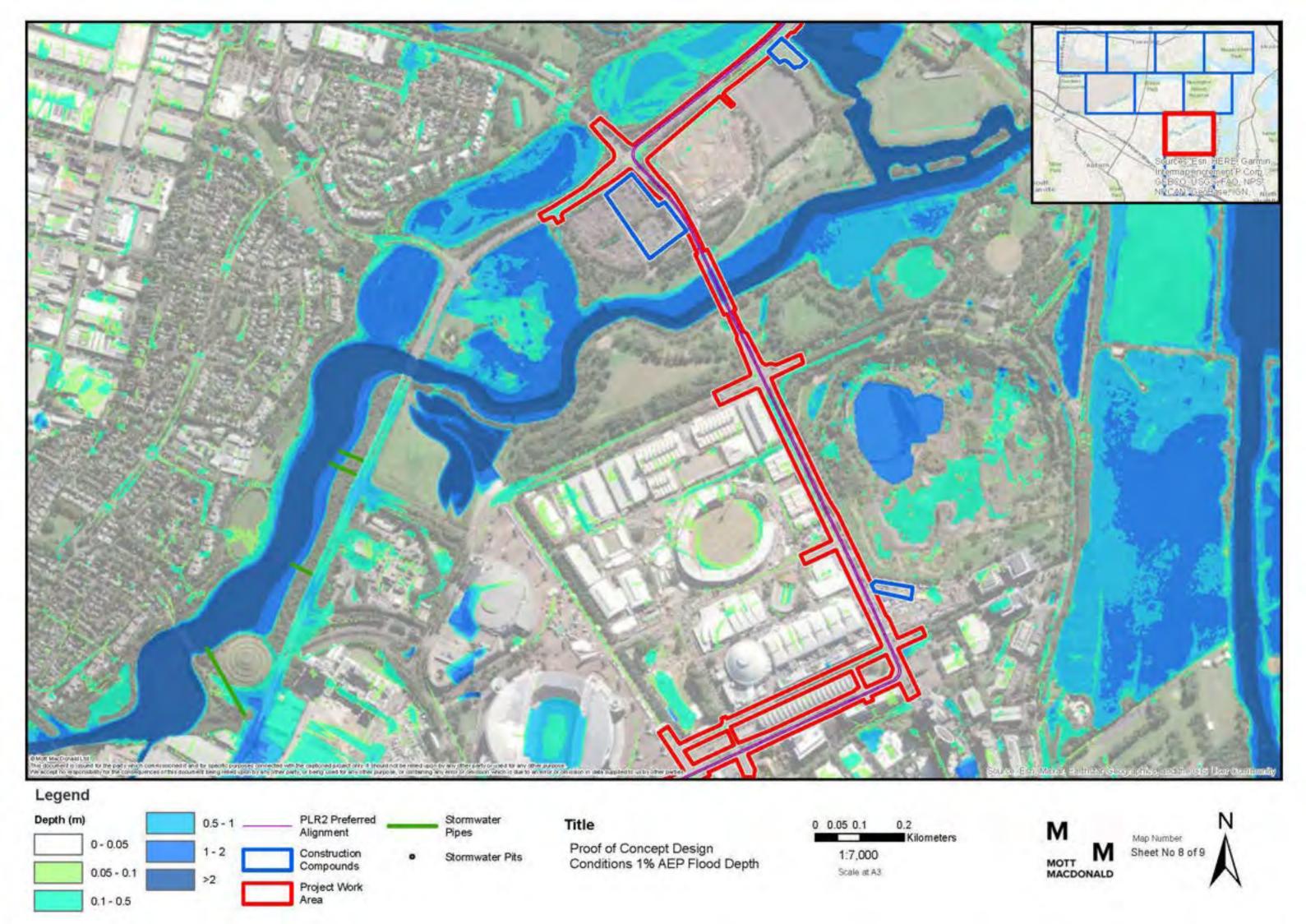


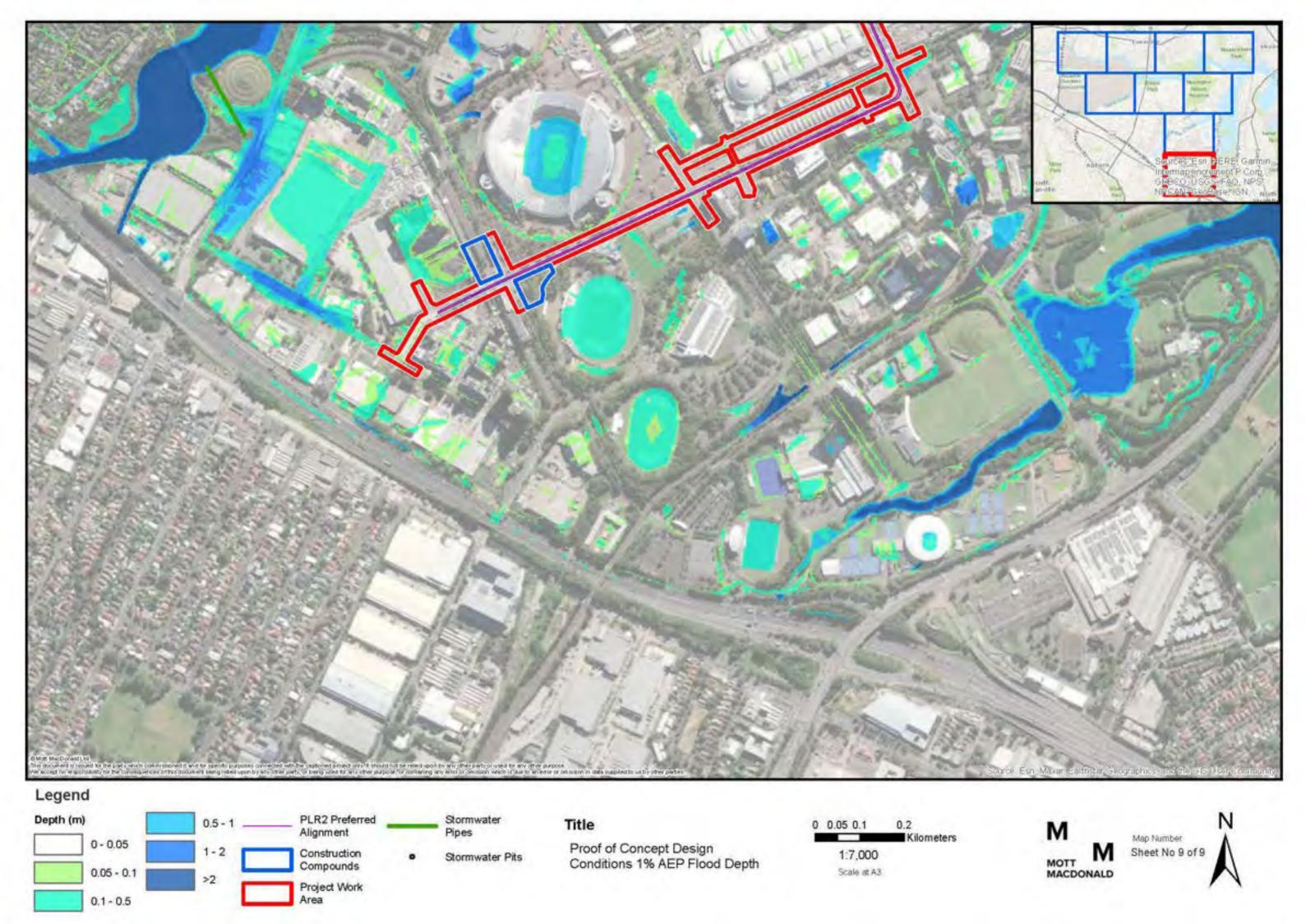


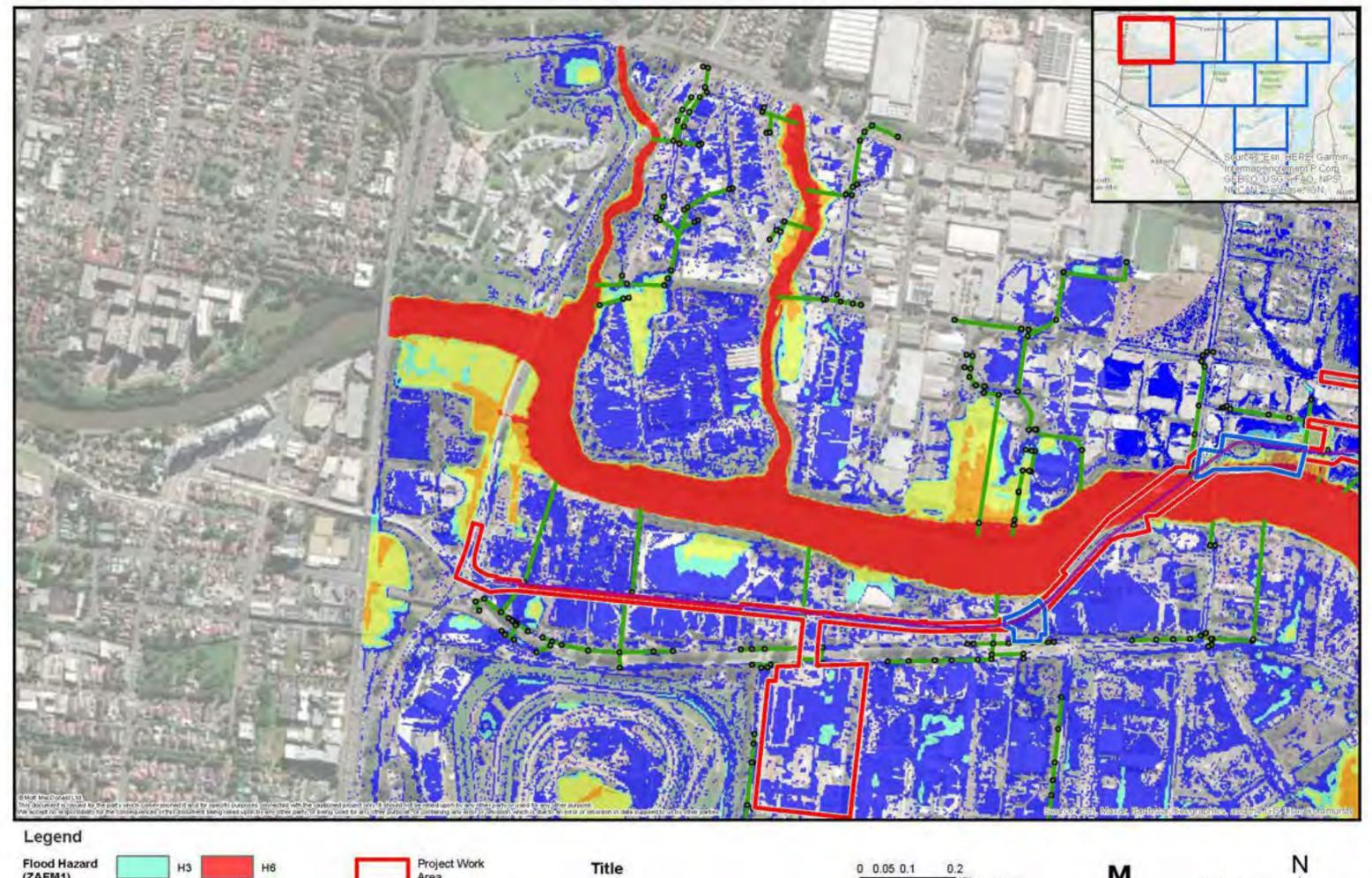


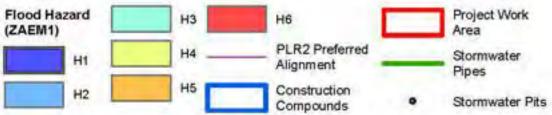


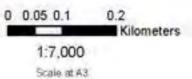






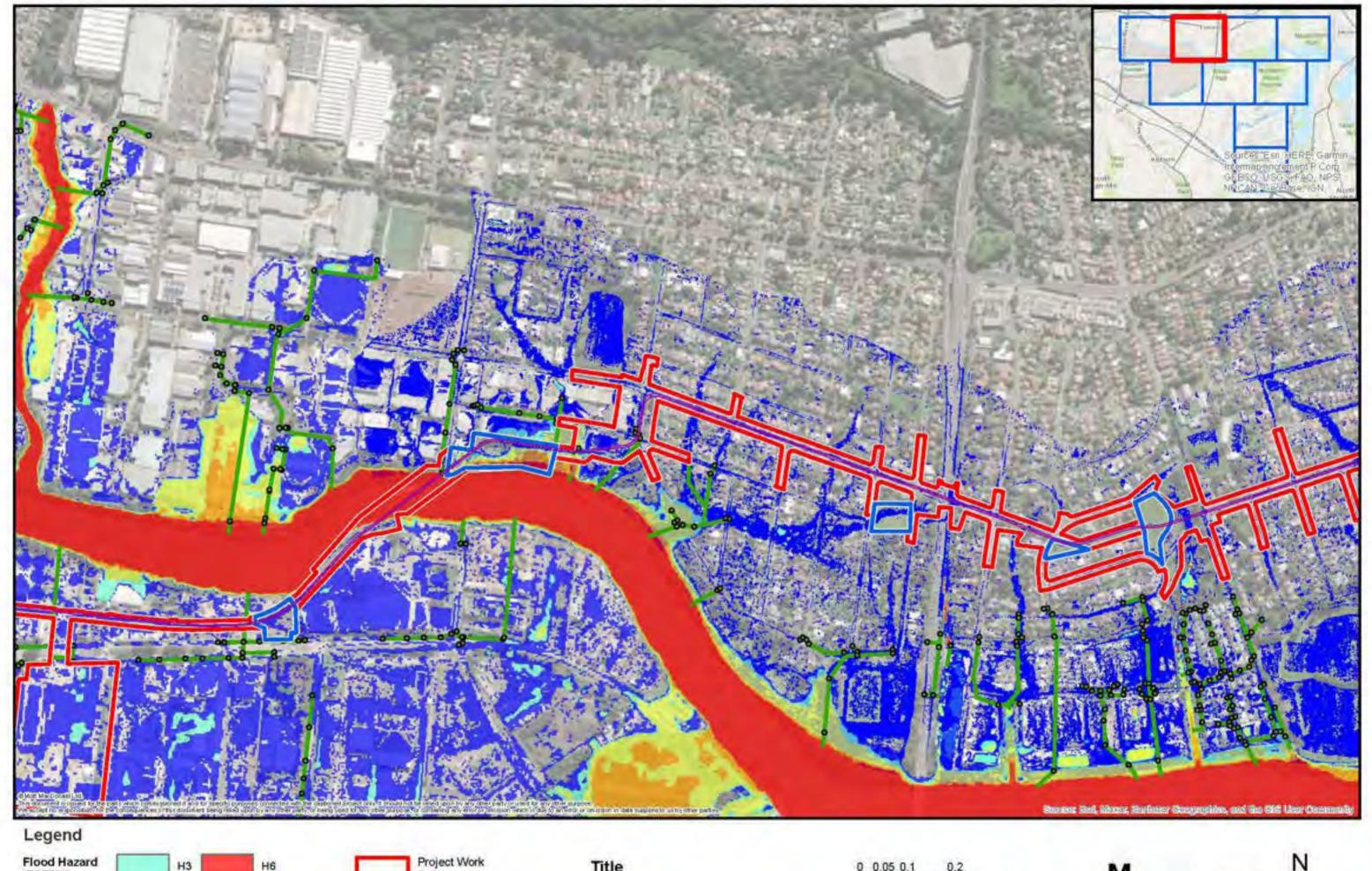


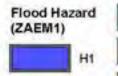






Map Number Sheet No 1 of 9



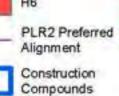




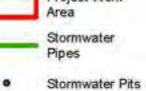












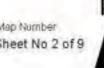
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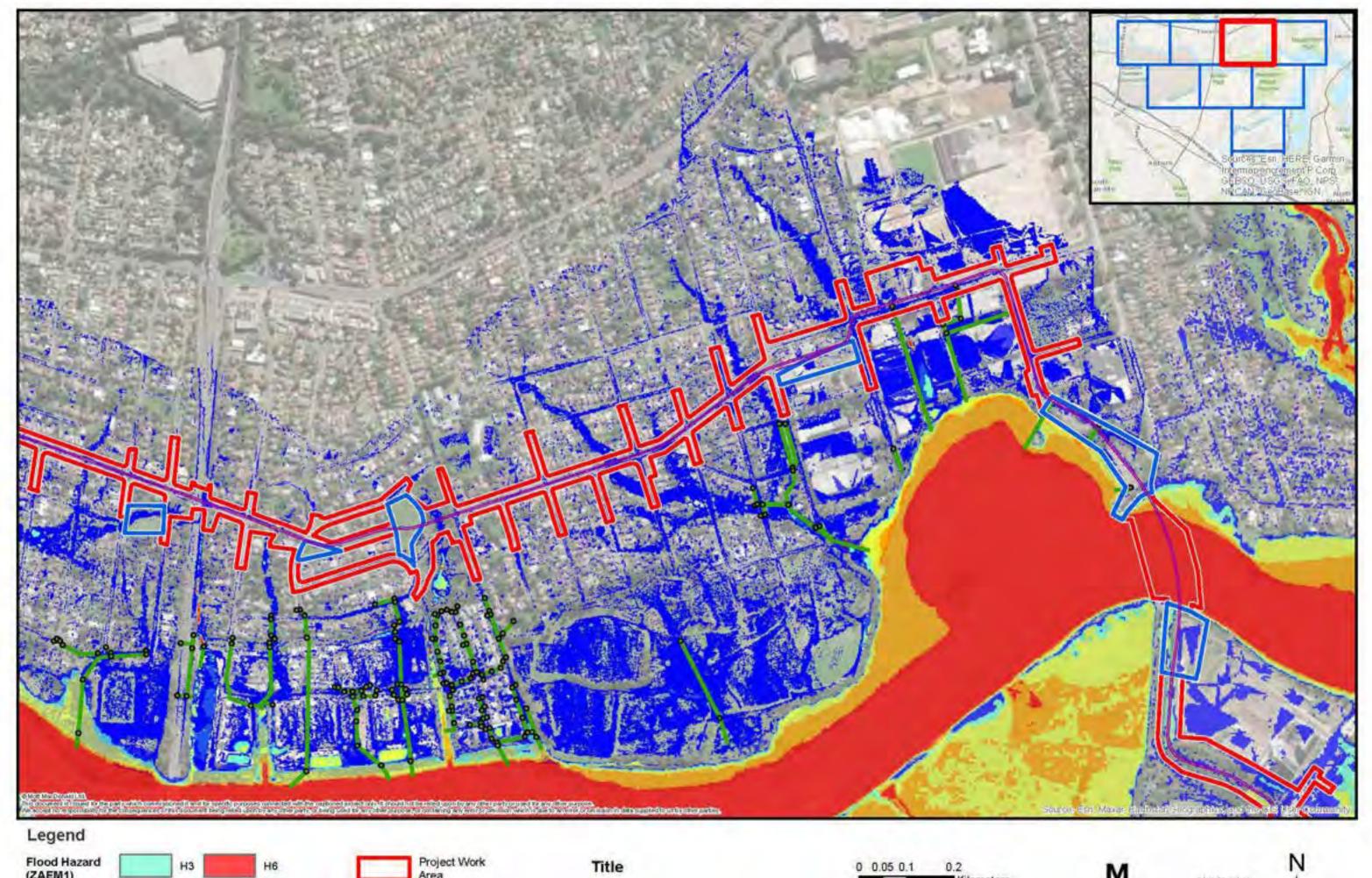
Proof of Concept Design Conditions 1% AEP Flood Hazard

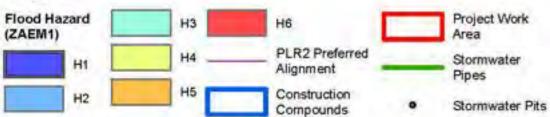




Map Number Sheet No 2 of 9



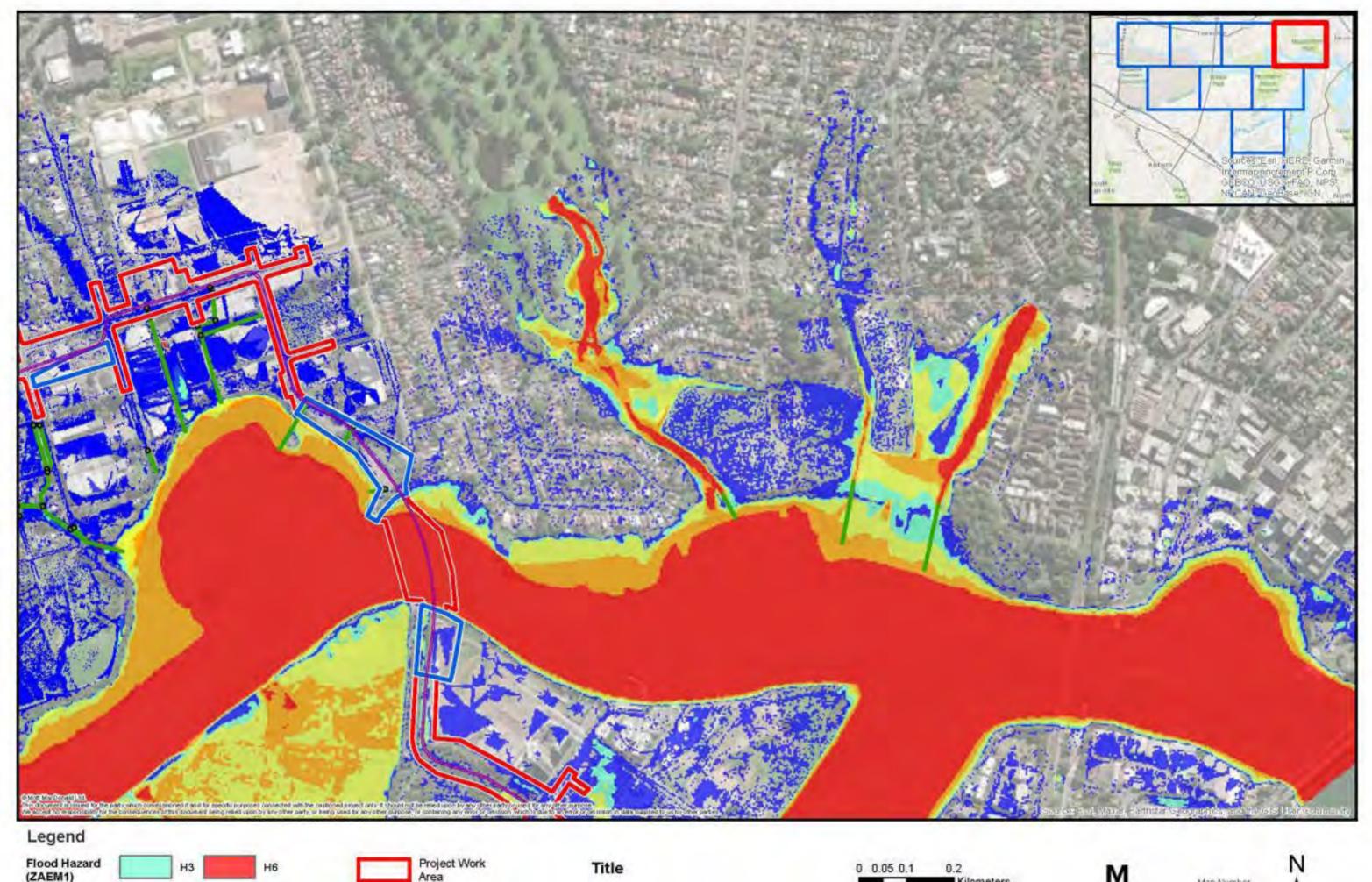


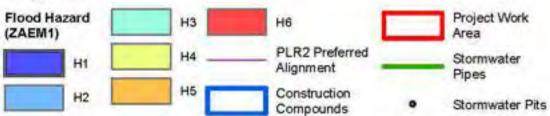




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Map Number Sheet No 3 of 9

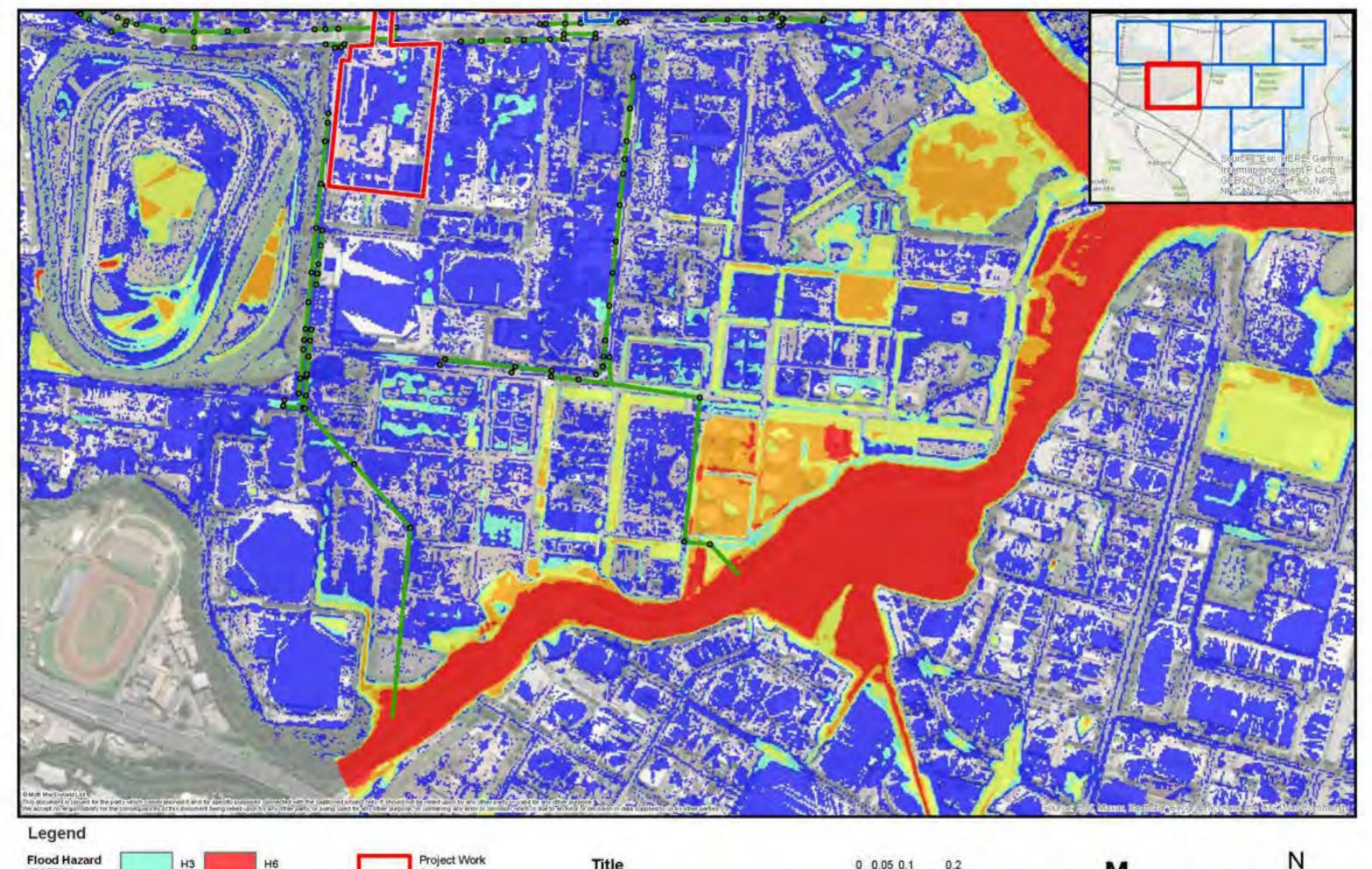








Map Number Sheet No 4 of 9





Compounds

Title

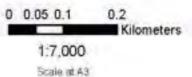
Area

Pipes

Stormwater

Stormwater Pits

Proof of Concept Design Conditions 1% AEP Flood Hazard

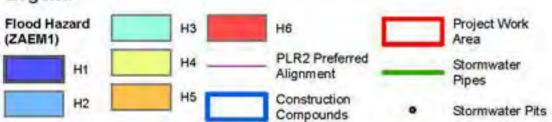




Map Number Sheet No 5 of 9





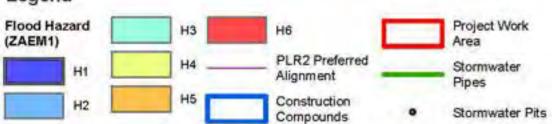






Map Number Sheet No 6 of 9



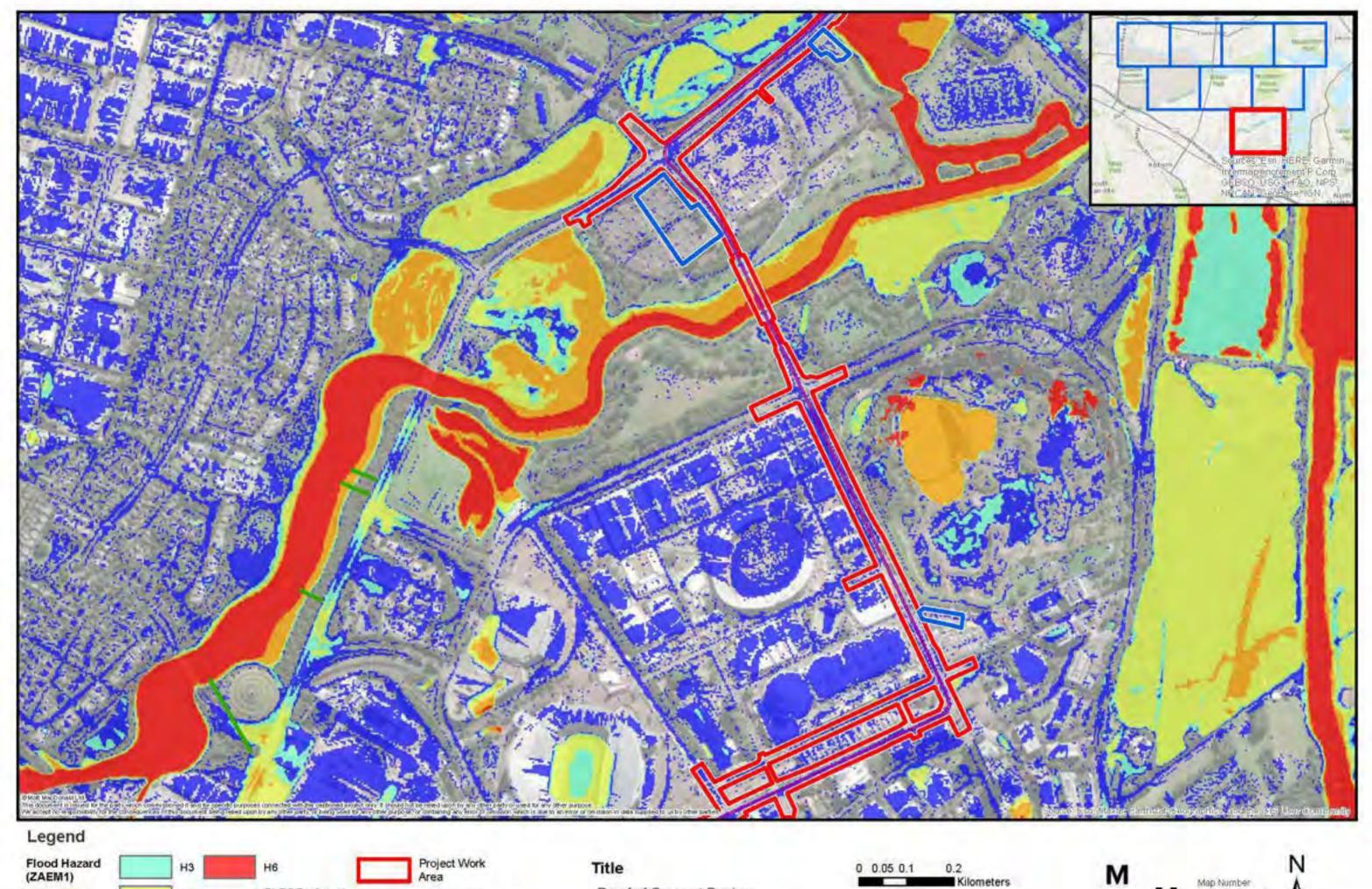


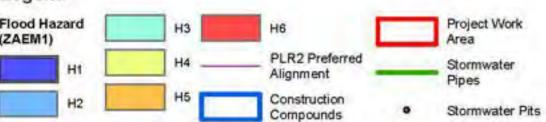




Map Number Sheet No 7 of 9

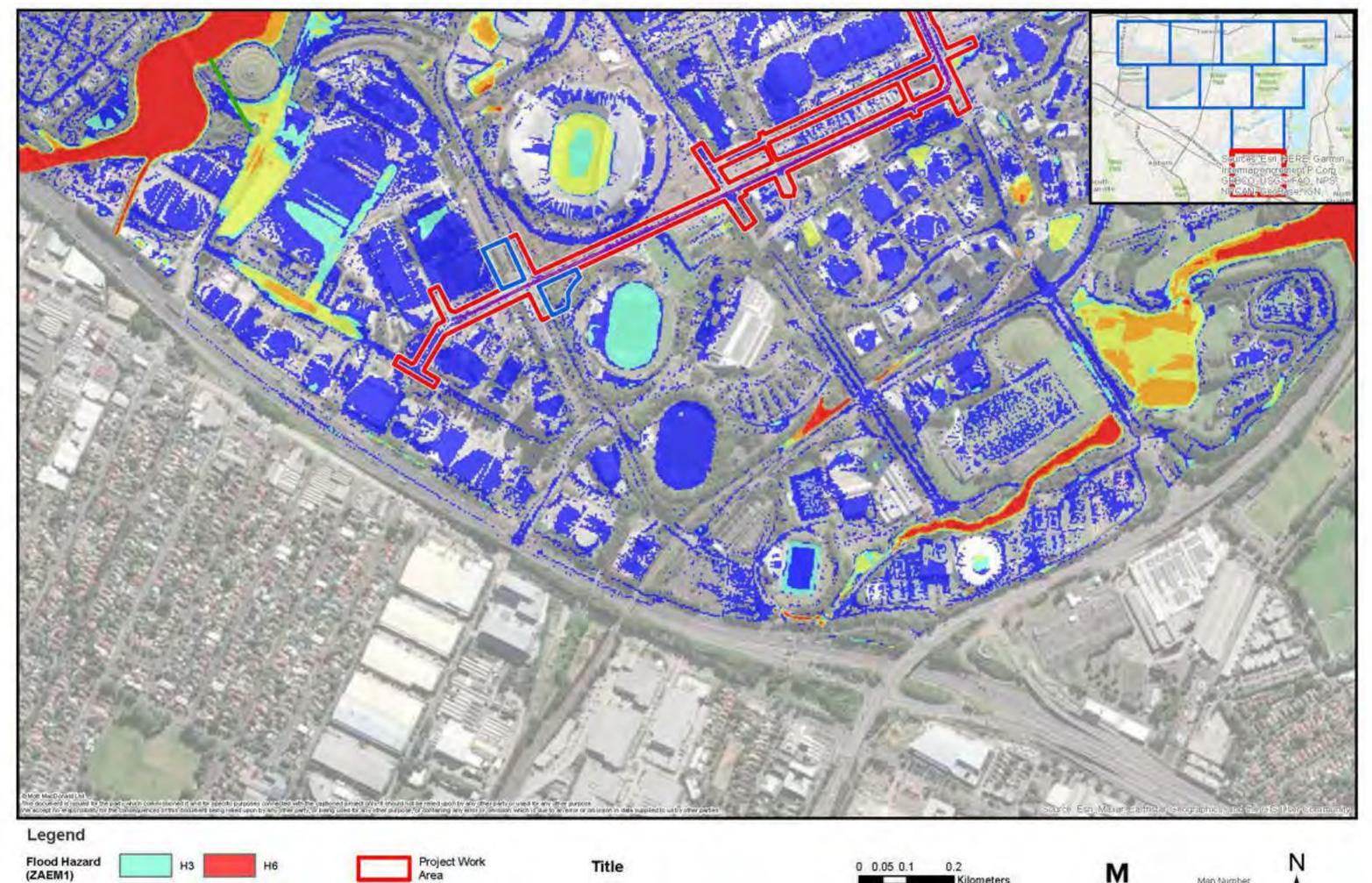


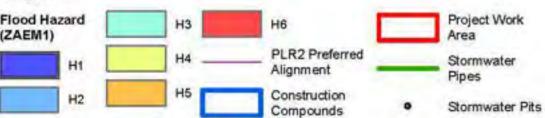








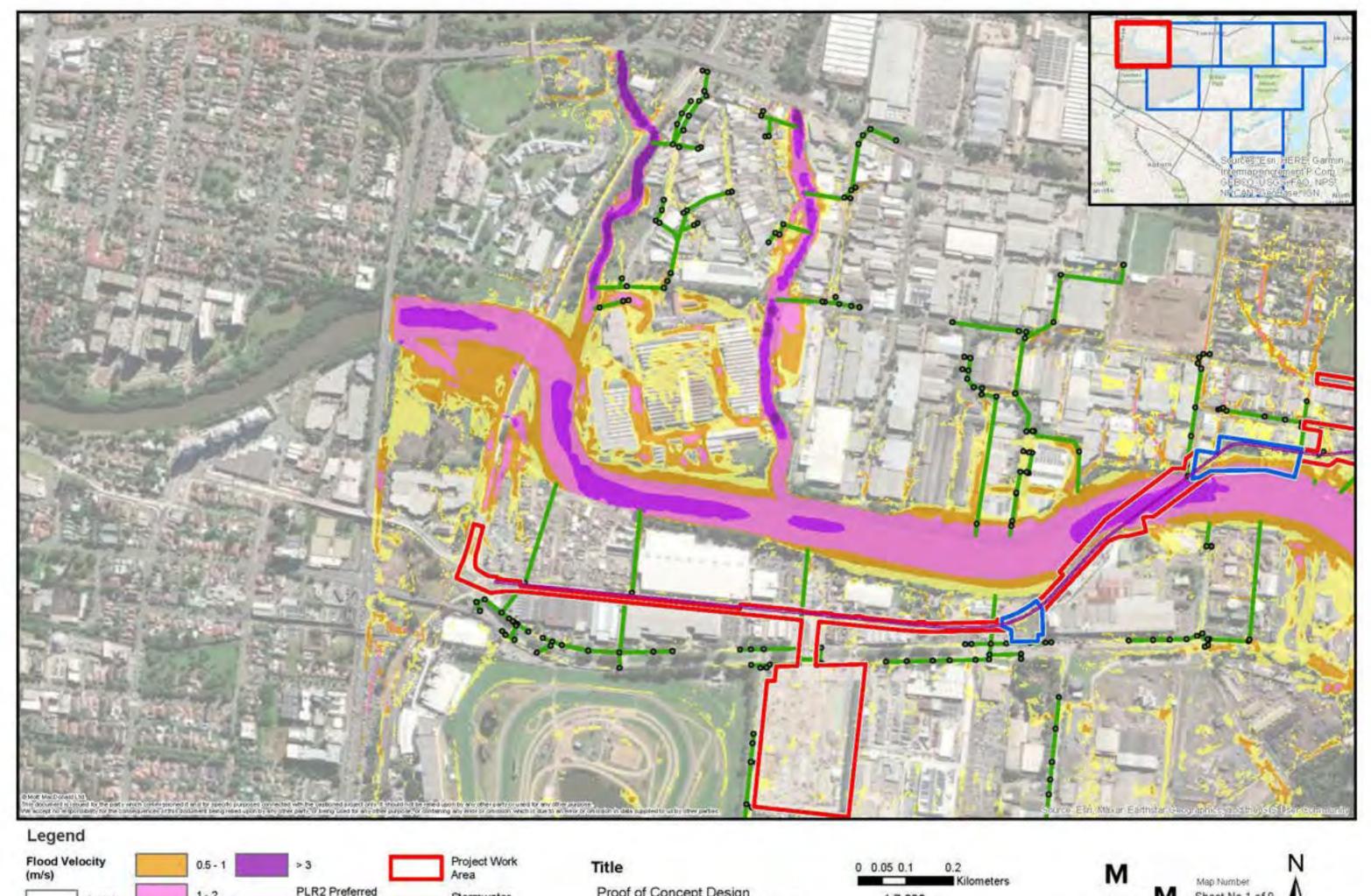


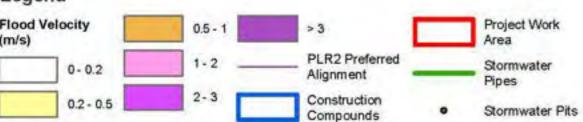




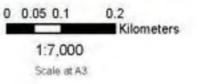


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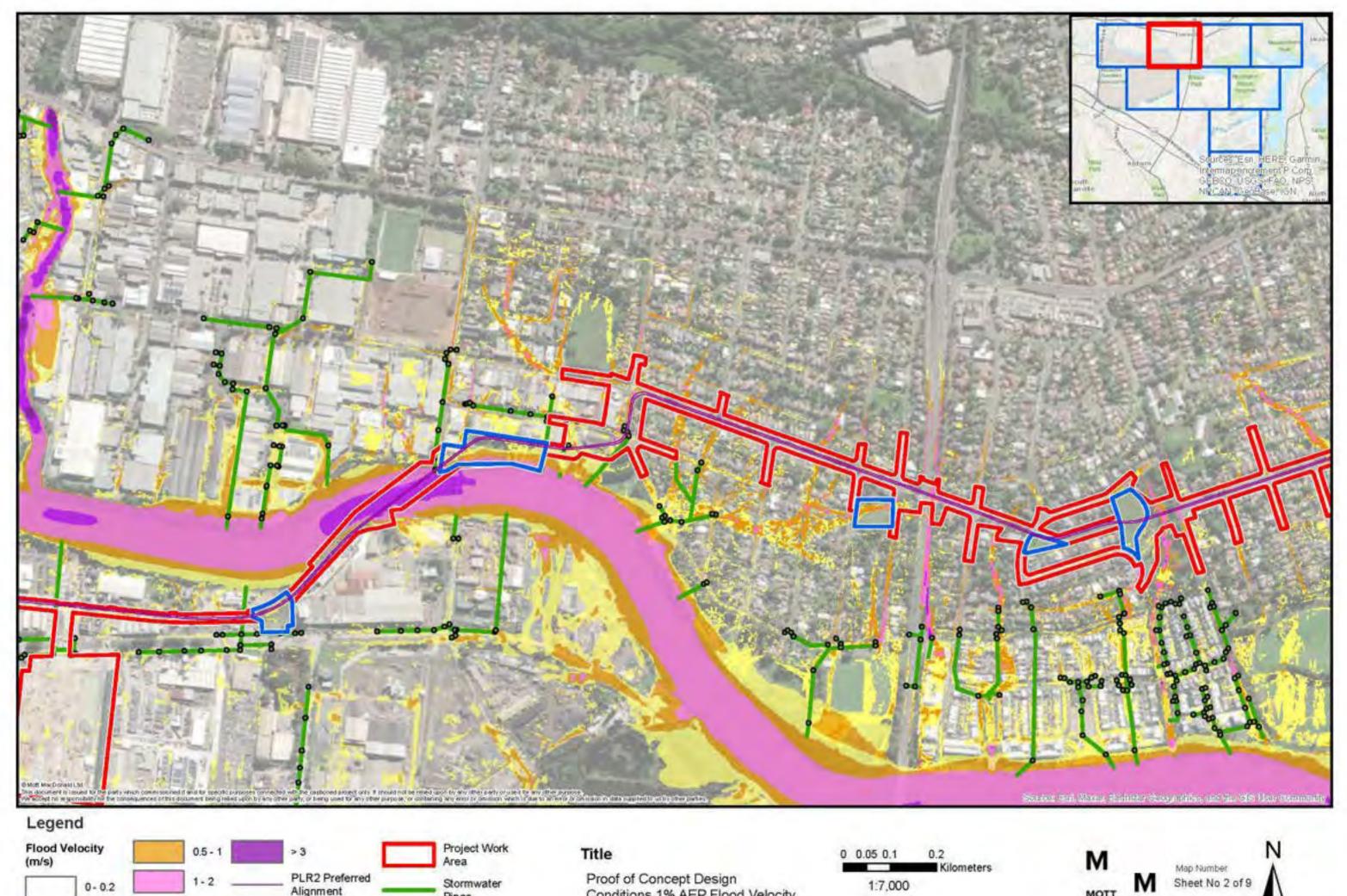








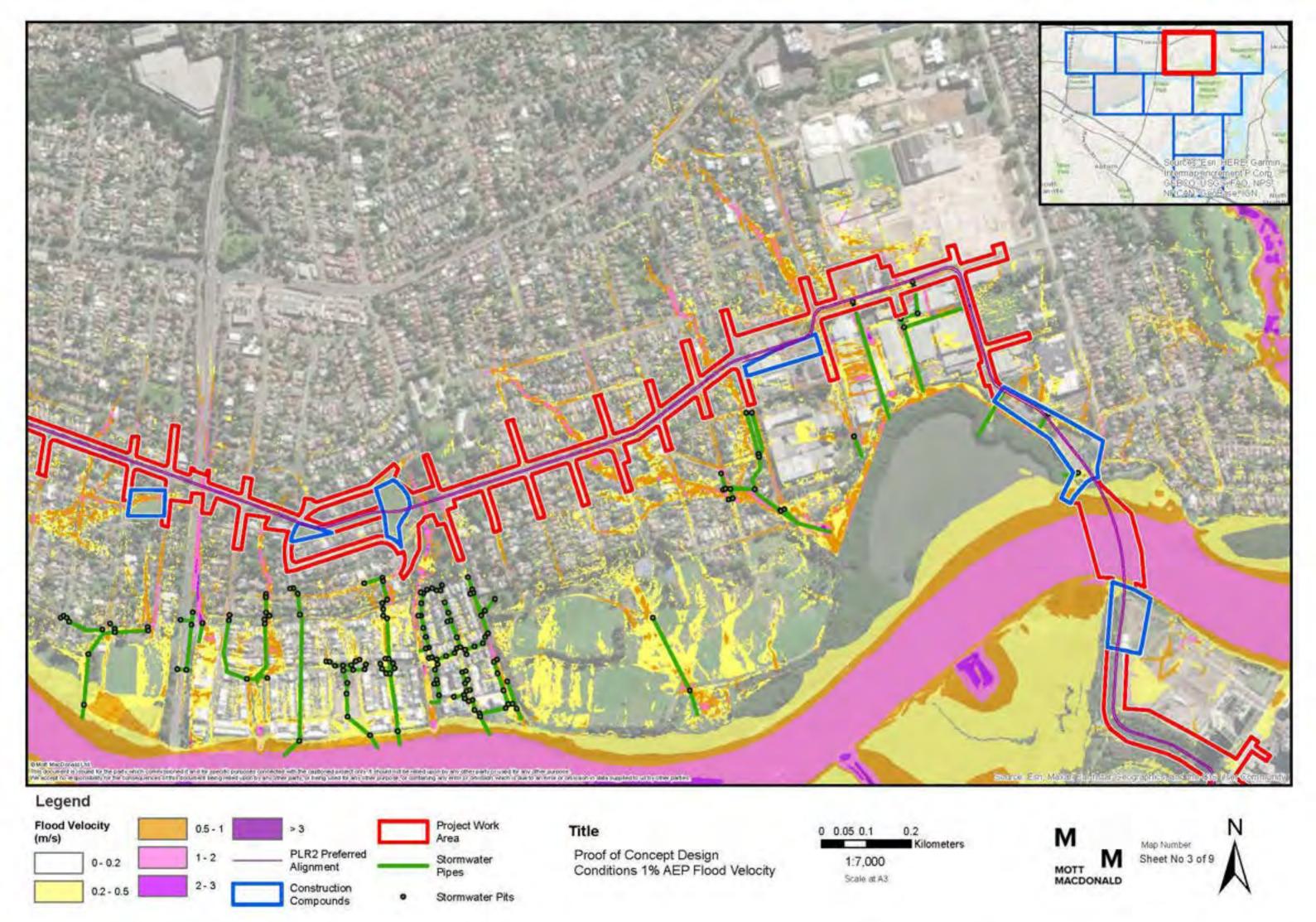


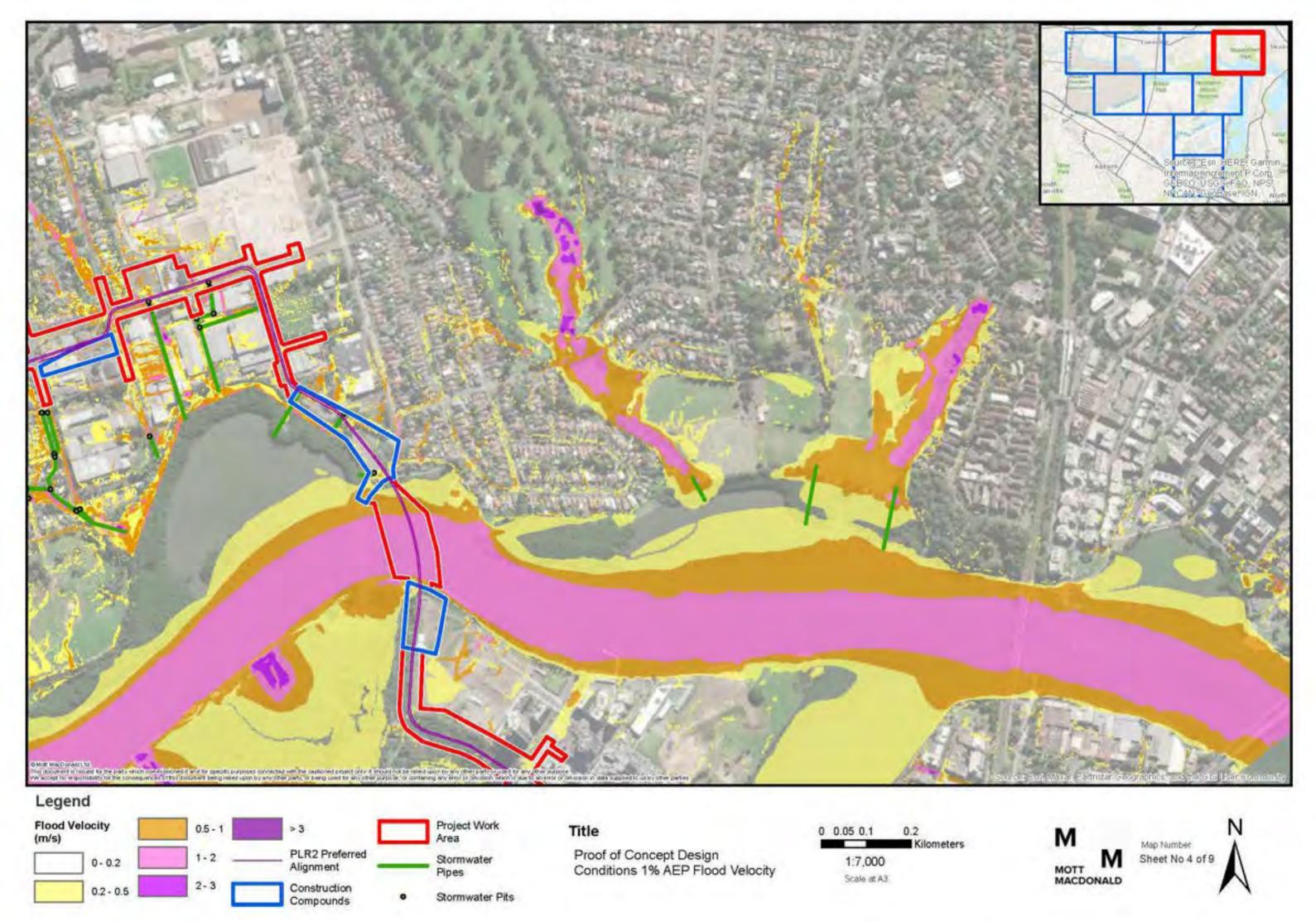


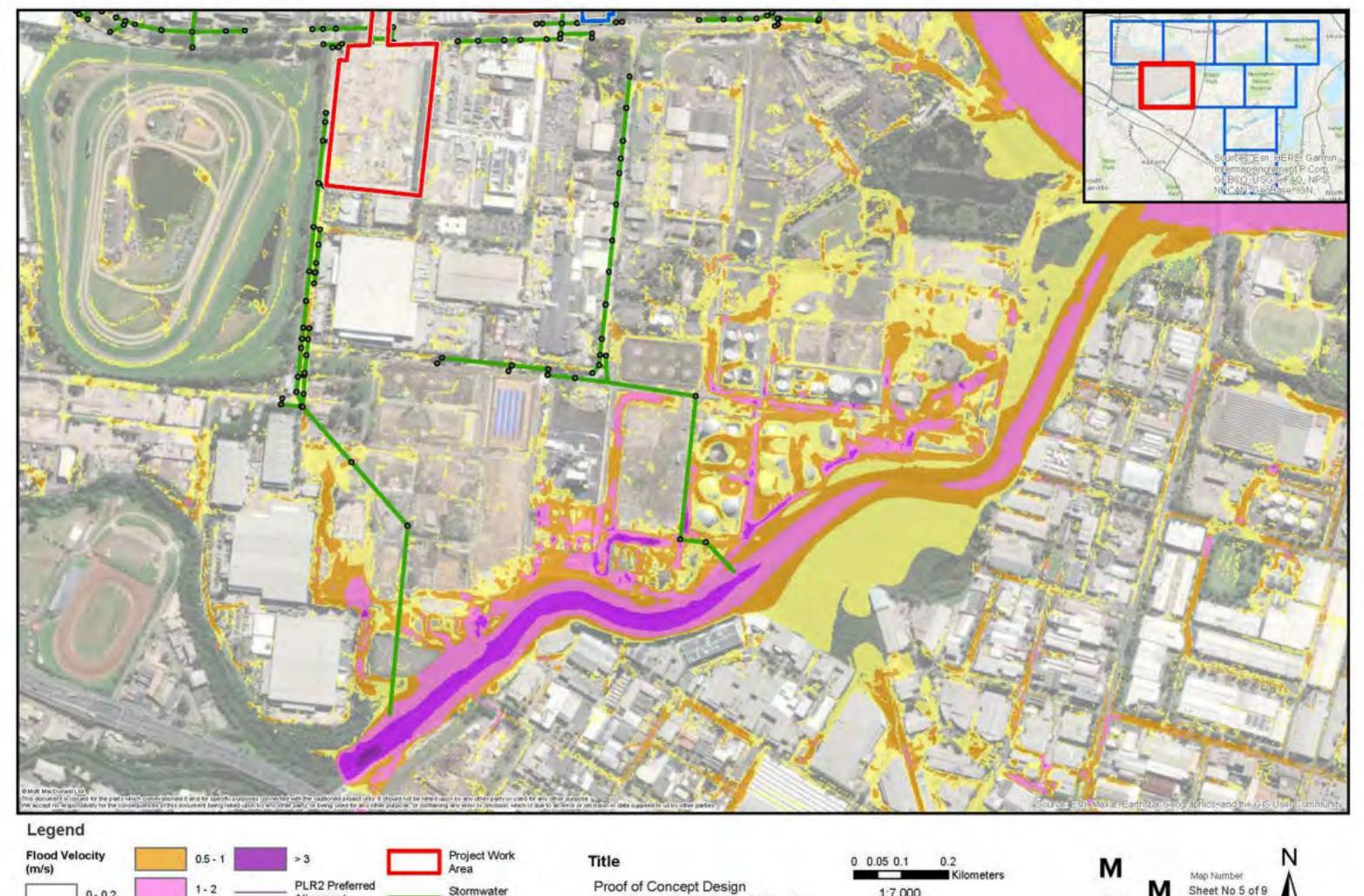












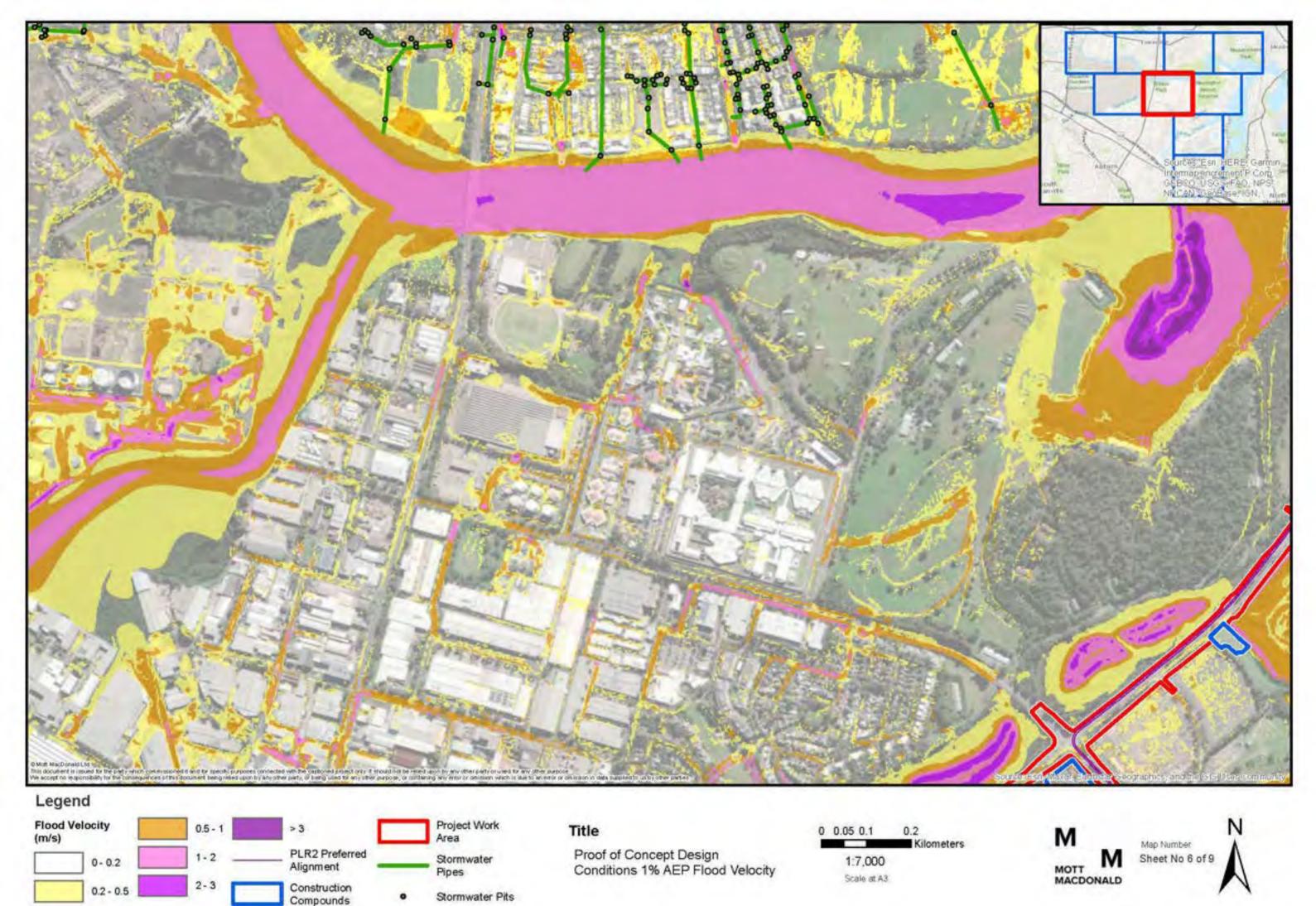


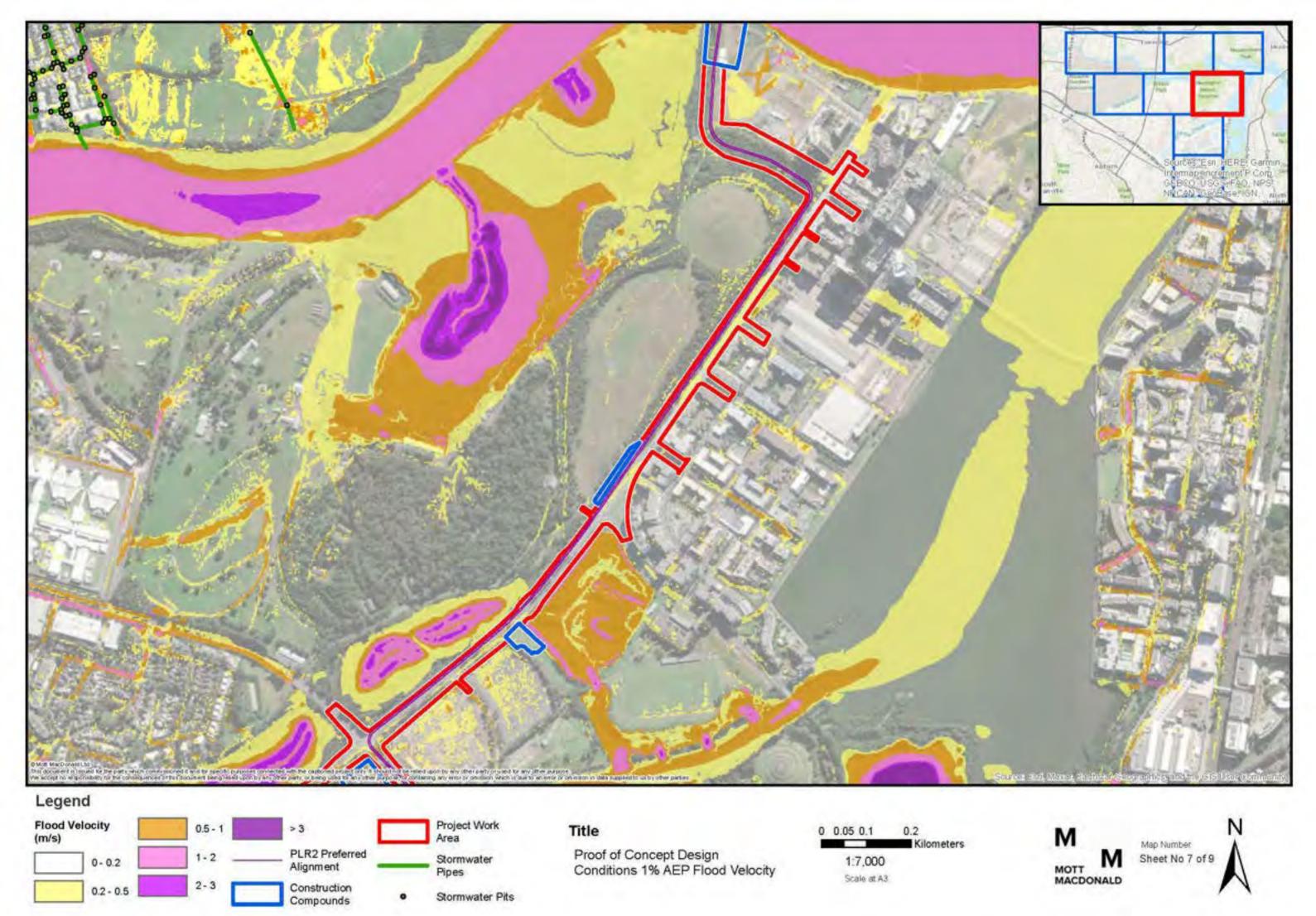
Proof of Concept Design Conditions 1% AEP Flood Velocity

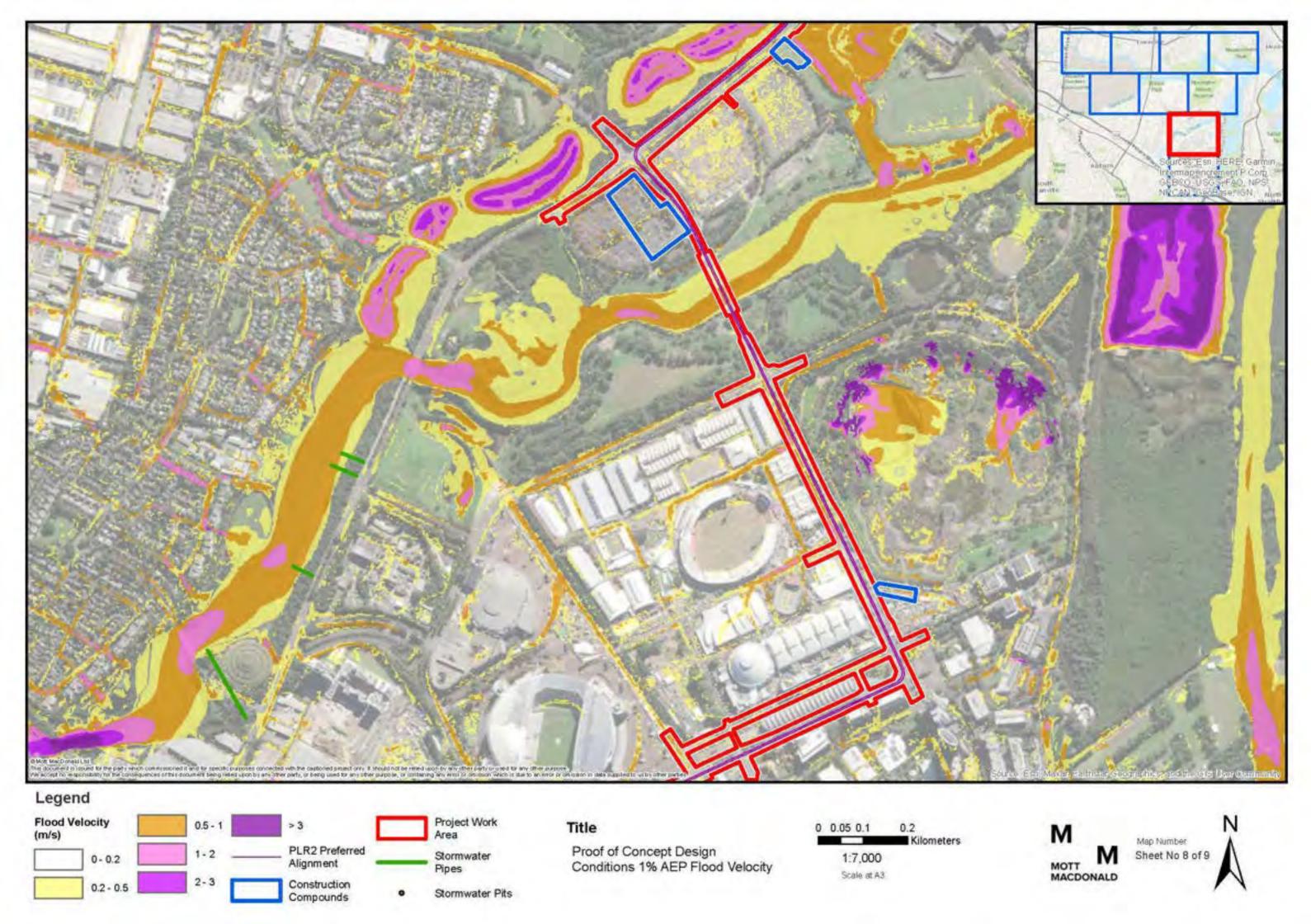


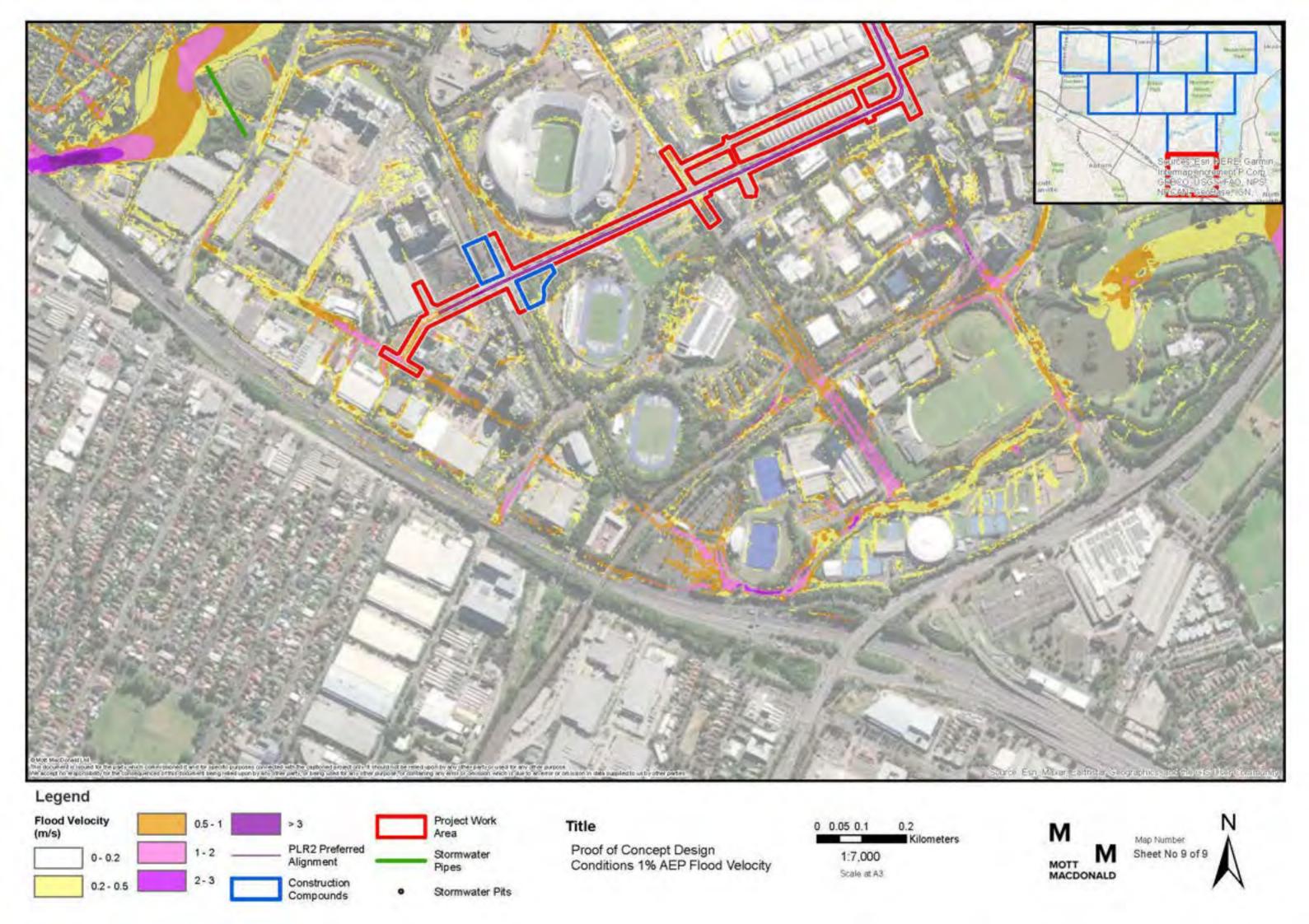
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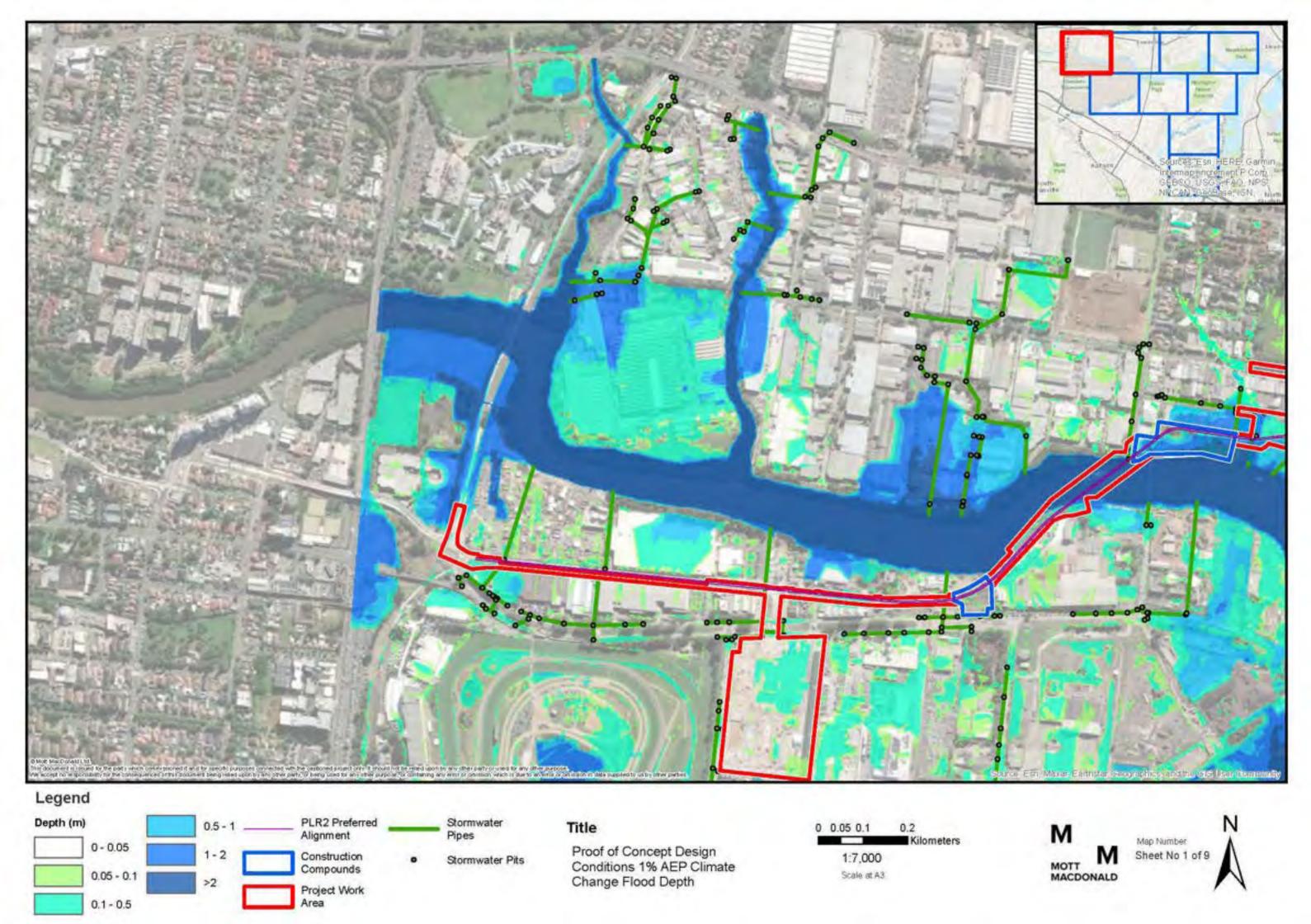
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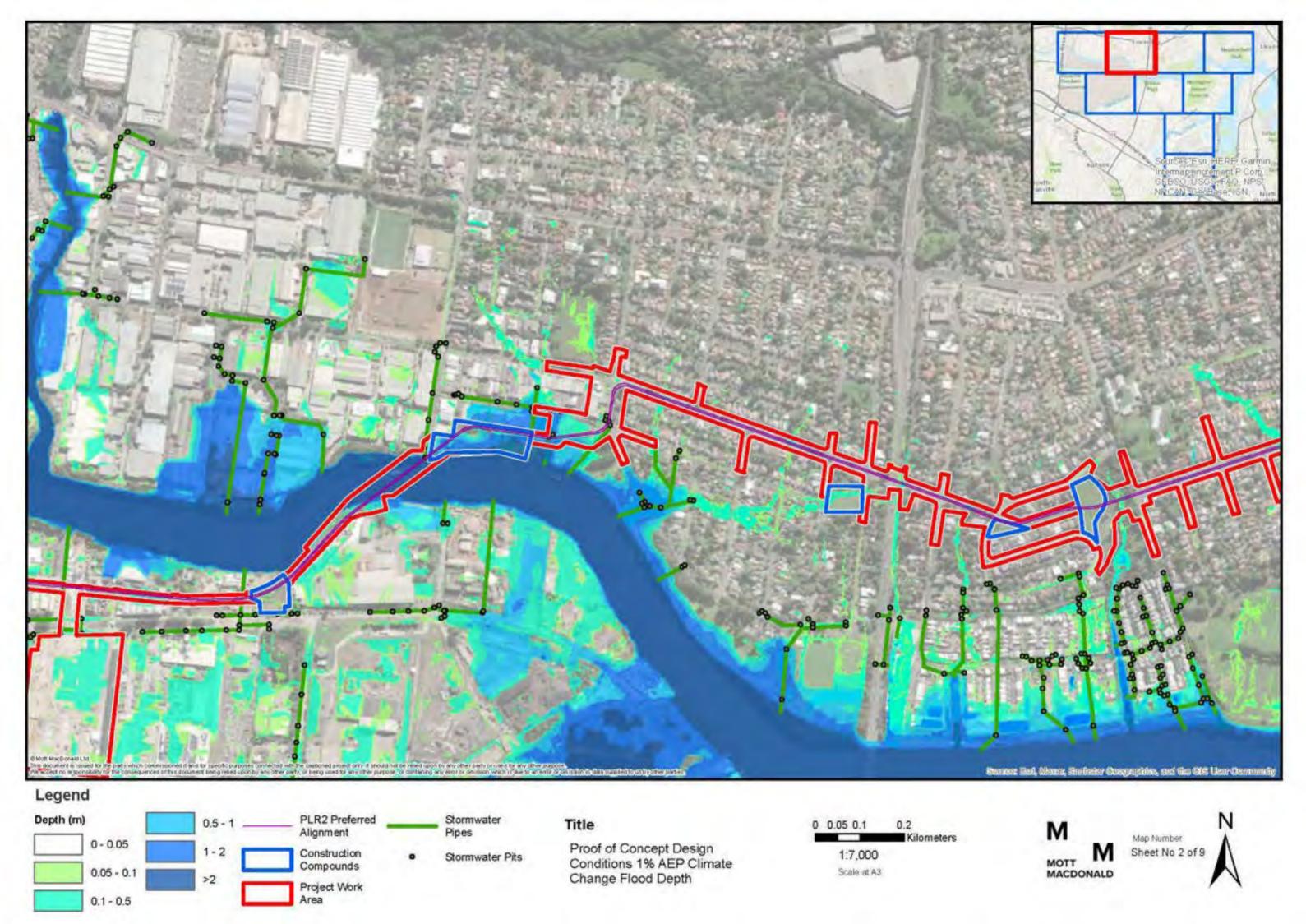


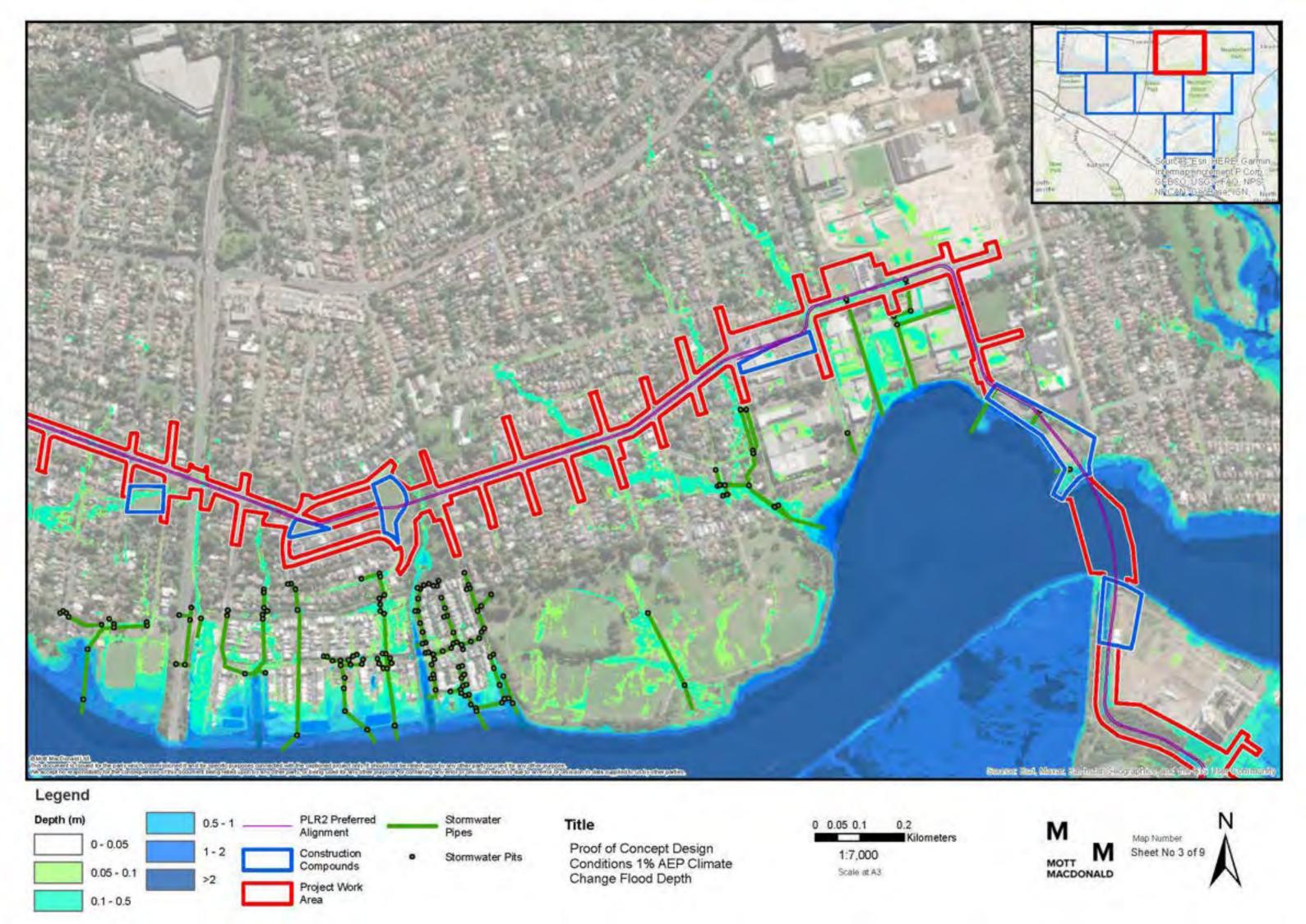


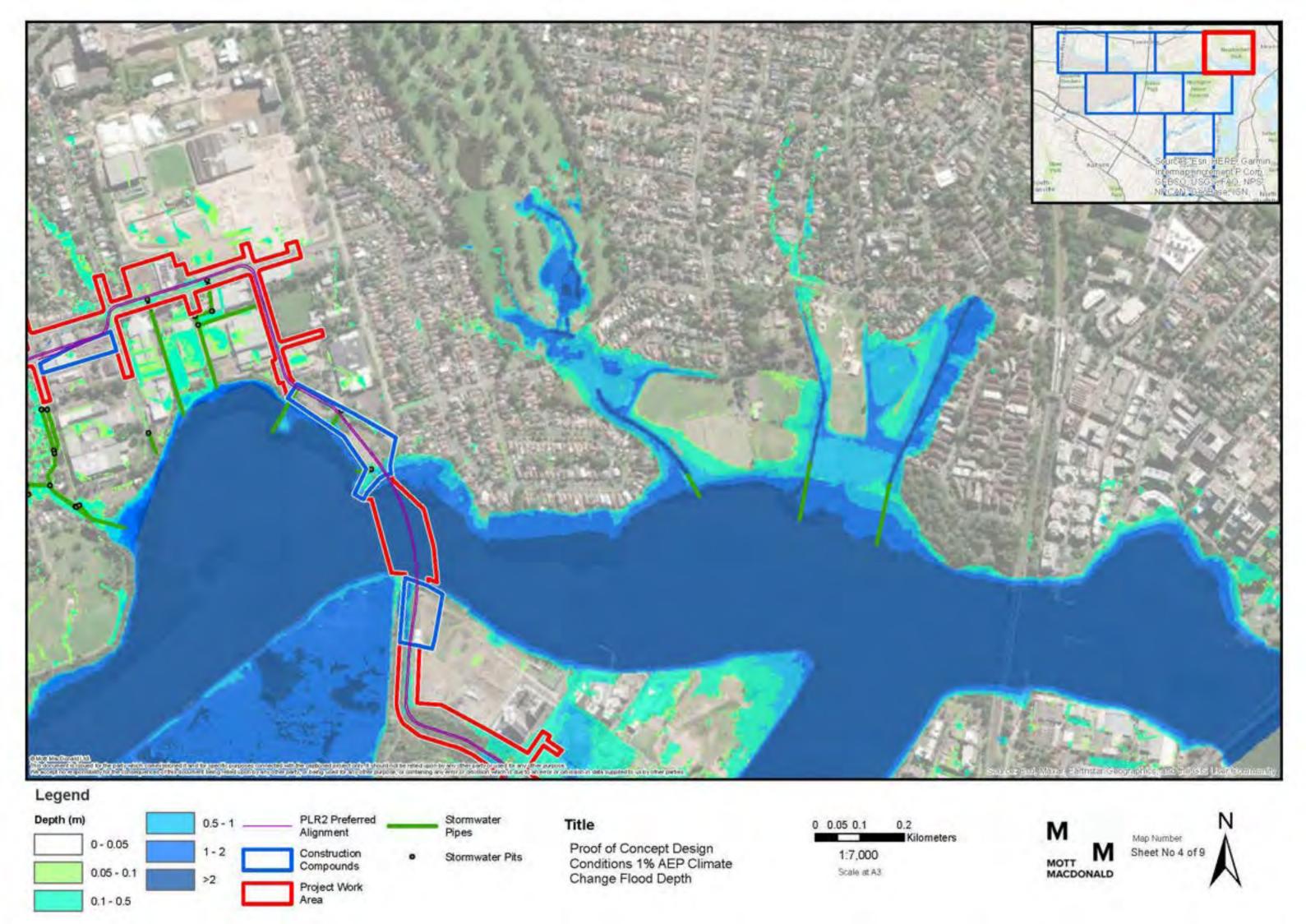


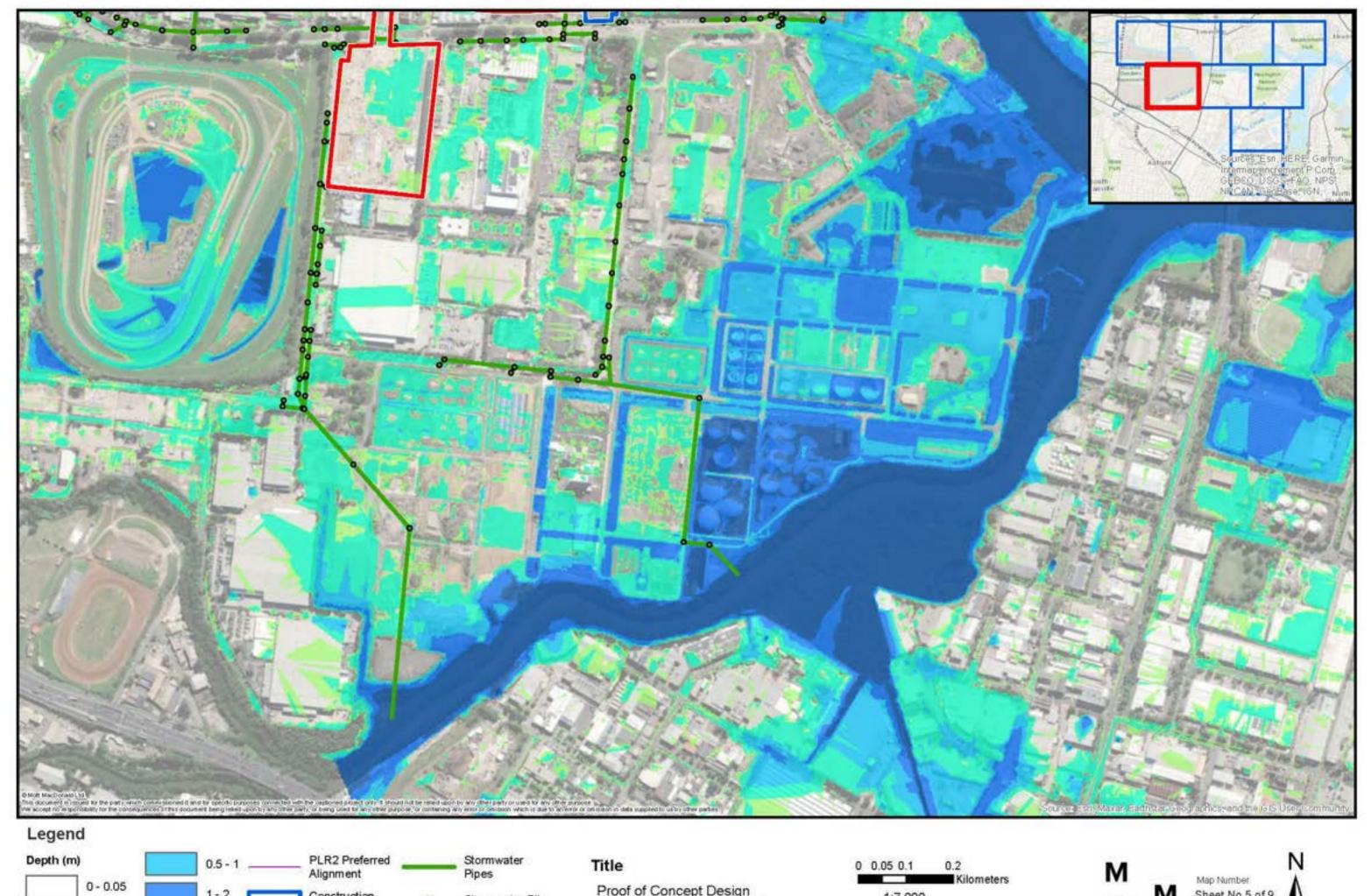


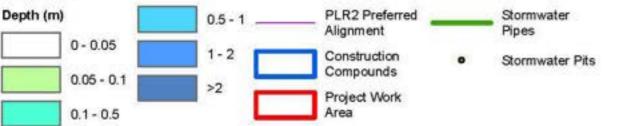










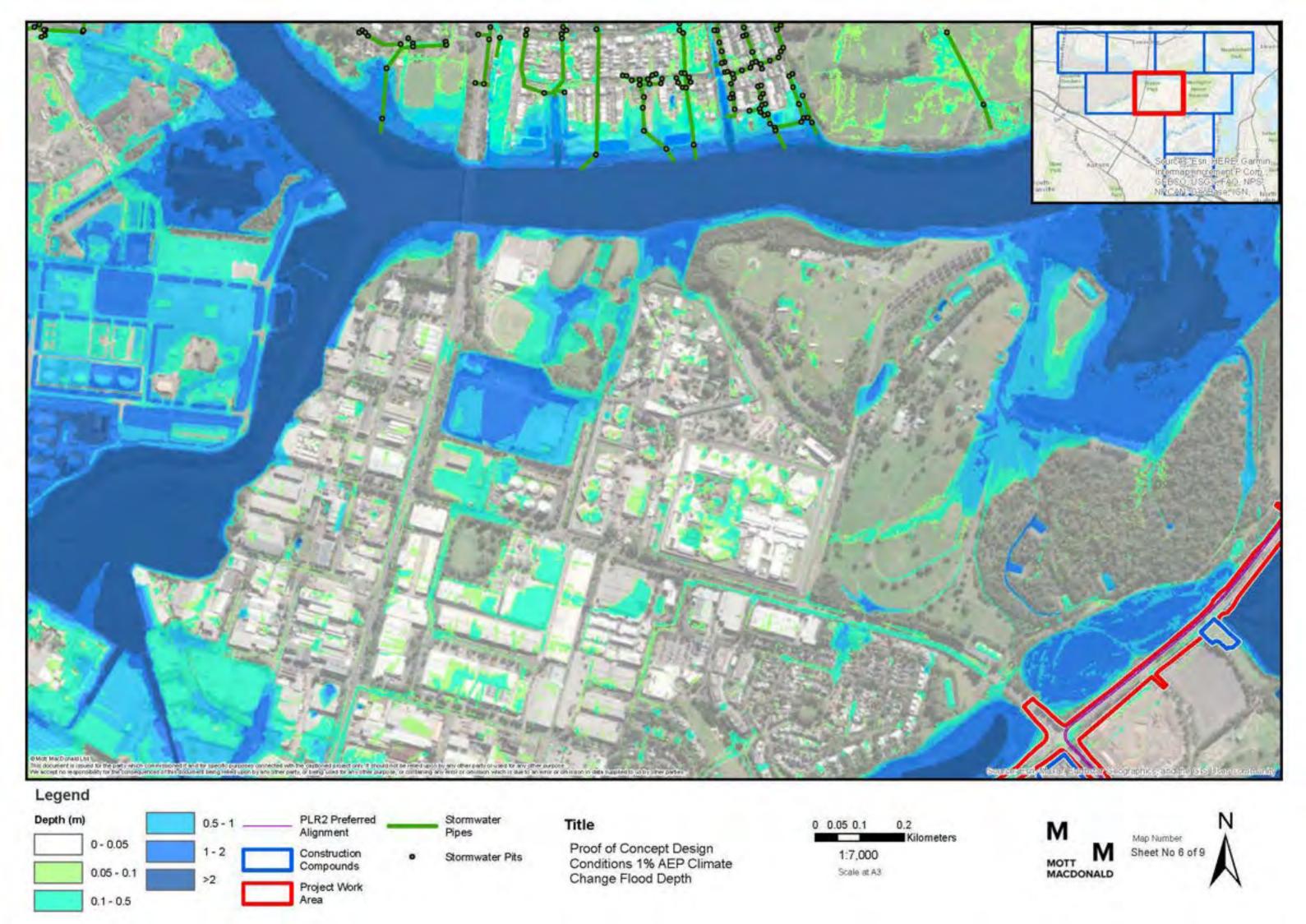


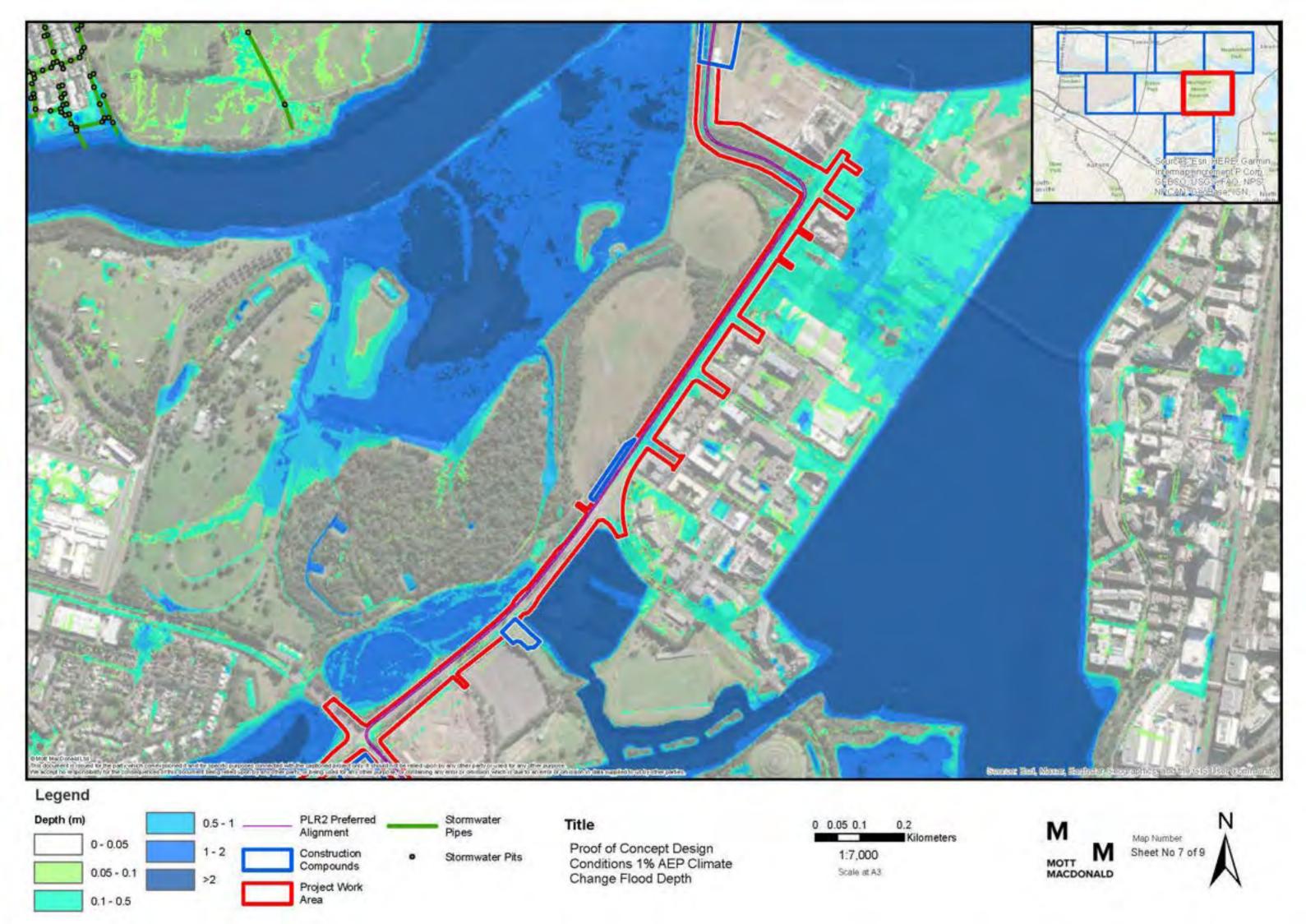
Proof of Concept Design Conditions 1% AEP Climate Change Flood Depth

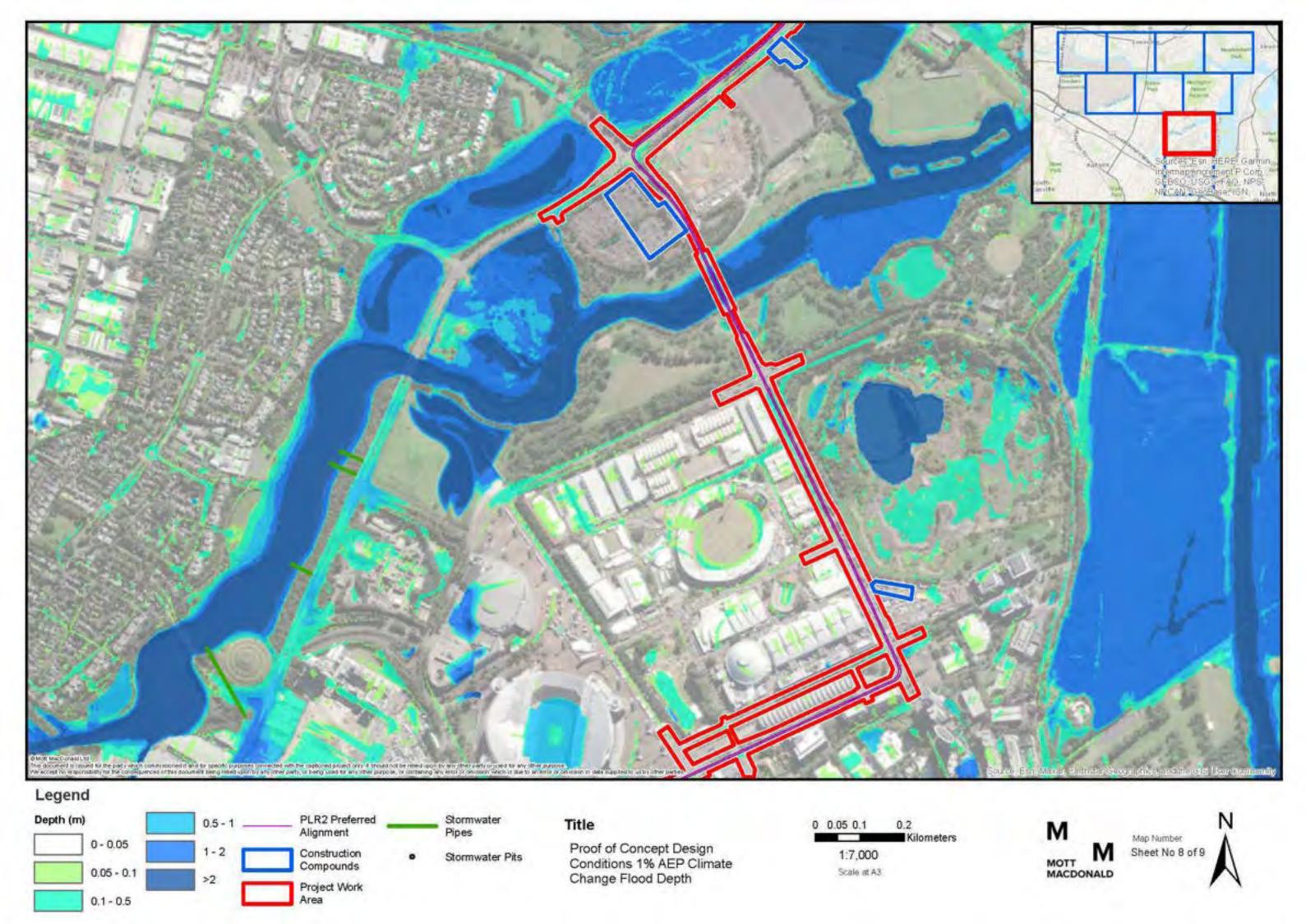


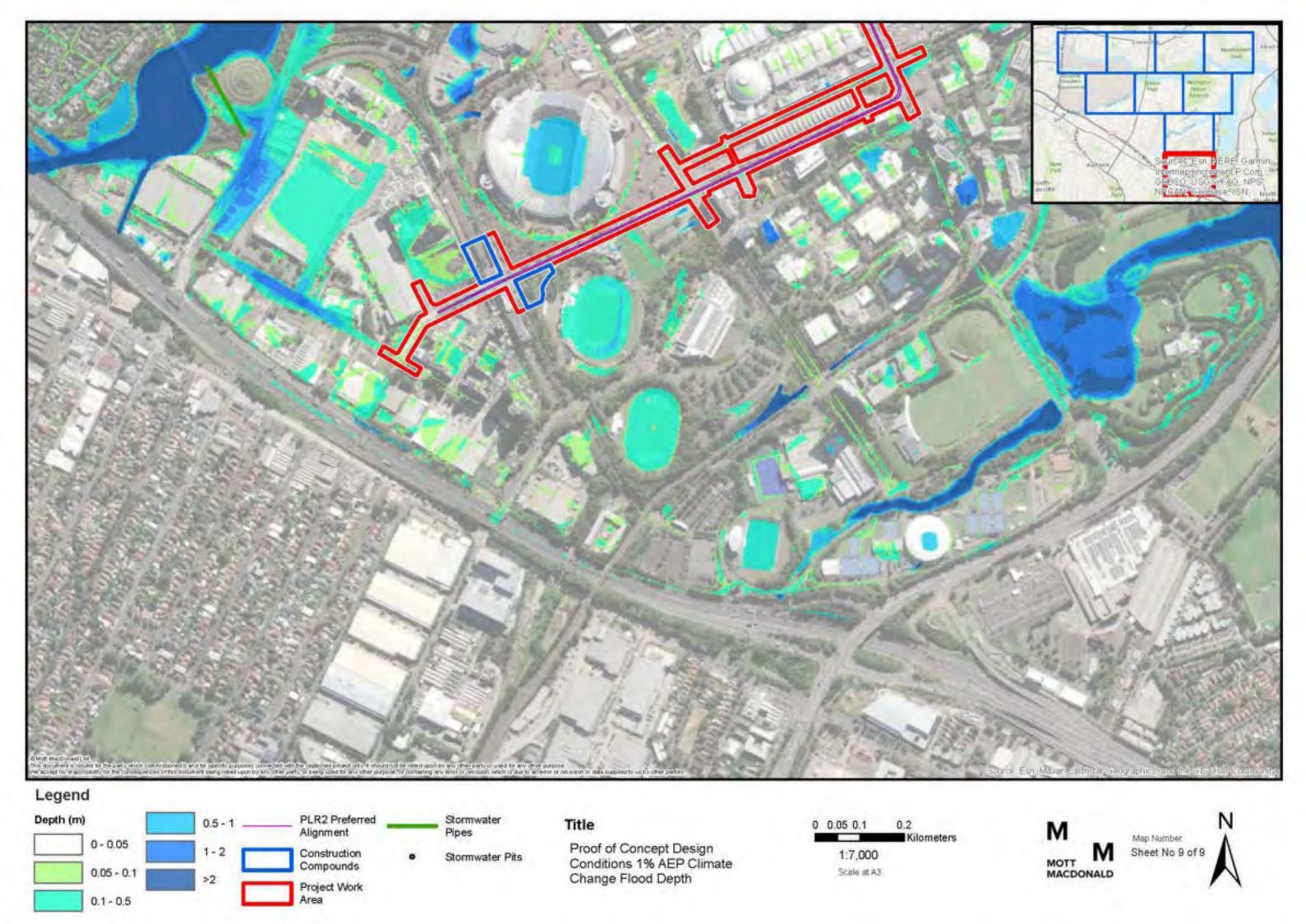


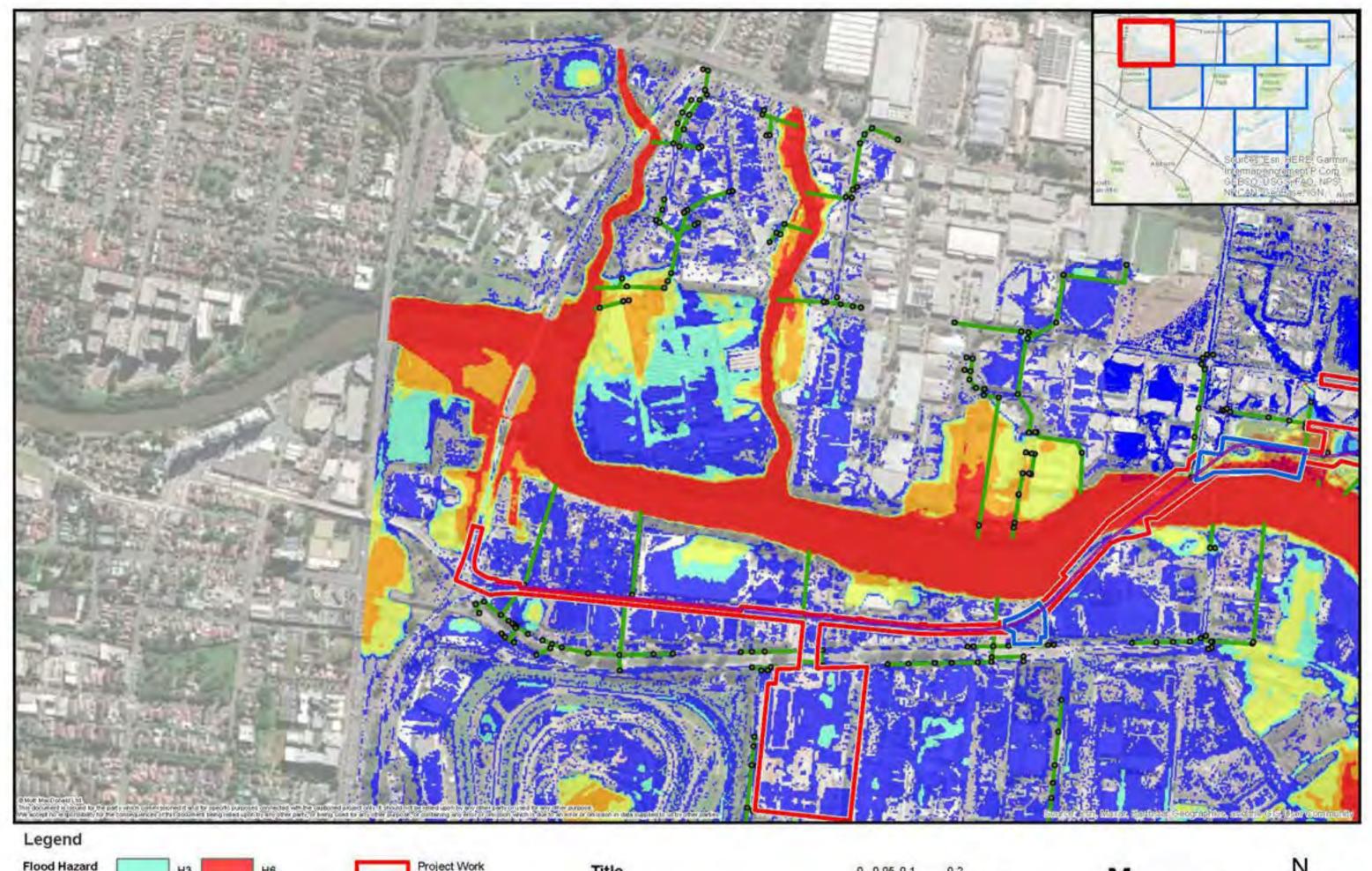


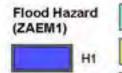


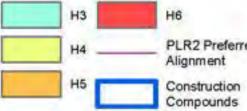




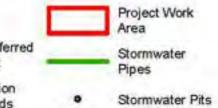






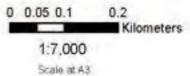






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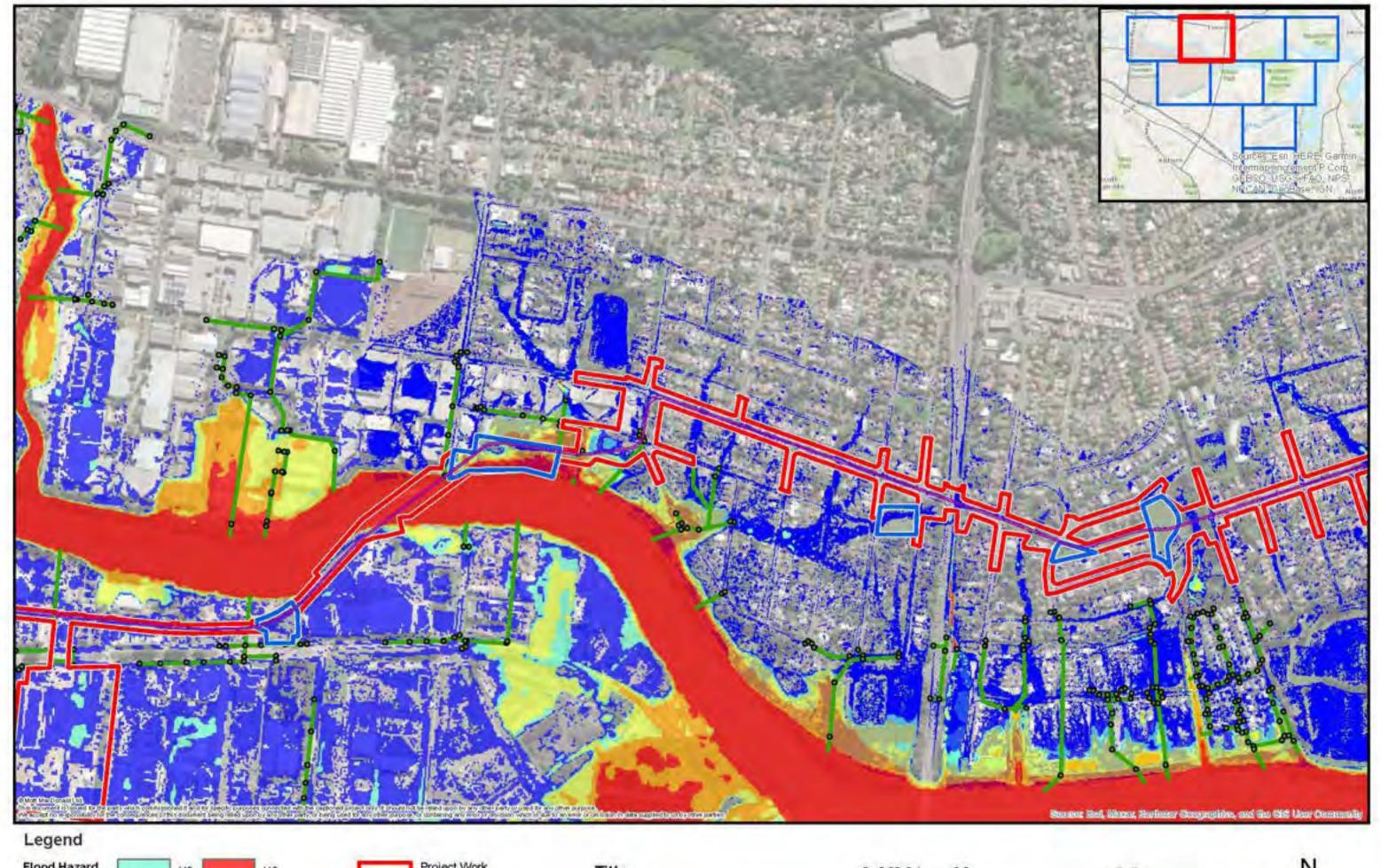
Proof of Concept Design Conditions 1% AEP Climate Change Flood Hazard



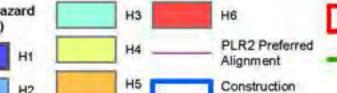


Map Number Sheet No 1 of 9









Compounds

Project Work Area R2 Preferred Stormwater

Stormwater Pipes Stormwater Pits

Title

Proof of Concept Design Conditions 1% AEP Climate Change Flood Hazard

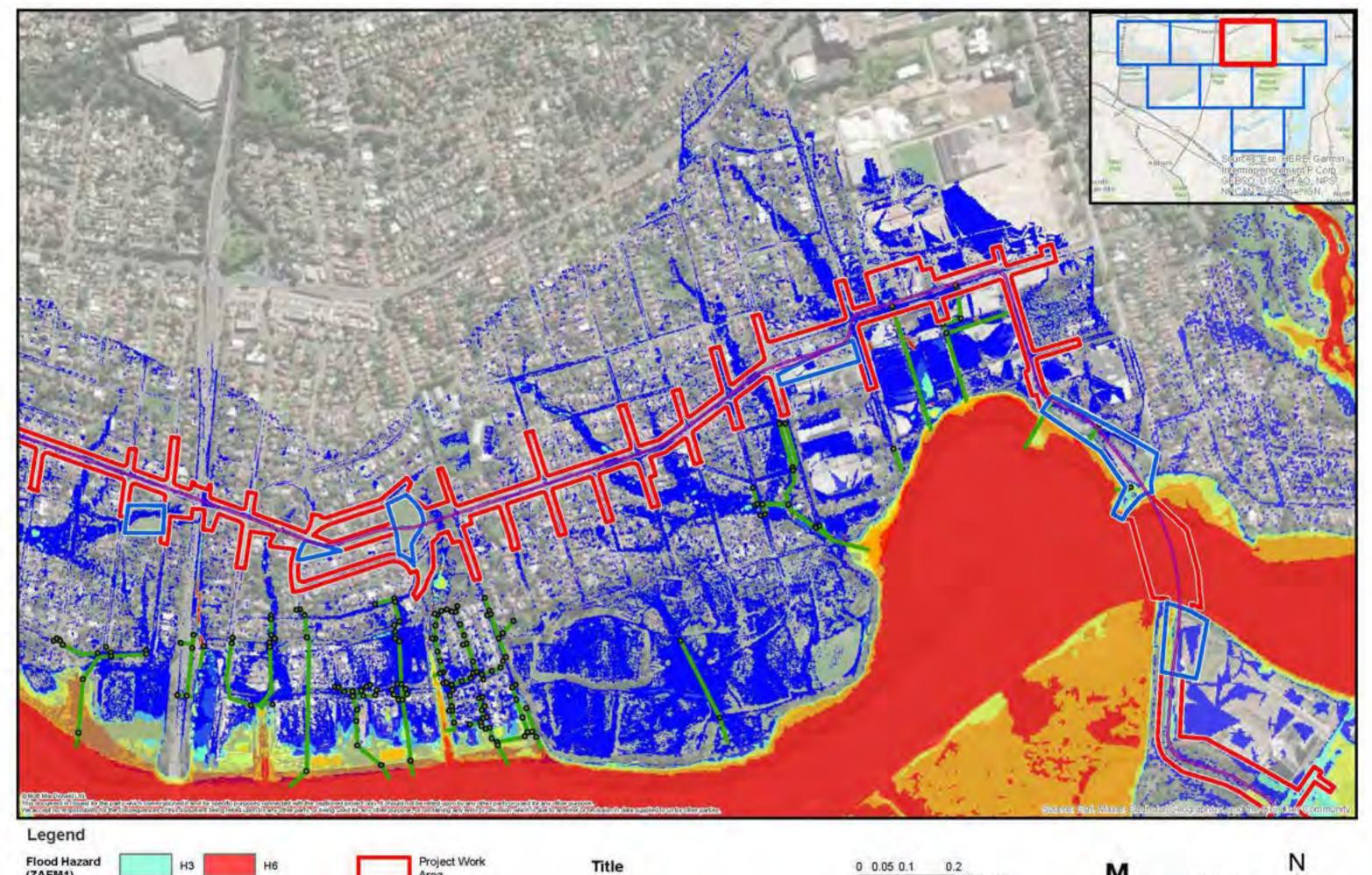
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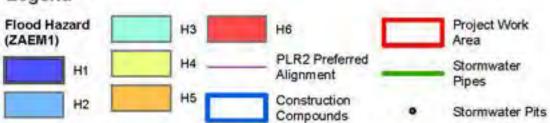
Scale at A3

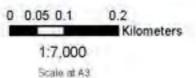
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Map Number Sheet No 2 of 9

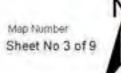


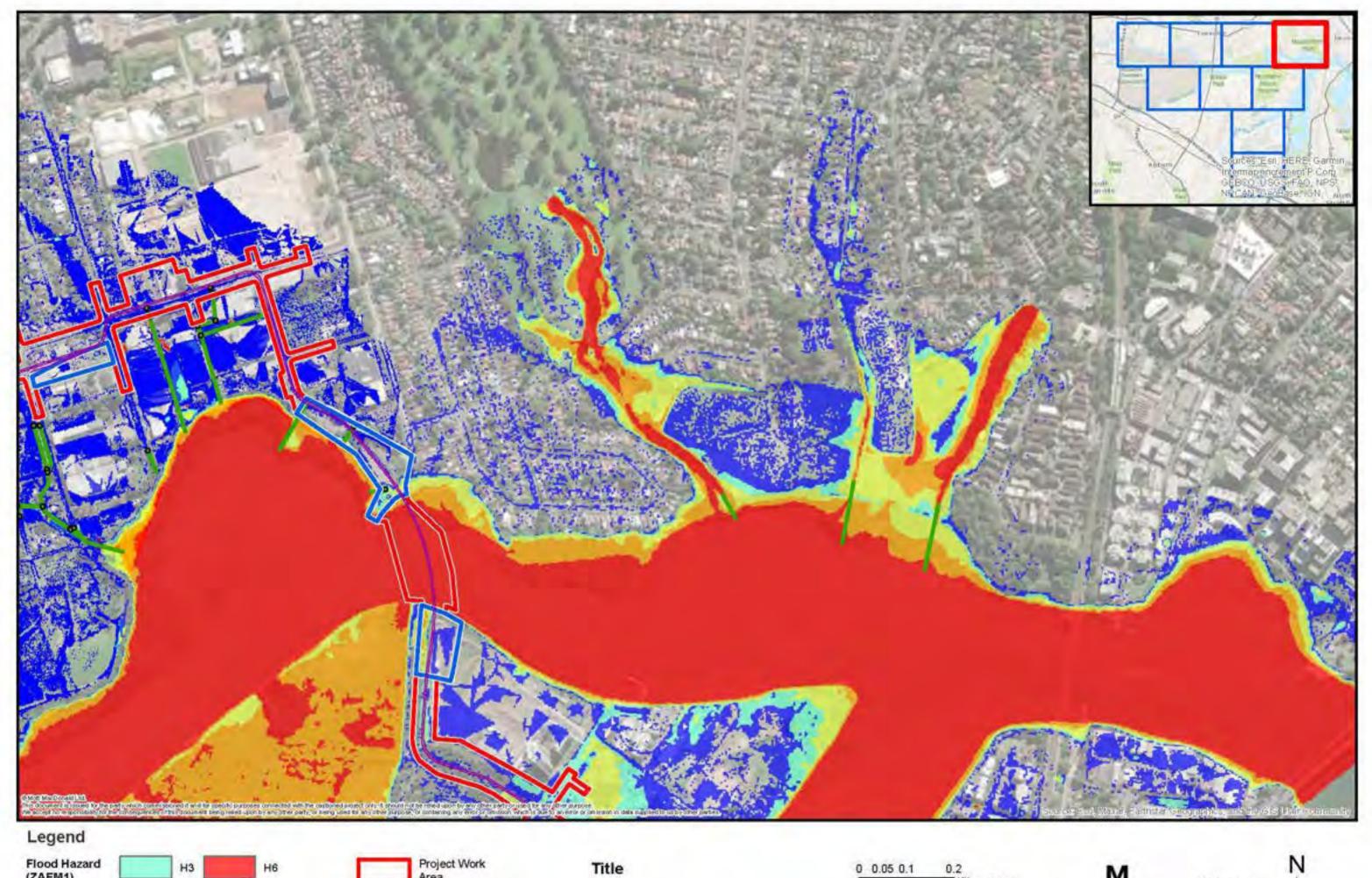


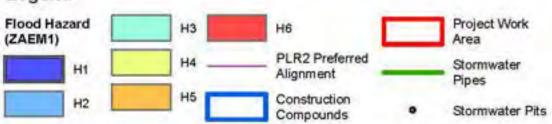










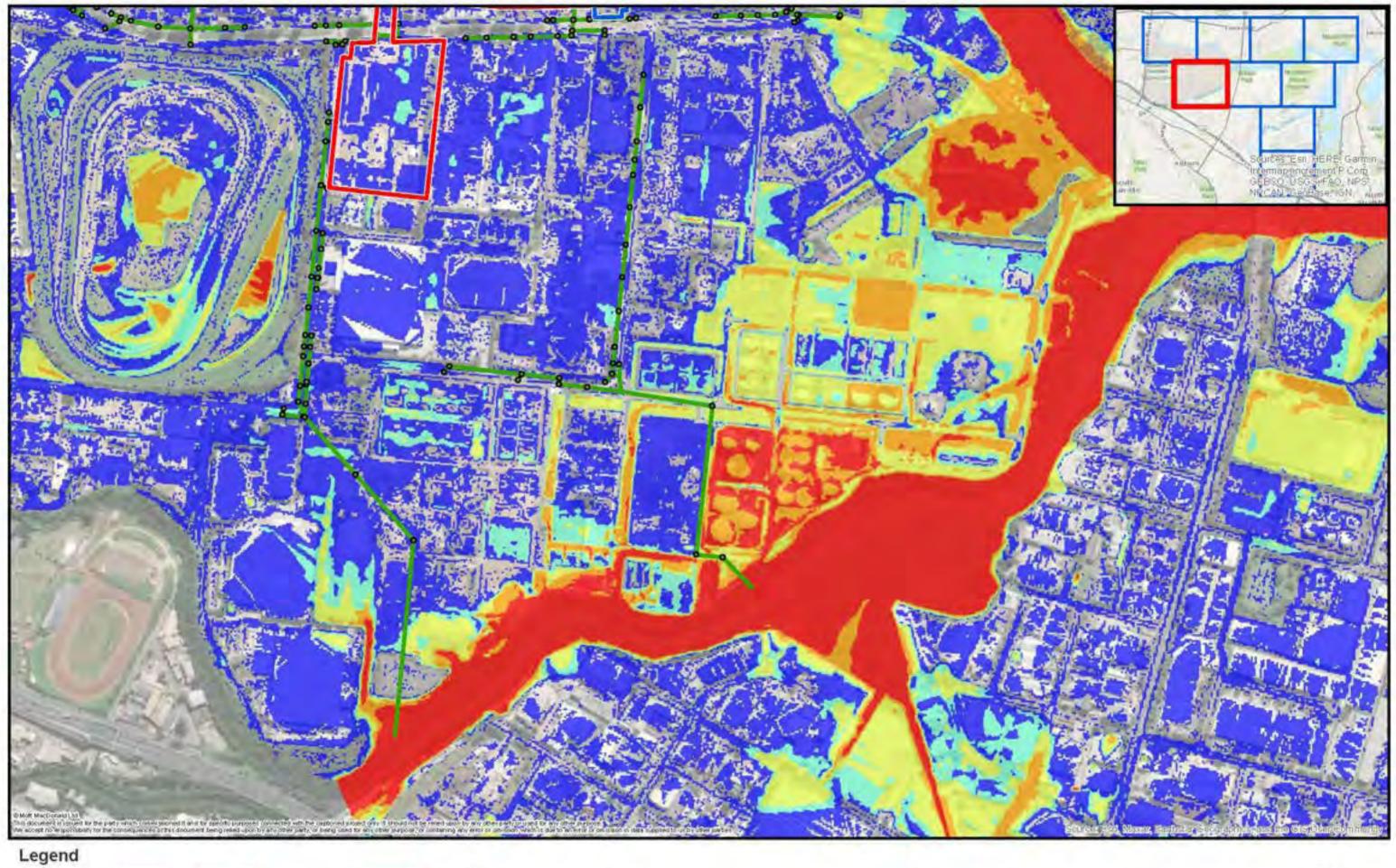




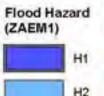


Map Number Sheet No 4 of 9







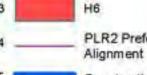


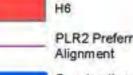


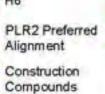














Project Work Area Pipes

Stormwater Stormwater Pits

Title

Proof of Concept Design Conditions 1% AEP Climate Change Flood Hazard

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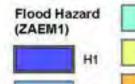
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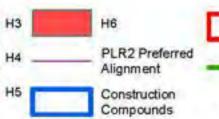
Map Number Sheet No 5 of 9

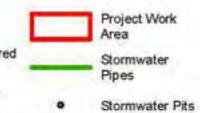


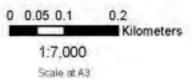






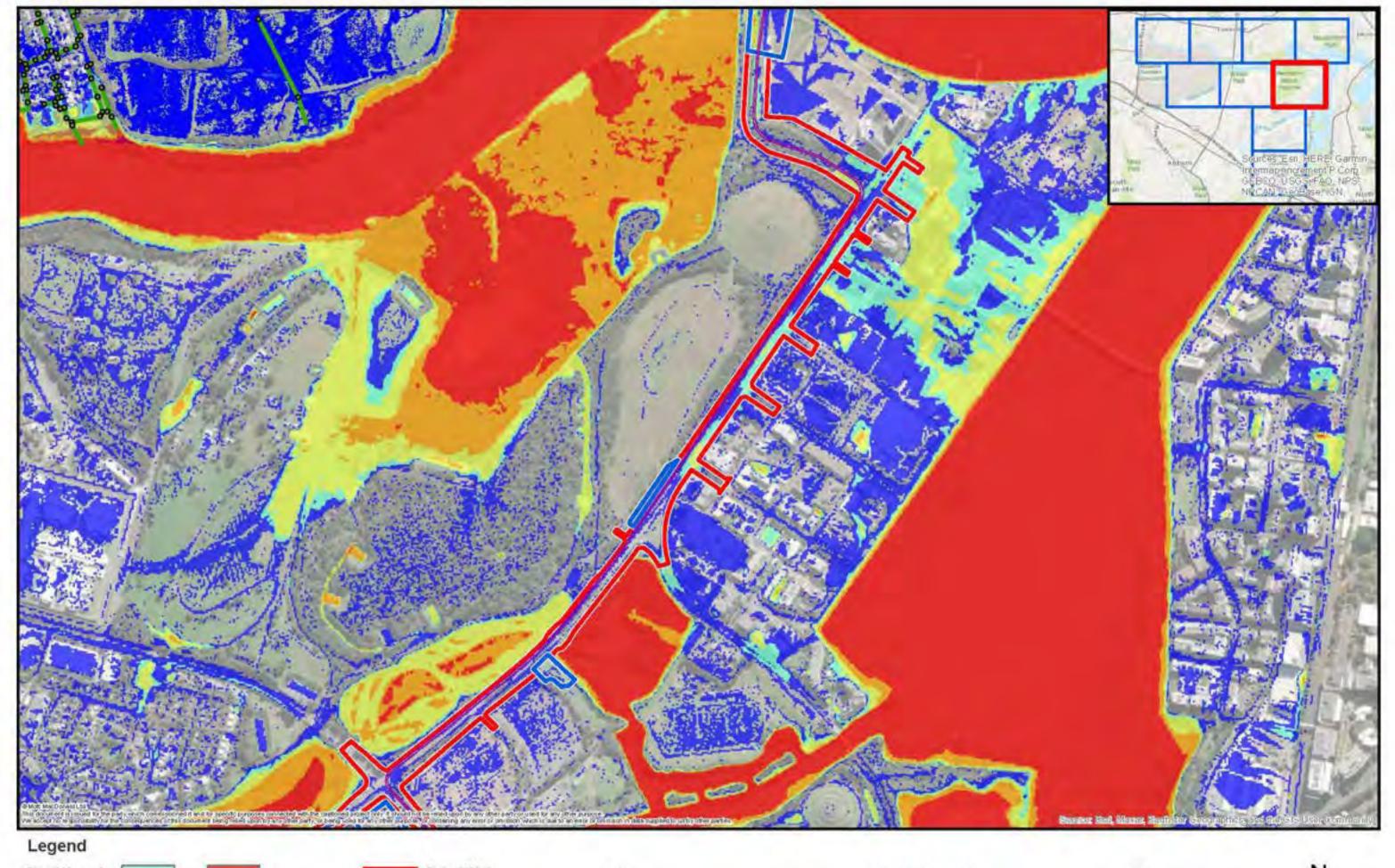


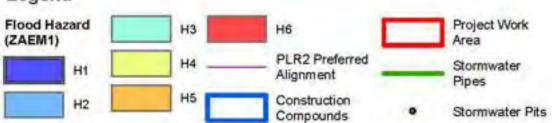


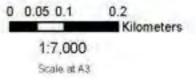




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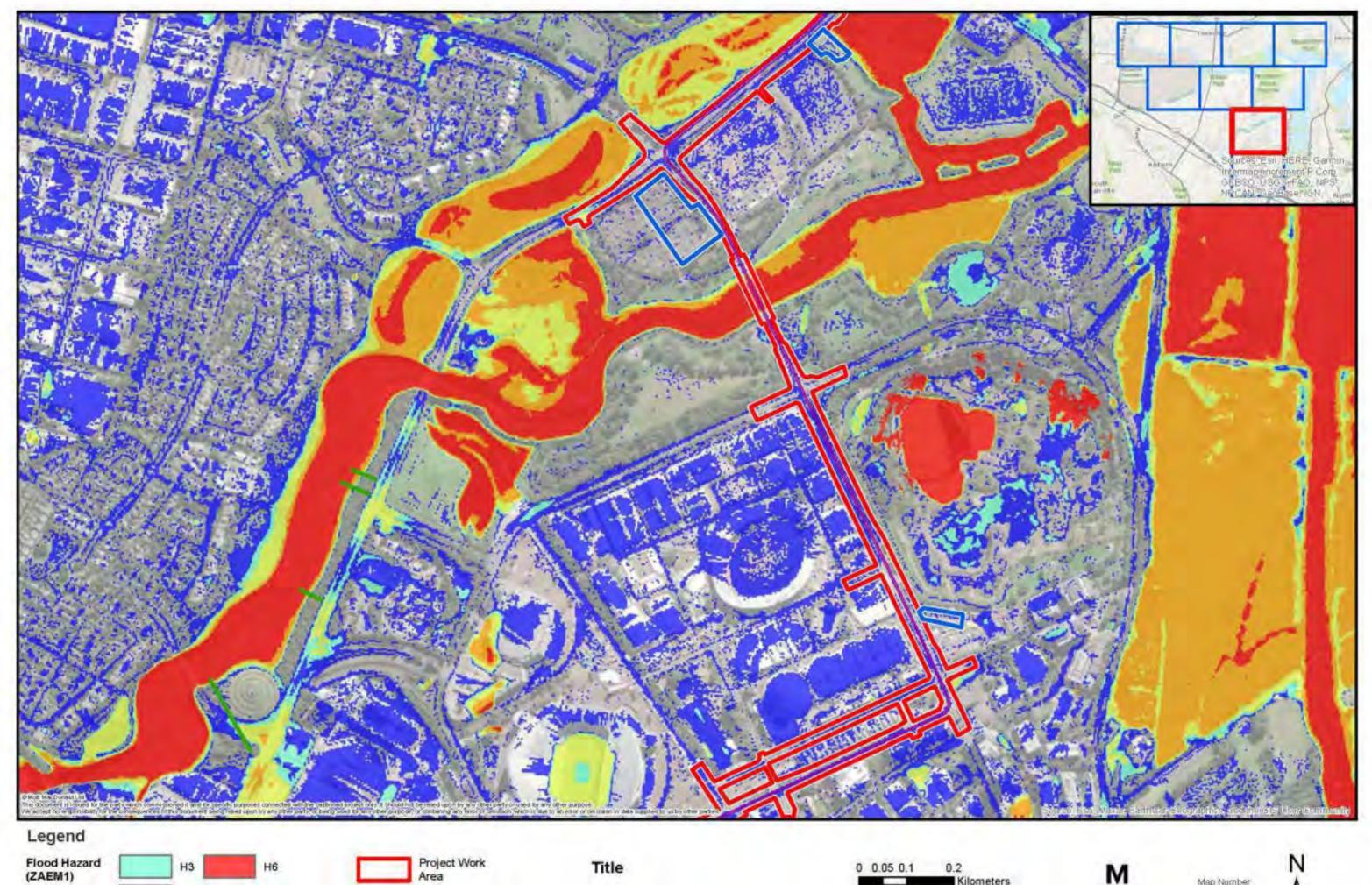


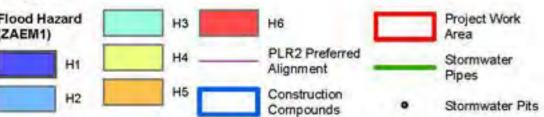






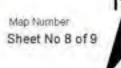
Map Number Sheet No 7 of 9

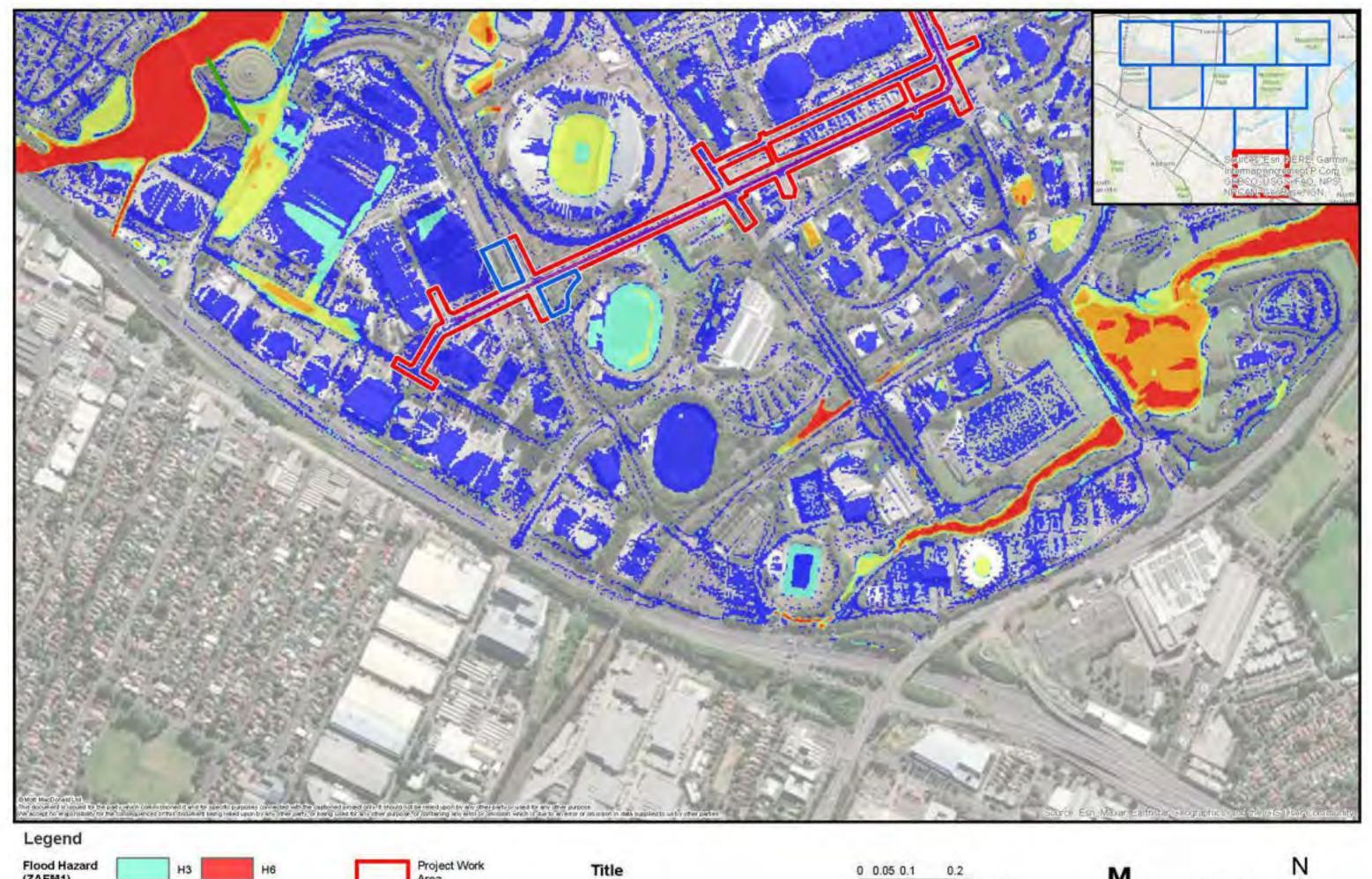


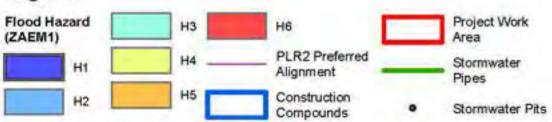


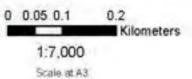






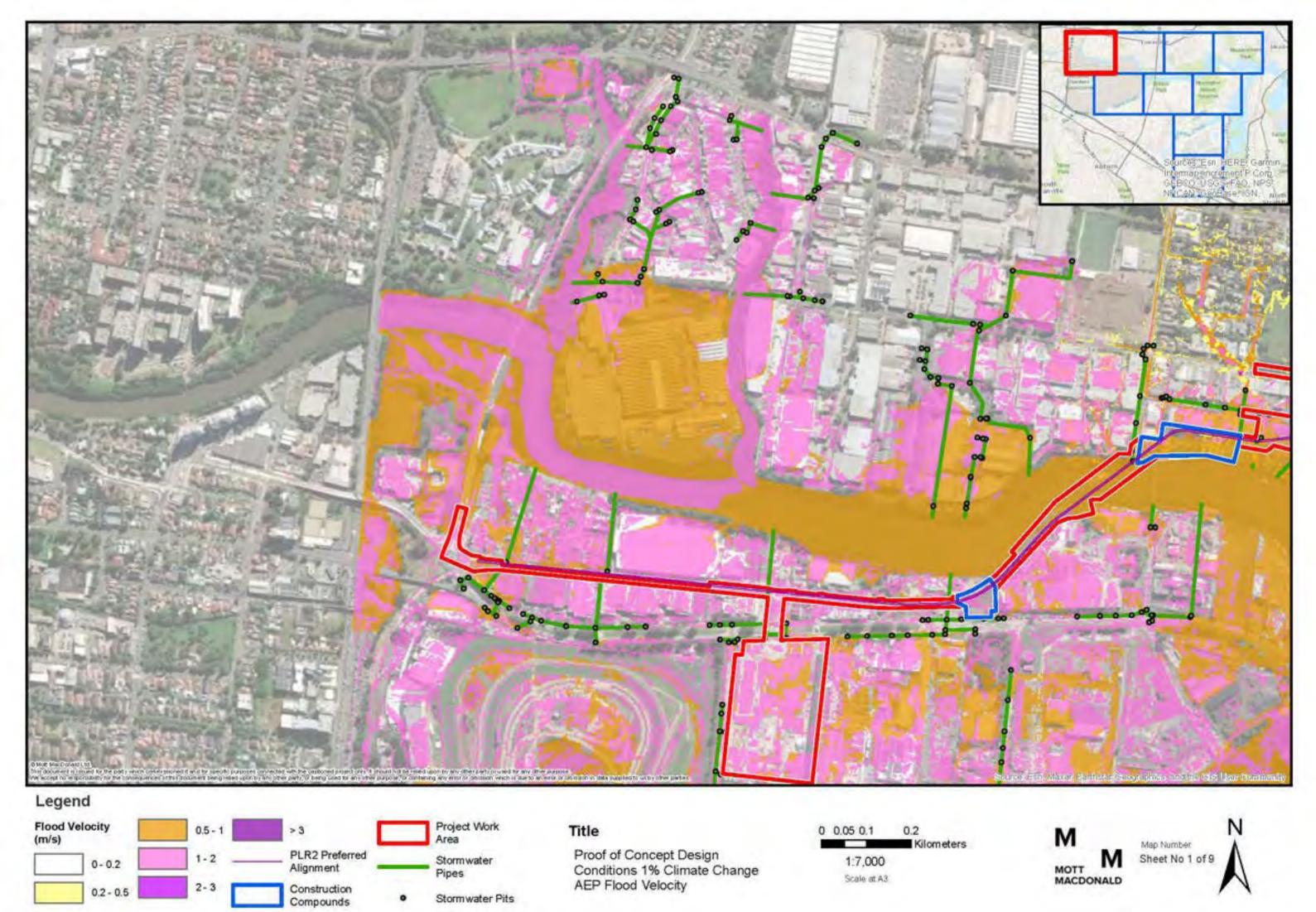


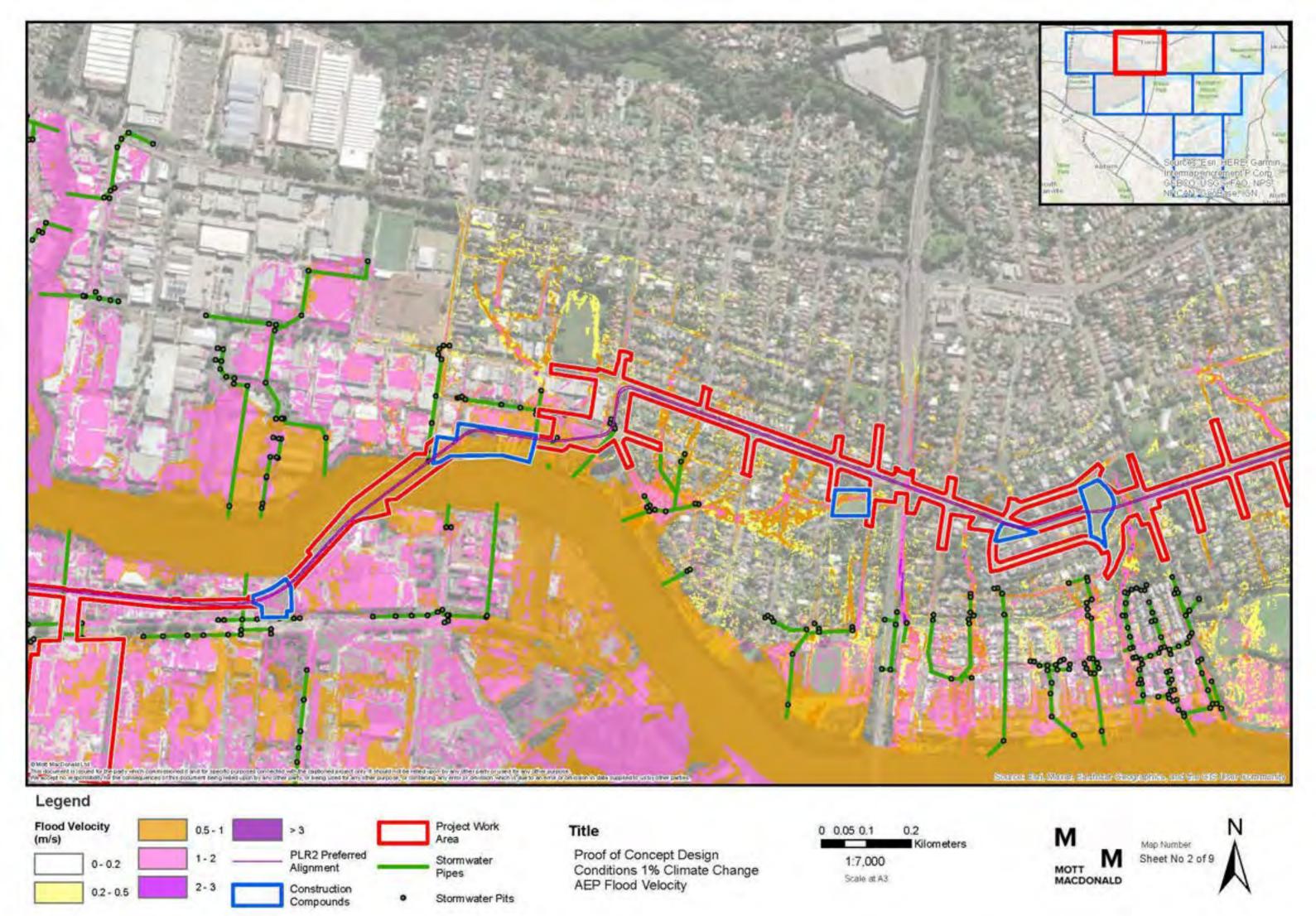


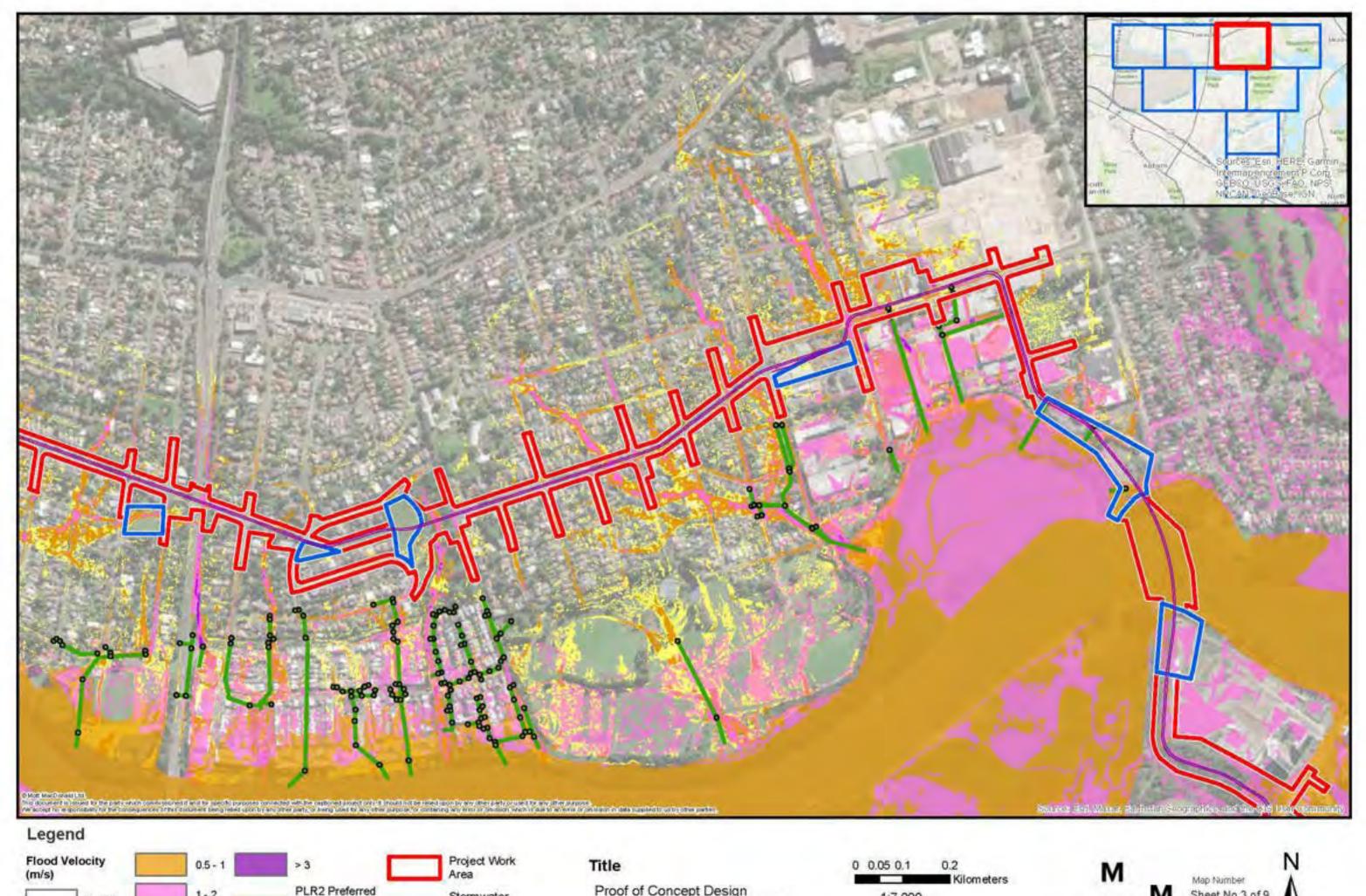




Map Number Sheet No 9 of 9



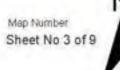


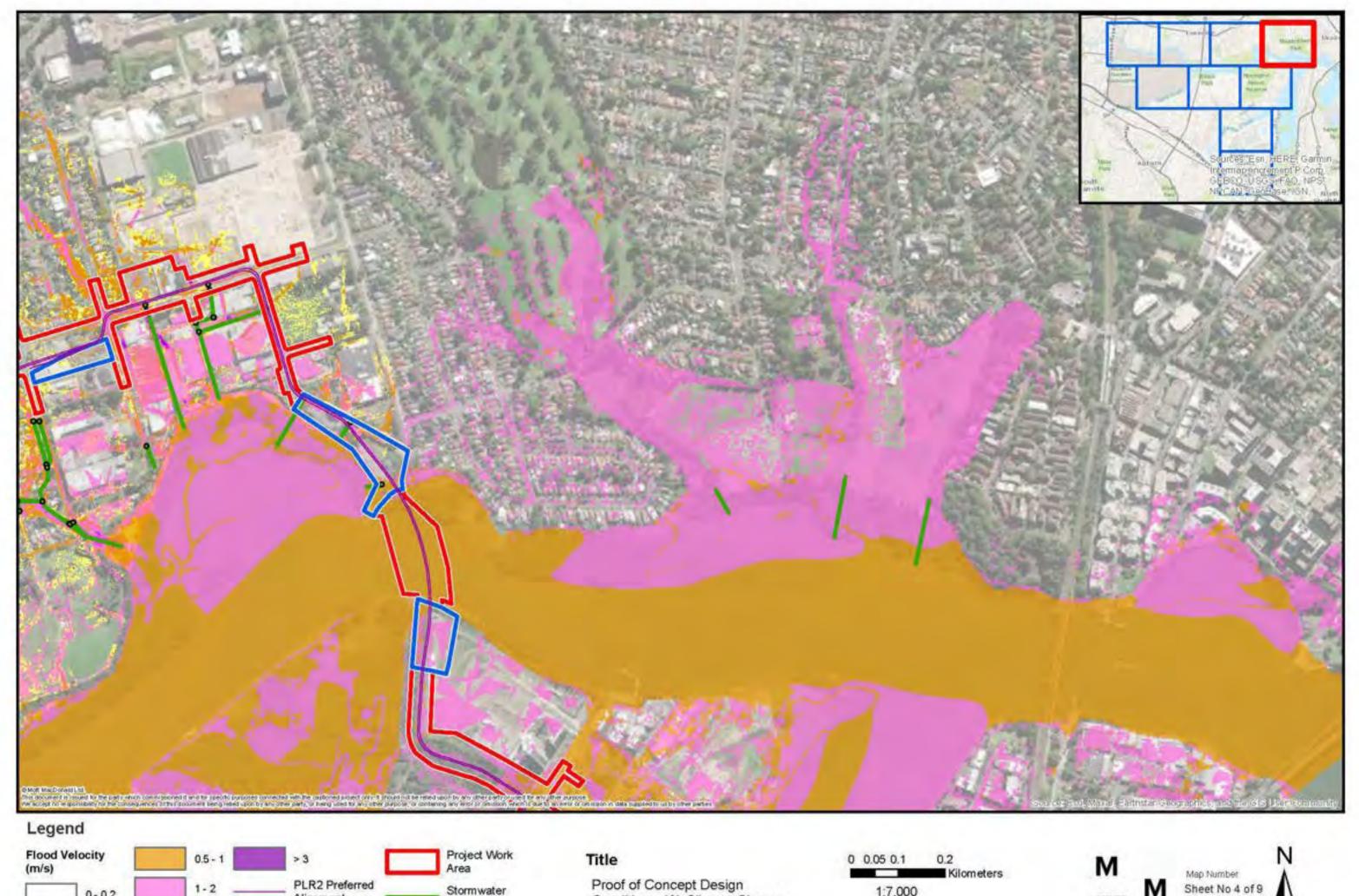








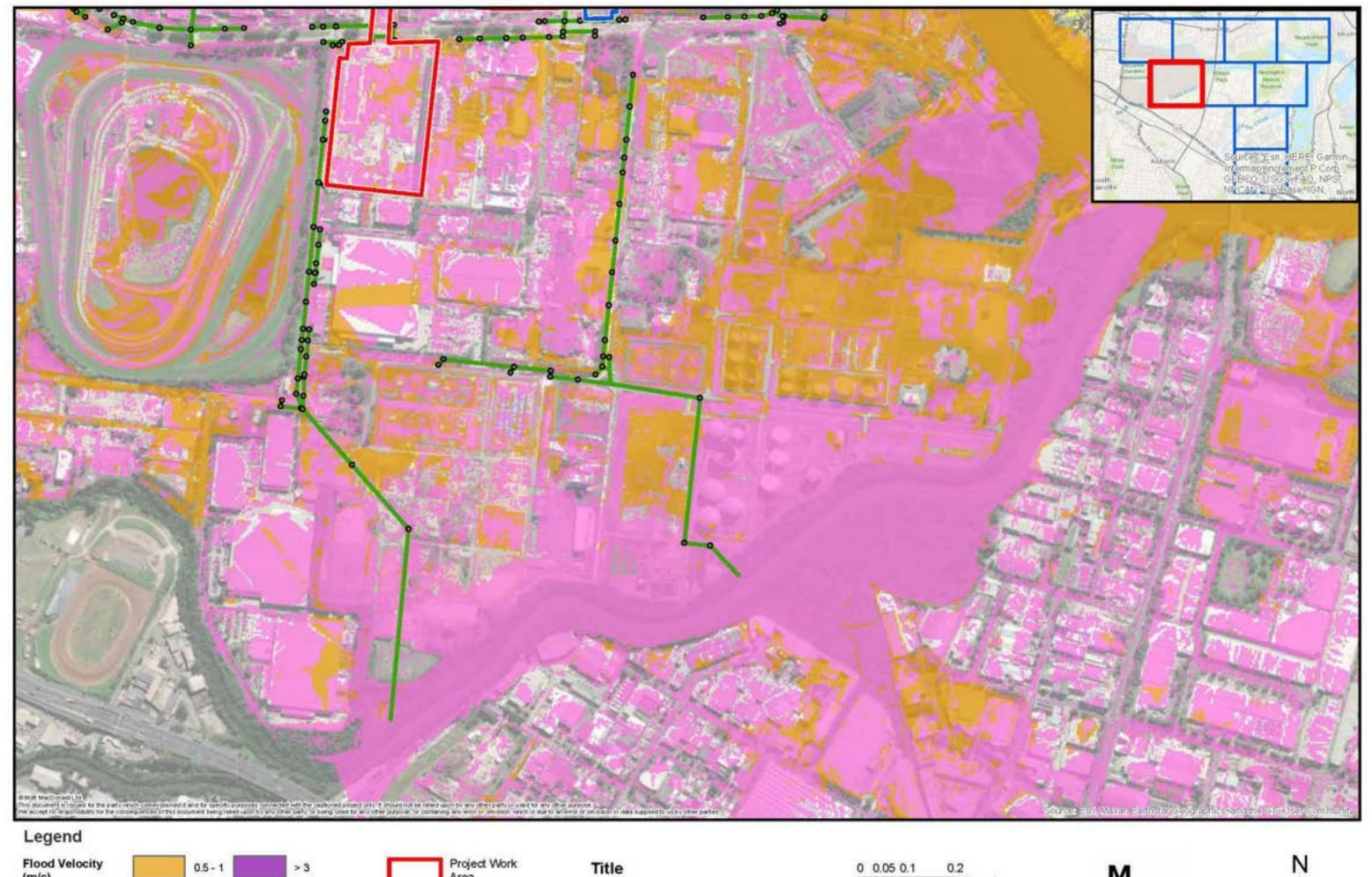


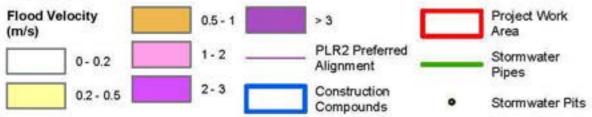


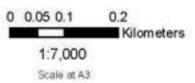


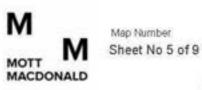
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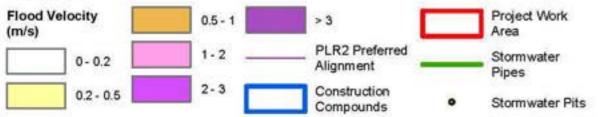








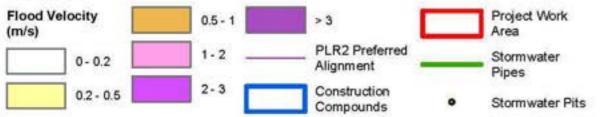








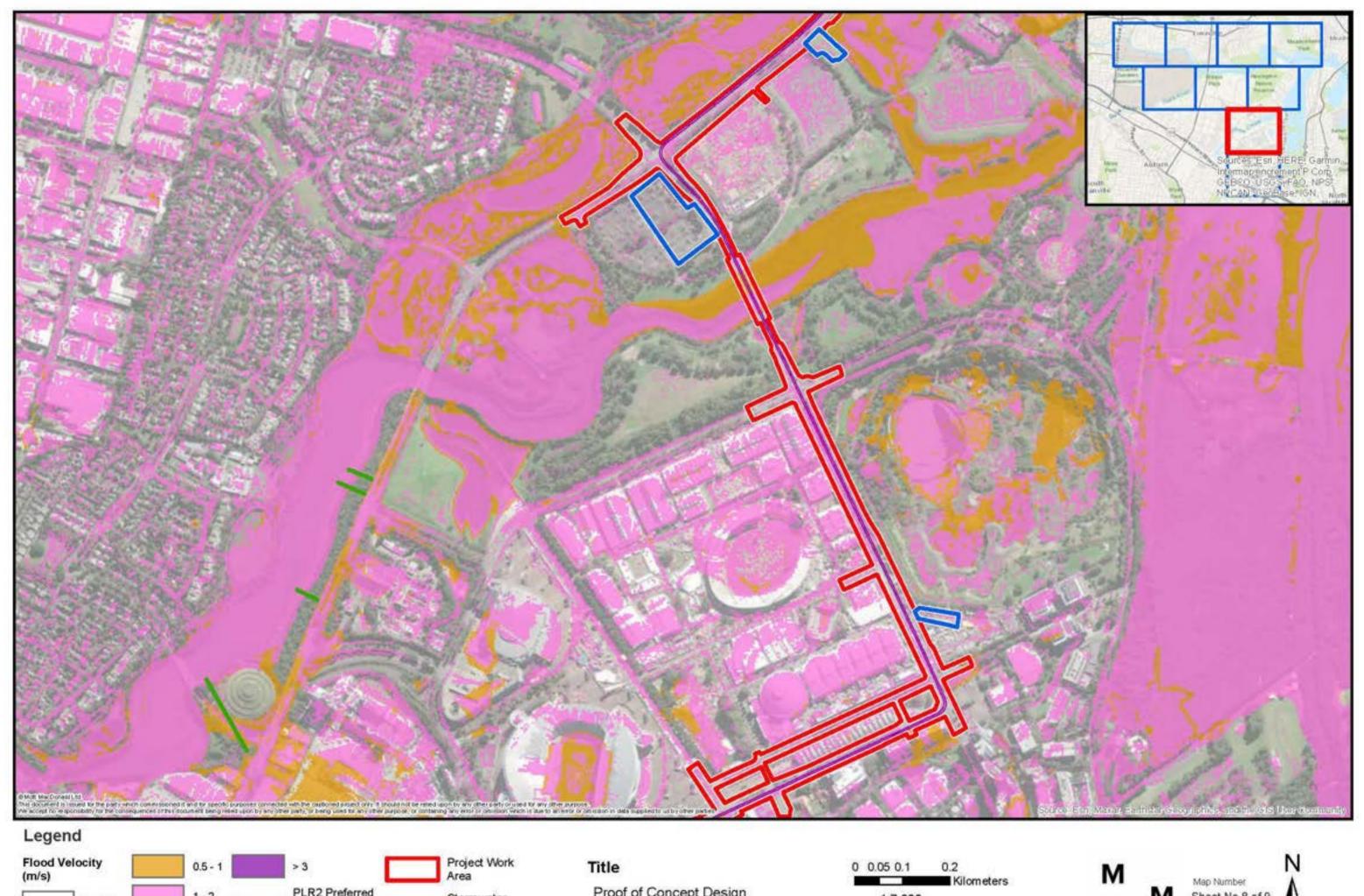


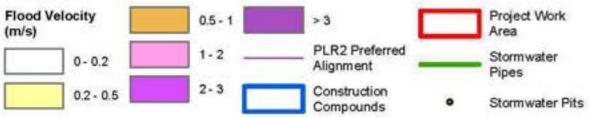






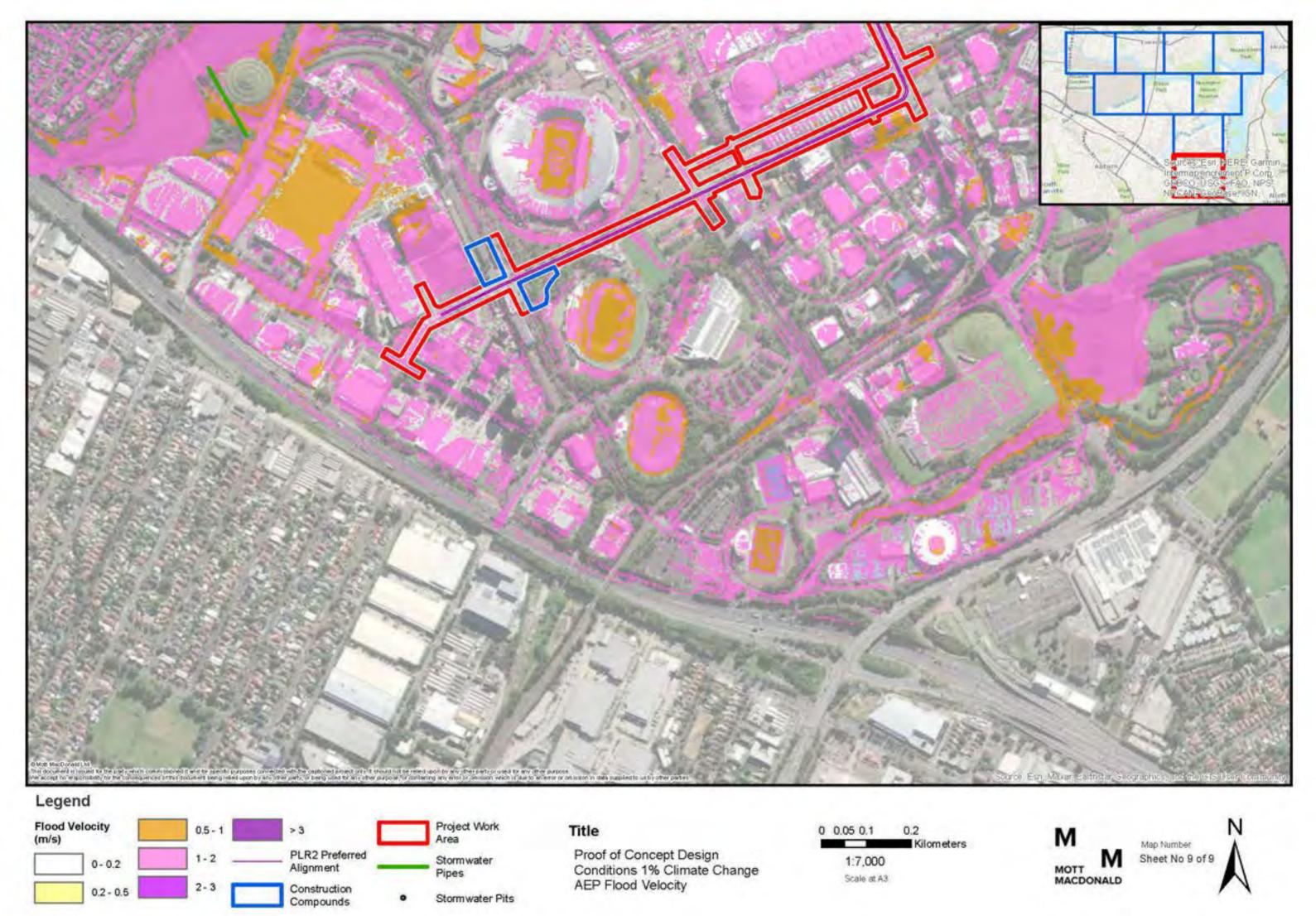
Map Number Sheet No 7 of 9



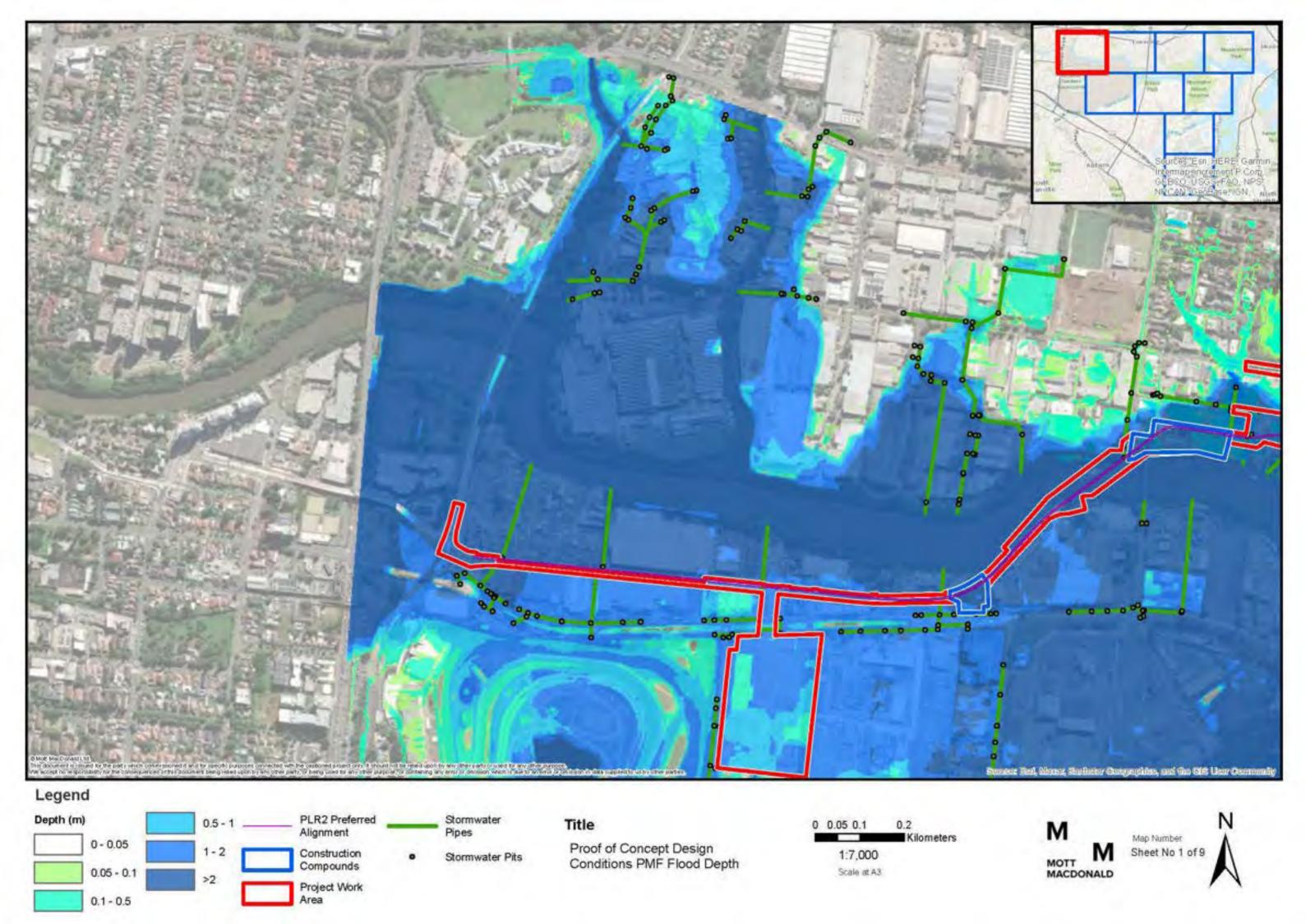


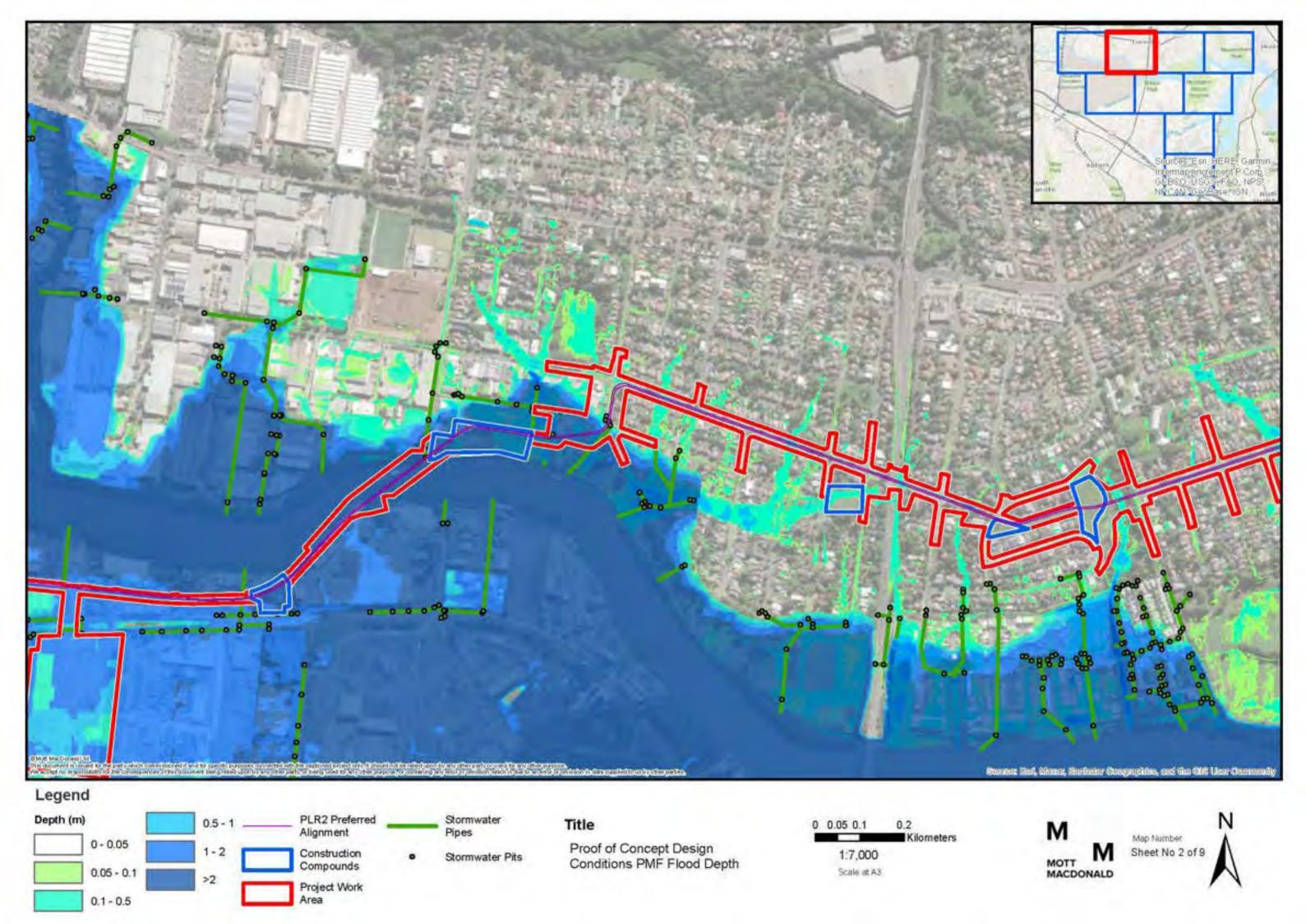


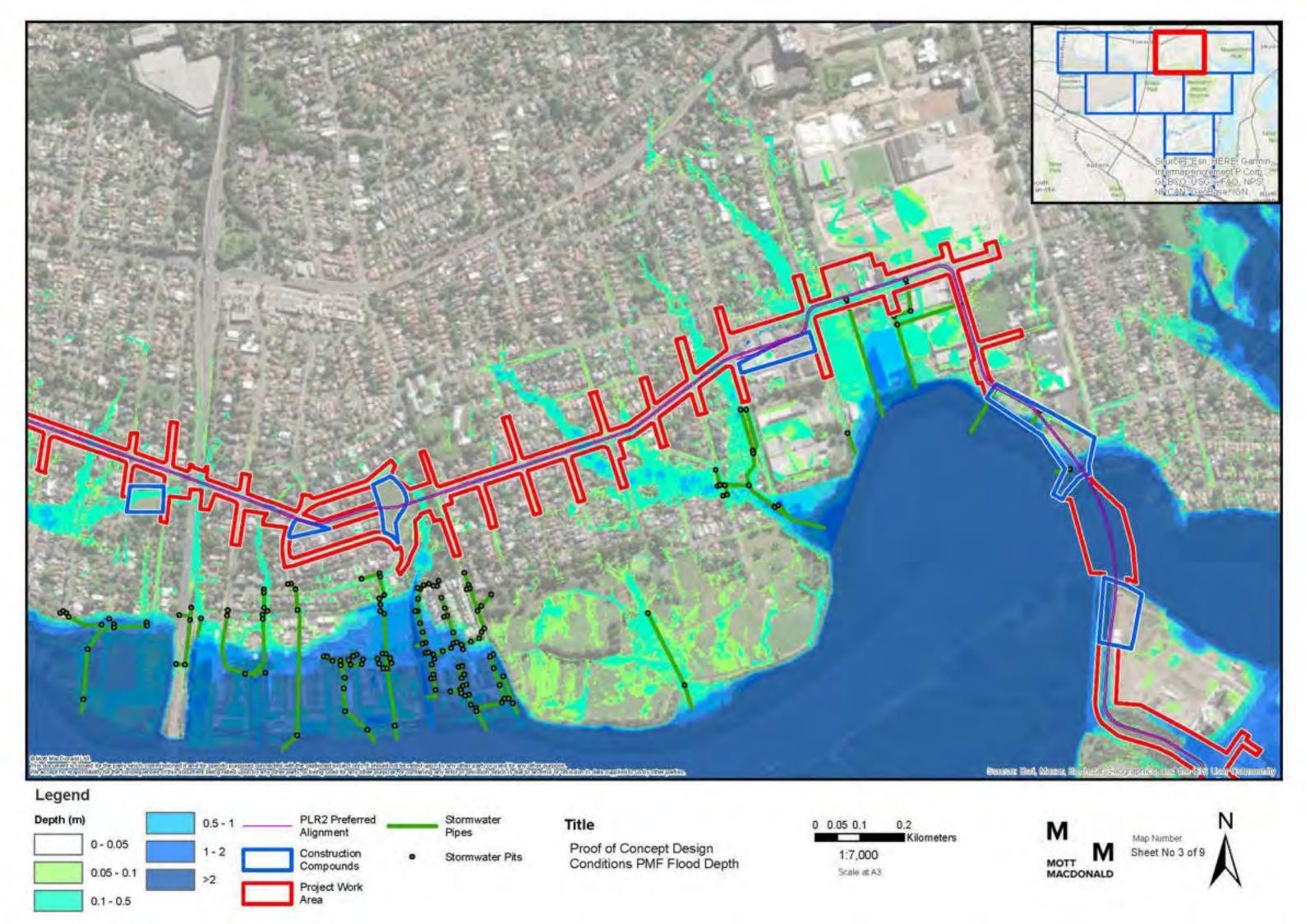


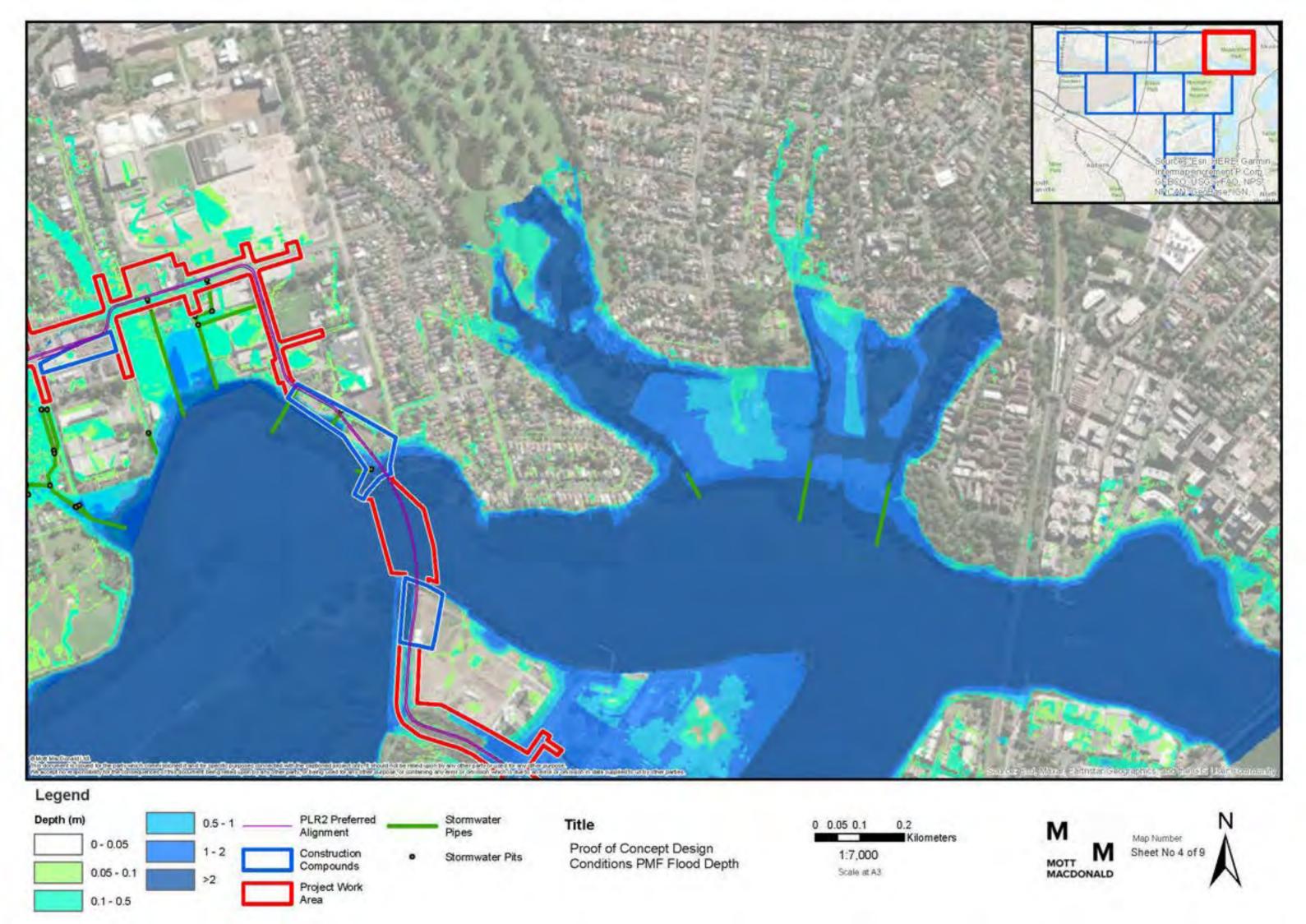


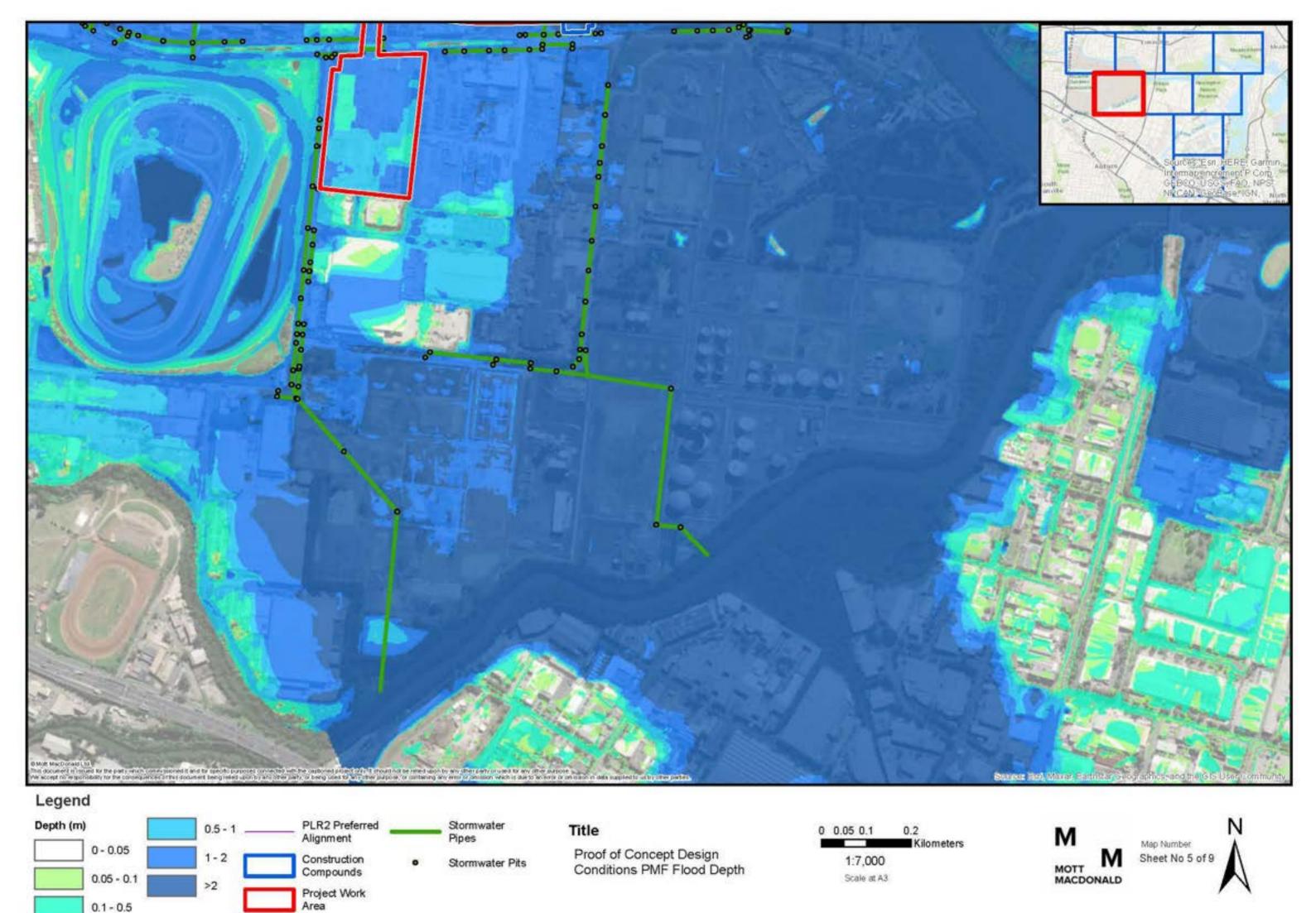
Appendix B3 – Flood model figures (Proof of concept) – PMF

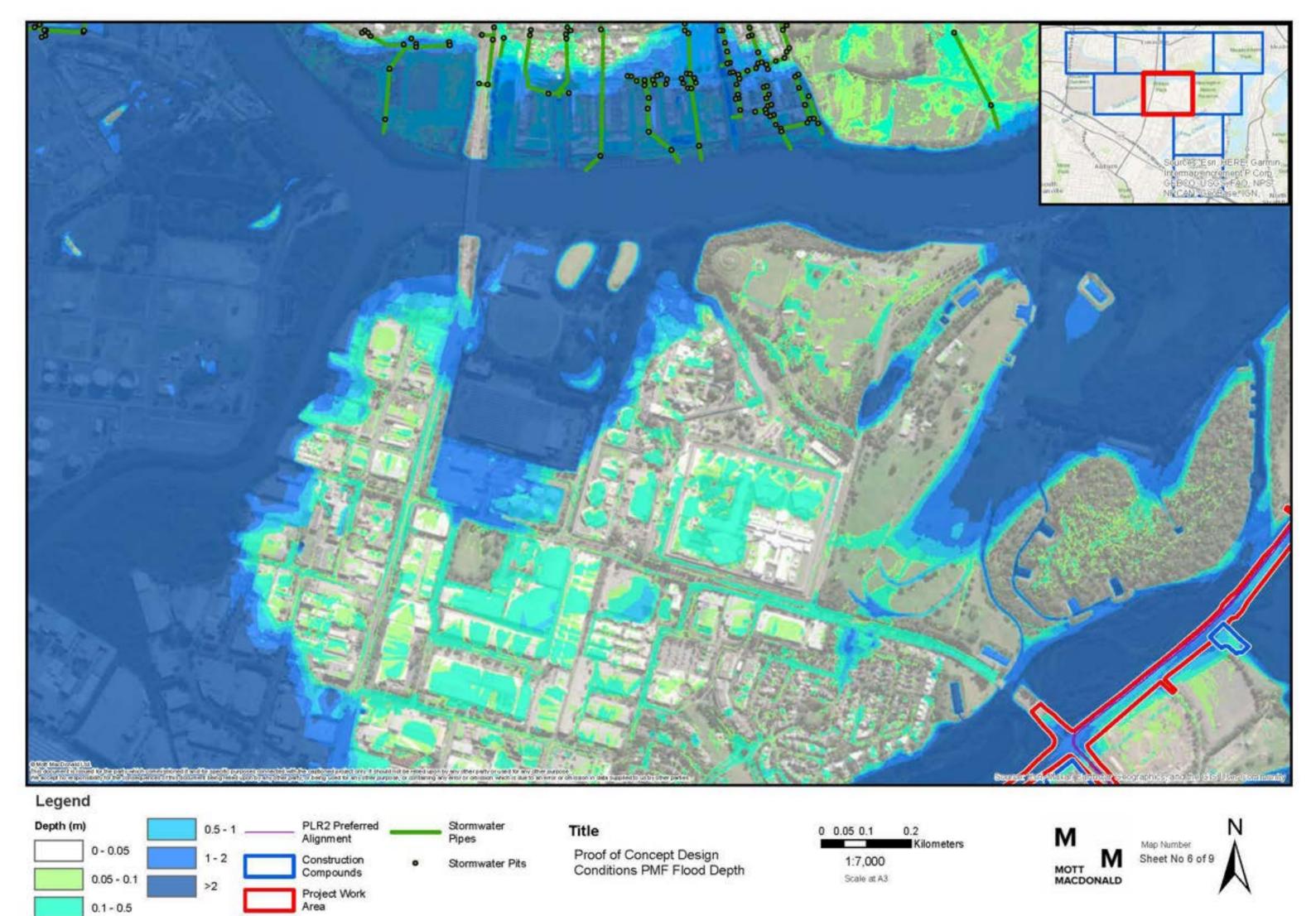


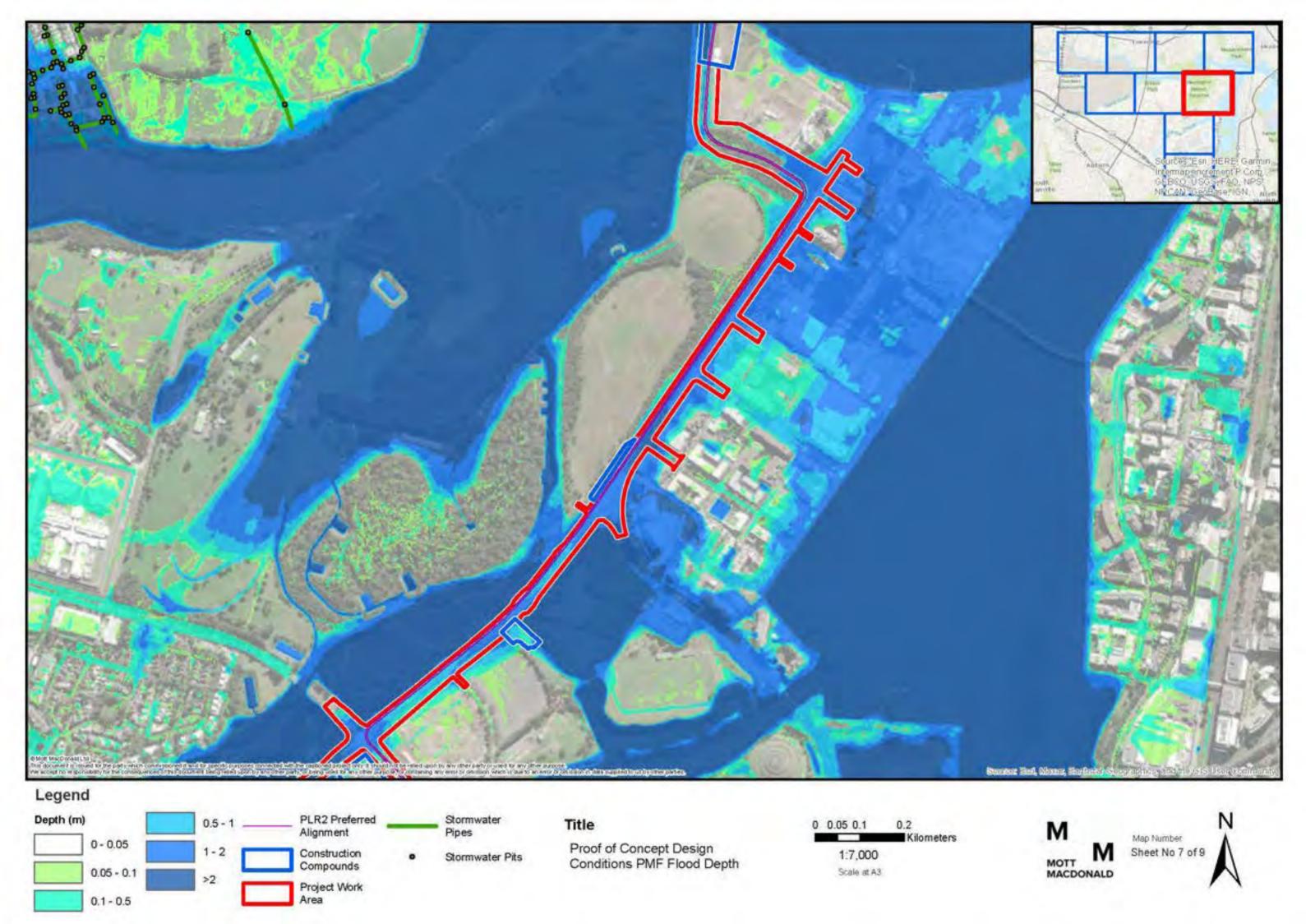


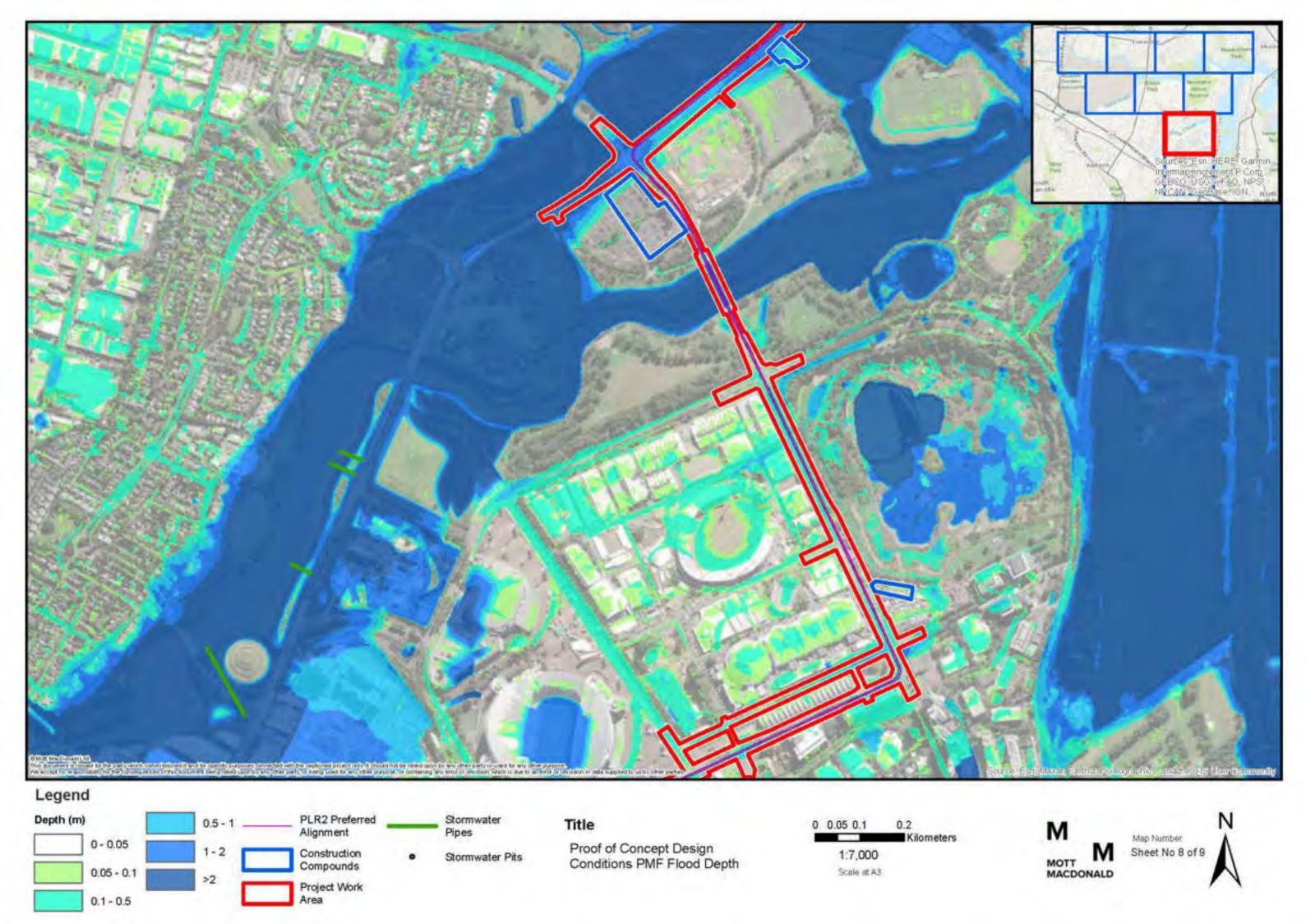


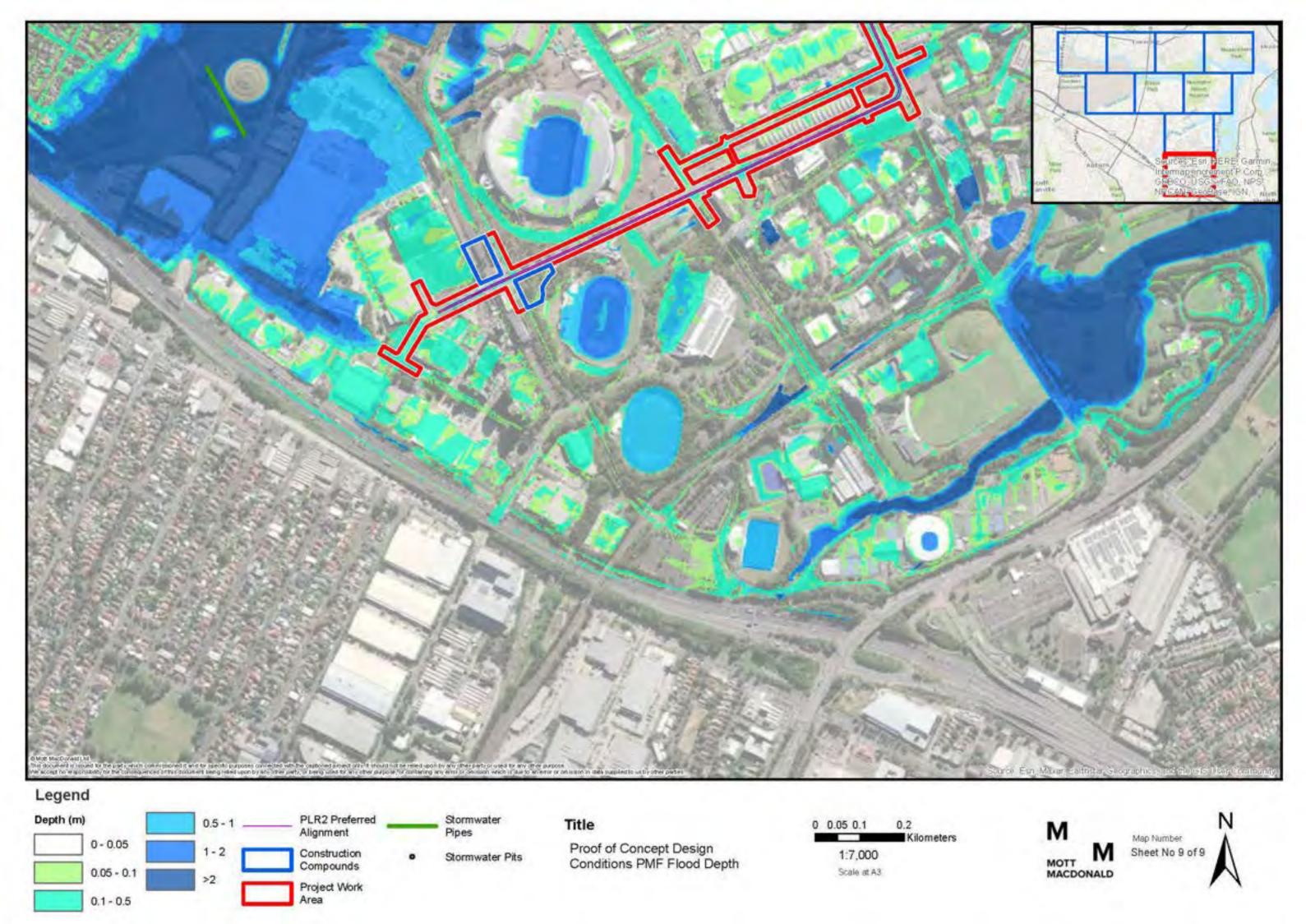


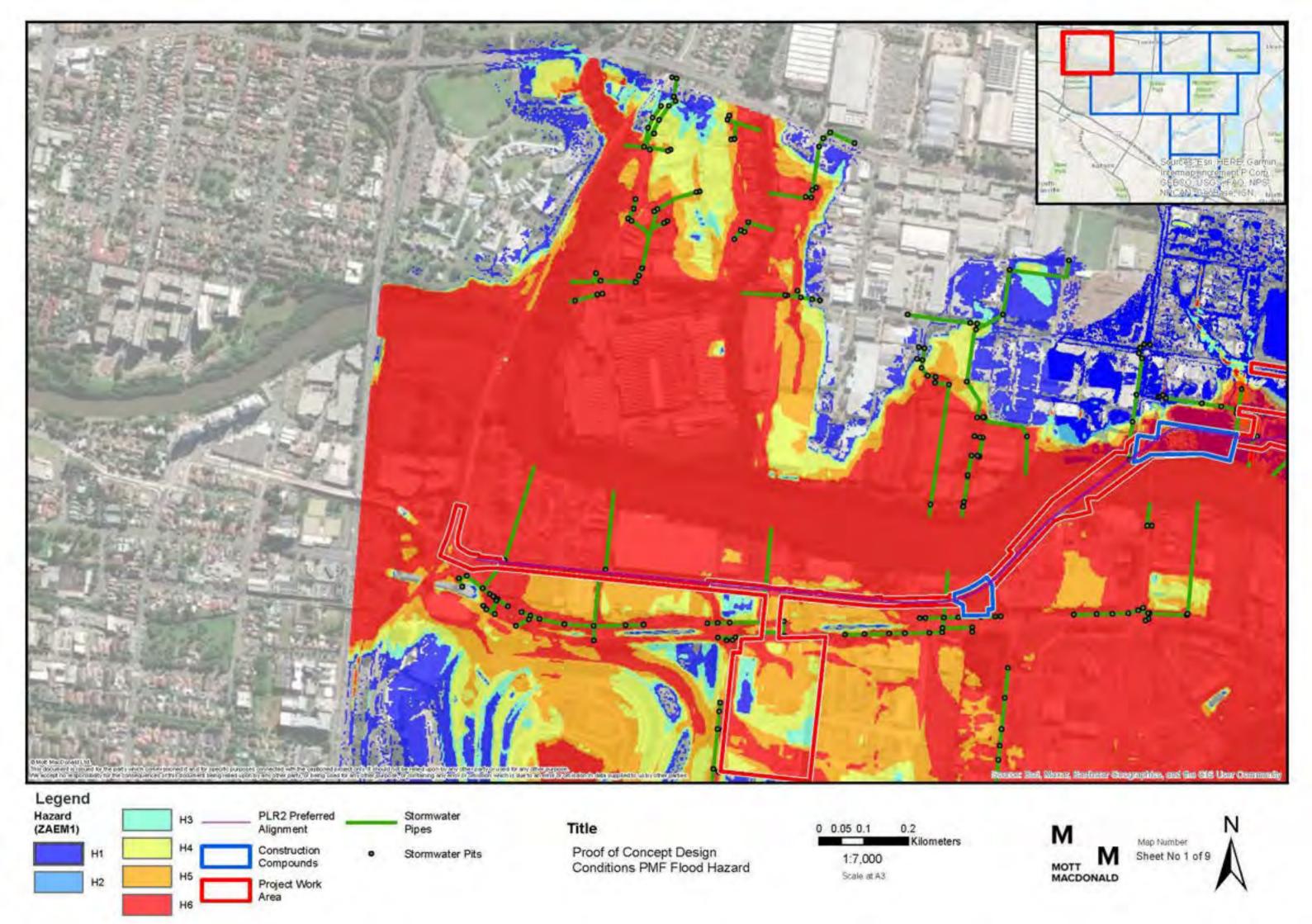


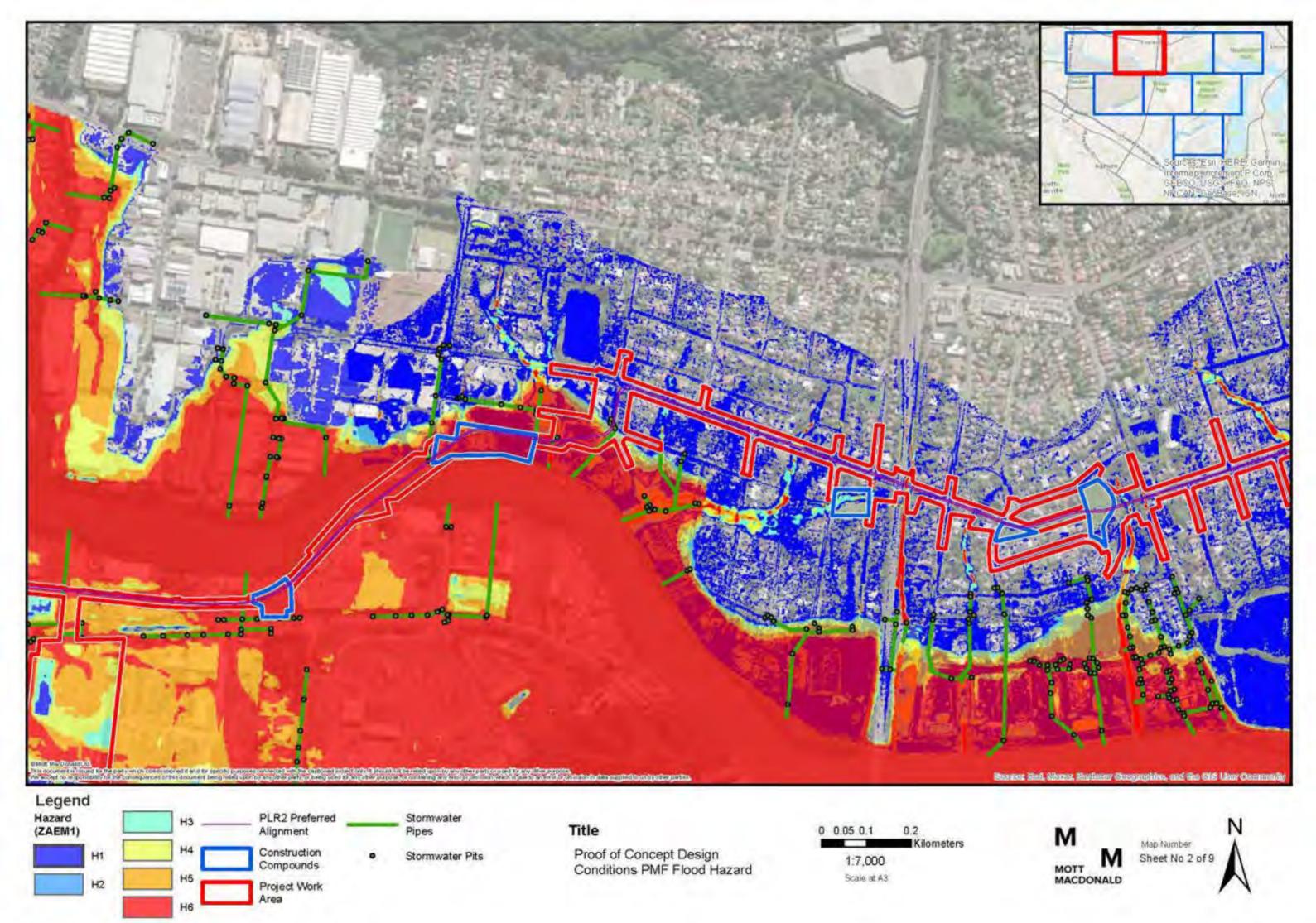


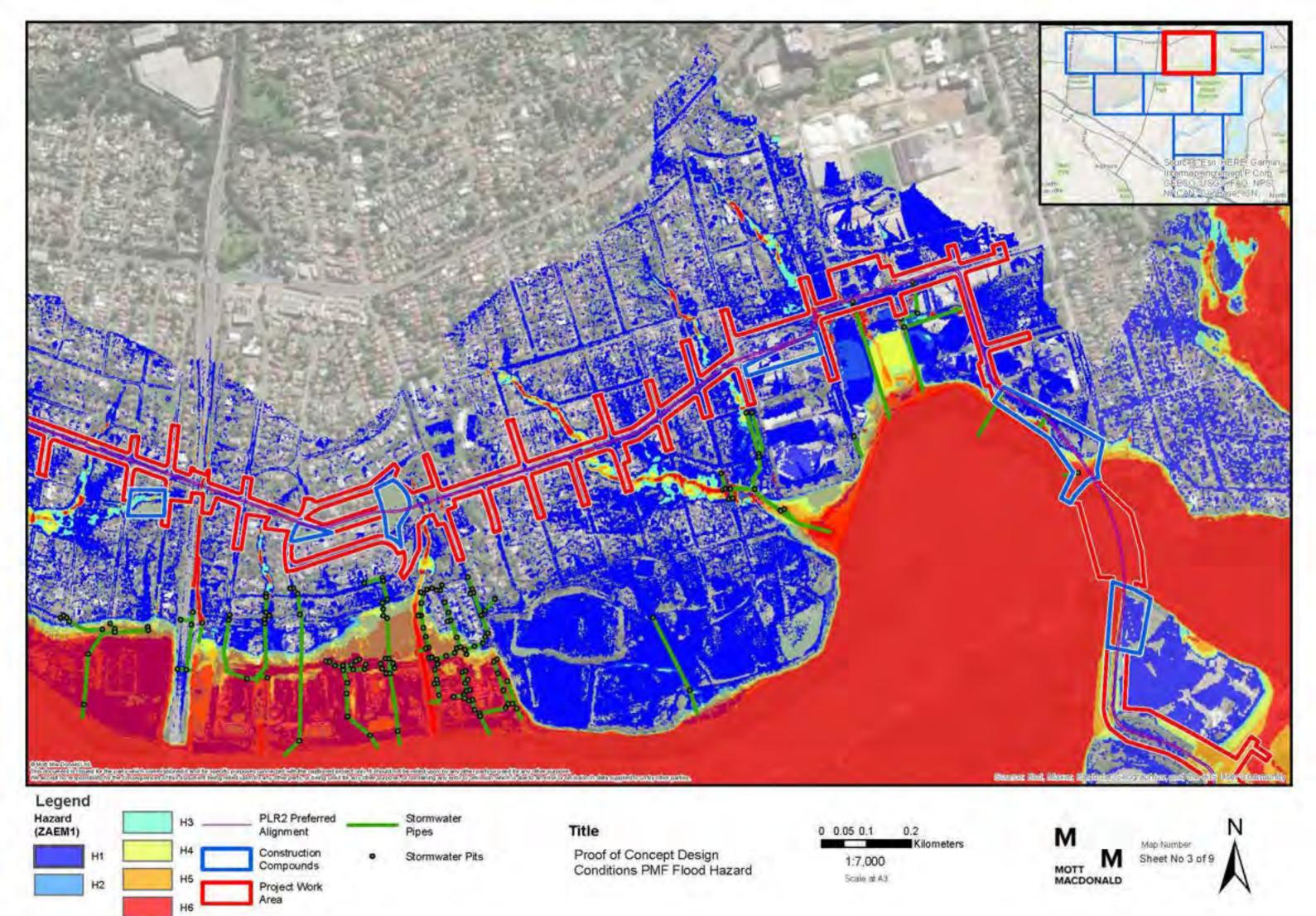


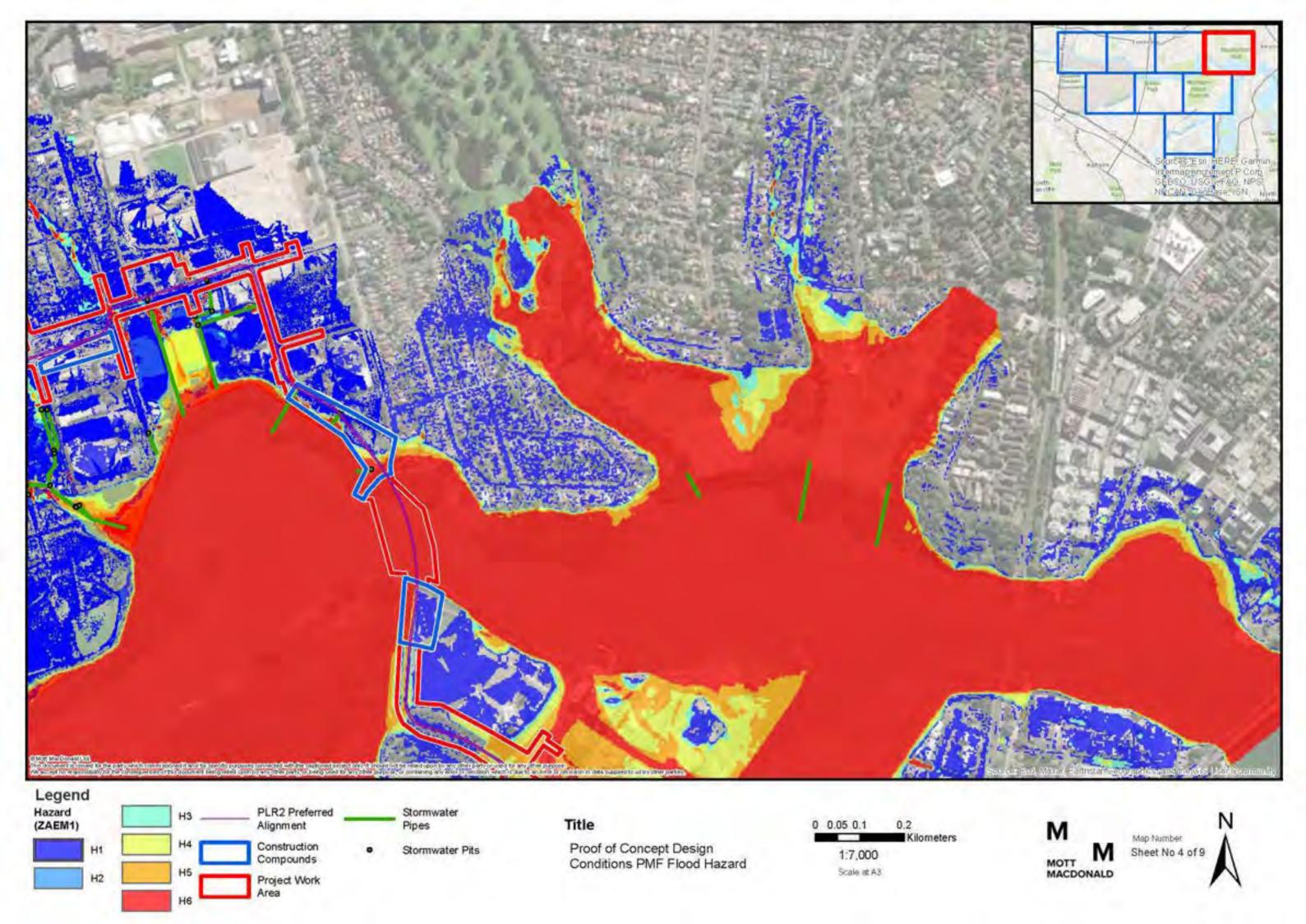


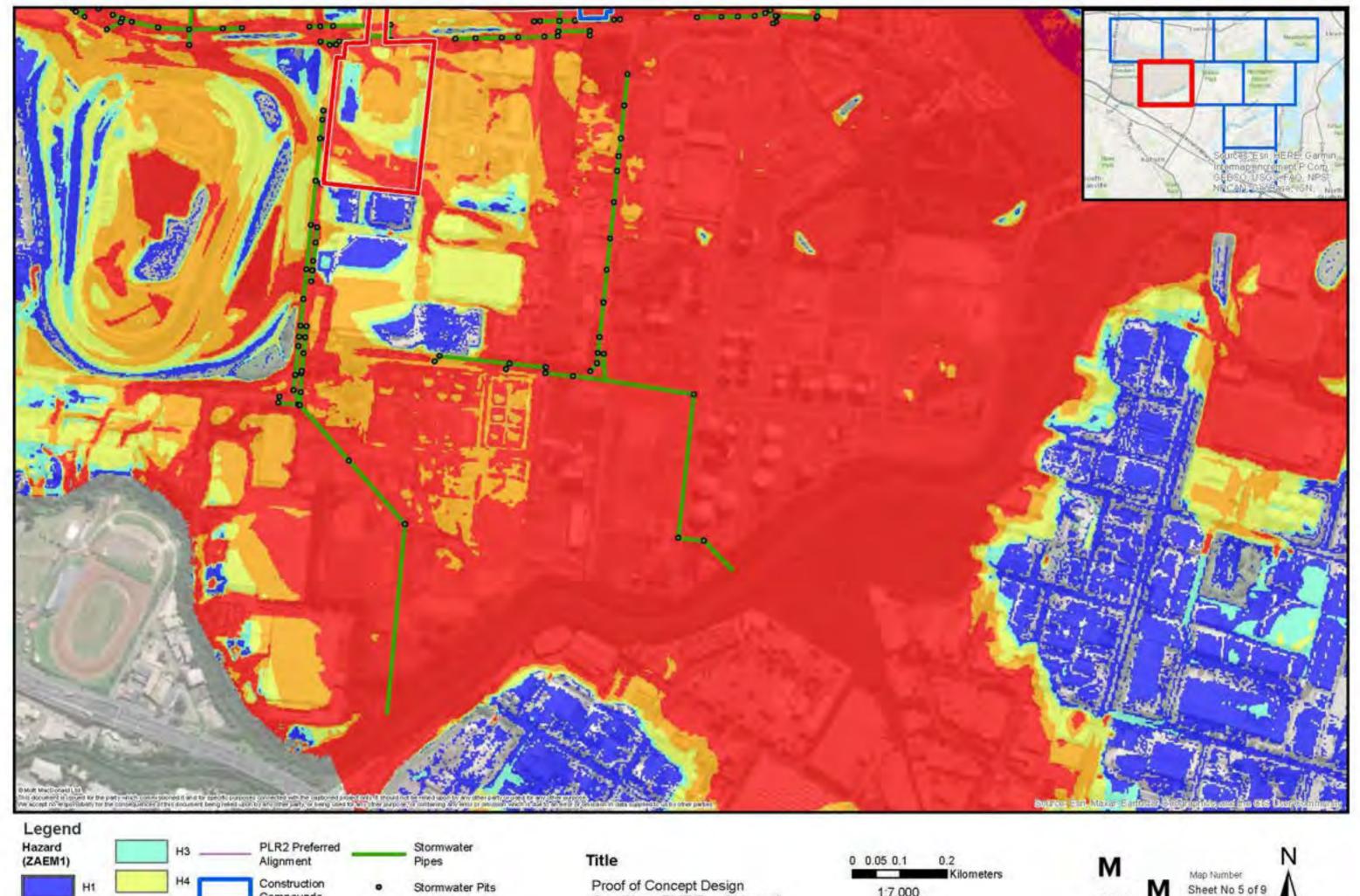


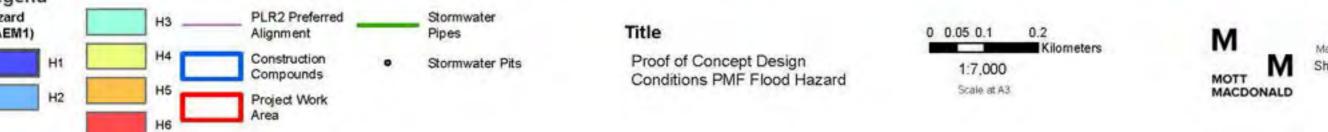


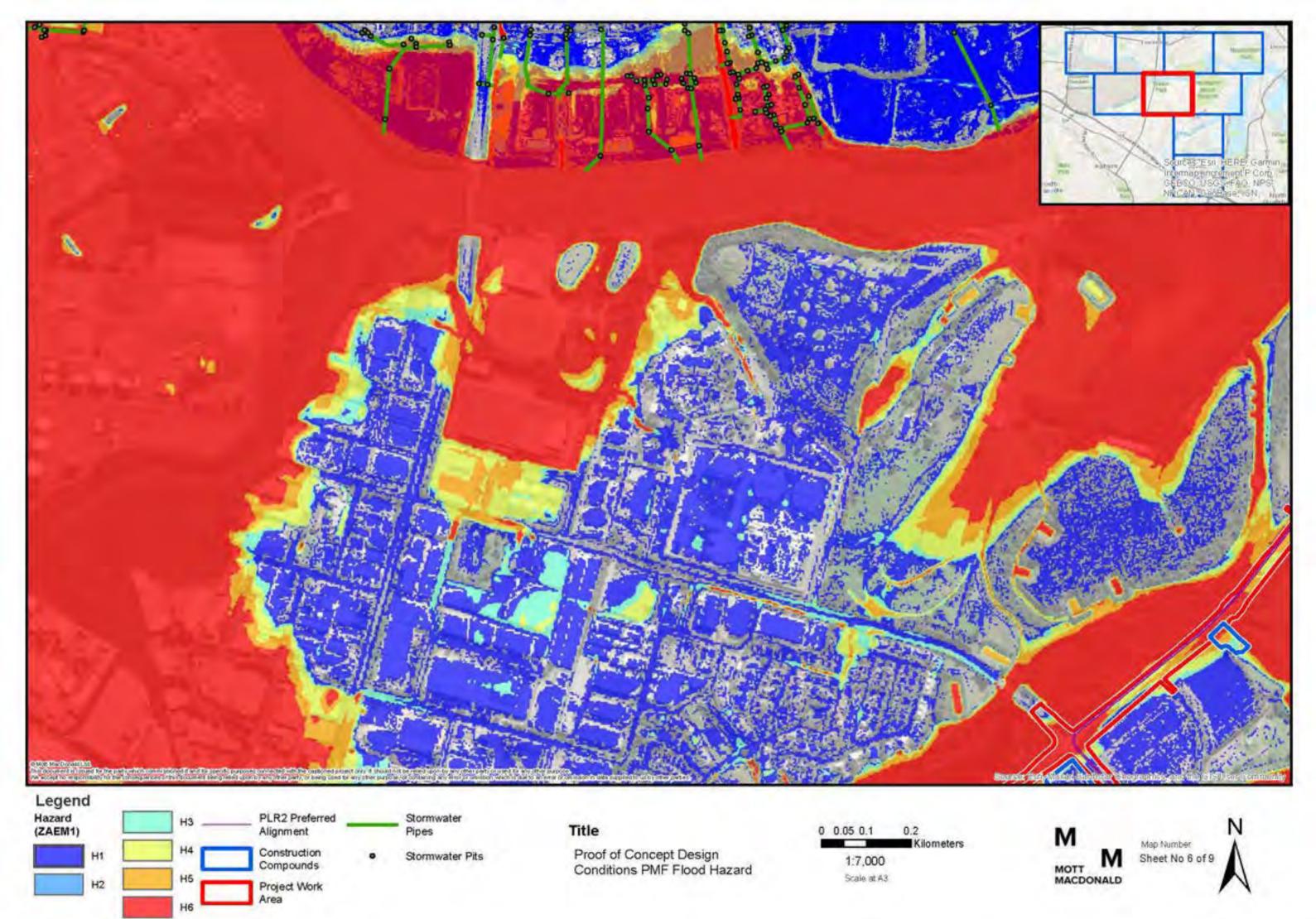




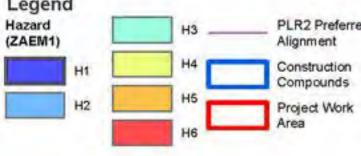






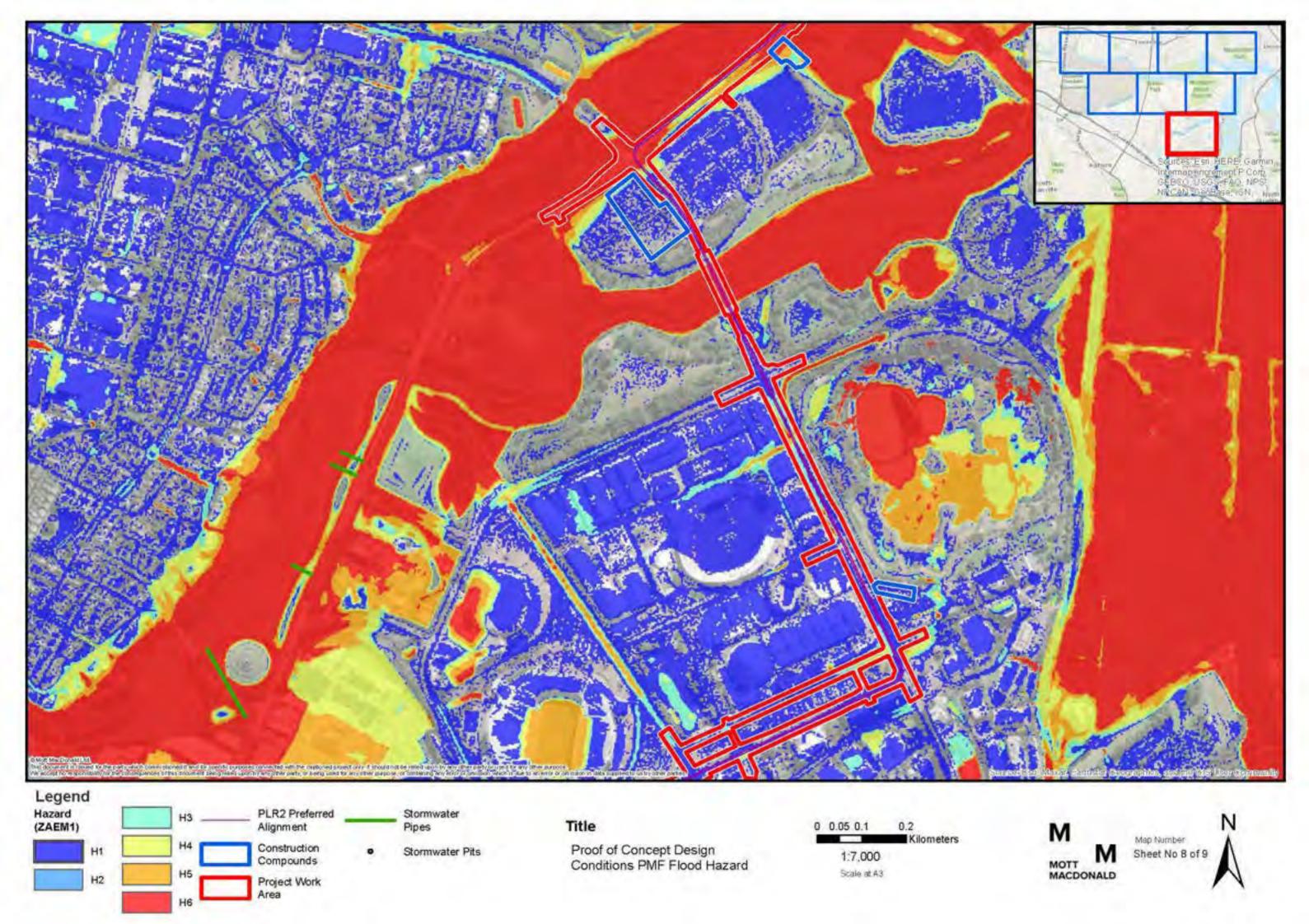


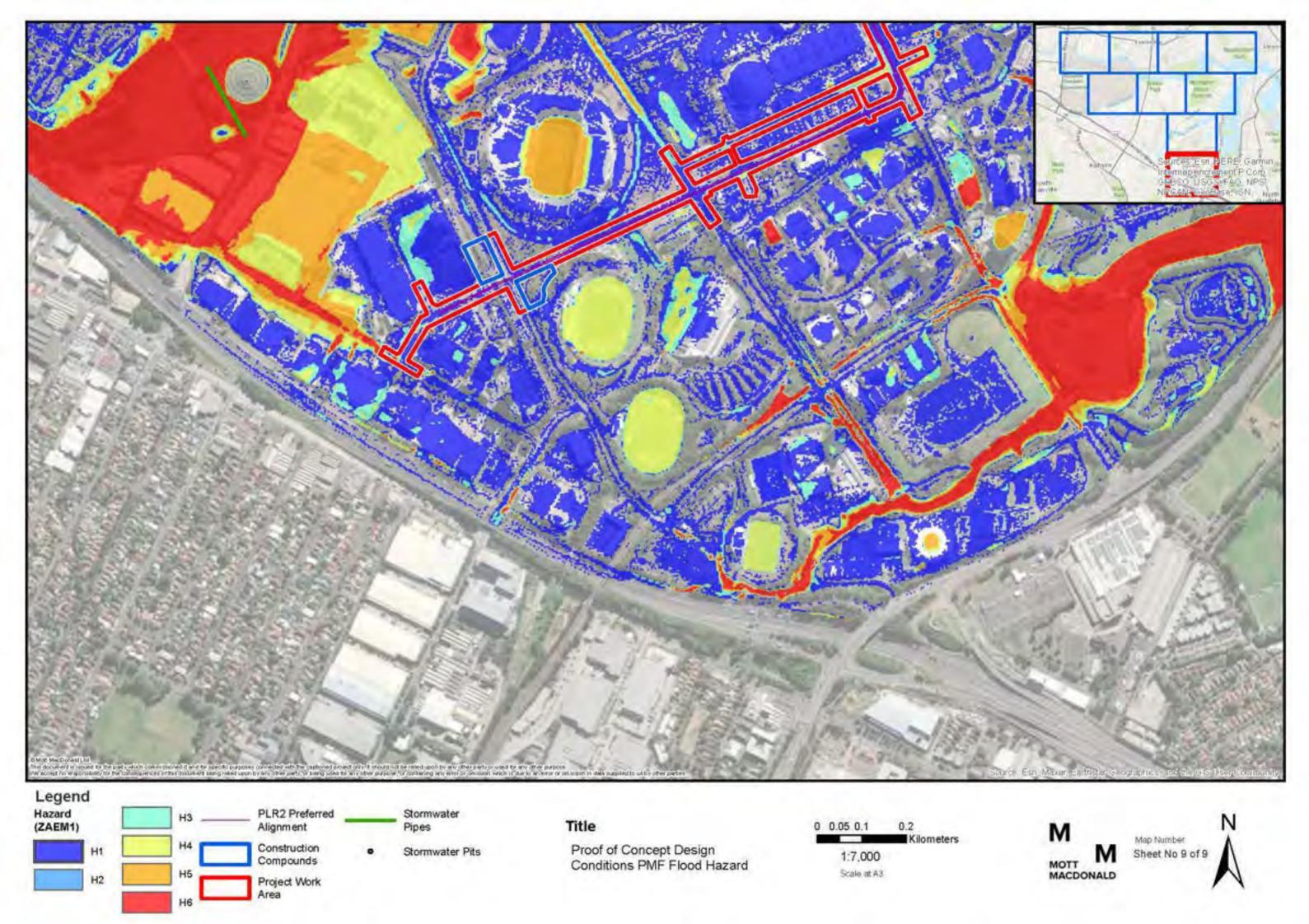


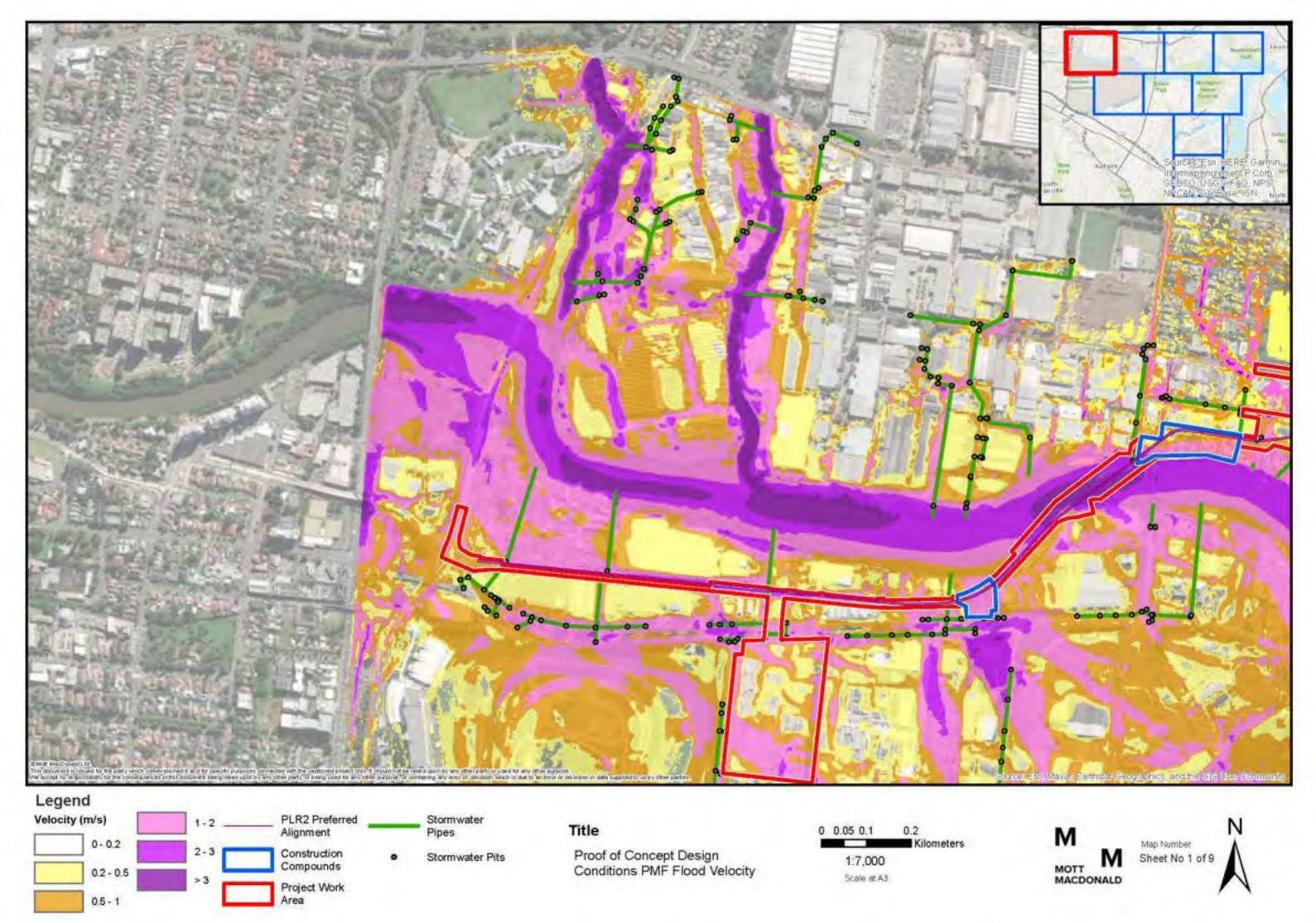


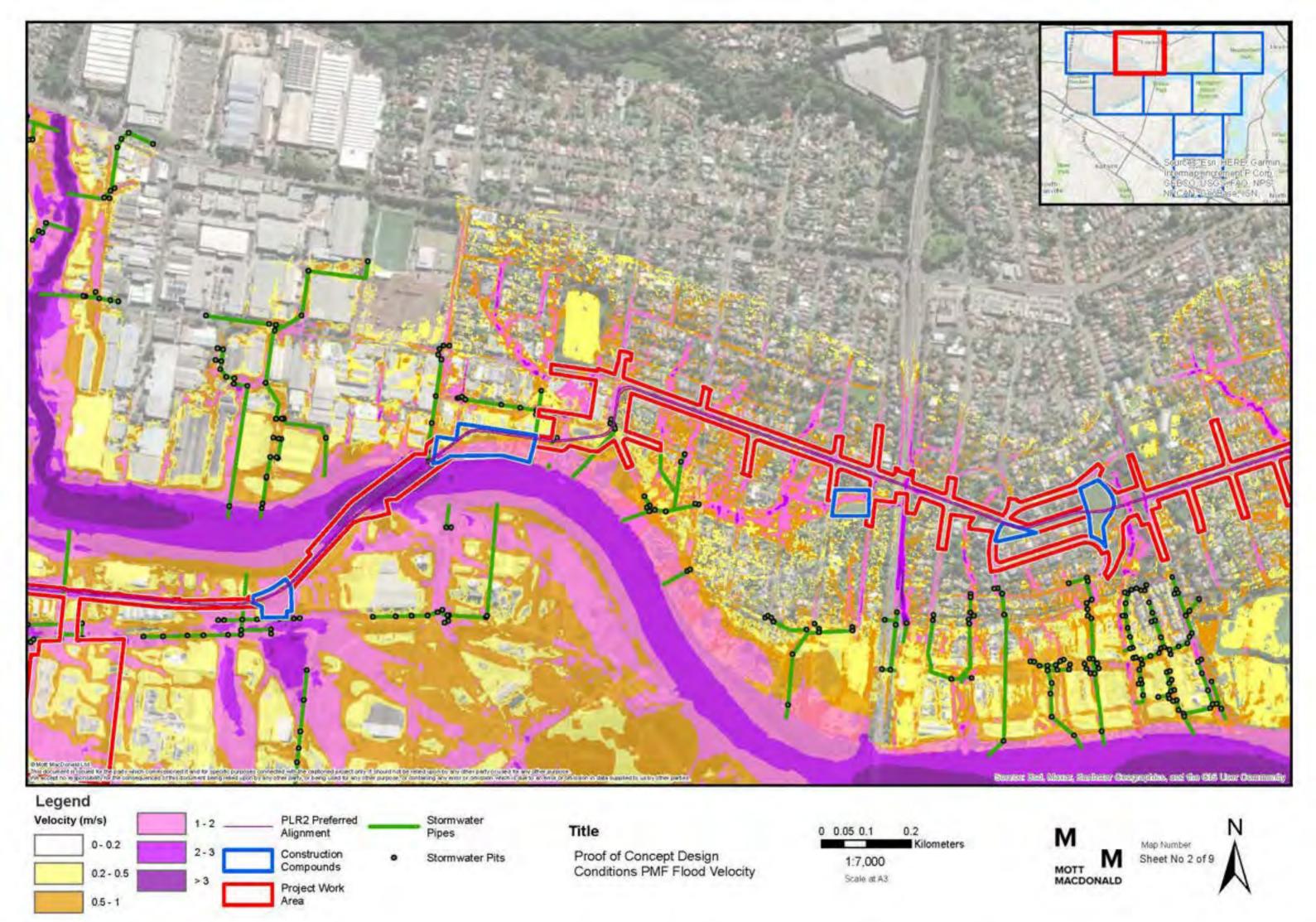
Proof of Concept Design Conditions PMF Flood Hazard

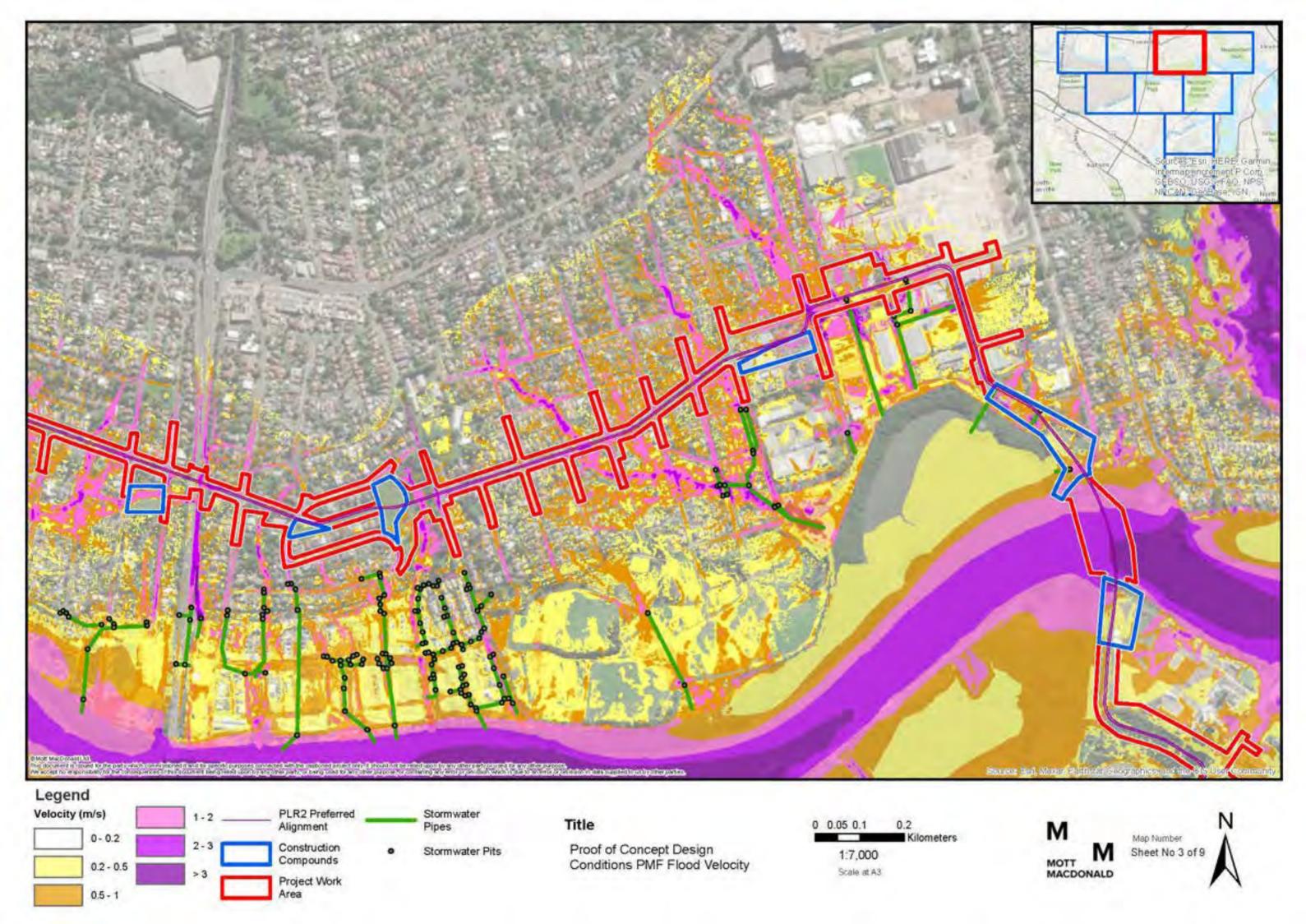
1:7,000 Scale at A3 MOTT MACDONALD

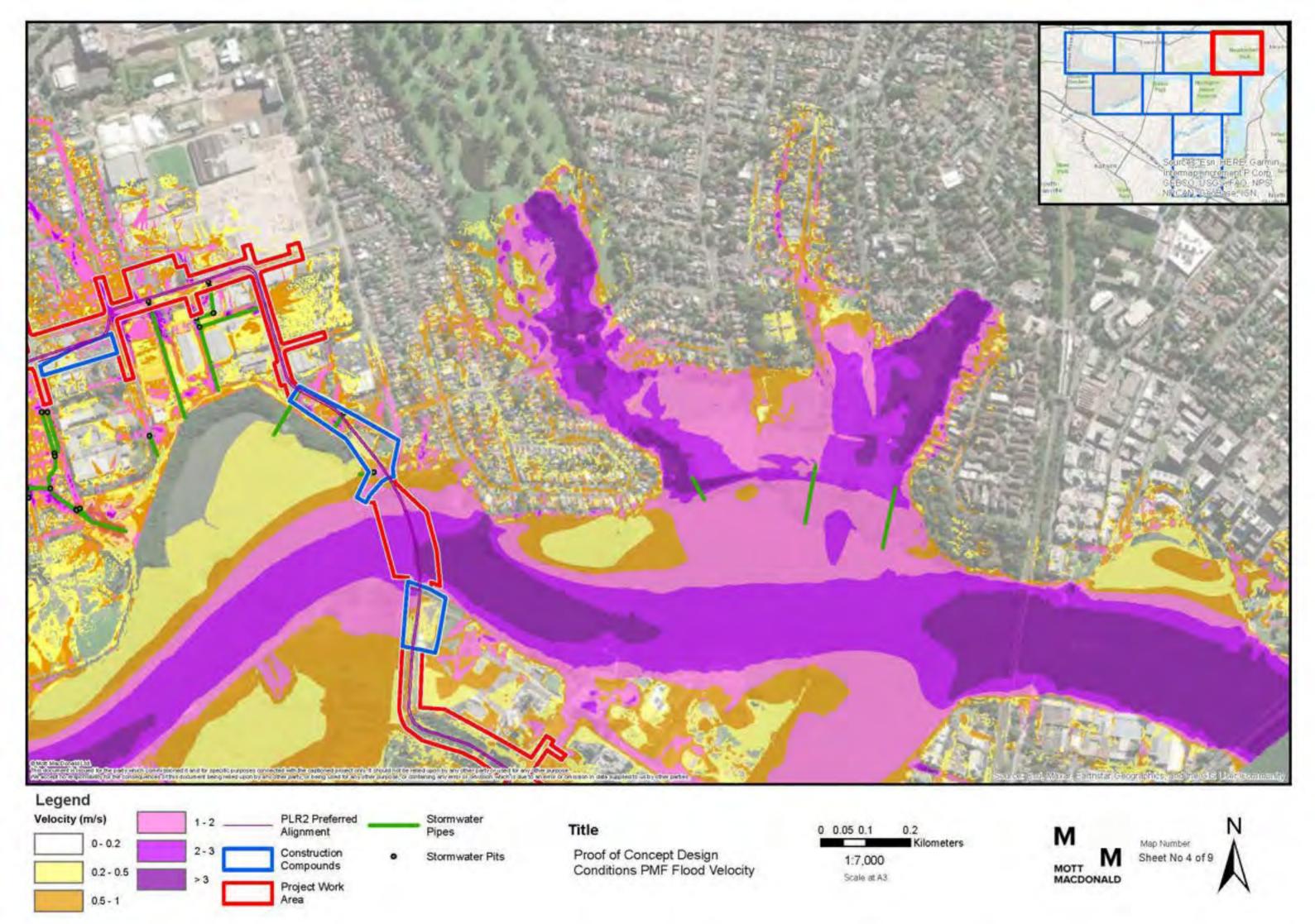


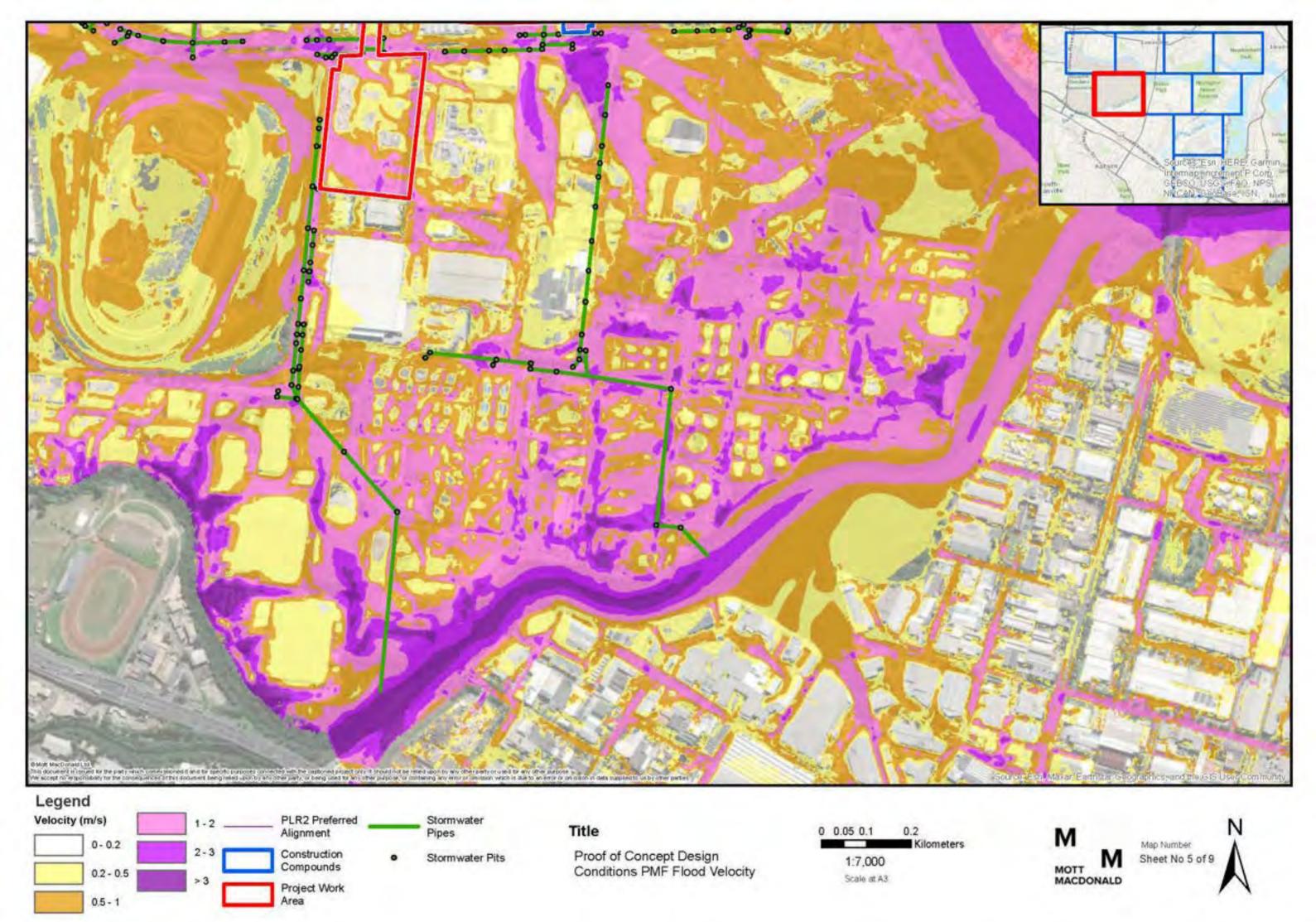


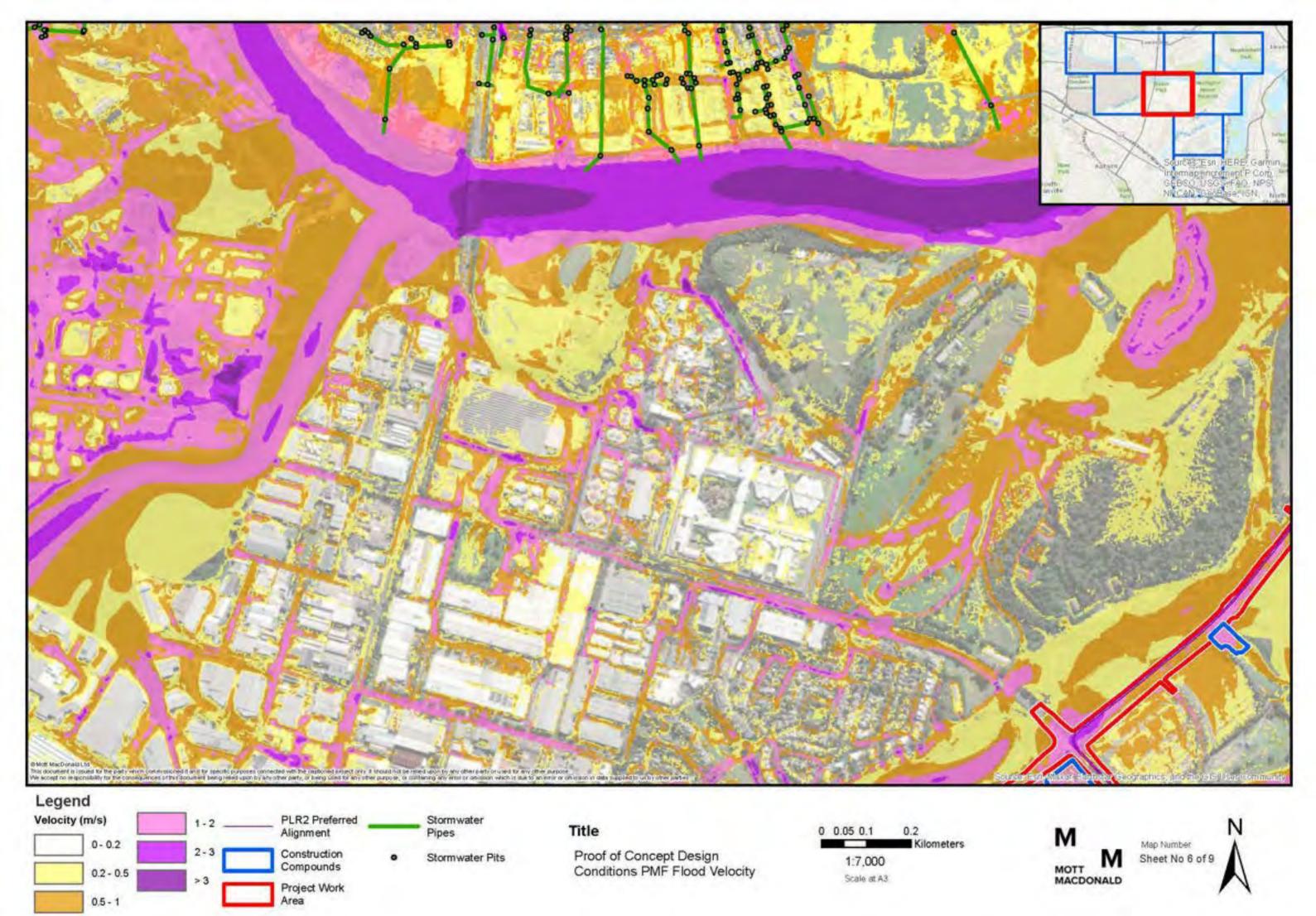


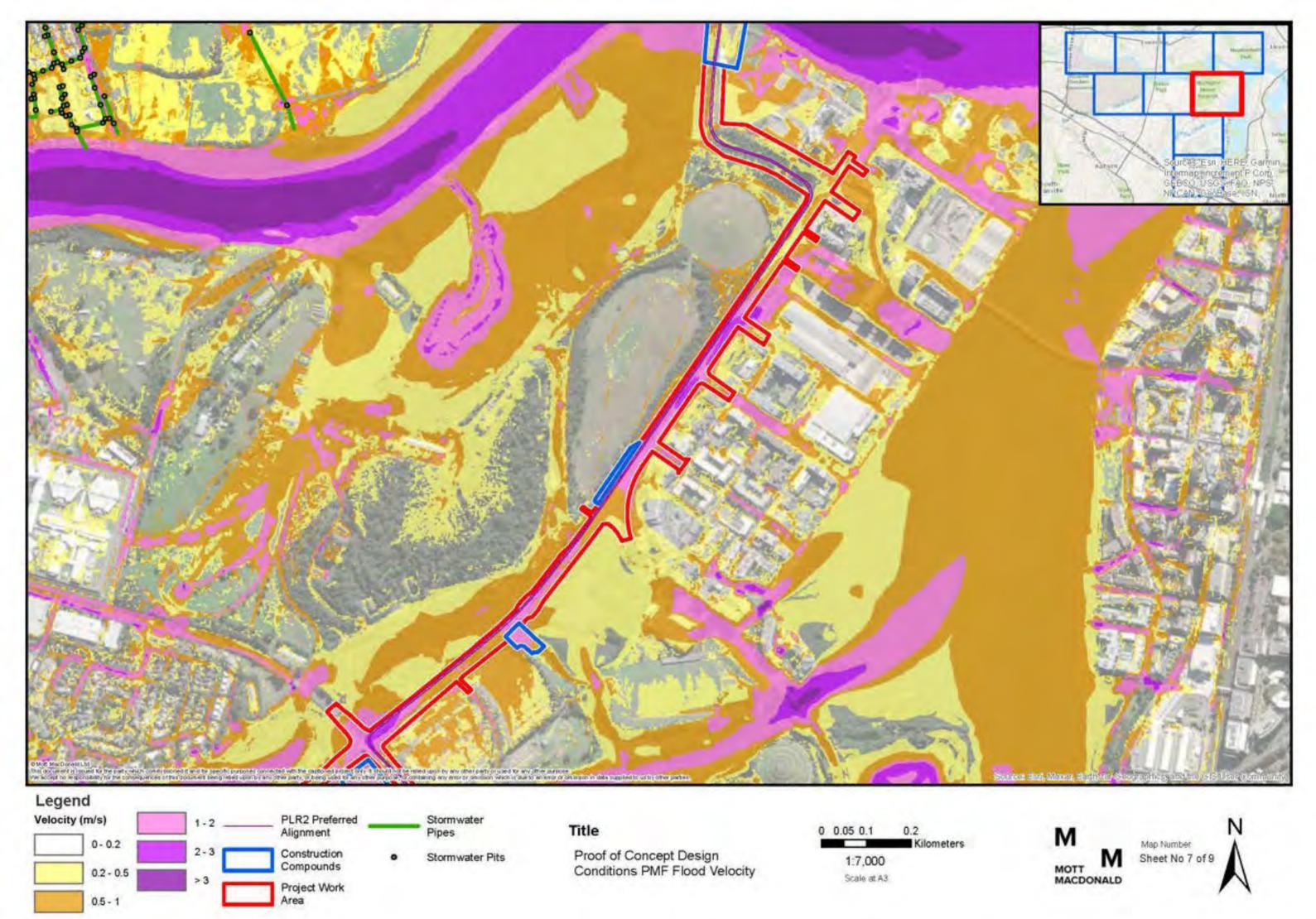


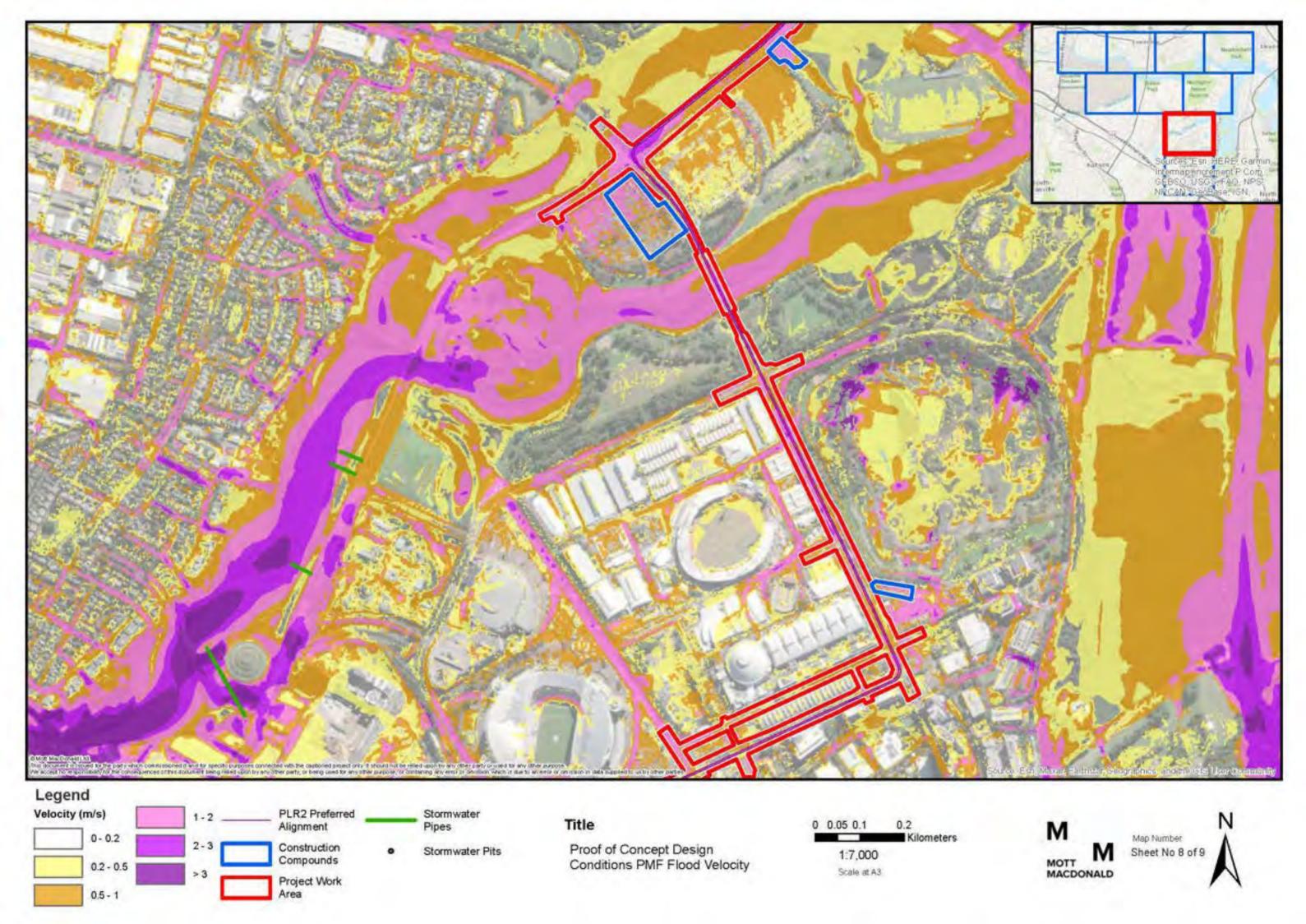


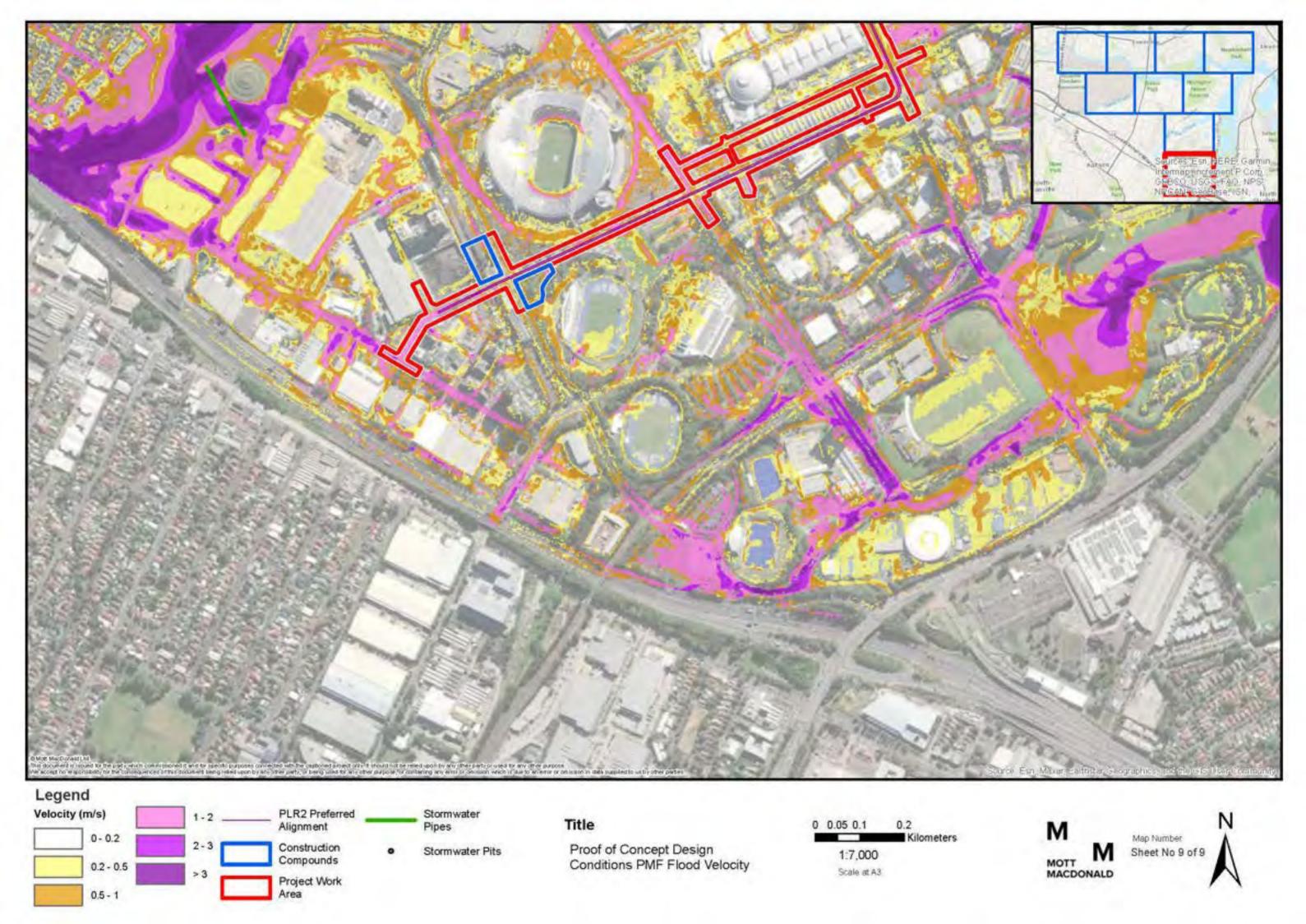




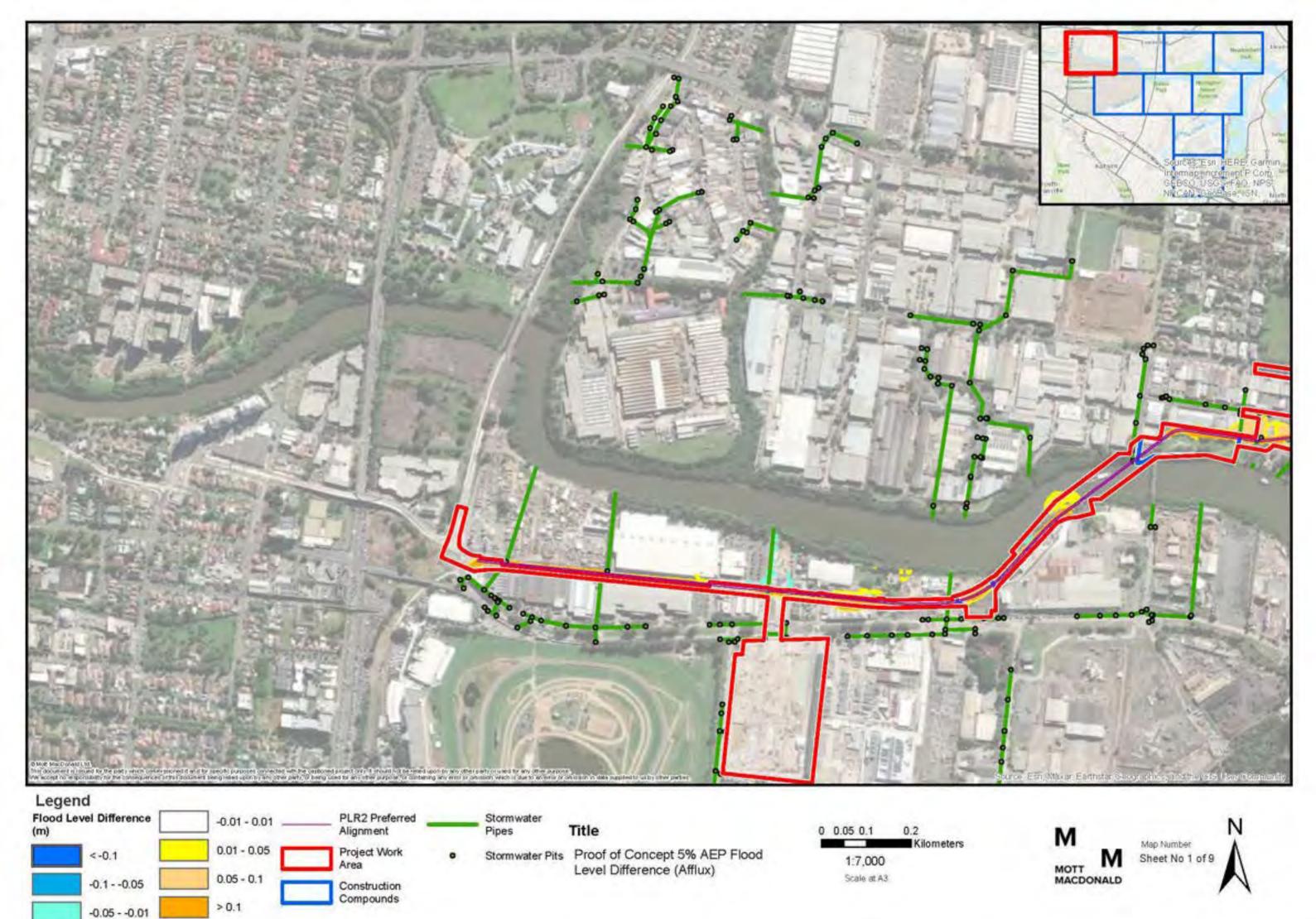


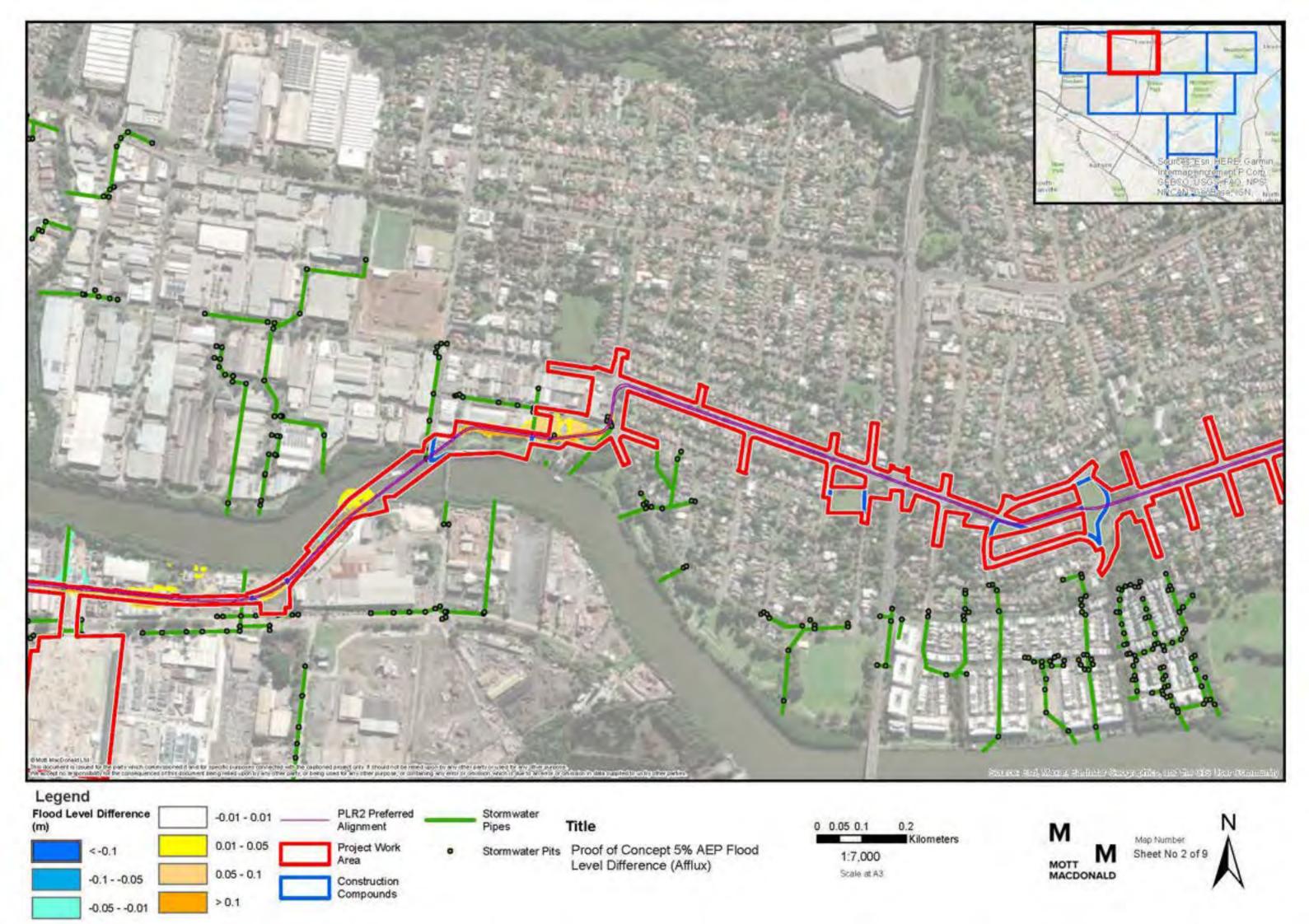


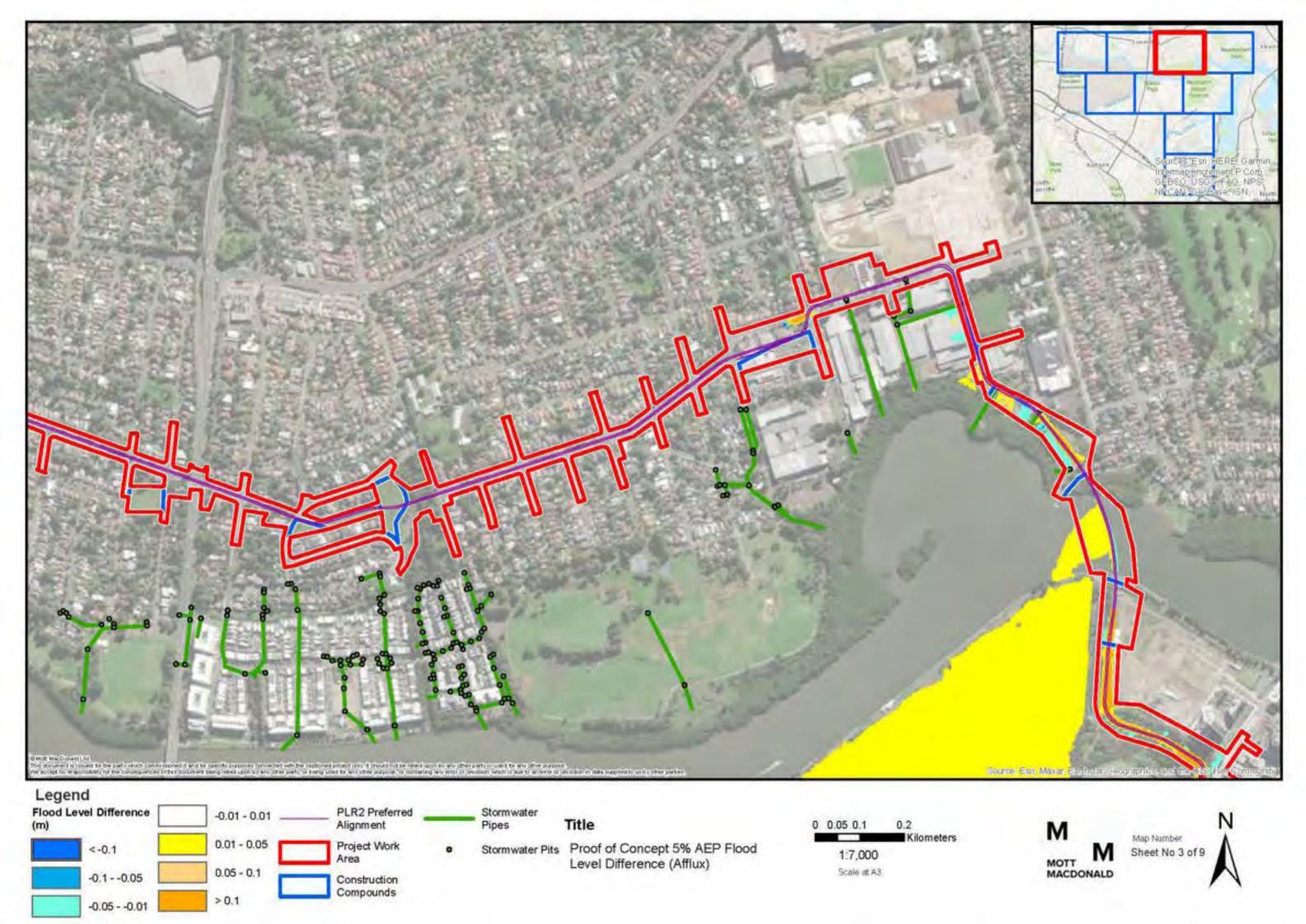


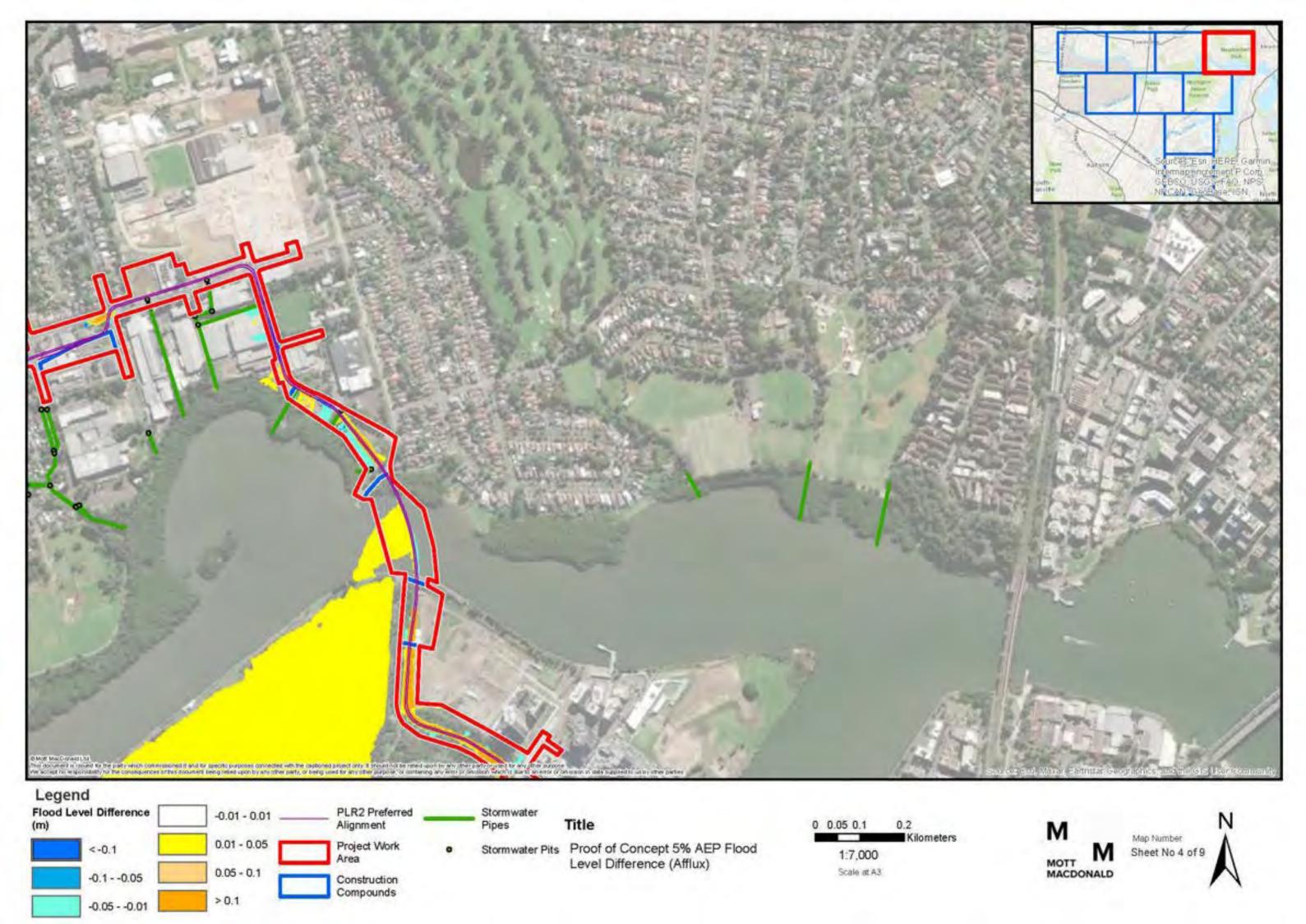


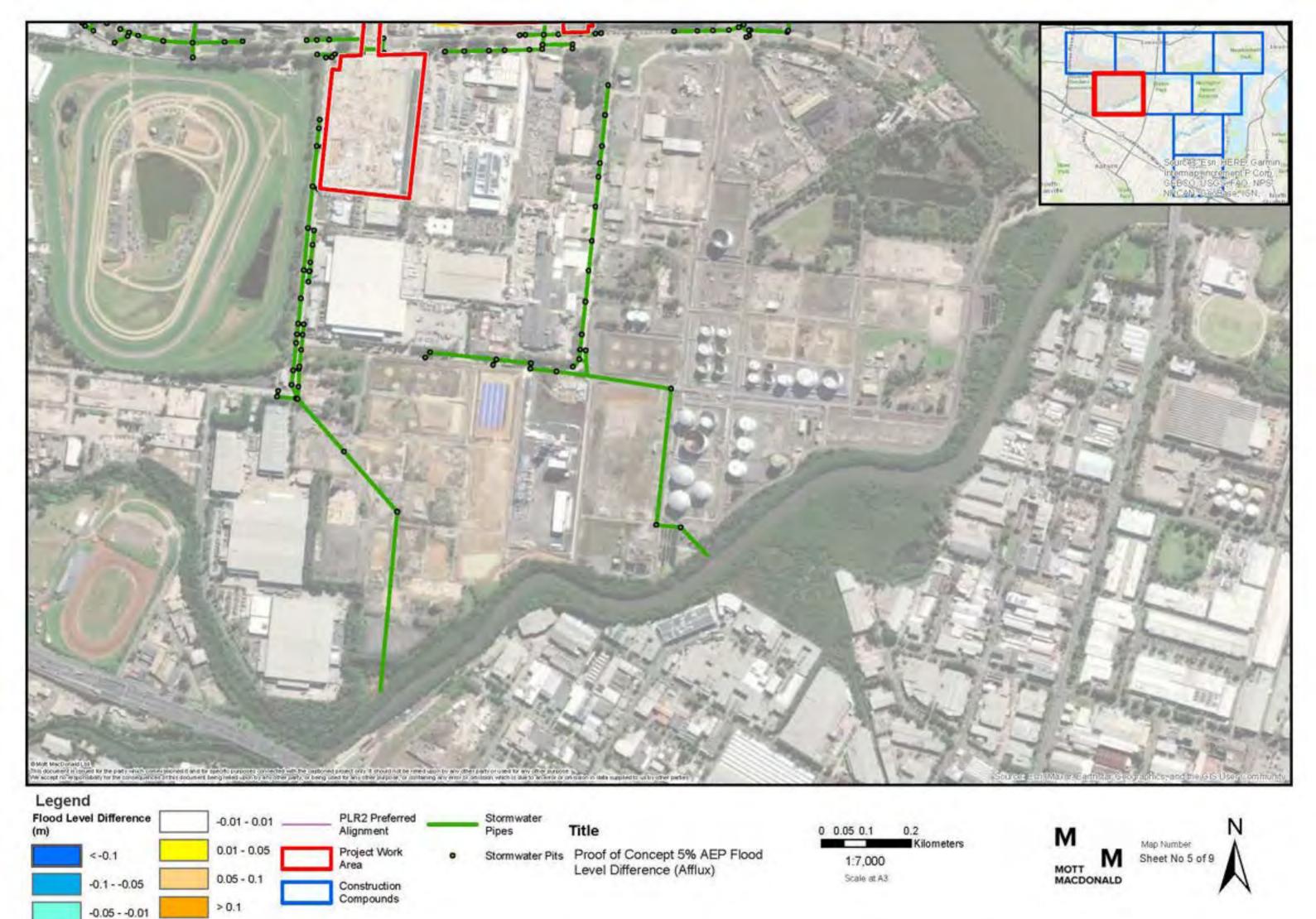
Appendix B4 – Flood model figures (Proof of concept) – Flood level difference



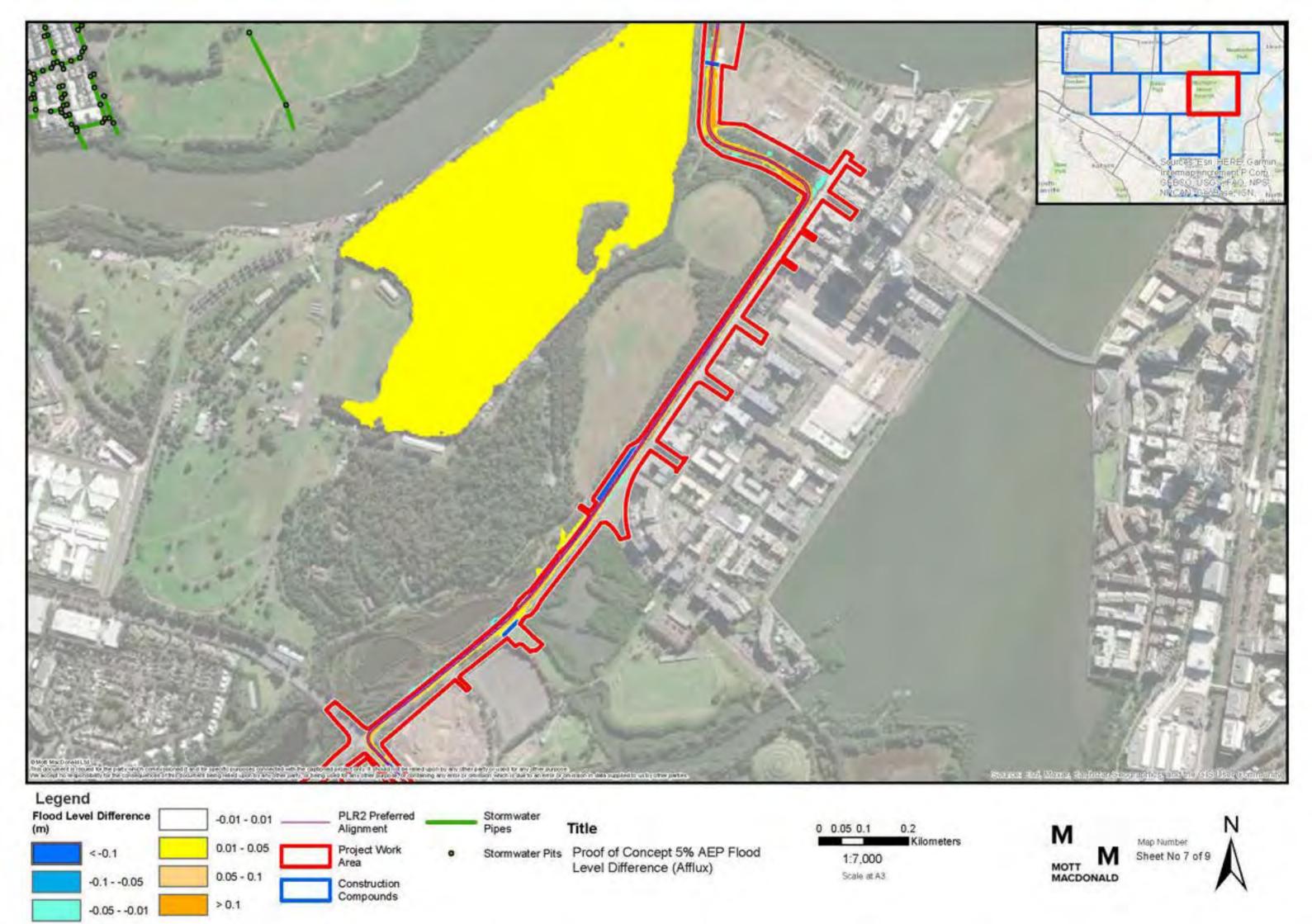


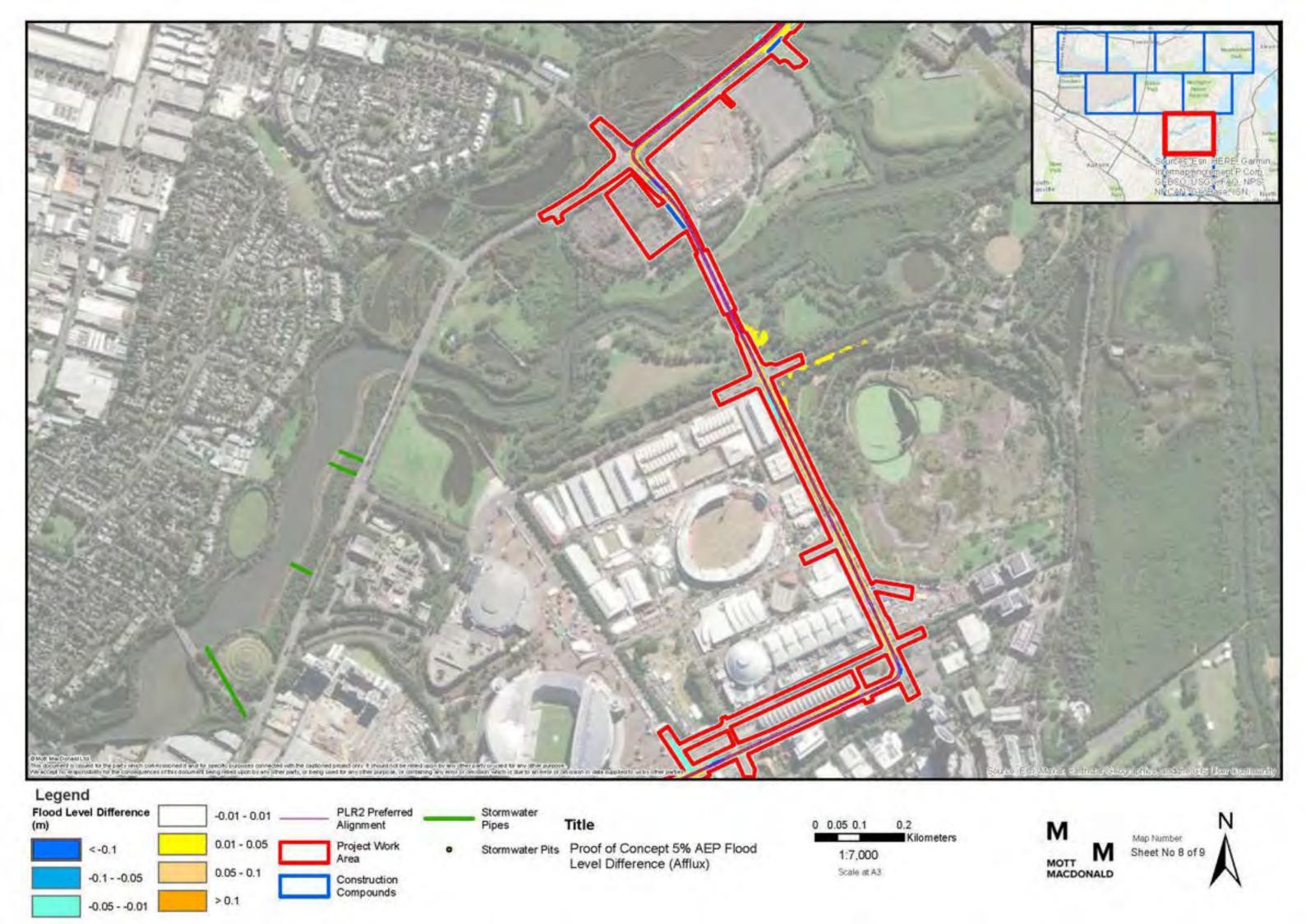


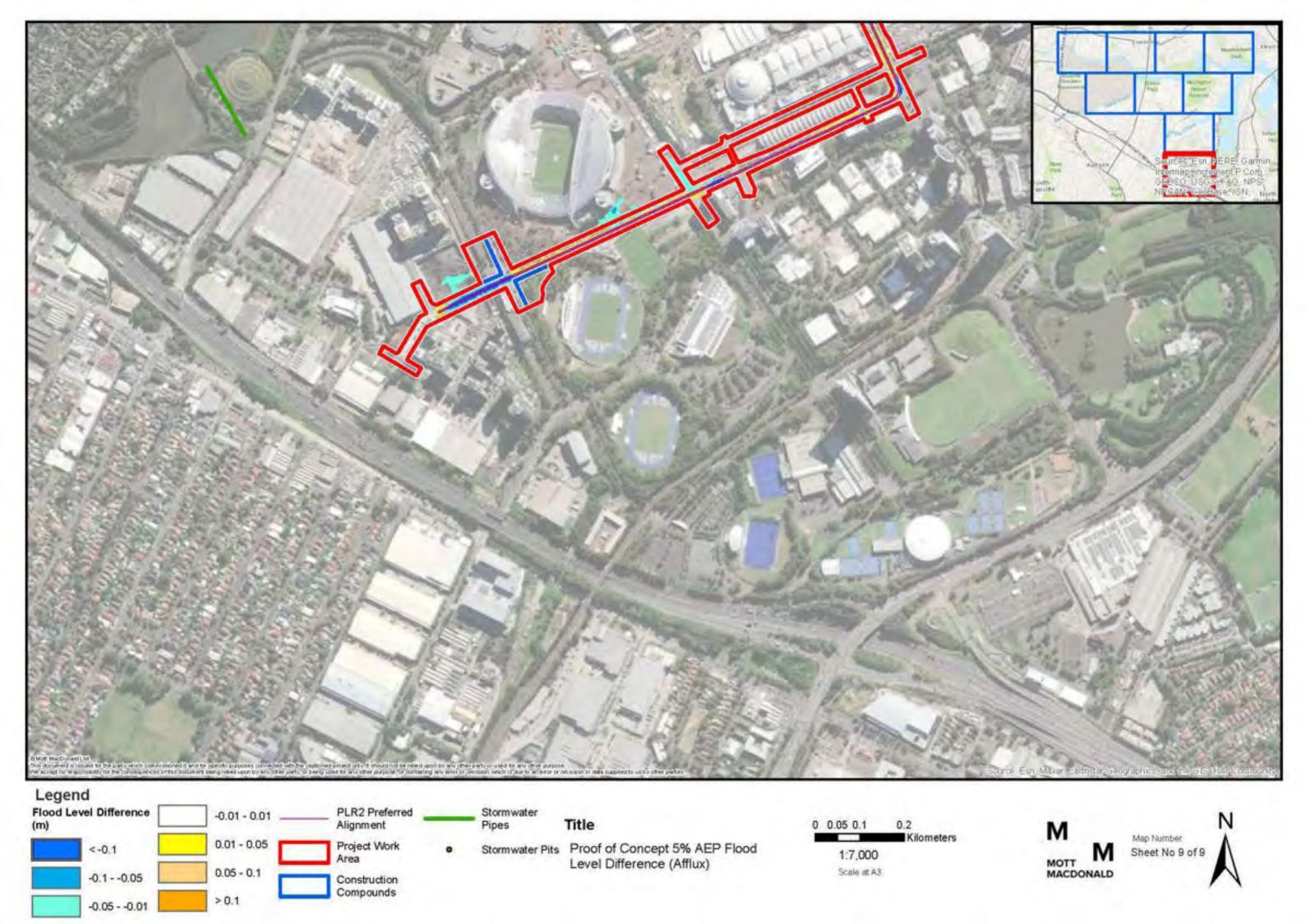


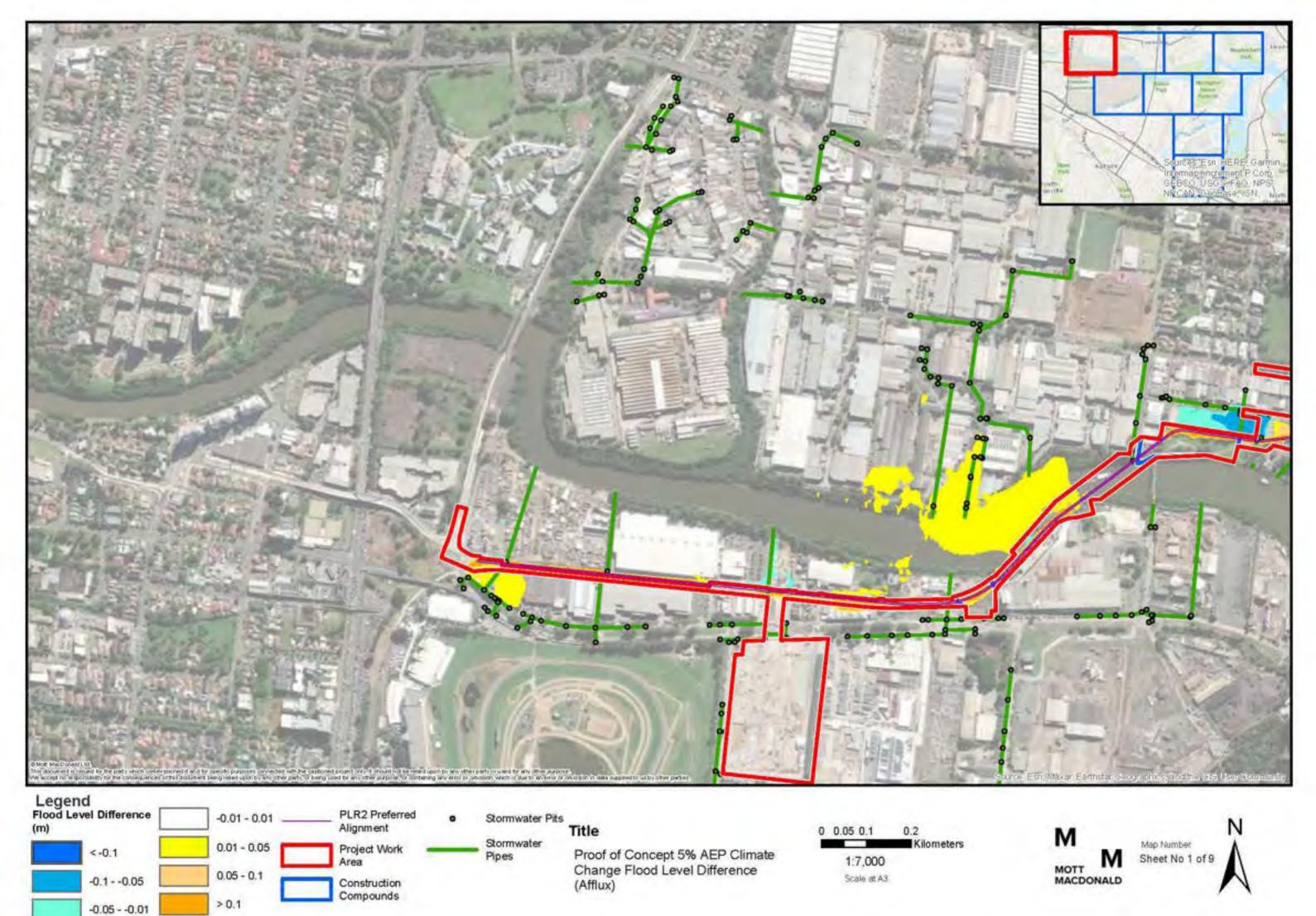


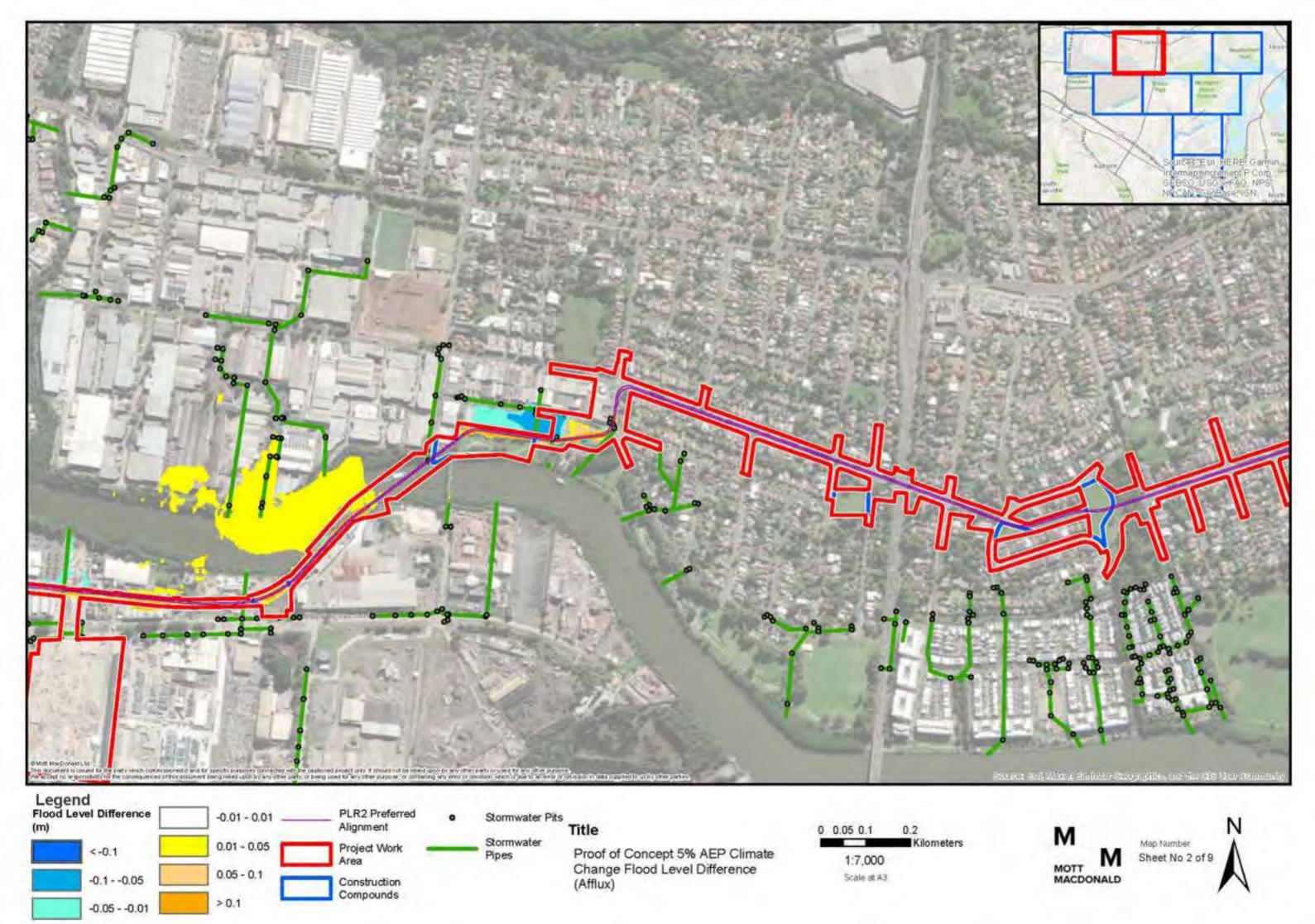


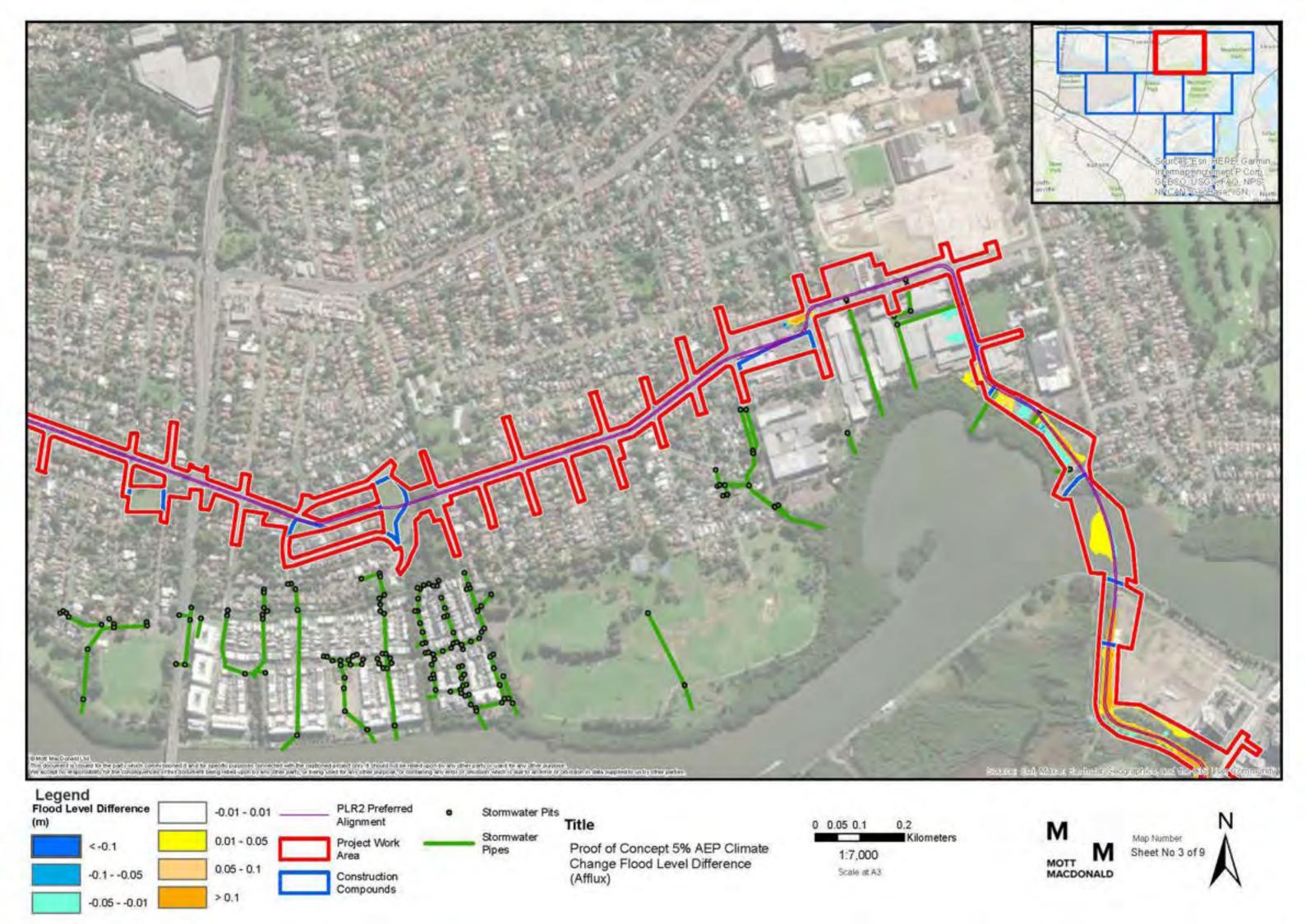


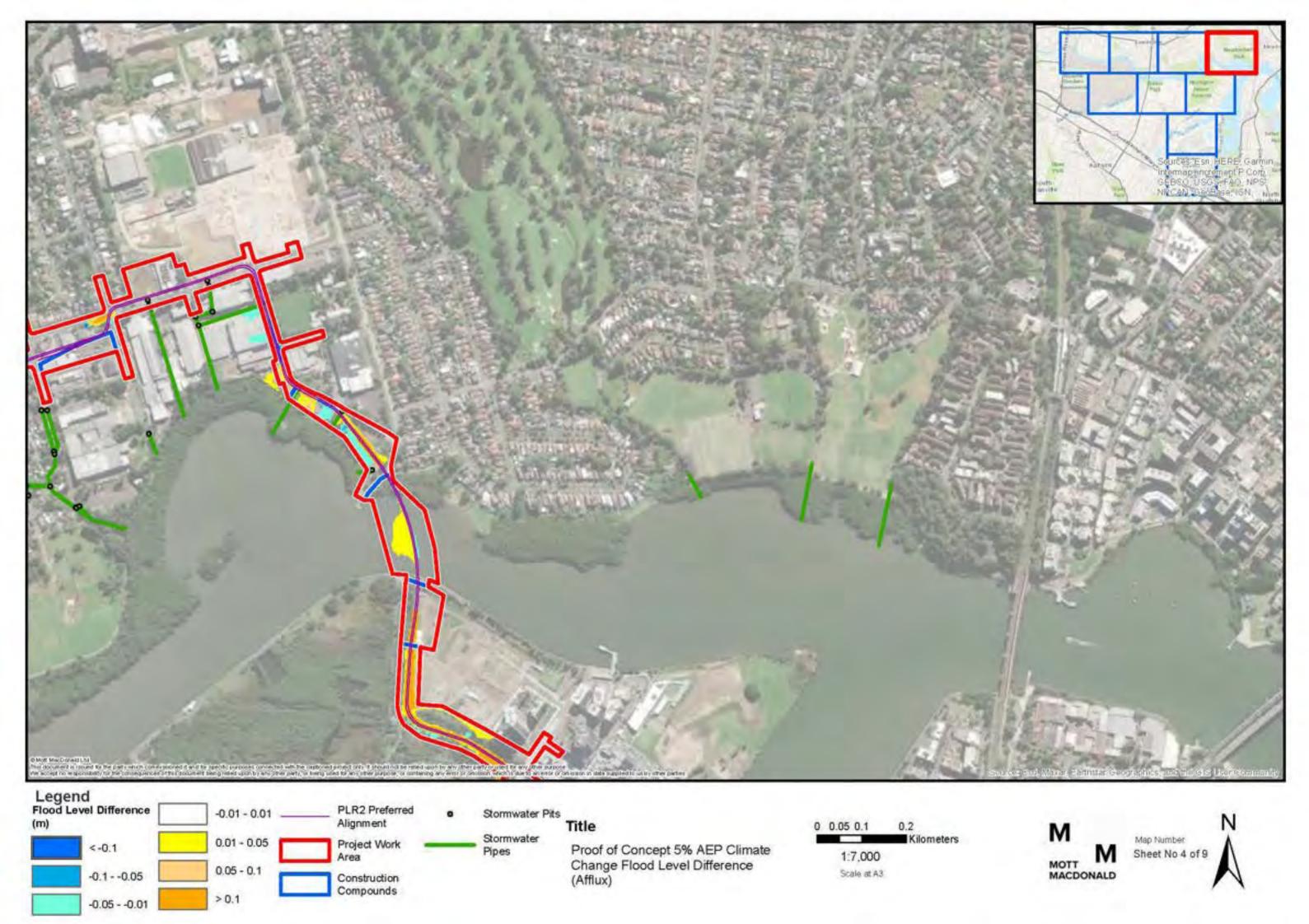


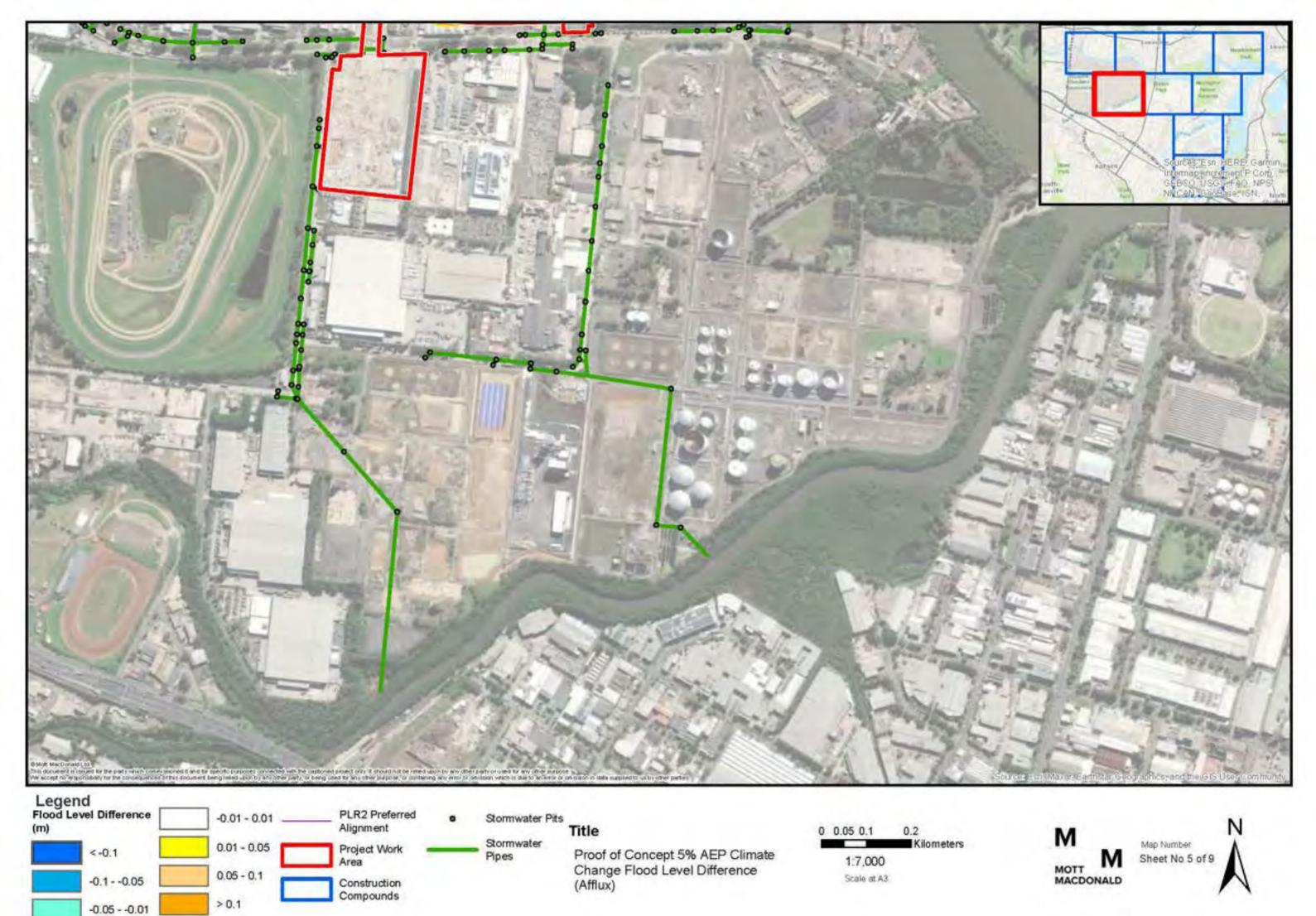




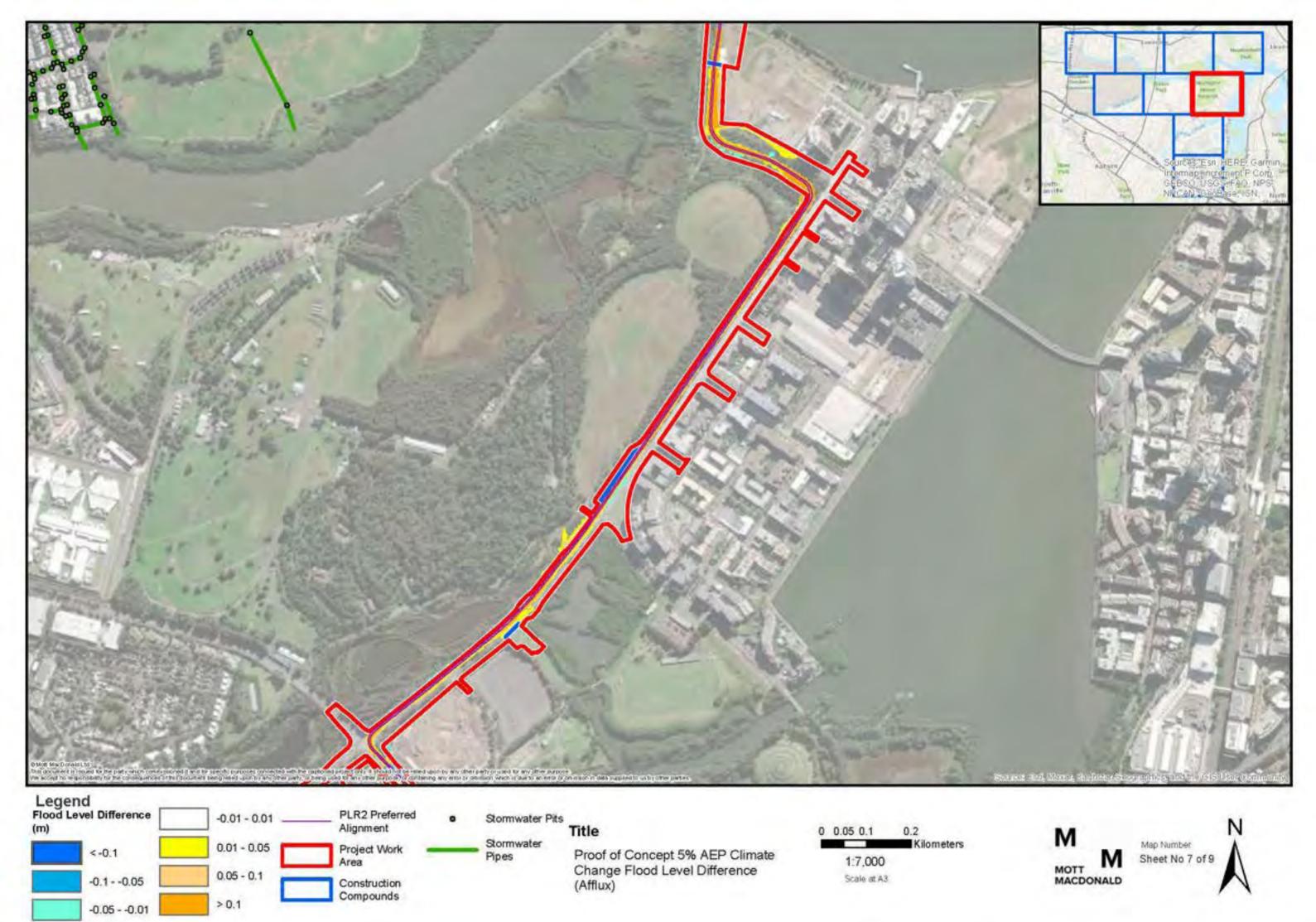


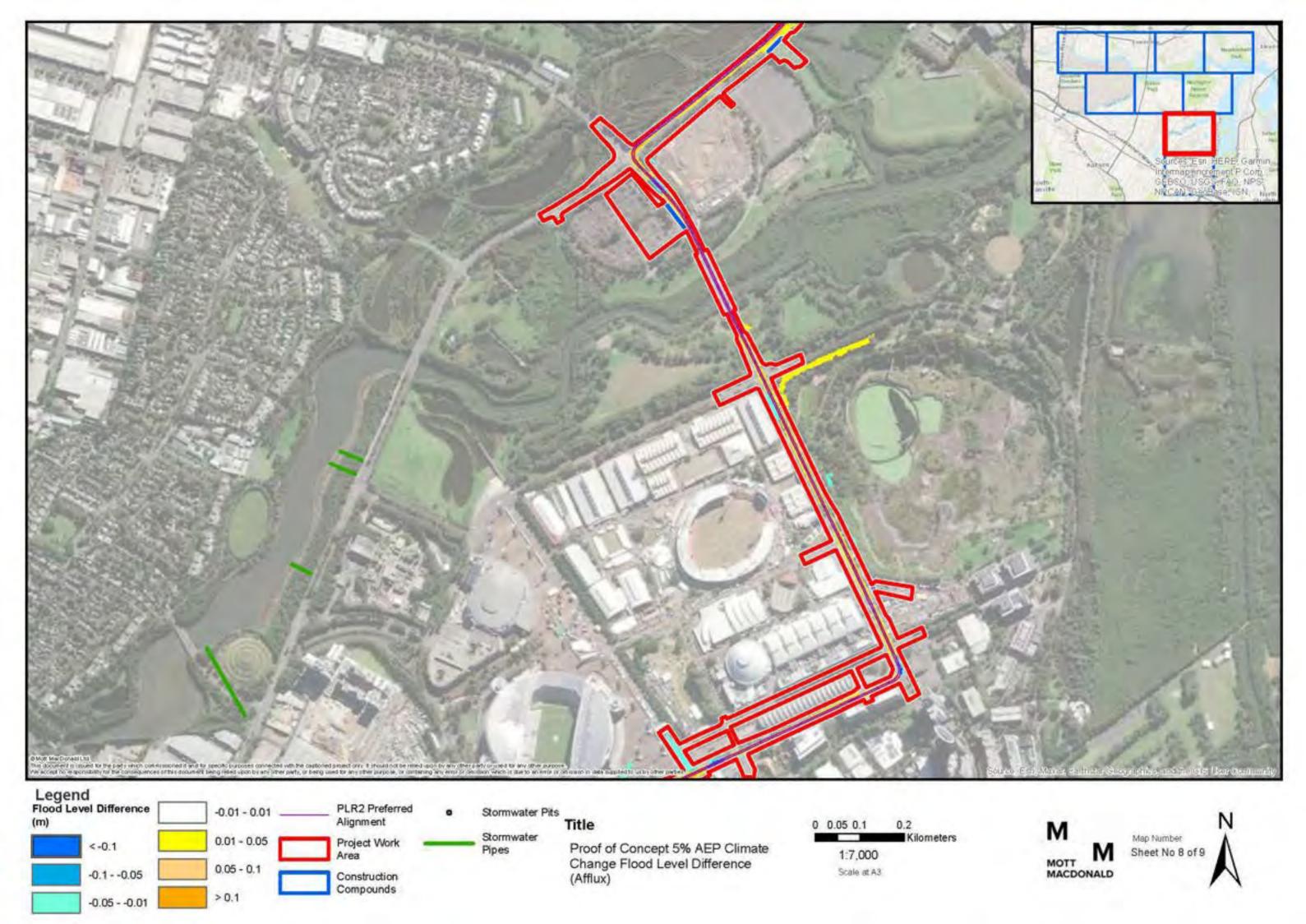


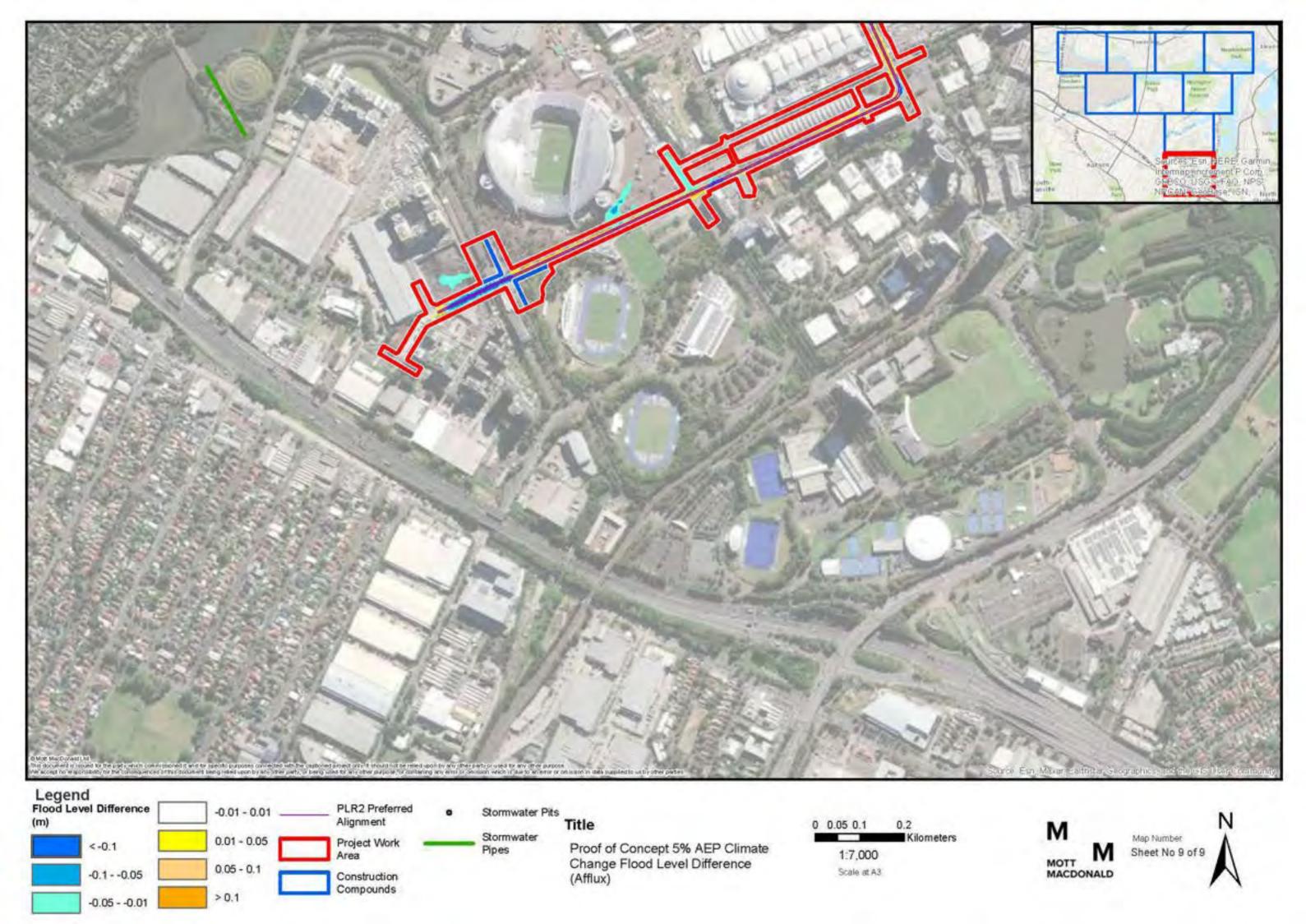


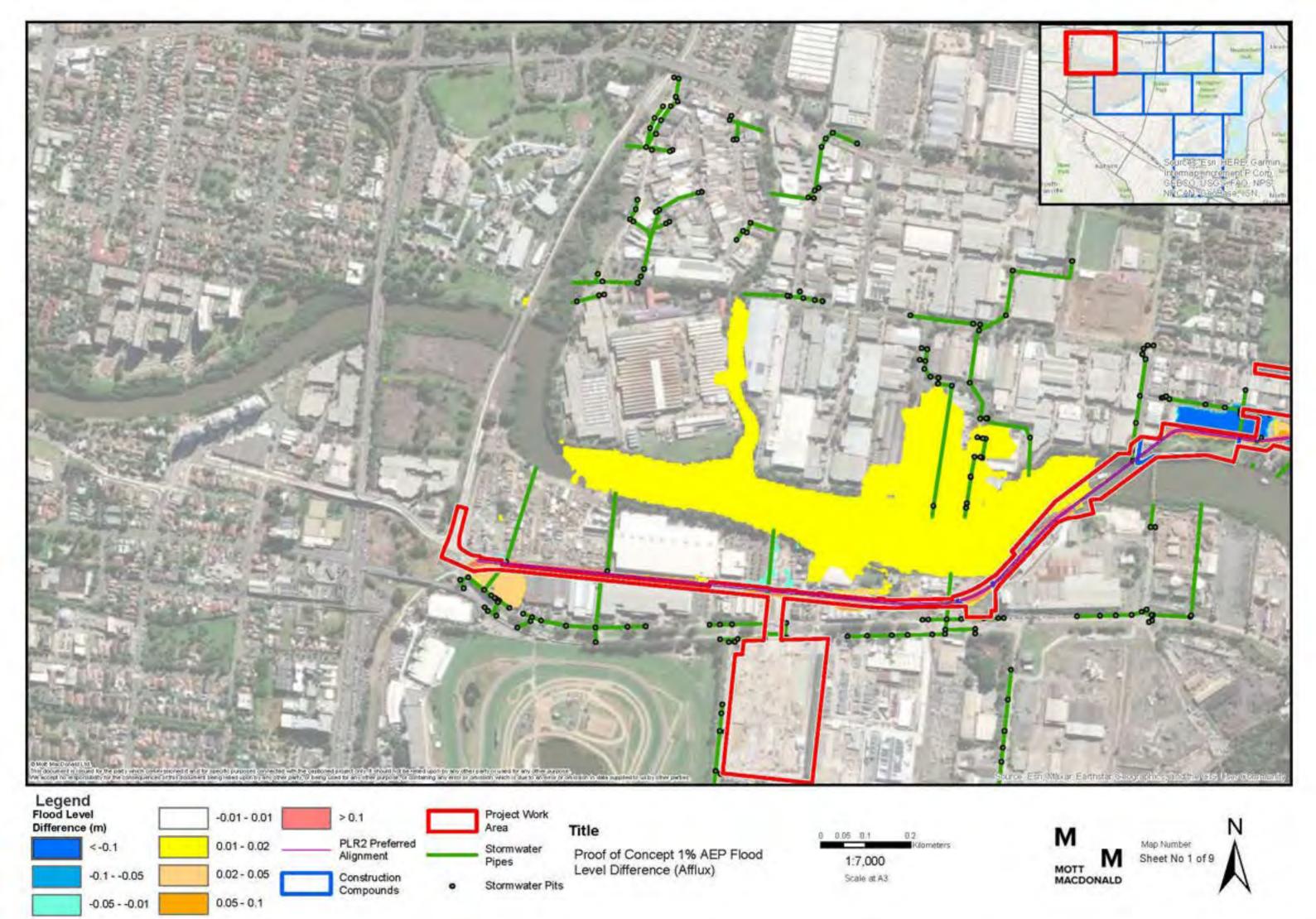


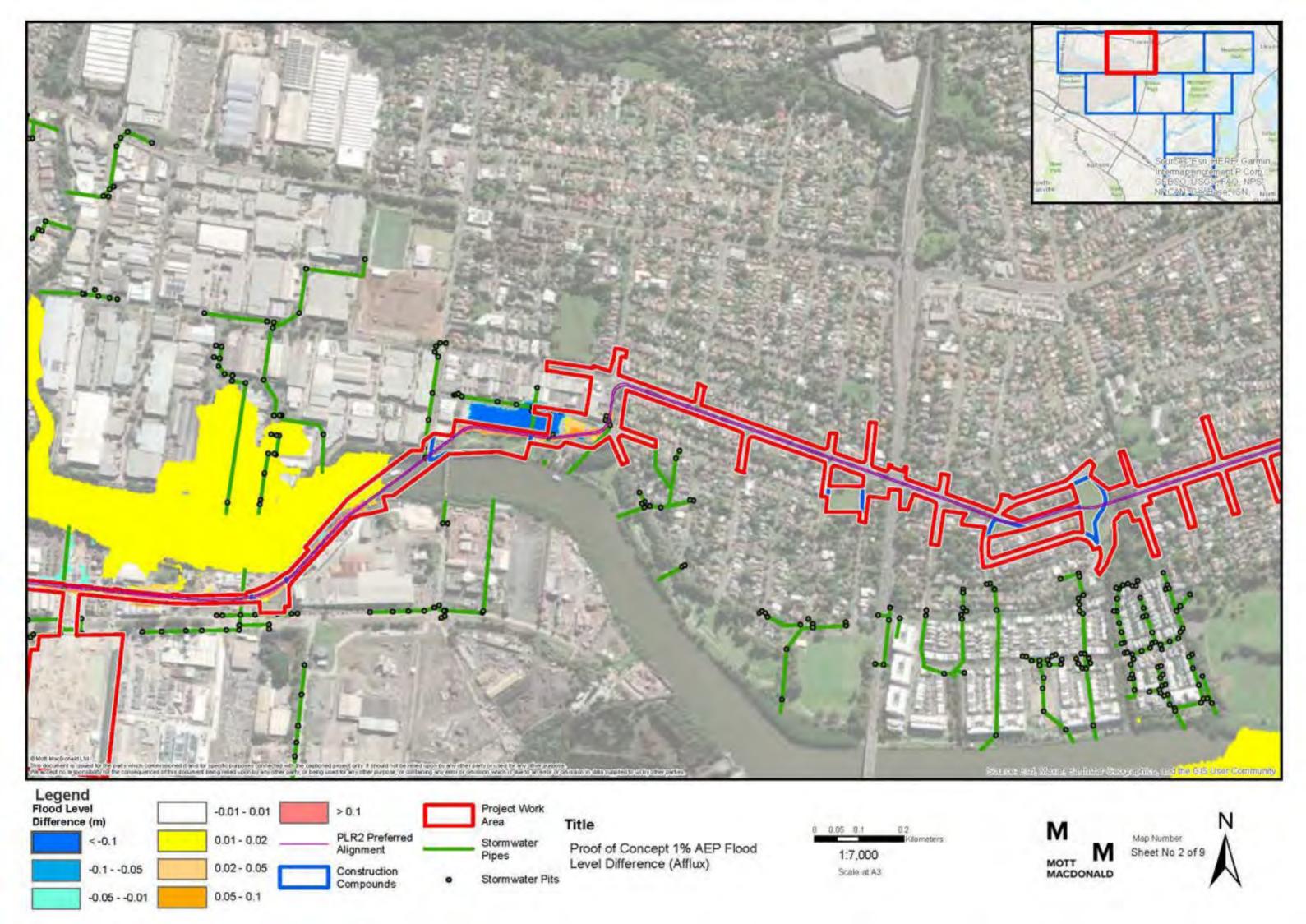


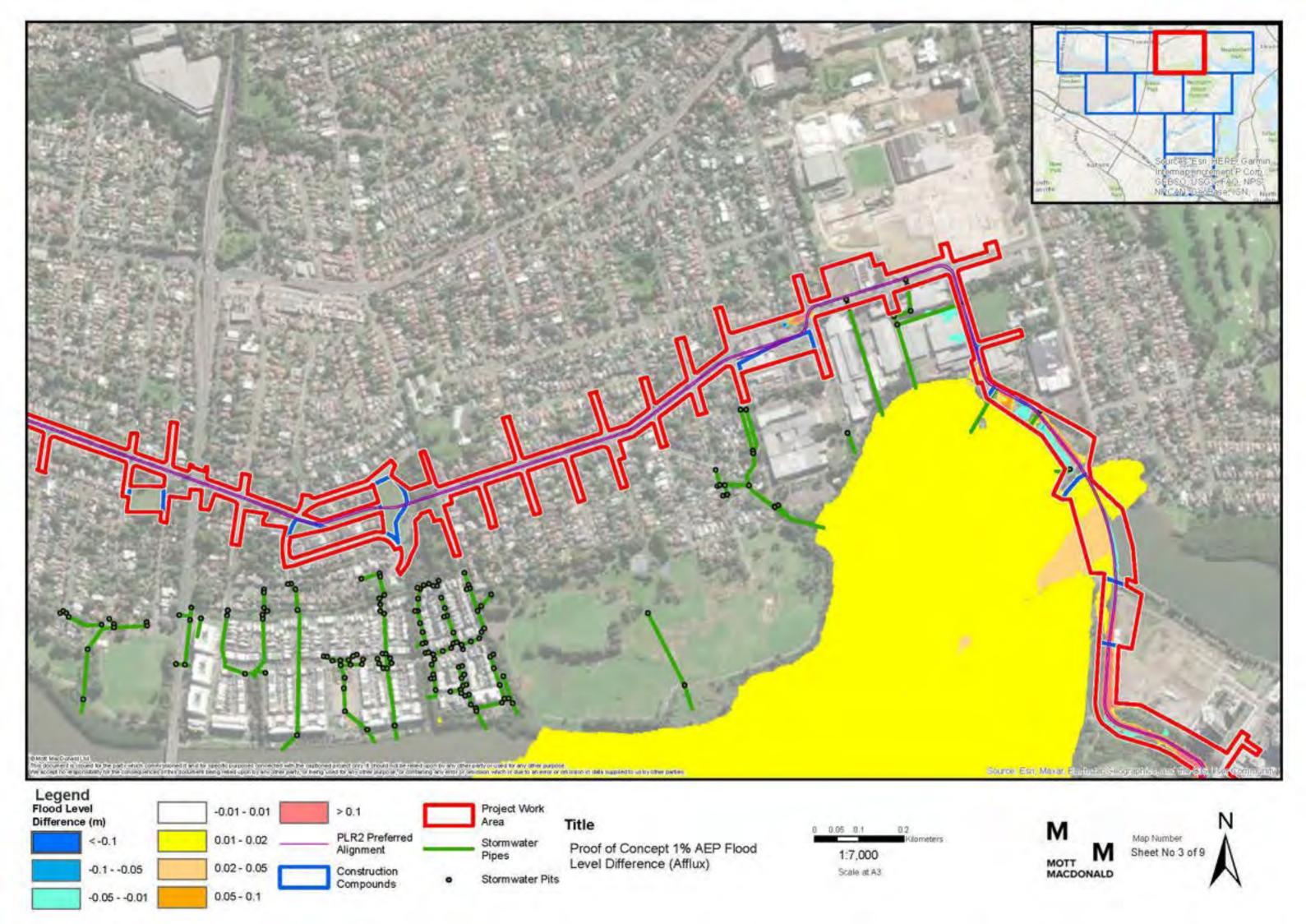


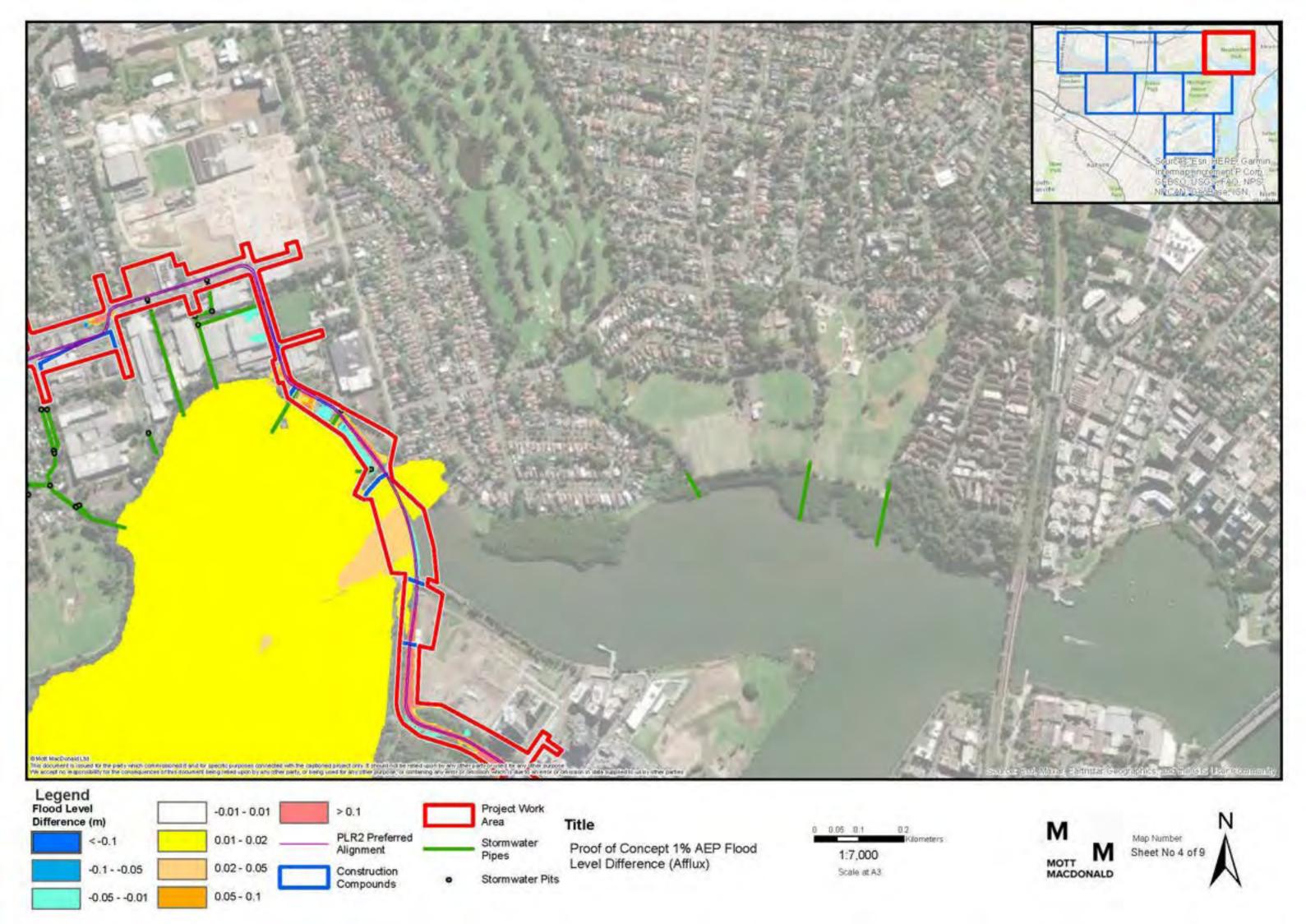


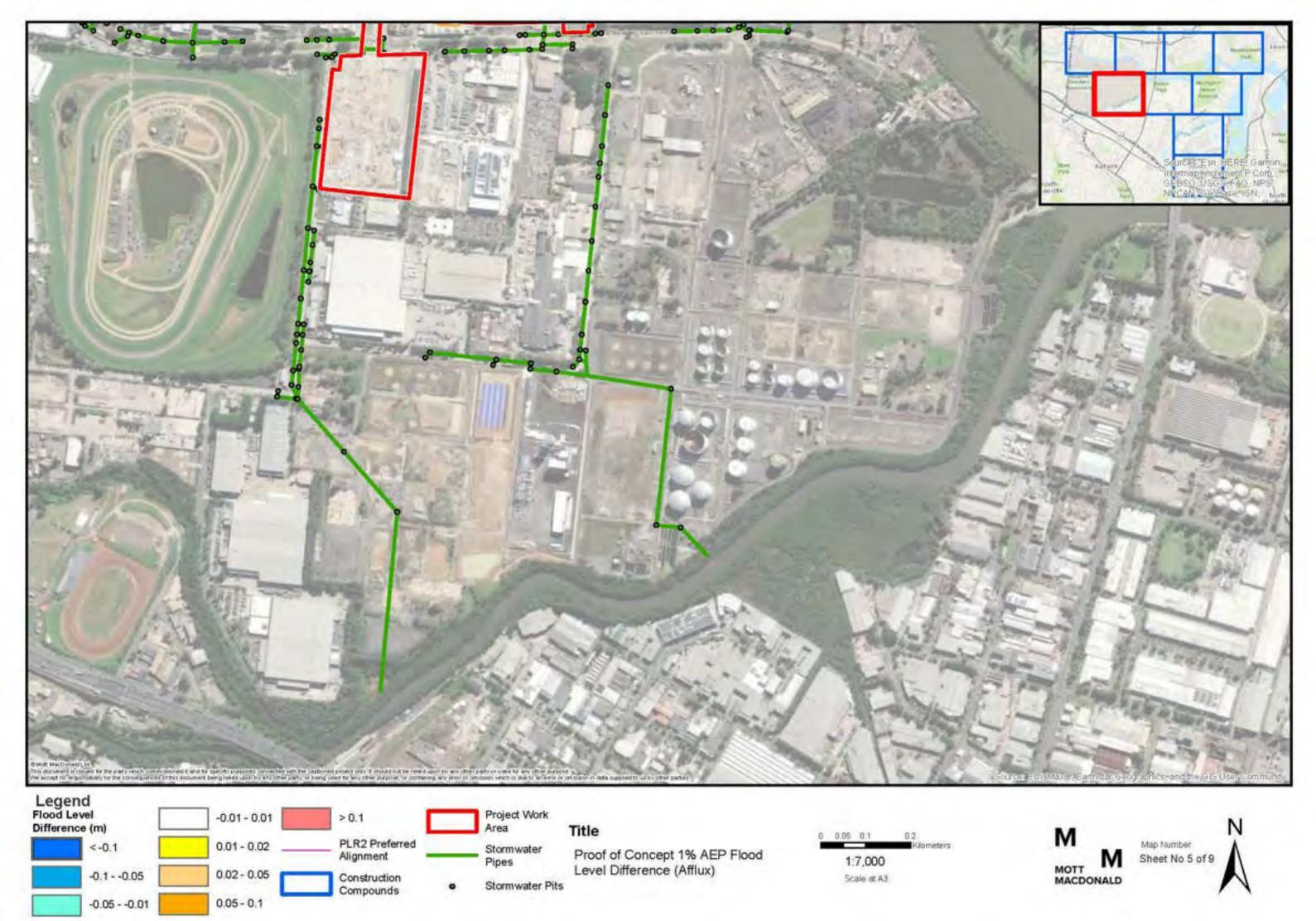


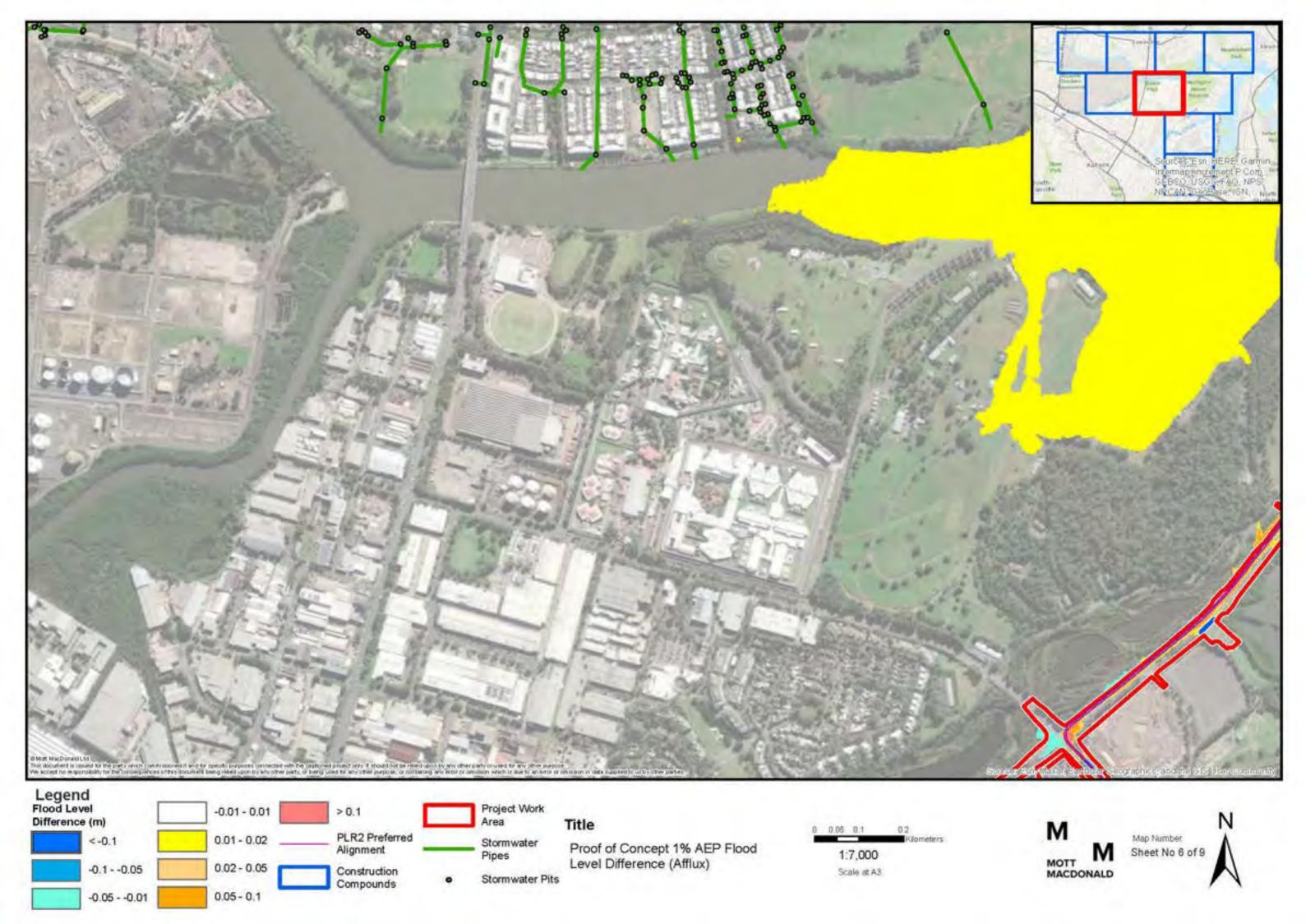


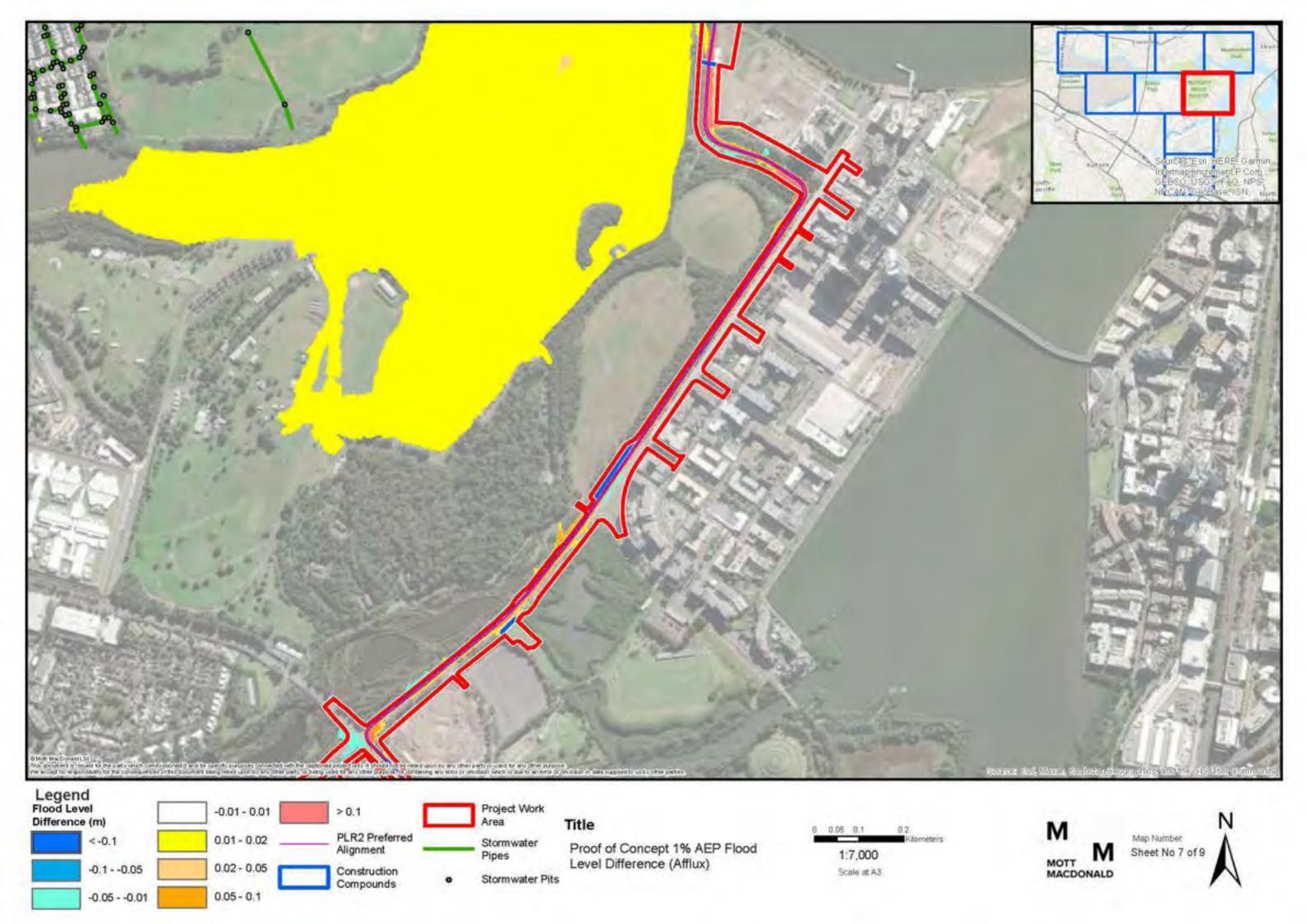


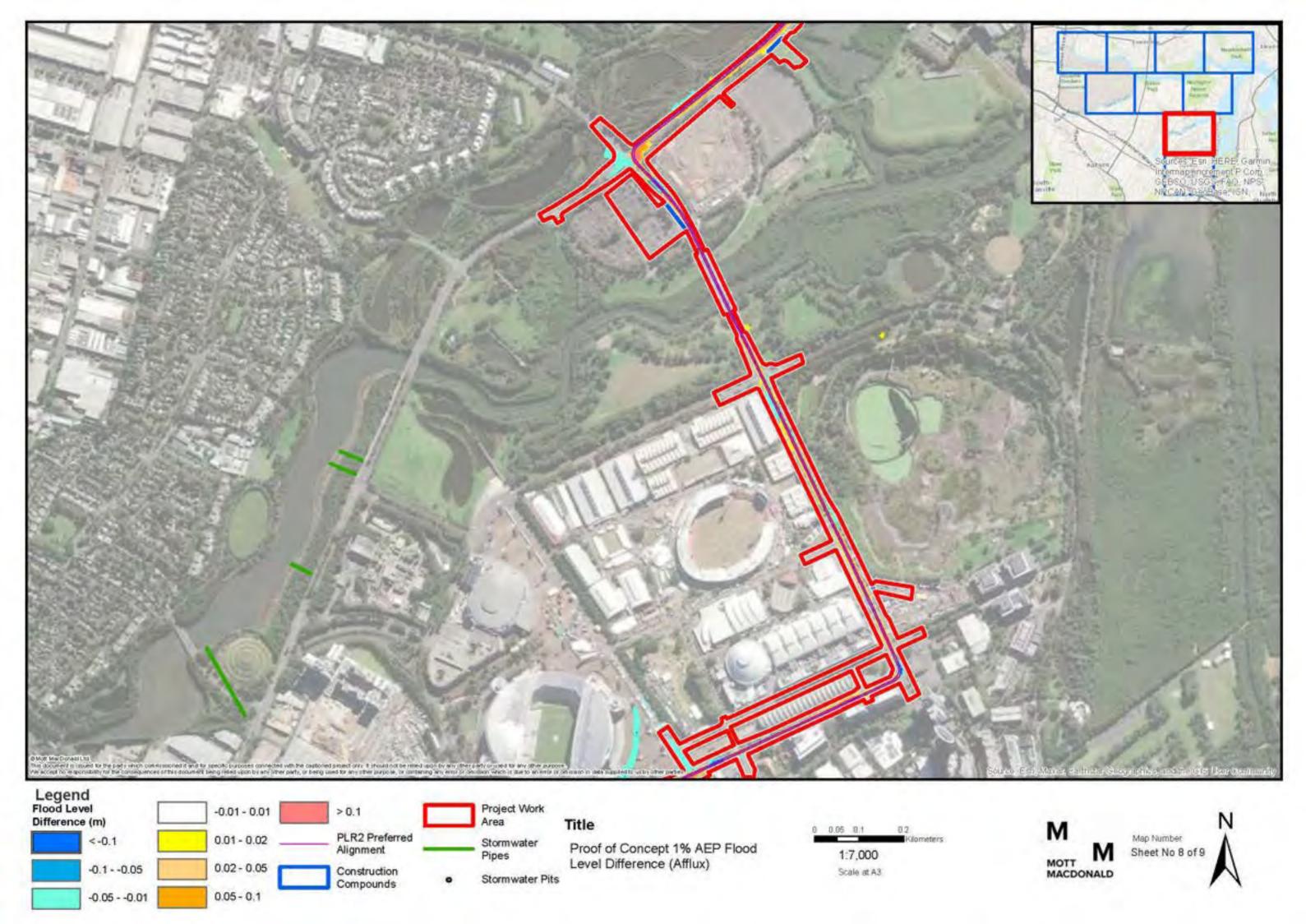


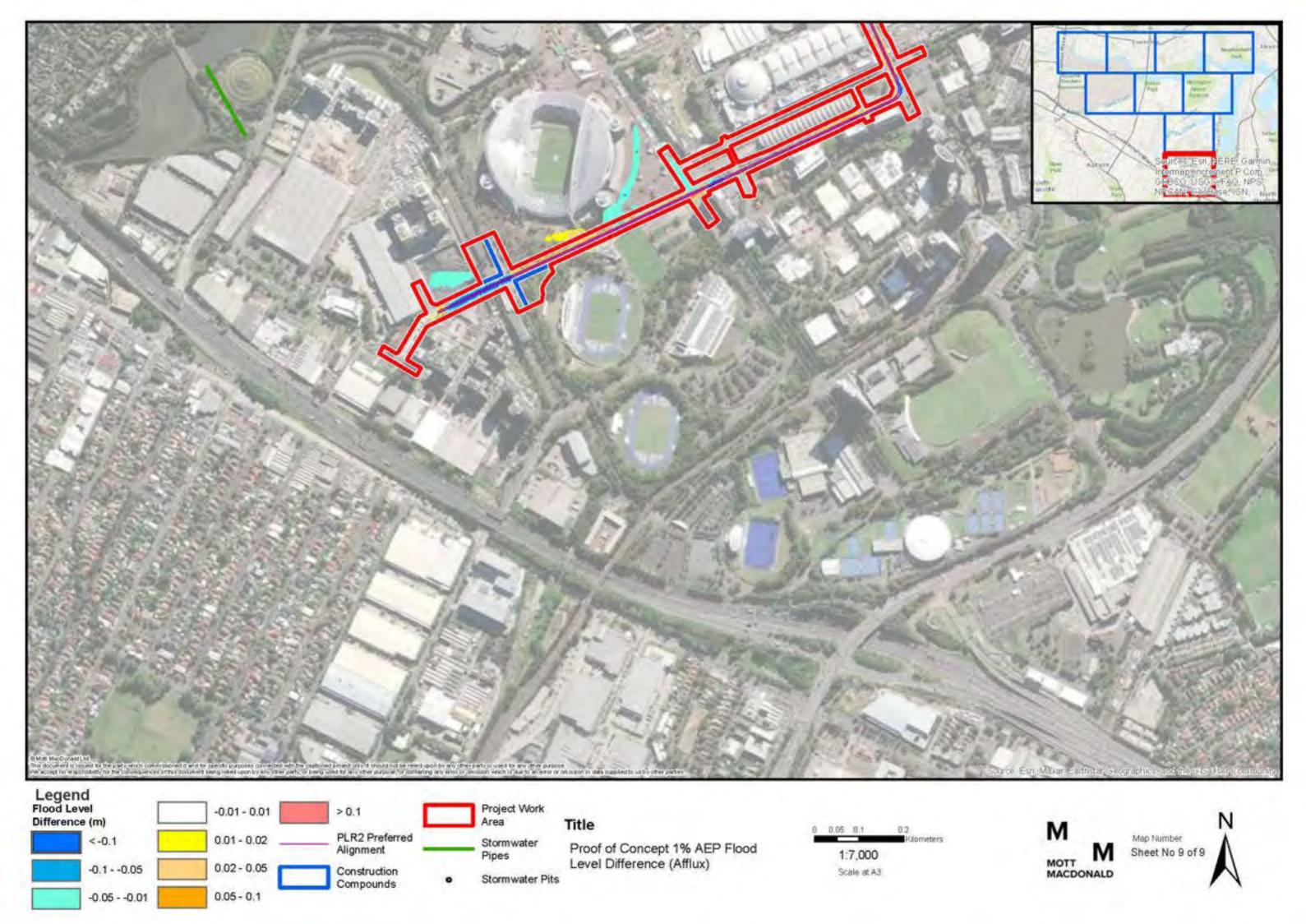


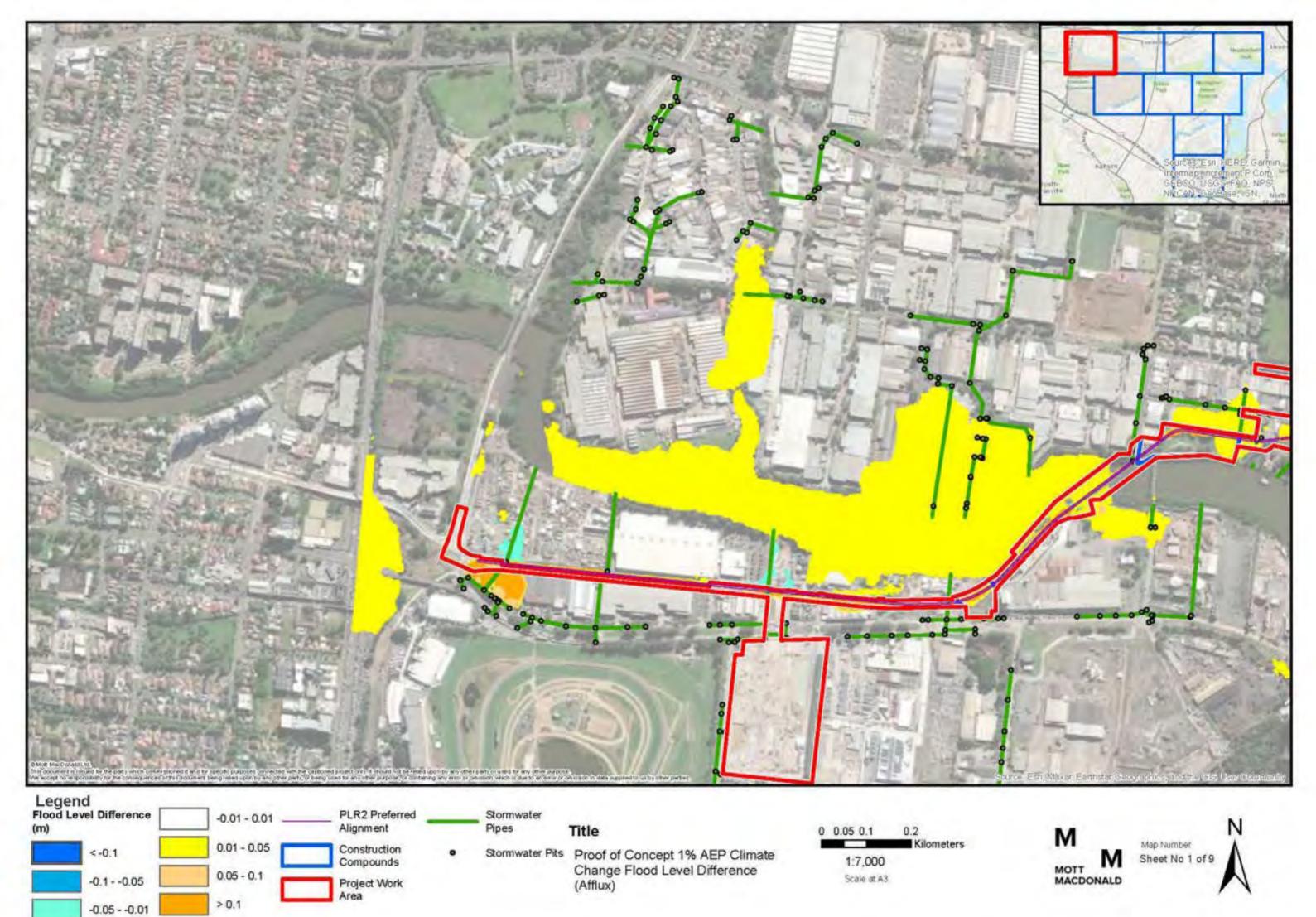


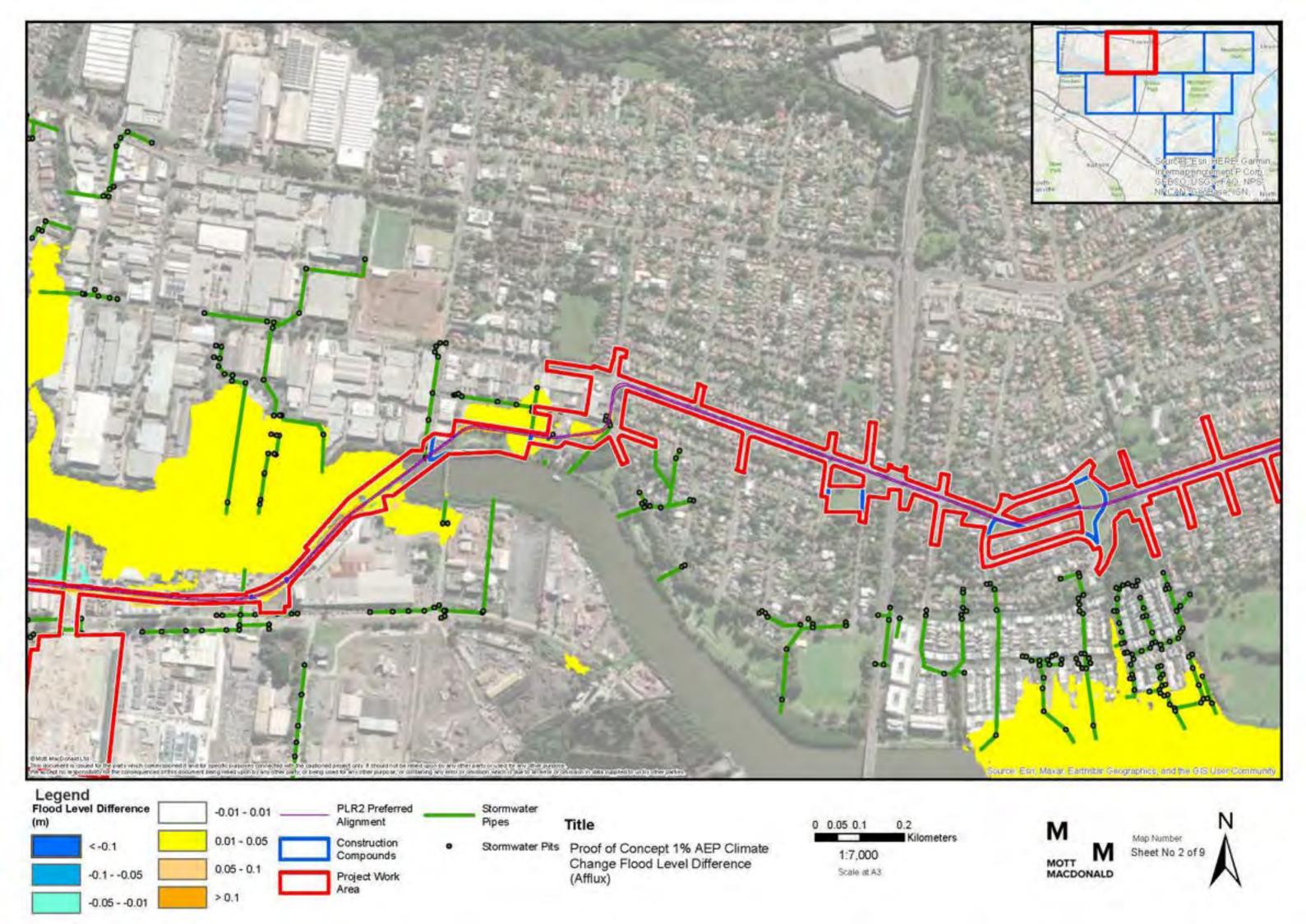


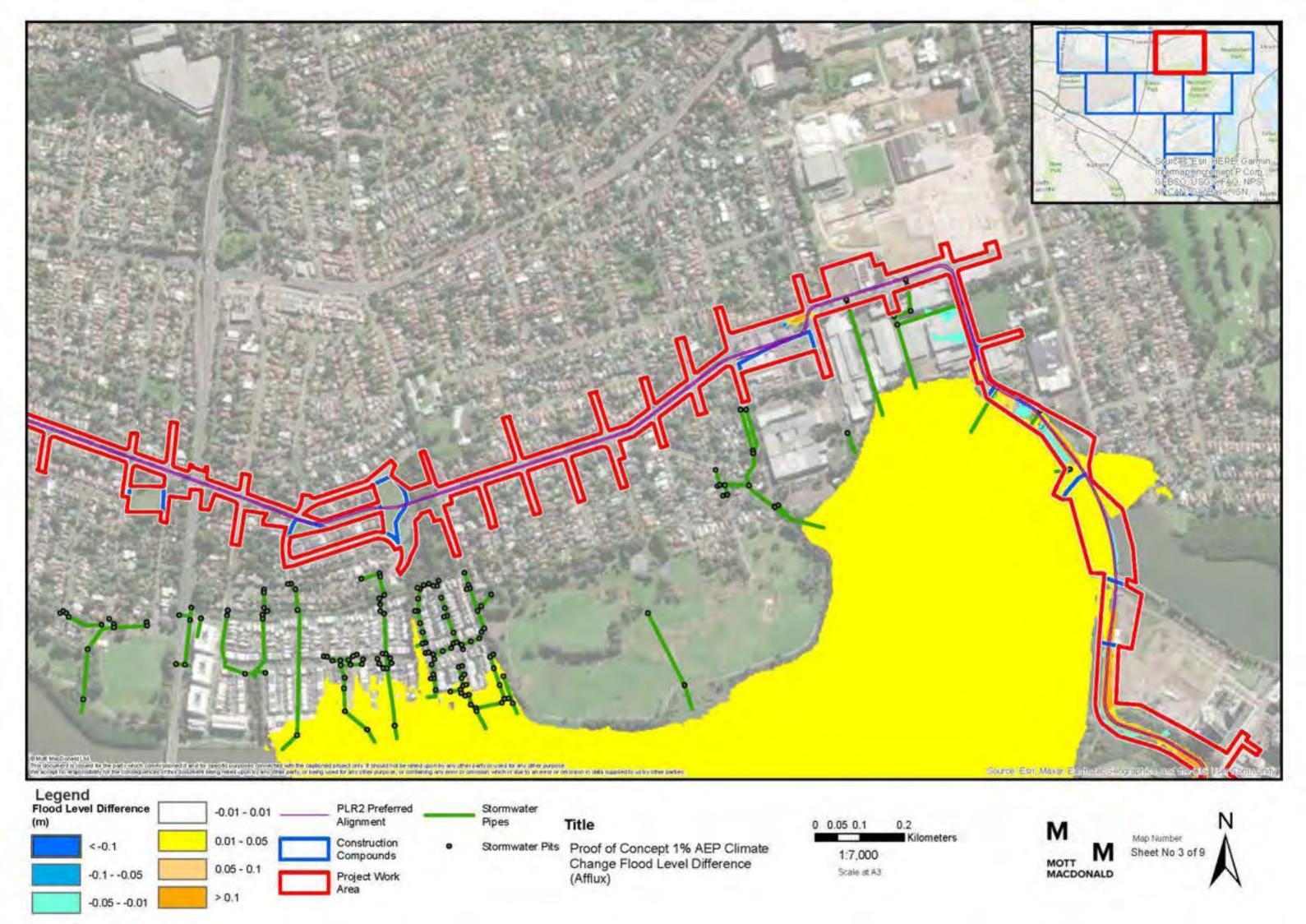


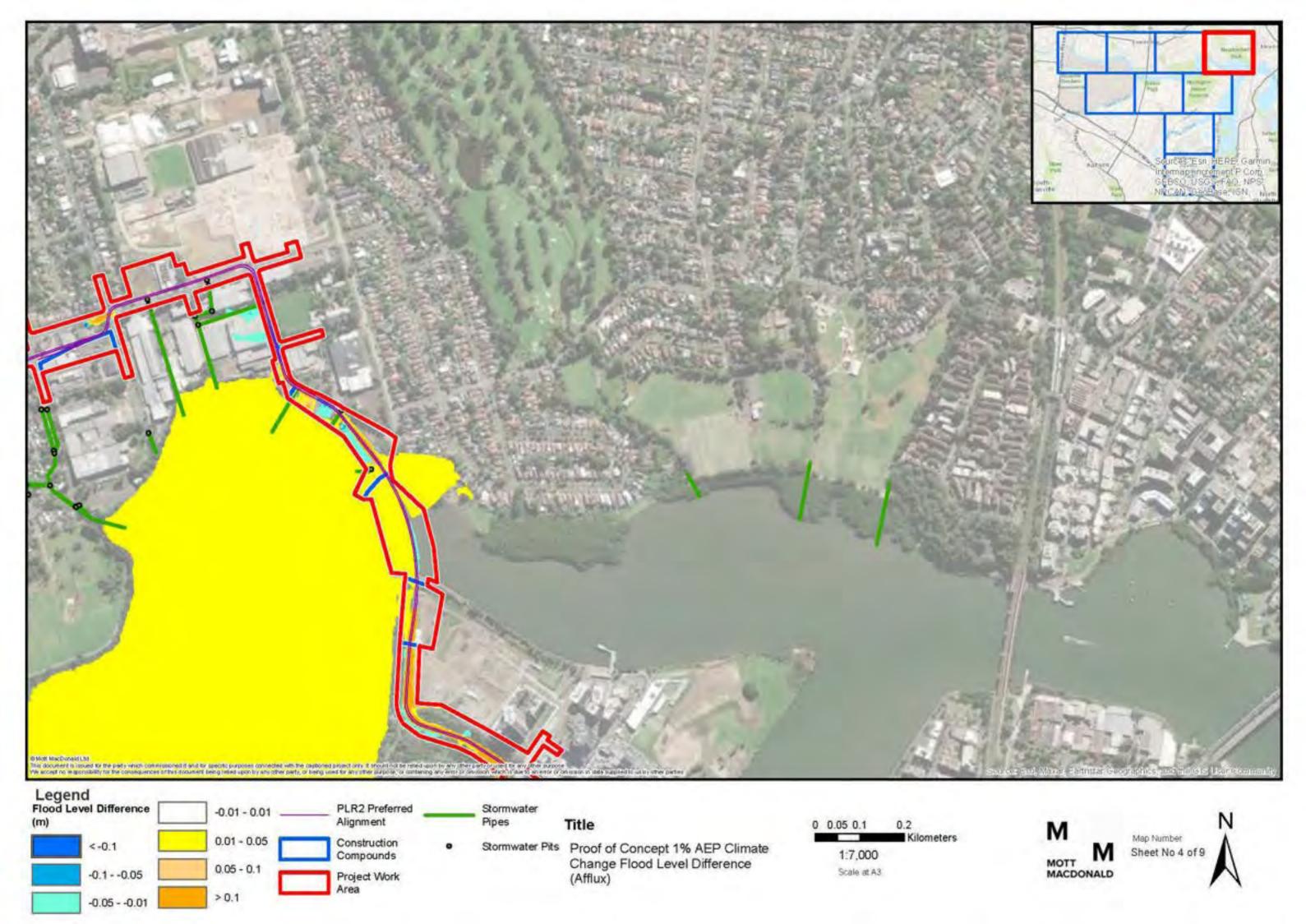


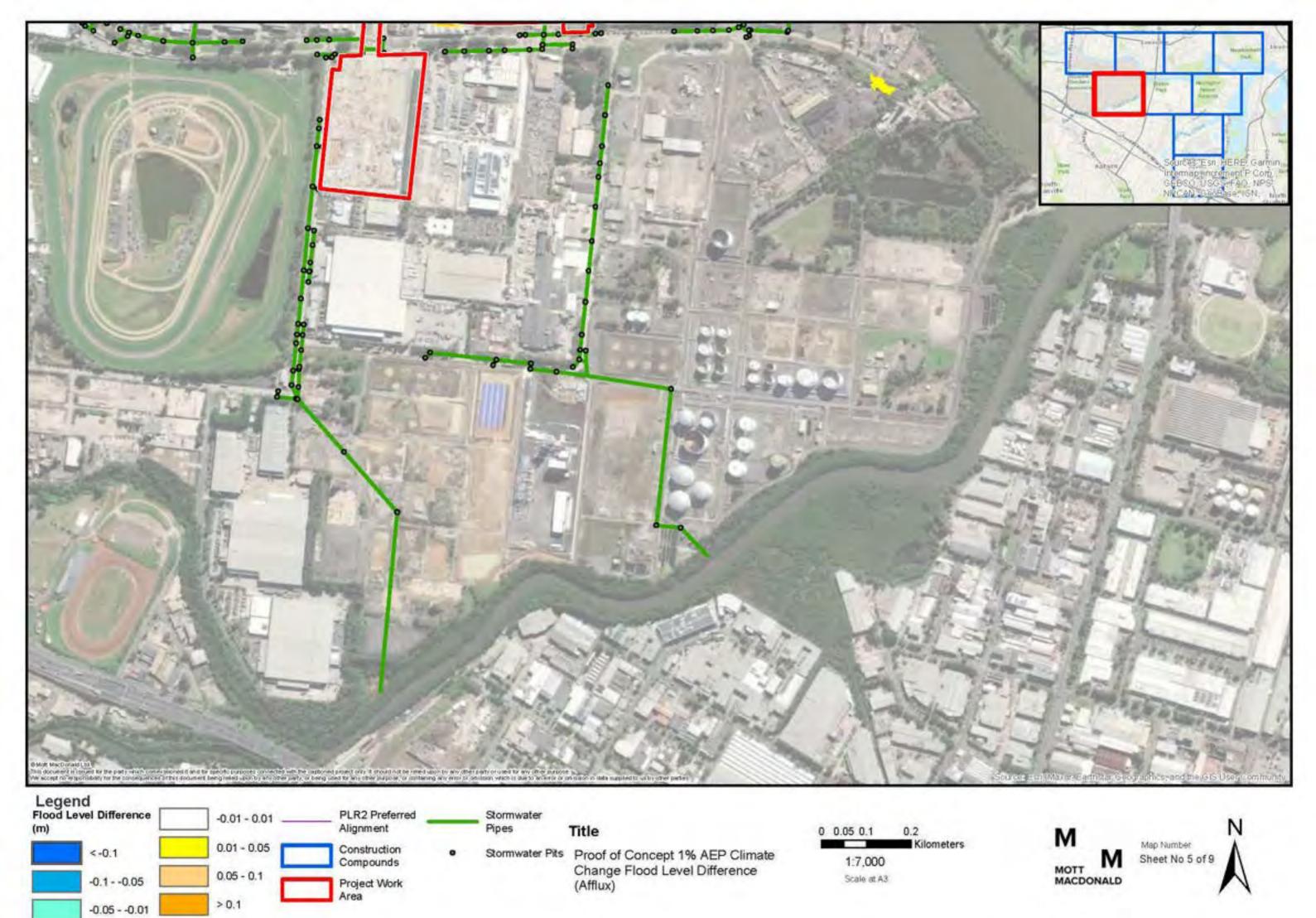


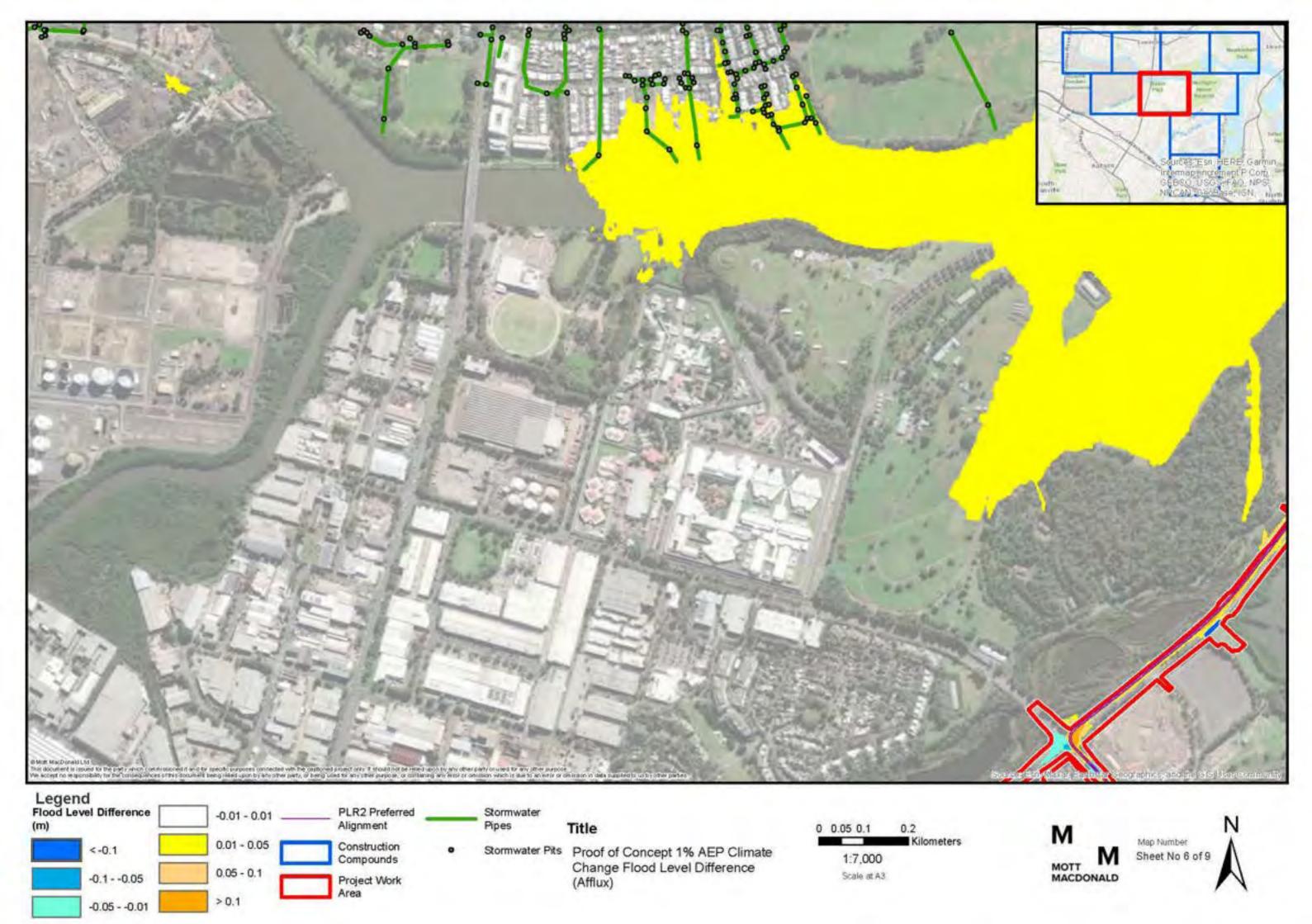


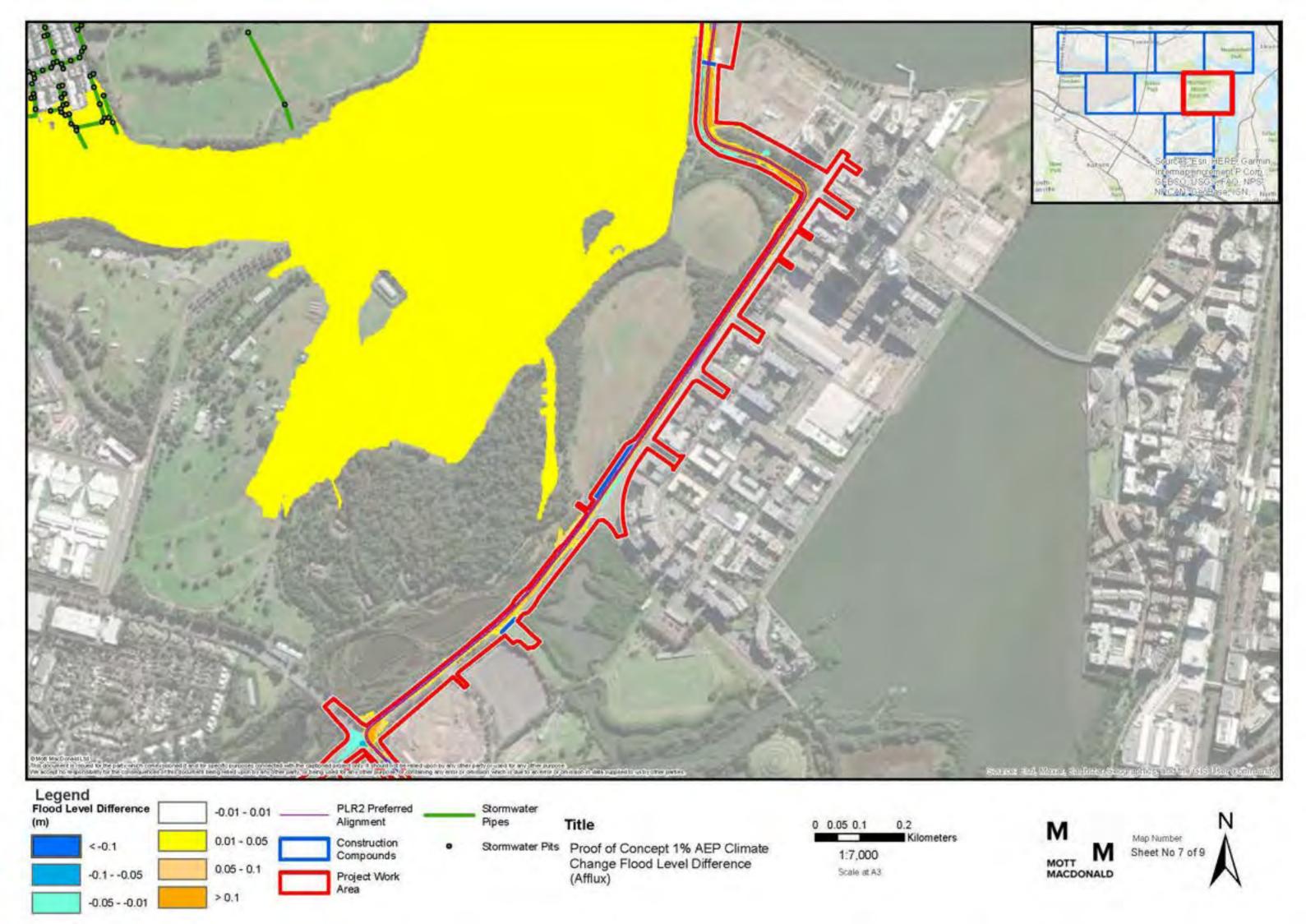


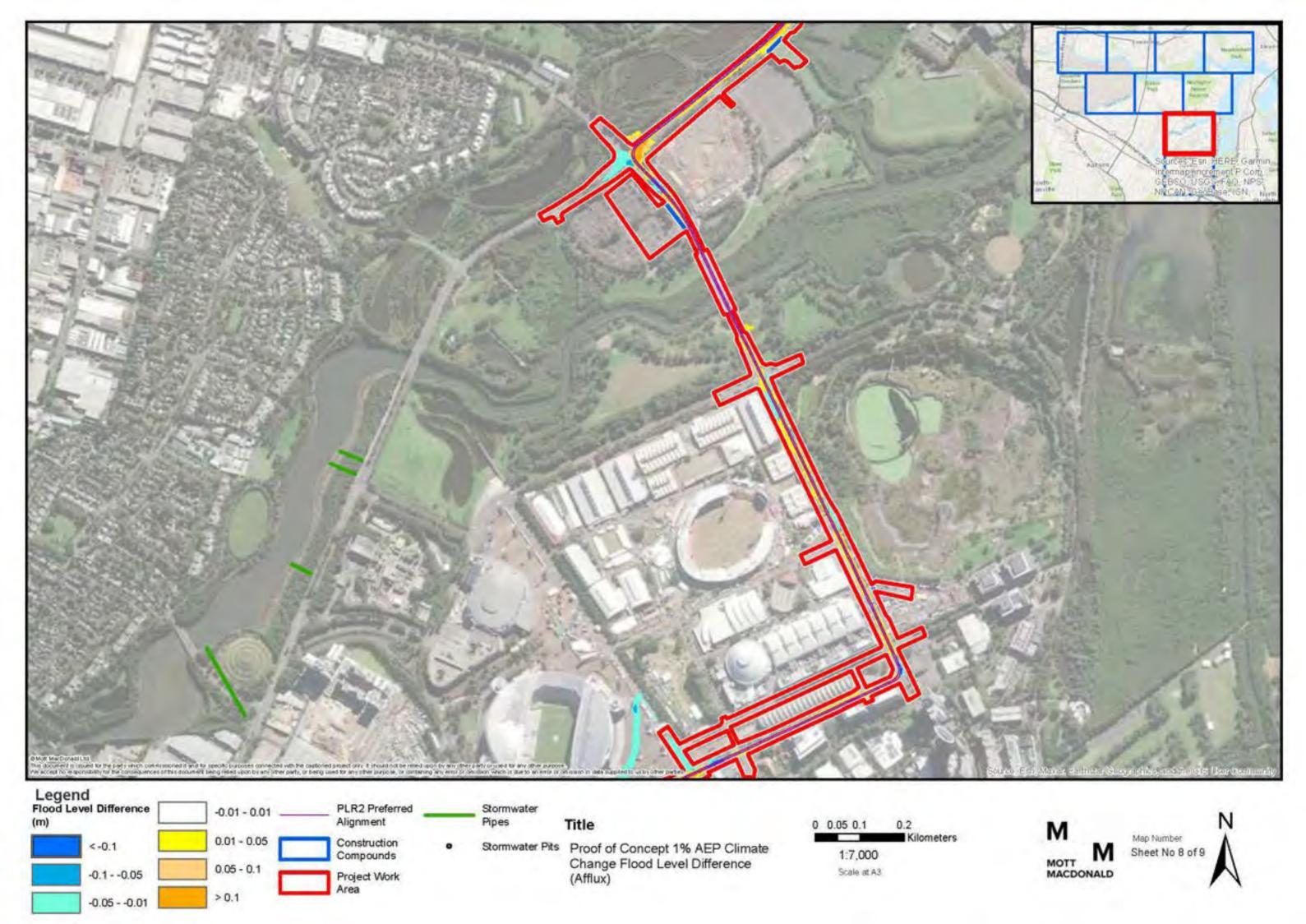


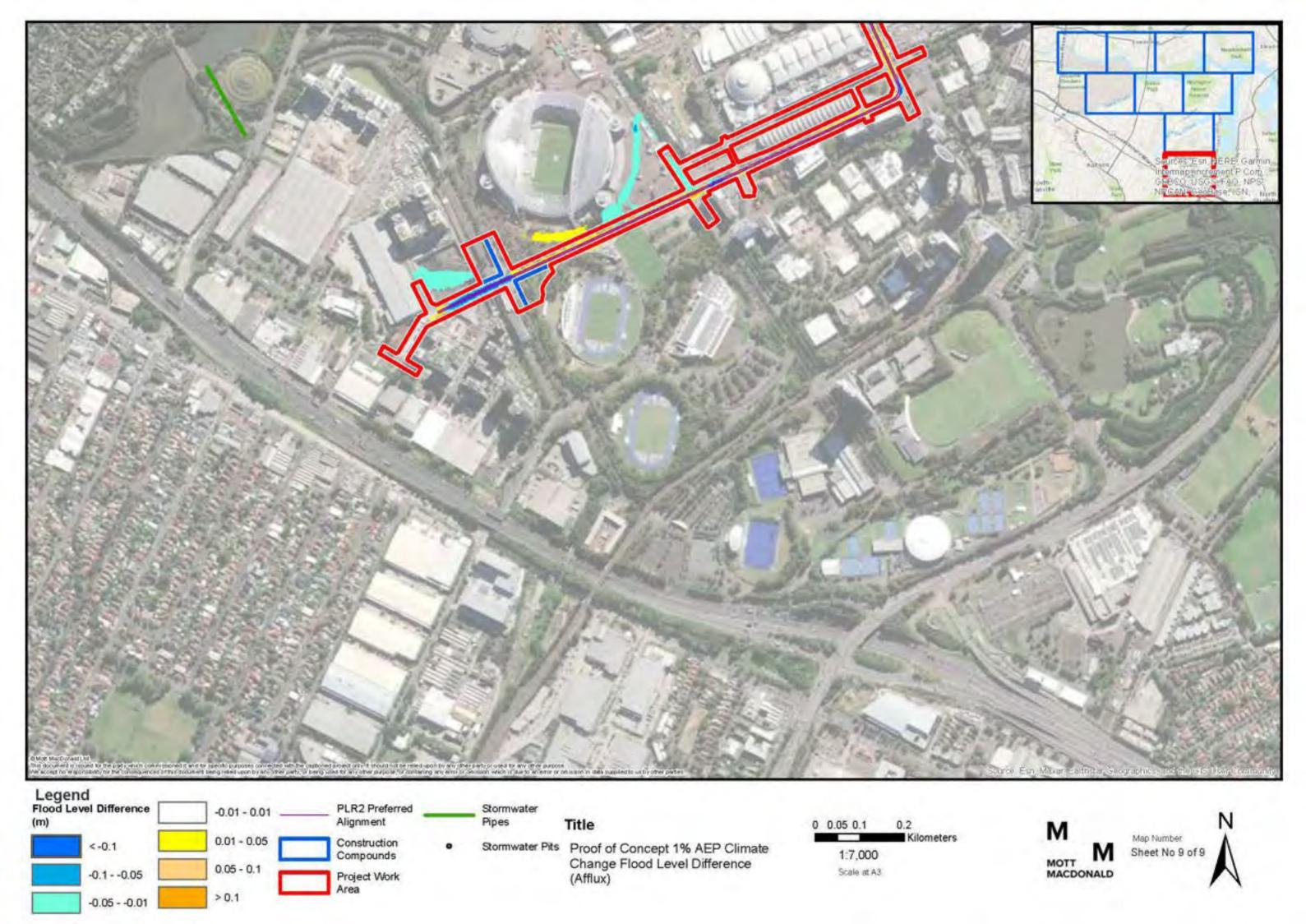


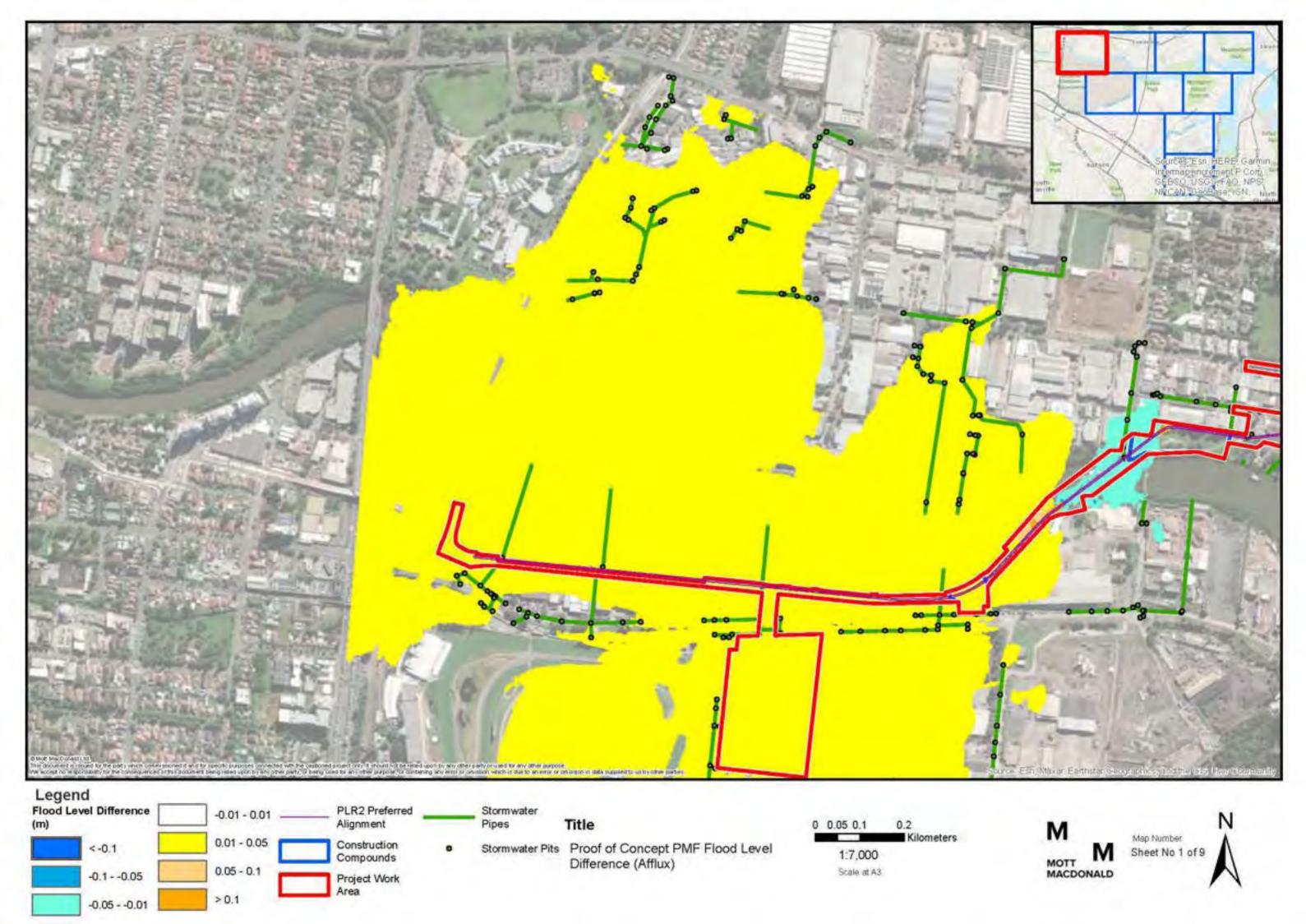


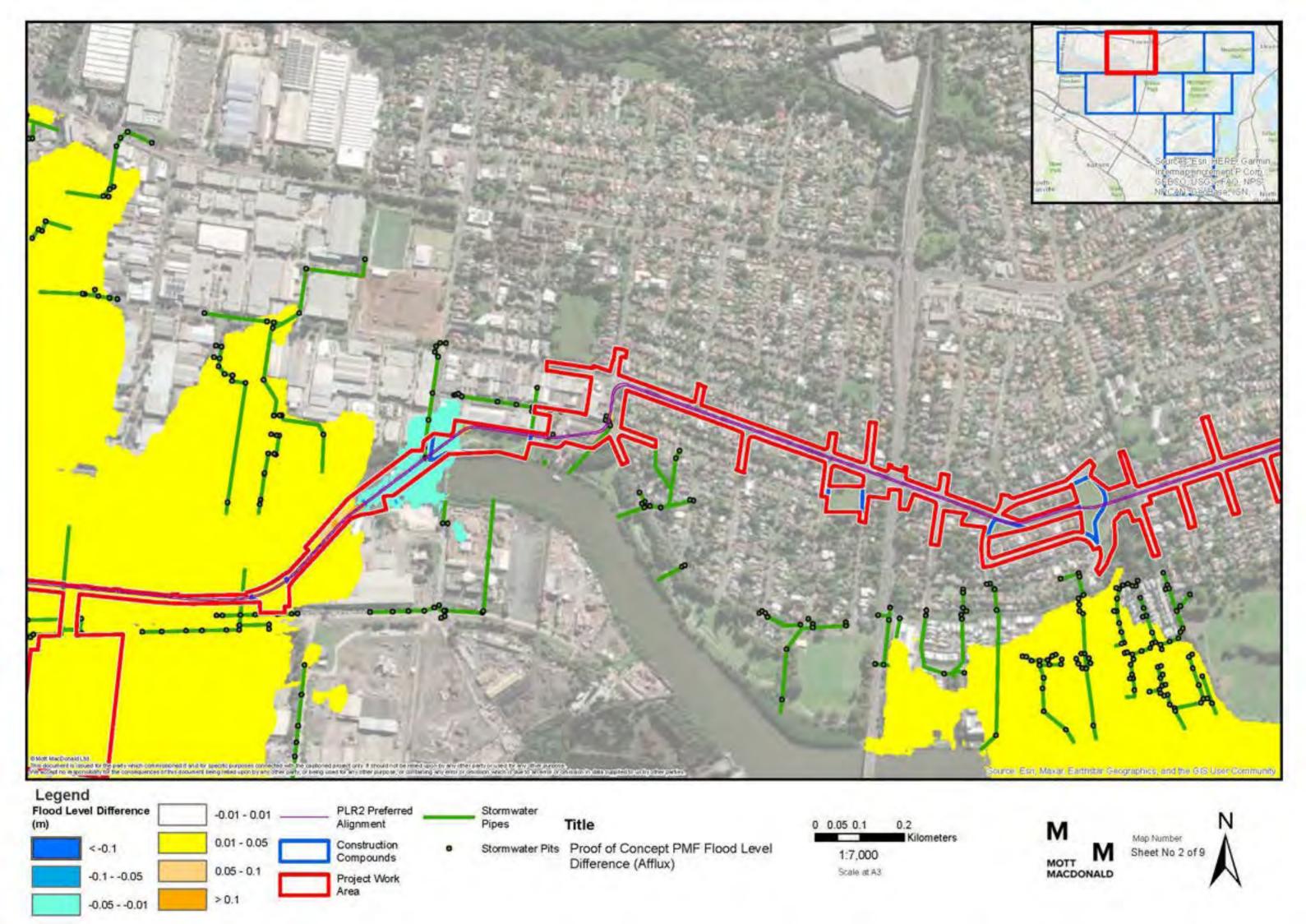


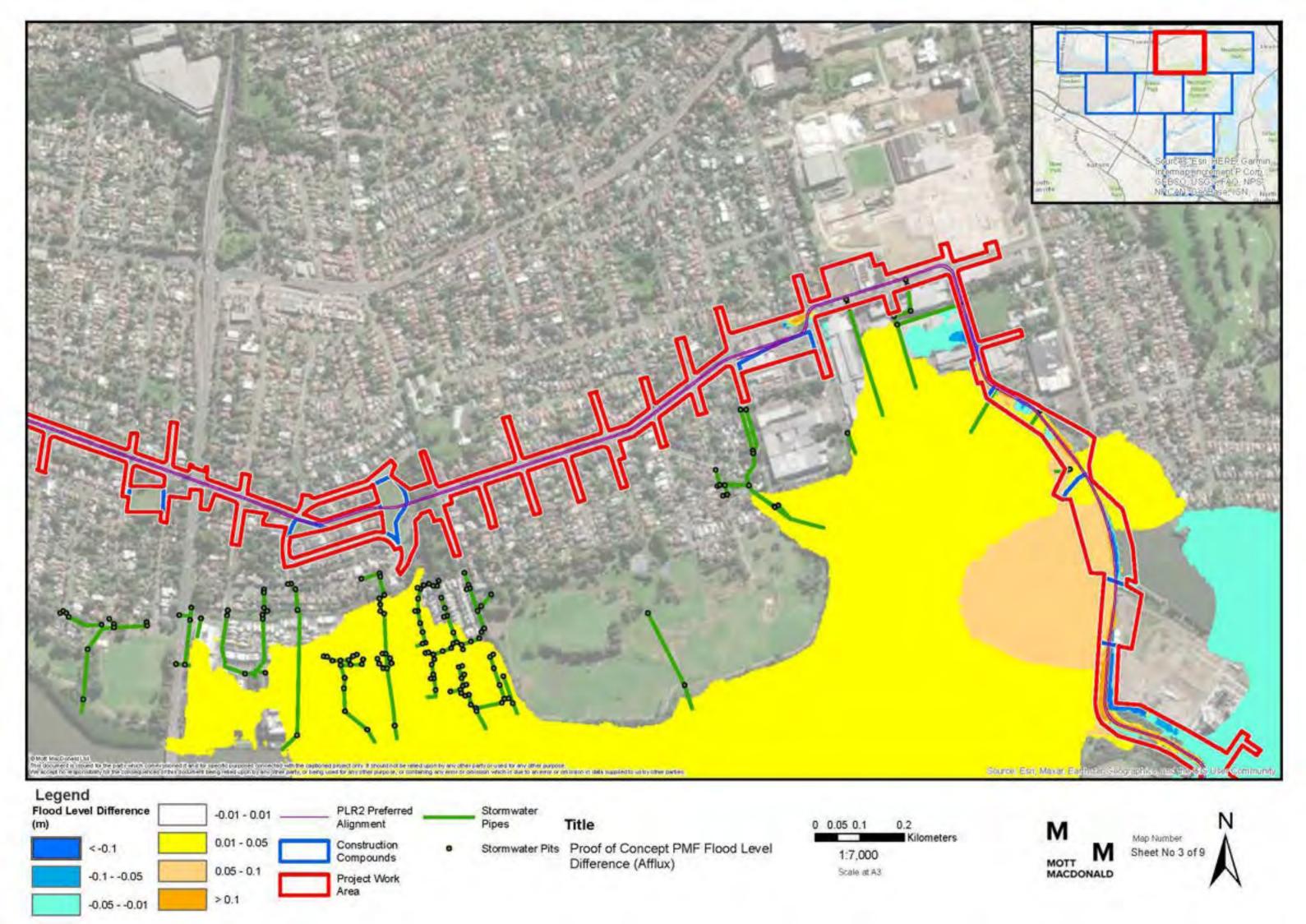


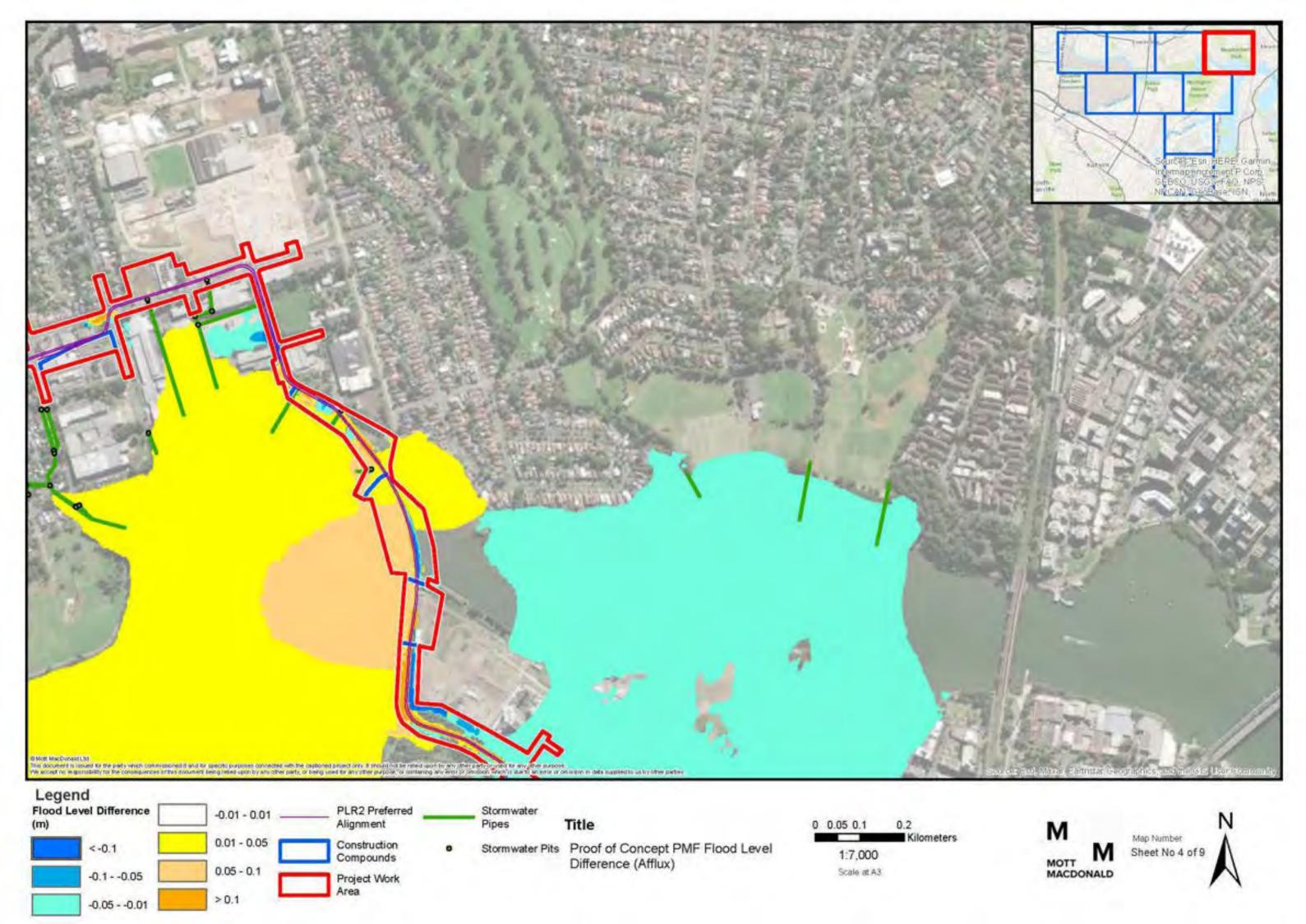


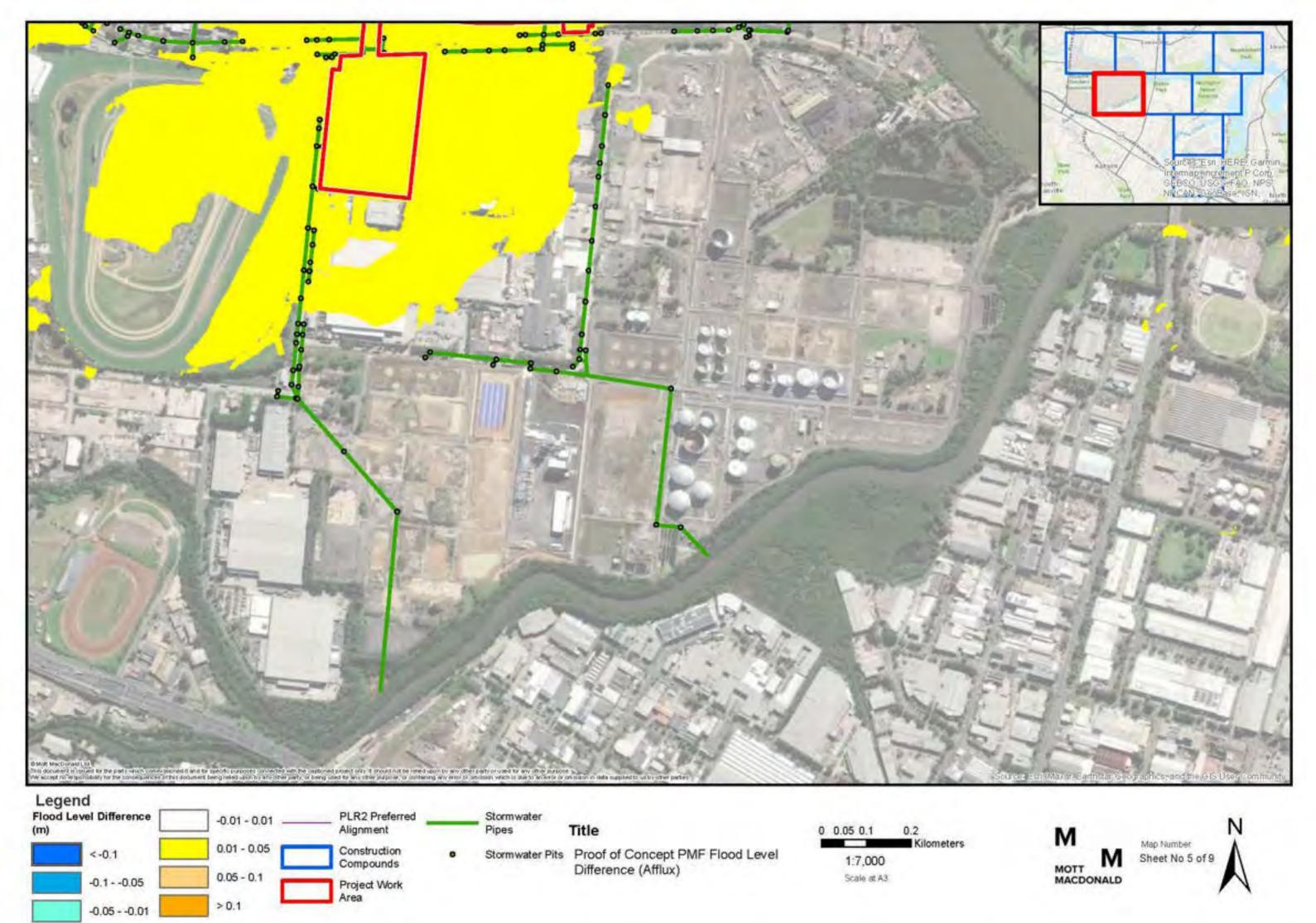


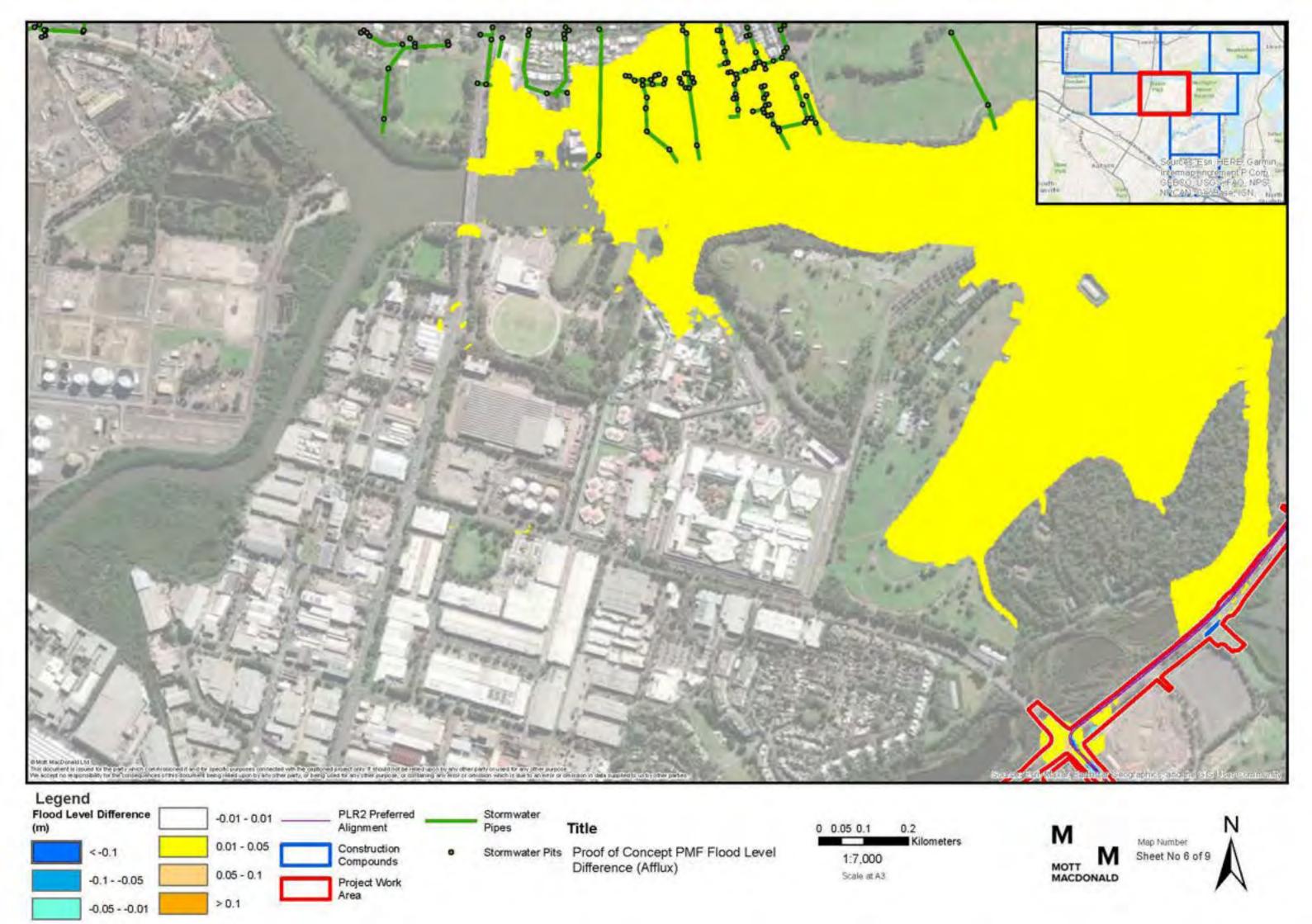


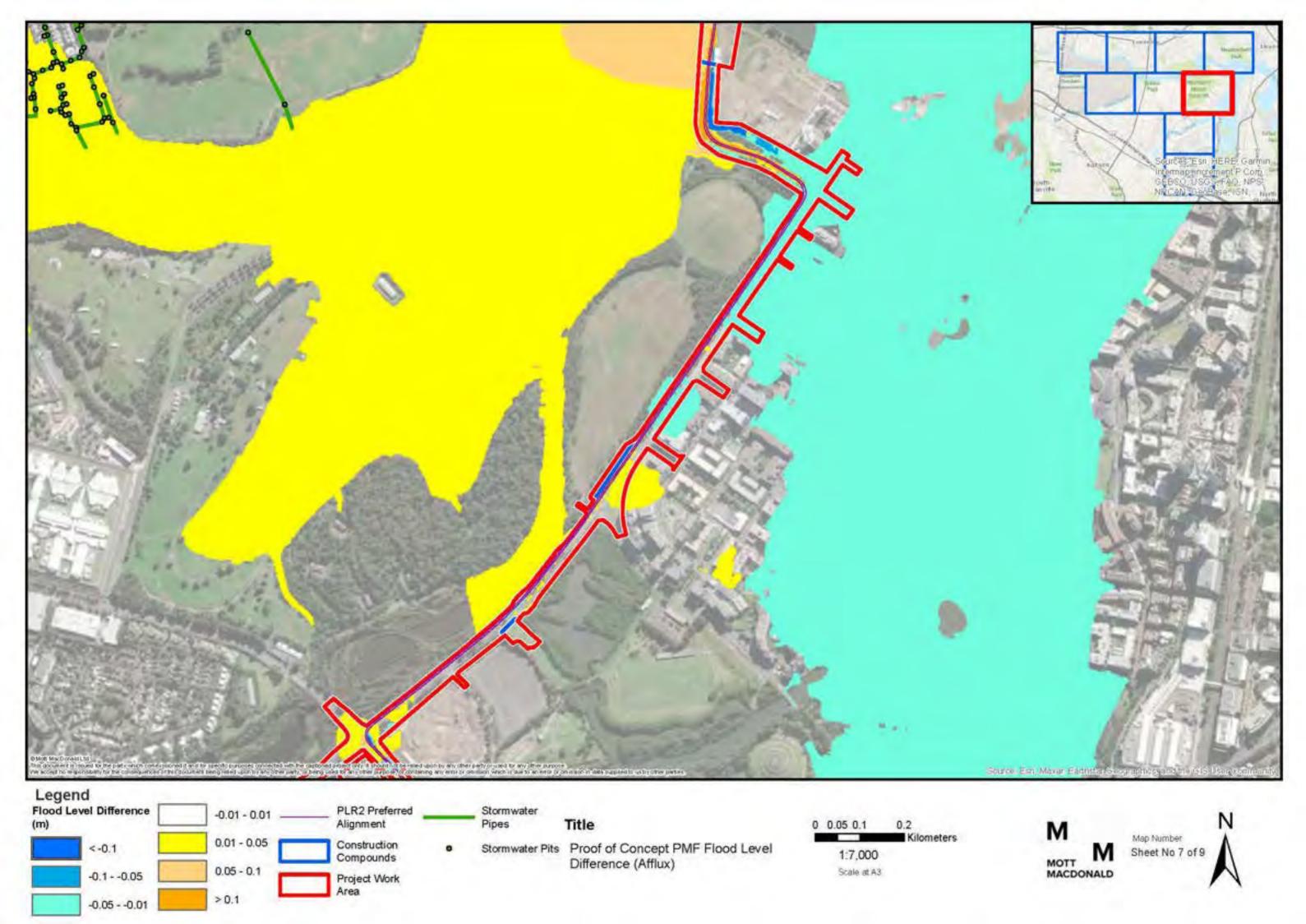


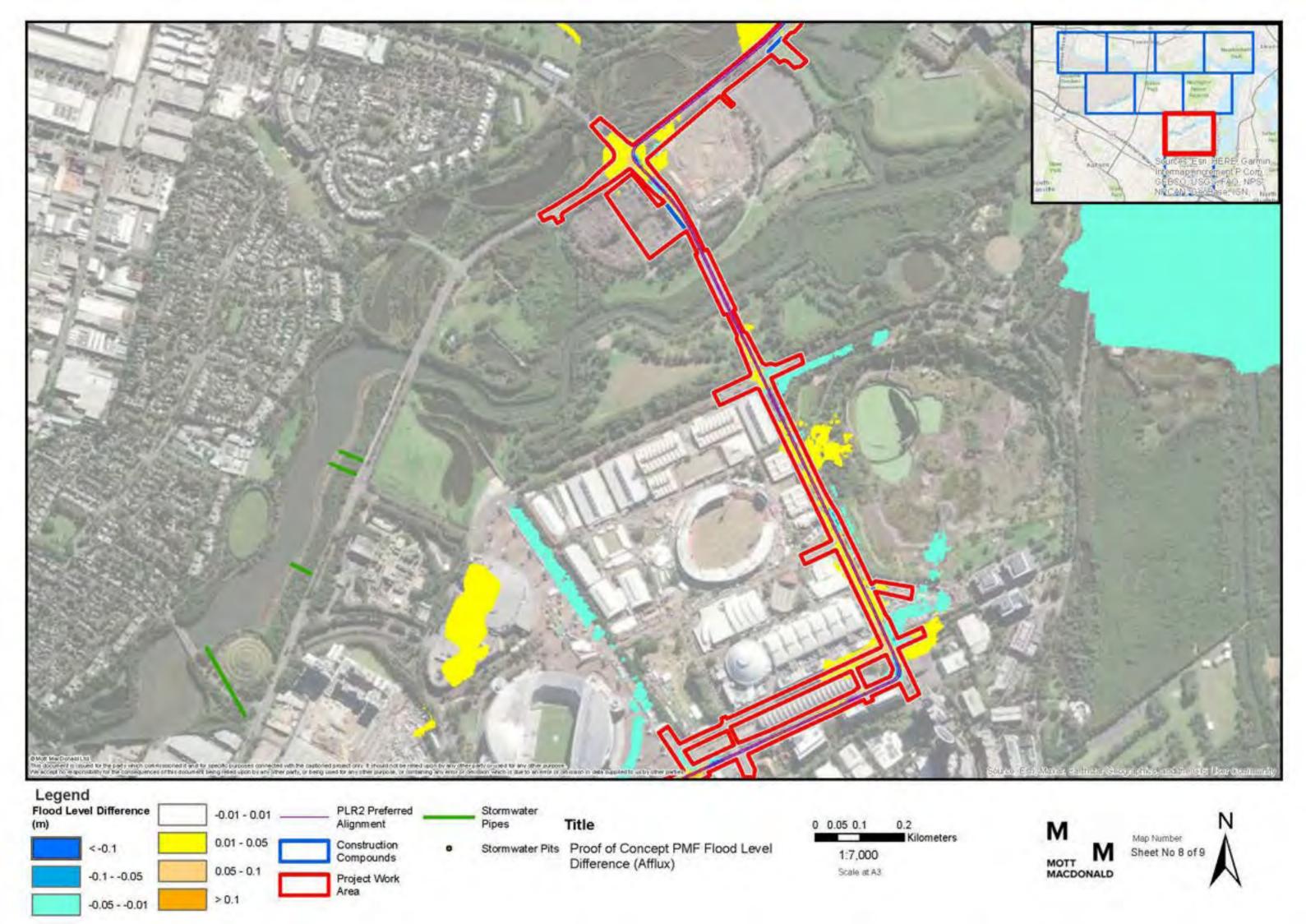


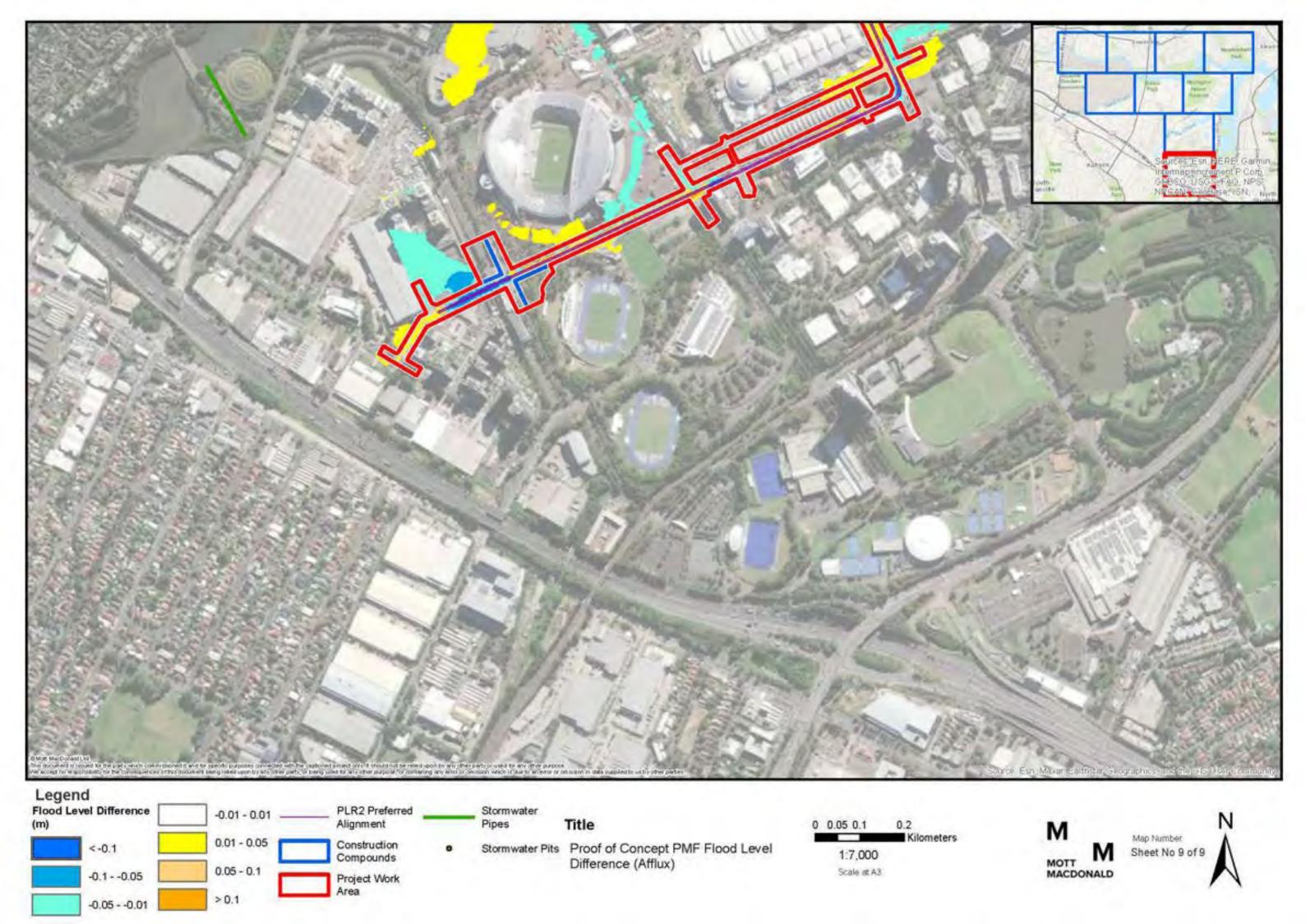












Appendix C Additional Modelling Configuration

Available data

The following datasets were supplied for this assessment:

- Re-aligned project wide rail alignment (CAD)
- Re-aligned Camellia Bridge plan (CAD)
- Re-aligned Camellia Bridge cross section (CAD)
- Re-aligned Camellia Bridge profile (CAD)
- Proposed navigation channel alignment (CAD)

TUFLOW flood modelling

Realignment of the bridge between Camellia and Rydalmere

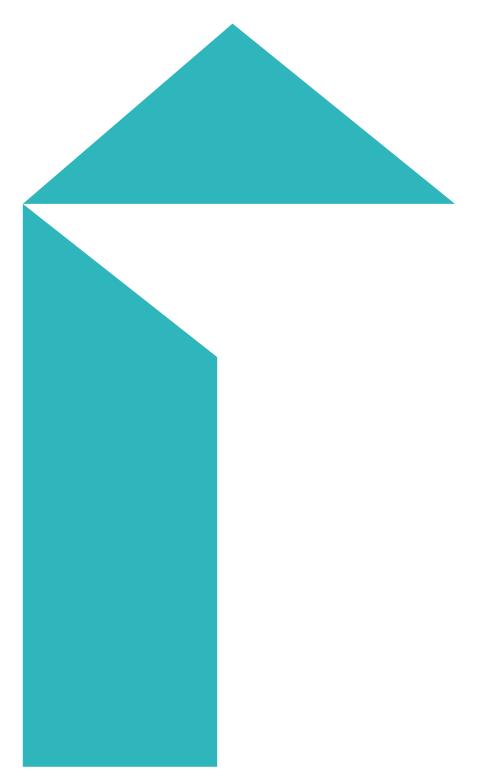
The proposed re-alignment of the bridge between Camellia and Rydalmere and bridge geometry was incorporated into the Parramatta River flood model developed for the EIS by including the supplied data in the following datasets:

- The PLR2 alignment was updated on either side of the approaches to Camellia bridge using a TUFLOW z-shape. The z-shape parameters are consistent with the approach used for the PLR2 EIS.
- The re-alignment of the bridge was incorporated into a 2D layered flow constriction element that can be used to model varying blockage and headloss values. Blockage and form loss factors were calculated following TUFLOW guidelines and are consistent with the approach used for the EIS flood modelling. Obverts and inverts of the bridge spans were calculated using the supplied plans. The following assumptions were made:
 - The vertical geometry of the bridge was split into three sections or layers
 - L1 = ground level to top of pile caps
 - L2 = top of pile cap to underside of bridge deck
 - L3 = bridge deck
 - A percentage blockage and opening ratio were calculated for each layer with the following assumptions
 - Pile cap width = 6m
 - Pier width = 2m
 - Deck thickness = 3.1m
 - Opening ratios used to calculate Form Loss Coefficient based on industry publications¹²

The final arrangement of the bridge between Camellia and Rydalmere in the flood model is shown in Figure 4-1

¹ Hydraulics of Bridge and Waterways (Bradley 1978)

² Modelling Bridge Piers and Afflux in TUFLOW (TUFLOW 2013)



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