Appendix B6: Flood Management Sub-Plan

NEWCASTLE INNER CITY BYPASS – RANKIN PARK TO JESMOND (STAGE 4 – MAIN WORKS)

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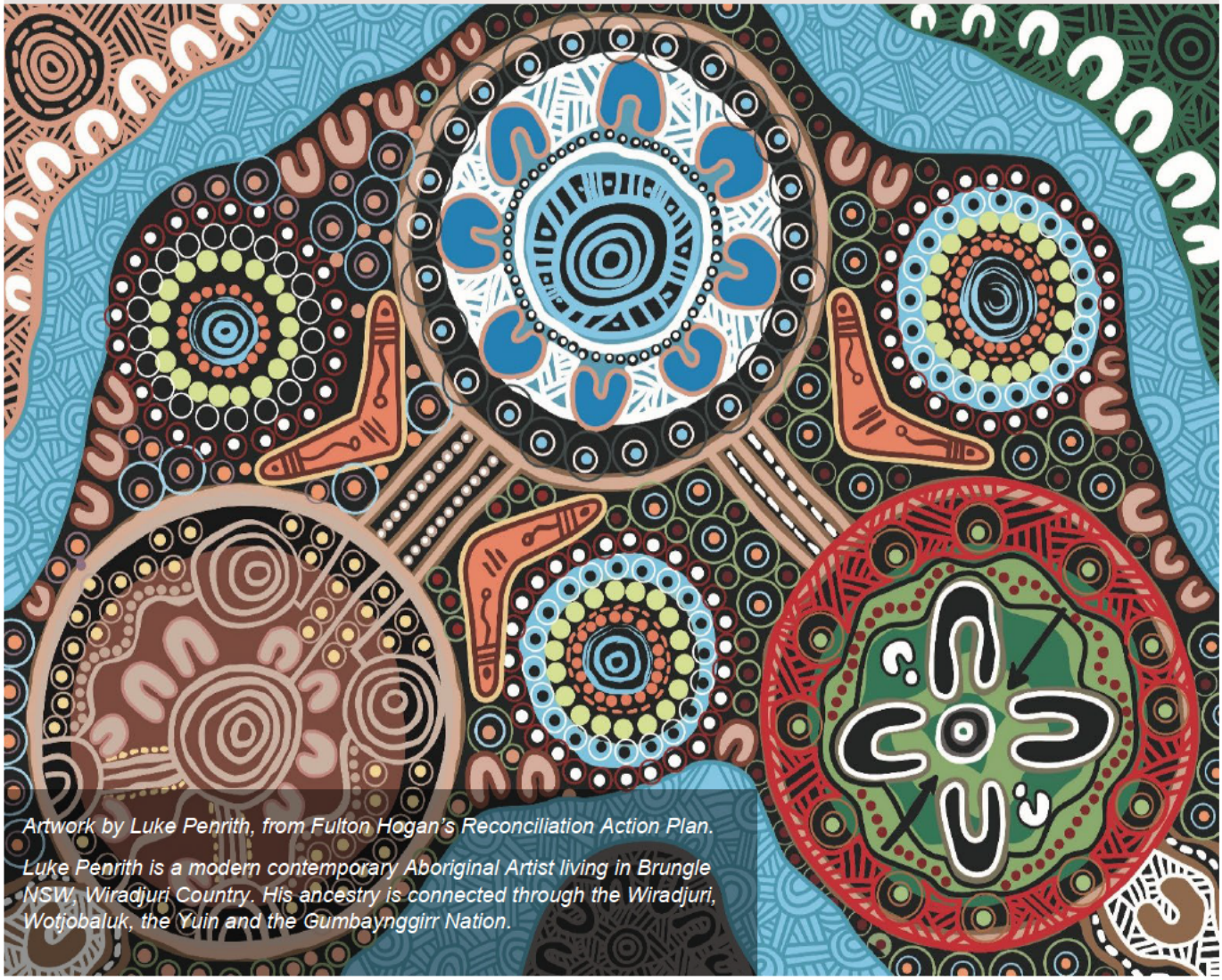
ACKNOWLEDGMENT OF COUNTRY

Fulton Hogan acknowledges the Awabakal People as the Traditional Owners of the land we are working on, and pay our respect to their Elders past, present and emerging.

We recognise their deep connection to Country and value the contribution to caring for, and managing the land and water.

We are committed to pursuing genuine and lasting partnerships with Traditional Owners to understand their culture and connections to Country in the way we plan for and carry out the delivery of the Works.



Artwork by Luke Penrith, from Fulton Hogan's Reconciliation Action Plan.

Luke Penrith is a modern contemporary Aboriginal Artist living in Brungle NSW, Wiradjuri Country. His ancestry is connected through the Wiradjuri, Wotjobaluk, the Yuin and the Gumbaynggirr Nation.

Document control

This is an e-copy of the Plan and it interfaces with the other associated plans, which together describe the proposed overall project management system for the project.

The latest revision of this plan is available on the Fulton Hogan server. If any unsigned hard copies of this document are printed, they are valid only on the day of printing.

The revision number is included at the bottom of each page. When revisions occur, the entire document will be issued with the revision number updated accordingly for each owner of a controlled copy.

Attachments/Appendices to this plan are revised independently of this plan.

Revision history

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Glossary/ Abbreviations

Term/ abbreviation	Definition
AHD	Australian Height Datum
ARI	Average Recurrence Interval
BoM	Bureau of Meteorology
CCS	Community Communication Strategy
CEMP	Construction Environmental Management Plan
CoA	Condition of Approval
Construction	Has the same meaning as the definition of the term in the Project Approval
Construction Boundary	Has the same meaning as the definition of the term in the Project Approval: The area physically affected by works described in documents listed in Condition A1.
D&C	Design and Construct
Department/ DPHI	NSW Department of Planning, Housing, and Infrastructure (formerly known as Department of Planning and Environment (DPE))
EIS	Environmental Impact Statement
EMS	Environmental Management System
EPA	NSW Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPL	Environment Protection Licence
ER	Environmental Representative for the SSI
ESCP	Primary Erosion and Sediment Control Plan
EWMS	Environmental Work Method Statement
Flood Warning	Has the same meaning as the definition of the term on the SES website: A Flood Warning is issued by the BoM when flooding is expected to occur or is happening. Flood Warnings provide a predicted flood level and time at which a river will reach that level. Flood Warnings are issued in relation to flood gauges which are situated at a certain point on a river. Flood Warnings may contain observed, peak or predicted river heights.
FMP	Flood Management Sub-Plan
HP	Hold Point: a point in the construction or verification process beyond which work may not proceed without receiving authorisation from the appropriate party.
Material harm	Has the same meaning as the definition of the term in the Project Approval: Is harm that: (a) involves actual or potential harm to the health or safety of human beings or to the environment that is not trivial, or (b) results in actual or potential loss or property damage of an amount, or amounts in aggregate, exceeding $10,000, (such loss includes the reasonable costs and expenses that would be incurred in taking all reasonable and practicable measures to prevent, mitigate or make good harm to the environment)
Minister, the	NSW Minister for Planning
NA	Not applicable

Term/ abbreviation	Definition
Non-compliance	Has the same meaning as the definition of the term in the Project Approval: An occurrence, set of circumstances or development that is a breach of the Project Approval. This includes a failure to comply with the processes included within this CEMP.
Non-conformance	Failure to conform to the requirements of project or Fulton Hogan system documentation.
NPI	National Pollutant Inventory
OEMP	Operational Environmental Management Plan
OEMS	Operational Environmental Management System
Planning Secretary, the	Planning Secretary of the DPHI (or nominee, whether nominated before or after the date on which the Project Approval was granted.
PMF	Probable Maximum Flood
POEO Act	*Protection of the Environment Operations Act 1997* (NSW)
Project, the	Newcastle Inner City Bypass Rankin Park to Jesmond
Project Approval, the	The Minister's approval for the SSI.
Relevant Council(s)	Has the same meaning as the definition of the term in the Project Approval: Lake Macquarie City Council and City of Newcastle, as relevant.
REMM	Revised Environmental Management Measure
RMS	Roads and Maritime Services (now TfNSW)
SSI	State Significant Infrastructure, as generally described in Schedule 1 of the Project Approval, the carrying out of which is approved under the terms of the Project Approval.
SWMP	Soil and Water Management Sub-Plan
SWTC	TfNSW Scope of Works and Technical Criteria
TfNSW	Transport for NSW (previously RMS)
UDLP	Urban Design and Landscape Plan
WC2	Watercourse 2: An un-named tributary of Dark Creek
Work(s)	Has the same meaning as the definition of the term in the Project Approval: All physical activities to construct or facilitate the construction of the SSI, including environmental management measures and utility works. however, does not include work that informs or enables the detailed design of the SSI and generates noise that is no more than 5 dB(A) above the rating background level (RBL) at any residence

1. Introduction

1.1. Purpose

This Flood Management Sub-Plan (FMP) describes how Fulton Hogan will manage construction of the Newcastle Inner City Bypass Rankin Park to Jesmond (RP2J) Project (the project) to ensure impacts on flooding are minimised and significant adverse impacts to the environment and property are avoided. Flooding impacts to people will be addressed separately as part of the Fulton Hogan Work Health and Safety Management Plan.

This FMP has been prepared to detail how Fulton Hogan will comply with the project approval, and implement and achieve relevant performance outcomes, commitments and mitigation measures specified in the EIS as amended by the SPIR and subsequent Modification 1 Submissions Report (also known as 'Revised Environmental Management Measures' (REMMs)) during construction of the project. Additionally, this FMP has been prepared to address the requirements of the Scope of Works and Technical Criteria (SWTC) Appendix 4 Additional Environmental Requirements, TfNSW Specification D&C G36 Environmental Protection (G36) and TfNSW Specification D&C G38 Soil and Water Management (G38).

For the avoidance of doubt, the CEMP (including this FMP) relates to the construction phase only. Detailed design environmental requirements will be addressed as part of the detailed design phase, separate to the CEMP approvals process. Detailed design is generally completed about six months after CEMP approval. In addition, operational environmental requirements will be met during the operational phase (upon the completion of construction) and addressed in the Operational Environmental Management Plan (OEMP) or Environmental Management System (EMS) as agreed with the Planning Secretary in accordance with CoA D3.

1.2. Background

Chapter 12 of the EIS assessed the extent and magnitude of potential impacts of construction and operation of the project on flooding and drainage. As part of this, a detailed flooding and drainage impact assessment was undertaken and included in the EIS as:

- EIS Volume 8 – Technical Paper 6 – Flooding and Drainage Assessment, prepared by Aurecon for RMS, dated November 2016.

1.3. Structure of FMP

This FMP is part of Fulton Hogan's environmental management framework for the project and is supported by other documents, such as Environmental Work Method Statements. The review and document control processes for this FMP are described in Chapters 11 and 12 respectively of the CEMP.

1.4. Consultation for preparation of the FMP

In accordance with CoA C4(g), consultation with the City of Newcastle has been undertaken during the preparation of this FMP. On 18/10/22, City of Newcastle advised they had no comments/concerns/changes in relation to the FMP. Copies of all consultation correspondence is included at Appendix A5 of the CEMP.

Ongoing consultation will be undertaken during detailed design and construction of the project as required by the project approval. This will be subject to a separate consultation process to that required for preparation of this FMP and undertaken in accordance with the Community Communication Strategy (CCS) approved by the Planning Secretary under CoA B3.

2. Objectives, targets and environmental performance outcomes

2.1. Objectives

The key objective of the FMP is to ensure that impacts to flooding are minimised and within the scope permitted by the project approval. To achieve this objective, Fulton Hogan will undertake the following:

- Ensure appropriate controls and procedures are implemented during construction activities to avoid or minimise potential adverse impacts to flooding along the Project corridor.
- Ensure appropriate measures are implemented to address the relevant CoA and REMMs outlined in Table 2 and Table 3 respectively.
- Ensure appropriate measures are implemented to comply with all relevant legislation and other requirements as described in Chapter 3 of this FMP.

2.2. Targets

The following targets have been established for the management of flooding impacts during the project:

- Ensure full compliance with the relevant legislative requirements, CoA and REMMs outlined in Table 2 and Table 3 respectively.
- Avoid any significant adverse impacts to the environment and property.

2.3. Environmental performance outcomes

The construction-related environmental performance outcomes relevant to this FMP are listed in Table 1. A cross reference is also included to indicate where the environmental performance outcome is addressed in this FMP in terms of how it will be implemented and achieved.

Table 1: Environmental performance outcomes relevant to flooding management

Key issue	Environmental performance outcome	How implemented and achieved
Flooding	Construction is undertaken in a manner that minimises flood risk.	Chapter 6 mitigation measures
	The project avoids impacts to surface water through flood preparedness.	Chapter 6 mitigation measures ID FMM1.

3. Legal and other requirements

3.1. Legislation

Legislation relevant to flooding management includes:

- *Environmental Planning and Assessment Act 1979* (EP&A Act)
- *Protection of the Environment Operations Act 1997* (POEO Act)
- *Water Management Act 2000* (WM Act).

Relevant provisions of the above legislation are explained in the Register of legal and other requirements included in Appendix A1 of the CEMP.

3.2. Guidelines and standards

The main guidelines, standards and policy documents relevant to this FMP include:

- Floodplain Risk Management Guideline (OEH 2007)
- Australian Rainfall and Runoff (Institution of Engineers, Australia)
- Managing Urban Stormwater: Soils and Construction. Landcom, (4th Edition) March 2004 (reprinted 2006) (the "Blue Book"). Volume 1 and Volume 2
- Managing Urban Stormwater: Soils and Construction Volume 2D Main Roads Construction (DECC 2008)
- Roads and Maritime Erosion and Sedimentation Management Procedure (Roads and Traffic Authority 2009)
- Roads and Maritime Technical Guideline, Temporary Stormwater Drainage for Road Construction (Roads and Maritime Services 2011b)

- Roads and Maritime Stockpile Site Management Guideline (Roads and Maritime Services 2015).
- Floodplain Development Manual (DIPNR, 2005)
- WorkCover's Storage and Handling of Dangerous Goods Code of Practice (WorkCover, 2005)
- Newcastle City-wide Floodplain Risk Management Study and Plan (BMT WBM, 2012).

3.3. Conditions of approval

The CoA relevant to this FMP are listed in Table 2 below. A cross reference is also included to indicate where the condition is addressed in this FMP or other project management documents.

Table 2: Conditions of approval relevant to FMP

<table>
<tr><th>CoA No.</th><th>Condition requirements</th><th>Document reference</th></tr>
<tr><td colspan="3">PART C - CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN</td></tr>
<tr><td colspan="3">CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN</td></tr>
<tr><td>C4</td><td>The following CEMP Sub-plans must be prepared in consultation with the relevant public authorities identified for each CEMP Sub-plan:
Table 3: CEMP Sub-plan and relevant public authorities
<table>
<tr><th></th><th>Required CEMP Sub-plan</th><th>Relevant public authorities to be consulted for each CEMP Sub-plan</th></tr>
<tr><td>(a)</td><td>Traffic and transport</td><td>Relevant council and Health Administration Corporation</td></tr>
<tr><td>(b)</td><td>Noise and vibration</td><td>Relevant council and Health Administration Corporation</td></tr>
<tr><td>(c)</td><td>Flora and Fauna</td><td>DPI Fisheries and Relevant council</td></tr>
<tr><td>(d)</td><td>Air quality</td><td>Relevant council and Health Administration Corporation</td></tr>
<tr><td>(e)</td><td>Soil and water</td><td>Relevant council, DPI Fisheries and DPE Water,</td></tr>
<tr><td>(f)</td><td>Aboriginal cultural heritage</td><td>Heritage NSW and Registered Aboriginal Parties</td></tr>
<tr><td>(g)</td><td>Flood management</td><td>Relevant council</td></tr>
</table></td><td>Section 1.4</td></tr>
<tr><td>C5

(a)</td><td>The CEMP Sub-plans must state how:

the environmental performance outcomes identified in the documents listed in Condition A1 and terms of this approval will be achieved;</td><td>Section 2.3</td></tr>
<tr><td>(b)</td><td>the mitigation measures identified in the documents listed in Condition A1 and terms of this approval will be implemented;</td><td>Through the implementation of this FMP (in particular refer to Section 3.4).</td></tr>
<tr><td>(c)</td><td>the relevant terms of this approval will be complied with; and</td><td>Through the implementation of this FMP</td></tr>
<tr><td>(d)</td><td>issues requiring management during construction, as identified through ongoing environmental risk analysis, will be managed.</td><td>Chapter 5, second paragraph

Chapter 6</td></tr>
<tr><td>C6</td><td>The CEMP Sub-plans must be developed in consultation with the relevant public authorities specified in Table 3. Details of all information requested by an authority to be included in a CEMP Sub-plan as a result of consultation, including copies of all correspondence from those authorities, must be provided with the relevant CEMP Sub-Plan.</td><td>Section 1.4</td></tr>
</table>

CoA No.	Condition requirements	Document reference
C7	Any of the **CEMP Sub-plans** may be submitted along with, or subsequent to, the submission of the **CEMP** but in any event, no later than one (1) month before construction for approval by the Planning Secretary.	CEMP (main section) Section 1.4
C8	Construction must not commence until the **CEMP** and all **CEMP Sub-plans** have been approved by the Planning Secretary, or as otherwise agreed by the Planning Secretary. The **CEMP** and **CEMP Sub-plans**, as approved by the Planning Secretary, including any minor amendments approved by the **ER** must be implemented for the duration of construction. Where construction of the SSI is staged, construction of a stage must not commence until the **CEMP** and **sub-plans** for that stage have been approved by the Planning Secretary.	CEMP (main section) Section 1.4
PART E – FLOODING		
E12	Measures to manage pre-existing flood characteristics must be incorporated into the detailed design of the SSI, following consultation with directly affected landowners, NSW State Emergency Service (SES) and City of Newcastle	Detailed Design
E13	Flood information including flood reports, models and geographic information system outputs, and works as executed information from a registered surveyor certifying finished ground levels and the dimensions and finished levels of all structures within the flood prone land, must be provided to City of Newcastle, BCD and the SES in order to assist in preparing relevant documents and to reflect changes in flood behaviour as a result of the SSI. The City of Newcastle, BCD and the SES must be notified in writing no later than one month following the completion of construction that the information is available. Information requested by the City of Newcastle, BCD or the SES must be provided no later than six months following the completion of construction or within another timeframe agreed with the City of Newcastle, BCD and the SES.	Operation

3.4. Revised environmental management measures

Relevant construction-related REMMs from the Modification 1 Submissions Report are listed in Table 3. A cross reference is also included to indicate where the measure is addressed in this FMP or other project management documents.

Table 3: Revised environmental management measures relevant to FMP

ID No.	Revised environmental management measure	Document reference
Flooding and drainage		
Flooding and stormwater impacts		
FD01	The proposed flood mitigation measures and changes to watercourses would be further refined during detailed design to minimise potential impacts.	Detailed Design

ID No.	Revised environmental management measure	Document reference
Flooding impacts		
FD02	Roads and Maritime will consult with affected property owners likely to be affected by a change in flood levels including providing details of the predicted actual changes in flood levels in relation to each individual property.	Detailed Design
FD03	Roads and Maritime will consult with the owners of the block of residential units to the north-east of the northern interchange where flood mitigation work will be carried out.	Detailed Design
FD04	Construction staging plans will be refined during detailed design to ensure flood mitigation structures are constructed in a way that minimises flood risk.	Detailed Design Chapter 6 mitigation measure ID FMM3.
Realignment of watercourse 2 (WC2)		
FD05	Further refinement of the design for the realignment of WC2 will be investigated during detailed design to ensure it is designed to behave in a similar hydrologic and geomorphic manner as existing conditions as far as is practicable.	Detailed Design
Flooding impacts during construction		
FD06	The construction environmental management plan will include a flood risk management plan that details the processes for flood preparedness, materials management, weather monitoring, site management and flood incident management. The plan will be developed in accordance with: ▪ *Managing Urban Stormwater, Soils and Construction, Volume 1 4th Edition, March 2004* (Landcom 2004) and *Managing Urban Stormwater, Volume 2D – Main road construction* (DECC 2008) ▪ Roads and Maritime *Erosion and Sedimentation Management Procedure* (Roads and Traffic Authority 2009) ▪ Roads and Maritime *Technical Guideline, Temporary Stormwater Drainage for Road Construction* (Roads and Maritime Services 2011b) ▪ Roads and Maritime *Stockpile Site Management Guideline* (Roads and Maritime Services 2015).	This FMP For flood preparedness, refer to Chapter 6 mitigation measure ID FMM1 and Appendix A Sections 4.1, 4.2, 4.3 points 1-7. For materials management, refer to Chapter 6 mitigation measure ID FMM5 and Appendix A Section 4.3 points 2, 5, 6. For weather monitoring, refer to Section 7.4 and Appendix A Section 4.1. For site management and flood incident management, refer to Chapter 6 and Appendix A.

ID No.	Revised environmental management measure	Document reference
Drainage impacts during construction		
FD07	Activities that may affect existing drainage systems will be carried out so that existing hydraulic capacity of these systems is maintained where possible.	Section 5.1.

4. Existing environment

This Chapter provides a brief summary of what is known about flooding and drainage within and adjacent to the project based on information provided in Chapter 12 of the EIS.

4.1. Catchment overview

The project is located in the Lower Hunter River catchment (EIS, p434). The project traverses parts of Ironbark Creek and Dark Creek catchments and is located on the edge of the Styx Creek catchment (Figure 1) which contain a number of named and un-named ephemeral and flowing creeks and drainage lines (EIS, p434).

The ridgeline that dominates the study area marks the boundary of these catchments. North of the John Hunter Hospital precinct the study area drains to Dark Creek which flows into a concrete lined channel near Jesmond Park which passes under the existing Jesmond roundabout through a culvert. Downstream of the culvert, Dark Creek continues as a concrete lined channel until Sandgate Road (a distance of about 1.5 kilometres), after which it flows along a modified open unlined channel for about one kilometre until it joins Ironbark Creek. Downstream of the existing Jesmond roundabout, Dark Creek passes through commercial, residential and agricultural land uses. The upper ephemeral reaches of Dark Creek are referred to as watercourse (WC) 2 on Figure 1 (EIS, p434).

West of the John Hunter Hospital precinct the area drains to Ironbark Creek via unnamed ephemeral creeks (referred to as WC3 and WC4 on Figure 1). To the west of Lookout Road and south of McCaffrey Drive, the study area drains into Blue Wren Creek and an unnamed creek that both flow into Ironbark Creek. Ironbark Creek generally consists of a natural waterway between the project and Cowper Street, Wallsend, about 2.8 kilometres to the north-west. At Cowper Street the creek drains through concrete lined channels through the Wallsend commercial centre before returning to its natural state near Minmi Road, Wallsend. Ironbark Creek continues to the north and enters extensive areas of wetlands, that border the south arm of the Hunter River, about six kilometres downstream of the project. Ironbark Creek passes through extensive developed areas of Rankin Park, Elermore Vale and Wallsend that include residential and commercial land use (EIS, p434).

Areas east of Lookout Road drain towards a number of unnamed tributaries that flow towards Styx Creek and then into the Hunter River. The project would only require relatively minor work in the Styx River catchment, these being along the eastern edge of Lookout Road. As such, no detailed analysis of this catchment was carried out as part of the EIS (EIS, p434).

Refer to Chapter 13 of the EIS for further discussion of the existing condition of these watercourses.

The catchments through which the project passes have been further divided into seven subcatchments (named A to G on Figure 1) in order to carry out hydraulic analysis of flow behaviour as follows (EIS, p434):

- Sub-catchment A – this includes WC4, which is an unnamed tributary of Ironbark Creek. This catchment is steeply sloped and consists of bushland. It starts at a ridgeline on which Lookout Road is located and drains to the west
- Sub-catchment B – located in a gully between the ridgeline near the John Hunter Hospital precinct and includes the upper reaches of WC3, an unnamed tributary of Ironbark Creek that joins WC4 to the west. This catchment is moderately sloped and consists of bushland
- Sub-catchment C – this catchment contains the confluence of WC3 and WC4, which drains to Ironbark Creek to the west. This catchment is located on lower slopes and contains areas of bushland and residential development

- Sub-catchment D – this catchment is located on the southern side of McCaffrey Drive, to the west of Lookout Road and contains the upper reaches of Blue Wren Creek
- Sub-catchment E – this catchment contains the southern branch of WC2 and consists of an area of moderate slopes and consists of bushland
- Sub-catchment F – this catchment contains the northern branch of WC2. This catchment contains an area of bushland, with moderate slopes draining to Dark Creek in the north
- Sub-catchment G – this catchment contains the confluence of the northern and southern branches of WC2 and drains to Dark Creek to the north. This catchment consists of bushland with minor to moderate slopes.

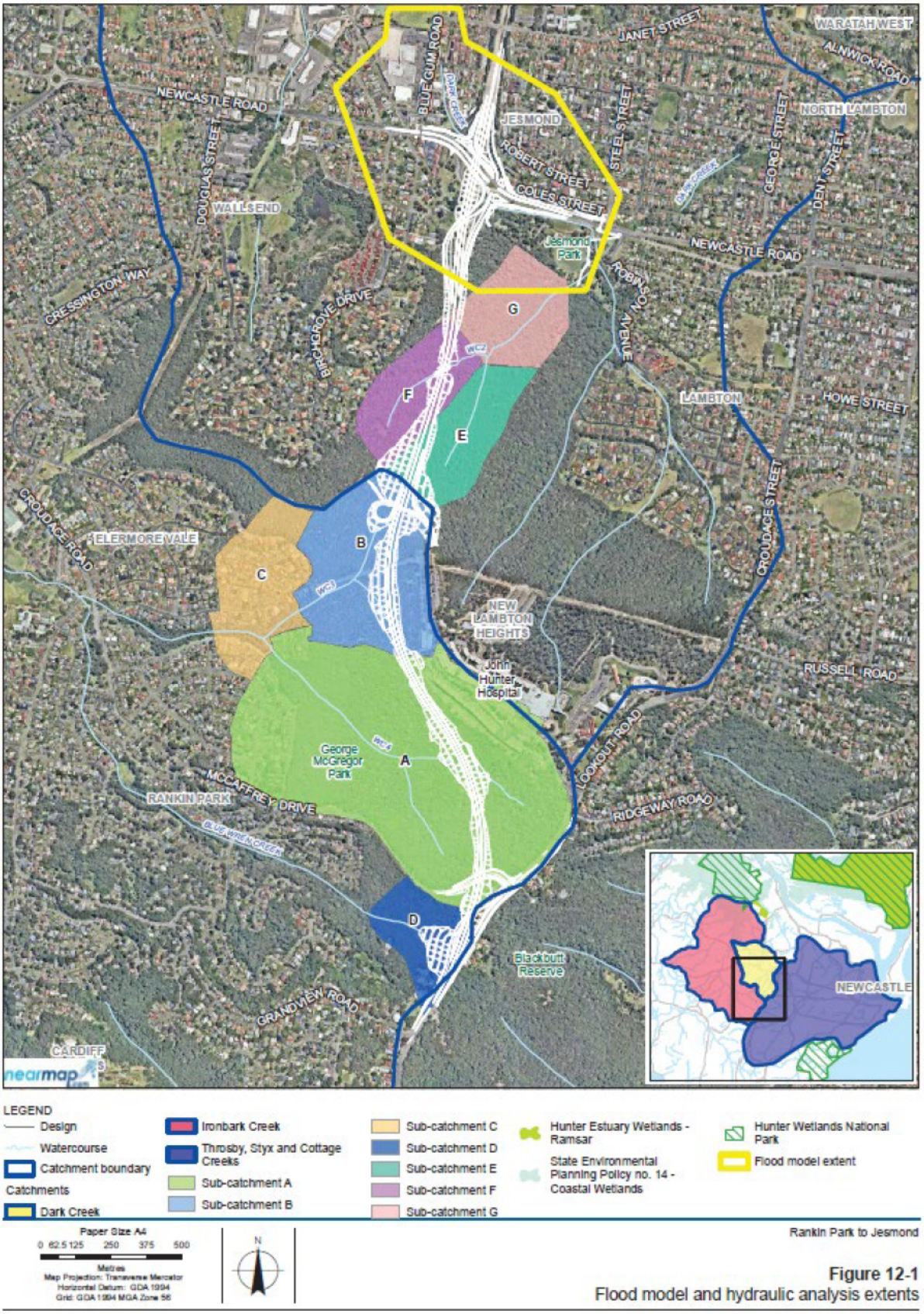

Figure 1: Flood model and hydraulic analysis extents (EIS, p436)

4.2. Flooding of Dark Creek

The *Newcastle City-wide Floodplain Risk Management Study and Plan* (BMT WBM 2012) identifies that flooding is restricted to Dark Creek in the northern extent of the project. Areas to the south are located high in the catchment in relatively steep terrain and at the headwaters of ephemeral watercourses. Flooding typically occurs in lower areas, where stormwater flows become concentrated due to the large upstream catchments. As a result, no flooding occurrences have been identified in the southern sections of the project.

The *Dark Creek Flood Study* (DHI 2008) was used as the basis of the flood modelling for the project. Flood behaviour near the Jesmond roundabout is influenced by flow through existing underground pipes and culverts, and when their capacity is exceeded by overland flows from three areas as follows:

- Residential areas located to the north-east (near Robert Street)
- Residential and bushland areas to the south-west
- Residential, parkland and bushland areas to the south-east.

These areas all drain to the existing culvert beneath the Jesmond roundabout. Under large rainfall events the capacity of the existing culvert beneath the roundabout is exceeded, resulting in upstream flooding and associated overland flows.

Flood modelling for the project shows that under existing conditions, the Jesmond roundabout on Newcastle Road at the northern end of the project, has a flood immunity of less than a 5 year ARI event. Newcastle Road is typically covered by about 0.3 to 0.4 metres of water for about an hour in such an event. In the smaller flood events (i.e. less than a 5 year ARI event) most of the flooding is caused by runoff from residential areas located to the north-east (near Robert Street). Typical peak velocities during the 5 year ARI event is about 1.5 metres per second.

During the 100 year ARI event, flooding of Newcastle Road is mostly caused by flows from the south-east. In this event, Newcastle Road is typically covered by about 0.5 to 0.6 metres of water for around two to four hours. About 38 cubic metres per second of water flows through culverts under the existing roundabout or flows across the road and roundabout. Typical peak velocities during the 100 year ARI event is about 2.5 metres per second.

In the 5 year and 100 year ARI events, floodwaters inundate the following areas:

- Parts of Jesmond Park generally along the alignment of Dark Creek at depths of about 1.74 metres in the 100 year ARI event
- Residential properties (including the garden area of a residential block of units) to the northeast of the Jesmond roundabout at depths of about one metre in the 100 year ARI event
- Commercial and residential properties to the north-west of the Jesmond roundabout at depths of about one metre or more in the 100 year ARI event.

The *Newcastle City-wide Floodplain Risk Management Study and Plan* (BMT WBM 2012) identifies the Dark Creek catchment as being affected by flash flooding and that Blue Gum Road and Robert Street are high priority flash flooding areas due to potential for above floor flooding or significant risk to life in extreme floods.

Mapping of existing flood extents for the 5 and 100 year ARI events is provided in Figure 2 and Figure 3. Refer to Appendix J of the EIS for mapping of other flood events.

Figure 2: Existing flooding – 5 year ARI event (EIS, p437)

Figure 3: Existing flooding – 100 year ARI event (EIS, p438)

4.3. Existing drainage infrastructure

Existing drainage infrastructure in the study area is mostly associated with existing roads. There are also drainage outlets from the John Hunter Hospital precinct that discharge into ephemeral watercourses in the in the study area.

Key existing drainage infrastructure includes:

- A major culvert beneath the existing Jesmond roundabout in Dark Creek. This culvert collects road runoff and overland flow from residential, bushland and Jesmond Park areas
- Culverts beneath the shared path that runs along the southern edge of Jesmond Park. These culverts convey overland flows from residential and bushland areas located to the south-west
- A number of underground culverts and pipes that carry stormwater runoff from roads in the study area including Lookout Road, McCaffrey Drive, Newcastle Road and surrounding roads.

Typically, the existing road drainage infrastructure in the study area either discharges into the Dark Creek concrete lined drain/culvert in the northern section, or into ephemeral watercourses in bushland areas associated with Blue Wren Creek or Ironbark Creek in the southern section.

4.4. Watercourse hydraulics

Hydraulic modelling for the watercourse sub-catchments (Figure 1) was carried out to identify existing peak flows, flow velocities and water depths for a range of ARI events, including the PMF. The results are summarised in Table 4, Table 5 and Table 6.

Table 4: Existing watercourse hydraulics – peak flows (cubic metres per second) (EIS, p439)

Sub-catchment	10 year ARI event	50 year ARI event	100 year ARI event	PMF
A	9	13	15	86.9
B	3	4.4	5.1	31.5
C (includes sub-catchments A and B)	14.5	21	24.2	138.8
D	2.2	3.2	3.7	15.5
E	2	2.9	3.3	20.8
F	2.5	3.6	4.1	24.9
G (includes sub-catchments E and F)	5.7	8.5	9.7	59.8

Table 5: Existing watercourse hydraulics – flow velocities (metres per second) (EIS, p440)

Sub-catchment	10 year ARI event	50 year ARI event	100 year ARI event	PMF
A	2.5	2.9	3	5.6
B	1.8	2.1	2.2	3.6
C (includes sub-catchments A and B)	0.7	0.7	0.8	1.1
D	0.9	1	1.1	1.7
E	1.4	1.5	1.6	2.5
F	1.4	1.6	1.6	2.4
G (includes sub-catchments E and F)	0.2	0.2	0.2	0.7

Table 6: Existing watercourse hydraulics – water levels (AHD metres) (EIS, p440)

Sub-catchment	10 year ARI event	50 year ARI event	100 year ARI event	PMF
A	29.09	29.28	29.36	30.75
B	29.51	29.58	29.61	30.67
C (includes sub-catchments A and B)	26.57	26.9	27.04	28.8
D	60.46	60.54	60.57	61.05
E	19.86	19.92	19.94	20.5
F	19.38	19.45	19.47	20.06
G (includes sub-catchments E and F)	13.55	13.8	13.9	15.96

5. Environmental aspects and impacts

The key construction activities and the associated potential sources of flooding impact are identified through a risk management approach. The consequence and likelihood of each activity's impact on the environment has been assessed to prioritise its significance. The results of this risk assessment are included in Appendix A3 of the CEMP.

Ongoing environmental risk analysis will be undertaken during construction through regular inspections, monitoring and auditing as described in Chapter 7. This will ensure that issues requiring management (including cumulative impacts) are appropriately managed.

5.1. Flooding

Construction activities, as described in the following section, will occur in areas subject to flooding around Dark Creek. The other sections of the project have not been identified as being flood affected by the *Newcastle City-wide Floodplain Risk Management Study and Plan* (BMT WBM 2012).

Construction will also occur close to, or in, other ephemeral creeks in the study area. A number of construction activities have the potential to impact flooding and drainage. These include:

- Work in flood affected areas impacts on overland flows and flood behaviour
- Site compounds and stockpile sites located in flood affected areas
- Work in existing watercourses
- Work in existing drainage systems
- Vegetation clearing and bulk earthworks.

These are discussed in the following sections.

5.1.1. Potential impacts on local overland flows and flood behaviour

The EIS (p441) identified that the construction of road embankments on either side of Newcastle Road associated with the northern interchange could reduce the overland flow path width and result in flood impacts upstream. In addition, the realignment of Newcastle Road, construction of the new intersection and the ramps would result in changes to existing road and ground levels and could cause flooding of the surrounding areas if not properly managed during construction.

To address potential flooding impacts the project includes permanent flood mitigation measures, including culvert works and bunding at the northern interchange. The staged construction of these measures will be planned to reduce potential flood impacts during construction and as such, there are not expected to be any significant impacts from the project on flood affected areas. Refer to Chapter 6 mitigation measure ID FMM2 and FMM3, and SWMP Chapter 6 mitigation measure ID SWMM1, SWMM3, SWMM6, SWMM13, SWMM33.

5.1.2. Site compounds and stockpile sites located in flood affected areas

The EIS (p441) identified that the site compounds B and C at the northern interchange are partly located in the existing 20 year ARI event flood extent and are located in close proximity to Dark Creek where it is a concrete channel (refer to Figure 4). Before the establishment of site compounds B and C, Fulton Hogan will first prepare an Ancillary Facility Establishment Management Plan (separately to the CEMP) to satisfy the requirements of CoA A15 to ensure risks are appropriately managed. Refer to Chapter 6 mitigation measure ID FMM4.

The EIS (p441) identified that the operation of the existing concrete channel would need to be maintained during construction to avoid potential impacts to the site compounds, Jesmond Park and Newcastle Road during a major storm event. The EIS identified that in order to gain access to site compound B from Newcastle Road temporary bridges across the existing channel may be established during the construction period. The design of temporary bridges will ensure the capacity of the channel is maintained. Refer to Chapter 6 mitigation measure ID FMM2.

The EIS (p441) also identified that if placed in flood affected areas, stockpiles could obstruct flow paths and result in flooding impacts. In this regard, stockpiles will be located in accordance with the criteria contained in the Stockpile location checklist e.g. stockpile site should be located above the 1 in 20 year flood level. Refer to Chapter 6 mitigation measure ID FMM5.

In a flood event, at or above a 1 in 20 year flood level, at these compound areas, there is potential for materials to be washed away from compounds or stockpile sites, resulting in blockage of Dark Creek and could pose a safety hazard. Stormwater control and flood preparedness measures would be addressed for the site compounds. Refer to Chapter 6 mitigation measure ID FMM4, FMM5, FMM6.

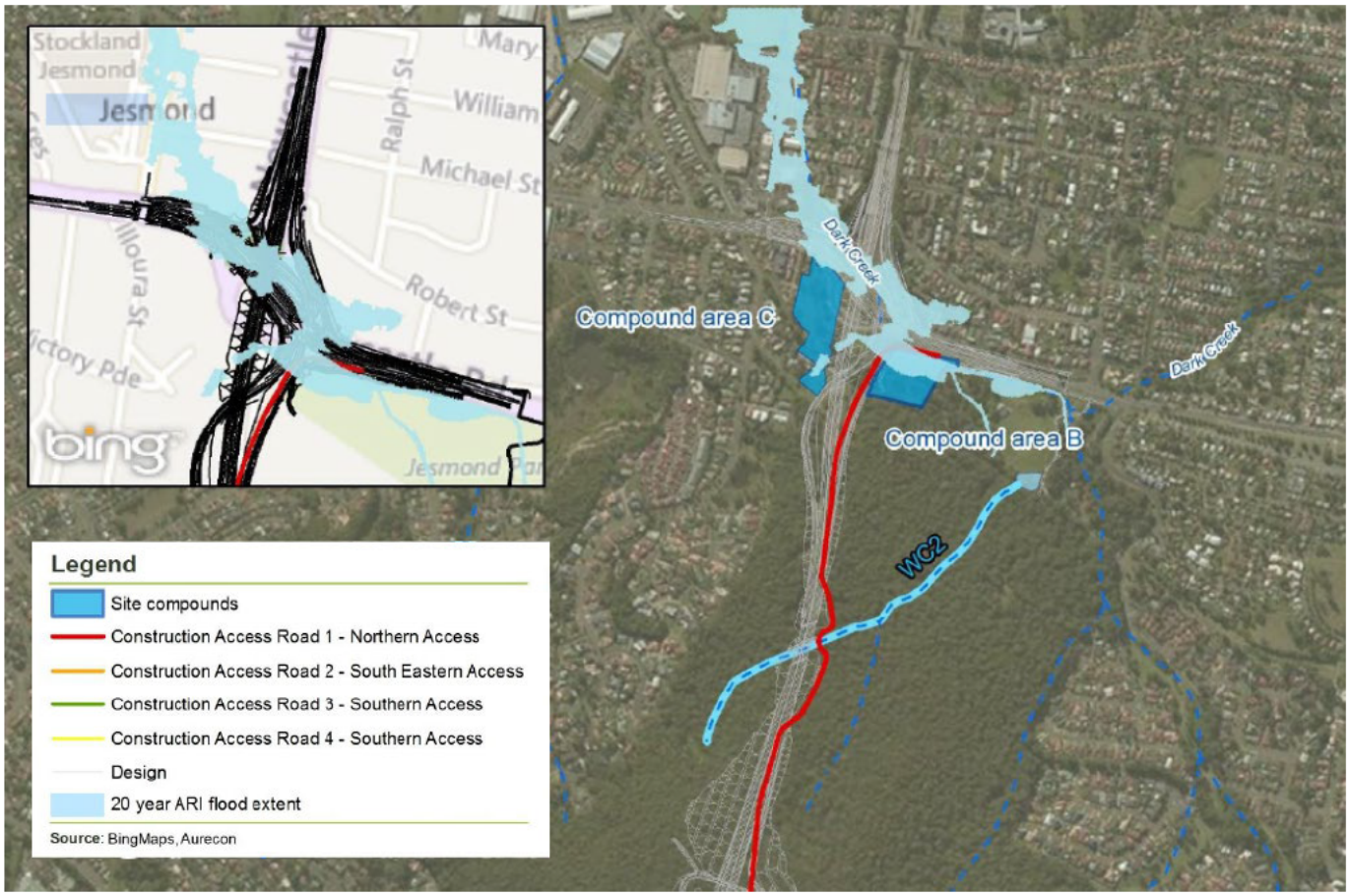

Figure 4: Potential flood impacts to site compounds B and C - 20 year ARI (EIS Appendix J, p44 as amended)

5.1.3. Work in existing watercourses

The EIS (p442) identified that construction of the project would impact existing watercourses as a result of:

- Construction of road embankments
- Temporary sedimentation basins
- Temporary working platforms for bridge construction
- Temporary construction access road crossings
- Realignment of WC2.

If not appropriately managed, construction has the potential to cause flooding of these watercourses and surrounding areas during storm events.

Where road embankments are constructed over existing watercourses, temporary cross drainage pipes would typically be installed. During construction, water flows across the work would be controlled via the new drainage

system and use of temporary open drains and pipes. Refer to SWMP Chapter 6 mitigation measure ID SWMM1, SWMM3, SWMM6, SWMM13, SWMM33.

During the construction of the temporary work (sedimentation basins, working platforms and construction access roads), similar drainage measures would be employed. Temporary work and associated drainage would be removed and the watercourses reinstated after the completion of works within these areas. Refer to SWMP Chapter 6 mitigation measure ID SWMM40.

The EIS acknowledged that the detailed design of the temporary drainage installations for crossings of the watercourses will include assessment of their potential impacts on flooding.

In light of the above and with implementation of the mitigation measures outlined in Chapter 6 of this FMP, there are not expected to be any significant impacts from the project on existing watercourses.

5.1.4. Work in existing drainage systems

Construction of the project will require permanent modification to existing drainage infrastructure. If existing drainage systems are blocked or become inoperable during construction, flooding and drainage impacts are likely to occur during major storm events (EIS, p442).

To mitigate the risk of flooding during construction, the existing drainage system will be maintained to ensure its capacity is not reduced during construction. This may involve the installation of new relief culverts, drainage pits and pipes before the existing structures are removed or connected (EIS, p442).

With the implementation of Chapter 6 mitigation measure ID FMM2 and FMM3, there are not expected to be any significant impacts from the project on the existing drainage systems.

5.1.5. Vegetation clearing and bulk earthworks

Clearing of existing vegetation and bulk earthworks will result in changes to flow paths and volumes in the construction footprint. If not managed appropriately this could result in flooding impacts and blockage of watercourses (EIS, p442).

During construction, appropriate stormwater and erosion and sedimentation controls, including sedimentation basins, will be implemented in accordance with the SWMP (refer to SWMP Chapter 6 mitigation measure ID SWMM1, SWMM3, SWMM6, SWMM13). These have been designed to minimise changes to existing flow paths and volumes. Construction staging will also seek to minimise substantial changes to flow paths and volumes as far as possible as outlined in Chapter 6 mitigation measure ID FMM2 and FMM3.

5.2. Watercourse hydraulics

The primary construction impact upon the geomorphology of watercourses will be the direct disturbance of soils and vegetation along watercourses during construction. During construction, runoff from the construction footprint will be managed in accordance with the primary and progressive erosion and sediment control plans. All controls will be designed to minimise potential downstream impacts associated with concentrations of flows. Refer to SWMP Chapter 6 mitigation measure ID SWMM1, SWMM3, SWMM6, SWMM13, SWMM34.

6. Environmental mitigation measures

Specific mitigation measures to address impacts on flooding during pre-construction (PC) and construction (C) are outlined in Table 7.

Table 7: Flooding mitigation measures

ID	Mitigation Measure	Timing		Responsibility
		PC[1]	C[2]	
EVACUATION				
FMM1	In the event of a Flood Warning and/ or flood evacuation, follow the process described in the Flood preparedness and flood incident management procedure contained in Appendix A.		✓	Project Director Emergency Coordinator Emergency Response Team Environmental Manager
DRAINAGE/ OVERLAND FLOW AND FLOOD BEHAVIOUR				
FMM2	Ensure any temporary bridges from Newcastle Road across the existing channel maintain the existing capacity of the channel.		✓	Project Engineers Foreman
FMM3	Plan/ stage construction of the northern interchange culvert works in a manner that minimises flood risk by: ▪ Adopting 'offline' (rather than 'online') construction. This means operation of the existing culvert will be maintained and then cutover to the new culvert, retaining the existing flood performance. ▪ Carrying out the work during dry weather.	✓	✓	Project Engineers
ANCILLARY FACILITIES AND STOCKPILE SITES				
FMM4	Before the establishment of site compounds B and C, first prepare an Ancillary Facility Establishment Management Plan (AFEMP) in accordance with CoA A15 to ensure potential risks are appropriately managed.	✓	✓	Project Engineers Designers
FMM5	Locate stockpiles in accordance with the Stockpile location checklist contained in Appendix H of the SWMP to ensure that potential flooding impacts are minimised.		✓	Project Engineers Foreman
FMM6	Locate equipment and material laydown areas in accordance with the Ancillary Facility Establishment Management Plan (AFEMP) (CoA A17) to ensure they do not impede floodwaters and adverse impacts on adjacent properties are avoided.		✓	Project Engineers Foreman

[1] PC means pre-construction; [2] C means construction

7. Compliance management

7.1. Roles and responsibilities

Fulton Hogan's Project Team organisational structure and overall roles and responsibilities are outlined in Section 4.1 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Table 7 of this FMP.

7.2. Training

All employees, subcontractors and utility staff working on site will undergo site induction training relating to flooding management issues, including:

- requirements of this FMP
- relevant legislation
- roles and responsibilities for flooding management

Further details regarding staff induction and training are outlined in Chapter 5 of the CEMP.

7.3. Complaints

Complaints will be recorded and addressed in accordance with Section 6.2.3 of the CEMP and the Community Communication Strategy (CCS).

7.4. Inspections and Monitoring

Inspections and monitoring specific to flooding will be undertaken during construction in accordance with Table 8. General requirements and responsibilities in relation to inspections and monitoring are documented in Sections 8.1 and 8.2 of the CEMP respectively.

Table 8: Inspections and monitoring

Monitoring details	Record	Responsibility	Frequency
'Flood Warning' issued by BoM	BoM weather data	Environmental Manager	At least twice daily as required
Weather forecast	BoM weather data Pre-start meeting record	Environmental Manager	Daily
Pre-flood site inspection	Environmental inspection checklist	Environmental Manager (for environmental component)	Upon a 'Flood Warning' issued by BoM
Post-flood site inspection	Environmental inspection checklist	Environmental Manager	As soon as allowable, subject to Fulton Hogan safety requirements

7.5. Auditing

Auditing (both internal and external) will be undertaken to assess the effectiveness of environmental mitigation measures, compliance with this FMP, TfNSW specifications and other relevant approvals, permits and licences. Auditing requirements are detailed in Section 8.4 of the CEMP.

7.6. Reporting

General reporting requirements and responsibilities are documented in Chapter 9 of the CEMP.

7.7. Non-conformances

Non-conformances will be dealt with and documented in accordance with Chapter 10 of the CEMP.

8. Review and improvement of FMP

The FMP will be reviewed to ensure compliance with legislative requirements and its suitability and effectiveness for the project.

The review may be in the form of:

- A formal management review
- An audit, and/or
- An inclusion as a separate item at a site meeting.

The Environmental Manager may review and update the FMP more regularly where:

- Significant changes in construction activities occur
- Where targets are not being achieved, or
- In response to audits and non-conformance reports.

Any minor changes to the FMP will be approved by the ER and the remainder approved by the Planning Secretary in accordance with CoA C8. For additional information about the document review process, refer to Section 1.6 of the CEMP.

Appendix A: Flood preparedness and flood incident management procedure

Appendix A: Flood preparedness and flood incident management procedure

1. Purpose

This procedure details the processes for flood preparedness and flood incident management, and is closely linked to the incident and emergency response flowchart for storms and flooding shown in Figure 5.

2. Scope

This procedure applies to all personnel working on the project site.

3. Roles and responsibilities

Emergency management roles and responsibilities in relation to flood preparedness and flood incident management are detailed in Table 9.

Table 9: Roles and responsibilities – Flood preparedness and flood incident management

Role	Responsibility
Project Director	Implement measures in this Flood preparedness and flood incident management procedure.
Emergency Coordinator	Implement measures in this Flood preparedness and flood incident management procedure.
Emergency Response Team (internal Fulton Hogan team)	Ensure the measures in this Flood preparedness and flood incident management procedure and adequate resources are allocated.
Environmental Manager	Ensure the measures in this Flood preparedness and flood incident management procedure are implemented and adequate resources are allocated. Inspect erosion and sediment controls, waste and chemical storage areas to ensure preparedness for potential flooding.

4. Procedure

4.1 Weather monitoring

To stay abreast of any potential flood threats, daily weather forecasts will be obtained from the Bureau of Meteorology (BoM) website and distributed to the project team in accordance with Table 8.

4.2 Flood and evacuation warnings

The Bureau of Meteorology issues Flood Warnings to alert communities to the threat of potential floods as part of the Total Flood Warning System. Warnings may be issued through the below modes:

- Bureau of Meteorology (BoM) flood warning – targeted warning for specific catchments
- Newcastle City Council Flood Alert Service – electronic alerts issued via the Early Warning Network (EWN) which continuously monitors local rainfall gauges
- State Emergency Services (SES) issue of local flood bulletins, evacuation warnings, evacuation orders and All Clear orders
- Local Radio Stations and media outlets.

The Environmental Manager will regularly consult these resources to stay abreast of any flood threats that may arise. Table 8 summarises the monitoring associated with Flood Warnings, weather forecasts pre-flood site inspections and post-flood site inspections.

4.3 Evacuation process

If the direction to evacuate the project has been issued by the SES or the Project Director has made the decision to evacuate, the following actions must be undertaken by personnel (refer to Table 9 and Figure 5) designated with the responsibility of coordinating the evacuation of the site:

1. The Project Director must direct the Emergency Coordinator to assign the emergency response team roles and responsibilities for the duration of the evacuation.
2. Before the storm hits:
    a. Inspect and maintain erosion and sediment controls, especially those around stockpile sites, and near waterways. Also inspect and maintain waste and chemical storage areas.
    b. Ensure site drainage is established, clear and where relevant directed to water treatment controls.
    c. Where possible remove plant, isolate remaining plant, stow or tie down loose items.
3. Should BoM issue a Flood Warning, then the emergency response team must instruct Fulton Hogan and subcontractor personnel to make their work areas safe and leave their work areas for higher ground.
4. Before leaving the work areas, operators must remove plant and machinery from the low points across the project, and station them at the higher elevations or offsite where flood waters should have the least impact, but only if safe to do so.
5. Key tools and hazardous materials should be removed from the work areas (using utility vehicles and light trucks), if it is safe to do so. These resources can be placed in or near storage containers.
6. Fuel tanks should be anchored or removed where possible; and water, electricity and gas mains must be turned off.
7. All utility vehicles will be relocated to higher elevations where flood waters should have the least impact, but only if safe to do so.
8. All personnel will then relocate to the emergency evacuation muster point, where a roll call will be facilitated by the Emergency Coordinator.
9. Should evacuation from site be required then the following steps are to be followed:
    a. After the roll call, the Emergency Coordinator will communicate the potential evacuation routes. The following resources should be consulted before evacuating the site, to ensure roads that are closed or areas where movement is restricted are avoided:
        i. RMS Live Traffic: www.livetraffic.com
        ii. Latest NSW Warnings: www.bom.gov.au/nsw/warnings/
    b. Staff will be reminded that when leaving the site, they must follow the guidance and instructions of the SES, NSW Police force, fire brigade and any other authority tasked with flood evacuations procedures.
10. If the flood event passes and the Emergency Coordinator determines it is safe to return to site (in compliance with advice from the SES, or other emergency service authorities), then the following steps will be followed:
    a. A post-flood site inspection will be undertaken prior to the site being re-occupied, including a review of:
        i. any potential flood damage, including damage to environmental controls
        ii. health and safety risks, and
        iii. material which may have been lost during the event.

Results of the initial site inspection will be provided to the Project Director and reported to TfNSW.

b. The site, including equipment, will be inspected and made safe

c. The site will be cleaned up. This includes retrieval of any material washed from the site, where safe to do so.

d. The Emergency Coordinator must give the "all clear" to resume work.

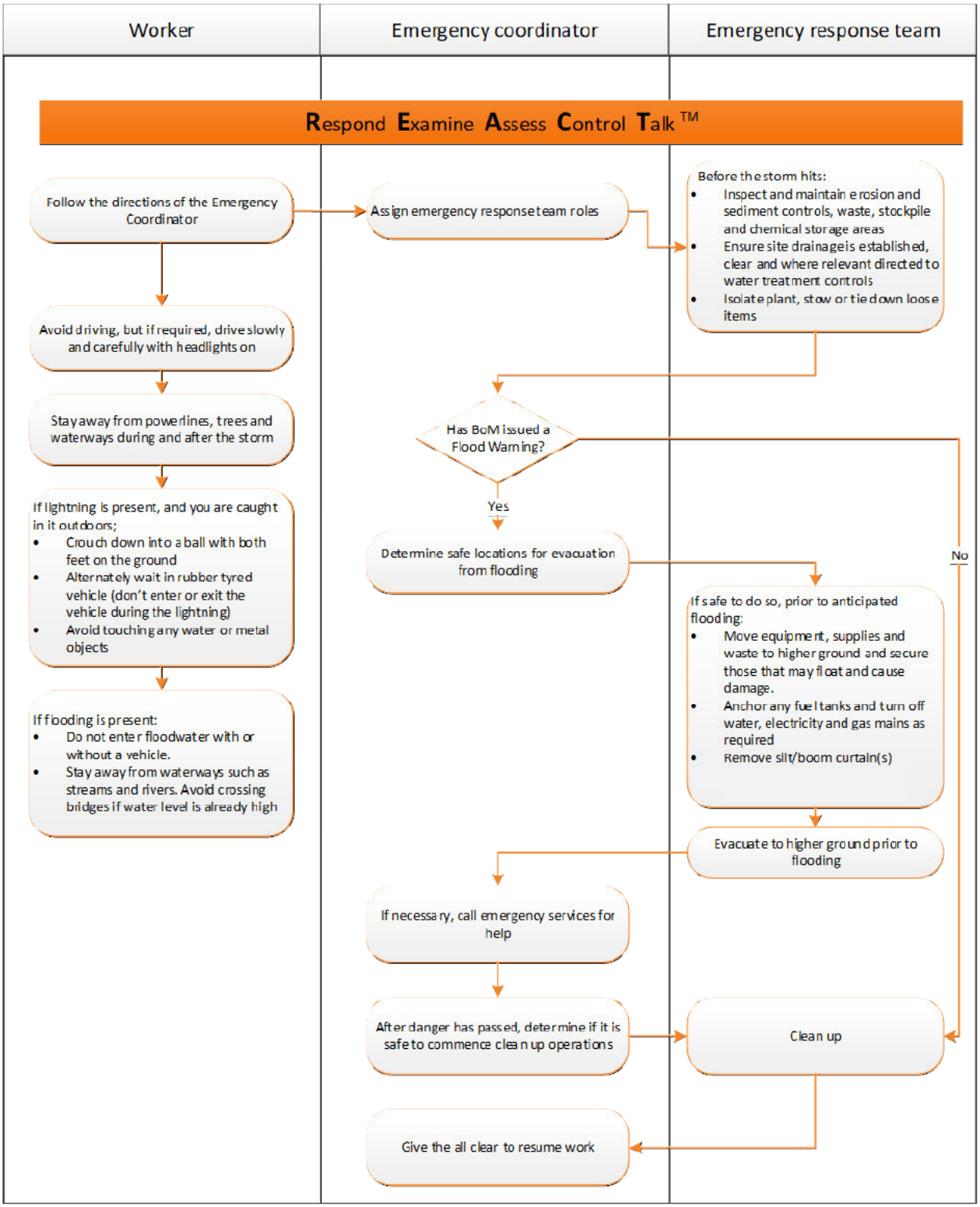

Figure 5: Incident and emergency response flowchart – Storms and flooding