Flood Management Plan

Cross River Rail – Rail, Integration and Systems Alliance

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Document Approval

Rev	Date	Prepared By	Reviewed By	Approved By	Remarks
A	04/01/221	Environmental Coordinator	Lead Engineer – Flooding Environmental Manager	Construction Manager	IFR
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Assured Integration for a New Era

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Plan Control

This Flood Management Plan (the Plan) has been developed for the Cross River Rail – Rail, Integration and Systems Project.

Approvals, Revisions, and Amendments

The latest approved version of the plan will be available in UNITY's Electronic Document Management System (EDMS). The Environment Manager will maintain, review and update the plan at least every six months in the first year and then annually thereafter. Revised plans will also be submitted to the Proponent, the Environmental Monitor, and the Coordinator-General and Independent Certifier.

Each revision to the plan will be distributed to all required personnel for review and approval. The document will be allocated a new revision type if the changes made affect the overall meaning of the document. Any minor change will be made without a change to the revision number.

When a new revision to the document is available, a notification email will be distributed to all project personnel by the Document Controller advising of the update.

Revision Details

Revision	Remarks
A	Draft Flood Management plan for Environmental Monitor Review
00	Up-rev after no comments from IEM
01	Issued for review to the IEM 6 monthly review No updates are required because of: • RfPC-11, and • The addition of the Southern Area Scope of Works (Dutton Park and Buranda)
02	Issued for Review Additional Context added to respond to reviewer Comments and updated inclusion of updated emergency response flowchart
03	Issued for Review Additional content to include instream works at Rocky Water Holes Creek
04	Issued for Use No further comments to be addressed

1 Acronyms and Abbreviations

Acronym/Abbreviation	Definition
ARI	Average Recurrence Interval
BCC	Brisbane City Council
BoM	Bureau of Meteorology
ESCP	Erosion and Sediment Control Plan
FMP	Flood Management Plan
H.A.T.	Highest Astronomical Tide

2 Purpose and Scope of this Plan

2.1 Background

Request for Project Change no.7 (RfPC 7) requested that two new Imposed Conditions (17(b) and 17(c)) be added to appendix 1 of the Coordinator General Imposed Conditions to supplement Imposed Condition 17(a) for in stream works associated the RIS Scope of Works at Breakfast Creek and Moolabin creek.

Indeed, Imposed Condition 17(a), which was the relevant condition at the time for in stream works would have prevented the construction of the Breakfast Creek and Moolabin Creek Bridges (refer RfPC 7, Volume 1 section 4.2.9), where temporary flood impacts were expected to occur based on flood modelling efforts undertaken at the time.

The proposed changes were Approved in June 2020.

Request for Project Change no.11 (RfPC 11) which focussed on the reconfiguration of the Project Works at Clapham Yard included a review of the proposed changes and their effect on hydrology. Consistent with RfPC 7, RfPC 11 confirmed that the components of the Proposed Change at Clapham Yard that were relevant to hydrology, and in particular Imposed Condition 17 (refer RfPC 11, Volume 1 section 4.4.4) continued to be the in-stream works at Moolabin Creek associated with the rail bridges construction.

Attachment C (Technical report: hydrology, of RfPC 11 Volume 3) provided revised flood modelling information pertaining to predicted construction impact to third parties. The body of works presented in RfPC 11 confirmed that a Flood Management Plan for Moolabin Creek in-stream works associated with the Bridges Construction would continue to be required.

Since these two RfPCs, detailed flood modelling for permanent and temporary scenarios at Breakfast Creek and Moolabin Creek has been carried out.

The outcomes the constructability review in conjunction with the detailed flood modelling and, whilst minimising the extent of afflux (flood impacts) during construction, do not all together prevent potential impacts for the 20% and 1% Annual Exceedance Probability (AEP) during Bridge construction at Breakfast Creek and Moolabin Creek.

It is noted that there will also be instream works at Rocky Water Holes Creek for the construction of a drainage line outlet. Whilst the instream works will not cause afflux that will affect third parties, the worksite itself will have a low flood immunity and is likely to be affected by 5-year ARI (20% AEP) floodwaters if such an event occurs during the execution of the drainage works.

Therefore, consistent with current imposed conditions a Flood Management Plan (FMP) must be prepared for these Relevant Project Works.

The FMP may be amended from time to time as additional relevant information becomes available.

2.2 Purpose

This FMP has been prepared to address the requirements of the Coordinator-General's Imposed Conditions – Appendix 1 – Part C, Condition 17b and c.

Imposed Condition 17b requires a *Flood Management Plan that applies to all worksites affected by tributary or creek flooding (in a 5-year ARI flood event and stormwater during a 2-year ARI rainfall event) must be endorsed by the independent Environmental Monitor before the commencement of Relevant Project Work. A Flood Management Plan is not relevant to flooding of the Brisbane River (main channel)*.

Imposed Condition 17c requires the FMP to include, as a minimum the content detailed in Table 1.

Table 1: Imposed Condition 17c requirements

Imposed Condition Reference	Condition Requirements	Location Addressed in the Plan
17c	The Flood Management Plan must include, as a minimum	

Imposed Condition Reference	Condition Requirements	Location Addressed in the Plan
(i)	General description of the Relevant Project Works	• Breakfast Creek: Section 3.1 • Moolabin Creek: Section 4.1
(ii)	Flood Assessment	• Breakfast Creek: Section 3.2 • Moolabin Creek: Section 4.2
(iii)	specific flood management measures, including:	
(iii) (A)	appropriate storage of materials and equipment	• Breakfast Creek: Section 3.3.2 • Moolabin Creek: Section 4.3.2
(iii) (B)	early warning indicators	• Breakfast Creek: Section 3.3.1 • Moolabin Creek: Section 4.3.1
(iii) (C)	risk management for predicted rainfall events	• Breakfast Creek: Section 3.3.3 • Moolabin Creek: Section 4.3.3
(iii) (D)	risk management for predicted tidal flooding events for works in the tidal zone	• Breakfast Creek: Section 3.3.4 • Moolabin Creek – Not Applicable
(iii) (E)	risk management for unpredicted flood events	• Breakfast Creek and Moolabin Creek: section 6
(iv)	Tidal works management for works in the tidal zone, including:	• Breakfast Creek: Section 3.4 • Moolabin Creek – Not Applicable
(iv) (A)	barge and marine equipment details	• Breakfast Creek: Section 3.4.1 • Moolabin Creek – Not Applicable
(iv) (B)	barge mooring plan	• Breakfast Creek: Section 3.4.2 • Moolabin Creek – Not Applicable
(iv) (C)	vessel traffic management plan	• Breakfast Creek: Section 3.4.3 • Moolabin Creek – Not Applicable
(iv) (D)	marking of navigational hazards	• Breakfast Creek: Section: 3.4.4 • Moolabin Creek – Not Applicable

The purpose of this FMP is to:

- Identify specific flood management measures
- Identify Tidal works management for works within the tidal zone
- Minimise the risks of adverse impacts associated if a flood event occurs during the construction phase of the project
- Detail the proposed monitoring program to facilitate early detection of potential flood events

2.3 Scope

The flood management plan provides greater clarity around the flood management requirements for the project at specific worksites that will be impacted by flooding events.

The scope of the FMP is:

- In-stream works in Breakfast Creek associated with the construction of the Breakfast Creek Bridge and Northern embankment drainage scope, and
- In-stream works in Moolabin Creek associated with the construction of the Moolabin Creek Bridges.
- In-stream works in Rocky Water Holes Creek associated with the construction of a new drainage lune and associated outlet.

Consistent with the Coordinator-General's change report (CGCR) – design refinements and condition changes 2020 (July 2020),

- the revised conditions will allow for the construction of the Breakfast Creek and Moolabin Creek bridges using standard construction techniques by providing a plan for effective management of potential flooding events that may occur during the works
- the Flood Management Plan will provide certainty that the works can be effectively managed in the specified event of a flood without causing adverse impacts to third parties.
- the Flood Management Plan will be endorsed by the independent Environmental Monitor before the commencement of the relevant works
- the revised conditions will be consistent with Imposed Condition 18 relating to erosion and sediment control
- Site-specific CEMPs (SEPs) and ESCPs, combined with the Waterways and Water Quality management sub-plans, will be implemented to adequately manage flooding impacts during construction

3 Flood Management – Breakfast Creek In-Stream Works

3.1 Relevant Project Works

The relevant project works to this plan are the in-stream works in Breakfast Creek associated with the construction of the new Breakfast Creek Bridge, abutment works and drainage works on the Northern embankment.

Breakfast Creek is a tidal waterway that is subject to frequent and extensive flooding, which can be caused by one or a combination of:

- Rainfall in the upper catchment
- Rainfall in the local catchment
- Large tides

Flooding is generally concentrated within the Brisbane River floodplains and tributaries with inundation in these areas sometimes occurring over several days.

This FMP is not relevant to flooding of the main channel of the Brisbane River but is relevant to the flooding of the tributaries and stormwater systems.

3.2 Flood Assessment

3.2.1 Construction activities

Activities during construction that could result in adverse impacts to flooding include:

- Breakfast Creek Structural Works (Bridge construction)
- General earthworks associated with
  - the abutment construction
  - the temporary rock platform construction
  - reprofiling of bed and banks required for the bridge construction inclusive of the permanent scour protection installation
- Temporary in-stream works associated with the temporary jetty required to enable the bridge construction
- Temporary and permanent drainage works.

3.2.2 Factors likely to affect flooding and impacts

Factors likely to affect the impact of flooding include:

- Size of the flood event
- Staging of the activities around creeks, channels, and other watercourses
- Temporary and permanent drainage capacities
- Temporary and permanent embankment heights
- Drainage and height of sites above the predicted flooding levels.

3.2.3 Impacts

The potential for impacts of flooding on construction depends on a number of factors. Primarily impacts will be dependent on the nature, extent, and magnitude of construction activities and their interaction with the natural environment. Potential impacts attributable to construction might include:

- Safety impacts
- Loss and/or damage of ancillary facilities, construction equipment/plant
- Sediment discharge into the receiving environment
- Increased area and depth of inundation
- Increased watercourse flow rates during rain events
- Increased duration of inundation

3.3 Specific Flood Management Measures

3.3.1 Early Warning Indicators

The following table summarises the frequency of monitoring associated with the Flood Warning and Response Procedure.

Table 2: Monitoring Frequency

Aspect	Frequency	Responsibility
Weather and tides forecast	Daily when no risk or low-level risk triggered (See section 3.3.3 and 3.3.4)	Environmental Site Representative
Initial Flood Warning Trigger	Email subscription to BCC flood warning alerts	Environmental Site Representative / Project Engineer
Weather and tides forecast	3 hourly when Medium or high-level risk triggered (See section 3.3.3 and 3.3.4)	Environmental Site Representative
Flood Levels	3 hourly monitoring when Medium or High-level risk triggered (See section 3.3.3 and 3.3.4)	Environmental Site Representative/ Project Engineer

The Environmental Site Representative and Project Engineer will monitor the Bureau of Meteorology (BoM) online Flood Warning Service, BCC flood alerts, and the latest river heights for Breakfast Creek daily during periods of rainfall. They will report the outcomes directly through to the works supervisor and project manager (if required).

3.3.2 Storage of equipment and materials

- All dangerous and hazardous goods will be stored at the main compounds, outside the extent of a 5-yr ARI flood event, in a dangerous goods container that is purpose-built and compliant with the Australian Standard for the storage and handling of flammable and combustible liquids (AS 1940:2017).
- If safe to do so, in the event a flood greater than the 5-yr ARI is predicted, the dangerous goods container is to be removed/relocated from the site to a safe and secure location outside the extent of the predicted flood event.
- If safe to do so, all plant and equipment, including earthworks plant that is within the 5-year ARI Flood model, are to be moved and parked in areas outside the 5-year ARI flood extent or higher depending on information from the Flood Warning Service.

- If safe to do so, geofabric (or similar) is to be placed around material stockpiles that cannot be relocated outside of the 5-year ARI flood extent, to prevent erosion and loss of material.
- If safe to do so, parked vehicles are to be moved to a safe place away from the Herston Compound Carpark or other known areas of localised flash flooding before significant rainfall events are at the discretion of project management. No movement of vehicles is permitted once the affected areas are flooded in the interest of all Unity team members, subcontractors, and other stakeholders' safety.

3.3.3 Predicted Rainfall Flooding Risk Management

The trigger levels (sourced from BOM Brisbane forecast) are intended to initiate a detailed assessment of the situation and review of work activities as per Table 3.

- Low-Level Risk (75 to 95mm of rainfall (2-year ARI, 6 hours) is expected over a 24-hour period, within 72-hour / 3-day forecast)
- Medium Level Risk (>95mm of rainfall (5-year ARI, 6 hours) is expected over a 24-hour period, within a 72-hour / 3-day forecast)
- High-Level Risk (Flood warning issued through the Queensland Flood Warning Centre or BCC Flood Warnings for properties in Windsor - based upon the river heights data for the Breakfast Creek at Bowen Hills Rail station).

Table 3: Risk Level Responses – Breakfast Creek

Low Level	
At least daily monitoring of forecast tides and rainfall forecast	Environmental Site Representative / Project Engineer
Assessment of material within flood-prone areas to ensure minimal impact to the receiving environment in the event of a flood (i.e. potential removal of material or additional stabilisation if practical)	Project Engineer / Supervisor
Review erosion and sediment controls to ensure they are implemented and maintained in accordance with the approved Erosion and Sediment Control Plan (ESCP).	Environmental Site Representative / Supervisor
Preparation/planning for the potential removal of plant and equipment within flood-prone areas. Where safe, non-essential construction equipment (i.e. plant) and materials are removed from flood-prone areas.	Project Engineer / Supervisor
If daily monitoring indicates an exacerbation of conditions, a secondary assessment will be undertaken including reviewing the recent tidal conditions and rainfall forecast. Should an exacerbation of conditions be found to be likely, the Medium Flood Warning Trigger responses are to be implemented.	Delivery Manager

Medium Level	
Completion of all Low-Level Risk Actions	
3-hourly monitoring of flood warning system, forecast tides, and rainfall forecast.	Environmental Site Representative / Project Engineer
Where safe, non-essential construction equipment (i.e. plant) and materials are removed from flood-prone areas. Project Manager to determine if further equipment is removed from flood-prone areas.	Delivery Manager
Preparations to commence for securing in-stream work platforms and the removal of in-stream controls. Project Manager to determine if further actions are necessary.	Delivery Manager

High Level – Flood Warning Triggered	
Completion of all Medium Level Risk Actions	
3-hourly monitoring of flood warning system, forecast tides, and rainfall forecast.	Environmental Site Representative / Project Engineer
Where safe, all construction equipment (i.e. plant) is removed from in-stream works/flood-prone areas.	Delivery Manager
Where safe, silt curtains or other in-stream environmental controls are to be removed to a location outside the 5-yr ARI flood event	Project Engineer / Supervisor
In-stream work platforms must be secured to avoid causing damage to property.	Delivery Manager

3.3.4 Predicted Tidal Flooding Risk Management

The trigger levels are intended to initiate a detailed assessment of the situation and review of work activities as per Table 3 in section 3.3.5. This is only relevant in the tidally influenced watercourse, Enoggera Creek (Breakfast Creek).

- Low-Level Risk (Spring Tide predicted within 48 hours)
- Medium Level Risk (Highest Astronomical Tide (HAT) levels predicted within 48 hours
- High-Level Risk (Flood warning issued through the Queensland Flood Warning Centre or BCC Flood Warnings)

3.3.5 Unpredicted Flood Event Risk Management

In the event of an unpredicted flood event, the emergency response protocols presented in section 6 will be implemented.

3.4 Management for Works in the Tidal Zone

A Marine Execution Plan has been prepared for the Breakfast Creek in stream works (RIS-UNA-ENV-PLN-00022). This plan is to be submitted to Maritime Safety Queensland 3 months prior to works commencing and outlines the relevant information related to maritime safety procedures and information relevant to community notifications. For further information, please refer to this plan.

3.4.1 Marine equipment

- Marine equipment shall be removed where feasible as per the triggers established within Table 2 (Section 6.5) of this FMP.
  - Silt curtains or other in-stream environmental controls are to be removed to a location outside of the 5-yr ARI flood event area
  - If feasible, in-stream work platforms must be secured to avoid causing damage to property.

3.4.2 Barge Mooring Plan

- Barges are not proposed to be used in relation to the required works.
- If Barges are required:
  - They shall be moored or secured as per a barge mooring plan where feasible as per the triggers for in-stream work platforms established within Table 3 of this FMP.
  - Any barges in use at the time of a flood warning trigger will cease works and either be moved to a designated mooring location or if not possible, must be secured to avoid causing damage to property

3.4.3 Vessel Traffic Management

- A Vessel Traffic Management Plan will be prepared for any scopes of works requiring marine vessels.
- Maritime Safety Queensland will be provided with a copy of the Vessel Traffic Management Plan (where applicable) as part of the Marine Execution Plan Process.

3.4.4 Marking of Navigational Hazards

- Navigational hazards such as piling pads, unattended piles, barge anchors, or silt curtains will be marked appropriately with navigational markers and signs.
- These markers will be installed in accordance with relevant guidelines and be designed to maintain appropriate demarcation during flooding events.

4 Flood Management – Moolabin Creek In-Stream Works

4.1 Relevant Project Works

The relevant project works to this plan are the in-stream works in Moolabin Creek associated with the construction of the new Moolabin Creek Bridges.

Moolabin Creek is not a tidal waterway. However, it is subject to frequent and extensive flooding, which can be caused by one or a combination of:

- Rainfall in the upper catchment
- Rainfall in the local catchment

Flooding is generally concentrated within the Brisbane River floodplains and tributaries with inundation in these areas sometimes occurring over several days. This can result in damage to buildings and roads, the risk to human life, and blocked access.

This FMP is not relevant to flooding of the main channel of the Brisbane River but is relevant to the flooding of the tributaries and stormwater systems.

4.2 Flood Assessment

4.2.1 Construction activities

Activities during construction that could result in adverse impacts to flooding include:

- Moolabin Structural Works (Bridge construction)
- General earthworks associated with
  - the abutment construction
  - reprofiling of bed and banks required for the bridge construction inclusive of the permanent scour protection installation
- Temporary in-stream works associated with in-stream rock platforms to enable the bridge construction
- Temporary and permanent drainage works.

4.2.2 Factors likely to affect flooding and impacts

Factors likely to affect the impact of flooding include:

- Size of the flood event
- Staging of the activities around creeks, channels, and other watercourses
- Temporary and permanent drainage capacities
- Temporary and permanent embankment heights
- Drainage and height of sites above the predicted flooding levels.

4.2.3 Impacts

The potential for impacts of flooding on construction depends on a number of factors. Primarily impacts will be dependent on the nature, extent, and magnitude of construction activities and their interaction with the natural environment. Potential impacts attributable to construction might include:

- Safety impacts

- Loss and/or damage of ancillary facilities, construction equipment/plant
- Sediment discharge into the receiving environment
- Increased area and depth of inundation
- Increased watercourse flow rates during rain events
- Increased duration of inundation

4.3 Specific Flood Management Measures

4.3.1 Early Warning Indicators

The following table summarises the frequency of monitoring associated with the Flood Warning and Response Procedure.

Table 4: Monitoring Frequency

Aspect	Frequency	Responsibility
Weather forecast	Daily when no risk or low-level risk triggered (See section 4.3.3)	Environmental Site Representative
Initial Flood Warning Trigger	Email subscription to BCC flood warning alerts	Environmental Site Representative / Project Engineer
Weather forecast	1-hourly when Medium or high-level risk triggered (See section 4.3.3)	Environmental Site Representative
Flood Levels	1-hourly monitoring when Medium or High-level risk triggered (See section 4.3.3)	Environmental Site Representative/ Project Engineer

The Environmental Site Representative and Project Engineer will monitor the Bureau of Meteorology (BoM) online Flood Warning Service, BCC flood alerts, and the latest river heights for Rocky Waterholes Creek (as an indicator for Moolabin Creek) daily during periods of rainfall. They will report the outcomes directly to the works supervisor and project manager (if required).

It is noted that whilst the Rocky Waterholes Creek catchment flooding levels may not line up perfectly with Moolabin Creek, it is commensurate with the levels that may occur in Moolabin Creek and represents the best data available to the project.

4.3.2 Storage of equipment and materials

- All dangerous and hazardous goods will be stored at the main compounds, outside the extent of a 5-yr ARI flood event, in a dangerous goods container that is purpose-built and compliant with the Australian Standard for the storage and handling of flammable and combustible liquids (AS 1940:2017).
- If safe to do so, in the event a flood greater than the 5-yr ARI is predicted, the dangerous goods container is to be removed/relocated from the site to a safe and secure location outside the extent of the predicted flood event.
- If safe to do so, all plant and equipment, including earthworks plant that is within the 5-year ARI Flood model, are to be moved and parked in areas outside the 5-year ARI flood extent or higher depending on information from the Flood Warning Service.
- If safe to do so, geofabric (or similar) is to be placed around material stockpiles that cannot be located outside of the 5-year ARI flood extent, to prevent erosion and loss of material.
- If safe to do so, parked vehicles are to be moved to a safe place away from t known areas of localised flash flooding before significant rainfall events at the discretion of project management. No movement of vehicles is permitted once the affected areas are flooded in the interest of all Unity team members, subcontractors, and other stakeholders' safety.

4.3.3 Predicted Rainfall Flooding Risk Management

- The trigger levels (sourced from BOM Brisbane forecast) are intended to initiate a detailed assessment of the situation and review of work activities as per Flood warning issued through the Queensland Flood Warning Centre or BCC Flood Warnings for properties in Yeerongpilly - based upon the river heights data for the Stable Swamp Creek at Musgrave Road station).

- Table 5.
  - Low-Level Risk (75 to 95mm of rainfall (2-year ARI, 6 hours) is expected over a 24-hour period, within a 72-hour/ 3-day forecast)
  - Medium-Level Risk (>95mm of rainfall (5-year ARI, 6 hours) is expected over a 24-hour period, within a 72-hour/ 3-day forecast)
  - Flood warning issued through the Queensland Flood Warning Centre or BCC Flood Warnings for properties in Yeerongpilly - based upon the river heights data for the Stable Swamp Creek at Musgrave Road station).

Table 5: Risk Level Responses – Moolabin Creek

Low Level	
At least daily monitoring of rainfall forecast	Environmental Site Representative / Project Engineer
Assessment of material within flood-prone areas to ensure minimal impact to the receiving environment in the event of a flood (i.e. potential removal of material or additional stabilisation if practical)	Project Engineer / Supervisor
Review erosion and sediment controls to ensure they are implemented and maintained in accordance with the approved Erosion and Sediment Control Plan (ESCP).	Environmental Site Representative / Supervisor
Preparation/planning for the potential removal of plant and equipment within flood-prone areas. Where safe, non-essential construction equipment (i.e. plant) and materials are removed from flood-prone areas.	Project Engineer / Supervisor
If daily monitoring indicates an exacerbation of conditions, a secondary assessment will be undertaken including reviewing the recent tidal conditions and rainfall forecast. Should an exacerbation of conditions be found to be likely, the Medium Flood Warning Trigger responses are to be implemented.	Delivery Manager

Medium Level	
1-hourly monitoring of flood warning system and rainfall forecast.	Environmental Site Representative
Where safe, non-essential construction equipment (i.e. plant) and materials are removed from flood-prone areas. Project Manager to determine if further equipment is removed from flood-prone areas.	Delivery Manager
Preparations to commence for securing in-stream work platforms and the removal of in-stream controls. Project Manager to determine if further actions are necessary.	Delivery Manager

High Level – Flood Warning Triggered	
1-hourly monitoring of flood warning system and rainfall forecast.	Environmental Site Representative / Project Engineer
Where safe, all construction equipment (i.e. plant) is removed from in-stream works/flood-prone areas.	Delivery Manager

Where safe, silt curtains or other in-stream environmental controls are to be removed to a location outside the 5-yr ARI flood event	Project Engineer / Supervisor
In-river work platforms must be secured to avoid causing damage to property.	Deliver Manager

4.3.4 Unpredicted Flood Event Risk Management

In the event of an unpredicted flood event, the emergency response protocols presented in section 6 will be implemented.

5 Flood Management – Rocky Water Holes Creek In-Stream Works

5.1 Relevant Project Works

The relevant project works to this plan are the in-stream works in Rocky Water Holes Creek associated with the construction of the new Rocky Water Holes Creek drainage outlet OUT/660.

Rocky Water Holes Creek is not a tidal waterway. However, it is subject to frequent and extensive flooding, which can be caused by one or a combination of:

- Rainfall in the upper catchment
- Rainfall in the local catchment

Flooding is generally concentrated within the Brisbane River floodplains and tributaries with inundation in these areas sometimes occurring over several days. This can result in damage to buildings and roads, the risk to human life, and blocked access.

This FMP is not relevant to flooding of the main channel of the Brisbane River but is relevant to the flooding of the tributaries and stormwater systems.

5.2 Flood Assessment

5.2.1 Construction activities

Activities during construction that could result in adverse impacts to flooding include:

- Temporary and permanent drainage works.

5.2.2 Factors likely to affect flooding and impacts

Factors likely to affect the impact of flooding include:

- Size of the flood event
- Staging of the activities around creeks, channels, and other watercourses
- Drainage and height of sites above the predicted flooding levels.

The latter is the key element pertaining to the likelihood of the in-stream works causing afflux. A review of the proposed temporary works in relations to the existing flood conditions confirmed that if flooding was to occur whilst in stream works are in place, they will not cause afflux event at lower flood events such as a 20%EAP.

5.2.3 Impacts

A review of the proposed temporary works in relations to the existing flood conditions confirmed that if flooding was to occur whilst in stream works are in place, the potential impact attributable to construction might include:

- Loss and/or damage of ancillary facilities, construction equipment/plant.
- Sediment discharge into the receiving environment.

5.3 Specific Flood Management Measures

5.3.1 Early Warning Indicators

The following table summarises the frequency of monitoring associated with the Flood Warning and Response Procedure.

Table 6: Monitoring Frequency

Aspect	Frequency	Responsibility
Weather forecast	Daily when no risk or low-level risk triggered (See section 4.3.3)	Environmental Site Representative
Initial Flood Warning Trigger	Email subscription to BCC flood warning alerts	Environmental Site Representative / Project Engineer
Weather forecast	1-hourly when Medium or high-level risk triggered (See section 4.3.3)	Environmental Site Representative
Flood Levels	1-hourly monitoring when Medium or High-level risk triggered (See section 4.3.3)	Environmental Site Representative/ Project Engineer

The Environmental Site Representative and Project Engineer will monitor the Bureau of Meteorology (BoM) online Flood Warning Service, BCC flood alerts, and the latest river heights for Rocky Waterholes Creek daily during periods of rainfall. They will report the outcomes directly to the works supervisor and project manager (if required).

5.3.2 Storage of equipment and materials

- All dangerous and hazardous goods will be stored at the main compounds, outside the extent of a 5-yr ARI flood event where possible, in a dangerous goods container that is purpose-built and compliant with the Australian Standard for the storage and handling of flammable and combustible liquids (AS 1940:2017).
- If safe to do so, in the event a flood greater than the 5-yr ARI is predicted, the dangerous goods container is to be removed/relocated from the site to a safe and secure location outside the extent of the predicted flood event.
- If safe to do so, all plant and equipment, including earthworks plant that is within the 5-year ARI Flood model, are to be moved and parked in areas outside the 5-year ARI flood extent or higher depending on information from the Flood Warning Service.
- If safe to do so, geofabric (or similar) is to be placed around material stockpiles that cannot be located outside of the 5-year ARI flood extent, to prevent erosion and loss of material.
- If safe to do so, parked vehicles are to be moved to a safe place away from t known areas of localised flash flooding before significant rainfall events at the discretion of project management. No movement of vehicles is permitted once the affected areas are flooded in the interest of all Unity team members, subcontractors, and other stakeholders' safety.

5.3.3 Predicted Rainfall Flooding Risk Management

- The trigger levels (sourced from BOM Brisbane forecast) are intended to initiate a detailed assessment of the situation and review of work activities as per Table 7.
  - Low-Level Risk (75 to 95mm of rainfall (2-year ARI, 6 hours) is expected over a 24-hour period, within a 72-hour/ 3-day forecast)
  - Medium-Level Risk (>95mm of rainfall (5-year ARI, 6 hours) is expected over a 24-hour period, within a 72-hour/ 3-day forecast)
  - Flood warning issued through the Queensland Flood Warning Centre or BCC Flood Warnings for properties in Yeerongpilly - based upon the river heights data for the Stable Swamp Creek at Musgrave Road station).

Table 7: Risk Level Responses – Rocky Water Holes Creek

Low Level	
At least daily monitoring of rainfall forecast	Environmental Site Representative / Project Engineer
Assessment of material within flood-prone areas to ensure minimal impact to the receiving environment in the event of a flood (i.e. potential removal of material or additional stabilisation if practical)	Project Engineer / Supervisor
Review erosion and sediment controls to ensure they are implemented and maintained in accordance with the approved Erosion and Sediment Control Plan (ESCP).	Environmental Site Representative / Supervisor
Preparation/planning for the potential removal of plant and equipment within flood-prone areas. Where safe, non-essential construction equipment (i.e. plant) and materials are removed from flood-prone areas.	Project Engineer / Supervisor
If daily monitoring indicates an exacerbation of conditions, a secondary assessment will be undertaken including reviewing the recent tidal conditions and rainfall forecast. Should an exacerbation of conditions be found to be likely, the Medium Flood Warning Trigger responses are to be implemented.	Delivery Manager

Medium Level	
1-hourly monitoring of flood warning system and rainfall forecast.	Environmental Site Representative
Where safe, non-essential construction equipment (i.e. plant) and materials are removed from flood-prone areas. Project Manager to determine if further equipment is removed from flood-prone areas.	Delivery Manager
Preparations to commence for securing in-stream work platforms and the removal of in-stream controls. Project Manager to determine if further actions are necessary.	Delivery Manager

High Level – Flood Warning Triggered	
1-hourly monitoring of flood warning system and rainfall forecast.	Environmental Site Representative / Project Engineer
Where safe, all construction equipment (i.e. plant) is removed from in-stream works/flood-prone areas.	Delivery Manager
Where safe, silt curtains or other in-stream environmental controls are to be removed to a location outside the 5-yr ARI flood event	Project Engineer / Supervisor
In-river work platforms must be secured to avoid causing damage to property.	Deliver Manager

5.3.4 Unpredicted Flood Event Risk Management

In the event of an unpredicted flood event, the emergency response protocols presented in section 6 will be implemented.

6 Emergency Response