Technical Project

Floodplain Risk Management Study

Template

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# Preface

This document provides a starting point for the preparation of a Technical Brief to support Council procurement of specialist services to undertake a Floodplain Risk Management Study and Plan.

The document is intentionally generic in nature to provide flexibility and local tailoring in study objectives, deliverables, scope, methodology, available study inputs and the flood mechanism and scale. There is an expectation that Council will consider the individual study requirements and tailor the brief as needed. Where required, both QRA and the Peer Review and Advisory Panel are available to provide advice and input.

The development of this guide has a been directly informed by Australian Rainfall and Runoff (2019), Australian Disaster Resilience Handbook Collection Handbook 7 (Handbook 7), Managing the Floodplain: Best Practice in Flood Risk Management in Australia, and the Queensland Flood Risk Management Framework (2021) to ensure compatibility with current national best practice.

This brief template does not cover general tendering or contractual matters.

Template text, which requires editing has been indicated as *[enter information specific to study].*

Guidance text that should be removed from the final project brief is indicated as *guidance information for deletion.*

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# Introduction

*[Council]* has received financial support through the Flood Risk Management Program, a jointly funded Australian and Queensland Government funding package managed by Queensland Reconstruction Authority (QRA), to undertake a *[**Floodplain Risk Management Study and Plan (or other type of mitigation assessment)]* for the *[location and/or catchment name]*.

## Project Stakeholders and Governance

Governance and stakeholder arrangements for *[this project]* are shown in *Figure [XX]* and Figure 1 below.

*Please provide a diagram of Council governance arrangements to reflect internal arrangements.*

**Queensland Reconstruction Authority**

Coordinator of funding for Flood Risk Management Program (FRMP)

**Department of Resources**

Responsible for capture of LiDAR as part of FRMP

**Independent Peer Review Panel and Advisory**

To ensure consistency with industry standards and current best practice

***Council***

Responsible for completing this Floodplain Risk Management Study and Plan

**Successful Tenderer**

Responsible for delivering scope of work outlined in this technical brief

Figure 1: Project Stakeholders

## Study Objectives

*Provide information around the intended study objectives and if it is a combined Floodplain Risk Management Study and Plan or for example, focusing on a mitigation assessment for a particular hotspot location. Provide information regarding how this study aligns with the* *Queensland Flood Risk Management Framework (refer Figure 2), previous data capture and studies and next steps.*

*The following section has been written assuming the project is a complete Floodplain Risk Management Study and Plan. Update this section as required.*

The recent Flood Study for *[location and / or catchment name]* provides an understanding of existing and future flood behaviour. *Provide a brief description of the study approach (i.e., creek / riverine or overland flow, hydrologic and hydraulic modelling completed, if calibration was completed etc.).* The aim of this Floodplain Risk Management Study and Plan (herein referred to as FRMS&P) is to use the outputs from the Flood Study to understand and quantify the existing and future flood risk and identify and assess potential options to manage this risk.

The primary objectives of this FRMS are to:

* Understand current and future flood risk across the study area, this includes considering the impact of climate change and future development
* Identify and assess the full range of management options including land use planning, design of built form, land and water management practices, disaster management, community awareness and resilience and structural mitigation options
* Provide the required information to inform future studies, updates to local planning schemes, disaster management planning, community education programs and future investment decisions
* To increase capacity and capability within *[Council]*
* Demonstrate best practice and set expectations for local flood risk management.

The FRMP will provide an agreed and prioritised plan of flood risk management options based on those assessed in the FRMS. This plan will include a strategy of implementation including priority, timeframe and how actions intend to be implemented.

Community consultation and engagement is an important part of an FRMS&P. Without community input, there is the potential that risk may not be adequately identified and described, that management measures and opportunities may be missed, and that preferred options may not be supported by the community.

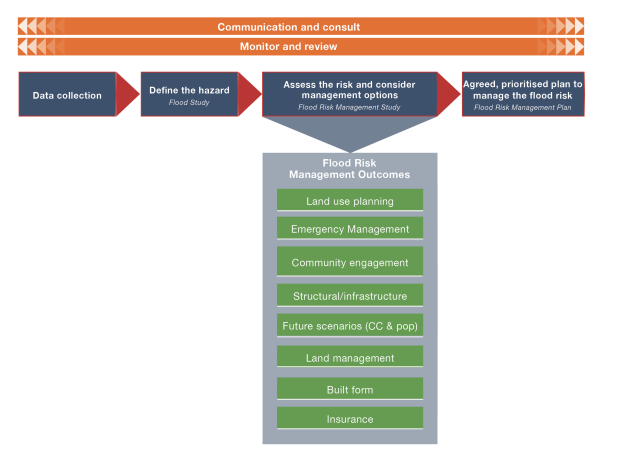
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Figure 2: Flood Risk Management Process (QRA, 2021)

## Purpose and Future Use of Floodplain Risk Management Study and Plan Outputs

*Provide a summary which reflects on the needs and focus of the identified user groups.*

This FRMS&P will inform investment decisions, updates to planning schemes, disaster response planning, community education programs, future studies, subsequently will be read by a broad range of users. This should be considered in the development of the FRMS&P and associated information. Likely users of this FRMS&P include:

* Engineers
* Hydrologists and meteorologists
* Floodplain managers
* Policy officers
* Land use planners
* Communications officers
* Disaster managers
* Emergency services (i.e., QFES, QPS etc)
* Community
* Insurers
* High-level decision makers.

*It is understood that some projects will are only focusing on certain elements of an FRMS&P (for example structural options only). In those instances, the following project brief template can be modified to best suit the projects purpose.*

# Background

*The following sections should be tailored to the area and support Council’s needs for the project. Where a section is not relevant to the project, remove. It may be beneficial to provide the corresponding Flood Study as an attachment to the project brief.*

## Study Area Overview

*Provide a summary of the following information where available:*

* *The catchment / city / town*
* *Defined area for flood risk definition*
* *Flood mechanism(s) to be defined (riverine, creek, and / or overland flow flooding)*
* *History of development*
* *Any key industries, cultural or community facilities*

*Provide a reference to a map (or maps).*

## Catchment Description

*Provide a summary of the following information where available and relevant:*

* *Catchment size (include a figure if available)*
* *Watercourses*
* *Topography (e.g., steep upper sections, flat flood plain) and any key topographic features*
* *Geology, soils and hydrogeology*
* *Ecosystems of interest and any important (marine and freshwater) water-dependent ecosystems*
* *Receiving waters*
* *Locations of environmental or cultural significance*
* *The general form and extent of drainage and any water sensitive urban design features (WSUD)*
* *The form and extent of residential/commercial/horticultural/other development across the catchment.*

## Socio-political Context

*Provide a summary of the following information where available and relevant:*

* *The local government area(s) involved*
* *The suburbs wholly or partially within the study area*
* *Any specific local government entities within the jurisdiction (e.g., regional subsidiaries)*
* *The relevant emergency services (i.e., State Emergency Service, Queensland Rural Fire Service, LDMGs and DDMGs, other local groups)*
* *Key legislative and policy instruments that are likely to have an influence on development and infrastructure in the area (Planning Schemes, Neighbourhood Plans, Strategies, Local Government Infrastructure Plans, water allocation plans etc.)*
* *Current disaster management plans for the study area.*

## Flood Behaviour Description

*Provide a summary of the current understanding of flood behaviour the area based on the Flood Study including the following information where available and relevant:*

* *Summary of the Flood Study methodology and findings related to the area*
* *Source of flooding (i.e., riverine, creek, tidal, and / or overland flow)*
* *Warning time and catchment response time*
* *Flooding duration (hours, days, months)*
* *Known flooding hot spots in the study area*
* *Areas subject to groundwater flooding (i.e., where the water table can rise above the surface of the ground and pond for periods of time)*
* *Frequently inundated areas and exacerbating factors (e.g., blockage, high tides, antecedent conditions)*
* *Major hydrologic and hydraulic features (including natural or constructed hydraulic controls, dams, bridges) as well as coincident tributary flooding.*

## Flood History Description

*Provide a summary of the following information where available and relevant:*

* *Description of most recent events including warning time, duration and magnitude if known*
* *Largest recorded events (in terms of their peak height and / or flow)*
* *Historic areas of inundation*
* *Impacts to the community (e.g., damage to property and community facilities, loss of life, areas cut off, disruption to community function)*
* *Any notable occurrences (e.g., levee was overtopped, dam was full, bridge was blocked and overtopped)*
* *Data availability such as gauges, flood marks, photographs, videos etc.*

*Where relevant and available it is useful to provide a map of adequate resolution to describe the study area and key features, such as waterways, receiving waters, towns/suburbs, main roads, key infrastructure etc.*

*If practical the map(s) should overlay an aerial image and cadastral information. If this is not feasible due to depth of detail, then separate maps should be provided.*

*The maps(s) should include a legend, appropriate labelling to orient the reader, and should be produced at a minimum of A4 size.*

# Available Information

*Provide a summary of known available and relevant information, data format, known gaps and data which will require collection as part of this study. Data should be summarised with an attachment, or in table with a brief description, format, author or source, year, etc.*

*Not all data listed below will be required for an FRMS&P and will depend on the previous Flood Study completed. Where an update from ARR87 to ARR19 is required, or calibration / validation to a recent event (i.e., 2021-22 rainfall and flooding events) there will likely be larger data requirements.*

*This data will likely include the following where available and relevant:*

* *Previous studies (flood studies, risk management studies, infrastructure studies etc.)*
* *Existing Models*
  + *Hydrologic models (including date, software, ARR methodology)*
  + *Hydraulic models (including date, software, ARR methodology)*
  + *Relevant models would be provided to the successful tenderer including model files, associated files and model log*
* *Historical flood information*
  + *Flood level marks and extents*
  + *Gauge data (rainfall, water level, stream flow)*
  + *Photos, videos (preferably with dates and times)*
  + *Antecedent conditions*
  + *Community complaints / comments*
  + *Anecdotal evidence, damage reports*
  + *Number of people / properties affected*
  + *Damage to infrastructure*
* *Spatial Datasets*
  + *Flood hazard overlay extents*
  + *Geographic information system (GIS) layers the Council or any other organisation has including cadastre, waterways, natural environment areas, street names, roads, building footprints, and land-use planning areas etc.*
* *Survey Data* 
  + *Digital Elevation Models (DEMs) or LiDAR data, creek / river cross sections or bathymetric surveys*
  + *Locations, dimensions and invert levels of drainage assets*
  + *Floor level information*
  + *Any survey data for current or existing structures (e.g., bridges, culverts, weirs, levees, irrigation channels, dams, asset management information systems)*

The data listed in Table 1 will be provided, or arrangements made for access prior to commencement of the project.

Table : Available information for *[this study]*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Dataset | Description | Format | Author / Source | Date | Relevant comments |
| *Previous Studies (flood studies, flood risk management studies etc.)* | *Provide a description of study purpose, outputs, use, gaps etc.* | *Report, hydrologic / hydraulic model availability etc.* | *Previous consultant, or if Council report* | *Date finalised* | *Any comments considered relevant.* |
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*Modify table setup and information as required.*

# Current Guidelines and References

The FRMS&P should be delivered in line with current industry best practice guidelines, manuals and technical reference documents relevant to the project, including as listed but not limited to those in Table 2.

Table : Current Guidelines and References

|  |
| --- |
| **Reference Document** |
| Australian Rainfall and Runoff (ARR) 2019 - all projects and chapters  <https://arr.ga.gov.au/arr-guideline> |
| Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (Handbook 7) (AIDR, 2017) and all supporting documents  <https://knowledge.aidr.org.au/media/3521/adr-handbook-7.pdf> |
| Queensland Flood Risk Management Framework (QRA, 2021)  <https://www.qra.qld.gov.au/sites/default/files/2021-06/queensland_flood_risk_management_framework_2021_qfrmf_0.pdf> |
| Economic Assessment Framework of Flood Risk Management Projects (QRA, 2021)  <https://www.qra.qld.gov.au/sites/default/files/2021-05/economic_assessment_framework_of_flood_management_projects_2021_0.pdf> |
| *Local Government Planning Schemes and Policy Documents* |
| *Local Floodplain Management/Water related Strategies etc* |
| *Relevant Catchment Action Plans* |
| *Local Corridor Plans* |
| State Planning Policy (SPP), Natural Hazards, Risks and Resilience – Flood  <https://dilgpprd.blob.core.windows.net/general/spp-guidance-natural-hazards-risk-resilience-flood.pdf> |
| Queensland Urban Drainage Manual  <https://ipweaq.intersearch.com.au/ipweaqjspui/bitstream/1/4983/1/2042%20QUDM%20FINAL%2018%20August%202017%20%282%29.pdf> |
| Coastal hazard technical guide, Determining coastal hazard areas (former DEHP)  <https://www.qld.gov.au/__data/assets/pdf_file/0025/67462/hazards-guideline.pdf> |
| A guide to ‘good practice’ storm inundation mapping and modelling (DES, 2018)  <https://www.publications.qld.gov.au/ckan-publications-attachments-prod/resources/93336e30-e1fd-4a1e-89e8-b4056692e26c/storm-tide-inundation-guidelines.pdf?ETag=2f101b1511eccc53dee83079b543d9ec> |

# Scope of Work

The primary purpose of this FRMS&P is to better understand flood risk across the study area and develop a plan to manage this risk into the future. To achieve this and satisfy objectives outlined in Section 1.3, the proposed scope of work to be delivered is outlined below. Tenders are to provide a detailed proposed methodology to deliver this scope of work.

## Data Collection and Review

At the project inception, Council will provide the available data listed in Table 1. Additional data required for collection and / or development is outlined below.

*Note that data collection could be delivered by Council or included in the scope of works for the successful tenderer to arrange. The cost of survey capture including floor level survey capture would be included as an optional item with indicative costs only. Extent of capture and associated costs would be refined following engagement and receival of quotes from surveyors.*

*Upon engagement, the successful tenderer will seek quotes from a minimum of three subconsultants to submit to Council with a data collection brief outlining evaluation, recommendation and upper limit fee to undertake this portion of work. Following approval from Council, the successful tenderer shall arrange for data collection to be undertaken. The successful tenderer will be responsible for engagement and supervision of the approved subconsultant and will be responsible for ensuring the overall quality of the data.*

### Flood Study Review

*Requirements for a Flood Study review will only be required where it has been some time since the Flood Study was completed. Generally, it has been assumed the Flood Study is fit for the purpose of completing a FRMS&P. Where Council believes a Flood Study review may be required, this section describes the requirements of a Flood Study review. This section should be deleted if not required.*

*A comprehensive review of the Flood Study and data review should be completed as part of the initial stage of the study. This should aim to identify if all necessary data is available, the quality of data available, the appropriateness of the model setup and schematisation for a FRMS&P and provide recommendations to Council where model updates or additional datasets will be required. This should be raised with Council early to ensure a suitable methodology for addressing gaps can be identified and agreed.*

### Floor Level Survey and Property Database

*Council should modify this section based on individual study needs.*

*For Councils receiving LiDAR as part of the Flood Risk Management Funding Program, floor levels will also be generated using algorithmic capture methods and provided as part of delivery. Provide a summary of the extent of floor level data available and the capture methods.*

*Where there is no current floor level data available, provide a summary of floor level survey capture requirements including if multiple capture methods are required and for which flood likelihoods (i.e., MLS up to the 1% AEP design flood extent and algorithmic from the 1% AEP design flood extent to the PMF). The Economic Assessment Framework of Flood Risk Management Projects (QRA, 2021) provides a detailed summary of capture methods, estimated accuracy, cost, limitations and the influence of survey accuracy on flood damages assessments. Available capture methods are described briefly below:*

* *Traditional survey – qualified surveyors will manually survey the floor level and ground level of each property.*
* *Mobile laser scanning (MLS) – uses a car-mounted, side-facing mobile laser scanner to capture a densely populated point cloud of survey points.*
* *Airborne laser scanning (ALS) – uses ALS or LiDAR and Google Street View to identify and extract the eave height. The floor level is estimated based on the eave height and an assumed ceiling height based on Google Street View.*
* *Desktop – uses LiDAR and Google Street View to identify the floor type (i.e., slab-on-ground, lowset etc.). Floor level is estimated based on a relative difference from the ground level and the assumed floor height from Google Street View.*
* *Algorithmic – uses a combination of LiDAR, a programming language compatible with GIS and other GIS-based algorithms to estimate eave levels, ground levels and floor levels based on a series of rules.*

*Each capture method has varying degrees of accuracy and cost. Council should consider how the floor level dataset may be used in the future. Where there are budgetary constraints and the primary use of the floor level dataset is for this study, higher accuracy and more costly survey methods may not necessary and cheaper methods such as desktop or algorithmic survey capture methods can still provide a fit-for-purpose dataset.*

*For detailed information around the influence of survey accuracy on flood damages assessments refer to the Brisbane River Floor Level Survey Analysis (WMA Water, 2019) or the summary included in the Economic Assessment Framework of Flood Risk Management Projects (QRA, 2021).*

A key deliverable will be the property database for the full floodplain including the following fields as a minimum:

* Unique ID (separate to Lot Parcel ID)
* Lot Parcel ID
* Address
* Land Use
* Building footprint area
* Ground Level (m AHD)
* Floor Level (m AHD)
* Floor Level estimation method
* Building type (detached house, semi-detached house, townhouse, terrace house / row house, unit – duplex, unit – multi-level)
* Floor type (slab-on-ground, lowset, highset, two-storey, multi-storey)
* Stage Damage Curve used
* Flood height (m AHD) for the full range of design events
* Flood damages across the full range of design events.

## Site Visit

A site visit is to be undertaken as part of all studies to ensure the successful tenderer has an appreciation of catchment condition and major hydrologic and hydraulic features. Expected outcomes of the site visit include:

* Understanding of potential flooding mechanisms and flows paths
* Location of all key stormwater assets within the catchment to ensure accuracy of dataset
* Where information is missing, capture sizing and invert levels of key structures
* Ensure major hydraulic features including cross-drainage infrastructure is identified
* Appreciate the type of development throughout the study area including locations of vulnerable and sensitive uses
* Identify major access roads across the study area that either are identified as major evacuation routes or may act as evacuation routes.

The initial site visit can also provide an opportunity for Council to raise any potential issues and highlight areas of interest.

## Flood Modelling

*Provide a description of any known modelling updates or calibration to recent events.* The hydrologic and hydraulic model from the Flood Study will be updated based on any required updates identified as part of the Flood Study and Data Review component outlined in Section 5.1.

### GIS Systems

All analysis, modelling and study outputs are required to be undertaken under the following GIS specification.

* Datum GDA 2020
* Coordinate System *[MGA 54 /MGA 55 / MGA 56].*

### Design Event and Sensitivity Scenarios

*Provide a list of the expected design events.* The full range of standard design events that should be included into the current and mitigated scenario assessment and include at a minimum 50% AEP, 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP, 1% AEP including climate change, 0.5% AEP, 0.1% AEP, 0.05% AEP design flood events and the PMF.

Additional sensitivity scenarios to consider include:

* Tailwater conditions including consideration of coincident flooding where discharging to a larger river system
* Tidal conditions if the downstream water body is tidal
* Dam break scenario
* Levee failure
* Blockage scenarios in line with ARR19.

Tenders should include a description of how sensitivity scenarios will be assessed as part of the project.

## Community Consultation

*Community consultation has a multitude of benefits to the floodplain risk management process and should be incorporated as part of every study. The extent of community consultation will be different for each study.*

An important part of an FRMS&P is the community consultation process, which aims to inform the community of the upcoming study and provide the community an opportunity to be involved. This consultation process is completed in two main components namely, at the commencement of the study and public exhibition of the draft FRMS&P prior to finalisation of the plan. *This process should be tailored for the study requirements, however, may include the following:*

* Initial community consultation
  + Preparation of an information leaflet providing information around the planned FRMS&P and details of how the community can be involved.
  + Preparation of a questionnaire form seeking information around historic flood behaviour, known key issues, areas the community considers hotspots, other general information and the community’s input on different management options. *Where calibration to a recent event is required additional questions seeking flood marks, photographs and videos.*
  + *Advertisement will be important to ensure the community is aware of the questionnaire.*
* Public exhibition consultation
  + Advertisement of where and how the community can review the Draft Floodplain Risk Management Study and Plan report (i.e., via Council website, mail drop, newspaper, etc.)
  + Two week period where the community are able to review the draft report and draft FRMP and provide any questions, comments or additional information
  + Organised community consultation sessions where the community can drop-in and ask questions or provide feedback
  + Two to four week period where the successful tenderer will address or answer any comments provided by the community.

Following this process, the FRMS&P will be considered by Council for approval and finalisation.

## Assessment of Current Flood Risk

Flood risk considers both the likelihood and consequences including the flood behaviour across the full range of design events, exposure, land use, vulnerability, community tolerability, evacuation or isolation constraints and any other risks including loss of services. There will always be local context that needs to be incorporated in understanding flood risk across a catchment.

Tenders should include the following items as a minimum in the preparation of their response:

* Detailed description of flood behaviour across the study area including a summary of flood behaviour for design events, results of the sensitivity scenarios and the significance (i.e., is the flood risk particularly sensitive to network blockages)
* Hydraulic classification (i.e., definition of flood fringe, storage and floodway)
* Hazard classification should be consistent with hazard definitions from Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (Handbook 7) (AIDR, 2017)
* Community vulnerability analysis, which should consider population demographics, mobility and physical vulnerability, social and economic vulnerability and flood awareness and resilience
* The community consultation outlined in Section 5.4 should include questions that will inform the understanding of community tolerability to flood risk
* Flood emergency response classification including low and high flood islands as a minimum
* Assessment of flood risk of evacuation routes, this may include either already identified evacuation routes or routes identified as part of this study. This assessment should assess the first event inundation, provide information relating to time to inundation and duration of inundation
* Assessment of property flood risk across the study area including consideration of use, event first impacted, identification of vulnerable and sensitive uses, time to inundation and duration of inundation
* Any information relating to time to inundation should, where possible, be linked back to a gauge level to provide a reference. Analysis and discussion of the potential variability relating to time to inundation is important to identify how the potential warning time may change based on different types of flood events
* Analysis of exposure of critical infrastructure
* Hot spot identification across the study area based on the findings of the above assessment.

## Assessment of Future Flood Risk

### Climate Change

A climate change scenario should be included in all studies. Where considered appropriate a flood event rarer than the design event can be utilised as a proxy for a climate change scenario. The tenderer should include an assessment of how flood risk is impacted in the future under a climate change scenario.

*Where there is an understanding of how sensitivity the flood risk is to climate change, select the appropriate RCP to include in the study. Where there isn’t an understanding of the catchments sensitivity to climate change, as a minimum assess RCP 4.5 and RCP 8.5.*

### Future Development

The impact of future development on flood risk should be assessed and discussed. It is recommended that a minimum of two future development scenarios are included. These scenarios should be based on current land use zoning and include future consolidation and expansion across the study area.

The successful tenderer will work with Council engineers and planners and the peer reviewer to develop a minimum of two future development scenarios. The setup of these scenarios will vary for different floodplains based on flood behaviour, sensitivity to climate change, and planned future development.

The expected outcome of this assessment is to understand the floodplains sensitivity to increases in development across the floodplain, high-level identification of any areas that may be more sensitive to fill, consideration of appropriateness of current planning levels.

## Economic Assessment of Flood Risk

An important component of an FRMS&P is the assessment of flood damages across the floodplain. This provides a mechanism to quantify the cost of flooding and forms the basis for which the benefit of management options can be assessed. The approach to the economic assessment should be consistent with the Economic Assessment Framework of Flood Risk Management Projects (QRA, 2021).

Tenderers should consider the following in their proposed flood damages methodology:

* All categories of flood damages should be qualified to understand the relative significance (for example agriculture costs are likely to be more significant in a rural environment than in a primarily urban environment)
* All damages identified as significant for the floodplain should be quantified. The Economic Assessment Framework of Flood Risk Management Projects (QRA, 2021) provides three tiers of quantification approaches for each damage type
* Flood damages should be quantified across the full range of design flood events and include an assessment of direct and indirect tangible damages and intangible damages
* Average Annual Damages (AAD) should be estimated to understand the average estimated damages from flooding for the study area over a very long time period.
* The impact of future development and climate change on future flood damage estimates should be assessed and reported
* Reporting should provide information on damages for each category of flood damages (property, transport, agriculture, emergency costs etc.), number of properties affected below floor, above floor, for each land use category (residential, commercial etc.), damages for each type (direct tangible, indirect tangible and intangible) and the average annual damages
* All assessment, assumptions and data limitations should be clearly documented in the final report.

*Council should consider the level of detail required for the flood damages assessment. For example, would it be beneficial to develop locally specific stage damage curves for property damages, or is further research required to understand the cost of agricultural damages? It will not be necessary to undertake this additional research for all projects. Where there are budgetary constraints and it is not likely to change the outcome of the FRMS&P, methods are available to estimate each type of flood damages. Both QRA and the Peer Review and Advisory Panel are available to advice regarding this component.*

## Options Identification and Assessment

An important component of a FRMS&P is to identify potential options to manage the flood risk both now and into the future. The option and identification should take a 2-tiered approach, with a long list of preliminary options identified. The list is then refined to a list of options considered to have merit based upon the preliminary assessment. The refined list progresses to detailed option assessment.

This process should be informed by local knowledge, community consultation, past studies that may have identified potential management options, Council knowledge and the understanding gained from the flood risk assessment.

The full range of management options should be considered including land use planning, design of built form, land and water management practices, disaster management, community resilience and response management and structural mitigation. All options should be assessed within an integrated catchment planning approach that understands there are a number of competing priorities including ecosystem health, development, alternate cycles of drought and flood, social and economic priorities.

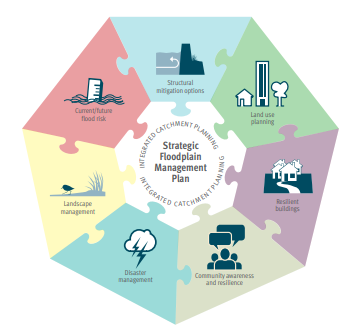


Figure 3 Integrated Flood Risk Management Planning

### Preliminary Options Identification and Assessment

The successful tenderer will complete an initial preliminary options identification. This will include the identification of many options to undergo a preliminary assessment. The purpose is to identify which options have merit for more detailed assessment. While, detailed modelling and optioneering is not required as part of this assessment, options that can be assessed hydraulically should be subject to modelling of concept for the purposes of validation and identification of potential hydraulic impacts.

### Detailed Options Assessment

Options identified in the preliminary options assessment should be assessed as part of the detailed options assessment. Options shortlisted based upon preliminary assessment, should be investigated in significant detail to understand the feasibility, benefit, cost-effectiveness, social and environmental impacts. The tenderer will consider the following items as a minimum in their response:

* Where possible, all options should be assessed for their impact on flood behaviour based across the full range of design events.
* Options viability under both the existing climate and a future climate should be considered.
* An economic assessment should be completed, including the options impact on the AAD and preparation of a benefit-cost ratio and return on investment. Economic assessment of options should consider the complete life-cycle costs including any future management costs. References should be included for how options have been costed. Given the early phase of the options assessment, assumptions and limitations will apply and these should be documented.
* Option limitations, unknowns, or required future studies (i.e., environmental impact statement, detailed economic assessment, detailed engineering design, impact on future development) should be documented.
* Assessment of all options through a multi-criteria assessment (MCA). This should consider all relevant factors from social, environmental, economic, political and flood behaviour. MCA criteria and associated weighting should be developed in consultation with Council, relevant stakeholders and the peer reviewer.
* Options should be initially prioritised based on the results of the MCA. This forms the Draft FRMP and will be finalised following public exhibition discussed in Section 5.9.

### Land Use Planning

*Provide a summary of the level of analysis expected to identify land use planning options.*

As part of the land use planning component, the following items should be considered:

* Review of current land use planning schemes and other relevant policies and overlay with the current understanding of current and future flood risk
* Review and provide feedback on Council’s current overlay codes
* In conjunction with other flood risk constraints (i.e., hazard, evacuation constraints etc.) and the results of the future development scenarios consider the appropriateness of the current zoning
* Identify and assess potential updates to the land use planning scheme and any other relevant policy documents or strategies
* Data produced as part of the FRMS and the assessment of current and future risk can be used to inform the completion of a State Planning Policy (SPP) compliant risk assessment.

### Design of built form

Identify and assess potential property specific actions to reduce flood risk. This should include the following items:

* Identification of at-risk properties across the study area, for which property specific actions are appropriate
* Undertake an economic assessment of property specific options including, voluntary house purchase, voluntary house raising and flood resilient design actions
* Make recommendations for how property specific actions could be implemented in the study area.

### Land and water management practices

The successful tenderer should review and summarise the current approach to land and water management practices. Identify current issues including but not limited to erosion hot spots, weed management, pollution, unregulated farm dams or levees etc.

Provide a summary and assessment of options for improved integrated land and water management practices. These options may include practices such as, water sensitive urban design, revegetation in the upper catchment, erosion management at hot spot locations, options looking at addressing pollution or ecosystem health. Hydraulic modelling should be completed for options as required.

*Where there are known issues within the study area, (such as pest species, channel erosion, increased channel sedimentation, historic clearing of vegetation etc.) provide a detailed summary of these to provide the tenders an appreciation of potential study requirements. For example, it may be necessary to engage sub-consultant ecologists or environmental scientists to provide technical input where there are complex issues. Provide links and information around current land and water management practices.*

### Disaster Management

*Where there are known gaps in the system, provide a description of these. If there is a corresponding total flood warning project, disaster dashboard project or other projects underway as well ensure that the outputs of this study align and support the delivery of those projects. This section will need to be tailored to each Council’s individual needs. Where required, both QRA and the Peer Review and Advisory Panel are available to provide advice and input.*

Complete a review of current disaster management planning documents, current flood intelligence, and undertake a review of the current flood warning system for the subject study area. As part of this, the successful tenderer should consider the below:

* Develop information and tools to inform emergency management including but not limited to
  + forecast location diagrams,
  + time to inundation information,
  + assessment of critical and sensitive infrastructure,
  + assessment of known evacuation routes or significant roads,
  + identification of isolation and evacuation constraints,
  + the identification of particularly risk areas in the floodplain (i.e., flash flooding, limited warning time, isolated first then inundated),
  + assessment of evacuation centres,
  + identify triggers for key actions,
  + spatial based tools to assess at risk infrastructure and property during an event with instructions for use.
* The development of information and tools should be prepared in consultation with Council officers, engineers, and disaster managers to understand the local context and needs
* Provide advice and recommendations for how outputs and tools from the FRMS can be used to inform response
* Based on an understanding of flood behaviour, evacuation constraints, areas of isolation, high risk areas, vulnerable community members etc., provide some recommendations or advice on how disaster management for the study area can be improved
* Identify and provide recommendations for how the current disaster management and flood warning system can be improved. This should consider what the current system looks like and reasonable improvements (i.e., a paper based system to a complete real time forecasting system would not be achievable)
* Consider results of the community consultation with regards to commentary on previous messaging and warnings, alerts, evacuation, access to items like sandbags, warning time, and support during and after an event
* Identify and provide recommendations for how any system redundancies and vulnerabilities can be improved
* Review and make recommendations for how products and services from the Bureau of Meteorology can be used
* Recommendations should be integrated with an all hazards approach and recognise other sources of flooding.

### Community resilience and response management

*This section will need to be tailored to each Council’s individual needs. Where required, both QRA and the Peer Review and Advisory Panel are available to provide advice and input. Consider what is known about the community or any already identified issues to be incorporated. Provide a summary of the current understanding of community resilience. This will be further refined and understood as part of the FRMS but include a summary of things like if the community is particularly engaged or not engaged, if previous resilience campaigns have been completed etc.*

Based on the findings from the community consultation, any market research completed and the vulnerability assessment, provide a summary of the communities needs and identify potential options to improve community resilience and response. As part of this, the successful tenderer should consider the below:

* Consistency with the state-wide Get Ready Program and Flood Communication Toolkit
* Develop appropriately scaled community profiles across the study area, which provide insight into how vulnerability varies across the area
* Provide a summary of key findings such as economic vulnerability is significant in some areas, large portion of transient communities or large portion of non-English speaking communities
* Prepare engagement materials for the Public Exhibition that will support resilience building. These materials are in addition to the materials seeking feedback on the Draft FRMS&P
* Based on the above, identify options to improve community resilience and response across the community. This may include things like:
  + Education and awareness campaigns (across different community groups i.e., school based and to a wider audience etc.)
  + Engagement plans
  + Community led initiatives
  + Place-based installations
  + Engagement leveraging off existing community events
  + Continuity panning resources for businesses and organisations.

The above potential list of resilience and response management options is not exhaustive and will be informed by each local community needs.

### Structural mitigation

The study should include the identification and assessment of structural management options. These should be informed by Council knowledge, community consultation comments and the understanding of flood risk and flood behaviour gained from the study. The assessment of structural options should include:

* An assessment of the impact on flood behaviour and risk across the study area
* An economic assessment of options to understand the change to flood damages including AAD. This should also include a life-cycle cost assessment to provide indicative benefit-cost ratios and return on investment
* Consider any feasibility constraints and ongoing maintenance requirements
* Identify all available structural options including stormwater network upgrades, hydraulic structures, levees and embankments, temporary flood barriers, channel modification, channel maintenance, flood storage areas and dams.

All identified options should be assessed through the multi-criteria assessment.

## Floodplain Risk Management Plan

As part of the options identification and assessment, identify and prioritise management options to include in the Draft Floodplain Risk Management Plan.

An important part prior to finalisation is understanding community support or opposition for options. This is incorporated into option prioritisation through the multi-criteria assessment. As part of the community consultation described in Section 5.4, seek feedback on the options included in the plan. The weightings for community support / opposition in the MCA are likely to change following public exhibition of the draft plan. This is an important component and without seeking this feedback, options are unlikely to proceed.

The Floodplain Risk Management Plan can be finalised following community public exhibition and should identify all recommended options, order of priority, expected initial and ongoing costs, if funding would be available and the timeframe in which options should be implemented.

## Deliverables

Deliverables to be provided are outlined in Table 3 below. It is expected deliverables will be provided via a data handover pack, which will include a description of file location, information included and how to interpret if necessary.

Table 3: Deliverable Requirements

|  |  |  |
| --- | --- | --- |
| Deliverable | Item | Requirements |
| Data | Any captured, generated and processed data. | Where data has been captured (i.e., ground survey, floor level etc.) provide a corresponding QA report. |
| Spatial information | Any captured, generated and processed data. | *Council to specify what GIS format is required (i.e., \*.shp or \*.tab)* |
| Model Files (hydrologic and hydraulic) | Modelling input files |  |
| Output files (raw) | Water surface level, depth, velocity, Z0, ZAEM1  All scenarios should be provided including:   * + - All design events     - Climate change     - Future development scenarios     - Mitigation options.   *Input which grid type is preferred (i.e., \*.flt or \*.asc)* |
| Hydrologic analysis | Where updates have been made as part of the FRMS - catchment and sub-catchment delineation (\*.shp), ARR Data Hub download, and temporal pattern analysis. |
| Processed output files | Water surface level, depth, velocity, Z0, ZAEM1, impact mapping  *Input which grid type is preferred (i.e., \*.flt or \*.asc)*  Datum GDA 2020  Coordinate System *[MGA 54 / MGA 55 / MGA 56]* |
| Timeseries outputs (XMDF) | *Input which design events and scenarios you would like timeseries information.* |
| Log files and check files | Only required for one design event not all |
| Modelling log | Should include any necessary instructions for model use, a summary of design events, scenario setup including sensitivity runs and details of critical duration assessment. |
| FRMS Processed outputs | Any results of the FRMS analysis or processed outputs. | Provision of all and any FRMS outputs including:   * + - Hydraulic classification,     - Hazard classification,     - Vulnerability analysis     - Future development scenarios     - Emergency response classifications     - Building database     - Flood damages database     - Information to support emergency management     - Hot spot identification |
| Flood Damages | All files relating to the flood damages assessment | Stage damage curves |
| Damages assessment tool (i.e., spreadsheet, code etc.) and instructions for use |
| Any other locally specific quantification tools |
| Damages database |
| Tools and Materials | Provision of any tools or materials prepared as part of the FRMS. | Any necessary instructions for interpretation, use or replication will be provided. |
| Multi-criteria analysis | MCA tool and assessment results | Excel |
| Mapping | Water surface level (m AHD) | PDF |
| Flood depth (m) |
| Flood velocity (m/s) |
| Velocity x depth |
| Hazard (ZAEM1) |
| Reporting | Final Report | PDF  Individual maps and figures to be provided as separate files. |
| Any interim reports not included in the final report. | PDF |
| Community Consultation | Summary of community consultation comments and how these have been responded to or addressed. | Excel or word |

# Intellectual Property

All data, models, modelling inputs and results, and reports associated with the development of the *Floodplain Risk Management Study and Plan* is licensed by *Council* under a Creative Commons Attribution (CC BY) 4.0 international licence. To view a copy of this licence, visit: <https://creativecommons.org/licenses/by/4.0/>

The successful tenderer must provide all required files to ensure Council or future consultants can view, modify and run the hydrologic and hydraulic model. This includes instructions of use, a detailed model log, results and details of post processing to ensure final results can be replicated.

Where internal scripts or tools have been prepared and are required to modify and/or run models, or post process results, these will be provided along with instructions of use.

# Program and Milestones

Under the FRMP funding arrangements there is a requirement that studies be completed by June 2026.

Tenderers are requested to provide a high-level schedule as part of their response outlining how the project will be delivered to meet the timeframe requirements with program dates specified for the milestones documented in Table 4.

Table 4: Draft Project Program

|  |  |
| --- | --- |
| Milestone | Target Date |
| Completion of any required updates to the modelling (for example update to ARR19) – *this may not be required* | *Input desired target dates* |
| Peer review hold point – *this may not be required* |  |
| Assessment of current and future flood risk |  |
| Peer review hold point |  |
| Economic Assessment of Flood Risk |  |
| Initial Options Identification |  |
| Peer review hold point |  |
| Assessment of identified options |  |
| Draft Floodplain Risk Management Study and Plan |  |
| Peer review hold point |  |
| Community Consultation |  |
| Finalisation of Floodplain Risk Management Study and Plan |  |

## Peer Review Process

QRA has arranged an Independent Peer Review and Advisory Panel to ensure projects delivered are consistent with industry standards and current best practice. This review process will include a minimum of three review points. Council may require more than three review points depending on the complexity of the project and Council’s needs.

To achieve project program and budgetary constraints, the proposed review process is recommended to be collaborative and proactive. That is, the successful tenderer is required to engage with the appointed project peer reviewer and with Council in an open forum to discuss the proposed approach prior to undertaking tasks. To this end, the project peer reviewer will attend and provide input into the project progress meetings documented in the subsequent section.

Proposed review points are detailed in Table 5 below, additional review points may be added as needed. To support the Peer Review process there is a minimum expectation that at each review point the successful tenderer will provide to Council and the reviewer the following:

* Draft reporting documenting the appropriate sections of the ultimate floodplain risk management study and plan report
* Modelling files and results
* Modelling QA log
* Any other analysis relevant to the review.

At each specified review point, the project peer reviewer will have a single opportunity to review the provided information and provide a single completed review document. Each item will be classified as OK, minor or major issue, with all major issues requiring rectification by the successful tenderer and close out with the peer reviewer before proceeding.

Table : Peer Review Points

|  |  |  |
| --- | --- | --- |
| Proposed review points | Deliverable | Target Date |
| Review Point 1 | Assessment of current and future flood risk | *Anticipated date* |
| Review Point 2 | Economic Assessment of Flood Risk and Initial Options Identification | *Anticipated date* |
| Review Point 3 | Draft Floodplain Risk Management Study and Plan | *Anticipated date* |

## Progress Reporting

*Council should update this section as required for internal reporting requirements. It may be necessary to request an informal monthly teams catch-up.*

Project progress shall be communicated and tracked via regular project meetings and project progress reports. Project meetings will be arranged as needed, however, will include the following key points:

* Inception meeting
* Presentation of data review and any updates to modelling
* Preparation and results of community consultation material
* Assessment of current flood risk
* Assessment of future flood risk
* Economic assessment of flood risk
* Options identification and preliminary assessment
* Detailed options assessment
* Draft Floodplain Risk Management Study and Plan
* Finalisation of Floodplain Risk Management Study and Plan.

It is expected the successful tenderer will provide high level progress reporting monthly. This report will include the project status based on the agreed project schedule, work completed in the reporting month, work to be completed next month, any emerging risks or issues, and decisions required from Council.

# Glossary

|  |  |
| --- | --- |
| Term | Definition |
| Average Annual Damages (AAD) | Average damage per year that would occur in a nominated area over a very long period of time. |
| Annual Exceedance Probability (AEP) | Annual Exceedance Probability (AEP)  expresses the probability of an event being equalled or exceeded in any year in percentage terms, for example, the 1% AEP design flood discharge. (ARR, 2019) |
| Australian Height Datum (AHD) | Australian surface level datum approximately corresponding to mean sea level. |
| Catchment | Area of land draining to a particular site downstream. |
| Digital Elevation Model (DEM) | Spatial dataset representing the topographic surface of the earth excluding buildings and trees. |
| Discharge | Rate of flow of water in terms of volume per time (m3/s). |
| Floodplain | Extent of land which could be subject to inundation from floods up to and including the PMF. |
| Flood risk | Flood risk considers the likelihood and consequences including the flood behaviour across the full range of design events, exposure, land use, vulnerability, tolerability, evacuation or isolation, other risks including loss of services. Flood risk should be determined at the local level to reflect local context. |
| Hydraulics | Represents the study of how water flows through waterways and estimates flood behaviour parameters such as water level, depth and velocity. |
| Hydrology | Refers to the rainfall runoff process and provides a way to estimate peak flows, volumes and flow hydrographs at specified locations within the catchment. |
| Hydrograph | A graph showing the flood flow or level (stage) for different times during a flood. |
| LiDAR | Laser imaging, detection and ranging (LiDAR) uses remote sensing to measure the elevation of objects on the ground. Raw LiDAR will include trees and building measurements. |
| Overland Flow Flooding | Overland flow is the surface runoff following  rainfall, concentrated in natural lower lying areas and swales across the landscape. Flooding is usually ‘flashy’ with peaks occurring shortly after rainfall. |
| Riverine Flooding | Flooding within large river systems where floods increase and break out of the riverbanks to inundate adjacent floodplains. Flooding is  generated from rainfall across the broad catchment area. It may take many hours, or even days, for peak flood levels to occur as rainfall  slowly drains from the catchment. |
| Hydrologic and hydraulic models | Computer modelling of rainfall and surface runoff to simulate real world flood conditions and therefore estimate likely flood extents and flood behaviour for theoretical future conditions and events. |
| Probable Maximum Flood  (PMF) | Denotes the largest possible flood that could occur at a particular location. The PMF is generally estimated based on the PMP. |
| Probable Maximum  Precipitation (PMP) | The PMP represents the largest depth of rainfall that could occur over a given catchment area. |
| Rating curve | A graph plotting flow versus stage (water level) at stream flow gauges. |
| Runoff | The amount of rainfall that will result in overland flow or streamflow. |
| Stage | Another term for water level and is measured based on a specified datum. |
| Water Sensitive Urban Design | Design and planning of the urban environment to consider the natural ecosystem and sustainable water management. |

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