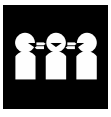
State Planning Policy – state interest guidance material

Natural hazards, risks and resilience – Flood

July 2017

Queensland Government

The State of Queensland, July 2017. Published by the Department of Infrastructure, Local Government and Planning, 1 William Street, Brisbane Qld 4000, Australia.



An electronic copy of this report is available on the Department of Infrastructure, Local Government and Planning's website at **www.dilgp.qld.gov.au.**

Using the SPP state interest guidance material

The Queensland Government established the State Planning Policy (SPP) to define the matters of state interest in land-use planning and development. State interests in the SPP consist of a state interest statement, state interest policies and, where applicable, assessment benchmarks.

This guidance material has been prepared to support the implementation of the SPP and the interpretation of the *Natural hazards, risk and resilience* state interest. Although the SPP broadly applies to a range of activities undertaken by state and local governments, the guidance material is particularly focused on assisting local governments when making or amending a local planning instrument and when applying the assessment benchmarks (to the extent relevant).

The SPP does not prioritise one state interest over another and thus provides flexibility for decision makers to respond to specific regional and local circumstances. This allows for the state interests to be considered in their entirety rather than as individual or separate priorities. State interests are to be considered in the context of the guiding principles in the SPP, which promote an *outcome focused*, *integrated*, *efficient*, *positive* and *accountable* planning system.

The SPP guidance material is intended to be read in conjunction with the SPP and the relevant state interest. The SPP guidance material is not statutory in its effect and does not contain any new policy requirements. It is not mandatory for local governments to use the guidance material; it is provided to assist with the interpretation and application of the state interest policies and the assessment benchmarks contained in the SPP.

The SPP guidance material is structured as follows:

Part A: Understanding the state interest – This section briefly explains why a particular matter is a matter of state interest, describes the purpose of the relevant state interest statement and defines the core concepts associated with the state interest.

Part B: Integrating the state interest policies – This section provides background and further explanation for each of the state interest policies defined in the SPP. It also provides examples and options regarding how to appropriately integrate each state interest policy into a local planning instrument.

Part C: Mapping – This section identifies and explains the mapping layers contained in the SPP Interactive Mapping System (IMS) relevant to a particular state interest. It also clarifies how a local government can locally refine state mapping in certain instances and outlines where online mapping for the state interest can be accessed (if relevant).

Part D: Applying assessment benchmarks – In accordance with the Planning Regulation, an assessment manager or referral agency must have regard to the SPP when assessing a development application. For some state interests, there are also specific assessment benchmarks that must be used by a local government for development assessment. This section outlines the development applications to which the assessment benchmarks apply and how a development application may demonstrate compliance with these benchmarks, to the extent that these are relevant. The assessment benchmarks contained in this section will apply to assessable development in addition to any assessment benchmarks contained in a local planning instrument, to the extent of any inconsistency.

Part E: Example planning scheme provisions – This section provides example planning scheme provisions that a local government may choose to adopt, or to adapt, when making or amending a local planning instrument. It is important to note that the example planning scheme provisions provided may only be in relation to a particular aspect of a state interest, rather than addressing all of the particular state interest policy requirements.

Part F: Supporting information – This section provides a list of technical resources that a local government may wish to refer to when making or amending a planning scheme. This section also provides a glossary of terms and acronyms used throughout the SPP guidance material.

Where text in this guidance material is in a coloured text box, it is an excerpt from the SPP and is either the state interest statement, state interest policy or the assessment benchmarks applicable to the *Natural hazards, risk and resilience* state interest.

Any queries related to the SPP guidance material or the SPP should be sent to SPP@dilgp.qld.gov.au.

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Part A: Understanding the state interest

State interest statement

The risks associated with natural hazards, including the projected impacts of climate change, are avoided or mitigated to protect people and property and enhance the community's resilience to natural hazards.

Background

Flooding is Queensland's most damaging natural hazard, and is second only to tropical cyclones in terms of fatalities.[1] Flooding also causes significant impacts on people's health and wellbeing, the environment, property and infrastructure, and the state's economic productivity. This is because many Queensland towns and cities, and the transport linkages connecting them are built on floodplains, usually for historical reasons of access to water for habitation, transportation and agriculture.

Responding to and recovering from flooding also places a significant burden on state and local governments, as demonstrated during major flood events in Queensland such as the 2011 floods in South East Queensland and the 2013 floods around the Bundaberg region.

Flooding is also an important natural process and resource. Flooding can replenish alluvial soils, vital for the long-term productivity of our agricultural lands. It can revitalise ecosystems and trigger renewed growth of flora and fauna.

The focus of this natural hazard is riverine flooding; however, where necessary a local government may also decide to incorporate overland flow considerations.

Awareness of flood risk and the measures to help address this risk have increased substantially in Queensland since the recent flood events. As a result, local and state governments have made significant efforts to improve flood information and flood risk management practices. These efforts provide a strong foundation for flood-responsive land-use planning practice.

The Queensland Strategy for Disaster Resilience (QSDR) seeks to make Queensland 'the most disaster-resilient state in Australia'. Effective management of flood risk is key to achieving this aim.

The Queensland Floods Commission of Inquiry also provides an important reference for continued advancement in land-use planning practices. The commission outlines recommendations and observations for local governments to consider and incorporate when they prepare and review planning schemes.

Governments can build on the lessons learnt from recent years in recovering from these natural flood hazards – to better embed flood risk management and community resilience principles into land-use planning instruments.

[1] Department of Community Safety 2012, *Historical analysis of natural hazard building losses and fatalities for Queensland 1900–2011: State-wide Natural Disaster Risk Assessment and Risk Register Program*.

Flood risk management and land-use planning

Planning is recognised as a key policy lever for influencing the level of future natural disaster risk.[2] The state therefore has an interest in ensuring that land-use planning practice supports the achievement of flood risk management and community resilience objectives. These objectives include:

- improving community awareness of flood risk to individuals, their property and their communities
- minimising damage to property, infrastructure and the carrying capacity of the environment
- supporting disaster management response or recovery capacity and capabilities
- maintaining operation of critical infrastructure during and following events, and minimising exposure of vulnerable uses to direct damage or isolation from flood events
- minimising recovery costs by helping to increase social, economic and environmental resilience
- encouraging and supporting continuous improvement in flood risk management capacity and capability.

Every community is different; flood exposure, vulnerability and tolerance to flooding are dependent upon specific local circumstances. Floodplain behaviour, settlement layout, socio-economic and demographic characteristics of the population at risk – all affect the community's resilience to flooding.

By its nature, flood risk management and community resilience involves continuous improvement. The objective should be to avoid or mitigate flood risk so that any residual risk (which is the responsibility of disaster management or mitigation works to address) is acceptable or tolerable.

Land-use planning approaches should therefore be fit-for-purpose and flexible in undertaking natural hazard studies and risk assessments. The approach may be tailored to meet the local needs, circumstances and resources of a community and must be informed by an integrated consideration of matters including, but not limited to:

- the characteristics of the natural hazard
- the population and land uses exposed to the natural hazard
- the anticipated growth and development of the community
- the suitability of existing studies to inform the risks associated with the natural hazard.

Through hazard avoidance strategies or risk mitigation, land-use planning must ensure that new development and communities are not placed at undue risk. Effective planning can improve community safety and resilience and minimise the burden for emergency management.

In preparing a planning scheme that responds to these risks, flood risk management involves a multi-disciplinary approach to strategically manage floodplains for the long-term benefit and safety of people, property, infrastructure and the environment.[3]

Effective land-use planning that aligns with and supports the implementation of broader flood risk management objectives is a core tool in managing flood risk. Other core mechanisms for managing flood risk include:

- emergency planning and management
- improved governance and management arrangements
- structural works

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2 Australian Government Productivity Commission (2014), *Natural disaster funding arrangements*, Volume 1.

3 Australian Institute for Disaster Resilience 2013 *Managing the floodplain: A guide to best practice in flood risk management in Australia*.

- building control
- landscape and environment programs
- community awareness and communication.

Flood risk management processes and activities may occur outside the land-use planning process, but all processes should be aligned to maximise the benefits gained through working together on common objectives.

Climate change

Climate change may also alter the exposure to and severity of flood events in different regions of Queensland. It is a risk multiplier and is likely to exacerbate the footprint, intensity, duration and timing of events.

It is expected that climate change factors will be incorporated into future flood studies.

Core concepts

Annual exceedance probability (AEP)

The annual exceedance probability (AEP) is the likelihood of the occurrence of a flood or event of a given size or larger in any one year, usually expressed as a percentage. For example, if an event has an AEP of 1 per cent, it means that there is a 1 per cent risk (i.e. a likelihood of 1 in 100) of this event occurring in any one year. A 1 per cent AEP event should not be interpreted as only occurring once in 100 years.

Hazard and risk

The difference between hazard and risk is:

- a hazard is a source of potential harm or a situation with a potential to cause loss
- risk is the chance of something happening that will have an impact on objectives (AS/NZS ISO 31000:2009). It is measured in terms of consequences and likelihood. Risk is based upon the consideration of the consequences of the full range of flood behaviour on communities and their social settings, and the natural and built environment. The SPP refers to ‘acceptable risk’ and ‘tolerable risk’, which are defined below along with a definition of ‘intolerable risk’.

Acceptable risk

An acceptable risk is a risk that, following an understanding of the likelihood and consequences, is sufficiently low to require no new treatments or actions to reduce risk further. Individuals and society can live with this risk without feeling the necessity to reduce the risk any further.

Tolerable risk

A tolerable risk is a risk that, following an understanding of the likelihood and consequences, is low enough to allow the exposure to continue, and at the same time high enough to require new treatments or actions to reduce risk. Society can live with this risk but believes that, as much as is reasonably practical, steps should be taken to reduce the risk further.

Intolerable risk

An intolerable risk is a risk that, following an understanding of the likelihood and consequences, is so high that it requires actions to avoid or reduce the risk. Individuals and society will not accept this risk and measures are to be put in place to reduce the risk to at least a tolerable level.

Risk assessment

A risk assessment is the overall process of identifying, analysing and evaluating risk. A risk assessment is the means used to understand the likelihood and consequences of a natural hazard event or events for existing and proposed communities, property and

infrastructure. In understanding the consequences of a natural hazard event, the risk assessment will consider the exposure, vulnerability and tolerability of communities and their assets to the risk associated with that natural hazard event.

Risk to existing development

Land-use planning can be used to arrest or limit increases in risk to existing development. Other treatment options (e.g. structural mitigation and emergency management) are usually better placed to reduce the area's existing risk profile. In areas of intolerable risk, however, where there is no feasible alternative, land-use planning may play a role in limiting existing risk through back-zoning, along with other measures like buy-back or land swap.

Risk to future development

Land-use planning plays a key role in addressing risk to future development that may occur as a result of greenfield development, infill or climate change.

Residual risk

Residual risk is the risk a community is exposed to that is not being remedied through established risk treatment processes. Generally, it is the total risk to a community, less any measure in place to reduce that risk.

Figure 1: Residual risk

For a town protected by a levee, the residual flood risk comprises the consequences of the levee being overtopped by floods larger than the design flood. For an area where flood risk is managed by land-use planning controls, the residual flood risk is the risk associated with the consequences of floods larger than the Defined Flood Event on the community.

Defined flood event (DFE)

A defined flood event (DFE) is the flood event adopted by a local government for the management of development in a particular locality.

Fit-for-purpose

This includes a flexible approach to tailoring a natural hazard study or risk assessment to meet the local needs, circumstances and resources of a community. The approach must be informed by an integrated consideration of matters including but not limited to:

- the characteristics of the natural hazard
- the population and land uses exposed to the natural hazard
- the anticipated growth and development of the community
- the suitability of existing studies to inform the risks associated with the natural hazard.

Climate change

Climate change refers to the changes to the present day climate associated with the effects of global warming. It is a risk multiplier and is likely to exacerbate the footprint, intensity, duration and timing of coastal hazards in Queensland. Climate change is projected to have a marked influence on flooding in Queensland, through an increase in rainfall (intensity or depth). It is expected that climate change factors will be incorporated into future flood studies.

Exposure
Exposure is the extent to which an area and/or population is exposed to flooding. Exposure to flood is generally greater when flooding occurs in urban areas rather than non-urban or rural areas.

Flood risk
A flood risk is the potential risk of flooding to people, their social setting, and their built and natural environment. The degree of risk varies with circumstances across the full range of floods. Flood risk is divided into three types – existing, future and residual.

Flood hazard area
A flood hazard area is defined by the SPP.

Floodplain
A floodplain is an area of land that is subject to inundation by floods up to and including the probable maximum flood event – i.e. 'flood-prone land'.[4]

Flood planning level (FPL)
The flood planning level (FPL) is a combination of the defined flood levels (derived from significant historical flood events or floods of specific annual exceedance probabilities (AEPs) and freeboard levels selected for floodplain management purposes, as determined in management studies and incorporated in management plans.[5]

Overland flow path
An overland flow path, where a piped drainage system exists, is the path where storm flows in excess of the capacity of the underground drainage system would flow. An overland flow path where no piped drainage system or other form of defined watercourse exists is the path taken by surface runoff from higher parts of the catchment to a watercourse, channel or gully. It does not include a watercourse, channel or gully with well-defined bed and banks.[6]

Probable maximum flood (PMF)
A probable maximum flood (PMF) is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation and, where applicable, snow melt, coupled with the worst flood-producing catchment conditions. It is not physically or economically possible to provide complete protection against this event.

The PMF defines the extent of flood-prone land – the floodplain. The extent, nature and potential consequences of flooding associated with a range of events rarer than the flood used for designing mitigation works and controlling development, up to and including the PMF event, should be addressed in a floodplain risk management study.[7]

Resilience
Resilience is the ability to adapt to changing conditions and prepare for, withstand, and rapidly recover from disruption.

Tolerability
Tolerability is the ability of a community to tolerate flooding events. Factors influencing tolerability include a community's awareness of and experience of flood, knowledge of previous flooding history, extent of social and community cohesiveness, and a range of

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4 *Managing the floodplain*, chapter 14 'Terminology'.
5 Ibid.
6 Department of Energy and Water Supply (2013), *Queensland urban drainage manual*, section 13.6 'Glossary of terms'.
7 *Managing the floodplain*, chapter 14 'Terminology'.

demographic and socio-economic characteristics of a community that affect their views on flooding risk.

Vulnerability

Vulnerability takes into account the characteristics of a location and/or population that influence the severity of flood impact. Vulnerabilities can include poor or under-designed infrastructure (thus reducing ability to evacuate), location of uses with vulnerable persons within flood areas, or the demographic or socio-economic characteristics of a population (including age, health, disability and other factors) which can influence a population's risk profile. (For example, an aged care facility without flood protection located in a low lying area would be vulnerable.)

Risk treatment options

Risk treatment options include a range of risk measures that could lower flood risk, e.g. land-use planning, structural works, emergency management, flood warning, infrastructure betterment and community awareness. Planning options, when applied, should form part of a coordinated suite of risk treatment measures that collectively reduce risk and enhance community resilience.

Part B: Integrating the state interest policies

When making or amending a local planning instrument, each local government is required to consider all state interests in the SPP and appropriately integrate those state interests applicable to their local area.

Appropriately integrating a state interest requires all state interest policies to be considered by a local government, but it does not necessarily mean a local government must address each and every state interest policy when making or amending a local planning instrument. For example, if a local government needs to balance competing state interests in a local planning instrument, it may mean that it is not possible to address all policies for a particular state interest.

This balancing of state interests may mean that the planning scheme preferences one state interest policy over another. This outcome will be considered as part of the state interest review, and ministerial approval means the approach taken by the local government in balancing the state interest polices is endorsed by the state.

This section provides examples for how to appropriately integrate each state interest policy for the *Natural hazards, risk and resilience* state interest.

This guidance material focusses on three key elements relevant for planning scheme preparation – hazard identification, risk assessment, and planning scheme responses.

To meet the objectives of the SPP for the *Natural hazards, risk and resilience* state interest a local government would have to follow the process of risk identification (policy 1) and risk assessment (policy 2) in order to develop fit-for-purpose measures in its planning scheme (policies 4–6).

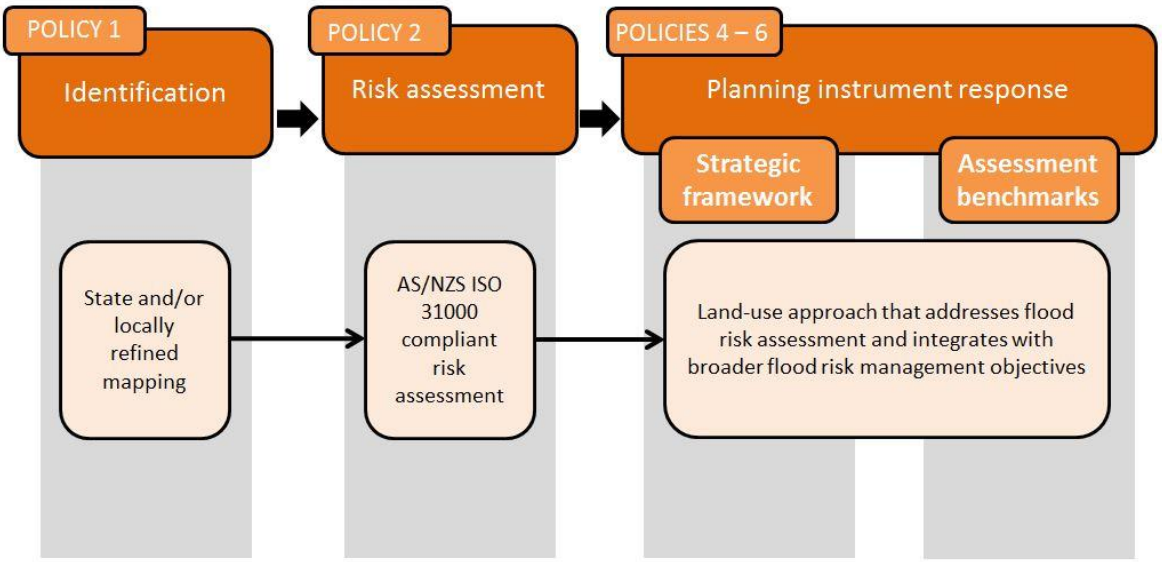

Figure 2: Alignment of fit-for-purpose assessment with the SPP guidance material in this document

State interest policy 1

Natural hazards areas are identified, including:
(a) bushfire prone areas
(b) flood hazard areas
(c) landslide hazard areas
(d) storm tide inundation areas
(e) erosion prone areas.

Background

Flood hazard mapping for inclusion in a planning scheme can be drawn from a range of sources. Many local governments have recently produced flood studies or maintain up-to-date flood models for particular parts or all of their local government area (LGA). The state has also undertaken many flood investigations from river sub-basin scale modelling to town-based investigations to support local governments in improving flood risk management capacity and capability.

Local governments should undertake a stocktake of available flood mapping in their LGA, from both internal local and state government sources, to identify flood hazard areas on an LGA-wide scale.

Additional fit-for-purpose flood studies can be undertaken at varying levels of precision depending upon the characteristics of the hazard, the land uses in that area and the rate of growth anticipated for that location.[8] The levels of precision broadly characterise the accuracy and reliability of the available information. The levels include:

- Level 1 acts as the baseline flood mapping and has been prepared by the state as part of the Queensland Floodplain Assessment Overlay (QFAO)
- Level 2 is a moderate, mid-level study, producing basic hazard mapping
- Level 3 is a comprehensive flood study, producing detailed hazard mapping.

Information from historic flood events

Studying information from historic flood events is encouraged in improving and refining the accuracy of Level 1 information, particularly the QFAO.

The use of Level 1 information is not encouraged when Level 2 or Level 3 information is available and where the historic information relied upon is based on survey marks, aerial photography or other anecdotal evidence. This is because Level 2 and Level 3 information generally contains more accurate or refined data with more detail regarding depth, velocity and hazard for specific design events.

For areas where population at risk is significant, or medium to high growth is expected, use of information from historic flood events is not encouraged, unless it is used while a local government awaits the outputs of a Level 2 or Level 3 study.

However, mapping of historic events is considered appropriate where:

1. a Level 2 or Level 3 study has been undertaken that replicates the event
2. detailed depth, velocity and hazard information is then available from that study
3. the historic event is known (via suitable hydrologic analysis) to either approximate or exceed the 1 per cent AEP for the local area.

[8] Refer to Department of Natural Resources (2016), *Guide for flood studies and mapping in Queensland* for details on scoping and preparing a study suitable for multiple end users.

How to appropriately integrate the policy

The planning scheme is informed by and contains mapping that identifies an LGA-wide flood hazard area derived from:

- locally prepared fit-for-purpose flood studies
- the compilation of suitable existing flood mapping where available.

1.1 The flood studies used to identify the LGA-wide flood hazard area are fit-for-purpose, and are of a precision that reflects the level of population, future growth and floodplain complexity of the areas to which the studies relate.

1.2 Flood studies are undertaken prior to or as early as possible in the preparation of the planning scheme to inform how flood risk will be addressed through land-use strategy and development assessment.

1.3 Flood mapping compiled to represent the flood hazard area, wherever available information permits, reflects the broad spectrum of flood risk (and/or flood potential of an area) by including:

- events of lesser and greater magnitude than the DFE
- information regarding flood behaviour, such as flood depth, velocity and/or hazard or risk
- areas where flood potential exists but detailed studies may not be available.

1.4 Based on local circumstances and needs, the fit-for-purpose approach may identify flood hazard areas through one or a combination of the following means:

- the use of statewide mapping and data at a scale and precision appropriate to the local context
- locally refined statewide mapping and data
- local flood studies that are prepared in accordance with national and state best practice.

1.5 Existing mapping that includes climate change factors should be used to identify the flood hazard area, in preference to mapping without climate change factors. New flood studies produced for the purpose of identifying the flood hazard area should incorporate climate change factors in the modelling.

1.6 Where a local government's resources to undertake natural hazards studies are constrained and statewide mapping is not sufficiently detailed to support plan-making, localised flood studies should be prioritised for areas where growth and development pressures are greatest and most imminent. A program of mapping updates should identify how the necessary level of mapping will be made available to enable informed development decisions (e.g. scheduled local area planning or site-based mapping as part of a development application).

State interest policy 2

A fit-for-purpose risk assessment is undertaken to identify and achieve an acceptable or tolerable level of risk for personal safety and property in natural hazard areas.

Background

Although a flood study will identify flood behaviour for a range of events, further analysis is needed to assess the risk that the flood hazard poses to people, property and infrastructure. This involves performing a fit-for-purpose *flood risk assessment* for the relevant parts of the LGA.

The risk assessment approach outlined in the national best practice guideline, *Managing the floodplain,* is consistent with nationally agreed emergency risk assessment guidelines – the *National emergency risk assessment guidelines* (NERAG), and *ISO 31000:2009 Risk management – principles and guidelines*. Flood risk management investigations prepared in accordance with *Managing the floodplain* and the flood risk assessment principles provided in table 1 below are considered to be compliant with this state interest policy.

Flood risk assessments should be tailored to be fit-for-purpose depending upon the characteristics of the hazard, the floodplain settlement pattern and the rate of growth anticipated for each location.

The extent and precision of the risk assessment process should be determined at a local level by the local government, informed by local needs, knowledge and issues. The flood risk assessment should not only inform planning scheme preparation – it also needs to meet broader flood risk management purposes and objectives.

Some local governments may choose to undertake a detailed region-wide flood risk assessment and floodplain management plan (possibly in conjunction with adjoining local governments in the same catchment). Other local governments may choose to undertake flood risk assessments for specific towns, sub-catchments or areas over time, as resources or requirements dictate.

A risk assessment will identify whether the level of risk presented by the flood hazard is acceptable, tolerable or intolerable when considered in relation to existing and proposed development. Planning strategies and provisions can reduce the level of risk to an acceptable or tolerable level by either avoiding the hazard or mitigating the risk through controls to reduce the exposure or vulnerability of people, property or infrastructure to the hazard.

The risk assessment may recommend a ‘whole-of-floodplain’ management approach to land-use strategy and regulation, rather than a ‘traditional’ approach of planning for the DFE only – particularly where the flood risk assessment reflects national flood risk best practice.

The risk assessment will therefore determine an appropriate level (or levels) of risk for managing land use and development across the region. It should also recommend appropriate risk treatment measures (including land-use planning strategies and assessment benchmarks) to avoid or mitigate identified risks.

The risk assessment helps local governments understand whether or not their land-use planning intentions are appropriate, given the level of risk posed by the natural hazard. It also helps them identify alterations needed to treat identified risks.

In applying the risk assessment, planning responses should manage risk to the greatest extent practicable. It is unlikely this will mitigate all residual risks associated with less probable events. Other risk treatment measures in mitigating residual risk should also be identified by the flood risk assessment.

The forecast effects of climate change should be considered in the flood risk assessment process, particularly where the flood hazard information relied upon does not incorporate climate change factors. Local governments may take a more conservative approach to determining acceptable, tolerable and intolerable levels of risk. They may apply more conservative risk treatment measures such as a rarer DFE (e.g. 0.5 per cent AEP rather than a 1 per cent AEP) or increased freeboard (e.g. 600mm rather than 300mm).

The risk assessment should build upon and integrate with the risk assessment conducted as part of disaster management planning in the LGA. The focus should be on areas where the emergency response is constrained, particularly where future development is being considered.

In areas that are deemed not to require a flood risk assessment at the planning scheme preparation phase (or where one is considered necessary but, due to resourcing constraints, has been programmed for a later date), a flood risk assessment must be undertaken if that area is subject to a development application in the future. This should be addressed through the assessment benchmarks in the planning scheme.

Mapping for risk assessments

Flood risk assessments should consider the widest range of flood events for which data is available. That is, where a flood study includes a range of design events (from frequent to rare), these should be incorporated in the flood risk assessment so that a fuller picture of flood behaviour and risks can be understood across the floodplain.

Mapping to complete a risk assessment will likely require different mapping types to be developed than that ultimately used in the planning scheme. This is due to the wide range of factors involved in the risk assessment process.

How to appropriately integrate the policy

The preparation of the planning scheme is informed by a fit-for-purpose flood risk assessment, consistent with best practice guidance, tailored to the flood information available, population at risk, expected growth rates and other local circumstances.

2.1 Based on local circumstances and needs, the fit-for-purpose risk assessment for flood-related risk is consistent with national flood risk management best practice[9] and the principles provided in table 1 below.[10]

2.2 A fit-for-purpose flood risk assessment is to be undertaken for all urban areas in the LGA.

2.3 Some examination of risk is expected to be undertaken in non-urban or areas of very limited development. This may lead to the requirement to undertake more precise flood studies in those areas, and/or to implement more conservative land-use controls in those areas until a more detailed risk assessment is undertaken.

[9] Currently, *Managing the floodplain.*

[10] These principles may be supported or superseded by other state government guidance in the future.

2.4 At a minimum, for land-use planning purposes, the risk assessment should result in:

- the identification of land uses that should not occur in a flood hazard area
- the risk criteria (that considers the community's exposure, tolerability and vulnerability) used to identify a broadly acceptable, tolerable or intolerable level of risk for each land use
- the planning provisions used to ensure that the community is not exposed to an unacceptable level of risk
- the hazard and risk information that is available or will be required to achieve the planning provisions.

Table 1: Principles for preparing flood risk assessments

Flood risk assessment principle	Description
1. Consider the widest range of flood events possible across the risk spectrum (i.e. for which data is locally available).	At a minimum this should include: a) the defined flood event b) several more frequent floods and a slightly rarer/more extreme flood c) the probable maximum flood (if available).
2. Analyse flood behaviour.	At a minimum this should include the characteristics of the hazard (e.g. depth, velocity, velocity and depth, isolation) and their relative severity should also be identified.
3. Analyse impact of flood on all zoned land, and to what hazard level.	Overlaying flood information on the planning scheme's maps helps identify the extent of flood exposure (the likelihood of an event and associated hazard and risk levels) – both local-scale impact and LGA-wide impact. The higher risk of the flood, the less likely it will be suitable for urban development without significant risk treatment. An awareness of the location and extent of land potentially affected by flood is an important strategic planning tool that can help guide LGA-wide and regional settlement planning decisions.
4. Assess impact of flood on the number and types of properties affected, and the potential for flood damage.	This is best undertaken where floor-level data are available for buildings subject to flood hazard. GIS analysis can determine the extent of potential inundation where this information exists. In the absence of floor-level data, assessment of potentially inundated or affected buildings can be undertaken by review of aerial imagery or site inspection, including analysis of built form (i.e. slab-on-ground vs pier and pole construction) which can provide a general indication of potential flood damage. An inventory of all vulnerable uses (such as child care, aged care, hospitals, hospices, residential care facilities and the like) should be undertaken to understand existing levels of flood exposure to these facilities.
5. Include areas with future land release plans and review impact of flood on those areas.	It is important to include future urban areas (whether or not formally released for urban development) into the analysis of flood impact.
6. Understand flood mitigation options and urban infrastructure immunity and capacity relative to the flood behaviour.	A description of existing flood mitigation measures should be included. Immunity of infrastructure (roads, bridges, utilities etc.) should be identified to ascertain risks associated with network interruptions/ failures. Areas likely to be isolated (and at what risk level/duration of isolation)

Flood risk assessment principle	Description
	should also be identified (and will enhance integration with the local disaster management planning process identified at Principle 7).
7. Ensure the flood risk assessment integrates with investigations related to and preparation of local disaster management plans. See state interest policy 5 for details.	Key areas of focus include: a) evacuation capability of specific areas including processes used to enact evacuation b) capability of emergency management personnel to respond – including response limitations across the floodplain to identify areas with different types and severities of response limitations.
8. Consider the effect of dams (both referable dams and non-referable dams, if known) on flood behaviour in the catchment, and the implications for risks to existing and future development in downstream towns.	Key elements to consider in the assessment include: a) influence of dam releases on flood flows, volumes and behaviours b) effect of dam releases on flood warning time and evacuation/communication requirements c) role of dam operators in communicating dam outflow operations to the local government and the community, and the risks associated with increased development relative to communication risks d) impacts on downstream communities and the likely required land-use responses to address the risks. **Climate change factors** Level 1 and Level 2 flood mapping provided via the Queensland Flood Mapping Program (QFMP) currently does not incorporate climate change factors. Some existing local government Level 3 studies also may not consider climate change factors. Existing flood studies should be used in planning scheme preparation as they represent best available information. Future studies should include climate change factors in accordance with state and national best practice guidance. The *Guide for flood studies and mapping in Queensland* (Department of Natural Resources and Mines, 2016) provides some preliminary direction on how climate change factors should be incorporated in flood studies prepared by local governments. Local governments should consult Geoscience Australia's *Australian rainfall and runoff: A guide to flood estimation* when scoping flood studies to include climate change considerations. This is a national guideline for the estimation of design flood characteristics in Australia. It includes estimation of rainfall, hydrologic and hydraulic modelling, and selection of climate change parameters. **Influence of dam releases on downstream flooding** Dams will typically reduce downstream flooding due to their capacity to attenuate and delay peak flood flows. Level 1 and Level 2 flood mapping provided via the QFMP currently does not incorporate detailed consideration of dam releases and outflows. Some existing Level 3 studies for catchments with dams also may not include these considerations. These flood studies should be used in planning scheme preparation as they represent best available information. Future studies should include consideration of dam releases and outflows in accordance with state and national best practice guidance. The extent to which dam releases are then considered in identifying the flood hazard area or the DFE or other flood planning levels should then be part of the risk assessment process and planning scheme

Flood risk assessment principle	Description
	preparation phases.
9. Consider how to address climate change, particularly if existing available flood studies do not include climate change factors.	Increased caution in the risk assessment process is suggested where climate change factors have not been incorporated into the flood studies upon which the risk assessment is based. Given it is important to address the resultant changing risk profile, this can be achieved by either adopting a more conservative approach to land-use allocation in flood hazard areas or by imposing more conservative development design parameters (such as increased freeboard).
10. Understand the demographic and socio-economic characteristics of the community at risk, to better understand community vulnerability to flood.	Key demographic/socio-economic characteristics that should be examined to determine community vulnerability include (but are not limited to): a) aged dependency ratios and child dependency ratios b) socio-economic index for areas c) core activity need for assistance d) number of motor vehicles per dwelling e) proficiency in spoken English. When the examination of these characteristics identifies areas that are particularly vulnerable to the effects of flooding, the flood-response arrangements should be suitably prioritised or modified for that area.
11. Develop and test options to improve risk management outcomes.	As per *Managing the floodplain*, identify, assess, compare, make recommendations and report on options to improve risk management for the community. Options should be tested against the current management practice and existing community exposure. This requires an understanding of the social, economic and environmental benefits and costs of options, and their relative benefit and effectiveness in managing risk. The assessment provides a basis for understanding the level of service provided, the feasibility, practicality and cost-effectiveness of different options, and constraints that may inhibit implementation. It also involves understanding where the benefits accrue, the work needed to achieve them and the residual risks that would remain should an option be implemented.
12. Consult with the community to identify tolerance to flood risk (if any) and test possible treatment options.	It is recommended a separate community engagement and consultation strategy be developed to address flood risk management objectives – preferably as a separate process to that undertaken for planning scheme preparation.
13. Articulate flood risk implications for future growth.	Articulating the implications for future growth in specific locations can help develop the policy options mentioned in Principle 14.
14. Develop recommended policy options.	Prepare flood-responsive, settlement-specific outcomes for existing and future development based on the identified implications for growth. Define preferred risk treatment measures to achieve the intent per settlement, including land-use planning requirements and their relationship to other risk treatment measures.

State interest policy 3

Land in an erosion prone area is not to be used for urban purposes, unless the land is located in:
(a) an urban area in a planning scheme; or
(b) an urban footprint identified in a regional plan.

This policy is not applicable to flood hazard considerations.

State interest policy 4

Development in bushfire, flood, landslide, storm tide inundation or erosion prone natural hazard areas:
(a) avoids the natural hazard area; or
(b) where it is not possible to avoid the natural hazard area, development mitigates the risks to people and property to an acceptable or tolerable level.

Background

Land-use planning is the primary way to manage risks to future development by avoiding incompatible development in flood hazard areas. Planning schemes can also limit risks to existing development through flood-responsive zoning and appropriate assessment benchmarks.

Planning schemes should acknowledge the risks identified through the flood risk assessment process. They should present a clear strategic settlement pattern that supports the achievement of broader flood risk management objectives for the LGA.

This may involve avoiding new urban development in flood-prone areas of intolerable risk, or excising higher risk areas from the urban footprint.

It may also involve avoiding increasing density in existing urban areas – both in terms of infill development and 'up-zoning' – to limit risk at existing levels.

In limited circumstances, it may also be appropriate to use the planning scheme (particularly through rezoning to non-urban uses) to address risks in existing urban areas. This may be in cases where the identified risks to existing property have been identified as intolerable and there is no feasible alternative to manage such risks.[11]

Land-use acceptability should be expressed primarily though the strategic framework and zoning that supports the strategic outcomes rather than through overlays and local plans.

The local government is encouraged to undertake community engagement in evaluating acceptable and tolerable risk to inform the preparation of appropriate planning responses.[12]

How to appropriately integrate the policy

4.1 A risk-responsive settlement strategy is developed for inclusion in the strategic framework and reflected in zoning for at-risk locations. The strategy:
1. is informed by the outcomes of the flood risk assessment
2. addresses flood risk to both existing and future development to achieve broader flood risk management objectives.

4.2 Planning schemes are to incorporate provisions consistent with the example and model provisions contained in Part D, tailored to meet local needs and circumstances.

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11 Refer to Department of Infrastructure, Local Government and Planning 2017, *Minister's Guidelines and Rules under the Planning Act 2016, chapter 4.*

12 Refer to Australian Institute for Disaster Resilience (2010),*Guidelines for the development of community education, awareness and engagement programs*.

4.3 In drafting planning provisions, the use of terminology that may impede an understanding of the risk of natural hazards to development should be avoided.

4.4 The strategic framework should articulate risk-responsive settlement strategies for at-risk locations and establish the principle of only appropriate development occurring in flood hazard areas.

4.5 Zoning must achieve the settlement strategy – for example, through avoiding urban uses if needed, limiting density relative to the risk, or promoting more compatible or resilient land uses in flood hazard areas. Zone and/or the flood hazard overlay codes should clearly articulate acceptability of land uses, lot reconfigurations and works relative to the flood risk.

4.6 The risk assessments for flood hazard should be used as a tool to inform drafting of planning provisions:

- Selection of the DFE /or the selection of a range of flood events or hazard/risk levels to manage land use and development may involve the definition and mapping of a particular flood event or events (e.g. 1 per cent, 0.5 per cent, 0.2 per cent AEP or hazard/risk level (e.g. very high, high, medium, low)) that will initiate planning and building controls (e.g. in zones, local plans or overlay codes).
- Assignment of categories of assessment within zones affected by flood risk is to ensure sensitive or vulnerable uses are avoided or are subject to a higher category of assessment.
- Special consideration is given to community infrastructure where it is anticipated to perform a role or service during and immediately following a natural hazard event, or where the infrastructure is utilised by people who are particularly vulnerable to the effects of flooding.
- A planning scheme policy may specify the scope and methodology to be followed in preparing a site-based natural hazards study and risk assessment, in support of a development application for a site in a flood hazard area.

The use of thresholds, overlay maps and codes, and the setting of categories of development for uses in areas affected by flood hazard are helpful tools. They may:

- trigger a higher category of development if required
- encourage development to avoid hazard areas
- require site-specific hazard investigation and risk assessment where required
- apply special conditions to development approvals to avoid or mitigate risk to an acceptable or tolerable level
- clearly communicate the risk to the community.

Overlays should not be the sole tool to manage flood risk in an area. Where flood risk cannot be addressed through built form, this should be reflected through the most appropriate allocation of zoning and the principle of avoidance of the risk.

State interest policy 5

Development in natural hazard areas:

(a) supports, and does not hinder disaster management capacity and capabilities

(b) directly, indirectly and cumulatively avoids an increase in the exposure of severity of the natural hazard and the potential for damage on the site or to other properties

(c) avoids risks to public safety and the environment from the location of the storage of hazardous materials and the release of these materials as a result of a natural hazard

(d) maintains or enhances the protective function of landforms and vegetation that can mitigate risks associated with the natural hazard.

Background

Key elements to consider in preparing planning provisions that constitute a flood-responsive intent for an area include:

1. land-use suitability and compatibility
2. built form and design
3. lot and subdivision layout
4. access and egress requirements for both pedestrians and vehicles
5. limitations on critical infrastructure and vulnerable uses (refer to policy 6)
6. imposition on disaster management and recovery
7. treatment and storage of hazardous materials
8. effects of development on floodplain behaviour and other uses/properties
9. effects of development on the protective function of landforms and vegetation that can mitigate risks associated with the flood hazard.

A key flood risk management objective is to avoid increasing the exposure of life and property to the hazard. Considerations include altering flow-paths or changing flood duration, depth, velocity, hazard or warning time.

A significant concern is the release of hazardous materials during a flood event, which can adversely impact water quality and affect human and environmental health during and following the hazard event. Design criteria are required to ensure hazardous materials are not exposed to floodwaters, or are otherwise appropriately sealed to avoid discharge or movement during an event.

The natural environment has an important role to play in mitigating risk. Riparian corridors and vegetation can provide a protective function during flood events. Retaining the natural environment and landscape values can reduce the need to construct mitigation infrastructure and enable the natural function of the floodplain to be maintained.

How to appropriately integrate the policy

5.1 Development requirements in zone, local plan, overlay and development codes should ensure that development in an area affected by a flood hazard area:

- avoids or mitigates the risk to people, property and infrastructure to an acceptable or tolerable level
- does not increase the number of people at risk to an intolerable level
- provides safe and efficient access and operation for emergency services

- enables the self-evacuation of occupants and visitors – people need to be able to safely shelter in place or evacuate via safe routes from the hazard area prior to or during an event
- does not cause or contribute to an increased level of risk affecting surrounding areas
- incorporates natural processes, landforms and vegetation that contribute to the mitigation of natural hazards and risks into development design, location and operation to enable these natural processes and functions to continue.

5.2 Where other instruments regulate development affected by flood hazard, the planning scheme should avoid duplicating assessment and regulation. In some cases the planning scheme plays a role in triggering these requirements. For example the Building Regulation 2006 allows a local government through its planning scheme to designate a 'flood hazard area', which triggers building requirements related to the mitigation of risks.

State interest policy 6

Community infrastructure is located and designed to maintain the required level of functionality during and immediately after a natural hazard event.

Background

The ability of community infrastructure to function effectively during and after a natural hazard event can have a significant effect on the ability of a community to respond and recover from an event.

The level of risk for community infrastructure is determined through the risk assessment process required by policy 2 and planning provisions applied under policy 4 during planning scheme preparation or designations of land for community infrastructure.

Different types of community infrastructure have different roles and vulnerabilities during and after natural hazards. The flood risk assessment can help determine appropriate locations for community infrastructure depending on local flood behaviour and settlement characteristics.

Regardless of whether it is in public or private ownership, community infrastructure, such as a hospital, should be able to continue operating during and after a flood event. These facilities need to continue providing essential services to both existing users and others affected by the flood event.

Community infrastructure such as retirement facilities, residential care facilities and childcare centres are highly sensitive to flood risk because of the vulnerability of their occupants. These people are more vulnerable than the general population because of their age, their need for assistance, or their health or disability. Locating these facilities in flood hazard areas can create a safety risk for occupants and the people seeking to reach them during a flood event. This places extra undue burden on disaster management capacity.

Community infrastructure such as libraries, museums and other cultural facilities should avoid flood hazard areas to minimise flood recovery costs and community inconvenience, and to minimise loss of important social or cultural items.

Community infrastructure such as showgrounds and sports facilities can perform an active role in flood response and recovery, serving as emergency accommodation and recovery staging points.

How to appropriately integrate the policy

6.1 Planning provisions (including land-use strategies, zoning and assessment benchmarks) respond to the flood risk assessment and achieve an acceptable level of risk for community infrastructure.

6.2 Community infrastructure catering for vulnerable persons, or infrastructure that must continue operating during or after a flood event, should avoid areas of flood risk. These facilities are best located outside flood hazard areas (preferably above the height of the PMF or other known extreme event) to achieve the highest practical level of flood immunity. Expansion of existing facilities in flood hazard areas should occur only where appropriate evacuation solutions and resilient design can be achieved.

6.3 Community infrastructure sensitive to property loss (such as museums, libraries, art galleries) should seek to avoid areas affected by the DFE. Where this is not possible, the development should be located above the height of the DFE and incorporate resilient design to protect valuable equipment and artefacts.

6.4 Community infrastructure with a role in flood response and recovery should be located outside areas affected by the DFE.

6.5 Development requirements in the planning scheme should stipulate a minimum level of immunity and/or location and design standards for the establishment of each type of community infrastructure. The requirements should consider the role and level of service the infrastructure would perform during and immediately following a natural hazard event.

6.6 Infrastructure designation should consider:

- the function the infrastructure serves during or immediately after a flood event and if it contributes to a broader community infrastructure network
- the standards proposed for the location and design of the community infrastructure
- the consequences of loss of service
- community tolerance to loss of service during or immediately after a flood event
- the natural hazard scenario under which the community infrastructure will cease to function effectively
- the compatibility of the siting of the infrastructure with the nature and extent of the hazard
- where flood hazard areas cannot be avoided, whether the risks associated with the hazard can be mitigated to acceptable levels to achieve the required level of service during and immediately after a defined event
- the likelihood and consequences of a future natural hazard event that exceeds the defined event.

State interest policy 7

Coastal protection work in an erosion prone area is undertaken only as a last resort where coastal erosion or inundation presents an imminent threat to public safety or existing buildings and structures, and all of the following apply:

a) the building or structure cannot reasonably be relocated or abandoned.
b) any erosion control structure is located as far landward as practicable and on the lot containing the property to the maximum extent reasonable.
c) any increase in coastal hazard risk for adjacent areas from the coastal protection work is mitigated.

This policy is not applicable to flood hazard considerations.

State interest policy 8

Development does not occur unless the development cannot feasibly be located elsewhere and is:

a) coastal-dependent development; or
b) temporary, readily relocatable or able to be abandoned development; or
c) essential community infrastructure; or
d) minor redevelopment of an existing permanent building or structure that cannot be relocated or abandoned.

This policy is not applicable to flood hazard considerations.

State interest policy 9

Development permitted in policy 8 above, mitigates the risks to people and property to an acceptable or tolerable level.

This policy is not applicable to flood hazard considerations.

Part C: Mapping

To support the SPP, wherever possible and to the extent relevant, matters of state interest are spatially represented as layers included in the SPP IMS. The mapping is necessary to help local government, the community and industry understand and interpret where and how state interest policies and assessment benchmarks included in the SPP apply.

Several mapping layers contained in the SPP IMS are prepared by entities other than the Department of Infrastructure, Local Government and Planning and may serve an additional purpose outside the Queensland planning system. Where relevant, the SPP IMS represents the single point of truth for the spatial representation of the state interests expressed in the SPP.

Appendix 1 of the SPP identifies three categories of mapping layers provided or referred to in the SPP IMS that are intended to be used in one of the following ways:

Category 1 – State mapping layers that must be appropriately integrated in a local planning instrument in a way that achieves the relevant state interest policy

Category 2 – State mapping layers that must be appropriately integrated, and can be locally refined by a local government in a local planning instrument, in a way that achieves the relevant state interest policy

Category 3 – State mapping layers that are provided for local government information purposes only.

The SPP IMS is located at: https://planning.dilgp.qld.gov.au/maps. Any queries related to the SPP mapping should be sent to mappingenquiries@dilgp.qld.gov.au.

This section provides clarity regarding the mapping layers on the SPP IMS relevant to the *Natural hazards, risk and resilience* state interest.

Mapping layers

Flood hazard area (Level 1) – Queensland Floodplain Assessment Overlay (QFAO)	
Purpose	This mapping layer acts as the baseline flood mapping for an LGA, where a local government does not otherwise have a region-wide understanding of flood hazard. Prior to use in planning scheme preparation, the QFAO should be validated by a local government and refined accordingly. This may involve: 1. refining the extent line as per the above; and/or 2. replacing parts of the QFAO where more detailed flood study information exists – such as Level 2 or Level 3 flood studies.
Mapping category	Category 2
Data custodian	Department of Natural Resources and Mines
Head of power	State Planning Policy
Methodology	The QFAO shows the floodplain areas in the various drainage sub-basins in Queensland. It has been prepared for use by local governments to define potential flood hazard areas. It represents an estimate of areas potentially at threat of inundation by flooding. The data have been produced through a process of drainage sub-basin analysis utilising data sources including 10 metre contours,

Flood hazard area (Level 1) – Queensland Floodplain Assessment Overlay (QFAO)	
	historical flood records, vegetation and soils mapping and satellite imagery. These data represent an initial assessment of flood potential and will be subject to refinement by local governments. The QFAO mapping is available in approximately 129 river sub-basins across the state. Areas not covered by the QFAO include most of South East Queensland, some offshore islands, and any other area where region-wide mapping has already been undertaken by the respective local governments.

Part D: Applying assessment benchmarks

The SPP contains specific assessment benchmarks for the *Natural hazards, risk and resilience* state interest.

Under the Planning Regulation 2017 the assessment benchmarks apply if the *Natural hazards, risk and resilience* state interest has not been appropriately integrated in a planning scheme. If this is the case, a development application must be assessed against the assessment benchmarks to the extent of any inconsistency with the planning scheme and where the assessment manager considers these assessment benchmarks are relevant to the proposed development.

In addition, the assessment manager must have regard to the SPP (including the *Natural hazards, risk and resilience* state interest statement and policies), where the planning scheme has not appropriately integrated the state interest. The SPP applies as a matter to have regard to where the assessment manager considers these matters are relevant to the proposed development and only to the extent of any inconsistency with the planning scheme.

This section provides guidance for local government when determining how a development application may satisfy these assessment benchmarks.

Applicable development

A development application for a material change of use, reconfiguration of a lot or operational works on premises in any of the following:

(1) bushfire prone areas
(2) flood hazard areas
(3) landslide hazard areas
(4) storm tide inundation areas
(5) erosion prone area.

Assessment benchmark 1

Erosion prone areas within a coastal management district:

Development does not occur in an erosion prone area within a coastal management district unless the development cannot feasibly be located elsewhere and is:

(a) coastal-dependent development; or
(b) temporary, readily relocatable or able to be abandoned development; or
(c) essential community infrastructure; or
(d) minor redevelopment of an existing permanent building or structure that cannot be relocated or abandoned.

This assessment benchmark is not applicable to flood hazard considerations.

Assessment benchmark 2

Erosion prone areas within a coastal management district:

Development permitted in (1) above, mitigates the risks to people and property to an acceptable or tolerable level.

This assessment benchmark is not applicable to flood hazard considerations.

Assessment benchmark 3

Bushfire, flood, landslide, storm tide inundation, and erosion prone areas outside the coastal management district:

Development other than that assessed against (1) above, avoids natural hazard areas, or where it is not possible to avoid the natural hazard area, development mitigates the risks to people and property to an acceptable or tolerable level.

How a development application may demonstrate compliance with the assessment benchmark

Development is located and designed to avoid or mitigate the risk to people, property and infrastructure to an acceptable or tolerable level. Development does not involve land uses that create an intolerable risk to people and property, either on site or elsewhere.

An application should demonstrate through a site-based risk assessment prepared in accordance with national best practice[13] (or state guidance, if available) that the risk presented by the development is acceptable or tolerable, at least for the 1 per cent AEP event determined for the location. Consideration should also be given to events rarer than the 1 per cent AEP event and the effects of climate change when undertaking the risk assessment.

The application should have regard to at least the following considerations:

1. compatibility of the development with the level of hazard presented, including use and built form/site layout
2. likely property damage as a result of the development
3. processes for evacuation of people on-site, and impacts on evacuation off-site
4. extent of upstream or downstream impact on flood flows and other properties.

At a minimum, development should incorporate the following mitigation/resilience measures:

1. habitable floor levels above at least the 1 per cent AEP, with a freeboard of 600mm to account for the effects of climate change
2. commercial or industrial floor levels above at least the 1 per cent AEP, with a freeboard of 600mm to account for the effects of climate change, where possible
3. finished ground levels of new residential, commercial or industrial lots above at least the 1 per cent AEP, with a freeboard of 600m to account for the effects of climate change
4. lot, road and building layout that supports self-evacuation

[13] Currently, *Managing the floodplain,* and its subordinate technical guidelines

5. utilities (water, sewer, power, telecommunications) located above the 1 per cent AEP or otherwise designed to prevent the intrusion of floodwaters.

Assessment benchmark 4

All natural hazard areas:

Development supports and does not hinder disaster management response or recovery capacity and capabilities.

How a development application may demonstrate compliance with the assessment benchmark

Development is located and designed to enable the self-evacuation of occupants and visitors. Depending on the nature of the risk, requirements that enable people, prior to or during an event, to safely shelter in place or evacuate via safe routes from the flood hazard area may be appropriate.

Development also provides for safe and efficient access and operation for emergency services. If development involves community infrastructure, the application demonstrates that the infrastructure will function effectively during and immediately after a defined natural hazard event.

An application should demonstrate that self-evacuation can be undertaken in an orderly and straightforward manner without imposing a significant additional burden on emergency services. If self-evacuation is not possible, alternative arrangements should demonstrate that the safety of people on site or elsewhere is not adversely affected by the development.

Shelter in place is not considered an appropriate response for uses involving vulnerable persons, unless the flood warning time is sufficient to evacuate all vulnerable persons or the areas of shelter are located above the height of the PMF.

A site-based evacuation plan that does not hinder existing disaster management plans in the surrounding area may be required to demonstrate the above.

Development should not create additional burden on disaster management operations – for example, by reducing flood warning time or requiring unique evacuation requirements over and above what might reasonably be expected in an area to present an acceptable risk. Evacuation or other disaster management requirements should not be the only means by which a development can be regarded as acceptable.

Assessment benchmark 5

All natural hazard areas:

Development directly, indirectly and cumulatively avoids an increase in the severity of the natural hazard and the potential for damage on the site or to other properties.

How a development application may demonstrate compliance with the assessment benchmark

Development is designed to ensure that the location, form and scale of buildings, structures and operational work do not cause or contribute to an increase in the flood hazard affecting the site or surrounding areas.

A development application may be supported by a hydraulic and hydrology report prepared by a qualified professional that demonstrates development will:

a) maintain the flood storage capacity on the subject site
b) not increase the volume, velocity, concentration or flow path alignment of stormwater flow across sites upstream, downstream or in the general vicinity of the subject site
c) avoid acceleration or retardation of flows or any reduction in flood warning times elsewhere on the floodplain
d) not increase stormwater ponding on sites upstream, downstream or in the general vicinity of the subject site.

Assessment benchmark 6

All natural hazard areas:

Risks to public safety and the environment from the location of hazardous materials and the release of these materials as a result of a natural hazard are avoided.

How a development application may demonstrate compliance with the assessment benchmark

Development may demonstrate that:

- materials manufactured or stored on-site are not hazardous or noxious, or do not comprise materials that may cause a detrimental effect on the environment if discharged in a natural hazard event or flood
- structures used for the manufacture or storage of hazardous materials are located above at least the 1 per cent AEP plus 600mm to account for the effects of climate change or are designed to prevent the intrusion of floodwaters
- evacuation plans are in place to safely remove hazardous materials to flood-free alternative sites.

Assessment benchmark 7

All natural hazard areas:

The natural processes and the protective function of landforms and the vegetation that can mitigate risks associated with the natural hazard are maintained or enhanced.

How a development application may demonstrate compliance with the assessment benchmark

Development may incorporate landforms and vegetation that contribute to the mitigation of natural hazards and risks. This will enable natural processes and functions to continue.

Development should demonstrate that riparian vegetation and landforms will be retained as far as practicable for the purposes of retaining the natural flood function of an area, including minimisation of erosion.

Development should avoid works in riparian corridors unless mitigation works are otherwise implemented to mitigate on-site and upstream/downstream impacts of the development to meet assessment benchmarks.

Part E: Example planning scheme provisions

Example planning scheme provisions for the *Natural hazards, risk and resilience* state interest have been prepared that a local government may choose to adopt or otherwise adapt, when making or amending a planning scheme.

The example planning scheme provisions should not be seen as the only way to appropriately reflect the *Natural hazards, risk and resilience* state interest. It is not intended that a local government would use these example provisions verbatim, as responding to the local context is an essential part of adopting the SPP.

Where a local government seeks to adopt the example planning scheme provisions, variations will be required to reflect the local circumstances, opportunities and aspirations of each LGA.

The full suite of planning scheme provisions is available to help manage flood risk. The planning scheme response should not be limited to the inclusion of a flood hazard overlay map and the adoption of the model overlay code.

The table 2 below provides guidance on delivering a land use response and table 3 outlines the planning scheme elements and their role in managing flood risk.

Table 2: Land-use response

Land-use response	Delivering the response	Detailed actions
Avoiding flood hazard areas	• Expanding into new areas with acceptable or tolerable flood risks and safe evacuation routes • Intensifying existing areas that are acceptable • Avoiding particular land uses in areas that create an intolerable risk (such as vulnerable uses).	• Avoid zoning areas of medium or high risk for future urban purposes. • Site-based investigations during application stage may identify additional areas of concern. Avoid inappropriate land uses in these areas. • Adjust current zonings to reflect flood-appropriate land uses. • Create flood-constrained precincts within zones, which may limit certain land-use types or density increases. • Tailor rural land uses appropriate to the flood risk, particularly intensive animal husbandry or intensive agriculture.
Mitigating flood risk to an acceptable or tolerable level	• Intensifying development with mitigation through built form responses and appropriate consideration of siting, design, access, evacuation and floodplain impact • Including mitigation infrastructure or changes to the natural environment that will reduce flood risk • Treating risks to transport/evacuation routes from flood hazard	• Improve built form outcomes through urban design and building code controls. • Set finished floor levels for development in areas potentially affected by flood. • Build with resilient materials. • Maintain/rehabilitate natural waterways and flow paths. • Avoid filling to minimise cumulative impacts on floodplain. • Avoid creating additional risks by not placing key transport/infrastructure linkages in floodable areas, or by ensuring their resilience to those events. • Investigate existing settlements to identify areas that would not flood but would be isolated from the balance of urban area when a flood occurs, and treat linkages accordingly.
Accepting residual risk in flood hazard	• Maintaining acceptable or	• Adjust current zonings to reflect appropriate land uses.

Land-use response	Delivering the response	Detailed actions
area	tolerable land uses in existing areas • Not further intensifying development (such as via rezoning) in areas of tolerable risk. • Not further developing in areas of intolerable risk.	• Identify flood-constrained precincts in which certain land-use types or density outcomes will be limited.
Retreating due to intolerable risk	• Through rezoning areas of intolerable risk where there is no feasible alternative.	• Refer to Minister's Guidelines and Rules (chapter 4)

Table 3: Role of planning scheme element in treating flood hazard risk

Planning scheme element	Role in treating flood hazard risk
Strategic framework	The strategic framework articulates how the land-use strategies will implement the approach to managing the flood risk to future and existing development in the LGA, and how the planning scheme zoning will contribute.
Overlays and mapping	Overlays and maps can be used to: • identify the flood hazard area • identify areas outside of the flood hazard area • identify areas where no flood hazard information is available • identify locations where land-use strategies can be used to avoid or mitigate the effects of flood. They can be used to: • trigger specific flood hazard related provisions in a zoning code • trigger a flood hazard overlay code • trigger building requirements • trigger more work (in a flood investigation area) where the land may flood but not enough information is currently available.
Land-use zones	• Zones identify land uses that are appropriate in flood hazard areas subject to the outcomes of the risk assessment which identify the acceptable, tolerable and intolerable levels of risk for each land use type. • Zones are also located to avoid intolerable risks by delivering the specific outcomes and land-use directions articulated in the strategic framework. • Zoning and associated categories of development are a highly effective statutory mechanism for ensuring that appropriate development occurs in the right locations and is consistent with the strategic framework which reflects the risk assessment.
Category of development	• The category of development for a particular land use should be consistent with the level of risk identified. A lower level of risk should translate into a lower category of development. • The category of development may vary throughout Queensland depending on the types of flooding experienced, the level of tolerability (as determined by the local government) and the information available.
Land-use zone codes	• Flood hazards may be addressed by using a limited development zone code and/or including planning provisions to address flood hazards in each zone code. • Zones codes clearly and consistently articulate how flood hazards will be addressed through the purpose of the zone code, the performance outcomes and the acceptable solutions.

Planning scheme element	Role in treating flood hazard risk
Overlay codes	• The overlay code identifies siting, design and layout techniques that can be used to achieve an acceptable or tolerable level of risk for the development. • If a local planning instrument includes a flood hazard overlay code, it should address flood hazards and associated risks to people, property, economic activity, social wellbeing and the environment. • The overlay code should not duplicate matters that are already covered by the building assessment provisions, unless otherwise allowed under the Building Act 1975.
Planning scheme policies	• Additional technical guidance can be provided through a flood hazard planning scheme policy. • The policy can provide additional specific detail on how to meet particular performance outcomes or acceptable outcomes in the flood hazard overlay code. • The planning scheme policy can provide details on flood modelling and risk management investigations required as part of development assessment.

Strategic framework provisions

Strategic intent and strategic outcomes

If a natural hazard exists in the LGA, the existence of the natural hazard should be referenced in the strategic framework. The strategic outcomes reflect the outcomes from natural hazard investigations and mapping.

The strategic intent component of the strategic framework provides the opportunity to succinctly articulate a local government's intent for management of development (both existing and future) with regard to natural hazards, and which meets the intent of the SPP.

The following are important when drafting these provisions:

- where natural hazards are present they are acknowledged
- natural hazards are identified to avoid or mitigate the hazard impacts and risks.

Table 4 provides examples of strategic intent and a commentary.

Table 4: Examples of strategic intent

Examples of strategic intent	Commentary
The local government is subject to natural hazards including bushfire, flood and storm tide inundation. Future development will therefore be resilient to the potential effects of natural hazards and protect health and safety through avoiding areas that are at significant risk of hazard, and ensuring resilient buildings in appropriate locations.	The local government has acknowledged that the LGA is subject to flooding and has identified *avoiding* and *mitigating* as the strategies to address flooding.
Parts of the LGA are subject to the natural hazards of flood, bushfire and landslide. The community's improved resilience to these hazards is the result of a good understanding of the hazards and the risks they present. While the flood risk for areas <insert> and <insert> has been identified as tolerable, built form outcomes and limiting vulnerable uses will further improve the resilience to the hazard. The lower-lying residential areas of <insert> at intolerable risk of flood have transitioned to open space and public recreation uses during the life of the planning scheme. All new greenfield development occurs in areas of no or low flood hazard, thereby minimising risk to these future communities. Environmental management, open space and recreation, and water-oriented development characterise the	This example provides a clear overview of the settlement intent for the LGA as it relates to natural hazards.

Examples of strategic intent	Commentary
future urban/undeveloped urban areas that are subject to medium and high flood hazard. Land uses and activities in the rural parts of the region respect and respond to the flood hazard.	
Risks to the community (including life and property) from hazardous activities and natural hazards are appropriately mitigated or avoided, ensuring disaster management response capabilities and capacities are supported.	This example acknowledges the important role of land-use planning in supporting disaster management response capabilities and capacities.
Development responds to the climate and incidence of flooding by providing sufficient drainage infrastructure for minor local flooding or overland flow, using water sensitive design of road infrastructure and open spaces, and establishing evacuation routes through disaster risk management. Urban and rural residential development adopts best practice water catchment planning, water cycle management and climate-responsive building design. Settlements in the LGA adjust to the risks associated with natural hazards through appropriate location and design of urban development and new development avoids places at significant risk of hazard. Urban development is compatible with the natural and human-made constraints on development including agricultural land, vegetation, air quality, noise, slope, natural hazards, flooding risk, erosion-prone land, acid sulfate soils, areas of environmental value and risks posed by coastal hazards.	This example identifies flooding as an issue. An integrated risk management approach to address flooding, including land-use planning, has been outlined. This strategic intent also provides commentary on the need for settlements to adjust to natural hazard risks through future development.

Strategic outcomes – by themes

A specific theme relating to flood risk management is a way to articulate specific outcomes and land-use strategies to build community resilience and avoid and/or mitigate the risks associated with flood hazard in particular locations. The following content, relevant to flood hazard, may be used when developing other themes in the strategic framework:

- The *settlement pattern theme* identifies where flood hazard areas are avoided or mitigated.
- The *natural environment theme* protects natural processes and landforms (e.g. the function of the floodplain) and could limit the severity or impact of the natural hazard.
- The *community identity and diversity theme* addresses the ability for resilient social infrastructure to function effectively during and after a flood hazard event and for multi-purpose social infrastructure to be used as emergency shelters.
- The *natural resources and landscape theme* protects natural processes and landforms (e.g. the function of the floodplain) with no worsening of the severity or impact.
- The *access and mobility theme* provides for effective disaster response and recovery through evacuation routes, access for emergency services and the supply of essential goods and services.
- The *economic development theme* addresses a resilient economy that will be able to operate after a flood hazard event.

***Note**: Planning schemes recognise the interrelationship between planning for flood risk and other themes.*

Table 5 provides examples of strategic outcomes and a commentary on the key components.

Table 5: Examples of strategic outcomes

Examples of strategic outcomes	Commentary
Risk to life, property and ecosystems as a result of natural hazards is minimised, and development is managed to respond to the likely effects of climate change.	The local government has provided a clear outcome for development as it relates to hazard minimisation and addressing the effects of climate change.
The shape of the city/region evolves to respond to the natural hazards affecting it, including bushfire, landside and flooding <insert others as required> by ensuring that the location and intensity of development does not place people, property and infrastructure at intolerable risk. The zoning plan in this planning scheme has been prepared with consideration to the risks posed by natural hazards.	This example provides a link to the risk assessment approach envisaged and its relationship to the zoning plan.

Specific outcomes

Specific outcomes relating to flood risk should seek to achieve development that is compatible with the level of risk. Specific outcomes should articulate what the LGA will look like if the natural hazard-related planning provisions in the planning scheme are successfully implemented. For example:

- Development avoids and mitigates risks to property damage.
- Infrastructure functions effectively during and after a hazard event.
- Natural processes and landforms such as the function of the floodplain are protected.
- The severity or extent of the natural hazard is not increased.
- Development supports, and does not unduly burden, disaster management response or recovery capacity and capabilities.

Table 6 provides examples of specific outcomes and a commentary on the key components.

Table 6: Examples of specific outcomes

Examples of specific outcomes	Commentary
The identified settlement pattern avoids further expansion of urban and rural residential uses into high and extreme hazard areas and mitigates the hazard risk in built-up urban areas.	This strategic outcome articulates that the settlement pattern theme has considered natural hazards to avoid and mitigate risks.
Significant urban areas in the state are already established in a floodplain. In these areas, the flood risk will be managed by avoiding the intensification of development and the fragmentation of land holdings in high or extreme hazard areas.	This outcome recognises the risks in existing areas and articulates the outcomes for future development in these areas.
Development ensures that the natural processes and the protective function of landforms and vegetation are maintained in natural hazard areas.	This strategic outcome protects natural processes and landforms, e.g. the function of the floodplain.
Land identified in statutory planning instruments as required for future hazard mitigation works is protected from development that would compromise the delivery of the works.	Through this strategic outcome, the local government has foreshadowed the need for land-use planning decision-making to integrate with other flood risk management objectives as part of an overall risk management strategy.

Examples of specific outcomes	Commentary
Avoiding increase to risk: (1) New development in areas subject to bushfire, landslide or flooding hazard is compatible with the nature of the hazard. (2) Development does not materially increase the extent or the severity of natural hazards, and the safety of people is maintained and damage to property is minimised. (3) The settlement pattern avoids further expansion of urban and rural residential uses into hazard areas.	This example has provided clear, specific outcomes regarding the intent for development related to natural hazard areas. References to the settlement pattern avoiding expansion into hazard areas and avoidance of expansion in existing areas within high hazard provides the means to avoid the risk as per policy 4 of the SPP.
(1) Development, other than coastal-dependent development, avoids areas that are vulnerable to natural hazards and avoids putting people and property at risk from natural hazards. (2) Development in areas susceptible to impacts of natural hazards provides for effective disaster response and recovery through evacuation routes, access for emergency services and the supply of essential goods and services. (3) In addition to the avoidance of areas that are vulnerable to natural hazards, development takes into account the effects of climate change. (4) Development in the coastal communities is contained within the existing identified urban area to prevent expansion into areas that are vulnerable to natural hazards. (5) Development, other than agricultural activities, does not occur within the flood plain.	This example provides clear outcomes in relation to risk avoidance, the role of development in supporting effective disaster response and recovery, and the requirement to take account of climate change. It also provides clear settlement direction for specific parts of the LGA susceptible to flood and other natural hazards.

Example code: Flood hazard overlay

Application

This code applies to assessing material change of use, reconfiguring a lot and operational work for development in the flood hazard overlay.

Purpose

(1) The purpose of the flood hazard overlay code is to:
- (a) provide for the assessment of the compatibility of development in the flood hazard overlay area to flood risk
- (b) ensure that risk to life, property, community, economic activity and the environment during flood events is avoided or mitigated
- (c) ensure that development does not increase the potential for flood damage on-site or to other property.

(2) The purpose of the code will be achieved through the following overall outcomes:
- (a) the development is compatible with the level of flood risk to which it may be subject
- (b) the development siting, layout, and access responds to the identified risk and minimises risk to personal safety
- (c) the development is resilient to flood events by ensuring siting and design accounts for the potential risks of flood to property
- (d) the development supports, and does not unduly burden disaster management response or recovery capacity and capabilities

(e) the development directly, indirectly and cumulatively avoids an unacceptable increase in flood severity and does not significantly increase the potential for damage on the site or to other properties
(f) the development avoids the release of hazardous materials as a result of a flood event
(g) natural processes and the protective function of landforms and/or vegetation are maintained in flood hazard areas.

Table 7: Assessment benchmarks for accepted and assessable development

Performance outcome	Acceptable outcome
PO1 Development is resilient to flood events by ensuring design and built form accounts for the potential risks of flooding.	**AO1.1** A new building or extension to an existing building is not located in a high hazard or high risk area.
	AO1.2 A new residential building in the flood hazard area provides a finished habitable floor level to at least the level specified in table 9. **OR** Where a finished habitable floor level is not prescribed, a new building is: a) not located in the flood hazard area; or b) located on the highest part of the site to minimise entrance of floodwaters.
	AO1.3 A new non-residential building (other than Class 10 buildings) in the flood hazard area: 1. provides a finished floor level to at least the level specified in table 9. **OR** Where a finished floor level is not prescribed, a new non-residential building (other than Class 10 buildings) is: a) not located in the flood hazard area; or b) located on the highest part of the site to minimise entrance of floodwaters.
PO2 Development: a) ensures occupants are prepared for flood events; and b) avoids release of hazardous materials into floodwaters.	**AO2.1** Materials stored on site: a) are readily able to be moved in a flood event; and b) where capable of creating a safety hazard by being shifted by floodwaters, are contained to minimise movement in times of flood. ***Note:*** *A business should ensure that the necessary emergency and continuity plans are in place to account for the potential need to evacuate personnel and to relocate property prior to a flood event (e.g. to allow enough time to transfer stock to the upstairs level of the building or elsewhere).*
	AO2.2 Development ensures: a) the manufacture or storage in bulk of hazardous materials is located at least above the flood planning level in table 9; or b) structures used for the manufacture or storage of hazardous materials in bulk are designed to prevent the intrusion of floodwaters.

Table 8: Assessment benchmarks for assessable development

Performance outcome	Acceptable outcome
Risk-compatible land use	
PO1 Development is compatible with the level of risk associated with the natural hazard, such that: a) urban development in the high hazard or high risk area is avoided b) urban development in the medium or low hazard or risk areas mitigates the flood risk c) community infrastructure is located to minimise risk to people and property.	**AO1.1** Development in high hazard or high risk areas is limited to non-urban uses.
	AO1.2 Development in medium or low hazard/risk areas is consistent with the overall outcomes of the applicable zone.
	AO1.3 Community infrastructure is located in accordance with the community infrastructure flood immunity standards specified in table 12.
Resilient built form	
PO2 Development is resilient to flood events by ensuring design and built form take appropriate account of the potential risks of flooding.	**AO2.1** A new building or extension to an existing building is not located in a high hazard or high risk area.
	AO2.2 A new residential building in the flood hazard area provides a finished habitable floor level to at least the level specified in table 9. **OR** Where a finished habitable floor level is not prescribed, a new building is: a) not located within the flood hazard area; or b) located on the highest part of the site to minimise entrance of floodwaters.
	AO2.3 A new non-residential building (other than Class 10 buildings) in the flood hazard area: a) provides a finished floor level to at least the level specified in table 9 **OR** Where a finished floor level is not prescribed, a new non-residential building (other than Class 10 buildings) is: a) not located in the flood hazard area; or b) located on the highest part of the site to minimise entry of floodwaters.
PO3 Development ensures that a use which requires an interface with the public realm (including a commercial or residential use) maintains a functional and attractive relationship with the adjacent street frontage.[14]	**AO3.1** Development for a residential use where pier and pole construction is utilised: a) if understorey screening is provided it is a minimum of 50% permeable to allow for the flow of floodwater through the understorey. **AO3.2** Development for a commercial building or structure maintains an active street frontage through: a) providing clear pedestrian access from any adjacent footpath to the floor level of the commercial activity;

[14] This is particularly relevant for commercial uses in centres with a strong 'town-centre' pedestrian realm that also may be affected by flood, or for residential uses to maintain an attractive presentation to the street.

Performance outcome	Acceptable outcome
	b) providing a retail or food and beverage use, if consistent with the purpose of the applicable zone and precinct, which interfaces with and overlooks the street; c) urban design treatments that screen the understorey of the building from view from the adjacent street frontage but do not impede flood flow.
Siting, access and isolation	
PO4 Development siting and layout responds to flooding potential and maintains personal safety at all times.	**AO4.1** A lot for an urban purpose: a) is not located in the flood hazard area; or b) has a ground level above the DFE.
	AO4.2 Development complies with the filling requirements of table 10.
	AO4.3 Development in a greenfield area protects a flood conveyance area by providing an easement or reserve over the area of the premises up to the DFE.
	AO4.4 The road and/or pathway layout in the development provides a safe and clear evacuation path: a) to ensure persons are not physically isolated from an adjacent flood-free urban area; b) by locating entry points into the reconfiguration above the DFE and avoiding cul-de-sacs or other non-permeable layouts; and c) in the form of at least one evacuation route that meets the requirements of table 11 during floods up to the DFE.
	AO4.5 Development allows for an area within the development site at or above the flood planning level with sufficient space to accommodate the likely population of the development in safety for a relatively short time until flash flooding subsides (if applicable) or people can be evacuated.
	AO4.6 Development ensures that: a) signage is provided on a road or pathway indicating the position and path of all safe evacuation routes off the premises; b) if the premise contains or is within 100m of a waterway, hazard-warning signage and depth indicators are provided at each key hazard point, such as at a waterway crossing or an entrance to a low-lying reserve.
Infrastructure and utilities	
PO5 Utilities/infrastructure in a site (including roads electricity, gas, water supply, wastewater and telecommunications) supports community resilience during flood events.	**AO5.1** Utilities infrastructure components that are likely to fail to function as a result of intrusion of floodwaters or are likely to result in contamination from floodwaters are: a) not located in the flood hazard area; b) located above the flood planning level; or c) located on the highest part of the site to enhance flood immunity and designed to prevent the intrusion of floodwaters.
	AO5.2 In new subdivisions and large master planned developments/redevelopments, arterial, sub-arterial or major collector roads are located above a suitable flood immunity level.[15]

[15] To be determined by the local government based on local circumstances.

Performance outcome	Acceptable outcome
Disaster management and recovery and business continuity	
PO6 The development supports, and does not unduly burden, disaster management response or recovery capacity and capabilities, and ensures occupants are prepared for flood events.	**AO6.1** Development is located to support self-evacuation of people, and ensure sufficient warning time for the nature of the use.
	AO6.2 Development does not: a) shorten warning time for other uses in the floodplain; b) impact on the ability of traffic to use evacuation routes, or unreasonably increase traffic volumes on evacuation routes.
	AO6.3 Materials stored on site: a) are readily able to be moved in a flood event to a flood-free area; and b) where capable of creating a safety hazard by being shifted by floodwaters, are contained in order to minimise movement in times of flood. ***Note:*** *Businesses should ensure that necessary emergency and continuity plans are in place to account for the potential need to evacuate personnel and to relocate property prior to a flood event (e.g. to allow enough time to transfer stock to the upstairs level of a building or elsewhere).*
Hazardous processes or materials	
PO7 Development avoids the release of hazardous materials into floodwaters.	**AO7.1** Materials manufactured or stored on site are not hazardous or noxious, or comprise materials that may cause a detrimental effect on the environment if discharged in a flood event. **OR** **AO7.2** If a DFE level is adopted, structures used for the manufacture or storage of hazardous materials are: a) located above the DFE level, or b) designed to prevent the intrusion of floodwaters. If a flood level is not adopted, hazardous materials and their manufacturing equipment are located on the highest part of the site to enhance flood immunity and designed to prevent the intrusion of floodwaters. ***Note:*** *Refer to the Work Health and Safety Act 2011 and associated Regulation and Guidelines, the Environmental Protection Act 1994 and the relevant building assessment provisions under the Building Act 1975 for requirements related to the manufacture and storage of hazardous substances. Information is provided by Business Queensland on the requirements for storing and transporting hazardous chemicals, available at: www.business.qld.gov.au/running-business/protecting-business/risk-management/hazardous-chemicals/storing-transporting*
Flood conveyance and behaviour	
PO8 Development directly, indirectly and cumulatively avoids: a) any increase in water-flow velocity or flood level; b) an increase the potential for flood damage either on site or on other properties; and	**AO8.1** Works in an urban area associated with a proposed development do not involve: a) any physical alteration to a watercourse or floodway including vegetation clearing; or b) a net increase in filling (including berms/mounds). ***Note:*** *Berms/mounds are considered to be an undesirable built form outcome and are not supported.*

Performance outcome	Acceptable outcome
c) reducing flood-warning times for any part of the floodplain.	**OR** **AO8.2** Works (including buildings and earthworks) in non-urban areas either: a) do not involve a net increase in filling greater than 50m3; **OR** **AO8.3** Development: a) complies with the filling requirements of table 10; b) maintains the flood storage capacity on the subject site; c) does not increase the volume, velocity, concentration or flow-path alignment of stormwater flow across sites upstream, downstream or in the general vicinity; d) avoids acceleration or *retardation* of flows or any reduction in flood-warning times elsewhere on the floodplain; and e) does not increase stormwater ponding on sites upstream, downstream or in the general vicinity of the subject site. ***Note:*** *The local government may request a hydraulic and hydrology report, prepared by a suitably qualified professional, to demonstrate compliance with this performance outcome/acceptable outcome.*
Community infrastructure	
PO9 Development involving community infrastructure, if necessary for the specific type of community infrastructure proposed: a) avoids areas or circumstances of intolerable risk; b) remains functional to serve community need during and immediately after a flood event, if required; c) is designed, sited and operated to avoid adverse impacts on the community or the environment due to the impacts of flooding on infrastructure, facilities or access and egress routes; d) retains essential site access during a flood event; and e) is able to remain functional even when other infrastructure or services may be compromised in a flood event.	**AO9.1** Community infrastructure is located in accordance with the community infrastructure flood-immunity standards specified in table 12. **AO9.2** Infrastructure components that are likely to fail to function as a result of intrusion of floodwaters or are likely to result in contamination from flood waters are: a) not located in the flood hazard area; b) located above the flood planning level; or c) located on the highest part of the site to enhance flood immunity and designed to prevent the intrusion of floodwaters; and d) are designed and constructed to resist hydrostatic and hydrodynamic forces as a result of inundation by flood. **AO9.3** Uses involving vulnerable persons or community infrastructure that must operate during and immediately after a flood event have direct access to low hazard evacuation routes as defined in table 11.

Notes:

1. *Subheadings may be used to differentiate between criteria for acceptable development and assessable development. Alternatively, the code table may be divided into further 'parts' to assist with usability.*
2. *Subheadings to identify criteria specific to a zone precinct or local plan precinct may be included.*
3. *Supporting material such as tables and figures may be used in support of the above assessment criteria. These may be included in the assessment column or referenced in the outcomes and located at the end of the code.*

4. *Notes may be included in assessment benchmarks, drawing attention to other legislation to be complied with. For example, an Australian Standard to support an acceptable outcome or local laws, or providing guidance on interpretation of a performance outcome.*

Table 9: Flood Hazard Overlay Code – Flood planning levels for finished floors (residential and non-residential development) and levels for hazardous chemicals

Part of flood hazard area	Freeboard	Flood planning level
Area with Level 2 or 3 mapping ***Note:*** *These areas may be broken down into hazard or risk areas on the basis of the outcomes from the risk assessment.*	For example, 300mm or 600mm, or other locally appropriate freeboard ***Notes:*** 1. *A local government should select a suitable freeboard based on local circumstances. In some areas, flood information may be less precise, thus a higher freeboard may be necessary to address uncertainties in modelling and climate change.* 2. *A local government may also wish to set different freeboards in different parts of the flood hazard area depending on flood risk.*	Defined Flood Event + freeboard ***Note:*** *In the part of the flood hazard area defined by Level 1 mapping (such as an 'investigation area') a local government may choose to:* *a) set a historic flood level known for the area as the DFE plus a conservative freeboard; or* *b) require site-based determination of the DFE by the applicant.* *In these circumstances a local government may apply these measures selectively across the floodplain, or for only certain aspects of development.*

Note: *If the premises are subject to another overlay or overlay component that states a planning level, the planning level that provides the highest level of immunity applies.*

Table 10: Flood Hazard Overlay Code – Fill requirements

Part of flood hazard area	Fill level
An area subject to Level 2 or Level 3 mapping	To be determined by local government ***Note:*** *Local governments may wish to provide more detailed requirements or advice in relation to the appropriateness of filling in key areas of the floodplain. Matters to be addressed can include:* *a) avoiding any filling (either across the floodplain or in high hazard or risk areas, for example);* *b) allowing filling in high hazard or risk areas where only for the purposes of public infrastructure or otherwise as directed by an approved floodplain management plan;* *c) setting an appropriate fill level for areas where, strategically, filling may be acceptable, such as the DFE or the Flood Planning Level; and/or* d) *setting different fill levels across the floodplain, if necessary to achieve a local intent.*
Further investigation area	Filling permissible where complying with PO ***Note:*** *In the absence of detailed flood information for a certain area, local governments may wish to take a more performance based approach to the regulation of filling and undertake case-by-case assessments based on suitable hydraulic and hydrology reports.*

Table 11: Flood Hazard Overlay Code – Flood evacuation route requirements

Criteria	Degree of Flood Hazard			
	Low	Medium	High	Extreme
Wading ability	If necessary children and the elderly could wade. (Generally, safe wading velocity depth product is less than 0.25.)	Fit adults can wade. (Generally, safe wading velocity depth product is less than 0.4.)	Fit adults would have difficulty wading. (Generally, where wading velocity depth product is less than 0.6.)	Wading is not an option.
Evacuation distances	< 200 metres	200 – 400 metres	400 – 600 metres	> 600 metres
Maximum flood depths	< 0.3 metres	< 0.6 metres	< 1.2 metres	> 1.2 metres
Maximum flood velocity	< 0.4 metres per second	< 0.8 metres	< 1.5 metres	> 1.5 metres
Typical means of egress	Sedan	Sedan early, but 4WD or trucks later	4WD or trucks only in early stages, boats or helicopters	Large trucks, boats or helicopters
Timing **Note: This category cannot be implemented until evacuation times have been established in the Counter Disaster Plan (flooding).**	Ample for flood forecasting. Warning and evacuation routes remain passable for twice as long as evacuation time.	Evacuation routes remain trafficable for 1.5 times as long as the evacuation time.	Evacuation routes remain trafficable for only up to minimum evacuation time.	There is insufficient evacuation time.

Note: ***The evacuation times for various facilities or areas would (but not necessarily) be included in the Counter Disaster Plan (flooding).***

Generally, safe wading conditions assume even walking surfaces with no obstructions, steps, soft underfoot, etc.

Table 12: Flood Hazard Overlay Code – Community infrastructure standards

Development type	Community/floodplain context	Minimum immunity
Select from table 18.	Select from table 18.	Select from table 18.

Note: *Local governments should review the community and floodplain context(s) of their LGA and select the appropriate minimum flood immunity standards for inclusion in this table.*

Refining the flood hazard overlay code provisions

The code provisions above are necessarily broad in nature – they are intended to act as 'baseline' provisions to which additional, locally relevant detail is added and therefore results in the alteration of the example provisions above. The outcomes of the flood risk assessment will provide the detail to enable local governments to tailor the planning provisions to local circumstances.

Local governments may wish to provide more detail, particularly in relation to the performance outcomes (POs) provided. For example, where there is a clear outcome sought by the flood risk assessment to manage development in a particular part of the flood hazard area, this can be articulated at the PO level to provide greater clarity on the outcomes sought.

Table 13: Assessment benchmarks

Performance outcome	Acceptable outcome
PO Development is compatible with the level of risk associated with the natural hazard, so that: a) urban development in the high hazard or high risk area is avoided; b) urban development in the medium or low hazard or risk areas mitigates the flood risk; and c) community infrastructure is located to minimise risk to people and property.	**AO** Development is compatible with the level of risk associated with the natural hazard, such that: a) residential uses, including tourism and short-term accommodation uses, are not located in a high or medium hazard/risk area (e.g. a tourist park); b) commercial and industrial development occurs only in a medium or low hazard/risk area; c) urban development in the medium or low hazard or risk area mitigates the flood risk; and d) community infrastructure involving vulnerable uses is not located in the flood hazard area.

Performance outcome	Acceptable outcome
	***Note**: Local governments may also wish to include locality-specific detail in the POs where there is a need for a specific development outcome identified by the flood risk assessment in that area.*
PO Development siting a layout responds to flooding potential and maintains personal safety at all e3times.	**AO** Development siting and layout responds to flooding potential and maintains personal safety at all times, so that: a) no new urban lots are located in a high hazard/risk area; b) lots in a medium or low hazard/risk area provides a ground level above the DFE; c) rural and rural residential lots provide sufficient area outside the DFE to accommodate the required minimum lot size. ***Note**: Local governments may also wish to include locality-specific detail in the POs where there is a need for a specific development outcome identified by the flood risk assessment in that area.*
	AO Development siting and layout responds to flooding potential and maintains personal safety at all times, so that: (a) the road layout avoids isolation in a flood hazard event and does not impede evacuation; (b) vehicular access during a flood hazard event is enabled; (c) provision is made for on-site sheltering during a flood event; and (d) signage is provided to enable community members to have a clear understanding of the nature of the flood risk in the area.
PO The development supports, and does not unduly burden, disaster management response or recovery capacity and capabilities.	**PO** The development supports, and does not unduly burden, disaster management response or recovery capacity and capabilities for all floods up to the DFE (or the PMF, if desired).

Optional flood hazard overlay code provisions

Isolated areas/flood islands

A flood risk assessment or management study may have identified isolated areas or flood islands in the floodplain that require risk treatment.

According to national best practice guidance,[16] isolated areas may be known as:

- flood islands, where areas are isolated solely by floodwaters. Where flood islands are completely submerged in the PMF, these may be called low-flood islands. Where flood islands have elevated areas above the PMF, they may be called high-flood islands.
- trapped perimeter areas, where areas are isolated by a combination of floodwaters and impassable terrain. Where trapped perimeter areas are completely submerged in the PMF, these may be called low-trapped perimeter areas. Where trapped perimeter

[16] Australian Institute for Disaster Resilience (2014), *Technical flood risk management guideline: Flood emergency response classification of the floodplain*.

areas have elevated areas above the PMF, they may be called high-trapped perimeter areas.

A local government should consider managing development in these locations due to the isolation risks associated with developing in these areas. Although they may only rarely or never flood, a flood event may create an indirect impact through isolation. At a minimum, local governments may wish to ensure that uses that may not be resilient to isolation are avoided in these areas.

Some examples of provisions that address development within isolated areas are included in Table 14.

Table 14: Development in isolated areas/flood islands only

Performance outcome	Acceptable outcome
PO Development that involves a vulnerable use avoids locating that use in an isolated area/flood island area.	**AO** The vulnerable-use component of development is not located in an isolated area/flood island area identified on the flood hazard overlay map.

The planning scheme will need to identify a vulnerable use where such a provision is proposed to be included. Examples of vulnerable uses include a childcare centre, community care centre, community residence, community use, detention facility, educational establishment, emergency services, hospital, non-resident workforce accommodation, relocatable home park, residential care facility, retirement facility, rooming accommodation, rural workers' accommodation and tourist park.

Overland flow

While the primary focus of flood hazard areas is riverine flooding, in some LGA overland flow is a particularly problematic issue. Local governments can incorporate overland flow studies into the planning scheme to regulate development in areas affected by these flows. This can be done by including overland flow path mapping in the planning scheme as a trigger for assessment, and by the inclusion of overland flow-specific code provisions.

Overland flow is defined by the Queensland Urban Drainage Manual (QUDM)[17] as follows:

- Where a piped drainage system exists: it is the path where storm flows in excess of the capacity of the underground drainage system would flow.
- Where no piped drainage system or other form of defined watercourse exists: it is the path taken by surface runoff from higher parts of the catchment to a watercourse, channel or gully. It does not include a watercourse, channel or gully with well-defined bed and banks.

QUDM also notes that the importance of mapping overland flow paths was recognised in the final reports of the Queensland Floods Commission of Inquiry. Traditionally, the mapping of overland flow paths was seen as a component of 'Master Drainage Planning', but this role is now often incorporated in flood studies.

The PMF only identifies the extent of flooding in floodplains. Property flooding can still occur outside the PMF zone as a result of severe flows passing along overland flow paths.

Local governments may wish to include design provisions like setting floor levels related to overland flow events in addition to riverine flood events. They may decide to include specific code provisions to address overland flow with regard to significant material changes of use or for reconfiguring a lot in these areas. The example code provisions can

[17] Available at www.dews.qld.gov.au/__data/assets/pdf_file/0008/78128/qudm2013-provisional.pdf.

also be amended to specifically refer to overland flow events as well as riverine events where similar development outcomes for overland flow are sought.

Some examples of provisions that address development within overland flow paths are given in table 15.

Table 15: Development in overland flow paths

Performance outcome	Acceptable outcome
PO Development siting and design is resilient to overland flow events, accommodates existing flow path characteristics and minimises risk to people, property and infrastructure.	**AO** A building in an overland flow path area provides a finished floor level to at least the overland flow planning level specified in table E.3. ***Note:*** *A report from a suitably qualified professional may be required to determine the overland flow planning level at the subject site.*
	AO Development avoids channelising or otherwise altering existing flow paths on the site. **OR** Development occurs in accordance with an approved site-based stormwater management plan.

Boundary realignments/rearrangements

Boundary realignments and rearrangements could reduce the amount of available land for development or hinder access and evacuation processes. Local governments may wish to include specific code requirements to address boundary realignments/rearrangements in flood hazard areas.

Some examples of provisions that address boundary realignments/rearrangements in flood hazard areas are included in table 16.

Table 16: Realignment/rearrangement of boundaries

Performance outcome	Acceptable outcome
PO Development layout does not increase the risk to existing or future people, property or infrastructure located on the premises or other premises.	**AO** Development ensures there is sufficient area outside the flood hazard area to accommodate the intended use(s). **AO** Development ensures that building envelopes avoid areas of high hazard or risk. **AO** Development ensures that the entry points into the development are located to provide a safe and clear evacuation route path that meets the requirements of table 11 during floods up to the DFE.

Relationship with building assessment provisions

For the building assessment provisions, the flood hazard area defined by the planning scheme is designated to be the flood hazard area outlined in section 13 of the Building Regulation 2006 (Building Regulation). For the purposes of the Building Regulation, a local government can prescribe the whole flood hazard overlay area, or it can designate an alternative area indicated on the flood hazard overlay map as being the flood hazard area for the purposes of the Building Regulation.

In accordance with section 13(1)(b) of the Building Regulation, the following parameters may be defined for all or part of the flood hazard area:

- the DFL as <local government may insert map references or height datum information>
- the maximum flow velocity of water as <local government may insert map references>
- an inactive flow or backwater area as <local government may insert map references>
- a freeboard of < local government should insert freeboard that is greater than 300mm>
- the finished floor level of Class 1 buildings built in all or part of the flood hazard area as <local government may insert floor level>.

In accordance with section 13 of the Building Regulation, the local government may choose which of the above requirements it wishes to declare in the planning scheme. The local government must also keep a register of the flood hazard areas it designates and when each designation was made.

Table 17 provides an overview of how the planning and building provisions can complement each other under different scenarios.

TABLE 17: Building assessment provisions

Scenario	Planning provisions	Building provisions
1. Where Level 2 or 3 mapping has been undertaken.	Include relationship with the building assessment provisions to declare a DFE and DFL. Include provisions that reflect or enhance the example planning provisions and model code herein.	Trigger Queensland Development Code (QDC) provisions that address: • structural stability • floor levels • utilities above DFL • infrastructure above DFL • backflow devices.
2. Where level 1 flood mapping is the only mapping available, Level 2 data inputs are available but Level 2 mapping has not been undertaken (no depth or velocity information available).	Include relationship with the building assessment provisions to state a DFL which could be based on: • a particular height in Australian Height Datum (AHD) • a particular height above natural ground level • above a historical event that was recorded by an authority, or • above a historical event recorded by a local resident and supported by a statutory declaration. Include provisions stated in scenario 1.	Trigger QDC provisions that address: • floor levels • utilities above DFL • infrastructure above DFL • backflow devices. Apply standard structural stability requirements.
3. Where Level 1 flood mapping is the only mapping available, Level 2 data inputs are not	Include relationship with the building assessment provisions to set a finished floor level and include provisions stated in scenario 1. Trigger QDC provisions that relate to a	Apply standard structural stability requirements.

Scenario	Planning provisions	Building provisions
available.	finished floor levels.	
4. Where Level 1 flood mapping is the only mapping available or where the potential for flooding is unknown.	Use zoning to determine the appropriate land uses and include provisions stated in scenario 2.	No building provisions triggered.

Flood hazard planning scheme policy

While not a mandatory element of a planning scheme, a *planning scheme policy* is a useful tool to provide guidance to an applicant about the flooding information required to support a development application and how that information should be presented.

If a flood related planning scheme policy is included in a planning scheme as noted in table 7:

- for development proposed on land susceptible to flooding (i.e. located in the flood hazard area), the policy may outline additional information an applicant should provide to the assessment manager as part of the development application
- for development proposed on land where the potential for flooding is unknown, the policy may ask an applicant to provide:
  - information to enable an assessment of whether the subject land is susceptible to flooding
  - upon determination that the subject land is susceptible to flooding, more detailed information to allow an assessment of the flood risk.

Key aspects to consider when drafting a flood planning scheme policy are:

- Under what circumstances does the planning scheme policy apply?
- What is the purpose and scope of the planning scheme policy?
- Who is a suitably qualified professional to, on behalf of the local government, undertake or assess flood modelling and flood assessments submitted to support the application?
  - The local government may have suitably qualified in-house personnel, or they may rely on a third party to undertake this assessment on their behalf.
  - A flood engineer, particularly a Registered Professional Engineer of Queensland, is qualified to undertake flood modelling.
- What information is required to support the development application and how should it be presented?
  - Key information can include:
    - requirements for site-based flood studies
    - details on outcomes sought from site-based flood risk assessments (if needed) and other mitigation/risk management investigations
    - details on reporting needed to meet overlay code outcomes related to alterations (if any) to floodplain behaviour or flood flows pre- and post-development.
- What information can the local government or other entities provide on request to the applicant?
  - This information may include flood modelling files, elevation data, other flood modelling assumptions (such as roughness etc.), details of proposed or completed flood mitigation infrastructure that should be included in the site-based assessment.
- What guidance can the local government provide to help the applicant decide:
  - which flood modelling methodology to use?
  - what assumptions or data to use?

- how to present the data in a report – what is the best electronic format?
- when to consult local government or other stakeholders?

- What references and/or standards should be used?
  - National best practice and other state-based documents provide a good basis for compliance with standards as well as other important background information.

Infrastructure

Minimum flood immunity standards

Table E12 sets down the required minimum flood immunity standards relative to the varying settlement and flood contexts across Queensland – from small, rural townships on broad floodplains to highly urbanised coastal cities in complex river deltas.

A local government should consider the nature of its floodplain context(s) for its LGA and select the appropriate minimum flood immunity standards for inclusion in the planning scheme. The level(s) of risk appropriate for infrastructure, having regard to local circumstances, is determined through the risk assessment process required by policy 2 of the SPP.

Table 18: Minimum flood immunity standards for infrastructure

Infrastructure type	Settlement context^	Floodplain context*	Minimum immunity
Transport infrastructure			
Any transport infrastructure as defined by the Regulation	All	All	No specific recommended flood level, but development proponents should ensure that the infrastructure is optimally located and designed to achieve suitable levels of service, having regard to the processes and policies of the administering government agency.
Needing to operate during and immediately after a flood event (Figure 3)			
Hospitals and associated institutions Emergency services facility (including police facilities) Water cycle management infrastructure (water treatment plant) Facilities utilised as an evacuation or recovery facility in addition to their normal function (e.g. sporting facility, community centre, meeting hall)	All	High hazard or limited warning (e.g. less than 24 hours)	Locate outside PMF or other available extreme event (such as 0.2% AEP,[18] at a minimum).
		High hazard and longer warning	Locate outside 0.2% AEP[19] **OR** Building floor levels above 0.2% AEP[20] + freeboard.
		Lower hazard and longer warning	
Involving vulnerable persons (Figure 4)			
Retirement village Residential care facility Facility where an education and care service under the Education and Care Services National Law (Queensland) is	Small non-coastal town/rural settlement	High hazard or limited warning (e.g. less than 24 hours)	Locate outside PMF or other available extreme event (such as 0.2% AEP, at a minimum).
		High hazard and longer warning	Locate outside 1% AEP.

[18] 0.5% AEP for water cycle management infrastructure (water treatment plant)
[19] 0.5% AEP for water cycle management infrastructure (water treatment plant)
[20] 0.5% AEP for water cycle management infrastructure (water treatment plant)

Infrastructure type	Settlement context^	Floodplain context*	Minimum immunity
operated or a childcare service under the *Child Care Act 2002* is conducted Correctional facility Education establishment		Lower hazard and longer warning	Locate outside 1% AEP **OR** Building floor levels above 1%AEP + freeboard.
	Small coastal town/ settlement	High hazard or limited warning (e.g. less than 24 hours)	Locate outside PMF or other available extreme event (such as 0.2% AEP).
		High hazard and longer warning	Locate outside PMF or other available extreme event (such as 0.2% AEP) **OR** Building floor levels above extreme event (such as 0.2% AEP).
		Lower hazard and longer warning	Locate outside 1% AEP **OR** Building floor levels above 1% AEP + freeboard.
	Larger urban centre (non-coastal)	High hazard or limited warning (e.g. less than 24 hours)	Locate outside PMF or other available extreme event (such as 0.2% AEP).
		Lower hazard or longer warning	Locate outside 1% AEP.
	Larger urban centre (coastal)	High hazard or limited warning (e.g. less than 24 hours)	Locate outside PMF or other available extreme event (such as 0.2% AEP).
		High hazard and longer warning	Locate outside PMF or other available extreme event (such as 0.2% AEP) **OR** Building floor levels above extreme event (such as 0.2% AEP) + freeboard.
		Lower hazard and longer warning	Locate outside 1% AEP **OR** Building floor levels above 1%AEP + freeboard.
Needing to operate soon after a flood event (Figure 5)			
Cemetery and crematorium Sporting facility, community centre, meeting hall (where not used as an evacuation or	All	High hazard or limited warning (e.g. less than 24 hours)	Locate outside 1% AEP.

Infrastructure type	Settlement context^	Floodplain context*	Minimum immunity
recovery facility) Waste management facilities Storage and works depots and similar facilities, including administrative facilities associated with the provision or maintenance of the community infrastructure mentioned in this part		High hazard and longer warning	Locate outside 1% AEP OR Building floor levels above 1% AEP + freeboard
		Lower hazard and longer warning	
Facilities with potential primarily for property loss			
Gallery, museum, library and any other similar community/cultural facility/use	All	High hazard or limited warning (e.g. less than 24 hours)	Locate outside 0.5% AEP.
		High hazard and longer warning	Locate outside 1% AEP OR Building floor levels above 1% AEP + freeboard.
		Lower hazard and longer warning	
Other infrastructure			
Any other infrastructure as defined by the Regulation	All	All	Unless stated through other infrastructure.

Notes:

1. *For the purposes of preparing the land-use strategy related to the risk-appropriate location of infrastructure, the term 'settlement context' is used to describe the general characteristics of urban settlement in a subject area. For example, small hinterland towns or rural settlements may be completely inundated by low hazard floodwaters during an event, but may still require infrastructure to service the settlement adequately. Provision of infrastructure in these areas may be possible where the risk presented by the flood hazard can be addressed through built form and design. Non-coastal urban centres often have multiple areas outside flood hazard areas available to accommodate infrastructure in preference to flood hazard areas. Coastal urban centres may have limited options available for higher immunity sites to accommodate infrastructure due to their low-lying nature.*

2. *For the purposes of preparing the land-use strategy related to the risk-appropriate location of infrastructure, the term 'floodplain context' is used to describe the general flood behaviour of the catchment in a subject area, having regard to a range of events. For example, higher in a catchment, floodwaters can rise quickly with little warning and can therefore represent high hazard. Lower in a catchment (such as near the coast), floodwaters can still represent high hazard but can be slower to rise with more warning and remain elevated for longer.*

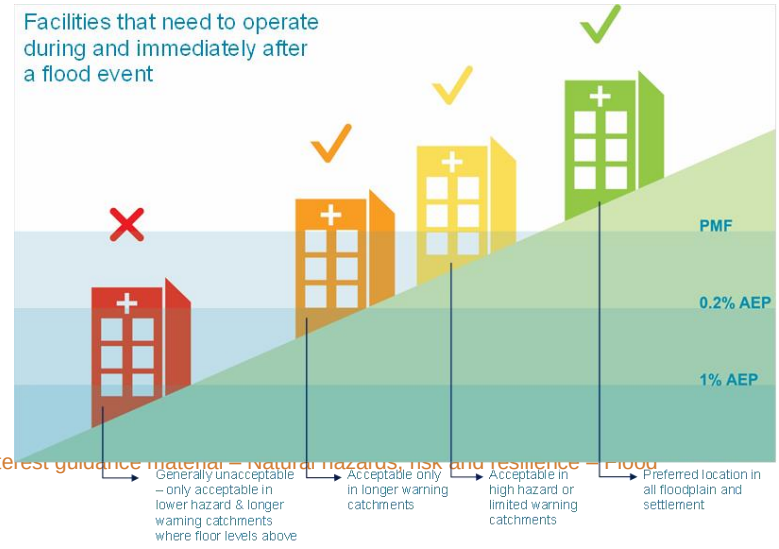

Figure 3: Facilities that need to operate during and immediately after a flood event

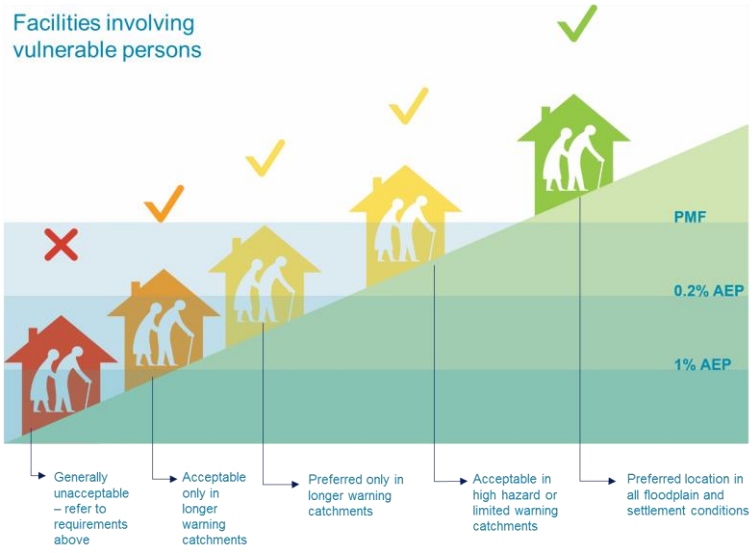

Figure 4: Infrastructure involving vulnerable persons

Figure 5: Infrastructure needing to operate soon after a flood event, or facilities with potential for property loss

Infrastructure designation

Key questions to be addressed when considering infrastructure designation:

1. What function does the infrastructure serve during or immediately after a natural hazard event?
2. What standards have been adhered to for the siting and design of the infrastructure?
3. What are the consequences of a loss of service?
4. What is the community's tolerance to loss of service during or immediately after a natural hazard event?

5. Under what natural hazard scenario will the infrastructure cease to function effectively?
6. Is the siting of the infrastructure compatible with the level of hazard?
7. Where natural hazard areas cannot be avoided, can the risks associated with the natural hazard be mitigated to acceptable or tolerable levels to achieve the required level of service during and immediately after a defined event?
8. Has consideration been given to the likelihood and consequences of a future natural hazard event that exceeds the defined event?

When infrastructure is replaced, particularly if it is due to damage caused by a natural hazard event, it is appropriate to consider re-building the infrastructure to be more resilient and/or in a better location.

The Council of Australian Governments (COAG 2011, p. 11) recommends that:

> Following a disaster, recovery efforts may require significant infrastructure reconstruction. Building public and private infrastructure to a more resilient standard, if appropriate, taking into account cost-benefit and other considerations, will reduce the need for significant expenditure on recovery in the future. Appropriate land-use planning is also likely to reduce the risk of repeated damage to such infrastructure.

To achieve these planning outcomes, the state or a local government should increase the resilience of the infrastructure when replacing it if it was affected by a natural hazard event.

There are three steps this policy identifies when making and amending a planning scheme:
1. hazard identification
2. undertaking a risk assessment
3. implementing mitigation measures to reduce risk to an acceptable or tolerable level.

Mitigating risks to acceptable or tolerable levels

The acceptability of risk from a natural hazard, in the context of land-use planning and development design, requires consideration of loss of life, as well as social, economic and infrastructure loss (COAG 2011).

A risk assessment should be conducted for the infrastructure that is consistent with national policy and best practice, as per policy 2 of the SPP. Key risk assessment considerations include:

Social risk assessment

1. The type of infrastructure is compatible with the level of risk associated with the natural hazard as it is, or the infrastructure network will be able to function effectively during and after a broad range of events.
2. Development siting, layout, access – particularly emergency evacuation routes and associated warning times – and emergency management plans responds to the natural hazard potential and maintains personal safety.
3. There is an emergency management plan/business continuity plan that meets the Minister's and the community's expectations.

Economic risk assessment

1. Infrastructure is resilient to natural hazard events by ensuring siting and design account for the potential risks of natural hazards to property.
2. The design lifespan of the infrastructure, initial design and construction costs and recovery costs have been considered if the infrastructure is damaged during an event.

Environmental risk assessment

1. Development directly, indirectly and cumulatively avoids an unacceptable increase in the severity of the natural hazard and does not significantly increase the potential for damage on the site or to other properties.
2. Development avoids the release of hazardous materials as a result of a natural hazard event.
3. Natural processes and the protective function of landforms and/or vegetation are maintained or managed in natural hazard areas.
4. Development avoids environmental and other impacts on the surrounding area and properties.

Part F: Supporting information

1. Australian Government Productivity Commission 2014, *Natural disaster funding arrangements*, Volume 1. http://www.pc.gov.au/inquiries/completed/disaster-funding/report/disaster-funding-volume1.pdf

2. Australian Institute for Disaster Resilience 2015, *National emergency risk assessment guidelines.* Handbook 10. www.aidr.org.au/media/1489/handbook-10-national-emergency-risk-assessment-guidelines.pdf

3. Australian Institute for Disaster Resilience 2014, *Technical flood risk management guideline: Flood emergency response classification of the floodplain,* Supporting document for the implementation of Australian Emergency Management Handbook 7, *Managing the floodplain: Best practice in flood risk management in Australia*. www.aidr.org.au/media/1570/aemhs-7-2-guideline.pdf

4. Australian Institute for Disaster Resilience 2013, *Managing the floodplain: A guide to best practice in flood risk management in Australia*. Handbook 7. www.aidr.org.au/media/1410/handbook-7-managing-the-floodplain-a-guide-to-best-practice-in-flood-risk-management-in-australia.pdf

5. Australian Institute for Disaster Resilience 2010, *Guidelines for the development of community education, awareness and engagement programs*. Australian Emergency Manual series 45. https://www.aidr.org.au/media/1475/manual-45-guidelines-for-the-development-of-communication-education-awareness-and-engagement-programs.pdf

6. COAG 2011, *National strategy for disaster resilience: Building the resilience of our nation to disasters*, Council of Australian Governments. www.ag.gov.au/EmergencyManagement/Documents/NationalStrategyforDisasterResilience.PDF

7. Department of Community Safety 2012, *Historical analysis of natural hazard building losses and fatalities for Queensland 1900–2011: State-wide Natural Disaster Risk Assessment and Risk Register Program*. www.disaster.qld.gov.au/Disaster-Resources/Documents/Historical%20analysis%20of%20natural%20hazard%20building%20losses%20and%20fatalities%20for%20Queensland%201900-2011.pdf

8. Department of Energy and Water Supply 2013, *Queensland urban drainage manual*. www.dews.qld.gov.au/__data/assets/pdf_file/0008/78128/qudm2013-provisional.pdf

9. Department of Housing and Public Works 2013, *Queensland Development Code parts referenced in legislation—mandatory parts*, MP 3.5 Construction of buildings in flood hazard areas. www.hpw.qld.gov.au/construction/BuildingPlumbing/Building/BuildingLawsCodes/QueenslandDevelopmentCode/Pages/QueenslandDevelopmentCodeCurrentParts.aspx

10. Department of Infrastructure, Local Government and Planning 2017, *Minister's Guidelines and Rules under the Planning Act 2016*. https://dilgpprd.blob.core.windows.net/general/MGRBook_FINALweb.pdf

11. Department of Natural Resources and Mines 2016, *Guide for flood studies and flood mapping in Queensland*. www.dnrm.qld.gov.au/__data/assets/pdf_file/0010/332695/guide-flood-studies-mapping-qld.pdf

12. Department of Natural Resources and Mines 2014, *Flood ready Queensland: Queensland Flood Mapping Program – Flood mapping implementation kit* www.dnrm.qld.gov.au/__data/assets/pdf_file/0009/230778/flood-mapping-kit.pdf

13. Department of Natural Resources and Mines 2017, FloodCheck map. http://dnrm-floodcheck.esriaustraliaonline.com.au/floodcheck/

14. Department of State Development, Infrastructure and Planning 2014, *Guidelines for environmental assessment and public consultation procedures for designating land for community infrastructure*. https://www.dilgp.qld.gov.au/resources/guideline/environmental-assessment-and-consultation-procedures-for-designating-land-for-community-infrastructure-april-2014.pdf

    This document provides guidance on how a Minister, before designating land for community infrastructure, can be satisfied that for development:
    - adequate environmental assessment has been carried out
    - in carrying out environmental assessment under paragraph (a), there was adequate public consultation
    - adequate account has been taken of issues raised during the public consultation.

    The guidelines also include a checklist identifying relevant matters for the assessment of environmental effects and also sources of advice or information. www.dilgp.qld.gov.au/resources/guideline/environmental-assessment-and-consultation-procedures-for-designating-land-for-community-infrastructure-april-2014.pdf

15. Geoscience Australia 2016, *Australian rainfall and runoff: A guide to flood estimation*. http://book.arr.org.au.s3-website-ap-southeast-2.amazonaws.com/

16. Planning Institute of Australia 2015, *National land use planning guidelines for disaster resilient communities*. www.planning.org.au/policy/national-land-use-planning-guidelines-for-disaster-resilient-communities-2

17. *Queensland Floods Commission of Inquiry: Final report*, 2012. www.floodcommission.qld.gov.au/publications/final-report/

18. Queensland Government 2014, *Queensland strategy for disaster resilience: To make Queensland the most disaster resilient state in Australia*. http://www.statedevelopment.qld.gov.au/resources/plan/local-government/queensland-strategy-or-disaster-resilience.pdf

19. Queensland Reconstruction Authority n.d., *Planning for stronger, more resilient electrical infrastructure: Improving the resilience of electrical infrastructure during flood and cyclones*. www.statedevelopment.qld.gov.au/resources/guideline/qra/planning-resilient-electrical-infrastructure.pdf

Appendix 1: Flood hazard area mapping methodology

Fit-for-purpose flood mapping selection

Using the available flood mapping information as a guide, the most appropriate form and quality of mapping to be used in planning scheme preparation should be determined at a local level by the local government. It should be informed by local needs, knowledge and issues. There may be a range of mapping sources and types used throughout a region to create a region-wide understanding of flood hazard.

Mapping provided by the state forms the 'baseline' standard of mapping – local government is responsible for deciding whether the baseline mapping is appropriate for their local government area (LGA), or whether they need to do more detailed mapping.

The approach to flood knowledge and data (particularly in relation to planning scheme preparation) should focus on a cycle of continuous improvement. It is important to use information that is fit-for-purpose. A lack of high-quality information should not preclude action. Rather, local governments need to improve flood planning using information that is currently available.

Where limited development activity is anticipated, it may be appropriate that a detailed study be timed to coincide with later local area or site-based planning (for example, through development assessment) that can consider the hazard in greater detail with more specific land-use planning. This approach may be suitable where a less precise study has indicated a general suitability for the anticipated land use.

There also may be areas anticipating growth at different levels or in different timeframes. In these circumstances, a common level of precision across the whole LGA may not be necessary. More precise studies should be considered for those areas where development pressures are greatest and most imminent.

The types of flood studies undertaken by local governments to complement or replace the state-level mapping often will be determined by broader floodplain risk management parameters rather than solely land-use planning needs. Scoping and preparing these studies should occur in accordance with the *Guide for flood studies and mapping in Queensland* produced by the Department of Natural Resources and Mines. This guide establishes a standardised approach which facilitates greater consistency for flood studies and mapping throughout the state. The guide extends the groundwork established through the QFMP by enabling local governments and other flood management entities (such as river improvement trusts) to create fit-for-purpose flood studies and mapping using a wide range of flood study techniques.

A suitably qualified professional should review all available studies and mapping (whether prepared by the local government or the state) to determine if an existing flood study is relevant and appropriate. This review should include, but not be limited to:

- study outputs
- study assumptions
- the data on which the study was based
- the techniques used to model the hydrology and floodplain hydraulics
- the range of AEP
- changes in the catchment since the flood study
- future development scenarios.

The choice of flood mapping used by a local government in its planning scheme is influenced by:

- the characteristics of the flood hazard that have occurred and are forecast in the future
- the current population (both numbers and spatial extent) and types of land use exposed to flooding
- future development and growth pressures
- local government capacity and capability
- community resilience to flooding.

Assuming an existing flood study is deemed suitable, it may be appropriate to adopt the study outputs directly. They may be revised by a suitably qualified professional as the basis for further studies/assessments of flood risks and mitigation measures and used as a trigger in development assessment.

A local government should always use the best available flood mapping in planning scheme preparation – this may mean undertaking new studies for specific areas well ahead of planning scheme preparation. It also means studies should be fit-for-purpose – local governments should focus effort and expenditure on areas of highest risk and greatest existing or future population, rather than on areas of limited population or growth. Table A.1 provides the minimum flood study requirements relative to the settlement context that should be used to inform planning scheme preparation.

Table A.1: Minimum flood study requirements per settlement context

Settlement context	Expected level of growth		
	None to very low	Low	Medium-high
Regional landscape low-intensity rural	Level 1	Level 1	N/A
Intensive rural production areas including large-scale irrigation development	Level 1	Level 2	Level 2
Low-density rural towns and settlements	Level 1	Level 2	Level 3
Urban areas (existing or known future)	Level 2	Level 3	Level 3
Industry or infrastructure of regional or state significance (e.g. mines, state development areas)	Level 3	Level 3	Level 3

Methodology

Including the community in verification of Level 1 QFAO mapping

In the absence of survey marks, aerial imagery and other information held by local government, the community may be able to help refine the Level 1 mapping based on anecdotal evidence – for example, photographs, flood marks and other local knowledge.

Caution must be exercised in dismissing the importance of flood risk considerations because of a lack of recorded flood history or local knowledge of the community. Community consultation can be a useful tool in sourcing historical data as part of mapping and verifying local characteristics relating to hazards. Every effort should be made to find out the flood history of the local area through scrutinising local government records, newspapers and talking with community members.

When additional historical data are received by the local government, it should undertake the same analysis process noted in the section titled *'Verifying Level 1 QFAO mapping'*.

Community consultation in relation to flooding has shown that:

- it is unlikely that the 'community view' will be totally unanimous; some people may feel aggrieved by the majority view
- the community's views are limited by the level of flood information available and the experience of that community; this view is likely to change as new information becomes available either through a new, more comprehensive study or an actual flood event

- community acceptance is often predicated on the level of appreciation of flood impacts (risk and consequence) and the extent to which individuals understand and accept how a flood will actually affect them.

Localities previously thought of as 'flood-free' have sometimes turned out to be aware of flood risk. It may be that no one recorded earlier events because the area was undeveloped. It may be that the last flood was poorly recorded or so long ago that it pre-dated recorded history. Local Indigenous communities may not have had any way to impart or record their own knowledge about past flooding.

Undertaking a more detailed study (such as a Level 2 or Level 3 study) is always a preferable means of refining the Level 1 QFAO mapping than using historic records or recollections.

Including the community in verification of Level 2 or Level 3 mapping
Similar to verification of Level 1 QFAO mapping, the community can play a role in contributing to the validation and calibration of more detailed flood studies prepared by local governments.

The *Guide for flood studies and mapping in Queensland* provides detail about how to best consult with the local community in relation to Level 2 or Level 3 studies.

Selecting flood events that make up the flood hazard area
The selection of flood events for use in the planning scheme should be informed by the outcomes of the flood risk assessment because:

1. Recommendations 2.13, 2.14 and 5.3 of the Queensland Flood Commission of Inquiry refer to the desire for multiple levels and/or 'zones' of risk to be incorporated in mapping made available by local governments.
2. National best practice notes the benefit of considering the full range of flood risk in land-use planning, via both strategic planning and development assessment.[21]
3. Relying solely on the DFE can mean a community is unprepared when a flooding event either exceeds or does not exactly replicate the DFE – both in terms of property damage and community expectation of flood protection.

In relation to this third point, in the scenario where only the DFE is mapped, buildings outside the area affected by the DFE would not be subject to any development requirements. Buildings immediately outside the area affected by the DFE can suffer significant flood damage as they have not been developed in accordance with any flood-related requirements.

Mapping an area larger than the area affected by the DFE based on the level of the freeboard for the DFE would provide a suitable 'buffer' for these circumstances.

Creating an LGA-wide flood hazard area for the planning scheme
Unless a local government has Level 3 mapping available across its entire area, the flood hazard area in a planning scheme (usually expressed as a flood hazard overlay) will often comprise multiple mapping products, 'stitched together' across the region, to provide a region-wide understanding of flood hazard and potential.

[21] Excerpt from *Managing the floodplain*, p. 99: 'The earlier flood risk is considered in the planning process, the more effectively flood risk can be addressed. For example, considering the full range of flood risk in zonings can encourage development in locations where it is compatible with flood function and flood hazard, and where emergency response arrangements are sustainable.'

Step 1: Select the mapping suite to use across the LGA
Unless a local government has undertaken flood studies across all floodplains in its LGA, it will probably use a combination of Level 1, Level 2 and/or Level 3 mapping.

Level 1 mapping should be considered as the 'baseline' mapping available across the region, while Levels 2 and 3 provide more precise mapping in specific towns/areas of the region.

Step 2: Select the appropriate events for use in the planning scheme
Inclusion of events greater than and less than the traditional 1 per cent AEP in the flood hazard overlay is encouraged. This represents a true risk-based approach to floodplain management. It meets Queensland Floods Commission of Inquiry recommendations, and incorporates the impacts of climate change into planning.

This approach can be achieved either by:
1. using additional events available through a Level 2 or Level 3 study for specific areas, in addition to the DFE
2. 'nesting' a more detailed study (such as an historic study) into the Level 1 mapping so multiple levels of risk can be demonstrated – the Level 1 mapping will likely exceed the extent of the historic study and provide a mapped alternative to a modelled extreme event.

Step 3: Select the appropriate symbology
Local governments should select the mapping symbology for use in the overlay based on the desired approach to identifying the flood hazard in the planning scheme. Generally, Level 1 mapping should be identified through the *Further investigation* mapping style.

Mapping of depth, hazard or risk should be undertaken using the other available mapping styles (i.e. the shades of blue). More detailed information on selecting the appropriate symbol is provided in the *Guide for flood studies and mapping in Queensland*.

Step 4: Stitch the mapping suite into a consolidated layer
As noted above, unless the local government has Level 3 mapping available across its region, the flood hazard overlay will reflect a compilation of mapping from multiple sources. This mapping must be compiled in a manner that reproduces the flood data from the original sources (particularly for Levels 2 and 3 studies) and enables refinement of the Level 1 mapping to better integrate with that more precise data.

Please refer to the *Stitching and nesting* section under step 5 for more detail.

Step 5: Prepare any supporting mapping (if desired)
A range of mapping outputs can be produced to support implementation of the planning scheme through development assessment.

Additional supporting mapping to assist development assessment can include:
- water surface level/building floor levels – water surface level mapping (whether or not manipulated to include the freeboard requirement) can be prepared to provide a clear indication to development proponents of the building floor height required at a specific site
- velocity mapping – where the local government is sufficiently confident in the data, velocity mapping can be prepared to assist assessment managers and certifiers in building approvals. This is particularly relevant where a local government has triggered the relevant building assessment provisions related to construction of buildings in flood hazard areas.[22]

[22] Currently, MP 3.5 of the Queensland Development Code.

Stitching and nesting

Stitching

Stitching relates to the process of combining flood mapping of different levels of precision to form one consolidated layer across the LGA. This process is primarily provided for those local governments intending to use a range of Level 1, 2 and/or 3 mapping products to create their region-wide flood hazard overlay. It requires some proficiency in Geographic Information Systems (GIS) to complete.

The process involves, in GIS:

1. Starting with Level 1 mapping as a base across the LGA.
2. Overlaying Level 2 and Level 3 mapping for those areas/towns that have this more precise information.
3. Clipping (using GIS techniques) the Level 1 mapping that is overlapped by Level 2 or 3 mapping from the dataset, so that the Level 2 or 3 data replaces the Level 1 mapping in those areas (the Level 1 data need not remain 'underneath' the Level 2 or 3 data, unless there was a planning control that required this to occur).
    - The clipping of the Level 1 data should occur at the data model boundary (usually a square or rectangle) rather than the flood extent such that the Level 2 or 3 flood mapping entirely replaces the Level 1 data in those locations
4. Reviewing all 'edges' of the data to ensure that they accurately reflect flood behaviour.*
5. Refining the Level 1 QFAO mapping (if used) to better integrate its extent with the extent of the flood events selected in the Level 2 or 3 mapping, as per figure A.1. This should be undertaken by a suitably qualified individual. This step should not be undertaken for Level 1 basin modelling mapping. It is not intended to be refined manually.

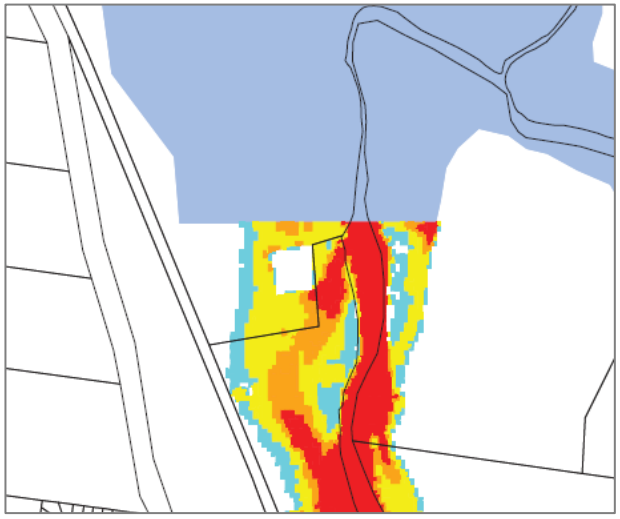

Figure A1: Refining Level 1 QFAO mapping

***Note**: Some flood model outputs can create 'boundary' or 'edge' effects whereby the downstream boundary of the flood model inaccurately displays very deep water. These effects should be clipped by a suitably qualified individual from the mapping in the planning scheme. They may inadvertently trigger certain use or development limitations where the planning provisions developed relate to depth or hazard.*

Nesting

Nesting involves placing the Level 2 or Level 3 mapping within the Level 1 mapping, rather than replacing it. Nesting is a preferred technique where Level 2 or Level 3 mapping may be limited to the DFE and there is the desire to include a representation of a more extreme event than the DFE for use as a planning control (such as limiting vulnerable uses in an area greater than the DFE).

Often, the Level 1 mapping exceeds the extent of the DFE. Therefore, it can be used as a representation of an extreme event where the Level 2 or Level 3 mapping sits within it.

The nesting approach also provides a 'buffer area' for the application of the freeboard control beyond the spatial area of the DFE. This gives an additional level of protection for buildings located outside the DFE, in the case of floodwaters covering a larger or different area than is affected by the DFE.

The nesting approach is preferred to the stitching approach. In terms of GIS process it replicates the stitching approach, with the exception of:

- Step 3 – rather than using the flood model boundary to clip the Level 1 mapping, the extent of the Level 2 or Level 3 flood event(s) are used. The Level 2 or Level 3 map then 'nests' within the Level 1 mapping in that location, rather than replacing it in its entirety.
- Step 5 – this step is no longer required given the Level 2 or Level 3 mapping nests within the Level 1 mapping.

Consideration of overland flow and creek flooding

Mapping and management of overland flow paths and creek flooding is an emerging area of practice for some local governments in Queensland, particularly including mapping and development controls within the planning scheme.

Preparation of creek and overland flow studies may be necessary for all local governments to understand more localised flooding and the role of planning schemes in managing the risk presented by these hazards.

Planning schemes should incorporate creek and/or overland flow mapping wherever they are available in an LGA. Where creek and/or overland flow flooding presents a risk to existing or future development within an LGA and mapping does not currently exist, the local government should prioritise studies to address this gap.

Revisions to flood studies and mapping

The undertaking of flood studies and mapping should be part of a cycle of continuous improvement to improve flood information and knowledge over time throughout the LGA.

The frequency, extent or severity of the hazard may change over time. This should be factored into a program of hazard mapping to ensure effective risk assessment. Where climate change might alter the severity of events, mapping may need to be updated more frequently than the planning scheme.

Also, as populations grow and development pressures and land-use patterns change, the results of flood hazard investigations should be revised. Improvements in mapping quality, data and availability may also enable a revision of the results of investigations.

Other flood mapping data available

Basin-level flood modelling (Level 1)	
Purpose	The sub-basin level models provide greater understanding of flood behaviour throughout various catchments during major flood events than the QFAO – specifically, an approximation of the 1% AEP event, and an extreme event. This mapping provides detail at a catchment level and complements the initial statewide QFAO by providing an increased level of accuracy for identifying flood hazard at a catchment scale.
Data custodian	Department of Natural Resources
Ability to locally refine	A local government can refine this mapping. Refinement and smoothing of this data may be required prior to inclusion in a local government planning scheme. However, it is not intended to be manipulated manually on the basis of other flood information (such as survey marks etc.) as it has been prepared through flood modelling rather than cartographic techniques.
Methodology	The modelling of river basins and sub-basins is a flood study approach that was undertaken during Phase 3 of the QFMP. Reports, catchment scale models, flood maps and video animations are available for various locations across Queensland. The Basin Flood Mapping activity provides catchment scale flood modelling that is a fit-for-purpose, risk-based and cost-effective solution that maximises the benefits of access to existing statewide datasets available for an entire catchment, e.g. SRTM elevation data. A list of locations completed under the QFMP is contained in the table below.

Basin name	Sub-basin name	Local governments
BAFFLE-KOLAN	Baffle Creek	Gladstone, Bundaberg
	Kolan Creek	
BARRON	Barron River	Cairns, Tablelands, Mareeba
	Freshwater Creek	
BOYNE-CALLIOPE	Boyne River	Gladstone
	Calliope River	
BURDEKIN	Bowen River	Burdekin, Barcaldine, Whitsunday, Charters Towers, Isaac
	Lower Burdekin River	
	Suttor River	
	Upper Burdekin River	
BURNETT	Barker & Barambah Creeks	North Burnett, South Burnett Bundaberg, Gympie, Cherbourg, Western Downs
	Boyne & Auburn Rivers	
	Lower Burnett River	
	Upper Burnett River	
CONDAMINE	Balonne River	Southern Downs, Toowoomba, Western Downs, Balonne, Maranoa, Murweh, Paroo
	Condamine River	
	Maranoa River	
	Wallam Creeks	
DON	Don River	Whitsunday
FITZROY	Comet River	Rockhampton, Central Highlands, Woorabinda, Banana, Isaac, Maranoa, Western Downs
	Dawson River	
	Fitzroy River	
	Isaac River	
	Mackenzie River	
	Nogoa River	
HERBERT	Herbert River	Tablelands, Hinchinbrook

			Cassowary Coast
	JOHNSTONE	North Johnstone River	Tablelands, Cassowary Coast
		South Johnstone River	
	MARY	Lower Mary River	Fraser Coast, Gympie, Sunshine Coast, Somerset, Noosa
		Noosa River	
		Upper Mary River	
	MULGRAVE-RUSSELL	Mulgrave River	Cairns, Yarrabah, Tablelands
		Russell River	
	MURRAY	Murray River	Cassowary Coast
	TULLY	Tully River	Tablelands, Cassowary Coast
Data limitations/preferred usage	There are limitations to the applicability and accuracy of flood modelling when undertaken at a catchment scale. The results are suitable for increasing the community understanding of flood risks, but should not be solely relied on for design of flood mitigation options such as levees or setting building floor levels. The methodology adopted for the catchment models is conservative. The modelling outputs should not be used for estimating flood levels. The vertical accuracy of the SRTM Digital Elevation Model (DEM) is at best ±5m. Flood depths should be considered as indicative only on a broad scale. Where basin-level flood modelling is available, this should be used by the local government in preference to the QFAO mapping. It represents an improved methodology (i.e. flood modelling rather than cartographic methods) for determining flood potential. It should be used as a trigger for development assessment primarily: 1. in rural or very low growth areas where no other flood information (such as a more detailed flood study) exists; and/or 2. as a means to represent a more extreme event where more detailed information (such as Level 2 or 3 mapping) is 'nested' to represent the DFE. There is increased utility for use in undertaking risk assessments as compared to the QFAO; however, the flood hazard information (e.g. depth) remains coarse and conservative given the data inputs (e.g. elevation data) used to derive the mapping.		

Town-based studies developed by the QFMP (Level 2)	
Purpose	The purpose of this mapping layer is to provide detailed flood extent and behaviour information for certain towns in an LGA. The type of mapping **available for towns covered by Level 2 mapping** includes flood depth, velocity and hazard for a range of events, including the 1% AEP, other selected AEPs (e.g. more extreme events), and historic events where applicable. This mapping layer provides useable town-specific flood mapping where a local government does not otherwise have access to suitable Level 3 mapping for that location. It should be used in place of Level 1 mapping.
Ability to locally refine	A local government can refine this mapping. Manual alteration of the mapping outputs is not recommended, given these outputs have been derived from flood modelling rather than cartographic means like the QFAO. However, the flood models used to derive the mapping are available from the state for more detailed calibration by local governments. This is usually more cost effective than creating new Level 3 flood models.
Methodology	The QFMP provided Level 2 flood studies and mapping for 172 towns around Queensland, particularly for locations for which flood studies were not previously available.

	The town-based studies aim to provide indicative flood extent and depths for historic and selected AEP events. The outputs and products from this investigation are intended to be used by the relevant local government in a range of ways. They can provide additional information for reviewing planning schemes and can be adapted in emergency management planning and response.
Data limitations/preferred usage	Not all locations in Queensland are covered by a Level 2 town-based study. Please refer to www.dnrm.qld.gov.au/mapping-data/maps/flood-mapping-program/floodcheck-map for specific information on the towns covered. The Level 2 flood models used to derive the flood mapping are two-dimensional models that use best available LiDAR-derived DEMs and streamflow information. The models are not comprehensive in validating and calibrating modelling outputs relative to previous events, or other hydraulic information. The Level 2 mapping is based on riverine flows only and therefore may not take into account smaller creeks and streams or overland flows. Level 2 mapping should not be used for the purposes of structural mitigation works assessment without first being calibrated to Level 3 quality. Mapping outputs can be used without calibration for risk assessment, to inform the preparation of the land-use strategy and development assessment processes where the mapping has been validated by the local government as reflecting flood behaviour in the study area. Building levels can be derived from the Level 2 information, noting that increased freeboard requirements are recommended given the ±0.5m accuracy of the indicated flood depths.

Local flood studies (Level 3)	
Purpose	The purpose of Level 3 mapping is to provide the best available flood mapping for an area for a range of flood risk management purposes, including land-use planning, disaster management, community awareness, mitigation works, and insurance.
Data custodian	Department of Natural Resources and Mines
Ability to locally refine	A local government can refine this mapping. A local government is responsible for maintaining and updating local flood studies as their own circumstances and requirements dictate.
Methodology	Local flood studies can be developed using techniques that meet national best practice. The *Guide for flood studies and mapping in Queensland* (DNRM, January 2016) is a comprehensive guide for scoping and preparing a local flood study.
Preferred usage	Level 3 mapping should be used in planning scheme preparation in preference to any other flood mapping available for a local area. Where Level 3 mapping is available for an area, it should replace any Level 1 or Level 2 mapping in planning scheme preparation. Level 3 mapping is usually suitable for setting building levels. However, this should be validated by the local government before it is used for this purpose.

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