SC6.4 Flood hazard

SC6.4.1 Application

1. This planning scheme policy applies to development where the Flood hazard overlay code identifies Planning Scheme Policy 4 Flood hazard as supporting an outcome of that code.

SC6.4.2 Relationship to the Planning Scheme

1. This planning scheme policy is to be read in conjunction with the assessment benchmarks specified in the Planning Scheme and applies when development is proposed in an area identified on OM7 Flood hazard overlay map. This policy specifically relates to section 8.7 Flood hazard overlay code and ensuring development is consistent with the purpose and performance outcomes of the code.

SC6.4.3 Purpose

1. The purpose of this planning scheme policy is to:
   a. provide supporting information about achieving outcomes in the planning scheme code;
   b. identify requirements for site assessments and management plans;
   c. provide supporting technical information, where relevant;
   d. identify other relevant guidelines, standards and information sources, where relevant;
   e. provide information about Council's flood regulation data, tools and processes to assist proponents in preparing well informed supporting documentation for development in flood affected areas.
2. The planning scheme policy is arranged into 4 sections:
   a. qualifications;
   b. technical Standards;
   c. minimum requirements for assessments and management plans;
   d. special areas;
   e. investigation areas.

SC6.4.4 Qualifications

1. A flood hazard risk assessment management plan is to be prepared and certified by a qualified and experienced Registered Professional Engineer of Queensland (RPEQ) who has a minimum seven years' experience in flood management.

SC6.4.5 Technical standards

1. A reference in the policy to a specific resource, guideline, standard or document means the latest version of the resource, guideline, standard or document. Refer also to Planning Scheme Policy 9 Stormwater management.
2. The listed technical standards are not intended to be exhaustive. It is expected that appropriate references are also used in accordance with accepted best practice.

SC6.4.5.1 Guidelines

1. The following guidelines may be relevant when designing flood resilient buildings:
   a. Hawkesbury-Nepean Floodplain Management Steering Committee (2006) Reducing Vulnerability of Buildings to Flood Damage: Guidance on Building in Flood Prone Areas, Parramatta;

b. Queensland Reconstruction Authority (2019) Flood Resilient Building Guidance for Queensland Homes, The State of Queensland, Brisbane.

SC6.4.5.2 Standards

1. The following standards may be relevant when preparing a Flood risks assessment and study.
   a. Australian Building Codes Board (2012) Buildings in Flood Hazard Areas, Commonwealth of Australia, Canberra;
   b. Australian Institute for Disaster Resilience (2017) Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia, Commonwealth of Australia;
   c. Australian Institute of Disaster Resilience (2017a) Evacuation Planning. Australian Disaster Resilience Handbook Collection Handbook 4;
   d. Australian Institute of Disaster Resilience (2017b) Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia;
   e. Australian Institute of Disaster Resilience (2017c) Flood Hazard, Australian Disaster Resilience Handbook Collection, Guideline 7-3;
   f. Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), Commonwealth of Australia (Geoscience Australia) (2019) Australian Rainfall and Runoff: A Guide to Flood Estimation;
   g. Department of Environment, Land, Water and Planning (2015) Guidelines for riparian fencing in flood-prone areas, East Melbourne, Victoria;
   h. Queensland Urban Drainage Manual (QUDM);
   i. Queensland Urban Drainage Manual, Background Notes;
   j. Red Cross Australia (2015) Preferred Sheltering Practises for Emergency Sheltering in Australia.

SC6.4.5.3 Information sources

1. The following information sources may be relevant when preparing a Flood risks assessment and study.
   a. Australian Rainfall and Runoff;
   b. Bureau of Meteorology - Stream gauge station records;
   c. Commonwealth Scientific and Industrial Research Organisation;
   d. Intergovernmental Panel on Climate Change;
   e. Queensland Water Monitoring Information Portal - https://water-monitoring.information.qld.gov.au;
   f. ARR Data Hub.

SC6.4.6 Policy specific definitions and abbreviations

1. Policy specific definitions are listed in the below table.

Abbreviation / acronym	Meaning
AEP	Annual exceedance probability
ARI	Average recurrence interval
ARR	Australian Rainfall and Runoff
DEM	Digital elevation model
DFE	Defined flood event
DRAINS	Urban hydrology and hydraulics software
HEC-RAS	Steady State One Dimensional Hydraulic Model
ISIS	Fully Dynamic One Dimensional Hydraulic Model

Abbreviation / acronym	Meaning
LiDAR	Light Detection and Ranging (Aerial Laser Survey)
MIKE11	Fully Dynamic One Dimensional Hydraulic Model
MIKE21	Fully Dynamic Two Dimensional Hydraulic Model
MIKE FLOOD	Fully Dynamic Coupled One & Two Dimensional Hydraulic Model
QUDM	Queensland Urban Drainage Manual
RAFTS	Runoff Routing Software
RORB	Runoff Routing Software
SWMM	Fully Dynamic One Dimensional Hydraulic Model
TUFLOW	Fully Dynamic Coupled One & Two Dimensional Hydraulic Model
URBS	Runoff Routing Software
WBNM	Runoff Routing Software
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
WSL	Water Surface Level

SC6.4.7 Consultation

1. The Council may seek third party advice or comment about an application where the development may conflict with a code or technical advice is required to assess the development. Where technical advice is outsourced to an independent consultant an additional fee will apply.

SC6.4.7.1 Flood mapping

1. The Flood hazard overlay map shows flood hazard derived from numerous sources.
2. Flood modelling studies are complex technical investigations requiring a detailed understanding of catchment hydrological processes and floodplain hydraulic controls. Computer simulations are used to quantify runoff from rainfall and evaluate flow patterns and flooding extents around floodplains. There are numerous flood modelling studies which have been completed for the Lockyer Valley local government area. Results from these flood modelling studies have been combined to provide the Flood hazard overlay map.
3. Flood modelling studies are under constant development due to the construction of infrastructure and the acquisition of new data. This information is available on Council's Flood Information Portal and digital copies of the latest and current flood modelling studies can be obtained under a data sharing agreement.

Note: A flood study must be conducted to determine the DFL and the flood hazard risk in an overland flow path.

SC6.4.7.1.1 Hydraulic risk (HR)

1. To formulate a hydraulic risk standard, Hazard category (H) is used. A Hazard category (H) is a general classification of flood hazard on a floodplain. The categories relate to the vulnerability of people and property during a flood. There are six categories, where H1 is the lowest level of risk and H6 is the highest level of risk:
   a. H1 Generally safe for vehicles, people and buildings. Relatively benign flood conditions. No vulnerability constraints.
   b. H2 Unsafe for small vehicles.
   c. H3 Unsafe for vehicles, children and the elderly.
   d. H4 Unsafe for vehicles and people.

e. H5 Unsafe for vehicles and people. Buildings require special engineering design and construction.
f. H6 Unsafe for vehicles and people. All buildings types considered vulnerable to failure.

2. The hydraulic risk involves the modelling of likely flood events. An essential component of flood management studies is to determine flood function or hydraulic categorisation of the floodplain. Hydraulic risk aids the development of appropriate flood risk management strategies into the future. The Hydraulic risk categories, HR1 to HR5, are shown below in the Hydraulic risk matrix.

AEP	H1	H2	H3	H4	H5	H6
PMF	HR5	HR5	HR5	HR5	HR5	HR5
1 in 500	HR4	HR4	HR4	HR4	HR4	HR4
1 in 200	HR4	HR4	HR4	HR3	HR3	HR3
2011	HR4	HR3	HR3	HR2	HR2	HR2
1 in 100	HR4	HR3	HR3	HR2	HR2	HR2
1 in 50	HR4	HR3	HR3	HR2	HR2	HR1
1 in 20	HR3	HR2	HR2	HR1	HR1	HR1
1 in 10	HR3	HR2	HR2	HR1	HR1	HR1

Source: WMA Water Community Precinct Risk Assessment 2022, p.101

3. Hydraulic risk does not take into consideration non-hydraulic risk factors such as the land use or development exposure to flooding, the vulnerability of the community at risk, specific challenges associated with evacuation or isolation during flooding, or risks associated with loss of essential services during a flood (Brisbane River Strategic Floodplain Management Plan, Technical Evidence Report BMT 2018). A flood hazard risk assessment management plan should consider and address all relevant flood risks.

SC6.4.7.2 Flood hazard categories

1. All of the below elements are combined to create the Flood hazard risk categories shown in the Flood hazard overlay.

FLOOD RISK CATEGORY	HYDRAULIC RISK AND RISK MULTIPLIER USED
Extreme	Below Grantham - use H5 & H6 from the 1% AEP event Grantham and above – use 2011 H5 & H6
High	Hydraulic risk categories 1 & 2 Low Flood Island - Category A Floodway (1% AEP Event) Any Moderate flood risk areas with warning time of less than 6 hours
Moderate	Hydraulic risk category 3 Low Flood Island - Category B High Flood Island Flood Storage areas (1% AEP Event) Any Low flood risk areas with warning time of less than 6 hours
Low	Hydraulic risk category 4 Flood fringe areas (1% AEP Event)
Very low	Hydraulic risk category 5

SC6.4.7.2.1 Flood islands

1. Flood islands are areas within the floodplain that remain dry but are surrounded by floodwaters. They may stay dry or become wet if a flood reaches a higher magnitude. Flood islands have a higher risk to people, as they can become trapped. People in areas of flood islands may need to evacuate before water encroaches into their property.
2. Three types of flood islands have been considered in categorising flood risk:
   a. Low flood island category A - areas which are dry and surrounded by floodwaters in the 5% (1 in 20 years) AEP event but become inundated once the event reaches a 1% (1 in 100 year) AEP event.
   b. Low flood island category B - areas which are dry but surrounded by floodwaters in the 1% (1 in 100 year) AEP event but become inundated once the event reaches a Probable Maximum Flood (PMF).
   c. High flood islands – areas surrounded by floodwaters, and the land is located above the Probable Maximum Flood (PMF).

SC6.4.7.2.2 Warning time

1. Flash flooding occurs when the warning time is less than 6 hours. Warning time is an important measure in categorising flood risk. If not in a suitable 'sheltering in place' arrangement, people who may be affected by flood need sufficient time to evacuate to a safer place.

SC6.4.7.3 Guiding principles of assessment

1. The following principles are to be used in the assessment of development.

SC6.4.7.3.1 Safety and access: Protect human life and ensure people are safe from flood hazard

1. Applies to all development applications except Critical infrastructure.
2. Safe place of shelter.
3. Safe evacuation by residents during floods (if identified as being required).
4. Property based services are operational during and after floods.
5. Conditions of approval may be applied including:
   a. approved development envelope area for the location of buildings, services and vehicle access;
   b. floor level height.
6. Applications that are unable to meet the safety objectives will be refused.

SC6.4.7.3.2 Safety and access: Protect and minimise flood damage to property and infrastructure

1. Applies to all development applications.
2. Buildings and allotments (or development envelopes) are clear of the DFL.
3. Buildings (including those for people to shelter in place) are able to withstand impacts from flood debris and water intrusion.
4. Safe evacuation by employees during floods (if identified as being required).
5. Businesses and services are able to operate after flood events.
6. A business continuity plan is provided (if identified as being required).
7. Conditions of approval may be applied including:
   a. floor level heights;
   b. service locations;
   c. resilient building materials;
   d. restrictions on building form;
   e. evacuation procedures.

8. Applications that are unable to meet the safety objectives will be refused.

SC6.4.7.3.3 Flood plain function: Improve flood conveyance and behaviour

1. Applies to all development near waterways and those parts of the floodplain that are regularly flooded.
2. The objective is usually satisfied by siting the works appropriately.
3. Natural function of the flood plain is protected.
4. Flood plain storage is not reduced.
5. Flood water conveyance is improved or unchanged.
6. Flood water is not diverted to any adjoining property.
7. Riparian corridors and overland flow paths are retained and improved.
8. Conditions of approval may be applied including:
   a. Setbacks to prevent harm and incorporate appropriate vegetation into site plans;
   b. Fencing restrictions;
   c. Easements over overland flow paths and 5% AEP events in the flood plain;
   d. Design modifications to subdivisions.

SC6.4.7.3.4 Disaster management recovery: Protect and minimise flood impact on Essential community infrastructure and Critical infrastructure

1. Applies to Essential community infrastructure and Critical infrastructure.
2. Services are located and configured to minimise impacts from flood events.
3. Services are operational during and after flood events.
4. Safe access by emergency services during floods.
5. Suburb based services (public and privately owned) are operational during and after flood events.
6. Conditions of approval may be applied.

SC6.4.8 Preparation of Flood hazard risk assessments and mitigation plan

1. The purpose of an individual Flood hazard risk assessment and management plan is to:
   a. describe the values and features of the site to be managed;
   b. meet the outcomes of the relevant planning scheme codes.
2. The Flood risk assessment and management plan should provide the minimum in the Table below.

Table SC6.4-1: Standard requirements for Flood hazard risk assessments and mitigation plans

Section:	Details
Executive Summary	This section should include: a. authorship details including contact information; b. industry accreditation number; c. document certification by RPEQ; d. key assumptions, assessment approach and outcomes of the risk assessment; e. key measures to mitigate flood risk; f. any areas of non-compliance with the Flood hazard overlay code;

Section:	Details
	g. how areas of non-compliance with the Flood hazard overlay code will be managed.
Section 1: Introduction	This section should include: a. the purpose and objectives of the Flood hazard risk assessment and management plan; b. scope of study including any limitations.
Section 2: Development details	This section should include: a. site details, real property description and street address; b. description of the proposed development and resulting land use/s; c. details of any relevant previous approvals; d. the date on which the assessment and any plans were prepared, including any amendments; e. name and relevant professional qualifications of the person/s preparing the assessment and management plan; f. plans that show as a minimum: north point, scale, location of property boundaries, roads, street names, vegetation location.
Section 3: Flood considerations	This section should include information on: a. data used and sources and assumptions; b. catchment drainage characteristics; c. any previous studies relevant to the site; d. hydrology Model setup and assessment; e. hydraulics Model setup and assessment; f. calibration method; g. results and findings. Note: See also Planning Scheme Policy 9 Stormwater management.
Section 4: Modelling of Design Flood Events	This section should include information on: a. Flooding mechanisms (e.g. regional and local catchments, overland flow paths and creek to be used); b. Existing catchment mapping using the Floodplain Management Guidelines of Australia methodology; c. Comparison of design event results with historic observation; d. Developed catchment mapping using the Floodplain Management Guidelines of Australia methodology; e. Impacts of development (afflux and hydrology) including afflux mapping for the following events: 63% AEP (Q1), 39% AEP (Q2), 10% AEP, 1 in 100 AEP, 1 in 2000 AEP and the PMF for current climate and the 1 in 100 AEP for future climate and extreme events (as relevant); f. Climate Change; g. Sensitivity Testing relating to both design of the water service level and impact assessment, e.g. consideration and application of relevant extreme events; h. Qualifications and limitations relevant to the methodology.
Section 5: Flood protection measures	This section should provide clear information and advice on how flood consequences are managed by the design of the development including but not limited to: a. Future habitable floor level of dwellings if a residential subdivision or residential use; b. Floor level of non-habitable buildings; c. Places of safe refuge on site; d. Evacuation routes including vehicles accesses, driveways, and carparks; e. Functioning of network services during and after the event; f. Functioning of Community infrastructure during and after the event;

Section:	Details
	g. Public safety measures to minimise flood intrusion of Hazardous material storage areas; h. Impact on basements and areas under the natural ground level; i. Backflow flooding (from a regional event).
Section 6: Assessment against code Flood hazard overlay code	This section should provide: a. demonstrate the risk to people and property is acceptable; b. an assessment demonstrating consistency with the acceptable solutions or performance outcomes or purpose of the code; c. justification for any variation from the measures outlined in the Flood hazard overlay code.
Section 7: Conclusions and Recommendations	This section should provide clear information and advice on how flood will affect development: a. inconsistency and consistency with the Flood hazard overlay code; b. flood mitigation measures including but not limited to: i. recommended minimum floor heights; ii. structural and building design measures including flood resilient materials; iii. management of development envelope areas; iv. driveway and basement designs; v. bulk earthworks plans are provided where filling is proposed to achieve flood immunity. c. specific qualification and limitations that are relevant to the methodology, conclusions or recommendations of the report.
References	List of documents referred to in the study.

3. A flood study consists of the following parts:
   a. a hydrological determination to calculate the likely volume of water that results from the storm under consideration;
   b. a hydraulic determination to calculate the inundation levels depths, velocities, velocity x depth, and hazard that will most likely occur from the flow of water determined in the hydrological determination; and
   c. subsequent modelling to determine development impacts for the proposed development along with evaluation of works to mitigate the impacts of development.

4. Flood studies will be accepted based on ARR and best practice, e.g. approved inundation estimation calculation procedures and on observed historical records that can be quantified and related to an Average Recurrence Interval (ARI) by the use of the appropriate statistical flood frequency analysis procedure. It should be noted, use of historical records may allow for determination of relative impacts, however, will not be able to quantify the impacts on flooding of a development.

5. For analysis purposes a specific storm event is nominated as the benchmark event or standard to which Council requires immunity against inundation for a development. That event is called the Defined Flood Event (DFE).

SC6.4.8.1.1 Documentation

Editor's note—Access to the local government's adopted flood model can be obtained by entering a data sharing agreement. Completing a flood study in accordance with the tenets identified in appendix 2 of SPP Guideline 01/03 is acceptable.

1. A flood study report shall include:

   a. an assessment of the catchment, as pertaining to the development area, for the full range of design flood events, specifically the 50, 20, 10, 5, 2 and 1 percent AEP events and 1

percent plus climate change AEP event and lower probability flood events if applicable to the type of development proposed along with extreme events (as applicable);

b. details of the tail water level (5, 2 and 1 percent plus climate change AEP flood levels) methodology adopted during the assessment of the catchment;

c. details of sensitivity analysis undertaken, assessing the influence of, but not limited to:
   i. variation of all Mannings 'n' values by 10 percent to 20 percent;
   ii. variation of the tail water level;
   iii. blockage considerations as outlined in the Queensland Urban Drainage Manual and Australian Rainfall and Runoff Project 11 Blockage of Hydraulic Structures;

d. details of, where possible, calibration of the model to known, recorded flood levels within the catchment or waterway or equivalent;

e. an assessment of flood level, flow, depth, velocity and hazard with a view to ensuring that no increase occurs in any of these;

f. an assessment demonstrating that no significant or sudden change in distribution of the defined flood event flow, flood level, velocity or hazard shall occur which may result in:
   i. the failure of a levee or dam;
   iv. blockage and/or breakout;
   v. excessive scour;
   vi. realignment of the waterway;
   vii. sedimentation;
   viii. bank instability and collapse;
   ix. a reduction in flood warning times;
   x. extension of the duration of inundation;
   xi. hindrance to emergency evacuation routes;
   xii. disruption to critical infrastructure, services or access routes;
   xiii. exacerbation of risk to people, property and community infrastructure;

g. an assessment of any general decrease in amenity;

h. an assessment of any impacts of the development upon the uses identified in Column 1 in Table 8.7-8 Flood immunity – minimum design requirements of the Flood hazard overlay code of the planning scheme;

i. details of safe access and egress for the development, including the calculation and documentation of access road flood depths and depth x velocity products;

j. details of all flood level and flow calculations made in the assessment of the existing site and the proposed development impact;

k. current Australian Rainfall and Runoff methodology for rainfall runoff generation and hydrograph estimation;

l. details of the methodology and input data for any hydraulic or hydrologic modelling undertaken;

m. provision of flood maps, as digital files, depicting the following:
   i. flood extents for the full range of ARI storm events modelled for various scenarios including pre-developed (existing case), developed case, and if applicable, ultimate developed case;
   ii. elevation, depth, velocity x depth mapping;
   iii. flood hazard H1 to H6 mapping;
   iv. flood velocity range and vectors;
   v. shear stress;
   vi. the effects of sensitivity analyses;
   vii. impact maps portraying effects of various increment levels to demonstrate compliance with the Flood hazard overlay code.

SC6.4.8.1.2 Certification

1. The certifying RPEQ must provide a signed a statement of certification, which is to be included at the beginning of the report, similar to the example below.

I, JOHN SMITH, RPEQ Licence Number: 123456 certify that this flood risk assessment is consistent with the Planning Scheme Policy 4 Flood hazard and best practice and addresses the following matters outlined in the table below:

Signature: **Date:**

Mechanisms of Flooding
This flood risk assessment has considered that the following mechanisms of flooding are relevant to the site: • Flooding from a regional catchment; • Flooding from a local area catchment; • Flood mapping and impact mapping has been included in this report for all relevant flood mechanisms.
The flood risk assessment has identified and included boundary conditions that represent backflow flooding of the local stormwater network from a regional event.
Flood Analyses
Flood modelling has been completed for a base case and developed case, for the 63% AEP (Q1), 39% AEP (Q2), 10% AEP, 1 in 100 AEP, 1 in 2000 AEP and the PMF current climate and 1 in 100 AEP future climate (at 2090) flood events and extreme events (as relevant). Flood mapping has been produced and included in this report for the following parameters, water surface level, depth, velocity, velocity x depth, and hazard. Flood level hydrographs are produced at relevant locations to demonstrate that actionable nuisance changes are not created and that maximum inundation times for roads are not exceeded. This information has been used to demonstrate that the development design has an acceptable flood impact in accordance with default tolerances prescribed in the Planning Scheme Policy 4 Flood hazard.
Afflux mapping has been produced for the 63% AEP (Q1), 39% AEP (Q2), 10% AEP and 1 in 100 AEP current climate flood events and the 1% AEP future climate (2090) event and extreme events (as relevant). This information has been used to demonstrate that this development design produces acceptable flood impacts in accordance with default tolerances prescribed in the Planning Scheme Policy 4 Flood hazard.
Where the use (current or future) on properties external to the development is sensitive to changes in the flow characteristics (depth, hazard, timing, duration of inundation, frequency, location, extent, scour velocity and water quality) from the development site, then the relevant characteristics (for which there is a sensitivity) have been assessed.
Provision of specification to manage flood consequence and protect property
Pad levels for essential network infrastructure within a site (e.g. electricity, water supply, sewerage, and telecommunications) have been specified in this report, in accordance with the flood immunity requirements of Table 8.7-8 of the Flood hazard overlay code.
Where the development design requires materials with a high level of water resistance to improve the flood resilience of infrastructure, these have been specified in this report.
Where community infrastructure forms part of the development design, floor levels for the infrastructure have been specified in this report consistent with the flood immunity requirements of Table 8.7-8 of the Flood hazard overlay code.

Essential community infrastructure will be able to function effectively during and immediately after a flood event. It has been demonstrated that access to the infrastructure is consistent with the requirements for evacuation routes as prescribed in the Flood hazard overlay code.
Where new lots are created as part of the development design, a minimum flood immunity to the DFE is provided for the protection of property. Pad levels and floor levels have been specified for each lot as part of the lot table information, with consideration of a minimum 500mm freeboard requirement.
Where an open air carpark forms part of the development design, the level of the carpark has been specified to have: • a flood immunity for the 20% AEP; • a flood depth no greater than 250mm in the 1 in 100 AEP to 250mm; • a velocity no greater than 2.0m/s; • a depth x velocity ratio no greater than 0.4m^2/s.
Where a basement forms part of the development design, the report has specified the provision of waterproofed perimeter walls, air vents and the level of entry/exit ramps on the basis that these are at least above the 1% AEP plus climate change flood level plus freeboard (at 2090) or the provisions of the code.
Where driveways with a downhill slope form part of the development design, a raised entry ramp from the roadway (to satisfy the requirements of *QUDM* for containment of flood flows) has been designed and the information noted in the comments field of the lot table information.
It has been demonstrated by the methodology that the development design provides an acceptable flood risk.
Protection of Life
The development design has addressed the residual flood risk beyond the DFE, for the protection of life; OR The development design does not rely on evacuation routes to offsite locations; OR The development design does not rely on evacuation routes that are shown to be flood affected. This requirement is for the purpose of managing the residual flood risk beyond the DFE for the protection of life.
The development design has provided a direct route to enable progressive evacuation to safer place above the level of the PMF.
The development design does not rely on the assistance of emergency services personnel, to manage residual risk beyond the DFE for the protection of life (i.e. development does not place additional demands on emergency services).
The development design ensures that public safety and the environment are not adversely affected by the detrimental impacts of floodwater on hazardous materials manufactured or stored in bulk during the DFE.
Where a detention basin or levee (where relevant) forms part of the development design, a dam failure impact assessment (FIA) has been prepared in accordance with the Guideline for failure impact assessment of water dams.
The FIA:

a. is based on information that is accurate at the time of assessment; b. analyses are appropriate and sufficiently accurate to account for any failure impact zone to justify the failure impact rating.
The FIA is a reasonable estimate of the population at risk for the purpose of the FIA and that the estimate is consistent with: a. the detail and accuracy of the modelling used; b. the extent of the failure impact zone.
Floodplain Storage and Waterway Conveyance Protection
Floodplain storage and waterway conveyance have been considered and consistent with the requirements of the Planning Scheme:
Queensland Development Code requirements
Where residential lots form part of the development design, a lot table has been provided to satisfy the requirements of the Queensland Development Code (MP3.5).

Note—Where a dam failure impact assessment shows more than two or more people at risk, the dam becomes a referrable dam under the Water Supply (Safety and Reliability Act) 2008. In the case of levees refer to the relevant regulation.

SC6.4.8.1.3 Freeboard requirements

1. The floor levels of buildings or lots are to be 500mm above the calculated 1% AEP (at 2090). The floor level must be above flood levels from the following sensitivity analyses:
   a. a severe storm that is the defined flood event with 100% structure blockages;
   b. a severe storm that is the 1 in 2000 AEP event;
   c. the defined flood event with roughness values reflective of unmaintained channels/site areas.

SC6.4.8.1.4 Documenting the data sources

1. The below table is an example of how data source information may be represented.

Data used	Data source	Matters of note
Catchment boundaries	Determined from ALS	
Topographic Information	2018 ALS, site survey	
Hydraulic structure details	Hydraulic structure reference sheets: Mulgowie Road Culvert crossing	
Land use	Planning Scheme	
Historical flood levels	Search Certificate No:123455	Peak flood levels for 2011 flood event

Data used	Data source	Matters of note
Existing Flood Studies	Tenthill Creek Flood Study, 2020	
Historic Rainfall data	BoM	Daily rainfall, Station No. 123456 Pluviometer data, Station No. 123456
Streamflow data	Water Monitoring Information Portal	Daily volumes, Station No. 123456
Design Rainfall Data	BoM	2017 IFD at 4 locations within model extent
Site photographs	Taken by Water Consultants Pty Ltd, 7 February 2022	Site photographs for predevelopment conditions

SC6.4.8.1.5 Catchment boundaries

1. Most hydrological techniques will require a catchment analysis and stream slope analysis. The catchment boundaries should be presented on as large a scale map (smallest reduction ratio) as possible. The following scales for catchment sizes are recommended for use:

Scale	Catchment area
1:1,000	up to 0.5 sq. kms (50 ha)
1:2,000	up to 1.0 sq. kms (100ha)
1:5,000	up to 1.5 sq. kms (150ha)
1:10,000	up to 50 sq. kms (5000ha)
1:25,000	limited to 300 sq. kms per sheet

2. Maps should be well presented with catchments contained upon one sheet where possible. Standard sized sheets should be used. Sub-catchments should be boldly defined, and the contours should be clearly defined to enable easy verification of the catchments in relation to the contours. Where sub-catchments are not consistent with the contour information then reasons should be stated in the text and clearly labelled on the map. Good drafting standards should be maintained in the presentation of these maps.

SC6.4.8.1.6 Topographic information

1. Topographic data used for the hydraulic determination will be dependent on hydraulic method:
   a. one-dimensional models employ cross-sections along branches to represent the study area topography; and
   b. two-dimensional models employ digital elevation models to represent the study area topography.
2. The accuracy of the topographic data governs the accuracy of the hydraulic determination.

3. The accuracy of the topographic data should be clearly stated.

SC6.4.8.1.7 Cross-sections

1. Cross-sections are required at representative locations along a stream reach and at locations where changes occur in discharge, slope, shape or roughness, and at bridges, culverts or control structures such as weirs. Where abrupt changes occur, several cross-sections should be used to describe the change in shape regardless of the distance between sections. Cross-section spacing is also a function of stream size, slope and uniformity of cross-section shape. For one-dimensional models, the cross-sections should be wide enough so that the water surface is contained within the extent of the cross-sections. The accuracy of the hydraulic modelling will be dependent upon the spacing of cross-sections and the accuracy of the cross-section survey.

SC6.4.8.1.8 Digital elevation models

1. Digital elevation models used for two-dimensional models should use a grid spacing fine enough to resolve watercourses within the study area. As a general rule, a watercourse should be represented by a minimum of 5 grid cells across the width of the watercourse. Coupled models can be used as an alternative to maintain the resolution within the watercourse.
2. The digital elevation model should be orientated to minimise disturbance of flows by the grid cell orientation. Aligning grid cells with streets (often part of the major drainage system) helps to achieve an appropriate orientation.
3. Digital elevation models are often captured from aerial surveying methods such as LiDAR or Photogrammetry. These methods can lose accuracy in areas of dense vegetation. It should be clearly demonstrated what steps (including ground survey) have been taken to improve the accuracy in areas potentially obscured by vegetation.

SC6.4.8.1.9 Catchment land use

1. Catchment land use is an important consideration for flood studies. The level of urbanisation within a catchment influences the volume of runoff and magnitude of peak discharges by:
   a. increasing the impervious fraction of the catchment which reduces the volume of infiltration and increases the total volume of runoff;
   b. decreasing the time to peak discharge due to construction of open drains and stormwater networks which concentrates flows and may increase the magnitude of peak discharges.
2. Strategies to avoid and increase in flooding as a result of any works may include:
   a. mitigation of flows at the individual development;
   b. catchment wide approach to mitigation of flows; or
   c. allowance for additional flow capacity within flow paths.
3. The strategy for accommodating flows will depend on existing land uses within the catchment and the environmental value of the watercourse. In preparing a flood study, Council must be consulted to identify the proposed approach to flood mitigation within the catchment. The flood study may require assessment beyond the planning horizon in the current planning scheme, and to the potential ultimate development.
4. As a general principle, drains are an opportunity to have several functions including providing flood mitigation for an area, however for the rest of the time they can be quite an effective open space for the community, subject to management of hazards for the proposed use including implementation of CPTED strategies, access and awareness strategies.

SC6.4.8.1.10 Documenting the Model setup

1. The below table outlines the matters that need to be documented when preparing and presenting the models to Council.

Section	Details
Hydrology	
Model software	Details of the adopted model software should be documented in this section, including software version number.
Model setup	Describes detail of the model setup undertaken for the existing and post development catchment conditions.
Sub-catchment delineation	Provide a plan showing the configuration of the model, in particular the extent of sub-catchments and the location of the proposed development. Discharges at locations of interest should not be obtained from the output at a single sub-catchment. Where distinct areas of different land use occur within a catchment, the catchment sub-division should reflect land use boundaries wherever possible.
Summary details	Presented in tabular form: • catchment areas; • fraction imperviousness; • catchment lag; • routing parameter.
Rainfall design intensities and temporal patterns	Provide details of the adopted design rainfall intensities and temporal patterns and details of any historic rainfall events used for either calibration or validation. ARR temporal patterns are to be used for peak WSL estimation, however use of alternate temporal patterns (available from Council) may be required in addition if the impact assessment needs to consider the timing of hydrographs.
Hydraulics	
Model software	Details of the adopted model software should be documented in this section, including software version number.
Model setup	Provide an overview of the method of analysis used to estimate design flood levels and justification for selection of steady or unsteady flow and whether a one or two dimensional model.
Inflow points	Provide details on how the inflows from the hydrological model are integrated into the hydraulic model.
Topography	Provide a plan showing the location and extent of cross-sections, or the arrangement and extent of the two-dimensional grid used in the model. Data used in deriving model cross-sections, or the two-dimensional grid should be specified in the source data table. Where two-dimensional grid data (ALS – aerial laser survey) is used, then a plan must be provided of the difference between pre and post development ground levels.
Structures	Provide a plan showing the location of structures that are included in the hydraulic model setup. State blockage assumptions based on ARR guidance and document sensitivity testing.
Hydraulic roughness	Provide a plan showing how hydraulic roughness has been applied spatially in the model. Include details of any sensitivity testing of roughness parameters

Section	Details
Boundaries	Provides details on the boundary conditions that were adopted in preparation for model calibration.
Floodplain storage	Provide earthworks plans and tables of storage volume calculations at each RL demonstrating whether flood storage has been preserved or lost at the site. Where compensatory earthworks are proposed to preserve flood storage such earthworks must maintain their storage function in all circumstances. That is, they cannot fill with water, or any other material, and lose their flood storage capacity. It must be demonstrated there is no adverse impact on floodplain function.

5. The hydrologic and hydraulic methods adopted should be fit for purpose as stated in the Hydrologic method and Hydraulic method.

SC6.4.8.1.11 Justifying the calibration method

1. Calibration is to be stated and justified based on the availability of existing Council model results, recorded historic flows and/or levels or use of flood frequency analysis or best practice.
6. Commentary should be provided on the quality of the calibration and the confidence in the calibrated model for design flood estimation. The quality of the calibration should be informed by a fit for purpose qualification, between modelled and observed flood data.
7. The parameters derived from the calibration of the hydrologic and hydraulic models should be clearly tabulated in this section of the report.
8. Calibration based on observed inundation events is preferred. Information is generally available from the Bureau of Meteorology or relevant Queensland Government departments.
9. Records from stream gauging stations will be required to match to hydrologic calculations and are generally available from the relevant Queensland Government departments.

SC6.4.8.1.12 Sensitivity Testing

1. Minimum requirements for sensitivity analyses that inform floor levels include:
    a. Regional Catchment Flooding – 0.2% AEP Design Flood Event (Severe Storm);
    b. Local Area Flooding – 1 in 2000 AEP Design Flood Event (Severe Storm) or as otherwise required by this policy;
    c. Regional and Local Area Flooding with:
        i. Blockages: No Blockages and 100% Blockages;
        ii. Boundary Conditions: Backwater flooding and free draining conditions;
        iii. Manning's Roughness: Channel roughness 50% higher to check for inundation of properties associated with unmaintained channels and 50% lower to check for scour of the channel due to higher velocities.

SC6.4.8.1.13 Lot information

1. The following information is to be provided as part of the design and at plan sealing so that it can inform the construction of dwellings on lots as consistent with the requirements of the Queensland Development Code:
    a. estate stage number;
    b. lot number;
    c. developed DFE level - Regional & Local Area;
    d. design event level (Local Area, with design structure blockages) – 1% AEP and 1 in 2,000 AEP;
    e. developed severe storm - Regional and Local Area 0.2% AEP;

f. largest sensitivity analysis flood level (e.g. 0.5%);
g. what sensitivity analysis produces the largest flood level;
h. developed PMF level;
i. developed PMF velocity;
j. minimum floor level;
k. minimum building pad level;
l. floor level below road level;
m. any additional comments.

SC6.4.8.1.14 Constructed immunity – Bulk earthworks plan

1. A bulk earthworks plan and supporting information shall include:
   a. a plan showing:
      i. existing and finished surface level contours (to AHD) of the development site, including survey point density and accuracy in accordance with Council's standards;
      ii. the compensatory free-draining excavation area for any proposed filling within the flood plain as justified by the impact assessment;
      iii. the alignment of the toe of the batter slope which is proposed to retain the fill;
      iv. the grading of the proposed cut and fill surfaces demonstrating the finished surface is free draining;
      v. level notations that identify the line of the defined flood event and the proposed area of filling and excavation (before and after filling);
   b. section drawings showing level notations which identify the line of the defined flood event and the proposed area of filling and excavation (before and after filling);
   c. details of:
      i. the hydraulic design of the development, using topographic data which includes at least one surveyed cross-section of the floodway aligned through the proposed fill area;
      ii. pre and post development finished surface level and the defined flood event level;
      iii. the flood modelling undertaken.
      iv. any adverse effects on the behaviour of a flood in excess of the defined flood event;
      v. any proposed batter slopes and retaining walls on the premises;
      vi. the provisions for stormwater run-off from any proposed area of filling and excavation;
      vii. how the natural drainage of adjacent premises has been catered for;
      viii. calculations of the cut, fill and balance to confirm compensatory earthworks and loss of floodplain storage;
      ix. plots of pre and post earthworks flood storage against depth;
      x. plots of pre and post earthworks conveyance against depth;
      xi. cross-sections at regular intervals showing the extent of cut and fill works to confirm earthworks and, if applicable, no loss of floodplain storage.

SC6.4.8.1.15 Numerical modelling requirements

1. All modelling used to demonstrate compliance with the flood plain management requirements shall be provided to Council with the development application.

Note—Numerical modelling is to be provided in TUFLOW (hydraulic) and URB's (hydrologic) compatible file formats.

2. **Guidance for satisfying the Flood hazard overlay code**

Outcome	Guidance
Car parking located below the flood level during the defined flood event.	Development, being a single car parking space, carport or similar located below the flood level of the defined flood event and not used for storage, is to be designed with finished floor levels at or above the ground level. Development, being more than one car parking space, may be located below the flood level of a defined flood event where: a. any increase in stormwater runoff is mitigated; b. car park access is inundated to a maximum depth of 300mm; c. the depth multiplied by velocity meets safety standards of the Queensland Urban Drainage Manual and equation 3.14.2 (Depth and velocity safety standards). Development, involving an open car park area is to be designed and constructed to allow for: a. a maximum depth of 600mm; b. complies with the requirements specified in Table 7.03.1 (Flow depth and width limitations) of the Queensland Urban Drainage Manual; c. achieves a maximum depth multiplied by velocity value of 0.4m^2/s; d. has a minimum 6hr flood warning time. Development, involving a car park located underneath a building that is elevated and not enclosed is required to: a. satisfy car parking requirements for the use; b. allow the flow of flood water through the car park without impediment; c. preserve flood plain storage. Development, being a car park located underneath a building and less than 50% of the total perimeter is enclosed, is to: a. achieves a maximum depth multiplied by velocity value of 0.4m^2/s; b. allow the flow of flood water through the car park without impediment or causing adverse flood impacts external to the site; c. preserve flood plain storage.
Flood storage and discharge capacity	
The natural conveyance of flood waters and natural overland flow paths are protected and maintained without adversely affecting adjoining premises.	An overland flow path is designed and constructed to convey the unmitigated 1% AEP plus climate change storm event. Rehabilitated overland flow paths are designed in accordance with section 9 of the Queensland Urban Drainage Manual, Australian Rainfall and Runoff and the Brisbane City Council Technical Design Guidelines for Natural Channel Design and this policy. An existing overland flow path is: a. retained, maintained and protected; b. the existing waterway values are protected, enhanced and rehabilitated; c. the waterway stream flow lengths are not reduced; d. no worsening of an overland flow path and potential associated flooding;

Outcome	Guidance
	e. a minimum 500mm freeboard between the overland flow path 1% AEP plus climate change flow level and all finished floor levels; f. a naturalised channel design. The overland flow path is to be contained entirely within any of the following: a. a drainage reserve; b. an overland flow path obtained through a park, open space or local government easement. Where modification of the overland flow path is unavoidable or necessary, the new overland flow path design is to comply with the following requirements of the Queensland Urban Drainage Manual and this policy: a. conform to the principle of no worsening; b. not increase the duration of the flood; c. not result in the loss of or changes to flood paths; d. not reduce flood warning times; e. not reduce flood storage; f. provide beneficial environmental enhancement. Development is to ensure that the maximum overland sheet flow length is: a. 50m in urban areas; or b. 200m in rural residential areas. Development is to ensure that overland sheet flow travel time is calculated using either: a. Friend's Equation; or b. the Kinematic Wave Equation. Concentrated overland flow path travel time is to be determined using Manning's equation and fall within the accepted time periods identified in the Queensland Urban Drainage Manual. Development in a rural residential area is to ensure that either an overland flow path is retained, or an open channel is constructed to achieve the following: a. the depth multiplied by velocity safety provisions of the Queensland Urban Drainage Manual and equation 3.14.2 (Depth and velocity safety standards); b. a minimum freeboard of 500 mm to all finished floor levels within the site; c. the batter slopes on any swale are no greater than 1:6(V:H). Development in a rural residential area is to ensure that where an overland flow path is conveyed within a road on site: a. the maximum depth within kerb and channel is 300mm; b. a minimum freeboard of 500mm is provided to all adjacent finished floor levels.
Development does not result in: a. Increase potential to cause damage; b. ponding of flood water;	Achieving this performance outcome needs to be demonstrated through the submission of a flood study report in accordance with this planning scheme policy.

Outcome	Guidance
c. adversely affect the flood discharge capacity of the floodplain; d. decrease the flood resilience of properties and infrastructure; e. cumulative increase in flood levels external to the premises.	
Adversely changing the flood characteristics for all flood events up to and including the defined flood event: a. peak flow; b. flow of any part of the flood before the peak; c. flood flow velocity; d. level of flooding; e. flood time to peak; f. hazard.	Development is to achieve the principle of no worsening or no actionable nuisance, in accordance with the Queensland Urban Drainage Manual and the code. In achieving the principle of no worsening, development is to achieve the following: a. not result in a detrimental impact on the flooding, or flood risk of any area; b. not result in adverse impacts of any other property in terms of changes in peak discharge, flood levels, the frequency of flooding, flow velocities, water quality, sedimentation or scour effects for all events up to and including the defined flood event and the major storm event; c. not result in an adverse outcome of the flood characteristics for the range of required events; d. ensure that the time of concentration to the peak of the event does not decrease and where it increases, consideration is given to the impacts up and downstream of the property boundary to ensure runoff from the site does not bring the hydrograph peak closer to coincidence with the peak flow in adjoining catchments; e. undertake modelling upstream of the site and where appropriate downstream of the site.
Filling and excavation	
Filling and excavation is carried out above the level of the 5% AEP event to protect in stream and banks of a waterway and wetland.	Earthworks on a floodplain may be considered where: a. flooding is predominantly due to backflow; b. the peak velocity is less than the maximum permissible velocity for considerable bare earth channels (typically 0.5m/sec) in accordance with Table 9.05.3 of Queensland Urban Drainage Manual; c. the cut and fill batters are not steeper than 1V:6H and the exposed earth surface is landscaped with erosion resistant vegetation cover; d. no adverse impact is assessed in accordance with this policy.
Access	
Road network and vehicular access for evacuation	During events up to and including the defined flood event, development provides access to the road network via: a. an access which is above the flood level of the defined flood event or is low flood hazard; or b. a secondary access route which is above the flood level of the defined flood event or is low flood hazard; or

Outcome	Guidance
	c. a temporary access arrangement which is above the flood level of the defined flood event or is low flood hazard and can be implemented without significant preparation being required.
Access to a safer location on site	Development where an internal road is proposed is to achieve a low flood hazard internal road network.

3. The minimum flood immunity standards for infrastructure should meet the requirements of the code.

4. **Low Hazard Evacuation Routes**

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 per second	<1.5 metres per second	>1.5 metres per second
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.

SC6.4.9 Special areas

1. Special areas are specific location where buildings are to be designed to be resilient to flood water intrusion and flood debris impacts. The location and design requirements for special areas are provided below.

Figure SC6.4-1: Special area map - Forest Hill

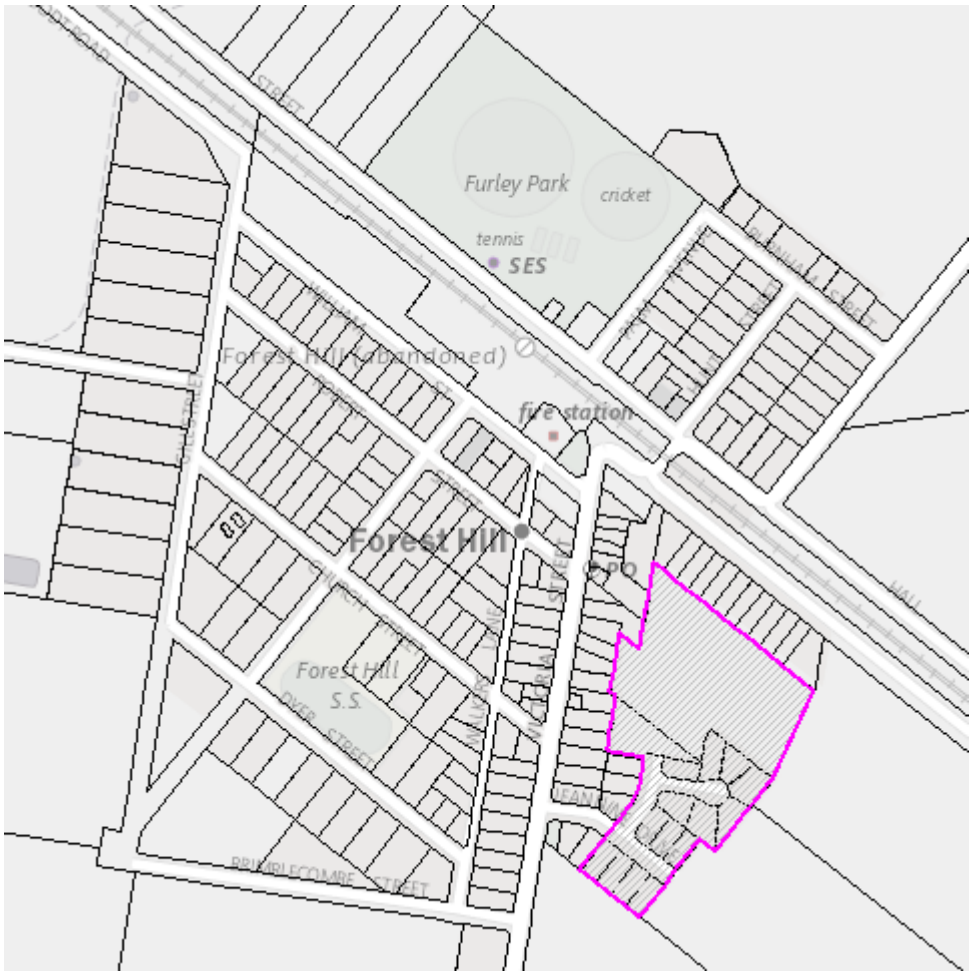

Table SC6.4-2: Special areas designated requirements for Forest Hill

DECLARED FINISHED FLOOR LEVEL	DEFINED FLOOD LEVEL 1% AEP	MAXIMUM FLOW VELOCITY
94.3m AHD	94m AHD	1 m/s

Figure SC6.4-2: Special area map - Laidley North

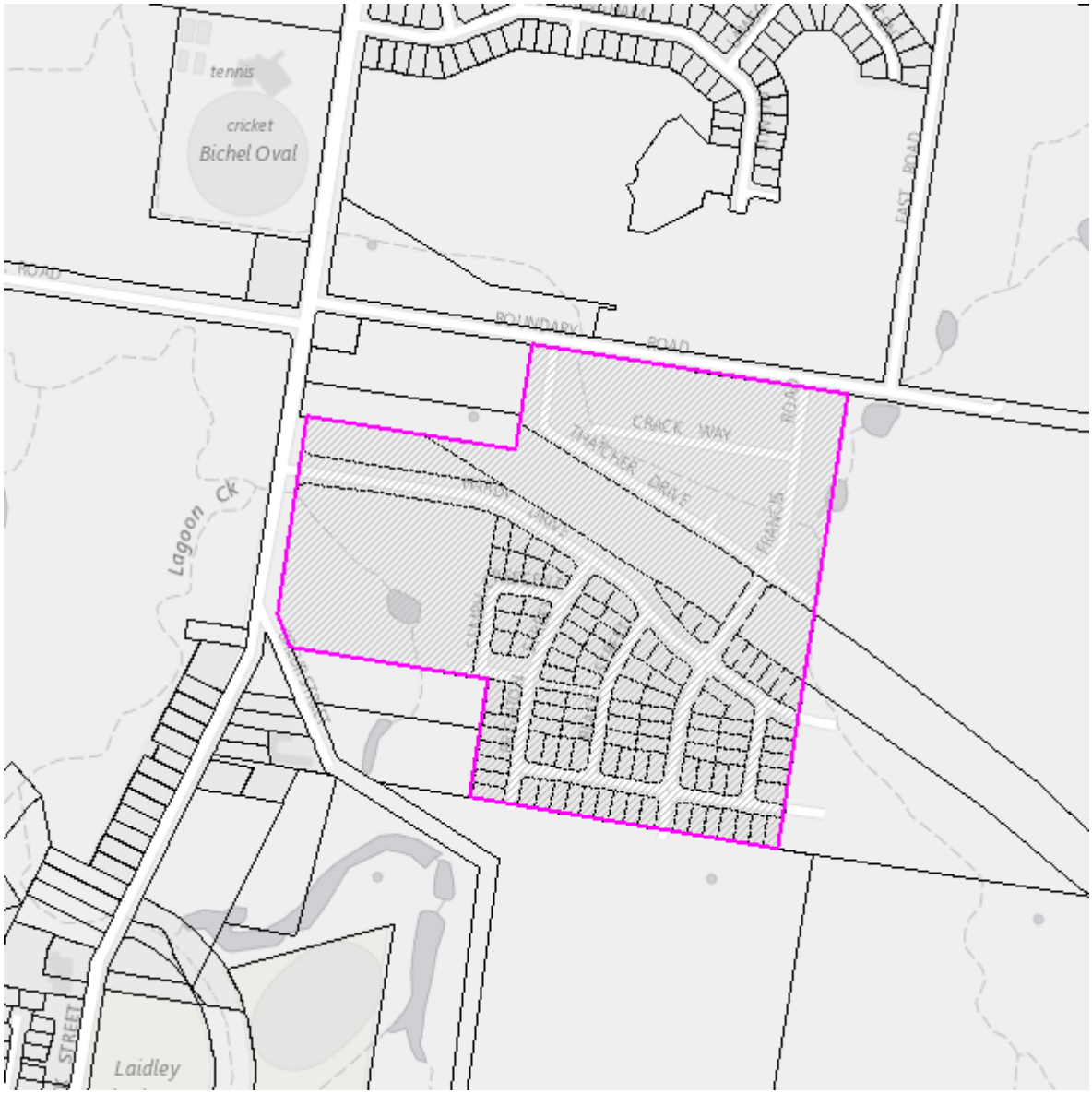

Table SC6.4-3: Special areas designated requirements for Laidley North

LOT & PLAN	DECLARED FINISHED FLOOR LEVEL (M AHD)	DEFINED FLOOD LEVEL 1% AEP (M AHD)	MAXIMUM FLOW VELOCITY (M/S)
65	101.2	100.7	0.50
66	101.2	100.7	0.50
67	101.3	100.8	0.75
68	101.4	100.9	1.00
69	101.4	100.9	1.25
70	101.3	100.8	0.50
71	101.3	100.8	<0.25
72	101.3	100.8	<0.25
73	102.1	101.6	1.50
74	102.1	101.6	1.00
75	102.1	101.6	0.50

LOT & PLAN	DECLARED FINISHED FLOOR LEVEL (M AHD)	DEFINED FLOOD LEVEL 1% AEP (M AHD)	MAXIMUM FLOW VELOCITY (M/S)
76	102.1	101.6	0.75
77	102.1	101.6	0.75
78	102.1	101.6	0.75
79	102	101.5	1.00
80	102	101.5	0.75
81	102	101.5	0.75
82	102	101.5	0.75
83	101.9	101.4	0.75
84	101.9	101.4	1.00
85	101.9	101.4	1.25
86	101.4	100.9	<0.25
87	101.5	101	<0.25
88	101.5	101	1.00
89	101.4	100.9	1.00
90	101.4	100.9	<0.25
91	101.4	100.9	<0.25
92	101.5	101	1.00
93	101.8	101.3	>1.50
94	101.8	101.3	1.25
95	101.8	101.3	1.25
96	101.9	101.4	1.00
97	101.9	101.4	0.75
98	101.9	101.4	>1.50
99	101.8	101.3	>1.50
100	102.1	101.6	0.75
101	102.1	101.6	0.75
102	102.1	101.6	<0.25
103	102.1	101.6	>1.50
104	102.1	101.6	>1.50
105	102	101.5	>1.50
106	101.9	101.4	1.50
107	102	101.5	1.00
108	102.1	101.6	>1.50
109	102	101.5	1.25
110	102.2	101.7	1.00
111	102.5	102	1.00
112	102.6	102.1	1.50
113	102.5	102	<0.25
114	102.5	102	<0.25
115	102.5	102	<0.25
116	102.5	102	<0.25
117	102.5	102	<0.25
118	102.5	102	>1.50

LOT & PLAN	DECLARED FINISHED FLOOR LEVEL (M AHD)	DEFINED FLOOD LEVEL 1% AEP (M AHD)	MAXIMUM FLOW VELOCITY (M/S)
119	102.5	102	>1.50
120	102.4	101.9	>1.50
121	102.2	101.7	>1.50
122	102.2	101.7	<0.25
123	102.1	101.6	1.00
124	102.1	101.6	1.00
125	102.1	101.6	0.50
126	102.1	101.6	0.75
127	103	102.5	>1.50
128	103.2	102.7	>1.50
129	103.2	102.7	0.75
130	103.2	102.7	0.75
131	103.2	102.7	0.75
132	103.2	102.7	>1.50
133	103.1	102.6	>1.50
134	103	102.5	>1.50
135	102.9	102.4	>1.50
136	103	102.5	<0.25
137	103.1	102.6	<0.25
138	103	102.5	0.50
139	103.1	102.6	1.25
140	102.2	101.7	>1.50
141	102.5	102	1.00
142	102.7	102.2	1.25
143	102.9	102.4	>1.50
144	103	102.5	>1.50
145	103.1	102.6	>1.50
146	103.2	102.7	>1.50
147	103.2	102.7	>1.50
148	103.5	103	>1.50
149	103.4	102.9	>1.50
150	103.4	102.9	0.75
151	103.4	102.9	1.00
152	103.5	103	1.50
153	103.5	103	>1.50
154	103.6	103.1	>1.50
155	103.5	103	>1.50
156	103.2	102.7	>1.50
157	103.2	102.7	>1.50
158	103.1	102.6	>1.50
159	102.9	102.4	>1.50
160	102.8	102.3	>1.50
161	102.5	102	>1.50

LOT & PLAN	DECLARED FINISHED FLOOR LEVEL (M AHD)	DEFINED FLOOD LEVEL 1% AEP (M AHD)	MAXIMUM FLOW VELOCITY (M/S)
162	102.5	102	>1.50
163	102.3	101.8	>1.50
164	102.2	101.7	>1.50
165	102.2	101.7	>1.50
166	102.1	101.6	>1.50
167	101.9	101.4	>1.50
168	101.9	101.4	>1.50
169	101.9	101.4	>1.50

SC6.4.9.1 Special areas designated requirement for Helidon Spa

Figure SC6.4-3: Special area map - Helidon Spa

1. The accepted development requirement for each lot is:
   a. the finished floor level of the habitable areas of the dwelling house is no less than the nominated height of the finished floor level above the level of the defined flood event indicated for the lot;
   b. the construction method for the dwelling house is that which is indicated for the lot;
   c. where boundary setbacks are specified, all buildings comply with the boundary setbacks indicated for the lot;
   d. where the dwelling is raised on stumps:

i. the area below the dwelling house remains open to allow for the free flow of floodwaters;

ii. those parts of the building that support the building and elevate it above the level of the defined flood or overland flow event are designed and constructed to resist hydrostatic and hydrodynamic forces as a result of inundation by flood water;

e. all electrical services are located at least 300mm above the level of the defined flood event.

LOT ON SP191206	DFL mAHD	FREEBOARD ABOVE DFL	FLOOD VELOCITY	CONSTRUCTION METHOD	MAX BUILDING PAD	MANDATORY SETBACKS FOR BUILDING PAD
1	148.47	300mm 390mm (SOG)	1.65m/s	Stumps or Slab on ground (SOG)	280m^2	Front: 18m, Side (North): 3m Rear: 92m, Side (South): 37m
2	148.40	300mm	1.50m/s	Stumps (1)	280m^2	Front: 15m, Side (North): 20m Rear: 19m, Side (South): 87m
3	148.20	300mm	1.30m/s	Stumps (1)	N/A	Front: 19m, Side (North): 22m Rear: 82m, Side (South): 17m
4	148.00	300mm	1.30m/s	Stumps or Slab on ground	325m^2	Front: 16m, Side (North): 15m Rear: 80m, Side (South): 33m
5	147.91	300mm	0.752m/s	Stumps (1)	N/A	Front: 10m, Side (North): 28m Rear: 84m, Side (South): 21m
6	147.8	300mm	0.60m/s	Stumps(1)	275m^2	Front: 56m, Side (North): 49m Rear: 32m, Side (South): 7m
7	147.77	300mm 320mm (SOG)	0.65m/s	Stumps or Slab on ground	330m^2	Front: 13m, Side (North): 27m Rear: 82m, Side (South): 30m
20	147.25	300mm	0.65m/s	Stumps (1)	330m^2	Front: 16m, Side (North): 13m Rear: 56m, Side (South): 27m
21	147.47	300mm	1.65m/s	Stumps (1)	N/A	Front: 14m, Side (North): 25m Rear: 81m, Side (South): 23m
22	147.45	300mm	1.1m/s	Stumps (1)	325m^2	Front: 18m, Side (North): 19m Rear: 51m, Side (South): 26m
23	147.45	300mm 310mm (SOG)	1.75m/s	Stumps or Slab on ground	325m^2	Front: 18m, Side (North): 6m Rear: 51m, Side (South): 41m
24	148.87	300mm	2..20m/s	Stumps (1)	430m^2	Front: 19m, Side (North): 13m Rear: 53m, Side (South): 24m
25	148.40	300mm	1.75m/s	Stumps or Slab on ground	N/A	Front: 19m, Side (North): 21m Rear: 85m, Side (South): 20m
26	148.42	300mm 350mm (SOG)	1.30m/s	Stumps or Slab on ground	280m^2	Front: 16m, Side (North): 4m Rear: 65m, Side (South): 33m
27 E	149.0	300mm	1.55m/s	Stumps or	280m^2	Front: 17m, Side (North): 32m

LOT ON SP191206	DFL mAHD	FREEBOARD ABOVE DFL	FLOOD VELOCITY	CONSTRUCTION METHOD	MAX BUILDING PAD	MANDATORY SETBACKS FOR BUILDING PAD
		400mm (SOG)		Slab on ground		Rear: 65m, Side (South): 54m
27 W	148.8	300mm 360mm (SOG)	1.3m/s	Stumps or Slab on ground	280m^2	Front: 17m, Side (North): 36m Rear: 89m, Side (South): 70m

Editor's notes: Where a slab on ground method of construction for a dwelling house is proposed modelling will always be required to be provided with the application to demonstrate that there are no adverse impacts on neighbouring properties.

2. Where not Accepted development (as above) the following are the Accepted outcomes (right hand column) for Code assessable development:
   a. the finished floor level of the habitable areas of the dwelling house is no less than the nominated height of the finished floor level above the level of the defined flood event indicated for the lot;
   b. the construction method for the dwelling house is that which is indicted for the lot;
   c. where boundary setbacks are specified, all buildings comply with the boundary setbacks indicated for the lot;
   d. where the dwelling is raised on stumps:
      i. the area below the dwelling house remains open to allow for the free flow of floodwaters;
      ii. those parts of the building that support the building and elevate it above the level of the defined flood or overland flow event are designed and constructed to resist hydrostatic and hydrodynamic forces as a result of inundation by flood water;
   e. all electrical services are located at least 300mm above the level of the defined flood event.

Property	Construction method	Minimum boundary setbacks
1 SP191206	Slab on ground	Setback 25m from east and western boundaries
2 SP191206	Slab on ground	Setback 25m from east and western boundaries
4 SP191206	Slab on ground	Setback 25m from western boundary
20 SP191206	Stumps (1)	In a location of least hazard
21 SP191206	Slab on ground	In a location of least hazard
22 SP191206	Stumps (1)	In a location of least hazard
24 SP191206	Stumps or Slab on ground (2)	In a location of least hazard
25 SP191206	Slab on ground	In a location of least hazard
26 SP191206	Slab on ground	In a location of least hazard
27 SP191206 E	Slab on ground	In a location of least hazard
27 SP191206 W	Stumps (1)	Setback 25m from east and western boundaries

Editor's notes:

- A slab on ground method of construction for a dwelling house is not an acceptable solution.
- Where a slab on ground method of construction for a dwelling house is proposed modelling is required to be provided with the application to demonstrate that there are no adverse impacts on neighbouring properties.

SC6.4.10 Investigation areas

1. Investigation areas within the Flood Hazard overlay are locations where the flood model requires further investigation and warrants a further flood risk assessment.

The location of Investigation areas is shown in the Figures below.

Figure SC6.4-4: Brightview flood investigation area

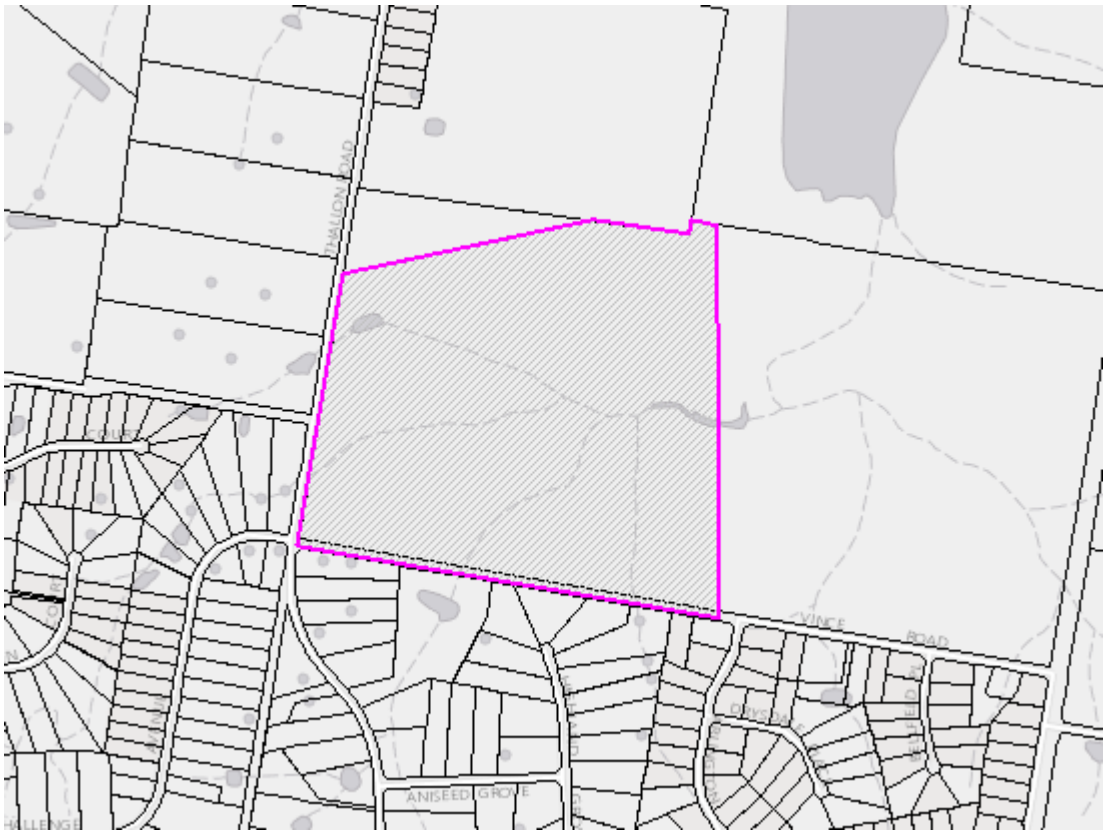

Figure SC6.4-5: Gatton racecourse flood investigation area

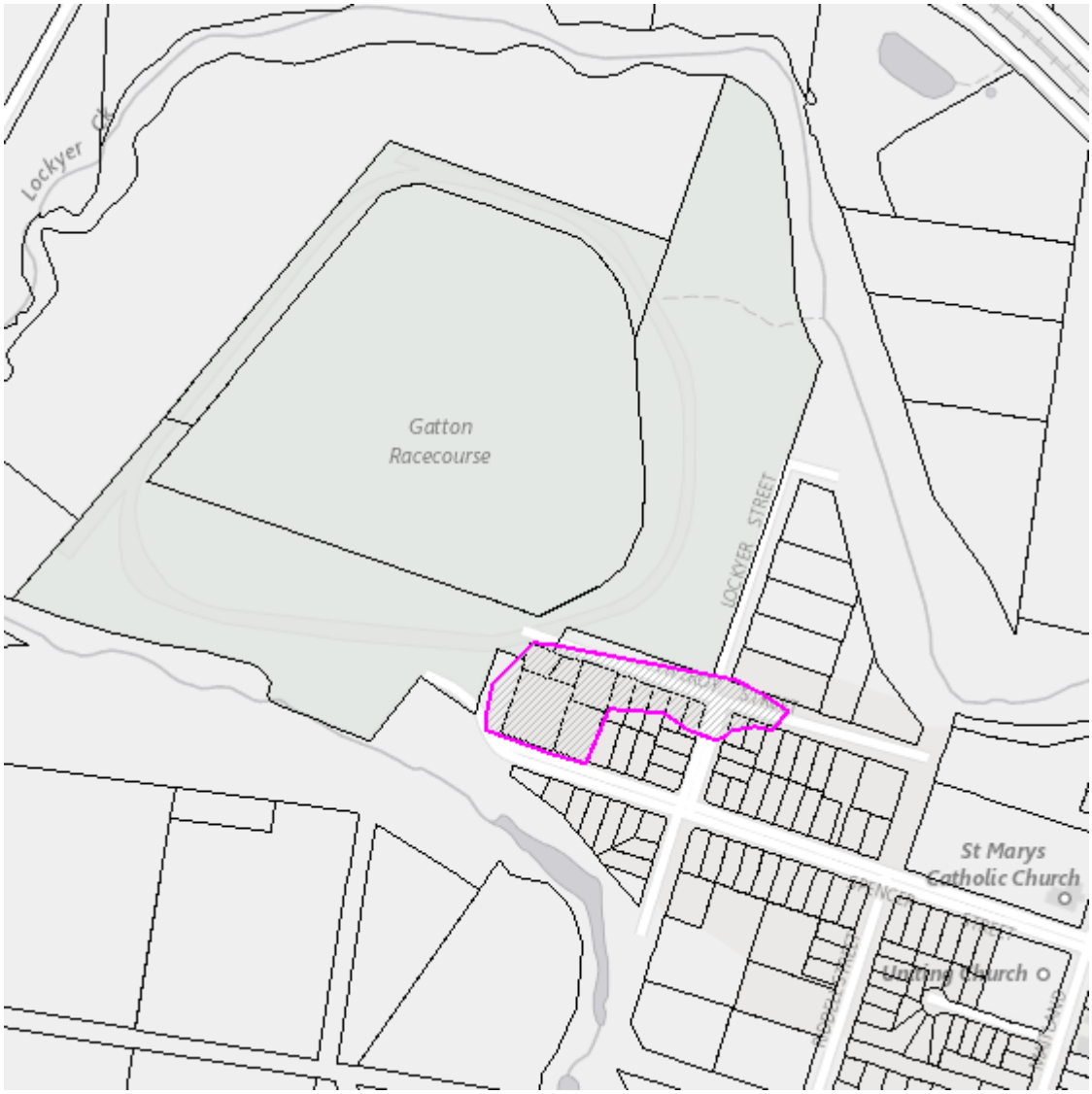

Figure SC6.4-6: Gatton industry flood investigation area

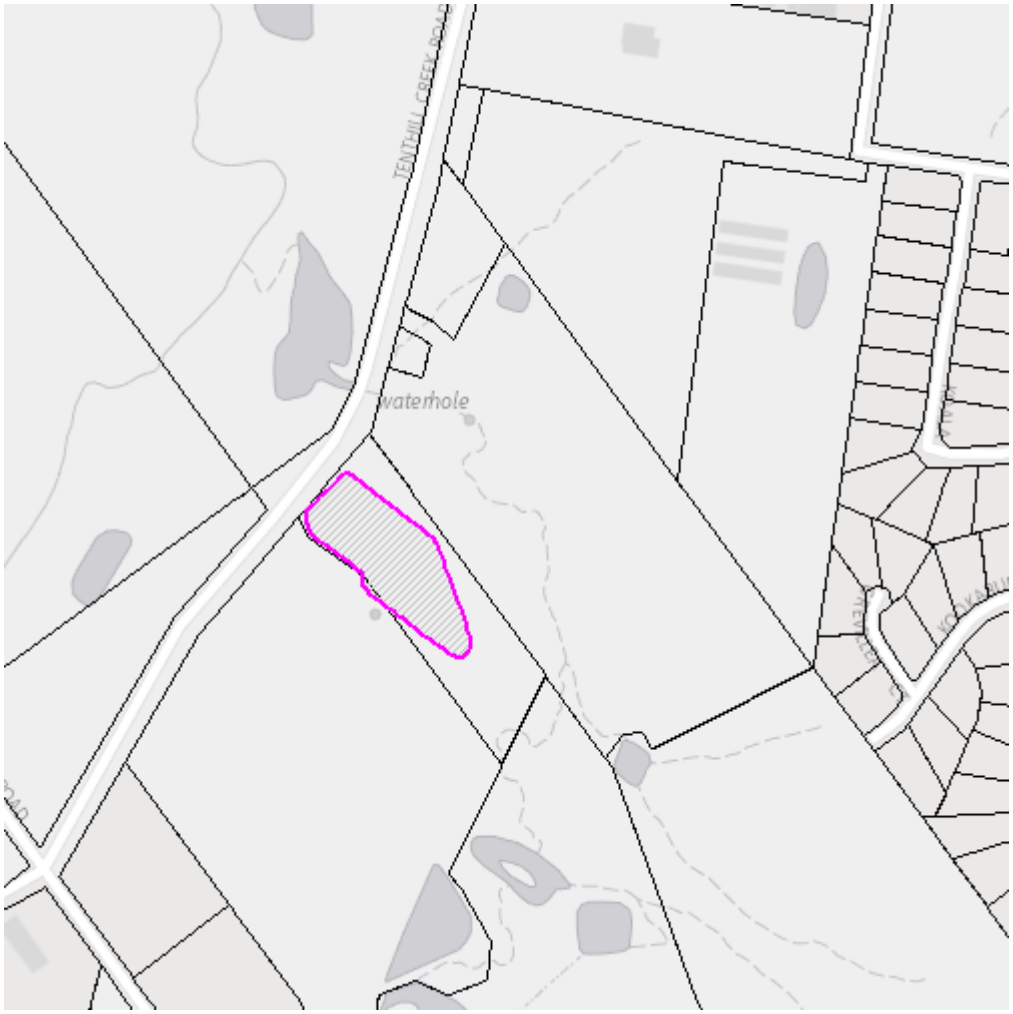

Figure SC6.4-7: Hatton Vale flood investigation area

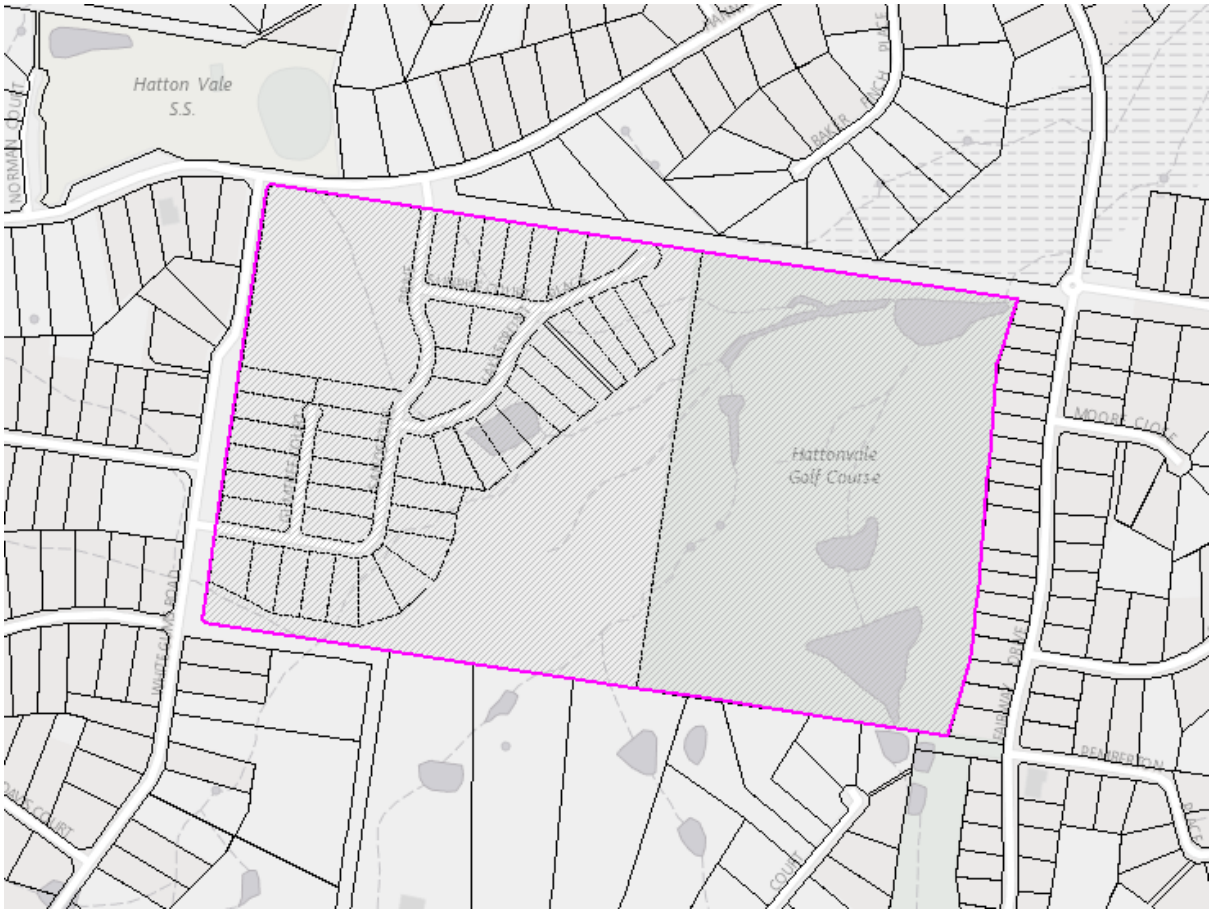

Figure SC6.4-8: Kensington Grove flood investigation area

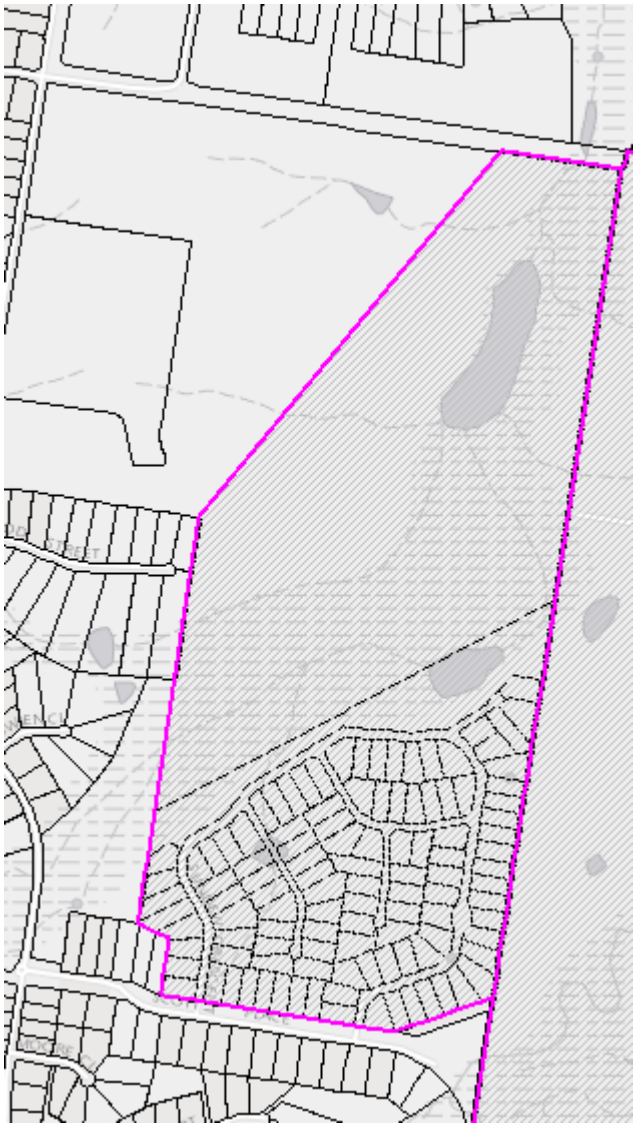

Figure SC6.4-9: Laidley Heights flood investigation area

Figure SC6.4-10: Plainland flood investigation area

Figure SC6.4-11: Withcott North flood investigation area

Figure SC6.4-12: Withcott South flood investigation area