Memorandum

From:	Ben Caddis, Teegan Burke	To:	Ballina Shire Council
Date:	9 June 2022	CC:	
Subject:	Interim Flood Impact Assessment (FIA) Procedure		

Introduction

This memorandum documents the interim Procedure for Flood Impact Assessment (FIA) using Ballina Shire Council's regional Integrated Flood Model. The **FIA Procedure** applies to assessment of flood impacts in suitably zoned areas of the floodplain, areas where rezoning is being considered, and Council infrastructure projects. The assessment of development in zoned areas shall be undertaken in accordance with the current Fixed Service Agreement (FSA). Speculative development in areas requiring rezoning is also covered by this **FIA Procedure**, although is not covered by the FSA.

The **FIA Procedure** relies upon the completion of a separate modelling exercise, referred to here as the Regional Mitigation Exercise (RME). The RME will identify regional flood mitigation measures to reduce the flood risk across the Ballina Shire so far as reasonably practical, including limiting the cumulative impacts associated with the development of appropriately zoned land and development in Council's identified strategic growth areas. The RME will consider the cumulative flood impacts of future development under current and future climate conditions. The base case for assessment of impacts is catchment conditions from 2005 (prior to construction of the Ballina Bypass). The RME will consequently set regional flood surfaces (for different events) that represent the agreed maximum cumulative flood level afflux across the floodplain (Ultimate Limit). The assumption that cumulative impacts resulting from the development of zoned land will be captured through this exercise, and either accepted or mitigated, underpins this **FIA Procedure**. The RME is yet to be formally scoped, and may require further updates to Council's Integrated Model, such as updated topography, bathymetry and application of ARR 2019 techniques.

As the completion of Regional Mitigation Exercise may be some time away, this memorandum recommends a **FIA Procedure** that can be applied on an interim basis. It is also noted that BMT are currently undertaking updates to the Integrated Flood Model to ensure current, proposed and strategic sites are accurately represented. It is intended that the Integrated Flood Model will regularly be updated to reflect changes as developments become approved and constructed.

Baseline models for impact assessment

To date, the Integrated Flood Model has generally included representation of all the fully zoned/approved development, and at times has included representation of strategic growth areas. Incremental impact assessments have been based on comparing modelling results from the fully developed catchment with and without the development being assessed. Cumulative impacts have been assessed by comparing the pre-existing scenario to the fully developed catchment conditions including the proposed development.

The revised approach proposes separating the Integrated Flood Model into the following baseline development scenarios, underpinned by the Regional Mitigation Exercise.

Pre-existing catchment conditions

At the time of publication of the Ballina Flood Study Update (2008), the pre-existing case for the catchment was set at 2005. Since then, the model has undergone various upgrades including changes to topographic and bathymetric data, and modelling approach and software. The pre-existing base case was later revised to refer to 2013 catchment conditions, although without the Ballina Bypass.

To avoid confusion, and conform with the intentions of the Ballina Flood Study Update, we recommend the pre-existing catchment conditions should remain as 2005.

The pre-existing catchment conditions will form the basis of the Regional Mitigation Exercise and defining the Ultimate Limit of allowable flood impact.

Developed catchment conditions

To assess the impacts of floodplain development and capture uncertainty in development timelines, several time horizons should be considered. These are:

- Current catchment conditions (B1) – to ensure impacts are managed should the proposed development proceed immediately, without further development or regional mitigation works. This scenario will be kept up to date with developments as they are constructed.
- Future catchment conditions (B2) – to ensure impacts are managed should the proposed development proceed assuming all other approved and rezoned land is developed. This scenario shall include infrastructure and flood mitigation works that are included in Council's Infrastructure Plan and mitigation measures that may arise from the Regional Mitigation Exercise. It will be kept up to date with proposed site plans as developments are approved, and assumed fill as sites are rezoned.
- Ultimate catchment conditions (B3) – to ensure impacts are controlled should the proposed development proceed assuming all other approved, rezoned and strategic sites are developed. This scenario builds upon the B2 future catchment conditions by including all strategic growth areas (SGAs), strategic infrastructure and strategic flood mitigation works. It will be kept up to date with strategic sites considered by Council.

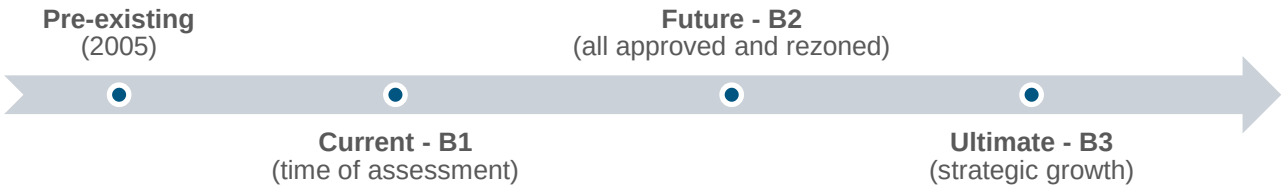

Figure 1 Baseline model timeline

Climate change

Previously, flood level impacts have not been assessed under future climate scenarios. At the time of writing, it is now less than 30 years until 2050, which has previously been considered as a mid-term planning horizon. BMT recommend that the proposed RME and this FIA Procedure consider the use of 2050 climate change conditions for **Future** and **Ultimate** baseline conditions. Testing should be undertaken on at least two hypothetical developments to ensure that adopting the 2050 climate change scenario does not mask impacts that could occur prior to 2050 climate change conditions being experienced.

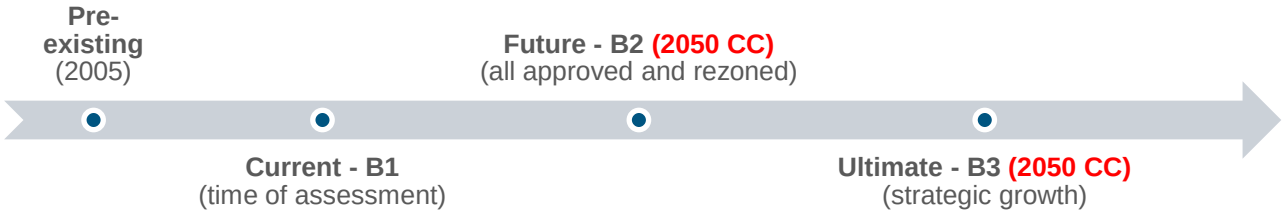

Figure 2 Baseline conditions for climate change consideration

Flood source considerations

Since the 1997 Ballina Floodplain Management Study, flooding in Ballina has been considered from three potential sources:

- Richmond River
- Local catchments
- Storm surge.

Each case considers occurrence of other sources at the same time (e.g. Richmond River event also has local catchment rainfall and a storm surge component). To date, most impact assessments have been based on simulating all three flood sources for the pre-existing scenario, and combining the three flood surfaces to make an 'envelope' of peak flood levels. The same is undertaken for the development scenario, and the two resulting flood surfaces are compared to identify impacts.

In some cases, this approach can lead to masking of impacts. Refer to combined event impacts mapping in Figure 3 which shows distributed impacts from a proposed road upgrade. When considering the impacts from the Richmond River event in isolation, impacts are as shown in Figure 4. In this scenario, there are impacts to private property that exceed 100mm. This can also be caused by a change in the dominant source of flooding affecting the area where impacts are greatest.

To avoid this undesirable 'masking' of impacts, we recommend impacts to be calculated for each dominant mechanism of flooding, then the results combined to produce a map of the worst impacts expected from each source: an enveloped maximum flood level impact, instead of the impact to enveloped peak flood levels. In cases where unacceptable impacts are assessed, mapping can be accompanied by source dominance mapping, similar to Figure 5, for peak water levels and peak impacts.

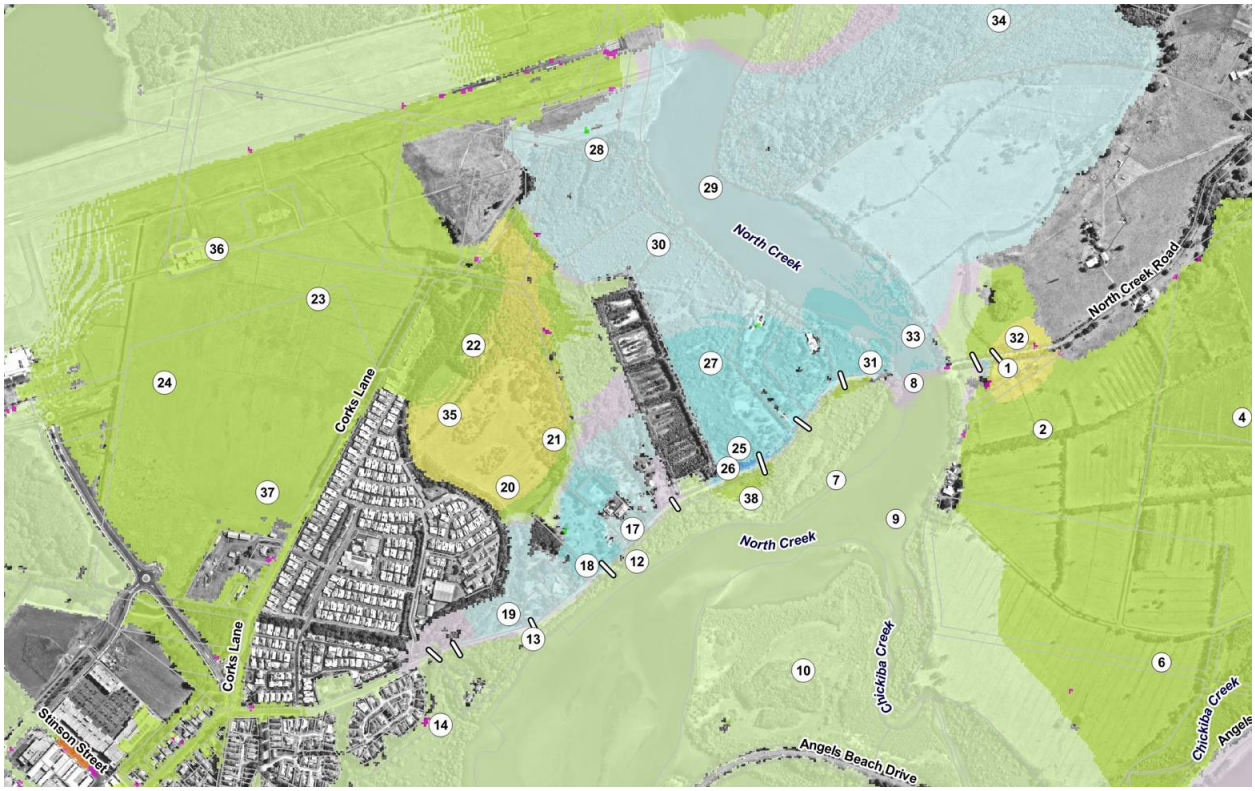

Figure 3 Example impacts of combined source dominance

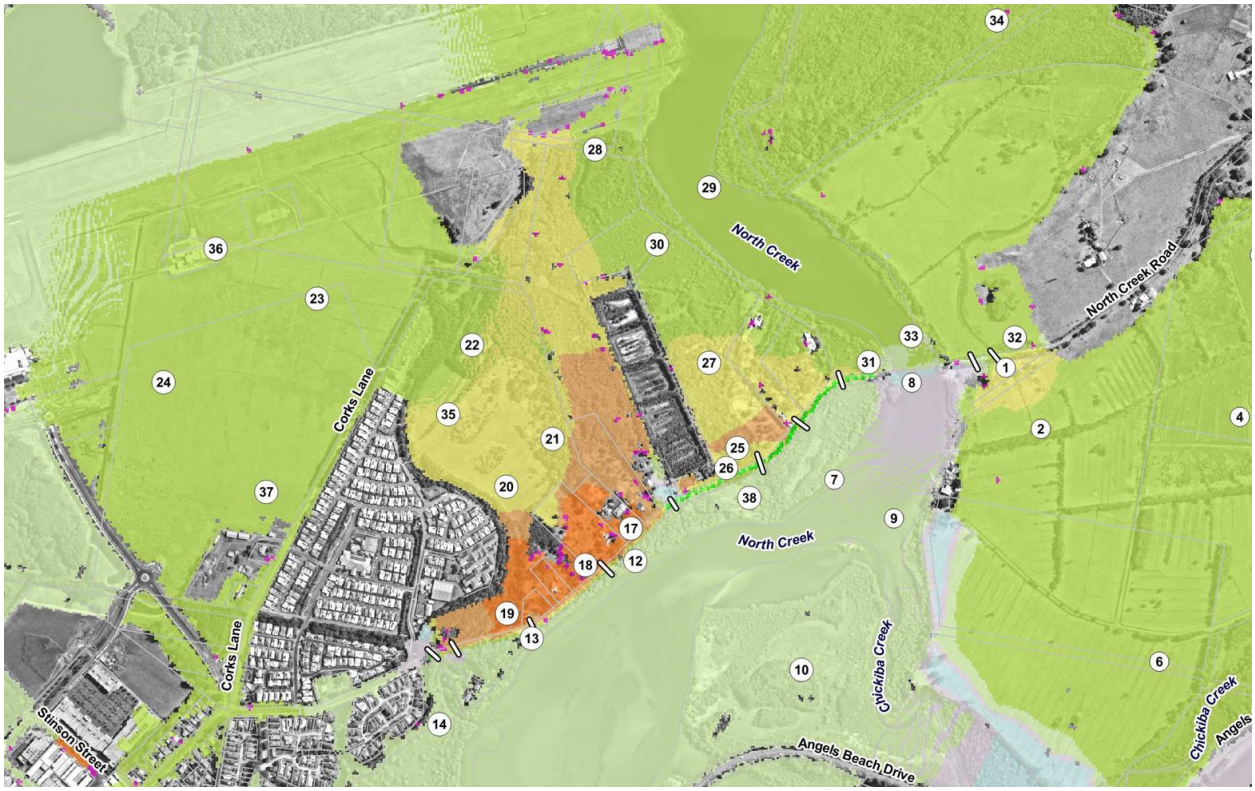

Figure 4 Example impacts of Richmond River dominated event only

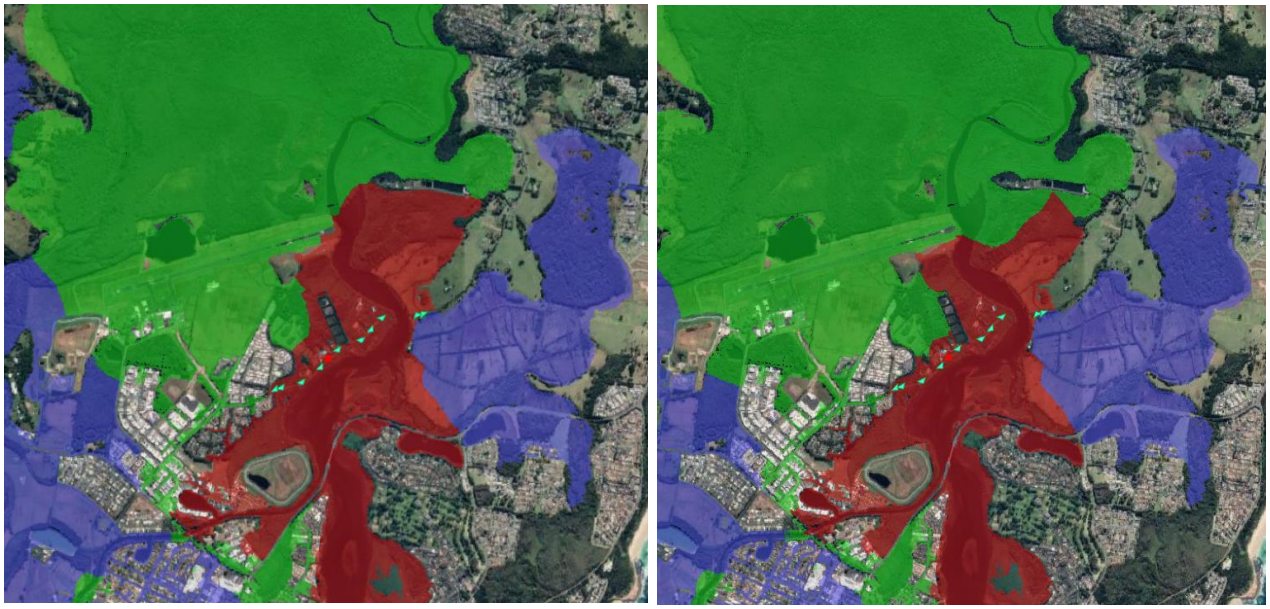

Figure 5 Example water level source dominance mapping for pre-existing and developed scenarios (red is Storm Surge dominant, blue is Richmond River dominant and green is local catchment dominant)

Flood impact criteria

To date, the following impact criteria has applied in Ballina:

- 10mm incremental impact; and
- 50mm cumulative impact compared to 2005/2013 pre-existing baseline.

In many areas of the floodplain the 50mm cumulative impact criterion has been exceeded, rendering the cumulative assessment of limited value. Changes to the modelling software, approach and topographic data has also caused the theme of impacts to change significantly. Further changes can be expected when the model is updated to Australian Rainfall and Runoff 2019 methodology.

This FIA Procedure therefore proposes to replace the 50mm cumulative impact criterion with an approach that assesses impacts of infill, DA approved, rezoned and SGA development at a regional scale for future 2050 climate conditions. The Regional Mitigation Exercise is proposed to reduce impacts to 50mm where possible (particularly at existing buildings). The maximum impact is expected to be greater than 50mm in some areas, however, this cumulative impact will be the upper limit of expected impact (Ultimate Limit) for all planned development, for all currently zoned land to assess against.

Impact assessment – recommended and interim approach

As part of the proposed Regional Mitigation Exercise (RME), it is proposed to test the following scenarios:

- **Future** baseline conditions:
  - Raise existing urban areas of Ballina Island and West Ballina to the minimum floor level. Minimum floor level filling accounts for the practice of filling higher than the minimum fill levels to achieve minimum floor levels for slab-on-ground construction.
  - Raise all approved and rezoned land to the minimum floor level.
  - Include regional flood mitigation associated with future catchment conditions.
- **Ultimate** baseline conditions:
  - Raise all strategic growth areas to minimum floor level.

- Include strategic flood mitigation associated with SGAs.

Assessment of impacts should consider three categories of development:

- Infill (Ballina Island and West Ballina) - assessments for this category of development by developers are not proposed;
- Greenfields (zoned) - assessments for this category of development by developers are proposed to be undertaken via BMT's Fixed Service Agreement, intended to support Development Application; and
- Greenfields (rezoning required) – assessments for this category of development are considered speculative and have not been accounted for in the Regional Mitigation Exercise. Consequently, they should not be undertaken for external developers by Council as part of the Fixed Service Agreement. Where proponents require flood modelling to support planning of development in areas requiring rezoning, access to the Integrated Flood Model may be provided to the proponent following execution of a disclaimer. Outcomes of third-party modelling may not be used to support a Development Application. Re-zoning application will require demonstration of compliance with the impacts as stated below.

The proposed impact assessment requirements for the recommended final approach are listed in Table 1. Until the Regional Mitigation Exercise has been completed and Council have defined strategic growth areas (SGAs), impact assessments should follow the interim process listed in Table 1. The following summarises key factors in the assessment approach:

- Assessing against B1, B2 and B3 Integrated Model Development scenarios captures the uncertainty associated with construction timelines.
- The incremental impacts resulting from Infill are assumed negligible due to the minor nature of infill development and method of impact assessment using the regional fill approach and hence assessment is not required.
- The cumulative impacts resulting from Infill are considered to be accounted for (either accepted or mitigated) via the Regional Mitigation Exercise to determine regional mitigation measures, resulting in an agreed upon Ultimate Limit.
- The cumulative impacts resulting from Zoned Greenfield sites are considered to be accounted for (either accepted or mitigated) via the Regional Mitigation Exercise to determine regional mitigation measures, resulting in an agreed upon Ultimate Limit. Confirmation that impacts of a proposed development layout do not exceed the adopted Ultimate Limit (which will include assumed representation of the development site) will be required.
- Greenfield sites requiring rezoning will be required to meet a stricter nil incremental impact tolerance.
- For the Interim Approach:
  - the reliance on outcomes of incremental impact assessments for the B2 and B3 Integrated Flood Model development scenarios for the support of development approval (Zoned Greenfield sites) or rezoning applications (Greenfield sites requiring rezoning) will be dependent on Council's assessment of the current status of model updates, and may require disclaimers or caveats as to the reliability of results.
  - Confirmation that impacts of a proposed development layout do not exceed the adopted Ultimate Limit (which includes assumed representation of the development site) cannot be undertaken at this interim stage, until completion of the Regional Mitigation Exercise.

Table 1 Proposed impact assessment matrix

Assessment type	Integrated Model Development Scenario	Infill (Ballina Island and West Ballina)		Greenfields (zoned)			Greenfield (Rezoning required)		
		Allowed impacts	Final (& Interim)	Allowed impacts	Final	Interim	Allowed impacts	Final	Interim
Incremental impacts	B1	N/A	N Preferential development areas , impacts assumed negligible due to the minor nature of infill development and method of impacts assessment using the regional fill approach.	10mm	Y Captures uncertainty in development timeline - impact if developed before any other zoned but not-yet-constructed sites.	Y As per Final	Nil*	Y Captures uncertainty in development timeline - impact if developed before any other zoned but not-yet-constructed sites. Can't be used to support DA.	Y As per Final
	B2			10mm	Y# Captures uncertainty in development timeline - impact if developed with all other zoned sites constructed.	Y^# As per Final, however applicability for support of DA caveated by Council, dependent on status of Integrated Model updates at time of assessment (B2 won't yet include regional mitigation elements until completion of RME)	Nil*	Y# Captures uncertainty in development timeline - impact if developed with all other zoned sites constructed. Can't be used to support DA.	Y^# As per Final, however applicability for support of rezoning application caveated by Council, dependent on status of Integrated Model updates at time of assessment (B2 won't yet include regional mitigation elements until completion of RME).
	B3			10mm	Y# Captures uncertainty in development timeline - impact if developed with all other zoned and SGAs included.	Y^# As per Final, however applicability for support of DA caveated by Council, heavily dependent on status of Integrated Model updates at time of assessment (B3 won't yet include regional mitigation elements until completion of RME).	Nil*	Y# Captures uncertainty in development timeline - impact if developed with all other zoned and strategic sites included. Can't be used to support DA.	Y^# As per Final, however applicability for support of rezoning application caveated by Council, heavily dependent on status of Integrated Model updates at time of assessment (B3 won't yet include regional mitigation elements until completion of RME).
Cumulative impacts check	B1	N/A	N Will be accounted for in RME for determining accepted afflux (Ultimate Limit) .	N/A	N Will be accounted for in RME for determining accepted afflux (Ultimate Limit) with respect to Zoned developments	N As per Final	N/A	N Won't be accounted for in RME for determining accepted afflux (Ultimate Limit) with respect to Zoned developments, nor RME with respect to SGAs. However, meeting a stricter nil impact tolerance for incremental impacts is assumed to result in no additional contribution to cumulative impacts.	N As per Final
	B2			Nil*	Y# Will be accounted for in RME for determining accepted afflux (Ultimate Limit) with respect to Zoned developments. Check to confirm that impacts of the proposed development layout do not exceed the adopted Ultimate Limit (which includes assumed representation of the development site).	N Impacts check (as per Final) cannot be undertaken until completion of RME for determining accepted afflux (Ultimate Limit)			
	B3			Nil*	Y# Will be accounted for in RME for determining accepted afflux (Ultimate Limit) with respect to Zoned developments. Check to confirm that impacts of the proposed development layout do not exceed those from RME with respect to SGAs (which includes assumed representation of the development site).	N Impacts check (as per Final) cannot be undertaken until completion of RME for determining accepted afflux (Ultimate Limit)			

* Nil is suggested to be less than 2mm || ^ outcomes likely to be caveated by Council based on status of Integrated Model updates || # assessments for B2 and B3 to consider 2050 climate scenario.