NOTICE OF MEETING

BYRON SHIRE FLOODPLAIN RISK MANAGEMENT COMMITTEE MEETING

A Byron Shire Floodplain Risk Management Committee Meeting of Byron Shire Council will be held as follows:

Venue	**Council Chambers, Station Street, Mullumbimby**
Date	**Wednesday, 14 March 2018**
Time	**4.00pm**

Phil Holloway
Director Infrastructure Services

I2018/410
Distributed 07/03/18

CONFLICT OF INTERESTS

What is a "Conflict of Interests" - A conflict of interests can be of two types:

Pecuniary - an interest that a person has in a matter because of a reasonable likelihood or expectation of appreciable financial gain or loss to the person or another person with whom the person is associated.

Non-pecuniary – a private or personal interest that a Council official has that does not amount to a pecuniary interest as defined in the Local Government Act (eg. A friendship, membership of an association, society or trade union or involvement or interest in an activity and may include an interest of a financial nature).

Remoteness – a person does not have a pecuniary interest in a matter if the interest is so remote or insignificant that it could not reasonably be regarded as likely to influence any decision the person might make in relation to a matter or if the interest is of a kind specified in Section 448 of the Local Government Act.

Who has a Pecuniary Interest? - a person has a pecuniary interest in a matter if the pecuniary interest is the interest of the person, or another person with whom the person is associated (see below).

Relatives, Partners - a person is taken to have a pecuniary interest in a matter if:

- The person's spouse or de facto partner or a relative of the person has a pecuniary interest in the matter, or
- The person, or a nominee, partners or employer of the person, is a member of a company or other body that has a pecuniary interest in the matter.

N.B. "Relative", in relation to a person means any of the following:

(a) the parent, grandparent, brother, sister, uncle, aunt, nephew, niece, lineal descends or adopted child of the person or of the person's spouse;

(b) the spouse or de facto partners of the person or of a person referred to in paragraph (a)

No Interest in the Matter - however, a person is not taken to have a pecuniary interest in a matter:

- If the person is unaware of the relevant pecuniary interest of the spouse, de facto partner, relative or company or other body, or
- Just because the person is a member of, or is employed by, the Council.
- Just because the person is a member of, or a delegate of the Council to, a company or other body that has a pecuniary interest in the matter provided that the person has no beneficial interest in any shares of the company or body.

Disclosure and participation in meetings

- A Councillor or a member of a Council Committee who has a pecuniary interest in any matter with which the Council is concerned and who is present at a meeting of the Council or Committee at which the matter is being considered must disclose the nature of the interest to the meeting as soon as practicable.
- The Councillor or member must not be present at, or in sight of, the meeting of the Council or Committee:
  (a) at any time during which the matter is being considered or discussed by the Council or Committee, or
  (b) at any time during which the Council or Committee is voting on any question in relation to the matter.

No Knowledge - a person does not breach this Clause if the person did not know and could not reasonably be expected to have known that the matter under consideration at the meeting was a matter in which he or she had a pecuniary interest.

Participation in Meetings Despite Pecuniary Interest (S 452 Act)

A Councillor is not prevented from taking part in the consideration or discussion of, or from voting on, any of the matters/questions detailed in Section 452 of the Local Government Act.

Non-pecuniary Interests - Must be disclosed in meetings.

There are a broad range of options available for managing conflicts & the option chosen will depend on an assessment of the circumstances of the matter, the nature of the interest and the significance of the issue being dealt with. Non-pecuniary conflicts of interests must be dealt with in at least one of the following ways:

- It may be appropriate that no action be taken where the potential for conflict is minimal. However, Councillors should consider providing an explanation of why they consider a conflict does not exist.
- Limit involvement if practical (eg. Participate in discussion but not in decision making or vice-versa). Care needs to be taken when exercising this option.
- Remove the source of the conflict (eg. Relinquishing or divesting the personal interest that creates the conflict)
- Have no involvement by absenting yourself from and not taking part in any debate or voting on the issue as if the provisions in S451 of the Local Government Act apply (particularly if you have a significant non-pecuniary interest)

RECORDING OF VOTING ON PLANNING MATTERS

Clause 375A of the Local Government Act 1993 – Recording of voting on planning matters

(1) In this section, **planning decision** means a decision made in the exercise of a function of a council under the Environmental Planning and Assessment Act 1979:
  (a) including a decision relating to a development application, an environmental planning instrument, a development control plan or a development contribution plan under that Act, but
  (b) not including the making of an order under Division 2A of Part 6 of that Act.

(2) The general manager is required to keep a register containing, for each planning decision made at a meeting of the council or a council committee, the names of the councillors who supported the decision and the names of any councillors who opposed (or are taken to have opposed) the decision.

(3) For the purpose of maintaining the register, a division is required to be called whenever a motion for a planning decision is put at a meeting of the council or a council committee.

(4) Each decision recorded in the register is to be described in the register or identified in a manner that enables the description to be obtained from another publicly available document, and is to include the information required by the regulations.

(5) This section extends to a meeting that is closed to the public.

BUSINESS OF MEETING

1. APOLOGIES

2. DECLARATIONS OF INTEREST – PECUNIARY AND NON-PECUNIARY

3. ADOPTION OF MINUTES FROM PREVIOUS MEETINGS

3.1 Byron Shire Floodplain Risk Management Committee Meeting held on 12 October 2017

4. STAFF REPORTS

Infrastructure Services

STAFF REPORTS - INFRASTRUCTURE SERVICES

Report No. 4.1 **North Byron Floodplain Risk Management Study and Plan**
Directorate: Infrastructure Services
Report Author: James Flockton, Drain and Flood Engineer
File No: I2018/241
Theme: Community Infrastructure
Emergency Services and Floods

Summary:

Council have now awarded the North Byron Floodplain Risk Management Study and Plan to WMA Water and initial work has begun. The following is provided as an update on works to date.

RECOMMENDATION:

That the committee note the report.

Attachments:

1 North Byron FRMS&P - WMA Draft North Byron Flood Model Review Memorandum, E2018/16972 , page 9⇩
2 North Byron FRMS&P - WMA Draft Model Update Memo, E2018/16970 , page 23⇩
3 North Byron FRMS&P - WMA Flood Level Survey Overview Memo, E2018/16973 , page 29⇩

Report

Council have now awarded the North Byron Floodplain Risk Management Study and Plan to WMA Water and initial work has begun. The following is taken from the WMA Water website.

WMAwater was established in 1983. We work with a wide range of clients with water management responsibilities including all levels of government, water supply and management utilities, water infrastructure owners, and developers.

We're recognised experts in flood and water management, working closely with industry and researchers to develop technical guidelines and policy in our fields. This gives us a deep understanding of the latest technical and regulatory best practice, which we apply to successfully deliver solutions for our clients.

We're a dynamic consultancy with a long history of assisting our clients to develop long term strategies and designs to understand and manage risks and optimise the use of water resources.

With over 30 technical staff we have the resources for a wide range of project sizes and the flexibility to respond quickly to our clients' needs, ensuring that projects are delivered within required timeframes. We provide our clients with direct access to the staff who are working on their project, encouraging collaboration and knowledge transfer, resulting in project outcomes that meet clients' requirements.

More information can be found at https://www.wmawater.com.au/

Project Update

Since awarding the contract to WMA the following work has been completed:

1. Reviewed all previous reports and data provided by Council.
2. Reviewed the existing hydrologic and hydraulic models
3. Reviewed the terrain and structure's in the models
4. Assessed the floor level survey needs and numbers of houses to be surveyed
5. Reviewed the available flash flood warning systems

The following is provided to update the committee on the findings of this work.

Model review report

WMA have completed an extensive review of the North Byron Flood Model. The results of this review are provided as a draft memorandum report at attachment 1.

Further to the review a draft Flood Model Update memorandum is provided at attachment 2. This updates the committee on the changes which have been made to the model and the further changes which are planned.

This information will be further reported and discussed with the committee via a presentation at the meeting.

Floor Level Survey

An integral part of the Risk Management Study is the development of a property dataset. This dataset provides important information that will inform the flood damages assessment for various flood mitigation options that will be modelled later in the project.

Attachment 3 provides an update to the committee on the planned method of data capture and the area being covered by this dataset.

This work is currently out for quotation and is programmed to begin as soon as possible.

Flash Flood Warning systems Options Review

At the request of Council this review has been brought forward in the project because Council is proposing to submit a grant application in June for a flash flood warning system.

The exact details and works proposed within this grant have not been finalised and this review will help finalise those works. The grant application may involve automated road flooded warning signs for hot spots within the shire, but that is yet to be decided.

WMA will provide a presentation to the committee at the meeting regarding this item.

Flood Gauge at Federation Bridge

On 14th February 2018 Council staff and contractors repaired and moved the manual flood gauge that is on the downstream side of Federation Bridge in Mullumbimby. The gauge is now set the Brunswick River Flood Datum, which is within 30mm of Australian Height Datum.

The manual gauge now reads the same level that can be found on the BOM website. This will prevent any community confusion in the future.

Pictures of the works are provided on the next page.

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Financial Implications

No financial implications for consideration by the committee.

5 **Statutory and Policy Compliance Implications**

NSW Councils are expected to prepare Floodplain Risk Management Studies and Plans for flood prone catchments within their local government areas. These documents must be prepared in accordance with State Government Policy.

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The NSW Floodplain Development Manual 2005 is the current policy used by State Government for the preparation of such documents. This project is following the methods prescribed in the NSW Floodplain Development Manual for completing Floodplain Risk Management Studies and Plans.

Memorandum

TO: James Flockton
FROM: Ella Harrison
DATE: 1 March 2018
SUBJECT: North Byron FRMS&P – Draft Hydrologic and Hydraulic Model Review
PROJECT NUMBER: 117098

1. INTRODUCTION

Byron Shire Council have engaged WMA Water to complete a Floodplain Risk Management Study and Plan (FRMS&P). The primary purpose of this FRMS&P is to better understand and manage flood risk throughout the North Byron catchments. As part of the initial stages of the study, WMA Water have undertaken a peer review of the hydrologic and hydraulic models developed in the North Byron Shire Flood Study (BMT WBM, 2016).

The purpose of this report is to outline the assessment of these models and determine their readiness for use within this FRMS&P. The review established that:

- The hydrologic model which has been developed using XP-RAFTS is fit-for-purpose and appropriately set up.
- The hydraulic model, developed using TUFLOW (version 2013-12AE-w64), is running and working well and meets standard quality criteria.
- Notwithstanding this, it is recommended the following updates are undertaken:
  - Incorporate latest topographic features and detail of missing structures into the hydraulic model configuration;
  - Incorporate the March 2017 event into model calibration and verification;
  - Further sensitivity tests of the form losses upstream of Mullumbimby;
  - Sensitivity tests on the initial losses for forested areas in design events.

2. BACKGROUND

The North Byron Shire Flood Study (herein referred to as the Flood Study) was completed by BMT WBM in April 2016. This Flood Study was commissioned in response to the Tweed-Byron Coastal Creeks Flood Study (BMT WBM, 2010) that recommended the development of a model to assess both the Brunswick River and Marshalls Creek catchments.

The following reports have also been considered background information as part of this review:

- Byron Shire Flood Review for Ex-Tropical Cyclone Debbie (BMT WBM, 2017)

- Hydrologic and Hydraulic Study at Bilinudgel (SMEC, 2005)

2.1. Study Area

The area of interest is located in northern New South Wales within the Byron Shire Council and includes the towns of Mullumbimby, Brunswick Heads, Ocean Shores, New Brighton, South Golden Beach and Billinudgel. The study area includes Marshalls Creek catchment to the north, the Brunswick River catchment and the Simpsons Creek catchment to the south.

Marshalls Creek is a tributary to the Brunswick River and enters the Brunswick River just upstream of the mouth of Brunswick River at Brunswick Heads. Simpsons Creek flows into the Brunswick River downstream of the Marshall Creek and Brunswick River confluence.

Figure 1 shows the hydrologic and hydraulic boundaries used within the Flood Study.

3. HYDROLOGIC MODEL REVIEW

The hydrologic model developed for the Flood Study was built using XP-RAFTS software. XP-RAFTS is a non-linear rainfall/runoff routing model and is widely used throughout Australia for both rural and urban catchments. The review looked at the catchment delineation, model setup and the appropriateness of adopted hydrologic parameters. The model was successfully run for the 12 hour and 24 hour storms for the 1% AEP and produced the same results as provided.

3.1. Catchment Delineation

The hydrologic study area consists of four catchments and are listed in Table 1.The delineation of the catchment and sub-catchment boundaries has been checked and is considered fit-for-purpose and appropriately defined. The sub catchment delineation is shown in Figure 2.

Table 1: Catchment areas

Catchment Name	Total Area (km^2)	Sub catchments
Brunswick River	112	47
Marshalls Creek	42	24
Yelgun Creek	11	13
Simpsons Creek	66	32

3.2. Model Input

The hydrologic model is built by delineating the catchment into sub catchments and connecting these using nodes and channel reaches to simulate creeks and rivers. XP-RAFTS requires geographical input data and hydrologic parameters for each sub catchment including the following:

- Slope (%)
- Area
- Fraction impervious
- Travel time between nodes
- Manning's n
- Storage Coefficient Multiplication Factor
- Initial Loss

- Continuing Loss

Terrain data and aerial data have been used to check the sub catchment slope, area and the fraction impervious. Appropriate values have been used for each sub catchment. The travel time between nodes was determined by assuming an average velocity. For a 1% catchment slope an average velocity of between 0.5m/s and 1m/s is considered normal. This approach was not adopted for all sub catchments. For the sub catchments in the Upper Main Arm area, the Muskingum-Cunge (defined in XP-RAFTS) method was adopted, which is standard.

Table 2 shows the adopted manning's n values to represent the roughness for each sub catchment. While these manning's n values are considered standard (ARR2016, Book 6, Chapter 2, Table 6.2.2), they are marginally lower than the recommended XP-RAFTS values. This is not considered to be an issue and are appropriate roughness values.

Table 2: Manning's values

Ground cover	Manning's n
Urban	0.025
Rural	0.04
Forested	0.06

3.2.1. Storage Coefficient Multiplication Factor (B_X)

The Durrumbul Gauge is the only stream gauge in the area (see location in Figure 3) and thus is the only calibration gauge available for the hydrologic model. BMT WBM's calibration runs indicated that additional storage was required at this point. It is most likely due to the model inability to represent the wide floodplain with significant potential storage in the upper catchments.

Two distinct methods have been used to increase the storage:

- A local storage has been added at Williams Bridge upstream of the Main Arm Road Embankment in Main Arm (see location in Figure 3),
- A Storage Coefficient Multiplication Factor (Bx) of 1.5 was used to modify the calculated storage time delay in all sub-catchments except Marshalls Creek and Yelgun Creek catchments.

Those changes have helped to reach a better calibration for the simulated events (mainly January 2012, June 2005 and May 1987). Incorporating the March 2017 event will help verify and recalibrate these values.

3.2.2. Initial and Continuing Losses

The amount of rainfall that will result in runoff is highly dependent on the antecedent conditions and type of ground cover, particularly the infiltration capacity. These conditions are represented in a hydrologic model using initial and continuing loss parameters. Table 3 shows the initial and continuing loss parameters adopted during the calibration events.

ARR (Book5, Ch.3, Figures 5.3.18 and 5.3.19) discusses typical loss values seen throughout Australia and for Mullumbimby, recommended rural initial and continuing losses are 38mm and 2.5 mm/h. While the continuing loss factor adopted for rural areas is higher than recommended by ARR (2016), it is still considered a reasonable parameter and was most likely adopted for a better calibration.

The initial loss conditions adopted for the design events are low in comparison to the calibration events (see Table 4). It is common when calibrating a hydrologic model to an actual event to alter this value significantly. This accounts for the antecedent conditions within the catchment and can be used to better match the peak

flow observed. The Flood Study notes that the design event loss conditions were chosen deliberately to ensure an element of conservatism.

However, the forest initial loss adopted for the design event is significantly lower than the calibration loss (from 80 – 100 mm to 20mm). WMA Water suggests using a conservative value of 40mm instead of 20mm and to check the impact of this change via a sensitivity test.

Table 3: Initial loss and continuing loss adopted for the calibration events

Ground cover	Initial Loss (mm)	Continuing Loss (mm/h)
Urban	0	1
Rural	30 (*May 1987*) 15 (*June 2005*) 5 (*Jan. 2012*)	4
Forested	100 (*June 2005, May 1987*) 80 (*Jan. 2012*)	6

Table 4: Initial loss and continuing loss adopted for the design events

Ground cover	Initial Loss (mm)	Continuing Loss (mm/hr)
Urban	0	1
Rural	5	4
Forested	20	6

3.3. Rainfall Sensitivity Assessment

The North Byron Flood Study was developed prior to the release of the 2016 ARR design rainfalls, as such the study used the 1987 Intensity-Frequency-Durations (IFDs). The 1987 ARR design rainfalls are expected to have an accuracy of +/- 30% and as such it is standard practice to compare the at-site rainfall data to the ARR IFDs.

The Flood Study estimated the 1% AEP event for eight storm durations for each gauge used in the rainfall frequency investigation. FLIKE, a widely used statistical program, was used for this statistical analysis and three statistical distributions were chosen; Lognormal, Log Pearson Type III and Generalised Extreme Value (GEV). Section 4.3 of the Flood Study discusses the results in detail and provides a comparison of the ARR 1987 IFDs against each gauge for the 1% AEP for three durations. The results highlighted where there was a +-10% discrepancy between the at-site gauge data and the 1987 ARR IFD.

These results show the ARR IFDs both over and underestimate the design rainfall when compared to the at-site gauge data. The report discusses the results from the gauges Main Arm, Huonbrook and Myocum in more detail. Main Arm and Myocum are within the catchment boundary and Huonbrook is the next closes to the Brunswick River catchment. While the Myocum gauge indicates the 1987 ARR IFD overestimates rainfall depths (17% - 55%), the results for Main Arm and Huonbrook show the 1987 ARR IFD are within +-30% and have no bias for over or underestimation.

The report concludes the rainfall frequency investigation does not provide justification to adopt a local correction factor and the 1987 ARR IFDs were used. Prior to the release of the 2016 IFDs, use of the 1987 ARR IFD was considered industry standard. While the assessment did show some differences between the at-site data and the 1987 IFD, there was no significant bias for over or underestimation. Given this, WMA Water concludes use of the 1987 ARR IFD to be defensible and fit-for-purpose.

4. HYDRAULIC MODEL REVIEW

The hydraulic model was built using the hydrodynamic package TUFLOW. TUFLOW is a widely used modelling package both nationally and internationally. The Flood Study model was configured using TUFLOW version 2013-12-AD TUFLOW_iDP_w64.exe and requires a multi domain license.

Figure 4 shows the hydraulic model boundary and the domain configurations. The hydraulic model covers 52 km^2 in total. The default 2D domain was represented with a 12.5m grid with a north-south grid orientation. For the areas of South Golden Beach and Brunswick Heads a 5m grid with no rotation was adopted. Mullumbimby was also represented using a 5m grid size, however a 19.5 degree grid rotation was applied.

There are two different TUFLOW simulation control files available to run *NBFS_~e1~_166.tcf* and *NBFS_~e1~_168_ext.tcf*. The former is used for all design events except for the PMF which used the second file. This is a relatively common practice.

WMA Water were able to successfully run the model for the 1% AEP events and results were consistent with the 2016 BMT WBM report.

4.1. Boundary Conditions

4.1.1. Tidal Conditions

Figure 5 shows the inflow and downstream boundaries included in the Flood Study model. The downstream boundary has been setup up as a water level versus time boundary to represent the tidal conditions. Table 5 describes the corresponding peak tidal conditions for each AEP and climate change conditions. Byron Shire Councils policy on Climate Change Strategic Planning discusses the adopted 2050 and 2100 and are 0.4m and 0.9m respectively.

Table 5: Tidal downstream boundary condition

AEP	Peak Water Level (mAHD)
20%	0.8
10%	1.5
5%	2.2
2%	2.48
1%	2.6
5% CC2050	2.4
1% CC2050	2.6
5% CC2100	2.9
1% CC2100	3.1

4.1.2. Inflow Boundaries

The inflow polygons have been represented as 2d_sa layer which applies to flow directly onto the lowest cells first and then distributing between wet cells within the defined polygons. These have been correctly identified as either local or total inflows depending on their location.

The TUFLOW boundary condition database (bc_dbase) contains hydrographs for the 12 hour and 24 hour storm durations for all AEPs and climate change scenarios.

All inflow files have been provided for the 12 hour and 24 hour storm durations.

4.1.3. 1D and 2D Boundaries

Marshalls Creek, Brunswick Head and Simpsons Creek are modelled in 1D when the 2D domain grid size is set to 12.5m (see Figure 4).

Marshalls Creek hydraulic roughness is set to 0.06 (upstream) and 0.024 (downstream). Brunswick Head and Simpsons Creek Hydraulic Roughness is set to 0.02. These are standard values for sandy bed rivers.

4.2. Review of Recent Developments

Figure 6 shows the ground and terrain data used in the hydraulic model.

4.2.1. Orchid Place (Mullumbimby)

Orchid Place roughness is defined as an urban place. The recent development topography has not been included in the model.

It is recommended survey of this area is obtained, if not already available, and incorporated into the model.

4.2.2. Shara Boulevard/Brunswick Valley Sportsfield (Billinudgel)

The roughness need to be updated to match the new development (from n = 0.045 to n = 0.025). Byron Shire Council has sent the latest development drawings to WMA Water and it is recommended these added to the model topography.

4.2.3. Tallow Wood Estate (Mullumbimby)

The model includes the Stage 3 development terrain data. Byron Shire Council has sent the Stage 4 development drawings to WMA Water including the Tuckeroo Avenue box culvert dimensions. It is recommended the model is updated to incorporate this information.

4.2.4. Miram Place/Rajah Road (Ocean Shores)

The model includes an older development terrain data. Byron Shire Council has sent the Stage 4 development drawings for Miram Place in Ocean Shores to WMA Water. It is recommended this information is incorporated into the model.

4.3. Bend loss

Bend loss are defined only for the Brunswick River. Values upstream of Mullumbimby are between 1.0 and 1.75 and between 2.0 and 3.0 downstream. These values are considered within range of normal.

However, these values can have a significant impact on flood level in Mullumbimby, and given the development pressures in this area, it is recommended the March 2017 event is used to support calibration of these parameters.

4.4. Review of Hydraulic Structures

4.4.1. Model Structures

Review of structures included within the Flood Study identified the following missing structures:

- Tuckeroo Avenue Culverts (Mullumbimby),
- Orana Road Culvert and Waterlily Park survey (Ocean Shores),

- Terrara Court Culvert (Ocean Shores),
- Golf Course Bridge (Ocean Shores).
- Narooma Drive Culvert (Ocean Shores)

Data for all structures has been made available to WMA Water, with the exception of Narooma Drive Culvert. It is recommended details of this structure are obtained.

Bonanza Drive drainage plan has been provided by Byron Shire Council, however as the road is not flooded until the PMF event, the road drainage would not have any significant impact on the flood behaviour. However, for completeness it is recommended this structure is included in the model.

It is recommended all other structures are incorporated into the model build.

5. 2016 AT-SITE IFD REVIEW

A separate report has been prepared outlining in the IFD review undertaken as part of this study.

6. RECOMMENDATIONS

Following the hydrologic and hydraulic model review, we recommend the following amendments to the model:

- Incorporate the following recent developments into the model's topography:
  - Shara Boulevard/Brunswick Valley Sportsfield (Billinudgel)
  - Tallow Wood Estate (Mullumbimby)
  - Miram Place (Ocean Shores)
  - Orchid Place (Mullumbimby)
- Incorporate the following structures:
  - Tuckeroo Avenue Culverts (Mullumbimby)
  - Orana Road Culvert and Waterlily Park survey (Ocean Shores)
  - Terrara Court Culvert (Ocean Shores)
  - Golf Course Bridge (Ocean Shores)
  - Bonanza Drive
  - Narooma Drive
- Run the March 2017 event (Ex-Tropical Cyclone Debbie).
  - Calibration of the Hydrological Model for this event through rainfall data and Durrumbul Stream Gauge
  - Calibration of the Hydraulic Model for this event through flood marks and rivers level data
- Perform a sensitivity test of the forested Initial Loss value to assess its impact on flows and volumes.
- Perform a sensitivity test of the hydraulic losses upstream of Mullumbimby to assess their impact on flood level particularly at Tallow Wood Estate

List of Figures

Reference

North Byron Shire Flood Study (BMT WBM, 2016)

Byron Shire Flood Review for Ex-Tropical Cyclone Debbie (BMT WBM, 2017)

Tweed-Byron Coastal Creeks Flood Study (BMT WBM, 2010)

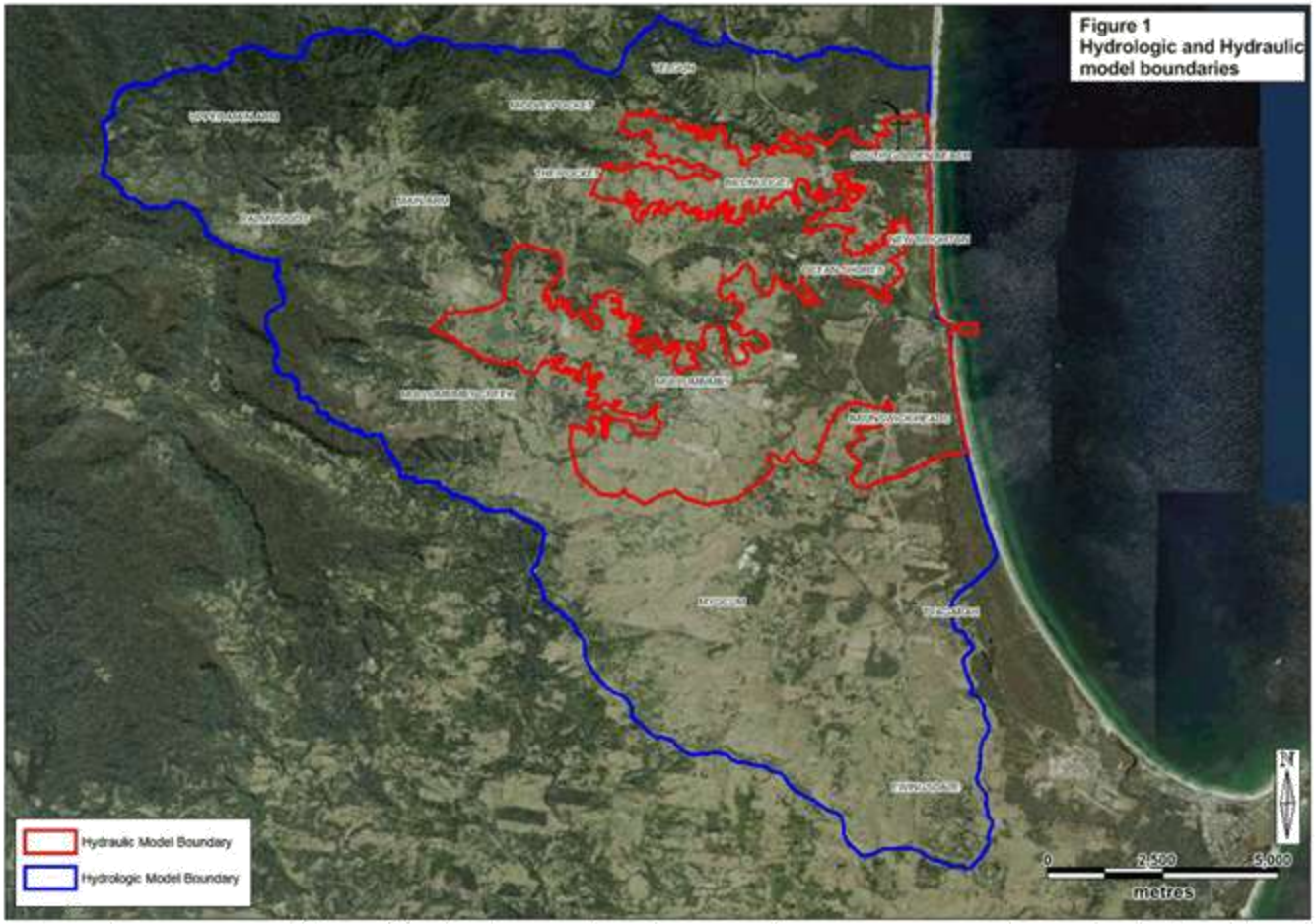

Figure 1: Hydrologic and Hydraulic Model Boundaries

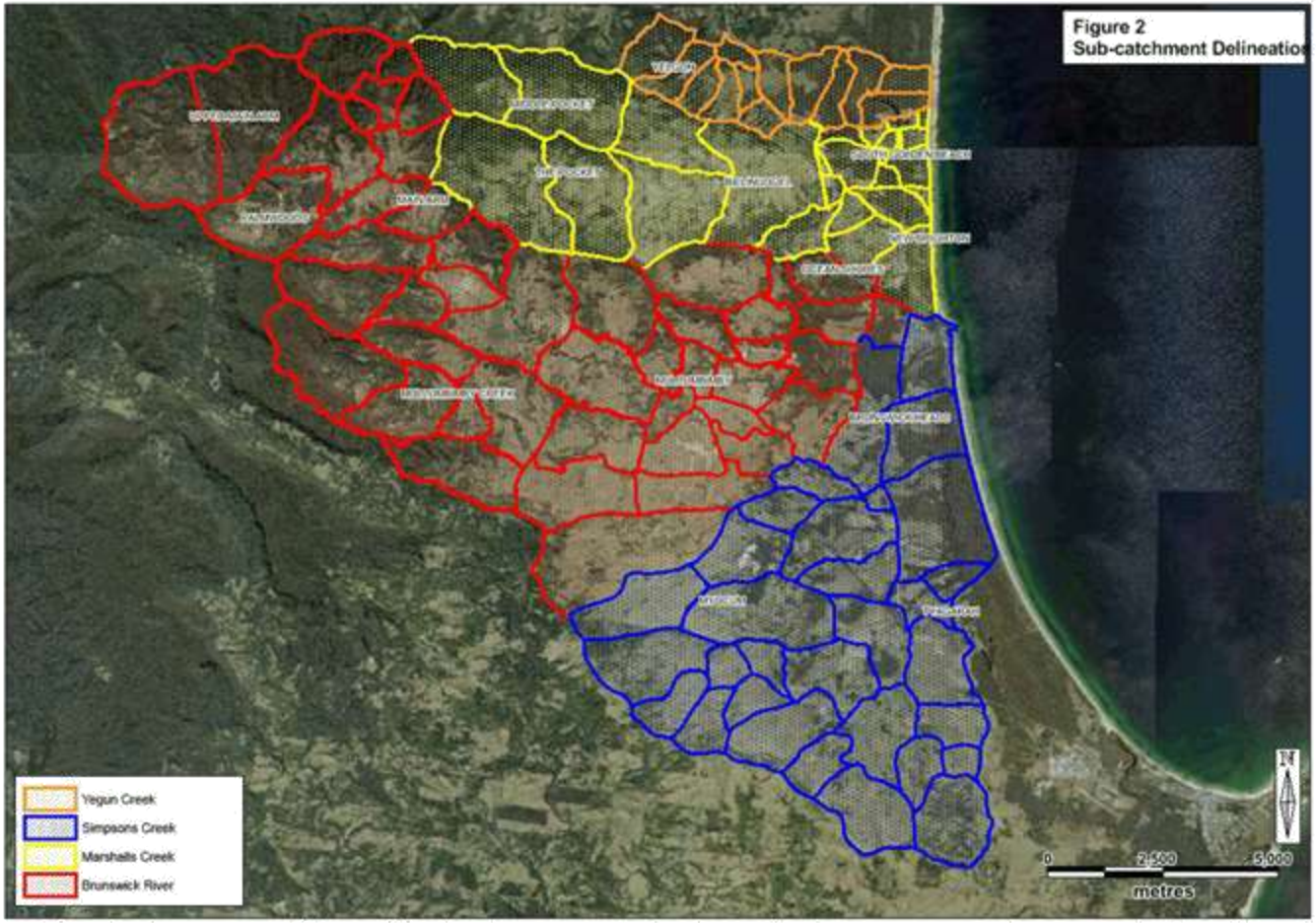

Figure 2: Sub-catchments division

Figure 3: Stream Gauge and Local Storage

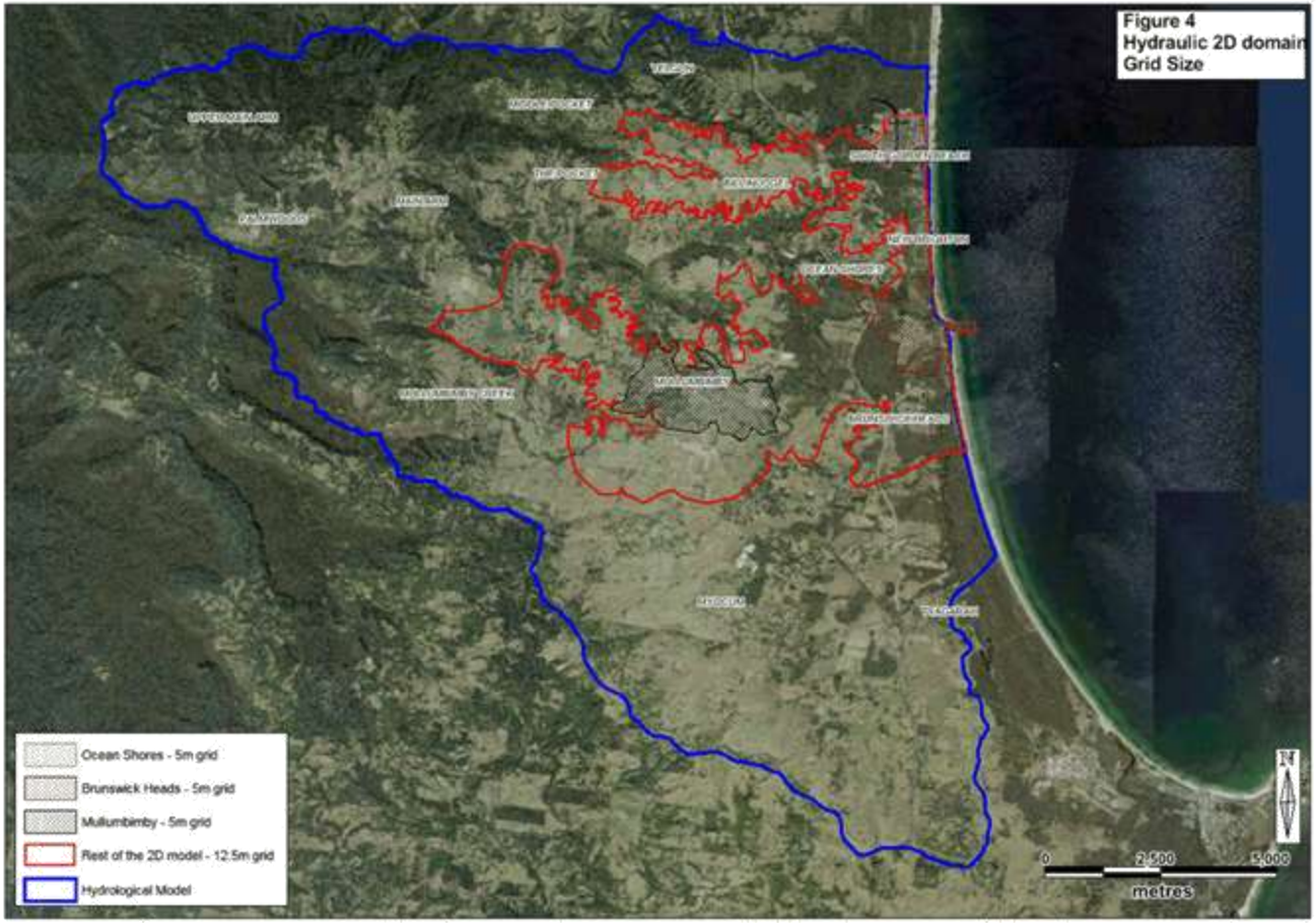

Figure 4: 2D Domain Grid Size

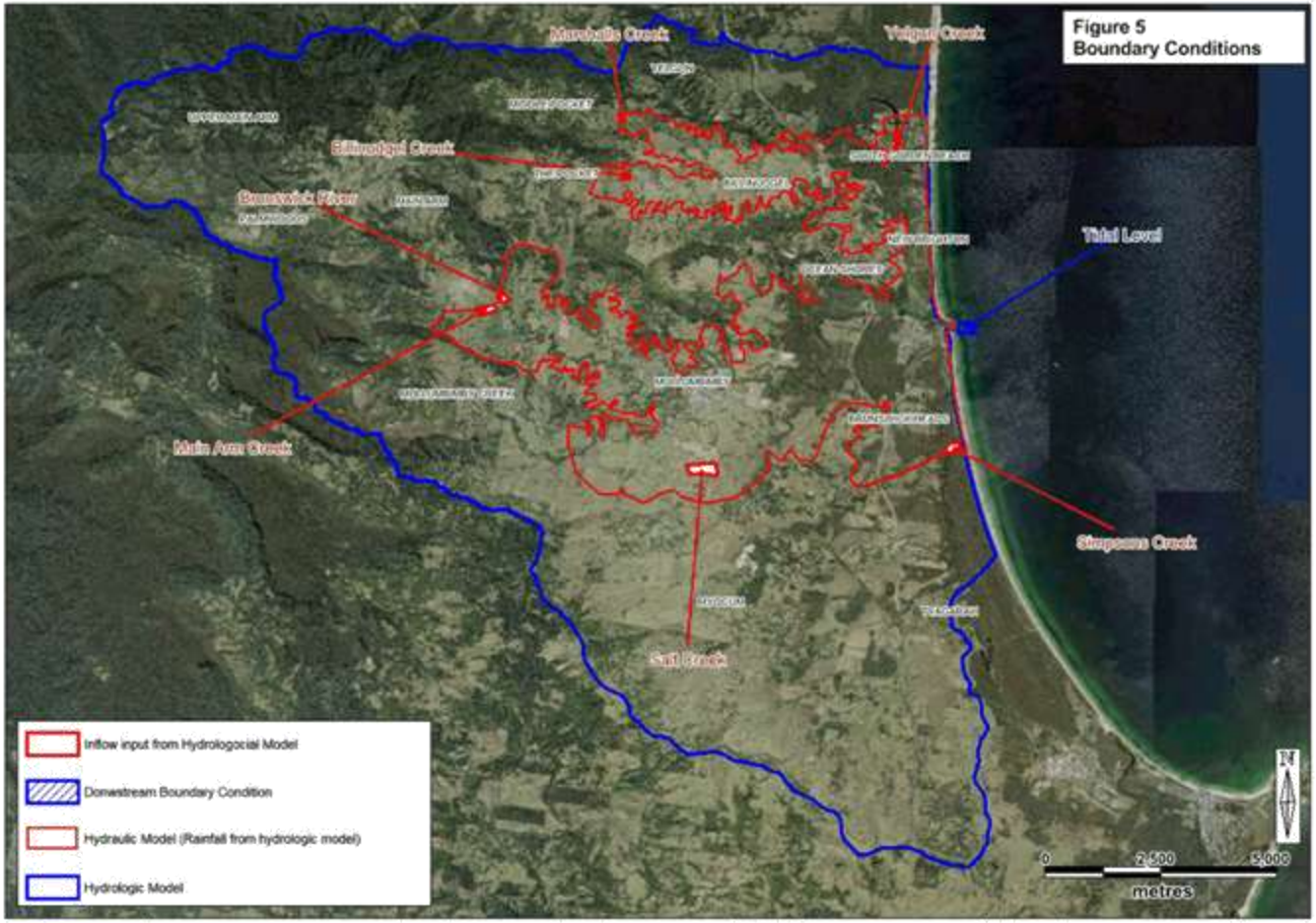

Figure 5: Boundary Conditions

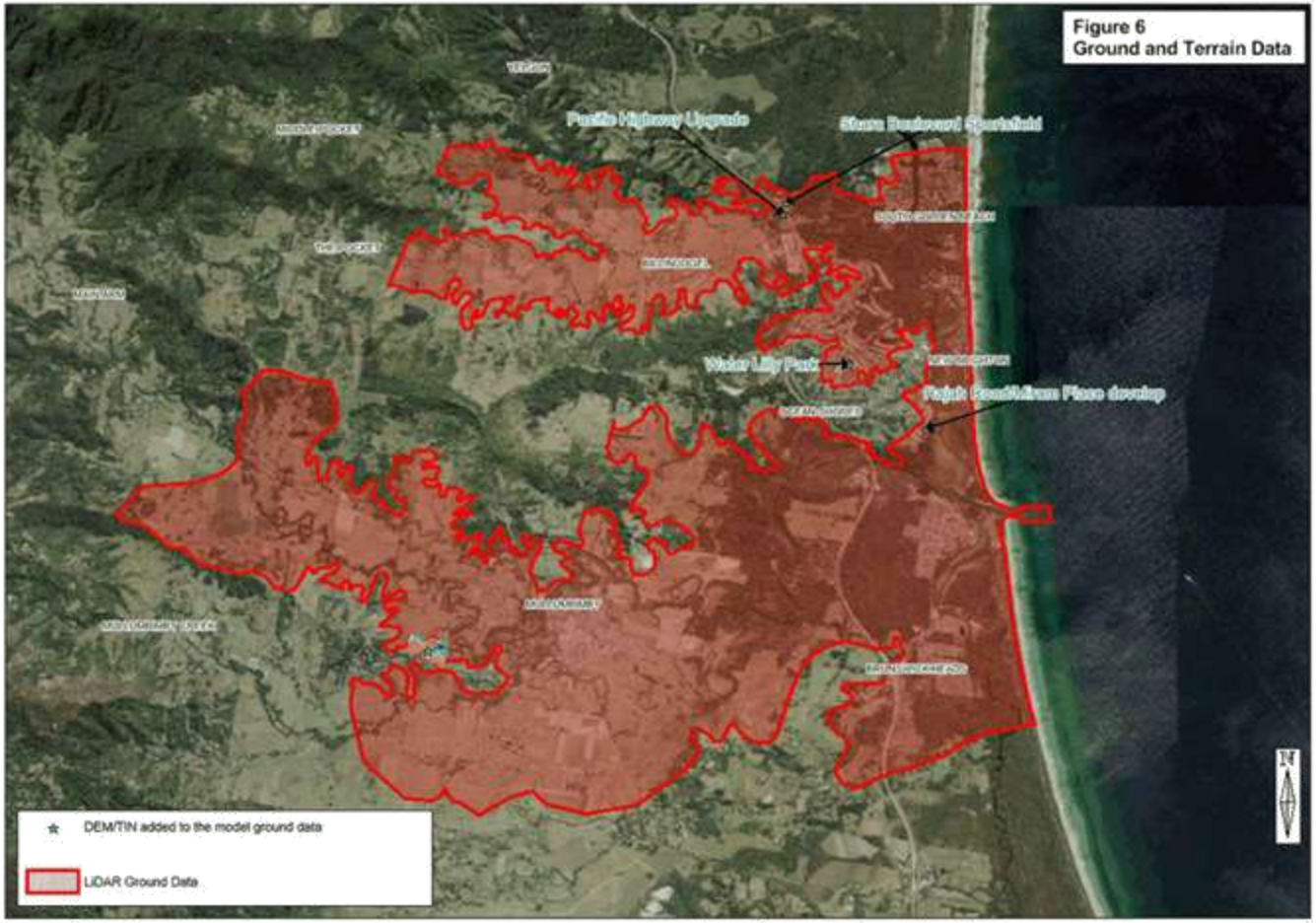

Figure 6: Ground and Terrain Data

Memorandum

TO: James Flockton
FROM: Ella Harrison
DATE: 1 March 2018
SUBJECT: North Byron FRMS&P – Model Update
PROJECT NUMBER: 117098

1. HYDRAULIC STRUCTURES

The following structures have been added to the model:

- Tuckeroo Avenue Culverts (Mullumbimby),
- Drain/Bund south of Mullumbimby,
- Orana Road Culvert (Ocean Shores),
- Balemo Drive South Culvert (Ocean Shores),
- Terrara Court Culvert (Ocean Shores),
- Golf Course Bridge (Ocean Shores).
- Bonanza Drive Culvert (Billinudgel),
- Wilfred Street Culvert (Billinudgel),
- Pacific Motorway Culvert (Billinudgel),
- Balemo Drive North Culvert (Billinudgel/Ocean Shores).

Byron Shire Council are still locating data for the following structures:

- Narooma Drive Culvert (Ocean Shores),
- Additional culvert in the golf course (Ocean Shores),
- Additional data about the bridge in the golf course (Ocean Shores),
- Balemo Drive North Culvert road level (Billinudgel/Ocean Shores).

2. ADDED DEVELOPMENT / TOPOGRAPHIC CHANGES

The following development have been added to the topographic model:

- Tallow Wood Estate Stage 4 (Mullumbimby),
- Waterlily Park survey (Ocean Shores),
- Shara Boulevard Sportsfield (Billinudgel).

Byron Shire Council are still locating data for the following development:

- Orchid Place (Mullumbimby).

Hydraulic Structures and topography from previous and updated models are shown in Figure 1.

3. MODEL EXTENSION

3.1. Sherry's Bridge

To better represent the flood behaviour around Sherry's Bridge, the hydraulic model has been extended 2.1km upstream of Sherry's Bridge (Main Arm). Figure 2 shows the previous and the updated model extend.

3.2. South Golden Beach Area and Yelgun Catchment

There is a complex interaction between Yelgun, Mooball and Marshalls creeks floodwaters. Flows from Yelgun creek either flow north into Mooball Creek or south under Kallaroo Circuit and into Marshalls Creek. Several bunds influence the interaction between the creek systems. Depending on the relative flood levels, flow between Mooball Creek and Marshalls Creeks can occur in both directions and can change during a single flood event.

Previous hydraulic model wasn't representing Yelgun Catchment and stopped at Kallaroo Circuit.
For the design events and June 2005 calibration event, inflow through Kallaroo Circuit was imported from Tweed-Byron Coastal Creeks Flood Study hydraulic model (BMT WBM 2010).

For all other calibration events (Mar1974, Mar1978, May1987 and Jan2012), inflow through Kallaroo Circuit was calculated through the hydrological model as if there was no interaction between Yelgun catchment and Mooball Creek.

The second method will be adopted for the March 2017 calibration event.

The hydraulic model has been extended from upstream of Kallaroo Circuit in South Golden Beach to Yelgun. Hydraulic structures such as culverts under the Pacific Motorway and the Railway have also been included in the model. Figure 3 shows the previous and the updated model extend.

List of Figures

Reference

North Byron Shire Flood Study (BMT WBM, 2016)

Tweed-Byron Coastal Creeks Flood Study (BMT WBM, 2010)

Figure 1: Structure and development added to the model

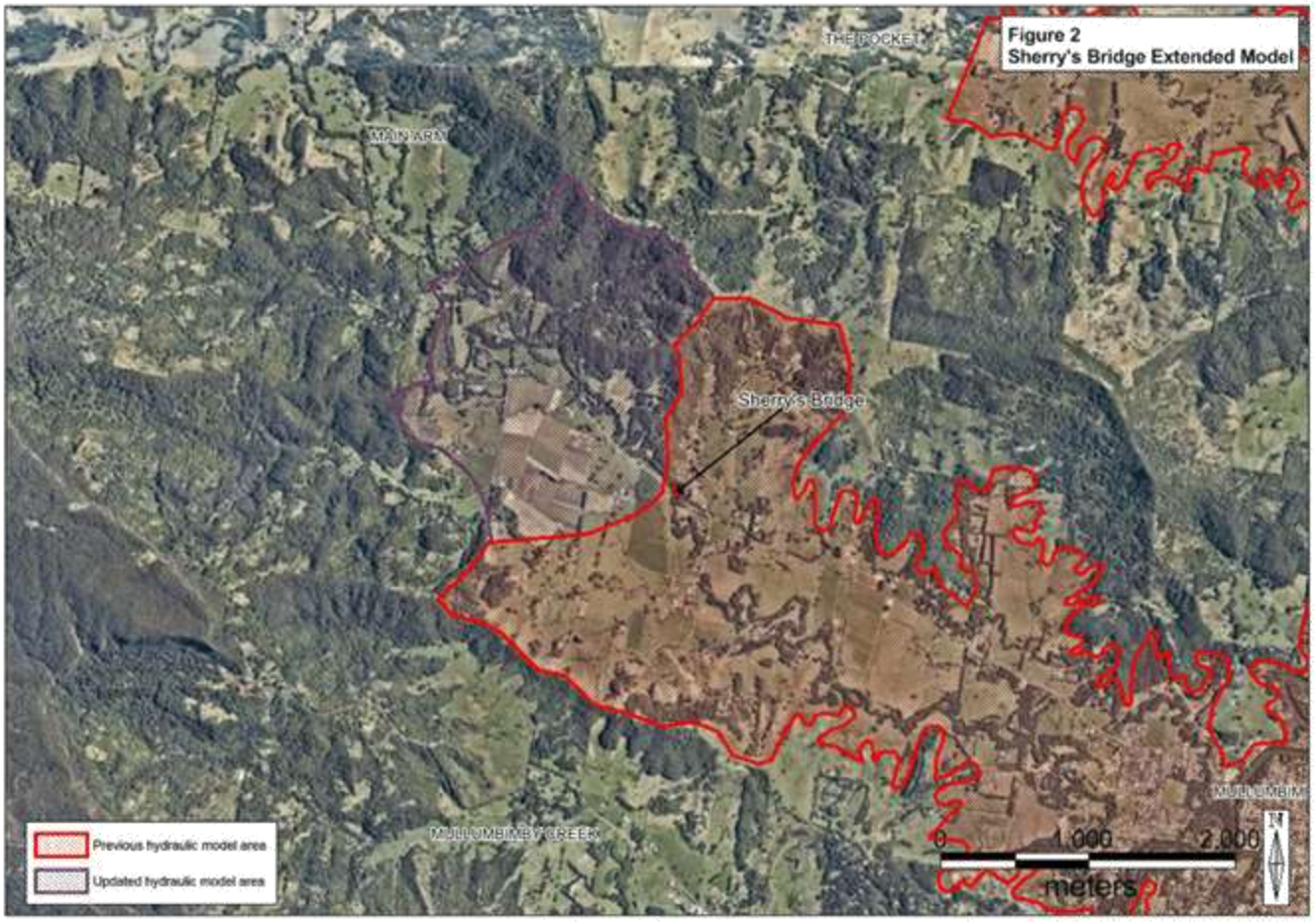

Figure 2: Sherry's Bridge model extension

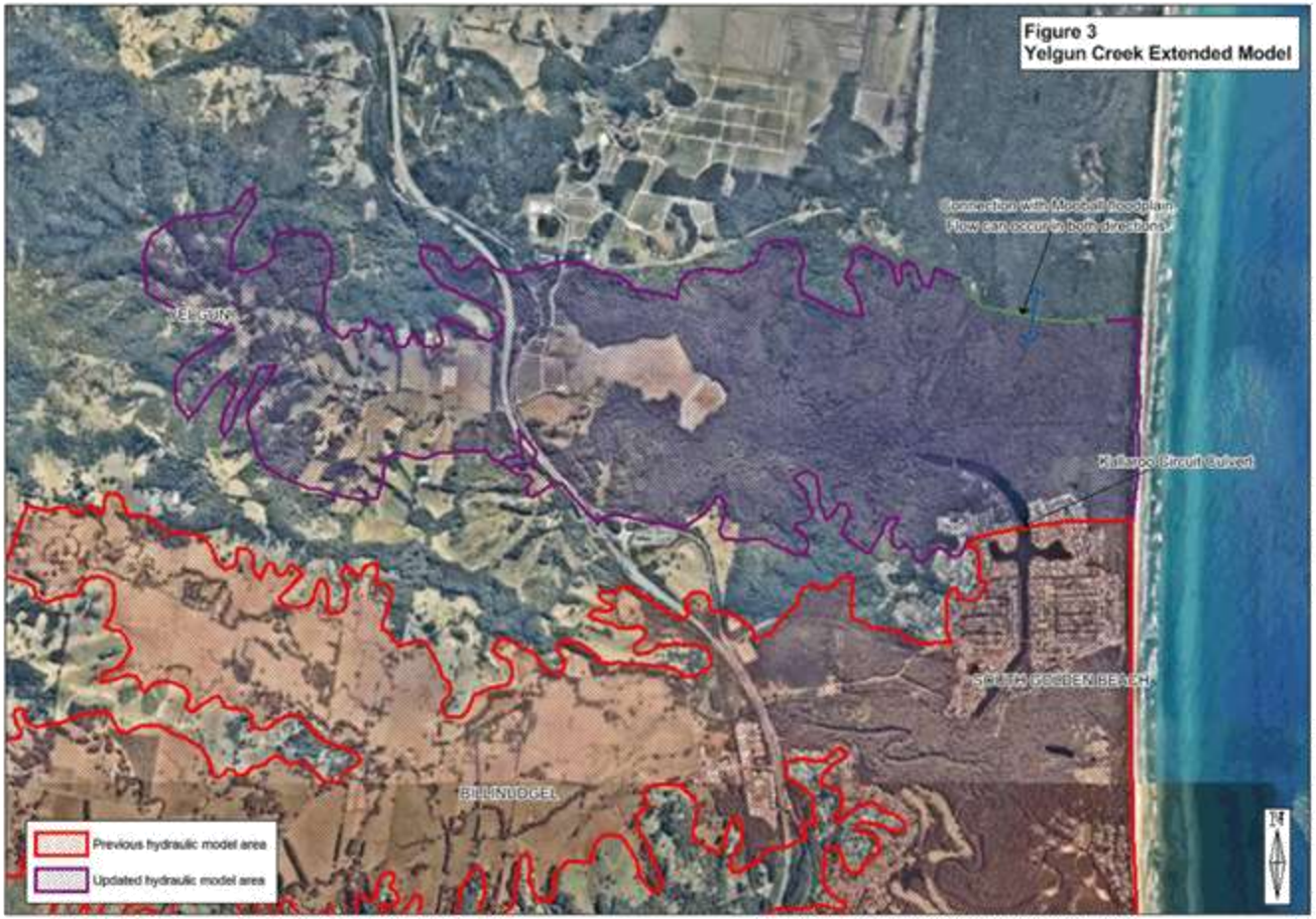

Figure 3: Yelgun Creek model extension

Memorandum

TO: James Flockton
FROM: Ella Harrison
DATE: 1 March 2018
SUBJECT: Floor Level Survey – methodology overview and tender
PROJECT NUMBER: 117098

1. OVERVIEW

Floor level data for the use within floodplain management studies and plans, involves obtaining data for each property within the nominated survey area. This data includes:

- Property ID
- Photograph (no more than 2MB) with linking property ID
- Eastings and Northings (in required projection, typically MGA56)
- Lowest habitable floor level (mAHD)
- Approximate ground level (mAHD)
- Lot Plan No
- Land use (residential, commercial, industrial, rural, rural-residential)
- Building type (slab on ground, low set, high set, two storey)
- Building material (brick, cladding, weatherboard, other)
- Number of stories
- Approximate building size

2. SURVEY CAPTURE METHODS

There are a number of survey methods to obtain the above information, which are varying in cost and accuracy, as briefly described below.

2.1. Traditional Manual Survey

This method offers the highest level of accuracy as a team of surveyors will individually survey the floor level and ground level of each property. Floor level accuracy often exceeds ± 0.075mm and offers higher accuracy collection of other building data (with the exception of approximate building size which is estimated from the road).

Costs vary based on the survey number but range from approximate $70-$75 per property for small samples (<100), down to $30 per property for moderate survey sizes (~2000 – 4000).

2.2. Mobile Laser Scanning (MLS) extraction

MLS involves the capture of new survey and imagery using car mounted side-facing survey methods. This results in very high accuracy survey points, comfortably within +/- 0.1mm for surveyed levels where there is a direct hit on the floor level. Assumptions would need to be made for floor levels which are obstructed – i.e. where there is no direct hit from the MLS, or which exceed approximately 30m from the road. In these instances, it is common to assume floor levels based on surrounding window, door or eave heights.

Costs range from $25 per property for moderate survey sizes (4000) to $10 for large scale acquisition (25,000)

Given the extraction of floor levels is done remotely (i.e. not at the time of capture), additional quality assurance of the outputs is required to ensure it meets the necessary accuracy targets, which may occur an additional fee depending on the sample size.

2.3. Airborne Laser Scanning (ALS) extraction

This method involves utilising existing ALS / LiDAR capture and Google StreetView to extract building eave heights remotely, from which an assumed floor level is derived based on assumed ceiling heights

As a result of the lower level accuracy survey and assumptions required to obtain floor levels from eave heights, overall floor level accuracy typically varies between 0.3 – 0.5m for obtained floor levels.

Other data is extracted from Google StreetView so is dependent on the clarity of the image and how recently the imagery has been updated

Costs range from $5 per property for large scale acquisition (40,000) to $15 for smaller scale (100).

Given the extraction of floor levels is done remotely (i.e not at the time of capture) and is based on a number of assumptions, additional quality assurance is required of the outputs to ensure it meets the necessary accuracy targets, which may occur an additional fee depending on the sample size.

3. NORTH BYRON SURVEY COST ESTIMATES

The final decision on methodology is most typically restrained by budget, balanced with accuracy requirements. For the North Byron catchment the number of buildings requiring survey has been estimated from cadastral lots within three flood extents – 1 in 20 (5%) AEP, 1 in 100 (1%) AEP and the PMF, provided in Table 1 below. Table 2 provides cost estimates based on the three methodology described above.

Flood Event	Approximate number of cadastral lots
1 in 20 (5%) AEP	1720
1 in 100 (1%) AEP	2440
PMF	4370

Table 1: Cadastral lot count by design event extent

	Indicative Cost Estimate		
Method	**1 in 20 (5%) AEP**	**1 in 100 (1%) AEP**	**PMF**
Traditional survey	$60,000	$73,000	$131,000
MLS	$31,000	$44,000	$79,000
ALS	$17,500	$24,500	$44,000

Table 2: Indicative survey cost estimates by method and extent of capture

Should budget permit, it is recommended that survey of all buildings out to the PMF is obtained, with MLS considered a suitably accurate methodology for the purposes of flood damage estimation. To minimise costs, a composite survey of MLS up to the 1% extent, and ALS for all other properties out to the PMF could be considered, with an indicative cost estimate of $65,000.

WMA were advised that Council wished to proceed with survey capture for all buildings within the PMF flood extent.

4. NORTH BYRON SURVEY TENDER

WMA issued a request for proposal to three reputable survey companies, specifying the data requirements and capture area. A copy of the tender document is provided in Attachment 1.

Responses have been requested for 9 March 2018.

North Byron Catchments
Floor level survey and associated building data as part of the North Byron Floodplain Management Study and Plan
Request for Proposal

1. BACKGROUND

WMA Water are a preparing a Floodplain Management Study and Plan for the North Byron Catchments on behalf of Byron Shire Council. Part of this work requires floor level survey and associated building data.

You are invited to provide an email with an attached letter quote, by **Friday, 9 March 2018** detailing your proposal and timeframe for completion to undertake the works as described below.

We have provided the following information to assist with your quotation:

- Table 1 which specifies the requirements of the survey
- Figure 1 which shows the survey area and cadastral lots located within this area

A GIS layer of the survey extent and cadastral lots can be provided should your quotation be accepted.

Should you require further clarification please contact our below representative

Katrina Smith
WMA Water, Level 7, 87 Wickham Terrace, SPRING HILL, QLD, 4000
(07) 3151 2660
kesmith@wmawater.com.au

2. SURVEY REQUIREMENTS

We require floor level survey and associated data for all buildings located within the Probable Maximum Flood Extent as shown in Figure 1. There are approximately 4370 cadastral lots within this extent, although the exact number of buildings is unknown. Table 1 provides the information which is to be collected for all buildings within this area.

In some instances several properties may span one building, or there may be several buildings on each cadastral lot. Please ensure all commercial, industrial and residential buildings are surveyed. Any small sheds or garages do not need to be included. Vacant lots do not need to be recorded or surveyed.

Private properties should not be entered to complete the proposed works. Where floor levels cannot be estimated from other building features (such as window frames, door heights), all other building information should be obtained, or a record made that it was not possible.

Table 1 details the specific information required

Property ID (prescribed by contractor)
Lot DP
Street address
Photograph (no more than 2MB) with linking property ID
Eastings and Northings (MGA56) of building
Lowest habitable floor level (m AHD)
Ground level at entrance to building (m AHD)
Land use (residential, commercial, industrial, rural, rural-residential)
Estimated number of properties per building
For multi-level buildings, total number of stories
Building type (slab on ground, low set, high set, multiple storey)
Building material (brick, cladding, weatherboard, other)
Approximate building size

Table 1: information required

We require the floor level survey, where a direct line of sight was possible, to achieve vertical accuracy of +/- 0.15m (2nd confidence interval and +/- 0.15m in the horizontal.

All data is required in the Map Grid of Australia (MGA) Zone 56 projected Cartesian coordinate system, based on the Geocentric Datum of Australia (GDA) 1994 geocentric coordinate system. An easting and northing is required for each survey point. All survey levels will be in metres reduced to Australian Height Datum (m AHD).

3. TENDER REQUIREMENTS

Please provide a proposal to undertaken the above work which specifies:

- Proposed methodology to obtain the required data, at the specified accuracy.
- Approach to ensure the quality of the data and the accuracy requirements are met.
- Proposed approached to estimate floor levels where a direct line of sight is not possible.
- Outline of deliverables, and their format.
- Inclusion of a brief report outlining the approach, results, Quality Assurance and final accuracy achieved.
- Referees for two previous jobs which involved similar requirements and methodology.
- Cost per building, assuming up to 4500 properties, and an additional cost per building for any above this
- Cost per building where only partial data is supplied (i.e. no surveyed levels, but some additional building features are recorded)
- Actual fees will be based on the number of building surveyed, up to a maximum of 4500. Specific requests from ourselves would be required prior to undertaking any further survey.

Proposals should be received via email to kesmith@wmawater.com.au by no later than **Friday 9 March 2018**. Please contact Katrina Smith if you require any further clarification.

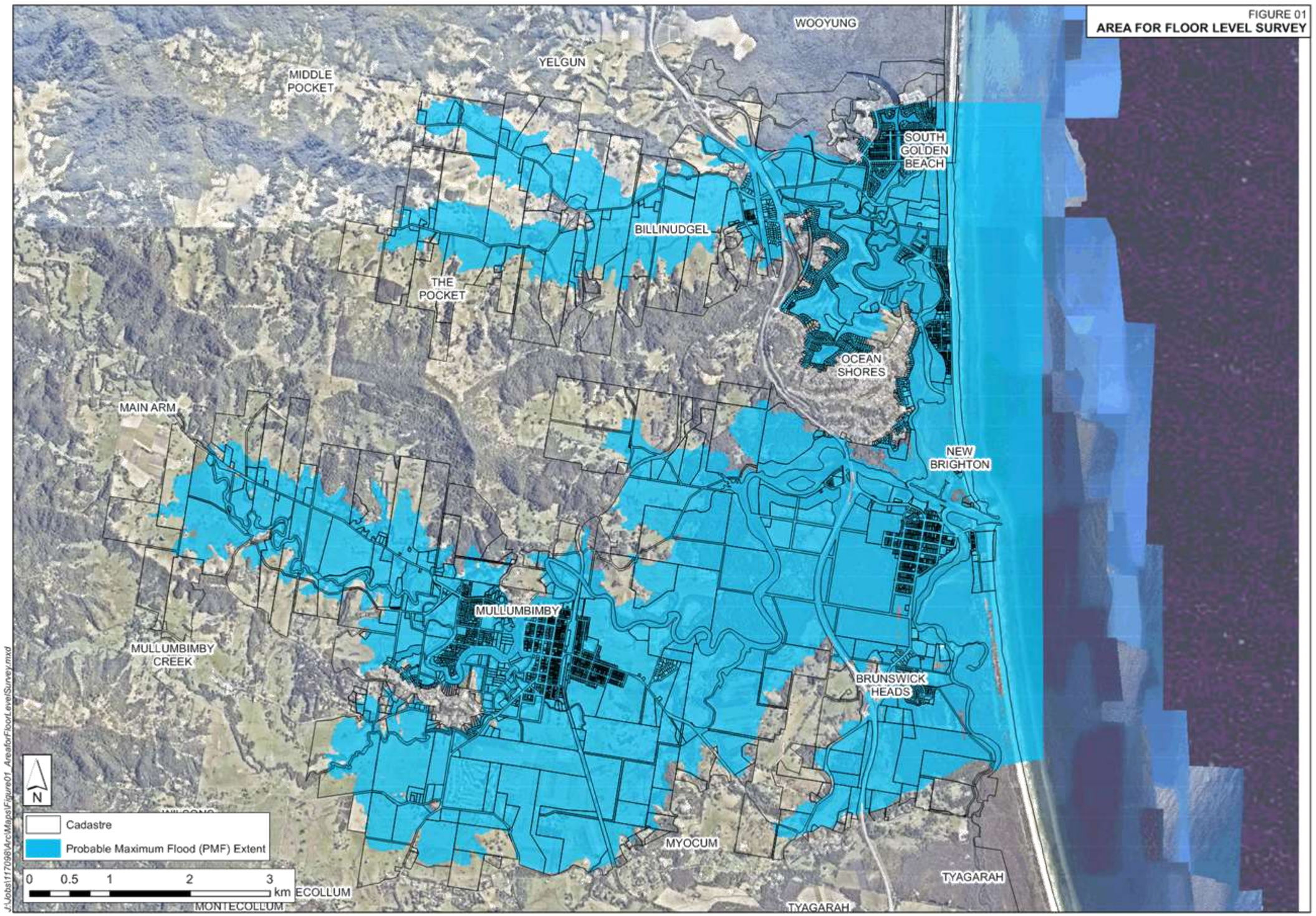
FIGURE 01
AREA FOR FLOOR LEVEL SURVEY
WOOYUNG
YELGUN
MIDDLE POCKET
SOUTH GOLDEN BEACH
BILLINUDGEL
THE POCKET
OCEAN SHORES
MAIN ARM
NEW BRIGHTON
MULLUMBIMBY
MULLUMBIMBY CREEK
BRUNSWICK HEADS
MYOCUM
TYAGARAH
ECOLLUM
MONTECOLLUM
N
Cadastre
Probable Maximum Flood (PMF) Extent
0 0.5 1 2 3
km
J:\Jobs\117098\ArcMaps\Figure01_AreaforFloorLevelSurvey.mxd