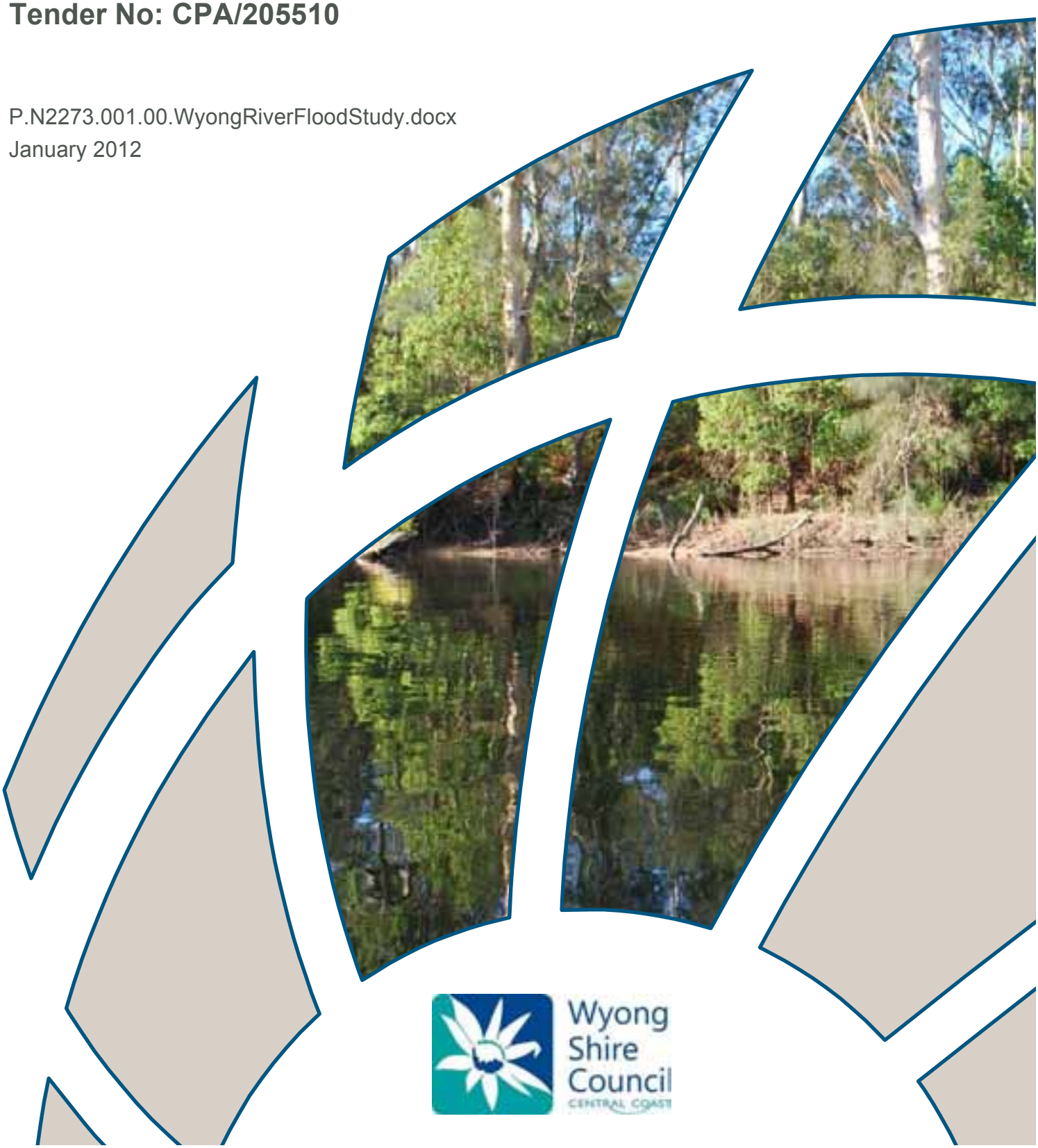
A part of BMT in Energy and Environment

Wyong River Catchment Flood Study

Proposal for Consultancy Services

Tender No: CPA/205510

P.N2273.001.00.WyongRiverFloodStudy.docx
January 2012



Wyong Shire Council
CENTRAL COAST

Wyong River Catchment Flood Study

Prepared For:	Wyong Shire Council
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Document:	P.N2273.001.00.WyongRiverFloodStudy.docx
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Client Reference:	CPA/205510

Synopsis: This document presents BMT WBM's proposal for completing a flood study for the Wyong River catchment. It contains our appreciation of the project requirements, proposed methodology, previous relevant project experience and our proposed study team and credentials. It also details our fee schedule and project program

REVISION/CHECKING HISTORY

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0	19/01/2012	DJL		DJL	

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1 WHY CHOOSE BMT WBM?

BMT WBM is responding to a tender by Wyong Shire Council (Council) (Tender No. CPA/205510) for the Wyong River Catchment Flood Study. Our tender proposal, provided herein, presents our appreciation for the works required and details our proposed methodology. We have also included details of our relevant experience, fees and study program. ***Completed Tender Schedules are included as Appendix A*** of this document.

BMT WBM is at the cutting edge of flood modelling in Australia due to our role as **principal model developer of the TUFLOW hydrodynamic modelling software**, and decades of flood modelling expertise. In particular, BMT WBM has extensive experience in the application of TUFLOW in a range of catchment and flooding environments. This includes detailed urban catchment models incorporating local drainage systems, expansive channel and floodplain areas in urban and rural catchments, and coastal and estuarine systems.

BMT WBM has a **proven track record to deliver comprehensive flood studies on major river and estuarine systems,** incorporating detailed hydrologic and hydraulic modelling. Recent flood studies including Wollombi Brook, Lake Wyangan, Lower Hunter River, Lake Conjola and Newcastle are testament to this. Further to this, the entrance and sediment transport modelling capability has been demonstrated in recent high profile projects such as the Murray Mouth and Lower Lakes, the Lower Myall and Lake Cathie.

BMT WBM are recognised as one of the leading-edge environmental consultancies in Australia, with specialist expertise in flood modelling and floodplain management. BMT WBM has a long history of working with local government in undertaking technical studies and developing strategic plans and policy that address a range of environmental issues. These relationships with local government have been maintained through the **provision of technical work of the highest calibre** and the recommendation of both innovative and practical solutions to environmental management issues.

BMT WBM is well placed to provide Council an exceptional outcome that truly **represents current best practice for flood modelling**. With the recent developments in our TUFLOW software, our capabilities and experience will guarantee that the Wyong River Flood Study will be of the highest technical standard. We thank Council for the opportunity to tender for this very interesting project, and trust that this proposal clearly demonstrates the advantages of choosing the BMT WBM team.

2 STUDY APPRECIATION

The Wyong River catchment area occupies some 440km^2 draining to Tuggerah Lakes. The majority of the catchment is largely undeveloped with sparse rural development; however, the lower catchment, including the Wyong town Centre includes higher density residential, commercial and industrial land use.

The flooding risk in the catchment emanates from a number of major tributaries that drain through the broader Wyong River system to including Cedar Brush Creek, Jilliby Creek, Deep Creek, Porters Creek, Mardi Creek and Tuggerah Creek. , The rapid catchment response to heavy rainfall and subsequent flooding in highly urbanised areas, including relative low-lying areas of the lower catchment, presents a major risk to people and property.

In identifying the scope of works for the study, consideration is given to the local catchment conditions and specific outcomes required for the study as summarised below.

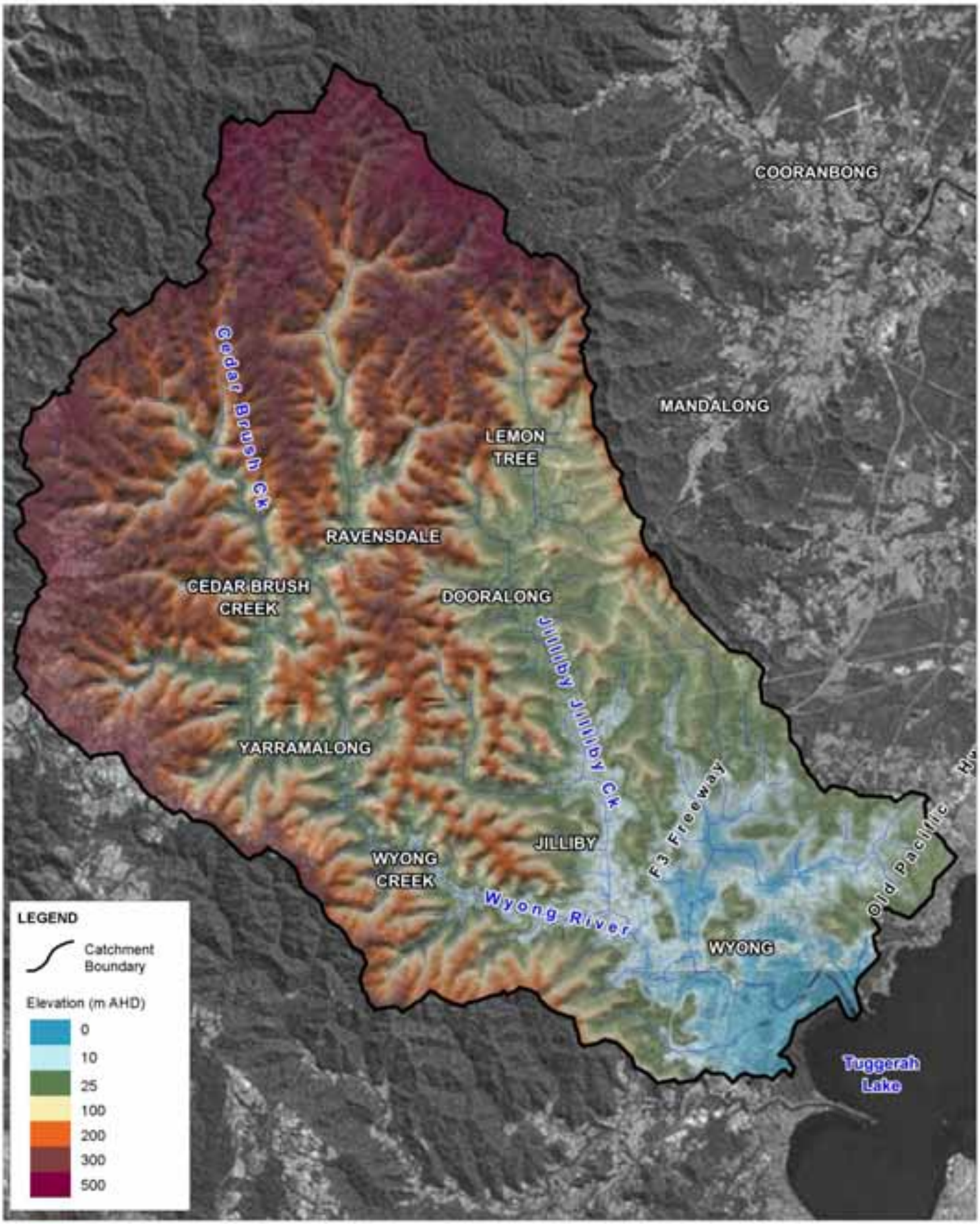
2.1 Local Catchment Issues

Complex Hydrology and Catchment Response

The study area is defined as the entire as the entire Wyong River catchment area, which itself contains a number of significant tributary sub-catchments. To date, only piecemeal analysis has been undertaken on some individual sub-catchments in attempting to define local catchment flood behaviour.

The study area and topography of the catchments is shown in Figure 2-1. Evident in the catchment topography are the numerous sub-catchments typically defined by relative steep upper catchments emanating from the Watagan Mountains at the headwaters of the catchment. The main flowpaths through the catchments are generally well-defined draining through to the low-lying area around Wyong and the system outlet at Tuggerah Lakes.

Individual catchment response and definition of critical flood conditions can be quite different for each major sub-catchment in comparison to the combined catchment inputs and critical flood condition for Wyong and the lower system near the Tuggerah Lakes. Differences in the scale of the catchments (area and mainstream lengths), degree of urbanisation and topographical variance, will provide for differences in the flood behaviour within each sub-catchment, and subsequently the timing and magnitude of inputs into the lower system. The overall spatial distribution of the catchments relative to the main receiving water body will also influence the flood behaviour in the lower parts of the system.



Title:

Study Area and Catchment Topography

Figure: 2-1

Rev: A

N

0 2.5 5km

Approx. Scale

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www.bmtwbm.com.au

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These sub-catchment scale issues add complexity to the study and warrant specific consideration with respect to the requirements of developed model configurations such as:

- Appropriate sub-catchment delineation to ensure adequate distribution of model inflow boundaries to provide local sub-catchment detail and combined response for cumulative flows.
- Appropriate parameterisation of hydrological response with consideration of degrees of urbanisation, land use, ground surface coverage and underlying soil conditions .
- Development of robust models for steep upper catchment reaches to accommodate rapid rises and falls in flow conditions with high peak flows and a fast progression of the flood wave through steeper areas of the catchment. From a floodplain management perspective, the short duration events provide for limited flood warning, such that an accurate representation of design flood conditions is paramount for formal flood risk assessment.
- Achieving an overall balance between model detail and run-time efficiency. In this regard, given BMT WBM's core business in numerical modelling studies, we have invested significantly in hardware resources to provide the required computing capacity to support detailed modelling studies and minimise constraints imposed by computing requirements.

Accordingly, it is envisaged that well planned, organised and structured models will be required to meet the objectives of Council to assess flood risk across the Wyong River catchment.

Design Hydrology

The estimation of design flow inputs to the study area is perhaps the most important factor to ensure appropriate representation of the flood risk. The availability of long term hydrographic records for flood frequency analysis enables some confidence to be built into design flow estimates, subject to appropriate analysis and interpretation.

Significantly, the study reach is serviced by a number of stream gauges which are generally located at the lower end of the system (Wyong Bridge, Gears, Jilliby and Gracemere). Furthermore, there is extensive network of rainfall gauges in the catchment and surrounding vicinity.

The hydrological analysis will centre on a review and update of flood frequency analysis of available peak water level/flow data and analysis of historical flood hydrographs. The broad objectives of the analysis is to identify:

- Appropriate historical event data for calibration;
- Design peak flow estimation for a range of return period events;

- Design hydrograph shape (i.e. volume and timing); and
- Distribution of flows between the main river and key tributary inflows between gauge locations.

In undertaking the hydrological analysis, it is considered imperative that a thorough review of gauging station data and history is undertaken at the outset. This would typically include a review of recorded data quality, data gaps through missing data/gauge failure and adequacy of stage-discharge relationships (rating curves). The latter point is considered a key component of the data review, particularly in the context of the flood study and focus on major events. The appropriateness of high-flow rating curves is crucial, and for many gauge locations in which high flow ratings have been derived by simple extrapolation techniques, existing ratings may misrepresent actual conditions for major flooding that are well beyond previously gauged levels at the sites.

Whilst it is envisaged the flood frequency analysis would provide for the majority design flow establishment, local catchment hydrology would be expected to be modelled via conventional rainfall-runoff modelling.

Hydraulic Controls and Flood Behaviour

The floodplain within the study area is traversed by a number of transport corridors (road and rail). In order to provide flood-free transport routes, many of the routes are elevated above the natural floodplain levels, constructed on embankment with major waterway openings (bridges/culverts) at appropriate cross drainage locations.

These structures are anticipated to have a significant influence on the flooding behaviour in the study area. The significant length of embankment provides impedance to out-of-bank floodplain flows in major flood events. Given the relatively flat topography, the extent of backwater influence may be extensive.

The modelling to be undertaken must be sufficiently detailed to determine individual and cumulative impacts of the floodplain developments.

Stages of inundation can be important, and in complex river/floodplain systems, the relative flow distributions can change significantly throughout the rise and fall of the flood hydrograph. In this regard the peak velocities and indeed flood hazard may not coincide with the peak water level/flow condition. The impact of key hydraulic controls such as major hydraulic structures and associated floodplain embankments can also change during an event (e.g. overtopping and bypassing at critical spill levels).

Similarly, timing of inundation – from an emergency management perspective, even lag times of an hour can be significant in terms of flood response. Relative timing of inundation at key points in the system and at key infrastructure can be crucial for identifying trigger levels for implementation of response actions. In order for this type of data to be available in a subsequent floodplain management study, the

appropriate model and analysis technique will need to be implemented in the current flood study.

Existing studies

Flood studies have been completed for some of the tributary catchments. The requirement of the current flood study is to incorporate these existing models where appropriate in a wider model of the total Wyong River catchment.

In reviewing the existing studies, and associated data, model structure and results, focus will be given to:

- Topographical and cross section databases;
- Boundary conditions;
- Structure configurations; and
- Schematisation of channel and floodplain interaction.

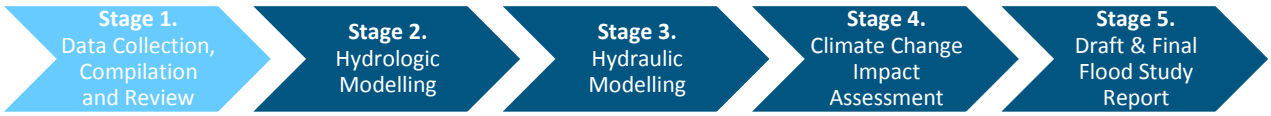
A key output of the study will be comparison of results with the previous sub-catchment studies. Indeed the model conversion and calibration process will aim to replicate existing results as best as possible where appropriate. It is possible that differences may arise however due to either an improvement in the system representation and changed simulation of the flood condition or due to physical changes in the catchment subsequent to completion of the previous models. Where significant differences arise, specific commentary/explanation will be provided.

3 STUDY METHODOLOGY

This chapter presents the methodology that BMT WBM proposes to follow in completing the study. Our methodology meets all requirements detailed in the specification of the study brief. Given our extensive previous experience, and the expertise of the proposed study team, we are able to offer an innovative and practical approach to meet the study's objectives.

The general approach and methodology employed to achieve the study objectives involve:

- Compilation and review of available information;
    - Site inspections;
    - Collection of historical flood information;
    - Collection of additional topographic survey data;
- Establish hydrologic and hydraulic models;
    - Calibration and verification of models;
    - Establish design flood conditions;
    - Sensitivity testing of key parameters.
- Assess impact of Climate Change on flooding;
    - Simulate climate change scenarios;
- Final Flood Study
    - Reporting and Mapping.



3.1 Stage 1 – Data Collection, Compilation and Review

3.1.1 Study Initiation

Following acceptance of our proposal, Darren Lyons will attend a Study Inception Meeting with Council representatives (Shah Alam) and other relevant bodies (e.g. Office of Environment and Heritage). The primary objectives of this meeting would be as follows:

- to confirm dates for the start, key milestones and completion of the study;
- to establish key contacts with Council and other stakeholder organisations as required;

- to confirm the proposed study methodology; and
- to initiate information collection and collation tasks.

3.1.2 Site Reconnaissance

BMT WBM will undertake a site reconnaissance of the study area at the commencement of the project to familiarise ourselves with the study area and gain an appreciation of local features influencing flooding behaviour. Some of the key observations to be accounted for during the site inspection will include:

- The characteristics of the entrance including the formation of the existing entrance berm and normal tide conditions in the entrance. A visual assessment will help to gain an appreciation of the processes contributing to the formation and design conditions for the flood modelling.
- General nature of the channels and overbank areas at potential flood risk. Existing low-lying properties identified in previous investigations will be inspected and any local characteristics affecting flooding mechanism noted.
- The presence of local hydraulic controls such as bridges and road culverts and natural topographical controls (it is noted that details of some 70 structures will be provided for the study).

It may be useful for Council staff to be involved in site inspections to provide details of local flooding concerns or key hydraulic features.

The site inspections would be expected to be undertaken subsequent to review of the completed flood studies. This would provide for an element of “ground truthing” simulated flood behaviour and confirmation of hot-spot flooding areas, the configuration or representation of key hydraulic structures or other controls,

3.1.3 Data Compilation and Review

Relevant data and information in the study area will be collated and reviewed from various sources, including Council and OEH. The availability of data will be discussed at the inception meeting. The data collection includes:

- **Topographic Survey:** It is understood that there is LiDAR data available for the whole catchment. Any additional available topographic survey in the form of cross sections, photogrammetric, and digital elevation models (DEM) will be obtained.

- **Structure Plans:** There are numerous major bridge/culvert structures in the model area, mostly associated with road crossings of the major waterways. Existing plans and details for these structures and any others of significance will be required to define invert levels and waterway area characteristics for representation in the hydraulic model. In addition, where elevated road embankments provide obstructions to overland flows, Councils’ roads database can provide alignments and levels of significant routes. Where

structure data is unavailable, collection of relevant details will be incorporated into the additional field survey.

- **Hydrographic Data:** Rainfall, stream flow, flood levels, water levels, and tidal and other flood related data will be collected and collated as a database. Information is available from OEH, Bureau of Meteorology (BOM), Hunter Water and other sources. BMT WBM will review the locations with respect to the catchment and source relevant data for the flood study.
- **GIS data:** Digitally available information such as aerial photography, cadastral boundaries, topography, watercourses, drainage networks, land zoning, vegetation communities and soil landscapes will be requested for the study area.
- **Historical Flood Data:** Information on historical flooding will be sourced from Council and community consultation will target the acquisition of additional flood data as available including recorded water levels, flows and photography. In the absence of recorded data, anecdotal evidence may provide valuable information on historical events. Also, historical databases, such as local newspaper archives, Council and other Government Department files, and historical society records, will be reviewed to obtain relevant data relating to known flood events.
- **Previous Studies:** Data collation and review undertaken for these studies will also be taken advantage of for the flood study.
- **Planning Documents:** A variety of planning documents are available and will be reviewed and considered, where relevant, as part of the study. These documents include the

If not already established, **BMT WBM would establish a GIS databas**e of available flood information and resources. We have found in previous studies for this to be a useful tool for rapid assessment, analysis and visualisation of available data. All databases developed would be handed over to Council at completion of the study in a readily usable GIS based format, consistent with Council's in-house system.

Gaps or deficiencies in the existing data will be identified at this stage. With consideration to the study objectives and the proposed methodology, the requirement for additional data collection will be assessed. Typically this may involve additional ground survey of the channel and/or floodplain to fill in missing data, provide further detail in critical areas, or address suspect data. The requirement for and extent of additional data collection would be discussed with Council along with prioritisation, planning and management of survey activities.

3.1.4 Community Consultation

The community consultation plan described below sets out in broad terms the method and program in engaging the community and stakeholders. However, it is envisaged that the consultation program will be dynamic in nature, responding to

community issues and study outcomes as they arise, and aligning with the community consultation toolkit and matrix as provided by Council.

At this stage of the floodplain management process consultation will be focused on historical flood data collection and anecdotal flood behaviour observation of local landholders. It is envisaged that data obtained will supplement Council's existing historical flood databases and provide valuable data input to the model calibration/validation process. It is understood that more intensive community consultation will be incorporated in future floodplain management studies.

3.1.4.1 Media Release / Poster / Resident Survey / Landholder Interviews

One of the initial tasks to be undertaken by the study team will involve preparation of a combined media release, brochure and resident survey to inform the wider community of the study, to canvass existing flooding issues and locate any outstanding flood level data or information for historical flood events in the catchment.

Initial modelling results may help define the area's most likely affected by flooding, thereby defining the area of interest for questionnaire distribution.

Through many years of experience in undertaking resident surveys, the study team has developed and refined set of questions that are easily interpreted and answered by local residents. Study team members recently undertook resident surveys as a component of the Burrill Lake Flood Study and Lake Conjola Flood Study on behalf of Shoalhaven City Council. For the Lake Conjola study, some 200 questionnaire responses were received, which is an exceptional result given the size of the local community. Similar resident surveys have also been recently carried out for studies at Wollombi, Liverpool, Kogarah, Bomaderry and Lake Macquarie.

Council's assistance will be sought in approving the final format of the brochure / survey and distribution to residents.

The study team will collate and analyse all results from the resident survey. Where necessary, we will make contact with specific respondents to confirm information provided and obtain further details (e.g. if historical flood marks have been captured by residents).

Following collation and review of all returned questionnaires, follow up consultation will be undertaken with relevant respondents of the questionnaire. This contact will comprise an initial telephone call, followed by an on-site meeting if warranted.

3.1.4.2 Community Information Session

One of the strategies the study team use to engage the local community is a Community Information Session. Operating over a period of about two hours on a weekday evening, the information session will be the mechanism for the exchange of knowledge between the study team and the community. Key study team members

will be available to discuss the project. Several techniques will be used to encourage input by community members who attend including:

- Formal presentation of technical information;
- Follow-up direct and informal verbal communication;
- Hand-out brochures and information sheets;
- Use of feedback forms; and
- Contribution to a large scale interactive map.

The information session will be held during the public exhibition of the draft documents. In addition to informing the community about flood study outcomes, the session will also be used to elicit options and ideas from the community about what can be done to help minimise future risks to life and property. Community feedback in this regard will be targeted through direct discussions, mark-up of interactive maps, and the feedback forms.

The study team have had considerable success in holding informative drop in sessions rather than open forum workshops and public meetings. Open forum meetings and public workshops can tend to be dominated by a few vocal participants, while more reserved community members feel less able to participate and contribute.

All displays and materials for the information sessions will be developed by the study team. It is assumed that Council will provide venues and refreshments for the sessions.

Whilst a comprehensive community consultation program would be expected to take place during the development of the floodplain risk management study, early engagement of the community in the floodplain management process is seen as an effective means to raise community interest and garner community support for the project. One of the primary goals of the consultation plan is simply to raise community interest and garner community support for the project.

3.1.4.3 Project Web-page

A project web-page will be created and periodically maintained by BMT WBM. The webpage will include general information on the study background and objectives, reporting progress of the flood study against key milestones, and provide preliminary study output subject to Council approval. We envisage that the project web-page will be used as one of several avenues for engagement with the local community. An example of a project webpage is illustrated in Figure 3-1 developed by BMT WBM for the Burrill Lake Floodplain Risk Management Study and can be accessed at http://gis.wbmpl.com.au/BurrillLake/

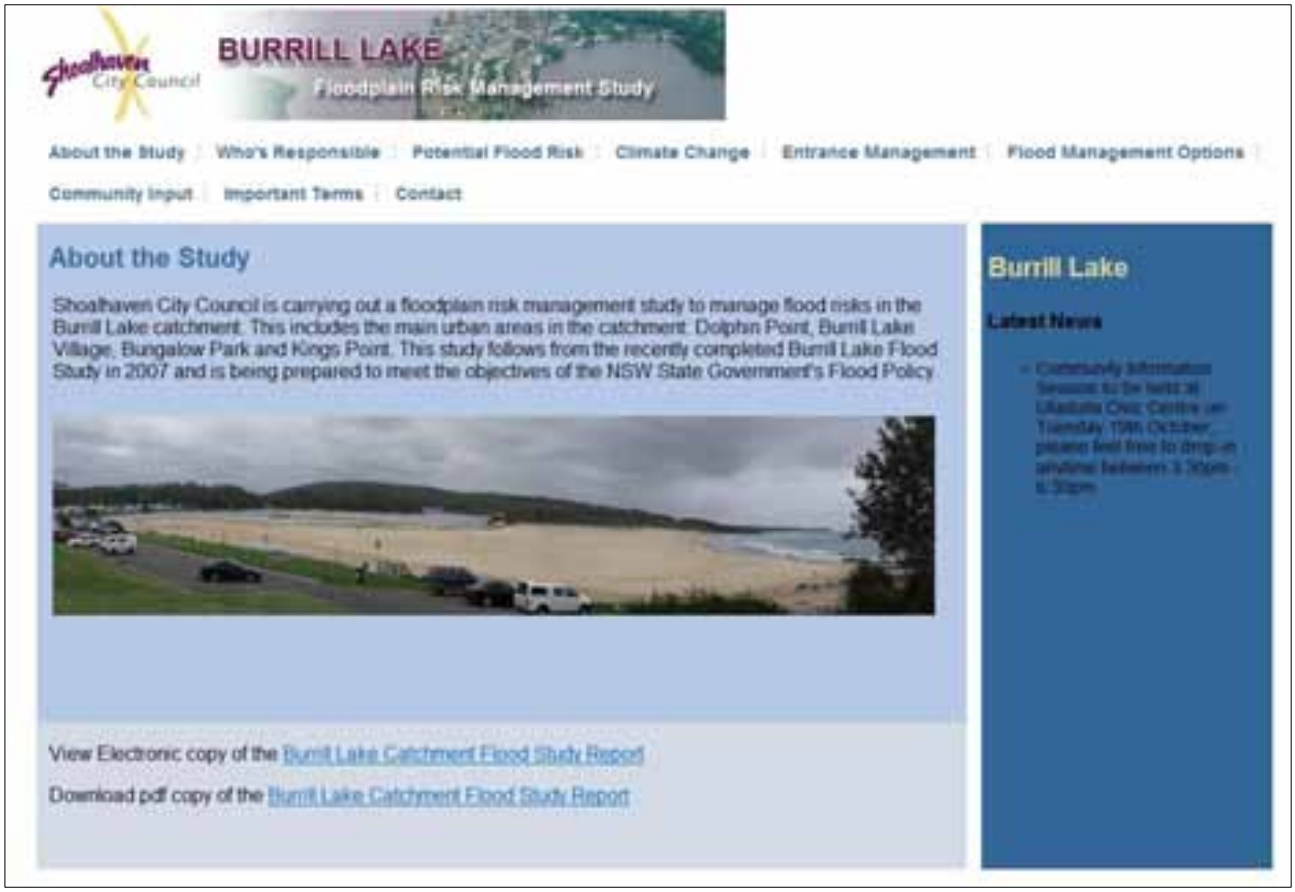
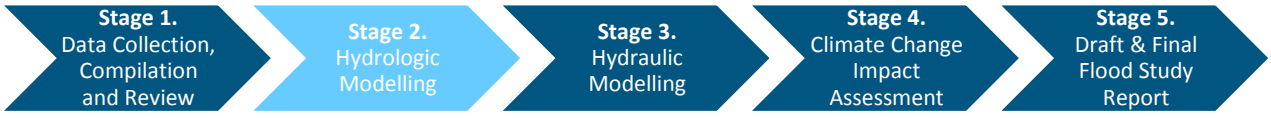


Figure 3-1 Example Webpage for Flood Study

Deliverable - Stage 1 Interim Report

- Data Review methodologies
- Summary of available data and Analysis of suitability of data for Flood Study
- Identification of data gaps
- Outline of price scehdule and time frames required to fill data gaps



3.2 Stage 2 – Hydrological Assessment

3.2.1 Proposed Software

BMT WBM propose to develop a RAFTS-XP hydrologic model for the study area. The majority of the sub-catchments are ungauged such that the model is required to simulate the rainfall-runoff process to derive catchment inflows to the hydraulic

model. Where appropriate, the flood frequency analysis at existing gauge sites will support the broader catchment modelling.

The process of developing the hydrological model includes:

- Sub-division of the catchment into a network of sub-catchments inter-connected by channel reaches representing the creeks and lakes. The sub-catchments are delineated, where practical, so that they each have a general uniformity in their slope, landuse, vegetation density, etc.
- Specification of rainfall characteristics including rainfall intensity, depth and temporal pattern. The network of sub-catchments allows for spatial variation of rainfall characteristics across the total catchment where appropriate.
- Specification of loss parameters incorporating storage and infiltration not contributing to direct runoff. These parameters are often dependent on catchment type and can be used to represent the antecedent conditions in which smaller losses may be expected for initial wet conditions (period of preceding rainfall).

The key model variables associated with the model development include:

- the catchment slope, area, roughness and other characteristics;
- variations in the distribution, intensity and amount of rainfall; and
- rainfall storage/loss coefficients reducing effective rainfall.

It is envisaged that there is some useful calibration data in the catchment with respect to runoff volumes and flow rate from the existing gauges. Nevertheless, sensitivity of key parameters will be important for the hydrological modelling.

Model output will be cross checked for appropriateness using the Rational Method for calculation of peak flows.

The developed RAFTS-XP model will be used to derive flow hydrographs at appropriate locations to be used as inflow boundaries to the hydraulic model. This analysis will include both calibration and design events. Appropriate calibration events will be selected following the review of available information.

The selection of suitable historical events for calibration of the computer models is largely dependent on available historical flood information. Ideally the calibration and validation process should cover a range of flood magnitudes to demonstrate the suitability of a model for the range of design event magnitudes to be considered. Key for the hydrological model is the establishment of representative spatial and temporal distribution of event rainfall. Review of available rainfall data (expected to include both continuous and daily read rainfall) will confirm suitable calibration events.

Design event flow conditions to be derived include the 0.5 %, 1%, 2%, 5%, 10%, 20% AEP events and the Probable Maximum Flood (PMF). The design rainfall

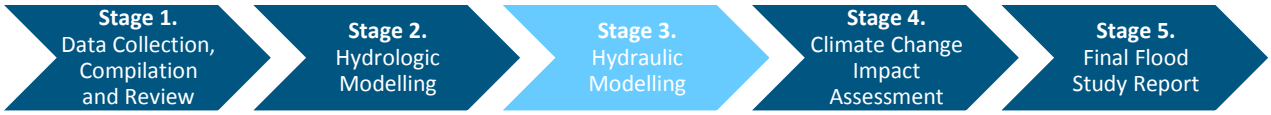
conditions for the design events will be determined according to the appropriate procedures outlined in AR&R.

The Probable Maximum Precipitation (PMP) is used in determining the PMF event. The PMP can be estimated in a number of ways, with the method being chosen based upon catchment location, size and critical duration of the catchment, and the purpose for which the PMP is needed. Techniques include the Generalised Short Duration Method (GSDM) and the Generalised Southeast Australia Method (GSAM).

As discussed in Section 2.1, the variation in the nature of the major contributing sub-catchments to the Wyong River will provide for variable system response to rainfall. Accordingly, critical design flood conditions will be driven by different events in most sub-catchments. In the simulation of design flood conditions across the entire study area, a range of storm durations will need to modelled, with an envelope approach adopted to represent critical conditions throughout the study area.

Deliverable - Stage 2 Interim Report

- Hydrological model, asssociated methodologies and assumptions;
- Model Calibration and Validation;
- Model Results including outputs showing Critical Durations, Rate of Rise of Floodwaters and Hydrographs for Key Locations within the Catchment



3.3 Stage 3 - Hydraulic Modelling

3.3.1 Model Development Process

BMT WBM proposes to use the fully two-dimensional (2D) software modelling package TUFLOW, which has been developed in-house by BMT WBM. TUFLOW remains Australia's leading flood modelling system

Development of a hydraulic model follows a relatively standard procedure:

1 Discretisation of the catchment, river, floodplain, etc.

2 Incorporation of physical characteristics (creek cross-sections, floodplain levels, structures etc).

3 Establishment of hydrographic databases (rainfall, river flows, flood levels) for historic events.

4 Calibration to one or more historic floods (calibration is the adjustment of parameters within acceptable limits to reach agreement between modelled and measured values).

5 Verification to one or more other historic floods (verification is a check on the model's performance without further adjustment of parameters).

6 Sensitivity analysis of parameters to measure dependence of the results upon model assumptions.

Once model development is complete it may then be used for:

- establishing design flood conditions;
- determining levels for planning control; and
- modelling development or management options to assess the hydraulic impacts.

3.3.2 Model Extent and Topography

The nominal study boundaries defined in Council's brief cover the whole Wyong River catchment, within specific defined limits on tributary streams for detailed hydraulic analysis.

Consideration needs to be given to the following elements in constructing the model:

- location of available data (e.g. river section surveys);
- location of recorded data (e.g. levels/flows for calibration);
- location of controlling features (e.g. dams, levees, bridges);
- desired accuracy to meet the study's objectives; and
- computational limitations.

A linked 1D/2D model will be developed covering the study extent identified in Council's brief. The ability of the model to provide an accurate representation of the flow distribution on the floodplain ultimately depends upon the quality of the underlying topographic model.

The model resolution will be determined following review of available data. Council's required minimum resolutions specified in the study brief have been noted. BMT WBM confirms these minimum resolutions will be achieved.

A high resolution DEM will be derived for the study area from the LiDAR data provided by Council. The ground surface elevation for the TUFLOW model grid points are sampled directly from the DEM established for the model area.

3.3.3 Structure Representation

Existing flood structures (e.g. bridges, culverts, road embankments) will be incorporated into the model based on survey detail of these elements.

These structures will be simulated either fully within the 2D model or as nested 1D element within the domain of the 2D model depending on their size and channel representation at the location. Head losses through key hydraulic structures will be compared to AUSTROADS 1994 publication, "Waterway Design – A Guide to the Hydraulic Design of Bridges, Culverts and Floodways." BMT WBM has undertaken considerable research and development in the modelling of road structures in 2D flood models and is recognised as a leader in this field.

3.3.4 Boundary Conditions

In determining the design floods it is necessary to take into account:

- Design rainfall parameters (rainfall depth, temporal pattern and spatial distribution). These inputs drive the hydrological model from which design flow hydrographs will be extracted as inputs to the hydraulic model;
- Design Tuggerah Lake boundary levels. Design water level data for the Tuggerah Lakes will be utlisded from existing studies, taking into account due consideration of the coincident flooding conditions for design purposes of the Wyong River catchment and the broader Tuggerah Lake system;
- The impact of future climate change on Tuggerah Lake levels and catchment inflows.

Local catchment runoff hydrographs will be applied directly to the hydraulic model. The hydrographs for historical and design events will be derived from the RAFTS-XP model developed for the study.

The final configuration of fluvial and Lake flood conditions will be confirmed with Council and OEH.

3.3.5 Calibration and Verification

The extent of suitable information available for model calibration across the entire study area is unknown at this stage. Through the data collation and community consultation exercises, it is foreshadowed to identify a number of events with available historical records for model validation.

In the calibration and verification process, consideration will be given to significant topographical changes between historical events. Separate models may be required to represent the topography, land use and arrangement of key hydraulic structures at the time of the event.

Given the potential lack of calibration data, the sensitivity analysis is expected to be an important component of this study. In addition, Council and OEH will be consulted in the model parameter selection process.

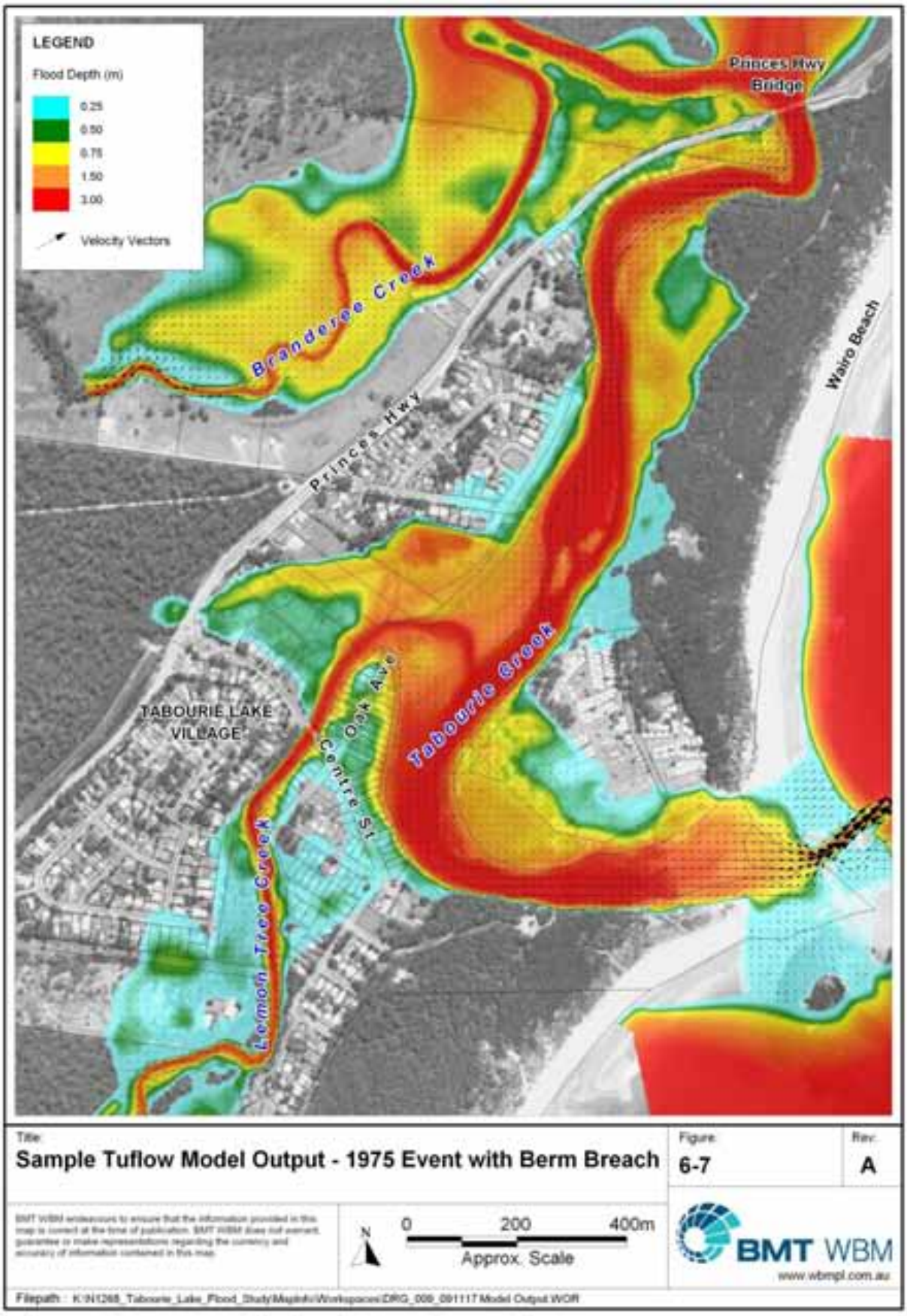
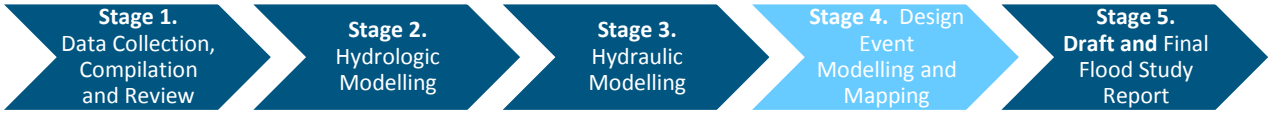


Figure 3-2 Sample Model Result Presentation (Tabourie Lake)



3.4 Stage 4 – Design Event Modelling and Mapping

3.4.1 Modelling of Design Events and Sensitivity Tests

The key inputs for modelling of the design events include:

- Design rainfall parameters (rainfall depth, temporal pattern and spatial distribution).
- Design downstream boundary levels (Tuggerah Lake); and
- Initial water levels.

The calibrated and verified hydraulic model will be modified, as necessary, to represent present day conditions, including topographical and land use changes. The model will then be applied to define present day design flood conditions.

In accordance with Council's brief, the design events to be simulated include the 50% AEP, 20% AEP, 10% AEP, 5% AEP, 1% AEP and 0.5% AEP and PMF event. The 1% and/or 0.5% AEP floods are generally used as reference floods for development planning and control.

A series of sensitivity tests will be carried out on the predicted modelling results. These tests will be conducted to determine the relative importance of different hydrologic and hydraulic factors, such as:

- Infiltration losses in the hydrologic model (representative high and low range tests);
- The XP-Rafts routing parameter (BX value) (representative high and low range tests);
- Hydraulic roughness in the hydrodynamic model (representative high and low range tests);
- Structural losses in the hydrodynamic model (representative high and low range tests); and
- Downstream boundary condition, i.e. Tuggerah Lake water level (representative high and low range tests).

The tests provide a basis for determining the relative accuracy of modelling results, and an initial focus for future floodplain management planning.

A number of blockage scenarios of key hydraulic structures will also be undertaken within study. Council has requested a provision for sensitivity analysis of 15 structure blockages. The location of these structures and degree of blockage will be confirmed following review of initial modelling results.

A series of predicted flood inundation extents will be developed for the range of design floods considered. These will illustrate the change in the footprint of flood affected areas with increasing flood event magnitude.

The assessment of a range of design events will enable the relative level of flood protection afforded to existing property to be identified and the flood magnitude at which damage is anticipated. The level of flood immunity will be important for assessing the potential for further development and the prioritisation for flood mitigation or protection works.

3.4.2 Provision of SES Flood Intelligence at Points of Interest

The provision of SES flood intelligence at points of interest will be done in accordance the locations and data requirements specified in the Brief. Provision of the results will involve:

- Confirm the locations of flood intelligence points prior to setting up the hydraulic model.
- Establishing the points of interest in the TUFLOW model as plot output points and lines.
- Run the TUFLOW model(s) for the range of design events.
- Collate the results from the various ARI TUFLOW models. BMT WBM has developed customised software to handle the large number of datasets and produce flood intelligence in the required formats.

3.4.3 - Climate Change Impact Assessment

A range of design events will be defined to model the potential impacts of future climatic change within the catchment. There are three outcomes of current climate change predictions which may have a significant impact of flood behaviour within the Wyong River catchment:

- Future sea-level rise (0.4m by 2050, and 0.9m by 2100);
- Increased extreme rainfall intensities (up to 30%)

These factors would be considered separately and in combination with each other for two future horizons, 2050 and 2100. The outcomes of these climate change considerations will help understand the potential changes in future flood behaviour and how to best plan for future development within the catchment. The design events

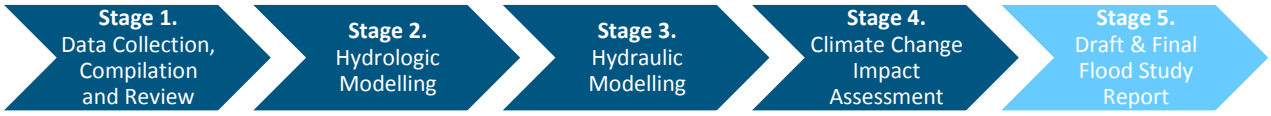
for which climate change impacts would be considered is the main planning event: the 1% AEP event.

Potential climate change may see an increase in the frequency and intensity of major rainfall events. Accordingly, increases in design rainfall intensity of up to 30% are being considered in floodplain management studies across NSW in accordance with OEH guidelines.

Additional model simulations incorporating increase in design rainfall intensities of 10%, 20% and 30% will be undertaken.

Deliverable - Stage 4 Interim Report

- Definition of Model Scenarios and Assumptions;
- Hazard Categories and Hydraulic Classification Maps;
- Presentation and Interpretation of Model Results; and
- Difference Mapping (where appropriate).



3.5 Stage 5 - Draft & Final Flood Study Report

The flood study will be documented in a concise report outlining study background, methodology, analysis and findings and will be e prepared generally in accordance with the NSW Government's Floodplain Development Manual.

The Draft Report will be prepared and presented to Council and the Floodplain Management Committee for comment. Following receipt of the comments from the Committee, the report will be modified as a Final Report.

3.5.1 Flood Mapping

The maps will identify the distribution across the study area of the key hydraulic parameters. All maps will be geographically referenced in the projection adopted for the study and will be provided in industry standard MapInfo and/or ArcGIS GIS formats. Maps can also be provided in DWG and other formats.

3.5.1.1 Inundation/Depth/Hazard Mapping

The visualisation of simulated model results is an important component in developing an understanding and appreciation of flooding conditions. The nature of the 2D modelling approach in simulating the spatial distribution of hydraulic parameters lends itself to the production of high quality flood mapping. This type of output is

more easily appreciated and understood by all stakeholders, and is considered a key study output. BMT WBM's experience in linking the TUFLOW models with GIS facilities will enable detailed and informative representation of model output.

The 2D modelling approach is amenable to analysis and presentation within a GIS framework. The spatial distribution of the simulated hydraulic characteristics can be efficiently generated with a high quality level of presentation. Typically the mapping will incorporate:

- flood levels and depths;
- flood velocities; and
- flood hazard and hydraulic categories.

A significant proportion of overland flow in highly urbanised areas is conveyed by the road system. This type of flow is typically shallow depth and high velocity. The on-set of vehicle instability in this type of flow condition happens at a low velocity-depth product (<0.4m^2/s). Consideration may need to be given to adjust the provisional hazard classification, such as that defined by Figure L2 of the NSW Floodplain Development Manual (2005), to separate a classification for roadways to reflect the higher risk to vehicular traffic.

The distribution across the study area of the key hydraulic parameters above represents standard outputs from the TUFLOW model. However, the GIS serves as a valuable tool in analysing design flood results and investigating alternative frameworks for assessing flood hazard and risk. This approach was considered as part of the recent Newcastle City-wide Flood Plan prepared by BMT WBM, and is illustrated in Figure 3-3 as an example.

3.5.2 Model Handover and Training

At completion of the project we will handover to Council all relevant project modelling files and associated data. This will include the collation of existing information and additional data acquisition undertaken for the project.

A ½ day training session will be provided to Council on completion of the project. This aim of this session is demonstrate to Council the model configuration, run parameters and key results of the assessment.

Deliverable - Stage 5 Reports

- Draft Report (3 copies)
- Final Report (6 copies)
- Electronic Data (DVD) (2 copies)

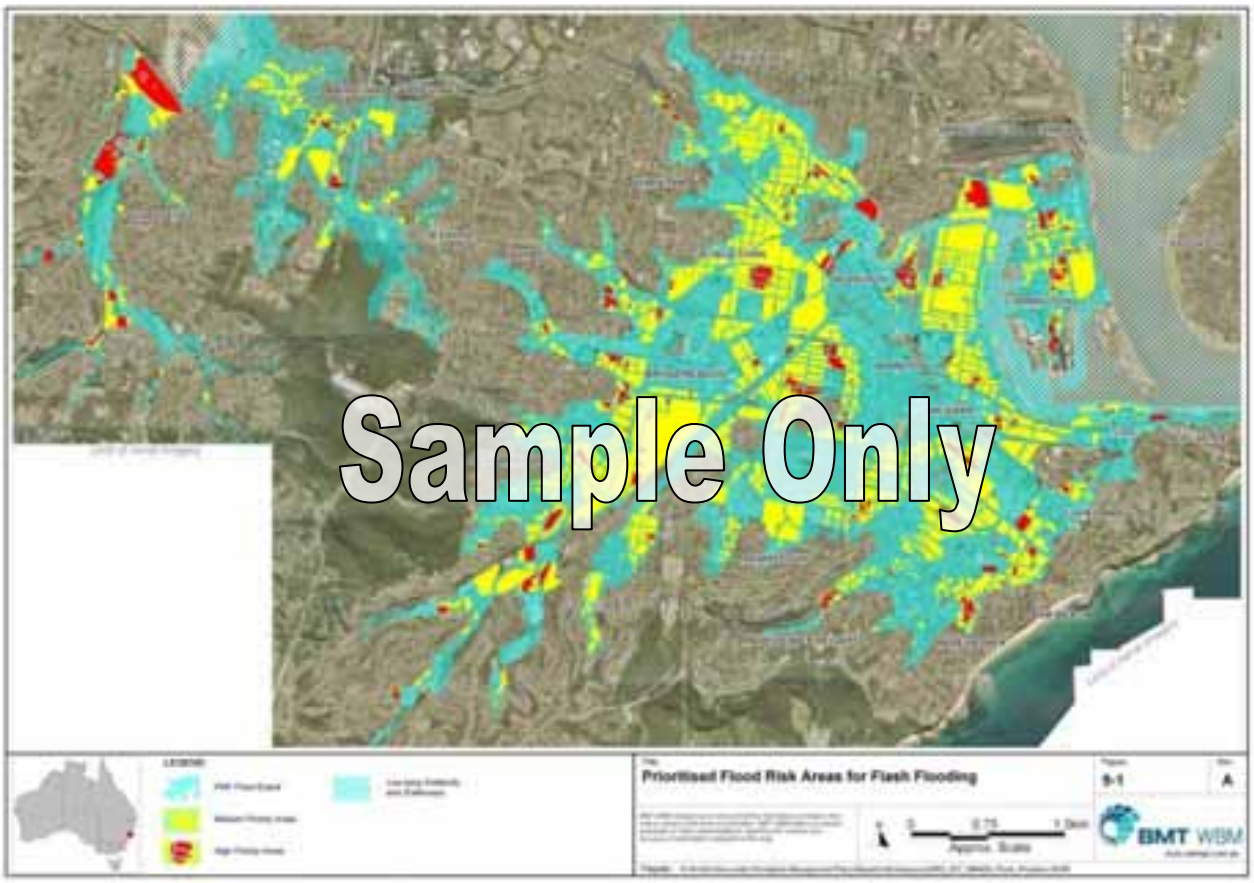


Figure 3-3 Sample Flood Risk Mapping

3.6 Project Management

3.6.1 Client Liaison and Reporting

Close liaison will be maintained throughout the study to ensure project timing, methodology and objectives are being achieved. BMT WBM's Project Manager, (Darren Lyons) will report regularly to Council's nominated representative (Kara Fleming).

3.6.2 Progress Planning and Reporting

Regular (quarterly) meetings will be held to discuss study progress. These discussions will include presentation of the following:

- an update of the study program, illustrating the completion status of each task;
- a list of tasks completed since the previous meeting; and
- an oral presentation summarising the investigations to date.

In addition, a tabulation of activities completed since the previous meeting and a plot of actual versus targeted progress will be provided.

The study program and fee estimate have allowed the following meetings during the study period:

- project inception meeting;
- quarterly progress meetings;
- three interim paper technical presentations to the Councils and DECCW;
- Attendance at four committee meetings; and
- Four additional one-off meetings with Council.

3.6.3 Quality Assurance and Internal Peer Reviews

BMT WBM Pty Ltd has full third-party Quality Assurance accreditation to AS/NZS ISO 9001:2001. Quality Assurance certificates are presented in Appendix C.

Our Quality Assurance system will be supplied to ensure:

- project management is organised, resource allocation is well managed and task deadlines are met; and
- technical investigations yield quality products designed and suited to meet the project's objectives.

We have full third-party Quality Assurance accreditation

A project control document will be drawn up, developed during the course of the Study and used by all Study Team members. The document will outline project specific standards for naming of computer files, "read-me" file locations, file management, etc so that work progresses in an orderly and functional manner between team members, and importantly, the Study files are easily accessed and understood during Quality Assurance reviews or when the files are retrieved at a later date. The client can view the control document at any time.

BMT WBM's Quality Policy is provided in Appendix E.

BMT WBM operates an electronic intranet-based Business Management System (BMS). This BMS replaces WBM's previous paper-based Quality Assurance systems, and is accredited to ISO9001:2000. The objectives of the BMS are:

- To ensure that WBM meets the requirements of ISO 9001: 2000;
- To improve the organisation and access to information on company operational and management matters; and
- To meet the flexible needs of each office and business unit.

In addition, periodic internal quality assurance and peer reviews of study findings will be conducted by Mick Turnley.

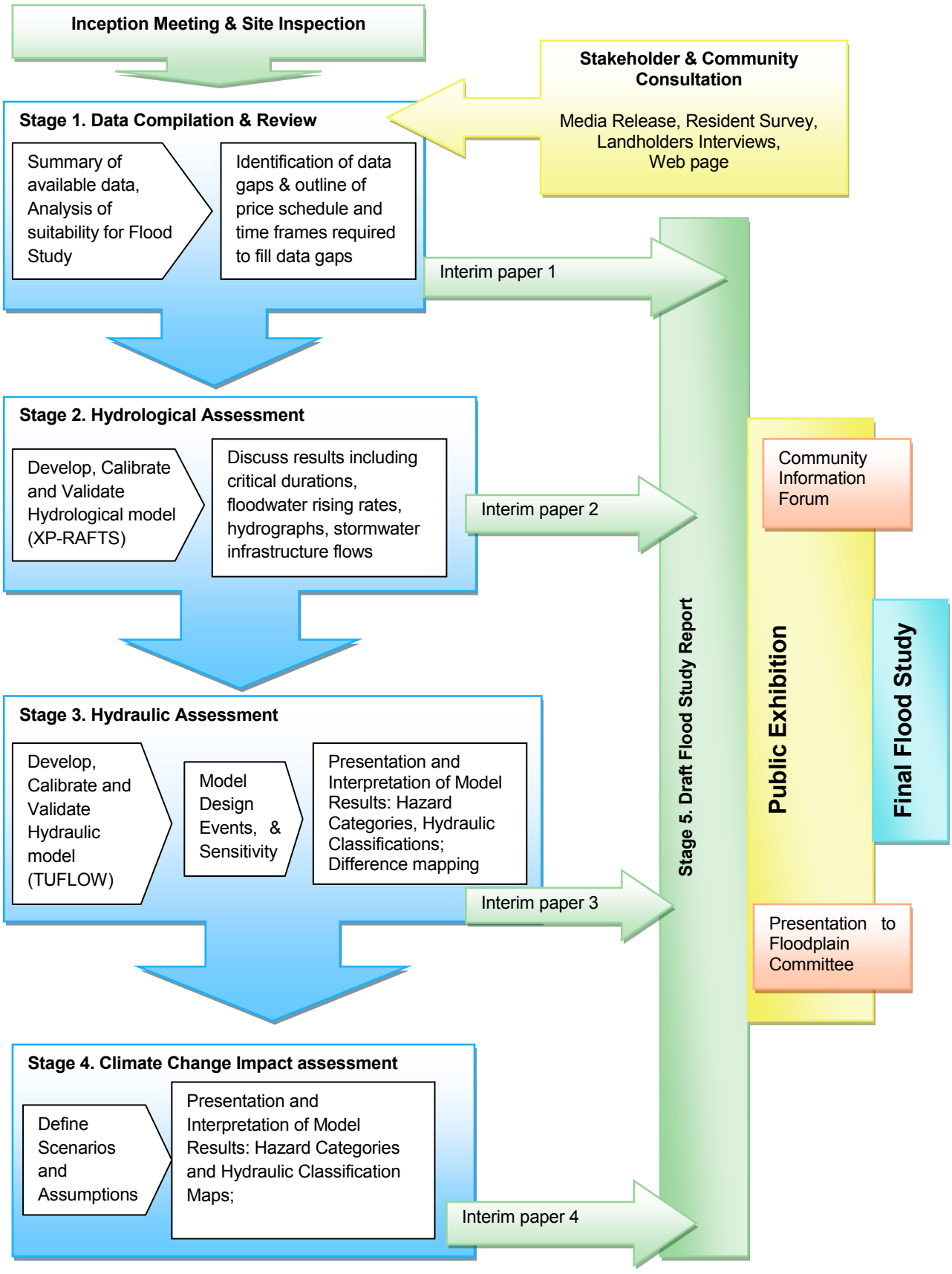


Figure 3-4 Project Work Breakdown Structure

4 STUDY TEAM

4.1 Company Background

The Water and Environment group of BMT WBM and is one of Australia's largest and most experienced environmental consultants.

BMT WBM is one of Australia's largest specialised water and environmental consultancies

BMT WBM commenced operations in 1969 and has carried out environmental investigations since 1972. Of a total staff of 150, 65 members are professionals working full-time on environmental studies. Our personnel include engineers, environmental scientists, and terrestrial and aquatic ecologists.

The firm's head office is in Brisbane. A fully owned subsidiary, BMT WBM Inc. is located in Denver, Colorado, and branch offices in Australia are located in Newcastle, Sydney, Melbourne, Mackay and Perth.

4.2 Personnel and Responsibilities

We propose to carry out the study using the following personnel. The study team has been selected on the basis of their sound knowledge and practical experience in undertaking such studies, together with their project management skills, which are essential to the study, is efficiently and successfully completed.

We offer an in-house, multi-disciplinary and experienced study team

Study Team Members

Darren Lyons (Project Manager) – Darren is the Manager of BMT WBM's Water and Environment Group in Newcastle with over 15 years experience in hydraulic modelling. As Project Manager, he will be responsible for the overall delivery of the project and the day-to-day management of project tasks, including client liaison. Darren will also be responsible for strategic development of the models. He has undertaken and managed numerous flood studies, including recent flood studies for LT Creek, Bomaderry Creek, Tabourie Lake and Wollombi Brook and overland flow studies in Liverpool, Kogarah, Port Stephens and Dungog.

Daniel Williams (Project Engineer) – Daniel will undertake a number of the model development tasks. In addition to his flood modelling experience, Daniel Williams has specialist expertise in GIS and mapping systems and will be responsible for the flood mapping production. Daniel has recently completed overland flow studies for six catchments in Liverpool and Raymond Terrace and prepared an extensive flood risk mapping series for the Newcastle Floodplain Risk Management Study (Stage 1), Bomaderry Creek Flood Study and LT Creek Flood Study.

Joshua Eggleton (Project Engineer) – Josh will undertake a number of the model development tasks, supporting Darren and Daniel. Josh has recently completed flood studies for Wollongong City Council (Duck Creek) and Dungog Shire Council (Clarence Town) and is currently undertaking the Manly Lagoon and Narrabeen Lagoon flood studies.

The proposed study team structure is illustrated in Figure 4-1. Curricula Vitae for the proposed study team members are presented in **Appendix B**. Brief summaries of the experience of these personnel are also listed hereafter.

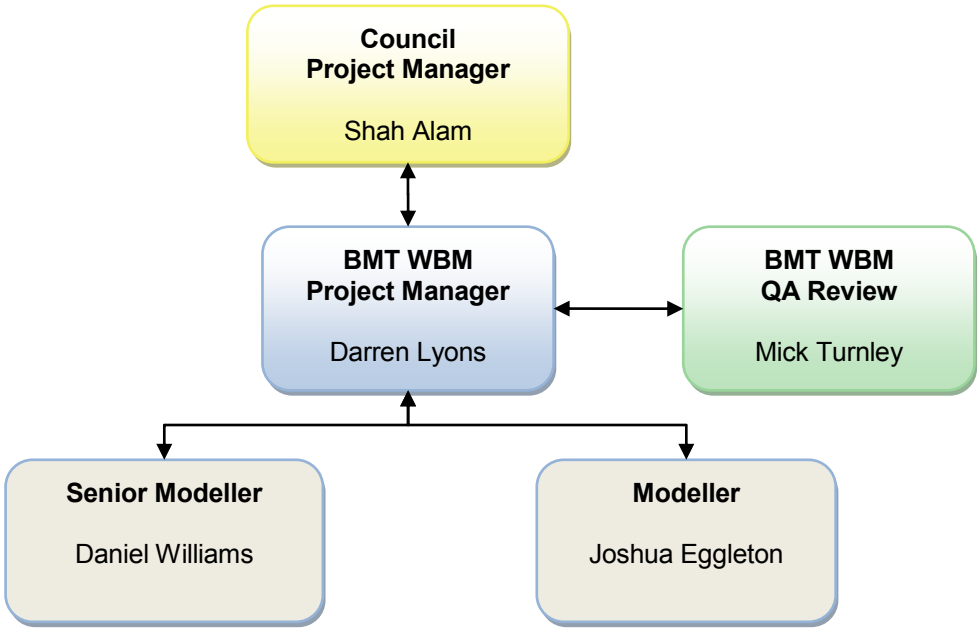


Figure 4-1 Study Team Structure

Darren Lyons

Darren Lyons is the Manager of the Newcastle Water & Environment Group and Flood Discipline Leader. Darren has a specialised background in both the development and application of numerical models for hydraulic, water quality and sediment transport studies.

As a cadet engineer and graduate with the NSW Dept of Land & Water Conservation Floodplain Management Unit, Darren's background is in flood investigations and management and has developed considerable expertise in numerical modelling. With six years experience with UK based international consulting firm Mott MacDonald, Darren has had key involvement in a range of water resources projects from morphological studies on the Nile River to thermal pollution studies in the Middle East, and the design of flood defences in the Scottish Highlands. Darren also has a number of years of urban flooding and drainage assessment and design experience with Connell Wagner.

Darren's broad experience in the water resources field has had at its core flood study applications. This includes both major rural and urban catchment studies, design and assessment of flooding components for major transport infrastructure and flood

impact assessment of urban developments. Recently completed and current projects include Anzac Creek Floodplain Risk Management Study, LT Creek Flood Study, Bomaderry Creek Flood Study and Wollombi Village Floodplain Risk Management Study.

Darren is in his final year of PhD studies being undertaken through the University of Surrey (UK) involving the development of a three-dimensional hydraulic model and turbulence modelling techniques for hydrodynamic applications.

Daniel Williams

Daniel Williams is a GIS officer / flood modeller with BMT WBM in their Newcastle office. Daniel has a BSc (Hons) degree in GIS and Environmental Science & Technology from Aston University (UK).

Daniel has more than five years experience working on a variety of flood management related studies, predominantly in the UK for engineering consultants Mott MacDonald, before joining BMT WBM in October 2008. During this time he undertook a number of 1D and 2D flood modelling studies using the ISIS, MIKE11 and TUFLOW packages. Daniel has experience in fluvial, tidal and urban flood studies, incorporating both the impact of climate change scenarios and potential flood mitigation measures.

During his academic and professional career Daniel has developed a wide range of GIS skills, particularly in the fields of environmental and water resource management. He has experience in the management, analysis and modelling of spatial data within a variety of GIS systems, including ArcGIS, IDRISI, MapInfo, GRASS and SAGA. He has provided ArcGIS technical expertise and training for the Water and Environment division of Mott MacDonald, supporting a wide range of engineering, environmental and water resource management studies.

Joshua Eggleton

Joshua has recently been awarded a bachelor degree in Environmental Engineering (with first class honors) through the University of Newcastle in 2009. During his time at University, Joshua gained valuable experience with a range of engineering and modeling software including FORTRAN, MATLAB, KINDOG, WUFS, MUSIC and MapInfo. Joshua completed a major project in his final year investigating in-stream sediment dynamics and their effect on steam habitat maintenance and formation.

Since joining BMT WBM in June 2009, Joshua has worked on a variety of projects including flood studies and environmental investigations. Joshua has gained skills in numerical modeling packages regularly used by BMT WBM such as TUFLOW, SMS, GMS, XP-RAFTS, CatchmentSIM, ELCOM, WBNM and MEDLI. Joshua has further developed skills in data analysis and interpretation using GIS packages including MapInfo and Vertical Mapper,

Joshua recent project activities include the development of hydrological and hydraulic models for a range of flood studies, including Clarence Town (Dungog Shire Council) and Duck Creek (Wollongong City Council).

4.3 Study Team Referees

Other clients who study team members have worked for previously who can attest to the dedication and technical expertise of BMT WBM in studies of this nature are provided below.

Referees will attest to the quality, value and dedication of BMT WBM

- David Gibbins, Newcastle City Council, 4974 2888
- Debbi Millener, Warringah Council, 9942 2381
- Greg Jones, Lake Macquarie City Council, 4921 0406
- Peter Jennings, Cessnock City Council, 4993 4119

5 RELEVANT EXPERIENCE

BMT WBM has recently undertaken a number of projects that illustrate the depth of experience and technical knowledge that we bring to this study. **Appendix C** contains descriptions of a selection of recent relevant projects that have been completed by BMT WBM personnel. Figure 5-1 lists the projects in the appendix. An extensive list of other relevant projects can also be provided on request.

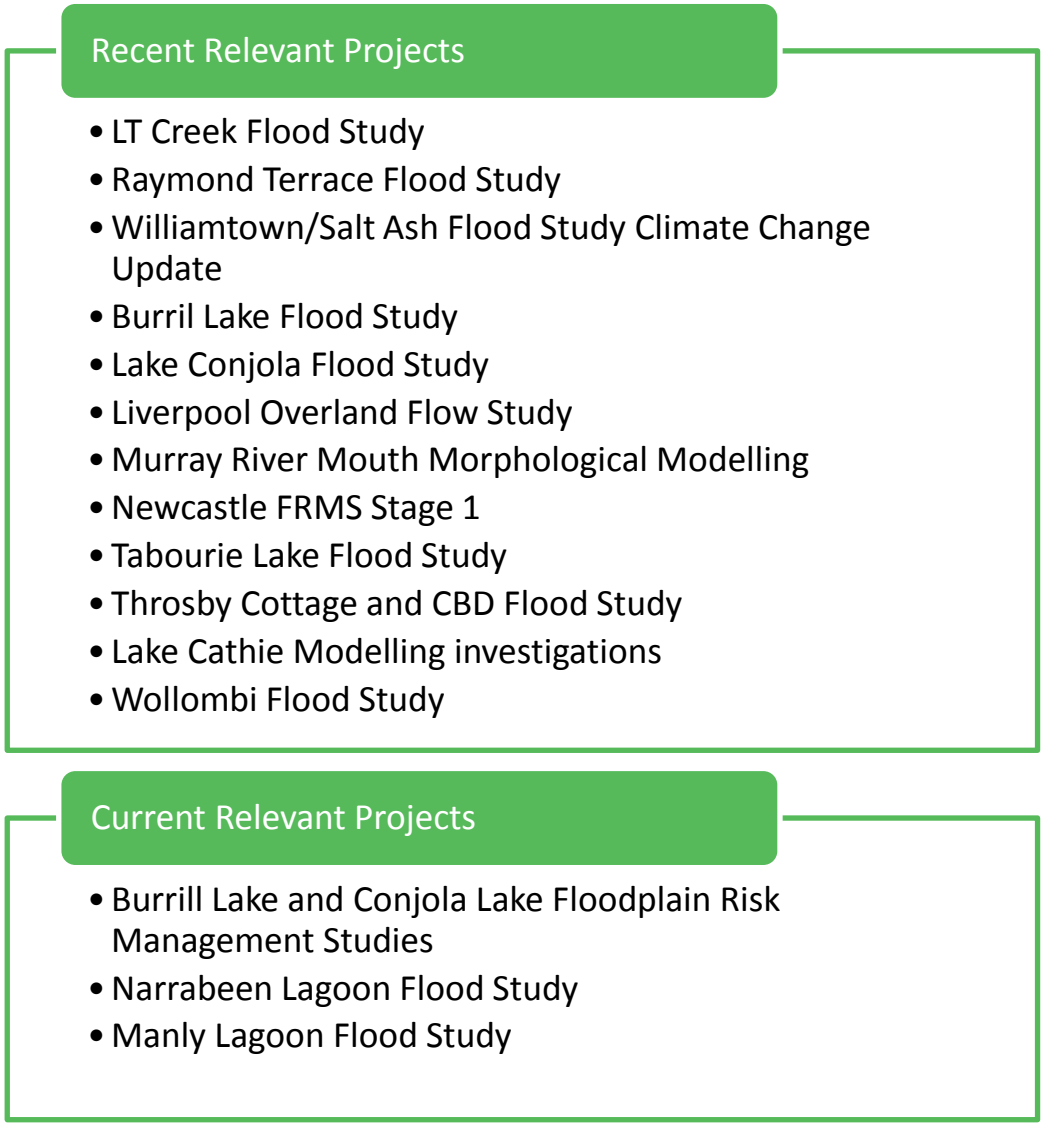


Figure 5-1 List of Recent and Current Relevant Projects

6 WORK PROGRAM

The project is proposed to be carried out in accordance with the work program shown in Figure 6-1. Sufficient project resources have been allocated to the study to ensure completion in accordance with the schedule outline in the study brief. The study work program will be constantly reviewed to ensure that we are achieving progressive study deadlines. It is anticipated this is a maximum realistic program, with opportunity for streamlining and hence earlier delivery of project stages.

Our Quality Assurance system requires the Project Manager to keep track of project tasks and resource allocation to ensure deadlines are met and the client is kept up to date with progress.

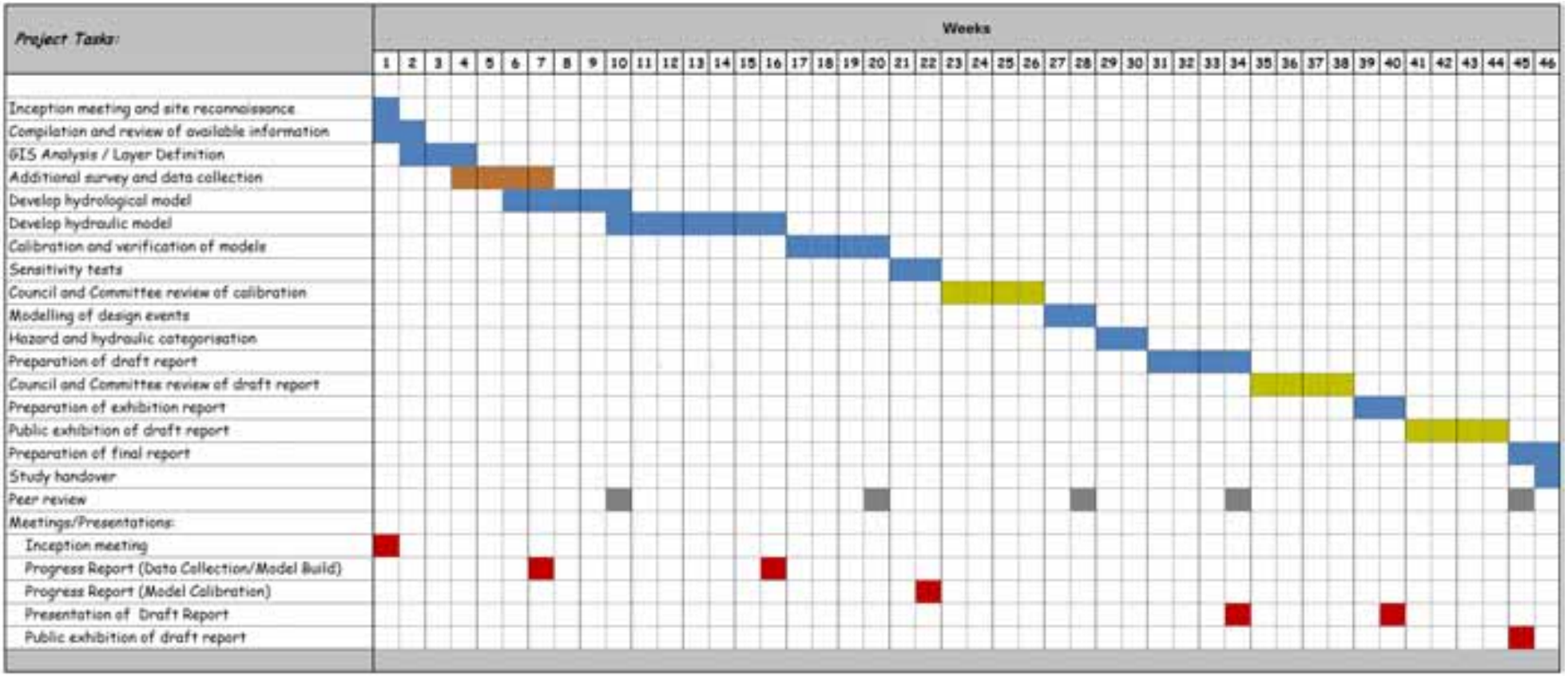


Figure 6-1 Study Work Program

7 STUDY FEE ESTIMATE

We propose to undertake the study for a fee of $156,260 (excl. GST). Our breakdown of this fee into the respective study components identified in the project brief is provided below.

Our fee estimate is realistic and excellent value for money

The above estimates are valid for a period of 30 days. The above costs are based on the current known scope of works. Any increase in scope of works may incur additional costs.

Table 7-1 Lump Sum Fee Schedule

WYONG RIVER FLOOD STUDY FEE PROPOSAL	Estimated Hours by each Team Member			Total	TOTAL
	DL	DWJE	MT	Hours	COST
Stage 1 – Data Collection, Assessment and Community Consultation					
1.1) Data collection and review	2	24		26	$ 4,060
1.2) Site inspection(s)	4	12		16	$ 2,720
1.3) Survey (including cost of preparing and managing survey (brief) Note (1)	4	12		16	$ 2,720
1.4) Community Consultation – Prepare , distribute brochures, questionnaires etc and process, analyse of returned surveys including preparation of summary report	8	32		40	$ 6,640
1.5) Prepare and present progress report for Stage 1	2	16		18	$ 2,860
Sub Total				***116***	***$ 19,000***
Stage 2 – Model Calibration and Validation					
2.1) Hydrology					
2.1.1)Flood Frequency Analysis	2	24		26	$ 4,060
2.1.2) Establish Hydrologic Model(s)	2	32		34	$ 5,260
2.1.3) Calibrate/Validate Hydrologic Model(s)	2	24	2	28	$ 4,520
2.1.4) Develop design hydrographs		16		16	$ 2,400
2.1.5 Prepare and present progress report for Hydrological model	8	30		38	$ 6,340
2.2) Hydraulics					
2.2.1) Establish Hydraulic Model(s)	16	200	4	220	$ 34,600
2.2.2) Calibrate/Validate Hydraulic Model(s)	8	80	2	90	$ 14,300
2.2.3) Prepare and present progress report for Hydraulic model	8	40	2	50	$ 8,300
Sub Total				***502***	***$ 79,780***
Stage 3 – Modelling and Mapping					
3.1) Model Design Flood Events	2	40		42	$ 6,460
3.2) Determining and Mapping Hydraulic and Hazard Categories	4	16		20	$ 3,320
3.3) Sensitivity Analyses including Climate Change	2	16		18	$ 2,860
3.4) Sensitivity Analysis for culvert Blockage (15nos)	4	40		44	$ 6,920
3.5) Determining and Mapping Preliminary Residential Flood Planning Areas for existing, 2050 and 2100 scenarios	2	8		10	$ 1,660
3.6) Prepare and present progress report for Stage 3	8	24		32	$ 5,440
Sub Total				***166***	***$ 26,660***
Stage 4 – Draft Flood Study Report					
4.1) Prepare and present draft Flood Study Report	16	30	4	50	$ 9,100
Sub Total				***50***	***$ 9,100***
Stage 5 – Final Flood Study Report					
5.1) Collate and review all comments/submissions regarding the draft Flood Study report	2	16		18	$ 2,860
5.2) Prepare Final Report (including all printing)	2	8		10	$ 1,660
Sub Total				***28***	***$ 4,520***
Stage 6 – Completion of Contract					
6.1) Handover of all study materials	2	12		14	$ 2,260
Sub Total				***14***	***$ 2,260***
Disbursements (to be itemised)					
1) Meetings (7 total) including preparation, attendance and presentations	48	16		64	$ 13,440
2) Travel and subsistence					$ 1,500
Sub Total				***64***	***$ 14,940***
11 - GST Allowance					
Sub Total					***$ 15,626***
TOTAL COST OF PROPOSAL				**940**	**$171,886**
ADDITIONAL COSTS (not included in TOTAL COST)					
A1) Additional meetings at Wyong Shire Council Offices (cost per meeting)					$ 2,200
A2) Re-familiarising with suspended project (see Part B, Section B3.8)					$ 500
A3) Itemised cost of work NOT detailed in this brief. Estimates only - not included in total cost of proposal					
A4) additional hydraulic model runs for one events excluding PMF					$ 1,500
A4) additional hydraulic model runs for six events excluding PMF					$ 6,000

Notes:
(1) - Cost does not include survey, only preparation of survey brief and management. Scope of works for the survey can only be confirmed following review of available information and detailed site inspections. BMT WBM would seek proposals from 3 independent survey

The following schedule of rates will apply work beyond the identified scope.

Table 7-2 Schedule of Rates

Title / Role	Hourly Rate $ (excl GST)
Project Manager - Darren Lyons	230
QA / Peer Reviewer – Mick Turnley	230
Senior Modeller – Daniel Williams	175
Modeller – Joshua Eggleton	125

APPENDIX A: TENDER SCHEDULES

Wyong Shire Council

Attachment 1: Returnable Forms and Schedules

Title: Wyong River Catchment Flood Study

No: CPA/205510

Enquiries regarding this Request for Tenders should be directed to the Contact Officer.

Shah Alam

Phone: (02)4350 5710

Email: shah.alam@wyong.nsw.gov.au

Tenders must be submitted by the Closing Time.

Closing Time: 2pm on Thursday, 19 January 2012

1: TENDER FORM

Name(s) of person, partners or company proposing:	BMT WBM Pty Ltd
A.C.N.	010 830 421
A.B.N.	54 010 830 421
Address: of	126 Belford Street BROADMEADOW NSW 2292
Name of Contact Person:	Mr Darren Lyons
Phone Number:	02 4940 8882
Facsimile Number:	02 4940 8887
Email address:	Darren.Lyons@bmtwbm.com.au
	hereby offers to perform the Professional Services detailed in The Brief for the Fee of:
The Total Fee (Excluding GST)	$156,260

The Tenderer nominates the following person the „Contractor's Representative'.

Name	Position	Contact Details
Darren Lyons	Manager	02 49408882

In submitting this Tender the Tenderer declares that it has complied with and will continue to be bound by the requirements set out in:

* the Statement of Business Ethics for Tenderers and Contractors; and
* *Section 2: Conditions of Tender* of the Request for Tender.

2: COMPLIANCE AND DEPARTURES

The Tender complies with the Request for Tender in every respect, except as detailed below.

Departures or Qualifications: Type "NIL" here if there are no departures or qualifications. **==>>**	NIL

Reference to Section(s) in Request for Tender document or its Attachments.	**Details**

Alternatives Type "NIL" here if there are no alternatives proposed. **==>>**	NIL

Reference to Section(s) in Request for Tender document or its Attachments.	**Details**

3: RECEIPT OF ADDENDA

The following Addenda have been received by the Tenderer. The Tenderer acknowledges that the Tender allows for all instructions, clarifications and/or alterations detailed in each Addendum.

Addendum Number	Subject/Title	Date of Addendum	Date Received

4: EXPERIENCE AND REFEREES

Listed below are several of the Tenderer's recent contracts of a similar nature to the works required by Council.

Client	Contract Value	Contract Period	Brief Description of Work
Greg D Jones Lake Macquarie City Council	$70,000	12months	LT Creek Flood Study
Peter Jennings Cessnock City Council	$120,000	24 months	Wollombi Village Flood Study and Floodplain Risk Management Study
Deborah Millener Warringah Council	$300,000	18 months (current)	Manly Lagoon and Narrabeen Lagoon Flood Studies
Durgananda Chaudhary Griffith City Council	$120,000	12 months	Lake Wyangan Flood Study

Listed below are three Referees who may be approached to establish that the Tenderer has, in the recent past, satisfactorily executed works of a similar nature to Council's requirements.

Client	Name of Referee Contact	Phone Number
Newcastle City Council	David Gibbins	4974 2888
Lake Macquarie City Council	Greg D Jones	4921 0406
Warringah Council	Deborah Millener	9942 2381

5: O.H.S. & R. CAPABILITY

OHS&R Capability: Table 1 This table is to be completed by ALL Tenderers.	
Question	Response
Does the Tenderer have a documented corporate management system in place to address OHS&R issues?	YES
Is the system certified?	YES
If "YES", to what standard and by who is the system certified?	OHSAS 18001:2007 AS/NZS 4801:2001 Compliance Australia Certification Services
What is/are name, title, qualifications, experience and phone number of the senior officer who would be responsible for OHS&R management for these works?	Darren Lyons Newcastle Water & Environment Manager B.E. (17 years experience) ph: 4940 8882 Jim Callow Corporate Safety Officer ph: 07 3831 6744
Does the Tenderer fully appreciate and intend to perform its duties under the NSW Occupational Health and Safety Act?	YES
If appointed as the „Principal Contractor', is the Tenderer able to properly develop and implement any „Site Safety Plans' relevant to the works under this Contract?	YES

OHS&R Capability: Table 2 This table is to be completed by Tenderers that do NOT have a certified or accredited system.	
Does the Tenderer have a documented and regularly reviewed Health and Safety Policy? Attach a copy of the Policy.	
Does the Tenderer have a documented OH&S Management System, Manual or Plan? Attach copy of contents page(s).	
Are OH&S responsibilities clearly identified and documented for all levels of staff?	
Does the Tenderer have safe work method statements or specific safety instructions relevant to its operations? Attach a summary listing and an example.	
Does the Tenderer have permit to work systems? Attach a summary listing and sample permit/s.	
Does the Tenderer have a documented incident investigation procedure? Attach the contents page, a completed incident report and a completed incident investigation.	
Does the Tenderer have procedures for maintaining, inspecting and assessing the hazards of plant it operates or owns? Attach contents page or other evidence.	
Does the Tenderer have procedures for storing and handling hazardous substances? Attach contents page or other evidence.	
Does the Tenderer have procedures for identifying, assessing and controlling risks associated with manual handling? Attach contents page or other evidence	
Does your company have procedures for identifying and meeting the OH&S training needs of its personnel? Attach contents page or other evidence	
Does the Tenderer undertake regular health and safety inspections at its work sites? Attach a sample completed inspection report.	
Is there a procedure for employee reporting of hazards in the workplace? Attach a completed hazard report.	
Does the Tenderer have workplace OH&S committees? Attach evidence	
Does the Tenderer have documented procedures for employee consultation on OH&S matters? Attach contents page or other evidence.	
Does the Tenderer have a system for managing health and safety statistics?	
Are employees regularly provided with information on company health and safety performance? Attach a copy of a sample report.	
Has the Tenderer ever been convicted of an OH&S offence? If yes attach details:	
Does the Tenderer have documented procedures for the management of incidents? Attach contents page or other evidence	

6: HAZARD CONTROL MEASURES

The Tenderer, having conducted a hazard assessment, anticipates employing the following control measures to manage safety hazards and environmental hazards over the life of the contract. The hazards addressed in this Schedule include all hazards identified by Wyong Shire Council, as well as all additional hazards identified by the Tenderer.

Hazard	Control Measures (Eg. Reference to particular Work Method Statements or management system components)
Refer attachment after pg 13	

7: LOCAL PREFERENCE POLICY - LOCAL CONTENT SCHEDULE

In accordance with Council's "Local Preference Policy – Procurement", to enable Council to assess the level of Local Content (as defined in Clause C.2 of the "Local Preference Policy – Procurement") contained in tenders, tenderers are required to detail in this Schedule the components of work, and their value, that will be sourced from businesses, persons or enterprises that have Physical Presence in their operations on the NSW Central Coast (as defined in Clause C.4 of the "Local Preference Policy – Procurement"). Details of proposed NSW Central Coast based subcontractors and suppliers are to be provided, as are details for the tenderers themselves, should they too have operations on the NSW Central Coast. Details should be sufficiently specific to allow Council to make its own checks and inquiries.

This Schedule shall form part of the Contract.

Tenderers are advised to familiarise themselves with Council's Local Preference Policy - Procurement. The Policy is viewable via the internet at:

https://tenders.nsw.gov.au/wyong/?event=public.policydocs.list

Name of Tenderer, Subcontractor & Suppliers Meeting Local Content Requirements	Value of Goods, Works or Services Within Tendered Amount (ex GST)	Component of the Works	Address of NSW Central Coast Operations	Contact Person & Phone Number
Total Value (ex GST)	**$**			

8: ANTICIPATED SUB-CONTRACTING PROPOSALS

Other than subcontractors detailed in Schedule 7, the Tenderer anticipates seeking approval to sub-contract the following work.

This Schedule is required for evaluation purposes, however it is provided for general information only and shall not form part of the contract.

Component of the Works.	Value of the Component.	Name of Subcontractor [Optional]
Additional Ground Survey	Unknown ($10K - $30K?)	

9: KEY PERSONNEL TO WORK ON THIS ENGAGEMENT

The Tenderer nominates the following personnel to conduct the work on this engagement.

To assist in valuing any variations that may be approved under the contract, Tenderers are to insert an hourly rate for each member of the nominated personnel.

Name	**Position**	**Type of Work**	**Estimated Time Input** (Hours)	**Hourly Rate (Excluding GST)**
Darren Lyons	Newcastle Water & Environment Manager	Project Manager, Strategic Model Development and Review	158	230
Daniel Williams	Senior Flood Modeller	Model development, mapping and reporting	384	175
Joshua Eggleton	Flood Modeller	Model development, mapping and reporting	384	125
Mick Turnley	Mangager, Hydraulics Victoria	QA/Review	14	230

10: ADDITIONAL DOCUMENTS TO BE SUBMITTED

The Tenderer is required to submit the following documents, along with these forms and schedules.

Documents Required	Document/s to form part of contract.	Document/s submitted. *(Tender to indicate "Yes" or "No" for each document.)*
A preliminary program of works showing times within which significant activities of the work will be executed, key milestones, task dependencies, the critical path, and external dependencies such as site access, drawing approvals and materials supply. The programme shall make due allowance for industry roster days, annual and public holidays. The program shall indicate the dependencies of individual items to each other and the Critical Path.	Yes	YES
A copy (if available) of accreditation certificates or letters of compliance relating to the Tenderer's safety management system, environmental management system and quality management system.	Yes	YES
Copies of certificates evidencing the currency of any general insurance (i.e. not one-time project specific insurances) required under the conditions of contract.	Yes	YES

11: THE FEE

The Tenderer will be required to complete the Attachment A – Hourly Rate & Attachment B- Cost schedule of the Flood Study Brief.

No.	Deliverable	Fee Excluding GST	GST	Fee Including GST
1	Wyong River Flood Study	$156,260	$15,626	$171,886
Totals >>		$156,260	$15,626	$171,886

BMT WBM Pty Ltd
Level 11, 490 Upper Edward St
Brisbane 4000
Queensland Australia
PO Box 203 Spring Hill 4004
Tel: +61 7 3831 6744
Fax: + 61 7 3832 3627
ABN 54 010 830 421
www.wbmpl.com.au

RISK ASSESSMENT – SITE VISITS

Project specific details			
Prepared by	**DJL**	**Job Name and Number**	**Wyong N2273**
Approved by	**DJL**	**Date**	**19/01/12**
Revisions			
Date	**Amended by**	**Details**	

This risk assessment does not cover every potential job step and associated hazards. Before completing a task, each individual has a responsibility to review the relevant risk assessment and add to it as necessary. If on-site procedures are more stringent than BMT WBM procedures, or have additional requirements, employees are to follow on-site procedures.

Hazard Checklist- SITE VISITS
The following checklist of hazards and other items should be considered when planning site visits:

Task related factors
- ☐ Interaction with other vehicles
- ☐ Generic/site specific induction
- ☐ Sufficiently trained personnel
- ☐ Noise
- ☐ Vibration
- ☐ Power tools
- ☐ Chemicals
- ☐ Pinching
- ☐ Cuts/abrasions
- ☐ Entanglement
- ☐ Entrapment
- ☐ Crushing

Site specific
- ☐ Hazardous/Dangerous goods storage, segregation, labelling and signage
- ☐ Blasting
- ☐ Heavy vehicles
- ☐ Water
- ☐ Ground instability
- ☐ Dust
- ☐ Isolation
- ☐ Dangerous animals
- ☐ Threats from people

Manual Handling
- ☐ Access to frequently used items
- ☐ Storage of heavy items
- ☐ Access to high shelves
- ☐ Trolley for heavy items
- ☐ Repetitive, sustained or awkward movement or posture

First Aid
- ☐ First aid kit in vehicle and at shed readily accessible and fully stocked
- ☐ Any additional items required?

Personal Items
- ☐ Sun hat
- ☐ Sunglasses
- ☐ Sunscreen
- ☐ Sufficient water
- ☐ Warm clothing
- ☐ Adequate exposure protection
- ☐ Appropriate footwear
- ☐ Appropriate tools

Pre & Post Task Factors
- ☐ Fitness
- ☐ Fatigue
- ☐ Dehydration
- ☐ Drugs/alcohol
- ☐ Exercise
- ☐ Sleep deprivation

Personal
- ☐ Mental stress
- ☐ Medical conditions
- ☐ Medication causing drowsiness
- ☐ Allergies
- ☐ Physical limitations
- ☐ Personal security and safety

Communication
- ☐ With co-workers
- ☐ Training and experience
- ☐ Emergency procedures
- ☐ Preparedness

General Information
- ☐ Air temperature
- ☐ Time of day
- ☐ Contaminants/ biological hazards
- ☐ Isolation

Emergency Response Factors
- ☐ Location/availability of medical facilities
- ☐ Emergency response/evacuation plan
- ☐ Communications
- ☐ Location of embassy/consulate

Fire and Explosion
- ☐ Flammable substances
- ☐ Combustibles
- ☐ Explosives
- ☐ Extinguisher
- ☐ Power leads
- ☐ Faulty equipment

Thermal hazards
- ☐ Hypothermia
- ☐ Hyperthermia
- ☐ Heatstroke
- ☐ Heat exhaustion
- ☐ Burns

Other (specify)
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐

Activity	Potential Hazards	Prior to Control Measures			Control Measures	After Control Measures		
		Consequence	Likelihood	Risk Level		Consequence	Likelihood	Residual Risk
Travel to and from site	Vehicle collision, crash, injury, explosion, pedestrian collision	4	2	**6**	Refuel away from sources of ignition, manage fatigue, share driving, obey road rules and signage, drive to conditions, do not drive under the influence of drugs, alcohol or medication that causes drowsiness or impairs ability to drive safely, use a spotter if necessary. All drivers to be licensed and competent. Carry means of communication. Vehicles on mine sites to be mine site compliant	4	1	**5**
	Slips, trips and falls	2	3	**5**	Wear non slip, enclosed footwear, maintain 3 points of contact when entering or exiting vehicles or plant	2	2	**4**
	Encounter with violent person or animal	4	2	**6**	Travel with another person or group, carry a mobile phone, avoid displaying signs of wealth	4	1	**5**
Mine site visits	Dangerous interaction with other vehicles, equipment and plant	4	3	**8**	All employees to be inducted. Employees should not drive around a mine site unless familiar with the mine site and received authorisation. Obey all rules and signage, maintain contact via radio. Wear appropriate PPE, do not enter restricted areas	4	2	**6**
	Ground instability	4	1	**5**	Do not enter areas that are signed as subsidence, areas of slumping or climb windrows, disposal or rehabilitation areas, dam walls, reject or coal stockpiles or walk on tailings dams	4	1	**5**
	Noise, vibration and dust	3	2	**5**	When working near drilling operations or wash plants, use ear protection and limit exposure to vibration on wash plants and dusty environments and use a dust respirator where necessary.	3	1	**4**
	Fire, explosion and blasting	5	2	**7**	Obey site rules, do not enter signed blasting areas, be aware of location of fire fighting equipment, carry means of contact	5	1	**6**
Visits to isolated areas	Emergency situation	4	2	**5**	Use call in contact procedure, carry means of contact and emergency contact details	4	1	**5**
	Flora and fauna	3	3	**6**	Wear closed in shoes, carry a first aid kit and means of contact, avoid long grass, waterways that may contain crocs or other dangerous animals, carry any personal medication and communicate potential hazards to colleagues	3	2	**5**
Working outdoors	Exposure	2	3	**5**	Be prepared for change in weather, take warm and waterproof clothing, sufficient water and food, wear sun protection and avoid working in the sun during the heat of	2	2	**4**

Activity	Potential Hazards	Prior to Control Measures			Control Measures	After Control Measures		
		Consequence	Likelihood	Risk Level		Consequence	Likelihood	Residual Risk
					the day in warm climates			
	Extreme weather events	3	2	**5**	Assess likelihood of flooding. Consider tides if working in or around tidally influenced areas. Research destination before departure to ensure adequate preparation of gear and clothing. Take adequate gear and clothing in case of extreme weather, check weather forecasts and warnings prior to departure	3	1	**4**
	Dehydration	1	3	**4**	Carry and consume sufficient water, avoid overexertion in hot conditions, avoid caffeinated beverages and alcohol, stay in cool shady areas where possible	1	2	**3**
	Allergic reaction	3	2	**5**	Carry medication or EpiPen if allergic to environmental factors, inform colleague of what to do in the case of a severe allergic reaction, carry means of contact	3	1	**4**

Score		TABLE OF CONSEQUENCE		
		People	Plant	Environment
5	Very High/ Catastrophic	Multiple Fatalities	> $10Million Loss	Catastrophe, destruction of sensitive environment, worldwide attention. Likely EPA prosecution. More than 30 days delay.
4	High/ Major	Fatality or Permanent Disabilities	$1- $10Million	Disaster, high levels of media attention, high cost of clean up. Offsite environmental harm, more than 10 days delay.
3	Moderate	Major Injuries - Incapacitations or requiring time of work	$100Thousand- $1Million	Major spills, onsite release, substantial environmental nuisance, more than 1day delay. (Leads to an additional resources call out i.e. SES)
2	Low/ Minor	Significant Injuries – Medical Treatments, non-permanent injury	$10- $100Thousand	Significant spills (leads to a call out of Site Emergency Response Group)
1	Very Low/ Insignificant	Minor Injuries – First Aid Treatments (cuts/bruises)	< $10Thousand	Low environmental impact. Minor Spills less than 80 Litres.

TABLE OF LIKELIHOOD		
Score		Likelihood
5	Almost certain	Likely to result from exposure to continuously occurring hazards
4	Likely/ probable	Likely to result from exposure to a frequently occurring hazardous activity, process or occurrence
3	Moderate/ occasional	Only likely to result from a little used process, activity or hazard occurrence
2	Remote/ unlikely	Only likely to result form a chain of unusual chain of events
1	Rare/ very unlikely	Only likely to result from a chain of extraordinary events leading to an incident

Risk= Consequence +Likelihood						
		Risk Rating				
Consequence	5	6	7	8	9	10
	4	5	6	7	8	9
	3	4	5	6	7	8
	2	3	4	5	6	7
	1	2	3	4	5	6
		1	2	3	4	5
		Likelihood				

Risk Rating	Definitions	Action Required
8-10	Intolerable	Task not to start till the risk is eliminated or reduced. Bring to the immediate attention of management. Formal assessment required. MUST reduce the risk as a matter of priority.
7	High	Bring to the immediate attention of management. Task not to start till the risk is eliminated or reduced. Further Assessment required. MUST reduce the risk as a matter of priority.
6	Significant Risk	Bring to the attention of supervision. Review risks and ensure that they are reduced to as low as reasonably practicable. To be dealt with as soon as possible, preferably before the task commences. Introduce some form of hardware to control risk.
5	Moderate Risk	Needs to be controlled but not necessarily immediately, an action plan to control the risk should be drawn up. Review effectiveness of controls. Ensure responsibilities for control are specified.
2-4	Low Risk	If practical reduce the risk. Ensure personnel are competent to do the task. Manage by routing procedure. Monitor for change

Main points on how to write a JHA.

1. Define the task; what is to be done.
2. Review previous JHA if any; have we done it before?
3. Identify the steps; what is to be done.
4. Identify the hazards of each step.
5. Identify who or what could be harmed.
6. Give the task a risk rating ; Consequence + Frequency
7. Develop solutions to eliminate or control hazards in each step.
8. Review the risk rating after the control system has been implemented.
9. If risk rating unacceptable review the solutions till risk rating acceptable.
10. Agree who will implement the control system.
11. Document the JHA and discuss with the relevant personnel.

Hierarchy of Hazard Management; Control Measures

These steps outline what should be planned for when deciding what control measures are to be put in place. Whenever possible the highest step should be used first and then progress down the list.

1. Eliminate the hazard.
2. Substitution.
3. Reducing the frequency of a hazardous task.
4. Enclosing the hazard.
5. Additional procedures.
6. Additional supervision.
7. Additional training.
8. Instructions / information.
9. Personal protective equipment.

APPENDIX B: CURRICULA VITAE

Darren Lyons

Position	Manager Water and Environment Group Newcastle
Years of Experience	17
Qualifications	Bachelor of Engineering Civil (1st Class Honours) University of Technology, Sydney (1996) PhD Candidate in Hydrodynamic Modelling University of Surrey, U.K.
Recent Employment Profile	2006 to Present BMT WBM Pty Ltd – *Manager Water and Environment Group, Senior Water Resources Engineer* 2005 to 2006 Connell Wagner Pty Ltd – *Senior Water Resources Engineer* 2001 to 2005 Mott MacDonald, Cambridge UK – *Water Resources Engineer and Senior Modeller*

Areas of Expertise

1, 2 & 3 Dimensional Hydraulic and Water Quality Modelling

Flood Studies and Floodplain Management

Flood Impact Assessments

River Engineering

Hydraulic/Geomorphic Assessments

Career Overview

Darren Lyons is the Manager of the Water and Environment Group in Newcastle. Darren has a specialised background in both the development and application of numerical models for hydraulic, water quality and sediment transport studies.

As a cadet engineer and graduate with the NSW Dept. of Land & Water Conservation Floodplain Management Unit, Darren's background is in flood investigations and management and has developed considerable expertise in numerical modelling. With six years experience with UK based consulting firm Mott MacDonald, Darren has had key involvement in a range of water resources projects including morphological studies on the Nile River, thermal pollution studies in the Middle East, and the design of flood defences in the Scottish Highlands.

Darren's broad experience in the water resources field has had at its core flood study applications, including both major rural and urban catchment studies, design and assessment of flooding components for major transport infrastructure and flood impact assessment of urban developments.

Specific Projects

Water Resources and Environmental Impact Studies
- Swansea Bridge Bed Scour Assessment (2007)
- Impact Assessment of Proposed Tombolo, Swansea Channel (2007)
- Port Phillip Bay Under Keel Clearance Study (2006)
- Port of Gladstone Regional RMA Model (2006)
- Ras Laffan Common Cooling Seawater System, Qatar (2005)
- Kestrel Recirculation Study, Dubai (2004)
- RNLI Life Boat Berth, Torness Point, Scotland (2004)
- Lake Victoria Environmental Management Project, Uganda (2001)
- Uzbekistan Drainage Project, Uzebkistan (1999)

Flood Studies and Floodplain Management
- Lake Wyangan Flood Study (2011)
- Duck Creek Flood Study (2011)
- Coogee Flood Study (2011)
- Clarence Town Flood Study (2011)
- Raymond Terrace Flood Study (2010)
- LT Creek Flood Study (2008-2009)
- Wollombi Flood Model Upgrade and Floodplain Management Study (2008-2009)
- Moore Reserve Overland Flow Study (2008-2009)
- Bomaderry Creek Flood Study (2008-2009)
- Anzac Creek Floodplain Management Study (2008)
- Liverpool Overland Flows Study – Stages 2 and 3 (2007-2009)
- Inverness Flood Defences, UK (2004)
- SMART Tunnel, Kuala Lumpur, Malaysia (2004)
- Lymm Dam Dambreak Analysis, UK (2003)

Flood Impact Assessments
- Northbank Enterprise Hub Tomago Flood Impact Assessment (2010)
- Pacific Highway Upgrade – F3 to Heatherbrae Flood Impact Assessment (2009)
- Williamtown Industrial Development Flood Assessment (2009)
- Medowie Structure Plan Flooding Assessment (2007)
- Airport Link Brisbane (2006)
- Pioneer Lakes Drainage Study, Mirani (2006)
- Barron River Flood Assessments, Cairns (2005)
- Kidbrooke Redevelopment, UK (2004)

River Engineering and River Management
- Assiut Barrage Rehabilitation, River Nile, Egypt (2003-2005)
- Banff Bridge Stability, UK (2005)
- Bridge 106 Sellafield Scour Assessment, UK (2004)
- Inchgarth Reservoir Stability Assessment, Aberdeen UK (1999)
- Spillway Capacity analysis of Washburn Valley Reservoirs UK (1998)
- Manager Tumut and Upper Murray River works Programs (1997-1998)
- Hydraulic-Geomorphic Assessment of the Cockburn River, Tamworth (1996)

Key Publications/Presentations

Guganesharajah, K., Lyons, D.J., Parsons, S.B., and Lloyd, B.J. (2006). Influence of Uncertainties in the Estimation Procedure of Flood Water Level. Journal of Hydraulic Engineering, ASCE, 132(10), 1052-1060

Guganesharajah, K., Pavey, J.F., van Wonderen, J., Khasankhanova, G.M, Lyons, D.J. and Lloyd, B.J. (2007) Simulation of Processes Involved in Soil Salinization to Guide Soil Remediation. Journal of Irrigation and Drainage Engineering, ASCE, 133(2), 131-139

Lyons, D.J. and Jennings, P. “Flooding in the Wollombi Valley – Learning from Experience”. Presented at the 51st NSW Floodplain Management Authorities Conference, Tamworth 2011

Daniel Williams

Position	GIS Officer/Flood Modeller
Years of Experience	8
Qualifications	BSc (Hons) Environmental Science and GIS Aston University (2004)
Recent Employment Profile	2008 to Present BMT WBM Pty Ltd – *GIS Officer and Flood Modeller* 2004 to 2008 Mott MacDonald Ltd, UK - *GIS Specialist and Modeller* 2002 to 2003 Mott MacDonald Ltd, UK – *Undergraduate*

Career Overview

Daniel has worked in Australia and the UK, predominantly in the field of flood modelling, including hydrological analysis, hydrodynamic flood modelling of urban, fluvial, estuarine and coastal environments and site-specific flood risk assessment.

Daniel has provided GIS capabilities to support a range of environmental management projects, including work in terrain analysis, spatial analysis, data processing, GIS modelling and mapping. He has also provided theoretical knowledge, technical support and training for a number of staff, assisting them in the undertaking of GIS-related tasks for project work.

Areas of Expertise

Spatial Analysis of Raster and Vector Data

Terrain Analysis Applications

Geostatistical Analysis

GIS Modelling Applications

Flood Hydrology

1D and 2D Hydrodynamic Flood Modelling

Flood Risk Assessment

Specific Projects

Hydrological Assessments
- River Medway Catchment Hydrological Assessments, UK (2007-2008)
- Welland Catchment Strategic Model, UK (2005-2006)

Flood Studies
- Coogee Bay Flood Study (2010-ongoing)
- Tabourie Lake Flood Study (2009-2010)
- Raymond Terrace Flood Study (2009-2010)
- Liverpool Overland Flow Study Stage 3 (2008-2009)
- EA Anglian Region Northern Area Tidal Modelling, UK (2008)
- Tonbridge Flood Modelling and Mapping Updates, UK (2007-2008)
- Lower Medway Flood Modelling and Mapping Study, UK (2007)
- Teise and Beult 2D Modelling and Mapping Study, UK (2006-2007)
- Welland Catchment Flood Mapping Study, UK (2006-2007)

Flood Impact Assessments
- Lake Wyangan Flood Study (2010-ongoing)
- Williamtown/Salt Ash Flood Study Review (2011-ongoing)
- Hexham Flood Gates Modelling (2009-ongoing)
- Pacific Highway Upgrade from the F3 to Heatherbrae (2009-ongoing)
- Various Newcastle City Development Impact Assessments (2009-ongoing)
- Newcastle Floodplain Management Options Testing (2008-2009)
- Riverfield Fish Farm Impact Modelling, UK (2008)
- Review of Syngenta Site Development, Yalding, UK (2008)
- Cannon Lane Development Flood Impact Assessment, Tonbridge, UK (2007-2008)
- Bourne Eau Pumping Station Decommissioning, UK (2007)
- River Welland Siphon Hood Removal, UK (2007)
- River Exe Flood Incident Management Study, UK (2006-2007)

Risk Mapping Projects
- Great Lakes On-site Sewage Planning (2011-ongoing)
- Greater Taree On-site Sewage Planning (2011-ongoing)
- Lake Conjola Floodplain Risk Management Study (2010-ongoing)
- Burrill Lake Floodplain Risk Management Study (2010-ongoing)
- Wollongong Coastal Zone Management Study & Plan (2010-2011)
- Port Stephens On-site Sewage Management Study (2009-2010)
- Coffs Coastal Process Hazard Definition Study (2010)
- Newcastle Floodplain Management Study (2008-2009)
- River Medway Flood Mapping Updates, UK (2008)
- Inverness Flood Mapping, UK (2008)
- River Exe Flood Risk Mapping Study, UK (2005-2006)
- River Severn Flood Risk Mapping Study, UK (2002-2003)

Specialist GIS Support (Various Projects)
- Management, processing and manipulation of spatial data
- Interpolation of spatial data to model continuous surfaces
- Development, processing and analysis of Digital Elevation Models
- Volumetric analysis of Digital Terrain Models for cut/fill exercises
- Spatial analysis of raster and vector data for spatial planning and environmental modelling
- Geostatistical analysis of spatial datasets
- Processing and classification of remotely sensed data
- Post-processing of hydrodynamic model results for analysis and mapping applications
- Development of GIS modelling tools to process and analyse spatial data
- Mapping of spatial data and analytical results to deliver clear and informative outputs

Joshua Eggleton

Position	Environmental Engineer
Years of Experience	3
Professional Affiliations	Member Institution of Engineers Australia Member APESMA
Qualifications	Bachelor of Engineering Environmental (Honours) University of Newcastle (2009)
Recent Employment Profile	2009 to Present BMT WBM Pty Ltd – *Environmental Engineer* 2008 to 2009 Douglas Partners Pty Ltd – *Undergraduate Engineer*

Career Overview

Joshua graduated with an undergraduate Environmental Engineering degree through the University of Newcastle in 2009, achieving first class honours. During his time at University, Joshua gained valuable experience with a range of software and model applications including FORTRAN, MATLAB, KINDOG, WUFS, MUSIC and MapInfo.

Since joining BMT WBM in June 2009, Joshua has worked on a variety of modelling projects including flood studies and coastal investigations. Joshua has acquired skills in numerical modelling packages such as TUFLOW, SMS, GMS, XPRAFTS, CatchmentSIM, ELCOM, MEDLI and WBNM. Joshua has also further developed his skills in data analysis / interpretation and application of GIS packages including MapInfo and Vertical Mapper.

Joshua has also gained experience in decentralised sewage management and reuse. This work encompasses site and soil assessments, impact assessment, wastewater system suitability assessment and irrigation planning and management.

Areas of Expertise

Application of GIS within Water Resources, Hydraulic and Environmental Studies

1D, 2D and 3D Hydraulic and Receiving Water Quality Modelling

Flood Studies and Floodplain Management

Decentralised Sewage Management and Reuse

Soil Science and Hydrology

Irrigation Planning and Management

Specific Projects

Small Scale and Decentralised Sewage Management and Reuse
- Evans Head Effluent Reuse Investigation (2010)
- Lochsport Decentralised Sewage Modelling Investigation (2010)
- Sydney Water Effluent Irrigation Research Study (2010)
- Kinglake West Sewerage Project Irrigation Management Plan (2011)
- Feasibility of Land Treatment by Subsurface Irrigation at Cowan (2010-2011)
- Cumulative Impact Assessments for Decentralised Wastewater Management Systems (2010-Ongoing)
- Site and Soil Assessment and System Design for Small to Medium Scale Wastewater Management Systems (2010-Ongoing)

Water Resources and Environmental Impact Studies
- Hunter Wetlands Centre Operations Management Plan (2011–Ongoing)
- Hunter Wetlands Centre EIS (2010)
- EIS of Seawater Flooding in the Lower Lakes, South Australia – Numerical Modelling Investigation (2010)

Flood Studies and Floodplain Management
- Manly Lagoon Flood Study (2011-Ongoing)
- Narrabeen Lagoon Flood Study (2011-Ongoing)
- Duck Creek Flood Study (2010)
- Clarence Town Flood Study (2010)

Integrated Water Cycle Management
- Cowra Water Reuse Study (2011-Ongoing)

Relevant Training and Proficiencies

Skills
- MapInfo
- Vertical Mapper
- TUFLOW
- SMS
- FORTRAN, MapBasic and MATLAB
- CatchmentSIM
- XP – RAFTS
- GMS
- MUSIC
- ELCOM
- WBNM
- MEDLI

A part of BMT in Energy and Environment

Michael Turnley

Position	Manager Flooding and Hydraulics Associate
Years of Experience	19
Professional Affiliations	Member of Institution of Engineers Australia
Qualifications	Bachelor of Engineering (Civil) Monash University (1992)
Recent Employment Profile	2001 to Present BMT WBM Pty Ltd – *Manager, Flooding and Hydraulics (Victoria)* 1996 to 2001 Egis Consulting Australia Pty Ltd (formerly CMPS&F Pty Ltd) – *Senior Water Resources Engineer; Project Manager; Project Engineer* 1994 to 1996 CMPS&F Pty Ltd – *Project Engineer* 1992 to 1993 Monash University, School of Engineering – *Researcher (Hydrology)*

Areas of Expertise

1D and 2D Hydraulic Modelling (floodplains, and drainage and reticulation networks)

Floodplain Management

Floodplain Mapping

Stormwater Management

GIS and GIS Application Development

Author of the '*miTools'* GIS Utilities

Career Overview

Michael has over 19 years industry experience in a broad range hydrological, hydraulic and environmental investigations, as well as civil and environmental infrastructure design.

Michael has personally undertaken studies across Australia (VIC, SA, ACT, NSW, QLD) and overseas (UK, Brunei, India). These studies have included flood studies, floodplain management plans, stormwater management, and master planning and detailed design of civil and environmental infrastructure.

Michael also is an Associate at WBM, and is the developer and manager of the *miTools* GIS software suite for MapInfo and TUFLOW.

Specific Projects

Flooding and Environmental Investigations

- Melbourne Water Flood and Risk Mapping, Flood Mitigation and Redevelopment Services Scheme Projects (numerous). Some specific catchments studies include: Mile Creek, Scotchmans Creek, Skye Karingal, Western Treatment Plant, Rix Street Main Drain, Blackburn Main Drains, Hoffmans Road Main Drain and many more
- South East Ocean Grove Drainage/Flood Study
- United Kingdom flood related studies (numerous) - Catchment Flood Management Plans; Strategic Flood Risk Assessments; Flood Risk Assessments; and providing TUFLOW training and model reviews
- London 2012 Olympics Site: Flood Risk Assessment (UK)
- 1st to 5th Creek Flood Study, South Australia
- Tatura Floodplain Management Plan
- Merrigum Flood Study and Flood Mitigation Option Assessment
- Great Ocean Green Golf Course - Flood and WQ Assessments
- Moolap Industrial Area Flood Management Plan
- Charleville and Augathella Flood Management Study
- Scrubby Creek Flood Mitigation Works - Water Quality Monitoring
- Birkdale Landfill Stormwater Management and Landfill Closure Plans
- Eastern Freeway Extension Options (Springvale Road to Ringwood) - Water Quality Impacts and Management
- Lake Marmal Catchment Management Plan

Civil and Environmental Infrastructure

- Master Planning, detailed design and documentation of hydraulic and water quality infrastructure for proposed developments (numerous projects). Infrastructure typically included stormwater systems (pipe drainage and soft engineered floodways), water quality control (WSUD, WQ ponds, GPTs, etc), and water and sewage reticulation.
- Melbourne City Link Project
- Bangalore Water Supply and Environmental Sanitation Project, India
- Craigieburn Bypass Hydraulic Investigations
- Infrastructure design and construction bids (numerous) - Morwell River Diversion, Geelong Road, Hallam Bypass
- Landsborough Highway Upgrade (Flood Immunity)
- Kampong Buang Sakar Vacuum Sewerage Scheme, Brunei
- Queanbeyan Waste Management Centre, ACT

Key Papers/Publications

Turnley, M. & Barry, M. (2010). "*Implementation of the SBRI Technique to Establish Catchment-Wide Flood Risk in a Victorian Catchment*". 7th Biennial Victorian Flood Conference, Bendigo, 9–11 November 2010.

Leister, J.G., Roberts, M & Turnley, M.A., (2007), *"Entire Catchment Flood Modelling as a Planning Tool – River Trent Case Study"*, 5th Victorian Flood Management Conference, Warrnambool, Victoria, October 2007

Roberts, M. & Turnley, M.A. (2006). *"Two-Dimensional Variable Geometry Modelling Of Flood Defence Breaches – Assisting In The Delivery Of Cost-Effective Flood Management."*, 41st DEFRA Flood and Coastal Management Conference, York, United Kingdom, July 2006.

Khouri, G.R. & Turnley, M.A. (2000). *"Drainage Investigation and Flood Mapping: A case study describing: the need, the methodology, the outcomes and benefits."*, 12th Queensland Hydrology Symposium, Brisbane, June 2000.

Clough, V., Hay, G.C., Sheehan, D.B. & Turnley, M.A. (1999), *"Drainage Overlays in Planning Schemes."* Presented at Local Government Workshop hosted by Egis Consulting Australia, Melbourne, December 1999.

APPENDIX C: RECENT RELEVANT PROJECT EXPERIENCE

BMT WBM

Tabourie Lake Flood Study

Tabourie Lake is situated on the south coast of NSW approximately 10km south-west of the township of Ulladulla. The Lake is an Intermittently Closed and Open Lake or Lagoon (ICOLL), which means it is intermittently disconnected to the sea by an entrance sand bar.

The majority of significant flooding in Tabourie Lake has coincided with a build up of the entrance berm height and/or rainfall events occurring with high antecedent water levels in the Lake. The conditions of the entrance, including the height of the berm crest, are a function of active coastal processes (waves and sediment transport). Consequently, for ICOLLs, an assessment of lake flood conditions requires consideration of adjacent coastal conditions.

BMT WBM has undertaken a detailed flood study of the Tabourie Lake catchment to assess flood behaviour in the catchment and to determine design flood level information that will be used to set appropriate flood planning levels for the study area. The ability to model morphological changes in the entrance during a flood using BMT WBM's TUFLOW morphological model was critical to this flood study. The changing entrance shape as the scour develops affects the effectiveness of the entrance in conveying water out of the Lake during a flood, and subsequently affects peak water levels.

Client
Shoalhaven City Council

Date
2007 - 2009

Services & Expertise Provided

Hydrologic and Hydraulic Flood Model Development (XP-RAFTS and TUFLOW);

Morphologic entrance scour model development;

Flood Model Calibration and Testing including detailed volumetric analysis;

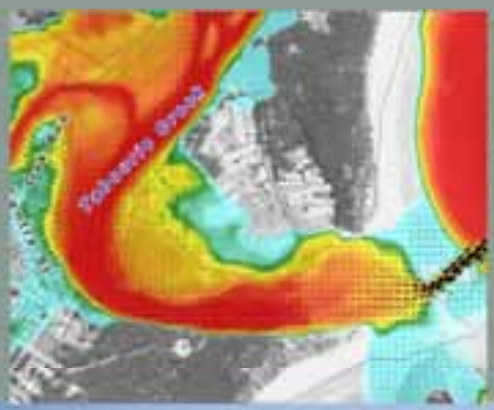
Design Event Modeling;

Probabilistic Berm Height Analysis;

Planning Level Assessment and Advice;

Flood Hazard and Category Determination; and

Stakeholder and community liaison.



A part of BMT in Energy and Environment

Liverpool Overland Flow Path Study

Client
Liverpool City Council

Date
2008

Services & Expertise Provided

Detailed TUFLOW 1D/2D Flood modelling;

Assessment of overland flooding patterns in urban areas and key flow paths;

Flood mapping of levels, velocities and impacts; and

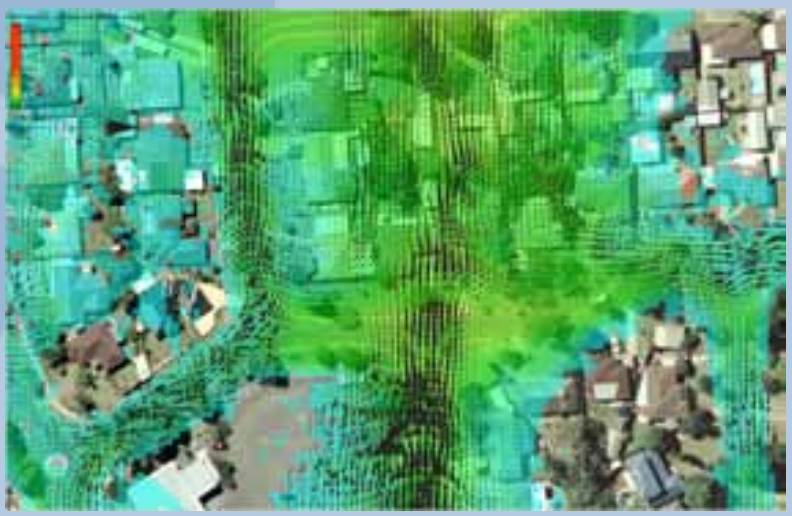
Recommendations for food mitigation measures.

The Liverpool study area was represented by highly urbanised catchments. Flood-prone land within these areas are typically characterised by:

- Large and shallow inundation of urban developments with interconnecting and varying flowpaths.
- A complex underground pipe network draining mainly to open channels and instances of flooding from pipe network surcharging.
- A road network that can convey floodwaters due to the hydraulic efficiency of the road surface compare to developed areas (e.g. blocked by fences and buildings).

Detailed 1D/2D TUFLOW models were developed to simulate the complex nature of flood flows within these urban environments, in particular the overland flooding and interaction with major trunk stormwater drainage.

With high resolution topographical data and the aid of aerial imagery, the simulated flooding patterns enabled identification of high flood risk areas associated with overland flooding, including high depth and velocity flows through and around individual properties.



A part of BMT in Energy and Environment

Throsby, Cottage and CBD Flood Study

Throsby and Cottage Creeks, and to a lesser extent the Newcastle CBD, have been heavily affected by flooding, especially during the 1988, 1990 and 2007 flood events. The catchments are steep around their perimeter, but drain onto low-lying, flat areas, where it is difficult for floodwaters to escape.
The Flood Study combined three catchments and was carried out to better understand the flood behaviour and the flood risk to the community.

The hydrologic and hydraulic models were developed to quantify flood discharges, the speed of floodwaters, flood heights and the flood depths. As part of their development process, the models were calibrated to two historical flood events, to demonstrate their ability to reproduce reality.

Eight design events were simulated for two critical storm durations for the existing topography. Three full developed design events were simulated; these model simulations have an allowance of 0.4m on tailwater levels to account for possible sea level rise in the future.

All eleven combination of development and design conditions were mapped to gain a comprehensive understanding of the existing and future flood behaviour.

The flood study models are considered a reliable and representative base to carry out flood risk management investigations and flood impact and mitigation assessments.

Client
Newcastle City Council (NCC)

Date
2006- 2008

Services & Expertise Provided

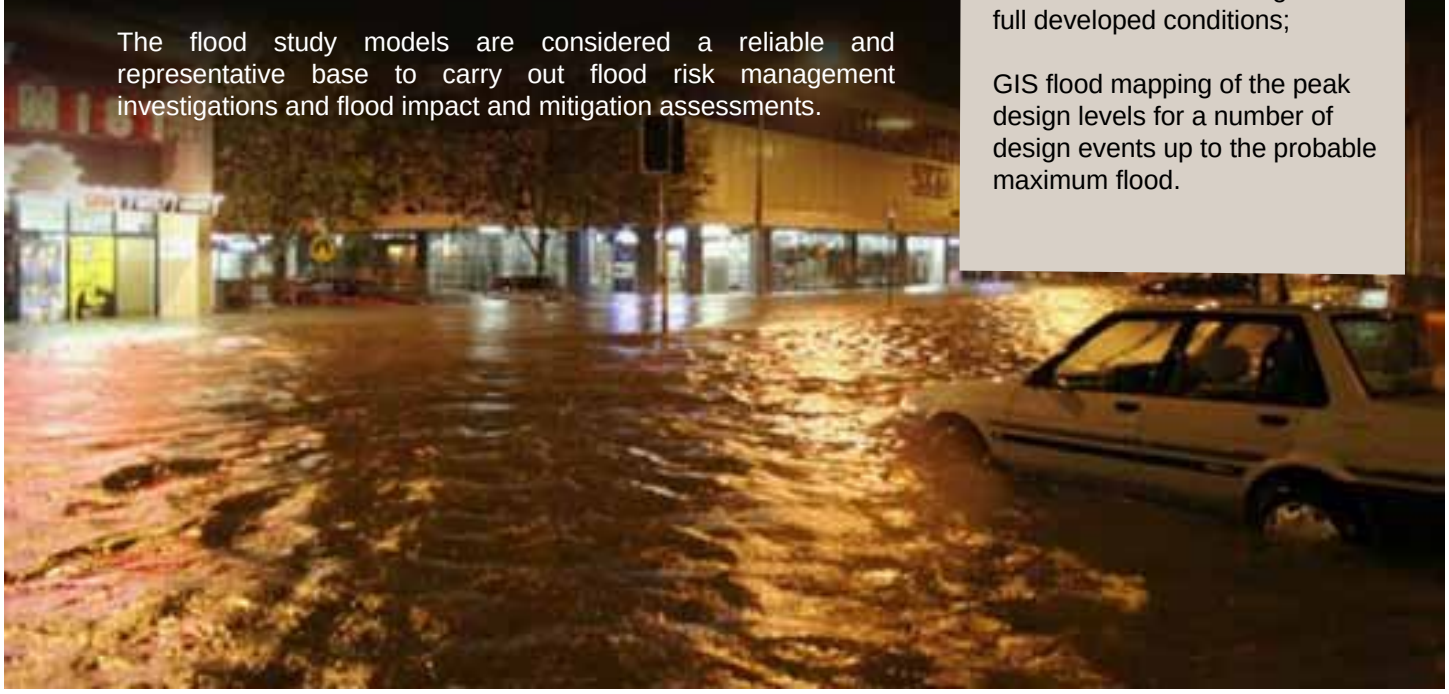
Development of WBNM hydrology model;

Leading-edge TUFLOW model that combined three catchments and simulates the interaction between catchments in the low-lying areas;

Joint calibration of hydrology and hydraulic models to two historical flood events;

Simulation of the existing and the full developed conditions;

GIS flood mapping of the peak design levels for a number of design events up to the probable maximum flood.



A part of BMT in Energy and Environment

Wollombi Valley Flood Study

BMT WBM was commissioned by Cessnock City Council to undertake a detailed flood study review and model upgrade of the Wollombi Valley, as a precursor to a floodplain management study focusing specifically on Wollombi Village.

A review of previous flooding investigations within the catchment was undertaken including technical review of existing hydrologic and hydraulic models. Subsequent to the review, BMT WBM developed a detailed 1D/2D linked hydrodynamic model of the Wollombi and Congewai Creeks using the in-house developed software TUFLOW.

A significant flood was experienced in the catchment during the course of the study. This event provided BMT WBM with a unique opportunity to provide Council on-ground assistance in flood data collection and then subsequently use the data for model calibration and assessment.

The June 2007 event provided a comprehensive data set of rainfall, flood level and stream flow information, not typically available in many catchment flood studies.

The revised flood study provides the basis for floodplain management activities investigated by BMT WBM in the Floodplain Risk Management Study. The extensive community consultation undertaken as part of the flood study and flood data collection activities established a sound platform for community involvement in the project.

Client
Cessnock City Council

Date
2007/08

Services & Expertise Provided

2D flood modelling of Wollombi Brook floodplain

Flood data collection for June 2007 flood event

Flood mapping of depths, velocities and levels

Community consultation

A part of BMT in Energy and Environment

Williams River Flood Study

Client
Port Stephens Council
Dungog Shire Council

Date
2006 - 2007

Services & Expertise Provided

Development of RAFTS-XP hydrological model;

Resident surveys and community consultation processes;

Digital terrain model development;

Development and calibration of TUFLOW hydraulic model;

Flood frequency analysis; and

Assessment of flood risk.

The Williams River is a major tributary of the Hunter River and the floodplain includes the towns of Dungog, Clarencetown, Seaham and Raymond Terrace.

As part of the NSW Floodplain Management Program, Port Stephens Council and Dungog Shire Council commissioned a flood study to quantify flooding behaviour through the development of a flood model. BMT WBM utilised the 2D/1D hydraulic model TUFLOW to undertake the study.

The model was calibrated to a number of flood events in conjunction with a hydrological model of the catchment (using RATFS-XP). A resident survey was a useful exercise in determining flood behaviour and records for the calibration phase.

The TUFLOW model simulated the in-bank details of the river system using 1D elements. The floodplain areas were simulated using 2D cells. Both the 1D network and the 2D domain were dynamically linked to each other and to the broader Lower Hunter TUFLOW model developed for the RTA's F3 investigations.

The TUFLOW model was an essential tool in the consultation with key study stakeholders. The model was then used to define flood levels, assess flood risk and flood patterns. The model can then be used in subsequent studies to assess past mitigation works and to investigate the potential impact of future works.

A part of BMT in Energy and Environment

Richmond River Flood Mapping Study

The Richmond River is one of Northern New South Wales largest coastal river systems draining a catchment of approximately 7,000km^2. Along the river, and one of its major tributaries, the Wilsons River, are the flood prone towns of Casino, Lismore, Coraki and Ballina.

The purpose of this study has been to flood map the entire floodplain between Casino, Lismore and Ballina, filling the gaps left by previous studies. A 400 sub-catchment hydrological model, together with a 600km^2 2D/1D hydraulic model have been developed by BMT WBM. The flood model has been calibrated and verified against 3 major historical flood events.

Photogrammetric, aerial laser scanning and ground survey were collated from numerous previous studies. These data were analysed to verify their accuracy and suitability for use with the project.

During the project, two major flooding events occurred within the study area. These floods provided an opportunity for an extensive field data collection exercise including community surveys, door knocking, and stream and rainfall data collection and analysis.

Client
Richmond River County Council & Richmond Valley Council

Date
2008 – ongoing

Services & Expertise Provided

DEM compilation and analysis;

Historical flood survey collection;

WBNM hydrological modelling of 400 sub-catchments;

TUFLOW 2D/1D hydraulic modelling including 360km of 1D network;

Joint model calibration and verification;

Community and stakeholder consultation; and

Flood hazard mapping.

2009 Flood Event
Peak Flood Depth Results

A part of BMT in Energy and Environment

Mullet Creek and Brooks Creek Flood Study

Client
Bewsher Consulting for Wollongong City Council

Date
2002-2005

Services & Expertise Provided

Development and calibration of WBNM hydrologic model;

Development and calibration of the TUFLOW hydraulic model; and

GIS flood mapping of design results for a range of flood events, storm durations and blockage scenarios.

Mullet Creek and Brooks Creek are located on the NSW coast south of Wollongong and feed into Lake Illawarra.

Two 1D/2D flood models were developed for the independent creek systems using TUFLOW.

The models were calibrated to a number of flood events including the large 1984 flood event, in conjunction with a WBNM hydrological model of the entire catchment. There were over 500 calibration points derived from anecdotal evidence and survey of debris marks.

The TUFLOW model was an essential tool in the consultation of key study stakeholders, and was valuable throughout the community consultation phase in gaining community acceptance of the model calibration results.

The calibrated model was then used to simulate a range of design events, storm durations and culvert blockage scenarios. The outputs were used to asses flood levels, flood risk, monetary damages and flood patterns.

A part of BMT in Energy and Environment

Tweed Valley Flood Study and Floodplain Risk Management Study

The Tweed River is a large coastal river on the east coast of Australia (catchment of 1,000km^2) with a floodplain area of over 150 km^2. This floodplain is dominated by the caldera of Mount Warning and the floodplain has experienced one of the highest urban growth rates in Australia.

A 1D flood model of the Tweed River and floodplain was developed by WBM Oceanics Australia in the 1980s. With the advent of more powerful computers and significant advances in 2D flood modelling and GIS flood mapping techniques, the opportunity was taken to update the flood model into a fully dynamic 2D/1D flood model as part of a new Flood Study in 2002.

A TUFLOW model was developed and calibrated to the 1974 flood and verified to two other events. Design flood events (i.e. 5 to 100 year ARI floods) were then simulated.

In 2007, the Flood Study was updated to include new and improved catchment topography (from ALS), a new hydrology model and climate change assessment. The outcomes of this update are now being used as a basis for investigations and advice as part of a Floodplain Risk Management Study.

Evacuation capability is a key challenge for the Risk Management Study due to the large number of residents within the floodplain. New TUFLOW features and tailored programming has been utilised to undertake an evacuation capability assessment including evaluation of a large number of evacuation routes, scenarios and options.

Client
Tweed Shire Council (TSC)

Date
2002 - 2005
2007 - 2009

Services & Expertise Provided

Large and complex TUFLOW model of river and floodplain;

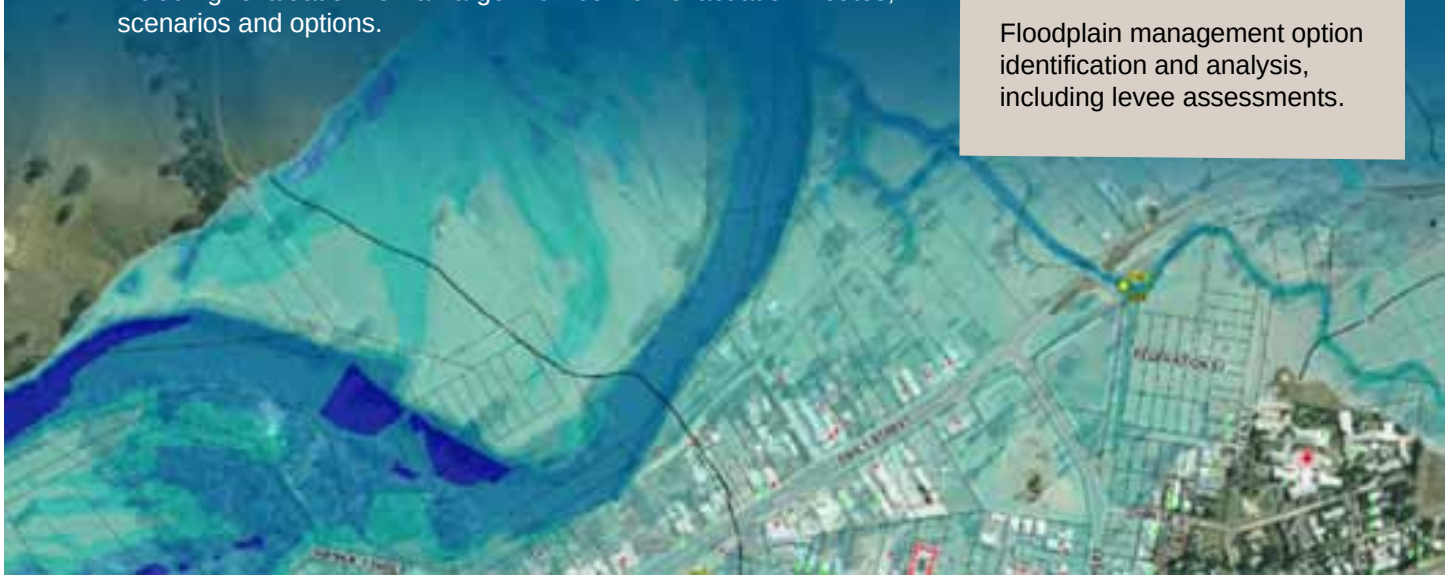
Development of WBNM hydrology model;

Joint calibration of hydrology and hydraulic models to historical flood events;

GIS flood mapping of levels, areas of inundation, velocities and hazards;

Evacuation capability and damages assessments; and

Floodplain management option identification and analysis, including levee assessments.



A part of BMT in Energy and Environment

Burrill Lake Flood Study

Burrill Inlet is a 2 km long sinuous tidal channel that connects the main body of Burrill Lake to the Ocean. During intense rainfall in the catchment, the water levels become super elevated and substantial inundation of residential areas on the floodplain of Burril Inlet can occur. Similarly, the combined effects of waves, wind and low atmospheric pressure associated with coastal storms can also raise water levels in the inlet as water rushes into the Lake from the ocean.

BMT WBM was engaged by Shoalhaven City Council to undertake a flood study of Burrill Lake, in accordance with the NSW Government's Floodplain Development Manual. The combined effects of both oceanic and catchment flooding processes were considered.

Using the hydrological model XP-RAFTS and BMT WBM's own two dimensional TUFLOW hydrodynamic flood modelling package, the study team determined that the developed areas around the edges of Burrill Inlet were susceptible to significant inundation for the design conditions adopted.

As part of the study, BMT WBM utilised a fully dynamic sediment transport, scour and entrance morphological model, developed within the TUFLOW modelling environment to represent the changing (rapidly scouring) conditions of the entrance during the flood.

Client
Shoalhaven City Council

Date
2005-2007

Services & Expertise Provided

Data Collation;

Community Consultation;

Additional Survey Management;

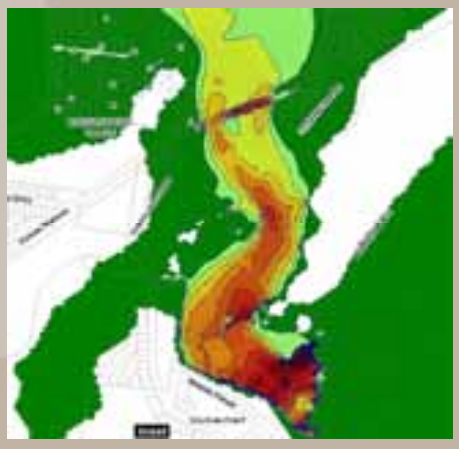
Hydrologic and Hydraulic Flood Model Development;

Flood Model Calibration and Testing;

Design Event Modeling;

Planning Level Assessment and Advice; and

Flood Hazard and Category Determination.



A part of BMT in Energy and Environment

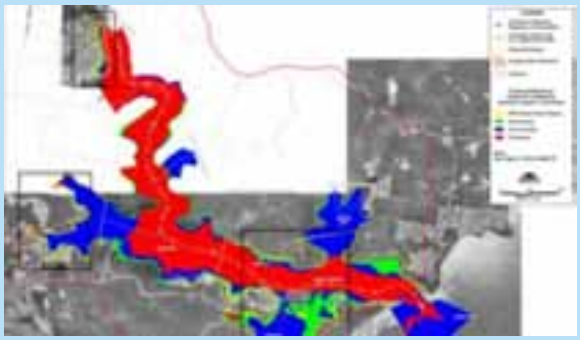
Lake Conjola Flood Study

Lake Conjola is an Intermittently Closed and Open Lake or Lagoon (ICOLL) located on the NSW South Coast, between Jervis Bay and Ulladulla. Low lying urban development around the lake becomes susceptible to inundation following periods of prolonged heavy rainfall. As experienced in April 2006, flooding can also be the result of elevated ocean levels conditions.

Flooding within the lake is very dependent on the condition of the entrance. When the entrance is heavily shoaled, or even closed, catchment runoff accumulates within the lake, inundating foreshores. During a flood, however, sands within the entrance become mobilised by the high velocities, progressively enlarging the entrance channel, making drainage from the lake easier.

BMT WBM undertook a Flood Study for Council in accordance with the NSW Floodplain Development Manual (2001, 2005). The purpose of the flood study was to develop a computational model capable of predicting probabilistic floods within the lake.

Despite the complexities of flooding within ICOLLs, the flood model was suitably calibrated and verified to historical events. The model was then used to define areas of different flood risk for a range of flood events, up to the PMF event.



Client
Shoalhaven City Council

Date
2002 - 2006

Services & Expertise Provided

Data Collation;

Community Consultation;

Additional Survey Management;

Hydrologic and Hydraulic Flood Model Development;

Morphologic entrance scour model development;

Flood Model Calibration and Testing;

Design Event Modeling;

Planning Level Assessment and Advice; and

Flood Hazard and Category Determination.

Coastal Modelling Investigations for Lake Cathie / Lake Innes Estuary

Client
Port Macquarie-Hastings Council & the Department of Environment Climate Change and Water

Date
2009-current

Services & Expertise Provided

Integrated numerical modelling using TUFLOW-FV, SWAN and TUFLOW-MORPH

Calibration of coastal hydrodynamics

Model sensitivity analysis

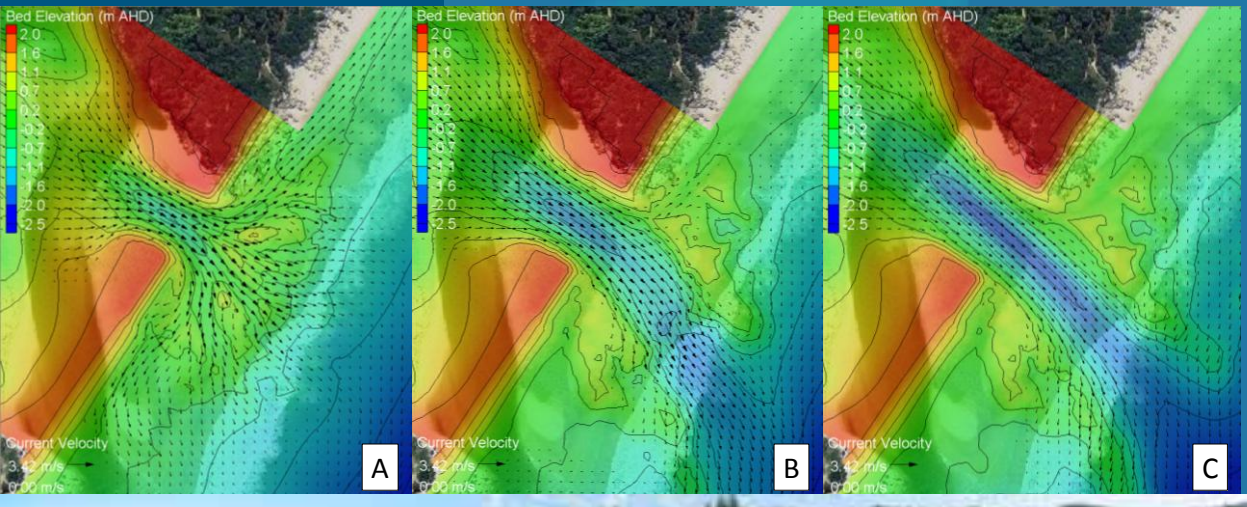
Validation of morphodynamic processes responsible for entrance breakout and closure

Numerical modelling of management options

The Lake Cathie/Innes Estuary is situated within the PMHC Local Government Area, approximately 20 km south of Port Macquarie. The Estuary is a shallow lake system surrounded by low-lying topography which is largely in an undeveloped 'natural' bushland condition. Urban development in the vicinity of the Estuary includes the small coastal town of Lake Cathie. Rainbow Beach and Lighthouse Beach are situated to the immediate south and north of the Lake entrance respectively. The Estuary is an Intermittently Open and Closed Lake and Lagoon (ICOLL) that has notable environmental and recreational values for local community.

Over the past 25 years, Lake Cathie has been the subject of numerous investigations which highlight a number of environmental issues relating to sediment transport, tidal hydrodynamics/flushing, sedimentation, shoaling etc . Recent studies have identified options to manage the Estuary for improved ecological and community outcomes, which are considered by this study.

In December 2009, Port Macquarie Hastings Council (PMHC) engaged BMT WBM to undertake a detailed study including development of a coastal hydrodynamic model of the Estuary with an aim to investigate the potential benefit of undertaking modifications/improvement works. The computer model developed was developed as a tool to investigate and review the current entrance opening strategy and assist with demonstrating justification for any changes to the management approach in the future.



APPENDIX D: QUALITY ASSURANCE CERTIFICATES

SAFETY

Compliance Australia Certification Services Pty Ltd
hereby grants this Safety Management System Certificate

Registration No 1069
to:

BMT WBM Pty Ltd

Level 8, 200 Creek Street Brisbane QLD 4000 Australia
126 Belford Street Broadmeadow NSW 2292 Australia
Level 5 99 King Street Melbourne VIC 3000 Australia
Suite 1, 138 Wood Street Mackay QLD 4740 Australia
Level 1, 256-258 Norton Road Leichhardt NSW 2040 Australia
Suite 6, 29 Hood Street Subiaco WA 6008 Australia

ABN 54 010 830 421

Scope:

Consulting engineering and scientific design services.

Compliance Australia
Certification Services
AS/NZS 4801
SAFETY

ANZSIC Code: 7823 , 7855

In Recognition of the Implementation of a Management System Conforming to

AS/NZS 4801:2001

This Certificate is valid from
09.12.2011 until 08.12.2014
Certified since 09.12.2011

JAS-ANZ

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This Certificate of Registration is granted subject to the regulations governing the certificate scheme by Compliance Australia Certification Services Pty Ltd and in respect of goods and or services described within the schedule hereto, at or supplied from the location/s shown on this certificate. Certification was determined by Compliance Australia Certification Services Pty Ltd against the criteria as laid down by AS/NZS 4801:2001.

Compliance Australia Certification Services Pty Ltd is accredited by the Joint Accreditation System of Australia and New Zealand.

W Chance

Authorised by the Managing Director

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certification services
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QUALITY

Compliance Australia Certification Services Pty Ltd
hereby grants this Quality Management System Certificate

Registration No 1069
to:

BMT WBM Pty Ltd

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126 Belford Street Broadmeadow NSW 2292 Australia
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Suite 6, 29 Hood Street Subiaco WA 6008 Australia

ABN 54 010 830 421

Scope:

Consulting engineering and scientific design services.

ANZSIC Code: 7823 , 7855

In Recognition of the Implementation of a Management System Conforming to

AS/NZS ISO 9001:2008

Scope Reduction if Applicable: N / A

This Certificate is valid from
09.12.2011 until 08.12.2014
Certified since 01.06.1995

Compliance Australia Certification Services
ISO 9001
QUALITY

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ENVIRONMENT

Compliance Australia Certification Services Pty Ltd
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ABN 54 010 830 421

Scope:

Consulting engineering and scientific design services.

ANZSIC Code: 7823 , 7855

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AS/NZS ISO 14001:2004

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ISO 14001
ENVIRONMENT

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ABN 54 010 830 421

Scope:

Consulting engineering and scientific design services.

SAFETY

Compliance Australia Certification Services
OHSAS 18001
SAFETY

ANZSIC Code: 7823 , 7855

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