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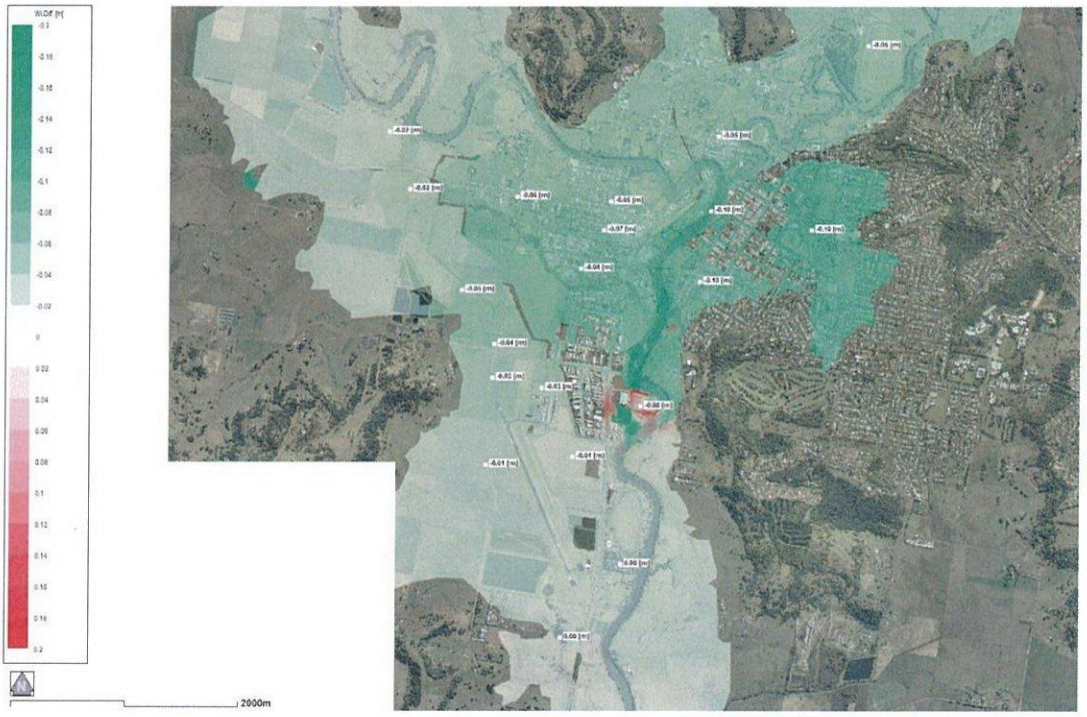
LISMORE CITY COUNCIL

Lismore Flood Model - LiDAR Update

Final Report

301077-08710

28 January 2016



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LISMORE CITY COUNCIL
LISMORE FLOOD MODEL - LIDAR UPDATE
FINAL REPORT

Disclaimer

PROJECT 301077-08710 - LISMORE FLOOD MODEL - LIDAR UPDATE

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
A	Final	C Druery	D McConnell	S Donohoo	2-2-16	N/A	

CONTENTS

1. INTRODUCTION

Lismore City Council has a regional 2D flood model built using RMA-2 (herein referred to as the "previous model"). Over time, detailed, localised "inset" models were created reflecting proposed and constructed development and flood mitigation measures.

Ground elevations in the "previous" RMA model were based on a mix of sources, including:

- Detailed Survey (by Council and Developers)
- NSW Lands Department 2m Contours
- Spot heights from 1:4,000 orthophoto mapping

In 2013, Council received LiDAR information collected by the NSW Department of Land and Property Information (LPI). Given the increased detail in this dataset, and its consistency across the floodplain, Council commissioned WorleyParsons to update the "previous" model using the LiDAR dataset. This model is herein referred to as the "detailed model".

The intent of the updated, detailed model was to:

- Increase model network detail to capture the finer terrain detail in the LiDAR dataset
- Update model network ground elevations
- Re-establish the impact of the lowering of the riverbank near Bunnings on flood behaviour
- Establish an updated "current conditions" model network reflecting constructed development/floodplain changes since the "previous" model was developed
- Update Councils floodplain categorisation polygons using the detailed model
- Expand the updated current conditions model to reflect currently approved development, as if it was constructed (the "approved development" model)

2. MODEL NETWORK UPDATE

2.1 Ground Elevations

Ground elevations for each node in the model network were extracted from the LiDAR dataset, with the exception of those nodes in Leycester Ck and the Wilsons River, which were kept the same as the "previous" model.

Levee crest elevations for the CBD levee were manually overridden with Work As Executed elevations, as used in the "previous" model.

Figure 1 and Figure 2 show the base elevation datasets used in the "previous" model (2m contours) and the "detailed" model (LiDAR), respectively. As highlighted by these figures, whilst the elevations are broadly similar, there is considerably more *detail* in the LiDAR dataset.

Figure 3 provides a difference map between the 2m contour based DEM and the LiDAR based DEM. The LiDAR data generally appears higher than the 2m contour based DEM, although the differences are not consistent across the floodplain.

A 2m DEM was created from the LiDAR datasets. This DEM was used to update the model network and in the post processing of model results.

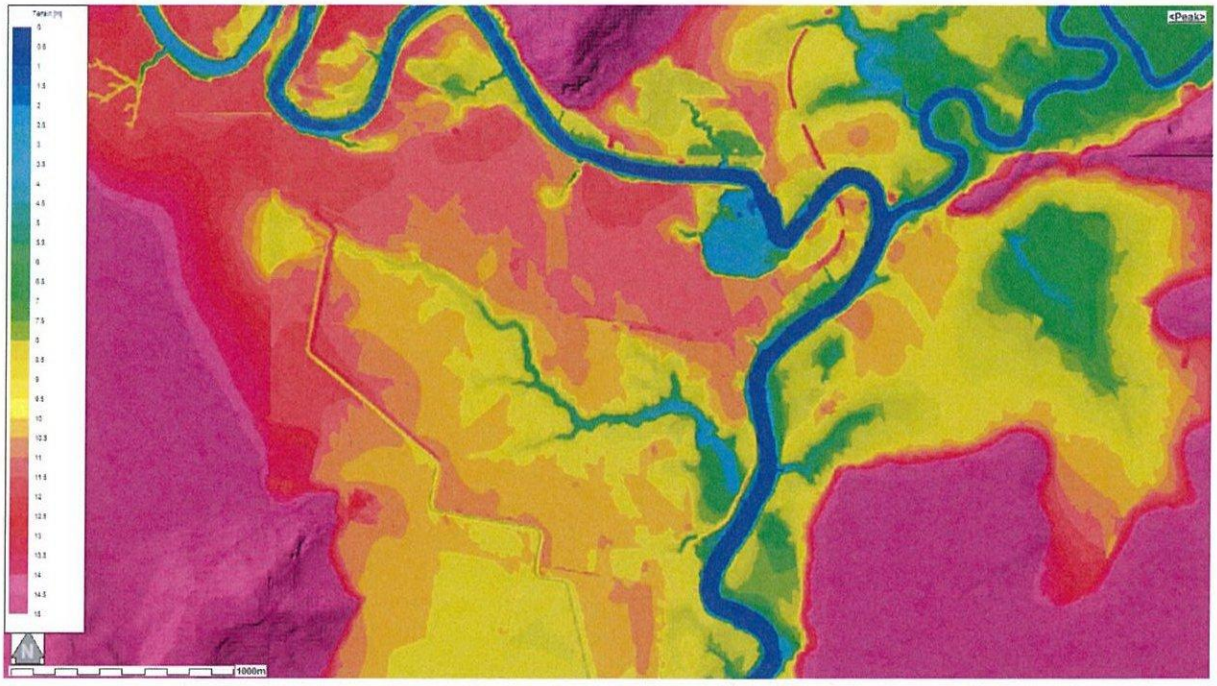

Figure 1 – Base Terrain Information used in "previous" model – Source: 2m Contours.

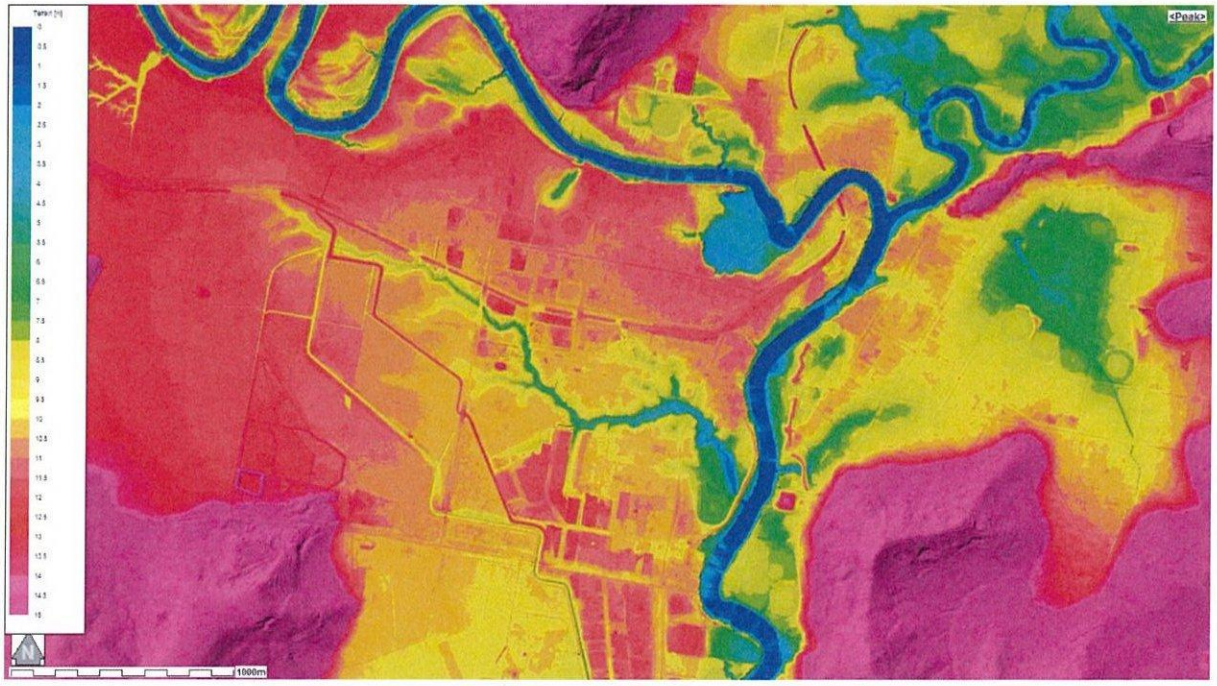

Figure 2 – Base Terrain Information used in "detailed" model – Source: LiDAR

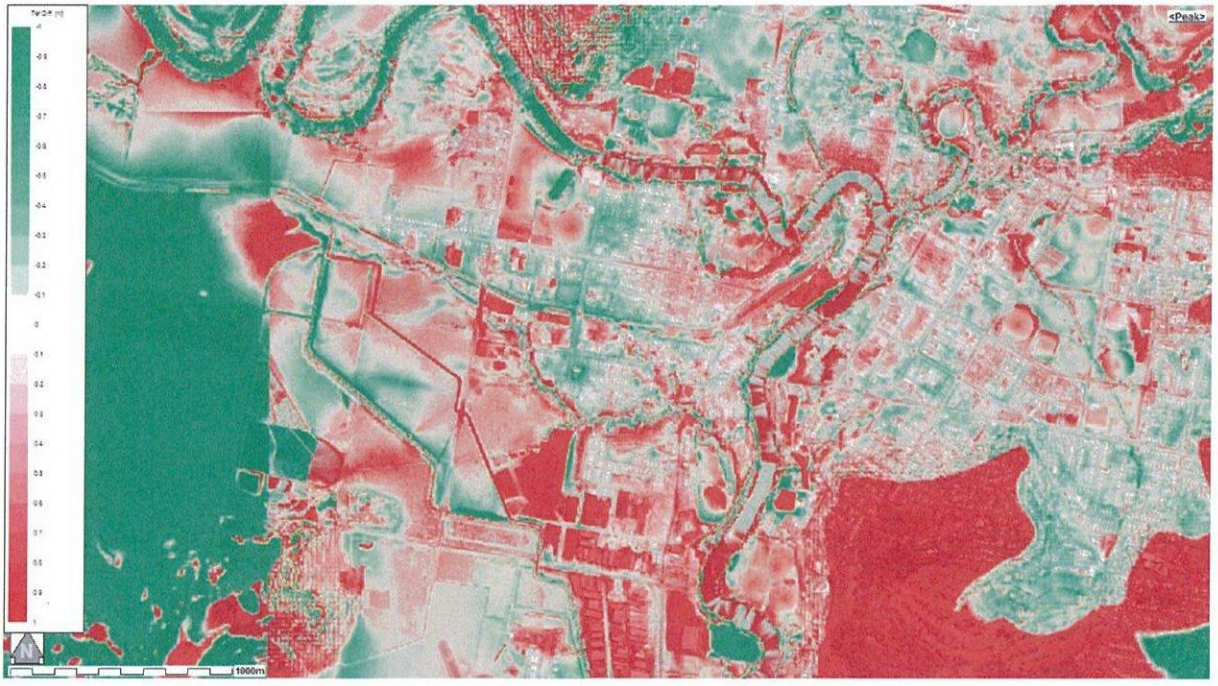

Figure 3 – Difference map – LiDAR based DEM *minus* 2m Contour based DEM.

2.2 Hydrology

No changes were made to the hydrology developed by SKM (circa 1999).

2.3 Model Network

The detail in the model network was increased to sufficiently capture the additional detail in the LiDAR based DEM. Figure 4 and Figure 5 show the model network for the "previous" and "detailed" models, respectively.

No changes were made to the roughness parameters across the network.

Figure 4 – Model network – "Previous" Model.

Figure 5 – Model network – "Detailed" Model.

3. MODEL RESULTS

The detailed model was run for the "full suite" of design flood probabilities: 10yr, 20yr, 50yr, 100yr, 200yr, 500yr, and the PMF. To facilitate comparison of changes to flood behaviour, a number of model networks were used in analysing the impact on the 100yr flood, as discussed in section 4.

Model results are provided in three waterRIDE™ projects on the hard drive/electronic deliverables accompanying this report. The first project (*Updated Current Conditions - Time Varying.vmmap*) provides access to the model outputs (on the model network) for the full time series of each design flood. This project is suited to time-varying analysis of the model results.

For the second project (*Updated Current Conditions - Mapped Peaks.vmmap*), the model outputs were mapped onto the 2m DEM derived from the LiDAR data. This has the benefit of increasing the detail of any hydraulic parameter associated with depth (flood extent, VxD, hazard, etc). Given the large file sizes associated with mapping dynamic model results, only the peaks of each parameter were retained. This project is suited to detailed analysis of the peak flood behaviour.

The third project (*100yr-Comparison.vmmap*) is provided for comparison purposes for the 100yr ARI design flood. It provides access to the model results/scenarios discussed in section 4.

For each of the above runs, the projects provide ready access to:

- Water level
- Depth
- Velocity
- Velocity x Depth
- Hazard

A waterRIDE™ license is required to access and interrogate these projects.

4. DISCUSSION OF MODEL RESULTS

For simplicity, this section focusses on the changes to flood behaviour for the 1 in 100yr ARI design flood only.

4.1 Impact of LiDAR Terrain

The key driving force affecting flood behaviour is topography. The LiDAR dataset represents a significantly more detailed terrain dataset than what was available at the time the "previous" model network was constructed and, consequently, changes to flood behaviour are evident.

Whilst generally similar, there are key differences between the LiDAR dataset and the previous terrain information that affect flood behaviour. Increased detail around the top of river banks in the LiDAR dataset resulted in the "detailed" model having higher, and steeper banks in the vicinity of the confluence of the Wilsons River and Leycester Creek.

The railway embankment through South Lismore is considerably higher in the LiDAR dataset than the 2m contour based DEM, as well as general terrain levels being higher in South Lismore.

Terrain levels near the STP on the Airport floodway are also higher, reducing the hydraulic efficiency of the floodway.

The result of these changes in elevation are an overall reduced flow capacity through South Lismore and a general increase in flood levels in South and North Lismore.

Figure 6 shows the change in peak flood levels for the 1 in 100yr ARI design flood as result of the model network update (terrain and network detail). There are minimal changes around the rowing club gauge and in the northern parts of the Lismore CBD. In South Lismore, peak flood levels increase by between 0.05m and 0.25m. In North Lismore, peak flood levels increase by 0.12m. At the airport, flood levels increase by up to 0.05m.

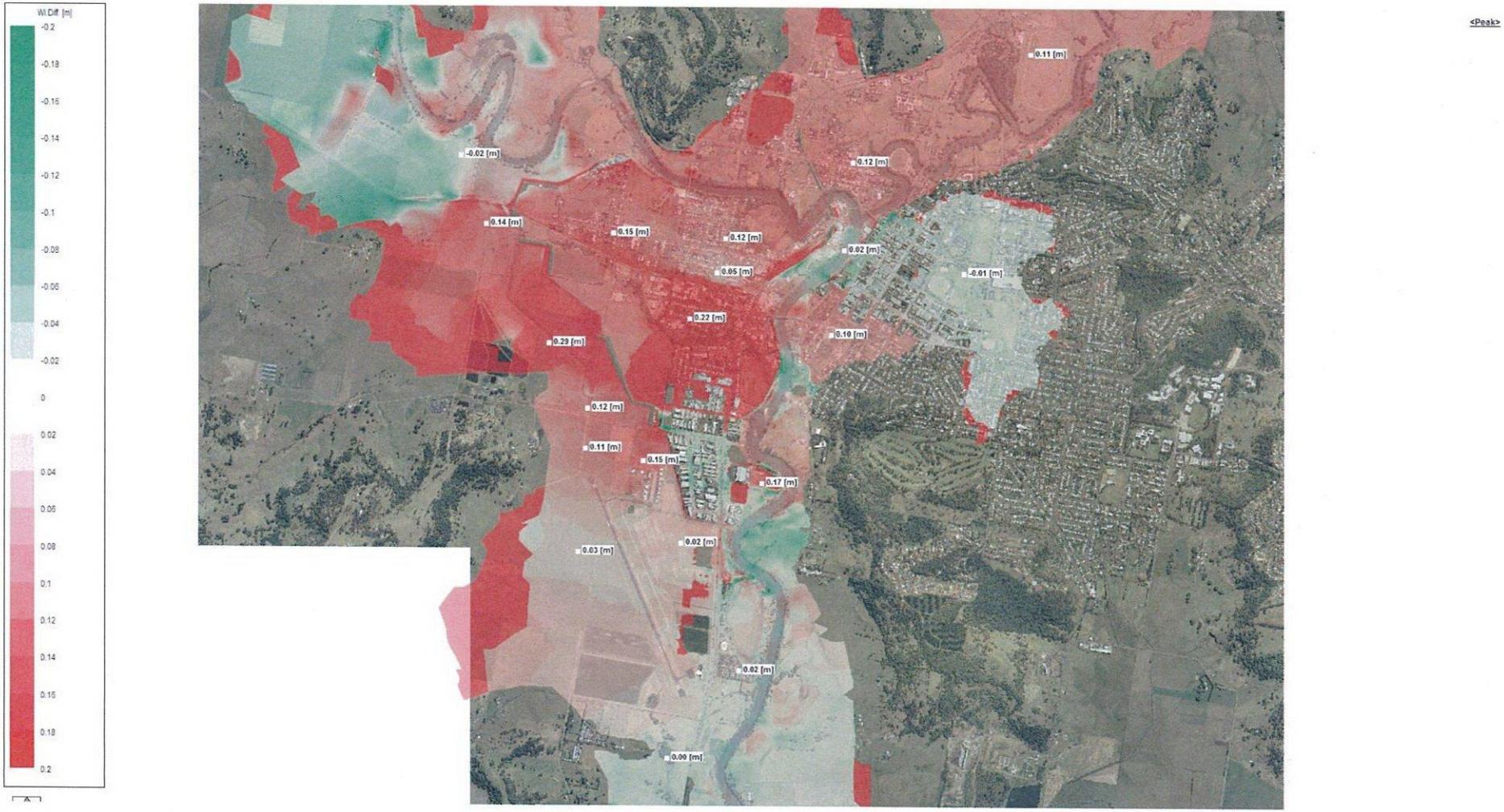

Figure 6 – Change in Peak Flood Levels – "Detailed" model *minus* "Previous" model – 1 in 100yr ARI Design Flood.

4.2 Impact of Lowering the River Bank to the East of the Bunnings Site

Acting as a significant hydraulic control, the "natural levee" along the river bank to the east of the Bunnings site had been identified as an area for floodplain mitigation works (refer WorleyParsons report *lr7047-06jjp080109-Lowering_Rvrbnk-1pg.pdf* dated 21-1-2008).

Subsequent to the development of the "previous" model network, partial excavation of the riverbank has been carried out as part of the "Masters site development". A model run for the 1 in 100yr ARI design flood using the "detailed" network and the works as executed drawings for the Masters site development was used to confirm that lowering the riverbank (partially in this case), still provides widespread reductions in peak flood levels as was found to be the case with the "previous" model.

Figure 7 shows the impact of partial excavation of the riverbank on peak flood levels. As previously found, there is a reduction in peak flood levels across most of Lismore.

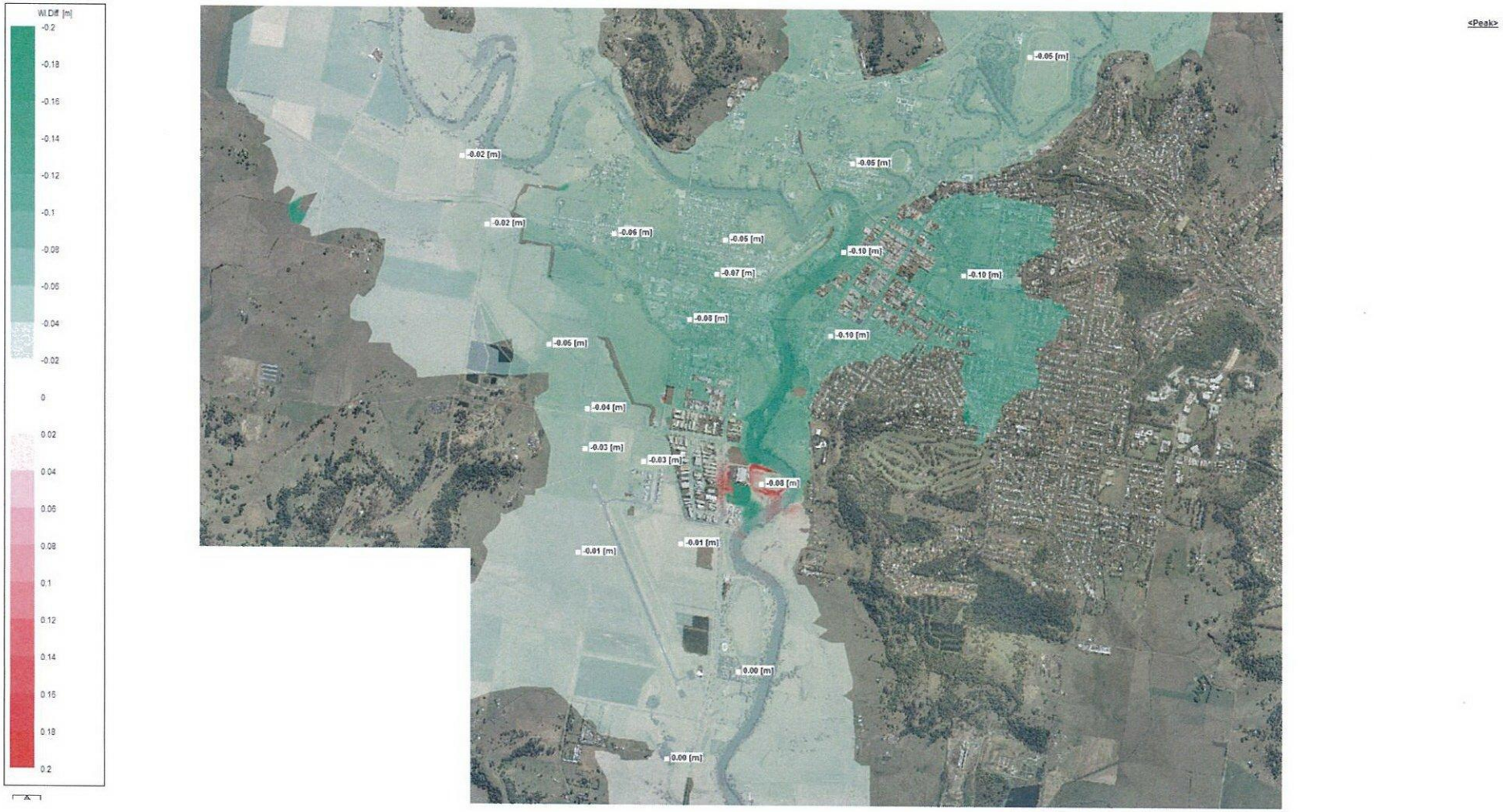

Figure 7 – Change in Peak Flood Levels – Partial lowering of riverbank adjacent to Bunnings Site – 100yr ARI Design Flood.

4.3 Updated "Current Conditions"

There has been significant development in the floodplain since the "previous" model was created. As such, a number of developments, flood mitigation measures, and operational procedures were included in the "detailed" model network, to reflect the "current conditions" of the floodplain.

The developments included were:

- Masters Site (and riverbank excavation) development
- Initial Lismore basin level of "zero"
- Browns Creek spillway crest levels as constructed
- Airport Estate filling "as is"
- Caniaba St development filling "as is"
- Wilson St Bridge over Hollingsworth Creek
- Orion St works (as per LiDAR)
- Singhs "popup flood protection barriers"

Figure 8 shows the change in peak flood levels for the 1 in 100yr ARI design flood between the "updated current conditions" (detailed model) and the "previous current conditions" (previous model).

There is a general decrease in flood levels in most of the Lismore CBD of up to 0.07m, with an increase of up to 0.02m in the southern part of the CBD. Peak flood levels in North Lismore increase by approximately 0.07m. In South Lismore, peak flood levels increase by between 0.0m to 0.10m north of the railway, and by 0.05m to 0.2m south of the railway.

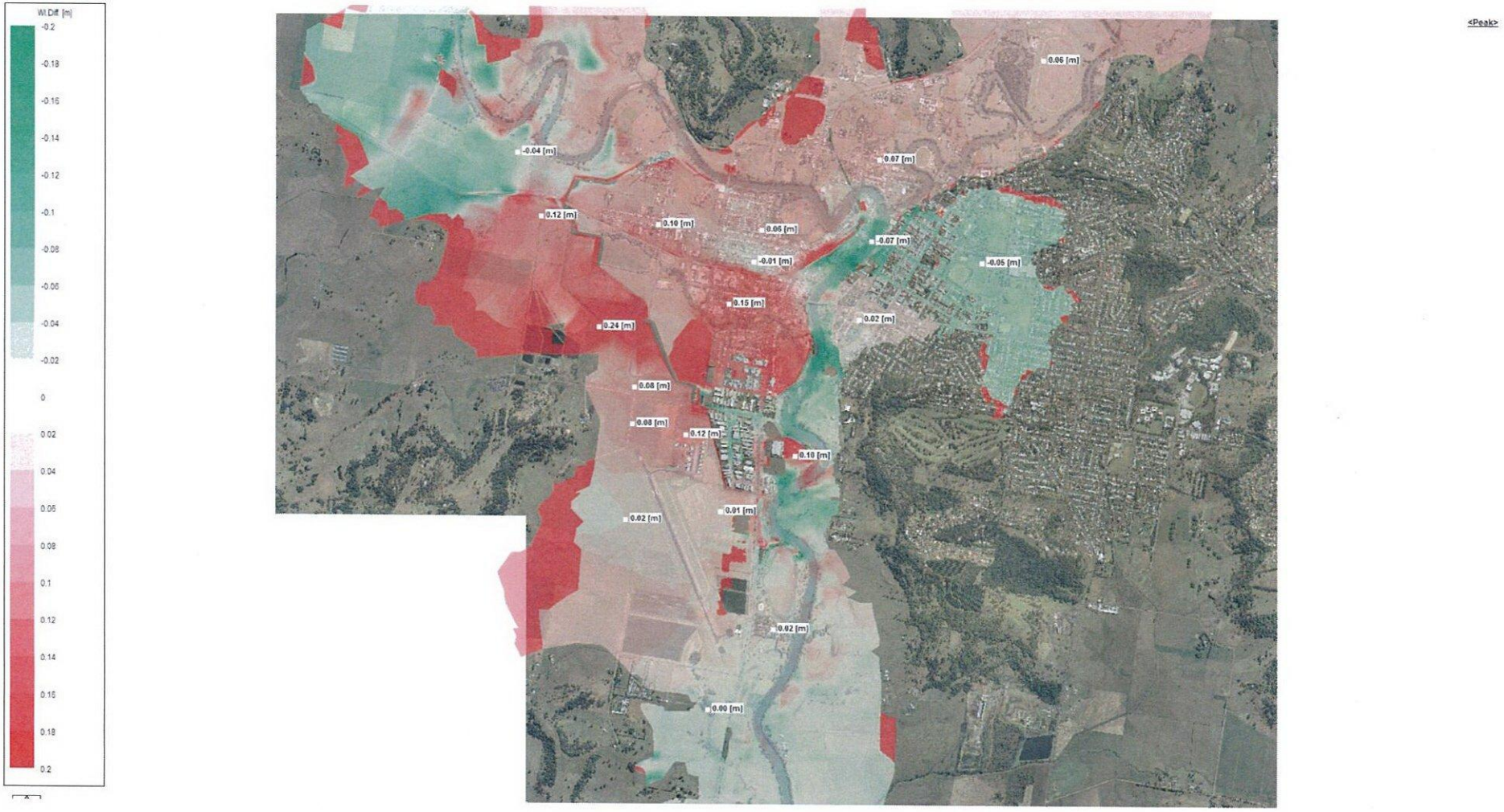

Figure 8 – Change in Peak Flood Levels – Updated Current Conditions MINUS Previous Current Conditions – 100yr ARI Design Flood.

4.4 Approved Development Model

In addition to the floodplain development incorporated into the updated "current conditions" model (section 4.3), a further four developments that have been approved, but not yet constructed, were incorporated into an "approved development" model, reflecting a potential future state of the floodplain.

The *additional* development included in this model network included:

- Airport Industrial Estate (Krauss Ave) as "fully filled"
- North Lismore Industrial Estate Filling
- Floodway Excavation
- Full East and West Caniaba St Filling

Figure 9 shows the change in peak flood levels for the 1 in 100yr ARI design flood as a result of the above developments, compared to the updated existing conditions (section 4.3).

Peak flood levels are reduced across much of Lismore, primarily as a result of the incorporation of the airport floodway excavation. Peak flood levels in the Lismore CBD are reduced by up to 0.09m, and reduced by 0.06m in North Lismore. In South Lismore, peak flood levels are reduced by between 0.08m and 0.1m.

As a result of the additional flow moving down the airport floodway, increases in peak flood levels of up to 0.05m at the airport hangars are evident.

Figure 9 – Change in Peak Flood Levels – Approved Development MINUS Updated Current Conditions – 100yr ARI Design Flood.

5. UPDATED PRELIMINARY FLOODPLAIN CATEGORISATION

The results from the updated "existing conditions" model for the 1 in 100yr ARI and PMF design floods were mapped to the 2m DEM derived from the LiDAR datasets.

The mapped model results were queried to obtain the extents of each hydraulic category as specified in Councils DCP:

- ***Floodway***
  - D > 0.5m **and** V >= 0.85m/s in 1% AEP Design Flood
- ***High Flood Risk***: In 1% AEP Design Flood :
  - 0 < D < 0.5m **and** V >= 1.0m/s, **OR**
  - 0.5 <= D < 1.0m **and** V >= 0.5m/s, **OR**
  - 1.0 <= D <= 1.5m **and** V >= 0.3m/s, **OR**
  - D > 1.5m, **OR**

  Human risk
  - 0.5 <= D <= 3.0m **and** VxD > 1.5 m^2/s **OR**
  - D > 3.0m

  Property risk
- ***Flood Fringe***
  - Those areas not within the above criteria but within the 1% AEP Design Flood extent
- ***Low Flood Risk***
  - Those areas not within the above criteria but within the PMF extent

The categories are based solely on the model outputs. Some interpretation and cadastral matching will be required by Council.

The hydraulic categories have been cropped to the limit of the model. On this note, we wish to highlight that the model *does not* extend into Minaltrie Creek. This was a decision made by Council when the model was first developed.

The updated hydraulic categorisation is shown in Figure 10.

The "updated existing conditions" model (section 4.3) results in some local changes to the hydraulic categorisation developed previously (WorleyParsons report: *It7047cjd090417-Raw Hydraulic Categorisation.pdf* dated 20-4-09), which are due to the finer detail at which the categorisation has been developed. However, on a regional level, the floodplain categorisation is quite similar to the previous categorisation.

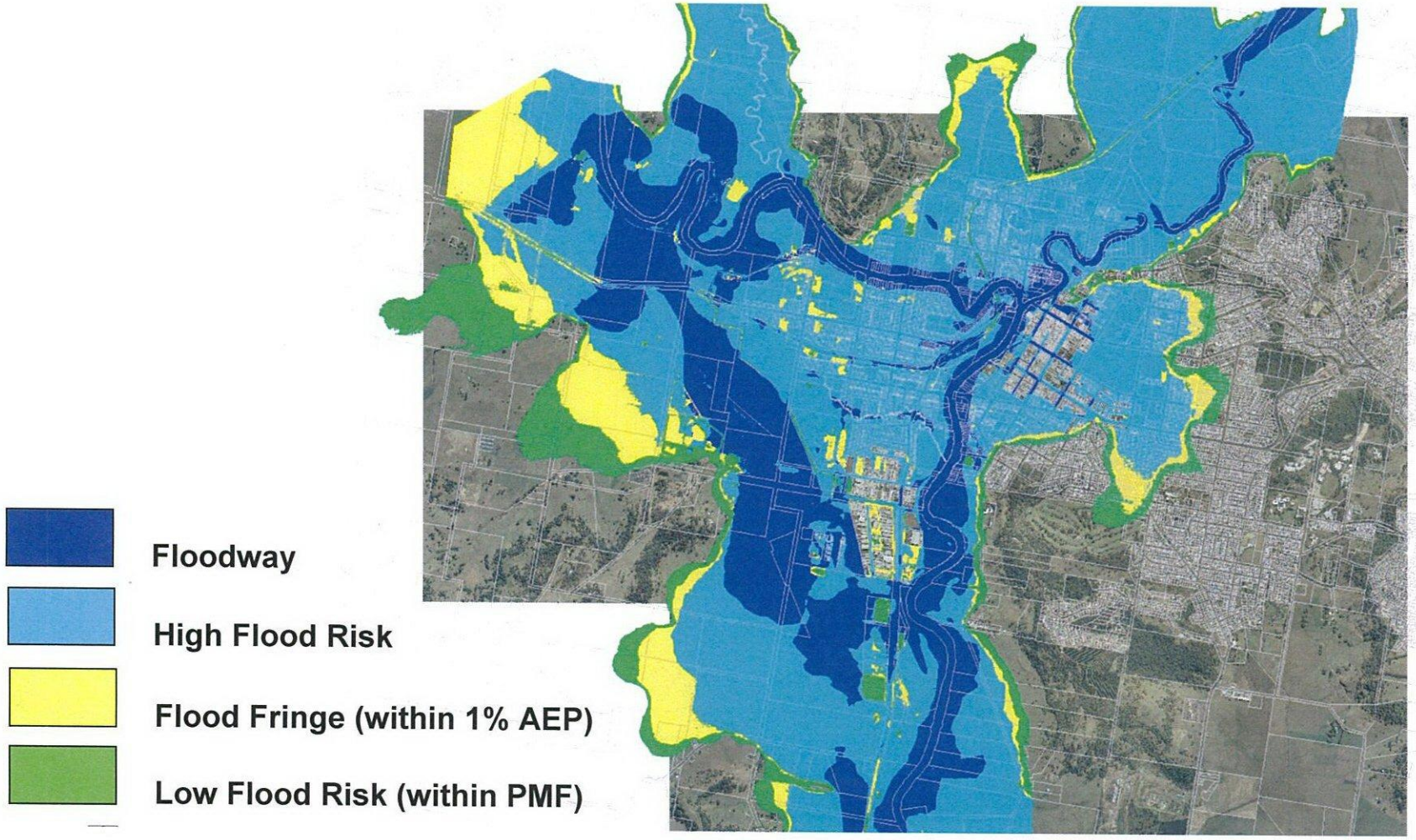

Figure 10 – Preliminary Updated Hydraulic Categorisation

6. GENERAL COMMENTS ON UPDATED MODELLING

Whilst *absolute* modelled flood behaviour across Lismore has changed as a result of incorporating the detail contained in the LiDAR elevation dataset into the model network, the *relative* changes in flood behaviour as a result of floodplain development and mitigation measures are largely unchanged, when "reinvestigated" on the updated model framework.

Significant reductions in general flood levels across much of Lismore are obtainable through the proposed floodway excavation, Additional benefit may be realised through further excavation of the river bank to the east of the Bunnings site. Both of these options have been identified in earlier investigation work with Council.

The updated *preliminary* floodplain categorisation (using Councils criteria) is similar to the previously developed categorisation at a regional level, with some changes to categorisation evident at a local level due to the increased detail at which these categories were able to be determined.