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Lismore City Council

Report for Lismore Tourist Caravan Park

Evaluation of Works to Improve Evacuation Time

November 2010

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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Appendices

1. Introduction

1.1 Background

The Lismore Flood Levee Scheme was officially opened in 2005 to reduce the risk of flooding of the Lismore CBD from the Wilsons River. The Lismore CBD levee was designed to contain the 10 year Average Recurrence Interval (ARI) flood event in the Wilsons River. The Lismore Flood Levee Scheme includes three major pump stations (Hollingworth Creek, Gasworks Creek and Browns Creek Flood Pump Stations) to pump stormwater from the landward side of the levee into the Wilsons River.

This report focuses on the flooding issue associated with the Lismore Tourist Caravan Park, located in the low-lying flood plain of the Browns Creek catchment.

Under normal circumstances, any stormwater generated in the catchment contributes to the flow of Browns Creek, which discharges into Wilsons River between Woodlark St and Zadoc St in the Lismore CBD. The last 400m of Browns Creek drains through a closed stormwater conduit into the Wilsons River. The Browns Creek Flood Pump Station is located at the downstream end of this conduit.

When the water level in the Wilsons River rises above a predetermined level, a radial flood gate at the end of the conduit is closed by the operators. This is to prevent backflow of water from the Wilsons River into the Browns Creek catchment as the river level rises. The pump station switches on when the flood gate closes, allowing stormwater collected within the Browns Creek catchment to be pumped over the levee and into the Wilsons River.

The level of the levee crest at the Browns Creek Flood Pump Station is RL10.95 m AHD. In the event that the water level in the Wilsons River continues to rise, the flood gate is opened again at RL10.95 m AHD to prevent water overtopping the levee.

The Lismore Tourist Caravan Park has a formal evacuation plan, included as part of the lease documents. Residents of the caravan park are generally not holiday, temporary residents but are long-term residents with a low number of occupants owning vehicles. As a result, the evacuation plan involves hiring of commercial tow vehicles to move caravans to temporary locations. It is understood that there could be up to 80 caravans that require towing, and as such, there is a concern for the evacuation time of the caravan park.

Consequently Council on 11 May 2010 resolved inter alia that “Council complete an evaluation of the effectiveness of structural works to extend evacuation time and reduce isolation risk for residents of the Lismore Caravan Park in high rainfall/flood events”.

GHD was engaged by Council to undertake the required evaluation without direction of what “structural works” were envisaged.

This report reviews the information and issues associated with the evacuation time of park occupants to determine what structural or non-structural works may be feasible and result in an improved evacuation time.

1.2 Scope of Works

The scope of this evaluation includes:

- Collecting data and local intelligence on potential outcomes;

- Reviewing previous report/s to confirm applicability of previous modelling; and
- Reassessing previous investigations with a focus on the caravan park and identify what works may be feasible that results in improved evacuation time for the park occupants.

It is not within the scope of works to conduct site inspections or undertake further hydrologic modelling.

2. Relevant Information

2.1 Browns Creek Flood Pump Station Report

The original Browns Creek Flood Pump Station was constructed in 1970. With the construction of the Lismore CBD levee there were concerns for its future performance under the changed operating conditions. An investigation into the operation and performance of the Browns Creek Flood Pump Station was conducted by GHD in February 2006.

Hydrologic modelling using XP-RAFTS computer software was used to investigate the relationship between flood pumping capacity and the flood levels and flood duration in the Browns Creek catchment. The modelling only considered the local flood events, ignoring any affects of the relative timing and duration of regional (Wilsons River) flood events. For this reason, it was assumed that the flood gate was closed for the entire duration of the storm and that Wilsons River does not overtop the CBD levee.

Five pumping rates were investigated, ranging from 4,000 L/s to 8,000 L/s, with 4,000 L/s being the approximate pumping capacity of the original pump station. It was found that increasing the discharge capacity of the pump station from 4,000 L/s to 8,000 L/s would result in a reduction of the peak flood level by 0.6 m to 0.7 m and a reduction in flood duration of 2 to 3 days. The duration of flooding was defined as the duration that the water level in the catchment exceeds RL6.0 m AHD. This is the level in which flood waters in the Browns Creek catchment begin to impact on the Lismore CBD area.

In the absence of building floor level information, 1 m contours were used to get a feel for the number of commercial and residential properties affected by the incremental rise in flood water level. It was determined that the reduced peak flood level achieved by doubling the pump station capacity would only provide protection against inundation to a small number of properties during a 10 year ARI local flood event. For flood events larger than the 10 year ARI flood, the number of properties inundated would be governed by regional flooding rather than local flooding.

Two main evacuation routes were already identified for the low lying flood plains of the Browns Creek catchment area. These are along Ballina Street (lowest level of RL9.8 m AHD) and Keen Street/Leycester Street (lowest level of RL9.5 m AHD). The hydrologic modelling found that maintaining a pump station discharge of 4,000 L/s was sufficient to prevent closure of these two evacuation routes for a 100 year ARI local storm (regional flooding from the Wilsons River was not considered in the hydrologic modelling).

A number of options for upgrading the pump station were investigated and costed, with the recommendations being to undertake additional work in the form of a formal benefit/cost analysis and to refurbish the Browns Creek Flood Pump Station. The Richmond River County Council has since refurbished the Browns Creek Flood Pump Station with the current discharge capacity of the pumps being 4,000 L/s.

2.2 Local Knowledge

In order to better understand the prevailing circumstances during potential inundation events and actual inundation events, discussions were held with the following stakeholders:

- Lismore City Council officers who provided the Flood Evacuation Plan for the Lismore Tourist Caravan Park;

- Representative of Richmond River County Council, Mr Bill Moorehouse; and
- NSW Public Works project managers for the upgrade of the Lismore Levee Scheme (then NSW Department of Commerce).

No contact was made with the SES or police with respect to evacuation protocols.

It is on the basis of this information and the previous Browns Creek Flood Pump Station Report that the views made in this report have been formed.

3. Structural Works Alternatives

Four sensible structural works alternatives have been identified as follows:

- Modify the pump station capacity;
- Construction of flood retardation basins within the Browns Creek catchment;
- Raise the level of the caravan park and associated evacuation route; and
- Construction of a deflection wall around the caravan park.

Each of these is outlined below.

3.1 Modify Existing Browns Creek Flood Pump Station

The previous investigation into the Browns Creek Flood Pump Station focused on flooding of the Lismore CBD, with RL6.0 m AHD being the level at which flood waters in the Browns Creek catchment begin to impact on the Lismore CBD area. The Lismore Tourist Caravan Park is at a lower elevation than the Lismore CBD, with levels ranging from RL5.6 to 6.0 m AHD. The outcomes from the previous investigation resulted in the pump capacity of Browns Creek Flood Pump Station being maintained at 4,000 L/s as this satisfied the then objectives to maintain escape routes in Ballina St and Keen St for acceptable periods. The feasibility of increasing the pump capacity and its effectiveness in increasing the evacuation time of the Lismore Tourist Caravan Park occupants is discussed below.

The previous hydrologic modelling found that increasing the pump capacity has limited benefit in flood level reduction. The RAFTS modelling results for a 10 year ARI storm are shown in Table 3-1. The results show that doubling the capacity of the pumps to 8,000 L/s results in a 0.6 m reduction in peak water level (to RL7.46 m AHD) but to a level still above the caravan park level.

This together with the following points deems the further upgrade of the Browns Creek Flood Pump Station to be not a viable solution to improve evacuation times:

- With the flood gate closed there is very little storage available within Browns Creek below RL6.0 m AHD for additional pumping capacity to make a material impact on localised flood events affecting the caravan park. Table 4.3 in Appendix A provides the flood storage volumes for Browns Creek in tabular format. The inference of this data is that the inflow into the catchment for the rainfall events investigated cannot be stored and cannot be removed quickly enough to prevent inundation. That is, it will not be feasible to provide a pump large enough to prevent inundation of the Caravan Park.
- As previously reported a doubling of the capacity of the pumps would require significant expenditure in the purchase of pumps of such a large size, and in bringing a new power supply to site, the availability of which is unknown; and
- There is always the risk that the Browns Creek Flood Pump Station will not be available to run due to power outage, which is a possibility during flood events resulting from cyclonic conditions.

Table 3-1 RAFTS Modelling Results[1]

Storm ARI (years)	Pump Rate (m^3/s)	Peak Water Level in Catchment (m AHD)	Peak Flood Duration (days)
10	4	8.07	3.4
	5	7.84	2.7
	6	7.69	2.0
	7	7.58	1.4
	8	7.46	1.2

[1] Results are a selection from Table 4.4 in GHD (2006), *Richmond River County Council - Report for Browns Creek Flood Pump Station*

3.2 Retardation Basins

A second structural option in order to increase evacuation time available to the park occupants is the construction of retardation basin/s in key locations in the Browns Creek catchment. Retardation basins are small dams constructed within a catchment for the temporary storage of stormwater runoff. They are designed to delay the downstream flood peaks by storing runoff.

Three locations within the catchment have been identified as potential sites for a retardation basin. These locations have been located to pick up flows from sub-catchments within Browns Creek catchment identified in the previous investigation (see Appendix A Figure 4.1). The locations identified are as follows:

- On the southern side of Eden Place, within the Lismore Golf Course (sub-catchment A);
- On the southern side of Uralba Street, in one of the sports fields (sub-catchment B and C); and
- In the sports fields south of Orion Street (sub-catchment D).

Some points to consider in regard to these locations is the public opposition to loss of land within Lismore Golf Course and the loss of use of the sports fields following rain events as they may not drain and dry out relatively as quickly as may now be the situation.

It is considered that the main cause of flooding within the Browns Creek catchment is water building up behind the gate once it is closed. Additional inflow from the sub-catchments is not considered to be the main cause of the flooding, and hence retardation basins are not expected to have a significant effect on the available evacuation time for park occupants. However, no additional hydrologic modelling has been undertaken at this stage to verify this conclusion.

To confirm one way or the other the viability of retardation basins it is recommended that the retardation basins be included in the existing XP-RAFTS model to determine the required size of and efficacy of retardation basins in achieving additional evacuation time. It is important to model the regional and local flood events because depending on the relative timing and duration of these events, delaying the downstream flood peak of the local storm could worsen the overall situation.

3.3 Raise Lismore Tourist Caravan Park Level

Raising the level of the caravan park to allow more time for evacuation of park occupants is another option considered. The local evacuation routes would also have to be raised in order to allow evacuation of park occupants.

The Lismore Tourist Caravan Park is situated in the flood plain of Browns Creek Catchment. Raising the level of the caravan park would reduce the storage available in the flood plain, resulting in afflux of flood water. Without hydrologic modelling the increase in the peak flood level and the additional number of properties affected is unknown. The extent of flood inundation within the catchment with water levels at RL6, 7, 8 and 9 m AHD are shown in Figure 4.5 (attached in Appendix A).

Compensatory earthworks in the catchment could be considered to off-set the fill required to raise the park level and maintain current flood level conditions. However significant fill volumes would be required to give similar immunity as the Keen St and Ballina St escape routes. Compensatory earthworks could be taken from sports fields at the corner of Magellan and Brewster Streets and at the corner of Orion and Brewster Streets between RL7.0 and 8.0 m AHD.

Raising the evacuation route (parallel with Dawson St) together with raising the park itself will create an unnatural impediment to flood water flow in these lower reaches of the catchment.

Again, to confirm the viability of this option further hydrologic modelling would be required.

Raising the level of the caravan park may set an unacceptable precedent of being able to build in flood plains.

3.4 Deflection Wall

The construction of a deflection wall around the perimeter of the Lismore Tourist Caravan Park has been considered as an option to improve the evacuation time of park occupants in the event of rising waters in Browns Creek due to rising levels in Wilsons River. The deflection wall would be in the form of an earth mound or similar constructed along the south (Uralba Street) and west sides (Dawson Street) of the caravan park.

The Lismore Tourist Caravan Park would effectively be removed from the flood plain, potentially resulting in an increase in the flood waters outside of the deflection wall. Similar to raising the level of the caravan park (see section 3.3 above), further hydrologic modelling is required to determine the increase in peak flood level and the additional number of properties affected by construction of the deflection wall. Compensatory earthworks could be considered to maintain current flood level conditions.

The deflection wall as described above would not protect the Lismore Tourist Caravan Park from runoff generated in Catchment D of the Browns Creek Catchment (see Figure 4.1 in Appendix A). Runoff generated within the catchment of the deflection wall would need to be removed. A flood pump station would be required behind the deflection wall to pump stormwater during flood events either into Browns Creek or Wilsons River.

From local catchment flood hydrographs given in the Report for Browns Creek Flood Pump Station (GHD, 2006), the gained evacuation time for two deflection wall heights has been approximated. The results are shown in Table 3-2.

Table 3-2 Additional Evacuation Time Approximated from Catchment Flood Hydrographs

Height of Deflection Wall (m AHD)	Additional Evacuation Time (mins)
6.0	36
7.0	115

It is important to note that the additional evacuation times above are approximations only, as additional hydrologic modelling has not been conducted. The required height of the deflection wall to allow a sufficient improvement to evacuation time of park occupants would need to be determined using hydrologic modelling. The feasibility of the deflection wall in terms of height and footprint would also need to be determined.

It is expected that diversion drainage works to existing flow paths within the catchment would be required to prevent additional stormwater entering the deflection wall catchment.

The entrance to the Lismore Tourist Caravan Park would need to be relocated further north along Dawson Street, as the deflection wall would block the current entrance.

4. Non-Structural Alternatives

The Local Emergency Management Committee has made the recommendation to close the caravan park after evacuation problems were encountered during the flood of June 30, 2005 (Lismore City Council (2005), *Lismore Flood Levee Scheme – Report of June 30, 2005 Flood*).

More recently in May 2010 Council considered three options for the future of the park (do-nothing, relocate it or close it) from which critical governance and regulatory issues were identified. This prompted the requirement for this report and concurrently the undertaking, by others, of "social impact assessment of the closure and work with appropriate agencies to relocate the residents".

Consequently comment on non-structural alternatives for the parks future is outside the scope of this report.

5. Conclusions and Recommendations

5.1 Conclusions

Four structural works solutions were evaluated in terms of their feasibility in providing additional evacuation time to the Lismore Tourist Caravan Park occupants.

1. Increasing the capacity of the existing Browns Creek Flood Pump Station is not considered a feasible option due to the large costs associated with it for marginal benefit (a 0.6 m reduction in peak water level).
2. Three locations have been identified as possible locations for retardation basins within the Browns Creek catchment. These locations may be met with public opposition due to loss of land for other requirements. Additional hydrologic modelling has not been undertaken, however from general knowledge of the catchment, additional inflows from Browns Creek catchment is not seen to be the main cause of flooding so retardation basins may not provide much if any additional evacuation time.
3. Raising the level of the Caravan Park and local evacuation routes would reduce the storage in the catchment, causing the peak flood level to increase affecting additional properties within the catchment. Compensatory earthworks in the catchment may have a mitigating effect on increases in flood water levels. It would also set an unacceptable precedent of work being entertained in flood plains.
4. Construction of a deflection wall on the south and west sides of the Caravan Park would result in afflux and increase the number of properties affected within the catchment. The deflection wall would not protect the Caravan Park from runoff generated within Catchment D of the Browns Creek Catchment. A flood pump station would be required to remove stormwater runoff generated within the catchment formed by the deflection wall.

5.2 Recommendations

Based on these conclusions, it is recommended that:

- Lismore City Council consider undertaking further hydrologic modelling to determine if retardation basins would be feasible in improving the evacuation time for park occupants;
- Lismore City Council consider undertaking further hydrologic modelling to determine if raising the park level and carrying out compensatory earthworks would provide any improvement to the evacuation time for park occupants;
- Lismore City council consider undertaking further hydrologic modelling to determine if the construction of a deflection wall and carrying out compensatory earthworks would improve evacuation time for park occupants, and at what height the deflection wall is feasible.

6. References

1. GHD (2006), Richmond River County Council - Report for Browns Creek Flood Pump Station
2. Lismore City Council (2005), *Lismore Flood Levee Scheme – Report of June 30, 2005 Flood*, Memorandum from Group Manager – City Works to Local Emergency Management Officer, T. Kohlenberg, July 2, 2005

Appendix A

Extract from Report for Browns Creek Flood Pump Station (GHD, February 2006)

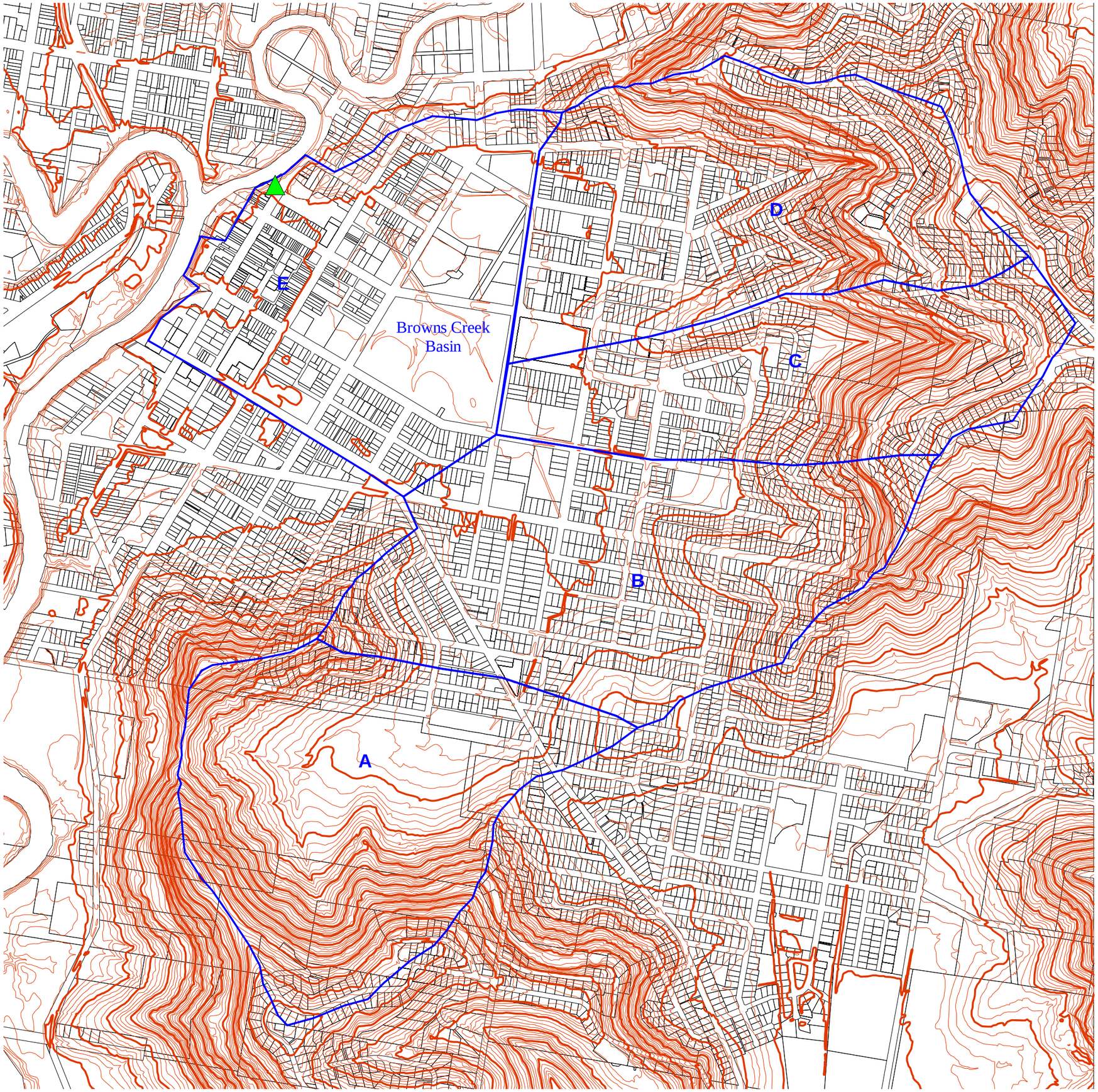
TABLE 4.3 Flood storage volumes in the Browns Creek basin

FIGURE 4.1 RAFTS Model Layout

FIGURE 4.5 Flood Inundation Extent

Table 4.3 Flood storage volumes in the Browns Creek basin

Level (m AHD)	Volume (m^3)
0.0	0
2.0	147
2.5	889
3.0	1,995
3.5	3,959
4.0	6,535
4.5	10,167
5.0	15,042
5.5	25,531
6.0	46,334
6.5	111,513
7.0	200,765
7.5	329,487
8.0	485,314
8.5	692,777
9.0	940,191
9.5	1,280,928
10.0	1,710,411



BROWNS CREEK FLOOD PUMP STATION INVESTIGATION REPORT

FIGURE 4.1
RAFTS Model Layout

LEGEND:

- Pump Station
- RAFTS Sub-Catchment
- Major Contour (10 m interval)
- Minor Contour (2 m interval)

North

0 200 400 600 800
METRES

Source Information: GIS data supplied by Lismore City Council.

GHD MANAGEMENT ENGINEERING ENVIRONMENT

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BROWNS CREEK FLOOD PUMP STATION INVESTIGATION REPORT

FIGURE 4.5
Flood Inundation Extent

LEGEND:

- Pump Station
- EL 6 m AHD contour
- EL 7 m AHD contour
- EL 8 m AHD contour
- EL 9 m AHD contour

North

0 50 100 150 200
METRES

Source Information: GIS data supplied by Lismore City Council.

GHD MANAGEMENT ENGINEERING ENVIRONMENT

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