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1. CATCHMENT AREA

The catchment rises in hilly country to the south of the town and flows through urbanised areas before discharging into the Cudgegong River to the north. The catchment is bordered by Palermo Road to the south, Cox Street to the west and Church Street to the east and has a total catchment area of 225 ha.

Urban development in the upper reaches of the catchment above Madeira Road has resulted in a large proportion of the natural creek system being piped. A network of inlet pits collects stormwater runoff and directs it towards existing open-space land to the east of Oporto Road. Runoff then flows as overland flow in a northerly direction within a wide grassed drainage swale which passes through the grounds of the Cudgegong Valley Public School. In 1999 Council constructed improvements to the stormwater system in the school grounds.

Previously, in the 1980s, Council constructed a large detention basin on the northern side of Madeira Road within the grounds of the Mudgee Showground. The retarding basin controls approximately 113 ha of catchment and attenuates stormwater flows from the largely urbanised upper reaches of the catchment. The catchment area controlled by the basin represents half the total catchment area of Catchment C.

The outlet to the basin consists of a 600 RCP located within a drop inlet. The invert of the basin is set approximately 0.5 m above the invert of the 600 RCP. A vertical section of 1025 RCP acts as a secondary outlet to the basin with the top of the pipe set approximately 3.2 m above the invert of the 600 RCP. At embankment crest level, approximately 3.6 m above the invert of the 600 RCP, the volume of storage is around 26,000 m$^3$. This volume of storage is equivalent to a depth of 30 mm of runoff from the catchment.

Downstream of the basin a large proportion of the creek invert has been protected by a concrete dish drain to reduce the extent of erosion within the creek.

Between Madeira Road and Douro Streets there are five road crossings. In addition the creek crosses the railway line in a culvert which conveys 100 year ARI flows without surcharging.

In the vicinity of Victoria Park stormwater flows surcharge the box culvert under Perry Street in the event of flows greater than 5 year ARI and follow the street system towards Douro Street. The presence of a raised gutter, central road island and a natural slope on the road to the north results in overflows being directed along the road acting as a floodway. Water flows in a northerly direction along Douro Street and gradually finds its way back to the creek system via Gladstone and Mortimer Streets as overland flow.

Downstream of Douro Street, many of the road crossings consist of old brick archway and oval construction. Between Mortimer and Market Streets, Council has constructed a concrete channel.

On the downstream side of Short Street which fronts the Cudgegong River floodplain, a gabion sill and trashrack arrangement has been constructed to dissipate energy and capture gross solids which have entered the creek system. A low flow pipe conveys trickle flows beneath a grass-lined channel that passes through Walkers Sports Complex and on to Court Street. To the west of Court Street the creek is joined by flows from Catchment B before flowing into the Cudgegong River.
The influence of 100 year ARI main river flooding from the Cudgegong River extends to Short Street. Upstream of Short Street the slope of the drainage system is such that the river has little to no effect on main channel flooding and flooding within the catchment is controlled by short duration local catchment storm events.
2. HYDROLOGIC MODELLING

2.1 Model Setup

Figure 2.1 shows the arrangement of sub-catchments and drainage links used to define the hydrologic computer model of Catchment C. The model extended downstream to the culverts under Court Street. Downstream of Court Street, Catchment B joins the watercourse of Catchment C before flowing into the Cudgegong River.

The retarding basin located within the Mudgee Showground was incorporated in the model with basin parameters being computed using data supplied by Council (Plan No. M 376: Sheets 1 and 2).

2.2 Model Results

Results of the hydrologic modelling indicate that, for the majority of the piped and open channel reaches within the catchment, storm durations of 20 to 25 minutes are critical. Table 2.1 gives peak discharges within the main channel system for the critical storm duration between Lisbon Road and the Cudgegong River.

In the steeper upper reaches of the catchment, upstream of Madeira Road, the DRAINS model indicates that surcharging of the piped drainage system is likely for the 5 year ARI. This is due mainly to insufficient flow capacity in the pipe network in the vicinity of Lowana Close and Lisbon and Norman Roads.

Large volumes of water can be expected to traverse Oporto Road as overland flow which then makes its way to the detention basin via Madeira Road. This overland flow is fed by surcharge flows from the catchments to the west of Oporto Road, between Havilah Terrace and Madeira Road.

Within the detention basin, the 60 minute storm is the critical duration as far as peak storage levels are concerned. This is due to the increased volume of stormwater runoff produced by the longer duration storm. The increased head of water within the basin storage also produces outflows which are larger than the shorter 20 minute storm. These effects extend for only a short distance downstream, to around Nicholson Street, before flows from the shorter duration storm once again become larger.

Table 2.2 shows the performance of the basin for the 20 and 60 minute storm events. The basin significantly reduces stormwater flows. Peak storage levels within the basin are below the inlet to the secondary basin outlet for all storm events excluding the 60 minute, 100 year ARI event.

As discussed in Section 1, the basin controls approximately half of the total catchment and therefore it has a significant effect on flows within the downstream channel. Downstream of the basin, peak flows do not exceed inflows to the basin until Douro Street is reached for the 5 and 20 year ARI events and until Market Street for the 100 year ARI event.
### TABLE 2.1
**PEAK DISCHARGES**
**EXISTING (2008) CONDITIONS**
(m³/s)

<table>
<thead>
<tr>
<th>Location</th>
<th>5 year ARI 20 min</th>
<th>20 year ARI 25 min</th>
<th>100 year ARI 20 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lisbon Road</td>
<td>0.8</td>
<td>1.18</td>
<td>2.62</td>
</tr>
<tr>
<td>Oporto Road</td>
<td>1.44</td>
<td>1.8</td>
<td>4.35</td>
</tr>
<tr>
<td>Inflow to Detention Basin</td>
<td>5.7</td>
<td>7.9</td>
<td>15.96</td>
</tr>
<tr>
<td>Outflow from Detention Basin</td>
<td>0.86</td>
<td>1.0</td>
<td>1.3</td>
</tr>
<tr>
<td>Nicholson Street</td>
<td>2.46</td>
<td>3.19</td>
<td>5.17</td>
</tr>
<tr>
<td>Perry Street</td>
<td>3.42</td>
<td>4.51</td>
<td>7.2</td>
</tr>
<tr>
<td>Douro Street</td>
<td>5.74</td>
<td>7.14</td>
<td>11.4</td>
</tr>
<tr>
<td>Market Street</td>
<td>7.6</td>
<td>9.3</td>
<td>14.5</td>
</tr>
<tr>
<td>Court Street</td>
<td>9.55</td>
<td>11.9</td>
<td>18.7</td>
</tr>
</tbody>
</table>

### TABLE 2.2
**PERFORMANCE OF EXISTING DETENTION BASIN**

<table>
<thead>
<tr>
<th></th>
<th>5 year ARI</th>
<th>20 year ARI</th>
<th>100 year ARI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20 min.</td>
<td>60 min.</td>
<td>25 min.</td>
</tr>
<tr>
<td>Peak Inflow (m³/s)</td>
<td>5.7</td>
<td>4.8</td>
<td>7.9</td>
</tr>
<tr>
<td>Maximum Depth of Ponding (m)</td>
<td>2.0</td>
<td>2.24</td>
<td>2.4</td>
</tr>
<tr>
<td>Peak Outflow (m³/s)</td>
<td>0.86</td>
<td>0.92</td>
<td>1.0</td>
</tr>
</tbody>
</table>
Figure 2.1

DRAINS MODEL LAYOUT

LEGEND
- Sub-Catchment Boundary
- Sub-Catchment Number
- Drainage Reach

MUDGEE LOCAL CREEKS
FLOOD BEHAVIOUR STUDIES - CATCHMENT C
Figure 2.1
DRAINS MODEL LAYOUT
3. HYDRAULIC MODELLING

3.1 Model Setup

The channel was modelled over the 2.6 km reach from Lisbon Street to the confluence with the stream draining Catchment B, approximately 60 m downstream of Court Street.

Bridges and culverts were incorporated into the model at locations where either road or railway lines crossed the creek. Table 3.1 gives details of the bridge/culvert arrangements for each crossing modelled and the hydrologic standard in terms of the flood ARI which can be conveyed without significant surcharging.

3.2 Cudgegong River Flood Levels

Peak 100 year ARI flood level in the Cudgegong River is RL 447.6. The influence of river flooding would extend to the downstream side of the Short Street crossing.

<table>
<thead>
<tr>
<th>Location</th>
<th>Opening</th>
<th>Waterway Area (m²)</th>
<th>Approx. Capacity (ARI years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Madeira Road</td>
<td>1 off 1200x600 RCBC</td>
<td>0.7</td>
<td>&gt; 5</td>
</tr>
<tr>
<td>Nicholson Street Footbridge</td>
<td>2 off 900x450 RCBC</td>
<td>0.8</td>
<td>&lt; 5</td>
</tr>
<tr>
<td>Nicholson Street</td>
<td>2 off 900x450 RCBC</td>
<td>0.8</td>
<td>&lt; 5</td>
</tr>
<tr>
<td>Main Railway</td>
<td>Piered Bridge</td>
<td>5.4</td>
<td>&gt; 100</td>
</tr>
<tr>
<td>Railway Siding</td>
<td>Bridge</td>
<td>2.7</td>
<td>&gt; 100</td>
</tr>
<tr>
<td>Inglis Street</td>
<td>3 off 600 RCP</td>
<td>0.9</td>
<td>&gt; 5</td>
</tr>
<tr>
<td>Horatio Street</td>
<td>1 off 2400x1300 Concrete Ellipse</td>
<td>2.5</td>
<td>100</td>
</tr>
<tr>
<td>Perry Street</td>
<td>1 off 1800x600 RCBC</td>
<td>1.1</td>
<td>&gt; 5</td>
</tr>
<tr>
<td>Gladstone Street</td>
<td>1 off 2400x1300 Concrete Ellipse</td>
<td>2.5</td>
<td>20</td>
</tr>
<tr>
<td>Mortimer Street</td>
<td>1 off 2400x1300 Concrete Ellipse</td>
<td>2.5</td>
<td>20</td>
</tr>
<tr>
<td>Market Street</td>
<td>1 off 2500x1800 Brick Arch</td>
<td>3.5</td>
<td>100</td>
</tr>
<tr>
<td>Short Street</td>
<td>1 off 3050x1050 RCBC</td>
<td>3.2</td>
<td>&lt; 5</td>
</tr>
<tr>
<td>Court Street</td>
<td>1 off 3000x1700 RCBC</td>
<td>5.1</td>
<td>&lt; 5</td>
</tr>
</tbody>
</table>
3.3 Model Results

3.3.1 General

Water surface profiles for the 5, 20 and 100 year ARI events and the PMF are shown on Figure 3.1. Indicative extents of inundation are shown on Figure 3.2.

3.3.2 Upstream of Detention Basin

At Madeira Road, the presence of a small drop inlet pit results in only trickle flows being conveyed beneath the road. Additionally, the road is set only around 200-300 mm above surrounding natural surface, leading to a large length of road becoming inundated.

3.3.3 Detention Basin to Perry Street

Downstream of the basin, the channel is overgrown with macrophytes, but due to the large reduction in stormwater flows produced by the basin, the creek is capable of conveying flows up to the 100 year ARI. Approximately 50 m upstream of Nicholson Street the channel reduces in size and the overbanks slope away from the stream. Surcharging flows leave the channel and on the right bank to the east of the channel, overbank flows make their way to Atkinson Street and flow into Nicholson Street, where they join flows surcharging the culvert under Nicholson Street.

Nicholson Street is set approximately 1 m below the elevation of the upstream channel banks. The culverts beneath the roadway and the footbridge upstream of the road have insufficient capacity to convey 5 year ARI flows. The presence of the roadway and insufficient capacity of the road culverts lead to flows spreading over a wide front along the length of the road.

Downstream of Nicholson Street, the channel has sufficient capacity to convey flows up to the 100 year ARI. Both the main railway and railway siding openings have sufficient capacity to convey flows up to the 100 year ARI.

At Inglis Street, the capacity of the 3 x 600 RCPs is sufficient to convey the 5 year ARI. The road is surcharged for greater floods.

Between Inglis and Horatio Streets, the channel is capable of conveying flows up to the 100 year ARI. Surcharging of the left bank immediately upstream of Horatio Street occurs for the 100 year ARI event, as water ponds behind the road.

Between Horatio and Perry Streets, the well defined drainage channel confines flows within the banks to Perry Street, where the capacity markedly reduces and stormwater flows surcharge the system.

3.3.4 Perry Street to Mortimer Street

At Perry Street, the 1800 x 600 RCBC has a capacity around the 5 year ARI and stormwater flows surcharge the channel and flow north along that street. From Perry Street, overland flows enter Denison Street, where they pond within low lying areas located on either side of the road. When this storage is full, floodwaters enter Douro Street and flow along the eastern gutter. The presence of a raised western gutter and central island along Douro Street, leads to floodwaters making their way further to the north rather than re-entering the open channel. The water which
flows along Douro Street would follow the natural slope of the catchment to the north and eventually find its way back into the main channel via Gladstone Street.

Within the main channel between Douro Street and Gladstone Street the modelling has been undertaken assuming that all of the flow is conveyed along the creek in this reach. However, under present day conditions, surcharge would occur further upstream, at Perry Street, and some of the discharge would be conveyed along the road system. The flow in the channel may be less than the full 100 year ARI discharge.

The reach of channel downstream of Douro Street is influenced by backwater flooding from Gladstone Street for the 20 year ARI event and larger. The channel has insufficient capacity to convey the 5 year ARI event which surcharges both the left and right channel banks. At Gladstone Street, ponding of stormwater flows will occur for the 20 year ARI event without overtopping of the road. For greater flood events, the presence of a brick fence impedes flows, and floodwaters are forced to outflank the fence before surcharging the roadway.

Backwater influences from Mortimer Street extend approximately 50 m upstream of the road culvert, and lead to the channel surcharging its banks for the 5 year ARI. The 20 year ARI discharge ponds behind the roadway but does not surcharge it. Upstream of the road, the left and right banks are confined by development and this reduces the effective waterway area. The floodwater spreads out and affects upstream residences.

### 3.3.5 Mortimer Street to Court Street

Approximately 50 m downstream of Mortimer Street, Council has constructed a concrete channel which extends as far as Market Street. At its most upstream end, the channel is approximately 2 m wide with vertical sides between 600-900 mm in height. The capacity of the concrete channel in this area is less than the 5 year ARI discharge. Overtopping of the right bank occurs with depths of flooding of 100-400 mm being experienced for a distance of approximately 70 m. The left bank of the channel is approximately 300 mm higher than the right and consequently is surcharged at the 100 year ARI event only.

At a location approximately 80 m upstream of Market Street, the concrete channel widens to around 2.7 m. The left bank of the channel remains vertical while the right bank grades back to existing surface levels. The capacity of the larger channel is in excess of the 20 year ARI. Portion of the 100 year ARI discharge is conveyed outside the extent of the channel due to backwater effects from the Market Street culvert.

At Market Street, the culvert causes a backwater effect for all flood events modelled. For the 5 year and 20 year ARI events, the backwater influence extends upstream approximately 30 m and 50 m respectively. At the 100 year ARI, ponding to road level occurs upstream of the culvert, and the backwater effect extends upstream to the transition on the concrete channel.

Downstream of Market Street, the dish drained concrete channel has low banks which are surcharged at the 5 year ARI.

The capacity of the culverts at Short Street is insufficient to convey the 5 year ARI flood and floodwaters bypass the culvert and flow to the east and across the road. Downstream of the culvert, floodwaters enter the Cudgegong River floodplain.
3.4 Impact of Access Bridges and Fences

There are property access bridges across the creek downstream of Douro Street which have the potential to exacerbate flooding problems should they be blocked by debris. These bridges have been incorporated in the hydraulic model but the probability of blockages are difficult to assess in a quantitative manner. In general it is considered there are alternative overland flow paths via the creek overbanks to cater for flows which surcharge the channel and it is not necessary to recommend removal of any of the bridges.

Inter allotment fences of residential allotments have the potential to block flows at several locations along the length of the main drainage line. The brick wall on the southern side of Gladstone Street in conjunction with fences bordering the creek result in restrictions to flow. Given the fact that most of the creeks are in private ownership in Mudgee it may be difficult for Council to remove obstructions such as the brick wall.

Council’s existing Flood Policy DCP which was developed during the preparation of the Mudgee Floodplain Management Study, 2002 incorporates requirements for fencing. It should be enforced to ensure that future development does not have the potential to reduce the capacity of the system and there are clearly defined overland flow paths in the event of blockage from debris.
The extents of inundation shown were determined from surveyed cross sections of the creek and floodplain and available data and are approximate only. The extent of inundation of individual allotments near the flood fringe should be confirmed by site specific survey.
THE EXTENTS OF INUNDATION SHOWN WERE DETERMINED FROM SURVEYED CROSS SECTIONS OF THE CREEK AND FLOODPLAIN AND AVAILABLE DATA AND ARE APPROXIMATE ONLY. THE EXTENT OF INUNDATION OF INDIVIDUAL ALLOTMENTS NEAR THE FLOOD FRINGE SHOULD BE CONFIRMED BY SITE SPECIFIC SURVEY.
4. IMPACTS OF FLOODING ON EXISTING DEVELOPMENT

4.1 Impact on Residential Property

Floor levels of 41 properties bordering the creek downstream of the detention basin were surveyed in Perry, Horatio, Denison, Douro, Gladstone, Mortimer, Market and Short Streets.

An indicative assessment of the numbers of properties which would be affected by PMF flooding was also carried out by relating the extents of flooding to aerial photography and the 2 m contour mapping. Tables 4.1 and 4.2 show the results.

At the 100 year ARI flood magnitude, comparison of computed flood levels with surveyed floor levels indicated that 13 residential allotments would be flooded, although floodwaters would not exceed floor levels of the houses. Two sheds in the school would be flooded and a commercial property downstream of Short Street would be flooded above floor level.

In the February 2003 flood, which on the basis of recorded rainfall depths could have been a flood greater than a 100 year ARI event only one residence was reported to have been flooded. This indicates that residents are able to exclude shallow flooding from houses by closing doors and covering openings prior to the ingress of floodwaters. Flooding is of a “flash flooding” nature and quickly recedes after the cessation of heavy rainfall.

### TABLE 4.1
IMPACTS OF FLOODING ON RESIDENTIAL DEVELOPMENT
CATCHMENT C

<table>
<thead>
<tr>
<th>Flood ARI</th>
<th>Number of Properties</th>
<th>Flood Damages $ x 10^3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flood Affected</td>
<td>Flood Damaged</td>
</tr>
<tr>
<td>20</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>100</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>PMF</td>
<td>130</td>
<td>20</td>
</tr>
</tbody>
</table>

Flood Affected = Flooding in Allotments + Residences Flooded above floor level.
Flood Damaged = No. of Residences flooded above floor level.

### TABLE 4.2
IMPACTS OF FLOODING ON COMMERCIAL DEVELOPMENT
CATCHMENT C

<table>
<thead>
<tr>
<th>Flood ARI</th>
<th>Number of Properties</th>
<th>Flood Damages $ x 10^3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flood Affected</td>
<td>Flood Damaged</td>
</tr>
<tr>
<td>20</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>100</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PMF</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>
5. **DRAINAGE IMPROVEMENTS**

5.1 **Introduction**

Because the creeks are in private ownership it would be difficult for Council to implement a large scale channel improvement scheme on Catchment C. Options for drainage improvements would therefore appear to be restricted to the implementation of detention basins to reduce downstream flood peaks, or increasing the hydraulic capacity of culverts at road crossings to reduce upstream ponding in residential allotments.

It is to be noted that the evaluation of the following options is of a preliminary nature only. More detailed analyses need to be undertaken to confirm the feasibility of these proposals and to advance their designs.

5.2 **Potential Detention Basins**

Catchment C has been largely urbanised and there is little opportunity to construct a detention basin of sufficient size which could offer flood mitigation benefits to the open channel to the north of the railway.

The impact of a basin upstream of Perry Street, with the storage extending into Victoria Park, is discussed in Section 5.3.3, in conjunction with upgrading the culvert beneath Perry Street. It is concluded that the storage option is worth further consideration. However survey of the area would be required to advance the initial analysis.

5.3 **Improvements to Culvert and Channel Capacity**

5.3.1 **Nicholson Street**

Nicholson Street is a low level crossing where natural surface levels rise considerably above the road level. To prevent flooding at the crossing, the road would need to be raised significantly and the pipe size beneath the road increased. Unfortunately, there does not appear to be the opportunity for directing floodwaters, which have surcharged the channel system upstream of the road to the head of the culverts and consequently raising the road would cause flooding in other locations.

The cost of undertaking such works may not be justified in view of the relatively small effects of existing flooding on surrounding properties. It may be preferable to leave the road in its existing condition and allow flood flows to surcharge the road. Some minor banking already exists on the downstream side of the road which helps to direct flood waters back into the channel system. If flooding on the downstream side of the road is considered a problem, then additional banking may be provided to further concentrate flows in the downstream channel.

5.3.2 **Inglis Street**

Upstream of Inglis Street hydraulic modelling shows that the channel system has sufficient capacity to convey the 100 year ARI discharge. The 3 x 600 RCPs at Inglis Street have the capacity to convey the 5 year ARI flow. For larger flows stormwater would surcharge the pipes and flow over the road.
The option was analysed where the waterway area beneath the road was increased by replacing the existing pipes with 2x1800x600 RCBCs. This arrangement would be capable of conveying discharges up to 20 year ARI. A low bank, about 200 mm, above the top of the culverts would be required to produce sufficient head to drive the 20 year ARI discharge through the culverts. Overtopping of the roadway could be expected for the 100 year ARI event. However, improvements at this location would not be given a relatively low priority as the impacts of flooding on upstream development are not great. It has not been included as an Option for further consideration.

### 5.3.3 Perry Street

Major overflows of the main channel system occur at Perry Street in the vicinity of Victoria Park. Flows would surcharge the 1800 x 600 RCBC for flood events greater than 5 year ARI and be conveyed into the road network which would acts as a floodway (as mentioned in Section 3.3.4). By increasing the size of the culverts between Perry and Douro Streets the frequency of surcharging could be reduced. However, given the length of pipeline required, around 300 m, and the route it takes through several properties, this option would be expensive and difficult to implement.

An alternative option assessed was to reduce the frequency of surcharging at Perry Street by promoting ponding of floodwaters at the head of the culvert. Banking works would be required to achieve the necessary ponding and could be located within the wide road reserve upstream of the culvert. Alternatively, the culvert could be extended upstream into Victoria Park to allow banking to be located within the boundary of the park. The pondage formed by the earthworks would essentially become a mini detention basin.

A simple basin arrangement was prepared and a stage-storage-discharge curve computed for input into the DRAINS model. Hydraulic modelling was undertaken for various depths of ponding at Perry Street to assess the influence of backwater flooding on the culvert beneath Horatio Street. Model results indicate that an embankment with a crest level approximately 1.3 m above the obvert of the Perry Street culvert will not adversely affect water levels upstream of Horatio Street.

Initial runs of the model were undertaken using the existing culvert arrangement beneath Perry Street as the outlet from the ponding area. The assumption of inlet control was adopted. (A hydraulic grade line analysis needs to be undertaken to verify this assumption as it may have a significant influence on the depths of ponding behind the embankment). Results of DRAINS modelling showed that the 20 year ARI flow could be retained in the pond without surcharging the crest of the embankment.

An alternative arrangement was analysed where the existing culvert was throttled to half its size ie 900 x 600 mm. Results of the modelling showed a reduction in the 5 and 20 year ARI discharges due to the attenuating effects of the storage in the basin. The 20 year ARI event ponds to a depth 200 mm below the crest of the embankment. The 100 year ARI overtops the embankment with surcharges conveyed in the street system, which acts as a floodway. The reduction in flows up to the 20 year ARI has the added advantage of increasing the capacity of the piped drainage system between Perry and Douro Streets, which allows local catchment flows which presently pond at pit inlets to more readily enter the system.
It should be noted that this scheme was analysed using existing survey and more detailed analyses with refined survey need to be carried out to confirm the results. It may be necessary to increase the width of the channel upstream of Perry Street to increase the available storage. This could involve excavation of the right bank of the channel in Victoria Park. (This scheme is denoted Option C.2 on Table 8.1 and Figure 8.1 of the Main Report, Volume 2)

5.3.4 Mortimer Street

The 20 year ARI discharge ponds behind the roadway but does not surcharge it. However, backwater from the culvert spread into adjacent residential properties. The existing waterway comprises a 2400 mm x 1300 mm culvert. A doubling of the waterway area would reduce the heading up of water levels and reduce the upstream extent of inundation. (Option C.1 on Table 8.1 and Figure 8.1 of the Main Report, Volume 2)

5.3.5 Mortimer to Market Street

Between Mortimer and Market Streets the creek comprises a concrete channel. At its upstream end the channel is approximately 2 m wide with vertical sides of 600 mm height on the right bank and 900 mm height on the left bank. The right bank of the channel is surcharged for the 5 year ARI discharge, with depths of flooding of around 100-300 mm. For larger events the left bank is surcharged by shallow sheet flow. Surcharge flows could be expected to enter adjacent properties and may cause flooding problems.

The construction of a low earth embankment on the right overbank of the channel would prevent flood flows from entering adjacent properties. The embankment would need to be set back from the channel to allow adequate waterway area for the conveyance of flows which cannot be contained within the channel. Minor mounding would be required on the top of the higher left bank to prevent shallow sheet flows escaping the channel for larger events.

It should be noted that the above assessment was made using waterway dimensions measured during site visits. No formal survey was undertaken on this reach of channel and before any works are undertaken in this area, the reach of concrete channel between Mortimer and Market Streets should be surveyed and modelling undertaken to verify the results of this initial assessment.

5.3.6 Short Street

The 5 year ARI discharge surcharges the roadway it. At the 100 year ARI, backwater from the culvert spread into adjacent residential properties including the ABC Child Care Centre on the right bank. The floor level of this property is around the obvert level of the culvert and would be overtopped at the 100 year ARI level of flooding on the creek.

The existing waterway comprises a 3050 mm x 1050 mm culvert inlet leading to a larger culvert of 3000 mm x 1500 mm dimensions. The channel at the downstream side of the culvert is above the invert level of the outlet, which further restricts capacity. Removal of these restrictions by improving the inlet and outlet characteristics of the culvert would reduce the heading up of water levels in the approach channel. A preliminary budget estimate for the work is $130,000. (This scheme is denoted Option C.3 in Table 8.1 and Figure 8.1 of the Main Report, Volume 2.)
6. FUTURE DEVELOPMENT IN CATCHMENT C

6.1 Development Potential in Catchment C

Catchment C is urbanised and future development would be restricted to re-development of individual residential allotments or urban consolidation. This form of development would be subject to Council’s On Site Detention Storage Policy, which is aimed at ensuring that development does not increase flood peaks by the implementation of individual on site detention.

6.2 Impact of Future Development on Flooding

The potential for blockage of the crossings of the channel by debris conveyed in the flow stream is significant and accordingly intrusion of development into the creek area is considered an undesirable practice.

With continuing development in town there will be pressure for re-development of allotments and urban consolidation. It is recommended that the open channel method of conveyance of creek flows be retained and the development should have adequate freeboard over above-floor inundation. Building over the creek should not be permitted unless it can be clearly demonstrated that the resulting closed conduit drainage system has the capacity to convey flows from major storm events and there are adequate provisions for the conveyance of overland flows.

A freeboard of 500 mm is recommended in accordance with Council’s present Flood Policy for Mudgee. Further, Council’s existing Flood Policy should be enforced in regard to boundary fencing.
7. SUMMARY AND CONCLUSIONS

Hydrologic and hydraulic models of the drainage system of Catchment C were developed. The objectives were to assess the capacity of the system under present day conditions, to identify areas of low capacity and to undertake preliminary investigation of measures to improve performance.

The DRAINS rainfall-runoff model was used to convert design storms to discharge hydrographs which were routed through the catchment. The existing detention basin in the Showgrounds area was incorporated in the model.

Water surface profiles along the main drainage channel were computed using the HEC-RAS steady state backwater program. The model was used to determine the capacity of the channel and estimate the hydrologic standard of the road culverts, which have a major influence on the performance of the system.

The major findings of the study were as follows:

- The existing detention basin has a major effect on downstream flood peaks up to the 100 year ARI (Table 2.2). The basin controls runoff from half of the total catchment area of about 240 ha.
- On the main drainage channel downstream of the detention basin, the more important locations requiring attention are summarised below:
  - At Perry Street, major surcharges occur into the street system. The capacity of the existing culvert could be increased by banking at the culvert inlet, which would encourage ponding. Depending on the results of survey of the area, it may be possible to formalise a detention basin in Victoria Park and reduce downstream flows. (Option C.2)
  - At Gladstone Street, removal of the brick wall across the boundary of the residence on the southern side of the road would provide an overland flow path for floodwaters which surcharge the capacity of the channel. (Option C.4)
  - The culvert at Mortimer Street is under capacity and results in backwater flooding in upstream residential properties. A new arrangement incorporating twin 2400 mm x 1300 mm RCBC’s and minor banking would reduce backwater effects. (Option C.1)
  - Improvements to the inlet and outlets of the culvert at Short Street, possibly in conjunction with a low levee to protect adjacent flood prone property, would reduce the heading up of water levels and reduce the upstream extent of inundation. (Option C.3)

To complement the above structural measures, Council should also enforce its on-site detention storage policy for future development proposals which result in a “significant” increase in impervious area. Broadly speaking, the objectives of such a policy are to ensure that peak flows in the drainage system are not increased above present day values.