On review of the various alternative recommendations from past investigation reports it was decided that the most appropriate method of servicing Stage 1 of the North Lismore Plateau would be via the existing 1 Ml Tullera Reservoir which is located off Dunoon Road, approximately 3 km north-east of the proposed development. This reservoir is currently supplied via a 150 mm main connected to the Lismore bulk water supply main at Howards Grass. The reservoir is currently operating at slightly more than half its capacity, and is capable of meeting requirements of Stage 1 development without further amplification.

It is recommended that the full development of the North Lismore Plateau be served by adopting the same supply route as used for Stage 1. This would require the construction of a new 2.5 Ml reservoir adjacent to the existing reservoir and the amplification of the Rous Water trunk main to the reservoir.

The difficulty of providing the stipulated 30 m minimum head within the higher parts of the North Lismore Plateau can be overcome by the provision of variable speed booster pumps located in a pumping station constructed at the intersection of Dunoon and McLeay Roads.

3. INVESTIGATION APPROACH

The report prepared for ACM Landmark Pty. Ltd. in September 2006 reviewed the work previously undertaken in two previous investigations, namely

a) Northern Rivers Engineers, Planners & Scientists Report, August 1994
b) Cardno CCS Pty Ltd Report, February 2003

In addition, a summary of all water supply information that had previously been supplied from Lismore City Council and Rous Water was compiled and additional minimum information requirements determined. Approaches were made to Lismore City Council and Rous Water for the additional information required for accurate hydraulic modelling. This was later followed with a visit to the offices of both authorities for direct discussions with the appropriate engineering staff.

Subsequently additional information became available which is summarised below.

1) From Lismore City Council – Specification for the Design & Construction of Water Reticulation Pipework, July 1999

a) Static head to each lot should be between 30 m and 60 m with a minimum static head of 20 m under peak instantaneous demand at the property boundary.
b) The desirable maximum design head is to be 70 m.

2) From Rous Water (letter dated 7 July 2006)

a) Tullera Reservoir is serviced by a 150 mm gravity main connected to the trunk main at Howards Grass. Howards Grass Pumping Station is decommissioned and does not pump to Tullera Reservoir.

b) *Rous Water expects that there would be no need to provide additional chlorination at Tullera Reservoir as the increased demand would reduce the storage time in the reservoir.*
c) *Rous Water will supply the peak day demand nominated by Lismore City Council to Tullera Reservoir over 22 hours.*

3) From Rous Water (letter dated 15 August 2006)

a) *The existing trunk main at Howards Grass presently operates in the range of 176 m static to 115 m. The system at Howards Grass operates via pressure reducing and pressure sustaining valves which limit the pressure in the bulk main. These valves have been set up to operate under the existing demand conditions and will be adjusted as demand grows.*
b) *Rous Water is presently decommissioning the old 450 mm trunk main and it is anticipated that new pressure settings will be required during the upcoming summer demand period.*

4) Visit to Lismore Council and Rous Water by David Stewart, 31 August 2006

a) *Rous Water estimates it can supply approximately 1 Megalitre of water to Tullera Reservoir over a 24 hour period.*
b) *Flow into Tullera Reservoir is controlled by an altitude valve set to Lismore City Council.*

With the aid of the information that could be obtained, various alternative water supply systems for both the initial stage of the subdivision and the ultimate subdivision were assessed. These alternative designs were analysed using a water modelling program (EPANET 2.0).

Estimates of cost were determined for the designs chosen.

4. DESIGN ASSUMPTIONS

Due to the fact that information which could be obtained from both Lismore Water and Rous Water was not as complete as required at the time when the 2006 Report was prepared, it was necessary to make a number of assumptions to enable the water analysis to proceed.

The design standards adopted by Lismore Water and Rous Water for peak day flow at the time the 2006 Report was prepared were based on 2500 l/day/ET. These peak day flows were considered somewhat high in comparison to the standards which had then been adopted by other Australian Water Authorities. It was considered that, as the Lismore Plateau development would be self-contained and the houses in the development would be designed with water saving criteria in mind (BASIX design requirements), it would not be unreasonable to anticipate some lowering in average and peak demands. Reductions in the order of 10% would be considered conservative under the circumstances.

It was understood at the time that if water saving measures were adopted for the development, some reduction from the standard demand figure may be accepted by Lismore City Council.

To allow for peaking of demand throughout the day, the demand pattern adopted by Hunter Water was adopted and imposed on the peak day flow. Because of the overall final size of the development, no additional peaking factors were considered necessary.

It was only possible to obtain limited information regarding the head available in Rous Water's 450mm trunk main at Howards Grass. This information was a necessary modelling input as it determined the rate that Tullera Reservoir can be fed from the bulk supply, particularly in the initial stages of the North Lismore Plateau development. However, as Rous Water had stated that it estimated it could provide a day's supply of one Megalitre of water to Tullera Reservoir (during a 22 hour period), this information was used to estimate the average head required to be inserted into the network model at the Howards Grass model node.

To gain an accurate picture of the available head at Howards Grass it would be necessary to monitor the pressures in the main with a suitable pressure recorder over a reasonable period of time.

For the purposes of assessing Stage 1 requirements, the requirements for head at Howards Grass were assessed on the basis of full utilisation of the Tullera Reservoir. Accordingly, the head losses in the 150 mm reservoir feed have been assessed for the situation where Tullera Reservoir was required to be filled over a 22 hour period. This would require an average flow rate of 12.6 l/s.

Friction head losses in the 150 mm x 3420 m supply main would be approximately 17m. If the RL of the reservoir top feed inlet is RL 147, the required head in the trunk main would be RL 147 + 17 = RL 164. This is 12 m below the static head available.

A sensitivity analysis was performed with the network model to ascertain the minimum head required to maintain a stable supply to Tullera Reservoir once Stage 1 development was connected. It was concluded that a stable supply could be maintained to the reservoir if the average head at Howards Grass was maintained at RL 161 (flow rate 10.6 l/s). Once the average head fell to RL 159 it became evident that it would be difficult to sustain minimum levels in the reservoir (50% capacity).

Therefore, for modelling purposes it was assumed that a minimum average head of RL 161 could be reasonably be expected to be available at Howards Grass. If this assumption is contradicted by subsequent data from Rous Water then it will be necessary to downgrade the level of demand that can be supplied from the reservoir.

Regarding fire flows, the performance of supply system was checked at critical nodes using a flow rate of 25 l/s applied for one hour to coincide with the peak hourly flow.

5. ALTERNATIVE METHODS OF SUPPLYING BOTH STAGE 1 AND FINAL DEVELOPMENT

a) Stage 1

It is considered possible to service an additional 150 to 200 additional lots from the existing Tullera Reservoir, based on information supplied by Rous Water. The potential size of a Stage 1 release (up to 163 lots) would fall within this available range.

The existing 150 mm supply main to the reservoir should also be adequate to service Stage 1 requirements, subject to assumption set out above.

An "internal" trunk main would need to be laid from Tullera Reservoir to the central part of Stage 1. This would initially be laid from the reservoir, along Dunoon Road to the intersection of Dunoon Road and McLeay Road.

As adequate pressures cannot be achieved in the higher parts of the Stage 1 development, it is proposed that a booster pumping station be located at the intersection of Dunoon Road and McLeay Road to boost residual pressures to acceptable levels. This is in accordance with the recommendations of the 1994 Report by Northern Rivers Engineers, Planners & Scientists and is still considered the most satisfactory site for this station.

As considered in the 1994 Report there are two alternative routes for this main after the booster station.

The first alternative, and the one still considered most suitable, is to lay the main along the ridge contour through land that will be developed at a later stage. This will necessitate conforming to the road layout for these later stages. This is not considered unreasonable, as the location of the subdivision ring road will follow contours and is unlikely to be changed greatly from its present designated position at a later date. However, the final location of the trunk main through the intervening land to the first stage of the subdivision would need to be reviewed as planning progresses and designs evolve.

A second alternative supply route could be provided by laying the main all the way along Dunoon Road from the reservoir and along the access road to Stage 1. However this route has many practical difficulties from a construction point of view as the road reserve is narrow and has a steep cross slope with limited shoulders.

Although this route would avoid the complications associated with determining its location in relation to future roadways, its route along the valley floor would lead to excessive pressures in part of the main (up to 130 metres head). This drawback is avoided with the first alternative, which is why it has been preferred.

No additional high level storage was considered necessary in the first stage development. This was deemed unnecessary on the basis of perceived risks to supply. In the event of a pump or power supply failure there would still be sufficient hydraulic head available from Tullera Reservoir to maintain an adequate supply of water to the higher lots in Stage 1.

b) Final Development

Depending on the actual demand generated from full development of Stage 1, subsequent development beyond Stage 1 of Lismore Plateau would, at some point, require the construction of additional storage to supply demand and guarantee security of supply.

It was considered that a best alternative would be to construct an additional reservoir alongside the existing Tullera Reservoir and supply the development via the same pipeline route as used for Stage 1. There appears to be no physical impediments to siting another reservoir alongside the existing reservoir although additional land may need to be acquired to accommodate the reservoir.

Calculations have revealed that it would be possible to utilise the Stage 1 trunk main from Tullera Reservoir to the development as the final trunk main, thereby avoiding the need for future amplification works.

For the final stages of the development it would be necessary to lay an additional length of 3420 m of trunk main from Howards Grass to the site of the new Tullera Reservoir. The provision of this additional trunk main would be the responsibility of Rous Water and its cost would be covered under current Rous Water headworks charges.

The major advantage of this proposal is that the new reservoir will be able to utilise the additional elevation afforded by the present reservoir site. This would allow the entire development to be supplied under gravity head (admittedly at lower than normal pressures).

It is further considered that the new Tullera Reservoir and trunk main feed should be sized to serve the full Lismore Plateau on its own without making use of any current spare capacity in the existing reservoir in the long term. This will allow the present reservoir and trunk main to be dedicated to serving the existing development in the area, along with any future growth in the surrounding villages.

The Lismore Plateau consists of two natural high parts of the ridge (north and south) with an elevation of RL 130. They are separated by a shallow depression with a level which varies from RL 105 to RL110.

This has created the opportunity to create two separate hydraulic zones within the Lismore Plateau development, namely, a "northern" and a "southern" zone. Each can be separately serviced from the proposed pumping station at the intersection of Dunoon Road and McLeay Road by direct boosting of pressure.

The advantages of such a system is that it will allow the use of smaller internal trunk mains (now only required to serve part of the development), and permit better control of pressures within each zone.

It would be relatively straightforward to link both zones so that one could be supplied from the other in the event of a part system failure.

6. NETWORK ANALYSIS

EPANET 2.0 was the hydraulic network program used to analyse the performance of the various supply alternatives considered.

EPANET 2.0 is a Windows based program developed by the Water Supply and Water Resources Division of the U.S. Environmental Protection Agency that performs extended period simulations of hydraulic and water-quality behaviour within pressurized pipe networks. It is public domain software (refer to website www.epa.gov for a full description of the capabilities of the program).

EPANET was specifically developed to help water utilities maintain and improve the quality of water delivered through their distribution systems. It provides a fully-equipped, extended period hydraulic analysis package which can handle systems of any size and perform a wide variety of modelling functions. Various data reporting and visualization tools are used to assist in interpreting the results of a network analysis. These include graphical views, tabular views and special reports.

Network analyses were performed to cover the performance of the options considered.

These are listed as follows with individual file names:

1. Stage 1 development with boosted flows (Lismore Plateau trial 3.NET)
2. Stage 1 development fed entirely from Tullera Reservoir without boosting (Lismore Plateau trial 5.NET)
3. Stage 1 development with boosted flows and fire flow of 25l/s applied at Node 14 (Lismore Plateau trial 3F.NET)
4. Stage 1 development fed entirely from Tullera Reservoir and fire flow of 25 l/s applied at Node 14 (Lismore Plateau trial 5F.NET)
5. Full development with boosted flows (Lismore Plateau Full Stg Trial A.NET)
6. Full development fed entirely from Tullera Reservoir without boosting (Lismore Plateau Full Stg Trial B.NET)
7. Full development with boosted flows and fire flows of 25l/s in each zone (Lismore Plateau Full Stg Fire Trial A.NET)
8. Full development fed entirely from Tullera Reservoir without boosting and fire flow of 25 l/s in each zone (Lismore Plateau Full Stg Fire Trial B.NET)

The network diagrams for each of the above simulations have been included in Appendix A of the report.

All network simulations were run over a 72 hour time frame and the results noted.

Bearing in mind the noted assumptions regarding the pressures in the Rous Water bulk supply main at Howards Grass, the results of the various network analyses were as follows:

1) Stage 1 - General

The trunk main from Tullera Reservoir to the booster pumping station was sized at 300mm and the trunk main from the pumping station to Stage 1 development was sized at 250 mm. The sizes selected were selected to suit the ultimate development.

An allowance was made for demand from existing development with a demand node created just downstream of the reservoir.

A pressure reducing valve was installed on the Stage 1 access road to control high heads in the lower blocks near Dunoon Road.

The booster pump was sized to deliver 10 l/s @ 15 m head. The operation of the pump was controlled by the pressure at Node 13 (RL 130). In practice, variable speed pumps would be employed so that the output of the pumps can match demand, allowing better control over pressures.

2) Stage 1 Results

With boosted flows, the level of Tullera Reservoir varied over a 2 m range over a 24 hour period. The variation of pressure at Node 13 (RL 130) varied from 35 m to 30 m over the same period. Pumping of the booster pump was continuous.

With non-boosted supply direct from Tullera Reservoir, the pressure head at Node 13 varied from 17m to 14.6 m head.

When fire flows of 25 l/s were imposed at Node 14 (RL 130) the residual heads obtained were:

1) Boosted flows – 7m
2) Non-assisted flow – 7 m

3) Stage 1 Observations

With boosting of flows, it was possible to maintain a minimum of 30 m head at the highest parts of Stage 1 over a 24 hour period.

If only the head from the current Tullera reservoir was available then it would be possible to maintain pressures in the range 14.6 m to 17 m. These pressures would be acceptable under emergency conditions.

If development was to be restricted to those parts of the subdivision where a minimum of 30 m head could be supplied from Tullera Reservoir without pumped assistance, then the maximum level of blocks would need to be kept below RL 115. This would severely impact on the design and viability of the subdivision.

Under all conditions it would be possible to maintain a fire flow of 25 l/s with sufficient residual pressure (7 metres minimum).

4) Conclusions

Based on initial analysis there appears to be no reason why Stage 1 of the Lismore Plateau Development could not be serviced by the spare capacity available in the Tullera Reservoir.

To provide the minimum head requirements of 30 metres stipulated by Lismore City Council, boosting of flows would be required. Variable speed pumps would be used to give better control over pressure as demand varies throughout the day and night.

As there will still be adequate pressure available in the system should the booster pumps be unable to operate, there is little risk to supply in adopting this option.

1) Full Development - General

To cater for the full development of Lismore Plateau it will be necessary to construct additional reservoir storage.

To service the development it is proposed that an additional 2.5 Ml reservoir be constructed alongside the existing Tullera Reservoir (20 m dia x 8 m water depth). This reservoir would be devoted solely to serving the subdivision, with the existing reservoir returning to its original function of serving the surrounding villages and properties.

To supply the new reservoir a new 250mm x 3420 m long trunk main would need to constructed parallel to the existing 150 mm main which supplies the existing Tullera Reservoir from the Lismore bulk water supply main at Howards Grass.

There would be no change in the trunk main from Tullera Reservoir to the pumping station or the trunk main from the pumping station to Stage 1 ("Southern" zone) as these pipes would be initially sized to suit the ultimate development.

A 200 mm trunk main would be laid from the pumping station to service the northern pressure zone of the development.

The booster pumps for the southern zone would need to be sized to deliver 35 l/s @ 19 m head, while the booster pumps for the northern zone would need to be sized to deliver 18 l/s at 17 m head. The operation of the pumps would be controlled by pressure sensors located at high points in both zones.

2) Full Development Results

A sensitivity analysis on the effects of varying the available pressure head in the bulk supply main at Howards Grass indicated that pressure heads could drop to RL 152 before supply problems were experienced at the new Tullera Reservoir. This was the

result of the lower friction head losses in the proposed 250 mm pipeline when compared with the present 150 mm pipeline. However, the pressure head of RL 161 m adopted for the Stage 1 network analysis was maintained for the full stage analysis.

With boosted flows, the level of Tullera Reservoir varied little from full level over a 24 hour period. The variation of pressure at Node 48 (same as Node 13 in Stage 1) in the southern zone varied from 43 m to 29 m over the same period. The variation of pressure at Node 23 (RL129) in the northern zone varied from 40 m to 31 m. Operation of the booster pumps was continuous. In practice these variations in pressure would be controlled by variable speed pumping.

With unassisted supply direct from Tullera Reservoir, the pressure head at Node 48 in the southern zone varied from 18m to 9 m head, while the pressure head at Node 23 in the northern zone varied from 18m to 13 m head.

When fire flows of 25 l/s were imposed the following results were obtained at Nodes 48 and 23:

Scenario	Southern Zone	Northern Zone
Boosted Flows	4.5 m residual	7.9 m residual
Tullera Res head only	-3.5 m residual	2.6 m residual

3) Full Development Observations

With boosting of flows, it was possible to maintain a minimum of 30 m head at the highest parts of both zones over a 24 hour period.

In the event of pump failure, the head available from the Tullera Reservoir would be capable of maintaining pressures at the highest points in the subdivision in the range 8 m to 17 m. These pressures would be acceptable under emergency conditions.

4) Conclusions

Based on initial analysis it would be feasible to serve the full development of Lismore Plateau with the provision of additional storage adjacent to the present Tullera Reservoir.

To provide the minimum head requirements of 30 metres stipulated by Lismore City Council boosting of flows would be required. In practice variable speed pumps would be used to give better control over pressure as demand varies throughout the day and night.

As there will still be adequate pressure available in the system should the booster pumps be unable to operate, there is little risk to supply in adopting pressure boosting without high level storage.

7. COST ESTIMATES

Preliminary cost estimates were prepared in the 2006 Report by David Stewart Consulting for both the proposed initial stage of the development comprising approximately 163 lots and the fully developed subdivision. These have been updated to June 2010 by applying CPI increases which have taken place since June 2006. All costs have accordingly been increased by 11%.

In the 2006 Report costs and unit rates were based on cost rates from several similar recent constructed works along the NSW East Coast. A comparison was also made with Hunter Water Corporation costing data, indexed for CPI increases. Watermain costs have been based on "greenfield" rates with an allowance in excavation rates for 20% rock. An additional factor of 5% was applied to cover expected differences in construction costs between the Newcastle Region and Lismore.

A summary of the adopted unit rates and costings as recommended by David Stewart Consulting is included in Appendix C.

No allowance was made for the provision of power to the site of the proposed booster station. It was noted however that there is an 11 kV supply available at the site of the reservoir and the booster pumping station.

Costs that may be involved in the acquisition of land and easements have been excluded.

Except where noted, the allowances of 15% that have used in previous investigations for both survey, investigation and design (SID) costs and contingencies have been increased in the current investigation to 16% for SID and 20% for contingencies.

The approach taken to determining the costs that would need to apportioned to both Stage 1 and the final development is as follows:

1. Rous Water Charges

Each stage would be subject to the major works amplification charges set by Rous Water. In 2006 these charges were $3275/ET (these charges may have increased since 2006).

It has been ascertained from Rous Water that the proposed amplified trunk main from Howards Grass to the new 2.5 Ml reservoir would be Rous Water's responsibility and its cost would be covered by the current $3275/ET amplification charge. Although the model has been based on a separate 250 mm trunk main, with the existing 150 mm trunk main continuing to serve the present reservoir, it is anticipated that Rous Water would install a single trunk main to serve both reservoirs.

2. Lismore Water Charges

Although the existing Tullera reservoir is currently controlled by Rous Water, it is understood that the new reservoir would fall under the control of Lismore Water. Therefore Lismore Water could recover the cost of the new reservoir as part of its subdivision amplification charges or alternatively the developer could construct the reservoir as works in kind to be offset against Water Headwork contributions.

The cost of constructing a new 2.5 Ml reservoir alongside the existing Tullera Reservoir, including overheads, is now estimated to be $1,309,000

Based on a final anticipated development of approximately 1000 ET, the amplification charge per ET for the new reservoir would be $1309/ET.

Major works, such as "internal" trunk mains and pumping stations, located downstream of the new Tullera Reservoir would fall under the control of Lismore Water. As it is anticipated that Lismore Water would expect developers to initially outlay all the funds necessary to construct the major works that are required to service the first stage development, the charges set out below are presented for comparative purposes only.

As stated earlier in this report it has been proposed that the overall development be separated into two supply zones, with each supply zone having its supply boosted by pumping so as to maintain a minimum pressure of 30m head as required by Lismore Water.

Under such a proposal the following major works would be required:

1840 m of 300 mm pipe to Booster Station
2620 m of 250 mm pipe, 813 m of 200 mm pipe for "internal" trunk mains

Cost of pipework, including overheads - $1,798,000

Booster Pumping Station (four variable speed pumps – two for each pressure zone)

Estimated cost, including overheads - $468,000 (excludes land and power costs)

Cost of trunk main and pumping works falling under control of Lismore Water =
$1,798,000 + $468,000 = $2,266,000

Total ET served (full development) – 1000

Charge for trunk main and pumping station works - $2266/ET

Total major works costs for works falling within the control of Lismore Water =
$1,309,000 + $2,266,000 = $3,575,000

3. Water Reticulation Costs (to be borne by Developers)

(a) Stage 1 Development (163 lots)

It is assumed that all costs for trunk and reticulation works downstream of Tullera Reservoir will initially be borne by the Stage 1 developer. Any recovery of part of these costs from subsequent developments utilising these works is outside the scope of this report. However as a general rule these costs are shared by benefiting developments.

It is assumed that Lismore Water will apply an amplification charge of $1309 to cover the future cost of the new 2.5 Ml Tullera Reservoir.

In addition it is assumed that Rous Water will apply amplification charges of $3275/ET for bulk water amplification which would include the future trunk main amplification from Howards Grass to Tullera Reservoir.

1. Internal Reticulation

i). 3931 m of 150mm reticulation @ $166.50/m		$654,500
ii) 1916 m of 100 mm reticulation @ $138.75/m		$265,800
		$920,300
Cost before overheads	Say	**$921,000**
SID, 16%		$147,400
Contingencies, 20%		$184,200
Cost with overheads		$1,252,600
	Say	**$1,253,000**

2. Trunk Main and Pumping Station Costs Downstream of Tullera Reservoir

i) 1840 m of 300mm main @ $311/m		$571,900
ii) 2620 m of 250mm main @ $228/m		$596,200
		$1,168,100
Cost before overheads	Say	**$1,168,000**
SID, 16%		$186,900
Contingencies, 20%		$233,600
Cost with overheads		$1,588,500
	Say	**$1,589,000**
iii) Booster Pumping Station		$222,000
SID, 16%		$35,500
Contingencies, 20%		$44,400
Cost with overheads		$301,900
	Say	**$302,000**
Total for Item 2 (= $1,589,000 + $302,000)		**$1,891,000**

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3. Lismore Water Amplification Charges for Future Reservoir

163 lots @ $1309/ET	$213,400

3. Rous Water System Amplification Charges

163 lots @ $3275/ET (current rate to be confirmed)	$533,825
Total Subdivider's Costs for Stage 1 Water (rounded to '000's)	**$3,901,000**
Cost per lot	**$23,930**

Note: Trunk Main and Pumping Station may be considered for offset against Water Headworks as works in kind (total $747,200)

(b) Full Subdivisional Development (Equivalent ET = 956)

1. Internal Reticulation

i) 13210 m of 150 mm reticulation @ $166.50/m		$2,199,500
ii) 9120 m of 100 mm reticulation @ $138.75/m		$1,265,400
		$3,464,900
Costs before overheads	Say	**$3,465,000**
SID, 16%		$554,400
Contingencies, 20%		$693,000
Cost with overheads		$4,712,400
	Say	**$4,713,000**

2. Trunk Main and Pumping Station Costs Downstream of Tullera Reservoir

i) 1840 m of 300mm main @ $311/m		$571,900
ii) 2620 m of 250mm main @ $228/m		$596,200
iii) 813 m of 200mm main @ $189/m		$153,400
		$1,321,500
	Say	**$1,322,000**
SID, 16%		$211,500
Contingencies, 20%		$264,400
Cost with overheads		$1,797,900
	Say	**$1,798,000**
iv) Booster Pumping Station		$344,100
SID, 16%		$55,100
Contingencies, 20%		$68,800
Cost with overheads		$468,000
	Say	**$468,000**
Total for Item 2 (= $1,798,000 + $468,000)		**$2,266,000**

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3. Lismore Water – Reservoir Charges

1000 ET @ $1370/ET	**$1,370,000**

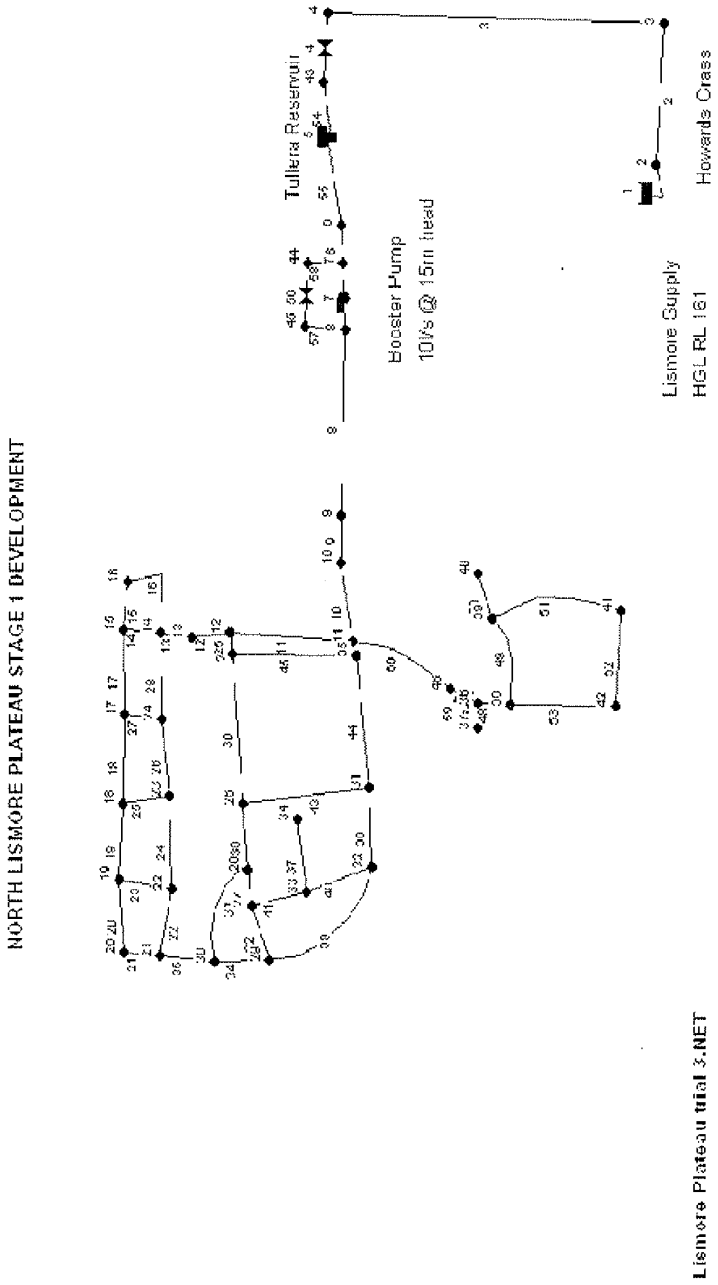
4. Rous Water System Amplification Charges

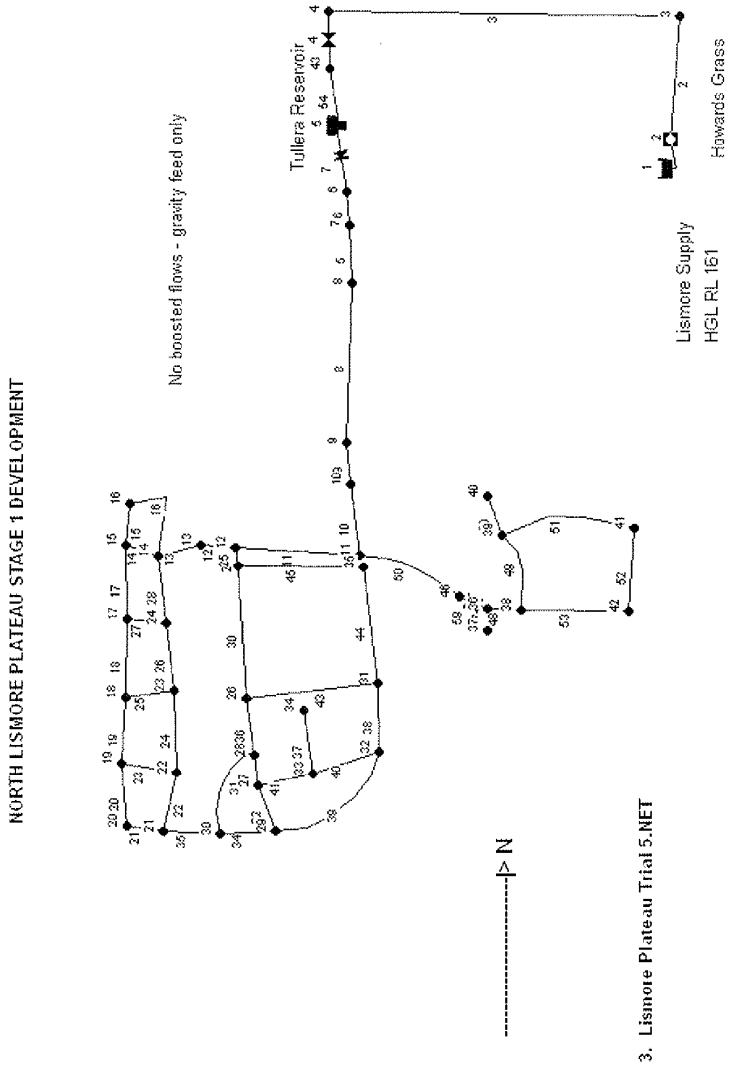
1000 ET @ $3275/ET (rate to be confirmed)	**$3,275,000**
Total Cost to Subdividers for Full Development	**$11,420,000**
Cost per ET	**$11,946**

Note: Trunk Main and Pumping Station may be considered for offset against Water Headworks as works in kind (total $4,645,000)

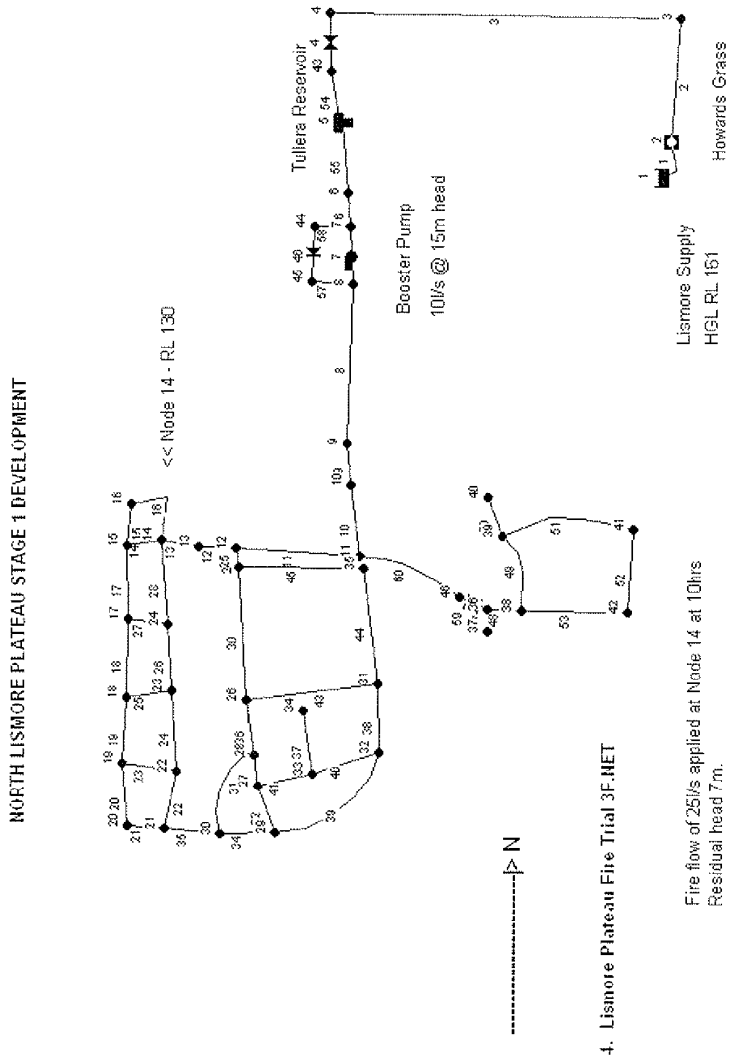
APPENDICES

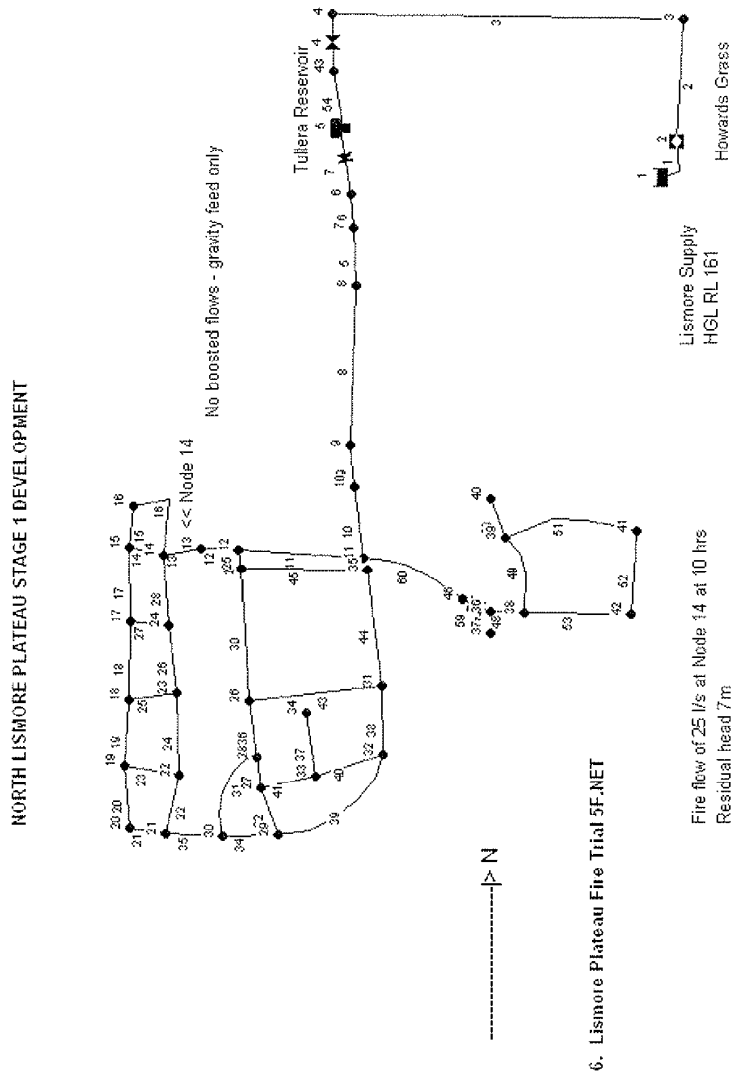
APPENDIX A
NETWORK AND PRESSURE DIAGRAMS


NORTH LISMORE PLATEAU STAGE 1 DEVELOPMENT
Tullera Reservoir
Booster Pump
10l/s @ 15m head
Lismore Supply
HGL RL 161
Howards Grass
Lismore Plateau trial 3.NET

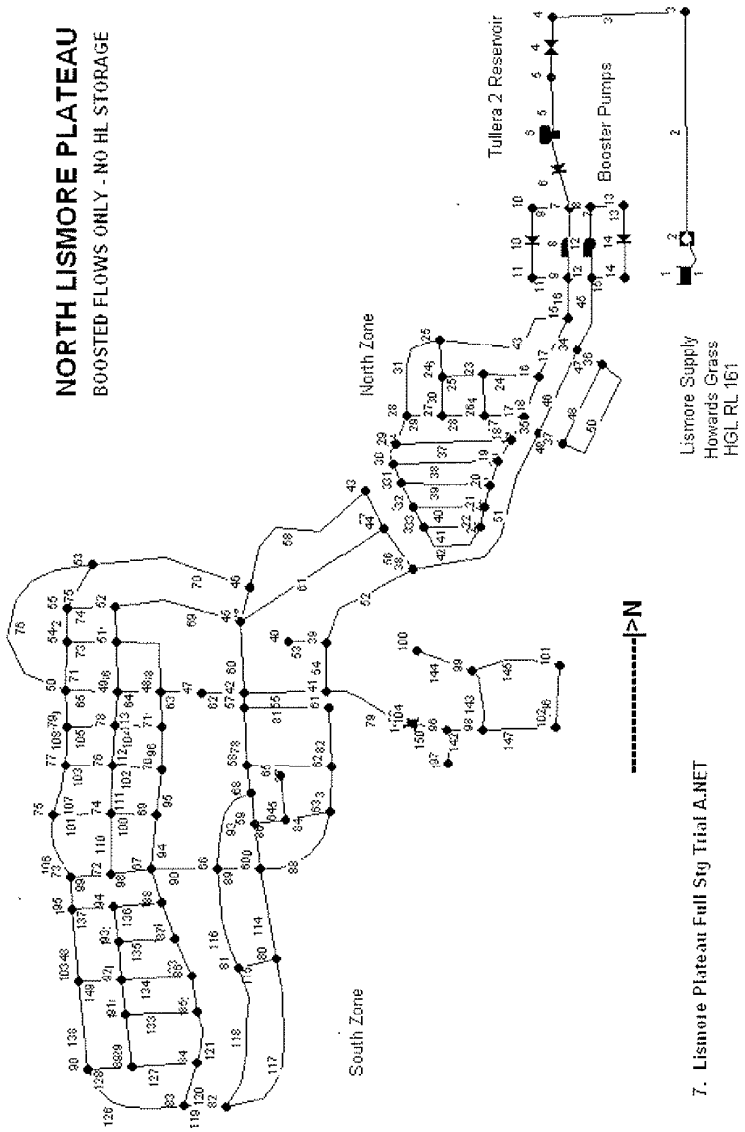

NORTH LISMORE PLATEAU STAGE 1 DEVELOPMENT
No boosted flows - gravity feed only
Tullera Reservoir
Howards Grass
Lismore Supply
HGL RL 161
N
3. Lismore Plateau Trial 5.NET

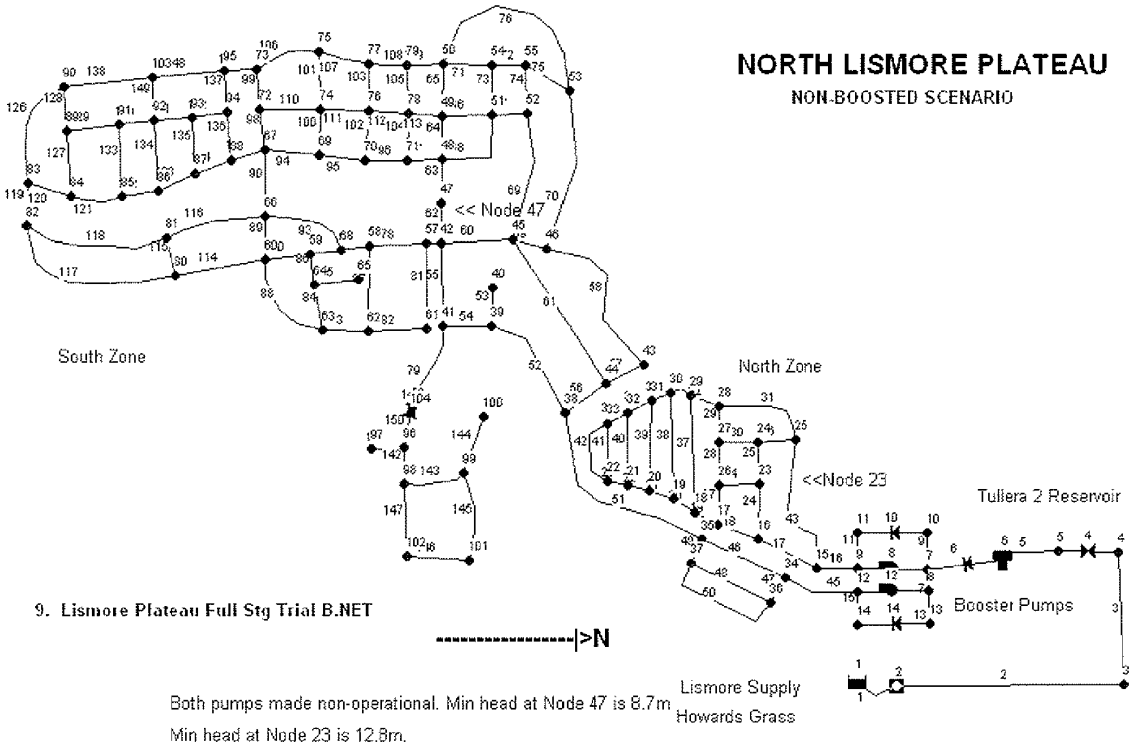
2

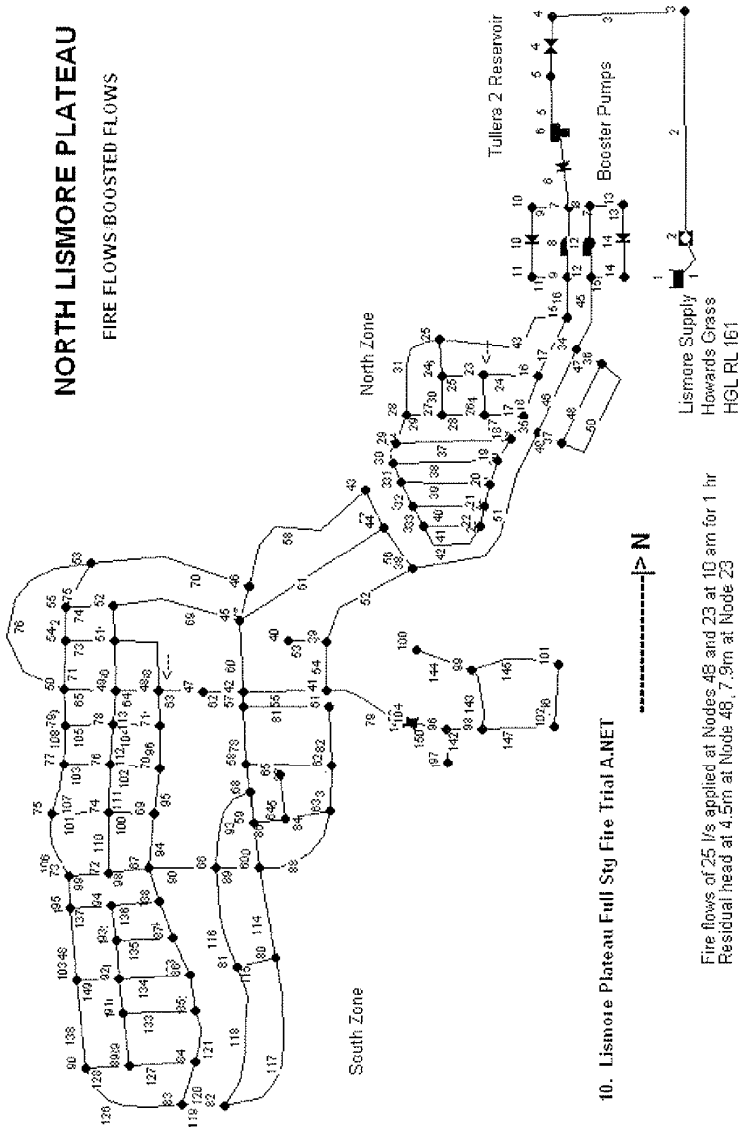

NORTH LISMORE PLATEAU STAGE 1 DEVELOPMENT
<< Node 14 - RL 130
Tullera Reservoir
Booster Pump
10l/s @ 15m head
Lismore Supply
HGL RL 151
Howards Grass
N
4. Lismore Plateau Fire Trial 3F.NET
Fire flow of 25l/s applied at Node 14 at 10hrs
Residual head 7m.


NORTH LISMORE PLATEAU STAGE 1 DEVELOPMENT
No boosted flows - gravity feed only
<< Node 14
Tullera Reservoir
Lismore Supply
HGL RL 161
Howards Grass
Fire flow of 25 l/s at Node 14 at 10 hrs
Residual head 7m
N
6. Lismore Plateau Fire Trial 5F.NET

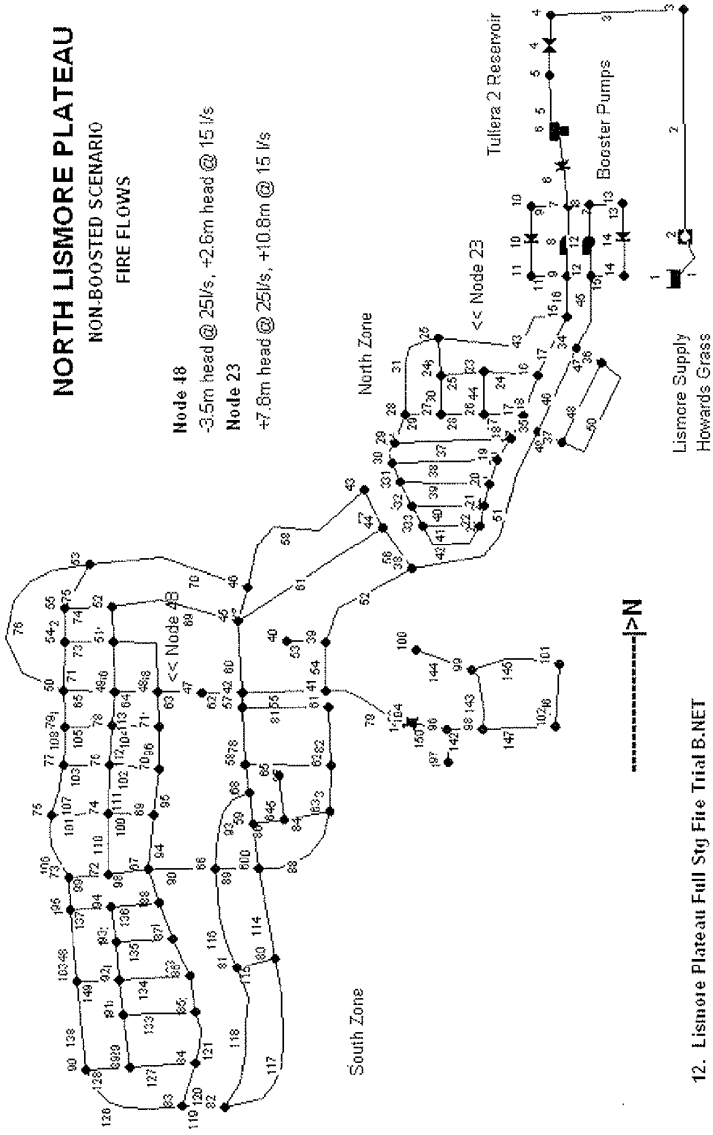
4

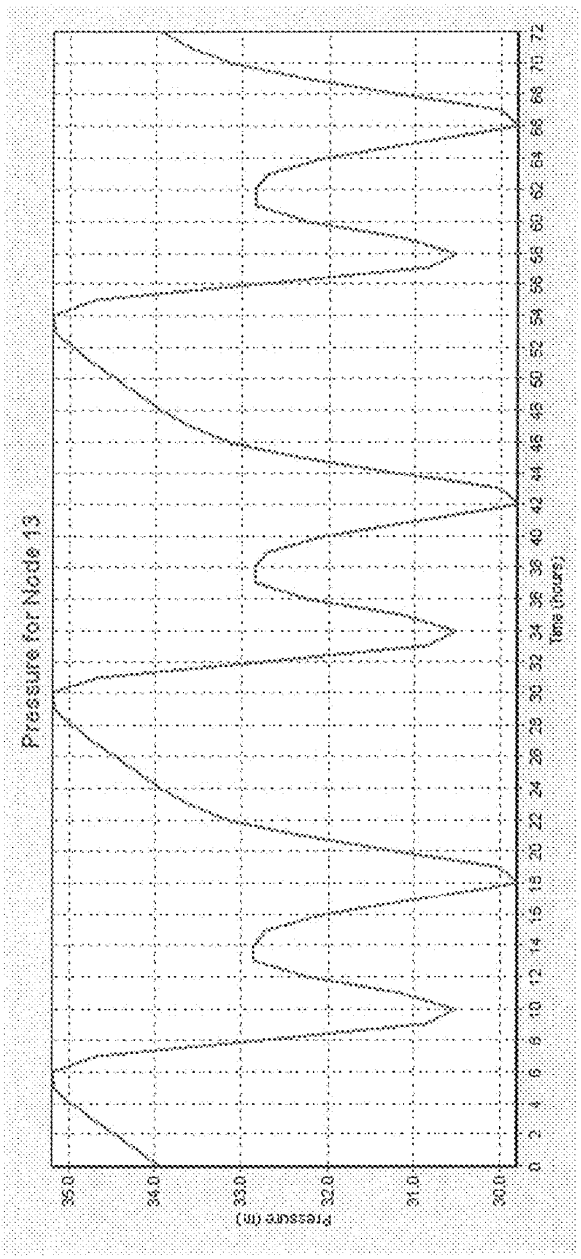

NORTH LISMORE PLATEAU
BOOSTED FLOWS ONLY - NO HL STORAGE
Tullera 2 Reservoir
Booster Pumps
North Zone
South Zone
Lismore Supply
Howards Grass
HGL RL 161
N
7. Lismore Plateau Full Stg Trial A.NET


NORTH LISMORE PLATEAU
NON-BOOSTED SCENARIO
<< Node 47
South Zone
North Zone
<<Node 23
Tullera 2 Reservoir
Booster Pumps
9. Lismore Plateau Full Stg Trial B.NET
>N
Lismore Supply
Howards Grass
Both pumps made non-operational. Min head at Node 47 is 8.7m
Min head at Node 23 is 12.8m.


NORTH LISMORE PLATEAU
FIRE FLOWS-BOOSTED FLOWS
Tullera 2 Reservoir
Booster Pumps
North Zone
South Zone
Lismore Supply
Howards Grass
HGL RL 161
Fire flows of 25 l/s applied at Nodes 48 and 23 at 10 am for 1 hr
Residual head at 4.5m at Node 46, 7.9m at Node 23
10. Lismore Plateau Full Sty Fire Trial A.NET
N

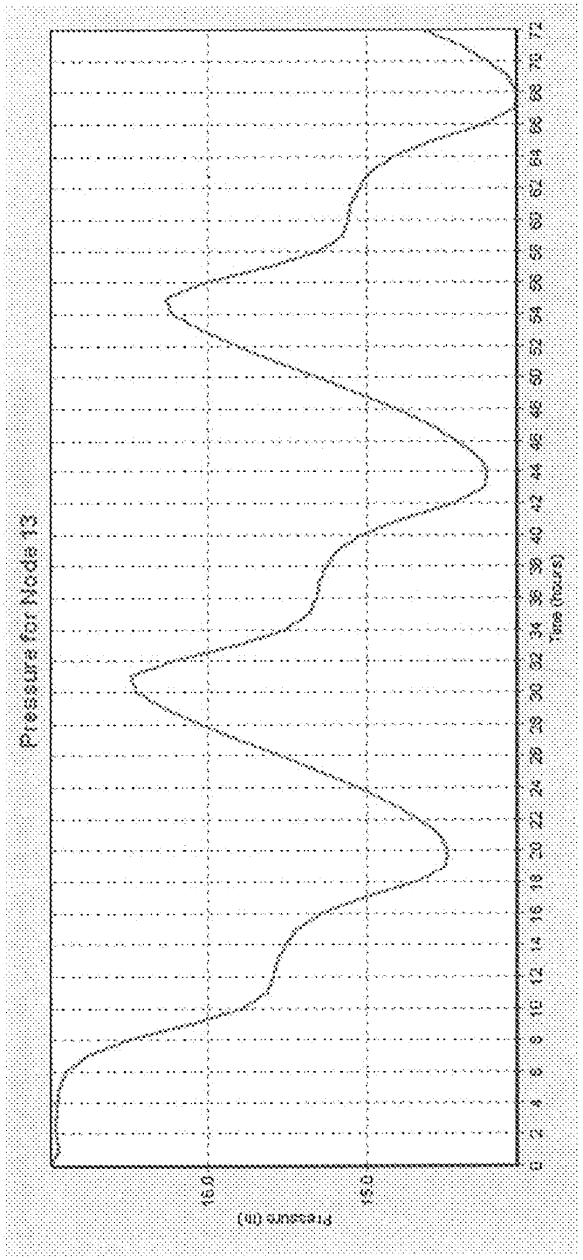
7


NORTH LISMORE PLATEAU
NON-BOOSTED SCENARIO
FIRE FLOWS
Node 48
-3.5m head @ 25l/s, +2.6m head @ 15 l/s
Node 23
+7.8m head @ 25l/s, +10.8m @ 15 l/s
Tullera 2 Reservoir
Booster Pumps
<< Node 23
<< Node 48
North Zone
South Zone
Lismore Supply
Howards Grass
HGL RL 161
N
12. Lismore Plateau Full Stg Fire Trial B.NET



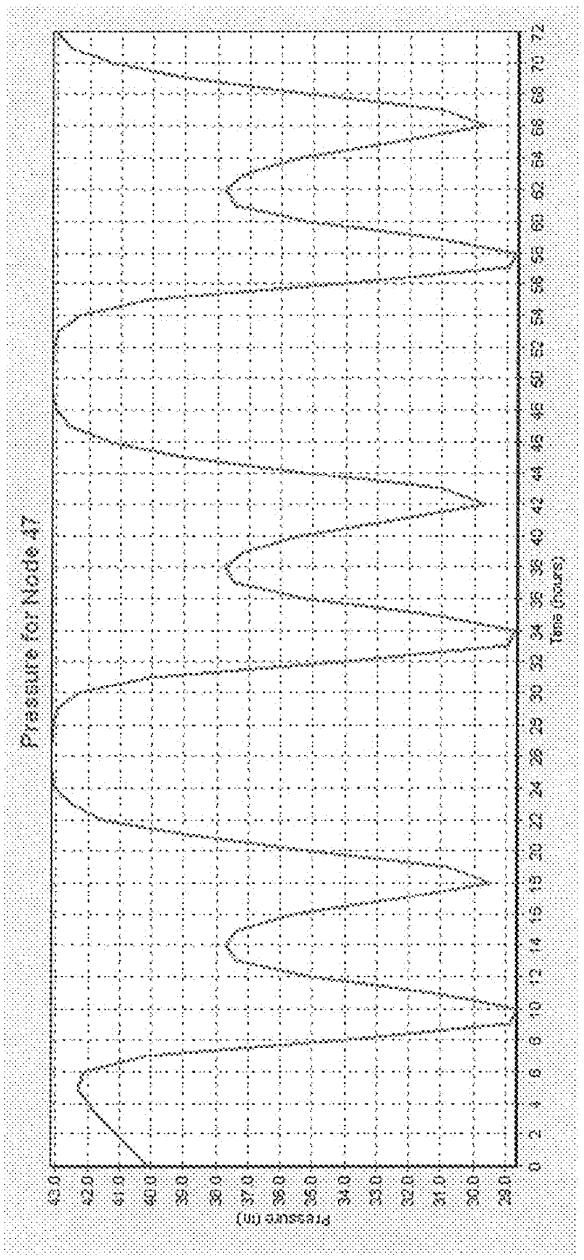
Pressure Diagram for Node 13 – Stage 1 development with boosted flows only
Refer to Network Diagram 1

9



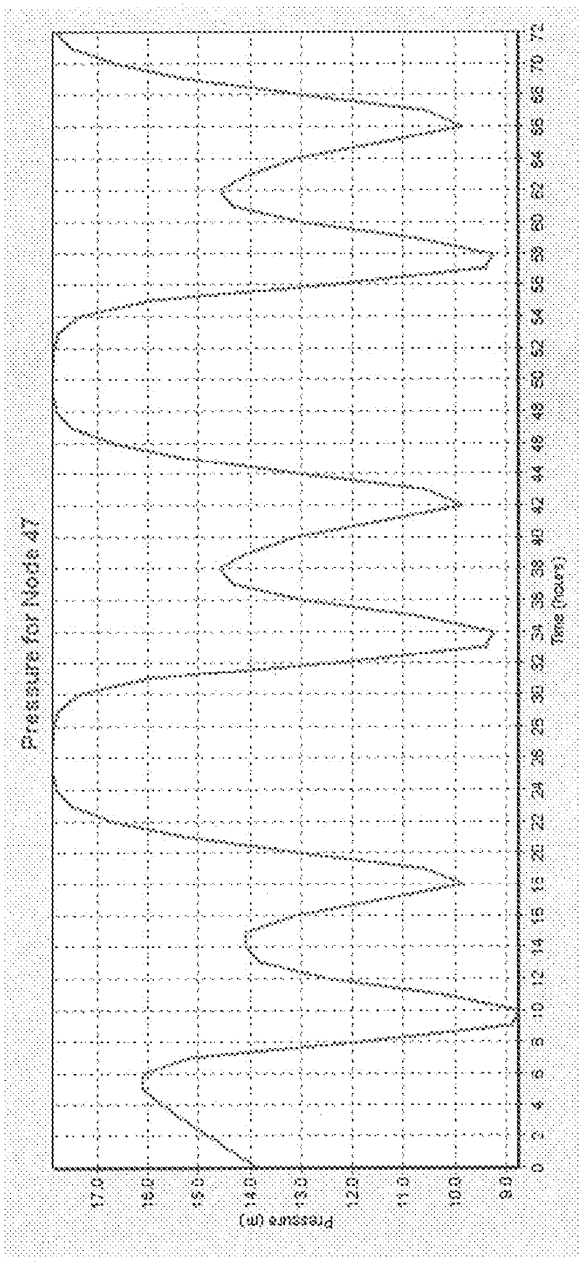
Pressure Diagram for Node 13 – Stage 1 development fed entirely from Tullera Reservoir
Refer to Network Diagram 3

10



Pressure Diagram for Node 47 – Full development with boosted flows only
Refer to Network Diagram 7 (note pressure range would be reduced by variable speed pumping – not modelled)

11



Pressure Diagram for Node 47 – Full development fed entirely from Tullera Reservoir (No 2)
Refer to Network Diagram 9

12

APPENDIX B
CORRESPONDENCE SUPPLIED BY DAVID STEWART CONSULTING
SEPTEMBER 2006

David Stewart Consulting
Engineering Management • Transport+Urban Systems
Newcastle East • NSW • Australia

21 September 2006

Manager, Distribution Engineering
Rous Water
PO Box 230
LISMORE NSW 2480

Attention Mr Terry Gobbe

Dear Mr Gobbe,

proposal for Development on North Lismore Plateau

Thank you for your generous time and ready information on my visit on 31st August 2006. I have attached some notes of the meeting for your confirmation and will proceed to adopt these as the basis for advice to the client for this proposed development. If you have any further information which would influence my advice I ask if you could let me know as soon as possible.

Yours faithfully

David Stewart
David Stewart Consulting

Enclosure: Notes of Meeting of 31 August 2006

CC: ACM Landmark, Cessnock NSW

PO BOX 431 • NEWCASTLE • 2300 NSW • AUSTRALIA
T: 02 4927 1585 • F: 02 4929 4505 • M: 0417 841 525
E: dstewart.consult@pacific.net.au

North Lismore Plateau – Proposed Development

Informal meeting at Rous Water Offices, Lismore on 31st August 2006.

Present Mr Terry Gobbe, Rous Water,

Mr David Stewart, David Stewart Consulting

1. If any development is approved by Lismore CC in the North Lismore Plateau district Rous Water will respond to a formal request from Lismore City Council to supply water to meet development needs based on the planned ET numbers advised by LCC.

2. The issue of demand factors related to standard ETs, requirements for rain water tanks at dwellings and reductions following Basix regulations is a matter for LCC. Rous Water use a standard demand figure of 2,500 l/day per ET.

3. Rous Water do not usually own distribution reservoirs and would expect LCC to provide a new reservoir at Tullera if that is required.

4. If a new supply main is required to feed a new reservoir at Tullera for a North Lismore development then Rous Water will construct and will own this asset. The cost of this would come from the standard amplification charges of $3,275 per ET which is levied by Rous Water on all new titled lots.

5. An analysis by Rous Water indicates that the feed to the existing Tullera Reservoir can provide one mega litre per day of 22 hours.

6. Operating conditions in the supply mains which feed Tullera and North Lismore are managed by Rous Water on a daily basis to meet the supply agreements and cannot be specified in detail.

David Stewart

21 September 2006

Manager Lismore Water
Lismore Water
PO Box 23A
LISMORE NSW 2480

Attention Dr Malcolm Jones

Dear Dr Jones,

proposal for Development on North Lismore Plateau

Thank you for your generous time and ready information on my visit on 31st August 2006. I have attached some notes of the meeting for your confirmation and will proceed to adopt these as the basis for advice to the client for this proposed development. If you have any further information which would influence my advice I ask if you could let me know as soon as possible.

Yours faithfully

David Stewart
David Stewart Consulting

Enclosure: Notes of Meeting of 31 August 2006

CC: ACM Landmark, Cessnock NSW

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North Lismore Plateau – Proposed Development

Informal meeting at Lismore Water Offices, Lismore on 31st August 2006.

Present Dr Malcolm Jones, Lismore Water,

Mr David Stewart, David Stewart Consulting

Water Supply Systems

7. Any development approved for North Lismore Plateau will use a supply from Rous Water through a Lismore Water Reservoir, probably near the existing Tullerra Reservoir.

8. All new developments in the Lismore Water area should expect a requirement that they be planned and designed to minimise water consumption, to maximise water device efficiency, to engage local catchment of rainwater at the dwelling, and to consider grey water re-use.

9. Grey water re-use is possibly most effective at a district or suburb level using a dual reticulation system. It would be collected at the district level in a lake, treated by UV or similar means and reticulated to dwellings and bulk users. The preferred method will also enable grey water re-use to serve community landscaping and recreation facilities.

10. If any development is approved by Lismore CC in the North Lismore Plateau district LCC will negotiate with Rous Water to supply water to meet development needs.

11. Lismore Water would consider the issue of demand factors related to standard ETs, reductions if rain water tanks are required at dwellings and reductions following Basix regulations. Some reduction from the standard demand figure may be accepted by LCC when a formal request for rezoning is submitted.

Sewerage Systems

The following comments were given by Dr Jones as information and observations and are not to be taken as policy, as directives or as guidance.

12. No new sewage treatment plant can be expected to serve a development such as the North Lismore Plateau in the City of Lismore. The area is close to the South Lismore treatment plant (SLTP) and a sewer main with possible pressure main sections could be constructed from a development at North Lismore to the SLTP.

13. The environmental planning requirements for a new sewage treatment plant are considerable and would be likely to cause long delays to any planning for a new urban development.

14. South Lismore plant could be expanded to cater for increased inflow from additional urban development in its catchment. There is not likely to be a requirement that sewage from North Lismore would be directed to the East Lismore treatment plant.

David Stewart

APPENDIX C
COSTING INFORMATION PREPARED BY DAVID STEWART CONSULTING

NORTH LISMORE PLATEAU DEVELOPMENT

STAGE 1 PROJECT COSTS - ASSUMPTIONS

Design Concept

The design costs are based on the provision of a 300 mm trunk main from Tullera Reservoir to the intersection of McLeay and Dunoon Roads. A booster pump will be located at this location. A 250 mm main will then be laid along the route of the future Plateau ring road to the central area of Stage 1. A combination of 150 mm and 100 mm watermains will service the lots in Stage 1.

Pipework

1. Costs have been based on past Hunter Water Revaluation figures, indexed for CPI increases and on contract prices from the Mid North Coast of 2000-2004 and from current suppliers quotations for materials.
2. Watermain costs have been based on "greenfield" rates
3. Hunter Water rates have been based using on Class 20 uPVC pipe. Although Class 16 pipe would be used in the Lismore Plateau Project, no reduction in material costs has been applied as it would be expected that pipe raw material cost increases would have exceeded CPI increases in recent times.
4. A factor of 5% has been allowed to compensate for costs associated with the locality.
5. No allowance has been made for connections to properties other than the provision of drilled connection points at the main.
6. Laying costs have been increased by 20% to allow for the possibility of rock excavation.

Reservoir

The existing reservoir at Tullera can serve the Stage 1 development.

Booster Station

1. Costs have been based on a 2006 quotation for pumps and controls systems from a supplier, and on past Hunter Water Revaluation figures, indexed for CPI increases.
2. It has been assumed that the booster pumps will be housed in a brick building.
3. The pump house has been sized for two pumps only and would need to be extended to accommodate an additional two pumps at a later time.
4. Allowance has been made for power and telemetry, with an 11kV supply adjacent in Dunoon road and a transformer to 415V.
5. No allowance has been made for land acquisition.

Overheads And Contingencies

1. An allowance of 16% has been made for survey, investigation and design and 20% for contingencies.

STAGE 1 COSTS

	Unit	Rate Sept 06	Quantity	Amount Sept 06	June 2010 (11% increase)
1. Pipework					
a. 300mm uPVC trunk main	m	$280.00	1,840	$515,200	$571,900
b. 250mm uPVC trunk main	m	$205.00	2,620	$537,100	$596,200
c. 200mm uPVC trunk main	m	$170.00	0		
c. 150mm uPVC reticulation	m	$150.00	3,931	$589,650	$654,500
d. 100 mm uPVC reticulation	m	$125.00	1,916	$239,500	$265,800
Cost before overheads				$1,881,450	$2,088,400
SID, 16%			16%	$301,032	$334,100
Contingencies, 20%			20%	$376,290	$417,700
Cost with overheads				$2,558,772	$2,840,200
		Allow		**$2,559,000**	**$2,841,000**
2. Booster Station					
Booster Station Pumps				$36,000	$40,000
Building& pipework				$83,000	$92,100
Electrical & telemetry				$80,000	$88,800
Cost before overheads				$199,000	$220,900
SID,16%			16%	$32,000	$35,300
Contingencies, 20%			20%	$40,000	$44,200
Cost with overheads				$272,000	$300,400
		Allow		**$272,000**	**$301,000**
		Allow		**$2,831,000**	**$3,142,000**

Note: Costs shown in the report are slightly higher than shown on this cost spreadsheet due to a difference staged approach to rounding off costs.

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FULL DEVELOPMENT PROJECT COSTS - ASSUMPTIONS

Design Concept

The design costs are based on the provision of a 300 mm trunk main from Tullera Reservoir to the intersection of McLeay and Dunoon Roads. A booster pump will be located at this location. This station will contain two sets of pumps. One set of pumps will boost pressure to the northern zone of the development (ET = 323) while the second set of pumps will boost pressure to the southern zone of the development (ET = 633). A 250 mm trunk main would carry boosted water along the route of the Plateau ring road to the centre of the northern zone while a 200 mm main would carry boosted water to the centre of the southern zone.

Reservoir

1 Costs for a reservoir have been derived from current prices for similar reservoirs on the Mid North Coast and from past Hunter Water Revaluation figures, indexed for CPI increases.
2. Adjustments of actual Mid North reservoir costs to obtain cost for a 2.5 Ml reservoir have been made using scaling factors from Hunter Water cost data.
3. Assume a steel 2.5 Ml reservoir, 20 m dia x 8 m high
4. The new Trunk Main from Existing Lismore Supply at Howards Grass to Tullera Reservoir is provided by Rous Water from their amplification works charges.

Pipework

1. Costs have been based on past Hunter Water Revaluation figures, indexed for CPI increases, on contract prices from the Mid North Coast of 2000-2004 and from current suppliers quotations for materials.
2. Watermain costs have been based on "greenfield" rates
3. Hunter Water rates have been based using on Class 20 uPVC pipe. Although Class 16 pipe would be used in the Lismore Plateau Project, no reduction in material costs has been applied as it would be expected that pipe raw material cost increases would have exceeded CPI increases in recent times.
4. A factor of 5% has been allowed to compensate for costs associated with the locality.
5. No allowance has been made for connections to properties other than the provision of drilled connection points at the main.
6. Laying costs have been increased by 20% to allow for the possibility of rock excavation.

Booster Station

1. Costs have been based on a quotation for pumps and controls systems from a supplier, and on past Hunter Water Revaluation figures, indexed for CPI increases.
2. It has been assumed that the booster pumps will be housed in separate brick buildings.
3. The pump house has been initially sized for two pumps only and would need to be extended to accommodate an additional two pumps.
4. Allowance has been made for power and telemetry, with an 11kV supply adjacent in Dunoon road and a transformer to 415V.
5. No allowance has been made for land acquisition.

Overheads And Contingencies

1. An allowance of 16% has been made for survey, investigation and design and 20% for contingencies. This is made up of 3% each for Survey and Investigations, 4% for Design and 6% for Contract Administration.

FULL Development Costs

	Unit	Rate Sept 06	Quantity	Amount Sept 06	Amount June 2010 (11% increase)
1. Pipework					
a. 300mm uPVC trunk main	m	$280.00	1,840	$515,200	$571,900
b. 250mm uPVC trunk main	m	$205.00	2,620	$537,100	$596,200
c. 200mm uPVC trunk main	m	$170.00	813	$138,210	$153,400
c. 150mm uPVC reticulation	m	$150.00	13,210	$1,981,500	$2,199,500
d. 100 mm uPVC reticulation	m	$125.00	9120	$1,140,000	$1,265,400
Cost before overheads				$4,312,010	$4,786,400
SID, 16%			16%	$689,922	$765,800
Contingencies, 20%			20%	$862,402	$957,300
Cost with overheads				$5,864,334	$6,509,500
		Allow		**$5,865,000**	**$6,510,000**
2. Booster Station					
Booster Station Pumps				$63,000	$69,900
Building& pipework				$167,000	$185,400
Electrical & telemetry				$80,000	$88,800
Cost before overheads				$310,000	$344,100
SID,16%			16%	$49,600	$55,100
Contingencies, 20%			20%	$62,000	$68,800
Cost with overheads				$421,600	$468,000
		Allow		**$422,000**	**$468,000**
3. Reservoir - Tullera No 2					
Steel 2.5 Ml, 20.0 m dia x 8.0 m high				$800,000	$888,000
Site formation				$100,000	$111,000
Cost before overheads				$900,000	$999,000
SID, 16%			16%	$144,000	$159,800
Contingencies, 15%			15%	$135,000	$149,900
Cost with overheads				$1,179,000	$1,308,700
		Allow		**$1,180,000**	**$1,309,000**
4. Total Project Costs				$7,464,934	
		Allow		**$7,465,000**	**$8,287,000**

Note: Costs shown in the report are slightly higher than shown on this cost spreadsheet due a different staged approach to rounding off costs.

CIVIL DESIGN SERVICES PTY LTD

REPORT ON FEASIBILITY OF PROVIDING AN ELEVATED STORAGE TO SERVICE NORTH LISMORE PLATEAU RESIDENTIAL DEVELOPMENT

REPORT FOR
ACM LANDMARK

January 2011

REPORT ON FEASIBILITY OF PROVIDING AN ELEVATED STORAGE TO SERVICE NORTH LISMORE PLATEAU RESIDENTIAL DEVELOPMENT

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