The Pejar Dam Pipeline

Review of submitted Capital Costs

This paper reviews the Capital Costs of the Pejar Dam Pipeline Proposal as submitted by GWG 17 Nov 2007. The review is in the same order of Capital Costs provided:

1.1 Upgrade the Rossi to Sooley pipeline (200ML/day)
600mm PE pipe x 2klm at $2000/m, $4.0m

Notes:

Existing pipe length is 2.3km
200ML/day equates to 2,314L/s over 24 hour period.
2,314L/s in a 600mm pipe.

a) Check velocity in diameter 600mm pipe:

Velocity = $\frac{2{,}314 m^3/s \text{ (flow rate)}}{0.283 m^2 \text{ (area of 600mm pipe)}}$

= 8.18m/s

Water supply pipeline rising mains generally operate around 1.5m/s in velocity to minimise friction loss, maintain suitable pumping head and minimise power consumption and hence greenhouse gas emission. An example is the Goulburn WTP 600mm rising main operating at approx 400L/s and a velocity of 1.4m/s.

The friction loss generated at 8.18m/s (2,314L/s) in the 600mm pipe (in excess of 50m per 1000m of pipe) conflicts with standard hydraulic engineering principles.

Look at a practical pipeline size – try 1200mm:

Velocity = $\frac{2{,}314 m^3/s \text{ (flow rate)}}{1.13 m^2 \text{ (area of 1200mm pipe)}}$

= 2m/s (Still high but may be ok for this process – would require further design)

Try 1500mm:

Velocity = $\frac{2{,}314 m^3/s \text{ (flow rate)}}{1.767 m^2 \text{ (area of 1500mm pipe)}}$

= 1.3m/s (ok for this process)

b) Costing using 1500mm diameter pipe:
(Noting that with further design it is possible that the pipeline size may be 1200mm in diameter)

Verbal quote from Tyco Water for 2.3km of 1500mm DICL was $1,800/m = $4.14m. Advice from Iplex regarding 1500mm PE pipe; They said the pipe materials of DICL, steel and GRP would be a cheaper option than PE due to the high costs of supply at this diameter and the significant butt welding costs for every PE pipe joint.

Installation costs of pipe this diameter is high due to the following:

- size of trench and benching required;
- additional plant for backfill and excess material removal;
- plant required for pipes installation – placing in trench and engaging sockets

For this process we will use 1.5 times the supply costs for installation. Acknowledging that this would be on the low side as the costs could be significantly higher. Therefore $2,700/m = $6.21m.

Therefore pipeline supply and installation costs will be in the order of **$10.35m** ($4.14m + $6.21m). Note that if 1200mm diameter is acceptable by design the costs would be approx $8.8m.

The $4.0m figure supplied by the GWG submission appears accurate for a 600mm PE pipeline. But for the 200ML/day pipeline as submitted this size is not acceptable by design.

1.2 Upgrade the Rossi to Sooley pump (200ML/day) $0.5m

Notes:

Pump flow rate	=	2,314L/s
Static Head	=	22m
Friction Loss	=	30m (check valve, isolation valves, elbows, 2.3km pipe, etc)

Therefore pump details (duty) are 2,314L/s at 52m head. Verbal quotation from ITT Flygt pumps is $350k. Note this pump is 1,400kW.

a) Associated costs:

The GWG submission has no costs associated with upgrading the pump station itself – pump well, switchgear, inlet works etc to accommodate this significantly larger pump. The existing pump well, inlet works (900mm diameter) and outlet works (600mm) will not accommodate this new pump due to the flow rates required. At this early stage of the process there appears only 1 option and that is to install a second pump station including a pump well with new inlet and outlet works designated for the Rossi to Sooley pump and pipeline only.

Costs associated with this new pump station will be significant. Costs include:

- excavation and drive access;
- concrete works including pump well, power supply room and ladder access;
- power supply, switchgear, controls and telemetry;
- inlet and outlet pipe work – including suction line drawing from the weir;
- mechanical installation works – suction and discharge manifolds, valving;

Estimated costs for this work is **$9.7m**

1.3 Design and Supervision $0.5m

Consultants and Project Managers allow nominally 4% of construction costs to accommodate project management, design and documentation.

Therefore 4% of $20.05m is **$800k.**

Total estimated cost of the Rossi to Sooley 200ML/day pump station and pipeline is **$20.85m**

2.1 Pejar to Sooley two way pipeline, via the preferred route, over open country south west of the Crookwell road (to grade, to gravity supply Sooley)
450mm PE pipe x 17.5klm at $1500/m, $26.25m

Costs as presented by this submission for the pipeline seem ok for this process.

2.2 Sooley to Pejar pumps x 3 $1.5m

The pump duty points are 580L/s at 370m (240m friction and 130m static). 580L/s being the 50ML/day transfer rate as per the GWG submission. Check motor size:

$$\text{Power} = \frac{580\text{L/s} \times 370(\text{h})}{102} \times \frac{100}{90\%} \times \frac{100}{90\%}$$

$$= 2{,}600\text{kW}$$

The $1.5m as submitted is ok for the pump supply costs but would not cover the costs of a pump station. These works include excavation, concrete, building, inlet and outlet structures and manifolds, switchgear, controls and telemetry. An estimate of these costs is $4.5m.

Therefore total costs of the Sooley to Pejar Pump Station is **$6m**

2.3 Power line to pumps. $0.5m

This cost is unknown at this point. Due to the significant size of the pump motors, costs may be in excess of $1m to supply power to the remote Sooley site. For the purpose of this review leave the estimate at $0.5m.

2.4 Renewable energy source x 1, at each of 3 Sooley to Pejar Pumps. $1.5m

Do not have any detail of what this submission is offering. For the purpose of this review leave the estimate at $1.5m

2.5 Design and Supervision. $5m

As per 1.3 above. Consultants and Project Managers allow nominally 4% of construction costs to accommodate project management, design and documentation.

Therefore 4% of $34.25m is **$1.37m.**

Total estimated cost of the Pejar to Sooley 2 way pipeline and associated works is **$35.62m**

Therefore the total estimated cost of the works as proposed in the GWG Submission is $20.05m + $35.62m = **$55.67m.**

Additional notes:

1. Power supply costs for both the Rossi to Sooley pumps and the Sooley to Pejar pumps could be significantly higher than detailed above due to the large motor sizes required for the pumps. These costs can not be quantified without input from the power supply service provider.

2. Hunter Water Australia report titled Pejar Transfer Evaluation dated October 2007 details 3 options to transfer water from Pejar to Sooley (One way pipeline only). The report includes for a pump station at Pejar Dam to transfer the water to Sooley, the cost of which is not included in the GWG submission. The cost range for the 3 options is $2.2m to $4.5m.

3. Item 2.1 above indicates $26.25m for the pipeline component. This estimate can be considered on the high side as Hunter Water Australia's estimate for the same pipeline is $24.5m

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05 February 2008

Additional review carried out 16 October 2008. Refer following page.

Additional Review

This additional review looks at the Capital Cost Item 2.1 of the GWG proposal. Specifically the flow rate of 50ML/day and pipeline size of 450mm proposed.

50ML/day equates to 580L/s over 24 hour period.
580L/s in a 450mm pipe.

a) Check velocity in diameter 450mm pipe:

Velocity = $\frac{0.580m^3/s \text{ (flow rate)}}{0.159m^2 \text{ (area of 450mm pipe)}}$

= 3.6m/s (This is extremely high and equates to over 240m friction loss over the 17.5km pipeline length).

Look at a practical pipeline size – try 600mm:

Velocity = $\frac{0.580m^3/s \text{ (flow rate)}}{0.283m^2 \text{ (area of 600mm pipe)}}$

= 2m/s (This equates to approx 60m friction loss over the 17.5km pipeline length).

By looking at the pipeline velocities only, it shows that 450mm pipe for the flow rates indicated is too small as the corresponding velocities and therefore friction losses are too great.

The 450mm diameter pipe as proposed by the GWG should be increased to 600mm diameter in part 2.1 of their proposal. This may impact on the proposed costs.

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