MEMO

To: The Files

Update: October 16, 2012

Subject: Review of Australian Water Reservoirs

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Principal Author: R.A. Beatty:

Contact: BobBeatty@bosmin.com

1. BACKGROUND

Irrigation water supplies in the Murray-Darling basin have become increasingly scarce over the years due to growing commercial demand for water. Much of the impounded water is lost to evaporation as the Basin sits within a region of high evaporation – generally in the order of two meters per year.

The importance of storage evaporation appears to have been understated in terms of asset loss as well as the impact on overall river salinity. Similarly the importance of maintaining water storage depth is underestimated in many instances with continuous sedimentation deposits allowed to accumulate in the storage. This feature is particularly costly as it incrementally replaces the most valuable water storage capacity with inert material.

Many of our water storages were not cleared of vegetation before filling let alone deepened with a view of increasing the water storage portion not subject to evaporation loss.

2. EFFICIENT SURFACE WATER GENERIC STORAGE

We define efficient storage as a measure of the ability of a dam to store water with minimum loss from evaporation, and that 100% is the efficiency of the “ideal” reservoir.

The shape of a reservoir has a large impact on the evaporation loss. The most efficient shape for storing an open body of water has a circular top, and we will assume a 10:1 slope angle for the dam wall (5.7^o slope). Deeper reservoirs will experience proportionately lower evaporation losses.

We will use this shape to define an “ideal” reservoir and compare existing storages against this standard. To complete this comparison, the publicly available reservoir parameters for capacity and surface area were analysed and converted from mega liters and hectares to cubic meters and square meters to facilitate the comparison of storage volumes and surface areas.

The cone volume V is given by

$$V = \frac{\pi r^2 \times H}{3}$$

Where r is the radius, H is the depth and for a 10:1 slope is related as:

$$\frac{H}{r} = 0.1 \; and \; r = \frac{H}{0.1}$$

Now $V = \pi \left(\frac{H}{0.1}\right)^2 \text{ x } \frac{H}{3}$

and $V = \frac{\pi H^3}{0.03}$

The ratio $\frac{V}{H^3}$ = 105.1 defines the “ideal” reservoir, and other reservoirs can now be compared to this constant using the ratio of volume divided by depth cubed.

This comparison generally delivers a very small ratio which is expressed as a percentage.

Results are tabulated in APPENDIX-A. AUSTRALIAN WATER STORAGES with the storages listed in ascending order of efficiency.

Dam storage shelf life is also listed. This shows the time it takes to evaporate the dam contents without further replenishment and assumes the full surface area is constant. With evaporation broadly 2 meters per year and the average storage depth 10.8m, this implies we lose 18.2% of the stored water capacity to evaporation. This amounts to 612 million cubic meters, or 612 Gigaliters per year. Further unspecified, but accumulating loss of storage capacity occurs through silt buildup.

3. AUSTRALIAN WATER STORAGES

The ten least efficient water storages are included in Table 1.

			Location	Storage Capacity	Surface Area	Average Depth	Storage Efficiency	Dam Storage Shelf Life	
Reference:	State			m3	m2	m	105.1/(V/H^3)	Years	Ranking
13	NSW	Menindee Lakes	Darling River	1,682,000,000	485,000,000	3.5	0.0003%	1.7	1
115	Qld	Wivenhoe Dam (Brisbane's main dam)	Brisbane River	264,000,000	109,400,000	2.4	0.0006%	1.2	2
21	Vic	Yarrawonga Weir	River Murray	117,500,000	43,900,000	2.7	0.002%	1.3	3
25	Vic	Kow Swamp	River Murray	51,730,000	24,000,000	2.2	0.002%	1.1	4
84	Qld	E.J. Beardmore Dam	Balonne River	81,700,000	28,500,000	2.9	0.003%	1.4	5
75	Qld	Burdekin Dam	Burdekin River	1,860,000,000	220,000,000	8.5	0.003%	4.2	6
85	Qld	Enoggera Dam (Enoggera Reservoir)	Brisbane	4,500,000	3,581,500	1.3	0.005%	0.6	7
32	Vic	Goulburn Weir	Goulburn River	25,500,000	11,300,000	2.3	0.005%	1.1	8
112	Qld	Southedge Dam	Mitchell River	129,000,000	32,900,000	3.9	0.005%	2.0	9
88	Qld	Fairbairn Dam	Nogoa River	1,301,000,000	150,000,000	8.7	0.005%	4.3	10

Table 1.

Images of these reservoirs include:

Menindee Lakes	Wivenhoe Dam	Yarrawonga Weir
		
Kow Swamp	E.J. Beardmore Dam	Enoggera Dam
		
Goulburn Weir	Southedge Dam	Fairbairn Dam
		

The ten most efficient storages are in Table 2:

			Location	Storage Capacity	Surface Area	Average Depth	Storage Efficiency	Dam Storage Shelf Life	
Reference:	State			m3	m2	m	105.1/(V/H^3)	Years	Ranking
50	SA	Baroota Reservoir	Port Pirie	6,140,000	630,000	9.7	1.585%	4.9	108
52	SA	Bundaleer Reservoir	Port Pirie	6,370,000	630,000	10.1	1.706%	5.1	109
54	SA	Middle River	Kangaroo Island	470,000	110,000	4.3	1.744%	2.1	110
65	WA	Victoria Dam	Australind	9,463,000	770,000	12.3	2.062%	6.1	111
95	Qld	Kroombit Dam	Callide	14,600,000	1,000,000	14.6	2.240%	7.3	112
51	SA	Beetaloo Reservoir	Crystal Brook	3,180,000	330,000	9.6	2.957%	4.8	113
44	SA	Kangaroo Creek Dam	Kangaroo Creek	19,160,000	1,030,000	18.6	3.531%	9.3	114
58	WA	Churchman Brook Dam	Ashendon	2,160,000	240,000	9.0	3.547%	4.5	115
102	Qld	Little Nerang Dam, Gold Coast	Gold Coast	9,280,000	490,000	18.9	7.693%	9.5	116
53	SA	Blue Lake	Mount Gambier	36,000,000	700,000	51.4	39.711%	25.7	117

Table 2.

Efficient storage images include:

Baroota Resevoir 	Kroombit Dam 	Victoria Dam 
Beetaloo Reservoir 	Churchman Brook Dam 	Blue Lake 

4. IMPROVING WATER STORAGE EFFICIENCY

The most practical way to improve dam efficiency is to increase the storage depth without increasing the surface area. In other words dig it deeper. This approach provides additional storage capacity without exposing the new found capacity to surface evaporation. This is more efficient than building a new dam. Deepening also removes silt buildup forming at the bottom of all storages. The question then becomes how to increase the storage depth without having to empty the water?

One approach is to float a dredge on the lake and pump the dredged material into a storage pond adjacent to the reservoir. This can be problematic if the dredge encounters buried logs or rocks. Dredging also favors removing the fine particles from the bottom silt which can result in increased leakage from the storage into the underlying formations.

Another approach is to use rope operated scraper equipment, otherwise described as Overburden Slushers (OS), which have the capacity to work submerged as shown in Figure 1:

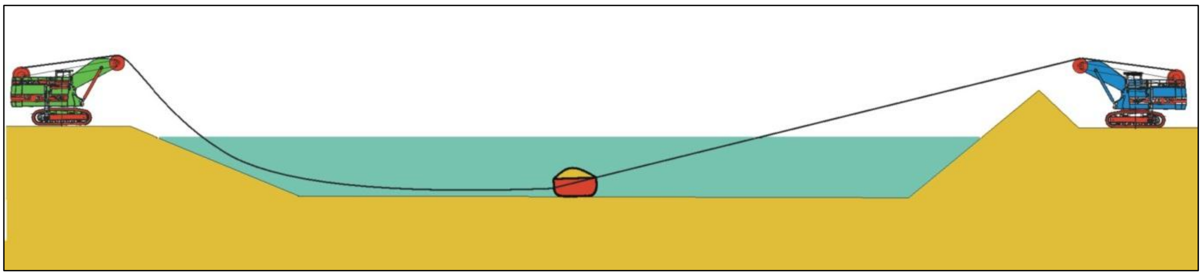

Figure 1.

Two mobile winching sets operate a hoe between them, alternatively pulling and retrieving the hoe across the base of the water storage. Winch power determines the OS capacity and large hydraulic excavators, including 4,000 HP units, are available and could be modified to suit. This combination of equipment is described as OS400 and recognises the main winch in the 4,000 HP class.

Under suitable circumstances, this arrangement could be used to deepen a river bed behind a storage weir. An inlet weir wall of some description may be required to limit up stream bed erosion. This may take the form of a large rock placement or possibly a submerged concrete structure. The aim is to develop a rock pool in the river bed which will be stable under flood conditions while improving the live holding capacity of the existing weir.

Alternatively, the retrieval winch could be mounted on an anchored barge in a lake, and the hauling winch could deposit the material in the shallow water around the lake edge. This approach reduces the surface area of the storage while also increasing the storage depth, thereby significantly improving storage efficiency.

5. HOE OPERATION - TECHNICAL DESCRIPTION

The hoe operates quite differently to a bulldozer blade - it operates more like a wood plane shaving off laminates of sedimentary material. The hoe is box shaped with two side plates; a rear mounted blade is set at a low angle, and a net structure covers the top (top-net). The hoe has no base plate, as shown in Figure 2.

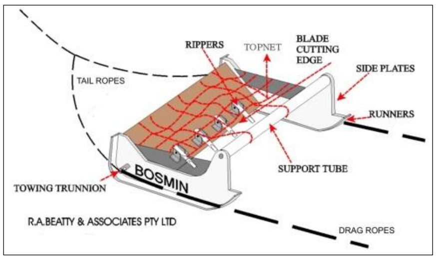

Figure 2.

As material enters the hoe it rides up the face of the blade - which may also be fitted with teeth. At the top of the blade the load comes up against the top-net. This prevents the material exiting over the back of the hoe. Since the material is constrained by the top net and the two side plates, hydrostatic pressure starts to build up within the hoe as does the gross weight. This squeezes some water from the load and prevents the load from rotating within the hoe. When it reaches design capacity, hydrostatic pressure buildup is sufficient to lift the load clear of the dig surface - a shear plane develops under the load and the payload advances to the dump point. It is worth noting here that the OS hoe has two distinct operating modes - one is the dig mode while the other is the transporting mode. Transporting mode requires a significantly lower rope pulling force.

On reaching the dump point, the underlying shear plane disappears and becomes a zone of passive resistance - so as the retrieval winch starts to operate the payload is left behind in a fairly discrete pile - aided by the fact that the box hoe is designed with the sides set on a slight front facing taper. This materials handling mechanism has been conclusively demonstrated on the surface, but it remains to be seen how well it operates below water. It is expected to deliver a thick paste load, which may need depositing a little bit further up the shoreline depending on its consistency. The other noteworthy point is the top-net permits some of the fine material to exit the hoe which biases the delivered load in favor of the coarse fractions of silt material, thereby improving the stability of the dumped material.

The OS400 hoe is a large piece of equipment (103 cubic meters) with a very large gape. A 3000 kW winch can pull a hoe 2.4m high, 5.8m long and 8.2m wide from below a water surface. Tare weight is 41t. It also has remarkable ripping ability, because the power plant is stationary and does not rely on a track system to generate the required pull. Cutting edge force is up to 1860 kN. This amount of usable energy puts vegetation material in the shredded category, most large rocks in the moved category and a lot of bedrock in the sheared category. However, if the immovable object is encountered, the hoe may jump over it, or can be backed off and run down an adjacent path to possibly undermine the object.

This equipment is very energy efficient as the load never lifts clear of the bottom where sliding friction forces are low, and large capacity hoes can be used. The OS400 can pull the hoe over a distance of 500m and produce material at a rate of 1,000 cubic meters per hour, at an operating cost in the order of $\$0.65/m^3$.

6. CONSTRUCTING NEW WATER STORAGES

In another application, the equipment could be used to excavate new water reservoirs, such as off-stream storages. Off-stream storages (refer Figure 2) can be used to better harvest and utilise runoff water resources.

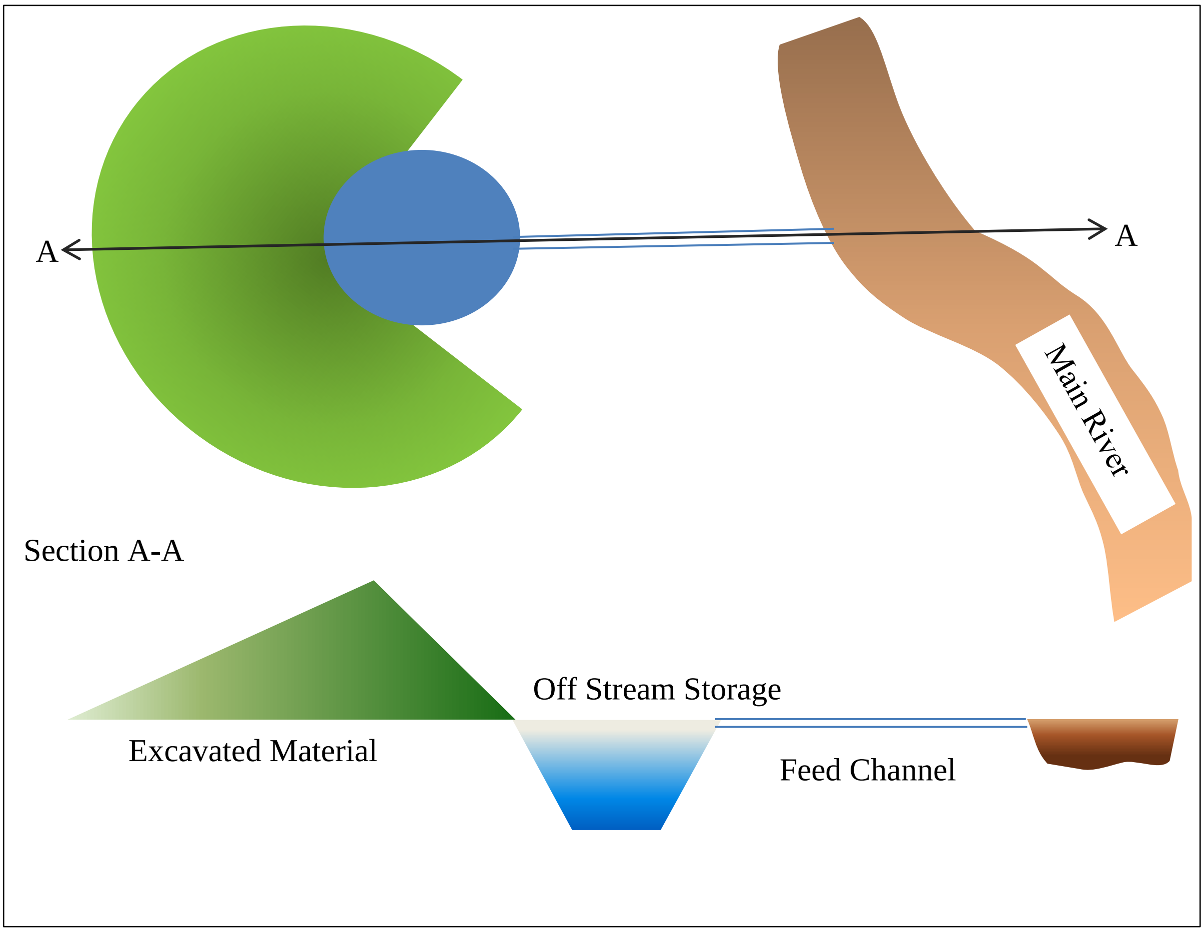

Figure 3.

Figure 3 shows a doughnut shaped excavation with a deep water reservoir partially surrounded by excavated material. This design provides a convenient spoil dump site close to the excavation which reduces construction cost. The bank provides wind protection to limit evaporation loss as well as a high point where a wind mill can be sited to provide pumping and/or aeration to maintain water quality.

Benefits for off-stream storage include:

1. Water is taken from the river only when the river is in flood.
2. The cleanest water is diverted to the storage reducing the incidence of silt buildup.
3. The natural course of the river remains substantially uninterrupted.
4. The storage can be relatively deep thereby reducing evaporation losses.
5. The excavated material high ground provides a useful refuge for fixed plant, equipment and fauna during flood periods.
6. Off-stream storages can be constructed anywhere along the length of the river providing site selection flexibility not present with the dam or weir options.
7. The size or number of storages can be adjusted to meet water resource needs of the resident community.

7. TROUGH STORAGES AND DIVERSION CANALS

In other circumstances it will be preferable to build a long trough shaped reservoir. These excavations can be dug across ephemeral river courses, taking due care to avoid river bed erosion. Alternatively, canals can be dug and used to divert large volumes of water within a drainage basin.

Reservoirs can be efficiently excavated using OS equipment, originally designed for open cut mining use. (Refer W6)

OS equipment can dig to any practical depth, but we will assume reservoirs have a maximum depth of 40m from the flood plain level surface. The excavation is trapezoid in cross section with sloping sides angled at 35° from horizontal as shown in Figure 4.

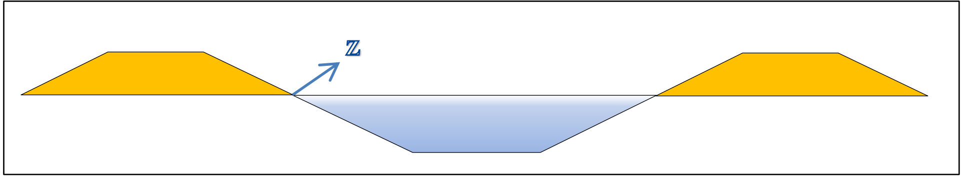

Figure 4.

OS400 is expected to excavate this profile at the linear rate of 1.5 meters per hour in direction Z, providing a water storage capacity of 3,250 m^3 per hour. The storage volume is controlled by the length of the excavation which may be perpendicular to the river course or angled to suit the local topography. One kilometer storage has a capacity of 2,166 Mm^3, or 2.1 Gigaliters. The storage efficiency comparison is 33.28%. If the storage is two kilometers long, the capacity doubles, but the efficiency drops to a still healthy 16.64%.

Alternatively, the excavation can be dug right across several river branches from a braided river system, as seen in Figure 5, thereby providing water storage at a point where no conventional dam site exists; Figure 6. Braided streams flow particularly slowly - which is why they braid and erosion problems are expected to be minimal, but the intakes could be amalgamated ahead of the reservoir and run down a concrete spillway, if necessary.

Figure 5. Cooper Creek near Innamincka May 1974

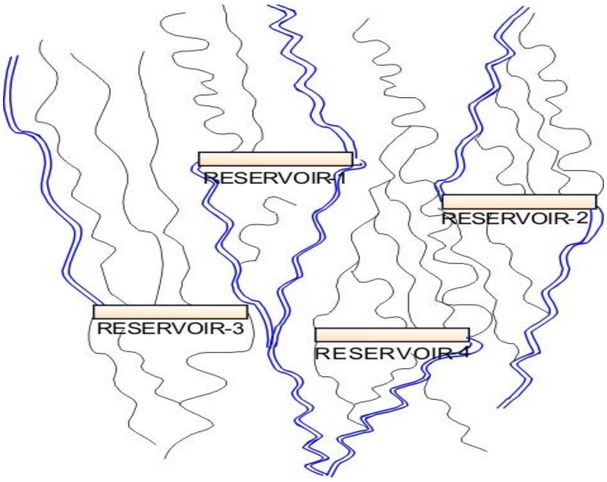

Figure 6. En-echelon Water Storage Reservoirs

8. SUMMARY

1. Evaporation loss represents a none productive use of a valuable water resource and could be expeditiously taxed by rating the surface area of an impounded storage, rather than by taxing the useful volume of water used for irrigation.

2. Several existing Australian water storages can be deepened using Overburden Slusher equipment to improve their water storing efficiency and capacity.

3. OS400 equipment is not currently available from original equipment manufacturers (OEMs). However, the basic engineering components are well understood and commercially available. It will require the services of an innovative engineering group to construct and demonstrate this new sought after bulk materials handling system.

4. The risk-cost of constructing the first OS400 can be mitigated by starting with two new hydraulic excavators. The shovel attachments can be removed and stored while a new set of hydraulic winching sets are installed above the engine housings. A custom built hoe is required as well as a set of winch ropes. This provides for the basic set of OS400 trial equipment suitable for demonstrating the productivity and materials handling capability of the OS400 at a target budget cost of $34m. Provided these requirements are satisfactorily met, OS400 may be assigned to permanent dam deepening duties.

5. However, should the field trial prove unsatisfactory, the hydraulic excavators may be reassembled with the winches assigned to other duties. The at-risk cost of this demonstration is constrained to about $4m.

9. WEBOLOGY.

W1. http://www.statewater.com.au/Water+delivery/Dams
W2. http://www.g-mwater.com.au/water-resources/storages/murray/yarrawongaweir
W3. http://www.sawater.com.au/SAWater/Templates/Generic.aspx?NRMODE=Published&NRNODEGUID={5F2F9F9A-2BA5-440F-8120-B6047D72AECB}&NRORIGINALURL=%2fsawater%2feducation%2fourwatersystems%2fwater%2bstorage%2b%28reservoirs%29.htm&NRCACHEHINT=NoModifyGuest#barossa
W4. http://www.watercorporation.com.au/D/dams_storagedetail.cfm?id=11933
W5. http://en.wikipedia.org/wiki/List_of_dams_and_reservoirs_in_Australia
W6. http://www.bosmin.com/OS/osbrochure2.pdf

APPENDIX-A. AUSTRALIAN WATER STORAGES

Reference:	1-19	W1							
Reference:	20-40	W2							
Reference:	41-56	W3							
Reference:	57-66	W4							
Reference:	77-117	W5							
			Location	Storage Capacity	Surface Area	Average Depth	Storage Efficiency	Dam Storage Shelf Life	
	State			m3	m2	m	9.34/(V/H^3)*100	Years	Ranking
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21	Vic	Yarrawonga Weir	River Murray	117,500,000	43,900,000	2.7	0.015%	1.3	3
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32	Vic	Goulburn Weir	Goulburn River	25,500,000	11,300,000	2.3	0.042%	1.1	8
112	Qld	Southedge Dam	Mitchell River	129,000,000	32,900,000	3.9	0.044%	2.0	9
88	Qld	Fairbairn Dam	Nogoa River	1,301,000,000	150,000,000	8.7	0.047%	4.3	10
38	Vic	Laanecoorie Reservoir	Loddon River	7,940,000	4,800,000	1.7	0.053%	0.8	11
105	Qld	Moondarra Dam (Lake Moondarra)	Leichhardt River	107,000,000	23,750,000	4.5	0.080%	2.3	12
33	Vic	Waranga Basin	Offstream - Goulburn River	432,360,000	58,480,000	7.4	0.087%	3.7	13
81	Qld	Coolmunda Dam	Macintyre Brook	69,000,000	16,450,000	4.2	0.100%	2.1	14
10	NSW	Hume Dam	Murray River	3,005,156,000	201,900,000	14.9	0.102%	7.4	15
24	Vic	Kangaroo Lake	River Murray	34,390,000	9,800,000	3.5	0.117%	1.8	16
34	Vic	Greens Lake	Offstream	32,440,000	9,055,000	3.6	0.132%	1.8	17
72	Qld	Bjelke-Petersen Dam (Lake Barambah)	Cherbourg	134,900,000	22,500,000	6.0	0.149%	3.0	18
26	Vic	Lake Boga	River Murray	37,000,000	9,400,000	3.9	0.154%	2.0	19
100	Qld	Lenthalls Dam (Lake Lenthall)	Burrum River	28,400,000	7,660,000	3.7	0.168%	1.9	20
111	Qld	Somerset Dam	Stanley River	380,000,000	42,100,000	9.0	0.181%	4.5	21
68	Qld	Lake Awoonga	Boyne River	777,000,000	67,500,000	11.5	0.183%	5.8	22
63	WA	South Dandalup Dam	Dandalup	138,000,000	21,220,000	6.5	0.186%	3.3	23
89	Qld	Fred Haigh Dam (Lake Monduran)	Kolan River	562,000,000	53,400,000	10.5	0.194%	5.3	24
11	NSW	Keepit Dam	Namoi River	425,510,000	43,700,000	9.7	0.203%	4.9	25
36	Vic	Cairn Curran Reservoir	Loddon River	147,130,000	19,430,000	7.6	0.276%	3.8	26
109	Qld	Peter Faust Dam (Lake Proserpine)	Proserpine	491,400,000	43,250,000	11.4	0.279%	5.7	27
35	Vic	Lake Eppalock	Campaspe River	304,651,000	30,110,000	10.1	0.318%	5.1	28
23	Vic	Mildura Weir	River Murray	36,600,000	7,320,000	5.0	0.319%	2.5	29
107	Qld	Paradise Dam	Burnett River	300,000,000	29,510,000	10.2	0.327%	5.1	30

91	Qld	Gordonbrook Dam	Kingaroy	6,600,000	2,290,000	2.9	0.339%	1.4	31
110	Qld	Six Mile Creek Dam (Lake MacDonald)	Cooroy	8,000,000	2,600,000	3.1	0.340%	1.5	32
17	NSW	Toonumbar Dam	Iron Pot Creek	11,000,000	3,200,000	3.4	0.345%	1.7	33
3	NSW	Burrendong Dam	Macquarie River	1,188,000,000	72,000,000	16.5	0.353%	8.3	34
45	SA	Little Para Reservoir	Adelaide Hills	2,800,000	1,250,000	2.2	0.375%	1.1	35
31	Vic	Lake Eildon	Goulburn and Delatite Rivers	3,334,158,000	138,320,000	24.1	0.392%	12.1	36
106	Qld	North Pine Dam (Lake Samsonvale)	North Pine River	214,960,000	22,000,000	9.8	0.405%	4.9	37
114	Qld	Tinaroo Dam (Lake Tinaroo)	Atherton Tableland	438,900,000	35,000,000	12.5	0.420%	6.3	38
98	Qld	Lake Gregory (Queensland) (Isis Balancing Storage)	Bundaberg	6,000,000	2,000,000	3.0	0.420%	1.5	39
94	Qld	Kinchant Dam	Sandy Creek	62,800,000	9,200,000	6.8	0.473%	3.4	40
27	Vic	Lake Charm	River Murray	22,000,000	4,570,000	4.8	0.474%	2.4	41
101	Qld	Leslie Dam	Warwick	106,200,000	12,880,000	8.2	0.493%	4.1	42
67	Qld	Atkinson Dam	Lowood	30,500,000	5,560,000	5.5	0.506%	2.7	43
87	Qld	Ewen Maddock Dam	Mooloolah	16,700,000	3,700,000	4.5	0.514%	2.3	44
117	Qld	Wyaralong Dam (Completion by mid 2011)	Albert River	103,000,000	12,300,000	8.4	0.532%	4.2	45
93	Qld	Julius Dam (Lake Julius)	Mount Isa	107,500,000	12,550,000	8.6	0.546%	4.3	46
22	Vic	Torrumbarry Weir	River Murray	36,810,000	6,135,000	6.0	0.548%	3.0	47
40	Vic	Hepburns Lagoon	Langdon's Creek	3,001,000	1,130,000	2.7	0.583%	1.3	48
116	Qld	Wuruma Dam	Burnett River	165,400,000	16,300,000	10.1	0.590%	5.1	49
4	NSW	Burrinjuck Dam	Murrumbidgee River	1,026,000,000	55,000,000	18.7	0.591%	9.3	50
97	Qld	Lake Kurwongbah	Petrie	14,500,000	3,200,000	4.5	0.599%	2.3	51
73	Qld	Boondooma Dam	Boyne River	204,200,000	18,150,000	11.3	0.651%	5.6	52
82	Qld	Corella Dam	Mary Kathleen	15,300,000	3,200,000	4.8	0.667%	2.4	53
19	NSW	Wyangala Dam	Lachlan River	1,220,000,000	53,900,000	22.6	0.888%	11.3	54
76	Qld	Callide Dam	Biolela	136,300,000	12,400,000	11.0	0.910%	5.5	55
30	Vic	Lake Nillahcootie	Broken River	39,950,000	5,300,000	7.5	1.001%	3.8	56
96	Qld	Koombooloomba Dam	Ravenshoe	200,700,000	15,500,000	12.9	1.010%	6.5	57
90	Qld	Glenlyon Dam	Dumaresq River	254,000,000	18,000,000	14.1	1.033%	7.1	58
104	Qld	Moogerah Dam (Lake Moogerah)	Reynolds Creek	83,700,000	8,270,000	10.1	1.157%	5.1	59
37	Vic	Tullaroop Reservoir	Tullaroop Creek	72,950,000	7,420,000	9.8	1.217%	4.9	60
59	WA	Mundaring Dam	Freemantle	63,597,000	6,760,000	9.4	1.223%	4.7	61
28	Vic	Lake Buffalo	Buffalo River	23,340,000	3,400,000	6.9	1.295%	3.4	62
79	Qld	Clarendon Dam (Lake Clarendon)	Gatton	24,330,000	3,390,000	7.2	1.419%	3.6	63
61	WA	Serpentine Main Dam	Perth	137,667,000	10,670,000	12.9	1.457%	6.5	64
16	NSW	Split Rock Dam	Manilla River	397,370,000	21,500,000	18.5	1.484%	9.2	65
18	NSW	Windamere Dam	Cudgegong River	368,120,000	20,300,000	18.1	1.513%	9.1	66
77	Qld	Cania Dam	Monto	88,500,000	7,600,000	11.6	1.666%	5.8	67
74	Qld	Borumba Dam	Yabba Creek	45,000,000	4,800,000	9.4	1.710%	4.7	68
7	NSW	Copeton Dam	Gwydir River	1,364,000,000	46,200,000	29.5	1.762%	14.8	69
113	Qld	Teemburra Dam	Mackay,	147,500,000	10,400,000	14.2	1.806%	7.1	70
80	Qld	Cooby Dam	Toowoomba	23,092,000	3,000,000	7.7	1.845%	3.8	71

56	SA	Warren Resevoir	South Para River	4,790,000	1,050,000	4.6	1.851%	2.3	72
70	Qld	Belmore Dam (Lake Belmore)	Croydon	5,800,000	1,180,000	4.9	1.912%	2.5	73
99	Qld	Lake Manchester	Cabbage Tree Creek	26,000,000	3,180,000	8.2	1.963%	4.1	74
62	WA	Serpentine Pipehead Dam	Perth	2,625,000	680,000	3.9	2.047%	1.9	75
9	NSW	Glennies Creek Dam	Glennies Creek	283,000,000	15,400,000	18.4	2.048%	9.2	76
5	NSW	Carcoar Dam	Belubula River	35,800,000	3,850,000	9.3	2.098%	4.6	77
42	SA	Happy Valley Reservoir	Happy Valley	11,600,000	1,780,000	6.5	2.228%	3.3	78
6	NSW	Chaffey Dam	Peel River	61,830,000	5,420,000	11.4	2.243%	5.7	79
64	WA	Stirling Dam	Stirling	36,563,000	3,810,000	9.6	2.258%	4.8	80
39	Vic	Newlyn Reservoir	Birch's Creek	3,215,000	720,000	4.5	2.586%	2.2	81
60	WA	North Dandalup Dam	Dandalup	60,791,000	5,060,000	12.0	2.664%	6.0	82
14	NSW	Oberon Dam	Fish River	45,000,000	4,100,000	11.0	2.744%	5.5	83
1	NSW	Blowering Dam	Tumut River	1,628,000,000	44,600,000	36.5	2.790%	18.3	84
8	NSW	Glenbawn Dam	Hunter River	749,840,000	26,140,000	28.7	2.940%	14.3	85
49	SA	South Para Resevoir	South Para River	45,330,000	4,000,000	11.3	2.999%	5.7	86
48	SA	Myponga Resevoir	Myponga	26,800,000	2,800,000	9.6	3.056%	4.8	87
12	NSW	Lostock Dam	Paterson River	20,000,000	2,200,000	9.1	3.509%	4.5	88
103	Qld	Maroon Dam	Boonah	44,300,000	3,500,000	12.7	4.275%	6.3	89
71	Qld	Bill Gunn Dam (Lake Dyer)	Laidley	6,940,000	1,000,000	6.9	4.498%	3.5	90
46	SA	Millbrook Reservoir	River Torrens	16,500,000	1,780,000	9.3	4.509%	4.6	91
83	Qld	Cressbrook Dam	Toowoomba	81,842,000	5,170,000	15.8	4.527%	7.9	92
78	Qld	Cedar Pocket Dam	Deep Creek	730,000	220,000	3.3	4.674%	1.7	93
55	SA	Tod River	Port Lincoln	11,300,000	1,340,000	8.4	4.957%	4.2	94
43	SA	Hope Valley Reservoir	Hope Valley	2,840,000	520,000	5.5	5.358%	2.7	95
108	Qld	Perseverance Dam	Toowoomba	30,140,000	2,500,000	12.1	5.430%	6.0	96
69	Qld	Baroon Pocket Dam (Lake Baroon)	Obi Obi Creek,	61,000,000	4,000,000	15.3	5.430%	7.6	97
20	Vic	Dartmouth Dam	Mitta Mitta River	3,907,590,000	63,800,000	61.2	5.492%	30.6	98
57	WA	Canning Dam	Ashendon	90,353,000	5,010,000	18.0	6.063%	9.0	99
86	Qld	Eungella Dam	Eungella	112,400,000	5,627,100	20.0	6.623%	10.0	100
47	SA	Mount Bold	Dorset Vale	46,180,000	3,080,000	15.0	6.817%	7.5	101
2	NSW	Brogo Dam	Brogo River	8,980,000	1,000,000	9.0	7.532%	4.5	102
15	NSW	Pindari Dam	Severn River	312,000,000	10,500,000	29.7	7.854%	14.9	103
41	SA	Barossa Resevoir	Williamstown	4,515,000	620,000	7.3	7.989%	3.6	104
66	WA	Wungong Dam	Wungong	59,796,000	3,300,000	18.1	9.293%	9.1	105
92	Qld	Hinze Dam, Gold Coast	Advancetown	310,730,000	9,700,000	32.0	9.881%	16.0	106
29	Vic	Lake William Hovell	King River	13,710,000	1,130,000	12.1	12.167%	6.1	107
50	SA	Baroota Reservoir	Port Pirie	6,140,000	630,000	9.7	14.082%	4.9	108
52	SA	Bundaleer Reservoir	Port Pirie	6,370,000	630,000	10.1	15.157%	5.1	109
54	SA	Middle River	Kangaroo Island	470,000	110,000	4.3	15.501%	2.1	110
65	WA	Victoria Dam	Australind	9,463,000	770,000	12.3	18.320%	6.1	111
95	Qld	Kroombit Dam	Callide	14,600,000	1,000,000	14.6	19.909%	7.3	112
51	SA	Beetaloo Reservoir	Crystal Brook	3,180,000	330,000	9.6	26.282%	4.8	113

44	SA	Kangaroo Creek Dam	Kangaroo Creek	19,160,000	1,030,000	18.6	31.378%	9.3	114
58	WA	Churchman Brook Dam	Ashendon	2,160,000	240,000	9.0	31.523%	4.5	115
102	Qld	Little Nerang Dam, Gold Coast	Gold Coast	9,280,000	490,000	18.9	68.368%	9.5	116
53	SA	Blue Lake	Mt Gambier	36,000,000	700,000	51.4	352.905%	25.7	117
			Total	33,057,905,000	Average Values	10.8	6.822%	5.4	
					Median Values	10.9	1.157%	4.6	