

STOCKINBINGAL STP Hydraulic Modelling Output High Load													
9	8	14.7	40	297.337	298.337	0.98	0.778	0.98	0.778	297.4	298	298.4	299
90	89	1.2	40	297.35	297.35	0.91	0.727	0.91	0.727	297.4	298	297.4	298
91	90	62.9	40	298.35	297.35	0.83	0.659	0.83	0.659	298.4	299	297.4	298
92	91	36.6	40	298.35	298.35	0.78	0.62	0.78	0.62	298.4	299	298.4	299
93	92	39.7	40	298.91	298.35	0.71	0.564	0.71	0.564	299	299	298.4	299
94	80	9.4	51	296.337	296.337	1.39	0.681	1.39	0.681	296.4	297	296.4	297
95	94	26.1	51	296.337	296.337	1.38	0.678	1.38	0.678	296.4	297	296.4	297
96	95	42	51	297.337	296.337	1.38	0.674	1.38	0.674	297.4	298	296.4	297
97	96	181.6	51	297.337	297.337	1.37	0.671	1.37	0.671	297.4	298	297.4	298
98	97	21.4	40	297.337	297.337	0.87	0.69	0.87	0.69	297.4	298	297.4	298
99	98	45.1	40	297.337	297.337	0.85	0.674	0.85	0.674	297.4	298	297.4	298
StandPipe	stpmh	6.4	102	300.8	291.8	5.39	0.623	5.39	0.203	301		292	292
stpmh	STP	4.4	102	300.8	291.306	5.39	3.785	5.39	3.785	292		292	292

STOCKINBINGAL STP Hydraulic Modelling Output Maximum Pump Head - Normal Load				
US node ID	Link suffix	DS node ID	Max DS total head (m AD)	Max Pressure at Pump Node (m)
201	1	40	315.825	18.525
202	1	52	313.587	18.187
203	1	51	313.65	18.25
204	1	50	313.772	17.372
205	1	49	313.899	17.499
206	1	48	313.933	17.533
207	1	47	313.965	17.565
208	1	54	313.674	18.274
208	2	54	313.674	18.274
208	3	54	313.674	18.274
208	4	54	313.674	18.274
209	1	122	325.222	29.822
209	2	122	325.222	29.822
210	1	56	311.219	15.819
211	1	59	309.586	14.186
211	2	59	309.586	14.186
212	1	127	321.13	26.73
301	1	1	327.521	31.121
302	1	4	325.721	29.321
303	1	5	324.871	27.471
304	1	27	323.319	23.919
305	1	9	323.423	26.023
306	1	10	323.263	25.863
307	1	11	323.24	26.84
308	1	12	323.235	26.835
309	1	15	325.34	28.94
310	1	13	325.173	28.773
311	1	17	325.927	30.527
312	1	16	325.632	29.232
313	1	19	326.277	31.877
314	1	34	323.107	23.807
315	1	35	322.776	23.476
316	1	38	319.904	21.604
317	1	37	320.721	22.421
318	1	45	312.248	14.248
319	1	46	313.964	16.564
320	1	39	316.849	18.549
321	1	123	324.618	29.218
322	1	33	324.479	25.079
323	1	89	318.973	21.573
324	1	88	318.445	21.045
325	1	86	318.019	20.619
326	1	85	317.551	20.151
327	1	82	316.958	19.558
328	1	81	316.446	20.046

STOCKINBINGAL STP Hydraulic Modelling Output Maximum Pump Head - Normal Load				
US node ID	Link suffix	DS node ID	Max DS total head (m AD)	Max Pressure at Pump Node (m)
329	1	93	320.326	21.326
330	1	92	320.327	21.927
331	1	91	319.822	21.422
332	1	90	318.988	21.588
333	1	87	318.141	20.741
334	1	84	317.476	20.076
335	1	83	316.972	19.572
336	1	96	316.437	19.037
337	1	79	315.908	19.508
338	1	78	315.702	19.302
339	1	74	314.318	18.918
340	1	73	313.899	18.499
341	1	72	313.039	17.639
342	1	57	310.805	15.405
343	1	75	314.767	18.367
344	1	76	315.341	18.941
345	1	77	315.67	19.27
346	1	94	316.307	19.907
347	1	95	316.351	19.951
348	1	98	316.871	19.471
349	1	99	316.868	19.468
350	1	100	316.866	18.466
351	1	101	316.863	18.463
352	1	103	316.861	18.461
353	1	106	316.86	18.46
354	1	107	316.86	16.86
355	1	105	316.86	18.46
356	1	104	316.86	18.46
357	1	102	316.862	18.462
358	1	108	317.409	20.009
359	1	112	318.554	20.154
360	1	111	317.406	21.006
361	1	60	308.502	13.102
362	1	63	306.723	12.323
363	1	64	305.666	11.266
364	1	113	306.002	11.602
365	1	116	311.873	17.473
366	1	62	307.236	12.836
367	1	61	308.376	12.976
368	1	119	311.869	17.469
369	1	68	303.814	10.414
370	1	114	307.645	13.245
371	1	115	311.542	17.142
372	1	117	311.871	17.471
373	1	118	311.87	17.47

STOCKINBINGAL STP Hydraulic Modelling Output Maximum Pump Head - Normal Load				
US node ID	Link suffix	DS node ID	Max DS total head (m AD)	Max Pressure at Pump Node (m)
374	1	142	308.552	16.152
375	1	143	307.538	15.138
376	1	121	311.869	17.469
377	1	139	311.4	19
378	1	138	311.8	18.4
379	1	137	313.144	19.744
380	1	136	314.956	21.556
381	1	135	316.586	22.186
382	1	132	317.791	23.391
383	1	130	319.48	25.08
384	1	128	320.827	26.427
385	1	125	323.116	28.716
386	1	134	316.678	22.278
387	1	133	317.72	23.32
388	1	131	318.994	24.594
389	1	129	320.453	26.053
390	1	126	322.738	28.338
391	1	124	323.912	29.512
392	1	146	305.384	12.984
393	1	145	305.872	13.472
394	1	69	304.412	11.012
395	1	165	319.875	27.475
396	1	159	319.675	27.275
397	1	157	318.194	26.794
398	1	166	318.291	26.891
399	1	168	318.29	26.89
400	1	156	317.79	26.39
401	1	152	316.687	25.287
402	1	151	316.509	25.109
403	1	153	317.666	26.266
404	1	150	312.683	21.283
405	1	169	310.011	18.611
406	1	162	321.577	28.277
407	1	163	322.054	28.754
408	1	164	322.248	27.948
409	1	23	332.319	38.919
410	1	71	305.032	13.632
411	1	26	335.694	42.294
412	1	36	321.952	22.652
413	1	147	306.975	14.575

STOCKINBINGAL STP Hydraulic Modelling Output Maximum Pump Head - High Load						
US node ID	Link suffix	DS node ID	Max DS total head (m AD)	DS Node Max Level (m AD)	Max Pressure at Pump Node (m)	
201	1	40	313.114	313.114	15.814	
202	1	52	314.044	314.044	18.644	
203	1	51	314.043	314.043	18.643	
204	1	50	314.042	314.042	17.642	
205	1	49	314.041	314.041	17.641	
206	1	48	314.041	314.041	17.641	
207	1	47	314.041	314.041	17.641	
208	1	54	314.195	314.195	18.795	
208	2	54	314.195	314.195	18.795	
208	3	54	314.195	314.195	18.795	
208	4	54	314.195	314.195	18.795	
209	1	122	320.635	320.635	25.235	
209	2	122	320.635	320.635	25.235	
210	1	56	312.134	312.134	16.734	
211	1	59	310.326	310.326	14.926	
211	2	59	310.326	310.326	14.926	
212	1	127	317.079	317.079	22.679	
301	1	1	326.554	326.554	30.154	
302	1	4	324.569	324.569	28.169	
303	1	5	323.603	323.603	26.203	
304	1	27	321.56	321.56	22.16	
305	1	9	321.863	321.863	24.463	
306	1	10	325.503	325.503	28.103	
307	1	11	327.33	327.33	30.93	
308	1	12	327.946	327.946	31.546	
309	1	15	330.22	330.22	33.82	
310	1	13	330.089	330.089	33.689	
311	1	17	330.689	330.689	35.289	
312	1	16	330.451	330.451	34.051	
313	1	19	330.973	330.973	36.573	
314	1	34	320.969	320.969	21.669	
315	1	35	320.462	320.462	21.162	
316	1	38	316.702	316.702	18.402	
317	1	37	317.773	317.773	19.473	
318	1	45	313.007	313.007	15.007	
319	1	46	314.041	314.041	16.641	
320	1	39	313.277	313.277	14.977	
321	1	123	319.939	319.939	24.539	
322	1	33	322.41	322.41	23.01	
323	1	89	327.129	327.129	29.729	
324	1	88	326.659	326.659	29.259	
325	1	86	326.272	326.272	28.872	
326	1	85	325.836	325.836	28.436	
327	1	82	324.629	324.629	27.229	

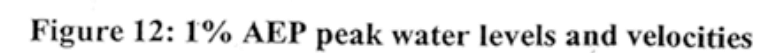
STOCKINBINGAL STP Hydraulic Modelling Output Maximum Pump Head - High Load						
US node ID	Link suffix	DS node ID	Max DS total head (m AD)	DS Node Max Level (m AD)	Max Pressure at Pump Node (m)	
328	1	81	323.468	323.468	27.068	
329	1	93	328.336	328.336	29.336	
330	1	92	328.336	328.336	29.936	
331	1	91	327.894	327.894	29.494	
332	1	90	327.143	327.143	29.743	
333	1	87	326.385	326.385	28.985	
334	1	84	325.765	325.765	28.365	
335	1	83	324.66	324.66	27.26	
336	1	96	323.347	323.347	25.947	
337	1	79	322.232	322.232	25.832	
338	1	78	321.754	321.754	25.354	
339	1	74	318.27	318.27	22.87	
340	1	73	317.071	317.071	21.671	
341	1	72	315.071	315.071	19.671	
342	1	57	311.673	311.673	16.273	
343	1	75	319.505	319.505	23.105	
344	1	76	321.073	321.073	24.673	
345	1	77	321.679	321.679	25.279	
346	1	94	323.143	323.143	26.743	
347	1	95	323.221	323.221	26.821	
348	1	98	323.926	323.926	26.526	
349	1	99	323.925	323.925	26.525	
350	1	100	323.925	323.925	25.525	
351	1	101	323.924	323.924	25.524	
352	1	103	323.924	323.924	25.524	
353	1	106	323.923	323.923	25.523	
354	1	107	323.923	323.923	23.923	
355	1	105	323.923	323.923	25.523	
356	1	104	323.924	323.924	25.524	
357	1	102	323.924	323.924	25.524	
358	1	108	324.401	324.401	27.001	
359	1	112	324.4	324.4	26	
360	1	111	324.401	324.401	28.001	
361	1	60	309.132	309.132	13.732	
362	1	63	307.18	307.18	12.78	
363	1	64	306.026	306.026	11.626	
364	1	113	305.927	305.927	11.527	
365	1	116	311.928	311.928	17.528	
366	1	62	307.742	307.742	13.342	
367	1	61	308.992	308.992	13.592	
368	1	119	311.928	311.928	17.528	
369	1	68	303.541	303.541	10.141	
370	1	114	307.593	307.593	13.193	
371	1	115	311.581	311.581	17.181	

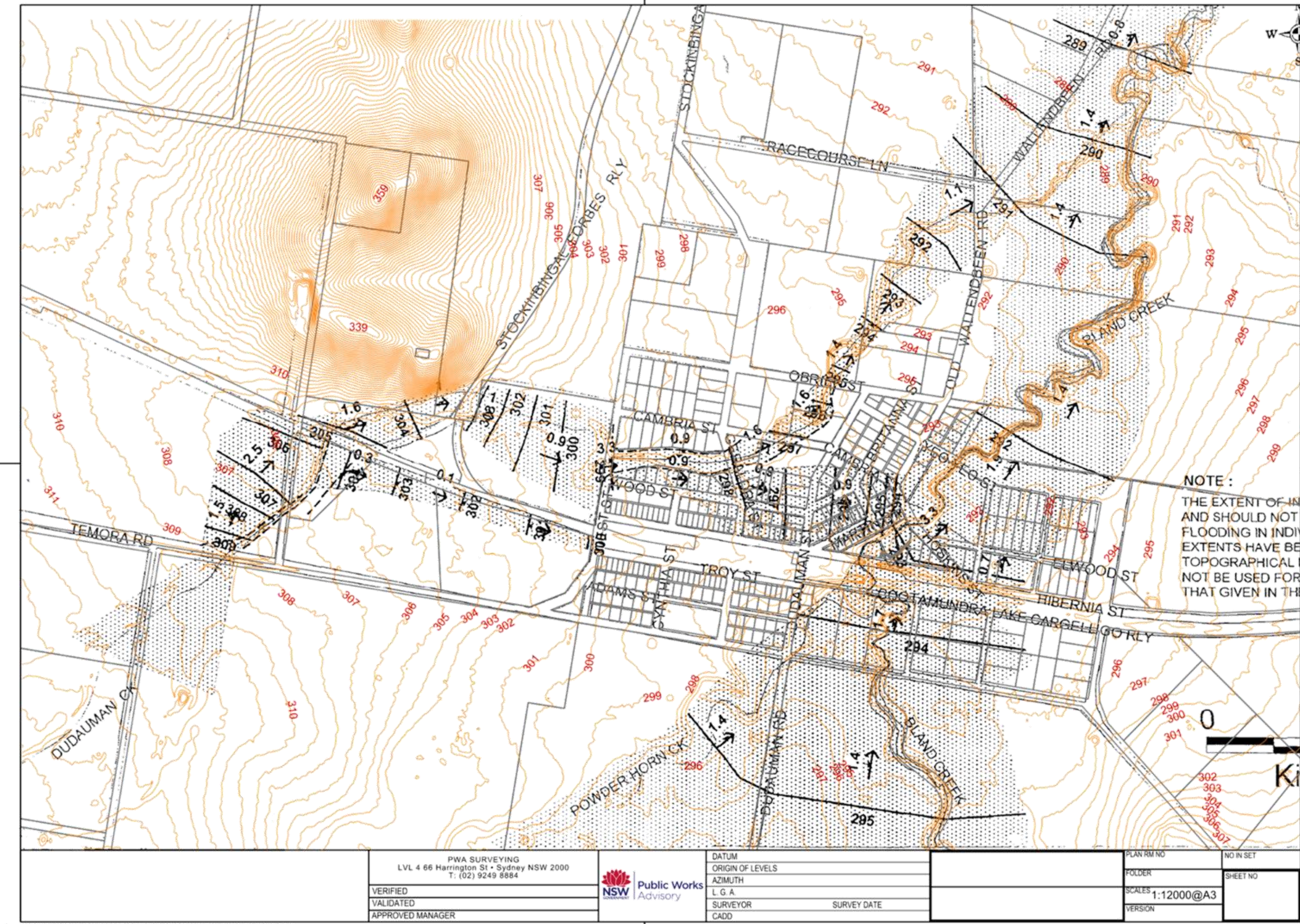
STOCKINBINGAL STP Hydraulic Modelling Output Maximum Pump Head - High Load						
US node ID	Link suffix	DS node ID	Max DS total head (m AD)	DS Node Max Level (m AD)	Max Pressure at Pump Node (m)	
372	1	117	311.928	311.928	17.528	
373	1	118	311.928	311.928	17.528	
374	1	142	310.122	310.122	17.722	
375	1	143	308.453	308.453	16.053	
376	1	121	311.928	311.928	17.528	
377	1	139	313.783	313.783	21.383	
378	1	138	314.096	314.096	20.696	
379	1	137	314.543	314.543	21.143	
380	1	136	315.14	315.14	21.74	
381	1	135	315.67	315.67	21.27	
382	1	132	316.06	316.06	21.66	
383	1	130	316.582	316.582	22.182	
384	1	128	316.989	316.989	22.589	
385	1	125	318.145	318.145	23.745	
386	1	134	315.7	315.7	21.3	
387	1	133	316.038	316.038	21.638	
388	1	131	316.432	316.432	22.032	
389	1	129	316.877	316.877	22.477	
390	1	126	317.945	317.945	23.545	
391	1	124	319.106	319.106	24.706	
392	1	146	305.221	305.221	12.821	
393	1	145	305.925	305.925	13.525	
394	1	69	303.832	303.832	10.432	
395	1	165	326.493	326.493	34.093	
396	1	159	325.723	325.723	33.323	
397	1	157	323.669	323.669	32.269	
398	1	166	324.907	324.907	33.507	
399	1	168	324.903	324.903	33.503	
400	1	156	320.774	320.774	29.374	
401	1	152	318.844	318.844	27.444	
402	1	151	318.787	318.787	27.387	
403	1	153	319.793	319.793	28.393	
404	1	150	317.886	317.886	26.486	
405	1	169	314.049	314.049	22.649	
406	1	162	331.603	331.603	38.303	
407	1	163	331.602	331.602	38.302	
408	1	164	332.578	332.578	38.278	
409	1	23	336.284	336.284	42.884	
410	1	71	304.89	304.89	13.49	
411	1	26	339.342	339.342	45.942	
412	1	36	319.384	319.384	20.084	
413	1	147	308.327	308.327	15.927	



Stockinbingal Sewerage Scheme Concept Design Report

Appendix E Flood Map (1 in 100 Year Event)







Stockinbingal Sewerage Scheme

Concept Design Report

Appendix F Capital Cost Estimate

**STOCKINBINGAL SGE
COLLECTION AND TRANSPORT SYSTEM
CAPITAL COST ESTIMATE**

PRESSURE SYSTEM					
ITEM NO.		QUANTITY	UNIT	RATE \$/unit	AMOUNT \$
1	Site Establishment				
1.1	Mobilisation / Demobilisation including site amenities.			Allowance	\$ 110,000
1.2	Traffic management including personnel, barriers, control signals (where required) etc			Allowance	\$ 50,000
2	Pressure Units				\$ 60,000
2.1	i) Standard	121	each	\$ 4,500	\$ 544,500
	ii) Duplex	5	each	\$ 9,000	\$ 45,000
	iii) Quad units	1	each	\$ 27,000	\$ 27,000
2.2	Installation				
	i) Property Owner consultation, electrical checks, photographic records, property	127	each	\$ 300	\$ 38,100
	ii) Installation Simplex	121	each	\$ 4,200	\$ 508,200
	iii) Installation Duplex	5	each	\$ 7,900	\$ 39,500
	iii) Installation Quadplex	1	each	\$ 18,500	\$ 18,500
2.3	Supply and Installation of Boundary Kits and Laterals	127	each	\$ 1,200	\$ 152,400
3	Reticulation				\$ 1,365,000
3.1	PE100, PN16 Polyethylene Pipe and Fittings				
	i) 40 mm	3,810	m	\$ 80	\$ 304,800
	ii) 50 mm	4,020	m	\$ 80	\$ 321,600
	iii) 63 mm	2,300	m	\$ 80	\$ 184,000
	iv) 75 mm	1,810	m	\$ 80	\$ 144,800
	v) 90 mm	530	m	\$ 100	\$ 53,000
	vi) 110 mm	660	m	\$ 100	\$ 66,000
	vii) 125 mm	260	m	\$ 120	\$ 31,200
3.2	Extra Over for Under Road Bore with Conduit				
	i) 63 mm	60	each	\$ 1,200	\$ 72,000
	ii) 75 mm		each	\$ 1,300	\$ -
	iii) 90 mm		each	\$ 1,400	\$ -
	iv) 110 mm		each	\$ 1,500	\$ -
3.3	Installation of Isolation Valves				
	i) 50 - 63 mm	5	each	\$ 1,200	\$ 6,000
	ii) 75 -125 mm	6	each	\$ 1,500	\$ 9,000
3.4	Flushing points (Type 1)				
	i) 50 - 110 mm	14	each	\$ 2,500	\$ 35,000
3.5	Barometric Loop	1	each	\$ 86,000	\$ 86,000
3.6	Railway Crossings	1	each	Allowance	\$ 51,600
4	Miscellaneous				\$ 44,000
	Testing and commissioning of the pressure sewerage system			Allowance	\$ 20,000
	Prepare and submit operations and maintenance manuals.			Allowance	\$ 8,000
	Work as executed documentation			Allowance	\$ 8,000
	Operational environmental management plan			Allowance	\$ 8,000
Sub-total Construction Cost					\$2,892,200
Contractor Indirect Costs					\$144,610
Construction Cost					\$3,036,810
Contingency (additional reticulation, air valves and general allowance)					\$682,800
Survey investigation and design and project management 10%					\$289,220
Capital Cost					\$4,008,830

STOCKINBINGAL STP COST ESTIMATE					
IDEA reactor					
Item	Item Description	Qty	Unit	Rate	Amount
1.0	Site Establishment				\$108,000
1.1	Site Establishment & disestablishment			Allowance	\$40,000
1.2	Strip top soil			Allowance	\$1,000
1.3	Provide and maintain erosion/ siltation control measures			Allowance	\$2,000
1.4	Landscaping			Allowance	\$10,000
1.5	Fencing	150	m	\$100	\$15,000
1.6	Operational Environmental Management Plan etc.			Allowance	\$40,000
2.0	Roadworks and Site Drainage				\$90,000
2.1	Roads				
	i) Sealed roadway (bitumen sealed)	500	m ²	\$100	\$50,000
2.2	Drainage Works			Allowance	\$40,000
3.0	Emergency Balance Tank				\$25,200
3.1	40 kL tank				\$12,000
3.2	Concrete Base	4	m ³	\$1,800	\$7,200
3.3	Level sensor	1	each	\$1,000	\$1,000
3.4	Return pump	1	Item	\$5,000	\$5,000
4.0	Inlet Works				\$90,000
4.1	Feed pump	1	Item	\$5,000	\$5,000
4.2	Flow meter	1	m ²	\$5,000	\$5,000
4.3	Mechanical Screen (5-8 mm bar screen) and auxiliary equipment		Item	LS	\$20,000
4.4	Odour Control	1	each	\$60,000	\$60,000
5.0	Concrete IDEA reactor and balance tank				\$728,471
5.1	Foundation and earthworks		No excavation		
	i) Foundation preparation		Item	LS	\$150,000
5.2	Concrete				
	i) Walls	82	m ³	\$2,500	\$206,061
	ii) Base	47	m ³	\$1,800	\$84,109
	iii) Pits	15	m ³	\$2,000	\$30,000
5.3	Metalwork				
	i) Emergency ladders	1	each	\$2,100	\$2,100
	ii) Handrails	32	m	\$150	\$4,800
	iii) Grating	18	m ²	\$300	\$5,400
5.4	Mechanical Works				
	i) Jet aeration system		Item	LS	\$70,000
	ii) Decanting system		Item	LS	\$100,000
	iii) WAS pumps, pipework and fittings		Item	LS	\$20,000
5.5	Pipework, valve and fittings				
	i) Decant pipework		Item	LS	\$50,000
	ii) DO sensor	2	each	\$2,000	\$4,000
	iii) pH sensor	1	each	\$1,000	\$1,000
	iv) level sensor	1	each	\$1,000	\$1,000
6.0	Sludge Tank				\$18,200
6.1	22.5 kL tank				\$10,000
6.2	Concrete Base	4	m ³	\$1,800	\$7,200
6.2	Level sensor	1	each	\$1,000	\$1,000
7.0	Sludge Dewatering				\$83,700
7.1	Foundation and Earthworks			Allowance	\$10,000
7.2	Supply and place concrete, including reinforcement				
	i) Walls	7	m ³	\$2,000	\$14,000
	ii) Floor	29	m ³	\$1,500	\$43,500
	iii) Pit		Item	LS	\$10,000
7.3	Dewatering bags	2	Item	\$1,600	\$3,200
7.4	Filtrate return pump			Allowance	\$3,000
8.0	Chemical Dosing				\$20,000
8.1	Colorbond roof			Allowance	\$10,000
8.2	Self bunded tanks and pumps			LS	\$10,000
9.0	Disinfection				\$30,000
9.1	UV disinfection		Item	LS	\$30,000
10.0	Treated effluent outfall pump				\$9,000
10.1	Treated effluent pump skid		Item	LS	\$9,000
11.0	Amenities Building				\$200,000
11.1	Building	72	m ²	\$2,000	\$144,000
11.2	Laboratory equipment			Allowance	\$18,000
11.3	Air conditioning			Allowance	\$20,000
11.4	Drainage pipework			Allowance	\$18,000
12.0	Pipework, Valves and Fittings				\$72,500
12.1	Pipeworks				
	i) General pipework between equipment			Allowance	\$30,000
	ii) Effluent discharge line to creek	85	m	\$500	\$42,500
13.0	Installation/Testing/Commissioning				\$145,000
13.1	Installation of Equipment			LS	\$40,000
13.2	Commissioning of Reactors			LS	\$25,000
13.3	Further Process Commissioning			Allowance	\$10,000
13.4	Mechanical			Allowance	\$10,000
13.5	Electrical testing demonstration and commissioning			Allowance	\$20,000
13.6	Demonstration to the Principal's technical personnel operation of installed equipment,			Allowance	\$40,000

STOCKINBINGAL STP COST ESTIMATE					
IDEA reactor					
Item	Item Description	Qty	Unit	Rate	Amount
14.0	Electrical Works				\$364,100
14.1	Electrical Switchboard and PLC Panel		Item	LS	\$41,000
14.2	Consumers' main cabling and Meter Box			LS	\$20,000
14.3	Earthing			LS	\$4,000
14.4	Electrical Conduits - trenching & bedding			LS	\$6,500
14.5	Electrical Conduits, 100mm dia.			LS	\$5,000
14.6	Electrical Pits 1.2mx1.2mx0.9m heavy-duty			LS	\$6,600
14.7	Electrical cables - power and control			LS	\$18,000
14.8	Building services - lights, power, alarm			LS	\$9,000
14.9	Instruments - level transmitters & Switches			LS	\$10,000
14.10	PLC and HMI programming			LS	\$33,000
14.11	Telemetry			LS	\$20,000
14.12	FD and CHAZOP Workshop			LS	\$11,000
14.13	Electrical accessories & misc. cost			LS	\$8,000
14.14	Electrical testing and commissioning			LS	\$6,000
14.15	Upgrade power supply			Allowance	\$100,000
14.16	Consumer mains supply and installation			Allowance	\$37,000
14.17	Supply and installation of main switchboard			Allowance	\$29,000
15.0	Potable water connection to STP				\$10,000
	Potable Water			Allowance	\$10,000
16.0	Miscellaneous				\$90,000
16.1	Work As Executed Drawings			Allowance	\$30,000
16.2	Training of personnel			Allowance	\$30,000
16.3	O & M guidelines and instructions			Allowance	\$25,000
16.4	QA plans			Allowance	\$5,000
TOTAL DIRECT CONSTRUCTION COST (including contractor margin)					\$2,084,171
	Project Contingency			20%	\$416,834
	Survey investigation and design and project management 10%			10%	\$208,417
TOTAL CAPITAL COST					\$2,709,422



DEPARTMENT OF PLANNING, INDUSTRY & ENVIRONMENT

Guidelines for applicants 2020-21

Floodplain Management Program



environment.nsw.gov.au

© 2020 State of NSW and Department of Planning, Industry and Environment

With the exception of photographs, the State of NSW and Department of Planning, Industry and Environment are pleased to allow this material to be reproduced in whole or in part for educational and non-commercial use, provided the meaning is unchanged and its source, publisher and authorship are acknowledged. Specific permission is required for the reproduction of photographs.

The Department of Planning, Industry and Environment (DPIE) has compiled this report in good faith, exercising all due care and attention. No representation is made about the accuracy, completeness or suitability of the information in this publication for any particular purpose. DPIE shall not be liable for any damage which may occur to any person or organisation taking action or not on the basis of this publication. Readers should seek appropriate advice when applying the information to their specific needs.

All content in this publication is owned by DPIE and is protected by Crown Copyright, unless credited otherwise. It is licensed under the [Creative Commons Attribution 4.0 International \(CC BY 4.0\)](#), subject to the exemptions contained in the licence. The legal code for the licence is available at [Creative Commons](#).

DPIE asserts the right to be attributed as author of the original material in the following manner: © State of New South Wales and Department of Planning, Industry and Environment 2020.

Cover photo: Flooded creek. Alexandra Gardiner/DPIE

Published by:

Environment, Energy and Science
Department of Planning, Industry and Environment
4 Parramatta Square, 12 Darcy Street, Parramatta NSW 2150
Phone: +61 2 9995 5000 (switchboard)
Phone: 1300 361 967 (Environment, Energy and Science enquiries)
TTY users: phone 133 677, then ask for 1300 361 967
Speak and listen users: phone 1300 555 727, then ask for 1300 361 967
Email: info@environment.nsw.gov.au
Website: www.environment.nsw.gov.au

Report pollution and environmental incidents
Environment Line: 131 555 (NSW only) or info@environment.nsw.gov.au
See also www.environment.nsw.gov.au

EES 2020/0069
February 2020

Find out more about your environment at:

www.environment.nsw.gov.au

Contents

Introduction	1
Eligibility	1
What will be funded?	1
What will not be funded?	2
Program objectives	2
Funding priorities	3
What applicants will need to contribute	3
Special consideration	3
Partnerships	4
Project implementation timeframe	4
Funding agreements	4
Assessment process	4
Assessment criteria	5
Essential criteria	5
Other criteria	5
Additional guidance on some specific items	6
Pit and pipe survey	6
Floor level survey	6
Community consultation	6
New works ranking form	6
Contacts for assistance	7
General administration inquiries	7
Submission process	7
Closing date	7
Other programs	7
Instructions for completing the New Works Ranking Form	8

List of tables

Table 1	Applications can be made for the following projects	1
---------	---	---

Floodplain Management Program – Guidelines for applicants 2020-21

Introduction

The NSW Government provides technical and financial support to local government under the Floodplain Management Program (the Program) to manage flood risk. The primary objective of the Program is to support the implementation of the NSW Flood Prone Land Policy, which aims to reduce the impacts of existing flooding and flood liability on communities and to reduce private and public losses resulting from floods, using ecologically positive methods wherever possible.

The Program is administered by the Department of Planning, Industry and Environment (DPIE).

The NSW Government recommends that local government manage its flood risk by following the floodplain risk management process outlined in the Floodplain Development Manual (2005).

Closing date: **5.00pm 8 April 2020**.

Eligibility

The following organisations are eligible to apply.

- local councils
- county councils
- other government bodies with equivalent floodplain risk management responsibilities to local councils (e.g. Lord Howe Island Board, Hunter Local Land Services (LLS)).

Local councils can also work together in a group, provided that either:

- one council is the lead agency in terms of signing of the funding agreement, managing monies and reporting on the project
- a relevant Regional Organisation of Councils applies for and manages the funding.

What will be funded?

Table 1 Applications can be made for the following projects

Project Category	
Stage 1	Flood study (including data collection).
Stage 2	Prepare or review a floodplain risk management study and plan
Stage 3	Investigation, design and/or feasibility study (where required) for works identified in a floodplain risk management plan; this stage must be undertaken for all works projects that are likely to exceed a total project cost of \$500,000.
Stage 4	Implementing actions identified in a floodplain risk management plan, including but not limited to: <ul style="list-style-type: none"> • structural works such as levees, detention basins, floodgates and flow conveyance improvements (if these are extensive works requiring a high level of funding, they should be broken into stages) • flood warning systems • evacuation management

Floodplain Management Program – Guidelines for applicants 2020-21

- upgrades of flood assets that have reached the end of their design life
- voluntary house raising (further information on the eligibility criteria and implementation of voluntary house raising projects is available in Floodplain Management Program Guidelines for voluntary house raising schemes)
- voluntary purchase (further information on the eligibility criteria and implementation of voluntary purchase projects is available in Floodplain Management Program Guidelines for voluntary purchase schemes).

Note: Lodging an application for financial assistance does not guarantee assistance will be offered.

Separate application forms must be completed for each project.

Councils can submit a maximum of four applications per funding round, these should be the highest priority projects for funding. An additional two applications (maximum six) will be considered if the applicant can demonstrate the need for all the projects and the ability to effectively manage the projects. Approval to exceed the four-application limit must be sought prior to submitting the additional applications from the Manager Contestable Grants – Coast, Estuary and Flood at coastalestuary.floodgrants@environment.nsw.gov.au.

What will not be funded?

Funding will not be provided for:

- GST – the project cost is to exclude GST.
- Retrospective projects – funding is not available for activities currently underway, completed or contractually committed to prior to the awarding of grants to successful applicants or prior to approval of the project work plan.
- Administration costs – unless otherwise approved in writing by the Department, all internal costs (including on-costs) associated with the core activities of the applicant are ineligible for funding. An applicant's core activities include preparing study briefs, reviewing proposals and tenders, researching and copying records, attending meetings, contract and grant administration, accounting costs, staff costs associated with liaising with the public and with government agencies. Costs related to the education of residents via mailouts, workshops or other methods will be funded where those costs are deemed to be reasonable and well justified.
- Project management costs – unless specifically approved at the time of application.
- Non-monetary contributions as matching funds – an applicant's matching funds must be in the form of monetary contributions from council revenue and cannot include in-kind or voluntary contributions or funding from other parties.
- Contingencies – should not be included in the application or work plan.
- Projects the applicant can reasonably be expected to undertake without financial assistance from the program.
- Maintenance of assets or replacement of assets that have not been appropriately maintained.
- Additional funding after commencing the project of more than 30% of the original amount requested.

Program objectives

The Floodplain Management Program objectives are to provide financial support to councils and eligible public land managers to:

Floodplain Management Program – Guidelines for applicants 2020-21

- reduce the impacts of existing flooding and flood liability on communities and to reduce private and public losses resulting from floods
- make informed decisions on managing flood risk by preparing floodplain risk management plans (and associated background studies) under the floodplain risk management process
- implement floodplain risk management plans to reduce flood risk to both existing and future development, and reduce losses through a range of property, flood and response modification measures as outlined in the Floodplain Development Manual
- provide essential information to the NSW State Emergency Service to enable the effective preparation and implementation of local flood plans to deal with flood emergency response.

Note: Projects which cannot demonstrate that they meet the objectives of the Floodplain Management Program will be considered ineligible for funding.

Funding priorities

Generally, the highest priority will be given to the following projects:

- Flood studies or floodplain risk management studies and plans (or reviews), with the highest priority given to those in areas with significant development pressures or where existing communities are exposed to flood risk but this risk is not fully understood.
- The next stage of a mitigation work that is integral to a stage in progress; for example, the next stage of a levee project or works to offset the impacts from a levee project being constructed.
- Mitigation works that are identified as a high priority in floodplain risk management studies and plans adopted by councils.

What applicants will need to contribute

Assistance under the Program is \$2 from government for every \$1 provided by the applicant (from council revenue), except where special consideration is provided.

Contributions to the project from other funding sources (not council revenue) must be removed from the whole project cost prior to applying the funding ratio, except for voluntary house raising.

Special consideration

An applicant unable to match the Program's funding contribution may apply for special consideration.

When applying for special consideration, the application should demonstrate why the issue being addressed is of regional or statewide significance and that the applicant does not have the financial capacity to address it.

The applicant's financial capacity will be assessed considering its per capita general-purpose grants under the Local Government Financial Assistance Grants, as established by the Local Government Grants Commission.

If the applicant intends to apply for special consideration, they should contact the Manager Contestable Grants – Coast, Estuary and Flood to discuss an agreed maximum funding ratio prior to submitting the application.

Floodplain Management Program – Guidelines for applicants 2020-21

If special consideration is awarded, the applicant will be eligible to:

- an increased government contribution towards the cost of the project
- claim project management costs (capped at a maximum of 10% of the total project cost) undertaken either:
 - internally (with the costs used as in-kind contributions to match funding)
 - externally (selected by a competitive process and funded as a specific cost).

Partnerships

Where a group of local councils are working together in partnership (either under the lead of one of the councils or a relevant Regional Organisation of Councils), then the lead council or Regional Organisation of Councils is able to claim a maximum of 10% of the total project cost for project management.

Eligible project management costs include:

- A project manager or staff member employed specifically for the project, who is selected by a competitive process. Note: We will not pay for staff already employed by the organisation submitting the application that will be supervising/project managing or working on the project as part of their usual duties.
- Administrative costs directly related to the funded project. This can include those noted under 'What will not be funded?'

Project implementation timeframe

Projects should not extend beyond three years.

Projects should be realistically timed as extensions to timeframes may not always be granted. It will also minimise the need for future paperwork to vary timeframes, which can take time to be assessed and stall progress on the project.

Funding agreements

Successful applicants must enter into a funding agreement that stipulates all funding obligations and conditions.

The agreement will need to be signed by the general manager (or someone with delegated authority) within 45 days of the formal grant offer.

The project will be tracked and managed against the work plan which must be kept current by the grant recipient, in consultation with the Department of Planning, Industry and Environment, throughout the funded period.

Consider the conditions in the [sample funding agreement](#) before submitting an application as changes to the agreement will only be made in exceptional circumstances.

Assessment process

Applications will be checked to confirm eligibility and completeness. Ineligible, late or incomplete applications will be considered ineligible for funding.

Floodplain Management Program – Guidelines for applicants 2020-21

Applications will then be assessed by the Department's technical staff against the assessment criteria.

An independent panel, which includes expert and stakeholder representation, will then assess and prioritise applications on a statewide basis.

Successful applications will be announced.

Details of successful applications will be placed on the Department's website. All applicants will be notified in writing of the outcome of their application.

Assessment criteria

Essential criteria

All applicants must be able to demonstrate:

- the project meets the objectives of the Floodplain Management Program
- capacity to deliver the project, past grants management history, available resources and financial commitment, proposed timeframe, and whether the project is realistic based on completion of prerequisite consultant briefs, preconstruction work or approvals
- commitment to maintain any works in a condition suitable to meet its design intent for the design life
- the floodplain risk management process outlined in the Floodplain Development Manual (2005) has been followed.

Projects must meet all four essential criteria to be eligible for funding.

Other criteria

Applications will also be assessed on:

- the extent to which the project is cost-effective in addressing one or more of the Program's priorities
- the technical feasibility, effectiveness and efficiency of the risk mitigation solutions
- the level of regional significance, including the immediacy of any threats
- the level of community support
- for works, the outcomes of ranking based on the scoring system endorsed by Floodplain Management Australia (see New Works Ranking Form and 'Instructions on completing the application form' for more details)
- the priority of the project with regard to the relevant adopted floodplain risk management plan (if applicable)
- the current risk to people and/or property from flooding in this area and how effectively the application addresses these risks.

Note: An application will be awarded a reduced ranking if it is not well thought out or it has unclear objectives or outcomes.

Additional guidance on some specific items

Pit and pipe survey

Floodplain risk management is primarily aimed at addressing riverine and local overland flooding.

As part of this understanding, an assessment of the capacity and performance of trunk drainage systems may be necessary. This may, in some cases, require some survey of the trunk drainage system and this is generally eligible for funding. However, broader surveys of minor and feeder drainage systems are not funded. Surveying for asset management purposes is ineligible for funding.

The extent of the drainage system surveyed will need to be justified by the applicant commensurate with the risk to ensure that the survey incorporated in the study is fit for purpose. As a guide, trunk drainage systems can be considered to involve pipes of a minimum of 0.75 metre diameter.

Floor level survey

Floor level surveys may be undertaken using a range of methods depending upon the intended end use of the information and the terrain.

These purposes may vary from assessment of flood damages through to provision of more specific advice to the community.

The applicant should consider the intended purpose and methodology relevant to their situation and include a suitable budgetary allowance as part of their application. If highly specific and detailed floor level survey is required then strong justification as to why this level of detail is required should be included in the application.

Community consultation

Community consultation is an integral part of the floodplain risk management process.

The methodology used for community consultation will vary depending upon the type and scale of the study, the area of concern, the needs of the community and the general methods council may use to consult the community.

All applications for flood studies and floodplain risk management studies and plans are to include an appropriate budgetary allowance that considers the scope and scale of consultation appropriate for the study.

For projects dealing with evacuation management or flood warning systems, provide written evidence of support from the State Emergency Service or Bureau of Meteorology, respectively.

Detailed descriptions of what will be involved in the consultation are required for all projects if costs are to be included as a component of the grant funding.

New works ranking form

This form only needs to be completed for implementation project (stage 3 or 4 as outlined on page 1 of these guidelines).

For new works (including structural works, flood warning, evacuation management, voluntary purchase and voluntary house raising) please submit a New Works Ranking Form to enable

Floodplain Management Program – Guidelines for applicants 2020-21

ranking using the scoring system endorsed by Floodplain Management Australia. The new works ranking form is available on the [Floodplain management grants page](#).

Note that councils should update this form once the investigation and design have been completed.

Contacts for assistance

For assistance with grant applications, contact the Department of Planning, Industry and Environment offices listed below.

Region	Telephone
Hunter/Central Coast	02 4927 3248
South West	02 6229 7170
North East	02 8289 6318
South East	02 4224 4153
Greater Sydney	02 8837 6097
North West	02 6883 5315

General administration inquiries

For general grant administration inquiries, contact the Grants Unit – Coast, Estuary and Flood on 02 9895 6494 or by email at coastalestuary.floodgrants@environment.nsw.gov.au.

Submission process

Closing date

Applications must be received by **5.00pm 8 April 2020**.

Any application that is late, incomplete or ineligible will not be considered.

Other programs

The Department of Planning, Industry and Environment also offers a Coastal and Estuary Grants Program, for further information, please see the [Current floodplain management grants page](#).

The NSW Environmental Trust offers a range of other environmental grants for local government. For further information, please see the [Environmental Trust website](#).

Instructions for completing the New Works Ranking Form

The New Works Ranking Form assists with the ranking of new works only and is the scoring system endorsed by the Floodplain Management Association. It should be completed when submitting an application for a new works project which has not previously been scored or where the council would like to update a project's scoring based on improved information.

The New Works Ranking Form includes a number of project assessment sheets.

All applicants are to complete sheets 1 and 2. In addition, depending on the type of project, complete sheet:

- three for integrated schemes and structural works projects
- four for evacuation management improvement projects
- five for flood warning improvement projects
- six for voluntary purchase and house raising projects.

Information should be provided in relation to the flood on which the flood planning level is based or, if this is not available, the largest known historical flood.

Sheet 1 Provides preliminary data. This is usually available from the relevant flood study and/or floodplain risk management study and indicates the extent of the flood problem to which a community is exposed.

Sheets 2-6 Provide detailed and specific data required for projects seeking funding for floodplain management works. Works include structural works, flood warning, evacuation management, voluntary purchase and voluntary house raising projects. This data is used to determine the effectiveness and efficiency of the project in reducing flood problems and meeting associated objectives so these can be compared on a statewide basis.

Project assessment sheet 1: All categories of applications

C1. The source of flood information used to answer the questions must be indicated. Where DPIE does not have a copy of the appropriate studies and other documentation such as a review of environmental factors (REF) or environmental impact statement (EIS), as appropriate, a copy will be requested to assist in undertaking an impartial check of the data provided.

C2. Hazard level in area assesses important factors in defining the level of flood hazard in the area, as defined in the *Floodplain Development Manual*.

Questions C3 to C6 provide an outline of the impacts of the flood on the community.

C3. Scale of problem – number of dwellings affected provides an indication of the number of people affected by flooding.

C4. Scale of problem – percentage of dwellings flooded provides an indication of the scale of the problem from a local perspective.

C5. Scale of problem – occurrence of over floor flooding looks at the frequency of damaging flooding and gives an indication of the regularity and therefore the ongoing impact of flooding on the community.

C6. Scale of problem – evacuation requirements indicates the degree of evacuation problems to which the community is exposed.

Floodplain Management Program – Guidelines for applicants 2020-21

Project assessment sheet 2: Detailed data – all categories of applications

Detailed data are required for all projects.

- C7. Community involvement in project** investigates the degree of project development in accordance with the principles of the *Floodplain Development Manual*.
- C8. Strategic planning in place** investigates the degree to which strategic planning is being used to control new development and redevelopment in the floodplain.
- C9. Benefit/cost ratio for proposed works** considers the economic efficiency of the project in reducing flood damages.
- C10. Incorporation of environmental considerations and enhancements** examines whether environmental impacts have been considered and whether these have been incorporated in the project. It also indicates whether opportunities for environmental enhancement have been considered and are being implemented as part of the project.
- C11. Environmental assessment for compatibility with ecologically sustainable development (ESD)** considers how the project has dealt with environmental impacts and addressed ESD principles.

Project assessment sheet 3: Specific data – integrated schemes and structural works only

Integrated schemes are projects that involved a range of structural work components or measures that work together as an integral scheme to provide flood benefits. The benefits of the scheme would generally significantly outweigh the benefits of individual components.

- C12. Average damage per dwelling** examines the existing damage level in the town based on average (determined from actual rather than potential) damage per dwelling that is likely to occur without the proposed management measures.
- C13. Average annual damage per dwelling** examines the cost of flooding per dwelling across a range of floods, not just the planning-level flood. This provides an indication of the long-term cost of flooding to the community.
- C14. Percentage reduction in average annual damage per dwelling** examines the efficiency of the project in reducing damage from a range of events on a per dwelling basis.
- C15. Social improvements resulting from project** examines the degree to which the project has addressed the social impacts.

Project assessment sheet 4: Specific data – projects to improve evacuation management only

- C16. Hazard level (as defined in the *Floodplain Development Manual*)** examines the hazard that exists in the township, the potential for isolation, the logistics of evacuation and the hazard associated with the evacuation route.
- C17. Evacuation management** examines whether external evacuation resources are required and flood predictions are available, how flood ready the community is, whether the State Emergency Service supports the project and whether their support reduces the need for external evacuation resources, i.e. there are fewer people to evacuate, or they can evacuate themselves unassisted.
- C18. Scale of evacuation problem** indicates the number of people requiring evacuation to provide information on the scale of the problem.
- C19. Social improvements resulting from project** examines the degree to which the project has addressed the social impacts.

Floodplain Management Program – Guidelines for applicants 2020-21

Project assessment sheet 5: Specific data – projects to improve flood warning only

- C20. Hazard level (as defined in the *Floodplain Development Manual*)** examines the level of hazard in the community.
- C21. Flood warning** examines the feasibility and likely effectiveness of flood warning projects. These projects must have the support of the Flood Warning Consultative Committee.
- C22. Flood warning – scale of problem** examines the current shortcomings in the existing flood warning system, if any system exists.
- C23. Social improvements resulting from project** examines the degree to which the project has addressed the social impacts.

Project assessment sheet 6: Specific data – voluntary purchase and house raising projects only

- C24. Average damage per dwelling** examines the existing damage level in the town based on average (determined from actual rather than potential) damage per dwelling that is likely to occur without the proposed management measures.
- C25. Average annual damage per dwelling** examines the cost of flooding per dwelling across a range of floods, not just the planning-level flood. This provides an indication of the long-term cost of flooding to the community.
- C26. Hazard level (as defined in the *Floodplain Development Manual*)** examines the hazard that exists in the township, the potential for isolation, the logistics of evacuation and the hazard associated with the evacuation route.
- C27. Social improvements resulting from project** examines the degree to which the project has addressed social impacts.

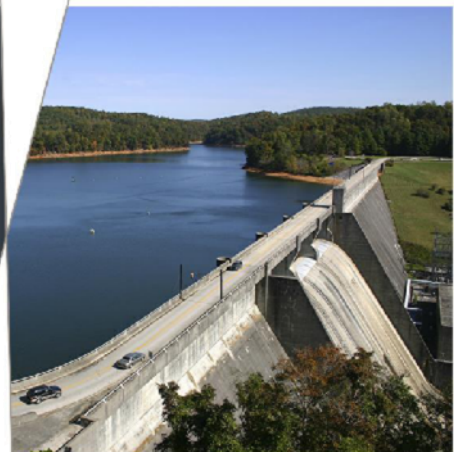
Feasibility Study

Nangus Water Supply

8202004301- R01-V02

Prepared for
Goldenfields Water

17 February 2020



 **Cardno®**



Feasibility Study
Nangus Water Supply

Contact Information

Cardno (NSW/ACT) Pty Ltd

ABN 95 001 145 035

16 Burelli Street
Wollongong NSW 2500
Australia

Phone +612 4228 4133

Fax +612 4228 6811

Document Information

Prepared for	Goldenfields Water
Project Name	Nangus Water Supply
File Reference	8202004301-R01-V02 Nangus Feasibility.docx
Job Reference	8202004301- R01-V02
Date	17 February 2020
Version Number	V02

Author(s):

Jonathan Knudsen
Principal – Water Infrastructure

Effective Date 11/12/2019

Approved By:

Bradley Elliott
Manager – Water Infrastructure

Date Approved 11/12/2019

Document History

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
V01	12/12/2019	Draft	JMK	BSE
V02	17/02/2020	Final	JMK	SB

© Cardno. Copyright in the whole and every part of this document belongs to Cardno and may not be used, sold, transferred, copied or reproduced in whole or in part in any manner or form or in or on any media to any person other than by agreement with Cardno.

This document is produced by Cardno solely for the benefit and use by the client in accordance with the terms of the engagement. Cardno does not and shall not assume any responsibility or liability whatsoever to any third party arising out of any use or reliance by any third party on the content of this document.

Our report is based on information made available by the client. The validity and comprehensiveness of supplied information has not been independently verified and, for the purposes of this report, it is assumed that the information provided to Cardno is both complete and accurate. Whilst, to the best of our knowledge, the information contained in this report is accurate at the date of issue, changes may occur to the site conditions, the site context or the applicable planning framework. This report should not be used after any such changes without consulting the provider of the report or a suitably qualified person.

8202004301- R01-V02 | 17 February 2020 | Commercial in Confidence

ii



Table of Contents

1	Introduction	1
2	Problem Definition	2
2.1	Existing Water Supply Arrangements	2
2.2	Drivers for a Reticulated Water Supply	2
3	Water Demand	6
4	Options Identification	8
4.1	Options Previously Identified	8
4.2	Additional Options	8
4.3	Options Assessed in this Feasibility Study	9
5	Evaluation Criteria	10
5.1	Capital Cost Estimate	10
5.2	Multi-criteria Analysis and Risk Assessment	10
6	Existing GWCC Tenandra Water Supply	12
7	Existing CGRC Gundagai Water Supply	13
8	Options Assessment	14
8.1	Nangus Service Area	14
8.2	Desktop Environmental Constraints Analysis	14
8.3	Options 1 to 4: Overview	14
8.4	Option 1: Pipeline from CGRC Water Supply at Gundagai	18
8.5	Option 2: Pipeline from GWCC Water Supply – from Oura Road	28
8.6	Option 3: Pipeline from GWCC water supply – from Tenandra Reservoirs following new route	37
8.7	Option 4: Pipeline from GWCC water supply – from Tenandra Reservoirs following existing easement	46
8.8	Option 5: Murrumbidgee River extraction and treatment	55
8.9	Option 6: Groundwater extraction and treatment	63
8.10	Option 7: Do nothing	72
9	Conclusions and Recommendations	74
10	References	76

Appendices

- Appendix A** Pipeline Option Route Maps
- Appendix B** Environmental constraints
- Appendix C** Water Treatment Options
- Appendix D** Hydrogeological Review
- Appendix E** Cost Estimates



Tables

Table 3-1	Water demand	6
Table 5-1	Multi-Criteria Analysis Parameters and Weighting	11
Table 8-1	State listed vegetation communities and associated BC Act TECs	21
Table 8-2	Federally listed TECs	22
Table 8-3	Option 1 – Multi-Criteria Analysis	26
Table 8-4	State listed vegetation communities and associated BC Act TECs	30
Table 8-5	Federally listed TECs	31
Table 8-6	Option 2 – Multi-Criteria Analysis	35
Table 8-7	State listed vegetation communities and associated BC Act TECs	39
Table 8-8	Federally listed TECs	40
Table 8-9	Environmental Stewardship Funding Deed management actions that may impact Option 3	40
Table 8-10	Option 3 – Multi-Criteria Analysis	44
Table 8-11	State listed vegetation communities and associated BC Act TECs	48
Table 8-12	Federally listed TECs	49
Table 8-13	Option 4 – Multi-Criteria Analysis	53
Table 8-14	State listed vegetation communities and associated BC Act TECs	58
Table 8-15	Option 5 – Multi-Criteria Analysis	62
Table 8-16	State listed vegetation communities and associated BC Act TECs	67
Table 8-17	Option 6 – Multi-Criteria Analysis	71
Table 8-18	Option 7 – Multi-Criteria Analysis	73
Table 9-1	Capital Cost Summary	74
Table 9-2	Multi-criteria Analysis Summary	75

Figures

Figure 2-1	Regional Map	3
Figure 2-2	Nangus Town Centre	4
Figure 2-3	Proposed area for rezoning (Source: CGRC)	5
Figure 3-2	Typical Residential Diurnal Pattern	7
Figure 4-1	Billabung (Billabong) Water Source (Source: Plan Map WSP023_Version 2 from the Water Sharing Plan for Murrumbidgee Unregulated and Alluvial Water Sources 2012)	9
Figure 8-1	Pipeline Route Options Map	15
Figure 8-2	Pipeline Route Options Elevation Profile	16
Figure 8-3	Nangus Reticulation Map	17
Figure 8-4	Option 1 – Hydraulic Grade & Elevation Profile	19
Figure 8-5	Option 2 – Hydraulic Grade & Elevation Profile	29
Figure 8-6	Option 3 – Hydraulic Grade & Elevation Profile	38
Figure 8-7	Option 4 – Hydraulic Grade & Elevation Profile	47



Figure 8-8 Option 5 – River Extraction Plan	56
Figure 8-9 Option 5 – Water Treatment Process	57
Figure 8-10 Option 6 – Groundwater Extraction Plan	64
Figure 8-11 Option 6 – Water Treatment Process	66



1 Introduction

Nangus is a village in the Cootamundra Gundagai Regional Council (CGRC) with an estimated population of 80 people. The village is located approximately 18 km west of Gundagai. Nangus does not currently have a reticulated water supply, and residents provide their own water supplies, typically from roof water, bottled water, bore water or water carting.

CGRC recently undertook community consultation for the Villages Strategy, which received strong support for provision of a reticulated water supply. CGRC has requested Goldenfields Water County Council (GWCC) investigate provision of a reticulated town water supply to Nangus.

The objectives of the overall project include:

- > Provide appropriate levels of service (LOS) as part of the design assessment and ensure the LOS can be achieved throughout its design life.
- > Achieve project delivery from initiation to construction completion in 4-6 years (should the project prove feasible).
- > Undertake a feasibility assessment Phase (Phase 1) of the project
- > Undertake a Business Case Phase of the project (Phase 2)
- > Cost estimates for whole of life costs to be equal to or less than 100% of benefit, achieving BCR of 1 or over
- > Achieve best practice principles
- > Secure construction funding
- > Assess and mitigate all risks associated with the delivery and ongoing operation of this project.

Cardno has been engaged by GWCC to undertake the Nangus Water Supply Feasibility Study, which meets Phase 1 in the above objectives. This study investigates and assesses a range of options to provide a reticulated water supply to Nangus.



2 Problem Definition

2.1 Existing Water Supply Arrangements

Nangus does not currently have a reticulated water supply. Residents are responsible for obtaining their own water supplies. This is typically achieved through the following:

- > Rain water tanks
- > Bottled water
- > Bores
- > Water carting

The current supply arrangements are onerous for residents to operate and maintain, and present potential risks in terms of supply quality and security.

Reticulated potable water supply systems currently exist to the west (GWCC network) and east (CGRC network in Gundagai) of Nangus. The regional context of Nangus is shown in Figure 2-1, while the town centre is shown in Figure 2-2.

2.2 Drivers for a Reticulated Water Supply

Drivers for a reticulated water supply in Nangus are outlined below.

- > Growth potential

The lack of a reticulated water supply may be holding back potential growth in the Nangus area. Investigations by CGRC indicate that provision of a reticulated water supply would support residential and economic growth. The following factors point to the potential for growth in the Nangus area:

- Nangus currently has other infrastructure and services, including a Public School, town hall, general store, post office, mechanic and a bus depot servicing Wagga Wagga and Gundagai. These existing facilities improve the outlook for growth in the area, should a reticulated water supply be provided.
- Nangus Road is currently being upgraded to support B-double traffic. Improved road linkages through the area may lead to increased traffic and demand for services. Nangus could potentially develop as a service hub on this regional route.
- At 15 minutes' drive from Gundagai, Nangus is an affordable residential lifestyle alternative to Gundagai. Nangus is also situated close to a number of other regional employment areas, including Junee (30 minutes), Wagga Wagga (45 minutes) and Cootamundra (45 minutes).
- CGRC estimates that the unoccupied dwelling rate in Nangus is lower than other villages in the Local Government Area (LGA). This may indicate potential demand for additional housing and development in the area.
- CGRC has identified an area adjacent to Nangus for subdivision into lots of 2 ha and 5 ha, as shown in Figure 2-3. It is proposed that this land will be rezoned from RU1 (Primary Production) to RU4 (Primary Production Small Holding).
- There are approximately 27 occupied dwellings in Nangus (data from CGRC). Based on population projections from CGRC, this may increase to approximately 79 occupied dwellings (see Section 3).







Figure 2-3 Proposed area for rezoning (Source: CGRC)

> Community Support

CGRC recently undertook community consultation as part of preparation of the Villages Strategy. The unanimous response from Nangus residents was in support of a reticulated water supply. Respondents indicated they believed lack of a reticulated water supply was holding the village back from potential residential growth.

> Security and water quality risks associated with current water supply arrangements

Current water supply arrangements are onerous for residents, and present potential health risks to residents. Provision of a reticulated supply would remove the health risks associated with residents' current supplies, and increase supply security, particularly with respect to rainwater tanks.

> Sustainable Development Goals

GWCC takes consideration of the United Nations Sustainable Development Goals (SDG) into account in its operations. Relevant goals to this project include:

- Goal 6: Ensure availability and sustainable management of water and sanitation for all.
- Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

> Equal opportunity and consistency of services for all townships within CGRC, which enables greater social cohesion through the provision of access to similar standard of water services currently available in the larger centres.



3 Water Demand

CGRC estimates the current population of Nangus to be approximately 80 people. The following are currently located within the village:

- > Approximately 27 occupied dwellings
- > Church
- > Hall
- > Public School
- > RFS Shed
- > General Store
- > Workshop

Therefore, there is potential for approximately 33 connections at the existing level of development. In addition, there are currently approximately 36 vacant lots.

Population projections from CGRC estimate a population of 213 people could be possible in the long term. This equates to 79 property connections at the 2016 Nangus census occupation rate of 2.7 people/dwelling.

To allow for additional growth, CGRC and GWCC have agreed the feasibility study should be based on a supply for 100 ET (equivalent tenements) in the village of Nangus. This will allow for all foreseeable growth.

The design average day demand (ADD) and maximum day demand (MDD) from within the village of Nangus are shown in Table 3-1. The design criteria per ET for ADD and MDD are taken from the level of service targets in the GWCC Drinking Water Management System (Atom Consulting, 2017). Note that the ADD is given as 294 kL/y/ET in the above document, which equates to the 0.81 kL/d/ET ADD given in Table 3-1.

Options that involve construction of a pipeline transferring potable water from either GWCC or Gundagai will also present opportunities to provide potable water to rural properties along the route. For all pipeline options an allowance for five rural property connections has been made, each with a MDD of 25 kL/d and ADD of 5kL/d. The total demands for the pipeline options are given in Table 3-1. In the hydraulic modelling it has been assumed that the full demand will be catered for in the pipelines through to Nangus, as it is unknown where these rural demands will be located along the pipeline.

Table 3-1 Water demand

Parameter	Nangus Village		Nangus Village and Rural Demand (pipeline options only)		
	Design Criteria (kL/d/ET)	Total Demand (kL/d)	Design Criteria for Rural Connection (kL/d/ET)	Rural Demand (kL/d)	Total Demand (kL/d)
Average Day Demand	0.81	80.5	5	25	105.5
Maximum Day Demand	4	400	25	125	525
Maximum hour Demand	7	712 (8.2L/s)	45	223	935 (10.8L/s)

A typical residential diurnal pattern was applied to the Nangus demands to determine the maximum hour requirements. The diurnal pattern has a peaking factor 1.78, which occurs at 4pm of a typical day. The applied curve is shown in Figure 3-2.



Feasibility Study
Nangus Water Supply

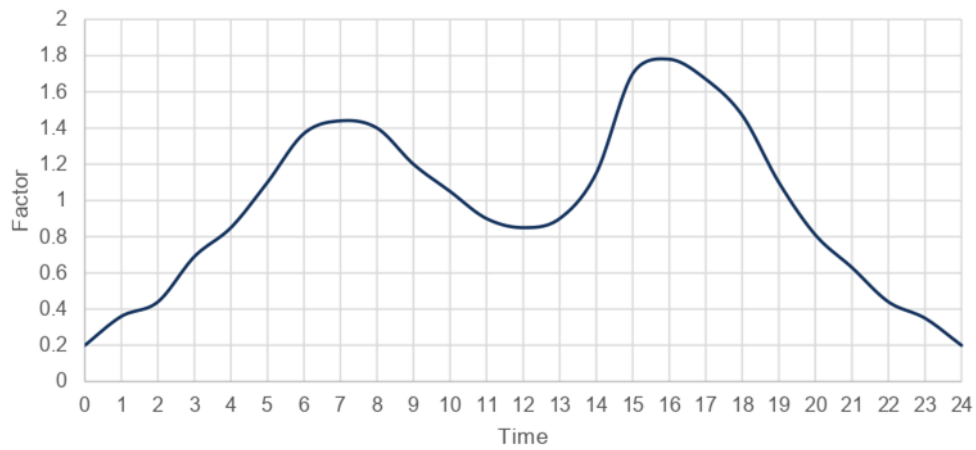


Figure 3-2 Typical Residential Diurnal Pattern



4 Options Identification

4.1 Options Previously Identified

GWCC previously identified the following potential options for supply of potable water to Nangus:

1. Extend the existing Gundagai potable water supply to Nangus
2. Connection to GWCC's Tenandra scheme at Oura Road to supply Nangus
3. Connection to GWCC's Tenandra, scheme near Tenandra reservoirs, and utilize the existing easement
4. Connection to GWCC's Tenandra reservoir and use the local terrain to determine the alignment to Nangus
5. River extraction including treatment process
6. Ground water extraction including treatment process
7. Do nothing, 'status quo'

4.2 Additional Options

A workshop was held with staff from GWCC, CGRC and Cardno to identify possible options not previously considered. The identified options include:

- > Permanent water carting
- > Dam on Billabong Creek with treatment
- > Pipeline to Tarcutta water supply
- > Pipeline to Riverina Water County Council Oura water supply

These options are further discussed below.

4.2.1 Permanent water carting

This option would involve construction of a reservoir and reticulation system in Nangus. However, water would be supplied to the reservoir by carting either from the GWCC system or from Gundagai. With a 20 kL tanker, at ADD this would equate to 4 truck movements per day, while at MDD 20 truck movements per day would be required.

Assuming a 20-minute drive between a truck fill location in Gundagai and a reservoir at Nangus and 50 minutes each for filling and emptying, a round trip would take approximately 2 hours. To accommodate ADD, the carting truck would be operational for 8 hours per day. To accommodate MMD, 5 trucks would be required to be in operation 8 hours per day.

Due to the high volume of truck movements required on a permanent basis, this option has been excluded from further analysis.

4.2.2 Dam on Billabong Creek with treatment

The Billabong Creek flows from the north to its confluence with the Murrumbidgee River west of Nangus. Note that the *Water Sharing Plan for the Murrumbidgee Unregulated and Alluvial Water Sources 2012* (NSW Government, 2016), which includes this creek, refers to it as the Billabong Creek. Other resources refer to this watercourse as the Billabong Creek. The area drained by the Billabong Creek is shown in Figure 4-1.

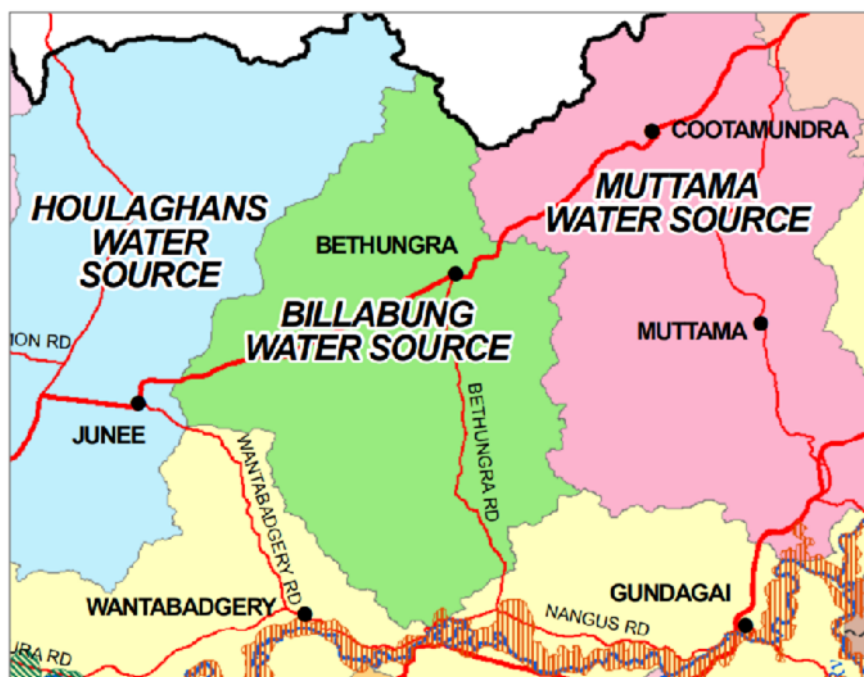


Figure 4-1 Billabong (Billabong) Water Source (Source: Plan Map WSP023_Version 2 from the Water Sharing Plan for Murrumbidgee Unregulated and Alluvial Water Sources 2012)

The creek is ephemeral, and as such either a dam or off-creek storage ponds would be required. Due to the significant costs associated with development of a new dam or off-creek storage, this option has been excluded from further analysis.

4.2.3 Pipeline to Tarcutta water supply

Riverina Water County Council currently operate a water supply scheme at Tarcutta using a groundwater source. Tarcutta is approximately 46 km from Nangus by road and approximately 31 km in a straight line. As the distance is significantly greater than options from the GWCC and Gundagai water schemes, this option is not considered any further in this study.

4.2.4 Pipeline to Oura water supply

Riverina Water County Council currently operate a water supply scheme at Oura using a groundwater source (separate from GWCC's Oura water supply system). Tarcutta is approximately 41 km from Nangus by road and approximately 35 km in a straight line. As the distance is significantly greater than options from the GWCC and Gundagai water schemes, this option is not considered any further in this study.

4.3 Options Assessed in this Feasibility Study

As no further practical options have been identified, the options carried forward for assessment in this Feasibility Study are based on those previously identified by GWCC, and are referred to by the following names in this report:

- > Option 1: Pipeline from Gundagai water supply
- > Option 2: Pipeline from GWCC water supply – from Oura Road
- > Option 3: Pipeline from GWCC water supply – from Tenandra Reservoirs following existing easement
- > Option 4: Pipeline from GWCC water supply – from Tenandra Reservoirs following new route
- > Option 5: Murrumbidgee River extraction and treatment
- > Option 6: Groundwater extraction and treatment
- > Option 7: Do nothing



5 Evaluation Criteria

Options analysed in this study have been assessed in terms of capital cost and a risk assessment and multi-criteria analysis (MCA).

5.1 Capital Cost Estimate

Capital cost estimates for all options include:

- > Costs for new delivery infrastructure, including pipelines, reservoirs, pump stations, bores, river intakes and treatment plants as required for each option.
- > Modifications to existing water supply infrastructure in the GWCC network and Gundagai network, as required for the pipeline options.
- > Costs for supply infrastructure including town reticulation and property service connections (excluding work after the supply meter required by the homeowner).
- > Land acquisition and easements.
- > Allowance for survey, investigation, design and project management.

Where appropriate, capital cost estimates have been based on the NSW Reference Rates Manual - Valuation of water supply, sewerage and stormwater assets (DPI, 2014), noting the following:

- > 2014 rates have been factored for cost increases through to 2017 using the 2017 factors published by the Department of Industry (DPI). Factors have not been published for 2018 or 2019.
- > Reference rates, which include an allowance for survey, investigation, design and project management, as directed by the manual, have been used.
- > An 'inherent risk' contingency of 30% has been applied, as per guidance in the manual for feasibility studies.
- > A 'contingent risk' of 10% has also been applied.
- > The manual has been used for costs for pipelines, pump stations and reservoirs. Other works, such as WTPs, have been estimated by Cardno.

5.2 Multi-criteria Analysis and Risk Assessment

A key component of MCA is to identify the constraints, risks and opportunities that are associated with each option, and categorise each of these under a key heading or theme. Examples of these themes can be; safety (construction and operation), security of supply, flexibility, constructability, environment impact/risk, delivery timeframe risk, etc.

The criteria to be used for this analysis, a description of the scoring criteria and the weighting of each parameter are given in Table 5-1. Through the analysis, each option has been scored against the weighted criteria, providing an MCA score between zero and ten.



Feasibility Study
Nangus Water Supply

Table 5-1 Multi-Criteria Analysis Parameters and Weighting

No.	Criteria	Score and Description				Weighting
		0		5	10	
1	Security of Supply Consider the security of the water supply and the impact/risks of prolonged drought.	Low security. High frequency of water restrictions	↔		↔	20%
2	Water Quality - Health Consider the reliability and risks to water quality with regard to health criteria.	Does not consistently meet the existing AWDG health requirements and draft HBTs.	↔	Meets the majority of current ADWG, but will potentially need investment to satisfy future changes to the ADWG.	↔	15%
3	Water Quality - Aesthetic Consider the reliability and risks to water quality with regard to asthenic criteria.	Does not consistently meet the AWDG aesthetic requirements.	↔	Meets the majority of current ADWG aesthetic requirements.	↔	10%
4	Operational Risk Consider the consequence of failure with regards to operator safety, community safety, scheme complexity, time needed to reinstate supply and resourcing risk.	Catastrophic risk - likely loss of life and property across a wide area. Alternate water supply needed to support town. High risk of not retaining suitably qualified operational staff.	↔	Moderate Injury risk to operations staff. Moderate risk to public and property.	↔	15%
5	Constructability Consider the ability to construct each option, including safety, availability of materials, availability of suitably qualified contractors, ground conditions, impact on existing services, access etc.	Constrained or limited access and egress for construction, significant impacts to day to day usage of the area. High WHS risk. Poor ground conditions. Complex work requiring specialist contractors.	↔	Average access and egress for construction, some impacts to day to day usage of the area. Moderate WHS risk.	↔	15%
6	Project Definition Risk Consider risk associated with level of definition and potential for currently unknown issues to impact schedule and budget.	Absence of available information for project definition increases the potential for project delays and budget exceedance.	↔	Reasonable level of project definition achieved. Typical project, with standardised design and construction needs. Moderate risk for project delays and budget exceedance.	↔	10%
7	Heritage, Environment and Approvals Consider environmental and heritage impacts and risks and the risk associated with obtaining approvals.	Critical heritage likely to be impacted. Adverse/significant impact to key vegetation communities. Potential for extended approvals period. Risk of approvals not obtained.	↔	PADs likely to be impacted - AHIP approval required. Minor impact to key vegetation communities. Moderate risk extended approvals period. Moderate risk approvals not obtained.	↔	15%
Total						100%

8202004301- R01-V02 | 17 February 2020 | Commercial in Confidence

11



6 Existing GWCC Tenandra Water Supply

GWCC water distribution infrastructure currently extends to the Tenandra Reservoirs, located on a hilltop approximately 8.6 km west of Nangus. At Tenandra there are two concrete reservoirs with a total storage of 3.2 ML.

The rising/gravity main to the Tenandra Reservoirs is a DN300 cast iron (CI) pipe constructed in the 1930s. The reservoirs and main were originally part of a scheme used to supply water from the Murrumbidgee River (extracted approximately 2km west of the reservoir site) through to Junee. When the Oura groundwater source was developed in the 1970s the river extraction at Tenandra became redundant and was decommissioned. However, the reservoirs were retained to service the current system. The mains supplying the other villages within the Tenandra scheme consist of mostly PVC pipe ranging in sizes from 50 mm to 200 mm, constructed between the early 1970s and mid-1980s.

The Oura scheme, which currently supplies the Tenandra part of the network, consists of a borefield that extracts water from the Wagga Wagga Alluvial Groundwater Source. Water is treated by way of aeration, chlorination and fluoridation.

Access to the Wagga Wagga Alluvial Groundwater Source is controlled by the *Water Sharing Plan for the Murrumbidgee Unregulated and Alluvial Water Sources 2012* (NSW Government, 2016). GWCC has a licence for extraction of 6 GL/y from the Oura system. The current demand on the supply is approximately 4.0 GL/y, projected to increase to 4.6 GL/y in 2048 (Cardno, 2019), not including Nangus. The peak day demand on the Oura scheme is currently 26.2 ML/d, projected to increase to 30.2 ML/d in 2048 (Cardno, 2019), not including Nangus. The Oura system supplies approximately 45% of the total water consumed by GWCC customers.

The Tenandra Reservoirs are used as header storage for the villages of Wantabadgery, Eurongilly, Illabo, Bethungra and minor rural consumers. Water is supplied from the Junee to Temora trunk main via an offtake to the Junee Silos Booster Pump Station, filling the Marinna reservoirs. Marinna Pump Station pumps to Tenandra, Wantabadgery, Eurongilly, Illabo and Bethungra reservoirs. Under gravity, water is fed out of the Tenandra Reservoirs via a common inlet/out supplying water to the reservoirs of Wantabadgery, Eurongilly, Illabo, Bethungra minor rural consumers and the east of Junee.

It is noted that GWCC's assets between the Junee Silos Pump Station and the Tenandra Reservoirs all have a condition rating of 3 (fair) or 4 (poor). Future investigations of options that incorporate supply from GWCC's network should include consideration of the condition of these assets, and what renewals may be necessary to ensure reliability of supply.



7 Existing CGRC Gundagai Water Supply

The Gundagai water supply scheme is owned and operated by CGRC. The scheme draws raw water from the Murrumbidgee River under water access licence (WAL) 6455, which allows an annual take of 1,250 ML. Access to water in the Murrumbidgee River is controlled under the *Water Sharing Plan for the Murrumbidgee Regulated River Water Source 2016* (NSW Government, 2018).

The Gundagai WTP process incorporates coagulation, flocculation, clarification, filtration, chlorination and fluoridation. Treated water is delivered to four reservoirs and to the reticulation network (see Figure 8-1).

CGRC has confirmed that there is sufficient spare capacity in the raw water supply and treatment plant to supply Nangus.



8 Options Assessment

8.1 Nangus Service Area

For all options, allowance has been made for reticulation to service the existing developed lots within the town. As per Figure 2-3, CGRC propose to rezone land to the north and north-west of the existing town to allow future development. Allowance has been made in the design service pressure to service these areas. The lowest elevation in the service area is approximately RL 215 m (along Nangus Road), while the highest elevation is approximately RL 260 m (at the north-west edge of the area noted for rezoning). GWCC design service pressure is 12 m to 90 m. Therefore, it is proposed to service the town in a single pressure zone.

8.2 Desktop Environmental Constraints Analysis

Cardno has undertaken a desktop environmental constraints analysis as part of the Nangus Water Supply Feasibility Study. The intent of the analysis was to highlight any 'red-flags' which may influence the alignment/location of the infrastructure involved in the various options. The analysis was desktop based, and therefore site specific investigations will be required in future project stages. The constraints analysis for each option is detailed in the relevant section below.

8.3 Options 1 to 4: Overview

Options 1 to 4 incorporate pipelines delivering potable water from existing networks; Option 1 from the CGRC system in Gundagai and Options 2 through 4 from the GWCC system to the west of Nangus. The pipeline routes are mapped on Figure 8-1, with comparative elevation profiles shown on Figure 8-2. Detailed maps are provided for the options in Appendix A.

For each option, reservoirs have been situated at locations of appropriate elevation along the pipe routes, as close as possible to Nangus. The elevations have been selected to provide sufficient service pressure as noted in Section 8.1.

In all options a DN100 pipeline between the supply source and the reservoir is suitable to convey peak day flows, while a DN150 pipeline is required between the reservoirs and the town to allow for peak hour flows.

A map of the proposed reticulation within Nangus (common to all options) is given in Figure 8-3. The reticulation is proposed to be constructed from DN100 PVC-O.

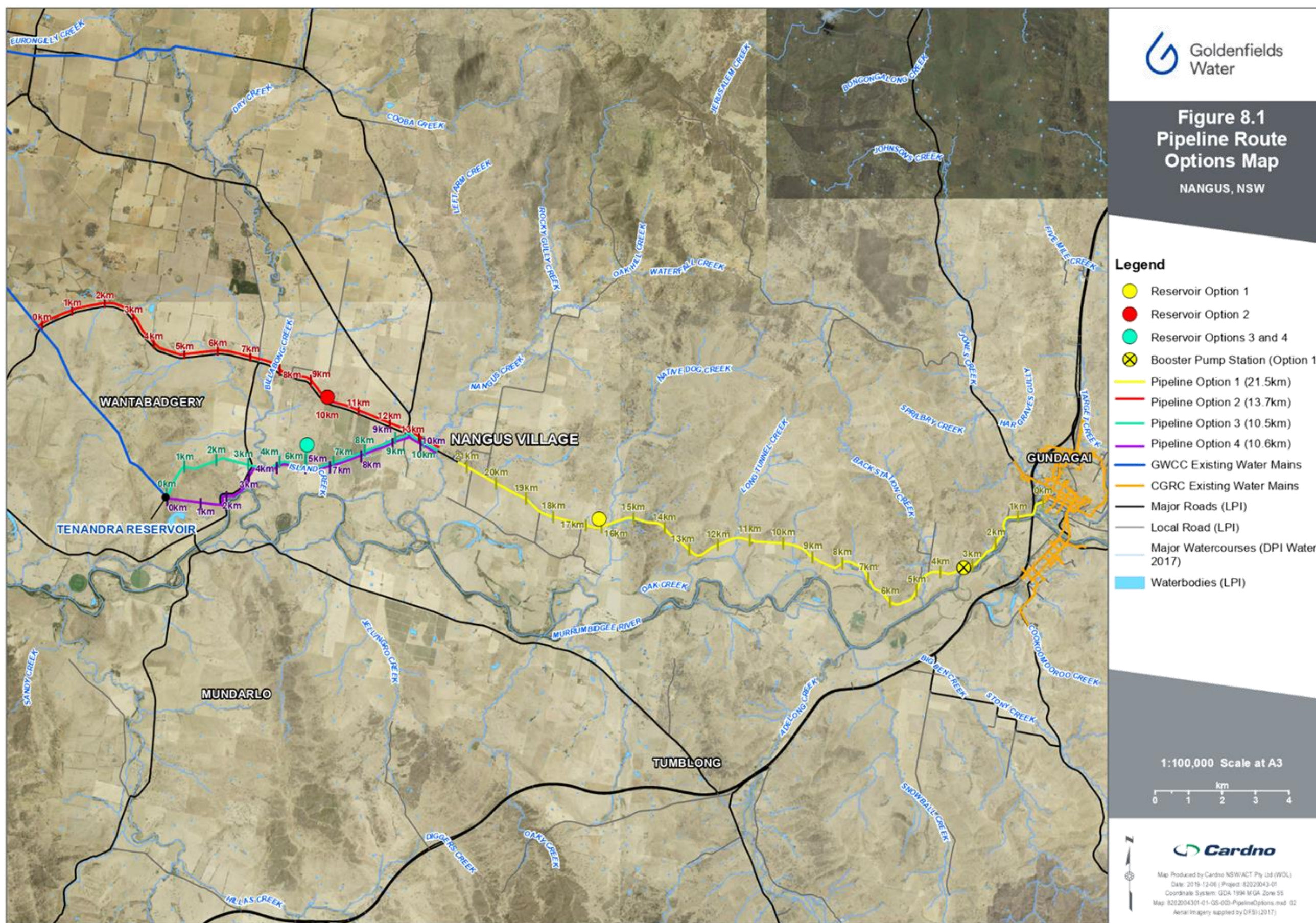




Figure 8-2 Pipeline Route Options Elevation Profile
Note: Nangus is located at distance 0m in the above figure for ease of comparison.





8.4 Option 1: Pipeline from CGRC Water Supply at Gundagai

8.4.1 Description

Option 1 incorporates the supply of potable water from CGRC's water supply in Gundagai to Nangus. Key components of this option include:

- > Connection to the existing CGRC watermain near the intersection Nangus Road and Sheridan Lane in Gundagai.
- > Approximately 16.3 km of DN100 PVC-O pipeline from Gundagai to Nangus reservoir, located to the east of Nangus, as mapped in Appendix A.
- > Booster pump station located at approximately CH3400 to deliver water from Gundagai to Nangus reservoir.
- > Nangus reservoir, with a usable volume of 250 kL.
- > Chlorine dosing facility at Nangus Reservoir to maintain quality.
- > Approximately 5.2 km of DN150 PVC-O pipeline from Nangus reservoir to Nangus.
- > Reticulation (DN100 PVC-O) to service the existing developed area in Nangus.

8.4.2 Preliminary Design and Pipeline Hydraulics

The pipeline connects to CGRC's water network in Gundagai via the existing watermain currently installed in Nangus Road, fronting Lot 11 DP1128590. From the connection point, the pipeline heads west towards Nangus. For the first 3,000 m of the pipe alignment Nangus road is followed closely by the Murrumbidgee River. For parts of this section, the road reserve becomes narrow and steeply battered. Specific consideration into the pipe's constructability through this section would need to be made.

A booster pump station is proposed to be located at CH3400. A pressure boost of approximately 85 m will be required. Existing overhead powerlines are adjacent to Nangus road at this location.

The proposed Nangus reservoir (CH16300) is located on elevated ground approximately 5 km east of Nangus. The reservoir will have a usable volume of 250 kL (three days of storage for the average day demand). This reservoir will be a steel standpipe type reservoir, due to the lack of sufficient ground elevation.

While a chlorine dosing facility has been allowed for at the proposed Nangus reservoir, water quality must comply with ADWG requirements at all locations in the network. There is the potential for chlorine residuals to fall between the chlorine dosing at Nangus reservoir and Nangus, and a secondary chlorination facility may be required downstream in the network to ensure chlorine residuals are maintained at suitable levels.

Refer to Appendix A for further details on the proposed pipe alignment for Option 1. The hydraulic grade line and elevation profile are shown in Figure 8-4.

The reticulation system would consist of DN100 PVC-O, with the extents as shown on Figure 8-3, matching the other options.

The pipeline infrastructure has been sized to convey the Nangus and rural demand MDD to the reservoir as outlined in Table 3-1. From the reservoir to Nangus, the infrastructure has been sized to convey the peak hour demand.

A water pressure of 60 m (or a head of RL 275 m) has been assumed at the point of connection in Gundagai. Actual pressures were not available for the study, so the pressure was estimated using the elevation of the Gundagai reservoirs (approximately RL 295 m) and making an allowance of 20 m headloss between the reservoirs and the connection point. The hydraulics were modelled using Infoworks WSPRO software.

GWCCs preference is for the pipeline to be installed within private property where possible, adjacent to the road reserve. GWCC's recent experience has shown installation in private property provides a more efficient pathway to obtaining environmental approvals than installation within road reserves.



Feasibility Study
Nangus Water Supply

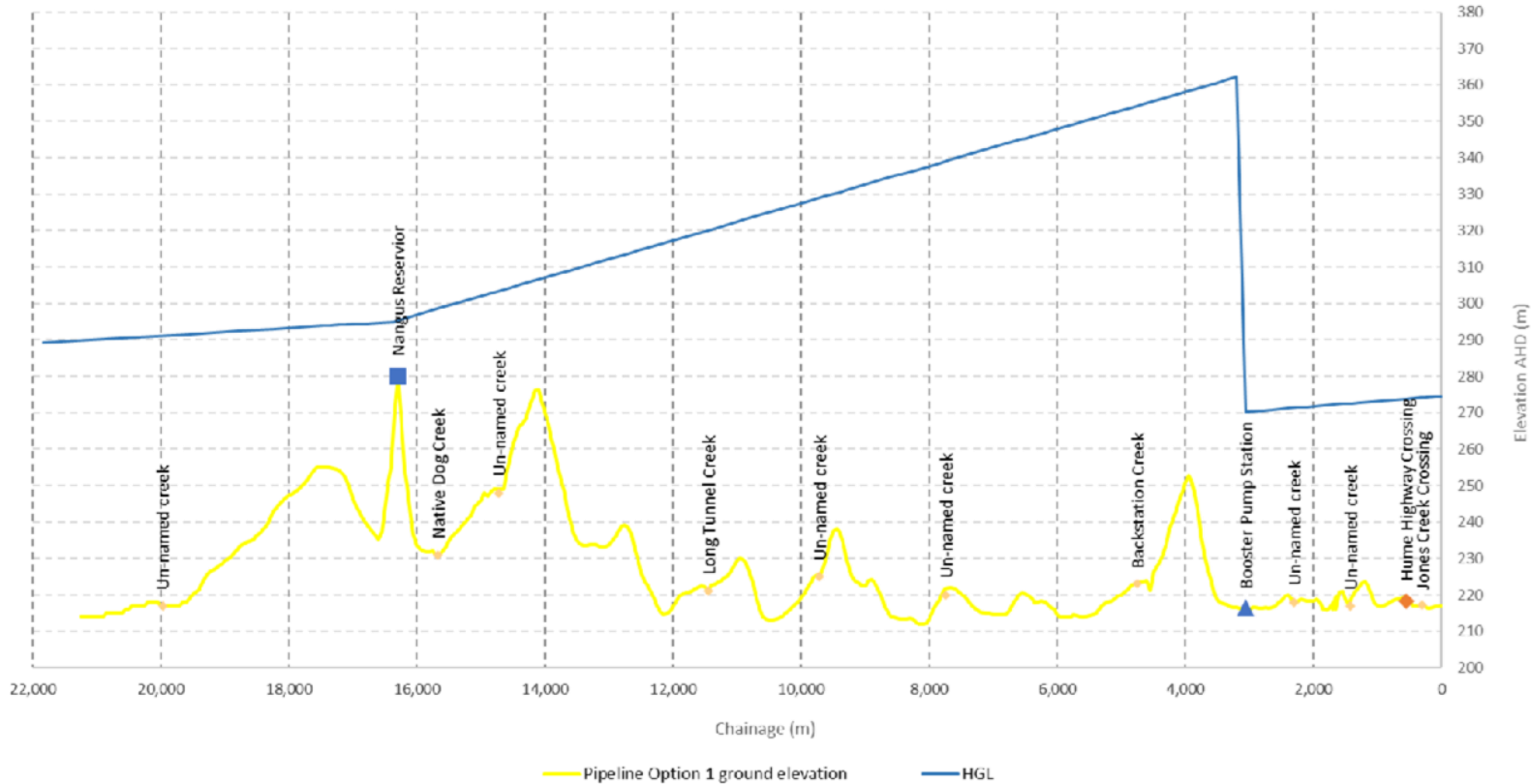


Figure 8-4 Option 1 – Hydraulic Grade & Elevation Profile



The proposed pipe alignment for Option 1 crosses the following watercourses (stream order 3 and higher) as shown on Figure 8-4. Crossing methodologies are also proposed.

- > Jones Creek – attached to bridge.
- > Backstation Creek – attached to bridge.
- > Long Tunnel Creek – open trench.
- > Native Dog Creek – attached to bridge.
- > Six un-named creeks – all open trench.

8.4.3 Environmental Constraints

A desktop review has been undertaken using online resources to provide initial high level advice of the environmental constraints associated with Option 1 which includes biodiversity, heritage, major waterbodies and watercourses, socio-economic considerations, soils and contamination, cumulative impacts and land use and land zoning.

Key features are presented in Appendix B and the findings of the desktop review are discussed below. Database searches were conducted between 20 and 25 November 2019 and are considered accurate at the time of writing. Most of the searches conducted present findings at a scale that does not allow for precise impact assessment, and the constraints would need to be confirmed on-site during future stages of the project in order to determine and either avoid and/or minimise potential impacts. This is particularly the case for heritage items and threatened flora, fauna and vegetation communities where the records reported generally relate to those found within a 10 km search area and/or are recorded imprecisely in public databases.

8.4.3.1 Biodiversity

NSW listed biodiversity constraints

The vegetation communities present in the area are mapped on the vegetation map in Appendix B and a brief description of the constraints is provided below:

- > The area is primarily dominated by non-native vegetation
- > There are eight native vegetation communities present along the alignment of Option 1. These Plant Community Types (PCT's) may be associated with Threatened Ecological Communities (TEC's) protected under the *Biodiversity Conservation Act 2016* (BC Act) as shown in Table 8-1.
- > NSW BioNet Atlas (OEH, 2019c) – a search for threatened species, populations and ecological communities undertaken on 22/11/2019 found 33 listed species under the BC Act recorded within the vicinity of the alignment. The alignment directly impacts on three recorded threatened flora species locations (Bionet, 2019).
- > A search of DPI – Key Fish Habitat found that Option 1 crosses a number of waterbodies that are considered Key Fish Habitat including:
 - Native Dog Creek
 - Backstation Creek
 - Murrumbidgee River
 - Long Tunnel Creek
- > According to the Gundagai LEP, Option 1 will have an impact on areas mapped as 'sensitive land' according to the Natural Resources Sensitivity Biodiversity Map. The objective of the mapped sensitive land is to help maintain terrestrial and aquatic biodiversity.



Table 8-1 State listed vegetation communities and associated BC Act TECs

PCT - ID	PCT	Associated BC Act listed TEC name*	Probable TEC Status*
5	River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.	Not listed under the BC Act	NA
79	River Red Gum Shrub/Grass Riparian Tall Woodland or Open Forest Wetland	** Status of this vegetation under state and federal legislation is currently unknown and should be investigated further in later project development stages.	**
266	White Box Grassy Woodland	White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion	TEC
276	Yellow Box Grassy Tall Woodland	White Box Yellow Box Blakely's Red Gum Woodland	EEC
277	Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	White Box Yellow Box Blakely's Red Gum Woodland	EEC
289	Mugga Ironbark – Inland Scribbly Gum – Red Box Shrub/Grass Open Forest	Not listed under the BC Act	NA
347	White Box – Blakely's Red Gum Shrub/Grass Woodland	White Box Yellow Box Blakely's Red Gum Woodland	EEC
796	Derived Grassland	Listed	EEC

* Derived from the NSW Vegetation Information System (VIS) which allows you to match PCTs with probable TECs.

** Data not available in the VIS.

Federally listed biodiversity constraints

- > NSW BioNet Atlas (OEH, 2019c) – a search for threatened species, populations and ecological communities was undertaken on 22/11/2019 with 9 listed species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) found within the vicinity of this option.
- > A search of the Protected Matters Search Tool (PMST) (Department of Environment and Energy (DOEE), 2019) was undertaken on 22/11/2019. The following Matters of National Environmental Significance (MNES) have been identified within 10 km of this option. Federally listed TEC's have been identified below in Table 8-2.
 - Four Wetlands of International Importance all of which are located approximately 400km – 800km downstream of Option 1.
 - 31 threatened species and 11 migratory species.



Table 8-2 Federally listed TECs

TEC	Status: Endangered (EEC) or Critically Endangered (CEEC)
Grey Box (<i>Eucalyptus microcarpa</i>) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	EEC
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CEEC
Derived Grassland	CEEC

Important conservation tenures

- > Areas of Outstanding Biodiversity Value (AOBV): AOBVs are special areas that contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. Areas of declared critical habitat under the (now repealed) *Threatened Species Conservation Act 1995* (TSC Act) have become the first AOBVs in NSW with the commencement of the new BC Act. A search of the Critical habitat register NSW Office of Environment and Heritage (OEH, 2019a) was conducted on 22/11/2019 and no areas of critical habitat/AOBVs are located within proximity of this option.
- > Option 1 does not impact on any listed National Parks and Wildlife Services (NPWS) reserves and national parks.
- > A search of the Biobanking Public Register (NSW OEH, 2019) was used to search for Biobanking agreements, expressions of interest and statements within the Cootamundra - Gundagai LGA. No Biobanking sites were located within the area of this option.

8.4.3.2 Heritage

8.4.3.2.1 Historic Heritage

Local Heritage

Heritage item '114 – Nangus Station Group' is identified under Gundagai LEP 2011 as a local heritage item and is located approximately 800m south of the alignment of Option 1. There are also 12 locally listed items under the Gundagai LEP 2011 in the township of Gundagai. The alignment does not intersect any of the above mentioned heritage items.

Heritage item '120: War Memorial Nangus' is identified under Gundagai LEP 2011 as a local heritage item, but will not be impacted by the proposed option.

State Heritage

Two State Heritage registered items reside within the town of Gundagai:

- > Gundagai Rail Station and Yard Group
- > Gundagai Rail Bridge

There are also two listed Conservation Areas within the town of Gundagai:

- > Gundagai Rail Station and Yard Group
- > Old Gundagai Town Site

These are items in the vicinity of Option 1 however the option does not have a direct impact on the items.

Federal Heritage

- > A search of the Australian Government's Australian Heritage Database (DoEE, 2019) identified 15 federally listed heritage items within the Cootamundra - Gundagai LGA.
- > The PMST search undertaken on 25/11/2019 found that no World Heritage Properties or National Heritage Places were identified within 10 km of the pipeline route.

A search of the Native Title Register and Native Title Claims Register (Native Title Tribunal, 2019) conducted on 25/11/2019 returned no records within the Cootamundra – Gundagai LGA.



8.4.3.2.2 Aboriginal Heritage

A search of the AHIMS register (NSW OEH, 2019d) on 25/11/2019 identified 56 Aboriginal sites and 0 (zero) Aboriginal places within the vicinity of Option 1. The search does not identify the precise locations of the sites and Aboriginal heritage constraints would be subject to confirmation during future project stages.

8.4.3.3 Hydrology, Water Quality and Groundwater

The hydrological, water quality and groundwater related features associated with this option are shown on the Hydrology figure in Appendix B.

- > From east to west, the proposed Option 1 would traverse:
 - Jones Creek
 - Backstation Creek
 - Long Tunnel Creek
 - Native Dog Creek
 - Unnamed drainage channels
- > Waterways range in size and, under the Strahler stream order system, are classified as ranging from major order streams (Murrumbidgee River) to third order watercourses (Department of Primary Industries (DPI) Water, 2017).
- > The Murrumbidgee River is mapped as Key Fish Habitat (DPI Water, 2017).
- > While works will be within 40m of these watercourses, a controlled activity approval under the Water Management Act 2000 (WM Act) is not required as the works would be undertaken by a public authority.
- > Creek crossings would need to be designed to be sensitive to the biodiversity values present at site.
- > Groundwater Dependent Ecosystems (GDE) are aquatic and terrestrial ecosystems which are sustained, to a degree, by groundwater. The named waterways crossed by the pipeline which are listed as low potential GDE. Option 1 also runs near the Murrumbidgee River which has been classified as having a high potential GDE (Bureau of Meteorology (BOM), 2019).
- > The pipeline would cross areas mapped as 'sensitive land' according to Gundagai LEP.
- > There are numerous groundwater bores along Option 1 pipeline route, with a number of them being approximately 50m from the proposed alignment. It is not expected that the pipeline would have any impact on the bores as the alignment could be set to avoid them.
- > According to the Australian Flood Study Database, there have been three studies conducted surrounding the Murrumbidgee River and surrounds. The studies include:
 - Gundagai Flood Scoping Study – 2013
 - Oura to Braehour Flood Model Extension – 2011
 - Murrumbidgee River Flood Modelling

A thorough investigation into these studies will help shape future stages of the proposed development.

8.4.3.4 Soil and Contamination

- > Soils present within the area are shown on the Soils figure in Appendix B.
- > Option 1 traverses multiple different soil classes including:
 - Kurosols
 - Kandosols
 - Rudosols (Aluvial)
 - Sodosols
- > Soil is not mapped as saline land in the DPE (2019) mapping.

A search of the OEH Contaminated Land Record and the Protection of the Environment Operation (POEO) Act Public Register of Licences was undertaken on 24/11/2019. The search highlighted 6 locations where a POEO License has been issued in the town of Gundagai. The listed locations of issued licences are not



impacted by Option 1. There are no known contaminated sites listed on the OEH Contaminated Land Register. This does not mean there is no contaminated land on site as not all contaminated areas have been recorded and constraints would need to be confirmed in future project stages.

8.4.3.5 Socio-economic, Land Use and Zoning

- > The majority of Option 1 alignment is within land zoned RU1 – Primary Production (see the land use and zoning map in Appendix B) however part of the pipeline route extends into land zoned RU5 – Village and SP3 – Tourist.
- > The pipeline option traversed across private properties in multiple locations.
- > The PMST search identified 1 potential area of Commonwealth Land protected under the EPBC Act within 10km of this option. The precise location of this land parcel will need to be confirmed in future investigations with impacts to these areas avoided and/or minimised where possible. If the project is likely to have a significant impact on Commonwealth land it may require referral to DoEE under the EPBC Act.
- > Socio-economic considerations relevant to this option include:
 - Potential adverse impacts on private properties during pipeline installation
 - Positive impacts associated with securing a water supply for Nangus.

8.4.3.6 Cumulative Impacts

The potential for cumulative impacts was considered through review of the Major Projects Register which identifies major projects proposed, under assessment or approved (including State Significant Development (SSD) and State Significant Infrastructure (SSI) projects). The register was searched for Cootamundra - Gundagai LGA and one major project was identified (the Adjungbilly Wind Farm), however the project is not in close proximity to this option and is therefore unlikely to generate cumulative impacts

Cootamundra – Gundagai Regional Council Development Application (DA) Tracking portal for Cootamundra - Gundagai LGA was accessed on 25 November 2019 to check for any development that may impact on the proposed pipeline option. The search included results from January 2019 through to June 2019 and concluded that there are no relevant DA Applications that will have an influence on the proposed project. It is noted that this search was not comprehensive and local developments should be checked as part of future project stages.

8.4.3.7 Summary of Environmental Constraints & Approval Pathway

Summary

The key environmental constraints related to Option 1 are the biodiversity and heritage constraints identified above. A more detailed assessment of the final alignment during future stages of the development will allow for avoidance or minimisation of potential impacts identified above. Impacts on other matters can generally be managed through careful construction management processes developed at future construction stages of development. Impacts to private property will also need to be minimised where possible with appropriate consultation with interested stakeholders and impacted community members where necessary.

The location and extent of all constraints, but in particular the biodiversity and heritage constraints, will need to be confirmed in future stages of the project through on-ground surveys and research. Significant impacts to biodiversity can trigger the need for an Environmental Impact Statement (EIS) under Part 5, Division 5.1, Subdivision 3 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Significant impacts to Commonwealth listed threatened entities or Commonwealth land can trigger the need for a referral to the Federal Government and assessment under the EPBC Act. If an EIS becomes necessary due to unavoidable impacts, the project approval timeframes and budgets allocated could be substantially increased. From this high level desktop constraints analysis, and given the proposed pipeline route could be developed to avoid or minimise such impacts, it is considered unlikely that the proposed alignment would have a significant impact on biodiversity and/or Commonwealth matters. This would need to be confirmed during future stages of the project as the constraints analysis is high level and the design is at a preliminary stage.

Initial approval pathway advice

The project will need assessment under the EP&A Act. State Environmental Planning Policy (SEPPs) guide the approval pathways under the EP&A Act.

The initial approval pathway will be assessed under the State Environmental Planning Policy (Infrastructure) 2001 (ISEPP), as the pipeline and associated ancillary structures is considered a "water reticulation system".



Under Clause 125(1) of ISEPP, development for the purpose of a water reticulation system (including reservoirs) may be carried out by or on behalf of a public authority without consent on any land. As the pipeline project would be undertaken by GWCC or CGRC (both public authorities) the proposal would be permissible without consent, and therefore it is currently anticipated that the applicable approval pathway is via a Review of Environmental Factors under Part 5 of the EP&A Act.

Clause 14(1) of the State and Regional Development SEPP states that development for the purpose of water storage facilities that has a capital investment value of more than \$30 million would be subject to a more intense approvals pathway which may trigger the need for an Environmental Impact Statement.

The approval pathway will need to be confirmed and will be dependent on confirmation of pipeline alignment and potential impacts which will be confirmed at later stages of the project. This will involve specialist studies and on-ground surveys to confirm environmental constraints, confirmation of land use and applicability of Part 5 provisions, confirmation of capital investment value and consideration of 'significant impacts' on the environment which could trigger the need for an EIS.

8.4.4 Cost Estimate

The estimated capital cost for Option 1 is \$4.56 million, excluding GST. A detailed breakdown of this estimate is provided in Appendix E. See Section 5.1 for a description of the inclusions and methodology for cost estimates.

8.4.5 Multi-criteria Analysis and Risk Assessment

MCA scoring (as per the template in Table 5-1), and a discussion on the risks related to each parameter are given in Table 8-3.



Table 8-3 Option 1 – Multi-Criteria Analysis

No.	Criteria	Weighting	Score	Discussion
1	Security of Supply Consider the security of the water supply and the impact/risks of prolonged drought.	20%	10	<ul style="list-style-type: none"> It is assumed that CGRC's Gundagai water supply will meet or exceed the 5/10/10 rule. Water is sourced from the Murrumbidgee Regulated Water Source, and has a high level of security.
2	Water Quality - Health Consider the reliability and risks to water quality with regard to health criteria.	15%	8	<ul style="list-style-type: none"> It is assumed that water supplied by CGRC's Gundagai water supply network will meet the ADWG health requirements. Chlorine dosing facility to be provided at Nangus reservoir to maintain residual. Nangus reservoir is proposed to be a standpipe type to gain the required elevation. A significant dead volume of water will be stored in the reservoir, increasing water age. Potential for chlorine residuals to fall between chlorine dosing at Nangus reservoir and Nangus, which would necessitate an additional chlorine dosing facility.
3	Water Quality - Aesthetic Consider the reliability and risks to water quality with regard to aesthetic criteria.	10%	10	<ul style="list-style-type: none"> It is assumed that water supplied by CGRC's Gundagai water supply network will meet the ADWG aesthetic requirements.
4	Operational Risk Consider the consequence of failure with regards to operator safety, community safety, scheme complexity, time needed to reinstate supply and resourcing risk.	15%	7	<ul style="list-style-type: none"> Proposed infrastructure (pipeline, booster pump station and chemical dosing facility) considered familiar to operators. Pump station required for Option 1 (no pump station required for other pipeline options). Potential point of failure. Longest pipeline option – more potential failure points. Majority of infrastructure will be located close to roads – easy access. In the event of a prolonged failure of the pipeline water may be carted from Gundagai or GWCC to the Nangus reservoir. Materials readily available and close by in case of repair.
5	Constructability Consider the ability to construct each option, including safety, availability of materials, availability of suitably qualified contractors, ground conditions, impact on existing services, access etc.	15%	7	<ul style="list-style-type: none"> Mostly conventional construction methods – open trenching. No specialised materials. Many experienced contractors available for this type of work. Similar works are currently being undertaken at other locations across NSW. The ability to swiftly construct water pipelines similar to this project has been proven at other sites in NSW. Due consideration to be made for steep batters and narrow road reserve along alignment, particularly near the Hume Highway crossing. Terrain considered generally suitable for pipeline installation works. Some constructability risk related to unknown geotechnical conditions. Ten creek crossings to be suspended from bridge, open trench or directional drilled.
6	Project Definition Risk Consider risk associated with level of definition and potential for currently unknown issues to impact schedule and budget.	10%	7	<ul style="list-style-type: none"> Geotechnical conditions unknown, however, the pipeline can be installed at minimum depth and rock is not considered to be a significant risk. Some unknown issues around pressure at the point of connection at Gundagai and the ability of the Gundagai network to deliver the required flow rate to the connection point.



Feasibility Study
Nangus Water Supply

No.	Criteria	Weighting	Score	Discussion
				<ul style="list-style-type: none"> Ability to mount pipeline on bridges (proposed at three locations) is not known. Underboring or open trenching are alternatives.
7	Heritage, Environment and Approvals Consider environmental and heritage impacts and risks and the risk associated with obtaining approvals.	15%	7	<ul style="list-style-type: none"> Avoidance of impacts to known state and federally listed TEC's and threatened species is likely to be possible. Waterway crossings will need to be sensitively designed to have minimal impact on the waterways. Impacts to indigenous heritage and a more accurate and verified survey of the land is needed for future project development. Obtaining easements for installation of the pipeline within private property presents a possible project delivery risk. However, experience has shown that use of private property can avoid delays due to environmental approvals for installation in the road reserve. The majority of the pipeline will be installed adjacent to the road reserve, so if significant barriers to implementing easement at certain locations are encountered, diverting to the road reserve will provide an alternative. Environmental approvals unlikely to significantly delay the project as careful route selection should allow avoidance of impacts.
	Total	100%	8.1	



8.5 Option 2: Pipeline from GWCC Water Supply – from Oura Road

8.5.1 Description

Option 2 incorporates the supply of potable water from GWCC's Oura Water Supply Scheme. This option would see the supply of water via a pipeline built along Oura Road from an existing DN300 CI watermain to the township of Nangus.

Key components of this option include:

- > Connection to the existing DN300 CI rising / gravity main operating between Marina Reservoir and the Tenandra Reservoir.
- > Pressure reducing valve (PRV).
- > Approximately 9.8 km of PN35 DN100 DI pipeline from the existing network to Nangus reservoir, located west of Nangus.
- > Nangus reservoir, with a usable volume of 250 kL.
- > Chlorine dosing facility at Nangus reservoir to maintain quality.
- > Approximately 3.9 km of DN150 PVC-O pipeline from Nangus reservoir to Nangus.
- > Reticulation (DN100 PVC-O) to service the existing developed area in Nangus.

8.5.2 Preliminary Design and Pipeline Hydraulics

The pipeline connects to GWCC's Oura Water supply scheme via an existing DN300 CI watermain that Crosses Nangus Road and fronts Lot 2 DP541744. From the connection point, the pipeline heads east towards Nangus.

A PRV will be located near the connection to reduce the pressure to that required to convey the water to Nangus.

The proposed Nangus reservoir (CH9770) is located on elevated ground approximately 4 km east of Nangus. The reservoir will have a usable volume of 250 kL (three days of storage for the average day demand). A concrete reservoir is proposed.

While a chlorine dosing facility has been allowed for at the proposed Nangus reservoir, water quality must comply with ADWG requirements at all locations in the network. There is the potential for chlorine residuals to fall between the chlorine dosing at Nangus reservoir and Nangus, and a secondary chlorination facility may be required downstream in the network to ensure chlorine residuals are maintained at suitable levels.

Refer to Appendix A for further details on the proposed pipe alignment for Option 2. The hydraulic grade line and elevation profile are shown in Figure 8-5.

The reticulation system would consist of DN100 PVC-O, with the extents as shown on Figure 8-3, matching the other options.

The pipeline infrastructure has been sized to convey the Nangus and rural demand MDD to the reservoir as outlined in Table 3-1. From the reservoir to Nangus, the infrastructure has been sized to convey the peak hour demand.

GWCC's preference is for the pipeline to be installed within private property where possible, adjacent to the road reserve. GWCC's recent experience has shown installation in private property provides a more efficient pathway to obtaining environmental approvals than installation within road reserves.

The proposed pipe alignment for Option 2 crosses the following watercourses (stream order 3 and higher) as shown on Figure 8-5. Crossing methodologies are also proposed.

- > Billabong Creek – attached to bridge.
- > Nangus Creek – attached to bridge.
- > Four un-named creeks – all open trench.

The model of the existing GWCC network was also analysed to determine any impacts due to the Nangus supply. No significant impacts were observed and it is therefore considered that no upgrade to the existing network will be required to supply Nangus on the basis of the additional demand. However, as noted in Section 6, future investigations should include consideration of the condition of these existing assets, and what renewals may be necessary to ensure reliability of supply.

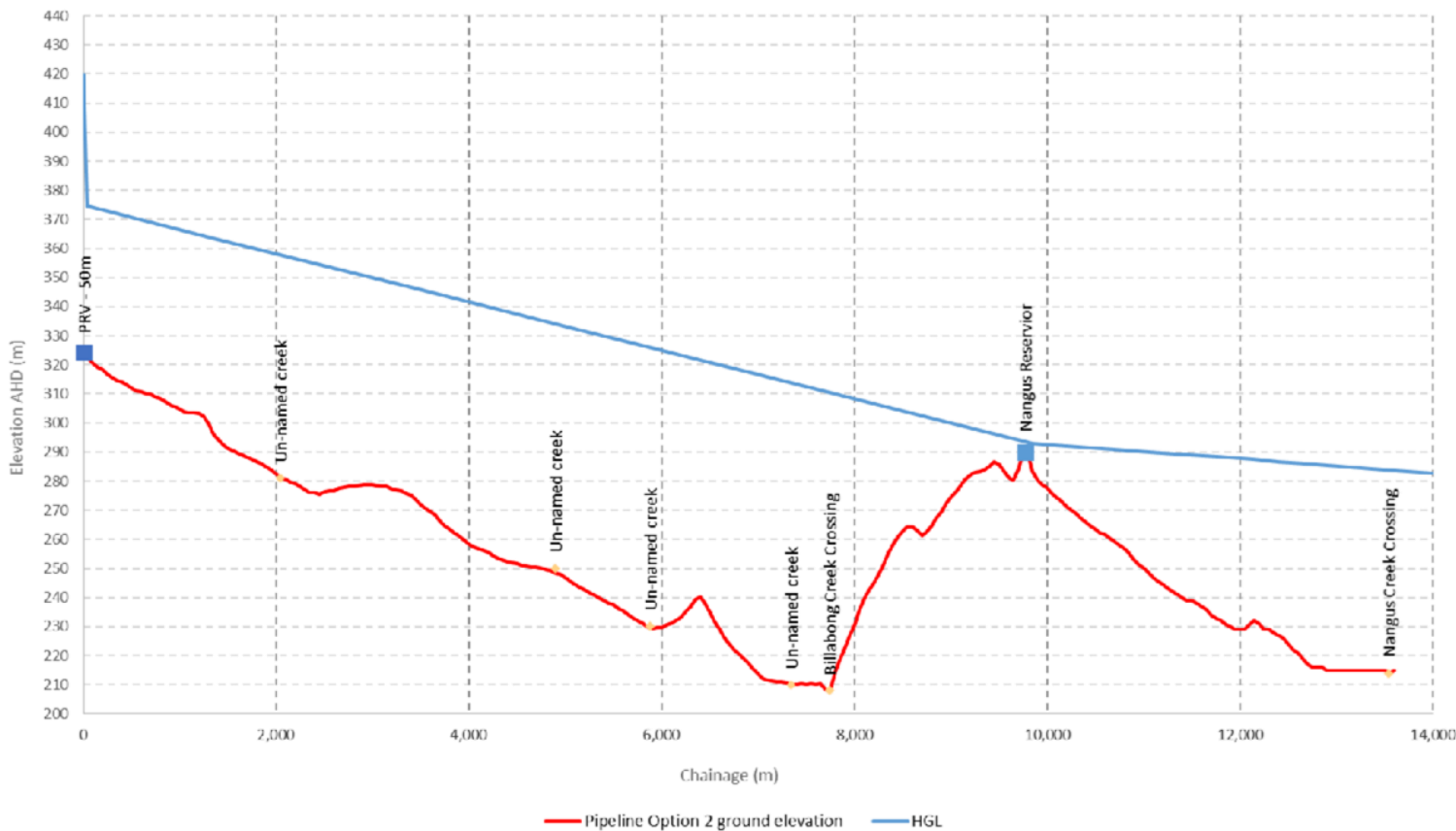


Figure 8-5 Option 2 – Hydraulic Grade & Elevation Profile



As noted in Section 6, the MDD and annual demand on the Oura WTP are projected to be 30.2 ML/d and 4,600 ML/y respectively by 2048 (without the Nangus supply). Supply of water to Nangus would equate to an additional 1.7% to the MDD and 0.8% to the annual demand.

8.5.3 Environmental Constraints

A desktop review has been undertaken using online resources to provide initial high level advice of the environmental constraints associated with Option 2 which includes biodiversity, heritage, major waterbodies and watercourses, socio-economic considerations, soils and contamination, cumulative impacts and land use and land zoning.

Key features are presented in Appendix B and the findings of the desktop review are discussed below. Database searches were conducted between 20 and 25 November 2019 and are considered accurate at the time of writing. Most of the searches conducted present findings at a scale that does not allow for precise impact assessment, and the constraints would need to be confirmed on-site during future stages of the project in order to determine and either avoid and/or minimise potential impacts.

This is particularly the case for heritage items and threatened flora, fauna and vegetation communities where the records reported generally relate to those found within a 10 km search area and/or are recorded imprecisely in public databases.

8.5.3.1 Biodiversity

NSW listed biodiversity constraints

The vegetation communities present in the area are mapped on the vegetation map in Appendix B and a brief description of the constraints is provided below:

- > The area is primarily dominated by non-native vegetation
- > There are three native vegetation communities present along the alignment of Option 2. These PCT's may be associated with TEC's protected under the BC Act as shown in Table 8-4.

Table 8-4 State listed vegetation communities and associated BC Act TECs

PCT - ID	PCT	Associated BC Act listed TEC name*	Probable TEC Status*
79	River Red Gum Shrub/Grass Riparian Tall Woodland or Open Forest Wetland	** Status of this vegetation under state and federal legislation is currently unknown and should be investigated further in later project development stages.	**
266	White Box Grassy Woodland	White Box Yellow Box Blakely's Red Gum Woodland	EEC
277	Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	White Box Yellow Box Blakely's Red Gum Woodland	EEC

* Derived from the NSW Vegetation Information System (VIS) which allows you to match PCTs with probable TECs.

** Data not available in the VIS.

- > NSW BioNet Atlas (OEH, 2019c) – a search for threatened species, populations and ecological communities was undertaken on 22/11/2019 with 22 listed species under the BC Act were recorded within the vicinity of the alignment. The alignment directly impacts on four recorded threatened flora species locations (Bionet, 2019).
- > A search of DPI – Key Fish Habitat found that Option 2 crosses two waterbodies that are considered Key Fish Habitat including:
 - Nangus Creek
 - Billabong Creek
- > According to the Gundagai LEP and Junee LEP, Option 2 will have an impact on areas mapped as 'sensitive land' according to the Natural Resources Sensitivity Biodiversity Map. The objective of the mapped sensitive land is to help maintain terrestrial and aquatic biodiversity.



Federally listed biodiversity constraints

- > NSW BioNet Atlas (OEH, 2019c) – a search for threatened species, populations and ecological communities was undertaken on 22/11/2019 with 5 listed species under the *EPBC Act* within the vicinity of the alignment.
- > A search of the PMST (DoEE, 2019) was undertaken on 22/11/2019. The following MNES have been identified within 10km of this option. Federally listed TEC's have been identified below in Table 8-5:
 - 4 Wetlands of International Importance all of which are located approximately 400km – 800km downstream of Option 2.
 - 30 threatened species and 11 migratory species

Table 8-5 Federally listed TECs

TEC	Status: Endangered (EEC) or Critically Endangered (CEEC)
Grey Box (<i>Eucalyptus microcarpa</i>) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	EEC
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CEEC

Important conservation tenures

- > Areas of Outstanding Biodiversity Value (AOBV): AOBVs are special areas that contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. Areas of declared critical habitat under the TSC Act have become the first AOBVs in NSW with the commencement of the new BC Act. A search of the Critical habitat register NSW Office of Environment and Heritage (OEH, 2019a) was conducted on 22/11/2019 and no areas of critical habitat/AOBVs are located within proximity of this option.
- > Option 2 does not impact on any listed National Parks and Wildlife Services (NPWS) reserves and national parks.
- > A search of the Biobanking Public Register (NSW OEH, 2019) was used to search for Biobanking agreements, expressions of interest and statements within the Cootamundra - Gundagai LGA and Junee LGA. No Biobanking sites were located within the area of this option.

8.5.3.2 Heritage

8.5.3.2.1 Historic heritage

Local Heritage

There is one heritage item identified under the Gundagai LEP 2011 in proximity to the proposed option (and none under the Junee LEP 2012).

- > I20: War Memorial Nangus – located on the outskirts of the town of Nangus

The abovementioned locally listed heritage item will not be impacted by the proposed option.

State Heritage

There are no State Heritage Register listed heritage items within proximity of Option 2.

Federal Heritage

- > A search of the Australian Government's Australian Heritage Database (DoEE, 2019) identified 15 federally listed heritage items within the Cootamundra - Gundagai LGA.
- > A search of the Australian Government's Australian Heritage Database (DoEE, 2019) identified 14 federally listed heritage items within the Junee LGA.
- > The PMST search undertaken on 25/11/2019 found that no World Heritage Properties or National Heritage Places were identified within 10 km of the pipeline route.

A search of the Native Title Register and Native Title Claims Register (Native Title Tribunal, 2019) conducted on 25/11/2019 returned no records within the Cootamundra – Gundagai LGA and Junee Shire Council LGA.



8.5.3.2.2 Aboriginal Heritage

A search of the AHIMS register (NSW OEH, 2019d) on 25/11/2019 identified 7 Aboriginal sites and 0 (zero) Aboriginal places within the vicinity of Option 2. The search does not identify the precise locations of the sites and Aboriginal heritage constraints would be subject to confirmation during future project stages.

8.5.3.3 Hydrology, Water Quality and Groundwater

The hydrological, water quality and groundwater related features associated with this option are shown on the Hydrology figure in Appendix B.

- > From east to west, the proposed Option 2 would traverse:
 - Nangus Creek
 - Billabong Creek
- > Waterways range in size and under the Strahler stream order system are classified as ranging from fifth order streams to third order watercourses (DPI Water, 2017).
- > The Murrumbidgee River is mapped as Key Fish Habitat (DPI Water, 2017).
- > While works will be within 40m of these watercourses, a controlled activity approval under the Water Management Act 2000 (WM Act) is not required as the works would be undertaken by a public authority.
- > Creek crossings would need to be designed to be sensitive to the biodiversity values present at site.
- > Groundwater Dependent Ecosystems (GDE) are aquatic and terrestrial ecosystems which are sustained, to a degree, by groundwater. Two named waterways are crossed by the pipeline (Nangus Creek and Billabong Creek) which are listed as moderate potential GDE (BOM, 2019).
- > The pipeline would cross areas mapped as 'sensitive land' according to Gundagai LEP 2011 and within Groundwater Vulnerable areas mapped in Junee LEP 2012.
- > In the vicinity of Option 2, there are a number of groundwater bore locations. The eastern extent of the alignment in Nangus Village has a large number of bores within 50m of the alignment. It is not expected that the pipeline would have any impact on the bores as the alignment could be set to avoid them.
- > According to the Australian Flood Study Database, there have been three studies conducted surrounding the Murrumbidgee River and surrounds. The studies include:
 - Gundagai Flood Scoping Study – 2013
 - Oura to Braehour Flood Model Extension – 2011
 - Murrumbidgee River Flood Modelling

A thorough investigation into these studies will help shape future stages of the proposed development.

8.5.3.4 Soil and Contamination

- > Soils present within the area are shown on the Soils figure in Appendix B.
- > Option 2 traverses multiple different soil classes including:
 - Kurosols
 - Kandosols
- > Option 2 passes through soils that are identified as saline land according to the DPE (2019) mapping.

A search of the OEH Contaminated Land Record and the Protection of the Environment Operation (POEO) Act Public Register of Licences was undertaken on 24/11/2019. The search highlighted 22 locations where a POEO License has been issued in Cootamundra – Gundagai LGA and 4 issued in Junee LGA. The listed locations of issued licences are not impacted by Option 2. There are no known contaminated sites listed on the OEH Contaminated Land Register in the vicinity of Option 2. This does not mean there is no contaminated land on site as not all contaminated areas have been recorded and constraints would need to be confirmed in future project stages.



8.5.3.5 Socio-economic, Land Use and Zoning

- > The majority of Option 2 alignment is within land zoned RU1 – Primary Production land zoning (see the land use and zoning map in Appendix B).
- > This option traverses both Junee LGA and Cootamundra – Gundagai LGA
- > The pipeline option traversed across private properties in multiple locations.
- > The PMST search identified 1 potential area of Commonwealth Land protected under the EPBC Act within 10 km of this option. The precise location of this land parcel will need to be confirmed in future investigations with impacts to these areas avoided and/or minimised where possible. If the project is likely to have a significant impact on Commonwealth land it may require referral to DoEE under the EPBC Act.
- > Socio-economic considerations relevant to this option include:
 - Potential adverse impacts on private properties during pipeline installation
 - Positive impacts associated with securing a water supply for Nangus.

8.5.3.6 Cumulative Impacts

The potential for cumulative impacts was considered through review of the Major Projects Register which identifies major projects proposed, under assessment or approved (including State Significant Development (SSD) and State Significant Infrastructure (SSI) projects) either under assessment or approved. The register was searched for Cootamundra - Gundagai LGA and Junee LGA. Three major projects were identified (the Adjungbilly Wind Farm, Sebastopol Solar and Young to Wagga Looping Pipeline), however the projects are not in close proximity to Option 2 and is therefore unlikely to generate cumulative impacts.

Cootamundra – Gundagai Regional Council DA Tracking portal for Gundagai LGA was accessed on 25 November 2019 to check for any development that may impact on the proposed pipeline option. The search included results from January 2019 through to June 2019 and concluded that there are no relevant DA Applications that will have an influence on the proposed project.

Junee Council DA Tracking portal for Junee LGA was accessed on 25 November 2019 to check for any development that may impact on the proposed pipeline option. The search included results from October 2019 through to November 2019 and concluded that there are no relevant DA Applications that will have an influence on the proposed project.

It is noted that this search was not comprehensive and local developments should be checked as part of future project stages.

8.5.3.7 Summary of Environmental Constraints & Approval Pathway

Summary

The key environmental constraints related to pipeline Option 2 are the biodiversity and heritage constraints identified above. A more detailed assessment of the final alignment during future stages of the development will allow for avoidance or minimisation of potential impacts identified above. Impacts on other matters can generally be managed through careful construction management processes developed at future construction stages of development. Impacts to private property will also need to be minimised where possible with appropriate consultation with interested stakeholders and impacted community members where necessary.

The location and extent of all constraints, but in particular the biodiversity and heritage constraints, will need to be confirmed in future stages of the project through on-ground surveys and research. Significant impacts to biodiversity can trigger the need for an Environmental Impact Statement (EIS) under Part 5, Division 5.1, Subdivision 3 of the EP&A Act. Significant impacts to Commonwealth listed threatened entities or Commonwealth land can trigger the need for a referral to the Federal Government and assessment under the EPBC Act. If an EIS becomes necessary due to unavoidable impacts, the project approval timeframes and budgets allocated could be substantially increased. From this high level desktop constraints analysis, and given the proposed pipeline route could be developed to avoid or minimise such impacts, it is considered unlikely that the proposed alignment would have a significant impact on biodiversity and/or Commonwealth matters. This would need to be confirmed during future stages of the project as the constraints analysis is high level and the design is at a preliminary stage.

Initial approval pathway advice

The project will need assessment under the EP&A Act. State Environmental Planning Policy (SEPPs) guide the approval pathways under the EP&A Act.



The initial approval pathway will be assessed under the State Environmental Planning Policy (Infrastructure) 2001 (ISEPP), as the pipeline and associated ancillary structures is considered a "water reticulation system". Under Clause 125(1) of ISEPP, development for the purpose of a water reticulation system (including reservoirs) may be carried out by or on behalf of a public authority without consent on any land. As the pipeline project would be undertaken by GWCC or CGRC (both public authorities) the proposal would be permissible without consent, and therefore it is currently anticipated that the applicable approval pathway is via a Review of Environmental Factors under Part 5 of the EP&A Act. Clause 14(1) of the State and Regional Development SEPP states that development for the purpose of water storage facilities that has a capital investment value of more than \$30 million would be subject to a more intense approvals pathway which may trigger the need for an Environmental Impact Statement.

The approval pathway will need to be confirmed and will be dependent on confirmation of pipeline alignment and potential impacts which will be confirmed during future stages of the project. This will involve specialist studies and on-ground surveys to confirm environmental constraints, confirmation of land use and applicability of Part 5 provisions, confirmation of capital investment value and consideration of 'significant impacts' on the environment which could trigger the need for an EIS.

8.5.4 Cost Estimate

The estimated capital cost for Option 2 is \$3.26 million, excluding GST. A detailed breakdown of this estimate is provided in Appendix E. See Section 5.1 for a description of the inclusions and methodology for cost estimates.

8.5.5 Multi-criteria Analysis and Risk Assessment

MCA scoring (as per the template in Table 5-1), and a discussion on the risks related to each parameter are given in Table 8-6.



Table 8-6 Option 2 – Multi-Criteria Analysis

No.	Criteria	Weighting	Score	Discussion
1	Security of Supply Consider the security of the water supply and the impact/risks of prolonged drought.	20%	10	<ul style="list-style-type: none"> It is assumed that GWCC's Oura water supply network will meet or exceed the 5/10/10 rule. Water is sourced from the Murrumbidgee Regulated Water Source, and has a high level of security.
2	Water Quality - Health Consider the reliability and risks to water quality with regard to health criteria.	15%	9	<ul style="list-style-type: none"> It is assumed that water supplied by GWCC's Oura water supply network will meet the ADWG health requirements. Chlorine dosing facility to be provided at Nangus reservoir to maintain residual. Potential for chlorine residuals to fall between chlorine dosing at Nangus reservoir and Nangus, which would necessitate an additional chlorine dosing facility.
3	Water Quality - Aesthetic Consider the reliability and risks to water quality with regard to asthenic criteria.	10%	10	<ul style="list-style-type: none"> It is assumed that water supplied by GWCC's Oura water supply network will meet the majority of current ADWG aesthetic requirements.
4	Operational Risk Consider the consequence of failure with regards to operator safety, community safety, scheme complexity, time needed to reinstate supply and resourcing risk.	15%	9	<ul style="list-style-type: none"> Operation and maintenance of pipeline, PRV, reservoir and chemical dosing facility considered familiar to operators. Majority of infrastructure will be located close to roads – easy access. In the event of a prolonged failure of the pipeline water may be carted from Gundagai or GWCC to the Nangus reservoir. Materials readily available and close by in case of repair.
5	Constructability Consider the ability to construct each option, including safety, availability of materials, availability of suitably qualified contractors, ground conditions, impact on existing services, access etc.	15%	9	<ul style="list-style-type: none"> Mostly conventional construction methods – open trenching. No specialised materials. Many experienced contractors available for this type of work. Similar works are currently being undertaken at other locations across NSW. The ability to swiftly construct water pipelines similar to this project has been proven at other sites in NSW. Terrain considered favorable for pipeline installation works. Some constructability risk related to unknown geotechnical conditions. Six creek crossings to be suspended from bridge, open trenching or directional drilled.
6	Project Definition Risk Consider risk associated with level of definition and potential for currently unknown issues to impact schedule and budget.	10%	9	<ul style="list-style-type: none"> Geotechnical conditions unknown, however, the pipeline can be installed at minimum depth and rock is not considered to be a significant risk. Ability to mount pipeline on bridges (proposed at two locations) is not known. Underboring or open trenching are alternatives.
7	Heritage, Environment and Approvals Consider environmental and heritage impacts and risks and the risk associated with obtaining approvals.	15%	8	<ul style="list-style-type: none"> Avoidance of impacts to known state and federally listed TEC's and threatened species is likely to be possible. Waterway crossings will need to be sensitively designed to have minimal impact on the waterways. Impacts to indigenous heritage and a more accurate and verified survey of the land is needed for future project development.

Feasibility Study
Nangus Water Supply

No.	Criteria	Weighting	Score	Discussion
				<ul style="list-style-type: none">▪ Obtaining easements for installation of the pipeline within private property presents a possible project delivery risk. However, experience has shown that use of private property can avoid delays due to environmental approvals for installation in the road reserve. The majority of the pipeline will be installed adjacent to the road reserve, so if significant barriers to implementing easement at certain locations are encountered, diverting to the road reserve will provide an alternative.▪ Environmental approvals unlikely to significantly delay the project as careful route selection should allow avoidance of impacts.
Total		100%	9.2	



8.6 Option 3: Pipeline from GWCC water supply – from Tenandra Reservoirs following new route

8.6.1 Description

Option 3 incorporates the supply of potable water from GWCC's Oura Water Supply Scheme. This option would see the supply of water via a pipeline built from the existing Tenandra Reservoirs to the township of Nangus.

Key components of this option include:

- > Connection to the existing Tenandra Reservoirs outlet pipeline.
- > Approximately 2.7 km of PN35 DN100 DI pipeline from the Tenandra Reservoirs to a PRV, located near River Road.
- > A PRV located near River Road.
- > Approximately 2.8 km of PN35 DN100 DI from the PRV to Nangus reservoir.
- > Nangus reservoir, with a usable volume of 250 kL.
- > Chlorine dosing facility at Nangus reservoir to maintain quality.
- > Approximately 5.0 km of DN150 PVC-O pipeline from Nangus reservoir to Nangus.
- > Reticulation (DN100 PVC-O) to service the existing developed area in Nangus.

8.6.2 Preliminary Design and Pipeline Hydraulics

The pipeline connects to GWCC's Oura Water supply scheme at the Tenandra Reservoirs located in Lot 1 DP172773, before heading east towards Nangus. The alignment for pipeline Option 3 primarily follows the top of natural ridge lines, fence lines, Island Creek and local access roads to Nangus. Refer to Appendix A for further details on the proposed pipe alignment for Option 3.

A PRV will be located near River Road at the base of the Tenandra mountain to reduce the pressure to that required to convey the water to Nangus.

The proposed Nangus reservoir (CH5500) is located on elevated ground approximately 5 km east of Nangus. The reservoir will have a usable volume of 250 kL (three days of storage for the average day demand). A concrete reservoir is proposed.

While a chlorine dosing facility has been allowed for at the proposed Nangus reservoir, water quality must comply with ADWG requirements at all locations in the network. There is the potential for chlorine residuals to fall between the chlorine dosing at Nangus reservoir and Nangus, and a secondary chlorination facility may be required downstream in the network to ensure chlorine residuals are maintained at suitable levels.

Refer to Appendix A for further details on the proposed pipe alignment for Option 3. The hydraulic grade line and elevation profile are shown in Figure 8-6.

The reticulation system would consist of DN100 PVC-O, with the extents as shown on Figure 8-3, matching the other options.

The pipeline infrastructure has been sized to convey the Nangus and rural MDD to the reservoir as outlined in Table 3-1. From the reservoir to Nangus, the infrastructure has been sized to convey the peak hour demand.

GWCC's preference is for the pipeline to be installed within private property where possible, adjacent to the road reserve. GWCC's recent experience has shown installation in private property provides a more efficient pathway to obtaining environmental approvals than installation within road reserves.

The proposed pipe alignment for Option 3 crosses the following watercourses (stream order 3 and higher) as shown on Figure 8-6. Crossing methodologies are also proposed.

- > Billabong Creek – horizontal directional drill.
- > Nangus Creek – attached to bridge.



Feasibility Study
Nangus Water Supply

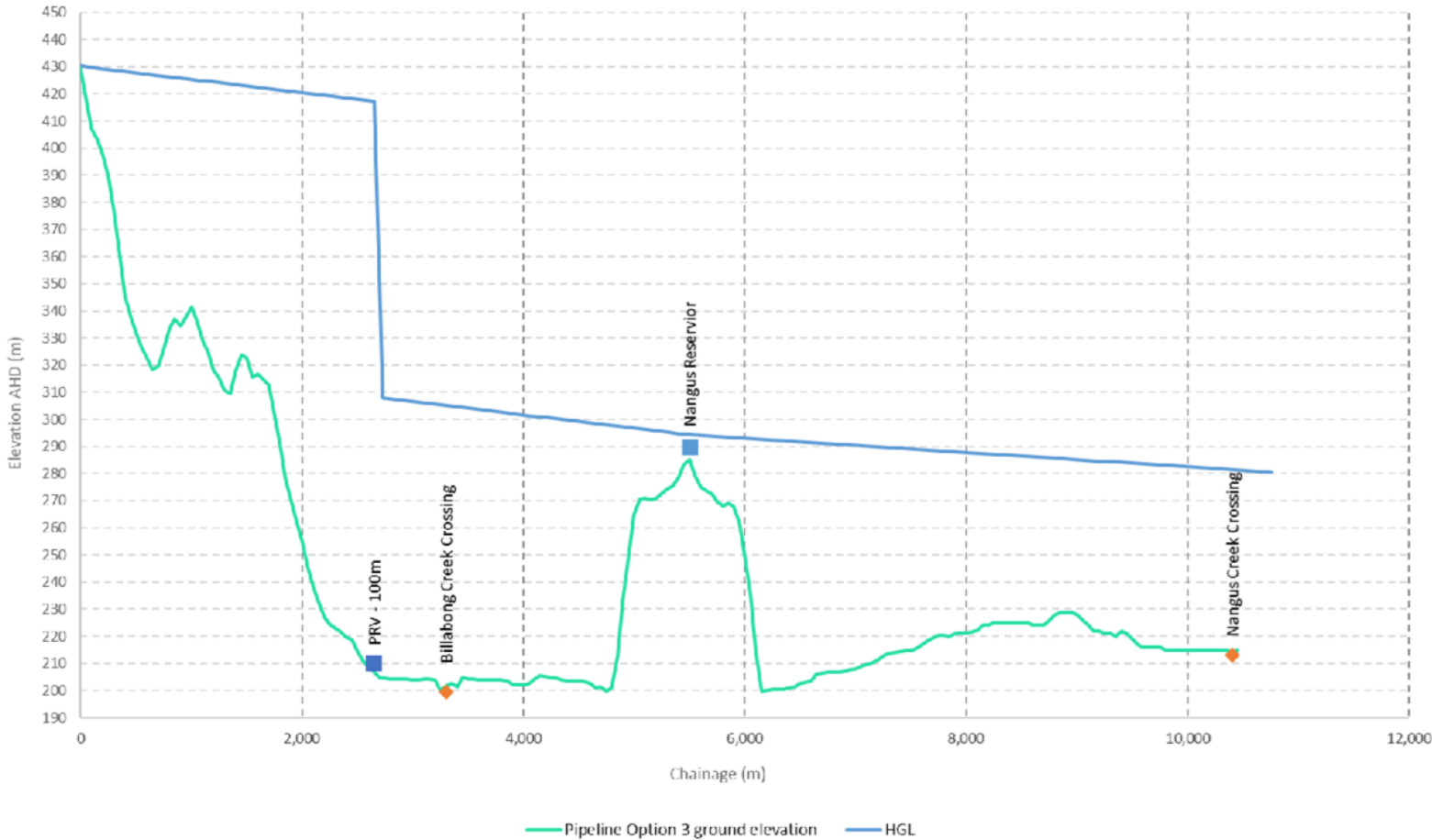


Figure 8-6 Option 3 – Hydraulic Grade & Elevation Profile



The model of the existing GWCC network was also analysed to determine any impacts due to the Nangus supply. No significant impacts were observed and it is therefore considered that no upgrade to the existing network will be required to supply Nangus on the basis of the additional demand. However, as noted in Section 6, future investigations should include consideration of the condition of these existing assets, and what renewals may be necessary to ensure reliability of supply.

As noted in Section 6, the MDD and annual demand on the Oura WTP are projected to be 30.2 ML/d and 4,600 ML/y respectively by 2048 (without the Nangus supply). Supply of water to Nangus would equate to an additional 1.7% to the MDD and 0.8% to the annual demand.

8.6.3 Environmental Constraints

A desktop review has been undertaken using online resources to provide initial high level advice of the environmental constraints associated with Option 3 which includes biodiversity, heritage, major waterbodies and watercourses, socio-economic considerations, soils and contamination, cumulative impacts and land use and land zoning.

Key features are presented in Appendix B and the findings of the desktop review are discussed below. Database searches were conducted between 20 and 25 November 2019 and are considered accurate at the time of writing. Most of the searches conducted present findings at a scale that does not allow for precise impact assessment, and the constraints would need to be confirmed on-site during future stages of the project in order to determine and either avoid and/or minimise potential impacts.

This is particularly the case for heritage items and threatened flora, fauna and vegetation communities where the records reported generally relate to those found within a 10 km search area and/or are recorded imprecisely in public databases.

8.6.3.1 Biodiversity

NSW listed biodiversity constraints

The vegetation communities present in the area are mapped on the vegetation map in Appendix B and a brief description of the constraints is provided below.

- > The area is primarily dominated by non-native vegetation
- > There are two native vegetation communities present along the alignment of Option 3. These PCT's may be associated with TEC's protected under the BC Act as shown in Table 8-7.

Table 8-7 State listed vegetation communities and associated BC Act TECs

PCT - ID	PCT	Associated BC Act listed TEC name*	Probable TEC Status*
5	River Red Gum Herbaceous – Grassy Very Tall Open Forest Wetland	Not listed under the BC Act	NA
79	River Red Gum Shrub/Grass Riparian Tall Woodland or Open Forest Wetland	** Status of this vegetation under state and federal legislation is currently unknown and should be investigated further in later project development stages.	**

* Derived from the NSW Vegetation Information System (VIS) which allows you to match PCTs with probable TECs.

** Data not available in the VIS.

- > NSW BioNet Atlas (OEH, 2019c) – a search for threatened species, populations and ecological communities was undertaken on 22/11/2019 with 20 listed species under the BC Act were recorded within the vicinity of the alignment. The alignment does not directly impact on known sighting locations of threatened flora or fauna.
- > A search of DPI – Key Fish Habitat found that Option 3 crosses two waterbodies that are considered Key Fish Habitat including:
 - Billabong Creek
 - Nangus Creek



- > According to the Gundagai LEP 2011 and Junee LEP 2012, Option 3 will have an impact on areas mapped as 'sensitive land' according to the Natural Resources Sensitivity Biodiversity Map. The objective of the mapped sensitive land is to help maintain terrestrial and aquatic biodiversity.

Federally listed biodiversity constraints

- > NSW BioNet Atlas (OEH, 2019c) – a search for threatened species, populations and ecological communities was undertaken on 22/11/2019 with 4 listed species under the EPBC Act found within the vicinity of this option.
- > A search of the PMST (DoEE, 2019) was undertaken on 22/11/2019. The following MNES have been identified within 10 km of this option. Federally listed TEC's have been identified below in Table 8-8:
 - 4 Wetlands of International Significance all of which are located approximately 400km – 800km downstream of Option 3.
 - 30 threatened species and 11 migratory species

Table 8-8 Federally listed TECs

TEC	Status: Endangered (EEC) or Critically Endangered (CEEC)
Grey Box (<i>Eucalyptus microcarpa</i>) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	EEC
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CEEC

Important conservation tenures

- > Areas of Outstanding Biodiversity Value (AOBV): AOBVs are special areas that contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. Areas of declared critical habitat under the TSC Act have become the first AOBVs in NSW with the commencement of the new BC Act. A search of the Critical habitat register NSW Office of Environment and Heritage (OEH, 2019a) was conducted on 22/11/2019 and no areas of critical habitat/AOBVs are located within proximity of this option.
- > Option 3 does not impact on any listed National Parks and Wildlife Services (NPWS) reserves and national parks.
- > A search of the Biobanking Public Register (NSW OEH, 2019) was used to search for Biobanking agreements, expressions of interest and statements within the Cootamundra - Gundagai LGA and Junee LGA. No Biobanking sites were located within the area of this option.
- > Option 3 traverses across a federally listed environmental stewardship zone for the maintenance or improvement of the condition and extent of the Box Gum Grassy Woodland Ecological Community. The pipeline will have a direct impact on this stewardship zone P1-Z1, a zone with an area of 413.9 ha. The landholder is under a legal obligation to ensure the management actions stipulated in the Environmental Stewardship Funding Deed are met and achieved for the lifetime of the agreement. The management actions that may impact Option 3 are shown in Table 8-9.

Table 8-9 Environmental Stewardship Funding Deed management actions that may impact Option 3

Management Action	Management Objective	Description of Management Actions
No cultivation or major soil disturbance	Remediate and minimise soil disturbance	The land manager will not cultivate, including cultivation for fire breaks, or undertake other measures resulting in significant soil disturbance within the area. Revegetation, where required, is to be undertaken only by means that involve minimal soil disturbance.