Appendix C Datasheets

PIPE HEADLOSS CALCULATION

PROJECT:	Eurobodalla Southern Storage - Ancillary Works	**PREPARED BY:**	Alvin Ting
CLIENT:	Eurobodalla Shire Council	**REVIEWED BY:**	Brent Palidwar
PURPOSE:	Concept Design Calculation for Stage 1 - 26MLD DN300 Pipeline from River Intake Pumps to Common Riser	**APPROVED BY:**	Hendrik Van Rhijn
DOCUMENT NO.:	30012127-AW-CD-001	**DATE PREPARED:**	14-June-2017

AVAILABLE DATA

Pump cut out elevation	=	-0.30	m AHD
Pump discharge elevation	=	19.70	m AHD
Pipe capacity, Q	=	0.100	m^3/s (each pump capacity)
Pipe roughness coefficient, C	=	140	(DICL DN300 PN20)
Internal diameter of pipe, D	=	0.3250	m (DICL DN300 PN20)
Area of pipe, A	=	0.08299	m^2
Perimeter of pipe, P	=	1.02143	m
Hydraulic radius, R	=	A / P	
	=	0.08125	m
Length of pipe, L	=	20.0	m

Velocity of pipe can be obtained using the simple equation, Q = A x V

V	=	Q / A	
	=	1.21	m/s

STATIC HEAD LOSS

Head loss due to level difference = 20.0 m

FRICTION HEAD LOSS

Head loss along length of pipe can be obtained using the Hazen Williams formula

$$V = 0.849\,C\,R^{0.63}\,S^{0.54}$$

$$S^{0.54} = \frac{V}{0.849\,C\,R^{0.63}}$$

$$S^{0.54} = 0.05$$

$$S = 0.0038$$

$$H_L / L = S$$

$$H_L = S \times L$$

$$= 0.07632 \text{ m}$$

FITTINGS HEAD LOSS

Description	Amount	*k*	$kV^2 / 2g$
Globe valve, fully open	0	10.00	0.0000
Angle valve, fully open	0	2.00	0.0000
Gate valve, wide open	0	0.15	0.0000
Gate valve, 1/4 closed	0	0.26	0.0000
Gate valve, 1/2 closed	0	2.10	0.0000
Gate valve, 3/4 closed	1	17.00	1.2658
Ball valve, fully open	0	0.05	0.0000
Ball valve, 1/3 closed	0	5.50	0.0000
Ball valve, 2/3 closed	0	200.00	0.0000
Diaphragm valve, fully open	0	2.30	0.0000
Diaphragm valve, Half open	0	4.30	0.0000
Diaphragm valve, 1/4 open	0	21.00	0.0000
Water meter	0	7.00	0.0000
Swing check, forward flow	1	2.00	0.1489
90° elbow, threaded	0	1.50	0.0000
90° elbow, flanged	4	0.30	0.0894
Long radius 90° elbow, threaded	0	0.70	0.0000
Long radius 90° elbow, flanged	0	0.20	0.0000
Regular 45° elbow, threaded	0	0.40	0.0000
Long radius 45° elbow, flanged	6	0.20	0.0894
long radius 45° elbow, threaded	0	0.20	0.0000
T, through side outlet	2	1.80	0.2681
Bell mouth	1	0.98	0.0730
Square edge	0	0.82	0.0000

Total head loss through fitting is 1.93 m

Total head loss through the pipe system = 22.01 m

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PIPE HEADLOSS CALCULATION

PROJECT:	Eurobodalla Southern Storage - Ancillary Works	**PREPARED BY:**	Alvin Ting
CLIENT:	Eurobodalla Shire Council	**REVIEWED BY:**	Brent Palidwar
PURPOSE:	Concept Design Calculation for Stage 1 - 26MLD DN710 HDPE Pipeline from Common Riser to ESS Inlet Chute	**APPROVED BY:**	Hendrik Van Rhijn
DOCUMENT NO.:	30012127-AW-CD-001	**DATE PREPARED:**	14-June-2017

AVAILABLE DATA

Pump cut out level	=	19.70	AHD
Discharge level	=	62.70	AHD
Pipe capacity, Q	=	0.301	m^3/s
Diameter of pipe, D	=	0.547	m (HDPE DN710 PE100 PN20)
Area of pipe, A	=	0.23466	m^2
Perimeter of pipe, P	=	1.71757	m
Hydraulic radius, R	=	0.136625	m
Roughness coefficient, C	=	150	(HDPE DN710 PE100 PN20)
Length of pipe, L	=	1500	m

STATIC HEAD LOSS

Head loss due to level difference is 43.0 m

FRICTION HEAD LOSS

Velocity of pipe can be obtained using the simple equation, Q = A x V

$$V = Q / A$$
$$= 1.28 \text{ m/s}$$

Head loss along length of pipe can be obtained using the Hazen Williams formula

$$V = 0.849\, C\, R^{0.63}\, S^{0.54}$$

$$S^{0.54} = \frac{V}{0.849\, C\, R^{0.63}}$$

$$S^{0.54} = 0.04$$

$$S = 0.0020$$

$$H_L / L = S$$
$$H_L = S \times L$$
$$= 3.07 \text{ m}$$

FITTINGS HEAD LOSS

Description	Amount	*k*	$kV^2 / 2g$
Globe valve, fully open	0	10.00	0.0000
Angle valve, fully open	0	2.00	0.0000
Gate valve, wide open	0	0.15	0.0000
Gate valve, 1/4 closed	0	0.26	0.0000
Gate valve, 1/2 closed	0	2.10	0.0000
Gate valve, 3/4 closed	2	17.00	2.8498
Ball valve, fully open	0	0.05	0.0000
Ball valve, 1/3 closed	0	5.50	0.0000
Ball valve, 2/3 closed	0	200.00	0.0000
Diaphragm valve, fully open	0	2.30	0.0000
Diaphragm valve, Half open	0	4.30	0.0000
Diaphragm valve, 1/4 open	0	21.00	0.0000
Water meter	0	7.00	0.0000
Swing check, forward flow	0	2.00	0.0000
90^o elbow, threaded	0	1.50	0.0000
90^o elbow, flanged	0	0.30	0.0000
Long radius 90^o elbow, threaded	1	0.70	0.0587
Long radius 90^o elbow, flanged	0	0.20	0.0000
Regular 45^o elbow, threaded	0	0.40	0.0000
Long radius 45^o elbow, flanged	10	0.20	0.1676
long radius 45^o elbow, threaded	0	0.20	0.0000
T, through side outlet	4	1.80	0.6035
Bell mouth	0	0.98	0.0000
Square edge	0	0.82	0.0000

Total head loss through fitting is 3.68 m

Total head loss through the pipe system = 49.75 m

PIPE HEADLOSS CALCULATION

PROJECT:	Eurobodalla Southern Storage - Ancillary Works	**PREPARED BY:**	Alvin Ting
CLIENT:	Eurobodalla Shire Council	**REVIEWED BY:**	Brent Palidwar
PURPOSE:	Concept Design Calculation for Stage 2 - Future 25MLD DN710 HDPE Pipeline from Future Storage Outlet Pump Station to Future WTP (near ESS)	**APPROVED BY:**	Hendrik Van Rhijn
DOCUMENT NO.:	30012127-AW-CD-001	**DATE PREPARED:**	14-June-2017

AVAILABLE DATA

Low water level	=	27.40	AHD
Discharge level	=	73.00	AHD
Pipe capacity, Q	=	0.320	m^3/s
Internal diameter of pipe, D	=	0.547	m (HDPE DN710 PE100 PN20)
Area of pipe, A	=	0.23466	m^2
Perimeter of pipe, P	=	1.71757	m
Hydraulic radius, R	=	0.136625	m
Roughness coefficient, C	=	150	(HDPE DN710 PE100 PN20)
Length of pipe, L	=	400	m

STATIC HEAD LOSS

Head loss due to level difference = 45.6 m

FRICTION HEAD LOSS

Velocity of pipe can be obtained using the simple equation, Q = A x V

$V = Q / A$

$= 1.36$ m/s

Head loss along length of pipe can be obtained using the Hazen-Williams formula

$V = 0.849\ C\ R^{0.63}\ S^{0.54}$

$S^{0.54} = \dfrac{V}{0.849\ C\ R^{0.63}}$

$S^{0.54} = 0.04$

$S = 0.00$

$H_L / L = S$

$H_L = S \times L$

$= 0.92$ m

FITTINGS HEAD LOSS

Description	Amount	*k*	$kV^2 / 2g$
Globe valve, fully open	0	10.00	0.0000
Angle valve, fully open	0	2.00	0.0000
Gate valve, wide open	1	0.15	0.0142
Gate valve, 1/4 closed	0	0.26	0.0000
Gate valve, 1/2 closed	0	2.10	0.0000
Gate valve, 3/4 closed	1	17.00	1.6112
Ball valve, fully open	0	0.05	0.0000
Ball valve, 1/3 closed	0	5.50	0.0000
Ball valve, 2/3 closed	0	200.00	0.0000
Diaphragm valve, fully open	0	2.30	0.0000
Diaphragm valve, Half open	0	4.30	0.0000
Diaphragm valve, 1/4 open	0	21.00	0.0000
Water meter	0	7.00	0.0000
Swing check, forward flow	1	2.00	0.1896
90^o elbow, threaded	0	1.50	0.0000
90^o elbow, flanged	10	0.30	0.2843
Long radius 90^o elbow, threaded	0	0.70	0.0000
Long radius 90^o elbow, flanged	0	0.20	0.0000
Regular 45^o elbow, threaded	0	0.40	0.0000
Long radius 45^o elbow, flanged	15	0.20	0.2843
long radius 45^o elbow, threaded	0	0.20	0.0000
T, through side outlet	10	1.80	1.7060
Bell mouth	0	0.98	0.0000
Square edge	0	0.82	0.0000

Total head loss through fitting is 4.09 m

Total head loss through the pipe system = 50.61 m

PIPE HEADLOSS CALCULATION

PROJECT:	Eurobodalla Southern Storage - Ancillary Works	**PREPARED BY:**	Alvin Ting
CLIENT:	Eurobodalla Shire Council	**REVIEWED BY:**	Brent Palidwar
PURPOSE:	Concept Design Calculation for Stage 2 - Future 25MLD DN710 HDPE Pipeline from Future WTP (near ESS) to Big Rock Reservoir	**APPROVED BY:**	Hendrik Van Rhijn
DOCUMENT NO.:	30012127-AW-CD-001	**DATE PREPARED:**	24-February-2017

AVAILABLE DATA

Low water level	=	73.00	AHD
Discharge level	=	145.00	AHD
Pipe capacity, Q	=	0.302	m^3/s
Internal diameter of pipe, D	=	0.547	m (HDPE DN710 PE100 PN20)
Area of pipe, A	=	0.23466	m^2
Perimeter of pipe, P	=	1.71757	m
Hydraulic radius, R	=	0.136625	m
Roughness coefficient, C	=	150	(HDPE DN710 PE100 PN20)
Length of pipe, L	=	7070	m

STATIC HEAD LOSS

Head loss due to level difference = 72.0 m

FRICTION HEAD LOSS

Velocity of pipe can be obtained using the simple equation, Q = A x V

$V = Q / A$

$= 1.29$ m/s

Head loss along length of pipe can be obtained using the Hazen-Williams formula

$V = 0.849\ C\ R^{0.63}\ S^{0.54}$

$S^{0.54} = \dfrac{V}{0.849\ C\ R^{0.63}}$

$S^{0.54} = 0.04$

$S = 0.00$

$H_L / L = S$

$H_L = S \times L$

$= 14.54$ m

FITTINGS HEAD LOSS

Description	Amount	*k*	$kV^2 / 2g$
Globe valve, fully open	0	10.00	0.0000
Angle valve, fully open	0	2.00	0.0000
Gate valve, wide open	1	0.15	0.0127
Gate valve, 1/4 closed	0	0.26	0.0000
Gate valve, 1/2 closed	0	2.10	0.0000
Gate valve, 3/4 closed	1	17.00	1.4344
Ball valve, fully open	0	0.05	0.0000
Ball valve, 1/3 closed	0	5.50	0.0000
Ball valve, 2/3 closed	0	200.00	0.0000
Diaphragm valve, fully open	0	2.30	0.0000
Diaphragm valve, Half open	0	4.30	0.0000
Diaphragm valve, 1/4 open	0	21.00	0.0000
Water meter	0	7.00	0.0000
Swing check, forward flow	1	2.00	0.1688
90^o elbow, threaded	0	1.50	0.0000
90^o elbow, flanged	10	0.30	0.2531
Long radius 90^o elbow, threaded	0	0.70	0.0000
Long radius 90^o elbow, flanged	0	0.20	0.0000
Regular 45^o elbow, threaded	0	0.40	0.0000
Long radius 45^o elbow, flanged	15	0.20	0.2531
long radius 45^o elbow, threaded	0	0.20	0.0000
T, through side outlet	10	1.80	1.5188
Bell mouth	0	0.98	0.0000
Square edge	0	0.82	0.0000

Total head loss through fitting is 3.64 m

Total head loss through the pipe system = 90.18 m

Appendix D Net Present Value

General Assumptions for Net Present Value (NPV) Analysis

- Cost estimates are based on reference rates indicated in the Department of Primary Industries Office of Water's NSW Reference Rates Manual – Valuation of Water Supply, Sewerage and Stormwater Assets dated 2014 and have been developed for comparative purposes only.
- 8% uplift has been applied for the 2014 NSW Reference Rates to bring the rates forward to 2016 (i.e. Reference rate is 1.1 x Contract Rate).
- Where NSW Reference Rates are not available, Rawlinson's Construction Handbook rates were used.
- GRP pipe rates are based on reference rates in Rawlinson's Construction Handbook 2012, these have been adjusted by 32% to bring the rates forward to 2016 (i.e. Reference rate is 1.32 x Contract Rate).
- Cost estimates excludes contingencies and 10% GST.
- Pipeline rates allow for pipe supply, excavate, lay, backfill, restoration, fittings, thrust blocks, air valves, scour valves and isolating valves.
- Excavation is assumed to be in other than rock and pipelines are assumed to be laid to minimum depth.
- Rates do not include; land acquisition, power supply, data connection, forced ventilation, lifting gantry, access roads, and fencing.
- Sizing of pumps is based on Grundfoss Product Centre sizing software available online.
- For whole of life costing, NPV analysis has been completed for a 25-year period and at 4%, 7% and 10% discount rate.
- $0.30 per kWH is assumed for power supply cost.

D-1 WTP Location Options

Table 16 - NPV for future WTP adjacent to ESS (Option 3)

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV at 7% Discount Rate ($)
New WPS - Tuross River intake and transfer pump station	26ML/d over 24hours	1	Item	2017	$1,379,268	$650,430	$8,959,108
Reconfigure Pipework - borefield to WTP and/or river pump station	6ML/d over 24 hours	100	m	2017	$36,720		$36,720
New Pipeline - river pump station to ESS inlet (Segment A)	26ML/d over 24hours	1337	m	2017	$1,486,744		$1,486,744
New Pipeline - ESS outlet to Southern WTP (Segment B)	6ML/d over 23 hours	300	m	2017	$110,160		$110,160
New WPS - ESS outlet (small)	25ML/d over 23 hours + treatment losses	1	Item	2030	$666,360	$566,663	$2,144,197
New Pipework - Connection to/from Future WTP from ESS	25ML/d over 23 hours + treatment losses	400	m	2030	$533,600		$221,425
New WPS - WTP clear water pump station (large)	25ML/d over 23 hours	1	Item	2030	$886,140	$997,326	$3,654,836
New Pipeline - Future WTP to Big Rock Reservoir (Segment C)	25ML/d over 23 hours	7070	m	2030	$9,431,380		$3,913,687
Decommission Southern WTP and existing pipeline to Big Rock Reservoir	-	-	-	2030	-		Nil
				Net Present Value	4%		$27,468,255
					7%		$19,777,415
					10%		$14,979,485

Table 17 - NPV for future WTP near Big Rock Reservoir - (Option 4)

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV at 7% Discount Rate ($)
New WPS - Tuross River intake and transfer pump station	26ML/d over 24hours	1	Item	2017	$1,379,268	$650,430	$8,959,108
Reconfigure Pipework - borefield to WTP and/or river pump station	6ML/d over 24 hours	100	m	2017	$36,720		$36,720
New Pipeline - river pump station to ESS inlet (Segment A)	26ML/d over 24hours	1337	m	2017	$1,486,744		$1,486,744
New Pipeline - ESS outlet to Southern WTP (Segment B)	6ML/d over 23 hours	300	m	2017	$110,160		$110,160
New WPS - ESS outlet (large)	25ML/d over 23 hours + treatment losses	1	Item	2030	$1,827,900	$1,888,875	$6,984,118
New Pipeline - ESS outlet pump station to Future WTP (Segment C)	25ML/d over 23 hours + treatment losses	6670	m	2030	$9,031,180		$3,747,619
New WPS - WTP clear water pump station (small)	25ML/d over 23 hours	1	Item	2030	$189,000	$110,814	$443,664
New Pipeline - Future WTP to Big Rock Reservoir	25ML/d over 23 hours	300	m	2030	$400,200		$166,069
Decommission Southern WTP and existing pipeline to Big Rock Reservoir	-	-	-	2030	-		Nil
				Net Present Value	4%		$31,320,613
					7%		$21,934,201
					10%		$16,179,784

D-2 NPV Estimates for Pipeline to Big Rock Reservoir (WTP - Option 3)

Table 18- NPV for WTP adjacent to ESS (Option 3) - DN600 - Pipe material - GRP

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (small)	25ML/d over 23 hours + treatment losses	1	Item	2030	$676,350	$566,663	$2,771,788
New Pipeline - Future WTP to Big Rock Reservoir (Segment C)	25ML/d over 23 hours	7070	m	2030	$9,429,154		$3,912,764
New WPS - WTP clear water pump station (large)	25ML/d over 23 hours	1	Item	2030	$1,018,008	$997,326	$4,806,821
New Pipework – ESS outlet (small) to Future WTP	25ML/d over 23 hours	300	m	2030	$400,106		$166,030
			Net Present Value	4%			$19,686,057
				7%			$11,657,403
				10%			$7,194,896

Table 19 – NPV for WTP adjacent to ESS (Option 3) - DN600 - Pipe Material - DICL

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (small)	25ML/d over 23 hours + treatment losses	1	Item	2030	$676,350	$566,663	$2,771,788
New Pipeline - Future WTP to Big Rock Reservoir (Segment C)	25ML/d over 23 hours	7070	m	2030	$5,726,700		$2,376,377
New WPS - WTP clear water pump station (large)	25ML/d over 23 hours	1	Item	2030	$1,018,008	$997,326	$4,806,821
New Pipework – ESS outlet (small) to Future WTP	25ML/d over 23 hours	300	m	2030	$243,000		$100,836
			Net Present Value	4%			$17,368,105
				7%			$10,055,823
				10%			$6,076,919

Table 20- NPV for future WTP adjacent to ESS (Option 3) - DN710 - Pipe Material - HDPE

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (small)	25ML/d over 23 hours + treatment losses	1	Item	2030	$676,350	$566,663	$2,771,788
New Pipeline - Future WTP to Big Rock Reservoir (Segment C)	25ML/d over 23 hours	7070	m	2030	$5,497,632		$2,281,322
New WPS - WTP clear water pump station (large)	25ML/d over 23 hours	1	Item	2030	$1,018,008	$997,326	$4,806,821
New Pipework – ESS outlet (small) to Future WTP	25ML/d over 23 hours	300	m	2030	$233,280		$96,803
			Net Present Value	4%			$17,224,695
				7%			$9,956,734
				10%			$6,007,751

Table 21 – NPV for future WTP adjacent to ESS (Option 3) - DN600 - Pipe Material - Steel (SCH80)

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (small)	25ML/d over 23 hours + treatment losses	1	Item	2030	$676,350	$566,663	$2,771,788
New Pipeline - Future WTP to Big Rock Reservoir (Segment C)	25ML/d over 23 hours	7070	m	2030	$6,566,616		$2,724,912
New WPS - WTP clear water pump station (large)	25ML/d over 23 hours	1	Item	2030	$1,018,008	$997,326	$4,806,821
New Pipework – ESS outlet (small) to Future WTP	25ML/d over 23 hours	300	m	2030	$278,640		$115,626
			Net Present Value	4%			$17,893,942
				7%			$10,419,147
				10%			$6,330,537

Table 22 – NPV for future WTP adjacent to ESS (Option 3) – DN525 - Pipe Material - GRP

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (small)	25ML/d over 23 hours + treatment losses	1	Item	2030	$736,290	$642,218	$3,128,812
New Pipeline - Future WTP to Big Rock Reservoir (Segment C)	25ML/d over 23 hours	7070	m	2030	$8,884,834		$3,686,890
New WPS - WTP clear water pump station (large)	25ML/d over 23 hours	1	Item	2030	$1,275,480	$1,284,435	$6,175,834
New Pipework – ESS outlet (small) to Future WTP	25ML/d over 23 hours	300	m	2030	$367,706		$152,585
			Net Present Value	4%			$22,490,386
				7%			$13,144,121
				10%			$8,014,141

Table 23 – NPV for future WTP adjacent to ESS (Option 3) – DN500 - Pipe Material - DICL

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (small)	25ML/d over 23 hours + treatment losses	1	Item	2030	$736,290	$642,218	$3,128,812
New Pipeline - Future WTP to Big Rock Reservoir (Segment C)	25ML/d over 23 hours	7070	m	2030	$4,505,004		$1,869,416
New WPS - WTP clear water pump station (large)	25ML/d over 23 hours	1	Item	2030	$1,275,480	$1,284,435	$6,175,834
New Pipework – ESS outlet (small) to Future WTP	25ML/d over 23 hours	300	m	2030	$191,160		$79,325
			Net Present Value	4%			$19,753,945
				7%			$11,253,387
				10%			$6,694,321

Table 24 – NPV for future WTP adjacent to ESS (Option 3) – DN630 - Pipe Material - HDPE

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (small)	25ML/d over 23 hours + treatment losses	1	Item	2030	$736,290	$642,218	$3,128,812
New Pipeline - Future WTP to Big Rock Reservoir (Segment C)	25ML/d over 23 hours	7070	m	2030	$4,324,804		$1,794,640
New WPS - WTP clear water pump station (large)	25ML/d over 23 hours	1	Item	2030	$1,275,480	$1,284,435	$6,175,834
New Pipework – ESS outlet (small) to Future WTP	25ML/d over 23 hours	300	m	2030	$183,514		$76,152
			Net Present Value	4%			$19,641,129
				7%			$11,175,437
				10%			$6,639,909

Table 25 – NPV for future WTP adjacent to ESS (Option 3) – DN500 - Pipe Material - Steel (SCH80)

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (small)	25ML/d over 23 hours + treatment losses	1	Item	2030	$736,290	$642,218	$3,128,812
New Pipeline - Future WTP to Big Rock Reservoir (Segment C)	25ML/d over 23 hours	7070	m	2030	$5,497,632		$2,281,322
New WPS - WTP clear water pump station (large)	25ML/d over 23 hours	1	Item	2030	$1,275,480	$1,284,435	$6,175,834
New Pipework – ESS outlet (small) to Future WTP	25ML/d over 23 hours	300	m	2030	$233,280		$96,803
			Net Present Value	4%			$20,375,388
				7%			$11,682,770
				10%			$6,994,051

Table 26 – NPV for future WTP adjacent to ESS (Option 3) – DN675 - Pipe Material - GRP

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (small)	25ML/d over 23 hours + treatment losses	1	Item	2030	$674,568	$528,885	$2,604,974
New Pipeline - Future WTP to Big Rock Reservoir (Segment C)	25ML/d over 23 hours	7070	m	2030	$10,182,886		$4,225,536
New WPS - WTP clear water pump station (large)	25ML/d over 23 hours	1	Item	2030	$856,170	$793,328	$3,842,858
New Pipework – ESS outlet (small) to Future WTP	25ML/d over 23 hours	300	m	2030	$422,786		$175,441
			Net Present Value	4%			$18,080,708
				7%			$10,848,809
				10%			$6,776,162

Table 27 – NPV for future WTP adjacent to ESS (Option 3) – DN750 - Pipe Material - DICL

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (small)	25ML/d over 23 hours + treatment losses	1	Item	2030	$674,568	$528,885	$2,604,974
New Pipeline - Future WTP to Big Rock Reservoir (Segment C)	25ML/d over 23 hours	7070	m	2030	$7,635,600		$3,168,503
New WPS - WTP clear water pump station (large)	25ML/d over 23 hours	1	Item	2030	$856,170	$793,328	$3,842,858
New Pipework – ESS outlet (small) to Future WTP	25ML/d over 23 hours	300	m	2030	$324,000		$134,448
			Net Present Value	4%			$16,491,547
				7%			$9,750,783
				10%			$6,009,690

Table 28- NPV for future WTP adjacent to ESS (Option 3) – DN800 - Pipe Material - HDPE

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (small)	25ML/d over 23 hours + treatment losses	1	Item	2030	$674,568	$528,885	$2,604,974
New Pipeline - Future WTP to Big Rock Reservoir (Segment C)	25ML/d over 23 hours	7070	m	2030	$7,330,176		$3,041,762
New WPS - WTP clear water pump station (large)	25ML/d over 23 hours	1	Item	2030	$856,170	$793,328	$3,842,858
New Pipework – ESS outlet (small) to Future WTP	25ML/d over 23 hours	300	m	2030	$311,040		$129,071
			Net Present Value	4%			$16,300,333
				7%			$9,618,665
				10%			$5,917,465

Table 29 – NPV for future WTP adjacent to ESS (Option 3) – DN700 - Pipe Material - Steel (SCH80)

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (small)	25ML/d over 23 hours + treatment losses	1	Item	2030	$674,568	$528,885	$2,604,974
New Pipeline - Future WTP to Big Rock Reservoir (Segment C)	25ML/d over 23 hours	7070	m	2030	$8,017,380		$3,326,928
New WPS - WTP clear water pump station (large)	25ML/d over 23 hours	1	Item	2030	$856,170	$793,328	$3,842,858
New Pipework – ESS outlet (small) to Future WTP	25ML/d over 23 hours	300	m	2030	$340,200		$141,171
			Net Present Value	4%			$16,730,563
				7%			$9,915,931
				10%			$6,124,970

D-3 NPV Estimates for Pipeline to Big Rock Reservoir (WTP - Option 4)

Table 30 – NPV for WTP Location at Big Rock Reservoir (Option 4) - DN600 - Pipe Material - GRP

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (large)	25ML/d over 23 hours + treatment losses	1	Item	2030	$1,827,900	$1,888,875	$9,062,271
New Pipeline - ESS outlet pump station to Future WTP (Segment C)	25ML/d over 23 hours + treatment losses	6770	m	2030	$9,248,288		$3,837,711
New WPS - WTP clear water pump station (small)	25ML/d over 23 hours	1	Item	2030	$189,000	$110,814	$565,582
New Pipework – WTP clear water pump station to Big Rock Reservoir	25ML/d over 23 hours	300	m	2030	$497,306		$206,364
			Net Present Value	4%			$23,385,706
				7%			$13,671,928
				10%			$8,338,561

Table 31 – NPV for WTP Location at Big Rock Reservoir (Option 4) - DN600 - Pipe Material - DICL

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (large)	25ML/d over 23 hours + treatment losses	1	Item	2030	$1,827,900	$1,888,875	$9,062,271
New Pipeline - ESS outlet pump station to Future WTP (Segment C)	25ML/d over 23 hours + treatment losses	6770	m	2030	$5,483,700		$2,275,541
New WPS - WTP clear water pump station (small)	25ML/d over 23 hours	1	Item	2030	$189,000	$110,814	$565,582
New Pipework – WTP clear water pump station to Big Rock Reservoir	25ML/d over 23 hours	300	m	2030	$243,000		$100,836
			Net Present Value	4%			$20,972,063
				7%			$12,004,230
				10%			$7,174,430

Table 32 – NPV for WTP Location at Big Rock Reservoir (Option 4) - DN710 - Pipe Material - HDPE

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (large)	25ML/d over 23 hours + treatment losses	1	Item	2030	$1,827,900	$1,888,875	$9,062,271
New Pipeline - ESS outlet pump station to Future WTP (Segment C)	25ML/d over 23 hours + treatment losses	6770	m	2030	$5,186,592		$2,152,251
New WPS - WTP clear water pump station (small)	25ML/d over 23 hours	1	Item	2030	$189,000	$110,814	$565,582
New Pipework – WTP clear water pump station to Big Rock Reservoir	25ML/d over 23 hours	300	m	2030	$233,280		$96,803
			Net Present Value	4%			$20,787,790
				7%			$11,876,907
				10%			$7,085,553

Table 33 – NPV for WTP Location at Big Rock Reservoir (Option 4) - DN600 - Pipe Material - Steel (SCH80)

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (large)	25ML/d over 23 hours + treatment losses	1	Item	2030	$1,827,900	$1,888,875	$9,062,271
New Pipeline - ESS outlet pump station to Future WTP (Segment C)	25ML/d over 23 hours + treatment losses	6770	m	2030	$6,287,976		$2,609,286
New WPS - WTP clear water pump station (small)	25ML/d over 23 hours	1	Item	2030	$189,000	$110,814	$565,582
New Pipework – WTP clear water pump station to Big Rock Reservoir	25ML/d over 23 hours	300	m	2030	$278,640		$115,626
			Net Present Value	4%			$21,476,495
				7%			$12,352,765
				10%			$7,417,724

Table 34 – NPV for WTP Location at Big Rock Reservoir (Option 4) – DN525 - Pipe Material - GRP

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (large)	25ML/d over 23 hours + treatment losses	1	Item	2030	$1,944,000	$2,014,800	$9,664,032
New Pipeline - ESS outlet pump station to Future WTP (Segment C)	25ML/d over 23 hours + treatment losses	6770	m	2030	$8,297,888		$3,443,329
New WPS - WTP clear water pump station (small)	25ML/d over 23 hours	1	Item	2030	$191,700	$113,333	$577,774
New Pipework – WTP clear water pump station to Big Rock Reservoir	25ML/d over 23 hours	300	m	2030	$367,706		$152,585
			Net Present Value	4%			$23,856,790
				7%			$13,837,720
				10%			$8,376,887

Table 35 – NPV for WTP Location at Big Rock Reservoir (Option 4) – DN500 - Pipe Material - DICL

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (large)	25ML/d over 23 hours + treatment losses	1	Item	2030	$1,944,000	$2,014,800	$9,664,032
New Pipeline - ESS outlet pump station to Future WTP (Segment C)	25ML/d over 23 hours + treatment losses	6770	m	2030	$4,313,844		$1,790,092
New WPS - WTP clear water pump station (small)	25ML/d over 23 hours	1	Item	2030	$191,700	$113,333	$577,774
New Pipework – WTP clear water pump station to Big Rock Reservoir	25ML/d over 23 hours	300	m	2030	$191,160		$79,325
			Net Present Value	4%			$21,358,048
				7%			$12,111,223
				10%			$7,171,712

Table 36 – NPV for WTP Location at Big Rock Reservoir (Option 4) – DN630 - Pipe Material - HDPE

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (large)	25ML/d over 23 hours + treatment losses	1	Item	2030	$1,944,000	$2,014,800	$9,664,032
New Pipeline - ESS outlet pump station to Future WTP (Segment C)	25ML/d over 23 hours + treatment losses	6770	m	2030	$4,141,290		$1,718,488
New WPS - WTP clear water pump station (small)	25ML/d over 23 hours	1	Item	2030	$191,700	$113,333	$577,774
New Pipework – WTP clear water pump station to Big Rock Reservoir	25ML/d over 23 hours	300	m	2030	$183,514		$76,152
			Net Present Value	4%			$21,249,824
				7%			$12,036,446
				10%			$7,119,515

Table 37 – NPV for WTP Location at Big Rock Reservoir (Option 4) – DN500 - Pipe Material - Steel (SCH80)

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (large)	25ML/d over 23 hours + treatment losses	1	Item	2030	$1,944,000	$2,014,800	$9,664,032
New Pipeline - ESS outlet pump station to Future WTP (Segment C)	25ML/d over 23 hours + treatment losses	6770	m	2030	$5,264,352		$2,184,519
New WPS - WTP clear water pump station (small)	25ML/d over 23 hours	1	Item	2030	$191,700	$113,333	$577,774
New Pipework – WTP clear water pump station to Big Rock Reservoir	25ML/d over 23 hours	300	m	2030	$233,280		$96,803
			Net Present Value	4%			$21,954,194
				7%			$12,523,128
				10%			$7,459,241

Table 38 – NPV for WTP Location at Big Rock Reservoir (Option 4) – DN675 - Pipe Material - GRP

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (large)	25ML/d over 23 hours + treatment losses	1	Item	2030	$1,735,020	$1,788,135	$8,580,862
New Pipeline - ESS outlet pump station to Future WTP (Segment C)	25ML/d over 23 hours + treatment losses	6770	m	2030	$9,399,932		$3,900,637
New WPS - WTP clear water pump station (small)	25ML/d over 23 hours	1	Item	2030	$179,550	$101,999	$522,910
New Pipework – WTP clear water pump station to Big Rock Reservoir	25ML/d over 23 hours	300	m	2030	$422,786		$175,441
			Net Present Value	4%			$22,476,382
				7%			$13,179,850
				10%			$8,061,089

Table 39 – NPV for WTP Location at Big Rock Reservoir (Option 4) – DN750 - Pipe Material - DICL

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (large)	25ML/d over 23 hours + treatment losses	1	Item	2030	$1,735,020	$1,788,135	$8,580,862
New Pipeline - ESS outlet pump station to Future WTP (Segment C)	25ML/d over 23 hours + treatment losses	6770	m	2030	$7,311,600		$3,034,054
New WPS - WTP clear water pump station (small)	25ML/d over 23 hours	1	Item	2030	$179,550	$101,999	$522,910
New Pipework – WTP clear water pump station to Big Rock Reservoir	25ML/d over 23 hours	300	m	2030	$324,000		$134,448
			Net Present Value	4%			$21,162,856
				7%			$12,272,274
				10%			$7,427,559

Table 40 – NPV for WTP Location at Big Rock Reservoir (Option 4) – DN800 - Pipe Material - HDPE

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (large)	25ML/d over 23 hours + treatment losses	1	Item	2030	$1,735,020	$1,788,135	$8,580,862
New Pipeline - ESS outlet pump station to Future WTP (Segment C)	25ML/d over 23 hours + treatment losses	6770	m	2030	$7,019,136		$2,912,692
New WPS - WTP clear water pump station (small)	25ML/d over 23 hours	1	Item	2030	$179,550	$101,999	$522,910
New Pipework – WTP clear water pump station to Big Rock Reservoir	25ML/d over 23 hours	300	m	2030	$311,040		$129,071
			Net Present Value	4%			$20,979,427
				7%			$12,145,534
				10%			$7,339,089

Table 41 – NPV for WTP Location at Big Rock Reservoir (Option 4) – DN700 - Pipe Material - Steel (SCH80)

Component Description	Capacity	Quantity	Units	Year	Capex ($)	Opex ($/yr)	NPV ($)
New WPS - ESS outlet (large)	25ML/d over 23 hours + treatment losses	1	Item	2030	$1,735,020	$1,788,135	$8,580,862
New Pipeline - ESS outlet pump station to Future WTP (Segment C)	25ML/d over 23 hours + treatment losses	6770	m	2030	$7,677,180		$3,185,757
New WPS - WTP clear water pump station (small)	25ML/d over 23 hours	1	Item	2030	$179,550	$101,999	$522,910
New Pipework – WTP clear water pump station to Big Rock Reservoir	25ML/d over 23 hours	300	m	2030	$340,200		$141,171
			Net Present Value	4%			$21,392,143
				7%			$12,430,700
				10%			$7,538,147

Appendix E Multi-criteria Assessment

General

The Multi Criteria Assessment (MCA) scoring is based upon a scoring of -5 to +5 for each criterion, where -5 is worst possible option and + 5 is the best possible option.

Weighting was determined in partnership with Council for the individual criteria defined.

Table 42 - MCA WTP location options

Decision Factors		Option 2: Future WTP close to Southern WTP	Option 3: FUTURE WTP at top of ESS	Option 4: Future WTP at Big Rock Reservoir	Comment
Criteria	**Wt.**				
Hydraulics	1.0	2	1	0	Option 1 gravity feed to future WTP with single PS. Options 2 (potentially) and 3 require multiple pump stations. Lose hydraulic head across WTP for Option 1 however this has been accounted for in NPV.
Cost (whole of life)	4.0	1	1	1	All relatively similar, NPVs of $24.8M, $25.8M and $24.8M, respectively (7% discount rate). Excludes upgrade to power network, earthworks, land costs.
Power supply	2.0	-1	-3	-1	Based on prelim advice from Essential Energy, all options require substantial upgrade to the power network for Stage 2 works (future WTP). Length of new line for Option 2 from nearest substation would be greater than for Options 1 and 3 and would require purchase of additional easement. Power supply upgrade may already be required in vicinity of Options 1 and 3 as part of Stage 1 works (Storage and river intake works).
Environment / biodiversity	2.0	3	1	2	Minimal clearing required as part of Option 1. Option 2 will require substantial clearing. Option 3 may utilise laydown area from construction of Storage.
Constructability	2.0	1	2	3	Likely largest earthworks for WTP required for Option 1. Access is required across valley. Good access for Option 3 will be established as part of off-stream storage construction.

Decision Factors		Option 2: Future WTP close to Southern WTP	Option 3: FUTURE WTP at top of ESS	Option 4: Future WTP at Big Rock Reservoir	Comment
Flood risk	1.0	1	2	2	WTP for Options 2 and 3 well out of flood zones. Option 1 potentially exposed for rare to extreme events.
Land availability	2.0	1	2	3	Will require purchase of land understood to be private land for Option 1 and Forestry Land for Option 2. Option 3 would require negligible increase in land required to be purchased for storage.
Community impact	2.0	1	3	2	Option 1 will be highly visible. Options 2 and 3 adjacent to existing infrastructure away from residential properties. Option 3 would require the regular use of roads past existing resident
Operational advantages	1.0	1	1	2	Option 3 close to storage.
Weighted Scores		18.0	**26.0**	18.0	

Appendix F Meeting Minutes

eurobodalla shire council

Eurobodalla Storage

Project Number: SMEC 30012127
Contract Number: ESC 10002151

SMEC Local People. Global Experience.

Meeting:	Eurobodalla Southern Storage		
Meeting Title:	30% Concept Design Review	**Date:**	8/5/17 and 9/5/17
Project No:	30012127	**Time**	10:00 am (Day 1) – 15:15 (Day 2)
Location:	SMEC Sydney, Level 10, 20 Berry Street		
Copies:	All attendees		
Attendees:	**SMEC:** Brian Butturini (BB), Dave Evans (DE), Cameron Purss (CP), Rod Westmore (RW), Amy Louis (AL) – Day 1 only, Hendrik van Rhijn (HvR) – Day 1 only, Frank Panetta (FP) **ESC:** Harvey Lane (HL), Brett Corven (BC), Warren Sharpe (WS) – Day 1 only **NSW PWA:** Ross Bailey (RB) **Entura:** Marius Jonker (MJ) – Day 1 only		
Apologies:			

RECORD OF DISCUSSION			
Item	**Details**	**Action by**	**Date**
1	Safety		
1.1	Safety evacuation location noted	None	
2	Introduction and Purpose of Meeting		
2.1	Discussed objectives of workshop: DE provided background of project and challenges faced on project to date.	None	
3	Volume 2 Storage Design		
3.1	RW presented staging of works, geotechnical considerations for the site and the proposed geotechnical investigations.		
3.2	CP presented the results of the hydrology and consequence assessment undertaken.		
3.3	SMEC advised that matching peak flow up to the 1 in 10 AEP flood to maintain a ‘transparent flow’ was not possible and could only be done by matching volume. The need for transparent storage was questioned. ESC advised preference is not to have a transparent storage. EIS to inform need for transparent storage. Backflow of water from Tuross River to be considered in assessment.	SMEC	EIS
3.4	MJ recommended that itinerants be considered along Eurobodalla Rd for estimation of PLL.	SMEC	Updated concept design report
3.5	SMEC recommended dam be designed with a dam crest level of EL49.4m to the top of the core (i.e. pavement on top of this). This is designed to pass the PMF and exceeds fallback flood criteria of DSC. MJ suggested only designing to fallback criteria. PMF design flood (EL49.4m for top of core) was agreed by ESC to be adopted as a conservative design level.	SMEC	Updated concept design report

RECORD OF DISCUSSION			
Item	**Details**	**Action by**	**Date**
3.6	RW presented concept design of storage including: • Embankment • Spillway • Inlet and outlet works • Access road	None	
3.7	MJ suggested shotcreteing foundation under core to address potential for piping into foundation.	SMEC	Updated concept design report
3.8	Discussion on the earthquake design criteria for the outlet tower bridge. SMEC advised that the ancillary works need to be designed consistent with the consequence category of the dam as need to be able to operate baulks in event of an earthquake.	Noted	
3.9	ESC advised that would like access bridge to outlet tower, however are concerned with the estimated costs for the structure. Bridge arrangement and cost estimate to be reviewed during detailed to optimise arrangement. Consideration to be given to the capability to deliver long T-beams to site over various river crossings near site (Clyde River, Tuross River, Narooma Bridge).	SMEC	Detailed design
3.10	ESC advised that dam would be raised based on projected water stress and not drought conditions. Therefore lowering the reservoir level during Stage 3 construction works would be available.	Noted	Updated concept design report
3.11	MJ suggested that location of outlet valve pit be reviewed based on discharge location of spillway.	SMEC	Concept
3.12	Question was asked over the volume of water required for storage within the cofferdam. SMEC response is that the volume of water for construction activity is not known and this is for the Contractor to determine. The design provides a volume of water available for construction activity, however the intent is to give the Contractor flexibility to alter the available volume, with constraints provided to ensure that the flood capacity of the cofferdam is maintained.	SMEC	Detailed design
3.13	SMEC advised that to win sufficient volume of fill from the rockfill quarry (i.e. within the storage) that the excavation will need to extend above the Stage 1 FSL level. Rehabilitation of the quarry will need to be addressed to manage stability and water quality issues.	SMEC	Detailed design
3.14	SMEC suggested that ESC maintain contact with Eurobodalla Quarry to understand how and when the Northern paddock will be worked. This is the area where the majority of potential earthfill has been identified. Eurobodalla Quarry previously removed overburden material using scrapers without any quality control. A similar approach to working the Northern paddock would present quality issues if the material is to be used as the core in the embankment.	ESC	
3.15	Clarification required on whether Eurobodalla Quarry can exceed their	SMEC	July 2017

RECORD OF DISCUSSION			
Item	**Details**	**Action by**	**Date**
	license limit to supply materials for the project.		
3.16	SMEC advised that may need stage environmental approval if clearing works were to be undertaken year(s) prior to construction of storage and ancillary works.	Noted	
3.17	Design requirement for intersection of 'Storage access road' and Eurobodalla Rd to be defined. Is this to be designed for construction vehicles or permanent traffic loads? Intersections to be designed for permanent traffic loads, with Contractor to consider temporary works required as part of traffic management plan. ESC advised that preference is for right angle intersections, rather than oblique, for line of site reasons.	SMEC	Detailed design
3.18	SMEC advised that width of storage access road is required for two-way construction vehicles. ESC advised that preference is for two-way seal on storage access road given needs to be constructed for two-way traffic.	SMEC	Updated concept design report
4	Volume 1 Ancillary Works		
4.1	BB presented on ancillary works design including: • River intake pump station • Pipelines to and from storage • Pipeline to Big Rock Reservoir • Connection to future WTP		
4.2	Design flows were confirmed to be: • River intake pump station – 26ML/d • Borefield – 6ML/d • Pipeline to storage – 26ML/d		Updated concept design report
4.3	Question was asked on the size of well required if number of pumps was reduced to three.	SMEC	Concept Design
4.4	RB advised that preference is to not use VSD pumps. To be considered in detailed design.	SMEC	Detailed design
4.5	ESC suggested removing second pipeline from storage to existing WTP. If supply is required from to WTP and need to pump to storage at the same time, can supply WTP from borefield. SMEC to review if any issues with this arrangement.	SMEC	Updated concept design report
4.6	SMEC advised that the proposed arrangement to have the pipeline within the storage access road was utilising the width required for the two-way construction vehicles. ESC is OK with having pipelines within access road.	Noted	
4.7	SMEC advised that can only design pipelines to Big Rock Reservoir as don't know the water levels at the future WTP.	Noted	
4.8	RB advised that pipeline route to storage inlet to too high. SMEC agreed with this and it is to be updated to at the Stage 3 dam crest level.	SMEC	Updated concept design

RECORD OF DISCUSSION

Item	Details	Action by	Date
			report
4.9	A 'T' fitting to be provided into future pipeline to allow for existing pipeline to Big Rock Reservoir to continue to operate if needed.	SMEC	Detailed design
5	River Intake Pump Station		
5.1	BB presented options for river intake location including: • Adjacent to existing river intake pump station (current design) • Alternative location behind existing WTP • Alternative location upstream and downstream of existing WTP (not preferred) ESC/ NSW PWA to inspect area behind existing WTP – this was undertaken subsequent to meeting and found to not be suitable location. An alternative dry well arrangement was put forward by ESC/ NSW PWA. Issues with purchasing land if location is changed.	ESC/ NSW PWA	
5.2	BB presented options for river intake arrangement including: 1. Wet well with self cleaning screens 2. As for option 1 but with vertical turbine pumps 3. Vertical turbine or centrifugal pump on incline (no wet well) 4. Rising pipe with internal pump – inflatable casing packer	Nil	
5.3	ESC advised that using a Johnson Screen at another side no problems have been reported. When purging Johnson Screens, waterway needs to be cleared due to buoyancy issues.	Noted	
5.4	Agreement that Options 1 and 4 were preferred, however final decision is dependent on geotechnical conditions. Concept design is to be closed out based on current design with Johnson Screen (Option 1).	SMEC	Updated concept design report 16/6/17
5.5	SMEC to submit Volume 1 report again for review by ESC/ NSW PWA	SMEC	Updated concept design report 16/6/17
6	Cost Estimate		
6.1	Some details of cost estimate were worked through, specifically for outlet tower access bridge and access roads.	Nil	
6.2	ESC have recent experience for another project with ~\$180/m^2 for a gravel road.	Noted	
6.3	Cost estimate for river intake pump station to be based on assumed ground conditions.	SMEC	30% project estimate
6.4	Cost estimate to provide explanation for change in costs from original cost	SMEC	30%

RECORD OF DISCUSSION			
Item	**Details**	**Action by**	**Date**
	estimate. E.g. increased volume, new items etc.		project estimate
7	Safety in Design		
7.1	FP presented on Safety in Design and procedure for CHAIR 1 process	Nil	
7.2	HSiD Risk Register was filled out during workshop to identify hazards associated with Storage and Ancillary Works. Risk register to be completed and distributed for comment.	SMEC	16/6/17

Attachments:

- Presentation slides

Eurobodalla Southern Storage

30% Project Review/ Concept CHAIR Workshop

8 and 9 May 2017
Project No. 30012127

Safety Evacuation

Vol 2 Storage Agenda

- **Introduction**
  - Project Outline
  - Staging of Works
- **Geotechnical Summary**
- **Hydrology and Consequences**
- **Features of Concept**
  - Embankment
  - Spillway
  - Outlet
  - Access
  - Destratification
  - Cost estimate

Staging of Works

- **Eurobodalla Southern Storage (ESS) constructed in 3 stages**
  - Stage 1 (2023): Offstream storage and associated inlet and outlet works
  - Stage 2 (2030): New WTP at storage and associated pump stations
  - Stage 3 (2070 plus): Increase storage capacity

Stage	Dam Infrastructure	Ancillary Infrastructure

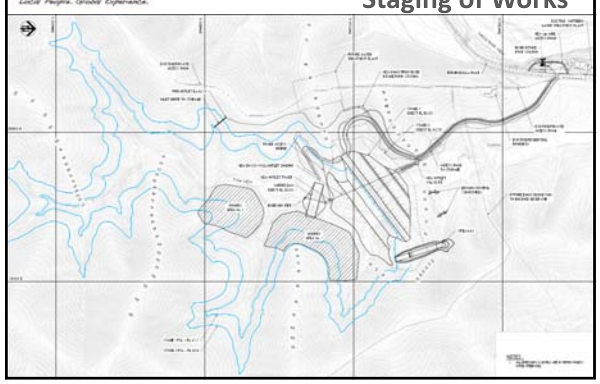
1	• 3,000ML offstream storage (ESS)
	• Embankment dam
	• Inlet chute/dissipator
	• Outlet works
	  • Multi-level intake tower
	  • Outlet conduit
	  • Outlet regulating structure
	• Spillway
	• Services to ESS
	  • Road
	  • Power supply
	  • Catchment fencing
		• New river intake pump station on the Tuross River
		  • Connection to existing borefield
		• New Pipeline (Segment A) to ESS
		• New Pipeline (Segment B) from ESS to existing WTP balance tank

Staging of Works

Stage	Dam Infrastructure	Ancillary Infrastructure
2		• New WTP at ESS, 25 ML/d capacity • New pump station – transfer ESS to new WTP • New pump station – transfer WTP to Big Rock Reservoir • Decommission existing WTP

3	• Increase ESS capacity to 8,000 ML
	  • Raise embankment
	  • Construct new spillway
	  • Raise intake tower and tower bridge	

Staging of Works



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Geotechnical Investigations and Construction Materials

- **Previous Concept Design Geotechnical Investigations (DoC 2005/2006)**
  - Functional Design
    - Dam Site investigations
    - Material sources
  - Concept Design
    - Material sources
    - Reservoir perimeter
- **Recent Concept Design Geotechnical Investigations (SMEC)**
  - Additional Eurobodalla Quarry – Earthfill Source
    - Confirm available materials
    - Sample for testing of blended material

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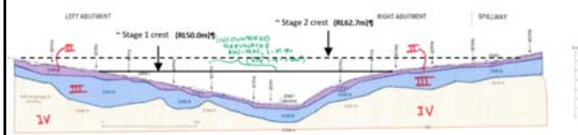
Geotechnical Investigations and Construction Materials

- **Storage Site Investigations (DoC 2005/2006)**
  - Argillite and Greywacke (essentially siltstones)
  - Refusal at 2m, XW-HW (Zone I)
  - HW to MW at 6m (Zone II, seismic) (12m on left abutment)
  - MW to SW at 20m (Zone III)



I – Surficial zone (typ 0.5m-1.5m and up to 3.5m depth) comprising shallow soil profile (typ<0.5m), XW-HW rock (typically argillite)

II – Typically persist to 6m depth and up to 12m on left abutment. Comprises HW-MW rock (typ argillite)

III – Typically extends to 18m-20m and up to 35m on upper left abutment. Comprises MW-SW rock (typ argillite) with more weathered beds (HW) in upper portion and expected fresh rock in lower portion

IV – Expected to be fresh rock

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Geotechnical Investigations and Construction Materials

- **Site Geotechnical / Geological Features**
  - Bedding sub-vertical dip, striking approx north-south
  - Primary joint set sub-vertical dip, striking approx east-west
  - Shear zones on bedding surfaces (up to 1m wide)
  - Groundwater not encountered
  - Expect rock to be readily rippable to 6m, more difficult to 20m (2,000m/s) (subject to defect spacing)
- **Bank foundation (Zoned Earthfill)**
  - Strip 0.5 to 0.75m (to XW)
  - Core trench additional 2m min (target MW)
  - Grout curtain

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Geotechnical Investigations and Construction Materials

- **Construction Materials**
- **Site Materials**
  - No suitable clay materials for Zone 1
    - Colluvium/alluvium, clayey silt, dispersive
    - Limited quantity, not feasible
  - Surface materials above valley, clayey silt, thin profile, Emerson Class 5
  - Rock quarry in upstream ridges
    - HW-MW rock, expect weak to medium strong (MW)
    - Breakdown to gravelly sand/silt (excess fines) with cobbles (depending on handling)
      - 2006 concept, heavy compaction into 150mm layer
      - Soil-like properties (silt/sand matrix)
  - Conclude: Shoulder materials only material sourced on site

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Geotechnical Investigations and Construction Materials

- **Zone 3 Shoulder Fill**
  - Potential Issues:
    - Potential breakdown under handling/compaction, unconfirmed
    - Ability to achieve an homogeneous fill, unconfirmed
    - Compatibility with filter zones, unconfirmed
    - Stability and water quality impacts of exposed batters, unconfirmed
    - Feasibility of quarrying less weathered rock:
      - Limit quarry operation to below Stage 3 FSL (RL60.3m)
        - » Increase surface area and/or depth of excavation
        - » Increased depth unlikely, as cut slopes in top 2m to 6m may need to be flat
      - Generate large quantity of XW-MW rock, can it be used?

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Geotechnical Investigations and Construction Materials

- **Off-Site Materials**
  - Clay materials for Zone 1
  - All filter, drainage and erosion protection materials
- **Clay for Zone 1**
  - Sources: Eurobodalla Quarry, Spring Water Quarry
    - Both quarry OB
    - Similar characteristics high plasticity residual soils (blending required)
  - Eurobodalla Quarry
    - residual clay over EW-HW Dolerite
    - Clay: high plasticity (CH), Emerson Class 1 & 2 (Dispersive)
    - Blend (approx. 50:50): CH, silty clay with sand/gravel
    - Reserves of blend (2017), up to 150,000m^3, expandable to 175,000m^3 if extend borrow beyond current proposed extension of extraction lease (estimated Zone 1 for Stage 1, 107,000m^3)
    - Issue: Reserves adequate for Stage 1, insufficient for Stage 3

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Geotechnical Investigations and Construction Materials

- **Filters, drainage, rip rap**
  - **Fine Filter (2A)**
    - Alluvial sand/gravel best for dispersive clay
    - Spring Water Quarry (42km)
  - **Coarse Filter / Drainage (2B)**
    - Processed quarry rock
    - Eurobodalla Quarry – Dolerite (approved for concrete aggregate)
  - **Rip Rap & bedding**
    - Processed quarry rock (2006, 500mm thick, hence D50 approx. 300mm)
    - Eurobodalla Quarry – Dolerite

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Geotechnical Investigations and Construction Materials

- **Proposed Geotechnical Investigations**
  - Embankment and spillway foundations
    - Rock structure and permeability
  - Quarry areas inside storage
    - Rock structure and quality
  - Ancillary works
    - Foundation and excavation conditions

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Geotechnical Investigations and Construction Materials

- Proposed Geotechnical Investigations

Structure	Proposed Investigations	Objectives
Embankment and Outlet	• Core drilling along centreline and at outlet structures • Installation of piezometers • Water pressure testing • Trench along centreline and test pits • Seismic Refraction • Rock Mapping	• Rock/soil structure, strength, composition. • Foundation seepage behaviour and permeability. • Understanding slope stability, excavation batters. • Excavatability and depth for foundation and core trench • Foundation conditions (tower) • Degree of weathering and suitability for usage within embankment.

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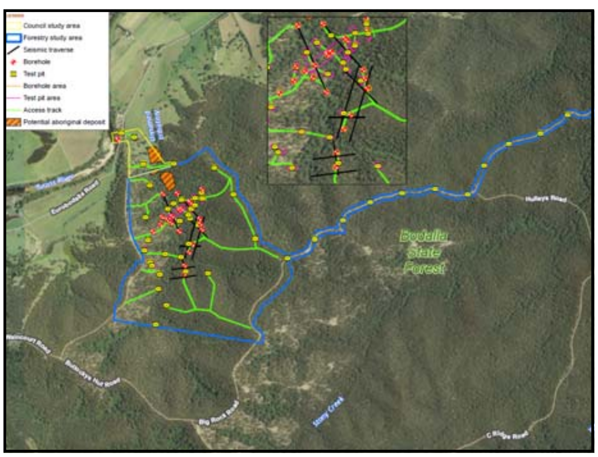
Geotechnical Investigations and Construction Materials

- Proposed Geotechnical Investigations

Structure	Proposed Investigations	Objectives
Spillway and Proposed Quarry Areas	• Test Pitting • Core drilling • Seismic Refraction • Rock Mapping	• Rock/soil structure, strength, composition. • Rock erodibility. • Degree of weathering and suitability for usage within embankment. • Understanding slope stability, excavation batters. • Excavatability
Storage Area	• Test Pitting	• Dispersion of surface soils
Ancillary Structures • Pipelines, roads	• Test Pitting	• Excavatability. • Foundation conditions.



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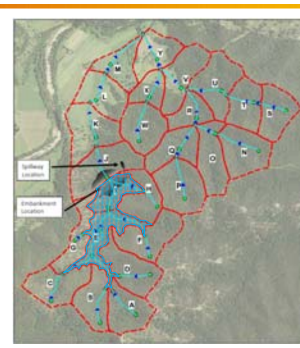
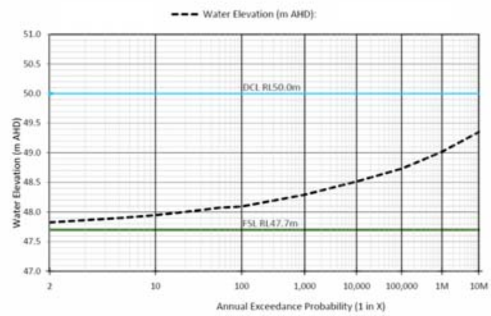
Hydrology



Hydrology

AEP (1 IN X)	Peak Storage Elevation (m)	Inflow (m^3/s)	Inflow Critical Duration (hrs)	Peak Outflow (m^3/s)	Outflow Critical Duration (hrs)
2	47.8	15.4	0.33	2.4	9
5	47.9	23.0	0.33	3.7	9
10	48.0	28.5	0.25	4.7	9
20	48.0	34.2	0.25	5.7	9
50	48.1	40.8	0.33	8.3	12
100	48.1	48.5	0.25	9.1	9
1,000	48.3	126.5	0.25	16.4	9
10,000	48.5	188.1	0.25	24.9	9
100,000	48.7	261.4	0.25	37.1	9
1,000,000	49.0	333.2	0.25	53.4	3
10,000,000	49.4	390.0	0.25	76.1	3
PMF	49.4	390.0	0.25	76.1	3

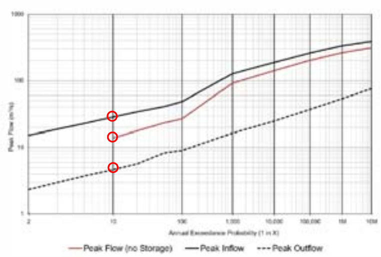
Hydrology



Transparent Storage

Transparent Flow

- Required?
- Flow or volume?



Transparent Storage Design Criteria

- Transparent Storage

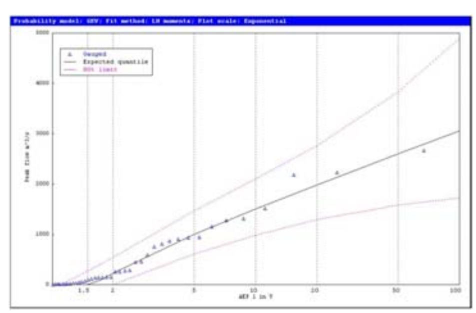
Design Criteria	Reference/Comment
Rainfall runoff from storage catchment, up to 1:10 rainfall event, to be released to natural watercourse	Requirements to be confirmed by Environmental studies. Interpretation: • Flow out of storage over 24 hour period to match catchment flow into reservoir. • Peak inflow retarded by storage. Operational Response: • Determine net inflow due to rain, via volume balance in reservoir • Regulate release to creek to pass net inflow (control by PLC at valve pit)

Hydrology

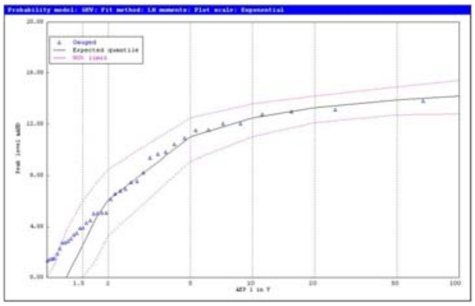
Coincident flooding

- Tuross River catchment 1,586 km²
- ESS catchment 1.6 km² (0.1%)
- Uncertainty over probability and timing of floods
- We know cannot be a convective storm of this size (PMF U/S of ESS and Tuross)
- Considered coincident floods 1 in 100 AEP (potential edge of development) in Tuross River with sensitivity of 1 in 1 AEP

Hydrology



Hydrology



Dam Break Assessment

Breach Parameters

Breach Characteristic	ESS		Cofferdam
	Adopted Value	Sensitivity	Adopted Value
Time for breach development (hour)	3	1	
Breach Side Slope (Y horizontal in 1 vertical)	0.5	NA	0.5
Breach Base Elevation (m AHD)	16	NA	18
Bottom width (m)	13	25 - 69	20

Dam Break Assessment

SDF

Dam Break Assessment

PMF without Breach

PMF and Breach

Dam Break Assessment

PLL

Consequence	Modelled Scenario		
	PMF	Sunny Day	Cofferdam (DCF)
Breach PAR	55	0.0	55
No Breach PAR	55	0.0	55
PAR Incremental	**0.0**	**0.0**	**0.0**
Breach PLL*	0.55 (0.13)	0.00 (0.00)	0.55 (0.20)
No Breach PLL*	0.01 (0.13)	0.00 (0.00)	0.011 (0.12)
PLL Incremental*	**0.54 (0.001)**	**0.00 (0.00)**	**0.54 (0.08)**
Breach Damage Cost	$46.9 M	$40.3M	$17.8 M
No Breach Damage Cost	$16.9 M	$0.0 M	$16.6 M
Damage Cost Incremental	**$30.0 M**	**$40.3 M**	**$1.2 M**

* - Number is brackets represent PLL computed using the alternative methodology

Dam Break Assessment

Consequence Category – sensitivity

Event	Breach Width (m)	Breach Time (hr)	Severity	PLL*	Consequence Category
PMF - Adopted	13.4	3 (top portion 0.3)	Major	0.001	Significant
PMF - Breach Time Check	13.4	1 (top portion 0.3)	Major	0.010	Significant
PMF - Breach Width Check	25	3 (top portion 0.3)	Major	0.006	Significant
PMF - Breach Width Check	69	3 (top portion 0.3)	Major	0.014	Significant

Dam Break Assessment

EUROBODALLA SOUTHERN STORAGE SUNNY DAY DAMAGE AND LOSS		Minor	Medium	Major	Catastrophic
TOTAL INFRASTRUCTURE COSTS	COST ESTIMATE				
Residential	$ M				
Commercial	$ M				
Community infrastructure	$10 M				
Dam replacement or repair cost	$[illegible] M				
Total Estimated Cost	**$ [illegible] Million**		x		
IMPACT ON DAM OWNER'S BUSINESS					
Importance to the business			x		
Effect on services provided by the owner			x		
Effect on continuing credibility				x	
Community reaction and political implications				x	
Impact on financial viability				x	
Value of water in storage			x		
HEALTH AND SOCIAL IMPACTS					
Public health		x			
Loss of service to the community		x			
Cost of emergency management		x			
Dislocation of people		x			
Dislocation of businesses		x			
Employment affected		x			
Loss of heritage		x			
Loss of recreational facility		x			
ENVIRONMENTAL IMPACTS					
Stock and fauna		x			
Ecosystems		x			
Rare and endangered species		x			
OVERALL					
Highest level of severity of damage and loss		Major			

Dam Break Assessment

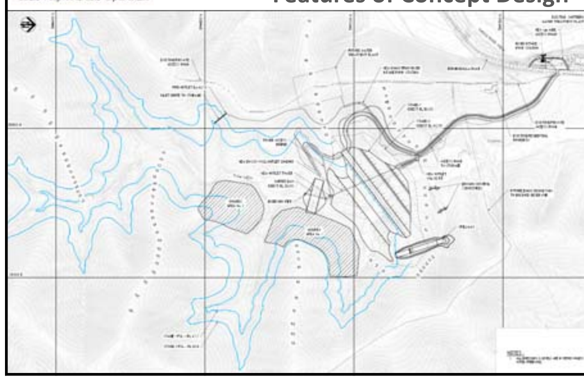
Consequence Category

Event	Severity	PLL*	Consequence Category
PMF (Graham, 1999)	Major	0.54	High C
PMF (alternative)	Major	0.001	Significant
Sunny Day (Graham, 1999)	Major	0.00	Significant
Sunny Day (alternative)	Major	0.00	Significant
Cofferdam (DCF) (Graham, 1999)	Minor	0.54	Significant
Cofferdam (DCF) (alternative)	Minor	0.09	Very Low

Dam Crest Level

Flood Capacity	Flood Level (m AHD)	Freeboard (Based on DSC3B) (m)	Embankment Crest Level (m AHD)	Comment
PMF	49.36	0.6	50.00	Design Criteria
1 in 10,000 year	48.51	0.3	48.81	Fallback freeboard based on Significant Consequence Category.

Features of Concept Design

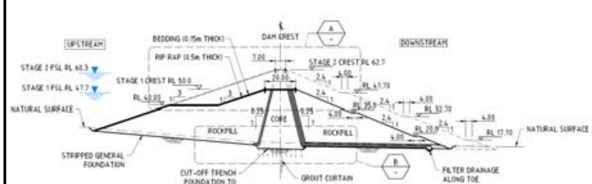


Features of Concept Design

- **Embankment - Alternatives**
  - Four types of embankment dams considered
    - Roller Compacted Concrete Dam
    - Zoned Earth and Rockfill Embankment with Central Core
    - Zoned Earth and Rockfill Embankment with Sloping Core
    - Concrete Face Rockfill Dam
  - Adopted Embankment dam
    - Zoned Earth and Rockfill Embankment with Central Core
      - Central core, 0.25H:1V side slopes (0.5H:1V nominal core width, minimum)
      - 3-stage filters on downstream (2A fine, 2B coarse, 3A transition)
      - Single stage transition upstream (2C broad grading)
      - Rockfill shoulders (3:1 U/S and 2.4:1 with berms D/S)(assumes "soil like" properties)
      - Rip Rap with bedding upstream erosion protection
      - Crest capping
    - Stage 1 bank – Truncation of Stage 3 profile

Features of Concept Design

- **Central Core Embankment**



- Upstream shoulder, partial construction of Stage 3
  - RL40 – provide sufficient stored water to maintain supply (1000 ML), noting Stage 3 implementation triggered by reduced security of supply
- Downstream shoulder, no construction of Stage 3
  - Unrestricted access will be available to construct from foundation

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Embankment Design Criteria

- Embankment

Design Criteria	Acceptance Criteria	Reference/Comment
Static Slope Stability	Industry Standards for Construction, FSL, flood surcharge, rapid drawdown	Well established criteria Upstream shoulder for Stage 2 Downstream shoulder for Stage 1
Earthquake Stability under Safety Evaluation Earthquake (SEE)(MDE)	Maintain function Acceptable safety factor post earthquake Acceptable crest settlement post earthquake	NSW DSC3C criteria ANCOLD (1998 / 2018?) Earthquake Design
Filter Criteria	No erosion for critical (downstream) filters Limit erosion for upstream filters	Fell et al (2015)
Freeboard	Function of consequence category Retain design flood Prevent wave overtopping	NSW DSC3B criteria ANCOLD (2012) Consequences ANCOLD (2000) Acceptable Flood

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Features of Concept Design

Spillway Concept

- **Stage 1**
  - Stage 1 spillway on right abutment
  - Concrete lined trapezoidal chute
  - Discharging to natural gully with cascading gabion overflow weirs
- **Stage 3**
  - Excavate and construct Stage 3 bank over alignment.
  - Stage 3 spillway higher on right abutment

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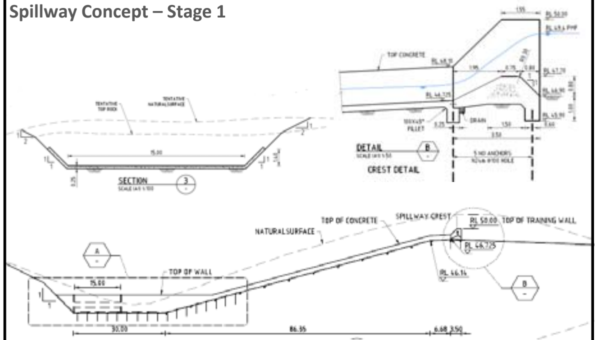
Features of Concept Design

Spillway Concept – Stage 1



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Design Criteria

- Flood Capacity (Spillway)

Design Criteria	Acceptance Criteria	Reference/Comment

Acceptable Design Flood	Function of Consequences of Failure
	• Flood: Significant
	• Sunny day: Significant
	• AFC: 1 in 10,000AEP
	• Design Flood (Adopted): PMF
	  • New dam
	  • Projected development/growth
	  • ALARP
		NSW DSC3B criteria
		ANCOLD (2012) Consequences
		ANCOLD (2000) Acceptable Flood

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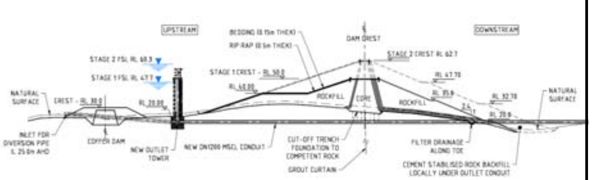
Features of Concept Design

Outlet Concept

- Stage 1
  - Relocated to left abutment
  - Cut and cover, concrete encased conduit (Stage 3 footprint)
  - Tower: Wet, multi-level offtakes (Stage 1 height)
  - Access bridge from left abutment
- Stage 3
  - No conduit works
  - Raise tower and bridge



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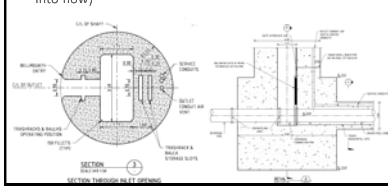
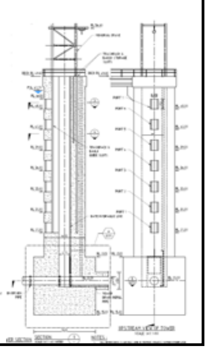
Features of Concept Design

Outlet Concept – Tower

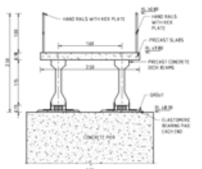
- Stage 1 height only
- Interchangeable baulks and trash racks in single slot
- Expect group of 3 offtakes to have trashracks for water quality and water level fluctuation
- MOL 27.4, 0.4m over lowest offtake sill
- Submerged penstock guard gate in tower base (closure into flow)

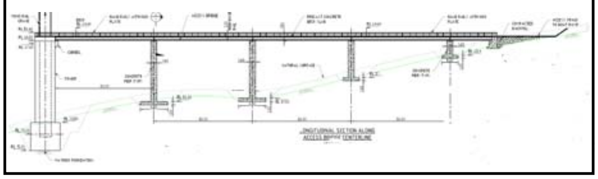



Features of Concept Design

Outlet Concept – Tower Bridge

- Stage 1 height
- Raise and extend for Stage 3 (jack off piers)
- Pedestrian and maintenance trolley access
- Beams could be steel or prestressed concrete





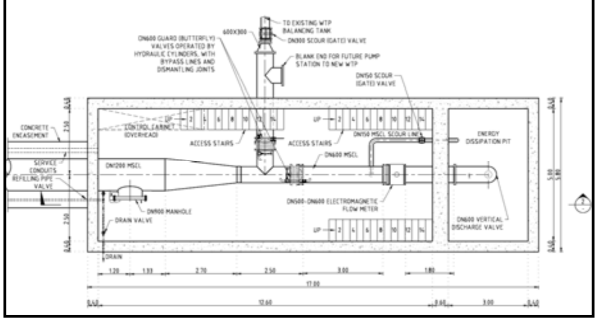
Features of Concept Design

Outlet Concept – Valve Pit

- Open pit with security fencing and access
- Equipment installation/maintenance by mobile crane
- Stairs for easy access (with tools etc)
- Single vertical discharge valve (in lieu of 2 cone valves)
  - Larger operating (flow) range
  - Hydraulic actuation
- Butterfly isolation valves, close into flow
  - Hydraulic actuation (or electric)
- Electromagnetic flowmeter

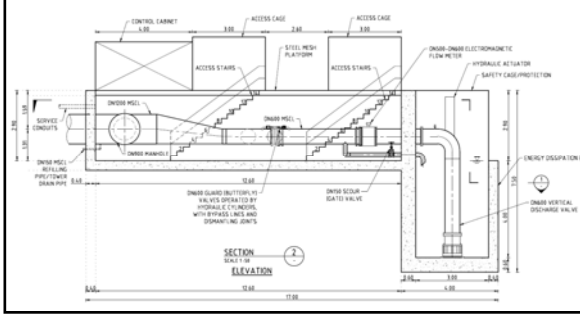
Features of Concept Design

Outlet Concept – Valve Pit



Features of Concept Design

Outlet Concept – Valve Pit



Design Criteria

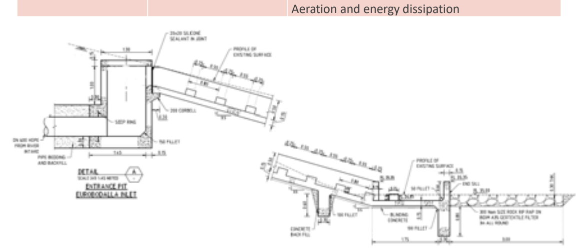
- Outlet Works

Design Criteria	Acceptance Criteria	Reference/Comment
Minimum Operating level	RL27.4	• Lowest level to meet delivery to existing WTP balance tank • 400mm over invert of lowest intake
Operation - Flow	Stage 1: 6 ML/d Stage 2 & 3: 25 ML/d	Existing WTP New WTP (required peak inflows to WTP to be confirmed, to ensure outflow of 25ML/d over 23hrs)
Emergency drawdown	USBR (1990) drawdown	
Cofferdam Diversion	Pass 1:10 AEP flood	Selected based on risk and ability to manage risk during construction. No third party consequences (very low consequence)

Design Criteria

- Inlet Works

Design Criteria	Acceptance Criteria	Reference/Comment
Discharge chute	26 ML/d	Peak transfer from new Tuross River pump station Aeration and energy dissipation



Design Criteria

- Instrumentation

Design Criteria	Proposed
"Significant" Consequence Category	**Storage (at tower)** Rainfall (T) Temperature (T) **Embankment** Seepage (flow, chemistry) Pore Pressure (piezometers) Surface Movement (vert, horiz) **Tower** Reservoir level (sensor (T) in stilling tube + external gauge boards) Water Quality (T) Telemetry, transfer to base

TABLE 5.3 GUIDE FOR "IN SERVICE" DAM MONITORING FREQUENCIES[1]

Monitoring	Hazard Category				
	Very Low	Low	Significant	High	Extreme
Rainfall	Monthly[2]	Monthly	Twice Weekly to Weekly (TC)[2]	Daily to Tri Weekly (TR)[2]	Daily (TR)[2]
Storage Level	Monthly[2]	Monthly	Twice Weekly to Weekly (TC)[2]	Daily to Tri Weekly (TR)[2]	Daily (TR)[2]
Seepage	Monthly[2]	Monthly	Twice Weekly to Weekly (TC)[2]	Daily to Tri Weekly (TC)[2]	Daily (TR)[2]
Chemical analysis of seepage[4]			Consider	Consider	Consider
Pore pressure[3]		Consider	3-Monthly to 6-Monthly	Monthly to 6-Monthly	Monthly to 3-Monthly
Surface movement, control[4]				5-Yearly to 10-Yearly	5-Yearly
Surface Movement, normal		Consider	Consider	2-Yearly	Yearly
Internal movement/stresses[3]			Consider	2-Yearly	Yearly
Seismological[3]				Consider (TR)[2]	Consider (TR)[2]
Post-tensioning[3]			10-Yearly	5-Yearly to 10-Yearly	5-Yearly

Destratification

Considered three systems:

1. **Bubble plume system**
   - Compressed air system
2. **SolarBee (Medora)**
   - Surface mounted impeller
3. **ResMix (WEARS Australia)**
   - Surface mounted impeller

Destratification

	Bubble Plume	SolarBee (Medora)	ResMix (WEARS)
Performance	Good	Reported issues	Good
OH&S ranking	1	3 (monthly maintenance)	2 (annual maintenance)
Capital Costs	$450k	$216k	$180k
Operational Costs (pa)	~$50k	~5k	~10k

Design Criteria

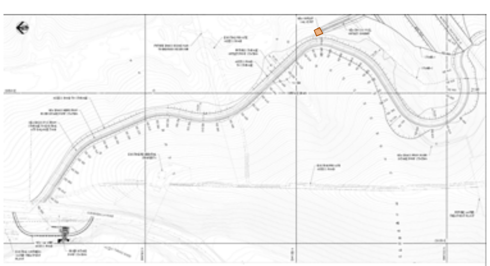
- Access Roads

Design Criteria	Reference/Comment
Construction access	Storage and WTP Construction
Long term operational access Austroads/ESC low speed, low traffic volume road design criteria	• Haulage of imported materials to bank and stockpiles • 2 lane to suit road trucks and trailers, two way traffic • 2 x 4m lane width plus shoulder • Vertical grade flatter than 1 in 7 • After Stage 1 construction, seal single lane for maintenance traffic

- Boat Ramp

Design Criteria	Reference/Comment
NSW Boat ramp facility Guidelines	• Vertical grade flatter than 1 in 7 • Width 4.5m • Base at RL33 for WL34 minimum access

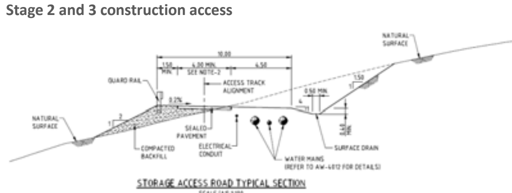
Access Track



Access Track

Vehicular loading:

1. Two-way construction vehicles
2. Operational vehicles 'Minor road' <250vpd
3. Public access?
4. Stage 2 and 3 construction access



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Cost Estimate

Item		Cost ($)
	Storage construction costs	
1	Clearing and Fencing	$0.4M
2	Access Roads	$1.4M
3	Environmental Management	$0.3M
4	Diversion & Watering	$3.6M
5	Inlet Works	$0.1M
6	Outlet Works	$4.7M*
7	Main Wall	$28.1M
8	Spillway	$2.4M
9	Water Quality	$0.3M
	TOTAL DIRECT COSTS	$41.3M
	Site overheads include mobilisation (30% of Direct costs)	$12.4M
	Contractor's Margin (12.5% of Contractor's costs)	$6.7M
	Site supervision	$2.4M*
	PM and contract admin (2% of contractor and supervision costs)	$1.3M*
	Land costs	$3.1M
	SUBTOTAL PROJECT COSTS	$67.1M
	Contingency (15%)	$10.1M
	TOTAL STORAGE CONSTRUCTION COSTS	$77.2M

Eurobodalla Southern Storage

Concept Design - Ancillary Works Design

8 May 2017
Project No. 30012127

Safety Evacuation

Agenda

Day 1

- Introduction
- Review existing facilities
- Presentation of the Concept Design – Stage 1
  - River Intake Pumping Station
  - Pipelines to and from storage
- Presentation of the Concept Design – Stage 2
  - Pipeline to Big Rock Reservoir
  - Connection to the future WTP
- Review updated options for the River Intake Pumping Station

Introduction

Introduction

Why are we here

- Focus on Ancillary works
- Review concepts presented
- Review options update on river intake pumping station, review MCA and agree decision matrix scores – preferred option.
- Confirm criteria for detailed design, civil, mechanical, electrical, controls
- Chair of option

Introduction

What are we trying to achieve

- Agree preferred option for the river intake pumping station
- Ancillary system configuration to allow design to proceed for:
  - intake & pumping system
  - pipework for delivery of river water to storage,
  - pipework to connect to existing and future WTP
  - pipework to supply Big Rock Reservoir

Introduction

Ancillary work drivers (revisit from 20% workshop)

- Correct sizing of intake, pumps and pipes
- Minimise environmental disturbance
- Minimise cost of construction
- Correct staging
- Constructability
- Minimise operational maintenance OH&S risks
- Optimised operational maintenance $

Ancillary system which is reliable, covers all operational needs and can be easily inspected and maintained.

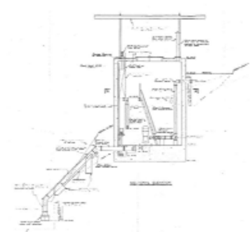
Review of Existing Facilities

Existing Borefield

- Good performance to date
- Agreed to retain and continue to use
- Connect directly to river intake pumping station
- Operational maintenance of pumps not reviewed?

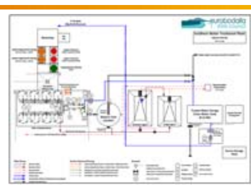
- Can be sustained up to 6.9 MLD if good operation maintenance occurring. (GHD Report – Aug 2007)

River offtake



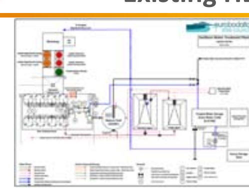
- Existing structure will not be used, needs to be decommissioned and demolished

Existing Water Treatment Plant



- Continue to use going forward
- Used when water quality permits, borefield or storage
- Process to be upgraded by addition of new process stream if water quality from storage not suitable
- Suitable redundancy in water supply system to provide the time to upgrade the treatment process if this is required

Existing HLPS & Pipeline



- 2 centrifugal pumps at 86 l/s (2 duty)
- Building, electrical and communication system are dated
- Fed from Treated Water Storage, 1.2 hours storage
- No reported issues with the pipeline

- Continued use untill Stage 2 of project commissioned
- Will retain pipeline and continue to use if condition OK

Abstraction licence

Alignment on river yield

- 20% workshop agreed 20 MLD for river intake and 6 Mld for borefield?
- Comments back on concept design – 26 MLD for river intake
  - Flow to storage could be
    - 6 MLD from boreholes
    - Up to 20 MLD river intake
    - 20 MLD river intake and 6 MLD boreholes
    - 26 MLD river intake

Alignment on delivery flows

- 20% workshop agreed 26 MLD from river intake to storage (pumping 24 hrs/day)
- 20% workshop agreed 25 MLD from future WTP to Big Rock Reservoir (pumping 22 hrs/day)

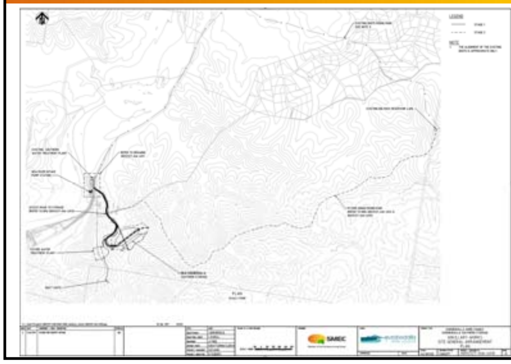
Concept Design of Ancillary works

Purpose of Concept Design

- Develop an integrated concept
- Update previous concept to latest standards
- Allow peer review
- Provide concept report
- Review and update the project estimate
- Incorporate identified environmental and legislative impact assessments
- Identify construction and operational risks
- Allow Principal, as end user to concur to the proposed concept

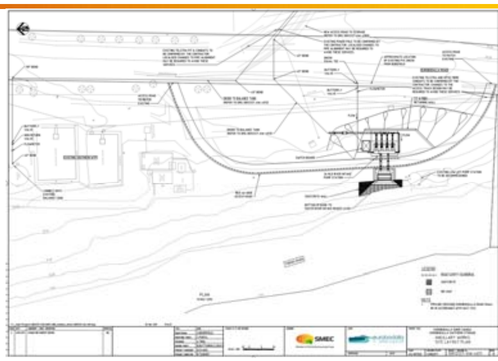
Ancillary Concept

Overall layout

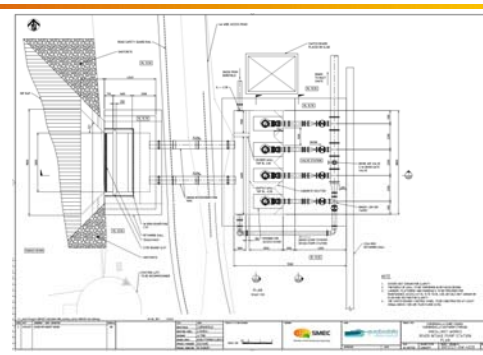


Raw Water Pumping

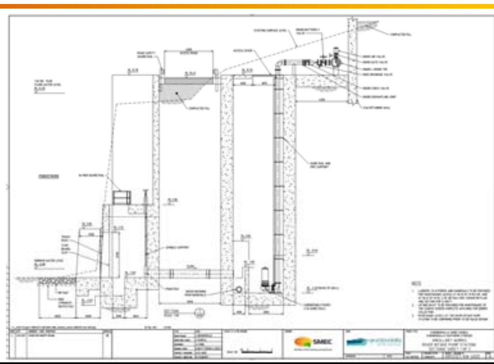
River Intake Pumping Station



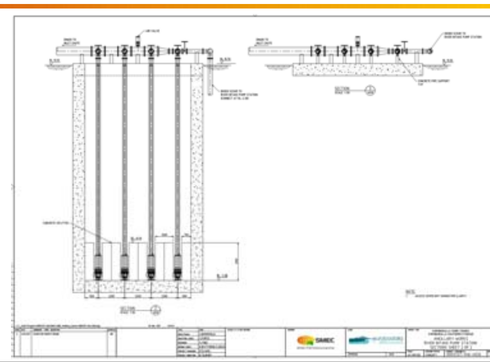
River Intake Pumping Station



River Intake Pumping Station



River Intake Pumping Station



River Intake Pumping Station

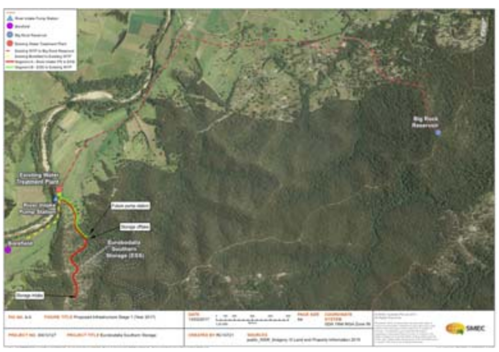
Table 13: Summary of ancillary works

Asset	Component	Description	Comments
River Intake	Structure	Wet well installation	• Requirement for reinforced concrete constructed under saline conditions • Deep excavation is required • Heavy structural weight to counter buoyancy
	Screen	Coarse screen type with clear opening of between 50 to 150mm	• Regular maintenance and working at heights • Potential for smaller marine life and debris to pass through
	Slot board slots	Allocation for insertion of 200mm thick panels	• Potential difficulty in placing the panels due to debris settlement at the bottom of the slot
	Handrails, platform and stairs for access to coarse screen for maintenance	Compliance with AS1657	• Multiple landing platforms required due to the depth of the structure
	Sediment collection pit	Prevent downstream sediment loading at the penstocks	• Extensive maintenance
	Penstocks	3 nos. DN600 penstocks	• Require maintenance personnel to operate at 1.0m mAHD
	Shotcrete	Reinforced shotcrete to prevent localised scouring	• Difficulty in installation during high river flows
	Rip-rap	Prevent localised scouring at the toe of the structure	• Difficulty in installation during high river flows
Pump Station Wet Well	Pumps	Submersible type complete with guide rail for easy removal during maintenance	• 3 duty and 1 standby configuration • Variable speed drives • Each pump with capacity of 8.6 ML/d?
	Weir Structure	Prevents sediments from entering the pumps and slows down the velocity entering the pumps	
	Pipes	DN300 pipes and fittings	• Pipes and fittings must be suitable for analysed water quality

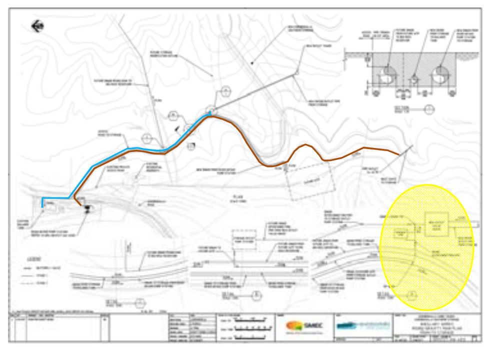
Asset	Component	Description	Comments
	Concrete splitters	Place to reduce turbulence at the pump intake and improve hydraulic flows	
	Retaining wall	3.5m high reinforced concrete retaining wall	
	Control panel	Weather proof type	• Placed at surface level above the 1 in 100 AEP flood level
	Culvert	2 nos. reinforced concrete culvert (class 4)	• Rubber ring jointed

Pipelines to and from Storage

Overall layout Stage 1



Overall layout



Summary

Asset	Component	Description	Comments
	Concrete splitters	Place to reduce turbulence at the pump intake and improve hydraulic flows	
	Retaining wall	3.5m high reinforced concrete retaining wall	
	Control panel	Weather proof type	• Placed at surface level above the 1 in 100 AEP flood level
	Culvert	2 nos. reinforced concrete culvert (class 4)	• Rubber ring jointed
Access Road	Road safety guard rail	RMS approved type	• Placed on both sides of the road
	Pavement	Suitable for ESC maintenance vehicle	
	Road	Utilises the existing access road	• Placed on mostly fill • Connects to existing Eurobodalla Road south of the site to allow for one way vehicle path • Potential relocation of existing utilities (i.e. Telstra optic fibre) due to construction of road
Pipeline River Intake Pump Station to ESS	Size	DN710	
	Capacity	26 ML/d	
	Type	HDPE PN16	
	Joint	Butt welded	
	Length	Approximately 1337m	
Pipeline ESS to Balance Tank (at Southern WTP)	Size	DN300	
	Capacity	8 ML/d	
	Type	PVC RRJ PN6 Pressure Pipe	
	Joint	Rubber ring jointed	
	Length	Approximately 900m	
	Pump	8ML/d temporary pump	• To be used during low reservoir levels in ESS (<35.00 mAHD)

Incorporation of existing WTP

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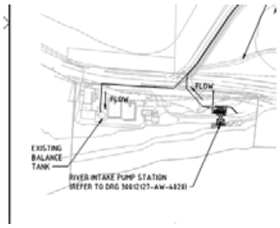
Incorporation of existing WTP



The existing WTP will be retained until the Future WTP is commissioned

Existing pumping station and rising main used to feed Big Rock Reservoir

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Treated water pipeline to Big Rock Reservoir

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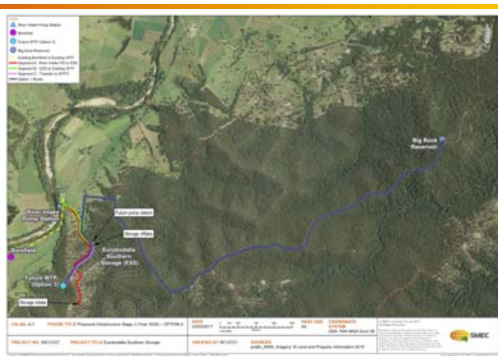
Overall layout of Stage 2



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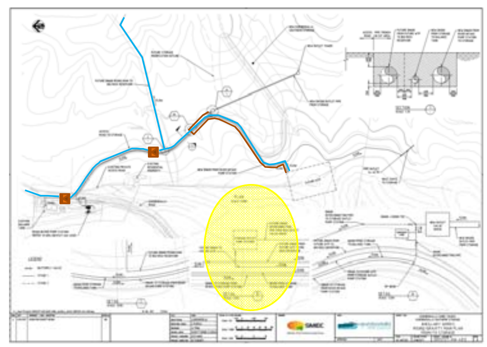
Overall layout



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Big Rock Reservoir

- Currently has the capacity to hold 4.6 ML treated water

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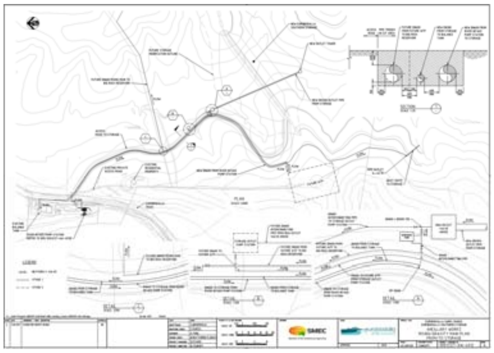
Siting of Future WTP

Plan of future WTP location



Discussion

- Clarifications ?
- Aspects to be taken forward to detailed design

Alternative options for River Intake Pumping Station

Eurobodalla Southern Storage

River Intake Pumping Station – Options update

01 May 2017
Project No. 30012127

Introduction

At the 20% workshop it was agreed to proceed on Option 7 – wet well offset from river bank.

- Option 7 has been developed and presented in the concept design report.
- However, during concept design development it became apparent that Option 7 will be more difficult to construct than initially though, leading to higher capital costs.
- Also manual cleaning of the inlet screen will present OH&S risks which need mitigation.

Way forward

- Present an alternative inlet screen configuration to mitigate the OH&S risks associated with manual cleaning of the screen
- Revisit whether Option 7 is still the preferred option by presenting a simple options analysis to reduce construction risks and capital costs. Preferred option to be recommended based upon the construction and operational Pro's and Con's supported by a simple MCA analysis.

Topics

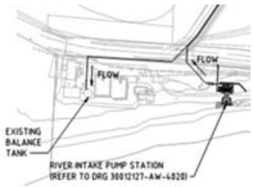
Location

- As presented in the concept design
- At the existing WTP close to existing buildings

Options for river intake pumping station

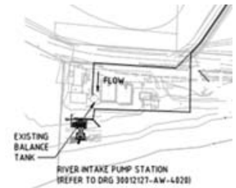
- Option 1 – As presented in concept but with self cleaning screens
- Option 2 – As Option 1 but with vertical turbine pumps
- Option 3 – Vertical Turbine or Centrifugal pumps on incline, no wet well
- Option 4 – Rising pipes with internal pumps – inflatable casing packer, no wet well

Location as presented



Con's	Pro's
Existing facility to be decommissioned	ESC familiar with concept
Long access road	At existing abstraction point, proven stability of embankment & stream
Limited space	Less earthworks
Steep embankment wall	Less intake pipework
Additional security fence required	Above estimated 1 in 100 year flood AEP

Alternative Location



Con's	Pro's
Existing facility to be decommissioned	At TP, power and entrance closer to existing facility
Not been presented to ESC previously	Survey from TP ?
Additional trees to be removed	Larger work area
Additional earthworks	Above estimated 1 in 100 year flood AEP
Greater length of intake pipework from river bank to wet well	Within existing security fence
	Possible less issues with approvals
	No retaining walls ?

Preferred location pending further site investigations

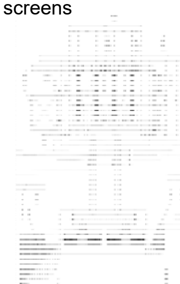
Other Locations

Options upstream and down stream of existing WTP considered

- **Pro's**
  - Wet well and pump stations not so deep
  - Easier construction of wet well
  - less construction cost of wet well
- **Con's**
  - Stream bed mobile,
  - Embankment in flood plane
  - Requires MCC and electrical equipment on raised platform (2 – 3 m)
  - Additional land purchase
  - Additional pipe lengths
  - Additional environmental approvals
  - Constraint of optical fibre cables for upstream pipe corridor
- **Not considered further**

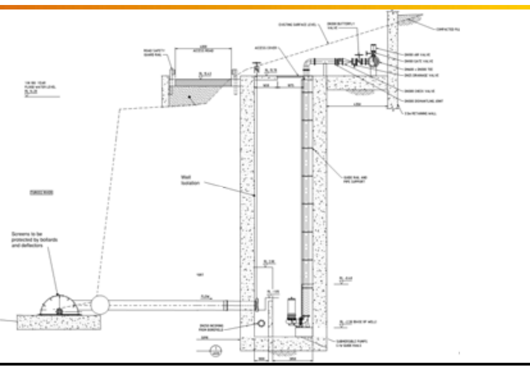
Option 1

As presented in concept but with self cleaning screens



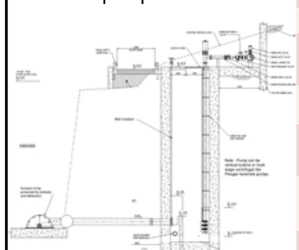
Con's	Pro's
Higher capex	Proven system reliability
Deep wet well	Concept done
Possibly construction issues depending upon Geotechnical results.	Less maintenance on the concrete structures and cast iron rising pipes
Limited site area for wet well	Screens on river bed
Possibility of silting requiring operational maintenance	
Maintenance of valves, pump gets suck, requires confined space entry	
Not as efficient – 4 % less efficiency than others	

Option 1 - Continued



Option 2

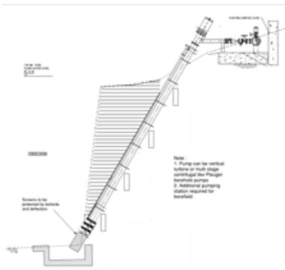
As Option 1 but with vertical turbine pumps



Con's	Pro's
Higher capex	Proven system reliability
Deep wet well	Most efficient – 85%
Possibly construction issue depending upon Geotechnical results.	Screens on river bed
Limited site area for wet well	
Possibility of silting requiring regular operational maintenance	
Maintenance valves, pump gets suck, requires confined space entry	
10 yearly removal for inspection and repainting	

Option 3

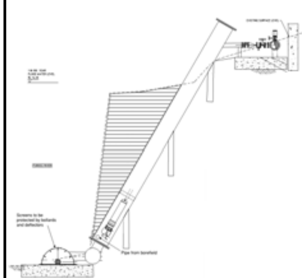
Vertical Turbine or Centrifugal pump on incline, no wet well



Con's	Pro's
10 yearly maintenance needs whole pump to be removed	Much less CAPEX
Storm damage possible	Easier to construct
Not as reliable	Does not require drilling
Screens need to be deeper and may attract more silt and sand	Less excavation
Additional pumping station required for borefield	

Option 4

Rising pipe with internal pump – inflatable casing packer



Con's	Pro's
Storm damage possible	Much less CAPEX
Not as well known	Easier to construct
10 yearly removal for inspection and repainting	Does not require drilling
Screens need to be deeper and may attract more silt and sand	Less excavation

Details on riserless packers

MCA Analysis

- MCA Analysis presented in a separate excel worksheet submitted with this presentation.
- The worksheet provides additional notes and clarification on the scores
- Option 4 is the option which is preferred based upon SMEC's analysis without input from ESC.
- Input from ESC to is essential to confirm/adjust scores based upon owner and operator preferences.
- To be discussed and finalised at the concept design workshop.

Decision Factors		Option 1	Option 2	Option 3	Option 4
Criteria	Wt.	1	2	3	4
Constructability	1.0	-1	-1	3	3
Flood risk	1.0	3	3	0	0
CAPEX $	2.0	-2	-2	1	2
OPEX $ cost of electricity	2.0	1	5	3	3
Siltation issues	1.0	2	2	1	1
Proven technology	2.0	4	3	2	2
OPEX - Operational maintenance - inspections	2.0	2	1	-1	2
OPEX - Operational maintenance - removal and maintenance	2.0	3	-1	-2	1
Weighted Scores		20.0	16.0	10.0	24.0

Application of riserless packers in Water

Caboolture Shire Council - Two systems were installed on 22 Deg incline and two on a 45 Deg incline.

- In NSW, Riserless Pump Packers have been installed for the following clients:
  - Approx. 10 units with Riverina Water County Council
  - 1 unit with Goldenfields Water County Council with another scheduled for late 2017
  - 3 units with Parkes Shire Council
- In VIC:
  - Approx. 10 units with Barwon Water Authority
- In QLD:
  - 4 units on angled incline at Caboolture Shire Council
  - 5 units with Woorabinda Shire Council
  - 2 units with Toowoomba Shire Council
- In WA:
  - Approx. 20 units for Water Corporation of WA
  - Aqwest Bunbury Water Board

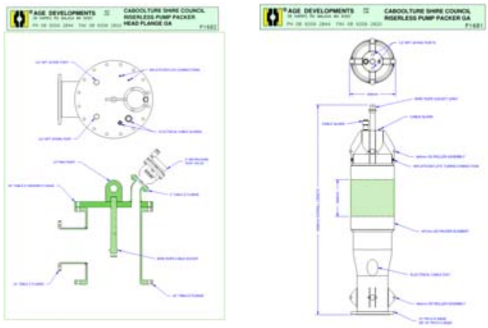
Package for Caboolture Shire Council supplied in 2006 was priced at approximately $65k for a 4 system order including:

- Stainless Steel Riserless Pump Packer
- Inflate / Deflate control lines
- Stainless Steel Suspension wire rope

Drawings next slide

- Stainless Steel 20" x 12" fabricated surface discharge tee
- Stainless Steel 20" blind hanging flange complete with air release vent valves, electrical cable glands, instrumentation etc

Supporting information



Maintenance and Support

- Crews throughout AU, maintain a workshop in Wagda NSW but main manufacturing is Malaga Western Australia
- Teams come to install and train staff on installation and removal of pumps
- Some Council continue to use age development, other do themselves
- Very first Riserless Pump Packer manufactured by the company back in 1988 is still operational
- Ozone and UV light main degradation factors for elastomeric compounds
- Neither present in installed situations, easily last 30+ years and outlast any pump installation.
- Metallic components are manufactured with either grade 304 or 316 stainless steel materials dependent on water quality suitability.

Other Clients who use the system

Mining, Oil and Gas Clients

- Kalgoorlie Consolidated Gold Mine
- Xstrata Earnest Henry Mine
- Vermillion Energy (Offshore Platform Oil Well)
- Rio Tinto Weipa
- Verve Energy
- Oil Search PNG (Onshore Oil Well)
- Belridge Minerals
- Liddell Coal
- New Acland Coal
- Roc Oil (Onshore Oil Well)
- Western Areas Flying Fox
- Kogan Creek Mine

Agricultural Installations of the top of my head include:

- Stanbroke Beef
- Jasper Farms
- Beef City Oakey
- Mort and Co Lot Feeders
- Oakey Abattoir
- Penrice
- Goondicum

- NOTE that the majority of these include multiple installations