WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

Wetland Functional Design Report

North Sale – Area C South

Wellington Shire Council

January 2018

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1 INTRODUCTION

The Area C South Wetland/Retarding Basin forms part of the North Sale Drainage Investigation located at the north- western corner of the intersection of Maffra-Sale Road and the Gippsland Railway Line.

Calculations used in the functional design are included in Appendix A.

1.1 Design Flow Rates

The design flow rates used in the design of the North Sale Area C South are shown in Table 1-1

Table 1-1 Design Flow Rates

Storm Event	Flow Rate (m^3/s)
3 month ARI inflow	0.15
1 year ARI Inflow	0.80
100 year AR Inflow	4.75
Target 100 year ARI outflow from retarding basin	0.92

1.2 Site Constraints

Several river red gums are located within drainage reserve which have been largely avoided by the wetland design. The existing trees are still located within the retarding basin below the 100 year ARI flood level, however the infrequent inundation of the river red gums has been investigated as part of the design process with no impact on the heath of the trees expected.

2 SEDIMENT BASIN

Sediment basins have been sized by the Fair and Geyer formula (Equation 10.3 in WSUD Engineering Procedures, 2004)) to determine minimum surface area required to ensure the settling velocity criteria for sediments was satisfied. The 1 year AR flow rate of 0.76 m^3/s was used to determine the required basin, which was sized to a cleanout frequency of 5 years or longer. It was found that the settling criteria was the critical factor in sizing of the sediment basins, not sediment storage volume.

An Extended Detention Depth of 350 mm has been incorporated into the sediment basin.

A 375 mm diameter pipe has been sized to convey the 3 month ARI flow from the sediment basin to the wetland macrophyte zone. The sediment basin outlet pit has been sized large enough to ensure that the pipe outlet forms the hydraulic control.

The 100 year velocity in the sediment basin has been calculated as 0.30 m/s based on the cross sectional area between NWL and the 10 year level in the basin. This 100 year velocity is within the requirement of 0.5 m/s to prevent re-suspension of deposited sediment during a major storm event.

The cleanout frequency of the sediment basin was determined to equal once every 5.9 years, with the cleanout volume determined to be 337 m^3, with a sediment drying area located north of the sediment basin within the drainage reserve.

3 WETLAND MACROPHYTE ZONE

Table 3-1 shows a summary of the macrophyte zonation areas within the Area C North wetland.

An Extended Detention Depth of 350 mm has been incorporated into the macrophyte zone. The maximum 3 month velocities within the macrophyte zone has been calculated to equal 0.01 m/s which is less than the 3 month velocity criteria of <0.05 m/s which is the threshold to prevent biofilm from being stripped within the marsh areas.

Table 3-1 Macrophyte Zonation Details

	Macrophyte Zone (m^2)	Percentage of Macrophyte Zone
Open Water	1,093	19%
Submerged Marsh	239	4%
Deep Marsh	3,516	61%
Shallow Marsh	896	16%
TOTAL	5,744	100%

A 125 mm weir has been sized as the wetland outlets to control Extended Detention Depths within the macrophyte zones. The residence time of the wetland has been calculated to equal 3 days (for the 90th percentile of events), which represents the time taken for a particle of water to travel through the wetland system for all storm events. The wetland Inundation Frequency Curve is shown below in Figure 3-1 which shows the expected distribution of expected water levels within the macrophyte zone. A water balance analysis for the wetland system has been extracted from the MUSIC model (10 years of rainfall data) and is shown in Figure 3-2. The water balance modelling further illustrates that water levels within the wetland will be sit within an acceptable range at or near NWL for the vast majority of events.

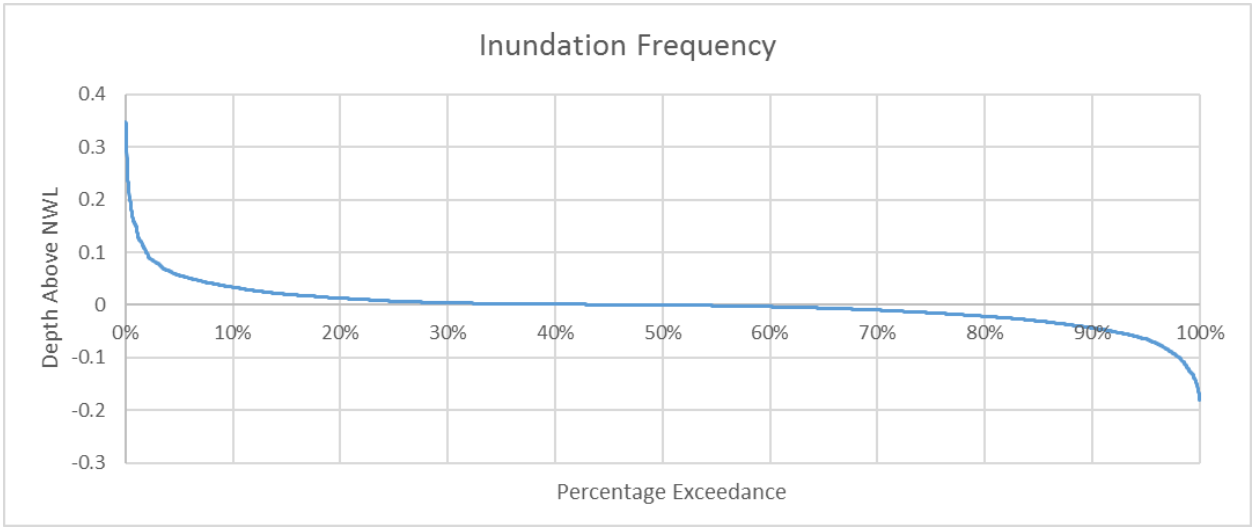

Figure 3-1 Macrophyte Zone Inundation Frequency Curve

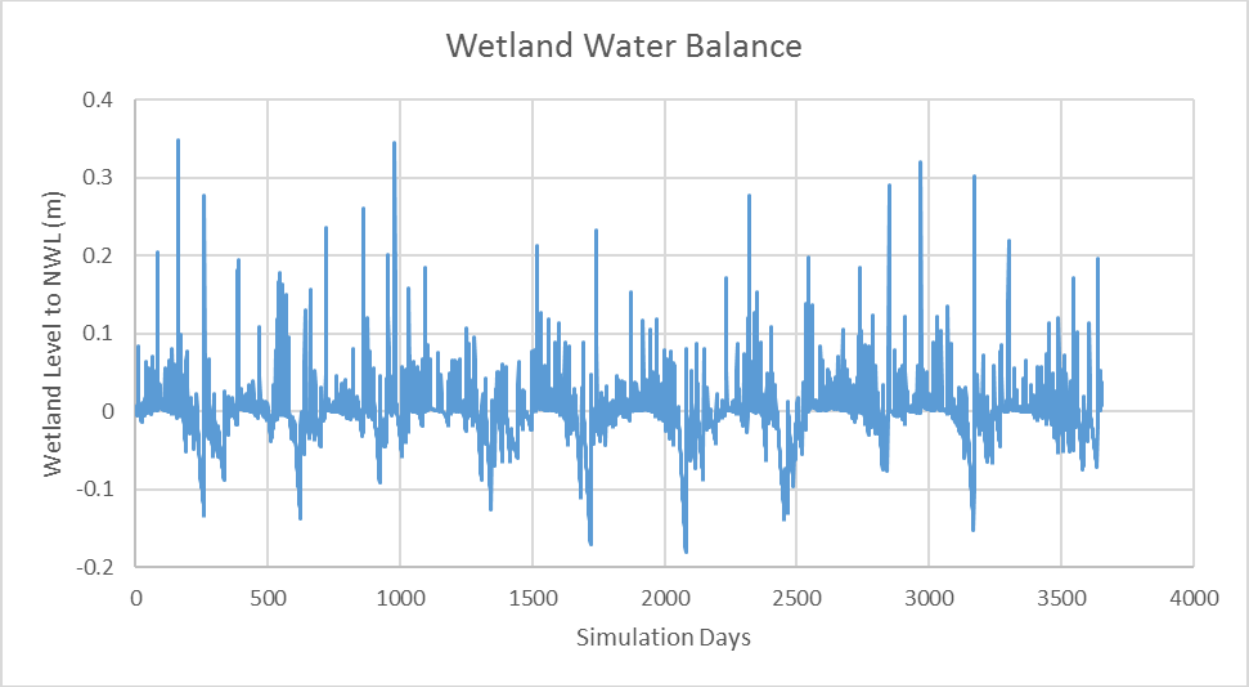

Figure 3-2 Macrophyte Zone Water Balance

4 DRAINAGE RESERVE

4.1 Edge Treatments

A 1 in 8 safety bench has been incorporated into the bathymetry below NWL to a depth of 350 mm. Minimum batter slopes of 1 in 6 are incorporated above NWL with the typical edge treatment shown in Figure 4-1 which are applicable for both the sediment basin and macrophyte zone.

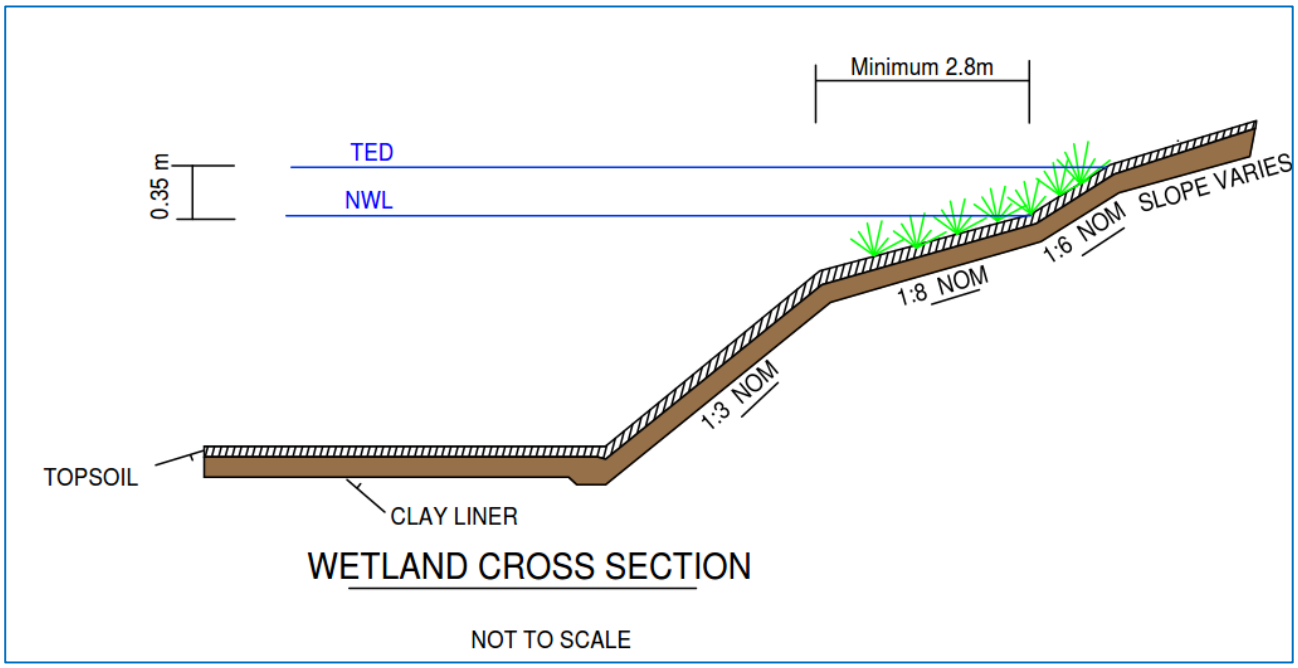

Figure 4-1 Typical Edge Treatment for Sediment Basin and Wetland Macrophyte Zone

4.2 Retarding Basin

4.2.1 Outlet Details

Twin 600 mm diameter pipelines have been sized to control flows leaving the retarding basin to desired flow rates. The outlet pit has been sized large enough to ensure that the twin 600 mm pipes form the hydraulic control for the system. An outlet weir at the 100 year ARI level has been sized to convey the total design outflow should blockage occur within the outlet structures.

4.2.2 Storage Volume

Table 4-1 shows the Height Storage relationship for the Area C South Retarding Basin.

Table 4-1 Retarding Basin Height-Storage Details

Height (m AHD)	Storage (m^3)	Outflow (m^3/s)
9.5	0	0
9.6	1	0.01
9.7	2	0.02
9.8	965	0.03
9.9	2,179	0.06
10	3,625	0.1
10.1	5,420	0.8
10.2	7,510	1.05
10.3	9,902	1.37
10.4	12,470	1.85
10.5	15,397	2.39
10.6	18,672	3.1
10.7	22,030	3.83
10.8	25,394	4.62

5 COSTINGS

5.1 Cost Overview

Detailed cost estimates have been provided to Water Technology by Crossco Consulting. As per Council specification these estimates include a cut and fill rate of $10.00 / m^3 and a contingency of 20%. An overview of these costs can be seen below in table 5.1. A detailed breakdown of cost estimates is included in Appendix C.

Table 5-1 Cost Estimates Area C South

	Total (ex GST)	Incl 20% contingency (ex GST)	Incl GST	TOTAL (incl GST and contingency)
Totals	**$ 496,669**	**$ 596,003**	**$ 59,600**	**$ 655,604**
Total Including 20% Contingency and GST				**$ 655,604**

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APPENDIX A
DESIGN CALCULATIONS

5.2 Sediment Basin Sizing

Vs =	0.011	m/s	Catchment Area =	33.8	ha
			Sediment load =	1.6	m^3/ha/yr
d_e =	0.35	m	Gross Pollutant Load =	0.4	m^3/ha/yr (Alison et al 1998)
d_p =	1.0	m	Actual basin depth =	1.0	m
d* =	1.0	m	Actual Basin area =	800.0	m^2
(d_e+d_p) =	1.0		Basin sediment accumilation fraction	0.17	per year
(d_e+d^*)					
Q =	0.76	m^3/s			
A =	800	m^2	Clean out every	5.9	years
V_s =	11.58				
Q/A					
λ =	0.26				
n =	1.35				

Fraction of Initial Solids Removed

R = 95%

5.3 Sediment Basin Outlet

Ignore the pit?? Yes/No			No		Are you Assuming INLET CONTROL??? Yes/No			No		
PIT					PIPE	INLET CONTROL		OUTLET CONTROL		
	Pit Sill Level	9.7	m AHD		Invert Level	8.5	m AHD	Ke	0.5	Square edge
	Width	0.6	m		Dia	0.375	m	Kex	1.0	
	Length	0.6	m		barrels	1		Length	22.0	m
	Area	0.36	m^2		Area	0.110446617	m^2	Tailwater Level	9.7	m AHD
	Grill blockage factor	50	%					wetted perim	1.18	m
	weir blockage	0	%					Hyd Radius	0.09	m

Height	Head	Orifice Flow	Weir Flow	total flow into pit	Head	Orifice Flow		head loss	flow	TOTAL FLOW RATE	
9.7	0	0.000	0.000	0.000	1.013	0.325		0.000	0.000	0.000	m^3/s
9.75	0.05	0.118	0.046	0.046	1.063	0.333		0.050	0.061	0.046	m^3/s
9.8	0.1	0.166	0.129	0.129	1.113	0.341		0.100	0.086	0.086	m^3/s
9.85	0.15	0.204	0.237	0.204	1.163	0.348		0.150	0.106	0.106	m^3/s
9.9	0.2	0.235	0.365	0.235	1.213	0.356		0.200	0.122	0.122	m^3/s
9.95	0.25	0.263	0.510	0.263	1.263	0.363		0.250	0.136	0.136	m^3/s
10	0.3	0.288	0.670	0.288	1.313	0.370		0.300	0.149	0.149	m^3/s
10.05	0.35	0.311	0.845	0.311	1.363	0.377		0.350	0.161	0.161	m^3/s

Broad Crested Weir **SED BASIN WEIR**

Formula $Q = CbH^{3/2}$

Inputs	C	1.60		Weir Coefficient (1.4-2.1, typically 1.6)
	b	3.00	m	Breadth of Weir
	H	0.300	m	Head Of Water Above Crest
Output	Q	0.79		m^3/s

5.4 Wetland Outlet

Wetland EDD	0.35	m
Wetland Area at TED	8299	m2
Wetland Area at NWL	6930	m2
Volume at EDD	2665.075	m3

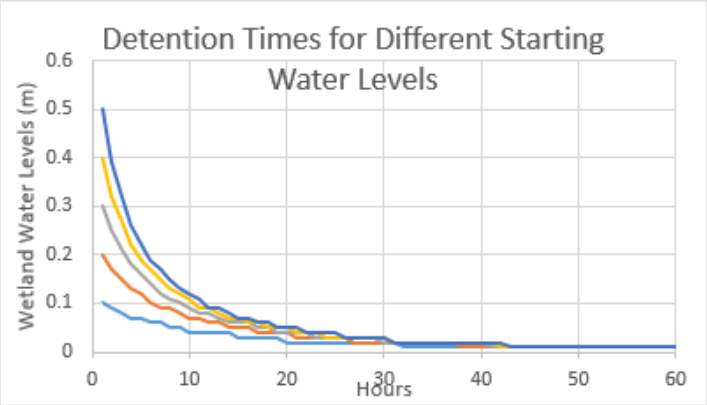
Starting Water Depth	Detention Time	
100mm	40	hrs
200mm	44	hrs
300mm	48	hrs
400mm	49	hrs
500mm	51	hrs
Average Detention Depth	46.4	hrs

Orifice configuration

Weir Coefficient 1.7

	Depth (m)	Weir Width (mm)
1	0	125
2	0.2	0
3	0.3	0

Assumed fully drained volume: 133.25375



Height Discharge Table

Height	Weir 1	Weir 2	Weir 3	TOTAL FLOW	
0	0	0	0	0	0.000 m3/s
0.1	0.019843	0	0	0.1	0.020 m3/s
0.2	0.056126	0	0	0.2	0.056 m3/s
0.3	0.10311	0	0	0.3	0.103 m3/s
0.4	0.158748	0	0	0.4	0.159 m3/s
0.5	0.221857	0	0	0.5	0.222 m3/s
0.6	0.291638	0	0	0.6	0.292 m3/s
0.7	0.367506	0	0	0.7	0.368 m3/s
0.8	0.449006	0	0	0.8	0.449 m3/s

Orifice Equation WETLAND OUTLET

Formula $Q = C_d A(2gH)^{1/2}$

C_d recommended by Tony Wong for design of Wetland Drains 0.67

C_d recommended by Keith Boniface 0.61-0.66, 0.61 for 0 velocity

Inputs	Cd	0.62		Coefficient of Discharge
	A	0.16	m^2	Cross Sectional Area
	H	0.350	m	Head above centreline of Orifice
Output	Q	0.26	m^3/s	

Pipe Dia (m)	Area (m2)
0.45	0.16

5.5 RB Outlet

Ignore the pit?? Yes/No					Are you Assuming INLET CONTROL??? Yes/No						
			No						No		
PIT					PIPE	**INLET CONTROL**		**OUTLET CONTROL**			
	Pit Sill Level	10.05	m AHD		Invert Level	9.5	m AHD	Ke	0.5	Square edge	
	Width	2.4	m		Dia	0.6	m	Kex	1.0		
	Length	2.4	m		barrels	2		Length	140.0	m	
	Area	5.76	m^2		Area	0.565486678	m^2	Tailwater Level	9.1	m AHD	
	Grill blockage factor	0	%					wetted perim	1.88	m	
								Hyd Radius	0.30	m	
Height	Head	Orifice Flow	Weir Flow	total flow into pit	Head	Orifice Flow		head loss	flow	TOTAL FLOW RATE (wetland connection NOT included)	
9.5	-0.55	0.000	0.000	0.000	-0.300	0.000		0.400	0.811	0.00	m^3/s
9.6	-0.45	0.000	0.000	0.000	-0.200	0.000		0.500	0.907	0.00	m^3/s
9.7	-0.35	0.000	0.000	0.000	-0.100	0.000		0.600	0.994	0.00	m^3/s
9.8	-0.25	0.000	0.000	0.000	0.000	0.000		0.700	1.073	0.00	m^3/s
9.9	-0.15	0.000	0.000	0.000	0.100	0.523		0.800	1.148	0.00	m^3/s
10	-0.05	0.000	0.000	0.000	0.200	0.739		0.900	1.217	0.00	m^3/s
10.1	0.05	3.765	0.193	0.193	0.300	0.802		1.000	1.283	0.80	m^3/s
10.2	**0.15**	**6.522**	**1.004**	**1.004**	**0.400**	**1.046**		**1.100**	**1.346**	**1.00**	**m^3/s**
10.3	0.25	8.419	2.160	2.160	0.500	1.169		1.200	1.405	1.17	m^3/s
10.4	0.35	9.962	3.578	3.578	0.600	1.281		1.300	1.463	1.28	m^3/s
10.5	0.45	11.296	5.216	5.216	0.700	1.383		1.400	1.518	1.38	m^3/s
10.6	0.55	12.488	7.048	7.048	0.800	1.479		1.500	1.571	1.48	m^3/s
10.7	0.65	13.576	9.056	9.056	0.900	1.568		1.600	1.623	1.57	m^3/s
10.8	0.75	14.583	10.600	10.600	1.000	1.653		1.700	1.673	1.65	m^3/s
10.9	0.85	15.525	12.789	12.789	1.100	1.734		1.800	1.721	1.72	m^3/s
11	0.95	16.413	15.111	15.111	1.200	1.811		1.900	1.768	1.77	m^3/s

Broad Crested Weir **RB WEIR**

Formula $Q = CbH^{3/2}$

Inputs	C	1.60		Weir Coefficient (1.4-2.1, typically 1.6)
	b	4.00	m	Breadth of Weir
	H	0.300	m	Head Of Water Above Crest
Output	Q	1.05		m^3/s

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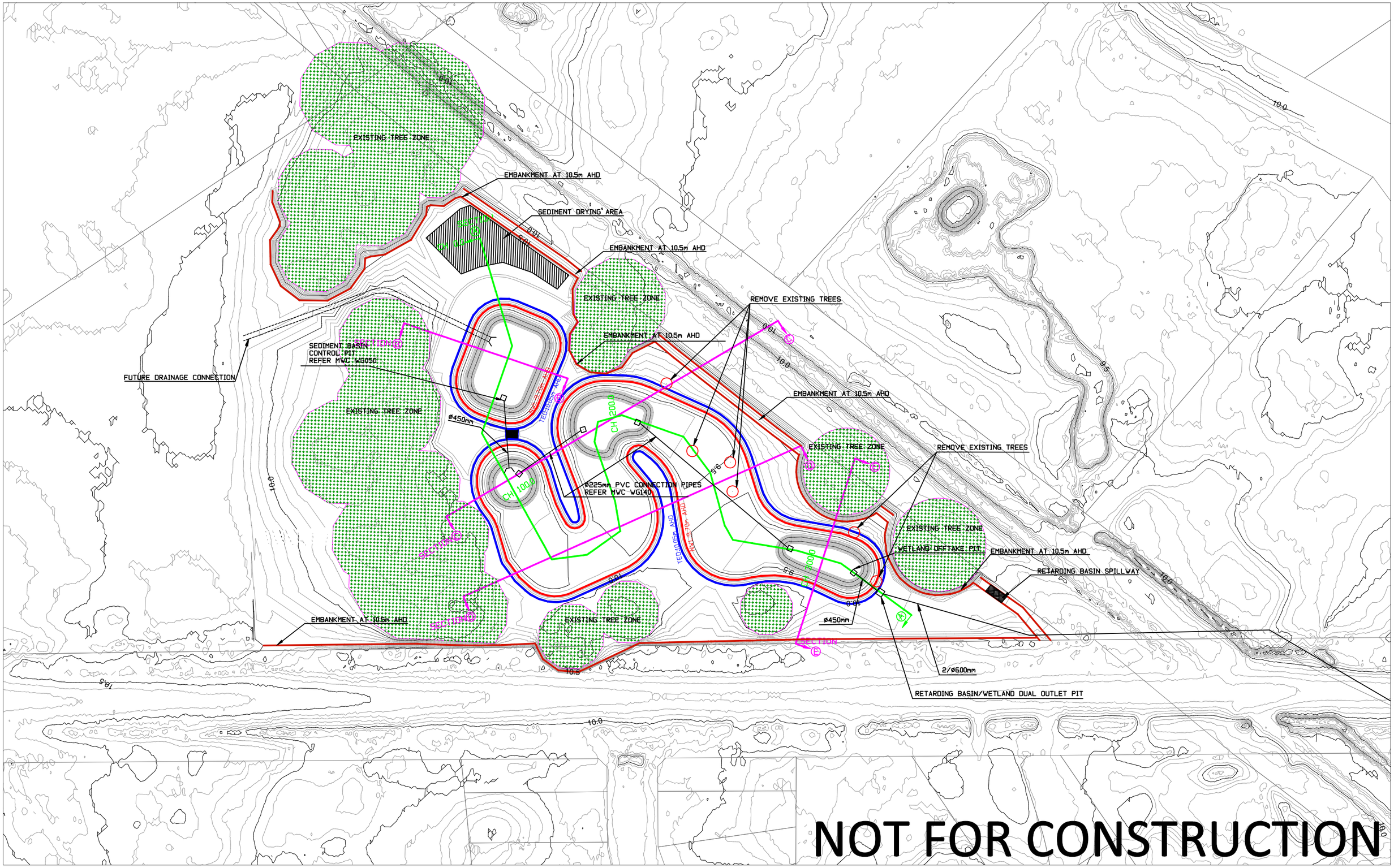
APPENDIX B
AREA C SOUTH FUNCTIONAL DESIGN PLANS



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REVISIONS			
REV.	DESCRIPTION	DATE	INIT.
V01	ISSUED FOR COMMENT	2/02/2017	TJC

CLIENT:
WELLINGTON SHIRE COUNCIL

WELLINGTON SHIRE COUNCIL

CONSULTANT:
Water Technology Pty Ltd
ABN: 60 093 377 283
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DRAWN	RJD
CHECKED	TJC
DESIGN	RJD
CHECKED	TJC
APPROVED	SMH

WATER TECHNOLOGY
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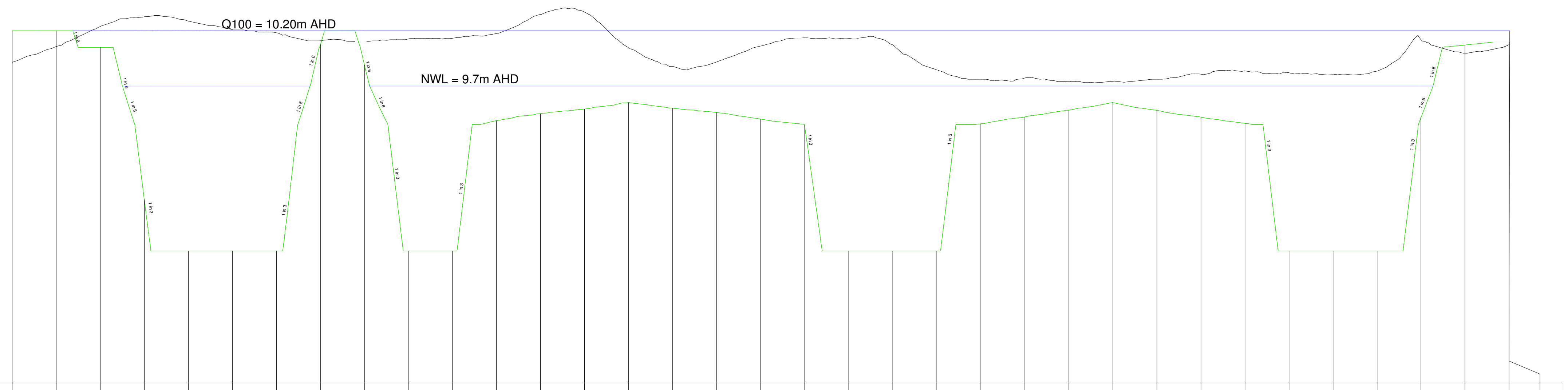
NORTH SALE AREA C SOUTH WETLAND

FUNTIONAL DESIGN
PLAN VIEW

JOB NO. J4276-01
SHEET 1 of 5

Drawing No. 4276-01_D02V01_001 SCALE: 1:1250
Rev No. V01

A3



DATUM R.L.7.000

CHAINAGES	0	10	20	30	40	50	60	70	80	90	100	110
Q100 LEVEL			10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
NWL				9.7	9.7	9.7	9.7			9.7	9.7	9.7
EXISTING SURFACE	9.915	10.059	10.242	10.329	10.29	10.212	10.184	10.112	10.1	10.127	10.133	10.176
DESIGN SURFACE	10.2	10.2	10.05	8.667	8.2	8.2	8.2	10.075	9.892	8.2	8.2	9.384

CHAINAGES	120	130	140	150	160	170	180	190	200	210	220	230
Q100 LEVEL	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
NWL	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
EXISTING SURFACE	10.35	10.371	10.047	9.877	9.919	10.063	10.137	10.131	10.073	9.846	9.76	9.771
DESIGN SURFACE	9.448	9.49	9.549	9.498	9.459	9.398	9.34	8.2	8.2	8.2	9.356	9.419

CHAINAGES	240	250	260	270	280	290	300	310	320	330	340	340.002
Q100 LEVEL	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	
NWL	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7			
EXISTING SURFACE	9.742	9.743	9.76	9.807	9.836	9.82	9.802	9.835	10.118	9.998	10.076	10.076
DESIGN SURFACE	9.48	9.549	9.479	9.416	9.361	8.2	8.2	8.2	9.415	10.072	10.1	10.1

LONG SECTION A-A
HORIZONTAL SCALE 1:1250 VERTICAL SCALE 1:50

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REVISIONS			
REV.	DESCRIPTION	DATE	INIT.
V01	ISSUED FOR COMMENT	2/02/2017	TJC

CLIENT:
WELLINGTON SHIRE COUNCIL

CONSULTANT:
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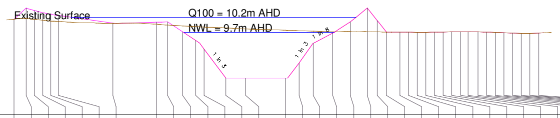
ABN: 60 093 377 283
Melbourne T +61 3 8526 0800

DRAWN	RJD
CHECKED	TJC
DESIGN	RJD
CHECKED	TJC
APPROVED	SMH

NORTH SALE AREA C SOUTH WETLAND
FUNTIONAL DESIGN
LONG SECTION

JOB NO. J4276-01
SHEET 2 of 5

Drawing No. 4276-01_D02V01_001
Rev No. V01
SCALE: AS NOTED
A3



DESIGN SURFACE	EXISTING SURFACE	CHAINAGES
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10.500	10.163	1.578
10.417	10.124	2.692
10.349	10.101	3.804
10.301	10.074	4.852
10.259	10.062	5.880
10.003	10.000	13.052
10.039	9.972	18.867
10.050	9.943	20.302
9.723	9.916	22.294
9.434	9.892	24.014
9.150	9.877	25.135
8.200	9.851	28.007
8.200	9.814	30.644
8.200	9.770	35.925
8.695	9.756	37.704
9.350	9.740	39.553
9.676	9.721	42.168
10.050	9.727	44.471
10.500	9.725	46.738
10.090	9.719	48.039
9.713	9.713	49.243
9.710	9.710	51.032
9.710	9.710	52.180
9.700	9.700	53.327
9.700	9.700	54.475
9.708	9.708	55.622
9.714	9.714	56.770
9.719	9.719	57.918
9.720	9.720	59.065
9.721	9.721	60.071
9.716	9.716	61.360
9.712	9.712	62.508
9.700	9.700	63.655
9.690	9.690	64.803
9.680	9.680	65.951
9.670	9.670	67.098
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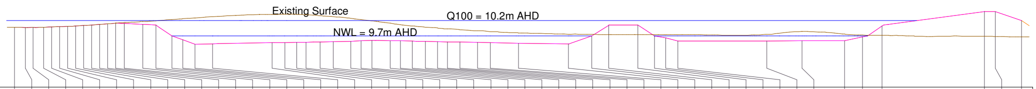
9.676	9.676	69.393

CROSS SECTION D-D
HORIZONTAL SCALE 1:1000 VERTICAL SCALE 1:250



DESIGN SURFACE	EXISTING SURFACE	CHAINAGES
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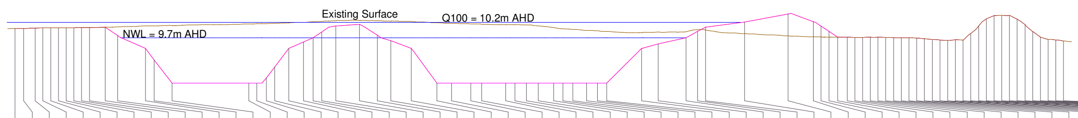
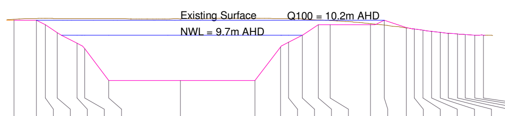
9.978	9.978	3.847
9.991	9.991	4.904
10.000	10.000	5.960
10.008	10.008	7.017
10.021	10.021	8.073
10.040	10.040	9.130
10.056	10.056	10.186
10.073	10.073	11.243
10.095	10.095	12.299
10.117	10.117	13.356
10.105	10.135	14.504
10.077	10.170	16.951
10.050	10.192	18.679
9.700	10.236	20.816
9.571	10.263	22.251
9.422	10.292	23.869
9.432	10.331	26.178
9.468	10.401	34.080
9.476	10.410	35.750
9.482	10.407	37.324
9.487	10.392	38.541
9.494	10.363	40.396
9.509	10.334	42.137
9.519	10.276	44.471
9.533	10.235	45.838
9.547	10.194	47.279
9.538	10.116	49.681
9.532	10.067	51.029
9.521	10.023	52.609
9.514	9.982	54.355
9.503	9.955	55.971
9.498	9.930	57.263
9.491	9.901	58.911
9.481	9.867	61.255
9.471	9.835	62.917
9.456	9.796	66.648
9.427	9.753	73.276
9.700	9.750	76.365
10.049	9.740	78.590
10.050	9.740	82.469
9.700	9.738	84.640
9.628	9.740	86.127
9.523	9.740	87.743
9.528	9.746	99.530
9.532	9.840	104.177
9.540	9.754	109.817
9.659	9.723	112.159
10.021	9.716	114.777
10.500	9.680	128.326
10.500	9.674	129.749
10.200	9.660	133.215

CROSS SECTION C-C
HORIZONTAL SCALE 1:1000 VERTICAL SCALE 1:250



DESIGN SURFACE	EXISTING SURFACE	CHAINAGES
10.003	10.003	0.000
10.005	10.005	1.118
10.018	10.018	2.660
10.020	10.020	3.683
10.020	10.020	4.707
10.025	10.025	5.730
10.020	10.020	6.754
10.029	10.029	7.777
10.030	10.030	8.801
10.036	10.030	9.858
10.050	10.040	11.901
9.770	10.057	13.565
9.350	10.090	17.252
8.970	10.090	18.397
8.200	10.103	20.756
8.200	10.149	30.922
8.200	10.157	31.999
8.374	10.162	33.255
8.731	10.170	34.360
9.350	10.188	36.223
9.556	10.204	38.184
9.700	10.222	39.446
9.886	10.240	40.582
10.089	10.262	42.439
10.137	10.270	45.598
9.781	10.258	47.942
9.602	10.249	49.720
9.350	10.233	52.452
8.200	10.189	55.830
8.200	10.170	57.776
8.200	10.156	60.307
8.200	10.146	61.750
8.200	10.129	64.911
8.200	10.126	66.145
8.200	10.120	67.677
8.200	10.089	69.247
8.200	10.030	71.271
8.200	9.991	72.520
8.200	9.975	73.800
8.200	9.939	75.643
8.200	9.925	77.091
8.200	9.911	78.306
9.344	9.869	82.931
9.491	9.882	85.127
9.700	9.899	88.816
9.909	9.964	90.347
10.050	9.952	91.384
10.219	9.833	96.541
10.481	9.757	102.290
10.229	9.730	105.652
10.080	9.724	106.669
9.908	9.720	107.730
9.720	9.720	108.868
9.720	9.720	110.126
9.710	9.710	111.149
9.710	9.710	112.173
9.716	9.716	113.196
9.716	9.716	114.220
9.710	9.710	115.243
9.700	9.700	116.267
9.693	9.693	117.290
9.695	9.695	118.314
9.687	9.687	119.337
9.669	9.669	120.361
9.639	9.639	121.384
9.620	9.620	122.407
9.608	9.608	123.431
9.637	9.637	124.454
9.620	9.620	125.478
9.831	9.831	126.501
10.084	10.084	127.525
10.325	10.325	128.548
10.428	10.428	129.572
10.438	10.438	130.595
10.436	10.436	131.619
10.306	10.306	132.642
10.130	10.130	133.666
9.897	9.897	134.689
9.713	9.713	135.713
9.646	9.646	136.736
9.626	9.626	137.760
9.592	9.592	138.782

CROSS SECTION B-B
HORIZONTAL SCALE 1:1000 VERTICAL SCALE 1:250



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9.441	10.256	8.323
9.260	10.250	9.326
8.200	10.250	12.514
8.200	10.249	21.993
8.200	10.270	31.872
9.318	10.255	35.229
9.471	10.250	36.295
9.700	10.240	38.127
10.050	10.212	40.228
10.050	10.194	41.821
10.050	10.089	47.165
10.200	10.040	48.954
9.964	9.951	51.883
9.912	9.912	52.965
9.871	9.871	54.103
9.830	9.830	55.234
9.799	9.799	56.379
9.771	9.771	57.451
9.744	9.744	58.655
9.730	9.730	59.663
9.710	9.710	60.931
9.710	9.710	62.069

CROSS SECTION A-A
HORIZONTAL SCALE 1:1000 VERTICAL SCALE 1:250

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REVISIONS			
REV.	DESCRIPTION	DATE	INIT.
V01	ISSUED FOR COMMENT	2/02/2017	TJC

CLIENT:
WELLINGTON SHIRE COUNCIL

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SHIRE COUNCIL

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DRAWN	RJD
CHECKED	TJC
DESIGN	RJD
CHECKED	TJC
APPROVED	SMH

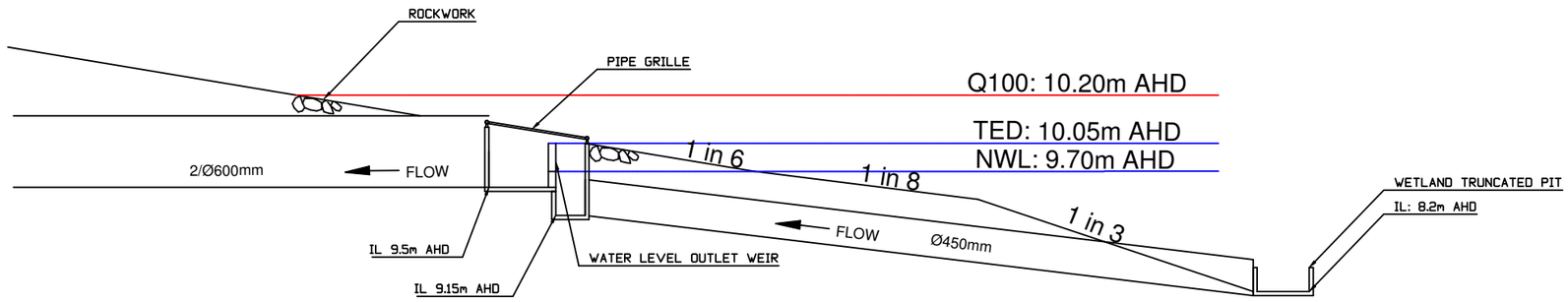
WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

NORTH SALE AREA C SOUTH WETLAND
FUNTIONAL DESIGN
CROSS SECTIONS

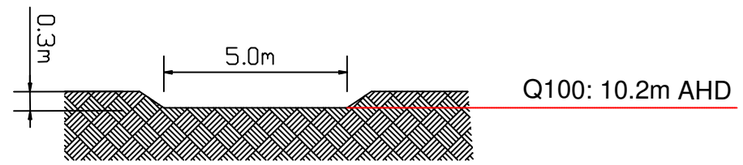
JOB NO. J4276-01
SHEET 3 of 5

Drawing No. 4276-01_D02V01_001
Rev No. V01
SCALE: AS NOTED

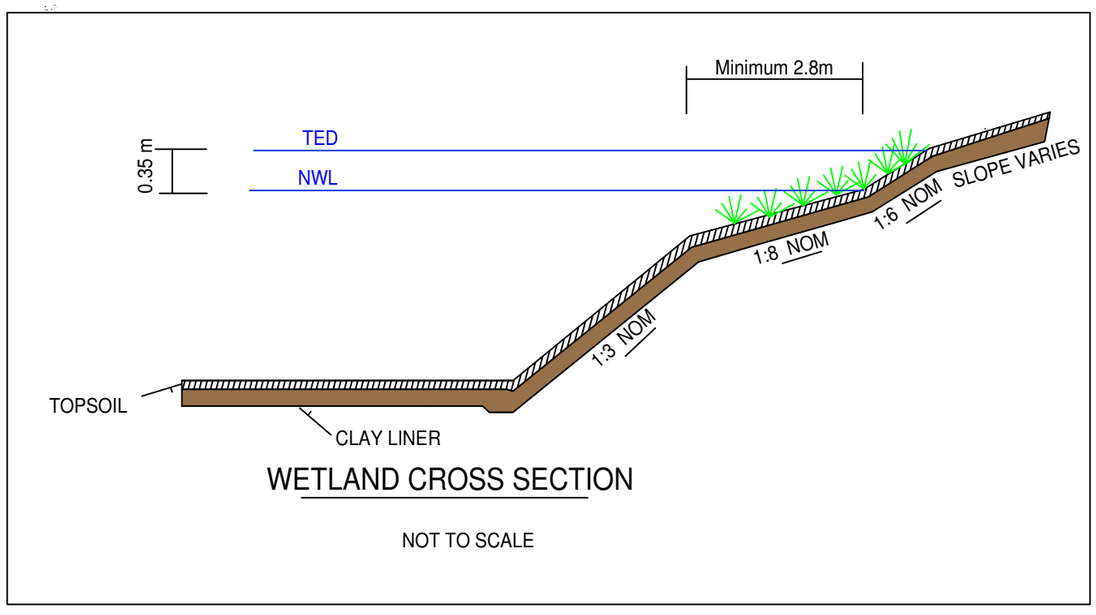
A3



TWIN CHAMBER OUTFALL / HIGH FLOW BYPASS PIT - REFER MWC 7251/12/4009



RETARDING BASIN SPILLWAY



WETLAND CROSS SECTION

NOT TO SCALE

NOT FOR CONSTRUCTION

REVISIONS			
REV.	DESCRIPTION	DATE	INIT.
V01	ISSUED FOR COMMENT	2/02/2017	TJC

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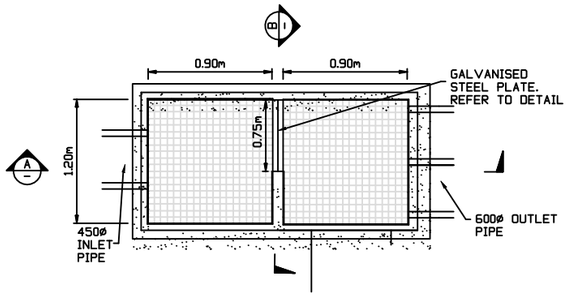
WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

NORTH SALE AREA C NORTH WETLAND
FUNTIONAL DESIGN
DETAIL 1

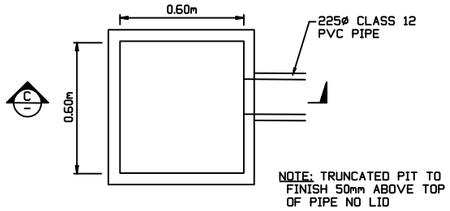
JOB NO. J4276-01
SHEET 4 of 5

Drawing No. 4276-01_D02V01_001 SCALE: NOT TO SCALE
Rev No. V01

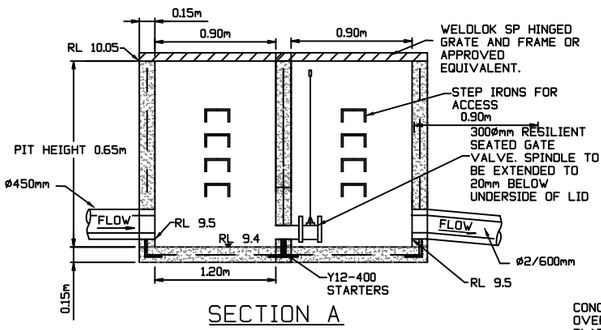
A3



WETLAND CONTROL PIT (DUAL FUNCTION PIT)
NTS



WETLAND TRUNCATED PIT
N.T.S



SECTION A
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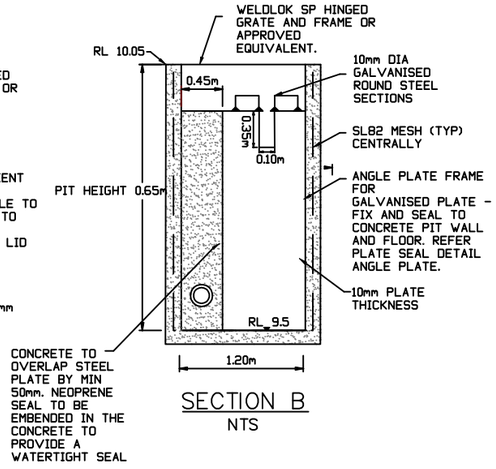

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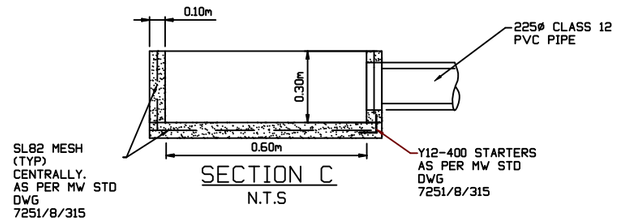

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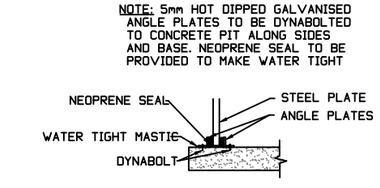
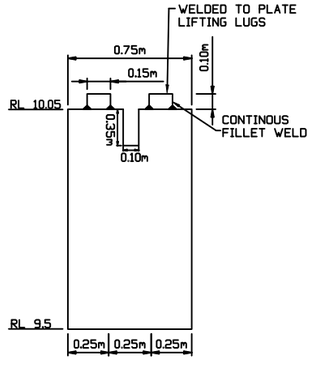
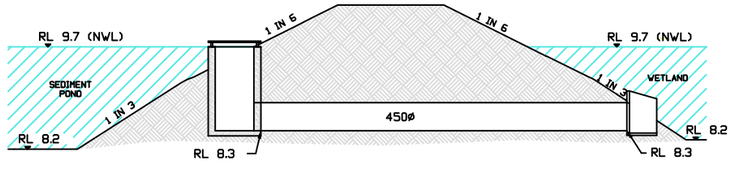


PLATE SEAL DETAIL ANGLE PLATE
NTS



GALVANISED STEEL PLATE
NTS



SEDIMENT POND TRANSFER PIPE
NTS

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REVISIONS			
REV.	DESCRIPTION	DATE	INIT.
V01	ISSUED FOR COMMENT	2/02/2017	TJC

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DESIGN	RJD
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APPROVED	SMH

WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

NORTH SALE AREA C NORTH WETLAND

FUNTIONAL DESIGN
DETAIL 2

JOB NO. J4276-01
SHEET 5 of 5

Drawing No. 4276-01_D02V01_001 SCALE: NOT TO SCALE
Rev No. V01

A3

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APPENDIX C
AREA C SOUTH COST ESTIMATES

North Sale - Area C South Wetland

Item	Qty	Unit	Rate	Total (ex GST)	Incl 20% contingency (ex GST)	GST	TOTAL (incl GST and contingency)	Comments
Establishment, contractor management and supervision			20,000.00	20,000	24,000	2,400	26,400	
Removal of vegetation	1	Item	3,000.00	3,000	3,600	360	3,960	
Earthworks								
Strip site (say 200mm depth)	22,425	sq.m	1.30	29,153	34,983	3,498	38,481	assumed all topsoil is stockpiled for reuse
Excavate to line and level	8,335	cu.m	10.00	83,348	100,018	10,002	110,019	excavate 300 below finished and below NTWL to allow for clay and topsoil and 200 below finished and above NTWL to allow for topsoil
Fill and compact to design levels	2,993	cu.m	20.00	59,860	71,832	7,183	79,015	
Construct Clay liner (300mm depth to NTWL)	2,096	cu.m	8.00	16,766	20,120	2,012	22,132	See provisional item if treatment required
Place topsoil won from s'pile (200mm depth)	21,674	sq.m	2.20	47,683	57,219	5,722	62,941	assumed material won from site; excludes area 500mm below NTWL in SB
Dispose of excess material from site	3,396	cu.m	15.00	50,943	61,132	6,113	67,245	allowance for approx. 1hr of travel and dozer time to spread
Associated drainage infrastructure					-			
225mm dia RCP	95	lm	130.00	12,350	14,820	1,482	16,302	
375mm dia RCP	25	lm	180.00	4,500	5,400	540	5,940	
450mm dia RCP	12	lm	250.00	3,000	3,600	360	3,960	
600mm dia RCP	175	lm	320.00	56,000	67,200	6,720	73,920	
900x900 Sed Basin Transfer Pit with pipe grille	1	#		-	-	-	-	
Endwall to suit 375 Dia pipe incl rock beaching	1	#	2,500.00	2,500	3,000	300	3,300	
600x600 Offtake Pit	4	#	1,000.00	4,000	4,800	480	5,280	
900x900 Offtake Pit	1	#	1,200.00	1,200	1,440	144	1,584	
WLRB Outlet Control pit (2.4mx2.4m)	1	#	15,000.00	15,000	18,000	1,800	19,800	
Landscaping					-			
Ephemeral batters (1,383m2) @6 plants/m2	8,298	#	1.70	14,107	16,928	1,693	18,621	SB = 281m2, WLTB = 1,102m2
Shallow Marsh (896m2) @2 plants/m2	1,792	#	1.70	3,046	3,656	366	4,021	
Deep Marsh (3,516m2) @2 plants/m2	7,032	#	1.70	11,954	14,345	1,435	15,780	
Submerged Marsh (239m2) @1 plant/m2	239	#	1.70	406	488	49	536	
Miscellaneous					-			
Construct Sed Basin hard base floor (400mm depth rock)	603	sq.m	15.00	9,045	10,854	1,085	11,939	
Construct drying areas with 100mm CL3 FCR	634	sq.m	12.00	7,608	9,130	913	10,043	
Construct Access Tracks / Ramps (200mm depth CR)	0	sq.m	20.00	-	-	-	-	
Construct Sed Basin bypass with concrete weir (b=3m)	1	Item	3,200.00	3,200	3,840	384	4,224	$150/m for 500 deep concrete weir (say 7m long) + $40/m2 for apron rock (say 52.5m2)
As-constructed survey of basin/WLRB	1	Item	8,000.00	8,000	9,600	960	10,560	**$560,003.28**
Maintenance of landscaping - 2yrs	1	Item	30,000.00	30,000	36,000	3,600	39,600	
Provisional Items					-			
Excavate and disposal of unsuitable material		cu.m	35.00	-	-	-	-	
Supply, place and compact clay fill from s'pile		cu.m	40.00	-	-	-	-	
Treat clay with (3% lime / 1% gysum) to 200mm depth		sq.m	9.00	-	-	-	-	
Totals				**496,669**	**596,003**	**59,600**	**655,604**	
Professional fees								
Detailed design & documentation (8% x const cost)	1	Item		-	-	-	-	$44,800.26
Geotechnical	1	Item		-	-	-	-	
Survey	1	Item		-	-	-	-	
Totals				**496,669**	**596,003**	**59,600**	**655,604**	
			Total including contingency and GST				**$ 655,603.61**	

Note:

1. Assumed 300mm depth for clay liner. TBC by Geotech investigation.

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