APPENDIX

C

COST SHEETS

Project: BEVERIDGE NORTHWEST PSP
Date: 31/10/2021
Rates Index Date: JUNE 2021

Issue : A
Status: DRAFT

Description:	Road - RD01 Secondary - 502m (Excluding intersection extents)
Civil Component Number:	RD01

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	17068	m2	3.73	63663.64	5.03	85852.04
	Soil stabilisation - gypsum treatment	12550	m2	4.65	58357.50	5.11	64130.50
	Additional construction staging measures to reduce grubbing and excavation	17068	m2	0.80	13654.40	0.88	15019.84
	Earthworks	2869	m3	34.53	99066.57	41.06	117801.14
	Erosion protection for 1:4 batters	4016	m2	3.84	15421.44	4.29	17228.64
Road Pavement	Primary Arterial Pavement	0	m2	171.88	0.00	188.74	0.00
	Secondary Arterial Pavement	4518	m2	128.70	581466.60	135.56	612460.08
	Collector Arterial Pavement	0	m2	106.55	0.00	113.94	0.00
	Subgrade Preparation	4518	m2	14.41	65104.38	16.38	74004.84
	Pavement Rehab	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation	4518	m2	48.64	219755.52	54.22	244965.96
	Crushed rock capping layer	4518	m2	25.34	114486.12	28.25	127633.50
Concrete Works	Kerb and Channel	1004	m	55.54	55762.16	61.71	61956.84
	Cycle Path	0	m2	77.61	0.00	93.16	0.00
	SUP/ Footpath	1004	m2	64.36	64617.44	74.61	74908.44
	Traffic Island	0	m2	78.63	0.00	85.19	0.00
Drainage	Drainage Pipe 300mm CR Bfilled	0	m	182.24	0.00	200.59	0.00
	Drainage Pipe 375mm CR Bfilled	200	m	262.54	52508.00	286.72	57344.00
	Drainage Pipe 450mm CR Bfilled	200	m	303.41	60682.00	338.77	67754.00
	Drainage Pipe 525mm CR Bfilled	102	m	409.22	41740.44	453.98	46305.96
	Drainage - pits	11	No.	2599.43	28593.73	2843.33	31276.63
	Drainage – Sub-soil drainage	1004	m	34.33	34467.32	43.98	44155.92
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
Traffic signals	Traffic Signals (all inclusive)	0	Item/ Per Leg	111186.08	0.00	130494.95	0.00
Landscape	Tree Planting, 45L tree	68	No.	307.37	20820.72	367.83	24916.17
	Topsoil with seeding, 100mm depth	11546	m2	7.31	84401.26	8.56	98833.76
Street Lighting	Street Lighting - Road	502	m	219.22	110048.44	228.67	114792.34
	Street Lighting - Intersections	0	Item/ Per Leg	49111.97	0.00	56355.63	0.00
	Erosion protection for lighting cables	1004	m	12.16	12208.64	13.56	13614.24
Misc	Regulatory Signage	8	Item	342.92	2743.36	385.44	3083.52
	Linemarking	4518	m2 of Pavement	3.16	14276.88	4.15	18749.70
	Landscape maintenance (intersections)	0	Item	72291.19	0.00	89300.67	0.00
	Landscape maintenance (roads)	11546	m2	2.94	33945.24	3.00	34638.00
	Tactile Pavers (Hazard only)	0	Item	296.31	0.00	324.03	0.00
Other	Rock Allowance	574	m3	101.33	58143.15	116.53	66864.91
	Existing pavement removal	3062.2	m2	65.87	201707.11	72.45	221856.39
	Geotextile mat to protect concrete items from erosion	2259	m2	12.00	27108.00	13.20	29818.80
Delivery	Council Fees	1	%	3.25	69379.38	3.25	77023.90
	VicRoads Fees	1	%	1.00	21347.50	1.00	23699.66
	Traffic Management	1	%	5.00	106737.50	5.00	118498.31
	Environmental Management	1	%	0.50	10673.75	0.50	11849.83
	Surveying and Design	1	%	5.00	106737.50	5.00	118498.31
	Supervision and Project management	1	%	9.00	192127.51	9.00	213296.95
	Site Establishment	1	%	2.50	53368.75	2.50	59249.15
	Contingency	1	%	15.00	320212.51	15.00	355494.92
Total	Excluding Delivery				**2,134,750**		**2,369,966**
	Including Delivery				**3,015,334**		**3,347,577**

Project: BEVERIDGE NORTHWEST PSP
Date: 31/10/2021
Rates Index Date: JUNE 2021

Issue : A
Status: DRAFT

Description:	Road - RD02 Secondary - 1075m (Excluding intersection extents)
Civil Component Number:	RD02

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	36550	m2	3.73	136331.50	5.03	183846.50
	Soil stabilisation - gypsum treatment	26875	m2	4.65	124968.75	5.11	137331.25
	Additional construction staging measures to reduce grubbing and excavation	36550	m2	0.80	29240.00	0.88	32164.00
	Earthworks	6143	m3	34.53	212117.79	41.06	252231.58
	Erosion protection for 1:4 batters	8600	m2	3.84	33024.00	4.29	36894.00
Road Pavement	Primary Arterial Pavement	0	m2	171.88	0.00	188.74	0.00
	Secondary Arterial Pavement	9675	m2	128.70	1245172.50	135.56	1311543.00
	Collector Arterial Pavement	0	m2	106.55	0.00	113.94	0.00
	Subgrade Preparation	9675	m2	14.41	139416.75	16.38	158476.50
	Pavement Rehab	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation	9675	m2	48.64	470592.00	54.22	524578.50
	Crushed rock capping layer	9675	m2	25.34	245164.50	28.25	273318.75
Concrete Works	Kerb and Channel	2150	m	55.54	119411.00	61.71	132676.50
	Cycle Path	0	m2	77.61	0.00	93.16	0.00
	SUP/ Footpath	2150	m2	64.36	138374.00	74.61	160411.50
	Traffic Island	0	m2	78.63	0.00	85.19	0.00
Drainage	Drainage Pipe 300mm CR Bfilled	0	m	182.24	0.00	200.59	0.00
	Drainage Pipe 375mm CR Bfilled	243	m	262.54	63708.92	286.72	69576.52
	Drainage Pipe 450mm CR Bfilled	243	m	303.41	73626.58	338.77	82207.17
	Drainage Pipe 525mm CR Bfilled	590	m	409.22	241305.86	453.98	267699.61
	Drainage - pits	22	No.	2599.43	56770.85	2843.33	62097.56
	Drainage – Sub-soil drainage	2609	m	34.33	89554.42	43.98	114727.74
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
Traffic signals	Traffic Signals (all inclusive)	0	Item/ Per Leg	111186.08	0.00	130494.95	0.00
Landscape	Tree Planting, 45L tree	216	No.	307.37	66391.92	367.83	79451.28
	Topsoil with seeding, 100mm depth	24725	m2	7.31	180739.75	8.56	211646.00
Street Lighting	Street Lighting - Road	1075	m	219.22	235661.50	228.67	245820.25
	Street Lighting - Intersections	0	Item/ Per Leg	49111.97	0.00	56355.63	0.00
	Erosion protection for lighting cables	2150	m	12.16	26144.00	13.56	29154.00
Misc	Regulatory Signage	18	Item	342.92	6172.56	385.44	6937.92
	Linemarking	9675	m2 of Pavement	3.16	30573.00	4.15	40151.25
	Landscape maintenance (intersections)	0	Item	72291.19	0.00	89300.67	0.00
	Landscape maintenance (roads)	24725	m2	2.94	72691.50	3.00	74175.00
	Tactile Pavers (Hazard only)	0	Item	296.31	0.00	324.03	0.00
Other	Rock Allowance	1229	m3	101.33	124494.04	116.53	143168.76
	Existing pavement removal	6235	m2	65.87	410699.45	72.45	451725.75
	Geotextile mat to protect concrete items	4838	m2	12.00	58050.00	13.20	63855.00
Delivery	Council Fees	1	%	3.25	150487.91	3.25	167240.64
	VicRoads Fees	1	%	1.00	46303.97	1.00	51458.66
	Traffic Management	1	%	5.00	231519.86	5.00	257293.29
	Environmental Management	1	%	0.50	23151.99	0.50	25729.33
	Surveying and Design	1	%	5.00	231519.86	5.00	257293.29
	Supervision and Project management	1	%	9.00	416735.74	9.00	463127.93
	Site Establishment	1	%	2.50	115759.93	2.50	128646.65
	Contingency	1	%	15.00	694559.57	15.00	771879.88
Total	Excluding Delivery				**4,630,397**		**5,145,866**
	Including Delivery				**6,540,436**		**7,268,536**

Project: BEVERIDGE NORTHWEST PSP
Date: 31/10/2021
Rates Index Date: JUNE 2021

Issue : A
Status: DRAFT

Description:	Road - RD03 (Section 1) - Primary - 123m
Civil Component Number:	RD03 SECTION 1

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	1478	m2	3.73	5511.64	5.03	7432.59
	Soil stabilisation - gypsum treatment	494	m2	9.30	4591.17	10.22	5045.35
	Additional construction staging measures to reduce grubbing and excavation	1478	m2	0.80	1182.12	0.88	1300.33
	Earthworks	570	m3	34.53	19672.64	41.06	23392.95
	Erosion protection for 1:4 batters	435	m2	3.84	1669.61	4.29	1865.27
Road Pavement	Primary Arterial Pavement	861	m2	171.88	147984.98	188.74	162501.08
	Secondary Arterial Pavement	0	m2	128.70	0.00	135.56	0.00
	Collector Arterial Pavement	0	m2	106.55	0.00	113.94	0.00
	Subgrade Preparation	861	m2	14.41	12406.70	16.38	14102.83
	Pavement Rehab	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation, 0.5m past BoK	984	m2	48.64	47860.71	54.22	53351.31
	Crushed rock capping layer, 0.5m past BoK	984	m2	25.34	24934.01	28.25	27797.39
Concrete Works	Kerb and Channel	246	m	55.54	13664.79	61.71	15182.82
	Cycle Path	370	m2	77.61	28720.52	93.16	34474.99
	SUP/ Footpath	0	m2	64.36	0.00	74.61	0.00
	Traffic Island	0	m2	78.63	0.00	85.19	0.00
Drainage	Drainage Pipe 300mm CR Bfilled	0	m	182.24	0.00	200.59	0.00
	Drainage Pipe 375mm CR Bfilled	0	m	262.54	0.00	286.72	0.00
	Drainage Pipe 450mm CR Bfilled	51	m	303.41	15473.91	338.77	17277.27
	Drainage Pipe 525mm CR Bfilled	72	m	409.22	29463.84	453.98	32686.56
	Drainage - pits	4	No.	2599.43	10397.72	2843.33	11373.32
	Drainage – Sub-soil drainage	246	m	34.33	8446.38	43.98	10820.62
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
	Swale lining - rip-rap	620	m2	65.87	40866.54	73.42	45550.65
Traffic signals	Traffic Signals (all inclusive)	0	Item/ Per Leg	111186.08	0.00	130494.95	0.00
Landscape	Tree Planting, 45L tree	26	No.	307.37	7991.62	367.83	9563.58
	Topsoil with seeding, 100mm depth	3375	m2	7.31	24669.96	8.56	28888.49
Street Lighting	Street Lighting - Road	123	m	219.22	26964.06	228.67	28126.41
	Street Lighting - Intersections	0	Item/ Per Leg	49111.97	0.00	56355.63	0.00
	Erosion protection for lighting cables	246	m	12.16	2991.36	13.56	3335.76
Misc	Regulatory Signage	2	Item	342.92	720.13	385.44	809.42
	Linemarking	861	m2 of Pavement	3.16	2720.69	4.15	3573.06
	Landscape maintenance (intersections)	0	Item	72291.19	0.00	89300.67	0.00
	Landscape maintenance (roads)	3375	m2	2.94	9921.98	3.00	10124.47
	Tactile Pavers (Hazard only)	0	Item	296.31	0.00	324.03	0.00
Other	Rock Allowance	114	m3	101.33	11546.07	116.53	13278.04
	Geotextile mat to protect concrete items from erosion	308	m2	12.00	3690.00	13.20	4059.00
Delivery	Council Fees	1	%	3.25	16382.05	3.25	18392.19
	VicRoads Fees	1	%	1.00	5040.63	1.00	5659.14
	Traffic Management	1	%	5.00	25203.16	5.00	28295.68
	Environmental Management	1	%	0.50	2520.32	0.50	2829.57
	Surveying and Design	1	%	5.00	25203.16	5.00	28295.68
	Supervision and Project management	1	%	9.00	45365.68	9.00	50932.22
	Site Establishment	1	%	2.50	12601.58	2.50	14147.84
	Contingency	1	%	15.00	75609.47	15.00	84887.03
Total	Excluding Delivery				**504,063**		**565,914**
	Including Delivery				**711,989**		**799,353**

Project: BEVERIDGE NORTHWEST PSP
Date: 31/10/2021
Rates Index Date: JUNE 2021

Issue : A
Status: DRAFT

Description:	Road - RD03 (Section 2) - Primary - 402m
Civil Component Number:	RD03 SECTION 2

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	4571	m2	3.73	17050.20	5.03	22992.63
	Soil stabilisation - gypsum treatment	1502	m2	9.30	13971.48	10.22	15353.61
	Additional construction staging measures to reduce grubbing and excavation	4571	m2	0.80	3656.88	0.88	4022.57
	Earthworks	3362	m3	34.53	116085.64	41.06	138038.71
	Erosion protection for 1:4 batters	1518	m2	3.84	5829.55	4.29	6512.70
	Rock armoring (LHS only)	810	m2	227.99	184706.92	254.12	205876.24
Road Pavement	Primary Arterial Pavement	2667	m2	171.88	458367.65	188.74	503329.71
	Secondary Arterial Pavement	0	m2	128.70	0.00	135.56	0.00
	Collector Arterial Pavement	0	m2	106.55	0.00	113.94	0.00
	Subgrade Preparation	2667	m2	14.41	38428.43	16.38	43682.00
	Pavement Rehab	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation, 0.5m past BoK	3069	m2	48.64	149265.88	54.22	166389.73
	Crushed rock capping layer, 0.5m past BoK	3069	m2	25.34	77763.11	28.25	86693.28
Concrete Works	Kerb and Channel	762	m	55.54	42295.67	61.71	46994.34
	Cycle Path	1143	m2	77.61	88690.74	93.16	106460.89
	SUP/ Footpath	0	m2	64.36	0.00	74.61	0.00
	Traffic Island	0	m2	78.63	0.00	85.19	0.00
Drainage	Drainage Pipe 300mm CR Bfilled	0	m	182.24	0.00	200.59	0.00
	Drainage Pipe 375mm CR Bfilled	0	m	262.54	0.00	286.72	0.00
	Drainage Pipe 450mm CR Bfilled	79	m	303.41	24050.58	338.77	26853.49
	Drainage Pipe 525mm CR Bfilled	301	m	409.22	123186.75	453.98	136660.77
	Drainage - pits	8	No.	2599.43	20795.44	2843.33	22746.64
	Drainage – Sub-soil drainage	762	m	34.33	26143.50	43.98	33492.32
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
	Swale lining - rip-rap	2028	m2	65.87	133563.81	73.42	148872.85
Traffic signals	Traffic Signals (all inclusive)	0	Item/ Per Leg	111186.08	0.00	130494.95	0.00
Landscape	Tree Planting, 45L tree	82	No.	307.37	25204.34	367.83	30162.06
	Topsoil with seeding, 100mm depth	10667	m2	7.31	77972.93	8.56	91306.19
Street Lighting	Street Lighting - Road	402	m	219.22	88126.44	228.67	91925.34
	Street Lighting - Intersections	0	Item/ Per Leg	49111.97	0.00	56355.63	0.00
	Erosion protection for lighting cables	804	m	12.16	9776.64	13.56	10902.24
Misc	Regulatory Signage	7	Item	342.92	2297.56	385.44	2582.45
	Linemarking	2667	m2 of Pavement	3.16	8427.05	4.15	11067.17
	Landscape maintenance (intersections)	0	Item	72291.19	0.00	89300.67	0.00
	Landscape maintenance (roads)	10667	m2	2.94	31359.84	3.00	31999.83
	Tactile Pavers (Hazard only)	0	Item	296.31	0.00	324.03	0.00
Other	Geotextile mat to protect concrete items fro	2094	m2	12.00	25122.17	13.20	27634.39
Delivery	Council Fees	1	%	3.25	58244.52	3.25	65407.94
	VicRoads Fees	1	%	1.00	17921.39	1.00	20125.52
	Traffic Management	1	%	5.00	89606.96	5.00	100627.61
	Environmental Management	1	%	0.50	8960.70	0.50	10062.76
	Surveying and Design	1	%	5.00	89606.96	5.00	100627.61
	Supervision and Project management	1	%	9.00	161292.53	9.00	181129.69
	Site Establishment	1	%	2.50	44803.48	2.50	50313.80
	Contingency	1	%	15.00	268820.88	15.00	301882.82
Total	Excluding Delivery				**1,792,139**		**2,012,552**
	Including Delivery				**2,531,397**		**2,842,730**

Project: BEVERIDGE NORTHWEST PSP
Date: 31/10/2021
Rates Index Date: JUNE 2021

Issue : A
Status: DRAFT

Description:	Road - RD03 (Section 3) - Primary - 64m
Civil Component Number:	RD03 SECTION 3

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	753	m2	3.73	2808.77	5.03	3787.70
	Soil stabilisation - gypsum treatment	249	m2	9.30	2317.48	10.22	2546.74
	Additional construction staging measures to reduce grubbing and excavation	753	m2	0.80	602.42	0.88	662.66
	Earthworks	1054	m3	34.53	36379.00	41.06	43258.66
	Erosion protection for 1:4 batters	454	m2	3.84	1745.01	4.29	1949.50
Road Pavement	Primary Arterial Pavement	440	m2	171.88	75597.94	188.74	83013.47
	Secondary Arterial Pavement	0	m2	128.70	0.00	135.56	0.00
	Collector Arterial Pavement	0	m2	106.55	0.00	113.94	0.00
	Subgrade Preparation	440	m2	14.41	6337.95	16.38	7204.41
	Subgrade Preloading Fill	0	m3	34.53	0.00	38.49	0.00
	Pavement Rehab	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation, 0.5m past BoK	504	m2	48.64	24506.28	54.22	27317.65
	Crushed rock capping layer, 0.5m past BoK	504	m2	25.34	12767.05	28.25	14233.19
Concrete Works	Kerb and Channel	127	m	55.54	7033.49	61.71	7814.85
	Cycle Path	188	m2	77.61	14584.07	93.16	17506.15
	SUP/ Footpath	0	m2	64.36	0.00	74.61	0.00
	Traffic Island	0	m2	78.63	0.00	85.19	0.00
Drainage	Drainage Pipe 300mm CR Bfilled	0	m	182.24	0.00	200.59	0.00
	Drainage Pipe 375mm CR Bfilled	0	m	262.54	0.00	286.72	0.00
	Drainage Pipe 450mm CR Bfilled	0	m	303.41	0.00	338.77	0.00
	Drainage Pipe 525mm CR Bfilled	64	m	409.22	26190.08	453.98	29054.72
	Drainage - pits	1	No.	2599.43	3539.65	2843.33	3871.77
	Drainage – Sub-soil drainage	172	m	34.33	5919.99	43.98	7584.07
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
	Swale lining - rip-rap	323	m2	65.87	21263.89	73.42	23701.15
Traffic signals	Traffic Signals (all inclusive)		Item/ Per Leg	111186.08	0.00	130494.95	0.00
Landscape	Tree Planting, 45L tree	14	No.	307.37	4303.18	367.83	5149.62
	Topsoil with seeding, 100mm depth	1972	m2	7.31	14414.80	8.56	16879.71
Street Lighting	Street Lighting - Road	64	m	219.22	14030.08	228.67	14634.88
	Street Lighting - Intersections	0	Item/ Per Leg	49111.97	0.00	56355.63	0.00
	Erosion protection for lighting cables	128	m	12.16	1556.48	13.56	1735.68
Misc	Regulatory Signage	1	Item	342.92	377.21	385.44	423.98
	Linemarking	440	m2 of Pavement	3.16	1389.86	4.15	1825.29
	Landscape maintenance (intersections)	0	Item	72291.19	0.00	89300.67	0.00
	Landscape maintenance (roads)	1972	m2	2.94	5797.47	3.00	5915.79
	Tactile Pavers (Hazard only)	0	Item	296.31	0.00	324.03	0.00
Other	Rock Allowance	211	m3	101.33	21351.20	116.53	24553.98
	Geotextile mat to protect concrete items fro	348	m2	12.00	4174.98	13.20	4592.48
Delivery	Council Fees	1	%	3.25	10042.12	3.25	11349.59
	VicRoads Fees	1	%	1.00	3089.88	1.00	3492.18
	Traffic Management	1	%	5.00	15449.42	5.00	17460.90
	Environmental Management	1	%	0.50	1544.94	0.50	1746.09
	Surveying and Design	1	%	5.00	15449.42	5.00	17460.90
	Supervision and Project management	1	%	9.00	27808.95	9.00	31429.63
	Site Establishment	1	%	2.50	7724.71	2.50	8730.45
	Contingency	1	%	15.00	46348.25	15.00	52382.71
Total	Excluding Delivery				**308,988**		**349,218**
	Including Delivery				**436,446**		**493,271**

Project: BEVERIDGE NORTHWEST PSP
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Issue : A
Status: DRAFT

Description:	Road - RD03B (Section 4) - Secondary - 2357m
Civil Component Number:	RD03 SECTION 4

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	93639	m2	3.73	349273.47	5.03	471004.17
	Soil stabilisation - gypsum treatment	70069	m2	9.30	651641.70	10.22	716105.18
	Additional construction staging measures to reduce grubbing and excavation	93639	m2	0.80	74911.20	0.88	82402.32
	Earthworks	24106	m3	34.53	832380.18	41.06	989792.36
	Erosion protection for 1:4 batters	15778	m2	3.84	60587.52	4.29	67687.62
Road Pavement	Primary Arterial Pavement	0	m2	171.88	0.00	188.74	0.00
	Secondary Arterial Pavement	21213	m2	128.70	2730113.10	135.56	2875634.28
	Collector Arterial Pavement	0	m2	106.55	0.00	113.94	0.00
	Subgrade Preparation	21213	m2	14.41	305679.33	16.38	347468.94
	Subgrade Preloading Fill	0	m3	34.53	0.00	38.49	0.00
	Pavement Rehab	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation, 0.5m past BoK	23570	m2	48.64	1146444.80	54.22	1277965.40
	Crushed rock capping layer, 0.5m past BoK	23570	m2	25.34	597263.80	28.25	665852.50
Concrete Works	Kerb and Channel	4714	m	55.54	261815.56	61.71	290900.94
	Cycle Path	0	m2	77.61	0.00	93.16	0.00
	SUP/ Footpath	4714	m2	64.36	303393.04	74.61	351711.54
	Traffic Island	0	m2	78.63	0.00	85.19	0.00
Drainage	Drainage Pipe 300mm CR Bfilled	0	m	182.24	0.00	200.59	0.00
	Drainage Pipe 375mm CR Bfilled	1634	m	262.54	429039.37	286.72	468554.00
	Drainage Pipe 450mm CR Bfilled	786	m	303.41	238379.12	338.77	266160.30
	Drainage Pipe 525mm CR Bfilled	786	m	409.22	321510.51	453.98	356676.95
	Drainage - pits	94	No.	2599.43	245074.26	2843.33	268069.15
	Drainage – Sub-soil drainage	4714	m	34.33	161831.62	43.98	207321.72
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
	Swale lining - rip-rap	0	m2	65.87	0.00	73.42	0.00
Traffic signals	Traffic Signals (all inclusive)	0	Item/ Per Leg	111186.08	0.00	130494.95	0.00
Landscape	Tree Planting, 45L tree	472	No.	307.37	145078.64	367.83	173615.76
	Topsoil with seeding, 100mm depth	68575	m2	7.31	501281.79	8.56	587000.29
Street Lighting	Street Lighting - Road	2357	m	219.22	516701.54	228.67	538975.19
	Street Lighting - Intersections	0	Item/ Per Leg	49111.97	0.00	56355.63	0.00
	Erosion protection for lighting cables	4714	m	12.16	57322.24	13.56	63921.84
Misc	Regulatory Signage	39	Item	342.92	13476.76	385.44	15147.79
	Linemarking	21213	m2 of Pavement	3.16	67033.08	4.15	88033.95
	Landscape maintenance (intersections)	0	Item	72291.19	0.00	89300.67	0.00
	Landscape maintenance (roads)	68575	m2	2.94	201609.91	3.00	205724.40
	Tactile Pavers (Hazard only)	0	Item	296.31	0.00	324.03	0.00
Other	Culverts - Item 31 (BM Report) with rock gabions	1	Item	181230.89	181230.89	289180.00	210218.55
	Geotextile mat to protect concrete items fro	8014	m2	12.00	96165.60	13.20	105782.16
Delivery	Council Fees	1	%	3.25	340900.27	3.25	379981.14
	VicRoads Fees	1	%	1.00	104892.39	1.00	116917.27
	Traffic Management	1	%	5.00	524461.95	5.00	584586.37
	Environmental Management	1	%	0.50	52446.20	0.50	58458.64
	Surveying and Design	1	%	5.00	524461.95	5.00	584586.37
	Supervision and Project management	1	%	9.00	944031.51	9.00	1052255.46
	Site Establishment	1	%	2.50	262230.98	2.50	292293.18
	Contingency	1	%	15.00	1573385.85	15.00	1753759.10
Total	Excluding Delivery				**10,489,239**		**11,691,727**
	Including Delivery				**14,816,050**		**16,514,565**

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Issue : A
Status: DRAFT

Description:	Road - RD04 Secondary - 1296m (Excluding intersection extents)
Civil Component Number:	RD04

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	44064	m2	3.73	164358.72	5.03	221641.92
	Soil stabilisation - gypsum treatment	32400	m2	4.65	150660.00	5.11	165564.00
	Additional construction staging measures to reduce grubbing and excavation	44064	m2	0.80	35251.20	0.88	38776.32
	Earthworks	10986	m3	34.53	379343.96	41.06	451082.04
	Erosion protection for 1:4 batters	10368	m2	3.84	39813.12	4.29	44478.72
Road Pavement	Primary Arterial Pavement	0	m2	171.88	0.00	188.74	0.00
	Secondary Arterial Pavement	11664	m2	128.70	1501156.80	135.56	1581171.84
	Collector Arterial Pavement	0	m2	106.55	0.00	113.94	0.00
	Subgrade Preparation	11664	m2	14.41	168078.24	16.38	191056.32
	Pavement Rehab	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation	11664	m2	48.64	567336.96	54.22	632422.08
	Crushed rock capping layer	11664	m2	25.34	295565.76	28.25	329508.00
Concrete Works	Kerb and Channel	2592	m	55.54	143959.68	61.71	159952.32
	Cycle Path	0	m2	77.61	0.00	93.16	0.00
	SUP/ Footpath	2592	m2	64.36	166821.12	74.61	193389.12
	Traffic Island	0	m2	78.63	0.00	85.19	0.00
Drainage	Drainage Pipe 300mm CR Bfilled	164	m	182.24	29944.12	200.59	32959.23
	Drainage Pipe 375mm CR Bfilled	568	m	262.54	149250.30	286.72	162996.29
	Drainage Pipe 450mm CR Bfilled	568	m	303.41	172484.32	338.77	192585.98
	Drainage Pipe 525mm CR Bfilled	0	m	409.22	0.00	453.98	0.00
	Drainage - pits	27	No.	2599.43	70184.61	2843.33	76769.91
	Drainage – Sub-soil drainage	2592	m	34.33	88983.36	43.98	113996.16
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
Traffic signals	Traffic Signals (all inclusive)	0	Item/ Per Leg	111186.08	0.00	130494.95	0.00
Landscape	Tree Planting, 45L tree	260	No.	307.37	79916.20	367.83	95635.80
	Topsoil with seeding, 100mm depth	29808	m2	7.31	217896.48	8.56	255156.48
Street Lighting	Street Lighting - Road	1296	m	219.22	284109.12	228.67	296356.32
	Street Lighting - Intersections	0	Item/ Per Leg	49111.97	0.00	56355.63	0.00
	Erosion protection for lighting cables	2592	m	12.16	31518.72	13.56	35147.52
Misc	Regulatory Signage	22	Item	342.92	7490.30	385.44	8419.05
	Linemarking	11664	m2 of Pavement	3.16	36858.24	4.15	48405.60
	Landscape maintenance (intersections)	0	Item	72291.19	0.00	89300.67	0.00
	Landscape maintenance (roads)	29808	m2	2.94	87635.52	3.00	89424.00
	Tactile Pavers (Hazard only)	0	Item	296.31	0.00	324.03	0.00
Other	Rock Allowance	2197	m3	101.33	222640.74	116.53	256037.95
	Geotextile mat to protect concrete items	5845	m2	12.00	70142.50	13.20	77156.75
Delivery	Council Fees	1	%	3.25	167745.50	3.25	186877.92
	VicRoads Fees	1	%	1.00	51614.00	1.00	57500.90
	Traffic Management	1	%	5.00	258070.00	5.00	287504.49
	Environmental Management	1	%	0.50	25807.00	0.50	28750.45
	Surveying and Design	1	%	5.00	258070.00	5.00	287504.49
	Supervision and Project management	1	%	9.00	464526.01	9.00	517508.07
	Site Establishment	1	%	2.50	129035.00	2.50	143752.24
	Contingency	1	%	15.00	774210.01	15.00	862513.46
Total	Excluding Delivery				**5,161,400**		**5,750,090**
	Including Delivery				**7,290,478**		**8,122,002**

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Issue : A
Status: DRAFT

Description:	INTERSECTION - Secondary - Secondary Intersection - IN01
Civil Component Number:	INTERSECTION 1

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	26125	m2	3.73	97446.25	5.03	131408.75
	Soil stabilisation - gypsum treatment	12325	m2	4.65	57311.25	5.11	62980.75
	Additional construction staging measures to reduce grubbing and excavation	26125	m2	0.80	20900.00	0.88	22990.00
	Earthworks	13238	m3	34.53	457108.14	41.06	543552.28
	Erosion protection for 1:4 batters	5776	m2	3.84	22179.84	4.29	24779.04
Road Pavement	Primary Arterial Pavement	0	m2	171.88	0.00	188.74	0.00
	Secondary Arterial Pavement	13800	m2	128.70	1776060.00	135.56	1870728.00
	Collector Arterial Pavement	0	m2	106.55	0.00	113.94	0.00
	Subgrade Preparation	13800	m2	14.41	198858.00	16.38	226044.00
	Pavement Rehab	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation	13800	m2	48.64	671232.00	54.22	748236.00
	Crushed rock capping layer	13800	m2	25.34	349692.00	28.25	389850.00
Concrete Works	Kerb and Channel	2000	m	55.54	111080.00	61.71	123420.00
	Cycle Path	0	m2	77.61	0.00	93.16	0.00
	SUP/ Footpath	1700	m2	64.36	109412.00	74.61	126837.00
	Traffic Island	680	m2	78.63	53468.40	85.19	57929.20
Drainage	Drainage Pipe 300mm CR Bfilled	260	m	182.24	47382.40	200.59	52153.40
	Drainage Pipe 375mm CR Bfilled	0	m	262.54	0.00	286.72	0.00
	Drainage Pipe 450mm CR Bfilled	900	m	303.41	273069.00	338.77	304893.00
	Drainage Pipe 525mm CR Bfilled	0	m	409.22	0.00	453.98	0.00
	Drainage - pits	40	No.	2599.43	103977.20	2843.33	113733.20
	Drainage – Sub-soil drainage	3100	m	34.33	106423.00	43.98	136338.00
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
Traffic signals	Traffic Signals (all inclusive)	4	Item/ Per Leg	111186.08	444744.32	130494.95	521979.80
Landscape	Tree Planting, 45L tree	60	No.	307.37	18442.20	367.83	22069.80
	Topsoil with seeding, 100mm depth	10465	m2	7.31	76499.15	8.56	89580.40
Street Lighting	Street Lighting - Road	0	m	219.22	0.00	228.67	0.00
	Street Lighting - Intersections	4	Item/ Per Leg	49111.97	196447.88	56355.63	225422.52
	Erosion protection for lighting cables	1444	m	12.16	17559.04	13.56	19580.64
Misc	Regulatory Signage	16	Item	342.92	5486.72	385.44	6167.04
	Line marking	13800	m2 of Pavement	3.16	43608.00	4.15	57270.00
	Landscape maintenance (intersections)	1	Item	72291.19	72291.19	89300.67	89300.67
	Landscape maintenance (roads)	0	m2 of l'scape	2.94	0.00	3.00	0.00
	Tactile Pavers (Hazard only)	24	Item	296.31	7111.44	324.03	7776.72
Other	Rock Allowance	2648	m3	101.33	268281.31	116.53	308524.83
	Geotextile mat to protect concrete items	4600	m2	12.00	55200.00	13.20	60720.00
Delivery	Council Fees	1	%	3.25	183991.30	3.25	206188.61
	VicRoads Fees	1	%	1.00	56612.71	1.00	63442.65
	Traffic Management	1	%	5.00	283063.54	5.00	317213.25
	Environmental Management	1	%	0.50	28306.35	0.50	31721.33
	Surveying and Design	1	%	5.00	283063.54	5.00	317213.25
	Supervision and Project management	1	%	9.00	509514.37	9.00	570983.85
	Site Establishment	1	%	2.50	141531.77	2.50	158606.63
	Contingency	1	%	15.00	849190.61	15.00	951639.76
Total	Excluding Delivery				**5,661,271**		**6,344,265**
	Including Delivery				**7,996,545**		**8,961,274**
	75% Apportionment				**5,997,409**		**6,720,956**

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Issue : A
Status: DRAFT

Description:	INTERSECTION - Secondary - Connector T Intersection - IN02
Civil Component Number:	INTERSECTION 2

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	14710	m2	3.73	54868.30	5.03	73991.30
	Soil stabilisation - gypsum treatment	7774	m2	4.65	36149.10	5.11	39725.14
	Additional construction staging measures to reduce grubbing and excavation	14710	m2	0.80	11768.00	0.88	12944.80
	Earthworks	5285	m3	34.53	182491.05	41.06	217002.10
	Erosion protection for 1:4 batters	2986	m2	3.84	11466.24	4.29	12809.94
Road Pavement	Primary Arterial Pavement	0	m2	171.88	0.00	188.74	0.00
	Secondary Arterial Pavement	6454	m2	128.70	830629.80	135.56	874904.24
	Collector Arterial Pavement	482	m2	106.55	51357.10	113.94	54919.08
	Subgrade Preparation	6936	m2	14.41	99947.76	16.38	113611.68
	Pavement Rehabilitation	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation	6936	m2	48.64	337367.04	54.22	376069.92
	Crushed rock capping layer	6936	m2	25.34	175758.24	28.25	195942.00
Concrete Works	Kerb and Channel	1458	m	55.54	80977.32	61.71	89973.18
	Cycle Path	170	m2	77.61	13193.70	93.16	15837.20
	SUP/ Footpath	1410	m2	64.36	90747.60	74.61	105200.10
	Traffic Island	407	m2	78.63	32002.41	85.19	34672.33
Drainage	Drainage Pipe 300mm CR Bfilled	140	m	182.24	25513.60	200.59	28082.60
	Drainage Pipe 375mm CR Bfilled	0	m	262.54	0.00	286.72	0.00
	Drainage Pipe 450mm CR Bfilled	450	m	303.41	136534.50	338.77	152446.50
	Drainage Pipe 525mm CR Bfilled	0	m	409.22	0.00	453.98	0.00
	Drainage - pits	21	No.	2599.43	54588.03	2843.33	59709.93
	Drainage – Sub-soil drainage	1958	m	34.33	67218.14	43.98	86112.84
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
Traffic signals	Traffic Signals (all inclusive)	3	Item/ Per Leg	111186.08	333558.24	130494.95	391484.85
Landscape	Tree Planting, 45L tree	41	No.	307.37	12602.17	367.83	15081.03
	Topsoil with seeding, 100mm depth	2175	m2	7.31	15899.25	8.56	18618.00
Street Lighting	Street Lighting - Road	0	m	219.22	0.00	228.67	0.00
	Street Lighting - Intersections	3	Item/ Per Leg	49111.97	147335.91	56355.63	169066.89
	Erosion protection for lighting cables	848	m	12.16	10311.68	13.56	11498.88
Misc.	Regulatory Signage	5	Item	342.92	1714.60	385.44	1927.20
	Line marking	6936	m2 of Pavement	3.16	21917.76	4.15	28784.40
	Landscape maintenance (intersections)	1	Item	72291.19	72291.19	89300.67	89300.67
	Landscape maintenance (roads)	0	m2 of l'scape	2.94	0.00	3.00	0.00
	Tactile Pavers (Hazard only)	18	Item	296.31	5333.58	324.03	5832.54
Other	Rock Allowance	1387	m2	101.33	140564.98	116.53	161650.42
	Existing pavement removal	2300	m2	65.87	151501.00	72.45	166635.00
	Geotextile mat to protect concrete items	2885	m2	12.00	34620.00	13.20	38082.00
Delivery	Council Fees	1	%	3.25	105307.42	3.25	118362.29
	VicRoads Fees	1	%	1.00	32402.28	1.00	36419.17
	Traffic Management	1	%	5.00	162011.41	5.00	182095.84
	Environmental Management	1	%	0.50	16201.14	0.50	18209.58
	Surveying and Design	1	%	5.00	162011.41	5.00	182095.84
	Supervision and Project management	1	%	9.00	291620.55	9.00	327772.51
	Site Establishment	1	%	2.50	81005.71	2.50	91047.92
	Contingency	1	%	15.00	486034.24	15.00	546287.51
Total	Excluding Delivery				**3,240,228**		**3,641,917**
	Including Delivery				**4,576,822**		**5,144,207**

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Issue : A
Status: DRAFT

Description:	INTERSECTION - Primary - Secondary - Connector Intersection - INT03
Civil Component Number:	INTERSECTION 3

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	31068	m2	3.73	115883.64	5.03	156272.04
	Soil stabilisation - gypsum treatment	16812	m2	9.30	156351.60	10.22	171818.64
	Additional construction staging measures to reduce grubbing and excavation	31068	m2	0.80	24854.40	0.88	27339.84
	Earthworks	7980	m3	34.53	275540.08	41.06	327647.71
	Erosion protection for 1:4 batters	7184	m2	3.84	27586.56	4.29	30819.36
	Rock armoring (LHS only)	3530	m2	227.99	804756.99	254.12	896990.42
Road Pavement	Primary Arterial Pavement	8373	m2	171.88	1439151.24	188.74	1580320.02
	Secondary Arterial Pavement	3166	m2	128.70	407464.20	135.56	429182.96
	Collector Arterial Pavement	1819	m2	106.55	193814.45	113.94	207256.86
	Subgrade Preparation	13358	m2	14.41	192488.78	16.38	218804.04
	Pavement Rehabilitation	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation, 0.5m past BoK	14256	m2	48.64	693411.84	54.22	772960.32
	Crushed rock capping layer, 0.5m past BoK	14256	m2	25.34	361247.04	28.25	402732.00
Concrete Works	Kerb and Channel	2883	m	55.54	160121.82	61.71	177909.93
	Cycle Path	1562	m2	77.61	121226.82	93.16	145515.92
	SUP/ Footpath	2123	m2	64.36	136636.28	74.61	158397.03
	Traffic Island	303	m2	78.63	23824.89	85.19	25812.57
Drainage	Drainage Pipe 300mm CR Bfilled	0	m	182.24	0.00	200.59	0.00
	Drainage Pipe 375mm CR Bfilled	800	m	262.54	210032.00	286.72	229376.00
	Drainage Pipe 450mm CR Bfilled	800	m	303.41	242728.00	338.77	271016.00
	Drainage Pipe 525mm CR Bfilled	166	m	409.22	67930.52	453.98	75360.68
	Drainage - pits	42	No.	2599.43	109176.06	2843.33	119419.86
	Drainage – Sub-soil drainage	2883	m	34.33	98973.39	43.98	126794.34
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
	Swale lining - rip-rap	6292	m2	65.87	414472.88	73.42	461979.64
Traffic signals	Traffic Signals (all inclusive)	4	Item/ Per Leg	111186.08	444744.32	130494.95	521979.80
Landscape	Tree Planting, 45L tree	180	No.	307.37	55326.60	367.83	66209.40
	Topsoil with seeding, 100mm depth	13722	m2	7.31	100307.82	8.56	117460.32
Street Lighting	Street Lighting - Road	0	m	219.22	0.00	228.67	0.00
	Street Lighting - Intersections	4	Item/ Per Leg	49111.97	196447.88	56355.63	225422.52
	Erosion protection for lighting cables	1796	m	12.16	21839.36	13.56	24353.76
Misc.	Regulatory Signage	16	Item	342.92	5486.72	385.44	6167.04
	Line marking	13358	m2 of Pavement	3.16	42211.28	4.15	55435.70
	Landscape maintenance (intersections)	1	Item	72291.19	72291.19	89300.67	89300.67
	Landscape maintenance (roads)	0	m2 of l'scape	2.94	0.00	3.00	0.00
	Tactile Pavers (Hazard only)	14	Item	296.31	4148.34	324.03	4536.42
Other	Rock Allowance	2672	m3	101.33	270713.23	116.53	311321.55
	Geotextile mat to protect concrete item	6538	m2	12.00	78456.00	13.20	86301.60
Delivery	Council Fees	1	%	3.25	246013.50	3.25	276971.99
	VicRoads Fees	1	%	1.00	75696.46	1.00	85222.15
	Traffic Management	1	%	5.00	378482.31	5.00	426110.75
	Environmental Management	1	%	0.50	37848.23	0.50	42611.07
	Surveying and Design	1	%	5.00	378482.31	5.00	426110.75
	Supervision and Project management	1	%	9.00	681268.16	9.00	766999.35
	Site Establishment	1	%	2.50	189241.16	2.50	213055.37
	Contingency	1	%	15.00	1135446.93	15.00	1278332.24
Total	Excluding Delivery				**7,569,646**		**8,522,215**
	Including Delivery				**10,692,125**		**12,037,629**

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Issue : A
Status: DRAFT

Description:	INTERSECTION - Primary - Connector Intersection - INT04
Civil Component Number:	INTERSECTION 4

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	24717	m2	3.73	92194.41	5.03	124326.51
	Soil stabilisation - gypsum treatment	13309	m2	9.30	123775.56	10.22	136020.02
	Additional construction staging measures to reduce grubbing and excavation	24717	m2	0.80	19773.60	0.88	21750.96
	Earthworks	6396	m3	34.53	220843.18	41.06	262607.03
	Erosion protection for 1:4 batters	5838	m2	3.84	22419.46	4.29	25046.74
	Rock armoring (LHS only)	3071	m2	227.99	700132.00	254.12	780374.33
Road Pavement	Primary Arterial Pavement	8271	m2	171.88	1421619.48	188.74	1561068.54
	Secondary Arterial Pavement	0	m2	128.70	0.00	135.56	0.00
	Collector Arterial Pavement	2407	m2	106.55	256465.85	113.94	274253.58
	Subgrade Preparation	10678	m2	14.41	153869.98	16.38	174905.64
	Pavement Rehabilitation	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation, 0.5m past BoK	11408	m2	48.64	554875.39	54.22	618530.92
	Crushed rock capping layer, 0.5m past BoK	11408	m2	25.34	289073.65	28.25	322270.35
Concrete Works	Kerb and Channel	2187	m	55.54	121465.98	61.71	134959.77
	Cycle Path	1578	m2	77.61	122468.58	93.16	147006.48
	SUP/ Footpath	1167	m2	64.36	75108.12	74.61	87069.87
	Traffic Island	153	m2	78.63	12030.39	85.19	13034.07
Drainage	Drainage Pipe 300mm CR Bfilled	0	m	182.24	0.00	200.59	0.00
	Drainage Pipe 375mm CR Bfilled	600	m	262.54	157524.00	286.72	172032.00
	Drainage Pipe 450mm CR Bfilled	458	m	303.41	138961.78	338.77	155156.66
	Drainage Pipe 525mm CR Bfilled	402	m	409.22	164506.44	453.98	182499.96
	Drainage - pits	35	No.	2599.43	90980.05	2843.33	99516.55
	Drainage – Sub-soil drainage	2187	m	34.33	75079.71	43.98	96184.26
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
	Swale lining - rip-rap	5114	m2	65.87	336839.99	73.42	375448.49
Traffic signals	Traffic Signals (all inclusive)	4	Item/ Per Leg	111186.08	444744.32	130494.95	521979.80
Landscape	Tree Planting, 45L tree	146	No.	307.37	44876.02	367.83	53703.18
	Topsoil with seeding, 100mm depth	11125	m2	7.31	81323.75	8.56	95230.00
Street Lighting	Street Lighting - Road	0	m	219.22	0.00	228.67	0.00
	Street Lighting - Intersections	4	Item/ Per Leg	49111.97	196447.88	56355.63	225422.52
	Erosion protection for lighting cables	1460	m	12.16	17748.74	13.56	19792.18
Misc.	Regulatory Signage	16	Item	342.92	5486.72	385.44	6167.04
	Line marking	10678	m2 of Pavement	3.16	33742.48	4.15	44313.70
	Landscape maintenance (intersections)	1	Item	72291.19	72291.19	89300.67	89300.67
	Landscape maintenance (roads)	0	m2 of l'scape	2.94	0.00	3.00	0.00
	Tactile Pavers (Hazard only)	12	Item	296.31	3555.72	324.03	3888.36
Other	Rock Allowance	2135.6	m3	101.33	216400.35	116.53	248861.47
	Geotextile mat to protect concrete item	3812	m2	12.00	45744.00	13.20	50318.40
Delivery	Council Fees	1	%	3.25	205151.99	3.25	231498.80
	VicRoads Fees	1	%	1.00	63123.69	1.00	71230.40
	Traffic Management	1	%	5.00	315618.44	5.00	356152.00
	Environmental Management	1	%	0.50	31561.84	0.50	35615.20
	Surveying and Design	1	%	5.00	315618.44	5.00	356152.00
	Supervision and Project management	1	%	9.00	568113.19	9.00	641073.60
	Site Establishment	1	%	2.50	157809.22	2.50	178076.00
	Contingency	1	%	15.00	946855.32	15.00	1068456.01
Total	Excluding Delivery				**6,312,369**		**7,123,040**
	Including Delivery				**8,916,221**		**10,061,294**

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Issue : A
Status: DRAFT

Description:	INTERSECTION - Primary - Connector Intersection - INT05
Civil Component Number:	INTERSECTION 5

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	22701	m2	3.73	84675.10	5.03	114186.53
	Soil stabilisation - gypsum treatment	9909	m2	9.30	92154.62	10.22	101270.99
	Additional construction staging measures to reduce grubbing and excavation	22701	m2	0.80	18160.88	0.88	19976.97
	Earthworks	2380	m3	34.53	82170.01	41.06	97709.25
	Erosion protection for 1:4 batters	2594	m2	3.84	9961.34	4.29	11128.68
	Rock armoring (LHS only)	1001	m2	227.99	228314.66	254.12	254481.87
Road Pavement	Primary Arterial Pavement	8540	m2	171.88	1467855.20	188.74	1611839.60
	Secondary Arterial Pavement	0	m2	128.70	0.00	135.56	0.00
	Collector Arterial Pavement	3460	m2	106.55	368663.00	113.94	394232.40
	Subgrade Preparation	12000	m2	14.41	172920.00	16.38	196560.00
	Pavement Rehabilitation	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation, 0.5m past BoK	12792	m2	48.64	622202.88	54.22	693582.24
	Crushed rock capping layer, 0.5m past BoK	12792	m2	25.34	324149.28	28.25	361374.00
Concrete Works	Kerb and Channel	2419	m	55.54	134351.26	61.71	149276.49
	Cycle Path	2255	m2	77.61	175031.66	93.16	210101.14
	SUP/ Footpath	1013	m2	64.36	65169.71	74.61	75548.67
	Traffic Island	141	m2	78.63	11086.83	85.19	12011.79
Drainage	Drainage Pipe 300mm CR Bfilled	0	m	182.24	0.00	200.59	0.00
	Drainage Pipe 375mm CR Bfilled	600	m	262.54	157524.00	286.72	172032.00
	Drainage Pipe 450mm CR Bfilled	549	m	303.41	166572.09	338.77	185984.73
	Drainage Pipe 525mm CR Bfilled	495	m	409.22	202563.90	453.98	224720.10
	Drainage - pits	36	No.	2599.43	93579.48	2843.33	102359.88
	Drainage – Sub-soil drainage	2419	m	34.33	83044.27	43.98	106387.62
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
	Swale lining - rip-rap	3995	m2	65.87	263140.64	73.42	293301.74
Traffic signals	Traffic Signals (all inclusive)	4	Item/ Per Leg	111186.08	444744.32	130494.95	521979.80
Landscape	Tree Planting, 45L tree	160	No.	307.37	49179.20	367.83	58852.80
	Topsoil with seeding, 100mm depth	14606	m2	7.31	106766.30	8.56	125023.19
Street Lighting	Street Lighting - Road	0	m	219.22	0.00	228.67	0.00
	Street Lighting - Intersections	4	Item/ Per Leg	49111.97	196447.88	56355.63	225422.52
	Erosion protection for lighting cables	1584	m	12.16	19261.44	13.56	21479.04
Misc.	Regulatory Signage	16	Item	342.92	5486.72	385.44	6167.04
	Line marking	12000	m2 of Pavement	3.16	37920.00	4.15	49800.00
	Landscape maintenance (intersections)	1	Item	72291.19	72291.19	89300.67	89300.67
	Landscape maintenance (roads)	0	m2 of l'scape	2.94	0.00	3.00	0.00
	Tactile Pavers (Hazard only)	12	Item	296.31	3555.72	324.03	3888.36
Other	Geotextile mat to protect concrete item	6365	m2	12.00	76383.26	13.20	84021.59
Delivery	Council Fees	1	%	3.25	189648.12	3.25	213655.06
	VicRoads Fees	1	%	1.00	58353.27	1.00	65740.02
	Traffic Management	1	%	5.00	291766.34	5.00	328700.08
	Environmental Management	1	%	0.50	29176.63	0.50	32870.01
	Surveying and Design	1	%	5.00	291766.34	5.00	328700.08
	Supervision and Project management	1	%	9.00	525179.42	9.00	591660.15
	Site Establishment	1	%	2.50	145883.17	2.50	164350.04
	Contingency	1	%	15.00	875299.03	15.00	986100.25
Total	Excluding Delivery				**5,835,327**		**6,574,002**
	Including Delivery				**8,242,399**		**9,285,777**

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Issue : A
Status: DRAFT

Description:	INTERSECTION - Primary - Connector Intersection - IN06
Civil Component Number:	INTERSECTION 6

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	23571	m2	3.73	87921.31	5.03	118564.12
	Soil stabilisation - gypsum treatment	13094	m2	9.30	121777.88	10.22	133824.73
	Additional construction staging measures to reduce grubbing and excavation	23571	m2	0.80	18857.12	0.88	20742.83
	Earthworks	16900	m3	34.53	583566.91	41.06	693925.78
	Erosion protection for 1:4 batters	7017	m2	3.84	26946.80	4.29	30104.63
	Rock armoring (LHS only)	4007	m2	227.99	913621.14	254.12	1018331.52
Road Pavement	Primary Arterial Pavement	8370	m2	171.88	1438635.60	188.74	1579753.80
	Secondary Arterial Pavement	0	m2	128.70	0.00	135.56	0.00
	Collector Arterial Pavement	1468	m2	106.55	156415.40	113.94	167263.92
	Subgrade Preparation	9838	m2	14.41	141765.58	16.38	161146.44
	Pavement Rehabilitation	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation, 0.5m past BoK	10477	m2	48.64	509601.28	54.22	568062.94
	Crushed rock capping layer, 0.5m past BoK	10477	m2	25.34	265487.18	28.25	295975.25
Concrete Works	Kerb and Channel	2415	m	55.54	134129.10	61.71	149029.65
	Cycle Path	1856	m2	77.61	144033.37	93.16	172892.01
	SUP/ Footpath	590	m2	64.36	37941.51	74.61	43984.09
	Traffic Island	191	m2	78.63	15018.33	85.19	16271.29
Drainage	Drainage Pipe 300mm CR Bfilled	0	m	182.24	0.00	200.59	0.00
	Drainage Pipe 375mm CR Bfilled	600	m	262.54	157524.00	286.72	172032.00
	Drainage Pipe 450mm CR Bfilled	235	m	303.41	71301.35	338.77	79610.95
	Drainage Pipe 525mm CR Bfilled	361	m	409.22	147728.42	453.98	163886.78
	Drainage - pits	28	No.	2599.43	72784.04	2843.33	79613.24
	Drainage – Sub-soil drainage	2415	m	34.33	82906.95	43.98	106211.70
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
	Swale lining - rip-rap	3223	m2	65.87	212306.65	73.42	236641.18
Traffic signals	Traffic Signals (all inclusive)	4	Item/ Per Leg	111186.08	444744.32	130494.95	521979.80
Landscape	Tree Planting, 45L tree	128	No.	307.37	39343.36	367.83	47082.24
	Topsoil with seeding, 100mm depth	18180	m2	7.31	132898.07	8.56	155623.45
Street Lighting	Street Lighting - Road	0	m	219.22	0.00	228.67	0.00
	Street Lighting - Intersections	4	Item/ Per Leg	49111.97	196447.88	56355.63	225422.52
	Erosion protection for lighting cables	1278	m	12.16	15540.48	13.56	17329.68
Misc.	Regulatory Signage	16	Item	342.92	5486.72	385.44	6167.04
	Line marking	9838	m2 of Pavement	3.16	31088.08	4.15	40827.70
	Landscape maintenance (intersections	1	Item	72291.19	72291.19	89300.67	89300.67
	Landscape maintenance (roads)	0	m2 of l'scape	2.94	0.00	3.00	0.00
	Tactile Pavers (Hazard only)	16	Item	296.31	4740.96	324.03	5184.48
Other	Geotextile mat to protect concrete iter	4846	m2	12.00	58150.33	13.20	63965.37
Delivery	Council Fees	1	%	3.25	206082.54	3.25	233374.43
	VicRoads Fees	1	%	1.00	63410.01	1.00	71807.52
	Traffic Management	1	%	5.00	317050.07	5.00	359037.59
	Environmental Management	1	%	0.50	31705.01	0.50	35903.76
	Surveying and Design	1	%	5.00	317050.07	5.00	359037.59
	Supervision and Project management	1	%	9.00	570690.12	9.00	646267.66
	Site Establishment	1	%	2.50	158525.03	2.50	179518.79
	Contingency	1	%	15.00	951150.20	15.00	1077112.77
Total	Excluding Delivery				**6,341,001**		**7,180,752**
	Including Delivery				**8,956,664**		**10,142,812**

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Issue : A
Status: DRAFT

Description:	INTERSECTION - Primary - Connector T-Intersection - IN07
Civil Component Number:	INTERSECTION 7

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	18107	m2	3.73	67537.66	5.03	91076.25
	Soil stabilisation - gypsum treatment	10066	m2	9.30	93610.18	10.22	102870.54
	Additional construction staging measures to reduce grubbing and excavation	18107	m2	0.80	14485.29	0.88	15933.82
	Earthworks	9736	m3	34.53	336181.73	41.06	399757.37
	Erosion protection for 1:4 batters	4400	m2	3.84	16894.51	4.29	18874.33
Road Pavement	Primary Arterial Pavement	7277	m2	171.88	1250770.76	188.74	1373460.98
	Secondary Arterial Pavement	0	m2	128.70	0.00	135.56	0.00
	Collector Arterial Pavement	764	m2	106.55	81404.20	113.94	87050.16
	Subgrade Preparation	8041	m2	14.41	115870.81	16.38	131711.58
	Pavement Rehabilitation	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation, 0.5m past BoK	8041	m2	48.64	391114.24	54.22	435983.02
	Crushed rock capping layer, 0.5m past BoK	8041	m2	25.34	203758.94	28.25	227158.25
Concrete Works	Kerb and Channel	2023	m	55.54	112357.42	61.71	124839.33
	Cycle Path	1763	m2	77.61	136804.31	93.16	164214.53
	SUP/ Footpath	229	m2	64.36	14727.11	74.61	17072.56
	Traffic Island	217	m2	78.63	17062.71	85.19	18486.23
Drainage	Drainage Pipe 300mm CR Bfilled	0	m	182.24	0.00	200.59	0.00
	Drainage Pipe 375mm CR Bfilled	600	m	262.54	157524.00	286.72	172032.00
	Drainage Pipe 450mm CR Bfilled	302	m	303.41	91629.82	338.77	102308.54
	Drainage Pipe 525mm CR Bfilled	144	m	409.22	58927.68	453.98	65373.12
	Drainage - pits	23	No.	2599.43	59786.89	2843.33	65396.59
	Drainage – Sub-soil drainage	2023	m	34.33	69449.59	43.98	88971.54
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
	Swale lining - rip-rap	3042	m2	65.87	200345.71	73.42	223309.28
Traffic signals	Traffic Signals (all inclusive)	3	Item/ Per Leg	111186.08	333558.24	130494.95	391484.85
Landscape	Tree Planting, 45L tree	119	No.	307.37	36577.03	367.83	43771.77
	Topsoil with seeding, 100mm depth	10463	m2	7.31	76483.53	8.56	89562.11
Street Lighting	Street Lighting - Road	0	m	219.22	0.00	228.67	0.00
	Street Lighting - Intersections	3	Item/ Per Leg	49111.97	147335.91	56355.63	169066.89
	Erosion protection for lighting cables	1206	m	12.16	14664.96	13.56	16353.36
Misc.	Regulatory Signage	6	Item	342.92	2057.52	385.44	2312.64
	Line marking	8041	m2 of Pavement	3.16	25409.56	4.15	33370.15
	Landscape maintenance (intersections	1	Item	72291.19	72291.19	89300.67	89300.67
	Landscape maintenance (roads)	0	m2 of l'scape	2.94	0.00	3.00	0.00
	Tactile Pavers (Hazard only)	8	Item	296.31	2370.48	324.03	2592.24
Other	Rock Allowance	1947	m3	101.33	197308.40	116.53	226905.63
	Geotextile mat to protect concrete iter	4378	m2	12.00	52532.58	13.20	57785.84
Delivery	Council Fees	1	%	3.25	144652.07	3.25	164072.55
	VicRoads Fees	1	%	1.00	44508.33	1.00	50483.86
	Traffic Management	1	%	5.00	222541.65	5.00	252419.31
	Environmental Management	1	%	0.50	22254.16	0.50	25241.93
	Surveying and Design	1	%	5.00	222541.65	5.00	252419.31
	Supervision and Project management	1	%	9.00	400574.97	9.00	454354.75
	Site Establishment	1	%	2.50	111270.82	2.50	126209.65
	Contingency	1	%	15.00	667624.94	15.00	757257.92
Total	Excluding Delivery				**4,450,833**		**5,048,386**
	Including Delivery				**6,286,802**		**7,130,845**

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Issue : A
Status: DRAFT

Description:	INTERSECTION - Secondary - Secondary Intersection - IN08
Civil Component Number:	INTERSECTION 8 (RD-03, Wallan South PSP)

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	26125	m2	3.73	97446.25	5.03	131408.75
	Soil stabilisation - gypsum treatment	24125	m2	4.65	112181.25	5.11	123278.75
	Additional construction staging measures to reduce grubbing and excavation	26125	m2	0.80	20900.00	0.88	22990.00
	Earthworks	13238	m3	34.53	457108.14	41.06	543552.28
	Erosion protection for 1:4 batters	5776	m2	3.84	22179.84	4.29	24779.04
Road Pavement	Primary Arterial Pavement	0	m2	171.88	0.00	188.74	0.00
	Secondary Arterial Pavement	13800	m2	128.70	1776060.00	135.56	1870728.00
	Collector Arterial Pavement	0	m2	106.55	0.00	113.94	0.00
	Subgrade Preparation	13800	m2	14.41	198858.00	16.38	226044.00
	Pavement Rehab	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation, 0.5m past BoK	13800	m2	48.64	671232.00	54.22	748236.00
	Crushed rock capping layer	13800	m2	25.34	349692.00	28.25	389850.00
Concrete Works	Kerb and Channel	2000	m	55.54	111080.00	61.71	123420.00
	Cycle Path	0	m2	77.61	0.00	93.16	0.00
	SUP/ Footpath	1700	m2	64.36	109412.00	74.61	126837.00
	Traffic Island	680	m2	78.63	53468.40	85.19	57929.20
Drainage	Drainage Pipe 300mm CR Bfilled	260	m	182.24	47382.40	200.59	52153.40
	Drainage Pipe 375mm CR Bfilled	0	m	262.54	0.00	286.72	0.00
	Drainage Pipe 450mm CR Bfilled	900	m	303.41	273069.00	338.77	304893.00
	Drainage Pipe 525mm CR Bfilled	0	m	409.22	0.00	453.98	0.00
	Drainage - pits	40	No.	2599.43	103977.20	2843.33	113733.20
	Drainage – Sub-soil drainage	3100	m	34.33	106423.00	43.98	136338.00
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
Traffic signals	Traffic Signals (all inclusive)	4	Item/ Per Leg	111186.08	444744.32	130494.95	521979.80
Landscape	Tree Planting, 45L tree	60	No.	307.37	18442.20	367.83	22069.80
	Topsoil with seeding, 100mm depth	10465	m2	7.31	76499.15	8.56	89580.40
Street Lighting	Street Lighting - Road	0	m	219.22	0.00	228.67	0.00
	Street Lighting - Intersections	4	Item/ Per Leg	49111.97	196447.88	56355.63	225422.52
	Erosion protection for lighting cables	1444	m	12.16	17559.04	13.56	19580.64
Misc	Regulatory Signage	16	Item	342.92	5486.72	385.44	6167.04
	Line marking	13800	m2 of Pavement	3.16	43608.00	4.15	57270.00
	Landscape maintenance (intersections)	1	Item	72291.19	72291.19	89300.67	89300.67
	Landscape maintenance (roads)	0	m2 of l'scape	2.94	0.00	3.00	0.00
	Tactile Pavers (Hazard only)	24	Item	296.31	7111.44	324.03	7776.72
Other	Rock Allowance	2648	m3	101.33	268281.31	116.53	308524.83
	Geotextile mat to protect concrete ite	4600	m2	12.00	55200.00	13.20	60720.00
Delivery	Council Fees	1	%	3.25	185774.57	3.25	208148.30
	VicRoads Fees	1	%	1.00	57161.41	1.00	64045.63
	Traffic Management	1	%	5.00	285807.04	5.00	320228.15
	Environmental Management	1	%	0.50	28580.70	0.50	32022.82
	Surveying and Design	1	%	5.00	285807.04	5.00	320228.15
	Supervision and Project management	1	%	9.00	514452.67	9.00	576410.67
	Site Establishment	1	%	2.50	142903.52	2.50	160114.08
	Contingency	1	%	15.00	857421.11	15.00	960684.46
Total	Excluding Delivery				**5,716,141**		**6,404,563**
	Including Delivery				**8,074,049**		**9,046,445**
	50% Apportionment				**4,037,024**		**4,523,223**

Project: BEVERIDGE NORTHWEST PSP
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Issue : A
Status: DRAFT

Description:	INTERSECTION - Secondary - Secondary Intersection - IN09
Civil Component Number:	INTERSECTION 9

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	26125	m2	3.73	97446.25	5.03	131408.75
	Soil stabilisation - gypsum treatment	24125	m2	4.65	112181.25	5.11	123278.75
	Additional construction staging measures to reduce grubbing and excavation	26125	m2	0.80	20900.00	0.88	22990.00
	Earthworks	13238	m3	34.53	457108.14	41.06	543552.28
	Erosion protection for 1:4 batters	5776	m2	3.84	22179.84	4.29	24779.04
Road Pavement	Primary Arterial Pavement	0	m2	171.88	0.00	188.74	0.00
	Secondary Arterial Pavement	13800	m2	128.70	1776060.00	135.56	1870728.00
	Collector Arterial Pavement	0	m2	106.55	0.00	113.94	0.00
	Subgrade Preparation	13800	m2	14.41	198858.00	16.38	226044.00
	Pavement Rehab	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation, 0.5m past BoK	13800	m2	48.64	671232.00	54.22	748236.00
	Crushed rock capping layer	13800	m2	25.34	349692.00	28.25	389850.00
Concrete Works	Kerb and Channel	2000	m	55.54	111080.00	61.71	123420.00
	Cycle Path	0	m2	77.61	0.00	93.16	0.00
	SUP/ Footpath	1700	m2	64.36	109412.00	74.61	126837.00
	Traffic Island	680	m2	78.63	53468.40	85.19	57929.20
Drainage	Drainage Pipe 300mm CR Bfilled	260	m	182.24	47382.40	200.59	52153.40
	Drainage Pipe 375mm CR Bfilled	0	m	262.54	0.00	286.72	0.00
	Drainage Pipe 450mm CR Bfilled	900	m	303.41	273069.00	338.77	304893.00
	Drainage Pipe 525mm CR Bfilled	0	m	409.22	0.00	453.98	0.00
	Drainage - pits	40	No.	2599.43	103977.20	2843.33	113733.20
	Drainage – Sub-soil drainage	3100	m	34.33	106423.00	43.98	136338.00
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
Traffic signals	Traffic Signals (all inclusive)	4	Item/ Per Leg	111186.08	444744.32	130494.95	521979.80
Landscape	Tree Planting, 45L tree	60	No.	307.37	18442.20	367.83	22069.80
	Topsoil with seeding, 100mm depth	10465	m2	7.31	76499.15	8.56	89580.40
Street Lighting	Street Lighting - Road	0	m	219.22	0.00	228.67	0.00
	Street Lighting - Intersections	4	Item/ Per Leg	49111.97	196447.88	56355.63	225422.52
	Erosion protection for lighting cables	1444	m	12.16	17559.04	13.56	19580.64
Misc	Regulatory Signage	16	Item	342.92	5486.72	385.44	6167.04
	Line marking	13800	m2 of Pavement	3.16	43608.00	4.15	57270.00
	Landscape maintenance (intersections)	1	Item	72291.19	72291.19	89300.67	89300.67
	Landscape maintenance (roads)	0	m2 of l'scape	2.94	0.00	3.00	0.00
	Tactile Pavers (Hazard only)	24	Item	296.31	7111.44	324.03	7776.72
Other	Rock Allowance	2648	m3	101.33	268281.31	116.53	308524.83
	Geotextile mat to protect concrete ite	4600	m2	12.00	55200.00	13.20	60720.00
Delivery	Council Fees	1	%	3.25	185774.57	3.25	208148.30
	VicRoads Fees	1	%	1.00	57161.41	1.00	64045.63
	Traffic Management	1	%	5.00	285807.04	5.00	320228.15
	Environmental Management	1	%	0.50	28580.70	0.50	32022.82
	Surveying and Design	1	%	5.00	285807.04	5.00	320228.15
	Supervision and Project management	1	%	9.00	514452.67	9.00	576410.67
	Site Establishment	1	%	2.50	142903.52	2.50	160114.08
	Contingency	1	%	15.00	857421.11	15.00	960684.46
Total	Excluding Delivery				**5,716,141**		**6,404,563**
	Including Delivery				**8,074,049**		**9,046,445**
	50% Apportionment				**4,037,024**		**4,523,223**

Project: BEVERIDGE NORTHWEST PSP
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Issue : A
Status: DRAFT

Description:	INTERSECTION - Secondary - Connector Intersection - IN10
Civil Component Number:	INTERSECTION 10

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	16350	m2	3.73	60985.50	5.03	82240.50
	Soil stabilisation - gypsum treatment	7918	m2	4.65	36818.70	5.11	40460.98
	Additional construction staging measures to reduce grubbing and excavation	16350	m2	0.80	13080.00	0.88	14388.00
	Earthworks	8313	m3	34.53	287046.51	41.06	341330.14
	Erosion protection for 1:4 batters	3824	m2	3.84	14684.16	4.29	16404.96
Road Pavement	Primary Arterial Pavement	0	m2	171.88	0.00	188.74	0.00
	Secondary Arterial Pavement	7470	m2	128.70	961389.00	135.56	1012633.20
	Collector Arterial Pavement	962	m2	106.55	102501.10	113.94	109610.28
	Subgrade Preparation	8432	m2	14.41	121505.12	16.38	138116.16
	Pavement Rehab	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation, 0.5m past BoK	8432	m2	48.64	410132.48	54.22	457183.04
	Crushed rock capping layer	8432	m2	25.34	213666.88	28.25	238204.00
Concrete Works	Kerb and Channel	2008	m	55.54	111524.32	61.71	123913.68
	Cycle Path	346	m2	77.61	26853.06	93.16	32233.36
	SUP/ Footpath	1166	m2	64.36	75043.76	74.61	86995.26
	Traffic Island	105	m2	78.63	8256.15	85.19	8944.95
Drainage	Drainage Pipe 300mm CR Bfilled	210	m	182.24	38270.40	200.59	42123.90
	Drainage Pipe 375mm CR Bfilled	0	m	262.54	0.00	286.72	0.00
	Drainage Pipe 450mm CR Bfilled	540	m	303.41	163841.40	338.77	182935.80
	Drainage Pipe 525mm CR Bfilled	0	m	409.22	0.00	453.98	0.00
	Drainage - pits	24	No.	2599.43	62386.32	2843.33	68239.92
	Drainage – Sub-soil drainage	2548	m	34.33	87472.84	43.98	112061.04
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
Traffic signals	Traffic Signals (all inclusive)	4	Item/ Per Leg	111186.08	444744.32	130494.95	521979.80
Landscape	Tree Planting, 45L tree	41	No.	307.37	12602.17	367.83	15081.03
	Topsoil with seeding, 100mm depth	7062	m2	7.31	51623.22	8.56	60450.72
Street Lighting	Street Lighting - Road	0	m	219.22	0.00	228.67	0.00
	Street Lighting - Intersections	4	Item/ Per Leg	49111.97	196447.88	56355.63	225422.52
	Erosion protection for lighting cables	956	m	12.16	11624.96	13.56	12963.36
Misc.	Regulatory Signage	10	Item	342.92	3429.20	385.44	3854.40
	Line marking	8432	m2 of Pavement	3.16	26645.12	4.15	34992.80
	Landscape maintenance (intersections)	1	Item	72291.19	72291.19	89300.67	89300.67
	Landscape maintenance (roads)	0	m2 of l'scape	2.94	0.00	3.00	0.00
	Tactile Pavers (Hazard only)	24	Item	296.31	7111.44	324.03	7776.72
Other	Rock Allowance	1663	m3	101.33	168470.45	116.53	193741.85
	Geotextile mat to protect concrete items from erosion	3041	m2	12.00	36492.00	13.20	40141.20
Delivery	Council Fees	1	%	3.25	124375.54	3.25	140196.04
	VicRoads Fees	1	%	1.00	38269.40	1.00	43137.24
	Traffic Management	1	%	5.00	191346.98	5.00	215686.21
	Environmental Management	1	%	0.50	19134.70	0.50	21568.62
	Surveying and Design	1	%	5.00	191346.98	5.00	215686.21
	Supervision and Project management	1	%	9.00	344424.57	9.00	388235.18
	Site Establishment	1	%	2.50	95673.49	2.50	107843.11
	Contingency	1	%	15.00	574040.95	15.00	647058.64
Total	Excluding Delivery				**3,826,940**		**4,313,724**
	Including Delivery				**5,405,552**		**6,093,135**

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Issue : A
Status: DRAFT

Description:	INTERSECTION - Secondary - Connector Intersection - IN11
Civil Component Number:	INTERSECTION 11

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	16350	m2	3.73	60985.50	5.03	82240.50
	Soil stabilisation - gypsum treatment	7918	m2	4.65	36818.70	5.11	40460.98
	Additional construction staging measures to reduce grubbing and excavation	16350	m2	0.80	13080.00	0.88	14388.00
	Earthworks	5345	m3	34.53	184562.85	41.06	219465.70
	Erosion protection for 1:4 batters	4229	m2	3.84	16238.29	4.29	18141.22
Road Pavement	Primary Arterial Pavement	0	m2	171.88	0.00	188.74	0.00
	Secondary Arterial Pavement	7470	m2	128.70	961389.00	135.56	1012633.20
	Collector Arterial Pavement	962	m2	106.55	102501.10	113.94	109610.28
	Subgrade Preparation	8432	m2	14.41	121505.12	16.38	138116.16
	Pavement Rehab	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation, 0.5m past BoK	8432	m2	48.64	410132.48	54.22	457183.04
	Crushed rock capping layer	8432	m2	25.34	213666.88	28.25	238204.00
Concrete Works	Kerb and Channel	2008	m	55.54	111524.32	61.71	123913.68
	Cycle Path	346	m2	77.61	26853.06	93.16	32233.36
	SUP/ Footpath	1166	m2	64.36	75043.76	74.61	86995.26
	Traffic Island	105	m2	78.63	8256.15	85.19	8944.95
Drainage	Drainage Pipe 300mm CR Bfilled	210	m	182.24	38270.40	200.59	42123.90
	Drainage Pipe 375mm CR Bfilled	0	m	262.54	0.00	286.72	0.00
	Drainage Pipe 450mm CR Bfilled	540	m	303.41	163841.40	338.77	182935.80
	Drainage Pipe 525mm CR Bfilled	0	m	409.22	0.00	453.98	0.00
	Drainage - pits	24	No.	2599.43	62386.32	2843.33	68239.92
	Drainage – Sub-soil drainage	2548	m	34.33	87472.84	43.98	112061.04
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
Traffic signals	Traffic Signals (all inclusive)	4	Item/ Per Leg	111186.08	444744.32	130494.95	521979.80
Landscape	Tree Planting, 45L tree	41	No.	307.37	12602.17	367.83	15081.03
	Topsoil with seeding, 100mm depth	11291	m2	7.31	82535.18	8.56	96648.58
Street Lighting	Street Lighting - Road	0	m	219.22	0.00	228.67	0.00
	Street Lighting - Intersections	4	Item/ Per Leg	49111.97	196447.88	56355.63	225422.52
	Erosion protection for lighting cables	956	m	12.16	11624.96	13.56	12963.36
Misc.	Regulatory Signage	10	Item	342.92	3429.20	385.44	3854.40
	Line marking	8432	m2 of Pavement	3.16	26645.12	4.15	34992.80
	Landscape maintenance (intersections)	1	Item	72291.19	72291.19	89300.67	89300.67
	Landscape maintenance (roads)	0	m2 of l'scape	2.94	0.00	3.00	0.00
	Tactile Pavers (Hazard only)	24	Item	296.31	7111.44	324.03	7776.72
Other	Rock Allowance	1069	m3	101.33	108321.77	116.53	124570.57
	Geotextile mat to protect concrete items from erosion	3041	m2	12.00	36492.00	13.20	40141.20
Delivery	Council Fees	1	%	3.25	120145.14	3.25	135220.24
	VicRoads Fees	1	%	1.00	36967.73	1.00	41606.23
	Traffic Management	1	%	5.00	184838.67	5.00	208031.13
	Environmental Management	1	%	0.50	18483.87	0.50	20803.11
	Surveying and Design	1	%	5.00	184838.67	5.00	208031.13
	Supervision and Project management	1	%	9.00	332709.61	9.00	374456.04
	Site Establishment	1	%	2.50	92419.34	2.50	104015.57
	Contingency	1	%	15.00	554516.01	15.00	624093.40
Total	Excluding Delivery				**3,696,773**		**4,160,623**
	Including Delivery				**5,221,692**		**5,876,879**

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Issue : A
Status: DRAFT

Description:	INTERSECTION - Secondary - Connector Intersection - IN12
Civil Component Number:	INTERSECTION 12

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	16350	m2	3.73	60985.50	5.03	82240.50
	Soil stabilisation - gypsum treatment	7918	m2	4.65	36818.70	5.11	40460.98
	Additional construction staging measures to reduce grubbing and excavation	16350	m2	0.80	13080.00	0.88	14388.00
	Earthworks	11981	m3	34.53	413703.93	41.06	491939.86
	Erosion protection for 1:4 batters	3824	m2	3.84	14684.16	4.29	16404.96
Road Pavement	Primary Arterial Pavement	0	m2	171.88	0.00	188.74	0.00
	Secondary Arterial Pavement	7470	m2	128.70	961389.00	135.56	1012633.20
	Collector Arterial Pavement	962	m2	106.55	102501.10	113.94	109610.28
	Subgrade Preparation	8432	m2	14.41	121505.12	16.38	138116.16
	Pavement Rehabilitation	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation, 0.5m past BoK	8432	m2	48.64	410132.48	54.22	457183.04
	Crushed rock capping layer	8432	m2	25.34	213666.88	28.25	238204.00
Concrete Works	Kerb and Channel	2008	m	55.54	111524.32	61.71	123913.68
	Cycle Path	346	m2	77.61	26853.06	93.16	32233.36
	SUP/ Footpath	1166	m2	64.36	75043.76	74.61	86995.26
	Traffic Island	105	m2	78.63	8256.15	85.19	8944.95
Drainage	Drainage Pipe 300mm CR Bfilled	210	m	182.24	38270.40	200.59	42123.90
	Drainage Pipe 375mm CR Bfilled	0	m	262.54	0.00	286.72	0.00
	Drainage Pipe 450mm CR Bfilled	540	m	303.41	163841.40	338.77	182935.80
	Drainage Pipe 525mm CR Bfilled	0	m	409.22	0.00	453.98	0.00
	Drainage - pits	24	No.	2599.43	62386.32	2843.33	68239.92
	Drainage – Sub-soil drainage	2548	m	34.33	87472.84	43.98	112061.04
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
Traffic signals	Traffic Signals (all inclusive)	4	Item/ Per Leg	111186.08	444744.32	130494.95	521979.80
Landscape	Tree Planting, 45L tree	41	No.	307.37	12602.17	367.83	15081.03
	Topsoil with seeding, 100mm depth	7062	m2	7.31	51623.22	8.56	60450.72
Street Lighting	Street Lighting - Road	0	m	219.22	0.00	228.67	0.00
	Street Lighting - Intersections	4	Item/ Per Leg	49111.97	196447.88	56355.63	225422.52
	Erosion protection for lighting cables	956	m	12.16	11624.96	13.56	12963.36
Misc.	Regulatory Signage	10	Item	342.92	3429.20	385.44	3854.40
	Line marking	8432	m2 of Pavement	3.16	26645.12	4.15	34992.80
	Landscape maintenance (intersections)	1	Item	72291.19	72291.19	89300.67	89300.67
	Landscape maintenance (roads)	0	m2 of l'scape	2.94	0.00	3.00	0.00
	Tactile Pavers (Hazard only)	24	Item	296.31	7111.44	324.03	7776.72
Other	Rock Allowance	2396	m3	101.33	242806.95	116.53	279229.19
	Geotextile mat to protect concrete items	3041	m2	12.00	36492.00	13.20	40141.20
Delivery	Council Fees	1	%	3.25	130907.84	3.25	147869.19
	VicRoads Fees	1	%	1.00	40279.34	1.00	45498.21
	Traffic Management	1	%	5.00	201396.68	5.00	227491.07
	Environmental Management	1	%	0.50	20139.67	0.50	22749.11
	Surveying and Design	1	%	5.00	201396.68	5.00	227491.07
	Supervision and Project management	1	%	9.00	362514.02	9.00	409483.92
	Site Establishment	1	%	2.50	100698.34	2.50	113745.53
	Contingency	1	%	15.00	604190.04	15.00	682473.20
Total	Excluding Delivery				**4,027,934**		**4,549,821**
	Including Delivery				**5,689,456**		**6,426,623**

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Issue : A
Status: DRAFT

Description:	INTERSECTION - Secondary - Connector Intersection - IN13
Civil Component Number:	INTERSECTION 13

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Siteworks/ Earthworks	Site Preparation	16350	m2	3.73	60985.50	5.03	82240.50
	Soil stabilisation - gypsum treatment	7918	m2	4.65	36818.70	5.11	40460.98
	Additional construction staging measures to reduce grubbing and excavation	16350	m2	0.80	13080.00	0.88	14388.00
	Earthworks	8313	m3	34.53	287046.51	41.06	341330.14
	Erosion protection for 1:4 batters	1912	m2	3.84	7342.08	4.29	8202.48
Road Pavement	Primary Arterial Pavement	0	m2	171.88	0.00	188.74	0.00
	Secondary Arterial Pavement	7470	m2	128.70	961389.00	135.56	1012633.20
	Collector Arterial Pavement	962	m2	106.55	102501.10	113.94	109610.28
	Subgrade Preparation	8432	m2	14.41	121505.12	16.38	138116.16
	Pavement Rehab	0	m2	52.27	0.00	60.11	0.00
	Lime stabilisation, 0.5m past BoK	8432	m2	48.64	410132.48	54.22	457183.04
	Crushed rock capping layer	8432	m2	25.34	213666.88	28.25	238204.00
Concrete Works	Kerb and Channel	2008	m	55.54	111524.32	61.71	123913.68
	Cycle Path	346	m2	77.61	26853.06	93.16	32233.36
	SUP/ Footpath	1166	m2	64.36	75043.76	74.61	86995.26
	Traffic Island	105	m2	78.63	8256.15	85.19	8944.95
Drainage	Drainage Pipe 300mm CR Bfilled	210	m	182.24	38270.40	200.59	42123.90
	Drainage Pipe 375mm CR Bfilled	0	m	262.54	0.00	286.72	0.00
	Drainage Pipe 450mm CR Bfilled	540	m	303.41	163841.40	338.77	182935.80
	Drainage Pipe 525mm CR Bfilled	0	m	409.22	0.00	453.98	0.00
	Drainage - pits	24	No.	2599.43	62386.32	2843.33	68239.92
	Drainage – Sub-soil drainage	2548	m	34.33	87472.84	43.98	112061.04
	Drainage Culvert	0	No.	0.00	0.00	0.00	0.00
Traffic signals	Traffic Signals (all inclusive)	4	Item/ Per Leg	111186.08	444744.32	130494.95	521979.80
Landscape	Tree Planting, 45L tree	41	No.	307.37	12602.17	367.83	15081.03
	Topsoil with seeding, 100mm depth	7062	m2	7.31	51623.22	8.56	60450.72
Street Lighting	Street Lighting - Road	0	m	219.22	0.00	228.67	0.00
	Street Lighting - Intersections	4	Item/ Per Leg	49111.97	196447.88	56355.63	225422.52
	Erosion protection for lighting cables	956	m	12.16	11624.96	13.56	12963.36
Misc.	Regulatory Signage	10	Item	342.92	3429.20	385.44	3854.40
	Line marking	8432	m2 of Pavement	3.16	26645.12	4.15	34992.80
	Landscape maintenance (intersections)	1	Item	72291.19	72291.19	89300.67	89300.67
	Landscape maintenance (roads)	0	m2 of l'scape	2.94	0.00	3.00	0.00
	Tactile Pavers (Hazard only)	24	Item	296.31	7111.44	324.03	7776.72
Other	Rock Allowance	1663	m3	101.33	168470.45	116.53	193741.85
	Geotextile mat to protect concrete items	3041	m2	12.00	36492.00	13.20	40141.20
Delivery	Council Fees	1	%	3.25	124136.92	3.25	139929.46
	VicRoads Fees	1	%	1.00	38195.98	1.00	43055.22
	Traffic Management	1	%	5.00	190979.88	5.00	215276.09
	Environmental Management	1	%	0.50	19097.99	0.50	21527.61
	Surveying and Design	1	%	5.00	190979.88	5.00	215276.09
	Supervision and Project management	1	%	9.00	343763.78	9.00	387496.96
	Site Establishment	1	%	2.50	95489.94	2.50	107638.04
	Contingency	1	%	15.00	572939.64	15.00	645828.26
Total	Excluding Delivery				**3,819,598**		**4,305,522**
	Including Delivery				**5,395,182**		**6,081,549**

Project: BEVERIDGE NORTHWEST PSP
Date: 31/10/2021
Rates Index Date: JUNE 2021

Issue : A
Status: DRAFT

Description:	BRIDGE - 165m - Secondary - BR01
Civil Component Number:	BRIDGE 01

Group	Sub Item	Qty	Unit	Rate (P50)	Amount P(50)	Rate (P90)	Amount P(90)
Earthworks	Site Preparation	14612.4	m2	3.73	54,504.25	6.71	98,049.20
	Soil stabilisation - gypsum treatment	14612.4	m2	4.65	67,947.66	5.11	74,669.36
	Earthworks	12313	m3	50.74	624,761.62	55.35	681,524.55
On-Structure Works	Retaining Walls, abutments, footings	0	No	374,340.70	0.00	421,447.10	0.00
	Bridge Deck	0	m2	1,275.18	0.00	2,087.48	0.00
	Guard Rails/ Balustrade	0	m	2,386.46	0.00	3,072.70	0.00
	Transition Slab	2	No	33,868.77	67,737.54	38,949.09	77,898.18
	Overall Super T Cost	2607	m2	4,484.29	11,690,544.03	5,295.74	13,805,994.18
Off Structure	Guard Rails/ Balustrade	240	m	189.59	45,501.60	227.52	54,604.80
	GREAT Terminal	4	No	8,883.74	35,534.96	14,059.75	56,239.00
	Off structure barrier	0	Item	1,586.22	0.00	2,342.63	0.00
	Additional construction staging measures to reduce grubbing and excavation	1	Item	15,199.01	15,199.01	16,940.73	16,940.73
	Erosion protection for 1:4 batters	1205	m2	3.84	4,627.20	4.29	5,169.45
Delivery	Council Fees	1	%	3.25	409,706.63	3.25	483,310.41
	VicRoads Fees	1	%	1.00	126,063.58	1.00	148,710.89
	Traffic Management	1	%	5.00	630,317.89	5.00	743,554.47
	Environmental Management	1	%	0.50	63,031.79	0.50	74,355.45
	Surveying and Design	1	%	5.00	630,317.89	5.00	743,554.47
	Supervision and Project management	1	%	9.00	1,134,572.21	9.00	1,338,398.05
	Site Establishment	1	%	2.50	315,158.95	2.50	371,777.24
	Contingency	1	%	20.00	2,521,271.57	20.00	2,974,217.89
Total	Excluding Delivery				**12,606,358**		**14,871,089**
	Including Delivery				**18,436,798**		**21,748,968**

Project: BEVERIDGE NORTHWEST PSP
Date: 31/10/2021
Rates Index Date: JUNE 2021

Issue : A
Status: DRAFT

Description:	BR-02: Pedestrian Bridge Over Kalkallo Creek
Civil Component Number:	BR-02

Group	Sub Item	Qty	Unit	Rate (P50)	Amount P(50)	Rate (P90)	Amount P(90)
Earthworks	Site Preperation	2600	m2	3.73	9,698.00	4.29	11,154.00
	Soil stabilisation - gypsum treatment	2600	m2	9.30	24,180.00	10.22	26,572.00
	Earthworks	900	m3	50.74	45,666.00	58.35	52,515.00
On-Structure Works	Retaining Walls, abutments, footings	1	Item	23,609.13	23,609.13	27,150.49	27,150.49
	Bridge Deck (Pre-stressed plank)	45	m2	911.95	41,037.75	1,048.74	47,193.30
	Guard Rails/ Balustrade	1	Item	8,967.42	8,967.42	10,312.53	10,312.53
	Transition Slab	2	No	1,264.56	2,529.12	1,454.25	2,908.50
Off Structure	Pedestrian Guard Rails/ Balustrade	0	m	189.59	0.00	218.03	0.00
	GREAT Terminal	0	No	8,883.74	0.00	10,216.30	0.00
	Off structure barrier	0	Item	1,586.22	0.00	1,824.16	0.00
Other	Lighting	1	Item	5066.34	5066.34	5826.29	5826.29
	Line-marking	1	Item	1013.27	1013.27	1165.26	1165.26
	Regulatory Signage	1	Item	506.64	506.64	582.63	582.63
	Maintenance of Works - 1 Year	1	Item	10132.67	10132.67	11652.58	11652.58
	Services Conduit on Bridge	1	Item	8106.14	8106.14	9322.06	9322.06
	Connecting footpath to network	150	m	64.36	9654.00	74.61	11191.50
	Erosion protection for lighting cables	300	m	12.16	3648.00	13.56	4068.00
Delivery	Council Fees	1	%	3.25	6,298.97	3.25	7,202.46
	VicRoads Fees	1	%	1.00	1,938.14	1.00	2,216.14
	Traffic Management	1	%	5.00	9,690.72	5.00	11,080.71
	Environmental Management	1	%	0.50	969.07	0.50	1,108.07
	Surveying and Design	1	%	5.00	9,690.72	5.00	11,080.71
	Supervision and Project management	1	%	9.00	17,443.30	9.00	19,945.27
	Site Establishment	1	%	2.50	4,845.36	2.50	5,540.35
	Contingency	1	%	20.00	38,762.90	20.00	44,322.83
Total	Excluding Delivery				**193,814**		**221,614**
	Including Delivery				**283,454**		**324,111**

Project: BEVERIDGE NORTHWEST PSP
Date: 31/10/2021
Rates Index Date: JUNE 2021

Issue : A
Status: DRAFT

Description:	BRIDGE - 50m - Connector - BR03
Civil Component Number:	BRIDGE 03

Group	Sub Item	Qty	Unit	Rate (P50)	Amount P(50)	Rate (P90)	Amount P(90)
Earthworks	Site Preparation	7506	m2	3.73	27,997.38	6.71	50,365.26
	Soil stabilisation - gypsum treatment	7506	m2	4.65	34,902.90	5.11	38,355.66
	Earthworks	12313	m3	50.74	624,761.62	55.35	681,524.55
On-Structure Works	Retaining Walls, abutments, footings	0	No	374,340.70	0.00	421,447.10	0.00
	Bridge Deck	0	m2	1,275.18	0.00	2,087.48	0.00
	Guard Rails/ Balustrade	0	m	2,386.46	0.00	3,072.70	0.00
	Transition Slab	2	No	33,868.77	67,737.54	38,949.09	77,898.18
	Overall Super T Cost	790	m2	4,484.29	3,542,589.10	5,295.74	4,183,634.60
Off Structure	Guard Rails/ Balustrade	240	m	189.59	45,501.60	227.52	54,604.80
	GREAT Terminal	4	No	8,883.74	35,534.96	14,059.75	56,239.00
	Off structure barrier	0	Item	1,586.22	0.00	2,342.63	0.00
Other	Extra compaction for sodic soil	1512	m2	20.00	30,240.00	22.00	33,264.00
	Additional construction staging measurest	1	Item	15,199.01	15,199.01	16,940.73	16,940.73
	Erosion protection for 1:4 batters	1205	m2	3.84	4,627.20	4.29	5,169.45
Delivery	Council Fees	1	%	3.25	143,945.47	3.25	168,934.88
	VicRoads Fees	1	%	1.00	44,290.91	1.00	51,979.96
	Traffic Management	1	%	5.00	221,454.57	5.00	259,899.81
	Environmental Management	1	%	0.50	22,145.46	0.50	25,989.98
	Surveying and Design	1	%	5.00	221,454.57	5.00	259,899.81
	Supervision and Project management	1	%	9.00	398,618.22	9.00	467,819.66
	Site Establishment	1	%	2.50	110,727.28	2.50	129,949.91
	Contingency	1	%	20.00	885,818.26	20.00	1,039,599.25
Total	Excluding Delivery				**4,429,091**		**5,197,996**
	Including Delivery				**6,477,546**		**7,602,069**

Project: BEVERIDGE NORTHWEST PSP
Date: 31/10/2021
Rates Index Date: JUNE 2021

Issue : A
Status: DRAFT

Description:	Culvert Option - Item 31
Civil Component Number:	CU-01

Group	Sub Item	Qty	Unit	Rate (P50)	Amount (P50)	Rate (P90)	Amount (P90)
Sitework and Earthwork	Site Preparation	118	m2	3.73	440.14	4.35	513.30
	Diversion works (item)	1	Item	9119.41	9119.41	10626.46	10626.46
	Waterway re-shaping	1	Item	3039.81	3039.81	3542.17	3542.17
	Stripping of topsoil	302	m2	3.96	1195.92	4.62	1395.24
	Excavation (m3)	602	m3	37.50	22575.00	43.70	26307.40
	Formation of batters	144	m3	15.20	2188.80	17.72	2551.68
Drainage Structure	Circular Pipes 1200 dia	34	No.	1823.89	62012.26	2125.31	72260.54
	Foundation Slab 1200 dia (250 mm)	183	m2	214.82	39312.06	250.33	45810.39
	Granular Bedding 150 mm CR, Class 3 compacted to 95% modified dry density	183	m2	17.48	3198.84	20.37	3727.71
	Apron Slab - w/ rock gabions	24	m2	156.23	3749.52	174.14	4179.36
	Wing wall - w/ rock gabions	19	m2	496.51	9433.69	553.41	10514.79
	Endwall - w/ rock gabions	12	m2	496.51	5958.12	553.41	6640.92
On Structure	Structural Fill	170	m3	76.00	12920.00	88.56	15055.20
	Vehicle Barrier	17	m2	250.79	4263.43	292.24	4968.08
	Signs	1	Item	1823.89	1823.89	2125.31	2125.31
Delivery	Council Fees	1	%	3.25	5890.00	3.25	6832.10
	Authority Fees	1	%	1.00	1812.31	1.00	2102.19
	Traffic Management	1	%	5.00	9061.54	5.00	10510.93
	Environmental Management	1	%	0.50	906.15	0.50	1051.09
	Surveying and Design	1	%	5.00	9061.54	5.00	10510.93
	Supervision and Project management	1	%	9.00	16310.78	9.00	18919.67
	Site Establishment	1	%	2.50	4530.77	2.50	5255.46
	Contingency	1	%	15.00	27184.63	15.00	31532.78
Total	Excluding Delivery				**181,231**		**210,219**
	Including Delivery				**255,989**		**296,934**

APPENDIX D

SODIC SOIL REPORT

Sodic Soils Assessment

Beveridge North West Precinct Area

8 | Final

6 July 2020

Victorian Planning Authority

Sodic Soils Assessment

Project No:	IA237500
Document Title:	Beveridge North West Precinct Area
Document No.:	8
Revision:	Final
Date:	6 July 2020
Client Name:	Victorian Planning Authority
Project Manager:	Dr Peter Sandercock
Author:	Peter Sandercock, Christian Bannan, Craig Clifton, Graeme Jardine, Chris Dwyer, Filomena Losi and Milos Pelikan
File Name:	08_BNW_Sodic_Soils_Assessment.docx

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Document history and status

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06	20/06/2020	Draft	P. Sandercock	P. Sandercock	
07	05/07/2020	Final	P. Sandercock, C. Bannan	C. Clifton	C. Clifton
08	06/07/2020	Final	P. Sandercock	P. Sandercock	

Contents

Executive Summary

Jacobs was engaged by Victorian Planning Authority to map sodic soils and erosion risk and provide advice on treatment options in light of future planned development in the Beveridge North West Precinct Area. This report provides an assessment of the distribution of sodic and dispersive soils, erosion risks and considers their implications for future planned development.

The soils of the Beveridge North West Precinct are classified as Sodosols, with a clear or abrupt textural B horizon in which the major part of the upper B2 horizon is sodic and not strongly acid. Apart from sites with shallow soil over rock most common in the north-eastern section of the precinct area, soils are duplex, with sandy loam or sandy clay-loam topsoils (A horizons) of variable depth overlying sodic, clay-dominant subsoil. The topsoil is typically non-sodic with Exchangeable Sodium Percentage (ESP) values <5%, the subsoils exhibit moderate to extreme sodicity with ESP values ranging from 7 to > 15% (max 32%). Deeper samples recorded higher ESP values, ranging from 14 to 35%. A horizon topsoil depths vary across the Precinct, measurements in the field ranging from 10-110 cm.

A vulnerability assessment approach was used to assess the risks associated with sodic soils for the construction phase and for the future developed land use.

Vulnerability (V) = Exposure (E) + Sensitivity (S)

Exposure (E): refers to attributes of soils that characterise their sodicity and exposure to erosion. Exposure criteria included sodicity of topsoil and subsoil, A horizon depth and slope.

Sensitivity (S) refers to attributes of the land or activities that influence its sensitivity and that of urban developments to sodic soils. Sensitivity criteria included position relative to waterway, potential disturbance associated with construction activity for different land use types and water balance change expected for future land use.

During construction, areas identified as particularly vulnerable to sodic soil erosion risks are the waterways and steeper slopes. Activities that expose these soils to rainfall and associated runoff will present significant construction challenges and need to be managed carefully.

Water balance changes resulting from future developed land use and associated impervious areas will generate high volumes of runoff, which will drain into the surrounding waterways, including Kalkallo Creek. Kalkallo Creek is already in a degraded condition, further increases in flows would be expected to accelerate erosion of bed and bank materials.

Areas identified at high erosion risk and recommended treatments include:

- Drainage depressions/seasonal wetlands – Ideally these areas should be identified and reserved as linear green spaces to retain their important hydrological function in retaining and temporarily storing water in the landscape and regulating the flow of water and nutrients throughout a catchment. Surface ground cover measures are critical for protecting the soils against dispersion and erosion.
- Kalkallo Creek and tributaries – This waterway is in a degraded state and further increases in runoff may result in increased erosion. Significant engineering works are likely to be required to create a stable waterway that is resilient to stormwater runoff from surrounding future land development.
- Steeper slopes – Cutting into these slopes will expose underlying subsoils, and erosion risk is increased with slope. Road batters must be designed with consideration to the erodibility of the soils. Stable linings that are resistant to rainfall and runoff will be required.

It is recommended that detailed plans are developed for managing sodic soil-related erosion risks in high risk areas identified in this investigation.

Important note about your report

The purpose of this report and the associated services performed by Jacobs is to provide an assessment of the distribution of sodic soils and erosion risks that relate to the characteristics of these soils, their position in the landscape and the implications of this for future planned development within the Beveridge North West Precinct Area. Advice is also provided on the range of treatment options that are available to manage identified sodic soils and erosion risks. The work has been conducted in accordance with the scope of services set out in the contract between Jacobs Group (Australia) and Victorian Planning Authority.

In preparing this report, Jacobs has relied upon, and presumed accurate information provided by Victorian Planning Authority and/or other sources as referenced in the report. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete, the observations and conclusions in this report may change.

The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession following applicable standards, guidelines, procedures and practices at the date of issue of this report. No other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be used in full, and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of, Victorian Planning Authority subject to, and issued in accordance with, the provisions of the contract between Jacobs and Victorian Planning Authority.

1. Introduction

1.1 Background

Jacobs was engaged by Victorian Planning Authority to map sodic soils and erosion risk and provide advice on treatment options in light of future planned development in four Precinct Areas located to the north of Melbourne: Beveridge North West, Wallan South, Wallan East and Shenstone Park.

1.2 Scope

This report provides an assessment of the distribution of sodic soils and erosion risks that relate to the characteristics of these soils, their position in the landscape and the implications of this for future planned development within the Beveridge North West Precinct Area (Figure 1-1). Advice is also provided on the range of treatment options that are available to manage identified sodic soils and erosion risks.

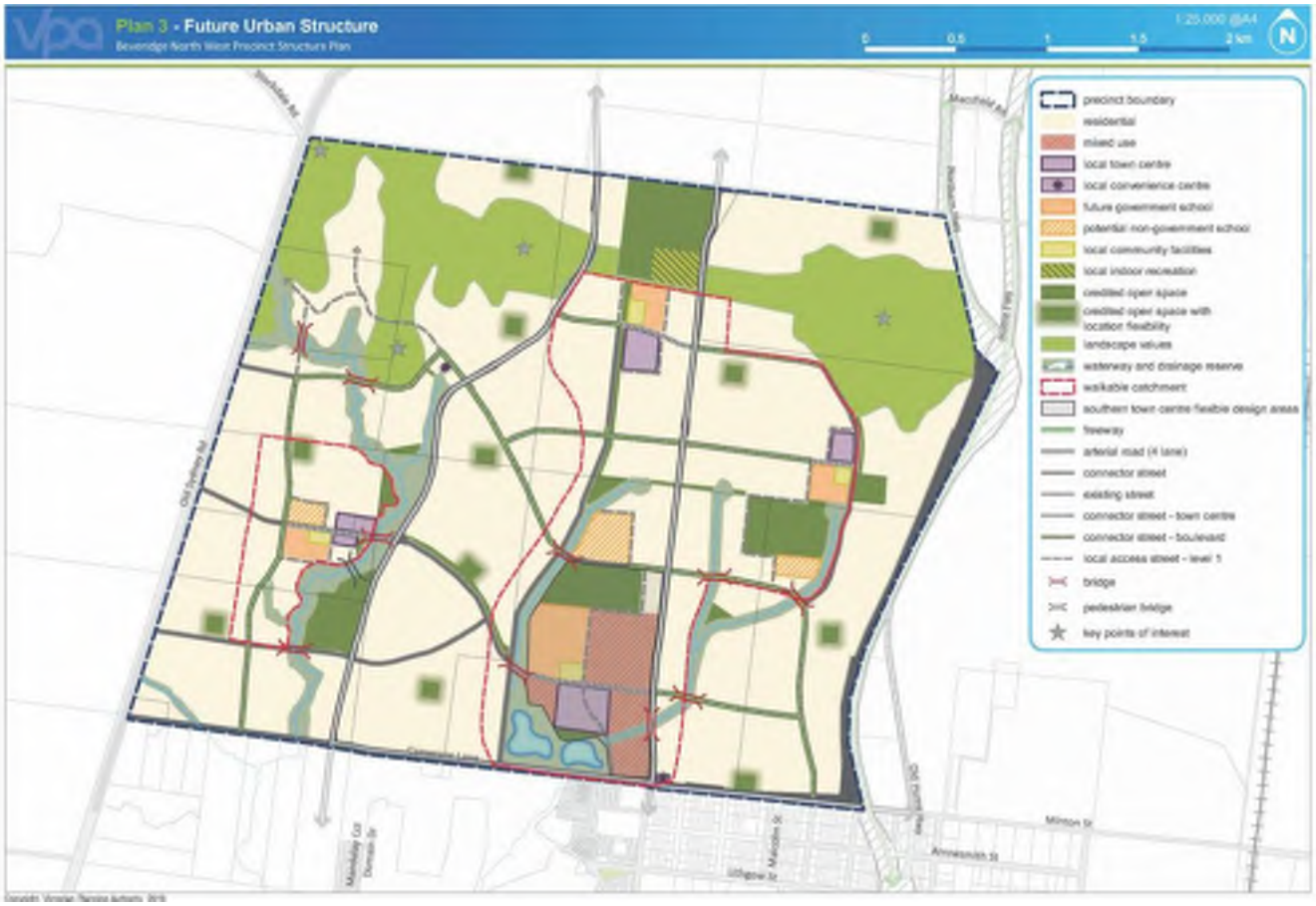

Figure 1-1 Beveridge North West Precinct – Site locality and context (Victorian Planning Authority 2019).

The Precinct will include residential neighbourhoods that that will have access to a range of facilities, including health care, education, recreation and community infrastructure. Areas of the landscape will be revived and enhanced through the rehabilitation and replanting along Kalkallo Creek and on the hilltops. Wetlands and water retention facilities will also be constructed on the open plains (Victorian Planning Authority 2019).

1.3 Report structure

This report has been structured as follows:

- Section 2 provides a brief summary of sodic and dispersive soils definitions and terms used in this report, Victorian context regarding the distribution of sodic soils and their implications for urban development.
- Section 3 describes our approach to mapping sodic soils and erosion risks.
- Section 4 presents the results of the assessment.
- Section 5 provides discussion and recommendations on options to manage identified erosion risks, including potential planning control measures.
- Section 0 documents gaps in knowledge/requirements for further soil investigations and further work to validate the predictions of the distribution of sodic soils and erosion risks.

2. Sodic and dispersive soils

2.1.1 Sodic and dispersive soil definitions and terms used in this report

Sodic soils in Australia are defined as those with an exchangeable sodium percentage (ESP) of 6% or greater (Northcote & Skene 1972). An ESP of 6% is considered to be the lower limit of exchangeable sodium where a detrimental impact on plant growth is recorded. Soil impacts occur when wetted with fresh water and include but are not limited to including clay dispersion, structural decline, crusting, waterlogging and low rates of hydraulic conductivity (Emerson 1967, Loveday & Pyle 1973). The measurements apply directly to agriculture but also have consequences with relation to environmental and geotechnical use and management.

Dispersive soils and criteria for their assessment were first recorded by Emerson (1967), with further research on the relationship between Emerson Score and hydraulic conductivity carried out by Loveday and Pyle (1973). Isbell and NCST (2016) provides detail of the Australian Soil Classification description of a 'Sodosol' soil, with a 'strong texture contrast between the A horizon and sodic B horizons which are not strongly acid'. This report not only seeks to identify 'Sodosols', but focuses on any soil horizon material observed across the Beveridge North West Precinct area with sodic and dispersive properties.

2.1.2 Sodic soil distribution across Victoria.

The distribution of sodic soils across Victoria is well known. Soil sodicity in Victoria was recorded by Ford et al. (1993) with further mapping by others, including Agriculture Victoria (2020), as shown in Figure 2.1 Sodic soils are common across large expanses of land used for agricultural and urban development. Sodicity and dispersion characteristics vary depending on parent material, geomorphic processes, particle size distribution, rainfall and leaching. In most cases, soils with sodic horizons are texture contrast soils with a clear or abrupt A horizon topsoil layer overlying a finer textured, clay-dominant B horizon subsoil.

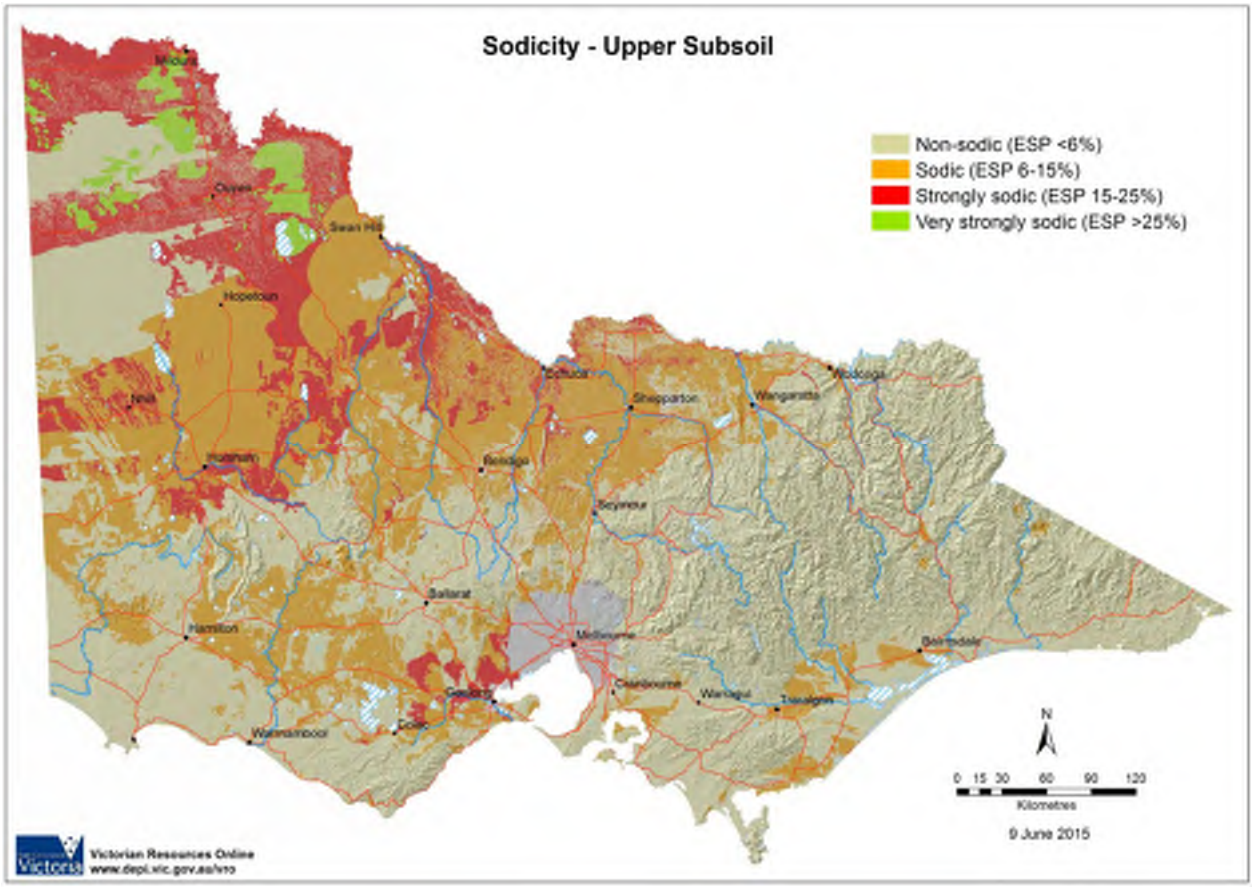

Figure 2.1: Mapping of Sodicity in Upper Subsoil, Victoria (Agriculture Victoria 2020).

2.1.3 Sodic soil implications for urban development

Urban development causes significant soil disturbance and may, expose sodic soils to erosion. This has implications for on-site development and off-site impacts (SCA 1979).

On-site development impacts arising from sodic and dispersive soil conditions include:

- Dispersion of topsoil and subsoil.
- Loss of topsoil and subsoil with overland flow.
- Poor infiltration and increased volumes of stormwater runoff.
- Water ponding in hollows, break of slope areas or depressions, increasing groundwater recharge.
- Poor ability to establish vegetative growth due to adverse soil chemical conditions.
- Increased tunnel, sheet, rill and gully erosion potential.
- Lack of trafficability.

Off-site development impacts arising from sodic and dispersive soil conditions include:

- Increased turbidity in waterways in response to runoff from development areas, a deterioration in water quality and degradation of aquatic flora and fauna habitat.
- Increased erosion potential in downstream waterways in response to larger volumes of stormwater runoff from developed areas.

3. Method

3.1 Spatial Logic Assessment Framework

Jacobs' Spatial Logic Assessment Framework was used in the delivery of this project (Figure 3-1). Spatial Logic is an approach that brings together source information, with the data used to represent criteria that reflect exposure or sensitivity. An assessment was made of potential sodic/dispersible soils' extent and their level of vulnerability, based on available evidence.

Spatial Logic has 5 key stages:

- Stage 1 – Define – Define the landscape profiling criteria, metric and supporting data sources, including and assessment of data suitability.
- Stage 2 & 3 – Collate and integrate – Collate source data and document for transparency, collate any accessible literature that supports soil studies in the area of interest that will inform or be the basis of the assessment.
- Stage 4 – Assess – With reference to landscape profile criteria, undertake an assessment of potential sodic soil extent, severity and/or risk. The assessment indicates where sodic/dispersible soils may occur and their level of risk, based on available evidence.
- Stage 5 – Communicate – Provide a short report on the study area, the project evidence base, assessment of findings and the information package.

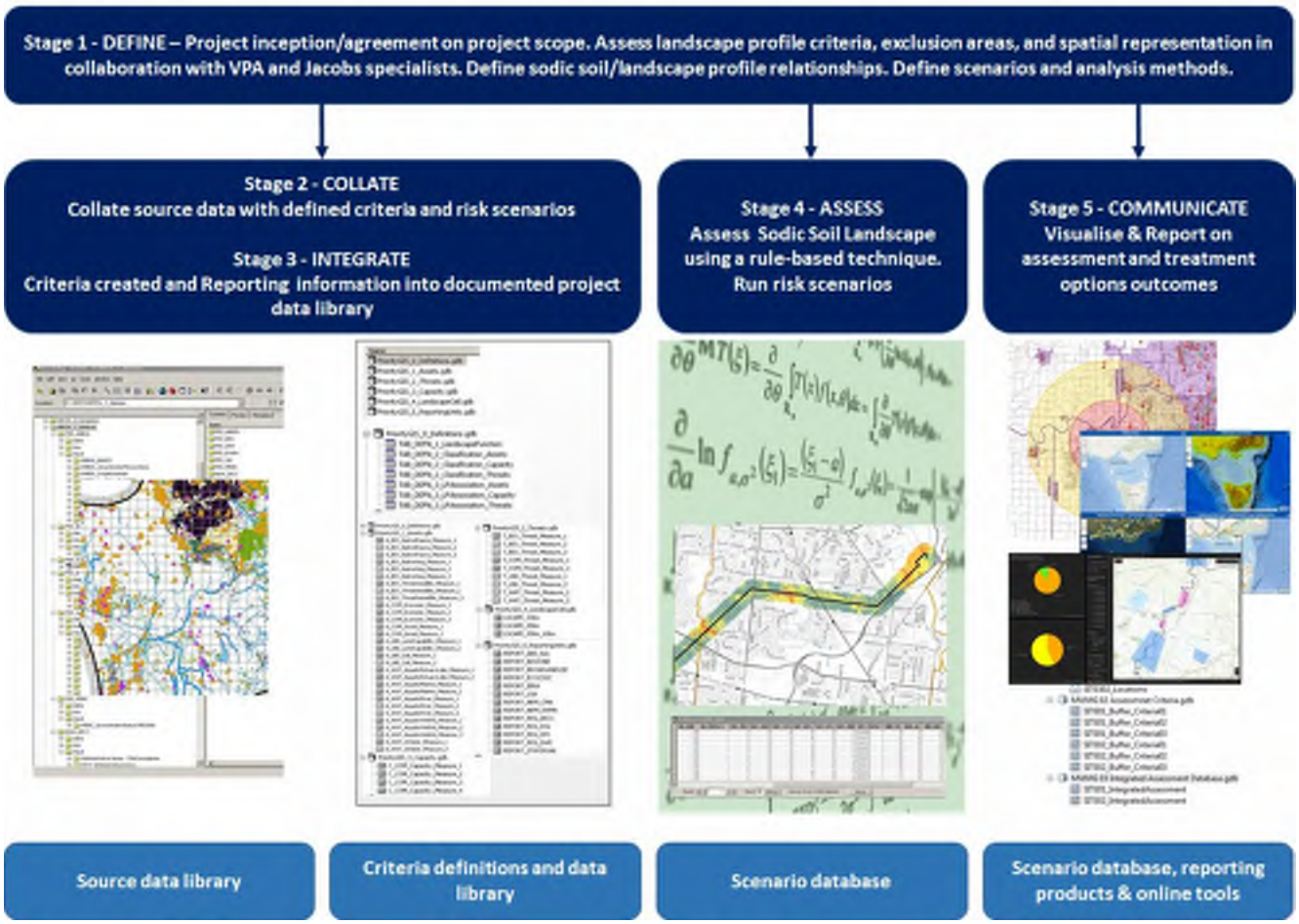

Figure 3-1 The Spatial Logic Assessment Framework.

3.2 Vulnerability Assessment

A specialist workshop was convened to define sodic soil/landscape profile relationships, risk scenarios and analysis methods. The principles of the Vulnerability Assessment approach and how they would be applied to this assessment were agreed upon in this workshop. Vulnerability is defined for the purposes of this assessment as:

Vulnerability (V) = Exposure (E) + Sensitivity (S)[1]

Where Exposure (E): Attributes of soils that characterise their sodicity and exposure to erosion
Sensitivity (S): Attributes of the land or activities that influence sensitivity of the land and urban developments to sodic soils

The specialist workshop identified that there was (at that time) insufficient information to adequately characterise soil sodicity levels across the precinct area. Some limited data was available from earlier geotechnical work, however only a few bore hole investigations were assessed and basic analysis of soil dispersion was completed confirming that sodic soils exist in the region (GHD 2019). This prompted further field sampling of soils and laboratory analysis (described in Appendix A).

3.2.1 Exposure criteria

Attributes of soils that were used to characterise their sodicity and exposure to erosion are:

- Sodicity of topsoil (0-10 cm) - Exchangeable Sodium Percentage (ESP) values. This soil layer is also referred to as A horizon topsoil throughout the report.
- Sodicity of subsoil (30-40 cm) – ESP. In most cases this layer is B horizon subsoil clay, but can include A2 horizon topsoil where topsoils were deeper than 40cm.
- A horizon depth – subsoil exposure/erosion risk decreases with depth.
- Slope – erosion risk increases with slope (which, for this assessment, was derived using LiDAR)

These attributes form the exposure criteria, with criteria values ranked according to the scoring system outlined in Table 3.1. Table 3.2 provides a description of the Exchangeable Sodium Percentage (ESP) values used to define the Sodicity exposure criteria.

3.2.2 Sensitivity criteria

Attributes of the land or activities that influence sensitivity to sodic soils are:

- Position relative to waterway – Based on mapped drainage extent in Future Urban Structure (FUS) Dataset.
- Construction activity – Potential disturbance of construction for future land use sub types mapped in FUS Dataset
- Water balance change – Potential for change in water balance due to future land use (based on FUS classes). This considers potential for increases in overland flow from impervious surfaces and stormwater pipes in proposed developments.

These attributes form the Sensitivity criteria, with criteria values ranked according to the scoring system outlined in Table 3.3. Table 3.4 and Table 3.5 provides a description of scorings used for Construction Activity and Water Balance Change criteria.

[1] Vulnerability is typically expressed as Exposure (E) + Sensitivity (S) – Adaptive Capacity (AC). In this case we have not included Adaptive capacity (AC) in the assessment. The Vulnerability assessment is essentially an assessment of potential impacts. Adaptive capacity is included in the discussion when considering aspects of urban development that can be managed oi mitigate risks.

Table 3.1: Exposure criteria and scores. For further descriptions of ESP values/scores, refer to Table 3.2.

	Score				
Criteria	1	2	3	4	5
Sodicity of Topsoil (ESP)	<5%	5 to <7%	7 to <10%	10 to <15%	>15%
Sodicity of Subsoil (ESP)	<5%	5 to <7%	7 to <10%	10 to <15%	>15%
A horizon depth	>40cm	30-40cm	20-30cm	10-20cm	<10cm
Slope	0-1 %	1-5%	5 to 10%	10 to 20%	>20%

Table 3.2: Exchangeable Sodium Percentage (ESP) values used to define Sodicity exposure criteria.

Score	ESP Range	Description
1	<5%	Non-sodic, unlikely to reveal dispersion when in contact with fresh rainfall or runoff.
2	5 to <7%	Transition between non-sodic and sodic soil (sodic soil of 6%). Clay fraction within samples likely to evince dispersion when in contact with fresh rainfall or runoff.
3	7 to <10%	Moderate to high sodicity. Dispersion likely to occur when in exposed to fresh rainfall or runoff.
4	10 to <15%	High to very high sodicity. Dispersion likely. Significant erosion risk when exposed to fresh rainfall or runoff.
5	>15%	Very high to extreme sodicity. Significant erosion risk when exposed to fresh rainfall or runoff.

Table 3.3: Sensitivity criteria and scores. For further description of Construction Activity and Water Balance Change values/scores, refer to Table 3.4 and Table 3.5.

	Score				
Criteria	1	2	3	4	5
Waterway[1]	No	-	-	-	Yes
Construction activity	Minimal disturbance				High level of disturbance
Water balance change	Low (stay the same, infiltration)				High (generate runoff)

[1] Based on waterway extent as mapped as Drainage (LU_TYPE Attribute) in Future Urban Structure (FUS)

Table 3.4: Descriptions of scorings for Construction Activity ranked by level of disturbance expected for Land Use Sub Types (LU_SUBTYPE Attribute) mapped in the Future Urban Structure (FUS).

Score	Level of Disturbance	Land Use Sub Types (LU_SUBTYPE)
1	Minimal disturbance	Landscape values, Local Park
2		(No land use subtypes fall in this category)
3		Local Sports Reserve
4		Mixed Use, Residential, Government School, Community Facilities, Indoor recreation, Local convenience centre, Local town centre, Non-Government School, Public acquisition overlay, Existing road reserve, Future Arterial Road, Widening/Intersection Flaring
5	High level of disturbance	Waterways

Table 3.5: Description of scorings for Water Balance Change expected for Land Use Classes (LU_CLASS Attribute) mapped in the Future Urban Structure (FUS).

Score	Water Balance Change	Land Use Class (LU_CLASS)
1	Low (stay the same, infiltration)	Credited open space, Uncredited open space
2		(No land use classes fall in this category)
3		(No land use classes fall in this category)
4		Education/Community/Government, Developable Area - Residential
5	High (generate runoff)	Transport

3.2.3 Risk scenarios

The distribution of erosion risk associated with sodic soils was modelled using the collated datasets. This assessment was undertaken using Jacobs' Vulnerability Assessment Engine (VAE) - a tool that assists in assembling and analysing spatial data sets. The VAE is based on a technology called Feature Manipulation Engine (FME).

The Vulnerability Assessment Engine was used to assess the risks associated with sodic soils for the following two scenarios:

- Construction phase, where the Vulnerability of land and urban development to sodic soil erosion risks during the construction phase is a function of the following Exposure and Sensitivity criteria:
  - Exposure (E) – Sodicity topsoil, Sodicity subsoil, A horizon Depth, Slope
  - Sensitivity (S) - Waterway, Construction Activity
- Future developed land use, where the Vulnerability of land and urban development to sodic soil erosion risks in the future land use is a function of the following Exposure and Sensitivity criteria:
  - Exposure (E) - Sodicity topsoil, Sodicity subsoil, A horizon Depth, Slope
  - Sensitivity (S) - Waterway, Water Balance Change

Exposure and Sensitivity criteria scores are summed to calculate Vulnerability. The decision was made to apply an equal weighting of scores to Exposure and Sensitivity Criteria. Our reasoning for this is that the criteria are considered to be equally important. The spatial distribution and range of Vulnerability scores informs an assessment of the potential impact of land and urban developments have on sodic soils erosion risks.

4. Results

4.1 Exposure and sensitivity

4.1.1 Sodicity of soils and their exposure to erosion

The soils of the Beveridge North West Precinct are classified as Sodosols. The characteristics of these soils is consistent with definition of Sodosols (Isbell & NCST 2016), as *soils with a clear or abrupt textural B horizon in which the major part of the upper B2 horizon is sodic and not strongly acid*. Soils were sampled on the 3rd and 4th June 2020 and sent for laboratory analysis. Conditions were very wet at the time of sampling following above average rainfall in the months of January to May 2020. Some photographs of the field area showing land slopes, waterlogging, the degraded condition of Kalkallo Creek and erosion are presented in Figure 4.1.

Figure 4.1: Selected photographs of Beveridge North West Precinct: steeper slopes and headwater areas (top left) saturated lower slopes and drainage depressions (top right), bed, bank, rill/gully and tunnel erosion along Kalkallo Creek waterway corridor (bottom left and right).

The topsoil across the Beveridge North West Precinct is typically non-sodic, with ESP values <5%. Subsoils exhibit moderate to extreme sodicity, with ESP values ranging from 7 to > 15% (max 32%). Deeper samples recorded higher ESP values, ranging from 14 to 35%. A horizon depths vary across the Precinct, with measurements in the field ranging from 10-110 cm. Detailed tables of soil test results are included in Appendix A.

An inverse distance weighted (IDW) interpolation was used to estimate values of soil sodicity (topsoil and subsoil) and A horizon depths at unsampled locations across the Precinct. IDW interpolation is a standard method that is used for spatial interpolation and development of soil maps (Mueller et al. 2004). It is expected that soil characteristics would generally vary in accordance with geology. Geological units provided the boundaries for soil mapping, the mean of interpolated values within each geological unit have been used to assign a score for each soil criteria.

Table 4.1 and Table 4.2 present summary statistics for interpolated topsoil and subsoil sodicity across the precinct area and maps showing spatial distribution of scores applied to these two exposure criteria are presented in Figure 4.2 and Figure 4.3. The western side of the precinct area is characterised by subsoils with high to very high (10 to <15%) and very high to extreme (>15%) ESP values.

Table 4.1: Topsoil sodicity – summary of Inverse Distance Weighted (IDW) interpolation of ESP values by geological units. Score and ESP Range assigned to unit presented in last two columns (based on mean IDW value).

Stratum (Unit)	Area (Ha)	Summary of Soil Sodicity (ESP %)					Criteria	
		Min	Max	Range	Mean	STD	Score	ESP Range
Alluvial terrace deposits (Qa2)	78.7	1.1	6.9	5.8	3.7	1.1	1	<5%
Newer Volcanic Group – scoria deposits (Nes)	3.5	2.8	4.2	1.4	3.2	0.5	1	<5%
Newer Volcanic Group – basalt flows (Neo)	70.1	2.5	4.6	2.1	3.1	0.3	1	<5%
Incised colluvium (Nc1)	93.4	1.8	5.7	3.9	3.6	0.8	1	<5%
Swamp and lake deposits (Qm1)	17.8	5.1	8.3	3.2	6.8	0.9	2	5 to <7%
Newer Volcanic Group - stony rises basalt (Neo2)	652.1	1.0	22.9	21.9	4.4	2.3	1	<5%
Humevale Siltstone (Dxh)	363.7	2.2	8.7	6.5	3.9	0.8	1	<5%

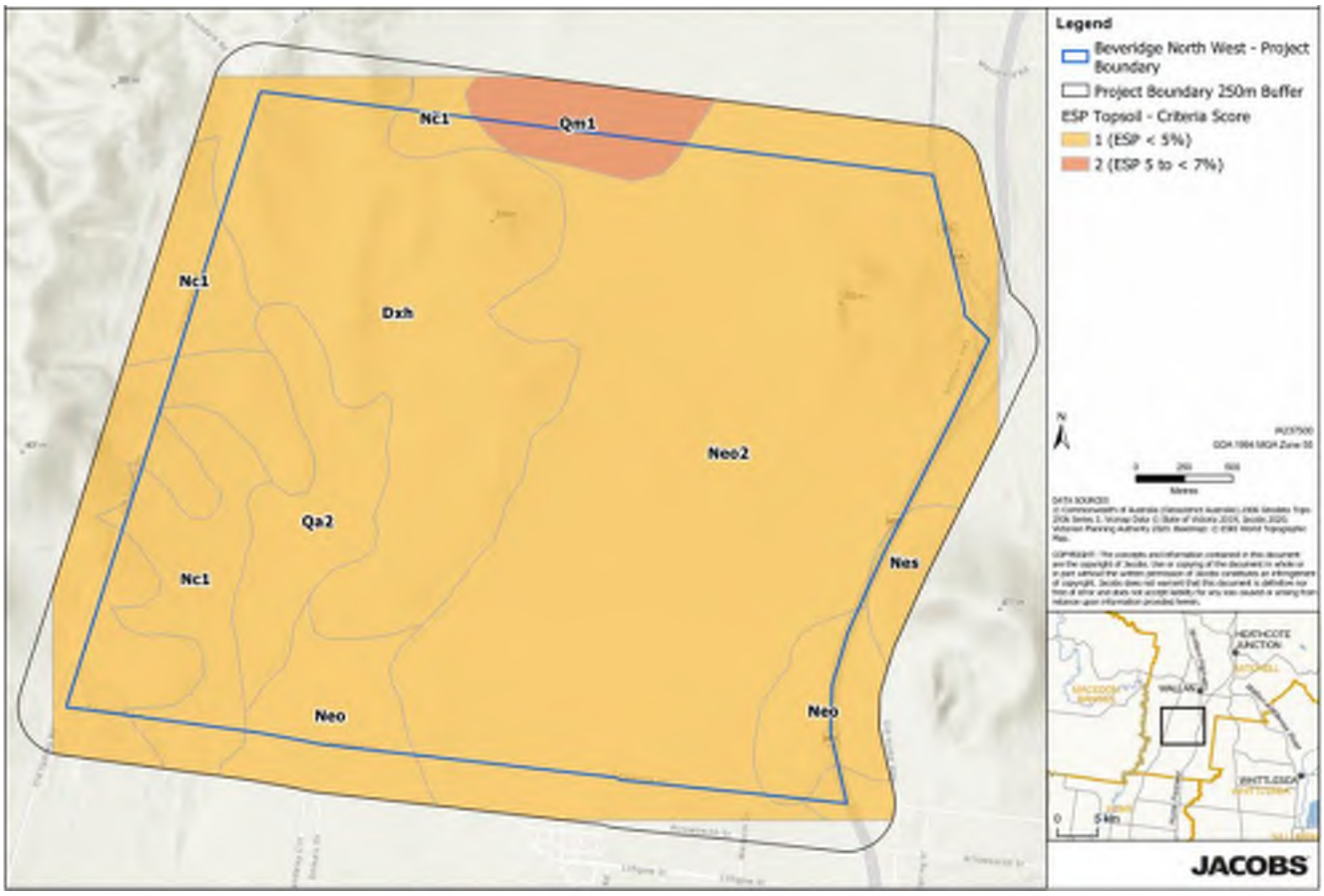

Figure 4.2: Mean topsoil sodicity.

Table 4.2: Subsoil sodicity - summary of Inverse Distance Weighted (IDW) interpolation of ESP values by geological units. Score and ESP Range assigned to unit presented in last two columns (based on mean IDW value).

Stratum (Unit)	Area (Ha)	Summary of Soil Sodicity (ESP %)					Criteria	
		Min	Max	Range	Mean	STD	Score	ESP Range
Alluvial terrace deposits (Qa2)	78.8	4.2	23.2	19.0	13.7	3.3	4	10 to <15
Newer Volcanic Group – scoria deposits (Nes)	3.5	6.0	8.9	2.9	7.1	0.9	3	7 to <10%
Newer Volcanic Group – basalt flows (Neo)	70.2	4.7	23.6	18.9	9.9	3.2	3	7 to <10%
Incised colluvium (Nc1)	93.4	6.2	31.9	25.7	15.9	3.8	5	>15%
Swamp and lake deposits (Qm1)	17.8	11.6	18.0	6.4	15.0	1.8	5	>15%
Newer Volcanic Group - stony rises basalt (Neo2)	652.1	1.3	26.9	25.6	9.9	3.7	3	7 to <10%
Humevale Siltstone (Dxh)	363.7	3.7	30.0	26.3	12.8	3.5	4	10 to <15%

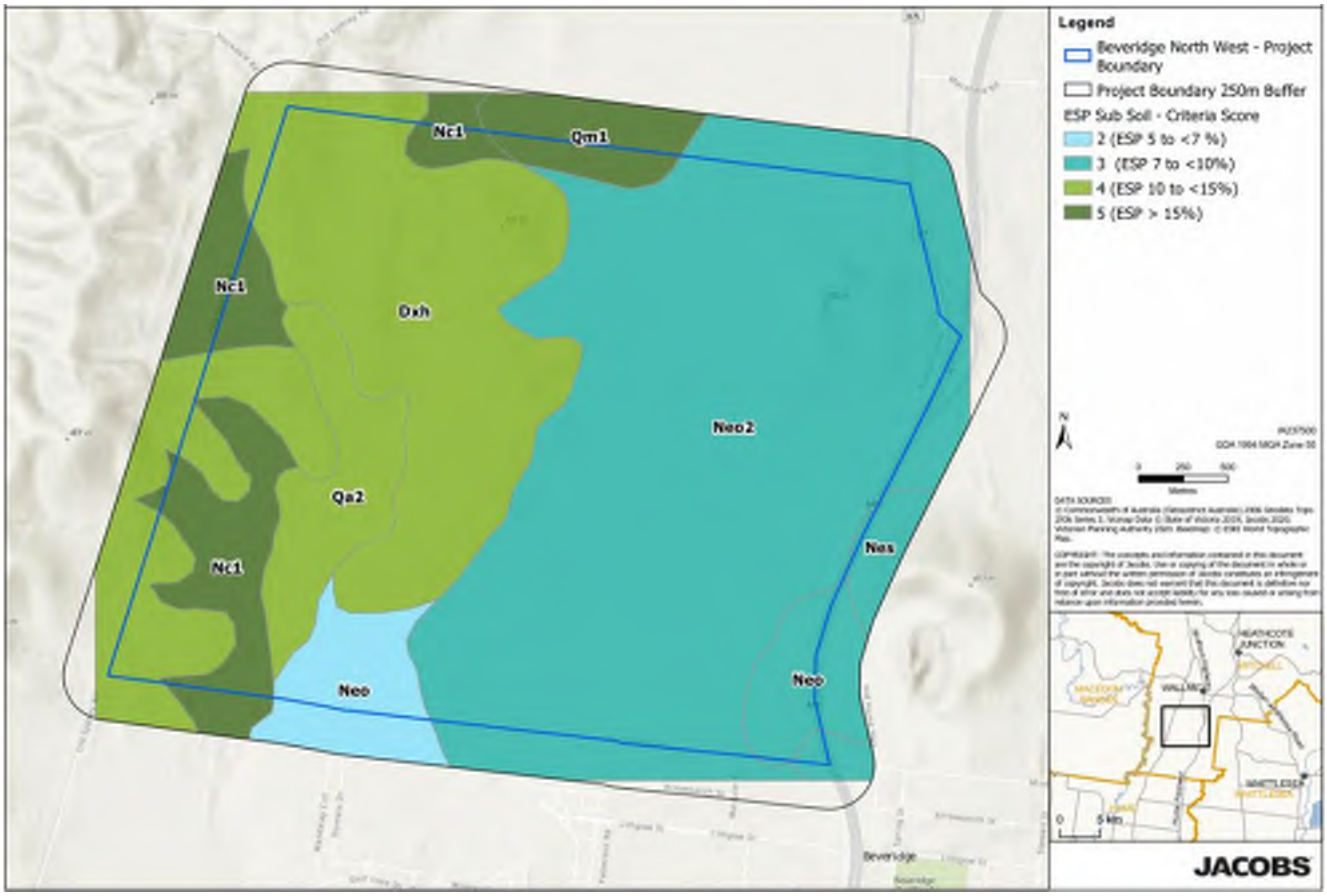

Figure 4.3: Mean subsoil sodicity.

Table 4.3 presents summary statistics for interpolated A horizon depth across the precinct area. Mean values within each geological unit range from 20-30 cm to >40 cm. A horizon depths on the western side of the precinct area are notably different to those on the eastern side. The final exposure criteria used is slope, with classes shown in Figure 4.5. Figure 4.6 presents the sum of the four exposure criteria (Topsoil sodicity, Subsoil sodicity, A horizon depth and slope). Soils on the western side of the Precinct Area have higher subsoil ESP values and greater erosion risk. Slope influences exposure to erosion, particularly in areas where gradients are higher than 10%.

Table 4.3: A horizon depth – summary of Inverse Distance Weighted (IDW) interpolation of ESP values by geological units. Score and depth range assigned to unit presented in last two columns (based on mean IDW value).

Stratum (Unit)	Area (Ha)	Summary of A horizon depth (cm)					Criteria	
		Min	Max	Range	Mean	STD	Score	A horizon depth
Alluvial terrace deposits (Qa2)	78.8	23.7	105.4	81.7	42.3	9.1	1	>40cm
Newer Volcanic Group – scoria deposits (Nes)	3.5	19.2	23.4	4.2	20.3	1.6	3	20-30cm
Newer Volcanic Group – basalt flows (Neo)	70.2	19.3	49.3	30.0	25.5	5.7	3	20-30cm
Incised colluvium (Nc1)	93.4	35.0	109.7	74.7	44.6	10.3	1	>40cm
Swamp and lake deposits (Qm1)	17.8	23.5	41.8	18.3	31.4	4.3	2	30-40cm
Newer Volcanic Group - stony rises basalt (Neo2)	652.1	10.0	74.7	64.7	24.5	8.8	3	20-30cm
Humevale Siltstone (Dxh)	363.7	15.5	109.5	94.0	44.5	8.9	1	>40cm

Figure 4.4: Depth to A horizon.

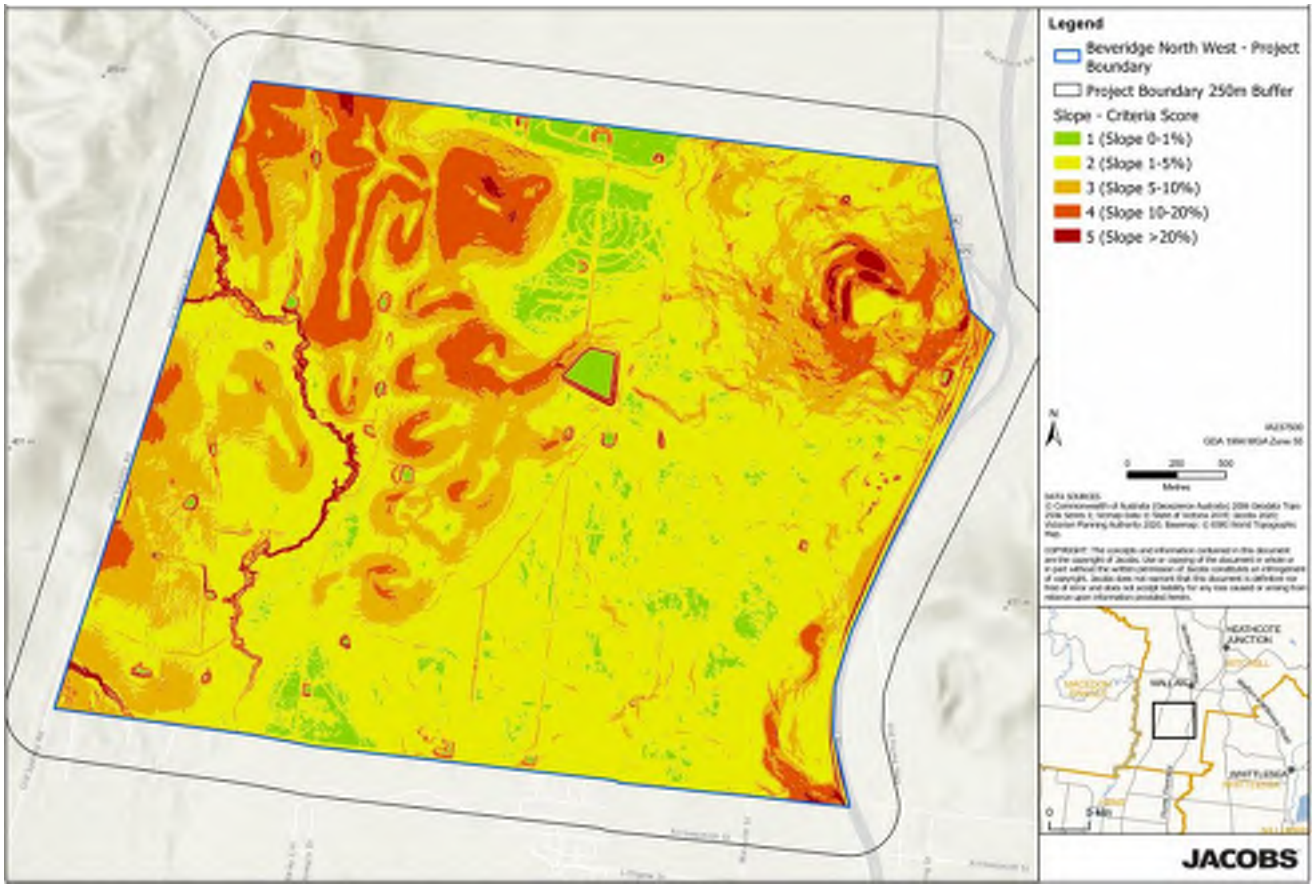

Figure 4.5: Slope.

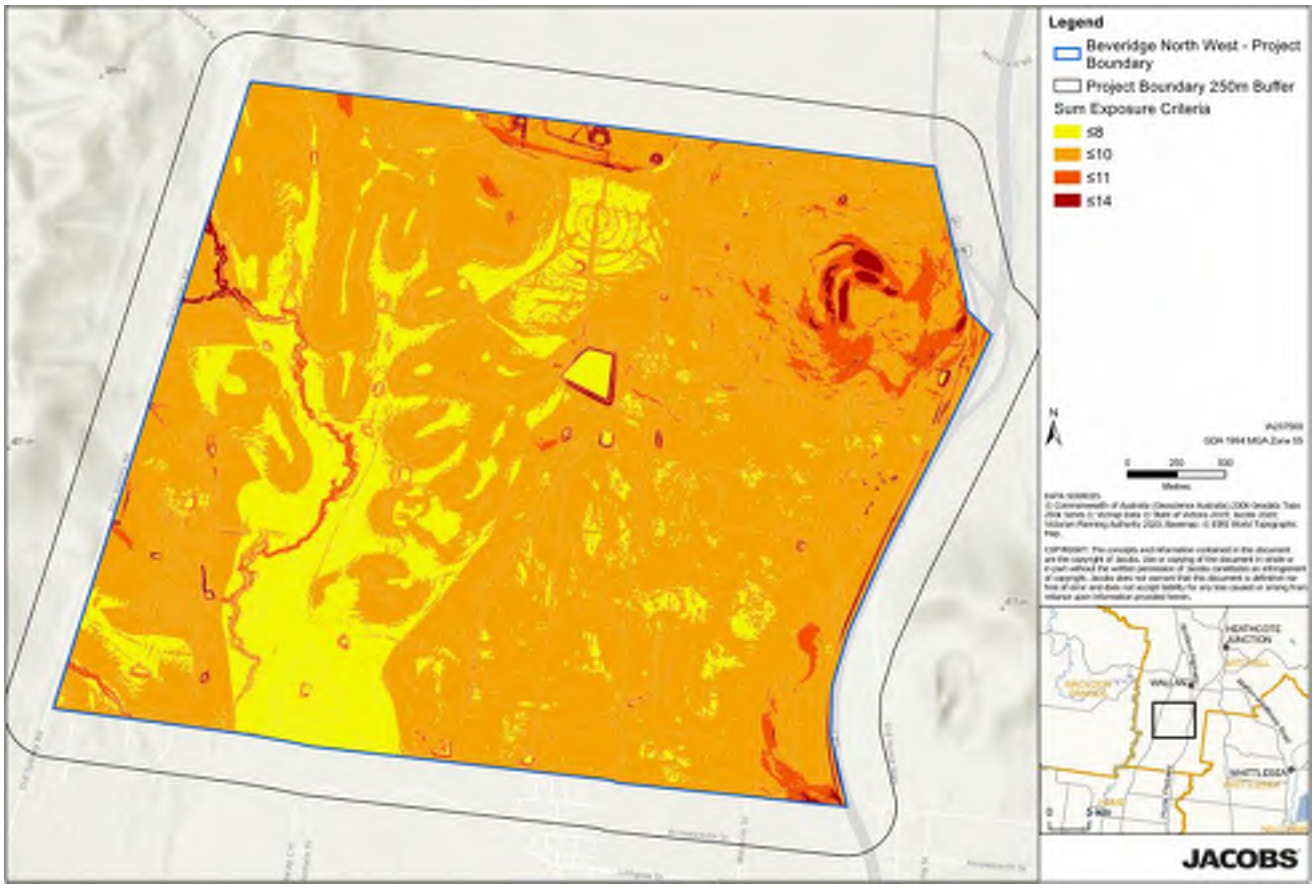

Figure 4.6: Sum of Exposure Criteria.

4.1.2 Sensitivity of land and urban development to sodic soils

The Future Urban Structure (FUS) dataset has been used as the basis for defining the sensitivity of land and urban development to sodic soils. Waterways are identified as areas that are particularly sensitive to urban development. The waterway extent across the Precinct is mapped as Drainage in the FUS. These areas score 5, whereas all other areas outside of the waterway extent score 1.

Figure 4.7 and Figure 4.8 present the spatial distribution of sensitivity scores as applied to the FUS dataset for construction activity and water balance change. Construction activities in different land use types are ranked on a scale from minimal disturbance to high levels of disturbance. Areas that are set aside for landscape values / local park have low levels of development and are scored as minimal disturbance (1), with the level of disturbance increasing with the intensity of development. The majority of the land use sub types are given a score of 4, with waterways experiencing the highest level of disturbance (5).

Similarly, in scoring watering balance change, open space areas are expected to experience low levels of water balance change (1). Increasing development of land use, will result in development of impervious areas that generate runoff and therefore result in high levels of water balance change (5).

Figure 4.9 and Figure 4.10 present the combined sensitivity scores for the construction and future development scenarios. These show a similar pattern in that the waterways are identified as areas of highest sensitivity. Transport corridors are also identified as areas with high sensitivity in the future urban structure, due to the high water balance change and generation of runoff associated with impervious surfaces in these corridors.

4.2 Vulnerability assessment

The outcomes of the vulnerability assessment for the construction phase and future developed land use scenarios are presented in Figure 4.11 and Figure 4.12.

During construction, areas identified with a high vulnerability to sodic soil erosion risks are the waterways and steeper slopes (Figure 4.11). Activities that expose these soils to rainfall and associated runoff will present significant construction challenges and need to be managed carefully.

For future developed land use, waterways and steeper slopes are areas identified with a high vulnerability to sodic soil erosion risks (Figure 4.12). Water balance changes resulting from future developed land use and associated impervious areas will generate high volumes of runoff, which will drain into the surrounding waterways, including Kalkallo Creek. Kalkallo Creek is already in a degraded condition, further increases in flows would be expected to accelerate erosion of bed and bank materials.

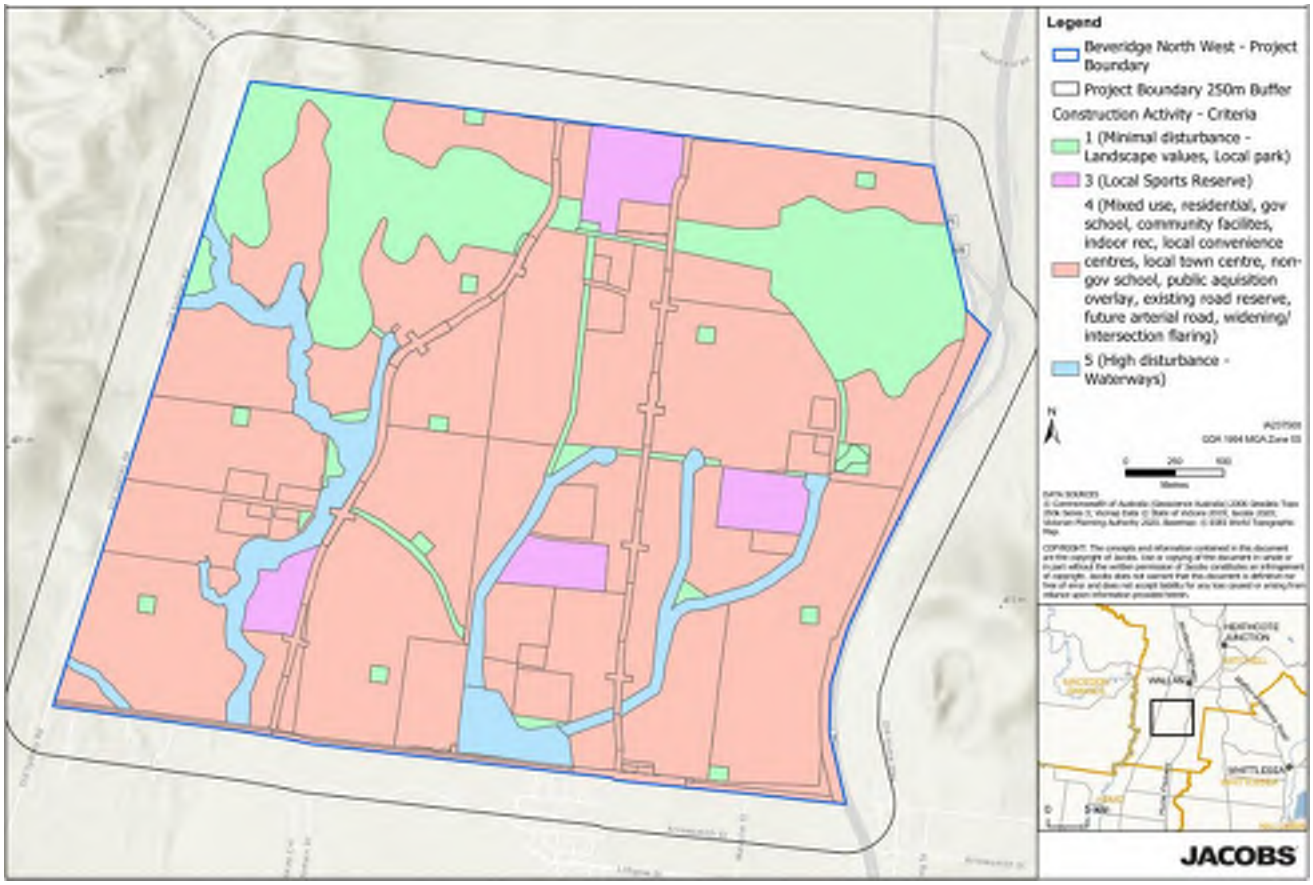

Figure 4.7: Construction activity.

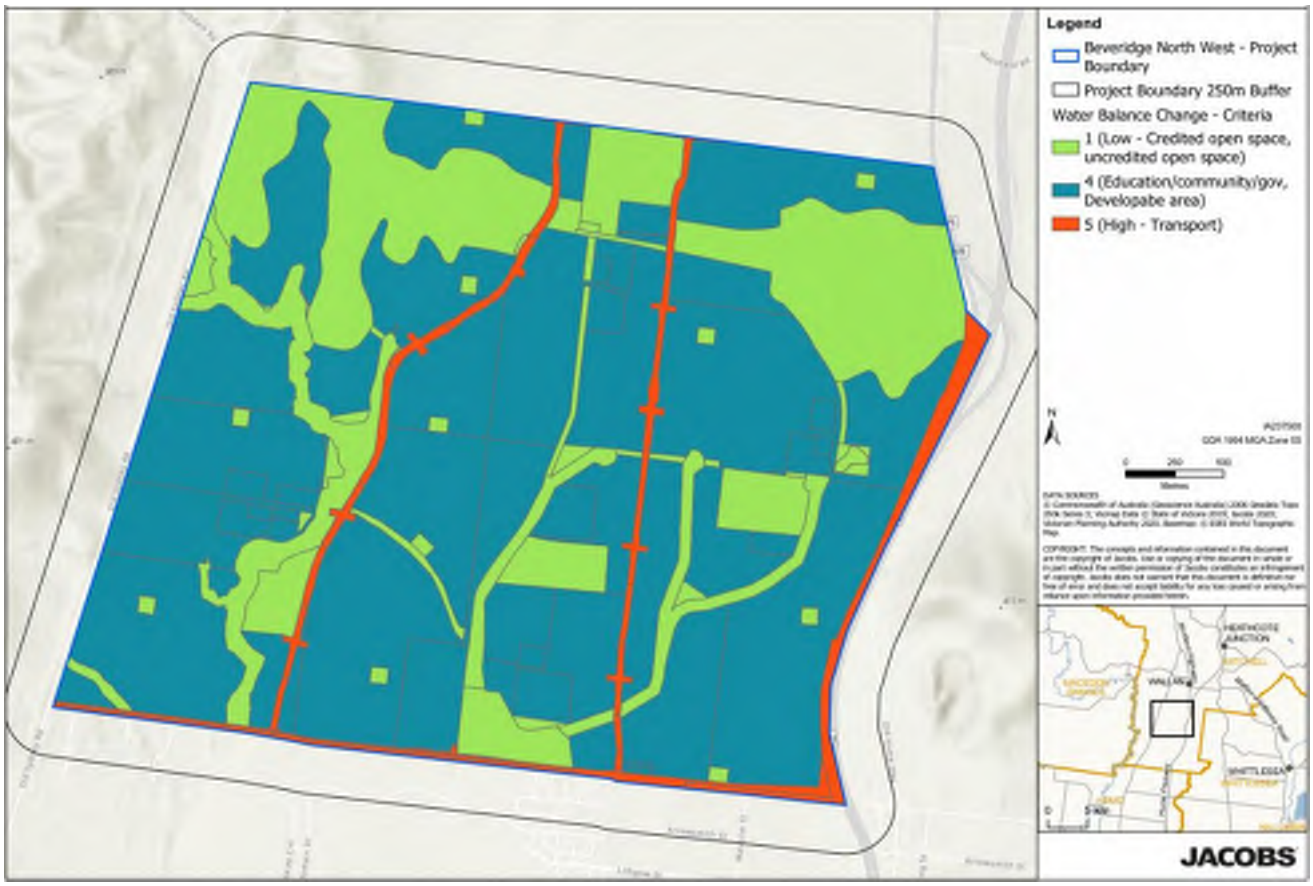

Figure 4.8: Water balance change.

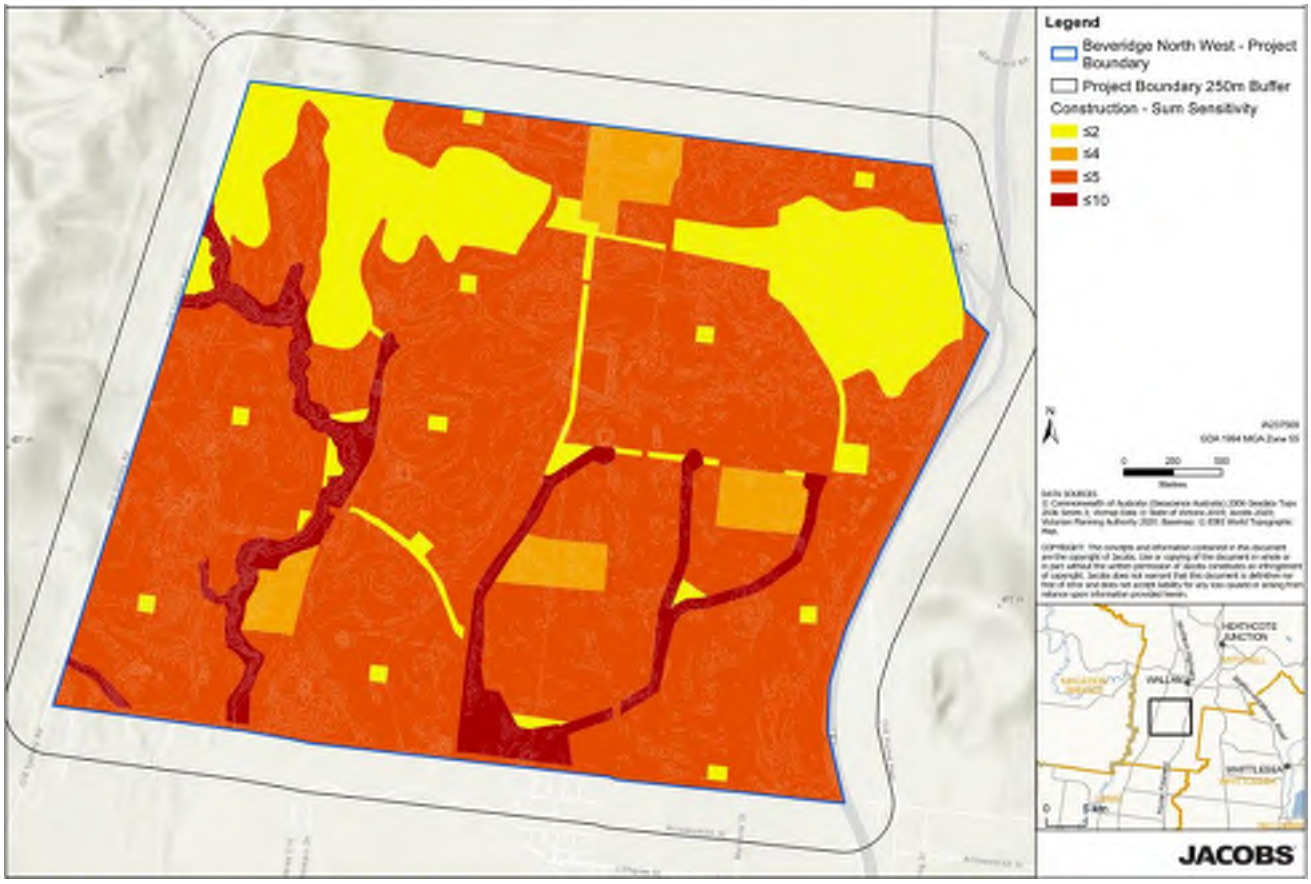

Figure 4.9: Sum of Sensitivity Criteria for Construction.

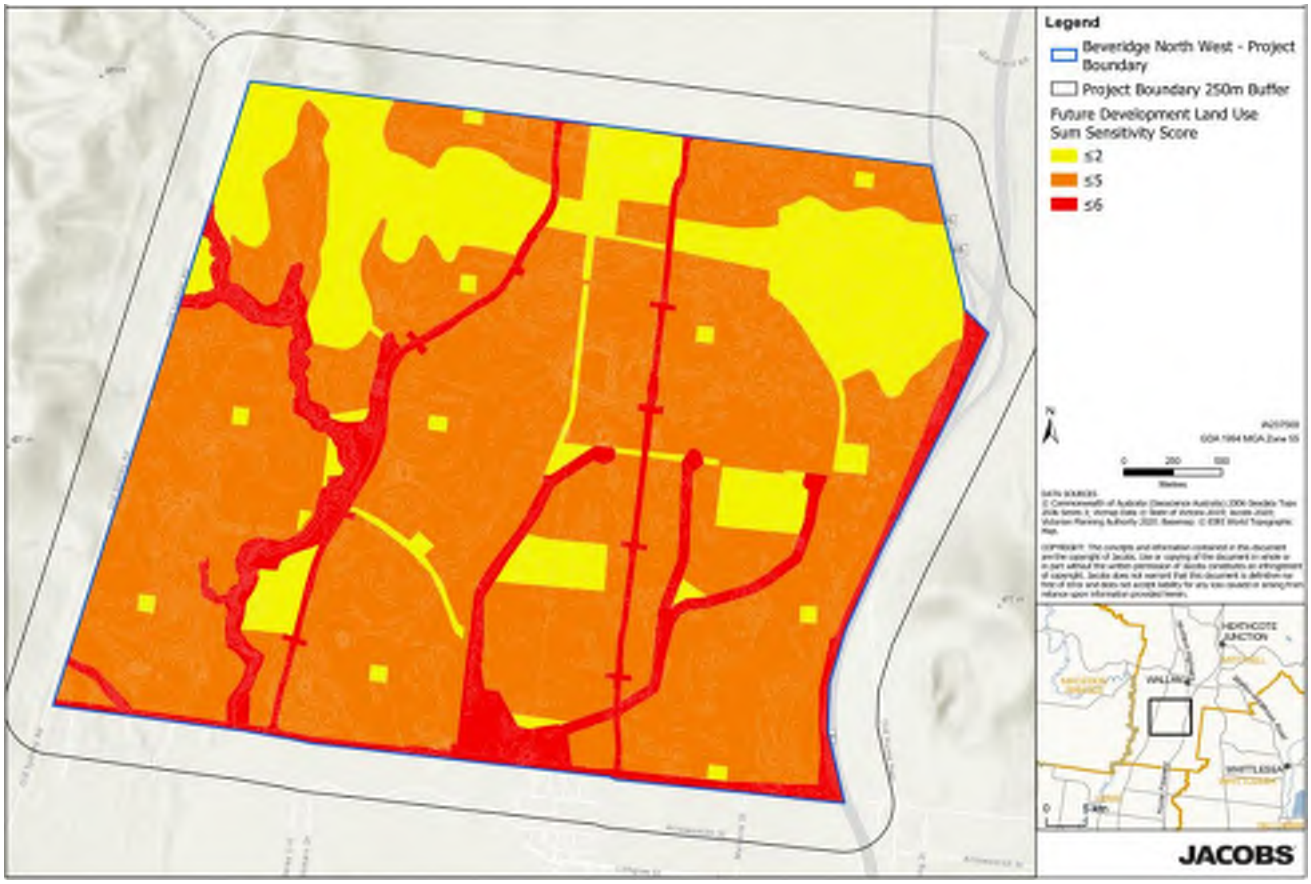

Figure 4.10: Sum of Sensitivity Criteria for Future Urban Structure.

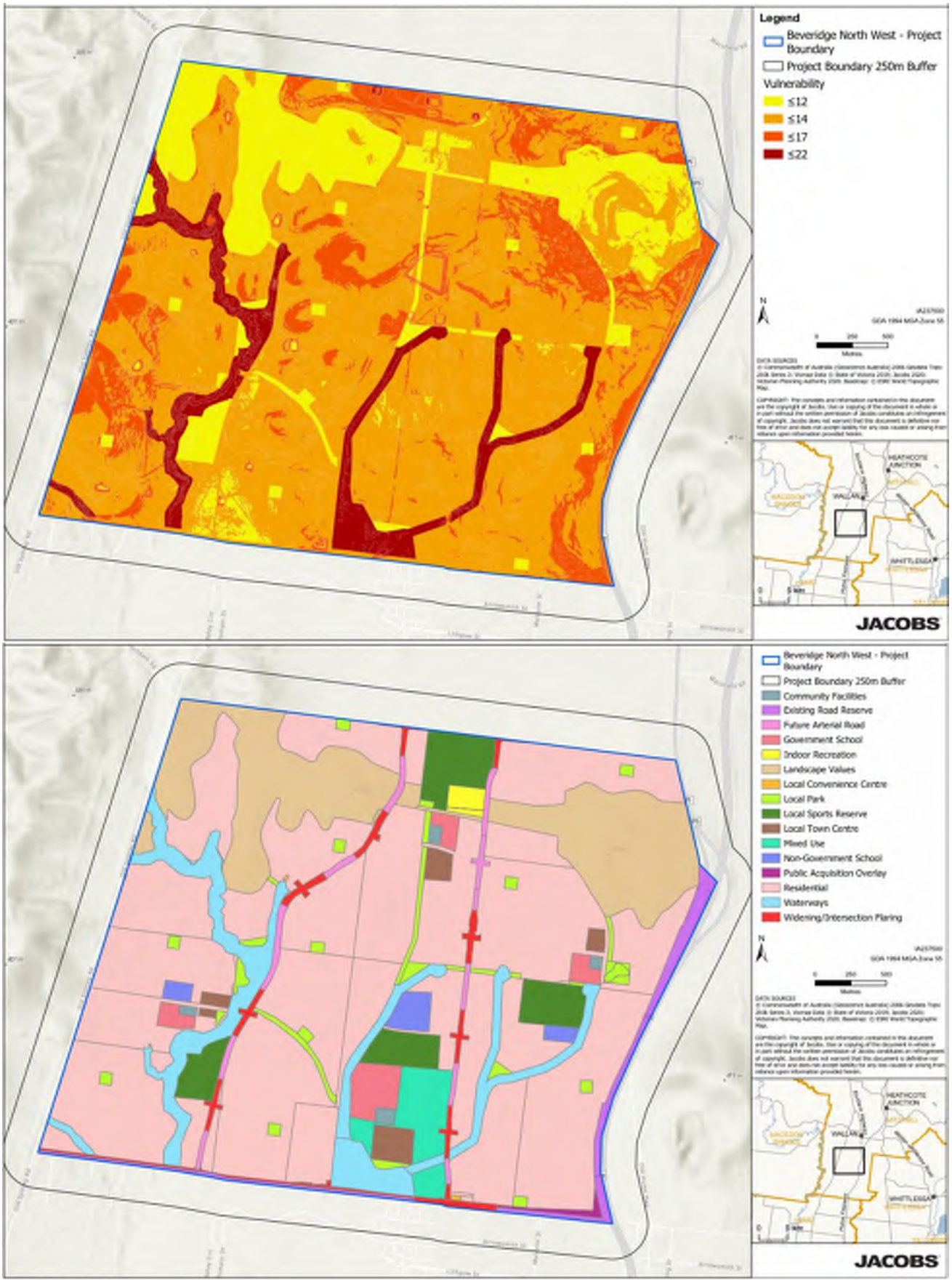

Figure 4.11: Vulnerability Construction Phase (upper). Yellow represents bottom 25% of data (low vulnerability) and red/brown top 25% of data (high vulnerability). Map of Future Land Use Sub Types (below).

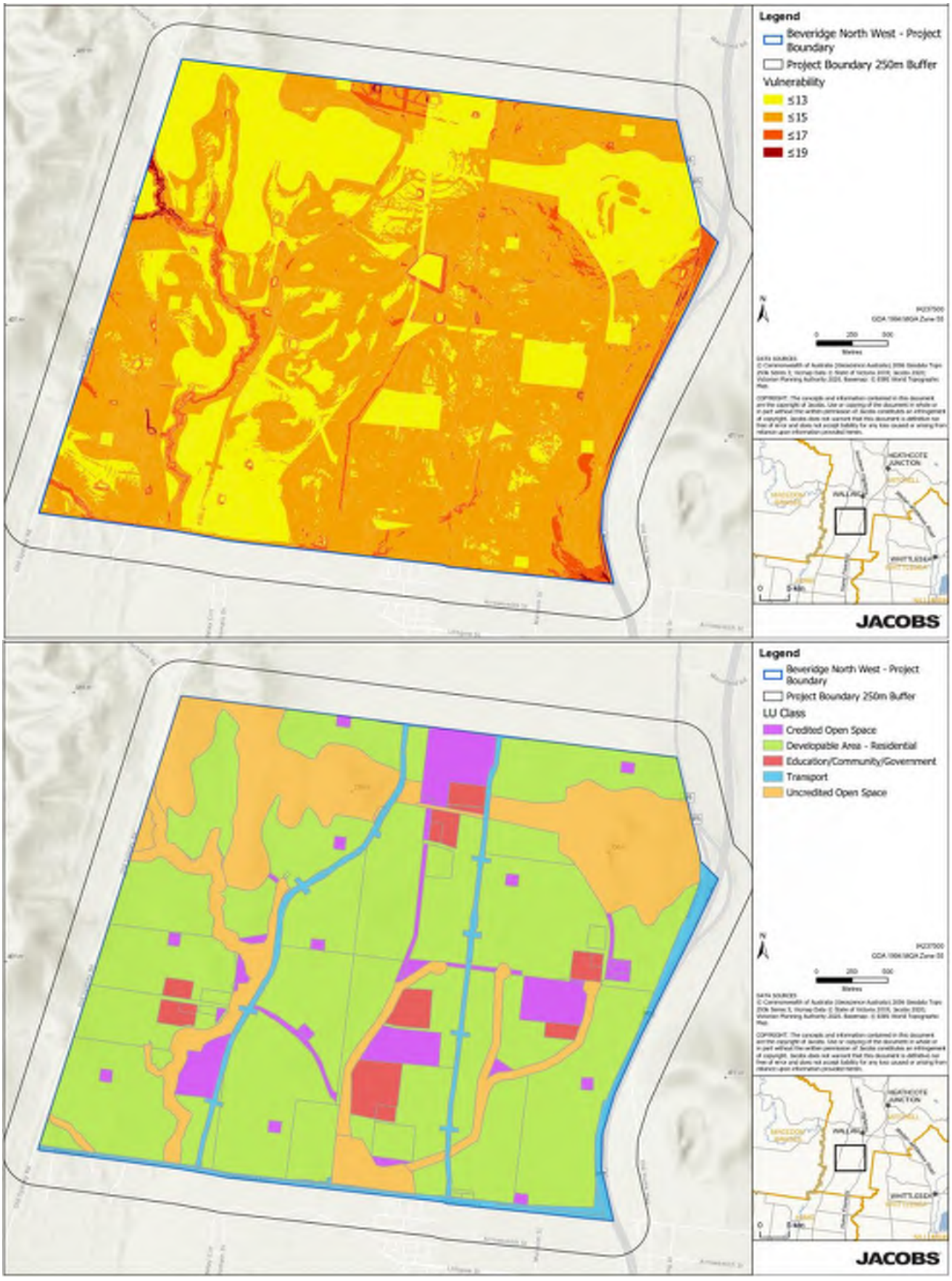

Figure 4.12: Vulnerability Future Developed Land Use (upper). Yellow represents bottom 25% of data (low vulnerability) and red/brown top 25% of data (high vulnerability). Map of Future Land Use Classes (below).

5. Discussion and recommendations

5.1 Erosion risks

Activities that expose sodic and dispersive soils include removal of topsoil, subsoil excavations (cut and fill), supply of services by trenches and construction of roads and culverts. Changes to hydrology, such as the concentration of flow in culverts, runoff from impervious areas and ponding of rainfall can lead to concentrated, elevated velocity water flow and may also increase erosion risk. Sand particles are likely to migrate downslope and drop out of suspension in low-energy detention points, while the dispersive clay fraction will remain suspended and enter waterways.

Erosion may also occur in areas of localised groundwater discharge, following recharge of rainfall upslope, seepage on top of clay or rock layers and a soak or discharge point appearing where clay or rock is close to the surface and/or there is break in slope. This increased erosion risk is typically associated with the break of slope below steeper slopes.

In the Beveridge North West Precinct, the potential for erosion problems to develop is clearly evident along Kalkallo Creek. The erosion issues that this creek is presently experiencing reflect a legacy of historical changes to the landscape. Initiation of scour in drainage depressions arising from increased runoff, exposure of subsoils and the dispersive nature of these soils require specific management. Future urban development, with clearing and removal of topsoils, trenching of slopes and changes to drainage patterns increases the erosion risks.

The following areas are identified as area of high erosion risk:

- Drainage depressions/seasonal wetlands – These areas can be broadly classified as headwater streams – small flow lines (swales/wetlands), creeks and streams that are closely linked to adjacent slopes. They may only flow or have ponds of water periodically following rainfall events, however they do play an important role in retaining and temporarily storing water in the landscape (Jacobs 2016). This ability slows down the rate of flow over the land and assists in regulating flows and reducing downstream flood peaks. The infiltration of surface water in headwater streams into the local groundwater system also plays an important role contributing to groundwater levels and maintaining base flows in downstream waterways. In fact many headwater streams have their source of water as groundwater. If small headwater streams are destroyed because of urbanisation there is an increase in the number of high flows to downstream reaches. These high flow events can cause bed and bank erosion that significantly degrades community and environmental values (Bond & Cottingham 2008).

  Headwater streams make up a significant proportion of the stream network and collect the majority of the runoff and dissolved nutrients from a catchment. Nutrient cycling and retention in headwater streams can significantly reduce nutrient exports to downstream reaches, estuaries and bays. This is because headwater streams provide the ideal mix of shallow depths, high surface-to-volume ratios, water-sediment exchange and biotic communities required for nutrient cycling (Peterson et al. 2001). If the nutrient processing capacity of headwater streams is diminished (for example through changed flows or the clearing of riparian vegetation), or lost altogether (e.g. through drainage and urbanisation), then more nutrients are delivered to downstream reaches (Jacobs 2016).

  With urban development, many headwater streams are converted into stormwater drains and these modified drainage courses become a key driver in the degradation of downstream reaches. Downstream reaches naturally have a lower capacity to process nutrients, and if the amount of nutrients exported from headwater reaches exceeds the processing capacity of these downstream reaches this results in a net increase in the amount of nutrients that are exported to receiving waters such as estuaries and bays (SKM 2013). Excessive erosion of downstream waterways is caused by increased flow and decreased sediment supply that results from urbanisation in headwater streams. The increased flow and pollutant load from conventional stormwater drainage networks greatly reduces the nutrient retention capacity of downstream waters through the multiple impacts of urbanisation (Vietz et al. 2014, Walsh et al. 2005). Increased loads of nutrients from the surrounding catchments are recognised as one of the major threats to environmental health, and community and recreational values, and also to the economic productivity of Port Phillip Bay (CSIRO & Melbourne Water 1996).

- Kalkallo Creek and incoming tributaries – The creek along its course is in a degraded condition and it is apparent that over the years there have been attempts to stabilise the bed with rock structures. Bed and bank erosion is active in sections, and further away from the banks, there are signs of active erosion (sheet, rill, tunnel and gully erosion). Increases in runoff from developed areas have the potential to cause further degradation to the creek.
- Steeper slopes – The hillslopes in the precinct area vary in gradient. Cutting into steeper slopes will likely lead to the exposure of dispersive subsoils. Runoff from steep slopes will result in higher velocity flow with a greater risk of scour and erosion. Sediments eroded from these areas will be deposited on lower slopes or be carried into connecting waterways, adversely affecting water quality.

5.2 Planning measures

Erosion risks associated with sodic and dispersive soils can be managed by appropriate planning. This report concurs with the planning requirements and guidelines documented in the Beveridge North West Precinct Structure Plan that related to Integrated Water Management. These are reproduced in Table 5.1.

Table 5.1: Integrated Water Management Requirements and Guidelines (Victorian Planning Authority 2019).

Requirements	
R13	Stormwater conveyance and treatment must be designed in accordance with the relevant Development Services Scheme and Plan 11 unless otherwise agreed by Melbourne Water and the responsible authority.
R14	Final designs and boundaries of constructed wetlands, retarding basins, stormwater quality treatment infrastructure, and associated paths, boardwalks, bridges, and planting, must be to the satisfaction of both the responsible authority and Melbourne Water.
R15	Development staging must provide for the delivery of ultimate waterway and drainage infrastructure, including stormwater quality treatment. Where this is not possible, development proposals must demonstrate how any interim solution adequately manages and treats stormwater generated from the development and how this will enable delivery of an ultimate drainage solution, to the satisfaction of Melbourne Water and the responsible authority.
R16	Stormwater runoff from the development must meet the performance objectives of the CSIRO Best Practice Environmental Management Guidelines for Urban Stormwater prior to discharge to receiving waterways and as outlined on Plan 11, unless otherwise approved by Melbourne Water and the responsible authority. Proposals that exceed the performance objectives will be considered to the satisfaction of the relevant authority.
R17	Applications must demonstrate how: § Waterways and integrated water management design enables land to be used for multiple recreation and environmental purposes. § Overland flow paths and piping within road reserves will be connected and integrated across property/parcel boundaries. § Melbourne Water and the responsible authority freeboard requirements for overland flow paths will be adequately contained within the road reserves.
Guidelines	
G57	Relevant Integrated Water Management (IWM) requirements of this PSP will be achieved to the satisfaction of the retail water authority, including the supply of recycled water where required by the relevant water authority.
G58	The design and layout of roads, road reserves, and public open space should optimise water use efficiency and long-term viability of vegetation and public uses through the use of overland flow paths, Water Sensitive Urban Design initiatives such as street swales, rain gardens and/or locally treated storm water for irrigation to contribute to a sustainable and green urban environment.
G59	Where practical, and where primary waterway or conservation functions are not adversely affected, land required for integrated water management initiatives should be integrated with the precinct open space and recreation system and as depicted on Plan 7.

The Beveridge North West Precinct Area is located in one of the Stormwater Priority Areas identified in the 2018 Healthy Waterways Strategy (Melbourne Water 2018a, 2018b). One of the specific target objectives that have been set for this area is to constrain directly connected imperviousness (DCI)[2] levels to <2% and this will require undertaking significant harvesting and infiltration of stormwater.

[2] The proportion of impervious area within a catchment that is directly connected to a stream via the stormwater drainage system

The current Kalkallo Creek Development Services Scheme (DSS) does not include provision for stormwater harvesting or for protection of existing drainage depressions/wetlands and waterways in the Precinct (Figure 5.1). Stormwater control measures can only protect waterways downstream of where they are located. Under the current Development Service Scheme, stormwater treatment on the eastern side of the Precinct Area is to be directed to Retarding Basin/Wetlands near the southern boundary (Figure 5.1). On the western side of the Precinct Area, no stormwater treatment is planned for Kalkallo Creek, stormwater treatment is deferred to the Kalkallo Retarding Basin (future proposed wetland), located approximately 7km downstream along the creek from the southern boundary (Figure 5.1). This means the functioning and stability of streams upstream from these points may not be adequately protected.

The current Development Service Scheme does not align with what is accepted Best Practice as summarised by the following references:

- *Urban Water: Best Practice Environmental Management Guidelines* (CSIRO 1999) states that stormwater management should be based on the principles of preservation, source and structural controls:
  - Preservation: preserve existing valuable elements of the stormwater system, such as natural channels, wetlands and stream-side vegetation;
  - Source control: limit changes to the quantity and quality of stormwater at or near the source; and
  - Structural control: use structural measures, such as treatment techniques or detention basins, to improve water quality and control streamflow discharges.

  These principles should be applied as part of an ordered framework to achieve environmental objectives as described in Figure 5.2.
- *"Best practice planning for urban development requires that the catchment's hydrologic response is maintained as close as practicable to pre-development conditions. Appropriately conceived and designed water management infrastructure can achieve this outcome"* (Melbourne Water 2009).
- Following on from this, it is now understood that maintaining ecologically and geomorphically important flow metrics close to their natural values requires preventing almost all the additional surface runoff generated by urbanisation from entering waterways (Duncan et al. 2016).

It is recommended that Melbourne Water undertake further work on the Kalkalko Creek DSS in light of the planned development in Beveridge North West PSP. This should consider the existing form of the waterways and how these may be protected or modified in future land developments. One design concept that Jacobs (2019) recommended for the Merrifield Central Waterway, a tributary of Kalkallo Creek (Figure 5.1) which is also experiencing sodic soil erosion issues, is that of distributed seasonal wetlands and swales that provides some stormwater treatment and flow conveyance.

Further details of this design concept are provided here:

- Configuration - A series of seasonal wetlands positioned along and across the width of the waterway corridor, which are connected by a low-flow channel or series of low-flow channels (rocky/grassed swales).
- Hydraulic behaviour – Seasonal wetland and channel features extend across the width of the waterway corridor. Widening of features within the corridor and reduction of overall gradient will assist in lowering boundary shear stresses. A dry system with seasonal inundation of wetlands. Low-flow channel(s) convey and spill water into wetland areas.
- How surface treatments may vary – Treatment of sodic soils required throughout, but variation in the requirement for and sizing of rock. More extensive rock treatment in areas of high boundary shear stress (along low-flow channels and where water spills into wetland). Need for rock treatment less within the body and margins of wetland where water ponds and boundary shear stresses are lower.

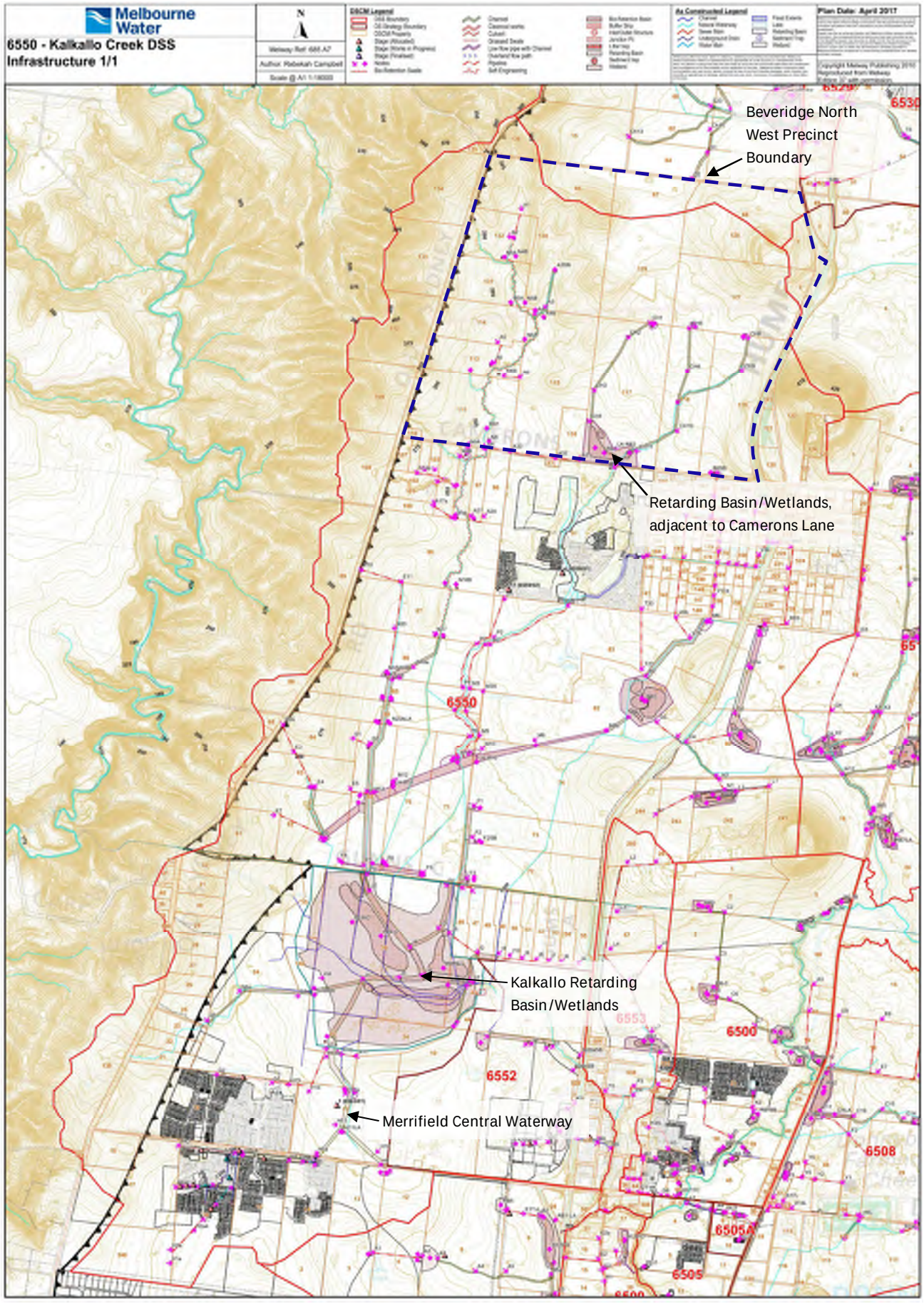

Figure 5.1: Kalkallo Creek DSS Infrastructure (Melbourne Water 2017).

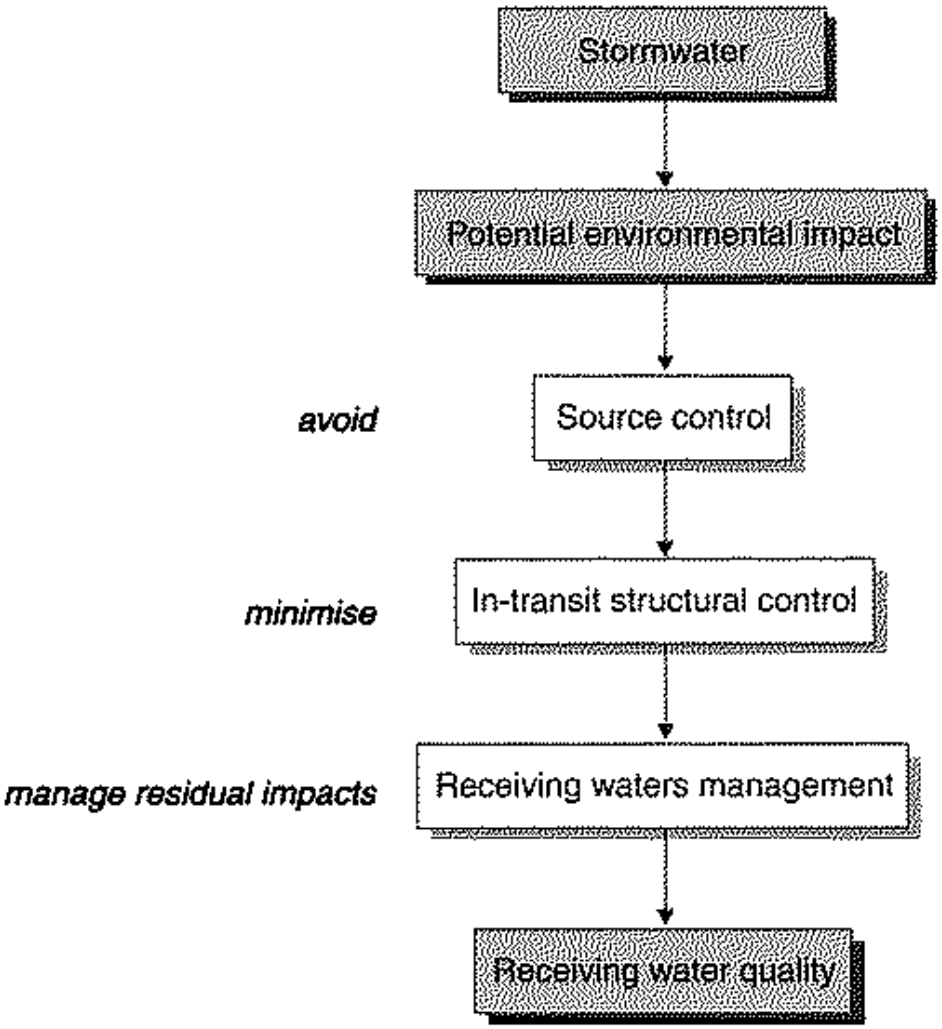

Figure 5.2: Stormwater management framework (CSIRO 1999).

Figure 5.3 is a schematic to help illustrate the design concept and show how the wetland and swale/low-flow channel would be distributed and connect along the waterway corridor. Further detail in relation to the sizing and configuration of wetlands and low-flow channel(s) in the waterway corridor and how surface treatments may vary would need to be worked through as part of the design process. It is expected that the hydraulic aspects of the design will require a number of iterations, varying the longitudinal grade and cross-sectional grades so as to distribute flow within the system of low-flow channels and seasonal wetlands, minimising bed shear stresses whilst also providing the required conveyance along the waterway corridor.

Careful design and construction of swale and wetland features, with particular attention to the formation of a protective layer on top of sodic soils will be required to provide a stable waterway corridor. In the case of Merrifield Central Waterway, this concept is considered to provide better outcomes as it more closely aligns with the characteristics and functioning of the existing waterway as a headwater stream, which is a broad depression/seasonal wetland that periodically holds water following rainfall events. Similar design concepts may also be applicable to the waterway corridors in the Beveridge North West Precinct Area. This could also lead to downstream benefits, such as a reduction in the scale of the wetland proposed for Kalkallo Basin.

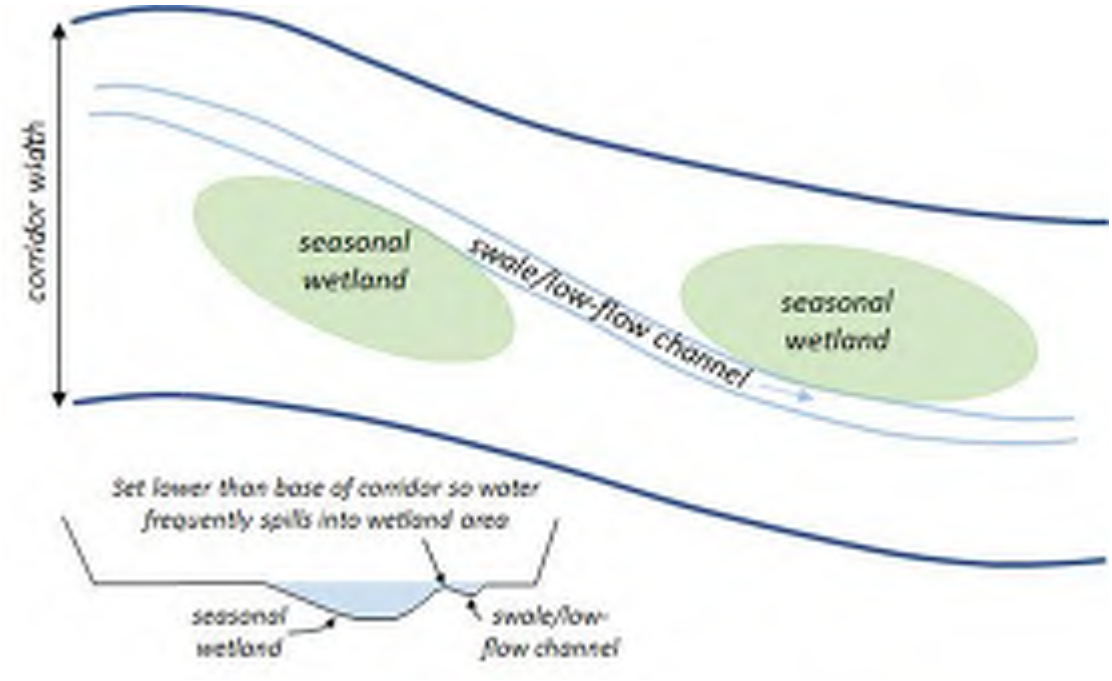

Figure 5.3: Schematic of distributed seasonal wetlands and swale/low flow channel (Jacobs 2019).

5.3 Treatment options

For areas of greatest risk, treatment options include:

- Drainage depressions/seasonal wetlands – Ideally these areas should be identified and reserved as linear green spaces to retain their important hydrological function in retaining and temporarily storing water in the landscape and regulating the flow of water and nutrients throughout a catchment (Jacobs 2016, Walsh et al. 2016). Surface ground cover measures are critical for protecting the soils against dispersion and erosion.
- Kalkallo Creek and tributaries – This waterway is in a degraded state and further increases in runoff could increase erosion. Significant engineering works are likely to be required to create a stable waterway that is resilient to stormwater runoff from surrounding future land development (construction of grade-control structures, geosynthetic clay liners / rock treatment of low-flow channels and where water spills into wetlands).
- Steeper slopes – Cutting into these slopes exposes underlying subsoils, and erosion risk is increased with slope. Road batters must be designed with consideration to the erodibility of the soils. Stable linings that are resistant to rainfall and runoff will be required.

The management of water flows over and through dispersive soils is a key tool in control of detrimental effects. Approaches may include:

a) Diversion of water flows away from these materials. This is not always an available option due to the wide extents, vertically and horizontally of these materials;

b) Minimising potential convergence and/or ponding of surface flows;

c) Compacting to minimise water movement through the material. The use of concave batter slopes without benching or contour banks has been shown to reduce the potential for convergence of water flows and to minimise flow velocities leading to gullying. However, it should be borne in mind that building extensive bank systems on dispersive soils can be problematic in themselves due to their surface erosion and tunnelling/piping potential;

d) Reducing the potential for undercut and piping failures for proposed road formations could be achieved by excavating interception trenches below and parallel with both sides of the formations. If these trenches are to carry large flows, then the use of agricultural pipes with appropriate granular backfill would be

appropriate, and where low flows are anticipated then the use of use appropriate granular porous backfill to the trench may be relevant; and

e) Reducing pore spaces by over compaction, and there-by reducing permeability, will reduce the potential for soil dispersion and piping developing. For road formation levels and any other areas stripped or in shallow excavations (culverts, utility ducts) consideration should be given to running plant over the surface a number of times or placing engineered fill. In the case of utility trenches, backfill material should be at least the same density as the material surrounding to minimise ponding, infiltration, leaching within the trench and around the ducting/piping.

Soil chemical ameliorants are recommended for short-term stabilisation of soils on construction sites. Three primary soil chemical ameliorants and their uses for stabilising dispersive soils on construction sites are:

- Gypsum ($CaSO_4$), primarily for stabilising dispersive topsoil or subsoil not intended for construction or geotechnical use. Gypsum flocculates soil and increases soil permeability, rendering materials less favourable for compaction and geotechnical use. Gypsum significantly reduces dispersion of clay and turbidity of runoff.
- Hydrated Lime ($Ca(OH)_2$). When slaked in water, hydrated lime stabilises soil cations by supply of calcium (reducing or eliminating dispersion and sodicity) and increases soil strength. Hydrated lime is the favoured soil chemical ameliorant for stabilisation of soils in civil and geotechnical works such as around pipes, structures, roads, trenches and any works requiring compaction upon reinstatement.
- Agricultural Lime ($CaCO_3$). Standard agricultural lime will provide minor soil stability however the solubility is low and immediate response is poor. Given that topsoils are acidic (pH water average 5.88) agricultural lime could be used to support improving plant growing conditions by adjustment of soil pH, however the affect on soil stability is expected to be low or negligible in the short term by comparison with gypsum.

Soil physical ameliorants are recommended for long-term structural stability of soils. Their effectiveness varies, depending on the nature of the ameliorant and how effective it is for protecting dispersive soils from direct contact with fresh water and erosion, or slowing down water flow. Examples of soil physical ameliorants and options include:

- Geotextile fabrics and mattings that provide sodic soil protection, shrouding and assist with plant establishment.
- Organic matter. Used as a protective shroud on topsoils, improving soil physical structure and biological condition. Hydro-mulching is a form of stabilisation using organic matter. Organic matter is not suitable for stabilisation of soils for civil or geotechnical works unless it is a final layer of protection used for shrouding.
- Seeding of sites to fast-growing species, or application of instant turfs.

DPIW (2008), Witheridge (2012), ICC (2016), SCA (1979) and others provide advice on options for reducing the risk of soil erosion during construction arising from development works on dispersive soils. Management options start with preservation and treatment of topsoil, with options variable depending on the level of disturbance (Table 5.2).

The stormwater drainage requirements of a site to be developed within the Precinct Area also needs to be appropriately incorporated into all stages of construction. This will require the development of temporary drainage control measures, separate to the sites' permanent drainage system. This will need to recognise the requirements and provide an appropriate drainage design for the diversion of up-slope "clean" water as opposed to the delivery of sediment-laden water generated within the construction site to sedimentation ponds. Appropriate hydrologic and hydraulic design is needed to size the drainage control measures for both the temporary and permanent drainage system (IECA 2008).

Table 5.2: Management options for reducing risk of erosion during construction for sodic and dispersive soils.

Management options	
Preservation and treatment of topsoil	§ Preservation of A-horizon topsoil should be used to shroud sodic and dispersive subsoil in all areas across the precinct. § Topsoils with sandy loam and sandy clay-loam textures have a greater resilience to erosion by comparison with finer textured clay-dominant subsoils. Topsoils are also easier to stabilise from dispersion and erosion. Reasons for this include: a) The sand fraction is angular and contains a range of particle sizes, providing lodgement and locking of particles and some resilience to dislodgement. b) Particle size and weight are far greater than clay and therefore they are less likely to become suspended and entrained in overland or concentrated flow of drainage water. c) The sand and silt fractions show little to nil chemical reaction with fresh water, unlike sodic and dispersive clay. d) The gypsum requirement for stabilising sand-dominant topsoils is significantly less than clay-dominant topsoil. § Gypsum treatment of all topsoils to minimise dispersion of any clay within topsoil or subsoil. Gypsum treatment of topsoil is a simple, fast and cost-effective solution that can be applied without use of specialised equipment.
Undisturbed sites	§ Maintenance of topsoil across undisturbed land, preferably with grasses to provide surface soil stability and root anchorage. § Maintenance of tree cover where trees exist. § Groundcover including a mix of grasses and larger shrubs and overstory vegetation is critical for slowing down overland flow and providing root anchorage of soil.
Disturbed sites – large scale surface disturbance	§ Minimise the amount of time land is exposed (e.g. by staging development). § Apply gypsum to all topsoils for improved stability. § Avoiding removal or disturbance to topsoil or vegetation until absolutely necessary. § Covering dispersive subsoils with a shroud of stabilised topsoil (100-150mm), should works cease for any period of time or prolonged rainfall be forecasted. § Consider using appropriately specified geotextile barriers and other engineering measures to protect disturbed areas particularly where there is minimal topsoil, or where steep slopes occur. § Re-vegetate exposed areas immediately after completion of earthworks, with specific emphasis on steep slopes. § Avoid construction techniques that result in exposure of dispersive subsoils. § Use alternatives to ‘cut and fill’ construction such as pier and pile foundations. § Use of interception trenches stabilised with topsoil to catch runoff in a controlled fashion and divert flow to sedimentation ponds to capture sediments. § Use of organic materials on finished surfaces to soften the impact of rainfall, filter runoff and aid the generation of seed or turf.
Disturbed sites – Trenching, culverts and drains	§ Where possible avoid the use of trenches for the construction of services i.e. water & power. § If trenches must be used, ensure that repacked spoil is properly compacted, treat with hydrated lime (subsurface treatment) and gypsum treat topsoils to limit dispersion and erosion. § Consider alternative trenching techniques that do not expose dispersive subsoils. i.e. use of trenchless technology installations of utilities/services such as horizontal directional drilling § Ensure runoff from hardstand areas is not discharged into areas with dispersive soils. § If necessary create safe areas for discharge of runoff. § If possible do not excavate culverts and drains in dispersive soils. § Following engineered design, consider placement of non-sodic soil to create appropriate road surfaces and drains without the need for excavation. § Ensure that culverts and drains excavated into dispersive subsoils are capped with non-dispersive topsoil, gypsum stabilised and vegetated.

The drainage schemes for the waterways, in particular Kalkallo Creek need to be designed with specific consideration to the erosion risks associated with sodic and dispersive soils . A high level of engineering will be required to create waterway corridors that are stable and can withstand the volume of water that will be generated from the developed areas. It is expected that all of the waterways will need to have a constructed form, with appropriate channel linings and/or armouring to provide protection for dispersive subsoils. Where possible, it is recommended that the waterway corridor includes distributed wetland and swales, to assist with attenuation and treatment of stormwater runoff.

It is recommended that further consideration is given to staging construction works, so as to manage erosion risks. In principle, it is better to work from top of catchment/higher areas in the landscape first and then progressively work downstream, but this may not be practical. Disturbances to high risk areas should be minimised, if not totally avoided, especially during the most erosive periods of the year (winter months). The development sequence should allow the installation of temporary drainage and erosion control measures, and preferably permanent stormwater drainage system as soon as practicable. As waterways are a high risk, if possible, it makes sense to start on these first and construct the drainage schemes and get the waterway corridors ready for the future developed land use. Runoff from construction sites should be managed by temporary drainage and sedimentation ponds, with the aim that it does not enter the waterway corridor until development is near completion.

6. Knowledge gaps and recommendations for further investigations

6.1 Knowledge gaps

To understand the distribution of sodic and dispersive soil conditions across the Beveridge North West Precinct, a grid-sampling pattern was proposed. Environmental conditions at the time forced Jacobs to abandon this method of sampling and collect samples at locations that were accessible by car and on foot, within the time constraints. Some properties could also not be sampled as permission to access was not granted. The scope of investigation was limited to 47 points across the precinct area. All soil results used for mapping are interpolated.

Ideally, to gain greater clarity around specific sodic and dispersive soil data from any set area, a gridded soil sampling approach should be maintained as the most appropriate method for gaining more accurate spatial data and provide greater accuracy within the area of the grid.

The spatial assessment undertaken in this investigation broadly considers surface erosion potential, however subsurface seepage and tunnel erosion impacts are difficult to relate with the data currently available. Processes of recharge and discharge are not well understood across the precinct area and are not represented in the spatial assessment.

6.2 Recommendations for further investigations

Recommendations for further investigation into sodic soil vulnerability and risks include:

- When environmental conditions permit access, carry out detailed survey of the site to improve the quality of mapping, better understand depth of the A-horizon topsoil, sodicity of the A and B horizons and define erosion risks and treatments.

It is recommended that detailed Site Environment Management Plans (SEMPs) and Erosion and Sediment Control Plans (ESCPs) are developed for managing sodic soil related erosion risks. These plans would be developed during the planning of building and construction projects within the Precinct Area. It is expected that further sampling of soils, testing and analysis of the sodicity of soils, dispersion and erosion potential will be required at a higher resolution to inform construction techniques and management of erosion risks.

It is recommended at a minimum that sodic soil management plans are a requirement at a subdivision / zone level, and at the individual block level. The subdivision level needs to be a detailed investigation with a report that covers all aspects of the subdivision, works to occur and management techniques to manage sodic and dispersive soil and erosion. The individual block level could simply be a set of requirements set by local council that ensure good soil management practices are mandated and sodic soil exposure and disturbances are minimised, with disturbed areas shrouded where possible.

It is recommended that further consideration is given to making an amendment to the Erosion Management Overlay in the Mitchell Planning Scheme[3]. The intent of this amendment would be that this considers more explicitly the potential impacts associated with development on sodic and dispersive soils and outline specific development objectives and requirements for parties that are proposing to develop areas that have these soils. It is noted that the current Erosion Management Overlay only extends over a very small portion of the Beveridge North West Precinct Area near the Western Boundary.

[3] https://planning-schemes.delwp.vic.gov.au/__data/assets/pdf_file/0008/485135/Mitchell_PS_Ordinance.pdf

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Appendix A. Soil Sampling and Analysis

A.1 Project scope

Jacobs and project partners South East Soil and Water were engaged by Victorian Planning Authority to complete additional soil sampling and analysis so as to obtain additional data on the sodicity of soils in the Beveridge North West Precinct.

Fieldwork was carried out by Peter Sandercock of Jacobs and Christian Bannan of South East Soil and Water on the 3rd and 4th of June 2020 following above-average rainfall conditions in the previous months of March, April and May.

It was proposed to sample soils using a gridded sampling program, with one sampling site per 10 Hectare. This plan changed when access for vehicles and coring equipment was limited to the fringes of gravel roads and compacted gateways where traction could be maintained. Foot traversing of parts of the site was also used to extend the boundaries of the sample area. Whilst we were unable to sample using a gridded approach, the extent of samples collected allowed for a suitable representation of the range of geological conditions for use in interpolating data and providing an indication of variability of soil characteristics across the Precinct.

The total number of sites inspected was 47 with the total number of samples collected recorded at 105. Figure A.1 provides an overview of the sampling sites. A Garmin 76CX handheld GPS was used to collect coordinates for each site. The breakdown of samples comprised of:

- 0-10cm samples: 47
- 30-40cm samples: 43
- Deeper samples from 40-150cm: 15

Figure A.1: Beveridge North West Sample Points June 2020.

A.2 Soil sampling and laboratory analysis

At each location, the soil profile was cored and a brief visual and textural classification of the soil profile was be completed, noting:

- depth of A horizon.
- quick / approximate hand texture of the A and B horizons
- Visual and Munsell colour of the A and B horizons
- Any other notes on soil physical characteristics defined by the assessor
- Photograph of the core or sample collected.

Samples will be collected from two depths, A horizon topsoil (0-10cm) and B horizon subsoil (30-40cm). Additional samples were also collected at greater depths at some locations (up to 1.5m).

Soil samples were dispatched to Nutrient Advantage (NA) Laboratories, Werribee, Victoria on the 5th of June with results received on 17th of June. NA are an ASPAC and NATA accredited laboratory. The following laboratory analysis were undertaken of the soil samples:

- Soil pH (water)
- Soil pH (CaCl2)
- Electrical Conductivity (1:5 soil water) (dS/m)
- Exchangeable Cations, including calcium, magnesium, potassium, sodium and aluminium (allowing calculation of ESP).

- Emerson Dispersion Class
- Loveday & Pyle Dispersion Score

A.3 Summary

Apart from sites with shallow soils over rock most common in the north-eastern section of the precinct area, soils are duplex, with sandy loam or sandy clay-loam topsoils (A horizons) of variable depth overlying sodic, clay-dominant subsoil. This pattern is consistent with other catchments to the north of Melbourne. This is a normal occurrence across Victorian soils with many areas of urban development located on sodic soil types (Ford et al, 1993). Soils across the precinct area follow patterns of occurrence that closely relate to their geology and geomorphology.

A number of tests were undertaken to identify sodic and dispersive soils, however in developing exposure criteria (refer to 3.2.1) we have chosen to base this on Exchangeable Sodium Percent (ESP), or 'sodicity' value (Ford et al. 1993, Isbell & NCST 2016). Exchangeable Sodium Percent (ESP) is the most common analytical technique used to identify sodic or potentially dispersive soils (DPIW 2008).

Of the 47 inspection sites accessed, sodicity results measured in terms of exchangeable sodium percentage (ESP) are summarised as follows:

- 1-10cm (A1 horizon topsoil): Average ESP of 4%. 41 of the 47 inspection points (87%) were deemed non-sodic while 6 inspection points (13%) were deemed sodic.
- 30-40cm (B horizon clay-dominant subsoil, sometimes a bleached A2 horizon topsoil above clay): Average ESP of 12.4%. Of the 43 samples collected from this depth, 34 samples were sodic (79%).
- Deeper samples collected from 40cm-1.5 metres: A total of 15 deeper samples were collected. All samples were sodic, with an average ESP of 24.7%.

Soils across the precinct area are broadly defined as evincing non-sodic, dispersive topsoil overlying sodic subsoil. Sodicity risks on development of the precinct area increase proportional to the depth of exposure or excavation. Examples of this were observed on the banks of the Kalkallo Creek, where erosion in excess of 1.0 metre of depth has occurred.

In general, the correlations between sodic soil conditions and Emerson dispersion were strong, but in some cases these correlations are not perfectly clear. In some cases an elevated EC level may be inhibiting dispersion, as observed in 5 of the 15 deep subsoil samples (Quirk & Schofield 1955). This is not an unusual outcome and is observed elsewhere on similar soils. We maintain that the measure of sodicity with reference to ESP values has been effective for inferring dispersive soil risks to erosion across the precinct.

A.4 Analytical results

Results from the laboratory were collated with additional information collected in the field. Results from the field and laboratory analysis of soils are also documented here in the following pages.

Table 7.1: Beveridge North West Field Sheet.

				Topsoil 0-10cm Sample						Subsoil 30-40cm Sample				
Site Name	Photo Collect	Easting	Northing	Lab Barcode	0-10cm Sample Collected	Depth of A Horizon (cm)	0-10cm Sample Texture	0-10cm Sample Visual Colour	0-10cm Sample Munsell Colour	Lab Barcode	30-40cm Samp Collected.	30-40cm Sample Texture	30-40cm Sample Visual Colour	30-40cm Sample Munsell Colour
BN1	YES	317768	5851907	22069159	Y	22	Sandy Clay Loam	Grey-Brown	7.5YR3/2	22065977	Y	Medium-Heavy Clay	Yellow-Grey-Brown	10YR4/3
BN2	YES	317555	5852053	22065979	Y	45	Sandy Loam	Dark Grey Brown	7.5YR3/1	22065978	Y	Sandy Loam	Grey	10YR6/2
BN3	YES	317945	5852313	22065981	Y	38	Sandy Loam	Dark Grey Brown	10YR3/2	22065982	Y	Sandy Loam	Grey	10YR5/2
BN4	YES	318236	5853000	22065983	Y	35	Light Sandy Clay Loam	Dark Grey Brown	7.5YR3/1	22068711	Y	Sandy Loam	Grey	7.5YR5/2
BN5	YES	317946	5853200	22068712	Y	45	Sandy Loam	Dark Grey Brown	7.5YR3/2	22068713	Y	Sandy Loam	Grey	10YR6/2
BN6	YES	317753	5853411	22068716	Y	27	Sandy Loam	Dark Grey Brown	10YR3/2	22068715	Y	Sandy Clay	Orange-Grey-Brown	10YR5/4
BN7	YES	318800	5853059	22068718	Y	42	Sandy Loam	Dark Grey Brown	7.5YR4/3	22068719	Y	Sandy Loam	Grey	7.5YR6/2
BN8	YES	318929	5853032	22068720	Y	60	Sandy Loam	Dark Grey Brown	10YR3/1	22068721	Y	Sandy Loam	Grey	10YR6/2
BN9	YES	319192	5853002	22067935	Y	75	Sandy Loam	Grey-Brown	7.5YR4/3	22067934	Y	Sandy Loam	Grey	10YR5/3
BN10	YES	319194	5852855	22067937	Y	39	Sandy Clay Loam	Dark Grey Brown	10YR3/2	22067936	Y	Sandy Loam	Grey	10YR5/3
BN11	YES	319183	5852580	22067939	Y	22	Sandy Clay Loam	Dark Grey Brown	10YR3/2	22067940	Y	Sandy Clay	Orange-Grey-Brown	10YR4/3
BN12	YES	319125	5852322	22067941	Y	18	Sandy Clay Loam	Dark Grey Brown	10YR3/2	22067942	Y	Medium Clay	Yellow-Grey-Brown	10YR4/2
BN13	YES	319123	5852054	22067944	Y	16	Clay Loam	Dark Grey Brown	10YR3/2	22067945	Y	Medium Clay	Yellow-Grey-Brown	10YR4/3
BN14	YES	319057	5851767	22067957	Y	14	Clay Loam	Dark Grey Brown	10YR3/1	22067956	Y	Medium-Heavy Clay	Dark Grey	10YR4/2
BN15	YES	318906	5851403	22067958	Y	15	Clay Loam	Dark Grey Brown	10YR3/2	22069085	Y	Heavy Clay	Yellow-Grey-Brown	10YR4/2
BN16	YES	319497	5853471	22069086	Y	17	Sandy Clay Loam	Dark Grey Brown	10YR3/2	22069087	Y	Medium-Heavy Clay	Yellow-Grey-Brown	10YR4/2
BN17	YES	319095	5853612	22069088	Y	70	Sandy Loam	Grey-Brown	7.5YR3/2	22069089	Y	Sandy Loam	Grey	10YR5/2
BN18	YES	319392	5854420	22069094	Y	28	Sandy Clay Loam	Grey-Brown	10YR3/2	22069095	Y	Medium Clay	Yellow-Brown	10YR5/8
BN19	YES	320220	5854503	22069093	Y	15	Light Sandy Clay Loam	Grey-Brown	7.5YR3/2	22069091	Y	Medium-Heavy Clay	Dark Grey	10YR4/2
BN20	YES	321049	5854404	22069092	Y	10	Sandy Loam	Grey-Brown	7.5YR4/3					
BN21	YES	320517	5854463	22069096	Y	10	Sandy Loam	Brown	7.5YR4/3					
BN22	YES	317552	5854723	22069098	Y	20	Sandy Loam	Dark Brown	7.5YR4/2	22069097	Y	Medium Clay	Yellow-Brown	10YR6/6
BN23	YES	317244	5853644	22069099	Y	35	Sandy Loam	Dark Brown	7.5YR4/3	22069100	Y	Sandy Clay	Yellow-Brown	10YR5/4
BN24	YES	316742	5852102	22069101	Y	35	Sandy Loam	Grey-Brown	7.5YR4/3	22069102	Y	Medium Clay	Yellow-Brown	7.5YR5/8
BN25	YES	319669	5853204	22069104	Y	15	Sandy Loam	Brown	7.5YR4/4					
BN26	YES	319865	5853299	22069105	Y	25	Clay Loam	Dark Grey Brown	10YR3/2	22069103	Y	Light Clay	Grey	10YR4/3
BN27	YES	320291	5853238	22069107	Y	28	Sandy Clay Loam	Dark Grey Brown	10YR3/2	22069108	Y	Clay Loam	Dark Grey Brown	10YR3/1
BN28	YES	320793	5853234	22069110	Y	10	Light-Medium Clay	Dark Grey Brown	10YR3/2	22069111	Y	Heavy Clay	Dark Grey Brown	10YR3/1
BN29	YES	321202	5853808	22069112	Y	25	Clay Loam	Dark Grey Brown	10YR3/2	22069113	Y	Heavy Clay	Dark Grey	10YR3/1
BN30	YES	319932	5851267	22069115	Y	20	Clay Loam	Dark Grey	10YR3/2	22069114	Y	Medium-Heavy Clay	Dark Grey	10YR2-1
BN31	YES	319124	5851362	22069116	Y	15	Clay Loam	Dark Grey	10YR3/2	22069117	Y	Medium-Heavy Clay	Dark Grey Brown	10YR4/2
BN32	YES	317818	5851532	22069118	Y	30	Clay Loam	Dark Grey	10YR3/2	22069119	Y	Heavy Clay	Yellow Grey	10YR4/3
BN33	YES	317168	5851745	22069120	Y	35	Sandy Loam	Dark Grey Brown	7.5YR3/2	22069121	Y	Medium-Heavy Clay	Orange Grey	10YR5/2
BN34	YES	318783	5853696	22069122	Y	15	Loam	Grey-Brown	7.5YR3/2					
BN35	YES	318809	5854041	22069123	Y	40	Sandy Loam	Dark Grey Brown	7.5YR4/3	22069124	Y	Sandy Loam	Grey-Brown	7.5YR5/3
BN36	YES	318265	5854135	22069125	Y	60	Loam	Grey-Brown	7.5YR3/2	22069126	Y	Sandy Loam	Grey	7.5YR6/2
BN37	YES	318300	5853672	22069128	Y	60+	Sandy Loam	Brown	7.5YR4/3	22069129	Y	Sandy Loam	Grey	7.5YR6/2
BN38	YES	318785	5853376	22069130	Y	60	Sandy Loam	Brown	7.5YR4/3	22069131	Y	Sandy Loam	Grey	7.5YR5/2
BN39	YES	317839	5853517	22069133	Y	60	Sandy Loam	Dark Brown	7.5YR4/4	22069134	Y	Sandy Loam	Grey-Brown	7.5YR6/2
BN40	YES	318127	5853058	22068823	Y	45	Sandy Loam	Dark Brown	7.5YR4/3	22068824	Y	Sandy Loam	Grey	7.5YR6/2
BN41	YES	317965	5852645	22069132	Y	40	Loam	Grey-Brown	10YR4/3	22068826	Y	Loam	Grey-Brown	10YR6/2
BN42	YES	317942	5851913	22068830	Y	25	Loam	Dark Grey Brown	10YR3/2	22068831	Y	Medium-Heavy Clay	Dark Grey Brown	10YR3/1
BN43	YES	317491	5851606	22068828	Y	50+	Sandy Loam	Yellow-Brown	10YR6/4	22068829	Y	Sandy Loam	Grey-Brown	10YR5/2
BN44	YES	317679	5854133	22068832	Y	30	Sandy Loam	Dark Grey Brown	10YR3/2	22068835	Y	Medium Clay	Orange Brown	7.5YR6/8
BN45	YES	317572	5853739	22068834	Y	110	Sandy Loam	Brown	7.5YR4/4	22068833	Y	Sandy Loam	Light Brown	10YR6/3
BN46	YES	317315	5853731	22068837	Y	60+	Sandy Loam	Brown	7.5YR5/4	22068838	Y	Sandy Loam	Grey	10YR7/2
BN47	YES	317397	5854088	22068839	Y	50	Sandy Loam	Brown	7.5YR4/4	22068840	Y	Sandy Loam	Grey	10YR6/1

Table A.1: Beveridge North West Field Sheet (Continued).

	Deeper Sample below 40cm						
Site Name	Lab Barcode	Deep Sample Collected	Deep Sample Depth	Deep Sample Texture	Deep Sample Visual Colour	Deep Sample Munsell Colour	Notes
BN1							
BN2	22065980	Y	140-150	Medium-Heavy Clay	Yellow-Grey-Brown	10YR4/3	
BN3							
BN4							
BN5	22068714	Y	140-150	Light-Medium Clay	Yellow-Grey-Brown	10YR5/4	
BN6							
BN7							
BN8							
BN9	22068717	Y	140-150	Medium-Heavy Clay	Orange Brown	10YR5/6	
BN10	22067939	Y	90-100	Heavy Clay	Yellow-Grey-Brown	10YR5/4	
BN11							Hit basalt rock at 40-60cm
BN12	22067943	Y	140-150	Medium Clay	Yellow-Brown	2.5Y5/3	
BN13							
BN14	22067946	Y	140-150	Medium Clay	Yellow-Brown	2.5Y5/3	
BN15							Hit basalt rock at 50cm
BN16							
BN17	22069090	Y	140-150	Medium Clay	Dark Grey	10YR4/3	
BN18							
BN19							Hit basalt rock at 50cm
BN20							Soil is shallow overlying basalt.
BN21							
BN22							Shallow soil over sandstone
BN23							
BN24							
BN25							Hit basalt rock at 15cm.
BN26	22069106	Y	80-90	Heavy Clay	Yellow-Grey-Brown	10YR5/3	Hit basalt rock at 90cm.
BN27	22069109	Y	80-90	Heavy Clay	Grey	10YR5/2	
BN28							
BN29							
BN30							Basalt rock at 45cm, water flowing into core hole.
BN31							High percentage of basalt from 0-10cm. Topsoil may be fill. A horizon is saturated above clay subsoil.
BN32							Bleached A2 horizon buckshot spew layer from 15-30cm, water flowing into auger hole.
BN33							Topsoil Sandy Loam, bleached A2 horizon from 15-35cm, water flowing into auger hole.
BN34							Topsoil Sandy Clay Loam, Bleached A2 horizon from 15-25cm over basalt.
BN35							A2 horizon contains sandstone, gravel and buckshot at 40cm, A2 horizon is bleached.
BN36	22069127	Y	60-70	Medium Clay	Yellow-Grey-Brown	7.5YR6/6	Bleached A2 horizon spew layer from 20-60cm, good representative profile to describe ESP on duplex profiles.
BN37							B1 horizon not reached. A2 horizon is a bleached layer.
BN38							Bleached A2 horizon from 20-60cm, sandstone gravel at 50-60cm.
BN39	22068822	Y	60-70	Medium Clay	Yellow-Grey-Brown	10YR5/4	Bleached A2 horizon above clay subsoil.
BN40	22068825	Y	50-60	Sandy Clay	Yellow-Grey-Brown	10YR4/3	
BN41	22068827	Y	50-60	Medium Clay	Grey Brown	10YR4/2	
BN42							Minor pale bleached A2 horizon from 10-25cm.
BN43							Topsoil is deeper than 50cm, the A2 horizon is the original topsoil.
BN44							
BN45	22068836	Y	120-130	Gravelly Clay	Yellow-Grey-Brown	10YR5/6	Deep layer sampled is gravelly clay, strong bleached A2 horizon from 70-110cm.
BN46							
BN47	22068841	Y	60-70	Medium-Heavy Clay	Yellow Brown	10YR5/6	Strong bleached A2 horizon above clay subsoil.

Table 7.2: Beveridge North West 0-10cm Sample Analytical Results.

Sample ID	Site	Sample Name	Sample Start Depth	Sample End Depth	Zone	GPS Easting	GPS Northing	Texture	pH (1:5 Water)	pH (1:5 CaCl2)
			cm	cm				SESW Field Classification		
22069159	BN1	BN1. 0-10	0	10	55H	317768	5851907	Sandy Clay Loam	6.10	5.20
22065979	BN2	BN2. 0-10	0	10	55H	317555	5852053	Sandy Loam	6.10	5.40
22065981	BN3	BN3. 0-10	0	10	55H	317945	5852313	Sandy Loam	5.70	4.90
22065983	BN4	BN4. 0-10	0	10	55H	318236	5853000	Light Sandy Clay Loam	5.70	4.70
22068712	BN5	BN5. 0-10	0	10	55H	317946	5853200	Sandy Loam	5.40	4.50
22068716	BN6	BN6. 0-10	0	10	55H	317753	5853411	Sandy Loam	5.80	4.90
22068718	BN7	BN7. 0-10	0	10	55H	318800	5853059	Sandy Loam	5.80	5.00
22068720	BN8	BN8. 0-10	0	10	55H	318929	5853032	Sandy Loam	5.40	4.50
22067935	BN9	BN9. 0-10	0	10	55H	319192	5853002	Sandy Loam	5.50	4.60
22067937	BN10	BN10. 0-10	0	10	55H	319194	5852855	Sandy Clay Loam	5.80	5.10
22067938	BN11	BN11. 0-10	0	10	55H	319183	5852580	Sandy Clay Loam	6.20	5.30
22067941	BN12	BN12. 0-10	0	10	55H	319125	5852322	Sandy Clay Loam	6.30	5.50
22067944	BN13	BN13. 0-10	0	10	55H	319123	5852054	Clay Loam	6.40	5.40
22067957	BN14	BN14. 0-10	0	10	55H	319057	5851767	Clay Loam	6.20	5.40
22067958	BN15	BN15. 0-10	0	10	55H	318906	5851403	Clay Loam	6.00	4.80
22069086	BN16	BN16. 0-10	0	10	55H	319497	5853471	Sandy Clay Loam	8.00	7.00
22069088	BN17	BN17. 0-10	0	10	55H	319095	5853612	Sandy Loam	7.20	6.30
22069094	BN18	BN18. 0-10	0	10	55H	319392	5854420	Sandy Clay Loam	7.50	6.50
22069093	BN19	BN19. 0-10	0	10	55H	320220	5854503	Light Sandy Clay Loam	6.10	5.20
22069092	BN20	BN20. 0-10	0	10	55H	321049	5854404	Sandy Loam	5.90	4.90
22069096	BN21	BN21. 0-10	0	10	55H	320517	5854463	Sandy Loam	6.00	5.20
22069098	BN22	BN22. 0-10	0	10	55H	317552	5854723	Sandy Loam	5.40	4.60
22069099	BN23	BN23. 0-10	0	10	55H	317244	5853644	Sandy Loam	5.50	4.60
22069101	BN24	BN24. 0-10	0	10	55H	316742	5852102	Sandy Loam	6.40	5.50
22069104	BN25	BN25. 0-10	0	10	55H	319669	5853204	Sandy Loam	6.10	5.20
22069105	BN26	BN26. 0-10	0	10	55H	319865	5853299	Clay Loam	5.60	4.80
22069107	BN27	BN27. 0-10	0	10	55H	320291	5853238	Sandy Clay Loam	6.20	5.50
22069110	BN28	BN28. 0-10	0	10	55H	320793	5853234	Light-Medium Clay	5.90	5.20
22069112	BN29	BN29. 0-10	0	10	55H	321202	5853808	Clay Loam	5.90	5.00
22069115	BN30	BN30. 0-10	0	10	55H	319932	5851267	Clay Loam	5.60	4.70
22069116	BN31	BN31. 0-10	0	10	55H	319124	5851362	Clay Loam	6.30	5.70
22069118	BN32	BN32. 0-10	0	10	55H	317818	5851532	Clay Loam	6.10	5.20
22069120	BN33	BN33. 0-10	0	10	55H	317168	5851745	Sandy Loam	5.70	4.90
22069122	BN34	BN34. 0-10	0	10	55H	318783	5853696	Loam	5.80	4.80
22069123	BN35	BN35. 0-10	0	10	55H	318809	5854041	Sandy Loam	4.90	4.30
22069125	BN36	BN36. 0-10	0	10	55H	318265	5854135	Loam	5.60	4.70
22069128	BN37	BN37. 0-10	0	10	55H	318300	5853672	Sandy Loam	5.40	4.40
22069130	BN38	BN38. 0-10	0	10	55H	318785	5853376	Sandy Loam	5.30	4.50
22069133	BN39	BN39. 0-10	0	10	55H	317839	5853517	Sandy Loam	5.20	4.20
22068823	BN40	BN40. 0-10	0	10	55H	318127	5853058	Sandy Loam	5.60	4.60
22069132	BN41	BN41. 0-10	0	10	55H	317965	5852645	Loam	6.20	4.80
22068830	BN42	BN42. 0-10	0	10	55H	317942	5851913	Loam	6.20	5.40
22068828	BN43	BN43. 0-10	0	10	55H	317491	5851606	Sandy Loam	5.70	4.60
22068832	BN44	BN44. 0-10	0	10	55H	317679	5854133	Sandy Loam	5.40	4.70
22068834	BN45	BN45. 0-10	0	10	55H	317572	5853739	Sandy Loam	4.80	4.00
22068837	BN46	BN46. 0-10	0	10	55H	317315	5853731	Sandy Loam	5.00	4.10
22068839	BN47	BN47. 0-10	0	10	55H	317397	5854088	Sandy Loam	5.30	4.30

Table A.2: Beveridge North West 0-10cm Sample Analytical Results (Continued).

Sample ID	Site	Sample Name	Electrical Conductivity (1:5 water)	Exchangeable Sodium Percentage	Emerson Class	Disp. Index, Loveday/Pyle	Slaking 2Hrs
			dS/m	%			
22069159	BN1	BN1. 0-10	0.09	2.6	7	6	Partial
22065979	BN2	BN2. 0-10	0.16	1.1	3	0	Water Stable
22065981	BN3	BN3. 0-10	0.07	2.2	7	1	Water Stable
22065983	BN4	BN4. 0-10	0.06	3.2	3	1	Water Stable
22068712	BN5	BN5. 0-10	0.10	4.3	3	1	Water Stable
22068716	BN6	BN6. 0-10	0.08	2.3	8	2	Water Stable
22068718	BN7	BN7. 0-10	0.12	3.0	8	4	Partial
22068720	BN8	BN8. 0-10	0.07	4.3	3	1	Water Stable
22067935	BN9	BN9. 0-10	0.08	6.3	8	1	Water Stable
22067937	BN10	BN10. 0-10	0.24	4.0	8	2	Water Stable
22067938	BN11	BN11. 0-10	0.17	3.8	8	5	Partial
22067941	BN12	BN12. 0-10	0.16	4.2	2	9	Partial
22067944	BN13	BN13. 0-10	0.12	7.1	8	6	Partial
22067957	BN14	BN14. 0-10	0.18	4.5	8	4	Partial
22067958	BN15	BN15. 0-10	0.05	2.4	2	4	Partial
22069086	BN16	BN16. 0-10	0.38	23.0	8	9	Partial
22069088	BN17	BN17. 0-10	0.14	7.3	2	4	Water Stable
22069094	BN18	BN18. 0-10	0.13	8.3	8	6	Water Stable
22069093	BN19	BN19. 0-10	0.14	1.8	7	4	Partial
22069092	BN20	BN20. 0-10	0.05	1.8	7	1	Water Stable
22069096	BN21	BN21. 0-10	0.08	1.5	7	2	Water Stable
22069098	BN22	BN22. 0-10	0.12	3.5	7	1	Water Stable
22069099	BN23	BN23. 0-10	0.05	2.6	2	4	Partial
22069101	BN24	BN24. 0-10	0.10	2.3	3	1	Water Stable
22069104	BN25	BN25. 0-10	0.07	1.0	3	3	Partial
22069105	BN26	BN26. 0-10	0.13	3.9	7	1	Water Stable
22069107	BN27	BN27. 0-10	0.12	1.7	2	6	Water Stable
22069110	BN28	BN28. 0-10	0.13	2.3	2	5	Partial
22069112	BN29	BN29. 0-10	0.09	2.5	8	3	Partial
22069115	BN30	BN30. 0-10	0.07	2.3	2	3	Water Stable
22069116	BN31	BN31. 0-10	0.14	1.0	2	3	Partial
22069118	BN32	BN32. 0-10	0.09	3.8	2	3	Partial
22069120	BN33	BN33. 0-10	0.13	3.7	3	1	Partial
22069122	BN34	BN34. 0-10	0.08	2.7	2	2	Water Stable
22069123	BN35	BN35. 0-10	0.15	2.4	6	0	Water Stable
22069125	BN36	BN36. 0-10	0.11	2.9	8	1	Water Stable
22069128	BN37	BN37. 0-10	0.06	5.3	3	4	Partial
22069130	BN38	BN38. 0-10	0.14	5.4	7	0	Water Stable
22069133	BN39	BN39. 0-10	0.05	2.6	8	2	Water Stable
22068823	BN40	BN40. 0-10	0.07	4.2	7	2	Water Stable
22069132	BN41	BN41. 0-10	0.03	6.9	8	12	Partial
22068830	BN42	BN42. 0-10	0.10	2.6	2	0	Water Stable
22068828	BN43	BN43. 0-10	0.06	4.7	7	5	Water Stable
22068832	BN44	BN44. 0-10	0.17	3.8	8	0	Water Stable
22068834	BN45	BN45. 0-10	0.06	5.7	7	2	Water Stable
22068837	BN46	BN46. 0-10	0.05	5.4	7	2	Water Stable
22068839	BN47	BN47. 0-10	0.07	5.5	7	10	Water Stable

Exchangeable Sodium Percentage (ESP) Interpretation

Colour	ESP Range	Interpretation
	<6%.	Non-sodic.
	6-10%.	Moderately Sodic
	10.1-15.0%	Strongly Sodic
	>15.1%	Very Strongly Sodic

Emerson Dispersion Class Interpretation.

Colour	Emerson Class	Interpretation
	4, 5, 6, 7, 8	Non-dispersive.
	3	Partial Dispersion after remoulding
	2	Partial Dispersion
	1	Complete Dispersion

Loveday & Pyle (L&P) Score Interpretation.

Colour	L&P Score	Interpretation
	1, 2, 3, 4	Low to moderate. Nil to slight gypsum resonse expected where dispersive.
	5, 6, 7, 8	Moderate to high. Gypsum response expected to control dispersion.
	9, 10, 11, 12	High. Gypsum response expected to control dispersion. High rates required.
	13, 14, 15, 16	Very high. Very high rates required to control dispersion.

Slaking Class Interpretation.

Colour	Slaking Class	Interpretation
	Water Stable	Aggregate stable when wetted, nil or minimal breakdown in structure.
	Partial	Low aggregate stability. Partial breakdown in structure when wetted.
	Considerable	Unstable. High or significant loss of structure when wetted.

Table A.2: Beveridge North West 0-10cm Sample Analytical Results (Continued).

Sample ID	Site	Sample Name	Calcium (Amm-acet.)	Magnesium (Amm-acet.)	Available Potassium	Sodium (Amm-acet.)	Aluminium (KCl)	Calcium (Amm-acet.)	Magnesium (Amm-acet.)	Potassium (Amm-acet.)	Sodium (Amm-acet.)	Aluminium (KCl)	Cation Exch. Cap.	Calcium (Amm-acet.)	Magnesium (Amm-acet.)	Potassium (Amm-acet.)	Aluminium Saturation
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	%	%	%	%
22069159	BN1	BN1. 0-10	1120	569	300	67	<9.0	5.6	4.7	0.77	0.29	<0.1	11.3	49	41	6.8	<1.0
22065979	BN2	BN2. 0-10	1620	436	370	32	<9.0	8.1	3.6	0.95	0.14	<0.1	12.9	63	28	7.4	<1.0
22065981	BN3	BN3. 0-10	1000	194	96	35	<9.0	5	1.6	0.25	0.15	<0.1	7	72	22	3.5	<1.0
22065983	BN4	BN4. 0-10	880	169	61	46	14	4.4	1.4	0.16	0.2	0.2	6.3	70	22	2.5	2.4
22068712	BN5	BN5. 0-10	680	109	170	51	15	3.4	0.9	0.44	0.22	0.2	5.2	66	18	8.6	3.3
22068716	BN6	BN6. 0-10	980	194	95	37	<9.0	4.9	1.6	0.24	0.16	<0.1	6.9	71	23	3.5	<1.0
22068718	BN7	BN7. 0-10	840	375	320	60	10	4.2	3.1	0.81	0.26	0.1	8.5	49	37	9.6	1.3
22068720	BN8	BN8. 0-10	800	194	61	62	19	4	1.6	0.16	0.27	0.2	6.2	65	25	2.5	3.4
22067935	BN9	BN9. 0-10	780	145	61	85	23	3.9	1.2	0.16	0.37	0.3	5.9	66	21	2.7	4.4
22067937	BN10	BN10. 0-10	940	460	720	99	<9.0	4.7	3.8	1.8	0.43	<0.1	10.8	44	35	17	<1.0
22067938	BN11	BN11. 0-10	1420	653	880	136	<9.0	7.1	5.4	2.3	0.59	<0.1	15.3	46	35	15	<1.0
22067941	BN12	BN12. 0-10	1360	968	910	175	<9.0	6.8	8	2.3	0.76	<0.1	17.9	38	45	13	<1.0
22067944	BN13	BN13. 0-10	1380	738	460	253	<9.0	6.9	6.1	1.2	1.1	<0.1	15.3	45	40	7.6	<1.0
22067957	BN14	BN14. 0-10	2000	1089	490	223	<9.0	10	9	1.3	0.97	<0.1	21.5	48	42	5.8	<1.0
22067958	BN15	BN15. 0-10	1280	1150	140	94	25	6.4	9.5	0.35	0.41	0.3	17	38	56	2	1.6
22069086	BN16	BN16. 0-10	800	774	270	759	<9.0	4	6.4	0.69	3.3	<0.1	14.4	28	44	4.8	<1.0
22069088	BN17	BN17. 0-10	2000	678	490	299	<9.0	10	5.6	1.2	1.3	<0.1	18.5	56	30	6.7	<1.0
22069094	BN18	BN18. 0-10	1660	375	160	253	<9.0	8.3	3.1	0.4	1.1	<0.1	12.8	65	24	3.1	<1.0
22069093	BN19	BN19. 0-10	1780	520	720	62	<9.0	8.9	4.3	1.8	0.27	<0.1	15.3	58	28	12	<1.0
22069092	BN20	BN20. 0-10	1140	545	73	44	<9.0	5.7	4.5	0.19	0.19	<0.1	10.6	53	43	1.8	<1.0
22069096	BN21	BN21. 0-10	1020	133	310	25	<9.0	5.1	1.1	0.79	0.11	<0.1	7.2	72	16	11	<1.0
22069098	BN22	BN22. 0-10	840	145	210	53	38	4.2	1.2	0.53	0.23	0.4	6.5	64	18	8.1	6.5
22069099	BN23	BN23. 0-10	620	109	45	25	15	3.1	0.9	0.12	0.11	0.2	4.4	70	21	2.6	3.8
22069101	BN24	BN24. 0-10	1200	157	360	44	<9.0	6	1.3	0.92	0.19	<0.1	8.4	71	15	11	<1.0
22069104	BN25	BN25. 0-10	1460	411	270	28	<9.0	7.3	3.4	0.7	0.12	<0.1	11.5	63	29	6	<1.0
22069105	BN26	BN26. 0-10	1140	641	350	113	10	5.7	5.3	0.9	0.49	0.1	12.5	45	42	7.2	0.9
22069107	BN27	BN27. 0-10	1540	545	510	53	<9.0	7.7	4.5	1.3	0.23	<0.1	13.7	57	33	9.4	<1.0
22069110	BN28	BN28. 0-10	2200	1331	490	124	<9.0	11	11	1.3	0.54	<0.1	23.3	46	46	5.4	<1.0
22069112	BN29	BN29. 0-10	1540	968	150	92	<9.0	7.7	8	0.38	0.4	<0.1	16.4	47	48	2.3	<1.0
22069115	BN30	BN30. 0-10	1120	823	200	69	16	5.6	6.8	0.5	0.3	0.2	13.3	42	51	3.8	1.4
22069116	BN31	BN31. 0-10	2600	835	380	48	<9.0	13	6.9	0.97	0.21	<0.1	20.6	61	33	4.7	<1.0
22069118	BN32	BN32. 0-10	1540	436	100	106	<9.0	7.7	3.6	0.26	0.46	<0.1	12	64	30	2.2	<1.0
22069120	BN33	BN33. 0-10	1060	218	180	67	<9.0	5.3	1.8	0.47	0.29	<0.1	7.8	68	22	6	<1.0
22069122	BN34	BN34. 0-10	880	157	70	37	<9.0	4.4	1.3	0.18	0.16	<0.1	6	73	21	3	<1.0
22069123	BN35	BN35. 0-10	620	157	200	32	88	3.1	1.3	0.51	0.14	1	6.1	51	22	8.5	16
22069125	BN36	BN36. 0-10	680	169	140	37	13	3.4	1.4	0.37	0.16	0.1	5.5	62	26	6.7	2.6
22069128	BN37	BN37. 0-10	540	133	76	55	28	2.7	1.1	0.19	0.24	0.3	4.6	60	24	4.2	6.9
22069130	BN38	BN38. 0-10	880	242	230	97	28	4.4	2	0.58	0.42	0.3	7.7	57	26	7.5	4
22069133	BN39	BN39. 0-10	360	169	98	25	54	1.8	1.4	0.25	0.11	0.6	4.2	43	35	6	14
22068823	BN40	BN40. 0-10	720	363	180	74	15	3.6	3	0.45	0.32	0.2	7.5	48	40	6	2.2
22069132	BN41	BN41. 0-10	240	218	46	55	11	1.2	1.8	0.12	0.24	0.1	3.5	34	53	3.4	3.4
22068830	BN42	BN42. 0-10	1820	387	170	81	<9.0	9.1	3.2	0.44	0.35	<0.1	13.1	70	25	3.4	<1.0
22068828	BN43	BN43. 0-10	360	315	110	55	9.7	1.8	2.6	0.28	0.24	0.1	5	36	52	5.5	2.2
22068832	BN44	BN44. 0-10	1080	303	230	78	12	5.4	2.5	0.6	0.34	0.1	9	60	28	6.7	1.5
22068834	BN45	BN45. 0-10	160	85	74	39	99	0.8	0.7	0.19	0.17	1.1	3	27	23	6.4	37
22068837	BN46	BN46. 0-10	280	133	100	41	41	1.4	1.1	0.26	0.18	0.5	3.4	41	32	7.7	14
22068839	BN47	BN47. 0-10	380	206	44	55	44	1.9	1.7	0.11	0.24	0.5	4.4	42	39	2.6	11

Table A.2: Beveridge North West 0-10cm Sample Analytical Results (Continued).

Sample ID	Site	Sample Name	Calcium/Magnesium Ratio	ESP% + EPP% Calculation SESW Calculation
22069159	BN1	BN1. 0-10	1.2	9.4
22065979	BN2	BN2. 0-10	2.3	8.5
22065981	BN3	BN3. 0-10	3.1	5.7
22065983	BN4	BN4. 0-10	3.1	5.7
22068712	BN5	BN5. 0-10	3.7	12.9
22068716	BN6	BN6. 0-10	3.1	5.8
22068718	BN7	BN7. 0-10	1.4	12.6
22068720	BN8	BN8. 0-10	2.5	6.8
22067935	BN9	BN9. 0-10	3.3	9.0
22067937	BN10	BN10. 0-10	1.2	21.0
22067938	BN11	BN11. 0-10	1.3	18.8
22067941	BN12	BN12. 0-10	0.9	17.2
22067944	BN13	BN13. 0-10	1.1	14.7
22067957	BN14	BN14. 0-10	1.1	10.3
22067958	BN15	BN15. 0-10	0.7	4.4
22069086	BN16	BN16. 0-10	0.6	27.8
22069088	BN17	BN17. 0-10	1.8	14.0
22069094	BN18	BN18. 0-10	2.7	11.4
22069093	BN19	BN19. 0-10	2.1	13.8
22069092	BN20	BN20. 0-10	1.3	3.6
22069096	BN21	BN21. 0-10	4.6	12.5
22069098	BN22	BN22. 0-10	3.5	11.6
22069099	BN23	BN23. 0-10	3.4	5.2
22069101	BN24	BN24. 0-10	4.6	13.3
22069104	BN25	BN25. 0-10	2.1	7.0
22069105	BN26	BN26. 0-10	1.1	11.1
22069107	BN27	BN27. 0-10	1.7	11.1
22069110	BN28	BN28. 0-10	1	7.7
22069112	BN29	BN29. 0-10	1	4.8
22069115	BN30	BN30. 0-10	0.8	6.1
22069116	BN31	BN31. 0-10	1.9	5.7
22069118	BN32	BN32. 0-10	2.1	6.0
22069120	BN33	BN33. 0-10	2.9	9.7
22069122	BN34	BN34. 0-10	3.4	5.7
22069123	BN35	BN35. 0-10	2.4	10.9
22069125	BN36	BN36. 0-10	2.4	9.6
22069128	BN37	BN37. 0-10	2.5	9.5
22069130	BN38	BN38. 0-10	2.2	12.9
22069133	BN39	BN39. 0-10	1.3	8.6
22068823	BN40	BN40. 0-10	1.2	10.2
22069132	BN41	BN41. 0-10	0.7	10.3
22068830	BN42	BN42. 0-10	2.8	6.0
22068828	BN43	BN43. 0-10	0.7	10.2
22068832	BN44	BN44. 0-10	2.2	10.5
22068834	BN45	BN45. 0-10	1.2	12.1
22068837	BN46	BN46. 0-10	1.3	13.1
22068839	BN47	BN47. 0-10	1.1	8.1

Table 7.3: Beveridge North West 30-40cm Sample Analytical Results.

Sample ID	Site	Sample Name	Sample Start Depth	Sample End Depth	Zone	GPS Easting	GPS Northing	Texture	pH (1:5 Water)	pH (1:5 CaCl2)
			cm	cm				SESW Field Classification		
22065977	BN1	BN1. 30-40	30	40	55H	317768	5851907	Medium-Heavy Clay	6.80	5.40
22065978	BN2	BN2. 30-40	30	40	55H	317555	5852053	Sandy Loam	7.30	6.30
22065982	BN3	BN3. 30-40	30	40	55H	317945	5852313	Sandy Loam	6.30	5.30
22068711	BN4	BN4. 30-40	30	40	55H	318236	5853000	Sandy Loam	5.80	4.60
22068713	BN5	BN5. 30-40	30	40	55H	317946	5853200	Sandy Loam	6.10	5.00
22068715	BN6	BN6. 30-40	30	40	55H	317753	5853411	Sandy Clay	6.10	4.70
22068719	BN7	BN7. 30-40	30	40	55H	318800	5853059	Sandy Loam	6.30	5.10
22068721	BN8	BN8. 30-40	30	40	55H	318929	5853032	Sandy Loam	6.00	4.90
22067934	BN9	BN9. 30-40	30	40	55H	319192	5853002	Sandy Loam	6.50	5.10
22067936	BN10	BN10. 30-40	30	40	55H	319194	5852855	Sandy Loam	6.30	5.40
22067940	BN11	BN11. 30-40	30	40	55H	319183	5852580	Sandy Clay	6.40	5.40
22067942	BN12	BN12. 30-40	30	40	55H	319125	5852322	Medium Clay	6.00	4.80
22067945	BN13	BN13. 30-40	30	40	55H	319123	5852054	Medium Clay	6.20	5.40
22067956	BN14	BN14. 30-40	30	40	55H	319057	5851767	Medium-Heavy Clay	6.30	5.20
22069085	BN15	BN15. 30-40	30	40	55H	318906	5851403	Heavy Clay	6.50	5.40
22069087	BN16	BN16. 30-40	30	40	55H	319497	5853471	Medium-Heavy Clay	6.20	5.30
22069089	BN17	BN17. 30-40	30	40	55H	319095	5853612	Sandy Loam	5.90	4.80
22069095	BN18	BN18. 30-40	30	40	55H	319392	5854420	Medium Clay	5.80	5.10
22069091	BN19	BN19. 30-40	30	40	55H	320220	5854503	Medium-Heavy Clay	6.90	6.00
22069097	BN22	BN22. 30-40	30	40	55H	317552	5854723	Medium Clay	5.60	4.50
22069100	BN23	BN23. 30-40	30	40	55H	317244	5853644	Sandy Clay	6.80	5.40
22069102	BN24	BN24. 30-40	30	40	55H	316742	5852102	Medium Clay	7.10	6.20
22069103	BN26	BN26. 30-40	30	40	55H	319865	5853299	Light Clay	5.50	4.40
22069108	BN27	BN27. 30-40	30	40	55H	320291	5853238	Clay Loam	5.50	4.60
22069111	BN28	BN28. 30-40	30	40	55H	320793	5853234	Heavy Clay	6.70	5.60
22069113	BN29	BN29. 30-40	30	40	55H	321202	5853808	Heavy Clay	6.50	5.20
22069114	BN30	BN30. 30-40	30	40	55H	319932	5851267	Medium-Heavy Clay	6.20	4.90
22069117	BN31	BN31. 30-40	30	40	55H	319124	5851362	Medium-Heavy Clay	6.20	5.20
22069119	BN32	BN32. 30-40	30	40	55H	317818	5851532	Heavy Clay	6.60	5.40
22069121	BN33	BN33. 30-40	30	40	55H	317168	5851745	Medium-Heavy Clay	7.20	6.00
22069124	BN35	BN35. 30-40	30	40	55H	318809	5854041	Sandy Loam	5.50	4.60
22069126	BN36	BN36. 30-40	30	40	55H	318265	5854135	Sandy Loam	6.30	5.30
22069129	BN37	BN37. 30-40	30	40	55H	318300	5853672	Sandy Loam	6.60	5.20
22069131	BN38	BN38. 30-40	30	40	55H	318785	5853376	Sandy Loam	6.00	4.70
22069134	BN39	BN39. 30-40	30	40	55H	317839	5853517	Sandy Loam	6.80	5.10
22068824	BN40	BN40. 30-40	30	40	55H	318127	5853058	Sandy Loam	6.40	5.00
22068826	BN41	BN41. 30-40	30	40	55H	317965	5852645	Loam	6.60	5.20
22068831	BN42	BN42. 30-40	30	40	55H	317942	5851913	Medium-Heavy Clay	6.20	4.90
22068829	BN43	BN43. 30-40	30	40	55H	317491	5851606	Sandy Loam	6.50	5.20
22068835	BN44	BN44. 30-40	30	40	55H	317679	5854133	Medium Clay	6.00	5.10
22068833	BN45	BN45. 30-40	30	40	55H	317572	5853739	Sandy Loam	5.80	4.50
22068838	BN46	BN46. 30-40	30	40	55H	317315	5853731	Sandy Loam	6.50	4.80
22068840	BN47	BN47. 30-40	30	40	55H	317397	5854088	Sandy Loam	5.20	4.70

Table A.3: Beveridge North West 30-40cm Sample Analytical Results (Continued).

Sample ID	Site	Sample Name	Electrical Conductivity (1:5 water)	Exchangeable Sodium Percentage	Emerson Class	Disp. Index, Loveday/Pyle	Slaking 2Hrs
			dS/m	%			
22065977	BN1	BN1. 30-40	0.12	15.0	8	16	Partial
22065978	BN2	BN2. 30-40	0.08	9.7	2	8	Considerable
22065982	BN3	BN3. 30-40	0.04	3.7	2	9	Partial
22068711	BN4	BN4. 30-40	0.05	14.0	2	12	Considerable
22068713	BN5	BN5. 30-40	0.03	5.2	2	10	Partial
22068715	BN6	BN6. 30-40	0.07	15.0	1	14	Partial
22068719	BN7	BN7. 30-40	0.05	7.6	2	14	Considerable
22068721	BN8	BN8. 30-40	0.05	11.0	2	10	Considerable
22067934	BN9	BN9. 30-40	0.07	27.0	2	12	Considerable
22067936	BN10	BN10. 30-40	0.17	13.0	2	10	Considerable
22067940	BN11	BN11. 30-40	0.16	12.0	3	5	Partial
22067942	BN12	BN12. 30-40	0.14	13.0	2	12	Partial
22067945	BN13	BN13. 30-40	0.31	9.7	8	4	Partial
22067956	BN14	BN14. 30-40	0.15	9.1	2	14	Partial
22069085	BN15	BN15. 30-40	0.06	3.8	2	5	Water Stable
22069087	BN16	BN16. 30-40	0.28	14.0	2	13	Partial
22069089	BN17	BN17. 30-40	0.17	25.0	3	9	Water Stable
22069095	BN18	BN18. 30-40	0.26	18.0	2	4	Considerable
22069091	BN19	BN19. 30-40	0.10	4.0	8	11	Partial
22069097	BN22	BN22. 30-40	0.11	9.0	2	8	Partial
22069100	BN23	BN23. 30-40	0.08	16.0	1	16	Partial
22069102	BN24	BN24. 30-40	0.27	19.0	1	16	Water Stable
22069103	BN26	BN26. 30-40	0.09	9.6	1	16	Partial
22069108	BN27	BN27. 30-40	0.12	6.3	2	2	Partial
22069111	BN28	BN28. 30-40	0.09	3.5	2	6	Partial
22069113	BN29	BN29. 30-40	0.07	5.5	1	16	Water Stable
22069114	BN30	BN30. 30-40	0.05	3.7	1	16	Considerable
22069117	BN31	BN31. 30-40	0.06	1.3	2	6	Considerable
22069119	BN32	BN32. 30-40	0.08	8.2	1	16	Considerable
22069121	BN33	BN33. 30-40	0.30	28.0	1	16	Partial
22069124	BN35	BN35. 30-40	0.08	8.0	2	6	Considerable
22069126	BN36	BN36. 30-40	0.03	5.3	2	6	Considerable
22069129	BN37	BN37. 30-40	0.04	11.0	2	16	Considerable
22069131	BN38	BN38. 30-40	0.05	9.4	1	15	Considerable
22069134	BN39	BN39. 30-40	0.04	22.0	2	14	Considerable
22068824	BN40	BN40. 30-40	0.05	14.0	2	13	Considerable
22068826	BN41	BN41. 30-40	0.11	23.0	8	16	Partial
22068831	BN42	BN42. 30-40	0.08	11.0	1	16	Considerable
22068829	BN43	BN43. 30-40	0.19	24.0	2	12	Partial
22068835	BN44	BN44. 30-40	0.11	8.5	1	16	Partial
22068833	BN45	BN45. 30-40	0.03	6.2	7	8	Water Stable
22068838	BN46	BN46. 30-40	0.04	17.0	2	10	Partial
22068840	BN47	BN47. 30-40	0.50	32.0	7	2	Water Stable

Exchangeable Sodium Percentage (ESP) Interpretation

Colour	ESP Range	Interpretation
	<6%.	Non-sodic.
	6-10%.	Moderately Sodic
	10.1-15.0%	Strongly Sodic
	>15.1%	Very Strongly Sodic

Emerson Dispersion Class Interpretation.

Colour	Emerson Class	Interpretation
	4, 5, 6, 7, 8	Non-dispersive.
	3	Partial Dispersion after remoulding
	2	Partial Dispersion
	1	Complete Dispersion

Loveday & Pyle (L&P) Score Interpretation.

Colour	L&P Score	Interpretation
	1, 2, 3, 4	Low to moderate. Nil to slight gypsum resonse expected where dispersive.
	5, 6, 7, 8	Moderate to high. Gypsum response expected to control dispersion.
	9, 10, 11, 12	High. Gypsum response expected to control dispersion. High rates required.
	13, 14, 15, 16	Very high. Very high rates required to control dispersion.

Slaking Class Interpretation.

Colour	Slaking Class	Interpretation
	Water Stable	Aggregate stable when wetted, nil or minimal breakdown in structure.
	Partial	Low aggregate stability. Partial breakdown in structure when wetted.
	Considerable	Unstable. High or significant loss of structure when wetted.

Table A.3: Beveridge North West 30-40cm Sample Analytical Results (Continued).

Sample ID	Site	Sample Name	Calcium (Amm-acet.)	Magnesium (Amm-acet.)	Available Potassium	Sodium (Amm-acet.)	Aluminium (KCl)	Calcium (Amm-acet.)	Magnesium (Amm-acet.)	Potassium (Amm-acet.)	Sodium (Amm-acet.)	Aluminium (KCl)	Cation Exch. Cap.	Calcium (Amm-acet.)	Magnesium (Amm-acet.)	Potassium (Amm-acet.)	Aluminium Saturation
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	%	%	%	%
22065977	BN1	BN1. 30-40	760	968	120	483	<9.0	3.8	8	0.3	2.1	<0.1	14.2	26	56	2.1	<1.0
22065978	BN2	BN2. 30-40	280	121	180	71	<9.0	1.4	1	0.46	0.31	<0.1	3.2	43	33	14	<1.0
22065982	BN3	BN3. 30-40	240	109	53	21	<9.0	1.2	0.9	0.14	0.09	<0.1	2.4	52	39	5.7	<1.0
22068711	BN4	BN4. 30-40	200	145	25	90	22	1	1.2	0.06	0.39	0.3	2.8	34	41	2.3	8.7
22068713	BN5	BN5. 30-40	220	97	30	25	9.6	1.1	0.8	0.08	0.11	0.1	2.2	52	35	3.5	4.9
22068715	BN6	BN6. 30-40	360	375	50	214	31	1.8	3.1	0.13	0.93	0.3	6.3	28	49	2	5.5
22068719	BN7	BN7. 30-40	180	121	150	44	<9.0	0.9	1	0.38	0.19	<0.1	2.5	37	41	15	<1.0
22068721	BN8	BN8. 30-40	160	85	15	48	14	0.8	0.7	0.04	0.21	0.2	1.9	40	39	2	8
22067934	BN9	BN9. 30-40	140	85	9	120	<9.0	0.7	0.7	0.02	0.52	<0.1	2	35	38	1.2	<1.0
22067936	BN10	BN10. 30-40	640	387	110	219	<9.0	3.2	3.2	0.27	0.95	<0.1	7.6	42	42	3.5	<1.0
22067940	BN11	BN11. 30-40	520	303	480	200	<9.0	2.6	2.5	1.2	0.87	<0.1	7.3	36	35	17	<1.0
22067942	BN12	BN12. 30-40	920	1004	170	460	21	4.6	8.3	0.44	2	0.2	15.5	30	53	2.8	1.5
22067945	BN13	BN13. 30-40	1360	1573	140	506	<9.0	6.8	13	0.37	2.2	<0.1	22.5	30	58	1.6	<1.0
22067956	BN14	BN14. 30-40	1420	1452	190	460	<9.0	7.1	12	0.48	2	<0.1	21.6	33	56	2.2	<1.0
22069085	BN15	BN15. 30-40	1420	1573	120	184	<9.0	7.1	13	0.31	0.8	<0.1	21.1	34	61	1.4	<1.0
22069087	BN16	BN16. 30-40	1080	1331	94	598	<9.0	5.4	11	0.24	2.6	<0.1	19.3	28	57	1.2	<1.0
22069089	BN17	BN17. 30-40	300	182	36	230	11	1.5	1.5	0.09	1	0.1	4.2	35	35	2.2	2.9
22069095	BN18	BN18. 30-40	560	617	60	414	11	2.8	5.1	0.15	1.8	0.1	10	28	51	1.5	1.2
22069091	BN19	BN19. 30-40	1560	1331	200	184	<9.0	7.8	11	0.52	0.8	<0.1	20.3	38	55	2.6	<1.0
22069097	BN22	BN22. 30-40	280	496	120	166	130	1.4	4.1	0.32	0.72	1.5	8	18	51	4	19
22069100	BN23	BN23. 30-40	340	399	49	219	<9.0	1.7	3.3	0.12	0.95	<0.1	6	28	54	2.1	<1.0
22069102	BN24	BN24. 30-40	480	992	580	644	<9.0	2.4	8.2	1.5	2.8	<0.1	14.9	16	55	10	<1.0
22069103	BN26	BN26. 30-40	360	557	53	175	63	1.8	4.6	0.13	0.76	0.7	8	22	58	1.7	8.8
22069108	BN27	BN27. 30-40	940	762	140	179	42	4.7	6.3	0.35	0.78	0.5	12.5	37	50	2.8	3.7
22069111	BN28	BN28. 30-40	2200	1936	220	230	<9.0	11	16	0.56	1	<0.1	28.7	39	55	1.9	<1.0
22069113	BN29	BN29. 30-40	1480	1452	92	253	<9.0	7.4	12	0.24	1.1	<0.1	20.3	36	57	1.2	<1.0
22069114	BN30	BN30. 30-40	980	1210	89	136	<9.0	4.9	10	0.23	0.59	<0.1	15.7	31	64	1.4	<1.0
22069117	BN31	BN31. 30-40	1880	1210	81	62	<9.0	9.4	10	0.21	0.27	<0.1	19.9	47	51	1	<1.0
22069119	BN32	BN32. 30-40	940	956	85	253	<9.0	4.7	7.9	0.22	1.1	<0.1	13.9	34	57	1.6	<1.0
22069121	BN33	BN33. 30-40	560	726	90	805	<9.0	2.8	6	0.23	3.5	<0.1	12.6	22	48	1.8	<1.0
22069124	BN35	BN35. 30-40	160	169	34	60	60	0.8	1.4	0.09	0.26	0.7	3.2	25	43	2.7	20
22069126	BN36	BN36. 30-40	140	73	13	18	<9.0	0.7	0.6	0.03	0.08	<0.1	1.4	51	41	2.4	<1.0
22069129	BN37	BN37. 30-40	180	97	19	46	<9.0	0.9	0.8	0.05	0.2	<0.1	1.9	46	41	2.6	<1.0
22069131	BN38	BN38. 30-40	160	169	57	64	28	0.8	1.4	0.15	0.28	0.3	3	27	48	4.9	10
22069134	BN39	BN39. 30-40	100	73	9	71	<9.0	0.5	0.6	0.02	0.31	<0.1	1.4	35	41	1.7	<1.0
22068824	BN40	BN40. 30-40	180	145	53	83	<9.0	0.9	1.2	0.13	0.36	<0.1	2.6	36	45	5.1	<1.0
22068826	BN41	BN41. 30-40	220	351	31	276	<9.0	1.1	2.9	0.08	1.2	<0.1	5.4	21	55	1.5	<1.0
22068831	BN42	BN42. 30-40	820	895	85	322	16	4.1	7.4	0.22	1.4	0.2	13.2	31	56	1.7	1.3
22068829	BN43	BN43. 30-40	360	351	26	345	<9.0	1.8	2.9	0.07	1.5	<0.1	6.4	29	46	1.1	<1.0
22068835	BN44	BN44. 30-40	660	629	82	189	11	3.3	5.2	0.21	0.82	0.1	9.6	34	54	2.2	1.3
22068833	BN45	BN45. 30-40	180	133	50	39	33	0.9	1.1	0.13	0.17	0.4	2.7	33	42	4.7	14
22068838	BN46	BN46. 30-40	120	121	46	83	<9.0	0.6	1	0.12	0.36	<0.1	2.1	28	49	5.7	<1.0
22068840	BN47	BN47. 30-40	140	182	17	230	<9.0	0.7	1.5	0.04	1	<0.1	3.3	21	46	1.3	<1.0

Table A.3: Beveridge North West 30-40cm Sample Analytical Results (Continued).

Sample ID	Site	Sample Name	Calcium/Magnesium Ratio	ESP% + EPP% Calculation
				SESW Calculation
22065977	BN1	BN1. 30-40	0.5	17.1
22065978	BN2	BN2. 30-40	1.4	23.7
22065982	BN3	BN3. 30-40	1.3	9.4
22068711	BN4	BN4. 30-40	0.8	16.3
22068713	BN5	BN5. 30-40	1.4	8.7
22068715	BN6	BN6. 30-40	0.6	17.0
22068719	BN7	BN7. 30-40	0.9	22.6
22068721	BN8	BN8. 30-40	1	13.0
22067934	BN9	BN9. 30-40	0.9	28.2
22067936	BN10	BN10. 30-40	1	16.5
22067940	BN11	BN11. 30-40	1	29.0
22067942	BN12	BN12. 30-40	0.6	15.8
22067945	BN13	BN13. 30-40	0.5	11.3
22067956	BN14	BN14. 30-40	0.6	11.3
22069085	BN15	BN15. 30-40	0.6	5.2
22069087	BN16	BN16. 30-40	0.5	15.2
22069089	BN17	BN17. 30-40	1	27.2
22069095	BN18	BN18. 30-40	0.6	19.5
22069091	BN19	BN19. 30-40	0.7	6.6
22069097	BN22	BN22. 30-40	0.3	13.0
22069100	BN23	BN23. 30-40	0.5	18.1
22069102	BN24	BN24. 30-40	0.3	29.0
22069103	BN26	BN26. 30-40	0.4	11.3
22069108	BN27	BN27. 30-40	0.8	9.1
22069111	BN28	BN28. 30-40	0.7	5.4
22069113	BN29	BN29. 30-40	0.6	6.7
22069114	BN30	BN30. 30-40	0.5	5.1
22069117	BN31	BN31. 30-40	0.9	2.3
22069119	BN32	BN32. 30-40	0.6	9.8
22069121	BN33	BN33. 30-40	0.5	29.8
22069124	BN35	BN35. 30-40	0.6	10.7
22069126	BN36	BN36. 30-40	1.2	7.7
22069129	BN37	BN37. 30-40	1.1	13.6
22069131	BN38	BN38. 30-40	0.6	14.3
22069134	BN39	BN39. 30-40	0.9	23.7
22068824	BN40	BN40. 30-40	0.8	19.1
22068826	BN41	BN41. 30-40	0.4	24.5
22068831	BN42	BN42. 30-40	0.6	12.7
22068829	BN43	BN43. 30-40	0.6	25.1
22068835	BN44	BN44. 30-40	0.6	10.7
22068833	BN45	BN45. 30-40	0.8	10.9
22068838	BN46	BN46. 30-40	0.6	22.7
22068840	BN47	BN47. 30-40	0.5	33.3

Table 7.4: Beveridge North West >40cm Sample Analytical Results.

Sample ID	Site	Sample Name	Sample Start Depth	Sample End Depth	Zone	GPS Easting	GPS Northing	Texture	pH (1:5 Water)	pH (1:5 CaCl2)	Electrical Conductivity (1:5 water)	Exchangeable Sodium Percentage	Emerson Class	Disp. Index, Loveday/Pyle	Slaking 2Hrs
			cm	cm				SESW Field Classification			dS/m	%			
22065980	BN2	BN2. 140-150	140	150	55H	317555	5852053	Medium-Heavy Clay	8.00	7.20	0.47	27	2	13	Considerable
22068714	BN5	BN5. 140-150	140	150	55H	317946	5853200	Light-Medium Clay	8.10	7.00	0.31	32	1	16	Considerable
22068717	BN9	BN9. 140-150	140	150	55H	319192	5853002	Medium-Heavy Clay	7.30	6.50	0.35	35	1	16	Considerable
22067939	BN10	BN10. 90-100	90	100	55H	319194	5852855	Heavy Clay	6.90	6.00	0.34	19	1	16	Partial
22067943	BN12	BN12. 140-150	140	150	55H	319125	5852322	Medium Clay	8.50	7.90	1.23	21	6	2	Considerable
22067946	BN14	BN14. 140-150	140	150	55H	319057	5851767	Medium Clay	8.20	7.80	0.98	14	7	0	Water Stable
22069090	BN17	BN17. 140-150	140	150	55H	319095	5853612	Medium Clay	6.10	5.60	0.25	30	8	16	Partial
22069106	BN26	BN26. 80-90	80	90	55H	319865	5853299	Heavy Clay	7.00	6.00	0.26	15	1	16	Partial
22069109	BN27	BN27. 80-90	80	90	55H	320291	5853238	Heavy Clay	7.40	6.70	0.67	21	8	14	Partial
22069127	BN36	BN36. 60-70	60	70	55H	318265	5854135	Medium Clay	6.80	5.50	0.08	19	1	16	Partial
22068822	BN39	BN39. 60-70	60	70	55H	317839	5853517	Medium Clay	7.40	6.10	0.17	30	1	16	Partial
22068825	BN40	BN40. 50-60	50	60	55H	318127	5853058	Sandy Clay	6.70	5.30	0.13	25	1	16	Partial
22068827	BN41	BN41. 50-60	50	60	55H	317965	5852645	Medium Clay	6.30	5.30	0.37	26	1	14	Considerable
22068836	BN45	BN45. 120-130	120	130	55H	317572	5853739	Gravelly Clay	6.40	5.20	0.21	22	8	14	Water Stable
22068841	BN47	BN47. 60-70	60	70	55H	317397	5854088	Medium-Heavy Clay	6.60	5.70	0.45	34	2	9	Considerable

Exchangeable Sodium Percentage (ESP) Interpretation

Colour	ESP Range	Interpretation
	<6%.	Non-sodic.
	6-10%.	Moderately Sodic
	10.1-15.0%	Strongly Sodic
	>15.1%	Very Strongly Sodic

Emerson Dispersion Class Interpretation.

Colour	Emerson Class	Interpretation
	4, 5, 6, 7, 8	Non-dispersive.
	3	Partial Dispersion after remoulding
	2	Partial Dispersion
	1	Complete Dispersion

Loveday & Pyle (L&P) Score Interpretation.

Colour	L&P Score	Interpretation
	1, 2, 3, 4	Low to moderate. Nil to slight gypsum resonse expected where dispersive.
	5, 6, 7, 8	Moderate to high. Gypsum response expected to control dispersion.
	9, 10, 11, 12	High. Gypsum response expected to control dispersion. High rates required.
	13, 14, 15, 16	Very high. Very high rates required to control dispersion.

Slaking Class Interpretation.

Colour	Slaking Class	Interpretation
	Water Stable	Aggregate stable when wetted, nil or minimal breakdown in structure.
	Partial	Low aggregate stability. Partial breakdown in structure when wetted.
	Considerable	Unstable. High or significant loss of structure when wetted.

Table A.4: Beveridge North West >40cm Sample Analytical Results (Continued).

Sample ID	Site	Sample Name	Calcium (Amm-acet.)	Magnesium (Amm-acet.)	Available Potassium	Sodium (Amm-acet.)	Aluminium (KCl)	Calcium (Amm-acet.)	Magnesium (Amm-acet.)	Potassium (Amm-acet.)	Sodium (Amm-acet.)	Aluminium (KCl)	Cation Exch. Cap.
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg
22065980	BN2	BN2. 140-150	440	1452	140	1219	<9.0	2.2	12	0.37	5.3	<0.1	19.4
22068714	BN5	BN5. 140-150	440	750	88	920	<9.0	2.2	6.2	0.23	4	<0.1	12.7
22068717	BN9	BN9. 140-150	320	1113	110	1357	<9.0	1.6	9.2	0.29	5.9	<0.1	17
22067939	BN10	BN10. 90-100	720	1210	86	759	<9.0	3.6	10	0.22	3.3	<0.1	17.3
22067943	BN12	BN12. 140-150	1780	3025	150	2047	<9.0	8.9	25	0.38	8.9	<0.1	42.8
22067946	BN14	BN14. 140-150	2000	3025	150	1288	<9.0	10	25	0.38	5.6	<0.1	40.9
22069090	BN17	BN17. 140-150	380	1004	87	1058	15	1.9	8.3	0.22	4.6	0.2	15.2
22069106	BN26	BN26. 80-90	700	1573	96	713	<9.0	3.5	13	0.25	3.1	<0.1	20.3
22069109	BN27	BN27. 80-90	1240	2299	160	1518	<9.0	6.2	19	0.42	6.6	<0.1	31.8
22069127	BN36	BN36. 60-70	260	520	55	299	<9.0	1.3	4.3	0.14	1.3	<0.1	7
22068822	BN39	BN39. 60-70	300	666	59	713	<9.0	1.5	5.5	0.15	3.1	<0.1	10.3
22068825	BN40	BN40. 50-60	240	448	87	391	<9.0	1.2	3.7	0.22	1.7	<0.1	6.8
22068827	BN41	BN41. 50-60	520	1041	110	943	9.3	2.6	8.6	0.28	4.1	0.1	15.6
22068836	BN45	BN45. 120-130	260	1077	100	690	14	1.3	8.9	0.26	3	0.2	13.6
22068841	BN47	BN47. 60-70	300	1210	83	1472	<9.0	1.5	10	0.21	6.4	<0.1	18.5

Sample ID	Site	Sample Name	Calcium (Amm-acet.)	Magnesium (Amm-acet.)	Potassium (Amm-acet.)	Aluminium Saturation	Calcium/Magnesium Ratio	**ESP% + EPP% Calculation**
			%	%	%	%		**SESW Calculation**
22065980	BN2	BN2. 140-150	11	60	1.9	<1.0	0.2	28.9
22068714	BN5	BN5. 140-150	17	49	1.8	<1.0	0.4	33.8
22068717	BN9	BN9. 140-150	9.3	54	1.7	<1.0	0.2	36.7
22067939	BN10	BN10. 90-100	21	59	1.3	<1.0	0.4	20.3
22067943	BN12	BN12. 140-150	21	58	0.89	<1.0	0.4	21.9
22067946	BN14	BN14. 140-150	25	60	0.92	<1.0	0.4	14.9
22069090	BN17	BN17. 140-150	13	55	1.5	1.1	0.2	31.5
22069106	BN26	BN26. 80-90	17	66	1.2	<1.0	0.3	16.2
22069109	BN27	BN27. 80-90	20	58	1.3	<1.0	0.3	22.3
22069127	BN36	BN36. 60-70	18	61	2	<1.0	0.3	21.0
22068822	BN39	BN39. 60-70	15	54	1.5	<1.0	0.3	31.5
22068825	BN40	BN40. 50-60	17	54	3.3	<1.0	0.3	28.3
22068827	BN41	BN41. 50-60	16	55	1.8	0.7	0.3	27.8
22068836	BN45	BN45. 120-130	9.8	65	1.9	1.2	0.2	23.9
22068841	BN47	BN47. 60-70	8	56	1.1	<1.0	0.2	35.1