Barossa Infrastructure Limited

Gomersal Recycled Water Reuse Scheme

Audit Report (2018/19)

Soil Analysis

September 2019

Commercial in Confidence

Gomersal Recycled Water Reuse Scheme

Soil Analysis

Audit Report (2018/19)

Prepared for

Barossa Infrastructure Limited

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1. Introduction

Seed Consulting Services (Seed) were engaged to undertake an independent review (audit) of the management of the Barossa Infrastructure Limited (BIL) Wastewater Reuse Scheme for the 2018/19 year.

BIL injects Community Wastewater Management Scheme (CWMS) water from The Barossa Council's Nuriootpa CWMS scheme in the BIL Gomersal Road pipeline where it blends the CWMS water with BIL water (unfiltered River Murray water – raw water). This is delivered to BIL customers along Gomersal Road as a blended product.

The operation of the wastewater reuse scheme was approved by Department of Health in August 2009 (approval number 2009-7292) and successfully reviewed in 2016.

This report presents a review of soil analytical data from soil samples taken from 6 vineyard locations where recycled water is distributed through drip irrigation systems. This is the second report of its type. The first and previous report was completed in 2014. Soil samples were taken from the same vineyards and the same blocks in those vineyards but not at the exact same locations.

Permit approvals from SA Health for BIL to deliver recycled water require analysis of soil following a period of 3 years from the start of the scheme and 5 yearly thereafter. It is anticipated that the next soil sample data analysis will be 2024.

Soil sampling is intended to identify particular soil chemistry that may suggest adverse impacts in locations where recycled water is used. In comparison to water sampling there are no predetermined SA Health safe limits, e.g. E coli for wastewater not to exceed 100 per 100mL. The data set in this report has combined results from 2014. The intention is not to observe trends given only 2 sampling events and 5 years between each. The report provides the soil analytical data, summarises the means, medians, range in values and outliers.

In preparing this report we have been very mindful of existing soil conditions and their dynamic nature. Consultation occurred with each site owner to identify any factor which may have affected soil chemistry and thereby influence the data reported. The 2014 soil report indicated there were no significant issues. Some blocks indicated saline conditions but not to the point of causing vine death, loss of vigour or browning of leaf margins or environmental or human health impact. It was not possible to determine that these conditions were as a consequence of use of recycled water. This report (2019) provides similar evidence, that there are no adverse impacts. Vineyard managers reported (verbally) that they had not observed overt saline symptoms in vines.

This report outlines the soil sampling method, results of both 2014 and this year (2019), interpretation of the data and recommended actions.

This report is submitted to BIL for lodgement with SA Health.

2. Background

BIL commenced use of it's Gomersal Road pipeline to deliver recycled water from Barossa Council's Nuriootpa Wastewater Reuse Scheme in 2010. As part of the approvals process SA Health issued a permit with a range of conditions. One of these conditions required periodic sampling of soils from properties using the recycled water. This has been completed in 2014 and now in 2019.

The intent of soil sampling is to identify any aspects of possible soil degradation that may be associated with the use of recycled water.

It is important to note however that a good understanding of existing soil structure and chemistry is needed to enable a comparison of soil pre and post use of recycled water to ensure that any aspects of soil chemistry can be linked directly to irrigation activity using recycled water and not simply be representative of soil conditions that existed prior to the use of recycled water.

The Soil Analysis Report of 2014 indicated that in some areas salinity issues were noted and that plans were in place to mitigate the influence of salinity. Viticulture management companies manage both vineyards sampled, and closely review and manage all aspects of viticulture including soil and water quality. In discussion with those management companies the discussion section of this report will present the strategies used to best manage salinity in response to the 2014 report.

The 2014 sampling provided the first set of results – a baseline. It should be noted that the report indicated "Based on the data and discussion with viticultural staff, irrigation with reclaimed water has not had an impact." It goes on to note that slightly elevated ECe and ESP was observed in some sites known to have saline and sodic issues. These observations could not be directly linked to the use of recycled water.

The information in this report has been forwarded to both companies to assist in their planning and management. Each company received their information only to ensure confidentiality.

3. Materials and Methods

Seed collected soil samples from 6 locations across a variety of soil types in vineyards managed by Food and Beverage Australia Ltd (FABAL) and Stirling Vineyard Services located along Gomersal Road, west of Tanunda.

Three blocks in each vineyard were sampled. They were the same blocks as 2014 but not the exact same site in each block.

Two samples were collected from each block. Soil was taken in the root zone at two levels 5 - 10 cm and further down at 20 – 30 cm. Samples were taken using a spade and trowel by taking a sample from a cut face. Samples were placed in sample bags and forwarded to APAL for analysis. Samples were taken on 29th August 2019 and sent to APAL laboratory (NATA accredited) for analysis. APAL completed analysis for both the 2014 and 2019 samples.

The soil analysis depths (5 – 10cm and 20 – 30 cm) are consistent with sampling recommendations within the national water quality management strategy: "Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1) 2006"

The following parameters were requested for testing:

pH CaCl and water	Boron	Calcium	Carbon	Carbonate	Chloride
Copper	Iron	Magnesium	Manganese	Molybdenum	Nitrogen
Phosphorous	Potassium	Sodium	Sulphur	Zinc	
CEC	Salinity EC	ECse	ECR		

Please note that APAL discretion they provided a GTRI analysis being Grass Tetany Risk where <0.07 is desired. This index is provided in both sets of results.

4. Results

APAL Laboratory (NATA accredited) provided comprehensive analysis results for both 2014 and 2019 soil sampling. These results have been sighted and summaries for both years detailed in Figure 1 and Figure 2. This is analytical data for each site, by block at each depth -5 – 10 cm and 20 – 30 cm. The tables summarise data from both years, 2014 and 2019. Full test data is provided in accompanying spreadsheets.

Over 400 test results were provided over both sampling years. This provided a large data set of analytical information for the vineyard soils which use recycled water. However, it is not realistic to draw conclusions of trends of how the soil has responded to use of recycled water, given only two sampling events have been considered and there is a 5 year gap between soil sampling events.

The results are interpreted by looking at individual parameters to determine if these results are higher than considered advisable for agriculture (viticulture in particular). This is in the context of recycled water use and consideration of parameters such as nitrogen, phosphorous, sodium and chloride which could create adverse effects on the soil environment.

The results have also been viewed with the understanding that the use of recycled water is diluted with raw Murray River water, stored in the Warren Reservoir and blended with recycled water through the BIL, Gomersal Road pipeline network. The 2019 Report indicates and average dilution of 12.4% of recycled water to raw water delivered to BIL customer drip irrigation systems. Natural rainfall will have added further dilution and leaching through the soil profile.

Table 1 has arranged the data by each soil chemistry parameter and combined analysis results from all blocks from both sites. This provides a “macro view” across all the soil in sampled sites down to the 20 – 30 cm level, and assists observing any unusual or outlier results. From the combined results, means, medians and range values were calculated. Table 1 summarises these values from all the data in Figure 3.

Table 1. Summary of Soil Sample Means, Medians, Range and Outliers.

Sample ID	MEAN	MEDIAN	RANGE	OUTLIERS
pH	7.82	7.79	6.93 – 8.61	No significant outliers
*Boron	1.55	1.09	0.48 – 10.0	One sample of 10.0 at 20 – 30 cm
*Chloride	57.17	20.0	7.0 – 450.0	One sample of 450.0 at 20 – 30 cm
*Copper	3.40	2.55	1.4 – 11.1	One sample of 11.1 at 5 – 10 cm
*Iron	13.67	12.98	5.11 – 31.0	One sample of 31.0 at 5 – 10 cm
*Magnesium	683.94	647.83	325.1 – 1285.45	One sample of 1285.45 at 5 – 10 cm
*Manganese	13.43	12.07	4.4 – 34.01	One sample of 34.01 at 5 – 10 cm
*Potassium	402.65	373.5	116.0 – 852.39	One sample of 852.39 at 5 – 10 cm
*Sodium	360.2	356.52	81.12 – 729.0	One sample of 729.0 at 20 – 30 cm
*Sulphur	26.33	13.94	6.10 – 139.02	One sample of 139.02 at 5 – 10 cm
*Zinc	5.09	3.13	0.14 – 22.34	One sample of 22.34 at 20 – 30 cm

* units of measurement are mg/kg

Notes: ECR is an exchangeable cation ratio, a modified ESP to include potassium, measure as ECR = 100*(Na+K) / (Na+K+Ca+Mg). Desired ration is<10. This parameter was not measured in 2014. 2019 samples indicated ratios above the desired level of 10.0 in all cases except two blocks.

Figure 1. Comparison of sample results 2014 and 2019

Vineyard 1		Block 1 5-10cm		Block 1 20-30cm		Block 2 5-10cm		Block 2 20-30cm		Block 3 5-10cm		Block 3 20-30cm	
Sample ID	Units	2014	2019	2014	2019	2014	2019	2014	2019	2014	2019	2014	2019
pH		7.61	8.08	7.78	8.33	7.56	7.53	8.46	7.95	6.77	7.74	6.92	7.24
Boron	mg/kg	1.24	1.80	0.84	1.10	1.28	0.98	1.09	1.20	0.66	1.20	0.48	0.97
Carbon Dumas	%	1.40	-	1.00	-	1.50	-	1.10	-	1.10	-	1.10	-
Carbon Total		-	<0.05	-	0.76	-	<0.05	-	0.19	-	<0.05	-	<0.05
Chloride	mg/kg	26.00	19.00	13.00	53.00	26.00	75.00	26.00	450.00	13.00	26.00	26.00	48.00
Copper	mg/kg	3.39	3.80	1.69	2.10	4.17	2.60	1.68	1.70	4.54	5.00	2.50	3.10
Carbonate	%	-	<0.4	-	6.30	-	<0.4	-	1.60	-	<0.4	-	<0.4
Iron	mg/kg	10.39	13.00	6.99	7.50	10.27	11.00	5.11	7.70	17.87	21.00	15.23	15.00
Manganese	mg/kg	16.04	7.30	10.69	4.40	13.14	11.00	5.46	5.90	19.21	19.00	20.09	21.00
Moybdenum	mg/kg	1.42	1.00	1.36	<0.25	1.69	0.95	1.88	0.98	1.44	0.92	1.24	1.20
N, total Dumas	%	0.11	0.26	0.13	0.24	0.18	0.19	0.14	0.21	0.11	0.24	0.12	0.21
P, Colwell	mg/kg	138.89	110.00	43.33	48.00	185.00	27.00	31.11	33.00	197.78	76.00	34.44	29.00
P, Total	mg/kg	487.33	663.00	282.74	327.00	677.53	249.00	260.77	310.00	601.60	529.00	262.00	287.00
Sulphur	mg/kg	28.16	14.00	26.89	16.00	8.92	15.00	9.35	36.00	139.02	7.70	79.49	28.00
Zinc	mg/kg	3.06	5.70	22.34	4.20	3.87	6.70	17.38	13.00	4.39	4.20	2.85	2.00
Ca	mg/kg	3859.16	4120.00	3679.65	5650.00	3544.61	2300.00	5403.04	3520.00	3464.18	2250.00	2296.05	2710.00
Ca	cmol/kg	19.26	20.60	18.36	28.20	17.69	11.50	26.96	17.60	17.29	11.20	11.46	13.50
Ca	%	68.49	69.60	73.75	77.50	64.18	59.10	79.12	70.80	79.95	56.50	65.69	56.80
Mg	mg/kg	740.47	702.00	513.44	666.00	857.40	609.00	629.66	527.00	325.10	708.00	596.78	834.00
Mg	cmol/kg	6.09	5.78	4.23	5.48	7.06	5.01	5.18	4.33	2.68	5.82	4.91	6.86
Mg	%	21.67	19.60	16.97	15.10	25.60	25.80	15.21	17.40	12.38	29.30	28.16	28.90
K	mg/kg	852.39	561.00	379.82	370.00	716.45	190.00	263.72	214.00	469.76	334.00	201.87	361.00
K	cmol/kg	2.18	1.430	0.97	0.946	1.83	0.487	0.67	0.548	1.20	0.85	0.52	0.92
K	%	7.75	4.90	3.90	2.60	6.65	2.50	1.98	2.20	5.56	4.30	2.96	3.90
Na	mg/kg	134.96	405.00	308.04	405.00	226.37	560.00	289.32	544.00	105.08	453.00	128.14	572.00
Na	cmol/kg	0.59	1.760	1.34	1.76	0.98	2.44	1.26	2.37	0.46	1.97	0.56	2.49
Na	%	2.09	6.00	5.38	4.80	3.57	12.50	3.69	9.50	2.11	9.90	3.20	10.50
Water Soluble													
Ca	mg/L	57.30	53.00	30.80	60.00	40.70	38.00	58.90	78.00	590.70	62.00	62.70	82.00
K	mg/L	48.90	37.00	18.00	8.50	38.60	54.00	7.55	6.40	57.80	150.00	9.34	120.00
Mg	mg/L	17.70	25.00	14.70	12.00	22.10	51.00	12.40	19.00	65.50	100.00	25.10	150.00
Na	mg/L	74.60	220.00	134.80	220.00	114.00	200.00	140.90	370.00	90.70	150.00	90.60	160.00
CEC	cmol/kg	28.12	30.00	24.90	36.00	27.56	19.00	34.08	25.00	21.62	20.00	17.44	24.00
Salinity EC 1:5	dS/m	-	0.229	-	0.240	-	0.169	-	0.478	-	0.138	-	0.145
ECR	ratio	-	11.0	-	7.4	-	15.0	-	12.0	-	14.0	-	14.0
ECse	dS/m	0.96	0.79	0.94	0.95	0.92	1.20	0.70	2.70	3.40	0.80	1.54	0.89
*GTRI		-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01

Figure 2. Comparison of sample results 2014 and 2019

Vineyard 2		Block 4 5-10cm		Block 4 20-30cm		Block 5 5-10cm		Block 5 20-30cm		Block 6 5-10cm		Block 6 20-30cm	
Sample ID	Units	2014	2019	2014	2019	2014	2019	2014	2019	2014	2019	2014	2019
pH		8.18	6.93	8.59	7.69	7.92	7.80	8.61	8.21	8.15	7.41	8.64	7.62
Boron	mg/kg	0.92	0.88	0.48	10.00	1.08	1.70	0.69	3.40	1.04	1.60	0.73	1.90
Carbon Dumas	%	4.00	-	2.30	-	1.80	-	1.10	-	1.40	-	0.79	-
Carbon Total		-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05
Chloride	mg/kg	26.00	7.00	26.00	230.00	26.00	11.00	39.00	66.00	26.00	20.00	26	68.00
Copper	mg/kg	11.10	5.60	1.90	2.50	6.58	2.50	2.65	1.40	4.31	2.30	2.12	2.40
Carbonate	%	-	<0.4	-	<0.4	-	<0.4	-	<0.4	-	<0.4	-	<0.4
Iron	mg/kg	10.45	31.00	9.85	11.00	24.22	15.00	13.44	20.00	14.02	14.00	12.95	11.00
Manganese	mg/kg	20.81	15.00	7.49	6.90	34.01	8.80	15.98	5.80	14.99	19.00	9.21	11.00
Molybdenum	mg/kg	0.06	0.60	0.06	1.30	1.83	1.40	1.66	1.70	1.71	1.10	1.71	1.40
N, total Dumas	%	0.16	0.11	0.10	0.13	0.21	0.13	0.13	0.12	0.14	0.16	0.17	0.13
P, Colwell	mg/kg	41.67	12.00	18.89	5.00	58.89	5.00	33.89	<5	37.22	6.00	2.78	<5
P, Total	mg/kg	324.90	242.00	208.80	218.00	365.33	206.00	247.53	158.00	327.02	204.00	165.13	141.00
Sulphur	mg/kg	12.79	51.00	9.88	66.00	13.88	6.10	11.07	8.70	12.73	6.10	11.15	14.00
Zinc	mg/kg	3.36	3.20	0.99	0.42	18.92	0.81	2.40	0.14	0.92	0.60	0.23	0.49
Ca	mg/kg	4959.80	1060.00	5225.38	2090.00	3741.67	3750.00	6187.62	4200.00	4361.35	2620.00	4447.16	3230.00
Ca	cmol/kg	24.75	5.31	26.07	10.40	18.67	18.70	30.88	21.00	21.76	13.00	22.19	16.10
Ca	%	81.48	59.20	83.88	46.10	58.48	70.80	76.34	68.20	65.05	62.80	71.16	66.30
Mg	mg/kg	475.40	346.00	486.74	969.00	1285.45	591.00	830.85	794.00	1130.91	541.00	726.47	529.00
Mg	cmol/kg	3.91	2.85	4.01	7.97	10.58	4.86	6.84	6.53	9.31	4.45	5.98	4.35
Mg	%	12.88	31.80	12.89	35.20	33.14	18.40	16.91	21.30	27.82	21.40	19.17	17.90
K	mg/kg	531.92	116.00	154.33	410.00	609.50	615.00	317.18	377.00	526.76	462.00	265.88	364.00
K	cmol/kg	1.36	0.297	0.39	1.05	1.56	1.57	0.81	0.965	1.35	1.18	0.68	0.931
K	%	4.48	3.30	1.27	4.60	4.88	5.90	2.01	3.10	4.03	5.70	2.18	3.80
Na	mg/kg	81.12	119.00	139.97	729.00	256.48	294.00	440.98	525.00	239.05	481.00	537.21	671.00
Na	cmol/kg	0.35	0.516	0.61	3.17	1.12	1.28	1.92	2.28	1.04	2.09	2.34	2.92
Na	%	1.16	5.80	1.96	14.00	3.49	4.80	4.74	7.40	3.11	10.10	7.49	12.00
Water Soluble													
Ca	mg/L	116.00	33.00	76.70	21.00	80.00	34.00	48.30	27.00	69.90	27.00	35.4	31.00
K	mg/L	87.20	11.00	9.75	15.00	27.10	23.00	9.20	22.00	18.70	34.00	9.35	37.00
Mg	mg/L	32.50	20.00	19.60	15.00	39.20	15.00	14.70	21.00	27.90	25.00	13.2	30.00
Na	mg/L	64.70	81.00	104.10	290.00	155.60	86.00	182.30	130.00	133.70	100.00	209.1	130.00
CEC	cmol/kg	30.38	9.00	31.08	23.00	31.93	26.00	40.44	31.00	33.46	21.00	31.19	24.00
Salinity EC 1:5	dS/m	-	0.136	-	0.336	-	0.104	-	0.135	-	0.10	-	0.14
ECR		-	9.0	-	19.0	-	11.0	-	11.0	-	16.0	-	16.0
ECse	dS/m	1.76	0.90	9.85	-	1.51	-	0.75	-	1.31	0.66	0.89	0.82
*GTRI			<0.01		<0.01		<0.01		<0.01		<0.01		<0.01

Figure 3. Summary of all 2019 samples from both sites – a "macro view".

"MACRO VIEW" MEANS, MEDIANS and RANGES																	
			Block 1 Block 4		Block 1 Block 4		Block 2 Block 5		Block 2 Block 5		Block 3 Block 6		Block 3 Block 6				
SOIL DEPTH			5_10 cm		20_30 cm		5-10 cm		20_30 cm		5-10 cm		20_30 cm				
	units		2014	2019	2014	2019	2014	2019	2014	2019	2014	2019	2014	2019	MEAN	MEDIAN	RANGE
p H		Vineyard 1	7.61	8.08	7.78	8.33	7.56	7.53	8.46	7.95	6.77	7.74	6.92	7.24	7.82	7.79	6.93_8.61
		Vineyard 2	8.18	6.93	8.59	7.69	7.92	7.80	8.61	8.21	8.15	7.41	8.64	7.62			
Boron	mg/kg	Vineyard 1	1.24	1.80	0.84	1.10	1.28	0.98	1.09	1.20	0.66	1.20	0.48	0.97	1.55	1.09	0.48_10.0
		Vineyard 2	0.92	0.88	0.48	10.00	1.08	1.70	0.69	3.40	1.04	1.60	0.73	1.90			
Calcium	mg/kg	Vineyard 1	3859.16	4120.00	3679.65	5650.00	3544.61	2300.00	5403.04	3520.00	3464.18	2250.00	2296.05	2710.00	3694.57	3710.66	1060_6187.62
		Vineyard 2	4959.80	1060.00	5225.38	2090.00	3741.67	3750.00	6187.62	4200.00	4361.35	2620.00	4447.16	3230.00			
Chloride	mg/kg	Vineyard 1	26.00	19.00	13.00	53.00	26.00	75.00	26.00	450.00	13.00	26.00	26.00	48.00	57.17	26.00	7.0_450.0
		Vineyard 2	26.00	7.00	26.00	230.00	26.00	11.00	39.00	66.00	26.00	20.00	26	68.00			
Copper	mg/kg	Vineyard 1	3.39	3.80	1.69	2.10	4.17	2.60	1.68	1.70	4.54	5.00	2.50	3.10	3.40	2.55	1.4_11.1
		Vineyard 2	11.10	5.60	1.90	2.50	6.58	2.50	2.65	1.40	4.31	2.30	2.12	2.40			
Iron	mg/kg	Vineyard 1	10.39	13.00	6.99	7.50	10.27	11.00	5.11	7.70	17.87	21.00	15.23	15.00	13.67	12.98	5.11_31.0
		Vineyard 2	10.45	31.00	9.85	11.00	24.22	15.00	13.44	20.00	14.02	14.00	12.95	11.00			
Magnesium	mg/kg	Vineyard 1	740.47	702.00	513.44	666.00	857.40	609.00	629.66	527.00	325.10	708.00	596.78	834.00	683.94	647.83	325.1_1285.45
		Vineyard 2	475.40	346.00	486.74	969.00	1285.45	591.00	830.85	794.00	1130.91	541.00	726.47	529.00			
Manganese	mg/kg	Vineyard 1	16.04	7.30	10.69	4.40	13.14	11.00	5.46	5.90	19.21	19.00	20.09	21.00	13.43	12.07	4.4_34.01
		Vineyard 2	20.81	15.00	7.49	6.90	34.01	8.80	15.98	5.80	14.99	19.00	9.21	11.00			
Molybdenum	mg/kg	Vineyard 1	1.42	1.00	1.36	<0.25	1.69	0.95	1.88	0.98	1.44	0.92	1.24	1.20	1.24	1.36	0.06_1.88
		Vineyard 2	0.06	0.60	0.06	1.30	1.83	1.40	1.66	1.70	1.71	1.10	1.71	1.40			
Potassium	mg/kg	Vineyard 1	852.39	561.00	379.82	370.00	716.45	190.00	263.72	214.00	469.76	334.00	201.87	361.00	402.65	373.50	116.0_852.39
		Vineyard 2	531.92	116.00	154.33	410.00	609.50	615.00	317.18	377.00	526.76	462.00	265.88	364.00			
Sodium	mg/kg	Vineyard 1	134.96	405.00	308.04	405.00	226.37	560.00	289.32	544.00	105.08	453.00	128.14	572.00	360.20	356.52	81.12_729.0
		Vineyard 2	81.12	119.00	139.97	729.00	256.48	294.00	440.98	525.00	239.05	481.00	537.21	671.00			
Sulphur	mg/kg	Vineyard 1	28.16	14.00	26.89	16.00	8.92	15.00	9.35	36.00	139.02	7.70	79.49	28.00	26.33	13.94	6.10_139.02
		Vineyard 2	12.79	51.00	9.88	66.00	13.88	6.10	11.07	8.70	12.73	6.10	11.15	14.00			
Zinc	mg/kg	Vineyard 1	3.06	5.70	22.34	4.20	3.87	6.70	17.38	13.00	4.39	4.20	2.85	2.00	5.09	3.13	0.14_22.34
		Vineyard 2	3.36	3.20	0.99	0.42	18.92	0.81	2.40	0.14	0.92	0.60	0.23	0.49			
	this highlights outliers described in Table 1																

5. Discussion

The aim of soil sampling and data analysis is to determine if the use of recycled water in drip irrigated systems is causing adverse impacts on the environment.

The key findings of this soil sample data analysis is:

- In general none of the 2019 soil chemistry parameters indicated adverse environmental impacts. All parameters are in an acceptable range.
- There is no significant difference between the 2014 and 2019 analysis on the basis of the data presented.
- Comparison of 2014 and 2019 data across both sites and at each sampling level indicates no significant trend either between sites or between years that indicates adverse impacts. The 2014 report indicated that one vineyard block had a history of salinity issues. The Salinity (EC 1:5) for both blocks are less than 0.29 which is the upper limit for soils considered to be slightly saline (for soil types from loamy sand to light clays). Moderately saline soils rate above this level for these soil types.
- Outliers do exist as described in table 1, however they are of single instances and not across multiple samples of both sample years.
- ECR's measured in 2019 at the lower depth's (20-30cm) indicates levels higher than a desired level of exchangeable cation ratio (e.g. above 10.0). This is not significant in terms of adverse impacts but worth noting.
- Molybdenum seems to have remained stable and varied little across both sites in all blocks.
- At one site at the 5 – 10 cm level, pH has increased slightly towards more alkaline, but this may be of more interest to site management. It is unlikely to be an adverse result caused by use of diluted recycled water.

Discussion with vineyard management indicated that since 2014 actions to maintain and improve soil sustainability included the addition of gypsum and compost. Salinity monitoring has been conducted through the use of Sentek probes.

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6. Recommendations

It is recommended that BIL undertake a further soil assessment in 5 years and that this work be completed in consultation with SA Health and Gomersal Road recycled water users.

At present no adverse impact is evident, albeit outlier results are noted. Given the influence of climate change, the reliance by growers on irrigated water supply to successfully manage wine grape crops and the requirement for ongoing professional management of important resources such as water and soil, it is considered that ongoing monitoring of soil data is critical. Irrigators are encouraged to undertake their own analysis as well as participating in provision of data to satisfy SA Health reporting requirements.

It is suggested that SA Health continue to review the required monitoring frequency and the number of sampling points. Note that the sampling for 2019 has recorded the site, the block, row number and panel number which can be used to identify the exact location for the next sampling cycle.