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Tiedman Irrigation Program

AGL Upstream Investments Pty Ltd

Soil Quality Monitoring and Management Program – Report 6: Irrigation (Activities from 1 January 2015 to 30 June 2015)

REF Approval 13/36641 and EPL 20358: R4.5 | Final

27 August 2015

IA059500-600-B

Document history and status

Revision	Date	Description	By	Review	Approved
A	20/07/2015	Draft for client review 1 of 2	KB and SL	GS	RC
B	05/08/2015	Draft for client review 2 of 2	KB and SL	GS	GS
C	10/08/2015	Final 1	KB and SL	GS	GS
D	20/08/2015	Final 2	KB and SL	AB	AB
E	27/08/2015	Final 3	KB and SL	AB	AB

Distribution of copies

Revision	Issue approved	Date issued	Issued to	Comments
A	20/07/2015	20/07/2015	James Duggleby (AGL)	Electronic copy
B	05/08/2015	05/08/2015	James Duggleby (AGL)	Electronic copy
C	10/08/2015	10/08/2015	James Duggleby (AGL)	Electronic copy
D	20/08/2015	20/08/2015	James Duggleby (AGL)	Electronic copy
E	27/08/2015	27/08/2015	James Duggleby (AGL)	Electronic copy

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Project no:	IA059500
Document title:	Soil Quality Monitoring and Management Program – Report 6 Irrigation (Activities from 1 January 2015 to 30 June 2015)
Document No.:	IA059500-600-B
Revision:	Final
Date:	27/08/2015
Client name:	AGL Upstream Investments Pty Ltd
Client no:	Client Reference
Project manager:	Garry Straughton
Author:	Katharine Brown
File name:	I:\ENVR\Projects\IA059500\600 Data Round 2\Final\Final 26Aug2015\IA059500 Baseline 7 Soil Study TIP - Final.docx

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ABN 37 001 024 095

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Executive Summary

This is the sixth in a series of reports presenting the results of soil analyses for AGL Upstream Investments Pty Ltd (AGL's) Tiedman Irrigation Program (TIP). This report specifically covers the period from 1st January to 30th June 2015, and is submitted in compliance with the Office of Coal Seam Gas (OCSG) approval dated 4th July 2014 and approved Soil Quality Monitoring and Management Program (SQMMP) (Fodder King 2012). The report is also submitted to the Environment Protection Authority (EPA) to comply with condition R5.5 of EPL 20358 for TIP reporting.

This report presents mass balances and soil physical and chemical data for the two TIP irrigation areas (Stage 1A and Stage 1B) following irrigation with blended water. In addition, this report provides a summary of the TIP, presenting results across the complete (April 2013 – April 2015) irrigation program undertaken at the site and commentary on the efficacy of the program.

Stage 1A is 12 hectares (ha) in area, and the primary focus of the approved SQMMP. The Stage 1A area consists of 16 plots, a mix of annual and perennial forage crop species and four soil treatments. Stage 1B is approximately 4.1 ha in area and consists of four plots and a mix of annual and perennial pasture species. No soil treatments were applied to the Stage 1B area.

The soils at the site were classified according to the Australian Soil Classification (ASC) (Isbell, 2002). Three of the eight soils observed during the test pit investigations had strongly acid B horizons (pH <5.5) and were classified as Kurosols. Two of the soils previously classified as Kurosols (strongly acid B horizons) in 2014 have been re-classified as Sodosols due to a slight increase in pH to greater than 5.5.

Both Sodosols and Kurosols are common soil types of the Gloucester region and are characterised by naturally low fertility, high sodicity, poor drainage and, in the case of Kurosols, acidic pH. Although both Sodosols and Kurosols have an abrupt increase in clay between the A and B horizons, test pit observations confirmed that root depth and abundance was greatest in the soils sown with lucerne. This is expected due to lucerne's tap root system being able to penetrate deeper (than the fibrous root system of triticale) into the medium to heavy clay subsoils.

At the time of reporting the Critical Control Point for the Stage 1A soils (soil salinity increase of more than 50% above the average value of the new baseline for the ameliorated soils) had not been triggered. Soil salinity of the Stage 1B soils did reach the Critical Control Point trigger (more than 50% above the average value of 0.12 dS/m in the root zone to 1 m depth).

Since the previous reporting period there was 47.1 ML of rainfall across the Stage 1A area during the 4-month irrigation period to 30 April 2015 (note that the reporting period is to the 30 June 2015 but no irrigation occurred for the months of May and June). During this irrigation period, Stage 1A:

- Received 12.4 megalitres (ML) of blended water with an average salinity of 1120 microsiemens (µS) per centimetre (cm) (equivalent to 1.03 ML/ha for the period);
- Showed a slight increase in salinity at depths greater than 60 cm;
- Showed increasing exchangeable sodium percentage (ESP) from 80 cm bgl.

The EM31 geophysical survey for the Stage 1A area suggests:

- Salinity patterns are the same as the previous EM31 surveys in April 2011 and October 2014;
- Apparent electrical conductivity (ECa) ranges from 31-187 millisiemens per metre (mS), equivalent to 0.31-1.87 dS/m; and
- ECa results reflect the soil moisture conditions at the time of measurement. Further, the range in ECa reflects the topography of the site (ridge top, slopes and low lying drainage areas) and the soil moisture movement across the area.

Since the previous reporting period there was 16.1 ML of rainfall across the Stage 1B area during the 4-month irrigation period to 30 April 2015. During this irrigation period, Stage 1B:

- Received 1.4 ML of blended water (equivalent to 0.34 ML/ha for the period);
- Showed a slight decrease in salinity and ESP (with the exception of the composite sample collected from 20-40 cm deep in the profiles).

The EM31 geophysical survey for the Stage 1B area suggests:

- Salinity patterns are the same as the previous EM31 surveys in April 2011 and October 2014;
- ECa ranges from between 20-80 mS/m (0.2-0.8 dS/m) on the eastern side of the area;

The natural (unimproved) soils of the site (and the Gloucester region in general) exhibit several contraints to plant growth. In order to improve the soils capacity for crop production and CSG water use, soil treatments were incorporated into the soils of the Stage 1A area in 2012/13. These treatments improved the soil condition, even after the application of blended water.

There was no evidence of adverse effects on the soil as a result of irrigating blended water or periodic rainfall. The increasing ESP trends in the Stage 1A area have stabilised. The ESP levels should remain stable or decrease with lime and gypsum applications scheduled for October 2015 along with the cessation of blended water irrigation. Minimal irrigation occurred across the Stage 1B area and soil quality has generally improved across this area.

The TIP approval expired on 30 April 2015 and AGL is no longer irrigating the TIP area with blended water.

Important note about your report

This report has been prepared on behalf of, and for the exclusive use of AGL Upstream Investments Pty Ltd (the Client) and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client.

This report should be read 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. Jacobs accepts no liability or responsibility for any use or reliance on the report by third parties.

The sole purpose of this report is to present the results (in accordance with the scope of services developed with the Client) of soil quality monitoring for the reporting period 1st January to 30th June 2015 as part of the Tiedman Irrigation Program.

Some information in this report was sourced from the Client and/or was available in the public domain at the times documented in the report. Except as otherwise stated, Jacobs has not attempted to verify the accuracy or completeness of information (or confirmation of the absence thereof) sourced from the Client and/or third parties, and any such information is presumed accurate.

If information sourced from the Client and/or third parties is determined to be false, inaccurate or incomplete, the observations, recommendations and conclusions expressed in this report may need to be revised. Similarly, the manifestation of existing conditions, changes in conditions over time, or the impacts of future events may require the contents of this report to be re-evaluated.

Jacobs has prepared this report with care, thoroughness, and with reference to the relevant standards, guidelines, procedures and practices applicable at the date of issue of this report. Jacobs, to the extent permitted by law, makes no other warranty or guarantee (expressed or implied) to the data, observations, recommendations and conclusions expressed in this report.

1. Introduction

1.1 Overview

AGL Upstream Infrastructure Investments Pty Ltd (AGL) currently holds Petroleum Exploration Licence (PEL) 285. PEL 285 was granted under the provisions of the Petroleum (Onshore) Act 1991, for the undertaking of coal seam gas (CSG) exploration, assessment and production. In accordance with the PEL, AGL submitted a Review of Environmental Factors (REF) in 2011 for approval under Part 5 of the Environmental Planning and Assessment Act (1979) for CSG irrigation activities.

Conditional approval was granted to AGL by the Division of Resources and Energy (DRE) in July 2012 (and extended in July 2014 by the Office of Coal Seam Gas (OCSG) to implement the Tiedman Irrigation Program (TIP) for produced water storage, blending and irrigation activities on AGL's Tiedman property at Stratford in New South Wales (NSW). The REF approval references are 12/14515 (July 2012) and 13/36641 (July 2014).

On 6 August 2014, the NSW Environment Protection Authority (EPA) issued Environment Protection Licence (EPL) 20358 that covers the approved CSG exploration, assessment and production activities across the Gloucester Gas Project (GGP). Soil and water monitoring and reporting associated with the TIP are captured under both these approvals.

In October 2014, AGL engaged Jacobs Group (Australia) Pty Ltd (Jacobs) to provide technical services and compliance reporting for the ongoing soil monitoring and compliance program. This is the final report submitted under the DRE/OCSG approvals and the current EPL condition relating to the TIP. It is the sixth irrigation program compliance report.

In accordance with Condition 6 a) of the current OCSG approval, more detailed soil test pit investigations (including soil profile descriptions) and EM31 surveying were undertaken during this reporting period. Summary details are included in the main compliance report (see Sections 4 and 5) with full details provided as appendices to this report (Appendices F and G).

1.2 Tiedman Irrigation Program

As per Condition 3 of the REF approval, a comprehensive Soil Quality Monitoring and Management Program (SQMMP) was developed (Fodder King, 2012) and approved by DRE prior to the commencement of the irrigation activities. The SQMMP has the following objectives:

- Develop and monitor the performance of soils on the irrigation area against baseline soil quality parameters.
- Develop, manage and monitor the water and salt balances.
- Monitor, act, and report on any adverse trends or impacts on soil structure and soil quality parameters.
- Assess whether any trends or impacts are the result of TIP operations.

The TIP involves monitoring the soils across the approved irrigation areas following the application of a blend of GGP produced and fresh water (blended water). The program was for the reuse of up to 70 megalitres (ML) of produced water from exploration programs (irrigated as blended water) to support crop and pasture growth. Some 54 ML of produced water was irrigated by the end of the TIP (30 April 2015).

The GGP produced water was derived from historical flow testing programs that were approved exploration activities. No produced water from the Waukivory pilot program was available for irrigation. Blended water irrigation was only proposed for the reuse of produced water derived from exploration program activities. For any future activities, AGL has proposed the use of desalination prior to the reuse of extracted water from the Gloucester Gas Project (Stage 1) development.

This report (Report 6) was prepared following sampling and analyses of the soils of the two main irrigation areas (Stage 1A and Stage 1B; refer **Figure 1-1**) after irrigation with blended water during the January 2015 to April

2015 period. This report is the sixth irrigation program compliance report and constitutes the Baseline 7 Soil Study and the final soil study as identified in the SQMMP. Soil sampling was undertaken between 18th and 20th May 2015 in accordance with Condition 6 Table 1 of the OCSG approval (reference 13/36641 dated July 2014).

Irrigation activities ceased at AGL's TIP on 30 April 2015, as per the OCSG approval conditions. AGL did not seek an extension to the TIP because there was less than 1 ML of produced water remaining to be irrigated and produced water from the Waukivory Pilot was unlikely to be available for 3 to 6 months.

1.3 Existing information

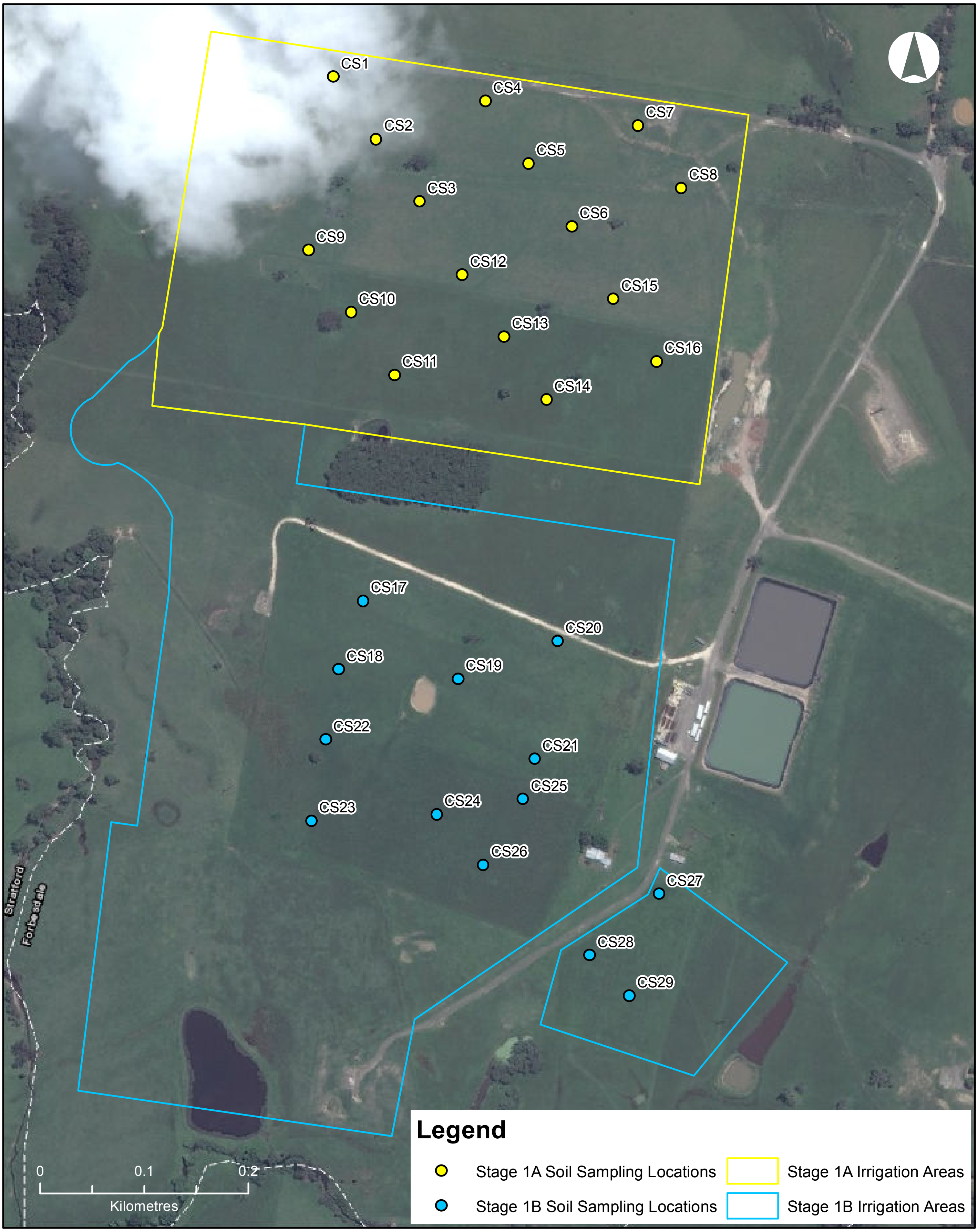
Baseline 1 (parent) soil and water studies were conducted in 2011 before irrigation activities at the Tiedman property began. Irrigation activities commenced in April 2013, and have been continuously monitored to assess the impacts of the blended water on the soils, water sources, and crops. All soil sampling events since early 2011 are referred to as 'baseline' as this irrigation program provides important information on soils, irrigation application rates and crops in advance of the irrigation reuse strategies proposed for the Stage 1 development.

The following reports on the soil studies have been submitted to date to comply with approvals:

- (Baseline 1) Preliminary Investigations and Design of an Irrigation Trial on land in the Gloucester Basin for irrigation of CSG water (Fodder King, 2011)
- Soil Quality Monitoring and Management Program (Fodder King, 2012).
- (Baseline 2) Soil Quality Monitoring and Management Program – Compliance Report 1: Pre-irrigation (Activities to 31 March 2013).
- (Baseline 3) Soil Quality Monitoring and Management Program – Compliance Report 2: Irrigation (Activities from 1 April to 30 June 2013).
- (Baseline 4) Soil Quality Monitoring and Management Program – Compliance Report 3: Irrigation (Activities from 1 July to 31 December 2013).
- (Baseline 5) Soil Quality Monitoring and Management Program – Compliance Report 4: Irrigation (Activities from 1 January to 4 July 2014) and Addendum.
- (Baseline 6) Soil Quality Monitoring and Management Program – Compliance Report 5: Irrigation (Activities from 5 July to 31 December 2014) .

In addition, two summary reports have been prepared on soil and cropping activities/results (mostly nutritional and salt/trace mineral results):

- Summary Report 1 (Soil and cropping activities to 31 August 2013) - Tiedman Irrigation Trial.
- Summary Report 2 (Soil and cropping activities from 1 September 2013 to 31 March 2014) - Tiedman Irrigation Program.



Site ID	Easting	Northing	Site ID	Easting	Northing	Site ID	Easting	Northing	Site ID	Easting	Northing	Site ID	Easting	Northing	Site ID	Easting	Northing
CS1	402197	6449447	CS6	402427	6449303	CS11	402256	6449160	CS16	402508	6449173	CS21	402391	6448791	CS26	402342	6448690
CS2	402239	6449387	CS7	402490	6449400	CS12	402321	6449256	CS17	402226	6448943	CS23	402177	6448732	CS27	402511	6448662
CS3	402281	6449327	CS8	402532	6449340	CS13	402361	6449197	CS18	402203	6448878	CS22	402190	6448810	CS28	402444	6448603
CS4	402344	6449423	CS9	402174	6449280	CS14	402402	6449137	CS19	402317	6448868	CS24	402297	6448738	CS29	402482	6448564
CS5	402385	6449363	CS10	402215	6449221	CS15	402467	6449233	CS20	402413	6448904	CS25	402380	6448753			

Figure 1-1 Tiedman Irrigation Program Soil Sampling Locations

1.4 Summary of previous studies and field activities

Table 1-1 presents summary information regarding the previous investigations, design studies and compliance reports conducted for the TIP. The rainfall and blended water irrigation applications are provided here to demonstrate that rainfall was generally more dominant than irrigation for the last two years.

Table 1-1 Previous studies and field activities for the Tiedman Irrigation Program

Baseline	OCSG Event	Reporting period	Report type	Rainfall (mm)	Stage 1A Irrigation (mm)	Stage 1B Irrigation (mm)	Comment
B1	-	Activities to 30th June 2011	Parent soil baseline	-	-	-	Parent soil sampling and analysis prior to amelioration and irrigation. Investigations included test pitting, push core sampling, and an EM31 survey.
B2	Baseline	Activities from 1st July 2012 to 31st March 2013	Compliance report 1	739	Zero	354	Sampling of ameliorated soil prior to irrigation
B3	Irrigation 1	1st April to 30th June 2013	Compliance report 2	206	39	42	Sampling of soil after initial irrigation activities.
B4	Irrigation 2	1st July to 31st December 2013	Compliance report 3	231	270	279	Soil sampling after irrigation during reporting period.
B5	Irrigation 3	1st January to 4th July 2014	Compliance report 4	303	212	182	Soil sampling after irrigation during reporting period. Investigations included test pitting and a repeat EM31 survey.
B6	Irrigation 4	5th July to 31st December 2014	Compliance report 5	417	154	Zero	Soil sampling after irrigation during reporting period.
B7	Irrigation 5 (this report)	1st January to 30th June 2015	Compliance report 6 (*this report*)	555 (393 (1))	103	24	Soil sampling after irrigation during reporting period. Investigations included test pitting and a repeat EM31 survey.

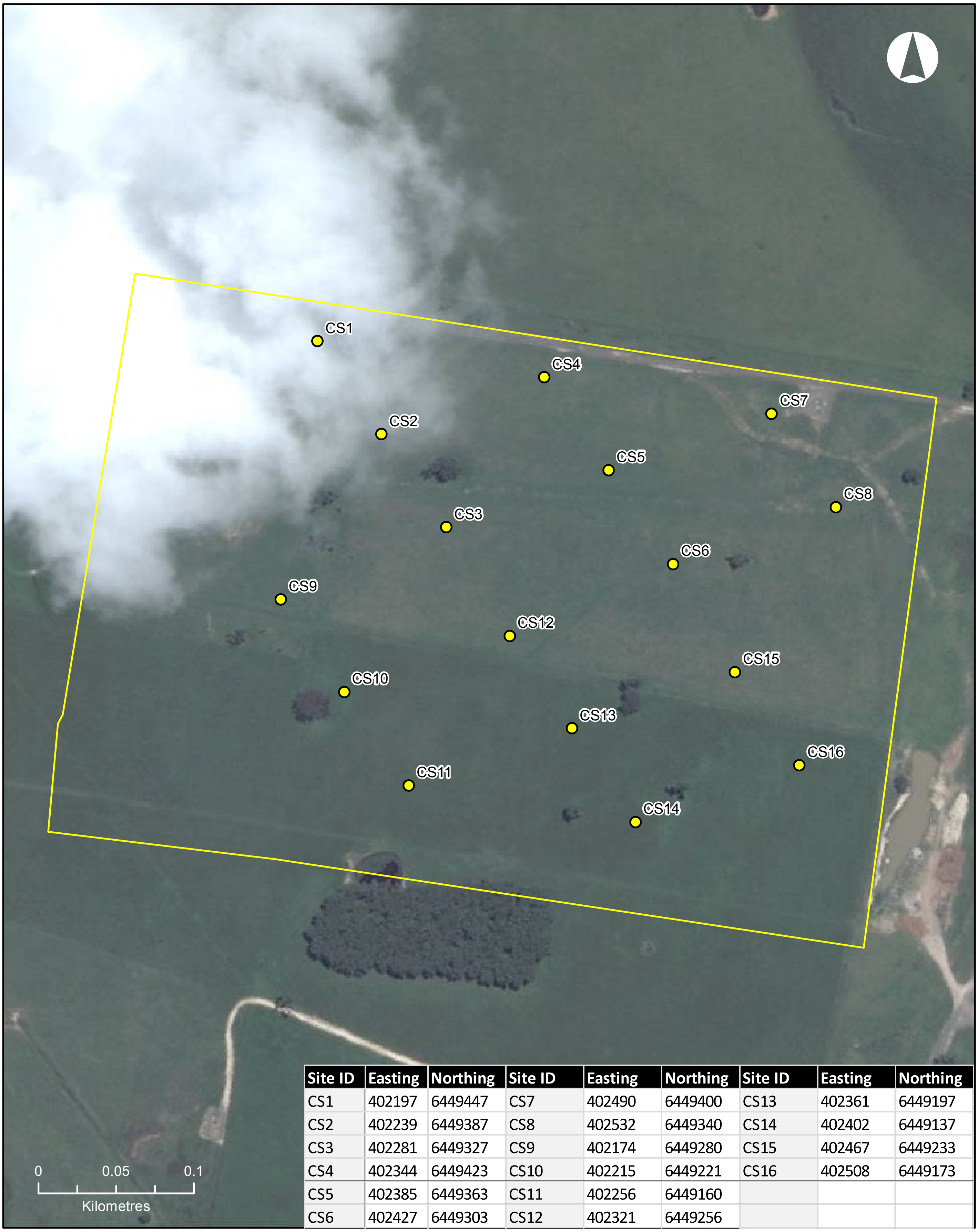
Note: (1) – this is the rainfall for the period 1 January to 30 April 2015.

1.5 Stage 1A irrigation area

1.5.1 Objectives

The active irrigation area within the Stage 1A area (**Figure 1-2**) is 12 hectares (ha) in size and comprises 16 plots (of equal dimensions) 0.75 ha in size. The irrigation program involves two crop systems (annuals and perennials) and four soil treatments. The objectives of the Stage 1A Irrigation program are to:

- Derive information about the use of blended water on improved soils in order to optimise the beneficial use of produced water.
- Provide information to optimise the design of a water treatment and storage system to match longer term beneficial re-use opportunities.
- Achieve blended water application rates in the range of 3 to 5 megalitres per hectare per year (ML/ha/Year) to minimise the overall 'footprint' of the project on the surrounding landscape.



Site ID	Easting	Northing	Site ID	Easting	Northing	Site ID	Easting	Northing
CS1	402197	6449447	CS7	402490	6449400	CS13	402361	6449197
CS2	402239	6449387	CS8	402532	6449340	CS14	402402	6449137
CS3	402281	6449327	CS9	402174	6449280	CS15	402467	6449233
CS4	402344	6449423	CS10	402215	6449221	CS16	402508	6449173
CS5	402385	6449363	CS11	402256	6449160			
CS6	402427	6449303	CS12	402321	6449256			

Legend

Stage 1A Soil Sampling Locations

Stage 1A Irrigation Areas

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Figure 1-2 Tiedman Irrigation Program
Stage 1A Soil Sampling Locations

1.5.2 Stage 1A Program activities

The program involves:

- Initial application and incorporation of ameliorants to the natural soils (complete).
- Irrigation of the ameliorated soils with blended water (complete).
- Regular sampling and testing of the soil samples (complete although some ongoing sampling is required as part of the EPL).
- Calculation of the mass and water balances (complete).
- Interpretation of, and reporting on, results of laboratory analyses (complete with this report).
- Application of lime and gypsum in April 2015 (complete).

The application of blended water to the Stage 1A area was subject to recommendations arising from daily water balance monitoring and anticipated weather conditions. For this reporting period, the irrigation application was 103 mm.

In the period from 1st January to 30th June 2015, approximately 12.4 ML of blended water was irrigated across the Stage 1A area, with the actual irrigation period ceasing on 30th April 2015. This blended water was taken from the Tiedman South dam (TSD) and applied using an overhead linear move irrigator.

1.6 Stage 1B irrigation area

1.6.1 Objectives

Stage 1B land area has no previous history of cropping or substantial soil improvement, although improved pasture was briefly irrigated in 2009 when small amounts of produced water were irrigated under an earlier REF approval (details provided in AGL 2010). Some soil sampling and monitoring was completed as part of this earlier irrigation program.

The Stage 1B irrigation area is approximately 4.1 ha containing four plots with a mix of annual and perennial pasture species. Even though a larger area was nominated in the SQMMP, the larger Stage 1B area was never irrigated under the current program. The Stage 1B irrigation area (actual and originally proposed) is shown in **Figure 1-3**.

1.6.2 Stage 1B Program activities

The program involves:

- Irrigation with blended water (complete);
- Regular sampling and testing of the soil samples (complete although some ongoing sampling is required as part of the EPL);
- Calculation of the mass and water balances (complete);
- Interpretation of, and reporting on, results of laboratory analyses (complete with this report).

The application of blended water to the Stage 1B (actual) area is subject to recommendations arising from daily water balance monitoring and anticipated weather conditions.

Only 1.4 ML of blended water was applied to the Stage 1B (actual) area from 1st January to 30th June 2015 with the irrigation period ceasing on 30th April 2015.

Site ID	Easting	Northing	Site ID	Easting	Northing	Site ID	Easting	Northing
CS17	402226	6448943	CS22	402190	6448810	CS29	402482	6448564
CS18	402203	6448878	CS24	402297	6448738			
CS19	402317	6448868	CS25	402380	6448753			
CS20	402413	6448904	CS26	402342	6448690			
CS21	402391	6448791	CS27	402511	6448662			
CS23	402177	6448732	CS28	402444	6448603			

Legend

- Stage 1B
- Stage 1B Irrigation Areas

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Figure 1-3 Tiedman Irrigation Program
Stage 1B Soil Sampling Locations

2. Mass balance results

2.1 Average rainfall patterns

The Tiedman irrigation site lies within a relatively high rainfall zone, with a mean rainfall of approximately 961 mm/year, slightly summer-dominant. Rainfall data used to determine long-term annual average was based on the 126 year record at the Gloucester Post Office Bureau of Meteorology (BOM) site (Station #060015). Actual rainfall data from the AGL weather station at the Tiedman site (located adjacent to the Stage 1B irrigation area), together with (in field) soil moisture probes are used to determine irrigation scheduling. The consideration of rainfall is a significant factor in determining the timing (and volume) of when irrigation will be undertaken.

2.2 Rainfall and evapotranspiration

Figure 2-1 summarises rainfall and evapotranspiration (ETo) from 1st January 2015 – 30th June 2015. 554.6 mm of rain occurred during the period (based on data from the AGL Tiedman weather station). Total rainfall across the Stage 1A (12 ha; 66.6 ML) and Stage 1B (4.1 ha; 22.8 ML) plot areas provided 89.4 ML of water, although for the actual irrigation period to 30th April 2015 the rainfall volumes equated to 47.1 ML (Stage 1A) and 16.1 ML (Stage 1B).

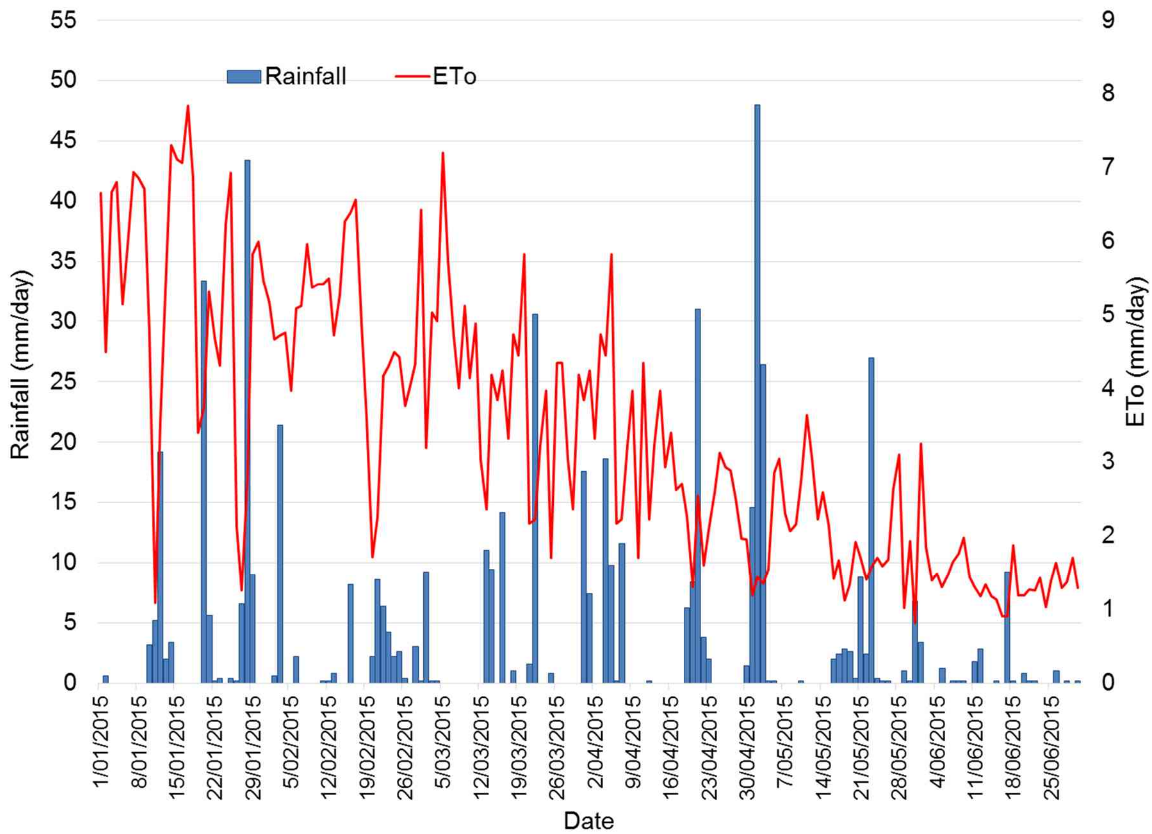

Figure 2-1: Rainfall (sourced from AGL weather station) and evapotranspiration (ETo) at the Tiedman property (1st January 2015 – 30th June 2015)

There are no evapotranspiration (ETo) data specific to the site (see explanation in Fodder King, 2011). Therefore, ETo was interpolated from regionally available data through the *iWater* service. Although the reporting period was from 1/1/2015 – 30/6/2015, the irrigation of blended water ceased on the 30/4/2015. **Table 2-1** shows the total water received across the Stage 1A area for both the reporting and irrigation periods. Total water received across the Stage 1B area, for both periods, is shown in **Table 2-2**.

Table 2-1: Rainfall and irrigation for Stage 1A

Units	Rainfall	Irrigation	Total	Rainfall	Irrigation	Total
	1/1/2015 – 30/4/2015			1/1/2015 – 30/6/2015		
mm	392.6	103.2	495.8	554.9	103.2	658.1
ML	47.1	12.4	59.5	66.6	12.4	79
%	79	21	100	84	16	100

Table 2-2: Rainfall and irrigation for Stage 1B

Units	Rainfall	Irrigation	Total	Rainfall	Irrigation	Total
	1/1/2015 – 30/4/2015			1/1/2015 – 30/6/2015		
mm	392.6	34.1	426.7	554.9	34.1	589.0
ML	16.1	1.4	17.5	22.8	1.4	24.2
%	92	8	100	94	6	100

2.3 Irrigation scheduling and water balance

2.3.1 Irrigation guidelines

The water balance calculated in the following sections is based on *Environmental Guidelines: Use of Effluent for Irrigation* (DECC 2004).

2.3.2 Stage 1A irrigation estimates

Calculation of the required amount of irrigation follows the formula:

Applied blended water (Qcsg) + Rainfall (Qr) ≤ Evapotranspiration (ET) + Percolation (P) + Runoff (R) + Interception Loss (IL), where R is designed to be zero.

From this, the daily water balance is:

Qcsg ≤ ET + P + IL – Qr

and the daily irrigation deficit is calculated:

Daily Irrigation Deficit (DID) = ET + P + IL – (Qr + Qcsg)

Negative resulting values indicate irrigation should not be applied.

The cumulative DID (over seven-day periods) was used in conjunction with real-time soil moisture monitoring to determine if irrigation was possible at a given time. For example, a 25 mm rainfall event may offset six days (or more) of low ETo, and if the rainfall event saturates the soil, then irrigation does not occur.

Figure 2-2 summarises the DID, cumulative DID (seven-day) and applied irrigation of blended water for the period 1st January 2015 – 30th June 2015. Cessation of irrigation at the TIP occurred on 30th April 2015.

In addition to the water balance, real-time soil moisture monitoring ensured that irrigation was only applied when there was available capacity, or “space”, in the soil profile. **Figure 2-3** and **Figure 2-4** show the wetting and drying patterns of soil moisture sensor (MS) one (MS1) (outside the irrigation area) and soil moisture sensor five (MS5) (in deepest treatment zone within irrigation area).

The broad similarity between irrigated and non-irrigated soils and their wetting and drying periods indicates that the structure of the receiving soil is being maintained and water is passing to the deeper sub-soil. For example, comparison of **Figure 2-3** and **Figure 2-4** shows that water movement through the soil has not been significantly altered by irrigation. That is, the general wetting and drying periods in MS1 (due to rainfall shown by blue columns in **Figure 2-3**) are generally observed in MS5 trends (**Figure 2-4**). These similar patterns reflect water either moving to deeper groundwater or being used by plants. Irrigation (black columns in **Figure 2-4**) was only applied to MS5, however, and these irrigation “spikes” increased the presence of soil water during this period and allowed considerable water uptake by plants in the Stage 1A area.

Irrigation of blended water occurred intermittently from 1st January - 30th April 2015 as indicated by the water balance previously described. Approximately 12.4 ML of blended water was applied to the Stage 1A area during the period. The DID, cumulative DID, and soil moisture indicated that these were optimum irrigation opportunities that would result in zero runoff while maintaining soil moisture levels suitable for crop growth.

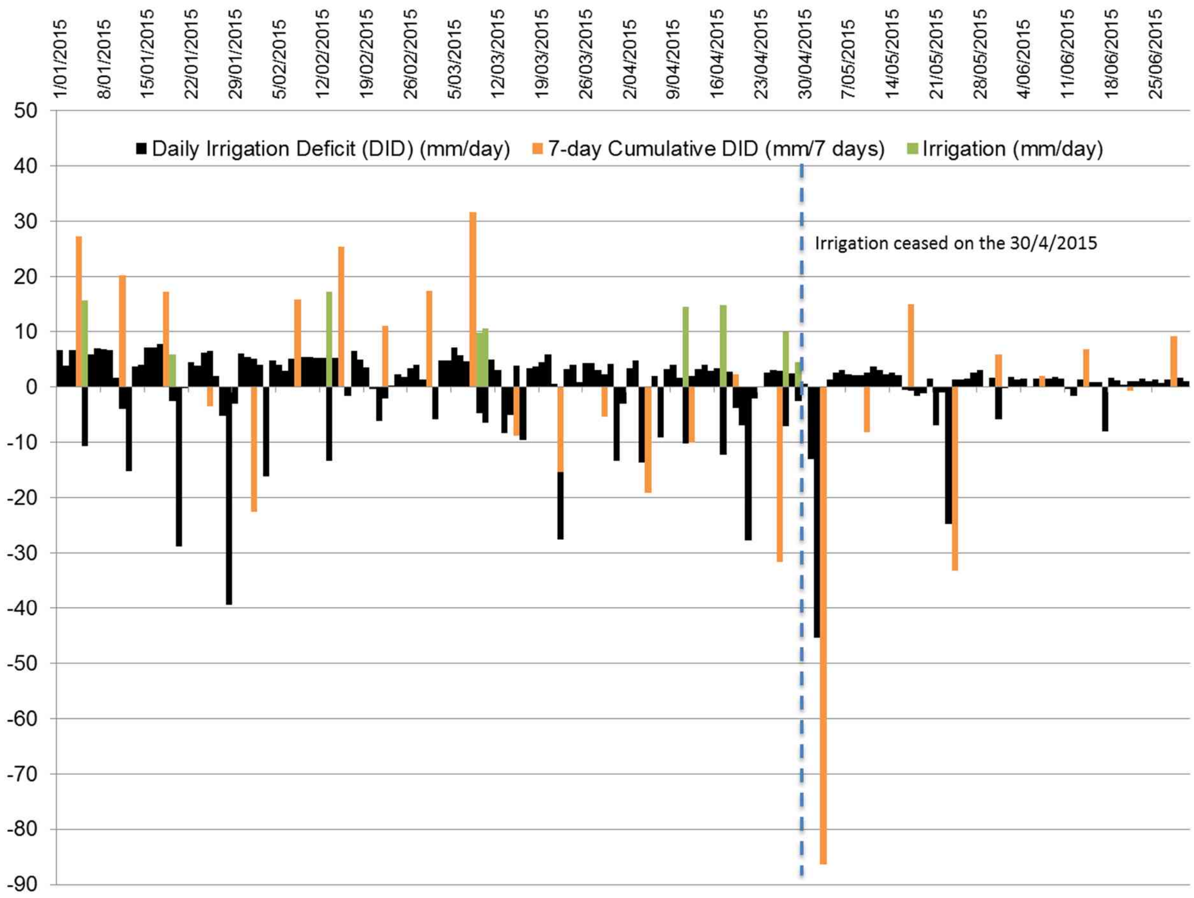

Figure 2-2: Stage 1A DID, seven-day cumulative DID and irrigation applied (1st January 2015 – 30th June 2015)

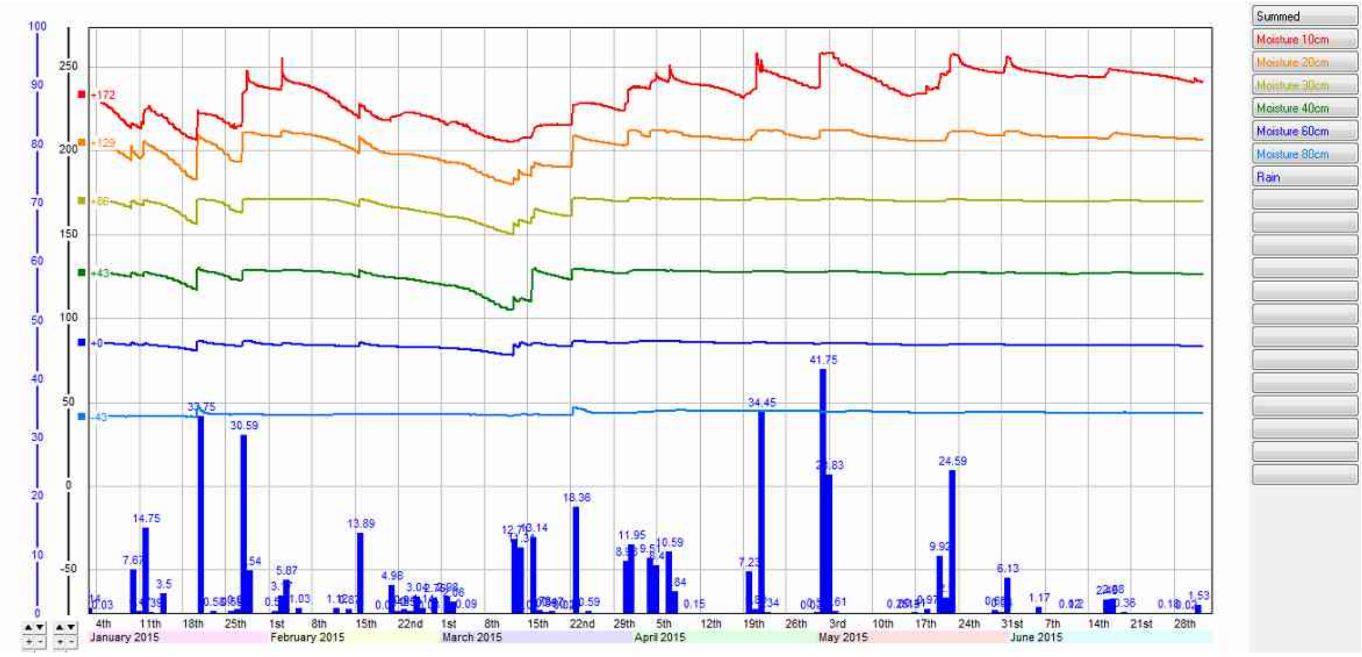

Figure 2-3: Soil moisture monitoring showing wetting and drying periods for MS1 (control, outside irrigation area) (1st January 2015 – 30th June 2015)

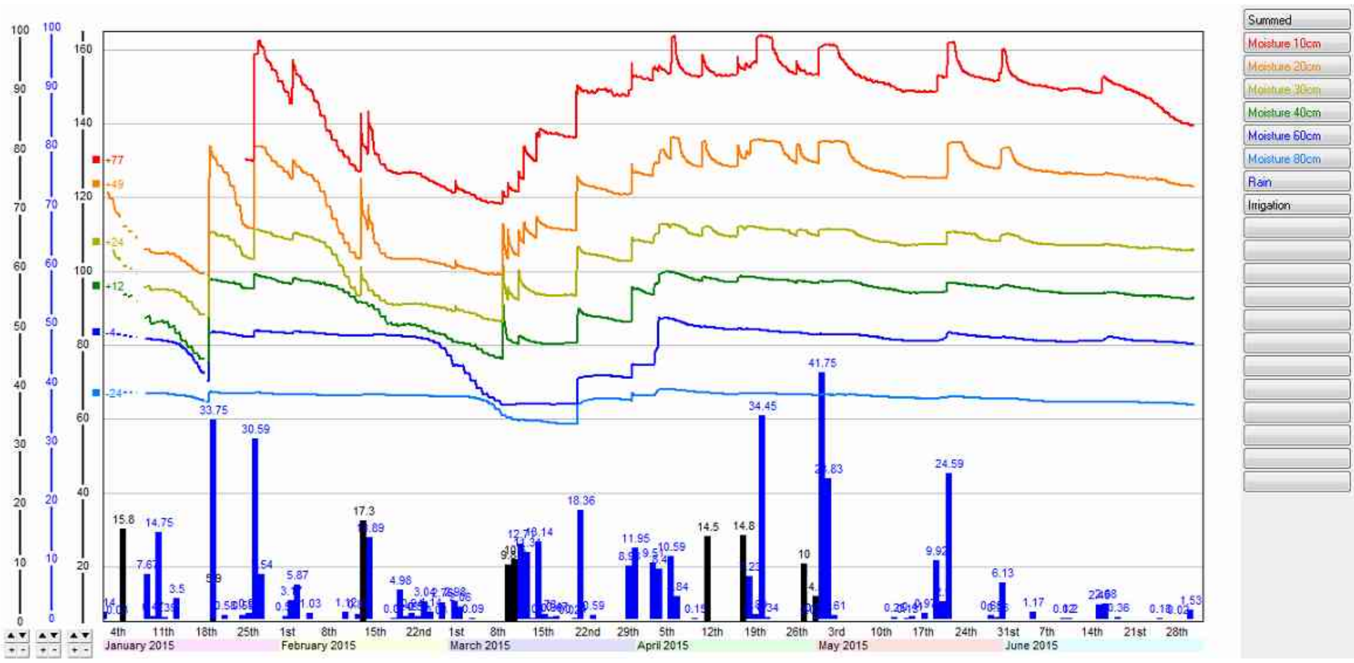

Figure 2-4: Soil moisture monitoring showing wetting and drying periods for MS5 (inside irrigation area) (1st January - 30th June 2015)

2.3.3 Stage 1B

Stage 1B does not contain moisture sensors or other telemetry systems due to the lack of any intensive irrigation operations across the site. Only 1.4 ML of blended water was irrigated across the Stage 1B area from 1st January - 30th April 2015. Stage 1B received 554.9 mm (22.8 ML) of rainfall during the reporting period (1/1/2015 – 30/6/2015) and 392.6 mm (16.1 ML) during the irrigation period (1/1/2015 – 30/4/2015).

2.4 Irrigation water quality

Table 2-3 summarises water quality of the blended water used to irrigate Stage 1A from 1st January - 30th April 2015 (from Parsons Brinckerhoff 2015). The water quality results presented are from the May 2015 quarterly sampling event from the TSD rather than the February 2015 sampling event because this lower salinity blended water is more representative of the irrigation water quality from March onwards.

Table 2-3: Water quality of the blended water prior to irrigation (sampled from TSD on the 13/5/2015)

Parameter	Units	Value	Parameter	Units	Value
Electrical Conductivity (EC)	µS/cm or decisiemens (dS)/metre (m)	1120 or 1.12	Iron (Fe various oxidation states)	mg/L	<0.05
pH	pH units	9.13	Magnesium (Mg^{2+})	mg/L	5
Chloride (Cl^-)	milligrams (mg)/litre (L)	167	Manganese (Mn^{2+})	mg/L	0.004
Sodium (Na^+)	mg/L	200	Nitrate nitrogen (NO_3^-)	mg/L	<0.01
Sodium Adsorption Ratio (SAR)	-	12.6	Total Kjeldahl Nitrogen (TKN)	mg/L	7.2
Total Alkalinity	mg $CaCO_3$/L	261	Total Phosphorus (total P)	mg/L	0.85
Bicarbonate Alkalinity (HCO_3)	mg $CaCO_3$/L	156	Orthophosphate (PO_4^{3-})	mg/L	0.01
Carbonate Alkalinity (CO_3^-)	mg $CaCO_3$/L	104	Potassium (K)	mg/L	56
Aluminium (Al^{3+})	mg/L	<0.01	Sulfate (SO_4^{2-})	mg/L	12
Boron (B)	mg/L	0.14	Zinc (Zn^{2+})	mg/L	0.009
Calcium (Ca^{2+})	mg/L	11	Total Dissolved Solids (TDS)	mg/L	586
Copper (Cu^{2+})	mg/L	0.002	Total Organic Carbon (TOC)	mg/L	25
Fluoride (F^-)	mg/L	0.3			

Note – Water quality analysis sourced from Parsons Brinckerhoff (2015)

The water monitoring compliance reports utilise the ANZECC (2000) (irrigation) water quality guidelines, which have been adopted as the most appropriate criteria to assess the suitability of blended water for irrigation. The late season blended water had an (laboratory) EC of 1120 µS/cm (1.12 dS/m) which was below the mixing-model design objective for water quality prior to irrigation (approximately 1500 µS/cm or 1.5 dS/m). Blended water with lower salinity levels was irrigated because of the (remaining) low volumes of produced water and availability of freshwater. pH just exceeds the upper end of the ANZECC guidelines (between 6 and 9) even though the blended water was dosed in March and field readings suggest that the pH was below pH 9 when irrigated in March-April 2015 (Parsons Brinckerhoff, 2015).

Sodium (Na^+), nutrients and total organic carbon (TOC) values are discussed in **Section 2.5.1** and **Section 2.5.2** with respect to mass balance results and potential impacts on site soils.

2.5 Sodium, nutrient and carbon balance

The aim of using mass balances was to determine how the Na^+, nutrient and carbon (C) load in the applied water was accumulating in the receiving soil over time. Mass balance results are presented as mg/kilogram (kg) applied during the reporting period and are compared to soil data to determine changes over time.

2.5.1 Stage 1A

The mass of soil in Stage 1A was calculated as:

Soil mass = 119,400 m^2 (plot area) x 0.333 m (average treatment depth) x 1200 kg/m^3 or grams (g)/cm^3 (soil bulk density)

= 47,712,240 kg of soil in Stage 1A.

Table 2-4 provides a summary of mass balances for Na^+, total nitrogen (total N) and nitrate (NO_3^-), total phosphorus (total P), and TOC in both water and soil.

Approximately 52 mg/kg of Na^+ (**Table 2-4**) has been applied during the reporting period. Soil analysis over this period (discussed in Section 4) indicated that Na^+ ranged from approximately 216 mg/kg to 1091 mg/kg (to 120 cm) with an average of 561 mg/kg (Standard Deviation (SD) = 181). The 52 mg/kg applied during this period decreased soil Na^+ compared to Baseline 6 (November 2014 results). At these levels, however, it is likely to have minor impact on soil structure and water movement through the soil at this time. This is discussed in **Section 3.1.6**.

Nitrate nitrogen, total phosphorous and total organic carbon (TOC) have been applied in negligible quantities (Table 2-4) through irrigation applications during the reporting period.

Table 2-4: Stage 1A mass balance summary for Na^+, NO_3^-, total N, total P and TOC (1st January - 30th June 2015)

Parameter	TSD water quality (mg/L)	Irrigation (ML)	Total Applied (mg)	Site soil mass (kg)	Total Applied (mg/kg)
Na^+	200	12.38	2,476,000,000	47,712,240	52
NO_3^-	0.01	12.38	123,800	47,712,240	0.003
Total N	7.2	12.38	89,136,000	47,712,240	1.87
Total P	0.85	12.38	10,523,000	47,712,240	0.22
TOC	25	12.38	309,500,000	47,712,240	6.49

2.5.2 Stage 1B

The mass of soil in Stage 1B was calculated as:

Soil mass = 40,000 m^2 (plot area) x 0.15 m (average treatment depth) x 1200 kg/m^3 or grams (g)/cm^3 (soil bulk density)

= 7,200,000 kg of soil in Stage 1B.

Table 2-4 provides a summary of mass balances for Na^+, N and NO_3^-, total P, and TOC in both water and soil. Only 1.4 ML of blended water was applied to Stage 1B from 1st January - 30th April 2015 so the mass balance results indicate a very low loading of all parameters.

Approximately 27.8 mg/kg of Na^+ has been applied during the reporting period. Soil analysis over this period (discussed in **Section 4**) indicated that Na^+ ranged from approximately 200 mg/kg to 940 mg/kg (to 120 cm) with an average of 602 mg/kg (Standard Deviation (SD) = 280). The 27.8 mg/kg applied during this period is likely to have minor impact on soil structure and water movement through the soil at this time.

Table 2-4: Stage 1A mass balance summary for Na^+, NO_3^-, total N, total P and TOC (1st January - 30th June 2015)

Parameter	TSD water quality (mg/L)	Irrigation (ML)	Total Applied (mg)	Site soil mass (kg)	Total Applied (mg/kg)
Na^+	200	1	200,000,000	7,200,000	27.8
NO_3^-	0.01	1	10,000	7,200,000	0.001
Total N	7.2	1	7,200,000	7,200,000	1.0
Total P	0.85	1	850,000	7,200,000	0.12
TOC	25	1	25,000,000	7,200,000	3.5

3. Soil sampling and analysis

3.1 Stage 1A

3.1.1 Introduction

The following sections summarise the findings of the Baseline 7 Soil Study (conducted by Jacobs between 18th and 20th May 2015) combined with historic data sourced from the existing reports listed in **Section 1.3,** which are available on the AGL website.

Baseline soils data from both within the Stage 1A and 1B irrigation areas, and outside of these areas on the Tiedman property are presented in Fodder King, 2011; Fodder King, 2012; and Parsons Brinckerhoff, 2014. Latest results are compared against the parent soil results (B1 from Fodder King, 2011) and baseline soil quality results (post treatment but pre irrigation – B2 from Fodder King, 2013).

Interpretation of these data is based on a 'desired range' for the soil properties analysed. The definition of the term 'desired range' is consistent with Hazelton and Murphy (2007), whereby soil property values are assessed in relation to achieving optimum soil conditions for pasture or crop yields. These data are not to be interpreted as absolute indicators of soil health.

3.1.2 Soil sampling

The soils were sampled at one sampling location per plot (CS1 to CS16) on each of the 16 plots that comprise the Stage 1A area (refer **Figure 1-2**). All soil samples were collected from within the slotted and ameliorated soil profile (where present). Soil samples were collected at 20 cm vertical depth intervals after hand augering to a maximum depth of 1.2 m, or until refusal on rock. Where the plots were slotted, samples were collected from the constructed slots to assess the migration of salts throughout the profile. **Table 3-1** presents a summary of the sampling depths reached during hand augering within the Stage 1A area.

Table 3-1 Summary of sampling depths reached for Site 1A locations

Site ID	0 to 20 cm	20 to 40 cm	40 to 60 cm	60 to 80 cm	80 to 100 cm	100 to 120 cm	Comment
CS1	✓	✓	✓	✓	✓	✓	
CS2	✓	✓	✓	✓	✓	✓	
CS3	✓	✓	✓	✓	✓	✓	
CS4	✓	✓	✓	✓	✓	✓	
CS5	✓	✓	✓	✓	×	×	Refusal of auger
CS6	✓	✓	✓	✓	✓	✓	
CS7	✓	✓	✓	✓	✓	✓	
CS8	✓	✓	✓	✓	✓	✓	
CS9	✓	✓	✓	✓	✓	✓	
CS10	✓	✓	✓	✓	✓	✓	
CS11	✓	✓	✓	✓	×	×	Refusal of auger
CS12	✓	✓	✓	✓	✓	✓	
CS13	✓	✓	✓	✓	✓	✓	
CS14	✓	✓	✓	✓	✓	✓	
CS15	✓	✓	✓	✓	✓	✓	
CS16	✓	✓	✓	✓	×	×	Refusal of auger

The samples were transported to the Eastwest Enviroag Pty Ltd (Eastwest) laboratory in Tamworth for analysis. The soil properties analysed by Eastwest are listed in **Appendix A**. A summary of the Stage 1A results is provided in **Appendix B**. Complete results for the sampling locations are provided in **Appendix C**.

Comparison of the Baseline 7 and Baseline 6 studies are shown in **Appendix D**. In addition, Baseline 7 results are also compared against Baseline 1 results (parent soil values). The following provides an overview the data and interpretation of results from the Stage 1A area.

3.1.3 Salinity

The extent to which salts accumulate in the soil depends on the degree of leaching, which is controlled by the climatic influences of rainfall and evaporation, together with soil permeability. Plant tolerances to salinity will vary depending on various soil properties, but also on the salinity of irrigation waters, which should be taken into account when using the $EC_{1:5}$ soil/water method of measurement.

The soluble salt contents (salinity) of the soil samples collected from Stage 1A were estimated by measuring the electrical conductivity (EC) of 1:5 soil/water solutions. This record of the salinity levels has proved a useful indicator of the physical condition of the soils and of plant thresholds to fluctuating salt levels.

Consistent with findings by Fodder King (2014b), the salinity 'spike' resulting from the use of compost prior to Baseline 2 and the mixing of horizons in the parent soil has subsided. Salinity levels are lower than the Baseline 5 event in 2014 when irrigation was more intensive and greater volumes of blended water were applied. Lower levels of soil salinity are not unexpected given the lower volumes of blended water and the lower salinity water that were irrigated during most of the reporting period.

The average $EC_{1:5}$ for Baseline 7 was similar at all depths compared to Baseline 6 results (refer to **Figure 3-1**) with the exception of CS3 (refer to **Figure 3-2**). Results down to 120 cm at CS3 indicate an increase in EC through the soil profile compared to Baseline 6. However, the deep slotted profile at this site, the addition of gypsum/lime in April 2015, and wetter conditions during April/May, would have likely contributed to increased EC at all depths at the time of sampling (May 2015).

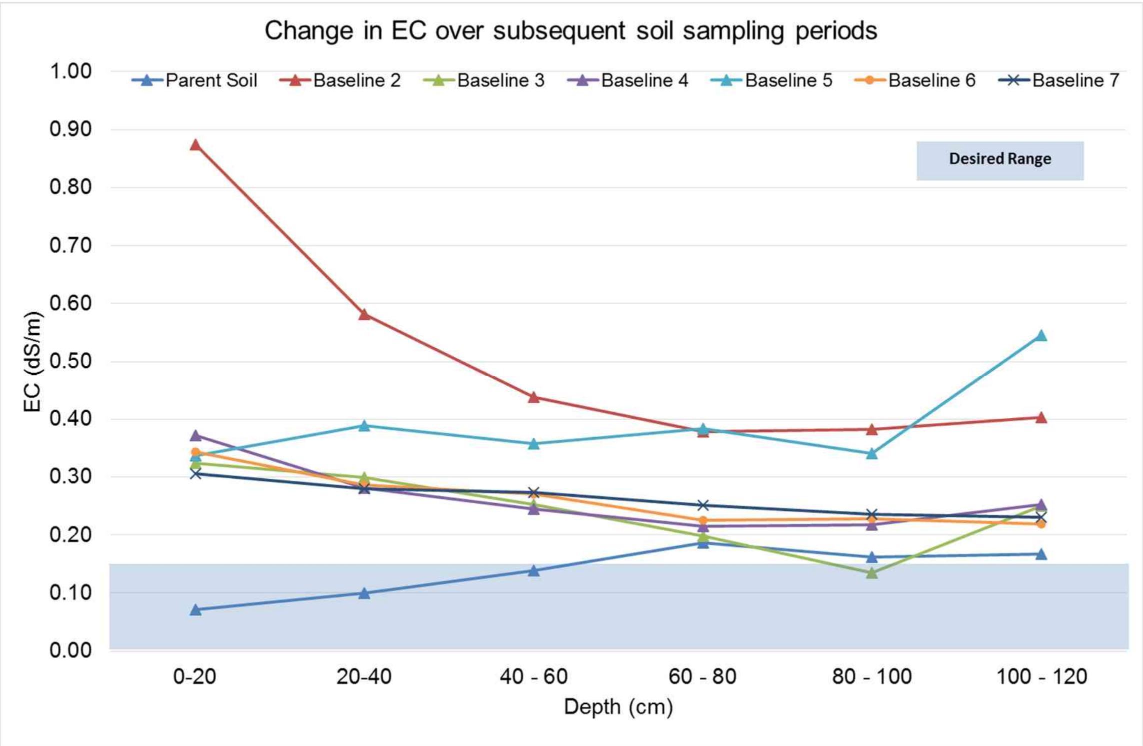

Figure 3-1: Change in (average) EC for all sites over subsequent sampling periods

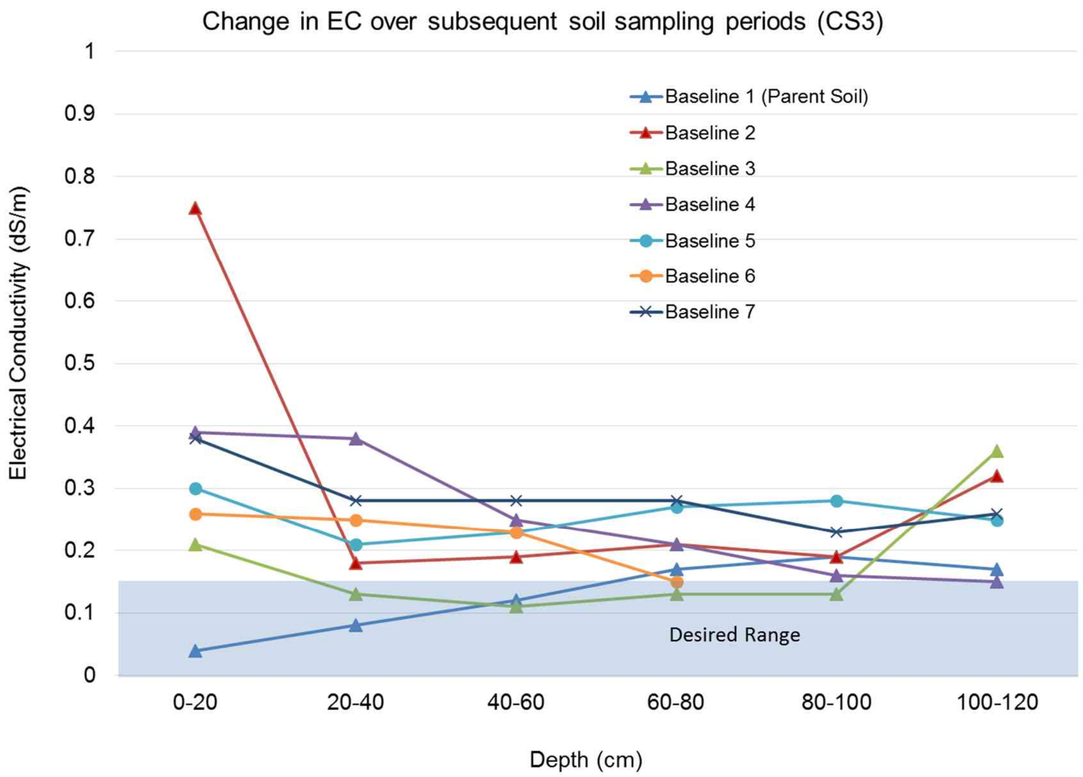

Figure 3-2 Change in EC at CS3 over subsequent sampling periods

3.1.4 Sodium and Exchangeable Sodium Percentage (ESP)

The ESP is the proportion of sodium (Na^+) in relation to total exchangeable cations, or cation exchange capacity (CEC), of the soils and may be considered an indicator of sodicity (the potential for soils to disperse due to low soil aggregate stability), with high sodicity being a significant impediment to soil health.

Sodicity is typically a consequence of widespread salt accumulation in the landscape, however not all sodic soils are saline. Indeed, highly sodic materials that are low in salt are those most susceptible to dispersion (Shaw, 1999), resulting in a decrease in soil permeability and porosity. This general degradation of soil physical condition (structure) will limit the movement of air, water and nutrients in the soil as well as inhibit pasture and crop root growth. Further, excessively high or low concentrations of Na^+ may affect the nutritional requirements of germinating plants.

ESP can be measured, but it is generally easily calculated. The ESP of the soil samples collected from the Stage 1A area was calculated using the following equation:

ESP = Exchangeable Na^+ (meq/ 100 g)/ CEC (meq/ 100 g)] x 100

The Stage 1A area soils are found to be naturally sodic, acidic and saline at depth (Fodder King, 2011; Fodder King, 2012; Parsons Brinckerhoff, 2014). Compared to Baseline 6 results, the latest average Na^+ values are similar for the upper soil profile to 80 cm but have increased slightly at depth (>80 cm). As a result, the ESPs at depth have also increased. These data are consistent with the irrigation of fresher water, high rainfall prior to soil sampling and the deep leaching of salts into the profile.

Throughout the profile, and through time, the ESP has been above what is considered the desirable level of 6% to 120 cm depth (refer to the composite changes shown in **Figure 3-3**). However most soil samples sampled during the blended water program have ESP values that are lower than the Baseline 1 values (untreated parent soil – pre-irrigation) except for the very shallow soils (<20 cm).

The slotting and soil treatments incorporated pre-irrigation with blended water improved the ESP of the soil profiles as evidenced by the Baseline 2 and 3 laboratory results. However in recent years there has been a gradual increase in ESP as evidenced by the Baseline 4, 5, 6, and 7 laboratory results. Soil ESPs are now similar (but still slightly less than) to the untreated parent soil results except for the very shallow soils (< 20 cms).

Although an ESP >6 is a general indication that the soil is sodic, there are no indications of adverse effects on the soil physical condition. It is important to note that, in addition to the electrolyte concentration of any irrigation waters, the effect of ESP on clay dispersion is also influenced by other soil properties such as organic matter content, clay mineralogy, cations, and oxide content (Rengasamy and Churchman 1999; McKenzie et al. 2004).

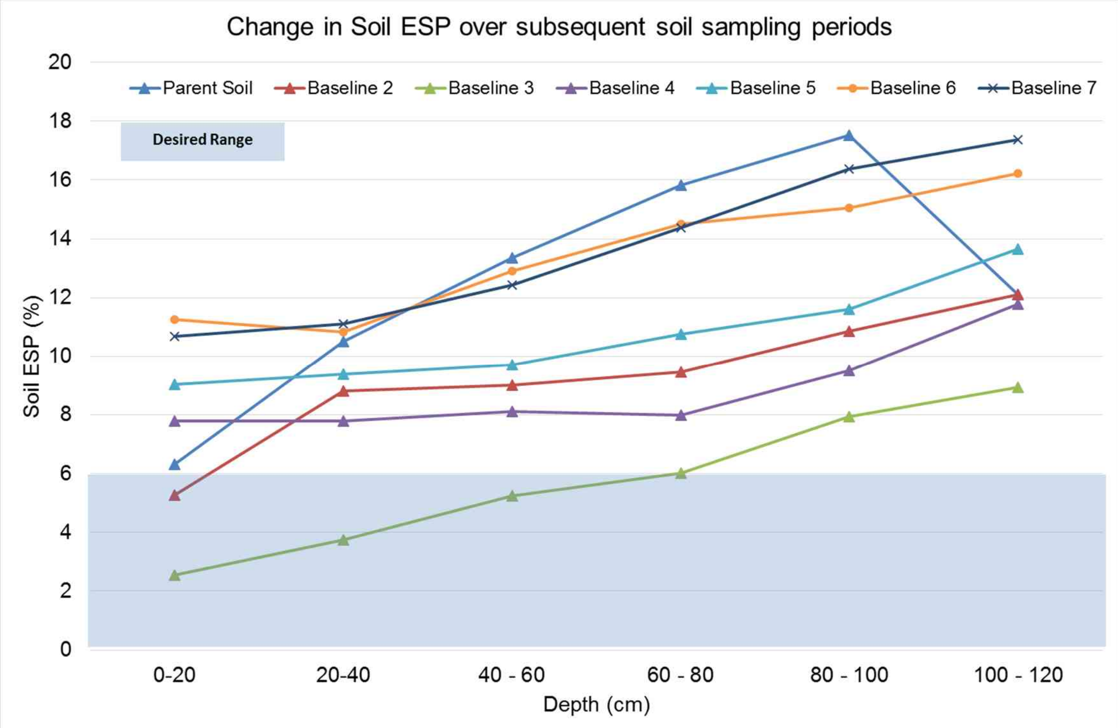

Figure 3-3: Change in (average) ESP for all sites over subsequent soil sampling periods

3.1.5 Calcium and magnesium

The calcium/magnesium ratio (Ca:Mg) is found by dividing the quantity of calcium (meq/100 g) by the quantity of magnesium (meq/100 g). If the value is below 2, this affects the ability for plants to take up potassium, and there can be problems with soil structure breaking down due to dispersion which may inhibit plant growth. A Ca:Mg ratio of around 2 is considered to represent the minimum requirement for plant growth, and 3 to 6 is optimal.

Compared to Baseline 6 results, Ca^{2+} levels (calculated as mg/kg), and Ca:Mg ratios, have increased in the Stage 1A area soils. This increase is the result of gypsum and lime applications that were applied to the upper soil profile in April 2015. The average Ca:Mg ratio for the samples collected at 0-20 cm depth is currently 1.8 (up from 1.2 in November 2014). The Ca:Mg for the samples taken from >20 cm depth remain extremely low (<1). The current Ca:Mg ratios (and those during the irrigation program) are higher that the untreated parent soil ratios which were all <0.7 with most being <0.1.

3.1.6 Effective cation exchange capacity

The amounts and relative proportions of the exchangeable cations (Na^+, Ca^{2+}, K^+, Mg^{2+}, Al^{3+} and H^+) in soil have important effects on both soil physical and soil chemical properties. The total amount of exchangeable cations that can be held by soil is designated by the effective cation exchange capacity (ECEC).

As previously discussed, high levels of exchangeable Na^+ will result in clay dispersion, reducing water movement and affecting near-surface aeration. In contrast, exchangeable Ca^{2+} flocculates colloids and will reduce dispersive tendencies. Excessively high or low concentrations of one or the other of the cations may result in nutritional disturbances to germinating plants.

Since the Baseline 4 study, the ECECs of the Stage 1A soils have stabilised near the surface and are, on average, moderate (12-25 milliequivalents (meq)/100 g) at all sites (and throughout the soil profile) (**Figure 3-4**). Baseline 3 results at 20-40 cm and 40-60 cm depth are the exception at 8 and 10 meq/100 g, but would still be considered to have moderate ECEC.

Assessment of Baseline 6 against Baseline 7 (and previous Baselines) indicates a similar ECEC at the majority of depth intervals. The recent addition of gypsum and lime into the uppermost soil profile appears to not have influenced the ECEC.

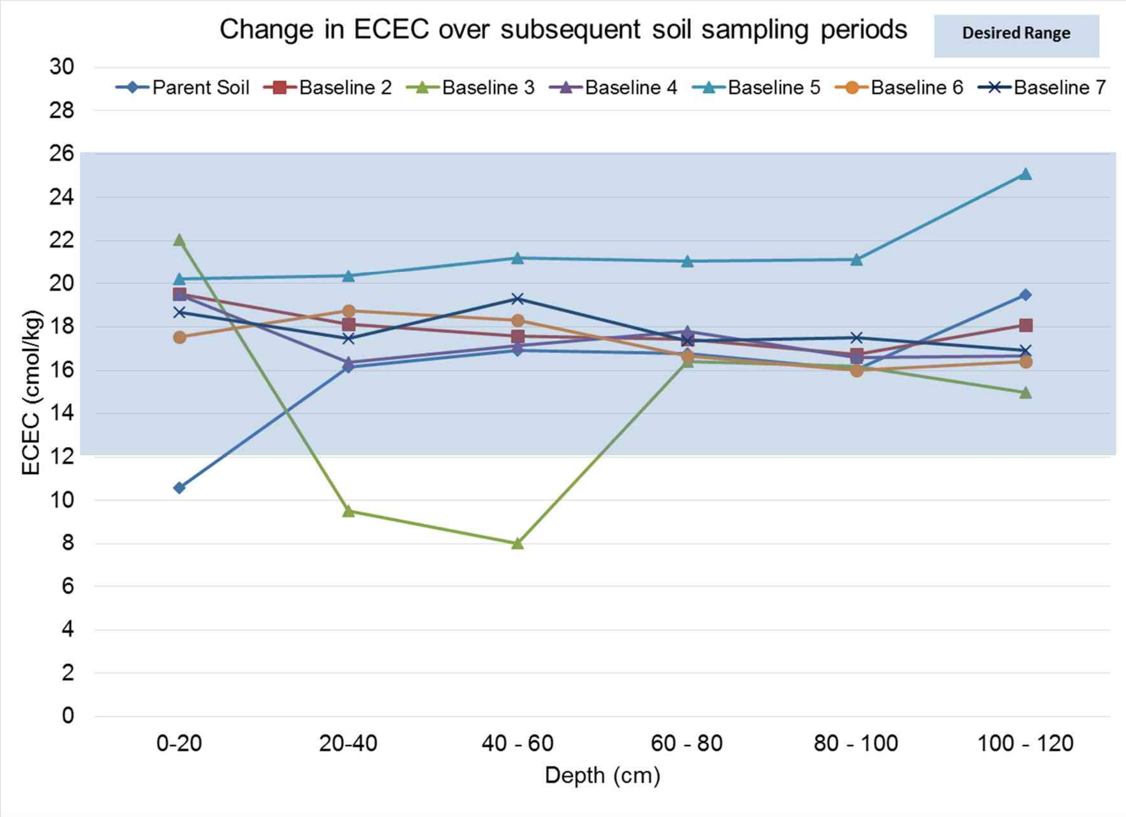

Figure 3-4: Change in (average) ECEC for all sites over subsequent sampling periods

3.1.7 Effects of blended water on soil structure

Soil amendment and application of blended water has the potential to impact on soil structure. Since the start of the blended water irrigation program, close scrutiny has been applied to the TIP with respect to maintaining soil structure and monitoring changes in soil chemistry and the water quality of applied waters (irrigation and rainfall).

Maintenance of soil structure can be interpreted from the leaching dynamics between each of the soil sampling campaigns. For example, the first 7 columns (in blue) in **Table 3-2** show average results for Baseline 1 (B1), Baseline 2 (B2), Baseline 3 (B3), Baseline 4 (B4), Baseline 5 (B5), Baseline 6 (B6) and Baseline 7 (B7). The 7 middle columns (in yellow) show the relative difference between each Baseline soil survey. The last 7 columns (in grey) show the relative difference between each Baseline compared to Baseline 1 (parent soil).

Table 3-2 indicates that, when compared to B1, Na^+ generally decreased for B2 and B3 then increased in B4, B5, B6 and B7. Similar trends can be observed in the soil ESP results which are a result of the balance between Na^{+} and Ca^{2+} and Mg^{2+}. For B7, calcium has increased throughout the profile and, by proxy, has stabilised soil ESP. There has been an increasing trend in soil ESP at 0 – 20 cm since the commencement of irrigation which can be seen in the grey columns, that is, the difference between the baseline surveys and the parent soil is increasing as more Na^{+} is applied through irrigation. However the ESPs have stabilised at depths shallower than 60 cm with the recent application of gypsum and lime.

Another key to maintaining soil structure is the sodium adsorption ratio (SAR) of applied waters (irrigation and rainfall) and the subsequent impact on clay dispersion or flocculation. SAR specifically compares the ratio of sodium to that of the major divalent ions (Ca^{2+} and Mg^{2+}) in the applied water and is calculated from solute concentrations. Long term, high SAR (>9) is undesirable as this will exacerbate the effects of high ESP and enhance clay dispersion. The SAR of the blended water (based on the May 2015 water quality results) was 12.6 (Parsons Brinckerhoff, 2015).

Clay dispersion is one end of diffuse double layer (DDL) theory whereby clay particles separate into single platelets. Conversely, clay particle flocculation is where many platelets align together to form clusters. Both depend on the electrolyte concentration of the applied waters and the antecedent ESP of the receiving soil (refer Chapter 2 in Lucas 2009). In general, high ESP and high SAR in applied waters results in increased dispersivity, though this is counteracted by high chloride salinity.

The degree of clay dispersion that may occur has a direct effect on soil permeability and, as a result, downward soil water movement. Therefore maintaining clay (micro-aggregate) stability will promote suitable infiltration rates. Lucas (2009) describes the soil ESP/effluent SAR continuum for micro-aggregate/soil pore stability which predicts clay particle behaviour in a soil of known ESP and irrigated with a water of known SAR.

Different electrolyte concentrations from blended irrigation water and from rainfall will initiate changes in clay particle behaviour (flocculation to dispersion) in the receiving soil over time. For example, the average soil ESP in the upper 40 cm of the soil profile was 10.9 in Baseline 7. The SAR of irrigation waters was approximately 12.6 during the same period. Based on the equation in **Figure 3-5**, the threshold concentration (C_{TH}) that maintains micro-aggregate stability would be:

Baseline 7: $C_{TH} = (0.56 \times 10.9) + (0.6) = 6.7$

Note that the ESP = SAR between 0-32 and soil ESP is used in the equations in **Figure 3-3**. The applied blended water with a SAR of 12.6 exceeds the C_{TH} indicating that while soil structure would be maintained there would be a small (expected) decrease in infiltration rate.

Since the beginning of the irrigation program and in view of (recent) increasing soil ESP at the site, a key question has been: "*Has soil structure been significantly altered?"* This question is addressed with reference to **Figure 3-6,** which conceptually shows the predicted susceptibility of clay dispersion (loss of soil structure) over time from irrigation with blended water and rainfall.

Table 3-2: Leaching dynamics between Baseline Soil Studies

Changes in Na (mg/kg)																			
cm	B1	B2	B3	B4	B5	B6	B7	B2-B1	B3-B2	B4-B3	B5-B4	B6-B5	B7-B6	B2-B1	B3-B1	B4-B1	B5-B1	B6-B1	B7-B1
0-20	135	239	128	342	407	445	449	104	-111	213	66	38	4	104	-7	207	272	310	314
20-40	381	356	153	273	423	464	447	-25	-203	121	150	41	-17	-25	-228	-108	42	83	66
40 - 60	527	361	181	306	464	551	552	-166	-180	125	158	86	1	-166	-346	-221	-63	24	25
60 - 80	606	383	220	331	524	563	574	-223	-163	112	193	39	11	-223	-387	-275	-82	-43	-32
80 - 100	643	426	298	367	567	570	664	-217	-129	69	201	3	93	-217	-345	-276	-76	-73	21
100 - 120	624	501	308	456	784	652	681	-123	-193	148	328	-132	29	-123	-316	-168	160	28	57
Changes in ESP (%)																			
cm	B1	B2	B3	B4	B5	B6	B7	B2-B1	B3-B2	B4-B3	B5-B4	B6-B5	B7-B6	B2-B1	B3-B1	B4-B1	B5-B1	B6-B1	B7-B1
0-20	6.2	5.3	2.5	7.8	9.0	11.3	10.7	-1	-3	5	1	2	-1	-0.9	-3.7	1.6	2.8	5.1	4.5
20-40	10.5	8.6	3.8	7.8	9.4	10.8	11.1	-2	-5	4	2	1	0	-1.9	-6.7	-2.7	-1.1	0.3	0.6
40 - 60	13.5	8.9	5.2	8.1	9.7	12.9	12.4	-5	-4	3	2	3	0	-4.6	-8.3	-5.4	-3.8	-0.6	-1.1
60 - 80	15.7	9.6	6.0	8.0	10.8	14.5	14.4	-6	-4	2	3	4	0	-6.1	-9.7	-7.7	-5.0	-1.2	-1.3
80 - 100	17.4	11.1	7.9	9.5	11.6	15.1	16.4	-6	-3	2	2	3	1	-6.4	-9.5	-7.9	-5.8	-2.4	-1.1
100 - 120	13.9	12.0	8.9	11.8	13.7	16.2	17.4	-2	-3	3	2	3	1	-1.9	-5.0	-2.2	-0.3	2.3	3.4
Changes in Ca (mg/kg)																			
cm	B1	B2	B3	B4	B5	B6	B7	B2-B1	B3-B2	B4-B3	B5-B4	B6-B5	B7-B6	B2-B1	B3-B1	B4-B1	B5-B1	B6-B1	B7-B1
0-20	570	2364	2981	2351	2439	1499	2016	1794	617	-630	88	-940	518	1794	2411	1781	1869	929	1446
20-40	360	1456	2094	1586	1783	623	817	1096	638	-508	197	-1159	194	1096	1734	1226	1423	263	457
40 - 60	259	1243	1385	1361	1421	347	607	984	142	-25	60	-1074	260	984	1126	1102	1161	88	348
60 - 80	292	1088	1075	1219	1420	271	531	796	-14	144	201	-1150	261	796	783	927	1128	-21	239
80 - 100	165	943	443	1106	1249	257	351	779	-500	663	143	-992	94	779	278	941	1084	92	187
100 - 120	147	903	370	897	1773	256	291	756	-533	527	876	-1517	34	756	223	750	1626	109	144
Changes in Mg (mg/kg)																			
cm	B1	B2	B3	B4	B5	B6	B7	B2-B1	B3-B2	B4-B3	B5-B4	B6-B5	B7-B6	B2-B1	B3-B1	B4-B1	B5-B1	B6-B1	B7-B1
0-20	625	1135	688	655	664	814	705	510	-447	-33	8	151	-109	1135	687	655	663	813	705
20-40	1360	1337	801	797	1077	1229	1043	-23	-536	-4	280	152	-186	1337	801	797	1077	1228	1042
40 - 60	1520	1507	884	982	1281	1329	1312	-12	-623	98	299	47	-16	1507	884	982	1281	1328	1312
60 - 80	1449	1519	1033	1087	1262	1251	1235	71	-487	54	176	-12	-15	1519	1032	1087	1262	1250	1235
80 - 100	1420	1446	1279	1089	1369	1195	1304	26	-168	-190	280	-174	109	1446	1279	1089	1369	1195	1304
100 - 120	1360	1434	1183	1195	1491	1271	1303	74	-252	13	296	-221	32	1434	1183	1195	1491	1271	1302
Changes in Ca/Mg																			
cm	B1	B2	B3	B4	B5	B6	B7	B2-B1	B3-B2	B4-B3	B5-B4	B6-B5	B7-B6	B2-B1	B3-B1	B4-B1	B5-B1	B6-B1	B7-B1
0-20	0.7	2.1	2.8	2.3	2.3	1.2	1.8	1.5	0.7	-0.6	0.1	-1.1	0.6	1.5	2.2	1.6	1.7	0.6	1.2
20-40	0.2	0.9	1.8	1.4	1.1	0.3	0.5	0.8	0.9	-0.4	-0.3	-0.7	0.2	0.8	1.6	1.3	0.9	0.2	0.3
40 - 60	0.1	0.8	1.0	0.9	0.7	0.2	0.3	0.7	0.2	-0.1	-0.3	-0.5	0.1	0.7	0.9	0.8	0.6	0.1	0.2
60 - 80	0.1	0.7	0.7	0.8	0.7	0.1	0.3	0.6	0.0	0.1	-0.1	-0.5	0.2	0.6	0.6	0.7	0.5	0.0	0.2
80 - 100	0.1	0.6	0.2	0.8	0.5	0.1	0.2	0.5	-0.4	0.6	-0.2	-0.4	0.0	0.5	0.2	0.7	0.5	0.0	0.1
100 - 120	0.1	0.4	0.2	0.5	0.7	0.1	0.1	0.4	-0.2	0.3	0.2	-0.6	0.0	0.4	0.1	0.4	0.6	0.1	0.1
Rainfall (mm)	528	82	113	273	213	470	549	82	113	273	213	470	549	82	113	273	213	470	549
Irrigation (mm)	0	0	39	276	187	154	103	0	39	276	187	154	103	0	39	276	187	154	103

Key: B1 = Baseline 1 soil sampling (parent soil), B2 = Baseline 2 soil sampling, B3 = Baseline 3 soil sampling, B4 = Baseline 4 soil sampling, B5 = Baseline 5 soil sampling, B6 = Baseline 6 soil sampling; blue columns = average results; yellow columns = difference from previous survey; grey columns = difference from Baseline 1

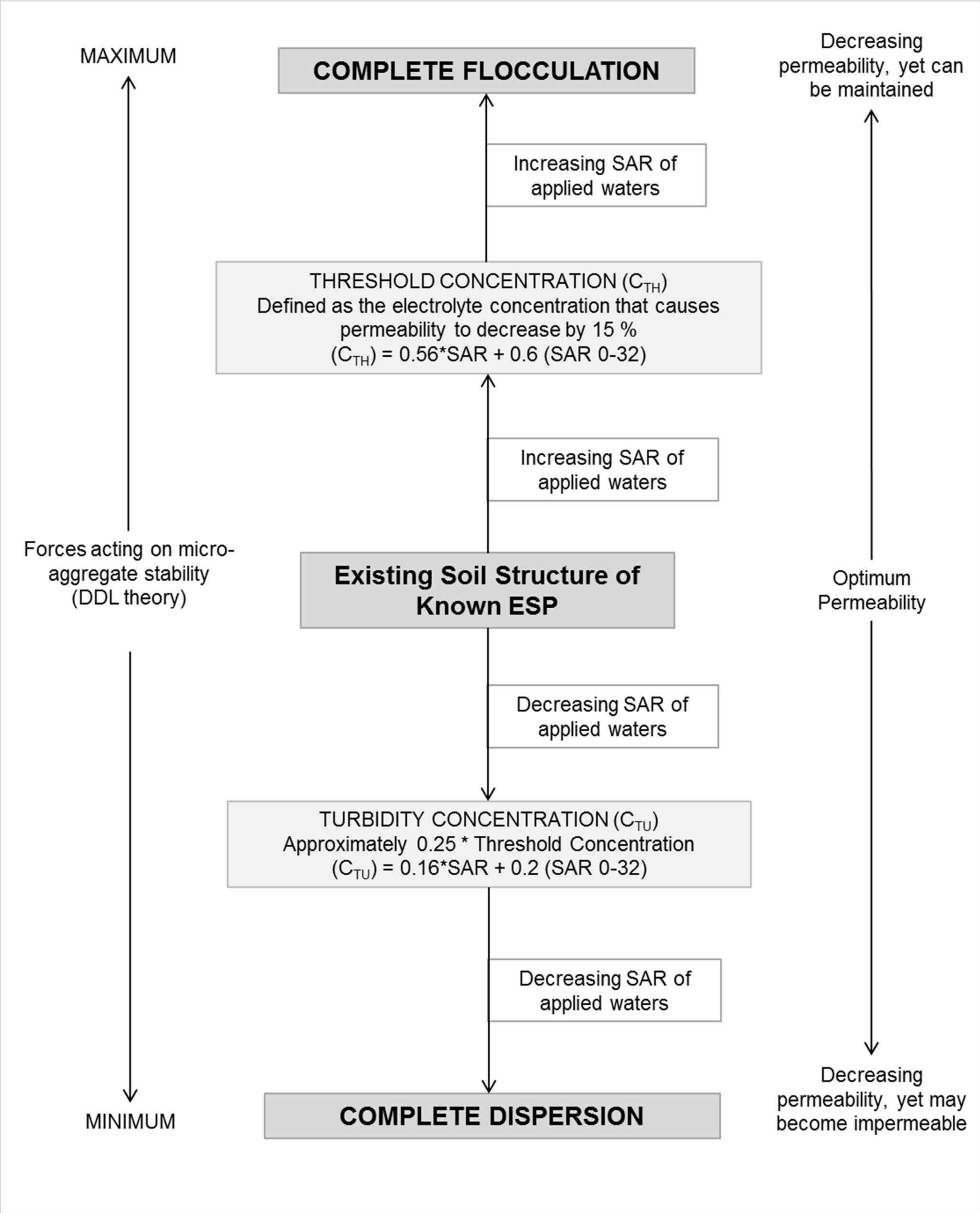

Figure 3-5: Soil ESP/effluent SAR continuum for micro-aggregate/soil pore stability (from Lucas 2009)

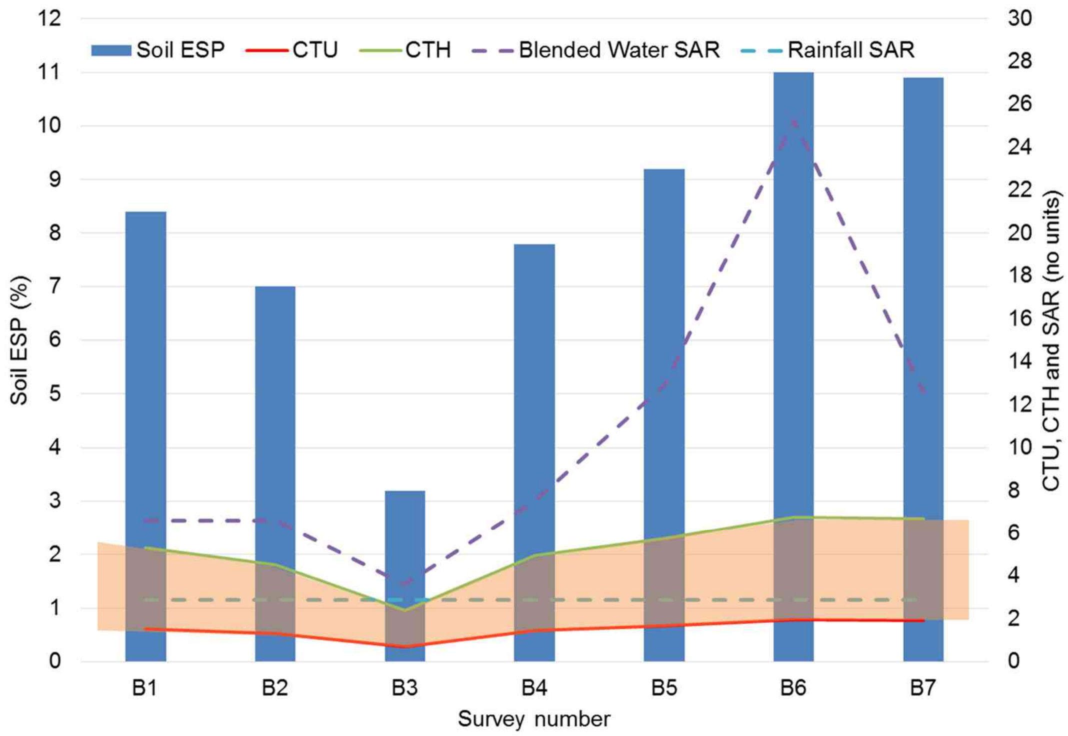

Figure 3-6: Conceptualisation of predicted susceptibility of clay dispersion from irrigation with blended water and rainfall

How to read the graph (**Figure 3-6**):

1. Both the C_{TU} and C_{TH} lines will move up or down dependent on soil ESP, but the C_{TH} will always be above the C_{TU} and provides a “zone” of optimum permeability (light orange shading) and stable soil structure;

2. Blended water SAR is highly variable while rainfall SAR remains relatively constant. Note: Rainfall will cause the most damage to a high ESP soil (> 18 in this case as the C_{TU} and rainfall SAR would then be the same and dispersion will follow);

3. At current soil ESP values the soil structure is being maintained, but towards the C_{TH} end of the continuum.

The columns represent soil ESP at 0 - 40 cm depth, and are an average of all soil sites (CS1 – CS16). The C_{TU} (red solid line) and C_{TH} (green solid line) are based on soil ESP and equations in **Figure 3-5** and, similar to soil ESP, will also fluctuate over time. The purple dotted line represents the SAR of blended water applied to the site (variable SAR) and the light blue dotted line represents the SAR of rainfall (relatively constant SAR).

If soil ESP increased then the corresponding C_{TH} and C_{TU} would also increase and rainfall would cause complete dispersion of surface micro-aggregates that would block soil pore spaces and severely reduce infiltration in the upper 10 cm of the soil profile. It is important to note that as ESP increases, the electrolyte concentration of the applied solution must also increase to maintain optimum permeability. Discussion of these processes has been previously provided in Fodder King (2014a).

The soil structure in Stage 1A has significantly improved subsequent to the amendments (Baseline 2) compared to the parent soil attributes. The increasing soil ESP trends (due to the high SAR blended water and increasing Na^{+} in the soil profile) were recently addressed by irrigating with lower SAR waters (blended waters with a lower ratio of Na^{+} to Ca^{2+} and Mg^{2+}) during this last reporting period, and application of gypsum (at 2250 kg/ha) and lime (at 1000 kg/ha) in April 2015 to the upper soil profile to assist in reducing the ESP.

The ESP of the soil is a surrogate for interpreting changes in soil structure from salt accumulation. Other such surrogates such as total soluble salts (TSS) may be also be used. However, given the well documented relationship between EC and TSS (approximately TSS = 0.65 x EC), TSS would have increased in a similar manner to EC, but there is no evidence the accumulation of salts has adversely impacted on the soil structure.

3.1.8 Summary of other analyses

3.1.8.1 Organic carbon

Organic carbon is a measure of the organic matter (undecomposed plant litter, soil organisms and humus) in the soil. The organic components of the Tiedman soils will contribute to maintaining the soil structure, feeding the soil microbes, slightly increasing soil water holding capacity, and holding a small store of N, P, S and trace elements.

Whether organic carbon values are high or low for a particular region will depend on the region's climate. For example, the climate in Gloucester would be considered wetter and warmer than other regions experiencing a similar East Coast Maritime (ECM) climate. We would expect, therefore, that organic carbon (and subsequently organic matter) levels in the soils of the Gloucester region to be high, at the very least reaching the NSW Department of Primary Industry's preferred level of 2% (Reid and Dirou 2014).

The total organic carbon (TOC) of the Stage 1A soils ranged from very low to high (0.1% to 3%), with an average TOC of 0.7%. The TOC of the Stage 1B soils ranged from 0.2% to 1.6%. According to Hazelton and Murphy (2007), TOC greater than 1.8% is considered high and equates to good soil structural condition and water holding capacity.

3.1.8.2 Phosphorus (Colwell)

Phosphorus (P) is essential to both plants and animals (particularly microorganisms) and exists in various forms in the soil. Extractable P defines the labile (water soluble) P in soils that is readily available for plant absorption. The availability of P will have a significant impact on crop and pasture establishment on the Stage 1A and Stage 1B land areas, being particularly important for establishing roots. The P levels in the Stage 1A soils are very high in the surface (averaging 84 mg/kg) samples (0-20 cm) and moderate to high at depth (averaging 17 mg/kg below 20 cm).

Comparing parent soil (2011) and that collected in May 2015, available phosphorus results suggest that available phosphorus was assimilated by the crops over the past few years. This is suggested as very little phosphorus has been applied through irrigation or fertiliser (Stage 1A only).

3.1.8.3 Nitrate nitrogen

Nitrogen (N) occurs in several (immobile) forms in soil and generally has to be in a mineralised (mobile) form for plant uptake. Nitrification, the conversion of ammonium-N (NH_4^+) to highly mobile nitrate-N (NO_3^-) via nitrite-N (NO_2^-) is performed primarily by soil-living bacteria. In addition to converting immobile N into an available N, the conversion of nitrites to nitrates is important because the accumulation of nitrites in soil is toxic to plants. Nitrate-N is the dominant source of soil mineral N and is commonly used to estimate plant-available N.

The NO_3^- levels below 20 cm depth at all sites have decreased and are low (averaging 2 mg/kg), most likely due to increased crop usage. It is important to note, however, that NO_3^- levels of soil materials may fluctuate widely, depending on rainfall, the season (time of sampling), and depth over which the sample is taken. Generally, NO_3^- levels less than 8 mg/kg would be considered low and low nitrogen soils respond favourably to a nitrogenous fertiliser for cropping (Hazelton and Murphy 2007).

3.1.8.4 Soluble chloride

Plant growth may be inhibited by either high absolute levels of total salts, or a high proportion (relative levels) of specific salts in solution. The chloride anion (Cl^-) is usually present in soil in association with the sodium cation (Na^+) and its high mobility makes it a useful indicator of the direction which salts in solution are moving throughout the soil.

The relative proportion of soluble Cl^- is useful when assessing the response of the soils to the applied treatments because the effects on plant growth may be observed at levels lower than might be expected from total soluble salt concentrations.

In addition, where gypsum is present (as it is in all the soils receiving Treatment 1) Cl^- is a more robust indicator of salinity than EC, due to the conductivity suppression from the released sulphate ions.

The Cl^- values for the Stage 1A and Stage 1 B samples were observed to be well below the 800 mg/kg threshold above which plant growth may be affected.

3.1.9 Soil Water

Soil water is monitored via the paired piezometers within and surrounding the Stage 1A irrigation area. This is not groundwater, as the regional water table is deeper (more detail is presented in Parsons Brinckerhoff, 2015). Soil water was present in only two piezometers (both outside of the irrigation area) when inspected during the routine May 2015 sampling event (Parsons Brinckerhoff, 2015). The lack of soil water within the irrigated plots suggests that there was high evapotranspiration and "deficit irrigation" practices were effective.

3.2 Stage 1B

3.2.1 Introduction

The Stage 1B area includes 10 sampling locations (CS17 to CS26) in its western zone, and three locations (CS27 to CS29) in its southern zone (as outlined in the SQMMP and the TIP EPL conditions). Soil samples were collected using a hand auger during the May soil sampling event.

3.2.2 Composite soil sampling

The samples were collected between the 18th and 20th May 2015 and combined to create composite samples (in accordance with the EPL condition). Soil samples were collected at 20 cm vertical depth intervals after hand augering to a depth of 120 cm, or until refusal on rock. Each 20 cm interval sample was combined with the corresponding depth samples for the other Site IDs on a plastic tarp and mixed thoroughly. A sample representative of all sites at the 20 cm interval was packaged and analysed. This is the sampling approach defined as 'Special Method 6" in EPL 20358 (Condition M2.5).

Table 3-3 presents a summary of the depth reached for each location in the Stage 1B area.

The summarised soil test results are shown in **Appendix E**. Full sample results from each of the sampling locations in Stage 1B can be found in **Appendix C.**

Table 3-3 Summary of sampling depth reached for Site 1B locations

Site ID	0 to 20 cm	20 to 40 cm	40 to 60 cm	60 to 80 cm	80 to 100 cm	100 to 120 cm	Comment
	Composite 1	*Composite 2*	*Composite 3*	*Composite 4*	*Composite 5*	*Composite 6*	
CS17	✓	✓	✓	✓	✓	✓	
CS18	✓	✓	✓	✓	×	×	Refusal of auger
CS19	✓	✓	✓	✓	✓	✓	
CS20	✓	✓	✓	✓	✓	×	Refusal of auger
CS21	✓	✓	✓	✓	✓	✓	
CS22	✓	✓	✓	✓	✓	✓	
CS23	✓	✓	✓	✓	✓	✓	
CS24	✓	✓	✓	✓	✓	✓	
CS25	✓	✓	✓	✓	✓	×	Refusal of auger

CS26	✓	✓	✓	✓	✓	✓	
CS27	ò	ò	ò	ò	ò	✓	
CS28	ò	ò	ò	ò	ò	✓	
CS29	ò	ò	ò	ò	ò	ò	

3.2.3 Key findings

A summary of the results for the Stage 1B area (for soils to 20 cm depth) and for the reporting period (Baseline 7 versus Baseline 6) are:

- Decrease in soil EC (0.24 to 0.14 dS/cm)
- Very slight increase in soil pH ($CaCl_2$) (4.5 to 4.6)
- Decrease in soil ESP (11.3% to 6.0%)
- Organic carbon decreased from 2.1% 1.6%
- ECEC remained relatively the same and ranged between 14 and 18 meq/100 g.

4. Soil test pit observations

The OCSG and EPA issued monitoring conditions in regards to soil test pit observations for the TIP (condition 6 a) in Attachment A OCSG, 2014 and Attachment A Section 2 EPA 2014). The following section provides information that addresses these conditions and comments, in particular, presenting detailed descriptions and high resolution photographs of the soil profiles.

4.1 Objectives

The overall objectives of the Soil Quality Monitoring and Management Program (SQMMP) were to:

a) Develop and monitor the performance of soils on the irrigation area against baseline soil quality parameters;

b) Develop, manage and monitor the water and salt balance; and

c) Monitor, act and report on any adverse trends or impacts on soil structure and quality parameters.

To achieve these overall objectives soil test pits were excavated in March 2014 and May 2015 at the Stage 1A area for the purpose of observing and describing soil properties that may prove useful indicators of the processes occurring within the soil profile. In addition, the observation, description and sampling of the soils from the test pits address OCSG approval condition 6 a) Points 1, 2 and 3 and Note (i).

The Mid-Trial Test Pit Report developed by Fodder King (2014) describes the 2014 observations. This section and **Appendix G** Soil description Sheets present the observations made in 2015. The information collected from observing and describing the observations complement the laboratory analysis of the soil samples collected from the site.

4.2 Method

Eight soil pits were excavated in May 2015 as part of the field program undertaken for the January 1st to June 30th reporting period. These 2015 soil pit observations follow the 2014 observations made by Fodder King and presented in the Mid-trial Test Pit Report (Fodder King 2014). Each of the soil pits were excavated using a backhoe to reveal the soil profile including at least one “slot” in each treatment.

Freshly excavated pits are the preferred method for soil characterisation and have the advantage (over drilling or augering for example) of allowing observation of both lateral and vertical variation within the soil profile. This was particularly important during the TIP in order to observe any treatment effects adjacent and beneath the slots. In addition to making observations of the soil profile easier, the digging of soil pits made the task of photographing and sampling the soils more efficient.

The treatments at each soil pit location are summarised in **Table 4-1**.

Further details regarding the trial design and strategy are included in Fodder King (2011).

The observations made at each soil pit were recorded on soil description sheets (**Appendix G**) and a sample was taken from the topsoil (typically the A horizon) and the subsoil (typically the B horizon) of each pit. Based on the soil descriptions and laboratory test results, the soils were classified using the Australian Soil Classification (Isbell 2002).

Table 4-1 The four treatments implemented at the Stage 1 area of the TIP.

Treatment No.	Treatment Description		
	Surface Treatment - All plots	**Treatment (slots only)**	**Slot dimensions**
1	Composted feedlot manure (50 t/ha) Lime (8 t/ha) Gypsum (4 t/ha) Zeolite (5 t/ha)	None	No slots
2	Composted feedlot manure (50 t/ha) Lime (8 t/ha) Gypsum (4 t/ha) Zeolite (5 t/ha)	Composted feedlot manure (50 t/ha) Lime (8 t/ha) Gypsum (4 t/ha) Zeolite (5 t/ha)	200 mm wide 650 mm deep 1.5 m apart
3	Composted feedlot manure (50 t/ha) Lime (8 t/ha) Gypsum (4 t/ha) Zeolite (5 t/ha)	Composted feedlot manure (50 t/ha) Lime (8 t/ha) Gypsum (4 t/ha) Zeolite (5 t/ha)	200 mm wide 950 mm deep 1.5 m apart
4	Composted feedlot manure (50 t/ha) Lime (8 t/ha) Gypsum (4 t/ha) Zeolite (5 t/ha)	Composted feedlot manure (50 t/ha) Lime (8 t/ha) Gypsum (4 t/ha) Zeolite (5 t/ha)	200 wide 1200 mm deep 1.5 m apart

The slotting depths and crops planted are summarised in **Table 4-2.**

Table 4-2. Soil pit slotting depths, treatment and pasture/ crop planted.

2014 Test Pit ID	2015 Test Pit ID	Slot Depth (m)	Excavation Depth (m)	Treatment	Crop (2015)
TP17	TP25	0	600	1	Triticale
TP18	TP26	0	600	1	Lucerne
TP19	TP27	1200	1200	1 + 4	Triticale
TP20	TP28	1200	1200	1 + 4	Lucerne
TP21	TP29	950	1000	1 + 3	Triticale
TP22	TP30	950	1000	1 + 3	Lucerne
TP23	TP31	650	800	1 + 2	Triticale
TP24	TP32	650	800	1 + 2	Lucerne

4.3 Summary of results

All of the soils investigated were duplex, displaying an abrupt increase in texture (clay content) between the A horizons (fine sandy loams) and B horizons (light medium clays to medium clays). The heavier textured subsoils have a high water holding capacity, but may restrict growing roots as soil structure is poor.

The soils were classified according to the Australian Soil Classification (ASC) (Isbell, 2002). Three of the eight soils had strongly acid B horizons (pH <5.5) and were classified as Kurosols. Two of the soils previously classified as Kurosols (strongly acid B horizons) in 2014 have been re-classified as Sodosols due to a slight increase in pH to greater than 5.5.

It is important to note that the pH of these soils need only vary by 0.1 of a pH unit (for example from 5.4 to 5.5) to be classed as Sodosols. Further, the Kurosols of the site (and the region typically) have sodic properties (ESP >6%) and belong to the Sodic Subgroup of the Kurosol soil order.

Summaries of the soil pit descriptions are provided in **Table 4-3** to **Table 4-10 .** The detailed soil descriptions are provided in **Appendix G**.

Table 4-3. Soil Classification at Plot 1, Treatment 1 Only, TP25 (2015).

	Subgroup	Great Group	Suborder	Order
Diagnostic Property	Mottling and Sodicity	Sodicity	Munsell Colour	pH
Result	Mottled and Sodic ESP >6	Sodic ESP >6	Yellow	Strongly Acidic pH<5.5
ASC	**Mottled-Sodic**	**Natric**	**Yellow**	**Kurosol**
ASC (Code)	HB	FD	AC	KU

Table 4-4. Soil Classification at Plot 4, Treatment 1+ Treatment 4, TP28 (2015).

	Subgroup	Great Group	Suborder	Order
Diagnostic Property	Ca:Mg	Mottling and ESP	Munsell Colour	pH
Result	Very low < 0.1	Mottled and ESP between 15 and	Yellow	Not Strongly Acidic
ASC	**Magnesic**	**Mottled-Mesonatric**	**Brown**	**Sodosol**
ASC (Code)	DB	FO	AB	SO

Table 4-5. Soil Classification at Plot 5, Treatment 1+ Treatment 3, TP29 (2015)

	Subgroup	Great Group	Suborder	Order
Diagnostic Property	Base Status	Mottling and ESP	Munsell Colour	pH
Result	Moderate <15 meq/100 g	Mottled ESP between 6	Reddish Yellow	Not Strongly Acidic
ASC	**Mesotrophic**	**Mottled-Subnatric**	**Yellow**	**Sodosol**
ASC (Code)	AG	FN	AC	SO

Table 4-6. Soil Classification at Plot 8, Treatment 1 + Treatment 2, TP32 (2015).

	Subgroup	Great Group	Suborder	Order
Diagnostic Property	Mottling and Sodicity	Sodicity	Munsell Colour	pH
Result	Mottling and Sodic ESP >6	Sodic ESP >6	Brown	Strongly Acidic pH <5.5
ASC	**Mottled-Sodic**	**Natric**	**Brown**	**Kurosol**
ASC (Code)	HB	FD	AB	KU

Table 4-7. Soil Classification at Plot 10, Treatment 1 Only, TP26 (2015).

	Subgroup	Great Group	Suborder	Order
Diagnostic Property	Ca:Mg	Mottling and ESP	Munsell Colour	pH
Result	Very low < 0.1	Mottled and ESP between 15 and 25	Brown	Not Strongly Acidic pH >5.5
ASC	**Magnesic**	**Mottled-Mesonatric**	**Brown**	**Sodosol**
ASC (Code)	DB	FO	AB	SO

Table 4-8. Soil Classification at Plot 11, Treatment 1 + Treatment 4, TP27 (2015).

	Subgroup	Great Group	Suborder	Order
Diagnostic Property	Sodicity	CEC	Munsell Colour	pH
Result	Sodic ESP >6	Moderate >15 meq/100 g	Yellow	Strongly Acidic pH<5.5
ASC	**Sodic**	**Eutrophic**	**Yellow**	**Kurosol**
ASC (Code)	EO	AH	AC	KU

Table 4-9. Soil Classification at Plot 14, Treatment 1 + Treatment 3, TP30 (2015).

	Subgroup	Great Group	Suborder	Order
Diagnostic Property	Sodicity	CEC	Munsell Colour	pH
Result	Sodic ESP >6	Moderate >15 meq/100 g	Yellow	Strongly Acidic pH<5.5
ASC	**Sodic**	**Eutrophic**	**Yellow**	**Kurosol**
ASC (Code)	EO	AH	AC	KU

Table 4-10. Soil Classification at Plot 15, Treatment 1 + Treatment 2, TP31 (2015).

	Subgroup	Great Group	Suborder	Order
Diagnostic Property	Sodicity	Exch. Ca:Mg	Munsell Colour	pH
Result	Sodic ESP >6	Very low < 0.1	Brown	Strongly Acidic pH<5.5
ASC	**Sodic**	**Magnesic-Natric**	**Brown**	**Kurosol**
ASC (Code)	EO	GP	AB	KU

4.4 Discussion

Soil landscape information was obtained from the Soil Landscapes of the Dungog 1:100,000 sheet (Henderson 2000). The majority of the property, including the trial areas, is defined by the Gloucester Soil Landscape (GOW), described as moderately deep to deep Brown Sodosols and shallow to deep Grey Kurosols.

The Sodosols are characterised by naturally low fertility, high sodicity (susceptibility to disperse may vary), alkaline pH and poor drainage. The Kurosols are limited by their strongly acidic subsoils, high potential for aluminium toxicity, low permeability and low fertility. Therefore the natural properties of these soils may limit their productive capacity.

Several of the soils showed similar soil chemistry to the 2014 soil test pit observations, including high magnesium, sodium and aluminium. Although an ESP of 6 is used to distinguish between dispersive and non-dispersive soils, the role of aluminium contributing to the low pH in these soils generally renders them more stable. Increased calcium content may also serve to improve the stability of soils that are high in sodium and magnesium.

From a land management perspective ESP may be a useful indicator of soil stability and a simple field-based adapted version of the Emerson Aggregate Test (EAT) may be conducted to confirm soil stability. From an agronomic perspective, crops and pastures may be affected by elevated levels of aluminium in particular.

As previously stated by Fodder King (2014), the role of the high exchangeable magnesium continues to cause debate amongst soil scientists. Both calcium and magnesium levels have remained relatively stable while sodium has been mobilised downwards, resulting in generally better soil quality for supporting crops.

Soil structure has been significantly improved by amelioration and shows no indication of adverse effects, such as abnormal salinity or sodium accumulation, or clay dispersion caused by irrigation with blended water. While it is evident that salts are accumulating in the soil profile, they are not accumulating at a level detrimental to soil structure or crop growth.

5. Geophysical survey

The OCSG and EPA issued monitoring conditions in regards to using electromagnetic surveying for investigating salt accumulation and movement at the TIP (condition 6 a) point 4 in Attachment A OCSG, 2014 and Attachment A Section 2 EPA, 2014). The following section provides information that addresses these comments, in particular, presenting results of an electromagnetic (EM31) geophysical survey.

5.1 Electromagnetic (EM31) geophysical survey

An EM31 geophysical survey was conducted by SMK Consultants Pty Ltd (SMK) across the TIP Stage 1A and Stage 1B areas on the 20 May 2015. **Figure 5-1** and **Figure 5-2** illustrate the results of these surveys.

Mitchel Hanlon Consultants Pty Ltd (MH) discussed the interpretation of the raw EM31 data in relation to the TIP operations. **Appendix F** presents the MH report on the interpreted EM31 survey. The following presents a summary of its findings:

- While the statistical correlations between the EM31 surveyed apparent electrical conductivity (ECa) and the laboratory measured data (ECw) were poor, the raw EM31 survey data does give a broad scale representation of the variability of electrical conductivity in soils across the irrigation areas to a depth of around 2 m.

- The results of the EM31 survey did not identify a relationship between ECa and the individual trial plots receiving different treatments. This is likely due to the scale of intensity of EM31 readings being more appropriate for broad scale application.

- ECa of less than 200 mS/m (2 dS/m) are generally considered acceptable for agricultural purposes. Readings within this range typically indicate the presence of surface salinity but the subsoil salinity and groundwater salinity levels (if groundwater levels are shallow) are likely to be lower.

- Based on the ECa and ECw results, salinity levels for both Stage 1A and Stage 1B areas are considered low to medium based on the soil salinity ratings of Shaw (1999). These ratings considers soil texture (clay content) and plant response to salinity (ECw) and are assessed in relation to achieving optimum soil conditions for pasture or crop yields.

- The EM31 survey suggests ECa for the Stage 1A area ranges from 31-187 mS (0.31-1.87 dS/m), with the highest readings occurring in the south western area of the plot (downslope). The salinity patterns are the same as the previous EM31 surveys in April 2011 and October 2014. An apparent increase in salinity may be due to increased soil moisture and/or increased salinity due to the surface or sub-surface movement of water and soluble salts downslope. Based on similar trends in the unirrigated western Stage 1B area, this may be a natural phenomenon.

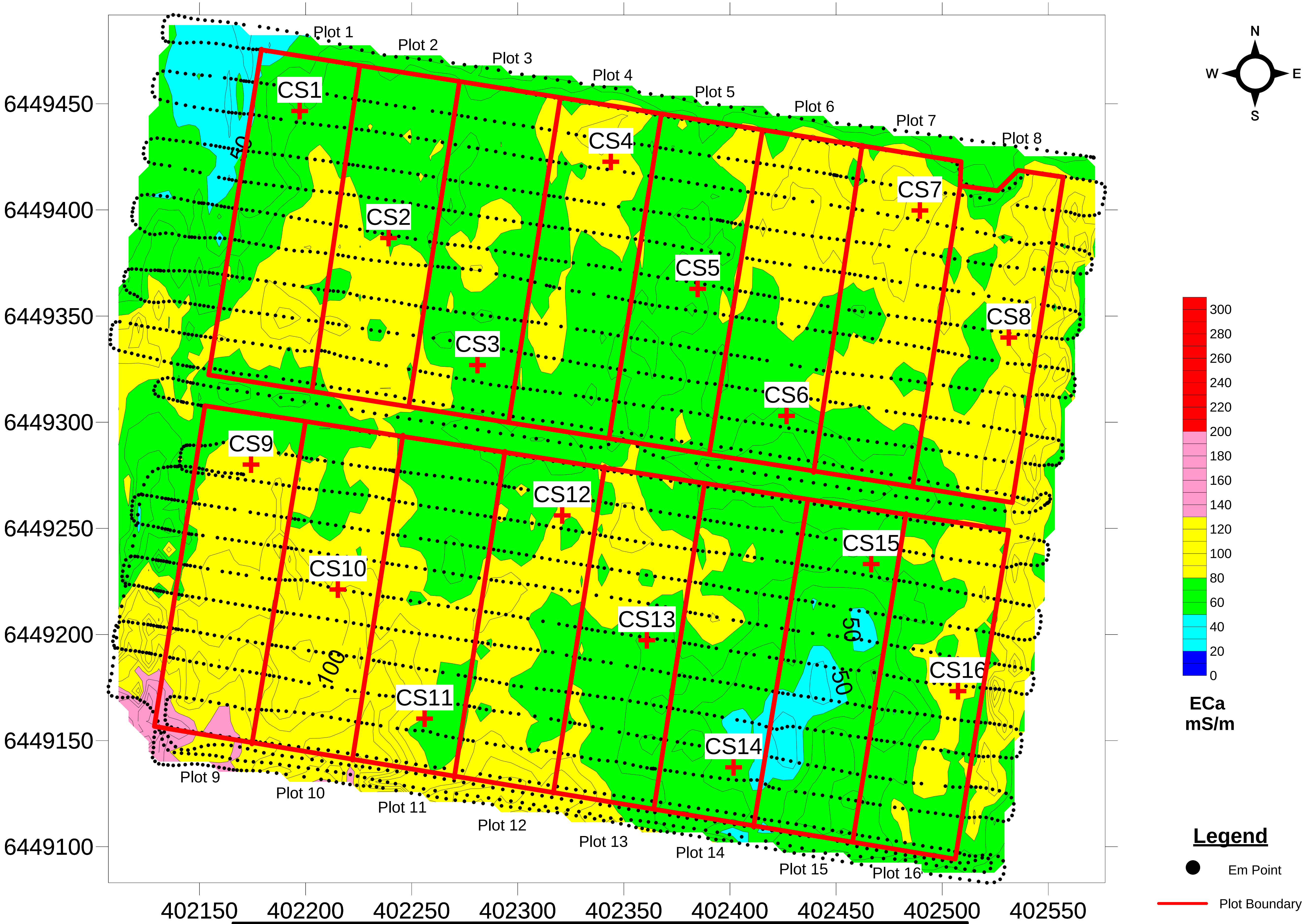

Figure 5-1 Geophysical survey (EM31) results: Site 1A

SMK CONSULTANTS
39 Frome St Moree
Ph. 02 67521021
Mob. 0428 521 020
www.smk.com.au

EM 31 Survey - Horizontal Survey
AGL Trial Plot Area A
Gloucester
Surveyed May 2015
By Jeremy Barr

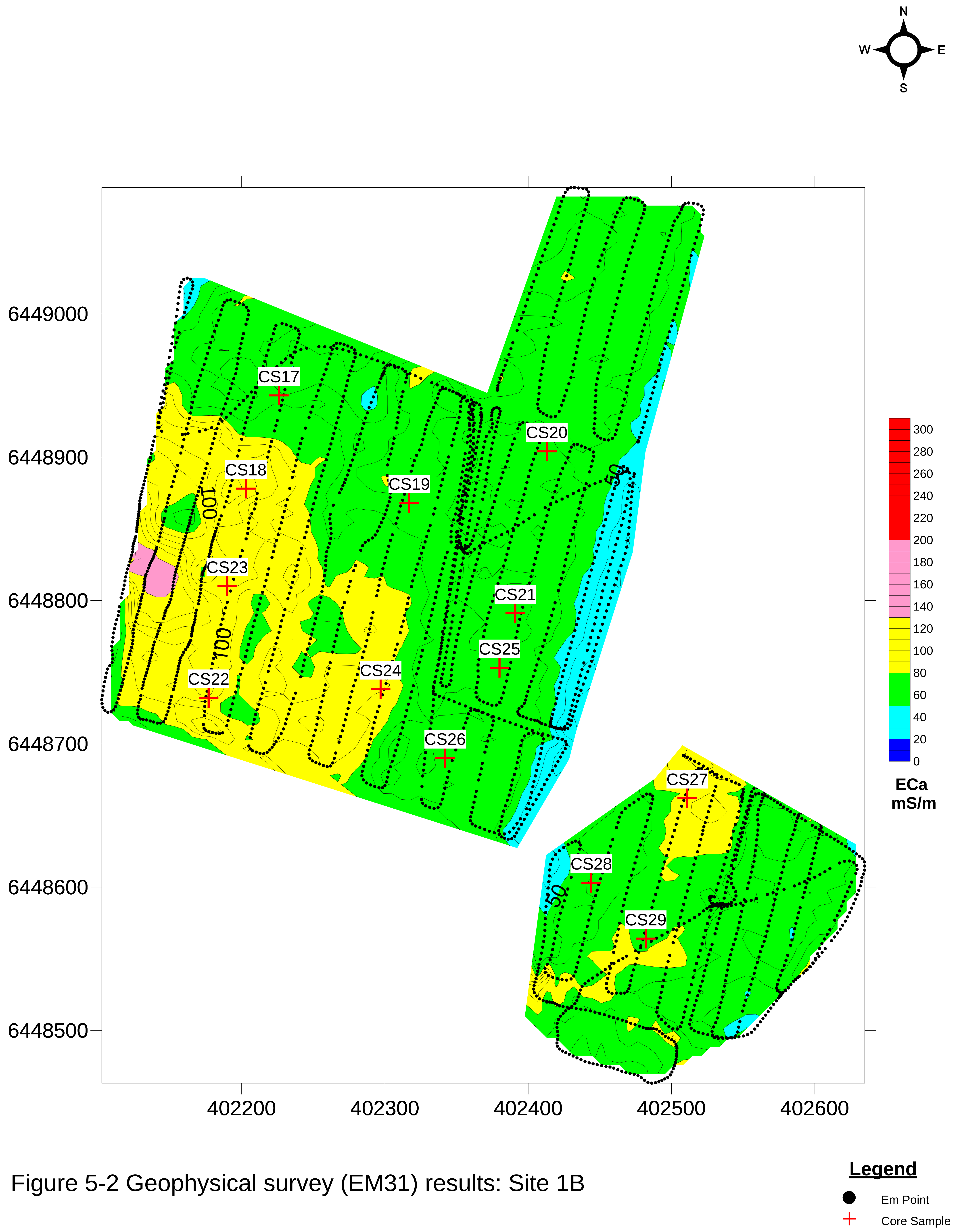

Figure 5-2 Geophysical survey (EM31) results: Site 1B

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EM 31 Survey - Horizontal Survey
AGL Trial Plot Area B
Gloucester
Surveyed May 2015
By Jeremy Barr

6. Conclusions

This 6-monthly compliance report (Baseline 7) concludes the soil reporting requirements for the Tiedman Irrigation Program (TIP) approved under the (extended) OCSG approval granted on the 4 July 2014.

6.1 Baseline 7 irrigation program

For the Reporting Period 1st January to 30th June 2015, the Stage 1A area was (due to the treatments applied) the primary focus of the TIP. During this reporting period, water balance calculations show that 16% (12.4 ML) of the water applied to the Stage 1A area was blended water while 84% (66.6 ML) was natural rainfall. During the irrigation period (1st January to 30th April 2015), water balance calculations show that 21% (12.4 ML) of the water applied to the Stage 1A area was blended water, while 79% (47.1 ML) was natural rainfall.

Only 1.4ML of blended water was applied to the Stage 1B area during the reporting period (this represents 6% of the total water applied to this area). During the irrigation period (1st January to 30th April 2015), this equates to 8% of the total water applied.

The conclusions from the May 2015 soil sampling program for the Reporting Period 1st January to 30th June 2015 compared to the Baseline 6 event (previous 6-monthly period) are summarised below.

6.2 Stage 1A area

- 12.4 ML of blended water was irrigated during the reporting period (all prior to 30th April 2015) (1.03 ML/ha for the period).
- Water balance management and environmental protective measures resulted in all the blended water being utilised within the irrigation area.
- Salinity ($EC_{1:5}$) is comparable to the previous (Baseline 6) survey. Salinity remains above the parent levels (Baseline 1) but below the ameliorated soil levels (Baseline 2) and intensive irrigation period in early 2014 (Baseline 5).
- At the time of reporting the Critical Control Point for the Stage 1A soils (soil salinity increase of more than 50% above the average value of the new baseline for the ameliorated soils) was not triggered.
- Sodium (Na^+) concentrations have increased slightly across all depths and most soil sampling sites with no obvious adverse effect on soil structure;
- Exchangeable Sodium Percentage (ESP) has remained steady (compared to Baseline 6) between 0 and 80 cm depth.
- ESP increased slightly in the soils samples taken from 80 to 120 cm.
- Calcium (Ca2+) concentrations have increased (as have Ca:Mg ratios) with the application of gypsum and lime during the period;
- The net mass balance indicates sodium salts have gradually accumulated in the soil profile. This increase is expected, however, the net mass balance is likely to decrease now that blended water irrigation operations have ceased.
- The EM31 geophysical survey suggests apparent electrical conductivity (ECa) ranges from 31-187 mS/m, with the highest readings occurring in the low-lying drainage (south western) area of the Stage 1A area. These salinity levels are considered low to medium.
- The salinity patterns are the same as the previous EM31 surveys in April 2011 and October 2014.

At the time of reporting there was no evidence of adverse effects on the soil as a result of irrigation of blended water or periodic rainfall. The increasing ESP trends in the Stage 1A area have stabilised. With the cessation of blended water irrigation, followed by the lime and gypsum applications scheduled for October 2015,this should result in a decrease in ESP over time as deep drainage and deep leaching of salts occurs.

6.3 Stage 1B area

- 1.4 ML of blended water was applied during the reporting period (all prior to 30th April 2015). (0.34 ML/ha for the period)
- With the exception of the sample taken at 20-40 cm, there has been a moderate decrease in salinity ($EC_{1:5}$).
- Soil salinity of the Stage 1B soils did reach the Critical Control Point trigger (more than 50% above the average value of 0.12 dS/m in the root zone to 1 m depth).
- A further decrease in Ca^{2+} levels is observed relative to previous surveys, however, not as great as between Baseline 6 and Baseline 5.
- A decrease in ESP has occurred.
- Since the last reporting period a decrease in TOC was observed (from 2.1% to 1.63% at 0-20 cm).
- The EC_a (from the EM31 survey) of Stage 1B area ranges between 20-80 mS/m on the eastern side of the area. The western side of the area is slightly higher and ranges between 50-147 mS/m. These salinity levels are considered low to medium.
- The higher ECa values are on the western side of the Stage 1B area (in the area that is not irrigated) and may be due to increased soil moisture at the base of slope and/ or the (natural) sub-surface movement of soluble salts.

Soil quality has generally improved across the Stage 1B area. . The decrease in the shallow soil attributes such as salinity, ESP and basic cations, are most likely due to the limited blended irrigation water applications across this area over the last 12 months.

7. Irrigation program recommendations

The final application of blended water to the TIP occurred in April 2015 and this is the final report on the TIP activities in accordance with the OCSG approval conditions and the EPL 20358. Due to there being no evidence of adverse effects on the soil as a result of irrigation of blended water or periodic rainfall, and the cessation of blended water irrigation, future monitoring of the Stage 1A and Stage 1B areas to the extent of the TIP is deemed unnecessary.

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Appendix A. Soil Properties Measured for the Baseline 7 Soil Study

Soil Properties Measured for the Baseline 7 Soil Study

Soil Parameter	Units
Chloride (soluble)	mg/kg
Electrical Conductivity (1:5 soil/water)	dS/m
pH (1:5 soil/water) and pH (1:5 soil/ $CaCl_2$)	pH units
Organic Carbon (OC)	%
Nitrate Nitrogen (NO_3^-)	mg/kg
Phosphorus (Colwell)	mg/kg
Total Phosphorus (ICP)	mg/kg
Phosphorus Buffer Index (PBI)	mg/kg
Sulfate	mg/kg
Sulfate - Sulphur	mg/kg
Extractable Copper	mg/kg
Extractable Zinc	mg/kg
Extractable Manganese	mg/kg
Extractable Iron	mg/kg
Extractable Boron	mg/kg
Exchangeable Potassium	mg/kg, Cmol/kg, %
Exchangeable Calcium	mg/kg, Cmol/kg, %
Exchangeable Magnesium	mg/kg, Cmol/kg, %
Exchangeable Sodium	mg/kg, Cmol/kg, %
Exchangeable Aluminium	mg/kg, Cmol/kg, %
Aluminium Saturation	%
Effective Cation Exchange Capacity (ECEC)	Cmol/kg
Calcium:Magnesium	-
Potassium:Magnesium	-
Soil Colour (wet and dry)	Munsell
Soil Bulk Density	kg/m^3 or g/cm^3
Saturated Hydraulic Conductivity	mm/hr^{-1}
Porosity Total	Calculated
Porosity Capillary	Calculated
Porosity Air Filled	Calculated
Air Dry Soil Moisture (ADMC)	%
Particle Size Analysis (PSA)	%

Appendix B. Baseline 7 Stage 1A Summary of Results

Baseline 7 Stage 1A Summary of Results

Average values

Depth	EC (1:5)	pH	NO3	Org-C	K	Ca	Mg	Na	Al	K	Ca	Mg	Na	Al	K	Ca	Mg	Na	Al	ECEC	Ca/Mg	ESP
cm	dS/m	CaCl2	mg/kg	%	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%	meq/100g	ratio	%
0-20	0.31	5.88	5.90	1.65	0.63	10.06	5.80	1.95	0.14	247	2016	705	449	13	3	54	31	10	1	18.69	1.84	10.7
20-40	0.28	4.74	1.80	0.72	0.54	4.08	8.58	1.94	2.23	211	817	1043	447	200	3	23	49	11	13	17.48	0.50	11.1
40 - 60	0.27	4.75	1.72	0.61	0.56	3.03	10.80	2.40	2.52	220	607	1312	552	227	3	16	56	12	13	19.29	0.31	12.4
60 - 80	0.25	4.90	1.85	0.50	0.58	2.65	10.16	2.50	1.54	226	531	1235	574	138	3	15	59	14	9	17.36	0.32	14.4
80 - 100	0.24	4.75	1.35	0.42	0.59	1.75	10.73	2.89	1.64	229	351	1304	664	148	3	10	61	17	9	17.49	0.16	16.4
100 - 120	0.23	4.80	2.17	0.25	0.62	1.45	10.72	2.96	1.20	243	291	1303	681	108	4	9	63	18	7	16.91	0.14	17.4

Maximum values

Depth	EC (1:5)	pH	NO3	Org-C	K	Ca	Mg	Na	Al	K	Ca	Mg	Na	Al	K	Ca	Mg	Na	Al	ECEC	Ca/Mg	ESP
cm	dS/m	CaCl2	mg/kg	%	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%	meq/100g	ratio	%
0-20	0.47	6.99	10.50	2.96	0.88	18.43	7.99	3.17	1.81	346	3693	971	728	163	3	71	31	12	7	25.90	3.95	15.4
20-40	0.37	6.38	5.00	1.63	0.72	10.99	12.83	2.84	6.23	281	2203	1559	652	560	3	49	57	13	28	22.40	1.27	15.2
40 - 60	0.40	6.37	4.20	1.59	0.73	11.88	15.77	4.27	8.30	284	2380	1917	981	746	3	45	60	16	31	26.40	1.00	19.3
60 - 80	0.39	6.15	3.30	1.23	0.78	10.00	13.68	3.73	4.86	305	2003	1663	857	437	3	44	60	16	21	22.70	1.40	20.9
80 - 100	0.39	6.58	2.10	1.86	0.85	5.11	12.90	4.75	4.19	332	1024	1568	1091	377	4	22	55	20	18	23.60	0.40	21.3
100 - 120	0.39	6.64	3.90	0.69	0.97	3.81	13.55	4.53	2.75	381	763	1647	1042	247	5	18	65	22	13	20.90	0.39	22.5

Minimum values

Depth	EC (1:5)	pH	NO3	Org-C	K	Ca	Mg	Na	Al	K	Ca	Mg	Na	Al	K	Ca	Mg	Na	Al	ECEC	Ca/Mg	ESP
cm	dS/m	CaCl2	mg/kg	%	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%	meq/100g	ratio	%
0-20	0.20	4.50	0.90	1.11	0.44	5.75	3.92	1.28	0.01	173	1152	477	294	1	3	40	28	9	0	14.20	0.90	6.08
20-40	0.09	4.05	0.70	0.42	0.39	1.88	4.40	1.15	0.00	152	377	535	265	0	4	18	42	11	0	10.50	0.17	9.14
40 - 60	0.14	4.03	0.60	0.25	0.38	1.00	4.57	1.09	0.00	147	200	555	251	0	4	10	44	10	0	10.40	0.07	7.76
60 - 80	0.12	4.09	0.80	0.13	0.38	0.65	3.92	0.94	0.00	147	130	476	216	0	4	7	45	11	0	8.73	0.06	7.66
80 - 100	0.10	3.92	0.60	0.10	0.36	0.58	4.23	1.02	0.00	140	117	514	235	0	3	5	38	9	0	11.20	0.06	9.13
100 - 120	0.09	3.98	1.00	0.09	0.42	0.60	4.08	0.99	0.01	166	121	496	228	1	4	6	42	10	0	9.77	0.06	10.20

Standard Deviation vlaues

Depth	EC (1:5)	pH	NO3	Org-C	K	Ca	Mg	Na	Al	K	Ca	Mg	Na	Al	K	Ca	Mg	Na	Al	ECEC	Ca/Mg	ESP
cm	dS/m	CaCl2	mg/kg	%	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%	meq/100g	ratio	%
0-20	0.08	0.69	2.48	0.50	0.14	3.82	1.27	0.46	0.45	53	766	154	105	40	4	101	33	12	12	3.80	0.92	2.58
20-40	0.05	0.70	1.20	0.21	0.10	2.37	2.15	0.47	2.07	40	474	261	108	186	3	71	64	14	62	3.36	0.31	1.56
40 - 60	0.07	0.72	1.53	0.39	0.09	2.89	2.79	0.77	2.57	37	579	340	178	231	2	75	72	20	66	3.87	0.29	3.21
60 - 80	0.07	0.81	0.92	0.38	0.10	2.74	2.76	0.80	1.60	40	550	336	183	144	3	82	82	24	48	3.36	0.38	3.89
80 - 100	0.07	0.90	0.51	0.50	0.13	1.45	2.32	0.85	1.44	50	290	282	194	129	4	46	73	27	45	3.18	0.12	3.58
100 - 120	0.08	0.94	1.21	0.08	0.16	1.00	2.64	0.90	0.97	62	200	321	207	87	5	29	77	26	28	3.45	0.10	3.73

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Appendix C. Baseline 7 Laboratory Raw Data

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eastwest GEO•AG•ENVIRO

ANALYSIS REPORT SOIL

PROJECT NO:	**EW150487**	**Date of Issue:**	**08/06/2015**
Customer:	JACOBS ENGINEERING	Report No:	1
Address:	PO Box 312 Flinders Lane MELBOURNE VIC 8009	Date Recieved:	21/05/2015
		Matrix:	Soil
Attention:	Garry Straughton	Location:	IA059500
Phone:	02 90321406	Sampler ID:	Client
Fax:		Date of Sampling:	18/05/2015
Email:	garry.straughton@jacobs.com	Sample Condition:	Acceptable

Comments:
CL = Clay Loam; CS = Clayey Sand; FSC = Fine Sandy Clay; FSCL = Fine Sandy Clay Loam; LC = Light Clay; LMC = Light Medium Clay; MC = Medium Clay and SC = Sandy Clay

Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

Signed: Stephanie Cameron
Laboratory Operations Manager

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East West is certified by the Australian-Asian Soil & Plant Analysis Council to perform various soil and plant tissue analysis. The tests reported herein have been performed in accordance with our terms of accreditation.

This report must not be reproduced except in full and EWEA takes no responsibility of the end use of the results within this report.

This analysis relates to the sample submitted and it is the client's responsibility to make certain the sample is representative of the matrix to be tested.

Samples will be discarded one month after the date of this report. Please advise if you wish to have your sample/s returned.

Results you can rely on.

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A-CS1	Site 1A-CS1	Site 1A-CS1	Site 1A-CS1
				DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-1**	**150487-2**	**150487-3**	**150487-4**
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	21.1	34.4	32.4	22.2
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	6.36	5.12	5.30	5.38
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	5.68	4.19	4.14	4.18
Chloride Soluble	Electrode	PMS-05	mg/kg	5	69.8	133	214	207
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.24	0.27	0.23	0.22
E.C.e	Calc	R&L 3A1	dS/m	na	2.0	2.3	1.9	1.6
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	4.4	0.7	0.9	<0.5
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	484	91.4	56.6	49.6
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	1.83	0.88	0.50	0.29
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	149	474	373	201
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	81.7	14.6	9.87	7.36
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	189	193	246	230
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	143	150	58.8	41.1
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	47.5	49.9	19.6	13.7
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.71	0.59	0.72	0.53
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.64	<0.5	<0.5	<0.5
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	16.6	1.99	0.68	<0.5
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	130	109	101	63.0
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	0.48	0.33	0.20	<0.2
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	0.9	299	336	217
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	0.06	16.2	16.4	11.5
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	NA	NA	NA	NA
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Soil Colour (wet exterior)	Dry	Munsell	Class	na	10YR 4/3	10YR 4/3	10YR 4/6	10YR 6/5
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.3	1.1	1.1	1.3
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	31	1.6	0.8	0.6
Soil Colour	Wet	Munsell	Class	na	10YR 4/3	10YR 4/6	10YR 4/6	10YR 5/8
Porosity Total	Calc	ASTM F1815-97	%	na	47.4	53	49.6	45.6
Porosity Capillary	Calc	ASTM F1815-97	%	na	37.6	35.8	40.3	40.0

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A-CS1	Site 1A-CS1	Site 1A-CS1	Site 1A-CS1
				DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-1**	**150487-2**	**150487-3**	**150487-4**
Porosity Air Filled	Calc	ASTM F1815-97	%	na	9.8	17.3	9.3	5.6
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	0.06	16.2	16.4	11.5
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	0.01	3.32	3.73	2.41
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
ECEC	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	2.99	2.45	2.82	2.77
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	63.1	25.4	8.24	6.05
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	25.1	46.3	60.4	66.3
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	8.77	9.69	12.1	13.4
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.49	0.50	0.64	0.58
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	10.4	5.22	1.88	1.27
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	4.16	9.51	13.8	13.9
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	1.45	1.99	2.75	2.80
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	2.51	0.55	0.14	0.09
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.12	0.05	0.05	0.04
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
ECEC	Calculation	PMS-15D3	Cmol/kg	na	16.6	20.5	22.7	20.9
Texture	Field	Northcote	Class	na	CL	LMC	LMC	MC
Emerson Aggregate	513.01	PMS-21	Class	na	NA	NA	NA	NA
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	193	196	250	226
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	2088	1044	375	253
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	499	1141	1650	1663
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	334	458	632	643
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	2.6	0.2	0.0	0.0
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	11.7	6.5	2.5	12.2

ANALYSIS REPORT

PROJECT NO: EW150487 Location: IA059500

				CLIENT SAMPLE ID	Site 1A-CS1	Site 1A-CS1	Site 1A-CS1	Site 1A-CS1
				DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-1**	**150487-2**	**150487-3**	**150487-4**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	36.6	26.7	28.3	43.3
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	15.8	13.8	13.2	13.9
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	33.4	52.9	56.0	30.6

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					CLIENT SAMPLE ID	Site 1A-CS1	Site 1A-CS1	Site 1A-CS2	Site 1A-CS2
					DEPTH (cm)	100cm	120cm	20cm	40cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**		**150487-5**	**150487-6**	**150487-7**	**150487-8**
Soil Moisture Content	Oven-Dry	R&L2A1	%	na		19.0	20.4	23.2	38.3
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na		5.37	5.48	5.51	5.11
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na		4.18	4.30	4.50	4.11
Chloride Soluble	Electrode	PMS-05	mg/kg	5		237	260	122	213
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01		0.22	0.26	0.25	0.28
E.C.e	Calc	R&L 3A1	dS/m	na		1.6	1.9	2.1	2.1
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5		1.2	1.0	4.3	1.3
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37		<37.5	47.1	173	96.2
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05		0.45	0.20	1.15	0.83
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na		81.5	64.8	448	622
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1		9.47	14.9	16.9	7.40
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10		262	218	264	281
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9		34.2	45.6	139	121
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3		11.4	15.2	46.3	40.2
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5		0.66	<0.5	0.70	0.55
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5		0.61	<0.5	<0.5	<0.5
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5		1.01	0.52	3.97	1.99
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5		46.2	39.6	113	60.7
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2		<0.2	<0.2	0.36	0.24
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5		95.0	49.2	163	528
Aluminium Saturation	ICP-OES	R&L 15O1	%	na		6.60	3.13	10.0	28.4
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10		NA	NA	NA	NA
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20		NA	NA	NA	NA
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10		NA	NA	NA	NA
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10		NA	NA	NA	NA
Soil Colour (wet exterior)	Dry	Munsell	Class	na		10YR 5/8	10YR 6/6	10YR 4/3	10YR 5/8
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na		1.4	1.4	1.3	1.1
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na		<0.3	<0.3	0.9	2.4
Soil Colour	Wet	Munsell	Class	na		10YR 5/8	10YR 6/6	10YR 4/3	10YR 5/8
Porosity Total	Calc	ASTM F1815-97	%	na		44.7	41.6	43.4	52.8
Porosity Capillary	Calc	ASTM F1815-97	%	na		35.6	36.1	41.2	41.8

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					CLIENT SAMPLE ID	Site 1A-CS1	Site 1A-CS1	Site 1A-CS2	Site 1A-CS2
					DEPTH (cm)	100cm	120cm	20cm	40cm
Test Parameter	Method Description	Method Reference	Units	LOR		150487-5	150487-6	150487-7	150487-8
Porosity Air Filled	Calc	ASTM F1815-97	%	na		9.1	5.5	2.2	11
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na		6.60	3.13	10.0	28.4
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na		1.06	0.55	1.81	5.87
Exchangeable Potassium %	Calculation	PMS-15A2	%	na		NA	NA	NA	NA
Exchangeable Calcium %	Calculation	PMS-15A2	%	na		NA	NA	NA	NA
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na		NA	NA	NA	NA
Exchangeable Sodium %	Calculation	PMS-15A2	%	na		NA	NA	NA	NA
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
ECEC	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
Exchangeable Potassium %	Calculation	PMS-15D3	%	na		3.09	3.10	3.80	2.64
Exchangeable Calcium %	Calculation	PMS-15D3	%	na		5.75	6.79	36.8	16.5
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na		67.7	68.7	38.1	42.6
Exchangeable Sodium %	Calculation	PMS-15D3	%	na		16.8	18.3	11.3	9.90
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na		0.49	0.54	0.69	0.55
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na		0.92	1.19	6.65	3.42
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na		10.8	12.0	6.88	8.81
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na		2.69	3.19	2.03	2.05
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na		0.08	0.10	0.97	0.39
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na		0.05	0.05	0.10	0.06
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
ECEC	Calculation	PMS-15D3	Cmol/kg	na		16.0	17.5	18.1	20.7
Texture	Field	Northcote	Class	na		MC	MC	LMC	MC
Emerson Aggregate	513.01	PMS-21	Class	na		NA	NA	3a	3b
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		193	211	268	213
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20		184	237	1330	684
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		1300	1440	826	1057
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		619	733	468	471
Gravel >2.0mm	Sieve	ASTMD422-63	%	na		0.1	0.3	5.4	0.2
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na		18.0	14.4	11.4	3.7

ANALYSIS REPORT

PROJECT NO: EW150487 Location: IA059500

				CLIENT SAMPLE ID	Site 1A-CS1	Site 1A-CS1	Site 1A-CS2	Site 1A-CS2
				DEPTH (cm)	100cm	120cm	20cm	40cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-5**	**150487-6**	**150487-7**	**150487-8**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	44.0	48.6	34.3	22.5
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	13.2	13.6	17.6	17.5
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	24.8	23.1	31.3	56.0

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ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					Site 1A-CS2	Site 1A-CS2	Site 1A-CS2	Site 1A-CS2
				CLIENT SAMPLE ID	Site 1A-CS2	Site 1A-CS2	Site 1A-CS2	Site 1A-CS2
				DEPTH (cm)	60cm	80cm	100cm	120cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-9**	**150487-10**	**150487-11**	**150487-12**
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	32.4	25.8	20.6	19.0
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	5.21	5.23	5.26	5.61
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	4.12	4.18	4.13	4.25
Chloride Soluble	Electrode	PMS-05	mg/kg	5	259	202	181	191
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.27	0.20	0.20	0.09
E.C.e	Calc	R&L 3A1	dS/m	na	2.0	1.5	1.5	0.6
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	<0.5	2.2	<0.5	<0.5
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	65.3	68.6	54.3	41.7
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	1.59	0.37	0.14	0.10
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	530	272	115	83.7
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	4.11	9.71	3.46	6.36
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	308	261	408	330
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	61.8	49.8	46.2	53.4
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	20.6	16.6	15.4	17.8
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.52	0.56	0.76	0.94
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.75	0.61	<0.5	<0.5
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	108	95.9	73.3	26.6
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	471	333	180	126
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	23.7	19.8	11.3	8.55
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	NA	NA	NA	NA
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Soil Colour (wet exterior)	Dry	Munsell	Class	na	10YR 5/6	10YR 5/6	10YR 6/8	10YR 6/4
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.1	1.2	1.3	1.1
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	1.5	<0.3	0.7	<0.3
Soil Colour	Wet	Munsell	Class	na	10YR 5/6	10YR 5/6	2.5Y 1/3	10YR 6/4
Porosity Total	Calc	ASTM F1815-97	%	na	51.6	49.9	40.0	39.4
Porosity Capillary	Calc	ASTM F1815-97	%	na	39.8	36.1	35.7	34.1

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					CLIENT SAMPLE ID	Site 1A-CS2	Site 1A-CS2	Site 1A-CS2	Site 1A-CS2
					DEPTH (cm)	60cm	80cm	100cm	120cm
Test Parameter	Method Description	Method Reference	Units	LOR		150487-9	150487-10	150487-11	150487-12
Porosity Air Filled	Calc	ASTM F1815-97	%	na		11.8	13.7	4.4	5.3
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na		23.7	19.8	11.3	8.55
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na		5.23	3.70	2.00	1.40
Exchangeable Potassium %	Calculation	PMS-15A2	%	na		NA	NA	NA	NA
Exchangeable Calcium %	Calculation	PMS-15A2	%	na		NA	NA	NA	NA
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na		NA	NA	NA	NA
Exchangeable Sodium %	Calculation	PMS-15A2	%	na		NA	NA	NA	NA
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
ECEC	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
Exchangeable Potassium %	Calculation	PMS-15D3	%	na		2.67	3.01	3.59	3.84
Exchangeable Calcium %	Calculation	PMS-15D3	%	na		7.98	4.94	3.92	3.73
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na		53.5	58.9	65.4	67.0
Exchangeable Sodium %	Calculation	PMS-15D3	%	na		12.2	13.4	15.8	16.9
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na		0.59	0.56	0.64	0.63
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na		1.77	0.93	0.70	0.61
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na		11.8	11.0	11.6	11.0
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na		2.70	2.50	2.80	2.77
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na		0.15	0.08	0.06	0.06
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na		0.05	0.05	0.05	0.06
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
ECEC	Calculation	PMS-15D3	Cmol/kg	na		22.1	18.7	17.7	16.4
Texture	Field	Northcote	Class	na		MC	MC	MC	MC
Emerson Aggregate	513.01	PMS-21	Class	na		3a	2	1	1
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		230	220	248	245
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20		353	185	139	122
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		1419	1323	1390	1316
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		622	575	645	637
Gravel >2.0mm	Sieve	ASTMD422-63	%	na		0.2	0.0	0.2	0.5
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na		5.7	2.2	2.2	5.4

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A-CS2	Site 1A-CS2	Site 1A-CS2	Site 1A-CS2
				DEPTH (cm)	60cm	80cm	100cm	120cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-9**	**150487-10**	**150487-11**	**150487-12**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	30.4	26.1	42.7	55.9
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	18.4	19.6	29.4	22.2
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	45.2	52.0	25.4	16.0

ANALYSIS REPORT

PROJECT NO: EW150487   Location: IA059500

					Site 1A-CS3	Site 1A-CS3	Site 1A-CS3	Site 1A-CS3
				CLIENT SAMPLE ID	Site 1A-CS3	Site 1A-CS3	Site 1A-CS3	Site 1A-CS3
				DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-13**	**150487-14**	**150487-15**	**150487-16**
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	22.8	22.5	26.1	30.5
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	6.72	5.68	6.66	6.72
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	6.41	4.84	5.48	5.76
Chloride Soluble	Electrode	PMS-05	mg/kg	5	104	129	133	150
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.38	0.28	0.28	0.28
E.C.e	Calc	R&L 3A1	dS/m	na	3.2	2.4	2.1	2.1
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	4.6	1.3	0.6	1.2
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	362	91.4	110	178
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	1.19	0.51	0.43	0.66
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	81.8	116	74.2	78.3
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	124	20.0	30.4	43.9
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	279	239	430	254
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	381	281	256	174
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	127	93.7	85.3	58.0
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.84	0.76	0.70	0.82
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.79	0.54	0.69	1.08
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	5.48	2.85	3.14	3.31
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	116	107	88.5	94.2
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	0.38	<0.2	<0.2	<0.2
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	0.8	23.3	1.2	0.3
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	0.05	2.09	0.07	0.02
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	101	NA	NA	NA
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	1688	NA	NA	NA
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	766	NA	NA	NA
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	258	NA	NA	NA
Soil Colour (wet exterior)	Dry	Munsell	Class	na	10YR 3/3	10YR 4/4	2.5Y 6/3	2.5Y 4/4
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.4	1.4	1.4	1.3
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	0.5	0.9	<0.3	<0.3
Soil Colour	Wet	Munsell	Class	na	10YR 3/3	10YR 4/4	2.5Y 6/3	2.5Y 4/4
Porosity Total	Calc	ASTM F1815-97	%	na	42.8	42.3	42.4	43.5
Porosity Capillary	Calc	ASTM F1815-97	%	na	38.8	36.8	36.3	37.9

ANALYSIS REPORT

PROJECT NO: EW150487 Location: IA059500

			CLIENT SAMPLE ID		Site 1A-CS3	Site 1A-CS3	Site 1A-CS3	Site 1A-CS3
			DEPTH (cm)		20cm	40cm	60cm	80cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-13**	**150487-14**	**150487-15**	**150487-16**
Porosity Air Filled	Calc	ASTM F1815-97	%	na	4.0	5.4	6.1	5.6
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	0.05	2.09	0.07	0.02
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	0.01	0.26	0.01	0.00
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	1.60	NA	NA	NA
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	52.1	NA	NA	NA
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	39.4	NA	NA	NA
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	6.92	NA	NA	NA
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	0.26	NA	NA	NA
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	8.44	NA	NA	NA
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	6.38	NA	NA	NA
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	1.12	NA	NA	NA
ECEC	Calculation	PMS-15A2	Cmol/kg	na	16.2	NA	NA	NA
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	1.32	NA	NA	NA
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	2.99	3.17	2.79	2.97
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	50.9	18.4	16.7	19.3
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	37.4	65.6	67.9	64.4
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	8.69	10.7	12.5	13.3
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.49	0.39	0.54	0.62
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	8.43	2.28	3.22	4.03
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	6.19	8.12	13.0	13.5
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	1.44	1.32	2.40	2.78
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	1.36	0.28	0.25	0.30
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.08	0.05	0.04	0.05
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	0.04	NA	NA	NA
ECEC	Calculation	PMS-15D3	Cmol/kg	na	16.6	12.4	19.2	20.9
Texture	Field	Northcote	Class	na	CL	LMC	MC	MC
Emerson Aggregate	513.01	PMS-21	Class	na	NA	NA	NA	NA
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	193	153	209	242
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	1685	456	643	806
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	743	974	1564	1615
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	331	303	552	639
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	2.0	0.3	0.5	0.6
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	13.4	9.5	5.7	6.2

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					CLIENT SAMPLE ID	Site 1A-CS3	Site 1A-CS3	Site 1A-CS3	Site 1A-CS3
					DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	Method Description	Method Reference	Units	LOR		150487-13	150487-14	150487-15	150487-16
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na		51.9	42.9	39.3	39.9
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na		18.4	16.4	23.4	22.6
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na		14.3	30.9	31.0	30.7

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					Site 1A-CS3	Site 1A-CS3	Site 1A -CS4	Site 1A -CS4
				CLIENT SAMPLE ID				
				DEPTH (cm)	100cm	120cm	20cm	40cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-17**	**150487-18**	**150487-19**	**150487-20**
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	29.0	31.9	20.7	28.7
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	6.67	6.78	7.25	5.21
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	5.72	5.96	6.56	4.32
Chloride Soluble	Electrode	PMS-05	mg/kg	5	161	171	38.6	137
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.23	0.26	0.24	0.28
E.C.e	Calc	R&L 3A1	dS/m	na	1.7	1.9	2.0	2.4
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	0.6	<0.5	6.5	1.5
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	140	173	646	107
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	1.86	0.43	2.07	0.63
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	71.3	72.9	118	409
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	47.6	26.1	241	19.7
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	228	220	213	241
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	136	97.2	158	158
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	45.4	32.4	52.6	52.5
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.92	1.05	0.91	0.65
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.66	<0.5	4.87	<0.5
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	7.97	12.9	10.7	1.10
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	68.1	126	109	118
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	<0.2	<0.2	0.37	0.30
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	0.4	0.6	0.8	275
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	0.02	0.04	0.04	15.6
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	NA	NA	NA	NA
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Soil Colour (wet exterior)	Dry	Munsell	Class	na	10YR 5/4	10YR 4/4	10YR 3/3	10YR 3/4
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.3	1.3	1.3	1.2
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	<0.3	0.3	<0.3	9.1
Soil Colour	Wet	Munsell	Class	na	10YR 5/4	10YR 4/4	10YR 3/3	10YR 3/4
Porosity Total	Calc	ASTM F1815-97	%	na	41.7	44	44.7	50.
Porosity Capillary	Calc	ASTM F1815-97	%	na	32.9	34.3	36.6	38.3

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

			CLIENT SAMPLE ID		Site 1A-CS3	Site 1A-CS3	Site 1A -CS4	Site 1A -CS4
			DEPTH (cm)		100cm	120cm	20cm	40cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-17**	**150487-18**	**150487-19**	**150487-20**
Porosity Air Filled	Calc	ASTM F1815-97	%	na	8.8	9.7	8.2	11.8
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	0.02	0.04	0.04	15.6
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	0.00	0.01	0.01	3.06
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
ECEC	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	3.17	3.09	2.19	3.24
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	14.3	17.2	70.7	21.0
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	67.8	64.7	21.0	48.4
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	14.8	15.0	6.08	11.7
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.61	0.55	0.54	0.63
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	2.75	3.08	17.5	4.12
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	13.1	11.6	5.21	9.47
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	2.85	2.69	1.51	2.30
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.21	0.27	3.37	0.43
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.05	0.05	0.10	0.07
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
ECEC	Calculation	PMS-15D3	Cmol/kg	na	19.3	17.9	24.8	19.6
Texture	Field	Northcote	Class	na	MC	MC	CL	LMC
Emerson Aggregate	513.01	PMS-21	Class	na	NA	NA	3b	3b
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	238	216	212	247
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	550	616	3507	823
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	1568	1391	625	1136
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	655	619	347	528
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	0.3	0.4	5.0	1.6
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	4.9	8.4	13.7	6.8

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					CLIENT SAMPLE ID	Site 1A-CS3	Site 1A-CS3	Site 1A -CS4	Site 1A -CS4
					DEPTH (cm)	100cm	120cm	20cm	40cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**		**150487-17**	**150487-18**	**150487-19**	**150487-20**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na		49.7	44.6	46.4	31.9
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na		22.3	23.1	19.4	16.9
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na		22.8	23.5	15.5	42.8

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ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					CLIENT SAMPLE ID	Site 1A -CS4	Site 1A -CS4	Site 1A -CS4	Site 1A -CS4
					DEPTH (cm)	60cm	80cm	100cm	120cm
Test Parameter	Method Description	Method Reference	Units	LOR		150487-21	150487-22	150487-23	150487-24
Soil Moisture Content	Oven-Dry	R&L2A1	%	na		30.3	31.7	24.9	22.8
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na		5.19	5.29	5.43	5.43
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na		4.26	4.27	4.30	4.35
Chloride Soluble	Electrode	PMS-05	mg/kg	5		223	205	194	219
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01		0.29	0.27	0.23	0.25
E.C.e	Calc	R&L 3A1	dS/m	na		2.1	2.0	1.7	1.8
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5		<0.5	<0.5	<0.5	<0.5
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37		64.1	54.7	<37.5	40.2
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05		0.41	0.31	0.16	0.14
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na		336	225	93.1	87.5
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1		12.6	15.2	10.7	10.0
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10		260	294	302	343
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9		150	104	61.8	64.5
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3		50.0	34.8	20.6	21.5
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5		0.74	0.81	1.13	<0.5
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5		<0.5	<0.5	0.60	0.87
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5		<0.5	<0.5	<0.5	0.56
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5		60.6	58.1	41.1	51.3
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2		<0.2	<0.2	<0.2	<0.2
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5		357	142	97.1	105
Aluminium Saturation	ICP-OES	R&L 15O1	%	na		19.8	8.44	5.65	5.69
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10		NA	NA	NA	NA
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20		NA	NA	NA	NA
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10		NA	NA	NA	NA
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10		NA	NA	NA	NA
Soil Colour (wet exterior)	Dry	Munsell	Class	na		10YR 4/6	10YR 5/6	10YR 4/4	10YR 7/1
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na		1.2	1.1	1.3	1.3
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na		2.2	<0.3	<0.3	<0.3
Soil Colour	Wet	Munsell	Class	na		10YR 4/6	10YR 5/6	10YR 4/4	10YR 7/1
Porosity Total	Calc	ASTM F1815-97	%	na		46.2	51.8	43.6	45.1
Porosity Capillary	Calc	ASTM F1815-97	%	na		37.3	38.8	40.0	36.7

ANALYSIS REPORT

PROJECT NO: EW150487 Location: IA059500

					CLIENT SAMPLE ID	Site 1A -CS4	Site 1A -CS4	Site 1A -CS4	Site 1A -CS4
					DEPTH (cm)	60cm	80cm	100cm	120cm
Test Parameter	Method Description	Method Reference	Units	LOR		150487-21	150487-22	150487-23	150487-24
Porosity Air Filled	Calc	ASTM F1815-97	%	na		8.9	13.0	3.6	8.4
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na		19.8	8.44	5.65	5.69
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na		3.97	1.58	1.08	1.17
Exchangeable Potassium %	Calculation	PMS-15A2	%	na		NA	NA	NA	NA
Exchangeable Calcium %	Calculation	PMS-15A2	%	na		NA	NA	NA	NA
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na		NA	NA	NA	NA
Exchangeable Sodium %	Calculation	PMS-15A2	%	na		NA	NA	NA	NA
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
ECEC	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
Exchangeable Potassium %	Calculation	PMS-15D3	%	na		3.39	3.79	3.66	3.80
Exchangeable Calcium %	Calculation	PMS-15D3	%	na		7.75	6.93	5.34	4.02
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na		54.5	63.1	66.4	66.9
Exchangeable Sodium %	Calculation	PMS-15D3	%	na		14.5	17.8	18.9	19.5
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na		0.68	0.71	0.70	0.78
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na		1.55	1.30	1.02	0.83
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na		10.9	11.8	12.7	13.7
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na		2.90	3.32	3.61	4.01
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na		0.14	0.11	0.08	0.06
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na		0.06	0.06	0.06	0.06
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	NA
ECEC	Calculation	PMS-15D3	Cmol/kg	na		20.0	18.7	19.1	20.5
Texture	Field	Northcote	Class	na		MC	MC	MC	MC
Emerson Aggregate	513.01	PMS-21	Class	na		3b	3a	2	1
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		264	276	273	304
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20		310	259	204	165
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		1307	1414	1523	1647
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		668	764	831	922
Gravel >2.0mm	Sieve	ASTMD422-63	%	na		0.6	1.3	0.0	0.2
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na		3.6	3.0	0.9	3.9

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					CLIENT SAMPLE ID / DEPTH (cm)	Site 1A -CS4 60cm	Site 1A -CS4 80cm	Site 1A -CS4 100cm	Site 1A -CS4 120cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**		**150487-21**	**150487-22**	**150487-23**	**150487-24**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na		30.8	29.4	39.1	31.5
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na		20.2	20.0	23.5	24.0
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na		44.8	46.4	36.5	40.4

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

Test Parameter	Method Description	Method Reference	Units	LOR	Site 1A CS5	Site 1A CS5	Site 1A CS5	Site 1A CS5
				CLIENT SAMPLE ID	Site 1A CS5	Site 1A CS5	Site 1A CS5	Site 1A CS5
				DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	Method Description	Method Reference	Units	LOR	150487-25	150487-26	150487-27	150487-28
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	24.8	23.4	25.9	22.8
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	7.19	6.22	6.11	6.39
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	6.64	5.50	5.31	5.83
Chloride Soluble	Electrode	PMS-05	mg/kg	5	134	131	101	89.0
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.38	0.24	0.19	0.23
E.C.e	Calc	R&L 3A1	dS/m	na	3.2	2.0	1.6	1.9
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	5.0	2.4	<0.5	3.3
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	559	145	103	198
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	1.43	0.76	0.50	0.94
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	109	86.6	85.7	82.7
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	150	26.3	17.0	26.5
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	753	215	328	439
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	223	159	137	159
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	74.4	53.0	45.8	53.0
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.86	0.80	0.95	1.04
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	2.70	0.91	0.83	0.95
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	14.2	18.6	21.1	22.5
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	120	164	201	184
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	0.62	0.26	0.25	0.30
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	3.7	1.6	2.8	0.4
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	0.18	0.12	0.22	0.02
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	214	NA	NA	NA
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	2387	NA	NA	NA
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	764	NA	NA	NA
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	292	NA	NA	NA
Soil Colour (wet exterior)	Dry	Munsell	Class	na	2.5Y 3/2	10YR 3/3	2.5Y 5/4	2.5Y 5/4
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.3	1.3	1.4	1.5
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	0.3	<0.3	<0.3	1.0
Soil Colour	Wet	Munsell	Class	na	2.5Y 3/2	10YR 3/3	2.5Y 5/4	2.5Y 5/4
Porosity Total	Calc	ASTM F1815-97	%	na	45.8	46.1	40.1	38.1
Porosity Capillary	Calc	ASTM F1815-97	%	na	40.0	33.0	35.9	31.3

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A CS5	Site 1A CS5	Site 1A CS5	Site 1A CS5
				DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	Method Description	Method Reference	Units	LOR	150487-25	150487-26	150487-27	150487-28
Porosity Air Filled	Calc	ASTM F1815-97	%	na	5.8	13.1	4.2	6.8
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	0.20	0.12	0.22	0.02
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	0.04	0.02	0.03	0.00
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	2.72	NA	NA	NA
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	59.2	NA	NA	NA
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	31.6	NA	NA	NA
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	6.30	NA	NA	NA
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	0.55	NA	NA	NA
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	11.9	NA	NA	NA
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	6.37	NA	NA	NA
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	1.27	NA	NA	NA
ECEC	Calculation	PMS-15A2	Cmol/kg	na	20.2	NA	NA	NA
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	1.87	NA	NA	NA
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	3.89	3.69	3.58	2.61
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	58.7	31.3	29.0	52.3
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	28.1	54.8	57.1	37.4
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	9.22	10.00	10.1	7.66
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.89	0.55	0.50	0.50
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	13.4	4.64	4.04	10.0
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	6.41	8.11	7.93	7.15
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	2.10	1.48	1.41	1.47
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	2.09	0.57	0.51	1.40
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.14	0.07	0.06	0.07
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	0.09	NA	NA	NA
ECEC	Calculation	PMS-15D3	Cmol/kg	na	22.8	14.8	13.9	19.1
Texture	Field	Northcote	Class	na	CL	CL	LMC	FSC
Emerson Aggregate	513.01	PMS-21	Class	na	NA	NA	NA	NA
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	346	213	194	195
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	2679	927	807	2003
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	769	973	952	858
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	484	340	324	337
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	1.6	10.4	0.3	20.7
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	7.8	9.2	11.1	32.0

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					CLIENT SAMPLE ID	Site 1A CS5	Site 1A CS5	Site 1A CS5	Site 1A CS5
					DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**		**150487-25**	**150487-26**	**150487-27**	**150487-28**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na		17.9	51.6	42.6	29.7
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na		19.4	12.0	13.7	8.3
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na		53.2	16.8	32.3	9.3

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ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A -CS6	Site 1A -CS6	Site 1A -CS6	Site 1A -CS6
				DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-29**	**150487-30**	**150487-31**	**150487-32**
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	24.8	27.7	25.8	21.9
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	7.16	6.94	6.84	6.66
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	6.42	6.38	6.37	6.15
Chloride Soluble	Electrode	PMS-05	mg/kg	5	52.0	129	246	277
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.20	0.28	0.34	0.35
E.C.e	Calc	R&L 3A1	dS/m	na	1.7	2.1	2.5	3.0
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	4.8	1.4	0.7	<0.5
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	173	71.0	48.9	62.8
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	1.11	0.42	0.25	0.99
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	76.6	91.6	79.3	60.5
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	12.8	11.3	15.9	8.12
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	225	333	228	229
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	138	195	195	178
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	45.9	65.1	64.9	59.4
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.89	0.69	0.69	1.01
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.83	0.54	<0.5	0.66
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	18.7	2.41	0.74	0.56
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	71.2	38.8	39.1	38.4
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	0.49	0.48	0.28	<0.2
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	0.7	0.4	0.4	0.5
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	0.05	0.02	0.02	0.02
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	96.1	84.3
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	NA	NA	2014	1323
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	1361	1312
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	248	242
Soil Colour (wet exterior)	Dry	Munsell	Class	na	10YR 4/3	10YR 6/8	10YR 5/6	10YR 5/8
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.3	1.2	1.3	1.3
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	4.6	0.7	0.7	<0.3
Soil Colour	Wet	Munsell	Class	na	10YR 4/3	10YR 6/8	10YR 5/6	10YR 5/8
Porosity Total	Calc	ASTM F1815-97	%	na	45.7	49.7	44.4	47.7
Porosity Capillary	Calc	ASTM F1815-97	%	na	34.6	35.3	39.8	37.0

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PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A -CS6	Site 1A -CS6	Site 1A -CS6	Site 1A -CS6
				DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	Method Description	Method Reference	Units	LOR	150487-29	150487-30	150487-31	150487-32
Porosity Air Filled	Calc	ASTM F1815-97	%	na	11.1	14.4	4.6	10.7
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	0.05	0.02	0.02	0.03
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	0.01	0.00	0.00	0.01
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	NA	NA	1.08	1.15
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	NA	NA	44.3	35.1
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	NA	NA	49.9	58.1
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	NA	NA	4.74	5.59
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	0.25	0.22
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	10.1	6.62
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	11.3	10.9
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	1.08	1.05
ECEC	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	22.7	18.8
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	0.89	0.61
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	3.45	2.82	2.24	2.37
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	54.2	49.2	45.1	36.1
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	30.9	38.8	44.9	51.9
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	11.4	9.14	7.76	9.60
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.52	0.63	0.59	0.54
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	8.09	11.0	11.9	8.20
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	4.61	8.68	11.9	11.8
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	1.71	2.04	2.05	2.18
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	1.75	1.27	1.00	0.69
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.11	0.07	0.05	0.05
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	0.02	0.02
ECEC	Calculation	PMS-15D3	Cmol/kg	na	14.9	22.4	26.4	22.7
Texture	Field	Northcote	Class	na	CL	MC	MC	LMC
Emerson Aggregate	513.01	PMS-21	Class	na	2	2	5	2
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	201	246	231	210
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	1617	2203	2380	1640
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	553	1041	1422	1416
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	393	470	471	502
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	1.3	0.2	0.3	0.8
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	20.8	8.6	5.7	6.1

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					Site 1A -CS6	Site 1A -CS6	Site 1A -CS6	Site 1A -CS6
			CLIENT SAMPLE ID					
			DEPTH (cm)		20cm	40cm	60cm	80cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-29**	**150487-30**	**150487-31**	**150487-32**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	46.1	26.4	25.4	32.8
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	21.5	15.4	20.2	30.4
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	10.3	49.4	48.4	29.9

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PROJECT NO: EW150487 **Location: IA059500**

					Site 1A -CS6	Site 1A -CS6	Site 1A- CS7	Site 1A- CS7
				CLIENT SAMPLE ID				
				DEPTH (cm)	100cm	120cm	20cm	40cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-33**	**150487-34**	**150487-35**	**150487-36**
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	17.5	19.9	29.2	24.0
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	6.17	6.15	6.24	5.13
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	5.37	5.32	5.68	4.34
Chloride Soluble	Electrode	PMS-05	mg/kg	5	234	228	273	271
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.28	0.23	0.38	0.34
E.C.e	Calc	R&L 3A1	dS/m	na	2.4	1.9	3.2	2.9
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	1.1	<0.5	6.4	<0.5
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	82.6	76.7	323	55.7
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	0.48	0.22	2.05	0.60
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	60.6	54.4	161	351
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	8.36	11.6	74.4	10.8
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	246	338	480	224
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	160	78.0	226	133
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	53.2	26.0	75.2	44.3
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.60	1.39	1.19	0.75
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.82	1.55	7.15	1.68
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.93	0.65	52.1	4.30
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	49.7	52.1	311	162
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	<0.2	<0.2	0.42	0.23
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	3.7	4.6	0.7	235
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	0.19	0.25	0.05	14.3
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	173	111
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	NA	NA	1141	469
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	737	1150
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	325	312
Soil Colour (wet exterior)	Dry	Munsell	Class	na	10YR 5/6	10YR 5/8	10YR 3/3	10YR 4/4
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.3	1.3	1.2	1.2
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	1.4	<0.3	3.7	0.3
Soil Colour	Wet	Munsell	Class	na	10YR 5/6	10YR 6/1	10YR 3/3	10YR 4/4
Porosity Total	Calc	ASTM F1815-97	%	na	46.4	45.7	48.9	48.3
Porosity Capillary	Calc	ASTM F1815-97	%	na	33.4	37.8	38.5	34.9

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					Site 1A -CS6	Site 1A -CS6	Site 1A- CS7	Site 1A- CS7
				CLIENT SAMPLE ID / DEPTH (cm)	100cm	120cm	20cm	40cm
Test Parameter	Method Description	Method Reference	Units	LOR	150487-33	150487-34	150487-35	150487-36
Porosity Air Filled	Calc	ASTM F1815-97	%	na	12.9	7.9	10.3	13.4
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	0.19	0.25	0.06	16.1
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	0.04	0.05	0.01	2.61
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	NA	NA	3.24	1.76
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	NA	NA	41.6	14.5
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	NA	NA	44.8	59.2
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	NA	NA	10.3	8.38
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	0.44	0.28
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	5.71	2.35
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	6.14	9.58
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	1.41	1.36
ECEC	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	13.7	16.2
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	0.93	0.24
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	3.00	2.99	5.31	3.21
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	24.2	18.4	40.7	15.8
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	61.0	65.8	39.1	53.7
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	11.6	12.5	14.9	13.0
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.64	0.62	0.83	0.58
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	5.12	3.82	6.35	2.88
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	12.9	13.6	6.09	9.79
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	2.46	2.59	2.32	2.36
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.40	0.28	1.04	0.29
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.05	0.05	0.14	0.06
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	0.07	0.03
ECEC	Calculation	PMS-15D3	Cmol/kg	na	21.2	20.7	15.6	18.2
Texture	Field	Northcote	Class	na	LMC	LMC	CL	LMC
Emerson Aggregate	513.01	PMS-21	Class	na	3a	2	NA	NA
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	248	242	323	228
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	1024	763	1270	576
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	1550	1637	731	1175
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	565	596	534	543
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	0.2	0.0	6.9	0.3
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	2.8	0.1	11.1	7.3

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A -CS6	Site 1A -CS6	Site 1A- CS7	Site 1A- CS7
				DEPTH (cm)	100cm	120cm	20cm	40cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-33**	**150487-34**	**150487-35**	**150487-36**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	28.0	28.3	42.9	36.2
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	36.4	32.0	11.5	14.2
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	32.6	39.6	27.6	42.1

ANALYSIS REPORT

PROJECT NO: EW150487 Location: IA059500

				CLIENT SAMPLE ID	Site 1A- CS7	Site 1A- CS7	Site 1A- CS7	Site 1A- CS7
				DEPTH (cm)	60cm	80cm	100cm	120cm
Test Parameter	Method Description	Method Reference	Units	LOR	150487-37	150487-38	150487-39	150487-40
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	27.2	23.7	16.6	17.3
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	5.18	5.39	5.36	5.15
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	4.27	4.37	4.35	4.25
Chloride Soluble	Electrode	PMS-05	mg/kg	5	268	253	234	254
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.30	0.27	0.27	0.32
E.C.e	Calc	R&L 3A1	dS/m	na	2.2	2.0	2.0	2.4
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	1.2	0.8	1.0	1.3
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	70.5	108	83.2	55.3
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	0.50	0.24	0.17	0.18
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	279	95.0	65.9	78.7
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	5.13	6.91	12.9	7.76
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	274	262	240	354
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	114	81.9	115	151
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	37.9	27.3	38.2	50.2
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.89	<0.5	1.08	1.16
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.05	0.72	0.67	0.84
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.27	0.66	1.24	0.73
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	121	64.4	43.8	37.2
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	263	113	92.8	83.9
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	15.3	7.78	6.06	5.13
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	145
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	NA	NA	NA	91.4
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	1253
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	587
Soil Colour (wet exterior)	Dry	Munsell	Class	na	5YR 5/6	10YR 6/3	10YR 5/6	10YR 6/6
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.3	1.4	1.3	1.2
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	0.4	1.2	1.0	0.4
Soil Colour	Wet	Munsell	Class	na	5YR 5/6	10YR 6/3	10YR 5/6	10YR 6/2
Porosity Total	Calc	ASTM F1815-97	%	na	44.1	41.8	47.6	52.1
Porosity Capillary	Calc	ASTM F1815-97	%	na	37.9	34.2	31.3	37.9

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ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					CLIENT SAMPLE ID	Site 1A- CS7	Site 1A- CS7	Site 1A- CS7	Site 1A- CS7
					DEPTH (cm)	60cm	80cm	100cm	120cm
Test Parameter	Method Description	Method Reference	Units	LOR		150487-37	150487-38	150487-39	150487-40
Porosity Air Filled	Calc	ASTM F1815-97	%	na		6.3	7.6	16.3	14.6
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na		15.3	7.78	6.06	6.32
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na		2.92	1.26	1.03	0.93
Exchangeable Potassium %	Calculation	PMS-15A2	%	na		NA	NA	NA	2.52
Exchangeable Calcium %	Calculation	PMS-15A2	%	na		NA	NA	NA	3.10
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na		NA	NA	NA	70.8
Exchangeable Sodium %	Calculation	PMS-15A2	%	na		NA	NA	NA	17.3
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	0.37
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	0.46
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	10.4
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	2.55
ECEC	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	14.8
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	0.04
Exchangeable Potassium %	Calculation	PMS-15D3	%	na		3.15	3.94	3.47	4.58
Exchangeable Calcium %	Calculation	PMS-15D3	%	na		9.80	6.26	6.35	5.22
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na		56.8	63.0	63.3	62.9
Exchangeable Sodium %	Calculation	PMS-15D3	%	na		14.9	19.0	20.9	22.1
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na		0.60	0.64	0.59	0.82
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na		1.87	1.01	1.08	0.94
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na		10.8	10.2	10.8	11.3
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na		2.85	3.07	3.55	3.97
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na		0.17	0.10	0.10	0.08
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na		0.06	0.06	0.05	0.07
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	NA	0.04
ECEC	Calculation	PMS-15D3	Cmol/kg	na		19.1	16.1	17.0	17.9
Texture	Field	Northcote	Class	na		MC	MC	MC	MC
Emerson Aggregate	513.01	PMS-21	Class	na		NA	NA	NA	NA
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		234	248	230	320
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20		374	202	216	187
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		1300	1221	1292	1352
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		655	705	816	912
Gravel >2.0mm	Sieve	ASTMD422-63	%	na		0.0	1.6	1.7	3.4
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na		2.1	4.9	12.8	14.8

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A- CS7	Site 1A- CS7	Site 1A- CS7	Site 1A- CS7
				DEPTH (cm)	60cm	80cm	100cm	120cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-37**	**150487-38**	**150487-39**	**150487-40**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	28.4	36.4	36.1	48.5
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	20.4	34.5	17.9	17.8
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	49.0	22.6	31.5	15.4

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A-CS8	Site 1A-CS8	Site 1A-CS8	Site 1A-CS8
				DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-41**	**150487-42**	**150487-43**	**150487-44**
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	28.6	26.2	29.3	24.5
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	6.63	5.72	5.46	5.43
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	6.27	4.90	4.68	4.56
Chloride Soluble	Electrode	PMS-05	mg/kg	5	123	204	344	347
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.33	0.31	0.40	0.39
E.C.e	Calc	R&L 3A1	dS/m	na	2.8	2.6	3.4	3.3
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	9.9	5.0	4.2	1.9
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	224	115	105	93.2
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	1.56	0.89	1.04	0.69
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	100	109	139	121
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	44.0	23.3	27.8	16.3
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	286	270	208	234
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	243	203	165	170
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	81.1	67.5	54.9	56.5
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.78	0.86	0.93	1.06
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.57	1.02	1.52	1.27
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	9.88	11.9	17.4	9.09
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	116	141	191	133
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	0.33	0.26	0.23	<0.2
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	1.9	13.8	26.8	47.1
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	0.12	0.89	1.74	2.83
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	101	87.3	88.4	119
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	1456	1489	578	345
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	868	809	1001	1358
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	340	337	339	557
Soil Colour (wet exterior)	Dry	Munsell	Class	na	10YR 3/3	10YR 4/3	10YR 5/6	10YR 5/8
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.3	1.2	1.2	1.1
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	0.9	0.3	<0.3	<0.3
Soil Colour	Wet	Munsell	Class	na	10YR 3/3	10YR 4/3	10YR 5/6	10YR 5/8
Porosity Total	Calc	ASTM F1815-97	%	na	45.7	49.8	51.1	38.6
Porosity Capillary	Calc	ASTM F1815-97	%	na	39.7	37.9	36.1	35.9

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ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A-CS8	Site 1A-CS8	Site 1A-CS8	Site 1A-CS8
				DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	Method Description	Method Reference	Units	LOR	150487-41	150487-42	150487-43	150487-44
Porosity Air Filled	Calc	ASTM F1815-97	%	na	6.0	12.0	15.0	2.7
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	0.13	0.96	2.25	3.21
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	0.02	0.15	0.30	0.52
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	1.59	1.40	1.71	1.87
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	44.7	46.4	21.8	10.6
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	44.5	42.1	63.1	69.5
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	9.08	9.14	11.1	14.9
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	0.26	0.22	0.23	0.31
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	7.28	7.45	2.89	1.73
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	7.23	6.74	8.34	11.3
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	1.48	1.47	1.47	2.42
ECEC	Calculation	PMS-15A2	Cmol/kg	na	16.3	16.0	13.2	16.3
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	1.01	1.10	0.35	0.15
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	3.02	3.03	3.31	3.26
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	45.4	44.2	19.5	12.7
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	39.5	39.7	57.0	61.1
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	12.0	12.2	18.4	20.1
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.55	0.52	0.57	0.60
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	8.30	7.61	3.34	2.35
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	7.21	6.83	9.76	11.3
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	2.19	2.09	3.16	3.72
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	1.15	1.12	0.34	0.21
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.08	0.08	0.06	0.05
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	0.04	0.03	0.03	0.03
ECEC	Calculation	PMS-15D3	Cmol/kg	na	18.3	17.2	17.1	18.5
Texture	Field	Northcote	Class	na	CL	CL	CL	LMC
Emerson Aggregate	513.01	PMS-21	Class	na	3a	3a	3a	1
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	215	203	221	235
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	1660	1522	668	470
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	865	819	1171	1353
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	503	481	726	855
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	3.2	1.6	0.8	0.2
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	10.9	11.2	8.1	13.6

ANALYSIS REPORT

PROJECT NO: EW150487

Location: IA059500

				CLIENT SAMPLE ID	Site 1A-CS8	Site 1A-CS8	Site 1A-CS8	Site 1A-CS8
				DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-41**	**150487-42**	**150487-43**	**150487-44**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	34.9	33.8	30.4	20.4
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	18.5	16.7	14.0	15.7
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	32.5	36.6	46.8	50.1

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					Site 1A-CS8	Site 1A-CS8	Site 1A-CS9	Site 1A-CS9
				CLIENT SAMPLE ID / DEPTH (cm)	100cm	120cm	20cm	40cm
Test Parameter	Method Description	Method Reference	Units	LOR	150487-45	150487-46	150487-47	150487-48
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	26.3	20.6	27.1	26.7
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	5.29	5.43	5.75	5.18
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	4.46	4.36	5.06	4.46
Chloride Soluble	Electrode	PMS-05	mg/kg	5	385	369	161	204
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.39	0.39	0.30	0.31
E.C.e	Calc	R&L 3A1	dS/m	na	3.3	3.3	2.5	2.6
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	1.6	1.2	5.8	3.1
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	49.3	62.7	153	58.3
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	0.28	0.48	1.87	0.73
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	80.4	87.5	192	241
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	7.55	23.9	30.9	11.0
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	540	353	255	326
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	107	87.6	202	162
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	35.8	29.2	67.4	53.9
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.17	1.08	0.85	0.74
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.53	0.99	1.05	<0.5
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	2.26	3.04	5.24	0.84
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	95.5	76.8	148	92.3
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	<0.2	<0.2	0.60	0.37
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	60.0	47.8	5.8	238
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	2.83	2.54	0.28	12.9
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	122	109	NA	162
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	133	266	NA	593
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	1188	1239	NA	1217
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	538	564	NA	313
Soil Colour (wet exterior)	Dry	Munsell	Class	na	10YR 5/4	10YR 5/8	10YR 3/3	10YR 5/6
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.2	1.2	1.1	1.1
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	1.3	<0.3	6.2	0.4
Soil Colour	Wet	Munsell	Class	na	10YR 5/4	10YR 5/8	10YR 3/3	10YR 5/6
Porosity Total	Calc	ASTM F1815-97	%	na	48.2	48.4	55.9	53.8
Porosity Capillary	Calc	ASTM F1815-97	%	na	33.6	29.7	35.3	36.8

ANALYSIS REPORT

PROJECT NO: EW150487 Location: IA059500

				CLIENT SAMPLE ID	Site 1A-CS8	Site 1A-CS8	Site 1A-CS9	Site 1A-CS9
				DEPTH (cm)	100cm	120cm	20cm	40cm
Test Parameter	Method Description	Method Reference	Units	LOR	150487-45	150487-46	150487-47	150487-48
Porosity Air Filled	Calc	ASTM F1815-97	%	na	14.6	18.8	20.6	17.1
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	4.80	3.56	0.28	15.1
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	0.67	0.53	0.06	2.64
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	2.25	1.87	NA	2.37
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	4.79	8.92	NA	16.9
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	71.3	69.2	NA	57.9
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	16.8	16.4	NA	7.76
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	0.31	0.28	NA	0.42
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	0.67	1.33	NA	2.97
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	9.90	10.3	NA	10.1
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	2.34	2.45	NA	1.36
ECEC	Calculation	PMS-15A2	Cmol/kg	na	13.9	14.9	NA	17.5
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	0.07	0.13	NA	0.29
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	3.61	3.35	2.97	3.39
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	18.1	10.1	52.7	19.3
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	55.3	62.3	33.5	53.3
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	20.1	21.7	10.6	11.1
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.85	0.70	0.68	0.69
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	4.27	2.11	12.0	3.96
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	13.1	13.0	7.63	10.9
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	4.74	4.53	2.41	2.27
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.33	0.16	1.57	0.36
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.07	0.05	0.09	0.06
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	0.03	0.03	NA	0.04
ECEC	Calculation	PMS-15D3	Cmol/kg	na	23.6	20.9	22.8	20.5
Texture	Field	Northcote	Class	na	LMC	LMC	CL	LMC
Emerson Aggregate	513.01	PMS-21	Class	na	1	1	NA	NA
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	332	273	264	271
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	854	422	2400	792
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	1566	1563	915	1309
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	1091	1042	555	522
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	2.1	0.2	0.7	0.2
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	3.0	6.1	5.3	2.8

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A-CS8	Site 1A-CS8	Site 1A-CS9	Site 1A-CS9
				DEPTH (cm)	100cm	120cm	20cm	40cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-45**	**150487-46**	**150487-47**	**150487-48**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	27.4	33.5	37.2	27.4
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	18.9	36.7	23.7	20.8
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	48.7	23.5	33.2	48.8

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A-CS9	Site 1A-CS9	Site 1A-CS9	Site 1A-CS9
				DEPTH (cm)	60cm	80cm	100cm	120cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-49**	**150487-50**	**150487-51**	**150487-52**
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	17.46	15.4	15.1	14.0
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	5.35	5.47	5.34	5.24
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	4.41	4.43	4.38	4.36
Chloride Soluble	Electrode	PMS-05	mg/kg	5	123	128	170	238
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.22	0.18	0.22	0.26
E.C.e	Calc	R&L 3A1	dS/m	na	1.8	1.5	1.6	2.2
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	0.8	<0.5	<0.5	<0.5
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	37.8	42.2	55.9	56.9
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	0.25	0.13	0.15	0.13
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	161	68.5	62.6	63.6
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	51.2	8.10	5.21	9.66
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	217	265	158	217
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	124	74.1	75.3	87.0
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	41.4	24.7	25.1	29.0
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.96	1.04	1.16	1.03
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.51	1.11	0.92	0.98
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.67	6.58	1.46	0.58
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	83.3	24.5	24.5	21.0
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	171	109	101	82.4
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	9.72	7.50	6.50	5.24
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	NA	NA	NA	NA
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Soil Colour (wet exterior)	Dry	Munsell	Class	na	10YR 5/6	10YR 5/4	10YR 5/6	10YR 7/2
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.2	1.4	1.4	1.4
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	0.9	0.7	0.4	<0.3
Soil Colour	Wet	Munsell	Class	na	10YR 5/6	10YR 5/4	10YR 5/6	10YR 7/2
Porosity Total	Calc	ASTM F1815-97	%	na	48.3	40.9	43.1	42.6
Porosity Capillary	Calc	ASTM F1815-97	%	na	33.8	35.0	33.8	32.5

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					Site 1A-CS9	Site 1A-CS9	Site 1A-CS9	Site 1A-CS9
				CLIENT SAMPLE ID				
				DEPTH (cm)	60cm	80cm	100cm	120cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-49**	**150487-50**	**150487-51**	**150487-52**
Porosity Air Filled	Calc	ASTM F1815-97	%	na	14.5	5.9	9.3	10.0
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	9.72	7.50	6.50	5.24
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	1.90	1.21	1.12	0.92
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
ECEC	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	2.97	2.78	2.78	2.93
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	7.24	5.82	6.98	4.63
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	67.7	68.4	66.5	68.5
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	12.3	15.5	17.2	18.7
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.58	0.45	0.48	0.51
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	1.42	0.94	1.21	0.81
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	13.2	11.1	11.5	12.0
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	2.41	2.50	2.97	3.27
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.11	0.09	0.10	0.07
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.04	0.04	0.04	0.04
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
ECEC	Calculation	PMS-15D3	Cmol/kg	na	19.5	16.1	17.3	17.5
Texture	Field	Northcote	Class	na	LMC	LMC	MC	LMC
Emerson Aggregate	513.01	PMS-21	Class	na	NA	NA	NA	NA
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	226	175	187	200
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	283	188	241	162
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	1588	1326	1378	1437
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	555	575	682	752
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	0.1	0.0	0.2	0.0
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	0.7	3.3	7.5	7.4

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A-CS9	Site 1A-CS9	Site 1A-CS9	Site 1A-CS9
				DEPTH (cm)	60cm	80cm	100cm	120cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-49**	**150487-50**	**150487-51**	**150487-52**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	37.8	59.2	46.1	50.8
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	27.8	18.9	27.6	25.0
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	33.6	18.6	18.6	16.9

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					CLIENT SAMPLE ID	Site 1A CS10	Site 1A CS10	Site 1A CS10	Site 1A CS10
					DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**		**150487-53**	**150487-54**	**150487-55**	**150487-56**
Soil Moisture Content	Oven-Dry	R&L2A1	%	na		26.4	23.60	22.4	16.3
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na		6.13	5.56	5.87	6.40
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na		5.50	4.63	5.03	5.46
Chloride Soluble	Electrode	PMS-05	mg/kg	5		84.3	208	353	340
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01		0.22	0.27	0.37	0.31
E.C.e	Calc	R&L 3A1	dS/m	na		1.8	2.0	2.7	2.3
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5		7.7	0.8	<0.5	1.3
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37		171	69.9	42.2	42.1
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05		1.52	0.59	0.32	0.21
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na		156	201	112	58.9
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1		61.5	71.1	6.56	9.62
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10		237	212	165	147
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9		85.8	77.4	79.8	50.1
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3		28.6	25.8	26.6	16.7
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5		1.17	0.75	0.75	0.73
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5		1.60	<0.5	<0.5	<0.5
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5		6.89	1.09	0.43	<0.5
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5		161	88.2	60.8	18.8
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2		0.56	0.20	<0.2	<0.2
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5		1.7	112	26.1	0.8
Aluminium Saturation	ICP-OES	R&L 15O1	%	na		0.12	6.66	1.32	0.06
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10		NA	NA	145	52.9
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20		NA	NA	137	102
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10		NA	NA	1385	1267
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10		NA	NA	491	540
Soil Colour (wet exterior)	Dry	Munsell	Class	na		10YR 3/3	10YR 5/6	10YR 4/6	10YR 5/6
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na		1.1	1.2	1.2	1.5
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na		1.0	<0.3	<0.3	<0.3
Soil Colour	Wet	Munsell	Class	na		10YR 3/3	10YR 5/6	10YR 4/6	10YR 5/6
Porosity Total	Calc	ASTM F1815-97	%	na		54.2	50.8	47.7	40.8
Porosity Capillary	Calc	ASTM F1815-97	%	na		33.3	35.0	37.9	32.7

ANALYSIS REPORT

PROJECT NO: EW150487 Location: IA059500

				CLIENT SAMPLE ID	Site 1A CS10	Site 1A CS10	Site 1A CS10	Site 1A CS10
				DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	Method Description	Method Reference	Units	LOR	150487-53	150487-54	150487-55	150487-56
Porosity Air Filled	Calc	ASTM F1815-97	%	na	20.9	15.7	9.8	8.1
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	0.12	6.69	1.93	0.07
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	0.02	1.24	0.29	0.01
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	NA	NA	2.47	1.00
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	NA	NA	4.56	3.76
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	NA	NA	76.8	77.9
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	NA	NA	14.2	17.3
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	0.37	0.14
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	0.69	0.51
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	11.5	10.6
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	2.13	2.35
ECEC	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	15.0	13.6
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	0.06	0.05
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	4.00	2.70	1.72	2.12
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	48.3	13.5	5.32	4.44
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	35.4	61.8	72.3	72.5
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	12.3	15.2	19.3	20.9
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.61	0.50	0.38	0.38
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	7.40	2.52	1.18	0.79
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	5.42	11.5	16.0	12.9
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	1.88	2.83	4.27	3.73
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	1.37	0.22	0.07	0.06
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.11	0.04	0.02	0.03
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	0.03	0.01
ECEC	Calculation	PMS-15D3	Cmol/kg	na	15.3	18.6	22.1	17.8
Texture	Field	Northcote	Class	na	CL	MC	MC	MC
Emerson Aggregate	513.01	PMS-21	Class	na	2	1	1	1
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	239	196	148	147
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	1479	504	235	158
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	650	1381	1917	1549
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	432	652	981	857
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	1.7	0.5	0.5	0.0
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	12.7	8.1	4.1	7.2

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A CS10	Site 1A CS10	Site 1A CS10	Site 1A CS10
				DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-53**	**150487-54**	**150487-55**	**150487-56**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	39.4	38.1	32.1	44.4
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	21.4	20.8	20.3	20.0
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	24.9	32.5	43.1	28.3

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A CS10	Site 1A CS10	Site 1A CS11	Site 1A CS11
				DEPTH (cm)	100cm	120cm	20cm	40cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-57**	**150487-58**	**150487-59**	**150487-60**
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	14.2	13.1	23.7	23.7
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	6.69	6.85	5.90	5.47
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	6.20	6.40	5.32	4.69
Chloride Soluble	Electrode	PMS-05	mg/kg	5	375	300	116	133
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.28	0.27	0.26	0.19
E.C.e	Calc	R&L 3A1	dS/m	na	2.1	2.3	2.2	1.4
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	2.1	3.9	4.9	0.7
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	77.4	89.2	130	50.8
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	0.14	0.05	1.17	0.62
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	52.2	47.4	187	153
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	12.1	6.61	37.0	21.4
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	136	213	172	154
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	49.5	14.1	138	94.5
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	16.5	14.7	45.9	31.5
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.73	0.74	0.84	0.95
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	<0.5	0.70	0.91	1.01
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.69	<0.5	6.87	1.98
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	15.2	8.89	89.5	96.6
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	<0.2	<0.2	0.55	0.27
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	<0.5	<0.5	7.5	78.6
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	0.04	0.05	0.50	8.28
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	NA	NA	NA	NA
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Soil Colour (wet exterior)	Dry	Munsell	Class	na	10YR 5/8	10YR 5/8	10YR 3/2	10YR 5/3
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.4	1.3	1.2	13
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	<0.3	0.4	2.4	2.2
Soil Colour	Wet	Munsell	Class	na	10YR 5/8	10YR 5/8	10YR 5/6	10YR 5/3
Porosity Total	Calc	ASTM F1815-97	%	na	42.9	48.4	45.7	46.9
Porosity Capillary	Calc	ASTM F1815-97	%	na	34.3	34.6	34.9	42.8

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ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A CS10	Site 1A CS10	Site 1A CS11	Site 1A CS11
				DEPTH (cm)	100cm	120cm	20cm	40cm
Test Parameter	Method Description	Method Reference	Units	LOR	150487-57	150487-58	150487-59	150487-60
Porosity Air Filled	Calc	ASTM F1815-97	%	na	8.6	13.7	10.8	4.1
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	0.04	0.05	0.52	8.28
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	0.01	0.01	0.08	0.87
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
ECEC	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	2.74	4.78	2.78	3.70
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	6.30	7.20	41.8	17.9
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	69.6	65.5	42.3	59.2
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	21.3	22.5	12.6	10.9
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.36	0.51	0.44	0.39
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	0.83	0.76	6.66	1.89
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	9.13	6.92	6.75	6.24
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	2.79	2.37	2.01	1.15
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.09	0.11	0.99	0.30
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.04	0.07	0.07	0.06
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
ECEC	Calculation	PMS-15D3	Cmol/kg	na	13.1	10.6	15.9	10.5
Texture	Field	Northcote	Class	na	MC	SC	CL	MC
Emerson Aggregate	513.01	PMS-21	Class	na	1	1	NA	NA
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	140	197	173	152
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	165	152	1332	377
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	1095	830	810	749
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	641	546	462	265
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	0.5	0.2	0.4	0.4
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	25.2	42.1	16.3	22.5

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PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	**Site 1A CS10**	**Site 1A CS10**	**Site 1A CS11**	**Site 1A CS11**
				DEPTH (cm)	**100cm**	**120cm**	**20cm**	**40cm**
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-57**	**150487-58**	**150487-59**	**150487-60**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	37.1	42.4	35.3	35.1
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	20.2	8.7	19.0	17.6
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	17.0	6.6	29.0	24.3

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ANALYSIS REPORT

PROJECT NO: EW150487 Location: IA059500

				CLIENT SAMPLE ID	Site 1A CS11	Site 1A CS11	Site 1A CS12	Site 1A CS12
				DEPTH (cm)	60cm	80cm	20cm	40cm
Test Parameter	Method Description	Method Reference	Units	LOR	150487-61	150487-62	150487-63	150487-64
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	15.9	11.4	25.7	30.5
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	5.62	5.84	5.66	5.44
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	4.57	4.77	4.96	4.77
Chloride Soluble	Electrode	PMS-05	mg/kg	5	100	73.3	98.8	289
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.14	0.12	0.24	0.33
E.C.e	Calc	R&L 3A1	dS/m	na	1.0	1.0	2.0	2.8
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	<0.5	<0.5	4.8	<0.5
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	<37.5	53.7	141	41.5
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	0.33	0.16	1.23	0.47
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	110	56.8	210	224
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	16.8	13.5	62.1	7.74
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	146	327	229	187
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	57.6	72.0	172	134
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	19.2	24.0	57.2	44.6
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.90	0.81	1.06	0.90
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	<0.5	0.63	1.63	<0.5
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.61	1.22	9.04	0.93
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	70.8	30.6	107	45.5
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	<0.2	<0.2	0.29	<0.2
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	69.1	19.5	14.2	156
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	7.41	2.48	1.11	8.74
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	108
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	NA	NA	NA	364
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	1562
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	423
Soil Colour (wet exterior)	Dry	Munsell	Class	na	10YR 5/3	10YR 6/6	10YR 4/4	10YR 4/6
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.4	1.2	1.3	1.1
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	2.1	2.1	4.9	0.3
Soil Colour	Wet	Munsell	Class	na	10YR 5/3	10YR 6/6	10YR 4/4	10YR 4/6
Porosity Total	Calc	ASTM F1815-97	%	na	42.9	49.9	44.7	51.3
Porosity Capillary	Calc	ASTM F1815-97	%	na	35.4	43.0	38.9	40.0

ANALYSIS REPORT

PROJECT NO: EW150487 Location: IA059500

				CLIENT SAMPLE ID	Site 1A CS11	Site 1A CS11	Site 1A CS12	Site 1A CS12
				DEPTH (cm)	60cm	80cm	20cm	40cm
Test Parameter	Method Description	Method Reference	Units	LOR	150487-61	150487-62	150487-63	150487-64
Porosity Air Filled	Calc	ASTM F1815-97	%	na	7.6	6.9	5.8	11.3
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	7.41	2.48	1.11	9.28
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	0.77	0.22	0.16	1.73
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	NA	NA	NA	1.48
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	NA	NA	NA	9.74
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	NA	NA	NA	69.7
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	NA	NA	NA	9.84
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	0.28
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	1.82
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	13.0
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	1.84
ECEC	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	18.7
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	0.14
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	3.64	6.72	4.53	2.42
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	9.99	17.8	40.5	10.9
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	68.4	62.2	44.8	65.7
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	10.5	10.8	9.00	12.2
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.38	0.59	0.64	0.48
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	1.04	1.56	5.76	2.16
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	7.09	5.43	6.37	13.0
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	1.09	0.94	1.28	2.42
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.15	0.29	0.90	0.17
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.05	0.11	0.10	0.04
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	0.02
ECEC	Calculation	PMS-15D3	Cmol/kg	na	10.4	8.73	14.2	19.8
Texture	Field	Northcote	Class	na	MC	SC	CL	LMC
Emerson Aggregate	513.01	PMS-21	Class	na	NA	NA	3a	3b
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	147	229	251	187
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	207	311	1152	432
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	851	652	764	1559
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	251	216	294	557
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	0.0	0.0	2.4	0.2
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	33.4	43.0	17.0	7.3

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PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A CS11	Site 1A CS11	Site 1A CS12	Site 1A CS12
				DEPTH (cm)	60cm	80cm	20cm	40cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-61**	**150487-62**	**150487-63**	**150487-64**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	24.9	31.4	47.8	26.4
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	17.8	12.0	19.0	17.9
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	23.9	13.6	13.7	48.1

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ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A CS12	Site 1A CS12	Site 1A CS12	Site 1A CS12
				DEPTH (cm)	60cm	80cm	100cm	120cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-65**	**150487-66**	**150487-67**	**150487-68**
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	24.5	13.8	14.7	13.5
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	5.71	6.67	7.38	7.41
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	4.94	6.14	6.58	6.64
Chloride Soluble	Electrode	PMS-05	mg/kg	5	333	234	198	173
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.31	0.25	0.26	0.20
E.C.e	Calc	R&L 3A1	dS/m	na	2.3	1.8	1.9	1.5
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	<0.5	<0.5	1.2	<0.5
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	48.8	132	160	120
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	0.32	0.15	0.23	0.13
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	131	62.9	64.6	55.9
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	18.9	11.8	50.6	9.73
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	173	198	206	247
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	77.7	94.2	115	116
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	25.9	31.4	38.4	38.6
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.75	0.98	1.08	1.04
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	<0.5	0.78	0.96	0.58
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.20	15.3	7.23	3.28
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	37.9	18.1	18.7	13.1
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	48.7	<0.5	<0.5	<0.5
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	2.90	0.06	0.03	0.04
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	74.1	NA	NA	NA
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	204	NA	NA	NA
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	1635	NA	NA	NA
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	482	NA	NA	NA
Soil Colour (wet exterior)	Dry	Munsell	Class	na	10YR 5/6	10YR 5/6	10YR 5/6	10YR 5/4
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.4	1.3	1.4	1.3
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	<0.3	1.8	<0.3	0.6
Soil Colour	Wet	Munsell	Class	na	10YR 5/6	10YR 5/6	10YR 5/6	10YR 5/4
Porosity Total	Calc	ASTM F1815-97	%	na	40.8	47.0	40.8	32.5
Porosity Capillary	Calc	ASTM F1815-97	%	na	35.9	30.7	32.7	28.4

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PROJECT NO: EW150487   Location: IA059500

				CLIENT SAMPLE ID	Site 1A CS12	Site 1A CS12	Site 1A CS12	Site 1A CS12
				DEPTH (cm)	60cm	80cm	100cm	120cm
Test Parameter	Method Description	Method Reference	Units	LOR	150487-65	150487-66	150487-67	150487-68
Porosity Air Filled	Calc	ASTM F1815-97	%	na	5.0	16.3	8.1	4.1
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	3.10	0.03	0.03	0.04
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	0.54	0.01	0.01	0.01
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	1.09	NA	NA	NA
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	5.84	NA	NA	NA
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	78.0	NA	NA	NA
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	12.0	NA	NA	NA
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	0.19	NA	NA	NA
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	1.02	NA	NA	NA
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	13.6	NA	NA	NA
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	2.10	NA	NA	NA
ECEC	Calculation	PMS-15A2	Cmol/kg	na	17.5	NA	NA	NA
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	0.07	NA	NA	NA
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	2.54	3.07	3.12	3.07
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	7.53	7.54	13.1	10.3
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	72.6	71.8	66.3	68.7
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	14.5	17.6	17.5	17.9
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.47	0.51	0.53	0.47
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	1.41	1.26	2.23	1.58
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	13.5	11.9	11.3	10.6
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	2.70	2.92	2.98	2.76
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.10	0.11	0.20	0.15
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.04	0.04	0.05	0.04
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	0.01	NA	NA	NA
ECEC	Calculation	PMS-15D3	Cmol/kg	na	18.6	16.6	17.0	15.4
Texture	Field	Northcote	Class	na	MC	MC	MC	MC
Emerson Aggregate	513.01	PMS-21	Class	na	2	2	2	1
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	185	199	207	184
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	281	251	445	316
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	1624	1433	1354	1269
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	620	672	685	634
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	0.5	0.0	0.0	0.0
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	6.0	11.7	17.1	12.3

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PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A CS12	Site 1A CS12	Site 1A CS12	Site 1A CS12
				DEPTH (cm)	60cm	80cm	100cm	120cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-65**	**150487-66**	**150487-67**	**150487-68**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	32.7	57.6	45.4	46.4
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	18.9	16.6	19.0	25.1
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	41.9	14.1	18.5	16.3

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					CLIENT SAMPLE ID	Site 1A CS13	Site 1A CS13	Site 1A CS13	Site 1A CS13
					DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	Method Description	Method Reference	Units	LOR		150487-69	150487-70	150487-71	150487-72
Soil Moisture Content	Oven-Dry	R&L2A1	%	na		22.6	19.5	35.2	25.8
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na		6.74	5.26	5.32	5.39
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na		6.30	4.33	4.18	4.19
Chloride Soluble	Electrode	PMS-05	mg/kg	5		179	191	161	118
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01		0.41	0.26	0.20	0.19
E.C.e	Calc	R&L 3A1	dS/m	na		3.5	1.9	1.5	1.4
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5		0.9	<0.5	<0.5	<0.5
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37		273	134	52.5	27.7
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05		1.88	0.75	0.56	0.22
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na		168	427	415	224
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1		47.0	24.9	3.69	3.51
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10		246	179	244	272
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9		432	155	68.4	76.8
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3		144	51.5	22.8	25.6
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5		1.25	1.08	0.71	0.88
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5		1.40	0.58	0.50	0.92
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5		22.3	1.55	0.47	0.33
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5		112	60.4	42.7	37.7
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2		0.46	<0.2	<0.2	<0.2
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5		0.7	427	746	437
Aluminium Saturation	ICP-OES	R&L 15O1	%	na		0.05	26.9	35.1	26.2
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10		141	NA	NA	NA
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20		1794	NA	NA	NA
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10		461	NA	NA	NA
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10		335	NA	NA	NA
Soil Colour (wet exterior)	Dry	Munsell	Class	na		10YR 3/3	10YR 3/2	10YR 4/3	5YR 4/6
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na		1.3	1.3	1.1	1.2
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na		1.4	3.0	0.7	0.4
Soil Colour	Wet	Munsell	Class	na		10YR 3/3	10YR 3/2	10YR 4/3	5YR 4/6
Porosity Total	Calc	ASTM F1815-97	%	na		45.6	44.8	52.5	47.8
Porosity Capillary	Calc	ASTM F1815-97	%	na		37.4	36.2	46.5	41.6

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					Site 1A CS13	Site 1A CS13	Site 1A CS13	Site 1A CS13
				CLIENT SAMPLE ID	Site 1A CS13	Site 1A CS13	Site 1A CS13	Site 1A CS13
				DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-69**	**150487-70**	**150487-71**	**150487-72**
Porosity Air Filled	Calc	ASTM F1815-97	%	na	8.2	8.6	6.1	6.2
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	0.05	26.9	35.1	26.2
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	0.01	4.74	8.29	4.86
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	2.47	NA	NA	NA
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	61.3	NA	NA	NA
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	26.2	NA	NA	NA
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	9.95	NA	NA	NA
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	0.36	NA	NA	NA
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	8.97	NA	NA	NA
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	3.84	NA	NA	NA
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	1.46	NA	NA	NA
ECEC	Calculation	PMS-15A2	Cmol/kg	na	14.6	NA	NA	NA
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	2.33	NA	NA	NA
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	3.46	2.65	2.59	2.81
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	58.3	16.7	4.24	3.51
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	25.8	42.7	47.5	54.9
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	12.4	11.0	10.6	12.5
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.53	0.47	0.61	0.52
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	8.99	2.94	1.00	0.65
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	3.98	7.53	11.2	10.2
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	1.92	1.93	2.50	2.32
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	2.26	0.39	0.09	0.06
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.13	0.06	0.05	0.05
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	0.09	NA	NA	NA
ECEC	Calculation	PMS-15D3	Cmol/kg	na	15.4	17.6	23.6	18.5
Texture	Field	Northcote	Class	na	CL	MC	MC	MC
Emerson Aggregate	513.01	PMS-21	Class	na	NA	NA	NA	NA
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	208	182	238	203
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	1797	587	200	130
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	477	903	1344	1221
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	441	445	575	533
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	9.8	19.7	3.7	0.7
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	12.8	12.2	3.9	2.2

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A CS13	Site 1A CS13	Site 1A CS13	Site 1A CS13
				DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-69**	**150487-70**	**150487-71**	**150487-72**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	35.8	36.0	22.9	25.6
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	21.0	14.4	10.8	16.2
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	20.6	17.6	58.7	55.2

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					Site 1A CS13	Site 1A CS13	Site 1A CS14	Site 1A CS14
				CLIENT SAMPLE ID				
				DEPTH (cm)	100cm	120cm	20cm	40cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-73**	**150487-74**	**150487-75**	**150487-76**
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	20.1	20.5	30.7	35.4
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	5.48	5.40	6.56	4.71
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	4.14	4.15	5.95	4.05
Chloride Soluble	Electrode	PMS-05	mg/kg	5	108	123	321	341
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.15	0.17	0.38	0.37
E.C.e	Calc	R&L 3A1	dS/m	na	1.1	1.2	3.2	2.7
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	<0.5	3.3	9.5	2.2
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	46.2	115	280	119
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	0.10	0.14	2.11	1.05
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	99.1	137	256	531
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	5.43	34.3	88.3	14.2
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	246	530	311	313
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	65.4	57.3	90.3	188
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	21.8	19.1	30.1	62.5
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.29	1.48	0.99	1.08
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.53	2.20	1.31	0.81
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.41	0.37	16.6	11.1
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	29.3	44.2	65.7	50.4
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	316	208	0.8	560
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	18.9	12.4	0.04	37.5
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	212	169
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	NA	NA	2449	628
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	526	534
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	513	193
Soil Colour (wet exterior)	Dry	Munsell	Class	na	10YR 6/6	10YR 5/6	10YR 4/2	10YR 3/2
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.4	1.4	1.1	1.2
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	0.3	0.4	0.3	2.2
Soil Colour	Wet	Munsell	Class	na	10YR 6/6	10YR 7/3	10YR 4/2	10YR 3/2
Porosity Total	Calc	ASTM F1815-97	%	na	43.4	43.0	51.8	47.4
Porosity Capillary	Calc	ASTM F1815-97	%	na	38.7	34.4	33.9	39.9

ANALYSIS REPORT

PROJECT NO: EW150487 Location: IA059500

				CLIENT SAMPLE ID	Site 1A CS13	Site 1A CS13	Site 1A CS14	Site 1A CS14
				DEPTH (cm)	100cm	120cm	20cm	40cm
Test Parameter	Method Description	Method Reference	Units	LOR	150487-73	150487-74	150487-75	150487-76
Porosity Air Filled	Calc	ASTM F1815-97	%	na	4.7	8.5	17.9	7.5
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	18.9	12.4	0.05	41.2
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	3.51	2.31	0.01	6.22
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	NA	NA	2.80	2.87
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	NA	NA	63.1	20.8
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	NA	NA	22.6	29.5
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	NA	NA	11.5	5.56
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	0.54	0.43
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	12.2	3.14
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	4.38	4.45
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	2.23	0.84
ECEC	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	19.4	15.1
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	2.79	0.71
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	3.87	5.25	3.67	4.34
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	4.78	5.24	59.6	21.8
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	57.3	60.6	21.3	26.9
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	15.2	16.5	15.4	9.48
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.72	0.98	0.76	0.72
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	0.89	0.98	12.3	3.63
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	10.7	11.3	4.38	4.46
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	2.83	3.07	3.17	1.57
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.08	0.09	2.80	0.81
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.07	0.09	0.17	0.16
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	0.12	0.10
ECEC	Calculation	PMS-15D3	Cmol/kg	na	18.6	18.6	20.6	16.6
Texture	Field	Northcote	Class	na	MC	MC	CL	MC
Emerson Aggregate	513.01	PMS-21	Class	na	NA	NA	2	6
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	281	381	295	281
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	178	195	2457	725
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	1279	1352	526	535
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	651	707	728	362
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	0.1	0.0	1.9	1.6
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	3.4	6.4	18.1	12.5

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	**Site 1A CS13**	**Site 1A CS13**	**Site 1A CS14**	**Site 1A CS14**
				DEPTH (cm)	**100cm**	**120cm**	**20cm**	**40cm**
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-73**	**150487-74**	**150487-75**	**150487-76**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	59.2	41.8	32.1	20.4
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	17.8	34.1	230	24.8
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	19.5	17.7	24.9	40.7

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PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A CS14	Site 1A CS14	Site 1A CS14	Site 1A CS14
				DEPTH (cm)	60cm	80cm	100cm	120cm
Test Parameter	Method Description	Method Reference	Units	LOR	150487-77	150487-78	150487-79	150487-80
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	37.1	34.9	20.4	20.9
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	4.82	4.99	5.19	5.30
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	4.03	4.13	3.92	4.05
Chloride Soluble	Electrode	PMS-05	mg/kg	5	297	208	102	83.8
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.29	0.23	0.10	0.10
E.C.e	Calc	R&L 3A1	dS/m	na	2.1	1.7	0.8	0.8
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	3.66	3.00	1.96	2.33
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	102	154	50.3	73.1
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	1.00	1.23	0.27	0.41
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	633	514	184	161
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	14.7	31.4	16.7	20.0
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	473	391	174	185
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	129	93.3	52.5	46.2
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	43.1	31.1	17.5	15.4
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.91	0.94	1.09	1.09
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.80	1.19	1.13	1.52
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	11.7	13.9	2.63	6.45
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	64.3	82.3	51.8	55.1
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	0.21	0.45	<0.2	0.22
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	474	315	377	235
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	34.0	26.5	37.4	26.7
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	NA	NA	NA	NA
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Soil Colour (wet exterior)	Dry	Munsell	Class	na	7.5YR 2.5/2	10YR 2/3	10YR 5/8	10YR 5/8
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.2	1.2	1.4	1.4
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	<0.3	<0.3	0.4	0.4
Soil Colour	Wet	Munsell	Class	na	7.5YR 4/6	10YR 5/6	10YR 5/8	10YR 5/8
Porosity Total	Calc	ASTM F1815-97	%	na	48.3	47.7	41.9	40.
Porosity Capillary	Calc	ASTM F1815-97	%	na	40.2	38.4	40.6	38.1

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ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A CS14	Site 1A CS14	Site 1A CS14	Site 1A CS14
				DEPTH (cm)	60cm	80cm	100cm	120cm
Test Parameter	Method Description	Method Reference	Units	LOR	150487-77	150487-78	150487-79	150487-80
Porosity Air Filled	Calc	ASTM F1815-97	%	na	8.0	9.3	1.0	1.9
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	34.0	26.5	37.4	26.7
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	5.27	3.50	4.19	2.61
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
ECEC	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	4.70	5.43	3.99	4.36
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	21.5	27.9	11.2	16.4
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	29.8	30.0	38.3	42.3
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	9.98	10.3	9.13	10.2
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.73	0.72	0.45	0.43
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	3.34	3.69	1.26	1.61
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	4.63	3.97	4.28	4.13
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	1.55	1.36	1.02	0.99
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.72	0.93	0.29	0.39
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.16	0.18	0.10	0.10
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
ECEC	Calculation	PMS-15D3	Cmol/kg	na	15.5	13.2	11.2	9.77
Texture	Field	Northcote	Class	na	MC	MC	FSC	FSC
Emerson Aggregate	513.01	PMS-21	Class	na	5	2	3b	3a
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	284	280	174	166
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	667	738	251	321
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	555	476	514	496
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	356	312	235	228
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	0.3	0.9	0.0	0.0
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	9.1	13.6	26.7	31.9

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A CS14	Site 1A CS14	Site 1A CS14	Site 1A CS14
				DEPTH (cm)	60cm	80cm	100cm	120cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-77**	**150487-78**	**150487-79**	**150487-80**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	22.4	23.3	37.7	45.6
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	17.2	19.1	11.3	13.8
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	51.0	43.1	24.3	8.7

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A CS15	Site 1A CS15	Site 1A CS15	Site 1A CS15
				DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-81**	**150487-82**	**150487-83**	**150487-84**
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	33.8	16.7	34.8	23.6
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	7.55	4.98	5.16	5.26
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	6.99	4.13	4.15	4.09
Chloride Soluble	Electrode	PMS-05	mg/kg	5	187	170	197	136
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.47	0.23	0.26	0.18
E.C.e	Calc	R&L 3A1	dS/m	na	4.0	1.9	1.9	1.3
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	10.5	1.00	<0.5	<0.5
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	484	70.8	59.2	42.5
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	2.96	0.62	0.57	0.30
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	149	365	532	182
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	225	15.9	11.6	11.0
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	404	173	271	310
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	275	114	104	90.6
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	91.7	37.9	34.5	30.2
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.08	1.14	0.86	1.30
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	3.68	0.90	0.85	1.44
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	26.5	1.66	0.84	0.63
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	123	127	60.1	51.5
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	0.71	0.24	<0.2	<0.2
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	0.8	255	411	204
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	0.03	22.1	23.6	13.2
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	231	NA	NA	NA
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	2740	NA	NA	NA
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	568	NA	NA	NA
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	302	NA	NA	NA
Soil Colour (wet exterior)	Dry	Munsell	Class	na	10YR 3/3	10YR 4/3	5YR 5/6	5YR 5/6
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.2	1.4	1.2	1.2
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	1.0	1.3	<0.3	<0.3
Soil Colour	Wet	Munsell	Class	na	10YR 3/3	10YR 4/2	5YR 5/6	5YR 5/6
Porosity Total	Calc	ASTM F1815-97	%	na	47.8	39.3	45.5	46.0
Porosity Capillary	Calc	ASTM F1815-97	%	na	37.7	35.3	4309	37.3

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ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A CS15	Site 1A CS15	Site 1A CS15	Site 1A CS15
				DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-81**	**150487-82**	**150487-83**	**150487-84**
Porosity Air Filled	Calc	ASTM F1815-97	%	na	10.1	4.0	1.7	8.6
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	0.04	22.1	23.6	13.2
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	0.01	2.83	4.57	2.27
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	2.91	NA	NA	NA
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	67.3	NA	NA	NA
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	23.3	NA	NA	NA
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	6.45	NA	NA	NA
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	0.59	NA	NA	NA
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	13.7	NA	NA	NA
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	4.73	NA	NA	NA
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	1.31	NA	NA	NA
ECEC	Calculation	PMS-15A2	Cmol/kg	na	20.3	NA	NA	NA
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	2.89	NA	NA	NA
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	3.22	3.18	2.97	4.55
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	71.3	16.6	10.2	7.45
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	18.1	48.3	53.5	62.0
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	7.39	9.78	9.70	12.8
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.83	0.41	0.57	0.78
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	18.5	2.13	1.97	1.28
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	4.68	6.18	10.3	10.7
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	1.91	1.25	1.87	2.20
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	3.95	0.34	0.19	0.12
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.18	0.07	0.06	0.07
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	0.13	NA	NA	NA
ECEC	Calculation	PMS-15D3	Cmol/kg	na	25.9	12.8	19.3	17.2
Texture	Field	Northcote	Class	na	CL	CL	MC	MC
Emerson Aggregate	513.01	PMS-21	Class	na	NA	NA	NA	NA
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	325	159	224	305
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	3693	425	394	256
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	561	742	1239	1278
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	440	288	431	505
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	5.7	19.2	0.4	0.8
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	17.1	12.9	3.3	1.4

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ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A CS15	Site 1A CS15	Site 1A CS15	Site 1A CS15
				DEPTH (cm)	20cm	40cm	60cm	80cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-81**	**150487-82**	**150487-83**	**150487-84**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	32.0	35.1	16.6	20.5
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	25.5	15.8	19.4	29.9
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	19.8	17.1	60.3	47.4

ANALYSIS REPORT

PROJECT NO: EW150487 Location: IA059500

				CLIENT SAMPLE ID	Site 1A CS15	Site 1A CS15	Site 1A CS16	Site 1A CS16
				DEPTH (cm)	100cm	120cm	20cm	40cm
Test Parameter	Method Description	Method Reference	Units	LOR	150487-85	150487-86	150487-87	150487-88
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	26.4	27.3	20.6	31.6
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	5.07	5.18	6.80	7.02
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	3.97	3.98	5.88	6.14
Chloride Soluble	Electrode	PMS-05	mg/kg	5	185	150	60.8	90.3
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.24	0.20	0.21	0.24
E.C.e	Calc	R&L 3A1	dS/m	na	1.8	1.5	1.8	2.0
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	<0.5	<0.5	4.4	2.0
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	194	123	223	253
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	1.05	0.69	1.25	1.17
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	201	157	101	123
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	12.4	7.05	43.6	76.3
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	216	219	258	280
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	146	91.2	73.2	118
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	48.5	30.4	24.4	39.4
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	2.84	2.84	1.15	1.33
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.58	1.63	1.34	2.21
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.27	0.38	4.69	4.20
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	70.2	57.3	73.4	63.7
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	303	247	0.6	0.5
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	20.6	16.9	0.03	0.03
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	NA	NA	NA	NA
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Soil Colour (wet exterior)	Dry	Munsell	Class	na	10YR 6/3	5YR 4/6	10YR 3/2	10YR 3/3
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.2	1.2	1.3	1.2
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	<0.3	<0.3	0.3	<0.3
Soil Colour	Wet	Munsell	Class	na	10YR 6/3	5YR 4/6	10YR 3/2	10YR 3/3
Porosity Total	Calc	ASTM F1815-97	%	na	50.8	47.8	48.2	50.1
Porosity Capillary	Calc	ASTM F1815-97	%	na	36.8	38.2	15.6	34.6

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					Site 1A CS15	Site 1A CS15	Site 1A CS16	Site 1A CS16
				CLIENT SAMPLE ID				
				DEPTH (cm)	100cm	120cm	20cm	40cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	150487-85	150487-86	150487-87	150487-88
Porosity Air Filled	Calc	ASTM F1815-97	%	na	14.0	9.7	32.6	15.4
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	20.6	16.9	0.03	0.03
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	3.37	2.74	0.01	0.01
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
ECEC	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	3.61	3.38	3.05	3.60
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	3.58	3.73	49.8	28.3
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	58.5	61.8	38.2	56.5
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	13.7	14.2	8.92	11.6
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.59	0.55	0.65	0.63
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	0.59	0.61	10.6	4.96
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	9.55	10.0	8.09	9.89
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	2.23	2.30	1.89	2.03
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.06	0.06	1.31	0.50
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.06	0.05	0.08	0.06
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
ECEC	Calculation	PMS-15D3	Cmol/kg	na	16.3	16.2	21.2	17.5
Texture	Field	Northcote	Class	na	MC	MC	CL	CL
Emerson Aggregate	513.01	PMS-21	Class	na	NA	NA	2	2
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	230	214	252	246
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	117	121	2112	992
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	1146	1203	971	1187
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	514	528	435	466
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	0.7	0.2	2.1	0.8
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	13.1	5.5	10.0	12.6

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site 1A CS15	Site 1A CS15	Site 1A CS16	Site 1A CS16
				DEPTH (cm)	100cm	120cm	20cm	40cm
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-85**	**150487-86**	**150487-87**	**150487-88**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	25.9	30.0	27.3	28.8
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	28.2	27.1	19.7	22.1
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	32.0	37.1	40.9	35.7

ANALYSIS REPORT

PROJECT NO: EW150487 Location: IA059500

				CLIENT SAMPLE ID	Site 1A CS16	Site 1A CS16	Site1B	Site1B
				DEPTH (cm)	60cm	80cm	0-0.2	0.2-0.4
Test Parameter	Method Description	Method Reference	Units	LOR	150487-89	150487-90	150487-91	150487-92
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	35.6	25.1	24.8	30.0
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	6.73	6.63	5.93	5.54
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	5.98	5.92	4.52	4.33
Chloride Soluble	Electrode	PMS-05	mg/kg	5	182	321	33.3	52.5
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.29	0.35	0.09	0.13
E.C.e	Calc	R&L 3A1	dS/m	na	2.4	3.0	0.7	1.1
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	<0.5	1.1	<0.5	<0.5
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	226	170	527	106
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	1.25	1.10	1.63	0.89
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	151	121	191	257
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	50.7	30.1	112	14.7
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	279	226	233	269
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	114	158	28.7	41.7
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	37.9	52.7	9.58	13.9
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.39	1.45	1.59	0.91
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.62	1.58	4.29	0.56
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	17.5	20.2	30.1	3.50
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	122	167	200	101
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	0.24	<0.2	0.37	0.29
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	<0.5	<0.5	28.9	124
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	0.03	0.04	3.54	8.63
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	111	NA	NA
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	NA	650	NA	NA
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	948	NA	NA
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	359	NA	NA
Soil Colour (wet exterior)	Dry	Munsell	Class	na	10YR 4/2	10YR 5/6	10YR 3/3	10YR 5/4
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.3	1.3	1.1	1.2
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	<0.3	<0.3	NA	NA
Soil Colour	Wet	Munsell	Class	na	10YR 4/2	10YR 5/6	10YR 3/3	10YR 5/4
Porosity Total	Calc	ASTM F1815-97	%	na	46.0	46.8	NA	NA
Porosity Capillary	Calc	ASTM F1815-97	%	na	36.6	35.4	NA	NA

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					CLIENT SAMPLE ID	Site 1A CS16	Site 1A CS16	Site1B	Site1B
					DEPTH (cm)	60cm	80cm	0-0.2	0.2-0.4
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**		**150487-89**	**150487-90**	**150487-91**	**150487-92**
Porosity Air Filled	Calc	ASTM F1815-97	%	na		9.4	11.4	NA	NA
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na		0.03	0.04	3.54	8.63
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na		0.01	0.01	0.32	1.38
Exchangeable Potassium %	Calculation	PMS-15A2	%	na		NA	2.19	NA	NA
Exchangeable Calcium %	Calculation	PMS-15A2	%	na		NA	25.0	NA	NA
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na		NA	60.8	NA	NA
Exchangeable Sodium %	Calculation	PMS-15A2	%	na		NA	12.0	NA	NA
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na		NA	0.28	NA	NA
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na		NA	3.25	NA	NA
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na		NA	7.90	NA	NA
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na		NA	1.56	NA	NA
ECEC	Calculation	PMS-15A2	Cmol/kg	na		NA	13.0	NA	NA
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na		NA	0.41	NA	NA
Exchangeable Potassium %	Calculation	PMS-15D3	%	na		3.18	4.15	6.08	3.95
Exchangeable Calcium %	Calculation	PMS-15D3	%	na		39.9	23.2	36.5	22.4
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na		47.5	57.3	44.3	55.4
Exchangeable Sodium %	Calculation	PMS-15D3	%	na		9.40	15.3	9.59	9.65
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na		0.61	0.58	0.55	0.63
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na		7.66	3.26	3.31	3.58
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na		9.13	8.03	4.02	8.83
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na		1.80	2.15	0.87	1.54
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na		0.84	0.41	0.82	0.40
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na		0.07	0.07	0.14	0.07
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na		NA	0.04	NA	NA
ECEC	Calculation	PMS-15D3	Cmol/kg	na		19.2	14.0	9.07	16.0
Texture	Field	Northcote	Class	na		LMC	LMC	CL	LMC
Emerson Aggregate	513.01	PMS-21	Class	na		2	2	3a	2
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		238	227	215	246
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20		1532	652	662	715
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		1095	964	482	1060
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		415	494	200	354
Gravel >2.0mm	Sieve	ASTMD422-63	%	na		2.7	0.8	NA	NA
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na		12.2	18.6	NA	NA

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	**Site 1A CS16**	**Site 1A CS16**	**Site1B**	**Site1B**
				DEPTH (cm)	**60cm**	**80cm**	**0-0.2**	**0.2-0.4**
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-89**	**150487-90**	**150487-91**	**150487-92**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	27.8	40.9	NA	NA
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	21.9	14.2	NA	NA
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	35.4	25.5	NA	NA

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ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					Site1B	Site1B	Site1B	Site1B
				CLIENT SAMPLE ID				
				DEPTH (cm)	0.4-0.6	0.6-0.8	0.8-1.0	1.0-1.2
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-93**	**150487-94**	**150487-95**	**150487-96**
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	25.9	19.0	16.7	18.3
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	5.34	5.35	5.31	5.24
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	4.13	4.28	4.51	4.12
Chloride Soluble	Electrode	PMS-05	mg/kg	5	191	285	317	481
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.24	0.33	0.37	0.52
E.C.e	Calc	R&L 3A1	dS/m	na	1.8	2.4	2.7	4.4
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	56.8	61.0	63.7	60.5
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	0.43	0.70	0.24	0.29
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	275	194	93.0	101
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	6.36	6.71	10.5	12.0
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	248	215	265	288
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	58.5	51.0	69.3	113
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	19.5	17.0	23.1	37.8
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.78	1.11	1.08	1.04
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.67	0.55	0.58	0.66
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.65	0.68	0.79	1.37
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	176	99.1	50.3	54.4
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	0.22	<0.2	<0.2	<0.2
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	279	131	62.6	65.8
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	18.6	7.67	3.99	3.98
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	105	103	118
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	NA	402	173	183
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	1414	1376	1408
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	540	587	587
Soil Colour (wet exterior)	Dry	Munsell	Class	na	10YR 5/6	10YR 5/6	10YR 4/2	10YR 4/6
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.1	1.3	1.3	1.3
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	NA	NA	NA	NA
Soil Colour	Wet	Munsell	Class	na	10YR 5/6	10YR 5/6	10YR 4/2	10YR 4/6
Porosity Total	Calc	ASTM F1815-97	%	na	NA	NA	NA	NA
Porosity Capillary	Calc	ASTM F1815-97	%	na	NA	NA	NA	NA

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ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					CLIENT SAMPLE ID	Site1B	Site1B	Site1B	Site1B
					DEPTH (cm)	0.4-0.6	0.6-0.8	0.8-1.0	1.0-1.2
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**		**150487-93**	**150487-94**	**150487-95**	**150487-96**
Porosity Air Filled	Calc	ASTM F1815-97	%	na		NA	NA	NA	NA
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na		18.6	8.15	4.39	4.50
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na		3.10	1.46	0.70	0.73
Exchangeable Potassium %	Calculation	PMS-15A2	%	na		NA	1.51	1.67	1.86
Exchangeable Calcium %	Calculation	PMS-15A2	%	na		NA	11.3	5.46	5.64
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na		NA	66.0	72.4	72.3
Exchangeable Sodium %	Calculation	PMS-15A2	%	na		NA	13.1	16.1	15.7
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na		NA	0.27	0.26	0.30
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na		NA	2.01	0.87	0.92
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na		NA	11.8	11.5	11.7
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na		NA	2.35	2.55	2.55
ECEC	Calculation	PMS-15A2	Cmol/kg	na		NA	17.9	15.8	16.2
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na		NA	0.17	0.08	0.08
Exchangeable Potassium %	Calculation	PMS-15D3	%	na		3.74	2.95	3.52	3.51
Exchangeable Calcium %	Calculation	PMS-15D3	%	na		8.39	11.2	6.03	6.57
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na		53.7	61.7	66.5	63.7
Exchangeable Sodium %	Calculation	PMS-15D3	%	na		15.6	16.5	20.0	22.3
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na		0.62	0.56	0.61	0.64
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na		1.40	2.12	1.05	1.21
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na		8.96	11.7	11.6	11.7
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na		2.60	3.13	3.48	4.09
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na		0.16	0.18	0.09	0.10
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na		0.07	0.05	0.05	0.06
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na		NA	0.02	0.02	0.03
ECEC	Calculation	PMS-15D3	Cmol/kg	na		16.7	19.0	17.4	18.3
Texture	Field	Northcote	Class	na		MC	MC	MC	FSC
Emerson Aggregate	513.01	PMS-21	Class	na		1	2	2	1
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		243	218	239	251
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20		280	424	210	241
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		1075	1404	1390	1402
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		597	721	800	940
Gravel >2.0mm	Sieve	ASTMD422-63	%	na		NA	NA	NA	NA
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na		NA	NA	NA	NA

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Site1B	Site1B	Site1B	Site1B
				DEPTH (cm)	0.4-0.6	0.6-0.8	0.8-1.0	1.0-1.2
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-93**	**150487-94**	**150487-95**	**150487-96**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	NA	NA	NA	NA
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	NA	NA	NA	NA
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	NA	NA	NA	NA

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Dup A	Dup B	Dup C	Dup D
				DEPTH (cm)				
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-97**	**150487-98**	**150487-99**	**150487-100**
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	34.5	30.5	33.1	30.6
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	5.03	5.22	6.99	4.98
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	4.15	4.18	6.34	4.13
Chloride Soluble	Electrode	PMS-05	mg/kg	5	203	235	81.5	183
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.25	0.23	0.23	0.25
E.C.e	Calc	R&L 3A1	dS/m	na	1.8	1.7	1.7	2.1
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	<0.5	<0.5	7.2	<0.5
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	57.4	52.6	316	169
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	0.59	0.49	1.30	1.13
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	412	316	129	412
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	7.01	8.76	70.2	23.8
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	296	209	303	260
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	58.5	46.2	72.3	124
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	19.5	15.4	24.1	41.4
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.63	0.79	0.92	1.27
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.83	<0.5	1.72	1.32
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.42	0.55	4.87	17.2
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	53.3	81.9	70.9	131
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	<0.2	<0.2	0.27	0.33
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	520	427	0.7	373
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	22.1	23.6	0.05	29.4
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	NA	NA	NA	NA
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	NA	NA
Soil Colour (wet exterior)	Dry	Munsell	Class	na	5YR 4/6	10YR 5/8	10YR 5/6	10YR 3/2
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.0	1.2	1.2	1.2
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	1.1	<0.3	<0.3	<0.3
Soil Colour	Wet	Munsell	Class	na	5YR 4/6	10YR 5/8	10YR 5/6	10YR 3/2
Porosity Total	Calc	ASTM F1815-97	%	na	53.9	46.9	48.8	46.4
Porosity Capillary	Calc	ASTM F1815-97	%	na	37.0	40.7	33.0	39.9

ANALYSIS REPORT

PROJECT NO: EW150487   Location: IA059500

				CLIENT SAMPLE ID	Dup A	Dup B	Dup C	Dup D
				DEPTH (cm)				
Test Parameter	Method Description	Method Reference	Units	LOR	150487-97	150487-98	150487-99	150487-100
Porosity Air Filled	Calc	ASTM F1815-97	%	na	16.9	6.2	15.8	6.5
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	22.1	23.6	0.04	29.4
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	5.78	4.74	0.01	4.14
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	NA	NA	NA	NA
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
ECEC	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	2.23	2.75	3.60	4.91
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	10.2	5.56	38.9	24.4
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	48.5	55.0	48.5	31.2
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	17.0	13.1	9.00	10.2
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.58	0.55	0.80	0.69
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	2.67	1.12	8.65	3.44
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	12.7	11.0	10.8	4.40
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	4.43	2.63	2.00	1.43
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.21	0.10	0.80	0.78
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.05	0.05	0.07	0.16
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	NA	NA	NA	NA
ECEC	Calculation	PMS-15D3	Cmol/kg	na	26.1	20.1	22.2	14.1
Texture	Field	Northcote	Class	na	MC	MC	MC	CL
Emerson Aggregate	513.01	PMS-21	Class	na	NA	NA	NA	NA
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	227	215	312	270
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	533	223	1729	688
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	1520	1324	1292	528
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	1019	604	460	330
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	0.0	0.0	0.1	0.0
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	1.5	5.9	8.1	16.1

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					Dup A	Dup B	Dup C	Dup D
				CLIENT SAMPLE ID	Dup A	Dup B	Dup C	Dup D
				DEPTH (cm)				
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-97**	**150487-98**	**150487-99**	**150487-100**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	15.0	30.5	25.8	28.7
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	18.2	17.3	24.0	15.2
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	65.4	46.3	42.0	40.0

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Dup E	Dup F	Dup G	Dup H
				DEPTH (cm)				
Test Parameter	Method Description	Method Reference	Units	LOR	150487-101	150487-102	150487-103	150487-104
Soil Moisture Content	Oven-Dry	R&L2A1	%	na	31.4	27.7	17.8	14.6
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	5.07	5.23	5.31	7.17
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na	4.21	4.16	4.30	6.43
Chloride Soluble	Electrode	PMS-05	mg/kg	5	222	211	262	144
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.25	0.26	0.31	0.27
E.C.e	Calc	R&L 3A1	dS/m	na	1.7	1.9	2.6	2.3
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37	67.7	40.9	52.2	205
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05	0.50	0.23	0.15	0.39
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	402	164	72.5	57.4
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	9.00	8.80	9.0	36.9
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10	238	264	256	187
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9	84.6	114	138	116
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3	28.2	38.0	45.9	38.5
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5	1.13	0.79	1.04	0.89
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.52	0.64	0.57	1.44
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5	0.71	0.50	0.61	9.11
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5	72.3	45.8	26.1	25.8
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2	0.26	<0.2	<0.2	<0.2
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5	554	284	109	0.5
Aluminium Saturation	ICP-OES	R&L 15O1	%	na	27.7	15.1	5.88	0.03
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	143	NA
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20	NA	NA	142	NA
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	1364	NA
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10	NA	NA	679	NA
Soil Colour (wet exterior)	Dry	Munsell	Class	na	10YR 4/6	10YR 5/6	10YR 4/4	10YR 5/4
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na	1.2	1.1	1.4	1.2
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na	0.4	<0.3	0.4	<0.3
Soil Colour	Wet	Munsell	Class	na	10YR 4/6	10YR 5/6	10YR 4/4	10YR 5/4
Porosity Total	Calc	ASTM F1815-97	%	na	45.9	50.6	39.7	53.8
Porosity Capillary	Calc	ASTM F1815-97	%	na	43.7	32.6	36.8	32.9

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					CLIENT SAMPLE ID	Dup E	Dup F	Dup G	Dup H
					DEPTH (cm)				
Test Parameter	Method Description	Method Reference	Units	LOR		150487-101	150487-102	150487-103	150487-104
Porosity Air Filled	Calc	ASTM F1815-97	%	na		2.2	18.0	2.9	20.9
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na		27.8	15.1	7.29	0.03
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na		6.16	3.16	1.21	0.01
Exchangeable Potassium %	Calculation	PMS-15A2	%	na		NA	NA	2.21	NA
Exchangeable Calcium %	Calculation	PMS-15A2	%	na		NA	NA	4.28	NA
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na		NA	NA	68.4	NA
Exchangeable Sodium %	Calculation	PMS-15A2	%	na		NA	NA	17.8	NA
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	0.37	NA
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	0.71	NA
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	11.4	NA
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	2.95	NA
ECEC	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	16.6	NA
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	0.06	NA
Exchangeable Potassium %	Calculation	PMS-15D3	%	na		2.76	3.17	3.05	2.82
Exchangeable Calcium %	Calculation	PMS-15D3	%	na		10.0	9.75	17.4	20.0
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na		47.7	56.3	55.0	61.9
Exchangeable Sodium %	Calculation	PMS-15D3	%	na		11.7	15.7	18.6	15.2
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na		0.61	0.66	0.63	0.47
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na		2.22	2.04	3.59	3.37
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na		10.6	11.8	11.3	10.4
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na		2.58	3.28	3.84	2.56
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na		0.21	0.17	0.32	0.32
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na		0.06	0.06	0.06	0.05
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na		NA	NA	0.03	NA
ECEC	Calculation	PMS-15D3	Cmol/kg	na		22.1	20.9	20.6	16.8
Texture	Field	Northcote	Class	na		FSC	MC	LMC	CL
Emerson Aggregate	513.01	PMS-21	Class	na		NA	NA	NA	NA
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		238	259	245	185
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20		443	408	718	673
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		1266	1414	1360	1250
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10		593	754	883	589
Gravel >2.0mm	Sieve	ASTMD422-63	%	na		0.0	0.0	0.1	0.0
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na		5.6	1.6	15.2	15.1

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	Dup E	Dup F	Dup G	Dup H
				DEPTH (cm)				
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-101**	**150487-102**	**150487-103**	**150487-104**
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	24.2	24.9	40.4	44.4
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	15.2	18.5	23.4	20.5
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	55.0	55.1	20.8	20.0

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ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

					CLIENT SAMPLE ID	Dup I	Dup J		
					DEPTH (cm)				
Test Parameter	Method Description	Method Reference	Units	LOR		150487-105	150487-106		
Soil Moisture Content	Oven-Dry	R&L2A1	%	na		20.4	25.7		
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na		6.53	5.24		
pH (1:5 in CaCl2)	Electrode	R&L4B2	pH units	na		6.25	4.36		
Chloride Soluble	Electrode	PMS-05	mg/kg	5		585	169		
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01		0.57	0.27		
E.C.e	Calc	R&L 3A1	dS/m	na		4.2	2.0		
Extractable Nitrate-N	H20/UV-Vis	PMS-08	mg/kg	0.5		<0.5	<0.5		
Phosphorus (Total)	HNO3/HCLO4 ICP	ICP-03	mg/kg	37		65.0	60.3		
Organic Carbon (LECO)	LECO	R&L 6B3	%	0.05		0.16	0.44		
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na		72.3	44.4		
Phosphorus (Available)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1		7.36	12.8		
Potassium (Available)	Bicarb/ICP	R&L 18A1	mg/kg	10		306	351		
Sulphate	KCl40/ICP	R&L 10D1	mg/kg	9		137	127		
Sulphate - Sulphur	KCl40/ICP	R&L 10D1	mg/kg	3		45.5	42.2		
Extractable Copper	DTPA/ICP	R&L 12A1	mg/kg	0.5		0.69	<0.5		
Extractable Zinc	DTPA/ICP	R&L 12A1	mg/kg	0.5		<0.5	0.53		
Extractable Manganese	DTPA/ICP	R&L 12A1	mg/kg	0.5		0.90	0.80		
Extractable Iron	DTPA/ICP	R&L 12A1	mg/kg	0.5		23.4	87.1		
Extractable Boron	Hot CaCl2/ICP	R&L 12C2	mg/kg	0.2		<0.2	<0.2		
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	0.5		<0.5	241		
Aluminium Saturation	ICP-OES	R&L 15O1	%	na		0.02	12.6		
Exchangeable Potassium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10		172	NA		
Exchangeable Cacium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	20		191	NA		
Exchangeable Magnesium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10		1297	NA		
Exchangeable Sodium	Wash NH4Cl/ICP	R&L 15A2	mg/kg	10		613	NA		
Soil Colour (wet exterior)	Dry	Munsell	Class	na		10YR 4/3	10YR 4/6		
Bulk Density	Recompacted	ASTM F1815-97	mg/m3	na		1.3	1.2		
Saturated Hydraulic Conductivity	30cm tension	ASTM F1815-97	mm/hr	na		<0.3	0.4		
Soil Colour	Wet	Munsell	Class	na		10YR 4/3	10YR 4/6		
Porosity Total	Calc	ASTM F1815-97	%	na		46.6	48.4		
Porosity Capillary	Calc	ASTM F1815-97	%	na		43.3	41.3		

ANALYSIS REPORT

PROJECT NO: EW150487 Location: IA059500

				CLIENT SAMPLE ID	Dup I	Dup J		
				DEPTH (cm)				
Test Parameter	Method Description	Method Reference	Units	LOR	150487-105	150487-106		
Porosity Air Filled	Calc	ASTM F1815-97	%	na	3.4	7.1		
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	0.04	12.6		
Exchangeable Aluminium	Calculation	R&L 15J1	Cmol/kg	na	0.01	2.68		
Exchangeable Potassium %	Calculation	PMS-15A2	%	na	2.96	NA		
Exchangeable Calcium %	Calculation	PMS-15A2	%	na	6.42	NA		
Exchangeable Magnesium %	Calculation	PMS-15A2	%	na	72.7	NA		
Exchangeable Sodium %	Calculation	PMS-15A2	%	na	17.9	NA		
Exchangeable Potassium	Calculation	PMS-15A2	Cmol/kg	na	0.44	NA		
Exchangeable Calcium	Calculation	PMS-15A2	Cmol/kg	na	0.96	NA		
Exchangeable Magnesium	Calculation	PMS-15A2	Cmol/kg	na	10.8	NA		
Exchangeable Sodium	Calculation	PMS-15A2	Cmol/kg	na	2.67	NA		
ECEC	Calculation	PMS-15A2	Cmol/kg	na	14.9	NA		
Ca/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	0.09	NA		
Exchangeable Potassium %	Calculation	PMS-15D3	%	na	2.87	2.93		
Exchangeable Calcium %	Calculation	PMS-15D3	%	na	5.79	15.2		
Exchangeable Magnesium %	Calculation	PMS-15D3	%	na	66.9	59.1		
Exchangeable Sodium %	Calculation	PMS-15D3	%	na	24.5	10.1		
Exchangeable Potassium	Calculation	PMS-15D3	Cmol/kg	na	0.64	0.62		
Exchangeable Calcium	Calculation	PMS-15D3	Cmol/kg	na	1.30	3.24		
Exchangeable Magnesium	Calculation	PMS-15D3	Cmol/kg	na	15.0	12.6		
Exchangeable Sodium	Calculation	PMS-15D3	Cmol/kg	na	5.47	2.16		
Ca/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.09	0.26		
K/Mg Ratio	Calculation	PMS-15D3	Cmol/kg	na	0.04	0.05		
K/Mg Ratio	Calculation	PMS-15A2	Cmol/kg	na	0.04	NA		
ECEC	Calculation	PMS-15D3	Cmol/kg	na	22.4	21.3		
Texture	Field	Northcote	Class	na	MC	MC		
Emerson Aggregate	513.01	PMS-21	Class	na	NA	NA		
Exchangeable Potassium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	250	243		
Exchangable Calcium	NH4OAc /ICP-OES	R&L 15D3	mg/kg	20	259	647		
Exchangeable Magnesium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	1795	1508		
Exchangeable Sodium	NH4OAc/ICP-OES	R&L 15D3	mg/kg	10	1258	496		
Gravel >2.0mm	Sieve	ASTMD422-63	%	na	5.6	0.0		
Coarse Sand 0.2-2.0mm	Sieve	ASTMD422-63	%	na	6.3	1.7		

ANALYSIS REPORT

PROJECT NO: EW150487 **Location: IA059500**

				CLIENT SAMPLE ID	**Dup I**	**Dup J**		
				DEPTH (cm)				
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**150487-105**	**150487-106**		
Fine Sand 0.02-0.2mm	Sieve	ASTMD422-63	%	na	33.2	27.3		
Silt 0.002-0.02mm	Hydrometer	ASTMD422-63	%	na	21.8	25.4		
Clay <0.002mm	Hydrometer	ASTMD422-63	%	na	33.2	45.7		

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NB: LOR is the Lowest Obtainable Reading.

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Appendix D. Comparison of Baseline Results

Comparison of Baseline Results

Baseline 7 - Parent soil (Baseline 1) (based on average values)

Depth	EC (1:5)	pH	NO3	Org-C	K	Ca	Mg	Na	Al	K	Ca	Mg	Na	Al	K	Ca	Mg	Na	Al	ECEC	Ca/Mg	ESP
cm	dS/m	CaCl2	mg/kg	%	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%	meq/100g	ratio	%
0-20	-0.04	0.46	-7.24	0.29	0.02	2.56	-0.98	0.02	-0.56	9	518	-109	4	9	0	12	-8	-1	-3	1.16	0.61	-0.58
20-40	-0.01	0.20	-3.61	0.12	0.12	0.96	-1.67	-0.07	-0.74	47	194	-186	-17	185	1	7	-6	0	-3	-1.28	0.17	0.28
40 - 60	0.00	0.28	-2.83	0.20	0.20	1.29	-0.28	0.01	-0.20	79	260	-16	1	212	1	6	-5	0	-2	1.00	0.14	-0.48
60 - 80	0.03	0.39	-2.09	0.26	0.26	1.29	-0.27	0.05	-0.57	104	261	-15	11	126	1	7	-4	0	-4	0.71	0.18	-0.13
80 - 100	0.01	0.27	-2.08	0.19	0.28	0.47	0.77	0.41	-0.34	110	94	109	93	134	1	3	0	1	-5	1.49	0.04	1.33
100 - 120	0.01	0.10	-1.60	0.09	0.30	0.17	0.12	0.13	-0.18	120	34	32	29	97	2	1	0	1	-4	0.51	0.02	1.17

Baseline 7 - Baseline 6 (based on average values)

Depth	EC (1:5)	pH	NO3	Org-C	K	Ca	Mg	Na	Al	K	Ca	Mg	Na	Al	K	Ca	Mg	Na	Al	ECEC	Ca/Mg	ESP
cm	dS/m	CaCl2	mg/kg	%	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%	meq/100g	ratio	%
0-20	0.20	1.25	-8.11	-0.56	0.23	6.83	0.59	1.33	-0.06	91	1368	71	306	-6	-1	20	-23	4	-2	9.01	1.10	4.37
20-40	0.19	0.36	-0.49	0.16	0.14	2.27	-2.74	0.29	1.74	53	455	-334	66	157	0	11	-22	1	9	1.81	0.33	0.58
40 - 60	0.14	0.13	-1.14	0.23	0.19	1.74	-1.71	0.11	2.05	76	348	-207	25	185	1	8	-17	-1	10	2.37	0.19	-0.93
60 - 80	0.06	0.09	-0.29	0.23	0.21	1.19	-1.76	-0.14	1.13	82	239	-213	-32	102	1	8	-13	-1	6	0.57	0.16	-1.45
80 - 100	0.07	-0.15	-1.02	0.17	0.25	0.93	-0.96	0.09	1.25	98	187	-116	21	112	1	5	-11	-1	6	1.46	0.08	-1.13
100 - 120	-0.17	-0.78	-9.74	-0.51	0.25	-3.06	-0.19	0.78	1.07	97	-612	-23	180	96	2	-15	2	5	6	-1.19	-0.28	5.29

Appendix E. Baseline 7 Stage 1B Summary of Results

Baseline 7 Stage 1B Summary of Results

Stage 1B (May 2015)

Depth	EC (1:5)	pH	NO3	Org-C	K	Ca	Mg	Na	Al	K	Ca	Mg	Na	Al	K	Ca	Mg	Na	Al	ECEC	Ca/Mg	ESP
cm	dS/m	CaCl2	mg/kg	%	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%	meq/100g	ratio	%
0-20	0.09	4.52	<0.5	1.63	0.55	3.30	3.97	0.87	0.32	215	662	482	200	28.9	6.1	36.7	44	9.66	3.6	9.01	0.82	9.7
20-40	0.13	4.33	<0.5	0.89	0.63	3.57	8.72	1.54	1.38	246	715	1060	354	124	4	22.5	55	9.72	8.7	15.84	0.40	9.7
40 - 60	0.24	4.13	<0.5	0.43	0.62	1.40	8.84	2.60	3.10	243	280	1075	597	279	3.8	8.44	53	15.7	19	16.56	0.16	15.7
60 - 80	0.33	4.28	<0.5	0.7	0.56	2.12	11.55	3.14	1.46	218	424	1404	721	131	3	11.2	61	16.7	7.7	18.82	0.18	16.7
80 - 100	0.37	4.51	<0.5	0.24	0.61	1.05	11.44	3.48	0.70	239	210	1390	800	62.6	3.5	6.07	66	20.1	4	17.27	0.09	20.1
100 - 120	0.52	4.12	<0.5	0.29	0.64	1.20	11.53	4.09	0.73	251	241	1402	940	65.8	3.5	6.61	63	22.5	4	18.20	0.10	22.5

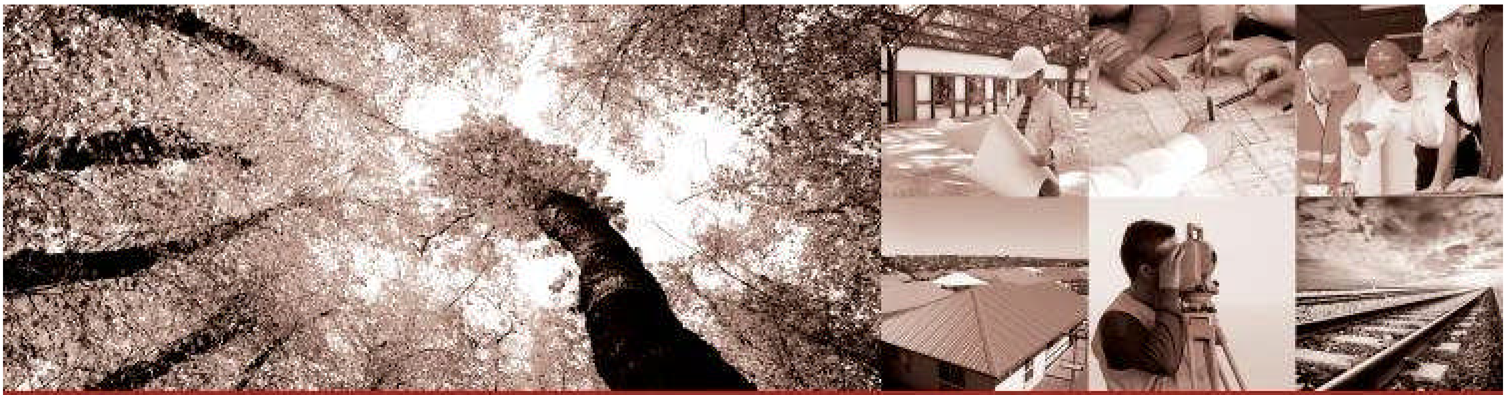
Stage 1B (December 2014)

Depth	EC (1:5)	pH	NO3	Org-C	K	Ca	Mg	Na	Al	K	Ca	Mg	Na	Al	K	Ca	Mg	Na	Al	ECEC	Ca/Mg	ESP
cm	dS/m	CaCl2	mg/kg	%	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%	meq/100g	ratio	%
0-20	0.12	4.59	7.4	2.15	0.56	3.47	4.67	1.12	0.19	220	695	568	258	17	6	34	47	11	2	10.10	0.73	11.1
20-40	0.14	4.29	2	0.9	0.44	2.41	8.14	1.89	1.39	173	482	989	434	125	3	17	57	13	10	14.40	0.29	13.1
40 - 60	0.25	4.27	1.3	0.57	0.50	1.62	10.30	2.64	1.69	196	324	1252	607	152	3	10	62	16	10	16.90	0.16	15.6
60 - 80	0.32	4.28	0.6	0.42	0.36	1.40	9.98	3.32	1.16	142	280	1213	763	104	2	9	62	20	7	16.30	0.14	20.4
80 - 100	0.45	4.43	0.7	0.2	0.32	0.95	10.18	4.06	0.32	126	190	1237	933	29	2	6	64	25	2	16.00	0.09	25.4
100 - 120	0.58	4.8	0.9	0.14	0.36	0.75	11.36	4.93	0.04	142	150	1381	1133	4	2	4	65	28	0	17.60	0.07	28.0

Difference (May 2015 - December 2014)

Depth	EC (1:5)	pH	NO3	Org-C	K	Ca	Mg	Na	Al	K	Ca	Mg	Na	Al	K	Ca	Mg	Na	Al	ECEC	Ca/Mg	ESP
cm	dS/m	CaCl2	mg/kg	%	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%	meq/100g	ratio	%
0-20	-0.03	-0.07	-6.9	-0.52	-0.01	-0.16	-0.71	-0.25	0.13	-5	-33	-86	-58	12	0.1	3	-3	-1	2	-1.09	0.09	-1.4
20-40	-0.01	0.04	-1.5	-0.01	0.19	1.16	0.58	-0.35	-0.01	73	233	71	-80	-1	1	6	-2	-3	-1	1.44	0.11	-3.4
40 - 60	-0.01	-0.14	-0.8	-0.14	0.12	-0.22	-1.46	-0.04	1.41	47	-44	-177	-10	127	0.8	-2	-9	0	9	-0.34	0.00	0.1
60 - 80	0.01	0	-0.1	0.28	0.19	0.72	1.57	-0.18	0.30	76	144	191	-42	27	1	2	-1	-3	1	2.52	0.04	-3.7
80 - 100	-0.08	0.08	-0.2	0.04	0.29	0.10	1.26	-0.58	0.37	113	20	153	-133	34	1.5	0	2	-5	2	1.27	0.00	-5.3
100 - 120	-0.06	-0.68	-0.4	0.15	0.28	0.45	0.17	-0.84	0.69	109	91	21	-193	62	1.5	3	-2	-6	4	0.60	0.03	-5.5

Appendix F. Mitchel Hanlon Consultants Pty Ltd - EM31 Interpretive Report



JACOBS GROUP (AUSTRALIA) PTY LTD

ELECTROMAGNETIC INDUCTION SURVEY

‘TIEDMANS’, TIEDMANS LANE, GLOUCESTER

LOTS 83 – 85 IN DP 979859

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ISSUE	REV.	DATE	AUTHOR	APPROVED	ISSUED TO
DRAFT	01	19 June 2015	K. Leedham	T. McLean	Issued for Review
FINAL DRAFT	02	21 June 2015	K. Leedham	T. McLean & K. Leedham	Jacobs Group (Australia) Pty Ltd for Comment
FINAL DRAFT	03	3 July 2015	K. Leedham	T. McLean	Jacobs Group (Australia) Pty Ltd for Comment
FINAL	04	13 July 2015	K. Leedham	T. McLean	Jacobs Group (Australia) Pty Ltd

File path: J:\2015\15055 Jacobs Group (Australia) EM Survey Report Gloucester\MHC Report\EM Survey Report FINAL _v04.doc

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1.0 Introduction

Mitchel Hanlon Consulting (MHC) has been engaged by Mr Garry Straughton of Jacobs Group (Australia) Pty Ltd (Jacobs) on behalf of AGL Upstream Infrastructure Investments Pty Ltd (AGL) to prepare a report compiling the results of an electromagnetic induction (EM) survey, soil sampling and analysis undertaken at Tiedman Property (Tiedman's), Tiedman Lane, Gloucester, New South Wales (NSW).

1.1 Background

The site (the Tiedman property) is situated within the locality of Forbesdale (Lots 83 – 85 in DP 979859). The site is currently used for irrigation and grazing. There are a number of coal seam gas (CSG) wells located on the property. The reuse of blended water (brackish produced water mixed with fresh water) is for irrigating purposes in a trial research project named Tiedman Irrigation Program (TIP).

The site is located approximately 9 km south of the township of Gloucester. Figure 1 (p10) depicts the site's location within NSW and Figure 2 (p11) illustrates the location of the site within the Gloucester Local Government Area.

An EM31 survey is required as part of the data collection and reporting for the AGL TIP. The trial has been underway since late 2012 to assess the potential effects on soil conditions of using blended water from CSG operations for irrigation purposes.

EM surveys are routinely used in agricultural settings for broad scale investigations of soil salinity. It can be a cost effective method of identifying potential accumulation of salts and impacts of trial amelioration techniques. The EM31 survey results were used to complement the regular soil sampling results that have been undertaken during the TIP.

2.0 Objectives and Scope of Works

2.1 Report Objectives

The main objectives of this report are to:

- Review existing soil and land information available for the site;
- Using an EM31 geophysical survey instrument, conduct an EM survey of the site to map the apparent electrical conductivity (EC_a) of soils of the site to an approximate depth of 2 m;
- Interpretation of results from laboratory testing of soil samples for validation of the EM31 data;
- Use of the laboratory data in conjunction with the EM31 data and simple correlation regression analysis to assess the spatial extent of soil salinity across the site;
- Brief discussion of the suitability of EM31 survey as a method of monitoring soil salinity at the trial site.

It is understood that this report forms part of the AGL *Soil Quality Monitoring and Management Program – Report 6: Irrigation (Activities from 1 January to 30 June 2015).* This report will be submitted to the Department of Trade and Investment – Resources and Energy for review to comply with the review of environmental factors (REF) approval conditions.

2.2 Scope of Works

It is understood that Jacobs engaged the services of SMK Consultants Pty Ltd (SMK) to undertake the EM31 survey. It is also understood that Jacobs personnel undertook the necessary soil sampling at the Tiedman Property. The soil sampling was undertaken at the same time as the EM31 survey with the aim of validating the EM31 survey results. Field activities were completed between 18/05/2015 and 21/05/2015.

MHC has subsequently been engaged to prepare a report to collate the site EM31 survey data and soil sampling data collected to validate the survey information. The report discusses the data in the context of the trial aims and objectives.

This report has been prepared in conjunction with the previous EM31 survey results undertaken on the 21st April 2011 detailed within the report prepared by SoilFutures Consulting Pty Ltd (SoilFutures) in July 2011 and the results detailed within the report prepared by MHC in December 2014.

Aerial Imagery and Cadastral Information Supplied by NSW Department of Lands, SIX Maps and Google Earth as such ALL Information is (including distances and locations) are APPROXIMATE

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EM SURVEY REPORT - 'TIEDMANS', 100 TIEDMANS LANE, FORBESDALE

FIGURE 1

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EM SURVEY REPORT - 'TIEDMANS', 100 TIEDMANS LANE, FORBESDALE

FIGURE 2

3.0 Previous Site Works

3.1 Electromagnetic Induction Survey Report (2014)

In 2014, MHC was engaged to prepare an EM31 survey report based upon soil sampling, and analysis report on the irrigation trial site located within the Tiedman Property. The aim of the works was to assess the spatial extent of soil salinity across the site prior to any soil amelioration or irrigation development. A copy of the MHC report has been included in Appendix A.

A summary of the conclusions of the MHC report has been reproduced below [sic]:

> The natural soils of the trial site are typical to the soil landscapes of the surrounding areas. The soils are dominated by texture contrast soil including Kurosols and Sodosols. These soils are characterised by naturally low fertility, high sodicity, poor drainage and acidic pH. In order to improve the soil capacity for crop production and for coal-seam gas water utilisation, a number of soil ameliorants were used in the trial plots.
>
> The site was visited on 23rd October 2014 by Mr Paul McCardell of Fodder King, Dr Steven Lucas of The Tom Farrell Institute for the Environment and Mr Jeremy Barr of SMK Consultants Pty Ltd for the purpose of undertaking the required EM survey and necessary soil sampling.
>
> The EM survey data was analysed using regression analyses in the Microsoft Excel program. The regression analysis demonstrated that the EM survey data is not highly correlated with the measured soil chemical data. The R^2 value of 0.63 between the measured electrical conductivity data (ECe) and the EM survey electrical conductivity data (EC_a) represents that there is a 63% of the soil salinity variability is described by the regression line.
>
> The low correlation of results is potentially due to the number of measured samples taken at the time of the EM survey. Ten (10) soil sampling locations were analysed in 2014 compared to 26 locations in 2011. The data correlation may have been improved by analysing the 26 original locations and confirmed that the EM survey is a suitable predictive tool for electrical conductivity assessment at the trial site. However, we note that, with a larger sample size of 26 locations in the 2011 EM survey, the authors experienced similar difficulties in establishing an R^2 value that was well correlated.

If good R^2 correlations can be established, Electromagnetic Induction (EM) surveys can be a cost-effective and rapid method of predicting electrical conductivity over a large area. In view of the variability identified in the two EM surveys it is not possible to make a conclusion as to what extent the EC_a values have changed. Nevertheless, it is recommended that a follow up EM survey is conducted at, say 6 or 12 months at a period when prior rainfall conditions are similar to either the 2011 or 2014 survey.

4.0 Methodology

4.1 Trial Description

The trial site is located on Lot 85 on DP979859 and is shown on Figure 2. The main trial area (Stage 1A) is approximately 18.2 ha, 12 ha of this area comprise of 16 trial irrigation plots with four different soil treatment methods applied. The plots were established in 2012/13.

The natural soils of the trial site are typical to the soil landscapes of the regional area. The soils are dominated by texture contrast soil including Kurosols and Sodosols. These soils are characterised by naturally low fertility, high sodicity, and poor drainage. Kurosols generally have a texture contrast between the A horizon and strongly acid B horizon. Sodosols however, generally have an alkaline B horizon. The natural characteristics of the soils have limited their capacity for agricultural production in the past, despite the high rainfall of the Gloucester region.

Water produced from the AGL operations is brackish to slightly saline, with an electrical conductivity (EC) of over 400 mS/m (4 dS/m). For the water to be reused, it is blended with fresh water to lower the EC to around 150 mS/m (1.5 dS/m). The blended water is then irrigated onto the trial plots using a lateral move irrigator.

In order to improve the soil capacity for crop production and for sustainable use of produced water, a number of soil ameliorants were used in the trial plots. Four treatments were applied to four plots, with a total of 16 plots.

1. Treatment 1 – Shallow surface ripping and ameliorant incorporated to 240 mm;
2. Treatment 2 – Shallow surface ripping to 240 mm and ameliorant, + deep ripping and ameliorant incorporated to 650 mm;
3. Treatment 3 – Shallow surface ripping to 240 mm and ameliorant, + deep ripping and ameliorant incorporated to 950 mm;
4. Treatment 4 – Shallow surface ripping to 240 mm and ameliorant, + deep ripping and ameliorant incorporated to 1200 mm.

The deep ripped runs were spaced 1.5 m apart, and each run was approximately 20 cm wide. Compost, lime, gypsum and zeolite ameliorants were used.

Perennial lucerne, annual triticale and forage sorghum crops have been planted in rotation in the trial plot areas. Moisture sensors were installed to monitor water irrigation scheduling and soil moisture.

Stage 1B comprises the existing irrigation area of about 8.6 ha (of which about 4 ha is currently under irrigation) plus an expansion area to the west and south (if required). It is highly unlikely that this additional area of 21 ha will be required.

Plate 1 and Plate 2 show the trial site plots and irrigator system. Plate 3 to Plate 5 show the trial site sampling and quad bike used to undertake the survey.

Plate 1: Stage 1A Trial Site – Facing West

Plate 2: Stage 1A Trial Site – Facing Southeast

Plate 3: Stage 1B Trial Site – Facing West

Plate 4: Sampling of Stage 1A Trial Site

Plate 5: EM31 Unit Mounted to Quad Bike

4.2 Soil Landscape Information

Soil landscape information was obtained from the *Soil Landscapes of the Dungog 1:100,000 sheet* (Henderson 2000). The majority of the property and the trial site area is defined by the Gloucester soil landscape (GOW). The soils of this landscape are generally moderately deep to deep Brown Sodosols, which are limited by high sodicity, alkaline sub soils, dispersive nature and low permeability. Shallow to deep Grey Kurosols are also present within this soil landscape. These soils are limited by strongly acidic pH, high potential for aluminium toxicity, low permeability, and low fertility.

The soil landscape boundaries as determined by Henderson (2000) have been detailed in Figure 3.

4.3 Electromagnetic Induction Survey

The EM31 instrument measures the EC_a of the ground based on the strength of a secondary magnetic field induced in the ground from a primary field emitted by the instrument. EM31 has an operating spacing of 3.66 m and an optimum depth of vertical penetration of 6 m (DERM, 2011).

Readings for EM instruments are typically given in mS/m, 100 times greater than the commonly accepted unit of dS/m for soil analyses. It is important to note that the EM31 readings are of the bulk soil at given water content and will not directly relate to the results of the laboratory measured conductivity (DERM, 2011).

The EM31 readings are influenced by several soil properties, including clay content and mineralogy, soil water content, and the depth of layers of more conductive material in the ground. For example, low readings usually correspond to sandy, gravelly soil or low moisture and high readings can be related to increased clay content.

Although there is no direct relationship between EC_a and laboratory measured EC (DERM 2011), it is recommended that the soils are sampled and tested for properties known to influence EM31 readings to determine if EM31 is an effective indicator of soil salinity at the site.

The site was visited on 20th May 2015 by Jacobs and SMK Consultants Pty Ltd (SMK) for the purpose of undertaking the required EM31 survey.

The methodology employed to undertake the EM31 survey and associated validation sampling was based upon the methodology utilised in the 2011 SoilFutures report. Raw EM31 data was provided to MHC for analysis. The expected penetration of the EM31 is approximately 2 m based on the horizontal survey mode adopted.

The trial area surveyed was approximately 20 ha, with a total of 3470 EC_a readings taken across the site (Stage 1A). An adjacent area of 4.1 ha (Stage 1B) was also sampled to provide a comparison to background levels of salinity. Stage 1B is not part of the trial area and has not received soil ameliorants but has been irrigated with the blended irrigation water in past operations.

The raw EM31 data for Stage 1A and Stage 1B was converted into a map depicting relative EC_a using ArcView (a GIS package). The map provides a focus for further investigation to determine the specific soil variations that are affecting electrical conductivity. The survey maps for Stage 1A and Stage 1B are presented in Figure 6 and Figure 9.

4.4 Soil Sampling for Validation of EM Survey

4.4.1 Stage 1A

Hand auger excavations were undertaken at 16 soil sampling locations between 18/05/2015 and 21/05/2015 by Jacobs personnel to provide validation data for the EM31 survey. Samples were taken at 20 cm intervals to 120 cm depth or until first refusal on rock.

Soil samples were obtained from locations CS1 to CS16 located within the Site 1A trial plot area for use in the validation exercise. MHC notes that samples CS2, CS4, CS6, CS8, CS10, CS12, CS14 and CS16 correspond to the same locations obtained from previous EM31 survey [Refer to Figure 5].

4.4.2 Stage 1B

Hand auger excavations were undertaken at 13 soil sampling locations by Jacobs personnel to provide data for the EM31 survey. Samples were excavated by hand auger from 20 cm intervals to 120 cm depth or until first refusal on rock. A lateral composite sample was formed for each depth and analysed.

Soil samples were obtained from locations CS17 to CS29 located within the trial plot area [Refer to Figure 8]. Soil samples for these locations were collected for composite samples, which involves mixing soil samples from all locations at the same depths together and forming one sample. These composite samples cannot be used within the validation of EM31 data due to their spatial mix. Therefore, Stage 1A results were used for validation purposes.

4.5 Soil Laboratory Analysis

Soil samples were analysed for (but not limited to):

- pH 1: 5 soil:water ($pH_{1:5}$);
- Electrical conductivity ($EC_{1:5}$) (soil:water) $pH_{1:5}$;
- Exchangeable cations;
- Soil moisture (%);
- Soil texture; and
- Bulk density.

All analysis was carried out as per NATA Accredited laboratory methods by East West Laboratory, Tamworth. A copy of the soil results is included in Appendix B.

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FIGURE 3

5.0 Results

5.1 EM31 Survey

Table 1 outlines typical readings and indicative soil characteristics for interpreting EM31 data.

Table 1: Typical Values for EM31 Readings and Likely Significance (DERM 2011)

TYPICAL EM READING (mS/m)	LIKELY MATERIAL	LIKELY CLAY CONTENT (%)	LIKELY $EC_{1:5}$ OF SUBSOIL (dS/m)
10-20	Coarse Sand	<10	<0.05
20-40	Earths	<20	<0.15
50-80	Light Clays	20-40	<0.25
80-130	Heavy Clays – Sodic Subsoils	45-60	<1.20
80-120	Heavy Clays – Non Sodic – Basalt in Origin	40-80	<0.60
130-200	Surface Salt and Low Salinity Groundwater	Variable	3.00-8.00 (Surface) 0.50-1.50 (Subsoil)
200-300+	Surface Salt and High Salinity Groundwater	Variable	4.00-10.00 (Surface) 1.50-3.00 (Subsoil)

Figure 5 shows the Stage 1A soil sampling sites and relevant GPS locations. Figure 6 shows the raw EM31 survey data for the Stage 1A area.

From the raw data, the EC_a ranges from 31-187 mS/m (0.31-1.87 dS/m) with an average of 79 mS/m (0.79 dS/m) over the trial site. The data ranges for the Stage 1A area indicate light to heavy clays, with likely subsoil $EC_{1:5}$ of 15 mS/m (0.15 dS/m) – 120 mS/m (1.2 dS/m).

There is an area of higher EC_a in the southwest corner of the Stage 1A area, which was identified previously in the 2011 and 2014 EM31 surveys. The increase in EC_a values in this area are consistent with this being the low point in the landscape where any run-off is collected in Catch Dam 2.

The EM31 survey did not distinguish changes in EC_a between the individual trial plots, or between the four different treatment depths in the plots. This is potentially due to the broad scale nature of the EM31 survey. The EM31 survey received an average of the EC_a over the 2 m of soil depth used in the horizontal dipole position, and received data over a greater bulk soil volume than what was sampled for laboratory analyses . It is not within the scope of this report to discuss the impacts of the trial soil ameliorations on reducing salinity impacts.

The two operating modes of the EM31 are characterised by the direction of the coils relative to the ground surface. In the horizontal dipole, the electromagnetic field is parallel to the ground surface. Positioning the EM31 in the horizontal dipole restricts the electromagnetic field to surface soils up to 2 m. Positioning the EM31 in the vertical dipole allows for deeper soil depths (up to 6 m) to be examined. Figure 4 shows the vertical and horizontal electromagnetic field pattern in each position.

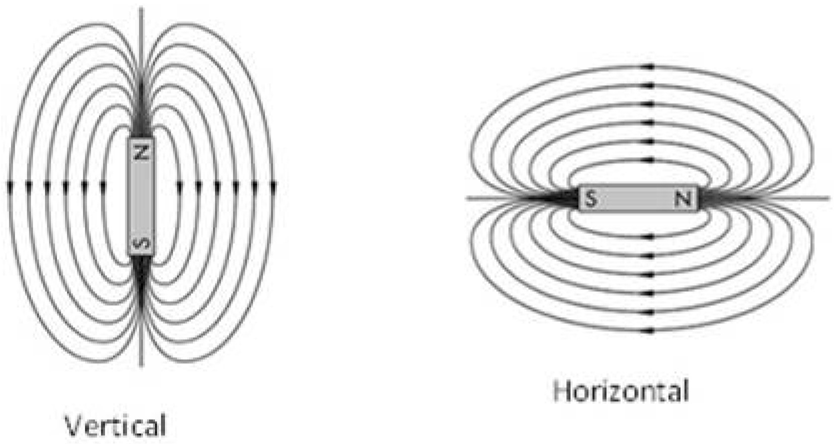

Figure 4: Vertical vs Horizontal Dipole Positions of the EM31 (UNE 2015)

Figure 7 shows the raw EM31 survey data for the Stage 1A area in 2014. In 2014, the raw data ranged from 50-80 mS/m (0.5-0.8 dS/m). The results of the EM31 survey indicate that the EC_a has increased over the trial site since 2014.

Figure 8 shows the soil sampling locations on an aerial image of the Stage 1B area. Figure 9 shows the raw EM31 data from the Stage 1B area.

The EC_a ranges between 20-80 mS/m (0.2-0.8 dS/m) on the eastern side of the Stage 1B area. The EC_a on the western side of the Stage 1B area is slightly higher, ranging between 50-147 mS/m (0.5 – 1.47 dS/m). The higher values on the western side of Stage 1B may be due to the slope of the ground surface encouraging surface runoff or sub-surface movement of soluble salts down slope.

The EC_a data for Stage 1B indicates the soil textures are likely to be light to heavy clays, indicating a likely subsoil $EC_{1:5}$ of 15 mS/m (0.15 dS/m) – 120 mS/m (1.2 dS/m) (refer to Table 1).

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0 0.05 0.1
Kilometres

Site ID	Easting	Northing	Site ID	Easting	Northing	Site ID	Easting	Northing
CS1	402197	6449447	CS7	402490	6449400	CS13	402361	6449197
CS2	402239	6449387	CS8	402532	6449340	CS14	402402	6449137
CS3	402281	6449327	CS9	402174	6449280	CS15	402467	6449233
CS4	402344	6449423	CS10	402215	6449221	CS16	402508	6449173
CS5	402385	6449363	CS11	402256	6449160			
CS6	402427	6449303	CS12	402321	6449256			

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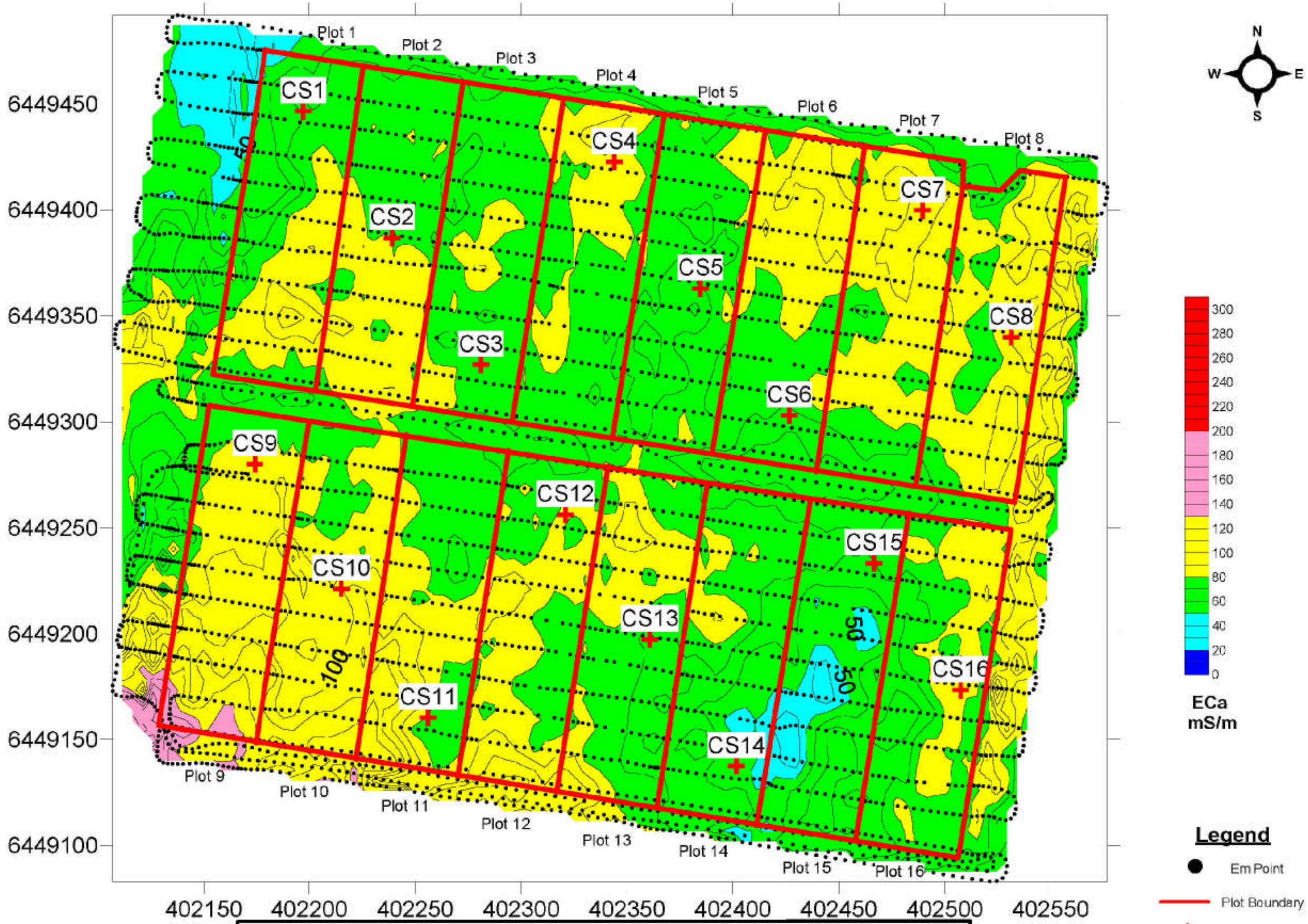
FIGURE 5



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EM 31 Survey - Horizontal Survey
AGL Trial Stage 1A
Gloucester
Surveyed May 2015
By Jeremy Barr

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FIGURE 6

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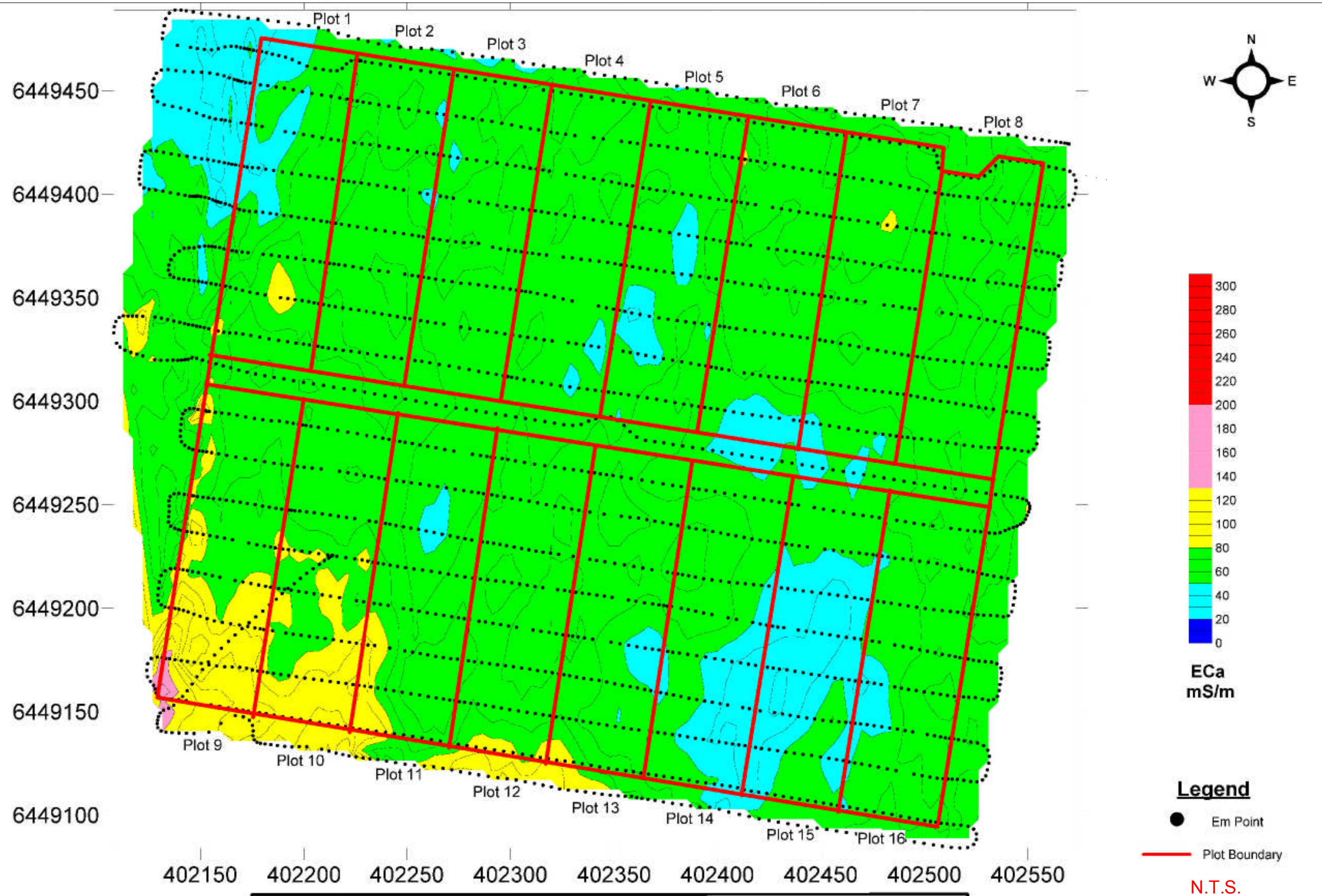

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EM 31 Survey - Horizontal Survey
AGL Trial Stage 1A
Gloucester
Surveyed October 2014
By Jeremy Barr

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FIGURE 7

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Site ID	Easting	Northing	Site ID	Easting	Northing	Site ID	Easting	Northing
CS17	402226	6448943	CS22	402190	6448810	CS29	402482	6448564
CS18	402203	6448878	CS24	402297	6448738			
CS19	402317	6448868	CS25	402380	6448753			
CS20	402413	6448904	CS26	402342	6448690			
CS21	402391	6448791	CS27	402511	6448662			
CS23	402177	6448732	CS28	402444	6448603			

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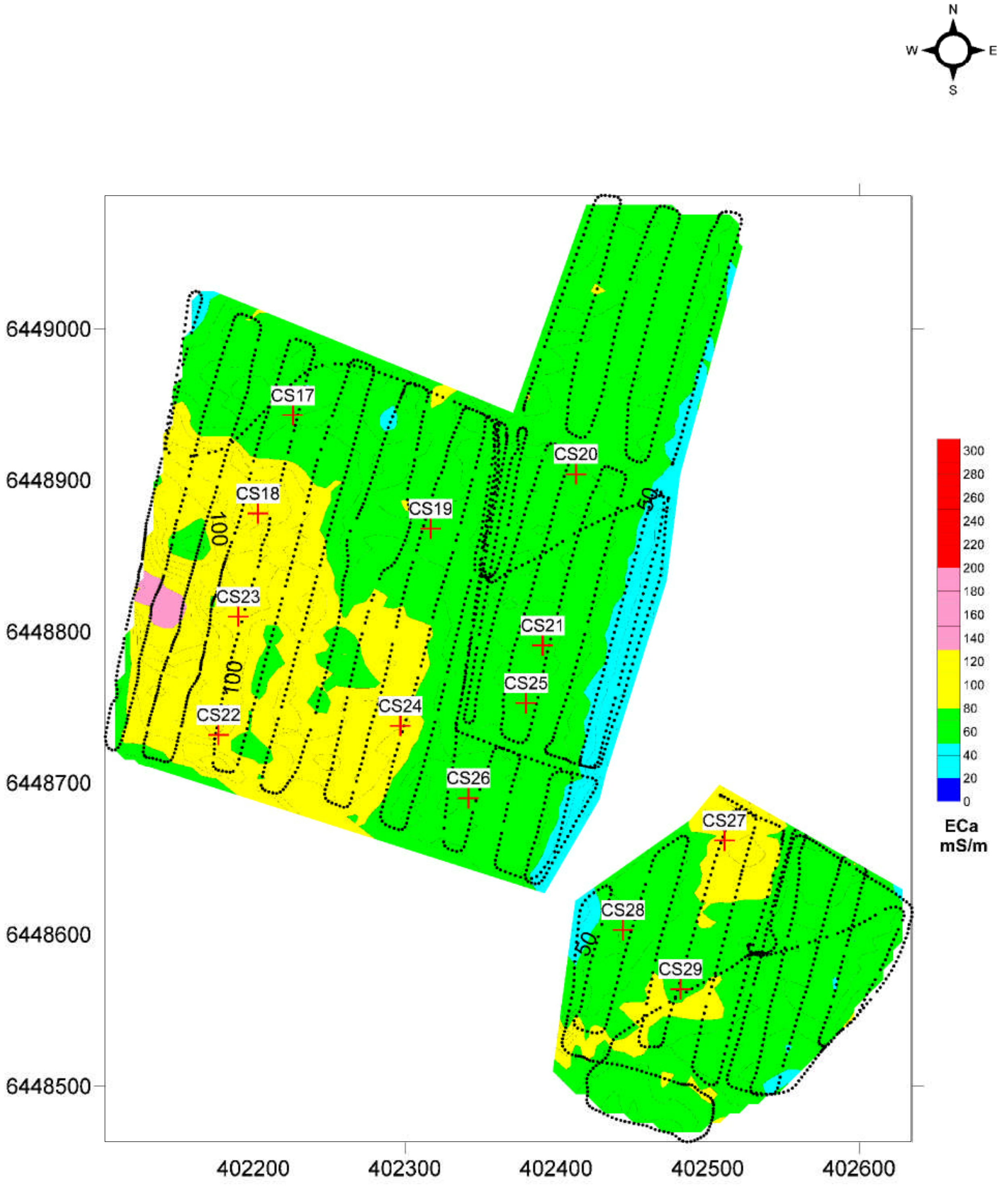
FIGURE 8



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Legend

● Em Point

+ Core Sample

N.T.S.

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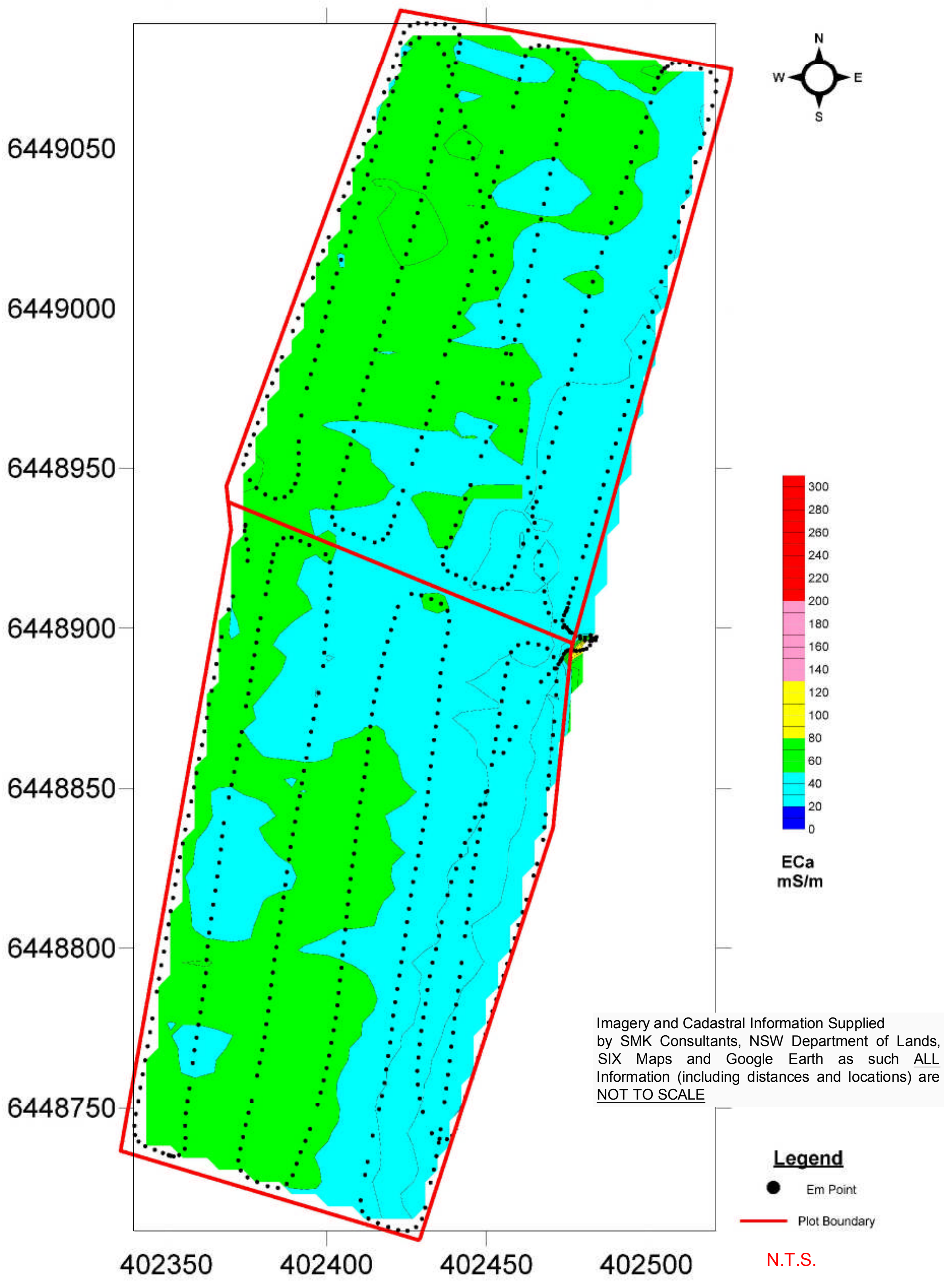
FIGURE 9



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EM 31 Survey - Horizontal Survey
AGL Trial Stage 1B
Gloucester
Surveyed October 2014
By Jeremy Barr

5.2 Soil Analysis

5.2.1 Soil Texture

Appendix B shows the results of the soil sample analyses that were undertaken at the time of the EM31 2015 survey. Soil texture was assessed in the field and the surface soils were found to be clay loams with an estimated clay content of 20-30%. The soil texture increased vertically down the profile in all soils to medium to heavy clays with an estimated clay content of 45-55%.

Some of the soil samples collected in the southern part of the trial area had a sandy clay layer at 80-120 cm, but this layer was not a common occurrence.

Due to the uniformity of the sub-surface clay content across the trial areas, it is considered that this soil property would not negatively impact the EM31 survey results.

5.2.2 Soil Moisture

Soil moisture was measured for the soil samples as it can influence the EC_a readings of the EM31 instrument.

In the two months prior to the April 2011 EM31 survey the rainfall for March and April, measured at Gloucester Post Office, was 243 mm and exceeded the mean of 205 mm by around 18%. This would have caused high soil moisture values at the time of sampling.

In contrast, in the 2 months prior to the October 2014 EM31 survey the rainfall for September and October was 48.0 mm and was 59% below the mean of 118 mm for those two months.

In April and May 2015 there was 202 mm of rain, which was approximately 40% above the long term average of 145 mm for those months (BOM, 2015).

The soil moisture for the May 2015 EM31 survey ranged from 20.6% to 33.8% in the surface soils (0-20 cm). This is a higher soil moisture content compared to the December 2014 survey (8.3%-14.7% in the surface soils).

Soil moisture levels were the highest 20-60 cm below the soil surface, ranging from 15.9% to 38.3%. This level of soil moisture is consistent with the rainfall of the previous months before sampling.

5.2.3 Soil pH

The soil $pH_{1:5}$ in the surface soils ranged from pH 5.5 (strongly acidic) to 7.6 (mildly alkaline). The sub-surface soils ranged from pH 5.2 (strongly acid) to 7.4 (mildly alkaline). Acidic soil pH can increase the availability of exchangeable aluminium that can affect plant growth.

5.2.4 Soil Electrical Conductivity

The $EC_{1:5}$ was measured to provide data to allow for regression analysis of the EM31 survey raw data. The surface soil $EC_{1:5}$ ranged from 20 mS/m (0.2 dS/m) (medium) to 47 mS/m (0.47 dS/m) (high). The subsoil $EC_{1:5}$ ranged from 9 mS/m (0.09 dS/m) (low) to 39 mS/m (0.39 dS/m) (medium).

The current $EC_{1:5}$ results are slightly higher in the surface soils compared to the December 2014 results; 10 mS/m (0.10 dS/m) (low) to 23 mS/m (0.23 dS/m) (medium). The subsoil $EC_{1:5}$ ranged from 11 mS/m (0.11 dS/m) (low) to 69 mS/m (0.69 dS/m) (high) in December 2014 (Hazelton and Murphy, 2007).

It is advised that these soil properties are compared to the data collected during the trial period to assess any trends and potential impacts of blended water irrigation.

5.3 Regression Analyses of EM31 Survey Data

5.3.1 Data Correlation

With any broad scale EM survey it is useful to assess the soil properties known to influence EM (either individually or collectively) to determine whether the EM data is a useful predictor or indicator of these soil properties.

Regression analysis was undertaken in Microsoft Excel to assess the correlation between the measured soil data and the EC_a data from the EM31 survey. The higher the R^2 value gained from the regression analysis, the greater the correlation between the data. Where a low R^2 value is obtained (<50%), there is high variation within the data set and low data correlation.

The equation for the regression line [which is usually expressed by the formula Y value = m (slope) x (X axis value) + b (Y intercept)], can be used to develop a predictive model based on the whole EM31 survey dataset. Maps can be produced showing the distribution of salinity, clay content or other measured soil properties which have a high correlation with the EM31 survey data.

Comprehensive data analysis is outside the scope of this report.

5.3.1.1 Electrical Conductivity ($EC_{1:5}$)

Figure 11 shows the linear regression of EC_a (mS/m) and measured $EC_{1:5}$ for the whole data set (using an average $EC_{1:5}$ value from each of the 16 soil sampling locations). The resulting regression (R^2 = 0.09) shows there is poor correlation between EC_a and $EC_{1:5}$.

The data set was reviewed and five points were visually assessed as being outliers and were subsequently removed from the regression to improve the data correlation.

Figure 12 shows the regression results for the revised data set. The R^2 value increased to 0.31, however this still represents a poor correlation and a high variability within the data set.

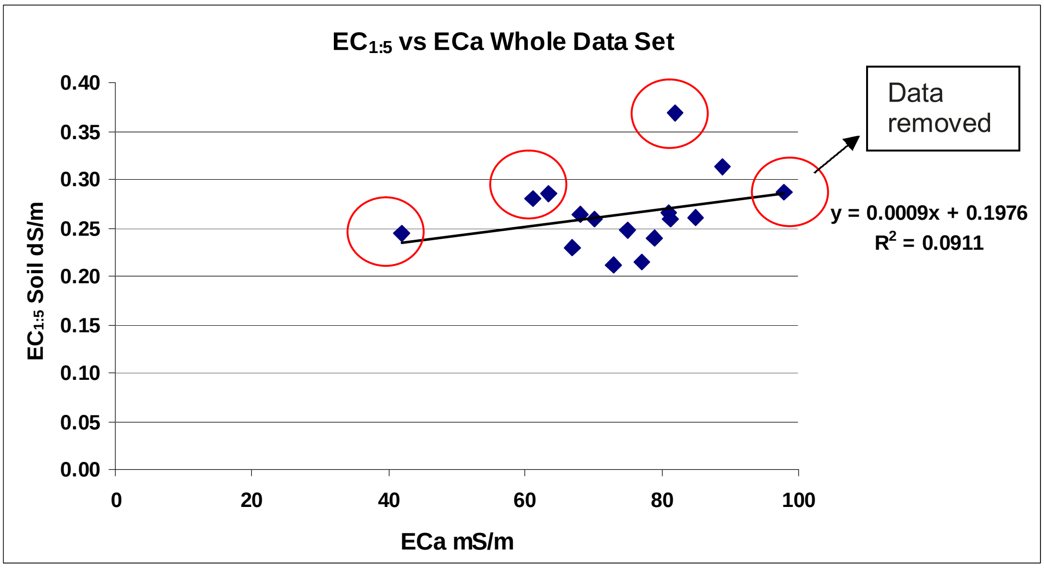

Figure 11: Measured Electrical Conductivity vs EM31 Survey Electrical Conductivity – Data Regression

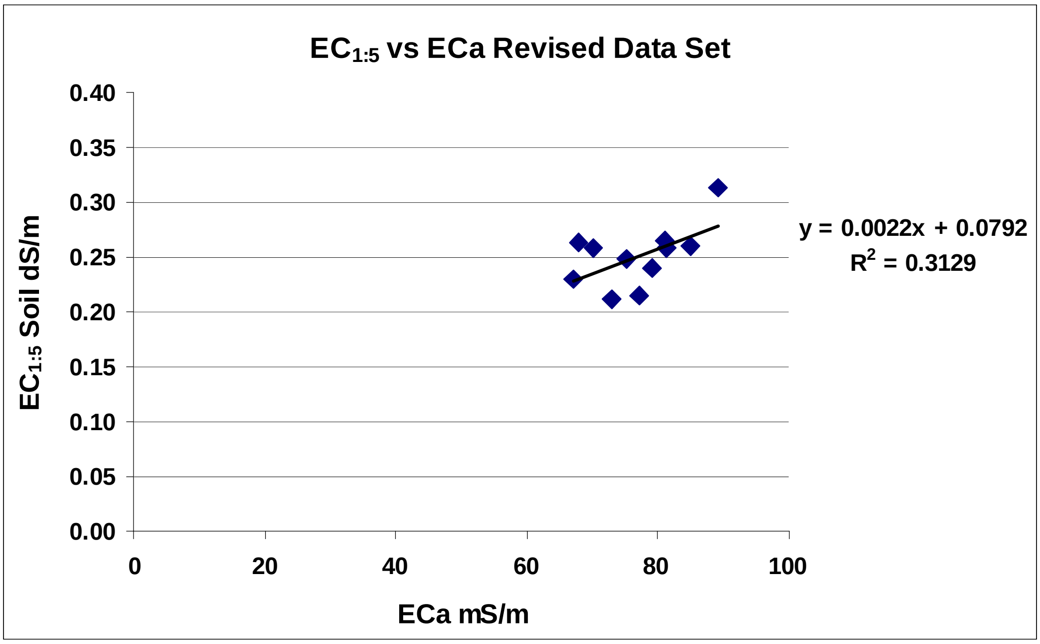

Figure 12: Measured Electrical Conductivity vs EM31 Survey Electrical Conductivity – Revised Data Set Regression

5.3.1.2 Soil Moisture

Figure 13 shows the linear regression of EC_a (mS/m) and soil moisture (%) for the entire dataset. The results (R^2 = 0.19) indicate these variables are poorly correlated.

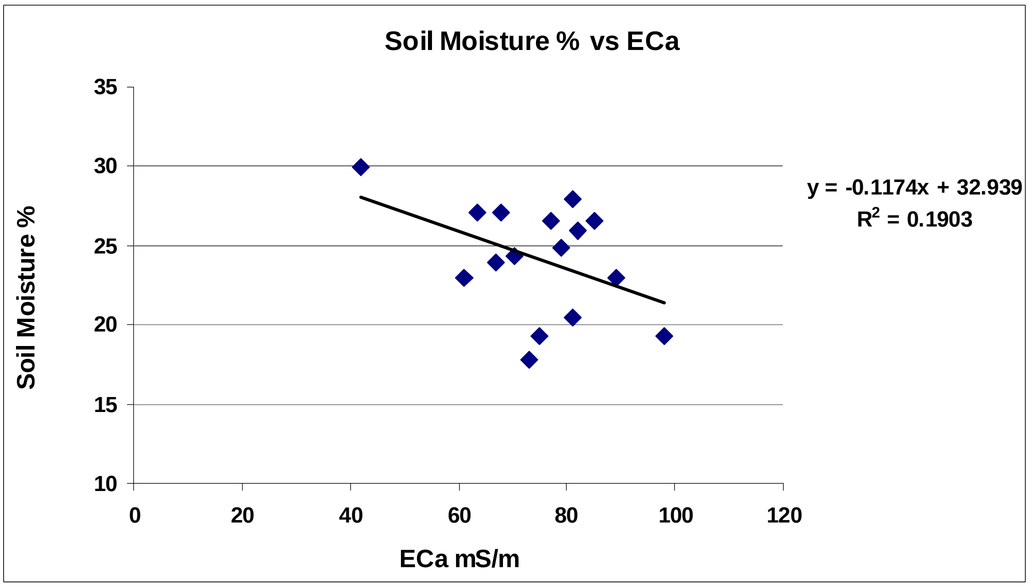

Figure 13: Measured Soil Moisture % vs EM31 Survey Electrical Conductivity – Whole Data Set Regression

5.3.1.3 Soil $pH_{1:5}$

Figure 14 shows the linear regression of EC_a (mS/m) and soil $pH_{1:5}$ for the entire dataset. The results show that soil pH and EC_a are very poorly correlated.

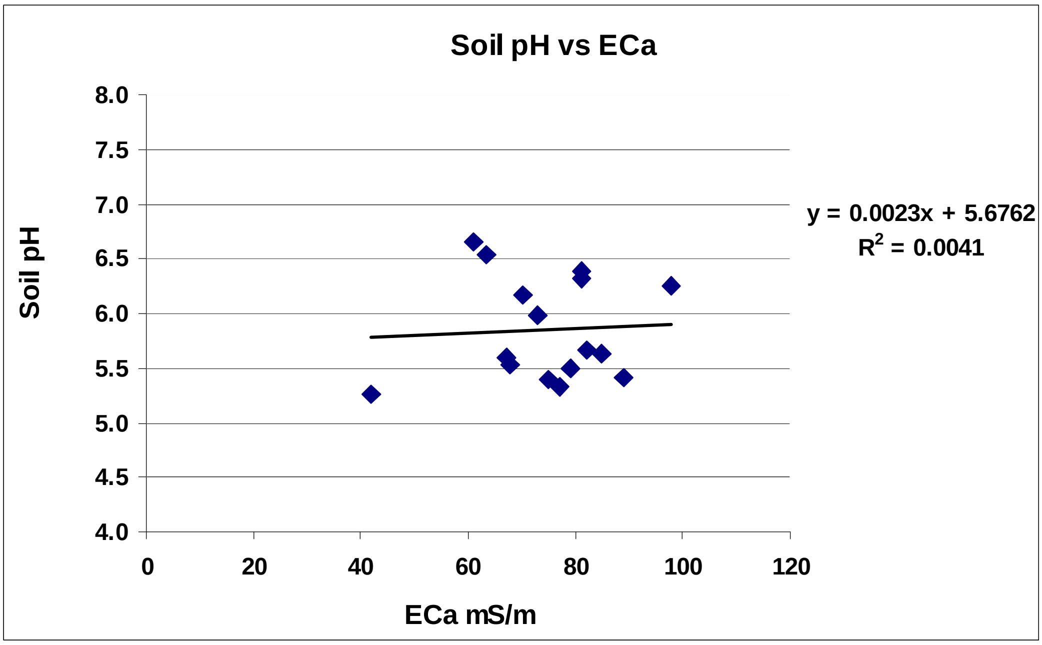

Figure 14: Measured Soil pH vs EM31 Survey Electrical Conductivity – Whole Data Set Regression

The soil $pH_{1:5}$ data were then analysed according to soil classification because it was recognised that a range in pH values could affect the relationship between pH and EC_a. Several of the soils were strongly acidic (Kurosols) however other soils showed more alkaline pH trends and could not be classified as Kurosols.

Figure 15 and Figure 16 show the linear regression of soil $pH_{1:5}$ and EC_a for Kurosols and Sodosols respectively. Whilst the correlation has improved by separating the soil types and analysing the data independently, $pH_{1:5}$ and EC_a were poorly correlated.

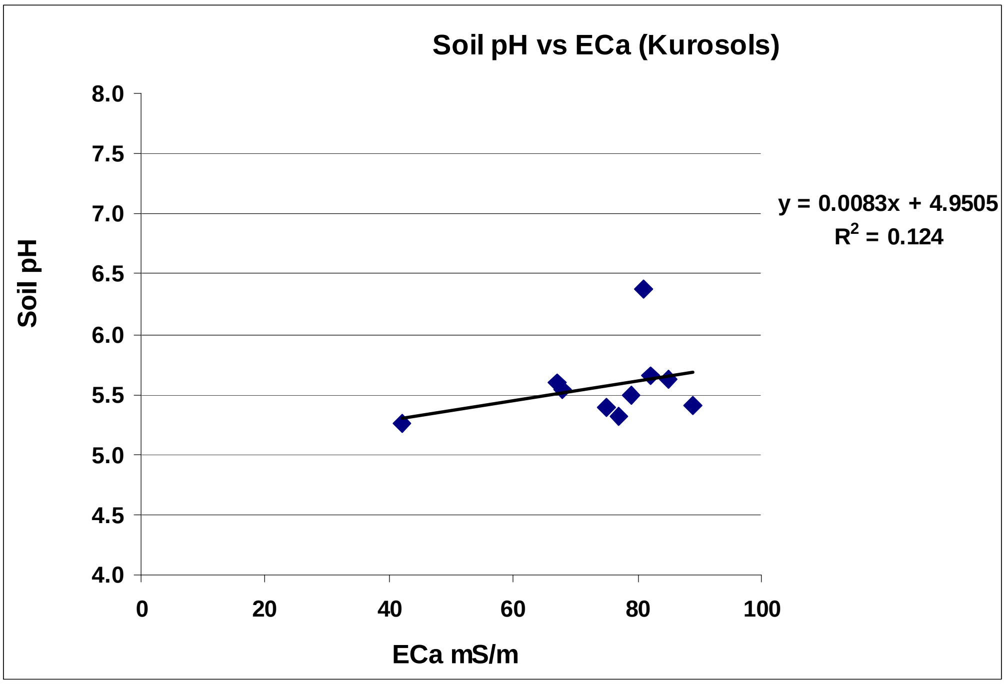

Figure 15: Measured Soil pH (Kurosols) vs EM31 Survey Electrical Conductivity

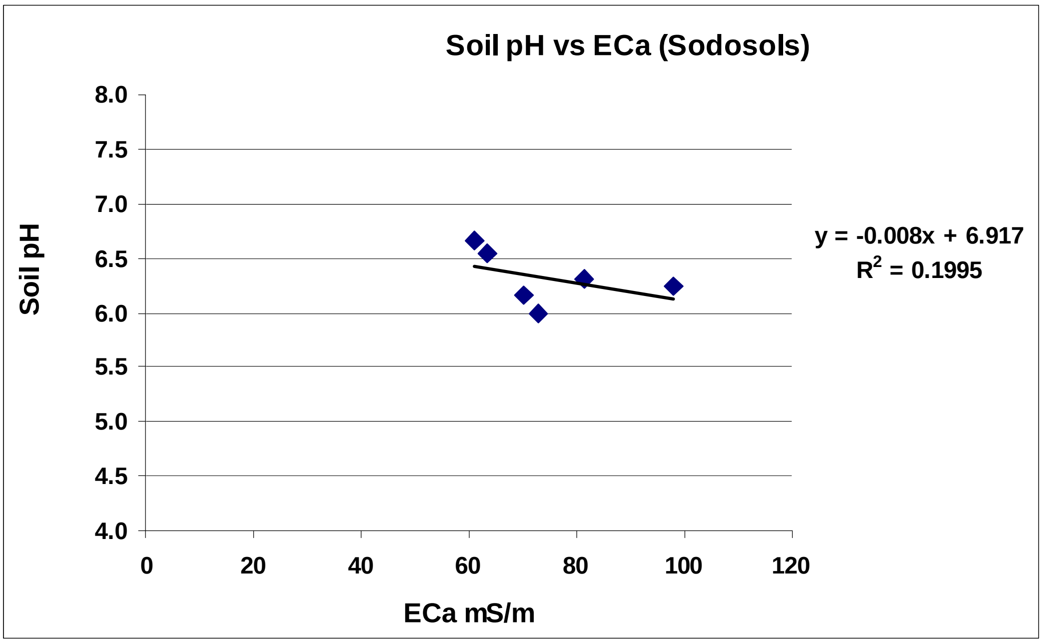

Figure 16: Measured Soil pH (Sodosols) vs EM31 Survey Electrical Conductivity

5.3.1.4 Data Correlation

The regression analyses demonstrated that the 2015 EM31 survey data are not correlated with any of the measured soil properties.

An R^2 value of 0.31 for $EC_{1:5}$ versus EC_a means that 31% of the soil salinity variability is described by the fitted line. This correlation has decreased since the December 2014 survey ($R^2 = 0.63$).

Soil moisture was higher in 2015 than the previous surveys due to increased rainfalls prior to the survey taking place, and this is reflected in the correlation of soil moisture versus EC_a as shown in Figure 13.

Soil $pH_{1:5}$ values have remained stable over the trial period, however the correlation between soil $pH_{1:5}$ and EC_a has decreased since the 2014 EM31 survey.

The 2015 EM31 survey data (EC_a) are not well correlated with any of the 2015 measured soil properties. These results suggest that, for 2015, EC_a is a poor predictor of actual salinity.

6.0 Discussion of Results

6.1 Stage 1A

From the May 2015 EM31 survey data, the EC_a ranges from 31-187 mS/m (0.31-1.87 dS/m) over the Stage 1A area. In 2014, EC_a ranges from 50-80 mS/m (0.5-0.8 dS/m) over the Stage 1A area. The baseline (raw) EC_a data from 2011 ranged from 20-50 mS/m (0.2-0.5 dS/m) over the trial site. Based on these results for 2011, 2014 and 2015, EC_a has increased at the site.

In the Stage 1A area, the increase in EC_a in the southwest corner may be due to increased soil moisture conditions and/ or increased salinity due to the surface or sub-surface movement of water and soluble salts downslope toward the catchment dam. However, it is noted that the 2011 EM31 survey had also detected elevated EC_a values in the southwest corner prior to the trial commencement.

The May 2015 EM31 survey results indicate increasing EC_a in the vicinity of the CS7 and CS8 soil sampling locations and also to the west of CS3 soil sampling location. The reasons for the increases in these locations may need to be assessed with regards to the regular soil monitoring and irrigation scheduling information.

6.2 Stage 1B

The EC_a of Stage 1B area ranges between 20-80 mS/m (0.2-0.8 dS/m) on the eastern side of the area. The western side of the area is slightly higher and ranges between 50-147 mS/m (0.5-1.47 dS/m).

The higher EC_a values on the western side of the Stage 1B area may be due to the slope of the site (increased surface water runoff and/ or the sub-surface movement of soluble salts down slope). No correlation with the measured data has been performed as the Stage 1B soil samples were composite samples.

7.0 Conclusions

There can be no direct comparison of salinity levels between the 2011, 2014 or 2015 surveys due to the poor correlation between the measured soil properties and EC_a data. The poor correlation of EM31 survey data with measured soil properties (in particular the 2015 results) raises questions as to the usefulness of EM31 survey for the Tiedman Irrigation Program.

The EM31 instrument is most useful for surveying at the catchment or reconnaissance scale and is effective to 6.0 m depth below the ground surface. Despite being used in the horizontal mode and mounted on the quad bike at 1.0 m height, the EM31 likely read EC_a at depths to 2.0 m. The soil samples (the analysis of which resulted in the measured soil properties dataset) used to validate the EM31 survey data were taken from 0-1.2 m depths. EC_a readings taken from 1.2 m to 2.0 m therefore, are not represented by the laboratory data.

The EM31 instrument can be operated in the vertical or horizontal position. The instrument was used in the horizontal position to examine the surface soils of the trial site from 0-2 m. In this mode, the EM31 instrument takes an average of the conductivity of the soil material within the sampled volume over 2 m. When used in the vertical mode, a deeper profile up to 6 m can be examined for electrical conductivity variation.

Whilst the EM31 survey data was not highly correlated to the measured data, the raw EM31 survey data does give a broad scale representation of the variability of electrical conductivity across the trial areas. When compared to the 2011 and 2014 survey data, there was an apparent increase in the electrical conductivity.

The results of the EM31 survey did not distinguish any relationship between EC_a and the individual trial plots receiving different treatments. This is likely due to the scale of intensity of EM31 readings being more appropriate for broad scale application. For this study in particular the effects of the individual treatments are best assessed against the measured soil properties.

EC_a of less than 200 mS/m (2 dS/m) are generally considered acceptable for agricultural purposes. Readings within this range typically indicate the presence of surface salinity but the subsoil salinity and groundwater salinity (if groundwater levels are reached) levels are likely to be low.

The salinity levels for both Stage 1A and Stage 1B areas of the trial areas are considered low to medium. It is noted that the relevant mass balances have been provided by Jacobs and are discussed separately in the covering report.

8.0 Recommendations

For future surveys, it is recommended that:

1. The methodology is reviewed toward improving the effectiveness of EM survey as a predictive tool for the Tiedman Irrigation Program.
2. The purpose of the EM survey be considered and clarified:
   a. Where the investigation is aimed at identifying deep drainage and salt movement offsite, EM31 may be a suitable due to it extending to 3-6 m depth below ground level.
   b. Where the investigation is aimed at identifying processes (including salinity) occurring within the root zone (0-1.5 m), the use of an EM38 instrument may be more appropriate.

9.0 References

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Appendix A Mitchel Hanlon Consulting Pty Ltd – Electromagnetic Induction Survey Report 2014

FODDER KING LIMITED

ELECTROMAGNETIC INDUCTION SURVEY

‘TIEDMANS’, TIEDMANS LANE, GLOUCESTER

LOTS 83 – 85 IN DP 979859

Client: Fodder King Limited
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ISSUE	REV.	DATE	AUTHOR	APPROVED	ISSUED TO
1	0	5 Dec 2014	T. McLean & K. Leedham	K. Leedham	Draft to Client
2	0	8 Dec 2014	T. McLean & K. Leedham	K. Leedham	Draft to Client for Comment
3	FINAL	10 Dec 2014	T. McLean & K. Leedham	K. Leedham	Draft to Client for Comment
4	FINAL	11 Dec 2014	T. McLean & K. Leedham	K. Leedham	Draft to Client for Comment

File path: J:\2014\14157 Fodder King EM Survey AGL Site Tiedman Property Gloucester\MHC Report\EM Survey Report FINAL_v04.doc

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1.0 Introduction

Mitchel Hanlon Consulting (MHC) has been engaged by Mr Paul McCardell of Fodder King Limited (Fodder King) on behalf of AGL Energy (AGL) to prepare a report compiling the results of an Electromagnetic Induction (EM) Survey, soil sampling and analysis undertaken at 'Tiedman', Tiedman Lane, Gloucester, NSW.

1.1 Background

The site is identified as 'Tiedmans', Tiedmans Lane, Gloucester, within the locality of Forbesdale (Lots 83 – 85 in DP 979859).The site is currently used for irrigation and grazing. There are a number of CSG wells located on the property but none are operational at this time. The reuse of blended water (brackish produced water mixed with fresh water) is for irrigating crops and permanent pasture.

The site is located approximately 9 kms south of the township of Gloucester. Figure 1 (p8) depicts the site's location within NSW and Figure 2 (p9) illustrates the location of the site within the Gloucester Local Government Area.

An electromagnetic (EM) survey is required as part of the data collection and reporting for the AGL coal-seam gas irrigation trial project at the 'Tiedmans' property. The trial has been underway since late 2012 to assess the impacts of coal-seam gas water irrigation on crop production.

EM surveys are routinely used in agricultural settings for broadscale investigations of soil salinity. It may be a cost effective method of identifying potential accumulation of salts and impacts of trial amelioration techniques. The EM survey results were used to complement the regular soil sampling results that have been undertaken during the trial project.

2.0 Objectives and Scope of Works

2.1 Report Objectives

The main objectives of this report are to:

- Review existing soil and land information available for the site;
- Conduct an EM31 survey of the site to map the apparent electrical conductivity (EC_a) of soils of the site to an approximate depth of 1.5 m;
- Collection of soil samples for laboratory testing and validation of the EM31 survey;
- Use of the laboratory data in conjunction with the EM31 data and simple correlation regression analysis to assess the spatial extent of soil salinity across the site;
- Brief discussion of the suitability of EM survey as a method of monitoring soil salinity at the trial site.

It is understood that this report is an addendum to the main report titled *Soil quality monitoring and management. Report 4 – Irrigation (activities from 1 January to 4 July 2014), August 2014* and will be submitted to the Department of Trade and Investment – Resources and Energy for review to comply with the REF approval conditions.

2.2 Scope of Works

It is understood that Fodder King engaged the services of SMK Consultants Pty Ltd (SMK) to undertake the EM survey. It is also understood that Fodder King have engaged Dr Steven Lucas of The Tom Farrell Institute for the Environment (University of Newcastle) to undertake the necessary soil sampling. The soil sampling was undertaken at the same time as the EM survey with the aim of validating the EM survey results.

Mitchel Hanlon Consulting has subsequently been engaged to prepare an EM Survey report to collate the site EM survey data and soil sampling data collected to validate the survey information. The report discusses the data in the context of the trial aims and objectives.

This report has been prepared in conjunction with the previous EM survey results undertaken on the 21st April 2011 detailed within the report prepared by SoilFutures Consulting Pty Ltd (SoilFutures) in July 2011.

Aerial Imagery and Cadastral Information Supplied by NSW Department of Lands, SIX Maps and Google Earth as such ALL Information is (including distances and locations) are APPROXIMATE

Mitchel Hanlon Consulting Pty Ltd

Plot Date: 4 December 2014
J:\2014\14157 Fodder King EM Survey AGL Site Tiedman Property Gloucester\ACAD\EM Survey.dwg

Fodder King Limited

EM SURVEY REPORT - 'TIEDMANS', 100 TIEDMANS ROAD, FORBESDALE

FIGURE 1

Mitchel Hanlon Consulting Pty Ltd

Plot Date: 4 December 2014
J:\2014\14157 Fodder King EM Survey AGL Site Tiedman Property Gloucester\ACAD\EM Survey.dwg

Fodder King Limited

EM SURVEY REPORT - 'TIEDMANS', 100 TIEDMANS ROAD, FORBESDALE

FIGURE 2

3.0 Previous Site Works

In 2011 SoilFutures were engaged by Fodder King to undertake an Electromagnetic Induction Survey, soil sampling, and analysis report on the irrigation trial site located within the property 'Tiedmans'. The aim of the works and subsequent report was to assess the spatial extent of soil salinity across the site prior to any soil amelioration or irrigation development.

A copy of the report prepared by SoilFutures has been included in Appendix A.

A summary of the conclusions of the SoilFutures report has been reproduced below.

3.1 Electromagnetic Survey (2011)

A summary of the conclusions of the SoilFutures report has been reproduced below [sic]:

> 'The EM31 (horizontal) survey and associated soil testing reveals that the Tiedman property is dominated by duplex soils of only low to moderate fertility, with poor internal drainage, and which are dominated by sodic, dispersive subsoils. Problems arose, possibly from the use of the GeoProbe, which may have mixed or compressed wet soils layers through its shaking motion when the jackhammer is turned on. Owing to the wet conditions at the time of the EM verification soil survey, the GeoProbe was the only way in which they could be taken.
>
> By culling data from the EM31 (horizontal) survey of 90 clearly outlying EC_a readings, it was possible to form a correlation regression relationship between soil salinity (expressed as EC_e) and apparent electrical conductivity (EC_a) from the EM31 machine. No other significant relationship existed with other measured soil parameters. This enabled a predictive model to be formed which, on the face of it, has an 83% predictive confidence for salinity. This model is only useful if it can be validated i.e. It has to be used in the field before any soil amelioration or irrigation takes place, to ensure that it does have both predictive capacity, and the capacity to monitor salinity levels when changes occur.
>
> To validate the correlation regression model, it will be necessary to take soil samples as for this project to a depth of 1.5 m in locations of known EC_a with a predicted EC_e value. Soil samples need only be analysed for electrical conductivity (EC) and texture. If the averaged salinity values for each profile fall within the range of predicted salinity, this model will be a highly valuable and cost saving tool for monitoring of any changes under a proposed

irrigation scheme where soil salinity values may increase over time.

If the model is verified, then it can be applied to determine spatially, the potential salinity build up in salinity before any irrigation commences. If the model is verified, employing serial EM31 (horizontal) surveys over time will become a cost effective way to measure changes in soil salinity over time. The model must be verified before any irrigation or soil ameliorants are applied, to achieve this aim.'

4.0 Methodology

4.1 Trial Description

The trial site is located on Lot 85 on DP979859 and is shown on Figure 2. The main trial area (Stage 1A) is approximately 12 ha, comprising of 16 plots of approximately 770 m^2. The plots were established in 2012/13.

The natural soils of the trial site are typical to the soil landscapes of the area. The soils are dominated by texture contrast soil including Kurosols and Sodosols. These soils are characterised by naturally low fertility, high sodicity, poor drainage and acidic pH. The natural characteristics of the soils limited their capacity for agricultural production in the past, despite the high rainfall of the Gloucester region.

Coal-seam gas (CSG) water produced from the AGL operations is brackish to slightly saline, with an electrical conductivity of over 4000 µs/cm. For CSG water to be reused, it is blended with fresh water to lower the EC to around 1500 µs/cm. The water is then irrigated onto the trial plots using a lateral move irrigator.

Over the period from 1/4/13 to 4/7/14 there was a total of 69.9 Ml of rainfall, supplemented by 54.2Ml of blended water averaging 1540us/m EC, applied to the main Stage 1A trial area.

In order to improve the soil capacity for crop production and for coal-seam gas water utilisation, a number of soil ameliorants were used in the trial plots. Four treatments were applied to four plots, with a total of 16 plots.

1. Treatment 1 – Shallow surface ripping and ameliorant incorporated to 240 mm;

2. Treatment 2 – Shallow surface ripping to 240 mm and ameliorant, + deep ripping and ameliorant incorporated to 650 mm;

3. Treatment 3 – Shallow surface ripping to 240 mm and ameliorant, + deep ripping and ameliorant incorporated to 950 mm;

4. Treatment 4 – Shallow surface ripping to 240 mm and ameliorant, + deep ripping and ameliorant incorporated to 1200 mm.

The deep ripped runs were spaced 1.5 m apart, and each run was approximately 20 cm wide. Compost, lime, gypsum and zeolite ameliorants were used.

Perennial Lucerne, annual triticale and forage sorghum crops have been planted in rotation in the trial plot areas. Moisture sensors were installed to monitor water irrigation scheduling and soil moisture. Plate 1 and Plate 2 show the trial site plots and irrigator system.

Plate 1: Stage 1A Trial Site – Facing West

Plate 2: Stage 1A Trial Site – Facing Southeast

4.2 Soil Landscape Information

Soil landscape information has been obtained from the *Soil Landscapes of the Dungog 1:100,000 sheet* (Henderson 2000). The majority of the property and the trial site area is defined by the Gloucester soil landscape (GOW). The soils of this landscape are generally moderately deep to deep Brown Sodosols, and shallow to deep Grey Kurosols. These soils are limited by strongly acidic pH, high potential for aluminium toxicity, low permeability, low fertility and high sodicity and dispersion.

The soil landscape boundaries as determined by Henderson (2000) have been detailed in Figure 3.

4.3 Electromagnetic Induction (EM) Survey

Electromagnetic Induction (EM) measures the apparent electrical conductivity (EC_a) of the soil. The EM31 instrument induces a current in the soil which is measured as a return signal and is logged by the machine. The current is influenced by a combination of soil properties. Field testing of soils at the time of the survey is required to determine if EM31 is an effective indicator of soil salinity.

The electrical conductivity readings are affected by factors including clay content, soil conductivity, moisture regime, organic matter, soil depth and vegetation cover. However, low readings usually correspond to sandy, gravelly soil or low moisture. High readings are usually related to clay content or soil salinity.

The site was visited on 23rd October 2014 by Mr Paul McCardell of Fodder King, Dr Steven Lucas of The Tom Farrell Institute for the Environment and Mr Jeremy Barr of SMK Consultants Pty Ltd for the purpose of undertaking the required EM survey and necessary soil sampling.

The methodology employed to undertake the EM survey and associated validation sampling was based upon the methodology utilised in the 2011 SoilFutures report.

An EM31 survey was conducted at the Tiedmans property by SMK Consultants Pty Ltd who provided raw EM31 data for MHC to analyse. In the horizontal mode which was used for this survey, the expected penetration of the EM31 is approximately 1.5 m.

The trial area surveyed was approximately 20 ha with a total of 2299 EC_a readings taken across the site (Stage 1A). An adjacent area of 4.1 ha (Stage 1B) was also surveyed to provide a comparison to background levels of salinity. Stage 1B is not part of the trial area and has not received soil ameliorants but has been irrigated with the blended irrigation water.

The raw EM31 data was converted into a map depicting relative apparent soil conductivity using Arcview (a GIS package). The map provides a focus for further investigation to determine the specific soil variations that are affecting electrical conductivity. Further investigation involves soil sampling of selected areas of soil variants identified on the EM map. The survey maps are presented in Figure 4 and Figure 5.

4.4 Soil Sampling for Validation of EM Survey

Ten soil sampling locations were sampled on the 23rd October 2014 by Dr Steven Lucas and Fodder King to provide data for the EM survey. Soil samples were taken manually using a hand auger to depths of 0-20 cm, 20-50 cm, 50-100 cm and 100-150 cm.

Soil sampling locations included CS2, CS4, CS6, CS8, CS10, CS12, CS14 and CS16 located within the trial plot area; and EM4 and EM5 from previous EM survey [Refer to Figure 7].

4.5 Soil Laboratory Analysis

Soil samples were analysed for pH (1:5 in water), electrical conductivity (EC, 1:5 in water), soil moisture (%), soil texture and bulk density as per standard soil laboratory methods at the University of Newcastle. A copy of the soil results is included in Appendix B.

Mitchel Hanlon Consulting Pty Ltd

Plot Date: 4 December 2014
J:\2014\14157 Fodder King EM Survey AGL Site Tiedman Property Gloucester\ACAD\EM Survey.dwg

Fodder King Limited

EM SURVEY REPORT - 'TIEDMANS', 100 TIEDMANS ROAD, FORBESDALE

FIGURE 3

5.0 Results

5.1 EM Survey

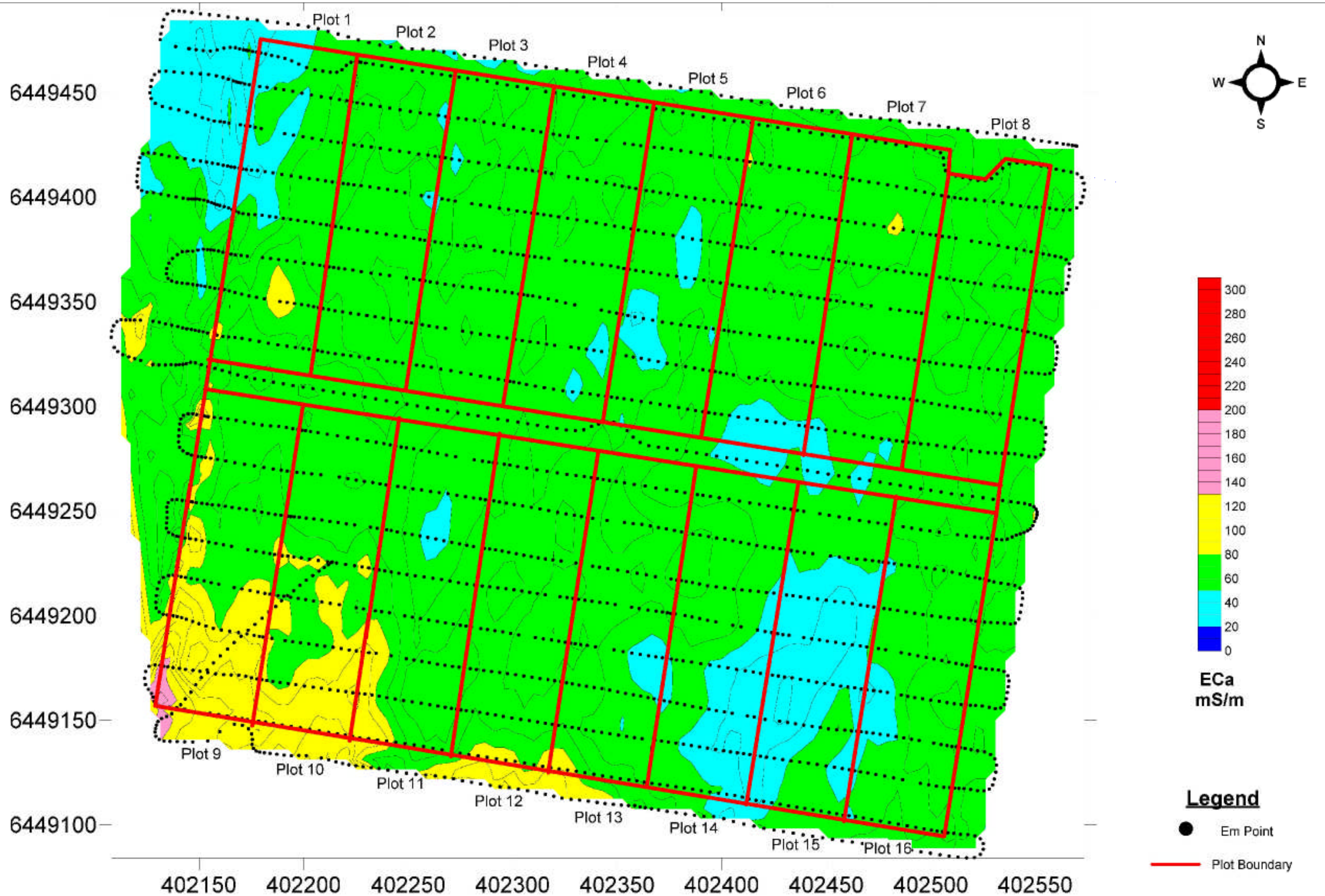
The site was visited on 23rd October 2014 by Mr Paul McCardell of Fodder King, Dr Steven Lucas of The Tom Farrell Institute for the Environment and Mr Jeremy Barr of SMK Consultants Pty Ltd for the purpose of undertaking the required EM survey and necessary soil sampling.

Figure 4 shows the raw EM survey data for the trial site area (Stage 1A). From the raw data, the apparent electrical conductivity (EC_a) generally ranges from 50-80 mS/m over the trial site. There is an area of higher EC_a in the southwest corner of the trial site which was identified previously in the 2011 EM survey. The increase in EC_a values in this area are consistent with this being the low point where any run-off is collected in Catch Dam 2.

The EM survey did not distinguish changes in EC_a between the individual trial plots, or between the 4 different treatment depths in the plots. This is potentially due to the broadscale nature of EM surveys. The EM survey receives an average of the EC_a over the 1.5 m of soil depth, and would not be of high enough resolution to differentiate between the deep and shallow treatments. It is not within the scope of this report to discuss the impacts of the trial soil ameliorations on reducing salinity impacts.

Figure 5 shows the raw EM survey data for the trial site area (Stage 1A) taken in 2011 prior to the trial establishment. In 2011, the raw data ranged from 20-50 mS/m. As previously noted, the area of high EC_a in the southwest corner of the trial area was evident in 2011 prior to the commencement of the trial. The results of the EM survey indicate that the EC_a may have increased over the trial site since 2011.

Figure 6 shows the raw data from the Stage 1B area. The EC_a of the baseline area appears to be lower than the trial plot area. The EC_a ranges between 20-50 mS/m on the eastern side of the area. The western side of the area is slightly higher and ranges between 50-80 mS/m. The higher values on the western side of the baseline site may be due to the slope of the site. The salinity in this area may be due to surface runoff or sub-surface movement of soluble salts.



Imagery and Cadastral Information Supplied by SMK Consultants, NSW Department of Lands, SIX Maps and Google Earth as such ALL Information is (including distances and locations) are APPROXIMATE

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EM 31 Survey - Horizontal Survey
AGL Trial Stage 1A
Gloucester
Surveyed October 2014
By Jeremy Barr

Mitchel Hanlon Consulting Pty Ltd

Fodder King Limited

EM SURVEY REPORT - 'TIEDMANS', 100 TIEDMANS LANE, FORBESDALE

FIGURE 4

Plot Date: 10 December 2014
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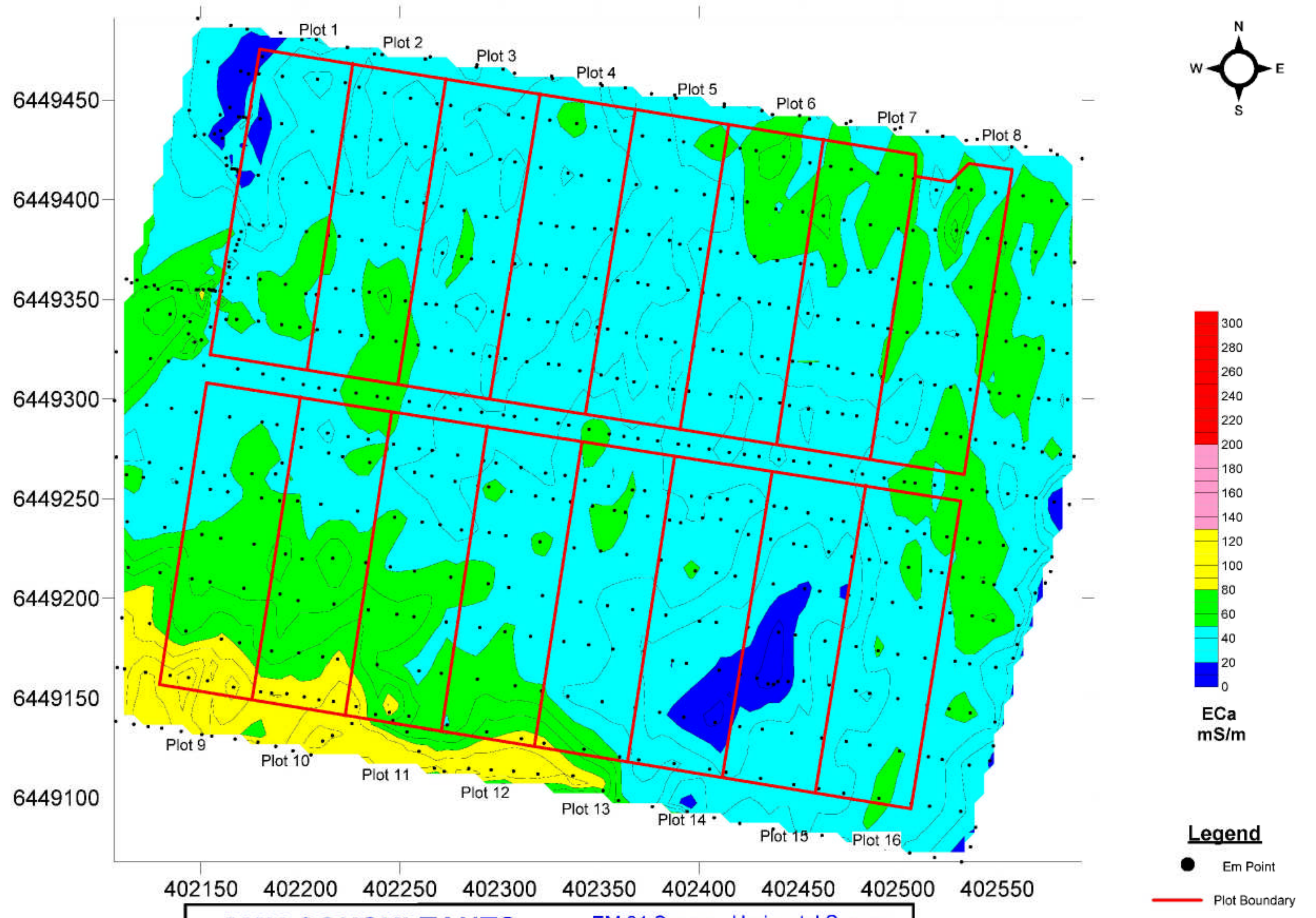

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EM 31 Survey - Horizontal Survey
AGL Trial Stage 1A
Gloucester
Surveyed April 2011
By Jeremy Barr

Mitchel Hanlon Consulting Pty Ltd

Fodder King Limited

EM SURVEY REPORT - 'TIEDMANS', 100 TIEDMANS LANE, FORBESDALE

FIGURE 5

Plot Date: 10 December 2014
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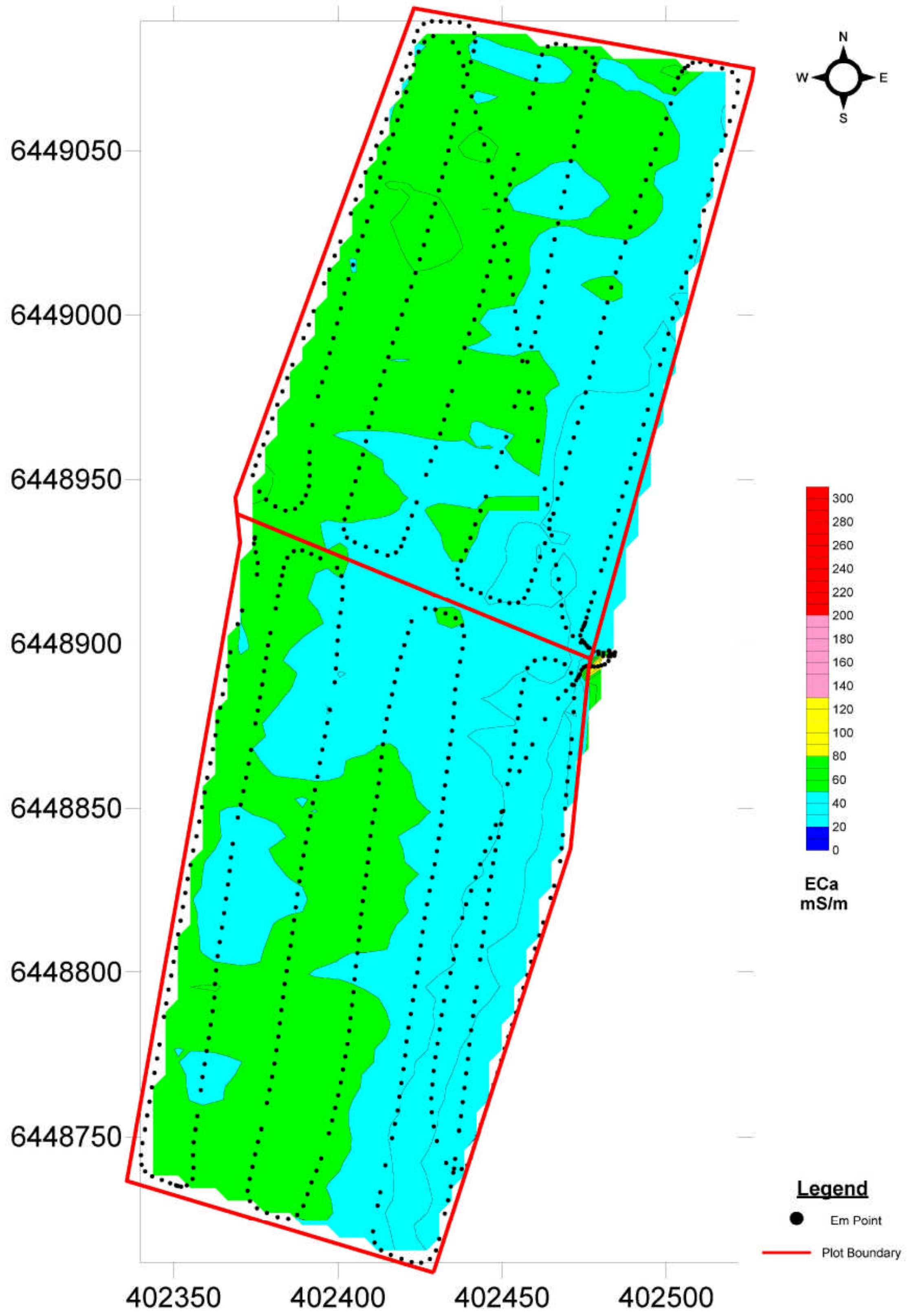

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EM 31 Survey - Horizontal Survey
AGL Trial Stage 1B
Gloucester
Surveyed October 2014
By Jeremy Barr

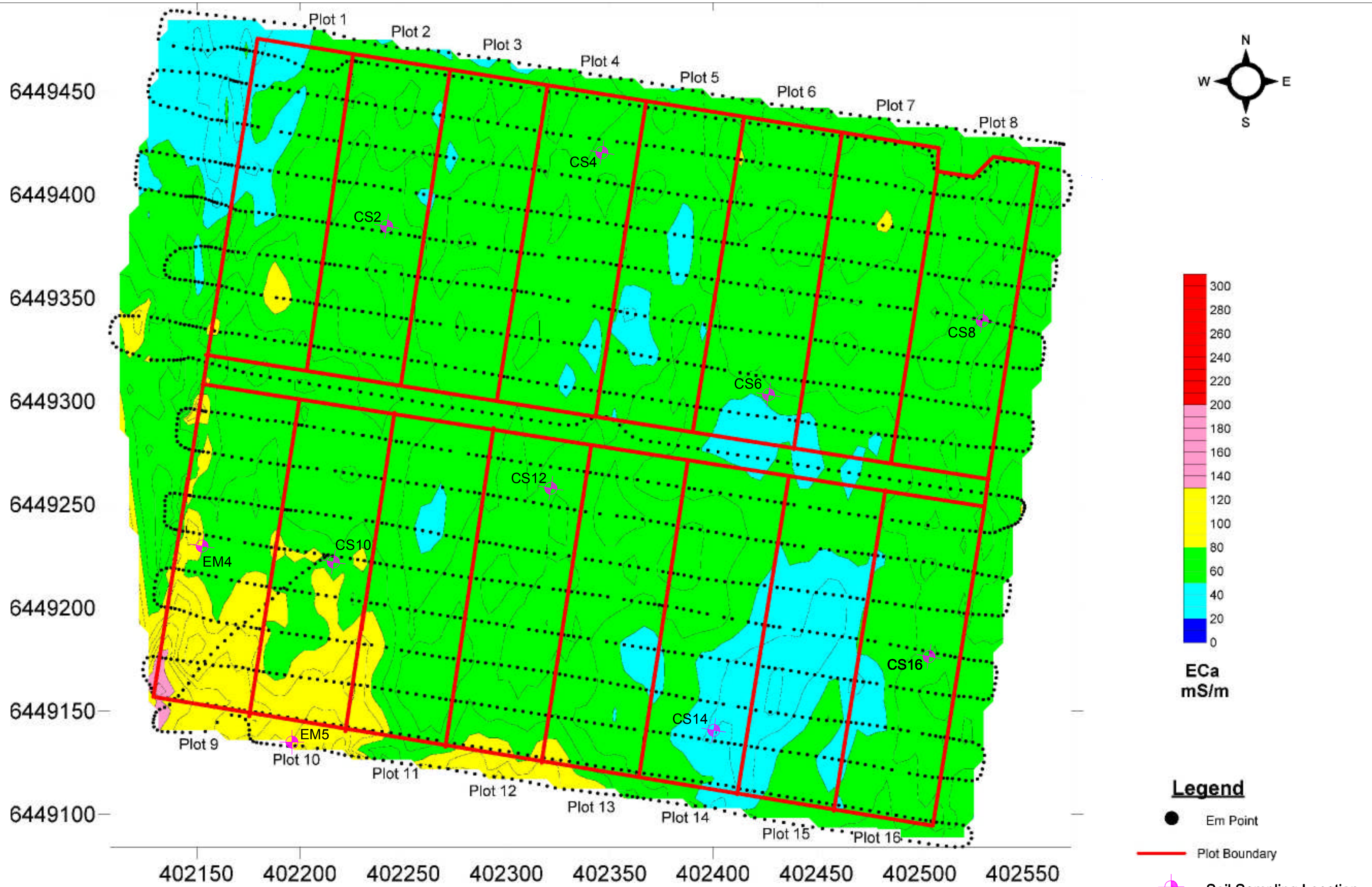
Mitchel Hanlon Consulting Pty Ltd

Plot Date: 10 December 2014
J:\2014\14157 Fodder King EM Survey AGL Site Tiedman Property Gloucester\ACAD\EM Survey.dwg

Fodder King Limited

EM SURVEY REPORT - 'TIEDMANS', 100 TIEDMANS LANE FORBESDALE

FIGURE 6



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EM 31 Survey - Horizontal Survey
AGL Trial Plot Area A
Gloucester
Surveyed October 2014
By Jeremy Barr

Mitchel Hanlon Consulting Pty Ltd

Fodder King Limited

EM SURVEY REPORT - 'TIEDMANS', 100 TIEDMANS ROAD, FORBESDALE

FIGURE 7

Plot Date: 4 December 2014
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5.2 Soil Analysis

5.2.1 Soil Texture

Appendix B provides a copy of the soil test results of the sampling that was undertaken at the time of the EM survey. The soils in the north of the trial plot area generally have a clay loam surface soil texture, with a clay content of approximately 20-30%. The southern part of the trial plot area has surface soils with a sandy clay loam texture, with slightly lower clay content. The clay content across the trial site increases with depth to a medium clay (approximately 40-50% clay content.) Due to the consistency of the sub-surface clay content, it is considered that this soil parameter would not negatively impact the EM survey results.

5.2.2 Soil Moisture

The soil moisture of the trial plot soils was analysed as this parameter can potentially affect the apparent electrical conductivity (EC_a) output of the EM survey.

We note that in the two months prior to the April 2011 EM survey the rainfall for March and April, measured at Gloucester post office, was 242.9mm and exceeded the mean of 204.9mm by around 18%. This would have caused high soil moisture values at the time of sampling.

In contrast, in the 2 months prior to the October 2014 EM survey the rainfall for September and October was 48.0mm and was 59% below the mean of 118.4mm for those two months.

The soil moisture for the October 2014 EM survey ranged from 8.3% to 14.7% in the surface soils (0-20 cm). The soil moisture generally increased with depth, which is relevant to the increasing clay content of the sub-soils. The sub-surface soil moisture ranged from 10.8% to 18.1%. This is also considered to be a low level of soil moisture and is consistent with the low rainfall in the previous two months.

5.2.3 Soil pH

The soil pH in the surface soils ranged from pH 5.59 (moderately acidic) to 7.25 (neutral). The sub-surface soils ranged from pH 4.52 (very strongly acid) to 7.57 (mildly alkaline). The soil pH can have an impact on soil sodicity and increase the availability of exchangeable aluminium that can affect plant growth.

5.2.4 Soil Electrical Conductivity

The soil electrical conductivity (EC) was analysed to provide data to allow for regression analysis of the EM survey raw data. The surface soil EC ranged from 0.10 dS/m (low) to 0.23 dS/m (medium). The subsoil EC ranged from 0.11 dS/m (low) to 0.69 dS/m (high).

It is advised that these soil parameters are compared to the data collected during the trial period to assess any trends and potential impacts of CSG water irrigation.

5.3 Regression Analyses of EM Survey Data

5.3.1 Data Correlation

With any broadscale evaluation of soil parameters, it is useful to assess the EM survey data for its ability to predict the electrical conductivity of the trial site. To assess the correlation between the measured soil data and the EM survey data, a regression analysis was undertaken in Microsoft Excel.

The EM survey data were examined with reference to the measured soil chemical properties. Generally, the highest correlation occurs with salinity and soil moisture. If soil moisture is removed as a component of EC_a, then it can be assumed that the survey data is a suitable prediction of soil electrical conductivity.

The differences in soil moisture from the April 2011 survey to the October 2014 survey are likely to be important, and hence it is beneficial to evaluate the data in relation to soil moisture.

Simple correlation regressions of the soil laboratory data and the EC_a data from the EM survey were undertaken. The higher the R^2 value gained from the regression analysis, the greater the correlation between the data. Where a low R^2 value is obtained (<50%), there is high variation within the data set and low data correlation.

The equation for the regression line [which is usually expressed by the formula Y value = m (slope) x (X axis value) + b (Y intercept)], can be used to develop a predictive model based on the whole EM survey dataset, and maps can be produced showing the distribution of salinity, clay content or other measured soil attributes which have a high correlation with the EM survey data.

5.3.2 Regression Analyses

Figure 8 shows the regression analysis for the whole data set (using an average value from each of the 10 soil profiles obtained) of measured electrical conductivity data (EC_e). The R^2 value of the regression line is very low (0.021). The regression line outlines that there is poor correlation between the EM survey data and the measured EC_e data.

The data set was reviewed and three outlier points were removed from the data set to improve the data correlation. Figure 9 shows the revised data set regression line. The R^2 value increased to 0.63, however this still represents a high variability within the data set.

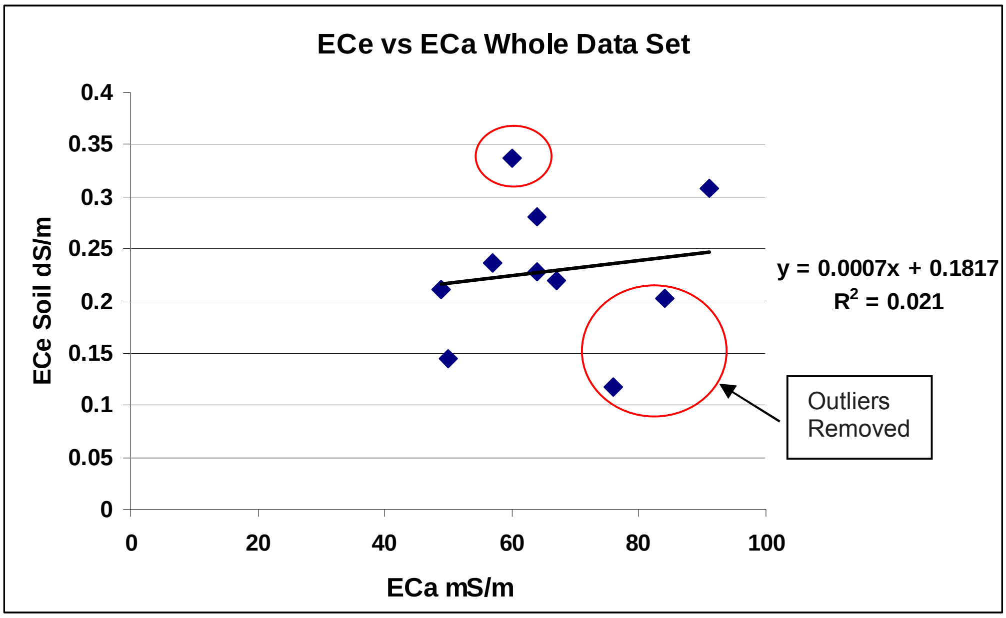

Figure 8: Measured Electrical Conductivity vs EM Survey Electrical Conductivity - Data Regression

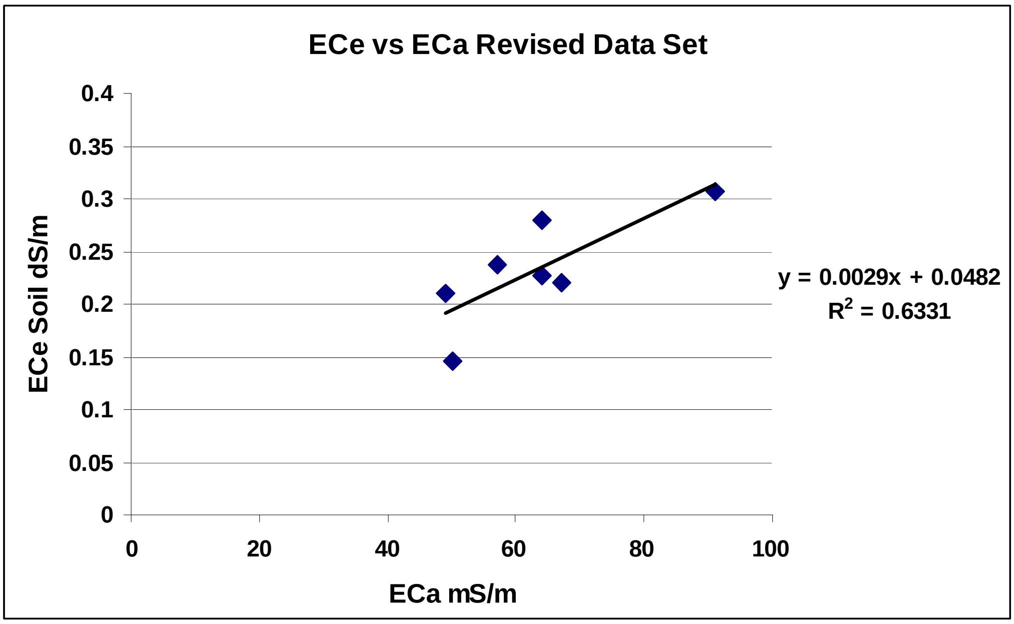

Figure 9: Measured Electrical Conductivity vs EM Survey Electrical Conductivity - Revised Data Set Regression

The measured soil moisture data was analysed with regards to the whole EM survey data set to assess the correlation. Figure 10 shows the correlation between the soil moisture and EM survey electrical conductivity (ECa). The regression shows a low correlation between soil moisture and apparent electrical conductivity. This demonstrates that soil moisture is not an influencing factor on the EM survey data, however, moisture content can influence the results from different EM surveys taken at different times.

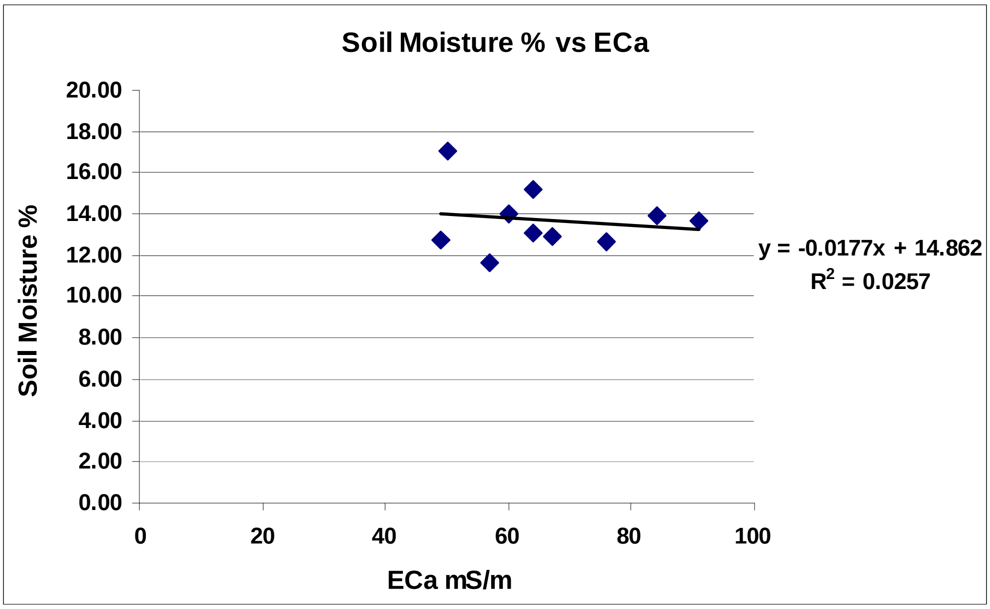

Figure 10: Measured Soil Moisture % vs EM Survey Electrical Conductivity - Whole Data Set Regression

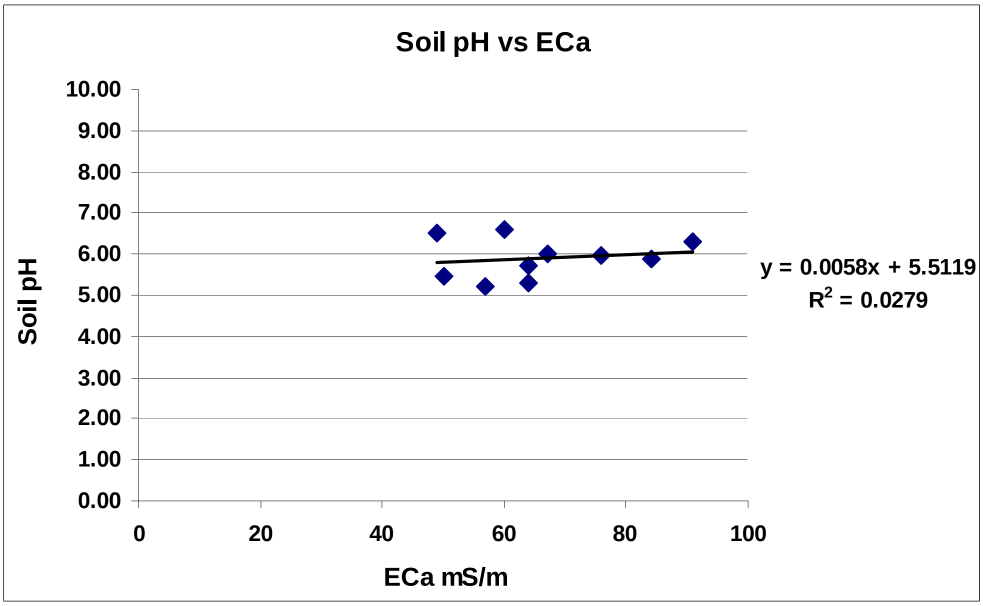

Figure 11: Measured Soil pH vs EM Survey Electrical Conductivity - Whole Data Set Regression

The measured soil pH data was analysed against the whole EM survey data set to assess the correlation. Figure 11 shows the correlation between the soil pH and EM survey electrical conductivity (EC_a). The regression shows a low correlation between soil pH and apparent electrical conductivity. This demonstrates that soil pH is not an influencing factor on the EM survey data.

5.3.3 Assessment of the Regression Results

The regression analysis demonstrated that the EM survey data is not highly correlated with the measured soil chemical data. The R^2 value of 0.63 between the measured electrical conductivity data (EC_e) and the EM survey electrical conductivity data (EC_a) represents that 63% of the soil salinity variability is described by the regression line. This was not seen to be a high enough correlation to undertake further data analysis. The EM survey data may not be strongly correlated enough to be able to predict soil salinity (EC_e) across the trial site.

The low correlation of results is potentially due to the small number of measured samples taken at the time of the EM survey. Ten (10) soil sampling locations were analysed in 2014 compared to 26 locations in 2011. The more sampling locations and subsequent measured data could potentially have improved the data correlation and confirmed that the EM survey is a suitable predictive tool for electrical conductivity assessment at the trial site. However, we note that the 2011 EM Report also encountered some difficulty in establishing an acceptable R^2 value for the larger number of locations.

6.0 Discussion of Data Analyses

From the 2014 EM survey data, the apparent electrical conductivity (EC_a) generally ranges from 50-80 mS/m over the trial site (Stage 1A). In 2011, the raw data ranged from 20-50 mS/m over the trial site. Generally, the EC_a appears to have increased over the trial site since 2011.

The EC_a of the Stage 1B area is generally lower than the Stage 1A area. In contrast, we understand that the calculated sodium concentrations from soil samples are lower in the Stage 1A area and higher in the Stage 1B area. The difference can be explained by the fact that the EM machine records the average of readings to a depth of approximately 1.5 metres whereas the salts in Stage 1B were concentrated in the top 100-200mm. In the Stage 1B area EC_a ranges between 20-50 mS/m on the eastern side. The western side of the Stage 1B area is slightly higher and ranges between 50-80 mS/m.

In Stage 1A the areas of increased EC_a levels in the southwest corner may be due to different soil moisture conditions or surface or sub-surface movement of soluble salts towards the catchment dam. However, we note that the 2011 EM survey had also detected elevated EC_a values in the southwest corner prior to the trial commencement.

There can be no direct salinity correlation between the 2011 survey and the 2014 survey due to the poor correlation of the measured and EM survey data in both years.

It is noted that the relevant mass balances have been provided by Fodder King and are discussed separately in the covering report.

The EM survey did not distinguish changes in EC_a between the individual trial plots, or within the deep ripped and natural areas of the trial plots. This is potentially due to the broadscale nature of EM surveys. It is difficult to discuss the impacts of the trial soil ameliorations on reducing salinity impacts with regards to the EM survey data. However, the measured soil data analysed during the trial period may provide further information on the individual plot trends.

The regression analyses of the whole EM survey data demonstrated that the R^2 value of the regression line is very low (0.021). The regression line indicates that there is poor correlation between the EM survey data and the measured EC_e data.

The data set was reviewed and three outlier points were removed from the measured EC_a data set to improve the data correlation. The R^2 value increased to 0.63, however this still represents a high variability within the data set (63% variability).

Whilst the EM survey data was not highly correlated to the measured data, the raw EM survey data does give a broadscale representation of electrical conductivity variation across the trial site. When compared to the 2011 survey data, there was an apparent increase in the electrical conductivity across the trial plots. It is recommended that the EM survey information is reviewed with regards to the ongoing soil monitoring at the site to confirm any increasing trends in soil salinity.

7.0 Conclusion

Mitchel Hanlon Consulting has been engaged by Fodder King Limited (Fodder King) on behalf of AGL Energy (AGL) to prepare a report compiling the results of an Electromagnetic Induction (EM) Survey, soil sampling and analysis undertaken at 'Tiedmans', Tiedmans Lane, Gloucester, NSW.

The site is identified as Lots 83 – 85 in DP 979859. The site is located approximately 9 kms south of the township of Gloucester.

The natural soils of the trial site are typical to the soil landscapes of the surrounding areas. The soils are dominated by texture contrast soil including Kurosols and Sodosols. These soils are characterised by naturally low fertility, high sodicity, poor drainage and acidic pH. In order to improve the soil capacity for crop production and for coal-seam gas water utilisation, a number of soil ameliorants were used in the trial plots.

The site was visited on 23rd October 2014 by Mr Paul McCardell of Fodder King, Dr Steven Lucas of The Tom Farrell Institute for the Environment and Mr Jeremy Barr of SMK Consultants Pty Ltd for the purpose of undertaking the required EM survey and necessary soil sampling.

The EM survey data was analysed using regression analyses in the Microsoft Excel program. The regression analysis demonstrated that the EM survey data is not highly correlated with the measured soil chemical data. The R^2 value of 0.63 between the measured electrical conductivity data (EC_e) and the EM survey electrical conductivity data (EC_a) represents that there is a 63% of the soil salinity variability is described by the regression line.

The low correlation of results is potentially due to the number of measured samples taken at the time of the EM survey. Ten (10) soil sampling locations were analysed in 2014 compared to 26 locations in 2011. The data correlation may have been improved by analysing the 26 original locations and confirmed that the EM survey is a suitable predictive tool for electrical conductivity assessment at the trial site. However, we note that, with a larger sample size of 26 locations in the 2011 EM survey, the authors experienced similar difficulties in establishing an R^2 value that was well correlated.

If good R^2 correlations can be established, Electromagnetic Induction (EM) surveys can be a cost-effective and rapid method of predicting electrical conductivity over a large area. In view of the variability identified in the two EM surveys it is not possible to make a conclusion as to what extent the ECa values have changed. Nevertheless, it is recommended that a follow up EM survey is conducted at, say 6 or 12 months at a period when prior rainfall conditions are similar to either the 2011 or 2014 survey.

8.0 References

Hazelton, P.A. and Murphy, B.M. (2007), *What Do All the Numbers Mean?, A Guide for the Interpretation of Soil Test Results,* CSIRO Publishing, Collingwood, Victoria;

Henderson, L. (2000) *Soil Landscapes of the Dungog 1:100,000 sheet*, Map and Report, Department of Land and Water Conservation, Sydney, NSW;

McDonald RC, Isbell RF, Speight JG, Walker J, Hopkins MS (1998) *Australian Soil and Land Survey Field Handbook*. (Australian Collaborative Land Evaluation Program: Canberra);

Rayment GE, Lyons DJ (2010) *Soil Chemical Methods – Australasia*, Australian Soil and Land Survey Field Handbook Series, CSIRO Publishing; and

Soilfutures Consulting Pty Ltd (2011), *'Electromagnetic Induction Survey (EM31 Horizontal), Soil Sampling and Analysis for the Tiedman Property, Gloucester'*, Gunnedah, NSW

Appendix A SoilFutures Consulting Pty Ltd – Electromagnetic Induction Survey Report 2011

Mitchel Hanlon Consulting Pty Ltd

Attachment 2.

Electromagnetic Survey and Report

1. **Location and spot levels for EM31 survey**

2. **EM31 survey, soil sampling and analysis**

IMPORTANT NOTES & CAUTIONS :-

1. SURVEY BY SMK MOREE.
2. DATE OF SURVEY: 20-April-2011
3. APPROX MGA & AHD ONLY.

Plot Date: 27 April 2011
J:\2011\11071 Fodder King Limited – Topo Detail Survey Gloucester\SMK\2011-04-21\SMK spot levels.dwg

Rv	DATE	REVISIONS	REC.	APPR.
A	27-04-11	INITIAL ISSUE		

SURVEY: SMK
DESIGN: N/A
DRAWN: SMK & M Hanlon
CHECKED: N/A
SURVEY/DESIGN FILE: n/a

A1

DATUM: approx AHD
ORIGIN:_____ RL:_____
CONTOUR INTERVAL:___m

APPROVED: PROJ.MAN

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Natural Resources
Planning
Surveying
Civil Engineering
Environmental Engineering

CLIENT: FODDER KING
PROJECT: AGL - GLOUCESTER - IRRIGATION TEST PLOT

SMK MOREE
EM SITE SURVEY

DATE: APRIL 2011
DRAWING No.: SHEET 1
Rv. A

SoilFutures Consulting Pty Ltd

ELECTROMAGNETIC INDUCTION SURVEY (EM31 HORIZONTAL), SOIL SAMPLING AND ANALYSIS FOR THE TIEDMAN PROPERTY, GLOUCESTER

Prepared for

FODDER KING LTD

COMMERCIAL IN CONFIDENCE

July 2011

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Disclaimer

The findings and opinions in this report are based on research undertaken by Robert Banks (BSc Hons, Certified Professional Soil Scientist, Dip Bus) of SoilFutures Consulting Pty Ltd, independent consultants, and do not purport to be those of the client.

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1. Introduction

1.1 Background

This report has been prepared in response to a request from Mr Paul McCardell of Fodder King Ltd for an Electromagnetic Induction (EM31 Horizontal mode) Survey, soil sampling, and analysis report for a property called the Tiedman Property at Gloucester, Owned by AGL and used for extraction of coal seam gas (Figure 1).

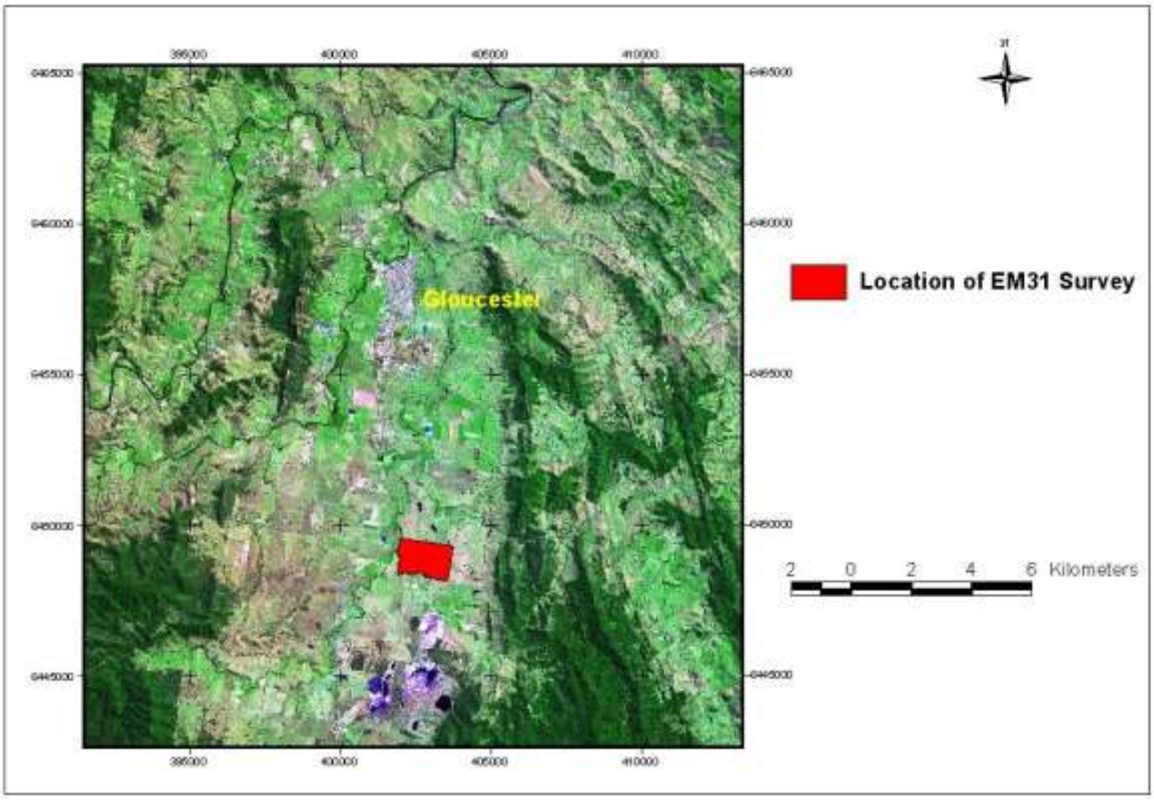

Figure 1: Location of proposed Tiedman property

The area of cleared land surveyed in question has an area of 192 Ha and is to the south of the township of Gloucester.

1.2 Report Objectives

The main objectives of this report are to:

1. Review existing soil and land information available for the site,

2. Conduct an EM31 survey (Horizontal mode) of the site to map the apparent electrical conductivity (EC_a) of soils of the site to an approximate depth of 2 m,

3. Collection of soil samples for laboratory testing and validation of the EM31 survey.

4. Use of the laboratory data in conjunction with the EM31 data and simple correlation regression analysis to assess the spatial extent of soil salinity across the site.

5. Determine the suitability of EM31 technology machine mode for monitoring potential accumulation of salts at an irrigation trial site to be developed by Fodder King.

2. Methods

2.1 Review of Existing Soil and Land Information

The most up to date and detailed broad scale public soil and land information for the site is well covered in Henderson (2000). Soil landscape boundaries are given below in Figure 2.

2.2 Electromagnetic Induction Survey for Salinity Mapping

Much research has been carried out into the use of Electromagnetic Induction (EM) technology for salinity investigation (Dooley *et al*, 2002) and it has been found that other variations including soil depth and textural changes are often determined using EM technology (Hafi *et al*, 2001). Resistive soils have a low Apparent Electrical Conductivity (EC_a), are low in stored salts and often correspond to sand or gravel lenses or bedrock highs in the landscape. High EC_a values generally correspond with high clay content, moisture and salinity. Where this is the case, EM31 is a cost effective way of stratifying soil sampling sites for salinity investigations.

The EM31 machine induces a current in the soil which is measured as a return signal and logged by the machine. The measured current, EC_a, is often proportional to soil texture or soil salinity or soil moisture, or a combination of these attributes. Field testing of soils is required to determine what the EM31 is actually measuring.

An EM31 survey was conducted at the Tiedman property by SMK Pty Ltd, Moree, who provided raw EM31 data for SoilFutures to analyse. In the horizontal mode which was used for this survey, the expected penetration of the EM31 is approximately 2 m.

The area surveyed was 94.1 Ha. A total of 3292 EC_a readings were taken across the site. The raw EM31 data was converted into an image of relative apparent soil conductivity in Arcview (a GIS package) and soil profile description and sampling sites were selected to represent the extremes of the range of EC_a zones within the survey (Figure 3).

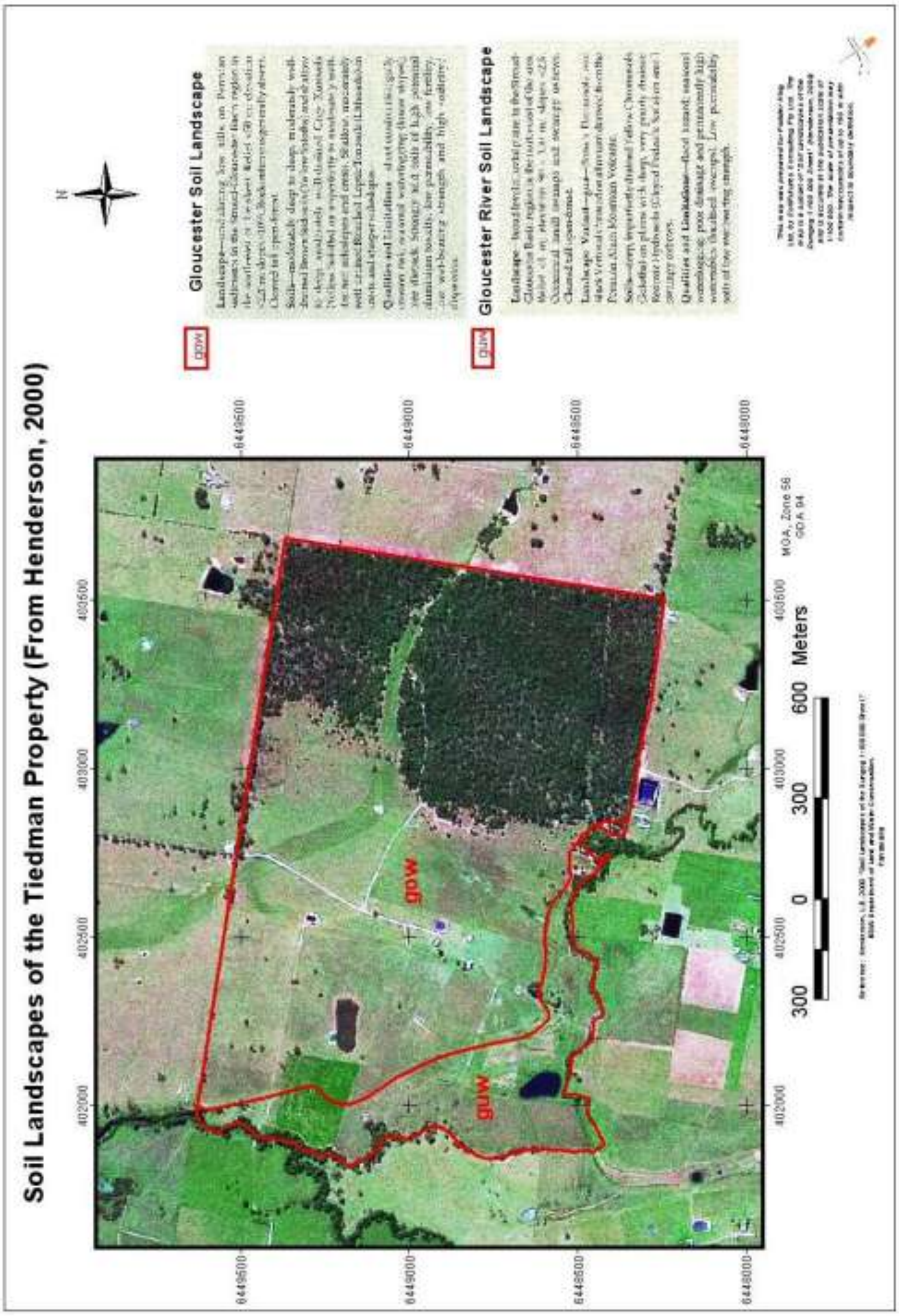

Figure 2: Soil Landscapes of the Tiedman Property, Gloucester

2.3 Soil Sampling for Validation of Electromagnetic Induction Survey

Ten soil profile description and sampling points were located based on the zoning of conductivity measurements (Figure 3). Soil description and sampling points were located within sites reflecting the range from low, medium and high relative EC_a.

Soil cores were taken to 1.5 m depth (within the bulk of the return signal of the EM31 in horizontal mode) and soils described and sampled using NSW Soil Data Cards. Soil descriptions were made according to CSIRO (2009) and soils were classified according to Isbell (2002). Field soil data were entered into SALIS (NSW Office of Environment and Heritage (OEH) soil database) for easy access and manipulation.

For EM31 validation soil samples were taken at each soil profile description site. Sample depths were 0 – 20 cm, 20 – 50 cm, 50 -100 cm, and 100 – 150 cm. Samples were retained for analysis by East West Enviroag Laboratories in Tamworth.

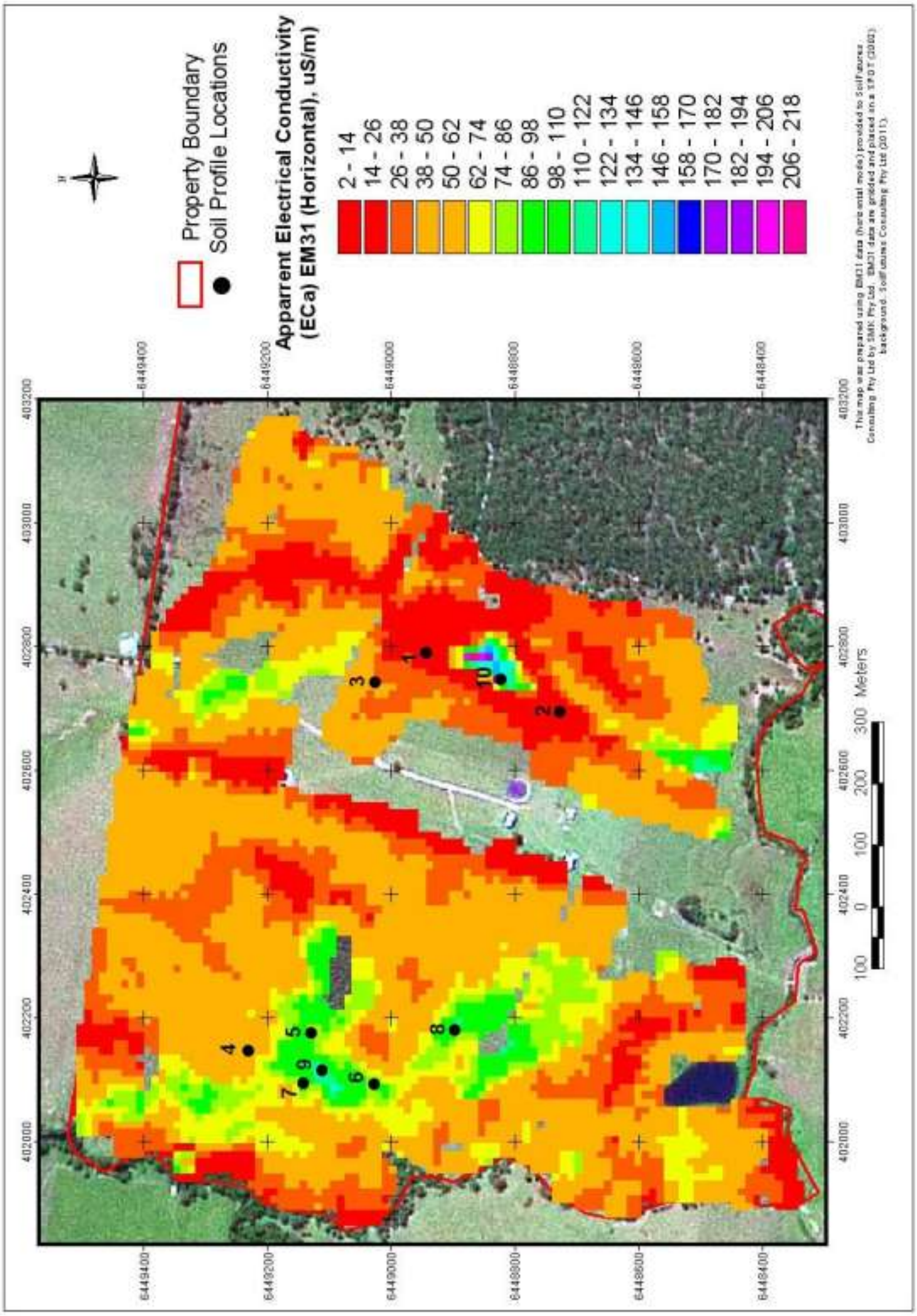

Figure 3: Raw EM31 data for Tiedman Block showing soil profile description and sampling sites

2.4 Soil Laboratory Analyses

Soil samples were analysed at East West Enviroag Laboratory in Tamworth. Soil samples from all soil profiles were tested for Soil Moisture Content, Bulk Density, Organic Carbon (OC), Electrical Conductivity (EC), pH, Emerson aggregate test (EAT), Cation Exchange Capacity (CEC) and exchangeable cations including aluminium.

An additional 16 soil data points measuring the same set of soil parameters down to 1.2 m was provided for EM Validation purposes by SoilFutures Consulting by Fodder King. Sample increments were 0 – 10 cm, 10 – 20 cm, 20 – 30 cm, 30 – 40 cm, 40 – 60 cm, 60 – 80 cm, 80 – 100 cm and 100 – 120 cm. The location of these trial samples is given in Figure 4 below.

East West Enviroag Laboratory in Tamworth is a National Australian Testing Authority (NATA) accredited laboratory for all of the above listed tests and as such meets OEH (EPA) requirements for reporting on suitability for effluent irrigation (EPA, 2004).

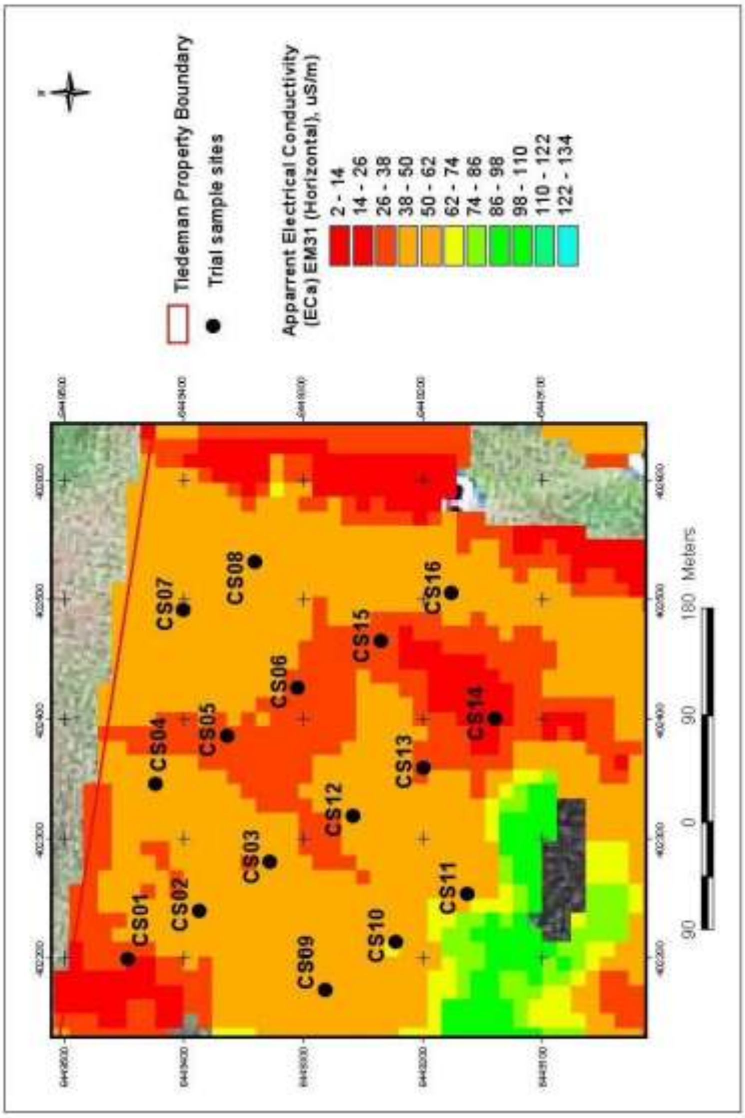

Figure 4: Raw EM31 data for Tiedman Block Trial site soil data points

2.5 Data Correlation

The laboratory data were received by SoilFutures Consulting, and checked for correlation with the EM31 data, with reference to all measured soil physical and chemical properties. Most commonly, the highest correlation occurs with salinity and soil moisture. If soil moisture is eliminated as a component of EC_a, then salinity generally dominates.

Measured soil laboratory data were used to do simple correlation regressions of the soil laboratory data and the EC_a data from the EM31 machine using Microsoft Excels' (MS Excel 2007) regression correlation and multiple regression capabilities. If a reasonable fit is achieved in doing this, then the data can be related back to the EC_a data by a formula. The measure of fit is called the R^2 Value – which shows how well a line fitted to the data describes the variation in the data. An R^2 value of 0.85 means that 85% of the soil salinity variability is described by the fitted line.

If a good fit is achieved, then the equation for the line [which is usually expressed by the formula Y value = m (slope) X (X axis value) + b (Y intercept)], can be used to develop a predictive model based on the whole EM31 dataset, and maps can be produced showing the distribution of salts (expressed as EC, EC_e [a measure of salinity effect on plants] or in Tons/Ha), clays or other measured soil attributes which have a high correlation with the EM31 values. Serial EM31 survey, following irrigation may then to be used to rapidly show changes in salinity if irrigation progresses.

3. Results and Discussion of Results

3.1 Existing Soil and Land Information

Soil Landscape mapping for the area has been carried out by Henderson (2000). The site is split between Gloucester soil landscape and Gloucester River Soil Landscape. Summaries of characteristics of these soil landscapes are given below as described by Henderson (2000)

Gloucester soil landscape is an undulating erosion landscape on Permian Coal measures of the Gloucester coal measures and the Dewrang group. Main parent materials in these groups include sandstone, siltstone, shale and conglomerate, with coal seams generally at depth. Soils are dominated by harsh texture contrast soils including Kurosols, and Sodosols. These soils generally are sodic, and have poor internal drainage, and are often acid, with associated aluminium toxicity.

Gloucester River soil landscape is a stagnant alluvial landscape including broad level plains on quaternary alluvial deposits derived from the surrounding Permian and volcanic bedrocks. Soils are dominated by mottled Chromosols, minor Sodosols and some Hydrosols in areas of permanent waterlogging. This soil landscape tends to have seasonally high water tables and sporadic permanently high water tables (localised swamps) and generally has soils of very poor internal drainage.

3.2 EM31 Survey and Soil Profile Locations

As shown in Figure 3 above, the EM31 survey revealed a range of EC_a from 1 to 220 millisiemens per metre (mS/m) across the site. This range was used to locate soil profile description and sampling pits across the site which represent the full spread of the range of EC_a data from the EM31 machine. The location of each profile description and sampling site chosen is given in Table 1 below.

Table 1: Location of Soil Profile Description Points and assciated EC_a values

Profile Number	Eastings	Northings	EC_a (mS/m)
EM1	402792	6448942	5
EM2	402697	6448726	22
EM3	402745	6449025	39
EM4	402150	6449230	56
EM5	402178	6449128	73
EM6	402096	6449027	90
EM7	402097	6449140	107
EM8	402183	6448896	120
EM9	402117	6449111	140
EM10	402750	6448821	190

3.2.1 Additonal Soil Data Points

Additional soil data points sampled by Fodder King for an irrigation trial were located according to Table 2 below. It should be noted that the data for the trial represent soil values only to 1.2 m and not to 1.5m, and that they are not located with specific reference to the EM31 survey.

Table 2: Location of additional soil data points provided by Fodder King

Core	Eastings	Northings	ECa (mS/m)
CS1	402200	6449446	35
CS2	402241	6449387	42
CS3	402281	6449327	51
CS4	402346	6449423	42
CS5	402386	6449363	26
CS6	402427	6449304	32
CS7	402492	6449399	58
CS8	402532	6449340	39
CS9	402174	6449281	50
CS10	402214	6449222	70
CS11	402255	6449163	43
CS12	402320	6449258	39
CS13	402360	6449199	34
CS14	402401	6449139	6
CS15	402466	6449235	36
CS16	402506	6449175	45

3.3 Field Soil Profile Data and Field Notes

Soils profiles at the site coincided with those described for Gloucester and Gloucester River soil landscapes as described in Henderson (2000). All soils described were harsh duplex soils, but ranging from Red Sodosols on hillcrests, ridges and upper slopes; to Brown and Yellow Sodosols on side slopes and footslopes; with Grey Sodosols dominating lower footslopes and drainage plains. Full soil profile descriptions and photographs are given in Appendix 1.

3.4 Laboratory Test Results and Interpretation

General comments on soil test results for all soil profiles are presented in Table 3 below. Raw laboratory soil data are presented in Appendix 2 with interpretations from Hazelton and Murphy (2007) in Appendix 3.

Table 3: Comments on Soil Tests results

Soil Test	Summary	Action Required
pH (1:5) and pH ($CaCl_2$)	All soil profiles described were neutral to strongly acid at the surface generally becoming more Acid with depth. Exceptions to this were soil profiles 8 and 9 which were in lower slope positions	Liming required for correction of surface soil pH
EC_e (derived from EC1:5)	Topsoils were all non-saline. Subsoils generally become increasingly saline in lower slope locations.	Monitor soil salinity
Bulk Density	Bulk density of all soil layers appeared to be in the moderate to high range with some exceptions for topsoils. Suggestion is that this may be an artefact of the coring method of profile extraction	Use soil pits and bulk density cores in future monitoring to avoid excessive compression of soils
Organic Carbon (C)	Topsoils were all in the moderate to very high range for organic carbon. Organic carbon content drops rapidly to low or very low levels below 20 cm	None
Cation Exchange Capacity (eCEC)	Topsoil CEC was generally low to very low. Deep subsoil CEC tended to be in the moderate range except for Profiles 1 and 10 which were higher up in the landscape and may have had significant mixing of sample mixing with C horizon or saprolite material	None

Table 2 Continued...		
Soil Test	**Summary**	**Action Required**
Exchangeable Potassium (K)	Exchangeable K (physical amount present) is generally low to moderate for all soil materials. As a % of CEC, however K generally in the moderate to high range with the exception of some lower slope subsoils.	May require regular monitoring if harvesting of stem material occurs, which rapidly depletes K
Exchangeable Calcium (Ca)	Exchangeable Ca (physical amount present) is universally low to very low across all soil profiles. As a % of CEC Ca in topsoils is low to moderate generally becoming low to very low in the subsoils.	Liming required to address
Exchangeable Magnesium (Mg)	Exchangeable Mg (physical amount present) is moderate to very high for all soil materials tested. As a % of CEC Mg is very high for all topsoils	May consider liming or gypsum applications as Magnesium can assist soil dispersion
Exchangeable Sodium (Na) And Sodicity	Exchangeable Na (physical amount present) is moderate to high for all topsoils and high to very high in all subsoils. As a % of CEC, all topsoils are classified as sodic except for the upslope profiles 1 and 10. All subsoils tested were sodic or strongly sodic	Ameliorant require correct poor drainage resulting from sodicity. Gypsum or lime will assist
Exchangeable Aluminium (Al)	Exchangeable Al as a % of cation exchange is variable for topsoils, ranging low to moderate and generally In the moderate to high range in deep subsoils.	None
Calcium Magnesium Ratio (Ca/Mg)	Ca is universally low or deficient across the site in all topsoils and subsoils tested.	Application of Lime
Emerson Aggregate Test (Dispersion)	Most topsoil materials are either aggregated or have only slight dispersion, with subsoils generally becoming highly dispersive at some level.	Drainage impedance will need to be corrected

3.5 Analysis of Soil Laboratory data and EM31 (Horizontal) data

As the EM31 (horizontal) data points represent an average apparent electrical conductivity (EC_a) reading for the surface 0 – 2 m, the soil chemistry parameters for the site were converted into averages over the depth of sampling for comparison.

A multiple regression of all measured and averaged soil laboratory parameters was done against EC_a. EC_a regressions against Soil Moisture Content, Bulk Density, Organic Carbon (OC), Electrical Conductivity (EC), Effective Electrical Conductivity (ECe) pH, Emerson aggregate test (EAT), Cation Exchange Capacity (CEC) and individual exchangeable cations had regression correlation R^2 values of less than 0.3, using the EM31 Data Validation set. Figure 5 below shows the regression of EC_a data with EC_e (salinity) data.

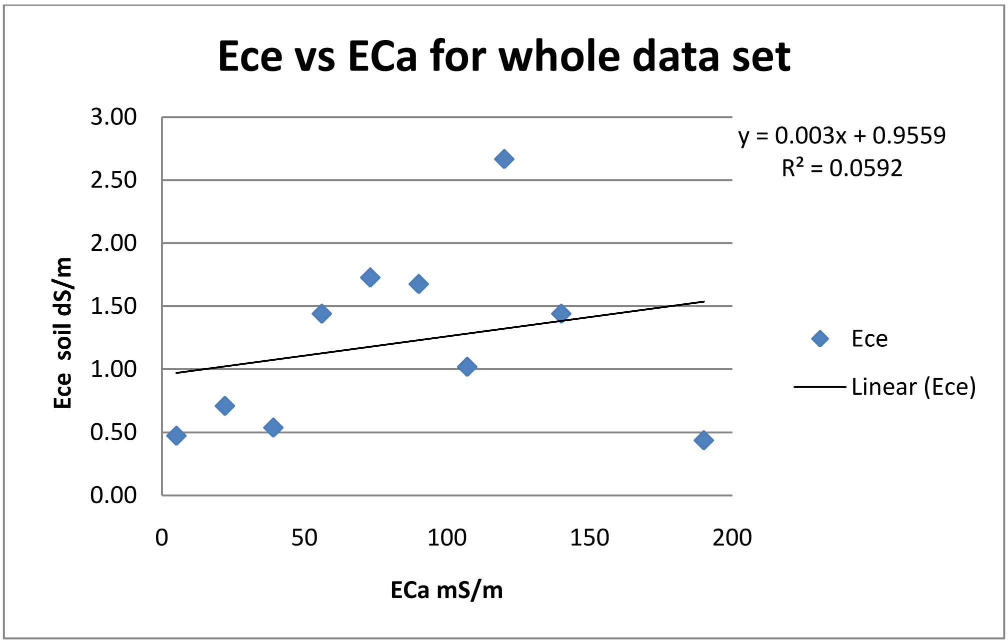

Figure 5: EC_a Data from EM31 (horizontal) regression against EC_e (salinity data)

A further set of multiple regressions was done with the Trial data set achieved the same result, with R^2 values lower than 0.4. Figure 6 below shows the regression of EC_a data with EC_e (salinity) data from the trial data set.

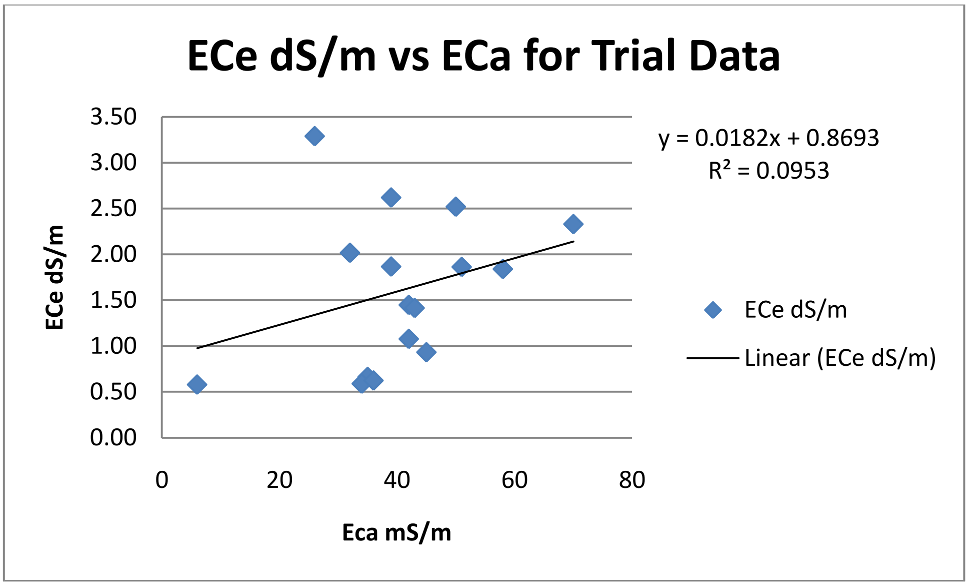

Figure 6: EC_a Data from EM31 (horizontal) regression against EC_e (salinity data) using trial site data

The EM31 (horizontal) data was examined following the above multiple regressions. It was decided to remove all EM31 (horizontal) values for EC_a which were greater than 100mS/m from the analysis and re run single regressions against soil laboratory data. The reason that this was done is that the area of EC_a >100 mS/m was less than 0.5 Ha. The reduced ECa data were considered outliers from the survey as they were only 90 readings above 100 mS/m, representing a very small area of the property. When this was done an R^2 value of 0.83 was achieved as shown in Figure 7 below.

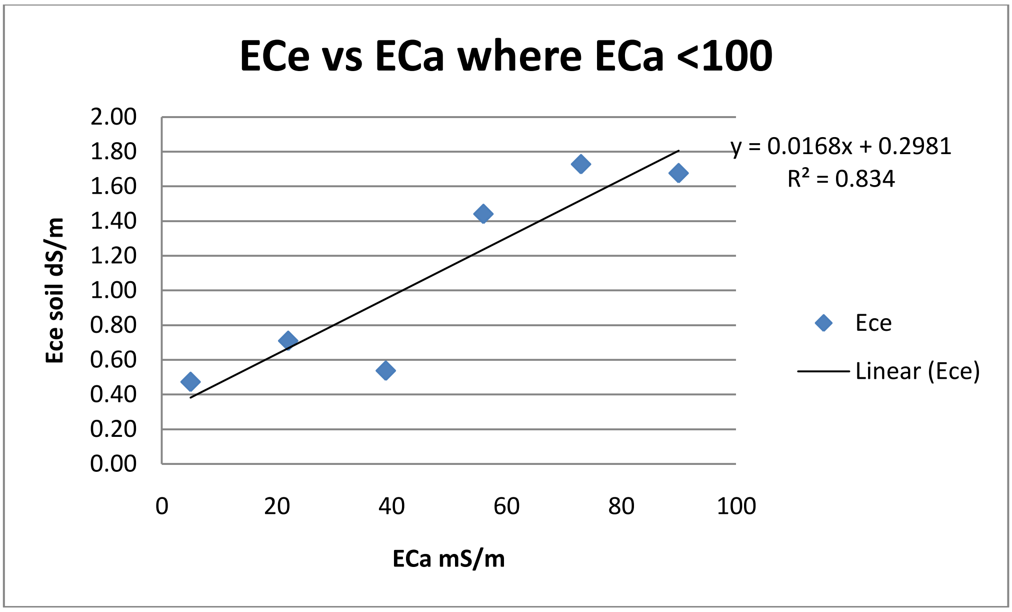

Figure 7: EC_a Data from EM31 (horizontal) regression against EC_e (salinity data) after removing ECa >100 mS/m.

As figure 7 was derived using only 6 data points, it was decided to merge the trial site soil data and the EM31 soil profile data together. To achieve this, all data was averaged for each site and profile to a depth of 1.2 m so that they were comparable. All values regressed against EC_a had R^2 values <0.4. The regression for salinity is shown in Figure 8 below. No improvement in this relationship occurred when EC_a

>100 mS/m was removed from the regression.

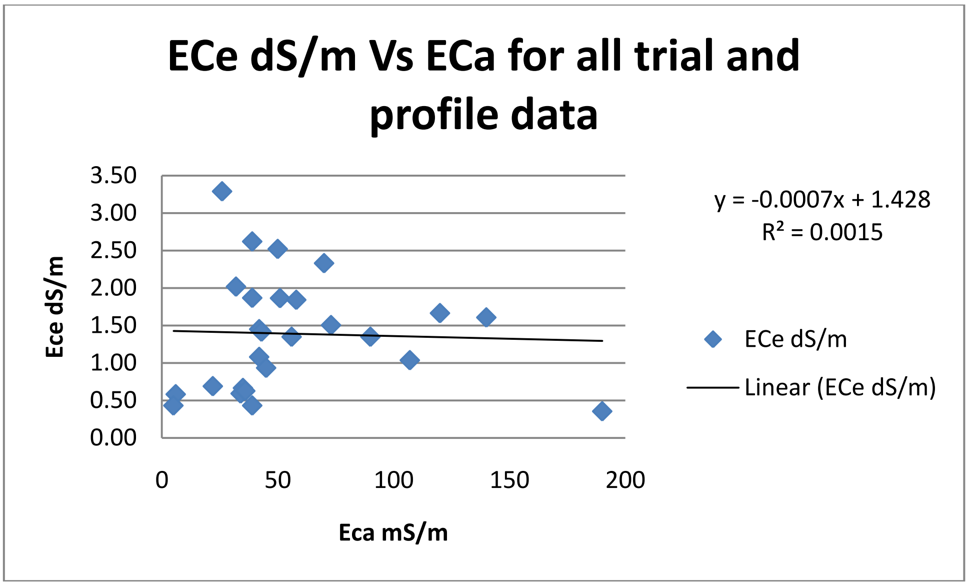

Figure 8: EC_a Data from EM31 (horizontal) regression against EC_e (salinity data) for combined profile and trial data sets

3.6 Use of Correlation Regression to create predicted salinity map.

The correlation regression data shown in Figure 7 were considered significant enough to attempt to convert the EC_a data from the EM31 (horizontal) machine to predicted soil EC_e (salinity) values across the site. As the EC_a data had been trimmed of all data points greater than 100 mS/m, only ECa data less than 100 mS/m were used in this model. The equation of the regression that was used is given below:

Predicted ECe (dS/m) = 0.0168 x ECa (mS/m) + 0.2981

The resulting data was converted into an image as shown in Figure 9 below. The resultant map shows that soil salinity averaged over 1.5 m soil depth should be <2 dS/m across most of the site surveyed.

It should be noted, that if this equation is then to be used as a model for monitoring salinity changes in future, it needs to be validated. Validation of the usefulness of the equation requires that areas of predicted EC_e be checked in the field to ensure that the equation is useful as a predictor of salinity.

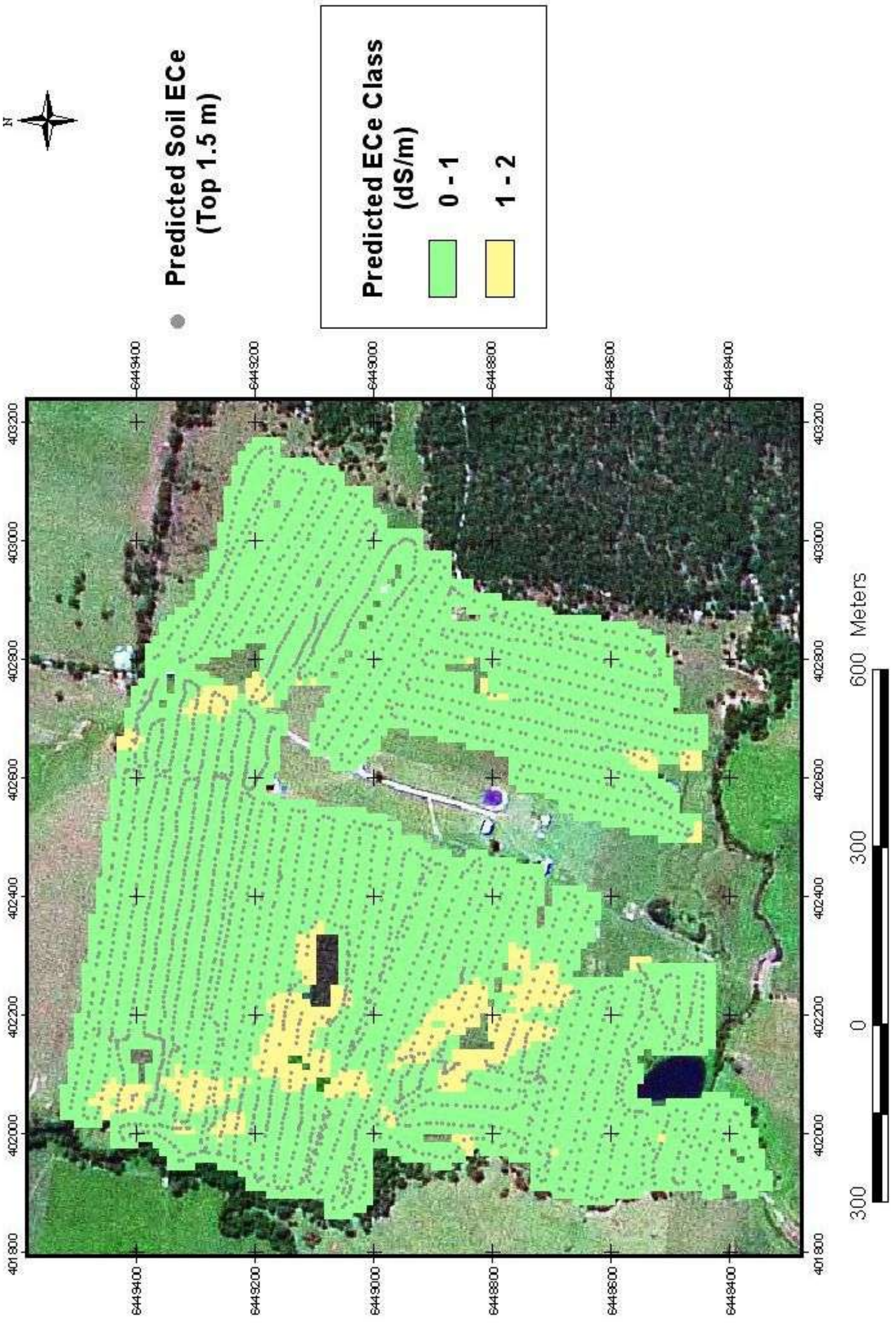

Figure 9: EC_a Data from EM31 (horizontal) regression against EC_e (salinity data) for combined profile and trial data sets

4. Discussion of Data Analysis

Figure 7 shows the only regression where the variation in relationship between the soil EC_e and EC_a data from the EM31 (horizontal) machine is explained by the fitted curve with any degree of predictive confidence. This means that 83.4% of the curve represents actual salinity (EC_e) in areas where EC_a<100mS/m. 6 profile points however is the absolutely minimum number of points to obtain a reasonably significant relationship in a regression correlation analysis. As such a low number of data points were used to construct a model of salinity variation across a site as in Figure 9, validation of the model is required if the equation is to be used in monitoring of salinity levels over time to test its effectiveness. As all other soil laboratory attributes have no clear relationship to $EC_{a,}$ a laboratory validation data set is only required to include Electrical Conductivity (EC) and field texture.

It is significant that there is poor correlation between EC_a and EC_e in areas where EC_a is higher than 100 mS/m. There were only 90 EC_a readings in this category (covering an area of < 0.5 Ha) so these sites were removed from the EC_a dataset and treated as outliers. As soil profile sampling reflected the full spread of the data, the resulting laboratory data appeared to have skewed any possible regression correlation of significance.

The agricultural trial site soil laboratory data was not useful in validating the EM31 survey. It is likely that this is because the agricultural trial was only sampled to 1.2 m rather than 1.5 m where it was assumed that the bulk of the return signal from the EM31 machine was coming from.

An EM31 machine in vertical mode gives a return signal over approximately 4 m depth of soil. In horizontal mode (with the machine turn sideways) the penetration is approximately 2 m. As most of the soils on the site were less than 2 m deep, it is reasonable to assume that the bulk of the return signal (EC_a) is from the 0 – 1.5 m depth range. It is most common for salts to be stored in subsoils so it is important to sample the bulk of the subsoil at any site for EM verification.

It was also observed during the sampling procedure that C horizon material and highly weathered rock was found in the lower depths of many of both the soil profile sites and the agricultural trial sites. The development of accurate lower subsoil EC_e values from these cores may well have been skewed as a result. EC_e is derived from the electrical conductivity of the soil (EC) multiplied by a textural adjustment factor which is low for clay and high for lighter materials as given in Hazelton and Murphy (2007). As much of the C horizon or highly weathered rock materials do not behave in the same way as soil aggregates, it is possible that treating these materials as soil (having soil structures as well as texture) may not be useful.

5. Conclusions and Recommendations

The EM31 (horizontal) survey and associated soil testing reveals that the

Tiedman property is dominated by duplex soils of only low to moderate fertility, with poor internal drainage, and which are dominated by sodic, dispersive subsoils. Problems arose, possibly from the use of the GeoProbe, which may have mixed or compressed wet soils layers through its shaking motion when the jackhammer is turned on. Owing to the wet conditions at the time of the EM verification soil survey, the GeoProbe was the only way in which they could be taken.

By culling data from the EM31 (horizontal) survey of 90 clearly outlying EC_a readings, it was possible to form a correlation regression relationship between soil salinity (expressed as EC_e) and apparent electrical conductivity (EC_a) from the EM31 machine. No other significant relationship existed with other measured soil parameters. This enabled a predictive model to be formed which, on the face of it, has an 83% predictive confidence for salinity. This model is only useful if it can be validated i.e. It has to be used in the field before any soil amelioration or irrigation takes place, to ensure that it does have both predictive capacity, and the capacity to monitor salinity levels when changes occur.

To validate the correlation regression model, it will be necessary to take soil samples as for this project to a depth of 1.5 m in locations of known EC_a with a predicted EC_e value. Soil samples need only be analysed for electrical conductivity (EC) and texture. If the averaged salinity values for each profile fall within the range of predicted salinity, this model will be a highly valuable and cost saving tool for monitoring of any changes under a proposed irrigation scheme where soil salinity values may increase over time.

If the model is verified, then it can be applied to determine spatially, the potential salinity build up in salinity before any irrigation commences. If the model is verified, employing serial EM31 (horizontal) surveys over time will become a cost effective way to measure changes in soil salinity over time. The model must be verified before any irrigation or soil ameliorants are applied, to achieve this aim. Example sampling points for model validation within the trial site area are given in Appendix 4.

6. References

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7. Appendices

Appendix 1: AGL – Tiedman Property – EM31 (Horizontal) Survey, Gloucester (2011)

Soil Profile Descriptions

Site location: Site 1 ECa 5uS/m

Profile details: AGL Tiedman - Gloucester - EM 31 (Hor) (1005257), Profile 1, recorded by Robert Banks on 09 Jun 2011

Map reference: MGA grid reference 402792E, 6448942N, MGA Zone 56; GDA Latitude -32.09164, GDA Longitude 151.96986; Dungog (9233) 1:100,000 map sheet

Terrain: residual crest; part of hillcrest within hills; local relief is low (30-90 m)

Hydrology: profile is imperfectly drained, run-on is none, runoff is moderate

Site condition: expected to be hardsetting when dry, ground cover is 100%

Soil type: Red Sodosol; medium, non gravelly, silty, clayey, moderate, no data available but sufficient knowledge (ASC); Soloth (Solod) (GSG)

Soil description

Layer 1, A1 horizon, 0 - 0.1 m: dark brown (brownish black) (7.5YR 3/2) light silty clay loam with massive structure, earthy fabric; field pH is 6; no layer notes recorded; abrupt (5-20 mm) boundary to...

Layer 2, B2 horizon, 0.1 - 0.9 m: yellowish red (bright reddish brown) (5YR 5/6) light clay with moderate pedality (sub-angular blocky, 20 - 50 mm), rough-faced peds; field pH is 6; no layer notes recorded; no boundary details recorded...

Layer 3, BCm horizon, 0.9 - 1.5 m: white (light grey) (5YR 8/1) clay with moderate pedality (sub-angular blocky, 20 - 50 mm), rough-faced peds; field pH is 6; no layer notes recorded; soil continues...

Site location: Site 2 ECa = 22uS/m

Profile details: AGL Tiedman - Gloucester - EM 31 (Hor) (1005257), Profile 2, recorded by Robert Banks on 09 Jun 2011

Map reference: MGA grid reference 402697E, 6448725N, MGA Zone 56; GDA Latitude - 32.09359, GDA Longitude 151.96883; Dungog (9233) 1:100,000 map sheet

Terrain: waning lower slope; part of drainage depression within hills; local relief is low (30-90 m), slope is 2% (measured)

Hydrology: profile is poorly drained, run-on is

Land use: used for improved pasture, with improved pasture in general area

Site condition: expected to be hardsetting when dry, ground cover is 100%

Soil type: Brown Sodosol; medium, non gravelly, silty, clayey, very deep, sufficient data available (ASC); Soloth (Solod) (GSG)

Soil description

Layer 1, A1 horizon, 0 - 0.15 m: dark reddish brown (5YR 3/2) silty clay loam; field pH is 6; no layer notes recorded; clear (20-50 mm) boundary to...

Layer 2, A2e horizon, 0.15 - 0.25 m: dark reddish grey (greyish brown) (5YR 4/2) silty clay loam; field pH is 6; no layer notes recorded; abrupt (5-20 mm) boundary to...

Layer 3, B2 horizon, 0.25 - 0.95 m: yellowish brown (dull yellowish brown) (10YR 5/4) light clay with moderate pedality (angular blocky, 20 - 50 mm), rough-faced peds; field pH is 6; no layer notes recorded; gradual (50-100 mm) boundary to...

Layer 4, BC horizon, 0.95 - 1.5 m: very pale brown (light yellow orange) (10YR 8/3) light clay with weak pedality, rough-faced peds; field pH is 6; no layer notes recorded; soil continues...

Site location: Site 3 ECa = 39uS/m

Profile details: AGL Tiedman - Gloucester - EM 31 (Hor) (1005257), Profile 3, recorded by Robert Banks on 09 Jun 2011

Map reference

MGA grid reference 402745E, 6449025N, MGA Zone 56; GDA Latitude -32.09089, GDA Longitude 151.96937; Dungog (9233) 1:100,000 map sheet

Terrain: residual upper slope; part of hillslope within hills; local relief is low (30-90 m), slope is 3% (measured)

Hydrology: profile is imperfectly drained, run-on is low, runoff is moderate

Site condition: expected to be hardsetting when dry, ground cover is 100%

Soil type: Red Sodosol; (ASC); Soloth (Solod) (GSG)

Soil description

Layer 1, A horizon, 0 - 0.25 m: silty clay loam with moderate pedality (sub-angular blocky, 5 - 10 mm), rough-faced peds; field pH is 6.5; no layer notes recorded; no boundary details recorded...

Layer 2, A2 horizon, 0.25 - 0.4 m: silty clay loam with moderate pedality (sub-angular blocky, 5 - 10 mm), rough-faced peds; field pH is 6; no layer notes recorded; no boundary details recorded...

Layer 3, B horizon, 0.4 - 0.6 m: light clay; field pH is 6; no layer notes recorded; no boundary details recorded...

Layer 4, B horizon, 0.6 - 0.8 m: silty clay loam; field pH is 6; no layer notes recorded; no boundary details recorded...

Layer 5, BC horizon, 0.8 - 1.1 m: light clay; field pH is 6; no layer notes recorded; no boundary details recorded...

Layer 6, C horizon, 1.1 - 1.3 m: no soil texture recorded ; no layer notes recorded; soil continues...

Site location: Site 4 ECa = 56uS/m

Profile details: AGL Tiedman - Gloucester - EM 31 (Hor) (1005257), Profile 4, recorded by Robert Banks on 09 Jun 2011

Map reference: MGA grid reference 402150E, 6449230N, MGA Zone 56; GDA Latitude -32.08899, GDA Longitude 151.96308; Dungog (9233) 1:100,000 map sheet

Terrain: transportational minimal mid-slope; part of hillslope within low hills; local relief is low (30-90 m)

Site condition: expected to be hardsetting when dry, ground cover is 100%

Soil type: Yellow Sodosol; medium, non gravelly, silty, clayey, deep, sufficient data available (ASC); Soloth (Solod) (GSG)

Soil description

Layer 1, A1 horizon, 0 - 0.2 m: very dark brown (brownish black) (10YR 2/2) silty loam with massive structure, earthy fabric; field pH is 5.5; no layer notes recorded; clear (20-50 mm) boundary to...

Layer 2, A2e horizon, 0.2 - 0.3 m: greyish brown (greyish yellow brown) (10YR 5/2) silty loam with massive structure, earthy fabric; field pH is 5.5; no layer notes recorded; abrupt (5-20 mm) boundary to...

Layer 3, B2 horizon, 0.3 - 0.5 m: olive yellow (bright yellowish brown) (2.5Y 6/6) light clay with moderate pedality (angular blocky), rough-faced peds; field pH is 6.5; no layer notes recorded; gradual (50-100 mm) boundary to...

Layer 4, BC horizon, 0.5 - 1 m: pale yellow (light grey) (2.5Y 8/2) sandy clay with massive structure, earthy fabric; field pH is 7; no layer notes recorded; directly overlies bedrock

Site location: Site 5 ECa = 73uS/m

Profile details: AGL Tiedman - Gloucester - EM 31 (Hor) (1005257), Profile 5, recorded by Robert Banks on 09 Jun 2011

Map reference: MGA grid reference 402178E, 6449128N, MGA Zone 56; GDA Latitude -32.08991, GDA Longitude 151.96337; Dungog (9233) 1:100,000 map sheet

Terrain: depositional waning open depression; part of drainage depression within low hills; slope is 2% (measured)

Soil type

? ? Brown Sodosol; medium, non gravelly, silty, clayey, very deep, sufficient data available (ASC); Soloth (Solod) (GSG)

Soil description

Layer 1, 4A1 horizon, 0 - 0.15 m: dark greyish brown (greyish yellow brown) (10YR 4/2) silty loam with massive structure, earthy fabric; field pH is 6; no layer notes recorded; abrupt (5-20 mm) boundary to...

Layer 2, B2 horizon, 0.15 - 0.6 m: brown (dull yellowish brown) (10YR 5/3) light clay with moderate pedality (angular blocky), rough-faced peds; field pH is 5.5; no layer notes recorded; clear (20-50 mm) boundary to...

Layer 3, B22 horizon, 0.6 - 1.5 m: brown (dull yellowish brown) (10YR 5/3) light medium clay with moderate pedality (angular blocky), rough-faced peds; field pH is 8; no layer notes recorded; soil continues...

No Photograph Available

Site location: Site 6 ECa = 90uS/m

Profile details: AGL Tiedman - Gloucester - EM 31 (Hor) (1005257), Profile 6, recorded by Robert Banks on 09 Jun 2011

Map reference: MGA grid reference 402096E, 6449027N, MGA Zone 56; GDA Latitude -32.09082, GDA Longitude 151.96249; Dungog (9233) 1:100,000 map sheet

Terrain: transportational waning lower slope; part of hillslope within low hills; local relief is low (30-90 m)

Land use: used for improved pasture, with improved pasture in general area

Soil type: Grey Sodosol; medium, non gravelly, clay loamy, clayey, moderate, sufficient data available (ASC); Soloth (Solod) (GSG)

Soil description

Layer 1, A1 horizon, 0 - 0.2 m: brown (7.5YR 4/3) fine clay loam sandy with massive structure, earthy fabric; field pH is 6; no layer notes recorded; clear (20-50 mm) boundary to...

Layer 2, B2 horizon, 0.2 - 0.7 m: yellowish brown (dull yellowish brown) (10YR 5/4) light clay with moderate pedality (angular blocky), smooth-faced peds; field pH is 6; no layer notes recorded; gradual (50-100 mm) boundary to...

Layer 3, C horizon, 0.7 - 1.5 m: very pale brown (light grey) (10YR 8/2) no soil texture recorded ; field pH is 5.5; no layer notes recorded; no boundary details recorded...

Site location: Site 7 ECa = 107uS/m

Profile details: AGL Tiedman - Gloucester - EM 31 (Hor) (1005257), Profile 7, recorded by Robert Banks on 09 Jun 2011

Map reference: MGA grid reference 402097E, 6449140N, MGA Zone 56; GDA Latitude -32.0898, GDA Longitude 151.96251; Dungog (9233) 1:100,000 map sheet

Terrain: depositional waning lower slope; part of footslope within low hills; local relief is low (30-90 m), slope is 1% (measured)

Soil type: Grey Sodosol; medium, non gravelly, silty, clayey, very deep, sufficient data available (ASC); Soloth (Solod) (GSG)

Soil description

Layer 1, A horizon, 0 - 0.2 m: brown (dull yellowish brown) (10YR 4/3) silty clay loam with massive structure, earthy fabric; field pH is 6.5; no layer notes recorded; no boundary details recorded...

Layer 2, B2 horizon, 0.2 - 0.7 m: dark greyish brown (greyish yellow brown) (10YR 4/2) light clay with moderate pedality (angular blocky, 20 - 50 mm), rough-faced peds; field pH is 5.5; no layer notes recorded; no boundary details recorded...

Layer 3, B22 horizon, 0.7 - 1.5 m: light brownish grey (greyish yellow brown) (10YR 6/2) light medium clay with moderate pedality (angular blocky, 20 - 50 mm), rough-faced peds; field pH is 8; no layer notes recorded; soil continues...

Site location: Site 8 ECa = 120uS/m

Profile details: AGL Tiedman - Gloucester - EM 31 (Hor) (1005257), Profile 8, recorded by Robert Banks on 09 Jun 2011

Map reference: MGA grid reference 402183E, 6448896N, MGA Zone 56; GDA Latitude -32.09201, GDA Longitude 151.9634; Dungog (9233) 1:100,000 map sheet

Terrain: waning lower slope; part of footslope within low hills; local relief is low (30-90 m), slope is 1% (measured)

Hydrology: profile is poorly drained, run-on is high

Land use: used for improved pasture, with improved pasture in general area

Site condition: expected to be hardsetting when dry, ground cover is 100%

Soil type: Yellow Sodosol; medium, non gravelly, silty, clayey, deep, sufficient data available (ASC); Soloth (Solod) (GSG)

Soil description

Layer 1, 4A horizon, 0 - 0.2 m: dark reddish grey (greyish brown) (5YR 4/2) silty clay loam; field pH is 6; no layer notes recorded; clear (20-50 mm) boundary to...

Layer 2, B2 horizon, 0.2 - 0.8 m: olive yellow (bright yellowish brown) (2.5Y 6/6) light clay; field pH is 7; no layer notes recorded; diffuse (>100 mm) boundary to...

Layer 3, BC horizon, 0.8 - 1.5 m: light yellowish brown (dull yellow) (2.5Y 6/3) light clay; field pH is 8.5; no layer notes recorded; soil continues...

Site location: Site 9 ECa = 140uS/m

Profile details: AGL Tiedman - Gloucester - EM 31 (Hor) (1005257), Profile 9, recorded by Robert Banks on 09 Jun 2011

Map reference: MGA grid reference 402117E, 6448821N, MGA Zone 56; GDA Latitude -32.09268, GDA Longitude 151.96269; Dungog (9233) 1:100,000 map sheet

Terrain: open depression; part of footslope within low hills; local relief is low (30-90 m),

Soil type: Grey Sodosol; medium, non gravelly, silty, clayey, very deep, sufficient data available (ASC); Soloth (Solod) (GSG)

Soil description

<u>Layer 1, A horizon, 0 - 0.2 m:</u> dark yellowish brown (brown) (10YR 4/4) silty clay loam with massive structure, earthy fabric; field pH is 6.5; no layer notes recorded; no boundary details recorded...

<u>Layer 2, B2 horizon, 0.2 - 1 m:</u> greyish brown (greyish yellow brown) (10YR 5/2) light clay with moderate pedality (angular blocky, 20 - 50 mm), rough-faced peds; field pH is 6.5; no layer notes recorded; no boundary details recorded...

<u>Layer 3, BC horizon, 1 - 1.5 m:</u> grey (brownish grey) (10YR 6/1) light clay with moderate pedality (angular blocky, 20 - 50 mm), rough-faced peds; field pH is 7.5; no layer notes recorded; no boundary details recorded...

Site location: Site 10 ECa = 190uS/m

Profile details: AGL Tiedman - Gloucester - EM 31 (Hor) (1005257), Profile 10, recorded by Robert Banks on 09 Jun 2011

Map reference:; MGA grid reference 402750E, 6448821N, MGA Zone 56; GDA Latitude -32.09273, GDA Longitude 151.9694; Dungog (9233) 1:100,000 map sheet

Terrain: upper slope; part of hillslope within low hills; local relief is low (30-90 m), slope is 6% (measured)

Site condition: expected to be hardsetting when dry, ground cover is 100%

Soil type: Humose Red Sodosol; medium, non gravelly, silty, clayey, very deep, sufficient data available (ASC); Soloth (Solod) (GSG)

Soil description

Layer 1, A1 horizon, 0 - 0.2 m: dark reddish brown (5YR 3/2) silty clay loam with massive structure, earthy fabric; field pH is 6; no layer notes recorded; clear (20-50 mm) boundary to...

Layer 2, A2e horizon, 0.2 - 0.4 m: reddish brown (dull reddish brown) (5YR 4/3) silty loam with massive structure, earthy fabric; field pH is 6; no layer notes recorded; clear (20-50 mm) boundary to...

Layer 3, B2 horizon, 0.4 - 1 m: yellowish red (bright reddish brown) (5YR 5/8) light clay with strong pedality (angular blocky, 10 - 20 mm), rough-faced peds; field pH is 6; no layer notes recorded; gradual (50-100 mm) boundary to...

Layer 4, BC horizon, 1 - 1.3 m: black (5YR 2.5/1) light clay with moderate pedality (angular blocky, 20 - 50 mm), rough-faced peds; field pH is 6; no layer notes recorded; diffuse (>100 mm) boundary to...

Layer 5, C horizon, 1.3 - 1.5 m: light grey (light brownish grey) (5YR 7/1) light clay; field pH is 5.5; no layer notes recorded; soil continues...

Appendix 2: Soil Laboratory Data

Appendix 2: Soil Laboratory Data - Tiedman EM31 (Horizontal) Survey

Profile Number	Sample Depths	Electrical Conductivity	Texture Modifier	Ece	pH (H2O)	pH (CaCl_2)	Organic carbon	Moisture % Gravimetric	Bulk Density	Potassium Ex	Calcium Ex	Magnesium Ex me/100g	Sodium Ex me/100g	Aluminium Ex me/100g	Ex Potassium % me/100g	Ex Calcium %	Ex Magnesium %	Ex Sodium %	Ex Aluminium %	ECEC me/100g	Ca	EAT
EM1	0-20cm	0.05	8.60	0.43	5.12	4.35	3.29	25.3	1.13	0.71	4.26	4.83	0.53	0.35	6.67	39.9	45.2	4.96	3.27	10.7	0.88	8
EM1	20-50cm	0.03	8.60	0.26	5.26	4.09	0.75	20.0	1.70	0.30	1.28	5.75	0.49	0.94	3.46	14.6	65.7	5.56	10.7	8.76	0.22	5
EM1	50-100cm	0.07	8.60	0.60	4.96	3.82	0.45	21.6	1.81	0.31	0.21	4.68	0.65	2.10	3.93	2.6	58.9	8.20	26.4	7.95	0.04	3b
EM1	100-150cm	0.07	8.60	0.60	5.07	3.86	0.28	16.0	1.88	0.33	0.22	5.78	0.90	1.96	3.63	2.4	62.9	9.80	21.3	9.19	0.04	3b
em1	Profile Average	0.06	8.60	0.47	5.10	4.03	1.19	20.73	1.63	0.42	1.49	5.26	0.64	1.34	4.42	14.87	58.16	7.13	15.41	9.15	0.30	
EM2	0-20cm	0.03	8.60	0.26	5.32	4.45	1.31	20.3	1.47	0.21	1.78	1.39	0.33	0.22	5.39	45.1	35.4	8.39	5.71	3.93	1.28	3b
EM2	20-50cm	0.08	8.60	0.69	5.26	4.10	0.85	24.9	1.76	0.46	0.89	7.87	1.17	0.92	4.08	7.87	69.5	10.3	8.17	11.3	0.11	3b
EM2	50-100cm	0.13	8.60	1.12	5.18	4.07	0.71	19.9	1.89	0.29	1.03	8.44	1.34	1.05	2.40	8.47	69.4	11.0	8.67	12.2	0.12	2
EM2	100-150cm	0.09	8.60	0.77	5.17	3.98	0.45	20.1	1.86	0.39	0.35	7.19	1.18	1.29	3.72	3.39	69.2	11.3	12.4	10.4	0.05	2
em2	Profile Average	0.08	8.60	0.71	5.23	4.15	0.83	21.30	1.74	0.34	1.01	6.22	1.01	0.87	3.90	16.21	60.88	10.28	8.74	9.45	0.39	
EM3	0-	0.04	8.60	0.	5.5	4.52	2.62	19.4	1.14	0.75	3.51	5.68	0.44	0.18	7.14	33.2	53.8	4.16	1.71	10.6	0.	8

	20cm			34	0																62	
EM3	20-50cm	0.03	8.60	0.26	5.63	4.36	1.61	16.2	1.61	0.37	2.03	7.94	0.53	0.33	3.30	18.1	70.9	4.74	2.96	11.2	0.25	8
EM3	50-100cm	0.08	8.60	0.69	5.31	4.14	0.89	20.3	1.67	0.35	0.83	10.2	1.03	0.78	2.65	6.27	77.4	7.80	5.91	13.2	0.08	3b
EM3	100-150cm	0.10	8.60	0.86	5.33	4.16	0.43	15.4	1.02	0.42	0.59	11.6	1.37	0.72	2.83	3.98	79.0	9.33	4.87	14.7	0.05	3b
em3	Profile Average	0.06	8.60	0.54	5.44	4.30	1.39	17.83	1.36	0.47	1.74	8.85	0.84	0.50	3.98	15.38	70.27	6.51	3.86	12.40	0.25	
EM4	0-20cm	0.08	8.60	0.69	5.04	4.36	2.07	21.9	1.61	0.35	3.38	5.01	0.46	0.34	3.66	35.4	52.5	4.83	3.59	9.54	0.67	7
EM4	20-50cm	0.13	8.60	1.12	5.36	4.26	0.78	19.3	1.96	0.33	1.60	11.1	1.16	0.50	2.23	10.9	75.5	7.91	3.40	14.6	0.14	2
EM4	50-100cm	0.26	8.60	2.24	5.87	5.00	0.47	11.0	1.76	0.41	0.77	12.4	1.99	0.03	2.62	4.89	79.6	12.7	0.18	15.6	0.06	3b
EM4	100-150cm	0.20	8.60	1.72	6.44	5.87	0.34	6.2	2.11	0.19	0.48	11.0	2.05	0.00	1.36	3.50	80.2	14.9	0.03	13.7	0.04	7
em4	Profile Average	0.17	8.60	1.44	5.68	4.87	0.92	14.60	1.86	0.32	1.56	9.88	1.41	0.22	2.47	13.69	71.95	10.10	1.80	13.38	0.23	
EM5	0-20cm	0.20	8.60	1.72	4.84	4.30	1.66	21.8	1.49	0.30	1.51	2.83	0.37	0.41	5.50	27.8	52.2	6.85	7.60	5.41	0.53	3b
EM5	20-50cm	0.08	8.60	0.69	5.47	4.14	0.64	13.4	1.99	0.27	0.68	6.69	1.01	0.84	2.87	7.12	70.5	10.6	8.84	9.49	0.10	1
EM5	50-100cm	0.28	7.50	2.10	5.36	4.36	0.54	15.5	2.01	0.30	0.69	8.27	2.14	0.34	2.58	5.88	70.4	18.2	2.91	11.7	0.08	1
EM5	100-150cm	0.32	7.50	2.40	6.67	5.56	0.51	16.2	2.16	0.29	1.01	8.33	2.46	0.01	2.40	8.32	68.9	20.3	0.07	12.1	0.12	1
em5	Profile	0.22	8.05	1.73	5.59	4.59	0.84	16.73	1.91	0.29	0.97	6.53	1.49	0.40	3.33	12.28	65.52	14.01	4.86	9.68	0.21	

	Average																					
EM6	0-20cm	0.05	8.60	0.43	5.43	4.40	1.72	17.3	1.30	0.48	2.37	2.95	0.33	0.29	7.55	36.8	46.0	5.09	4.57	6.42	0.80	7
EM6	20-50cm	0.15	8.60	1.29	4.57	3.59	0.92	24.8	1.64	0.28	1.61	7.33	1.29	3.59	1.96	11.4	52.0	9.13	25.5	14.1	0.22	3b
EM6	50-100cm	0.27	8.60	2.32	4.75	3.73	0.49	17.3	1.73	0.34	0.56	8.88	2.53	2.67	2.29	3.74	59.3	16.9	17.8	15.0	0.06	3b
EM6	100-150cm	0.19	14.00	2.66	5.17	4.07	0.36	8.2	1.99	0.32	0.54	6.03	2.33	1.06	3.07	5.21	58.7	22.7	10.3	10.3	0.09	5
em6	Profile Average	0.17	9.95	1.68	4.98	3.95	0.87	16.90	1.67	0.36	1.27	6.30	1.62	1.90	3.72	14.30	53.99	13.45	14.53	11.44	0.29	
EM7	0-20cm	0.05	8.60	0.43	5.40	4.37	1.93	15.2	1.64	0.24	2.87	4.11	0.38	0.34	3.04	36.2	51.8	4.73	4.27	7.93	0.70	2
EM7	20-50cm	0.18	8.60	1.55	5.11	4.29	1.11	21.1	1.67	0.32	2.58	10.2	1.35	0.42	2.18	17.4	68.5	9.09	2.85	14.8	0.25	3b
EM7	50-100cm	0.15	7.50	1.13	5.24	4.38	1.01	20.8	2.47	0.32	2.41	8.73	1.04	0.30	2.51	18.8	68.2	8.12	2.36	12.8	0.28	3b
EM7	100-150cm	0.13	7.50	0.98	6.50	5.93	0.77	19.7	2.30	0.36	3.26	15.7	3.55	0.01	1.59	14.2	68.6	15.51	0.03	22.9	0.21	1
em7	Profile Average	0.13	8.05	1.02	5.56	4.74	1.21	19.20	2.02	0.31	2.78	9.67	1.58	0.27	2.33	21.66	64.28	9.36	2.38	14.61	0.36	
EM8	0-20cm	0.07	8.60	0.60	5.71	4.65	2.17	22.0	1.37	0.31	3.14	4.99	0.50	0.12	3.40	34.6	55.1	5.57	1.32	9.06	0.63	8
EM8	20-50cm	0.30	8.60	2.58	6.51	5.78	0.65	19.2	2.10	0.40	3.06	11.8	2.07	0.01	2.29	17.6	68.1	12.0	0.04	17.3	0.26	2
EM8	50-100cm	0.21	8.60	1.81	9.10	8.26	0.22	15.3	1.33	0.43	4.40	12.6	4.13	0.00	1.98	20.4	58.4	19.2	0.01	21.5	0.35	3a
EM8	100-150c	0.66	8.60	5.68	8.32	7.58	0.19	15.1	2.09	0.41	1.85	9.38	3.72	0.00	2.66	12.0	61.1	24.2	0.01	15.4	0.20	3b

	m																					
em8	Profile Average	0.31	8.60	2.67	7.41	6.57	0.81	17.90	1.72	0.38	3.11	9.68	2.61	0.03	2.58	21.18	60.66	15.24	0.35	15.82	0.36	
EM9	0-20cm	0.08	8.60	0.69	5.15	4.51	1.52	25.4	1.66	0.28	2.90	2.96	0.37	0.19	4.25	43.3	44.1	5.45	2.88	6.70	0.98	8
EM9	20-50cm	0.10	8.60	0.86	5.25	4.18	0.66	16.4	2.12	0.19	2.15	5.54	0.80	0.66	2.08	23.0	59.4	8.52	7.05	9.33	0.39	2
EM9	50-100cm	0.38	8.60	3.27	6.10	5.38	0.30	14.3	2.10	0.19	1.44	7.73	2.28	0.01	1.59	12.4	66.4	19.6	0.09	11.6	0.19	3b
EM9	100-150cm	0.11	8.60	0.95	7.38	6.26	0.18	9.7	1.53	0.18	1.49	7.65	3.20	0.00	1.43	11.9	61.1	25.6	0.03	12.5	0.19	2
em10	Profile Average	0.17	8.60	1.44	5.97	5.08	0.67	16.45	1.85	0.21	1.99	5.97	1.66	0.22	2.34	22.63	57.74	14.78	2.51	10.05	0.44	
EM10	0-20cm	0.05	8.60	0.43	5.02	4.47	2.68	26.7	1.40	0.37	2.65	2.08	0.16	0.22	6.81	48.2	37.9	2.97	4.06	5.49	1.27	8
EM10	20-50cm	0.03	9.50	0.29	5.24	4.08	0.73	19.4	1.82	0.27	0.79	2.61	0.31	0.98	5.38	15.9	52.6	6.25	19.8	4.96	0.30	3b
EM10	50-100cm	0.04	8.60	0.34	4.86	3.82	0.41	17.0	2.12	0.28	0.22	3.37	0.49	2.23	4.20	3.41	51.1	7.39	33.9	6.59	0.07	3b
EM10	100-150cm	0.08	8.60	0.69	4.43	3.64	0.82	32.9	1.35	0.36	0.22	3.83	0.79	3.14	4.30	2.64	45.9	9.49	37.7	8.34	0.06	3b
em10	Profile Average	0.05	8.83	0.44	4.89	4.00	1.16	24.00	1.67	0.32	0.97	2.97	0.44	1.65	5.18	17.56	46.87	6.53	23.87	6.34	0.42	

Appendix 3: Interpreted Soil Laboratory Data

Appendix 3: Ranked Soil Laboratory Data Tiedman Em31 (Horizontal Survey

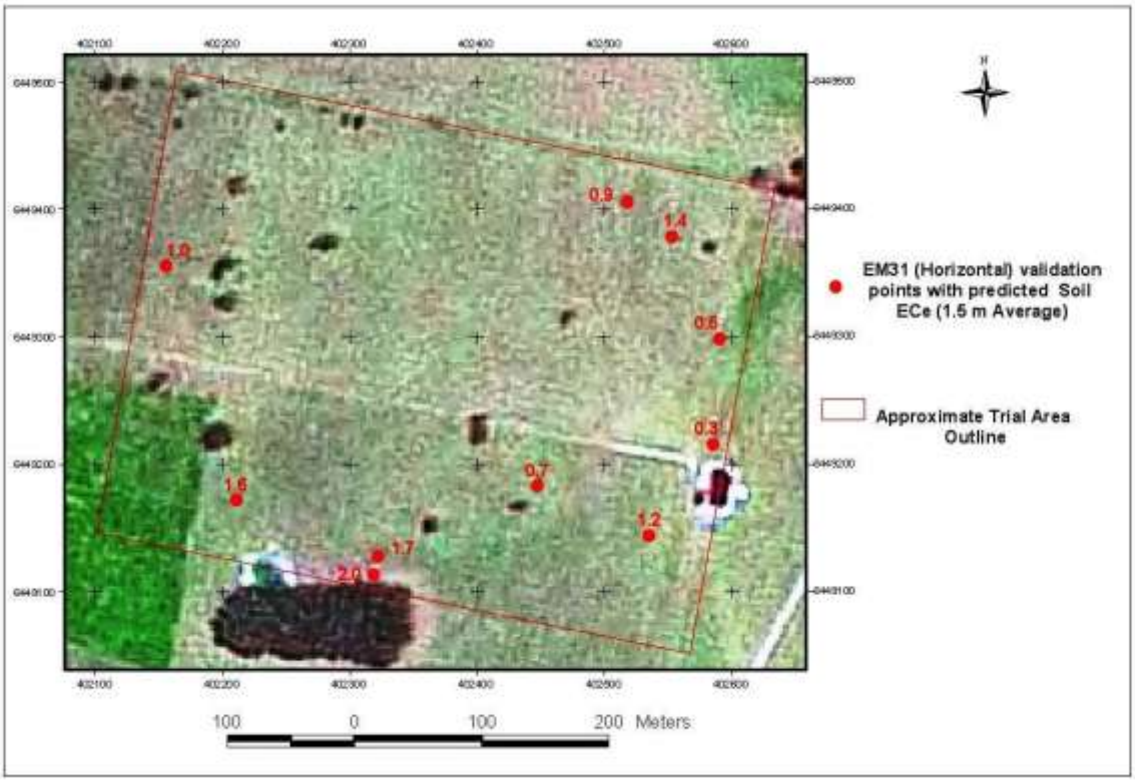
Profile Number	Sample Depths	ECe	pH (H2O)	pH ($CaCl_2$)	Organic carbon	Bulk Density	Potassium Ex me/100g	Calcium Ex me/100g	Magnesium Ex me/100g	Sodium Ex me/100g	Ex Potassium %	Ex Calcium %	Ex Magnesium %	Ex Sodium %	Ex Aluminium %	ECEC me/100g	Ca/Mg Ratio	EAT Dispersibility
EM1	0-20cm	Non-saline	Str Acid	Str Acid	V High	Low	High	Low	Moderate	Moderate	High	Moderate	V High	Non - Sodic	Low	Low	Ca Deficient	Aggregated
EM1	20-50cm	Non-saline	Str Acid	V Str Acid	Low	High	Moderate	V Low	Moderate	Moderate	Moderate	Low	V High	Sodic	Moderate	Low	Ca Deficient	Slightly Dispersible
EM1	50-100cm	Non-saline	V Str Acid	V Str Acid	V Low	High	Moderate	V Low	Moderate	Moderate	Moderate	V Low	V High	Sodic	High	Low	Ca Deficient	Slightly Dispersible
EM1	100-150cm	Non-saline	Str Acid	V Str Acid	Ext Low	High	Moderate	V Low	Moderate	High	Moderate	V Low	V High	Sodic	High	Low	Ca Deficient	Slightly Dispersible
EM2	0-20cm	Non-saline	Str Acid	Str Acid	Moderate	Moderate	Low	V Low	Moderate	Moderate	High	Moderate	V High	Sodic	Low	V Low	Ca Low	Slightly Dispersible
EM2	20-50cm	Non-saline	Str Acid	V Str Acid	Low	High	Moderate	V Low	Moderate	High	Moderate	V Low	V High	Strongly Sodic	Low	Low	Ca Deficient	Slightly Dispersible
EM2	50-100cm	Non-saline	Str Acid	V Str Acid	Low	High	Low	V Low	V High	High	Moderate	V Low	V High	Strongly Sodic	Low	Moderate	Ca Deficient	Highly Dispersible
EM2	100-150cm	Non-saline	Str Acid	V Str Acid	V Low	High	Moderate	V Low	Moderate	High	Moderate	V Low	V High	Strongly Sodic	Moderate	Low	Ca Deficient	Highly Dispersible
EM3	0-20cm	Non-saline	Str Acid	Str Acid	High	Low	High	Low	Moderate	Moderate	High	Moderate	V High	Non - Sodic	Low	Low	Ca Deficient	Aggregated
EM3	20-50cm	Non-saline	Mod Acid	Str Acid	Moderate	High	Moderate	Low	Moderate	Moderate	Moderate	Low	V High	Non - Sodic	Low	Low	Ca Deficient	Aggregated
EM3	50-100cm	Non-saline	Str Acid	V Str Acid	Low	High	Moderate	V Low	V High	High	Moderate	V Low	V High	Sodic	Low	Moderate	Ca Deficient	Slightly Dispersible
EM3	100-150cm	Non-saline	Str Acid	V Str Acid	V Low	Low	Moderate	V Low	V High	High	Moderate	V Low	V High	Sodic	Low	Moderate	Ca Deficient	Slightly Dispersible

EM4	0-20cm	Non-saline	Str Acid	Str Acid	High	High	Moderate	Low	Moderate	Moderate	Moderate	Moderate	V High	Non - Sodic	Low	Low	Ca Deficient	Aggregated
EM4	20-50cm	Non-saline	Str Acid	Str Acid	Low	V High	Moderate	V Low	V High	High	Moderate	Low	V High	Sodic	Low	Moderate	Ca Deficient	Highly Dispersible
EM4	50-100cm	Slightly saline	Mod Acid	Mod Acid	V Low	High	Moderate	V Low	V High	High	Moderate	V Low	V High	Strongly Sodic	V Low	Moderate	Ca Deficient	Slightly Dispersible
EM4	100-150cm	Non-saline	Sl Acid	Neutral	Ext Low	V High	Low	V Low	V High	V High	Low	V Low	V High	Strongly Sodic	V Low	Moderate	Ca Deficient	Aggregated
EM5	0-20cm	Non-saline	V Str Acid	Str Acid	Moderate	Moderate	Low	V Low	Moderate	Moderate	High	Low	V High	Sodic	Low	V Low	Ca Deficient	Slightly Dispersible
EM5	20-50cm	Non-saline	Str Acid	V Str Acid	Low	V High	Low	V Low	Moderate	High	Moderate	V Low	V High	Strongly Sodic	Low	Low	Ca Deficient	Very Highly Dispersible
EM5	50-100cm	Slightly saline	Str Acid	Str Acid	V Low	V High	Moderate	V Low	V High	V High	Moderate	V Low	V High	Strongly Sodic	V Low	Low	Ca Deficient	Very Highly Dispersible
EM5	100-150cm	Slightly saline	Neutral	Sl Acid	V Low	V High	Low	V Low	V High	V High	Moderate	V Low	V High	Strongly Sodic	V Low	Moderate	Ca Deficient	Very Highly Dispersible
EM6	0-20cm	Non-saline	Str Acid	Str Acid	Moderate	Moderate	Moderate	Low	Moderate	Moderate	High	Moderate	V High	Sodic	Low	Low	Ca Deficient	Aggregated
EM6	20-50cm	Non-saline	V Str Acid	Ext Acid	Low	High	Low	V Low	Moderate	High	Low	Low	V High	Sodic	High	Moderate	Ca Deficient	Slightly Dispersible
EM6	50-100cm	Slightly saline	V Str Acid	V Str Acid	V Low	High	Moderate	V Low	V High	V High	Moderate	V Low	V High	Strongly Sodic	High	Moderate	Ca Deficient	Slightly Dispersible
EM6	100-150cm	Slightly saline	Str Acid	V Str Acid	Ext Low	V High	Moderate	V Low	Moderate	V High	Moderate	V Low	V High	Strongly Sodic	Moderate	Low	Ca Deficient	Slightly Dispersible
EM7	0-20cm	Non-saline	Str Acid	Str Acid	High	High	Low	Low	Moderate	Moderate	Moderate	Moderate	V High	Non - Sodic	Low	Low	Ca Deficient	Highly Dispersible
EM7	20-50cm	Non-saline	Str Acid	Str Acid	Moderate	High	Moderate	Low	V High	High	Moderate	Low	V High	Sodic	Low	Moderate	Ca Deficient	Slightly Dispersible
EM7	50-100cm	Non-saline	Str Acid	Str Acid	Moderate	V High	Moderate	Low	V High	High	Moderate	Low	V High	Sodic	Low	Moderate	Ca Deficient	Slightly Dispersible

EM7	100-150cm	Non-saline	Sl Acid	Neutral	Low	V High	Moderate	Low	V High	V High	Low	Low	V High	Strongly Sodic	V Low	Moderate	Ca Deficient	Very Highly Dispersible
EM8	0-20cm	Non-saline	Mod Acid	Str Acid	High	Moderate	Moderate	Low	Moderate	Moderate	Moderate	Moderate	V High	Sodic	Low	Low	Ca Deficient	Aggregated
EM8	20-50cm	Slightly saline	Neutral	Neutral	Low	V High	Moderate	Low	V High	V High	Moderate	Low	V High	Strongly Sodic	V Low	Moderate	Ca Deficient	Highly Dispersible
EM8	50-100cm	Non-saline	V Str Alkaline	V Str Alkaline	Ext Low	Moderate	Moderate	Low	V High	V High	Low	Low	V High	Strongly Sodic	V Low	Moderate	Ca Deficient	Slightly Dispersible
EM8	100-150cm	Moderately Saline	Str Alkaline	Sl Alkaline	Ext Low	V High	Moderate	V Low	V High	V High	Moderate	Low	V High	Strongly Sodic	V Low	Moderate	Ca Deficient	Slightly Dispersible
EM9	0-20cm	Non-saline	Str Acid	Str Acid	Moderate	High	Low	Low	Moderate	Moderate	Moderate	Moderate	V High	Sodic	Low	Low	Ca Deficient	Aggregated
EM9	20-50cm	Non-saline	Str Acid	V Str Acid	Low	V High	Low	Low	Moderate	High	Moderate	Low	V High	Sodic	Low	Low	Ca Deficient	Highly Dispersible
EM9	50-100cm	Slightly saline	Sl Acid	Sl Acid	Ext Low	V High	Low	V Low	Moderate	V High	Low	Low	V High	Strongly Sodic	V Low	Low	Ca Deficient	Slightly Dispersible
EM9	100-150cm	Non-saline	Sl Alkaline	Neutral	Ext Low	Moderate	Low	V Low	Moderate	V High	Low	Low	V High	Strongly Sodic	V Low	Moderate	Ca Deficient	Highly Dispersible
EM10	0-20cm	Non-saline	Str Acid	Str Acid	High	Moderate	Moderate	Low	Moderate	Low	High	Moderate	V High	Non -Sodic	Low	V Low	Ca Low	Aggregated
EM10	20-50cm	Non-saline	Str Acid	V Str Acid	Low	High	Low	V Low	Moderate	Moderate	High	Low	V High	Sodic	High	V Low	Ca Deficient	Slightly Dispersible
EM10	50-100cm	Non-saline	V Str Acid	V Str Acid	V Low	V High	Low	V Low	Moderate	Moderate	Moderate	V Low	V High	Sodic	High	Low	Ca Deficient	Slightly Dispersible
EM10	100-150cm	Non-saline	Ext Acid	Ext Acid	Low	Moderate	Moderate	V Low	Moderate	High	Moderate	V Low	V High	Sodic	V High	Low	Ca Deficient	Slightly Dispersible

Appendix 4: Suggested EM31 (Horizontal) Model Validation sample points

Appendix 4: Suggested EM31 (Horizontal) Model Validation Soil Sampling Points			
Eastings	**Northings**	**Measured Eca (mS/m)**	**Predicted Soil Average ECe Value over 1.5 soil column (dS/m)**
402586	6449215	3	0.3
402591	6449298	13	0.5
402448	6449182	23	0.7
402519	6449405	33	0.9
402156	6449355	43	1
402536	6449143	53	1.2
402554	6449378	63	1.4
402211	6449171	75	1.6
402322	6449127	84	1.7
402319	6449112	99	2



Soil Sampling and Analysis at Tiedmans to provide EM Survey data

A report for Fodder King Ltd and AGL Gloucester
November 2014

Prepared by Dr Steven Lucas

The Tom Farrell Institute for the Environment

The University of Newcastle

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

THE TOM FARRELL INSTITUTE FOR THE ENVIRONMENT

"Regional solutions for a sustainable future"

Eight soil sampling locations were re-sampled on the 23 October 2014 by Dr Steven Lucas and Fodder King to provide data for the EM survey. Soil samples were taken manually using a hand auger to depths of 0-20 cm, 20-50 cm, 50-100 cm and 100-150 cm. Soil sampling locations included CS2, CS4, CS6, CS8, CS10, CS12, CS14 and CS16 located within Stage 1A; and EM4 and EM5 from previous EM survey.

Soil samples were analysed for pH (1:5 in water), Electrical Conductivity (EC, 1:5 in water), soil moisture (%), texture and bulk density as per standard soil laboratory methods (McDonald et al, 1998; Rayment and Lyons, 2010) at the University of Newcastle. Results from analyses are shown in Table 1.

			WET		DRY				g/cm^3		dS/m
ID	**cm**	**Tray wt (g)**	**T + Soil (g)**	**Soil (g)**	**T + Soil (g)**	**Soil (g)**	**Moisture %**	**Texture**	**BD**	**pH (1:5)**	**EC (1:5)**
CS2	0-20	8.2	683.4	675.2	627.4	619.2	8.3	CL	1.34	6.72	0.20
	20-50	8.3	529.5	521.2	454.9	446.6	14.3	MC	1.30	5.78	0.21
	50-100	8.3	649	640.7	545	536.7	16.2	MC	1.30	5.57	0.25
	100-150	NO SAMPLE	-								
CS4	0-20	8.2	715.5	707.3	637.4	629.2	11.0	CL	1.32	6.54	0.21
	20-50	8.3	705.6	697.3	614.5	606.2	13.1	MC	1.31	6.55	0.28
	50-100	8.1	808.9	800.8	692.4	684.3	14.5	MC	1.29	6.53	0.41
	100-150	8.2	577.8	569.6	478.7	470.5	17.4	MC	1.29	6.75	0.45
CS6	0-20	8.2	602.8	594.6	522.3	514.1	13.5	CL	1.33	6.23	0.23
	20-50	8.2	608.8	600.6	529.4	521.2	13.2	MC	1.28	5.32	0.31
	50-100	8.2	742.8	734.6	634.7	626.5	14.7	MC	1.27	5.49	0.33
	100-150	8.2	497.4	489.2	444.7	436.5	10.8	MC	1.28	5.76	0.25
CS8	0-20	8.1	777.6	769.5	710.5	702.4	8.7	CL	1.34	6.49	0.21
	20-50	8.1	650.9	642.8	577.7	569.6	11.4	MC	1.30	4.68	0.26
	50-100	8.1	597.9	589.8	510.4	502.3	14.8	MC	1.29	4.52	0.24
	100-150	NO SAMPLE	-								
CS10	0-20	8.1	640.4	632.3	568.2	560.1	11.4	CL	1.33	6.47	0.18
	20-50	8.1	544	535.9	452.9	444.8	17.0	MC	1.29	5.61	0.20
	50-100	8.1	610.5	602.4	529.7	521.6	13.4	MC	1.27	5.55	0.23
	100-150	NO SAMPLE	-								
CS12	0-20	8.1	555.4	547.3	500.5	492.4	10.0	SCL	1.31	7.25	0.19
	20-50	8.1	469.5	461.4	401.1	393	14.8	LMC	1.32	5.55	0.21
	50-100	8.1	587.7	579.6	499.7	491.6	15.2	MC	1.30	6.14	0.25
	100-150	8.1	682	673.9	608	599.9	11.0	MC	1.28	7.13	0.20
CS14	0-20	8.1	490	481.9	419.3	411.2	14.7	SCL	1.33	6.75	0.23
	20-50	8.1	605.3	597.2	535.4	527.3	11.7	MC	1.26	5.22	0.12
	50-100	8.2	230.7	222.5	178	169.8	23.7	MC	1.27	4.85	0.11
	100-150	8.2	276.7	268.5	228.1	219.9	18.1	MC	1.29	5.01	0.11
CS16	0-20	8.3	631.6	623.3	557	548.7	12.0	SCL	1.33	5.63	0.26
	20-50	8.2	586.2	578	501.7	493.5	14.6	MC	1.31	5.06	0.19
	50-100	8.2	542.8	534.6	456	447.8	16.2	MC	1.28	5.34	0.24
	100-150	8.2	388.1	379.9	319.4	311.2	18.1	MC	1.29	5.21	0.22
EM4	0-20	8.3	703.5	695.2	619.9	611.6	12.0	SCL	1.34	6.67	0.11
	20-50	8.2	455.4	447.2	403.1	394.9	11.7	MC	1.28	5.68	0.10
	50-100	8.2	490	481.8	421.9	413.7	14.1	MC	1.27	5.50	0.14
	100-150	NO SAMPLE	-								
EM5	0-20	8.2	460.5	452.3	412.8	404.6	10.5	SCL	1.35	5.59	0.10
	20-50	8.2	467.6	459.4	410	401.8	12.5	LMC	1.32	5.42	0.11
	50-100	8.2	500.3	492.1	422.4	414.2	15.8	MC	1.29	6.57	0.33
	100-150	8.2	548.6	540.4	463.3	455.1	15.8	MC	1.28	7.57	0.69

Texture Key

CL = clay loam

SCL = silty clay loam

LMC = light medium clay

MC = medium clay

Table 1: Soil analysis results

References

McDonald RC, Isbell RF, Speight JG, Walker J, Hopkins MS (1998) *Australian Soil and Land Survey Field Handbook*. (Australian Collaborative Land Evaluation Program: Canberra).

Rayment GE, Lyons DJ (2010) *Soil Chemical Methods – Australasia*, Australian Soil and Land Survey Field Handbook Series, CSIRO Publishing.

Appendix B Soil Laboratory Results

(See Appendix C of Jacobs (2015) report)

Appendix G. Soil Description Sheets

Site Information

Project	IA059500
Date	27/05/2015
Scribe	K Brown
Location	TP25 (Plot 1)
Observation	Soil pit
Easting/ Latitude	0402187/ 32°5'16.67" S
Zone	56
ASC Mapped	
Dominant Vegetation Form	Non-woody
Ground Cover %	Dense (>70%)
Aspect	South West
Northing/ Longitude	6449344/ 151°57'48.55"E
Scale	
ASC Ground Truth	
Secondary Vegetation Form	
Ground Cover %	
Slope %	5
Rock Outcrop	No rock outcrop
Erosion Type	None evident
Vegetation (species)	Triticale (annual)
Drainage (site)	Imperfectly drained
Erosion Extent	None evident
Landform	Mid-slope
Soil Surface Condition	Soft
Land Use	Pastures
Erosion State	Stabilised

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief

Type None evident

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Topsoil

Other Information

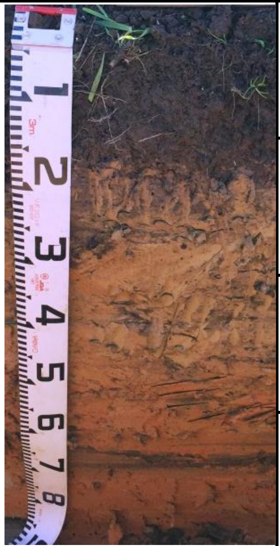
TP25 comparative to TP17 (2014)
Plot 1 (Treatment 1 Only)
No Slots

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Subsoil

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	Lab pH_w (1:5)	Lab EC_w (1:5) dS/m	Depth of Sample for Lab (mm)
A1	0-150		Gradual	Clay Loam	Very dark brown (7.5YR 2.5/3)	Dark grey (7.5YR 3/1)	Not recorded	Not recorded	Subangular blocky	Moderate	Weak (moist)	Many (25-200) medium (2-5 mm) and fine	7.4	0.2	A
B2	200-500		Gradual	Medium Clay	Reddish yellow (7.5YR 6/8)	Grey (7.5YR 6/1)	Not recorded	Not recorded	Subangular blocky	Moderate	Very firm (moist)	Common (10-25) fine (1-2 mm) and very fine (<1 mm)	5.1	0.31	B
B3	500-600+			Medium Heavy Clay			Not recorded	Not recorded	Apedal	Moderate	Very firm (moist)	Few (0-10) (10-25) fine (1-2 mm) and very fine (<1 mm)			

Other information

Treatment 1 (composted feedlot manure at 50 t/ha + lime at 8 t/ha + gypsum at 4 t/ha + zeolite at 5 t/ha) spread and incorporated to 240 mm depth. Planted to annual species (triticale) in 05/15. No worm activity was observed.

Soil Profile Description

Project	Date	Scribe	Location	Observation	Easting/ Latitude	Zone	ASC Mapped
IA059500	27/05/2015	K Brown	TP26 (Plot 10)	Soil pit	0402219/ 32°5'19.18" S	56	

Dominant Vegetation Form Non-woody	**Ground Cover %** Dense (>70%)	**Aspect** South West	**Northing/ Longitude** 6449267/ 151°57'49.74"E	**Scale**	**ASC Ground Truth**
Secondary Vegetation Form	**Ground Cover %**	**Slope %** 5	**Rock Outcrop** No rock outcrop	**Erosion Type** None evident	
Vegetation (species) Lucerne (perennial)			**Drainage (site)** Imperfectly drained	**Erosion Extent** None evident	
Landform Mid-slope	**Soil Surface Condition** Soft		**Land Use** Pastures	**Erosion State** Stabilised	

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief

Type None evident

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Other Photo

Other Information

TP26 comparative to TP18 (2014)
Plot 10 (Treatment 1 Only)
No Slots

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	Lab pH_w (1:5)	Lab EC_w (1:5) dS/m	Depth of Sample for Lab (mm)
A1	0-150		Gradual	Sandy Clay Loam	Very dark brown (7.5YR 2.5/2)		Not recorded	Not recorded	Subangular blocky	Moderate	Weak (moist)	Many (25-200) coarse (5-10 mm), medium (2-5 mm) and fine (1-2 mm)	7.3	0.16	A
B2	200-500		Gradual	Medium Clay	Strong brown (7.5YR 5/6)	Grey (7.5YR 6/1)	Not recorded	Not recorded	Subangular blocky	Moderate	Firm (moist)	Common (10-25) medium (2-5 mm), fine (1-2 mm) and very fine (<1	6	0.28	B
B3	500-600+			Medium Heavy Clay			Not recorded	Not recorded	Apedal	Moderate	Weak (moderately moist)	Few (0-10) fine (1-2 mm) and very fine (<1 mm)			

Other information

Treatment 1 (composted feedlot manure at 50 t/ha + lime at 8 t/ha + gypsum at 4 t/ha + zeolite at 5 t/ha) spread and incorporated to 240 mm depth. Planted to perennial species (lucerne). Abundant worms in the topsoil. No worms observed in the subsoil.

Soil Profile Description

Project	Date	Scribe	Location	Observation	Easting/ Latitude	Zone	ASC Mapped
IA059500	27/05/2015	K Brown	TP27 (Plot 11)	Soil pit	0402187/ 32°5'19.68" S	56	

Dominant Vegetation Form	Non-woody
Ground Cover %	Mid-dense (30-70%)
Aspect	South West
Northing/ Longitude	6449344/ 151°57'51.61"E
Scale	
ASC Ground Truth	
Secondary Vegetation Form	
Ground Cover %	
Slope %	5
Rock Outcrop	No rock outcrop
Erosion Type	None evident
Vegetation (species)	Triticale (annual)
Drainage (site)	Imperfectly drained
Erosion Extent	None evident
Landform	Upper slope
Soil Surface Condition	Soft
Land Use	Pastures
Erosion State	Stabilised

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief

Type None evident

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Soil Profile (2)

Other Information

TP27 comparative to TP19 (2014)
Plot 11 (Treatment 1 and Treatment 4)
Slots to 1200 mm

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Other Vegetation Photo

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	Lab pH_w (1:5)	Lab EC_w (1:5) dS/m	Depth of Sample for Lab (mm)
A1	0-150		Clear	Clay Loam	Very dark brown (7.5YR 2.5/3)		Not recorded	Not recorded	Polyhedral	Moderate	Firm (moist)	Many (25-200) fine (1-2 mm) and few (10-25) medium (2-5 mm)	7.3	0.49	A
B2	200-500		Clear	Medium Clay	Strong brown (7.5YR 5/8)	Grey (7.5YR 6/1)	Not recorded	Not recorded	Subangular blocky	Weak	Weak (moist)	Few (0-10) fine (1-2 mm) and very fine (<1 mm)	5.3	0.32	B
B3	500-600+			Medium Heavy Clay			Not recorded	Not recorded	Apedal		Firm (moist)	None evident			Duplicate 1 sampled from TP27 A Horizon

Other information

Treatment 1 (composted feedlot manure at 50 t/ha + lime at 8 t/ha + gypsum at 4 t/ha + zeolite at 5 t/ha) spread and incorporated to 240 mm depth plus Treatment 4 (composted feedlot manure at 50 t/ha + lime at 8 t/ha + gypsum at 4 t/ha + zeolite at 5 t/ha) within excavated soil slots 200 mm wide, at 1.5 m spacings and to a depth of 1200 mm. Planted to annual species (triticale) in 05/15. Abundant worms in the A horizon.

Soil Profile Description

Project	Date	Scribe	Location	Observation	Easting/ Latitude	Zone	ASC Mapped
IA059500	27/05/2015	K Brown	TP28 (Plot 4)	Soil pit	0402324/ 32°5'16.13077''S	56	

Dominant Vegetation Form: Non-woody
Ground Cover %: Dense (>70%)
Aspect: South West
Northing/ Longitude: 6449326/ 151°57'53.78349''E
Scale:
ASC Ground Truth:

Secondary Vegetation Form:
Ground Cover %:
Slope %: 4
Rock Outcrop: No rock outcrop
Erosion Type: None evident

Vegetation (species): Lucerne (perennial)
Drainage (site): Imperfectly drained
Erosion Extent: None evident

Landform: Upper slope
Soil Surface Condition: Soft
Land Use: Pastures
Erosion State: Stabilised

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief

Type None evident

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Soil Profile (2)

Subsoil

Other Information

TP28 comparative to TP20 (2014)
Plot 4 (Treatment 1 and Treatment 4)
Slots to 1200 mm

Dominant Vegetation Photo 1

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	Lab pH$_w$ (1:5)	Lab EC$_w$ (1:5) dS/m	Depth of Sample for Lab (mm)
A1	0-200	 	Gradual	Clay Loam	Dark brown (7.5YR 3/3)	Reddish yellow (7.5YR 6/8)	Not recorded	2-10 % 6-20 mm	Polyhedral	Weak	Weak (moist)	Many (25-200) coarse (5-10 mm), medium (2-5 mm) and fine (1-2 mm)	7	0.13	A
B2	200-700		Clear	Medium Heavy Clay	Reddish yellow (7.5YR 6/8)	Light grey (7.5YR 7/1)	Not recorded		Subangular blocky	Weak	Weak (wet)	Common (10-25) fine (1-2 mm) and very fine (<1 mm)	5.7	0.24	B
B3	700-1200+			Heavy Clay								Few (0-10) (10-25) fine (1-2 mm) and very fine (<1 mm)			

Other information

Treatment 1 (composted feedlot manure at 50 t/ha + lime at 8 t/ha + gypsum at 4 t/ha + zeolite at 5 t/ha) spread and incorporated to 240 mm depth plus Treatment 4 (composted feedlot manure at 50 t/ha + lime at 8 t/ha + gypsum at 4 t/ha + zeolite at 5 t/ha) within excavated soil slots 200 mm wide, at 1.5 metre spacings and to a depth of 1200 mm. Planted to perennial species (lucerne). Soil and treatment material within the slots is saturated from 200 mm depth. Worms observed in the A horizon (0-200 mm).

Soil Profile Description

Project	Date	Scribe	Location	Observation
IA059500	27/05/2015	K Brown	TP29 (Plot 5)	Soil pit

Easting/ Latitude	Zone	ASC Mapped
0402187/ 32°5'19.68" S	56	

Dominant Vegetation Form	Ground Cover %	Aspect
Non-woody	Dense (>70%)	South West

Northing/ Longitude	Scale	ASC Ground Truth
6449344/ 151°57'51.61"E		

Secondary Vegetation Form	Ground Cover %	Slope %
		4

Rock Outcrop	Erosion Type
No rock outcrop	None evident

Vegetation (species)	Drainage (site)	Erosion Extent
Triticale (annual)	Imperfectly drained	None evident

Landform	Soil Surface Condition	Land Use	Erosion State
Upper slope	Soft	Pastures	Stabilised

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief

Type None evident

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Topsoil

Other Information

TP29 comparative to TP21 (2014)

Plot 5 (Treatment 1 and Treatment 3)

Slots to 950 mm

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Subsoil

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	Lab pH_w (1:5)	Lab EC_w (1:5) dS/m	Depth of Sample for Lab (mm)
A1	0-150		Clear	Clay Loam	Very dark brown (7.5YR 2.5/3)	Dark grey (7.5YR 3/1)	Not recorded	Not recorded	Subangular blocky	Moderate	Weak (moist)	Many (25-200) medium (2-5 mm) and fine	6.5	0.26	A
B2	200-500		Clear	Medium Clay	Reddish yellow (7.5YR 6/8)	Grey (7.5YR 6/1)	Not recorded	Not recorded	Subangular blocky	Moderate	Very firm (moist)	Common (10-25) fine (1-2 mm) and very fine (<1 mm)	5.6	0.19	B
B3	500-600+			Medium Heavy Clay			Not recorded	Not recorded	Apedal	Massive	Very firm (moist)	Few (0-10) (10-25) fine (1-2 mm) and very fine (<1 mm)			

Other information

Treatment 1 (composted feedlot manure at 50 t/ha + lime at 8 t/ha + gypsum at 4 t/ha + zeolite at 5 t/ha) spread and incorporated to 240 mm depth plus Treatment 3 (composted feedlot manure at 50 t/ha + lime at 8 t/ha + gypsum at 4 t/ha + zeolite at 5 t/ha) within excavated soil slots 200 mm wide, at 1.5 metre spacings and to a depth of 950 mm. Planted to annual species (triticale). No worm activity was observed.

Soil Profile Description

Project	Date	Scribe	Location	Observation	Easting/ Latitude	Zone	ASC Mapped
IA059500	27/05/2015	K Brown	TP30 (Plot 14)	Soil pit	0402417/ 32°5'20.45''S	56	

Dominant Vegetation Form	Non-woody
Ground Cover %	Mid-dense (30-70%)
Aspect	West
Northing/ Longitude	6449230/ 151°57'57.28''E
Scale	
ASC Ground Truth	
Secondary Vegetation Form	
Ground Cover %	
Slope %	3
Rock Outcrop	No rock outcrop
Erosion Type	None evident
Vegetation (species)	Lucerne (perennial)
Drainage (site)	Imperfectly drained
Erosion Extent	None evident
Landform	Upper slope
Soil Surface Condition	Soft
Land Use	Pastures
Erosion State	Stabilised

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief

Type None evident

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Topsoil

Other Information

TP30 comparative to TP22 (2014)
Plot 14 (Treatment 1 and Treatment 3)
Slots to 950 mm

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Subsoil

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	Lab pH_w (1:5)	Lab EC_w (1:5) dS/m	Depth of Sample for Lab (mm)
A1	0-200		Diffuse	Clay Loam	Dark brown (7.5YR 3/2)		Not recorded	Not recorded	Subangular blocky	Weak	Weak (wet)	Many (25-200) coarse (5-10 mm), medium (2-5 mm) and fine (1-2 mm)	6.1	0.19	A
B1	200-550		Clear	Medium Clay	Yellowish red (5YR 5/8)	Very light brown (10YR 7/4)	Not recorded	Not recorded	Subangular blocky	Moderate	Weak (moist)	Common (10-25) medium (2-5 mm), fine (1-2 mm) and very fine (<1	5.2	0.27	B
B2	550-900+			Heavy Clay		Light grey (2.5Y 7/1)	Not recorded	Not recorded	Apedal	Massive	Firm (moist)	Few (0-10) fine (1-2 mm) and very fine (<1 mm)	5.1	0.44	B

Other information

Treatment 1 (composted feedlot manure at 50 t/ha + lime at 8 t/ha + gypsum at 4 t/ha + zeolite at 5 t/ha) spread and incorporated to 240 mm depth plus Treatment 3 (composted feedlot manure at 50 t/ha + lime at 8 t/ha + gypsum at 4 t/ha + zeolite at 5 t/ha) within excavated soil slots 200 mm wide, at 1.5 metre spacings and to a depth of 950 mm. Planted to perennial species (lucerne). No worm activity was observed.

Soil Profile Description

Project	Date	Scribe	Location	Observation	Easting/ Latitude	Zone	ASC Mapped
IA059500	27/05/2015	K Brown	TP31 (Plot 15)	Soil pit	0402460/ 32°5'20.39''S	56	

Dominant Vegetation Form	Non-woody
Ground Cover %	Dense (>70%)
Aspect	West
Northing/ Longitude	6449232/ 151°57'58.92''E
Scale	
ASC Ground Truth	
Secondary Vegetation Form	
Ground Cover %	
Slope %	3
Rock Outcrop	No rock outcrop
Erosion Type	None evident
Vegetation (species)	Triticale (annual)
Drainage (site)	Imperfectly drained
Erosion Extent	None evident
Landform	Upper slope
Soil Surface Condition	Soft
Land Use	Pastures
Erosion State	Stabilised

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief

Type None evident

Vertical (m)

Horizontal (m)

Sampled

Landscape Photo (South)

Landscape Photo (West)

Soil Profile (2)

Other Information

TP31 comparative to TP23 (2014)
Plot 15 (Treatment 1 and Treatment 2)
Slots to 650 mm

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	Lab pH_w (1:5)	Lab EC_w (1:5) dS/m	Depth of Sample for Lab (mm)
A1	0-200		Diffuse	Light Clay	Very dark brown (7.5YR 2.5/3)		Not recorded	Not recorded	Polyhedral	Weak	Weak (wet)	Many (25-200) fine (1-2 mm) and very fine (<1 mm)	7.3	0.37	A
B1	200-550		Clear	Medium Heavy Clay	Strong brown (7.5Y 5/6)	Grey (7.5Y 6/1)	Not recorded	Not recorded	Subangular blocky	Moderate	Weak (moist)	Few (0-10) fine (1-2 mm) and very fine (<1 mm)	5	0.22	B
B2	550-900+			Heavy Clay		Red (2.5YR 5/6)	Not recorded	Not recorded	Not recorded	Not recorded	Firm (moist)				

Other information

Treatment 1 (composted feedlot manure at 50 t/ha + lime at 8 t/ha + gypsum at 4 t/ha + zeolite at 5 t/ha) spread and incorporated to 240 mm depth plus Treatment 2 (composted feedlot manure at 50 t/ha + lime at 8 t/ha + gypsum at 4 t/ha + zeolite at 5 t/ha) within excavated soil slots 200 mm wide, at 1.5 metre spacings and to a depth of 650 mm. Planted to annual species (triticale). Worm activity (one!) was observed.

Soil Profile Description

Project	IA059500
Date	27/05/2015
Scribe	K Brown
Location	TP32 (Plot 8)
Observation	Soil pit
Easting/ Latitude	0402516/ 32°5'18.49612''
Zone	56
ASC Mapped	
Dominant Vegetation Form	Non-woody
Ground Cover %	Dense (>70%)
Aspect	Crest
Northing/ Longitude	6449291/ 151°58'1.08109''
Scale	
ASC Ground Truth	
Secondary Vegetation Form	
Ground Cover %	
Slope %	0
Rock Outcrop	No rock outcrop
Erosion Type	None evident
Vegetation (species)	Lucerne (perennial)
Drainage (site)	Imperfectly drained
Erosion Extent	None evident
Landform	Upper slope
Soil Surface Condition	Soft
Land Use	Pastures
Erosion State	Stabilised

Landscape Photo (North)

Landscape Photo (East)

Soil Surface Condition Photo

Site Type

Detailed + Sampled for Lab

Microrelief

Type	None evident
Vertical (m)	
Horizontal (m)	
Sampled	

Landscape Photo (South)

Landscape Photo (West)

Soil Profile (2)

Other Information

TP32 comparative to TP24 (2014)
Plot 8 (Treatment 1 and Treatment 2)
Slots to 650 mm

Dominant Vegetation Photo 1

Dominant Vegetation Photo 2

Soil Profile Description

Horizon	Depth (mm)	Profile Photo	Boundary	Texture	Moist Colour	Mottle (colour, abundance)	Segregations (abundance, nature)	Coarse fragments (abundance, size)	Structure (type)	Structure (grade)	Consistence (soil water status)	Roots (abundance, size)	Lab pH_w (1:5)	Lab EC_w (1:5) dS/m	Depth of Sample for Lab (mm)
A1	0-300		Clear	Clay Loam	Brown (7.5YR 4/2)		Not recorded	Not recorded	Polyhedral	Weak	Weak (moist)	Many (25-200) coarse (5-10 mm), medium (2-5 mm) and fine (1-2 mm)	6.5	0.21	A
B21	300-600		Clear	Medium Clay		Strong brown (7.5YR 4/6)	Not recorded	Not recorded	Polyhedral	Moderate	Weak (moist)	Many (25-200) coarse (5-10 mm), medium (2-5 mm) and fine (1-2 mm)	5.3	0.25	B
B22	600+			Medium Heavy Clay		Reddish yellow (7.5YR 6/6)	Not recorded	Not recorded	Subangular blocky	Moderate	Weak (moderately moist)	Common (10-25) medium (2-5 mm), fine (1-2 mm) and very fine (<1			

Other information

Treatment 1 (composted feedlot manure at 50 t/ha + lime at 8 t/ha + gypsum at 4 t/ha + zeolite at 5 t/ha) spread and incorporated to 240 mm depth plus Treatment 2 (composted feedlot manure at 50 t/ha + lime at 8 t/ha + gypsum at 4 t/ha + zeolite at 5 t/ha) within excavated soil slots 200 mm wide, at 1.5 metre spacings and to a depth of 650 mm. Planted to perennial species (lucerne). No worm activity was observed.