MURRAY**FUTURES**
Lower Lakes & Coorong Recovery

Acid Sulfate Soils Research Program

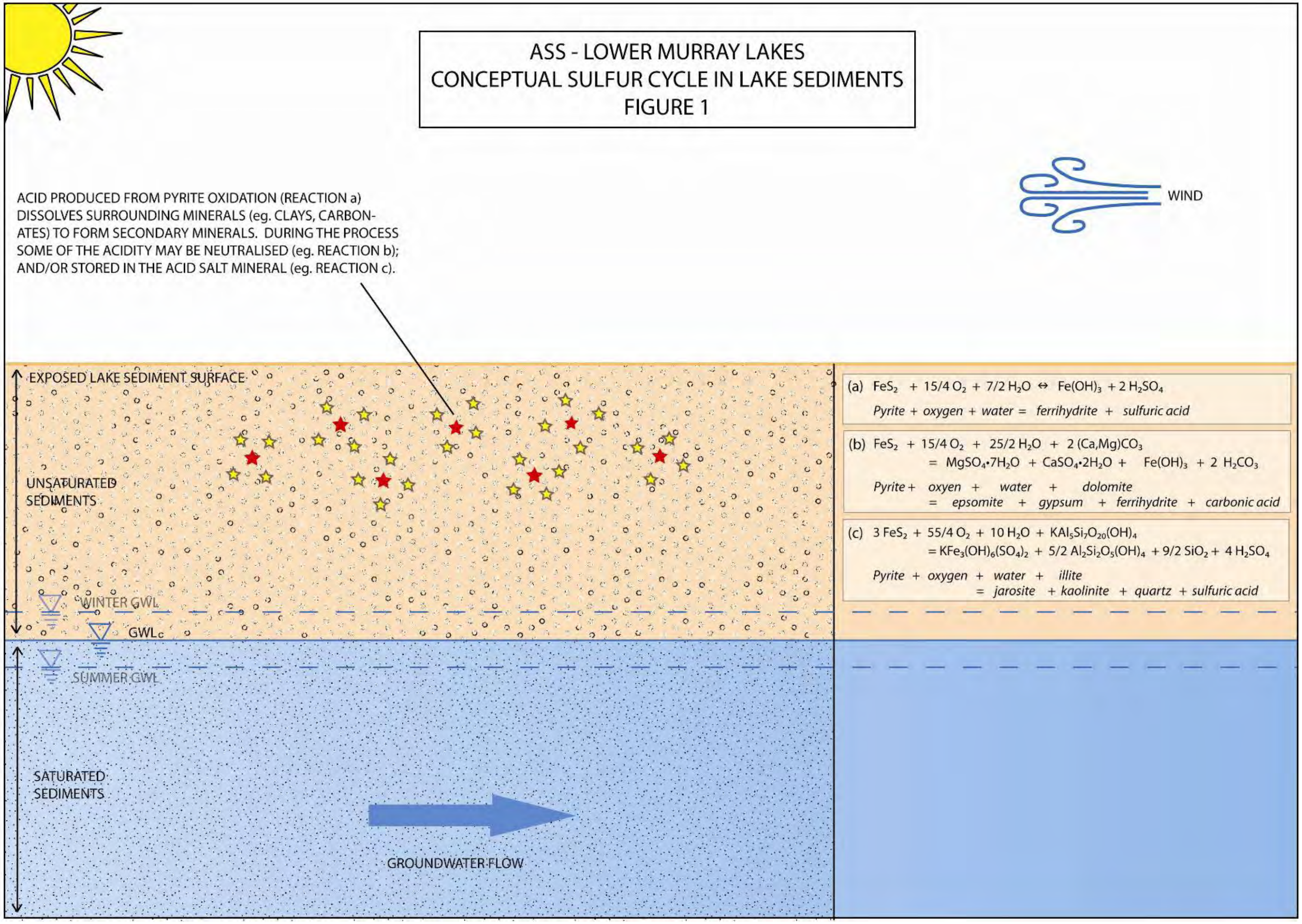
Quantification of Acidity Flux Rates to the Lower Murray Lakes

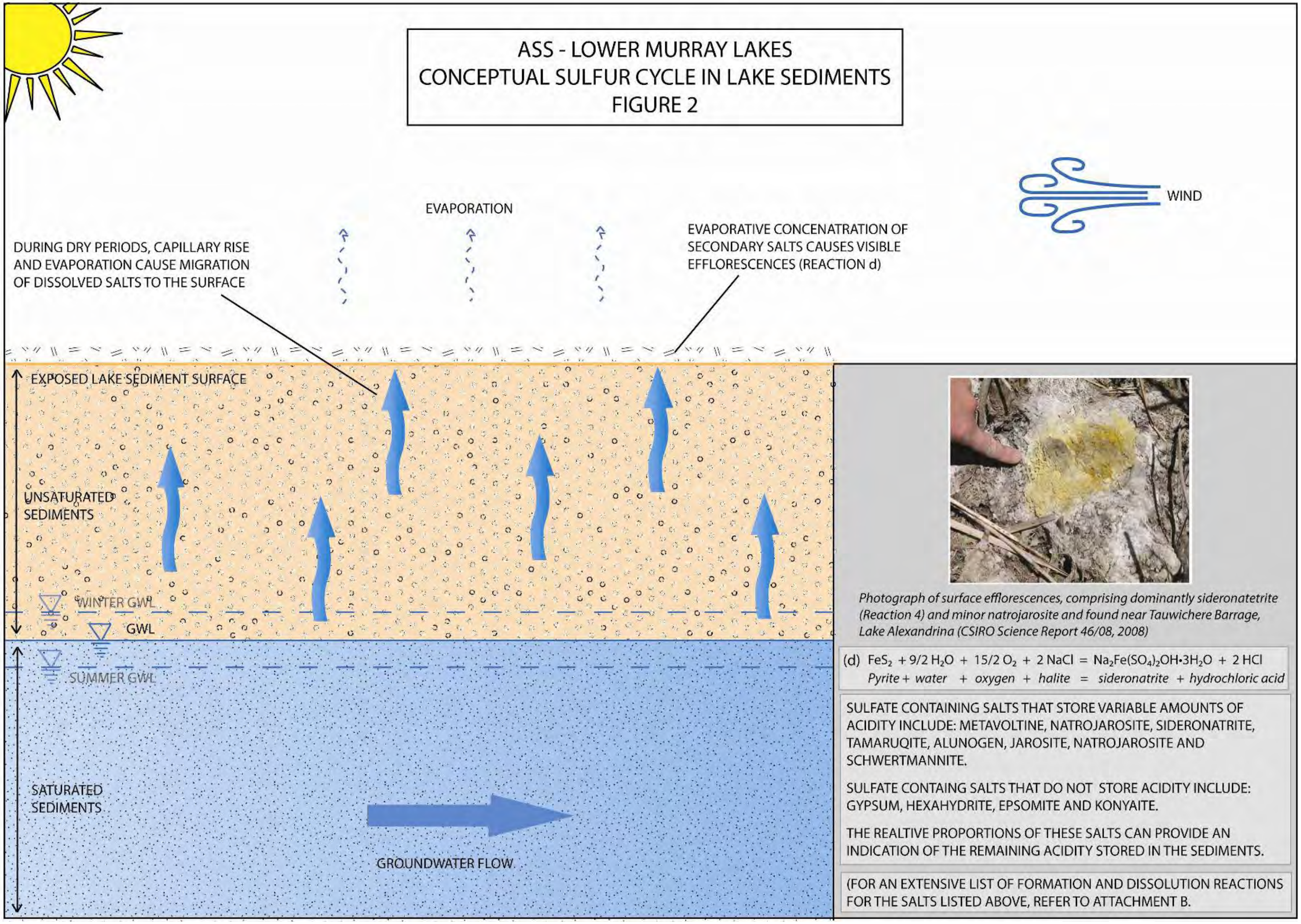
Report 2 | Part 2 of 3: Attachments A – J | April 2010

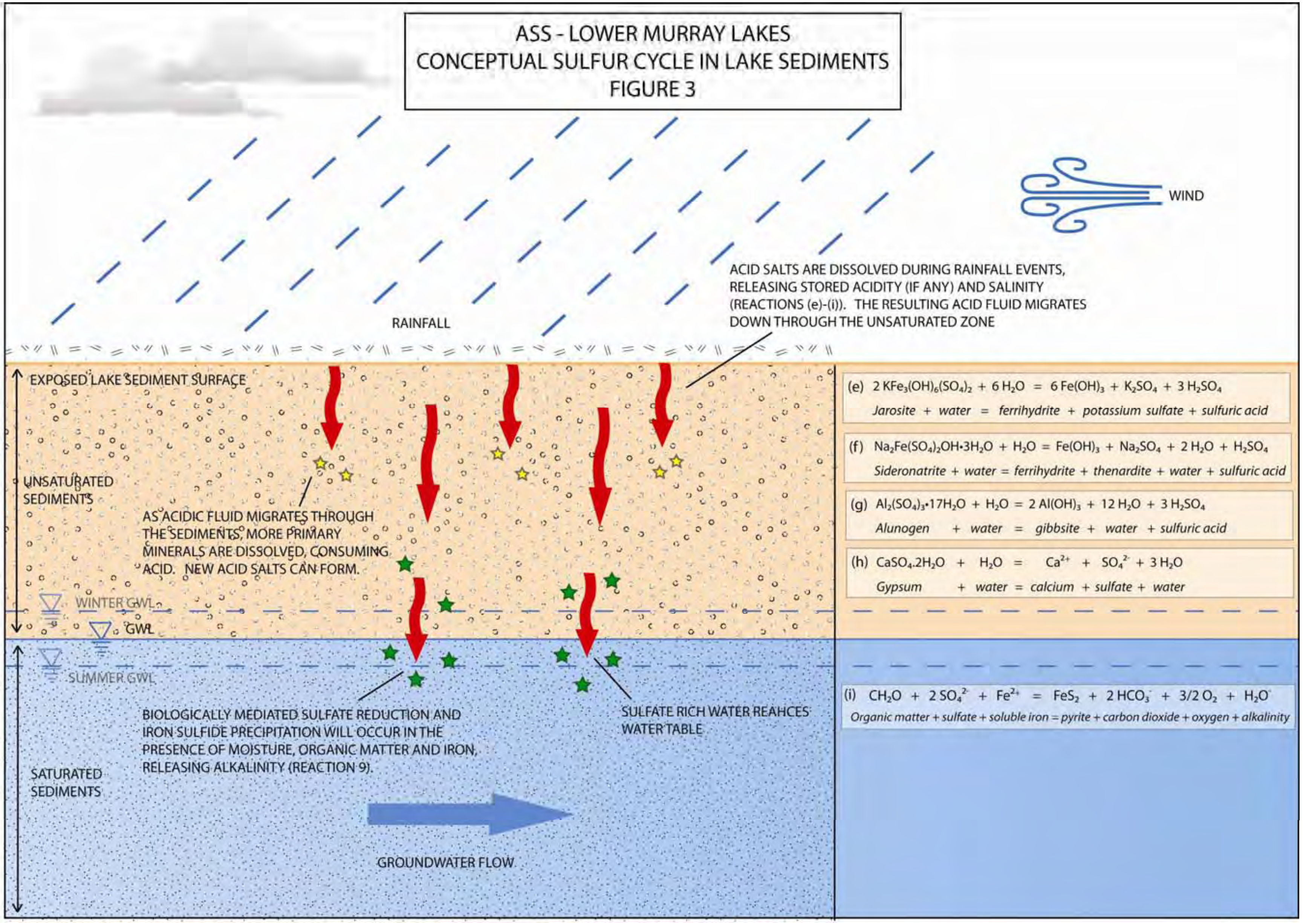
Australian Government
Government of South Australia
WATER FOR GOOD

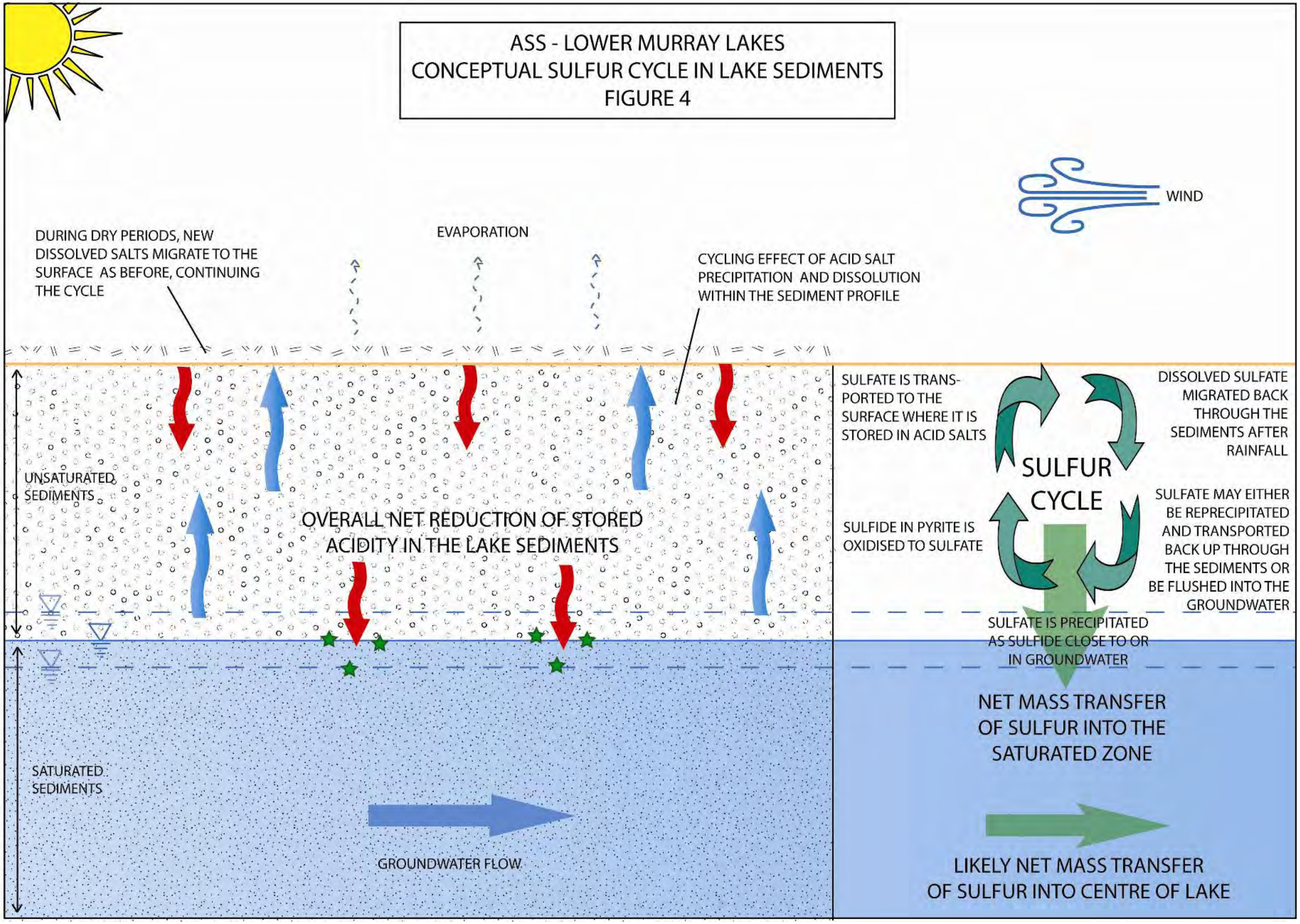
Attachment A:

Key sulfur cycling processes in lake sediments


ASS - LOWER MURRAY LAKES
CONCEPTUAL SULFUR CYCLE IN LAKE SEDIMENTS
FIGURE 1
WIND
ACID PRODUCED FROM PYRITE OXIDATION (REACTION a) DISSOLVES SURROUNDING MINERALS (eg. CLAYS, CARBONATES) TO FORM SECONDARY MINERALS. DURING THE PROCESS SOME OF THE ACIDITY MAY BE NEUTRALISED (eg. REACTION b); AND/OR STORED IN THE ACID SALT MINERAL (eg. REACTION c).
EXPOSED LAKE SEDIMENT SURFACE
UNSATURATED SEDIMENTS
WINTER GWL
GWLc
SUMMER GWL
SATURATED SEDIMENTS
GROUNDWATER FLOW
(a) $FeS_2 + 15/4\ O_2 + 7/2\ H_2O \leftrightarrow Fe(OH)_3 + 2\ H_2SO_4$
Pyrite + oxygen + water = ferrihydrite + sulfuric acid
(b) $FeS_2 + 15/4\ O_2 + 25/2\ H_2O + 2\ (Ca,Mg)CO_3$
$= MgSO_4{\cdot}7H_2O + CaSO_4{\cdot}2H_2O + Fe(OH)_3 + 2\ H_2CO_3$
Pyrite + oxyen + water + dolomite
= epsomite + gypsum + ferrihydrite + carbonic acid
(c) $3\ FeS_2 + 55/4\ O_2 + 10\ H_2O + KAl_5Si_7O_{20}(OH)_4$
$= KFe_3(OH)_6(SO_4)_2 + 5/2\ Al_2Si_2O_5(OH)_4 + 9/2\ SiO_2 + 4\ H_2SO_4$
Pyrite + oxygen + water + illite
= jarosite + kaolinite + quartz + sulfuric acid


ASS - LOWER MURRAY LAKES
CONCEPTUAL SULFUR CYCLE IN LAKE SEDIMENTS
FIGURE 2
WIND
EVAPORATION
DURING DRY PERIODS, CAPILLARY RISE AND EVAPORATION CAUSE MIGRATION OF DISSOLVED SALTS TO THE SURFACE
EVAPORATIVE CONCENATRATION OF SECONDARY SALTS CAUSES VISIBLE EFFLORESCENCES (REACTION d)
EXPOSED LAKE SEDIMENT SURFACE
UNSATURATED SEDIMENTS
WINTER GWL
GWL
SUMMER GWL
SATURATED SEDIMENTS
GROUNDWATER FLOW
Photograph of surface efflorescences, comprising dominantly sideronatetrite (Reaction 4) and minor natrojarosite and found near Tauwichere Barrage, Lake Alexandrina (CSIRO Science Report 46/08, 2008)
(d) $FeS_2 + 9/2\ H_2O + 15/2\ O_2 + 2\ NaCl = Na_2Fe(SO_4)_2OH{\cdot}3H_2O + 2\ HCl$
Pyrite + water + oxygen + halite = sideronatrite + hydrochloric acid
SULFATE CONTAINING SALTS THAT STORE VARIABLE AMOUNTS OF ACIDITY INCLUDE: METAVOLTINE, NATROJAROSITE, SIDERONATRITE, TAMARUQITE, ALUNOGEN, JAROSITE, NATROJAROSITE AND SCHWERTMANNITE.
SULFATE CONTAING SALTS THAT DO NOT STORE ACIDITY INCLUDE: GYPSUM, HEXAHYDRITE, EPSOMITE AND KONYAITE.
THE REALTIVE PROPORTIONS OF THESE SALTS CAN PROVIDE AN INDICATION OF THE REMAINING ACIDITY STORED IN THE SEDIMENTS.
(FOR AN EXTENSIVE LIST OF FORMATION AND DISSOLUTION REACTIONS FOR THE SALTS LISTED ABOVE, REFER TO ATTACHMENT B.


ASS - LOWER MURRAY LAKES
CONCEPTUAL SULFUR CYCLE IN LAKE SEDIMENTS
FIGURE 3
WIND
RAINFALL
ACID SALTS ARE DISSOLVED DURING RAINFALL EVENTS, RELEASING STORED ACIDITY (IF ANY) AND SALINITY (REACTIONS (e)-(i)). THE RESULTING ACID FLUID MIGRATES DOWN THROUGH THE UNSATURATED ZONE
EXPOSED LAKE SEDIMENT SURFACE
UNSATURATED SEDIMENTS
AS ACIDIC FLUID MIGRATES THROUGH THE SEDIMENTS, MORE PRIMARY MINERALS ARE DISSOLVED, CONSUMING ACID. NEW ACID SALTS CAN FORM.
WINTER GWL
GWL
SUMMER GWL
BIOLOGICALLY MEDIATED SULFATE REDUCTION AND IRON SULFIDE PRECIPITATION WILL OCCUR IN THE PRESENCE OF MOISTURE, ORGANIC MATTER AND IRON, RELEASING ALKALINITY (REACTION 9).
SULFATE RICH WATER REAHCES WATER TABLE
SATURATED SEDIMENTS
GROUNDWATER FLOW
(e) $2\,KFe_3(OH)_6(SO_4)_2 + 6\,H_2O = 6\,Fe(OH)_3 + K_2SO_4 + 3\,H_2SO_4$
Jarosite + water = ferrihydrite + potassium sulfate + sulfuric acid
(f) $Na_2Fe(SO_4)_2OH{\cdot}3H_2O + H_2O = Fe(OH)_3 + Na_2SO_4 + 2\,H_2O + H_2SO_4$
Sideronatrite + water = ferrihydrite + thenardite + water + sulfuric acid
(g) $Al_2(SO_4)_3{\cdot}17H_2O + H_2O = 2\,Al(OH)_3 + 12\,H_2O + 3\,H_2SO_4$
Alunogen + water = gibbsite + water + sulfuric acid
(h) $CaSO_4.2H_2O + H_2O = Ca^{2+} + SO_4^{2-} + 3\,H_2O$
Gypsum + water = calcium + sulfate + water
(i) $CH_2O + 2\,SO_4^{2-} + Fe^{2+} = FeS_2 + 2\,HCO_3^- + 3/2\,O_2 + H_2O^-$
Organic matter + sulfate + soluble iron = pyrite + carbon dioxide + oxygen + alkalinity


ASS - LOWER MURRAY LAKES
CONCEPTUAL SULFUR CYCLE IN LAKE SEDIMENTS
FIGURE 4
WIND
EVAPORATION
DURING DRY PERIODS, NEW DISSOLVED SALTS MIGRATE TO THE SURFACE AS BEFORE, CONTINUING THE CYCLE
CYCLING EFFECT OF ACID SALT PRECIPITATION AND DISSOLUTION WITHIN THE SEDIMENT PROFILE
UNSATURATED SEDIMENTS
OVERALL NET REDUCTION OF STORED ACIDITY IN THE LAKE SEDIMENTS
SULFATE IS TRANSPORTED TO THE SURFACE WHERE IT IS STORED IN ACID SALTS
SULFUR CYCLE
DISSOLVED SULFATE MIGRATED BACK THROUGH THE SEDIMENTS AFTER RAINFALL
SULFIDE IN PYRITE IS OXIDISED TO SULFATE
SULFATE MAY EITHER BE REPRECIPITATED AND TRANSPORTED BACK UP THROUGH THE SEDIMENTS OR BE FLUSHED INTO THE GROUNDWATER
SULFATE IS PRECIPITATED AS SULFIDE CLOSE TO OR IN GROUNDWATER
NET MASS TRANSFER OF SULFUR INTO THE SATURATED ZONE
SATURATED SEDIMENTS
GROUNDWATER FLOW
LIKELY NET MASS TRANSFER OF SULFUR INTO CENTRE OF LAKE

Attachment B:

Acidity generation, neutralisation, storage and release reactions

A series of reactions depicting the formation and subsequent dissolution of key secondary salts in sediments from the Lower Murray Lakes (identified by Fitzpatrick et al., 2008) is summarised below. Reactions of formation of the salts represent the simplest and most likely derivation from pyrite oxidation products and other widely available mineralogical components of lake sediments. Dissolution reactions simply involve the addition of water and sometimes oxygen to the salt.

A summary of the implications of each reaction in terms of the fate of the acidity produced is tabulated below. Reaction stoichiometries used to generate the table are provided later in Attachment B.

No.	Pyrite + oxygen + water +		=	+/- sulfuric acid +/- hydrochloric acid				Relative to acid produced per mol of pyrite oxidised		
	Source Mineral 1	Source Mineral 2		Mineral Formed 1	Mineral Formed 2	Mineral Formed 3	Mineral Formed 4	% acidity neutralised in reaction	% acidity stored in Mineral Formed 1	% acidity released during reaction
1	halite	illite	=	metavoltine	kaolinite	-	-	0%	57%	36%
3	halite	-	=	sideronatrite	-	-	-	0%	50%	50%
5	halite	montmorillonite	=	tamarugite	gypsum	ferrihydrite	-	38%	31%	31%
6	halite	kaolinite	=	tamarugite	ferrihydrite	-	-	0%	50%	50%
9	kaolinite	-	=	alunogen	ferrihydrite	-	-	0%	100%	0%
10	illite	-	=	alunogen	ferrihydrite	-	-	6%	94%	0%
13	calcite[1]	-	=	gypsum	ferrihydrite	-	-	50%	0%	50%
14	calcite[1,2]	-	=	gypsum	ferrihydrite	-	-	100%	0%	0%
15	montmorillonite	-	=	gypsum	ferrihydrite	-	-	100%	0%	0%
16	dolomite[1]	-	=	gypsum	ferrihydrite	-	-	100%	0%	0%
18	dolomite[1]	-	=	magnesium hexahydrite	gypsum	ferrihydrite	-	100%	0%	0%
20	dolomite	halite	=	konyaite	gypsum	ferrihydrite	-	67%	0%	33%
21	montmorillonite	halite	=	konyaite	gypsum	kaolinite	ferrihydrite	56%	0%	44%
23	dolomite[1]	-	=	botrygen	gypsum	ferrihydrite	-	67%	33%	0%
24	montmorillonite	-	=	botrygen	gypsum	kaolinite	ferrihydrite	56%	44%	0%
26	montmorillonite	-	=	pickeringite	gypsum	ferrihydrite	-	45%	55%	0%
27	dolomite[1]	kaolinite	=	pickeringite	gypsum	ferrihydrite	-	40%	60%	0%

No.	Pyrite + oxygen + water +		=	+/- sulfuric acid +/- hydrochloric acid				Relative to acid produced per mol of pyrite oxidised		
	Source Mineral 1	Source Mineral 2		Mineral Formed 1	Mineral Formed 2	Mineral Formed 3	Mineral Formed 4	% acidity neutralised in reaction	% acidity stored in Mineral Formed 1	% acidity released during reaction
30	kaolinite	-	=	(Al,Fe) redingtonite	ferrihydrite	-	-	0%	100%	0%
33	montmorillonite	kaolinite	=	(Al,Mg) redingtonite	gypsum	ferrihydrite	-	29%	71%	0%
34	montmorillonite	-	=	(Al,Mg) redingtonite	gypsum	ferrihydrite	-	45%	55%	0%
37	montmorillonite	-	=	halotrichite	gypsum	kaolinite	ferrihydrite	56%	44%	0%
38	kaolinite	-	=	halotrichite	ferrihydrite	-	-	0%	100%	0%
41	-	-	=	ferrihydrite	-	-	-	0%	0%	100%
42	-	-	=	schwertmannite	-	-	-	0%	6%	94%
44	halite	-	=	natrojarosite	-	-	-	0%	25%	75%
47	illite	-	=	jarosite	kaolinite	-	-	8%	25%	67%
48	muscovite	-	=	jarosite	kaolinite	-	-	8%	25%	67%
50	-	-	=	copiapite	-	-	-	0%	60%	40%

[1] Carbon dioxide gas is evolved. [2] Assumes an excess of calcite is available. The release of carbon dioxide as a gas is probably dependent on the degree of saturation of a sediment during secondary salt formation.

Metavoltine [$Na_6K_2FeFe_6(SO_4)_{12}O_2{\cdot}18H_2O$]

(1) $7\ FeS_2 + 37/2\ O_2 + 29\ H_2O + 6\ NaCl + 2\ KAl_5Si_7O_{20}(OH)_4$

$= Na_6K_2FeFe_6(SO_4)_{12}O_2{\cdot}18H_2O + 5\ Al_2Si_2O_5(OH)_4 + 4\ SiO_2 + 2\ H_2SO_4 + 6\ HCl$

pyrite + oxygen + water + halite + illite = metavoltine + kaolinite + quartz + sulfuric acid + hydrochloric acid

(2) $Na_6K_2FeFe_6(SO_4)_{12}O_2{\cdot}18H_2O + 11/4\ O_2 + H_2O = 7\ Fe(OH)_3 + 2\ K^+ + 6\ Na^+ + 4\ SO_4^{2-} + 11/2\ H_2O + 8\ H_2SO_4$

metavoltine + oxygen + water = ferrihydrite + potassium ions + sodium ions + sulfate ions + water + sulfuric acid

Sideronatrite [$Na_2Fe(SO_4)_2OH{\cdot}3H_2O$]

(3) $FeS_2 + 9/2\ H_2O + 15/4\ O_2 + 2\ NaCl = Na_2Fe(SO_4)_2OH{\cdot}3H_2O + 2\ HCl$

pyrite + water + oxygen + halite = sideronatrite + hydrochloric acid

(4) $Na_2Fe(SO_4)_2OH{\cdot}3H_2O + H_2O = Fe(OH)_3 + 2\ Na^+ + SO_4^{2-} + 2\ H_2O + H_2SO_4$

sideronatrite + water = ferrihydrite + sodium ions + sulfate ions + water + sulfuric acid

Tamarugite [$Na_2Al(SO_4)_2.OH{\cdot}3H_2O$]

(5) $13/2\ FeS_2 + 171/8\ O_2 + 75/4\ H_2O + 8\ NaCl + CaMg_4Si_4Al_4O_{20}(OH)_4$

$= 4\ Na_2Al(SO_4)_2OH{\cdot}3H_2O + CaSO_4{\cdot}2H_2O + 4\ Mg^{2+} + 4\ SO_4^{2-} + 13/2\ Fe(OH)_3 + 4\ SiO_2 + 8\ HCl$

pyrite + oxygen + water + halite + montmorillonite

= tamarugite + gypsum + magnesium ions + sulfate ions + ferrihydrite + quartz + hydrochloric acid

(6) $FeS_2 + 5\ O_2 + 5/2\ H_2O + 2\ NaCl + 1/2\ Al_2Si_2O_5(OH)_4 = Na_2Al(SO_4)_2OH{\cdot}3H_2O + Fe(OH)_3 + SiO_2 + 2\ HCl$

pyrite + oxygen + water + halite + kaolinite = tamarugite + ferrihydrite + quartz + hydrochloric acid

(7) $Na_2Al(SO_4)_2OH{\cdot}3H_2O + H^+ = 2\ Na^+ + Al^{3+} + 2\ SO_4^{2-} + 4\ H_2O$

tamarugite + hydrogen ions = sodium ions + aluminium ions + sulfate ions + water

(8) $Al^{3+} + 3\ H_2O = Al(OH)_3 + 3H^+$

aluminium ions + water = gibbsite + hydrogen ions

Alunogen [$Al_2(SO_4)_3{\cdot}17H_2O$]

(9) $3\ FeS_2 + 45/4\ O_2 + 35/2\ H_2O + 2\ Al_2Si_2O_5(OH)_4 = 2\ Al_2(SO_4)_3{\cdot}17H_2O + 3\ Fe(OH)_3 + 4\ SiO_2$

pyrite + oxygen + water + kaolinite = alunogen + ferrihydrite + quartz

(10) $8\ FeS_2 + 32\ O_2 + 93\ H_2O + 2\ KAl_5Si_7O_{20}(OH)_4 = 5\ Al_2(SO_4)_3{\cdot}17H_2O + 8\ Fe(OH)_3 + 2\ K^+ + SO_4^{2-} + 14\ SiO_2$

pyrite + oxygen + water + illite = alunogen + ferrihydrite + potassium ions + sulfate ions + quartz

(11) $Al_2(SO_4)_3{\cdot}17H_2O + H_2O = 2\ Al^{3+} + 3\ SO_4^{2-} + 18\ H_2O$

alunogen + water = Aluminium ions + sulfate ions + water

(12) $Al^{3+} + 3\ H_2O = Al(OH)_3 + 3H^+$

aluminium ions + water = gibbsite + hydrogen ions

Gypsum [$CaSO_4{\cdot}H_2O$]

(13) $FeS_2 + 15/4\ O_2 + 9/2\ H_2O + CaCO_3 = CaSO_4{\cdot}2H_2O + Fe(OH)_3 + H_2SO_4 + CO_2$

pyrite + oxygen + water + calcite = gypsum + ferrihydrite + sulfuric acid + carbon dioxide gas

(14) $FeS_2 + 15/4\ O_2 + 11/2\ H_2O + 2\ CaCO_3 = 2\ CaSO_4{\cdot}2H_2O + Fe(OH)_3 + 2\ CO_2$

pyrite + oxygen + water + calcite = gypsum + ferrihydrite + carbon dioxide gas

(15) $5/2\ FeS_2 + 55/8\ O_2 + 31/4\ H_2O + CaMg_4Si_4Al_4O_{20}(OH)_4$

$= CaSO_4{\cdot}2H_2O + 2\ Al_2Si_2O_5(OH)_4 + 4\ Mg^{2+} + 4\ SO_4^{2-} + 5/2\ Fe(OH)_3$

pyrite + oxygen + water + montmorillonite = gypsum + kaolinite + magnesium ions + sulfate ions + ferrihydrite

(16) $FeS_2 + 15/4\ O_2 + 7/2\ H_2O + 2\ (Ca,Mg)CO_3 = CaSO_4{\cdot}2H_2O + Mg^{2+} + SO_4^{2-} + Fe(OH)_3 + 2\ CO_2$

pyrite + oxygen + water + dolomite = gypsum + magnesium ions + sulfate ions + ferrihydrite + carbon dioxide gas

(17) $CaSO_4.2H_2O + H_2O = Ca^{2+} + SO_4^{2-} + 3 H_2O$

gypsum + water = calcium ions + sulfate ions + water

Magnesium Hexahydrite [$MgSO_4{\cdot}6H_2O$]

(18) $FeS_2 + 7/4\ O_2 + 19/2\ H_2O + 2\ (Ca,Mg)CO_3 = MgSO_4{\cdot}6H_2O + CaSO_4.2H_2O + Fe(OH)_3 + 2\ CO_2$

pyrite + oxygen + water + dolomite = magnesium hexahydrite + gypsum + ferrihydrite + carbon dioxide gas

(19) $MgSO_4{\cdot}6H_2O + H_2O = Mg^{2+} + SO_4^{2-} + 7\ H_2O$

magnesium hexahydrite + water = magnesium ions + sulfate ions + water

Konyaite [$Na_2Mg(SO_4)_2{\cdot}5H_2O$]

(20) $3\ FeS_2 + 13/4\ O_2 + 41/2\ H_2O + 4\ (CaMg)CO_3 + 4\ NaCl = 2\ Na_2Mg(SO_4)_2{\cdot}5H_2O + 2\ CaSO_4.2H_2O + 3\ Fe(OH)_3 + 4\ HCl$

pyrite + oxygen + water + dolomite + halite = konyaite + gypsum + ferrihydrite + hydrochloric acid

(21) $9/2\ FeS_2 + 123/8\ O_2 + 139/4\ H_2O + CaMg_4Si_4Al_4O_{20}(OH)_4 + 8\ NaCl$

$= 4\ Na_2Mg(SO_4)_2{\cdot}5H_2O + CaSO_4.2H_2O + 2\ Al_2Si_2O_5(OH)_4 + 9/2\ Fe(OH)_3 + 8\ HCl$

pyrite + oxygen + water + montmorillonite + halite = konyaite + gypsum + kaolinite + ferrihydrite + hydrochloric acid

(22) $Na_2Mg(SO_4)_2{\cdot}5H_2O + H_2O = 2\ Na^+ + 2\ SO_4^{2-} + Mg^{2+} + 6\ H_2O$

konyaite + water = sodium ions + sulfate ions + magnesium ions + water

Botryogen [$MgFe^{3+}(SO_4)_2(OH){\cdot}7H_2O$]

(23) $3/2\ FeS_2 + 45/8\ O_2 + 41/4\ H_2O + 2\ (Ca,Mg)CO_3 = MgFe(SO_4)_2OH{\cdot}7H_2O + CaSO_4{\cdot}2H_2O + 1/2\ Fe(OH)_3 + 2\ CO_2$

pyrite + oxygen + water + dolomite = botryogen + gypsum + ferrihydrite + carbon dioxide gas

(24) $9/2\ FeS_2 + 111/8\ O_2 + 139/4\ H_2O + CaMg_4Si_4Al_4O_{20}(OH)_4$

$= 4\ MgFe(SO_4)_2OH{\cdot}7H_2O + CaSO_4.2H_2O + 2\ Al_2Si_2O_5(OH)_4 + 1/2\ Fe(OH)_3$

pyrite + oxygen + water + montmorillonite = botryogen + gypsum + kaolinite + ferrihydrite

(25) $MgFe(SO_4)_2OH{\cdot}7H_2O + H_2O = Mg^{2+} + SO_4^{2-} + Fe(OH)_3 + H_2SO_4 + 6\ H_2O$

botryogen + water = magnesium ions + sulfate ions + ferrihydrite + sulfuric acid + water

Pickeringite [$MgAl_2(SO_4)_4{\cdot}22H_2O$]

(26) $11/2\ FeS_2 + 89/8\ O_2 + 209/4\ H_2O + CaMg_4Si_4Al_4O_{20}(OH)_4$

$= 2\ MgAl_2(SO_4)_4{\cdot}22H_2O + CaSO_4.2H_2O + 2\ Mg^{2+} + 2\ SO_4^{2-} + 4\ SiO_2 + 11/2\ Fe(OH)_3$

Pyrite + oxygen + water + montmorillonite = pickeringite + gypsum + magnesium ions + sulfate ions + quartz + ferrihydrite

(27) $5/2\ FeS_2 + 75/8\ O_2 + 103/4\ H_2O + 2\ (Ca,Mg)CO_3 + Al_2Si_2O_5(OH)_4$

$= MgAl_2(SO_4)_4{\cdot}22H_2O + CaSO_4.2H_2O + 2\ SiO_2 + 5/2\ Fe(OH)_3 + 2\ CO_2$

pyrite + oxygen + water + dolomite + kaolinite = pickeringite + gypsum + quartz + ferrihydrite + carbon dioxide gas

(28) $MgAl_2(SO_4)_4{\cdot}22H_2O + H_2O = Mg^{2+} + 2\ Al^{3+} + 4\ SO_4^{2-} + 23\ H_2O$

Pickeringite + water = magnesium ions + aluminium ions + sulfate ions + water

(29) $Al^{3+} + 3\ H_2O = Al(OH)_3 + 3H^+$

aluminium + water = gibbsite + hydrogen ions

Redingtonite [$(Fe^{2+},Mg,Ni)(Cr,Al)_2(SO_4)_4{\cdot}22H_2O$]

(Fe, Al rich)

(30) $2\ FeS_2 + 29/4\ O_2 + 43/2\ H_2O + Al_2Si_2O_5(OH)_4 = FeAl_2(SO_4)_4{\cdot}22H_2O + 2\ SiO_2 + Fe(OH)_3$

pyrite + oxygen + water + kaolinite = redingtonite + quartz + ferrihydrite

(31) $FeAl_2(SO_4)_4 \cdot 22H_2O + 1/4\ O_2 + H_2O = Fe(OH)_3 + 2\ Al^{3+} + 3\ SO_4^{2-} + H_2SO_4 + 41/2\ H_2O$

redingtonite + oxygen + water = ferrihydrite + aluminium ions + sulfate ions + sulfuric acid + water

(32) $Al^{3+} + 3\ H_2O = Al(OH)_3 + 3H^+$

aluminium ions + water = gibbsite + hydrogen ions

<u>Mg, Al rich:</u>

(33) $17/2\ FeS_2 + 243/8\ O_2 + 387/4\ H_2O + CaMg_4Si_4Al_4O_{20}(OH)_4 + 2\ Al_2Si_2O_5(OH)_4$

$= 4\ MgAl_2(SO_4)_4 \cdot 22H_2O + CaSO_4.2H_2O + 8\ SiO_2 + 17/2\ Fe(OH)_3$

pyrite + oxygen + water + montmorillonite + kaolinite = redingtonite + gypsum + quartz + ferrihydrite

(34) $11/2\ FeS_2 + 137/8\ O_2 + 209/4\ H_2O + CaMg_4Si_4Al_4O_{20}(OH)_4$

$= 2\ MgAl_2(SO_4)_4 \cdot 22H_2O + CaSO_4.2H_2O + 2\ Mg^{2+} + SO_4^{2-} + 4\ SiO_2 + 11/2\ Fe(OH)_3$

pyrite + oxygen + water + montmorillonite

= redingtonite + gypsum + magnesium ions + sulfate ions + quartz + ferrihydrite

(35) $MgAl_2(SO_4)_4 \cdot 22H_2O + H_2O = Mg^{2+} + 2\ Al^{3+} + 4\ SO_4^{2-} + 23\ H_2O$

redingtonite + water = magnesium ions + aluminium ions + sulfate ions + water

(36) $Al^{3+} + 3\ H_2O = Al(OH)_3 + 3H^+$

aluminium ions + water = gibbsite + hydrogen ions

Halotrichite [$Fe^{2+}Al_2(SO_4)_4 \cdot 22H_2O$]

(37) $9/2\ FeS_2 + 89/8\ O_2 + 149/4\ H_2O + CaMg_4Si_4Al_4O_{20}(OH)_4$

$= FeAl_2(SO_4)_4 \cdot 22H_2O + Al_2Si_2O_5(OH)_4 + CaSO_4.2H_2O + 4\ Mg^{2+} + 4\ SO_4^{2-} + 7/2\ Fe(OH)_3 + 2\ SiO_2$

pyrite + oxygen + water + montmorillonite

= halotrichite + kaolinite + gypsum + magnesium + sulfate ions + ferrihydrite + quartz

(38) $2\ FeS_2 + 29/4\ O_2 + 43/2\ H_2O + Al_2Si_2O_5(OH)_4 = FeAl_2(SO_4)_4{\cdot}22H_2O + Fe(OH)_3 + 2\ SiO_2$

pyrite + oxygen + water + kaolinite = halotrichite + ferrihydrite + quartz

(39) $FeAl_2(SO_4)_4{\cdot}22H_2O + 1/4\ O_2 + H_2O = Fe(OH)_3 + 2\ Al^{3+} + 3\ SO_4^{2-} + 41/2\ H_2O + H_2SO_4$

halotrichite + oxygen + water = ferrihydrite + aluminium ions + sulfate ions + water + sulfuric acid

(40) $Al^{3+} + 3\ H_2O = Al(OH)_3 + 3H^+$

aluminium ions + water = gibbsite + hydrogen ions

Ferrihydrite [$Fe(OH)_3$]

(41) $FeS_2 + 15/4\ O_2 + 7/2\ H_2O = Fe(OH)_3 + 2\ H_2SO_4$

pyrite + oxygen + water = ferrihydrite + sulfuric acid

Schwertmannite [$Fe^{3+}_{16}O_{16}(OH)_{12}(SO4)_2$]

(42) $8\ FeS_2 + 30\ O_2 + 18\ H_2O = Fe_8O_8(OH)_6SO_4 + 15\ H_2SO_4$

pyrite + oxygen + water = Schwertmannite + sulfuric acid

(43) $Fe_8O_8(OH)_6SO_4 + 10\ H_2O = 8\ Fe(OH)_3 + H_2SO_4$

schwertmannite + water = ferrihydrite + sulfuric acid

Natrojarosite [$NaFe_3(SO_4)_2(OH)_6$]

(44) $3\ FeS_2 + 45/4\ O_2 + 15/2\ H_2O + NaCl = NaFe_3(OH)_6(SO_4)_2 + HCl + 4\ H_2SO_4$

pyrite + oxygen + water + halite = natrojarosite + hydrochloric acid + sulfuric acid

(45) $8\ NaFe_3(OH)_6(SO_4)_2 + H_2O = 3\ Fe_8O_8(OH)_6SO_4 + 8\ Na^+ + 4\ SO_4^{2-} + 9\ H_2SO_4 + 7\ H_2O$

natrojarosite + water = schwertmannite + sodium ions + sulfate ions + sulfuric acid + water

(46) $2\ NaFe_3(OH)_6(SO_4)_2 + 6\ H_2O = 6\ Fe(OH)_3 + 2\ Na^+ + SO_4^{2-} + 3\ H_2SO_4$

natrojarosite + water = ferrihydrite + sodium ions + sulfate ions + sulfuric acid

Jarosite (Na and/or K) [$KFe_3(OH)_6(SO_4)_2$]

(47) $3\ FeS_2 + 53/4\ O_2 + 10\ H_2O + KAl_5Si_7O_{20}(OH)_4 = KFe_3(OH)_6(SO_4)_2 + 5/2\ Al_2Si_2O_5(OH)_4 + 2\ SiO_2 + 4\ H_2SO_4$

pyrite + oxygen + water + illite = jarosite + kaolinite + quartz + sulfuric acid

(48) $3\ FeS_2 + 12\ O_2 + 21/2\ H_2O + KAl_3Si_3O_{10}(OH)_2 = KFe_3(OH)_6(SO_4)_2 + 3/2\ Al_2Si_2O_5(OH)_6 + 4\ H_2SO_4$

pyrite + oxygen + water + muscovite = jarosite + kaolinite + sulfuric acid

(49) $2\ KFe_3(OH)_6(SO_4)_2 + 6\ H_2O = 6\ Fe(OH)_3 + 2\ K^+ + SO_4^{2-} + 3\ H_2SO_4$

jarosite + water = ferrihydrite + potassium sulfate + sulfate ions + sulfuric acid

Copiapite: [$Fe^{2+}Fe^{3+}_4(SO_4)_6(OH)_2 \cdot 20H_2O$]

(50) $5\ FeS_2 + 37/2\ O_2 + 25\ H_2O = FeFe_4(SO_4)_6(OH)_2 \cdot 20H_2O + 4\ H_2SO_4$

pyrite + oxygen + water = copiapite + sulfuric acid

(51) $FeFe_4(SO_4)_6(OH)_2 \cdot 20H_2O + 13/4\ O_2 + H_2O = 5\ Fe(OH)_3 + 6\ H_2SO_4 + 29/2\ H_2O$

copiapite + oxygen + water = ferrihydrite + sulfuric acid + water

Attachment C:

Static acid-base accounting testwork data for samples used in OxCon apparatus and piezometer sediments – Currency Creek, Point Sturt, Campbell Park and Windmill locations

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EB0913942**	Page	: 1 of 16
Client	: **EARTH SYSTEMS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MS SOPHIE PAPE	Contact	: Tim Kilmister
Address	: SUITE 507 1 PRINCESS STREET KEW VIC, AUSTRALIA 3101	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: sophie.pape@earthsystems.com.au	E-mail	: Services.Brisbane@alsenviro.com
Telephone	: +61 92059515	Telephone	: +61-7-3243 7222
Facsimile	: +61 03 92059519	Facsimile	: +61-7-3243 7218
Project	: RSSAO823	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 03-SEP-2009
Sampler	: Sophie Sape	Issue Date	: 16-SEP-2009
Site	: ----		
		No. of samples received	: 94
Quote number	: ME/194/08	No. of samples analysed	: 60

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

WORLD RECOGNISED ACCREDITATION

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dianne Blane		Newcastle
Kim McCabe	Senior Inorganic Chemist	Inorganics
Kim McCabe	Senior Inorganic Chemist	Stafford Minerals - AY

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **ANC Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong.**
- **LCS recovery for [Net Acid Generation] fell outside Dynamic Control Limits. It is however within ALS Static Control Limits and hence deemed acceptable.**

Analytical Results

Sub-Matrix: **COMPOSITE**			Client sample ID	16 & 17 PSD 10 1.59-2.0/2.0-3M	24 & 25 CPO1 2-3 / 3-3.69M	66-68 WM03 60-0.64/64-0.75/.75-0.8 0M	76 & 74 WM03 2.36-2.37/2.37-2.67M	75 & 76 WM03 2.67-2.86/2.86-2.98M
			Client sampling date / time	22-AUG-2009 10:00	23-AUG-2009 10:00	28-AUG-2009 10:00	28-AUG-2009 10:00	28-AUG-2009 10:00
Compound	CAS Number	LOR	Unit	EB0913942-087	EB0913942-088	EB0913942-089	EB0913942-090	EB0913942-091
EA009: Nett Acid Production Potential								
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-38.2	-3.9	12.0	-202	-276
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	11.7	8.6	3.0	11.3	11.0
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	5.7	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	10.8	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	38.8	8.8	3.9	216	290
^ ANC as CaCO3	----	0.1	% CaCO3	4.0	0.9	0.4	22.0	29.6
Fizz Rating	----	0	Fizz Unit	4	2	0	3	3
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.16	0.52	0.44	0.46
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	0.06	0.06	0.71	0.12	0.06

Analytical Results

Sub-Matrix: **COMPOSITE**			Client sample ID	53 & 54 WM04 1.9-2.3/2.3-3M	----	----	----	----
			Client sampling date / time	25-AUG-2009 10:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB0913942-092	----	----	----	----
EA009: Nett Acid Production Potential								
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	**-181**	----	----	----	----
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**11.2**	----	----	----	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	----	----	----	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	----	----	----	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**185**	----	----	----	----
^ ANC as CaCO3	----	0.1	% CaCO3	**18.9**	----	----	----	----
Fizz Rating	----	0	Fizz Unit	**3**	----	----	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.15**	----	----	----	----
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	**0.06**	----	----	----	----

Work Order : EB0913942
Client : EARTH SYSTEMS PTY LTD
Project : RSSAO823

Analytical Results

Sub-Matrix: **LEACHATE**			Client sample ID	13 PSO10 0.34-0.92M	40 CPO4 0.45-0.60M	46 WMO4 0.15-0.36M	----	----
			Client sampling date / time	16-SEP-2009 12:00	16-SEP-2009 12:00	16-SEP-2009 12:00	----	----
Compound	CAS Number	LOR	Unit	EB0913942-007	EB0913942-048	EB0913942-076	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.16**	**1.03**	**0.01**	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.002**	<0.001	**0.003**	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	**0.018**	**0.001**	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L	**0.068**	**0.140**	**0.195**	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.013**	**0.001**	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L	**0.014**	**0.011**	<0.005	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	**0.84**	<0.05	----	----

Analytical Results

Sub-Matrix: SOIL			Client sample ID	8 PS009 0 58-0.89M	9 PS009 1.19-1.29M	10 PS009 2.00-2.47M	11 PS009 2.47-2.58M	12 PS009 2.58-2.74M
			Client sampling date / time	22-AUG-2009 10:00	22-AUG-2009 10:00	22-AUG-2009 10:00	22-AUG-2009 10:00	22-AUG-2009 10:00
Compound	CAS Number	LOR	Unit	EB0913942-001	EB0913942-002	EB0913942-003	EB0913942-004	EB0913942-005
EA009: Nett Acid Production Potential								
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	5.9	-193	-5.6	-123	-221
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	5.4	11.1	8.5	11.4	11.4
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	1.0	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	2.0	199	5.8	124	222
^ ANC as CaCO3	----	0.1	% CaCO3	0.2	20.3	0.6	12.6	22.6
Fizz Rating	----	0	Fizz Unit	0	3	2	3	3
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.26	0.19	0.01	0.03	0.03
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	0.18	0.11	<0.02	0.07	0.14

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	PS-1D	13 PSO10 0.34-0.92M	14 PSO10 1.0-1.18M	15 PSO10 1.18-1.59M	PS-2D
			Client sampling date / time	22-AUG-2009 15:00	22-AUG-2009 10:00	22-AUG-2009 10:00	22-AUG-2009 10:00	22-AUG-2009 15:00
				EB0913942-006	EB0913942-007	EB0913942-008	EB0913942-009	EB0913942-013
EA150: Particle Sizing								
+75µm	----	1	%	78	----	----	----	83
+150µm	----	1	%	54	----	----	----	67
+300µm	----	1	%	18	----	----	----	32
+425µm	----	1	%	5	----	----	----	11
+600µm	----	1	%	1	----	----	----	3
+1180µm	----	1	%	<1	----	----	----	1
+2.36mm	----	1	%	<1	----	----	----	1
+4.75mm	----	1	%	<1	----	----	----	<1
+9.5mm	----	1	%	<1	----	----	----	<1
+19.0mm	----	1	%	<1	----	----	----	<1
+37.5mm	----	1	%	<1	----	----	----	<1
+75.0mm	----	1	%	<1	----	----	----	<1
EA009: Nett Acid Production Potential								
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	----	-4.6	-43.4	-253	----
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	----	11.6	11.4	11.2	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t	----	<0.1	<0.1	<0.1	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t	----	<0.1	<0.1	<0.1	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	----	7.0	55.0	262	----
^ ANC as CaCO3	----	0.1	% CaCO3	----	0.7	5.6	26.7	----
Fizz Rating	----	0	Fizz Unit	----	2	2	3	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	19	----	----	----	13
Silt (2-60 µm)	----	1	%	3	----	----	----	5
Sand (0.06-2.00 mm)	----	1	%	78	----	----	----	82
Gravel (>2mm)	----	1	%	<1	----	----	----	<1
Cobbles (>6cm)	----	1	%	<1	----	----	----	<1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	----	0.08	0.38	0.30	----
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	----	0.08	0.10	0.10	----

Analytical Results

Sub-Matrix: SOIL			Client sample ID	1 PSOO8 0.20-0.72M	2 PSOO8 1-1.32M	3 PSOO8 1.45-1.75M	4 PSOO7 0.11-0.80M	5 PSOO7 1-1.16M
			Client sampling date / time	21-AUG-2009 10:00	21-AUG-2009 10:00	21-AUG-2009 10:00	23-AUG-2009 10:00	22-AUG-2009 10:00
Compound	CAS Number	LOR	Unit	EB0913942-014	EB0913942-015	EB0913942-016	EB0913942-018	EB0913942-019
EA009: Nett Acid Production Potential								
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-12.4	-118	-146	-19.8	-265
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	11.6	10.6	11.3	11.6	11.2
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	17.0	127	152	21.1	267
^ ANC as CaCO3	----	0.1	% CaCO3	1.7	13.0	15.5	2.2	27.3
Fizz Rating	----	0	Fizz Unit	2	3	3	2	3
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.15	0.31	0.19	0.04	0.09
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	0.08	0.10	0.07	0.10	0.06

Analytical Results

Sub-Matrix: SOIL			Client sample ID	6 PSOO7 1.16-1.27M	7 PSOO7 1.43-1.69M	19 CPO1 0.35-0.72M	20 CPO1 0.72-0.91M	22 CPO1 1-1.78M
			Client sampling date / time	22-AUG-2009 10:00	22-AUG-2009 10:00	23-AUG-2009 10:00	23-AUG-2009 10:00	23-AUG-2009 10:00
Compound	CAS Number	LOR	Unit	EB0913942-020	EB0913942-021	EB0913942-023	EB0913942-024	EB0913942-026
EA009: Nett Acid Production Potential								
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-240	-209	8.2	14.1	36.5
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	11.4	11.4	3.0	2.7	2.8
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	6.2	10.2	15.9
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	10.6	15.4	28.2
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	241	210	4.0	27.5	8.5
^ ANC as CaCO3	----	0.1	% CaCO3	24.6	21.4	0.4	2.8	0.9
Fizz Rating	----	0	Fizz Unit	3	3	0	2	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.02	0.40	1.36	1.47
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	0.06	0.11	0.36	1.12	2.61

Analytical Results

Sub-Matrix: SOIL			Client sample ID	26 CPO1 3.69-4M	CP-1D	27 CPO2 0.38-0.98M	28 CPO2 1-2M	31 CPO2 2.40-3.00M
			Client sampling date / time	23-AUG-2009 10:00	23-AUG-2009 15:00	23-AUG-2009 10:00	23-AUG-2009 10:00	23-AUG-2009 10:00
Compound	CAS Number	LOR	Unit	EB0913942-030	EB0913942-031	EB0913942-032	EB0913942-033	EB0913942-036
EA150: Particle Sizing								
+75µm	----	1	%	----	66	----	----	----
+150µm	----	1	%	----	31	----	----	----
+300µm	----	1	%	----	4	----	----	----
+425µm	----	1	%	----	2	----	----	----
+600µm	----	1	%	----	1	----	----	----
+1180µm	----	1	%	----	<1	----	----	----
+2.36mm	----	1	%	----	<1	----	----	----
+4.75mm	----	1	%	----	<1	----	----	----
+9.5mm	----	1	%	----	<1	----	----	----
+19.0mm	----	1	%	----	<1	----	----	----
+37.5mm	----	1	%	----	<1	----	----	----
+75.0mm	----	1	%	----	<1	----	----	----
EA009: Nett Acid Production Potential								
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-284	----	-32.0	49.1	-15.6
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	11.0	----	4.6	2.5	10.6
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	----	<0.1	42.0	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	----	4.3	47.9	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	302	----	44.5	10.3	21.1
^ ANC as CaCO3	----	0.1	% CaCO3	30.8	----	4.5	1.0	2.2
Fizz Rating	----	0	Fizz Unit	3	----	2	0	2
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	27	----	----	----
Silt (2-60 µm)	----	1	%	----	6	----	----	----
Sand (0.06-2.00 mm)	----	1	%	----	67	----	----	----
Gravel (>2mm)	----	1	%	----	<1	----	----	----
Cobbles (>6cm)	----	1	%	----	<1	----	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.61	----	0.41	1.94	0.18
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	0.11	----	0.25	3.20	0.08

Analytical Results

Sub-Matrix: SOIL			Client sample ID	CP-2D	34 CPO3 0.50-0.985M	35 CPO3 1.0-2.0M	36 CPO3 2.0-2.35M	37 CPO3 2.35-2.81M
			Client sampling date / time	23-AUG-2009 15:00	23-AUG-2009 10:00	23-AUG-2009 10:00	23-AUG-2009 10:00	23-AUG-2009 10:00
Compound	CAS Number	LOR	Unit	EB0913942-039	EB0913942-040	EB0913942-041	EB0913942-042	EB0913942-043
EA150: Particle Sizing								
+75µm	----	1	%	86	----	----	----	----
+150µm	----	1	%	49	----	----	----	----
+300µm	----	1	%	6	----	----	----	----
+425µm	----	1	%	2	----	----	----	----
+600µm	----	1	%	1	----	----	----	----
+1180µm	----	1	%	<1	----	----	----	----
+2.36mm	----	1	%	<1	----	----	----	----
+4.75mm	----	1	%	<1	----	----	----	----
+9.5mm	----	1	%	<1	----	----	----	----
+19.0mm	----	1	%	<1	----	----	----	----
+37.5mm	----	1	%	<1	----	----	----	----
+75.0mm	----	1	%	<1	----	----	----	----
EA009: Nett Acid Production Potential								
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	----	14.4	46.6	50.0	35.3
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	----	2.6	2.5	2.4	2.8
NAG (pH 4.5)	----	0.1	kg H2SO4/t	----	8.4	27.9	41.0	23.8
NAG (pH 7.0)	----	0.1	kg H2SO4/t	----	13.5	37.6	53.8	30.0
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	----	1.5	8.5	12.1	11.5
^ ANC as CaCO3	----	0.1	% CaCO3	----	0.2	0.9	1.2	1.2
Fizz Rating	----	0	Fizz Unit	----	0	0	0	0
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	13	----	----	----	----
Silt (2-60 µm)	----	1	%	1	----	----	----	----
Sand (0.06-2.00 mm)	----	1	%	86	----	----	----	----
Gravel (>2mm)	----	1	%	<1	----	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	----	0.52	1.80	2.03	1.53
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	----	0.40	2.51	3.72	6.08

Analytical Results

Sub-Matrix: SOIL			Client sample ID	55 CPO3 2.81-3.0M	38 CPO3 3.0-3.28M	40 CPO4 0.45-0.60M	41 CPO4 0.60-0.98M	42 CPO4 1.0-1.87M
			Client sampling date / time	23-AUG-2009 10:00	23-AUG-2009 10:00	24-AUG-2009 10:00	24-AUG-2009 10:00	24-AUG-2009 10:00
Compound	CAS Number	LOR	Unit	EB0913942-044	EB0913942-045	EB0913942-048	EB0913942-049	EB0913942-050
EA009: Nett Acid Production Potential								
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-11.3	-13.1	4.6	24.5	44.3
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	8.4	10.2	3.6	2.5	2.6
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	1.2	16.4	30.7
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	5.7	18.6	41.0
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	55.0	15.2	<0.5	<0.5	7.1
^ ANC as CaCO3	----	0.1	% CaCO3	5.6	1.6	<0.1	<0.1	0.7
Fizz Rating	----	0	Fizz Unit	4	2	0	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	1.43	0.07	0.15	0.80	1.68
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	1.10	0.07	0.32	0.65	3.33

Analytical Results

Sub-Matrix: SOIL			Client sample ID	44 CPOM 2.0-2.25M	45 CPO4 2.30-2.98M	56 WMO1 0.16-0.44M	57 WMO1 0.44-0.985M	58 WMO1 1.0-1.985M
			Client sampling date / time	24-AUG-2009 10:00	24-AUG-2009 10:00	28-AUG-2009 10:00	28-AUG-2009 10:00	28-AUG-2009 10:00
Compound	*CAS Number*	*LOR*	*Unit*	EB0913942-052	EB0913942-053	EB0913942-055	EB0913942-056	EB0913942-057
EA009: Nett Acid Production Potential								
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-36.8	-34.0	5.9	5.5	4.6
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	10.4	11.3	2.9	2.8	2.9
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	5.4	5.1	3.4
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	8.2	8.4	6.8
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	39.8	49.2	3.3	0.6	1.8
^ ANC as CaCO3	----	0.1	% CaCO3	4.1	5.0	0.3	<0.1	0.2
Fizz Rating	----	0	Fizz Unit	2	4	0	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.10	0.50	0.30	0.20	0.21
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	0.10	0.09	0.13	0.03	0.03

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	59 WM02 0.03-0.30M	60 WM02 0.30-0.52M	61 WM02 0.52-0.72M	62 WM02 1.0-1.72M	64 WM02 2.0-2.98M
			Client sampling date / time	28-AUG-2009 10:00	28-AUG-2009 10:00	28-AUG-2009 10:00	28-AUG-2009 10:00	28-AUG-2009 10:00
				EB0913942-059	EB0913942-060	EB0913942-061	EB0913942-062	EB0913942-064
EA009: Nett Acid Production Potential								
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	1.1	21.7	15.8	-30.8	-22.5
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	6.0	2.6	2.5	6.8	10.3
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	12.1	12.4	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	0.7	18.4	16.4	0.2	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	1.1	5.8	0.7	35.7	23.4
^ ANC as CaCO3	----	0.1	% CaCO3	0.1	0.6	<0.1	3.6	2.4
Fizz Rating	----	0	Fizz Unit	0	0	0	2	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.07	0.90	0.54	0.16	0.03
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	0.06	1.20	0.15	<0.02	0.14

Analytical Results

Sub-Matrix: SOIL			*Client sample ID*	65 WM03 0.14-0.64M	77C WM03 0.80-2.36M	46 WMO4 0.15-0.36M	47 WMO4 0.36-0.54M	78C WMO4 0.54-1.44M
			Client sampling date / time	28-AUG-2009 10:00	28-AUG-2009 10:00	25-AUG-2009 10:00	25-AUG-2009 10:00	25-AUG-2009 10:00
Compound	*CAS Number*	*LOR*	*Unit*	EB0913942-066	EB0913942-070	EB0913942-076	EB0913942-077	EB0913942-078
EA009: Nett Acid Production Potential								
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	<0.5	**5.2**	**0.6**	**8.7**	**3.7**
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**5.3**	**3.1**	**5.9**	**4.5**	**3.3**
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	**4.6**	<0.1	<0.1	**3.3**
NAG (pH 7.0)	----	0.1	kg H2SO4/t	**2.0**	**8.3**	**1.7**	**3.1**	**4.7**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**2.7**	<0.5	<0.5	**2.6**	<0.5
^ ANC as CaCO3	----	0.1	% CaCO3	**0.3**	<0.1	<0.1	**0.3**	<0.1
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**0**	**0**	**0**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.09**	**0.17**	**0.02**	**0.37**	**0.12**
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	**0.24**	**0.05**	**0.02**	**1.55**	**0.05**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	51 WMO4 1.51-1.78M	52 WM04 1.78-1.90M	OCM-S	OCM-C	----
Client sampling date / time				25-AUG-2009 10:00	25-AUG-2009 10:00	[08-SEP-2009]	[08-SEP-2009]	----
				EB0913942-080	EB0913942-081	EB0913942-093	EB0913942-094	----
EA150: Particle Sizing								
+75µm	----	1	%	----	----	94	----	----
+150µm	----	1	%	----	----	69	----	----
+300µm	----	1	%	----	----	15	----	----
+425µm	----	1	%	----	----	4	----	----
+600µm	----	1	%	----	----	1	----	----
+1180µm	----	1	%	----	----	<1	----	----
+2.36mm	----	1	%	----	----	<1	----	----
+4.75mm	----	1	%	----	----	<1	----	----
+9.5mm	----	1	%	----	----	<1	----	----
+19.0mm	----	1	%	----	----	<1	----	----
+37.5mm	----	1	%	----	----	<1	----	----
+75.0mm	----	1	%	----	----	<1	----	----
EA009: Nett Acid Production Potential								
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-249	15.0	1.1	28.1	----
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	10.2	2.8	5.4	2.4	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	11.3	<0.1	20.7	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	17.2	2.0	26.4	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	252	4.0	3.8	4.4	----
^ ANC as CaCO3	----	0.1	% CaCO3	25.7	0.4	0.4	0.4	----
Fizz Rating	----	0	Fizz Unit	3	0	0	0	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	----	4	----	----
Silt (2-60 µm)	----	1	%	----	----	2	----	----
Sand (0.06-2.00 mm)	----	1	%	----	----	94	----	----
Gravel (>2mm)	----	1	%	----	----	<1	----	----
Cobbles (>6cm)	----	1	%	----	----	<1	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.11	0.62	0.16	1.06	----
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	0.12	0.08	0.11	0.64	----

CERTIFICATE OF ANALYSIS

Work Order	: **EB0907676**	Page	: 1 of 5
Client	: **EARTH SYSTEMS PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR JEFF TAYLOR	Contact	: Tim Kilmister
Address	: SUITE 507 1 PRINCESS STREET KEW VIC, AUSTRALIA 3101	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: jeff.taylor@earthsystems.com.au	E-mail	: Services.Brisbane@alsenviro.com
Telephone	: +61 92059515	Telephone	: +61-7-3243 7222
Facsimile	: +61 03 92059519	Facsimile	: +61-7-3243 7218
Project	: RSSA0823	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 14-MAY-2009
Sampler	: Sophie Pape	Issue Date	: 29-MAY-2009
Site	: ----		
		No. of samples received	: 12
Quote number	: ME/194/08	No. of samples analysed	: 12

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory 825

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Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Inorganics
Stephen Hislop	Senior Inorganic Chemist	Stafford Minerals - AY

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **ANC Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong.**

Analytical Results

Sub-Matrix: **SOIL**

			Client sample ID	UCC-P1-1	UCC-P1-2	UCC-P1-3	UCC-P1-4	LCC-P2-1
			Client sampling date / time	30-APR-2009 16:00	30-APR-2009 16:00	30-APR-2009 16:00	30-APR-2009 16:00	01-MAY-2009 16:00
Compound	CAS Number	LOR	Unit	EB0907676-001	EB0907676-002	EB0907676-003	EB0907676-004	EB0907676-005
EA009: Nett Acid Production Potential								
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-1.9	-1.9	2.1	7.6	-0.8
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	1.9	2.8	2.2	6.4	1.4
^ ANC as CaCO3	----	0.1	% CaCO3	0.2	0.3	0.2	0.6	0.1
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
EA026 : Chromium Reducible Sulphur								
Chromium Reducible Sulphur	----	0.02	%	<0.02	<0.02	0.08	0.46	<0.02
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	0.03	0.14	0.46	0.02
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	0.04	0.07	0.19	0.46	0.07

Analytical Results

Sub-Matrix: SOIL			Client sample ID	LCC-P2-2	LCC-P2-3	LCC-P2-4	UCC-P3-1	UCC-P3-2
			Client sampling date / time	01-MAY-2009 16:00	01-MAY-2009 16:00	01-MAY-2009 16:00	02-MAY-2009 12:10	02-MAY-2009 12:10
Compound	CAS Number	LOR	Unit	EB0907676-006	EB0907676-007	EB0907676-008	EB0907676-009	EB0907676-010
EA009: Nett Acid Production Potential								
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	**1.2**	**5.8**	<0.5	**2.3**	<0.5
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	<0.5	<0.5	**3.5**	**1.6**	**1.9**
^ ANC as CaCO3	----	0.1	% CaCO3	<0.1	<0.1	**0.4**	**0.2**	**0.2**
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**0**	**0**	**0**
EA026 : Chromium Reducible Sulphur								
Chromium Reducible Sulphur	----	0.02	%	<0.02	**0.10**	**0.07**	<0.02	<0.02
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.04**	**0.19**	**0.12**	**0.13**	**0.05**
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	**0.28**	**0.13**	**0.05**	**0.55**	**0.11**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	UCC-P3-3	UCC-P3-4	----	----	----
			Client sampling date / time	02-MAY-2009 12:10	02-MAY-2009 12:10	----	----	----
				EB0907676-011	**EB0907676-012**	**----**	**----**	**----**
EA009: Nett Acid Production Potential								
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	**15.3**	**-1.7**	----	----	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	<0.5	**2.9**	----	----	----
^ ANC as CaCO3	----	0.1	% CaCO3	<0.1	**0.3**	----	----	----
Fizz Rating	----	0	Fizz Unit	**0**	**0**	----	----	----
EA026 : Chromium Reducible Sulphur								
Chromium Reducible Sulphur	----	0.02	%	**0.45**	**0.03**	----	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.50**	**0.04**	----	----	----
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	**0.10**	**0.05**	----	----	----

Certificate of Analysis

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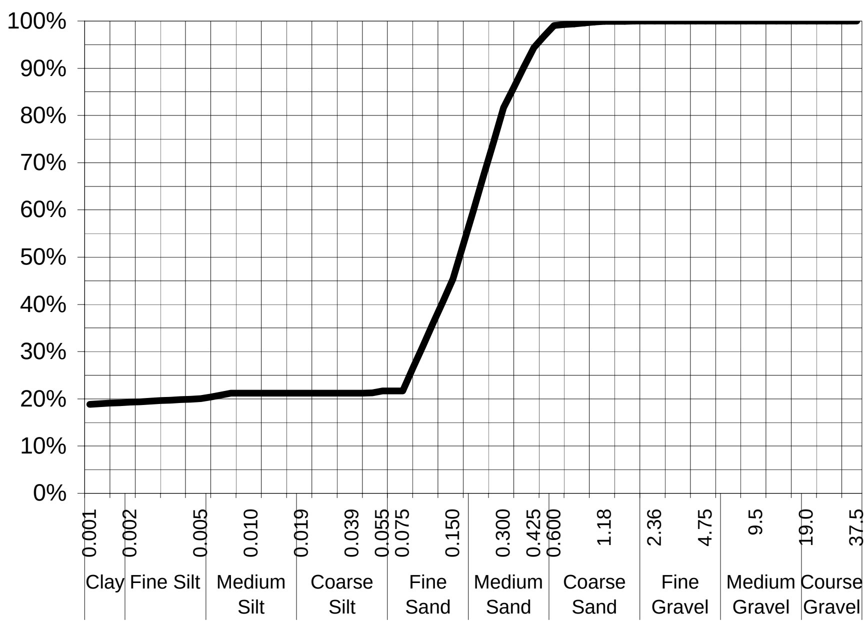
ALS Environmental

Newcastle, NSW

CLIENT:	Sophie Pape	**DATE REPORTED:**	15-Sep-2009
COMPANY:	Earth Systems Pty Ltd	**DATE RECEIVED:**	3-Sep-2009
ADDRESS:	Suite 507 1 Princess Street Kew, Vic, Australia 3101	**REPORT NO:**	EB0913942-006 / PSD
PROJECT:	RSSA0823	**SAMPLE ID:**	PS-1D

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	100%
0.600	99%
0.425	94%
0.300	82%
0.150	45%
0.075	22%
Particle Size (microns)	
55	22%
39	21%
19	21%
10	21%
5	20%
3	20%
1	19%

Samples analysed as received.

Sample Comments:		**Analysed:**	10-Sep-09
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	Sand & clay	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3	**Hydrometer Type**	ASTM E100
Soil Particle Density	2.65 Assumed		

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Dianne Blane
Senior Analyst
Authorised Signatory

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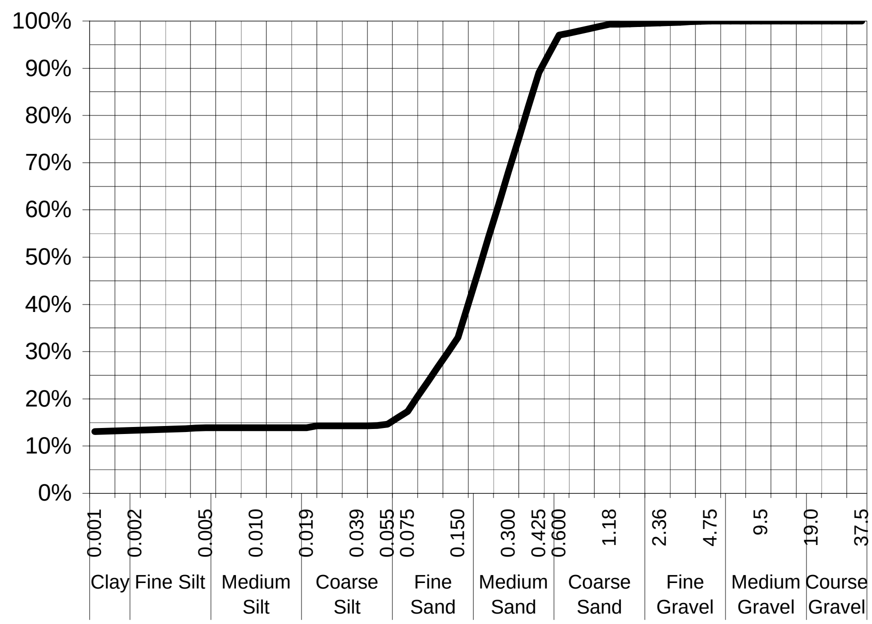
Newcastle, NSW

CLIENT:	Sophie Pape	**DATE REPORTED:**	15-Sep-2009
COMPANY:	Earth Systems Pty Ltd	**DATE RECEIVED:**	3-Sep-2009
ADDRESS:	Suite 507 1 Princess Street Kew, Vic, Australia 3101	**REPORT NO:**	EB0913942-013 / PSD
PROJECT:	RSSA0823	**SAMPLE ID:**	PS-2D

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	99%
0.600	97%
0.425	89%
0.300	68%
0.150	33%
0.075	17%
Particle Size (microns)	
55	15%
39	14%
19	14%
10	14%
5	14%
3	14%
1	13%

Samples analysed as received.

Sample Comments:		**Analysed:**	10-Sep-09
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	Sand & clay	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3	**Hydrometer Type**	ASTM E100
Soil Particle Density	2.65 Assumed		

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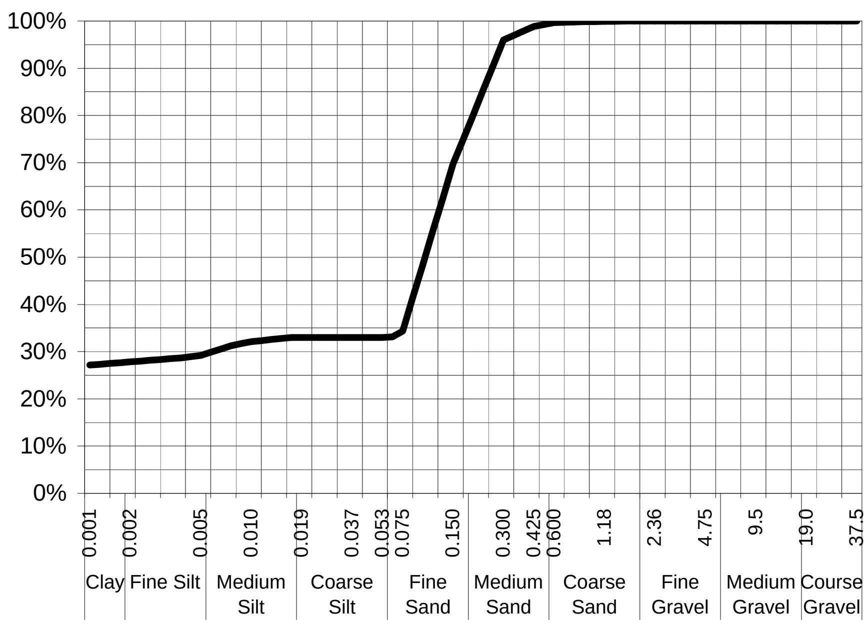
CLIENT:	Sophie Pape	**DATE REPORTED:**	15-Sep-2009
COMPANY:	Earth Systems Pty Ltd	**DATE RECEIVED:**	3-Sep-2009
ADDRESS:	Suite 507 1 Princess Street Kew, Vic, Australia 3101	**REPORT NO:**	EB0913942-031 / PSD
PROJECT:	RSSA0823	**SAMPLE ID:**	CP-1D

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	100%
0.600	100%
0.425	99%
0.300	96%
0.150	70%
0.075	34%
Particle Size (microns)	
53	33%
37	33%
19	33%
10	32%
5	29%
3	29%
1	27%

Samples analysed as received.

Sample Comments:		**Analysed:**	10-Sep-09
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	Sand & clay	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3	**Hydrometer Type**	ASTM E100
Soil Particle Density	2.65 Assumed		

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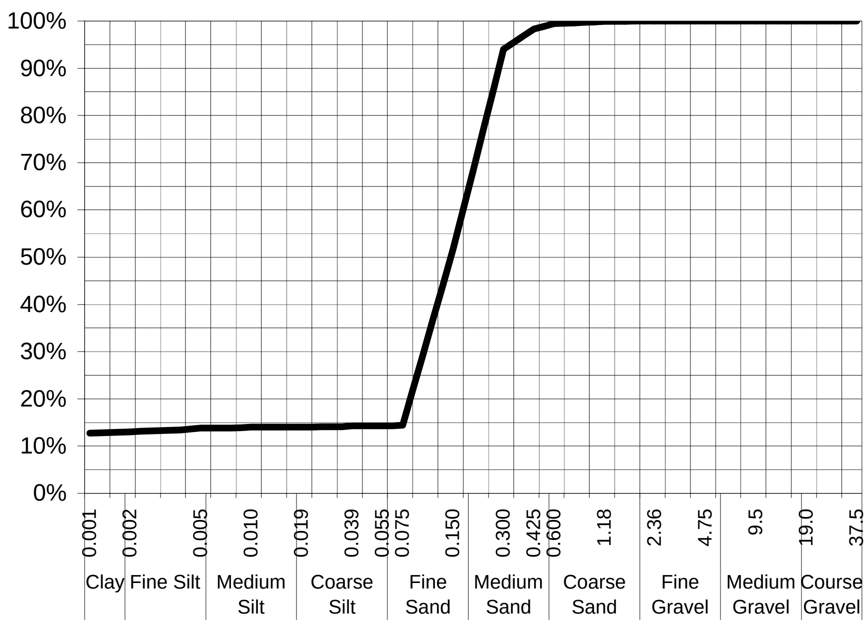
CLIENT:	Sophie Pape	**DATE REPORTED:**	15-Sep-2009
COMPANY:	Earth Systems Pty Ltd	**DATE RECEIVED:**	3-Sep-2009
ADDRESS:	Suite 507 1 Princess Street Kew, Vic, Australia 3101	**REPORT NO:**	EB0913942-039 / PSD
PROJECT:	RSSA0823	**SAMPLE ID:**	CP-2D

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	100%
0.600	99%
0.425	98%
0.300	94%
0.150	52%
0.075	14%
Particle Size (microns)	
55	14%
39	14%
19	14%
10	14%
5	14%
3	13%
1	13%

Samples analysed as received.

Sample Comments:		**Analysed:**	10-Sep-09
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	Sand & clay	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3	**Hydrometer Type**	ASTM E100
Soil Particle Density	2.65 Assumed		

NATA Accreditation: 825 Site: Newcastle
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Dianne Blane
Senior Analyst
Authorised Signatory

Certificate of Analysis

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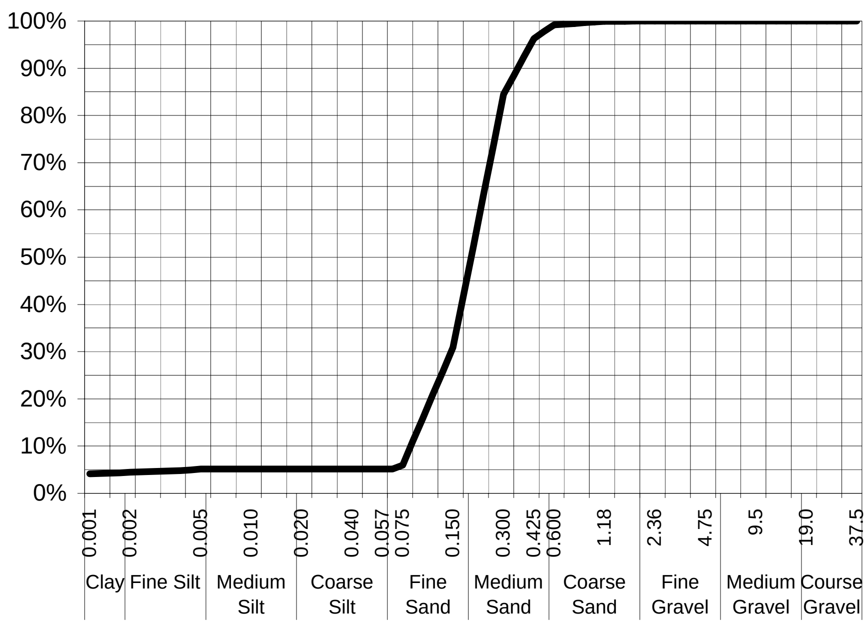
ALS Environmental

Newcastle, NSW

CLIENT:	Sophie Pape	**DATE REPORTED:**	15-Sep-2009
COMPANY:	Earth Systems Pty Ltd	**DATE RECEIVED:**	3-Sep-2009
ADDRESS:	Suite 507 1 Princess Street Kew, Vic, Australia 3101	**REPORT NO:**	EB0913942-093 / PSD
PROJECT:	RSSA0823	**SAMPLE ID:**	OCM-S

Particle Size Distribution



Particle Size (mm)	Percent Passing
19.0	100%
9.5	100%
4.75	100%
2.36	100%
1.18	100%
0.600	99%
0.425	96%
0.300	84%
0.150	31%
0.075	6%
Particle Size (microns)	
57	5%
40	5%
20	5%
10	5%
5	5%
4	5%
1	4%

Samples analysed as received.

Sample Comments:		**Analysed:**	10-Sep-09
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	Sand & fines	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3	**Hydrometer Type**	ASTM E100
Soil Particle Density	2.65 Assumed		

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Dianne Blane
Senior Analyst
Authorised Signatory

Attachment D:

OxCon test specifications and results

OxCON TEST SPECIFICATIONS AND RESULTS – APPARATUS A

Lower Lakes Sand, 8.0 wt% water

Test specifications

Parameter	Unit	Value
Sample ID	-	Sand (GMC 8.0%)
Apparatus ID	-	A
Test start date and time	dd/mm/yyyy hh:mm	27-Aug-09 23:30
Test end date and time	dd/mm/yyyy hh:mm	02-Sep-09 13:00
Test duration	days	5.563
Apparatus details		
Empty volume inside system	L	6.678
Mass of displacement bottle (empty) including cap	g	890.5
Sample details		
Sample mass (including water content)	g	1937.3
Gravimetric water content (GMC)	wt% water	8.0%
Sample dry mass	g	1793.8
Volume of sample solids and water content	L	0.87
Total sulfur content	wt% S	0.16%
Pyrite content*	wt% FeS_2	0.30%
	g	5.34

* Based on the assumption that all sulfur measured in the sample is present as available reactive pyrite.

Results

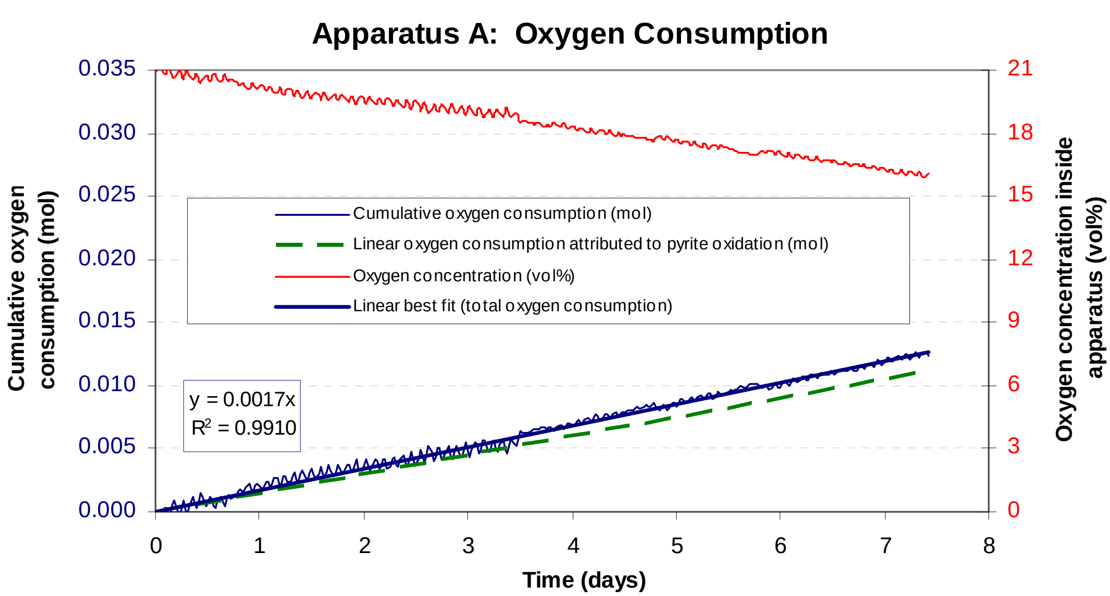

Figure: Cumulative oxygen consumption (attributed to oxidation of organic carbon and pyrite) vs. time for oxygen concentrations inside the apparatus ranging from 15-21 vol%. Data shown in blue has been processed from raw data relating to the volumetric consumption of oxygen vs time and room temperature and pressure considerations (refer to OxCon methodology). A linear line of best fit was fitted to the cumulative oxygen consumption data (green dotted line). Oxygen consumption attributed to pyrite oxidation (linear best fit total oxygen consumption minus linear best fit oxygen consumption attributed to organic carbon oxidation) is also plotted (orange dashed line). Data shown in red indicates the estimated volumetric oxygen concentration vs. time.

Results (continued)

Parameter	Unit	Value
Oxygen consumption attributed to oxidation of organic carbon		
Initial mass of dry CO_2 adsorbent	g	9.329
Final mass of dry CO_2 adsorbent	g	9.797
Mass change in adsorbent	g	0.468
Total moles CO_2 adsorbed	mol	1.1E-02
Time that adsorbent was in main chamber	days	54.3
Linear rate of oxygen consumption from organic carbon oxidation	mol/day	1.9E-04
Oxygen consumption attributed to pyrite oxidation		
Linear rate of total oxygen consumption	mol/day	1.7E-03
Linear rate of oxygen consumption from pyrite oxidation	mol/day	1.5E-03
Pyrite oxidation and pollution generation rates (linear)		
Pyrite oxidation rate (linear)	g / day	0.048
	wt% available pyrite / day	0.90%
Pollution generation rate (linear)	kg H_2SO_4 / t / day	0.04
Days to oxidise 50% pyrite in sample	days	56
Days to oxidise 100% pyrite in sample	days	112
Calculated oxygen concentration inside apparatus at end of test	vol%	15

OxCON TEST SPECIFICATIONS AND RESULTS – APPARATUS B

Lower Lakes Sand, 10.3 wt% water

Test specifications

Parameter	Unit	Value
Sample ID	-	Sand (GMC 10.3%)
Apparatus ID	-	B
Test start date and time	dd/mm/yyyy hh:mm	28-Aug-09 00:00
Test end date and time	dd/mm/yyyy hh:mm	06-Sep-09 09:30
Test duration	days	9.396
Apparatus details		
Empty volume inside system	L	6.654
Mass of displacement bottle (empty) including cap	g	881.4
Sample details		
Sample mass (including water content)	g	2217.3
Gravimetric water content (GMC)	wt% water	10.3%
Sample dry mass	g	2010.2
Volume of sample solids and water content	L	1.05
Total sulfur content	wt% S	0.16%
Pyrite content*	wt% FeS_2	0.30%
	g	5.98

* Based on the assumption that all sulfur measured in the sample is present as available reactive pyrite.

Results

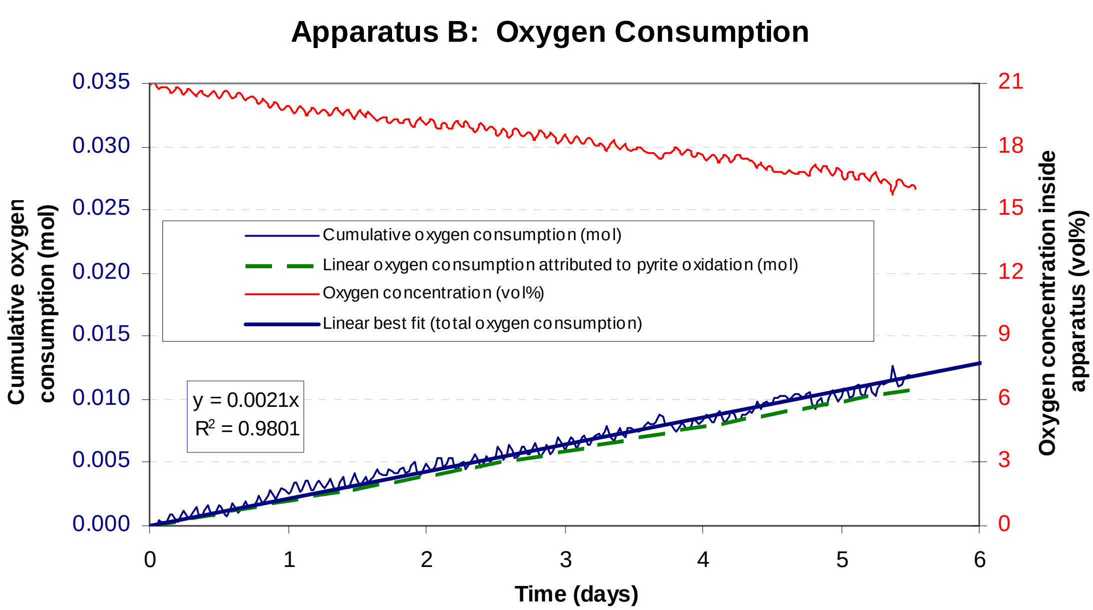

Figure: Cumulative oxygen consumption (attributed to oxidation of organic carbon and pyrite) vs. time for oxygen concentrations inside the apparatus ranging from 15-21 vol%. Data shown in blue has been processed from raw data relating to the volumetric consumption of oxygen vs time and room temperature and pressure considerations (refer to OxCon methodology). A linear line of best fit was fitted to the cumulative oxygen consumption data (green dotted line). Oxygen consumption attributed to pyrite oxidation (linear best fit total oxygen consumption minus linear best fit oxygen consumption attributed to organic carbon oxidation) is also plotted (orange dashed line). Data shown in red indicates the estimated volumetric oxygen concentration vs. time.

Results (continued)

Parameter	Unit	Value
Oxygen consumption attributed to oxidation of organic carbon		
Initial mass of dry CO_2 adsorbent	g	10.093
Final mass of dry CO_2 adsorbent	g	10.411
Mass change in adsorbent	g	0.318
Total moles CO_2 adsorbed	mol	7.2E-03
Time that adsorbent was in main chamber	days	54.3
Linear rate of oxygen consumption from organic carbon oxidation	mol/day	1.3E-04
Oxygen consumption attributed to pyrite oxidation		
Linear rate of total oxygen consumption	mol/day	2.1E-03
Linear rate of oxygen consumption from pyrite oxidation	mol/day	2.0E-03
Pyrite oxidation and pollution generation rates (linear)		
Pyrite oxidation rate (linear)	g / day	0.062
	wt% available pyrite / day	1.04%
Pollution generation rate (linear)	kg H_2SO_4 / t / day	0.05
Days to oxidise 50% pyrite in sample	days	48
Days to oxidise 100% pyrite in sample	days	96
Calculated oxygen concentration inside apparatus at end of test	vol%	15

OxCON TEST SPECIFICATIONS AND RESULTS – APPARATUS C

Lower Lakes Sand, 5.6 wt% water

Test specifications

Parameter	Unit	Value
Sample ID	-	Sand (GMC 5.6%)
Apparatus ID	-	C
Test start date and time	dd/mm/yyyy hh:mm	01-Sep-09 00:30
Test end date and time	dd/mm/yyyy hh:mm	10-Sep-09 08:00
Test duration	days	9.313
Apparatus details		
Empty volume inside system	L	6.679
Mass of displacement bottle (empty) including cap	g	744.1
Sample details		
Sample mass (including water content)	g	2316
Gravimetric water content (GMC)	wt% water	5.6%
Sample dry mass	g	2193.2
Volume of sample solids and water content	L	0.84
Total sulfur content	wt% S	0.16%
Pyrite content*	wt% FeS_2	0.30%
	g	6.52

* Based on the assumption that all sulfur measured in the sample is present as available reactive pyrite.

Results

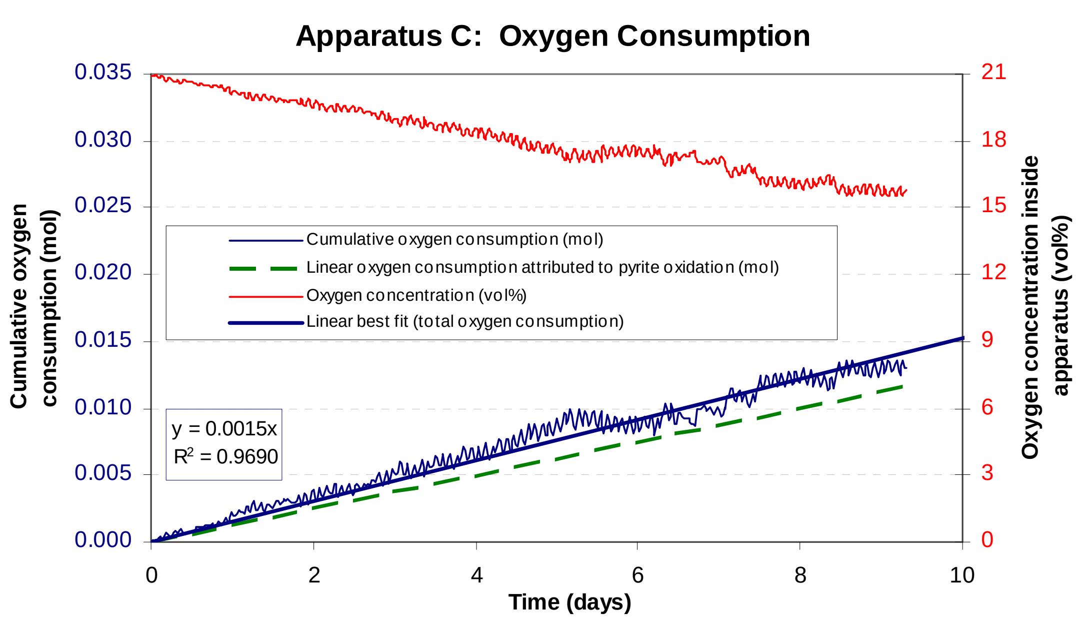

Figure: Cumulative oxygen consumption (attributed to oxidation of organic carbon and pyrite) vs. time for oxygen concentrations inside the apparatus ranging from 15-21 vol%. Data shown in blue has been processed from raw data relating to the volumetric consumption of oxygen vs time and room temperature and pressure considerations (refer to OxCon methodology). A linear line of best fit was fitted to the cumulative oxygen consumption data (green dotted line). Oxygen consumption attributed to pyrite oxidation (linear best fit total oxygen consumption minus linear best fit oxygen consumption attributed to organic carbon oxidation) is also plotted (orange dashed line). Data shown in red indicates the estimated volumetric oxygen concentration vs. time.

Results (continued)

Parameter	Unit	Value
Oxygen consumption attributed to oxidation of organic carbon		
Initial mass of dry CO_2 adsorbent	g	17.712
Final mass of dry CO_2 adsorbent	g	18.271
Mass change in adsorbent	g	0.559
Total moles CO_2 adsorbed	mol	1.3E-02
Time that adsorbent was in main chamber	days	50.2
Linear rate of oxygen consumption from organic carbon oxidation	mol/day	2.5E-04
Oxygen consumption attributed to pyrite oxidation		
Linear rate of total oxygen consumption	mol/day	1.5E-03
Linear rate of oxygen consumption from pyrite oxidation	mol/day	1.2E-03
Pyrite oxidation and pollution generation rates (linear)		
Pyrite oxidation rate (linear)	g / day	0.040
	wt% available pyrite / day	0.61%
Pollution generation rate (linear)	kg H_2SO_4 / t / day	0.03
Days to oxidise 50% pyrite in sample	days	82
Days to oxidise 100% pyrite in sample	days	165
Calculated oxygen concentration inside apparatus at end of test	vol%	15

OxCON TEST SPECIFICATIONS AND RESULTS – APPARATUS D

Lower Lakes Clay, 47.9 wt% water

Test specifications

Parameter	Unit	Value
Sample ID	-	Clay (GMC 47.9%)
Apparatus ID	-	D
Test start date and time	dd/mm/yyyy hh:mm	31-Aug-09 18:30
Test end date and time	dd/mm/yyyy hh:mm	21-Oct-09 15:00
Test duration	days	50.854
Apparatus details		
Empty volume inside system	L	6.663
Mass of displacement bottle (empty) including cap	g	748.9
Sample details		
Sample mass (including water content)	g	2653.6
Gravimetric water content (GMC)	wt% water	47.9%
Sample dry mass	g	1794.2
Volume of sample solids and water content	L	1.73
Total sulfur content	wt% S	1.06%
Pyrite content*	wt% FeS_2	1.97%
	g	35.36

* Based on the assumption that all sulfur measured in the sample is present as available reactive pyrite.

Results

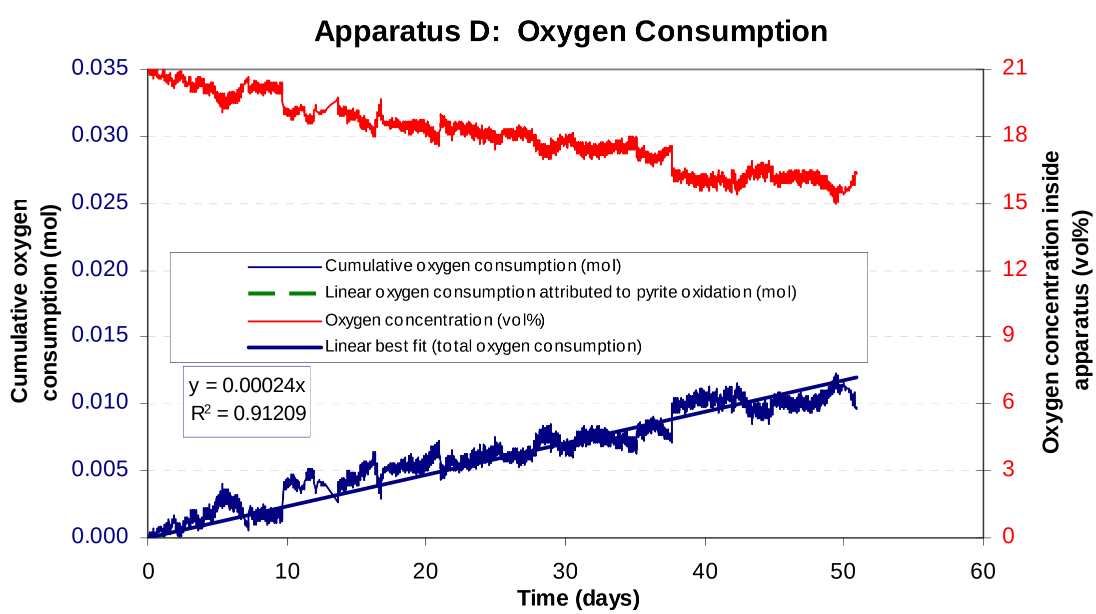

Figure: Cumulative oxygen consumption (attributed to oxidation of organic carbon and pyrite) vs. time for oxygen concentrations inside the apparatus ranging from 16.3-21 vol%. Data shown in blue has been processed from raw data relating to the volumetric consumption of oxygen vs time and room temperature and pressure considerations (refer to OxCon methodology). A linear line of best fit was fitted to the cumulative oxygen consumption data (green dotted line). Oxygen consumption attributed to pyrite oxidation (linear best fit total oxygen consumption minus linear best fit oxygen consumption attributed to organic carbon oxidation) is also plotted (orange dashed line). Data shown in red indicates the estimated volumetric oxygen concentration vs. time.

Results (continued)

Parameter	Unit	Value
Oxygen consumption attributed to oxidation of organic carbon		
Initial mass of dry CO_2 adsorbent	g	18.96
Final mass of dry CO_2 adsorbent	g	19.602
Mass change in adsorbent	g	0.642
Total moles CO_2 adsorbed	mol	1.5E-02
Time that adsorbent was in main chamber	days	50.2
Linear rate of oxygen consumption from organic carbon oxidation	mol/day	2.9E-04
Oxygen consumption attributed to pyrite oxidation		
Linear rate of total oxygen consumption	mol/day	2.4E-04
Linear rate of oxygen consumption from pyrite oxidation	mol/day	-4.7E-05
Pyrite oxidation and pollution generation rates (linear)		
Pyrite oxidation rate (linear)	g / day	-0.001
	wt% available pyrite / day	0.00%
Pollution generation rate (linear)	kg H_2SO_4 / t / day	0.00
Days to oxidise 50% pyrite in sample	days	n/a
Days to oxidise 100% pyrite in sample	days	n/a
Calculated oxygen concentration inside apparatus at end of test	vol%	16.3

OxCON TEST SPECIFICATIONS AND RESULTS – APPARATUS E

Lower Lakes Sand, 14.0 wt% water

Test specifications

Parameter	Unit	Value
Sample ID	-	Sand (GMC 14%)
Apparatus ID	-	E
Test start date and time	dd/mm/yyyy hh:mm	27-Aug-09 18:00
Test end date and time	dd/mm/yyyy hh:mm	31-Aug-09 15:00
Test duration	days	3.875
Apparatus details		
Empty volume inside system	L	6.687
Mass of displacement bottle (empty) including cap	g	898.1
Sample details		
Sample mass (including water content)	g	2396.5
Gravimetric water content (GMC)	wt% water	14.0%
Sample dry mass	g	2102.2
Volume of sample solids and water content	L	1.80
Total sulfur content	wt% S	0.16%
Pyrite content*	wt% FeS_2	0.30%
	g	6.25

* Based on the assumption that all sulfur measured in the sample is present as available reactive pyrite.

Results

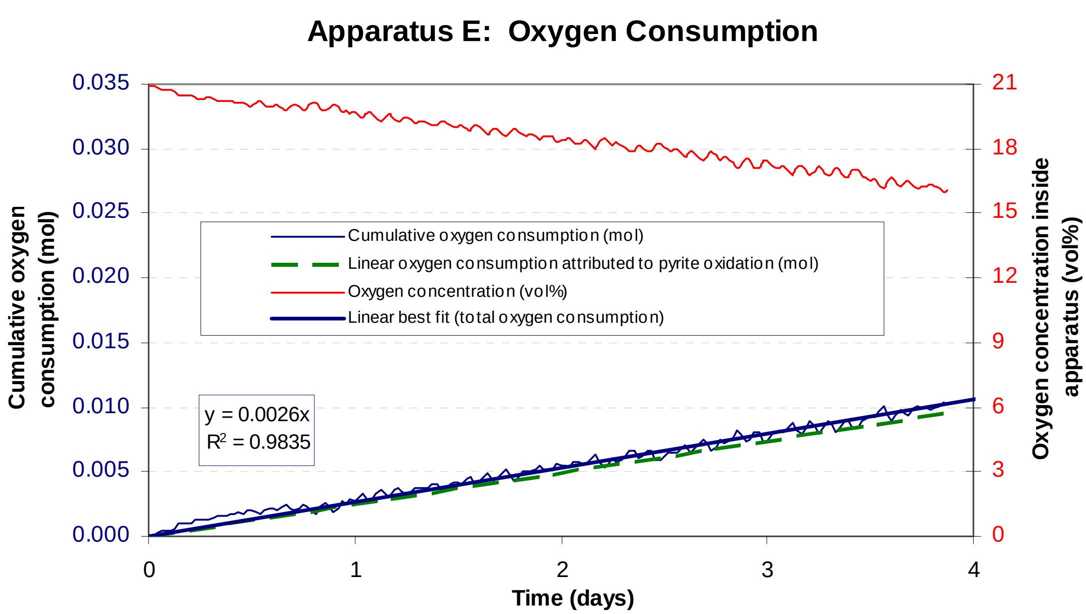

Figure: Cumulative oxygen consumption (attributed to oxidation of organic carbon and pyrite) vs. time for oxygen concentrations inside the apparatus ranging from 15-21 vol%. Data shown in blue has been processed from raw data relating to the volumetric consumption of oxygen vs time and room temperature and pressure considerations (refer to OxCon methodology). A linear line of best fit was fitted to the cumulative oxygen consumption data (green dotted line). Oxygen consumption attributed to pyrite oxidation (linear best fit total oxygen consumption minus linear best fit oxygen consumption attributed to organic carbon oxidation) is also plotted (orange dashed line). Data shown in red indicates the estimated volumetric oxygen concentration vs. time.

Results (continued)

Parameter	Unit	Value
Oxygen consumption attributed to oxidation of organic carbon		
Initial mass of dry CO_2 adsorbent	g	13.866
Final mass of dry CO_2 adsorbent	g	14.228
Mass change in adsorbent	g	0.362
Total moles CO_2 adsorbed	mol	8.2E-03
Time that adsorbent was in main chamber	days	54.4
Linear rate of oxygen consumption from organic carbon oxidation	mol/day	1.5E-04
Oxygen consumption attributed to pyrite oxidation		
Linear rate of total oxygen consumption	mol/day	2.6E-03
Linear rate of oxygen consumption from pyrite oxidation	mol/day	2.5E-03
Pyrite oxidation and pollution generation rates (linear)		
Pyrite oxidation rate (linear)	g / day	0.078
	wt% available pyrite / day	1.24%
Pollution generation rate (linear)	kg H_2SO_4 / t / day	0.06
Days to oxidise 50% pyrite in sample	days	40
Days to oxidise 100% pyrite in sample	days	80
Calculated oxygen concentration inside apparatus at end of test	vol%	15

OxCON TEST SPECIFICATIONS AND RESULTS – APPARATUS F

Lower Lakes Sand, 18.8 wt% water

Test specifications

Parameter	Unit	Value
Sample ID	-	Sand (GMC 18.8%)
Apparatus ID	-	F
Test start date and time	dd/mm/yyyy hh:mm	27-Aug-09 13:00
Test end date and time	dd/mm/yyyy hh:mm	05-Sep-09 19:30
Test duration	days	9.271
Apparatus details		
Empty volume inside system	L	6.623
Mass of displacement bottle (empty) including cap	g	869.2
Sample details		
Sample mass (including water content)	g	1330.8
Gravimetric water content (GMC)	wt% water	18.8%
Sample dry mass	g	1120.2
Volume of sample solids and water content	L	0.64
Total sulfur content	wt% S	0.16%
Pyrite content*	wt% FeS_2	0.30%
	g	3.33

* Based on the assumption that all sulfur measured in the sample is present as available reactive pyrite.

Results

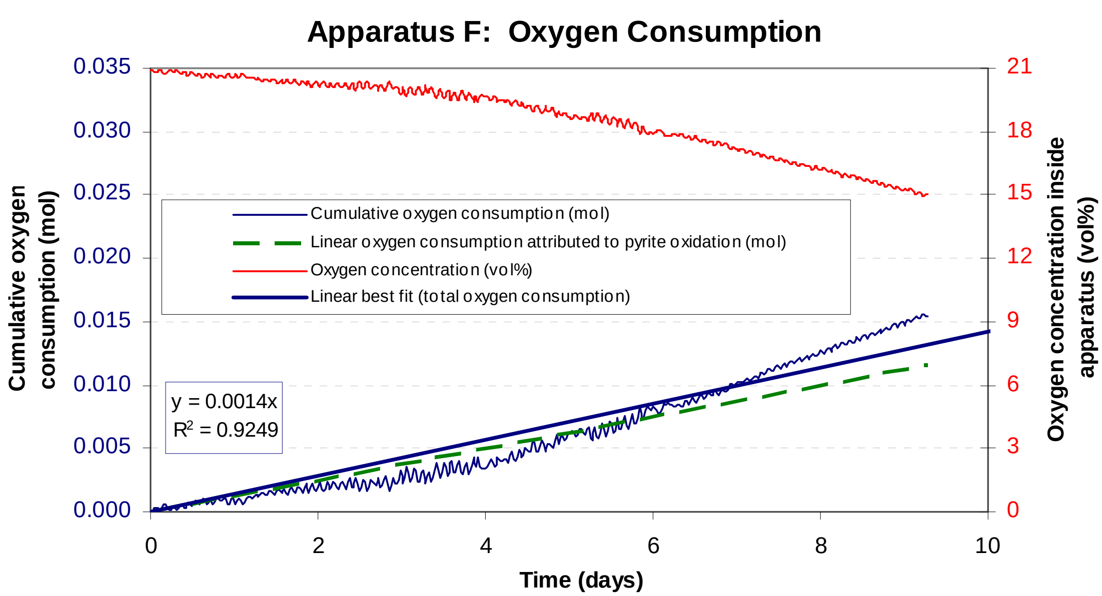

Figure: Cumulative oxygen consumption (attributed to oxidation of organic carbon and pyrite) vs. time for oxygen concentrations inside the apparatus ranging from 15-21 vol%. Data shown in blue has been processed from raw data relating to the volumetric consumption of oxygen vs time and room temperature and pressure considerations (refer to OxCon methodology). A linear line of best fit was fitted to the cumulative oxygen consumption data (green dotted line). Oxygen consumption attributed to pyrite oxidation (linear best fit total oxygen consumption minus linear best fit oxygen consumption attributed to organic carbon oxidation) is also plotted (orange dashed line). Data shown in red indicates the estimated volumetric oxygen concentration vs. time.

Results (continued)

Parameter	Unit	Value
Oxygen consumption attributed to oxidation of organic carbon		
Initial mass of dry CO_2 adsorbent	g	10.262
Final mass of dry CO_2 adsorbent	g	10.647
Mass change in adsorbent	g	0.385
Total moles CO_2 adsorbed	mol	8.7E-03
Time that adsorbent was in main chamber	days	54.5
Linear rate of oxygen consumption from organic carbon oxidation	mol/day	1.6E-04
Oxygen consumption attributed to pyrite oxidation		
Linear rate of total oxygen consumption	mol/day	1.4E-03
Linear rate of oxygen consumption from pyrite oxidation	mol/day	1.2E-03
Pyrite oxidation and pollution generation rates (linear)		
Pyrite oxidation rate (linear)	g / day	0.039
	wt% available pyrite / day	1.18%
Pollution generation rate (linear)	kg H_2SO_4 / t / day	0.06
Days to oxidise 50% pyrite in sample	days	42
Days to oxidise 100% pyrite in sample	days	85
Calculated oxygen concentration inside apparatus at end of test	vol%	15

OxCON TEST SPECIFICATIONS AND RESULTS – APPARATUS G

Lower Lakes Sand, 23.5 wt% water

Test specifications

Parameter	Unit	Value
Sample ID	-	Sand (GMC 23.5%)
Apparatus ID	-	G
Test start date and time	dd/mm/yyyy hh:mm	27-Aug-09 21:00
Test end date and time	dd/mm/yyyy hh:mm	21-Oct-09 15:00
Test duration	days	54.750
Apparatus details		
Empty volume inside system	L	6.719
Mass of displacement bottle (empty) including cap	g	837.4
Sample details		
Sample mass (including water content)	g	2735
Gravimetric water content (GMC)	wt% water	23.5%
Sample dry mass	g	2214.6
Volume of sample solids and water content	L	1.72
Total sulfur content	wt% S	0.16%
Pyrite content*	wt% FeS_2	0.30%
	g	6.59

* Based on the assumption that all sulfur measured in the sample is present as available reactive pyrite.

Results

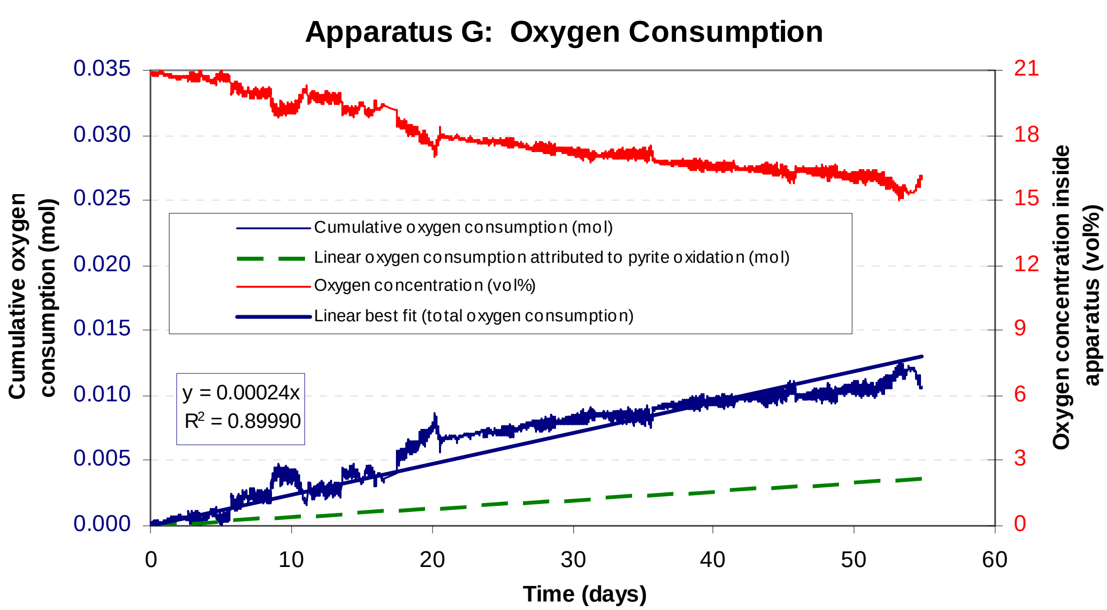

Figure: Cumulative oxygen consumption (attributed to oxidation of organic carbon and pyrite) vs. time for oxygen concentrations inside the apparatus ranging from 16-21 vol%. Data shown in blue has been processed from raw data relating to the volumetric consumption of oxygen vs time and room temperature and pressure considerations (refer to OxCon methodology). A linear line of best fit was fitted to the cumulative oxygen consumption data (green dotted line). Oxygen consumption attributed to pyrite oxidation (linear best fit total oxygen consumption minus linear best fit oxygen consumption attributed to organic carbon oxidation) is also plotted (orange dashed line). Data shown in red indicates the estimated volumetric oxygen concentration vs. time.

Results (continued)

Parameter	Unit	Value
Oxygen consumption attributed to oxidation of organic carbon		
Initial mass of dry CO_2 adsorbent	g	11.578
Final mass of dry CO_2 adsorbent	g	11.998
Mass change in adsorbent	g	0.42
Total moles CO_2 adsorbed	mol	9.5E-03
Time that adsorbent was in main chamber	days	54.1
Linear rate of oxygen consumption from organic carbon oxidation	mol/day	1.7E-04
Oxygen consumption attributed to pyrite oxidation		
Linear rate of total oxygen consumption	mol/day	2.4E-04
Linear rate of oxygen consumption from pyrite oxidation	mol/day	6.6E-05
Pyrite oxidation and pollution generation rates (linear)		
Pyrite oxidation rate (linear)	g / day	0.002
	wt% available pyrite / day	0.03%
Pollution generation rate (linear)	kg H_2SO_4 / t / day	0.00
Days to oxidise 50% pyrite in sample	days	1580
Days to oxidise 100% pyrite in sample	days	3160
Calculated oxygen concentration inside apparatus at end of test	vol%	16.0

OxCON TEST SPECIFICATIONS AND RESULTS – APPARATUS H

Lower Lakes Sand, 21.5 wt% water

Test specifications

Parameter	Unit	Value
Sample ID	-	Sand (GMC 21.5%)
Apparatus ID	-	H
Test start date and time	dd/mm/yyyy hh:mm	02-Sep-09 13:30
Test end date and time	dd/mm/yyyy hh:mm	02-Oct-09 09:30
Test duration	days	29.833
Apparatus details		
Empty volume inside system	L	6.693
Mass of displacement bottle (empty) including cap	g	893.8
Sample details		
Sample mass (including water content)	g	2541
Gravimetric water content (GMC)	wt% water	21.5%
Sample dry mass	g	2091.4
Volume of sample solids and water content	L	1.27
Total sulfur content	wt% S	1.06%
Pyrite content*	wt% FeS_2	1.97%
	g	41.22

* Based on the assumption that all sulfur measured in the sample is present as available reactive pyrite.

Results

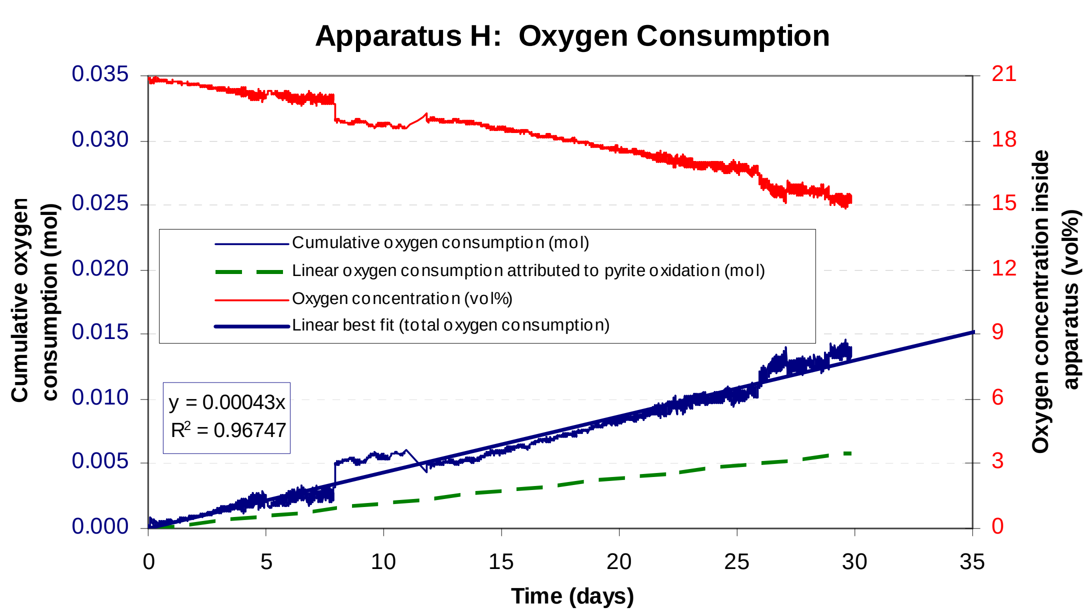

Figure: Cumulative oxygen consumption (attributed to oxidation of organic carbon and pyrite) vs. time for oxygen concentrations inside the apparatus ranging from 15-21 vol%. Data shown in blue has been processed from raw data relating to the volumetric consumption of oxygen vs time and room temperature and pressure considerations (refer to OxCon methodology). A linear line of best fit was fitted to the cumulative oxygen consumption data (green dotted line). Oxygen consumption attributed to pyrite oxidation (linear best fit total oxygen consumption minus linear best fit oxygen consumption attributed to organic carbon oxidation) is also plotted (orange dashed line). Data shown in red indicates the estimated volumetric oxygen concentration vs. time.

Results (continued)

Parameter	Unit	Value
Oxygen consumption attributed to oxidation of organic carbon		
Initial mass of dry CO_2 adsorbent	g	17.954
Final mass of dry CO_2 adsorbent	g	18.464
Mass change in adsorbent	g	0.51
Total moles CO_2 adsorbed	mol	1.2E-02
Time that adsorbent was in main chamber	days	48.4
Linear rate of oxygen consumption from organic carbon oxidation	mol/day	2.4E-04
Oxygen consumption attributed to pyrite oxidation		
Linear rate of total oxygen consumption	mol/day	4.3E-04
Linear rate of oxygen consumption from pyrite oxidation	mol/day	1.9E-04
Pyrite oxidation and pollution generation rates (linear)		
Pyrite oxidation rate (linear)	g / day	0.006
	wt% available pyrite / day	0.01%
Pollution generation rate (linear)	kg H_2SO_4 / t / day	0.00
Days to oxidise 50% pyrite in sample	days	3351
Days to oxidise 100% pyrite in sample	days	6702
Calculated oxygen concentration inside apparatus at end of test	vol%	15

OxCON TEST SPECIFICATIONS AND RESULTS – APPARATUS J

Lower Lakes Clay, 22.5 wt% water

Test specifications

Parameter	Unit	Value
Sample ID	-	Clay (GMC 22.5%)
Apparatus ID	-	J
Test start date and time	dd/mm/yyyy hh:mm	01-Sep-09 19:30
Test end date and time	dd/mm/yyyy hh:mm	14-Sep-09 20:00
Test duration	days	13.021
Apparatus details		
Empty volume inside system	L	6.683
Mass of displacement bottle (empty) including cap	g	910.2
Sample details		
Sample mass (including water content)	g	1086.1
Gravimetric water content (GMC)	wt% water	22.5%
Sample dry mass	g	886.6
Volume of sample solids and water content	L	0.50
Total sulfur content	wt% S	1.06%
Pyrite content*	wt% FeS_2	1.97%
	g	17.47

* Based on the assumption that all sulfur measured in the sample is present as available reactive pyrite.

Results

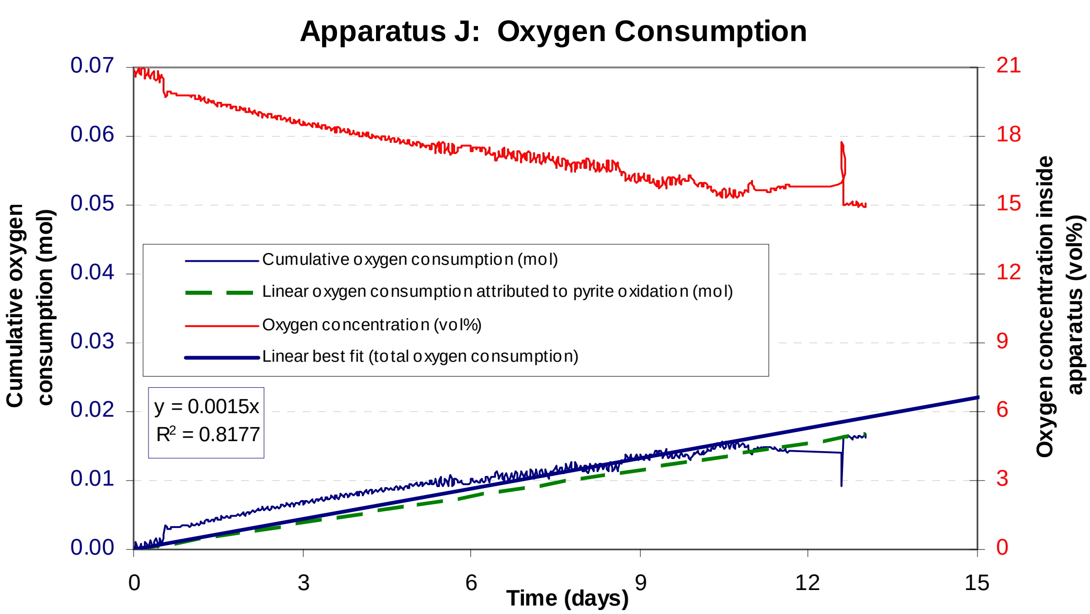

Figure: Cumulative oxygen consumption (attributed to oxidation of organic carbon and pyrite) vs. time for oxygen concentrations inside the apparatus ranging from 15-21 vol%. Data shown in blue has been processed from raw data relating to the volumetric consumption of oxygen vs time and room temperature and pressure considerations (refer to OxCon methodology). A linear line of best fit was fitted to the cumulative oxygen consumption data (green dotted line). Oxygen consumption attributed to pyrite oxidation (linear best fit total oxygen consumption minus linear best fit oxygen consumption attributed to organic carbon oxidation) is also plotted (orange dashed line). Data shown in red indicates the estimated volumetric oxygen concentration vs. time.

Results (continued)

Parameter	Unit	Value
Oxygen consumption attributed to oxidation of organic carbon		
Initial mass of dry CO_2 adsorbent	g	16.92
Final mass of dry CO_2 adsorbent	g	17.392
Mass change in adsorbent	g	0.472
Total moles CO_2 adsorbed	mol	1.1E-02
Time that adsorbent was in main chamber	days	49.2
Linear rate of oxygen consumption from organic carbon oxidation	mol/day	2.2E-04
Oxygen consumption attributed to pyrite oxidation		
Linear rate of total oxygen consumption	mol/day	1.5E-03
Linear rate of oxygen consumption from pyrite oxidation	mol/day	1.3E-03
Pyrite oxidation and pollution generation rates (linear)		
Pyrite oxidation rate (linear)	g / day	0.041
	wt% available pyrite / day	0.23%
Pollution generation rate (linear)	kg H_2SO_4 / t / day	0.08
Days to oxidise 50% pyrite in sample	days	214
Days to oxidise 100% pyrite in sample	days	429
Calculated oxygen concentration inside apparatus at end of test	vol%	15

OxCON TEST SPECIFICATIONS AND RESULTS – APPARATUS K

Lower Lakes Clay, 31.4 wt% water

Test specifications

Parameter	Unit	Value
Sample ID	-	Clay (GMC 31.4%)
Apparatus ID	-	K
Test start date and time	dd/mm/yyyy hh:mm	01-Sep-09 17:00
Test end date and time	dd/mm/yyyy hh:mm	08-Sep-09 12:00
Test duration	days	6.792
Apparatus details		
Empty volume inside system	L	6.669
Mass of displacement bottle (empty) including cap	g	862.4
Sample details		
Sample mass (including water content)	g	974.4
Gravimetric water content (GMC)	wt% water	31.4%
Sample dry mass	g	741.6
Volume of sample solids and water content	L	0.54
Total sulfur content	wt% S	1.06%
Pyrite content*	wt% FeS_2	1.97%
	g	14.62

* Based on the assumption that all sulfur measured in the sample is present as available reactive pyrite.

Results

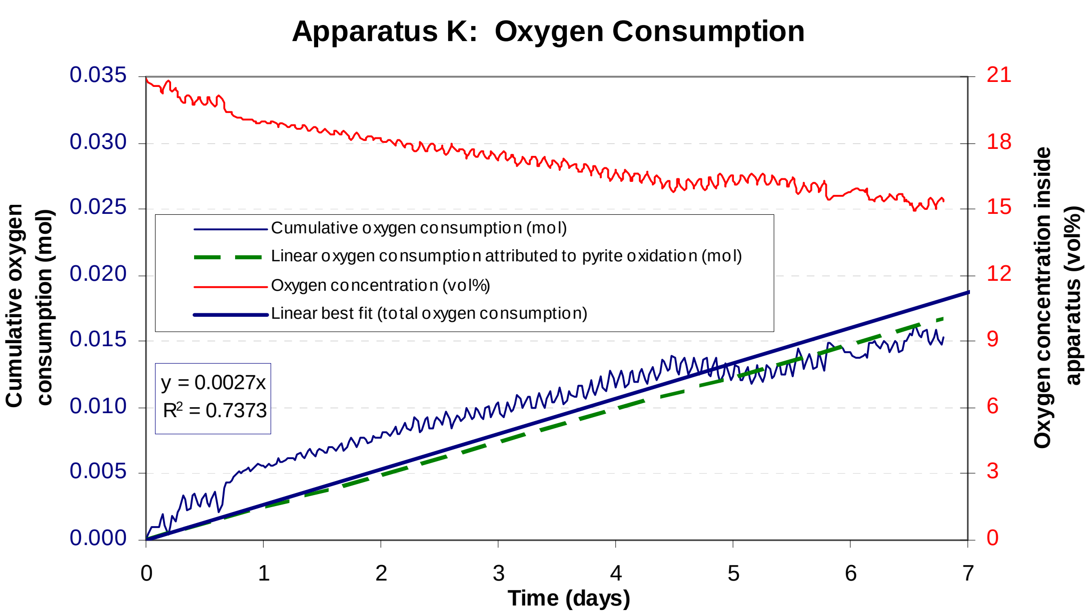

Figure: Cumulative oxygen consumption (attributed to oxidation of organic carbon and pyrite) vs. time for oxygen concentrations inside the apparatus ranging from 15-21 vol%. Data shown in blue has been processed from raw data relating to the volumetric consumption of oxygen vs time and room temperature and pressure considerations (refer to OxCon methodology). A linear line of best fit was fitted to the cumulative oxygen consumption data (green dotted line). Oxygen consumption attributed to pyrite oxidation (linear best fit total oxygen consumption minus linear best fit oxygen consumption attributed to organic carbon oxidation) is also plotted (orange dashed line). Data shown in red indicates the estimated volumetric oxygen concentration vs. time.

Results (continued)

Parameter	Unit	Value
Oxygen consumption attributed to oxidation of organic carbon		
Initial mass of dry CO_2 adsorbent	g	-
Final mass of dry CO_2 adsorbent	g	-
Mass change in adsorbent	g	0.5*
Total moles CO_2 adsorbed	mol	1.1E-02
Time that adsorbent was in main chamber	days	49.9
Linear rate of oxygen consumption from organic carbon oxidation	mol/day	2.3E-04
Oxygen consumption attributed to pyrite oxidation		
Linear rate of total oxygen consumption	mol/day	2.7E-03
Linear rate of oxygen consumption from pyrite oxidation	mol/day	2.7E-03
Pyrite oxidation and pollution generation rates (linear)		
Pyrite oxidation rate (linear)	g / day	0.086
	wt% available pyrite / day	0.59%
Pollution generation rate (linear)	kg H_2SO_4 / t / day	0.19
Days to oxidise 50% pyrite in sample	days	85
Days to oxidise 100% pyrite in sample	days	171
Calculated oxygen concentration inside apparatus at end of test	vol%	15

* No CO_2 adsorbent was used for this apparatus. A reasonable assumption for the mass of CO_2 adsorbed has been used based on CO_2 adsorption in other apparatus containing clays (J,L and N).

OxCON TEST SPECIFICATIONS AND RESULTS – APPARATUS L

Lower Lakes Clay, 22.7 wt% water

Test specifications

Parameter	Unit	Value
Sample ID	-	Clay (GMC 22.7%)
Apparatus ID	-	L
Test start date and time	dd/mm/yyyy hh:mm	02-Sep-09 21:00
Test end date and time	dd/mm/yyyy hh:mm	10-Sep-09 04:30
Test duration	days	7.313
Apparatus details		
Empty volume inside system	L	6.671
Mass of displacement bottle (empty) including cap	g	771.1
Sample details		
Sample mass (including water content)	g	590.7
Gravimetric water content (GMC)	wt% water	22.7%
Sample dry mass	g	481.4
Volume of sample solids and water content	L	0.31
Total sulfur content	wt% S	1.06%
Pyrite content*	wt% FeS_2	1.97%
	g	15

* Based on the assumption that all sulfur measured in the sample is present as available reactive pyrite.

Results

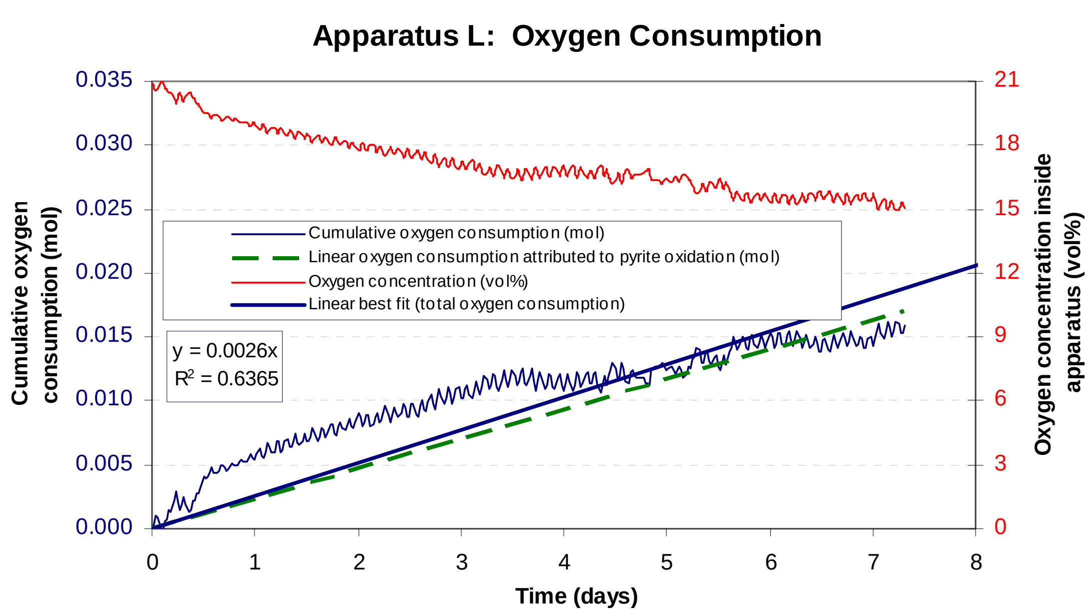

Figure: Cumulative oxygen consumption (attributed to oxidation of organic carbon and pyrite) vs. time for oxygen concentrations inside the apparatus ranging from 15-21 vol%. Data shown in blue has been processed from raw data relating to the volumetric consumption of oxygen vs time and room temperature and pressure considerations (refer to OxCon methodology). A linear line of best fit was fitted to the cumulative oxygen consumption data (green dotted line). Oxygen consumption attributed to pyrite oxidation (linear best fit total oxygen consumption minus linear best fit oxygen consumption attributed to organic carbon oxidation) is also plotted (orange dashed line). Data shown in red indicates the estimated volumetric oxygen concentration vs. time.

Results (continued)

Parameter	Unit	Value
Oxygen consumption attributed to oxidation of organic carbon		
Initial mass of dry CO_2 adsorbent	g	17.651
Final mass of dry CO_2 adsorbent	g	18.234
Mass change in adsorbent	g	0.583
Total moles CO_2 adsorbed	mol	1.3E-02
Time that adsorbent was in main chamber	days	48.1
Linear rate of oxygen consumption from organic carbon oxidation	mol/day	2.7E-04
Oxygen consumption attributed to pyrite oxidation		
Linear rate of total oxygen consumption	mol/day	2.6E-03
Linear rate of oxygen consumption from pyrite oxidation	mol/day	2.3E-03
Pyrite oxidation and pollution generation rates (linear)		
Pyrite oxidation rate (linear)	g / day	0.074
	wt% available pyrite / day	0.78%
Pollution generation rate (linear)	kg H_2SO_4 / t / day	0.25
Days to oxidise 50% pyrite in sample	days	64
Days to oxidise 100% pyrite in sample	days	128
Calculated oxygen concentration inside apparatus at end of test	vol%	15

OxCON TEST SPECIFICATIONS AND RESULTS – APPARATUS M

Lower Lakes Sand, 0.0 wt% water

Test specifications

Parameter	Unit	Value
Sample ID	-	Sand (GMC 0.0%)
Apparatus ID	-	M
Test start date and time	dd/mm/yyyy hh:mm	02-Sep-09 17:00
Test end date and time	dd/mm/yyyy hh:mm	21-Oct-09 15:00
Test duration	days	48.917
Apparatus details		
Empty volume inside system	L	6.676
Mass of displacement bottle (empty) including cap	g	899.2
Sample details		
Sample mass (including water content)	g	746.8
Gravimetric water content (GMC)	wt% water	0.0%
Sample dry mass	g	746.8
Volume of sample solids and water content	L	0.24
Total sulfur content	wt% S	0.16%
Pyrite content*	wt% FeS_2	0.30%
	g	2.22

* Based on the assumption that all sulfur measured in the sample is present as available reactive pyrite.

Results

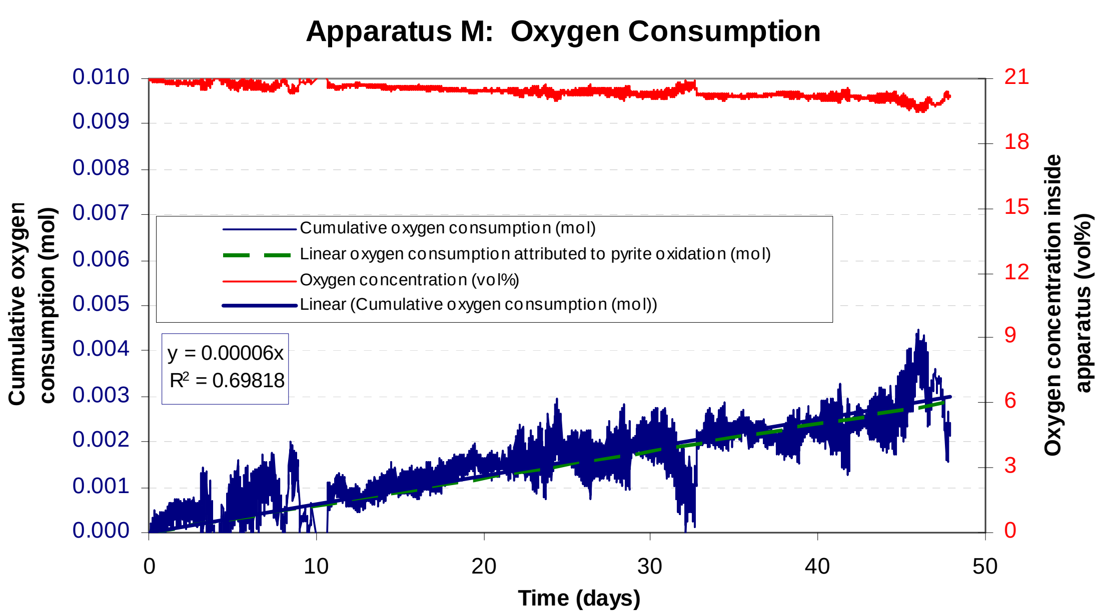

Figure: Cumulative oxygen consumption (attributed to oxidation of organic carbon and pyrite) vs. time for oxygen concentrations inside the apparatus ranging from 19.7-21 vol%. Data shown in blue has been processed from raw data relating to the volumetric consumption of oxygen vs time and room temperature and pressure considerations (refer to OxCon methodology). A linear line of best fit was fitted to the cumulative oxygen consumption data (green dotted line). Oxygen consumption attributed to pyrite oxidation (linear best fit total oxygen consumption minus linear best fit oxygen consumption attributed to organic carbon oxidation) is also plotted (orange dashed line). Data shown in red indicates the estimated volumetric oxygen concentration vs. time.

Results (continued)

Parameter	Unit	Value
Oxygen consumption attributed to oxidation of organic carbon		
Initial mass of dry CO_2 adsorbent	g	-
Final mass of dry CO_2 adsorbent	g	-
Mass change in adsorbent	g	0
Total moles CO_2 adsorbed	mol	0.0E+00
Time that adsorbent was in main chamber	days	-
Linear rate of oxygen consumption from organic carbon oxidation	mol/day	-
Oxygen consumption attributed to pyrite oxidation		
Linear rate of total oxygen consumption	mol/day	6.0E-05
Linear rate of oxygen consumption from pyrite oxidation	mol/day	6.0E-05
Pyrite oxidation and pollution generation rates (linear)		
Pyrite oxidation rate (linear)	g / day	0.002
	wt% available pyrite / day	0.09%
Pollution generation rate (linear)	kg H_2SO_4 / t / day	0.00
Days to oxidise 50% pyrite in sample	days	583
Days to oxidise 100% pyrite in sample	days	1167
Calculated oxygen concentration inside apparatus at end of test	vol%	19.7

OxCON TEST SPECIFICATIONS AND RESULTS – APPARATUS N

Lower Lakes Clay, 38.2 wt% water

Test specifications

Parameter	Unit	Value
Sample ID	-	Clay (GMC 38.2%)
Apparatus ID	-	N
Test start date and time	dd/mm/yyyy hh:mm	31-Aug-09 20:00
Test end date and time	dd/mm/yyyy hh:mm	27-Sep-09 15:00
Test duration	days	26.792
Apparatus details		
Empty volume inside system	L	6.663
Mass of displacement bottle (empty) including cap	g	897.9
Sample details		
Sample mass (including water content)	g	1645.7
Gravimetric water content (GMC)	wt% water	38.2%
Sample dry mass	g	1190.8
Volume of sample solids and water content	L	1.00
Total sulfur content	wt% S	1.06%
Pyrite content*	wt% FeS_2	1.97%
	g	23.47

* Based on the assumption that all sulfur measured in the sample is present as available reactive pyrite.

Results

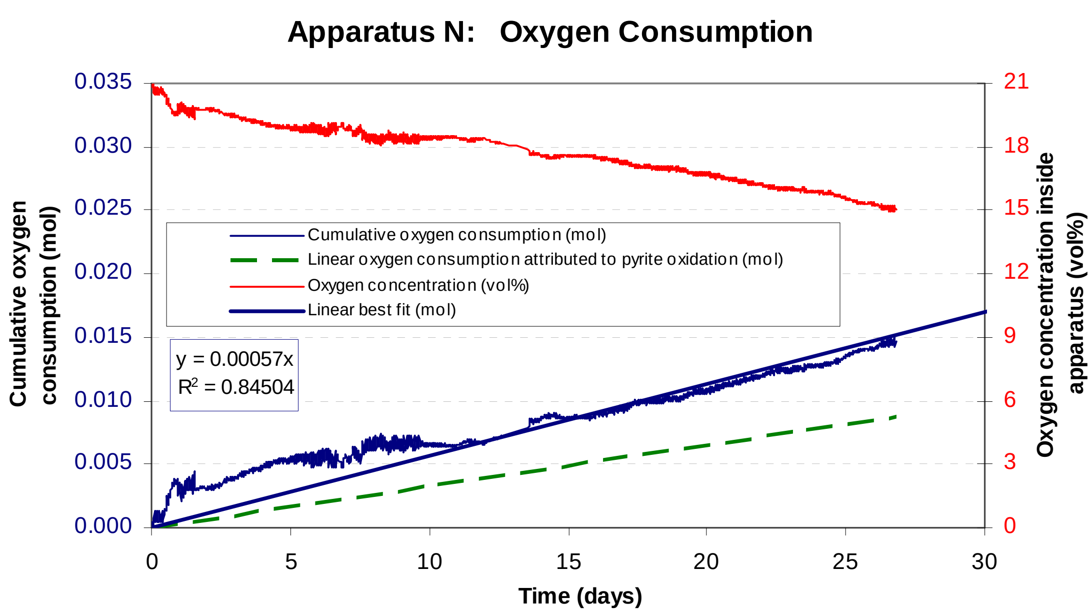

Figure: Cumulative oxygen consumption (attributed to oxidation of organic carbon and pyrite) vs. time for oxygen concentrations inside the apparatus ranging from 15-21 vol%. Data shown in blue has been processed from raw data relating to the volumetric consumption of oxygen vs time and room temperature and pressure considerations (refer to OxCon methodology). A linear line of best fit was fitted to the cumulative oxygen consumption data (green dotted line). Oxygen consumption attributed to pyrite oxidation (linear best fit total oxygen consumption minus linear best fit oxygen consumption attributed to organic carbon oxidation) is also plotted (orange dashed line). Data shown in red indicates the estimated volumetric oxygen concentration vs. time.

Results (continued)

Parameter	Unit	Value
Oxygen consumption attributed to oxidation of organic carbon		
Initial mass of dry CO_2 adsorbent	g	18.38
Final mass of dry CO_2 adsorbent	g	18.92
Mass change in adsorbent	g	0.54
Total moles CO_2 adsorbed	mol	1.2E-02
Time that adsorbent was in main chamber	days	50.2
Linear rate of oxygen consumption from organic carbon oxidation	mol/day	2.4E-04
Oxygen consumption attributed to pyrite oxidation		
Linear rate of total oxygen consumption	mol/day	5.7E-04
Linear rate of oxygen consumption from pyrite oxidation	mol/day	3.3E-04
Pyrite oxidation and pollution generation rates (linear)		
Pyrite oxidation rate (linear)	g / day	0.010
	wt% available pyrite / day	0.04%
Pollution generation rate (linear)	kg H_2SO_4 / t / day	0.01
Days to oxidise 50% pyrite in sample	days	1126
Days to oxidise 100% pyrite in sample	days	2252
Calculated oxygen concentration inside apparatus at end of test	vol%	15

Attachment E:

Geophysical survey results

Meningie – Line 3 (Conductivity ranging from 240-1000 mS/cm)

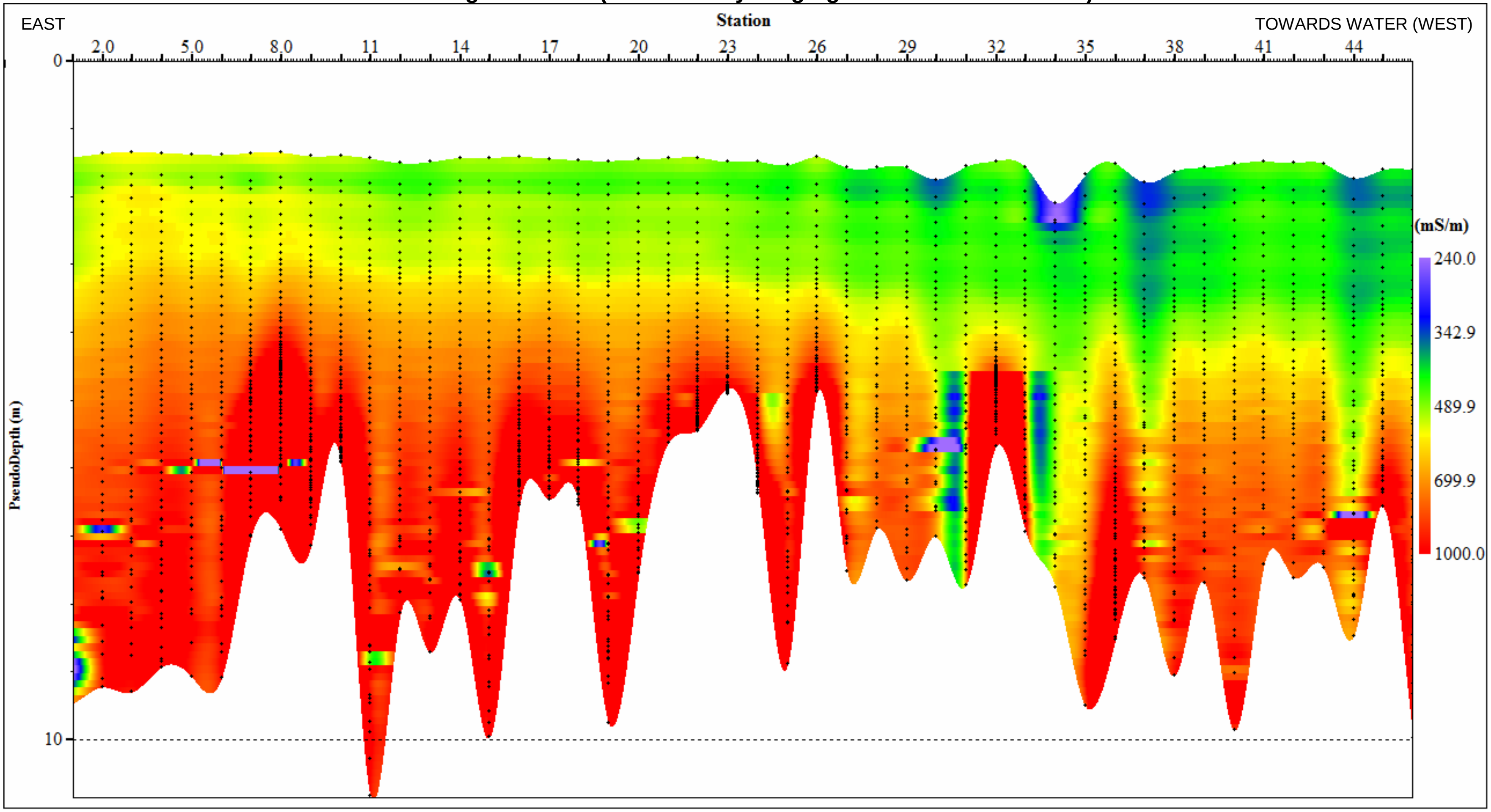

Figure 1: TEM pseudo-section from Meningie Line 3 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in metres. This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities has been narrowed to highlight features with conductivities ranging from 240.0 mS/m to 1000 mS/m.

Meningie – Line 4 (Conductivity ranging from 240-2000 mS/cm)

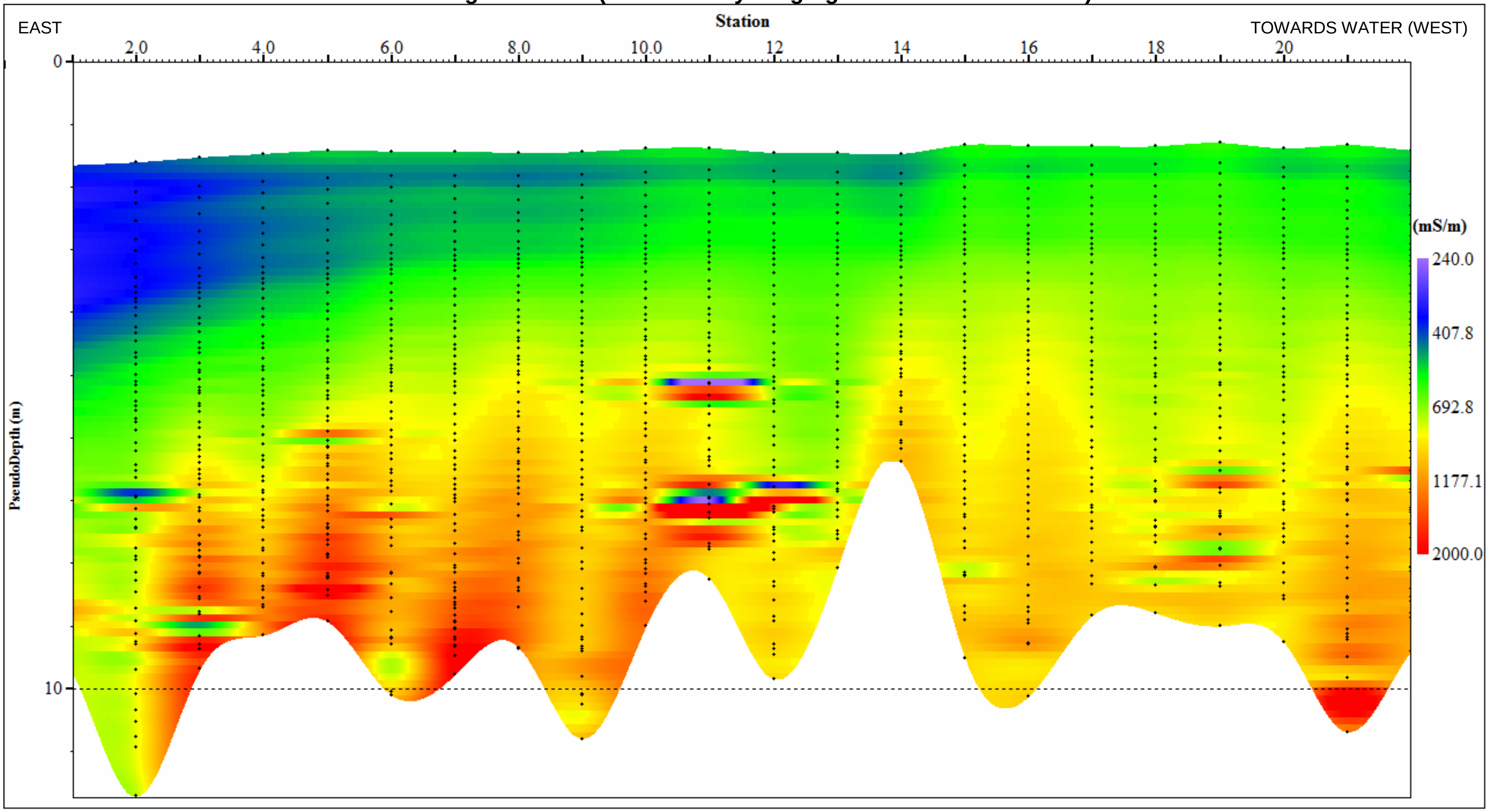

Figure 2: TEM pseudo-section from Meningie Line 4 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in metres. This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities has been narrowed to highlight features with conductivities ranging from 240.0 mS/m to 2000 mS/m.

Meningie South – Line 1

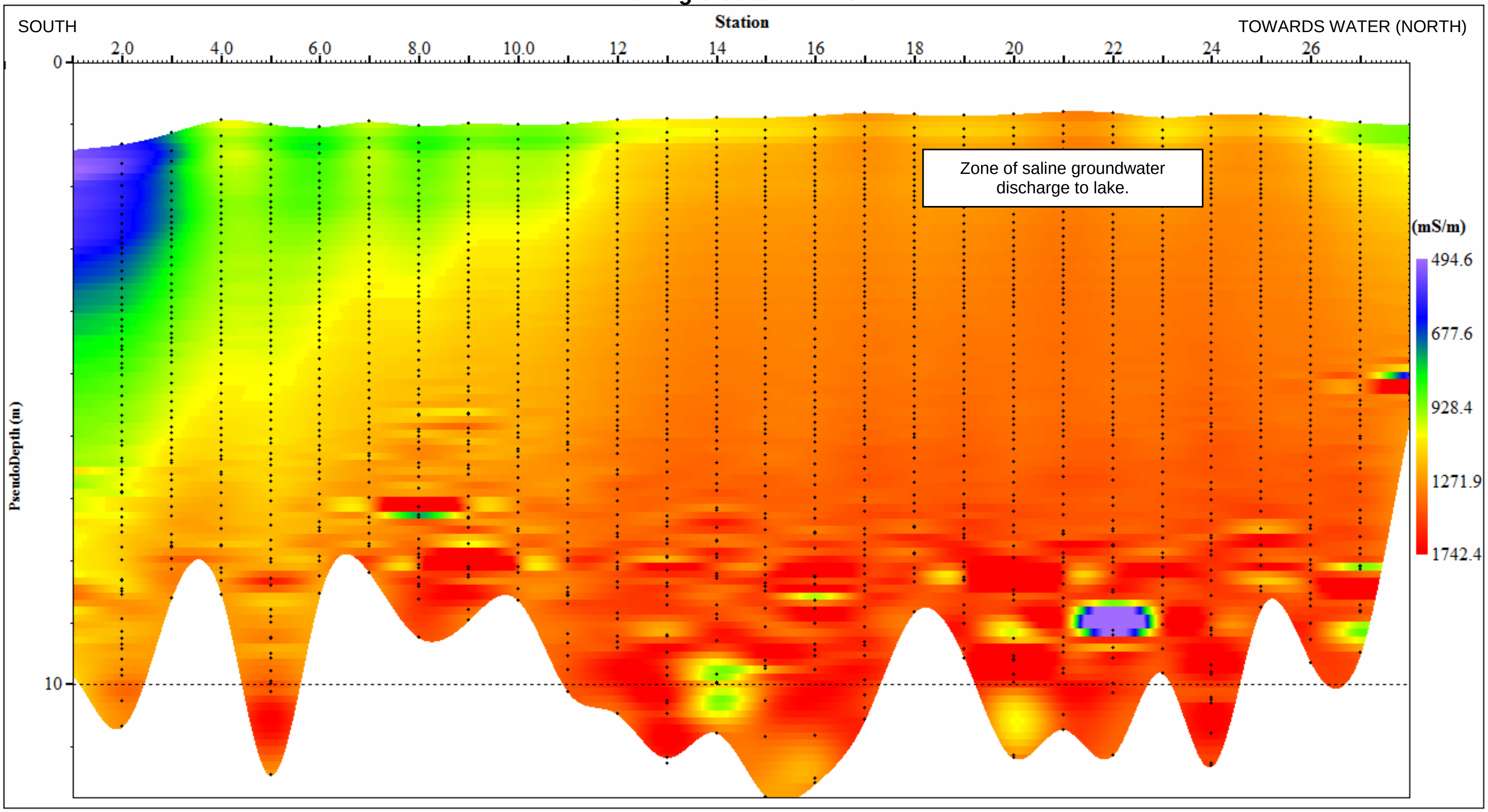

Figure 3: TEM pseudo-section from Meningie South Line 1 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in metres. This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities ranged from 494.6 mS/m to 1742.4 mS/m.

Meningie South – Line 2

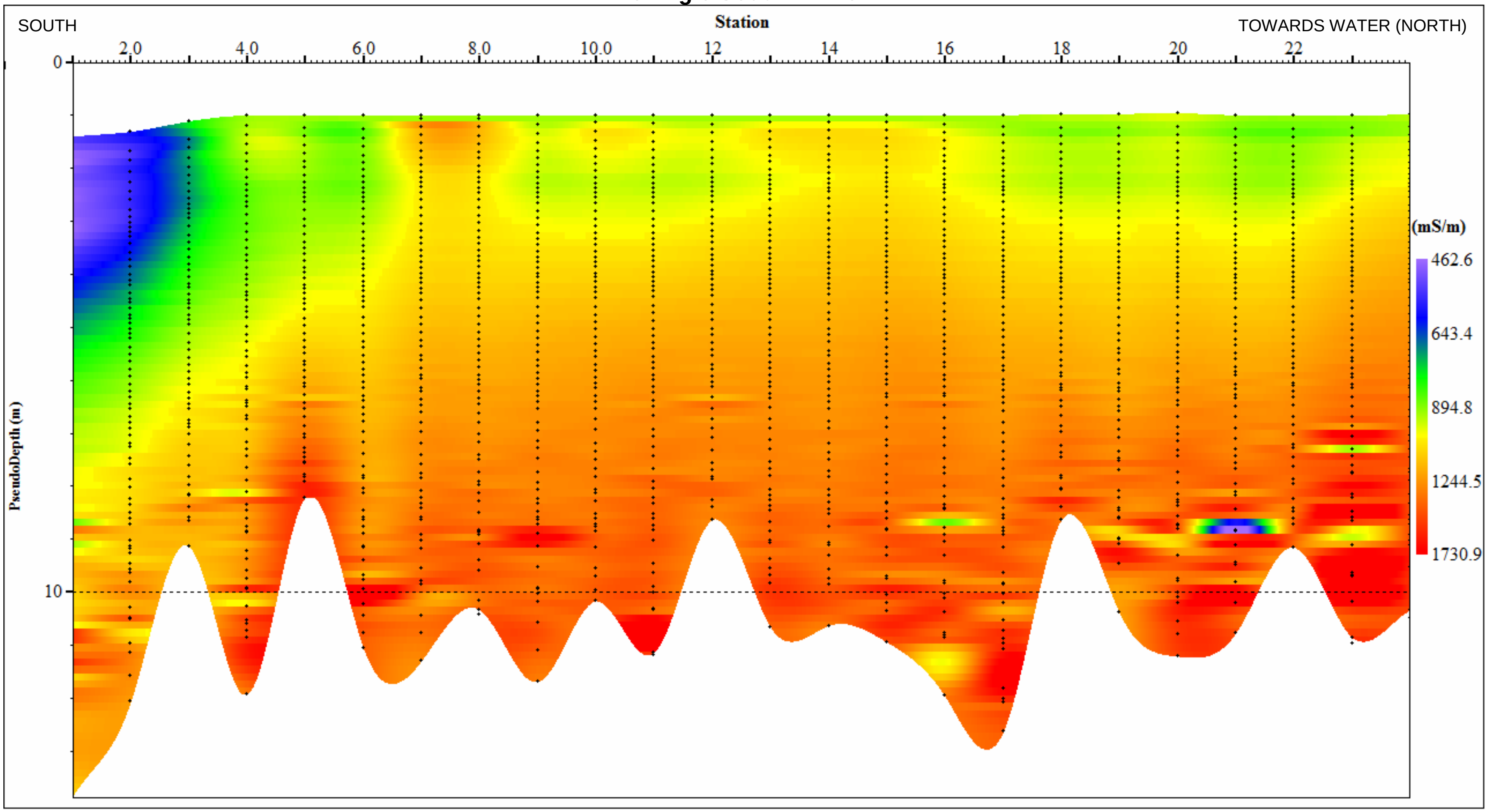

Figure 4: TEM pseudo-section from Meningie South Line 2 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in metres. This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities ranged from 462.6 mS/m to 1730.9 mS/m.

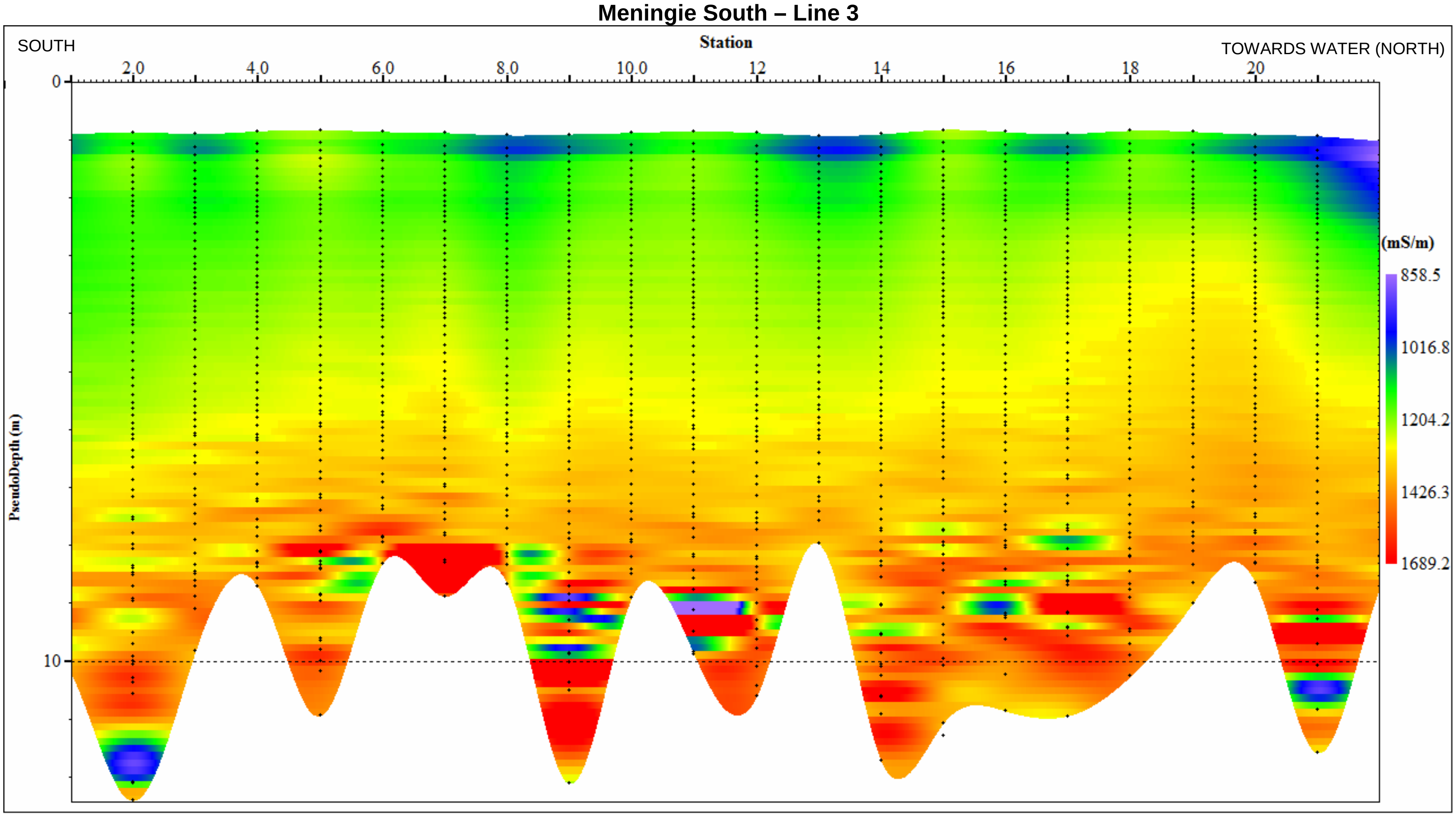

Figure 5: TEM pseudo-section from Meningie South Line 3 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in metres. This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities ranged from 858.5 mS/m to 1689.2 mS/m.

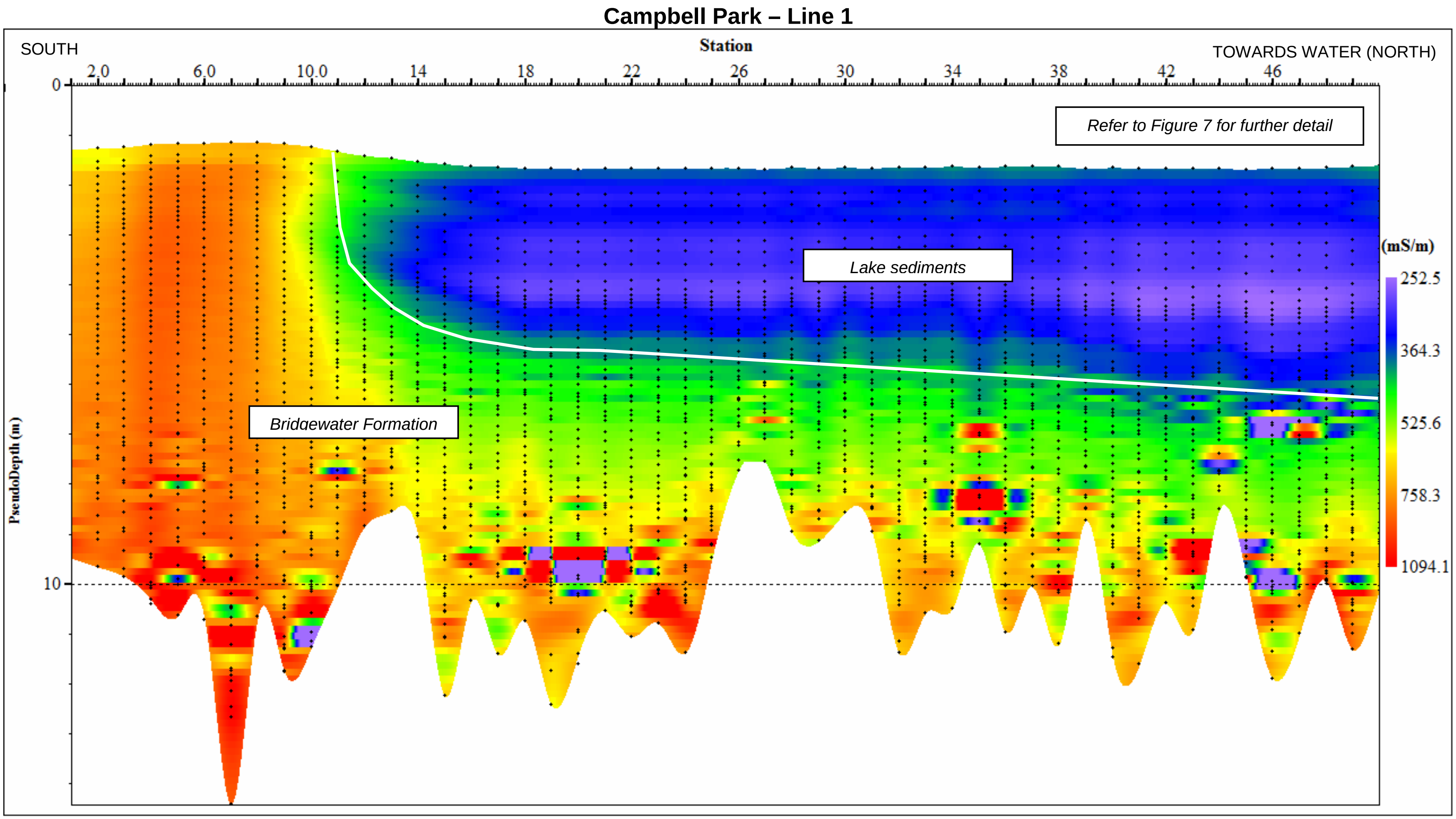

Figure 6: TEM pseudo-section from Campbell Park Line 1 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in metres. This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities ranged from 252.5 mS/m to 1094.1 mS/m. Low conductivity values are thought to represent lake sediments (see Figure 7 for further detail within the conductivity range of 250-400 mS/cm). Higher bulk conductivity resulting from more saline water within the Bridgewater Formation is shown underlying the lake sediments.

Campbell Park – Line 1 (Pseudo-depth 0-7m; Conductivity ranging from 250-400 mS/cm)

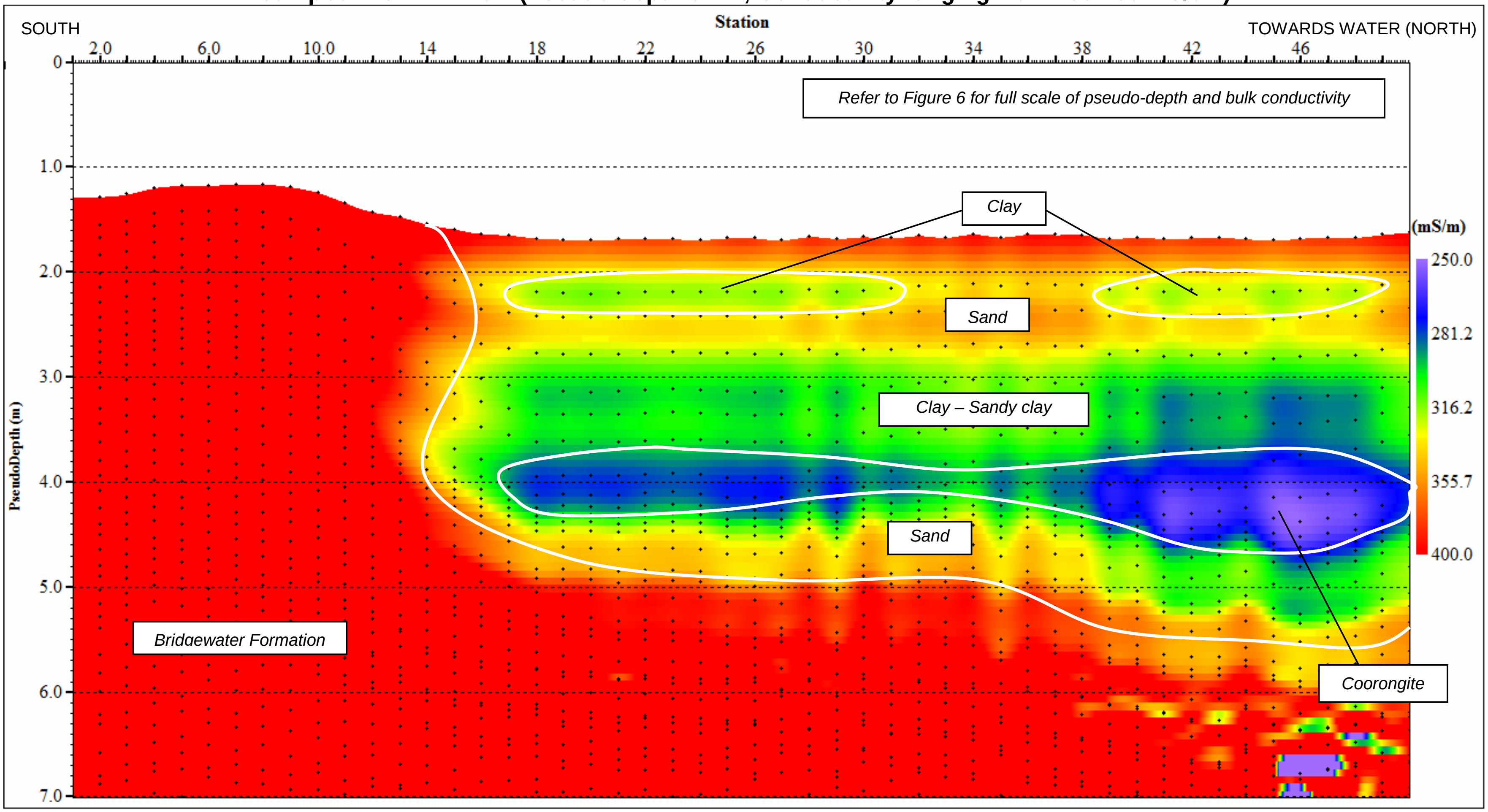

Figure 7: TEM pseudo-section from Campbell Park Line 1 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in meters (0-7 m plotted in this Figure). This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities has been narrowed to highlight features with conductivities ranging from 250 mS/cm to 400 mS/cm. Refer to Figure 6 for full scale pseudo-depth and bulk conductivity. Within the lake sediment zone overlying the higher conductivity Bridgewater Formation (Stations 14-50 and 1.2-5.5 m pseudo-depth), distinct continuous layers of sand, clay and sandy clay are present. Coorongite is thought to be the lowest conductor (~<300 mS/cm).

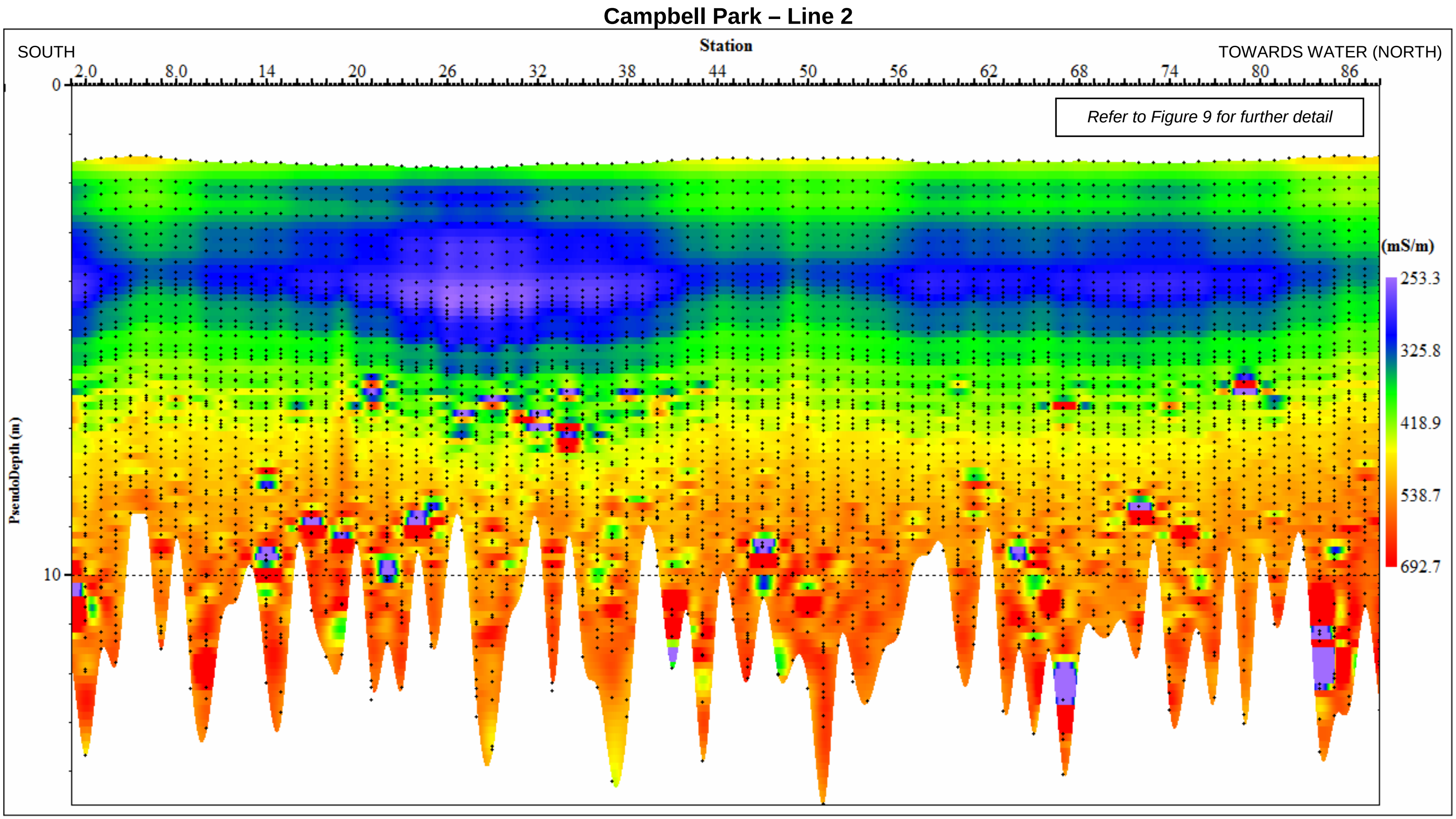

Figure 8: TEM pseudo-section from Campbell Park Line 2 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in metres. This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities ranged from 253.3 mS/m to 692.7 mS/m. Refer to Figure 9 for further detail within the conductivity range of 250-400 mS/cm).

Campbell Park – Line 2 (Pseudo-depth 0-7m; Conductivity ranging from 250-400 mS/cm)

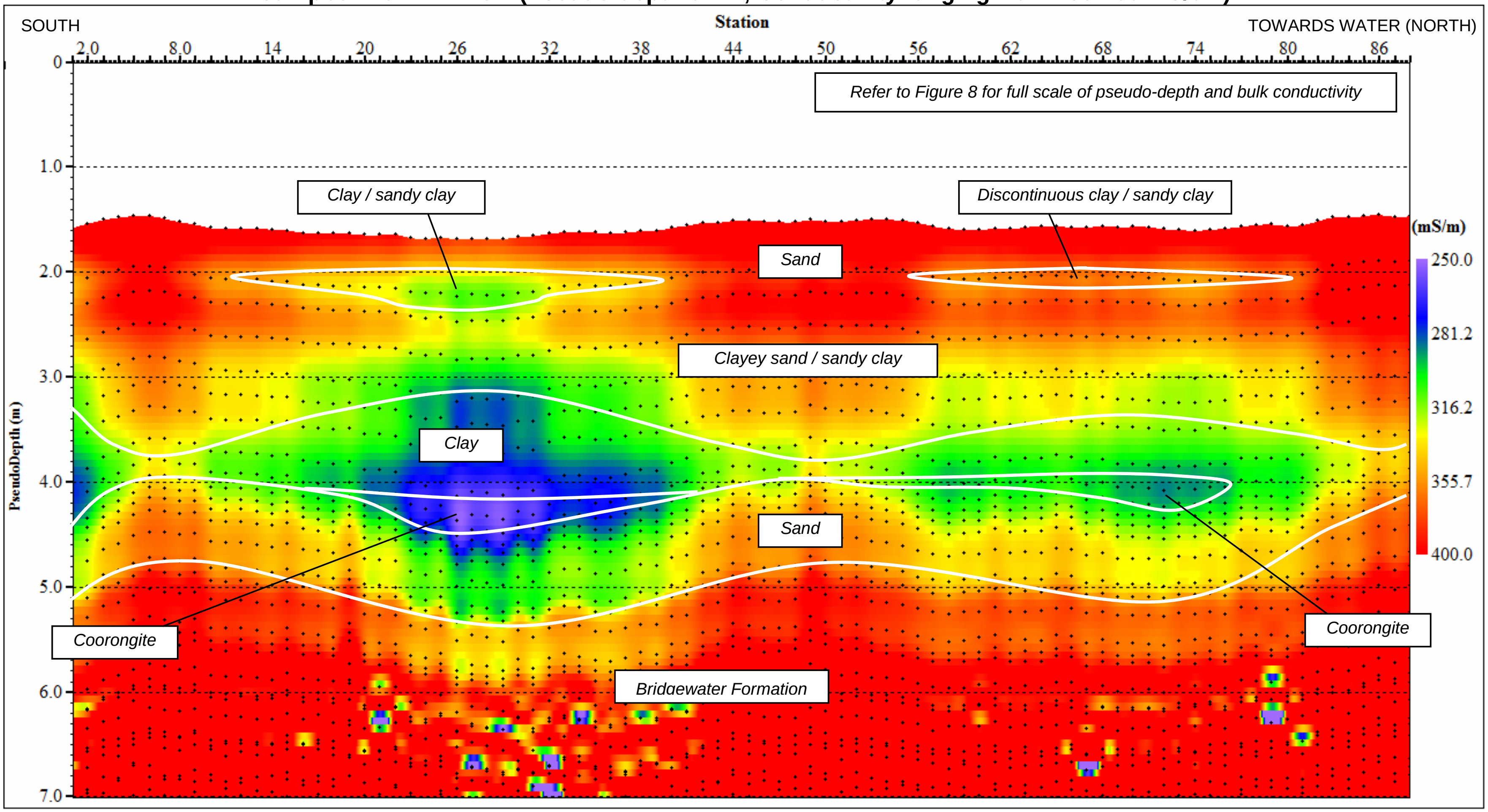

Figure 9: TEM pseudo-section from Campbell Park Line 2 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in meters (0-7 m pseudo-depth plotted in this Figure). This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities has been narrowed to highlight features with conductivities ranging from 250 mS/cm to 400 mS/cm. Refer to Figure 8 for full scale pseudo-depth and bulk conductivity. Interpretation is inferred from Campbell Park Line 1 as no cores were retrieved at this location. Within the lake sediment zone overlying the higher conductivity Bridgewater Formation (~1.5-5 m pseudo-depth), distinct continuous layers of sand, clay and sandy clay are present. Coorongite is thought to be the lowest conductor (~<250 mS/cm).

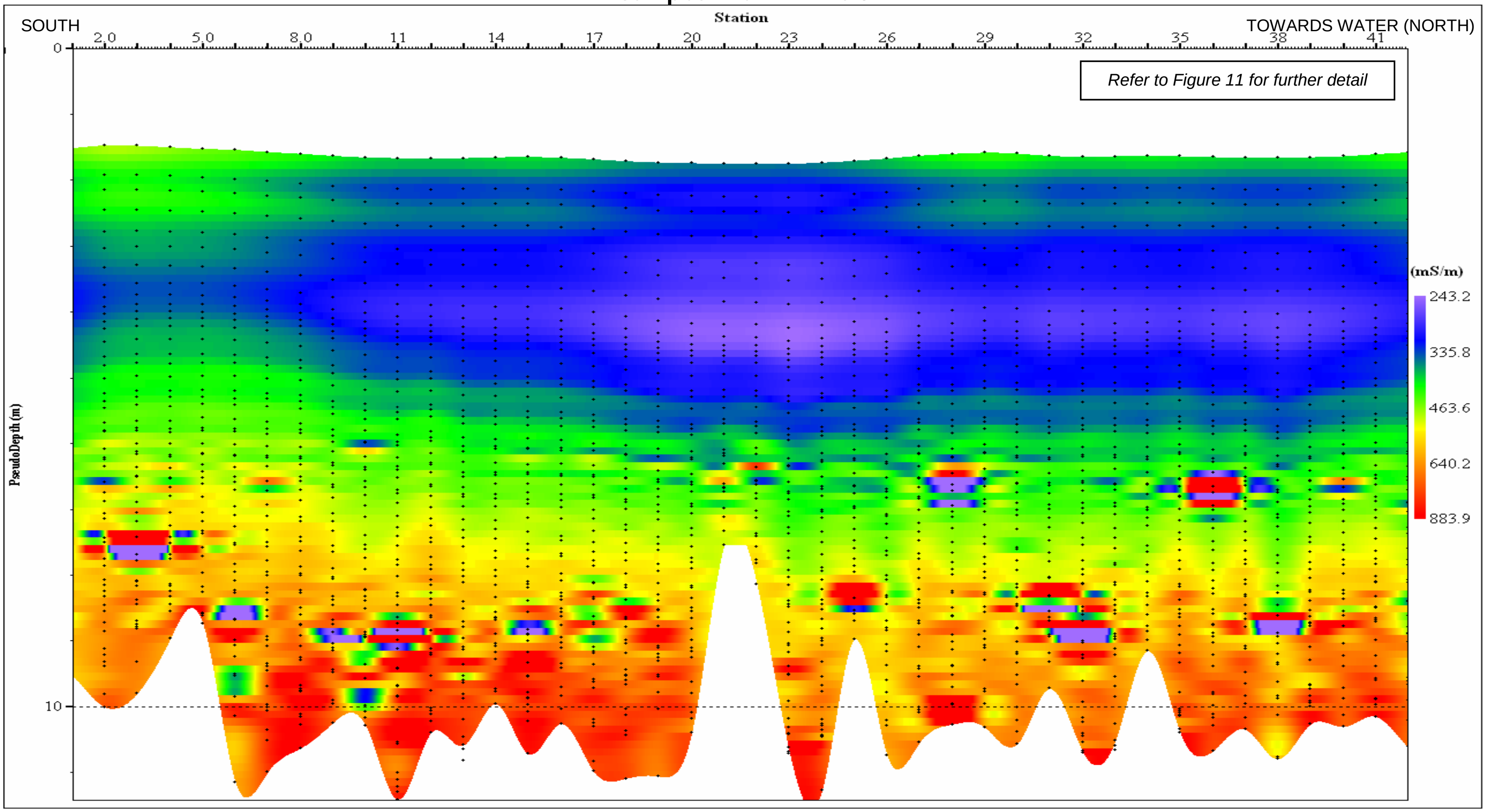

Figure 10: TEM pseudo-section from Campbell Park Line 3 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in metres. This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities ranged from 243.2 mS/m to 883.9 mS/m. As shown in report Figure 6, Campbell Park Line 3 commences 20 m west of Campbell Park Line 2 (at Station 1) and ends intersecting of Campbell Park Line 2 (at Station 38). A good correlation in features exists between Campbell Park Lines 2 and 3, indicating lateral continuity in lithology. Refer to Figure 11 for further detail within the range of 0-6 m pseudo-depth and 240-600 mS/cm bulk conductivity.

Campbell Park – Line 3 (Pseudo-depth 0-6m; Conductivity ranging from 240-600 mS/cm)

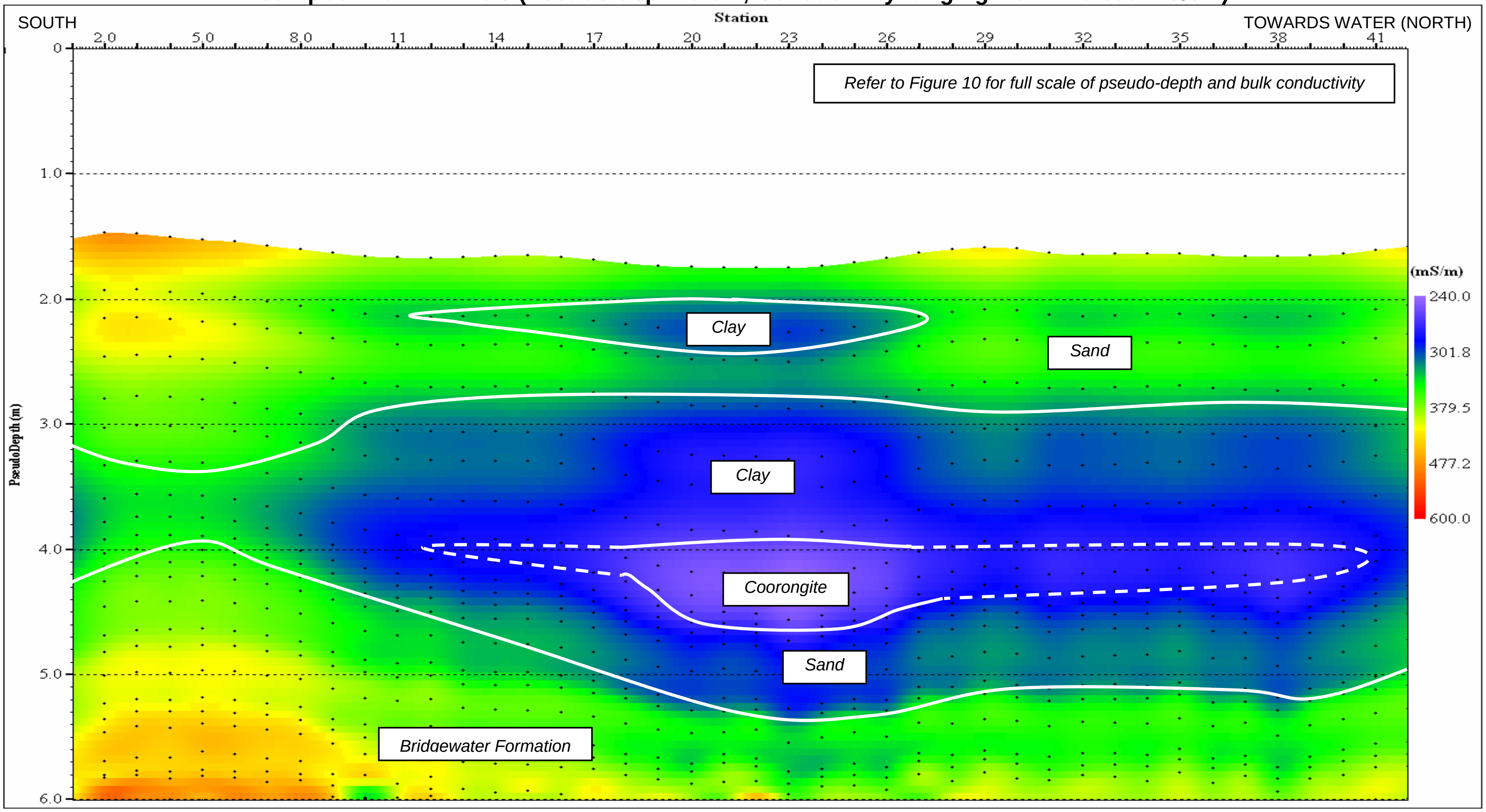

Figure 11: TEM pseudo-section from Campbell Park Line 3 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in metres (0-6 m pseudo-depth plotted in this Figure). This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities has been narrowed to highlight features with conductivities ranging from 240 mS/cm to 600 mS/cm. Refer to Figure 10 for full scale pseudo-depth and bulk conductivity. Interpretation is inferred from Campbell Park Line 1 as no cores were retrieved at this location. Within the lake sediment zone overlying the higher conductivity Bridgewater Formation (~1.5-5 m pseudo-depth), distinct continuous layers of sand, clay and sandy clay are present. Coorongite is thought to be the lowest conductor (~<250 mS/cm).

Windmill – Line 1

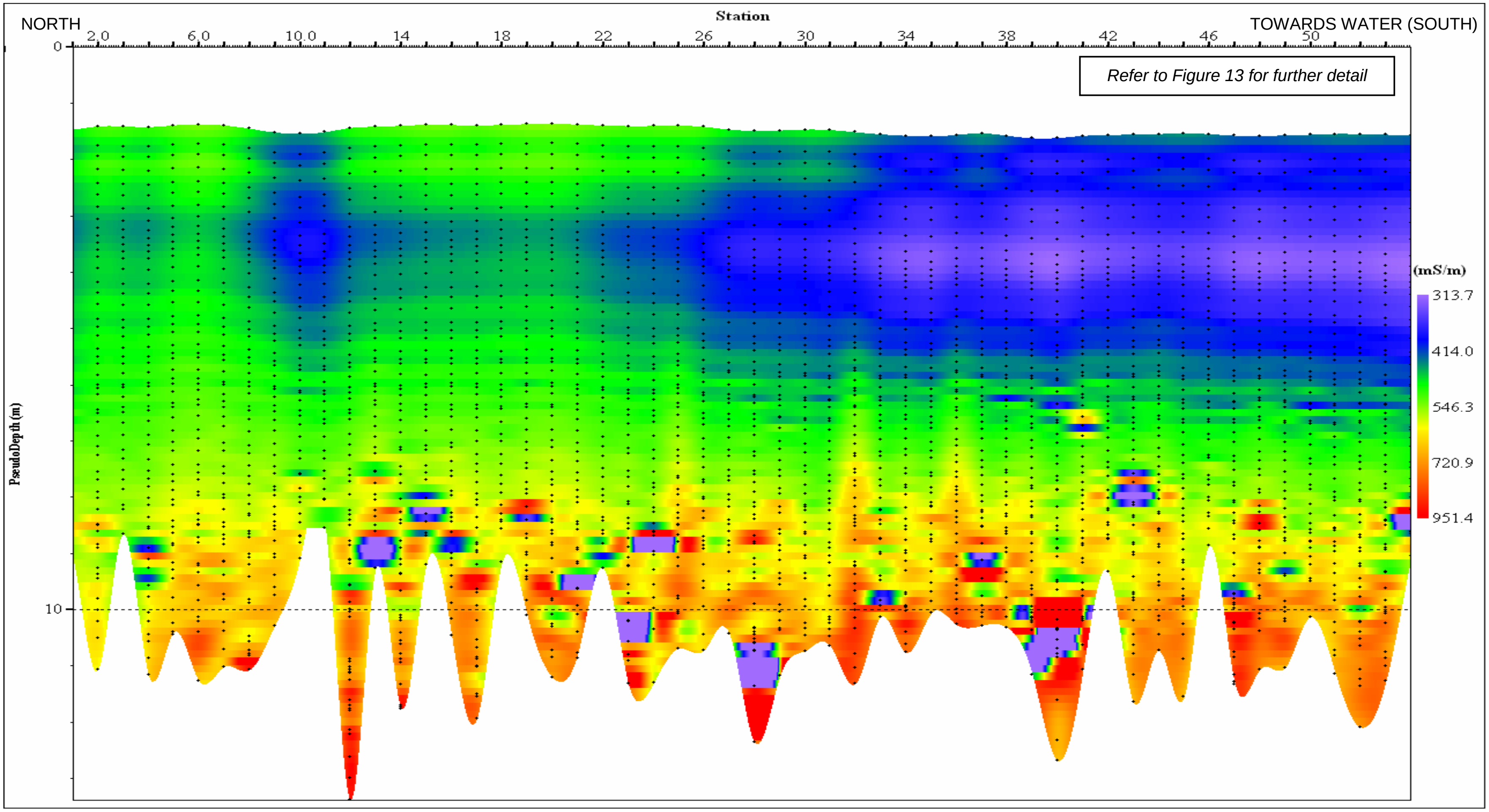

Figure 12: TEM pseudo-section from Windmill Line 1 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in metres. This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities ranged from 313.7 mS/m to 951.4 mS/m. Refer to Figure 13 for further detail within the range of 0-6 m pseudo-depth and 200-600 mS/cm bulk conductivity. Low conductivity values are thought to represent lake sediments. Higher bulk conductivity resulting from more saline water within the Bridgewater Formation is shown underlying the lake sediments.

Windmill – Line 1 (Pseudo-depth 0-6m; Conductivity ranging from 200-600 mS/cm)

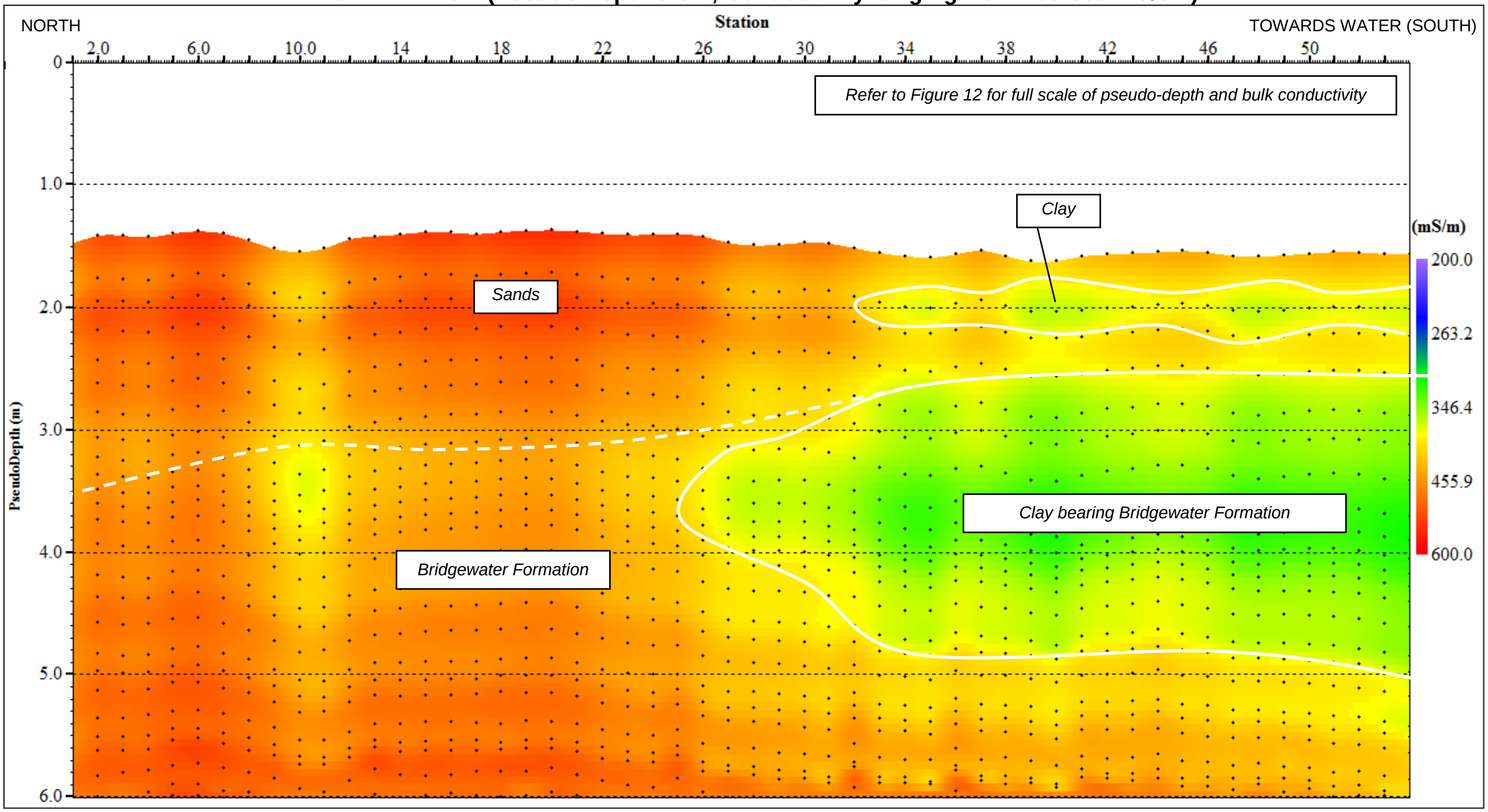

Figure 13: TEM pseudo-section from Windmill Line 1 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in meters (0-6 m pseudo-depth plotted in this Figure). This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities has been narrowed to highlight features with bulk conductivities ranging from 200 mS/cm to 600 mS/cm. Refer to Figure 12 for full scale pseudo-depth and bulk conductivity. Continuous layering of sediments is evident from 0-6 m pseudo-depth. Higher conductivity zones are thought to represent sandy material elevated salinity within sandy material pore water relative to within clayey material.

Windmill – Line 2

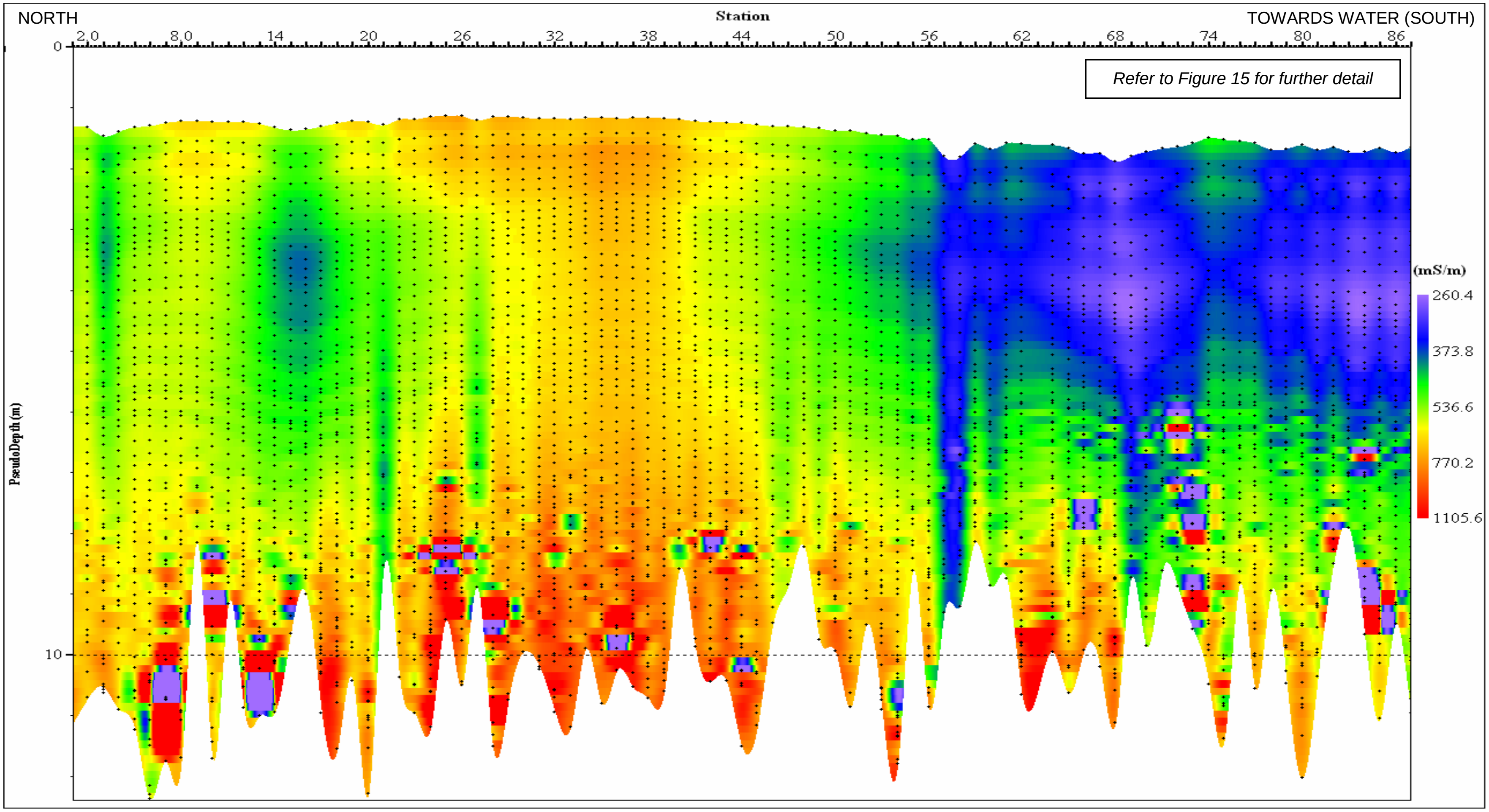

Figure 14: TEM pseudo-section from Windmill Line 2 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in metres. This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities ranged from 260.4 mS/m to 1105.6 mS/m. Refer to Figure 15 for further detail within the lake sediments (pseudo-depth range of 0-7 m and bulk conductivity range of 200-600 mS/cm). Low conductivity values are thought to represent lake sediments. Higher bulk conductivity resulting from more saline water within the Bridgewater Formation is shown underlying the lake sediments and outcropping near the ground surface from Stations 26-44.

Windmill – Line 2 (Pseudo-depth 0-7m; Conductivity ranging from 200-600 mS/cm)

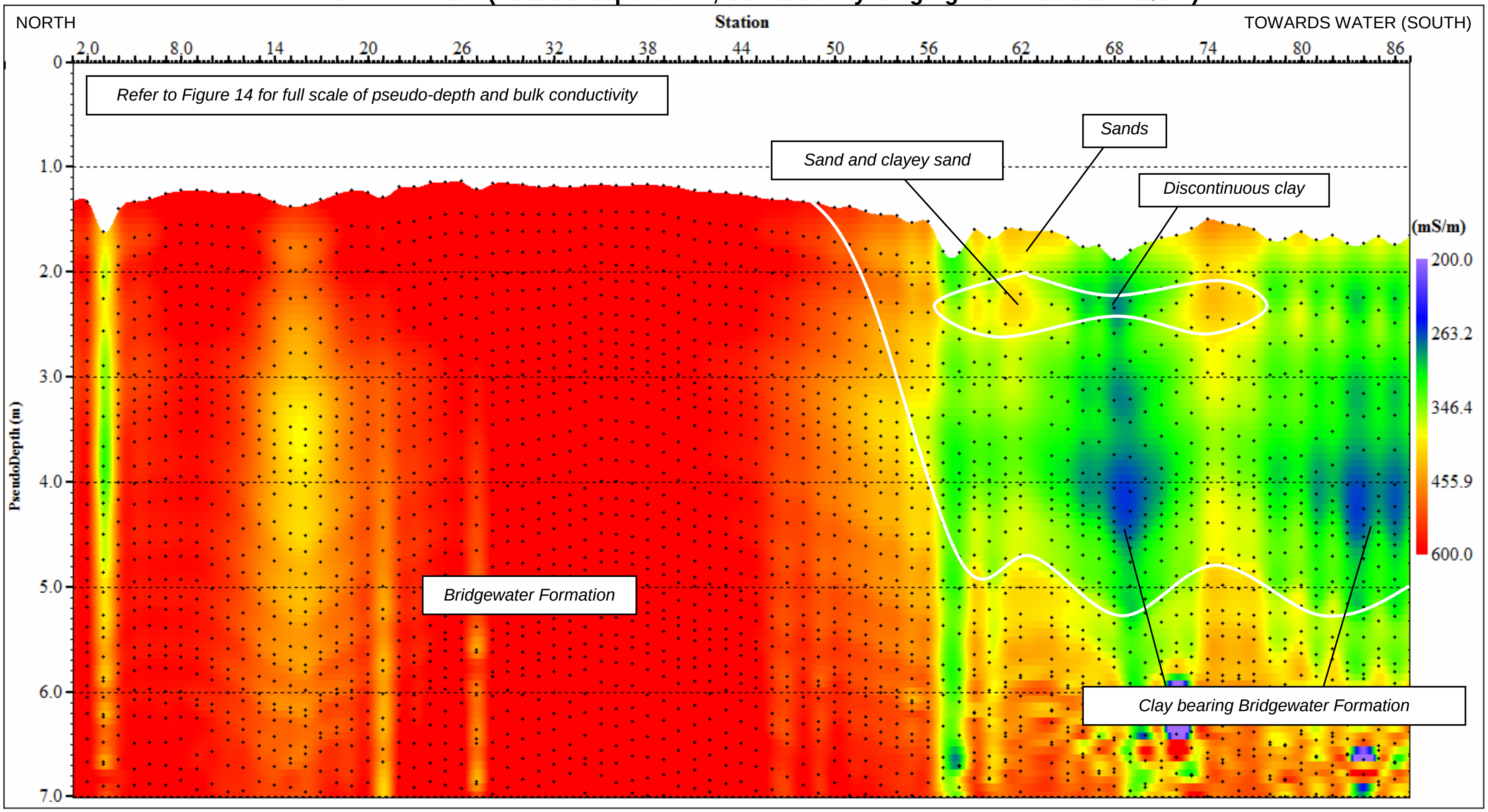

Figure 15: TEM pseudo-section from Windmill Line 2 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in meters (0-7 m pseudo-depth plotted in this Figure). This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities has been narrowed to highlight features with bulk conductivities ranging from 200 mS/cm to 600 mS/cm. Refer to Figure 14 for full scale pseudo-depth and bulk conductivity. Within the lake sediments, low bulk conductivity layers are thought to represent clay bearing material within the Bridgewater Formation. Continuous layers evident from Stations 56-88 and pseudo-depth ~1.5-3.5 m are thought to represent layers of sand clayey sand and discontinuous clay recovered in the push tube cores.

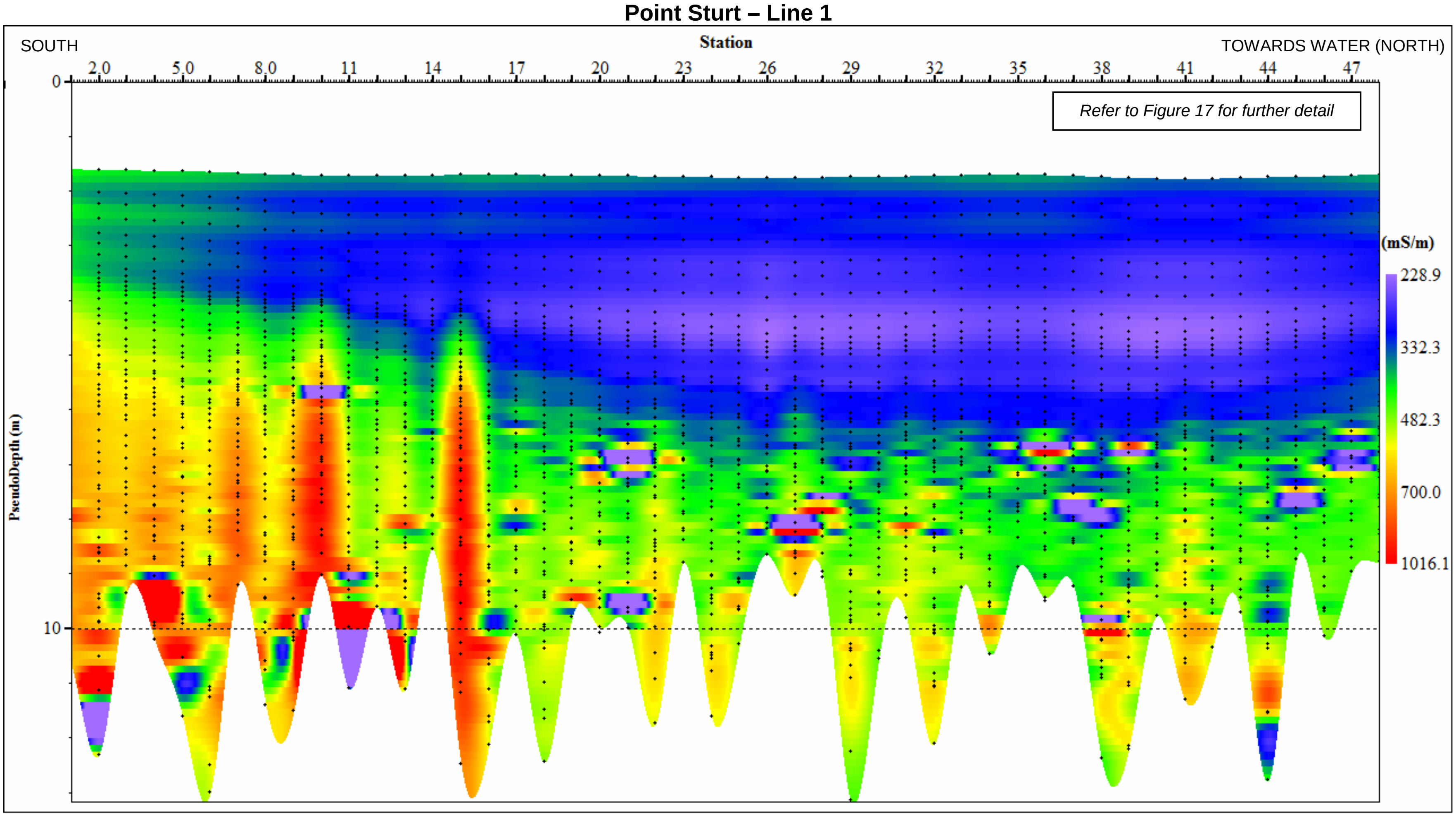

Figure 16: TEM pseudo-section from Point Sturt Line 1 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in metres. This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities ranged from 228.9 mS/m to 1016.1 mS/m. Refer to Figure 17 for further detail within the lake sediments (pseudo-depth range of 0-6 m and bulk conductivity range of 200-450 mS/cm). Low conductivity values are thought to represent lake sediments. Higher bulk conductivity resulting from more saline water within the Bridgewater Formation is shown underlying the lake sediments.

Point Sturt – Line 1 (Pseudo-depth 0-6m; Conductivity ranging from 200-450 mS/cm)

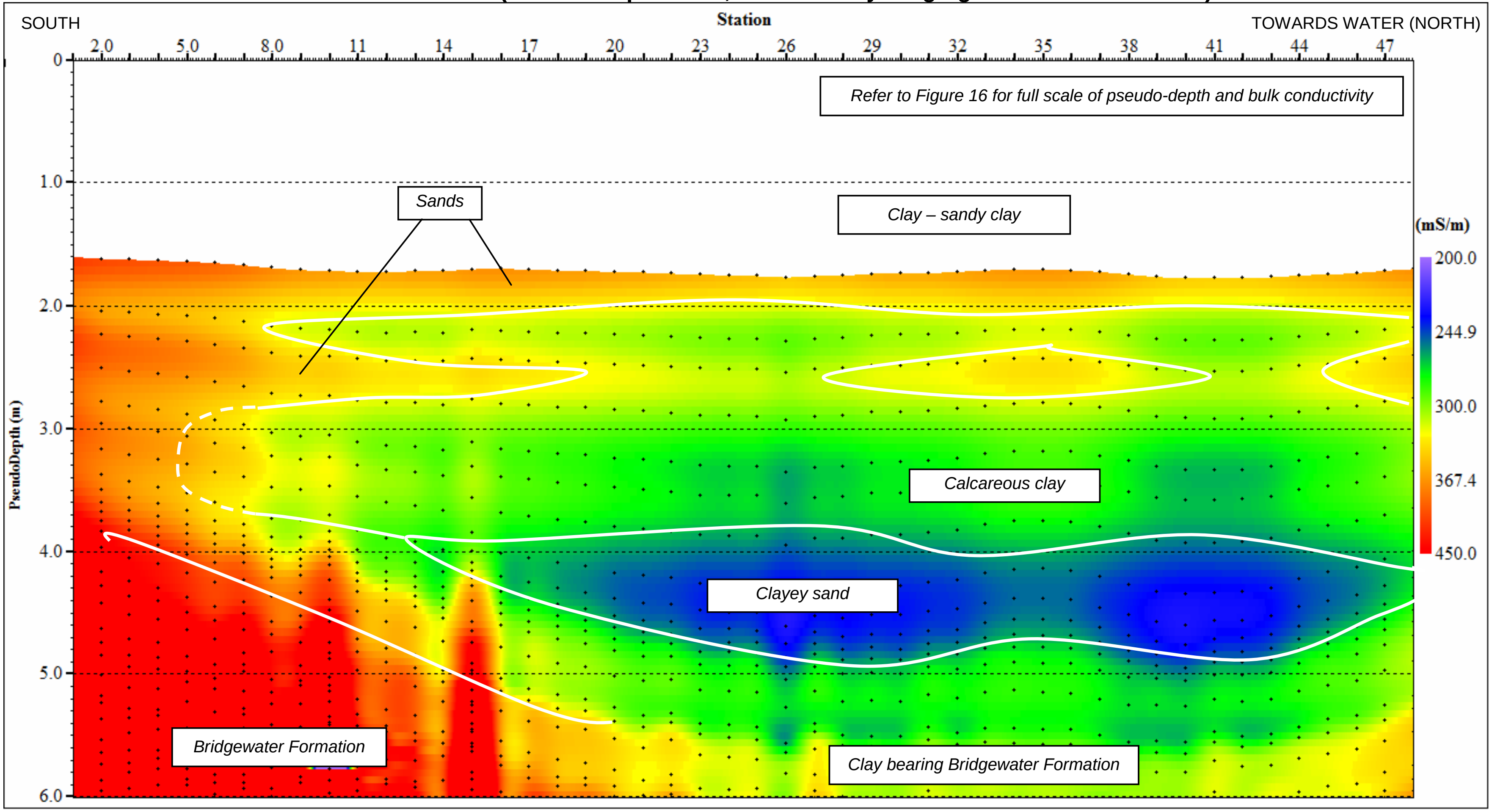

Figure 17: TEM pseudo-section from Point Sturt Line 1 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in meters (0-6 m pseudo-depth plotted in this Figure). This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities has been narrowed to highlight features with conductivities ranging from 200 mS/cm to 450 mS/cm. Refer to Figure 16 for full scale pseudo-depth and conductivity. Continuous layering is evident throughout cross-section. These layers are thought to represent continuous and discontinuous sands, calcareous clay and clayey sand overlying the Bridgewater Formation.

Point Sturt – Line 2

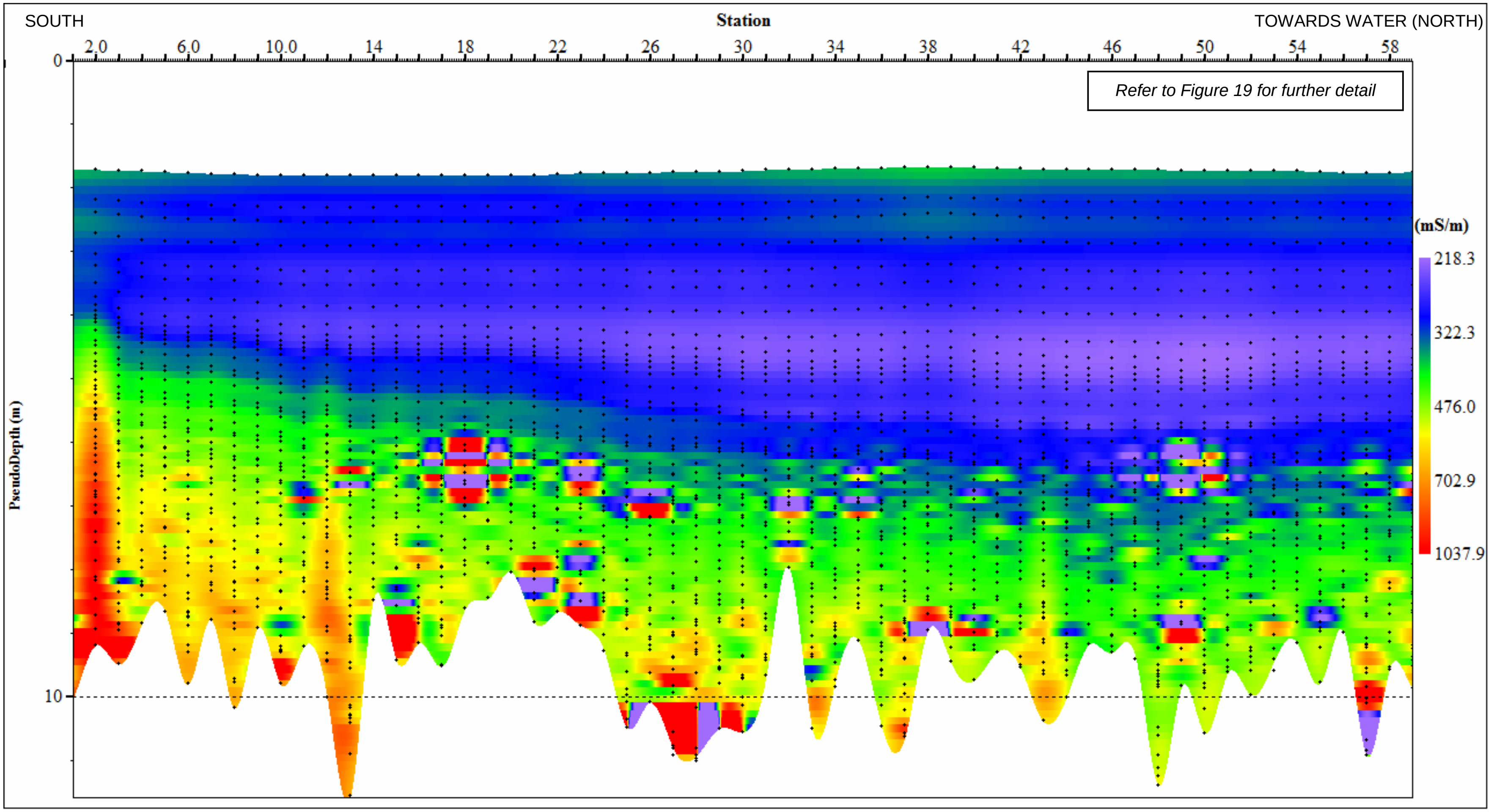

Figure 18: TEM pseudo-section from Point Sturt Line 2 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in metres. This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities ranged from 218.3 mS/m to 1037.9 mS/m. Refer to Figure 19 for further detail within the lake sediments (pseudo-depth range of 0-7 m and bulk conductivity range of 200-400 mS/cm). Low conductivity values are thought to represent lake sediments. Higher bulk conductivity resulting from more saline water within the Bridgewater Formation is shown underlying the lake sediments.

Point Sturt – Line 1 (Pseudo-depth 0-7m; Conductivity ranging from 200-400 mS/cm)

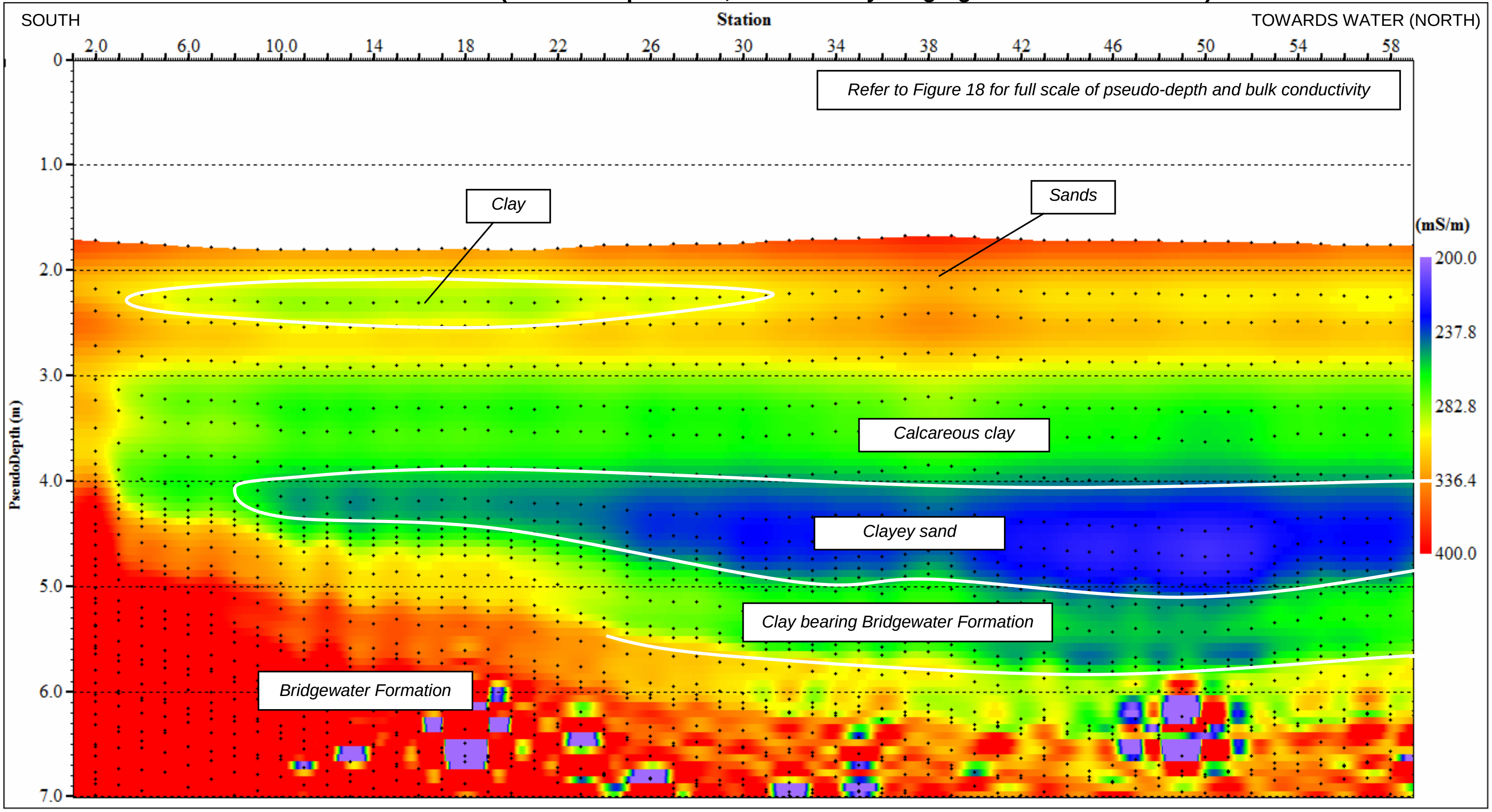

Figure 19: TEM pseudo-section from Point Sturt Line 2 (refer to report Figure 6 for location). TEM soundings were taken at 5 m intervals (or stations), as indicated along the upper horizontal axis. The vertical series of dotted lines at each of these 5 m intervals are the data points retrieved from each sounding. Pseudo-depth is recorded on the vertical axis in meters (0-7 m pseudo-depth plotted in this Figure). This provides a general indication of the actual depth below ground surface. The full scale of bulk conductivities has been narrowed to highlight features with conductivities ranging from 200 mS/cm to 400 mS/cm. Refer to Figure 18 for full scale pseudo-depth and conductivity. Continuous layering is evident throughout the cross-section. These layers are thought to represent continuous sands, discontinuous clay, calcareous clay and clayey sand overlying the Bridgewater Formation.

Attachment F:

Geological and piezometer construction logs – Currency Creek, Point Sturt, Campbell Park and Windmill locations

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Suite 507, 1 Princess Street, Kew,
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Log of Borehole: UCC-P1

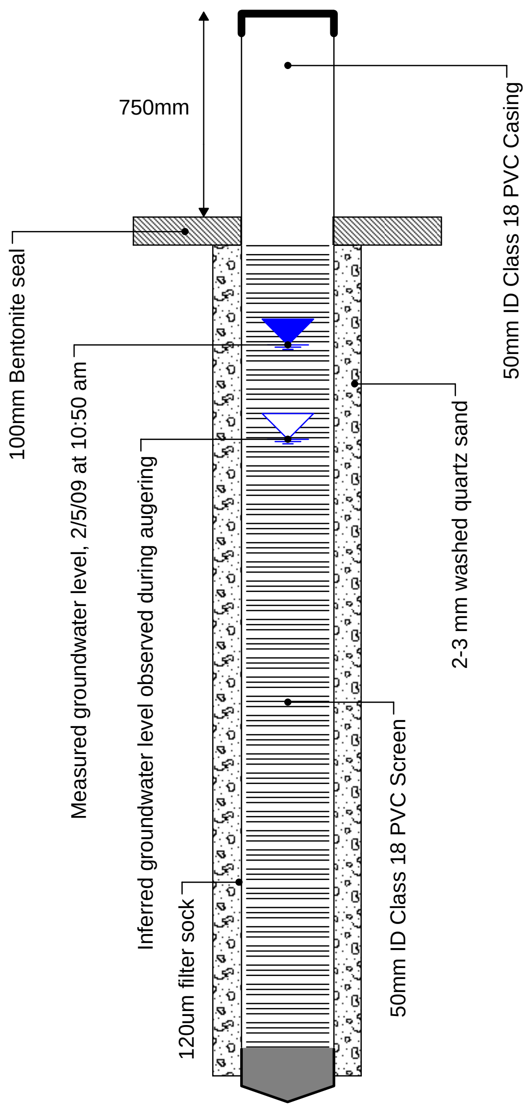
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 30/04/2009; 4:00 pm
Easting: 299150 m
Northing: 6073942 m
Project Manager: Dr. Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Description	Depth (m)	Sample #
		Ground Surface	0.0	
0.0		**Fine sand** Beige, dry, with some coarse fragments	0.3	1
		Sand Light grey tan, moist, with some clay, patches of oxidation products	0.5	2
0.5		**Sandy clay** Dark grey, wet, very faint H_2S odour	0.8	3
1.0		**Clay** Dark grey, wet, strong H_2S odour		
1.5				
2.0				4
2.5			3.0	
3.0		**End of bore**		
3.5				

Piezometer Construction Details



Width not to scale

Drilled By: SP / NB
Drill Method: Hand auger

Hole Size: 0.075m x 3.0m
Datum: GDA 84 (Zone 54 H)

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Suite 507, 1 Princess Street, Kew,
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www.earthsystems.com.au

Log of Borehole: LCC-P2

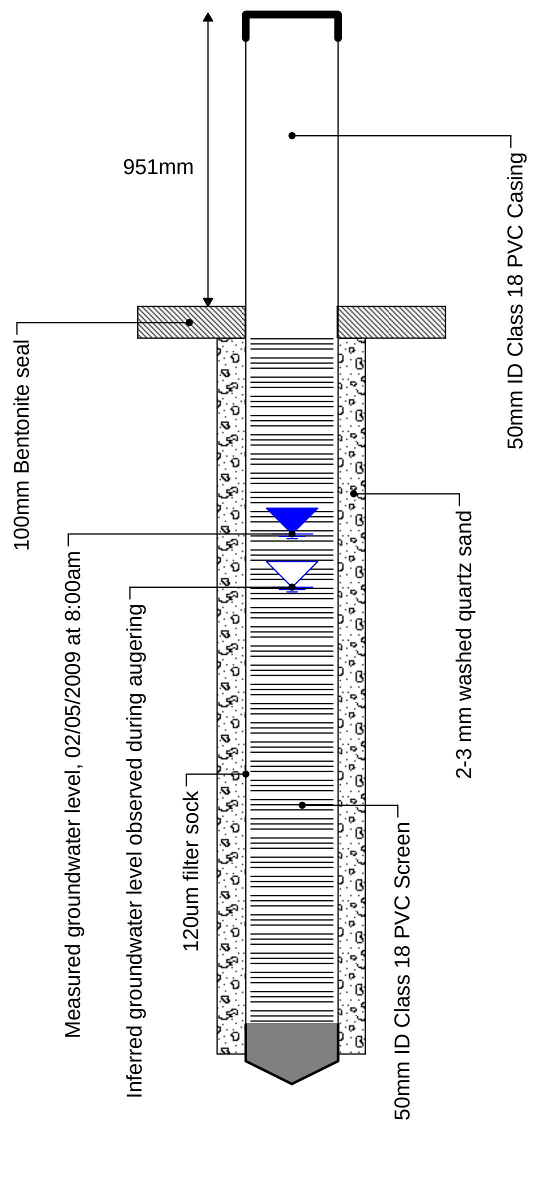
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 01/05/2009; 3:30pm
Easting: 301197 m
Northing: 6072776 m
Project Manager: JRT

SUBSURFACE PROFILE

Depth (m)	Description	Depth (m)	Sample #
0.0	Ground Surface	0.00	
	Medium Sand Patches of Fe staining, moist	0.10	1
	Medium Sand Grey (reduced), moist	0.40	2
0.5	**Medium sand** No Fe staining, moist, some clay	1.00	
1.0	**Clayey Sand** Grey, wet		
1.5			3
2.0		2.10	
	Sandy Clay Orange	2.20	
	Clay Grey, dense	2.50	4
2.5	**End of bore**		
3.0			

Piezometer Construction Details



Width not to scale

Drilled By: SP / NB
Drill Method: Hand auger

Hole Size: 0.075m x 3.0m
Datum: GDA 84 (Zone 54 H)

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Log of Borehole: UCC-P3

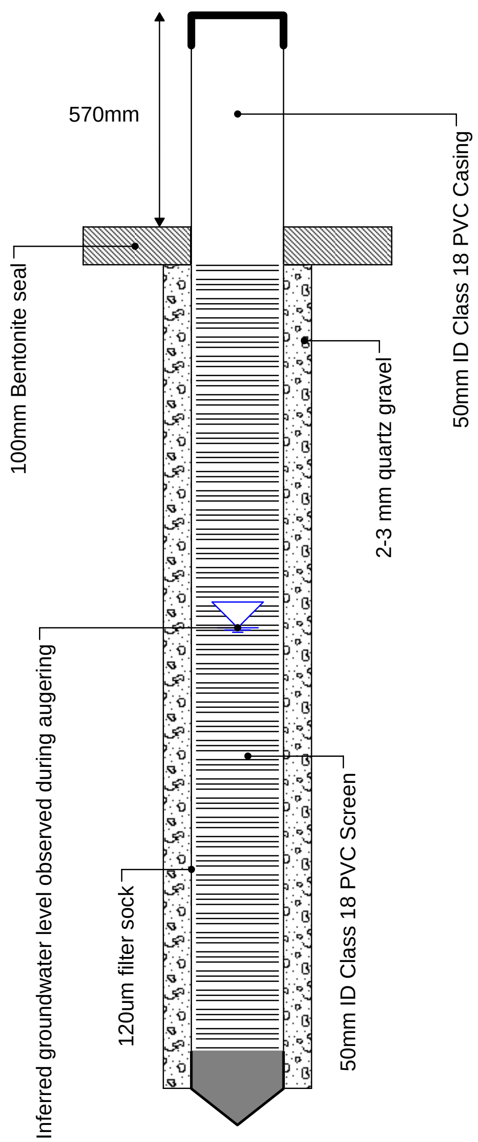
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 02/05/2009; 12:10 pm
Easting: 299452 m
Northing: 6072826 m
Project Manager: Dr Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Description	Depth (m)	Sample #
		Ground Surface	0.00	
0.0		**Medium Sand** No staining, moist, no odour	0.10	1
		Sand Brown, moist, some clay, no odour	0.40	2
0.5		**Sand** Grey, moist, some clay	0.60	
		Sand Pink-orange, moist, some clay	0.70	
1.0		**Clayey Sand** Grey, moist	1.20	3
		Clay Grey		
1.5		**Sandy Clay** Brown-grey, very wet, dense		4
2.0			2.10	
		Sandy Clay Brown-grey, very wet, dense, less sand than above layer	2.38	
2.5		**End of bore**		

Piezometer Construction Details



Width not to scale

Drilled By: SP / NB
Drill Method: Hand Auger
Hole Size: 0.075m x 3.0m
Datum: GDA 84 (Zone 54 H)

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Log of Borehole: CP-1S

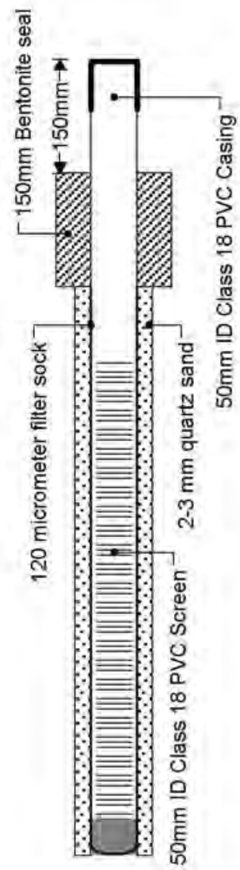
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341219
Northing: 6056465
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Description	Depth (m)	Sample #
0.00	Ground Surface		
	Quartz Sand Beige, medium subrounded sand, oxidised		
	Quartz Sand Beige, medium subrounded sand, oxidised, iron stains	0.12	
0.20	**Sandy Clay** Grey, medium sand		
	Quartz Sand Beige, medium subrounded sand, oxidised	0.34	
0.40	**Quartz Sand** Dark grey, medium subrounded sand; oxidation present near organic root material, contains thin (0 - 3mm) laminae of organic rich material, moist	0.41	
	Clayey Sand Light grey, medium subrounded sand with clay bands, moist	0.48	19
0.60	**Clay** Grey, moist		
	Clayey Sand Light grey, medium subrounded sand with clay bands, moist	0.72	
0.80	**Clay** Grey		20
	Sandy Clay Grey, discrete sand bands contained within a predominant clay matrix, moist	0.91	
1.00	**Sediment Loss**	0.98	
1.20	**Clay** Grey to green, H2S odour, moist.		
1.40			22

Piezometer Construction Details



Width not to scale

Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 0.9m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-1S

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341219
Northing: 6056465
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Description	Depth (m)	Sample #
1.60		1.72	
	Silt Grey to green, moist	1.78	
1.80	**Coorongite** Dark brown to black, layered	1.85	
	Quartz Sand Light grey, medium to fine sand	1.94	
2.00	**Coorongite** Dark brown to black, layered	1.99	
	Quartz Sand Dark to light grey, medium to fine subrounded sand		
2.20	**Sediment Loss**		
2.40	**Quartz Sand** Grey, fine subrounded sand; silt layer between the 2.520m to 2.523m interval; clay layer between the 2.560m to 2.565m interval	2.56	
2.60, 2.80	**Quartz Sand** Grey, medium to fine subrounded sand, contains laminae of black organic material, no reaction to HCl, moist	3.00	
3.00, 3.20	**Quartz Sand** Grey to green, medium to fine subrounded sand, contains laminae of black organic material, moist		24-25

Piezometer Construction Details

Drilled by: Boart longyear
Drilled Method: Push Tube
Hole Size: 0.23m x 0.9m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-1S

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341219
Northing: 6056465
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #	Piezometer Construction Details
3.40						
3.60				3.65		
			Sandy Clay Green, moist	3.69		
3.80			**Quartz Sand** Light grey to white, fine subrounded sand, thin band of calcareous clayey sand observed between the 3.723m to 3.73m interval. Reaction to HCl indicate carbonate rich	3.79	26	
			Clayey Sand Dark grey, fine subrounded sand, contains organic material, reactionto HCl indicates carbonate rich, moist	3.89		
		Top of Calcrete and Bridgewater Formation	**Quartz Sand** Light grey to white, fine subrounded sand, contains organic material, reaction to HCl indicates carbonate rich, moist	3.95		
4.00			**Quartz Sand** Light green, medium to fine subrounded sand; strong reaction to HCl, moist	4.00		
4.20			**Calcareous Sand** Contains carbonate and silicate cemented sand pebbles indicating the weathered surface of the Bridgewater Formation; reactionto HCl indicates carbonate rich			
4.40			**Sediment Loss**			
4.60						
4.80						
5.00						

Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 0.9m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-1D

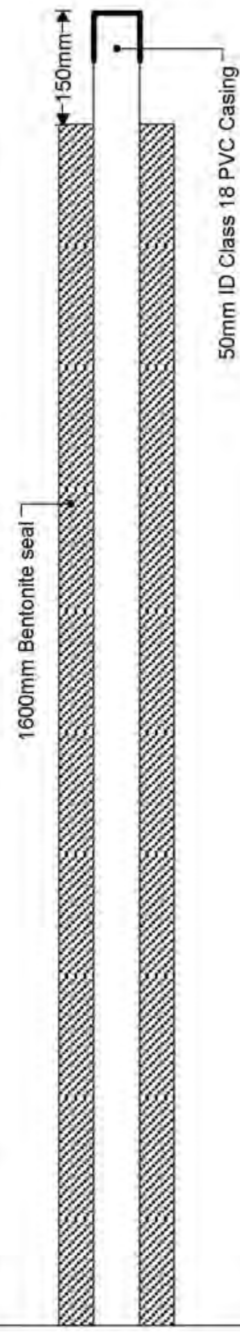
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341216
Northing: 6056465
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #
0.00			Ground Surface		
			Quartz Sand Beige, medium subrounded sand, oxidised		
			Quartz Sand Beige, medium subrounded sand, oxidised, iron stains	0.12	
0.20			**Sandy Clay** Grey, medium sand		
			Quartz Sand Beige, medium subrounded sand, oxidised	0.34	
0.40			**Quartz Sand** Dark grey, medium subrounded sand; oxidation present near organic root material, contains thin (0 - 3mm) laminae of organic rich material, moist	0.41	
				0.48	
			Clayey Sand Light grey, medium subrounded sand with irregular clay bands, moist		19
0.60			**Clay** Grey, moist		
			Clayey Sand Light grey, medium subrounded sand with clay bands, moist	0.72	
0.80			**Clay** Grey		20
				0.91	
			Sandy Clay Grey, discrete sand bands contained within a predominant clay matrix, moist	0.98	
1.00			**Sediment Loss**		
			Clay Grey to green, H2S odour, moist.		
1.20					
1.40					22

Piezometer Construction Details



Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 3.6m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-1D

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

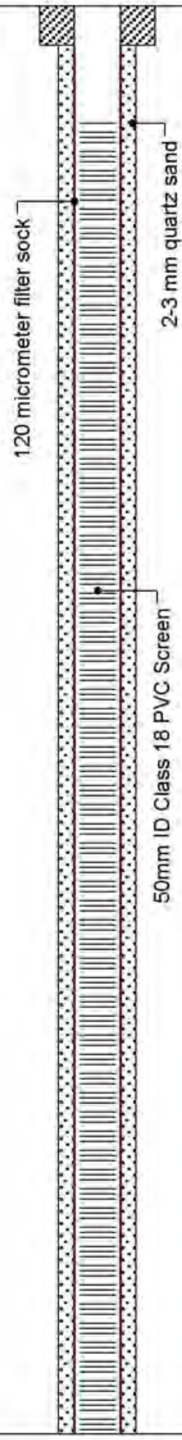
Drill Date: 23/08/2009
Easting: 341216
Northing: 6056465
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Description	Depth (m)	Sample #
	1.72	
Silt Grey to green, moist	1.78	
Coorongite Dark brown to black, layered	1.85	
Quartz Sand Light grey, medium to fine sand	1.94	
Coorongite Dark brown to black, layered	1.99	
Quartz Sand Dark to light grey, medium to fine subrounded sand		
Sediment Loss		
Quartz Sand Grey, fine subrounded sand, silt layer between the 2.520m to 2.523m interval; clay layer between the 2.560m to 2.565m interval	2.56	
Quartz Sand Grey, medium to fine subrounded sand, contains laminae of black organic material, moist	3.00	24-25
Quartz Sand Grey to green, medium subrounded sand, contains laminae of black organic material, moist		

Depth (m): 1.60, 1.80, 2.00, 2.20, 2.40, 2.60, 2.80, 3.00, 3.20

Piezometer Construction Details



Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 3.6m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-1D

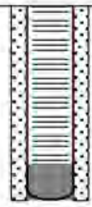
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341216
Northing: 6056465
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Interpretation	Description	Depth (m)	Sample #
3.40				
3.60			3.65	
		Sandy Clay Green, moist	3.69	
3.80		**Quartz Sand** Light grey to white, fine subrounded sand, contains organic material; thin band of calcareous clayey sand observed between the 3.723m to 3.73m interval. Reaction to HCl indicates carbonate rich	3.79	26
		Clayey Sand Dark grey, reaction to HCl indicates carbonate rich, moist	3.89	
4.00	Top of Calcrete and Bridgewater Formation	**Quartz Sand** Light grey to white, fine subrounded sand, contains organic material, HCl reaction indicates carbonate rich, moist	3.95	
		Quartz Sand Llight green, medium to fine subrounded sand; reaction to HCl indicates carbonate rich, moist	4.00	
4.20		**Calcareous Sand** Contains carbonate and silicate cemented sand pebbles indicating the weathered surface of the Bridgewater Formation; reaction to HCl indicates carbonate rich		
4.40		**Sediment Loss**		
4.60				
4.80				
5.00				

Piezometer Construction Details



Width not to scale

Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 3.6m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-2S

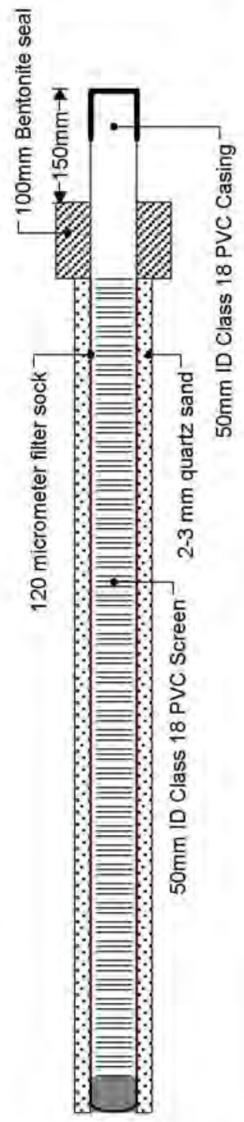
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341215
Northing: 6056515
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #
			Ground Surface		
0.00			**Quartz Sand** Beige, medium subrounded sand; oxidised	0.10	
0.20			**Clayey Sand** Beige, medium subrounded sand with clay bands, oxidised; transition to reduced material towards base of interval	0.38	
0.40			**Clayey Sand** Medium grey,medium subrounded sand with clay, moist	0.47	
			Sandy Clay Grey		
0.60			**Clayey Sand** Medium grey, medium subrounded sand with clay, moist	0.58	
			Sandy Clay Grey		27
0.80			**Quartz Sand** Grey, medium subrounded sand		
			Sandy Clay Grey, medium subrounded quartz sand bands are contained within a predominant clay matrix, moist	0.98	
1.00			**Sediment Loss**		
1.20			**Clay** Grey to green, H2S odour, moist		
1.40					28

Piezometer Construction Details



Width not to scale

Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 1.20m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-2S

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341215
Northing: 6056515
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Interpretation	Description	Depth (m)	Sample #	Piezometer Construction Details
1.60					
1.80			1.90		
		Sandy Clay Grey to green, approximately 20% medium to fine sand and 80% clay, H2S odour, moist	1.98		
2.00		**Sediment Loss**	2.08		
		Clay Brown to dark green, H2S odour, moist			
2.20		**Coorongite** Dark brown to black	2.24		
		Silt Brown to dark green	2.32		
		Coorongite Dark brown to black, layered	2.40		
2.40		**Silt** Brown to dark green	2.46		
		Coorongite Dark brown to black, layered			
2.60		**Silt** Brown to dark green			
		Coorongite Dark brown to black		31	
2.80		**Sandy Clay** Dark grey, sand content increases towards the bottom of the interval, moist			
		Quartz Sand Grey to green, medium sand; contains shell fragments, within the 2.46m to the 2.53m interval, moist	3.00		
3.00		**Clayey Sand** Green, approximately 15% clay and 85% medium to fine subrounded sand, moist	3.17		
3.20	Top of Calcrete and Bridgewater Formation	**Calcareous Sand** Contains carbonate and silicate cemented sand pebbles indicating the weathered surface of the Bridgewater Formation; HCl reaction indicates carbonate rich, moist	3.21		

Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 1.20m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-2D

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

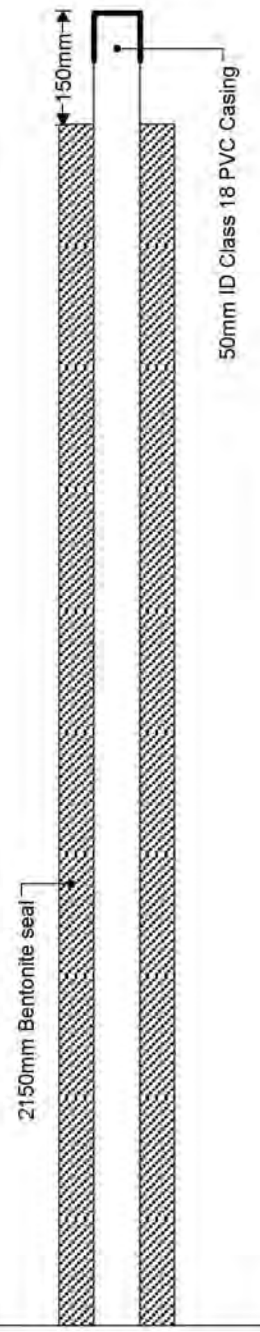
Drill Date: 23/08/2009
Easting: 341212
Northing: 6056515
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Description	Depth (m)	Sample #
Ground Surface	0.00	
Quartz Sand Beige, medium subrounded sand; oxidised	0.10	
Clayey Sand Beige, medium subrounded sand with clay bands, oxidised; transition to reduced material towards base of interval	0.38	
Clayey Sand Medium grey, medium subrounded sand with clay, moist	0.47	
Sandy Clay Grey		
Clayey Sand Medium grey, medium subrounded sand with clay, moist	0.58	
Sandy Clay Grey		27
Quartz Sand Grey, medium subrounded sand		
Sandy Clay Grey, medium subrounded quartz sand bands are contained within a predominant clay matrix, moist	0.98	
Sediment Loss		
Clay Grey to green, H2S odour, moist		28

Depth (m) scale: 0.00, 0.20, 0.40, 0.60, 0.80, 1.00, 1.20, 1.40

Piezometer Construction Details



Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 3.1m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-2D

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

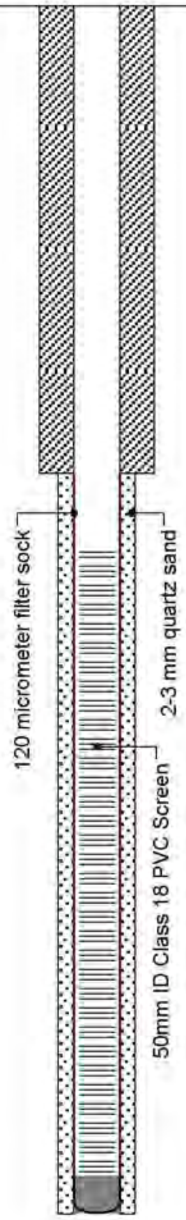
Drill Date: 23/08/2009
Easting: 341212
Northing: 6056515
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Interpretation	Description	Depth (m)	Sample #
		1.90	
	Sandy Clay Grey to green, approximately 20% medium to fine sand and 80% clay, H2S odour, moist	1.98	
	Sediment Loss	2.08	
	Clay Brown to dark green, H2S odour, moist		
	Coorongite Dark brown to black	2.24	
	Silt Brown to dark green	2.32	
	Coorongite Dark brown to black, layered	2.40	
	Silt Brown to dark green	2.46	
	Coorongite Dark brown to black, layered		
	Silt Brown to dark green		
	Coorongite Dark brown to black		31
	Sandy Clay Dark grey, sand content increases towards the bottom of the interval, moist		
	Quartz Sand Grey to green, medium sand; contains shell fragments, within the 2.46m to the 2.53m interval, moist	3.00	
	Clayey Sand Green, approximately 15% clay and 85% medium to fine subrounded sand, moist	3.17	
Top of Calcrete and Bridgewater Formation	**Calcareous Sand** Contains carbonate and silicate cemented sand pebbles indicating the weathered surface of the Bridgewater Formation; HCl reaction indicates carbonate rich, moist	3.21	

Depth (m): 1.60, 1.80, 2.00, 2.20, 2.40, 2.60, 2.80, 3.00, 3.20

Piezometer Construction Details



Width not to scale

Drilled by: Boart longyear
Drilled Method: Push Tube
Hole Size: 0.23m x 3.1m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-3S

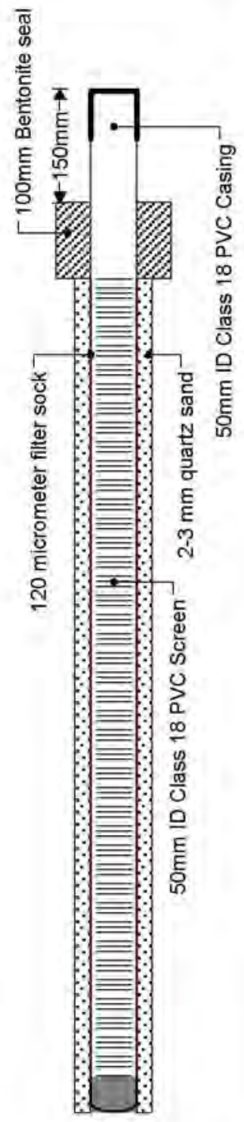
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341211
Northing: 6056565
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Description	Depth (m)	Sample #
0.00	Ground Surface		
	Clayey Sand Beige , beige , medium subrounded sand with clay, oxidised	0.10	
	Clay Grey		
0.20	**Clayey Sand** Beige, medium subrounded sand with clay, oxidised	0.29	
0.40	**Clayey Sand** Light grey to beige, contains organic material, moist	0.50	
0.60	**Sandy Clay** Grey, fine subrounded sand bands within a predominant clay matrix, shows oxidation (Fe precipitation) along organic root zones	0.73	34
0.80	**Clayey Sand** Grey, approximately 15% clay and 85% fine sand, moist	0.81	
	Clayey Sand Grey, moist	0.98	
1.00	**Sediment Loss**		
1.20	**Clay** Grey to green, H2S odour, moist		
1.40			35

Piezometer Construction Details



Width not to scale

Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 1.20m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-3S

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341211
Northing: 6056565
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #	Piezometer Construction Details
1.60						
1.80				2.00		
2.00			**Clay** Grey to green, H2S odour, moist	2.35	36	
2.20						
2.40			**Coorongite** Dark brown to black; contains some silty horizons	2.61	37	
2.60			**Silt** Brown to dark green	2.76		
2.80			**Coorongite** Dark brown to black, layered	2.81		
			Silt Green to grey, contains organic material and occasional dispersed shelly fragments	2.98	55	
3.00			**Sediment Loss**			
			Quartz Sand Grey, medium subrounded sand, moist	3.21	38	
3.20			**Quartz Sand** Grey, fine subrounded sand, contains carbonacous root material and occasional dispered shelly fragments; moist	3.29		

Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 1.20m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-3S

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341211
Northing: 6056565
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #	Piezometer Construction Details
3.40			**Quartz Sand** Grey, fine subrounded sand, contains occasional shell fragments; moist	3.44		
3.60		Top of Calcrete and Bridgewater Formation	**Calcareous Sand** Carbonate cemented calcareous sand, contains some carbonate and silicate cemented sand pebbles indicating the weathered surface of the Bridgewater Formation, reaction to HCl indicates carbonate rich, moist			
3.80						
4.00				4.00		
4.20						
4.40						
4.60						
4.80						
5.00						

Drilled by: Boart longyear
Drilled Method: Push Tube
Hole Size: 0.23m x 1.20m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-3D

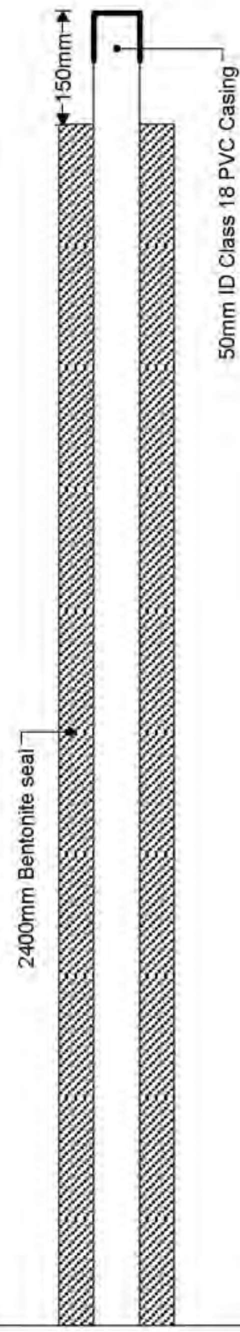
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341208
Northing: 6056564
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Description	Depth (m)	Sample #
0.00	Ground Surface		
	Clayey Sand Beige medium subrounded sand with clay, oxidised	0.10	
	Clay Grey		
0.20	**Clayey Sand** Beige, medium subrounded sand with clay, oxidised	0.29	
0.40	**Clayey Sand** Light grey to beige; contains organic material, moist	0.50	
0.60	**Sandy Clay** Grey, fine subrounded sand bands within a predominant clay matrix, shows oxidation (Fe precipitation) along organic root zones	0.73	
0.80	**Clayey Sand** Grey, approximately 15% clay and 85% fine sand, moist	0.81	34
	Clayey Sand Grey, moist	0.98	
1.00	**Sediment Loss**		
1.20	**Clay** Grey to green, H2S odour, moist		
1.40			35

Piezometer Construction Details



Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 3.3m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-3D

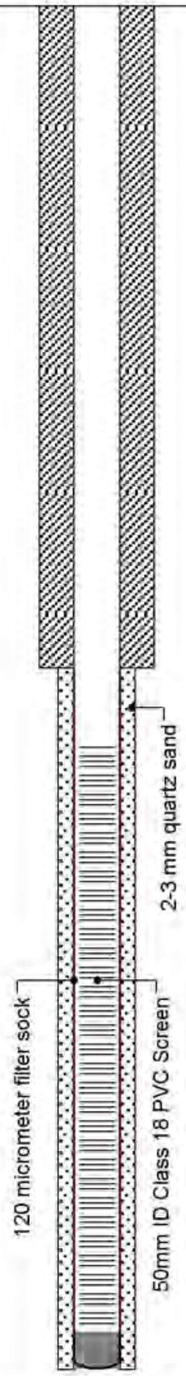
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341208
Northing: 6056564
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #
1.60 – 2.00				2.00	
2.00 – 2.35			**Clay** Grey to green, H2S odour, moist	2.35	36
2.35 – 2.61			**Coorongite** Dark brown to black; contains some silty horizons	2.61	37
2.61 – 2.76			**Silt** Brown to dark green	2.76	
2.76 – 2.81			**Coorongite** Dark brown to black, layered	2.81	
2.81 – 2.98			**Silt** Green to grey, contains organic material and occasional dispersed shelly fragments; moist	2.98	55
2.98 – 3.00			**Sediment Loss**		
3.00 – 3.21			**Quartz Sand** Grey, medium subrounded sand, moist	3.21	38
3.21 – 3.29			**Quartz Sand** Grey, fine subrounded sand, contains carbonacous root material and occasional dispered shelly fragments; moist	3.29	

Piezometer Construction Details



Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 3.3m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-3D

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341208
Northing: 6056564
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #	Piezometer Construction Details
3.40			**Quartz Sand** Grey, fine subrounded sand, contains occasional shell fragments; moist	3.44		Width not to scale
3.60		Top of Calcrete and Bridgewater Formation	**Calcareous Sand** Carbonate cemented calcareous sand, contains some carbonate and silicate cemented sand pebbles indicating the weathered surface of the Bridgewater Formation, reaction to HCl indicates carbonate rich, moist			
3.80						
4.00				4.00		
4.20						
4.40						
4.60						
4.80						
5.00						

Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 3.3m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-4S

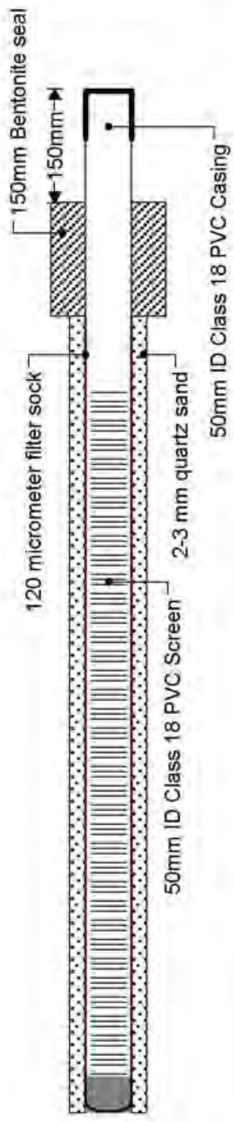
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341207
Northing: 6056614
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Interpretation	Description	Depth (m)	Sample #
0.00		Ground Surface		
		Quartz Sand Beige, medium sand, root zone, oxidised		
		Clay Grey, root zone	0.20	
0.20		**Clayey Sand** Grey, medium subrounded sand with clay bands, oxidised	0.31	
		Clayey Sand Grey, clay bands within a predominant beige medium subrounded sand, contains organic material, oxidised sand material	0.45	
0.40		**Clayey Sand** Light grey, fine subrounded sand grading to clay towards bottom of interval, moist	0.57	40
0.60		**Clayey Sand** Beige to light grey, medium subrounded sand with clay bands; oxidised, moist		
		Clay Grey, clay grading to sand towards the top of the interval, shows signs of oxidation along organic root zones, moist	0.98	41
0.80				
1.00		**Sediment Loss**		
	Lake Sediments	**Clay** Grey to green, H2S odour, moist		
1.20				
1.40				42

Piezometer Construction Details



Width not to scale

Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 1.20m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-4S

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341207
Northing: 6056614
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Interpretation	Description	Depth (m)	Sample #	Piezometer Construction Details
1.60					
1.80			1.87		
		Coorongite Dark brown to black	1.98		
2.00		**Sediment Loss**			
		Quartz Sand Grey, medium subrounded sand, contains occasional shell fragments; moist	2.15	44	
2.20		**Sandy Clay** Green	2.25		
	Top of Calcrete and Bridgewater Formation	**Quartz Sand** Grey, fine subrounded sand, contains occasional shell fragments; moist	2.34		
2.40		**Calcareous Sand** Light yellow to orange, fine sand; contains carbonate and silica cemented fine sand pebbles indicating the weathered surface of the Bridgewater Formation, HCl reaction indicates carbonate rich, moist			
2.60		**Calcareous Sand** Yellow to orange, medium sand; HCl reaction indicates carbonate rich, moist		45	
2.80			2.98		
3.00					
3.20					

Drilled by: Boart longyear
Drilled Method: Push Tube
Hole Size: 0.23m x 1.20m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-4M

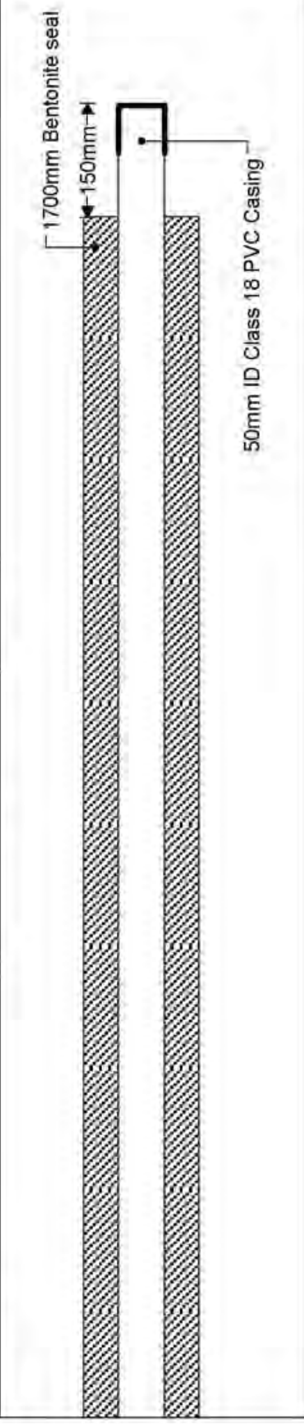
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341204
Northing: 6056614
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Interpretation	Description	Depth (m)	Sample #
0.00		Ground Surface		
		Quartz Sand Beige, medium sand, root zone, oxidised		
		Clay Grey, root zone	0.20	
0.20		**Clayey Sand** Grey, biege medium subrounded sand with clay bands, oxidised	0.31	
		Clayey Sand Grey, clay bands within a predominant beige medium subrounded sand, contains organic material, oxidised sand material	0.45	
0.40		**Clayey Sand** Light grey, fine subrounded sand grading to clay towards bottom of interval, moist	0.57	40
0.60		**Clayey Sand** Beige to light grey, medium subrounded sand with clay bands; oxidised, moist		
		Clay Grey, clay grading to sand towards the top of the interval, shows signs of oxidation along organic root zones, moist	0.98	41
0.80				
1.00		**Sediment Loss**		
	Lake Sediments	**Clay** Grey to green, H2S odour, moist		42
1.20				
1.40				

Piezometer Construction Details



Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 2.15m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-4M

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

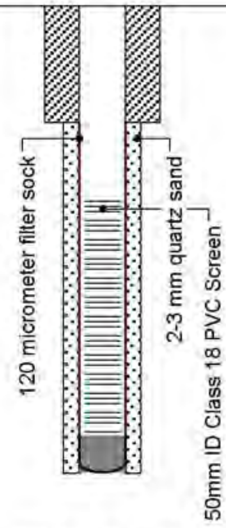
Drill Date: 23/08/2009
Easting: 341204
Northing: 6056614
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Interpretation	Description	Depth (m)	Sample #
		1.87	
	Coorongite Dark brown to black	1.98	
	Sediment Loss		
	Quartz Sand Grey, medium subrounded sand, contains occasional shell fragments; moist	2.15	44
	Sandy Clay Green	2.25	
Top of Calcrete and Bridgewater Formation	**Quartz Sand** Grey, fine subrounded sand, contains occasional shell fragments; no reaction of sand to HCl. Shells react to HCl, moist	2.34	
	Calcareous Sand Light yellow to orange, fine sand; contains carbonate and silica cemented fine sand pebbles indicating the weathered surface of the Bridgewater Formation, HCl reaction indicates carbonate rich, moist		
	Calcareous Sand Yellow to orange, medium sand; HCl reaction indicates carbonate rich, moist	2.98	45

Depth (m): 1.60, 1.80, 2.00, 2.20, 2.40, 2.60, 2.80, 3.00, 3.20

Piezometer Construction Details



Width not to scale

Drilled by: Boart longyear
Drilled Method: Push Tube
Hole Size: 0.23m x 2.15m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: CP-4D

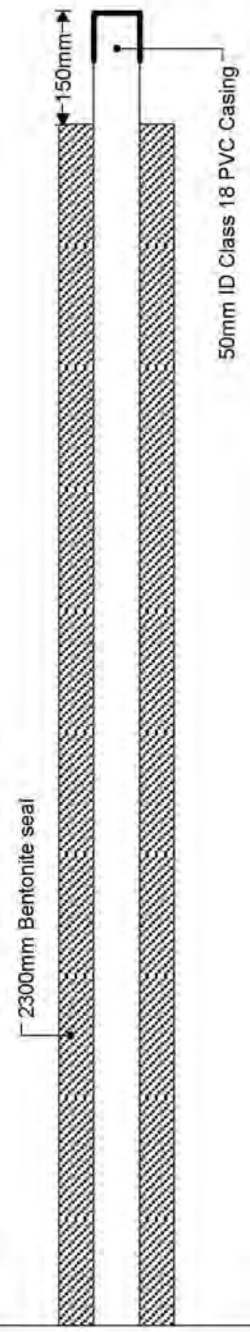
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341210
Northing: 6056615
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Interpretation	Description	Depth (m)	Sample #
0.00		Ground Surface		
		Quartz Sand Beige, medium sand, root zone, oxidised		
		Clay Grey, root zone	0.20	
0.20		**Clayey Sand** Grey, medium subrounded sand with clay bands, oxidised	0.31	
		Clayey Sand Grey, clay bands within a predominant beige medium subrounded sand, contains organic material, oxidised sand material	0.45	
0.40		**Clayey Sand** Light grey, fine subrounded sand grading to clay towards bottom of interval, moist	0.57	40
0.60		**Clayey Sand** Beige to light grey, medium subrounded sand with clay bands; oxidised, moist		
0.80		**Clay** Grey, clay grading to sand towards the top of the interval, shows signs of oxidation along organic root zones, moist	0.98	41
1.00		**Sediment Loss**		
1.20	Lake Sediments	**Clay** Grey to green, H2S odour, moist		
1.40				42

Piezometer Construction Details



Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 4.4m
Datum: GDA 1994 MGA Zone 54

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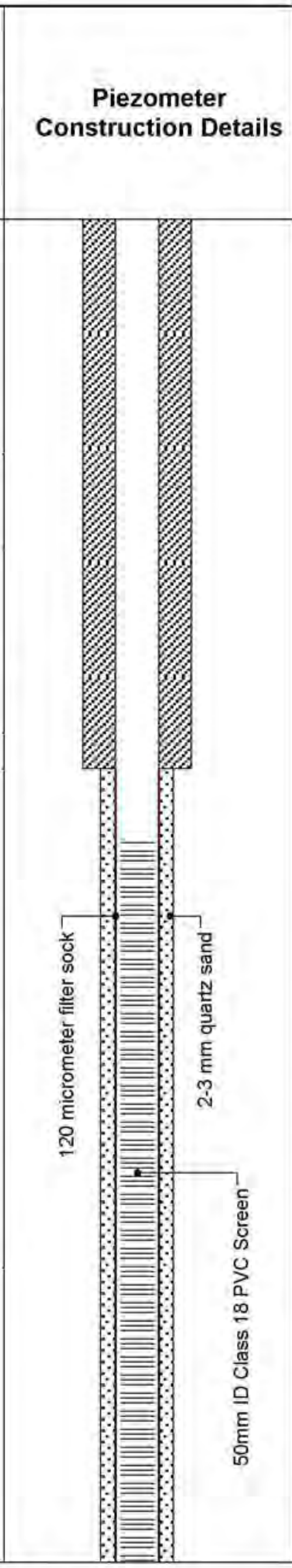
Log of Borehole: CP-4D

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341210
Northing: 6056615
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Interpretation	Description	Depth (m)	Sample #
1.60–1.87			1.87	
		Coorongite Dark brown to black	1.98	
2.00		**Sediment Loss**		
		Quartz Sand Grey, medium subrounded sand, contains occasional shell fragments ; moist	2.15	44
2.20		**Sandy Clay** Green	2.25	
	Top of Calcrete and Bridgewater Formation	**Quartz Sand** Grey, fine subrounded sand, contains occasional shell fragments; no reaction of sand to HCl. Shells react to HCl, moist	2.34	
2.40		**Calcareous Sand** Light yellow to orange, fine sand; contains carbonate and silica cemented fine sand pebbles indicating the weathered surface of the Bridgewater Formation, HCl reaction indicates carbonate rich, moist		
2.60–2.98		**Calcareous Sand** Yellow to orange, medium sand; HCl reaction indicates carbonate rich, moist	2.98	45
3.00		End of Log		



Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 4.4m
Datum: GDA 1994 MGA Zone 54

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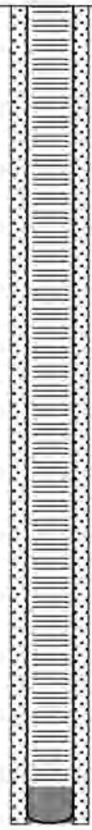
Log of Borehole: CP-4D

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 341210
Northing: 6056615
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #	Piezometer Construction Details
3.40						
3.60						
3.80						
4.00						
4.20						
4.40				4.40		
4.60						
4.80						
5.00						



Width not to scale

Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 4.4m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: PS-1S (ex PS009)

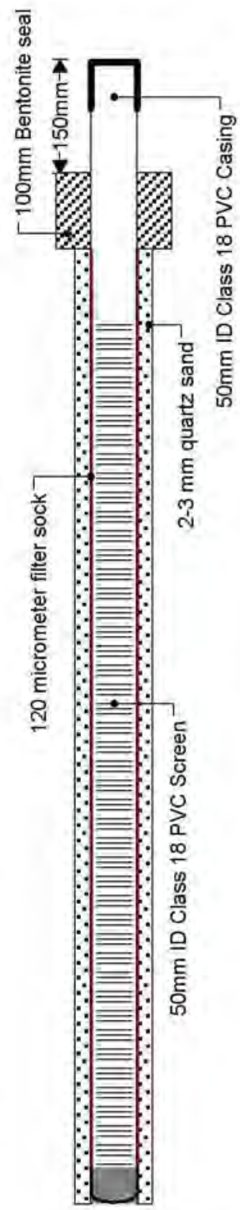
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 321171
Northing: 6070261
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #
			Ground Surface		
0.00			**Quartz Sand** Beige,medium subrounded sand; oxidised	0.32	
0.20					
0.40			**Quartz Sand** Grey, medium subrounded sand; transition from oxidised to reduced material with depth, moist	0.58	
0.60			**Clayey Sand** Grey medium subrounded sand with clay bands, moist	0.89	8
0.80			**Sediment Loss**	1.00	
1.00			**Clayey Sand** Grey, approximately 20% clay and 80% fine to meduim subrounded sand, moist	1.10	
			Sandy Clay Green to grey, approximately 20% medium subrounded sand and 80% clay, moist	1.19	
1.20		Lake Sediments	**Calcareous Clay** Green, contains organic root material and thin organic (0 - 4mm) laminae, HCl reaction indicates carbonate rich, moist	1.29	9
1.40			**Sediment Loss**		

Piezometer Construction Details



Drilled by: Boart longyear
Drilled Method: Push Tube
Hole Size: 0.23m x 1.36m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: PS-1S (ex PS009)

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 321171
Northing: 6070261
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #	Piezometer Construction Details
1.60, 1.80						
2.00 – 2.47			**Clayey Sand** Grey, medium sand grading to fine subrounded sand towards the base of the interval, approximately 20% clay and 80% sand, no reaction to HCl	2.00	10	
2.47 – 2.58		Top of Calcrete and Bridgewater Formation	**Calcareous Clayey Sand** Medium subrounded sand grading to sandy clay towards top of interval, contains carbonate and silica cemented sand pebbles indicating weathered surface of Bridgewater Formation, HCl reaction indicates carbonate rich, moist	2.47	11	
2.58 – 2.74			**Calcareous Sand** White to light grey, fine sand, contains carbonate and silica cemented pebbles, HCl reaction indicates carbonate rich, moist	2.58	12	
				2.74		
2.80, 3.00, 3.20						

Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 1.36m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: PS-1D (ex PS009)

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

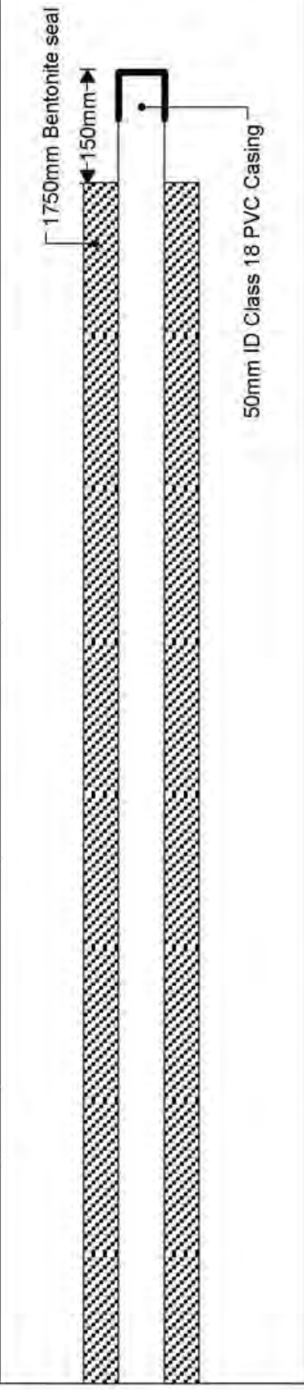
Drill Date: 23/08/2009
Easting: 321168
Northing: 6070262
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #
0.00			Ground Surface		
0.00 – 0.32			**Quartz Sand** Beige, medium subrounded sand; oxidised	0.32	
0.32 – 0.58			**Quartz Sand** Grey, medium subrounded sand; transition from oxidised to reduced material with depth, moist	0.58	
0.58 – 0.89			**Clayey Sand** Grey medium subrounded sand with clay bands, moist	0.89	8
0.89 – 1.00			**Sediment Loss**	1.00	
1.00 – 1.10			**Clayey Sand** Grey, approximately 20% clay and 80% fine to meduim subrounded sand, moist	1.10	
1.10 – 1.19			**Sandy Clay** Green to grey, approximately 20% medium subrounded sand and 80% clay, moist	1.19	
1.19 – 1.29		Lake Sediments	**Calcareous Clay** Green, contains organic root material and thin organic (0 - 4mm) laminae, HCl reaction indicates carbonate rich, moist	1.29	9
1.29 –			**Sediment Loss**		

Depth scale: 0.00, 0.20, 0.40, 0.60, 0.80, 1.00, 1.20, 1.40

Piezometer Construction Details



Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 2.46
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: PS-1D (ex PS009)

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

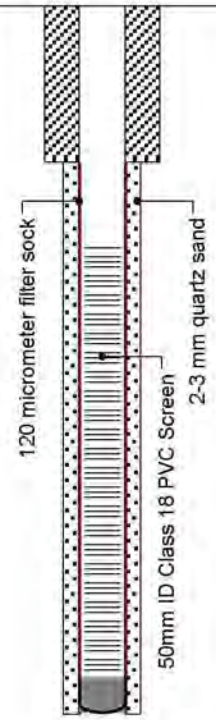
Drill Date: 23/08/2009
Easting: 321168
Northing: 6070262
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #
2.00			**Clayey Sand** Grey, medium sand grading to fine subrounded sand towards the base of the interval, approximately 20% clay and 80% sand, no reaction to HCl	2.00	10
2.47		Top of Calcrete and Bridgewater Formation	**Calcareous Clayey Sand** Medium, subrounded sand grading to sandy clay towards top of interval, contains carbonate and silica cemented sand pebbles indicating weathered surface of Bridgewater Formation, HCl reaction indicates carbonate rich moist	2.47	11
2.58			**Calcareous Sand** White to light grey, white to light grey, contains carbonate and silica cemented pebbles, HCl reaction indicates carbonate rich, moist	2.58	12
2.74				2.74	

Depth scale (m): 1.60, 1.80, 2.00, 2.20, 2.40, 2.60, 2.80, 3.00, 3.20

Piezometer Construction Details



Width not to scale

Drilled by: Boart longyear
Drilled Method: Push Tube
Hole Size: 0.23m x 2.46
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: PS-3S (ex PS008)

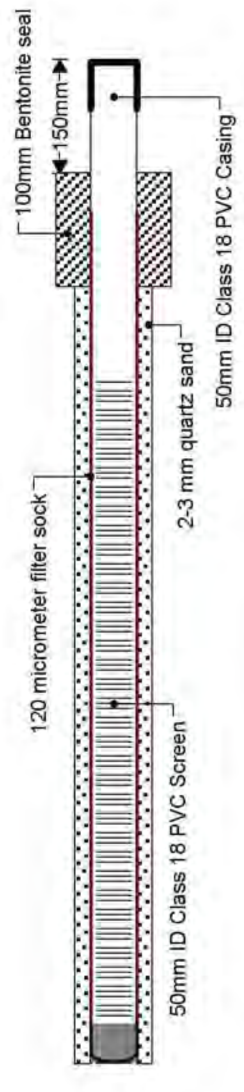
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 21/08/2009
Easting: 321234
Northing: 6070397
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #
0.00			Ground Surface		
			Quartz Sand Beige, medium subrounded sand; oxidised	0.17	
0.20			**Quartz Sand** Llight grey, medium subrounded sand, transition from oxidised to reduced material towards bottom of interval		
0.40			**Quartz Sand** Grey to light grey, medium sand; laminae of black organic rich material within the 0.20 to 0.45 m interval. Shelly fragments within the 0.45 to 0.72 m interval with two distinct shelly horizons from 0.45 to 0.47 m and from 0.660 to 0.665 m; moist		1
0.60				0.72	
0.80		Lake Sediments	**Calcareous Sandy Clay** Green, approximately 15% subrounded medium to fine sand and 85% clay, contains carbonate and silicate cemented medium sand pebbles, strong reaction to HCl. Moist	0.85	
			Sediment Loss	1.01	
1.00			**Calcareous Clay** Green, HCl reaction indicates carbonate rich		2
1.20				1.32	
			Calcareous Sandy Clay Green, clay grades towards sand towards top of interval, contains carbonate and silicate cemented sand pebbles, HCl reaction indicates carbonate rich. Moist	1.40	
1.40			**Clayey Sand** Light green to white, medium sand with clay, HCl reaction indicates carbonate rich, moist		

Piezometer Construction Details



Width not to scale

Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 1.175m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: PS-3S (ex PS008)

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 21/08/2009
Easting: 321234
Northing: 6070397
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #	Piezometer Construction Details
1.60					3	
				1.74		
1.80		Top of Silcrete and Bridgewater Formation	**Silcrete** Light orange to pink, highly indurated silica cemented fine sand			
2.00						
2.20						
2.40						
2.60						
2.80						
3.00						
3.20						

Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 1.175m
Datum: GDA 1994 MGA Zone 54

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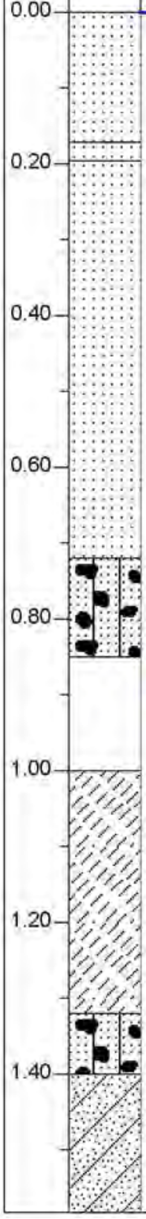
Log of Borehole: PS-3D(ex PS008)

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

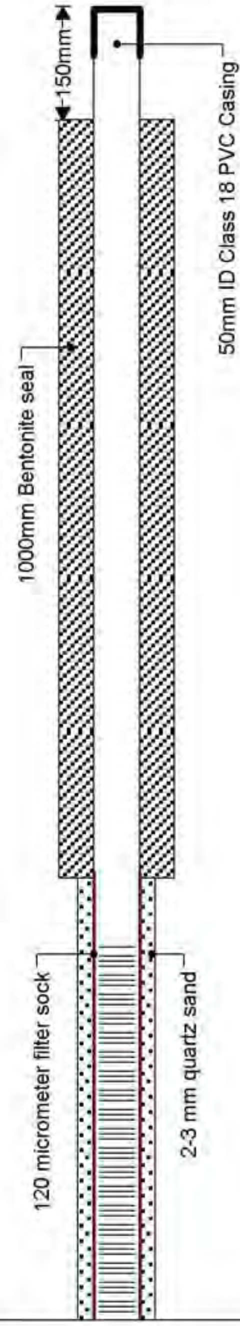
Drill Date: 21/08/2009
Easting: 321231
Northing: 6070398
Project Manager: Jeff Taylor

SUBSURFACE PROFILE



Depth (m)	Interpretation	Description	Depth (m)	Sample #
0.00		Ground Surface		
0.00–0.17	Lake Sediments	**Quartz Sand** Beige, medium subrounded sand; oxidised	0.17	
		Quartz Sand Llight grey, medium subrounded sand, transition from oxidised to reduced material towards bottom of interval		
		Quartz Sand Grey to light grey, medium sand; laminae of black organic rich material within the 0.20 to 0.45 m interval. Shelly fragments within the 0.45 to 0.72 m interval with two distinct shelly horizons from 0.45 to 0.47 m and from 0.660 to 0.665 m; unoxidised zone, moist	0.72	1
		Calcareous Sandy Clay Green, approximately 15% subrounded medium to fine sand and 85% clay, contains carbonate and silicate cemented medium sand pebbles, strong reaction to HCl. Moist	0.85	
		Sediment Loss	1.00	
		Calcareous Clay Green, HCl reaction indicates carbonate rich.	1.32	2
		Calcareous Sandy Clay Green, grading to sand towards bottom of interval, contains carbonate and silica cemented pebbles; contains areas of organic material, moist	1.40	
		Clayey Sand Llight green to white, medium sand with clay, HCl reaction indicates carbonate rich, moist		

Piezometer Construction Details



Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 1.99m
Datum: GDA 1994 MGA Zone 54

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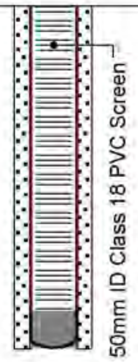
Log of Borehole: PS-3D(ex PS008)

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 21/08/2009
Easting: 321231
Northing: 6070398
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #	Piezometer Construction Details
1.60					3	
				1.74		
1.80		Top of Silcrete and Bridgewater Formation	**Silcrete** Light orange to pink, highly indurated silca cemented fine sand			
2.00						
2.20						
2.40						
2.60						
2.80						
3.00						
3.20						



Width not to scale

Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 1.99m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: PS-4S (ex PS007)

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 321265
Northing: 6070465
Project Manager: Jeff Taylor

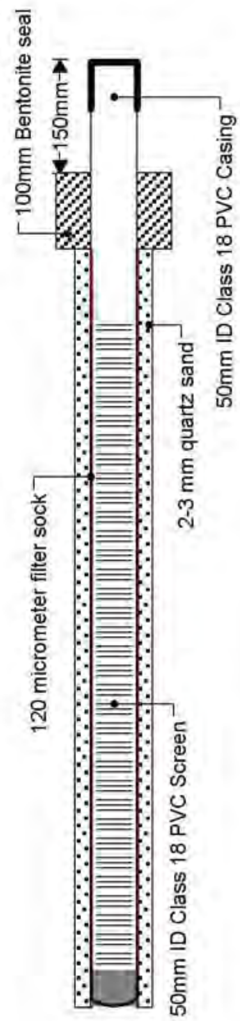
SUBSURFACE PROFILE

Interpretation: Lake Sediments

Description	Depth (m)	Sample #
Ground Surface	0.00	
Quartz Sand Beige, medium subrounded sand; oxidised		
Quartz Sand Beige to dark grey, meduim subrounded sand; transition from oxidised to reduced material towards base of interval	0.11	
Quartz Sand Grey, medium subrounded sand		
Quartz Sand Dark grey, medium subrounded sand, contains laminae of black organic rich material, moist	0.48	4
Quartz Sand Grey to dark grey, medium subrounded sand. Contains a 1 cm thick clay layer between the 0.57 to 0.58 m interval. The 0.58 to 0.70 interval contains few rounded coal pebbles (< 2cm); the 0.70 to 0.74 interval contains shelly fragments. Moist	0.80	
Sediment Loss	1.00	
Quartz Sand Llight grey, fine subrounded sand, contains medium to fine carbonate and silica cemented pebbles, HCl reaction indicates carbonate rich	1.16	5
Calcareous Sandy Clay Llight green, grading towards sand towards top of interval, contains occasional carbonate and silica cemented sand pebbles, HCl reaction indicates carbonate rich, moist	1.27	6
Clayey Sand Reddish, contains carbonate and silica cemented sand pebbles (3-4 cm diameter), moist, HCl reaction indicates carbonate rich, moist	1.43	
Quartz Sand Light grey, fine sand, contains carbonate and silica cemented medium sand pebbles, HCl reaction indicates carbonate rich,		7

Depth (m): 0.00, 0.20, 0.40, 0.60, 0.80, 1.00, 1.20, 1.40

Piezometer Construction Details



Width not to scale

Drilled by: Boart longyear
Drilled Method: Push Tube
Hole Size: 0.23m x 1.10m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: PS-4S (ex PS007)

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/08/2009
Easting: 321265
Northing: 6070465
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #	Piezometer Construction Details
1.60				1.69		
		Top of Silcrete and Bridgewater formation	**Clayey Sand** Light grey, fine sand, contains carbonate and silica cemented medium sand pebbles, HCl reaction indicates carbonate rich	1.75		
1.80			**Silcrete** Llight orange to pink, highly indurated silca cemented fine sand			
2.00						
2.20						
2.40						
2.60						
2.80						
3.00						
3.20						

Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 1.10m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: PS-4D (ex PS007)

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

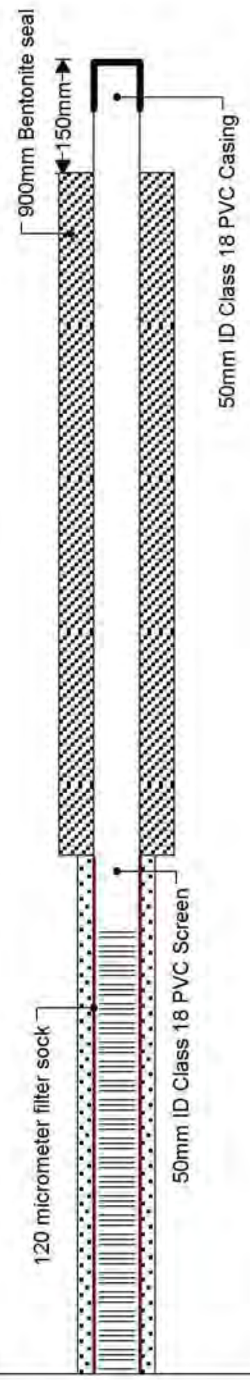
Drill Date: 23/8/09
Easting: 321262
Northing: 6070467
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Interpretation	Description	Depth (m)	Sample #
0.00		Ground Surface		
	Lake Sediments	**Quartz Sand** Beige, medium subrounded sand; oxidised		
		Quartz Sand Beige to dark grey, meduim subrounded sand; transition from oxidised to reduced material towards base of interval	0.11	
		Quartz Sand Grey, medium subrounded sand		
		Quartz Sand Dark grey, medium subrounded sand, contains laminae of black organic rich material, moist	0.48	4
		Quartz Sand Grey to dark grey, medium subrounded sand. Contains a 1 cm thick clay layer between the 0.57 to 0.58 m interval. The 0.58 to 0.70 interval contains few rounded coal pebbles (< 2cm); the 0.70 to 0.74 interval contains shelly fragments. Moist	0.80	
0.80		**Sediment Loss**	1.00	
1.00		**Quartz Sand** Llight grey, medium to fine subrounded sand, contains carbonate and silica cemented pebbles; HCl reaction indicates carbonate rich	1.16	5
		Carbonaceous Sandy Clay Llight green, grading towards sand towards top of interval, contains occasional carbonate and silica cemented sand pebbles, HCl reaction indicates carbonate rich, moist	1.27	6
		Clayey Sand Reddish, contains carbonate and silica cemented sand pebbles (3-4 cm diameter), moist, strong reaction to HCl	1.43	
		Quartz Sand Light grey, fine sand, contains carbonate and silica cemented medium sand pebbles, HCl reaction indicates carbonate rich		7

Depth scale (m): 0.00, 0.20, 0.40, 0.60, 0.80, 1.00, 1.20, 1.40

Piezometer Construction Details



Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 1.73m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: PS-4D (ex PS007)

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 23/8/09
Easting: 321262
Northing: 6070467
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #	Piezometer Construction Details
1.60				1.68		2-3 mm quartz sand
		Top of Silcrete and Bridgewater Formation	**Clayey Sand** Light grey, fine sand, contains carbonate and silica cemented medium sand pebbles, HCl reaction indicates carbonate rich	1.72		
1.80			**Silcrete** Llight orange to pink, highly indurated silca cemented fine sand			
2.00						Width not to scale
2.20						
2.40						
2.60						
2.80						
3.00						
3.20						

Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 1.73m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: WM-1S

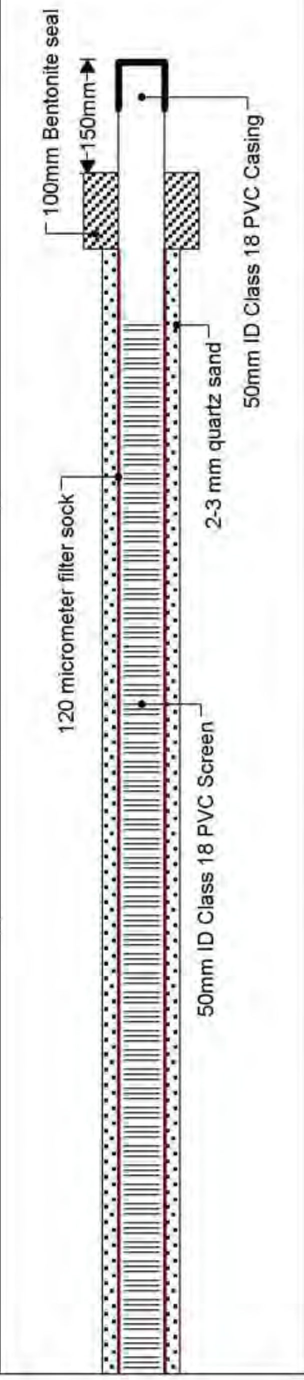
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 25/08/2009
Easting: 345596
Northing: 6064183
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #
0.00			Ground Surface		
			Quartz Sand Beige, medium subrounded sand, oxidised	0.16	
0.20			**Quartz Sand** Medium to dark grey, medium subrounded sand, contains thin horizons (1 - 4 mm) of organic material, moist	0.25	
0.40			**Quartz Sand** Medium to dark grey, medium subrounded sand, moist, contains thin horizons (1 - 4 mm) of organic material.	0.44	56
0.60 0.80			**Quartz Sand** Grey to light brown, medium to fine subrounded sand, moist.	0.98	57
1.00		Lake Sediments	Sediment Loss		
1.20 1.40			**Quartz Sand** Grey, medium to fine subrounded sand, moist		58

Piezometer Construction Details



Drilled by: Boart longyear
Drilled Method: Push Tube and Auger

Hole Size: 0.23m x 3.3m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: WM-1S

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 25/08/2009
Easting: 345596
Northing: 6064183
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #	Piezometer Construction Details
1.60						
1.80						
2.00		Likely Lake Sediments	Sediment Loss - Drilling and logging is conducted using an Auger **Quartz Sand**	1.98		
2.20						
2.40						
2.60						
2.80						
3.00						
3.20						

Drilled by: Boart longyear
Drilled Method: Push Tube and Auger

Hole Size: 0.23m x 3.3m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: WM-1S

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 25/08/2009
Easting: 345596
Northing: 6064183
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #	Piezometer Construction Details
3.40						Width not to scale
3.60				3.70		
		Top of Calcrete and Bridgewater Formation	**Calcrete/Silcrete** Carbonate and silica cemented sand	3.77		
3.80			**Calcareous Clayey Sand** Green, medium sand with clay bands, contains carbonate and silica cemented sand pebbles; HCl reaction indicates carbonate rich			
4.00						
4.20						
4.40						
4.60						
4.80						
5.00						

Drilled by: Boart longyear
Drilled Method: Push Tube and Auger

Hole Size: 0.23m x 3.3m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: WM-1S

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 25/08/2009
Easting: 345596
Northing: 6064183
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #	Piezometer Construction Details
5.20						
5.40						
5.60						
				5.77		
5.80						
6.00						
6.20						
6.40						
6.60						
6.80						

Drilled by: Boart longyear
Drilled Method: Push Tube and Auger

Hole Size: 0.23m x 3.3m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: WM-1D

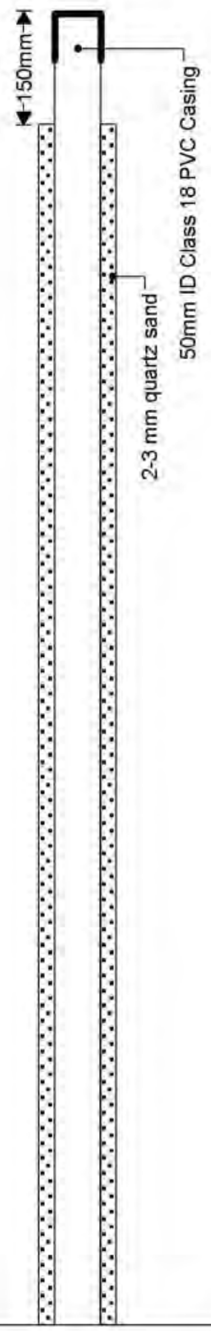
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 25/08/2009
Easting: 345599
Northing: 6064182
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #
0.00			Ground Surface		
0.00		Lake Sediments	**Quartz Sand** Beige, medium subrounded sand, oxidised	0.16	
0.20			**Quartz Sand** Grey, medium subrounded sand, organic material showing signs of oxidation	0.25	56
			Quartz Sand Medium to dark grey, medium subrounded sand, moist, contains thin horizons (1 - 4 mm) of organic material.	0.44	
0.40–0.80			**Quartz Sand** Grey to light brown, medium to fine subrounded sand, moist.	0.98	57
1.00			Sediment Loss		
1.20–1.40			**Quartz Sand** Grey, medium to fine subrounded sand, moist		58

Piezometer Construction Details



Drilled by: Boart longyear
Drilled Method: Push Tube and Auger
Hole Size: 0.23m x 5.2m
Datum: GDA 1994 MGA Zone 54

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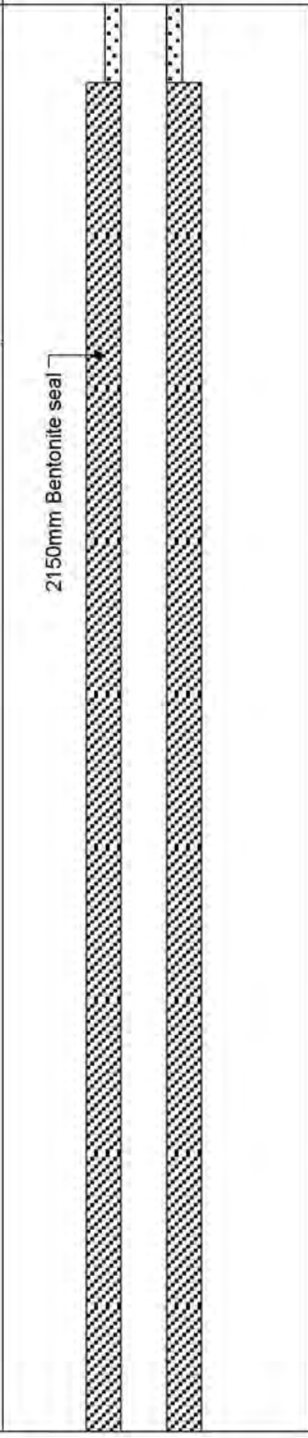
Log of Borehole: WM-1D

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 25/08/2009
Easting: 345599
Northing: 6064182
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #	Piezometer Construction Details
1.60						
1.80						
2.00		Likely Lake Sediments	Sediment Loss - Drilling and logging is conducted using an Auger **Quartz Sand**	1.98		2150mm Bentonite seal
2.20						
2.40						
2.60						
2.80						
3.00						
3.20						



Drilled by: Boart longyear
Drilled Method: Push Tube and Auger

Hole Size: 0.23m x 5.2m
Datum: GDA 1994 MGA Zone 54

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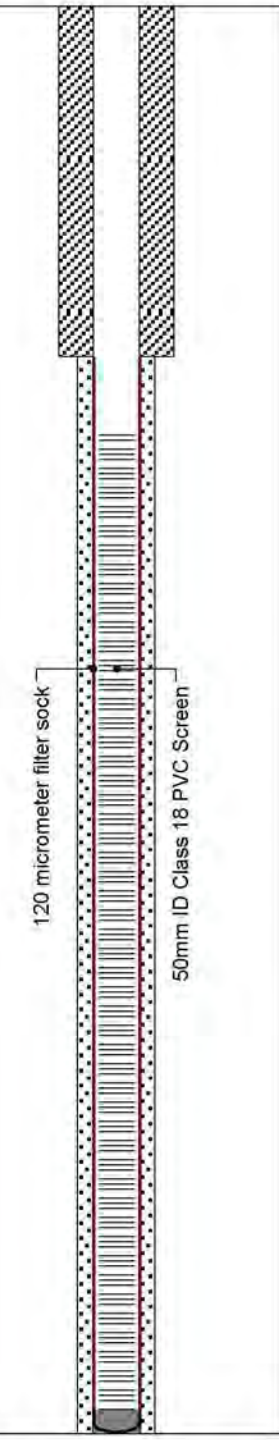
Log of Borehole: WM-1D

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 25/08/2009
Easting: 345599
Northing: 6064182
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #	Piezometer Construction Details
3.40 – 3.60				3.70		
		Top of Calcrete and Bridgewater Formation	**Calcrete/Silcrete** Carbonate and silica cemented sand	3.77		
3.80 – 5.00			**Calcareous Clayey Sand** Green, medium sand with clay bands, contains carbonate and silica cemented sand pebbles; HCl reaction indicates carbonate rich			



Drilled by: Boart longyear
Drilled Method: Push Tube and Auger
Hole Size: 0.23m x 5.2m
Datum: GDA 1994 MGA Zone 54

EARTH SYSTEMS
Environment - Water - Sustainability
Suite 507, Princess Street, Kew
Melboune, Australia, 3101
www.earthsystems.com.au

Log of Borehole: WM-1D

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 25/08/2009
Easting: 345599
Northing: 6064182
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #	Piezometer Construction Details
5.20						Width not to scale
5.40						
5.60						
				5.77		
5.80						
6.00						
6.20						
6.40						
6.60						
6.80						

Drilled by: Boart longyear
Drilled Method: Push Tube and Auger
Hole Size: 0.23m x 5.2m
Datum: GDA 1994 MGA Zone 54

Suite 507, Princess Street, Kew
Melboune, Australia, 3101
www.earthsystems.com.au

Log of Borehole: WM-2S

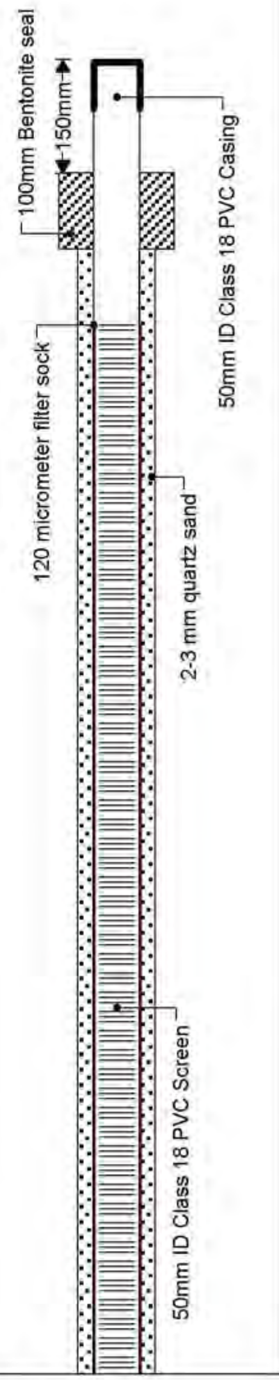
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 25/08/2009
Easting: 345569
Northing: 6064141
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Interpretation	Description	Depth (m)	Sample #
0.00		Ground Surface		
		Quartz Sand Medium subrounded sand, oxidised zone		
0.20		**Quartz Sand** Grey, medium subrounded sand, contains occasional shell fragments	0.30	59
0.40		**Sandy Clay** Grey, medium grain size sandy clay with few shelly fragments		60
		Clay Green to grey, moist	0.48	
0.60		**Clayey Sand** Grey, medium sand grading to clay towards top of interval, moist		
		Clayey Sand Green to grey, medium to fine sand with few clay lenses, moist		61
		Clayey Sand Grey, medium subrounded sand with clay lenses, moist	0.72	
0.80		**Sediment Loss**	1.00	
1.00		**Quartz Sand** Grey, medium subrounded sand; contains oxidised areas, moist		
1.20				
1.40	Lake Sediments			62

Piezometer Construction Details



Drilled by: Boart longyear
Drilled Method: Push Tube
Hole Size: 0.23m x 2.8m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: WM-2S

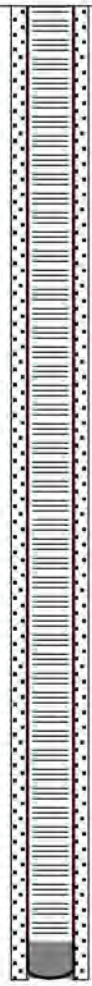
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 25/08/2009
Easting: 345569
Northing: 6064141
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #
1.60				1.72	
1.80			**Quartz Sand** Grey to light brown, medium to fine subrounded sand, contains occasional organic root material, moist	1.98	
2.00			**Sediment Loss**		
2.20 – 2.80			**Quartz Sand** Light brown, medium subrounded sand, contains occassional shelly fragments, moist	2.96	64
3.00		Top of Calcrete and Bridgewater Formation	**Calcrete/silcrete** Highly indurated carbonate and silica cemented fine sand		
3.20					

Piezometer Construction Details



Width not to scale

Drilled by: Boart longyear
Drilled Method: Push Tube
Hole Size: 0.23m x 2.8m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: WM-3S

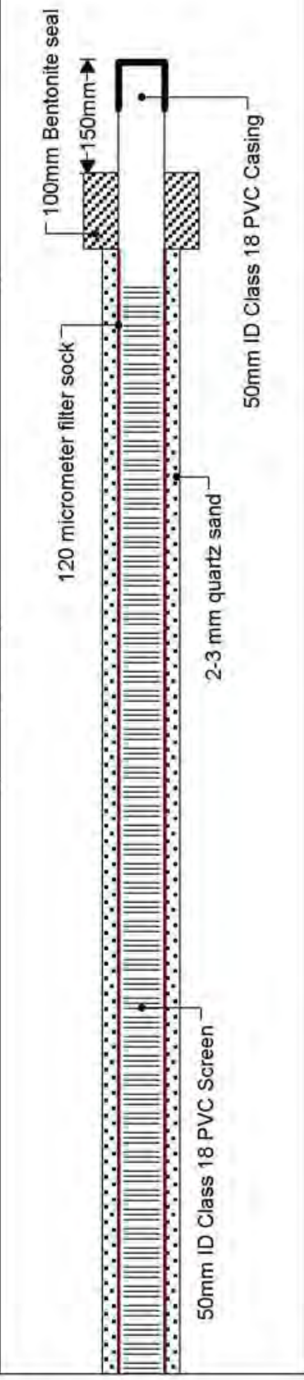
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 25/08/2009
Easting: 345543
Northing: 6064100
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Interpretation	Description	Depth (m)	Sample #
0.00		Ground Surface		
		Quartz Sand Beige, medium subrounded sand, oxidised	0.14	
0.20		**Quartz Sand** Grey to dark gray, medium subrounded sand	0.53	65
0.40				
		Clayey Sand Grey, moist	0.60	
0.60		**Quartz Sand** Grey, medium subrounded sand, moist	0.64	66-68
		Sandy Clay Grey, moist	0.75	
0.80		**Clay** Green to grey, moist	0.80	
		Clay Green grey, contains few sand bands (1 - 3mm), moist	0.90	
1.00		**Quartz Sand** Grey to dark grey, medium subrounded sand, moist	1.00	
		Sediment Loss		
1.20	Lake Sediments	**Quartz Sand** Grey to green, medium subrounded sand, contains thin (0 - 5mm) organic laminae, moist		
1.40				

Piezometer Construction Details



Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 2.2m
Datum: GDA 1994 MGA Zone 54

EARTH SYSTEMS
Environment - Water - Sustainability
Suite 507, Princess Street, Kew
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Log of Borehole: WM-3S

Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

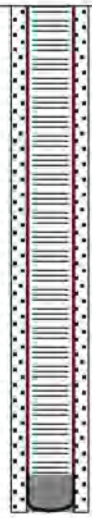
Drill Date: 25/08/2009
Easting: 345543
Northing: 6064100
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Interpretation	Description	Depth (m)	Sample #
1.60–1.99			1.99	77C
1.99–2.05		**Sediment Loss**	2.05	
2.05–2.36		**Quartz Sand** Green to grey, medium subrounded sand, moist	2.36	
2.36–2.67	Bridgewater Formation	**Clayey Sand** Light green, medium grain size, HCl reaction indicates carbonate rich, moist **Calcareous Clayey Sand** Green, fine sand with clay bands, contains carbonate and silica cemented sand pebbles indicating the weathered surface of the Bridgewater Formation, HCl reaction indicates pebbles are carbonate rich, moist	2.67	73-74
2.67–2.86		**Calcareous Clayey Sand** Green, medium sand with clay bands, contains carbonate and silica cemented sand pebbles, HCl reaction indicates carbonate rich, moist	2.86	75-76
2.86–2.98		**Calcareous Clayey Sand** Green to yellow, medium sand with clay bands, contains carbonate and silica cemented medium sand pebbles; HCl reaction indicates pebbles are carbonate rich, moist.	2.98	

Depth scale: 1.60, 1.80, 2.00, 2.20, 2.40, 2.60, 2.80, 3.00, 3.20

Piezometer Construction Details



Width not to scale

Drilled by: Boart longyear
Drilled Method: Push Tube
Hole Size: 0.23m x 2.2m
Datum: GDA 1994 MGA Zone 54

EARTH SYSTEMS
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Melboune, Australia, 3101
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Log of Borehole: WM-4S

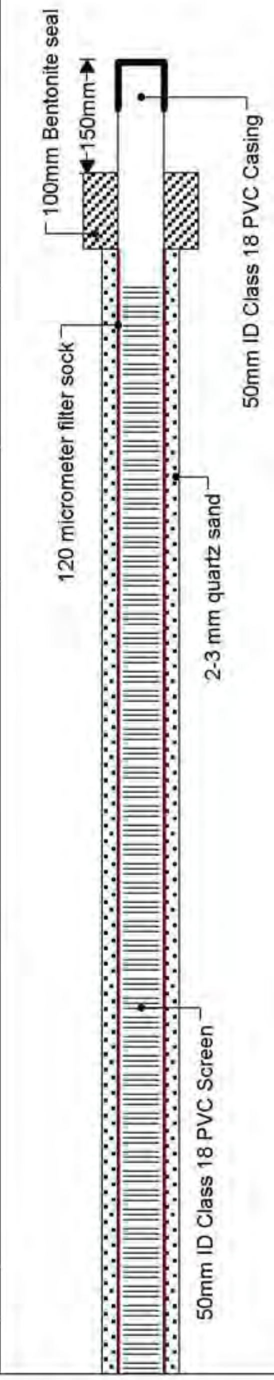
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 25/08/2009
Easting: 345516
Northing: 6064057
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Borehole Lithology	Interpretation	Description	Depth (m)	Sample #
0.00			Ground Surface		
			Quartz Sand Beige, medium subrounded sand, oxidised	0.12	
0.20			**Quartz Sand** Light grey, medium subrounded sand, transition from oxidised to reduced zone		
			Quartz Sand Llight grey, to grey, medium subrounded sand, moist	0.36	46
0.40			**Sandy Clay** Grey, moist		
			Clay Grey, moist	0.54	47
0.60			**Quartz Sand** Grey, medium subrounded sand grading to a fine sand towrds the bottom of the interval, occasional shelly fragments, moist	0.69	
0.80			**Sediment Loss**	1.00	78C
1.00		Lake Sediments	**Quartz Sand** Grey, medium subrounded sand, moist		
1.20					
1.40				1.44	
			Silt Brown to dark green, moist	1.51	

Piezometer Construction Details



Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 1.80m
Datum: GDA 1994 MGA Zone 54

EARTH SYSTEMS
Environment - Water - Sustainability
Suite 507, Princess Street, Kew
Melboune, Australia, 3101
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Log of Borehole: WM-4S

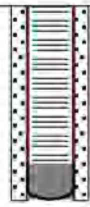
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 25/08/2009
Easting: 345516
Northing: 6064057
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Interpretation	Description	Depth (m)	Sample #
1.60		**Quartz Sand** Dark grey to gray, fine subrounded sand, contains occasional shell fragments, moist	1.78	51
1.80		**Clay** Green, no reaction to HCl	1.90	52
	Top of Bridgewater Formation	**Calcareous Clayey Sand** Light green to green, medium sand with clay bands, contains carbonate and silica cemented sand pebbles indicating weathered surface of the Bridgewater Formation; moist, HCl reaction indicates carbonate rich	2.00	53-54
2.00		**Calcareous Clayey Sand** Light green to white, medium to fine sand with clay, contains carbonate and silica cemented sand pebbles; moist, HCl reaction indicates carbonate rich	2.30	
2.20				
2.40		**Calcareous Clayey Sand** Green, medium subrounded sand with clay, contains carbonate and silica cemented sand pebbles; HCl reaction indicates carbonate rich	2.60	
2.60		**Calcareous Clayey Sand** Green grading to ocra, medium sand with clay, contains carbonate and silica cemented sand pebbles; HCl reaction indicates carbonate rich, moist	2.88	
2.80		**Calcareous Sand** White to very light green; medium subrounded sand, contains carbonate and silica cemented sand pebbles; HCl reaction indicates carbonate rich	2.95	
3.00		**Calcareous Clayey Sand** Green, medium subrounded sand with clay, contains carbonate and silica cemented sand pebbles; HCl reaction indicates carbonate rich	3.00	
3.20				

Piezometer Construction Details



Width not to scale

Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 1.80m
Datum: GDA 1994 MGA Zone 54

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Log of Borehole: WM-4D

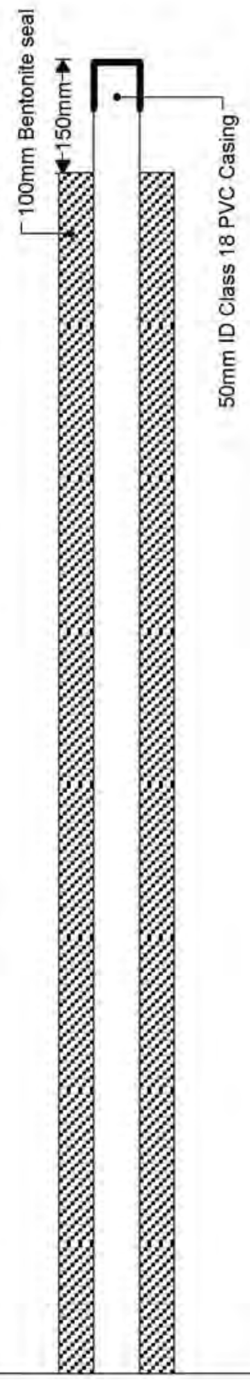
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 25/08/2009
Easting: 345518
Northing: 6064056
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Interpretation	Description	Depth (m)	Sample #
0.00		Ground Surface		
	Lake Sediments	**Quartz Sand** Beige, medium subrounded sand, oxidised	0.12	
0.20		**Quartz Sand** Light grey, medium subrounded sand, transition from oxidised to reduced zone		46
		Quartz Sand Llight grey, to grey, medium subrounded sand, moist	0.36	
0.40		**Sandy Clay** Grey, moist		47
		Clay Grey, moist	0.54	
0.60		**Quartz Sand** Grey, medium subrounded sand grading to a fine sand towrds the bottom of the interval, occasional shelly fragments, moist	0.69	
0.80		**Sediment Loss**	1.00	78C
1.00		**Quartz Sand** Grey, medium subrounded sand, moist		
1.20				
1.40			1.44	
		Silt Brown to dark green, moist	1.51	

Piezometer Construction Details



Drilled by: Boart longyear
Drilled Method: Push Tube

Hole Size: 0.23m x 3.0m
Datum: GDA 1994 MGA Zone 54

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Suite 507, Princess Street, Kew
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Log of Borehole: WM-4D

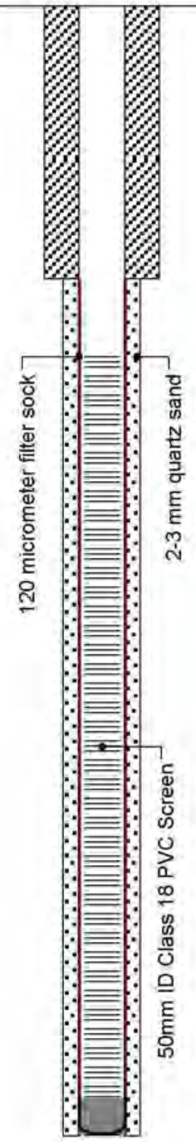
Project No.: RSSA0823
Project: Lower Murray Lakes
Client: Dept. for Environment & Heritage, SA
Location: South Australia

Drill Date: 25/08/2009
Easting: 345518
Northing: 6064056
Project Manager: Jeff Taylor

SUBSURFACE PROFILE

Depth (m)	Interpretation	Description	Depth (m)	Sample #
1.60		**Quartz Sand** Dark grey to gray, fine subrounded sand, contains occasional shell fragments, moist	1.78	51
1.80		**Clay** Green, no reaction to HCl	1.90	52
	Top of Bridgewater Formation	**Calcareous Clayey Sand** Light green to green, medium sand with clay bands, contains carbonate and silica cemented sand pebbles indicating weathered surface of the Bridgewater Formation; moist, HCl reaction indicates carbonate rich	2.00	
2.00 – 2.20		**Calcareous Clayey Sand** Light green to white, medium to fine sand with clay, contains carbonate and silica cemented sand pebbles; moist, HCl reaction indicates carbonate rich	2.30	
2.40		**Calcareous Clayey Sand** Green, medium subrounded sand with clay, contains carbonate and silica cemented sand pebbles; HCL reaction indicates carbonate rich	2.60	53-54
2.60 – 2.80		**Calcareous Clayey Sand** Green grading to ocra, medium sand with clay, contains carbonate and silica cemented sand pebbles; HCl reaction indicates carbonate rich. moist	2.88	
		Calcareous Sand White to very light green; medium subrounded sand, contains carbonate and silica cemented sand pebbles; HCl reaction indicates carbonate rich	2.95	
3.00		**Calcareous Clayey Sand** Green, medium subrounded sand with clay, contains carbonate and silica cemented sand pebbles; HCl reaction indicates carbonate rich	3.00	
3.20				

Piezometer Construction Details



Width not to scale

Drilled by: Boart longyear
Drilled Method: Push Tube
Hole Size: 0.23m x 3.0m
Datum: GDA 1994 MGA Zone 54

Attachment G:

Survey data – Currency Creek, Point Sturt, Campbell Park and Windmill locations

Earth Systems - Piezometer survey, Lower Murray Lakes

Point Sturt

	MGA Z54		AHD	GDA 94		N	WGS 84
Point Id	**Easting**	**Northing**	**Height**	**Latitude**	**Longitude**	**Height**	**Height**
PS 1D	321168.99	6070262.78	0.411	-35.495102	139.028422	-1.186	1.597
PS 1S	321171.69	6070261.35	0.514	-35.495116	139.028451	-1.186	1.700
PS 2D	321200.06	6070330.82	-0.001	-35.494495	139.028779	-1.184	1.183
PS 2S	321202.85	6070329.48	-0.011	-35.494507	139.028809	-1.184	1.173
PS 3D	321231.43	6070398.82	-0.190	-35.493888	139.029140	-1.182	0.992
PS 3S	321234.04	6070397.53	-0.308	-35.493900	139.029168	-1.182	0.874
PS 4D	321262.98	6070467.58	-0.289	-35.493274	139.029502	-1.179	0.891
PS 4S	321265.24	6070465.70	-0.358	-35.493291	139.029527	-1.179	0.822
PS SMP	321174.36	6070259.96	0.499	-35.495129	139.028480	-1.186	1.685

Currency Creek

	MGA Z54		AHD	GDA 94		N	WGS 84
Point Id	**Easting**	**Northing**	**Height**	**Latitude**	**Longitude**	**Height**	**Height**
LCC P2	301320.03	6072955.17	1.272	-35.467071	138.810384	-1.253	2.525
UCC P1	299269.07	6074127.42	1.215	-35.456096	138.788085	-1.214	2.429
UCC P3	299589.45	6073004.15	1.205	-35.466282	138.791337	-1.251	2.456

Campbell Park

	MGA Z54		AHD	GDA 94		N	WGS 84
Point Id	**Easting**	**Northing**	**Height**	**Latitude**	**Longitude**	**Height**	**Height**
CP 1D	341216.34	6056465.84	0.439	-35.622854	139.246635	-1.279	1.718
CP 1S	341219.32	6056465.63	0.464	-35.622857	139.246668	-1.279	1.743
CP 2D	341212.23	6056515.05	0.137	-35.622410	139.246599	-1.278	1.415
CP 2S	341215.23	6056515.35	0.176	-35.622408	139.246632	-1.278	1.454
CP 3D	341208.25	6056564.21	0.083	-35.621967	139.246565	-1.277	1.360
CP 3S	341211.17	6056565.10	0.183	-35.621959	139.246597	-1.277	1.460
CP 4D	341210.25	6056615.27	0.025	-35.621507	139.246597	-1.275	1.300
CP 4M	341204.20	6056614.63	-0.014	-35.621512	139.246530	-1.276	1.262
CP 4S	341207.18	6056614.90	0.006	-35.621510	139.246563	-1.275	1.281
CP SMP	341224.41	6056465.20	0.423	-35.622862	139.246724	-1.279	1.702

Windmill

	MGA Z54		AHD	GDA 94		N	WGS 84
Point Id	**Easting**	**Northing**	**Height**	**Latitude**	**Longitude**	**Height**	**Height**
WM 1D	345599.05	6064182.03	0.149	-35.554006	139.296486	-0.964	1.113
WM 1S	345596.80	6064183.99	0.146	-35.553988	139.296461	-0.964	1.110
WM 2S	345569.96	6064141.90	0.120	-35.554364	139.296157	-0.966	1.086
WM 3S	345543.31	6064100.04	0.049	-35.554737	139.295855	-0.968	1.017
WM 4D	345518.66	6064056.22	-0.006	-35.555128	139.295575	-0.970	0.964
WM 4S	345516.25	6064057.76	0.031	-35.555113	139.295549	-0.970	1.001
WM SMP	345625.28	6064237.70	0.518	-35.553509	139.296785	-0.962	1.480

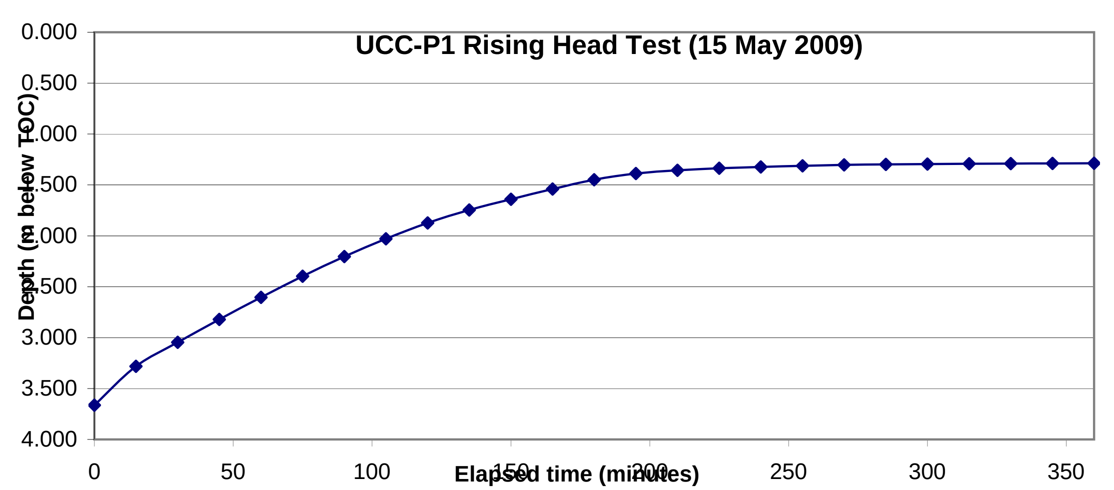
NOTE: SMP = soil mositure probe

Attachment H:

Rising head test data and hydraulic conductivity calculations

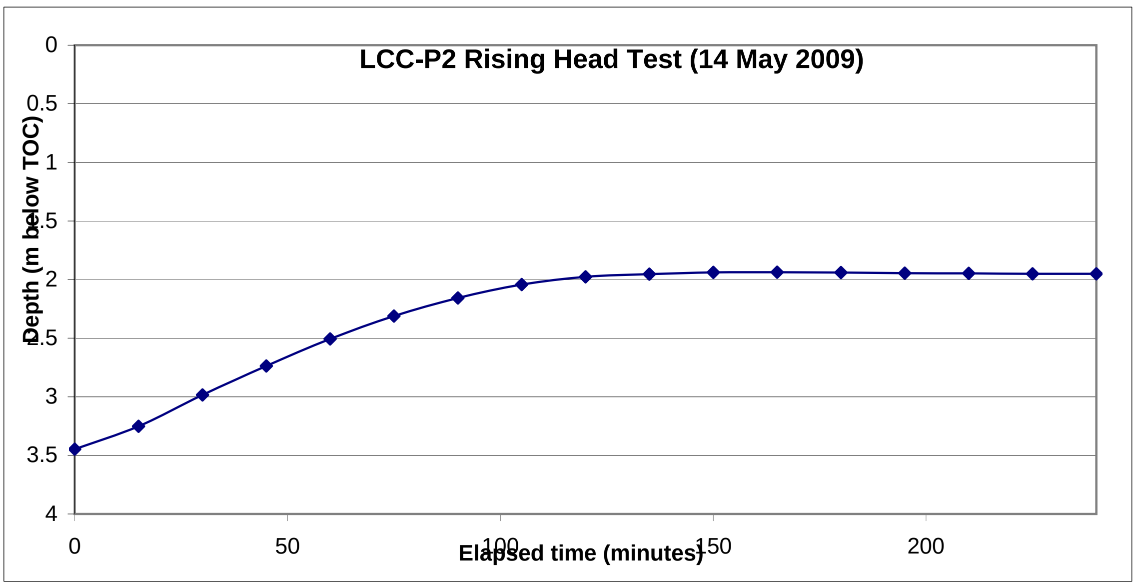
RISING HEAD TEST
Site: UCC-P1
Date: 15-May-09
Time: 9:00 AM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0	0.086	3.664	2.377
900	15	0.468	3.282	1.995
1800	30	0.704	3.046	1.760
2700	45	0.929	2.821	1.534
3600	60	1.145	2.605	1.318
4500	75	1.352	2.398	1.111
5400	90	1.547	2.203	0.917
6300	105	1.721	2.029	0.742
7200	120	1.876	1.874	0.587
8100	135	2.003	1.747	0.460
9000	150	2.109	1.641	0.355
9900	165	2.210	1.540	0.253
10800	180	2.301	1.449	0.163
11700	195	2.362	1.388	0.101
12600	210	2.394	1.356	0.069
13500	225	2.414	1.336	0.050
14400	240	2.427	1.323	0.036
15300	255	2.438	1.312	0.026
16200	270	2.447	1.303	0.017
17100	285	2.452	1.298	0.011
18000	300	2.455	1.295	0.008
18900	315	2.458	1.292	0.005
19800	330	2.460	1.290	0.004
20700	345	2.461	1.289	0.003
21600	360	2.463	1.287	0.001



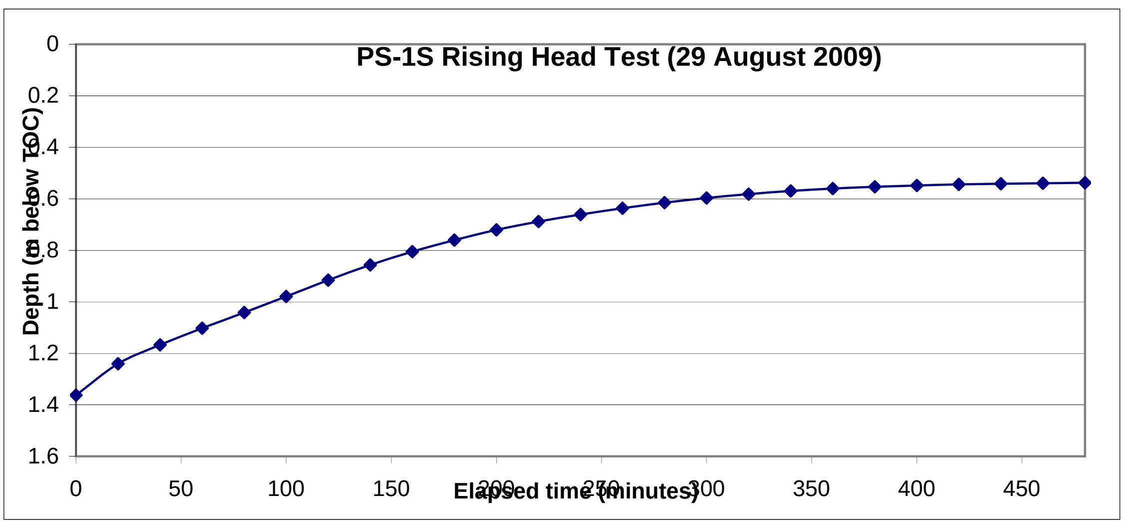
RISING HEAD TEST
Site: LCC-P1
Date: 14-May-09
Time: 6:00 PM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0	0.104	3.447	1.497
900	15	0.299	3.252	1.302
1800	30	0.567	2.984	1.034
2700	45	0.813	2.738	0.787
3600	60	1.045	2.506	0.556
4500	75	1.239	2.312	0.361
5400	90	1.395	2.156	0.206
6300	105	1.509	2.042	0.092
7200	120	1.575	1.976	0.026
8100	135	1.598	1.953	0.003
9000	150	1.613	1.938	-0.012
9900	165	1.614	1.937	-0.014
10800	180	1.611	1.940	-0.010
11700	195	1.606	1.945	-0.005
12600	210	1.604	1.947	-0.003
13500	225	1.600	1.951	0.000
14400	240	1.601	1.950	0.000



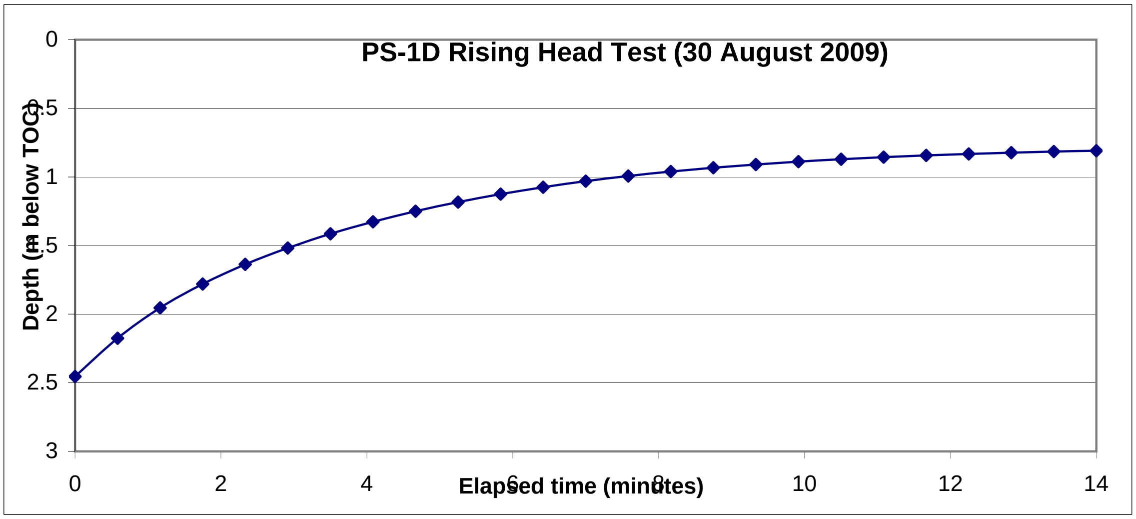
RISING HEAD TEST
Site: PS-1S
Date: 29-Aug-09
Time: 2.30 pm

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0	0.145	1.365	0.827
1200	20	0.269	1.241	0.703
2400	40	0.283	1.227	0.689
3600	60	0.407	1.103	0.565
4800	80	0.469	1.041	0.503
6000	100	0.530	0.980	0.442
7200	120	0.593	0.917	0.379
8400	140	0.652	0.858	0.320
9600	160	0.704	0.806	0.268
10800	180	0.749	0.761	0.223
12000	200	0.789	0.721	0.183
13200	220	0.822	0.688	0.150
14400	240	0.849	0.661	0.123
15600	260	0.873	0.637	0.099
16800	280	0.895	0.615	0.078
18000	300	0.913	0.597	0.059
19200	320	0.928	0.582	0.044
20400	340	0.940	0.570	0.032
21600	360	0.949	0.561	0.023
22800	380	0.956	0.554	0.016
24000	400	0.961	0.549	0.011
25200	420	0.966	0.544	0.006
26400	440	0.969	0.541	0.003
27600	460	0.971	0.539	0.001
28800	480	0.972	0.538	0.000



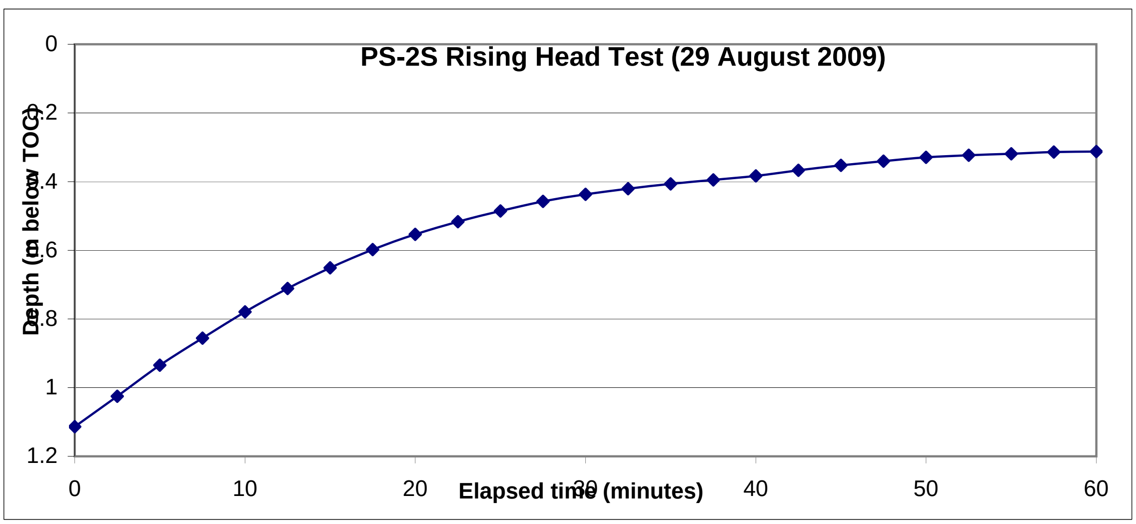
RISING HEAD TEST
Site: PS-1D
Date: 30-Aug-09
Time: 7:00 AM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0.0	0.176	2.454	1.647
35	0.6	0.455	2.175	1.368
70	1.2	0.676	1.954	1.147
105	1.8	0.850	1.780	0.973
140	2.3	0.993	1.637	0.830
175	2.9	1.112	1.518	0.710
210	3.5	1.216	1.414	0.607
245	4.1	1.303	1.327	0.519
280	4.7	1.380	1.250	0.443
315	5.3	1.447	1.183	0.376
350	5.8	1.505	1.125	0.318
385	6.4	1.555	1.075	0.268
420	7.0	1.599	1.031	0.224
455	7.6	1.637	0.993	0.186
490	8.2	1.669	0.961	0.154
525	8.8	1.697	0.933	0.125
560	9.3	1.721	0.909	0.102
595	9.9	1.742	0.888	0.081
630	10.5	1.759	0.871	0.063
665	11.1	1.774	0.856	0.048
700	11.7	1.787	0.843	0.036
735	12.3	1.798	0.832	0.025
770	12.8	1.807	0.823	0.016
805	13.4	1.814	0.816	0.008
840	14.0	1.821	0.809	0.002



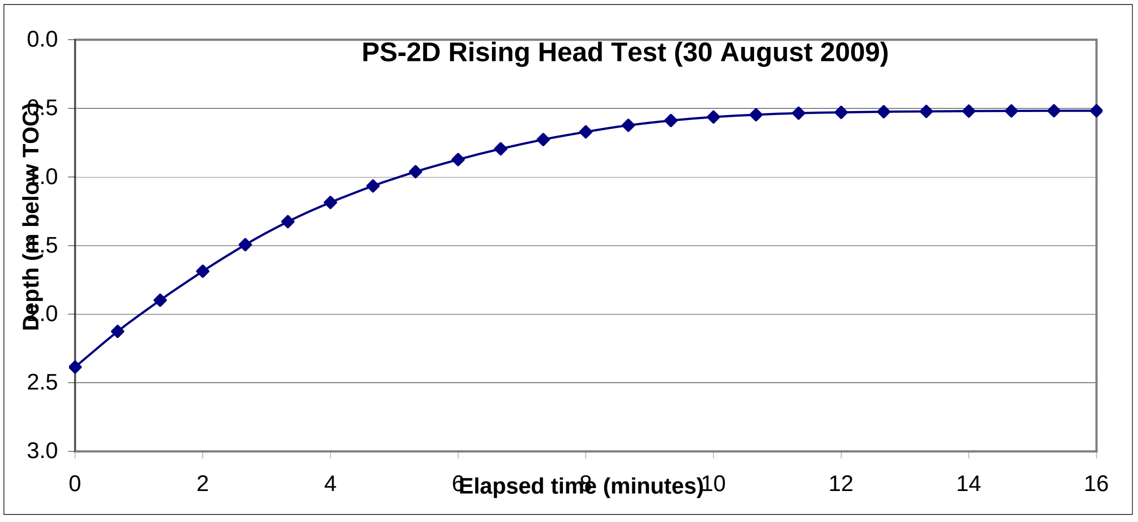
RISING HEAD TEST
Site: PS-2S
Date: 29-Aug-09
Time: 2:30 PM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0.0	0.136	1.114	0.803
150	2.5	0.225	1.025	0.714
300	5.0	0.315	0.935	0.623
450	7.5	0.394	0.856	0.545
600	10.0	0.471	0.779	0.468
750	12.5	0.539	0.711	0.400
900	15.0	0.599	0.651	0.340
1050	17.5	0.652	0.598	0.287
1200	20.0	0.696	0.554	0.243
1350	22.5	0.733	0.517	0.206
1500	25.0	0.764	0.486	0.174
1650	27.5	0.792	0.458	0.147
1800	30.0	0.813	0.437	0.126
1950	32.5	0.829	0.421	0.110
2100	35.0	0.843	0.407	0.096
2250	37.5	0.855	0.395	0.084
2400	40.0	0.867	0.383	0.072
2550	42.5	0.883	0.367	0.056
2700	45.0	0.898	0.352	0.041
2850	47.5	0.909	0.341	0.029
3000	50.0	0.921	0.329	0.018
3150	52.5	0.927	0.323	0.012
3300	55.0	0.931	0.319	0.008
3450	57.5	0.936	0.314	0.003
3600	60.0	0.937	0.313	0.001



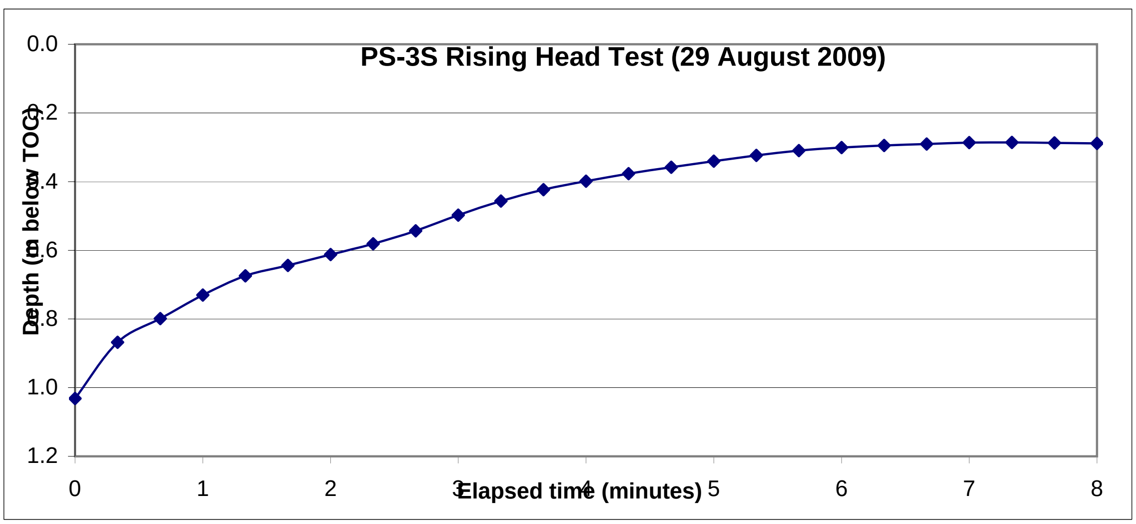
RISING HEAD TEST
Site: PS-2D
Date: 30-Aug-09
Time: 7:20 AM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0.0	0.125	2.385	1.868
40	0.7	0.385	2.125	1.608
80	1.3	0.612	1.898	1.380
120	2.0	0.822	1.688	1.170
160	2.7	1.016	1.494	0.977
200	3.3	1.184	1.326	0.808
240	4.0	1.324	1.186	0.668
280	4.7	1.444	1.066	0.548
320	5.3	1.548	0.962	0.445
360	6.0	1.637	0.873	0.355
400	6.7	1.715	0.795	0.277
440	7.3	1.783	0.727	0.210
480	8.0	1.839	0.671	0.153
520	8.7	1.886	0.624	0.107
560	9.3	1.921	0.589	0.071
600	10.0	1.947	0.563	0.046
640	10.7	1.963	0.547	0.029
680	11.3	1.974	0.536	0.018
720	12.0	1.981	0.529	0.011
760	12.7	1.985	0.525	0.007
800	13.3	1.988	0.522	0.004
840	14.0	1.990	0.520	0.002
880	14.7	1.991	0.519	0.001
920	15.3	1.992	0.518	0.000
960	16.0	1.992	0.518	0.000



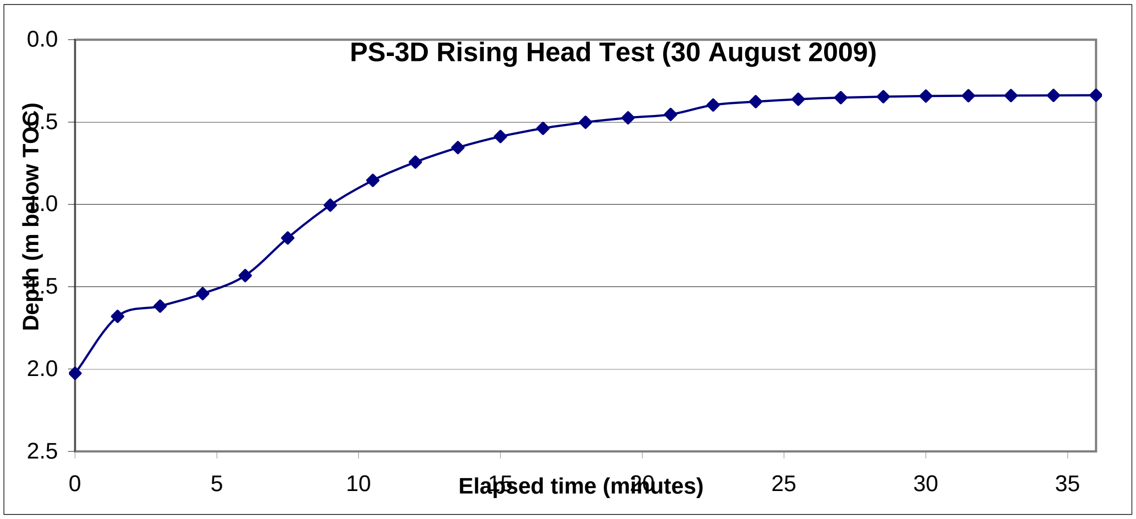
RISING HEAD TEST
Site: PS-3S
Date: 29-Aug-09
Time: 2:30 PM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0.0	0.314	1.031	0.744
20	0.3	0.477	0.868	0.580
40	0.7	0.546	0.799	0.511
60	1.0	0.615	0.730	0.442
80	1.3	0.671	0.674	0.386
100	1.7	0.701	0.644	0.356
120	2.0	0.732	0.613	0.325
140	2.3	0.764	0.581	0.293
160	2.7	0.802	0.543	0.256
180	3.0	0.847	0.498	0.210
200	3.3	0.888	0.457	0.169
220	3.7	0.922	0.423	0.136
240	4.0	0.946	0.399	0.111
260	4.3	0.968	0.377	0.089
280	4.7	0.987	0.358	0.070
300	5.0	1.004	0.341	0.053
320	5.3	1.021	0.324	0.036
340	5.7	1.035	0.310	0.022
360	6.0	1.044	0.301	0.013
380	6.3	1.050	0.295	0.007
400	6.7	1.055	0.290	0.003
420	7.0	1.059	0.286	-0.002
440	7.3	1.059	0.286	-0.002
460	7.7	1.057	0.288	0.000
480	8.0	1.056	0.289	0.001



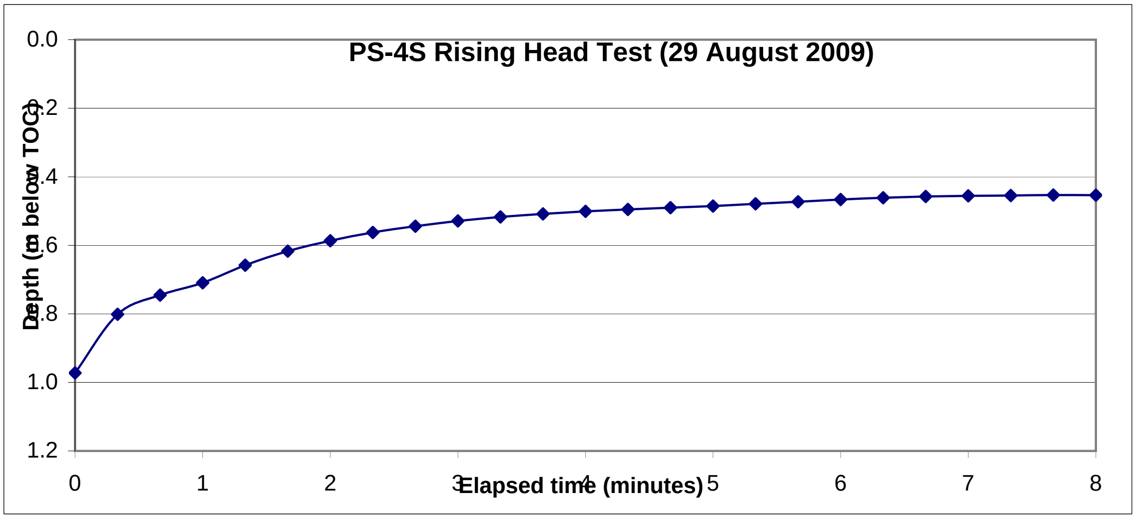
RISING HEAD TEST
Site: PS-3D
Date: 30-Aug-09
Time: 7:30 AM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0.0	0.134	2.026	1.689
90	1.5	0.480	1.680	1.343
180	3.0	0.542	1.618	1.281
270	4.5	0.618	1.542	1.205
360	6.0	0.728	1.432	1.095
450	7.5	0.956	1.204	0.867
540	9.0	1.156	1.004	0.668
630	10.5	1.306	0.854	0.517
720	12.0	1.416	0.744	0.407
810	13.5	1.505	0.655	0.319
900	15.0	1.572	0.588	0.251
990	16.5	1.622	0.538	0.201
1080	18.0	1.658	0.502	0.165
1170	19.5	1.685	0.475	0.138
1260	21.0	1.706	0.454	0.117
1350	22.5	1.763	0.397	0.060
1440	24.0	1.784	0.376	0.039
1530	25.5	1.799	0.361	0.024
1620	27.0	1.808	0.352	0.015
1710	28.5	1.814	0.346	0.009
1800	30.0	1.818	0.342	0.005
1890	31.5	1.820	0.340	0.003
1980	33.0	1.821	0.339	0.002
2070	34.5	1.821	0.339	0.002
2160	36.0	1.823	0.337	0.000



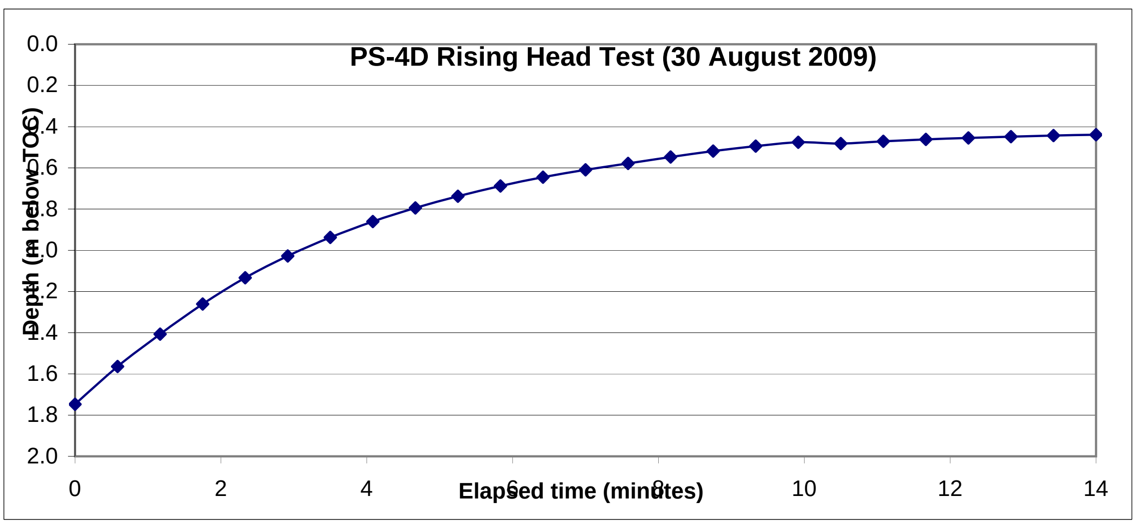
RISING HEAD TEST
Site: PS-4S
Date: 29-Aug-09
Time: 2:40 PM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0.0	0.298	0.972	0.520
20	0.3	0.469	0.801	0.350
40	0.7	0.525	0.745	0.293
60	1.0	0.560	0.710	0.258
80	1.3	0.612	0.658	0.206
100	1.7	0.653	0.617	0.165
120	2.0	0.683	0.587	0.135
140	2.3	0.707	0.563	0.111
160	2.7	0.726	0.544	0.092
180	3.0	0.741	0.529	0.077
200	3.3	0.753	0.517	0.065
220	3.7	0.762	0.508	0.056
240	4.0	0.769	0.501	0.049
260	4.3	0.775	0.495	0.043
280	4.7	0.780	0.490	0.038
300	5.0	0.784	0.486	0.034
320	5.3	0.791	0.479	0.027
340	5.7	0.797	0.473	0.021
360	6.0	0.803	0.467	0.015
380	6.3	0.809	0.461	0.010
400	6.7	0.813	0.457	0.005
420	7.0	0.814	0.456	0.004
440	7.3	0.815	0.455	0.003
460	7.7	0.817	0.453	0.001
480	8.0	0.816	0.454	0.000



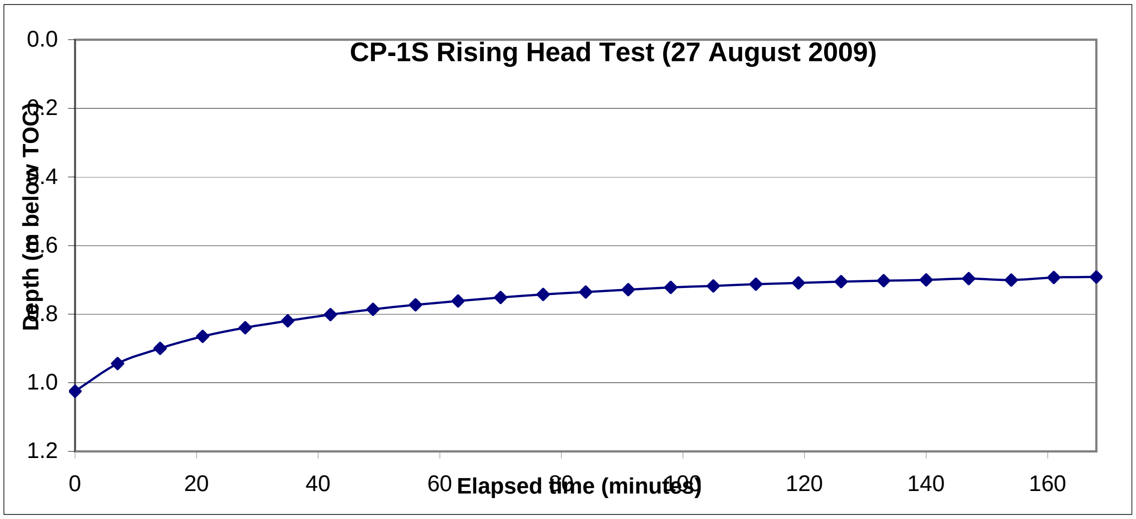
RISING HEAD TEST
Site: PS-4D
Date: 30-Aug-09
Time: 7:30 AM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0.0	0.152	1.748	1.310
35	0.6	0.336	1.564	1.126
70	1.2	0.493	1.407	0.969
105	1.8	0.640	1.260	0.822
140	2.3	0.766	1.134	0.695
175	2.9	0.872	1.028	0.590
210	3.5	0.963	0.937	0.499
245	4.1	1.040	0.860	0.422
280	4.7	1.106	0.794	0.356
315	5.3	1.163	0.737	0.299
350	5.8	1.212	0.688	0.250
385	6.4	1.254	0.646	0.207
420	7.0	1.291	0.609	0.171
455	7.6	1.322	0.578	0.140
490	8.2	1.353	0.547	0.109
525	8.8	1.381	0.519	0.080
560	9.3	1.405	0.495	0.056
595	9.9	1.425	0.475	0.037
630	10.5	1.418	0.482	0.044
665	11.1	1.429	0.471	0.033
700	11.7	1.438	0.462	0.024
735	12.3	1.446	0.454	0.016
770	12.8	1.452	0.448	0.010
805	13.4	1.457	0.443	0.005
840	14.0	1.461	0.439	0.000



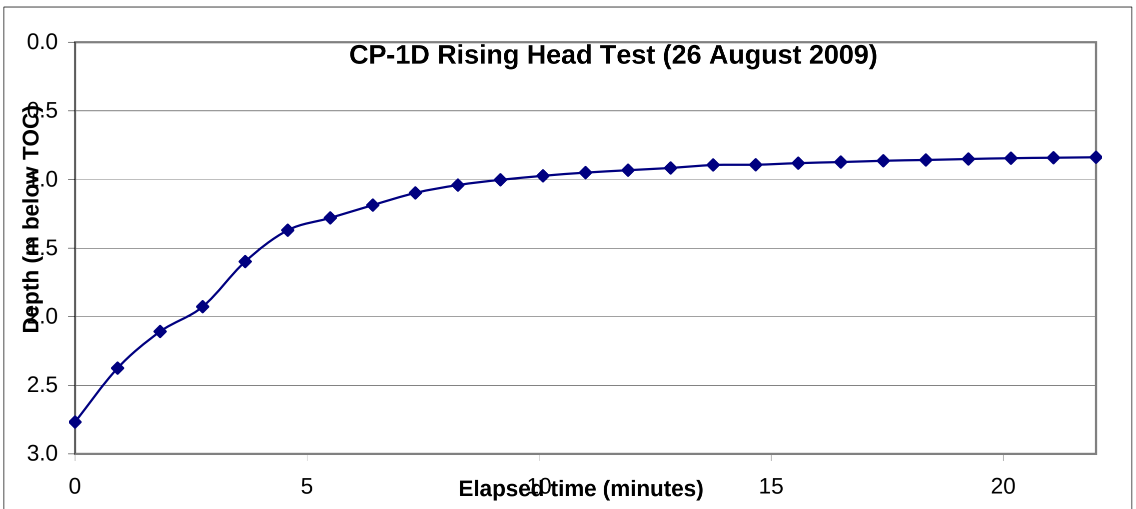
RISING HEAD TEST
Site: CP-1S
Date: 27-Aug-09
Time: 7:30 AM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0	0.045	1.025	0.334
420	7	0.126	0.944	0.253
840	14	0.170	0.900	0.209
1260	21	0.205	0.865	0.174
1680	28	0.230	0.840	0.148
2100	35	0.250	0.820	0.128
2520	42	0.269	0.801	0.110
2940	49	0.284	0.786	0.095
3360	56	0.297	0.773	0.082
3780	63	0.309	0.761	0.070
4200	70	0.319	0.751	0.060
4620	77	0.328	0.742	0.051
5040	84	0.335	0.735	0.044
5460	91	0.341	0.729	0.037
5880	98	0.348	0.722	0.031
6300	105	0.352	0.718	0.027
6720	112	0.357	0.713	0.022
7140	119	0.361	0.709	0.018
7560	126	0.365	0.705	0.014
7980	133	0.368	0.702	0.011
8400	140	0.370	0.700	0.009
8820	147	0.374	0.696	0.005
9240	154	0.370	0.700	0.009
9660	161	0.377	0.693	0.002
10080	168	0.378	0.692	0.000



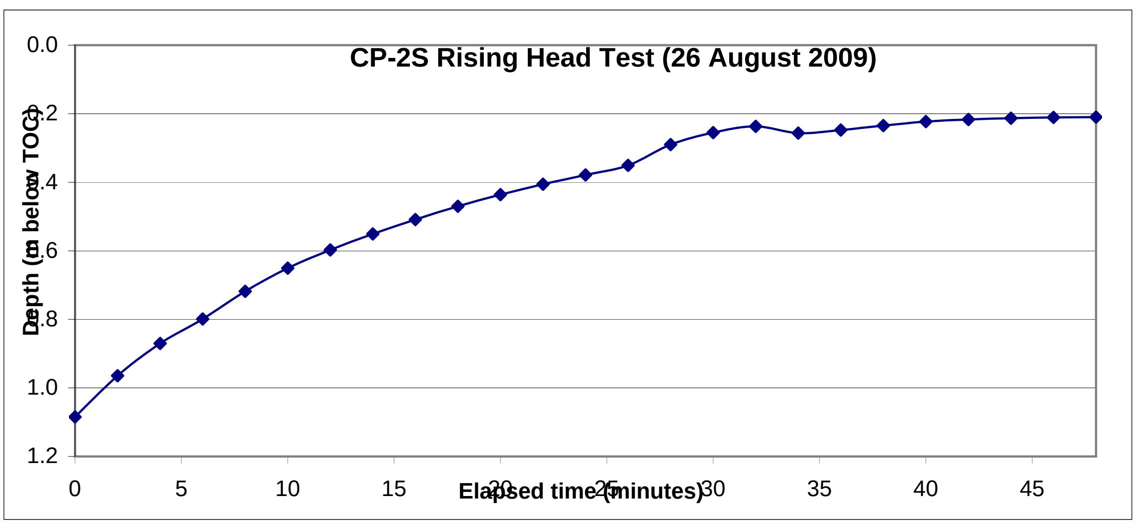
RISING HEAD TEST
Site: CP-1D
Date: 26-Aug-09
Time: 1:30 PM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0.0	1.002	2.768	1.932
55	0.9	1.395	2.375	1.539
110	1.8	1.662	2.108	1.272
165	2.8	1.842	1.928	1.092
220	3.7	2.171	1.599	0.763
275	4.6	2.400	1.370	0.534
330	5.5	2.490	1.280	0.444
385	6.4	2.583	1.187	0.351
440	7.3	2.672	1.098	0.262
495	8.3	2.729	1.041	0.205
550	9.2	2.767	1.003	0.167
605	10.1	2.796	0.974	0.138
660	11.0	2.820	0.950	0.114
715	11.9	2.838	0.932	0.097
770	12.8	2.853	0.917	0.081
825	13.8	2.876	0.894	0.058
880	14.7	2.877	0.893	0.057
935	15.6	2.888	0.882	0.046
990	16.5	2.897	0.873	0.037
1045	17.4	2.906	0.864	0.028
1100	18.3	2.912	0.858	0.022
1155	19.3	2.919	0.851	0.015
1210	20.2	2.924	0.846	0.010
1265	21.1	2.928	0.842	0.006
1320	22.0	2.932	0.838	0.000



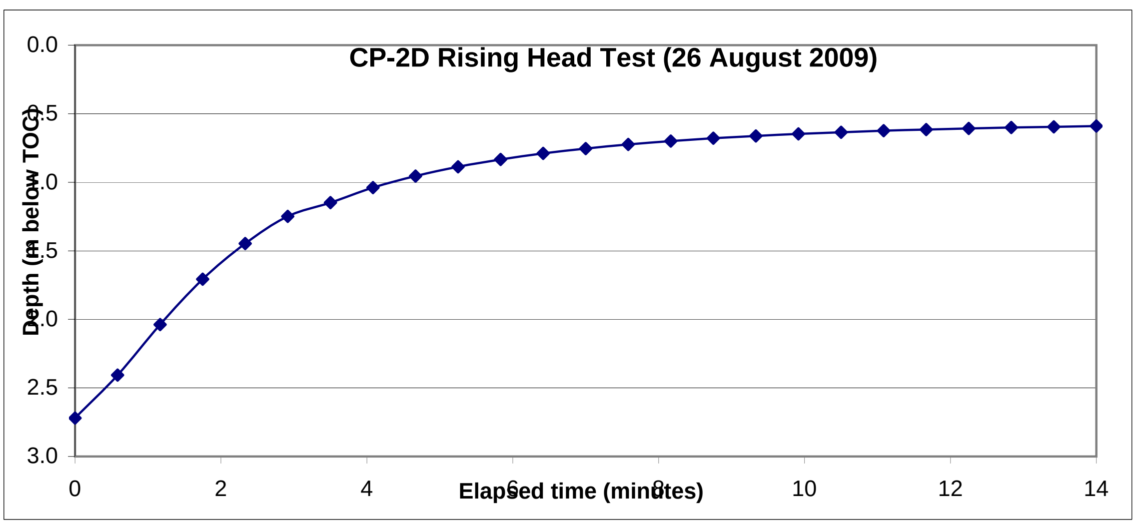
RISING HEAD TEST
Site: CP-2S
Date: 26-Aug-09
Time: 1:30 PM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0	0.285	1.085	0.875
120	2	0.406	0.964	0.754
240	4	0.500	0.870	0.660
360	6	0.571	0.799	0.589
480	8	0.652	0.718	0.508
600	10	0.719	0.651	0.441
720	12	0.772	0.598	0.387
840	14	0.819	0.551	0.341
960	16	0.861	0.509	0.298
1080	18	0.900	0.470	0.260
1200	20	0.934	0.436	0.226
1320	22	0.964	0.406	0.195
1440	24	0.991	0.379	0.168
1560	26	1.019	0.351	0.141
1680	28	1.080	0.290	0.080
1800	30	1.115	0.255	0.045
1920	32	1.133	0.237	0.027
2040	34	1.113	0.257	0.046
2160	36	1.123	0.247	0.037
2280	38	1.135	0.235	0.025
2400	40	1.147	0.223	0.013
2520	42	1.153	0.217	0.007
2640	44	1.157	0.213	0.003
2760	46	1.159	0.211	0.001
2880	48	1.160	0.210	0.000



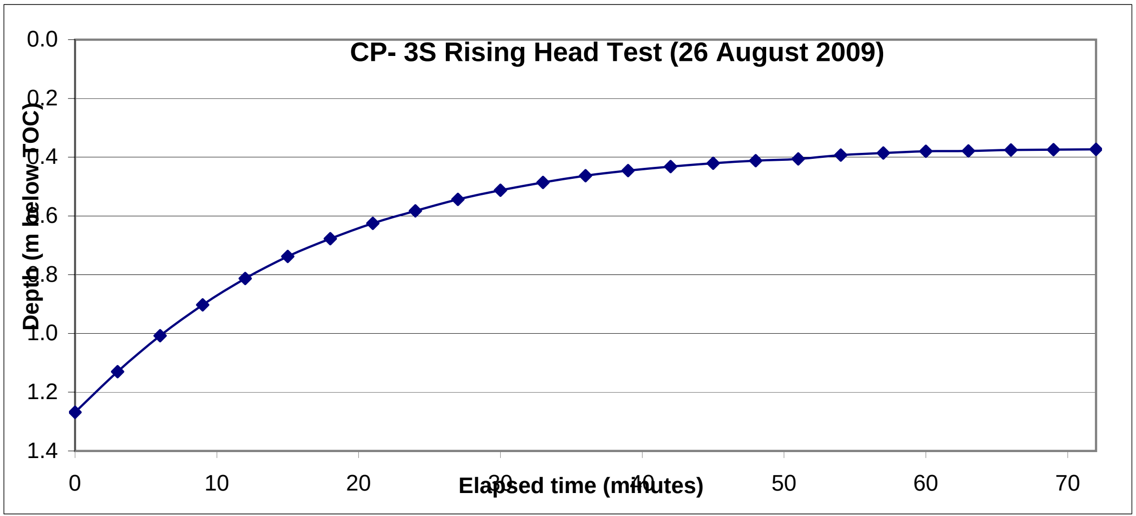
RISING HEAD TEST
Site: CP-2D
Date: 26-Aug-09
Time: 1:30 PM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0.0	0.549	2.721	2.131
35	0.6	0.863	2.407	1.818
70	1.2	1.232	2.038	1.448
105	1.8	1.562	1.708	1.118
140	2.3	1.823	1.447	0.858
175	2.9	2.022	1.248	0.659
210	3.5	2.122	1.148	0.559
245	4.1	2.231	1.039	0.450
280	4.7	2.315	0.955	0.365
315	5.3	2.383	0.887	0.298
350	5.8	2.437	0.833	0.244
385	6.4	2.480	0.790	0.200
420	7.0	2.516	0.754	0.164
455	7.6	2.546	0.724	0.135
490	8.2	2.571	0.699	0.110
525	8.8	2.591	0.679	0.090
560	9.3	2.607	0.663	0.073
595	9.9	2.623	0.647	0.058
630	10.5	2.635	0.635	0.046
665	11.1	2.646	0.624	0.035
700	11.7	2.654	0.616	0.026
735	12.3	2.662	0.608	0.018
770	12.8	2.669	0.601	0.011
805	13.4	2.674	0.596	0.006
840	14.0	2.680	0.590	0.000



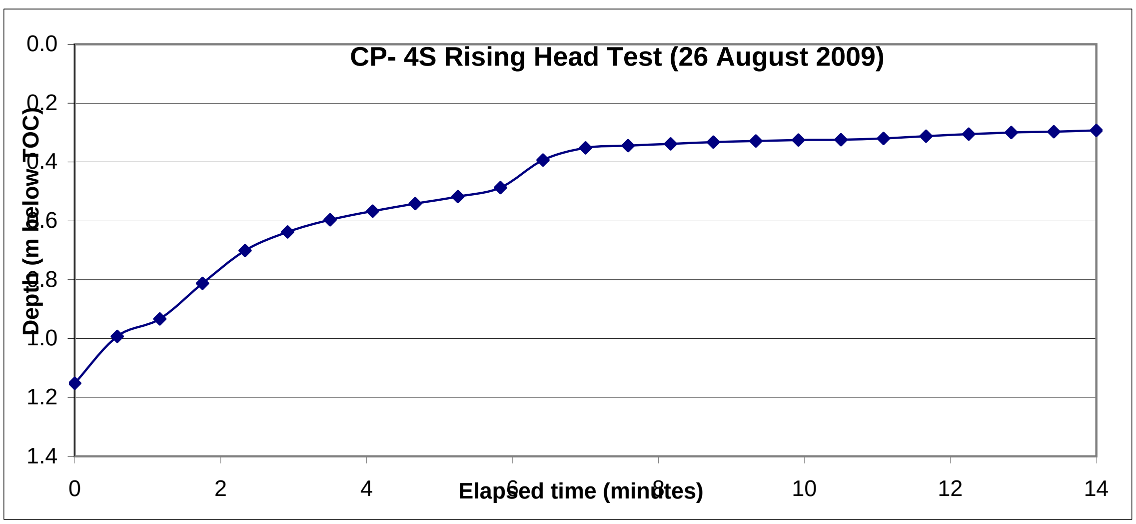
RISING HEAD TEST
Site: CP-3S
Date: 26-Aug-09
Time: 1:30 PM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0	0.102	1.268	0.895
180	3	0.240	1.130	0.756
360	6	0.362	1.008	0.634
540	9	0.467	0.903	0.529
720	12	0.557	0.813	0.439
900	15	0.632	0.738	0.364
1080	18	0.693	0.677	0.304
1260	21	0.745	0.625	0.252
1440	24	0.787	0.583	0.209
1620	27	0.826	0.544	0.170
1800	30	0.858	0.512	0.139
1980	33	0.884	0.486	0.112
2160	36	0.907	0.463	0.090
2340	39	0.925	0.445	0.072
2520	42	0.938	0.432	0.059
2700	45	0.950	0.420	0.047
2880	48	0.958	0.412	0.038
3060	51	0.964	0.406	0.032
3240	54	0.977	0.393	0.019
3420	57	0.984	0.386	0.012
3600	60	0.990	0.380	0.006
3780	63	0.991	0.379	0.005
3960	66	0.995	0.375	0.002
4140	69	0.996	0.374	0.001
4320	72	0.997	0.373	0.000



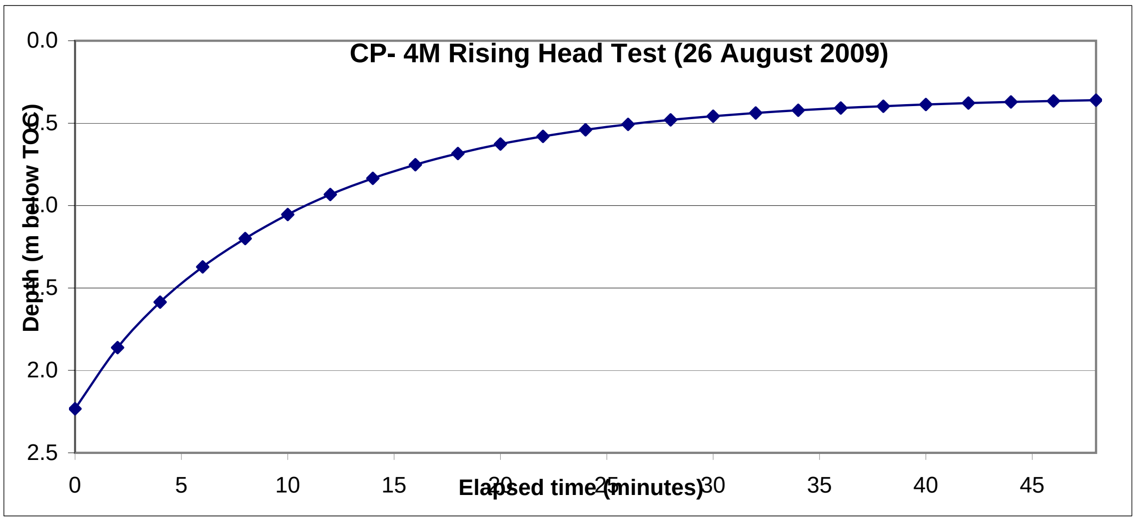
RISING HEAD TEST
Site: CP-4S
Date: 26-Aug-09
Time: 1:30 PM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0.0	0.218	1.152	0.860
35	0.6	0.378	0.992	0.700
70	1.2	0.437	0.933	0.641
105	1.8	0.558	0.812	0.520
140	2.3	0.669	0.701	0.408
175	2.9	0.732	0.638	0.345
210	3.5	0.774	0.596	0.304
245	4.1	0.803	0.567	0.275
280	4.7	0.829	0.541	0.249
315	5.3	0.852	0.518	0.225
350	5.8	0.883	0.487	0.195
385	6.4	0.976	0.394	0.101
420	7.0	1.018	0.352	0.060
455	7.6	1.025	0.345	0.052
490	8.2	1.032	0.338	0.046
525	8.8	1.037	0.333	0.040
560	9.3	1.042	0.328	0.036
595	9.9	1.044	0.326	0.033
630	10.5	1.046	0.324	0.032
665	11.1	1.050	0.320	0.027
700	11.7	1.058	0.312	0.020
735	12.3	1.065	0.305	0.013
770	12.8	1.070	0.300	0.007
805	13.4	1.073	0.297	0.004
840	14.0	1.078	0.292	0.000



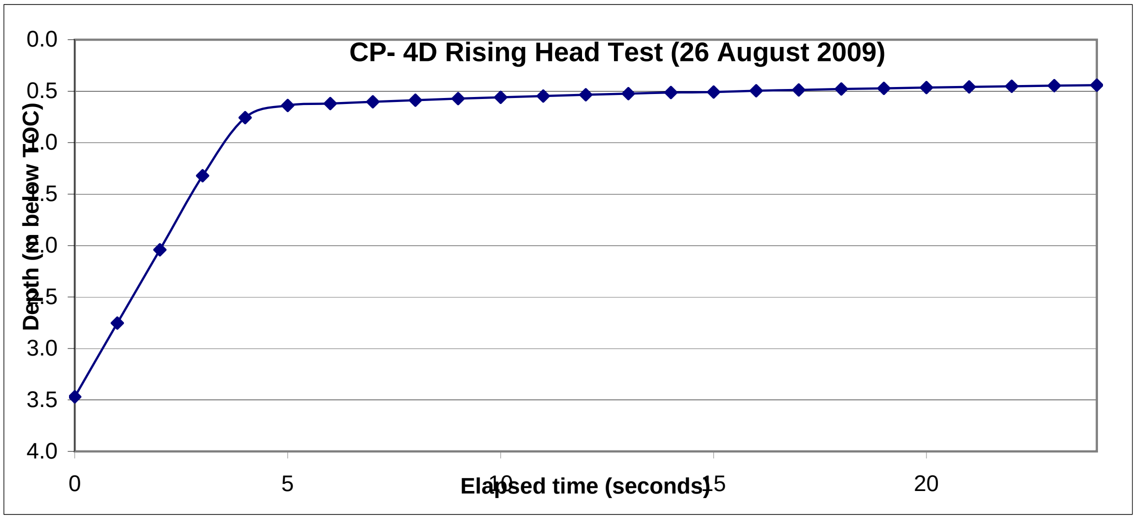
RISING HEAD TEST
Site: CP-4M
Date: 26-Aug-09
Time: 1:30 PM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0	0.087	2.233	1.873
120	2	0.459	1.861	1.501
240	4	0.735	1.585	1.225
360	6	0.948	1.372	1.012
480	8	1.120	1.200	0.840
600	10	1.266	1.054	0.694
720	12	1.387	0.933	0.573
840	14	1.485	0.835	0.475
960	16	1.568	0.752	0.392
1080	18	1.636	0.684	0.324
1200	20	1.693	0.627	0.267
1320	22	1.740	0.580	0.220
1440	24	1.780	0.540	0.180
1560	26	1.813	0.507	0.147
1680	28	1.840	0.480	0.120
1800	30	1.863	0.457	0.097
1920	32	1.882	0.438	0.078
2040	34	1.898	0.422	0.062
2160	36	1.912	0.408	0.048
2280	38	1.923	0.397	0.037
2400	40	1.933	0.387	0.026
2520	42	1.942	0.378	0.018
2640	44	1.949	0.371	0.011
2760	46	1.955	0.365	0.005
2880	48	1.960	0.360	0.000



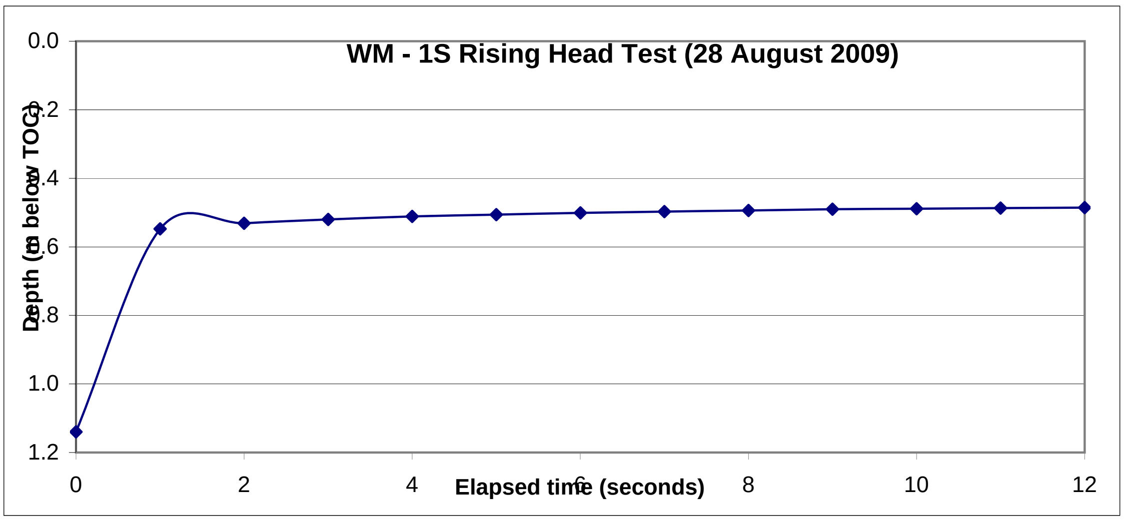
RISING HEAD TEST
Site: CP-4D
Date: 26-Aug-09
Time: 1:30 PM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0.00	1.100	3.470	3.117
1	0.02	1.816	2.754	2.401
2	0.03	2.528	2.042	1.689
3	0.05	3.248	1.322	0.969
4	0.07	3.813	0.757	0.404
5	0.08	3.932	0.638	0.285
6	0.10	3.950	0.620	0.267
7	0.12	3.967	0.603	0.250
8	0.13	3.983	0.587	0.234
9	0.15	3.999	0.571	0.219
10	0.17	4.011	0.559	0.206
11	0.18	4.023	0.547	0.194
12	0.20	4.035	0.535	0.182
13	0.22	4.046	0.524	0.171
14	0.23	4.057	0.513	0.161
15	0.25	4.062	0.508	0.155
16	0.27	4.075	0.495	0.142
17	0.28	4.082	0.488	0.135
18	0.30	4.090	0.480	0.127
19	0.32	4.098	0.472	0.119
20	0.33	4.105	0.465	0.112
21	0.35	4.112	0.458	0.105
22	0.37	4.117	0.453	0.100
23	0.38	4.123	0.447	0.094
24	0.40	4.128	0.442	0.089



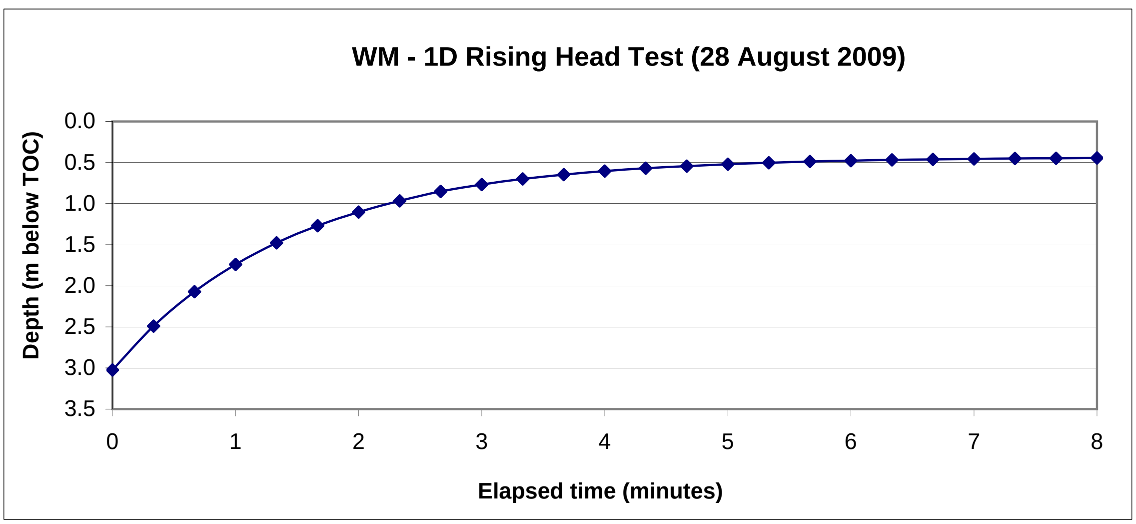
RISING HEAD TEST
Site: WM-1S
Date: 28-Aug-09
Time: 5:30 PM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0.00	2.380	1.140	0.663
1	0.02	2.973	0.547	0.070
2	0.03	2.989	0.531	0.054
3	0.05	3.000	0.520	0.043
4	0.07	3.009	0.511	0.034
5	0.08	3.014	0.506	0.029
6	0.10	3.019	0.501	0.024
7	0.12	3.023	0.497	0.020
8	0.13	3.026	0.494	0.017
9	0.15	3.030	0.490	0.013
10	0.17	3.031	0.489	0.011
11	0.18	3.033	0.487	0.010
12	0.20	3.034	0.486	0.008



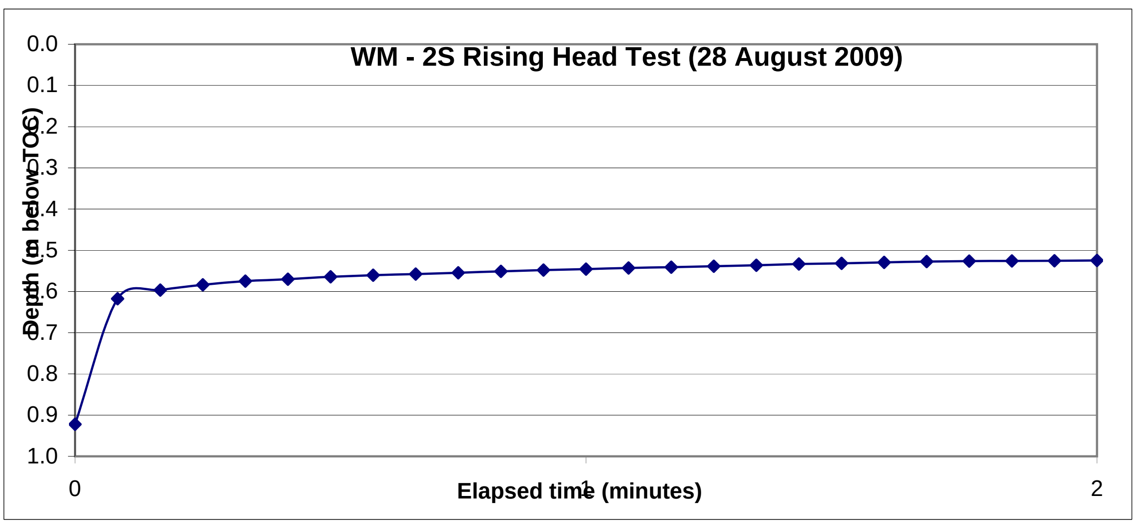
RISING HEAD TEST
Site: WM-1D
Date: 28-Aug-09
Time: 5:30 PM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0.0	2.396	3.024	2.580
20	0.3	2.930	2.490	2.046
40	0.7	3.349	2.071	1.627
60	1.0	3.680	1.740	1.296
80	1.3	3.943	1.477	1.033
100	1.7	4.151	1.269	0.825
120	2.0	4.318	1.102	0.658
140	2.3	4.453	0.967	0.522
160	2.7	4.568	0.852	0.408
180	3.0	4.653	0.767	0.323
200	3.3	4.721	0.699	0.255
220	3.7	4.773	0.647	0.203
240	4.0	4.816	0.604	0.159
260	4.3	4.851	0.569	0.125
280	4.7	4.877	0.543	0.099
300	5.0	4.900	0.520	0.076
320	5.3	4.918	0.502	0.058
340	5.7	4.932	0.488	0.044
360	6.0	4.943	0.477	0.033
380	6.3	4.952	0.468	0.024
400	6.7	4.959	0.461	0.017
420	7.0	4.964	0.456	0.012
440	7.3	4.969	0.451	0.007
460	7.7	4.973	0.447	0.003
480	8.0	4.976	0.444	0.000



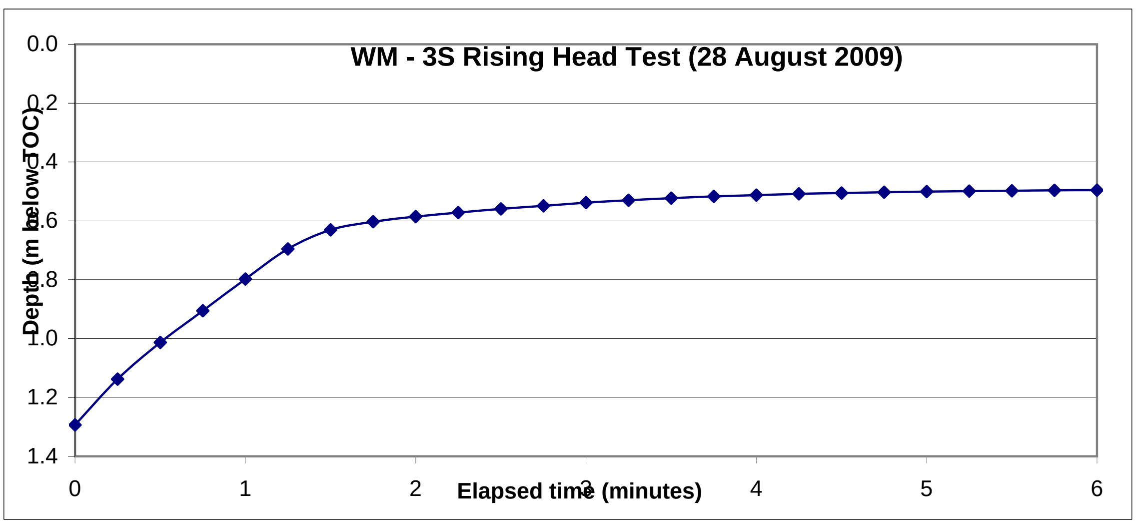
RISING HEAD TEST
Site: WM-2S
Date: 28-Aug-09
Time: 6:15 PM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0.0	2.098	0.922	0.397
5	0.1	2.402	0.618	0.093
10	0.2	2.423	0.597	0.072
15	0.3	2.436	0.584	0.059
20	0.3	2.445	0.575	0.050
25	0.4	2.450	0.570	0.045
30	0.5	2.456	0.564	0.039
35	0.6	2.459	0.561	0.036
40	0.7	2.462	0.558	0.033
45	0.8	2.465	0.555	0.030
50	0.8	2.469	0.551	0.026
55	0.9	2.472	0.548	0.023
60	1.0	2.474	0.546	0.021
65	1.1	2.477	0.543	0.018
70	1.2	2.479	0.541	0.016
75	1.3	2.481	0.539	0.014
80	1.3	2.484	0.536	0.011
85	1.4	2.487	0.533	0.009
90	1.5	2.488	0.532	0.007
95	1.6	2.491	0.529	0.004
100	1.7	2.493	0.527	0.003
105	1.8	2.494	0.526	0.001
110	1.8	2.494	0.526	0.001
115	1.9	2.495	0.525	0.001
120	2.0	2.495	0.525	0.000



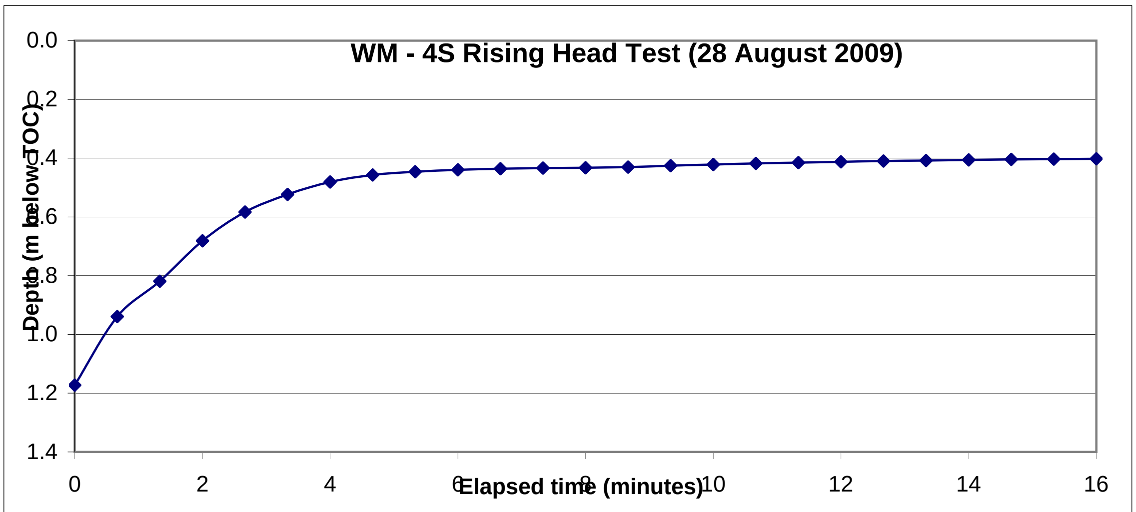
RISING HEAD TEST
Site: WM-3S
Date: 28-Aug-09
Time: 6:15 PM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0.0	1.127	1.293	0.798
15	0.3	1.282	1.138	0.642
30	0.5	1.407	1.013	0.518
45	0.8	1.515	0.905	0.410
60	1.0	1.623	0.797	0.302
75	1.3	1.725	0.695	0.200
90	1.5	1.789	0.631	0.135
105	1.8	1.817	0.603	0.108
120	2.0	1.835	0.585	0.090
135	2.3	1.848	0.572	0.076
150	2.5	1.861	0.559	0.064
165	2.8	1.871	0.549	0.054
180	3.0	1.882	0.538	0.043
195	3.3	1.890	0.530	0.034
210	3.5	1.897	0.523	0.027
225	3.8	1.903	0.517	0.022
240	4.0	1.908	0.512	0.017
255	4.3	1.912	0.508	0.013
270	4.5	1.915	0.505	0.010
285	4.8	1.917	0.503	0.007
300	5.0	1.920	0.500	0.005
315	5.3	1.921	0.499	0.003
330	5.5	1.922	0.498	0.002
345	5.8	1.924	0.496	0.001
360	6.0	1.925	0.495	0.000



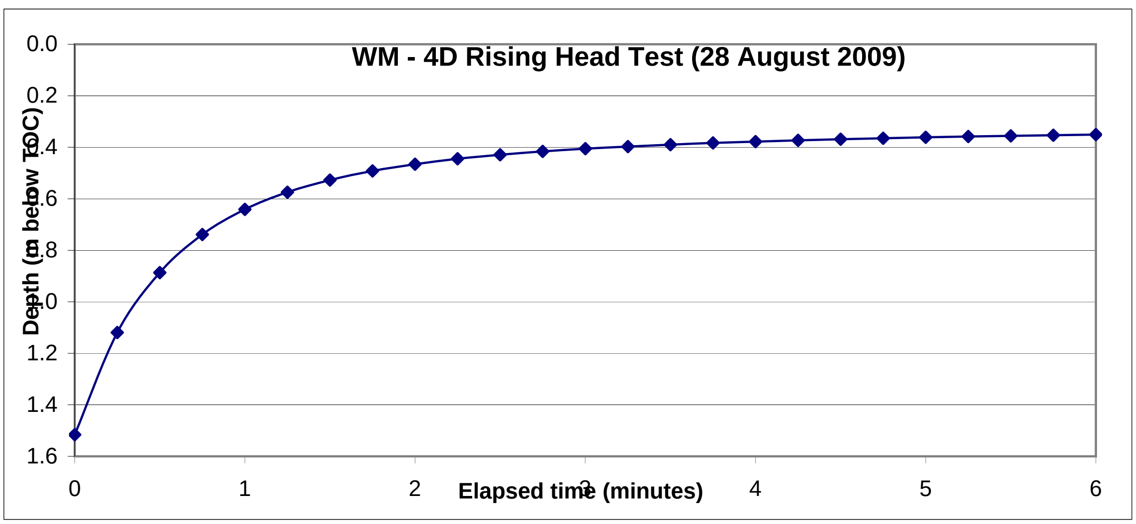
RISING HEAD TEST
Site: WM-4S
Date: 28-Aug-09
Time: 6:15 PM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0.0	0.848	1.172	0.770
40	0.7	1.081	0.939	0.537
80	1.3	1.201	0.819	0.416
120	2.0	1.339	0.681	0.279
160	2.7	1.437	0.583	0.181
200	3.3	1.497	0.523	0.121
240	4.0	1.539	0.481	0.079
280	4.7	1.563	0.457	0.055
320	5.3	1.574	0.446	0.044
360	6.0	1.580	0.440	0.038
400	6.7	1.584	0.436	0.033
440	7.3	1.586	0.434	0.031
480	8.0	1.588	0.432	0.030
520	8.7	1.590	0.430	0.028
560	9.3	1.594	0.426	0.023
600	10.0	1.598	0.422	0.019
640	10.7	1.602	0.418	0.016
680	11.3	1.605	0.415	0.013
720	12.0	1.608	0.412	0.010
760	12.7	1.610	0.410	0.007
800	13.3	1.612	0.408	0.006
840	14.0	1.614	0.406	0.004
880	14.7	1.615	0.405	0.002
920	15.3	1.617	0.403	0.001
960	16.0	1.618	0.402	0.000



RISING HEAD TEST
Site: WM-4D
Date: 28-Aug-09
Time: 6:15 PM

Time (s)	Time (min)	Depth (m above sensor)	Depth (m below TOC)	Displacement (m)
0	0.0	1.704	1.516	1.165
15	0.3	2.101	1.119	0.769
30	0.5	2.333	0.887	0.536
45	0.8	2.481	0.739	0.388
60	1.0	2.579	0.641	0.291
75	1.3	2.645	0.575	0.224
90	1.5	2.693	0.527	0.177
105	1.8	2.728	0.492	0.141
120	2.0	2.754	0.466	0.115
135	2.3	2.775	0.445	0.094
150	2.5	2.791	0.429	0.078
165	2.8	2.804	0.416	0.065
180	3.0	2.814	0.406	0.055
195	3.3	2.823	0.397	0.046
210	3.5	2.830	0.390	0.039
225	3.8	2.837	0.383	0.033
240	4.0	2.842	0.378	0.027
255	4.3	2.847	0.373	0.022
270	4.5	2.851	0.369	0.018
285	4.8	2.855	0.365	0.014
300	5.0	2.859	0.361	0.010
315	5.3	2.862	0.358	0.007
330	5.5	2.864	0.356	0.005
345	5.8	2.867	0.353	0.002
360	6.0	2.869	0.351	0.000



AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Currency Creek
Test Date: 15 May 2009

AQUIFER DATA

Saturated Thickness: 2.563 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: UCC-P1

X Location: 0. m
Y Location: 0. m

Initial Displacement: 2.377 m
Static Water Column Height: 2.563 m
Casing Radius: 0.025 m
Well Radius: 0.0375 m
Well Skin Radius: 0.0375 m
Screen Length: 2.363 m
Total Well Penetration Depth: 2.363 m
Corrected Casing Radius (Bouwer-Rice Method): 0.03125 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	2.377	1.17E+4	0.1014
900.	1.995	1.26E+4	0.06929
1800.	1.76	1.35E+4	0.04981
2700.	1.534	1.44E+4	0.03623
3600.	1.318	1.53E+4	0.02583
4500.	1.111	1.62E+4	0.01657
5400.	0.9166	1.71E+4	0.01143
6300.	0.742	1.8E+4	0.007996
7200.	0.5872	1.89E+4	0.00536
8100.	0.4601	1.98E+4	0.003569
9000.	0.3546	2.07E+4	0.002536
9900.	0.2532	2.16E+4	0.000743
1.08E+4	0.1628		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 2.983

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.01907	m/day
y0	5.215	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Currency Creek
Test Date: 14 May 2009

AQUIFER DATA

Saturated Thickness: 1.601 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: LCC-P2

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.497 m
Static Water Column Height: 1.601 m
Casing Radius: 0.025 m
Well Radius: 0.0375 m
Well Skin Radius: 0.0375 m
Screen Length: 1.401 m
Total Well Penetration Depth: 1.401 m
Corrected Casing Radius (Bouwer-Rice Method): 0.03125 m
Gravel Pack Porosity: 0.45

No. of Observations: 17

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	1.497	8100.	0.002568
900.	1.302	9000.	-0.01208
1800.	1.034	9900.	-0.01353
2700.	0.7873	1.08E+4	-0.01047
3600.	0.5557	1.17E+4	-0.005135
4500.	0.3611	1.26E+4	-0.003409
5400.	0.2058	1.35E+4	0.000168
6300.	0.09168	1.44E+4	0.
7200.	0.02574		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 2.532

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.05545	m/day
y0	4.217	m

K = 6.418E-5 cm/sec
T = K*b = 0.08875 m²/day (0.01027 sq. cm/sec)

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Point Sturt
Test Date: 29 August 2009

AQUIFER DATA

Saturated Thickness: 0.9917 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PS-1S

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.8275 m
Static Water Column Height: 0.9917 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 0.8117 m
Total Well Penetration Depth: 0.8117 m
Corrected Casing Radius (Bouwer-Rice Method): 0.07888 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.8275	1.56E+4	0.0988
1200.	0.703	1.68E+4	0.07751
2400.	0.6887	1.8E+4	0.05924
3600.	0.5652	1.92E+4	0.04406
4800.	0.5028	2.04E+4	0.03203
6000.	0.4416	2.16E+4	0.02274
7200.	0.3787	2.28E+4	0.016
8400.	0.3196	2.4E+4	0.0106
9600.	0.2677	2.52E+4	0.006009
1.08E+4	0.2229	2.64E+4	0.003434
1.2E+4	0.1831	2.76E+4	0.001368
1.32E+4	0.1504	2.88E+4	0.000339
1.44E+4	0.1228		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 1.201

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.08973	m/day
y0	1.86	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Point Sturt
Test Date: 30 August 2009

AQUIFER DATA

Saturated Thickness: 1.821 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PS-1D

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.647 m
Static Water Column Height: 1.821 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 0.6 m
Total Well Penetration Depth: 1.801 m
Corrected Casing Radius (Bouwer-Rice Method): 0.07888 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	1.647	455.	0.1862
35.	1.368	490.	0.1538
70.	1.147	525.	0.1255
105.	0.9729	560.	0.1016
140.	0.8299	595.	0.08121
175.	0.7102	630.	0.06347
210.	0.6072	665.	0.04826
245.	0.5193	700.	0.03556
280.	0.4427	735.	0.02511
315.	0.376	770.	0.01576
350.	0.3177	805.	0.008258
385.	0.2678	840.	0.001847
420.	0.2238		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 1.537

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	4.411	m/day
y0	2.435	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Point Sturt
Test Date: 29 August 2009

AQUIFER DATA

Saturated Thickness: 0.9375 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PS-2S

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.8027 m
Static Water Column Height: 0.9375 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 0.7375 m
Total Well Penetration Depth: 0.755 m
Corrected Casing Radius (Bouwer-Rice Method): 0.07888 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.8027	1950.	0.1096
150.	0.7139	2100.	0.09563
300.	0.6235	2250.	0.08395
450.	0.5448	2400.	0.07201
600.	0.4682	2550.	0.05594
750.	0.4002	2700.	0.04128
900.	0.3399	2850.	0.02946
1050.	0.2869	3000.	0.01805
1200.	0.2425	3150.	0.01211
1350.	0.2057	3300.	0.007793
1500.	0.1744	3450.	0.002922
1650.	0.1465	3600.	0.001348
1800.	0.1256		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 1.138

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.6158	m/day
y0	1.345	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Point Sturt
Test Date: 30 August 2009

AQUIFER DATA

Saturated Thickness: 1.992 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PS-2D

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.868 m
Static Water Column Height: 1.992 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 1.04 m
Total Well Penetration Depth: 1.972 m
Corrected Casing Radius (Bouwer-Rice Method): 0.07888 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	1.868	520.	0.1067
40.	1.608	560.	0.07113
80.	1.38	600.	0.04571
120.	1.17	640.	0.02891
160.	0.9765	680.	0.01792
200.	0.8083	720.	0.0112
240.	0.6681	760.	0.007037
280.	0.5481	800.	0.004219
320.	0.4447	840.	0.002296
360.	0.3553	880.	0.001254
400.	0.2773	920.	0.000441
440.	0.2095	960.	-1.8E-5
480.	0.1534		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 1.841

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	4.047	m/day
y0	4.624	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Point Sturt
Test Date: 29 August 2009

AQUIFER DATA

Saturated Thickness: 1.056 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PS-3S

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.7435 m
Static Water Column Height: 1.056 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 0.7611 m
Total Well Penetration Depth: 0.8972 m
Corrected Casing Radius (Bouwer-Rice Method): 0.07888 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.7435	260.	0.08871
20.	0.5802	280.	0.07004
40.	0.5108	300.	0.05265
60.	0.4424	320.	0.03581
80.	0.3863	340.	0.02163
100.	0.3561	360.	0.01268
120.	0.3246	380.	0.006795
140.	0.2933	400.	0.002502
160.	0.2556	420.	-0.001759
180.	0.2099	440.	-0.001819
200.	0.1688	460.	-0.000412
220.	0.1355	480.	0.001004
240.	0.1107		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 1.225

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	5.564	m/day
y0	1.387	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Point Sturt
Test Date: 30 August 2009

AQUIFER DATA

Saturated Thickness: 1.823 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PS-3D

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.689 m
Static Water Column Height: 1.823 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 0.9 m
Total Well Penetration Depth: 1.803 m
Corrected Casing Radius (Bouwer-Rice Method): 0.07888 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	1.689	1170.	0.1378
90.	1.343	1260.	0.1174
180.	1.281	1350.	0.05982
270.	1.205	1440.	0.03883
360.	1.095	1530.	0.02423
450.	0.8668	1620.	0.0151
540.	0.6676	1710.	0.009209
630.	0.5171	1800.	0.005279
720.	0.4068	1890.	0.00318
810.	0.3185	1980.	0.002013
900.	0.2511	2070.	0.001789
990.	0.2015	2160.	0.000293
1080.	0.1648		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 1.732

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.873	m/day
y0	4.324	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Point Sturt
Test Date: 29 August 2009

AQUIFER DATA

Saturated Thickness: 0.8164 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PS-4S

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.5205 m
Static Water Column Height: 0.8164 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 0.5964 m
Total Well Penetration Depth: 0.5964 m
Corrected Casing Radius (Bouwer-Rice Method): 0.07888 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.5205	260.	0.0433
20.	0.3496	280.	0.03839
40.	0.2933	300.	0.03368
60.	0.2578	320.	0.02727
80.	0.2062	340.	0.02105
100.	0.1653	360.	0.01474
120.	0.135	380.	0.009592
140.	0.1107	400.	0.005478
160.	0.09246	420.	0.003764
180.	0.07694	440.	0.00278
200.	0.06529	460.	0.001413
220.	0.05649	480.	0.001788
240.	0.04922		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 0.97

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	4.92	m/day
y0	0.5806	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Point Sturt
Test Date: 30 August 2009

AQUIFER DATA

Saturated Thickness: 1.461 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PS-4D

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.31 m
Static Water Column Height: 1.461 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 0.73 m
Total Well Penetration Depth: 1.441 m
Corrected Casing Radius (Bouwer-Rice Method): 0.07888 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	1.31	455.	0.1402
35.	1.126	490.	0.1092
70.	0.9685	525.	0.08038
105.	0.8222	560.	0.05635
140.	0.6954	595.	0.03726
175.	0.5898	630.	0.04394
210.	0.4992	665.	0.03306
245.	0.422	700.	0.02358
280.	0.3559	735.	0.01625
315.	0.2992	770.	0.009948
350.	0.2497	805.	0.005131
385.	0.2073	840.	0.000858
420.	0.1711		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 1.543

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	3.943	m/day
y0	2.171	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Campbell Park
Test Date: 27 August 2009

AQUIFER DATA

Saturated Thickness: 0.3784 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: CP-1S

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.3336 m
Static Water Column Height: 0.3784 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 0.2084 m
Total Well Penetration Depth: 0.2084 m
Corrected Casing Radius (Bouwer-Rice Method): 0.07888 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.3336	5460.	0.03743
420.	0.253	5880.	0.03107
840.	0.2086	6300.	0.02678
1260.	0.1737	6720.	0.02168
1680.	0.1485	7140.	0.0177
2100.	0.1284	7560.	0.01424
2520.	0.11	7980.	0.01114
2940.	0.09456	8400.	0.009003
3360.	0.0815	8820.	0.005224
3780.	0.0703	9240.	0.009306
4200.	0.06017	9660.	0.002116
4620.	0.05134	1.008E+4	0.000489
5040.	0.04431		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 0.3524

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.2194	m/day
y0	0.3991	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Campbell Park
Test Date: 26 August 2009

AQUIFER DATA

Saturated Thickness: 2.932 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: CP-1D

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.932 m
Static Water Column Height: 2.932 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 1.9 m
Total Well Penetration Depth: 2.912 m
Corrected Casing Radius (Bouwer-Rice Method): 0.07888 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	1.932	715.	0.09661
55.	1.539	770.	0.08079
110.	1.272	825.	0.05826
165.	1.092	880.	0.05706
220.	0.763	935.	0.04595
275.	0.5338	990.	0.03723
330.	0.4442	1045.	0.02804
385.	0.3512	1100.	0.02183
440.	0.2624	1155.	0.0149
495.	0.2051	1210.	0.009817
550.	0.1667	1265.	0.005949
605.	0.1378	1320.	0.002314
660.	0.1143		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 2.321

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.446	m/day
y0	2.064	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Campbell Park
Test Date: 26 August 2009

AQUIFER DATA

Saturated Thickness: 1.16 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: CP-2S

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.8745 m
Static Water Column Height: 1.16 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 0.9901 m
Total Well Penetration Depth: 1.08 m
Corrected Casing Radius (Bouwer-Rice Method): 0.07888 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.8745	1560.	0.1407
120.	0.7541	1680.	0.07997
240.	0.6603	1800.	0.04482
360.	0.5887	1920.	0.0267
480.	0.508	2040.	0.0464
600.	0.4405	2160.	0.03728
720.	0.3874	2280.	0.0245
840.	0.3407	2400.	0.0127
960.	0.2984	2520.	0.006571
1080.	0.26	2640.	0.003045
1200.	0.2257	2760.	0.000876
1320.	0.1954	2880.	-0.00024
1440.	0.1684		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 1.44

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.8102	m/day
y0	1.704	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Campbell Park
Test Date: 26 August 2009

AQUIFER DATA

Saturated Thickness: 2.68 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: CP-2D

X Location: 0. m
Y Location: 0. m

Initial Displacement: 2.131 m
Static Water Column Height: 2.68 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 0.85 m
Total Well Penetration Depth: 2.66 m
Corrected Casing Radius (Bouwer-Rice Method): 0.07888 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	2.131	455.	0.1345
35.	1.818	490.	0.1096
70.	1.448	525.	0.08951
105.	1.118	560.	0.07301
140.	0.8577	595.	0.05784
175.	0.6589	630.	0.04559
210.	0.5588	665.	0.03475
245.	0.4497	700.	0.02592
280.	0.3649	735.	0.01793
315.	0.2976	770.	0.01114
350.	0.2436	805.	0.006353
385.	0.2002	840.	0.
420.	0.1643		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 1.861

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	3.869	m/day
y0	2.355	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Campbell Park
Test Date: 26 August 2009

AQUIFER DATA

Saturated Thickness: 0.9969 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: CP-3S

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.8948 m
Static Water Column Height: 0.9968 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 0.8268 m
Total Well Penetration Depth: 0.8268 m
Corrected Casing Radius (Bouwer-Rice Method): 0.07888 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.8948	2340.	0.07172
180.	0.7564	2520.	0.05858
360.	0.6342	2700.	0.0467
540.	0.5291	2880.	0.03818
720.	0.4394	3060.	0.0325
900.	0.364	3240.	0.01918
1080.	0.3035	3420.	0.01186
1260.	0.2517	3600.	0.00638
1440.	0.2091	3780.	0.004844
1620.	0.1699	3960.	0.001801
1800.	0.1388	4140.	0.000463
1980.	0.1125	4320.	0.
2160.	0.08959		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 1.218

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.5934	m/day
y0	1.561	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Campbell Park
Test Date: 26 August 2009

AQUIFER DATA

Saturated Thickness: 1.078 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: CP-4S

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.8595 m
Static Water Column Height: 1.078 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 0.8075 m
Total Well Penetration Depth: 0.915 m
Corrected Casing Radius (Bouwer-Rice Method): 0.07888 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.8595	455.	0.05219
35.	0.6999	490.	0.04572
70.	0.6407	525.	0.04022
105.	0.5199	560.	0.03598
140.	0.4081	595.	0.03312
175.	0.3455	630.	0.03161
210.	0.3036	665.	0.02727
245.	0.2745	700.	0.01997
280.	0.2488	735.	0.01278
315.	0.2252	770.	0.007429
350.	0.1947	805.	0.004445
385.	0.101	840.	0.
420.	0.05966		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 1.253

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	2.518	m/day
y0	1.042	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Campbell Park
Test Date: 26 August 2009

AQUIFER DATA

Saturated Thickness: 1.96 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: CP-4M

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.873 m
Static Water Column Height: 1.96 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 0.35 m
Total Well Penetration Depth: 1.94 m
Corrected Casing Radius (Bouwer-Rice Method): 0.07888 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	1.873	1560.	0.1473
120.	1.501	1680.	0.1202
240.	1.225	1800.	0.09717
360.	1.012	1920.	0.07789
480.	0.8396	2040.	0.06207
600.	0.6939	2160.	0.0478
720.	0.573	2280.	0.03704
840.	0.4747	2400.	0.02646
960.	0.3915	2520.	0.01772
1080.	0.3236	2640.	0.01139
1200.	0.2669	2760.	0.004901
1320.	0.2196	2880.	0.
1440.	0.1802		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 1.275

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.848	m/day
y0	2.28	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Campbell Park
Test Date: 26 August 2009

AQUIFER DATA

Saturated Thickness: 15. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: CP-4D

X Location: 0. m
Y Location: 0. m

Initial Displacement: 3.117 m
Static Water Column Height: 4.128 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 2. m
Total Well Penetration Depth: 4.108 m
Corrected Casing Radius (Bouwer-Rice Method): 0.025 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	3.117	13.	0.1714
1.	2.401	14.	0.1605
2.	1.689	15.	0.1549
3.	0.9691	16.	0.1424
4.	0.4042	17.	0.1346
5.	0.2853	18.	0.1266
6.	0.2667	19.	0.1192
7.	0.2498	20.	0.1119
8.	0.2342	21.	0.1054
9.	0.2186	22.	0.0996
10.	0.206	23.	0.09397
11.	0.1936	24.	0.08883
12.	0.1821		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 1.963

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	31.3	m/day
y0	1.007	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Windmill Site
Test Date: 28 August 2009

AQUIFER DATA

Saturated Thickness: 15. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: WM-1D

X Location: 0. m
Y Location: 0. m

Initial Displacement: 2.58 m
Static Water Column Height: 4.976 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 1.3 m
Total Well Penetration Depth: 4.956 m
Corrected Casing Radius (Bouwer-Rice Method): 0.025 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	2.58	260.	0.1253
20.	2.046	280.	0.09929
40.	1.627	300.	0.07604
60.	1.296	320.	0.05811
80.	1.033	340.	0.04374
100.	0.8245	360.	0.03289
120.	0.6583	380.	0.02394
140.	0.5224	400.	0.0172
160.	0.4077	420.	0.01198
180.	0.3227	440.	0.006961
200.	0.2552	460.	0.003112
220.	0.2029	480.	0.
240.	0.1594		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 1.757

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.4828	m/day
y0	3.222	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Windmill Site
Test Date: 28 August 2009

AQUIFER DATA

Saturated Thickness: 1.925 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: WM-3S

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.7977 m
Static Water Column Height: 1.925 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 1.755 m
Total Well Penetration Depth: 1.755 m
Corrected Casing Radius (Bouwer-Rice Method): 0.07888 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.7977	195.	0.03426
15.	0.6423	210.	0.02729
30.	0.5178	225.	0.02156
45.	0.4097	240.	0.01686
60.	0.302	255.	0.01302
75.	0.1998	270.	0.009832
90.	0.1351	285.	0.007195
105.	0.1076	300.	0.005023
120.	0.09002	315.	0.003253
135.	0.07638	330.	0.002146
150.	0.06393	345.	0.000992
165.	0.0536	360.	0.
180.	0.04291		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 1.842

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	4.906	m/day
y0	0.8471	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Windmill Site
Test Date: 28 August 2009

AQUIFER DATA

Saturated Thickness: 1.618 m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: WM-4S

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.7702 m
Static Water Column Height: 1.618 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 1.448 m
Total Well Penetration Depth: 1.448 m
Corrected Casing Radius (Bouwer-Rice Method): 0.07888 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.7702	520.	0.0279
40.	0.5369	560.	0.02339
80.	0.4163	600.	0.01931
120.	0.2789	640.	0.01574
160.	0.1808	680.	0.0129
200.	0.121	720.	0.01005
240.	0.0785	760.	0.007403
280.	0.05471	800.	0.005614
320.	0.04381	840.	0.003821
360.	0.03755	880.	0.002188
400.	0.03328	920.	0.001117
440.	0.03124	960.	0.
480.	0.03001		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 1.674

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.83	m/day
y0	0.4908	m

AQTESOLV for Windows

PROJECT INFORMATION

Company: Earth Systems
Client: DEH
Project: RSSA0823
Location: Windmill Site
Test Date: 28 August 2009

AQUIFER DATA

Saturated Thickness: 15. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: WM-4D

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.165 m
Static Water Column Height: 2.869 m
Casing Radius: 0.025 m
Well Radius: 0.1143 m
Well Skin Radius: 0.1143 m
Screen Length: 1. m
Total Well Penetration Depth: 2.849 m
Corrected Casing Radius (Bouwer-Rice Method): 0.025 m
Gravel Pack Porosity: 0.45

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	1.165	195.	0.04632
15.	0.7686	210.	0.03898
30.	0.5358	225.	0.03258
45.	0.3882	240.	0.02703
60.	0.2906	255.	0.02203
75.	0.2238	270.	0.0178
90.	0.1765	285.	0.01403
105.	0.1413	300.	0.01046
120.	0.1149	315.	0.007431
135.	0.09406	330.	0.004747
150.	0.07833	345.	0.002243
165.	0.0654	360.	0.
180.	0.05495		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 1.447

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.5939	m/day
y0	0.8379	m

Attachment I:

Rainfall, wind speed and wind direction data for Currency Creek, Langhorne Creek and Narrung

Data available to download at
http://www.samdbnrm.sa.gov.au/Portals/7/AWMN/awsview.php

Attachment J:

Surface water quality data – Currency Creek, Lake Alexandrina and Lake Albert

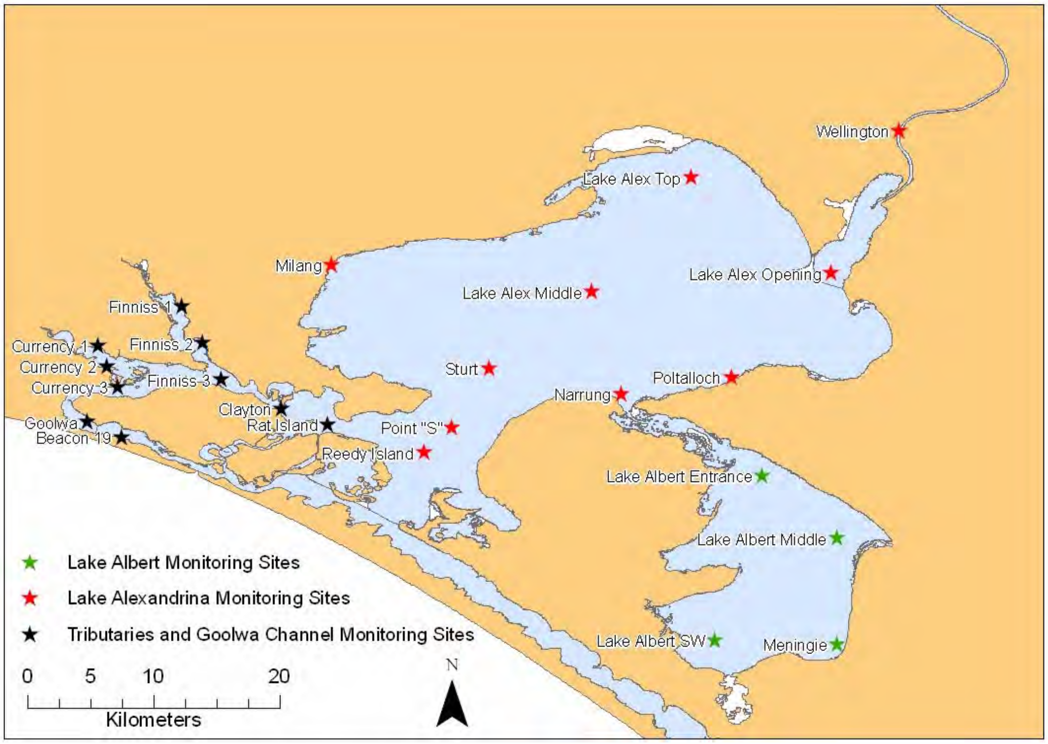


Figure 1: Map of surface water quality monitoring sites for the data provided by EPA (EPA, 2009).

Table 1: Surface water quality data for Lake Albert (see Figure 1 for site locations).

Site Name	Sample date	alkalinity (as CaCO3)	chloride	pH	sulphate	Calculated Cl:SO4
		mg/L	mg/L	-	mg/L	-
Meningie	24-Apr-08	245	1530	8.72	283	5.41
Meningie	05-May-08	257	1660	8.7	315	5.27
Meningie	12-May-08	253	1680	8.6	309	5.44
Meningie	19-May-08	251	1660	8.4	309	5.37
Meningie	26-May-08	251	1690	8.7	295	5.73
Meningie	02-Jun-08	247	1750	8.6	321	5.45
Meningie	10-Jun-08	264	1580	8.5	269	5.87
Meningie	16-Jun-08	257	1550	8.6	256	6.05
Meningie	23-Jun-08	258	1630	8.2	280	5.82
Meningie	03-Jul-08	252	1610	8.5	291	5.53
Meningie	07-Jul-08	251	1590	8.5	285	5.58
Meningie	16-Jul-08	235	1460	8.3	262	5.57
Meningie	23-Jul-08	222	1450	8.7	281	5.16
Meningie	29-Jul-08	228	1440	8.7	267	5.39
Meningie	06-Aug-08	228	1600	8.6	312	5.13
Meningie	18-Aug-08	220	1480	8.6	280	5.29
Meningie	21-Sep-08	229	1800	8.6	303	5.94
Meningie	16-Oct-08	224	1780	8.4	295	6.03
Meningie	12-Nov-08	230	1920	8.6	339	5.66
Meningie	11-Dec-08	240	2350	8.4	411	5.72
Meningie	06-Jan-09	243	2380	8.7	417	5.71
Meningie	04-Feb-09	249	2990	8.5	564	5.30
Meningie	18-Feb-09	280	3210	8.1	585	5.49
Meningie	26-Feb-09	264	3760	8.2	582	6.46
Meningie	10-Mar-09	267	3580	8.5	636	5.63
Meningie	16-Mar-09	255	3540	7.9	642	5.51
Meningie	19-Mar-09	270	3640	8.77	639	5.70
Meningie	25-Mar-09	264	4000	8.3	621	6.44
Meningie	01-Apr-09	269	3830	8.3	669	5.72
Meningie	07-Apr-09	265	3830	8.5	699	5.48
Meningie	14-Apr-09	264	3810	8.5	687	5.55
Meningie	20-Apr-09	290	4010	8.5	663	6.05
Meningie	29-Apr-09	245	3530	8.5	615	5.74
Meningie	06-May-09	250	3620	8.6	642	5.64
Meningie	12-May-09	255	3470	8.6	627	5.53
Meningie	18-May-09	255	3300	8.4	570	5.79
Meningie	26-May-09	249	3150	8.7	546	5.77
Meningie	11-Jun-09	265	3220	8.34	558	5.77
Meningie	16-Jun-09	258	2830	8.4	456	6.21
Meningie	23-Jun-09	263	3010	8.5	513	5.87
Meningie	29-Jun-09	254	2960	8.6	516	5.74
Meningie	06-Jul-09	242	3200	8.6	567	5.64
Meningie	09-Jul-09	253	3060	8.6	516	5.93
Meningie	22-Jul-09	244	2860	8.6	492	5.81
Meningie	04-Aug-09	247	3020	8.6	516	5.85
Meningie	18-Aug-09	253	2960	8.5	483	6.13
Meningie	01-Sep-09	249	2900	8.5	522	5.56

Site Name	Sample date	alkalinity (as CaCO3)	chloride	pH	sulphate	Calculated Cl:SO4
		mg/L	mg/L	-	mg/L	-
Meningie	08-Sep-09		3160	8.4	540	5.85
Enterance	29-Apr-08	219	1330	8.7	240	5.54
Enterance	12-May-08	231	1290	8.6	236	5.47
Enterance	19-May-08	181	1110	8.4	209	5.31
Enterance	26-May-08	220	1360	8.6	243	5.60
Enterance	02-Jun-08	246	1540	8.7	281	5.48
Enterance	10-Jun-08	246	1310	8.5	212	6.18
Enterance	16-Jun-08	261	1480	8.6	246	6.02
Enterance	23-Jun-08	241	1400	7.9	245	5.71
Enterance	03-Jul-08	253	1570	8.5	273	5.75
Enterance	07-Jul-08	248	1510	8.5	272	5.55
Enterance	16-Jul-08	244	1620	8.5	273	5.93
Enterance	23-Jul-08	243	1430	8.6	263	5.44
Enterance	29-Jul-08	231	1440	8.7	254	5.67
Enterance	06-Aug-08	223	1380	8.85	265	5.21
Enterance	18-Aug-08	166	1270	8.6	263	4.83
Enterance	01-Sep-08	229	1320	8.4	243	5.43
Enterance	21-Sep-08	226	1540	8.6	254	6.06
Enterance	02-Oct-08	221	1460	8.81	265	5.51
Enterance	16-Oct-08	228	1810	8.4	306	5.92
Enterance	03-Nov-08	239	2000	8.4	333	6.01
Enterance	12-Nov-08	222	1830	8.7	333	5.50
Enterance	26-Nov-08	238	2040	8.5	393	5.19
Enterance	11-Dec-08	215	1950	8.4	318	6.13
Enterance	19-Dec-08	252	2250	8.6	402	5.60
Enterance	06-Jan-09	240	2370	8.7	414	5.72
Enterance	21-Jan-09	215	1940	8.3	327	5.93
Enterance	04-Feb-09	204	1910	8.6	369	5.18
Enterance	18-Feb-09	211	2540	8.4	426	5.96
Enterance	26-Feb-09	266	3360	8.4	576	5.83
Enterance	10-Mar-09	244	2980	8.3	498	5.98
Enterance	16-Mar-09	237	3010	8.3	558	5.39
Enterance	19-Mar-09	239	2920	8.91	462	6.32
Enterance	25-Mar-09	210	2410	8.3	357	6.75
Enterance	01-Apr-09	235	3030	8.4	498	6.08
Enterance	07-Apr-09	210	2210	8.6	339	6.52
Enterance	14-Apr-09	198	2050	8.5	309	6.63
Enterance	20-Apr-09	214	2270	8.6	351	6.47
Enterance	29-Apr-09	250	3390	8.5	582	5.82
Enterance	06-May-09	190	2020	8.8	318	6.35
Enterance	12-May-09	213	2040	8.5	312	6.54
Enterance	18-May-09	236	2910	8.2	489	5.95
Enterance	26-May-09	240	2900	8.7	519	5.59
Enterance	11-Jun-09	242	2840	8.29	483	5.88
Enterance	16-Jun-09	244	3030	8.4	501	6.05
Enterance	23-Jun-09	257	3060	8.5	510	6.00
Enterance	29-Jun-09	254	2430	8.5	519	4.68
Enterance	06-Jul-09	245	3010	8.6	519	5.80

Site Name	Sample date	alkalinity (as CaCO3)	chloride	pH	sulphate	Calculated Cl:SO4
		mg/L	mg/L	-	mg/L	-
Enterance	09-Jul-09	250	3030	8.7	483	6.27
Enterance	22-Jul-09	251	2880	8.4	489	5.89
Enterance	04-Aug-09	254	2930	8.5	504	5.81
Enterance	18-Aug-09	252	2960	8.4	474	6.24
Enterance	01-Sep-09	248	2970	8.5	531	5.59
Enterance	08-Sep-09		3140	8.4	540	5.81
Middle	29-Apr-08	206	1120	8.71	195	5.74
Middle	05-May-08	247	1510	8.7	276	5.47
Middle	12-May-08	247	1530	8.6	279	5.48
Middle	19-May-08	222	1420	8.3	247	5.75
Middle	26-May-08	243	1520	8.7	271	5.61
Middle	02-Jun-08	247	1440	8.3	259	5.56
Middle	10-Jun-08	267	1550	8.4	264	5.87
Middle	16-Jun-08	251	1500	8.6	247	6.07
Middle	23-Jun-08	257	1520	8.1	274	5.55
Middle	03-Jul-08	251	1530	8.4	266	5.75
Middle	07-Jul-08	247	1470	8.5	266	5.53
Middle	16-Jul-08	226	1510	8.4	261	5.79
Middle	23-Jul-08	236	1410	8.6	265	5.32
Middle	29-Jul-08	234	1410	8.7	254	5.55
Middle	06-Aug-08	226	1410	8.6	280	5.04
Middle	18-Aug-08	214	1360	8.6	247	5.51
Middle	01-Sep-08	219	1310	8.2	248	5.28
Middle	21-Sep-08	229	1540	8.6	250	6.16
Middle	02-Oct-08	230	1500	8.74	276	5.43
Middle	16-Oct-08	225	1750	8.4	291	6.01
Middle	03-Nov-08	231	1920	8.4	315	6.10
Middle	12-Nov-08	226	1770	8.7	390	4.54
Middle	26-Nov-08	233	1900	8.6	339	5.60
Middle	11-Dec-08	242	2280	8.4	393	5.80
Middle	19-Dec-08	242	2260	8.5	396	5.71
Middle	06-Jan-09	240	2370	8.7	411	5.77
Middle	21-Jan-09	244	2710	8.2	450	6.02
Middle	18-Feb-09	254	3050	8.4	534	5.71
Middle	26-Feb-09	270	3400	8.4	576	5.90
Middle	10-Mar-09	265	3430	8.5	642	5.34
Middle	16-Mar-09	257	3500	7.9	651	5.38
Middle	19-Mar-09	260	3530	8.57	609	5.80
Middle	25-Mar-09	254	3400	8.3	588	5.78
Middle	01-Apr-09	263	3660	8.3	627	5.84
Middle	07-Apr-09	248	3370	8.5	585	5.76
Middle	14-Apr-09	267	3570	8.5	630	5.67
Middle	20-Apr-09	237	2800	8.7	453	6.18
Middle	29-Apr-09	239	2960	8.5	537	5.51
Middle	06-May-09	244	3300	8.6	576	5.73
Middle	12-May-09	253	3320	8.5	594	5.59
Middle	18-May-09	240	2970	8.4	504	5.89
Middle	26-May-09	237	2800	8.7	498	5.62

Site Name	Sample date	alkalinity (as CaCO3)	chloride	pH	sulphate	Calculated Cl:SO4
		mg/L	mg/L	-	mg/L	-
Middle	11-Jun-09	245	2920	8.29	468	6.24
Middle	16-Jun-09	243	2930	8.4	471	6.22
Middle	23-Jun-09	254	2970	8.5	510	5.82
Middle	29-Jun-09	260	3030	8.5	525	5.77
Middle	06-Jul-09	250	3050	8.5	531	5.74
Middle	09-Jul-09	252	3030	8.6	483	6.27
Middle	22-Jul-09	250	2890	8.4	501	5.77
Middle	04-Aug-09	255	2900	8.5	510	5.69
Middle	18-Aug-09	251	2970	8.3	471	6.31
Middle	01-Sep-09	251	2930	8.5	516	5.68
Middle	08-Sep-09		3110	8.4	537	5.79
SW	06-Aug-08	229	1360	8.5	266	5.11
SW	18-Aug-08	221	1410	8.5	256	5.51
SW	01-Sep-08	228	1360	8.5	246	5.53
SW	21-Sep-08	240	1450	8.6	250	5.80
SW	02-Oct-08	228	1480	8.68	268	5.52
SW	16-Oct-08	229	1680	8.4	285	5.89
SW	03-Nov-08	244	1850	8.3	312	5.93
SW	12-Nov-08	227	1840	8.5	327	5.63
SW	26-Nov-08	233	1940	8.6	363	5.34
SW	11-Dec-08	241	2270	8.5	402	5.65
SW	18-Dec-08	261	2310	8.7	402	5.75
SW	06-Jan-09	238	2330	8.3	411	5.67
SW	21-Jan-09	241	2600	8.4	456	5.70
SW	18-Feb-09	260	3210	8.4	576	5.57
SW	26-Feb-09	266	3430	8.3	585	5.86
SW	10-Mar-09	272	3490	8.5	606	5.76
SW	16-Mar-09	259	3530	7.8	663	5.32
SW	19-Mar-09	262	3620	8.63	597	6.06
SW	25-Mar-09	264	3890	8.2	630	6.17
SW	01-Apr-09	269	3880	8.2	663	5.85
SW	07-Apr-09	263	3970	8.2	675	5.88
SW	14-Apr-09	267	3780	8.4	675	5.60
SW	20-Apr-09	264	3620	8.5	648	5.59
SW	29-Apr-09	256	3460	8.4	612	5.65
SW	06-May-09	252	3550	8.5	612	5.80
SW	12-May-09	251	3320	8.4	597	5.56
SW	18-May-09	251	3340	8.4	582	5.74
SW	26-May-09	252	3460	8.6	573	6.04
SW	11-Jun-09	247	3150	8.22	546	5.77
SW	16-Jun-09	243	3040	8.4	507	6.00
SW	23-Jun-09	254	3190	8.5	546	5.84
SW	29-Jun-09	254	2940	8.5	516	5.70
SW	06-Jul-09	247	3040	8.5	528	5.76
SW	09-Jul-09	249	3030	8.5	465	6.52
SW	22-Jul-09	243	2840	8.4	489	5.81
SW	04-Aug-09	250	2920	8.5	504	5.79
SW	18-Aug-09	256	2970	8.4	483	6.15

Site Name	Sample date	alkalinity (as CaCO3)	chloride	pH	sulphate	Calculated Cl:SO4
		mg/L	mg/L	-	mg/L	-
SW	01-Sep-09	250	2950	8.5	522	5.65
Lake Albert: golf course irrigation pipe tap.	23-Apr-08	245	1720	8.3	296	
Lake Albert: golf course irrigation pipe tap.	21-May-08	245	1680	8.2	318	

Table 2: Surface water quality data for Lake Alexandrina (see Figure 1 for site location)

Site Name	Sample Date	alkalinity (as CaCO3)	chloride	pH	sulphate	Calculted Cl:SO4
		mg/L	mg/L	-	mg/L	-
Lake Alexandrina - Poltalloch plains recorder	14-May-08	178	924	8.91	149	6.20
Lake Alexandrina - Poltalloch plains recorder	15-Aug-08	170	972	8.6	164	5.93
Lake Alexandrina - Poltalloch plains recorder	19-Aug-08	178	1100	8.6	188	5.85
Lake Alexandrina - Poltalloch plains recorder	16-Sep-08	165	944	8.2	161	5.86
Lake Alexandrina - Poltalloch plains recorder	10-Nov-08	176	1090	8.5	178	6.12
Lake Alexandrina - Poltalloch plains recorder	08-Dec-08	177	1180	8.4	198	5.96
Lake Alexandrina - Poltalloch plains recorder	06-Jan-09	186	1280	8.3	219	5.84
Lake Alexandrina - Poltalloch plains recorder	04-Feb-09	184	1560	8.3	238	6.55
Lake Alexandrina - Poltalloch plains recorder	02-Mar-09	188	1740	8.6	285	6.11
Lake Alexandrina - Poltalloch plains recorder	31-Mar-09	184	1750	8.4	280	6.25
Lake Alexandrina - Poltalloch plains recorder	28-Apr-09	162	1180	8.5	218	5.41
Lake Alexandrina - Poltalloch plains recorder	27-May-09	161	1060	8.6	179	5.92
Lake Alexandrina - Poltalloch plains recorder	25-Jun-09	173	1110	8.4	216	5.14
Lake Alexandrina - Poltalloch plains recorder	29-Jul-09	174	1240	8.2	210	5.90
Lake Alexandrina - Poltalloch plains recorder	27-Aug-09	179	1660	8.3	240	6.92
Lake Alexandrina: Beacon 97	14-May-08	182	1020	8.86	166	6.14
Lake Alexandrina: Beacon 97	19-Aug-08	174	1060	8.6	176	6.02
Lake Alexandrina: Beacon 97	16-Sep-08	184	1300	8.4	212	6.13
Lake Alexandrina:	15-Oct-08	183	1070	8.6	179	5.98

Site Name	Sample Date	alkalinity (as CaCO3)	chloride	pH	sulphate	Calculted Cl:SO4
		mg/L	mg/L	-	mg/L	-
Beacon 97						
Lake Alexandrina: Beacon 97	10-Nov-08	185	1280	8.5	204	6.27
Lake Alexandrina: Beacon 97	08-Dec-08	184	1300	8.4	215	6.05
Lake Alexandrina: Beacon 97	06-Jan-09	181	1300	8.4	219	5.94
Lake Alexandrina: Beacon 97	04-Feb-09	179	1500	8.2	233	6.44
Lake Alexandrina: Beacon 97	01-Mar-09	182	1680	8.5	282	5.96
Lake Alexandrina: Beacon 97	31-Mar-09	178	1660	8.5	260	6.38
Lake Alexandrina: Beacon 97	28-Apr-09	186	1840	8.5	299	6.15
Lake Alexandrina: Beacon 97	27-May-09	195	2030	8.6	315	6.44
Lake Alexandrina: Beacon 97	25-Jun-09	189	1250	8.4	217	5.76
Lake Alexandrina: Beacon 97	29-Jul-09	190	1890	8.3	283	6.68
Lake Alexandrina: Beacon 97	27-Aug-09	192	1810	8.4	271	6.68
Middle	05-Aug-08	187	1190	8.5	181	6.57
Middle	01-Sep-08	186	995	8.3	177	5.62
Middle	02-Oct-08	197	1160	8.58	195	5.95
Middle	30-Oct-08	189	1140	8.6	192	5.94
Middle	25-Nov-08	192	1240	8.5	211	5.88
Middle	17-Dec-08	184	1340	8.6	216	6.20
Middle	21-Jan-09	185	1520	8.2	249	6.10
Middle	17-Feb-09	176	1690	8.6	246	6.87
Middle	18-Mar-09	182	1830	8.87	263	6.96
Middle	14-Apr-09	185	1950	8.66	303	6.44
Middle	12-May-09	187	1780	8.3	272	6.54
Middle	10-Jun-09	193	1860	8.17	271	6.86
Middle	09-Jul-09	187	1640	8.3	231	7.10
Middle	04-Aug-09	180	1310	8.5	219	5.98
Middle	01-Sep-09	180	1590	8.4	258	6.16
Lake Alexandrina: Milang off shore	04-Aug-08	186		8.9	201	#N/A
Lake Alexandrina: Milang off shore	01-Sep-08	183		9.39	172	#N/A
Lake Alexandrina: Milang off shore	02-Oct-08	197		8.68	198	#N/A
Lake Alexandrina: Milang off shore	29-Oct-08	189		8.9	218	#N/A
Lake Alexandrina: Milang off shore	24-Nov-08	197		8.76	217	#N/A
Lake Alexandrina: Milang off shore	18-Dec-08	188		8.7	247	#N/A
Lake Alexandrina:	20-Jan-09	193		8.5	275	#N/A

Site Name	Sample Date	alkalinity (as CaCO3)	chloride	pH	sulphate	Calculted Cl:SO4
		mg/L	mg/L	-	mg/L	-
Milang off shore						
Lake Alexandrina: Milang off shore	19-Feb-09	196	1930	8.77	300	6.43
Lake Alexandrina: Milang off shore	17-Mar-09	180	2010	8.64	330	6.09
Lake Alexandrina: Milang off shore	15-Apr-09	202	2090	8.92	330	6.33
Lake Alexandrina: Milang off shore	12-May-09	223	2020	7.8	306	6.60
Lake Alexandrina: Milang off shore	09-Jun-09	194	1760	8.02	280	6.29
Lake Alexandrina: Milang off shore	09-Jul-09	192	1770	8.5	252	7.02
Lake Alexandrina: Milang off shore	04-Aug-09	195	1830	8.6	268	6.83
Lake Alexandrina: Milang off shore	01-Sep-09	187	1560	8.4	245	6.37
Lake Alexandrina: Narrung	05-Aug-08	185		9.08	199	#N/A
Lake Alexandrina: Narrung	02-Sep-08	177		8.72	205	#N/A
Lake Alexandrina: Narrung	02-Oct-08	179		8.51	192	#N/A
Lake Alexandrina: Narrung	31-Oct-08	186		8.64	184	#N/A
Lake Alexandrina: Narrung	25-Nov-08	184		8.6	196	#N/A
Lake Alexandrina: Narrung	17-Dec-08	184		8.7	220	#N/A
Lake Alexandrina: Narrung	21-Jan-09	198		8.7	247	#N/A
Lake Alexandrina: Narrung	17-Feb-09	180	1780	8.85	256	6.95
Lake Alexandrina: Narrung	18-Mar-09	178	1800	8.83	258	6.98
Lake Alexandrina: Narrung	14-Apr-09	189	2000	9.06	318	6.29
Lake Alexandrina: Narrung	12-May-09	191	1930	8.6	279	6.92
Lake Alexandrina: Narrung	10-Jun-09	197	2070	8.29	312	6.63
Lake Alexandrina: Narrung	09-Jul-09	194	2100	8.6	297	7.07
Lake Alexandrina: Narrung	04-Aug-09	191	1860	8.5	281	6.62
Lake Alexandrina: Narrung	01-Sep-09	186	1720	8.6	288	5.97
Lake Alexandrina: Opening @ Murray river mouth	05-Aug-08	130	668	8.84	117	5.71
Lake Alexandrina: Opening @ Murray river mouth	02-Sep-08	113	559	8.73	102	5.48

Site Name	Sample Date	alkalinity (as CaCO3)	chloride	pH	sulphate	Calculted Cl:SO4
		mg/L	mg/L	-	mg/L	-
Lake Alexandrina: Opening @ Murray river mouth	02-Oct-08	145	796	8.42	135	5.90
Lake Alexandrina: Opening @ Murray river mouth	31-Oct-08	138	732	8.57	122	6.00
Lake Alexandrina: Opening @ Murray river mouth	25-Nov-08	117	588	8.4	105	5.60
Lake Alexandrina: Opening @ Murray river mouth	17-Dec-08	130	750	8.6	129	5.81
Lake Alexandrina: Opening @ Murray river mouth	21-Jan-09	144	935	8.3	157	5.96
Lake Alexandrina: Opening @ Murray river mouth	17-Feb-09	122	743	8.9	134	5.54
Lake Alexandrina: Opening @ Murray river mouth	18-Mar-09	104	410	8.42	84.9	4.83
Lake Alexandrina: Opening @ Murray river mouth	14-Apr-09	106	456	8.56	87.6	5.21
Lake Alexandrina: Opening @ Murray river mouth	12-May-09	110	493	8.2	83.4	5.91
Lake Alexandrina: Opening @ Murray river mouth	10-Jun-09	119	685	8.23	122	5.61
Lake Alexandrina: Opening @ Murray river mouth	09-Jul-09	150	1020	8.4	163	6.26
Lake Alexandrina: Opening @ Murray river mouth	04-Aug-09	139	853	8.5	136	6.27
Lake Alexandrina: Opening @ Murray river mouth	01-Sep-09	143	854	8.6	137	6.23
Top	05-Aug-08	186	1060	8.52	178	5.96
Top	02-Sep-08	181	1040	8.94	176	5.91
Top	02-Oct-08	185	1100	8.52	183	6.01
Top	30-Oct-08	186	1180	8.68	194	6.08
Top	25-Nov-08	190	1270	8.69	217	5.85
Top	17-Dec-08	182	1430	8.6	239	5.98
Top	21-Jan-09	184	1500	8	235	6.38
Top	17-Feb-09	182	1760	8.61	258	6.82
Top	17-Mar-09	186	1990	8.2	289	6.89
Top	14-Apr-09	185	2000	8.76	315	6.35
Top	12-May-09	196	1830	8.4	282	6.49
Top	10-Jun-09	193	1660	8.4	260	6.38
Top	09-Jul-09	193	1770	8.4	244	7.25

Site Name	Sample Date	alkalinity (as CaCO3)	chloride	pH	sulphate	Calculted Cl:SO4
		mg/L	mg/L	-	mg/L	-
Top	04-Aug-09	191	1760	8.5	243	7.24
Top	01-Sep-09	184	1570	8.5	247	6.36
Clayton	04-Aug-08	183	3660	8.3	579	6.32
Clayton	01-Sep-08	135	2900	8	459	6.32
Clayton	03-Oct-08	174	2130	8.53	336	6.34
Clayton	29-Oct-08	206	2260	8.61	336	6.73
Clayton	24-Nov-08	210	2340	8.5	354	6.61
Clayton	17-Dec-08	215	2420	8.6	402	6.02
Clayton	20-Jan-09	255	3960	8.2	591	6.70
Clayton	19-Feb-09	266	6070	8.14	873	6.95
Clayton	17-Mar-09	224	4500	8.54	714	6.30
Clayton	15-Apr-09	214	6950	8.46	1020	6.81
Clayton	12-May-09	192	6400	8.1	930	6.88
Clayton	09-Jun-09	178	6450	7.89	990	6.52
Clayton	09-Jul-09	154	4850	8.1	798	6.08
Clayton	04-Aug-09	65	1340	7.4	390	3.44
Clayton	01-Sep-09	69	2340	7.9	540	4.33
Lake Alexandrina: off Point Sturt	04-Aug-08	185		8.67	348	#N/A
Lake Alexandrina: off Point Sturt	19-Aug-08	183		8.74		#N/A
Lake Alexandrina: off Point Sturt	01-Sep-08	185		8.76	190	#N/A
Lake Alexandrina: off Point Sturt	16-Sep-08	183		8.65		#N/A
Lake Alexandrina: off Point Sturt	03-Oct-08	182		8.64	208	#N/A
Lake Alexandrina: off Point Sturt	14-Oct-08	184		8.8		#N/A
Lake Alexandrina: off Point Sturt	29-Oct-08	187		8.44	191	#N/A
Lake Alexandrina: off Point Sturt	10-Nov-08	188		8.65		#N/A
Lake Alexandrina: off Point Sturt	24-Nov-08	172		8.5	179	#N/A
Lake Alexandrina: off Point Sturt	08-Dec-08	185		8.71		#N/A
Lake Alexandrina: off Point Sturt	17-Dec-08	184		8.7	216	#N/A
Lake Alexandrina: off Point Sturt	06-Jan-09	187		8.76		#N/A
Lake Alexandrina: off Point Sturt	20-Jan-09	189		8.2	255	#N/A
Lake Alexandrina: off Point Sturt	20-Jan-09	160		8.73		#N/A
Lake Alexandrina: off Point Sturt	04-Feb-09	183		8.77		#N/A
Lake Alexandrina: off Point Sturt	17-Feb-09	182	1800	8.69		#N/A
Lake Alexandrina: off Point Sturt	18-Mar-09	181	1860	8.9	303	6.14

Site Name	Sample Date	alkalinity (as CaCO3)	chloride	pH	sulphate	Calculted Cl:SO4
		mg/L	mg/L	-	mg/L	-
Lake Alexandrina: off Point Sturt	14-Apr-09	189	2160	8.82	339	6.37
Lake Alexandrina: off Point Sturt	12-May-09	196	2240	8.6	351	6.38
Lake Alexandrina: off Point Sturt	10-Jun-09	200	2360	8.27	357	6.61
Lake Alexandrina: off Point Sturt	09-Jul-09	193	1790	8.4	251	7.13
Lake Alexandrina: off Point Sturt	04-Aug-09	190	1950	8.5	292	6.68
Lake Alexandrina: off Point Sturt	01-Sep-09	185	1730	8.6	276	6.27
Lake Alexandrina: off Reedy Island	04-Aug-08	189	1520	8.43	272	5.59
Lake Alexandrina: off Reedy Island	01-Sep-08	187	1320	9.06	227	5.81
Lake Alexandrina: off Reedy Island	03-Oct-08	186	1410	8.74	226	6.24
Lake Alexandrina: off Reedy Island	29-Oct-08	193	1370	8.61	232	5.91
Lake Alexandrina: off Reedy Island	24-Nov-08	189	1280	8.5	218	5.87
Lake Alexandrina: off Reedy Island	20-Jan-09	200	2060	8.4	303	6.80
Lake Alexandrina: off Reedy Island	17-Feb-09	200	2440	8.83	372	6.56
Lake Alexandrina: off Reedy Island	18-Mar-09	198	2620	8.76	369	7.10
Lake Alexandrina: off Reedy Island	14-Apr-09	206	2740	8.93	420	6.52
Lake Alexandrina: off Reedy Island	12-May-09	205	2770	8.4	414	6.69
Lake Alexandrina: off Reedy Island	10-Jun-09	205	2510	8.28	384	6.54
Lake Alexandrina: off Reedy Island	09-Jul-09	198	2530	8.5	369	6.86
Lake Alexandrina: off Reedy Island	04-Aug-09	189	2630	8.6	417	6.31
Lake Alexandrina: off Reedy Island	01-Sep-09	185	2160	8.5	375	5.76