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Soil survey of Magenta catchment - Taidia Road, Jerramungup

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SOIL SURVEY OF MAGENTA CATCHMENT

TAIDIA ROAD, JERRAMUNGUP

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DEPARTMENT OF AGRICULTURE

LAND MANAGEMENT SERVICES

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Contents

Summary

This report identifies the major soil types within the Lake Magenta Catchment and provides soil physical and chemical data relevant to catchment hydrology and land use.

The catchment contains part of the Lake Magenta Nature Reserve and four adjoining farms that together have a total area of 9940 hectares. The head of the catchment is situated on a major drainage divide associated with the Fitzgerald and Gardiner River drainage systems. Runoff from the catchment converges into a first order stream of the Fitzgerald River.

Vegetation is predominantly mallee shrubland with Proteacea shrubland and heath associated with valley floors and drainage lines.

The dominant soils are shallow loamy and sandy duplex soils. Associated soils are grey clays and gravelly duplex soils with minor areas of sandy duplex and deep sands occurring within or bordering drainage lines. The soils are characteristically strongly sodic and mildly saline, having an average electro-conductivity of 60mS/m (1:5 H20) within the upper 60cm of the clay layer.

Soil erosion, waterlogging and salinity are significant hazards that are evident on all properties within the catchment. These limitations are reducing agricultural production and also impacting on the Magenta reserve. The development of a catchment model using spatial soils data should generate management options specific to the Magenta catchment and similar landscapes within the Mallee zone.

Catchment description

Apart from the area covered by the Magenta Reserve, the catchment is predominantly cleared. Under present management systems approximately 40% of the cleared paddocks are pastured with the remainder in stubble or crop.

The paddocks are generally worked on the contour and cropped utilising minimum tillage. Catchment and property boundaries can be located on Land Administration cadastral map sheet 2135IV.

Climate

The region has a Mediterranean climate with a mean annual rainfall of approximately 380 mm (based on Average Annual Rainfall Map, 1979).

Topography

The catchment is very gently undulating with slopes generally between 1-2% with maximum slopes of about 4%.

Maximum relief is 30m over 4 km and aspect is commonly northeast.

Geology and geomorphology

The catchment is situated on the Yilgarn block and the dominant rocks are porphyritic adamellite. Laterite gravels and silcrete can be encountered on crests and ridge lines however, these weathering products are generally of minor extent and development.

Dolerite and quartz stones and gravels were sporadically encountered while major lineaments could not be determined from ground observation or aerial photography.

Deposits of sand occurred within the drainage channels and deep extensive deposits were encountered within the Fitzgerald River valley

Survey method

The main purpose of the survey was to identify the dominant soils and collect soil data relevant to hydrological modelling i.e. soil depth and soil texture are required to predict soil moisture storage and infiltration.

140 site observations were made to identify the soil types and 1:25,000 colour aerial photography was used as a base for map production.

The soils have been identified from auger holes to a maximum depth of 90cm if soil conditions allowed. Soil attributes recorded included: soil colour, texture, pH, structure and horizon depth. A soil map was produced (see attached map) by defining areas of similar soil types. The soil types have been described using terminology of McDonald et al (1990). Soil colours are described according to standard Munsell colour chart notation.

Electro-conductivity measurements were carried out with an EM 38 and EC 1:5 analysis was also determined in the field to correlate the EM38 readings at selected sites.

Soil/Landform relationship

The most common soils occurring within the catchment are shallow duplex soils derived from granitic rocks. The main variations in soil morphology are topsoil texture, depth and subsoil pH.

Gravelly duplex soils containing laterite or silcrete gravels and cobbles may be encountered on very gently inclined upper slopes and crests. The occurrence of gravels on near level upper landscape positions suggests insitu development under conditions of low topsoil erosion and lateral leaching.

Shallow duplex soils occur between upper to lower slopes having grades of 0.5-3%. Topsoil texture ranges from weak loamy sand to sandy clay loam and topsoil depth is usually between 5-10cm.

On lower slopes and within drainage lines the soils are moderately deep to deep duplex. Topsoil texture is usually weak loamy sand and it is commonly 20-60cm deep.

Map unit descriptions

Nine major map units (soil units) have been identified within the catchment. The map units represent an association of similar soil types and landforms. Provided below is a description of the map units.

Note: A summary of soil characteristics for each soil observation site is listed in Table 1. Furthermore, soil depth ranges are stated in the map unit descriptions while depths for specific areas may also be indicated on the attached map.

GrS/C Gravelly Sand over Clay

Australian Soil Classification: Ferric-Sodic Mesotrophic Yellow Chromosol.
Soil Groups of Western Australia: Yellow/brown shallow sandy duplex grading to moderately deep sandy gravel.

Landform
This unit is associated with crest and upper slopes.

Parent material
Soil profiles have developed from ferruginised weathered granite.

Morphological description
Topsoils are dark yellowish brown to very dark greyish brown loamy sand overlying light yellowish brown to brownish yellow gravelly loamy sand to clayey sand. 10-60% ironstone gravel usually occurs within the lower topsoil and there can be a scree of gravel on the soil surface.

Brownish yellow, strong brown or yellowish red gravelly light sandy clay loam to light medium clay is encountered at 10-60 cm, although commonly between 15-25cm. Topsoils are loose to firm when dry.

The soil reaction trend is neutral. Topsoils are slightly acid while subsoils are commonly neutral.

Land management characteristics
The soil profile is shallow to moderately deep.

Loose to firm surface conditions.

Well drained to moderately well drained soil profile.

Gravel scree provides protection against wind erosion

Apart from minor areas of shallow duricrust there are no major limitations associated with this unit.

Cropping options
Most of the unit supports good cereal crops and subterranean clover pastures.
The deeper gravels could support a lupin/ cereal rotation.

CS/C Clayey Sand over Clay

Australian Soil Classification: Mesotrophic Mottled-Subnatric Yellow Sodosol.
Soil Groups of Western Australia: Grey Shallow Sandy Duplex to Grey Shallow Loamy Duplex (see Moorungup or Warralonga Soil Series in Overhue, 1996)

Landform
This is the most commonly encountered soil type within the farms and it can be encountered on any position within the landscape.

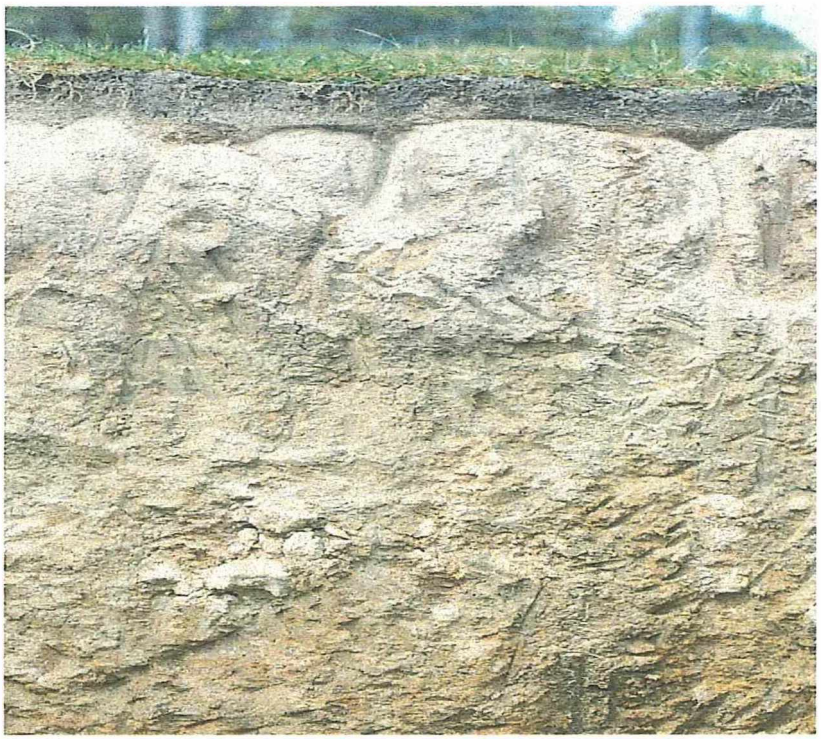

Fig.1 Typical CS/C soil profile featuring columnar "domed" clay subsoil.

Parent material
The soils are developed from granitoid basement rock, weathered rock is likely to be encountered on crest and upper slopes within a depth of 200cm.

Morphological description
Topsoils are very dark grey-brown loamy sand to clayey sand or less commonly sandy loam. Hardsetting is a common characteristic of cleared areas where it develops through the loss of soil structure, organic matter and by the incorporation of clayey subsoils during cultivation.

Clayey subsoil horizons are usually encountered at 10 cm. The A/B boundary is usually sharp or abrupt and a thin pale or bleached A2 horizon is often present. Soil colour is variably yellow, pale brown, brown or red with brownish red mottles and organic staining being common within the upper 10cm of the horizon.

Soil texture is usually sandy clay to light medium clay although the upper10 cm of the clayey horizon may possess a sandy clay loam texture as a result of clay eluviation.

The structure is usually massive or coarse columnar "domed" at the top of the clay layer and massive or coarse blocky at depth.

Fine lime segregations can be encountered below 30 cm however the shallow depth of observation does not allow prediction of spatial variability. Very acid subsoils were also encountered.

Topsoil pH is commonly 6.0-6.5 while the pH of the subsoil is variably 6.0-9.0.

The subsoil clays are often dense, weakly cemented, slake readily and dispersive, which suggests that the clay is sodic.

Land management characteristics
The soil profile is very shallow to shallow.

Firm to hardsetting surface conditions.

Subsoil horizons can be mildly to moderately saline (20-120mS/m $_{1:5}$).

Moderately well drained to poorly drained soil profile.

Topsoils are prone to erosion under conventional cultivation particularly if shallower than 10cm.

Eroded topsoils are prone to soil crusting and salt scalding as the clays slake and disperse readily thus promoting the capillary rise of soil salts.

Minimum or no-till farming systems would reduce the erosion risk and topsoil structure decline.

Cropping options
Cereal/medic, cereal/peas, chickpeas and faba bean rotations.

Lucerne has been successfully established on mid-upperslopes where waterlogging is not persistent.

The slightly acid topsoil can support subterranean clover pastures but if the topsoil is eroded or the alkaline subsoil clay is brought to the surface by ploughing, clover pastures do not persist. Medics would be more suited to hardsetting alkaline soil types.

LS/C Loamy Sand over Clay

Australian Soil Classification: Mesotrophic Mottled-Subnatric Yellow Sodosol.
Soil Groups of Western Australia: Grey Shallow Sandy Duplex.

This unit is similar to CS/C although the soils are generally not hardsetting. It usually occurs on low rises and crests and represents a transition between GrS/C and CS/C soil types. Topsoil depth is usually slightly deeper ie. 10-15cm.

Cropping options
Cereal/Subterranean clover or medic, cereal/peas, chickpea, and faba bean rotations. Subterranean clover pastures generally do better on sand or loamy sand topsoils.

Lucerne has been successfully established on mid-upperslopes where waterlogging is not persistent.

S/C Sands over Clay

Australian Soil Classification: Bleached-Sodic Mesotrophic Yellow Chromosol.
Soil Groups of Western Australia: Grey Shallow Sandy Duplex to Grey Deep Sandy Duplex.

Landform
This unit is usually situated on mid-lower slopes and adjacent to drainage lines.

Parent material
Weathered granitoid basement rock with overlying fluvial sand.

Morphological description
Topsoils are loose greyish brown weak loamy sand overlying to white to pale brown sand to loamy sand. A light yellowish brown, brownish yellow, brown or yellowish red, whole coloured or mottled sandy clay loam occurs at 20-60 cm. Within drainage lines and wet depressions the clays may also exhibit greyish–green (gley) mottles that indicate permanent saturation.

Subsoils often exhibit columnar (domed) structure however, it is not as dense relative to the shallow CS/C soil types. The deeper topsoil horizons acts as mulch that maintains moisture within the subsoil.

Sandy clay or light medium clay is usually evident 10-20 cm below the domed layer.

The soil reaction trend is acid to alkaline.
Topsoil pH: 6.0
Subsoil pH: 6.0-8.5

Land management characteristics
Soil types are shallow to moderately deep.

Topsoils are structureless with a loose to firm surface condition.

Wind and water erosion is a limitation requiring, careful grazing management.

Management of a grass cover or the planting of trees has been implemented on some farms to reduce erosion.

Cropping options
Cereal and Subterranean clover rotation. Yellow and pink serradella are options on deeper sand while Balansa and Trikkala clover can be very productive on wetter sites.

Perennial pastures that may be productive are Rhodes grass, cocksfoot, veldt grass, couch grass and Console love grass.

Fig2. Within the drainage lines sedges colonise the deeper sand over clay.

SL/C Grey Clay (Moort Soil)

Australian Soil Classification: Self-mulching Grey Sodosol or Vertic Eutrophic Grey Chromosol.

Soil Groups of Western Australia: Shallow Loamy Duplex

This unit represents the Moort soil types or grey clays (see Bimburra Soil Series in Overhue, 1996).

Landform

Grey clays are usually encountered on upper to lower slopes in areas of dissection.

Parent material

Quartz gravel is commonly evident on the soil surface, which suggest the parent material is truncated weathered granite.

Morphological description

Soil types vary from shallow duplex soils with grey to light brown subsoils to very dark grey-brown clay loam overlying brown or red clay.

Surface cracking and gilgai microrelief is commonly associated with this unit. Subsoils usually exhibit strong, medium to coarse blocky or subangular blocky structure.

Quartz gravel is also present in some soil profiles and up to 10% quartz grit may occur on the soil surface.

Minor pockets of Moort soil types were also encountered in CS/C.

The soil profile can be very acid to alkaline.
Topsoil pH: 5.0-6.5
Subsoil pH: 5.0-8.5
Note: alkaline subsoils are more common.

Land management characteristics
Topsoils are prone to hardsetting and surface crusting. Polygonal surface cracking is usually evident in the pasture phase and scalding can develop through overgrazing and water erosion.

Subsoil horizons are mildly to moderately saline.

Sheet and rill erosion can be a major problem on slopes.

Vehicle movement is a problem once the soil becomes saturated. The timing of cultivation is limited since dry topsoils are often powdery and wind erodible while the saturated subsoils will smear when worked, resulting in the development of large massive clods.

Cropping options
Cereal/medic rotation using Santiago, Jemmalong and Caliph medic varieties; peas, chickpeas and faba beans can be productive on this soil type but contour working is recommended to reduce the risk of water erosion. Lucerne can also be established within sloping areas provided the soil profile is not to acidic or prone to salinity. The upper 30 cm of the soil profile should have a pH >4.8 (in $CaCl_2$).

Perennial pastures such as Rhodes grass, tall fescue and perennial rye may be suitable on moist non saline sites while puccinellia and saltwater couch could be established in degraded or potentially saline areas.

Fig 3: The sodic soils within soil units SL/C and CS/C are prone to water erosion and scalding.

S/PYS Sand over Pale Yellow Sand

Australian Soil Classification: Basic Arenic Bleached- Orthic Tenosol.
Soil Groups of Western Australia: Pale Deep Sand.

Landform
This unit is encountered within the nature reserve bordering the Fitzgerald River. The soils are associated with very gently undulating sandplain occurring within and bordering the valley.

Parent material
Derived from reworked sandy aeolian –alluvial sediments.

Morphological description
Topsoils are greyish brown weak loamy sand overlying light grey siliceous sand. Pale yellow or very pale brown sand is encountered below 50cm and extends below 100cm.

A few ferruginous gravels may occur within the pale yellow subsoil.

S Deep Sand

Australian Soil Classification: Arenic Rudosol.
Soil Groups of Western Australia: Pale Deep Sand.

Landform
This is an area of deep pale sand occurring within a drainage line.

Parent material
Derived from reworked sandy aeolian –alluvial sediments.

Morphological description
Topsoils are greyish brown weak loamy sand overlying light grey siliceous sand that extends below 100cm. A few yellowish brown mottles indicate periodic waterlogging.

The soil reaction trend is alkaline, which may indicate the occurrence of salt.

S/GrS/C Sand over Gravelly Sand over Clay

Australian Soil Classification: Ferric-Sodic Dystrophic Yellow Chromosol.
Soil Groups of Western Australia: Gravelly Pale Deep Sand.

Landform
This unit is associated with very gently undulating sandplain. Most of this unit is uncleared.

Parent material
Soil profiles have developed from ferruginised weathered granite or ferruginised clayey colluvium.

Fig4. Channel cutting of S/GrS/C. Note: spade handle at the top of the gravel layer.

Morphological description
Topsoils are greyish brown sands overlying structureless, light grey or pale brown sand. Abundant ferruginous gravel is encountered within 60cm and sandy clay subsoils are usually present within 100cm.

The soil reaction trend is neutral. Topsoils are slightly acid while subsoils are commonly neutral.

Land management characteristics
The soil profile is moderately deep to deep with clay occurring at or below 100cm.

High wind erosion risk due to loose surface conditions and sandy texture.

Well drained to rapidly drained.

Low water-holding capacity.

Cropping options
Capable of supporting a lupin/ cereal rotation.

Subterranean clovers and lucerne would not persist, serradella or deep-rooted perennials are better options.

R Rock

This unit represents outcrops of granite rock, laterite or silcrete. No major outcrops of dolerite were found although dolerite stone and gravel was occasionally encountered in areas having red-brown topsoils (see plan).

Soil types associated with rock outcrops were highly variable. Yellow - brown sand or gravelly sand was associated with laterite and shallow red and grey duplex soils occurred adjacent to granite outcrops.

Vegetation Associations

The major soil vegetation associations, as determined from remnant vegetation, are described below.

GrS/C Shrubland or open Mallee shrubland dominated by *Eucalyptus redunca, Euc. uncinata, Acacia spp., Dryandra spp., Banksia media* and she oak *(Allocasaurina campestris)*

S/C Mallee Shrubland or open Mallee shrubland dominated by *Eucalyptus redunca, Euc. uncinata, Euc flocktonaie, Euc. eromophila, Euc. falcata, Melaleuca uncinata* and *Mel. Pentagona.*

Note: Soils with deeper topsoils >30cm contain *Euc. tetragona, Euc incrassata, Acacia spp., Dryandra* and *Hakea spp., Banksia media* and she oak *(Allocasaurina campestris)*

CS/C, LS/C Open Mallee Shrubland, species include: *Eucalyptus calycagona, Euc. flocktonaie, Euc. conglobata, Euc. uncinata, Euc. merrickiae, Melaleuca laxiflora, Mel. undulata, Mel. uncinata, Mel. pentagona, Mel cymbifolia* and *Dryandra spp..* Adjacent to drainage lines *Euc. spathulata* was also encountered.

SL/C Mallee shrubland or low woodland, predominantly moort *Euc. platypus, Euc. annulata, Euc. flocktonaie Melaleuca cymbifolia, Mel. pauperiflora, Mel. cucculata* and *Mel. Cardiophylla.*

Note: Acid soils types usually carry Euc uncinata, Euc.redunca, Euc spathulata with an understorey of Mel uncinata and Mel pentagona while alkaline soils carry *Euc flocktonaie, Euc.conglobata, Melaleuca cymbifolia, Mel. pauperiflora, Mel. cucculata, Mel. Cardiophylla.*

Fig5. Open mallee shrubland with an understorey of tea-tree.

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Glossary

Colour

Soil colour is defined in terms of hue, value and chroma using Munsell soil colour charts. Colours are classified by an alphabetical/numerical code.

e.g. 10 YR 6/8: hue (brownish yellow)
6: medium high value
8: high chroma

The classification makes it possible to distinguish slight differences in colour.

Dispersion

A property of soils whereby the soil clay becomes unstable in water and breaks down into separate particles. A common property of sodic soils.

Gleying

Soil condition indicative of permanent or periodic waterlogging and is characterised by greenish, bluish and grey colours. Gleyed horizons are represented by the suffix (g) e.g. B2g.

Massive

A soil layer that appears as a coherent or solid mass that has no structure.

Mottles

Mottles are spots, blotches or streaks of colour which can be distinguished from the main background soil colour. Mottles usually indicate periodic waterlogging in the zone of its occurrence.

Pan

An indurated and/or cemented soil horizon. The nature of the dominant cementing agent is used to identify different types of pans. The most common types are:

Silica pan	Cementing agent is amorphous silica analogous to fragipan, silcrete, red brown hardpan and duripan.
Sesquioxide pan	Cemented by iron and aluminium oxides analogous to laterite, bauxite, bog iron ore.
Iron pan	Cemented by iron oxides, analogous to ferricrete.
Carbonate pan	Cemented by calcium and magnesium carbonates analogous to travertine, calcrete.
Clay pan	Concentrations of dense clays.

Segregations	A soft to hard accumulation of minerals that have formed within the soil by the precipitation of cementing compounds. Some forms of segregation are: concretions, nodules and crystals.
Sodic soils	Soils that contain appreciable amounts of sodium within the clay fraction. High concentrations of sodium are associated with soils having poor structure and drainage.
Soil horizon	A layer of soil that is distinguished by the degree of alteration brought about by soil formation factors. Soil horizon are designated by letters e.g. A,B,C and D.
Soil units	Groupings of soils occurring in the landscape. They should: * contain soils with similar chemical and physical properties; * be sufficiently different to justify their separation at the published map scale; * meet the specified objectives of the soil survey.
Structure	The term relates to the arrangement of soil particles (soil aggregates or peds). Structured soils have soil particles orderly arranged in a recognisable shape. The forms are: crumb, granular, polyhedral, subangular blocky, blocky, platy, columnar and prismatic. The degree of development or grade of structure expresses the strength of the soil aggregates and has a bearing infiltration and the ease of root penetration. Grade of structure is recorded as follows: Structureless- no observable aggregation: massive if coherent; single grain and loose if non-coherent. Weak- poor aggregation, peds are not clearly evident in the undisturbed soil. When the soil is disturbed < 30% recognisable aggregates. Moderate-common aggregates are evident in the undisturbed soil. When the soil is disturbed 30-60% recognisable peds. Strong- peds are clearly evident in the undisturbed soil and >60% peds are evident in the disturbed soil.

	Ped or aggregate size influences potential root volume. Ped size is dependant on ped form although 3 divisions are commonly recognised. In relation to subangular blocky structure the divisions are: Fine <10mm diameter; Medium- 10-20 mm diameter; Coarse- >20mm diameter.
Texture	Soil texture is determined by the proportion of sand, silt and clay content. The descriptive terms fine, medium and coarse refer to the sand particle size, that is: coarse sand - 2mm - 0.6mm medium sand - 0.6mm - 0.2mm; and fine sand - 0.2mm - 0.02mm.

Table 1. Site Location and Soil Characteristics

Site No.	Easting	Northing	Soil type	Topsoil Texture	Topsoil Depth	Subsoil Ec 1:5 mS/m	Soil reaction trend pH	Surface condition
1	703774	6268378	S/Gr/C	GrS	100			L
2	702730	6268430	GrS/C	GrS				
3	690619	6267560	CS/C	CS	10		N	F
4	690830	6267600	SL/C	SL	7	60	A	H
5	691185	6267814	LS/C	LS	10	80	Alk	L
6	691118	6268204	CS/C	CS-SL	8		A	H
7	691058	6268630	SL/C	LSCL	10		A	H
8	691355	6268607	SL/C	SCL	8	50	Alk	H
9	691902	6268580	CS/C	CS	8	60	Alk	H
10	691964	6268393	S/C	CS-LSCL	70		N	H
11			SL/C		5			H
12	693093	6268113	SL/C	LSCL	5	160	Alk	H
13	693210	6267470	S/C	WLS	30		N	L
14	693010	6267408	SL/C	CS-SL	2	700	A	H
15	692326	6266965	S/C	S	30		N-Alk	L
16	692111	6266538	SL/C	SL	5			H
17	691753	6265997	CS/C	CS	10		A	F
18	691581	6266233	S/C	WLS	40		Alk	L
19	691369	6266394	SL/C	SL-LSCL	5		A	H
20	691928	6267106	GrS/C	WLS-SL	30		N	S
21	693334	6267497	CS/C	SL	8		A	F
22	692701	6268239	GrS/C	WLS	15		N-Alk	L
23	693636	6268573	S/C	WLS	15			L
24	693124	6268579	CS/C	CS	10		Alk	H
25	693837	6268538	S/C	S-SL	40		Alk	L
26	693992	6267954	SL/C	SL-LSCL	5		Alk	H
27	694215	6267789	LS/C	LS	10		Alk	L
28	694096	6267272	SL/C	SL	4		Alk	H
29	693948	6266905	S/C	CS	20		Alk	H
30			CS/C	CS	5			H
31	695663	6268479	S/C	WLS-S	15	32	N-Alk	L
32	695855	6268126	S/SCL	WLS-LSCL	50			L
33	695566	6267761	CS/C	LS-CS	8		Alk	H
34	695347	6267728	CS/C	CS	10		N	H
35	695216	6267124	CS/C	LS	10		N	H
36	695996	6266498	SL/C	SCL	8		Alk	H
37	695674	6266462	S/C	WLS	20			

Site No.	Easting	Northing	Soil type	Texture	Depth	Subsoil Ec1:5 mS/m	Soil reaction trend pH	Surface condition
38	695336	6266448	S/C	LS	23		Alk	L
39	695556	6266392	S/C	S	10			
40	696178	6267203	S/C	LS	50			F
41	696416	6267248	SL/C	SCL	6		Alk	H
42	696512	6267617	CS-SL/C	LSCL	5			
43	696805	6267743	CS/C	CS	8			
44	697034	6268005	GrS/C	LS	20		N	S
45			S/C	WLS	40			S
46	696852	6268510	CS/C	CS	10		N-Alk	F-S
47	696292	6268511	CS/C	CS	5		Alk	
48	696088	6268469	CS/C	CS	15		Alk	F
49	695975	6268357	SL/C	SCL	5		Alk	H
50	695548	6268025	SL/C	SL-LSCL	7	105	Alk-A	H
51	690509	6266547	S/C	S	35			L
52	690533	6266370	CS/C	CS	10	75*	A	H
53	690366	6266114	CS/C	CS	6	90*		F
54	690034	6265934	CS/C	CS	8	115*		
55	689612	6265818	S/C	LS	20	63*		L
56	689612	6265735	S/C	LS-S	25	82*	Alk	L
57	689551	6265969	S/C	LS	25		A	S
58	689037	6266427	S/C	S	20			L
59	688632	6266234	S/C	S	15	83*	N	L
60	688656	6265864	S/C	S-LSCL	40		Alk	L
61	688669	6265731	CS/C	CS	8			F
62	688681	6265524	S/C	WLS	45	75	N	L
63	688753	6265376	CS/C	CS	10			
64	688785	6265187	S/C	WLS	20	35*	N	L
65	688410	6265187	S/C	LS	10			L
66	688652	6264932	S/C	WLS	40		N	L
67	688818	6264553	S/C	WLS	25			L
68	689021	6264386	GrS/C	WLS	30		N	L
69	689299	6264106	GrS/C	WLS	20			L
70	689265	6263781	LS/C	LS	15			
71	689889	6264304	LS/C	LS-S	15			L
72	690128	6264641	S/C	WLS	40			L
73	690080	6264747	LS/C	LS	12			L
74	690101	6263960	S/C	S	20			L
75	696902	6266804	CS/C	CS	10	39*	N	H
76	697060	6267055	LS/C	WLS	20			L
77	697203	6267328	GrSL/C	SL	15		A	F
78	698232	6268510	CS/C	CS	8		N	H

Site No.	Easting	Northing	Soil type	Texture	Depth	Subsoil EC 1:5 mS/m	Soil reaction trend pH	Surface condition
79	698626	6268504	WLS/C	WLS	10			L
80	699100	6268499	LS/C	LS	10			
81	699517	6268487	LS/C	LS-WLS	10		Alk	L
82	699889	6268182	S/C	WLS	50			
83	699887	6268129	LS/C	LS	8		N	H
84	699990	6267967	WLS/R	WLS	15			L
85	699995	6267892	LS/C	LS	6			H
86	699996	6267764	LS/C	LS	6			H
87	699737	6267847	LS/C	LS	8		Alk	H
88	699658	6267967	S/C	CS	10			
89	699658	6267967	S/C	WLS	20			
90	699782	6268137	S/C	LS-CS	25			
91	699766	6268172	S/C	LS-CS	20			F
92	699727	6268231	CS/C	LKS	15			F
93	699865	6268368	LS/C	LS	15			H
94	700094	6268480	S/C	LKS	40	270		S
95	700600	6268469	CS/C	LS	8			H
96			SL/C	CS-SL	5		A	H
97	701498	6268467	LS/C	LS	12	168*	N	L
98	701551	6268654	S	S	80+		Alk	L
99	701546	6268771	S/Gr	S	50			L
100	701502	6268862	S/Gr	S	50			L
101	702336	6268444	S/C	S	25	173*	Alk	L
102	702633	6268434	S/C	S	15	170*	Alk	L
103	702798	6268428	S/Gr/C	S	40	98*	A	L
104	703040	6268433	S	S	100	23*	N	L
105	703912	6268758	S/Gr/C	LS-GrLS	30	117*	N	L
106	691418	6265790	S/C	S	60		Alk	L
107	691361	6265840	LS/C	LS	10			
108	691315	6265914	S/C	L-S	40			
109	691219	6265975	CS/C	CS	5			H
110	690871	6266155	GrS/C	LS	13		N	
111	690851	6265970	CS/C	LS	10		N	H
112	691122	6265631	CS/C	CS	10		N	H
113			CS/C	CS	8			H
114	690952	6265159	S/C	S	25			L
115	691056	6265049	CS/C	CS	6		A	H
116	690525	6265253	SL/C	SL	3	114*	Alk	H
117	690402	6265510	S/C	WLS	50	54*	Alk	H
118	690228	6265509	S/C	WLS	20			
119	690049	6265228	S/C	S	20		A	L

Site No.	Easting	Northing	Soil type	Texture	Depth	Subsoil Ec1:5 mS/m	Soil reaction trend pH	Surface condition
120			S/C	S	20			
121	688094	6268707	S/C	S	40		N	L
122	688463	6268704	S/C	LS	20		A	L
123	688852	6268691	S/C	WLS	20		A	L
124	688463	6268704	S/C	LS	20		A	L
125	689829	6268671	S/C	WLS	20		N	L
126	690590	6268655	SL/C		5		Alk	
127	693106	6268863	LS/C	WLS	5		Alk	
128	693090	6269112	LS/C	LS	8			
129	693050	6269608	LS/C	LS	20	130*	A	L
130	693025	6269982	SL/C	LSCL	5	44*	N	H
131	693004	6270392	SL/C	SL	5	167*	A	H
132	689064	6268096	LS/C	WLS-LSCL	20		N-Alk	L
133	689322	6268022	LS/C	LS	25			L
134			SL/C	CS-SL	6		Alk	H
135	689669	6267695	CS/C	LS-CS	12		N	H
136	689780	6267286	S/C	S	70		Alk	L
137	690198	6267280	CS/C	CS	6		N	H
138	690280	6267166	S/C	LS	6	172*		L
139	690417	6266891	CS/C	CS-SL	2			H
140	690417	6266891	S/C	S	25		A	L

Abbreviations

- Topsoil texture: gr, gravelly; k, coarse; s, sand; ls, loamy sand; wls, weak loamy sand cs, clayey sand; sl, sandy loam; lscl, light sandy clay loam.

- Subsoil Ec 1:5 mS/m determined soil/water extract. * determined from EM38 vertical dipole readings.

- Soil reaction trend (pH) A, acid; N, neutral; Alk, alkaline.
- Surface condition: L, loose; F, firm