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Department of Agriculture
Government of Western Australia



**Soils of the Mantinea Loop
Ord River Valley
East Kimberley
Western Australia**

*by Noel Schoknecht and
Chris Grose*



March 1996



**RESOURCE MANAGEMENT
TECHNICAL REPORT 154**



Summary

A brief assessment of the soils of 1,186 hectares in the Mantinea Loop, and their suitability for irrigated agriculture, was conducted in June 1994.

Four map units based on soil, landform and vegetation were identified.

The soils are mainly calcareous brown fine sandy loams. The landform is an alluvial plain, with numerous small depressions and channels caused by the meandering and flooding of the Ord River. These channel features are probably now relict because flooding of the lower Ord River is largely prevented by the Argyle Dam.

Most of the area (approximately 1,100 ha or 90%) is considered suitable for spray or trickle irrigation.



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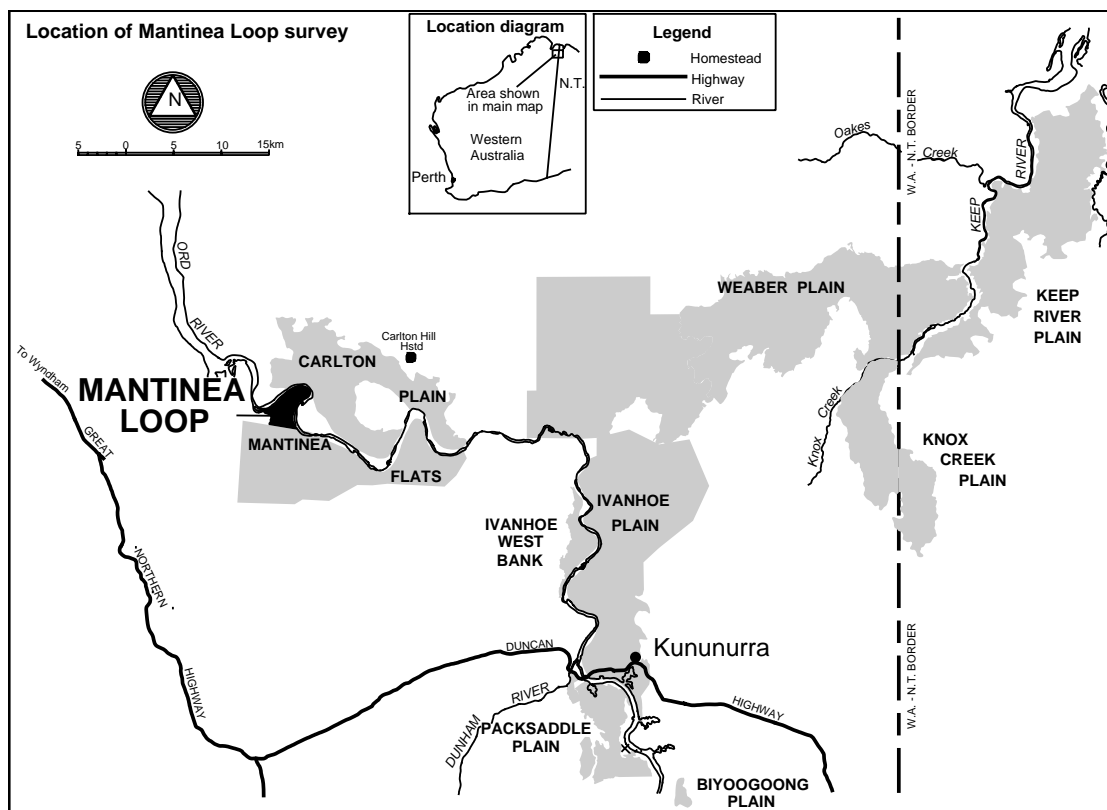
1. Introduction

In 1944 a survey team from the Lands and Surveys Department and the Department of Agriculture (now Agriculture Western Australia) spent several months investigating the soils between Wyndham and the Western Australian-Northern Territory border. Their soil surveys covered two areas in the lower Ord Valley — the Carlton Reach Plain and the Mantinea Flats-Goose Hill area. The results of these surveys are available as part of this agency's Technical Bulletin series (Burvill 1991) and are recommended background reading for those wishing to gain a wider perspective of the area.

During the survey of Mantinea Flats an extensive area of alluvial soils within a meander loop of the Ord River was omitted from the survey. Today, these soils are considered to be some of the most fertile in the area and a request was made by the Ord Stage 2 Steering Committee to fill this gap. This account summarises the findings of a two-day reconnaissance of the area, named for the purposes of this survey as Mantinea Loop.

The Mantinea Loop is on Ivanhoe Station, south of the Ord River and some 40 km from Wyndham. It includes a meander loop north of the area surveyed by Burvill in 1944, north-east of Goose Hill and west of House Roof Hill.

The area can be accessed by four-wheel drive track from either Wyndham or Kununurra. The study area itself lies within the Noogoora Burr Quarantine area and authorisation from Agriculture Western Australia in Kununurra is needed.



The Mantinea Loop in relation to other potential irrigation areas near the Ord River.



2. History of land use

This area was first settled by Europeans in the 1880s. Mantinea Loop is presently within Ivanhoe Station and is used for grazing of cattle (Brahman, Shorthorn and Brahman-Shorthorn cross) on native grasslands and woodlands.

3. Climate

The area is semi-arid with summer monsoonal rains. Average annual rainfall for Kununurra is 778 mm, most of which falls in the four months December to March, with a virtual drought for the rest of the year. The mean maximum temperatures range from 30.5°C in July to 38.8°C in November and mean minima range from 14.2°C in July to 24.8°C in December. The area is virtually frost-free (Delane 1987).

Cattle near a watering point on the Mantinea Flats. House Roof Hill, near Carlton Hill Homestead on the north side of the Ord River, is visible in the distance.



4. Geology and physiography

The Martinea Loop forms only a small part of a much larger geomorphic system. In this area the Ord River flows in a broad flood plain, up to 8 km wide, flanked by rocky hills and outcrops. The plain merges gradually with the tidal flats of the Cambridge Gulf. The river remains tidal to a point several kilometres east of the study site and Burvill suggested that some of the soils may have developed from deltaic and tidal marsh deposits. This may account for the saline nature of some clay subsoils.

For the most part, the flats are essentially alluvial in origin and the mature Ord River now meanders in a well defined channel across the plain. Old meander loops, levee banks and point-bar deposits are common throughout the area and flood channels and outwash fans from minor creeks flowing off the surrounding hills during periods of rain, are an obvious feature of aerial photographs.

The study site occupies a prominent meander loop west of House Roof Hill and shows ample evidence of the mobile nature of the river course and the erosive impact of flood events that occurred before construction of the Argyle Dam and its subsequent controlling influence on peak flows.

Within the study site there is a microrelief of long, linear or crescent-shaped and often discontinuous depressions 20 to 70 m apart which can reach 2 m deep. Some of these channels have developed where flood waters from the Ord River have broken over its banks. Some may be partially filled meander remnants, while others appear to be erosion channels created by run-off returning to the river. Such irregularities are likely to have significant impact on the suitability of the area for irrigation.

5. Native vegetation

The vegetation of the study site comprises savanna woodland with varying densities of tree cover. Within the old flood channels *Eucalyptus microtheca* (flooded box) is dominant, with the introduced species *Cenchrus setiger* (Birdwood grass) dominating the grasses. Elsewhere the woodland is more open and varied in character, frequently no more than open grassland with scattered trees. Here *Gyrocarpus americanus* (helicopter tree, shitwood), *Eucalyptus papuana* (ghost gum), *Ficus opposita* (sandpaper fig) and *Adansonia gregorii* (boab) are common. Grass species include *Cenchrus setiger* and *Sporobolus australasicus* (Australian dropseed).

In some areas a number trees appeared to be dying. This is believed to be an indirect result of the damming of the Ord River which now controls peak flows and has reduced the frequency of flooding. As a result, the annual replenishment of water to these areas, which are naturally very permeable and well drained, has been significantly reduced and there is now insufficient water to meet the trees' requirements.



Kori bustards are common in the study area, foraging among the introduced Birdwood grass.



6. Survey methods

This reconnaissance survey of Mantinea Loop was conducted during a two-day visit in June 1994. During this time 15 soil observations were made using an Edison Drill Rig to collect soil cores to a depth of up to 150 cm. Each core has been described according to accepted methodology as defined in McDonald *et al.* (1990). Samples were collected from each horizon identified and field tests undertaken on 1:5 soil:water mix to determine pH and salt content.

Aerial photographs at 1:25,000 scale were used for navigation and mapping purposes. The final map has been digitised directly from these photographs.



7. Map units

The four map units delineated are all subdivisions of the Group A soils map unit described by Burvill in 1944 (Burvill 1991). With the exception of unit A4, they are all brown alluvial soils. There appears to be little correlation between variants of the principal soil type and the map units, and differences between units are based on the relative degree of irregularity in surface topography and vegetation cover. Unit A4 has different soils, topography and vegetation.

A1 Flat to gently undulating plain with numerous small depressions and ridges

This unit comprises most of the Mantinea Loop. It includes areas of treeless plain and open grassland with scattered trees. Numerous discontinuous depressions and ridges with occasional more even or undulating areas are characteristic of the area. General relief is about 1 m although some depressions may be up to 2 m deep and 10 to 50 m apart. Main tree species include *Eucalyptus papuana* (ghost gum), *Adansonia gregorii* (boab) and *Gyrocarpus americanus* (helicopter tree).

A2 Undulating plain with numerous distinct ridges, channels and depressions

This consists of old flood channels lying up to 2 m below the general area but with distinct discontinuous ridges. During the wet season water is likely to lie in many depressions. The unit represents former flood channels created by the regular seasonal over-bank flow from the Ord. Following construction of the dam it is unlikely that these channels now operate except under exceptional circumstances. The areas generally maintain a *Eucalyptus microtheca* (flooded box) woodland.

A3 Undulating plain with numerous crescent-shaped channels and ridges

In the north of Mantinea Loop is a small area of distinct crescent-shaped channels up to 2 m deep and 50 m wide separated by level or undulating narrow ridges. It is very similar to unit A2 but has probably developed as a result of the extension of the point-bar deposits rather than as a flood channel. These features are probably now largely relict.

A4 Current floodplain terraces and recent point-bar deposits

Sandy point-bar deposits occur at the extreme north of Mantinea Loop with minor terrace elements which are likely to be inundated during very high tides or minor flood events. The terraces have high groundwater levels and silty to clayey textured soils.

8. Soils

Burvill (1991) described the soils adjacent to the study site as Group A soils - brown soils of light texture, on alluvial deposits adjoining the Ord. He stated that while they had all developed in recent light textured alluvium, considerable variation occurred within a given range. Results of the current investigation confirm that several soil types could be identified, but to map them individually would require a very detailed survey.

The principal soil type identified has a dark brown fine sandy loam surface over a similar coloured loamy fine sand subsoil. EC values (Table 1) are consistently low and pH (except for some surface layers which recorded 7.8) range from 8.2 to 8.7. Fine mica flakes occur throughout the profile and provide evidence of the relatively youthful nature of these soils. A weak pedality is often evident within the A horizon but this rarely extends to any great depth.

The profiles typically show A/C or A/AC/C horizonation and are classified as such. Variations include silt loam or loam surfaces, loam, silt loam or clay loam horizons within the profile representing buried A horizons, deep fine sandy loam profiles and medium to coarse sandy lenses. Occasional profiles showed evidence of sediment stratification. This variability is typical of alluvial deposits in floodplain systems. Given the relative coarseness and the friability of the soils, drainage difficulties are not anticipated.

Typical soil profile in map unit A1

Horizon	Depth (cm)	Description
A1	0-5	Dark brown (7.5YR 3/4) fine sandy loam, weak subangular blocky structure, weak (2D), moderately calcareous, pH 8.4, clear boundary.
AC	5-25	Brown (7.5YR 4/4) silty loam, apedal and massive, firm (3D), moderately calcareous, pH 8.7, diffuse boundary.
C	25-150+	Brown (7.5YR 4/4) fine sandy loam, apedal and massive, soft (2D), moderately calcareous, pH 8.6.

Australian Soil Classification: Calcareous Stratic Rudosol
(Isbell 1995)

Table 1. EC and pH readings (1:5 soil:water) for soils at Mantinea Loop.

Depth				5 cm		25 cm		75 cm		140 cm	
Site	Map unit	Easting	Northing	EC	pH	EC	pH	EC	pH	EC	pH
M1	A1	437907	8279120	9	8.0	6	8.3	12	8.5	-	-
M2	A1	436442	8279661	20	7.5	2	8.2	4	8.3	9	8.0
M3	A2	435987	8280189	3	8.0	4	8.3	6	8.6	8	8.6
M4	A1	436331	8281371	6	8.2	2	8.4	1	8.6	3	8.6
M5	A1	436607	8282114	3	7.8	2	8.2	-	-	2	8.6
M6	A1	436908	8282914	3	8.3	6	8.6	3	8.4	7	8.5
M7	A3	437881	8283755	8	8.0	2	8.5	3	8.6	-	-
M8	A3	437088	8284102	3	8.0	3	8.4	3	8.6	-	-
M9	A1	435982	8283378	5	8.4	10	8.7	8	8.6	-	-
M10	A1	435186	8282771	4	8.3	6	8.7	-	-	8	8.5
M11	A1	434261	8281857	5	8.6	-	-	9	8.4	12	8.4
M12	A1	439742	8281306	8	8.3	-	-	9	8.6	5	8.6
M13	A2	435001	8280847	5	8.4	-	-	9	8.6	10	8.6
M14	A1	435441	8280696	6	8.2	-	-	5	8.5	6	8.3
M15	A2	435613	8280268	9	8.2	6	8.4	11	8.4	11	8.4

Note: Electrical conductivity (EC) was calculated in mS/m. Sample depths are only approximate.

No observations were made on the occasional fragments of more recent terraces but the soils are likely to include coarse sandy point-bar deposits (at the northern end of Mantinea Loop) and finer textured silts and clays. Being only slightly above current river levels, these areas are likely to have high groundwater levels and be subject to frequent seasonal inundation.

9. Suitability for irrigated agriculture

Agronomically, the alluvial brown soils of Mantinea Loop appear very attractive for agriculture. The light texture provides a good rooting medium and nutrient retention ability is likely to be adequate. The well drained nature of the profiles suggests that a build-up of groundwater following irrigation is unlikely to be a problem but further investigations may be necessary on this aspect (i.e. deep bores to determine the nature of underlying sediments).

Burvill, however, suggested that Mantinea Loop and adjacent areas may be of limited use for irrigated agriculture due to the very irregular surface topography. Current investigations confirm that microrelief would cause considerable difficulties for farm and irrigation layout and cultivation. Should levelling be required, then considerable disturbance of the soil profile would occur, but given the current lack of development of these profiles, this is unlikely to cause any serious damage.

Other problems concern the method of irrigation. The permeability of the light textured soils suggests that flood irrigation systems may be inappropriate for this area. Also, variable topsoil textures over relatively short distances may create problems with variable infiltration rates. If channels are used to transport water, lining would be required to prevent seepage losses. The use of trickle or spray irrigation systems and pipes to carry water would largely overcome these concerns.

All samples taken for salinity tests revealed very low levels of soluble salts and salinity is not considered a risk in this area.

Table 2. Areas of map units, and suitability for trickle or spray irrigation.

Map unit	Area (ha)	Suitability for trickle or spray irrigation
A1	729	Suitable
A2	201	Suitable
A3	177	Suitable
A4	79	Unsuitable
TOTAL	1,186	



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Appendix

EC values and textures of deep drilling samples, Mantinea Loop

DOME sample number ORD94 & AMG	Depth (m)	EC (1:5) mS/m @ 25°C	Field texture	DOME sample number ORD94 & AMG	Depth (m)	EC (1:5) mS/m @ 25°C	Field texture
23 434200mE 8275375mN	0-3	302	LMC	25 441120mE 8277100mM	0-3	165	LMC
	3-6	292	MC		3-6	170	LMC
	6-9	227	MC		6-9	117	LMC
	15-18	85	SCL		9-12	112	LMC(s)
24 438027mE 8276574mN	0-3	55	LMC	26 449820mE 8276390mN	0-3	18	LC
	3-6	167	LMC		3-6	33	LMC
	6-9	28	KS		6-7.5	40	LMC(ks)
	9-12	23	KS				
	12-15	47	WLKS				
15-18	43	WLKS					

Textures

KS	Loamy sand	LC	Light clay
LKS	Loamy coarse sand	SC	Sandy clay
CS	Clayey sand	LMC	Light medium clay
S	Sand	MC	Medium clay
SCL	Sandy clay loam	MHC	Medium heavy clay
WLKS	Weak loamy coarse sand		
(ks)	coarse sandy		
(s)	sandy		



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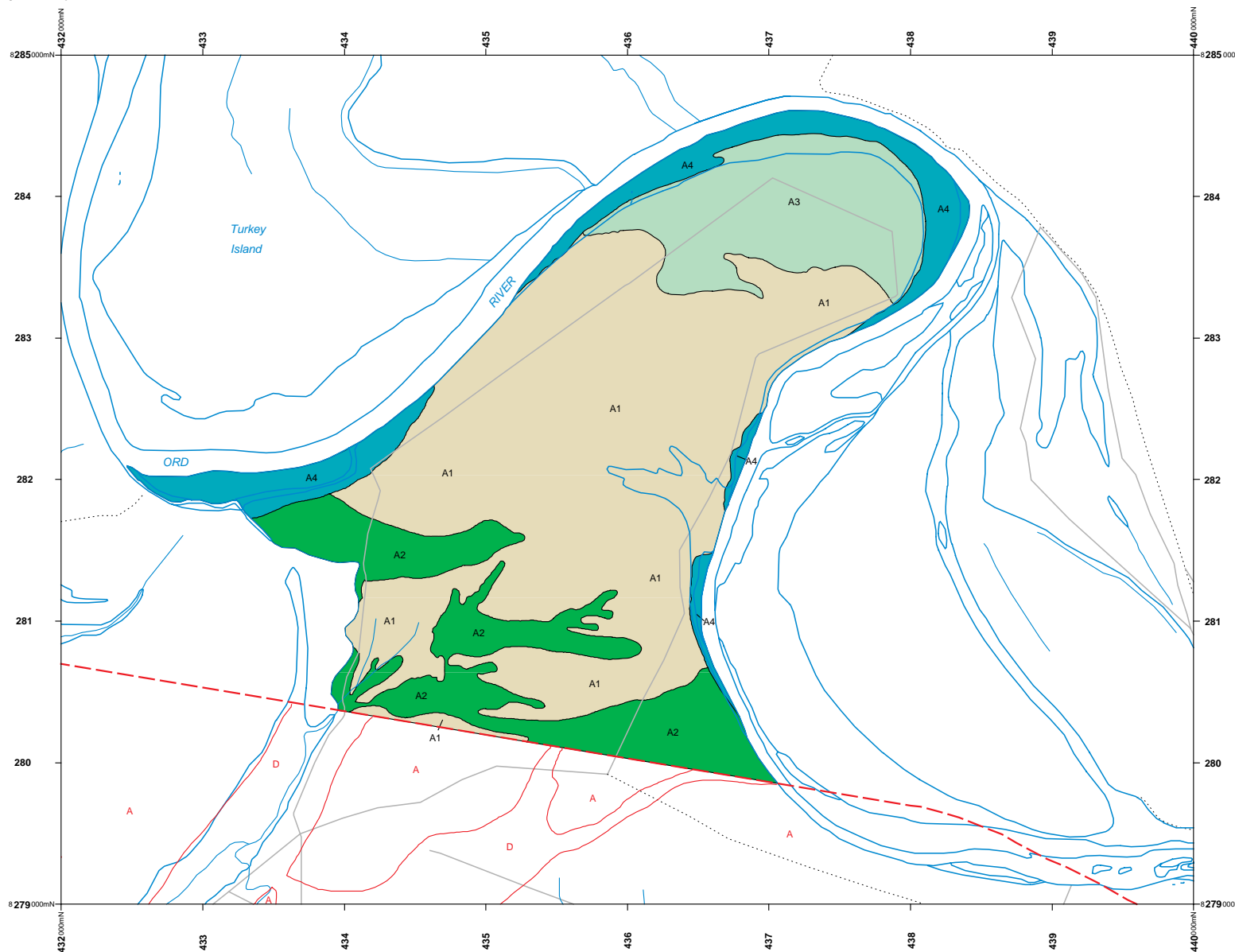
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SOILS OF THE MANTINEA LOOP WESTERN AUSTRALIA

Noel Schoknecht and Chris Grose
Agriculture Western Australia



Legend

Map unit names have been selected to match with the adjacent soil survey of the Mantinea Flats-Goose Hill area (Burvill 1991). All map units would also fit within unit 7 of the common map key for the Ord Irrigation Area (Aldrick et al. 1990)

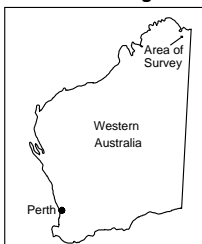
- A1** Flat to gently undulating plain with numerous small depressions and ridges. Brown fine sandy loam alluvial soils.
- A2** Undulating plain with numerous distinct ridges, channels and depressions. (Former flood channels of the Ord River, now relict). Brown fine sandy loam alluvial soils.
- A3** Undulating plain with numerous crescent shaped channels and ridges. (Point bar deposits of the migrating Ord River, now largely relict). Brown fine sandy loam alluvial soils.
- A4** Current flood plain terraces and recent point bar deposits (seasonally inundated). Variable soils including sands, silts and clays.

Map units of the Mantinea Flats-Goose Hill survey (Burvill 1991).

- A Brown soils variable generally light texture
- D Swamps and billabongs, well defined, low lying unsuitable for reclamation.

- Soil mapping unit boundary
- - - Soil mapping unit boundary (indistinct)
- Vehicular track
- Fence
- River/stream
- Soil mapping unit boundary (Burvill)
- - - Boundary of Mantinea Flats-Goose Hill Survey (Burvill 1991)

Location diagram



Bibliographic reference

Schoknecht, N. and Grose, C. "Soils of the Mantinea Loop Western Australia" (Scale 1:25,000) Land Resource Map No. 27. To accompany technical report.

Acknowledgements

Soil survey by N. Schoknecht and C. Grose, Natural Resources Assessment Group, Agriculture Western Australia. Digital topographic base supplied by the Department of Land Administration. Map prepared by P.M. Goulding, Agriculture Western Australia.

Reference

Projection: Universal Transverse Mercator
Grid: AMG zone 52
Source data: Field survey and interpretation of aerial photography.
Aerial photography: WA 3243 (C), 1:20,000, Jul. 1993

Use of map

This map is designed for use at the published scale. Technical queries should be directed to Natural Resources Assessment Group, Agriculture Western Australia

Areal scale



40 ha in units of 5 ha



Scale 1:25,000

