

BUB Bugga Bugga Land System

Rises and plateau areas, with drainage depressions and a few lagoonal depressions. The major part of this system consists of the catchment of Bugga Bugga Creek. Also included is a narrow ridge to the west of this catchment area. To the east and north-east of this system are coastal slopes and gullies. To the north are plateau areas which are predominantly 'gilgaied' (an intricate pattern of flats, mounds, and crabholes) with cracking clay soils. To the south are low-lying plains with saline lagoonal depressions.

Area: 73.8 km²

Annual rainfall: 500 – 565 mm average

Geology: The majority of the system is underlain by early Cambrian age (Kanmantoo Group) Tapanappa Formation meta-sandstone, which has only minor areas of near surface to surface expression. This rock is mostly covered with Pliocene-Quaternary age colluvium. This colluvium consists of clayey sediments, often overlain by ironstone gravel. The clay is derived from the weathered Kanmantoo Group rock. A few remnants of Pliocene age regolith remain as highs in the landscape. On these areas are found very thick sands with ironstone gravel over clayey sediments. Where the sand and ironstone have been stripped off such remnant areas, cracking clay soils occur. Many clayey subsoils throughout this system show evidence of cracking tendencies.

A small area of Permo-Carboniferous age clayey glacial deposits occurs in the west of the system, where rocks transported and deposited by glacial ice can presumably be found. Deposits of recent alluvium occur in drainage depressions and lagoonal depressions. The two lagoonal depressions in the extreme west of the system, one of which is known as Dead Horse Lagoon, consist of Pleistocene age lacustrine clayey sediments. Minor recent deposits of wind-blown sand occur, which have been derived from adjacent topsoils.

Topography: Mostly undulating rises, with gently undulating rises, and with gently undulating plain areas (or plateau surfaces in the north-east). There are a few lagoonal depressions. Slopes are mostly 1-8%, with a few slopes reaching 13%. The saline drainage depression of Bugga Bugga Creek drains the major part of this area, flowing south-west into Salt Lagoon. A narrow ridge extends as a western arm of this system.

Elevation: Elevation varies from about 20 m in the lower reaches of Bugga Bugga Creek, to 117 m on a rise on the plateau area in the very north-east of the system.

Relief: Typically 10 – 20 m. It can be less than 10 m or up to 30 m

Main Soils:

J2-J1	Ironstone soil
F2a-J1a	Cracking texture contrast soil
F2b-G4-N2	Texture contrast soil

Minor Soils:

K4-D7	Stony texture contrast soil
I1-H3	Deep sands
E3	Cracking clay

Main Features: This system is mostly arable. Topsoils are mostly sandy loams; while significant areas of loamy sands also occur. The rocks and subsoil clays of the major part of this system have abundant stored salts, as evidenced by the saline drainage depression of Bugga Bugga Creek and its tributaries, and the raised salinity levels of many subsoils (especially on lower slopes). Low permeability sodic clay subsoils restrict drainage and increase runoff. Ironstone gravel reduces the fertility of many soils. Many soils have fine carbonate in their



lower subsoils. Cracking clay subsoils occur, as do a few areas with cracking clay soils, and such soils provide unstable support for structures.

Soil Landscape Unit summary: Bugga Bugga Land System (BUB)

SLU	% of area	Main features #
DVA DVB DVC DVD DVE	0.4 1.3 0.3 0.1 0.2	<p>Arable to semi-arable slopes, plains and depressions with mostly soils forming on weathering rock.</p> <p>Main soils: <u>stony texture contrast soil</u> – medium thickness sandy loam, often with bleached sub-surface layer, and often with some ferruginized rock and/or quartz fragments and/or ironstone gravel; over sodic to non-sodic olive-brown or yellow-brown clay; on weathering rock; sometimes to occasionally there is fine carbonate in lower subsoil K4-D7 (<i>stony Brown Sodosol-Chromosol</i>). With 10-40% <u>ironstone soil</u> and <u>texture contrast soil</u> – sandy loam, often with a bleached sub-surface layer, and often with ironstone gravel; over sodic clay, sometimes with cracking tendencies but with no evidence of gilgai relief, and often with fine carbonate in lower subsoil: J1-J2 and F2b (<i>Ferric Brown Sodosol</i> and <i>Brown Sodosol</i>).</p> <p>DVA – gently undulating plains/plateau. DVB – slopes (1.5-3%, 2e) DVC – slopes (3-8%, 3-2e) DVD – slopes (10-15%, 4e) DVE – depression.</p> <p>Summary: the main issues are water erosion risk on sloping land and stoniness; while waterlogging can be a problem in some areas.</p>
FBB FBC FBK FBL FBM FBO FBZ	1.7 1.5 6.0 3.3 0.2 0.5 2.0	<p>Arable slopes, plateau surfaces and depressions, with mostly medium thickness loamy soil; and with some patches of gilgai relief.</p> <p>Main soils: <u>ironstone soil</u> – sandy loam with some sandy, usually with a bleached sub-surface layer, and usually with ironstone gravel; over sodic clay, which often has cracking tendencies but no evidence of actual gilgai relief; often with fine carbonate in lower subsoil J2-J1 (<i>Ferric Brown Sodosol</i>). With 10-40% of area with slight gilgai mounds and <u>cracking texture contrast soil</u> – thin to medium thickness sandy loam to loam, sometimes with a bleached sub-surface layer, and sometimes with ironstone gravel; over olive or olive-brown clay with cracking tendencies, and with fine carbonate in the lower subsoil or subsoil F2a-J1a (<i>Vertic Brown Sodosol</i> with <i>Vertic Ferric Brown Sodosol</i>). With 0-10% cracking clay soils E3 (<i>Brown Vertosol</i>). With 0-5% soil forming over weathering rock (K4-D7).</p> <p>FBB – slopes (1.5-3.5%, 2e) FBC – slopes (3.5-7%, 3e) FBK – gently undulating to level plain/plateau, with <10% saline seepage (2-3s) FBL – slopes with <10% saline seepage (1.5-3.5%, 2e, 2-3s) FBM – slopes with <10% saline seepage (3.5-7%, 3e, 2-3s) FBO – depression (colluvial deposits) with <10% saline seepage (2-3s) FBZ – gently undulating plateau/summit surface.</p> <p>Summary: fertility is reduced due to phosphorous fixation where ironstone gravel occurs, subsoils are sodic and often cracking, some water erosion risk occurs on sloping land, some raised subsoil salinity levels occur, and some wind erosion risk and water repellence occurs with sandy soils.</p>
FCK FCO	2.1 0.5	<p>Arable to semi-arable depressions, plains and plateaux mostly exhibiting slight gilgai relief (mounds/flats and 10-20% crabhole depressions).</p> <p>Main soils: <u>cracking texture contrast soil</u> – thin to medium, thickness sandy loam to loam, sometimes with a bleached sub-surface layer, and sometimes with ironstone gravel; over olive or olive-brown cracking clay, with fine carbonate in the lower subsoil or subsoil F2a-J1a (<i>Vertic Brown Sodosol</i> with <i>Vertic Ferric Brown Sodosol</i>). With 10-40% <u>cracking clay soil</u> with fine carbonate in the subsoil or lower subsoil E3 (<i>Epipedal Brown Vertosol</i>).</p> <p>FCK - gently undulating plain/plateau with <10% saline seepage (2-3s) FCO - depression with <10% saline seepage (2-3s)</p> <p>Summary: the main issues are waterlogging, subsoil physical condition, and reduced fertility in soils with ironstone gravel due to the fixation of phosphorous; other issues include raised salinity levels in some subsoils, and some wind erosion risk and water repellence occurs with sandy soils; while surface soil management can be difficult on cracking clay soils. Also, structures built in areas where clayey subsoils expand and contract need foundations which are designed to cope with such conditions or else structural damage can result.</p>
FFA	3.2	Mostly arable slopes, plains, plateau/summit surface and drainage depression with



FFB	3.0	medium thickness, and some thick, sandy loam soils.	
FFC	5.6	<p>Main soils: <u>ironstone soil</u> – medium thickness, with thick, sandy loam (with some sandy and some loams), with a usually bleached sandy to loamy sub-surface layer, and usually including ironstone gravel; over usually sodic olive-brown, yellow-brown, or olive clay; often with fine carbonate, or even carbonate rubble in the lower subsoil J2-J1 (<i>Ferric Brown Sodosol-Chromosol</i>). 0-5% of area has cracking (vertic) subsoil clays (F2a-J1a). 0-5% of area has weathering rock within 1m of the surface (K4-D7).</p> <p>FFA – gently undulating plain (1-2e, 1-2g) FFB – slopes (1.5-3.5%, 2e) FFC – slopes (3.5-8%, 3-2e) FFK – gently undulating plains with <10% saline seepage (2-3s) FFL – slopes with <10% saline seepage (slopes 1.5-3.5%, 2e, 2-3s) FFM – slopes with <10% saline seepage (slopes 3.5-12%, 3e, 2-3s) FFT – drainage depression with 10-50% saline seepage (4-3*s) FFZ – gently undulating and level plateau/summit surfaces.</p> <p>Summary: fertility (phosphorous fixation) and waterholding capacity are reduced by ironstone gravel, waterlogging and saline seepage are a major issue in the drainage depression, water erosion is a risk on sloping land, some wind erosion risk and water repellence occurs with sandy topsoils, raised subsoil salinity levels occur, and many subsoils are sodic.</p>	
FFK	6.9		
FFL	11.4		
FFM	0.6		
FFT	0.2		
FFZ	10.0		
FGA	1.6		<p>Mostly arable slopes, plains and summit/plateau surfaces, with medium thickness, and some thick, sandy and some loamy soils.</p> <p>Main soils: <u>ironstone soil</u> – medium thickness, with some thick, sandy to sandy loam topsoil, usually with a bleached sandy or sandy loam sub-surface layer, and usually with ironstone gravel; over usually sodic yellow-brown, olive-brown or red-brown clay; sometimes with fine carbonate in the lower subsoil J2-J1 (<i>Ferric Brown-Red Sodosol-Chromosol</i>). With 0-5% <u>deep sands</u> – moderate to deep bleached sands, over clay I1-H3 (<i>Podosol-Tenosol</i>).</p> <p>FGA – level to gently undulating plains. FGB – slopes (1.5-3.5%, 2e) FGC – slopes (3.5-8%, 3-2e, 2-1g) FGL – slopes with <10% saline seepage (slopes 1.5-4%, 2-3e, 2-3s) FGM – slopes with <10% saline seepage (slopes 3.5-8%, 3-2e, 2-1g, 2-3s) FGZ – gently undulating plateau/summit surfaces (1-2e)</p> <p>Summary: fertility (phosphorous fixation) and water holding capacity are reduced by ironstone gravel, water erosion is a risk on sloping land, some wind erosion risk and water repellence occurs with sandy topsoils, raised subsoil salinity levels occur in places, and many subsoils are sodic.</p>
FGB	3.2		
FGC	3.3		
FGL	2.8		
FGM	0.4		
FGZ	2.6		
FJB	0.6	<p>Arable with semi-arable slopes and plateau/summit surfaces, with medium thickness, and some thick, loamy soil; and with some soils forming over weathering rock.</p> <p>Main soils: <u>ironstone soil</u> – medium thickness, with thick, sandy loam (with some loamy sand and some loam), with a usually bleached sandy to loamy soil sub-surface layer, and usually including ironstone gravel; over usually sodic olive-brown, yellow-brown or olive clay; often with fine carbonate, or even carbonate rubble in the lower subsoil J2-J1 (<i>Ferric Brown Sodosol-Chromosol</i>). With 10-40% <u>stony texture contrast soil</u> – medium thickness, sandy loam (with some sandy and some loams), often with a bleached sub-surface layer, and often with some ferruginized rock and/or quartz fragments and/or ironstone gravel; over sodic to non-sodic olive-brown or yellow-brown clay; over weathering rock; sometimes with fine carbonate in lower subsoil K4-D7 (<i>stony Brown Sodosol-Chromosol</i>). With drainage depressions with <u>texture contrast soil</u> – sandy topsoil over olive sodic clay G4 (<i>Grey Sodosol</i>). With 0-5% red-brown earth over rock, on small spurs jutting into gullies in 'FJM' land units D2 (<i>Calcic Red Chromosol</i>).</p> <p>FJB – slopes (1.5-3.5%, 2e) FJC – slopes (3.5-8%, 3e) FJL – slopes with <10% saline seepage (1.5-3.5%, 2e, 2-3s) FJM – slopes with <10% saline seepage (3.5-12%, 3e, 2-3s). The area adjacent to the MacGillivray Plains (MGP) Land System includes significant drainage depressions with marginal salinity (4s). FJZ – gently undulating plateau/summit surfaces.</p> <p>Summary: fertility (phosphorous fixation) and water holding capacity are reduced where ironstone gravel occurs, raised subsoil salinity levels occur in places, water erosion is a risk on sloping land, some wind erosion risk and water repellence occurs with sandy soils, many subsoils are sodic, and some stoniness occurs.</p>	
FJC	0.1		
FJL	2.4		
FJM	3.6		
FJZ	2.9		
OZK	0.8	Semi-arable to non-arable siliceous sand deposits.	



OZD OZg OZR	0.7 0.5 0.3	<p>Main soils: <u>deep sands</u> – deep to moderate depth bleached sand with iron and organic compound accumulations in the sandy subsoil; usually underlain by a clayey substrate 11-H3 (<i>Podosol-Tenosol</i>).</p> <p>OZK – sand spread on slopes of up to 5%.</p> <p>OZD – low dunes, mostly linear (<5m)</p> <p>OZg – sand spreads on rises and slopes (slopes around 10%)</p> <p>OZR – sand spread on slopes up to 5%; 5-10% saline seepage in depression area (2^os-2⁺s).</p> <p>Summary: these sandy soils are infertile, hold relatively little moisture, and are subject to the risk of wind erosion.</p>
PkA PkB PkC PkK PkL PkO PkU PkZ	0.2 1.9 0.2 0.8 1.4 2.0 0.2 0.5	<p>Mostly arable slopes, plains, summit surfaces, depressions and drainage depressions with medium thickness, and some thick, loamy to sandy soils.</p> <p>Main soils: <u>texture contrast soil</u> – medium thickness, with some thick, sandy loam, light loamy or loamy sand, usually with a bleached sub-surface layer of loamy sands or clayey sand, and sometimes including ironstone gravel; over olive-brown, olive or yellow-brown sodic clay; often with fine carbonate in the lower subsoil, and sometimes with some carbonate rubble F2b-G4 (<i>Brown Sodosol</i>).</p> <p>PkA – gently undulating plains</p> <p>PkB – slopes (1.5-3.5%, 2e)</p> <p>PkC – slopes (3.5-6%, 3-2e)</p> <p>PkK – gently undulating plains with <10% saline seepage (2-3s)</p> <p>PkL – slopes (1.5-3.5%, 2-1e) with <10% saline seepage (2-3s)</p> <p>PkO – depression with <10% saline seepage (2-3s)</p> <p>PkU – drainage depression with marginal salinity (4-3s)</p> <p>PkZ – gently undulating summit surfaces.</p> <p>Summary: waterlogging is significant in many areas and is associated with sodic subsoils, significant saline seepage occurs in the drainage depression where flooding is also a risk, raised subsoil salinity levels occur, and there is some wind erosion risk and water repellence with the lighter textured topsoils.</p>
TGK TGZ	0.7 0.1	<p>Arable to semi-arable plains and plateaux exhibiting gilgai and slight gilgai relief (mounds/flats and 20% crabhole depressions).</p> <p>Main soils: <u>cracking clay</u> soil with subsoil or lower subsoil fine carbonate E3 (<i>Epipedal Brown Vertosol</i>). With 10-40% <u>cracking texture contrast soil</u> – thin to medium thickness sandy loam to loam, sometimes with a bleached sub-surface layer, and sometimes with ironstone gravel; over olive or olive-brown cracking clay subsoil, with fine carbonate in the lower subsoil or subsoil F2a-J1a (<i>Vertic Brown Sodosol</i> and <i>Vertic Ferric Brown Sodosol</i>).</p> <p>TGK – level to gently undulating plain/plateau with <10% saline seepage (2-3s)</p> <p>TGZ – level plain/plateau.</p> <p>Summary: the main issues are subsoil physical condition and problems with surface soil management on cracking clay soils. Some areas have raised subsoil salinity levels. Also, physical structures built in such areas need foundations which are designed to cope with the expansion and contraction of the clayey subsoils or else structural damage can result.</p>
ZA-	4.1	<p>Non-arable saline drainage depressions. Bugga Bugga Creek and its tributaries, and including the saline head of one gully which flows eastward into sea. These areas are a combination of bare saline patches, saline areas with samphire and melaleucas, and marginally saline areas with salt/waterlogging tolerant grasses.</p> <p>Main soils: medium to thick sandy loam, light loam or loamy sand, usually with a bleached sub-surface layer of loamy sand or sand, and sometimes with ironstone nodules; over grey or olive sodic clay; sometimes with fine carbonate in the lower subsoil; often with rock within 1m of the surface F2b-G4-N2-D7 (<i>Grey Sodosol-Hydrosol</i>).</p> <p>ZA- – saline drainage depressions (5s)</p> <p>Summary: saline watercourse.</p>
ZP- ZQ-	0.5 0.9	<p>Non-arable lagoonal depressions. Lagoons usually have a water table perched on top of tight clayey subsoil.</p> <p>Main soils: medium to thick loamy to sandy soil, often with a bleached sub-surface layer; over grey or olive sodic clay; probably fine carbonate in lower subsoil of some soils, especially those in saline to marginally saline lagoons N2 (<i>Grey Hydrosol</i>).</p> <p>ZP- – lagoons with no obvious salinity (1-2s). The main part of lagoon is covered by waterlogging tolerant grasses; while lagoon edge has bottle brush, melaleucas and cup gums. These areas are ringed by a strip of rock outcrop.</p> <p>ZQ- – saline to marginally saline lagoons (5-4s). Lagoon area is covered by melaleucas, reeds and/or grasses, and is often ringed by eucalypts.</p> <p>Summary: saline lagoons, and lagoons with no obvious salinity; subject to seasonal inundation.</p>



Classes in the 'Soil Landscape Unit summary' table (eg. 2-1e, 3w, 2y, etc) describe the predominant soil and land conditions, and their range, found in Soil Landscape Units. The number '1' reflects minimal limitation, while increasing numbers reflect increasing limitation. Letters correspond to the type of attribute:

a - wind erosion	e - water erosion	f - flooding	g - gullyng
r - surface rockiness	s - salinity	w - waterlogging	y - exposure

Detailed soil profile descriptions:

Main Soils:

- J2-J1** Ironstone soil (*Ferric Brown-Red Sodosol-Chromosol*). Medium thickness to thick loamy sand, sandy loam or light loam, with a sub-surface layer of sand to loamy sand which is usually bleached, and includes ironstone gravel; over yellow-brown, olive-brown, red-brown, or olive usually sodic clay, usually with red and olive mottles. Often there is fine carbonate in the lower subsoil, and occasionally calcrete or calcrete fragments. Found on slopes, flats and crests.
- F2a-J1a** Cracking texture contrast soil (*Vertic Brown-Grey Sodosol*). Medium thickness to thin light sandy loam to loam, usually with a bleached loamy sand to sandy loam sub-surface layer, and sometimes with ironstone gravel; over olive-brown, olive or grey cracking and sodic clay, usually with some dull mottles, and with fine carbonate in the subsoil or lower subsoil. Found on slopes, flats, mounds and crabholes in the areas of gilgai relief. Areas with these soils usually have a slight gilgai or 'mounded' look.
- F2b-G4-N2** Texture contrast soil (*Brown-Grey Sodosol-Hydrosol*). Medium thickness to thick loamy sand, sandy loam or light loam, usually with a bleached loamy sand to sandy loam sub-surface layer, and sometimes with some ironstone nodules; over olive-brown, yellow-brown, olive or red-brown sodic clay (or grey in drainage or lagoonal depressions), usually with olive and red mottles, and often with fine carbonate in the lower subsoil. Found on slopes, flats, crests, depressions and drainage depressions. This soil type is morphologically closely related to ironstone soil, except that it does not have ironstone gravel, is more likely to be bleached, and is more likely to have domed sodic clay subsoil.

Minor Soils:

- K4-D7** Stony texture contrast soil (*stony Brown Sodosol-Chromosol*). Medium thickness light sandy loam to sandy loam, with a sandy loam sub-surface layer which is often bleached, and often has ironstone gravel, ferruginized rock fragments, rock fragments and/or quartz fragments; over olive-brown, yellow-brown or red-brown clay, which is often sodic, and has red and sometimes olive mottles, and sometimes includes weathered rock fragments; on weathering rock (usually weathering meta-sandstone within 1m of the soil surface). Found on slopes and crests.
- I1-H3** Deep sands (*Podosol-Tenosol*). Deep to moderate depth loamy sand over bleached sand; on yellow-brown or red-brown sand or sandy loam, which usually includes accumulations of iron and/or organic compounds. This is underlain by sodic clay. Sometimes there are some ironstone nodules in the bleached layer. Often there is ironstone gravel in the layer directly above the clayey substrate. Found on slopes, crests, sand spreads and low dunes.
- E3** Cracking clay (*Epipedal Brown Vertosol*). A thin to medium thickness light clayey topsoil which usually has a blocky structure overlying a brown clayey subsoil with fine carbonate in the subsoil or lower subsoil. These land areas exhibit a gilgai relief with mounds/flats and some crabholes. Found on plateau surfaces/plains and depressions.

Further information: [DEWNR Soil and Land Program](#)

