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Lansdown Station Environmental Study: Final Report

June 2018



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Version	Date	Revision Details	Typist	Author	Verifier	Approver
5	July 2018	Final report for issue	■	■	■	■

Please cite as:

Earth Environmental 2018, *Lansdown Station Environmental Study: Final Report*, prepared for Townsville City Council, Townsville.

1. Introduction

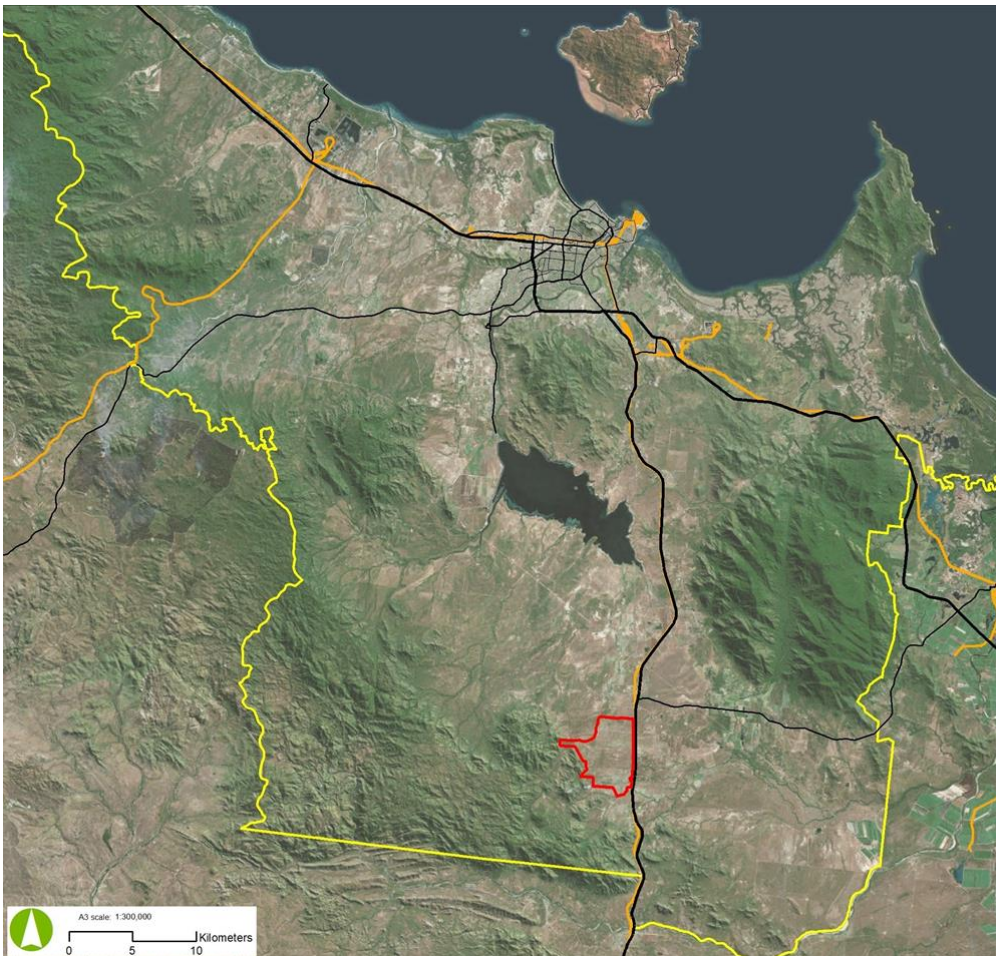
1.1 Background

The Lansdown Station site is located approximately 40 kilometres from the Townsville CBD (see Figure 1-1) and is generally referred to as being at Woodstock rather than the actual locality of Calcium. Lansdown Station was a working cattle property prior to its acquisition by the Commonwealth Scientific and Industrial Research Organization (CSIRO) in 1962/63.

CSIRO's Division of Tropical Pastures established the Lansdown Pasture Research Station in conjunction with the establishment of the Davies Laboratory, adjacent to the James Cook University campus, "on a site made available by the Townsville Council" (CSIRO 1962, pp.21-22).

Townsville City Council acquired the part of the Lansdown Pasture Research Station on the western side of the Flinders Highway (the Site) from CSIRO in 2001/2002. The remaining part of the Lansdown Pasture Research facility, on the eastern side of the Flinders Highway, is still operated by CSIRO.

Figure 1-1 Location



Note: Map produced by Aurecon [See Map Compendium Figure B1 Location]. The Lansdown Station study area is shown in red. The yellow line is the boundary of Townsville City Council local government area (LGA).

1.2 Planning Context

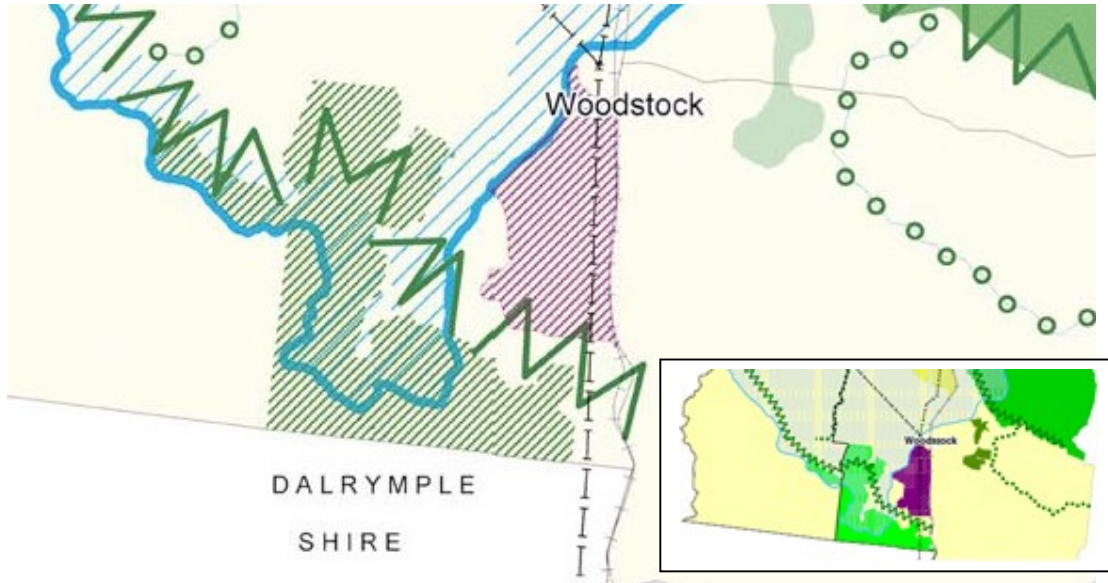
1.2.1 Intent

Townsville City Council (TCC) acquired the Lansdown site (the Site) with the intent of establishing an industrial area at some time in the future. The decision was based on a number of factors including the Site's proximity to the main transport corridor linking inland North Queensland to the Port of Townsville [Flinders Highway and Great Northern Rail Line) and the north-south transport corridor [Bruce Highway and North Coast Line] while also being relatively isolated from sensitive land uses.

1.2.2 TTSP designation

The Townsville-Thuringowa Strategy Plan (TTSP) (2000 and 2007 update) shows the Site as a Major Industry Investigation Area (Woodstock) on the Regional Structure Plan (see Figure 1-2), which illustrates “the preferred broad physical form of the region for a notional long-term population of around 320,000...” (DLGPSR 2007, p.27).

Figure 1-2 TTSP Regional Structure Plan



Note: Source is TTSP 2000 Map 4 Regional Structure Plan (p.29). The inset is from the revised TTSP (2007).

1.2.3 Townsville City Plan

The Lansdown Station site is currently included in the Rural zone in the Townsville City Plan and is identified in the Strategic framework (Part 3 of the Townsville City Plan) as a location to be investigated for future industrial land. “The Strategic framework sets the policy position for the whole city and identifies the future development intent for Townsville.” (Townsville City Council [TCC] 2014b).

“The Woodstock area has been identified as a possible future site for heavy industry due to its separation from existing urban areas and other sensitive land uses. In the long-term, it would help to ensure an adequate supply of heavy industry land is available to accommodate large new enterprises.” (TCC 2014b).

A Townsville City Plan Local Area Information Sheet (TCC 2014b) was released in conjunction with the Townsville City Plan and explains the intent of both the Woodstock and Bohle Plains industrial investigation areas. The Information Sheet states “The industrial investigation areas at Bohle Plains and Woodstock will need further detailed planning before they are developed including consideration of infrastructure, amenity protection (i.e. noise, odour impacts) and environmental considerations.” and “Industrial land supply and demand will be monitored by council to determine when land in the investigation areas may need to be made available.” (TCC 2014b).

1.2.4 City Plan amendment

The Townsville City Plan needs to be amended to change the zone of the Lansdown Station site from Rural to Industrial to facilitate industrial development at the Site. In July 2017 TCC agreed to a planning recommendation to start a formal rezoning process for the Lansdown future industrial area.

“Mayor Jenny Hill said the site would go through a rigorous assessment involving community consultation and background investigations.” (Townsville Bulletin, 25 July 2017).

This report provides the results of an environmental study of the Site and is one of the “background investigations” required to inform the amendment of the Townsville City Plan.

2. Background

2.1 Tenure

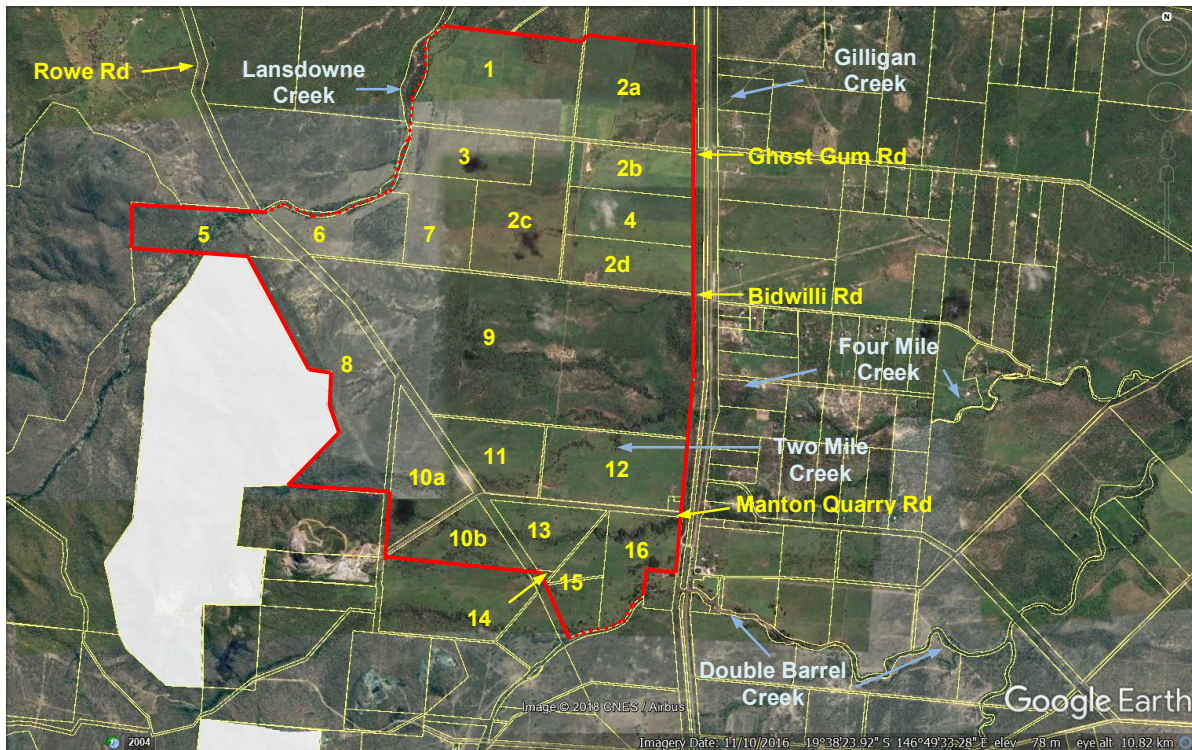
Townsville City Council's Lansdown Station property (the Site) is comprised of 16 lots and a number of road reserves (105 hectares) with a total land area of approximately 2,070 hectares. The Site is shown in Figure 2-1 with the lots listed in Table 2-1. Additional tenure information e.g. easements, is provided in the Lansdown Station Environmental Study Background Report (Earth Environmental 2018a) (the Background Report). A high resolution tenure map showing Lot on Plan numbers is provided in the Map Compendium.

Table 2-1 Lansdown Station Lots

#	Lot / Plan	Area	Notes
1	20/E124189	161.9	Northwest corner with western boundary defined by Lansdowne Creek
2	19/RP901592	356.9	Northeast corner with highway frontage
3	31/E124247	64.8	Western boundary defined by Lansdowne Creek
4	34/E124243	64.8	Highway frontage 'surrounded' by 19/RP901592
5	500/E12466	64.8	Westerly 'protruding' lot. Adjoins State Forest. Incised by Lansdowne Creek
6	39/E124247	64.8	Northern boundary defined by Lansdowne Creek
7	38/E124269	64.8	Western boundary defined by Lansdowne Creek
8	44/SP260018	168.6	Western edge adjoining Unallocated State Land (USL) [L4/USL44323]
9	87/RP911426	480.0	Highway frontage adjoining Manton Quarry Road [south]
10	41/E124381	139.5	Southwest corner. 2 parts split by road access to quarry
11	55/E124248	64.8	Separated from 13 by Manton Quarry Road
12	51/E124242	107.3	Highway frontage
13	65/E124264	46.8	East of old Townsville Road
14	104/E124279	1.1	Small lot adjoining the old Townsville Road
15	64/E124248	43.3	2 parts. Southern boundary defined by Double Barrel Creek
16	417/E12421	64.8	Southeast corner. Highway frontage. Creek bounded

Notes: Area is hectares rounded to one decimal place. [Conversion - 0.405 hectares per acre. 2.47 acres per hectare]

Figure 2-1 The Lots



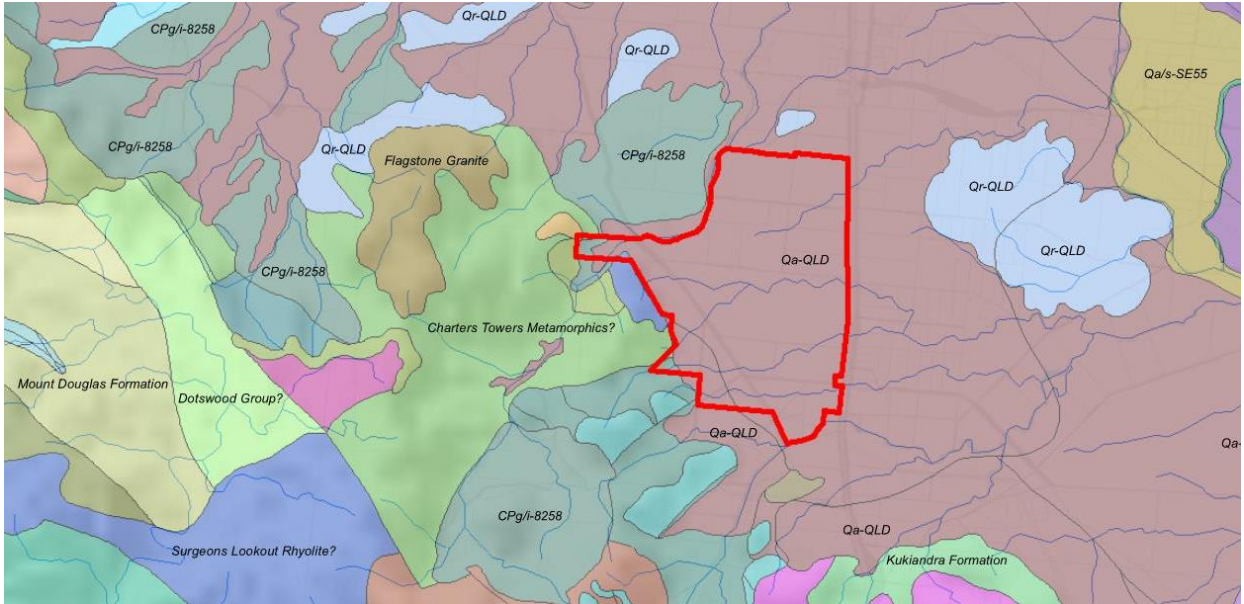
Note: Image generated through Queensland Globe and Google Earth. The Site boundary [shown in red] was prepared by Aurecon. Table 2-1 show lot descriptions and areas with reference to the numbered lots above. The white area is State land. Lots 2c, 3, 5, 6 and 7 is the [Drive It] Motorsports Precinct . Lots 2b, 4 and 2d is the proposed [lithium] battery plant. The remaining lots are currently leased for grazing purposes. [See Map Compendium Figure B2 Tenure]

2.2 Physical Features

2.2.1 Geology

The majority of the Site is shown (see Figure 2-2) as Quaternary alluvium [Qa] described as “*Alluvium and colluvium*” (1:250,000 Geological Series mapping) and “*Clay, silt, sand, gravel; flood-plain alluvium*” (1:100,000 mapping). The other main geological features to the west of the Site are granitoids, felsites and sedimentary units. Geological descriptions are provided in Table 2-2. Mapped areas of the various geological units on the Site are listed in Table 2-3. Additional geological information is provided in the Background Report (Earth Environmental 2018a). High resolution geology maps are provided in the Map Compendium i.e. Figure B3 Regional Geology (1:200,000) and Figure B4 1:100,000 Geology.

Figure 2-2 Geology 1:100,000



Note: Map prepared by Aurecon from 1:100,000 geology data.

Table 2-2 Geology Key and Description [1:100,000]

Code / Unit name	Description [Age]
Qa-QLD	Clay, silt, sand, gravel; flood-plain alluvium [Quaternary]
Surgeons Lookout Rhyolite [?] [CPis]	Pink to purple, spherulitic, flow-banded rhyolite and buff to pink, flow-banded, porphyritic granophyre [Carboniferous-Permian] Dominant rock type: Felsites (Lavas, clastics and high level intrusives)
Charters Towers Metamorphics [?] [PLEct]	Mica schist, quartzite, quartz-feldspar-biotite gneiss, hornblende schist; cordierite, andalusite and staurolite hornfels, chlorite schist, marble [Neoproterozoic – Cambrian] Dominant rock type: Metamorphosed sedimentary
CPg/i	Unassigned hornblende-biotite granodiorite tonalite and diorite, pink to grey, fine to medium-grained porphyritic microgranodiorite and microdiorite [Carboniferous-Permian] Dominant rock type: Granitoid
CPg/a-8258	Pink, buff or grey microgranite, aplite, alkali granite
Ravenswood Batholith [ODg]	Unassigned equigranular to porphyritic, locally foliated biotite-hornblende to biotite granite, granodiorite, microgranite, microgranodiorite and leucogranite

Table 2-3 Geology Units Mapped Areas

Geological unit	Area [ha]	Geological unit	Area [ha]
Qa-QLD	2026.5	Surgeons Lookout Rhyolite?	3.8
CPg/i-8258	18.0	Surgeons Lookout Rhyolite	1.3
Ravenswood Batholith [ODg]	11.9	CPg/a-8258	0.2
Charters Towers Metamorphics?	4.9	Total	2,067

Note: Areas are hectares [ha].

2.2.2 Soils

CSIRO undertook a detailed soil survey of the Lansdown Pasture Research Station in 1966 (Murtha and Crack) at a scale of 1:11,880. Twenty-nine soils were identified during the soil survey and those soils present on the Site along with the area of each of the soil types are listed in Table 2-4. Soil type descriptions and mapping is provided in the Background Report (Earth Environmental 2018a). A more recent report by Rogers and Musumeci (2001) describes the land resources of the Major Creek area and relies heavily on the work by Murtha and Crack (1996) for the Lansdown site with no apparent new information. A high resolutions soils map [Figure B5 CSIRO Detailed Soils] is provided in the Map Compendium.

Table 2-4 Lansdown Site Soils Areas

Code	Map Unit	Area [ha]	%
Cc	Calman Clay	5.3	0.3
Creek	Creek bed	4.1	0.2
DI	Double Barrel Loam	23.5	1.1
Dsl	Double Barrel Sandy Loam	40.8	2.0
Gsl	Glenoming Sandy Loam	59.1	2.9
LC	Lansdown Complex	274.7	13.3
Lfsl	Lansdown Fine Sandy Loam	105.0	5.1
Lsl	Lansdown Sandy Loam	5.4	0.3
M1	Miscellaneous Unit 1	24.6	1.2
M2	Miscellaneous Unit 2	9.1	0.4
M5	Miscellaneous Unit 5	37.5	1.8
Mls	Magenta Loamy Sand	78.8	3.8
MtC	Manton Gilgai Complex	123.7	6.0
MtC(g)	Manton Gilgai Complex, gravelly phase	82.0	4.0
Mtl	Manton Loam	17.2	0.8
SC	Sandalwood Gilgai Complex	17.6	0.9
Ssl	Sandalwood Sandy Loam	45.1	2.2
Stl	Stockyard Loam	1.8	0.1
Stsl	Stockyard Sandy Loam	108.5	5.3
WC	Woodridge Gilgai Complex	150.2	7.3
WI	Woodridge Loam	239.3	11.6
Wsl	Woodridge Sandy Loam	327.8	15.9
Wsl(s)	Woodridge Sandy Loam, sloping phase	137.9	6.7
Wysl	Wyoming Sandy Loam	147.6	7.1

Notes: Area is the soil type on the Site. % is soil type area as percentage of the total Site area. Total area is 2,067ha.

2.2.3 Topography

The majority of the Site lies between the 110 metre and 70 metre contours with gentle slopes between 1:150 and 1:90 i.e. <2%. The highest point on the Site is approximately 180m elevation on a spur near the southern boundary of Lot 500 on E12466. The gradient here is also the steepest on the Site at approximately 44%. The gradient of the foothills on the steeper, western side of the site is generally between 10% and 20% with steeper gradients to the west of the Site above the break of slope.

2.2.4 Catchments

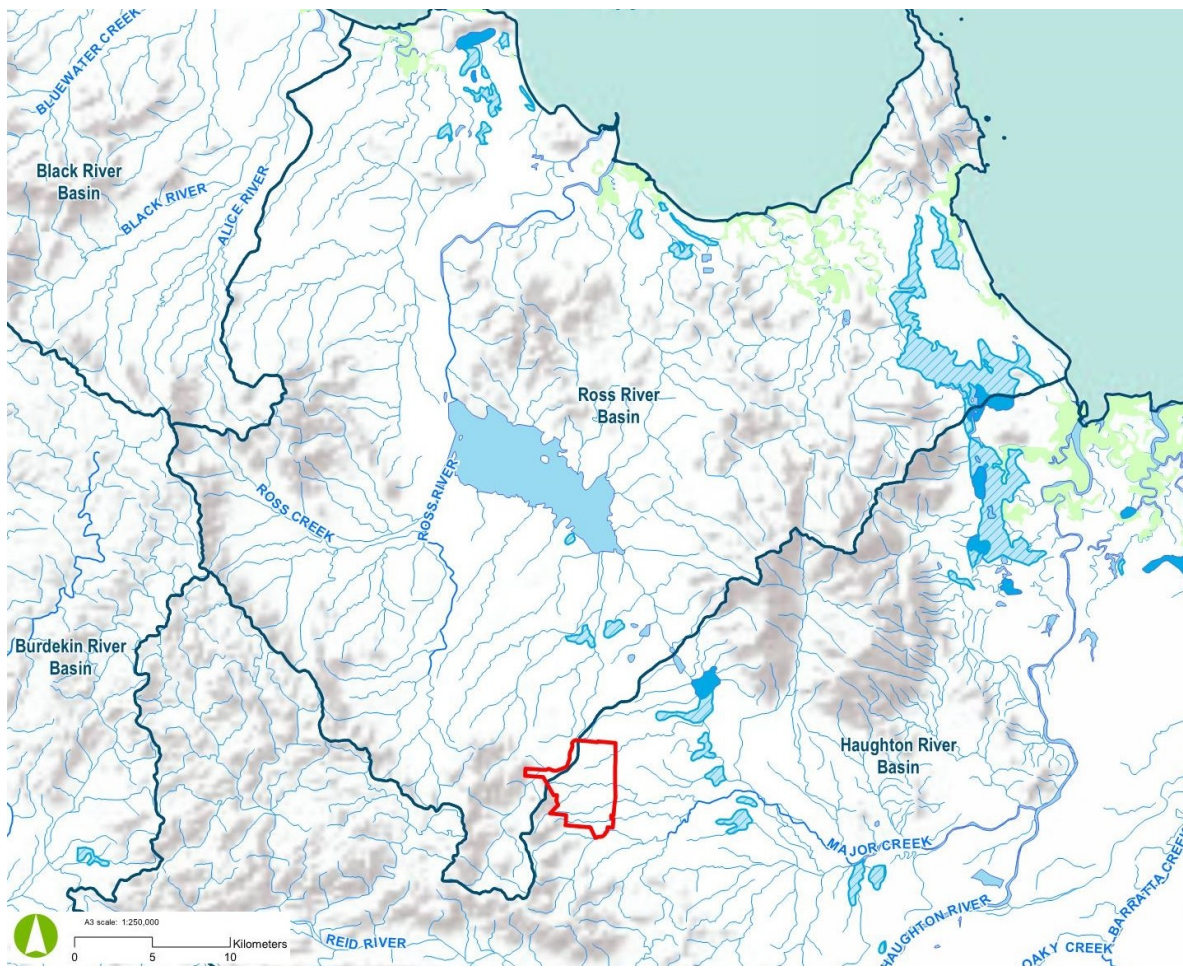
The majority of the site (90% - 1,893ha) is within the Major Creek catchment, which is part of the Haughton River Basin. The remainder of the Site (174ha) is in the Lansdowne Creek catchment, which is part of the Ross River Basin (see Figure 2-3). Lansdowne Creek is part of the Ross River Dam catchment and forms part of the boundary of four of the Site lots and dissects Lot 500 on E12466.

2.2.5 Drainage

Lansdowne Creek is the main drainage feature associated with the Site and has the largest catchment upstream of the Site. Lansdowne Creek flows in a northerly direction and meets Five Head Creek, which feeds into the Ross River Dam. The other main drainage line associated with the Site is Double Barrel Creek, which is the southern boundary of Lot 64 on E124248 and Lot 417 on E12421.

Internal drainage lines (from north to south) are; Gilligan Creek, Four Mile Creek, Two Mile Creek and a northern tributary of Double Barrel Creek. All of these drainage lines flow in an easterly direction and are tributaries of Major Creek. Major Creek flows to and joins the Houghton River approximately 27 kilometres east of the Site. Gilligan Creek is the only drainage feature emanating on the Site with the other creeks having at least part of their catchment in the hills to the west (see Figure 2-4). Two Mile Creek has the largest area of catchment in the western hills (see Table 2-5), which would create a greater volume of run-off and swifter creek flows than the other easterly flowing creeks on the Site.

Figure 2-3 Regional Drainage



Notes: Map prepared by Aurecon. A high resolution copy of the River Basins and regional drainage map is provided in the Map Compendium [Figure B6 1:250,000 Drainage].

Two Mile Creek and Four Mile Creek converge before flowing into Double Barrel Creek. Gilligan Creek flows to Surprise Creek with the confluence being downstream of Serpentine Lagoon. Surprise Creek joins Major Creek just upstream of the confluence of Double Barrel Creek and Major Creek.

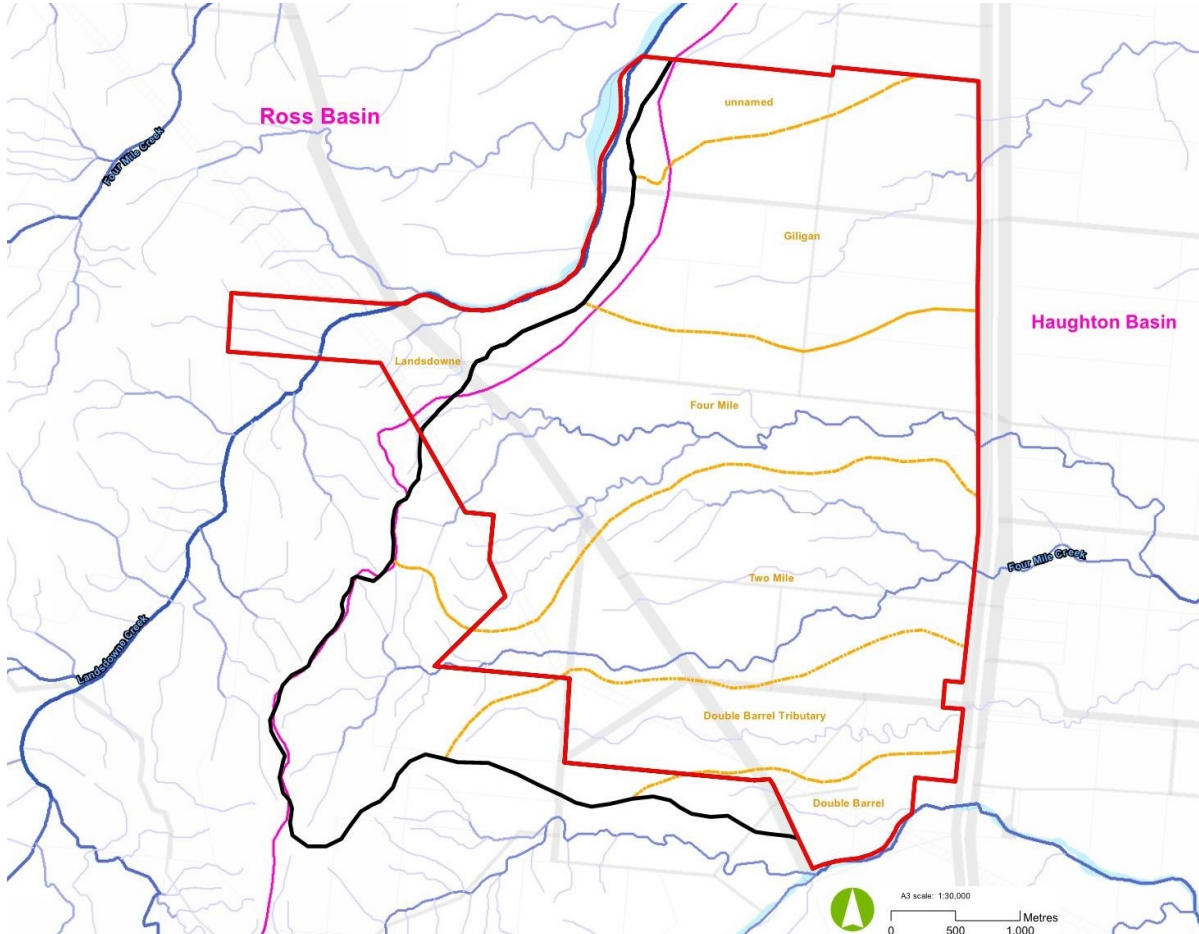
Table 2-5 Catchment Areas

Creek catchment	Catchment area	On site	Upstream
Lansdowne	-	174	-
[North] Gilligan	92.8	93	na
Gilligan	448.8	449	na
Four Mile	616	551	65
Two Mile	708	485	223
Double Barrel tributary	405	336	69
Double Barrel	105	73	32

Note: Catchment area is total area upstream of the eastern boundary of the Site. Upstream is the catchment area upstream of the western boundary of the Site.

Discussions with the holder of the current grazing lease over the Site (pers. comm. Ron Dixon 30 May 2018) revealed an interesting drainage anomaly. When there is a significant rainfall event in the upper Lansdowne Creek catchment the water cannot be contained within the creek system and it 'breaks out' and flows across the Site in the general direction of Gilligan Creek. This is both an inter-catchment and inter-Basin break out. It is possible/probable that Lansdowne Creek was part of the Haughton Basin sometime in the past with at least one 'buried' paleo channel traversing the Site in the vicinity of Gilligan Creek.

Figure 2-4 Catchment Boundaries



Note: Yellow lines indicate the approximate catchment boundaries of the main creek systems [as labelled] passing through and emanating on the Site. Purple line is the Basin boundary. Map prepared by Aurecon. See Figure B7 Water Catchments and Drainage in the Map Compendium for a high resolution map.

The soils mapping over the Lansdown Station (Murtha and Crack 1966) described the geology of much of the Site as *“an old alluvial system draining east to the H[a]ughton river”*. Additional catchment and drainage information is provided in the Background Report (Earth Environmental 2018).

2.2.6 Groundwater

The current surface drainage lines are not necessarily related to the presence of and direction of flow of groundwater in the vicinity of the Site. Groundwater systems can be, and often are, much more complex than the surface expressions of the current drainage pattern. Given the topography of the Site i.e. the interface between the volcanic hills and the plains, groundwater relationships and movement patterns may be a significant environmental factor enhancing the ecological values and biophysical functions associated with the Site. This would be particularly pertinent to colluvial recharge areas at the footslopes of the hills.

Murtha and Crack (1966) inspected bore logs which showed parts of the alluvial plain are *“underlain by 20 to 30 ft of stratified sediments which in turn overlie deeply weathered granite.”* The bore logs also confirmed that granites were the underlying geological formation, which would also be the lower limit of groundwater resources. Fresh granite *“was not encountered until 70-75 ft”* [21m-23m] in several bores however the granites were generally closer to the surface (Murtha and Crack 1966, pp.2-3).

3. Review of Environmental Features

3.1 Review of Literature and Mapping

A review of literature and available mapping was undertaken to provide background on the environmental features associated with the Site. Results and findings are summarised below.

3.2 Vegetation

3.2.1 Regional ecosystems

Regional ecosystems and their vegetation management status are defined by the *Vegetation Management Act 1999*. Regional ecosystem (RE) mapping is prepared and maintained by the Queensland Herbarium (Department of Environment and Science). The Site is located primarily within the Brigalow Belt bioregion (Townsville Plains subregion) with less than 1% of the Site mapped as part of Einasleigh Uplands bioregion vegetation. Descriptions of REs mapped on the Site are listed in Table 3-1 and are shown on Figure 3-1.

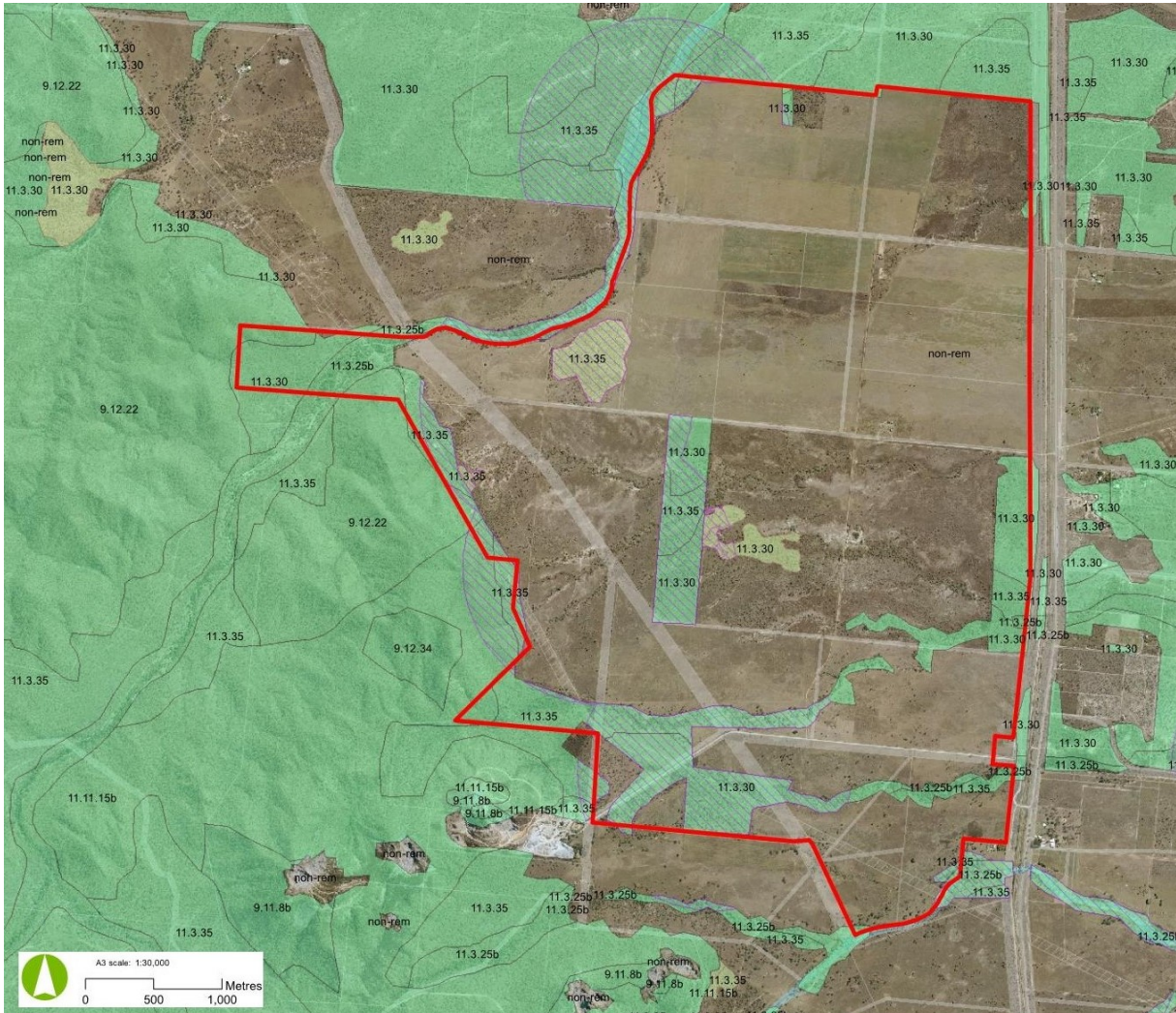
Table 3-1 Regional Ecosystem Descriptions

RE No.	Description	VM status
11.3.25b 29.5ha 54.8%	<i>Melaleuca leucadendra</i> and/or <i>M. fluviatilis</i> , <i>Nauclea orientalis</i> open forest. A range of other canopy or sub-canopy tree species also occur including <i>Pandanus tectorius</i> , <i>Livistona</i> spp., <i>Eucalyptus tereticornis</i> , <i>Corymbia tessellaris</i> , <i>Millettia pinnata</i> , <i>Casuarina cunninghamiana</i> , <i>Livistona decora</i> , <i>Lophostemon suaveolens</i> or <i>L. grandiflorus</i> , rainforest species and, along drainage lines, <i>Eucalyptus camaldulensis</i> or <i>E. tereticornis</i> . A ground layer of tall grasses such as <i>Chionachne cyathopoda</i> , <i>Mnesithea rottboellioides</i> or <i>Heteropogon triticeus</i> may be present. Often occurs on coarse sand spits and levees within larger river channels. Riverine wetland or fringing riverine wetland. (BVG1M: 22c)	Least concern
11.3.30 154.5ha 13.5%	<i>Eucalyptus crebra</i> or <i>E. paedoglauca</i> and <i>Corymbia dallachiana</i> woodland. Forms an open woodland to open forest in places. Has a grassy ground layer of <i>Heteropogon contortus</i> , <i>Bothriochloa bladhii</i> , <i>Themeda triandra</i> , <i>Sehima nervosum</i> , <i>Enneapogon</i> spp., with forbs such as <i>Indigofera</i> spp., <i>Glycine tabacina</i> , <i>Galactia tenuiflora</i> and <i>Tephrosia juncea</i> common. Occurs on older floodplain complexes on Cainozoic alluvial plains. (BVG1M: 18b)	Least concern
11.3.35 100.8ha 13.7%	<i>Eucalyptus platyphylla</i> , <i>Corymbia clarksoniana</i> woodland. This association usually occurs as woodland of <i>Eucalyptus platyphylla</i> and <i>Corymbia clarksoniana</i> with <i>Corymbia tessellaris</i> occurring in some areas. A low tree layer of species such as <i>Planchonia careya</i> , <i>Pandanus spiralis</i> , <i>Melaleuca viridiflora</i> or <i>M. nervosa</i> and <i>Petalostigma pubescens</i> is often present. The ground layer is usually grassy with common species including <i>Themeda triandra</i> , <i>Heteropogon contortus</i> , <i>Mnesithea rottboellioides</i> and <i>Bothriochloa decipiens</i> , together with herbs or forbs such as <i>Glycine tabacina</i> , <i>Galactia tenuiflora</i> or <i>Sida hackettiana</i> . Occurs on Cainozoic alluvial plains. Older floodplain complexes, major stream levees and lighter deltaic deposits. (BVG1M: 9e)	Least concern
11.11.15b 7.2ha 92.3%	<i>Eucalyptus drepanophylla</i> and/or <i>E. platyphylla</i> woodland +/- vine thicket species. (BVG1M: 13c) General description 11.11.15 <i>Eucalyptus crebra</i> +/- <i>Corymbia erythrophloia</i> +/- <i>E. populnea</i> +/- <i>E. melanophloia</i> +/- <i>C. tessellaris</i> +/- <i>C. clarksoniana</i> woodland to open woodland often with a shrubby layer. <i>Eucalyptus exserta</i> and <i>E. platyphylla</i> present in central coastal part of bioregion. Occurs on undulating rises and low hills, often with distinct strike pattern formed on moderately to strongly deformed and metamorphosed sediments and interbedded volcanics and Permian sediments. (BVG1M: 13c)	Least concern
9.12.22 16.8ha 98.8%	Woodland of <i>Eucalyptus drepanophylla</i> (grey ironbark), <i>Corymbia clarksoniana</i> (Clarkson's bloodwood) or <i>C. intermedia</i> (pink bloodwood), <i>C. dallachiana</i> (Dallachy's gum) +/- <i>E. platyphylla</i> (poplar gum) +/- <i>E. portuensis</i> (white mahogany) +/- <i>E. tereticornis</i> (bluegum). An open to mid-dense sub-canopy can include <i>Planchonia careya</i> (cocky apple), <i>Acacia flavescens</i> (yellow	Least concern

wattle), *Bursaria incana* (prickly pine), *Vachellia bidwillii* (corkwood wattle) and *Grevillea parallela* (silver oak). *Capparis canescens* (wild orange), *Larsenaikia ochreatea* (native gardenia) and *Acacia spp.* occur in a scattered shrub layer. The ground layer is dense grassy and dominated by *Themeda triandra* (kangaroo grass), *Heteropogon contortus* (black speargrass) and *H. triticeus* (giant speargrass). *C. erythrophloia* (red bloodwood) may be found in the western area of this community. Occurs in steep rugged hills and valleys on igneous steep rugged ranges. (BVG1M: 13c)

Note: RE descriptions are from the Queensland Herbarium’s regional ecosystem description database (REDD) version 10 (December 2016). In the RE No. column the #ha is the amount of hectares of the RE mapped on the Site and the percentage figure is the percentage of the RE remaining on the Site when compared to the pre-clear mapping.

Figure 3-1 Regional Ecosystems



Notes: Map produced by Aurecon [see Figure B10 Regional Ecosystems and Essential Habitat in the Map Compendium for a high resolution map]. Slanted lines indicate essential habitat. Green is Least concern REs. Light green is high value regrowth (HVR). Unshaded areas are non-remnant. The Site boundary is red.

Pre-clear vegetation extent on the Site has been compared to the current RE map and the percentage of remaining vegetation calculated for each RE. The area in hectares and the percentage of each RE remaining is shown in Table 3-1. The total area of mapped remnant vegetation on the Site, according to the current RE mapping, is 308.8 hectares (15% of the Site lots). This does not include remnant vegetation on the road reserves. Additional information on pre-clear and current RE mapping and land zones is provided in the Background Report (Earth Environmental 2018a) including the area of each RE mapped on each lot.

3.2.2 Essential habitat

Essential habitat applies to areas of mapped remnant and high value regrowth vegetation regardless of the condition and actual status on ground. The essential habitat shown on the RE map (see Figure 3-1) is predominantly for the Squatter Pigeon [southern subspecies – label 1785] (*Geophaps scripta scripta*) with minor areas mapped for the Black-throated Finch [southern subspecies – label 1365] (*Poephila cincta cincta*) i.e. Lot 417 E12421. As the REs on the Site listed as essential habitat for the Squatter Pigeon and Black-throated Finch are the same it is not understood why both species essential habitat is not included on the regulated vegetation management maps for all lots with remnant and high value regrowth vegetation.

3.2.3 Survey plans

The pre-clear RE mapping is a hypothetical construct of the vegetation that may have been present prior to European settlement and 'development' activities i.e. clearing. The main flaw is with the pre-clear RE mapping is its point of reference i.e. 1970s aerial photographs. In most cases these photos show an already disturbed landscape as significant clearing occurred in the early years of settlement, as mandated by the [land] legislation of the time, and intermittently from that time on depending on location and circumstances. Hindcasting based on an initially and continually disturbed landscape cannot be accurate and a more reliable picture can be gained from original survey plans. These survey plans were prepared prior to property clearing improvements and were required as a condition of the selection, leasing and freeholding processes.

Original survey plans for the Site have been obtained and reviewed to obtain a better picture of the pre-clear vegetation map of the Site and surrounds. The suite of cleaned survey plans is included in Attachment 2 along with commentary on the vegetation and soils on each of the lots on the Site.

3.2.4 Aerial Photography

The earliest available aerial photography on QImagery [Q1121] was flown in 1961. This was around the time that CSIRO acquired Lansdown Station as a research site for grazing and pasture production enhancement in the dry tropical environment of North Queensland. At this stage CSIRO was a well-resourced and highly respected organisation with a significant and expanding on-ground presence.

Aerial photographs and satellite imagery from 1961 to 2016 have been interpreted to provide a chronological summary of the history of vegetation clearing of the Site (see Table 3-2).

Table 3-2 Clearing History via Aerial Photograph Interpretation

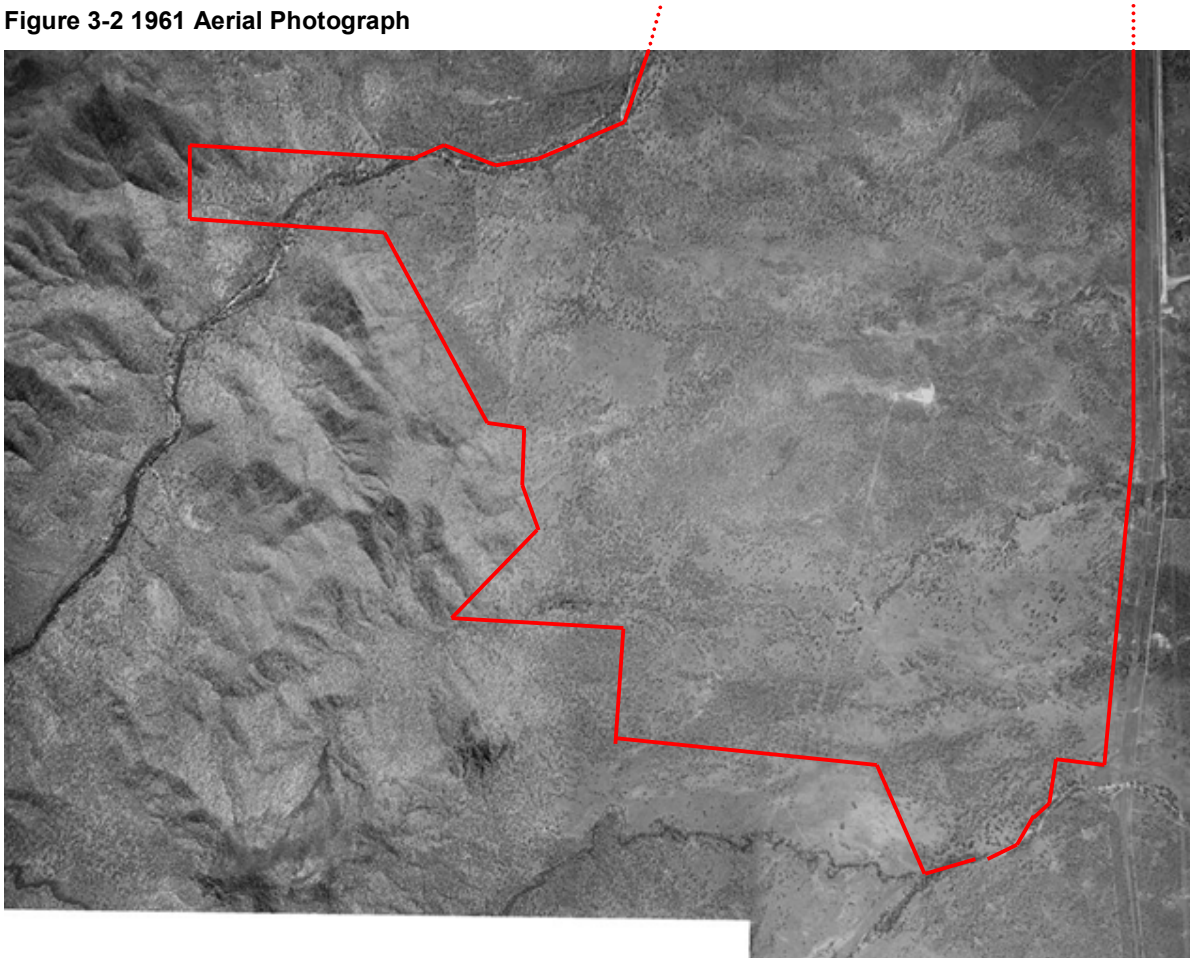
Year ¹	Reference	Comments
1961	Q1121 Run 5 Frames 29, 30 and 32 [15 May 1961], Q1139 Run 6 Frame 57 and 58 [4 June 1961] and Q1150 Run 6A Frame 4 [10 June 1961]	The two main dams are visible. There are some small areas that have been extensively cleared with most of the Site selectively cleared and/or consisting of regrowth. This assumption is based on the original survey plans which describe the vegetation on the various lots including " <i>Thickly timbered Gum, Ironbark and Bloodwood</i> " on Lot 20 E124189, which is now mostly cleared.
1969	Q2011 Run 12 Frames 218, 219, 220 and 221 [12 June 1969]	Shows extensive clearing in southeast east parts of the Site and the recently constructed Lansdown Field Station east of the Flinders Highway. [Note: Photos taken of the highway so lateral extent is limited]
1974	Q2882 Run 2 Frames 6808, 6809 and 6810 [29 May 1974] and Q2882 Run 3 Frames 6830 and 6831 [29 May 1974]	Further extensive clearing is visible especially in the northern parts of the Site. Experimental plots are also visible including what is assumed to be a <i>Leucaena</i> trial in the southeast corner. Drainage lines are visible including the inter-Basin overflow from Lansdowne Creek to Gilligan Creek. RE [remnant] vegetation mapping aligns approximately with the remaining vegetation on this aerial photograph
1981	Q3878 Run 5 Frames 43 and 45 [12 June 1981] and Q3878 Run 4 Frames 213 and 214 [13 June 1981]	The Site has been 'cleaned up' including the vegetation associated with the inter-Basin overflow areas. Many more experimental plots are visible especially in the northern section. With the exception of the southern section of the Site much of the riparian buffer vegetation has been cleared and erosion is apparent. This appears to be the maximum extent of development
1984	Q4397 Run1 Frames 89, 90, 91 and 92 [6 July 1984]	Experimental plots are pronounced on the eastern side of the Site. [Note: Photos taken of the highway so lateral extent is limited]

1995	QC5386 Run 11W Frame 99 and 100 [29 October 1995] and QC5386 Run 12 Frame 1 [29 October 1995]	This shows the context of the Site with regard to the Haughton catchment and Mt Elliot including Gilligan Creek, Surprise Creek and Serpentine Lagoon and Double Barrel Creek and Major Creek confluence
2002	QAP6020 Run 4 Frame 198 and 200 [12 July 2002] and QAP6020 Run 5 Frames 168 and 169 [12 July 2002]	This is the last aerial photograph taken when CSIRO was the manager of the Site. After this time there was less emphasis on keeping the Site clear of regrowth vegetation
2005	QAP6235 Run 3 Frames 212, 213 and 214 [19 August 2005]	No significant changes are visible. Regrowth in the central part of the Site [Lot 87 RP911426] is visible extending eastward from an mapped as remnant

Note: Year is the year that the aerial photographs were flown with the date included in the Reference column.

1961 aerial photography over part of the Site is included as Figure 3-2 and the aerial photograph pictorial history of the progressive development/clearing of the Site by CSIRO is provided in Attachment 1.

Figure 3-2 1961 Aerial Photograph



Notes: The approximate location of the Site boundary is shown in red with the general direction of the northern extension of the Site shown as a dotted line. One of the main dams is visible on the centre east of the frame.

3.3 Wildlife Searches

3.3.1 Wildnet

A species list request was submitted to Wildlife Online [Wildnet database] on 25 May 2018 defined by latitude 19.6 to 19.7 and longitude 146.77 to 146.84. 135. Fauna and flora records were retrieved with most of the records being for bird species [avifauna]. Seven of the 12 listed flora species were introduced and included; *Ziziphus mauritiana* [Indian jujube/Chinee Apple], *Cryptostegia grandiflora* [rubber vine] and *Leucaena leucocephala* [Leucaena].

There were no species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and all fauna listed under the *Nature Conservation Act 1992* (NC Act) were Least Concern (C). There was only one NC Act flora species listed as Near Threatened (NT) i.e. *Oldenlandia polyclada*.

The full list of species from Wildlife Online is included in Appendix A of the Background Report (Earth Environmental 2018).

3.3.2 EPBC matters

The Protected Matters Search Tool [<http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf>] was used to generate a report to help determine whether matters of national environmental significance or other matters protected by the *Environment Protection and Biodiversity Conservation Act 1999* are likely to occur on the Site. As noted on the website the information in the report is indicative only and needs to be supplemented by local expert knowledge i.e. field assessment.

Matters from the report are summarised in Table 3-3 with the full list included in Appendix B of the Background Report (Earth Environmental 2018a).

Table 3-3 EPBC Protected Matters

Matter	Number [Notes]
Matters of National Environmental Significance	
Wetlands of International Importance	1 [20 - 30km upstream of Bowling Green Bay]
Listed Threatened Species	23 [7 birds, 8 mammals, 2 reptiles and 8 plants]
Listed Migratory Species	17 [16 of these also included in Marine Species]
Other Matters Protected by the EPBC Act	
Listed Marine Species	23 [16 of these also included in Migratory Species]
Extra Information	
Invasive Species	23 [7 birds, 1 frog/toad, 7 mammals and 8 plants]

Of the 23 listed threatened species only one Presence was described as “*Species or species habitat known to occur within area*” while the rest were either likely to occur [11] or may occur [10] with one “*Breeding likely to occur within area*”. The list of threatened species that are likely to occur or may be present on the Site is provided in Table 3-6.

3.4 CSIRO Files

3.4.1 CSIRO drawings

CSIRO was approached to provide any available information on the Site and a list of drawing files was subsequently received from Glenn Dibben (31 May 2018). Only one of the drawings, a paddock plan from 1968, is relevant to the study and provides some confirmation of the development/clearing that occurred post 1961. This drawing has been included in Attachment 1 along with the historic aerial photographs.

3.4.2 Managing old sites

A report prepared by the Queensland Department of Primary Industries and Fisheries for Meat and Livestock Australia Limited (Bishop 2003) investigated discontinued plant evaluation sites in Queensland with regard to the containment and eradication of target pest plants. Sites included the CSIRO Lansdown Station facility and the Davies Laboratory at the JCU campus. Plants requiring management at Lansdown Station included *Acacia angustissima* and *Leucaena*. The report recommended that “management of old plant evaluation sites need to continue for another 3 to 4 years” (Bishop 2003, p.27). This report was published after the acquisition of the Site by TCC and was Lansdown Station was not included in further management efforts.

3.5 Townsville City Plan

3.5.1 Amalgamated planning

The Townsville City Council planning scheme came into effect in October 2014 following an extended period of investigations, study compilation and consultation. The preparation of the Townsville City Plan was a requirement of the *Sustainable Planning Act 2009* and a need arising from the amalgamation of Townsville City Council and Thuringowa City Council local government areas (LGA) in March 2008.

The planning studies prepared for City Plan were previously reviewed by the author during the preparation of the environmental importance rating mapping for the natural assets overlay (NAO) and associated documentation i.e. Natural Assets Overlay Code and Natural Assets Planning Scheme Policy (PSP).

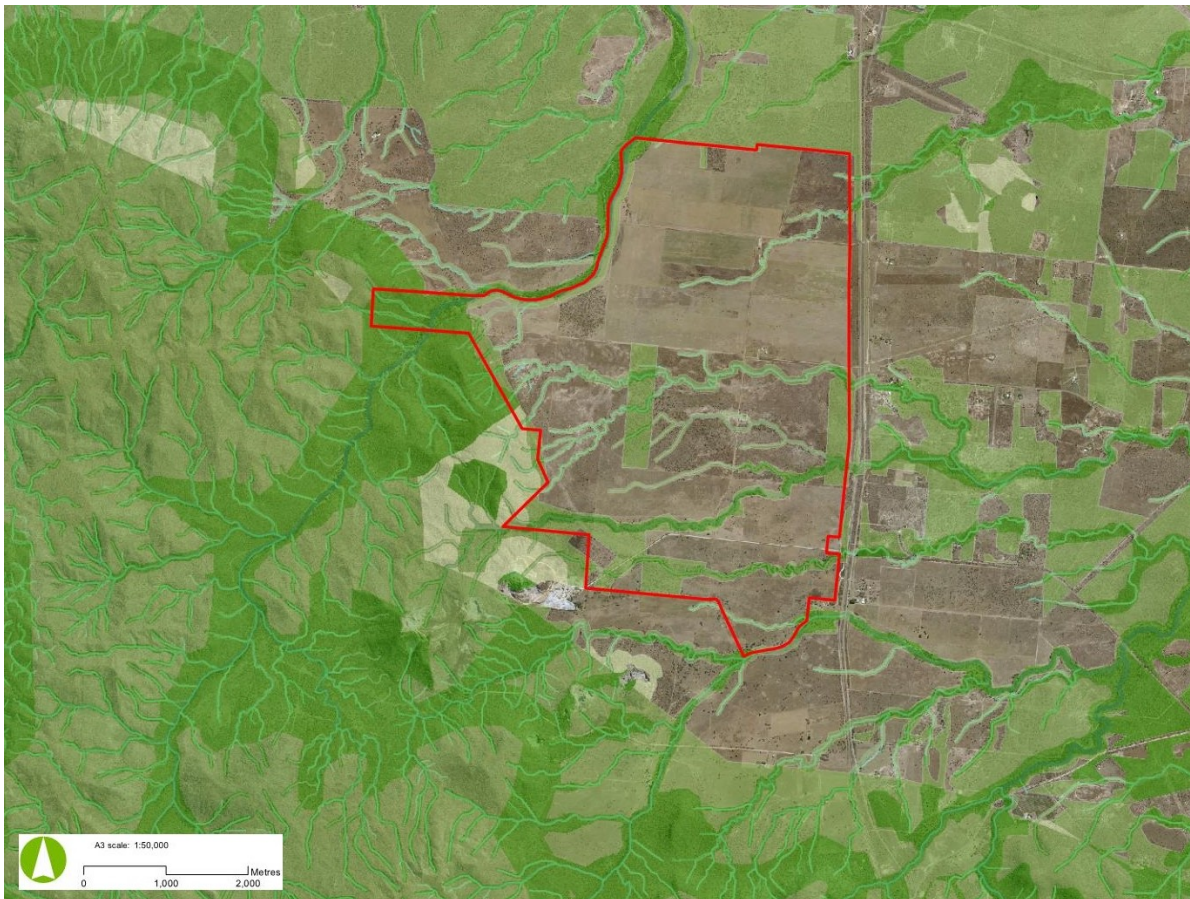
The review included the planning studies that are most relevant to the Site i.e. Rural Resources Study (Buckley Vann and LRAM 2011) and Industrial Land Use Study. The industrial land use study recommended that the Woodstock Site be zoned “as an ‘industrial investigation area’ for long term servicing of Townsville’s industrial requirements.” (Arup 2011, p.iii). While the relevant planning studies refer to or mentioned the Lansdown Station site there was no accompanying detailed site data and as a result the previous City Plan studies are not included here.

Additional information and mapping from the Townsville City Plan about the Site is provided in the Background Report (Earth Environmental 2011) including for the Strategic Framework and Zoning.

3.5.2 Natural assets overlay

The most relevant component of the Townsville City Plan is the Natural Assets Overlay (NAO). The NAO is comprised of a variety of elements that are combined to provide an environmental importance rating. The Site, according to the NAO (see Figure 3-3), contains areas of Very high, High and Medium environmental importance. The NAO environmental importance ratings for each lot are listed in Table 3-4.

Figure 3-3 Natural Assets Overlay



Notes: Mapped prepared by Aurecon from the Townsville City Council Planning Scheme [Environment] Natural Assets Overlay Map - OM-08. The Site location is shown in red. Higher resolution mapping is provided in the Map Compendium [Figure B12 Environmental Importance Landscape Map and Figure B11 Environmental Importance Map].

According to Table 3-4 the High and Very high ratings account for around 24% of the total area of the lots. This is in comparison to approximately 309 hectares of mapped remnant vegetation on the site (see section 3.2.1), which is equivalent to approximately 16% of the Site. This indicates the presence of other factors that are not directly related to the RE mapping e.g. buffered waterways and connectivity corridors.

A number of environmental features from the Natural Assets Overlay (NAO) are imbedded in the environmental importance ratings. These features can be discovered by using the NAO interrogation tool, which is a spreadsheet query tool that intersects the environmental features from the underlying GIS data table with the Queensland Government's digital cadastral database (DCDB). Areas of the Medium, High and Very high environmental importance ecological/environmental features present on the Site are listed in Table 3-5.

Table 3-4 Environmental Importance Ratings

Lot on plan	Low	%	Medium	High	%	V. High	%	HV	HV%	Area	%HV
104E124279	1.02	94.0		0.07	6.0			0.07	6	1.09	0.0
19RP901592	340.81	95.4		16.27	4.6	0.32	0.1	16.6	4.7	357.40	3.5
20E124189	143.67	88.2		11.32	7.0	7.81	4.8	19.1	11.8	162.81	4.1
31E124247	58.93	91.2		4.45	6.9	1.22	1.9	5.7	8.8	64.60	1.2
34E124243	65.01	98.7		0.85	1.3			0.9	1.3	65.86	0.2
38E124269	64.72	96.1		2.51	3.7	0.10	0.1	2.6	3.8	67.32	0.6
39E124247	49.50	75.4		15.07	22.9	1.11	1.7	16.2	24.6	65.67	3.4
417E12421	50.78	77.4		6.31	9.6	8.50	13.0	14.8	22.6	65.59	3.1
41E124381	64.56	51.6		47.72	38.1	12.91	10.3	60.6	48.4	125.20	12.9
44SP260018	98.75	58.5	4.2 [2.5]	51.59	30.6	14.21	8.4	65.8	39	168.74	13.9
500E12466	6.35	9.6		4.84	7.3	54.86	83.1	59.7	90.4	66.05	12.7
51E124242	93.76	87.5		7.11	6.6	6.31	5.9	13.4	12.5	107.19	2.8
55E124248	50.52	79.2		6.71	10.5	6.53	10.2	13.2	20.7	63.76	2.8
64E124248	37.01	84.5		4.78	10.9	2.02	4.6	6.8	15.5	43.82	1.4
65E124264	38.43	81.8		4.13	8.8	4.41	9.4	8.5	18.2	46.96	1.8
87RP911426	318.50	65.5		143.71	29.6	24.05	4.9	167.8	34.5	486.26	35.6
Totals	1482.30	75.7	4.20	327.45	16.7	144.36	7.4	471.8	24.1	1958.31	

Notes: Low, Medium, High and V. High are areas of each category for each lot in hectares. Area is the area of the lot in hectares. % is the rating category area as a percentage of the lot area. As there is only one lot with a Medium rating the % is shown in [brackets]. Totals are hectares for Low, Medium, High and V. High columns, with the corresponding percentage of the total area of the Site. HV is the sum of the High and Very high ratings areas on each lot in hectares. HV% is the percentage of the lot area with High and Very high ratings. %HV is the percentage of the total High and Very high rated area that occurs on each lot.

The total area of the environmental features listed in Table 3-5 is approximately 913 hectares. This is not indicative of the actual area as most of the polygons will include more than one feature meaning the sum of the features is not equivalent to the actual area due to the feature overlaps. The actual area is 476 hectares, which is the sum of the Medium, High and Very High environmental importance rating categories from Table 3-4.

Table 3-5 NAO Environmental Features

Lot on plan	Environmental Features [Hectares]									
	LU	NBE	SWC	BW	RE	BS	WRE	BTF	ED	Area
104E124279				0.07						0.07
19RP901592				16.1	1.4			1.4		18.9
20E124189	7.7			14.5	10.4	5.0	3.0	10.4		51
31E124247	1.3			5.8	1.3	1.3	0.7	1.3		11.7
34E124243				0.9						0.9
38E124269	0.1			2.6	0.1	0.1				2.9
39E124247	1.2			1.7	1.2	1.2		1.2		6.5
417E12421	2.4			10.9	11.6	4.2	4.2	11.6		44.9
41E124381				16.3	57.5			57.5		131.3
44SP260018				2.7	18.1		0.1	18.1	0.2	39.2
500E12466	13.6	7.1	36.7	26.4	59.3	18.3	14.4	45.7		221.5
51E124242				11.8	8.2			8.2		28.2
55E124248				11.6	8.2			8.2		28
64E124248	0.7			6.0	2.5	0.8	0.8	2.5		13.3
65E124264				4.8	8.3			8.3		21.4
87RP911426				99.8	96.2	0.9		96.2		293.1
Totals	27	7.1	36.7	232.0	284.3	31.8	23.2	270.6	0.2	912.87

Notes: Area is the sum in hectares of NAO features in each lot. Environmental features are; LU is Land units of limited extent, NBE is Non bioregional ecosystems, SWC is Statewide corridors, BW is Buffered waterways, VM is Vegetation management status and high value regrowth (HVR), BS is Biodiversity status, WRE is Wetland regional ecosystems, BTF is Black-throated Finch habitat, ED is Ecosystem diversity. SWC has High and Very high components and these have been added together in the table.

Commentary on the preparation of the NAO is provided in a report by Earth Environmental (2014) including the underlying principles and relationship of the environmental features with State and Australian legislation. The report also includes background information such as the REs included in the draft Black-throated Finch habitat mapping.

Information on subsequent refinements made to the environmental importance rating overlay is provided the reports titled *Townsville City Plan: Implementing the Natural Assets Overlay* (Earth Environmental 2015) and *Townsville City Plan Natural Assets Overlay Update 2014 to 2016* (Earth Environmental 2016). Information relevant to the Site from these reports is included in Appendix B.

3.6 Preliminary Assessment of Environmental Values

3.6.1 Condition reports

Prior to the establishment of the CSIRO facility in the early 1960s Lansdown Station may have retained reasonable environmental values as evident from the extent of vegetation on the 1961 aerial photograph. Reports on the condition of Lansdown Station, if any still exist, were not discovered during this study. CSIRO's Davies Laboratory was closed in 2010 and the library resources were given away or relocated to Canberra. CSIRO presence is now located on the James Cook University campus in the science precinct and Glenn Dibben [Precinct Manager - ATSIP, Business and Infrastructure Services CSIRO] made internal enquiries to obtain available information on Lansdown Station, which consists mainly of building plans and drawings of built infrastructure. A list of information supplied by CSIRO is provided in the Background Report (Earth Environmental 2018).

CSIRO activity on Lansdown Station from 1963 included extensive clearing of woodland vegetation to establish experimental plots. By 1974 approximately 70% of the Site had been extensively cleared and by 1981 only the areas currently mapped as remnant (see section 3.1) remained undisturbed. This equates to 16% of the Site i.e. approximately 300 hectares.

3.6.2 Queensland Government mapping and reports

Queensland Government mapping applies to and is administered through environment based and planning legislation and associated regulations including:

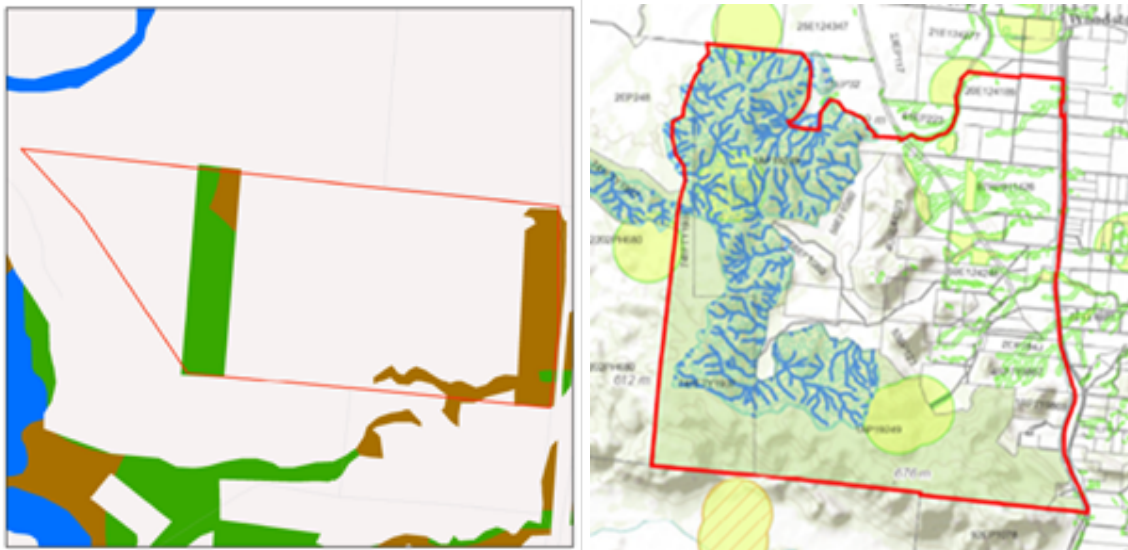
- The *Vegetation Management Act 1999* (VMA);
- The *Planning Act 2016*;
- *Nature Conservation Act 1992*.

There were no significant features associated with the Site discovered through various Queensland Government mapping sources that are not already included in the NAO mapping. Queensland Government mapping and reports sourced include:

- Vegetation Management Reports (Department of Natural Resources, Mines and Energy) incorporating;
 - Regulated vegetation management map vegetation categories (see the Background Report),
 - Vegetation management supporting map regional ecosystems (see section 3.2.1),
 - Essential habitat (see section 3.2.2) [**Note:** Identifies areas of suitable habitat for species of wildlife that are Endangered or Vulnerable under the *Nature Conservation Act 1992* i.e. have been known to occur from sightings or may occur due to defined habitat factors]
 - kilometres from a lot on which there is assessable vegetation,
 - Watercourses [**Note:** Vegetation management watercourses and drainage features are included on the Vegetation management supporting map] (see section 2.2.5 and 2.2.4),
 - Wetlands [**Note:** No vegetation management wetlands were present on the Site],
 - Land suitability [**Note:** Land suitability mapping and information is required when applying to clear vegetation for high-value or irrigated high-value agriculture e.g. cropping, irrigated agriculture and forestry. It does not apply to this situation. Relevant mapping is Land Resources of the Major Creek Area, North Queensland],
 - Coastal/non-coastal [**Note:** for the purposes of the Self-assessable vegetation clearing codes and the State Development Assessment Provisions (SDAP), the Site is regarded as Coastal],

- Protected plants map [**Note:** Administered by DES under the *Nature Conservation (Wildlife Management) Regulation 2006*. None shown on the Site and only relevant if clearing is proposed].
- Regulated vegetation mapping [**Note:** Regional ecosystems and Essential habitat is included in the Vegetation management supporting map and also incorporated in the Vegetation Management Reports (above)];
- Map of Referable Wetlands for Great Barrier Reef catchments;
- Biodiversity and Conservation Values Environmental Report [**Note:** Principally derived from Biodiversity Planning Assessments (Brigalow Belt v2.1) and Aquatic Conservation Assessments [ACA] (Great Barrier Reef Catchment v1.1 – riverine) and (Great Barrier Reef Catchment v1.3 – non riverine)] incorporating;
 - Queensland Herbarium's 'biodiversity status' for remnant regional ecosystems,
 - State, Regional or Local significance according to the DES's *Biodiversity Assessment and Mapping Methodology* (BAMM) [**Note:** Based on various criteria including; habitat / presence of endangered, vulnerable and/or near threatened (EVNT) taxa and context and connection e.g. corridors] (see example in Figure 3-4),
 - Non-riverine wetlands and Riverine wetlands aquatic conservation significance according to DES's *Aquatic Biodiversity Assessment and Mapping Method* (AquaBAMM),
 - Priority species recorded on, or within 4km of the Site.
- Matters of State Environmental Significance Environmental Report,
- State Planning Policy Development Assessment Mapping System (DAMS) (see example in Figure 3-4).

Figure 3-4 Mapping Examples



Notes: Left is Biodiversity Planning Assessment map from Biodiversity and Conservation Values Environmental Report for Lot 87 RP911426. Blue is State, Green is Regional and Brown is Local significance and/or other values. Right is State Planning Policy (Department of State Development, Manufacturing, Infrastructure and Planning) map for the Calcium locality showing Environmental and Heritage State Interests.

The primary legislation [see above], in conjunction with associated policies and codes form the Vegetation Management Framework, which regulates the management and clearing of assessable vegetation in Queensland. In addition the Queensland *Environmental Protection Act 1994* (EP Act) and environmental protection policies (EPP) apply to post-clearing activities such as construction works that may cause environmental harm e.g. soil erosion.

At the national level the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) regulates matters of national environmental significance, such as threatened species and ecological communities. EPBC mapping may be available showing the actual or potential location of endangered ecological communities and threatened species habitat. These features are included in the NAO mapping.

The EP Act, and most of the Queensland Government mapping will apply to the development assessment stage/s and is not considered relevant to the Lansdown site for this environmental assessment. All of the relevant environmental information associated with the Queensland Government mapping and reports is incorporated in the NAO as listed in Table 3-5 for the Site.

The most useful portal to access the full range of Queensland Government mapping available online for development assessment and general purposes is “Environmental maps and data online” at <https://www.ehp.qld.gov.au/maps-imagery-data/online/>.

3.6.3 Wildlife databases

Wildlife Online and the EPBC [Act] Protected Matters databases were investigated as part of this assessment. Wildlife Online (see section 3.3.1) did not identify any endangered, vulnerable and/or near threatened (EVNT) fauna taxa, and only one near threatened flora species.

EPBC matters (see section 3.3.2) need to be considered for the Site including the possibility of 23 threatened species being present on the site for at least a part of their life cycle. The species identified as most likely to have habitat and/or be present on the Site are listed in Table 3-6.

Table 3-6 Potential Threatened Species

Common name	Scientific name	Act	Status	Presence
Birds				
Squatter Pigeon	<i>Geophaps scripta scripta</i>	NCA		EH
Black-throated Finch	<i>Poephila cincta cincta</i>	Both	End	Known /EH
Curlew Sandpiper	<i>Calidris ferruginea</i>	EBCB	CEnd	May
Red Goshawk	<i>Erythrotriorchis radiates</i>	EBCB	Vul	Likely
Star Finch	<i>Neochmia ruficauda ruficauda</i>	EBCB	End	Likely
Eastern Curlew	<i>Numenius madagascariensis</i>	EBCB	CEnd	May
Australian Painted Snipe	<i>Rostratula australis</i>	EBCB	End	May
Masked Owl [Northern]	<i>Tyto novaehollandiae kimberli</i>	EBCB	Vuln	Likely
Mammals				
Northern Quoll	<i>Dasyurus hallucatus</i>	EBCB	End	Likely
Semon's Leaf-nosed Bat	<i>Hipposideros semoni</i>	EBCB	Vul	May
Ghost Bat	<i>Macroderma gigas</i>	EBCB	Vul	Breed
Greater Glider	<i>Petauroides volans</i>	EBCB	Vul	May
Koala	<i>Phascolarctos cinereus</i>	EBCB	Vul	May
Spectacled Flying-fox	<i>Pteropus conspicillatus</i>	EBCB	Vul	May
Large-eared Horseshoe Bat	<i>Rhinolophus robertsi</i>	EBCB	Vul	Likely
Bare-rumped Sheath-tailed Bat	<i>Saccolaimus saccolaimus nudicluniatus</i>	EBCB	Vul	Likely
Reptiles				
Ornamental Snake	<i>Denisonia maculate</i>	EBCB	Vul	May
Yakka Skink	<i>Egernia rugosa</i>	EBCB	Vul	May
Flora				
Miniature Moss-orchid	<i>Bulbophyllum globuliforme</i>	EBCB	Vul	Likely
[8635]	<i>Cajanus mareebensis</i>	EBCB	End	May
Bluegrass [14159]	<i>Dichanthium setosum</i>	EBCB	Vul	Likely
Mt Stuart Ironbark	<i>Eucalyptus paedoglauca</i>	EBCB	Vul	Likely
[64585]	<i>Marsdenia brevifolia</i>	EBCB	Vul	Likely
[64586]	<i>Omphalea celata</i>	EBCB	Vul	Likely

Notes: Act is *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or *Nature Conservation Act 1992* (NCA), or Both. Status for ¹EPBC is; CEnd is Critically endangered, End is Endangered and Vul is Vulnerable and for ²NCA; NT is near threatened. Presence is; EH from essential habitat mapping, Known is Species or species habitat known to occur within area Likely is Species or species habitat likely to occur within area, May is Species or species habitat may occur within area and Breed is Breeding likely to occur within area.

The on-ground site assessment will provide some of the information required to determine the potential presence of the species listed in Table 3-6.

3.6.4 Natural assets overlay

As the base or underlying layer for the Natural assets overlay (NAO) is regional ecosystem (RE) mapping most areas mapped as non-remnant will not show up on the NAO (see Figure 3-3). The exceptions are; Statewide corridors [SWC] and Buffered waterways [BW], which are mostly independent of the RE mapping. There will be overlap between these two categories and remnant vegetation [RE], and there is also significant overlap of the other six categories [LU, NBE, BS, WRE, BTF and ED] with remnant vegetation [RE mapping] (see Table 3-5 notes for codes key). As a result sums and percentages of NAO

environmental features will not provide a true indication of the extent of environmentally significant areas on the Site as individual polygons may contain two or more features that overlap.

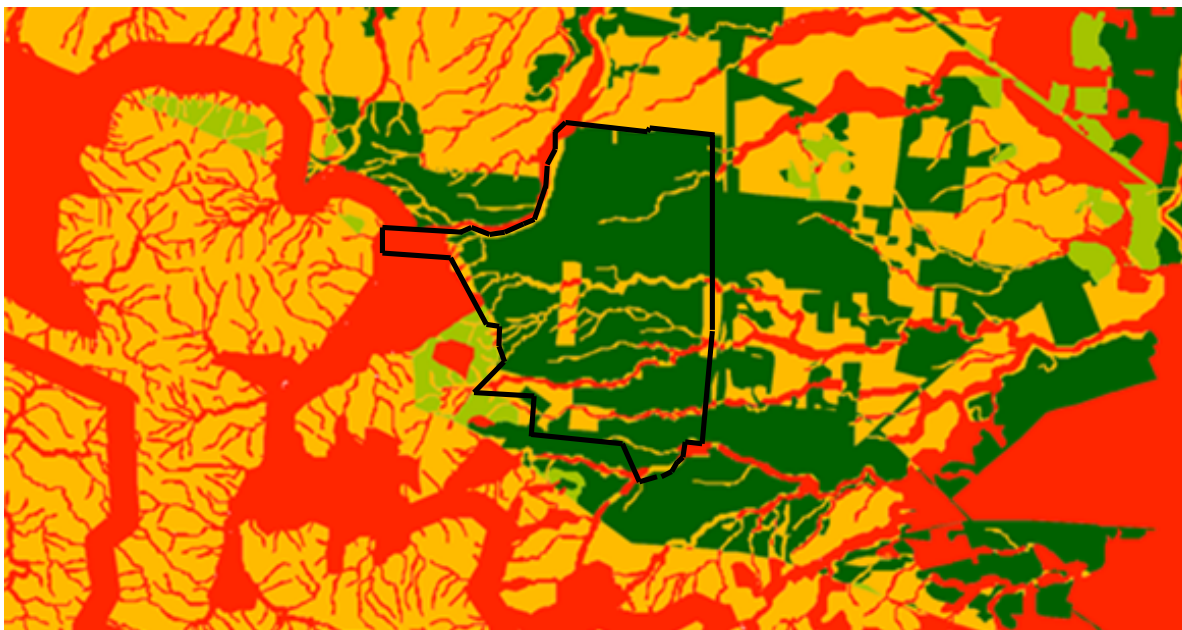
A better understanding of the extent of mapped environmentally significant areas can be gained from the environmental importance ratings shown in Table 3-4. 75.7% of the Site is shown as having Low environmental values. This figure is principally due to the area mapped as non-remnant (see Figure 3-1). This means that 24.3% of the Site is mapped as having Medium [0.2%], High [16.7%] and Very High [7.4%] environmental values.

Based on the NAO, which incorporates Matters of National Environmental Significance (MNES), Matters of State Environmental Significance (MSES) and some Matters of Local Environmental Significance (MLES), it appears that somewhere between 20% and 30% of the Site could contain significant environmental features and/or values.

This however does not take into account some ecological functions that are not incorporated in the NAO e.g. groundwater recharge areas that cannot be determined without conducting an on-ground assessment. This is also the case for some NAO features such as Black-throated Finch habitat, which is based on regional ecosystem extent rather than condition, as well as listed protected matters under the EPBC Act.

The site assessment is therefore critical to determine the actual extent of environmental values associated with the Site to enable recommendations to be made with respect to appropriate conservation areas and buffers. Any preliminary assessment of environmental values can only be based on existing desktop mapping such as the environmental importance rating (EIR) map that underpins the NAO. The EIR map over the Site is shown in Figure 3-5.

Figure 3-5 Preliminary Environmental Values Map



Notes: The approximate location of the Site is shown in black. Red is Very high, yellow High, light green Medium and dark green Low environmental value. Low environmental value indicates the area has been cleared. Map prepared by Aurecon for the Natural Assets Overlay reports (Earth Environmental 2014 and 2015).

4. Site Assessment

4.1 Site Visits

4.1.1 Reconnaissance

Two reconnaissance visits were made to the site to:

- Determine road access and driving/walking strategy for field work [12 May 2018];
- Meet the property manager i.e. holder of the grazing lease, gather background information about the Site and make arrangements for detailed site assessment [30 May 2018].

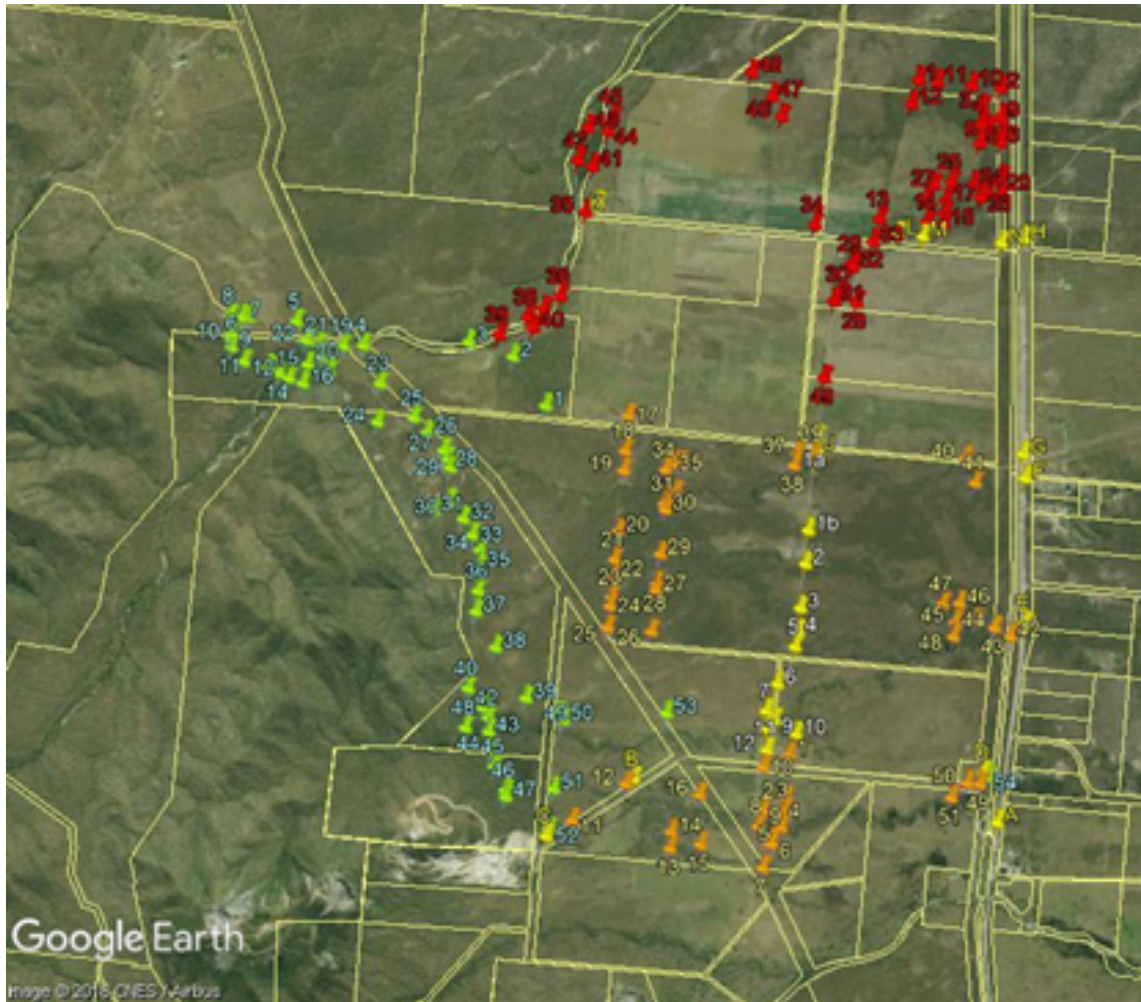
4.1.2 Detailed assessment

Following on from the reconnaissance visits and based on preliminary mapping from the literature review the most relevant areas of the Site was systematically traversed to observe the environmental features and condition. Site assessment visits were conducted on:

- 1 June 2018 – northern portion of the Site, including Lansdowne Creek, north of Bidwilli Road;
- 2 June 2018 – western portion of the Site including Lansdowne Creek and the foothills;
- 14 June 2018 – central and southern section south of Bidwilli Road.

Site coverage, with reference to GPS waypoints, is shown on Figure 4-1.

Figure 4-1 GPS Waypoints Site Coverage



Notes: Yellow icons are reconnaissance visits on 12 and 30 May 2018. Detailed observations are; 1 June [red icons], 2 June [green icons] and 14 June 2018 [orange icons]. Map generated by [redacted] using Qld Globe and Google Earth.

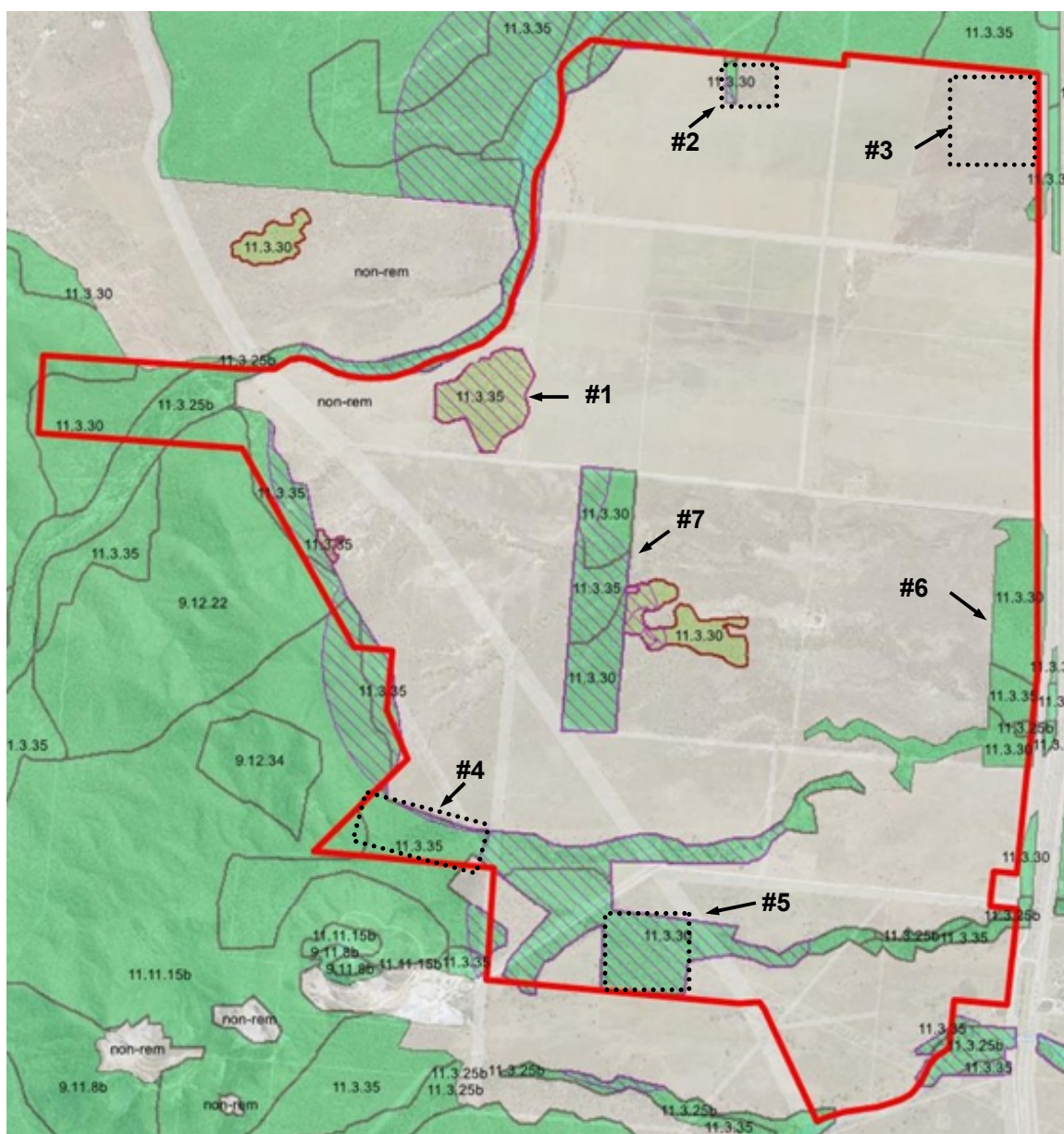
Field notes, GPS waypoints, photographs referenced to GPS waypoints with additional descriptions and maps are provided in the Lansdown Station Site Visits Report (Earth Environmental 2018b). Observations by main defined Site sections are provided below.

4.2 Vegetation Patches

The Site has been extensively cleared and as a result there are a number of distinct and/or isolated patches of remnant vegetation mapped on the Site along with some areas of regrowth that may be returning to remnant status. In most cases the remnant patches and regrowth areas are dissected by the drainage system creating connectivity between what would otherwise be isolated patches of vegetation.

The location of vegetation patches is shown on Figure 4-2. Summary features of the vegetation patches are provided in Table 4-1 with field observations provided in Table 4-2.

Figure 4-2 Vegetation Patches



Note: Map produced by Aurecon using DNRME data. See Figure B10 Regional Ecosystems and Essential Habitat in the Map Compendium for a higher resolution map.

Table 4-1 Vegetation Patches Summary

#	Location	Lot	Mapped RE/s
1	Adjacent to Lansdowne Creek and north of Bidwilli Road	Lot 39 E124247	HVR 11.3.35
2	Adjoining the northern boundary of the Site	Lot 20 E124189	8.3.30 [part]
3	Regrowth in the northeast corner of the site	Lot 19 RP901592	Non-remnant
4	Vegetation associated with Two Mile Creek in the southwest corner of the property	Lot 44 SP260018	11.3.35 and 11.11.15b
5	Adjoins the southern boundary of the property and Double Barrel Creek tributary	Lot 41 E124381	11.3.30
6	Adjoins the eastern boundary in the central portion of the property [eastern strip]	Lot 87 RP911426	11.3.30, 11.3.35 and 11.3.25b
7	A mapped remnant strip [western strip] south of Bidwilli Road and adjoining an area of regrowth to the east. Connected to the eastern strip by Two Mile and Four Mile Creeks	Lot 87 RP911426	11.3.30, 11.3.35 and HVR 11.3.30

Notes: HVR is high value regrowth. Numbered vegetation patches are shown on Figure 4-2.

Table 4-2 Vegetation Patches Summary Field Observations

#	Observations	Area ¹
1	<p>Connectivity The paddocks to the east, south and west have been extensively cleared leaving this patch relatively isolated from the remainder of the property. The patch is separated from the vegetation along Lansdowne Creek by a 90m cleared strip. The close proximity of the patch to the Lansdowne Creek riparian vegetation provides the greatest degree of landscape connectivity particularly for smaller species of birds.</p> <p>Vegetation The T1 layer consists of Bloodwood and Poplar Gum + Ironbark + <i>Corymbia tessellaris</i> in the northern section with Ironbark, Dallachy Gum and an occasional <i>C. tessellaris</i> in the southern part. There is more <i>C. tessellaris</i> on the northeast. The shrub layer is dominated by a suite of weeds predominantly Stylo, Hyptis and Branchy in varying proportions. There is some Spear Grass and other species however it is relatively sparse compared to the shrubby weeds.</p>	20
2	<p>Connectivity The patch is connected to vegetation on the neighbouring property to the north, which has a connection to an unnamed creek flowing to Serpentine Lagoon. The patch is isolated from other vegetated areas on the property.</p> <p>Vegetation The T1 layer is 12-17m with a canopy cover of approximately 25% and consists of Dallachy Gum and Ironbark with an occasional Poplar Gum. Ironbark becomes dominant to the north. T1. The T2 layer ranges from 6-10m with a canopy cover of approximately 30% and consists predominantly of T1 juveniles. The shrub layer is dominated by Stylo and Hyptis with Lessor Joy Weed and minor grasses in the ground layer.</p>	7
3	<p>Connectivity No real connectivity for the Site or surrounding areas given the separation created by the transport corridor and the extensive clearing on the Site. May have some use as a buffer.</p> <p>Vegetation <i>Grevillea striata</i> is dominant in the T1 layer and/or co-dominant with Ironbark. There is an occasional Dallachy Gum and Poplar Gum. <i>Dolichandrone heterophylla</i> and <i>Melaleuca viridiflora</i> may be present in the T2 and/or shrub layer with occasional patches of both. The ground layer is a mixture of grasses and woody weeds with various proportions across the area. The ground layer includes; Stylo, Hyptis, Spear Grass, Rhodes Grass [Feather top] and Sabi Grass. Minor occurrence of Chinee Apple and Rubber Vine on the Site with more on the neighbouring properties.</p>	6
4	<p>Connectivity Associated with Two Mile Creek and is the link to the hills to the west including unallocated state land (USL) [Lot 4 USL44323] and Mingela State Forest [Lot 1 AP19249].</p>	28

	<p>Vegetation Away from the creek line the vegetation is a mixture, in various proportions of; Dallachy Gum, Bloodwood, Poplar Gum, Ironbark and <i>Corymbia tessellaris</i>. The understory has tall Stylo and Hyptis on the creek terraces and is less robust on the upper banks. Vegetation in the vicinity of the creek has more <i>Corymbia tessellaris</i> and <i>Lophostemon grandifloras</i>.</p>	
5	<p>Connectivity Traversed by an unnamed tributary of Double Barrel Creek and tenuously connected to Patch 4 and the Two Mile Creek corridor. The patch is loosely connected to the main riparian corridor in the southern portion of the Site albeit with a cleared power line easement providing a degree of separation.</p> <p>Vegetation This consists of a mixture of Poplar Gum, Bloodwood and <i>Corymbia tessellaris</i> with minor Ironbark in places. Sabi Grass is present on the southern edges with Spear Grass in internal sections. Hyptis and Stylo are generally dominant in the shrub-ground layer.</p>	10
6	<p>Connectivity Two Mile Creek and Four Mile Creek traverse the patch and provide connection to the western parts of the Site and the catchments to the east of the Flinders Highway.</p> <p>Vegetation The northern section is generally Ironbark country with some Dallachy Gum and occasional Bloodwood. <i>Melaleuca viridiflora</i> may be present in the T2/shrub layer. Stylo and Hyptis are less dominant in the understory however grasses are also relatively sparse [soil deficiency?]. Vegetation associated with the southern creeks and terraces is more diverse with <i>Melaleuca dealbata</i>, Blue Gum, <i>Corymbia tessellaris</i> and <i>Lophostemon sp.</i> These areas also have more woody weeds including Chinese Apple and Leucaena.</p> <p>Upstream Vegetation upstream [1km] on Four Mile Creek is Ironbark, Poplar Gum and Dallachy Gum and Ironbark, Dallachy Gum with the occasional Bloodwood 2km upstream.</p>	36
7	<p>Connectivity Four Mile Creek connects the Site to the eastern sections as well as to the western hills adjoining the Site. The northern tributary of Two Mile Creek also connects the patch to the eastern parts of the Site.</p> <p>Vegetation The patch has some distinct vegetation community mixes that appear to be 'controlled' by drainage lines i.e. changes between vegetation communities occur at drainage lines. North commences with Dallachy Gum and Ironbark. Changes to Ironbark and Dallachy Gum with occasional Bloodwood before Ironbark becomes dominant. Poplar Gum becomes more dominant to the south with Bloodwood and <i>Melaleuca viridiflora</i> in the understory near the southern boundary fence. Vegetation to the east has less Ironbark and a more diverse mix. The understory has various permutations and proportions of Stylo, Hyptis, Flannel weed, branchy and grasses. Grass cover varies between 5% and 90% however areas of high grass coverage are limited and more likely to be <15%.</p>	30

Notes: ¹ area is approximate hectares observed and does not coincide with areas from regional ecosystem mapping.

4.2.1 Summary results

The vegetation patches have variable upper layer characteristics i.e. T1 and T2, and are generally consistent with intact native woodland remnant and regrowth vegetation. In such a disturbed landscape all the patches have some intrinsic environmental values and especially for avifauna.

Without exception the ecological values of all the patches were compromised by the extent of exotic species in the understory. While some areas were dominated by pasture legumes i.e. *Stylosanthes spp.*, suitable for cattle grazing there were also areas dominated by Hyptis and other exotic species which had little value for either cattle grazing purposes or native wildlife.

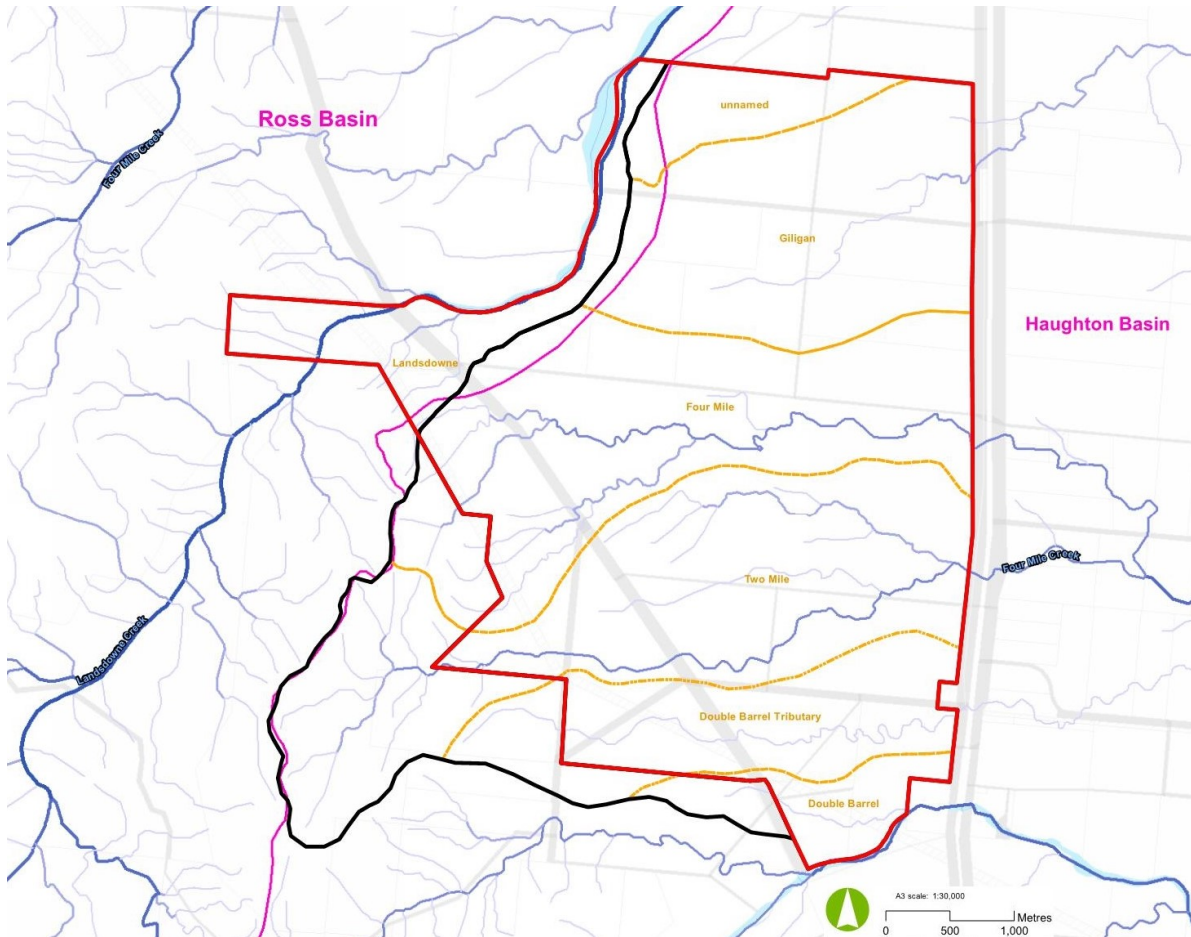
In terms of Black-throated Finch resources less than 10% of the area observed would be suitable for foraging however other species e.g. parrots, would feed on the Stylos and Amaranth family species.

4.3 The Creeks

4.3.1 Introduction

The creeks and drainage lines are one of the main environmental features with both ecological and biophysical functions that are important for the Site, as well as adjoining and downstream areas (see Figure 2-3). The main creek systems and on-site observations are summarised below in the context of the Site and connectivity to adjoining catchments (see Figure 4-3). Additional detail is provided in the Lansdown Station Site Visits Report (Earth Environmental 2018b).

Figure 4-3 Creeks and Catchments



Note: Yellow lines indicate the approximate catchment boundaries of the main creek systems [as labelled] passing through and emanating on the Site. Purple line is the Basin boundary. Map prepared by Aurecon. See Figure B7 Water Catchments and Drainage in the Map Compendium for a high resolution map.

4.3.2 Gilligan Creek

Gilligan Creek has its source on the Site with the channel becoming a defined drainage feature on the western part of Lot 19 RP901592. It then flows through the northwest corner of Lot 4 E124243 before re-entering Lot 19 to the north. The creek is well defined here and approximately 0.5m deep. The soils in this section are poor and a concreted layer is visible in the base of the creek. There is a borrow pit between the creek and fence to the west and assume this has been used to extract rock/gravel/sand for road base and/or hardstands. Soils here are mapped as Stockyard Sandy Loams with the Woodridge Gilgai Complex upstream and downstream, and what remains of the vegetation is dominated by Poplar Gum.

Gilligan Creek crosses Ghost Gum Road and enters the northeast paddock with a plunge pool on the downstream side of the causeway. The creek runs parallel to the road [east/west] for approximately 180 metres before taking a sharp turn to head north in the vicinity of a tributary joining from the south. This change in direction is geologically controlled with a higher, hardened and rocky/gravelly feature to the east. This is also an indication that the land zone is incorrectly mapped and is more likely to be land zone 12 or 11 and not alluvium i.e. land zone 3, as per regional ecosystem mapping. Soils in the northern paddock [Lot

19 RP901592] are mapped as the Manton Gilgai Complex and Gilligan Creek remains in this unit until it leaves the Site.

Gilligan Creek [flowing north] meanders across the flat and has banks generally less than 2 metres with an average height of ~1.5m. Closer to Ghost Gum Road the creek base is mostly rock and gravel with little sand. The base becomes more clayey and undulating with the occasional boggy hole where water has been laying. The clay and clay loam banks are generally stable and do not appear to be eroding. This is confirmed by the presence of bird burrows in the banks in places e.g. Striated Pardalote (*Pardalotus striatus*) [see cover photograph].

The creek continues to be meandering and undulating after it takes an easterly turn and gradually increases in size to contain the volume of water flowing across the flat landscape. One body of standing water was encountered in the vicinity of another change in creek direction from easterly flow to northerly flow and this may be underlain by a concreted layer. Whether there are sub-surface concreted layers the changes of creek direction are geologically controlled by the harder unit in the southeast corner of the paddock. After the change of flow direction the creek flows parallel to the eastern boundary of the Site, while still meandering, before leaving the Site approximately 470 metres north of Ghost Gum Road.

Fringing native vegetation is generally dominated by Poplar Gum and/or *Corymbia tessellaris* ± Bloodwood + Dallachy Gum and is confined to the near vicinity of the creek and within meander loops. There was one only one occurrence of Pandanus noted. The native vegetation is interspersed with a number of exotic species including Leucaena, which is dominant in small patches. Rubber Vine is also present along the creek, as is Chinese Apple in places. Hyptis and Stylo are present in the riparian zone and dominate the understory in places. The base of the creek is generally kept free of vegetation by the intermittent swift flows.

While the vegetation is compromised by exotic species the creek and core native vegetation is an important ecological corridor and the main conduit for stormwater flowing of the northern catchment adjoining the main Lansdowne Creek catchment. Gilligan Creek also has a hydrological function associated with the transport of breakout overflow from Lansdowne Creek during heavy falls in the upper catchment of Lansdowne Creek (see section 2.2.5).

4.3.3 Four Mile Creek

Four Mile Creek is a feature of the central section of the Site and is located south of Bidwilli Road. Part of its catchment is located in the hills to the west of the Site with the headwaters being in the adjoining Lot 4 USL44323, which is unallocated State land. A number of tributaries flow out of the hills and across Lot 44 on SP260018 before converging into two main branches/arms on Lot 87 on RP911426. The two branches pass through vegetation patch 7 (see section 4.2) and join together east of the patch. The main creek then flows in an easterly direction and leaves the Site approximately 250 metres south of Bidwilli Road.

Prior to the confluence the two branches generally have sandy beds and meander across the flats. Banks are generally 1m to 1.5m high and there are areas within the creek dominated by more silty sections with organic material. Downstream of the confluence the creek is wider and deeper, as would be expected to contain the increased volume of water. There is a pool of standing water where the creek is closest to Bidwilli Road. Concretions were observed upstream of this pool and it may also be an underlying feature of the pool preventing the water infiltrating.

Vegetation in general is limited to the vicinity of the creek line with the exception of the two vegetation patches it passes through (see section 4.2). The creek is more a hydrological link than an ecological link.

4.3.4 Two Mile Creek

The main branch of Two Mile Creek has its headwaters in the hills to west of the Site including on Lot 4 USL44323 and Lot 45 on SP260018 [Manton Quarry northern lot]. The upper catchment flow is funnelled between converging hills and by the time the creek enters the Site at the southern end of Lot 44 on SP260018 is a well-defined channel. The main branch then flows sequentially through Lot 41 on E124381, Lot 55 on E124248, Lot 51 on E124242 before entering Lot 87 on RP911426. A smaller parallel tributary arises in Lot 41 on E124381 and passes through the northwest corner of Lot 55 on E124248 before joining the main creek in Lot 87 on RP911426 near the southern boundary and approximately 700 metres from the eastern boundary.

The catchment of the northern tributary of Two Mile Creek is predominantly located in Lot 87 on RP911426 with a small part in Lot 41 on E124381. This tributary joins the main branch approximately 150 metres from the eastern boundary where Two Mile Creek leaves the Site.

4.3.5 Double Barrel Creek [tributary]

This northern tributary of Double Barrel Creek arises in Lot 45 on SP260018 and flows sequentially through Lot 41 on E124381 and Lot 64 on E124248 and then into Lot 417 on E12421 where it leaves the Site and crosses Manton Quarry Road. This creek was not traversed laterally to any extent. It is understood (pers. comm. Ron Dixon 30 May 2018) that there is a significant floodout zone in the southern paddock associated with the main Double Barrel Creek during high rainfall events in the upper catchment. It is not known if waters from this tributary join up with waters from the main channel during these events.

Available observations are provided in the Site Visits Report (Earth Environmental 2018b).

4.3.6 Lansdowne Creek

Lansdown Creek is the main hydrological feature with the largest upstream catchment. It passes through Lot 500 on E12466 and forms part of the boundary of Lot 39 on E124247, Lot 38 on E124269, Lot 31 on E124247 and Lot 20 on E124189. Lansdowne Creek is described in the Feature Areas section (4.4.3) below and in the Lansdown Station Site Visits Report (Earth Environmental 2018b).

Needless to say it is a significant environmental and hydrological feature of the Site and is an integral connecting corridor linking the coastal plains to the ranges as well as being the eastern-most catchment of the Ross Basin with cross basin linkages to the Haughton Basin.

Figure 4-4 Creeks and Catchments



4.4 Feature Areas

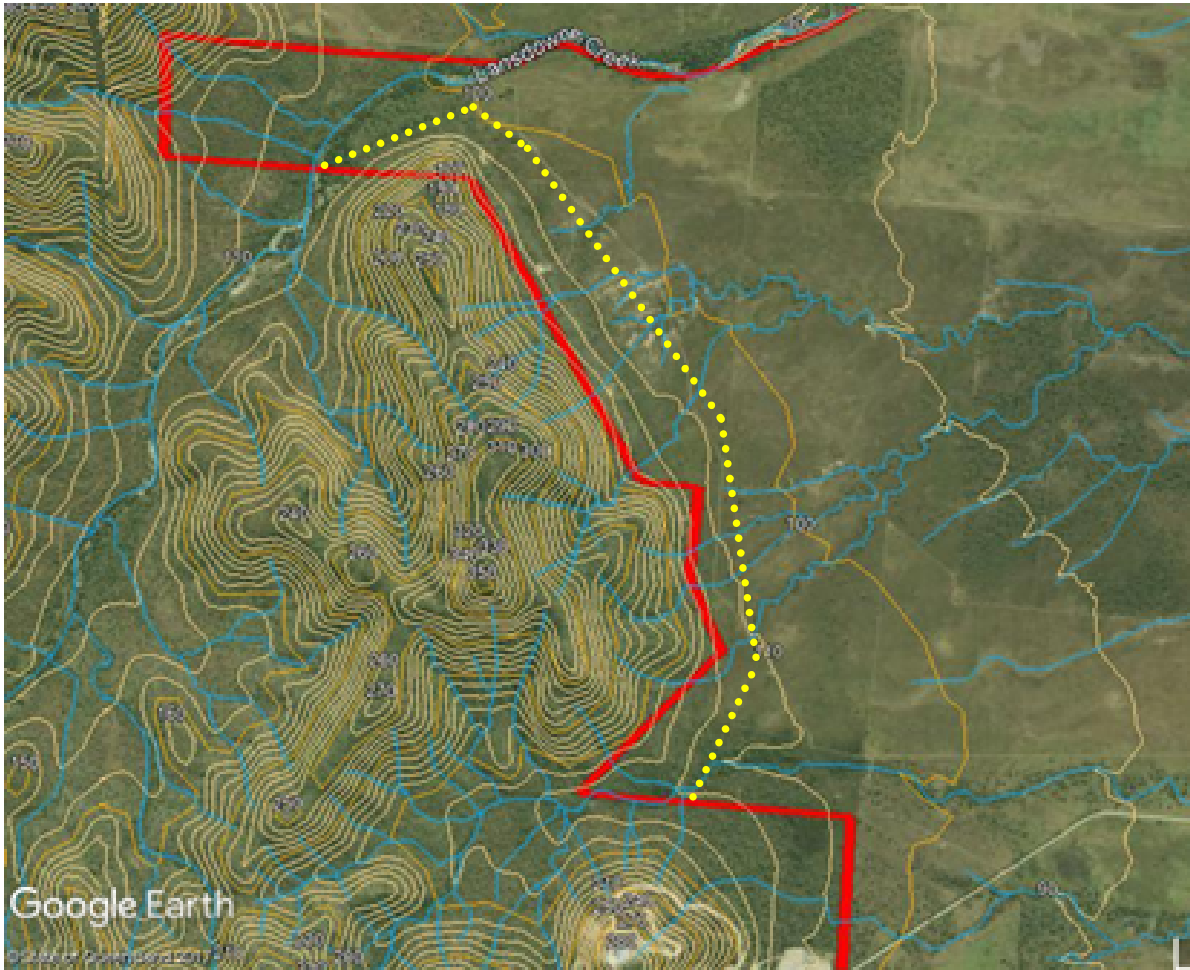
4.4.1 Introduction

The main feature areas are located on the west of the site and consist of ecotones and connections between the higher granitoids, felsites and metamorphics to the west and coastal plains. This includes the colluvial footslopes and interface between areas mapped as land zone 12 and 11 and land zone 3 (see section 3.2.1). There was no land zone 3 observed here, or on the Site in general, and this evidenced by rocky outcrops and surface expressions of angular rock in the western footslopes feature in areas mapped as land zone 3. This has implications for much of the regional ecosystem mapping on the Site and could be the basis of further assessment and amendments to the regional ecosystem mapping.

4.4.2 Western footslopes

The western footslope feature is shown on Figure 4-5 with a detailed description of this feature included in the Site Visits Report (Earth Environmental 2018b). The feature is primarily within Lot 44 on SP260018.

Figure 4-5 Western Footslopes

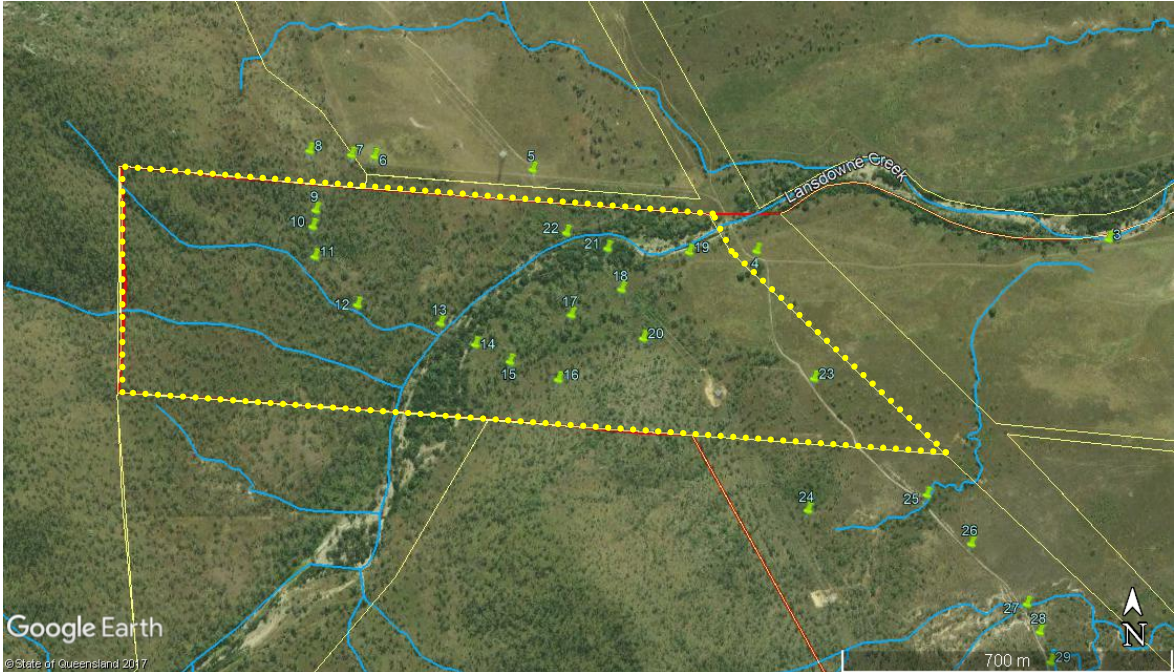


Notes: The Site boundary is red. The western footslopes feature is shown as a yellow dotted line and is bounded by the western boundary of the Site. Map prepared by [redacted] using Qld Globe and Google Earth.

4.4.3 Lot 500 E12466

Lot 500 is shown in Figure 4-6 with sample scenery shown in Figure 4-7. A more detailed description of this feature is included in the Lansdown Station Site Visits Report (Earth Environmental 2018b).

Figure 4-6 Lot 500



Notes: The Site boundary is red. Lot 500 is shown as a yellow dotted line. Map prepared by [redacted] using Qld Globe and Google Earth.

Figure 4-7 Lot 500 Scenes



5. Results and Discussion

5.1 Desktop vs Observation

5.1.1 Purpose

The site assessment was designed to gain a general understanding of the landscape and environmental features of the Site to enable a comparison with the features identified during the desktop review. As a result the fine level detail required for a comprehensive ecological and environmental assessment was not attempted and most of the observations are necessarily higher level and/or general in nature.

5.1.2 Context

The context for the comparison of material discovered in the desktop review is included in the Lansdown Station Environmental Study Background Report (Earth Environmental 2018a) while the detail associated with on ground observations is included in Lansdown Station Site Visits Report (Earth Environmental 2018b). The following is a brief discussion and summary of the results.

5.1.3 Vegetation

The vegetation communities observed on the Site were generally different to those shown on the regional ecosystem mapping. This is due in part to the likelihood that incorrect land zones have been applied to the Site, particularly in the central and western sections. This flows onto incorrect regional ecosystem (RE) codes being assigned to the vegetation communities and pre-clear vegetation. In some cases the mapped vegetation communities were similar to those observed however this is more the exception than the rule.

More detailed examination of the field notes and cross referencing with the photographs from the site visits is required to gain a better understanding of the vegetation communities to enable a more accurate designation of the RE codes. This will need to be supplemented with additional site work and a review of bore logs to delineate the extent of alluvium [land zone 3] and colluvium [land zone 12] to enable the correct land zone to be identified in the first instance.

In addition to the need to better define the location of land zone 3 and land zone 12 the site investigations showed the possibility of land zone 5 [see definition in the text box below] also being present on the Site.

Land zone 5

Short description: Tertiary-early Quaternary loamy and sandy plains and plateaus

General term: old loamy and sandy plains

Tertiary-early Quaternary extensive, uniform near level or gently undulating plains with sandy or loamy soils. Includes dissected remnants of these surfaces. Also includes plains with sandy or loamy soils of uncertain origin, and plateau remnants with moderate to deep soils usually overlying duricrust. Excludes recent Quaternary alluvial systems (land zone 3), exposed duricrust (land zone 7), and soils derived from underlying bedrock (land zones 8 to 12). Soils are usually Tenosols and Kandosols, also minor deep sandy surfaced Sodosols and Chromosols. There may be a duricrust at depth.

Duricrust is a general term for a zone of chemical precipitation and hardening formed at or near the surface usually in the presence of sedimentary layers i.e. unconsolidated or semi-consolidated material. Thickness of duricrusts ranges from a few centimetres to several metres. Duricrusts can form in a variety of situations including fluctuations in groundwater levels and sub-surface movement of mineralised water associated with periods of higher rainfall.

Duricrusts were observed in a number of creeks i.e. bed and banks, and displayed characteristics inconsistent with 'pure' alluvial material i.e. transported and deposited by rivers/streams. The angular and/or slightly rounded nature of the cemented material observed was more consistent with weathered bedrock. The duricrust layers on the Site may consist of a mixture of colluvium and/or breccia intermingled with minor alluvium and/or old Paleo channel material in places. The concretions were light in colour indicating a greater proportion of silica (SiO₂) in the 'cement' base compared to darker red/browns associated with higher iron (Fe₂O₃) concretions and/or aluminium (Al₂O₃). This would be consistent with the likely source of the mineralised water i.e. acid volcanics [high silica content], to the west of the Site.

The scale of geological mapping [originally 1:250,000] and lack of on-ground verification of the same means that this geological anomaly has not previously been identified. As the land zones of the RE

mapping are based on the available geology this will almost invariably mean the land zones are incorrect and therefore the RE codes are incorrect.

5.1.4 Essential habitat

Essential habitat is linked to the vegetation communities present on the site and as such cannot be seen as an accurate representation due to:

- The incorrect RE codes mapped across much of the Site;
- The condition of the understory vegetation and especially the prevalence of exotic species.

Further targeted, detailed work would be required to delineate the actual extent of essential habitat on the Site following the reclassification of RE codes. From the cursory observations during the site assessment it was obvious that there is less suitable Black-throated Finch habitat on the Site than indicated in the list of NAO environmental features (see Table 3-5). The possible exception includes small pockets observed on the flats and parts of the western footslopes feature. As the focus of the assessment was the remnant vegetation patches and creeks much of the Site entire was not traversed. There may also be suitable grassland habitat in the cleared areas that were not visited or observed.

5.1.5 Threatened species

Due to the high level nature and relative brevity of the current site assessment i.e. four days for 2,000 hectares, the potential extent of threatened species habitat would need to be assessed as a separate targeted study. The EPBC protected matters species list is provided in Appendix A with high level assessment notes based on the preliminary observations recorded during the site visits included in the Sites Visit Report (Earth Environmental 2018b).

5.2 Natural Assets Overlay

Environmental features from the natural assets overlay mapped on the Site are shown in section 3.5.2. Lots with the greatest area of remnant vegetation are; 87 on RP911426 [also the largest area of buffered waterways], 500 on E12466, which has 8 of 9 features including all of the state wide corridors (SWC) area, and Lot 41 E124381 [3rd largest RE extent].

Environmental features that are imbedded in the RE mapping are; Land units of limited extent (LU), Non bioregional ecosystems (NBE), Biodiversity status (BS), Wetland regional ecosystems (WRE) and Ecosystem diversity (ED). Each of these will be subject to re-assessment following the likely re-assignment of RE codes.

5.3 Information Gaps

Information gaps are mentioned briefly above with additional detail provided in the Lansdown Station Background Report and Site Visits Report (Earth Environmental 2018a and 2018b). The key information gaps and/or additional analysis of available information required includes:

1. Compilation of a pre-clear vegetation map based on original survey plans [see Background Report Attachment 2];
2. Cross-referencing CSIRO soils mapping vegetation/soils relationship with regional ecosystem (RE) mapping to determine potential REs on the Site post initial clearing [1883 to 1961] and prior to CSIRO clearing i.e. 1962 to 2002;
3. Review of bore hole logs to identify;
 - a. the [potential] location of aquifers and groundwater resources,
 - b. land zone extent particularly land 12, zone 5 and land zone 3,
 - c. the relationship/s between soils and land zones,
 - d. the relationship between groundwater resources and land zones,
 - e. the likely location of Quaternary alluvium compared to recent alluvium and duricrusts,
4. Site work to gather additional information with regard to land zones e.g. surface expressions of colluvium and other non-alluvial rock and gravel, and concretion types;
5. Cross-referencing site visit results with 1 to 4 [above] to enable a more accurate representation of the land zones and subsequently the vegetation communities [RE codes] present on the Site and previously cleared;
6. Redefinition of the regional ecosystems and land zones through the preparation of a property map of assessable vegetation (PMAV) [**Note:** The natural assets overlay is based on regional ecosystem mapping],
7. Redefinition of natural asset overlay environmental features based on tasks 1 to 5 [above] including for;

- a. Land units of limited extent,
 - b. Wetland regional ecosystems,
 - c. Biodiversity status,
 - d. Black-throated Finch habitat [draft],
 - e. Ecosystem diversity,
 - f. Essential habitat [NC Act].
8. Additional site work in areas not traversed as part of this study to identify the potential presence of Black-throated Finch (BTF) habitat (see Figure 5-1) and re-assess areas identified as potential BTF habitat during the current site assessment to provide a more conclusive assessment of BTF and other threatened species habitat e.g. Squatter Pigeon,
 9. In light of the tasks above, assess the likely presence of habitat for protected matters species listed under the EPBC Act with cross-reference to Queensland's Essential habitat.

Figure 5-1 Weed Compromised BTF Habitat



6. Conclusion and Recommendations

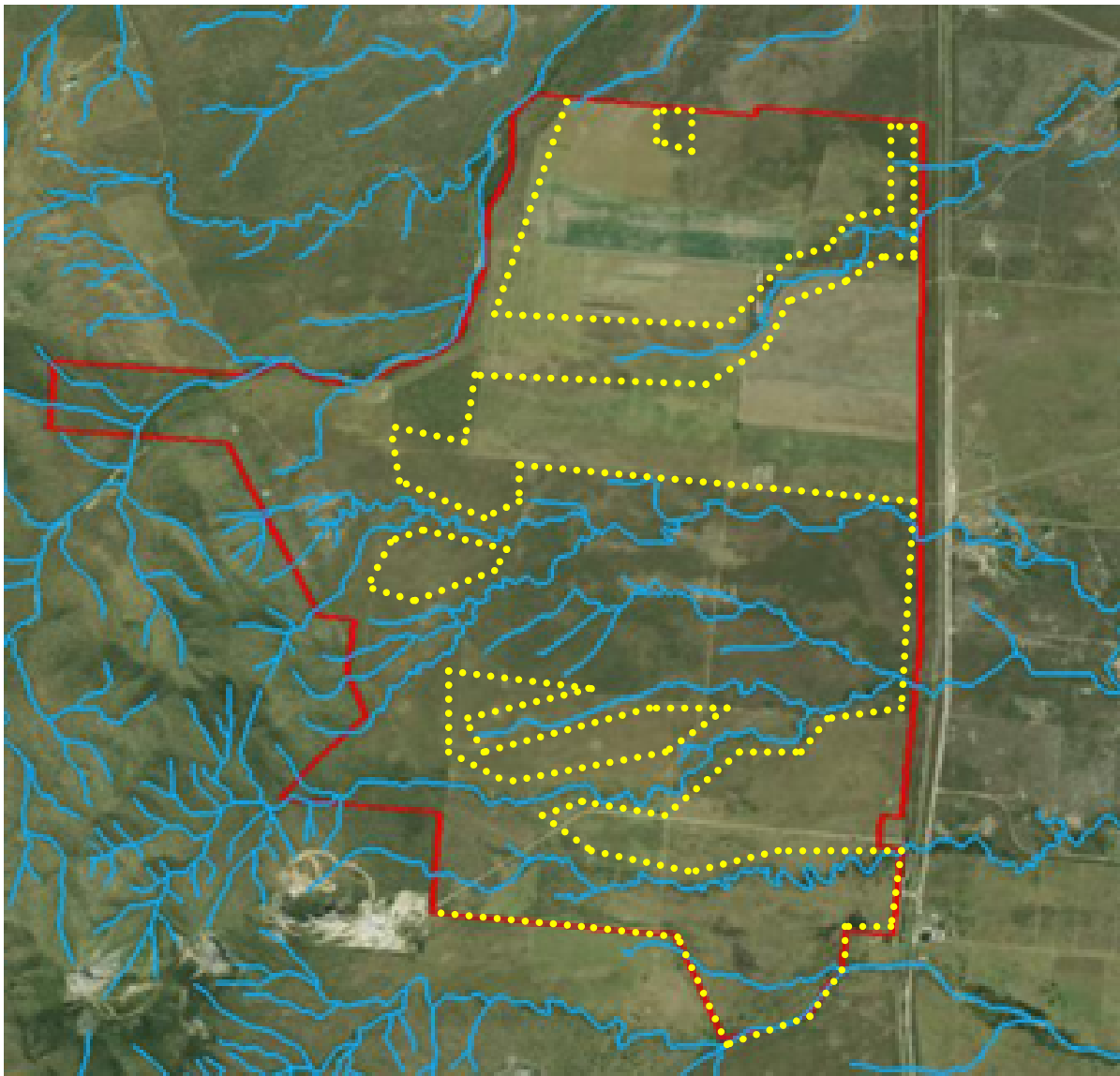
6.1 Areas Worthy of Protection

6.1.1 High level concepts

The high level concepts associated with natural assets protection are briefly outlined in the Natural Assets Planning Scheme Policy (PSP) along with an explanation of the environmental features imbedded in the Natural Assets Overlay (NAO). The concept of environmental infrastructure was introduced in the report titled *Sustainable Environmental Infrastructure in the Townsville City Planning Scheme* (Earth Environmental 2014a). Environmental infrastructure encompasses the full range of environmental features in the NAO along with other underlying biophysical and hydrological functions e.g. recharge and discharge areas. These are included in Appendix D of the Background Report (Earth Environmental 2018a).

Taking into account the concepts associated with environmental infrastructure an indication of the areas that may be worthy of protection on the Lansdown Station site are shown on Figure 6-1.

Figure 6-1 Environmental Protection Areas



Note: The Site boundary is red. A high level indication of potential environmental infrastructure protection areas is shown as a yellow dotted line and has a border with the Site's western boundary. Map prepared by [REDACTED] using Qld Globe and Google Earth.

6.2 Environmental Infrastructure Components

6.2.1 Core areas

Core areas with environmental values that are worthy of protection include the majority of the areas mapped as remnant vegetation and regrowth. This is not purely a function of the condition of these areas rather it is due to the limited extent of vegetation remaining as a result of the extensive clearing by CSIRO during the development of the Site as a pasture research facility. Due to its limited extent i.e. approximately 16% of the Site, the remaining vegetation is important core habitat refugia and is an integral part of the ecological connectivity across the Site and with adjoining areas.

6.2.2 Connectivity

Connectivity within the Site and to adjoining areas is probably even more important than the core areas again due to the extensive clearing of the Site. Connectivity is provided principally by the creek systems with upstream and downstream connections, although the downstream connectivity is compromised by the road and rail corridor.

Connectivity is also provided by the lateral strips of remnant vegetation, particularly in Lot 87 on RP911426, and this becomes more important for the Site, and potentially for surrounding areas, given the disconnect associated with road/rail corridor.

The western footslopes feature is also an important connectivity area and also functions as a buffer to the neighbouring high value ecological areas to the west.

6.2.3 Hydraulic function

Water and where it flows and pools is an important part of the broader environmental infrastructure package required to maintain physical processes and ecological function. It is also important in terms of flood management and risk reduction for development activities. One significant hydraulic feature of the Site was identified during the study i.e. Lansdowne Creek breakout to the Gilligan Creek catchment, that requires consideration for inclusion in the environmental infrastructure protection area.

6.2.4 Buffers

Buffers are required for a variety of purposes including to protect areas of core habitat and ecological corridors. Without adequate buffers the integrity of core areas and corridors can be compromised especially where the length to width ratio of a feature is high i.e. edge effect, as with corridors.

For this study buffers have been applied principally along the waterways to:

- Ensure an adequate extent of riparian vegetation is maintained to enhance the intrinsic values of the waterways;
- Enable future meandering by the creeks in a protected 'envelope';
- Protect the integrity of the main ecological corridors;
- Maintain hydraulic capacity and floodout areas [in part and subject to detailed investigation].

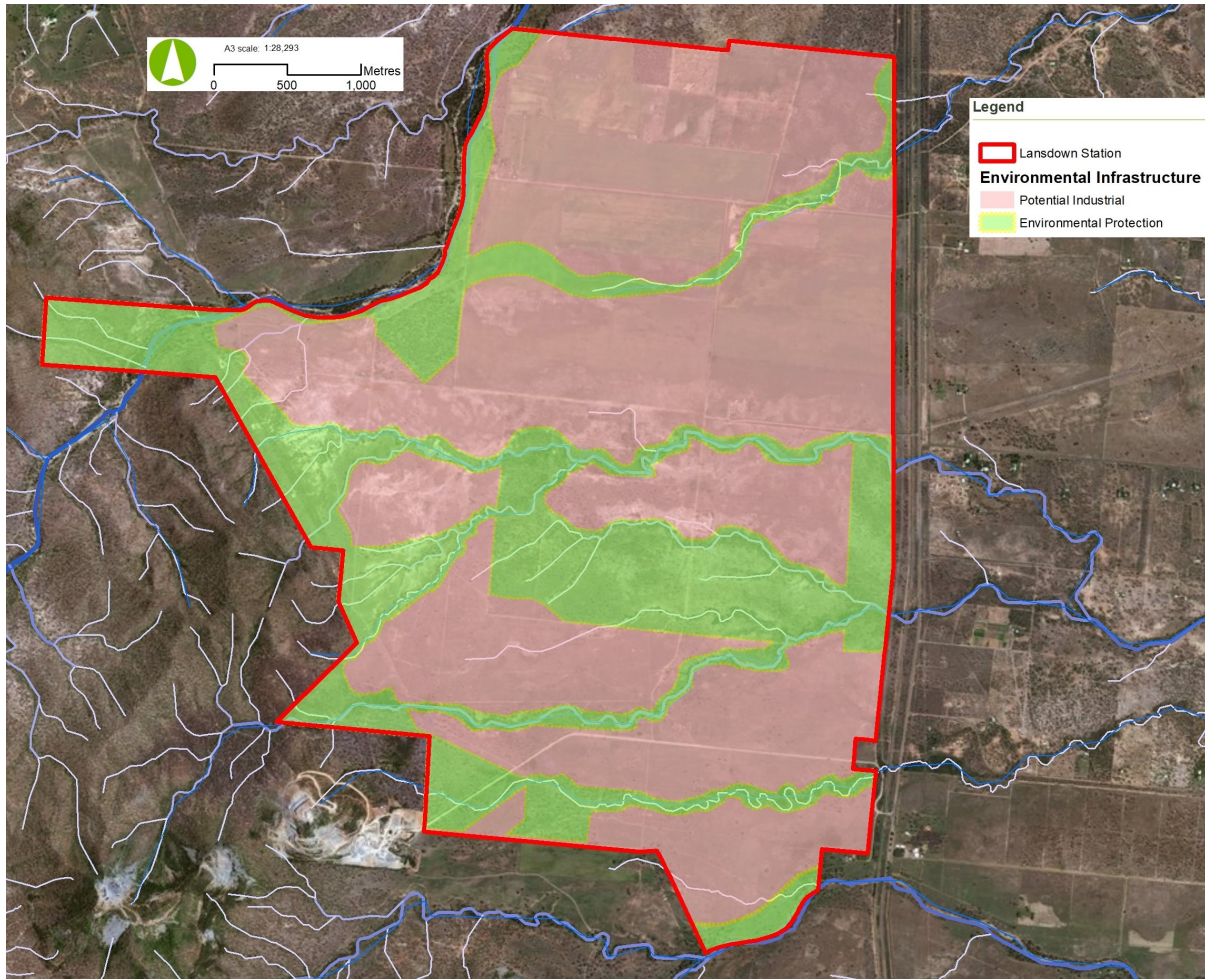
In terms of development, buffers may also be required to separate environmental features and areas from industrial activity and to ensure stormwater drainage and/or potential for flood mitigation is not compromised by placement/incursion of built infrastructure. Determining the appropriate location of such buffers will necessarily be a function of development assessment processes.

6.2.5 Combined components

For the purposes of this study core areas, connecting corridors and buffers have been combined to create a [mostly] joined up environmental infrastructure protection area. The draft environmental infrastructure map determined through this study is shown Figure 6-2. The area identified as Environmental Protection [important environmental infrastructure] totals 680 hectares. The larger joined up area is 664 hectares with another 16 hectares being a separate Double Barrel Creek buffer. In terms of Basins 117 hectares is in the Ross Basin [Lansdowne Creek catchment] with 547 hectares in the Haughton Basin.

Based on the protection of the identified environmental infrastructure alone the remaining potential area for industrial development is 1,380 hectares.

Figure 6-2 Environmental Infrastructure



Note: Map prepared by Aurecon [see Figure B13 Environmental Infrastructure in the Map Compendium].

Base maps used for the Background Report and to assist with the preparation of the draft environmental infrastructure map are provided in the Map Compendium (see map key table in Appendix B).

6.3 Catchment Management

6.3.1 Strategies

Specific measures to ensure that future industrial development within the Lansdown Station site does not impact Serpentine Lagoon or other downstream features have not been formulated as part of this study. The identification of the environmental infrastructure protection area and incorporation of this area in an amendment to the Townsville City Plan should be sufficient to prevent detrimental downstream impacts if the environmental protection areas are adopted in full.

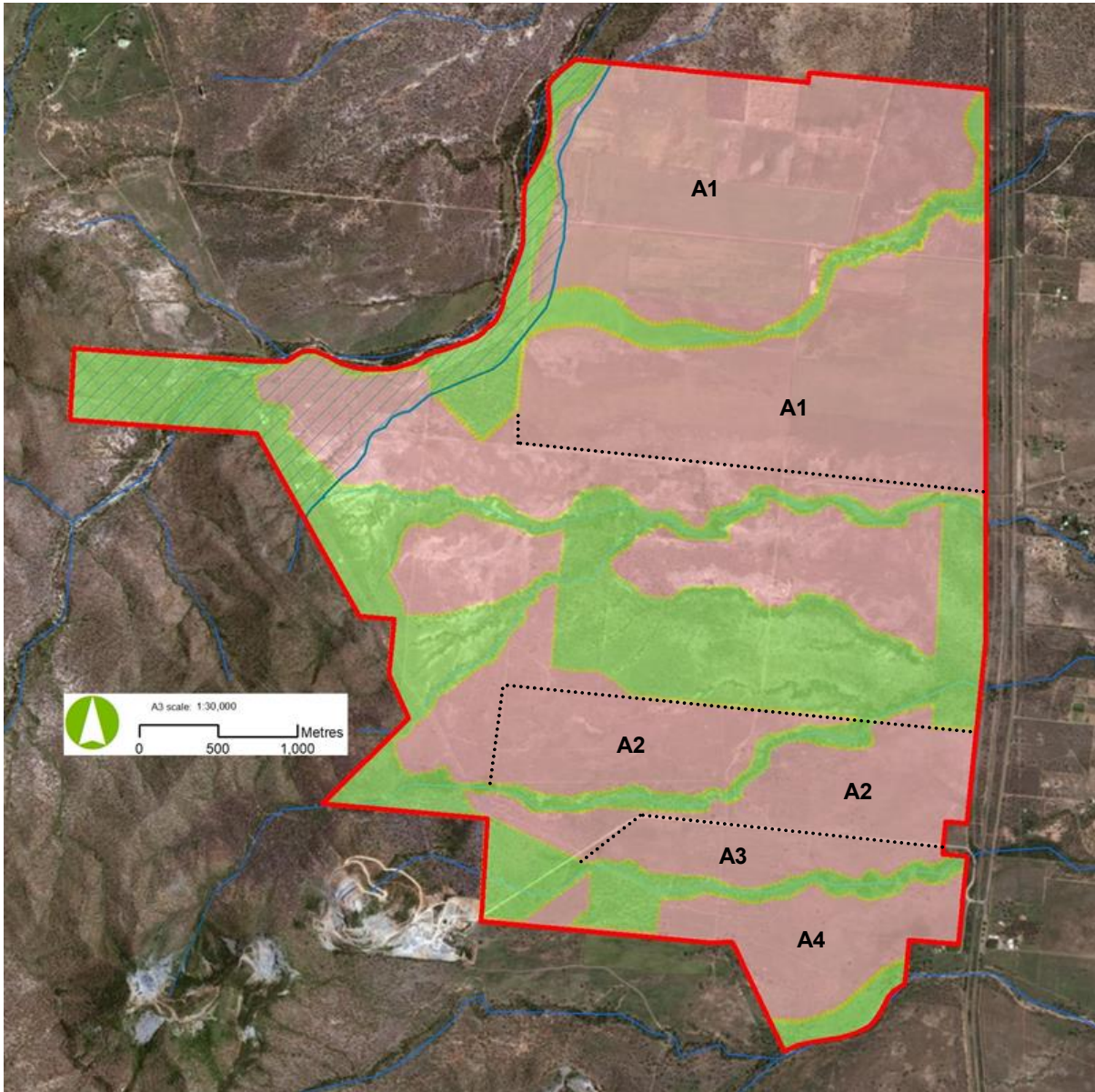
The mapped environmental infrastructure protection area (see Figure 6-2) includes environmental, ecological and hydrologically important Site features. This has been compiled from a catchment system perspective and is the principle strategy to protect downstream catchment features while maintaining connectivity and/or providing buffering to surrounding catchments.

6.3.2 Ross Dam catchment protection

A specific measure to ensure there are absolutely no impacts from any industrial activity at the Lansdown site on the raw water entering Townsville's main water supply would be to include an industrial activity exclusion area in the Ross River Dam [water resource] catchment. In reality this would only be relevant to high impact industry and a more appropriate designation may be an "industrial impact investigation area" as

illustrated in Figure 6-3. An explanation of this approach, including any new or revised Performance outcomes and Acceptable outcomes, would need to be included in the Water resource catchment overlay code [8.2.9].

Figure 6-3 Ross Dam Catchment Protection



Notes: Map prepared by Aurecon [see Figure B14 in the Map Compendium]. The green indicates the proposed Environmental Infrastructure Protection Area and the pink is the potential Industrial area. The blue line is the Ross Basin boundary. The blue striped area is the potential industrial activity exclusion area i.e. the Ross Dam catchment protection area. Numbers refer to the discussion of potential industrial rezoning areas in section 6.4.4.

6.3.3 Groundwater

Implementing the environmental infrastructure protection area will assist with the protection of groundwater resources, particularly the western colluvium and creek line infiltration, however it is not the complete solution. The protection of groundwater resources from future industrial activities will necessarily be a function of detailed investigations associated with the development assessment process.

The need for the adequate investigation of potential impacts should be discussed with development applicants prior to environmental impact assessments being undertaken and a suitable plan for assessment agreed.

If possible bore log details should be obtained from CSIRO as they had up to 30 bores on the Site when the full Lansdown Research facility was operating. If this is not possible then drill holes will be required to log the soil profiles, underlying geology and potential groundwater resource depths.

6.4 City Plan Amendments

6.4.1 NAO matters of local environmental significance

Matters of local environmental significance (MLES) have been incorporated in the most recent (2016) amendments to the Natural Assets Overlay (NAO) however this may not have been included in recent minor amendments to the Townsville City Plan. Regardless of whether the NAO amendments have been included in the City Plan the first logical step is to include the identified Lansdown environmental infrastructure protection area in the NAO MLES feature layer.

MLES in the NAO is currently rated as having High environmental importance and this would be the principal mechanism to provide for the protection of the identified environmental features on the Site without the need for any rezoning of these areas. Regardless of the zoning the High and Very high environmental importance areas in the NAO need to be comprehensively addressed as part of any development assessment process.

Updates to the documentation associated with NAO is required to ensure the MLES overrides other environmental features and cannot be negated on the basis of physical condition or feature interpretation.

6.4.2 NAO updates

Future amendments to the planning scheme will require, as an initial step, an update to NAO components including:

- Natural Assets Overlay MLES feature layer;
- The Natural Assets Overlay Code to reflect the changes associated with MLES;
- The Natural Assets Planning Scheme Policy to explain the principles and assumptions associated with MLES and its position in the hierarchy of environmental importance ratings.

6.4.3 Environment and conservation zoning

As mentioned the western side of the Site had previously been identified (Earth Environmental 2014a) as an area to investigate for potential inclusion in the environment and conservation zone. The western section adjoins a part of Mingela State Forest and abuts a USL block. This study has shown that this part of the Site contains the most significant environmental values and as such it may be appropriate to include the western footslopes feature in the Environment and conservation zone to provide an added element of protection.

In terms of inclusion of the whole of the environmental infrastructure protection area identified on Figure 6-2 it is not deemed appropriate given the highly disturbed nature i.e. mostly weed infestation, of much of the area.

6.4.4 Industrial zoning

The section of the Site north of Bidwilli Road [A1] (see Figure 6-3) is seen as the most appropriate area to rezone for industrial land use. This northern section of the Site is constrained to some extent by Gilligan Creek including the Lansdowne Creek breakout pathway and detailed stormwater/flooding investigations will be required as part of any development approval to determine a safe buffer for this feature.

The area north of Manton Quarry Road and south of Lot 87 RP911426 [A2 on Figure 6-3] i.e. Lot 55 E124248 and Lot 51 E124242, also appears to be a good area for rezoning to industrial land use with minimal environmental constraints and relatively large areas. These lots were not investigated as they did not have any noticeably significant environmental features apart from being dissected by Two Mile Creek, which has been buffered and included in the environmental infrastructure protection area. In addition to this creek buffer the tributary of Two Mile Creek in the western part of this area [A2] will require additional investigation as part of any proposed development to determine the stormwater management requirements associated with this drainage feature including whether a buffer is required for erosion prevention purposes.

The area south of Manton Quarry Road to the buffered edge of the Double Barrel Creek tributary [A3 on Figure 6-3] is also relatively devoid of important environmental features and another potential area for rezoning to industrial land use.

The area between Double Barrel Creek tributary and Double Barrel Creek [A4 on Figure 6-3] i.e. the southernmost section, has not been investigated and no firm opinion is provided for that area. It may be suitable for industrial purposes however it was identified as being a potential floodout area of Double Barrel Creek (pers. comm. Ron Dixon, 30 May 2018) and may have limiting hydrological constraints.

6.4.5 Water resource catchment overlay

The Ross River Dam [water resource] catchment is protected from adverse impacts of development through the Water resource catchment overlay. If an industrial activity exclusion area or industrial impact investigation area is included as a further protection measure then the Water resource catchment overlay code [Townsville City Plan section 8.2.9] will need to be amended accordingly to reflect this measure.

6.5 Additional Matters

6.5.1 Environmental offsets policy

An associated environmental offsets policy needs to be prepared to accompany and strengthen the matters of local environmental significance (MLES) sub component of the natural assets overlay (NAO). This could become an integral part of the proposed Major Amendment for the Lansdown Station site or be a stand-alone project that is linked to future planning scheme amendments and include a separate planning scheme policy (PSP) linked to the *Environmental Offsets Act 2014* and the NAO.

6.5.2 Knowledge gaps

Knowledge gaps and more detailed investigations required to better define the environmental values of the Site and that may be required to inform a Major Amendment to the Townsville City Planning Scheme are listed in section 5.3.

Figure 6-4 Lansdowne Creek Fringing Vegetation



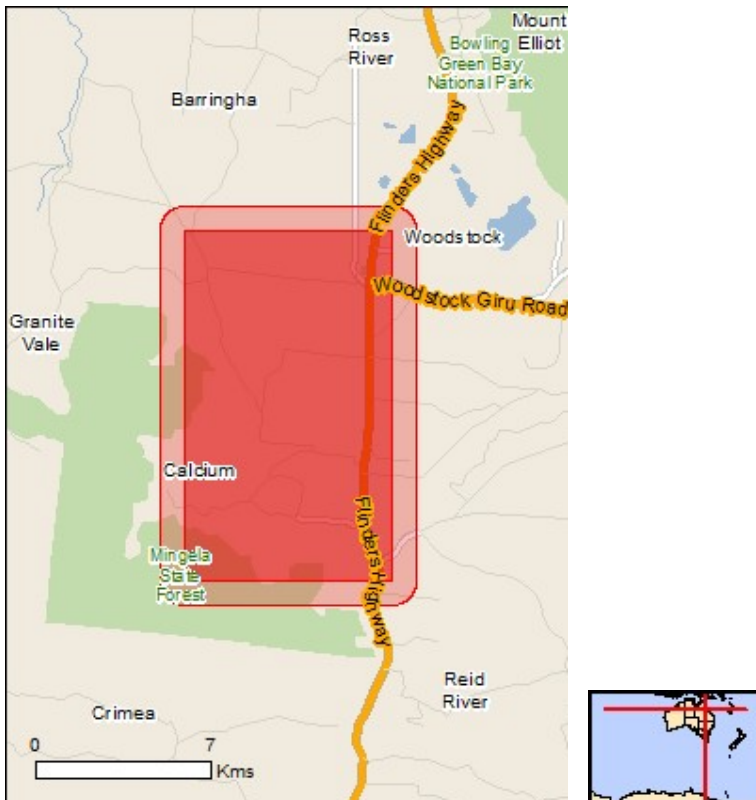
Appendix A

Threatened Species List

Appendix A EPBC Matters [Threatened Species] List

EPBC Act Protected Matters Report

Report created: 25/05/18 14:30:53



Coordinates: -19.57635 146.77267,-19.57635 146.84717,-19.69438 146.84717,-19.69438 146.77267,-19.57635 146.77267 [with] Buffer: 1.0Km

Listed Threatened Species

Common Name	Scientific Name	Status	Type of Presence
Birds			
Curlew Sandpiper [856]	<i>Calidris ferruginea</i>	Critically Endangered	Species or species habitat may occur within area
Red Goshawk [942]	<i>Erythrotriorchis radiates</i>	Vulnerable	Species or species habitat likely to occur within area
Star Finch (eastern), Star Finch (southern) [26027]	<i>Neochmia ruficauda ruficauda</i>	Endangered	Species or species habitat likely to occur within area
Eastern Curlew, Far Eastern Curlew [847]	<i>Numenius madagascariensis</i>	Critically Endangered	Species or species habitat may occur within area
Southern Black-throated Finch [64447]	<i>Poephila cincta cincta</i>	Endangered	Species or species habitat known to occur within area
Australian Painted Snipe [77037]	<i>Rostratula australis</i>	Endangered	Species or species habitat may occur within area
Masked Owl (northern) [26048]	<i>Tyto novaehollandiae kimberli</i>	Vulnerable	Species or species habitat likely to occur within area
Mammals			
Northern Quoll [331]	<i>Dasyurus hallucatus</i>	Endangered	Species or species habitat likely to occur within area
Semon's Leaf-nosed Bat, Greater Wart-nosed Horseshoe-bat [180]	<i>Hipposideros semoni</i>	Vulnerable	Species or species habitat may occur within area
Ghost Bat [174]	<i>Macroderma gigas</i>	Vulnerable	Breeding likely to occur within area
Greater Glider [254]	<i>Petauroides volans</i>	Vulnerable	Species or species habitat may occur within area
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	<i>Phascolarctos cinereus</i> (combined populations of Qld, NSW and the ACT)	Vulnerable	Species or species habitat may occur within area
Spectacled Flying-fox [185]	<i>Pteropus conspicillatus</i>	Vulnerable	Species or species habitat may occur within area
Large-eared Horseshoe Bat, Greater Large-eared Horseshoe Bat [87639]	<i>Rhinolophus robertsi</i>	Vulnerable	Species or species habitat likely to occur within area
Bare-rumped Sheath-tailed Bat [66889]	<i>Saccolaimus saccolaimus nudicluniat</i>	Vulnerable	Species or species habitat likely to occur within area
Reptiles			
Ornamental Snake [1193]	<i>Denisonia maculate</i>	Vulnerable	Species or species habitat may occur within area
Yakka Skink [1420]	<i>Egernia rugosa</i>	Vulnerable	Species or species habitat may occur within area
Plants			
Miniature Moss-orchid, Hoop Pine Orchid [6649]	<i>Bulbophyllum globuliforme</i>	Vulnerable	Species or species habitat likely to occur within area
[8635]	<i>Cajanus mareebensis</i>	Endangered	Species or species habitat may occur within area
bluegrass [14159]	<i>Dichanthium setosum</i>	Vulnerable	Species or species habitat likely to occur within area
Mt Stuart Ironbark [56188]	<i>Eucalyptus paedoglauca</i>	Vulnerable	Species or species habitat likely to occur within area
[64585]	<i>Marsdenia brevifolia</i>	Vulnerable	Species or species habitat likely to occur within area
[64586]	<i>Omphalea celata</i>	Vulnerable	Species or species habitat likely to occur within area

Appendix B

Maps

Appendix B Maps

See the separate Map Compendium

Map Compendium key

Figure	File [pdf]
B1 Location	220996_Lansdown_Figure1_locality
B2 Tenure	220996_Lansdown_Figure2_cadastre
B3 1:200,000 Geology	220996_Lansdown_Figure3_Regional_Geology
B4 1:100,000 Geology	220996_Lansdown_Figure4_Detailed_Geology
B5 CSIRO Detailed Soils	220996_Lansdown_Figure5_detailed_soils
B6 1:250,000 Drainage	220996_Lansdown_FigureB6_200k_drainage
B7 Water Catchments and Drainage	220996_Lansdown_FigureB7_catchments_drainage
B8 Pre Clear Regional Ecosystems	220996_Lansdown_FigureB8_preclear_REs
B9 Regulated Vegetation Management Map	220996_Lansdown_Figure9_RVM
B10 Regional Ecosystems and Essential Habitat	220996_Lansdown_FigureB10_proposedRE
B11 Environmental Importance Map	220996_Lansdown_Figure11_enviro_importance
B12 Environmental Importance Landscape Map	220996_Lansdown_Figure12_enviro_importance_landscape
B13 Environmental Infrastructure	220996_Lansdown_Figure13_environmental_infrastructure

Appendix C

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