

NORTHERN TERRITORY

ANNUAL REPORT 2019-20

depws.nt.gov.au/pastorallandboard

LETTER OF TRANSMITTAL

Hon Eva Lawler MLA Minister for Environment Parliament House GPO Box 3146 DARWIN NT 0801

Dear Minister,

In accordance with section 29(a) of the *Pastoral Land Act 1992*, I hereby submit for your information and presentation to Parliament, the Pastoral Land Board Annual Report into the land condition of the NT Pastoral Estate for the reporting period 1 October 2019 to 31 December 2020.

Yours sincerely

Koss

Julie Ross Chairperson



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EXECUTIVE SUMMARY

The Board is a statutory authority under the *Pastoral Land Act 1992*, made up of at least five members, including a Chairperson, appointed by the Minister for Environment. It reports annually to the Minister on the NT Pastoral Estate, which is held over 224 pastoral leases in 11 pastoral districts.

Rangelands Monitoring Officers, Department of Environment, Parks and Water Security, use on-ground field data, remote sensing satellite monitoring and first-hand accounts from land managers to compile an assessment on land condition at the property, landscape and regional scales. The Board uses this information to make its annual report on the condition of pastoral land.

This covers a period of 15 months from October 2019 to December 2020. At the pastoral district level, the Roper, Katherine and Sturt Plateau districts experienced low to average rainfall and modelled pasture growth was consistently low when compared to average pasture growth. Large areas of these districts also showed below average vegetation cover in late 2020 when compared to the previous years since 1988. There were occasional pockets of above average vegetation cover, which correlated with localised rainfall.

The Gulf, Barkly, VRD and the Northern and Southern Alice Springs districts displayed varied and patchy conditions for the reporting period. Rainfall was sporadic and modelled pasture growth ranged from very much below average to pockets of very much above average in most districts. These districts had a high degree of variability in vegetation cover ranging from very much below average to very much above average when compared to the previous years since 1988.

The Darwin, Plenty and Tenant Creek districts largely displayed average condition, with the Darwin district showing greater variability, including above average rainfall and modelled pasture growth.

Fires affected areas in the Gulf, Roper, Darwin, VRD and Katherine districts during the reporting period. When considered in isolation, there was a strong correlation between fire occurrence and below average vegetation cover and areas of bare ground.

Monitoring was undertaken at 157 sites on 24 pastoral leases in eight pastoral districts; 51 sites were assessed as Excellent / Good condition, 83 were assessed Fair condition and 23 were assessed as Poor condition. The results from targeted monitoring sites verified the modelling to support this report and were considered by the Board to be representative of the condition of the Territory's pastoral land. In particular, it highlighted that some pastoral land is in a condition that requires active recovery measures to be implemented to respond to combined poor seasonal conditions and land management practices.

The Board held 12 meetings and considered 12 out-of-session briefings. It met in Darwin and Alice Springs and visited pastoral stations in the Tennant Creek pastoral district during the reporting period. The Board reviewed policy matters and considered new initiatives including voluntary management plan processes, the pastoral land clearing guidelines, efficiency programs and delegation of powers. The Board issued 23 land clearing permits, three non-pastoral use permits for agriculture and horticulture, and three variation permits.

CONTENTS

LETTER OF TRANSMITTAL	I
EXECUTIVE SUMMARY	Ш
CONTENTS	1
CHAIRPERSON'S FOREWORD	2
MEMBERSHIP	3
FUNCTIONS OF THE BOARD	4
LAND CONDITION	5
PASTORAL LAND MONITORING PROGRAM	6
CRITERIA USED TO ASSESS LAND CONDITION	9
2019-20 MONITORING SEASON AND PASTORAL DISTRICTS	10
PASTORAL DISTRICT REPORTS	21
DARWIN PASTORAL DISTRICT	21
KATHERINE PASTORAL DISTRICT	29
VRD PASTORAL DISTRICT	37
STURT PLATEAU PASTORAL DISTRICT	46
ROPER PASTORAL DISTRICT	54
GULF PASTORAL DISTRICT	61
BARKLY PASTORAL DISTRICT	67
TENNANT CREEK PASTORAL DISTRICT	74
PLENTY PASTORAL DISTRICT	82
NORTHERN ALICE SPRINGS PASTORAL DISTRICT	87
SOUTHERN ALICE SPRINGS PASTORAL DISTRICT	95
SUPPLEMENTARY INFORMATION	102
MEETINGS OF THE BOARD	103
APPLICATIONS CONSIDERED BY THE BOARD	105
BUSHFIRE ACTIVITY	107
WEED ACTIVITY	111
FERAL ANIMALS	123
APPENDICES	126

CHAIRPERSON'S FOREWORD



As Chairperson of the Pastoral Land Board, I have the pleasure in presenting the Annual Report of the Board for the period of October 2019 to December 2020.

The Board acknowledges the challenges faced by the Rangelands Monitoring team during 2020, especially with the vast restrictions placed on travel for site visits due to the COVID19 pandemic.

These restrictions also impacted the ability for the Board to meet in person, resulting in additional teleconferences to consider applications for land clearing and non pastoral uses. Late in 2020 the Board managed to meet in person in Alice Springs as well as conduct site visits in the Tennant Creek Pastoral District.

This Annual Report provides informative data on the land condition for 24 leases physically attended by the Rangelands Monitoring team across eight pastoral districts. The remaining data has been obtained through satellite imagery and assessment of changes throughout multiple years.

The Board would like to encourage all pastoralists to consider poor seasonal conditions in their business planning, and encourage understanding of expected changes in seasonal conditions through the long-term regular monitoring undertaken and data provided by the Rangelands Monitoring team.

We appreciate the professional advice received from service authorities across the NT Government in supporting our decision making.

In conclusion, I would like to thank the Pastoral Lease Administration staff, in assisting the Board to carry out its extensive work and all the Board members for their dedication and contributions to the considerations and decisions undertaken during 2019-20.

Julie Ross

MEMBERSHIP

CHAIRPERSON



Ms Julie Ross

Commenced with the Board on: 22 November 2019

MEMBERS



Dr Leigh Hunt

Commenced with the Board on: 28 September 2015



Mr Alastair Shields

Commenced with the Board on: 19 June 2019



Mr Steven Craig

Commenced with the Board on: 25 June 2002



Mr Roy Chisholm

Commenced with the Board on: 28 August 2019



Mr David James

Commenced with the Board on: 28 September 2015

EXECUTIVE OFFICERS

- Ms Jailee Kelly
- Ms Tammy Smart

FUNCTIONS OF THE BOARD

Section 29 of the *Pastoral Land Act 1992* outlines the function of the Board are:

- a. to report regularly to, and as directed by, the Minister, but in any case not less than once a year, on the general condition of pastoral land and the operations of the Board;
- b. to consider applications for the subdivision or consolidation of pastoral land and make recommendations to the Minister in relation to them;
- c. to plan, establish, operate and maintain systems for monitoring the condition and use of pastoral land on a District or other basis;
- d. to assess the suitability of proposed new pastoral leases over vacant Crown land;
- e. to direct the preparation, and monitor the implementation, of remedial plans;
- f. to monitor, supervise or cause to be carried out work in relation to the rectification of degradation or other damage to pastoral land;
- g. to monitor the numbers and effect of stock and feral and other animals on pastoral land;
- h. to monitor and administer the conditions to which pastoral leases are subject;
- ha. to consider and determine applications for permission to use pastoral land for a non-pastoral purpose in accordance with Part 7;
- j. to make recommendations to the Minister on any matter relating to the administration of this Act;
- k. to hear and determine all questions, and consider and make recommendations on all matters, referred to it by the Minister; and
- m. such other functions as are imposed on it by or under this or any other Act or as directed by the Minister.

Other functions outlined in the Act include:

- to determine applications for clearing pastoral land;
- to determine applications for non-pastoral use of pastoral land under Part 7;
- to consider breaches of conditions referred by the Minister;
- to consider and make recommendations to the Minister on application for conversion of term pastoral leases to perpetual tenure;
- to consider and make recommendations to the Minister on application for consent to transfer a pastoral lease or sub-lease should the advice of the Board be sought; and
- to administer the access provisions of the Act, including nomination of access routes under Part 6.

LAND CONDITION

Land condition is an assessment of vegetation and soil health as indicated by ground cover species composition, tree and shrub density, abundance of invading plants (native and exotic), soil surface condition and soil erosion. These attributes are assessed relative to land in near-pristine condition.

The main influences on land condition are grazing by domestic, native and feral grazers, fire and combinations of the two. Grazing is managed by manipulating stocking rate, stock water distribution, feral grazing control and fire. Fire on its own can change land condition by being too frequent or too infrequent over a long period of time, but its main effect on land condition is through changing the distribution of grazing as grazers prefer younger grass.

Implementation of management plans to address land condition issues

In cases where land condition issues are identified on a pastoral property, the Board may request the lessee to prepare a management plan detailing the action to be taken to address the land management issues which have been identified. It is a basic tenet of the *Pastoral Land Act 1992* that pastoral lessees acknowledge their duty to adopt sound management practises and their responsibility to address any land condition issues that may arise. In line with this philosophy, the Board seeks voluntary collaboration with pastoral lessees to address land condition issues and implementation of rehabilitation programs.

While voluntary management plans are preferred in the first instance, if the Board is of the opinion that where pastoral land has been degraded or otherwise damaged it may require a remedial management plan detailing the proposed management of the pastoral land over a specified period of time. Remedial plans need to be endorsed by the Board and are registered on the title. There are currently no remedial plans in place.

PASTORAL LAND MONITORING PROGRAM

The Department of Environment, Parks and Water Security (DEPWS) is chartered with the assessment, monitoring and reporting of land condition on behalf of the Pastoral Land Board.

Integrated monitoring program

The integrated monitoring program was introduced in 2013 to provide objective, whole of landscape reporting of changes in land cover across the pastoral estate. It comprises a network of ground based sites, incorporating the existing Tier 1 sites where suitable, with newly established ground sites appropriate to validate and inform satellite data and products.

New sites are established at or near existing Tier 1 sites to maintain consistency in the photographic and data records. In some cases, it is not appropriate to locate a site nearby due to factors such as proximity to infrastructure, land system boundaries and changes in vegetation structure and type. Where Tier 1 sites are not appropriate for inclusion in the integrated monitoring program, sites continue to be photographed to expand the Tier 1 photo archive.

The integrated monitoring program, like the previous Tier 1 system, is heavily reliant upon the knowledge and experience of land managers and lessees. Both the ground data collected and information products produced from satellite data require on-ground local knowledge and understanding to explain changes and gain a further understanding of landscape dynamics. Measured field data are used to better calibrate Landsat-derived products to Northern Territory conditions and then validate their accuracy for specific locations. The two sources of information (ground based and remote sensing) are then interpreted with regard to the knowledge and experience of practical land managers to enable reporting of land condition at property, landscape and regional scales.

As the number of revisits increase at a site, the expanding monitoring record will allow changes in the vegetation and soils, and their probable causes, to be documented.

Remote sensing of the dynamics of vegetation cover

The remote sensing or satellite based data component of the integrated monitoring program was developed through a collaborative research program between DEPWS and the Queensland Department of Environment and Science. Through this collaboration, DEPWS is contributing to an internationally recognised method for systematically monitoring change in vegetation cover and its converse, bare ground, at a range of spatial and temporal scales. The 30-m pixel size of Landsat imagery allows change in vegetation cover to be analysed at site level (1ha) through to pastoral districts (~10 000km² to >130 000km²) and the Northern Territory (~1 346 500km²). Reporting interval can be as short as two weeks over a 32-year period (1988 to current).

Fractional cover

Analyses of the dynamics of vegetation cover (conversely, bare ground) in this report is based on fractional cover. This is an estimate of the three components of land cover that can be distinguished from the spectral data collected by the Thematic Mapper instrument carried on the Landsat satellite (i.e. Landsat TM). The three components are bare ground (comprising soil, rocks and gravels), actively growing (photosynthetic) vegetation and senescent (non-photosynthetic) vegetation (including litter). This is represented in Figure 1.



Figure 1: The three components of fractional cover and the combinations illustrated in the associated ground cover photos.

The level of vegetation cover or bare ground present and its change over time is reported in three ways:

- 1. As the actual amount present during a specified period of time. For this report, this is September to November 2020, termed 'spring composite', coinciding with the latter part of the Dry season for central and northern pastoral districts and the time when early summer storms may promote pasture growth in the southern NT. It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense, early Wet season/summer storms. It is also important to carry dry feed, and associated ground cover, into the latter months of each calendar year in case there is a late start to the usual Wet season/summer and/or rains fail more generally.
- 2. As a decile rank of vegetation cover present in late 2020 (winter or spring composite) compared with that present at similar times back to 1988, a 32 year period.
- 3. The percentage area of each pastoral district having various categories of bare ground between September and November 2020 (spring composite). Categories of bare ground are:
 - minor, \leq 20% of Landsat pixel is bare ground;
 - moderate, 21% 40% bare ground in pixel;
 - high, 41% 60% bare ground in pixel; and
 - very high, > 60% of pixel is bare ground.

The number of pixels in each category are counted, multiplied by pixel area (900m² or 0.09ha) and converted to the percentage of pastoral district area.

The bare ground threshold for each district is based on the frequency distribution of all 30m Landsat bare ground fractional ground cover pixels at the end of 2020 (spring composite). A threshold was determined which represents 75% of a district's bare ground. The remaining 25% is considered to have above-threshold bare ground.

A 75% threshold bare ground value of 48% equates to 48% actual bare ground of a Landsat fractional ground cover pixel.

Rainfall

The amount, timing and effectiveness of rainfall is a major driver of the quantity, composition and quality of pastures across the NT pastoral estate. Monitoring data collected using ground and remote sensing-based methods must account for the effects of variable rainfall (seasonal quality) in understanding the impacts of stocking rates and grazing management on the vegetation resource.

Due to the large variation in annual rainfall across the Northern Territory, a comparison of location-specific rainfall against its longer term history is a useful way of illustrating recent seasonal conditions. A map of decile-ranked rainfall for the period between 1 October 2019 and 30 September 2020 is shown in Figure 2.

Fire

Fire and its effect on vegetation cover across the Northern Territory cannot be understated. This can be seasonal in the savannah landscapes of the central and northern parts of the Northern Territory or relatively infrequent and episodic in the southern arid region. Mapped fire scars and associated statistics accessible from the North Australia and Rangelands Fire Information website (<u>firenorth.org.au/nafi3/</u>) are used to report spatial and temporal information on burnt area.

Woody Cover

The density of trees and shrubs changes over time in many rangeland environments but generally at a slower rate than changes in the pasture layer. A particular issue facing long-term sustainability of the pastoral industry in some landscapes is woody thickening, which can suppress pasture growth and reduce opportunities to use fire for broad scale control of problem tree or shrub species. Two remote sensing products are being adapted to Northern Territory conditions to improve monitoring of vegetation cover dynamics. The first is a foliage projective cover product that discriminates woody cover from ground cover. The second is a probability-based model that allows ground cover under trees to be estimated. Both will allow improved monitoring of cover dynamics in woodland/savannah environments when suitably refined and validated.

CRITERIA USED TO ASSESS LAND CONDITION

Assessing land condition

Table 1 summarises how the pasture and woody layers, soil surface features and presence of any weeds are considered to assess land condition.

Table 1: Factors to assess land condition.

Land Condition	Soil	Pasture	Weed	Woodland and Shrubland
A (= Excellent) All of these features	No erosion and good surface condition	Good coverage of palatable perennial grasses in the north and annual forage species in the south, minimal bare ground in most years	No weeds	No signs of woody thickening
B (= Good) At least one or more of these features	Minimal evidence of previous erosion or of current erosion risk	Some decline in the presence of palatable grasses and other forage species, a small increase in bare ground	Small infestations of weeds	Some thickening in the density of woody plants
C (= Fair) One or more of these features	Evidence of past erosion and/or current susceptibility to erosion	General decline in palatable perennial and annual grasses, obvious increase in the amount of bare ground	Obvious presence of weeds	General thickening in the density of woody plants
D (= Poor) One or more of these features	Severe erosion, scalding or compaction resulting in a hostile environment for plant growth	General lack of palatable forage species	Large weed infestations covering significant areas	Thickets of woody plants that cover significant area

2019-20 MONITORING SEASON AND PASTORAL DISTRICTS

The Rangeland Monitoring Branch within the Department of Environment, Parks and Water Security visited 24 pastoral leases across eight Pastoral Districts. The number of stations inspected in 2019-20 was lower in comparison to previous years, due to the COVID-19 pandemic. Assessed land condition for each district is summarised in this section. This overview is drawn from the analysis of vegetation-cover dynamics based on Landsat imagery, data collected at 157 integrated monitoring sites and more general assessment of land condition during lease visits.

The criteria and methods used to monitor land condition are explained on pages 5 to 9.

Seasonal conditions

Seasonal conditions for 2019-20, based on rainfall amount compared with the long-term record (Figure 2), were:

- Below-average to lowest on record for large areas of the Northern Territory.
- Most of the northern Barkly, Sturt Plateau, Northern Alice Springs, and the southern VRD Districts had lowest on record conditions.
- Most of the Roper, Southern Alice Springs, and Tennant Creek Pastoral Districts had below average rainfall.
- The Plenty Pastoral District had average to above-average rainfall and the central and western part of the Gulf Pastoral District had average conditions.

Assessing land condition

Land condition was assessed using a combination of remotely sensed (satellite) and field (site) data, and lease inspection. Landsat data are processed to indicate the proportions of vegetation cover (photosynthetic and non-photosynthetic) and bare ground in each pixel, an area of 0.09ha. Change in each component can be examined since 1988 providing important information on cover dynamics over the last 32 years.

It is important that pastoral land managers maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense summer storms. It is also important to carry dry feed, and associated ground cover, into this period in case there is a late start to the usual wet season / summer rains and/or monsoonal rains fail more generally.

Total rainfall for the 2019-20 reporting period was below average to average for most of the eleven Pastoral Districts (Figure 2). Decile ranked total cover for the winter seasonal composite image for 2019 and 2020 is shown in Figure 3. The decile ranked total cover provides an indication of how the current season compares against a constant baseline 1988-2020 and indicates that total vegetation cover was below to lowest on average over large parts of the NT. There was a decrease in areas with well below average vegetation cover in a number of the Districts (e.g. Barkly, Gulf) in 2020 when compared with the previous year (2019). However large areas were still well below the long-term average.

Figure 3 shows the contrast and relative change in levels of vegetation cover (conversely, bare ground) across the NT over one year, the extent and significance of fire on the dynamics of vegetation cover and, within individual pastoral districts, the influence of rainfall on the amount of cover present.



Figure 2: Decile ranked rainfall for the October 2019 to September 2020 period (Source Bureau of Meteorology)



Figure 3: Decile ranked total cover for winter seasonal composite images for June to August 2019 and 2020.

Understanding seasonal effects on land condition

The amount of forage available for grazing or level of ground cover present to protect the soil surface against erosion is influenced by the quantity and effectiveness of rainfall throughout the year (or Wet season in the north), and subsequent grazing and fire. The effects of rainfall variability and fire, whether episodic or recurrent, must be accounted for when assessing grazing impacts in the rangelands.

A simple framework for better understanding seasonal (mainly rainfall) effects on vegetation change is the 'seasonal quality' matrix (Figure 4). Some measure of recent seasonal quality is intersected with the direction of change for those attributes of the vegetation being monitored. In the case of remotely sensed bare ground, expected bare ground to decrease following more rainfall (better seasons) and increase in droughts (i.e. poorer seasonal quality). When it is known what is expected, it is then possible for monitoring and management to focus on unexpected change. For example, at landscape and regional scales, the amount of bare ground will increase after extensive wildfire that can follow improved seasonal conditions. This is one obvious plausible explanation for unexpected change. At more local scales (water points and paddocks), an unexpected increase in bare ground may be associated with heavy stocking. A decrease in the amount of bare ground following poorer seasonal quality probably requires further investigation. It could be that areas are being temporarily spelled (protected from grazing) or the composition and/or structure of the vegetation are changing. These changes could mean recruitment of perennial species, a desirable change for the pastoral industry where such species are palatable, or longer-term thickening of woody vegetation – less desirable for grazing where competition results in reduced pasture availability.

Second Quality	Change in I	remotely-sensed ba	are ground
Seasonal Quality	Increase	No change	Decline
Above average	××	×	~
Average	×	~	√
Below average	~	✓	J J

Figure 4: Seasonal quality matrix used to interpret change in bare ground with respect to preceding seasonal conditions. The white cells with the ~ symbol represent expected change and coloured cells show unexpected change, akin to traffic lights; that is, less desirable change in the case of orange and red cells and more desirable for green cells.

Regional interpretation of change in bare ground: 2019 to 2020

This change, for bare ground, is summarised for the extent of pastoral leases in pastoral districts in Table 2. In producing this statistical summary:

• Seasonal quality is described in terms of expected pasture growth based on rainfall received, simulated using AussieGRASS (<u>longpaddock.qld.gov.au</u>). Modelled growth between October 2019 and September 2020 was ranked as a percentile of the growth for all previous 12-month periods (back to 1957).

Areas (5km by 5km grid cells) having less than 30% of their long-term modelled pasture growth were assigned 'below-average' seasonal quality. Growth percentiles above 70 were allocated to 'above-average' seasonal quality. Remaining grid cells were considered to have experienced average seasonal quality.

• Change in bare ground was arbitrarily split between 'increase', 'no change' and 'decline' according to pastoral district.

In the southern NT (Southern and Northern Alice Springs, Plenty, Tennant Creek and Barkly Pastoral Districts), 'no change' was interpreted as bare ground (for each Landsat pixel) in 2020 being within ± 15 percentage points of that present in 2019. An increase in bare ground of >15 percentage points was considered an 'increase' and a decrease of more than 15 points a 'decline'.

For remaining (central and northern) pastoral districts, change in bare ground of more than ± 5 percentage points was considered an 'increase' or 'decline' (depending on its direction).

• The percentage area of the pastoral estate in each of the nine cells (Figure 4) was then calculated for each pastoral district. The percentage areas showing unexpected change (decline in bare ground with below-average seasonal quality or increase in bare ground with above-average seasonal quality) is summarised in Table 2. Percentage areas for increased bare ground following average seasonal quality are also included. This could serve as a possible warning to where areas of future concern may lie.

If a reasonable upper limit for unexpected change is less than 5% of the pastoral area within the pastoral district, then the magnitude and direction of change in bare soil from 2019 to 2020 accorded with seasonal expectations in most pastoral districts (Table 2).

Seven Pastoral Districts recorded an increase in bare ground with above average seasonal quality (Table 2). It is likely that fire has contributed to the unexpected increase in bare ground in a number of these Pastoral Districts, given above-average seasonal quality. Fire dynamics play an important role in vegetation dynamics in these environments. The percentage of area identified with an unexpected increase ranged from 1-16%, with areas above 10% occurring in Districts where fire is a common occurrence.

The threshold used for assigning 'no change' in bare ground obviously influences the percentage area calculated as exhibiting unexpected change. This is also applicable to threshold 'bare ground' based on the frequency distribution of all 30-m pixels within each district; arbitrarily determined as the value which represents 75% of a district's bare ground.

Table 2: The percentage area of pastoral leases within pastoral districts showing unexpected change in bare ground with respect to seasonal quality between the latter parts of 2019 and 2020. Larger percentage values in the first column (e.g. >10%) serve as a possible warning of future concern. Higher values (e.g. >5%) in the second column are of greater concern; except for recent effects of fire, bare ground should not increase following above-average seasonal quality. The third (final) column is a more favourable outcome and it is useful to try and understand where and why the amount of bare ground has decreased following unfavourable seasonal conditions.

Pastoral District	Increase in bare ground following average seasonal quality	Increase in bare ground following above average seasonal quality	Decline in bare ground following below average seasonal quality
Darwin	2	12	7
Katherine	0	16	0
VRD	1	6	0
Sturt Plateau	0	2	0
Roper	0	14	0
Gulf	1	7	1
Barkly	0	0	0
Tennant Creek	0	1	0
Plenty	1	0	0
Northern Alice Springs	0	0	0
Southern Alice Springs	0	0	0

Percentage area showing unexpected change

Other indicators of land condition

The following sections provide a detailed account of other components of land condition for each pastoral district. Information is compiled on:

- Seasonal quality the spatially averaged growth percentile (from AussieGRASS) for each district as a summarising statistic of the amount and effectiveness of rainfall in growing forage for livestock,
- Extent and timing of wildfire,
- Further information on bare ground dynamics including mapped areas exceeding specified thresholds of bare ground, and
- Data collected at monitoring sites and observations made during lease inspections relevant to pasture condition, presence of weed species, tree-grass balance (e.g. woody thickening) and soil erosion.

Information from the pastoral district reports is summarised in Table 3. This table effectively provides a brief snapshot of each pastoral district.

			% PD w	ith categor	y of Bar	e Ground ³	U I I	ite Data		
Pastorat District	Au ⁻ Growth Percentile	% PD ⁴ Burnt	minor	moderate	high	very high	#" stations	Rating	#° sites	Summary of Pastoral District
	Ţ	ſ	(1	ć	C	c	c	Good	4	Seasonal quality based on AussieGRASS-modelled pasture growth, varied from much below to much above average across the Darwin Pastoral District (Map 1). The District experiences extensive and frequent fire. The total area burnt between October 2019 and September 2020 was 19 484km ² , an increase of approximately 2,266km ² when compared with the preceding reporting period (2018-19, 17 218km ²). Based on the Landsat record for the last 30 vears. most areas of reduced vegetation cover were related
Larvin	74	Ϋ́ Ϋ́	π/	73	m	D	'n	Fair	ω	to recent fire. One-quarter of the District had bare ground above 22% per 30-m pixel (bare ground threshold) late in the 2020 dry season. On-ground monitoring for land condition was conducted on twelve sites on three pastoral leases. Perennial and annual grasses dominated at the majority of sites, with bare ground, on average, comprising approximately 13.4% of total ground cover. Overall land condition at all three leases inspected during the 2019-20 reporting period were rated as Fair (C).
	(ſ	Ç	Ļ	L	c	ſ	Fair	Q	Seasonal quality, as indicated by AussieGRASS-modelled pasture growth was very much below average for the majority of the District. Approximately 22% of the District was affected by fire between October 2019 and September 2020, with the most extensive areas being burnt in May 2020. One-quarter of the District had bare ground above 26% per 30-m pixel (bare ground threshold) late in the 2020 dry season. Approximately sixty percent of
Хасле	٥	77	0	n n	n	Þ	N	Poor	-	the District had minor occurrence (< 20%) of bare ground at this time. On-ground monitoring was conducted at seven sites on two pastoral leases, with six sites rated as Fair and one site rated as Poor (D). Sites, on average, had a moderate cover of perennial and annual grasses, low bare ground, and moderate amounts of litter, as would be expected from more timbered country in this District. Forbs were a minor component of total ground cover.

3 Site Data Summary of Summary of	n stations Rating sites Pastoral District	The District experienced mostly below average seasonal quality, while some regions in the north and south Excellent 1 were average, based on rainfall and below median (17 th percentile) modelled pasture growth through the 2019-2 wet season. Eight percent of the District burnt between October 2019 and September 2020. Compared with the	last 32 years, total vegetation cover was ranked as avera for 43% of the VRD Pastoral District. Approximately 419 Good 19 of the District had vegetation cover ranked below averag to well below average, while 17% was above average. One quarter of the District had bare ground per pixel dreater than 47%, with these areas predominantly locat.	 B in the southern half of the District, which in general, recorded rainfall below the long-term median in 2019- Fair 28 20. On-ground monitoring was conducted at 58 sites or eight pastoral leases across the District. Vegetation cover on average represented just under half of the total cover for the 58 sites, with a higher proportion (on average) 	of perennial grasses, followed by annual grasses and forbs. Bare ground represented just under one third of the total cover with significant variability between sites, Poor 10 with values ranging between 1 and 76%. Litter cover als varied between the sites with values between 4 and 799 Twenty of the sites were in Good (B) condition, 28 in Fai condition and 10 sites were in Poor (D) condition.	 Modelled pasture growth generally reflected rainfall distribution across the Sturt Plateau Pastoral District, with most of the District experiencing below-average Good 10 season quality. A very small proportion of the District burnt (0.52%) between October 2019 and September 2020. Rainfall was below the long-term median and tot vegetation cover (as measured by satellite) was ranked 	 4 average (> 1 %) to above average (∠0%) for much of the District. Monitoring was conducted at 27 sites on four leases. Sites, on average, had a good cover of perennial and annual grasses, a moderate amount of litter and bar Fair 17 ground as would be expected with the more timbered la systems in this District. Pasture utilisation was generally well-aligned with pasture availability. Ten sites were assessed to be in Good (R) condition and 17 in Fair (C)
are Ground ³	very high			ц			0
ory of Ba	e high			36			M
with categ	moderat					41	
% PD \	minor					56	
% PD ²	Burnt			ω			0.1
ΔG ¹ Growth	Percentile			17			10
Pactoral	District			VRD			Sturt Plateau

,	Pastoral District	A large portion of the District experienced very much below average seasonal quality based on AussieGRASS- modelled pasture growth and below-average rainfall. Rainfall varied across the District with some areas	experiencing totals just below the long-term median, while other regions were well below. Vegetation cover was ranked as average for 43% of the District and above average for 25%. Approximately 33% of the District was ranked as having below to very much below average	vegetation cover. In total, 18% of the District burnt between October 2019 and September 2020, a reduction in nearly 50% of the area burnt when compared to the previous reporting period. On-ground monitoring for land	condition was conducted on four sites, across one pastoral lease. Sites, on average, had a good cover of perennial grasses and moderate amount of annual grasses. Overall land condition at the single lease inspected during the 2019-20 reporting period were rated as Good (B).	The Gulf coast and hinterland extending up to 100km inland experienced much below to very much below average quality based on AussieGRASS-modelled pasture growth, consistent with below average rainfall in much of the District. Fire is an important feature of this savanna region, with approximately 8% of the District burnt between October 2019 and September 2020. Total rainfall for the Gulf Pastoral District was just below the long-term median, however total rainfall was highly variable with some regions experiencing well above and others well below median rainfall. One quarter of the region had more than 30% bare ground later in the 2020 dry season. Areas of low vegetation cover were scattered throughout the District, with large areas of bare ground (>30%) associated with the highly variable rainfall distribution across the District.
ΠE	#° sites	~	19	28	10	not porting
Site Data	Rating	Excellent	Good	Fair	Poor	On-ground monitoring conducted 2019-20 rep period.
Ť	# stations		•	_		0
e Ground ³	very high		c	5		~
y of Bar	high		L	n		∞
ith categor	moderate					45
% PD w	minor	20 20				46
	% ru Burnt		ç	<u>0</u>		∞
A C 1 C 4 L	Percentile		c	ά		9
	District			Корег		Gulf

			% PD v	vith category	y of Bar	e Ground ³	71	Site Data	<u>u</u>	
District	Percentile	8 PD- Burnt	minor	moderate	high	very high	# stations	Rating s	es	burninary or Pastoral District
Barkly	27	0. 1	ć	34	44	6	0	On-ground monitoring nc conducted in 2019-20 repo period.	Seasonal quality, b varied across the E of the region cons Rainfall was below northern and sout in the north of the for the late dry sea cover was average veg below average veg ing District, representi of the District had in the late dry sea eastern half of the District burnt betw 2020.	ased on expected pasture growth, larkly Pastoral District with the majority idered average too much below average. / the long term median for both the hern Barkly with higher rainfall occurring District. Analysis of Landsat imagery ason of 2020 showed that vegetation for 48% of the District. Areas of getation cover were scattered across the ng 39% of the total area. One quarter >52% bare ground (per Landsat pixel) son, predominantly in the southwest and District. The occurrence of fire in the ww with only 0.1% of the Barkly Pastoral /een October 2019 and September
								Good	Seasonal quality b modelled pasture o average to across just under half of vegetation cover n 32% above averad	ased on rainfall and AussieGRASS- growth ranged from average to below the District. Based on Landsat imagery, the District had average levels of ecorded since 1988, with approximately as and 21% of the region had below the
Tennant Creek	35	0.07	-	19	74	~	m	Fair	long-term average fire activity records and September 20 2020. One quarte per Landsat pixel (vegetation cover. There was very little ed in the District between October 2019 20 with most fire activity in January of the District had > 53% bare ground threshold bare ground). Areas of low
								Poor	of the District. Thr Pastoral District w assessed as in eith Overall, the three condition and still	ee pastoral leases in the inproceed parts ere visited during 2020 with the 21 sites er Good, Fair or Poor land condition. oroperties inspected were in Fair (C) recovering from previous poor seasons.

Dactor	A C1 Gtb	2/10/20	% PD v	/ith categor	y of Bar	e Ground ³	717	Site Data	H 5	C. memory of
District	Percentile	Burnt	minor	moderate	high	very high	# stations	Rating	#° sites	Pastoral District
Plenty	ŝ	O	0	ć	69	17	0	On-ground monitoring conducted 2019-20 rej period.	n not Donting	The Plenty Pastoral District experienced average seasonal quality based on AussieGRASS-modelled pasture growth and lower than average rainfall, with the exception for the north-west and central regions which had average to above average rainfall. There was no incidence of fire across the District between October 2019 and September 2020. Based on the Landsat satellite records for the last 32 years, most of the District had average to above average vegetation cover, with areas of below average cover located in the east of the District, coinciding with areas experiencing lower rainfall. Just under 13% of the District had equater had >57% bare ground.
								Good	2	Much of the District experienced either average or below- average seasonal quality based on expected pasture growth (modelled using AussieGRASS), and rainfall well below the long-term median. Approximately 42% the Northern Alice Springs Pastoral District had average vegetation cover, with 40% having below to very
Northern Alice Springs	26	0.07	0	6	65	16	~	Fair	Г	of the District had more than 57% bare period of 2020 compared with previous years since 1988. One-quarter of the District had more than 57% bare ground per 30-m pixel at this time (bare ground threshold), with the majority of these areas occurring in the regions which experienced low rainfall. On-ground monitoring for land condition was conducted at 11 sites on one pastoral lease, with two sites rated as Good (B). seven as Fair (C), and two as
								Poor	Ν	Poor (D). The seasonal conditions for the lease were poor, with well below average rainfall and seasonal growth. Sites, on average, had high level of bare soil, with annual grasses the dominant vegetation cover. Pasture utilisation recorded at eight of the field sites was minimal, while three were assessed as moderately grazed at the time of the inspection.

	Summary of Pastoral District	The District experienced average to below average seasonal conditions based on rainfall and expected pasture growth (modelled using AussieGRASS). Rainfall varied across the District with large areas experiencing totals well below the long-term median. Analysis of Landsat imagery	acquired during the latter months of 2020 showed that significant regions in the District had vegetation cover very much below average vegetation cover when compared to the same period in previous years, since 1988. One quarter of the District was found to have more than 72% bare	ground per 30-m Landsat pixel. The high levels of bare ground measured from the Landsat satellite imagery were consistent with the field observations on the two pastoral leases inspected. Eighteen field sites were assessed during the lease inspections; four sites were rated in Good (B) condition. eight in Fair (C) and six in Poor (D).				
	#5 sites	4	Ø	Q				
õite Data	Rating	Good	Fair	Poor				
	# ⁴ stations		7					
e Ground ³	very high	0 4 39 57						
/ of Bar	high							
ith category	moderate							
% PD w	minor							
	% PD ² Burnt							
	AG ¹ Growth Percentile		26					
	Pastoral District		Southern Alice Springs					

- periods. The 12-month growth percentile used for the Northern and Southern Alice Springs Pastoral Districts and the Plenty District. The summer growth percentile reported elsewhere. AussieGRASS modelled pasture growth for the period November 2019 to April 2020 or October 2019 to September 2020 as a percentile of the modelled growth for all previous similar Percentile values are available for Australia on a 5-km square grid. Reported value is the spatial average of all grid-cell values in the pastoral district. -
- Percentage area of pastoral district burnt between October 2019 and September 2020. Fire scars sourced from the North Australian and Rangelands Fire Information website (firenorth. org. au/nafi3). Repeat fires in the Darwin Pastoral District means that cumulative burnt area is greater than the area of the pastoral district. 2
- satellite imagery where the fractions of photosynthetic (green) vegetation, non-photosynthetic vegetation (dry vegetation and litter) and bare ground are estimated in each 30-m square The area of bare ground present between September and November 2020 (spring composite), as a percentage of the area of the pastoral district. Bare ground is derived from Landsat very high, >60% of pixel is bare ground. The number of pixels in each category are counted, multiplied by pixel area (0.09ha) and converted to the percentage of pastoral district area. pixel (900m² or 0.09ha). Categories of bare ground are: minor, ≤20% of pixel is bare ground; moderate, 21% - 40% bare ground in pixel; high, 41% - 60% bare ground in pixel; and ო
- ⁴ Number of stations visited in the pastoral district between October 2019 and October 2020.
- ⁵ Number of integrated monitoring sites in each condition class measured in the pastoral district.



Map 1: Location of Darwin Pastoral District

Seasonal quality

The Darwin Pastoral District encompasses approximately 37 000km² and includes 23 pastoral leases.

Seasonal quality based on AussieGRASS-modelled pasture growth, varied from much below to much above average across the Darwin Pastoral District (Map 1). The District experiences extensive and frequent fire. The total area burnt between October 2019 and September 2020 was 19 484km², an increase of approximately 2266km² when compared with the preceding reporting period (2018-19, 17 218km²). Based on the Landsat record for the last 30 years, most areas of reduced vegetation cover were related to recent fire. One-quarter of the District had bare ground above 22% per 30-m pixel (bare ground threshold) late in the 2020 Dry season. On-ground monitoring for land condition was conducted on twelve sites on three pastoral leases. Perennial and annual grasses dominated at the majority of sites, with bare ground, on average, comprising approximately 13.4% of total ground cover. Overall land condition at all three leases inspected during the 2019-20 reporting period were rated as "Fair".

'Seasonal quality' describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long-term median and expected pasture growth based on rainfall received, simulated using AussieGRASS (longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 4) are based on gridded rainfall produced by the Bureau of Meteorology (<u>bom.gov.au/jsp/awap/rain/index.jsp</u>). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year thus incorporating an entire growing season. Modelled pasture growth is for the summer/wet season period November 2019 to April 2020. This growth is ranked as a percentile of the growth for all previous summers.

Table 4: Indicators of seasonal quality. Data spatially averaged for the Darwin Pastoral District.

Rainfall (m	ım)	AussieGl	RASS
2019 – 2020	1024	Growth (kg/ha)	1959
Long-term median	1267	Percentile	47

Spatially averaged rainfall for the Darwin Pastoral District was less than the long-term median (Table 4) but displayed considerable spatial variation (Figure 5, left-hand panel). Rainfall increased from the south-east to north-west (drier inland to wetter coastal areas in the west) across the District with areas near the coast in the north-west having rainfall greater than the long term median District rainfall.

Modelled pasture growth over the last summer was slightly below the long term average based on the spatial mean (Table 4). The spatial distribution of modelled pasture growth generally related to the distribution of total rainfall (Figure 5).



Figure 5: Maps of seasonal quality. Left, spatially interpolated rainfall, October 2019 to September 2020; right, AussieGRASS-modelled pasture growth for the 2019-20 summer (wet season) period as a percentage of previous summers.

Fire

The North Australian and Rangelands Fire Information website (<u>firenorth.org.au/nafi3/</u>) reports that 19 484km² burnt (53% of Darwin Pastoral District) between October 2019 and September 2020 (Figure 6). This was relatively similar to the previous two reporting periods (October 2018 to September 2019 and October 2017 to September 2018), which recorded areas of 17 218km² and 18 791km² burnt.



Figure 6: Monthly area burnt (km²) in the Darwin Pastoral District between October 2019 and September 2020.

Total vegetation cover and bare ground dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise ground loss from wind erosion and intense summer storms. It is also important to carry dry feed, and associated ground cover, into the latter months of each calendar year in case there is a late start to the usual wet season and/or monsoonal rains fail more generally.

The amount of bare ground present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare ground in each 30-m square Landsat pixel (900m² or 0.09ha) was used to report the amount of bare ground across all pixels in the Darwin Pastoral District for the end of dry season (September to November Spring composite).

Vegetation cover in the Darwin Pastoral District is strongly correlated with incidence of fire which is a recurrent (almost annual) event across the Top End region. Most areas of reduced vegetation cover, compared with the last 30 years, across much of the District were associated with recent fire (Figure 7, burnt areas shown with diagonal hatching). While large areas in the District were impacted by fire, vegetation cover for the majority of the District was ranked as average to very much above average. Thirty-seven percent of the District was ranked as average, 13% was above average, 14% much above average while 17% was very much above average (blue regions Figure 7).



Figure 7: Rank of the amount of remotely-sensed vegetation cover present from September to November 2020 against that for previous years back to 1988.

Approximately 73% of the District had minor amounts of bare ground (< 20% of the 30-m Landsat pixel) towards the end of 2020 (Figure 8). The threshold level of bare ground used for mapping purposes is selected to show at what level approximately 25% of the district is affected; for the Darwin Pastoral District, this was calculated as 22% bare ground in each Landsat pixel (mapped in Figure 9). The relationship between the occurrence of fire and higher levels of bare ground can been seen in Figure 9 which includes areas burnt earlier in 2020.



Figure 8: Percentage cumulative frequency of varying levels of bare ground in 30-m square Landsat pixels in the Darwin Pastoral District between September and November 2020. Areas with > 22% bare ground are mapped in Figure 9.



Figure 9: Parts of the Darwin Pastoral District having > 22% bare ground per Landsat pixel in late 2020. Areas burnt between January and November 2020 shown with diagonal lines. Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

Site-based monitoring

Three pastoral leases in the Darwin Pastoral District were visited in 2020. Vegetation cover of the ground layer was measured at twelve sites on the lease.

Vegetation was generally the dominant cover component at most sites with perennial grasses representing 34% (Figure 10). Litter was recorded at all sites representing (on average) 25% of the total ground cover. Bare ground, on average, comprised approximately 13% of total ground cover with one site recording 72% as a result of fire.

Perennial grasses are important because they protect the ground surface against wind and water erosion and, where palatable, provide persistent forage to carry livestock through dry times. Litter cover also protects the ground surface, assists infiltration of rain water and helps retain plant seeds in-situ.



Figure 10: Mean percentage and standard error of measured components of vegetation cover in the ground layer from 12 sites on three pastoral leases in the Darwin Pastoral District.

The majority of the 12 sites (69%) recorded minimal grazing, while a number recorded moderate levels of grazing and one site was not assessed due to the occurrence of fire (Table 5). There was no evidence of erosion recorded at any of the monitoring sites, consistent with the high cover provided by perennial grasses and litter.

Table 5: Levels of pasture utilisation recorded at 12 sites on three pastoral leases in the Darwin Pastoral District.

Pasture utilis	ation
Rank	% of sites
No grazing	0
Minimal (←25%)	69
Moderate (26-50%)	23
Moderate to heavy (51-75%)	0
Heavy (76-90%)	0
Very heavy (→90%)	0
Burnt site (not assessed)	8

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of pastoral leases traversed are summarised in Table 6. To the extent possible, these assessments are independent of the variable seasonal quality across the Darwin Pastoral District during 2019-20 (described on previous page).

Table 6: Assessed land condition at monitoring sites and traversed parts of four pastoral leases in the Darwin Pastoral District.

Station	Monitoring site condition rating	Comments with regard to pastoral lease
1	Good: 3 Fair: 1	Land condition was generally assessed as being in Fair (C) condition, which is consistent with the previous monitoring conducted in 2015. Pasture cover, species composition, including the presence of 3P grasses, and soil condition were the major factors in determining land condition ratings. The presence of weeds at some sites was the main factor in dropping land condition ratings from Good to Fair condition. Erosion was observed on several tracks, and some of the unmaintained tracks had erosion issues and as a result were not useable. Wildfire has impacted the station annually since 2000, with the mean percentage of the station burnt annually being 46%, with fires tending to occur in the more remote parts of the station. The more intensively managed area in the central part of the station were less affected by fire during this time.
2	Fair: 4	Land condition was generally assessed as Fair (C) condition, which is consistent with the previous monitoring conducted in 2017. The 2019-2020 below average wet season was reflected in pasture growth; although due to minimal grazing on the property the species composition was the factor which influenced land condition scores the most during 2020. There was a significant amount of fire activity on the lease in 2020 prior to the inspection, with 38% burning in the early dry season (April-June) and 9% burning in the late dry season (August). Fire management on the station included strategic aerial and on ground burning programmed into the early dry season to mitigate the impact of late dry season wildfires. There were isolated patches of weed infestations on the property. Weeds were found to occur mostly around areas, which showed evidence of illegal camping activity, roadsides, the railway corridor and other disturbed areas.
3	Good: 1 Fair: 3	Land condition was assessed as being in Fair (C) condition, and has declined from the previous monitoring conducted in 2015. This decline in land condition is likely to be as a result of the below average 2019-2020 wet season, which resulted in poor pasture growth. Wildfire has impacted this station annually since 2000, with the mean percentage of the station burnt annually being 57%. Fires have predominantly occurred in the southern two-thirds of the station, with the northern section remaining relatively untouched by fire. Six species of declared weeds were found during the 2020 inspection, including one class A weed and five class B weeds. Management of Mimosa (class A weed) is the highest priority and there is an active control program in place for this weed.



Map 2: Location of Katherine Pastoral District

The Katherine Pastoral District encompasses just over 19 000km². Seasonal quality, as indicated by AussieGRASS-modelled pasture growth was very much below average for the majority of the District.

Approximately 22% of the District was affected by fire between October 2019 and September 2020, with the most extensive areas being burnt in May 2020. One-quarter of the District had bare ground above 26% per 30-m pixel (bare ground threshold) late in the 2020 dry season. Approximately sixty percent of the District had minor occurrence (< 20%) of bare ground at this time. On-ground monitoring was conducted at seven sites on two pastoral leases, with six sites rated as fair and one site rated as poor. Sites, on average, had a moderate cover of perennial and annual grasses, low bare ground, and moderate amounts of litter, as would be expected from more timbered country in this District. Forbs were a minor component of total ground cover.

Seasonal quality

'Seasonal quality' describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long-term median and expected pasture growth based on rainfall received, simulated using AussieGRASS (longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 7) are based on gridded rainfall produced by the Bureau of Meteorology (<u>bom.gov.au/jsp/awap/rain/index.jsp</u>). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year thus incorporating an entire growing season. Modelled pasture growth is for the period November 2019 to April 2020. This growth is ranked as a percentile of the growth for all previous summers (back to 1957).

Table 7: Indicators of seasonal quality. Data spatially averaged for the Katherine Pastoral District.

Rainfall (m	m)	AussieGRASS		
2019 – 2020	548	Growth (kg/ha)	1554	
Long-term median	897	Percentile	6	

Spatially averaged rainfall for the Katherine Pastoral District was significantly below the long-term median (Table 7). Total rainfall varied across the District, ranging from 808 to 374 mm with the highest rainfall occurring in the northern region (Figure 11). Rainfall in the central regions of the District was significantly below the long-term median. The average total rainfall for the 2019-20 season represents two consecutive years where rainfall has been significantly below the long-term median, which is reflected in the modelled pasture growth.

Modelled pasture growth over the last summer was very much below average across the majority of the District (Table 7, Figure 11). There were some areas in the north of the region where predicted pasture growth was average to above average (Figure 11).



Figure 11: Maps of seasonal quality. Left, Spatially interpolated rainfall, October 2019 to September 2020; right, AussieGRASS-modelled pasture growth for the 2019-20 summer period as a percentage of previous summers. The grid cells on these maps are at 5km x 5km resolution (i.e. each square represents 25km²)

Fire

The North Australia and Rangelands Fire Information website (<u>firenorth.org.au/nafi3/</u>) reports that 4179km² (22% of the District) burnt between October 2019 and September 2020. Fire activity was highest in May 2020, which may reflect managed early dry-season burns or could be the early curing of grass, due to lower soil moisture as a result of the very low rainfall in the 2019-20 wet season.



Figure 12: Monthly area burnt (km²) in the Katherine Pastoral District between October 2019 and September 2020.

Total vegetation cover and bare ground dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense wet-season storms. It is also important to carry dry feed, and associated ground cover, into the latter months of each calendar year in case there is a late start to the usual wet season and/or monsoonal rains fail more generally.

Approximately 43% of the total vegetation cover for the District was ranked as average when compared back to the previous spring seasons since 1988 (Figure 13). Vegetation cover for 32% of the District was ranked as above average to very much above average, while 24% was below average to very much below average. Fire clearly contributed to some of the areas with lower vegetation cover (Figure 13, burnt areas shown with diagonal hatching), however not all areas with low vegetation cover correspond with fire. The higher levels of total vegetation cover across the District may reflect the early dry-season fires and overall reduction in burnt areas across the District in 2019-20.



Figure 13: Rank of the amount of remotely-sensed vegetation cover present in late 2020 against that for previous years back to 1988. Diagonal lines show those areas burnt between January and November 2020.

The amount of bare ground present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare ground in each 30-m Landsat pixel (900m² or 0.09ha) was used to report the amount of bare ground across all pixels in the Katherine Pastoral District.

The bare ground threshold is based on the cumulative frequency distribution of bare ground for all 30-m Landsat pixels at the end of 2020 (spring composite). The bare ground percentage corresponding to 75% cumulative frequency was selected as the bare ground threshold (Figure 14). Bare ground percentage for 75% of the district is equal to or below this threshold. The remaining 25% of the district is considered to have above-threshold bare ground.

Sixty percent of the District had minor amounts of bare ground (< 20% of the 30-m Landsat pixel) towards the end of 2020 (Figure 14). The bare ground threshold value for the Katherine Pastoral District was 26%; one quarter of the District had bare ground per pixel greater than this value (Figure 15) and includes areas burnt earlier in 2020.



Figure 14: Percentage cumulative frequency of varying levels of bare ground in 30-m Landsat pixels in the Katherine Pastoral District between September and November 2020. Areas with greater than 26% bare ground are mapped in Figure 15.
KATHERINE PASTORAL DISTRICT



Figure 15: Parts of the Katherine Pastoral District having more than 26% bare ground per Landsat pixel in late 2020. Areas burnt between January and November 2020 shown with diagonal lines. Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

KATHERINE PASTORAL DISTRICT

Site-based monitoring

Two pastoral leases within the Katherine Pastoral District were visited during 2020.

Vegetation cover of the ground layer was measured at seven sites across the two leases. Perennial and annual grasses were the dominate cover type, representing on average around 42% of the total cover Figure 16. Forbs represented the lowest cover while on average litter represented 32%, which is not unexpected given the timbered landscapes in this District, and contributed to the low levels of bare ground as a percentage of total ground cover.

Perennial grasses are important because they protect the soil surface against wind and water erosion and, where palatable, provide persistent forage to carry livestock through dry times. Litter cover also protects the soil surface, assists infiltration of rain water and helps retain plant seeds in situ.



Figure 16: Mean percentage and standard error of measured components of vegetation cover in the ground layer from seven sites on two pastoral leases in the Katherine Pastoral District.

Pasture utilisation at 43% of the integrated monitoring sites was assessed as moderate to heavy while the remaining sites were assessed as moderate to minimal grazing (Table 8). There was no evidence of erosion recorded at any of the integrated monitoring sites, however erosion was observed on both pastoral leases assessed.

Table 8: Levels of pasture utilisation recorded at seven sites on two pastoral leases in the Katherine Pastoral District.

Pasture utilisation		
Rank	% of sites	
No grazing	0	
Minimal	29	
Moderate	29	
Moderate to heavy	43	

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of the pastoral lease traversed are summarised in Table 9. To the extent possible, these assessments are independent of the variable seasonal quality across the Katherine Pastoral District during 2019-20 (described above).

KATHERINE PASTORAL DISTRICT

Table 9: Assessed land condition at monitoring sites and traversed parts of two pastoral leases in the Katherine Pastoral District.

Station	Monitoring site condition rating	Comments with regard to pastoral lease
1	Fair: 2 Poor: 1	Land condition on the station was generally assessed in Fair (C) condition. Changes in land condition scores at monitoring sites and general observations, indicate that land condition has remained fairly constant since the previous monitoring inspection conducted in 2015, where it was also assessed in Fair (C) condition. While areas affected by the 2019 wildfire had not fully recovered post a poor wet season, the presence of perennial grass tussocks indicate that condition is still fair. The presence and level of the A class weed Gamba grass has reduced marginally since the 2015 inspection and will require ongoing control and monitoring. There were a few areas where gully erosion had developed, mainly in the lower drainage areas that have not been rectified, however new erosion controls have been installed along fence lines and tracks.
2	Fair: 4	Land condition on the station was assessed (overall) as Poor (D) condition. Changes in land condition scores at monitoring sites and general observations, indicate that land condition has remained stable since the previous monitoring inspection conducted in 2015. The majority of the property had high bare ground due to high utilisation levels with some areas having a large increase in annual grass species and forbs since the inspection in August 2015. There were three species of declared class B weeds sighted in numerous areas on the station including bellyache bush, grader grass and hyptis. Although attempts have been undertaken to control these species, there are still large, widespread infestations, especially along one creek and its tributaries. There were a number of areas where gully erosion had developed and while some areas appear to be naturally stabilising, in other areas there has been no attempt to reverse or stabilise the erosion and in the some cases, a new road being created around the affected area.



Map 3: Location of the VRD Pastoral District.

The VRD Pastoral District is the largest of the eleven districts, encompassing nearly 134 000km².

The District experienced mostly below average seasonal quality, while some regions in the north and south were average, based on rainfall and below median (17th percentile) modelled pasture growth through the 2019-20 wet season. Eight percent of the District burnt between October 2019 and September 2020.

Compared with the last 32 years, total vegetation cover was ranked as average for 43% of the VRD Pastoral District. Approximately 41% of the District had vegetation cover ranked below average to well below average, while 17% was above average. One quarter of the District had bare ground per pixel greater than 47%, with these areas predominantly located in the southern half of the District, which in general, recorded rainfall below the long-term median in 2019-20.

On-ground monitoring was conducted at 58 sites on eight pastoral leases across the District. Vegetation cover on average represented just under half of the total cover for the 58 sites, with a higher proportion (on average) of perennial grasses, followed by annual grasses and forbs. Bare ground represented just under one third of the total cover with significant variability between sites, with values ranging between 1 and 76%. Litter cover also varied between the sites with values between 4 and 79%. Twenty of the sites were in Good condition, 28 in Fair condition and 10 sites were in Poor condition.

Seasonal quality

'Seasonal quality' describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long-term median and expected pasture growth based on the rainfall received, simulated using AussieGRASS (longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 10) are based on gridded rainfall data produced by the Bureau of Meteorology (<u>bom.gov.au/jsp/awap/rain/index.jsp</u>). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year thus incorporating one entire growing season. Due to the considerable north-south transition in long-term median rainfall for this large District, rainfall statistics are reported based on an arbitrary split of the region into two sub-districts (Map 3 and Figure 17).

Table 10: Recent seasonal quality for the VRD Pastoral District as indicated by spatially averaged rainfall relative to the long-term median.

Rainfall (mm)	VRD North	VRD South
2019 – 2020	633	387
Long-term median	746	468

Spatially averaged rainfall for the north and south sub-districts of the VRD Pastoral District was below the long-term median across each sub-district (Table 10). In the north of the District, totals varied across the region with above average rainfall along the coast and below average moving south (Figure 17). A number of areas in the south VRD Pastoral District had higher rainfall totals than the long-term median however for the majority of the region rainfall was below the long-term median.

Table 11: Recent seasonal quality averaged across the entire VRD Pastoral District, as indicated by modelled pasture growth.

AussieGRASS

Growth (kg/ha)	1554
Percentile	6

AussieGRASS-modelled pasture growth, as a second indicator of seasonal quality for the entire VRD Pastoral District, is for the period November 2019 to April 2020. This growth is ranked as a percentile of the growth for all previous summers back to 1957. Spatially-averaged growth through the 2019-20 wet season was well below the long-term median (Table 11 and Figure 18).



Figure 17: Spatially interpolated, gridded rainfall for the VRD Pastoral District. Reporting period is October 2019 to September 2020.



Figure 18: Simulated pasture growth for the 2019-20 wet season as a percentage of the long-term record.

Fire

The North Australia Rangelands and Fire Information website (<u>firenorth.org.au/nafi3</u>) reports that 10 837km² (8%) of the District was burnt between October 2019 and September 2020. Fire was most extensive in October to December 2019 and in April to June in 2020 (Figure 19). The majority of the area burnt between October 2019 and September 2020 was in the northern half of the District, with approximately 42% occurring on pastoral leases.



Figure 19: Monthly area burnt (km²) in the VRD Pastoral District between October 2019 and September 2020.

Total vegetation cover and bare ground dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense summer storms. It is also important to carry dry feed, and associated ground cover, into the latter months of each calendar year in case there is a late start to the usual wet season and/or monsoonal rains fail more generally.

When compared with the last 32 years total vegetation cover was ranked as average for 43% of the VRD Pastoral District. Approximately 41% of the District had vegetation cover ranked below average to well below average, while 17% was above average (Figure 20). Generally, the spatial distribution of the areas with above average vegetation cover occurred in the regions with higher rainfall.



Figure 20: Rank of the amount of remotely-sensed vegetation cover present from September to November 2020 against that for previous years back to 1988. Diagonal lines show those areas burnt between January and November 2020.

The amount of bare ground present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. Remote sensing was used to assess the amount of bare ground. The percentage of bare ground in each 30-m square Landsat pixel (900m² or 0.09ha) was used to report the amount of bare ground across all pixels in the VRD Pastoral District.

Approximately 16% of the District had minor levels of bare ground (< 20% of the 30-m Landsat pixel) towards the end of 2020 (Figure 21). The bare ground threshold value for the VRD Pastoral District was 47%; one quarter of the District had bare ground per pixel greater than this value (Figure 21 and Figure 22). Areas with >47% bare ground were predominantly located in the southern half of the District which in general, recorded rainfall below the long-term median in 2019-20.



Figure 21: Percentage cumulative frequency of varying levels of bare ground in 30-m square Landsat pixels in the VRD Pastoral District between September and November 2020. Areas with greater than 47% bare ground are mapped in Figure 22.



Figure 22: Parts of the VRD Pastoral District having greater than 47% bare ground per Landsat pixel in late 2020. Country burnt between January and November 2020 is shown with diagonal lines. Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

Site-based monitoring

Eight pastoral leases in the VRD Pastoral District were visited by monitoring officers in 2020.

Vegetation cover of the ground layer was measured at 58 sites across the eight leases. While bare ground, on average, represented just under one third of the total cover there was significant variability between sites, with values ranging between 1 and 76%. Litter cover also varied between the sites with values between 4 and 79%. Vegetation cover on average represented just under half of the total cover for the 58 sites, with a higher proportion (on average) of perennial grasses, followed by annual grasses and forbs (Figure 23).

Perennial grasses are important because they protect the soil surface against wind and water erosion and, where palatable, provide persistent forage to carry livestock through dry times. Litter cover also protects the soil surface, assists infiltration of rain water and helps retain plant seeds in situ.



Figure 23: Mean percentage and standard error of measured components of vegetation cover in the ground layer from 58 sites on eight pastoral leases in the VRD Pastoral District.

Pasture utilisation for just under half of the sites was minimal with 7% of sites having no grazing, while 45% of the sites were moderately to very heavily grazed at the time of assessment (Table 12). There was no erosion recorded across the 58 monitoring sites.

Table 12: Levels of pasture utilisation assessed at 58 sites on eight pastoral leases in the VRD Pastoral District.

Pasture utilis	ation
Rank	% of sites
No grazing	7
Minimal (←25%)	48
Moderate (26-50%)	17
Moderate to heavy (51-75%)	10
Heavy (76-90%)	9
Very heavy (→90%)	9

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of pastoral leases traversed are summarised in Table 13. To the extent possible, these assessments are independent of the variable seasonal quality experienced across the region in the current reporting cycle (described on previous page).

Table 13: Assessed land condition at 58 monitoring sites and traversed parts of eight pastoral leases in the VRD Pastoral District.

Station	Monitoring site condition rating	Comments with regard to pastoral lease
1	Fair: 3 Poor: 1	Land condition on the station was generally assessed as Fair (C) condition. Changes in land condition scores at monitoring sites and general observations, supported by satellite based products (fractional cover and bare ground threshold), indicate that land condition appeared to be declining since the previous monitoring conducted in 2015. This decline was modest and is in line with the two previous poor wet seasons. With the change in management and stocking rates these sites and general land condition are expected to improve with good wet seasons.
2	Good: 1 Fair: 3 Poor: 2	Land condition on the station was generally assessed in Fair (C) condition. Changes in land condition scores at monitoring sites and general observations supported by satellite based products, (fractional cover and bare ground threshold), indicate that land condition has slightly declined since the previous monitoring inspection conducted in 2015, where it was also assessed in Fair (C) condition. This decline was observed as an increase in bare ground and litter cover and a decrease in 3P grass cover. Non-desirable grasses and forbs also increased. High utilisation of pasture was observed throughout the property, and this in combination with three below average wet seasons has contributed to this decline. There were a few areas where gully erosion had developed and while some areas appear to be naturally stabilising, in other areas there has been no attempt to reverse or stabilise the erosion with new roads being created around the affected area, in the majority of cases.
3	Good: 1 Fair: 4	Land condition on the station was generally assessed in Fair (C) condition. The station received 320 mm of rainfall for the 2019/20 wet season; which is well below the average of 616 mm. Changes in land condition scores at monitoring sites and general observations supported by satellite based products, (fractional cover and bare ground threshold), indicate that land condition has remained fairly constant since the previous monitoring inspection conducted in 2015, where it was also assessed in Fair (C) condition. The Spinifex country in the east of the property was generally in Good (B) condition due to minimal grazing while the developed north-west was in Fair (C) condition. The developed areas had high bare ground due to high utilisation levels with some areas having a large increase in annual grass species and forbs since the inspection in May 2015. There were also areas, especially in the Barry land system which showed an increase in Aristida, an undesirable perennial grass. There was one class A and three species of declared class B weeds sighted in numerous areas of the station during the inspection. Although these species have been controlled in the past there are still areas of differing infestation sizes throughout the station.
4	Excellent: 1 Good: 4 Fair: 4	Land condition on the station was generally assessed in Good (B) condition. Changes in land condition scores at monitoring sites and general observations supported by satellite based products (fractional cover and bare ground threshold), indicate that land condition has declined since the previous monitoring inspection conducted in 2015. This decline was observed as an increase in bare ground and litter cover and a decrease in 3P grass cover. Non-desirable grasses and forbs also increased. High utilisation of pasture was observed throughout the property, and this in combination with three below average wet seasons has contributed to this decline. Three species of class B declared weeds were found during the 2020 inspection. Other weeds that have been recorded on the property in the past include the class A weeds prickly acacia and gamba grass. It is recommended that weed surveys are undertaken and a control program is implemented.

Station	Monitoring site condition rating	Comments with regard to pastoral lease
5	Good: 5 Fair: 2 Poor: 3	Land condition on the station was generally assessed in Fair (C) condition. Changes in land condition scores at monitoring sites and general observations supported by satellite based products, (fractional cover and bare ground thresholds), indicate that land condition has slightly deteriorated since the previous monitoring inspection conducted in 2015, where it was also assessed in Fair (C) condition. There has been a general decrease in perennial grass species and biomass, resulting in an increase in annual grasses and forbs. The recent poor wet seasons have contributed to these changes in pasture composition.
6	Good: 2 Fair: 6	Land condition on the station was generally assessed in Fair (C) condition. Changes in land condition scores at monitoring sites and general observations supported by fractional cover and bare ground threshold products, indicate that land condition has deteriorated since the previous monitoring inspection conducted in 2015, where it was assessed in Good (B) condition. The Mitchell grass plains were depleted due to a series of poor wet seasons but are still the most valuable grazing lands on the property. There were a few weed species present on the property but the spread of these weeds appear to be controlled, and in the case of rubber bush potentially can be eliminated. The main species of concern are Parkinsonia and Rubber bush which are scattered throughout the property. There was also a few areas where gully erosion had developed however, through mitigation and controlling access, these areas appear to be stabilising.
7	Good: 3 Fair: 2 Poor: 2	Land condition on the station was generally assessed in Fair (C) condition. Changes in land condition scores at monitoring sites and general observations supported by fractional cover and bare ground threshold products, indicate that land condition has deteriorated since the previous monitoring inspection in 2015, where it was assessed in Good (B) condition. The Mitchell grass plains were depleted due to a series of poor wet seasons but are still the most valuable grazing lands on the property. There were a few weed species present on the property however, the spread of these weeds appear to be controlled, and in the case of rubber bush, it can potentially be eliminated. The main species of concern are Parkinsonia and Rubber bush which are scattered throughout the property. There was also a few areas where gully erosion had developed however, through mitigation and controlling access, these areas appear to be stabilising.
8	Good: 3 Fair: 4 Poor: 2	Land condition on the station was generally assessed in Fair (C) condition. Changes in land condition scores at monitoring sites and general observations supported by satellite based products, (fractional cover and bare ground threshold), indicate that land condition has deteriorated since the previous monitoring inspection conducted in 2015, where it was assessed in Good (B) condition. The Spinifex country in the south of the property was generally in Good (B) condition but the pastorally productive north was in Fair (C) to Poor (D) condition. This was mainly due to an increase in annual grasses and forbs. There were a number of areas that seemed to have changed from a perennial to an annually dominated grassland.



Map 4: Location of Sturt Plateau Pastoral District

Seasonal quality

This District encompasses just over 43 000km² and includes 31 pastoral leases.

Modelled pasture growth generally reflected rainfall distribution across the Sturt Plateau Pastoral District, with most of the District experiencing below-average season quality. A very small proportion of the District burnt (0.52%) between October 2019 and September 2020. Rainfall was below the long-term median and total vegetation cover (as measured by satellite) was ranked average (51%) to above average (20%) for much of the District.

Monitoring was conducted at 27 sites on four leases. Sites, on average, had a good cover of perennial and annual grasses, a moderate amount of litter and bare ground as would be expected with the more timbered land systems in this District. Pasture utilisation was generally well-aligned with pasture availability. Ten sites were assessed to be in Good condition and 17 in Fair condition.

'Seasonal quality' describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long-term median and expected pasture growth based on the rainfall received, simulated using AussieGRASS (longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 14) are based on gridded rainfall produced by the Bureau of Meteorology (<u>bom.gov.au/jsp/awap/rain/index.jsp</u>). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year thus incorporating one entire growing season. Modelled pasture growth is for the period November 2019 to April 2020. This growth is ranked as a percentile of the growth for all previous wet seasons back to 1957.

Table 14: Indicators of seasonal quality. Data spatially averaged for the Sturt Plateau Pastoral District.

Rainfall (mm)		AussieGRAS	SS
2019 – 2020	511	Growth (kg/ha)	1124
Long-term median	623	Percentile	10

Spatially averaged rainfall for the Sturt Plateau Pastoral District in 2019-20 was below the long-term median (Table 14). While the majority of the District was below the long-term median, rainfall did vary with some areas receiving totals close to or slightly above the long-term median (Figure 24, left-hand panel).

Modelled pasture growth over the 2019-20 summer for the District was 1124kg/ha, which was at the 10th percentile. (Table 14). Predicted pasture growth for the Sturt Plateau Pastoral District reflected the low rainfall with much below to well below the average pasture growth predicted across the District (Figure 24, right hand panel).



Figure 24: Maps of seasonal quality. Left, gridded rainfall, October 2019 to September 2020; right, AussieGRASS-modelled pasture growth for the 2019-20 summer as a percentage of previous summers.

Fire

The North Australian and Rangelands Fire Information website (<u>firenorth.org.au/nafi3</u>) reports that 52km² (0.12%) of the Sturt Plateau Pastoral District was burnt over the reporting period. The majority of the area burnt in the current reporting period occurred in November 2019 (Figure 25). When compared with the previous reporting period (2018-19), the total area burnt across the District was very low.



Figure 25: Monthly area burnt between October 2019 and September 2020 in the Sturt Plateau Pastoral District.

Total vegetation cover and bare ground dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense wet-season storms. It is also important to carry dry feed, and associated ground cover, into the latter months of each calendar year in case there is a late start to the usual wet season and/or monsoonal rains fail more generally.

Figure 26 depicts the amount of vegetation present in the late 2020 dry season relative to that present at the same time each year since 1988. Areas of below average vegetation cover were distributed across the District, covering around 29% of the entire District. Approximately 51% of the Sturt Plateau Pastoral District had average vegetation cover, while 20% of the area was ranked as above average to very much above average (Figure 26).



Figure 26: Rank of the amount of remotely-sensed vegetation cover present from September to November 2020 against that for previous years back to 1988. Diagonal lines show those areas burnt between January and November 2020.

The amount of bare ground present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare ground in each 30-m square Landsat pixel (900m² or 0.09ha) was used to report the amount of bare ground across all pixels in the Sturt Plateau Pastoral District.

The bare ground threshold is based on the frequency distribution of all 30-m Landsat bare ground cover pixels at the end of 2020 (spring composite). A threshold was determined which represents 75% of a district's overall bare ground. The remaining 25% is considered to have above-threshold bare ground.

Approximately 56% of the District had negligible amounts of bare ground (< 20% of the 30-m Landsat pixel) towards the end of 2020 (Figure 27). The bare ground threshold value for the Sturt Plateau Pastoral District was 26%; one quarter of the District had bare ground greater than this value (Figure 27). While there were areas of bare ground > 26% located across the District, the majority of the region with bare ground >26% was located in the southern region (Figure 28).



Figure 27: Percentage cumulative frequency of varying levels of bare soil in 30-m square Landsat pixels in the Sturt Plateau Pastoral District between September and November 2020. Areas with greater than 26% bare ground are mapped in Figure 28.



Figure 28: Parts of the Sturt Plateau Pastoral District having more than 26% bare ground per Landsat pixel in late 2020 (threshold bare ground). Diagonal lines show areas burnt between January and November 2020. Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

Site-based monitoring

Four pastoral leases in the Sturt Plateau Pastoral District were visited in the 2019-2020 reporting period.

Vegetation cover of the ground layer was measured at 27 sites across the four leases. Sites, on average, had a good vegetation cover with perennial grasses dominant, followed by annual grasses and forbs. On average, the 27 sites had moderate amounts of litter as would be expected given the predominance of wooded land systems, and moderate amounts of bare ground (Figure 29). Perennial grasses are important because they protect the soil surface against wind and water erosion and, where palatable, provide persistent forage to carry livestock through dry times. Litter cover also protects the soil surface, assists infiltration of rain water and helps retain plant seeds in-situ.



Figure 29: Mean percentage and standard error of measured components of vegetation cover in the ground layer from 27 sites on four pastoral leases in the Sturt Plateau Pastoral District.

Pasture utilisation at the majority of sites (62%) was minimal, while 19% were not grazed at the time of assessment (Table 15). There was evidence of erosion at one of the 27 sites assessed.

Table 15: Levels of pasture utilisation assessed at 27 sites on four pastoral leases in the Sturt Plateau Pastoral District.

Pasture utilisat	tion
Rank	% of sites
No grazing	19
Minimal (←25%)	62
Moderate (26-50%)	15
Moderate to heavy (51-75%)	0
Heavy (76-90%)	4
Very heavy (→90%)	0

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of pastoral leases traversed are summarised in Table 16. To the extent possible, these assessments are independent of the average to below-average seasonal quality applying to the general area of each station.

Table 16: Assessed land condition at integrated monitoring sites and traversed parts of four pastoral leases in the Sturt Plateau Pastoral District.

Station	Monitoring site condition rating	Comments with regard to pastoral lease
1	Good: 4 Fair: 2	Land condition on the station was generally assessed in Good (B) condition. Changes in land condition scores at monitoring sites and general observations supported by satellite based products, indicate that land condition has decreased slightly since the previous monitoring inspection conducted in 2015. This decline in land condition is likely due of the below average 2018/19 and 2019/20 wet seasons, which resulted in greater bare ground throughout the property. The station had a good range of desirable species with the pasture responding as expected to the preceding poor wet seasons, although there were some areas where pasture response was very poor with evidence of tussock death.
2	Good: 2 Fair: 8	Land condition on the station was generally assessed in Fair (C) condition. Changes in land condition scores at monitoring sites and general observations supported by satellite based products, indicate that land condition has deteriorated since the previous monitoring inspection conducted in 2015, where it was assessed in Good (B) condition. There has been a general decrease in perennial grass species and biomass, resulting in an increase in annual grasses. The recent poor wet seasons have contributed to these changes in pasture composition. There has also been a noticeable decrease in the undesirable Aristida species, which are known to reduce in abundance compared to other hardier perennial species, such as Mitchell grasses, during extended periods of dry years.
3	Good: 1 Fair: 3	Land condition on the station was generally assessed in Fair (C) condition. Changes in land condition scores at monitoring sites and general observations supported by satellite based products, indicate that land condition has deteriorated since the previous monitoring inspection conducted in 2015, where it was assessed in Good (B) condition. Due to poor wet seasons and high utilisation levels bare ground has increased remarkably since the 2015 inspection. There has been a general increase in annual grass species and forbs to the detriment of the more desirable perennial species. In areas where utilisation levels were low, there was a wide variety and good cover of palatable perennial grasses with limited undesirable species. There were some areas of woody thickening especially in the cleared areas in a number of paddocks with juvenile tree density increasing since the 2015 inspection.
4	Good: 3 Fair: 4	Land condition on the station was generally assessed in Fair (C) condition. Changes in land condition scores at monitoring sites and general observations supported by satellite based products, indicate that land condition has deteriorated since the previous monitoring inspection conducted in 2016, where it was assessed in Good (B) condition. There has been a general decrease in perennial grass species and biomass, resulting in an increase in annual grasses. The recent poor wet seasons have contributed to these changes in pasture composition. Due to a number of poor wet seasons retarding growth there were also a number of areas where pasture was still recovering post fires in 2018 and 2019.



Map 5: Location of Roper Pastoral District

Seasonal quality

The Roper Pastoral District encompasses just over 42 000km² and includes eleven pastoral leases.

A large portion of the District experienced very much below average seasonal quality based on AussieGRASS-modelled pasture growth and below-average rainfall. Rainfall varied across the District with some areas experiencing totals just below the long-term median, while other regions were well below. Vegetation cover was ranked as average for 43% of the District and above average for 25%. Approximately 33% of the District was ranked as having below to very much below average vegetation cover. In total, 18% of the District burnt between October 2019 and September 2020, a reduction in nearly 50% of the area burnt when compared to the previous reporting period. On-ground monitoring for land condition was conducted on four sites, across one pastoral lease. Sites, on average, had a good cover of perennial grasses and moderate amount of annual grasses. Overall land condition at the single lease inspected was rated as Good during the 2019-20 reporting period.

'Seasonal quality' describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long-term median and expected pasture growth based on rainfall received, simulated using AussieGRASS (longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 17) are based on gridded rainfall produced by the Bureau of Meteorology (<u>bom.gov.au/jsp/awap/rain/index.jsp</u>). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year. Modelled pasture growth is for the period November 2019 to April 2020. This growth is ranked as a percentile of the growth for all previous summers.

Table 17: Indicators of seasonal quality. Data spatially averaged for the Roper Pastoral District.

Rainfall (mm)		AussieGRASS	
2019 – 2020	583	Growth (kg/ha)	1,452
Long-term median	797	Percentile	8

Spatially averaged 12-month rainfall (October 2019 to September 2020) for the Roper Pastoral District was below the long-term median (Table 17). The distribution of rainfall varied across the District with most leases experiencing totals below to well below the long-term median (Figure 30).

Below-median rainfall (October 2019 to September 2020) across most of the Roper Pastoral District was reflected by very much below average modelled pasture growth over the 2019-20 wet season across the majority of the District (Table 17 and Figure 31). Patches across the north-west ranged from very much above average to average growth compared to long-term records (Table 17 and Figure 31).



Figure 30: Spatially interpolated rainfall, October 2019 to September 2020.



Figure 31: AussieGRASS-modelled pasture growth for the 2019-20 summer period as a percentage of previous summers.

Fire

The North Australian and Rangelands Fire Information website (<u>firenorth.org.au/nafi3</u>) reports that 7494km² (18% of the District) burnt between October 2019 and September 2020. This represents close to a 50% reduction in the total area burnt in the District, when compared with the previous reporting period. The majority of the area burnt occurred in the months of October 2019 and in the early dry season (May and June) 2020 (Figure 32).



Figure 32: Monthly area burnt (km²) in the Roper Pastoral District between October 2019 and September 2020.

Total vegetation cover and bare ground dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense wet-season storms. It is also important to carry dry feed, and associated ground cover, into the latter months of each calendar year in case there is a late start to the usual wet season and/or monsoonal rains fail more generally.

Vegetation cover was ranked as average for approximately 43% of the Roper Pastoral District, while 33% was below to very much below average (Figure 33). Areas with below average vegetation cover were distributed across the District however, a higher proportion occurred in the eastern half. Areas with above average cover were scattered across the District, with a higher concentration in the north and western regions.



Figure 33: Rank of the amount of remotely-sensed vegetation cover present from September to November 2020 (spring composite) against the average cover since 1988. Diagonal lines show those areas burnt between January and November 2020.

The amount of bare ground present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare ground in each 30-m square Landsat pixel (900m² or 0.09ha) was used to report the amount of bare ground across all pixels in the Roper Pastoral District.

The bare ground threshold is based on the frequency distribution of all 30-m Landsat bare ground cover pixels at the end of 2019 (spring composite). A threshold was determined which represents 75% of a district's overall bare ground. The remaining 25% is considered to have above-threshold bare ground.

Approximately 59% of the District had negligible amounts of bare ground (<20% of a 30-m Landsat pixel) towards the end of 2019 (Figure 34). The bare ground threshold value for the Roper Pastoral District was 26%; one quarter of the District had bare ground greater than this value (Figure 34 and Figure 35).

Bare ground threshold across the District is presented in Figure 35 and includes areas burnt earlier in 2020; areas with bare ground >26% were distributed across the District.



Figure 34: Percentage cumulative frequency of varying levels of bare ground in 30-m square Landsat pixels in the Roper Pastoral District between September and November 2020 (spring composite). Areas with > 36% bare ground (threshold) are mapped in Figure 35.



November 2020 shown with diagonal lines. Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected. Figure 35: Parts of the Roper Pastoral District having >26% bare ground per Landsat pixel in late 2020 (Landsat Spring composite). Areas burnt between January and

Site-based monitoring

One pastoral lease in the Roper Pastoral District was visited in the 2019-2020 reporting period.

Vegetation cover of the ground layer was measured at four sites across the lease. Sites, on average, had a good cover of perennial grasses and moderate amount of annual grasses (Figure 36). One of the four sites had been burnt, which increased on average, the cover values for bare ground and litter. Forbs were a minor component of the total ground cover.

Perennial grasses are important because they protect the soil surface against wind and water erosion and, where palatable, provide persistent forage to carry livestock through dry times. Litter cover also protects the soil surface, assists infiltration of rain water and helps retain plant seeds in-situ.



Figure 36: Mean percentage and standard error of measured components of vegetation cover in the ground layer from four sites on one pastoral lease in the Roper Pastoral District.

At the time of the inspection, pasture utilisation was minimal at two sites, moderate at one and no grazing was reported for one site. There was no evidence of erosion at any site.

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of pastoral lease traversed are summarised in Table 18. To the extent possible, these assessments are independent of the average to below-average seasonal quality applying to the general area of each station.

Table 18: Assessed land condition at integrated monitoring sites and traversed parts of one pastoral lease in the Roper Pastoral District.

Station	Monitoring site condition rating	Comments with regard to pastoral lease
1	Good: 2 Fair: 1	Land condition on the station was generally assessed in Good (B) condition. From the data collected at the monitoring sites and general observations supported by satellite based products, (fractional cover and bare ground levels), land condition has remained stable since the previous monitoring inspection conducted in 2018, where it was also assessed in good condition. Vegetation cover was consistently high across the property. There was a high diversity of 3P grasses and their distribution was consistent across the property. At the monitoring sites, 3P grasses were stable or increasing, and a diversity of annual grasses were also common. Given the low numbers of cattle on the property, utilisation of pasture was low. Bare ground levels were generally low and stable, with increases occurring only following fire, after which recovery was generally good, even following on from several below average wet seasons. There is an active weed management and feral animal program on the station. One monitoring site was not given a condition rating due to being burnt.



Map 6: Location of Gulf Pastoral District

This District encompasses more than 92 000km² and includes 16 pastoral leases.

The Gulf coast and hinterland extending up to 100km inland experienced much below to very much below average quality based on AussieGRASS-modelled pasture growth, consistent with below average rainfall in much of the District. Fire is an important feature of this savanna region, with approximately 8% of the District burnt between October 2019 and September 2020. Total rainfall for the Gulf Pastoral District was just below the long-term median, however total rainfall was highly variable with some regions experiencing well above and others well below median rainfall. One quarter of the region had more than 30% bare ground later in the 2020 dry season. Areas of low vegetation cover were scattered throughout the District, with large areas of bare ground (>30%) associated with the highly variable rainfall distribution across the District.

No pastoral leases were inspected in the Barkly Pastoral District during the 2019-20 monitoring program.

Seasonal quality

'Seasonal quality' describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long-term median and expected pasture growth based on rainfall received, simulated using AussieGRASS (longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 19) are based on gridded rainfall produced by the Bureau of Meteorology (<u>bom.gov.au/jsp/awap/rain/index.jsp</u>). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year. Modelled pasture growth is for the period November 2019 to April 2020. This growth is ranked as a percentile of the growth for all previous summers.

Table 19: Indicators of seasonal quality. Data spatially averaged for the Gulf Pastoral District.

Rainfall (mm)		AussieGRASS	
2019 – 2020	627	Growth (kg/ha) 1266	
Long-term median	654	Percentile 16	

Spatially averaged rainfall for the Gulf Pastoral District was only slightly lower than the long-term median (Table 19) however, the spatial distribution of rainfall varied (303 to 979mm) across the District. In the central and northeast region, estimated rainfall was above the long-term median while in the north and southern regions of the District total rainfall was well below the long-term median (Figure 37).

Modelled pasture growth over the last wet season, as a percentage of the long-term record, was predominantly much below or very much below the long-term average (Figure 38). Modelled growth in central and eastern regions of the District were average to below average, reflecting the distribution of rainfall across the District.



Figure 37: Spatially interpolated rainfall, October 2019 to September 2020. The grid cells on this map are at 5km x 5km resolution (i.e. each square represents 25km²).



Figure 38: AussieGRASS-modelled pasture growth for the 2019-20 summer period as a percentage of previous summers. The grid cells on this map are at 5km x 5km resolution (i.e. each square represents 25km²).

Fire

The North Australian Fire and Rangelands Information website (<u>firenorth.org.au/nafi3</u>) reports that 7270km² (8% of the District) burnt between October 2019 and September 2020. The area burnt between October 2019 and September 2020 was significantly less than the 19 464km² burnt in the preceding reporting period. Fires occurred in all months over the 2019-20 reporting period with the majority of area burnt between July and September 2020 (Figure 39).



Figure 39: Monthly area burnt (km²) between October 2019 and September 2020 in the Gulf Pastoral District.

Total vegetation cover and bare ground dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense wet-season storms. It is also important to carry dry feed, and associated ground cover, into the latter months of each calendar year in case there is a late start to the usual wet season and/or monsoonal rains fail more generally.

The relative amount of vegetation cover present in the late dry season of 2020, compared to the average long-term cover is presented in Figure 40. Approximately 48% of the Gulf Pastoral District had cover values similar to the long-term average while 25% of the region was above and 27% below the long-term average. Generally, the areas recording below average cover followed the spatial distribution of rainfall (Figure 37) across the District.



Figure 40: Rank of the amount of remotely-sensed vegetation cover present from September to November 2020 against that for previous years back to 1988. Diagonal lines show those areas burnt between January and November 2020.

The amount of bare ground present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare ground in each 30-m Landsat pixel (900m² or 0.09ha) was used to report the amount of bare ground across all pixels in the Gulf Pastoral District.

The bare ground threshold is based on the cumulative frequency distribution of bare ground for all 30-m Landsat pixels at the end of 2020 (spring composite). The bare ground percentage corresponding to 75% cumulative frequency was selected as the bare ground threshold (Figure 41). Bare ground percentage for 75% of the district is equal to or below this threshold. The remaining 25% of the district is considered to have above-threshold bare ground.

The bare ground threshold value for the Gulf Pastoral District was 30%; one quarter of the District had bare ground greater than this value (Figure 41 and Figure 42). Areas of bare ground >30% were distributed across the District with a number associated with the occurrence of fire. A number of the large areas of bare ground >30% were associated with regions recording low rainfall totals during the 2019-20 wet season. Many of these regions were reported to have high bare ground in the previous reporting period (2018-19) and it is likely that they have not has sufficient rainfall to recover in 2019-20. Approximately 46% of the District had minor amounts of bare ground (<20% of the 30-m Landsat pixel) towards the end of 2020 (Figure 41).



Figure 41: Percentage cumulative frequency of varying levels of bare ground in 30-m square Landsat pixels in the Gulf Pastoral District between September and November 2020. Areas with greater than 30% bare ground are mapped in Figure 42.



threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected. Areas burnt between January and November 2020 shown with diagonal lines. Figure 42: Parts of the Gulf Pastoral District having more than 30% bare ground per Landsat pixel in late 2020 (bare ground threshold). Note that the

BARKLY PASTORAL DISTRICT



Map 7: Location of Barkly Pastoral District

The Barkly Pastoral District encompasses nearly 134 000km² making this the most extensive of the 11 pastoral districts.

Seasonal quality, based on expected pasture growth, varied across the Barkly Pastoral District with the majority of the region considered average too much below average. Rainfall was below the longterm median for both the northern and southern Barkly with higher rainfall occurring in the north of the District. Analysis of Landsat imagery for the late dry season of 2020 showed that vegetation cover was average for 48% of the District. Areas of below average vegetation cover were scattered across the District, representing 39% of the total area. One quarter of the District had >52% bare ground (per Landsat pixel) in the late dry season, predominantly in the southwest and eastern half of the District. The occurrence of fire in the District was very low with only 0.1% of the Barkly Pastoral District burnt between October 2019 and September 2020.

No pastoral leases were inspected in the Barkly Pastoral District during the 2019-20 monitoring program.

Seasonal quality

'Seasonal quality' describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long-term median and expected pasture growth based on the rainfall received, simulated using AussieGRASS (longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 20) are based on gridded rainfall produced by the Bureau of Meteorology (<u>bom.gov.au/jsp/awap/rain/index.jsp</u>). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year. Due to the considerable north-south transition in long-term median rainfall for this large pastoral district, rainfall statistics are reported based on an arbitrary split of the region into two sub-districts (Figure 43).

Table 20: Recent seasonal quality for the Barkly Pastoral District as indicated by spatially averaged rainfall relative to the long-term median and AussieGrass modelled pasture growth.

Rainfall (mm)			AussieGRASS		
	Barkly North	Barkly South	В	arkly Pastoral District	
2019 – 2020	382	277	Growth (kg/ha)	1452	
Long-term median	423	300	Percentile	8	

Spatially averaged rainfall for the northern and southern sections of the Barkly Pastoral District were just below the long-term median (Table 20). Twelve-month rainfall was lower in the south Barkly in line with the increasing aridity of this part of the Barkly region. Rainfall was higher in the north with some areas experiencing totals above the long-term median (Figure 43).

BARKLY PASTORAL DISTRICT



Figure 43: Spatially interpolated, gridded rainfall for the Barkly Pastoral District. Reporting period is October 2019 to September 2020. The grid cells on this map are at 5km x 5km resolution (i.e. each square represents 25km²).

AussieGRASS-modelled pasture growth, as a second indicator of seasonal quality for the entire Barkly Pastoral District, is for the period November 2019 to April 2020. This growth is ranked as a percentile of the growth for all previous summers (back to 1957). In this case, spatially-averaged growth through the 2019-20 wet season was approximately 401kg/ha which was just below the long-term median (Table 20).

Modelled pasture growth over the 2019-20 wet season, as a percentage of the long-term record varied across the District with areas of much below average, below average to average growth predicted for the majority of the District (Figure 44).

BARKLY PASTORAL DISTRICT



Figure 44: Simulated pasture growth for the 2019-20 wet season as a percentage of the long-term record. The grid cells on this map are at 5km x 5km resolution (i.e. each square represents 25km²).
Fire

The North Australia and Rangelands Fire Information website (<u>firenorth.org.au/nafi3/</u>) reports that 151km² (0.1% of the Barkly Pastoral District) burnt between October 2019 and September 2020. Fire in the District was generally very low with the majority occurring in October and November 2019 (Figure 45).



Figure 45: Monthly area burnt (km²) in the Barkly Pastoral District between October 2019 and September 2020.

Total vegetation cover and bare ground dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense summer storms. It is also important to carry dry feed, and associated ground cover, into the latter months of each calendar year in case there is a late start to the usual wet season and/or monsoonal rains fail more generally.

Nearly half (48%) of the Barkly Pastoral District had average vegetation cover when compared to the past three decades, while approximately 39% of the District was below to very below average (Figure 46). The spatial distribution of the areas identified as below to very below average vegetation cover were scatted across the District, however there were extensive regions in the south west, central, north east and eastern regions of the District.

The amount of bare ground present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare ground in each 30-m Landsat pixel (900m² or 0.09ha) was used to report the amount of bare ground across all pixels in the Barkly Pastoral District.



Figure 46: Rank of the amount of remotely-sensed vegetation cover present from September to November 2020 against that for previous years back to 1988.

The bare ground threshold is based on the cumulative frequency distribution of bare ground for all 30-m Landsat pixels at the end of 2020 (Spring composite). The bare ground percentage corresponding to 75% cumulative frequency was selected as the bare ground threshold (Figure 47). Bare ground percentage for 75% of the district is equal to or below this threshold. The remaining 25% of the district is considered to have above-threshold bare ground.

The bare ground threshold value for the Barkly Pastoral District was 52%; one quarter of the District had bare ground greater than this value (Figure 47). This latter area was distributed across the District, predominantly in the southwest and eastern half of the District (Figure 48). Approximately 13% of the District had minor amounts of bare ground (<20% of the 30-m Landsat pixel), while 10% of the region had bare ground >60% towards the end of 2020.



Figure 47: Percentage cumulative frequency of varying levels of bare ground in 30-m Landsat pixels in the Barkly Pastoral District between September and November 2020. Areas with greater than 52% bare ground are mapped in Figure 48.



Figure 48: Parts of the Barkly Pastoral District having more than 52% bare ground per Landsat pixel in late 2020. Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.



Map 8: Location of Tennant Creek Pastoral District.

The Tennant Creek Pastoral District encompasses approximately 69 200km² and includes eight pastoral leases.

Seasonal quality based on rainfall and AussieGRASS-modelled pasture growth ranged from average to below average to across the District. Based on Landsat imagery, just under half of the District had average levels of vegetation cover recorded since 1988, with approximately 32% above average and 21% of the region had below the long-term average vegetation cover. There was very little fire activity recorded in the District between October 2019 and September 2020 with most fire activity in January 2020. One quarter of the District had > 53% bare ground per Landsat pixel (threshold bare ground). Areas of low ground cover extended well beyond fire-impacted parts of the District. Three pastoral leases in the Tennant Creek Pastoral District were visited during 2020 with the 21 sites assessed as in either Good, Fair or Poor land condition. Overall, the three properties inspected were in Fair condition and still recovering from previous poor seasons.

Seasonal quality

'Seasonal quality' describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long-term median and expected pasture growth based on rainfall received, simulated using AussieGRASS (longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 21) are based on gridded rainfall produced by the Bureau of Meteorology (<u>bom.gov.au/jsp/awap/rain/index.jsp</u>). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year. Modelled pasture growth is for the period November 2019 to April 2020. This growth is ranked as a percentile of the growth for all previous summers.

Table 21: Indicators of seasonal quality. Data spatially averaged for the Tennant Creek Pastoral District.

Rainfall (mm)		AussieGRASS	
2019 – 2020	262	Growth (kg/ha) 203	
Long-term median	275	Percentile	35

Spatially averaged rainfall for the Tennant Creek Pastoral District was slightly below the long-term median (Table 21). Rainfall total varied across the District (182 to 373mm) with higher levels in the northwest and in the north-eastern region of the District (Figure 49). The lowest rainfall totals in the District occurred in the southwest region.

Modelled pasture growth over the last summer, as a percentage of the long-term record, was predominately average across the District (Figure 50). Pasture growth for large areas across the District was predicted to be below average to well below average, with the majority of these areas located outside of the pastoral estate (Figure 50).



Figure 49: Spatially interpolated rainfall, October 2019 to September 2020.



Figure 50: AussieGRASS-modelled pasture growth for the 2019-20 summer period as a percentage of previous summers.

Fire

The North Australia and Rangelands Fire Information website (<u>firenorth.org.au/nafi3/</u>) reports that 51km² (0.07%) of the Tennant Creek Pastoral District burnt between October 2019 and September 2020. This was significantly less than the area burnt during the 2018-19 reporting period (2001km²). Most of the area was burnt in January 2020 (Figure 51).



Figure 51: Monthly area burnt (km²) in the Tennant Creek Pastoral District between October 2019 and September 2020.

Total vegetation cover and bare ground dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense summer storms. It is also important to carry dry feed, and associated ground cover, into the latter months of each calendar year in case there is a late start to the usual Wet season and/or summer rains fail more generally.

Just under half (47%) of the District had average levels of vegetation cover when compared to the longterm record since 1988. Approximately 25% of the District recorded vegetation cover above average or much above average, while 7% was very much above average. Around 21% of the District had vegetation cover below to very much below average when compared with the long-term average (Figure 52).



Figure 52: Rank of the amount of remotely-sensed vegetation cover present from September to November 2020 against that for previous years back to 1988. Diagonal lines show those areas burnt between January and November 2020.

The amount of bare ground present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare ground in each 30-m square Landsat pixel (900m² or 0.09ha) was used to report the amount of bare ground across all pixels in the Tennant Creek Pastoral District. The bare ground threshold is based on the frequency distribution of all 30-m Landsat bare ground cover pixels at the end of 2020 (spring composite). A threshold was determined which represents 75% of a district's overall bare ground. The remaining 25% is considered to have above-threshold bare ground.

Less than one percent of the District had minor bare ground (< 20% of the 30-m Landsat pixel) towards the end of 2020 (Figure 53) and one quarter of the District had > 53% bare ground (bare ground threshold) (Figure 53 and Figure 54).



Figure 53: Percentage cumulative frequency of varying levels of bare ground in 30-m square Landsat pixels in the Tennant Creek Pastoral District between September and November 2020. Areas with > 53% bare ground are mapped in Figure 54.



Figure 54: Parts of the Tennant Creek Pastoral District having > 53% bare ground per Landsat pixel in late 2020. Areas burnt between January and November 2020 shown with diagonal lines. Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

Site-based monitoring

Three pastoral leases in the Tennant Creek Pastoral District were visited during 2020.

Vegetation cover of the ground layer was measured using the point intercept method at 21 sites across the three leases. Sites, on average, had low to high level of bare ground with values ranging between 7 to 61 percent across the 21 sites assessed. Perennial and annual grasses covered, on average, approximately 31% of the total cover across the 21 sites, however cover at individual sites varied for perennials between 2 to 49% and 0.6 to 32% for annuals. On average, litter cover was moderate while forb cover for the majority of sites was low (Figure 55).

Perennial grasses are important because they protect the soil surface against wind and water erosion and, where palatable, provide persistent forage to carry livestock through dry times. Litter cover also protects the soil surface, assists infiltration of rain water and helps retain plant seeds in situ.



Figure 55: Mean percentage and standard error of measured components of vegetation cover in the ground layer from 21 sites on three pastoral leases in the Tennant Creek Pastoral District.

Pasture utilisation at the 21 sites ranged from minimal through to very heavy (Table 22). Sixty-two percent of the 21 sites had been minimally grazed at the time of property inspection, while 24% were either moderately to heavily grazed and 14% were very heavily grazed. Erosion by wind and water sheeting was recorded on 48% of the sites inspected (Table 22).

Table 22: Levels of pasture utilisation and evidence of erosion assessed at 21 sites on three pastoral leases in the Tennant Creek Pastoral District.

Pasture utilisation		Evidence of erosion		
Rank	% of sites	Туре	% of sites	
No grazing	0	Wind	29	
Minimal (←25%)	62	Scalding	0	
Moderate (26-50%)	14	Water sheeting	19	
Moderate to heavy (51-75%)	5	Gullying	0	
Heavy (76-90%)	5			
Very heavy (→90%)	14			

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of pastoral leases traversed are summarised in Table 23. Overall land condition on all three stations was rated as Fair condition and it was noted that they were still in a state of recovery after the previous extremely poor (2018-2019) season. The stations visited experienced below average to average seasonal quality, based on rainfall and modelled pasture growth. To the extent possible, condition assessments are independent of year-to-year variability in rainfall.

Table 23: Assessed land condition at monitoring sites and traversed parts of three pastoral leases in the Tennant Creek Pastoral District.

Station	Monitoring site condition rating	Comments with regard to pastoral lease
1	Good: 4 Fair: 3 Poor: 2	Land condition on the station was varied, however was generally in Fair to Good (B) condition, representing an improvement in conditions from the 2015 visit, where conditions were generally in Poor (D) to Fair (C) condition. Although the 2015 Land Condition Summary noted that "while substantial areas were in Poor condition, these areas generally showed signs of improvement". In the year prior to the 2015 visit, the station had above average rainfall, however prior to the current visit, it had below average rainfall with a dry 2019. The majority of the station is made up of spinifex (<i>Triodia</i> sp.) sandplains in the southwest portion. The spinifex sandplains were largely in Good condition. Woody thickening by wattles is the main issue, in particular, scrub wattle (<i>Acacia stipuligera</i>), leading to increased fire risk. No weeds were observed during the visit and extensive efforts have been made over the last decade to rehabilitate scalded country.
2	Good: 2 Fair: 3 Poor: 2	Land condition on the station was generally assessed in Fair (C) condition. Changes in land condition scores at monitoring sites indicate that land condition has declined slightly since the previous monitoring inspection conducted in 2015, where it was also assessed in Fair (C) condition. This decrease in condition was due to a number of below average wet seasons but is mitigated by the robustness of the major pasture being spinifex. These tussock have been shown to remain productive even during times of drought and will remain photosynthetic long after other species have hayed off. The spinifex country in the south west of the property was generally in Good (B) to Fair (C) condition due to ongoing management and maintenance of the pastures through strategic burning. The north east of the property was in Fair (C) condition with some areas in Poor (D) condition due to areas affected by wildfire not recovering as quickly as expected due to poor rainfall and higher levels of undesirable species.
3	Good: 3 Fair: 2	Land condition on the station in 2020 was overall generally in Fair (C) condition, similar to the last visit in 2015. Climatic conditions prior to the 2020 visit were very dry, with well below average rainfall in 2019. Remote sensing imagery from the spring of 2019, at the end of a dry year, highlight very high levels of bare ground in some of the alluvial country. This was in contrast to the previous visit in 2015 when rainfall was slightly above average in the preceding 12 months, but the station was heavily impacted by widespread fires in 2011 and 2012. Two class B weeds, rubber bush and parkinsonia were observed generally along creek lines.



Map 9: Location of Plenty Pastoral District.

Seasonal quality

The Plenty Pastoral District encompasses approximately 52 242km² and includes 14 pastoral leases.

The Plenty Pastoral District experienced average seasonal quality based on AussieGRASS-modelled pasture growth and lower than average rainfall, with the exception for the north-west and central regions which had average to above average rainfall. There was no incidence of fire across the District between October 2019 and September 2020. Based on the Landsat satellite records for the last 32 years, most of the District had average to above average vegetation cover, with areas of below average cover located in the eastern side of the District, coinciding with areas experiencing lower rainfall. Just under 13% of the District had <40% bare ground, while one quarter had >57% bare ground.

No pastoral leases were inspected in the Plenty Pastoral District during the 2019-20 monitoring period.

'Seasonal quality' describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long-term median and expected pasture growth based on rainfall received, simulated using AussieGRASS (longpaddock.gld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 24) are based on gridded rainfall produced by the Bureau of Meteorology (<u>bom.gov.au/jsp/awap/rain/index.jsp</u>). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year. Modelled pasture growth is for the period November 2019 to April 2020. This growth is ranked as a percentile of the growth for all previous summers.

Table 24: Indicators of seasonal quality. Data spatially averaged for the Plenty Pastoral District.

Rainfall (mm)		AussieGRASS	
2019 – 2020	193	Growth (kg/ha) 307	
Long-term median	205	Percentile	58

Spatially averaged rainfall for the Plenty Pastoral District was close to the long-term median (Table 24). Rainfall varied across the District and was above average in the central, north, north-western regions. Rainfall totals for much of the south and south-eastern regions were below to well below the long-term median rainfall (Figure 56).

Modelled pasture growth for the 2019-20 summer period was average based on the spatial mean (Table 24). In some areas in the District pasture growth was predicted to be above average (central region) and below average in the east.



Figure 56: Maps of seasonal quality for the period, October 2019 to September 2020. Left, Spatially interpolated rainfall; right, AussieGRASS-modelled pasture growth as a 2019-20 summer period as a percentage of previous summers.

Fire

There was no fire activity recorded in the Plenty Pastoral District between October 2019 and September 2020 based on data from the North Australian and Rangelands Fire Information website (firenorth.org.au/nafi3).

Total vegetation cover and bare ground dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense summer storms. The highly variable nature of rainfall in the southern NT also means that it is necessary to carry dry feed, and associated ground cover, into the hotter months in case summer rains fail.

Most of the District (80%) had average to above average vegetation cover when compared to the longterm median going back to 1988 (Figure 57). There were patches across the west, north-west, centre and south of the District where vegetation cover was below average to very much below average, however the majority of the low vegetation cover occurred in the eastern region of the District, coinciding with the lower rainfall totals.



Figure 57: Rank of the amount of remotely-sensed vegetation cover present from September to November 2020 against that for previous years back to 1988.

The amount of bare soil present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare ground in each Landsat pixel (900m² or 0.09ha) was used to report the amount of bare ground across all pixels in the Plenty Pastoral District.

Less than 1% of the District had a small amount of bare ground towards the end of 2020 (i.e. < 20% of the 30-m Landsat pixel) (Figure 58); and just under 13% of the region had < 40% bare ground. The bare ground threshold value for the Plenty Pastoral District was 57%; one quarter of the District had bare ground per pixel greater than this value, with the majority occurring in the eastern side of the District, which experienced lower rainfall totals (Figure 59).



Figure 58: Percentage cumulative frequency of varying levels of bare soil in 30-m square Landsat pixels in the Plenty Pastoral District between September and November 2020. Areas with > 57% bare ground are mapped in Figure 59.



Figure 59: Parts of the Plenty Pastoral District having more than 57% bare ground per Landsat pixel in late 2020. Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.



Map 10: Location of Northern Alice Springs Pastoral District

The Northern Alice Springs Pastoral District encompasses just under 103 000km² including 28 pastoral leases, one of which was visited in 2020.

Much of the District experienced either average or below-average seasonal quality based on expected pasture growth (modelled using AussieGRASS), and rainfall well below the long-term median. Approximately 42% the Northern Alice Springs Pastoral District had average vegetation cover, with 40% having below to very much below average cover in the latter period of 2020 compared with previous years since 1988. One-quarter of the District had more than 57% bare ground per 30-m pixel at this time (bare ground threshold), with the majority of these areas occurring in the regions which experienced low rainfall.

On-ground monitoring for land condition was conducted at 11 sites on one pastoral lease, with two sites rated as Good, seven as Fair, and two as Poor. The seasonal conditions for the lease were poor, with well below average rainfall and seasonal growth. Sites, on average, had high level of bare soil, with annual grasses the dominant vegetation cover. Pasture utilisation recorded at eight of the field sites was minimal, while three were assessed as moderately grazed at the time of the inspection.

Seasonal quality

'Seasonal quality' describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long-term median and expected pasture growth based on rainfall received, simulated using AussieGRASS (longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 25) are based on gridded rainfall produced by the Bureau of Meteorology (<u>bom.gov.au/jsp/awap/rain/index.jsp</u>). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year. Modelled pasture growth is for the period November 2019 to April 2020. This growth is ranked as a percentile of the growth for all previous summers.

Table 25: Seasonal quality indicators for the Northern Alice Springs Pastoral District.

Rainfall (mm)		AussieGRASS	
2019 – 2020	143 Growth (kg/ha)		116
Long-term median	258	Percentile	26

Spatially averaged rainfall for the Northern Alice Springs Pastoral District during 2019-20 was well below the long-term median across the District (Table 25, Figure 60). Rainfall was variable across the District with totals just below the long-term median in some areas (eastern) and very much below in the west and southern parts of the District (Figure 60).

Modelled pasture growth was generally well correlated with rainfall distribution, with average pasture growth predicted for the eastern portion of the District and below to very much below average pasture growth across the southern and western regions (Figure 61).



Figure 60: Spatially interpolated rainfall, October 2019 to September 2020.



Figure 61: AussieGRASS-modelled pasture growth as a 2019-20 summer period as a percentage of previous summers.

Fire

Data available from the North Australia and Rangelands Fire Information website (<u>firenorth.org.au/nafi3</u>) shows that 73km² (0.07% of the District) burnt between October 2019 and September 2020 (Figure 62). The area burnt was significantly lower than the previous season with fire only recorded in November 2019.



Figure 62: Monthly area burnt (km²) in the Northern Alice Springs Pastoral District between October 2019 and September 2020.

Total vegetation cover and bare ground dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense summer storms. The highly variable nature of rainfall in the southern NT also means that it is necessary to carry dry feed, and associated ground cover, into the hotter months in case summer rains fail.

The amount of bare ground present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare ground in each 30-m square Landsat pixel (900m² or 0.09ha) was used to report the amount of bare ground across all pixels in the Northern Alice Springs Pastoral District.

Approximately 42% the Northern Alice Springs Pastoral District had average vegetation cover, while 17% of the region recorded vegetation cover above average to very much above average (Figure 63). Around 40% of the District recorded vegetation cover below to very much below average. The majority of regions in the District below with below average vegetation cover correspond with areas that experienced very low rainfall totals.



Figure 63: Rank of the amount of remotely-sensed vegetation cover present from September to November 2020 against that for previous years back to 1988. Diagonal lines show those areas burnt between January and November 2020.

The bare ground threshold is based on the frequency distribution of all 30-m Landsat bare ground cover pixels at the end of 2020 (Spring composite). A threshold was determined which represents 75% of a district's overall bare ground. The remaining 25% is considered to have above-threshold bare ground.

Less than one percent of the Northern Alice Springs Pastoral District had small amounts of bare ground (<20% of the 30-m Landsat pixel) towards the end of 2020 (Figure 64). The bare ground threshold value for the Northern Alice Springs Pastoral District was 57%; one quarter of the District had bare ground greater than this value, with the majority of these areas occurring in the regions experiencing low rainfall (Figure 65).



Figure 64: Percentage cumulative frequency of varying levels of bare ground in 30-m square Landsat pixels in the Northern Alice Springs Pastoral District between September and November 2020. Areas with greater than 57% bare ground (threshold) are mapped in Figure 65.



Site-based monitoring

One pastoral lease was visited in the Northern Alice Springs Pastoral District during 2020.

Vegetation cover of the ground layer was measured at 11 sites across the one lease. Sites, on average, had a high level of bare ground with values ranging between 31 and 81%. Annual grasses were the dominant vegetation cover for most sites, followed by perennial grass and forbs. On average 12% litter cover was recorded across the 11 sites (Figure 66). Litter cover is important because it assists infiltration of rain water, helps retain seed on site and reduces erosion risk.



Figure 66: Mean percentage and standard error of measured components of vegetation cover in the ground layer in the Northern Alice Springs Pastoral District.

Seventy-three percent of the 11 sites were rated as having minimal grazing and 27% were considered to have moderate levels of grazing (Table 26). Evidence of erosion was recorded at four of the eleven sites (Table 26).

Table 26: Levels of pasture utilisation assessed	in the Northern Alice Springs Pastoral District
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Pasture utilisation		Evidence of erosion		
Rank	% of sites	Туре	% of sites	
No grazing	0	Wind	45	
Minimal (←25%)	73	Scalding	27	
Moderate (26-50%)	27	Water sheeting	36	
Moderate to heavy (51-75%)	0	Gullying	27	
Heavy (76-90%)	0			
Very heavy (→90%)	0			

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of pastoral leases traversed are summarised in Table 27. Rainfall on the lease assessed was well below the long-term median and experienced much below average seasonal quality based on modelled pasture growth. To the extent possible, condition assessments are independent of year-to-year variability in rainfall and associated seasonal condition.

Table 27: Assessed land condition at monitoring sites and traversed parts of one pastoral lease in the Northern Alice Springs Pastoral District.

Station	Monitoring site condition rating	Comments with regard to pastoral lease
1	Good: 2 Fair: 7 Poor: 2	Land condition on the station could generally be seen as in Fair (C) condition, which represents a deterioration from conditions at the last visit in 2015, which was in general in Good (B) condition. It is, however, notable that the three years prior to the 2020 visit have been much drier than average, with 2019 being the driest on record. No weeds were observed on the station. However, erosion was widespread on the southern productive country, much of this is historical and some of it has stabilised. Some of this erosion is linked to the public access. Remote sensing and ground observations highlight an active area of erosion, this scalded area will need active intervention if the negative impacts of this erosion are to be curtailed. In other areas, erosion control measures were observed.



Map 11: Location of Southern Alice Springs Pastoral District

The Southern Alice Springs Pastoral District encompasses approximately 92 500km². Two pastoral leases were assessed for land condition in 2020.

The District experienced average to below average seasonal conditions based on rainfall and expected pasture growth (modelled using AussieGRASS). Rainfall varied across the District with large areas experiencing totals well below the long-term median. Analysis of Landsat imagery acquired during the latter months of 2020 showed that significant regions in the District had vegetation cover very much below average vegetation cover when compared to the same period in previous years, since 1988. One quarter of the District was found to have more than 72% bare ground per 30-m Landsat pixel. The high levels of bare ground measured from the Landsat satellite imagery were consistent with the field observations on the two pastoral leases inspected. Eighteen field sites were assessed during the lease inspections; seven sites were rated in Good condition, five in Fair and six in Poor.

Seasonal quality

'Seasonal quality' describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long-term median and expected pasture growth based on rainfall received, simulated using AussieGRASS (longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 28) are based on gridded rainfall produced by the Bureau of Meteorology (<u>bom.gov.au/jsp/awap/rain/index.jsp</u>). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year. Modelled pasture growth is for the period November 2019 to April 2020. This growth is ranked as a percentile of the growth for all previous summers.

Table 28: Indicators of seasonal quality. Data spatially averaged for the Southern Alice Springs Pastoral District.

Rainfall (mm)		AussieGRASS	
2019 – 2020	84	Growth (kg/ha) 71	
Long-term median	167	Percentile	26

Spatially averaged rainfall for the Southern Alice Springs Pastoral District was well below the long-term median (Table 28). Total rainfall varied across the District with average to slightly above average totals occurring in the northwest, while the majority of the District was well below the long-term median (Figure 67). Modelled pasture growth was much below average for significant areas across the District with regions in the east predicted to have average pasture growth (Figure 68).





Figure 68: AussieGRASS-modelled pasture growth as a 2019-20 summer period as a percentage of previous summers.

Fire

No fire activity was reported by the North Australian and Rangelands Fire Information (<u>firenorth.org.au/nafi3/</u>) in the Southern Alice Springs Pastoral District between October 2019 and September 2020.

Total vegetation cover and bare ground dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense summer storms. The highly variable nature of rainfall in the southern NT also means that it is necessary to carry dry feed, and associated ground cover, into the hotter months in case summer rains fail.

Approximately 70% of the District had below average vegetation cover in the latter part of 2020 when compared to the previous years since 1988 (Figure 69). A large proportion of the District (36%) was ranked as having vegetation cover very much below average. Around 25% of the District was ranked as average, while a small proportion (6%) was above average. There was a clear relationship between total rainfall (Figure 67) and the spatial distribution of total vegetation cover across the District (Figure 69).



Figure 69: Rank of the amount of remotely-sensed vegetation cover present from September to November 2020 against that for previous years since 1988.

The amount of bare ground present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare ground in each 30-m Landsat pixel (900m² or 0.09ha) was used to report the amount of bare ground across all pixels in the Southern Alice Springs Pastoral District.

The bare ground threshold is based on the frequency distribution of all 30-m Landsat bare ground cover pixels at the end of 2020 (spring composite). A threshold was determined which represents 75% of a district's overall bare ground. The remaining 25% is considered to have above-threshold bare ground.

Less than 1% of the Pastoral District had minor to moderate amounts of bare ground (<20% of the 30-m Landsat pixel) towards the end of 2020 (Figure 70). The bare ground threshold value for the Southern Alice Springs Pastoral District was 72%; one quarter of the District had bare ground greater than this value (Figure 70 and Figure 71). Considerable areas of increased bare ground in the central and eastern portions of the District appear to be a continuing legacy effect of extensive wildfire in 2011.



Figure 70: Percentage cumulative frequency of varying levels of bare ground in 30-m square Landsat pixels in the Southern Alice Springs Pastoral District between September and November 2020. Areas with > 72% bare ground (threshold) are mapped in Figure 71.



Figure 71: Parts of the Southern Alice Springs Pastoral District having > 72% bare ground per Landsat pixel in late 2020. Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

Site-based monitoring

Two pastoral leases were visited during 2020.

Vegetation cover of the ground layer was measured using the star transect method at 18 sites across two leases. On average bare ground at the 18 sites was high (59%) however, there was considerable variability with values ranging from 25 to 97% (Figure 72). Litter, on average, represented 19% of the cover while annual grasses were the dominant vegetation cover for most sites, followed by forbs and a very low cover of perennial grasses. Litter cover is important because it assists infiltration of rainwater, helps retain seed on site and reduces erosion risk.



Figure 72: Mean percentage and standard error of measured components of vegetation cover in the ground layer from 18 sites on two pastoral leases in the Southern Alice Springs Pastoral District.

Twenty-eight percent of the sites were assessed as having minimal levels of grazing, while 28% were moderately grazed. The remaining 44% of sites were ranked as moderate-heavy to very heavily utilised (Table 29). Wind erosion was observed at all sites, with water sheeting occurring at just over half the sites and scalding was recorded at 6% of the sites (Table 29).

Pasture utilisation		Evidence of erosion		
Rank	% of sites	Туре	% of sites	
No grazing	0	Wind	100	
Minimal (←25%)	28	Scalding	6	
Moderate (26-50%)	28	Water sheeting	56	
Moderate to heavy (51-75%)	22	Gullying	0	
Heavy (76-90%)	17			
Very heavy (→90%)	5			

Table 29: Levels of pasture utilisation and evidence of erosion assessed at 18 sites across two pastoral leases in the Southern Alice Springs Pastoral District.

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of pastoral leases traversed are summarised in Table 30. To the extent possible, assessment of land condition is independent of recent seasonal conditions.

Table 30: Assessed land condition at monitoring sites and traversed parts of two pastoral leases in the Southern Alice Springs Pastoral District.

Station	Monitoring site condition rating	Comments with regard to pastoral lease
1	Good: 4 Fair: 5 Poor: 1	During the 2020 visit, monitoring sites and analysis of remote sensing products have indicated that land condition on the station was varied, however generally in Fair (C) to Good (B) condition. This is an improvement on conditions from the 2015 visit, where conditions were assessed to be in Poor (D) to Fair (C) condition. These results are supported through the use of fractional cover and bare ground threshold products. Integrated monitoring sites were located principally on the station's pastorally productive country. This productive country makes up the central spine of the station stretching from the north to the south, and was generally in Fair (C) to Good (B) condition, with a few localised areas in Poor (D) condition. This productive country comprises 35% of the station.
2	Fair: 3 Poor: 5	Land condition on the station was generally consistent with the results from the 2015 visit and are supported through the use of fractional cover and bare ground threshold products. During the 2020 visit, monitoring sites and analysis of remote sensing products indicated poorer condition in the north- western area of the station. There were areas that were generally in Fair (C) condition with a good cover of pastorally useful annual grasses (e.g. woolly oatgrass, <i>Enneapogon polyphyllus</i>). Additionally, the north eastern area of the station was in Good (B) condition supporting decent amounts of buffel grass and palatable annual grasses. Prior to the 2020 visit, the station had experienced the driest year on record with 25mm of rain in 2019.

SUPPLEMENTARY INFORMATION

MEETINGS OF THE BOARD

Twelve meetings of the Pastoral Land Board were held between 1 October 2019 and 31 December 2020:

124th Meeting: held 23 - 24 October 2019 in Darwin

Two land clearing applications were re-considered by the Board, with one granted and one deferred for further information.

Three compliance matters regarding land clearing were considered. The Board determined to confirm an exemption provision, noted historic clearing and revoked a permit requiring a new application be submitted.

Members discussed the Voluntary Management Plan processes and endorsed continued support in revising the current process. Members also discussed the Land Condition Reports and Annual Report, determining to adjust the reporting period to be calendar year.

125th Meeting: teleconference held 4 December 2019

One land clearing application was re-considered and permit granted. The Board endorsed the 2020 Rangeland Monitoring schedule.

The Board considered and recommended six applications for conversion for term leases to be converted to perpetual tenure.

Members discussed matters relating to development plans, access to waterways, the voluntary management plan update and trial plantation of crops.

126th Meeting: videoconference and teleconference held 24 March 2020

The Board considered a request to vary a pastoral land clearing permit determining to accept the application and proceed with formal assessment. The Board further reconsidered an application for land clearing determining to approve the permit.

Members were briefed on land condition matters, access, progress on voluntary management plans and potential non-compliance issues. The Board reviewed and amended the Pastoral Land Clearing Guidelines. A sub-committee was appointed to consider rent waivers referred by the Minister for advice. Members also acknowledged the likely impact that Covid-19 would have on the pastoral estate.

127th Meeting: teleconference held 14 May 2020

The Board considered two applications, for land clearing and non-pastoral use determining to approve both applications.

128th Meeting: teleconference held 25 June 2020

The Board considered an application for land clearing. Members considered and endorsed an update to the 2020 Rangeland Monitoring schedule due to the impacts of Covid-19. Updates were provided on voluntary management planning processes, updates to the pastoral land clearing guidelines, and land condition reports. Members were briefed on compliance matters, noting that the legislation had limited penalty provisions.

129th Meeting: teleconference held 10 July 2020

The Board considered an application for non-pastoral use determining to request further information.

130th Meeting: videoconference and teleconference held 17 July 2020

The Board considered an application for non-pastoral use noting a request from the department for further time and determining to defer determination pending further information from the department.

MEETINGS OF THE BOARD

131st Meeting: teleconference held 5 August 2020

One land clearing application was considered and the Board determined to issue a permit. Members noted briefings on the Board's newsletter and the Gamba Plan 2020-2030.

132nd Meeting: held 25 and 26 August 2020 in Alice Springs

Two new land clearing applications were considered with permits issued. The Board set-aside a previous decision regarding a land clearing application and re-considered the matter, determining to alter the area applied for and approve the issuance of a permit.

Members were briefed on the status of the pastoral estate, weed declarations, carbon sequestration and outcomes from the NT Government Territory Economic Reconstruction Commission Report. Members determined to provide a submission on the Gamba Plan 2020-2030 highlighting areas of concern relevant to the pastoral estate.

On day two of the meeting, the Board heard from guest speakers from the Arid Lands Environment Centre, the Department of Environment, Parks and Water Security, and the Department of Industry, Tourism and Trade about projects being conducted in the central Australian region. Members were provided with a briefing regarding a project relating to a new type of recovery plan to assist with voluntary management plan processes.

133rd Meeting: videoconference and teleconference held 21 September 2020

An application to vary an existing non-pastoral use permit was considered with members determining to vary the purpose of the permit to include an additional agricultural crop.

134th Meeting: videoconference and teleconference held 2 October 2020

The Board were provided a briefing on suitable permit conditions for the varied non pastoral use permit approved in the previous meeting and determined an updated condition should be included on the varied permit. Members were briefed on the Department of Environment, Parks and Water Security's efficiency program and the opportunities to consider delegations of powers. Members determined the dates for 2021 Board meetings.

135th Meeting: held 26 November 2020 in Alice Springs

One application to vary a pastoral land clearing permit was considered, with members determining to increase the clearing area and issue a varied permit. A further three land clearing and one non-pastoral use permit application were considered and determined. Members reviewed the 2019 Land Condition Reports and noted an update on the status of the 2020 rangeland monitoring site visits and endorsed the proposed 2021 monitoring program. Members also considered the Board's 2018-2019 Annual Report.

A Sub-Committee report was provided on a site visit undertaken in the Tennant Creek Pastoral District with guests from the station and the department attending the meeting. Members were briefed on a proposed simplified pastoral land clearing application process and considered the delegations required.

Out of Session

The Board considered twelve matters out of session including weed incursion responses, land clearing applications and variations, non-pastoral use variations, extension to permit terms, appointment of sub-committees, updates to the Pastoral Land Clearing Guidelines, and rent waiver applications.

The Board also determined to issue delegations allowing for delegates to determine pastoral land clearing applications that do not exceed 50ha in size, including applications to vary existing permits.

APPLICATIONS CONSIDERED BY THE BOARD

Land Clearing Applications

Station	Pastoral District	Durnose	Total Area ha	Decision
Gilpockie	Sturt Plateau			Deferred
			-	
Newcastle Waters	Barkly	Pastoral Purposes	505.97	Approved
Ucharonidge	Barkly	Pastoral Purposes	317.81	Approved
Maryfield	Sturt Plateau	Pastoral Purposes	4544.87	Approved
Maryfield	Sturt Plateau	Pastoral Purposes	372.58	Approved
Auvergne	VRD	Pastoral Purposes	50.53	Approved
Newry	VRD	Pastoral Purposes	49.34	Approved
Ucharonidge	Barkly	Pastoral Purposes	4916.1	Approved
Lakefield	Sturt Plateau	Non-pastoral purposes	2703.89	Approved
Dry River	Sturt Plateau	Pastoral purposes	415.67	Approved
Flying Fox	Roper	Pastoral purposes	189.24	Approved
Lonesome Dove	Roper	Pastoral purposes	1585.22	Approved
Bridge Creek	Darwin	Pastoral purposes	1337.93	Approved
Labelle Downs	Darwin	Pastoral purposes	707.04	Approved
Aileron Station	Northern Alice Springs	Non-Pastoral Purposes	343.58	Approved
Margaret Downs	Sturt Plateau	Pastoral purposes	585.98	Approved
Amungee Mungee	Gulf	Seismic monitoring station	0.99	Approved
Avago	Sturt Plateau	Seismic monitoring station	0.99	Approved
Beetaloo	Barkly	Seismic monitoring station	1.98	Approved
Buchanan Downs	Sturt Plateau	Seismic monitoring station	5.27	Approved
Nenen	Sturt Plateau	Seismic monitoring station	0.99	Approved
Nutwood Downs	Gulf	Seismic monitoring station	0.99	Approved
Tandyidgee	Barkly	Seismic monitoring station	0.99	Approved
Tanumbirini	Gulf	Seismic monitoring station	0.99	Approved
APPLICATIONS CONSIDERED BY THE BOARD

Station	Pastoral District	Purpose	Term	Decision
Tipperary East	Darwin	Agriculture	30 years	Approved
Aileron	Northern Alice Springs	Irrigated agriculture and horticulture	30 years	Approved
Lakefield	Sturt Plateau	Horticulture and agriculture	30 years	Approved
Scott Creek	Katherine	Horticulture	30 years	Approved variation
Undoolya	Southern Alice Springs	Irrigated cropping and perennial horticulture	30 years	Approved variation
Legune	VRD	Aquaculture	30 years	Approved variation

Non-Pastoral Use Applications

Subdivision Applications

Under section 61 of the *Pastoral Land Act 1992*, the Minister can refer applications for subdivision of pastoral leases to the Board for consideration and recommendation. During 2019-20 no applications for subdivision were lodged with the Board.

Perpetual Pastoral Lease Applications

Under section 62 of the *Pastoral Land Act 1992*, the Minister can refer applications for conversion of term pastoral leases to perpetual tenure to the Board for consideration and recommendation. There were six applications for conversion referred during 2019-20 and one development plan considered by the Board.

Information provided by Bushfires NT



Map 12: Fire Management Zones

Climate and weather conditions have significant influence on bushfire activity. Seasonal climatic conditions have a strong influence on fuel loads and fuel curing rates, while daily weather conditions are the key drivers of short-term bushfire risk.

Following below average rainfall across much of the Territory in 2019, better falls were experienced in most areas in 2020. Better summer rainfall across central and southern parts taking in the Savanna, Barkly and Alice Springs Fire Management Zones supported improved grass growth, but not to the extent of creating significant bushfire fuel loads.

Following the low level of bushfire activity experienced across central and southern parts of the Territory in 2019, the 2020 fire season was even quieter with historic low levels of activity in the Alice Springs and Barkly Fire Management Zones. The Savanna zone had around 30% of long-term average fire activity, while the Alice Springs and Barkly zones each had less than 2% of long-term average fire activity.

Following the poor 2018/19 wet season, the 2019/20 wet season saw a slight increase in rainfall across the Top End. The record high proportion of land affected by fire in 2019 was not repeated, largely due to the early onset of the 2020/21 wet season, particularly in the western Top End. Fire response capacity was tested by a period of extreme fire weather in late August with several consecutive days of extreme and severe fire danger across the Top End and much of the Savanna region. Overall fire activity for the season in the Top End was around 10% less than average.

Fire activity in the Arnhem zone continues to reflect the environmental and fire management benefits provided by carbon abatement projects in Arnhem Land and on the Tiwi Islands. Income generated by these projects has funded extensive early strategic burning programs. Early season planned burning was up, and late season wildfires were at historic low levels across the Arnhem zone in 2020.

Like so many Territory businesses and organisations, in 2020 Bushfires NT and the volunteer bushfire brigade network faced a range of challenges related to the COVID-19 pandemic. At various times the requirements for social distancing and disinfection of vehicles and equipment, along with restrictions on movement of staff and contractors, added significant complexity to fire management planning and operations. Despite these difficulties, there was a high level of early fuel reduction burning and other bushfire mitigation activities in the Top End and Savanna regions leading to a high level of preparedness for the season. Fire response operations later in the season were also delivered effectively.

Fire Management Zone	Vernon Arafura	Arnhem	Savanna	Barkly	Alice Springs	ALL NT
Proportion burned 2020 ¹	45.8%	36.3%	8.1%	0.17%	0.06%	7.8%
Early fire ²	23.7%	29.3%	4.9%	0.01%	0.01%	4.9%
Late fire ²	22.1%	7.0%	3.1%	0.16%	0.04%	2.4%
Average 2011-2019 ¹	51.3%	39.4%	26.8%	15.9%	8.7%	18.4%

Table 31: Area burned in each Fire Management Zone in 2020

¹ from NRM Infonet

² early fire mostly planned burning, late fire mostly wildfire

ALICE SPRINGS

Following very dry conditions in 2019, the Alice Springs fire management zone experienced rainfall in most areas during the period. Fuel did not accumulate to the point of creating any significant bushfire risk. As was the case in 2019, very little fuel reduction burning was undertaken during the period, and there was a very low level of bushfire activity. Good summer rainfall across most of the zone towards the end of 2020 will lead to increased fuel loads in 2021, with the possibility of a more active fire season in 2022.

Table 32: Fire extent in the Alice Springs Fire Management Zone 2020

	Area burned (km²)	% of zone
Planned burning, April-September 2020	69	0.01%
Wildfire 2020	267	0.04%
TOTAL	336	0.06%
Area affected by fire in 2019	9708	1.6%
Average area affected by fire 2011-2019	51 403	8.7%

BARKLY

Dry conditions continued through the Barkly Fire Management Zone through much of 2020, although some good summer falls towards the end of the year pushed rainfall totals for the year slightly above average. The absence of any significant fuel load across most of the area led to extremely low levels of fuel reduction burning. Following the record low levels of fire activity in 2019, the 2020 season saw even less fire activity. Just 0.17% of the Barkly zone was affected by fire in 2020, less than 2% of the long term average.

Table 33: Fire extent in the Barkly Fire Management Zone 2020

	Area burned (km²)	% of zone
Planned burning, April-September 2020	25	0.01%
Wildfire 2020	444	0.16%
TOTAL	469	0.17%
Area affected by fire in 2019	3714	1.4%
Average area affected by fire 2011-2019	39 503	14.7%

SAVANNA

Just 8% of the Savanna fire management zone was affected by fire in 2020, this was around 30% of the long term average and 50% less than the area affected in 2019. The poor 2018/19 wet season was followed by similar rainfall levels in 2019/20 leading to continued lower fuel loads through 2020. The early onset of the 2020/21 wet season saw an early end to significant fire activity in the area, with rainfall across much of the zone in September and October.

The two poor wet seasons leading in to the 2020 fire season produced lower than average fuel levels and a reduced frequency and severity of fires. The amount of early season fuel reduction burning, including aerial incendiary burning, was also much lower than average. Volunteer brigades in Katherine and Edith Farms continued to conduct roadside burning within the Katherine Fire Protection Zone early in the season, and roadside burning was also undertaken by pastoralists further afield.

Table 34: Fire extent in the Savanna Fire Management Zone 2020

	Area burned (km²)	% of zone
Planned burning, January-July 2020	14 700	4.9%
Wildfire 2020	9411	3.1%
TOTAL	24 111	8.0%
Area affected by fire in 2019	43 136	14.4%
Average area affected by fire 2011-2019	80 286	26.8%

ARNHEM

The Arnhem Fire Management Zone includes all of Arnhem Land along with Kakadu National Park and the Tiwi Islands. Fire management outcomes across the zone continue to improve, reflecting the continuing refinement of fire management practices associated with carbon abatement projects in the zone. Extensive early burning is carefully planned in order to create a mosaic of burned and unburned areas that will both limit the extent of destructive late season fires, and minimise the environmental impact of fire. Carbon abatement projects now take up over 80% of the land area of Arnhem Land along with substantial areas within Kakadu and the Tiwi Islands.

Despite the challenges created by pandemic related restrictions on travel to and within these areas, the area affected by early burning remained steady in 2020, and the area affected by wildfire late in the season was at an historically low level.

Table 35: Fire extent in the Arnhem Fire Management Zone 2020

	Area burned (km²)	% of zone
Planned burning, January-July 2020	14 700	4.9%
Wildfire 2020	9411	3.1%
TOTAL	24 111	8.0%
Area affected by fire in 2019	43 136	14.4%
Average area affected by fire 2011-2019	80 286	26.8%

VERNON ARAFURA

The 2020 fire season in the Vernon Arafura Fire Management Zone saw less severe conditions than those experienced in 2019, but with the added challenges associated with the COVID-19 pandemic. The period immediately after the wet season traditionally sees extensive fuel reduction and other bushfire mitigation activity. In 2020 this coincided with a period of uncertainty surrounding the refining of arrangements to manage the pandemic. Despite these difficulties, Bushfires NT, volunteer bushfire brigades and landowners in the Top End completed around 85% of planned fuel reduction burning.

The area affected by planned burning was a little less than average, and the area affected by wildfire was significantly lower than average. This good outcome was assisted by the lower frequency of severe fire weather and the relatively early onset of wet season rains. Above average rainfall in September and October saw an early end to the fire season across most of the region.

	Area burned (km²)	% of zone
Planned burning, April-September 2020	14 142	23.7%
Wildfire 2020	13 217	22.1%
TOTAL	27 359	45.8%
Area affected by fire in 2019	37 572	62.9%
Average area affected by fire 2011-2019	30 661	51.3%

Table 36: Fire extent in the Barkly Fire Management Zone 2020

Information provided by the Weed Management Branch

NT-WIDE

Gamba grass

Gamba grass (*Andropogon gayanus*) was originally introduced as an improved pasture through the mid-1900s. It was promoted and planted widely in the Darwin region through the latter half of the century. Unfortunately, the weedy potential of the plant was not given enough attention and it has led to severe infestations in areas where gamba is not controlled and maintained through appropriate grazing regimes. Gamba grass continues to destroy infrastructure, native bushland and wildlife with its large biomass late curing and resulting in high intensity fires.

In late 2020, the Weed Management Plan for Gamba Grass 2020-2030 was approved by the Minister for Environment. This plan has requirements for all landholders in Class A and B zone with new targets for control and eradication to be met over the period of the plan. Gamba grass is declared a weed across the NT and management objectives are split to reflect varying distribution, density, and feasibility of control. The eradication zone (Class A) has lower density and a higher feasibility of eradication, while gamba grass in the management zone (Class B) is at a higher density and has a lower feasibility of control and therefore requiring growth and spread to be controlled (Figure 73).

It is the landholder's responsibility to locate gamba grass on their property and report all gamba grass to the Weed Management Branch.

In the Class A – eradication zone all gamba grass must be destroyed by July 2023. Monitoring must be conducted for all gamba grass regrowth, which must be destroyed. These requirements aim to achieve the objective of eradicating gamba grass in the Class A zone by July 2026.

Three permits to graze gamba in the eradication zone were issued to pastoral properties in the Katherine Pastoral District. One of the permits was cancelled in 2019, with the remaining permit holders being compliant with permit conditions. The Weed Management Branch is supporting the cancelled permit holder with their eradication program. It is now departmental policy that no new permits will be issued for the purposes of grazing within the eradication zone.

Gamba grass may be utilised for hay by pastoral lessees in the Class B management zone; it must only be used internally on the property it was cut on. Gamba hay should be cut whilst the plant is vegetative and prior to flowering. Hay containing gamba must not be sold, traded or transported along roadways.



Figure 73: Gamba grass zones

Weed management planning

The Weed Management Branch has developed a number of species-specific weed management plans under the *Weeds Management Act 2001* (the Act) that set out additional requirements for landholders and landowners in addition to general requirements outlined under the Act. Ten statutory weed management plans have been developed and are available at:

• <u>nt.gov.au/environment/weeds/how-to-comply-with-the-law/statutory-weed-management-plans</u>

In accordance with the Act, these plans must be reviewed at least every three years. The prickly acacia and mesquite weed management plan reviews were finalised and amended plans were released. These plans can be found at:

- <u>nt.gov.au/environment/weeds/weeds-in-the-nt/A-Z-list-of-weeds-in-the-NT/mesquite</u>
- nt.gov.au/environment/weeds/weeds-in-the-nt/A-Z-list-of-weeds-in-the-NT/prickly-acacia

Review of the neem and chinee apple plans are being finalised.

Review of the grader grass and cabomba weed management plans commenced in late 2019. The review of the cabomba weed management plan has been completed with no changes made to this plan. The grader grass weed management plan is still to be finalised.

Review of the athel pine weed management plan also commended in early 2020 and will soon be finalised.

A new Weed Management Plan for Gamba Grass 2020–2030 was completed in 2020. This plan can be found at:

• nt.gov.au/environment/weeds/weeds-in-the-nt/A-Z-list-of-weeds-in-the-NT/gamba

Onshore petroleum weed management

The *Scientific Inquiry into Hydraulic Fracturing in the Northern Territory* made 135 recommendations to reduce the identified risks associated with the development of any onshore shale gas industry in the NT to acceptable limits. Three of these recommendations related directly to weeds:

- 8.2 baseline weed assessments be conducted with ongoing weed monitoring
- 8.3 companies to employ a dedicated weed officer for each gasfield. Additionally, the industry funds an NT Government weed management officer
- 8.4 companies are required to have an approved weed management plan for areas to be accessed for exploration

In response to condition 8.3 of the inquiry, the NT Government Onshore Petroleum Weed Management Officer continues to co-ordinate weed management activities of onshore petroleum companies in the Sturt Plateau, Gulf, Barkly and Alice Springs pastoral districts.

Baseline weed assessments are undertaken prior to the commencement of exploration activities. These assessments inform and assist in the development of Weed Management Plans. Onshore petroleum companies are subsequently required to monitor all areas of ground disturbance, in accordance with the annual action plan identified in their Weed Management Plan, for weed introduction and spread.

The weed species most commonly detected during surveys include hyptis, sida, sicklepod, Parkinsonia and rubber bush. These weeds are mostly in areas of disturbance and high cattle traffic, such as along roads, around water points and on approaches to paddock gates.

Good weed hygiene practices are vital for petroleum companies and pastoralists to prevent weed introduction and spread. Weed identification and spread prevention training has been provided to petroleum companies, their contractors and NT Government agencies involved in the industry. Extension resources such as the 'What Themeda is that?' poster (Figure 74), and weed ID and spread prevention programs continue to be developed and delivered.

DARWIN REGION

The Darwin Region weed management area covers approximately 150 000km², encompassing 21 pastoral leases that make up 13% of the region's land area. Aboriginal land accounts for 73% of the region and includes Arnhem Land, Kakadu and the Daly/Port Keats Aboriginal Land Trust and most of the NT's islands. Many of the NT's high value floodplain pastoral properties are in the Darwin Region. Priority weeds identified in the Darwin Regional Weed Management Plan 2015-2020 have been the critical focus for the Weed Management Branch. The Plan is being reviewed and a new strategy is expected mid-2021. During 2019, a Siam weed emergency response was initiated and this response has been the main focus for on ground activities in the Darwin Region for 2020.

Siam weed

Siam weed (Chromolaena odorata) was first detected in the Territory in July 2019. An emergency response was enacted and a further two 'infected premises' (on Aboriginal Land Trust) were identified.

Siam weed has an extremely fast growth rate (up to 20mm per day) and prolific seed production. In the tropics of Africa and Asia, it is a major pest of crops such as coconuts, rubber, tobacco and sugar cane. Some agricultural areas in south-east Asia have been abandoned because Siam weed has taken over pastures and crops. Siam weed is toxic to stock and there are also health issues to humans, such as skin irritation and asthma.

The known Siam weed infestations in the NT have been treated, either by:

• Ground spraying

- Hand pullingFire
- Tebuthiuron (Graslan) application
- Biocontrol release Gall Fly (Cecidochares connexa)

• Aerial spraying

The current priority for the Weed Management Branch is to contain and to find the extent of the infestation in the known area and to determine if it is present in the NT. Survey for Siam weed is best carried out during flowering (June to August). Further surveillance is required outside the known infestation area in 2021 and efforts towards containment of the core infestations and eradication of outliers will be a main focus for the Top End.

The known infestation area has been fenced off by the landholder and strict spread prevention practices implemented.

What Themeda is that?

There are 4 species of *Themeda* in the Northern Territory. They are tufted or tussock grasses growing 1-3m tall. *Themeda* are characterised by the complex arrangements of the spikelets in the seed head. A range of characteristics should be considered to identify your *Themeda*. Learn to identify **grader grass** for early detection and successful control.

The introduced Class B weed, grader grass (*Themeda quadrivalvis*), is mostly unpalatable to stock and outcompetes more useful grasses. Grader grass seed is often transported as a contaminant in hay or mud stuck to vehicles and machinery, including slashers and graders.



Figure 74: Example extension material prepared for the onshore petroleum industry.



Photo 1: Siam weed through the seasons

Photo 2: Siam weed Flower (June)

Mimosa

Mimosa (*Mimosa pigra*) remains the major weed impacting on the pastoral industry in the Top End, having infested the Mary, Adelaide, Finniss, Reynolds and Daly River catchments. Major infestations negatively impact on pastoral production, stocking rates and land condition.

The biological control agent 'Nessie' (*Nesaecrepida infuscata*) continues to increase its distribution. Nessie, a flea beetle, is having a dramatic effect reducing the vigour of mimosa plants especially in the lower Daly, Mary, Adelaide, Finniss and Reynolds River areas.

Rat's tail grasses

Giant rat's tail grass (*Sporobolus natalensis*) and American rat's tail grass (*S. jacquemontii*) are present in the NT. These introduced grasses cause many millions of dollars' worth of damage to the Queensland and New South Wales pastoral industries. Other than reducing available pasture, this tough unpalatable grassy weed can reduce grazing life of cattle through increased wear of teeth.

Rat's tail grass continues to spread across Top End properties. Pastoralists need to know, recognise and control this weed in new areas. Yarding, laneways and high traffic areas such as water points and gates are very prone to infestation and it is from these areas that it is spread to wider pasture. Glyphosate control in the first instance can be effective in preventing further spread.



Photo 3: Rat's tail grass infested paddock

Grader Grass

Grader grass (*Themeda quadrivalvis*) continues to spread north into the Darwin Region. It is important that pastoralists:

- ensure heavy machinery and vehicles are clean of seeds, vegetative material and soils before entering their property;
- do not spread or introduce soils from known grader grass contaminated areas; and
- do not let anybody drive through seeding grader grass.

It is also important that hay sourced from properties is from grader grass-free paddocks. As grader grass seeds early in the Wet season, it easily contaminates hay product cut later in the year. Once cut into product it can easily be transported from property to property.

Grader grass identification and control is very difficult. Being an annual grass it is almost impossible to identify until flowering. However, the time between flowering and seed set is very short. Stations need to be ready to treat the grass as soon as it becomes noticeable, or have measures in place to treat known infestation areas prior to flowering.



Photo 4: Grader grass

KATHERINE REGION

The Katherine Region weed management area covers approximately 386 000km², encompassing 95 pastoral leases. The region includes the VRD, Katherine, Roper, Sturt Plateau and Gulf Pastoral Districts. Priority weeds identified in the Katherine Regional Weed Management Plan 2015-2020 have been the critical focus for Weed Management Branch business in this region. This document is currently under review by the Katherine Regional Weed Reference Group with the new strategy to be completed in May 2021.

The 2020 reporting year has seen the continuation of the emergency responses for parthenium weed and rubber vine, both self-reported by pastoralists within the Katherine Region. The Weed Management Branch has kept an ongoing focus on working with managers of government-owned land, local government and corridors to ensure priority weeds are managed in accordance with statutory obligations. This engagement is starting to see improved results, including a significant decrease in the amount gamba grass found within road reserves. Weed management officers are also working to improve grader grass management in the road reserves.

Parthenium weed

Parthenium weed (*Parthenium hysterophorus*) was reported the Weed Management Branch in October 2018. Extensive and regular survey and control has seen around 2273 plants, with 173 seedling plants detected in 2020 and all plants were destroyed on site. Parthenium weed plants have not been found outside the initial infestation area and the current infestation has been assessed as technically feasible to eradicate. The Weed Management Branch is in the process of handing the responsibility of the infestation to the landholder with ongoing oversight from weed management officers.



Photo 5: Parthenium seedling

Rubber vine

Rubber vine (*Cryptostegia grandiflora*) is widespread throughout northern Queensland. It was reported on Settlement Creek near the NT/Queensland border in March 2019. Initial control of over 500 plants involving the Weed Management Branch, Parks and Wildlife rangers and a large station contingent made the infestation manageable. Since then, the landholder has worked hard towards eradication, achieving excellent results with 14 plants being treated in 2020. Survey for rubber vine will be ongoing as there are known infestations along waterways 3km from the NT border. The Weed Management Branch is working with Indigenous ranger groups and government authorities in Queensland to ensure that any future incursions of this weed are detected as soon as possible and re-instatement of the 5km rubber vine buffer on the border with Queensland. The Branch continues close communications with Western Australia as rubber vine control and eradication continues in the East Kimberley.

Mimosa

Mimosa (*Mimosa pigra*) is only found in small isolated infestations and remains a priority for the Katherine Region. All known infestations currently have active control and monitoring programs. One property reported that in 2019 no mimosa plants were found. However, monitoring of this site continues. This is a long-term surveillance program and it is promising to see that the size of these small infestations is decreasing with three survey and control visits each year.

Weed data collection

The collection of weed data utilising the NT Weedmate app has increased with a number of pastoral leases now using the app to collect weed data. Weed management officers provide maps upon request which are being used to develop property weed management plans.



Photo 6: Treated rubber vine plant

BARKLY REGION

The Barkly Region weed management area encompasses the Mitchell Grass Downs and Davenport Murchison Ranges Bioregions and parts of the Tanami and Sturt Plateau. It covers an area of 283 648km². The Weed Management Branch, in conjunction with regional stakeholders, implements the Barkly Regional Weed Management Plan. The Plan, which will be reviewed in early 2021, identifies the declared weeds prickly acacia, mesquite, bellyache bush, parkinsonia and rubber bush as priority species that require management.

Prickly acacia

There has been a continued focus on prickly acacia (*Vachellia nilotica*) in the Barkly Region with core infestations surveyed and control programs implemented. Core infestations have showed a reduction in abundance and distribution; there has also been a clear change in the population, with the age cohort shifting from predominantly adult trees to seedlings and juveniles. Eradication of prickly acacia remains the highest priority within the Barkly.

Funding through the Australian Government's 'Established Pest Animals and Weeds Measure' allowed for a remote sensing project for prickly acacia on the Barkly. Using existing techniques applied in Queensland by Desert Channels Queensland and Queensland University of Technology, trials were conducted to detect infestations using both satellite and UAV imagery. Results indicated that, due to the low densities of prickly acacia on the Barkly, this technology is currently not suitable to detect individual or small isolated infestations. The final report can be found on the DEPWS webpage.

In 2019, the Weed Management Branch joined the Prickly Acacia Alliance, which comprises key stakeholders in both Queensland and the Northern Territory. This group aims to work collaboratively to share information and lobby for coordinated approaches to eradicate prickly acacia.

Mesquite

Mesquite (*Prosopis* spp.) has remained a focus with two surveys completed on the Barkly's largest mesquite infestation. Data collected from this survey will allow the lessee to complete the required work during the 2020 dry season. All of the more isolated occurrences of mesquite on remaining Barkly Region properties are currently under active management programs. Mesquite remains an achievable eradication target on the Barkly with a reduction in both distribution and density on many properties.



Photo 7: Mesquite

Bellyache Bush

Bellyache bush (*Jatropha gossypiifolia*) is found on one pastoral lease in the Barkly. The drier than average wet season on the Barkly in 2019 prevented any germination of bellyache bush. The close proximity to Tennant Creek ensures regular monitoring is undertaken, with eradication an achievable goal. The promising start to the 2019/20 wet season may trigger germination, and survey and control is planned for early 2020 to control all plants prior to seeding.

Parkinsonia

Parkinsonia (*Parkinsonia aculeata*) can be found on most pastoral leases in the Barkly region. Ad-hoc control occurs during the survey and treatment of priority weeds. A naturally occurring dieback (soil-borne fungus) is having dramatic effects on what were once large, dense infestations across several catchment areas. This includes the Lake Sylvester catchment, which incorporates several large pastoral holdings in the region. To complement the success of the naturally occurring dieback, a commercial bioherbicide 'Di-Bak' continues to be used to inoculate infestations at various locations where the dieback phenomenon has not been shown to occur.

Rubber bush

Rubber bush (*Calotropis procera*) continues to be a significant concern for landholders within the region. Weed Management Branch are continuing to investigate further potential for herbicide trials to establish an effective and convenient means of controlling this weed. During the 2019 Dry season, weed management officers observed lesser wanderer butterfly larvae actively eating and defoliating rubber bush. In Australia, the foods of this butterfly are all from the milkweed family, to which rubber bush belongs.



Photo 8: Parkinsonia

ALICE SPRINGS REGION

The Alice Springs Region weed management area covers a vast area of approximately 576 000km² bordered by Western Australia, Queensland and South Australia. The pastoral estate in central Australia is made up of 66 pastoral leases which cover approximately 40% of the land area. Aboriginal land in the region makes up 50% of the total land area. The Alice Springs Regional Weed Management Plan, which is currently being revised, lists priority weed species and landscapes across the region which are the focus for weed management activities. The priority weeds listed for management within the region include athel pine, cacti, parkinsonia and rubber bush; all of which have undergone a rigorous scientific weed risk assessment process, which has determined their weed risk and high potential for effective management.

Athel pine

The Weed Management Branch have continued to work collaboratively with affected landholders in the upper managed 420km of the Finke River catchment in managing residual infestations of athel pine (located on Henbury, Idracowra, Maryvale, and Horseshoe Bend Stations). The success of the ongoing management of residual levels of athel pine in the upper catchment areas of the Finke River presents a real opportunity for eradication within the next 5-10 years.

Cacti

There are several species of declared Class A weedy opuntioid cacti within Central Australia, which have become naturalised at several different locations. All of the known cacti infestations located on the pastoral estate are currently under active management programs, with ongoing monitoring and controls in place, and eradication at all sites is a distinct possibility in the next 5 years. An ongoing awareness and education campaign is currently underway with local Alice Springs residents and landholders to assist with the identification and removal of amenity plantings of declared cacti from gardens. Ongoing surveillance for the presence of declared cacti has continued across the region in 2019 with continued education and awareness.

Mesquite

Mesquite (*Prosopis* spp.) within the region occurs as one isolated infestation to the northwest of Alice Springs. Previous issues with organic certification hampered the use of chemicals for the control of this infestation but these have now been resolved. Weed management officers have recently liaised with station management to initiate an eradication program for the identified infestation in 2020.



Photo 9: Athel pine infestation

FERAL ANIMALS

The NT harbours a suite of established feral animal species, which have negative impacts on production values as well as the environment and culturally important sites. The main species of concern on the pastoral estate are feral horses, donkeys, camels, water buffalo and pigs. The Department of Environment, Parks and Water Security (DEPWS) is supporting the management of feral animals on Aboriginal land through the Indigenous Ranger Grants Program. Introduced predators such as foxes and feral cats can have significant impact on conservation values. DEPWS is supporting an Australian Government initiative to develop updated maps of the distribution of vertebrate feral animals and weeds across Australia.

Water buffalo

Feral water buffalo are widely distributed across the northern third of the NT, extending from the Daly River Region in the west to the eastern edge of Arnhem Land. Buffalo have serious negative impacts on the environment and on cultural sites and can serve as a reservoir for exotic livestock disease, including carrier status for foot and mouth disease. They are also potentially a valuable resource with a demand for buffalo in domestic slaughter and live export markets. With the conclusion of the Brucellosis and Tuberculosis Eradication Campaign in 1997, coordinated and integrated management of feral water buffalo in the NT ceased and the population has progressively increased. An aerial survey conducted in Arnhem Land in 2014 provided a population estimate of nearly 98 000 buffalo at a density of 1.1 buffalo per km². The total population in the NT may be as high as 120 000 animals. Buffalo are counted during annual surveys conducted across the Top End to assess Magpie Goose population size. The data indicate that the buffalo do occur in significant numbers outside of Arnhem Land and that the overall population has increased over the period 2016-2020.

A Commonwealth Government funded project led by CSIRO under the Smart Farming Partnerships Program is investigating large-scale herd management techniques to enhance commercial use of buffalo on Aboriginal land and reduce environmental impacts.



Photo 10: Water Buffalo

Rabbits

Rabbit numbers in central Australia are well below levels recorded prior to the arrival of Rabbit Haemorrhagic Disease (RHD) in the mid-1990s. RHD and myxomatosis are periodically active throughout the region and help keep rabbit numbers in check. Very little additional rabbit management is undertaken anywhere in central Australia.

FERAL ANIMALS

Feral pigs

The recent spread of African Swine Fever in south-east Asia has raised awareness of feral pig management in NT more broadly as feral populations are likely to be a significant reservoir if the disease were to reach Australia, threatening the domestic pig herd. One of the more long-standing programs has been the Territory NRM supported pastoral floodplain pig management project around the Finniss/Reynolds River regions now into its 7th year. Whilst funding has been variable, there have been high levels of collaboration and certain areas have retained low pig populations. A key outcome has been improved mimosa management. DEPWS has been attempting to develop a better understanding of the distribution of feral pigs in northern Australia in relation to habitat through annual aerial surveys. Pigs are counted during annual surveys conducted across the Top End to assess Magpie Goose population size. The data suggest that the pig population has been relatively stable over the period 2017-2020.



Photo 11: Feral pigs



Photo 12: Red fox



Photo 13: Camel

Red foxes

Red foxes are distributed throughout the arid and semi-arid regions of the NT. Red foxes pose a threat to native fauna species. However, there is no systematic management in the NT due to the potential impact that widespread baiting in the conservation context may have on native carnivores such as the dingo.

Horses, Donkeys and Camels

DEPWS was not involved in the aerial culling of horses or camels over the reporting period. However, DEPWS continued to work with Traditional Owners to protect and rehabilitate wetlands damaged by horses and camels in central Australia.

FERAL ANIMALS

Feral cats

Feral cats are prevalent across the NT, including arid and remote regions. Cats are renowned for their impacts on our native wildlife and are recognised a key threatening process. They can also have an impact on the meat industry in some parts of Australia through spreading the parasite Toxoplasmosis gondii. Controlling cats is best undertaken in a targeted manner, through creating refuges on cat-free islands or by constructing exclusion fencing, or by undertaking ongoing targeted control to protect particular high conservation value wildlife.

Exclusion fences are used to protect small populations of the endangered mala (rufous hare wallaby) from foxes and cats on Uluru-Kata Tjuta National Park and Newhaven Reserve. Other threatened animals also benefit from these areas and more species may be re-introduced to them as insurance populations.

In 2019/20, DEPWS carried out experimental cat control with the 1080 Eradicat bait in core central rockrat refuge habitat in the Tjoritja/West MacDonnell National Park. Baits were deployed aerially at a density of 50 per km² in two 4000ha areas during winter months. Monitoring results showed a reduction in the density of cats, and the ongoing cat control is improving the colonization and persistence of the central rock-rat.



Photo 14: Feral cat in a camera trap

Wild dogs and dingoes

Dingoes are a native species and are protected in the NT. However, wild domestic dogs and hybrids between domestic dogs and dingoes are considered feral animals. Dingoes, hybrids and wild domestic dogs cause damage to livestock through direct predation of calves and through mauling. On the pastoral estate, dingoes can be killed under permit to mitigate damage to cattle. The majority of stations deploy 1080 baits for this purpose. The 1080 baiting program is administered by the Department of Industry, Tourism and Trade.



Photo 15: Dingo

APPENDICES

Grazing Land Management Research and Advisory Services

Information provided by the Department of Industry, Tourism and Trade

The Department of Industry, Tourism and Trade (DITT) Livestock Industries Development group provides research, development and extension services to facilitate the sustainable development of the NT pastoral industry. Areas of expertise include grazing land management, carrying capacity assessment, animal production, genetics, improved pastures and market development. During 2019-20, DITT also continued to support Aboriginal economic development through its partnership in the Indigenous Pastoral Program.

The DITT Rangeland Program's research and extension activities aim to optimise the sustainable and productive use of native pastures. Over the past 20 years, DITT has developed a nationally-significant catalogue of pasture growth models for the important pastoral land types of the NT. These models are used to estimate sustainable livestock carrying capacity and to test management scenarios with potential to increase the resilience of pastoral businesses to seasonal variability and climate change. The following sections highlight some of the main activities undertaken in the past 18 months.

NT Pastoral Feed Outlook

Since late 2011 DITT has produced a quarterly bulletin that summarises the seasonal outlook, recent forage growth and current estimated standing pasture biomass in each of the 11 pastoral districts of the NT. The Outlook can alert producers and industry advisers to issues such as low pasture levels, increasing drought risk and high fire risk. The Outlook is available as a free subscription service on the NTG website: industry.nt.gov.au/publications/primary-industry-publications/northern-territory-pastoral-feed-outlook

The 2019-2020 summer season resulted in below average rainfall across most districts. For large areas of the VRD, Sturt Plateau, Roper, Gulf and Tennant Creek districts, this was the second consecutive below average season. As a result, many districts experienced extremely low pasture growth (in the lowest 10% of years on record). By the end of 2020, critically low pasture levels (less than 200kg/ha) were widespread in the Barkly, Tennant Creek, Northern and Southern Alice Springs districts. Furthermore, large parts of the NT were experiencing very low levels (200-500 kg/ha) of standing pasture biomass, including in the Darwin, Katherine, VRD, Sturt Plateau, and Plenty. Significant destocking occurred in several districts throughout 2019 and 2020 in response to the deteriorating feed conditions.

Carrying Capacity Research and Advice

The DITT provides carrying capacity assessments to property owners on request. This typically involves a property visit to verify infrastructure and land type mapping and to assess pasture growth and land condition. The agency also fields numerous requests each year from both family-owned and corporate enterprises to provide advice on property development and land management.

The DITT has calibrated pasture growth models for more than 20 pasture types across the NT. Median pasture growth estimates from these models are routinely used for property carrying capacity assessments, Grazing Land Management workshops and for testing the performance of management options/practices arising from research projects.

High quality land type mapping is essential for carrying capacity assessment. Ongoing investment by DEWPS to improve the land type mapping in the Roper, Gulf and southern Sturt Plateau Districts, in particular, has been welcomed by DITT.

APPENDICES

Evidence-based Property Development

In 2019 the DITT started a new project called Paddock Power. This Meat and Livestock Australia funded project aims to provide sound evidence for the sustainable and profitable intensification of infrastructure in northern Australia. DITT is conducting research in the Barkly region to measure the impact of paddock area and distance to water on livestock production, with a focus on reproductive performance. The project is developing a calculator tool so that producers can compare different paddock development options they have in mind and work out the return on investment on the basis of their specific cost base, land types and animal productivity.

In September 2020, 160 GPS collars were deployed to breeders at Rocklands Station. These are recording locations at 5 to 15 minute intervals. Once these collars are retrieved we will have a better understanding of how cattle use paddocks at different times of the year and examine whether factors such as distance walked has an impact on breeder performance or calf loss. More information about the project can be found on FutureBeef: <u>futurebeef.com.au/projects/paddockpower/</u>.

Grazing Management Research

The Sweet Spot project also commenced in 2019. This project is using existing grazing trial datasets from across northern Australia to identify pasture utilisation rates that optimise breeder herd productivity. Ultimately the goal of the project is to help producers to maximise the kilograms turned off per hectare whilst maintaining the resource base. More information about the project can be found on FutureBeef: <u>futurebeef.com.au/projects/sweetspot/</u>.

DITT grazing systems trials and demonstrations continue to be conducted at Old Man Plains Research Station near Alice Springs, Douglas Daly Research Farm and Victoria River Research Station (Kidman Springs). Updates on these projects can be found in the latest DITT Annual Research Achievement Report.

The "Quality Graze" trial at Old Man Plains is testing and demonstrating recommendations that have been identified from recent research projects and promoted through the Grazing Land Management (GLM) workshops. The strategies being investigated include using the GLM methodology to set sustainable stocking rates, annual stocking rate adjustment based on seasonal variability, and pasture spelling achieved via rotational grazing. Pasture productivity, land condition and animal performance are regularly measured. Key findings to date include:

- Our current carrying capacity methodology appears to be sustainably matching stocking rate to land capability and maintaining land condition regardless of spelling or annual stocking strategy, and provides a buffering strategy for cattle production over a dry period of at least 12 months.
- Consistent production of steers for premium beef markets is possible in terms of growth rate and fat deposition across a range of seasons when stocking rates are matched to forage supply.
- Meat Standards Australia compliance is possible under conditions similar to those experienced over the past 5 years however more research is required to determine how to achieve more consistent levels of compliance.

More information about this trial can be obtained by contacting chris.materne@nt.gov.au.

APPENDICES

Prescribed Burning Research

The "Shruburn" experiment at Kidman Springs (established in 1993) has been investigating how to use prescribed burning to manage woodland thickening and optimise pasture production. The trial plots are replicated on red and black soil sites, with the experiment testing the influence of seasonal burning (early vs late dry season) and frequency of burning (every two, four and six years). The experiment also includes a series of unburnt control plots for comparison. The major findings can be found in the Rangeland Journal (Cowley et al. 2014, Rangeland Journal 36(4): 323-345). More information about this long-term experiment can be found at: <u>futurebeef.com.au/resources/projects/kidman-springs-fire-experiment-shruburn</u>. The local industry has asked DITT to continue this research because it is providing rigorous data to demonstrate that 4-yearly late dry season burning is an environmentally sound management practice in grazed savannas.

To implement the recommendations of the Shruburn project, a paddock-scale burning demonstration was established at Kidman Springs in 2016. Every year, one or two paddocks identified as having higher than expected woody cover are spelled from the early dry season to ensure optimal fuel loads and burnt late in the dry season. They are then wet season spelled in accordance with grazing land management best practice recommendations. Each paddock has between 4-8 permanent photo monitoring points that are revisited annually.

Industry Training Opportunities

DITT continues to provide a range of grazing management training opportunities to industry. These include the EDGE Network Grazing Land Management course, the one-day Grazing Fundamentals workshop, Rangeland Management Courses for first-year stock-camp staff and the Barkly Herd Management Forum. Producers can contact their local DITT office to find out more.



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