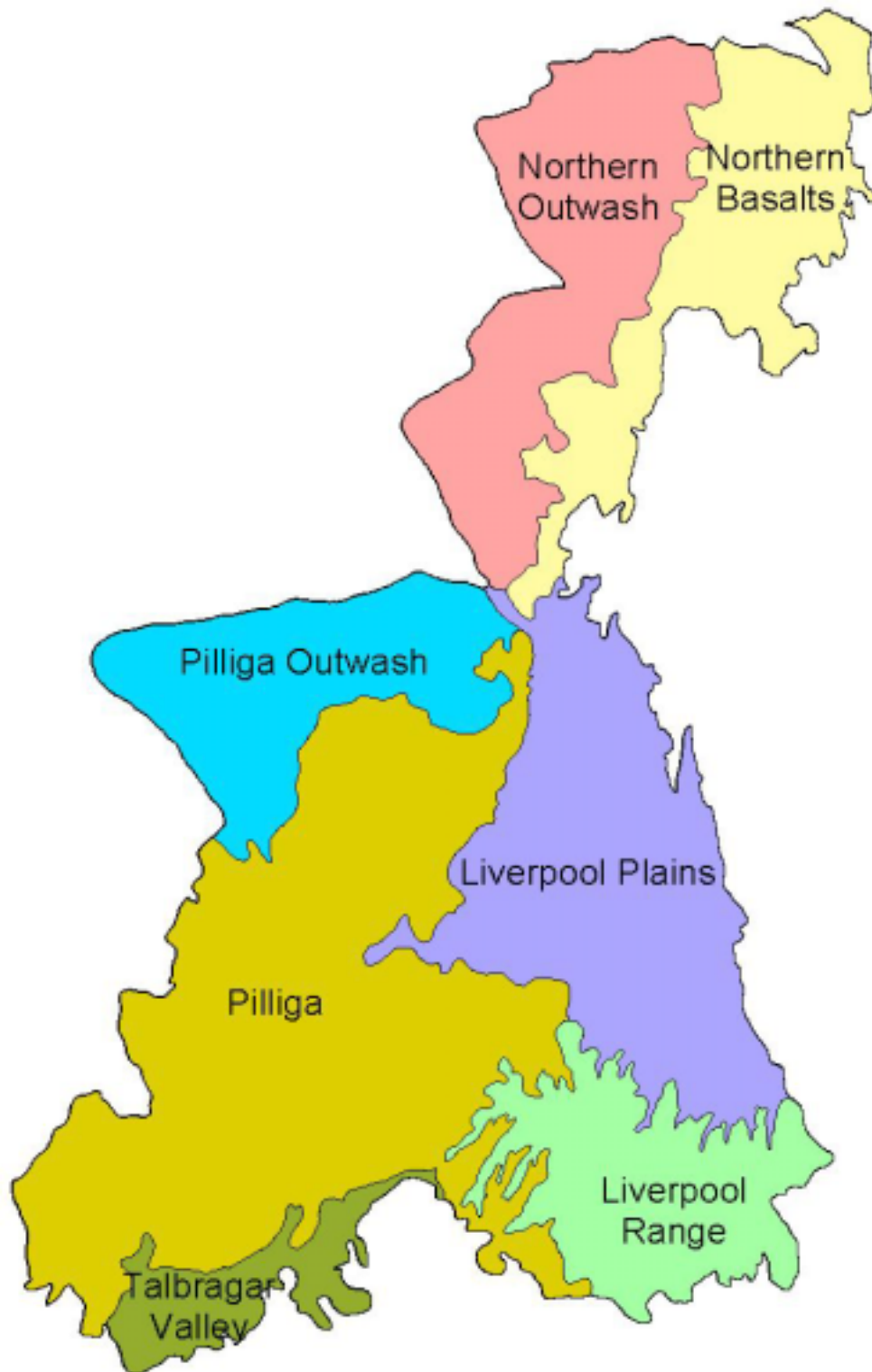


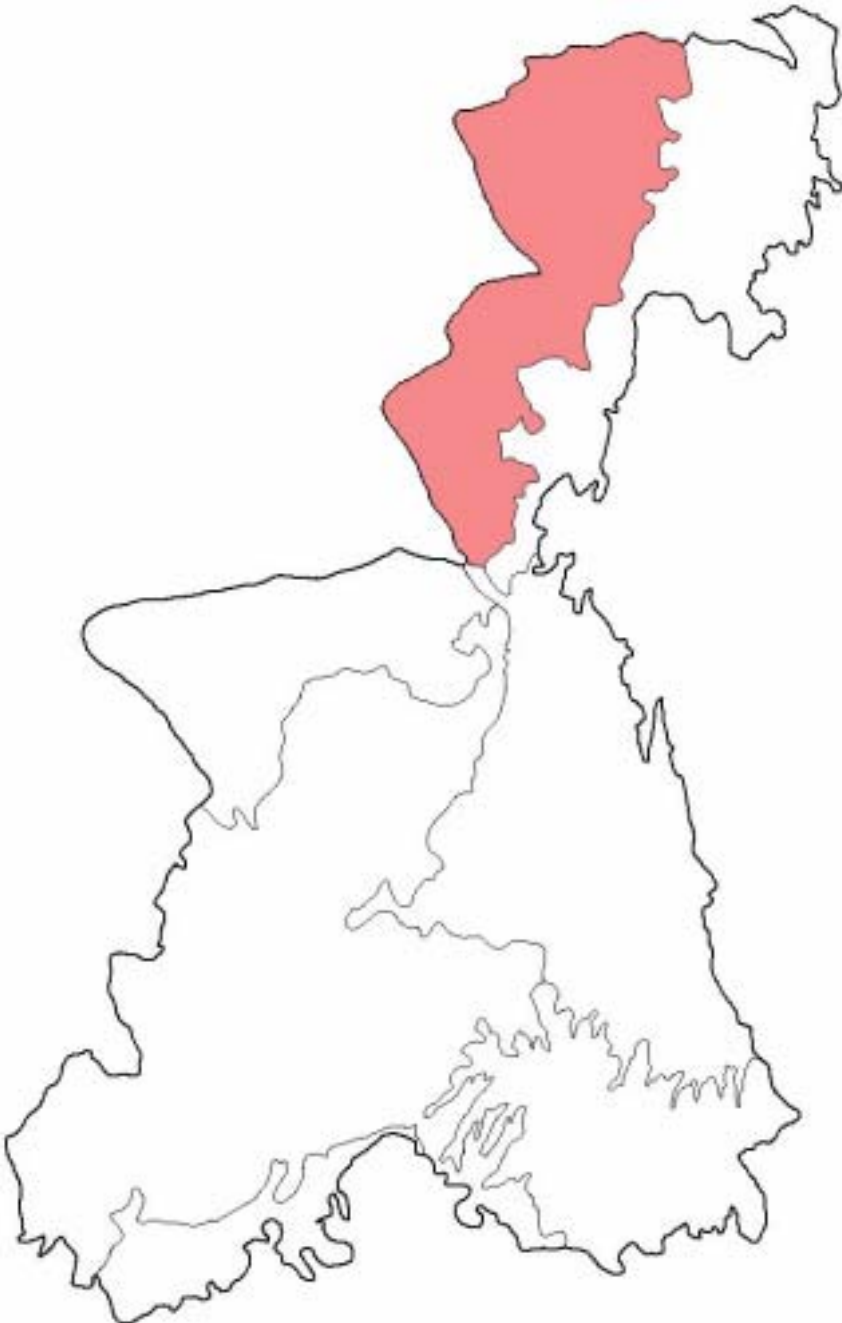
APPENDIX A

LANDFORM PROFILES

Provinces of the Brigalow Belt South Bioregion



Northern Outwash Province



Area: 940 000ha

Division of Tenure:

- National Parks 0.1%
- State Forests <0.1%
- Crown Land 21%
- Freehold 79%

Basic Description: Low red rises and alluvial fans originating from sandstones and basalts.

Area in hectares of Aboriginal LALC

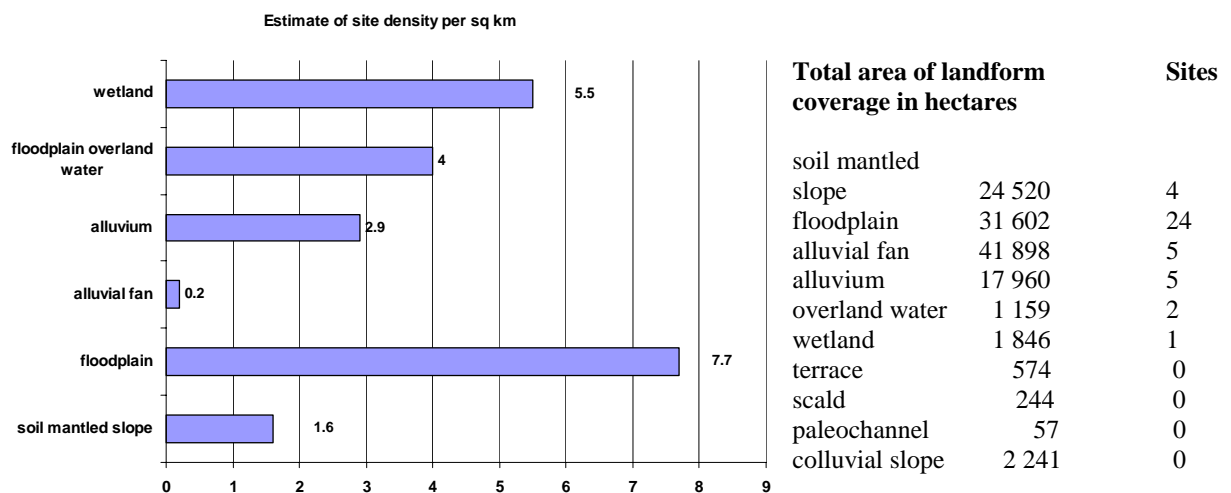
Toomelah	201 1471
Moree	411 843
Wee Waa	3 225
Narrabri	77 405

Known number of Aboriginal sites: 99 (Pre- and post BBS assessment)

Landforms of Northern Outwash Province

General description

Very gentle soil-mantled slopes dominate the eastern regions of the province, where it joins the Northern Basalts Province. Narrow, colluvium filled drainage lines are associated with the eastern area of the Province. In the western areas of the Province several large alluvial fans dominate (e.g. Croppa Ck) and valleys (e.g. Gil Gil Ck). The fans are sourced from the Northern Basalts province, to the east. On the western boundary these alluvial fans meet the floodplains of the McIntyre and Gwydir Rivers.



Landform and site association

Ten landform categories representative of the Northern Outwash Province were identified and mapped. Alluvial fan (41 898 ha) and floodplain (31 602 ha) dominate the areas of mapped landform coverage. Both landforms occur more frequently within the western region of the province. Soil mantled slope (24 520 ha), and alluvium (17 960 ha) occur mostly in the eastern region although alluvium is associated with the western creek systems. The remaining landforms are much smaller in size and are predominately landforms associated with alluvium and floodplain landforms (Alluvial group).

Sites are strongly associated among floodplain and alluvium landforms with an average distance of water from sites calculated at 119 metres. Site density among the Alluvial group of landforms, particularly floodplains, is higher than the High contour group (soil mantled slope). Aggrading landform processes may be affecting site distribution among alluvial fans and floodplain. Estimates of site density is also affected by limited survey and mapping coverage in the region. However, the higher estimated results of sites among the Alluvial group of landforms, compared with the other landform types, is an expected result. Travelling stock routes and reserves were the main areas where the province was sampled. More sampling and landform mapping is required for this region.

Liverpool Plains Province



Area: 940 000 ha

Division of Tenure:

- National Parks 0.1%
- State Forests 3%
- Crown Land 12%
- Freehold 85%

Basic Description: Extensive grasslands on alluvial plains with small wooded sedimentary and volcanic hills

Area in hectares of Aboriginal LALC

Red Chief (462 438)
Walhallow (252 637)
Coonabarrabran (100 264)
Narrabri (64 511)
Nungeroo (60 075)

Total number of recorded Aboriginal sites: 307
(Pre- and post BBS assessment)

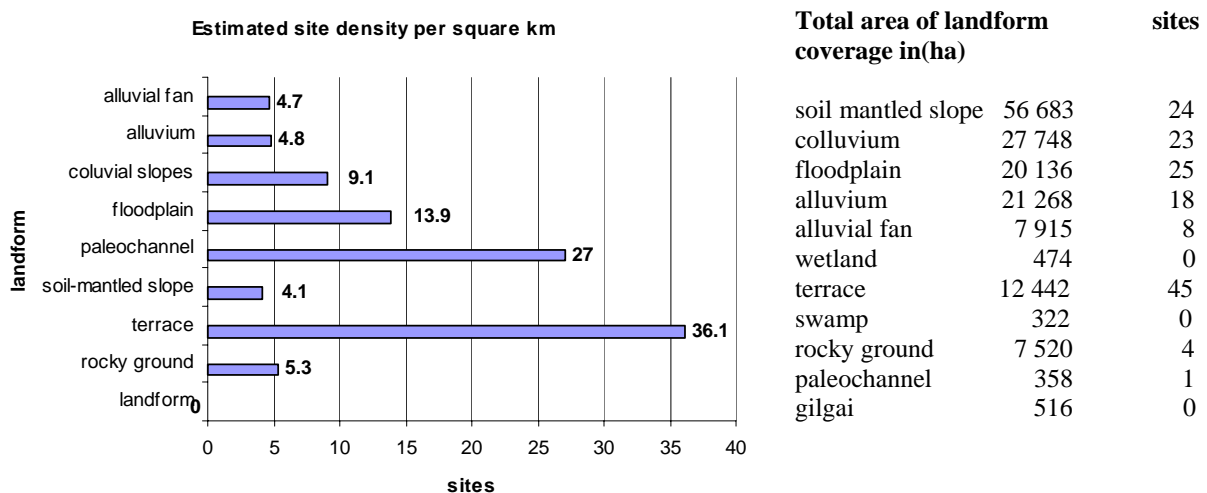
Landforms of the Liverpool Plains

General description

This province is quite diverse. It includes some very high and very rugged ranges for example Deriah State Forest including bare rock benches and cliffs and deep valleys with pockets of alluvium but very little colluvium.

At the other extreme are the broad black clay floodplains of the Mooki River and its tributaries draining from the Liverpool Range. These floodplains are extensively cropped and exhibit evidence of dramatic soil erosion and deposition from floodwaters. The tributaries of the Mooki River tend to decrease in size downstream as more water is discharged to the floodplains. Extensive sheet flooding is characteristic of this area and is the cause of the sheet erosion on the cultivated land. Between the Mooki tributaries are isolated ridges of sandstone (sometimes capped with basalt), mostly forming gentle soil mantled hills, sometimes with rock benches. The lower slopes of these hills are usually mantled in broad colluvial deposits. Further areas of sandstone hills with some rock outcrop and colluvium filled valleys are found north of Lake Goran (and east of Boggabri (Leard Sf).

Lake Goran is a shallow but extensive depression fed by creeks draining the Liverpool Range. Floodwaters are contained in the basin formed between the floodplains of Cox's Creek in the west, Mooki River in the east and the sandstone hills around Curlewis in the north. Overflow can occur towards the Mooki River, however there is no defined overflow channel. The lake has some shoreline deposits including lunettes and sandy beaches. In the southwest (between Tambar Springs and Mullaley) are several steep 'sugarloaf' mountains formed on Jurassic volcanic rock.



Landform and site association

A distinguishing feature of the Liverpool Plains Province is the strong site association among terrace, paleochannel and floodplain landforms. Paleochannels (despite only a small area of mapped coverage and sample) have a potentially high site density estimate because of its association with floodplain landforms, which in the Liverpool Plains are broad in area. Similarly, results show that terrace landforms are high in site density because of the landscape relationship between terrace and floodplain. Terrace landforms are gently raised above the floodplain and offer suitable locations for strategic camp sites. The terraces associated with the Namoi River, Mooki River and Cox River floodplains are examples of landforms with a high potential for containing sites. All the state forests in the Liverpool Plains are covered by landform coverage and were sampled for sites. The bulk of mapped areas of soil mantled slope, colluvium and rocky ground occur within these areas. Additional coverage is required. Seventy nine percent of the Liverpool Plains remains unmapped.

Pilliga Outwash Province



Area: 535,000 ha

Division of Tenure:

- National Parks <0.1%
- State Forests 36%
- Crown Land 19%
- Freehold 45%

Basic Description: Forested sandy plains

Area in hectares of Aboriginal LALC

Walgett	77 002
Wee Waa	91 128
Narrabri	103 070
Pilliga	236 516
Coonamble	27 376

Total number of recorded
Aboriginal sites: 193
(Pre- and post BBS
assessment)

Landforms of the Pilliga Outwash

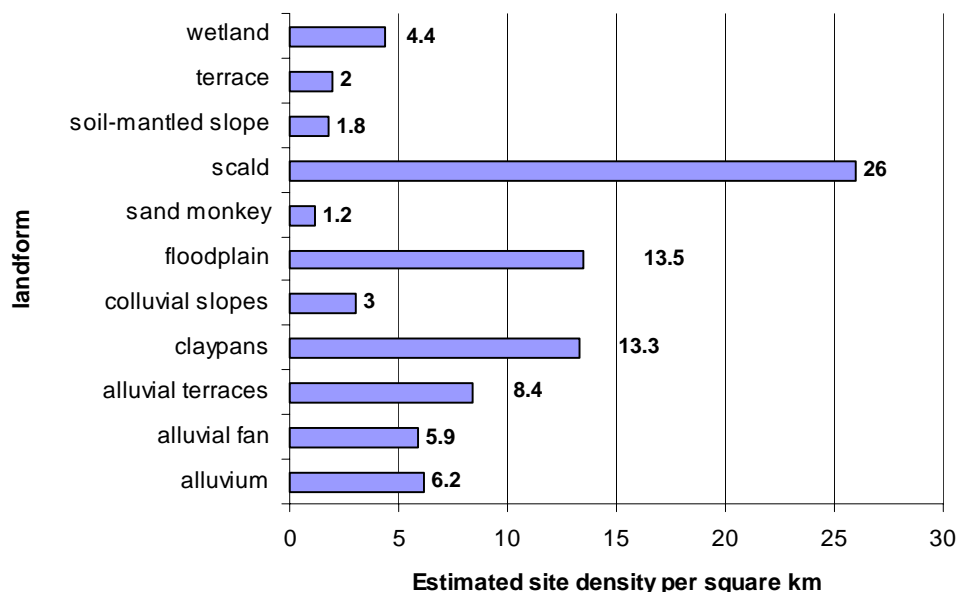
General description

Mapped as alluvium and alluvial terrace, the Pilliga Outwash province can also be thought of as a series of intersecting alluvial fans formed by creeks draining from the Pilliga province towards the Namoi River.

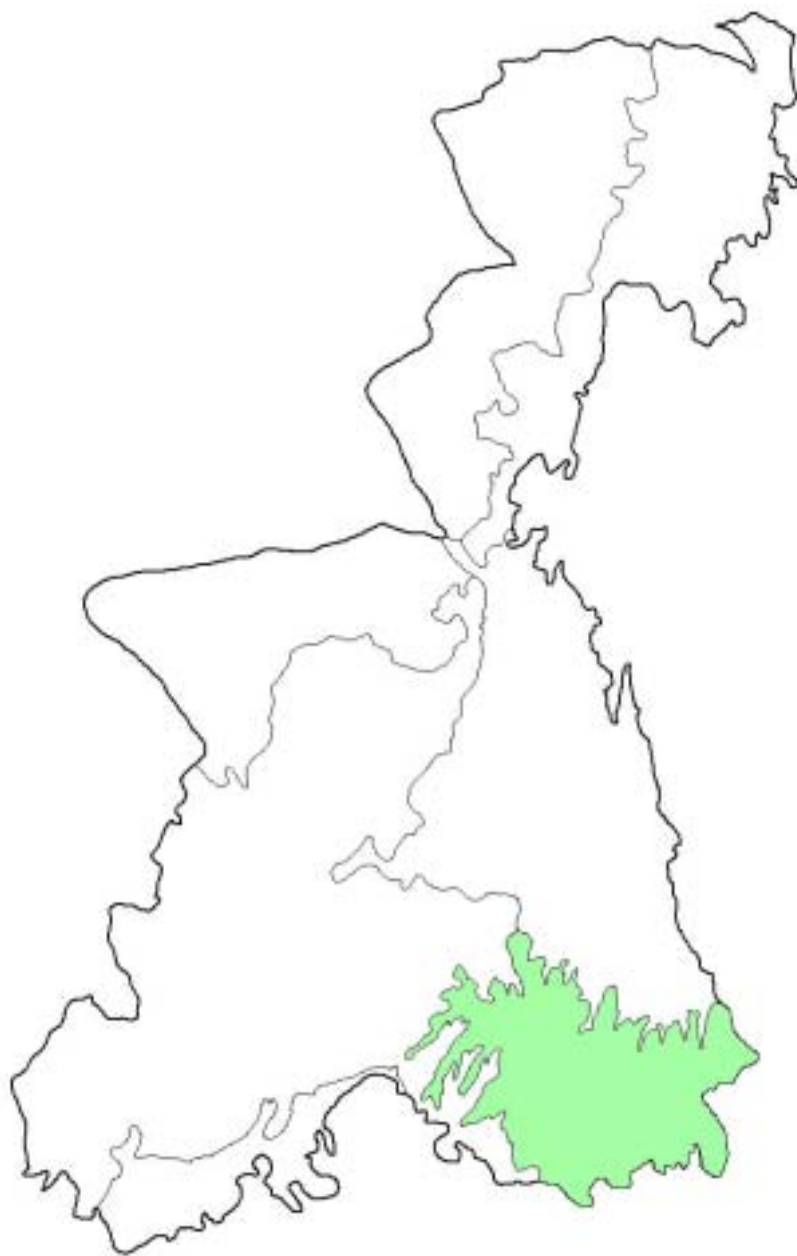
The outwash has a gentle slope, but still great enough to form a distinct boundary with the Namoi River floodplain and be above the level of inundation of that river. The Bohena Ck fan is identifiable because of the enormous area of gilgai formed on the alluvial surface. This was the largest area of gilgai observed in the bioregion. The gilgai form on the high points of the undulating landscape while the low areas between are subject to overland flow from local runoff. The terrace of Baradine Ck also has substantial local runoff which joins the overflow from the creek downstream of Gwabegar as the terrace becomes indistinct.

Between Baradine Ck and Coghill Ck and in the West Pilliga Forest the outwash surface has less overland flow and a more irregular surface formed by sand monkeys, claypans and small patches of gilgai. The sand monkeys are sand-filled palaeochannels (now raised above the level of the plain) which form a radiating pattern from each of the main creeks (Baradine, Etoo, Talluba, Coghill).

Landform	Hectares mapped	Sites Count	Landform and site association
Alluvial fan	35124	21	Eighty-four percent of the Pilliga Outwash has mapped landform coverage. One hundred and ninety eight sites occur among many of the landforms providing a good indication of which landforms have the higher potential for sites. Calculated by size of landform area and the number of known sites, scald, claypan and floodplain landforms have very high site density. Scald and claypan belong to the Terrace group of landforms which adjoin the margins of the floodplain landform, an example is the Namoi floodplain complex. The Alluvial group of landforms, floodplain, alluvium, alluvial fan, wetland and alluvial terrace, have strong site association. A distinctive feature of the Pilliga Outwash province is that the Higher group of landform (colluvial slope, rocky ground and soil mantled slope) have very low site numbers. The high site concentration among landform type (lunette) has not been graphed because of the high site density calculated (1 724). Sampling occurred at one specific lunette landform which is small in area (116 ha) and where many sites were recorded.
Alluvial plain	73020	31	
Alluvial terraces	49415	42	
Alluvium	65613	58	
Claypans	2251	3	
Colluvial slopes	6557	2	
Floodplain	5149	7	
Gilgai	1724	0	
Lake	105	1	
Lunette	116	20	
Paleochannel	550	3	
Rocky ground	30	0	
Sand monkey	16130	2	
Scald	384	1	
Soil-mantled slope	27730	5	
Terrace	4826	1	
Wetland	2258	1	
Yellow sand sheets	1	0	



Liverpool Ranges



Area: 523,000 ha

Division of Tenure:

- National Parks 3%
- State Forests 1%
- Crown Land 8%
- Freehold 88%

Basic Description: Basalt ranges and hills with tall open forests and white box woodlands.

Area in hectares of Aboriginal LALC

Wanaruah 218 026

Walhallow 176 623

Nungeroo 53 222

Gilgandra 23 470

Mudgee 48 110

Coonabarrabran 3 646

Total number of recorded

Aboriginal sites: 98

(Pre- and post BBS
assessment)

Liverpool Range

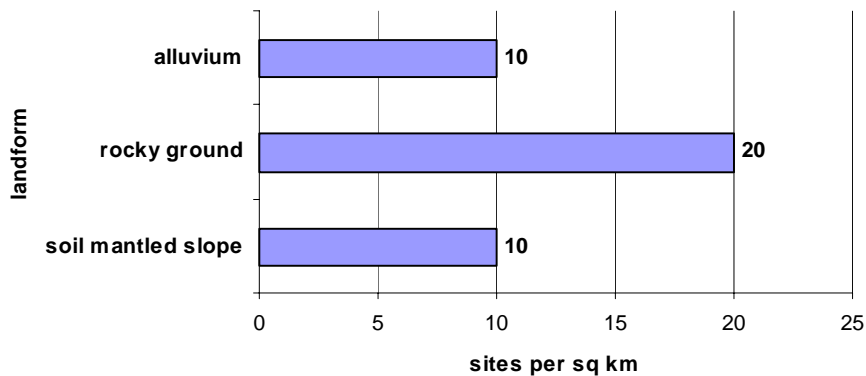
Comprises two contrasting landscapes: the undulating surface of the Liverpool Range and the deep valleys around it. The plateau surface is mostly covered by gentle soil-mantled slopes with some mappable areas of alluvium closely following the creeks. All soils are clays (derived from basalt), but are thin in many locations. Around the plateau edge, but especially on the northern side, there are long basalt cliffs and talus deposits beneath. The deeper valleys draining to the north and south have long soil-mantled slopes and infrequent low cliffs (following individual basalt flows or sandstone strata). The valley floors are narrow and without sediment in the headwaters, but after several kilometres a black clay floodplain is formed beside a gravel bed stream. Further downstream the floodplain widens while the stream may decrease in dimensions and change rapidly from gravel-bed to mud dominated (there is little sand in these creeks). Both the depth of these valleys, the relative width of the floodplain and lack of major tributaries are characteristic of this province.

Landform and site association

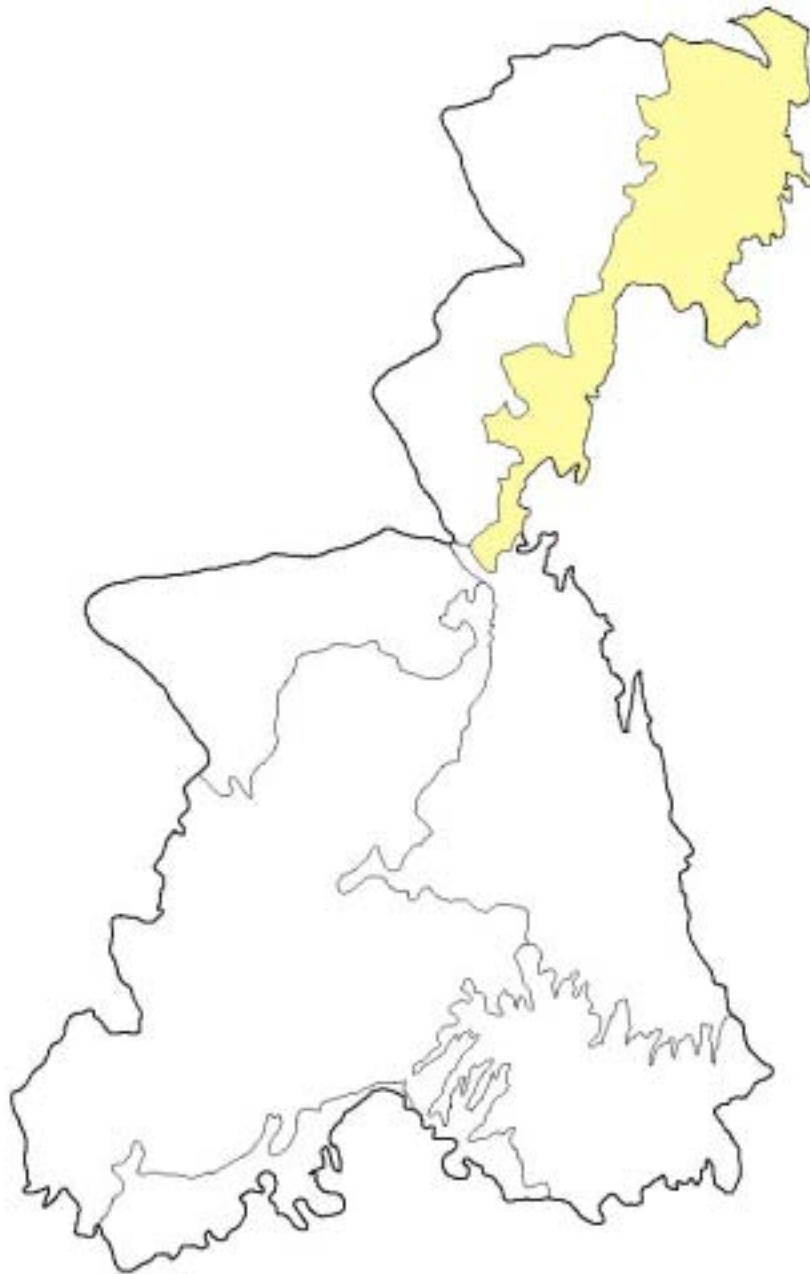
Landform	area	sites
Alluvial fan	82	0
Alluvium	1171	1
Colluvial slopes	677	0
Rocky Ground	1723	1
Slide	10	0
Soil-mantled slope	28688	20
Spring	2	0
Swamp	101	0
Terrace	107	0

The Liverpool range has the least area of mapped landforms for the bioregion (6.2%). Ninety four percent remains unmapped. Nine landforms were identified and mapped in areas where the survey team could gain access or where registered sites could assist in providing a picture of Aboriginal site patterns among landforms. Soil mantled slope dominate the area of mapped coverage and has the highest number of sites recorded. The results are biased from the assessment of Towarri National Park which is dominated by soil mantled slope. There is poor representation of alluvium and terrace landform coverage where sites are likely to occur in high numbers. The deep valleys of the Liverpool range are dominated by soils deposited by fluvial action which can conceal sites. The lower slopes of the valley (soil mantled and colluvial slopes) will have potential for sites where these landforms meet the valley floor (terrace, floodplain, alluvium).

Estimated site density among landforms of the Liverpool ranges



Northern Basalts Province



Area: 611,000 ha

Division of Tenure:

• National Parks	0.4%
• State Forests	6%
• Crown Land	20%
• Freehold	74%

Basic Description: Gently undulating landscape with basalt capped hills

Area in hectares of Aboriginal LALC

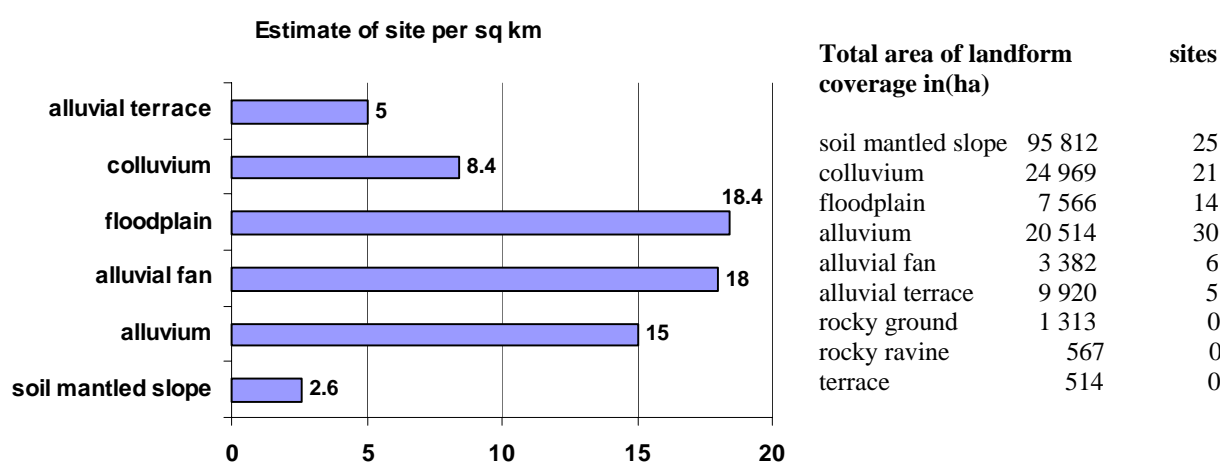
Goomelah	278 427
Moree	297 521
Narrabri	35 197

Total number of recorded
Aboriginal sites: 183
(Pre- and post BBS
assessment)

Northern Basalts

General description

The area near Narrabri comprises headwater valleys very similar to the Liverpool Ranges province: rocky slopes. The lower reaches of these valleys form broad alluvial fans bordering the Namoi River floodplain. In the mid reaches there are low ridges formed on sandstone with soil-mantled crests and broad, gentle colluvium filled valleys, very similar to the Pilliga Province and the area of Bebo S.F. in the far north. Around Terry Hie Hie the ridges are again similar but separated by broader alluvium filled valleys, changing to more complex floodplain downstream of Terry Hie Hie. The headwaters along the eastern boundary of the bioregion become more rugged with greater areas of rocky ground and areas of rocky ravines just beyond the bioregion boundary in Berygill and Courallie S.F.

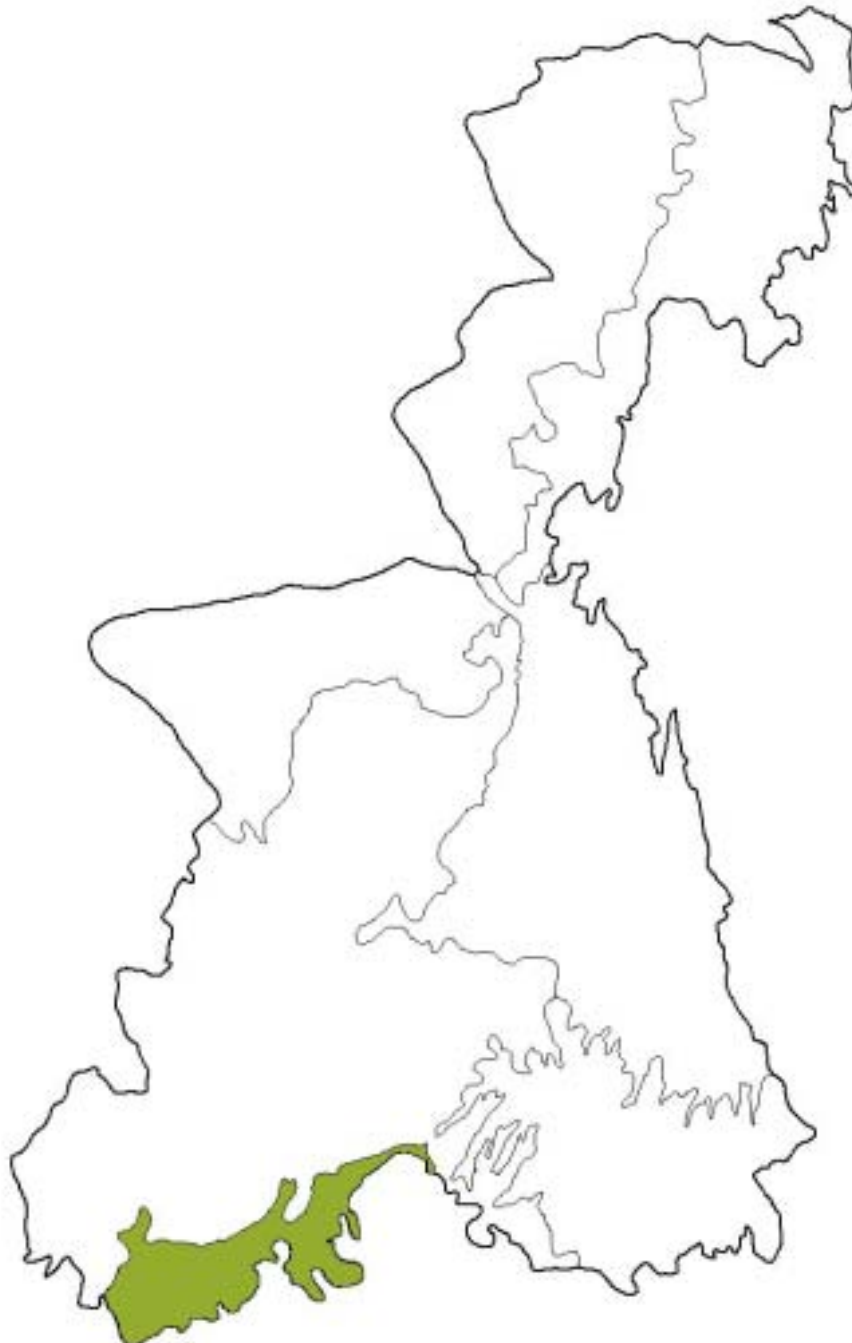


Landform and site relationship

Of the 183 sites known in the Northern Basalts, 55% (101) occur among areas of mapped landform coverage. The results show a strong site relationship with the alluvial group of landforms, compared with the higher group of landforms. The landscape of the Northern basalt province is dominated by the higher contour group of landforms especially in eastern regions of the province. Landform coverage within the Northern Basalt Province includes the following state forests; Bebo, Yetman, Stonehenge, Warialda, Terry Hie Hie, Mission, Campbell, Irrigappa, Montrose, Couralie and Berrygill. Sample surveys occurred in each of these forests with the exception of Stonehenge and Warialda. The Terry Hie Hie Group of forests (including Montrose and Couralie) have a diverse variety of landform with sites occurring among each type. The close proximity of this region to the natural resources of the Nandewar bioregion has influenced the many Aboriginal sites occurring in this region. Larger and more significant sites occur among the Alluvial group of landforms situated near the boundary of the two bioregions, BBS and Nandewar.

More landform coverage is required to link the Terry Hie Hie forest area with the areas mapped in the north around Bebo state forest.

Talbragar Valley Province



Area: 205,000 ha

Division of Tenure:

- National Parks 0.5%
- State Forests 2%
- Crown Land %
- Freehold 90%

Basic Description: Gently undulating; woodlands on red loams

Area in hectares of Aboriginal LALC

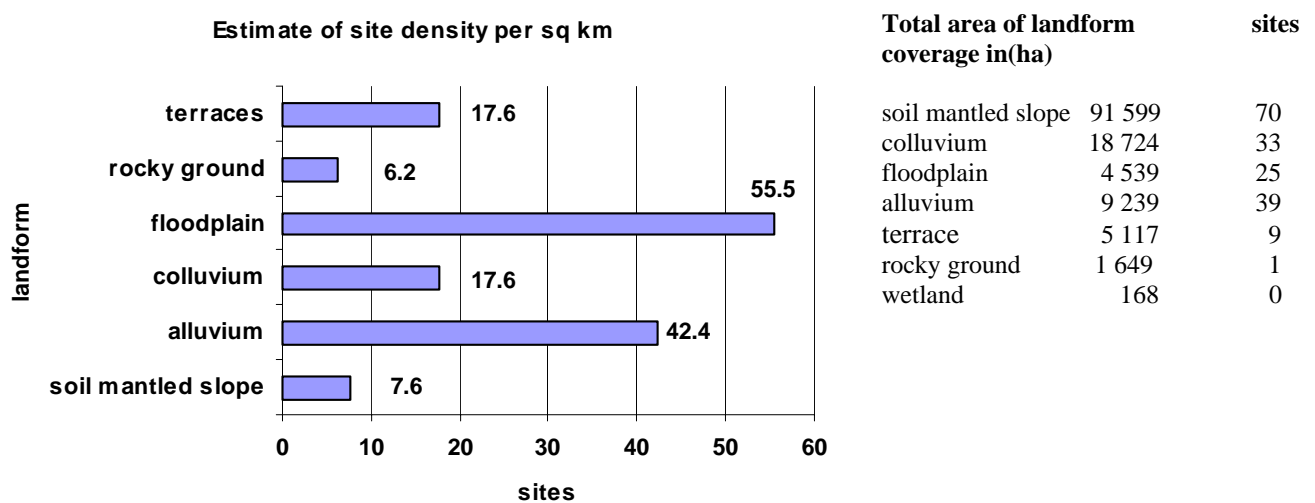
Dubbo	194 810
Gilgandra	6 222
Mudgee	4 296

Total number of recorded Aboriginal sites: 212
(Pre- and post BBS assessment)

Talbragar Valley Province

General description

Similar in many ways to the Pilliga Province, except for a greater proportion of shale (?) and basalt soils, but still retaining some prominent sandstone strata, especially near hill crests and upper slopes. As a result, the landscape is dominated by undulating soil-mantled slopes with minor rock outcrops, colluvial footslopes narrow alluvial valleys. The Talbragar River floodplain is mapped as alluvium not floodplain because it has few of the surface features associated with floodplains of the larger rivers (flood channels, palaeochannels, swamps etc.) and is an intermittent stream. The soils of the Talbragar floodplain are dominated by black clay from the Liverpool Range headwater.



Landform and site association

Seven landform types were identified and mapped in the Talbragar Valley Province. The highest concentration of sites occurs among the Alluvial group of landforms represented by floodplain and alluvium. The estimated high site density is a result of the small area in size of floodplain and alluvium (associated with the (Macquarie, Mogriguy and Talbragar Rivers) and that among them, many sites have been registered along the river frontage areas. The landforms associated with the Province's rivers and creeks will have very high potential for sites. The average distance from water sites were recorded in the Province was 101 metres. The area of total mapping for the province is 64% with 177 sites occurring among mapped areas. Wetland landforms may be poorly represented. The variety of wetlands within the Talbragar Province (associated with the Macquarie River) is not easily recognisable because land clearing, agriculture and urban infrastructure have altered them. During major flood episodes wetland features become more obvious along the margins of the outer floodplain/alluvium. Wetlands can be considered a landform element which is one of several water features influencing site distribution among floodplain and alluvium landforms.

Pilliga Province



Area: 1,734,000 ha

Division of Tenure:

- National Park 7%
- State Forests 17%
- Crown Land 13%
- Freehold 64%

Basic Description: Extensive sandstone hills with areas of high basalt peaks

Area in hectares of Aboriginal LALC

Wee Waa	1 797
Narrabri	158 640
Pilliga	88 954
Coonamble	2 526
Red Chief	11 378
Coonabarrabran	502 870
Weilwan	94 660
Walhallow	68 754
Gilgandra	517 343
Wanaruah	1 299
Mudgee	50 398
Dubbo	192 640
Narromine	42 959

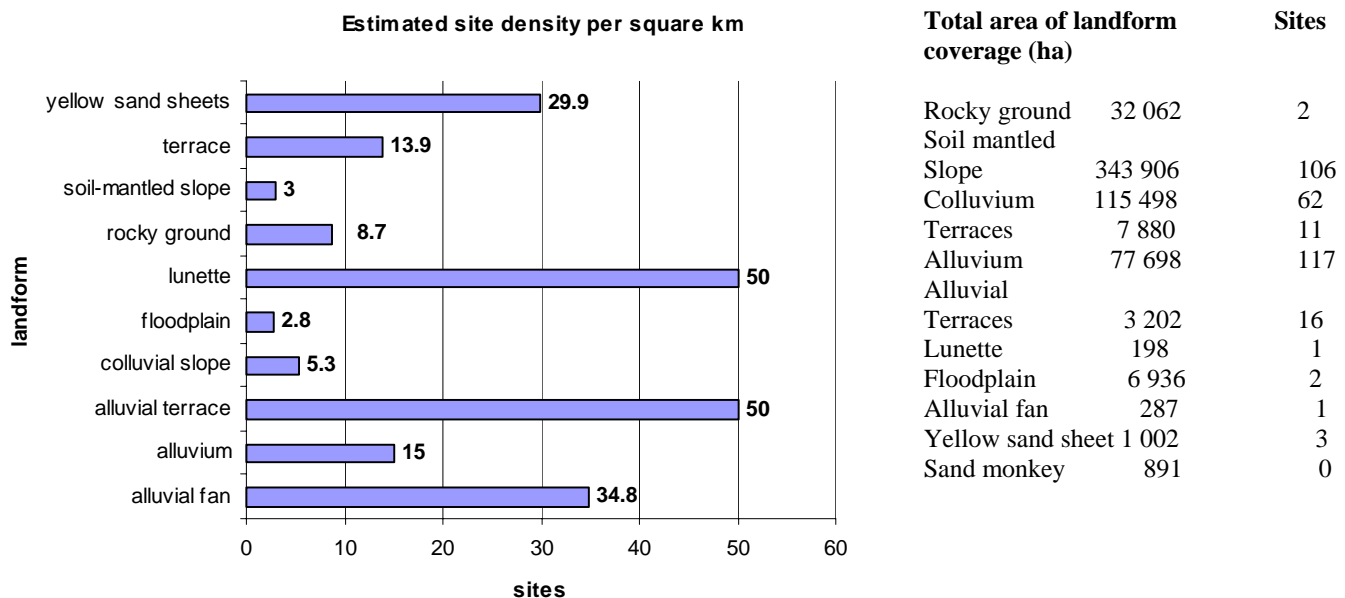
Total number of recorded
Aboriginal sites: **609**
(Pre- and post BBS
assessment)

Landforms of the Pilliga Province

General description

Except for the Warrumbungle, the landforms and soils of the Pilliga Sandstone Formation dominate the Pilliga Province area. In general, the relief is low and soil-mantled slopes overwhelmingly dominate the surface. There are areas of high relief such as, the southern Pilliga forests, Goulburn River Valley, Warrumbungle foothills, where the valleys are deep and narrow. There are some distinct differences in the patterns of landforms within the province depending on the rock type. Within the Pilliga Sandstone Formation there is a wide variety of rock type which has not been recognised in the geological mapping. The conspicuous sandstone and conglomerate beds of outcrop are only a part of the formation.

There extensive fine-grained sedimentary rocks (shales, or possibly lithic sandstones which weather to clay) and Jurassic volcanics which form both different soils and different landforms. The sandstone dominated areas tend to have narrow convex crests above colluvial footslopes and narrow alluvial valleys. By contrast, the finer soils of the shales and basalts in higher relief areas have broader convex crests and longer, steeper slopes with very little colluvium to narrow valleys with small alluvial deposits. In lower relief areas, the shales and basalts form extensive gentle convex slopes, but with small areas of colluvium and alluvium. The landform units represented are common to both sandy and clayey areas, however their proportions are quite different.



Landform and site association

A total of 34.4% of the Pilliga Province is covered by mapped landform coverage. Sixty-five percent of the Province remains unmapped. Two major forests are included in the mapped coverage, Goonoo and Pilliga (includes part of the NPWS Pilliga Nature Reserve). Combined, both forest cover an area of over 500 000 square hectares. Both forest were sampled for sites in Stage 1 (251 sites) and a strong site relationship with the Alluvial group of landforms established (RACD 2000 App:C). Stage 2 mapping connected the southern areas of the Goonoo forest to the Talbragar River and Talbragar Valley Province to highlight valley landforms (terrace, floodplain). Access to carry out site surveys to valley areas was achieved through Travelling stock routes and private properties. Alluvium and alluvial terrace landforms were also sampled for sites in the valley regions away from the forests. Both landform types have potential for high site density. Sites among soil mantled slope and colluvial slope show only a low site density, relative to the large area in size of each landform. A single lunette landform was identified in the Province and has a very high estimate of site density per square km. Despite only one site registered, the area is highly sensitive and many other sites are likely to be associated with this landform. Yellow sand sheet is a rare landform for the Province and occurs in the northern Goonoo forest region. The central areas of the province, which are dominated by undulating to hilly terrain (soil mantled slopes) are not mapped. Additional mapping of the Province is required.

APPENDIX B

Extracts from the BBS Stage 1 Report, Aboriginal Cultural Heritage Assessment (Appendix C, Aboriginal cultural heritage field survey of the Goonoo and Pilliga State Forests, NPWS)

Sampling

Aboriginal sites are associated with a variety of landforms. Sampling is designed to identify patterns which indicate site and landform association. Predictive statements about site distribution across a landscape can be made using the results of selective sampling.

The project team reviewed studies about the central north west of NSW to collect information about Aboriginal site distribution. The sampling methods used in the selected works are briefly discussed in the methods section of this report. Information about the variety of Aboriginal sites recorded commonly in the region is discussed.

Developments associated with Environmental Impact Assessments (EIA) generate most of the Aboriginal site surveys in the central north west of NSW. Academic research in the region has generally investigated individual sites of interest, for example Wright (1982) and Beck *et al* (1989). Throughout the region, approximately 80% of Aboriginal site surveys resulted from development proposals requiring EIAs (James 1995:22).

Non-linear developments such as dams or mining ventures, may affect an entire suite of landform types. Opportunities exist to gather information about Aboriginal site distribution by selecting a representation of each landform present in a non-linear development. The scale and relatively high impact of these activities compared to those on linear developments, provide opportunities to survey a larger sample of a landform selected for fieldwork.

Surveys of linear developments sample a narrow 'window' of each landform encountered. Extensive linear surveys sample a small proportion of a relatively large number of landform types. Surveys associated with non-linear developments sample a much larger proportion of a relatively small number of landform types.

Distribution of known sites in the region

Most developments in the central north west of NSW have occurred in the fertile rich river valleys where major economic growth centres are situated, or along routes linking regional centres. Aboriginal site surveys have generally been concentrated in these areas, creating a biased record of site distribution. Compared to the broader region there has been little survey work done in the Goonoo and Pilliga State Forests.

The Goonoo and Pilliga are made up of infertile landscapes between the fertile river valleys (Hesse 2000 app:Ca). Sites have been recorded in both forests (Koetigg 1986, Roberts 1991), but relatively little is known of the extent of Aboriginal land-use in these regions.

Selection of Previous work

AGL Pipeline (AGL 1999) – an example of linear development.

An AGL gas pipeline development between Dubbo and Tamworth (226 kms) required an Aboriginal site survey as part of the development assessment. The pipeline route allowed the survey team to sample systematically a variety of landscapes for Aboriginal sites. Sampling intensified where major rivers and creek tributaries occurred because of the likely occurrence of sites in these areas.

A total of 212 watercourses were crossed during the AGL survey. More than 50% of sites recorded were associated with watercourses (see table 2.1 below). Survey transects were designed to approach watercourses at right angles, to allow opportunities for recording the distance artefacts extended from watercourses. General conclusions were drawn about the average distance artefact material extended from

creeks. Table 2.2 summarises the average distance from creeks Aboriginal sites were frequently recorded during the survey. The summary includes those sites commonly recorded in the region.

Table 2.1 Aboriginal site association to water. Summarised from AGL (1999:43)

Type of stream	Percentage of sites
Major stream (rivers) 4+order	46%
Intermittent (1st, 2nd, 3rd order)	11%

Number of sites and distance from water

Distance from water	Number of sites
Less than 50m	25
100-200m	19
200-300m	4
300-400m	13
400-500m	9
500-600m	4
600-700m	6
800-900m	5
1-2km	6
2-3km	3

The AGL study demonstrated that an extensive linear survey was able to distinguish a pattern of Aboriginal site distribution, despite a narrow survey width which averaged approximately 20 metres. Interpretation of the results produced predictive statements about Aboriginal site distribution across various landform features, particularly watercourses. 50% of sites recorded were within 200 metres of water. Poor surface conditions at the time work was carried out restricted adequate sampling of many landforms encountered (AGL 1999:14).

Dubbo Local Environmental Plan (Koetigg 1986)

An assessment of Aboriginal cultural heritage undertaken in 1986 for Dubbo Council's Local Environmental Plan (LEP) provided an opportunity to sample various landscapes in the Dubbo, Geurie and Wellington region. The assessment included parts of the Goonoo State Forest, where nine sites were recorded in the Goondy Creek area. The Aboriginal site survey sampled landforms of major physiographic features such as, ridges, rivers, creeks, valleys and hills. The study tested a model of Aboriginal site distribution previously developed by Pearson (1981). This model identified accessibility to water as the single most important factor influencing site distribution.

The LEP study identified that sites may occur across the whole landscape, with higher concentrations occurring along major watercourses. Sampling of landforms located away from major watercourses was restricted to crown lands (Travelling Stock Routes (TSRs) and State Forests). Landform assessment on freehold land was not carried out due to denied access (Koetigg 1986:67).

The Aboriginal site survey concentrated investigations in the narrow river valley corridors of the Dubbo, Geurie and Wellington region. The river corridors are hypothesised as providing an abundance of resources readily accessible to Aboriginal people (Koetigg 1986:84-99). Many of the sites recorded in the Dubbo shire are located in these areas.

Only a small sample of landforms, located significant distances from water, were surveyed. Despite this, Aboriginal sites were recorded considerable distances from water (Koetigg 1986:81). The project team surveyed extensive areas by quadrangle transects, which provided sample areas of up to 16.5 sq kms (calculated from Koetigg p 110). The survey was assisted by dry climatic conditions, which increased ground surface visibility.

Table 2.3 provides the results of the Koetigg survey for the greater Dubbo region showing site association with landform types.

Table 2.2 Site and landform association for southern study area. Summarised from Koetig (1986)

Most frequent site type recorded	Most frequent landform feature associated with sites	Intensive areas of occupation	Least frequent occupation
<ul style="list-style-type: none"> • Artefact scatters • Scarred trees • Axe-grinding grooves 	<ul style="list-style-type: none"> • Watered localities (major rivers, swamps, wetlands) • creeks with exposed bedrock 	<ul style="list-style-type: none"> • Adjacent to waterholes along rivers • Wetlands • Swamps • lagoons 	<ul style="list-style-type: none"> • Ridges • Upper catchments

Pilliga State Forest survey (Roberts 1991)

In 1991 parts of the Pilliga State Forest were surveyed for Aboriginal sites on behalf of the NSW State Forest by Roberts (1991). Balme (1986) had included parts of the Pilliga in her study of north-western NSW, however, Roberts sampled a relatively large part of the forest. Overall, a large part of the forest remains unsurveyed.

Roberts used a sample strategy based on a landsystem approach. Three major landsystem units were identified for the Pilliga region. Surveys occurred in the low-lying landsystem units (Gwebagar and Cubbo). The higher contoured landforms of the Pilliga (Bulgandrie) were not sampled due to lack of resources. The areas investigated were biased towards the alluvium areas where the larger intermittent stream channels occur. A common pattern of Aboriginal sites associated with creeks was therefore established.

Roberts concluded with a prediction about the type of sites that occur in the Pilliga and to some extent, their distribution within different environmental constraints. Attempts to demonstrate a link between site distribution and the diversity of flora resources associated with broom plains were unable to be tested due to a lack of surface visibility (Roberts 1991:25-6).

Analyses of recorded scarred trees and artefact assemblages provided some insight into the prehistory of the Pilliga region. The investigation highlighted the problems of poor surface conditions affecting observations of artefact material in a forest landscape. The survey was restricted to vehicle tracks and eroded areas along creeks. Extensive artefact scatters were recorded along major creeks.

Summary of studies

From the three selected studies the following points are highlighted.

Aboriginal site distribution

Each investigation sampled intensively landforms where watered localities occur. High frequencies of sites were recorded in association with these features. Areas distant from water were less thoroughly investigated. Small frequencies of Aboriginal sites were recorded on landforms dominated by ridges, hill slopes and undulating plains and where water is scarce. This result prompted each researcher to predict that sites are associated with all landforms but are concentrated in resource rich zones.

Survey strategy

The survey strategy of each investigation varied, yet similar conclusions were made about Aboriginal site distribution. The AGL site survey was based on a narrow linear transect which intersected landforms of various landscapes. This proved to be effective for distinguishing regular patterns of Aboriginal site distribution. The Dubbo LEP site survey used linear and quadrangle transects. In some cases, quadrangle investigations encompassed sizeable areas, allowing numerous areas of surface exposures to be inspected. The Pilliga survey (Roberts 1991) developed a survey strategy based on sampling landsystem units (Mitchell in Roberts 1991). Each of the three units was used to identify the overall pattern of creeks and streams that occur in the Pilliga (Roberts 1991:5). Survey transects were linear and restricted to vehicle tracks, which offered better surface visibility than the forest areas. The focus of the site investigation along watercourses influenced the use of linear transects.

Access

Access was restricted to parts of the study area in each investigation. The Pilliga survey was able to sample only two of the three landsystems identified. The unsampled landsystem unit (Bulgandrie) was expected to contain a variety of Aboriginal sites, but development objectives did not allow for its inclusion. The Dubbo LEP investigation was restricted to crown land as property owners often denied access to freehold land (Koetigg 1986). The AGL study sampled some freehold land but was denied access in many instances (AGL 1999:35-6).

Surface conditions

Each investigation was subject to varied surface conditions. This prompted each researcher to evaluate the effects of landform processes and local conditions on the potential for undetected sites to occur in the area of development proposal.

Forestry Aboriginal site surveys - general

Since 1978, numerous heritage assessments of cultural heritage have been done in NSW State Forests (Hughes and Buckley 2000). The bulk of these studies have occurred along the coastal margins, with very few assessments occurring in the western regions of NSW. An assessment of Goobang National Park (English *et al* 1998) and parts of the Liverpool ranges (Pearson 1993) are the only site surveys of forested landscapes in central NSW, other than those done in the Pilliga. Both areas had once been used for commercial forestry operations.

Previous forestry assessments have occurred in more rugged and dissected landscapes than the low lying areas of the Pilliga and Goonoo.

There are several repeated results from previous forest studies that are of relevance to this project. Briefly highlighted in table 2.4 are the results of those studies which assisted the project team to develop a sampling method for the Stage 1 assessment of the Goonoo and Pilliga State Forests.

Effective survey coverage

Effective survey coverage refers to information about ground surface visibility. This information assists in assessing the effectiveness of the survey in detecting sites. Conservation management decisions are often influenced by such assessment.

Archaeologists produce details of surface exposures by using a variety of methods. Each method provides the reader with an indication of the percentage of surface exposure encountered. These methods range from casual observations to detailed estimates.

Witter (1995) developed a method which allows for field data about surface exposure to be summarised to assess the effective capacity of the survey to detect sites. This approach has been formally adopted by the National Parks and Wildlife Service for statewide use in Aboriginal heritage consultancies (NPWS 1997).

In general, past assessment of the effectiveness of forest surveys has been inadequate. This is probably due to the widely recognised facts that forests provide very little exposure for detecting sites. Effective coverage analysis allows management strategies to consider the likelihood of sites occurring in areas zoned for logging.

Previous forestry studies

Relevance to project	Previous studies	Stage 1 assessment
Size of study area	A common trait of previous forestry and regional assessments has been the large areas investigated and the small percentage of sampled area. For example, Bryne (1983), James and Conyers (1995) Hughes (2000), AGL (1999), Koetigg (1986) and Roberts (1991).	The size of the study area is 4 560 sq kms. Sampling of each forest will equate to a small percentage overall, approximately .04% overall.
Landform approach	In each of the above studies a broad landform approach was used to identify and sample the environmental context, site type and frequency in each study area. The approach taken in each study differed in the level of detail included about landform features. A predictive model for Aboriginal site distribution was developed from this approach.	Sampling the variety of landforms within the Goonoo and Pilliga for Aboriginal site distribution was a project objective. The project team sampled a representation of each landform type in the study area to determine the link between Aboriginal site distribution and landform.
Geographical Information Systems (GIS)	Previous studies used GIS technology to spatially organise information, for example Hughes (2000) and James and Conyers (1995). GIS has been used in cultural heritage management as a tool to assist in determining areas of cultural sensitivity to be conserved.	All data gathered from the field will be manipulated by GIS to provide information layers which will assist in developing Plans of Management.
Surface visibility	The lack of adequate surface visibility in archaeological surveys of forestry environments is a common issue. Vehicle tracks, which provided the main type of ground disturbance suitable for sighting artefacts, have been a principle component built into survey strategies for forestry landscapes.	Vehicle tracks were the principal survey unit due to the lack of other adequate surface conditions in the forests. It is important to understand the effects of aggrading and eroding processes in order to understand the limited extent of suitable surface conditions.
Aboriginal site density - (site size)	The most common type of Aboriginal site type recorded in forests has been low densities of stone artefacts. Models of Aboriginal land use have been developed from artefact site distribution. Visibility may have been affected by various conditions, influencing perceptions about the extent of site distribution. The results of sub-surface excavations in forest environments indicated that in some instances, interpretations of low artefact densities and distribution might require re-evaluation (Hughes and Buckley 2000).	The results of central north west studies by Balme (1989) and Roberts (1991) indicate that artefacts may be buried or moved in areas of flood prone soils. Mitchell (1985) has demonstrated the extent of bioturbation which occurs in the region. This will restrict observation of artefact material.

APPENDIX C

Aboriginal Organisations Informed of the BBS Aboriginal Cultural Heritage Assessment

Local Aboriginal Land Councils	Traditional Owners	Government organisation
Toomelah/Boggabilla	Wirrimbah Descendants	ATSIC
Mungindi	Toomelah/Boggabilla Elders Group	Department of Aboriginal Affairs (NSW)
Moree	Wiridjuri Council of Elders	NSW State Land Council
Narrabri	Reps: Mr Jim Birtles (Mudgee) and Mr Steve Ryan (Dubbo)	Central West LALC
Walgett	Moree Elders Group	North West LALC
Coonamble	Allira Elders Group (Dubbo)	
Wee Waa		
Pilliga		
Red Chief		
Walhallow		
Coonabarrabran	Other	
Gilgandra	Muronga Giralinga ATSIC	
Dubbo	Corporation (Mudgee)	
Narromine	Aboriginal Health Moree	
Nungeroo	Gilgandra CDEP	
Wanaruah	Gulargombone CDEP	
Mudgee		
Weilwan		