

6.0 ABORIGINAL ARCHAEOLOGICAL CONTEXT

6.1 Ethnohistory

Despite a proliferation of known Aboriginal sites there is considerable ongoing debate about the nature, territory and range of pre-contact Aboriginal language groups in the greater Sydney region. These debates have arisen largely due to the lack of ethnographic and linguistic information recorded at the time of European contact. By the time colonial diarists, missionaries and proto-anthropologists began making detailed records of Aboriginal people in the late 19th Century; pre-European Aboriginal groups had been broken up and reconfigured by European settlement activity. The following information relating to Aboriginal people on the Illawarra is based on such early detailed records.

6.1.1 Language Groups

Despite conflicting views between historical sources of the exact boundaries of tribal groups in the region, the linguistic evidence does identify distinct language groups at the time of European contact. Based on this information it appears that the current Concept Area was situated within the Tharawal (also Dharawal, Darawal, Carawal, Turawal, Thurawal) linguistic group. The named groups (often referred to as 'clans', 'bands' or 'tribes') belonging to the Tharawal/Dharawal language group included the following: Gweagal, Norongerraga, Illawarra, Threawal, Tagary, Wandeanega, Wodi Wodi and Ory-ang-ora (Tindale 1974).

Ethnographic evidence considered by Sefton (1988: 22-29) indicates population mobility on the Woronora Plateau with frequent contact between the neighbouring Gandangarra, Cobrakall (Liverpool and Cabramatta) and Wodi Wodi (Illawarra).

The areas inhabited by each of the groups are considered to be indicative only and would have changed through time and possibly also depending on circumstances (i.e. availability and distribution of resources). Interactions between different types of social groupings would have varied with seasons and resource availability. It has been noted that interactions between the groups inhabiting the many resource zones of the Sydney Basin (coastal and inland) would have varied but were continuous. This is reflected in the relatively homogenous observable cultural features such as art motifs, technology and resource use (McDonald 1992).

6.1.2 Contact History

Historic accounts of Lake Illawarra and its hinterland that specifically reference the Aboriginal inhabitants are scarce. Some early ethnographic accounts (e.g. research compiled by Sullivan 1982 and Organ 1990) suggest that at the time of European occupation, a highly mobile, largely dispersed Aboriginal population occupied the region (Table 8 below). It is thought that there were slightly higher populations near Lake Illawarra given the resource base associated with and accessible at the Lake.

Table 8: Ethnographic accounts of Aboriginal resource use in the Illawarra

DATE	LOCATION	SUBJECT	COMMENT	SOURCE
29 Oct 1818	Illawarra	Seed	Fetilo ? longorilius – a large spreading tree. Rivulet banks etc – the red arella? of the seed of this tree is eaten by the natives	Cunningham 1816-19, cited in Sullivan 1982: Table 4
1845	Illawarra	Bark Canoes	'The natives who reside upon the coast use canoes...a gum tree with a thick and tough bark is selected. This is girdled and the bark slit so that by care, a piece of it may be stripped from the large tree enough to make the canoe...14 feet long and 7 feet wide...bark charred on the inside...folded in each end...edges are fastened by cords and wooden rivets...they use paddles of different sizes.	Wilkes 1845:193, cited in Sullivan 1982: Table 6
1845	Illawarra	Bark Huts	'At Illawarra, their huts were made by setting two forked sticks upright, on which another was laid horizontally, on the latter, one end of pieces of bark, taken from the nearest gum tree, is laid, while the other end rests upon the ground'	Wilkes 1845:184-185, cited in Sullivan 1982: Table 6
1825	Illawarra	Torches	'they make torches of bundles of bark, beaten and tied up'	Field 1825:467, cited in Sullivan 1982: Table 6
24 Oct 1818	Illawarra	Fishing Lines	'...my native guide was [?] himself with long pieces of the stringy tough bark of Curragon (<i>Hibiscus tetenphyluss</i>) for fishing lines'	Cunningham 1816-19, cited in Sullivan 1982: Table 6

DATE	LOCATION	SUBJECT	COMMENT	SOURCE
26 Oct 1818	Illawarra	Water Bucket	'I yesterday observed they had their [?] water in buckets made of the leaf schecutttes of some palm, which they call Baugla [?] which they informed me grew under the mountain'	Cunningham 1816-19, cited in Sullivan 1982: Table 6
1825	Illawarra / Shoalhaven	Water Bucket	'Here we saw the first seaforthia elegans, a palm equal in size to the cabbage tree, with pinnate, ferny or cocoa-nut leaves, from whose broad membranous leaf-stalks, or spathae of the flowers, the natives make their water buckets, simply by tying up each end, like their bark canoes'	Field 1825:464, cited in Sullivan 1982: Table 6
1843	Kiama / Dapto	Kangaroo	'the females had their hair ornamented with kangaroo teeth'	Backhouse 1943:428, cited in Sullivan 1982: Table 6

6.2 Previous Archaeological Work – Regional Archaeological Context

Numerous archaeological investigations have been conducted on the south coast of New South Wales in the past 30 years. Studies were initially concentrated on coastal and estuarine zones; however, with demand for an increased understanding of the forest hinterland zones, the focus of investigations has widened.

The majority of south coast sites date to the last 6,000 years when the sea-level stabilised following the last ice age. Prior to this, sea-levels were lower and the coast-line was located approximately 14 km to the east of its current position. Coastal sites older than 6,000 years are rare, as most would have been inundated by the rising sea. Pleistocene-aged Aboriginal sites on the south coast include Bass Point, dated at 17,010±650 BP (ANU-536) (Bowdler 1976:254) and Burrill Lake rock shelter, dated at 20,830±810 BP (ANU-138) (Lampert 1971:122). Test excavations undertaken at the Wollongurrie Point midden dated the site to 3360±90 years BP (Navin 1987b:104).

Several studies of site patterns and distribution have been completed for the Illawarra and South Coast. Lampert (1971:114-130) identified three basic groups of site types:

Specialised foreshore sites focused on exploitation of coastal resources, such as fish, shellfish and marine birds (e.g. Durras North, Wollumboola and Wattamolla). Specialised fishing equipment, including spears tipped with bone points and shell fish hooks, were used at such sites.

Specialised estuarine sites focussed on the exploitation of inland resources (e.g. Shoalhaven Creek and Bomaderry Creek). These sites contain evidence of estuarine fish and shellfish exploitation.

Combination sites located beside creeks or estuaries near the sea shore where a mix of inland and coastal resources was exploited (e.g. Burrill Lake, Currarong and Curracurrang).

More recent research has highlighted the diversity of landscapes that were utilised by Aboriginal people, including the forest hinterland (Byrne 1983; Dallas & Sullivan 1995; Sefton 1980), coastal plains, foreshores, foothills and escarpments surrounding Lake Illawarra. Sites found within these landscapes include artefact scatters, isolated finds, middens, rock shelters with art and/or deposit, scarred trees, grinding grooves and burial sites.

Aboriginal Resources of the Illawarra Region Sefton 1980

Sefton (1980) completed the first regional Proposal of Aboriginal archaeological sites and relics within the Illawarra Region. Geographic areas included in the survey include the catchment areas of the Port Hacking, Wingecaribee, Wollondilly and Nattai Rivers, Water Catchment Areas, northern Illawarra Escarpment, Bass Point, Kangaroo Valley, Nowra and the lower reaches of the Shoalhaven River, Jervis Bay, McDonald State Forest, the upper reaches of the Clyde River and Murramurung Aboriginal Area (Sefton 1980: 2). The report recommends the regional mapping and sampling of coastal shell middens within the area, due to their increasingly endangered status.

Archaeological Survey along the Southern Foreshore of Lake Illawarra, and on Bevens, Picnic, Berageree and Werrang Islands Dallas & Navin 1987

Dallas and Navin (1987) carried out large-scale subsurface testing in an area of ridgelines and alluvial flats in the western Illawarra and concluded that the most likely site type to be encountered in the foothills and ridges of the Illawarra comprise low density artefact scatters. Based on the similarities in landforms to the current Proposal Area it is possible to extrapolate a predictive model based upon these previous findings.

Wollongong City Aboriginal Heritage Planning Concept Dallas & Sullivan 1995

Dallas and Sullivan (1995) prepared an Aboriginal heritage planning Concept of the Wollongong Local Government Area (LGA). This document describes the landforms of the Wollongong LGA and specifies the site types likely to be encountered in each landform unit. The current Proposal Area is located in the southern part of the Wollongong LGA boundary.

Based on the archaeological potential mapping for this concept study, the following management conclusions relevant to this assessment are:

- Ridgeline areas: further selected subsurface testing would be required, should it be necessary to ascertain the extent of any past Aboriginal occupation.
- Land between ridgelines and identified flood prone areas are less likely to require further selected subsurface testing to ascertain the extent of any past Aboriginal occupation.

Aboriginal Resources of the Illawarra Region Navin Officer 2000

Several regional patterns have been identified in the Aboriginal archaeological heritage record in the Illawarra region. In 2000 Navin Officer prepared the Shellharbour City Council Aboriginal Heritage Concept incorporating land immediately south of the current Concept Area. Based on examination of background variables, Navin Officer (2000:51-52) generated a predictive model for site locations. Predictive modelling pertinent to open artefact scatters and landform utilisations are included below:

Sites are likely to occur at varying densities in all broad topographic zones. However, a range of micro-topographic variables can effectively predict topographies that are archaeologically sensitive. These include: relatively level ground without significant surface rock, proximity to a freshwater source and locally elevated and well-drained ground.

- Sites tend to be situated at or close to ecotones – the areas where different plant communities meet.
- Artefact occurrences, detected as isolated finds or surface scatters of artefacts and/or subsurface archaeological deposits, are likely to be the most common site type within the Shellharbour City Council area.
- Artefact scatters (also termed open camp sites), are most likely to occur on level, well-drained ground, either adjacent to sources of freshwater and wetlands, or along the crests of spurs and ridgelines.

- Ridge and spurlines, which afford effective through-access and relative to the surrounding landscape, will tend to contain more frequent and larger sites.
- The crests of low relief spurs that extend into and across valley floor flats are likely to be a focus for occupation due to their well drained and elevated context in close proximity to a range of exploitable environments.

Isolated finds can occur anywhere in the landscape and may represent the random loss, deliberate discard of artefacts, or the remains of dispersed artefact scatters.

Aboriginal Heritage Management Plan: West Dapto Release Area

AMBS 2006

This page of the assessment contains culturally sensitive information. Sydney Water has removed the contents to protect and manage culturally sensitive information out of the respect to the Aboriginal community.

Results identified that the stream landforms have a higher density of Aboriginal artefactual material than other landforms, with the larger streams apparently more frequently utilised than smaller ones. Spur crests and hill slopes were found to have much lower densities.

AMBS (2006) concluded that from the known site patterning it is likely that additional archaeological sites may occur throughout all landforms of the WDRA – although at varying site and artefact densities- and subsequently all parts of the Concept Area are considered to have some archaeological potential. The report recommended further investigation and management of those areas considered to have higher archaeological potential, including a number of spur crests within the Mullet Creek corridor, the benched foot slopes within the Escarpment foothills adjacent to creek lines and the lower tributaries of major creeks (AMBS 2006). These landforms would have provided camping sites, functioned as travel routes and/or provided a range of resources.

Areas of high archaeological significance were identified along major creek lines that provided permanent and semi-permanent sources of water or elevated alluvial flats suitable for camping. Other areas of high potential include wetlands associated with these creek lines, including Duck Creek and Wollingurri Creek (AMBS 2006:266).

Areas of cultural value highlighted by the Aboriginal stakeholders throughout the development of this report are closely related to the archaeological record and the natural environment (AMBS 2006: VIII). All archaeological sites were identified as having value, with the connection between cultural and natural values being emphasised. Large scatters and scarred trees were considered of higher significance, as were those sites retained within a natural setting. Conservation of important archaeological sites and natural areas, such as creek lines and vegetated areas, was a common theme identified among the Aboriginal stakeholder comments (AMBS 2006).

Preliminary Aboriginal and Historic Heritage Assessment: West Dapto Urban Release Area, NSW.

AMBS 2010

AMBS were commissioned by Sydney Water Corporation to prepare a preliminary Aboriginal and historic heritage assessment for the provision of proposed water and wastewater infrastructure for the WDURA. This involved the completion of a comprehensive desktop assessment of both historic and Aboriginal sites located throughout the WDURA, resulting in the production of a predictive model for Aboriginal archaeological sites and an assessment of the significance for both Aboriginal and historical sites.

The report largely focuses on the historic heritage items located within the WDURA, as a comprehensive study of the Aboriginal archaeology located within the WDURA was presented in AMBS 2006 (refer to summary above).

The study concluded that areas of high archaeological significance were located over 12% of the WDURA, being focussed in particular watercourses and specific ridgelines (AMBS 2010:113). Approximately 74% of the WDURA has been assessed as being of moderate Aboriginal archaeological significance, and the remaining 14% is considered to be of low significance.

The study recommended that before any infrastructure works are commenced that a comprehensive survey of the WDURA be undertaken with an aim of “verifying the presence of known and additional Aboriginal and historic heritage items, places or archaeological sites within the study area [WDURA], specifically along pipeline routes, and to assess potential impacts to these items or places”. (AMBS 2010:113). Further consultation with the local Aboriginal stakeholder groups was also recommended.

6.2.1 Localised Archaeological Studies

A significant amount of archaeological work has been undertaken within the Project Approval Area. This work includes that by Sefton (1980), Langendoen (1971), McIntyre (1984, 1987), Navin (1987a, 1987b, 1988), Salmon (1998), Biosis Research (2006), AMBS (2006, 2010), Kelleher and Nightingale (2006), Dallas and Sullivan (1995) and AHMS (2009, 2010). Details of these reports can be found in Part 2 – Project Proposal Area, Section 10.1.

6.3 AHIMS Results

6.3.1 Identified Aboriginal Archaeological Sites – Concept Area

A search of the OEH AHIMS database identified 189 Aboriginal archaeological sites within the boundaries of the Concept Area (Appendix 3; Figure 4). 139 of these are located outside of the project area and are analysed below. Sites within the project area have been analysed separately in Section 10.2 and are not included within the following section.

It should be noted that the AHIMS database reflects Aboriginal sites that have been officially recorded and included on the database. Large areas of NSW have not been subject to systematic, archaeological survey; hence AHIMS listings may reflect previous survey patterns and should not be considered a complete list of Aboriginal sites within a given area.

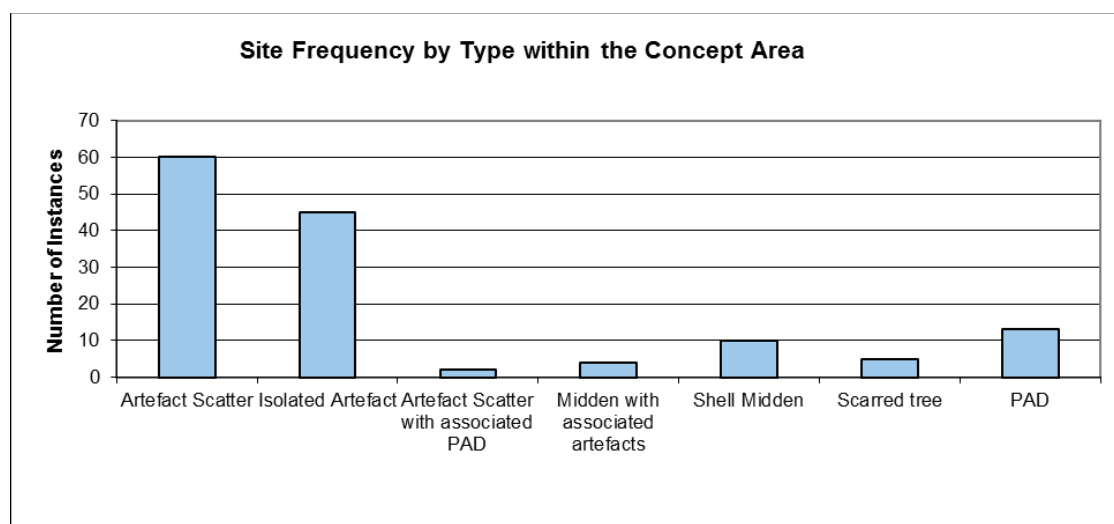
6.4 AHIMS Site Analyses

Simple analyses of the Aboriginal archaeological heritage sites registered within the boundaries of the Concept Area were conducted, with the results displayed in Graph 1 to Graph 2.

The variability in descriptions provided in AHIMS site cards can often reduce the detail of information within various analysis categories. Each analysis only includes sites for which information had been recorded that was applicable to one or more categories used in the particular analysis. The AHIMS database only includes Aboriginal sites registered with AHIMS and is not complete list of Aboriginal sites within any given area.

6.4.1 Site Types

Information was available for 100% of sites. Lithic (stone) artefact sites (artefact scatters and isolated artefacts) were the most dominant site types, representing 75.54% ($n=60$, 43.17%; $n=45$, 32.37% respectively) of sites located within the Concept Area (Graph 1). PAD ($n=13$, 9.35%) and midden sites ($n=10$, 7.19%) are represented in even proportions within the Concept Area. Frequencies of scar trees are very limited within the Concept Area ($n=5$, 3.6%), likely a direct result of agricultural land clearance within the area.

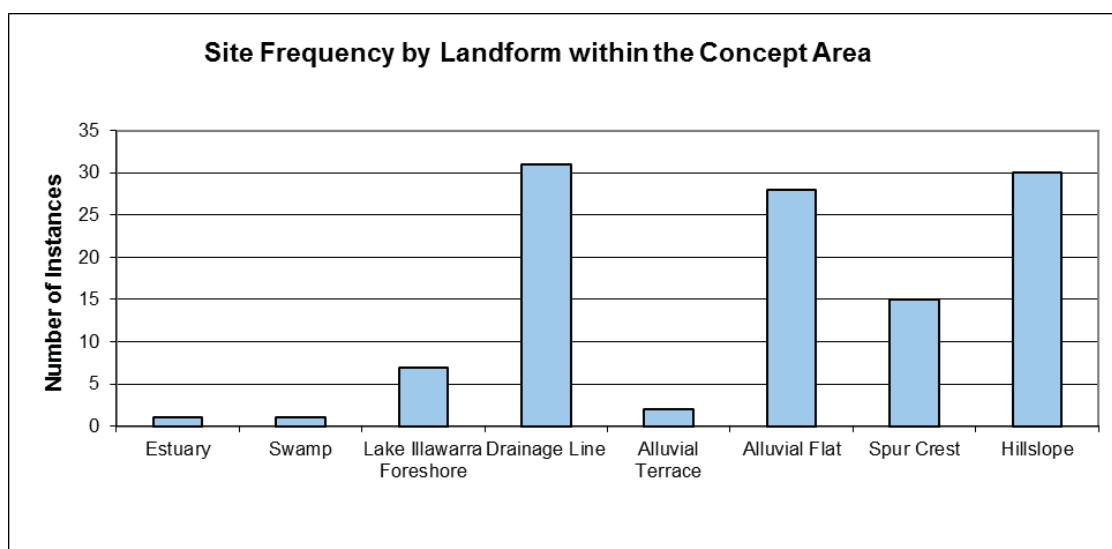


Graph 1: Site frequency by type within the Concept Area.

6.4.2 Landforms associated with sites

Information was available for 82.7% of sites located within the Concept Area (Graph 2). Drainage lines ($n=31$, 22.3%), hill slopes ($n=30$, 21.58%), alluvial flats ($n=28$, 20.14%) and spur crests ($n=15$, 10.79%) were the landforms most highly associated with archaeological sites. The Lake Illawarra Foreshore ($n=7$, 5.04%), alluvial

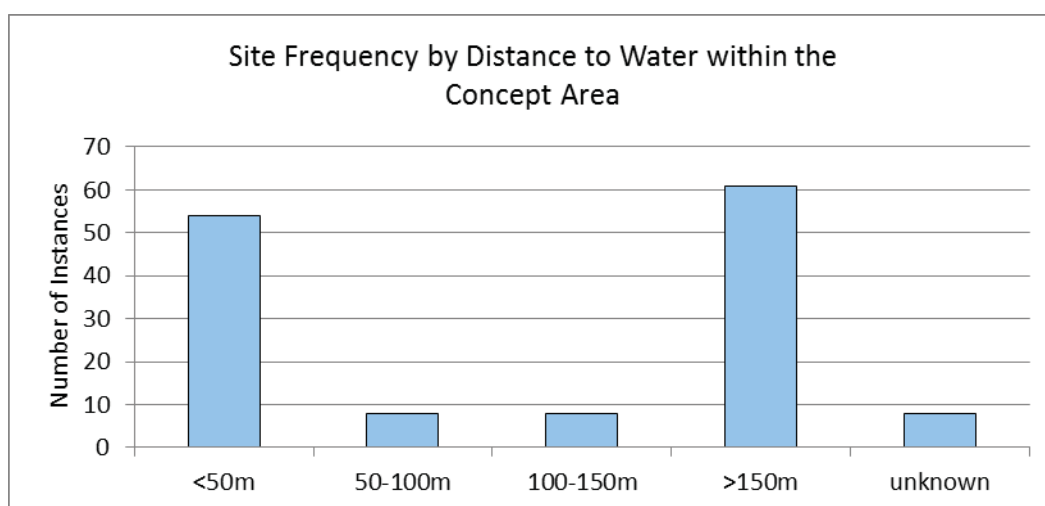
terraces ($n=2$, 1.44%), swamps ($n=1$, 0.72%) and estuaries ($n=1$, 0.72%) while also being represented, were represented to a much lesser extent.



Graph 2: Site frequency by landform within the Concept Area.

6.4.3 Site distance from water source

Sites are located at variable distances from permanent water sources throughout the Concept Area (Graph 3). Sites are most commonly located either less than 50m ($n=54$, 38.8%), or greater than 150m ($n=61$, 43.9%), from water sources, reflecting the presence of sites located within both alluvial flat and hill slope landforms.



Graph 3: Site frequency within the Concept Area by distance from water.

6.4.4 Aboriginal Archaeological Site Patterning

In summary, the dominant site type of the archaeological record in the Concept Area are artefact scatters and isolated artefacts, reflecting the local site patterns of site distribution across the coastal plain (Lampert 1971; Dallas & Sullivan 1995; Sefton 1980; Navin Officer 2000; AMBS 2006). Higher densities of artefacts and accumulation of shell midden material are likely to be associated with significant occupation events, or the results of repeated visitation of low intensity activity in an area resulting in the accumulation of numerous artefacts. Lower density sites are generally considered to be single events, one-off site use or artefacts discarded whilst moving through the landscape.

The Concept Area would have provided many natural resources for the local Aboriginal inhabitants to exploit. Ethno-historical information indicates that the region was intensively occupied by the Dharawal language group. Tangible evidence of such occupation will be reflected across the landscape in the form of shell middens, open stone artefact sites, isolated artefact occurrences and burial sites.

The Concept Area is characterised by both the coastal plain landscape and the escarpment foothills, comprising erosional, residual, and alluvial soils landscapes. The depths of erosional and residual soils are generally shallow across ridge lines and associated slopes and therefore subject to erosional processes, resulting in the exposure or movement of archaeological material. Alluvial deposits, however, provide high archaeological potential in regards to the preservation of cultural material, particularly within the Duck Creek and Mullet Creek corridors.

Previous archaeological work has not only focussed on specific development activities but has recognised the archaeological and cultural landscape values of the locality. All of the previous studies provide a general overview of Aboriginal archaeological site modelling and predictive behaviour within the current Concept Area. In general, previous archaeological work indicates that areas of archaeological potential will occur where disturbance has been limited, the most likely site type to be encountered will be midden sites and low to moderate density stone artefact occurrences.

7.0 ABORIGINAL ARCHAEOLOGICAL SITE DEFINITIONS AND PREDICTIVE MODEL

The archaeological predictive model has been formulated based on the results of the landform, location and type of Aboriginal sites previously recorded within the regional area and information from previous archaeological work completed throughout the region. This information has been broken down into patterns that have been compared to the character of the entire Concept Area (incorporating the Project Proposal Area) to allow for an understanding of Aboriginal archaeological potential.

7.1 Criteria for Assessment for the Archaeological Predictive Model

Based on this information, AMBS (2006) produced a comprehensive Predictive Model for the WDURA (including the Concept Area), incorporating both archaeological and geomorphological data. As a result, this predictive model shall be used for the duration of this study, and is reproduced, with limited adaptations for those areas beyond the WDURA, below (AMBS, 2006: 144-154).

Archaeological potential refers to the likelihood that Aboriginal cultural materials will be present within an area, occurring as surface and/or subsurface artefact deposits. The criteria used to determine the archaeological potential of the Concept Area landforms includes:

1. Patterns of Aboriginal land use and occupation of the region, to identify those landscape areas where material was likely to have been deposited;
2. Distribution of known sites of the Concept Area and broader coastal plain, to identify the landforms known to contain archaeological materials (and patterning of those materials);
3. Geomorphic evolution of the Concept Area landscape, to identify those natural processes that may have affected the archaeological resource;
4. Terrain integrity of the Concept Area, considering the impact of post-contact land use history on the potential of archaeological site survival; and
5. Likely detection of archaeological materials within the Concept Area, considering the nature of the resource (surface/subsurface materials) and ground surface visibility constraints.

Social/cultural potential may be completely independent of archaeological potential, and refer to areas that form intangible expressions of Aboriginal culture.

During consultation undertaken for the current study, the areas and issues of contemporary cultural significance identified by Aboriginal community members are

strongly related to material culture - known and potential archaeological sites and areas.

Areas specifically noted by Aboriginal community members include the Mullet Creek catchment, streams throughout the Concept Area and the importance of high points within the landscape. The general local Aboriginal community have noted, during previous archaeological studies, that the potential occurrence of burials in alluvial flats is of concern, as these sites are of high significance. The potential occurrence of large open camp sites, and open camp sites of significant age (Pleistocene sites) has also been noted. Community members have also noted the potential for additional artefacts to occur at identified site locations within the Concept Area. The values expressed by Aboriginal community members have been incorporated into the following assessment of sensitivity.

Each criterion for the assessment of archaeological potential is discussed following.

Criterion 1: Patterns of Aboriginal Occupation and Land Use

Developing an understanding of patterns of Aboriginal land use and occupation of the region is important in the identification of those landforms/areas where material may have been deposited. As outlined in Section 5.8, the pre-contact landscape of the Concept Area contained significant resources (flora, fauna, and available water) that would have made the locality attractive to occupation and exploitation. Variation in flora and fauna communities would have provided a range of resources throughout the area, and the positioning of the Concept Area between the Illawarra escarpment, Lake Illawarra and the coast would have encouraged movement across the landscape for resource exploitation. The freshwater wetlands on the floodplains of Kembla Grange, Duck Creek and Macquarie Rivulet would have provided a focal point for flora and fauna exploitation, although the archaeology of swamp landforms has not been the focus of archaeological investigation in the Illawarra. Although availability of drinking water is a key influence on patterns of Aboriginal land use and occupation, drinking water is freely available across the Concept Area and may not have been the overriding factor determining land use. Other influences on occupation may include vantage points within the Concept Area, such as hill tops and ridge lines, and lower hill slopes above swamp landscapes.

Criterion 2: Archaeological Site Distribution Patterning

Understanding archaeological site distributions at local and regional levels is crucial in predicting the occurrence of as yet unknown sites within the Concept Area. Within the Concept Area, known sites occur throughout all landforms, including creek lines, alluvial flats, spanning creeks and alluvial flats, lower hill slopes, upper hill slopes and spur crests.

Open camp sites are the most common site type represented within the Concept Area, representing 43.17% ($n=60$) of sites. Over half of the sites are located on drainage lines, alluvial flats or hill slopes ($n=89$, 64.02%), while a further 10% of sites are associated directly with spur crests ($n=15$). No assessment of distance to water could be completed at this time as the AHIMS site cards do not contain this information.

A review of regional site data also identifies patterning in site type distribution. Throughout the Illawarra, open camp sites may occur in all landform contexts, although water is often the defining characteristic in distribution patterns (Dallas and Sullivan 1995:37), with previous studies identifying that artefact density generally increases in proximity to permanent water sources or the coast (Therin 2003:19). From the body of research throughout the region and broader state context, it is generally accepted people tended to camp in proximity to water, resources or vantage points (Therin 2003: 16). The presence of swamp landforms within the Concept Area may also form focal areas of archaeological site distribution, with studies in other regions of New South Wales identifying that wetlands are of high archaeological sensitivity due to the concentrated presence of a diversity of resources (Umwelt 2002). Although predicted to be sensitive, the archaeological resources of wetland landforms have not been investigated in the Illawarra.

Criterion 3: Geomorphic Evolution of the WDURA Landscape

As outlined in Section 5, the landscape of the current Concept Area is primarily the result of two key influences: (a) the erosion of the sandstone block from the Illawarra Escarpment, resulting in the deposition of large quantities of talus across the coastal plain; and (b) the sea level rise in the late Pleistocene/early Holocene, creating drowned river valleys, barrier formations, coastal lagoons and estuaries. These geomorphic processes have had a direct influence on the distribution of archaeological resources within the Concept Area, and the chance of site preservation since deposition.

As a result of geomorphic influences, the majority of landforms within the Concept Area are low-lying, naturally deposited landscapes, particularly in the north of the area along the Mullet Creek catchment. This area is characterised by gently undulating alluvial floodplains and terraces, where archaeological materials are likely to be retained rather than removed by erosion. The deposition of talus across these landforms is likely to have covered any archaeological materials deposited in these areas. Higher landforms throughout the Concept Area are generally erosional, and the increased level of sediment movement is generally expected to result in some post-depositional movement of artefacts.

Archaeological materials deposited along spur crests and upper hill slopes may therefore be subject to movement, most likely being transferred to lower landforms. As above, archaeological materials deposited in lower landforms are likely to have

been buried by this process. Published geomorphic information therefore indicates that the archaeological resource of the lower landforms is likely to be found in subsurface deposits. Although many higher landforms are erosional, sites may still be found in these contexts.

Criterion 4: Land Use History and Terrain Integrity

Information about the nature and extent of post-contact land use in a specific area can indicate the potential for archaeological site survival since deposition. As discussed in Section 5, the landscape of the Concept Area has been primarily pastoral since the first land grants in the West Dapto area in 1817. Pastoral landscapes require extensive clearance and localised areas of earthworks and construction, but despite this, many pastoral areas are of high terrain integrity as impact to the soil profile is relatively limited. However, historical changes to the landscape have also altered natural erosion patterns, often accelerating sediment movement in cleared areas and therefore increasing post-depositional movement. Clearance of vegetation in pastoral landscapes also limits the potential occurrence of Aboriginal scarred trees. Areas subject to more intensive development within the Concept Area, such as the residential centre of Horsley and the industrial centre of Kembla Grange, are less likely to retain archaeological deposits, although it is recognised that materials may survive in landforms subject to earthworks and development.

Criterion 5: Detection of Archaeological Sites

Detection of surface archaeological material is often influenced by ground surface visibility patterns, and the nature of the archaeological resource. Throughout the Proposal Area, ground surface visibility is generally low as a result of dense grass cover, with the majority of areas assessed in both the AMBS (2006) and Biosis Research (2010) studies having less than two per cent effective ground surface visibility. Visibility increases in areas of erosion, such as along creek lines and break of slopes, and as a result of human action. Patterning of visibility influences patterning of known sites, particularly in areas only investigated by archaeological survey, and the higher visibility rates along creek lines may be directly responsible for the concentration of known sites of the Concept Area along creek lines.

Erodibility of soil landscapes is an important consideration in the detection of archaeological materials, and the higher erodibility of soil landscapes of the southern section of the Concept Area may account for the concentration of archaeological sites within the Duck Creek catchment. The nature of the archaeological resources within the Concept Area also needs to be considered, as review of environmental and archaeological data suggests that the archaeological resource of many landforms is likely to be buried. Detection of buried archaeological deposits requires subsurface testing, and it is of interest that all subsurface testings conducted within the Proposal Area, such as Hagland (1983), Saunders (1993), AMBS (2006) and Biosis Research

[Tallawarra (2010) and the West Dapto Flood Plain (2010)], identified subsurface deposits.

Based on the assessment criteria, it has been identified that there exists potential for archaeological sites with moderate-high scientific and cultural significance to be present within the Concept Area. The discussion of archaeological potential presented below also comments on the potential significance of material culture.

7.2 Predictive Statements - Aboriginal Archaeological Site Types

Based on the criteria described previously, the following predictive model has been developed, indicating the site types most likely to be encountered within the Concept Area. The definition of each site type is described firstly, followed by the predicted likelihood of this site type occurring within the Concept Area.

7.2.1 Open sites

Open lithic sites (artefact scatters or isolated artefacts) are the most likely site type to be identified within the Concept Area.

Numbers of artefacts within Open Artefact Scatters can vary considerably depending on a number of factors, including the geographic region and the level of preservation at the site. They can be associated with everyday activities such as stone reduction, woodworking and food preparation (Kohen 1986). Artefact scatters that cannot be associated with discrete, focused activities are referred to as 'background scatters'.

Artefact scatters may be identified anywhere within the Concept Area, but they are more likely to be identified near water-related landforms and on gently inclined slopes within 100 m of water. Stone artefacts are more likely to consist of silcrete, quartz or chert.

Isolated artefacts may also be located anywhere within the Concept Area. True isolated artefacts are likely to represent discard or loss by Aboriginal people when travelling (Kohen 1986) or artefacts that have been shifted from scatters by geomorphic processes.

7.2.2 Rock shelters, axe grinding grooves and quarries

Rock shelters

Rock shelters may occur within landscapes in which suitable geological features exist, such as shelving and overhangs that provide sufficient sheltered space. Shelters may exhibit art or contain archaeological deposits such as stone artefacts.

Axe-grinding grooves

Axe-grinding grooves are produced by rubbing a stone implement against a friable stone to produce a durable cutting edge. The resulting grooves are generally characterised by elongated, narrow depressions. They are usually found on sandstone outcrops near watercourses as water was used in the process to make the sandstone “more abrasive and to reduce dust”.

Aboriginal stone quarries

Aboriginal stone quarries are outcrops of stone that were exploited by Aboriginal people, often repeatedly, for raw materials to be used in the manufacture of stone tools.

Summary

The geological background of the Concept Area indicates that shelters, grinding grooves and raw materials suitable for stone tool manufacture will not occur within the Concept Area. The immediate geological unit that outcrops in the Concept Area is predominantly shale.

7.2.3 Culturally Modified trees

Scarred trees exhibit scars caused by the removal of bark or wood, which was used by Aboriginal people for a variety of purposes. Such scars can be found on old growth trees that tend to be of a size from which a piece of bark or wood suitably sized for its intended purpose can be removed.

Scarred trees may occur anywhere within the Concept Area where mature trees remain.

However, scar trees are generally unlikely to be found within the Concept Area for a combination of reasons:

- the lifespan of trees is relatively short, with lifespan generally decreasing in proportion to length of European settlement,
- the practise of utilising wood and bark from trees by Aboriginal people increasingly diminished after European settlers moved into the area,
- significant timber clearances occurred with European settlement of the area.

7.2.4 Burials

Aboriginal burial sites are generally situated within deep, soft sediments, such as aeolian or alluvial deposits, that would have been relatively easy to excavate for the purpose of burial. Burials would only be visible as surface expressions if they had been exposed by erosion or as the result of animal or human activities (Brayshaw 1982d: 92).

The lack of suitable soil landscapes within the Concept Area indicate that burial sites are unlikely to occur.

7.2.5 Post-contact sites that relate to Aboriginal people

These are sites that relate to the shared history of Aboriginal and more recent settlers since the European invasion of the Australian continent in 1788. Many of these sites can hold special significance for Aboriginal people and may include places such as missions, massacre sites, post-contact camp sites, and buildings associated with post-contact Aboriginal use. This site type is usually known from historical records or knowledge preserved within the local community.

No known post-contact sites are documented within the Concept Area.

7.2.6 Aboriginal places

Aboriginal places are places of cultural significance to Aboriginal people. Archaeological materials need not be present for the identification of an Aboriginal place. Often they are places tied to community history and may include natural features (such as swimming and fishing holes), places where Aboriginal historical political events commenced, or particular post-contact buildings.

No Aboriginal places have been declared within the Concept Area (October 2010) or are listed on AHIMS

(<http://www.environment.nsw.gov.au/conservation/AboriginalPlacesNSW.htm>).

7.3 Aboriginal Archaeological Potential

Defined levels of archaeological *potential* are not to be taken as a reflection of the presence or absence of Aboriginal archaeological material, rather an indication of the likelihood of archaeological material considered to be of archaeological significance within the Concept Area. The identified areas of archaeological potential will be used as one 'general' guide for understanding potential development impacts.

Archaeological sensitivity maps (Figure 8) have been developed for the Concept Area following the three various 'levels' (low, medium and high) defined for this study (Table 9).

Table 9: Definitions of each level of archaeological potential.

Level of Archaeological Potential	Description
<p>Low</p> <p><i>Low likelihood for intact Aboriginal archaeological remains</i></p>	<p>Areas that have been identified as having specific locations where there has been a high degree of disturbance since the arrival of non-Aboriginal people, where the impact has been to the extent where no intact deposits are believed to be present. Areas may also include steep slopes or plains away from water sources. Artefacts found in this area are likely to be isolated, representative of 'background scatter', or in a highly disturbed context.</p>
<p>Moderate</p> <p><i>Moderate likelihood for intact Aboriginal archaeological remains</i></p>	<p>This includes areas incorporating minor creek lines and waterways where less intrusive post-contact disturbance has occurred, such as light vegetation clearing and pasture enhancement. Sites are likely to reflect temporary habitation of a localised area, with artefact scatters likely to vary in density, although still concentrated in small areas.</p>
<p>High</p> <p><i>High likelihood for intact Aboriginal archaeological remains</i></p>	<p>Areas associated with major creek lines, raised flat landforms such as ridges and hills, where disturbance has been minimal and it is believed that an intact sensitive landscape exists. Artefacts that remain within these areas are likely to be high density.</p>

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7.3.1 Low Archaeological Potential

A number of areas within the Concept Area have been assessed to be of low archaeological potential (Table 10; Figure 8). These include transport infrastructure (graded road, rail), industrial infrastructure, the urban centre of Horsley, isolated residential buildings and infrastructure, and cemeteries at Kembla Grange and on West Dapto Road. The sensitivity of these areas was determined on the basis of the following criteria.

Table 10: Criteria for low archaeological potential.

Criteria	Description
Criterion 1	Areas span all landform contexts including streams, alluvial flats, hill slopes and spur crests. Aboriginal occupation strategies involved use of all areas with more intensive use of resource zones and vantage areas. Material culture likely to have been deposited in all areas at varying densities.
Criterion 2	Archaeological sites known to occur in all landform contexts and may have been deposited/retained in these landforms. Site and artefact density higher in proximity to streams but predicted to be higher in resource zones and vantage points.
Criterion 3	Variable geomorphic processes affecting areas. Lower landforms more likely to retain deposits. Higher landforms more likely to be subject to post depositional artefact movement.
Criterion 4	Recent land use history involving very high impact in all areas. Excavation and earthworks conducted for urban infrastructure including residential and industrial areas.
Criterion 5	Often higher exposure in these areas resulting from earthworks more likely to detect surface archaeological deposits.

The defining characteristic of all areas of archaeological potential is the high level of ground disturbance resulting from urban development, with excavation and earthworks conducted in all above areas. This level of earthworks is likely to have resulted in the destruction or disturbance of the archaeological resource. Although recognised that some deposit may be retained in these areas, site density and integrity is predicted to be low.

7.3.2 Moderate Archaeological Potential

The areas within the Concept Area assessed to be of moderate archaeological potential include mid-upper hill slopes throughout the locality (Table 11; Figure 8). The archaeological potential of these areas was determined on the basis of the following criteria.

Table 11: Criteria for moderate archaeological potential.

Criteria	Description
Criterion 1	Aboriginal occupation and land use of these areas is known to occur, but at a less intensive rate than other landforms. Material culture likely to have been deposited in these landforms, but at lower density than surrounding landforms.
Criterion 2	Archaeological sites known to occur in these landforms, but generally at lower site and artefact densities than other landforms.
Criterion 3	Mid and upper hill slopes are erosional landscapes, although level of sediment transfer varies between north and south of the Project Approval Area. Post-depositional movement of artefacts likely to occur in these landforms, affecting site integrity and possibly moving artefacts to lower landforms (lower slopes, alluvial flats, stream channels).
Criterion 4	Impact of modern land use in these landforms is variable. Pastoral land use dominates the areas, which involves localised areas of earthworks, but much of the area is of moderate to high terrain integrity.
Criterion 5	Ground surface visibility is predicted to be relatively low due to grass cover (particularly in pastoral landscapes). However, erosional landscape will contain areas of exposure, particularly along breaks of slope in landforms. These landforms are predominantly erosional landscapes, and the assessment of moderate sensitivity is fundamentally based on the impact of natural processes to the potential archaeological resource. Aboriginal occupation of these landforms is known, although at a less intensive rate than surrounding landforms. Materials deposited in these landforms are likely to have been subject to post-depositional movement, possibly moved to lower landforms. Disturbance to sites from pastoral land use is expected to be limited and localised. Due to the influence of landform processes, site integrity in these landforms is not predicted to be high, so sites of high scientific significance are not expected.

7.3.3 High Archaeological Potential

The areas within the Concept Area assessed to be of high archaeological potential include sections of the Dapto Creek, Sheaffes Creek, Forest Creek, Robins Creek, Mullet Creek and Duck Creek systems, including streams, alluvial flats and undulating hill slopes (Table 12; Figure 8). The archaeological potential of these areas was determined on the basis of the following criteria.

Table 12: Criteria for high archaeological potential.

Criteria	Description
Criterion 1	Aboriginal occupation and land use of these areas is known to occur, with these creek catchments providing resources (water, flora, fauna) making use of the landforms attractive. These landforms provide permanent water resources, and also contain a diversity of flora and fauna species, being wetland habitats prior to contact. Resource distribution extended from streams to associated flats and undulating hill slopes,
Criterion 2	Archaeological site and artefact density is predicted to be higher in these landforms than the surrounding landscape. These creek catchments are often focal areas of archaeological site density, and the presence of wetland resources also indicates that archaeological site and artefact density will be high.
Criterion 3	These landforms are aggrading soil landscapes, indicating that materials deposited in these areas will be retained. Sediment transfer from higher landforms may also deposit artefacts from other landforms in these naturally deposited landscapes.
Criterion 4	Impact of modern land use in these landforms is variable. Pastoral land use dominates the areas, which involves localised areas of earthworks, but much of the area is of moderate to high terrain integrity. Due to the flood constraints of these areas, recent land use is generally lower than the surrounding landscape.
Criterion 5	Ground surface visibility is predicted to be relatively low throughout these landforms due to lower levels of erosion and human action. Potential of surface artefact detection is therefore considered to be low. As these landforms are aggrading, it is predicted that the archaeological resource will be buried, and can only therefore be detected through excavation

Part 2:

Project Approval Area

Introduction to Part 2 – Project Proposal Area

Part 2 of this report deals with the specific predictive modelling, AHIMS and survey results within the **Project Approval Area**. The following Sections are provided within this part of the report.

Part 2 details the following sections:

8. Heritage Registers and Information Management
9. Environmental Context
10. Aboriginal Archaeological Context
11. Aboriginal Archaeological Site Definitions and Predictive Model
12. Project Approval Area (water only)
13. Aboriginal Archaeological Field Survey
14. Significance Assessment
15. Impact Assessment

8.0 HERITAGE REGISTERS AND INFORMATION MANAGEMENT

8.1 Summary of Heritage Listings in the Project Approval Area

Details of the various Commonwealth and State Heritage Registers searched during this investigation are provided in Part 1, Section 4.

Of all the heritage registers searched, Aboriginal archaeological sites were only listed on the OEH AHIMS database Figure 9, Figure 10. Fifty (50) Aboriginal archaeological sites are currently registered within the Project Approval Area, and seven of these are situated within the proposed water and wastewater pipeline corridors.

LISTING	RNE	CHL	NHL	AHIMS	SHLEP 2000	WLEP 2009	WEST DAPTO LEP 2010	IREP 1986	SHR	SHI
Previously recorded Aboriginal Archaeological Sites	N	N	N	Y	N	N	N	N	N	N

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9.0 ENVIRONMENTAL CONTEXT

A description of the environmental background to the Concept Plan Area (including geology, geomorphology, soil landscapes, hydrology, climate, flora and fauna) is provided in Part 1, Section 5. Information relating specifically to the Project Approval Area is presented in the sections below, dealing specifically with soils (Section 9.1) and hydrology (Section 9.2).

9.1 Soil Landscapes

The Project Approval Area contains four distinct types of soil landscapes: residual, erosional, depositional and swamp (Figure 11). Details and examples of these soil landscapes are provided in the section below.

Residual soil landscapes are characterised by areas where soils are derived from the long-term, in situ weathering of parent materials. Examples of these types of soil landscapes are typically level to undulating elevated landforms, flats and plains, with poorly defined drainage lines.

Erosional soil landscapes comprise soils that are derived from the erosive action of running water, primarily well defined streams that have the ability to transport their sediment load. Soils may be either absent, derived from water-washed parent materials or derived from in situ weathered bedrock.

Depositional soil landscapes are characterised by areas where soils are deposited through geomorphic movements such as fluvial and alluvial flooding and wash from erosional areas. Examples of these types of soil landscapes are typically level to undulating flats and plains, commonly associated with small to large watercourses.

Swamp soil landscapes are dominated by ground surfaces and soils that are at least seasonally wet, with water tables frequently close to the surface. Soil parent material includes large amounts of accumulated decayed organic matter. Landform elements may include swamps and some relic oxbows, abandoned channels, lagoons and swales (Abraham & Abraham 1996).

The formation characteristics of each of these soil landscapes will affect the survival of archaeological material. Residual and erosional soil landscapes are generally subject to movement of shallow soils, resulting in poor preservation of archaeological material. With little cover, archaeological material is likely to occur at shallow depths or will be exposed where there is little or no vegetation cover. Swamp soil landscapes behave in the opposite manner, and accumulate parent soils and deposition of transported soils, particularly along water lines. This process would therefore preserve archaeological material.

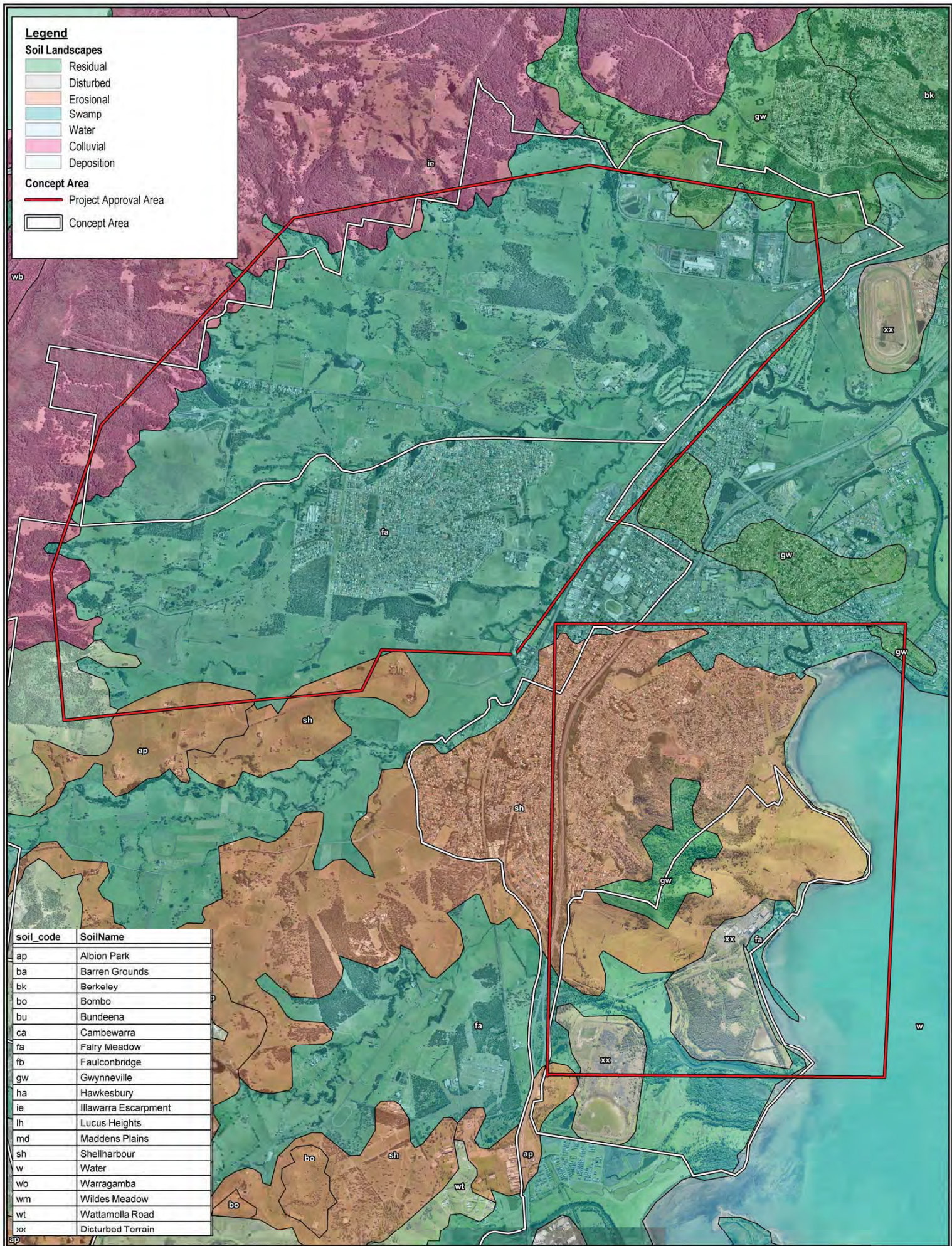


Figure 11: Soils landscapes within the Project Approval Area.



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kilometres

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Map Projection: Universal Transverse Mercator
Horizontal Datum: Geoidetic Datum of Australia 1994
Map Grid: Map Grid of Australia Zone 56



9.2 Hydrology

The key hydrological features of the broader Concept Plan Area are outlined within Part 1, Section 5.4. Stream order analysis specific to the Project Approval Area are presented within the following Section. A map detailing the results of the analysis is presented in Figure 12.

9.2.1 Stream Order Analysis

Strahler's method has been used to determine watercourse order within the Concept Plan Area. In a similar trend to the broader Concept Plan Area, stream order increases with proximity to Lake Illawarra, demonstrating that the Illawarra coastal plain drains eastwards towards both Lake Illawarra and the Tasman Sea.

Artefact density appears to be in keeping with the trends presented in the stream order analysis, increasing with proximity to Lake Illawarra.

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10.0 ABORIGINAL ARCHAEOLOGICAL CONTEXT

10.1 Previous Archaeological Work – Localised Archaeological Studies

A significant amount of archaeological work has been undertaken within the Project Approval Area itself. The findings from this work have contributed to a more informed understanding of Aboriginal archaeological cultural heritage along the shores of Lake Illawarra and the associated coast plain and escarpment slopes (e.g. Sefton 1980; Langendoen 1971; McIntyre 1984, 1987; Navin 1987a, 1987b, 1988; Salmon 1998; Biosis Research 2006; AMBS 2006; Kelleher and Nightingale 2006; AHMS 2009; 2010).

These studies have largely involved pedestrian surveys in response to developmental pressures within the area. Methods have largely involved a combination of predictive modelling and resulting targeted surveys. The most detailed of these was produced by AMBS (2006), *“Aboriginal Heritage Management Plan: West Dapto Release Area”*. As all work up until 2006 has been summarised in detail by AMBS (2006), it shall not be repeated here. The AMBS (2006) study has been summarised previously in Part 1 – Section 6.2, of this report. Detailed below are summaries of those studies conducted between 2006 and 2010 within the Project Approval Area and within the immediate vicinity.

Kelleher and Nightingale (2006) contributed to the Tallawarra Lands Local Environmental Study (LES) potential land use allocation planning. The assessment identified sites and places of Aboriginal archaeological heritage and/or archaeological significance. It was noted that the cultural and archaeological sites, places and areas of potential archaeological deposit are of high Aboriginal heritage value. All of these areas were assessed as having high potential for intact archaeological deposit. Further, the areas identified as being of cultural or archaeological integrity were considered to be of moderate Aboriginal heritage value.

The recommendations of the report are summarised below:

Conservation should be the prime consideration when establishing Aboriginal heritage management strategies during the planning process.

If the *culturally or archaeologically sensitive areas* will be impacted by future land use, the impacted areas should be subject to archaeological test investigation (under a section 87 permit).

Where it is not possible to conserve area of identified PAD, an AHIP will be required. An archaeological salvage/test excavation will be necessary for these places.

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understanding and defining the nature of the Aboriginal archaeological material in the Study Area.

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Thirty-five test pits were excavated across the site focussing on Potential Archaeological Deposits (PADs) and areas of high Aboriginal archaeological sensitivity. Twelve Aboriginal artefacts and five items of historic heritage were recovered from the test excavations. Cleveland Road PAD 1 (52-5-0583), Cleveland Road PAD 4 (52-5-0586), Cleveland Road PAD 7 (52-5-0584), Test Site 1, Test Site 2 and Test Site 3 were all found to contain at least one Aboriginal artefact.

10.2 AHIMS Results

10.2.1 Aboriginal Archaeological Sites within the Project Approval Area

Fifty Aboriginal archaeological heritage sites registered with AHIMS are located within the Project Approval Area (Figure 9; Figure 10). The mapping coordinates recorded for these sites were checked for consistency with their descriptions and location on maps from site cards and Aboriginal heritage reports where available. These descriptions and maps were relied where notable discrepancies occurred.

The coordinates provided by AHIMS for the Aboriginal archaeological heritage sites recorded during the ABMS (2006) study did not correspond to the applicable descriptive locations or mapping (AMBS 2006). These had been incorrectly labelled as being in GDA projection by OEH, rather than the correct AGD. The data was recalibrated for the correct projection, altering the alignment of the sites slightly. The sites were surveyed within the correct projection.

Details of the sites located within the Project Approval Area are presented in Appendix 3.

10.2.2 Aboriginal Archaeological Sites within the Proposed Water and Wastewater Alignments

Seven Aboriginal Archaeological sites *registered with AHIMS* are located within the proposed alignments. All sites within the Project Approval Area have been described from OEH AHIMS site recording forms and are summarised in Appendix 3.

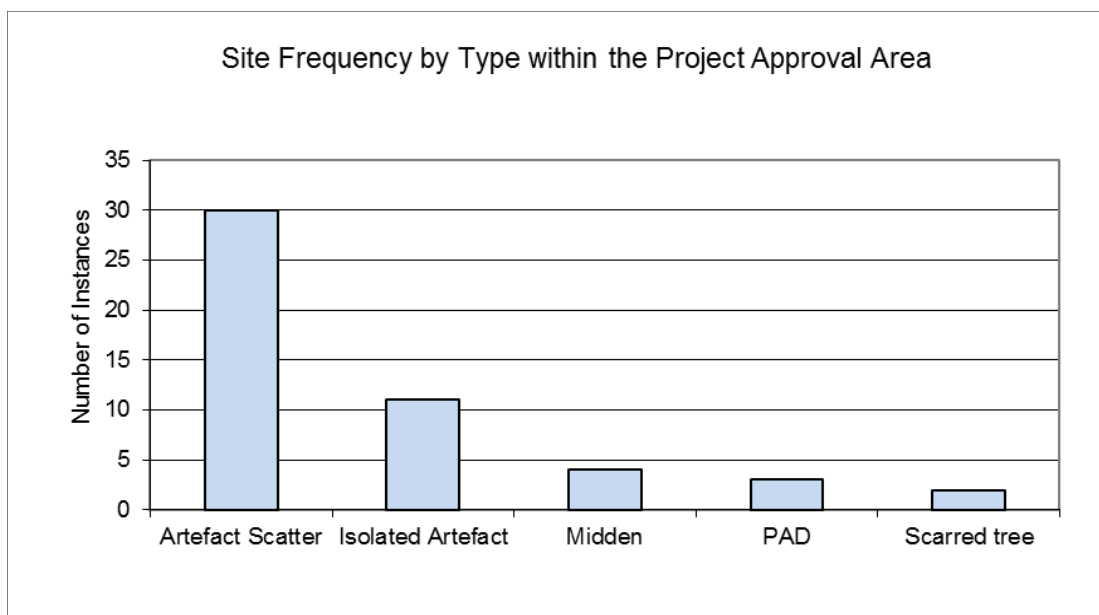
10.3 AHIMS Site Analyses

Simple analyses of the Aboriginal archaeological heritage sites registered within the boundaries of the Project Approval Area were conducted, with the results displayed in Graph 4 to Graph 9.

The variability in descriptions provided in AHIMS site cards can often reduce the detail of information within various analysis categories. Each analysis only includes sites for which information had been recorded that was applicable to one or more categories used in the particular analysis. The AHIMS database only includes Aboriginal sites registered with AHIMS and is not complete list of Aboriginal sites within any given area.

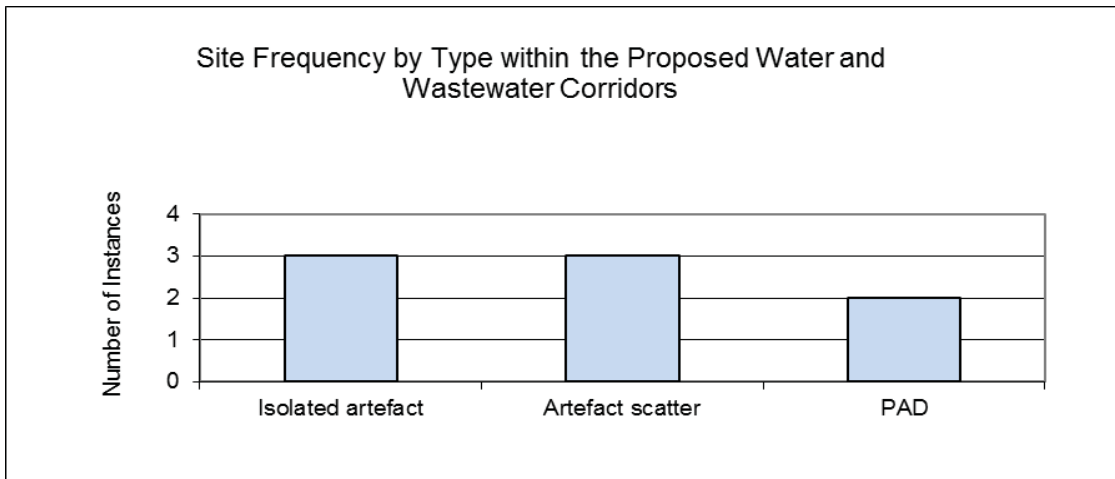
10.3.1 Site Types

The frequencies of site types within the Project Approval Area (Graph 4) are consistent with the trends shown in the broader Concept Plan Area (Part 1, Section 6.4). Artefact sites represent 82% ($n=41$) of all site types (artefact scatters $n=30$, 60%; isolated artefacts $n=11$, 22%). Middens ($n=4$, 8%) and PAD ($n=3$, 6%) were represented relatively infrequently, as in the broader Project Approval Area site frequencies. Again, the number of scar trees ($n=2$, 4%) is likely to be a direct reflection of the use of land for agricultural purposes



Graph 4: Site frequency by type within the Project Approval Area.

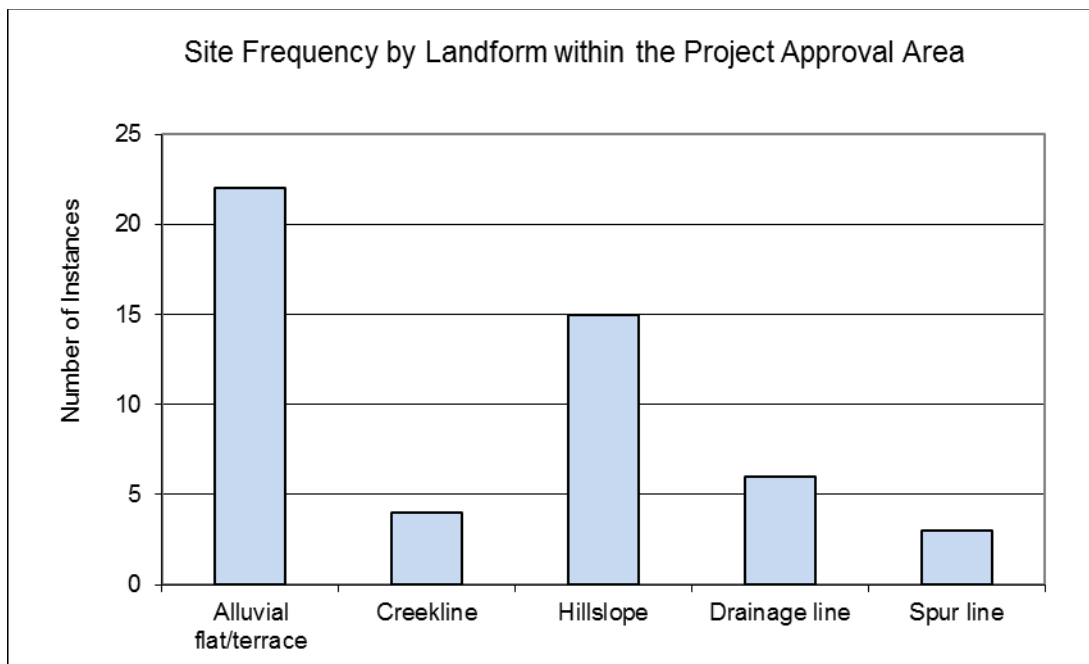
Only a very small number ($n=8$) of registered sites actually fall within the proposed water and wastewater corridors. Artefact sites make up the majority (artefact scatters $n=3$, 37.5%; isolated artefacts $n=3$, 37.5%), with the remainder comprising PAD ($n=2$, 25%) (Graph 5).



Graph 5: Site frequency by type within the proposed water and wastewater corridors .

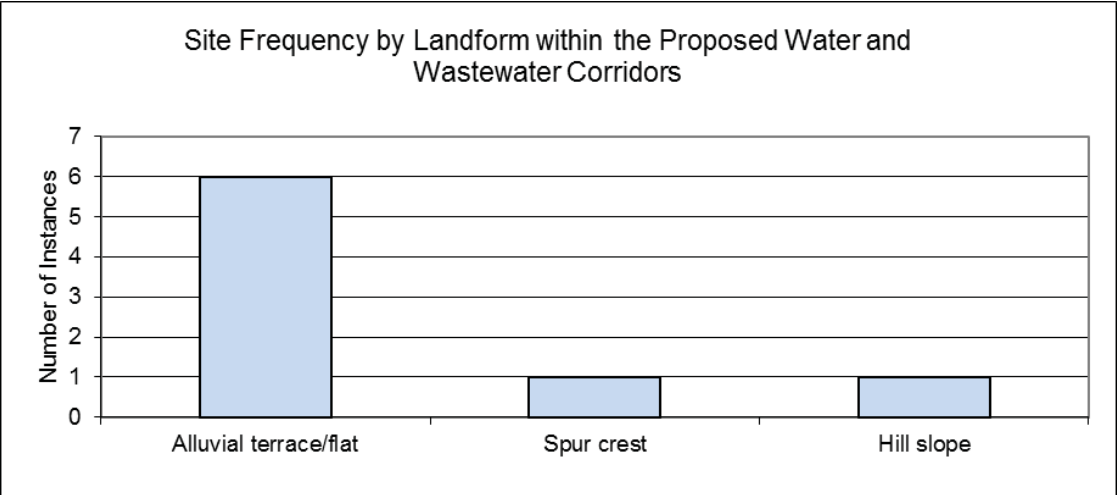
10.3.2 Landforms associated with sites

The variation in site frequency per landform within the Project Approval Area is likely to be directly linked to the reduced area of land being surveyed. The reduction in the number of landform types is therefore more likely to reflect a concentration of survey area within a limited number of landforms, rather than a greater concentration of sites within these landforms within this area. There are fewer hill slopes ($n=15$, 30.0%) being represented but a greater proportion of alluvial flats ($n=22$, 44.0%) (Graph 6). The landforms present within the Project Approval Area are shown in Figure 13 to Figure 21.

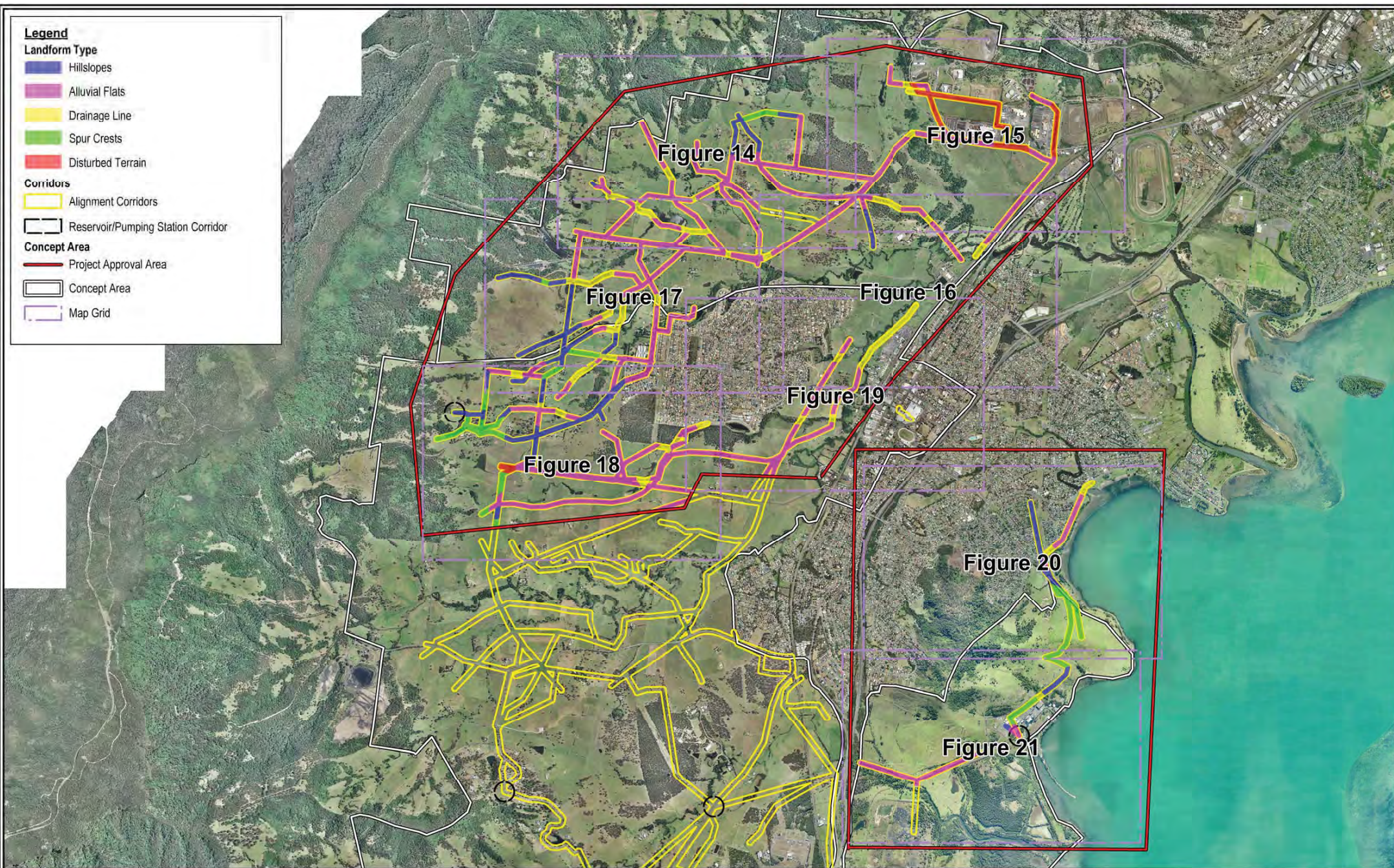


Graph 6: Site frequency by landform within the Project Approval Area.

The landform distribution within the proposed water and wastewater pipeline corridors has also been greatly affected by the reduced size of the study area compared with the Project Approval Area, with the number of spur crests and hill slopes being significantly reduced as a result (Graph 7).



Graph 7: Site frequency by landform within the proposed water and wastewater corridors.



Legend

Landform Type

- Hillslopes
- Alluvial Flats
- Drainage Line
- Spur Crests
- Disturbed Terrain

Corridors

- Alignment Corridors
- Reservoir/Pumping Station Corridor

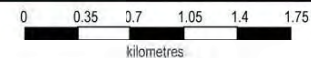
Concept Area

- Project Approval Area
- Concept Area
- Map Grid

Figure 13: Landforms located within the Project Approval Area - Overview.

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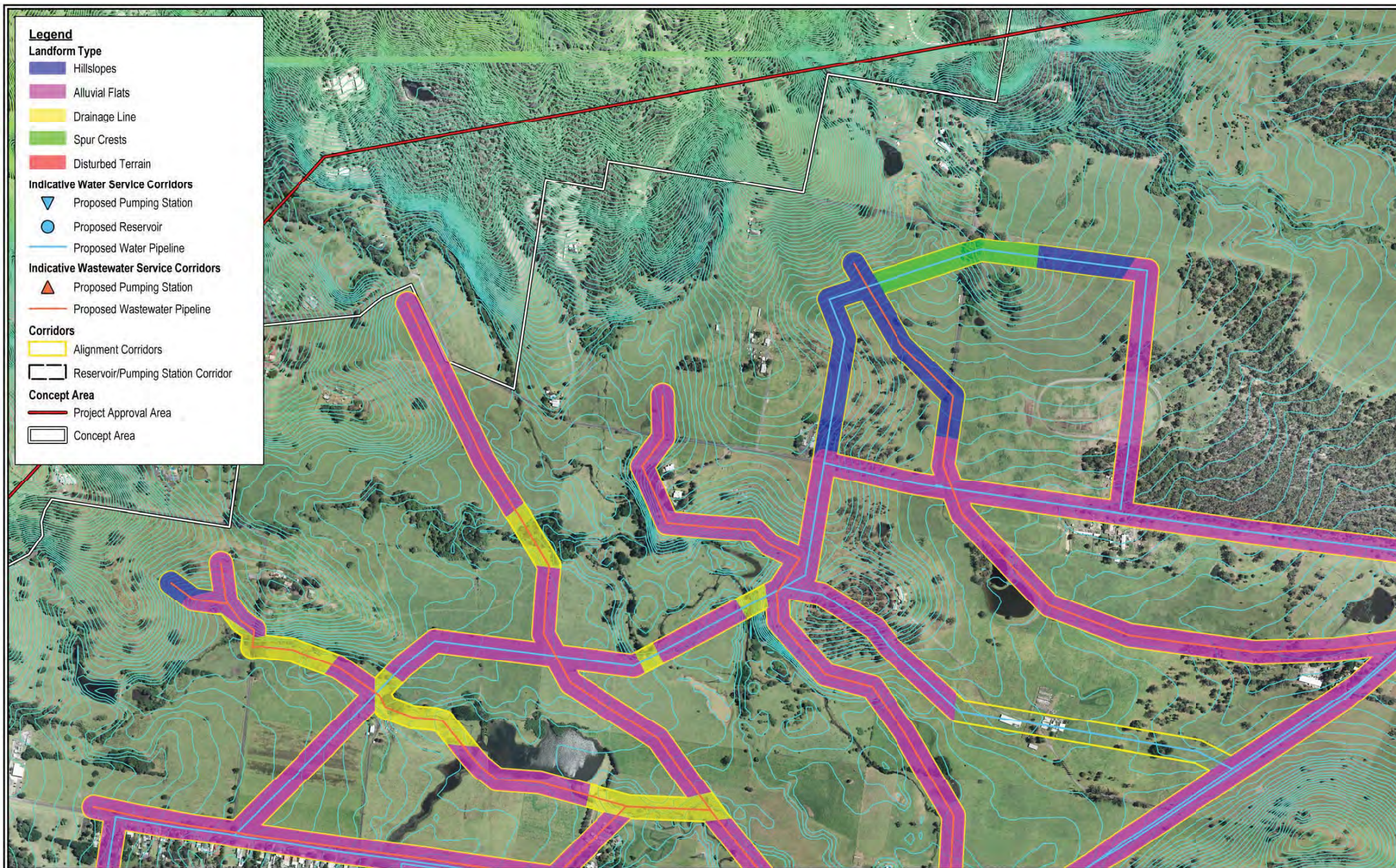


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Figure 14: Landforms located within the Project Approval Area.

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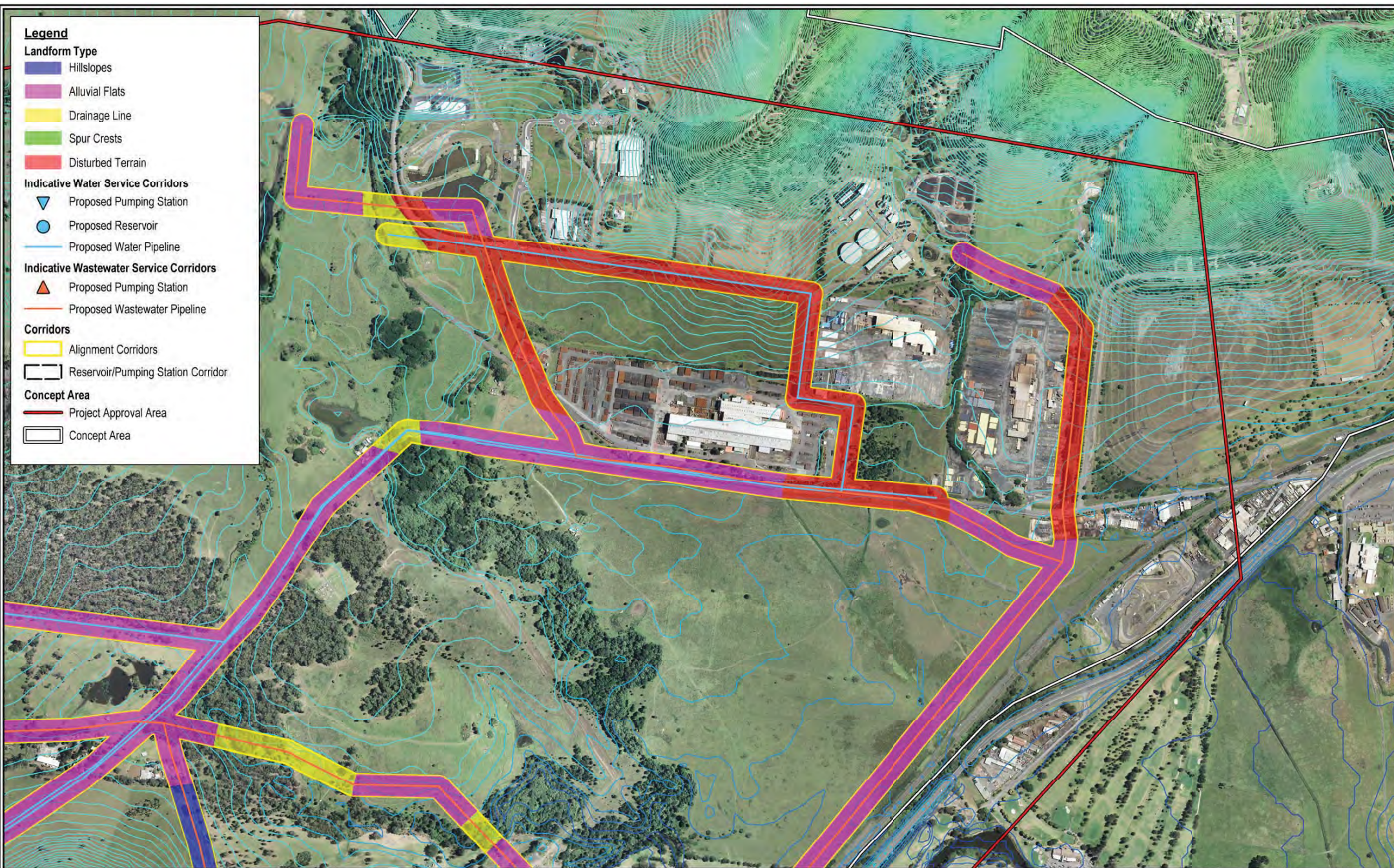
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metres

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Map Projection: Transverse Mercator
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Grid: Map Grid of Australia, Zone 58





Legend

Landform Type

- Hillslopes
- Alluvial Flats
- Drainage Line
- Spur Crests
- Disturbed Terrain

Indicative Water Service Corridors

- Proposed Pumping Station
- Proposed Reservoir
- Proposed Water Pipeline

Indicative Wastewater Service Corridors

- Proposed Pumping Station
- Proposed Wastewater Pipeline

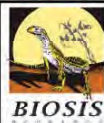
Corridors

- Alignment Corridors
- Reservoir/Pumping Station Corridor

Concept Area

- Project Approval Area
- Concept Area

Figure 15: Landforms located within the Project Approval Area.



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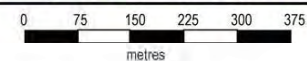
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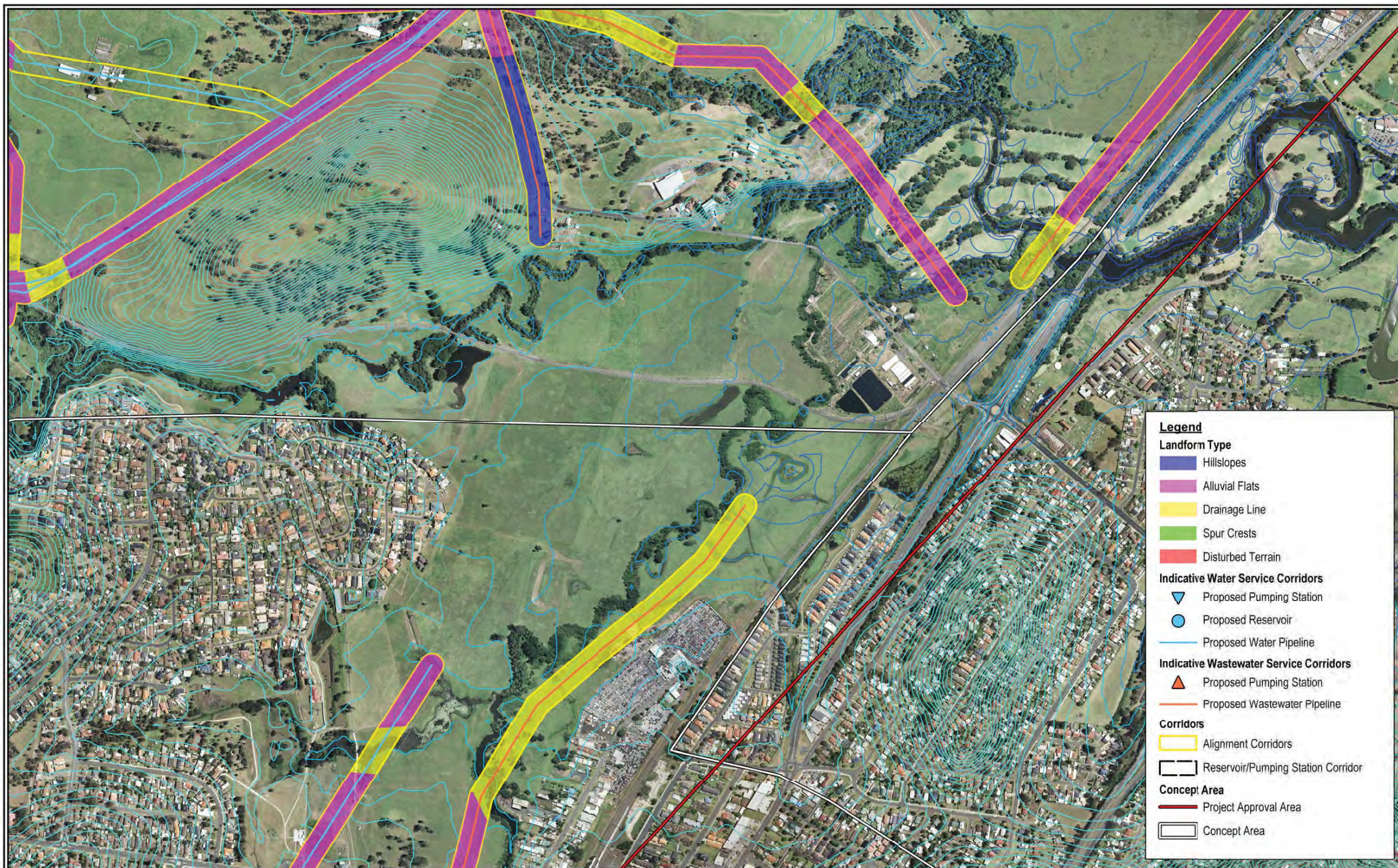
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Figure 16: Landforms located within the Project Approval Area.

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