Appendix 1. Threatened species likelihood of occurrence

Scientific Name	TSC Act	EPBC Act	Habitat	Likelihood
Acacia bynoeana	E	V	Grows mainly in heath and dry sclerophyll forest in sandy soils. Mainly south of Dora Creek-Morisset area to Berrima and the Illawarra region, west to the Blue Mountains, also recorded from near Kurri Kurri in the Hunter Valley and from Morton National Park.	Low
Allocasuarina glareicola	E	E	This species is restricted to a few small populations in and around Castlereagh, north-east of Penrith, NSW.	None
Asterolasia elegans	E	E	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Also likely to occur in the western part of Gosford local government area. Known from only seven populations, only one of which is wholly within a conservation reserve.	None
Caladenia tessellata	E	V	The Tessellated Spider Orchid is found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct.	None
Callistemon linearifolius	V	-	Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Recorded in 2000 at Coalcliff in the northern Illawarra. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. The species was more widespread in the past, and there are currently only 5-6 populations remaining from the 22 populations historically recorded in the Sydney area. Three of the remaining populations are reserved in Ku-ring-gai Chase National Park, Lion Island Nature Reserve and Spectacle Island Nature Reserve. The species has also been recorded from Yengo National Park.	None
Cryptostylis hunteriana	V	V	Grows in swamp-heath on sandy soils, chiefly in coastal districts, south from the Gibraltar Range.	Low
Cynanchum elegans	E	E	Recorded from rainforest gullies scrub and scree slopes from the Gloucester district to the Wollongong area and inland to Mt Dangar.	None
Epacris purpurascens var. purpurascens	V	-	Recorded from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Found in a range of habitat types, most of which have a strong shale soil influence.	Moderate
Eucalyptus nicholii	V	V	The Narrow-leaved Peppermint occurs in grassy or sclerophyll woodland, in association with other eucalypts that grow in the region, including New England Blackbutt (*Eucalyptus andrewsii*) and many of the stringybarks, such as Broad-leaved Stringybark (*E. caliginosa*). The species is found on shallow, relatively infertile soils on shale and slate geology.	None
Grevillea parviflora subsp. parviflora	V	V	Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks.	Moderate

Scientific Name	TSC Act	EPBC Act	Habitat	Likelihood
Gyrostemon thesioides	E	-	Grows on hillsides and riverbanks and may be restricted to fine sandy soils Within NSW, has only ever been recorded at three sites, to the west of Sydney, near the Colo, Georges and Nepean Rivers. The most recent sighting was of a single male plant near the Colo River within Wollemi National Park. The species has not been recorded from the Nepean and Georges Rivers for 90 and 30 years respectively, despite searches. Also occurs in Western Australia, South Australia, Victoria and Tasmania.	None
Haloragis exalata subsp. exalata	V	V	Haloragis exalata subsp. exalata occurs in New South Wales and Victoria from as far north as the NSW north-western slopes (near Narrabri), south to the Glenelg River in south-western Victoria. In New South Wales populations are known from the areas of western Sydney, Kosciuszko National Park, the Bega Valley, Bungonia Gorge east of Goulburn on the Central Tablelands, the Shoalhaven River and Lake Illawarra on the Central Coast, the North Coast and the Northern Tablelands. In Victoria populations are known from near the Glenelg and Curdies Rivers, both in the south-west of the state. Important populations occur in the following NSW National Parks: Kosciuszko National Park, Geehi Valley (NSW), Lower Glenelg National Park, Moleside Creek (VIC), Gulaga National Park, Wallaga Lake (NSW), Eurobodalla National Park, Corunna Lake (NSW) and Marramarra National Park (NSW). Other important populations occur at Cuttagee Lake (NSW), Gooseberry Island in Lake Illawarra (NSW) and Bungonia State Conservation Area (NSW).	None
Leucopogon exolasius	V	V	Grows in woodland on sandstone. Restricted to the Woronora and Grose Rivers and Stokes Creek, Royal National Park.	Low
Melaleuca biconvexa	V	V	Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north.	Low
Melaleuca deanei	V	V	Grows in wet heath on sandstone in coastal districts from Berowra to Nowra.	None
Pelargonium sp. striatellum	E	E	The species is known to occur in habitat usually located just above the high water level of irregularly inundated or ephemeral lakes. During dry periods, the species is known to colonise exposed lake beds. In New South Wales, *Pelargonium* sp. is currently known to occur at four localities in the Southern Tablelands, at altitudes ranging from 680-1030 m a.s.l.	Low
Persoonia bargoensis	E	V	The Bargo Geebung occurs in woodland or dry sclerophyll forest on sandstone and on heavier, well drained, loamy, gravely soils.	Low
Persoonia hirsuta	E	E	The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone.	Low
Persoonia nutans	E	E	Confined to aeolian and alluvial sediments and occurs in a range of sclerophyll forest and woodland vegetation communities, with the majority of individuals occurring within Agnes Banks woodland or Castlereagh Scribbly Gum woodland. Restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south.	Low
Pimelea curviflora subsp. *curviflora*	V	V	*Pimelea curviflora* subsp. *curviflora* occurs on ridge tops and upper slopes in open forest and woodland on sandy soil derived from sandstone on shaley/lateritic soils and shale/sandstone transition soils. The population at Albion Park on the Illawarra coastal plain occurs in Lowland Grassy Woodland habitat. It often grows among dense grasses and sedges (CSIRO Plant Industry & Threatened Species Unit 1999) making it difficult to detect.	Low

Scientific Name	TSC Act	EPBC Act	Habitat	Likelihood
Pimelea spicata	E	E	Once widespread on the Cumberland Plain, the Spiked Rice-flower occurs in two disjunct areas; the Cumberland Plain (Narellan, Marayong, Prospect Reservoir areas) and the Illawarra (Lansdowne to Shellharbour to northern Kiama). In both the Cumberland Plain and Illawarra environments this species is found on well-structured clay soils. On the inland Cumberland Plain sites it is associated with Grey Box and Ironbark. In the coastal Illawarra it occurs commonly in Coast Banksia open woodland with a better developed shrub and grass understorey.	Low
Pomaderris brunnea	V	V	The species is expected to live for 10 - 20 years, while the minimum time to produce seed is estimated to be 4 - 6 years. Found in a very limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area. It also occurs at Walcha on the New England Tableland and in far eastern Gippsland in Victoria.	Low
Pterostylis saxicola	E	E	Restricted to western Sydney between Freemans Reach in the north and Picton in the south. Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where *Pterostylis saxicola* occurs are sclerophyll forest or woodland on shale-sandstone transition soils or shale soils.	Low
Pultenaea aristata	V	V	Prickly Bush-pea is restricted to the Woronora Plateau, a small area between Helensburgh, south of Sydney, and Mt Kiera above Wollongong. The species occurs in either dry sclerophyll woodland or wet heath on sandstone.	Low
Pultenaea pedunculata	E	-	*Pultenaea pedunculata* occurs in a range of habitats. NSW populations are generally among woodland vegetation but plants have also been found on road batters and coastal cliffs. It is largely confined to loamy soils in dry gullies in populations in the Windellama area.	Low
Syzygium paniculatum	E	E	*Syzygium paniculatum* occupies restricted habitats that have been extensively cleared or modified (DECC 2007) including lowland and littoral rainforest. Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions and Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions are listed as Endangered Ecological Communities under the NSW *Threatened Species Conservation Act* 1995 (NSW Scientific Committee 2004).	Low
Thesium australe	V	V	Grows in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland or grassy woodland. Grows on Kangaroo Grass tussocks but has also been recorded within the exotic Coolatai Grass.	Low
Thelymitra sp. Kangaloon (D.L.Jones 18108)	-	E	Recorded from shallow black peaty soil in coastal heath on sandstone. *Thelymitra sp. Kangaloon* is a terrestrial orchid endemic to New South Wales, and is known from three locations near Robertson in the Southern Highlands.	None

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood
Anthochaera Phrygia	Regent Honeyeater	CE	E,M	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. Its range has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests.	Low
Apus pacificus	Fork-tailed Swift	-	M	The Fork-tailed Swift is almost exclusively aerial, flying from less than one metre to at least 300 metres above ground and probably much higher.	Low
Ardea alba	Great Egret	-	M	Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands.	Low
Ardea ibis	Cattle Egret	-	M	The Cattle Egret is found in grasslands, woodlands and wetlands, and is not common in arid areas. It also uses pastures and croplands, especially where drainage is poor.	Low
Botaurus poiciloptilus	Australasian Bittern	E	E	The Australasian Bitterns is widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes and spikerushes.	Low
Burhinus grallarius	*Bush Stone-curlew*	V	-	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber.	Low
Callocephalon fimbriatum	*Gang-gang Cockatoo*	V	-	In summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas.	Low
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Inhabits forest with low nutrients, characteristically with key Allocasuarina spp. Tends to prefer drier forest types with a middle stratum of *Allocasuarina* below *Eucalyptus* or *Angophora spp*. Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead. Endangered population in the Riverina.	Low
Cercartetus nanus	*Eastern Pygmy-possum*	V	-	Inhabits rainforest through to sclerophyll forest and tree heath. Banksias and myrtaceous shrubs and trees are a favoured food source. Will often nest in tree hollows, but can also construct its own nest (Turner, 1995). Because of its small size it is able to utilise a range of hollow sizes including very small hollows (Gibbons, 1997). Individuals will use a number of different hollows and an individual has been recorded using up to 9 nest sites within a 0.5ha area over a 5 month period (Ward, 1990).	None

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Located in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Can also be found on the edges of rainforests and in wet sclerophyll forests. This species roosts in caves and mines in groups of between 3 and 37 individuals. Much of the known distribution is within NSW. Available records suggest that the largest concentrations of populations appear to be in the sandstone escarpments of the Sydney basin and the north-west slopes	Low
Circus assimilis	Spotted Harrier	V	-	Occurs in grassy open woodland including *Acacia* and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn), with young remaining in the nest for several months. Preys on terrestrial mammals (e.g. Bandicoots, Bettongs, and rodents), birds and reptile, occasionally insects and rarely carrion	Low
Climacteris picumnus victoriae	*Brown Treecreeper*	V	-	Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (*Eucalyptus camaldulensis*) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.	Moderate
Daphoenositta chrysoptera	Varied Sittella	V	-	Inhabits wide variety of dry eucalypt forests and woodlands, usually with either shrubby under storey or grassy ground cover or both, in all climatic zones of Australia. Usually in areas with rough-barked trees, such as stringybarks or ironbarks, but also in paperbarks or mature Eucalypts with hollows.	Moderate
Dasyornis brachypterus	Eastern Bristlebird	E	E	Found in coastal woodlands, dense scrub and heathlands, particularly where it borders taller woodlands.	None
Grantiella picta	Painted Honeyeater	V	V	Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus *Amyema*. Insects and nectar from mistletoe or eucalypts are occasionally eaten. Nest from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches	Low
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Spotted-tailed Quoll are found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	None

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood
Falsistrellus tasmaniensis	*Eastern False Pipistrelle*	V	-	Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	Low - moderate
Gallinago hardwickii	Latham's Snipe	-	M	Latham's Snipe is a non-breeding migrant to the south east of Australia including Tasmania, passing through the north and New Guinea on passage. Latham's Snipe breed in Japan and on the east Asian mainland. Seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration.	Low
Glossopsitta pusilla	Little Lorikeet	V	-	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes.	Low-moderate
Heleioporus australiacus	Giant Burrowing Frog	V	V	The Giant Burrowing Frog has been recorded breeding in a range of water bodies associated with more sandy environments of the coast and adjacent ranges from the Sydney Basin south the eastern Victoria. It breeds in hanging swamps, perennial non-flooding creeks and occasionally permanent pools, but permanent water must be present to allow its large tadpoles time to reach metamorphosis.	None
Hieraaetus morphnoides	Little Eagle	V	-	Most abundant in lightly timbered areas with open areas nearby. Often recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. May nest in farmland, woodland and forest in tall trees.	Low
Hirundapus caudacutus	White-throated Needletail	-	M	An aerial species found in feeding concentrations over cities, hilltops and timbered ranges.	Low
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Occurs almost exclusively in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they spend most of the year sheltering in and under rock crevices and exfoliating rock. However, some individuals will migrate to tree hollows to find shelter during hotter parts of summer.	None
Isoodon obesulus	Southern Brown Bandicoot (eastern)	E	-	Prefers sandy soils with scrubby vegetation and-or areas with low ground cover that are burn from time to time. A mosaic of post fire vegetation is important for this species.	None
Lathamus discolor	Swift Parrot	E	E	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood
Litoria aurea	Green and Golden Bell Frog	E	V	Inhabits a very wide range of water bodies including marshes, dams and streams, particularly those containing emergent vegetation such as bullrushes or spikerushes. It also inhabits numerous types of man-made water bodies including quarries and sand extraction sites. Optimum habitat includes water-bodies that are un-shaded, free of predatory fish such as Plague Minnow, have a grassy area nearby and diurnal sheltering sites available.	None
Litoria littlejohni	Littlejohn's Tree Frog	V	V	Occurs in wet and dry sclerophyll forests and heathland associated with sandstone outcrops between 280 and 1000 m on the eastern slopes of the Great Dividing Range from the Central Coast down into Victoria. Individuals have been collected from a wide range of water bodies that includes semi-permanent dams, permanent ponds, temporary pools and permanent streams, with calling occurring from fringing vegetation or on the banks. Individuals have been observed sheltering under rocks on high exposed ridges during summer and within deep leaf litter adjacent to the breeding site. Calling occurs in all months of the year, often in association with heavy rains. The tadpoles are distinctive, being large and very dark in colouration.	None
Litoria raniformis	Southern Bell Frog	V	V	This species is found mostly amongst emergent vegetation (Robinson 1993), including *Typha* sp. (bullrush), *Phragmites* sp. (reeds) and *Eleocharis* sp.(sedges), in or at the edges of still or slow-flowing water bodies such as lagoons, swamps, lakes, ponds and farm dams (NSW DEC 2005a). The Growling Grass Frog can be found floating in warmer waters in temperatures between 18–25°C.	None
Lophoictinia isura	Square-tailed Kite	V	-	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland. Is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage.	Low
Melanodryas cucullata cucullata	*Hooded Robin*	V	-	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.	Low
Melithreptus gularis gularis	*Black-chinned Honeyeater*	V	-	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*) and Forest Red Gum (*E. tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees.	Low
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	Primarily inhabits Cumberland Plain woodland (an EEC). This community is a grassy, open woodland with occasional dense patches of shrubs. Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.	Low-Moderate
Miniopterus australis	Little Bentwing-bat	V	-	Coastal north-eastern NSW and eastern Queensland. Little Bent-wing Bat is an insectivorous bat that roost in caves, in old mines, in tunnels, under bridges, or in similar structures. They breed in large aggregations in a small number of known caves and may travel 100s of km from feeding home ranges to breeding sites. Little Bent-wing Bat has a preference for moist eucalypt forest, rainforest or dense Coastal Banksia Scrub where it forages below the canopy for insects.	Low-moderate

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	Eastern Bent-wing Bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	Low
Mixophyes balbus	Stuttering Frog	E	V	Associated with streams in dry sclerophyll and wet sclerophyll forests and rainforests of more upland areas of the Great Dividing Range of NSW and down into Victoria. Breeding occurs along forest streams with permanent water where eggs are deposited within nests excavated in riffle zones by the females and the tadpoles swim free into the stream when large enough to do so. Outside of breeding, individuals range widely across the forest floor and can be found hundreds of metres from water	Low
Monarcha melanopsis	Black-faced Monarch	-	M	Found along the coast of eastern Australia, becoming less common further south. Inhabits rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating.	Low
Monarcha trivirgatus	Spectacled Monarch	-	M	The Spectacled Monarch prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.	Low
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	Most records are from dry eucalypt forests and woodlands to the east of the Great Dividing Range. Appears to roost in trees, but little is known of this species' habits.	Low-moderate
Motacillia flava	Yellow Wagtail		M	This insectivorous bird inhabits open country near water, such as wet meadows.	Low
Myiagra cyanoleuca	Satin Flycatcher	-	M	The Satin Flycatcher is found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. Found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests.	Low
Myotis macropus	Southern Myotis	V	-	The Large-footed Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage.	Low - moderate
Neophema pulchella	*Turquoise Parrot*	V	-	Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	Low
Ninox connivens	*Barking Owl*	V	-	Generally found in open forests, woodlands, swamp woodlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood
Ninox strenua	Powerful Owl	V	-	Occupies wet and dry eucalypt forests and rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. It is most commonly recorded within red turpentine in tall open forests and black she-oak within open forests. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm.	Low
Pandion haliaetus	Osprey	-	M	Eastern Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging. They frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes	Low
Petalura gigantea	Giant Dragonfly	E	-	Live in permanent swamps and bogs with some free water and open vegetation. Adults emerge from late October and are short-lived, surviving for one summer after emergence. Adults spend most of their time settled on low vegetation on or adjacent to the swamp. They hunt for flying insects over the swamp and along its margins. Adults fly over the swamp and along its margins hunting for flying insects. Males sometimes congregate waiting for females to mate with. Females lay eggs into moss, under other soft ground layer vegetation, and into moist litter and humic soils, often associated with groundwater seepage areas within appropriate swamp and bog habitats. The species does not utilise areas of standing water wetland, although it may utilise suitable boggy areas adjacent to open water wetlands.	None
Petaurus australis	*Yellow-bellied Glider*	V	-	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south.	None
Petaurus norfolcensis	Squirrel Glider	V	-	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.	None
Petroica boodang	Scarlet Robin	V	-	The Scarlet Robin is found from SE Queensland to SE South Australia and also in Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood
Petroica phoenicea	Flame Robin	V	-	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes. In winter, birds migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains).	Low
Pezoporus wallicus	Eastern Ground Parrot	V	-	The Ground Parrot occurs in high rainfall coastal and near coastal low heathlands and sedgelands, generally below one metre in height and very dense (up to 90% projected foliage cover). These habitats provide a high abundance and diversity of food, adequate cover and suitable roosting and nesting opportunities for the Ground Parrot, which spends most of its time on or near the ground. When flushed, birds fly strongly and rapidly for up to several hundred metres, at a metre or less above the ground.	Low
Phascolarctos cinereus	Koala	V	V	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall.	Low
Phoniscus papuensis	Golden-tipped Bat	V	-	Found in rainforest and adjacent wet and dry sclerophyll forest up to 1000m. Also recorded in tall open forest, Casuarina-dominated riparian forest and coastal Melaleuca forests. Bats will fly up to two kilometres from roosts to forage in rainforest and sclerophyll forest on mid and upper-slopes. Roost mainly in rainforest gullies on small first- and second-order streams in usually abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests modified with an access hole on the underside. Bats may also roost under thick moss on tree trunks, in tree hollows, dense foliage and epiphytes. Bats will use multiple roost and change roosts regularly	Low
Potorous tridactylus	Long-nosed Potoroo	V	-	Inhabits coastal heath and wet and dry sclerophyll forests. Generally found in areas with rainfall greater than 760 mm. Requires relatively thick ground cover where the soil is light and sandy.	None
Pommerhelix duralensis	Diurnal Woodland Snail		E	The species has a strong affinity for communities in the interface region between shale-derived and sandstone-derived soils, with forested habitats that have good native cover and woody debris. It favours sheltering under rocks or inside curled-up bark. It does not burrow nor climb. The species has also been observed resting in exposed areas, such as on exposed rock or leaf litter, however it will also shelter beneath leaves, rocks and light woody debris.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood
Pseudomys novaehollandiae	New Holland Mouse	-	V	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.	Low
Pseudophryne australis	*Red-crowned Toadlet*	V	-	Red-crowned Toadlets are quite a localised species that appear to be largely restricted to the immediate vicinity of suitable breeding habitat. Red-crowned Toadlets are usually found as small colonies scattered along ridges coinciding with the positions of suitable refuges near breeding sites. Due to this tendency for discrete populations to concentrate at particular sites, a relatively small localised disturbance may have a significant impact on a local population if it occurs on a favoured breeding or refuge site. Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones.	Low
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km.	Low
Pyrrholaemus saggitatus	*Speckled Warbler*	V	-	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area.	Low
Rhipidura rufifrons	Rufous Fantail	-	M	Migratory species that prefers dense, moist undergrowth of tropical rainforests and scrubs. During migration it can stray into gardens and more open areas	Low
Rostratula australis	Australian Painted Snipe	E	E, M	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	Low
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Breeding has been recorded from December to mid-March, when a single young is born.	Low - moderate
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Prefer moist gullies in mature coastal forests and rainforests, between the Great Dividing Range and the coast. They are only found at low altitudes below 500 m. In dense environments they utilise natural and human-made opening in the forest for flight paths. Creeks and small rivers are favoured foraging habitat. This species roosts in hollow tree trunks and branches.	Low

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Likelihood
Stagonopleura guttata	Diamond Firetail	V	-	Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Eucalyptus pauciflora Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.	Low
Tringa nebularia	Common Greenshank	V	-	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Breeding has been recorded from December to mid-March, when a single young is born.	Low
Tyto novaehollandiae	*Masked Owl*	V	-	Pairs have a large home-range of 500 to 1000 ha. Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	Low
Varanus rosenbergi	*Rosenberg's Goanna*	V	-	Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component.	Low

Key: CE = Critically Endangered; E, E1 = Endangered; EP = Endangered Population; V = Vulnerable; M = Migratory.

Note: Fauna that are exclusively dependant on marine environments, including near shore environments, were not included in the assessment due to lack of suitable habitat. Habitat descriptions taken from the relevant profiles on the OEH Threatened Species website unless otherwise stated.

Appendix 2. Flora recorded during field survey

Family	Species	Common Name	Introduced species *
Adiantaceae	*Cheilanthes sieberi*	Rock Fern	
Apocynaceae	*Araujia hortorum*		*
Asparagaceae	*Asparagus asparagoides*	Bridal Creeper	*
Asteraceae	*Ageratina riparia*	Mistflower	*
Asteraceae	*Bidens pilosa*	Cobbler's Pegs	*
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	*
Asteraceae	*Hypochaeris radicata*	Catsear	*
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood	
Asteraceae	*Senecio madagascariensis*	Fireweed	*
Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell	
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak	
Chenopodiaceae	*Einadia nutans*	Climbing Saltbush	
Convolvulaceae	*Dichondra repens*	Kidney Weed	
Convolvulaceae	*Polymeria calycina*		
Cyperaceae	*Carex inversa*	Knob Sedge	
Ericaceae	*Lissanthe strigosa*	Peach Heath	
Fabaceae (Faboideae)	*Glycine tabacina*	Variable Glycine	
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla	
Fabaceae (Faboideae)	*Indigofera australis*	Australian Indigo	
Fabaceae (Faboideae)	*Jacksonia scoparia*	Dogwood	
Fabaceae (Mimosoideae)	*Acacia parramattensis*	Parramatta Wattle	
Geraniaceae	*Geranium solanderi*	Native Geranium	
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	*
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark	
Myrtaceae	*Eucalyptus moluccana*	Grey Box	
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	
Myrtaceae	*Kunzea ambigua*	Tick Bush	
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree	
Oxalidaceae	*Oxalis perennans*		
Phormiaceae	*Dianella caerulea*	Blue Flax-lily	
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn	
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	*
Poaceae	*Aristida ramosa*	Purple Wiregrass	
Poaceae	*Austrodanthonia spp.*	A Wallaby Grass	
Poaceae	*Austrostipa scabra*	Speargrass	
Poaceae	*Briza minor*	Shivery Grass	*
Poaceae	*Chloris gayana*	Rhodes Grass	*
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass	

Family	Species	Common Name	Introduced species *
Poaceae	*Cynodon dactylon*	Common Couch	
Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog-grass	
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	*
Poaceae	*Eragrostis brownii*	Brown's Lovegrass	
Poaceae	*Eragrostis curvula*	African Lovegrass	*
Poaceae	*Lolium perenne*	Perennial Ryegrass	*
Poaceae	*Microlaena stipoides*	Weeping Grass	
Poaceae	*Paspalum dilatatum*	Paspalum	*
Poaceae	*Pennisetum clandestinum*	Kikuyu Grass	*
Poaceae	*Setaria gracilis*	Slender Pigeon Grass	*
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass	
Poaceae	*Themeda australis*	Kangaroo Grass	
Ranunculaceae	*Clematis aristata*	Old Man's Beard	
Rosaceae	*Rubus fruticosus*	Blackberry complex	*
Verbenaceae	*Lantana camara*	Lantana	*
Verbenaceae	*Verbena bonariensis*	Purpletop	*

Appendix 3. Hollow-bearing tree locations

Waypoint name	Latitude	Longitude
159	-34.1989	150.7513
160	-34.2008	150.752
161	-34.202	150.7522
162	-34.203	150.7524
163	-34.2016	150.7521
164	-34.204	150.7526
165	-34.2067	150.7551

Appendix 4. Assessments of Significance

Assessments of significance (Seven Part Tests) have been conducted below for the following items of threatened biodiversity under the TSC Act:

- Cumberland Plain Woodland
- Cumberland Plain Land Snail
- Hollow dependent species: Eastern False Pipistrelle, Little Lorikeet, Little Bentwing-bat, Eastern Freetail-bat, Southern Myotis, and Yellow-bellied Sheathtail-bat

Note: Unless otherwise stated – the habitat and general ecological information contained in these assessments of significance has been taken from the NSW Office of Environment and Heritage (OEH) Threatened Species Profiles database (DECC 2005) and/or the Commonwealth SPRAT database (SEWPAC 2012):

http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/

http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Definitions

The following definitions are taken from the OEH *Threatened Species Assessment Guidelines: The Assessment of Significance* (DECC 2007) and have been adopted for this assessment.

Subject site: the area to be directly affected by the proposed development.

Project Area: the subject site and any additional areas which may potentially be affected by the proposed development either directly or indirectly.

Direct impacts: those that directly affect the habitat and/or individual plants and animals and cannot be avoided or mitigated.

Indirect impacts: those that affect species, populations or ecological communities in a manner other than through direct loss or disturbance. These can usually be avoided or mitigated.

Local population: the population of a particular species that occurs in the locality.

Locality: the area within 10 km of the study area.

Cumberland Plain Woodland (CPW)	
Description	Cumberland Plain Woodland (CPW) is listed as a critically endangered ecological community under Part 3 of Schedule 1 of the TSC Act.
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	n/a
b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	n/a
c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction	**Extent and composition** Approximately 162.9 ha of CPW exists within 10 kilometres of the study area [NPWS 2002]. This is considered to be the local occurrence of CPW in this instance. Of this local occurrence, approximately 0.45 ha may be removed by the proposal (<1 per cent of the local occurrence). This is likely an over estimate of the impact given the CPW in the study area is a combination of remnant regrowth mixed with areas dominated by introduced species adjacent to an existing road corridor. Mitigation measures as described in Section 5 are likely to ameliorate the effect of indirect impacts and therefore not substantially alter the composition of CPW within the locality. The CPW in the study area has been subjected to historic clearing and modification. The CPW was fragmented as a result of previous clearing for the road corridor. Apart from the area of direct clearing, the proposal is unlikely to result further modify the current condition of CPW at the site. **Assessment** Therefore, the action proposed is considered unlikely to have an adverse effect on either the extent or composition of CPW such that its local occurrence is placed at risk of extinction as: • Less than one percent of CPW in the locality may be impacted by the proposal. • The area of CPW to be impacted is fragmented, affected by weeds and does not have all stratum intact. • The area to be impacted is likely an overestimate.

Cumberland Plain Woodland (CPW)	
d) In relation to the habitat of a threatened species, population or ecological community: i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.	**Extent of impact on habitat** Approximately 162.9 ha of CPW exists within 10 kilometres of the study area [NPWS 2002]. This is considered to be the local occurrence of CPW in this instance. Of this local occurrence, approximately 0.45 ha may be removed by the proposal (<1 per cent of the local occurrence). It should be noted that this is likely an over estimate of the impact given the CPW in the study area is a combination of remnant regrowth and extensive plantings. **Habitat fragmentation** The area that may be impacted by the proposal is currently fragmented from other patches of CPW due to previous land clearing. The area that may be impacted consists of CPW within a regenerating condition along the existing road corridor. Some isolated juvenile eucalyptus may require removal. **Importance of habitat to be impacted** The proposal is likely to have a very minor impact on the extent of CPW within the locality as it will remove fragmented patches along an existing road corridor. Further, the proposal will not exacerbate existing fragmentation of the TEC within the locality. Therefore, the habitat potentially affected by the proposal is likely to be of little or no importance to the long-term survival of the TEC within the locality.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	Critical habitat declarations in NSW include: • Gould's Petrel - critical habitat declaration; • Little penguin population in Sydney's North Harbour; • Mitchell's Rainforest Snail in Stotts Island Nature Reserve; and • Wollemi Pine. None of these areas of critical habitat will be affected by the proposal.
f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan	An approved recovery plan exists for CPW as part of the recovery plan for the Cumberland Plain. The main recovery objectives of this recovery plan include: • To build a protected area network, comprising public and private lands, focused on the priority conservation lands • To deliver best practice management for threatened biodiversity across the Cumberland Plain, with a specific focus on the priority conservation lands and public lands where the priority management objectives are compatible with biodiversity conservation • To develop and understanding and enhanced awareness in the community of the Cumberland Plain's threatened biodiversity, the best practice standards for its management and the recovery program • To increase knowledge of the threats to the survival of the Cumberland Plain's threatened biodiversity, and thereby improve capacity to manage these in a strategic and effective manner. The proposal is not likely to interfere with the recovery of CPW, given the impact is quite small and likely an over estimate.

Cumberland Plain Woodland (CPW)	
g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	KTPs that are likely to be exacerbated by the proposed development include: 1. Clearing of native vegetation 2. Invasion and establishment of exotic vines and scramblers – currently operating however likely to be managed via Penrith City Council Bushland Restoration works in the area. 3. Invasion, establishment and spread of *Lantana* – as above. 4. Invasion of native plant communities by exotic perennial grasses – as above.
Conclusion	The local occurrence of CPW is unlikely to be significantly affected by the proposal as: • Impact on extent and composition of local occurrence will be minor (conclusion from C above); • No important habitat will be affected (conclusion from D above); • Consistency with recovery plan (conclusion from F above).

Cumberland Plain Land Snail	
Description	Cumberland Plain Land Snail is listed as endangered under Part 3 of Schedule 1 of the TSC Act.
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	The Cumberland Plain Land Snail was not recorded during the field survey. Some potential habitat occurs within the study area given the presence of CPW. The following is known about the species: • Primarily inhabits Cumberland Plain Woodland. It is also known from Shale Gravel Transition Forests, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest, which are also listed communities. • Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish. • Can dig several centimetres into soil to escape drought. • Is a fungus specialist. Unlike the Garden Snail, does not eat green plants. It is generally active at night. • Little is known of its biology, including breeding biology. It is known to be hermaphroditic, laying clutches of 20-25 small, round, white eggs in moist, dark areas (such as under logs), with the eggs taking 2-3 weeks to hatch. There is a suggestion that the species breeds throughout the year when conditions are suitable. Given the minor scale of clearing along an existing managed road edge that may occur as a result of the proposal (0.45 ha), some potential habitat may be impacted. However, the species was not recorded in the study area, despite targeted surveyed underneath the bases of large eucalypts which occurred immediate toward east of the study area and along the edge of the study area. Given this, along with the relatively minor scale of clearing it is unlikely that the life cycle of the species would be impacted by the proposal.
b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	n/a

Cumberland Plain Land Snail	
c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction	N/A
d) In relation to the habitat of a threatened species, population or ecological community: i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.	**Extent of impact on habitat** Approximately 837.4 ha of potential habitat occurs within 10 kilometres of the study area (CPW, RFEF, Shale Sandstone Transition Forest (Low Sandstone Influence), Shale Hills Woodland, Shale Plains Woodland, Riparian Forest, Moist Shale Woodland, Shale Sandstone Transition Forest (High Sandstone Influence) [NPWS 2002]. This is considered to be the local occurrence of habitat in this instance. Of this local occurrence, approximately 0.45 ha may be removed by the proposal (<0.04 per cent of the local occurrence). **Habitat fragmentation** The area that may be impacted by the proposal is currently fragmented from other patches of habitat due to previous land clearing and its position adjacent to an existing road. **Importance of habitat to be impacted** The proposal is likely to have a very minor impact on the extent of habitat within the locality as it will remove a fragmented and isolated patches which lack mature eucalypts, log and woody debris which the species tends to prefer. Further, the proposal will not exacerbate existing fragmentation of habitat within the locality. Therefore, the habitat potentially affected by the proposal is likely to be of little or no importance to the long-term survival of the species within the locality.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	Critical habitat declarations in NSW include: • Gould's Petrel - critical habitat declaration; • Little penguin population in Sydney's North Harbour; • Mitchell's Rainforest Snail in Stotts Island Nature Reserve; and • Wollemi Pine. None of these areas of critical habitat will be affected by the proposal.

Cumberland Plain Land Snail	
f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan	No approved recovery plan exists for the species.
g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	KTPs that are likely to be exacerbated by the proposed development include: 1. Clearing of native vegetation 2. Invasion and establishment of exotic vines and scramblers – currently operating however likely to be managed via Penrith City Council Bushland Restoration works in the area. 3. Invasion, establishment and spread of *Lantana* – as above. 4. Invasion of native plant communities by exotic perennial grasses – as above.
Conclusion	The Cumberland Plain Land Snail is unlikely to be significantly affected by the proposal as: • The species was not recorded in the study area. • The species has not been previously recorded in the study area. • Impact on extent and composition of local occurrence of habitat will be minor (conclusion from C above); • No important habitat will be affected (conclusion from D above); • Fragmentation of habitat is minor.

Hollow dependent species: Eastern False Pipistrelle, Little Lorikeet, Little Bentwing-bat, Eastern Freetail-bat, Southern Myotis, and Yellow-bellied Sheathtail-bat	
Description	Hollow dependent species: Eastern False Pipistrelle, Little Lorikeet, Little Bentwing-bat, Eastern Freetail-bat, Southern Myotis, and Yellow-bellied Sheathtail-bat may be impacted by the removal of up to three hollow bearing trees which occur within an existing paddock.
a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	The following is known about the species: Eastern False Pipistrelle • Prefers moist habitats, with trees taller than 20 m. • Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. • Hunts beetles, moths, weevils and other flying insects above or just below the tree canopy. • Hibernates in winter. • Females are pregnant in late spring to early summer. Little Bentwing-bat • Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. • Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. • They often share roosting sites with the Common Bentwing-bat and, in winter, the two species may form mixed clusters. • In NSW the largest maternity colony is in close association with a large maternity colony of Eastern Bentwing-bats (Miniopterus schreibersii) and appears to depend on the large colony to provide the high temperatures needed to rear its young. • Maternity colonies form in spring and birthing occurs in early summer. Males and juveniles disperse in summer. • Only five nursery sites /maternity colonies are known in Australia. Southern Myotis • Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage. • Forage over streams and pools catching insects and small fish by raking their feet across the water surface. • In NSW females have one young each year usually in November or December. Eastern Freetail-bat • Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. • Roost mainly in tree hollows but will also roost under bark or in man-made structures. • Usually solitary but also recorded roosting communally, probably insectivorous. Yellow-bellied Sheathtail bat • Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. • When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. • Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. • Breeding has been recorded from December to mid-March, when a single young is born.

Hollow dependent species: Eastern False Pipistrelle, Little Lorikeet, Little Bentwing-bat, Eastern Freetail-bat, Southern Myotis, and Yellow-bellied Sheathtail-bat	
	• Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and autumn. Little Lorikeet • Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. • Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species. • Feeds mostly on nectar and pollen, occasionally on native fruits such as mistletoe, and only rarely in orchards • Gregarious, travelling and feeding in small flocks (<10), though often with other lorikeets. Flocks numbering hundreds are still occasionally observed and may have been the norm in past centuries. • Roosts in treetops, often distant from feeding areas. • Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked Eucalypts. Entrance is small (3 cm) and usually high above the ground (2–15 m). These nest sites are often used repeatedly for decades, suggesting that preferred sites are limited. Riparian trees often chosen, including species like Allocasuarina. • Nesting season extends from May to September. In years when flowering is prolific, Little Lorikeet pairs can breed twice, producing 3-4 young per attempt. However, the survival rate of fledglings is unknown Given the relatively minor scale of clearing that may occur as a result of the proposal (0.45 ha), some potential habitat may be impacted. Furthermore, the removal of up to three hollow-bearing tree may provide habitat for the species. Vegetation clearing protocols have been put in place to safeguard against potential harm to the species should they occupy the hollow.
b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	n/a
c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: iii. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or iv. Is likely to substantially and adversely modify the composition of	N/A

Hollow dependent species: Eastern False Pipistrelle, Little Lorikeet, Little Bentwing-bat, Eastern Freetail-bat, Southern Myotis, and Yellow-bellied Sheathtail-bat	
the ecological community such that its local occurrence is likely to be placed at risk of extinction	
d) In relation to the habitat of a threatened species, population or ecological community: i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.	**Extent of impact on habitat** Approximately 897.0 ha of potential foraging habitat occurs within 10 kilometres of the study area (Shale Sandstone Transition Forest, Shale Plains Woodland, Alluvial Woodland, Moist Shale Woodland, Sandstone Ridgetop Woodland, Upper Georges River Sandstone Woodland, Western Sandstone Gully Forest, and Shale Hills Woodland [NPWS 2002]. This is considered to be the local occurrence of habitat in this instance. Of this local occurrence, approximately 0.62 ha of foraging habitat may be removed by the proposal (<0.04 per cent of the local occurrence). Three hollow-bearing tree may be removed for the Project. **Habitat fragmentation** The area that may be impacted by the proposal is currently fragmented from other patches of native vegetation due to previous land clearing and its location within a managed road easement. Much of the habitat to be impacted either consists of areas of regenerating native vegetation. Three hollow-bearing trees may be removed for the Project. The tree hollow-bearing trees occur within an open paddock area which has been fragmented through historic clearing. **Importance of habitat to be impacted** The proposal is likely to have a very minor impact on the extent of habitat within the locality as it will remove fragmented and isolated patches of foraging habitat and possibly up to three hollow bearing trees. The removal of foraging habitat is unlikely to significantly impact the species. The removal of three hollow bearing trees may be of importance should the species only occupy the one tree, however, this scenario is unlikely given all these species are relatively mobile, and may occupy other hollow trees in the locality (and drainage pipes, buildings etc. in the case of some microbats) not impact by the proposal.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	Critical habitat declarations in NSW include: • Gould's Petrel - critical habitat declaration; • Little penguin population in Sydney's North Harbour; • Mitchell's Rainforest Snail in Stotts Island Nature Reserve; and • Wollemi Pine. None of these areas of critical habitat will be affected by the proposal.
f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan	No approved recovery plan exists for the species.
g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	KTPs that are likely to be exacerbated by the proposed development include: 1. Clearing of native vegetation 2. Invasion and establishment of exotic vines and scramblers – currently operating however likely to be managed via Penrith City Council Bushland Restoration works in the area. 3. Removal of hollow-bearing trees.

Hollow dependent species: Eastern False Pipistrelle, Little Lorikeet, Little Bentwing-bat, Eastern Freetail-bat, Southern Myotis, and Yellow-bellied Sheathtail-bat	
	4. Invasion, establishment and spread of *Lantana* – as above. 5. Invasion of native plant communities by exotic perennial grasses – as above.
Conclusion	The Eastern False Pipistrelle, Little Lorikeet, Little Bentwing-bat, Eastern Freetail-bat, Southern Myotis, and Yellow-bellied Sheathtail-bat is unlikely to be significantly affected by the proposal as: • The species was not recorded in the study area. • The species has not been previously recorded in the study area. • Impact on extent and composition of local occurrence of habitat will be minor (conclusion from C above); • No important habitat will be affected (conclusion from D above); • Fragmentation of habitat is minor.

EPBC ACT Significant Impact Criteria

Significant Impact Criteria assessments been conducted below for the following items of threatened biodiversity under the EPBC Act:

Cumberland Plain Woodland

Note: Unless otherwise stated – the habitat and general ecological information contained in these assessments has been taken from the NSW Office of Environment and Heritage (OEH) Threatened Species Profiles database (DECC 2008) and/or the Commonwealth SPRAT database (SEWPaC 2012):

http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/

http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Definitions

'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

Cumberland Plain Woodland	
Critically Endangered Ecological Community	**Significant Assessment Criteria**
Background	The proposal may involve the removal of approximately 0.45 ha of Cumberland Plain Woodland (CPW) as a result of clearing required for the proposal.
An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:	
Reduce the extent of an ecological community	Approximately 162.9 ha of CPW exists within 10 kilometres of the study area [NPWS 2002]. This is considered to be the local occurrence of CPW in this instance. Of this local occurrence, approximately 0.45 ha may be removed by the proposal (<1 per cent of the local occurrence). It should be noted that this is likely an over estimate of the impact given the CPW in the study area is a combination of remnant regrowth and disturbed areas.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	The area that may be impacted by the proposal is currently fragmented from other patches of CPW due to previous land clearing. The area that may be impacted consists of a row regenerating CPW in varying condition along a road easement.
Adversely affect habitat critical to the survival of an ecological community	Cumberland Plain Woodland is included in the Cumberland Plain Recovery Plan (DECC 2010), which identifies Priority Conservation Lands considered to contain habitat critical to the survival of threatened biodiversity listed under the Plan (including CPW). The study area is not identified as a Priority Conservation Land in the Recovery Plan. No critical habitat has been declared under the Act that is relevant to the study area.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	The proposal may involve the clearing of approximately 0.45 ha of CPW and therefore destroy some abiotic factors necessary for the EEC survival within the impact footprint. However, the component of CPW that would not be impacted by the proposal that would remain in the locality (approximately 162.9 ha) is considered viable. Therefore the proposal is not likely to adversely affect all abiotic factors critical to the survival of the broader community in the locality.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	The proposal may result in the clearing of approximately 0.2 ha of CPW, largely consisting of just overstorey species with introduced ground cover. As stated above, the proportion of the community within the locality not impacted directly by the proposal would remain viable. The proposal is not likely to cause changes in the TEC in the broader locality that would lead to the decline or loss of functionally important species.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to; assisting invasive species, that are harmful to the listed ecological community, to become established, or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or	The proposal may result in the reduction of CPW within the study area through the clearing of approximately 0.45 ha of the lowest quality vegetation on site. The proposal is not likely to exacerbate the existing weed invasion occurring within adjoining areas of native vegetation, given that the vegetation is currently being impacted by existing land uses such sporting fields. The proposed development is not likely to increase the mobilisation of fertilisers, herbicides or other chemicals or pollutants into the TEC which would impact on the species occurring in the TEC. All chemicals used as part of the proposal would remain on site and be contained according to best practice.
Interfere with the recovery of an ecological community.	An approved recovery plan exists for CPW as part of the recovery plan for the Cumberland Plain (DECCW 2010). The main recovery objectives of this recovery plan include (DECCW 2010): • To build a protected area network, comprising public and private lands, focused on the priority conservation lands • To deliver best practice management for threatened biodiversity across the Cumberland Plain, with a specific focus on the priority conservation lands and

	public lands where the priority management objectives are compatible with biodiversity conservation • To develop and understanding and enhanced awareness in the community of the Cumberland Plain's threatened biodiversity, the best practice standards for its management and the recovery program • To increase knowledge of the threats to the survival of the Cumberland Plain's threatened biodiversity, and thereby improve capacity to manage these in a strategic and effective manner. The proposal is not likely to interfere with the recovery of CPW given the very minor potential impact.

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Annex 4 Cultural Heritage Assessment

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Environment and Heritage

Bulli Seam Operations

Mine Safety Gas Management Project

Aboriginal Cultural Heritage Assessment

Prepared for Prepared for South 32 Illawarra Coal

June 2016

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Locations

Sydney
Central Coast
Illawarra
Armidale
Newcastle
Mudgee
Port Macquarie
Brisbane
Cairns

Cover photograph: Survey of the Subject Area (Niche 2016)

Glossary and abbreviations

Term	Definition
Aboriginal cultural heritage	The tangible (objects) and intangible (dreaming stories, legends and places) cultural practices and traditions associated with past and present day Aboriginal communities.
ACHA	Aboriginal Cultural Heritage Assessment
Aboriginal object(s)	The legal definition for material Aboriginal cultural heritage under the NSW *National Parks and Wildlife Act 1974.*
Aboriginal stakeholders	Members of a local Aboriginal land council, registered holders of Native Title, Aboriginal groups or other Aboriginal people who may have an interest in the Project.
Archaeology	The scientific study of human history, particularly the relics and cultural remains of the distant past.
Archaeological deposit	A layer of soil material containing archaeological remains.
Archaeological investigation	The process of assessing the archaeological potential of an impact area by a qualified archaeologist.
Archaeological site	A site with material evidence of past Aboriginal or non-Aboriginal activity in which material evidence (artefacts) of past activity is preserved.
Artefact	An object made by human agency (e.g. stone artefacts).
Assemblage	A group of stone artefacts found in close association with one another. Any group of items designated for analysis – without any assumptions of chronological or spatial relatedness.
Avoidance	A management strategy which protects Aboriginal sites within an impact area by avoiding them totally in development.
BSOP	Bulli Seams Operation Project
Catchment	The area from which a surface watercourse or a groundwater system derives its water.
Code of Practice	*Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales*
Cumulative impacts	Combination of individual effects of the same kind due to multiple actions from various sources over time.
DECCW	The Department of Conservation, Climate Change and Water, now the Office of Environment and Heritage
Development	The operations involved in preparing a mine for extraction, including cutting roadways and headings. Also includes tunnelling, sinking, crosscutting, drifting, and raising.
Drainage	Natural or artificial means for the interception and removal of surface or subsurface water.
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
Exploration	The work done to prove or establish the extent of a mineral resource.
Flake	A piece of stone detached from a core, displaying a bulb of percussion and striking platform.
Harm	With regard to Aboriginal objects this has the same meaning as the NSW *National Parks and Wildlife Act 1974*.
HMP	Heritage Management Plan
Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment.
Impact area	An area that requires archaeological investigation and management assessment.
In situ	Latin words meaning ‘on the spot, undisturbed’.
Isolated artefact / find	A single artefact found in an isolated context.

Term	Definition
Landscape character	The aggregate of built, natural and cultural aspects that make up an area and provide a sense of place. Includes all aspects of a tract of land – built, planted and natural topographical and ecological features.
Land unit	An area of common landform, and frequently with common geology, soils and vegetation types, occurring repeatedly at similar points in the landscape over a defined region. It is a constituent part of a land system.
Landform	Any one of the various features that make up the surface of the earth.
LEP	Local Environmental Plan
Management plans	Conservation plans which identify short and long term management strategies for all known sites recorded within a (usually approved) Study area.
Methodology	The procedures used to undertake an archaeological investigation.
Mitigation	To address the problem of conflict between land use and site conservation.
NPW Act	National Parks and Wildlife Act 1974
NPW Regulation	National Parks and Wildlife Regulation 2009
OEH	Office of Environment and Heritage
Open camp site	An archaeological site situated within an open space (e.g. archaeological material located on a creek bank, in a forest, on a hill, etc.).
PAD	Potential archaeological deposit. A location considered to have a potential for subsurface archaeological material.
Site recording	The systematic process of collecting archaeological data for an archaeological investigation.
Site	A place where past human activity is identifiable.
Survey coverage	A graphic and statistical representation of how much of an impact area was actually surveyed and therefore assessed.

Executive summary

This report presents an Aboriginal Cultural Heritage Assessment for the installation and operation of proposed gas drainage infrastructure within South32 Illawarra Coal's Bulli Seam Operations, which are located approximately 25km northwest of Wollongong between the areas of Douglas Park and Appin in the Southern Coalfields of NSW. The Bulli Seam Operations Project (BSOP) was approved by the Planning Assessment Commission in 2011 under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). To continue underground mining, South 32 Illawarra Coal (Illawarra Coal) now propose to optimise the pre-mining extraction and utilisation of methane gas from the mine, as a means to support the safe and efficient extraction of coal. This would result in considerable benefits in terms of power generation and reduction in greenhouse gas emissions. The construction and use of future gas drainage infrastructure was not included in the existing BSOP Approval. Therefore, a s75W modification to the BSOP Approval is now required.

No Aboriginal objects, or landscape features with the potential for subsurface archaeological deposits, were identified during the assessment. South 32 Illawarra Coal can proceed with the proposed works without any further archaeological assessment.

Recommendations:

Should any Aboriginal objects be unexpectedly uncovered during the works, all activity must stop and further investigation must be carried out by a qualified archaeologist in consultation with the relevant Aboriginal stakeholders.

Should suspected human skeletal remains be uncovered by the proposed drilling, works must stop immediately and the NSW Police and OEH contacted for further analysis.

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1. Introduction

1.1 Project Background

The Bulli Seams Operation is an ongoing mining operation at the Appin-West Cliff Mining Complex, located in the Southern Coalfield of New South Wales, approximately 25km northwest of Wollongong. As part of the Environmental Assessment process for the Bulli Seams Operation Project (BSOP), an Aboriginal Cultural Heritage Assessment (ACHA) was prepared by Biosis Research in 2009. The BSOP was granted approval under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP& A Act) on 22 December 2011. Subsequently, a Heritage Management Plan (HMP) was implemented to manage Aboriginal heritage values within the Subject Area (Biosis Research 2012).

South 32 Illawarra Coal (Illawarra Coal) propose to continue underground mining at their Bulli Seam Operations. In order to do so, they propose optimising the pre-mining extraction and utilisation of methane gas from the mine, as a means to support the safe and efficient extraction of coal in the Bulli Seam Operations. This would involve the construction and operation of gas drainage infrastructure and result in considerable benefits in terms of power generation and reduction in greenhouse gas emissions. The proposed activities are hereafter referred to as the Mine Safety Gas Management Project (MSGMP).

The MSGMP requires a Section 75W modification to the existing BSOP Approval.

Niche Environment and Heritage Pty Ltd (Niche) has been commissioned by Illawarra Coal to prepare an ACHA to inform the Environmental Assessment of the MSGMP.

1.2 Location

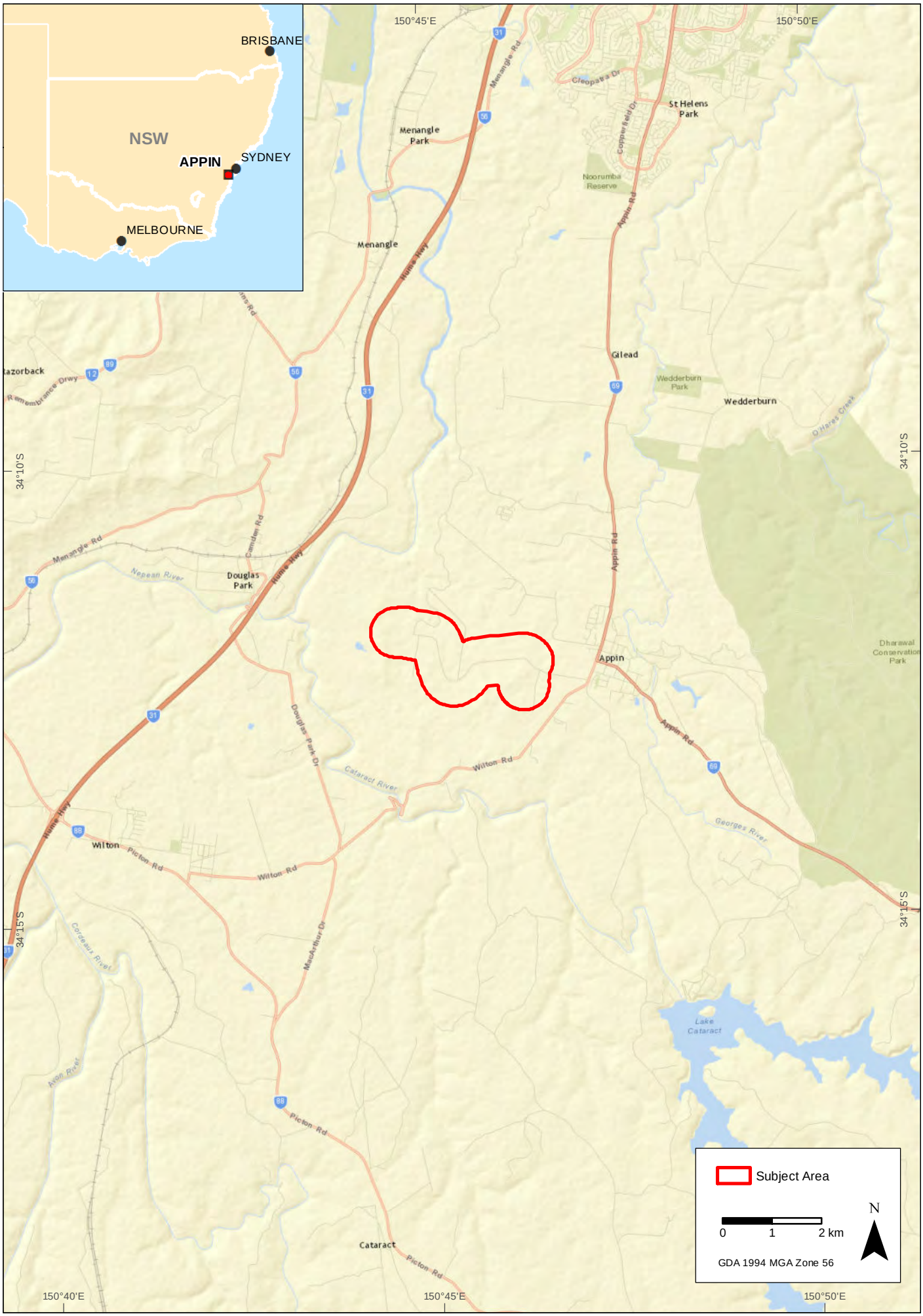
The Bulli Seam Operations are located in the Southern Coalfield of New South Wales, approximately 25km northwest of Wollongong in the vicinity of the Appin, Wilton, Douglas Park, Picton and Menangle townships (Figure 1). The proposed MSGMP works are located within the Appin mining operations, between the townships of Appin and Douglas Park, within the vicinity of Brooks Point Road. For this ACHA, the Subject Area is defined as the disturbance footprint of the proposed gas drainage pipeline that extends along Brooks Point Road between Appin No. 3 Shaft and the existing gas infrastructure and power generation facilitates located at the Appin No. 2 Shaft site (Figure 2).

1.3 Scope

The following ACHA report has been prepared with reference to the following standards, guidelines and policies:

- *Due diligence code of practice for the protection of Aboriginal objects in NSW*
- *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (NSW Department of Environment, Climate Change and Water [DECCW] 2010a) (the Code of Practice).
- *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (NSW Office of Environment and Heritage [OEH] 2011).

The only notable departure from the current regulatory guidance documents will be with regards to Aboriginal community consultation. In this case the BSOP has a well-established and well-functioning protocol in place under the existing Heritage Management Plan, which means consultation in accordance with the OEH *Aboriginal community consultation requirements for proponents* was not considered appropriate (Biosis Research 2012).



Drawn by: RJ Project Manager: CMcE Project Number: 2522 Date: 16/06/2016

Subject Area

Aboriginal Cultural Heritage Assessment, Appin East Mine Safety Gas Management Project - s75 Modification

FIGURE 1

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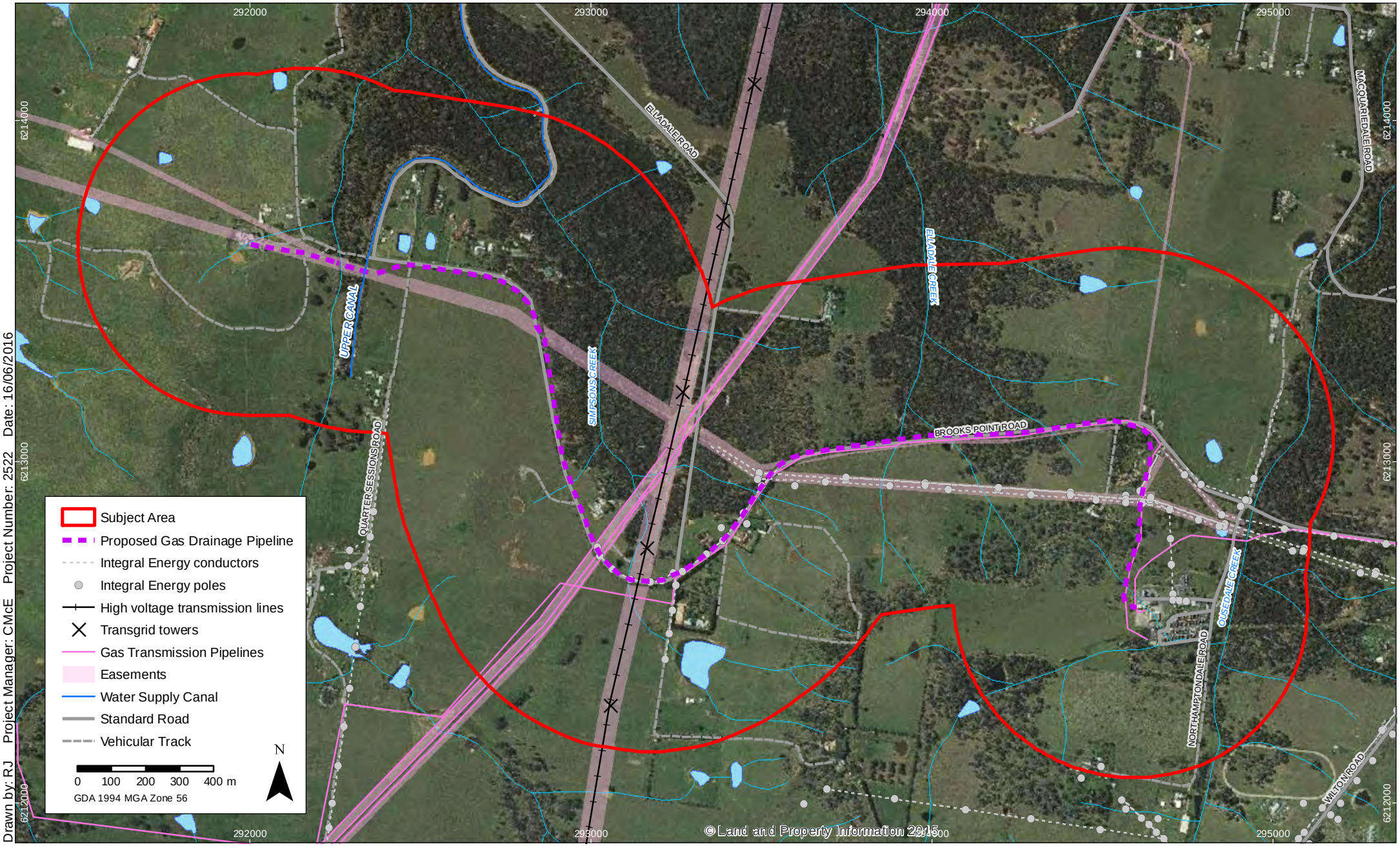

Drawn by: RJ Project Manager: CMcE Project Number: 2522 Date: 16/06/2016

Subject Area

Aboriginal Cultural Heritage Assessment, Appin East Mine Safety Gas Management Project - s75 Modification

FIGURE 2

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2. Investigators and contributors

This investigation was conducted by Renée Regal (Senior Heritage Consultant; Niche). This report was written by Renée Regal and Clare Anderson (Senior Heritage Consultant's; Niche) and was reviewed by Balazs Hansel (Senior Archaeologist, Niche) and Fiona Leslie (Principal Archaeologist, Niche). Table 1 provides a list of all investigators and contributors for the Aboriginal heritage survey component of the assessment

Table 1: Investigators and contributors to the Aboriginal heritage survey

Participant	Organisation
Aleisha Buckler	Niche
Luke Baker	Niche
Renée Regal	Niche
Chris McEvoy	Niche
James Davis	Wodi Wodi Traditional Owner
Ali Maher	National Koori Site Management
Paul Cummins	Woronora Plateau Gundungara Elders Corporation
Danny Franks	Tocomwall Pty Ltd
Graeme Dobson	Ngunawal Heritage Aboriginal Corporation
Duncan Falk	Peter Falk Consultancy

3. Statutory framework

3.1 The NSW Environmental Planning & Assessment Act 1979

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) establishes the framework for cultural heritage values to be formally assessed in the land use planning and development consent process and requires that environmental impacts are considered prior to land development; this includes impacts on heritage items. The Act also requires that local governments prepare planning instruments (such as Local Environmental Plans) in accordance with the principles of the legislation to provide guidance on the level of environmental assessment required. Statutory environmental planning instruments made under Part 3 of the EP&A Act that guide development and land use include State Environmental Planning Policies (SEPPs) and Local Environmental Plans (LEPs).

The existing BSOP was approved as a Major Project (08_0150) under the now repealed Part 3A of the NSW EP&A Act. The proposed activity requires modification to the existing approval through Section 75W.

Where development consent is granted through Part 3A / Section 75W, certain parts of the *National Parks and Wildlife Act 1974* (NPW Act) are switched off. However some aspects of the NPW Act 1974 and *National Parks and Wildlife Regulation 2009* (NPW Regulation) may still be applicable.

The Aboriginal community consultation process for this assessment was carried out in accordance with BSOP HMP Section 5 (Biosis 2012) which outlines what is required for community consultation in regards to amendments to the BSOP approval.

3.2 The National Parks and Wildlife Act 1974 (NSW)

The NPW Act, administered by OEH, provides statutory protection for Aboriginal objects by making it illegal to harm Aboriginal objects and Aboriginal places, by providing two tiers of offence against which individuals or corporations who harm Aboriginal objects or Aboriginal places can be prosecuted. The NPW Act defines Aboriginal objects and Aboriginal places:

Aboriginal object means any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains.

Aboriginal place means any place declared to be an Aboriginal place under section 84.

The highest tier offences are reserved for knowledgeable harm of Aboriginal objects or knowledgeable desecration of Aboriginal places. Second tier offences are strict liability offences—that is, offences regardless of whether or not the offender knows they are harming an Aboriginal object or desecrating and Aboriginal place—against which defences may be established under the *National Parks and Wildlife Regulation 2009* (NSW) (the 'NPW Regulation') (see below).

- Section 87 of the NPW Act establishes defences against prosecution under s.86 (1), (2) or (4). The defences are as follows*:*
  - An Aboriginal Heritage Impact Permit (AHIP) authorising the harm (s.87[1])
  - Exercising due diligence to establish Aboriginal objects will not be harmed (s.87[2]) Due diligence may be achieved by compliance with requirements set out in the *National Parks and Wildlife Regulation 2009* (the NPW Regulation) or a code of practice adopted or prescribed by the NPW Regulation (s.87[3])
  - Undertaking "low impact" activities (s.87 [4]).

As noted above, in the case of a modified Part 3A Project, s.90 of the NP&W Act is switched off. This means that application for an AHIP is not required, with any impacts to Aboriginal heritage managed under the conditions of consent for the project approval.

Under Section 89A of the NP&W Act, a person who is aware of the location of an Aboriginal object that is the property of the Crown or, not being the property of the Crown, is real property, and does not, in the prescribed manner, notify the Director-General thereof within a reasonable time after the person first becomes aware of that location is guilty of an offence against this Act unless the person believes on reasonable grounds that the Director-General is aware of the location of that Aboriginal object. It is therefore a requirement, irrespective of a major project approval, that Aboriginal Heritage Site Recording Forms are submitted to the Office of Environment and Heritage in accordance with the NPW Regulation.

Under section 85 of the NP&W Act, the Chief Executive of the NSW Office of Environment and Heritage (OEH) (as the delegate of the Director-General of the Department of Premier and Cabinet) is the authority for the proper care, preservation and protection of Aboriginal objects and Aboriginal places in New South Wales. This legislative responsibility applies to Aboriginal objects and Aboriginal places as defined under the NP&W Act. The Act allows the transfer of Aboriginal objects for safekeeping. The person or organisation must enter into a care agreement with OEH, irrespective of whether an AHIP is not required by the Conditions of Consent for a major project approval.

4. Description of the development proposal

The MSGMP includes the following gas management infrastructure works:

- Installation and operation of a gas upcast riser within Appin No. 3 shaft and ancillary infrastructure such as explosion protection and gas flow valving within the Appin No. 3 shaft precinct.
- Installation and operation of a buried nominal 1000mm diameter surface suction high density polyethylene (HDPE) pipeline between Appin No. 3 Shaft and the existing gas extraction infrastructure and power generation facilities located at the Appin No. 2 Shaft site.
- Brooks Point Road would be crossed twice by the buried surface suction pipeline in accordance with a Section138 approval under the Roads Act 1993 issued by Wollondilly City Council.
- Installation and operation of four water collection traps and associated small diameter pipelines (nominal 50mm PE) / access infrastructure to enable captured condensate to be removed by suction truck.
- Installation and operation of above ground crossing of the Upper Canal and a 1st order tributary of Simpsons Creek. These crossings would be nominal 1000mm steel pipe with supporting concrete abutments and steel gantries.
- Under boring of gas and electrical power distribution systems in accordance with infrastructure owner requirements.

The proposed activities would occur in an existing disturbed road corridor and require ground disturbance through excavation and vegetation clearance. The Project would require approximately 0.45 ha of native vegetation clearing within an existing road corridor. A further 0.35 ha of introduced vegetation and cleared land would be disturbed. In total, the area of direct disturbance is approximately 0.8 ha (i.e. the Subject Area).

5. Consultation with the Aboriginal community

It is a requirement of the project approval that consultation is ongoing with the Aboriginal community. Continued involvement of Registered Aboriginal Parties (RAPs) in management actions and decisions for Aboriginal heritage is critical for achieving best practice management outcomes and RAPs have continually raised during all stages of consultation their desire to be actively involved in the management of Aboriginal sites (Biosis Research 2012: 14).

Community consultation has been undertaken in accordance with the BSOP HMP. The following individuals and organisations were previously identified by Illawarra Coal as RAPs in accordance with Section 5.1 of the BSOP HMP:

- Cubbitch Barta Native Title Claimants
- Illawarra Local Aboriginal Land Council
- Korewal Elouera Jerrungurah Elders Council
- Representing himself
- Wulungulu Elders Corporation
- Wargon and Burra
- Woronora Plateau Gundungara Elders Council
- Wadi Wadi Coomaditchie Aboriginal Corporation
- Tharawal Local Aboriginal Land Council
- Wodi Wodi Elders Corporation
- Peter Falk Consultancy
- Ngunawal Heritage Aboriginal Corporation
- Kullila Welfare and Housing Aboriginal Corporation
- Illawarra Aboriginal Corporation
- Coomaditchie United Aboriginal Corporation

In accordance with the requirements of Section 5.1.2 of the BSOP HMP, the identified RAPs were invited to attend a site inspection of the proposed activities.

A copy of this draft report will be provided to the RAPs to provide an opportunity to be involved in heritage values risk assessments and the development of further management actions, if any.

6. Landscape context

6.1 Overview

Consideration of the landscape is essential to the definition and interpretation of past Aboriginal land use across a landscape and is a requirement of any Aboriginal archaeological and cultural heritage investigation (DECCW 2010a: 8). The landscape may provide clues as to those areas of land that may have been more intensively used by Aboriginal people in the past due to the presence of resources such as water, stone, plants and animals and other raw materials or landscape features associated with sustenance, shelter, tool manufacture and cultural activities. The landscape provides the context within which the material remains of past Aboriginal occupation may be preserved and detectable due to the movement of soil through geomorphic processes such as erosion or its removal from the landscape through past land use and disturbance (DECCW 2010a: 8). By considering these factors, an Aboriginal cultural heritage investigation may develop a sampling strategy for identifying any tangible Aboriginal heritage values within the Subject Area.

The Subject Area is situated within the boundary of the Cumberland and Cataract subregions of the Sydney Basin Bioregion (SBB) and is situated above the Illawarra escarpment along the south eastern margin of the Cumberland Lowlands and the eastern margin of the Woronora Plateau.

The climate within the Appin area consists of mild summers with an average maximum of 29.3 degrees Celsius and minimum of 15.4 degrees Celsius in February, and cold, wet winters with an average minimum of 1.7 degrees Celsius and a maximum of 16.8 degrees Celsius in July (Bureau of Meteorology 2011, based on records taken between 1981-2010).

Recorded rainfall readings indicate an average annual rainfall of 802.7 millimetres (Bureau of Meteorology 2011, based on records taken at Picton between 1880 and 2010). Whilst conditions and temperatures are wide ranging, the conditions in the region of the Subject Area can be summarised as being mild and very suitable for year round hunter-gatherer occupation of all parts of the region.

6.2 Geology and potential stone sources

The underlying geology of the Subject Area consists of Bringelly Shales and Ashfield Shales of the Wianamatta Group and Hawkesbury Sandstone (Figure 3). Conglomerate sources of quartz may be present in association with exposed Hawkesbury Sandstone. There are however, no known sources of stone material suitable for artefact manufacture within the Subject Area, although exposed rock may be present in the Luddenham soil landscape (discussed further below).

6.3 Soils

Soil formation in the Subject Area has been affected by the underlying geology and natural geomorphic processes. There are three soil landscapes within the Subject Area: the Blacktown residual soil landscape, the Luddenham erosional soil landscape and the Picton colluvial soil landscape (Murphy and Lawrie 1998, Figure 3).

A comparison of soil landscapes and site distribution was originally undertaken as part of the Aboriginal Cultural Heritage Assessment for the BSOP.

The Blacktown residual soil landscape is associated with gently undulating rises on the Wianamatta Group Shale (Hazelton and Tille 1990). The landscape contains broad rounded crests and ridges with gently inclined slopes (Hazelton and Tille 1990). Local relief ranges up to 30 metres, with slopes generally less than

5%. Soils are generally texture contrast soils and are characterised by red, brown and yellow Podzolic Soils and Soloths. Residual soils are characterised by areas where soils are derived from the long term, in-situ weathering of parent materials. This soil landscape is associated with areas of archaeological potential, especially in well-drained and slightly elevated area associated with drainage features (Biosis Research 2009: 21). Residual soils in this region can be associated with buried archaeological deposits, though often these soils are generally shallow and may lack integrity in the top 10 to 20 cm due to land clearance activities.

The Picton colluvial soil landscape, generally, has steep to very steep hill slopes with local relief from 90 to 300m and slopes greater than 20%. Topographically the landscape comprises steep, precipitous hill with upper slopes, irregular lower slopes and colluvial benches. Soils are generally shallow, dark sandy loams and brown, sandy stony clay with no rock outcrops. The soil landscape in the upper slopes is highly erosive. Artefacts rarely occur in this landscape but may be expected to occur on the flat to gently inclined landforms such as hill crests (Biosis research 2009: 20). Buried archaeological deposits are only likely in areas where soil can be trapped and built up, such as lower slopes and gullies.

The Luddenham erosional soil landscape is associated with undulating rolling hill slopes and tors. Benches and rock outcrops may occur in this landscape. The local relief is between 50 to 80 m with moderate slope gradients. Soils comprise shallow sandy clay on crests and loamy sand on lower slopes and along drainage lines. Alhough few archaeological site shave been identified in this soil landscape, there is the potential for surface stone artefacts, especially on hill crests (Biosis Research 2009: 20). This soil landscape contains the potential for buried archaeological deposits on lower slopes.

6.4 Hydrology

Water is one of the most important resources to human occupation in a landscape and is considered the primary factor in the prediction of where Aboriginal sites may be present landscape. Across NSW, there is a strong correlation to the presence, frequency and density of Aboriginal objects with the abundance and permanency of water sources. Areas within 200 m of are identified by the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* as landscape features likely to indicate the presence of Aboriginal objects. The Subject Area generally falls within 200 m of first and second order drainage lines that feed into the third order Simpsons, Elladale and Ousedale Creeks. (Figure 4, Plate 1, Plate 2). The drainage lines within the Subject Area have, however, often been modified as a result of land use in the last 200 years and may have lessened archaeological potential as a result.

Plate 1: Example of drainage line or water

Plate 2: Example of drainage line or water

6.5 Flora and fauna

The bulk of the Subject Area has been cleared of vegetation and existing vegetation mostly comprises of regrowth Grey Box – Forest Red Gum Grassy Woodland. Generally speaking, transitional environments such as the Subject Area which contains a number of soil landscapes, would have traditionally contained a diverse range of plant and animal specifies suitable for use by past Aboriginal people.

6.6 Past land use and disturbance

The Subject Area is located within the first land parcels to be granted in Appin. It is situated within 1,000 acres granted to Deputy Commissary General William Broughton in April 1811, and which he named 'Lachlan Vale' after Governor Macquarie (MPHMC 2009:7).

Broughton's brother-in-law, John Kennedy, was also granted 200 acres at 'Teston Farm' at this time (MPHMC 2009:7). The 'Teston Farm' property, at the west of the Subject Area on Brooks Point Road, would later be owned by the Morrison family who established the Morrison Brother's Dairy there, which closed in 2003.

The 'Lachlan Vale' estate was subdivided into ten farm lots in 1856, varying in size from 80 to 188 acres (*Empire* 18 June 1856:8) (Figure 5). At this time the estate was described as being "*cultivated meadow and forest lands*", with some huts, stockyards and fencing established (*Empire* 18 June 1856:8). An early road (in the same location as Brooks Point Road, today), extended through Lots 4-6 and 8.

The Upper Canal was constructed in the 1880s and forms part of the Upper Nepean Scheme and consists of a system of tunnels, aqueducts and open canals which enable water diverted through the Nepean Tunnel to flow a distance of 64km to the major distribution reservoir at Prospect, and supply water to a number of localities en route (MPHMC 2009: A-113). The canal intersects the Subject Area and resulted in high levels of past land use disturbance.

Plate 3: Sandstone culvert and discharge channel running beneath the Upper Canal on the north side of Brooks Point Road, looking south west.

In 1974, a wider road was proposed and its new alignment corresponds with the current route of Brooks Point Road through the Subject Area (Figure 8). A transmission line easement on resumed land was established in this section of Brooks Point Road in 1948. The location of this easement and other later land disturbance works within the Subject Area, in the vicinity of the road corridor are shown in Figure 9, including:

- Easements for transmission line (3).
- Ethane pipeline (7).
- Easements for transmission line (8).
- Closed earlier road dating to 1974 (14) (refer to Figure 8 for details).
- Easement for natural gas pipeline (15).
- Easement for water supply purposes (26), and
- Easement for pipeline (28).

Plate 4: Example of high levels disturbance road cutting, construction and utility installation within the Subject Area.

Plate 5: Example of low to moderate levels of disturbance through road construction and vegetation clearance.

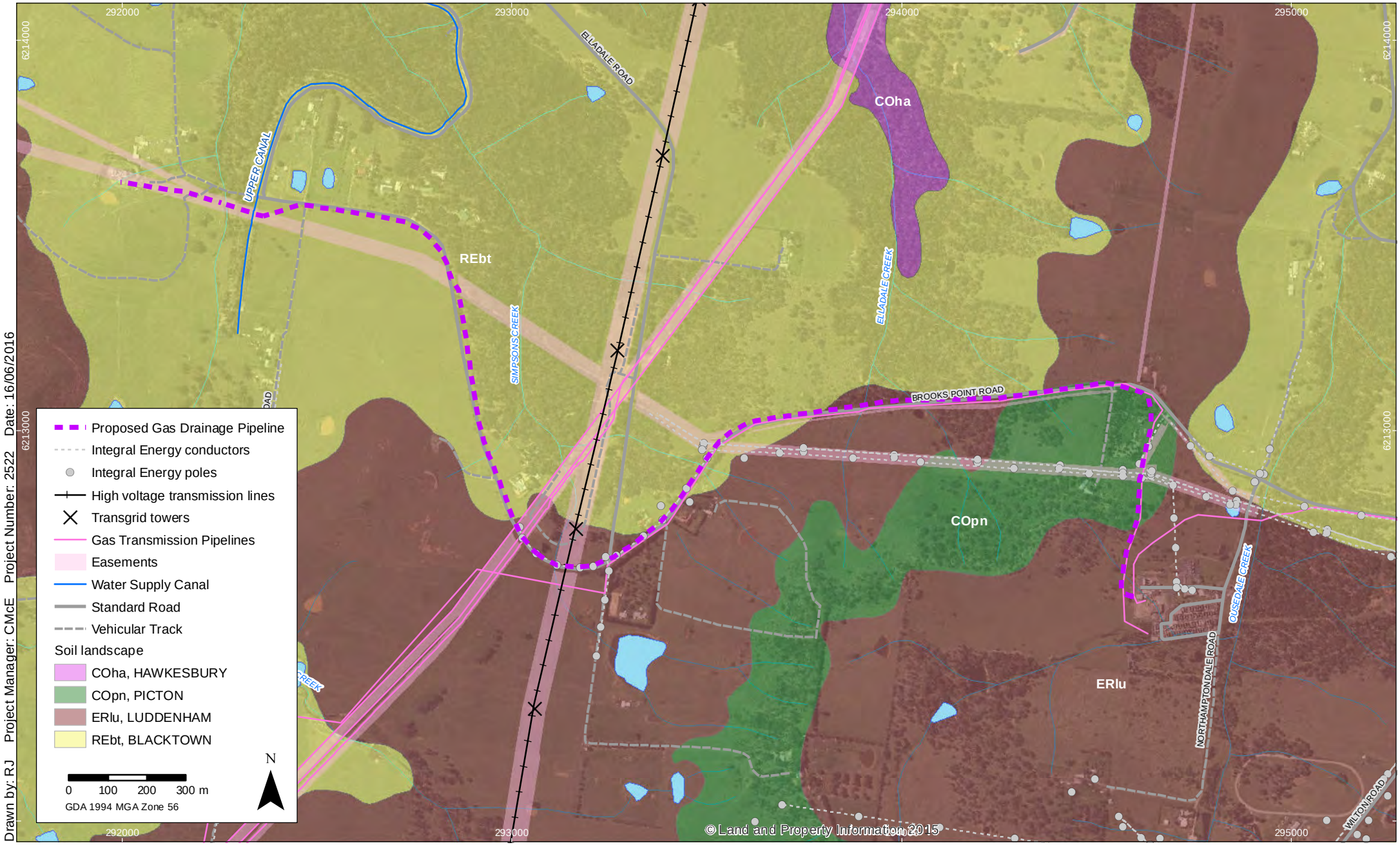
6.7 Summary

Archaeological visibility and exposure within the Subject Area is likely to be low due to the cover of native and imported grasslands. Visibility and exposure will most likely occur as a result of surface wash, utility and road construction and other past land use disturbance.

The Subject Area would typically be considered to have moderate potential for surface and buried Aboriginal objects due to the combination of:

- Available resources in the form of water, associated with first and second order drainage lines, potential stone sources in the form of quartz conglomerates from Hawkebury sandstone, and plant and animal species.
- Residual, colluvial and erosional soils offering the potential to preserve buried Aboriginal objects in association with drainage lines, flats and lower slopes.

This archaeological potential, however, has been negated by the levels of vegetation clearance and past land use in the Subject Area to the extent that there is some, but limited, potential for Aboriginal objects to be retained in-situ.



Drawn by: RJ Project Manager: CMcE Project Number: 2522 Date: 16/06/2016

Soil landscapes within the Subject Area

Aboriginal Cultural Heritage Assessment, Appin East Mine Safety Gas Management Project - s75 Modification

FIGURE 3

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Imagery: (c) LPI 2014-01-04

Topography and hydrology

Aboriginal Cultural Heritage Assessment, Appin East Mine Safety Gas Management Project - s75 Modification

FIGURE 4

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Imagery: (c) LPI 2014-01-04

7. Aboriginal archaeological context

7.1 Ethnography and history

It is generally accepted that Aboriginal occupation of Australia dates back at least 40,000 years (Allen and O'Connell 2003). The result of this extensive and continued occupation of the Sydney Basin of which the Woronora Plateau is a part has left a vast amount of accumulated depositional evidence. The oldest date generally considered to be reliable for the earliest occupation around the region comes from excavations at Parramatta where archaeological material has been dated to 30,735 ± 407 BP (McDonald et al 2005). The site of Bass Point at Shellharbour was occupied from 20,000 years ago, indicating a great antiquity of Aboriginal occupation in the region (Attenbrow 2010: 153, Flood 1995: 112).

The majority of reliably dated archaeological sites within the region are less than 5,000 years old, with previous excavations of rock shelters on the Woronora Plateau providing an oldest date of just over 2,000 years before present (Sefton 1998).

Attenbrow (2010: 34) indicates four main language groupings for the region with Darug (coastal and hinterland dialects), Gundungarra and Tharawal. The hinterland Darug language groups is thought to have covered the Cumberland Plain from Appin to the Hawekbury River to the west of the Georges River, Parramatta, the Lane Cover River and Berowra Creek while the Gundungurra language covered the area west of Georges River on the southern rim of the Cumberland Plain as well as the Souther Blue Mountains (Attenbrow 2010: 34).

The Subject Area is in the traditional lands of the Tharawal language group. Tindale has identified the Tharawal boundaries as being from the south side of Botany Bay around the Georges River to north of the Shoalhaven River, and running inland to the Campbelltown and Camden area (Attenbrow 2010: 34; SA Museum 2010). Attenbrow (2010:35) points out that such boundary mapping, undertaken as it was in the nineteenth century is indicative at best, however there appears to be reasonably strong agreement between those who have mapped language boundaries that the area is Tharawal country. The Wodi Wodi were also Tharawal speakers, and they inhabited the coastal plains and escarpment around Wollongong. Tharawal people distinguished themselves as Fresh Water, Bitter Water or Salt Water depending on where in the wider language boundary their traditional lands were – the inland hills and valleys, the plateaus and swamps or the coastal plain respectively (DEC 2005: 6).

The arrival of the First Fleet in Sydney Cove in 1788 was followed the next year by a smallpox epidemic, which spread to the neighbouring regions and, although the exact effects are not known, killed over half the Aboriginal population of the areas effected (Organ 1990: 5).

The records and histories of the Tharawal and their country at the time of contact with Europeans are subject to bias and are generally fragmented, providing nothing like a complete picture of the way Aboriginal people were living prior to European interference. Nevertheless, we know the Tharawal regularly communicated, moved, traded and participated in ceremonies between their country and neighbouring areas. It is most likely family groups or clans would 'intermingle and interact along both physical and social boundaries' rather than be strictly confined to the 'tribal' borders that were to be artificially imposed by European anthropologists (Organ 1990: xliii). For example, Mount Annan, approximately 20 km north of the Subject Area, is regarded as an important ceremonial and traditional area where groups from many tribes and clans would come together for law, trade and ceremonial practices while the rockshelter art and engraving sites in the Woronora Plateau are also considered an important part of the traditional cultural, social and ceremonial network of the local region.

Early in the nineteenth century European graziers began taking land in the south of the Cumberland Plain and the coastal plains around Wollongong, with cedar getting being conducted in the narrower northern coastal plain and rainforest areas of the escarpment (DEC 2005).

Early in the nineteenth century British colonists arrived and stayed in the Appin area (DEC 2005a). The township of Appin is the oldest in the Wollondilly Shire: the settlement was established in 1810 and was named in 1811. The area was deemed suitable for agriculture by the early British colonists where wheat, barley and vegetables were grown in the early phases of the town's settlement (http://www.stonequarry.com.au/towns/appin.html). This period was a time of drought, and the competition for resources between the Europeans and the Tharawal, who were adapting to the massive changes that were so quickly brought to them, led to several years of conflict. Organ (1990) documents the various skirmishes, killings and reprisals between Europeans and the Tharawal during 1814 – 1815 in the Cowpastures, Camden and Appin districts.

An initial conflict, involving the death of at least seven people, resulted in Governor Macquarie sending a punitive military expedition in 1816 (MPHMC 2009:8). On 17 April 1816, a group of 14 Aboriginal people, including men, women and children, were shot or driven over a cliff, most likely Broughton's Pass, to their deaths, in an event known as the Appin Massacre (MPHMC 2009:8). Descendants of individuals, such as Bundle, who survived the massacre still live within the region today.

With access to traditional lands and foods restricted, Aboriginal people began to participate more in the European economy, with many examples of employment on farms and properties in the region (Listgon 1988: 54-55 in Biosis Research 2009: 28). Corroborees were recorded to occur in the region until the 1850s (Liston 1988: 56- 57).

Aboriginal people of the Appin area and the wider Sydney and Illawarra districts continued to assert the importance of the land to their culture following the arrival of Europeans by maintaining their spiritual connection with the land through ceremony and story (NPWS 2004). Many community members are involved in community building exercises including improving business development, health and cultural heritage in their region.

7.2 Heritage registers

In accordance with Section 7.1 of the BSOP HMP and with respect to the Code of Practice for Archaeological Investigation, the following registers were searched to identify Aboriginal heritage items and studies:

- Commonwealth and National Heritage Lists
- OEH Aboriginal Heritage Information Management System (AHIMS)
- National Native Title Register including the:
  - Register of Native Title Claims
  - Register of Aboriginal Land Use Agreement
- The State Heritage Inventory, including the:
  - Register of the National Estate
  - State Heritage Register (SHR)
  - Relevant Council Local Environmental Plans (LEPs)

7.2.1 Commonwealth and national heritage lists

Under the *Environmental Protection and Biodiversity Conservation Act 1999 Amendments* (No. 88, 2003), two mechanisms have been created for the protection of heritage places of National or Commonwealth significance: The National Heritage List (NHL) and the Commonwealth Heritage List (CHL). The NHL provides protection to places of cultural significance to the nation of Australia, while the CHL comprises natural, Aboriginal and historic heritage places owned and controlled by the Commonwealth. These lists can be searched via the Australian Heritage Database (https://www.environment.gov.au/cgi-bin/ahdb/search.pl), which also includes places in the World Heritage List and the Register of the National Estate.

- A search of Commonwealth and National heritage registers via the Australian Heritage Database was undertaken on 7 January 2016. No Aboriginal objects or places were identified.

7.2.2 OEH Aboriginal Heritage Information Management System (AHIMS)

An extensive Aboriginal Heritage Information Management System (AHIMS) search was conducted on 19 January 2016 (AHIMS Client ID #207931) for a 4.5 km x 2 km area centred on the Subject Area (Figure 5).

Table 2 provides a summary of the AHIMS search results, Table 3 highlights sites within 500 m of the Subject Area and a copy of the search is provided in Annex 2.

The search returned 13 records. No Aboriginal sites were located within 100 m of the Subject Area. Six sites were located between 100 and 500 m from the Subject Area. These are discussed further in Section 7.3. In general, isolated stone artefact and stone artefact scatters are the most common sites with the search area, followed by sites associated with stone outcrops, overhangs or shelters such as rock shelters with art, grinding grooves and rock shelters with artefacts and shell.

The AHIMS search area represents a small percentage of a well surveyed and study region and there are a large number of Aboriginal archaeological studies providing additional information regarding the nature of material evidence of Aboriginal occupation in the region. The results are discussed further in Section 7.3, Section 7.4 and Section 7.5.

Table 2: Summary of AHIMS search results

Aboriginal Site Features in AHIMS	Aboriginal Site Count	Percentage of Aboriginal Sites
Rock shelter with Art	2	15.38%
Artefacts	9	69.23%
Artefacts and Grinding Grooves	1	7.69%
Rock shelter with artefacts and shell	1	7.69%
Grand Total	13	100.00%

Table 3: Known Aboriginal sites within 500 m of the Subject Area

AHIMS Site ID	Site name	Context	Aboriginal Site Features	Distance from Subject Area
52-2-1610	Ousedale Creek 1;	Open site	Midden	200 m
52-2-1880	Brooks Point 5	Closed site	Shelter with Art	100 m
52-2-3577	MDO4	Open site	Artefact	100 m
52-2-1881	Brooks Point 6	Closed site	Shelter with Art	100 m
52-2-1877	Brooks Point 2	Closed site	Axe Grinding Groove,	500 m

			Shelter with Deposit	
52-2-2231	ACC2	Open site	Artefact	240 m

7.2.3 National Native Title Register

A search of the native title register, claims and land use agreement register was undertaken on 8 March 2016 using the Local Government Area "Wollondilly" and "Wollongong":

- The search did not return any native title claims in, or in close proximity to, the Subject Area.
- The search did not return any Aboriginal land use agreements in, or in close proximity to, the Subject Area.

7.2.4 State Heritage Inventory

A search of the State Heritage Inventory was undertaken on 7 January.

- No Aboriginal heritage items were listed under Section 60 of the Heritage Act 1977 on the State Heritage Register.
- No Aboriginal heritage items were listed on the Section 170 Register under the Heritage Act 1977.
- No Aboriginal heritage items on the Register of the National Estate were listed.
- Three historical heritage items located in close proximity to the Subject Area were listed on the Wollondilly Local Environmental Plan 2011. No Aboriginal heritage objects, sites or places were identified.

Figure 5: Previously recorded Aboriginal heritage sites in AHIMS in proximity to the Subject Area (Source: OEH and Niche).

Item removed due to cultural sensitivity

7.3 Previous archaeological studies

Archaeological studies document material evidence of Aboriginal use of the landscape at times both before and after written history, and complement the oral histories and cultural knowledge held by the Aboriginal community.

An annotated bibliography of Aboriginal archaeological assessments within 1 km of the Subject Area is presented below. A synthesis of these studies, as they relate to the Subject Area and the wider region, is presented in Section 8.

7.3.5 Archaeological survey of Appin Area 4 (Sefton 1996)

Three Aboriginal sites were identified within 500 m of the Subject Area during an archaeological survey of Appin Area 4. The sites consist of two rock shelters with art (52-2-1880 and 52-2-1881) between 100 and 200 m of the Subject Area) and one rock shelter with grinding grooves and archaeological deposit (52-2-1887) located 500 m from the Subject Area. The site card descriptions accurately match their current location as plotted from the AHIMS database. Based on this information and the lack of sandstone shelters in the Subject Area, the proposed activities will not impact on these sites.

7.3.6 BSOP Aboriginal Cultural Heritage Assessment (2009)

The BSOP Aboriginal Cultural Heritage Assessment contains a large scale archaeological assessment that consider Aboriginal heritage sites from Maldon in the west to Darkes Forest in the east, including a desktop consideration of the Subject Area. An AHIMS search over a 30 km x 20 km area, including the Subject Area was conducted in 2008. That search returned 1140 recorded Aboriginal sites and indicated that closed sites such as sandstone shelters with art, grinding groove, engravings or deposit were the most common Aboriginal sites in the Woronora Plateau area followed by sandstone platforms with grinding grooves or engravings. Stone artefact sites and Potential Archaeological Deposits, more commonly associated with the Cumberland Lowlands and were the next most common site types in the region.

632 Aboriginal sites were identified within the BSOP study area, including 44 Aboriginal sites identified as a result of archaeological survey in 2008 and 260 previously known site locations investigated to confirm their location and significance. Only one of the six Aboriginal sites within 500 m of the Subject Area was identified in the 2009 assessment. 52-2-1160, an artefact and shell midden site original recorded by Navin Officer, is assessed as having low archaeological significance (Biosis Research 2009: 220).

The BSOP archaeological assessment noted the heightened significance of art sites; both charcoal and pigment art in shelters and rock engravings while noting the general importance of sites as record of the presence and activities of Aboriginal ancestors in the landscape and provided an assessment of the cultural heritage landscape for the wider Woronora Plateau and Cumberland Plain region (Biosis Research 2009: 79).

7.3.7 BSOP Heritage Management Plan (2012)

Biosis (2012) prepared the BSOP HMP based on the ACHA. The HMP outlines programs and procedures for the management of Aboriginal and non-Aboriginal (historical) heritage in the BSOP area, including the preparation of subsequent management plans required for Extraction Plans and surface works. The HMP identifies items and/or places of Aboriginal and historical heritage within the BSOP area and details the management procedures and requirements to manage these items in accordance with the conditions and performance measures of the BSOP Approval.

7.3.8 Heritage Concepts (2007)

MDO 4 (AHIMS ID #52-2-3577), located by Heritage Concepts, comprises three isolated artefacts located 100m west of the Subject Area. These artefacts were situated within an erosion scour along a dirt track. Owing to the disturbed context of these finds, the artefacts are thought to represent a secondary context and are not likely to be associated with a potential buried archaeological deposit (Navin Officer 2007). This site was relocated as part of an assessment carried out for Walker Corporation on Morrisons Dairy.

7.3.9 Navin Officer (2002)

ACC 2 (AHIMS ID #52-2-2231) is comprised of a ground basalt hatchet located by Navin Officer during their 2002 assessment of a proposed communications cable route for Appin Colliery NSW. The site is located 240 m south of Subject Area. This isolated find would not be disturbed by the proposed works.

7.4 Regional archaeological character

These models provide a wider, regional context to Aboriginal land use and allow comparisons to be drawn with the local archaeological studies closer to the Subject Area. A summary of these regional archaeological studies is presented below and then synthesised in Section 8 with the landscape context, ethno-history and local archaeological studies to form a predictive model for the Subject Area.

7.4.1 Chronology of Aboriginal occupation

Material evidence of Aboriginal occupation of Australia dates back at least 48,000 years. (Turney et al. 2001). The oldest human remains in Australia date to approximately 40,000 years ago. The Sydney Basin region, of which the Subject Area is a part, contains extensive evidence of human occupation. The oldest date generally considered to be reliable for occupation of the region comes from excavations at Parramatta. Archaeological material from the Parramatta sand body has been dated to 30,735 ± 407 BP (JMCHM 2005). Sites at Shaw's Creek K2 (have been dated to 14,700 BP (Kohen et al 1981) Bass Point at Shellharbour, approximately 55km south-east of the Subject Area, was occupied from 20,000 years ago (Attenbrow 2010: 153). A number of contested dates from Cranebrook Terrace hint further at the great antiquity of Aboriginal occupation in the region (Flood 1995: 112). These early sites are most consistently associated with stratified rock shelter deposits and alluvial sediments along the Nepean and Parramatta Rivers.

Within the Cumberland Plain, archaeological excavation indicates the Cumberland Plain was intensively occupied from approximately 4,000 years B.P (JHCM 2007).

On the Woronora Plateau, the oldest recorded date for Aboriginal occupation is 2,200 BP at Mill Creek 11 (Sefton 199a). A date of 1820 BP was recovered from Bull Cave, indicating sporadic use dating before and after European settlement in the region (Koettig 1990).

A relative chronology for the Woronora Plateau has been developed by Dibden (2003) and is presented in Ford 2005:

- Woronora Plateau Rock Art Phase 1: Petroglyphs of animal tracks - > 4000 BP
- Woronora Plateau Rock Art Phase 2: Rec ochre paintings and stencilling, some white stencilling. Anthropomorphic, zoomorphic and abstract motifs <:4000 to > 1600 BP
- Woronora Plateau Rock Art Phase 3: Charcoal drawings, white stencils, greater variety of colour. Continuation of older motif styles with some additional styles. Some evidence of retouch > 1600 to 1000 years BP to European contact.

7.4.2 Site and artefact distribution

Influential regional studies of the Sydney Basin included Kohen's (1986) regional study of Aboriginal archaeological sites identified through surface surveys within the Cumberland Plain, Attenbrow's studies of local geographical variation and temporal changes in subsistence patterns and material culture in Port Jackson area and the Upper Mangrove Creek catchment (Attenbrow 2002: 7), McDonald's study of rock art in the Sydney Basin and McDonald's synthesis of excavations at Rouse Hill to develop a predictive model for the Cumberland Plain (McDonald and White 2012). Extensive excavation works undertaken by McDonald over a number of years have demonstrated that surface expression is not necessarily required for subsurface archaeological deposits to be present. McDonald (1997) demonstrated that:

- 27.8% (n=17) of excavated sites had no surface artefacts prior to excavation.
- The ratio of recorded surface artefacts to excavated material was 1:25.
- None of the excavated sites could be properly characterised in terms of nature, extent and significance based on the surface artefacts alone.

These major studies highlight the importance of designing adequate subsurface testing methodology so as to identify the nature, extent and significance of the archaeological deposit, demonstrate changing frequencies in the presence of occupation sites, shift in site patterning over time, changes in material culture over time, and local and sub-regional variation in human activities across the Sydney Basin.

Archaeological sites in the Sydney Basin "*provide invaluable and essential data*" to inform research into the "*the life and customs of the original inhabitants of the Sydney Region*" and how humans have adapted to changing environmental conditions (Attenbrow 2002: 8).

Building on the work undertaken by Kohen (1986), excavations across the Cumberland Plain have combined data on artefact distribution, artefact density, topographic and stream order variables to identify patterns that may signal preferences for Aboriginal people's artefact discard across the landscape and indicate suitable environments for the preservation of artefacts (McDonald and White 2010). Excavations at Rouse Hill in the Cumberland Plain suggest that higher artefact densities and more continuous artefact scatters occur on terraces and lower slopes associated with 4th and 2nd order streams, especially 50-100m from 4th order streams (McDonald and White 2010). This refined Kohen's observations of open artefact sites being more densely clustered along permanent creek and river lines. In the Rouse Hill area McDonald and White (2010: 36) found that creek flats, despite perceptions, contained fewer artefacts than the terraces and lower slopes. Most 1st order landscapes were found to have very low mean artefact densities and scatters tended to be more discontinuous, that is there was a predominance of test squares with zero artefacts and test squares with more than 10 artefacts were rare. Open area excavation occasionally found higher concentrations but this was considerably rarer compared to the results along higher order streams. Upper slopes were found to have sparse discontinuous artefact distributions but were still found in these landscapes. McDonald and White (2010: 36) further hypothesised that the sandstone-shale interface may have affected distribution and density.

A number of possible human explanatory factors, beyond environmental and non-human geomorphic agents are suggested for higher numbers of artefacts in landscapes associated with higher order streams including (White 1999, in McDonald and White 2010):

- large numbers of people conducting many small-scale flaking and discard episodes.
- small numbers of people conducting small-scale flaking and discard episodes over long periods of time, and/or (3) a small number of intensive, and
- flaking activities during which many flakes were struck from cores .

AMBS (2000, 2002) have suggested that the variation in densities may simply be a result of differing intensity of use over time, rather than more complex activity (ENSR 2009:15). Excavations at Oran Park suggest some local and regional variation to this model (ENSR 2009).

The BSOP archaeological model of the Cumberland Lowlands in which the Subject Area is situated follows the Cumberland Plain model presented above.

It further states that:

- Culturally modified trees are considered rare in the region due to the history of past land clearance and bushfires.
- Burial locations will most likely occur in areas where soft sediments occur rather than in the harder silts and clays of the Cumberland Lowlands.
- There have been no identified Aboriginal ceremonial and dreaming sites identified in the BSOP study area
- Ochre outcrops occur in the local region but are not known in BSOP study area and are unlikely to occur in the Subject Area.

7.4.3 Raw material use in the region

Between 2004 and 2010, recent archaeological excavations in the Cumberland Plain have investigated the characteristics of silcrete artefact assemblage to identify potential regional and local variations in artefact manufacture and raw material utilisation (Austral 2004, AHMS 2007: 7, ENSR 2008, ENSR 2009, JMCHM 2010). It has been argued that excavations in south-west Sydney have been characterised by small silcrete and fine grained siliceous rocks with minimal cortex and low core to flake ratios. These assemblages appear to contain smaller artefacts than those in the northern Cumberland Plain. To test this hypothesis, ENSR undertook a comparative analysis of core sizes across the Oran Park and Turner Road assemblages, western Cumberland Plain assemblages at Rouse Hill and Parklea and William Street site in the northern Cumberland Plain (ENSR 2009). The analysis concluded that there was a significant difference between cores from the Oran Park and Turner Road Precinct and cores from the western Cumberland Plain (the Rouse Hill Town Centre and Parklea sites) but no significant difference between Oran Park and Turner Road Precincts and the East Sydney site.(ENSR 2009: 61). Explanatory factors provided for this conclusion were that the differences between sampling affected the result or that Aboriginal people were recycling cores more often in the south-west Cumberland Plain. This in turn may indicate different resource acquisition and utilisation models.

8. Synthesis and predictive model

Portions of the Subject Area have previously been surveyed (Sefton 1996) or have been subject to desktop archaeological assessment (Biosis Research 2009) but the bulk of the Subject Area has not previously been inspected for Aboriginal heritage values.

Archaeological visibility and exposure within the Subject Area is likely to be low due to the cover of native and imported grasslands. Visibility and exposure will most likely occur as a result of surface wash, utility and road construction and other past land use disturbance.

The Subject Area would typically be considered to have good potential for surface and buried Aboriginal objects due to the combination of:

- Available resources in the form of water, associated with first and second order drainage lines, and plant and animal species.
- Residual, colluvial and erosional soils offering the potential to preserve buried Aboriginal objects in association with drainage lines and gullies, flats and lower slopes.

This archaeological potential, however, has been negated by the levels of vegetation clearance and past land use in the Subject Area to the extent that there is some but limited potential for Aboriginal objects to be retained in-situ.

Where Aboriginal objects are present they will most likely occur as:

- Stone artefact sites consisting of isolated stone artefacts or low density stone artefacts will be the most common site type in the Subject Area and;
  - occur within 200 m of a drainage line on flat to gently inclined land such as flats, lower slopes and hill crests;
  - be more frequently be associated with the Blacktown soil landscape rather than the Picton or Luddenham soil landscapes;
  - increase in the range, density and frequency of Aboriginal objects within sites with proximity to water and resource rich zones;
  - be most likely be manufactured from silcrete, quartz, followed by chert, quartzite, tuff and other volcanic stones;
- Raw material for stone artefacts will most likely be sourced from outside the Subject Area though some quartz artefacts may have procured opportunistically from quartz conglomerates associated with Hawkesbury sandstones
  - Silcrete artefacts within the Subject Area may potentially have been sourced from the northern Cumberland Plain (e.g. Appin Areas 8 and 9) from both outcrops and cobble beds.
  - Tuff , chert, mudstone, quartz, quartzite and basalt may have been sourced from elsewhere on the Woronora Plateau and Cumberland Lowlands (Smith 1989a, Smith 1989b cited in Biosis Research 2009: 23)
- Potential Archaeological Deposits of Aboriginal objects where intact soil profiles are present in association with drainage lines and well drained flats and lower slopes.
- Culturally modified trees where mature age trees are present, although this is unlikely to do so due to the levels of past vegetation clearance.
- Grinding groove and engraving sites where sandstone outcrops and creek beds are present although this is unlikely to do so in the Subject Area due to limited availability of suitable sandstone outcrops.

Most evidence of Aboriginal occupation within the Subject Area will date to the last 5,000 years although any intact archaeological deposits may contain evidence of older occupation.

9. Survey methodology

9.1 Survey sampling strategy

The *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010) requires a stratified and weighted sample of the landscapes to be assessed based on their occurrence in an impact or disturbance footprint, and the anticipated Aboriginal cultural heritage potential within those landforms.

Due to the small size of the Subject Area, the survey sampled the entirety of the Subject Area.

9.2 Survey methods

The Aboriginal heritage survey was conducted on 20 January 2016.

The survey team consisted of nine individuals (six representatives of the RAPS, two archaeologists and one ecologist). The survey team walked the length and width of the proposed activity. Survey participants were generally spaced 1 m apart.

The location of survey units and archaeological finds were recorded using a hand-held DGPS, and uploaded to a GIS for presentation on maps and figures. All positional recording used Map Grid of Australia (MGA) coordinates (zone 56) based on the Geocentric Datum of Australia (GDA94). Details such as landform, visibility and exposure for each survey unit were recorded on standard survey unit recording forms, with transects being determined based on changes in the landform, as per the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010b). Exposure and visibility were estimated in accordance with the requirements of the Code of Practice. A digital camera with 7 mega pixel resolution was used for all photography

10. Results

10.1 Survey coverage

The survey achieved 100% coverage of the Subject Area. Table 4, in accordance with the Code of Practice, provides a summary of the survey coverage, landform data and survey results for the survey. No Aboriginal objects were identified. The survey results and coverage are presented in Figure 6.

The survey commenced at Appin No. 3 Shaft at the western end of Brooks Point Road, and proceeded east along the proposed location of the gas drainage pipeline for approximately 4km. While generally flat, the road sloped in some sections and crossed a few small gullies (Plate 6 and Plate 7). The survey assessed the cleared and vegetated area 2m either side of the road to encompass the disturbance area associated with installation of the 1 m diameter pipe.

Plate 6: General photo of the Subject Area, looking east along Brooks Point Road.

Plate 7: General photo of the Subject Area, looking east along Brooks Point Road.

Progressing east along Brooks Point Road from Appin No. 3 Shaft, a stone culvert was identified across a vegetated gully (8 and9). This item has been assessed for non-Aboriginal historic values (Niche 2016) and demonstrates the levels of past land use disturbance within the Subject Area.

Plate 8: Stone culvert along Brooks Point Road, facing north east.

Plate 9: Stone culvert along Brooks Point Road, facing south west.

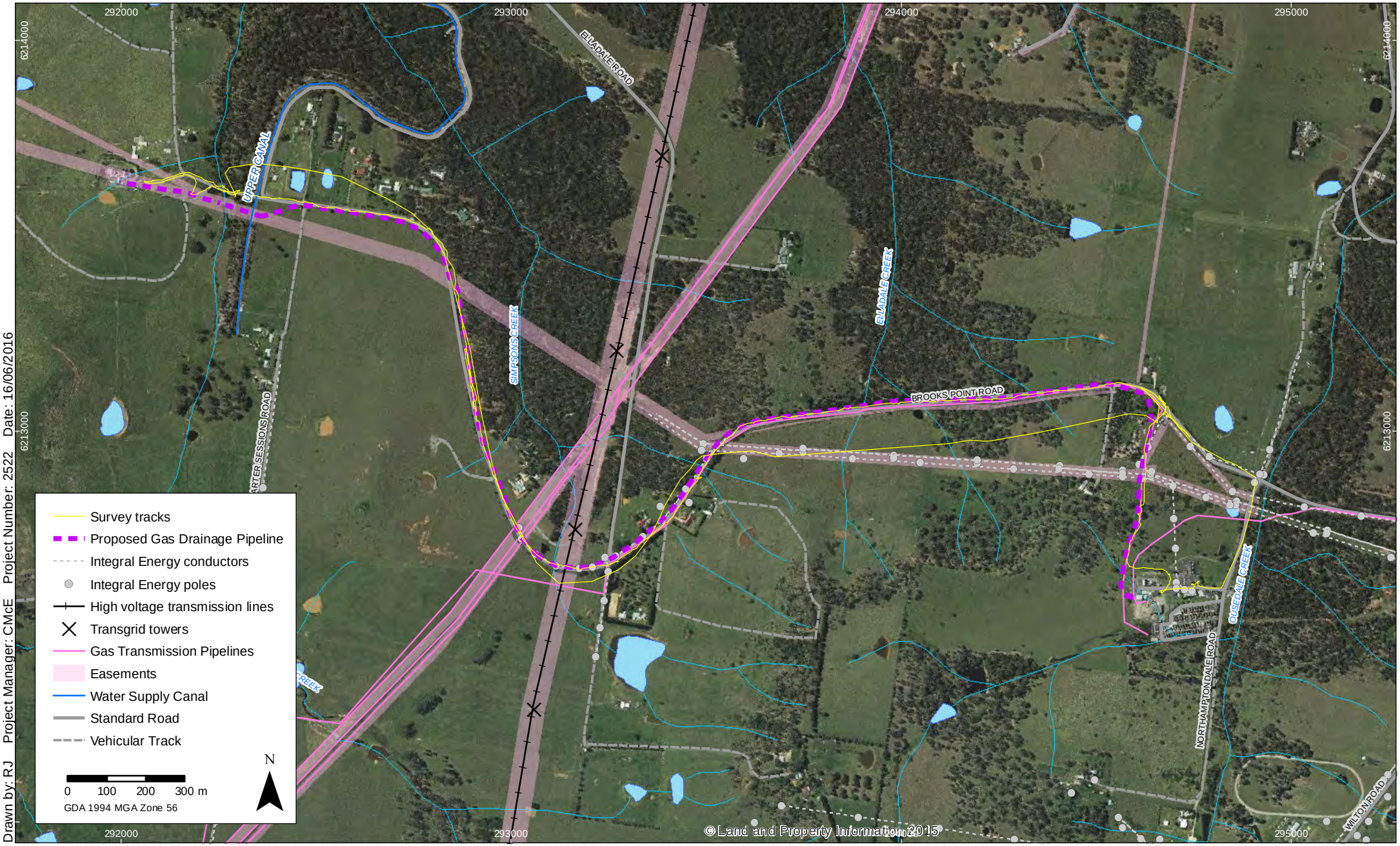
Further east along Brooks Point Road, the project is proposed to cross the Upper Canal, which is located towards the western end of Brooks Point Road. The Canal extends either side (to the north and south) of Brooks Point Road and is crossed by a single lane road overbridge. This local heritage item has been assessed elsewhere in a non-Aboriginal heritage assessment for the proposed activities (Niche 2016). Here the canal demonstrates the high levels of past land use disturbance.

Plate 10: The Upper Canal, looking south from the canal overbridge on Brooks Point Road.

Plate 11: Canal overbridge at Brooks Point Road, looking south west.

Table 4: Summary of survey coverage and landform data

Landform / Survey Unit	Landform and Survey Unit Area (m^2)	Visibility (%)	Exposure (%)	Effective Coverage (m^2)	Effective Coverage (%)	Number of Sites
Drainage lines	12	0	0	0		0
Flats	1500	5	5	37,500	10%	0
Simple slopes	2000	10	10	200	5%	0
Hill crests	500	10	5	25,000	67%	0
Total	3712					0



Survey effort

Aboriginal Cultural Heritage Assessment, Appin East Mine Safety Gas Management Project - s75 Modification

FIGURE 6

Path: T:\spatial\projects\a2500\a2522_AppinEastGas\Maps\report\Archaeo\2522_Figure_6_Survey.mxd

Imagery: (c) LPI 2014-01-04

11. Analysis and discussion

The results of the archaeological investigations and the analysis of the data produced by the survey are summarised below:

- The entire area has a high level of disturbance due to previous land use for cattle grazing and associated farming practices. The development of the Upper Canal as well as Brooks Point Road would have added to this disturbance.
- The lack of any surface artefacts located in-situ during this assessment further indicates the disturbed nature of the proposed pipeline.
- The confirmation of previously developed predictive models for the area which suggested a very low possibility of sub-surface archaeological deposits exists in the Subject Area.
- Compared to other landforms adjacent to the Subject Area and prominent soil landscapes the Subject Area has low research potential.

The archaeological investigation concluded that the occupation of the Subject Area by Aboriginal people could have been very sparse and occasional in the past. Other landscape units in the immediate vicinity of the Subject Area provided significantly more archaeological data and proof of previous human occupation.

12. Cultural heritage values and significance assessment

12.1 Assessment framework

Section 7.1 of the BSOP HMP states that significance assessments for Aboriginal heritage must include a cultural heritage values assessment and be undertaken in accordance with the following relevant guidelines:

- ICOMOS Australia Burra Charter 1999;
- Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW 2010); and,
- Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH 2011).

The BSOP HMP further states that assessment of significance for Aboriginal and Non-Aboriginal heritage sites should be undertaken using a landscape approach where possible and referencing themes identified in the New South Wales Historical Themes (NSW Heritage Council 2001) or local heritage studies

The Burra Charter (Australia ICOMOS 1999) defines the basic principles and procedures to be observed in the conservation of important places. It provides the primary framework within which decisions about the management of heritage sites in Australia should be made. The Burra Charter defines cultural significance as being derived from the following presented in Table 5.

Table 5: Definition of Heritage Values from the Burra Charter

Cultural Significance Criteria	Definition
Aesthetic value:	Aesthetic value includes aspects of sensory perception for which criteria can and should be stated. Such criteria may include consideration of the form, scale, colour, texture and material of the fabric; the smells and sounds associated with the place and its use.
Historic value:	Historic value encompasses the history of aesthetics, science and society, and therefore to a large extent underlies all of the terms set out in this section. A place may have historic value because it has influenced, or has been influenced by, an historic figure, event, phase or activity. It may also have historic value as the site of an important event. For any given place the significance will be greater where evidence of the association or event survives in situ, or where the settings are substantially intact, than where it has been changed or evidence does not survive. However, some events or associations may be so important that the place retains significance regardless of subsequent treatment.
Scientific value:	The scientific or research value of a place will depend upon the importance of the data involved, on its rarity, quality or representativeness, and on the degree to which the place may contribute further substantial information
Social value:	Social value embraces the qualities for which a place has become a focus of spiritual, political, national or other cultural sentiment to a majority or minority group.

12.1.1 Other approaches: scientific significance

The categorisation into aesthetic, historic, scientific and social values is one approach to understanding the concept of cultural significance. However, more precise categories may be developed as understanding of a particular place increases.

The NSW DECCW guidelines for the significance assessment of Aboriginal archaeological sites are contained within the Aboriginal Cultural Heritage Standards and Guidelines Kit (National Parks and Wildlife Service

1997). The Kit identifies with two main streams in the overall significance assessment process: the assessment of cultural/social significance to Aboriginal people and the assessment of scientific significance to archaeologists. This approach encapsulates those aspects of the Burra Charter that are relevant to Aboriginal archaeological sites. The guidelines specify the following criteria for archaeological significance, as paraphrased in Table 6

Table 6: Criteria for assessing archaeological / scientific significance

Significance Criteria	Definition
Research Potential	It is the potential to elucidate past behaviour which gives significance under this criterion rather than the potential to yield collections of artefacts. Matters considered under this criterion include – the intactness of a site, the potential for the site to build a chronology and the connectedness of the site to other sites in the archaeological landscape.
Representativeness	As a criterion, representativeness is only meaningful in relation to a conservation objective. Presumably all sites are representative of those in their class or they would not be in that class. What is at issue is the extent to which a class of sites is conserved and whether the particular site being assessed should be conserved in order to ensure that we retain a representative sample of the archaeological record as a whole. The conservation objective which underwrites the 'representativeness' criteria is that such a sample should be conserved.
Rarity	This criterion cannot easily be separated from that of representativeness. If a site is 'distinctive' then it will, by definition, be part of the variability which a representative sample would represent. The criteria might best be approached as one which exists within the criteria of representativeness, giving a particular weighting to certain classes of site. The main requirement for being able to assess rarity will be to know what is common and what is unusual in the site record but also the way that archaeology confers prestige on certain sites because of their ability to provide certain information. The criterion of rarity may be assessed at a range of levels: local, regional, state, national, and global
Educational Potential	Heritage sites and areas should be conserved and managed in relation to their value to people. It is assumed that archaeologists have the ability to speak of the value of sites to members of their own profession. Where archaeologists or others carrying out assessments are speaking for the educational value of sites to the public, the onus is on them to go to the public for an assessment of this value, or to reputable studies which have canvassed public demand for education. The danger, otherwise, is that archaeologists would be projecting their values onto a public which is itself given no voice on the matter
Aesthetics	Archaeologists are not expected to include an assessment of aesthetic significance along with their assessment of scientific significance. In relation to heritage places, aesthetic significance is generally taken to mean the visual beauty of the place. Aesthetic value is not inherent in a place, but arises in the sensory response people have to it..

12.1.2 Grading values and significance

The following gradations, where a site or zone satisfies at least one criterion, have been applied to provide a measure of the values/significance for Aboriginal objects identified within the Subject Area, and to provide an overall assessment of the significance of each of the zones used that define the Subject Area.

Low: The site or object contains only a single or limited number of features, and has no potential to meaningfully inform our understanding of the past beyond what it contributes through its current recording (i.e. no or low research potential). The site or object is a representative but unexceptional example of the most common class of sites or objects in

the region. Many more similar examples can be confidently predicted to occur within the Study area, and in the region.

Moderate: The site, or object, derives value because it contains features, both archaeological and contextual, which through further investigation may contribute to our understanding of the local past. These features include, but are not limited to: the relationship with landscape features or other Aboriginal archaeological sites or areas of identified heritage importance; diagnostic archaeological or landscape features that inform a chronology; and a relatively large assemblage of stone artefacts. The presence of a diverse artefact and feature assemblage, and connectedness with landscape features and other notable sites provide relatively higher representative and rarity values than sites of low significance.

High: The site, or object, has value because it contains archaeological and/or contextual features which through further investigation may significantly contribute to our understanding of the past, both locally and on a regional scale. These features include, but are not limited to: Aboriginal ancestral remains; the site's relationship with landscape features or other Aboriginal archaeological sites or areas of identified heritage importance; diagnostic archaeological or landscape features that inform a chronology; and a very large assemblage of stone artefacts associated with other features such as oven remains or shell midden. Such sites will be relatively rare, and will be representative of a limited number of similar sites that make up this class; hence they derive high representative and rarity values.

12.2 Assessment of scientific significance by site

As there are no Aboriginal sites relocated during this assessment or previously recorded on AHIMS within the Subject Area as assessment of scientific significance by site is not required as part of this assessment.

12.3 Statements of significance for the Subject Area

The Subject Area is situated in the wider landscape of the Woronora Plateau and Cumberland Plain. The BSOP Aboriginal Cultural Heritage Assessment states "the presence of many sites on the Cumberland Plain and Woronora Plateau is well known amongst Aboriginal local communities. This gives the landscape value as a well-known and highly visible cultural resource for the local Aboriginal communities. The rugged sandstone bushland of the Woronora Plateaus and its numerous sites are in many ways a touchstone of identify the Aboriginal people of the Illawarra while the rolling hills of the Cumberland Plain preserve an important history of the occupation of the plain prior to their development. For this reason the BSOP study area must be considered to have high value as a cultural landscape."

The Subject Area however is situated within a disturbed road corridor and contains no identified Aboriginal sites and to date no specific Aboriginal heritage values have been identified by the Registered Aboriginal Parties.

12.3.1 Social value

The Subject Area is situated in a disturbed road corridor and no Aboriginal heritage items have been identified within its boundaries. The RAPs have not made comment on the social value of the Subject Area.

12.3.2 Aesthetic value

The Subject Area is situated in a disturbed road corridor and no Aboriginal heritage items have been identified within its boundaries. The RAPs have not made comment on the aesthetic values of the Subject Area.

12.3.3 Historic value

The background literature review indicates that the Subject Area falls within land originally owned by Broughton upon whose land the Appin massacre was carried out. The Appin massacre is an import historical event that is of high significance to the local Aboriginal community and is associated with commemorative memorial practices continued today. The Appin massacre, however, is thought to have most likely occurred near Broughton's Pass and outside the Subject Area.

Broughton's ownership of the Subject Area ceased in 1856 and since then the Subject Area has been utilised as a road and utility corridor.

Beyond the land tenure connection to the landowner associated with the Appin massacre, the RAPs and background literature review identified no direct historical figures, events, phases, activities did not identify any direct historical figures, events, phases or activities within the historical or oral history records for the Subject Area.

12.3.4 Scientific (Archaeological) Value

The Subject Area is situated within a disturbed road corridor with limited potential for surface or buried Aboriginal object to be present. There are no known Aboriginal sites in the Subject Area. The Subject Area therefore contain no Aboriginal scientific research value.

13. Impact assessment

The *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011) requires that both direct, and indirect, harm to Aboriginal objects and Aboriginal places be considered. Generally, direct harm refers to occasions where an activity physically impacts a site or objects and therefore affects the heritage values of the site or objects. Indirect harm is usually taken to mean harm stemming from secondary consequences of the activity, and may affect sites or objects as an indirect consequence of the activity. Examples of such indirect harm are increased visitors to a site, or increased erosion in an area as a result of an activity.

13.1 Assessment of direct and indirect harm to Aboriginal heritage sites and values

There are six known Aboriginal sites between 100 and 500 m from the Subject Area. These sites will not be directly, or indirectly, harmed by the proposed activity.

This assessment has been undertaken in consultation with the RAPs and determined that there are no Aboriginal heritage sites or values present. The proposed activities will be a continuation of use of the Subject Area as a road and utility infrastructure corridor.

13.2 Consideration of cumulative impacts

Cumulative impacts are the successive, incremental and combined impacts of one or more activities on the environment, including cultural heritage values. Taken in context with pre-existing development and conservation in the region, the proposed activities will have limited cumulative impact on the cultural heritage values of the region due to the proposed activities occurring in an existing, disturbed road and utility infrastructure corridor.

13.3 Consideration of ecologically sustainable development

Section 5(vii) of the Environmental Planning and Assessment Act 1979 requires proponents to consider the key principles of Ecologically Sustainable Development (ESD) in the design of their projects. The principles of ESD are defined within the Protection of the Environment Administration Act 1991. This Act defines the precautionary principle and the principles of inter-generational equity, conservation of biological diversity and ecological integrity. The precautionary principle is defined as:

"*if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation*".

Table 7 considers the key principles of ESD with respect to the results of the literature review, Aboriginal heritage survey results, significance assessment contained within this report.

Table 7: Consideration of the EIA and ESD Guidelines

Principles of the EIA and ESD Guidelines	ESD Assessment
A fundamental consideration for conservation of biological diversity and ecological integrity	The Proponent has undertaken an Aboriginal Cultural Heritage Assessment in consultation with the Registered Aboriginal Parties and determined that there are no Aboriginal heritage sites or values present. As a result, the proposed activity would not result in practicable, serious or irreversible damage to the cultural heritage environment and would not result in any intergenerational loss of cultural heritage items or
Careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment	

Principles of the EIA and ESD Guidelines	ESD Assessment
Consideration of intergenerational equity	knowledge. Rather the assessment process has added additional knowledge regarding the cultural resources (or lack thereof) to the general population. There are no identified conservation values
Where risk of serious or irreversible harm and lack of scientific knowledge of the nature of environmental harm combine, the precautionary principle applies. Where there is risk of serious or irreversible harm, it is necessary to establish whether there is adequate scientific knowledge of the subject to evaluate the perceived threat.	This assessment has considered a review of all heritage items and their associated scientific report identified in heritage searches of a 2 km radius of the Subject Area. It has also considered a non-Aboriginal historic heritage assessment of the Subject Area and the results of an Aboriginal heritage survey with Registered Aboriginal Parties. The assessment did not identify any Aboriginal heritage sites or values that would be impacted by the proposed activity. The assessment therefore concludes that there is limited risk of serious, or irreversible, harm and detailed scientific knowledge of the nature of the archaeological record in the Subject Area and that the precautionary principle does not apply.
An assessment of the risk-weighted consequences of various options	The Subject Area is situated within a disturbed road corridor within a wider cultural heritage landscape. Shifts in the proposed alignment of the works would bring the proposed activities closer to known Aboriginal sites. The proposed activities and their current location are therefore considered the best option.

14. Conclusions and recommendations

No Aboriginal objects, or landscape features with the potential for subsurface archaeological deposits, were identified during the assessment. South 32-Illawarra Coal can proceed with the proposed works without any further archaeological assessment.

14.1 Recommendations

- Should any Aboriginal objects be unexpectedly uncovered during the works, all activity must stop and further investigation must be carried out by a qualified archaeologist in consultation with the relevant Aboriginal stakeholders.
- Should suspected human skeletal remains be uncovered by the proposed drilling, works must stop immediately and the NSW Police contacted for further analysis.

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Annex 1 – AHIMS Search Results

Item removed due to cultural sensitivity

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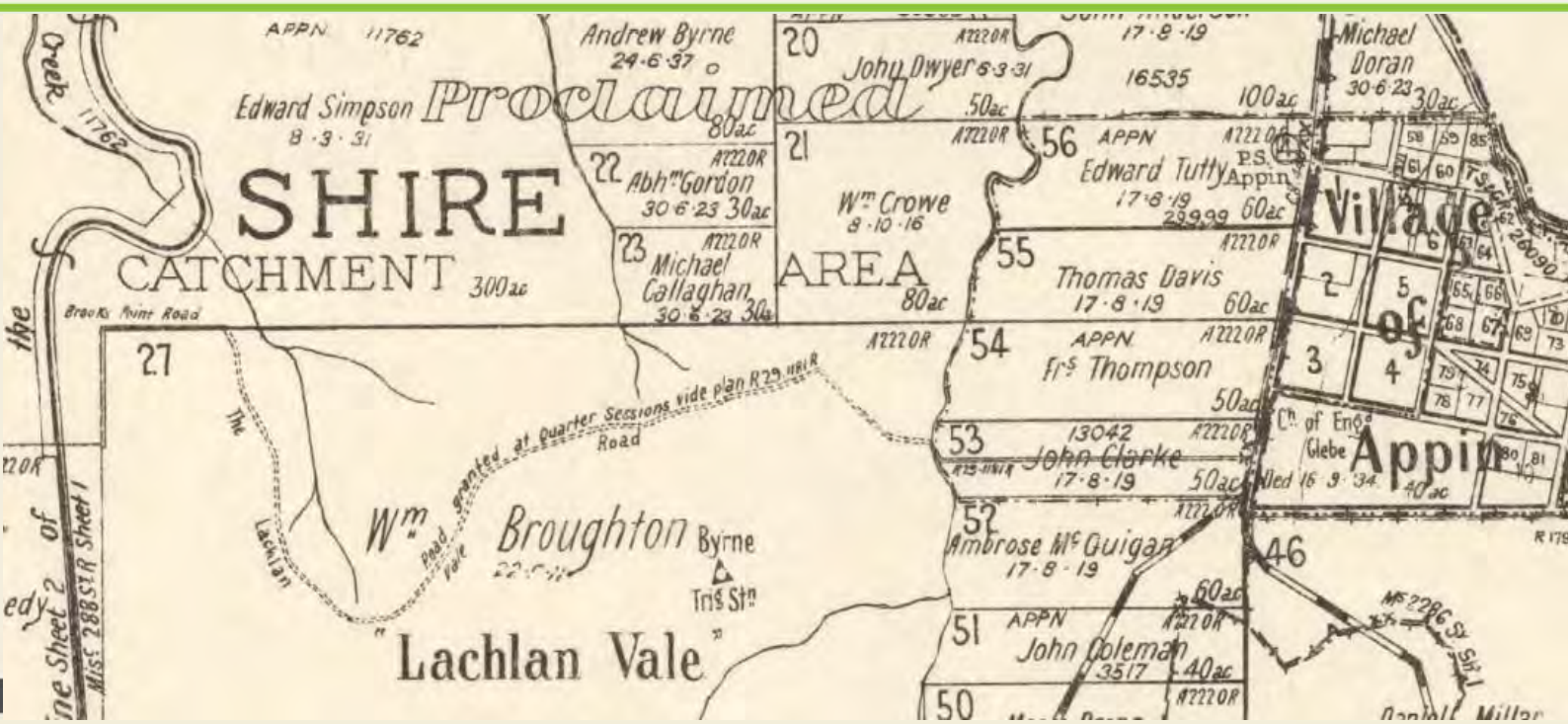
Annex 5 Built Heritage Assessment



Bulli Seam Operations

Mine Safety Gas Management Project

Historical Heritage Assessment

Prepared for South32 Illawarra Coal

19 April 2016

Document control

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Project office:	Illawarra
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Project Manager:	Chris McEvoy
Author:	Aleisha Buckler
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Document revision status

Authors	Revision number	Internal review	Date issued
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Cover photograph: The subject area within Appin in 1930 (LPI 1930).

Executive Summary

This report presents an historical heritage assessment of the proposed installation and operation of gas drainage infrastructure within South32 Illawarra Coal's Bulli Seam Operations, which are located approximately 25km northwest of Wollongong between the areas of Douglas Park and Appin in the Southern Coalfields of NSW. The Bulli Seam Operations Project (BSOP) was approved by the Planning Assessment Commission in 2011 under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). To continue underground mining, South32 Illawarra Coal now propose to optimise the pre-mining extraction and utilisation of methane gas from the mine, as a means to support the safe and efficient extraction of coal. This would result in considerable benefits in terms of power generation and reduction in greenhouse gas emissions. The construction and use of future gas drainage infrastructure was not included in the existing BSOP Approval. Therefore, a s75W modification to the BSOP Approval is now required.

This historical heritage assessment has been prepared to support the s75W modification and aims to assess the impact of the proposed gas drainage pipeline on known and potential historical heritage items, and propose recommendations for impact mitigation and management. The report includes the results of heritage register searches, summary historical background, the results of a field survey, significance and impact assessment, conclusions and the provision of management recommendations. This assessment has been prepared in accordance with best practice in historical heritage management as guided by the *NSW Heritage Manual* (Department of Urban Affairs and Planning 1996) and the *Burra Charter* (Australia ICOMOS 2013) with reference to the provisions of the *NSW Heritage Act 1977* and the *Wollondilly Local Environmental Plan 2011*. This assessment has also been prepared with regard to the requirements of the BSOP Heritage Management Plan and refers to the non-Aboriginal heritage assessment completed in 2009 as part of the Environmental Assessment to support the existing BSOP Approval.

Only one heritage item was identified within the subject area. This item is the Upper Canal, which is a State significant heritage item listed on the NSW State Heritage Register (SHR ID: 01373). This assessment has found that the proposed above-ground pipe crossing the Upper Canal would have a minor impact on the heritage significance of the Upper Canal and its associated infrastructure. It also concludes that there is a low likelihood for archaeological deposits to exist within the subject area. If any such deposits have survived they are likely to be highly disturbed and have limited historical significance or research potential. As such, no further historical heritage assessment of the subject area is required, prior to the commencement of project works.

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1. Introduction

1.1 Project Background

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by South32 Illawarra Coal to prepare a non-Aboriginal (historical) heritage assessment for the proposed installation of gas drainage infrastructure within their Bulli Seam Operations. The Operations are a continuation of the Appin and West Cliff mining operations and are located in the Southern Coalfield of New South Wales, approximately 25km northwest of Wollongong. The proposed works require a s75W modification to the existing Bulli Seam Operations Project (BSOP) Approval, which was granted by the Planning Assessment Commission on 22 December 2011 under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). South32 Illawarra Coal propose to continue underground mining at their Bulli Seam Operations. In order to do so, they propose optimising the pre-mining extraction and utilisation of methane gas from the mine, as a means to support the safe and efficient extraction of coal in the Bulli Seam Operations. This would result in considerable benefits in terms of power generation and reduction in greenhouse gas emissions.

The construction and use of future gas drainage infrastructure was not included in the existing BSOP Approval. Therefore, a s75W modification to the BSOP Approval is proposed, to incorporate the construction and operation of the proposed gas management infrastructure, hereafter referred to as the Mine Safety Gas Management Project (MSGMP).

1.2 Site Location

The Bulli Seam Operations are located in the Southern Coalfield of New South Wales, approximately 25km northwest of Wollongong in the vicinity of the Appin, Wilton, Douglas Park, Picton and Menangle townships (Figure 1). The proposed MSGMP works are located within the Appin mining operations, between the townships of Appin and Douglas Park, within the vicinity of Brooks Point Road. For this heritage assessment, the subject area is defined as the disturbance footprint of the proposed gas drainage pipeline, which extends along Brooks Point Road between Appin No. 3 Shaft and the existing gas infrastructure and power generation facilitates located at the Appin No. 2 Shaft site (Figure 2).

1.3 Proposed Works

The MSGMP includes the following gas management infrastructure works:

- Installation and operation of a gas upcast riser within Appin No. 3 shaft and ancillary infrastructure such as explosion protection and gas flow valving within the Appin No. 3 shaft precinct.
- Installation and operation of a buried nominal 1000mm diameter surface suction high density polyethylene (HDPE) pipeline between Appin No. 3 Shaft and the existing gas extraction infrastructure and power generation facilities located at the Appin No. 2 Shaft site (see Annex 1).
- Brooks Point Road would be crossed twice by the buried surface suction pipeline in accordance with a s.138 approval under the *Roads Act 1993* issued by Wollondilly City Council.
- Installation and operation of four water collection traps and associated small diameter pipelines (nominal 50mm PE) / access infrastructure to enable captured condensate to be removed by suction truck.
- Installation and operation of above ground crossing of the Upper Canal and Simpsons Creek. These crossings would be nominal 1000mm steel pipe with supporting concrete abutments and steel gantries (see Annex 2 for design plans of the crossing at the Upper Canal).
- Underboring of gas and electrical power distribution systems in accordance with infrastructure owner requirements.

1.4 Aims

This historical heritage assessment aims to assess the impact of the proposed gas drainage pipeline on historical heritage items, and propose recommendations for impact mitigation and management. It has been prepared in accordance with best practice in historical heritage management as guided by the *NSW Heritage Manual* (Department of Urban Affairs and Planning 1996) and the *Burra Charter* (Australia ICOMOS 2013) with reference to the provisions of the *NSW Heritage Act 1977* and the *Wollondilly Local Environmental Plan 2011*. This assessment has also been prepared with regard to the requirements of the BSOP Heritage Management Plan (BSOP HMP) (Biosis 2012) and in reference to the non-Aboriginal heritage assessment completed by Michael Pearson Heritage Management Consultants Pty Ltd (MPHMC) in 2009 as part of the Environmental Assessment (EA) (Resource Strategies Pty Ltd 2009) completed to support the BSOP Approval.

1.5 Methodology and Report Outline

The assessment was prepared by undertaking the following tasks:

- **Review of Heritage Listings**

  A search of relevant statutory and non-statutory, local, State and National heritage registers to identify any items of heritage significance in the subject area was undertaken and is presented in Section 2, alongside a summary of relevant legislation.

- **Review of Previous Heritage Assessments**

  A review of relevant previous heritage assessments relevant to the subject area was completed, the results of which are summarised in Section 3.

- **Preparation of Historical Background**

  A summary historical background of the subject area was prepared to provide a context for the assessment and is presented in Section 4.

- **Field Survey**

  A field survey of the subject area was conducted in January 2016. The results of this survey are outlined in Section 5.

- **Significance Assessment**

  Significance assessments of heritage items identified within, or in close proximity to, the subject area using the NSW Heritage Criteria are presented in Section 6.

- **Impact Assessment**

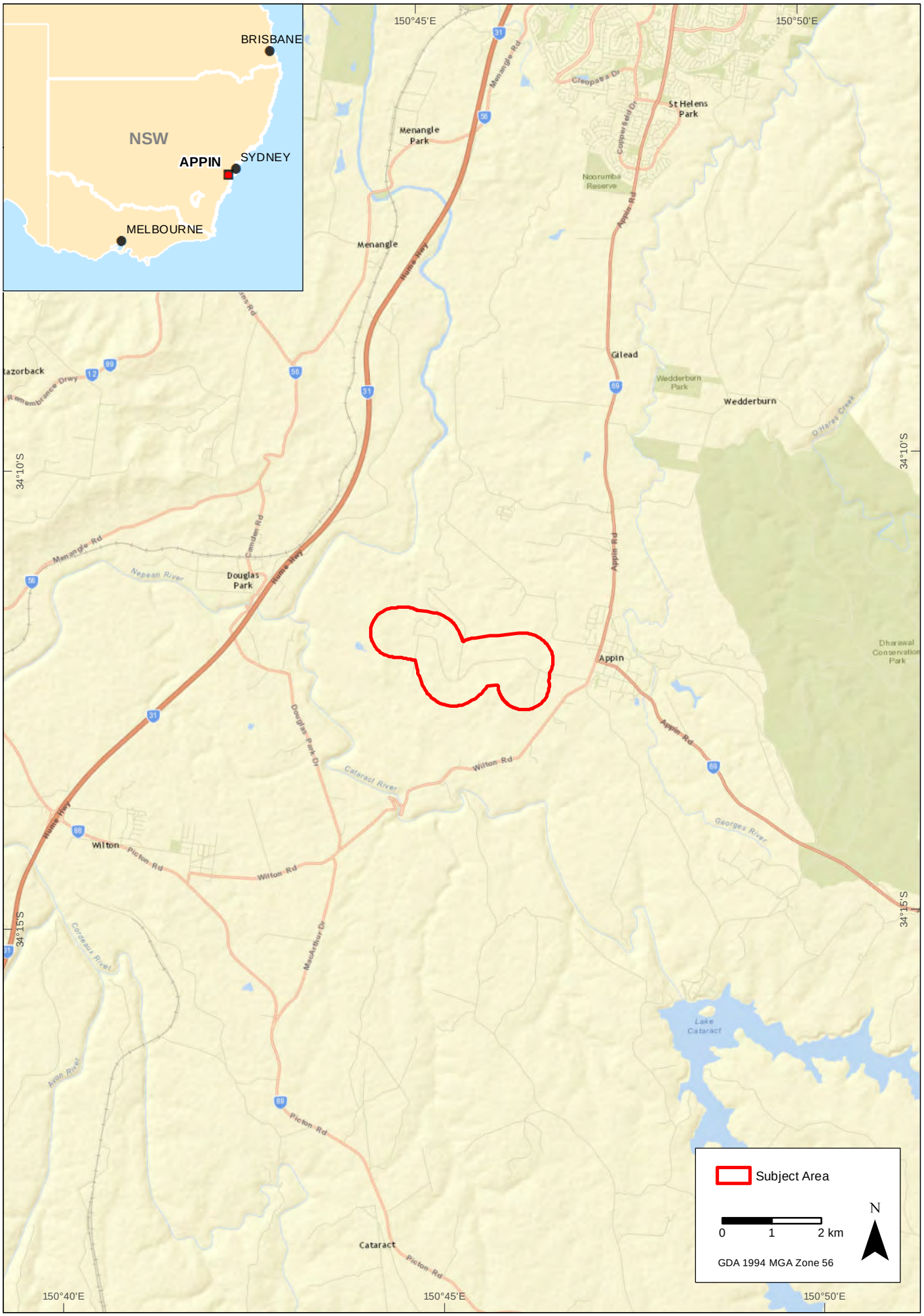
  Following the identification and significance assessment of historical heritage items within, or in close proximity to, the subject area, the potential impact of the proposed works on historical heritage was assessed. The results of this impact assessment are included in Section 7.

- **Recommendations and Conclusions**

  Recommendations to manage, minimise or avoid any identified impacts on items of historical heritage were devised and are presented in Section 8.

1.6 Authorship and Acknowledgements

This report has been prepared by Aleisha Buckler (Archaeologist, Niche) and has been reviewed by Fiona Leslie (Principal Archaeologist, Niche).



Drawn by: RJ Project Manager: CMcE Project Number: 2522 Date: 01/02/2016

Locality Map

Appin East Mine Safety Gas Management Project - s75 Modification

FIGURE 1

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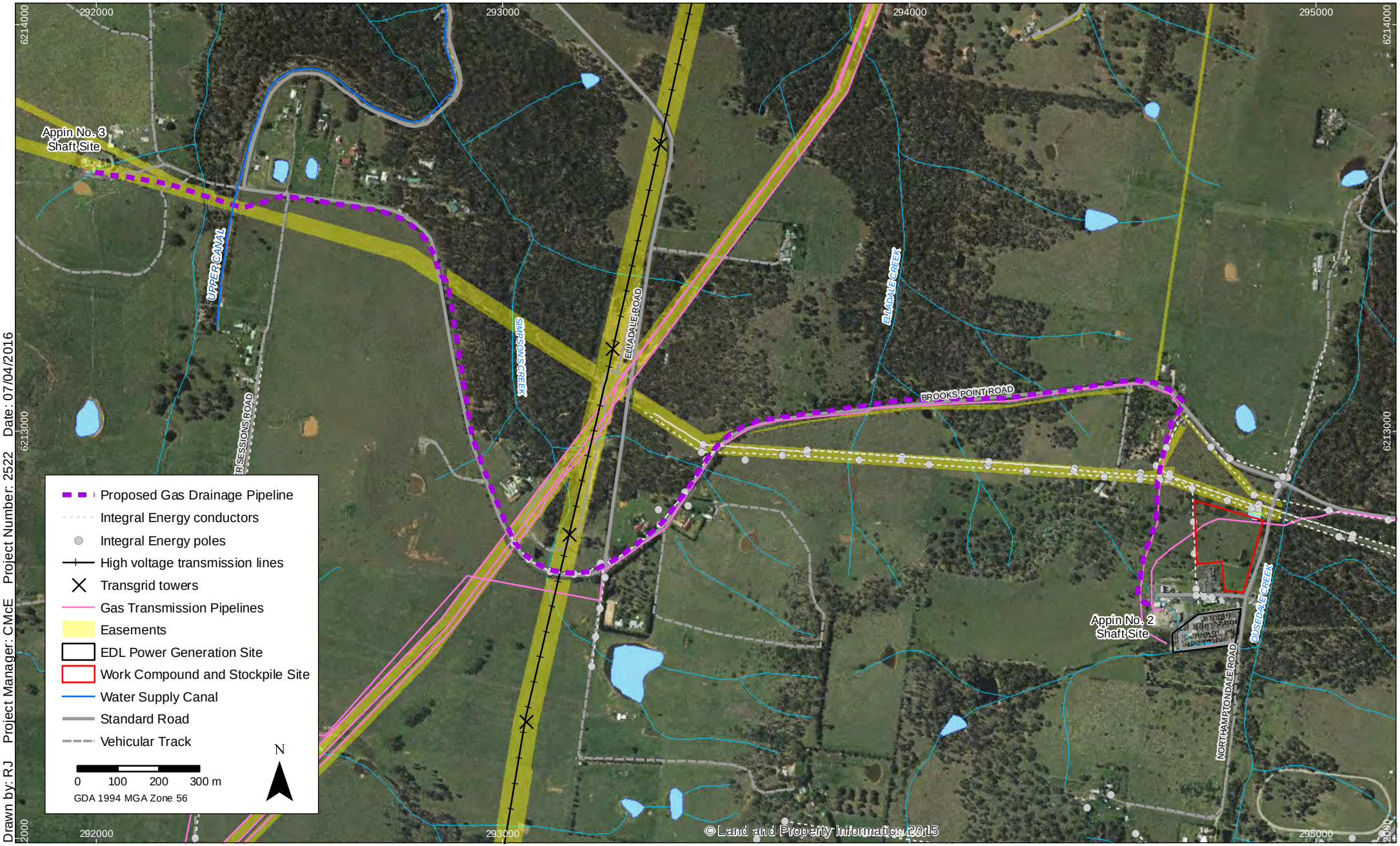

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niche Environment and Heritage

Site Plan

Appin East Mine Safety Gas Management Project - s75 Modification

FIGURE 2

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2. Statutory Context

2.1 Preamble

There are two statutory instruments designed to conserve and manage significant historical heritage items in NSW: the *Heritage Act 1977* and the *Environmental Planning and Assessment Act 1979*. The following subsections provide a summary of these Acts as they relate to State Significant Developments (SSDs). The results of heritage register searches for the subject area are also summarised and presented in Section 2.3.

2.2 Regulatory and Assessment Framework

2.2.1 The NSW Environmental Planning & Assessment Act 1979

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) establishes the framework for cultural heritage values to be formally assessed in the land use planning and development consent process and requires that environmental impacts are considered prior to land development, including impacts on heritage items. The Act also requires that local governments prepare planning instruments (such as Local Environmental Plans) in accordance with the principles of the legislation to provide guidance on the level of environmental assessment required.

Under Division 4.1 of the EP&A Act, a specific assessment system has been created to consider projects classed as State Significant Development (SSD). A range of development types such as mines and manufacturing plants as well as warehousing, waste, energy, tourist, education and hospital facilities are considered to be SSD if they are over a certain size or located in a sensitive environmental area. The Minister for Planning and Environment is the consent authority for SSDs and, following the submission of a Preliminary Environmental Assessment (PEA), Director General's Requirements (DGR) are normally issued outlining the requirements for detailed environmental assessment in accordance with the relevant State Environmental Planning Policy.

With regards to the existing Bulli Seam Operations Project, an approval was granted by the Planning Assessment Commission on 22 December 2011 under the former Part 3A of EP&A Act, which was designed to streamline the approval process for SSDs. South 32A Illawarra Coal now require a s75W modification to the existing approval.

2.1.3 The NSW Heritage Act 1977

The NSW *Heritage Act 1977* (or the 'Heritage Act' or 'Act') is a statutory tool designed to conserve environmental heritage in NSW. It is used to regulate development impacts on the State's historical heritage assets. The Act defines a heritage item as 'a place, building, work, relic, moveable object or precinct'.

To assist management of the State's heritage assets, the Act distinguishes between items of Local and State heritage significance:

> *'Local heritage significance', in relation to a place, building, work, relic, moveable object or precinct means significance to an area in relation to the historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic value of the item; and*
>
> *'State heritage significance', in relation to a place, building, work, relic, moveable object or precinct means significance to the State in relation to the historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic value of the item.*

To assist with the assessment of the environmental heritage of NSW under the Act, the *NSW Heritage Manual* (1996) provides Heritage Council endorsed guidelines which outline three steps to manage heritage items in NSW, which are:

- Investigate significance.
- Assess significance.
- Manage significance.

These steps apply to all types of heritage including built, archaeological and landscape places. They apply to any level of significance assessment and are relevant to all developments subject to the EP&A Act, including SSDs.

2.3 Heritage Register Searches

The following subsections present the results of Commonwealth, National, State and local heritage register searches. The location of heritage listed items within, or in close proximity to, the subject area are shown in Figure 3.

2.3.1 Commonwealth and National Heritage Registers

Under the *Environmental Protection and Biodiversity Conservation Act 1999 Amendments* (No. 88, 2003), two mechanisms have been created for the protection of heritage places of National or Commonwealth significance: The National Heritage List (NHL) and the Commonwealth Heritage List (CHL). The NHL provides protection to places of cultural significance to the nation of Australia, while the CHL comprises natural, Aboriginal and historic heritage places owned and controlled by the Commonwealth. These lists can be searched via the Australian Heritage Database (https://www.environment.gov.au/cgi-bin/ahdb/search.pl), which also includes places in the World Heritage List and the Register of the National Estate.

- A search of Commonwealth and National heritage registers via the Australian Heritage Database was undertaken on 7 January 2016. The closest heritage listed item to the subject area is the Upper Nepean Water Catchment (Place ID: 14746), which covers an area of land to the south of the subject area, and is listed on the Register of the National Estate.

2.3.2 NSW State Heritage Register

The NSW State Heritage Register (SHR) lists items that have been assessed as being of State heritage significance. Items listed on the SHR are granted protection under S.60 of the *Heritage Act 1977*.

- A search of the SHR was completed on 7 January 2016. The subject area extends through a section of the State heritage listed Upper Canal System (Pheasant's Nest Weir to Prospect Reservoir) (SHR ID: 01373). The relevant section of this item is located on Lot 1 DP732571 (Figure 3).

2.3.3 NSW State Heritage and Conservation (S.170) Registers

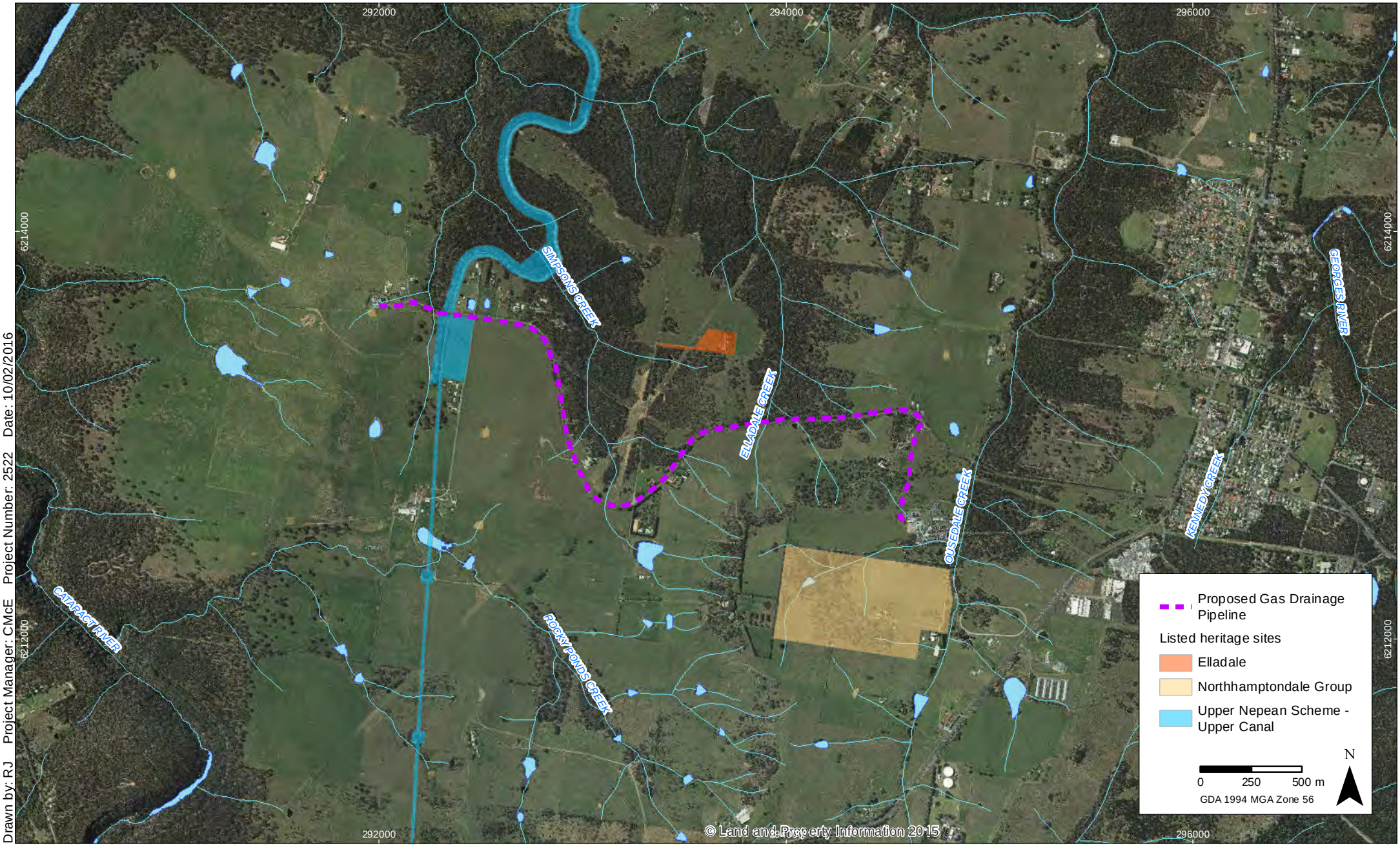
S.170 of the *Heritage Act 1977* requires that State Government Agencies establish and maintain a Heritage Conservation Register for heritage items located on land under their control or ownership. Items listed on a S.170 Register are listed on the State Heritage Inventory (SHI) and bound by the regulations of the *Heritage Act 1977*.

- A search of the SHI was completed on 7 January 2016. The Upper Nepean Scheme (SHI No. 4580004) is listed on the Water NSW S.170 heritage register.

2.3.4 Wollondilly Local Environmental Plan (LEP) 2011

Each Local Government Area (LGA) is required to create and maintain an LEP that identifies and conserves Aboriginal and historical heritage items. These items are protected under the *EP&A Act*.

- A search of the Wollondilly LEP was undertaken on 7 January 2016. Three listed heritage items are located in close proximity to the subject area:
  - Upper Nepean Scheme – Upper Canal (Item No. I16). This item is located within Lots 1 and 2 DP625921 and Lots 1-3 DP719962 to the north of the subject area.
  - Elladale (Item No. I11). This item is located within Lot 101 DP790844, to the north of the subject area.
  - Northampton Dale Group – House, Trees, Slab Farm, Outbuildings, Stables (I13). This item is located within Lots 201 and 203 DP819476 to the south of the subject area.



Historical Cultural Heritage Sites

Appin East Mine Safety Gas Management Project - s75 Modification

FIGURE 3

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3. Previous Heritage Assessments

3.1 Preamble

The following subsections provide a summary of the most relevant previously prepared cultural heritage reports which relate to historical heritage items within the subject area and its surrounds.

3.2 Conservation Management Plan for the Upper Canal (2002)

A Conservation Management Plan (CMP) was prepared for the Upper Canal as part of the Upper Nepean Scheme, by Edward Higginbotham & Associates in 2002 (Higginbotham 2002). The purpose of the CMP was to ensure the conservation of the cultural heritage of the Upper Canal, whilst maintaining operational efficiency (Higginbotham 2002:2). The CMP provides a detailed historical background, an inventory of all significant items along the route of the Upper Canal, significance assessment, and conservation policies, guidelines and recommendations. The CMP Inventory identifies the following items within, or in close proximity to, the subject area:

- Canal (Section 2, Inventory Nos. 1-2). Constructed c.1880s, this section of the Canal was assessed as having 'exceptional' significance;
- Canal Overbridge (Section 2, Inventory No. 6). Constructed c.1917, the canal overbridge was assessed as having 'considerable' significance; and
- Culvert (Section 2, Inventory No. 7). Constructed c.1880s, the culvert and discharge channel was assessed as having 'exceptional' significance.

A copy of the inventory sheets for these items is attached in Annex 3.

A major driver for the preparation of the CMP was to provide approval for operational activities, maintenance works and minor construction works to be undertaken on the Canal (Higginbotham 2002:1). In particular, the CMP outlines a number of exempt activities, including protection of the fabric of the Canal and associated structures, day-to-day operation, periodic maintenance, minor construction works and installation of interpretation material. Of relevance to this assessment, the CMP outlines the following general principles in relation to the installation of new items along the Upper Canal:

- *New buildings or structures should be similar in style, scale, form and building materials to those of heritage significance formerly constructed along the Upper Canal.*
- *When placing new items next to heritage items, care should be taken to use similar materials, scale, form and size, where appropriate.*
- *New items should not introduce poor standards of workmanship or materials which are incompatible with historical construction along the Canal.*
- *New items should be unobtrusive and should not obscure adjacent heritage items or detract from their setting, and*
- *Significant fabric should not be disturbed or demolished by the construction of new items.*

The Upper Canal CMP was endorsed by the Heritage Council in 2003 for a period of five years, which has now expired. Water NSW are currently in the process of updating the CMP (Neil Abraham, Environmental Advisor, Water NSW 2016, pers.comm., 14 January).

3.3 BSOP Non-Aboriginal Heritage Assessment (2009)

As part of the BSOP Environmental Assessment (EA), Michael Pearson Heritage Management Consultants (MPHMC 2009) undertook an assessment of non-Aboriginal (historical) heritage for the Project. The assessment identified 49 historical heritage items of local and State significance across the entire BSOP area. These included existing heritage items, as well as some proposed for future inclusion. Of the four non-Aboriginal heritage items listed for the Appin area (within the BSOP area), only one is relevant to this Project: the Upper Nepean Water Supply System Canal (Item No. 38). Its summary statement of heritage significance is given as:

> *State historical significance as part of Sydney's water scheme of the 1880s and an excellent example of 19th century hydraulic engineering, including the use of gravity to feed water along the canal.*

The assessment found that the BSO Project had the potential to cause cosmetic damage, cracks and leaks to the canal, but also noted that it had already been affected by mining in the past (MPHMC 2009:40). Heritage management measures were recommended in light of these potential impacts, namely, that serviceability and safety of the canal be maintained, and that impacts on the heritage values of the canal be minimised in accordance with the CMP (MPHMC 2009:40). The assessment recommended that advice from a specialist Conservation Architect be obtained with respect to any engineering works at the canal (MPHMC 2009:40).

The assessment included 'Elladale' and the 'Northampton Dale Group' in a list of heritage items that would not be impacted by the Project (MPHMC 2009:24).

The non-Aboriginal heritage assessment, together with a separate Aboriginal Cultural Heritage Assessment (ACHA), were used to inform the preparation of the Heritage Management Plan (HMP) for the Project.

3.4 BSOP Heritage Management Plan (2012)

Biosis (2012) prepared the BSOP Heritage Management Plan (HMP) in 2012. The HMP outlines programs and procedures for the management of Aboriginal and non-Aboriginal (historical) heritage in the BSOP area, including the preparation of subsequent management plans required for Extraction Plans and surface works. The HMP identifies items and/or places of Aboriginal and historical heritage within the BSOP area and details the management procedures and requirements to manage these items in accordance with the conditions and performance measures of the BSOP Approval.

The BSOP HMP outlines requirements for the preparation of future heritage assessments and HMPs. The following summarised procedures are considered relevant to this Project:

- Review and update of heritage register searches.
- Additional heritage investigations:
  - Additional background research for non-Aboriginal heritage will be undertaken to address any knowledge gaps identified in the investigations undertaken for the EA.
  - Supplementary surveys will be undertaken to identify new and relocate previously recorded historic heritage sites.
- Significance assessments:
  - Updated significance assessments must be provided for non-Aboriginal heritage items.
- Impact assessments:
  - Revised impact assessments must be included for non-Aboriginal heritage items.
  - Impact assessments must consider all relevant potential impact activities.

- Heritage management programs:
  - Detail of heritage management programs for non-Aboriginal heritage, including:
    - Consideration of avoidance or minimisation of harm strategies.
    - A protocol for the management and reporting of any non-Aboriginal heritage sites that may be identified during the life of the project in compliance with an unanticipated finds procedure.
- Discovery of unanticipated historical relics.

The BSOP HMP provides a list of historical heritage items of local and State significance in the BSOP study area, which was compiled using the non-Aboriginal heritage assessment (MPHMC 2009) previously prepared for the EA (see Section 3.3.2 of this report).

4. Historical Background

4.1 Preamble

This section of the report summarises the history of Appin and its surrounds, focusing on past land use within the subject area along Brooks Point Road. Its purpose is to provide a historical context for existing and potential heritage items located within the subject area. This background has been prepared primarily using secondary sources, with much of the information reproduced from previous heritage studies (see Section 3). Additional research has also been undertaken where necessary, including the addition of parish plans sourced from the Department of Land and Property Information (LPI).

4.2 Appin

The Appin area originally formed part of the 'Cowpastures', an area of land in which the Colony's stray cattle herds were rediscovered by an exploration party led by Governor Hunter in 1795 and 1796 (MPHMC 2009:5). The area was set aside for the purpose of raising stock, and a house – the first in the district, known as 'Cowpastures House' – was built for officers to mind the cattle in 1805 (MPHMC 2009:5). A number of stockyards in the district were later established (MPHMC 2009:5). John Macarthur was granted 5,000 acres of land in the district in the same year, which he named Camden Park and began exporting wool to Britain. Governor Macquarie visited the district in 1810, naming the district around present-day Campbelltown 'Airds' after the family estate of his wife Elizabeth, which was located near the village of Appin in Scotland, where she was born (MPHMC 2009:6). Land was soon made available for the purposes of farming (MPHMC 2009:6).

By 1814, large numbers of displaced Dharawal Aboriginal people had begun to congregate in the Appin area in search of food and other resources, which resulted in the stealing of crops (MPHMC 2009:8). An initial conflict, involving the death of at least seven people, resulted in Governor Macquarie sending a punitive military expedition in 1816 (MPHMC 2009:8). On 17 April 1816, a group of 14 Aboriginal people, including men, women and children, were shot or driven over a cliff to their deaths, in an event known as the Appin Massacre (MPHMC 2009:8). The massacre took place on Broughton's land, but the exact site of the massacre is unknown (MPHMC 2009:8).

The village of Appin was formally surveyed in 1834 (MPHMC 2009:8). From the 1820s, grain was the major crop grown and mills were established in the district (MPHMC 2009:8). With the collapse of wheat in the region in the 1870s, due to rust, dairying, particularly the production and treatment of cream, became a major industry in Appin – with the last dairy in Appin, located on Brooks Point Road, closing in 2003 (MPHMC 2009:8). Before the South Coast Railway linked Wollongong to Sydney in 1887, Appin served as a staging post for people travelling to the Illawarra region (MPHMC 2009:10).

The Appin area has, in more recent years, been characterised by coal mining. The State Coal Mine Reserve was proclaimed in 1926 and encompassed the West Cliff Colliery Site, where mining commenced in 1976. The Appin Colliery commenced operations in 1962 (MPHMC 2009:12).

4.3 The Subject Area

The subject area is located within the first land parcels to be granted in Appin. It is situated within 1,000 acres granted to Deputy Commissary General William Broughton in April 1811, and which he named 'Lachlan Vale' after Governor Macquarie (MPHMC 2009:7) (Figure 4). Broughton had arrived on the First Fleet in 1788 as a servant to surgeon John White (Whitaker 2005:6). Broughton's brother-in-law, John Kennedy, was also granted 200 acres at 'Teston Farm' at this time (MPHMC 2009:7). The 'Teston Farm'

property, at the west of the subject area on Brooks Point Road, would later be owned by the Morrison family who established the Morrison Brother's Dairy there, which closed in 2003. In total, six settlers were granted land in the district in 1811-1812, and another 22 land grants were made in 1815-1816 (MPHMC 2009:7). Broughton, Kenny and the other early settlers in the district proceeded to clear and improve their lands for the purpose of farming, as documented in a visit by Governor Macquarie in 1815 (Whitaker 2005:6).

Figure 4: Early land grants in Appin, c.1834. The subject area extends across the 'Lachlan Vale' estate granted to William Broughton (State Library of NSW 1834).

Broughton and his family built at least three homesteads on their estate, the first being near the 'Teston Farm' property (Figure 5), and the last in the location of 'Northampton Dale', which was renamed by John Percival who became the owner of the property following the deaths of William Broughton in 1821 and his wife Elizabeth in 1843 (Whitaker 2005:103). 'Elladale' was another early property established in the area and was built in 1838 by Appin's first Anglican minister, the Reverend Hart Sparling who named the homestead after his wife Ella (Whitaker 2005:114). The sandstone house also served as a church during those early years.

The 'Lachlan Vale' estate was subdivided into ten farm lots in 1856, varying in size from 80 to 188 acres (*Empire* 18 June 1856:8) (Figure 5). At this time the estate was described as being "cultivated meadow and forest lands", with some huts, stockyards and fencing established (*Empire* 18 June 1856:8). According to *The Maitland Mercury and Hunter River General Advertiser* (31 July 1856:3), the lots were "chiefly purchased by parties who had been living thereon as tenants". As shown in Figure 5, an early road (in the same location as Brooks Point Road, today), extended through Lots 4-6 and 8. The following lot descriptions for these particular lots at the time of subdivision in 1856 are provided in an advertisement in the *Empire* (18 June 1856:8):

- Lot 4 – 15 acres of cultivation. About 28 acres of grass and the remainder forest lands. A hut and abundance of water.
- Lot 5 – 11 acres of cultivation and remainder forest lands. A good hut or dwelling.
- Lot 6 – About 46 acres of cultivation. The remainder forest land. A hut and stockyard.

- Lot 8 – 31 acres of cultivation, orchard and garden. About 70 acres of grass and the remainder of forest land. On this lot stands the Old Family Mansion containing 13 rooms.

The 'Old Family Mansion' referred to in the lot description is annotated on the subdivision plan as 'Lachlan Vale House' and is likely the first (or possibly, second) homestead built by the Broughton family on their estate (Figure 5).

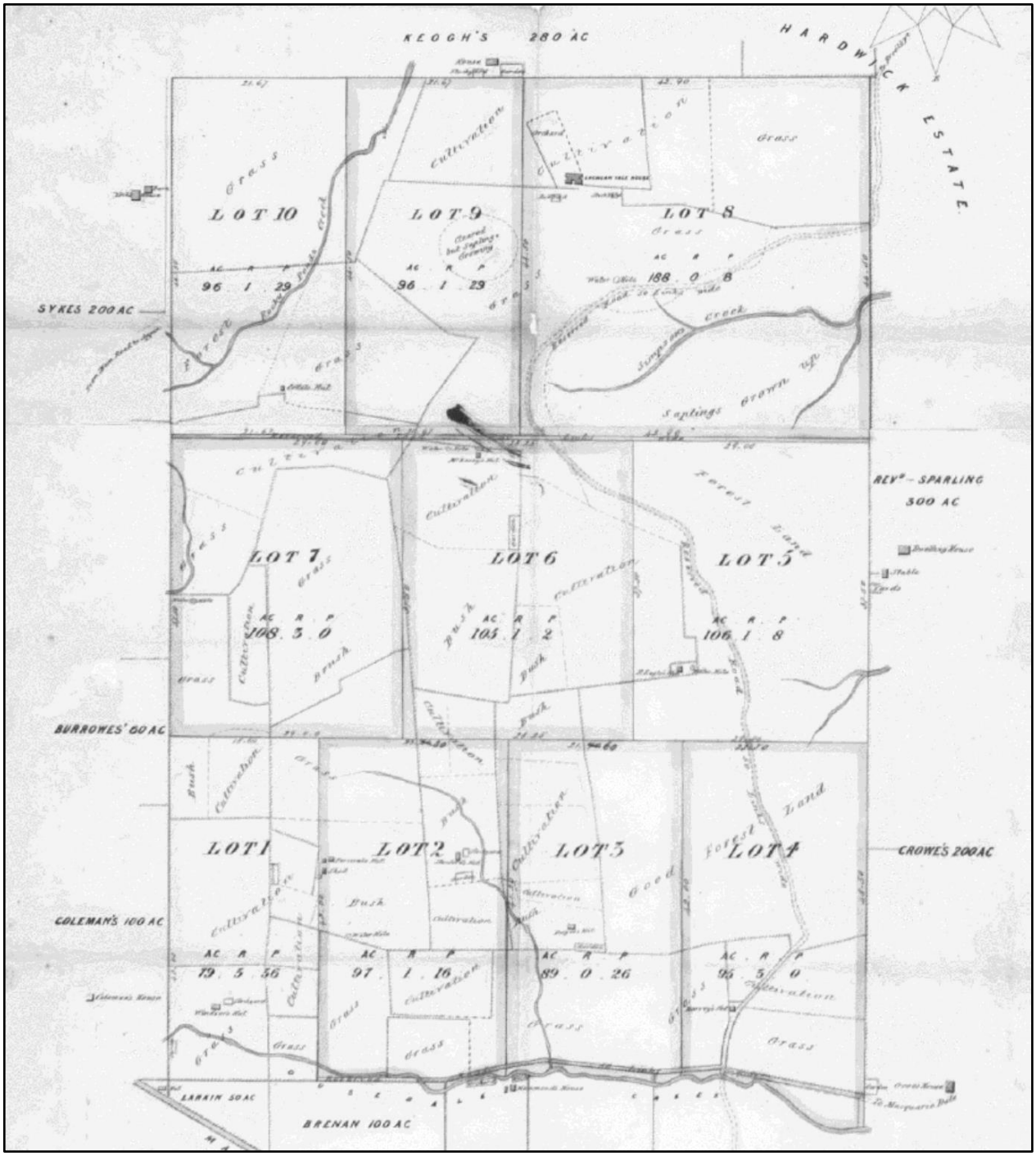

Figure 5: Plan of the Lachlan Vale Estate subdivision in 1856 (State Library of NSW 1856).

The road extending through the estate, between 'Teston Farm' and the Hardwicke Estate and Appin, within the lots described above, was not formally established until early 1858 (Figure 6). This road was named The Lachlan Vale Road, and included a junction with an earlier Brooks Point Road to the north-east of 'Teston

Farm'. Figure 7 depicts a later map which also shows The Lachlan Vale Road and the location of the Upper Canal in the west of the subject area, as part of the Upper Nepean Water Scheme.

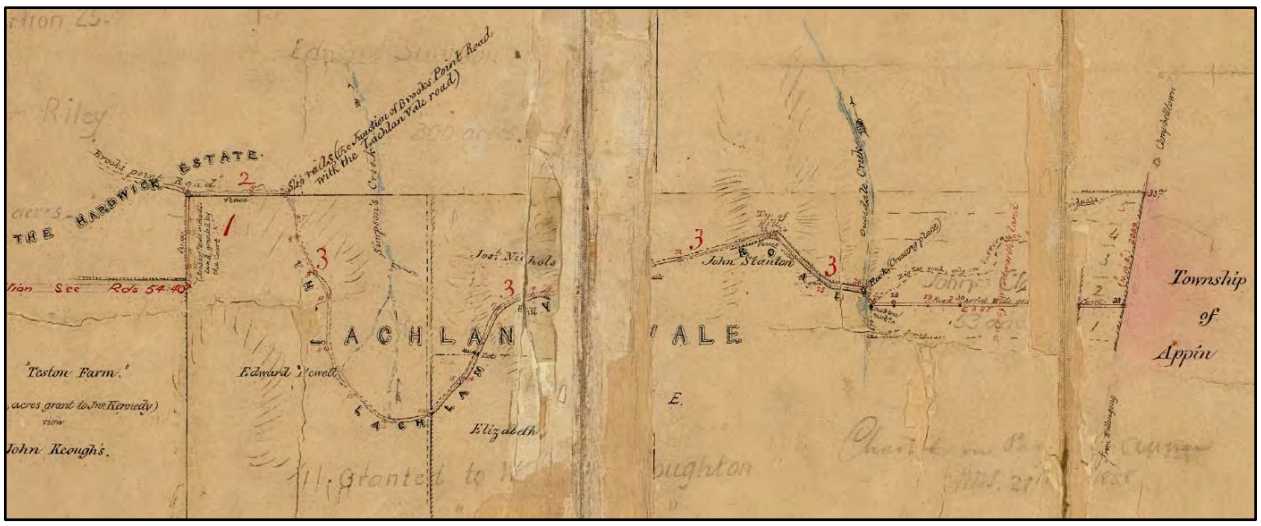

Figure 6: Plan of The Lachlan Vale Road between Teston Farm and Appin through Lachlan Vale in February 1858 (LPI R29.1181).

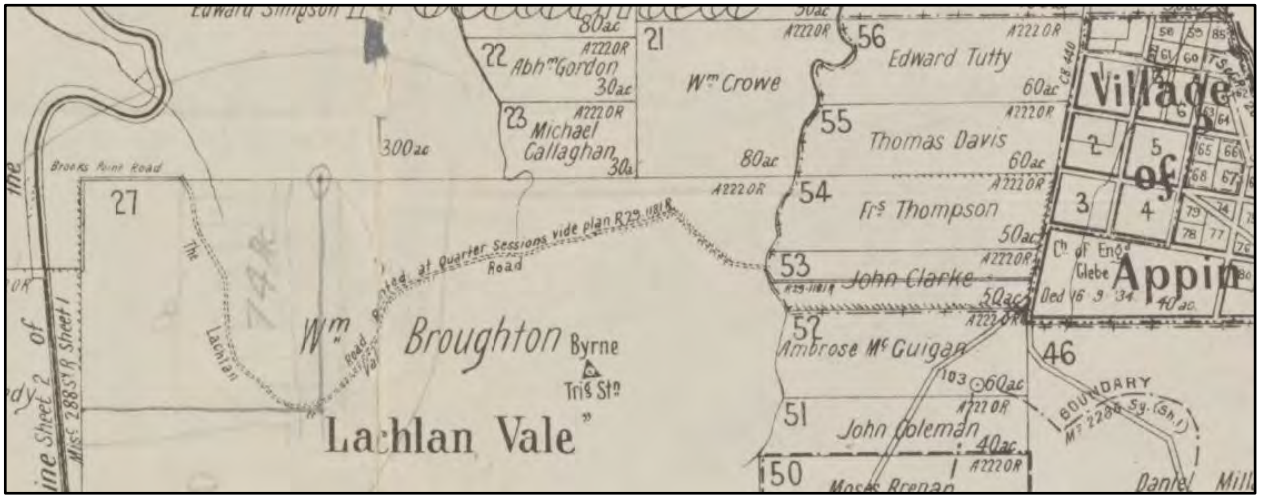

Figure 7: The Lachlan Vale Road, Brooks Point Road and the Upper Canal in 1905 (NLA 1905).

In 1974, a wider road was proposed and its new alignment corresponds with the current route of Brooks Point Road through the subject area (Figure 8). A transmission line easement on resumed land was established in this section of Brooks Point Road in 1948. The location of this easement and other later land disturbance works within the subject area, in the vicinity of the road corridor are shown in Figure 9, including:

- Easements for transmission line (3).
- Ethane pipeline (7).
- Easements for transmission line (8).
- Closed earlier road dating to 1974 (14) (refer to Figure 8 for details).
- Easement for natural gas pipeline (15).
- Easement for water supply purposes (26), and
- Easement for pipeline (28).

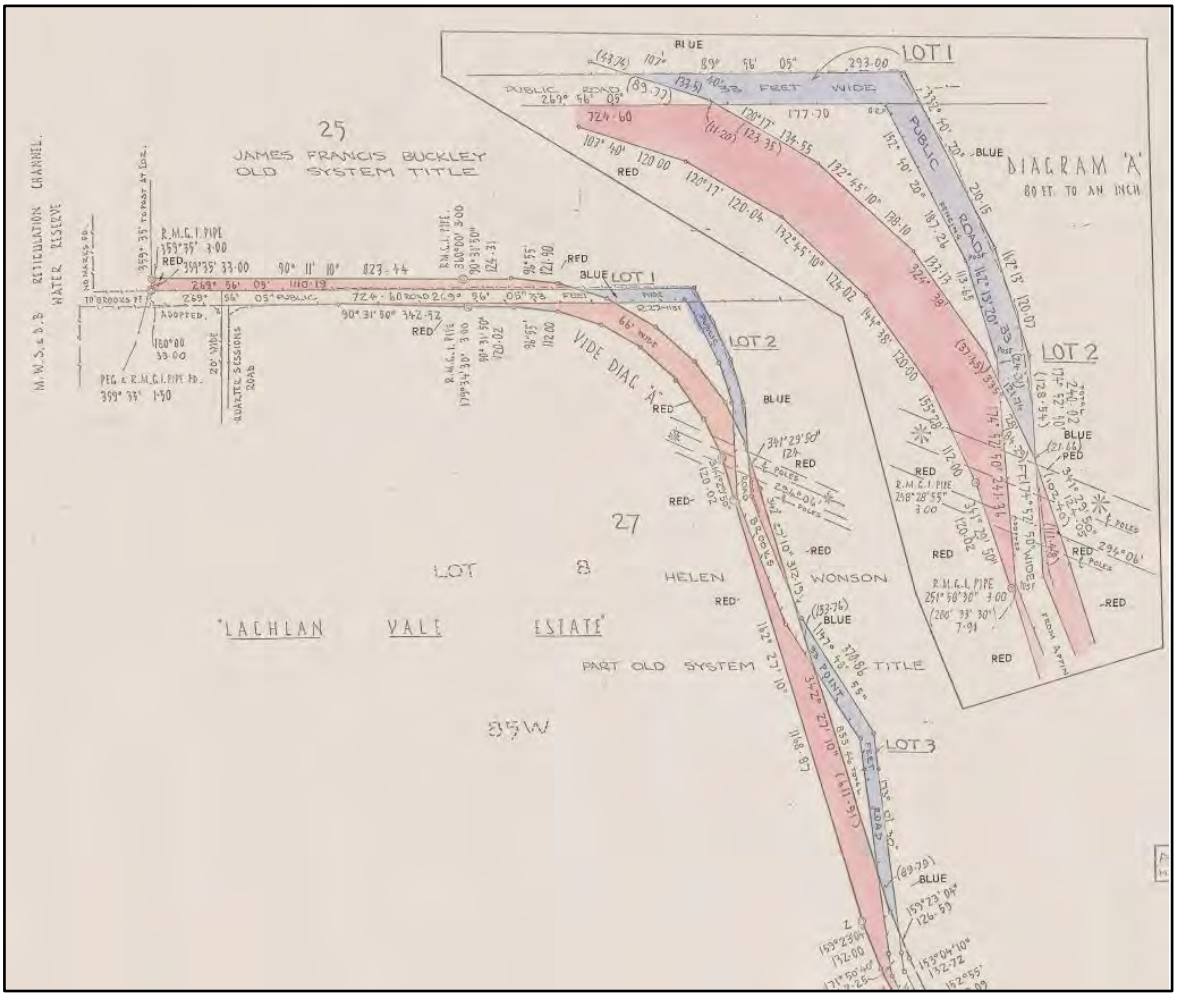

Figure 8: A section of the plan of the proposed road marked in red in 1974 (LPI R34224.1603).

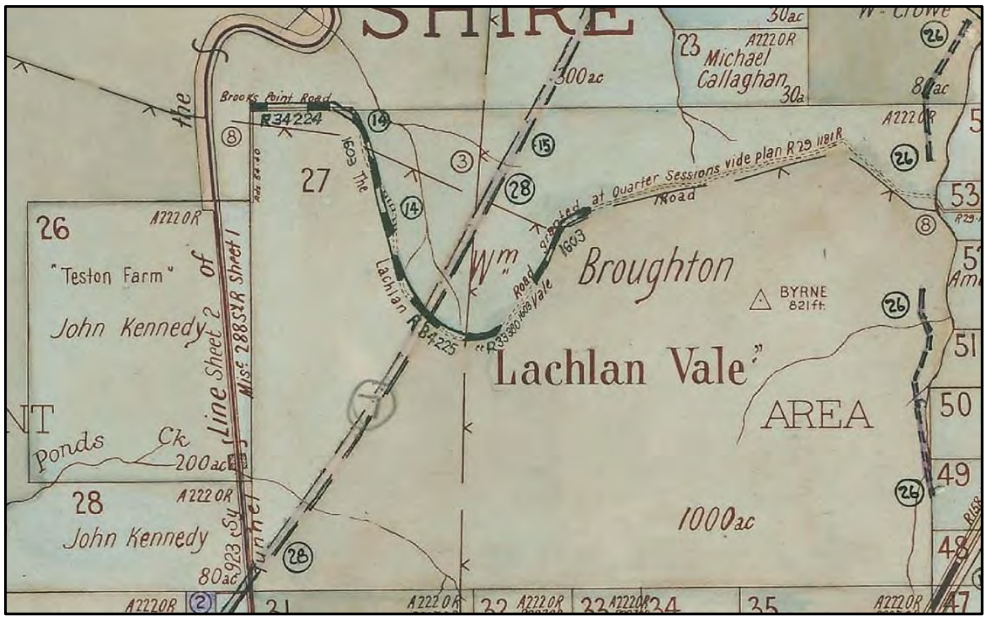

Figure 9: The subject area in 1982 showing numerous transmission line and pipeline easements along The Lachlan Vale Road (LPI 1982).

4.3.1 The Upper Canal

The Upper Canal forms part of the Upper Nepean Scheme and consists of a system of tunnels, aqueducts and open canals collectively known as the Upper Canal, which enable water diverted through the Nepean Tunnel to flow a distance of 64km to the major distribution reservoir at Prospect, and supply water to a number of localities en route (MPHMC 2009: A-113). Built in the 1880s, the Upper Canal is still the only way of transferring water to Sydney from the four Upper Nepean dams (Cataract, Cordeaux, Avon and Nepean) and the Upper Nepean Scheme continues to supply 20 to 40 percent of Sydney's Water (Water NSW 2016).

The following section provides a summary chronology for the Upper Canal and Upper Nepean Scheme generally, with information primarily sourced from the non-Aboriginal heritage assessment previously prepared for the BSOP area (MPHMC 2009) and the Upper Canal CMP (Higginbotham 2002), which provides a more detailed history.

- By 1867, Sydney water supply was in a precarious position, with a number of solutions investigated, ultimately leading to the selection of the Upper Nepean Scheme, which consists of the following stages:
  - A weir at Pheasant's Nest just below the junction of the Avon and Cordeaux Rivers, a portion to the flow to be directed by tunnel (Nepean Tunnel) to connect with the Cataract River.
  - A similar weir at Broughton's Pass on the Cataract River to receive the water from Pheasant's Nest Weir, and from there directed into the approximately 60km long Upper Canal, consisting of tunnels, open canals and aqueducts.
  - A storage reservoir at Prospect, at the end of the Upper Canal.
  - An 8km canal from Prospect to Guildford (now Pipe Head Reservoir or the Lower Canal).
  - Iron pipelines to distribution reservoirs at Potts Hills and Crown Street.
- Cataract Dam was completed by the end of 1907 as a means to augment the water supply.
- Cordeaux Dam was completed in 1926, Avon Dam soon afterwards in the same year and the Nepean Dam (Warragamba) was completed in 1935.
- Repairs and maintenance were carried out on the Upper Canal where necessary. By the 1990s, some lengths were re-lined.
- The Upper Canal was built of a variety of materials resulting in a variety of section profiles. Where the ground was soft the Canal was V-shaped and the sides were pitched with shale or sandstone slabs. In other sections the Canal was U-shaped and the sides were walled with sandstone masonry or unlined if cut into solid rock.
- Where the Canal crossed creeks or large depressions, the water was carried across in wrought iron inverted syphons resting on stone piers.
- As well as bridges over major roads, 'occupation bridges' were erected to allow property owners with land severed by the Canal access between parts of their holdings.

5. Field Survey

5.1 Preamble

A field survey of the proposed location of the gas drainage pipeline along Brooks Point Road between Appin No. 3 Shaft and the existing gas infrastructure and power generating facilities located at the Appin No. 2 Shaft site, was undertaken on 20 January 2016 by Aleisha Buckler (Niche, Archaeologist). The historical heritage field survey was carried out concurrently with the Aboriginal heritage and ecology field surveys.

5.2 Field Survey Results

The survey commenced at Appin No. 3 Shaft at the western end of Brooks Point Road, and proceeded east along the proposed location of the gas drainage pipeline for approximately 4km. While generally flat, the road sloped in some sections and crossed a few small gullies (Plate 1 and Plate 2). The survey assessed the cleared and vegetated area 2m either side of the road to encompass the disturbance area associated with the burial of the 1m diameter pipe. This area was surveyed for known and any potential items of historical heritage, specifically associated with fencing, culverts or other features relating to early pastoral development and settlement within the subject area.

Plate 1: General photo of the subject area, looking east along Brooks Point Road.

Plate 2: General photo of the subject area, looking east along Brooks Point Road.

Progressing east along Brooks Point Road from Appin No. 3 Shaft, a stone culvert was identified across a vegetated gully (Plate 3 and Plate 4). The use of concrete mortar and the integration of the pipe with the surrounding stonework indicates that the culvert is of modern construction (at least post 1920s). It is most likely associated with more recent road improvement works along Brooks Point Road and is unlikely to be of local heritage significance. Subsequently, the culvert has not been classified as a heritage item.

Plate 3: Stone culvert along Brooks Point Road, facing north east.

Plate 4: Stone culvert along Brooks Point Road, facing south west.

Further east along Brooks Point Road, particular attention was paid to the proposed location of the gas drainage pipeline and where it was proposed to cross the Upper Canal, which is located towards the western end of Brooks Point Road. Here, the Upper Canal is of an open, masonry lined canal construction with vertical, square sides and appears to be in a good, functional condition (Plate 5 and Plate 6). According to the Upper Canal CMP Inventory Sheets (see Annex 3 – Section 2, Inventory Nos. 1-2), the Canal in this section measures 3.8m across and has a depth of water of 2.4m (Higginbotham 2002).

The Canal extends either side (to the north and south) of Brooks Point Road and is crossed by a single lane road overbridge (Plate 7 and Plate 8) (see Annex 3 – Section 2, Inventory No.6). The bridge was constructed in c.1917 using reinforced concrete beams set into the top of the Canal with barbed wire, iron and corrugated iron railings forming side balustrades. The above ground crossing of the Upper Canal would be sited just to the south of the existing road overbridge and would consist of a 1000mm diameter steel pipe with supporting concrete abutments and steel gantries and would extend a minimum of 5m each side of the Upper Canal (see Plate 8). The proposed steel gas reticulation pipeline would be co-located within an existing 66kV power line easement.

An original sandstone culvert with modern trash rack and discharge draining channel runs below and on both sides of the Canal, but primarily on the north side of Brooks Point Road (see Annex 3 – Section 2, Inventory No. 7) (Plates 9-12).

Plate 5: The Upper Canal, looking south from the canal overbridge on Brooks Point Road.

Plate 6: The Upper Canal, looking north from the canal overbridge on Brooks Point Road.

Plate 7: Canal overbridge at Brooks Point Road, looking south west.

Plate 8: Canal overbridge at Brooks Point Road, looking south east.

Plate 9: Sandstone culvert and discharge channel running beneath the Upper Canal on the north side of Brooks Point Road, looking south west.

Plate 10: Sandstone culvert and discharge channel on the south side of Brooks Point Road, looking south.

Plate 11: Sandstone discharge channel running west from the Upper Canal on the north side of Brooks Point Road, looking north west.

Plate 12: Sandstone discharge channel running west beneath the Upper Canal on the north side of Brooks Point Road, looking north.

No additional heritage items were identified within the subject area. A small number (>10) of blue transfer ware fragments, dating to the mid to the late nineteenth century, were identified approximately 1km east along the north side of Brooks Point Road. Given the absence of any previous historical development, or construction, the ceramics are likely associated with the use of the earlier road through the subject area ('Lachlan Vale Road') from c.1858, and later land disturbance due to the realignment and widening of the road in 1974 (see Figure 8). They are not considered to be *in situ* or to be associated with an area of archaeological potential and were subsequently assessed to have no heritage significance.

6. Significance Assessment

6.1 Preamble

The *NSW Heritage Manual*, prepared by the former NSW Heritage Office and Department of Urban Affairs and Planning, provides the framework for assessing significance in NSW These guidelines incorporate the five aspects of cultural heritage value identified in the *Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance 1999* (Burra Charter) into a framework currently accepted by the NSW Heritage Council. The following subsections present significance assessments for the heritage items identified during the background reviews and field survey, specifically the Upper Canal and associated infrastructure. Significance assessments of 'Elladale' and 'Northampton Dale' are not included as they are not in close proximity to the subject area and would not be impacted by the proposed works.

6.2 Upper Canal

The following significance assessment (Table 1) and Statement of Significance has been reproduced from the NSW State Heritage Register (SHR) listing for the Upper Canal (SHR ID: 01373).

Table 1. Significance assessment for the Upper Canal (SHR ID: 01373).

SHR Criterion	Significance
(a) An item is important in the course, or pattern, or NSW's cultural or natural history (or the cultural or natural history of the local area)	The Upper Nepean Scheme has functioned as part of the main water supply system for Sydney since 1888. Apart from the augmentation and development in supply and other improvements, the Upper Canal and Prospect Reservoir portions of the Scheme have changed little and in most cases operate in essentially the same way as was originally envisaged.
(b) An item has strong or special associations with the life or works of a person, or group of persons, of importance in the cultural or natural history of NSW (or the cultural and natural history of the local area)	The construction of the Upper Nepean Scheme made the big advance from depending on local water sources to harvesting water in upland catchment areas, storing it in major dams and transporting it to the city by means of major canals and pipelines.
(c) An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievements in NSW (or the local area)	The Upper Canal and associated infrastructure is not of State significance under this criterion.
(d) An item has a strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons	The Upper Canal and associated infrastructure is not of State significance under this criterion.
(e) An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or	The Upper Nepean Scheme provides detailed and varied evidence of engineering construction techniques prior to the revolution inspired by reinforced concrete construction. Although concrete was later used to improve the durability of the System, much of the earlier technology is still evident along the canal. It also provides extensive evidence of the evolution of engineering practice, such

natural history of the local area)	as the replacement of timber flumes by wrought iron flumes to be followed by concrete flumes. The early utilisation of concrete for many engineering purposes in the System, also demonstrates the growing emergence of an engineering technology based upon man-made materials. Many of the original control installations such as the 'Stoney gates', stop logs, penstocks, gate valves are still in service and continue to illustrate the technology of the time.
(f) An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area); and	The Upper Nepean Scheme is unique in NSW, being the only extensive canal, reservoir and dam network to supply a large city and its population with fresh water from a distant source in the hinterland. This type of water supply system is also rare in Australia and only has major comparative examples in other countries.
(g) An item is important in demonstrating the principal characteristics of a class of NSW's (or the local area's) ***(i) cultural or natural places; or*** ***(ii) cultural or natural environments.***	The Upper Canal and associated infrastructure is not of State significance under this criterion.

6.2.1 Statement of Significance

The Upper Canal System is significant as a major component of the Upper Nepean Scheme. As an element of this Scheme, the Canal has functioned as part of Sydney's main water supply system since 1888. Apart from maintenance and other improvements, the Upper Canal has changed little. As part of this System, the Canal is associated with Edward Moriarty, Head of the Harbours and Rivers Branch of the NSW Public Works Department. The Canal is aesthetically significant, running in a serpentine route through a rural bushland setting as an impressive landscape element with sandstone and concrete-lined edges. The Canal is significant as it demonstrates the techniques of canal building, and evidence of engineering practice. The Canal as a whole is an excellent example of 19th century hydraulic engineering, including the use of gravity to feed water along the canal. The Upper Nepean Scheme is significant because:

- In its scope and execution, it is a unique and excellent example of the ingenuity of late 19th century hydraulic engineering in Australia, in particular for its design as a gravity-fed water supply system.
- It has functioned as a unique part of the main water supply system for Sydney for over 100 years, and has changed little in its basic principles since the day it was completed.
- It represented the major engineering advance from depending on local water sources to harvesting water in upland catchment areas, storing it in major dams and transporting it the city by means of major canals and pipelines.
- It provides detailed and varied evidence of the engineering construction techniques prior to the revolution inspired by reinforced concrete construction, of the evolution of these techniques (such as the replacement of timber flumes with wrought iron and then concrete flumes), and of the early use of concrete for many engineering purposes in the system.
- The scheme possesses many elements of infrastructure which are of world and national renown in technological and engineering terms.
- Many of the structural elements are unique to the Upper Nepean Scheme.

7. Heritage Impact Assessment

7.1 Preamble

The following section assesses the impact of the proposed works (see Section 1.3 of this report) on the Upper Canal and its associated heritage values.

7.2 Proposed Works

The Upper Canal (SHR ID: 01373) is the only historical heritage item of significance identified within the subject area that has the potential to be impacted by the proposed works. As outlined in Section 1.3, the only component of work that has the potential to impact the Upper Canal is the installation and operation of an above ground crossing of the Upper Canal. Design plans for this crossing are provided in Annex 2. As per these plans, the above ground crossing would take the form of a 1000mm steel pipe with concrete supports. Anti-climb barrier devices would be fixed on both sides of the pipe where it crosses the Canal. The pipe would be sited just to the south of the existing road overbridge over the Canal at Brooks Point Road within an existing 66kV powerline easement (see Plates 5, 7 and 8 and Annex 2). The above ground section of the pipe to the east of the Upper Canal would extend for approximately 5m, with a barrier installed at the point of its transition underground. Light vehicle access would be provided for at this point. The above ground pipe would continue through existing vegetation to the west of the Upper Canal towards the vent shaft.

7.3 Impact Assessment

The NSW Heritage Manual guidelines for preparing Statements of Heritage Impacts (SoHIs) pose a range of questions to be considered when assessing heritage impacts for new development adjacent to a heritage item. Relevant considerations in relation to impacts to the Upper Canal are addressed in Table 2 below.

Table 2. Upper Canal impact assessment.

Consideration	Response
How is the impact of the new development on the heritage significance of the item or area to be minimised?	Installation of the above ground gas drainage pipeline crossing over the Upper Canal would have no direct impacts to the fabric of the Upper Canal and associated infrastructure. The above ground pipe crossing is preferable to underboring to minimise the potential for unintended geotechnical impacts to the base / sides of the canal, as well as for practical engineering reasons.
Why is the new development required to be adjacent to a heritage item?	The proposed gas drainage pipeline must cross the Upper Canal at some point, as the Canal runs between Appin No. 3 Shaft and the existing gas infrastructure and power generation facilities located at the Appin No. 2 Shaft site.
How does the new development affect views to, and from, the heritage item? What has been done to minimise negative effects?	Despite its size (1000mm diameter), the proposed above ground gas drainage pipeline would only have a minor impact on views to and from the Upper Canal, given the length and extent of the Canal system. Further, the pipeline would only cross the southern section (from Brooks Point Road) of the Upper Canal in an existing 66kV power line easement and would therefore have no impacts on views of the Upper Canal extending to the north (see Annex 2 and Plates 5, 7 and 8).
Is the development sites on any known, or potentially significant archaeological deposits? If so, have alternative sites been considered? Why were they rejected?	The SHR entry and historical research undertaken for this assessment does not identify any areas of archaeological potential within the curtilage of the Upper Canal in the vicinity of the proposed gas drainage pipeline.

Is the new development sympathetic to the heritage item? In what way (e.g. form, siting, proportions, design)?	The proposed above ground gas drainage pipeline is sympathetic to the Upper Canal as it is sited independently to the Canal itself, and would therefore avoid any direct impact to the Canal's fabric or associated infrastructure (see Annex 2). Further, it would be constructed of concrete and steel, which is compatible with the adjacent existing overbridge at Brooks Point Road as well as a number of smaller pipe crossings over the canal in the local area.
Will the additions visually dominate the heritage item? How has this been minimised?	Despite its size (1000mm diameter), the proposed above ground gas drainage pipeline would only have a minor impact on the visual amenity of the Upper Canal. Views of the Upper Canal running beneath and extending beyond the above ground pipeline in both directions would be retained.
Will the public, and users of the item, still be able to view and appreciate its significance?	The proposed above ground gas drainage pipeline would have a minor impact on the visual setting of the Upper Canal. Its installation above the Canal would still allow for the public and users of the item to appreciate the significance of the Canal, and view it running beneath and in both directions, beyond the pipeline.

7.4 Statement of Heritage Impact

Based on the information provided by the Proponent, the proposed installation of an above ground gas drainage pipeline crossing the Upper Canal in the vicinity of Brooks Point Road is of a minor nature and would have little, to no, adverse impacts on the heritage significance of the Upper Canal. The proposed gas drainage pipeline would be sited independently to the Canal itself, and would have no direct impacts to the Canal's fabric or associated infrastructure. The proposed pipeline would have a minor impact on views to and from the Canal and its visual setting, although its aesthetic values could continue to be appreciated by the public and users in many other localities along its length.

8. Conclusions and Recommendations

8.1 Conclusions

- The only item of historical heritage significance identified within the subject area is the Upper Canal, a State significant heritage item listed on the NSW State Heritage Register (SHR ID: 01373).
- The proposed gas drainage pipeline would extend into the heritage curtilage of the Upper Canal in the vicinity of the canal overbridge at Brooks Point Road. The proposed above ground pipe would cross over the Upper Canal but would not result in any direct impacts to its fabric or associated infrastructure, specifically the overbridge, culvert and drainage channel at Brooks Point Road. The proposed crossing is within an existing 66kV power line easement. The proposed crossing would result in a minor visual impact to the heritage item.
- The potential for in situ archaeological deposits to be present in the subject area is considered to be low, given the lack of development in the area aside from activities associated with farming, and more recent land disturbance caused by the installation of other pipe infrastructure across the subject area, and realignment of an earlier road in 1974. If any archaeological deposits survive in the subject area they would be highly disturbed and possess limited historical significance or research potential.

8.2 Recommendations

- No further historical heritage assessment of the subject area is considered necessary prior to the commencement of Project works.
- The Proponent should undertake consultation with WaterNSW in regards to the design and construction footprint of the above ground pipe crossing over the Upper Canal to ensure that no impacts occur to the Canal, or its associated infrastructure.
- Additional historical heritage assessment, including the preparation of a Statement of Heritage Impact (SoHI) report, may be required if any changes to the design plans for the gas drainage pipeline infrastructure are made which involve future works within the heritage curtilage of the Upper Canal.
- Detailed construction plans and on-site work methods must ensure that no impact occurs to the significant fabric of the Upper Canal or its associated infrastructure, including the overbridge, culvert and draining channel on Brooks Point Road. Appropriate protective mechanisms may include temporary signage and fencing of these items during construction, as deemed safe and appropriate.
- On-site inductions highlighting the specific heritage context, legislative values and significance of the Upper Canal and its associated infrastructure should be provided to all personnel working within, or in the vicinity of, the Upper Canal.
- In the unlikely event that historical archaeological relics were to be discovered during ground disturbance for the installation of the proposed gas drainage pipeline along Brooks Point Road (including sections on both sides of the Upper Canal), work in the immediate area would need to cease and a suitably qualified archaeologist be engaged to assess the condition, extent and likely significance of the remains. Depending on the results of this assessment, OEH may need to be notified of the discovery in accordance with s.146 of the *Heritage Act 1977*.

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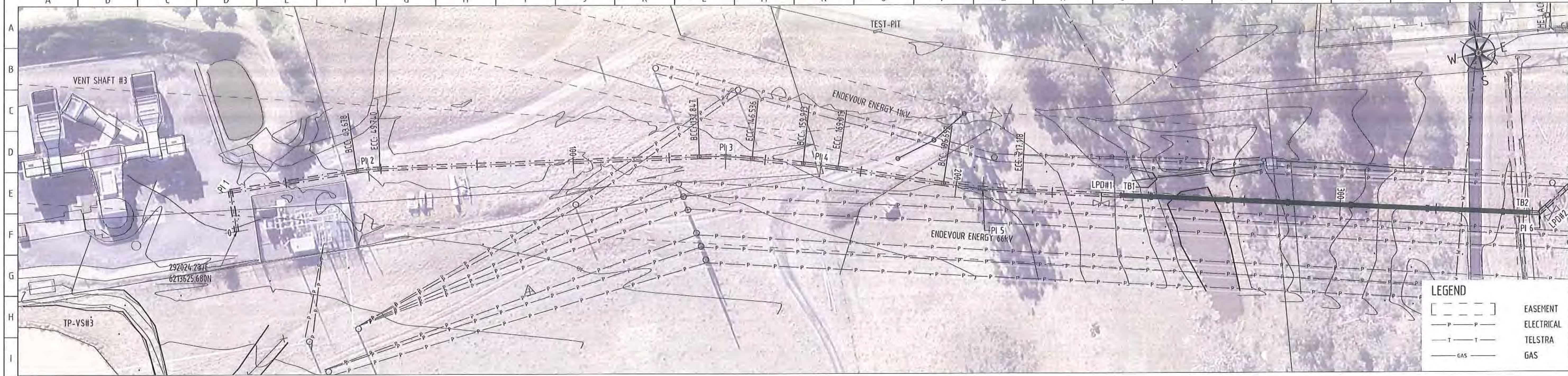
Annex 1 – Pipeline Alignment



PI = POINT OF INTERSECTION
BCC = BEGINNING OF CURVE CENTRE LINE
ECC = END OF CURVE CENTRE LINE
CH = CHAINAGE
LPD = LOW POINT DRAIN
TB = THRUST BLOCK
NGL = NATURAL GROUND LEVEL
MP = MARKER POST

SCALES:
HORIZONTAL 1:500
VERTICAL 1:100

DATUM 120.000

PIPELINE DETAILS: HDPE 1000ø PE100 (to CH 244.830); DN900 ABOVE GROUND STEEL PIPE REFER TO DRAWING NO. H350892-00000-250-270-0001 (CH 244.830 – 351.811)

CHAINAGE (m)	GROUND LEVEL	PIPE INVERT LEVEL	DEPTH TO INVERT
			1.720
10.490	130.122	128.402	1.720
43.678	128.926	127.033	1.892
49.740	128.510	126.888	1.622
100.000	129.140	126.862	2.278
132.847	128.466	126.845	1.622
146.536	128.295	126.363	1.933
159.913	127.942	126.278	1.664
169.013	127.841	126.220	1.622
196.692	127.979	126.050	1.929
200.000	127.990	126.043	1.947
217.109	127.625	126.003	1.622
237.806	126.356	123.857	2.499
242.806	125.851	123.857	1.994
244.830	125.638	123.857	1.780
300.000	125.878	124.891	0.988
349.299	127.861	125.776	2.085 / 2.313
351.811	128.089	125.776	2.542
354.299	128.318	125.776	2.626

SLOPE / LENGTH

Slope	Length
4.530 %	10.49 m
4.125 %	33.19 m
2.398 %	6.06 m
0.052 %	83.11 m
3.519 %	13.69 m
0.637 %	13.38 m
0.637 %	9.10 m
0.612 %	27.68 m
0.230 %	20.42 m
10.369 %	20.70 m
0.000 %	5.00 m
0.000 %	2.02 m
0.000 %	2.02 m
0.000 %	2.51 m

CHANGE IN DIRECTION (VERT / HOR / COMBINED): 0.232 90.000 89.893; 0.988 3.474 3.609; 1.344 3.474 3.724; 1.986 3.922 4.396; 1.651 3.922 4.255; 0.000 1.304 1.303; 0.014 1.304 1.304; 0.219 2.925 2.933; 5.788 2.927 6.484; 5.920 0.000 5.920; 0.000 0.000 0.000; 1.073 0.000 1.073; 1.073 0.000 1.073; 0.000 0.099 0.099; 0.000 43.344

HORIZONTAL ALIGNMENT: DIRECTION 183°46'50"; DIRECTION 273°46'50"; R=50.0m BCC2 43.678 49.740 ECC2 I=277°15'20"; DIRECTION 280°43'40"; BCC3 132.847 R=100.0m I=284°39'00" 146.536 ECC3; DIRECTION 288°34'20"; BCC4 159.913 R=200.0m I=289°52'30" 169.013 ECC4; DIRECTION 291°10'40"; BCC5 196.692 R=200.0m I=288°15'10" 217.118 ECC5; DIRECTION 285°19'30"; DIRECTION 240°21'2

MARKER POST: MP MP MP MP MP MP MP MP MP

REV	DESCRIPTION	DATE	DRN	CKD
A	CLIENT REVIEW	31-03-2016	FH	EC

SUPPLIER DRAWING No. H350892-00000-220-271-0001
AUTOCAD SAVE NAME H350892-00000-220-271-0001
RESPONSIBLE ENG E CARVALHO
APPROVAL C BEARDMORE
SUPPLIER REFERENCE NO.s H350892

HATCH

Contractor Identification

SOUTH32

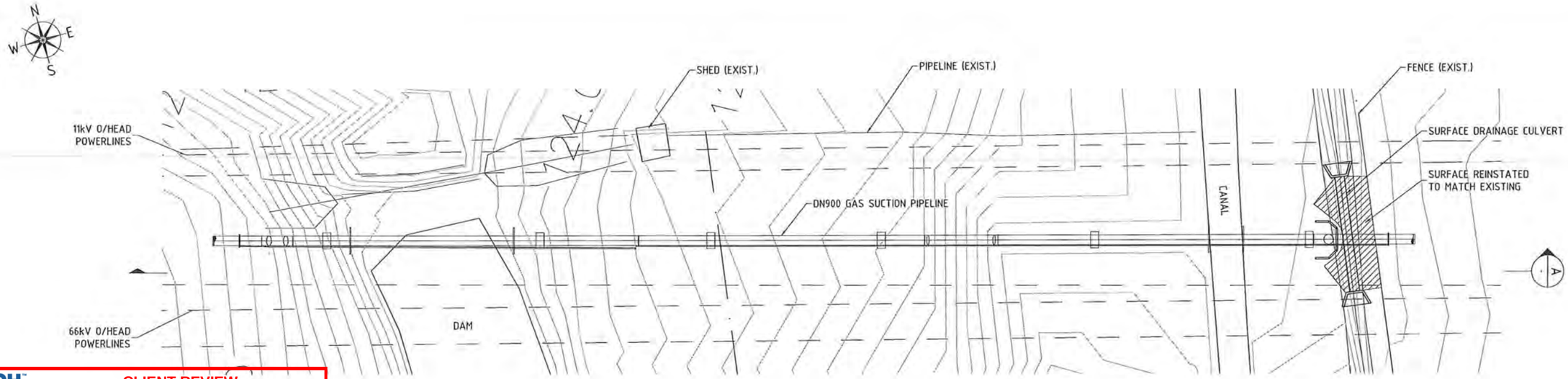
Illawarra Coal Holdings Pty Ltd
PO Box 514 Unanderra NSW 2526 Australia
ABN 69 093 857 286

	NAME	DATE
DRN	F HUGO	31-03-2016
CKD	E CARVALHO	31-03-2016
APP	C BEARDMORE	31-03-2016
SCALE	1:500	SIZE A1

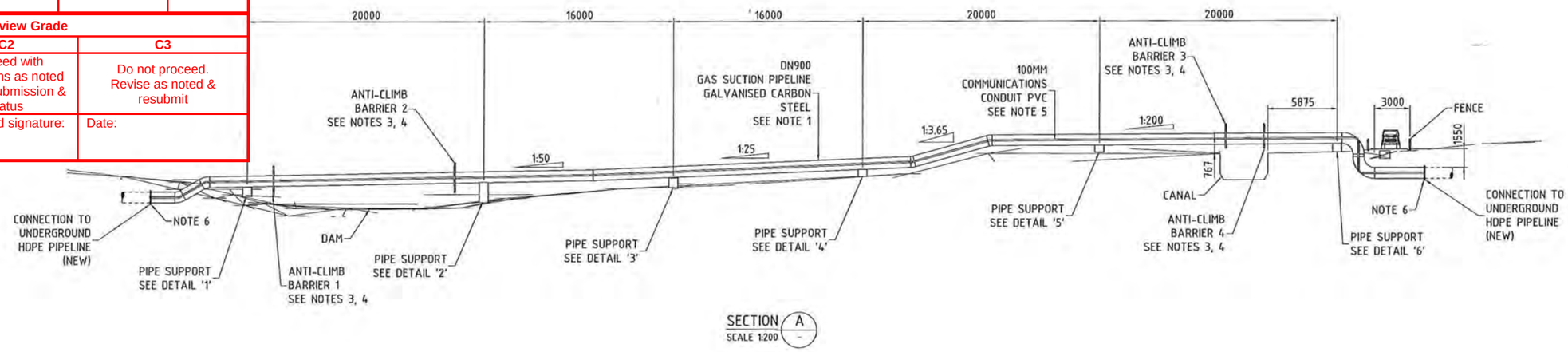
Title APGDP UPGRADE
VS#3 TO APGDP PIPELINE
PIPELINE ALIGNMENT SHEET No.1

DRAWING NUMBER APGDP_0703902_001
SHEET 1
REV A

Annex 2 – Upper Canal Crossing Design Plans



PLAN VIEW
SCALE 1:200



SECTION A
SCALE 1:200

HATCH

CLIENT REVIEW

Doc Number	H350892-00000-250-270-0001	Rev	B
Discipline	Discipline Engineer Name / Signature	Date yy-mm-dd	

Review Grade

C1	C2	C3
Proceed to next submission & status	Proceed with exceptions as noted to next submission & status	Do not proceed. Revise as noted & resubmit

Responsible Engineer: Name and signature: | Date:

NOTES:
1. FOR GALVANISED CARBON STEEL PIPE MATERIALS SPECIFICATION SEE H350892-00000-250-206-0002.
2. FOR PIPE SUPPORT DETAILS REFER TO H350892-00000-230-260-0006.
3. LOCATION OF ANTI-CLIMB BARRIERS TBD.
4. FOR ANTI-CLIMB BARRIER DETAILS REFER TO H350892-00000-250-260-0001.
5. FOR PIPE CLAMP SUPPORT DETAILS OF COMMUNICATIONS CONDUIT REFER TO H350892-0000-250-260-0002.
6. BURIED PIPE CONNECTING TO UNDERGROUND HDPE SYSTEMS SHALL BE COATED WITH PETROLATUM WRAPPING TAPE.

PRELIMINARY
NOT FOR CONSTRUCTION
REV. No: B DATE: 23 MAR 16

REV	DESCRIPTION	DATE	DRN	CKD
B	CLIENT REVIEW	23-03-2016	SR	CB
A	CLIENT REVIEW	10-03-2016	GN	MC

SUPPLIER DRAWING No. H350892-00000-250-270-0001
AUTOCAD SAVE NAME H350892-00000-250-270-0001
RESPONSIBLE ENG M. COATES | APPROVAL C. BEARDMORE | SUPPLIER REFERENCE NO.s H350892

HATCH

Contractor Identification

SOUTH32

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PO Box 514 Unanderra NSW 2526 Australia
ABN 69 093 857 286

	NAME	DATE
DRN	GN	10-03-2016
CKD	MC	10-03-2016
APP	CB	10-03-2016
SCALE	1:200	SIZE A1

Title APGDP UPGRADE
VS#3 TO APGDP PIPELINE
PIPING GENERAL ARRANGEMENT - CANAL CROSSING

DRAWING NUMBER ADGP-0701401-001 | SHEET 1 | REV B

NOTES:
1) THE PIPELINE DEPICTED IS BASED ON A PRELIMINARY DESIGN.
2) THE PIPELINE DEPICTED IS SHOWN IN APPROXIMATE LOCATION BASED ON CURRENT DESIGN.
3) REFER TO 'PIPING GA – CANAL CROSSING' DRAWING ADGP-0701401-001 FOR FURTHE DETAILS.

REV	DESCRIPTION	DATE	DRN	CKD
A	ISSUED FOR CLIENT REVIEW	14/04/16	JM	CB

SUPPLIER DRAWING No. H350892-00000-250-272-0001
AUTOCAD SAVE NAME H350892-00000-250-272-0001
RESPONSIBLE ENG C.BEARDMORE | APPROVAL C.BEARDMORE | SUPPLIER REFERENCE NO.s H350892

HATCH™

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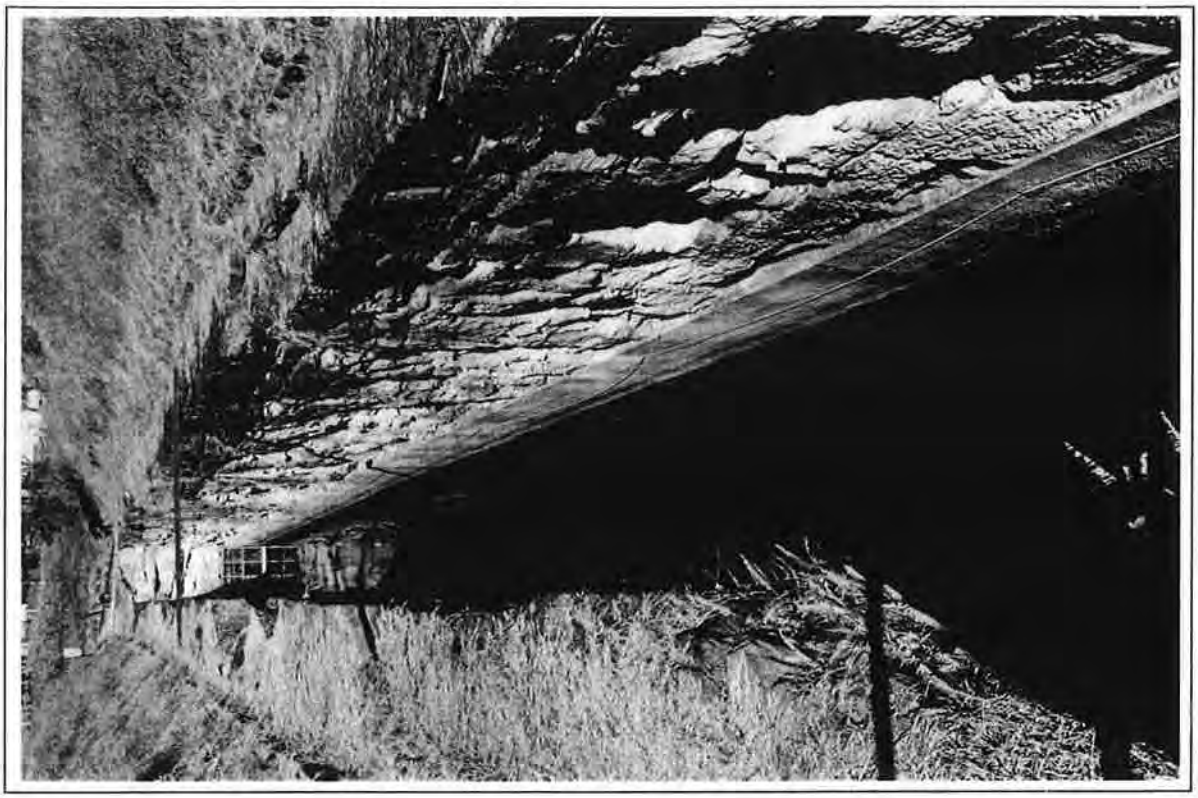
APP	C.BEARDMORE	14/04/16
SCALE	NTS	SIZE A1

Title: APGDP UPGRADE
VS#3 TO APGDP PIPELINE
PHOTO MONTAGE - CANAL CROSSING

DRAWING NUMBER APGDP-041004-001 | SHEET 1 | REV A

Annex 3 – Upper Canal CMP Inventory Sheets

Precinct no **Precinct** **Locality** Upper Canal **Section** 2 **Inventory** 1



Caption *Upper Canal at Cataract Tunnel exit, Brooks Point.* **Film** 2 **Frame** 19

Item name **Canal - Concrete & masonry lined** **Item type** **Canal**

Location Cataract Tunnel exit to c. 6 1/2 miles **Date from** 1880s **Date to** 1916

Item description Open canal construction which is vertical sided with a U-shaped cross-section. Canal has a width of 9 feet (2.75 metres) at the top and an 8 feet (2.4 m) depth of water. Gradient is 1 in 1508 or 3 feet 6 inches per mile.
The initial section after the Cataract Tunnel exit (now sealed by a screen) is lined with concrete. Concrete lining commenced in 1896 and continued sporadically to 1916 or later. Slightly downstream the original masonry wall begins and continues to about 6 1/2 miles, just south of Brooks Point Road.

Significance Exceptional **References** Water Board, Official Handbook 1913, 33.

Notes on significance

Condition

Precinct no **Precinct** **Locality** Upper Canal **Section** 2 **Inventory** 2

Caption *Upper Canal, Brooks Point* **Film** 22 **Frame** 6

Item name **Canal - Masonry lined** **Item type** **Canal**

Location Between c. 6 1/2 and 7 miles **Date from** 1880s **Date to**

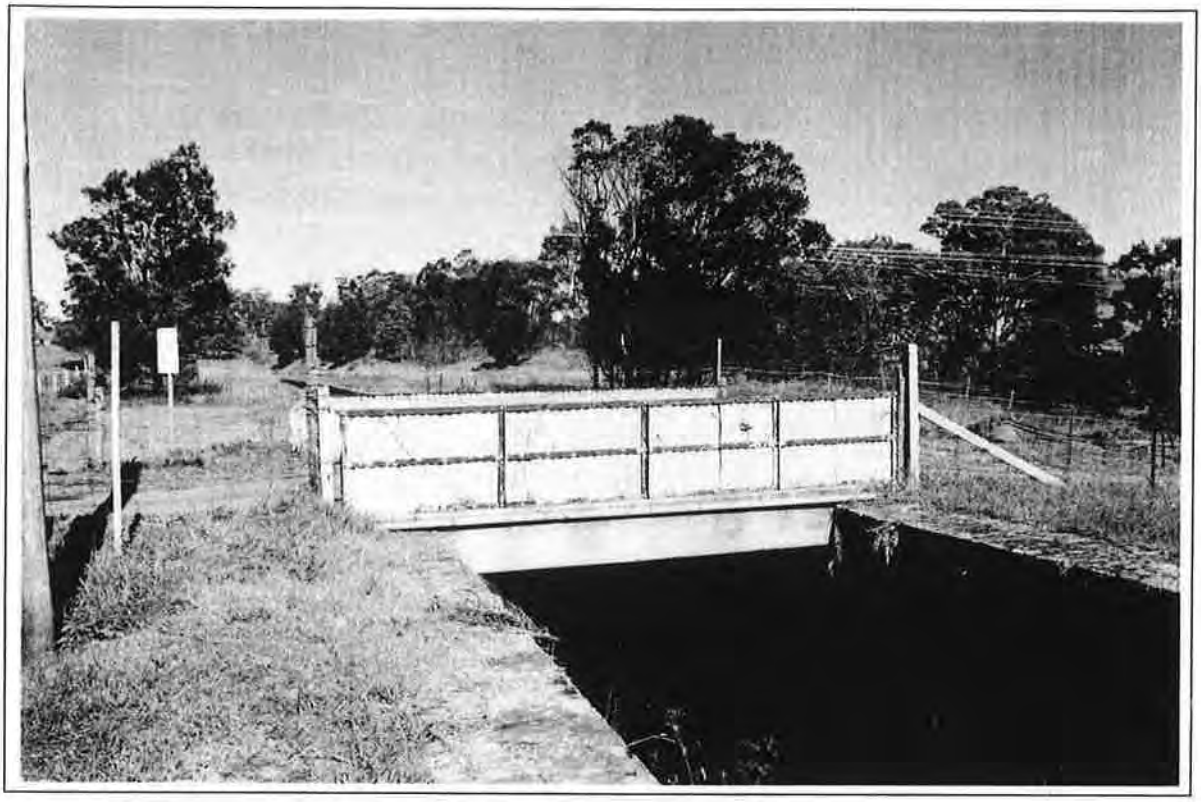
Item description Open canal construction which is vertical sided with a U-shaped cross-section. Masonry lined. Canal has a width of 12 feet 6 inches (3.8 m) at the top and an 8 feet (2.4 m) depth of water. Gradient is 1 in 2017 or 1 foot 9 inches per mile.

Significance Exceptional **References** Water Board, Official Handbook 1913, 22.

Notes on significance

Condition Sides of canal braced just south of 6 3/4 miles.

Precinct no **Precinct** **Locality** Upper Canal **Section** 2 **Inventory** 6



Caption *Canal Overbridge, Brooks Point Road.* **Film** 2 **Frame** 23

Item name **Canal Overbridge, Brooks Point** **Item type** **Canal Overbridge**

Location Brooks Point Road **Date from** 1917 **Date to** 1918

Item description Bridge with reinforced concrete beams set into top of canal, slab deck, single lane width. Railings of flat and angle iron clad with corrugated iron to form side balustrades.

Significance Considerable **References** T Kass, Historical Report - Chronology 1991

Notes on significance

Condition Corrosion apparent.

Precinct no **Precinct** **Locality** Upper Canal **Section** 2 **Inventory** 7

Caption *Inverted syphon masonry culvert, Brooks Point Road* **Film** 2 **Frame** 24

Item name **Culvert - Discharge channel** **Item type** **Culvert**

Location Brooks Point Road **Date from** 1880s **Date to**

Item description Straight masonry (sandstone) culvert and drain running below Upper Canal.
Arch of stone voussoirs forming culvert mouth / inlet with stone headwall and coping above. Culvert width of 48 inches (4 ft). Modern trash rack.

Significance Exceptional **References**

Notes on significance

Condition Culvert needs cleaning out.

Niche Environment and Heritage

A specialist environmental and heritage consultancy.

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All mail correspondence should be through our Head Office

Annex 6 Noise Assessment

ACOUSTICS AND AIR

APPIN MINE SAFETY GAS MANAGEMENT PROJECT

CONSTRUCTION NOISE STUDY OF BURIED PIPELINE

REPORT NO. 16084
VERSION A

MARCH 2016

PREPARED FOR

SOUTH32
ILLAWARRA COAL
PORT KEMBLA NSW 2505

WILKINSON MURRAY

DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
A	Final	7 March 2016	George Jenner	Rob Bullen

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GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

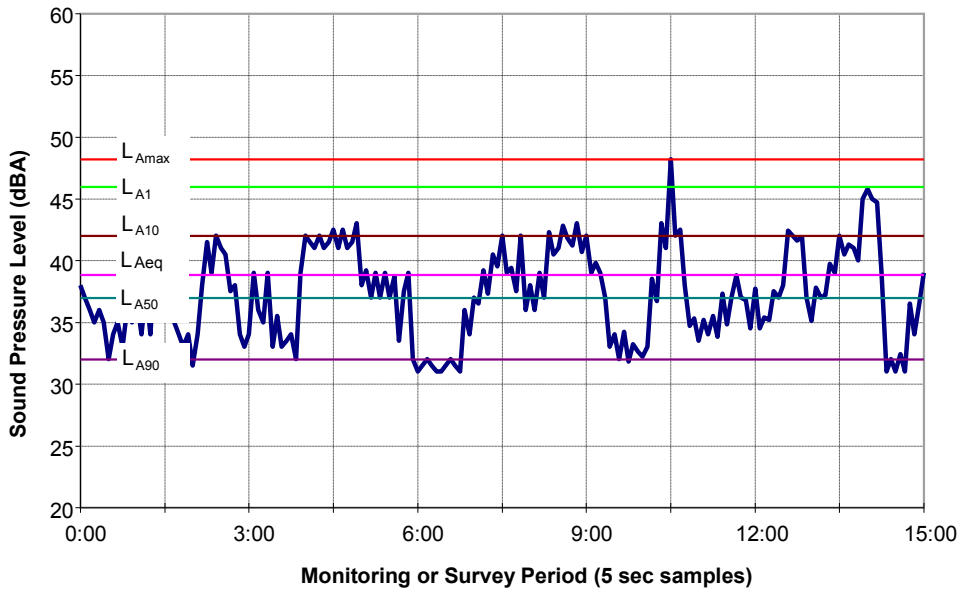
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

Illawarra Coal is currently preparing an s75W modification to the Bulli Seam Operations Project Approval to construct and operate a suction gas pipeline between Appin No. 3 Vent Shaft and the existing gas drainage plant at Appin No. 2 Shaft.

This report presents a noise assessment of the construction of that pipeline. The operational phase of this project is unlikely to generate any audible noise and has not been considered further in this assessment.

2 DESCRIPTION OF THE PROPOSAL

2.1 Overview

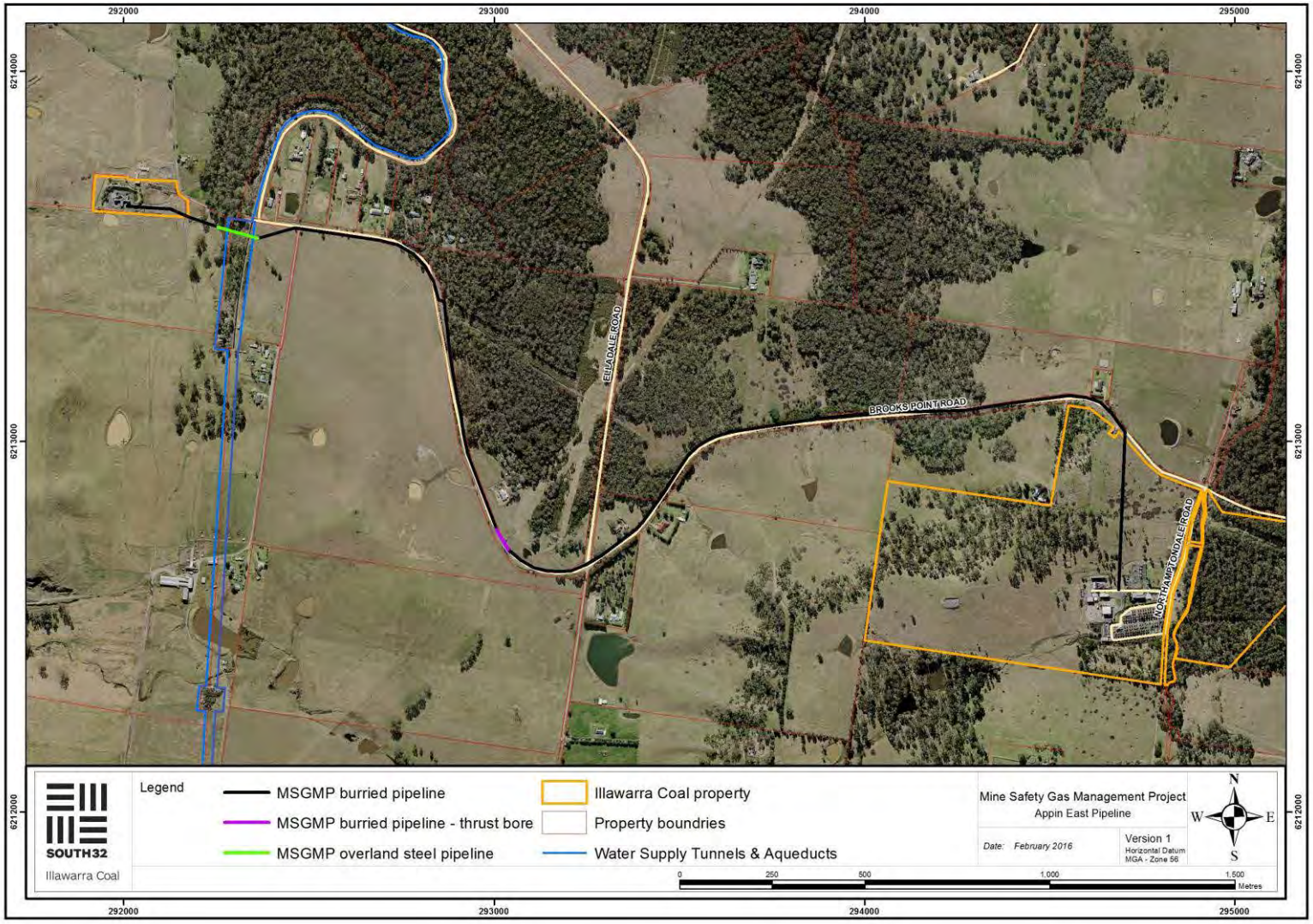
The location of the proposal is shown on **Figure 2-1**.

All construction will take place during standard day time hours as defined by Wollondilly Shire Council and / or NSW EPA. The overall duration of the construction is expected to be four months based on Monday to Saturday construction.

The project consists of several elements:

- The buried pipeline;
- A section of overland steel pipeline over the Upper Canal;
- A section of thrust bored underground pipeline under existing gas reticulation pipelines;
- Rehabilitation; and
- Traffic Management.

Figure 2-1 Location of the Proposal



2.2 Equipment Sound Power Levels

A range of construction equipment will be used. Details of site noise emission are given in the following sections. The estimated $L_{Aeq,15min}$ emission from each site is based on combinations of the equpment shown in Table 2-1.

Table 2-1 Sound Power Level of Construction Equipment

Equipment	Number	Sound Power Level, dBA
Large Excavator	1	108
Large Excavator with Rock Saw	1	108
Small Excavator	1	104
Dump Trucks	2 (up to 8 deliveries per day)	108
Front End Loader	1	111
Semi-Trailer	2 per day	108
Franna Crane	1	113
Small Crane	1	103
Grader	1	110
Vibratory Roller	1	114
Concrete Truck	1	110

2.3 Buried Pipeline

A trench nominally 2 m wide and 2 m deep will be constructed by a large excavator. No blasting or rock picking will be required, however the shale / sandstone may need to be ripped or cut with a rock saw. HDPE pipe of approximately 1m overall diameter will be laid on bedding sand in the trench and then backfilled. Approximately 50-100m of trench / pipe will be laid per day. The length of the buried pipeline is nominally 3800m. Two work fronts will operate simultaneously from either end of the pipeline route and meet in the middle. Each work front will require:

- Large Excavator;
- 2x Dump Trucks to deliver bedding sand (say up to 8 deliveries / day after the trench has been excavated);
- 2x Dump Trucks to move excavated soil / rock to temporary stockpiles within a few kilometres of the work front;
- Front End Loader for stock pile management / loading dump trucks ;
- Semi-Trailer delivery of pipes (2 / day); and
- Franna Crane for pipe installation.

All equipment would not operate simultaneously, and in considering overall sound power levels the total sound power level would generally be lower than the total of the maximum values shown in Table 2-1. The overall site sound power levels of the main activities are shown in Table 2-2.

Table 2-2 Buried Pipeline Construction – Site Sound Power Levels

Equipment	Site Sound Power Level, $L_{Aeq,15min}$ dBA
Trenching by Excavator	110
Laying Pipe	113

Once the pipeline is installed and buried, surface disturbance of the road verge / driveways will be repaired and profiled using standard road maintenance equipment. Depending on the surface, this will require, for example, a front end loader, grader, roller, and delivery of road base material by dump trucks.

The overall site sound power levels of the main activities are shown in Table 2-3.

Table 2-3 Rehabilitation – Site Sound Power Levels

Equipment	Site Sound Power Level, $L_{Aeq,15min}$ dBA
Surface repair	110- 114 (depending on surface)

2.4 Overland Steel Pipe

A nominal 1 m diameter overland steel pipeline will be constructed to bridge the NSW Water Upper Canal and adjacent creek / farm dam. The foundations will be excavated by a small excavator, formwork installed and concrete poured. There will be approximately 6 cement truck deliveries. All steel elements will be fabricated off site and be transported to site by 6 semi-trailer loads. Two franna cranes will install the prefabricated steel pipeline elements. This section should take 2 weeks to construct.

The overall site sound power levels of the main activities are shown in Table 2-4.

Table 2-4 Overland Steel Pipe – Site Sound Power Levels

Equipment	Site Sound Power Level, $L_{Aeq,15min}$ dBA
Foundation	106
Laying Pipe	115

2.5 Thrust Bore

A thrust bore will be required to install the buried pipeline below the existing Jemena / APA / Gorodok high pressure gas pipelines. This will require 5 m x 5m wide x 6 m deep portals to be constructed at both ends of the bore. The equipment will include a large excavator, dump trucks, and a small crane to install shoring equipment. This element will take approximately 2 weeks.

The thrust boring will take approximately 5 days. The thrust boring equipment will be lowered into the portals with a small crane over 1 day. The source sound power level of the thrust boring equipment is expected to similar to an operating excavator. One semi-trailer of pipes will be delivered, and a franna crane used for handling pipes. Once the thrust bore is completed, soil and rock will be used to fill the portals. This is expected to take no more than 4 days.

The overall site sound power levels of the main activities are shown in Table 2-5.

Table 2-5 Thrust Boring – Site Sound Power Levels

Equipment	Site Sound Power Level, $L_{Aeq,15min}$ dBA
Excavation	110
Thrust Boring	115

2.6 Traffic Management

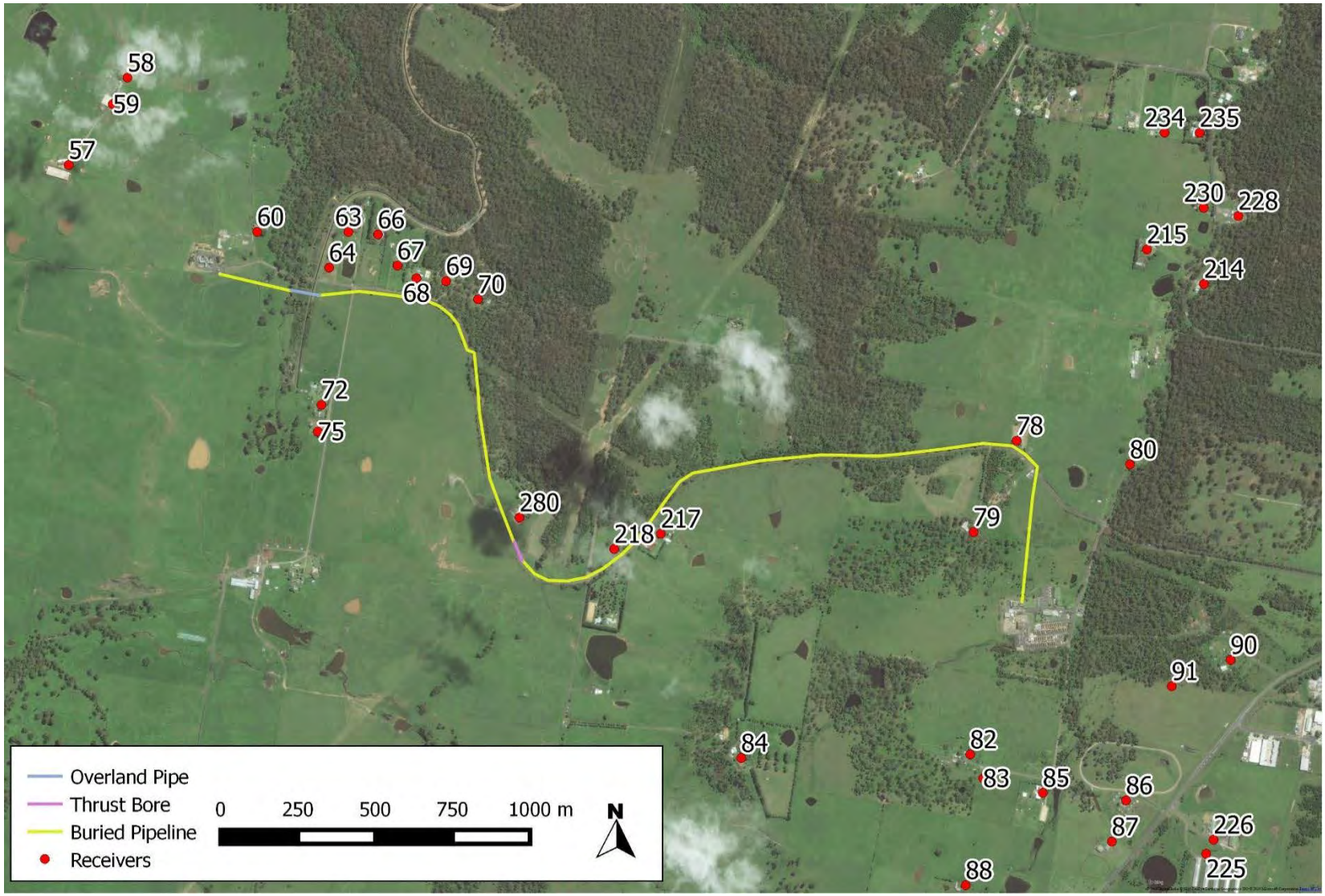
During the proposed construction period, traffic management will be required to ensure disruption to the relatively small amount of traffic on Brooks Point Road is kept to a minimum.

3 NOISE SENSITIVE RECEIVERS & BACKGROUND LEVELS

3.1 Noise Sensitive Receivers

The residential receivers potentially impacted by the pipeline construction have previously been studied for the Environmental Assessment of the Bulli Seams Operation Project (BSOP). The receivers closest to the pipeline route are shown in Figure 3-1. Receiver numbering from the BSOP has been used for consistency.

Figure 3-1 Noise Sensitive Receivers



Background levels as determined for the BSOP are shown in Table 3-1.

The EA report identified 268 receivers that are potentially impacted by noise associated with the BSOP. These are generally residences, but also include recreation areas and commercial buildings. They are shown in Figures I4-1 to I4-6 of the BSOP EA report. Receiver numbering used in the EA report will be retained in the present report, for ease of comparison.

The receivers were classified into eight groups on the basis of location and background noise level. This is shown in Table 3-1, which is based on Table I3-2 of the EA report. The three groups potentially impacted by construction of the pipeline are shaded in the table.

Table 3-1 Residences and Rating Background Level (RBL) Values

Receiver No.	Receiver Area Description	Assigned RBL, dBA		
		Daytime (7am – 6pm)	Evening (6pm – 10pm)	Night (10pm – 7am)
1-7, 9-11, 13, 184, 188-189	Appin West Receivers south-west of Appin West	34	34	34
185-187, 190	Appin West receivers near Hume Highway	38	38	38
14-48, 50-56	All other Appin West Receivers	38	38	38
57-58, 60, 63-64, 66-72, 74-76, 217, 218, 233, 279-282	Appin No. 3 Receivers	34	34	34
78-80, 82-91, 199, 212-216, 226, 228-230, 232, 234, 235	Appin No. 1 & No. 2 Receivers	35	35	35
93, 95-144, 146-160, 194-197, 200-209, 211, 236-278	Appin Township	37	37	37
165	Cataract Scout Park	32	32	30
166-183	Darkes Forest Receivers	31	31	31

dBA = A-weighted decibels.
Note: Receivers 184-190 denote receivers representative of the Bingara Gorge future development area.

4 NOISE CRITERIA

4.1 Construction Noise Criteria

The EPA's *Interim Construction Noise Guidelines* (ICNG) recommends the following objectives:

Recommended standard hours of work

- Monday to Friday 7.00am to 6.00pm
- Saturday 8.00am to 1.00pm
- No work on Sundays or Public Holiday

Management Noise Goals

Noise goals are detailed in Table 4-1.

Table 4-1 Noise at Residences using Quantitative Assessment

Time of Day	Management Level $L_{Aeq,15min}$	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL[1] + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq,15\ min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Time of Day	Management Level $L_{Aeq,15min}$	How to Apply
Outside recommended standard hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

Note: 1. RBL (Rating Background Level) is defined in the glossary.

Table 4-2 presents a summary of the construction noise management levels (NML) for receiver groups closest to the construction route.

Table 4-2 Noise Management Levels – dBA

Receiver	Standard Construction Hours $L_{Aeq,15min}$
Appin No. 3 Receivers	44
Appin No. 1 & No. 2 Receivers	45
Appin Township	47

Note: 1. Receivers are identified in Figure 3-1.

5 NOISE IMPACT

5.1 Noise Predictions

Noise predictions were performed using Bruel & Kjaer Predictor noise modelling software using ISO 9613 noise prediction algorithms. This software takes into account sound source level, distance to receiver, shielding by topography, meteorological influences on noise propagation, and air absorption.

5.2 Noise Impact of Pipe Laying

The predicted noise levels to receivers near the pipe route were calculated for three phases of construction: excavation, laying pipe, and rehabilitation. The predicted levels are presented in Table 5-1. Only receivers where there is predicted exceedance of the NML are shown.

Some of the exceedances are significant, but because the construction site is moving up to 100m per day, the levels shown in Table 5-1 would generally only occur for 1 to 2 days at receivers close to the road, such as the group from Receiver 67 to 70. Some noise impact would be expected for up to 1 week, such as receiver 78. Generally, all activities would comply once the construction site was more than approximately 500m from any residence.

Table 5-1 Predicted Noise Levels of Pipe Laying

Receiver	NML, dBA	Excavation 110	Laying Pipe 113	Rehabilitation 114
57	44	***45***	***48***	***49***
58	44	44	***47***	***48***
59	44	***47***	***50***	***51***
60	44	***60***	***63***	***64***
63	44	***59***	***62***	***63***
64	44	***65***	***68***	***69***
66	44	***60***	***63***	***64***
67	44	***65***	***68***	***69***
68	44	***70***	***73***	***74***
69	44	***67***	***70***	***71***
70	44	***65***	***68***	***69***
72	44	***54***	***57***	***58***
75	44	***51***	***54***	***55***
78	45	***82***	***85***	***86***
79	45	***56***	***59***	***60***
80	45	***55***	***58***	***59***
82	45	***50***	***53***	***54***
83	45	***46***	***49***	***50***
84	45	42	***45***	***46***
85	45	***48***	***51***	***52***
86	45	***46***	***49***	***50***
87	45	***45***	***48***	***49***
89	45	42	***45***	***46***
90	45	***46***	***49***	***50***
91	45	***49***	***52***	***53***
206	47	42	***45***	***46***
208	47	41	44	***45***
212	45	41	44	***45***
213	45	42	***45***	***46***
214	45	***45***	***48***	***49***
215	45	***45***	***48***	***49***
217	44	***72***	***75***	***76***
218	44	***79***	***82***	***83***
226	45	43	***46***	***47***
228	45	41	44	***45***
230	45	43	***46***	***47***
280	44	***68***	***71***	***72***

5.3 Noise Impact from Thrust Boring

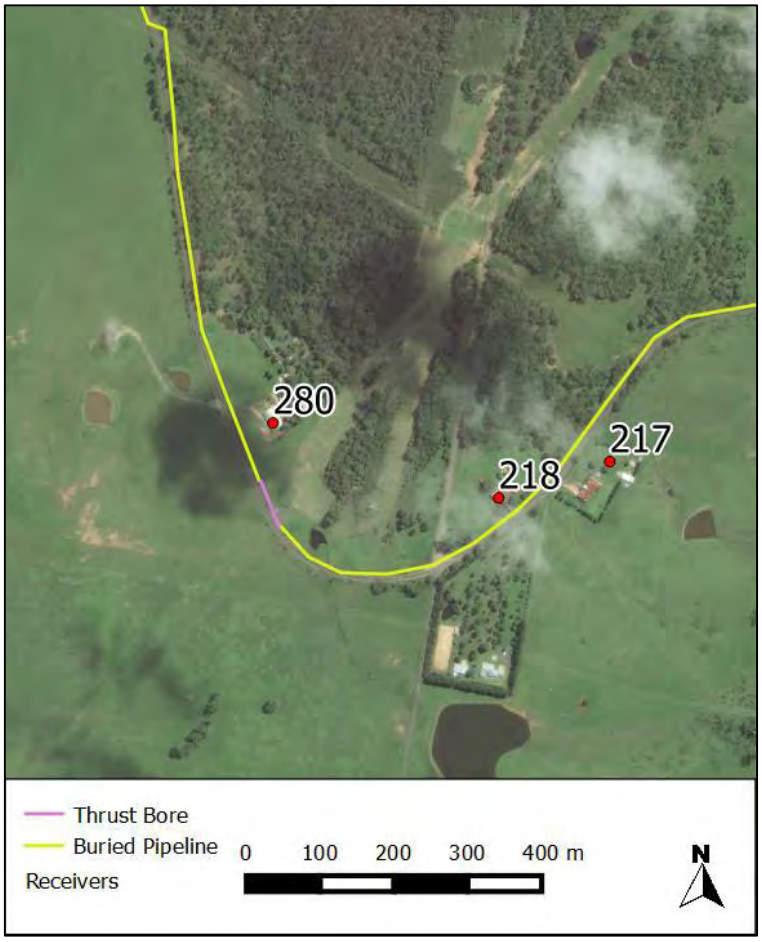
The predicted noise levels from thrust boring are shown in Table 5-2. Only the two receivers where exceedance of the NML is predicted are shown. Noise is predicted to comply with the NML at all other receivers.

The highest exceedance is at Receiver 280 during surface works to excavate the shaft for the thrust boring machine. Figure 5-1 shows the location of the thrust boring and the relation to Receiver 280. The predictions assumed that the thrust boring machine would be located at the southern end of the section that is closest to Receiver 280. Noise emission from work at the southern end of the thrust bored section would be up to 6 dBA quieter at Receiver 280.

Table 5-2 Predicted Noise Levels from Thrust Boring, $L_{Aeq,15min}$ dBA

Receiver	Excavation / Filling (NML 44dBA) 2 weeks Excavation plus 4 weeks Filling	Thrust Boring (NML 44dBA) 5 days
280	59-65	45
218	45-47	33

Figure 5-1 Thrust Boring Location



5.4 Noise Impact from Steel Pipe Construction over Upper Canal

The noise levels at receivers where exceedances of the NML are predicted are given in Table 5-3. The locations of the receivers are shown in Figure 5-2, and the NML is 44dBA at all potentially impacted receivers. Short duration exceedances up to 21 dBA are predicted as the pipes are lifted into place.

Table 5-3 Predicted Noise Levels from Steel Pipe Construction over Upper Canal, $L_{Aeq,15min}$ dBA

Receiver	Foundations (NML 44dBA)	Laying Pipe (NML 44dBA)
64	56	65
73	54	63
63	50	59
60	50	59
61	48	57
62	48	57
66	48	57
71	48	57
67	48	57
65	47	56
68	46	55
72	46	55
74	46	55
75	44	53

Figure 5-2 Steel Pipe Construction over Upper Canal Location

6 NOISE MITIGATION

To mitigate the impacts of construction noise, the following measures are recommended:

- Work should only occur during standard construction hours; and
- Residents impacted by the construction of the overland pipe and thrust boring should be notified that construction will occur, and the timeframe of the potential impacts.
- Receiver 78 is predicted to be "highly noise impacted" as the pipeline construction passes within 50m the residence. While the site is this close to the residence, any unnecessary equipment should be turned off or parked away from the site.

7 TRAFFIC NOISE ASSESSMENT

The *ICNG* refers to the NSW *Road Noise Policy (RNP)* for the assessment of construction traffic on public roads.

7.1 Road Traffic Noise Goals

The *RNP* sets out noise criteria (the controlling criteria) for 'freeway / arterial / sub-arterial roads' and 'local roads'. The pipeline follows the route of Brooks Point Road for much of its length. Brooks Point Road is considered a local road for assessment purposes.

Criteria for existing residences affected by **additional traffic** are shown in Table 7-1.

Table 7-1 *RNP* Criteria for Traffic Noise due to Land Use Development

Road Category	Assessment Criteria – dBA	
	Day (7am-10pm)	Night (10pm-7am)
Freeway / arterial / sub-arterial roads	$L_{Aeq15hr}$, 60 (external)	$L_{Aeq,9hr}$ 55 (external)
Local Roads	L_{Aeq1hr}, 55 (external)	$L_{Aeq,1hr}$ 50 (external)

Where predicted noise levels exceed the project-specific noise criteria, an assessment of all feasible and reasonable mitigation options should be considered. The *RNP* states that *an increase of up to 2 dBA represents a minor impact that is considered barely perceptible to the average person*.

7.2 Construction Traffic Assessment

Section 2 describes the use of heavy vehicles for delivery of materials, and temporary removal of soil to stockpiles. The number of heavy vehicles along Brookes Point Road would vary, but it is estimated that a typical volume throughout the project would be up to eight heavy vehicles per hour.

All receivers are more than 30m from Brookes Point Road. Using the *Calculation of Road Traffic Noise (CoRTN)* procedures and assuming a speed of 60 km/h, the typical traffic noise contribution from construction traffic is $L_{Aeq,1hr}$ 50dBA. Brookes Point Road otherwise only carries local traffic, and it is unlikely that the addition of the construction traffic would increase traffic noise above the criterion for local roads during daytime hours of $L_{Aeq,1hr}$ 55dBA.

8 CONCLUSION

This report presents a construction noise assessment of the proposed Illawarra Coal suction gas pipeline between Appin No. 3 Vent Shaft and the existing gas drainage plant at Appin No. 2 Shaft.

In summary:

- Noise from construction of the buried pipeline is predicted to exceed standard Noise Management Levels (NMLs) when the construction site is within approximately 500m of any receiver. Significant exceedances would occur for 2-3 days at receivers close to the route.
- Noise from construction of the overland steel pipeline is predicted exceed the NML at up to 14 receivers while cranes are used to lay the pipe.
- Noise from thrust bored underground pipeline is predicted to exceed the NML at two receivers during the excavation phase (approximately 2 weeks). During the thrust boring phase only one receiver will be impacted, and the predicted exceedance is only 1dBA. (approximately 9 days).
- Construction traffic noise is predicted to comply with the Road Noise Policy criteria.

To mitigate the impacts of construction noise, the following measures are recommended:

- Work should only occur during standard construction hours; and
- Notify residents impacted by the construction of the overland pipe and thrust boring that construction will occur, and the timeframe of the potential impacts.
- Receiver 78 is predicted to be "highly noise impacted" as the pipeline construction passes within 50m the residence. While the site is this close to the residence, any unnecessary equipment should be turned off or parked away from the site.

Annex 7 WaterNSW Requirements and NorBE Assessment of Works Near Upper Canal

ADDRESSING WATERNSW'S REQUIREMENTS FOR THE PROTECTION OF THE UPPER CANAL

1 BASIS OF DESIGN OF THE PROPOSED PIPELINE TO CROSS THE UPPER CANAL

The following outlines the basis of design for the pipeline:

Pipeline material (buried):	non-metallic high density polyethylene (HDPE), 1000mm OD.
Pipeline material (above ground):	Galvanised steel, 900mm nominal bore.
Operating Pressure:	Suction pressure of 150kPa (g). Being a suction line, any breach or penetration of the pipeline (when operational) will result in air being drawn into the pipeline, and not an escape of gas. The pipeline is therefore considered a low pressure pipeline.
Gas Composition	30% - 55% methane, plus CO2 (10%), air (34% to 50%), some higher hydrocarbons, water and coal particulates.

The pipeline will cross the Upper Canal above the canal as shown in the drawings provided in Attachment 1. The engineering design has been undertaken on this crossing option to address in full the WaterNSW detailed Requirements for the Protection of the Upper Canal, as described below.

The option of installing the pipeline under the canal was explored in detailed as discussed in Attachment 2.

2 WATER QUALITY

Issue *(refer to "WaterNSW Requirements for protection of Upper Canal")*	**Assessment and Controls**	**Additional Control Measures**	**Risk Level**
Design - drainage / runoff from the proposed pipeline must be designed to be directed away from the Canal.	The pipeline will be self-supporting in spanning the Upper Canal, i.e., no additional support structure is required on the canal walls. Pipe support foundations are located a minimum 5m from the canal walls and are designed to not impact the existing drainage/runoff. There is therefore no area for water to collect drainage/runoff.	The proposed design addresses the issue without further control measures needed.	Negligible
Design - drainage systems for developments or infrastructure works adjacent to the Canal corridor must be designed to avoid overloading of the Canal's stormwater system and thereby affecting the Canal waters.	At the east side of the canal, where the pipeline transitions to underground, the existing vegetated dish drain will be modified with new culvert and headwalls to ensure the light vehicle access is maintained around the pipeline. This system will be design to match existing drainage system capacity and therefore will not impact on the existing flows There is no change or impact to the existing Canal stormwater system.	The proposed design addresses the issue without further control measures needed.	Negligible
Design - permanent measures, such as traffic barriers and/or fencing, are required to minimise the likelihood of vehicles entering the Upper Canal in the event of a vehicle accident and thereby impacting on water quality and causing disruption to supply.	It is only proposed to install the pipeline across the canal. There are no structures proposed that could be used for vehicle traffic. Hence traffic barriers are not required.	The proposed design addresses the issue without further control measures needed.	Negligible

Addressing WaterNSW's Requirements for the Protection of the Upper Canal

Issue *(refer to "WaterNSW Requirements for protection of Upper Canal")*	**Assessment and Controls**	**Additional Control Measures**	**Risk Level**
Design - appropriate measures are required, such as anti-throw screens or caging; to prevent pedestrians throwing objects into the Canal.	The design of the pipeline will include appropriate anti-climbing barriers to prevent persons climbing onto the pipeline. This will prevent persons climbing the pipeline in order to drop objects into the canal, or climb the pipeline and accidently fall in.	The proposed design addresses the issue without further control measures needed. It is noted however that no change is proposed to the open WaterNSW lands adjacent to the canal where people may enter by crossing the existing WaterNSW property fence.	Very low
Construction - measures must be implemented to prevent pollution entering the Upper Canal during construction.	Detailed erosion and sedimentation control plans and methods will be developed and implemented for all works adjacent to the canal. Detailed spill control and management plans and methods will be developed and implemented for all works adjacent to the canal. These will be documented in the project Environmental and Construction Management Plans against which the works will be managed.	WaterNSW can be provided with a copy of the appropriate documentation for review prior to the works commencing.	Low
Construction - a soil and water management plan should be prepared for the construction stage of any works, and WaterNSW must be consulted during preparation of this plan.	Soil and water management plans will be documented either separately too or as part of the project Environmental and Construction Management Plans against which the works will be managed. WaterNSW will be consulted during the preparation of these documents.	No further control measures needed.	Low

Addressing WaterNSW's Requirements for the Protection of the Upper Canal

Issue *(refer to "WaterNSW Requirements for protection of Upper Canal")*	**Assessment and Controls**	**Additional Control Measures**	**Risk Level**
Construction - incident and spill management procedures are required, to be incorporated into an EMP/CEMP and displayed on site, including measures designed to avoid spillages and details of how spillages should be contained and the proper disposal of contaminated material. All incidents and spills affecting, or potentially affecting the Upper Canal must be reported on WaterNSW's Incident Notification Number 1800 061 069 (24 hour – service)	Detailed spill control and management plans and methods will be developed and implemented for all works adjacent to the canal. These will be documented in the project Environmental and Construction Management Plans against which the works will be managed. As part of these Plans, the necessary signage within the work area will be provided including the WaterNSW Incident Notification Number.	No further control measures needed.	Low
Construction – appropriate / adequate safety barriers, or other appropriate measures, may be required to be installed along the Upper Canal within the construction area prior to works commencing, to prevent construction vehicles etc falling in the canal.	The Construction Management Plan will require that an appropriate safety barrier is erected along the edge of the canal to prevent objects entering the canal. When the pipeline is lifted into place, the necessary crane lift procedures and controls will be fully implemented to ensure that the lift is undertaken safely. These procedures will be documented in the project Construction Management Plans against which the works will be managed.	WaterNSW can be provided with a copy of the appropriate documentation for review prior to the works commencing.	Low
Stormwater Management	As stated above, no part of the works will impact stormwater flows, system capacity, catchment or scour valves.	The proposed design addresses the issue without further control measures needed.	Negligible

Issue *(refer to "WaterNSW Requirements for protection of Upper Canal")*	Assessment and Controls	Additional Control Measures	Risk Level
NorBE Assessment - WaterNSW recommends that any environmental impact assessment (e.g. REF) prepared for proposed works includes an assessment of whether there is likely to be a neutral or beneficial effect on water quality (NorBE), to assess the potential impacts of the road upgrade on the water in the Upper Canal.	Approval for the proposed pipeline and associated works will be sought as a Section 75W modification to the Bulli Seam Operations Project Approval. This will require an Environmental Assessment be undertaken. Illawarra Coal will ensure that the Environmental Assessment includes a NorBE assessment in respect of water quality.	Environmental Assessment review, findings and recommendations	Negligible

3 PROTECTION OF WATERNSW INFRASTRUCTURE

Issue	Assessment	Control Measures	Risk Level
Damage during construction works	The design of the pipeline and pipeline foundations requires no excavation or construction within 5m of the outer edge of the canal wall. Piering will be undertaken by bored piers only. No vibrator compactors or equipment is required to be used. The above design and construction features are aimed to mitigate against any damage to the canal wall.	Monitoring of the canal wall for movement and vibration could be undertaken if deemed necessary.	Low
Traffic barriers	It is only proposed to install the pipeline across the canal. There are no structures proposed that could be used for vehicle traffic. Hence traffic barriers are not required.	The proposed design addresses the issue without further control measures needed.	Negligible

Addressing WaterNSW's Requirements for the Protection of the Upper Canal

Issue	Assessment	Control Measures	Risk Level
Work under bridges	It is only proposed to install a pipeline across the canal of diameter 1m. This will have no impact to the existing coping drain system along the canal.	The proposed design addresses the issue without further control measures needed.	Negligible
Stability of embankments/cutting within the Upper Canal corridor	No works will be undertaken on or near embankments within the Upper Canal corridor.	The proposed design addresses the issue without further control measures needed.	Negligible
Upper Canal Collapse Contingency Plan	Given that the works will be undertaken at least 5m from the outer wall of the canal, and taking into account the measures and controls described above, Illawarra Coal does not believe that it will be necessary to prepare an "Upper Canal Collapse Contingency Plan".	WaterNSW and Illawarra Coal to discuss and agree on a need for an "Upper Canal Collapse Contingency Plan".	Low
Dilapidation survey	A dilapidation survey will be undertaken of the canal wall approximately 20m each side of the proposed work area. This will be provided to WaterNSW for review at least 4 weeks prior to the works commencing on site.	No further control measures needed.	Negligible
Geotechnical assessment	A geotechnical investigation has been undertaken at the location of the proposed piers to support the pipe. This investigation has been used to determine the depth of pier required, the size of pier and the most appropriate method of construction of the piers. It also addressed whether the ground conditions warrant the attendance of a geotechnical engineer during the construction of the works.	Additional control measures as recommended by the investigation.	Negligible
Underground pipelines / services – carrier and encasing pipes and pressure grouting	Not applicable to the scope of works proposed.	N/a	Nil

Issue	Assessment	Control Measures	Risk Level
Underground pipelines / services – Service pits	Not applicable to the scope of works proposed.	N/a	Nil
Underground pipelines / services – isolation	Not applicable to the scope of works proposed.	N/a	Nil
Documentation – Design Stage	The detailed design documentation of the pipe structure, foundations, piers and associated equipment will be provided to WaterNSW for review at least 4 weeks prior to the works commencing on site.	The proposed design addresses the issue without further control measures needed.	Negligible
Documentation – Work-as-Executed Plans	Work As-executed design documentation of the pipe structure, foundations, piers and associated equipment will be provided to WaterNSW for its information and records at the completion of construction.	The proposed design addresses the issue without further control measures needed.	Negligible

4 OPERATION AND MAINTENANCE OF THE UPPER CANAL

Issue	Assessment	Control Measures	Risk Level
Works within the water supply corridor	The proposed pipeline and foundation works will be designed so that they do not restrict WaterNSW's operation and maintenance activities for the canal. Light vehicle access is being maintained around the east side of the pipeline to ensure that WaterNSW is provided with equivalent access along the east side of the canal as it currently has.	The proposed design addresses the issue without further control measures needed.	Negligible
Vehicular access points into WaterNSW land-	The proposed pipeline and foundation works will not impact any existing access points that WaterNSW's has from public roads onto WaterNSW land.	The proposed design addresses the issue without further control measures needed.	Negligible

Issue	Assessment	Control Measures	Risk Level
Vehicular access within WaterNSW land	The proposed pipeline and foundation works will not impact any existing access to the canal within WaterNSW land. There will be no structures that will impede vertical clearance for vehicular access. Light vehicle access is being maintained around the east side of the pipeline to ensure that WaterNSW is provided with equivalent access along the east side of the canal as it currently has.	The proposed design addresses the issue without further control measures needed.	Negligible

5 SECURITY AND PUBLIC SAFETY

Issue	Assessment	Control Measures	Risk Level
Security fencing	As the above ground works are entirely within the boundaries of the existing WaterNSW fence land, there will be no impact or change to existing security. In the events that persons enter the existing WaterNSW fenced area, the design of the pipeline will include appropriate anti-climbing barriers to prevent persons climbing onto the pipeline. This will prevent persons climbing the pipeline in order to drop objects into the canal, or climb the pipeline and accidently fall in. Where construction activities require the temporary removal of existing WaterNSW security fencing, temporary fencing will be provided. The permanent security fencing will be re-established to the standard at the start of the works once construction is completed. This will be reflected within the Construction Management Plan.	The proposed design and Construction Management Plans address the issue without further control measures needed.	Low

6 FUTURE CONSTRUCTION OF A NEW WATER SUPPLY PIPELINE

Issue	Assessment	Control Measures	Risk Level
WaterNSW is currently planning for the possible construction of a new water supply pipeline to replace the Upper Canal. The current preferred option is for a 2100 or 2500 mm dia pipeline to be laid at grade along the floor of the open canal on a sand bedding. This will require clearance of 3 m from the invert of the canal (i.e. 2.5 m pipe plus 0.5 m bedding).	The proposed design places the gas pipeline over the top of the existing canal. Therefore, there is no impact to the existing clearances from the invert of the canal.	The proposed design addresses the issue without further control measures needed.	Negligible

7 INCIDENT NOTIFICATION AND ENTRY ONTO CONTROLLED AREAS

Issue	Assessment	Control Measures	Risk Level
Incident Notification	Detailed spill control and management plans and methods will be developed and implemented for all works adjacent to the canal. This will include notification of any incident, accident, spill or fire within, or potentially affecting the Upper Canal corridor. These will be documented in the project Environmental and Construction Management Plans against which the works will be managed. As part of these Plans, the necessary signage within the work area will be provided including the WaterNSW Incident Notification Number. In order to ensure appropriate protection and management of the water supply infrastructure and timely response to incidents.	No further control measures needed	Low

Issue	Assessment	Control Measures	Risk Level
Entry into WaterNSW lands	During the design period, Illawarra Coal and its contractors/agents will need to access the WaterNSW lands in and around the location of where the gas pipeline crosses the Upper Canal to undertake survey, site investigations and geotechnical investigations. During the construction period, Illawarra Coal and its contractors/agents will need to access the WaterNSW lands in and around the location of where the gas pipeline crosses the Upper Canal to undertake the construction works. Illawarra Coal notes that it will need to be granted access consent for the period of design and construction, in accordance with the WaterNSW processes and procedures. We also note that each employee or contractor must complete WaterNSW approved induction prior to entry to the Pipelines corridor, unless accompanied by WaterNSW personnel. Each employee or contractor must have in their possession an appropriate identification card at all times while in the Upper Canal corridor. These requirements will confirmed in discussions with WaterNSW and Illawarra Coal, and will be documented in the project Construction Management Plan against which the works will be managed. During the operational phase, from time to time, Illawarra Coal and its contractors/agents will need to access the WaterNSW lands in and around the location of where the gas pipeline crosses the Upper Canal to undertake periodic inspections. Illawarra Coal will seek a Section 88 instrument to define a pipeline easement on the land title to provide for this access.	Illawarra Coal requests further discussions with WaterNSW around this issue in order to make the process as efficient and effective as possible for the 3 stages of the project life cycle.	Low

8 HERITAGE

Issue	Assessment	Control Measures	Risk Level
The Upper Canal is listed on the State Heritage Register	The design and construction of the pipeline crossing the upper canal has been proposed to have a negligible impact to the heritage significance of the canal. Approval for the proposed pipeline and associated works will be sought as a Section 75W modification to the Bulli Seam Operations Project Approval. This will require an Environmental Assessment be undertaken, which will include the necessary reference and consultation in regard to the heritage aspects of the Upper Canal.	Further control measures if needed would be identified in the Section 75W approval process.	Low

9 LAND TITLE, EASEMENT OR LICENCE AGREEMENT WITH WATERNSW FOR NEW STRUCTURES

Issue	Assessment	Control Measures	Risk Level
Easement Establishment	Illawarra Coal will seek a Section 88 instrument to define a pipeline easement on the land title to provide for access to the pipeline where it crosses the Upper Canal. The easement will be coincident with the existing s88 instrument for the Endeavour Energy 66kV power line.	No further control measures needed	Low

2 ATTACHMENT 1 – PROJECT DRAWINGS

The following drawings describe the project proposal:

Number	Rev	Title
APGDP_0703902_001	A	APGDP Upgrade VS#3 to APGDP Pipeline Pipeline Alignment Sheet No.1
APGDP_0701401_001	B	APGDP Upgrade VS#3 to APGDP Pipeline Piping General Arrangement – Canal Crossing
APGDP_041004_001	A	APGDP Upgrade VS#3 to APGDP Pipeline Photomontage – Canal Crossing

3 ATTACHMENT 2 – ASSESSMENT OF AN UNDERGROUND CROSSING

1 BACKGROUND

During the option evaluation phase of the project, both above ground and underground options were considered and assessed for crossing WaterNSW Upper Canal. This assessment took into account the following issues:

1. Geotechnical conditions;
2. Risk of damage to canal;
3. Visual amenity;
4. Extent of excavation (and commensurate risk to canal);
5. Impact to community from construction;
6. Operational and maintainability issues with the pipeline;
7. Management of water within the pipeline (wet gas, water dropout requires low point drains);
8. Capital cost.

The design options are based on the following WaterNSW Canal details (provided by WaterNSW, refer email from Neil Abraham to Bruce Blunden 20/5/2015):

- Rectangular section with a slightly curved floor;
- Width – 9ft or 2.75m.
- Depth – 10ft or 3.05m.
- Depth of Water – 8ft or 2.45m.
- Construction – direct cut into sandstone.

2 ABOVE GROUND PIPELINE OPTION

This option involves a section of above ground 900mm NB galvanised steel pipe being installed above the canal between CH404m and CH305m. The pipe is installed on small concrete footings located at nominal 20m intervals. Refer to Figure 1 below.

At the east end (CH404), the pipe has an elbow which allows for the connection to the underground HDPE pipe. A low point drain and underground tank containment is installed at this location to manage water that drops out of the gas in transit and to prevent accumulation of water.

At the west end (CH305m), the pipe transitions linearly to the underground HDPE pipe. A low point drain and underground tank containment is installed at this location to manage water that drops out of the gas in transit and to prevent accumulation of water.

The key design features of this option are:

a) The pipe is installed nominally 300mm above the top of the canal wall.

b) The pipe would span the canal without intermediate supports or structure.

c) Support footings would be installed at least 5m away from the outside edge of the canal wall.

d) Small vehicle access around the pipeline would be maintained.

e) The pipeline across the canal would be installed within a few days.

f) Excavation in and around the canal is minimised.

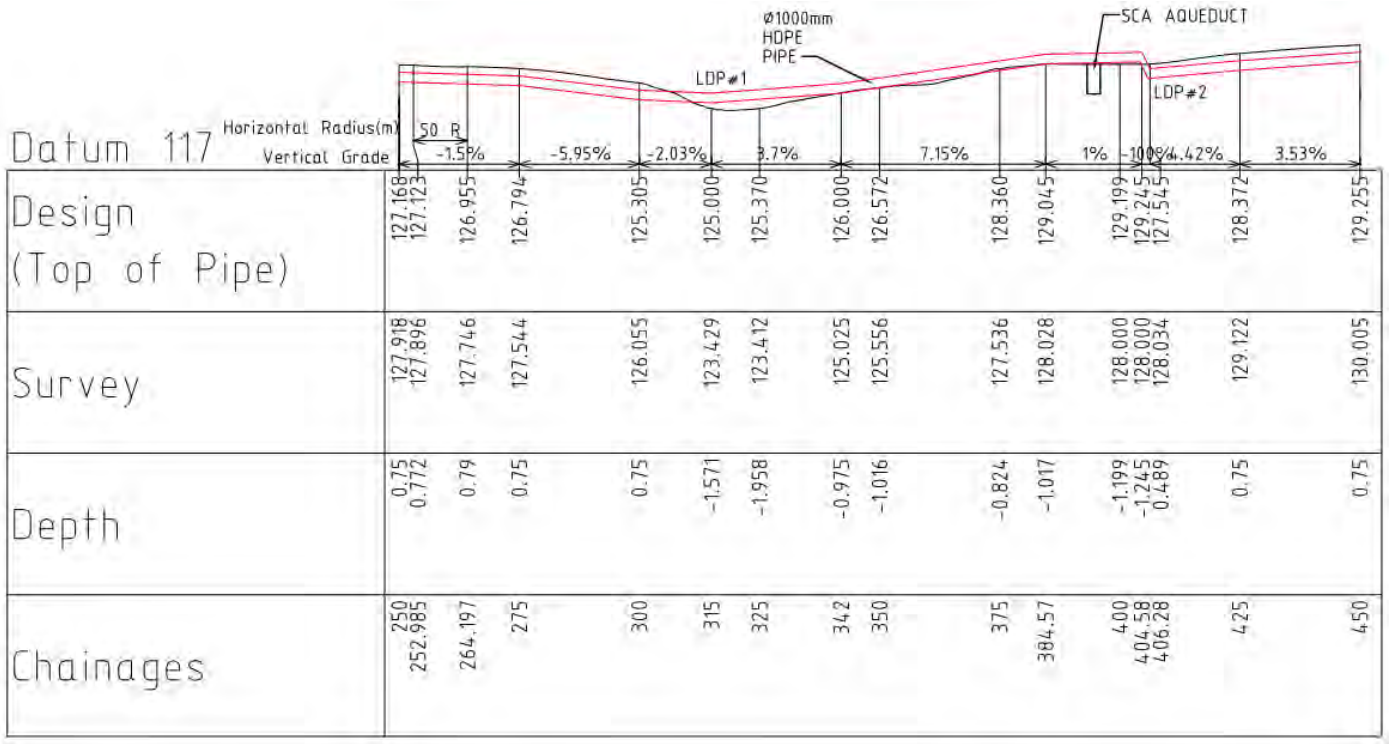


Figure 1 - Above Ground Canal Crossing Option

3 UNDERGROUND PIPELINE OPTION

This option involves continuing the 1000mm OD HDPE pipeline under the canal. Construction would be by direction drilling or thrust bore with a minimum separation between the bore and the bottom of the canal of approximately 1.5m. Refer to Figure 2 below.

At the west end (CH315m), a low point drain and underground tank containment is installed at this location to manage water that drops out of the gas in transit and to prevent accumulation of water.

The key design features of this option are:

a) The pipe is installed at a maximum depth of 5.5m to bottom of pipe.

b) No change to visual amenity or vehicle access once completed.

c) Construction would require a large portal to be constructed at the east side, to accommodate the drilling/boring equipment. This portal would be 6m depth, 10m wide and 15m long.

d) Excavation would require a number of weeks, with drilling/boring taking another 4 weeks. Including installation of the pipeline and reinstatement and restoration works, the works around the canal are estimate to take between 8 and 12 weeks.

e) Significant additional geotechnical investigations will be required to ensure that the sandstone conditions under the canal are sufficient to manage any risk of impact to the canal. It is noted that the base of the canal is sandstone without a lining layer.

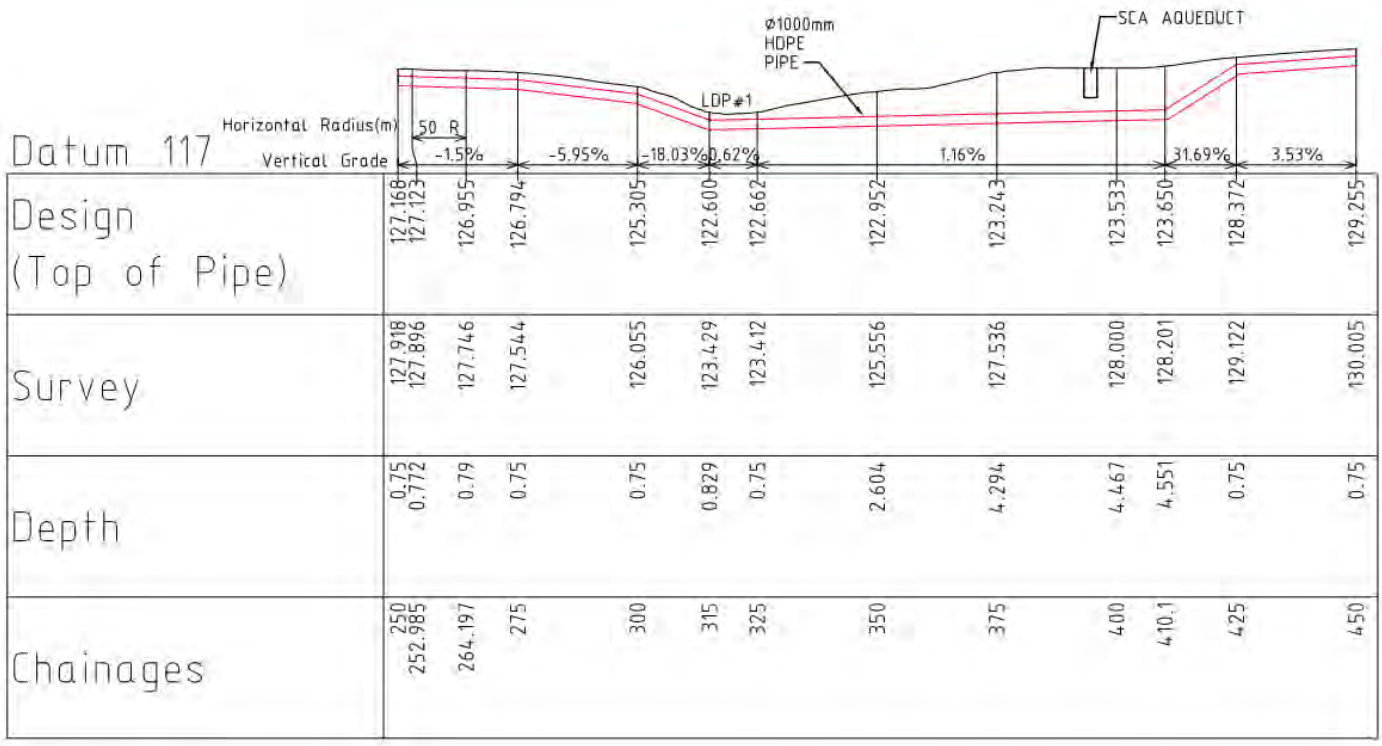


Figure 2 - Underground Canal Crossing Option

4 OPTIONS ASSESSMENT

The table below summarises the assessment of the above and below ground options against the 7 issues detailed above.

Issue	Above Ground	Underground
Geotechnical conditions	Limited influence	Extensive geotechnical investigations will be required to quantify the geotechnical conditions and risks. Key issues will be integrity of the sandstone, water connectivity and transport through the sandstone, cracks, fissures or inclusions that may impact on the base of the canal floor.
Risk of damage to canal	Low risk as all excavation works are more than 5m from the canal walls and	Moderate risk due to extensive portal excavation adjacent to

	are small footings.	canal (but still 5m from the canal walls), construction vibration and period of construction works. Risk mitigation by vibration monitoring, geotechnical investigations and reduced drilling/boring rates
Visual amenity	Pipeline will have a visual impact from road bridge. However it is noted that the bridge itself has significant industrial visual impact, as do numerous other small pipes crossing the canal to the north and south of the canal. The pipeline is also installed under a major transmission line corridor consisting of 3 lines and associated poles. Pipeline could be painted to reduce visual impact.	Negligible impact once site is restored.
Extent of excavation (and commensurate risk to canal)	Low level of excavation, required for small footings only.	High level of excavation on the east side of canal to accommodate portal.
Impact to community from construction	Limited – construction of crossing will only take a few days.	Construction is expected to take between 8-12 weeks. This will involve significant heavy machinery and spoil management. High level of impact to community along Brooks Point Road.
Operational and maintainability issues with the pipeline	2 low point drain stations are required which will increase marginally O&M costs.	Only 1 low point drain required.
Management of water within the pipeline (wet gas, water dropout requires low point drains	Water managed by 2 low point drains.	Water managed by 1 low point drain.
Capital cost	Low capital option	Very high capital options, estimated to be around 10x above ground option. This excludes any remediation costs to the canal if it is damaged by construction.

5 CONCLUSION

Based on the above assessment, the option of installing the pipeline above the canal presents a significantly reduced risk to the project and the canal infrastructure. This option does present a higher visual impact, but in considering the location and adjacent utility infrastructure, the net impact to visual amenity in not considered significant.

NorBE assessment – will there be a neutral or beneficial effect on water quality? ***(Assessment must consider surface and ground water and must consider construction and operational phases)***	
1. Are there any identifiable potential impacts on water quality? What pollutants are likely? Major potential pollutants are sediments (fine & coarse), nitrogen, phosphorus, pathogens and hazardous chemicals and contaminants such as oil/fuel. During construction and/or post construction?	During construction there is a low risk that: • If sediment is left on pipe it could drop from the pipe into the canal during crane movement and fixing into place. • Hydrocarbons could potentially enter the canal if nearby plant hydraulic hose collapses or leaks during crane movement. • Gross pollutants such as construction materials could potentially enter the canal if they fall from either plant or the pipe during crane movement and installation. During operation there is negligible risk of water quality impacts. The pipeline will be self-supporting in spanning the Upper Canal, i.e., no additional support structure is required on the canal walls. Pipe support foundations are located a minimum 5m from the canal walls and are designed to not impact the existing drainage/runoff. There is therefore no area for water to collect drainage/runoff. Anti-climb devices will be fitted on the pipe for security.
2. For each pollutant list the safeguards needed to prevent or mitigate potential impacts on water quality (these may be WaterNSW endorsed current recommended practices (CRPs) and/or equally effective other practices)?	Design elements and environmental safeguards will ensure that there are no issues arising from pollutants by employing the following: • Ensuring all equipment is fit for purpose and in good working order. • Maintaining appropriate distance from the edge of the Upper Canal for heavy equipment to ensure its structural integrity. • Installing protective barriers over and around the canal during works to prevent entry of pollutants from the pipe or plant. • The Construction Management Plan will require that an appropriate safety barrier is erected along the edge of the canal to prevent objects entering the canal. • Installing the steel pipeline over the canal so that there is no physical connection to the canal structure. • Any temporary surface flow diversions deemed necessary on the land adjacent to the canal to avoid overland flow into the Canal. • Design of the pipeline will include appropriate anti-climbing barriers to prevent persons climbing onto the pipeline. This will prevent persons climbing the pipeline in order to drop objects into the canal, or climb the pipeline and accidently fall in. • Detailed erosion and sedimentation control plans and methods will be developed and implemented for all works adjacent to the

	canal. • Detailed spill control and management plans and methods will be developed and implemented for all works adjacent to the canal. • These will be documented in the project Environmental and Construction Management Plans against which the works will be managed. • Minimising site disturbance and managing erosion and sediment as described above. • Ensuring all major refuelling exercises are undertaken outside of the canal area. • Observing standard wash down procedures for all vehicles entering the canal area. Water quality protection measures will follow the Department of Housing (2004) Soils and Construction guidelines and will include: • Fabric Sediment Barriers and fences. • A best practice (Department of Housing 2004) self-auditing program for site stabilisation and erosion controls will be implemented for the site. The timing of site inspections will be on a weekly basis and at opportunistic times such as during and immediately following rainfall events that cause run-off.
3. Will the safeguards be adequate for the time required? How will they need to be maintained?	Yes – all safeguards have been developed to address specific impacts until those impacts can be adequately mitigated (this is essentially during the short construction period). During operation there is negligible risk of water quality impacts however regular monitoring of the pipeline span will be conducted to ensure it remains safe, serviceable and non-polluting.
4. Will all impacts on water quality be effectively contained on the site by the identified safeguards (above) and not reach any watercourse, water body or drainage depression? Or will impacts on water quality be transferred outside the site for treatment? How? Why?	At the east side of the canal, where the pipeline transitions to underground, the existing vegetated dish drain will be modified with new culvert and headwalls to ensure the light vehicle access is maintained around the pipeline. This system will be design to match existing drainage system capacity and therefore will not impact on the existing flows. There is no change or impact to the existing Canal stormwater system. No part of the works will impact stormwater flows, system capacity, catchment or scour valves.
5. Is it likely that a neutral or beneficial effect on water quality will occur? Why?	Through a combination of engineering design and implementation of appropriate mitigation measures installation of the overhead pipe spanning the canal will have a neutral effect on the water quality in the canal.
Prepared by / Date	Chris McEvoy- Niche Environment and Heritage – 20

	April 2016

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