CLASS NAME	SCIENTIFIC NAME	COMMON NAME	TSC Act	EPBC Act	ELA (2011)	EcoBiological (2008)	EcoHub (2009)
Aves	*Rhipidura leucophrys*	Willie Wagtail	-	-		x	x
Aves	*Scythrops novaehollandiae*	Channel-billed Cuckoo	-	-		x	x
Aves	*Sturnus vulgaris*	Common Starling	-	-		x	x
Aves	*Threskiornis molucca*	Australian White Ibis	-	-		x	x
Aves	*Threskiornis spinicollis*	Straw-necked Ibis	-	-		x	x
Aves	*Tyto capensis*	Grass Owl	V	-		x	x
Aves	*Accipiter novaehollandiae*	Grey Goshawk	-	-		x	
Aves	*Ardea ibis*	Cattle Egret	-	-		x	
Aves	*Cacatua sanguinea*	Little Corella	-	-		x	
Aves	*Chenonetta jubata*	Australian Wood Duck	-	-		x	
Aves	*Chrysococcyx basalis*	Horsfield's Bronze-Cuckoo	-	-		x	
Aves	*Circus approximans*	Swamp Harrier	-	-		x	
Aves	*Egretta garzetta*	Little Egret	-	-		x	
Aves	*Epthianura albifrons*	White-fronted Chat	-	-		x	
Aves	*Falco longipennis*	Australian Hobby	-	-		x	
Aves	*Hieraaetus morphnoides*	Little Eagle	V	-		x	
Aves	*Hirundo ariel*	Fairy Martin	-	-		x	
Aves	*Malurus lamberti*	Variegated Fairy-wren	-	-		x	
Aves	*Motacilla flava*	Yellow Wagtail	-	-		x	
Aves	*Pelecanus conspicillatus*	Australian Pelican	-	-		x	
Aves	*Plectorhyncha lanceolata*	Striped Honeyeater	-	-		x	
Aves	*Rhipidura fuliginosa*	New Zealand Fantail	-	-		x	
Aves	*Sericornis frontalis*	White-browed Scrubwren	-	-		x	
Aves	*Tregellasia leucops*	White-faced Robin	-	-		x	
Aves	*Zosterops lateralis*	Silvereye	-	-		x	
Aves	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill	-	-			x
Aves	*Actitis hypoleucos*	Common Sandpiper	-	-			x
Aves	*Alcedo azurea*	Azure Kingfisher	-	-			x
Aves	*Anhinga melanogaster*	Darter	-	-			x

CLASS NAME	SCIENTIFIC NAME	COMMON NAME	TSC Act	EPBC Act	ELA (2011)	EcoBiological (2008)	EcoHub (2009)
Aves	*Anseranas semipalmata*	Magpie Goose	V	M			x
Aves	*Anthochaera chrysoptera*	Little Wattlebird	-	-			x
Aves	*Aphelocephala leucopsis*	Southern Whiteface	-	-			x
Aves	*Apus pacificus*	Fork-tailed Swift	-	-			x
Aves	*Aquila audax*	Wedge-tailed Eagle	-	-			x
Aves	*Artamus leucorynchus*	White-breasted Woodswallow	-	-			x
Aves	*Aviceda subcristata*	Pacific Baza	-	-			x
Aves	*Botaurus poiciloptilus*	Australasian Bittern	V	-			x
Aves	*Bubulcus ibis*	Cattle Egret	-	-			x
Aves	*Cacatua galerita*	Sulphur-crested Cockatoo	-	-			x
Aves	*Calidris ferruginea*	Curlew Sandpiper	-	-			x
Aves	*Chlidonias hybridus*	Whiskered Tern	-	-			x
Aves	*Colluricincla harmonica*	Grey Shrike-thrush	-	-			x
Aves	*Columba livia*	Rock Dove	-	-			x
Aves	*Coturnix ypsilophora*	Brown Quail	-	-			x
Aves	*Cuculus pallidus*	Pallid Cuckoo	-	-			x
Aves	*Dacelo novaeguineae*	Laughing Kookaburra	-	-			x
Aves	*Dendrocygna eytoni*	Plumed Whistling-Duck	-	-			x
Aves	*Dicrurus bracteatus*	Spangled Drongo	-	-			x
Aves	*Egretta novaehollandiae*	White-faced Heron	-	-			x
Aves	*Eopsaltria australis*	Eastern Yellow Robin	-	-			x
Aves	*Eudynamys scolopacea*	Common Koel	-	-			x
Aves	*Eurystomus orientalis*	Dollarbird	-	-			x
Aves	*Falco cenchroides*	Nankeen Kestrel	-	-			x
Aves	*Fulica atra*	Eurasian Coot	-	-			x
Aves	*Gallinago hardwickii*	Latham's Snipe	-	M			x
Aves	*Geopelia humeralis*	Bar-shouldered Dove	-	-			x
Aves	*Gerygone levigaster*	Mangrove Gerygone	-	-			x
Aves	*Haliastur sphenurus*	Whistling Kite	-	-			x
Aves	*Hirundapus caudacutus*	White-throated Needletail	-	M			x

CLASS NAME	SCIENTIFIC NAME	COMMON NAME	TSC Act	EPBC Act	ELA (2011)	EcoBiological (2008)	EcoHub (2009)
Aves	*Lalage tricolor*	White-winged Triller	-	-			x
Aves	*Larus novaehollandiae*	Silver Gull	-	-			x
Aves	*Lichenostomus chrysops*	Yellow-faced Honeyeater	-	-			x
Aves	*Lonchura castaneothorax*	Chestnut-breasted Mannikin	-	-			x
Aves	*Manorina melanocephala*	Noisy Miner	-	-			x
Aves	*Manorina melanophrys*	Bell Miner	-	-			x
Aves	*Meliphaga lewinii*	Lewin's Honeyeater	-	-			x
Aves	*Merops ornatus*	Rainbow Bee-eater	-	M			x
Aves	*Microeca fascinans*	Jacky Winter	-	-			x
Aves	*Monarcha melanopsis*	Black-faced Monarch	-	-			x
Aves	*Ninox boobook*	Southern Boobook	-	-			x
Aves	*Numenius phaeopus*	Whimbrel	-	-			x
Aves	*Pardalotus punctatus*	Spotted Pardalote	-	-			x
Aves	*Passer domesticus*	House Sparrow	-	-			x
Aves	*Petroica rosea*	Rose Robin	-	-			x
Aves	*Phaps chalcoptera*	Common Bronzewing	-	-			x
Aves	*Philemon corniculatus*	Noisy Friarbird	-	-			x
Aves	*Plegadis falcinellus*	Glossy Ibis	-	-			x
Aves	*Podargus strigoides*	Tawny Frogmouth	-	-			x
Aves	*Psephotus haematonotus*	Red-rumped Parrot	-	-			x
Aves	*Rhipidura albiscapa*	Grey Fantail	-	-			x
Aves	*Sphecotheres viridis*	Figbird	-	-			x
Aves	*Stipiturus malachurus*	Southern Emu-wren	-	-			x
Aves	*Strepera graculina*	Pied Currawong	-	-			x
Aves	*Streptopelia chinensis*	Spotted Turtle-Dove	-	-			x
Aves	*Tringa stagnatilis*	Marsh Sandpiper	-	-			x
Aves	*Turdus merula*	Eurasian Blackbird	-	-			x
Mammalia	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	-	cp5	x	x
Mammalia	*Lepus capensis*	Brown Hare	-	-	opp	x	x
Mammalia	*Oryctolagus cuniculus*	Rabbit	-	-	opp	x	x

CLASS NAME	SCIENTIFIC NAME	COMMON NAME	TSC Act	EPBC Act	ELA (2011)	EcoBiological (2008)	EcoHub (2009)
Mammalia	*Vulpes vulpes*	Fox	-	-	opp	x	x
Mammalia	*Vespadelus vulturnus*	Little Forest Bat	-	-		x	probable
Mammalia	*Chalinolobus gouldii*	Gould's Wattled Bat	-	-		x	x
Mammalia	*Mormopterus "Species 2"*	Undescribed Freetail Bat	-	-		x	x
Mammalia	*Mormopterus norfolkensis*	Eastern Freetail-bat	V	-		x	x
Mammalia	*Tadarida australis*	White-striped Freetail-bat	-	-		x	x
Mammalia	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	V	-		x	
Mammalia	*Isoodon macrourus*	Northern Brown Bandicoot	-	-		x	
Mammalia	*Miniopterus australis*	Little Bentwing-bat	V	-		x	
Mammalia	*Myotis adversus*	Large-footed Myotis	V	-		x	
Mammalia	*Nyctophilus sp.*	long-eared bat	-	-		x	
Mammalia	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V	-		x	
Mammalia	*Vespadelus pumilus*	Eastern Forest Bat	-	-		x	
Mammalia	*Nyctophilus gouldi*	Gould's Long-eared Bat	-	-			possible
Mammalia	*Bos taurus*	European cattle	-	-			x
Mammalia	*Chalinolobus morio*	Chocolate Wattled Bat	-	-			x
Mammalia	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	V	-			x
Mammalia	*Mus musculus*	House Mouse	-	-			x
Mammalia	*Rattus fuscipes*	Bush Rat	-	-			x
Mammalia	*Rattus rattus*	Black Rat	-	-			x
Mammalia	*Sus scrofa*	Pig	-	-			x
Mammalia	*Vespadelus darlingtoni*	Large Forest Bat	-	-			x
Reptilia	*Chelodina longicollis*	Eastern Snake-necked Turtle	-	-	cp5		x
Reptilia	*Cryptoblepharus virgatus*	Cream-striped Shinning-skink	-	-		x	
Reptilia	*Demansia psammophis*	Yellow-faced Whip Snake	-	-		x	
Reptilia	*Eulamprus tenuis\martini*	Barred-sided Skink	-	-		x	
Reptilia	*Pogona barbata*	Bearded Dragon	-	-		x	
Reptilia	*Pseudechis porphyriacus*	Red-bellied Black Snake	-	-		x	

Appendix C: Statutory Assessment

The likelihood of occurrence table identifies the following species as likely to occur within the study area, based on previous records, local records and suitable habitat. For each species or endangered ecological community, an assessment has been carried out in accordance with *Draft Guidelines for Threatened Species Assessment (DEC and DPI).*

Table 12: Threatened biodiversity requiring assessment

Scientific Name	Common Name	TSC Act	EPBC Act	Likelihood of Occurrence
Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions.		EEC	—	Recorded
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions		EEC	—	Recorded
Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions		EEC	—	Recorded
Zannichellia palustris		E	—	Potential
Litoria aurea	Green and Golden Bell Frog	E	V	Potential
Hieraaetus morphnoides	Little Eagle	V	—	Recorded
Anseranas semipalmata	Magpie Goose	V	M	Recorded
Botaurus poiciloptilus	Australasian Bittern	V	—	Recorded
Ephippiorhynchus asiaticus	Black-necked Stork	E	—	Potential
Rostratula australis (a.k.a. R. benghalensis)	Painted Snipe (Australian subspecies)	E	V	Potential
Irediparra gallinacea	Comb-crested Jacana	V	—	Potential
Ixobrychus flavicollis	Black Bittern	V	—	Potential
Tyto capensis	Grass Owl	V	—	Recorded
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Potential
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	—	Recorded
Miniopterus australis	Little Bent-wing Bat	V	—	Recorded
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	—	Recorded
Mormopterus norfolkensis	East Coast Freetail Bat	V	—	Recorded
Myotis adversus	Large-footed Myotis	V	—	Recorded
Pteropus poliocephalus	Grey-headed Flying-Fox	V	V	Recorded
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	—	Potential
Scoteanax rueppellii	Greater Broad-nosed Bat	V	—	Recorded

Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Not applicable for an EEC.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Whilst 47 hectares of the biometric vegetation type "Swamp oak swamp forest fringing estuaries, Sydney basin", only 28 ha of this matched the definition of the Swamp Oak Floodplain Forest Endangered Ecological Community. Of that, 4.0 ha will be cleared for construction of the TSF. This loss is not expected to have a significant impact on the extent of this community in the Lower Hunter.

This community can also be susceptible to changes in hydrological environment. The impacts from the proposal on stormwater, flooding and groundwater have been assessed in several reports (Douglas Partners 2012b; BMTWBM 2012: Worley Parsons 2012). The proposed development is not considered likely to impact upon this EEC due to stormwater changes, as the proposed development will not significantly change the hydrological regime. Where structures could change the hydrology (such as the access road), culverts and/or a bridge will be designed to allow a larger conveyance of flood water to move freely. The groundwater report prepared by Douglas Partners (2012), indicates that there will be minor increases in the level of groundwater directly adjacent to the proposed development; however, these impacts are not considered likely to occur at the Swamp Oak Forest area.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The occurrence of this EEC on the subject site is not at the limit of its known distribution.

4. How is the proposal likely to affect current disturbance regimes?

The majority of the subject site has been historically cleared for industrial and subsequent agricultural land use. Although some areas within this site have been rehabilitated using both endemic and non-endemic species, the majority still remains cleared. The proposed development will require removal of all vegetation within the subject site. The remaining areas of the study area (i.e. outside of the subject site) are proposed to be used as a conservation offset managed under a CMP that will control and manage current disturbances. This will include removal of stock, control of weeds and feral pests and the restoration of both cleared and native vegetation within the offset area.

5. How is the proposal likely to affect habitat connectivity?

The Swamp Oak Floodplain Forest within the study area is fragmented and is isolated from other remnant patches of this EEC and other vegetation occurring in the locality. This community will not be affected as part of the proposal. Accordingly, the proposal is unlikely to affect the habitat connectivity.

6. How is the proposal likely to affect critical habitat?

No critical habitat occurs within the study area.

Conclusion:

The proposed development is not likely to have a significant impact on this EEC in the locality or in the region.

Coastal Saltmarsh in the NSW North Coast, Sydney Basin and Southeast Corner bioregions

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Not applicable for an EEC.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Approximately 9.24 ha of Saltmarsh is mapped within the study area. The proposal will impact on 0.35 ha of this EEC from within the subject site. The remainder of the saltmarsh within the study area is proposed to be set aside as a conservation offset and managed via a CMP.

Impacts from the proposal on stormwater, flooding and groundwater have been assessed in several reports (Douglas Partners 2012b; BMTWBM 2012: Worley Parsons 2012). Although Worley Parsons (2012) indicates that there will be some increase in the amount of freshwater entering the Saltmarsh from stormwater discharge, impacts on the EEC are likely to be negligible due to regular tidal flushing from the south.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The occurrence of this EEC on the subject site is not at the limit of its known distribution.

4. How is the proposal likely to affect current disturbance regimes?

The majority of the subject site has been historically cleared for industrial and subsequent agricultural land use. Although some areas within this site have been rehabilitated using both endemic and non-endemic species, the majority still remains cleared. The remaining areas of the study area (i.e. outside of the subject site) are proposed to be used as a conservation offset managed under a CMP that will control and manage current disturbances. This will include removal of stock, control of weeds and feral pests and the restoration of both cleared and native vegetation within the offset area.

5. How is the proposal likely to affect habitat connectivity?

Habitat connectivity for this community will not be affected by the proposal.

6. How is the proposal likely to affect critical habitat?

No critical habitat occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on this Endangered Ecological Community in the locality or in the region.

Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Not applicable for EEC.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Approximately 25.35ha of Freshwater Wetlands on Coastal Floodplains were mapped within the study area. The proposal will remove approximately 3.39 ha of this EEC. The area of Freshwater Wetlands on Coastal Floodplains proposed to be removed has been subject to past disturbance, in some cases complete clearing followed by re-colonization.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The occurrence of this EEC on the subject site is not at the limit of its known distribution.

4. How is the proposal likely to affect current disturbance regimes?

The majority of the subject site has been historically cleared for industrial and subsequent agricultural land use. Although some areas within this site have been rehabilitated using both endemic and non-endemic species, the majority still remains cleared. The proposed development will require removal of 3.39 ha of this EEC. Approximately 13.41 ha will be protected in an offset area that will be managed for long-term conservation outcomes. This will include removal of stock, control of weeds and feral pests and the restoration of both cleared and native vegetation within the offset area.

5. How is the proposal likely to affect habitat connectivity?

The removal of approximately 3.39 ha of Freshwater Wetlands on Coastal Floodplains EEC will not significantly affect habitat connectivity, because the areas to be removed either occur on the edge of a larger remanent or are already isolated from other patches of this EEC occurring in the locality. Accordingly, the proposal is unlikely to affect the habitat connectivity of this community but may impact its ability to recover into the future.

6. How is the proposal likely to affect critical habitat?

No critical habitat occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on this Endangered Ecological Community in the locality or in the region.

Zannichellia palustris

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Zannichellia palustris is considered to have potential to occur within the study area, as it occurs in fresh to brackish, still or slowly moving waters and has previously been recorded locally, at Cessnock, Kooragang, Shortland and Wallsend. Targeted searches conducted within the study did not detect any individuals of this species.

The proposal may involve modification of and indirect impacts on potential *Zannichellia palustris* habitat within the study area, particularly due to the creation of train tracks and access roads. It is unlikely that the proposed action would have an adverse effect on the life cycle of this species, if it does in fact occur within the study area, as long as potential disturbances are managed appropriately, as detailed in Section 6.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The proposed development may remove approximately 1.32 hectares of potential habitat for this species, located in the Phragmites australis and typha orientalis freshwater wetland. Other indirect impacts, including sedimentation, weed invasion, hydrological change and nutrient input will need to be mitigated as recommended in Section 6.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

This species has only been recorded in the Murray River estuary in South Australia and the lower Hunter region in NSW. Given the proposal does not affect known occurrences of the species, an impact at the limit of the species known distribution or otherwise will not occur.

4. How is the proposal likely to affect current disturbance regimes?

The majority of the subject site has been historically cleared for industrial and subsequent agricultural land use. Although some areas within this site have been rehabilitated using both endemic and non-endemic species, the majority still remains cleared. The proposed development will affect 1.32 hectares of potential habitat for the species. The remaining areas of the study area (i.e. outside of the subject site) are proposed to be used as a conservation offset managed under a Conservation Management Plan that will control and manage current disturbances. This will include removal of stock, control of weeds and feral pests and the restoration of both cleared and native vegetation within the offset area.

5. How is the proposal likely to affect habitat connectivity?

The study area is situated in an already fragmented landscape with limited connectivity, therefore the proposal does not cause the severance of connectivity. The proposed management of the conservation offset area, in time, will improve connectivity through the subject site.

6. How is the proposal likely to affect critical habitat?

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on this species in the locality or the region.

Green and Golden Bell Frog *(Litoria aurea)*

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The habitat preference and requirements of the Green and Golden Bell Frog (GGBF) are not well understood and difficult to define (Mahony 1999), particularly in recent years where threats have to some degree altered habitat preferences. Although the site has a long history of industrial and agricultural disturbance, the species has the propensity to turn up in highly disturbed sites. Generally large, permanent water bodies containing high levels of emergent vegetation such as *Typha*, *Baumea* and the introduced *Juncus acutus* appears to be favourable for species, however it has been observed utilising a wide range of natural and man-made water bodies including coastal swamps, marshes, dune swales, lagoons, lakes, estuary wetlands, riverine floodplain wetlands, billabongs, storm water retention basins, farm dams, bunded areas, storage tanks, water troughs, drains, ditches and other excavation areas capable of capturing water such as quarries and brick pits (DEC, 2005). Terrestrial habitat attributes that appear to favour the species include large grassy areas associated with adjacent cover from logs, holes and burrows, rocks or tussock forming vegetation that provide shelter.

The subject site contains many of the above mentioned habitat characteristics and closely resembles habitat present within nearby areas of known habitat for the species, namely the Sandgate/Hexham Swamp key population and the nearby Kooragang/Ash Island key population which is less than 4km away. It is considered, therefore, that the subject site contains potential habitat for the Green and Golden Bell Frog and, due to these nearby populations, has a greater likelihood of supporting the species.

Surveys for the GGBF have been conducted by EcoBiological (2008) on three occasions from November 2007 to January 2008 with one survey undertaken during heavy rain. EcoHub (2009) undertook additional surveys on five evenings following rainfall in November 2008. Supplementary surveys have been completed as part of this study on four nights in January and February 2011 following rainfall. No GGBFs were detected on the subject site during any survey event.

Despite this lack of detection from several survey events over three different seasons, failure to detect the species does not necessarily preclude it from occurring in the study area. Long-term monitoring of the Sandgate/Hexham Swamp population of GGBF has shown that significant decline has occurred in recent years and that it appears to be under imminent threat of extinction. While the Kooragang/Ash Island population is believed to be relatively secure, there can be long periods where the GGBF cannot be found in places that it is commonly found in at other times, and there are areas of habitat where detection only occurs on a very infrequent basis.

There are numerous records of the GGBF from the area surrounding the subject site with the closest of these being less than 350m away (NSW NPWS Wildlife Atlas; DECC, 2007) and it is well accepted that the Green and Golden Bell Frog once occurred in and along the northern boundary of Hexham Swamp (Mahony, 2003). Additionally there are anecdotal records of the frog nearby to the 'coal washery' that forms part of the subject site (EcoBiological 2008). More importantly a significant breeding population occurs less than 3km to the south east of subject site, listed as the Sandgate/Hexham Swamp key population in both the Green and Golden Bell Frog Draft Recovery Plan and the Green and Golden Bell Frog Lower Hunter Key Population Management Plan (DEC, 2005; DECC, 2007). The subject site lies within the historical distribution of the Sandgate/Hexham Swamp population as mapped by the Management Plan. The GGBF is known to be capable of moving considerable distances in relatively short periods and has been noted moving distances of greater than 1km in a single day/night (Pyke & White, 2001; DEC, 2005). Considering that the subject site is within dispersal capabilities of the frog to a known population and that the subject site is directly linked to that population it is reasonable to assume that the frogs could use the subject site from time to time.

With respect to whether the proposal is likely to affect the lifecycle of the GGBF, no individuals have been recorded on the site, despite survey events spread of three different breeding seasons. Therefore, no known breeding, refuge or forage habitat is present within the site. It is considered that while the habitat removal and modification on the subject site due to the proposed development is not considered likely to impact on the lifecycle of the GGBF. Despite this, the proposal includes securing a conservation offset which contains less disturbed potential habitat.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The proposed development will result in the removal of approximately 38ha of vegetated and disturbed land that offers variously suitable potential habitat, including 3.39 ha of freshwater wetland.

It is difficult to quantify the level of this impact on the species, given the GGBF has not been recorded on the site and the site is considered to represent potential habitat that may be used at some point. However, provided recommendations are implemented including pre-clearing and clearing surveys, the securing of the conservation offset lands in perpetuity, the proposal is unlikely to constitute a significant impact on the species.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Green and Golden Bell Frog is not at the known limit of its distribution at this location.

4. How is the proposal likely to affect current disturbance regimes?

The majority of the subject site has been historically cleared for industrial and subsequent agricultural land use. Although some areas within this site have been rehabilitated using both endemic and non-endemic species, the majority still remains cleared. The remaining areas of the study area (i.e. outside of the subject site) are proposed to be used as a conservation offset managed under a CMP that will control and manage current disturbances. This will include removal of stock, control of weeds and feral pests and the restoration of both cleared and native vegetation within the offset area.

5. How is the proposal likely to affect habitat connectivity?

The GGBF can reportedly capable of moving considerable distances in relatively short periods and has been noted moving distances of greater than 1km in a single day/night (Pyke & White, 2001; DEC,

2005). The proposed development will result in clearing and development of 41 ha of disturbed land that the GGBF is capable of traversing. The project will however be aligned in a north-south direction. To the east is the Pacific Highway which already acts as a barrier to east-west movement. The project would not disrupt north-south movement. The reduction in connectivity is considered to be offset by the securing of with the conservation offset lands within the study area which, via a small parcel of private land, is contiguous with Hunter Wetlands National Park directly to the west of the subject site. Therefore, connectivity across the landscape would be maintained and further secured.

6. How is the proposal likely to affect critical habitat?

No critical habitat for this species occurs at this location.

Conclusion:

The proposal will remove potential habitat for the GGBF. However, given the species has not been recorded within the study area, despite surveys over three seasons, and the proposal involves securing 53ha of conservation offset, the proposal is not considered to represent a significant impact on the species.

Magpie Goose *(Anseranas semipalmata)*

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Magpie Goose is known to inhabit terrestrial sedge-dominated wetlands, particularly those on floodplains of rivers (Marchant & Higgins 1993; Simpson & Day 1999). Phragmites Rushland vegetation in the south of the study area provides habitat foraging and roosting for the Magpie Goose, and the species was recorded onsite by EcoHub (2009).

The proposal involves the removal of 3.39 ha of freshwater wetland habitats. No breeding habitat is available within the study area. As long as potential disturbances are managed appropriately, as detailed in Section 6, it is unlikely that the proposal will have a significant impact on the life cycle of the Magpie Goose.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The Magpie Goose was recorded within the study area by EcoHub (2009) and the subject site is considered to contain some marginal foraging habitat for the species. The proposal involves removal of 3.39 ha of freshwater wetland and areas of open grassland from subject site. Provided appropriate management strategies are implemented to minimise disturbance, it is unlikely that the proposal will have a significant impact on the habitat of the Magpie Goose.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The study area is not at the limit of the known distribution of the Magpie Goose.

4. How is the proposal likely to affect current disturbance regimes?

The majority of the subject site has been historically cleared for industrial and subsequent agricultural land use. Although some areas within this site have been rehabilitated using both endemic and non-endemic species, the majority still remains cleared. The remaining areas of the study area (i.e. outside of the subject site) are proposed to be used as a conservation offset managed under a CMP that will control and manage current disturbances. This will include removal of stock, control of weeds and feral pests and the restoration of both cleared and native vegetation within the offset area.

5. How is the proposal likely to affect habitat connectivity?

The proposal would not isolate or fragment any areas of habitat for the species.

6. How is the proposal likely to affect critical habitat?

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on this species in the locality or the region.

Australasian Bittern *(Botaurus poiciloptilus)*

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Australasian Bittern inhabits terrestrial wetlands, reedbeds, swamps, streams and estuaries, (Marchant & Higgins 1993; Simpson & Day 1999). Phragmites Rushland and Saltmarsh vegetation in the south of the study area provides some marginal foraging habitat for this species, and it was recorded onsite by EcoHub (2009). No breeding habitat was observed or is considered likely to occur on the site.

The proposal involves the removal of 3.39ha of freshwater wetland habitat. As long as potential disturbances are managed appropriately, as detailed in Section 6, it is unlikely that the proposal will have a significant impact on the life cycle of the Australasian Bittern.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Australasian Bittern foraging habitat occurs in the Phragmites Rushland and Saltmarsh vegetation in south of the study area. The proposal involves removal of approximately 3.39ha of freshwater wetland that represents potential forage habitat for the species. Provided appropriate management strategies are implemented to minimise disturbance, it is unlikely that the proposal will have a significant impact on the habitat of the Australasian Bittern.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The study area is not at the limit of the known distribution of the Australasian Bittern.

4. How is the proposal likely to affect current disturbance regimes?

The majority of the subject site has been historically cleared for industrial and subsequent agricultural land use. Although some areas within this site have been rehabilitated using both endemic and non-endemic species, the majority still remains cleared. The remaining areas of the study area (i.e. outside of the subject site) are proposed to be used as a conservation offset managed under a CMP that will control and manage current disturbances. This will include removal of stock, control of weeds and feral pests and the restoration of both cleared and native vegetation within the offset area.

5. How is the proposal likely to affect habitat connectivity?

The Australasian Bittern is a mobile species capable of traversing open areas where it is necessary. The proposal is not considered likely to cause barriers to the movement of the species and therefore will not affect habitat connectivity.

6. How is the proposal likely to affect critical habitat?

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on this species.

Black-necked Stork *(Ephippiorhynchus asiaticus)*

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Black-necked Stork is associated with tropical and warm temperate terrestrial wetlands, estuarine and littoral habitats, and occasionally woodlands and grasslands floodplains (Marchant & Higgins 1993). The species forages in fresh or saline waters up to 0.5m deep, mainly in open fresh waters, extensive sheets of shallow water over grasslands or sedgeland, mangroves, mudflats, shallow swamps with short emergent vegetation and permanent billabongs and pools on floodplains (Marchant & Higgins 1993; DECC 2007). The NPWS Atlas of NSW Wildlife contains numerous local Black-necked Stork records in the locality, including within Hexham Swamp. The subject site contains some potential foraging habitat for the Black-necked Stork, particularly in the freshwater wetland and Saltmarsh vegetation in the south of the study area.

The proposal involves the removal of 3.39ha of freshwater wetland vegetation which represents marginal potential forage habitat for the species. No breeding habitat is present on the site. If disturbances are managed appropriately, as detailed in Section 6, it is unlikely that the proposal will have a significant impact on the life cycle of the Black-necked Stork.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Marginal potential Black-necked Stork foraging habitat occurs in the freshwater wetland vegetation, open grassy areas and Saltmarsh vegetation in south of the study area. The proposal involves removal of 3.39ha of freshwater wetland. The subject site comprises mostly disturbed lands and therefore of marginal habitat quality for the species. Provided appropriate management strategies are implemented to minimise disturbance, it is unlikely that the proposal will have a significant impact on the habitat of the Black-necked Stork.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The study area is not at the known limit of the distribution of the Black-necked Stork.

4. How is the proposal likely to affect current disturbance regimes?

The majority of the subject site has been historically cleared for industrial and subsequent agricultural land use. Although some areas within this site have been rehabilitated using both endemic and non-endemic species, the majority still remains cleared. The remaining areas of the study area (i.e. outside of the subject site) are proposed to be used as a conservation offset managed under a CMP that will control and manage current disturbances. This will include removal of stock, control of weeds and feral pests and the restoration of both cleared and native vegetation within the offset area.

5. How is the proposal likely to affect habitat connectivity?

Proposed vegetation removal would not lead to the further fragmentation or isolation of vegetated areas, and would not threaten the long-term survival of the Black-necked Stork in the locality as the species is considered to be highly mobile.

6. How is the proposal likely to affect critical habitat?

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on the Black-necked Stork.

Painted Snipe (Australian subspecies) *(Rostratula australis)*

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Australian Painted Snipe prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (DECC 2007). It nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds, and breeding is often in response to local conditions and generally occurs from September to December (DECC 2007). The species in known to roost during the day in dense vegetation (NSW Scientific Committee 2004) and forages nocturnally on mud-flats and in shallow water, feeding on worms, molluscs, insects and some plant-matter (DECC 2007). The NPWS Atlas of NSW Wildlife contains a 2004 record of the Australian Painted Snipe at Ash Island in 2004. The freshwater wetland vegetation types within the subject site provides potential foraging habitat for this species.

The proposal involves the removal of approximately 3.39ha of freshwater wetland habitat constituting highly disturbed marginal foraging habitat. As long as potential disturbances are managed appropriately, as detailed in Section 5, it is unlikely that the proposal will have a significant impact on the life cycle of the Australian Painted Snipe.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Potential foraging habitat for the Australian Painted Snipe occurs in the freshwater wetland vegetation types within the subject site. Approximately 3.39ha of highly disturbed marginal potential habitat is proposed to be removed as part of the proposal. Provided appropriate management strategies are implemented to minimise disturbance, it is unlikely that the proposal will have a significant impact on the habitat of the Australian Painted Snipe.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The study area is not at the known limit of the distribution of the Australian Painted Snipe.

4. How is the proposal likely to affect current disturbance regimes?

The majority of the subject site has been historically cleared for industrial and subsequent agricultural land use. Although some areas within this site have been rehabilitated using both endemic and non-endemic species, the majority still remains cleared. The remaining areas of the study area (i.e. outside of the subject site) are proposed to be used as a conservation offset managed under a CMP that will control and manage current disturbances. This will include removal of stock, control of weeds and feral pests and the restoration of both cleared and native vegetation within the offset area.

5. How is the proposal likely to affect habitat connectivity?

Proposed vegetation removal would not lead to the further fragmentation or isolation of vegetated areas, and would not threaten the long-term survival of the Australian Painted Snipe in the locality, as the species is capable of traversing open areas of land.

6. How is the proposal likely to affect critical habitat?

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on the Australian Painted Snipe in the locality or the region.

Comb-crested Jacana *(Irediparra gallinacea*)

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Comb-crested Jacana usually inhabit coastal freshwater wetlands, such as lagoons, billabongs, swamps, lakes and reservoirs, generally with abundant floating aquatic vegetation (Marchant and Higgins 1999).

It forages on floating vegetation and feeds on insects, invertebrates as well as vegetation and seeds. Comb-crested Jacanas breed in spring and summer a cup-nest or platform constructed of available vegetation. The species moves in response to the prevailing conditions of the wetland areas (OEH 2012). The NPWS Atlas of NSW Wildlife contains records of the Comb-crested Jacana to the east in the vicinity of Ash Island. The freshwater wetland vegetation types within the subject site provide some potential foraging habitat for this species.

The proposal involves the removal of approximately 3.39ha of freshwater wetland habitat constituting highly disturbed marginal foraging habitat. As long as potential disturbances are managed appropriately, as detailed in Section 5, it is unlikely that the proposal will have a significant impact on the life cycle of the Comb-crested Jacana.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Potential foraging habitat for the Comb-crested Jacana occurs within portions of the freshwater wetland vegetation types within the subject site. Approximately 3.39ha of highly disturbed marginal potential habitat is proposed to be removed as part of the proposal. Provided appropriate management strategies are implemented to minimise disturbance, it is unlikely that the proposal will have a significant impact on the habitat of the Comb-crested Jacana.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The study area is not at the known limit of the distribution of the Comb-crested Jacana, although the Hunter region is sometimes considered as such. The species is known to occur to the north and west, but is also known from the NSW South Coast.

4. How is the proposal likely to affect current disturbance regimes?

The majority of the subject site has been historically cleared for industrial and subsequent agricultural land use. Although some areas within this site have been rehabilitated using locally indigenous and non-endemic species, the majority still remains cleared. The remaining areas of the study area (i.e. outside of the subject site) are proposed to be used as a conservation offset managed under a CMP that will control and manage current disturbances. This will include removal of stock, control of weeds and feral pests and the restoration of both cleared and native vegetation within the offset area.

5. How is the proposal likely to affect habitat connectivity?

Proposed vegetation removal would not lead to the further fragmentation or isolation of vegetated areas, and would not threaten the long-term survival of the Comb-crested Jacana in the locality, as the species is capable of traversing open areas of land.

6. How is the proposal likely to affect critical habitat?

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on the Comb-crested Jacana in the locality or the region.

Black Bittern (*Ixobrychus flavicollis*)

The Black Bittern is listed as vulnerable under the TSC Act. They have a wide distribution, from southern NSW north to Cape York and along the north coast to the Kimberley region. In NSW, records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland.

Black Bitterns are cryptic species inhabiting both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation and littoral habitats. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves (DECCW 2010a). This species forages on the edges of still or running water, usually in permanent wetlands fringed by dense vegetation (Shultz 1989).

Black Bitterns are solitary but occur in pairs during the breeding season, from December to March. Nests are built in spring on a branch overhanging water and consist of a bed of sticks and reeds on a base of larger sticks. During the day, they roost in trees or on the ground amongst dense reeds. When disturbed they freeze or will fly up to a branch or flush for cover where it will freeze again (DECCW 2010a).

Key threats identified for the Black Bittern include (DECCW 2010a, NPWS, 1999):

- Clearing of riparian vegetation.
- Predation by foxes and feral cats on eggs and juveniles.
- Grazing and trampling of riparian vegetation by stock.
- Drainage, salinisation, siltation and pollution of wetlands and waterbodies.
- Poor representation of preferred habitats in conservation reserves.

This has not been recorded within the study area and surrounds during surveys. Suitable habitat for the Black Bittern is present in areas of estuarine reedland and throughout the Swamp Oak Forest within the study area. There is also the potential for this species to utilise stands of *Phragmites australis* and *Typha orientalis*. They may nest in densely vegetated areas and in secluded places in the trees over water within the study area.

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Black Bittern are a cryptic species utilising terrestrial and estuarine wetlands generally in areas of permanent water and dense vegetation. Factors that would be likely to impact upon the life cycle of a viable population of Black Bittern if present within the study area would include significant removal of habitat, predation of foxes and cats, reduced water quality due to siltation, pollution and salinity and use of pesticides and other chemicals near wetland areas.

It nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds, and breeding is often in response to local conditions and generally occurs from September to December (DECC 2007). The species in known to roost during the day in dense vegetation (NSW Scientific Committee 2004) and forages nocturnally on mud-flats and in shallow water, feeding on worms, molluscs, insects and some plant-matter (DECC 2007). The NPWS Atlas of NSW Wildlife contains a 2004 record of the Australian Painted Snipe at Ash Island in 2004. The freshwater wetland vegetation types within the subject site provides potential foraging habitat for this species.

The proposal involves the removal of approximately 3.39ha of freshwater wetland habitat constituting highly disturbed marginal foraging habitat. As long as potential disturbances are managed

appropriately, as detailed in Section 5, it is unlikely that the proposal will have a significant impact on the life cycle of the Black Bittern.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Potential foraging habitat for the Black Bittern occurs in the freshwater wetland vegetation types within the subject site. Approximately 3.39ha of highly disturbed marginal potential habitat is proposed to be removed as part of the proposal. Provided appropriate management strategies are implemented to minimise disturbance, it is unlikely that the proposal will have a significant impact on the habitat of the Black Bittern.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The study area is not at the known limit of the distribution of the Black Bittern.

4. How is the proposal likely to affect current disturbance regimes?

The majority of the subject site has been historically cleared for industrial and subsequent agricultural land use. Although some areas within this site have been rehabilitated using local native as well as non-endemic species, the majority still remains cleared. The remaining areas of the study area (i.e. outside of the subject site) are proposed to be used as a conservation offset managed under a CMP that will control and manage current disturbances. This will include removal of stock, control of weeds and feral pests and the restoration of both cleared and native vegetation within the offset area.

5. How is the proposal likely to affect habitat connectivity?

Proposed vegetation removal would not lead to the further fragmentation or isolation of vegetated areas, and would not threaten the long-term survival of the Black Bittern in the locality, as the species is capable of traversing open areas of land.

6. How is the proposal likely to affect critical habitat?

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on the Black Bittern in the locality or the region.

Little Eagle (*Hieraetus morphnoides*)

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Reported habitats of the Grass Owl include tall grass, swampy, sometimes tidal areas, mangrove fringes, grassy plains, coastal heaths, grassy woodland, cane grass, lignum, sedges, cumbungi, cane fields and grain stubble (Pizzey and Knight, 1997). The Grass Owl nests on the ground within dense tall grass, sedges, reeds and even sugarcane plantations (Pizzey and Knight, 1997). The Grass Owl primarily feeds on rodents, hunting on the wing over heathland, grassland and sedgeland, as well as along the edge of sugar cane, crops and pastureland (Pizzey and Knight, 1997). This species was recorded onsite by both Ecobiological (2008) and EcoHub (2009), however no evidence of roosting owls or regurgitated owl pellets was detected. It is considered unlikely that habitat within the subject site supports breeding, as extensive areas of dense rushland or sedgeland is not present. Therefore the site is considered to contain marginal foraging habitat only.

The proposal involves the removal of vegetation and modification of 38ha of a mosaic of cleared and disturbed vegetation and what is considered to be marginal foraging habitat. No nests were observed within the study area and no suitable nest trees are present within the subject site. The proposal

includes the securing of approximately 53 ha of habitat within a conservation offset. Given no breeding habitat will be affected by the proposal, the level of this impact (i.e. removal of marginal foraging habitat) is not considered likely to have an effect on the lifecycle of the species or the local breeding pair.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

A mosaic of 38 ha of variously suitable foraging habitat for the Little Eagle is proposed to be removed as part of the proposal. This is considered to be a small portion of available foraging habitat for a local breeding pair. The retention of 53.ha of more intact habitat that will be managed via a CMP within an offset area is considered on balance to offset any impact on the species.

Provided appropriate management strategies are implemented to minimise disturbance, it is unlikely that the proposal will have a significant impact on the habitat of the Little Eagle.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The subject site is not at the limits of the known distribution for the species.

4. How is the proposal likely to affect current disturbance regimes?

The majority of the subject site has been historically cleared for industrial and subsequent agricultural land use. Although some areas within this site have been rehabilitated using both endemic and non-endemic species, the majority still remains cleared. The remaining areas of the study area (i.e. outside of the subject site) are proposed to be used as a conservation offset managed under a CMP that will control and manage current disturbances. This will include removal of stock, control of weeds and feral pests and the restoration of both cleared and native vegetation within the offset area.

5. How is the proposal likely to affect habitat connectivity?

The Little Eagle was recorded flying above the site by EcoBiological (2008). The species is considered highly mobile and is therefore capable of traversing areas of open ground. The proposed development is therefore not considered likely to result in the severing of habitat for this species.

6. How is the proposal likely to affect critical habitat?

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on the Little Eagle in the locality or the region.

Grass Owl (*Tyto capensis*)

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Reported habitats of the Grass Owl include tall grass, swampy, sometimes tidal areas, mangrove fringes, grassy plains, coastal heaths, grassy woodland, cane grass, lignum, sedges, cumbungi, cane fields and grain stubble (Pizzey and Knight, 1997). The Grass Owl nests on the ground within dense tall grass, sedges, reeds and even sugarcane plantations (Pizzey and Knight, 1997). The Grass Owl primarily feeds on rodents, hunting on the wing over heathland, grassland and sedgeland, as well as along the edge of sugar cane, crops and pastureland (Pizzey and Knight, 1997). This species was recorded onsite by both Ecobiological (2008) and EcoHub (2009), however no evidence of roosting owls or regurgitated owl pellets was detected. It is considered unlikely that habitat within the subject site supports breeding, as extensive areas of dense rushland or sedgeland is not present. Therefore the site is considered to contain marginal foraging habitat only.

The proposal involves the removal of vegetation and modification of 53 ha of a mosaic of cleared and disturbed vegetation and what is considered to be marginal foraging habitat. The proposal includes the securing of approximately 53 ha of more intact habitat within a conservation offset. Given no breeding habitat will be affected by the proposal, the level of this impact (i.e. removal of marginal foraging habitat) is not considered likely to have an effect on the lifecycle of the species or the local breeding pair.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

A mosaic of 53 ha of variously suitable foraging habitat for the Grass Owl is proposed to be removed as part of the proposal. This is considered to be a small portion of available foraging habitat for a local breeding pair. An offset of 53 ha of more intact habitat that will be managed via a CMP within an offset area is considered on balance to offset any impact on the species.

Provided appropriate management strategies are implemented to minimise disturbance, it is unlikely that the proposal will have a significant impact on the habitat of the Grass Owl.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The subject site is not at the limits of the known distribution for the species.

4. How is the proposal likely to affect current disturbance regimes?

The majority of the subject site has been historically cleared for industrial and subsequent agricultural land use. Although some areas within this site have been rehabilitated using both endemic and non-endemic species, the majority still remains cleared. The remaining areas of the study area (i.e. outside of the subject site) are proposed to be used as a conservation offset managed under a CMP that will control and manage current disturbances. This will include removal of stock, control of weeds and feral pests and the restoration of both cleared and native vegetation within the offset area.

5. How is the proposal likely to affect habitat connectivity?

The Grass Owl was recorded flying into the site from the adjacent nearby habitats present on Ash Island to the southeast (EcoHub 2009) and southwest (EcoBiological 2008) and is therefore capable of traversing areas of open ground. The proposed development is therefore not considered likely to result in the severing of habitat for this species.

6. How is the proposal likely to affect critical habitat?

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on the Grass Owl in the locality or the region.

Tree Roosting Microchiropteran Bats: Eastern False Pipistrelle *(Falsistrellus tasmaniensis),* East Coast Freetail Bat *(Mormopterus norfolkensis),* Yellow-bellied Sheathtail-bat *(Saccolaimus flaviventris),* Large-footed Myotis *(Myotis adversus)* and Greater Broad-nosed Bat *(Scoteanax rueppellii)*

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

These four species of bat all inhabit woodlands and forests, and their preferred roost sites are in tree hollows and under loose bark on trees (Churchill 1998). Suitable habitat within the subject site for these species occurs as a mosaic of variously structured foraging habitat. A number of hollow bearing trees have been recorded and mapped (EcoBiological 2008) in the remnant patch of Swamp Oak Forest in the north of the study area, though none of these are to be affected by the proposal. Eastern False

Pipistrelle, East Coast Freetail Bat and Greater Broad-nosed Bat have previously been recorded within the study area (Ecobiological 2008; EcoHub 2009), while the Yellow-bellied Sheathtail-bat is considered to have potential to inhabit the study area.

The subject site contains potential forage habitat only for these species and the proposal does not require removal of any hollow bearing trees (refer to **Appendix E**), therefore there will be no impact on critical lifecycle phases for these species.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The subject site contains a mosaic of 38ha of variously suitable foraging habitat for these species, which will be cleared and modified as part of the proposal. No roosting habitat will be affected by the proposal. This impact is considered to be a small portion of available foraging habitat in the local area. The retention of 51 ha of more intact habitat that will be managed via a CMP within an offset area is considered on balance to offset any impact on these species.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The study area is not at the limit of the known distribution of these species.

4. How is the proposal likely to affect current disturbance regimes?

The majority of the subject site has been historically cleared for industrial and subsequent agricultural land use. Although some areas within this site have been rehabilitated using both endemic and non-endemic species, the majority still remains cleared. The remaining areas of the study area (i.e. outside of the subject site) are proposed to be used as a conservation offset managed under a CMP that will control and manage current disturbances. This will include removal of stock, control of weeds and feral pests and the restoration of both cleared and native vegetation within the offset area.

5. How is the proposal likely to affect habitat connectivity?

Foraging habitat for these species is currently heavily fragmented in the locality by agricultural, residential and industrial development. Whilst the proposal will to some degree cause additional fragmentation of habitat, a critical corridor will not be severed and these species are all considered capable of traversing the open areas. Therefore the effect on habitat connectivity for these species is not considered significant.

6. How is the proposal likely to affect critical habitat?

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on these microchiropteran bat species in the locality or the region.

Cave Roosting Microchiropteran Bats including Large-eared Pied Bat *(Chalinolobus dwyeri),* Little Bent-wing Bat *(Miniopterus australis),* Eastern Bent-wing Bat *(Miniopterus schreibersii oceanensis)*

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

These four species of bat roost in caves, and inhabit woodlands and forests (Churchill 1998). Suitable habitat within the subject site for these species occurs as a mosaic of variously structured foraging habitat. Little Bentwing-bat, Eastern Bent-wing Bat and Large-footed Myotis have previously been recorded within the study area (Ecobiological 2008; EcoHub 2009), while the Large-eared Pied Bat is

considered to have potential to inhabit the study area. No suitable roost habitat for these species is available within the study area, therefore impacts on the lifecycles of these species will not result.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The subject site contains a mosaic of 53 ha of variously suitable foraging habitat for these species, which will be cleared and modified as part of the proposal. No roosting habitat for these species will be affected by the proposal. This impact is considered to be a small portion of available foraging habitat in the local area. The retention of 53 ha of more intact habitat that will be managed via a CMP within an offset area is considered on balance to offset any impact on these species.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The study area is not at the limit of the known distribution of these species.

4. How is the proposal likely to affect current disturbance regimes?

The majority of the subject site has been historically cleared for industrial and subsequent agricultural land use. Although some areas within this site have been rehabilitated using both endemic and non-endemic species, the majority still remains cleared. The remaining areas of the study area (i.e. outside of the subject site) are proposed to be used as a conservation offset managed under a CMP that will control and manage current disturbances. This will include removal of stock, control of weeds and feral pests and the restoration of both cleared and native vegetation within the offset area.

5. How is the proposal likely to affect habitat connectivity?

The majority of the subject site has been historically cleared for industrial and subsequent agricultural land use. Although some areas within this site have been rehabilitated using both endemic and non-endemic species, the majority still remains cleared. The remaining areas of the study area (i.e. outside of the subject site) are proposed to be used as a conservation offset managed under a CMP that will control and manage current disturbances. This will include removal of stock, control of weeds and feral pests and the restoration of both cleared and native vegetation within the offset area.

6. How is the proposal likely to affect critical habitat?

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on these microchiropteran bat species in the locality or the region.

Grey-headed Flying-Fox *(Pteropus poliocephalus)*

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Grey-headed Flying-Fox inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 1998, Eby 1998). Their camps are often located in gullies, typically close to water, in vegetation with a dense canopy (Churchill 1998). The Grey-headed Flying-fox was recorded flying over the study area during field investigations as part of this study and has also previously been recorded onsite (EcoHub 2009; Ecobiological 2008). There is extremely limited potential foraging habit within the study area, with the occasional planted Eucalypt occurring within rehabilitation areas of the subject site and Melaleuca species north of the subject site providing seasonal and intermittent inflorescence. No roost habitat is present within the study area.

Due to highly mobile nature of the species, the clearing of the subject site and small isolates of potential forage habitat and given there will be no impact on roost habitat the proposal will not have a significant impact on the life cycle of the Grey-headed Flying-Fox.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

There is extremely limited potential foraging habit within the study area, with the occasional planted Eucalypt occurring within rehabilitation areas of the subject site offering seasonal and intermittent forage. The proposal will result in the removal of this small area of potential habitat, which is not considered to represent a significant impact. Additionally, the retention of 53 ha of more intact habitat that will be managed via a CMP within an offset area is considered on balance to offset any impact on these species.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The study area is not at the limit of the known distribution of the Grey-headed Flying.

4. How is the proposal likely to affect current disturbance regimes?

The majority of the subject site has been historically cleared for industrial and subsequent agricultural land use. Although some areas within this site have been rehabilitated using both endemic and non-endemic species, the majority still remains cleared. The remaining areas of the study area (i.e. outside of the subject site) are proposed to be used as a conservation offset managed under a CMP that will control and manage current disturbances. This will include removal of stock, control of weeds and feral pests and the restoration of both cleared and native vegetation within the offset area.

5. How is the proposal likely to affect habitat connectivity?

Proposed vegetation removal would not lead to the further fragmentation or isolation of vegetated areas, and would not threaten the long-term survival of the Grey-headed Flying Fox in the locality.

6. How is the proposal likely to affect critical habitat?

No critical habitat for this species occurs at this location.

Conclusion:

The proposed development is not likely to have a significant impact on Grey-headed Flying Fox in the locality or the region.

Appendix D: Consolidated survey effort for all flora and fauna studies and comparison to guidelines.

Survey method	Survey Guidelines (DEC 2004; OE&H 2010)	Survey	Timing	Stratification type, area and survey effort per type					Compliance with OE&H Guidelines
				Swamp Oak swamp forest fringing estuaries, Sydney Basin and South East Corner	Coastal floodplain sedgelands, rushlands and forbs of the North Coast	Phragmites Australia and Typha orientalis coastal freshwater wetlands of the Sydney basin	Saltmarsh in estuaries of Sydney basin and south east corner	Disturbed / Cleared Vegetation	
				47.15	**9.69**	**15.66**	**9.24**	**172.26**	
Rapid Data Points (RDP)	N/A	EcoBiological (2008)	3/12/207 and 9/1/2008	4 points	3 points		1 point		N/A
		ECOHUB (2008) (descriptive quadrats)	December 2007	7 points in total (locations unknown)					
Floristic quadrats	Swamp Oak Forest - 4 quadrats; Coastal floodplain sedgelands - 3 quadrats; Phragmites australis and Typha orientalis freshwater wetlands - 3 quadrats; Saltmarsh - 3 quadrats; Distrubed/cleared - 0 quadrats	EcoBiological (2008)	3/12/207 and 9/1/2008	3 plots					Not all stratification units have been sampled as per the guidelines; however given the homogeneity of stratification units as found during extensive random meanders, the site is considered to have been adequately surveyed.
		ECOHUB (2008)	11-16 June 2008	4 quadrats in total (locations unknown					
		Eco Logical Australia (2011)	January - February 2011	4 quadrats	2 quadrats	2 quadrats	2 quadrats		
Wetland survey	N/A	EcoBiological (2008)	11/1/2008 and 31/3/2008		1 survey				N/A
Floristic searches	N/A	EcoBiological (2008)	3/12/207 and 9/1/2008	1 transect	1 transect			1 transect	N/A
		ECOHUB (2008)	11-16th June 2008	3 transects	1 transects	2 transects	1 transects	1 transects	

		Eco Logical Australia (2011)	January - February 2011	2 transects plus random meander accross study area (Figure 3)	1 plus random meander accross study area (Figure 3)	1 plus random meander accross study area (Figure 3)	1 plus random meander accross study area (Figure 3)	random meander accross study area (Figure 3)	
Vegetation community mapping	Stratify the site in to Biometric vegetation types	EcoBiological (2008)	3/12/207 and 9/1/2008	Random meander across the entire site					Yes
		Eco Logical Australia (2011)	January - February 2011	Random meander across the entire site					
		ECOHUB (2008)	June 2008	Random meander across the entire site					
Targeted flora and fauna habitat transects	N/A	EcoBiological (2008)	November 2007 to March 2008	1 transect	1 transect			1 transect	N/A
		ECOHUB (2008)	11-16 June 2008	2 transects	1 transect			1 transect	
		Eco Logical Australia (2011	January - February 2011	Random meander accross the entire site					
Elliot A trapping (terrestrial)	100 trap nights over 3-4 consecutive nights. Effort per stratification unit up to 50ha, plus an additional effort for every additional 100ha	EcoBiological (2008)	19-23/11/2007	72 trap nights					132 trap nights have been sampled on the site. Given the suitability of the habitat on the site (depauperate and long history of disturbance), this level of survey effort is considered adequate.
		ECOHUB (2008)	11th-14th June 2008 and 21-25th June 2008	80 trap nights (western boundary of subject site) plus 80 trap nights (southwest section of subject site). Actual location unknown					
Elliot B trapping (terrestrial)	100 trap nights over 3-4 consecutive nights. Effort per stratification	EcoBiological (2008)	19-23/11/2007	36 trap nights					Due to inadequate location of survey sites, it's difficult to say whether precise guidelines per stratification unit have been met. However, 36 trap nights have been

	unit up to 50ha, plus an additional effort for every additional 100ha								sampled on the site, presumably in more favourable habitats. Given the suitability of the habitat on the site (depauperate and long history of disturbance), this level of survey effort is considered adequate.
Arboreal trapping (ECOHUB arboreal glider traps)	24 trap nights over 3-4 consecutive nights. Effort per stratification unit up to 50ha, plus an additional effort for every additional 100ha	ECOHUB (2008)	11th-14th June 2008 and 21-25th June 2008	72 trap nights plus 36 trap nights (location unknown)					Given arboreal habitat is confined to the swamp oak forest, the combined arboreal trapping and hair tubing effort by EcoBiological (2008) and ECOHUB (2008) is adequate.
Hair tubes (arboreal)		EcoBiological (2008)	19-23/11/2007	96 trap nights					
Cage trapping	24 trap nights over 3-4 consecutive nights. Effort per stratification unit up to 50ha, plus an additional effort for every additional 100ha	ECOHUB (2008)	11th -14th June and 21st -25th June 2008	16 trap nights (location unknown)					No. However, given the available habitat, past disturbance and the likelihood of encountering threatened fauna targeted by this method, this level of effort is considered adequate.
Spotlighting	2x 1 hour up to 200 hectares of stratification unit at 1km per hour on 2 separate nights.	EcoBiological (2008)	22/11/2007;	12.5hrs total effort (location unknown)					It is difficult to accurately calculate effort per stratification unit, due to lacking survey location information. However, given the complexity and habitat suitability of the study area, the effort employed is considered adequate.
		Eco Logical Australia (2011)	January - February 2011	1 x 20min transect 3 repeat visits	1 x 20min transect 3 repeat visits	2 x 20min transects 3 repeat visits	1 x 20min transect 3 repeat visits	meander transects	
		ECOHUB (2008)	8th June 2008	2 hours (location unknown)					
Call playback	Sites to be separated by 800m-1km. At least 5 visits on separate nights for Powerful Owl, Barking Owl and Grass Owl. 6 visits for Sooty Owl and 8 visits for Masked Owl.	EcoBiological (2008)	22nd November 2007 - 10th January 2008	3 sites over 4 nights					Yes
		ECOHUB (2008)	8th -12th June 2008	1hr each night for 4 nights (unknown locations)					

Anabat II bat call recorder	2 sound activated devices - effort per 100ha of stratification unit targeting preferred habitat.	EcoBiological (2008)	22nd November 2007 - 10th January 2008	4 sites x 12hrs			1 site x 12hrs	3 sites x 12hrs	Yes
		ECOHUB (2008)	11th -14th June and 21st -25th June 2008	2 sites (nights and hours unknown)	2 sites (nights and hours unknown)	2 sites (nights and hours unknown)		1 sites (nights and hours unknown)	
Bird survey	Species time curve is suggested	EcoBiological (2008)	22nd November 2007 - 10th January 2008	4 transects x 30min each	1 transects x 30min each	1 transects x 30min each	1 transects x 30min each	3 transects x 30min each	Yes
		ECOHUB (2008)	11th -14th June and 21st -25th June 2008	3 transects (12 hours total)	1 transect (12 hours total)	1 transect (12 hours total)		1 transect (12 hours total)	
		Eco Logical Australia (2011	January - February 2011	Opportunistic	Opportunistic	Opportunistic	Opportunistic	Opportunistic	
Targeted waterbird survey	A 1 hr census at dawn or duck per wetland	EcoBiological (2008)			2x2hr searches				Yes
Nocturnal amphibian survey (including Green and Golden Bell Frog call playback)	Tadpole surveys, call surveys and active searches (day and night). Small habitat areas 1hr on 3 separate occasions. Large areas 3 separate four-hourly searches. Surveys should be done between Sept - January during wet and humid nights.	EcoBiological (2008)	4 separate days/nights 22nd November 2007 - 10th January 2008	4 survey points (14 hours total effort)	5 survey points x 30min each (14 hours total effort)	4 survey points x 30min each (14 hours total effort)	3 survey points x 30min each (14 hours total effort)	5 survey points x 30min each (14 hours total effort)	Yes
		ECOHUB (2008) (descriptive quadrats)	June 2008; and humid and wet nights 9th, 10th, 14th, 19th and 21st November 2008	5 repeat visits of 2 sites	5 repeat visits of 3 sites	5 repeat visits of 3 sites		5 repeat visits of 1 site (dam)	
		Eco Logical Australia (2011	January - February 2011		1 site 3 repeat visits	4 sites 3 repeat visits	1 site 3 repeat visits	2 sites 3 repeat visits (dam)	
Diurnal reptile and amphibian survey	30-minute search on two separate days targeting specific habitat	EcoBiological (2008)	22nd November 2007 - 10th January 2008	6 person hours within subject site and opportunistic through subject site					Yes
		ECOHUB (2008) (descriptive quadrats)	18th June 2008	2 transects with 5 sub-plots (location unknown)					

Appendix E: Hollow bearing tree survey results from EcoBiological (unpub) and flora survey locations and tracks (EcoBiological 2007 & 2008)

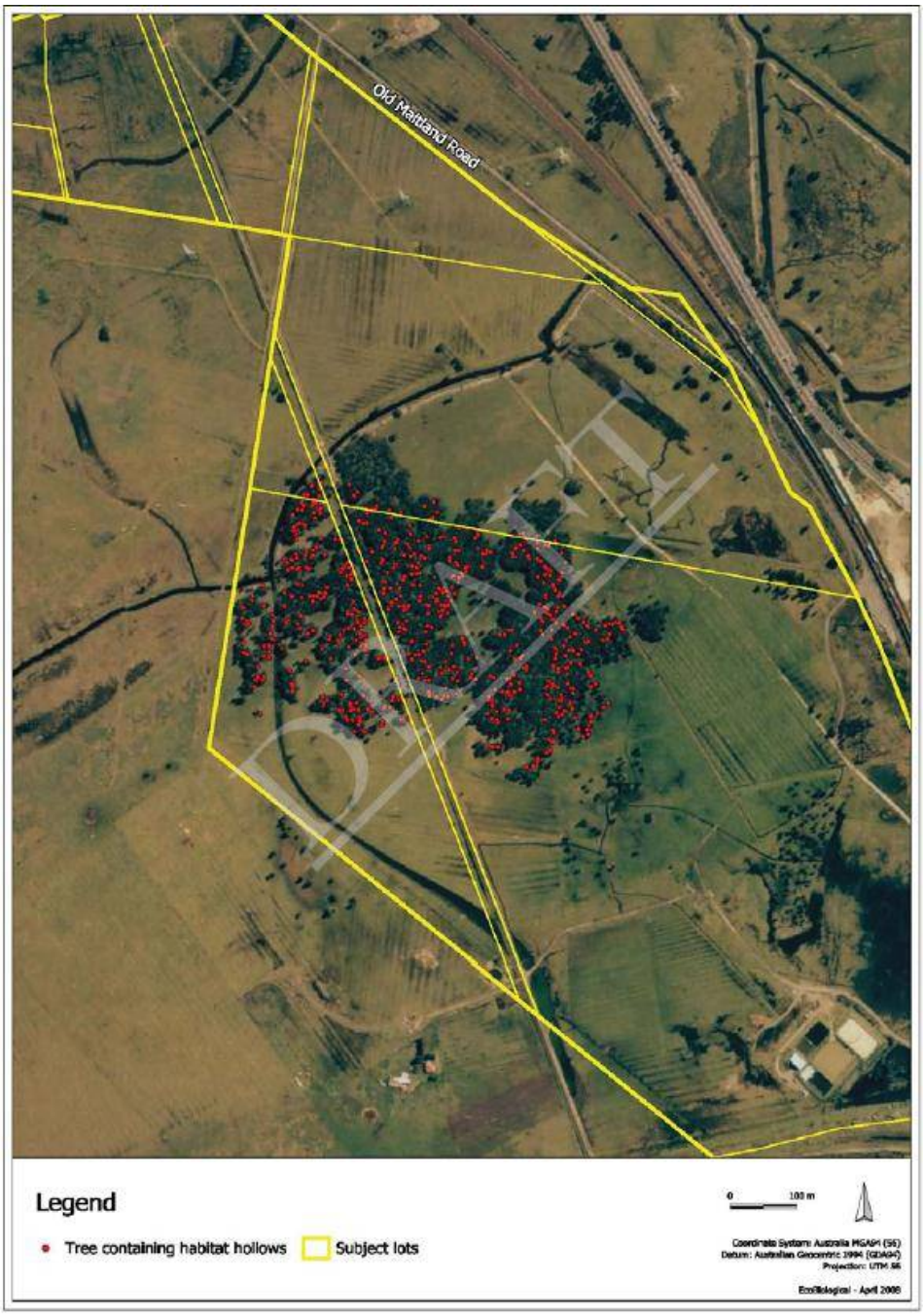

Figure 12: Location of trees containing potential habitat hollows within the study area (From EcoBiological 2008).

A total of 682 trees bearing potential habitat hollows were identified and mapped and the size class of hollows were recorded. The majority of hollows were small and over 90% of the hollow bearing trees were Swamp Oak (EcoBiological 2008).

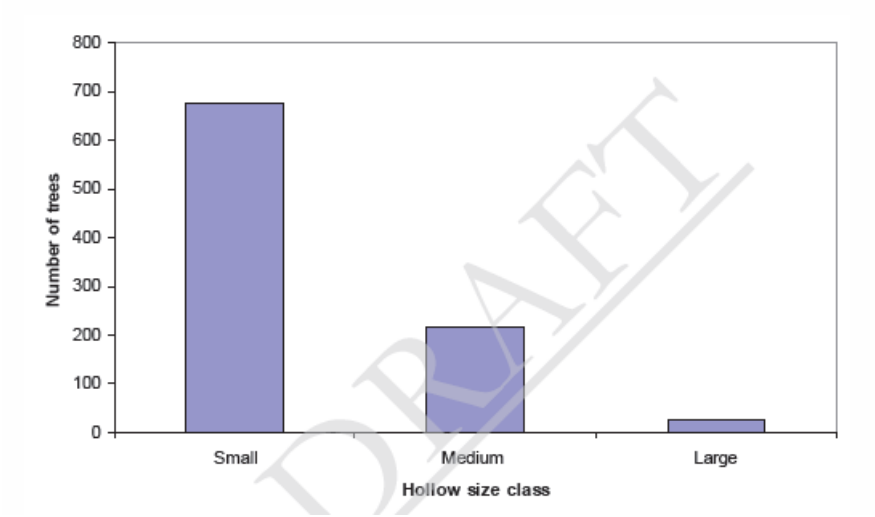

Figure 13: Number of trees with each hollow size class (small <8cm, medium 8-20cm and large >20cm) (From EcoBiological 2008).

Figure 14: Survey sites and Random meander tracks (Ecobiological 2007 and 2008)

Appendix F: Biobanking Credit Reports

Submission of Biobanking Reports

Biobanking Credit Reports were submitted on the Biobanking website. This section provides background information on some of the data inputs.

Landscape Value Assessment - Assessment Circles

The amount of vegetation currently in the 1000ha and 100ha circles was calculated for the areas of development and biobank. The same 1000ha circle was used for both assessments. The 100ha circles were placed in the area of greatest change i.e. where the greatest impact or most rehabilitation will occur.

Four biometric vegetation types occur on the site and it was assumed that these vegetation types comprise those within the 1000ha circle. Of these vegetation types, three are non-woody, and so areas where these were likely to occur were included as native vegetation cover in the 1000ha assessment circle. These vegetation types include Coastal floodplain sedgelands, rushlands and forblands, *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands and saltmarsh. The vegetation in the Hunter Wetlands National Park is an example of this.

The other biometric vegetation type, Swamp Oak swamp forest, was included as native vegetation cover when the overstorey was in benchmark.

Table 13 summarises the results of the assessment for each circle.

Table 13: Area of vegetation in each assessment circle before and after the Biobank site

		BEFORE BIOBANK		AFTER BIOBANK	
Circle No.	**Circle Type**	**Area of Vegetation Within Assessment Circle (ha)**	**Native Vegetation Cover Class (%)**	**Area of Vegetation Within Assessment Circle (ha)**	**Native Vegetation Cover Class (%)**
1	1000 ha	297 ha	21-30%	289 ha	21-30%
	100 ha – Dev	16 ha	11-20%	11 ha	11-20%
	100 ha - Biobank	28 ha	21-30%	43 ha	41-50%

Connectivity Assessment

It was determined that the primary connection link extends from the south-west, through the Hunter Wetlands National Park and into the southern offset area. It was also determined that the patches of vegetation in and around the northern offset site were not part of this connection or any other. This is due the surrounding vegetation being predominately exotic pasture grasses and the gaps between patches are greater than 100m.

Connectivity Width Assessment

The narrowest point of the current vegetated connection is occurs outside both the proposed development and biobank sites along the finger of vegetation that extends from the northern point of the Hunter Wetlands National Park on the western side of the study area. The minimum width of the connection is approximately 50m. The most limiting width will not be impacted or improved and so will remain at 50m. Therefore, the width class used for both before and after development and biobanking is **30-100m**.

Connectivity Condition Assessment

Although the moderate to good condition vegetation in the study is not in benchmark, the sites (both the development and the biobank) are adjacent to the Hunter Wetlands National Park. This is a large area of non-woody vegetation that is in benchmark condition for mid-storey/ground cover. This then extends to the south-west and links to areas of dense tree cover which are likely to be in benchmark for both the overstorey and mid-storey/ground cover. These large areas of benchmark condition vegetation will not be impacted or improved by any action in the study area and so will remain in the same condition class after works have been completed.

Table 14 summarises the condition class considering the information above.

Table 14: Condition classes before and after site works

Strata	Condition Class (Before Biobank)	Condition Class (After Biobank)
Connectivity Value (Over-storey Condition)	PFC at benchmark	PFC at benchmark
Connectivity Value (Mid-storey/Ground Cover Condition)	PFC at benchmark	PFC at benchmark

Adjacent Remnant Area and Patch Size

As mentioned previously, the vegetation in and surrounding the northern offset area is not connected to the other areas of vegetation in the study area. As a result, the adjacent remnant area is a total of the vegetation that is within 100m, and totals 30 hectares. These patches are in moderate to good condition and surrounded by cleared land, as defined by the *Biobanking Operational Manual,* and so the patch size is also 30 hectares.

The other vegetation patches in the study area are in moderate to good condition, and link with the Hunter Wetlands National Park. These linkages of moderate/good condition vegetation result in a Patch Size of 501 hectares for all patches, and an Adjacent Remnant Area of 501 hectares for the moderate to good condition vegetation onsite. The Adjacent Remnant Area for low condition patches (areas of cleared land that will be revegetated) is 0.

Appendix G: Correspondence with OEH re Offsets

David

From OEH point of you, a Conservation Agreement under the NP&W Act is considered an appropriate mechanism for conserving in perpetuity and is one of OEH preferred methods (providing it is done in accordance with the legislation and supported by Lynn W's group). Cheers Steve

Steve Lewer

Regional Biodiversity Conservation Officer

Planning and Aboriginal Heritage Section

Conservation and Regulation - North East Branch

Office Of Environment and Heritage

PO Box 488G

NEWCASTLE (NSW) 2300

ph: (02) 4908 6814

mobile: 0459 082 162

fax: (02) 4904 6810

email: steve.lewer@environment.nsw.gov.au

From: David Bonjer [mailto:DavidB@ecoaus.com.au]
Sent: Friday, 24 August 2012 2:13 PM
To: Gibson Robert

Cc: Lewer Steve
Subject: Trani Support facility, Hexham

Hi Robert and Steve

As you may recall we are assisting Aurizon and their project managers (Engenicom) with the ecological assessment and biodiversity offsets for the Train Support Facility at Hexham (MP 07-0171).

In order to determine what kind of instrument should be used to secure the offsets, I made initial enquires to Lynn Webber and Rebecca Scrivener at OEH, seeking their opinion on whether a Conservation Agreement (CA) under the NP&W Act would be suitable. From both i received a positive verbal response – although it was pointed out that this was not a comment on the adequacy of the offset – as that is assessed under the Part 3A process. However, for the purposes of the part 3A assessment i would like to get a little more certainty that a CA would be supported by OEH as a means of securing the offset. Are you able to respond to this email with some advice on this issue. I understand this could be in-principle only because the CA application would need to be assessed in the usual process – as would the development proposal itself.

For your information, the offset is likely to be about 53 hectares and in two portions. A 20 ha area of freshwater wetland and saltmarsh which adjoins the National Park, and a 33 ha portion of which half is Swamp Oak and half needs rehabilitation of cleared land. Exclusion of stock, fencing and weed management will go a long way to achieving this. A Plan of Management will be prepared and implemented. At this point in time it is not intended to transfer land to NPWS, but the CA would not preclude this from happening in the future if all parties agreed. Also FYI, our Biobanking Credit calculations show that the offsets will generate 431 credits, compared to the 261 required for the project –a surplus of 170 credits. Three out of four biometric veg types are adequately offset, with one falling short by just 9 credits.

Aurizon intend to lodge the application for the Part 3A project very shortly so a quick response would be appreciated. Please don't hesitate to call if you would like to discuss.

Thanks

David Bonjer

Senior Environmental Planner

Eco Logical Australia Pty Ltd
PO Box 20529, World Square, Sydney 2002
T + (02) 8536 8668| M 0405 910 839
davidb@ecoaus.com.au

http://www.ecoaus.com.au

Appendix H: Targeted Flora Surveys – Parsons Brinkerhoff and EcoBiological

Figure 1. Random meander tracks (Ecobiological 2007 and 2008)

Project Area

Cadastre

Vegetation Communities

Exotic Herbfield

Phragmites australis and *Typha orientalis* Coastal Freshwater Wetlands

Swamp Mahogany Swamp Forest on Coastal Lowlands

Swamp Oak Swamp Forest Fringing Estuaries

A4 Original

0 25 50 100

Metres

GDA 1994 MGA Zone 56

ARTC
Hexham Relief Roads

Targeted Survey
Asperula asthenes

Job Number	2110501B
Revision	A2
Date	17.12.2012
Scale	1:3,000

Figure 1a

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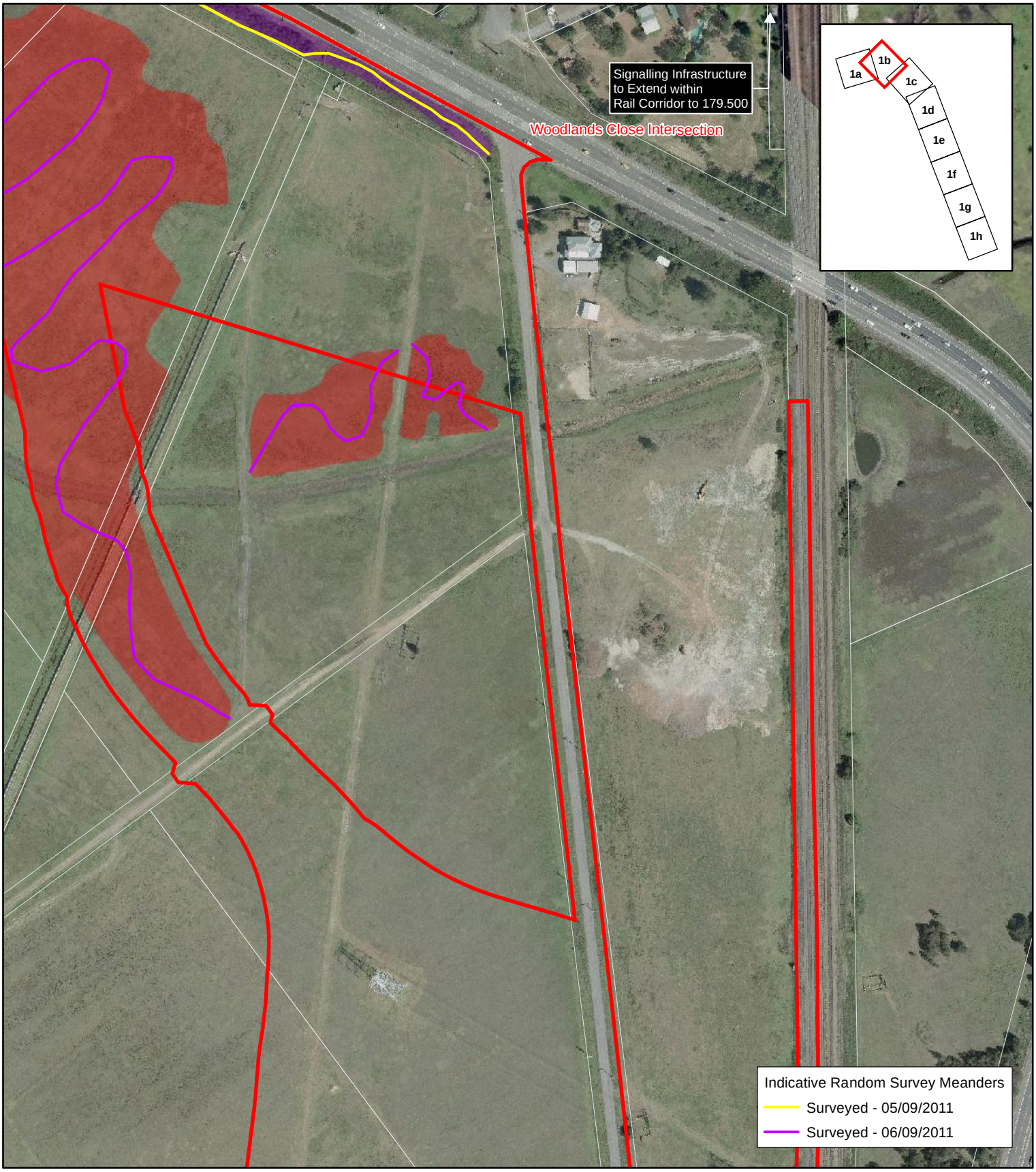

Project Area

Cadastre

Vegetation Communities

Exotic Herbfield

Phragmites australis and *Typha orientalis* Coastal Freshwater Wetlands

Swamp Mahogany Swamp Forest on Coastal Lowlands

Swamp Oak Swamp Forest Fringing Estuaries

A4 Original

0 25 50 100

Metres

GDA 1994 MGA Zone 56

ARTC

Hexham Relief Roads

Targeted Survey

Asperula asthenes

Job Number	2110501B
Revision	A2
Date	17.12.2012
Scale	1:3,000

Figure 1b

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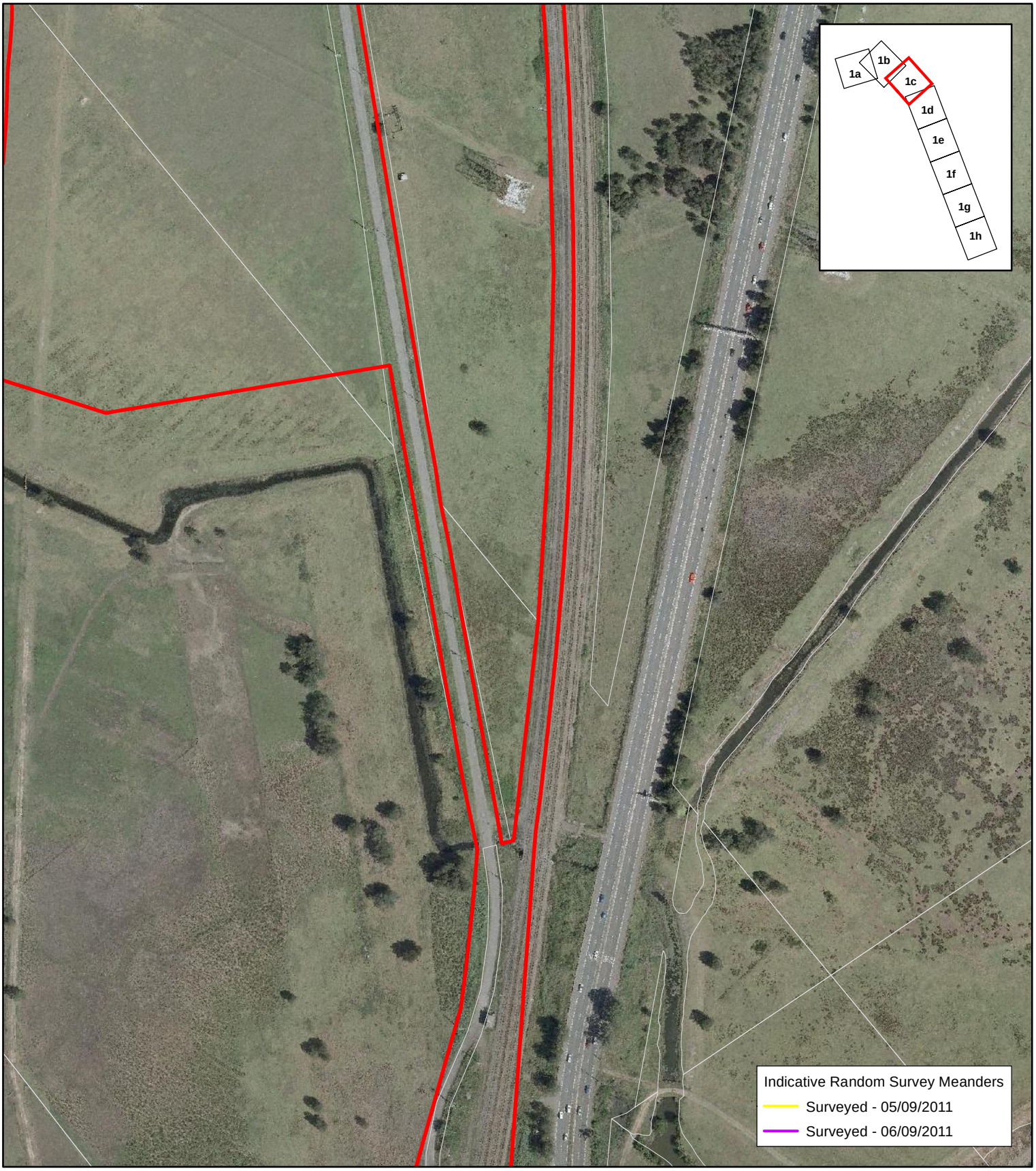

Project Area

Cadastre

Vegetation Communities

Exotic Herbfield

Phragmites australis and *Typha orientalis* Coastal Freshwater Wetlands

Swamp Mahogany Swamp Forest on Coastal Lowlands

Swamp Oak Swamp Forest Fringing Estuaries

A4 Original

0 25 50 100

Metres

GDA 1994 MGA Zone 56

ARTC
Hexham Relief Roads

Targeted Survey
Asperula asthenes

Job Number	2110501B
Revision	A2
Date	17.12.2012
Scale	1:3,000

Figure 1c

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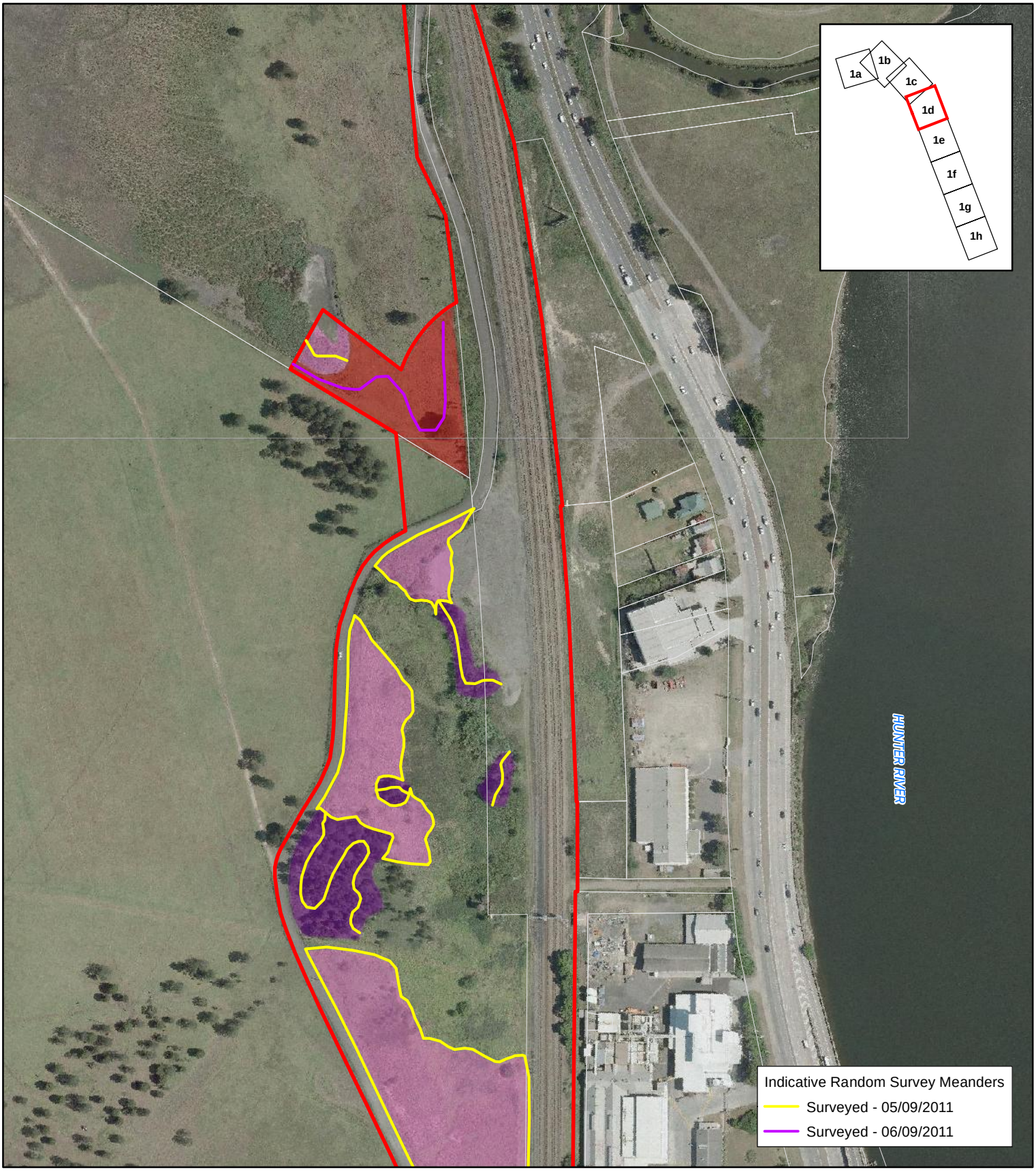

Project Area
Cadastre

Vegetation Communities
Exotic Herbfield
Phragmites australis and *Typha orientalis* Coastal Freshwater Wetlands
Swamp Mahogany Swamp Forest on Coastal Lowlands
Swamp Oak Swamp Forest Fringing Estuaries

A4 Original

0 25 50 100

Metres

GDA 1994 MGA Zone 56

ARTC
Hexham Relief Roads

Targeted Survey
Asperula asthenes

Job Number	2110501B
Revision	A2
Date	17.12.2012
Scale	1:3,000

Figure 1d

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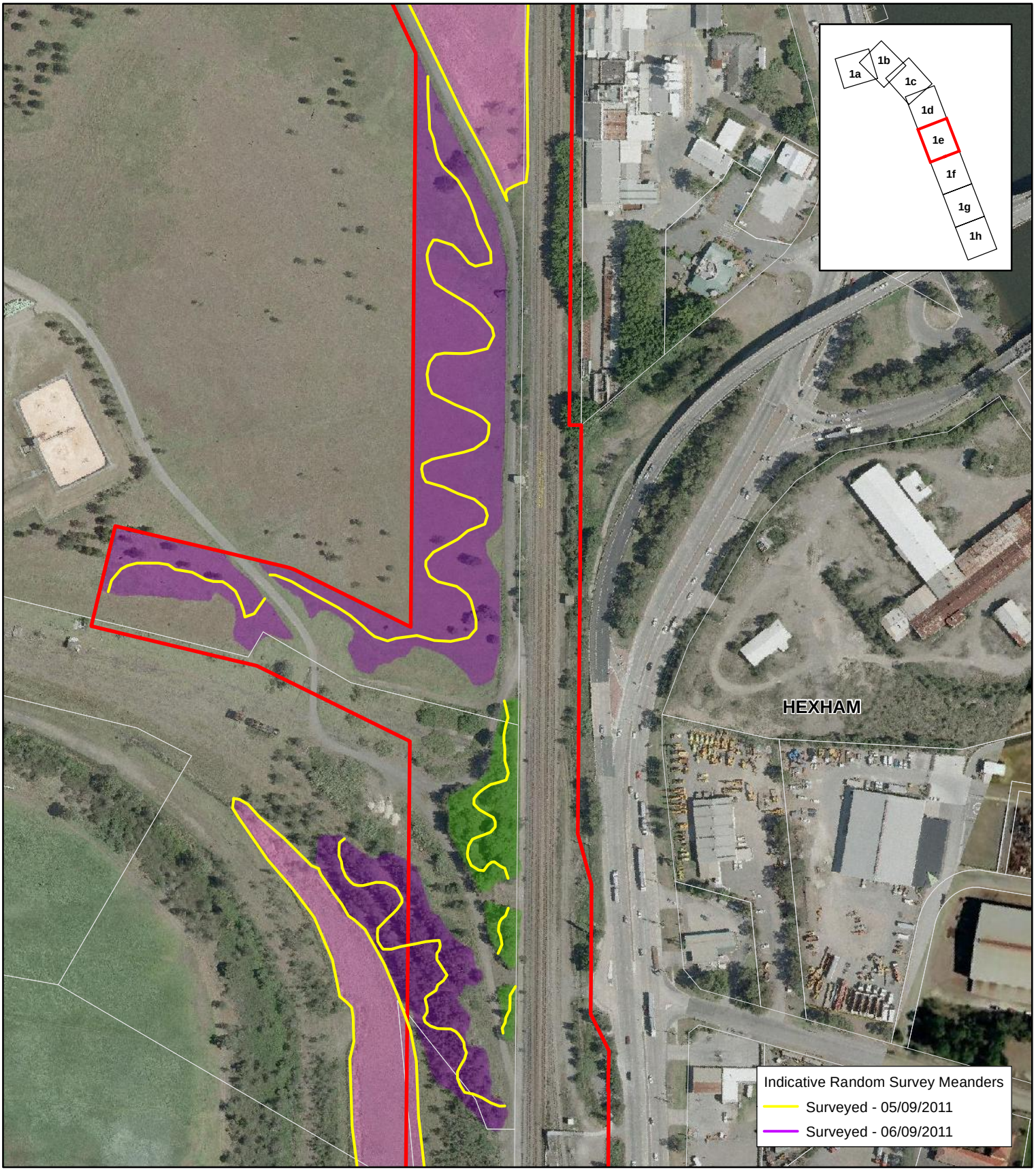

Project Area

Cadastre

Vegetation Communities

Exotic Herbfield

Phragmites australis and *Typha orientalis* Coastal Freshwater Wetlands

Swamp Mahogany Swamp Forest on Coastal Lowlands

Swamp Oak Swamp Forest Fringing Estuaries

A4 Original

0 25 50 100

Metres

GDA 1994 MGA Zone 56

ARTC
Hexham Relief Roads

Targeted Survey
Asperula asthenes

Job Number	2110501B
Revision	A2
Date	17.12.2012
Scale	1:3,000

Figure 1e

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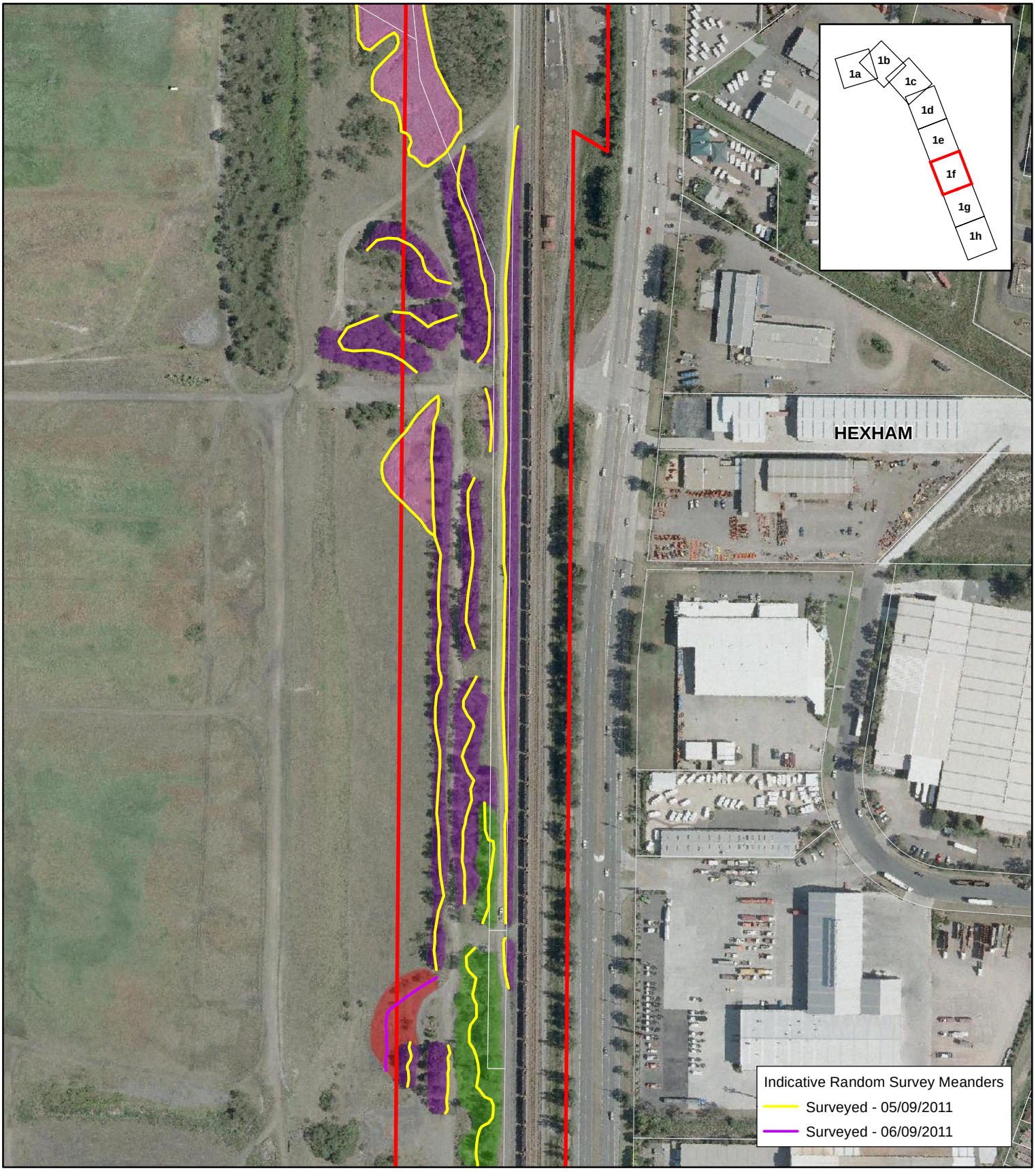

Project Area

Cadastre

Vegetation Communities

Exotic Herbfield

Phragmites australis and *Typha orientalis* Coastal Freshwater Wetlands

Swamp Mahogany Swamp Forest on Coastal Lowlands

Swamp Oak Swamp Forest Fringing Estuaries

A4 Original

0 25 50 100

Metres

GDA 1994 MGA Zone 56

ARTC
Hexham Relief Roads

Targeted Survey
Asperula asthenes

Job Number	2110501B
Revision	A2
Date	17.12.2012
Scale	1:3,000

Figure 1f

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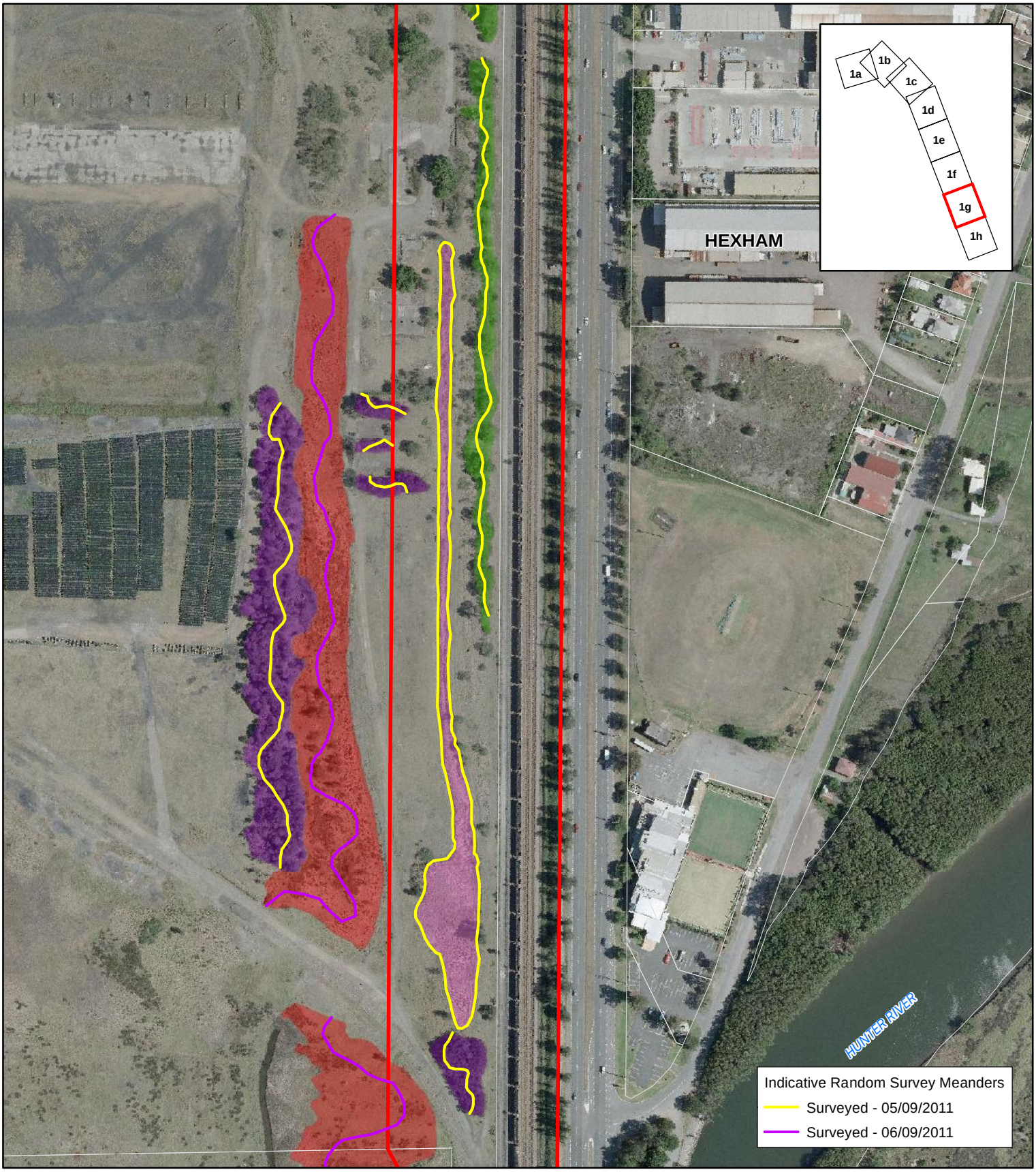

Project Area
Cadastre

Vegetation Communities
Exotic Herbfield
Phragmites australis and *Typha orientalis* Coastal Freshwater Wetlands
Swamp Mahogany Swamp Forest on Coastal Lowlands
Swamp Oak Swamp Forest Fringing Estuaries

A4 Original

0 25 50 100

Metres

GDA 1994 MGA Zone 56

ARTC
Hexham Relief Roads

Targeted Survey
Asperula asthenes

Job Number	2110501B
Revision	A2
Date	17.12.2012
Scale	1:3,000

Figure 1g

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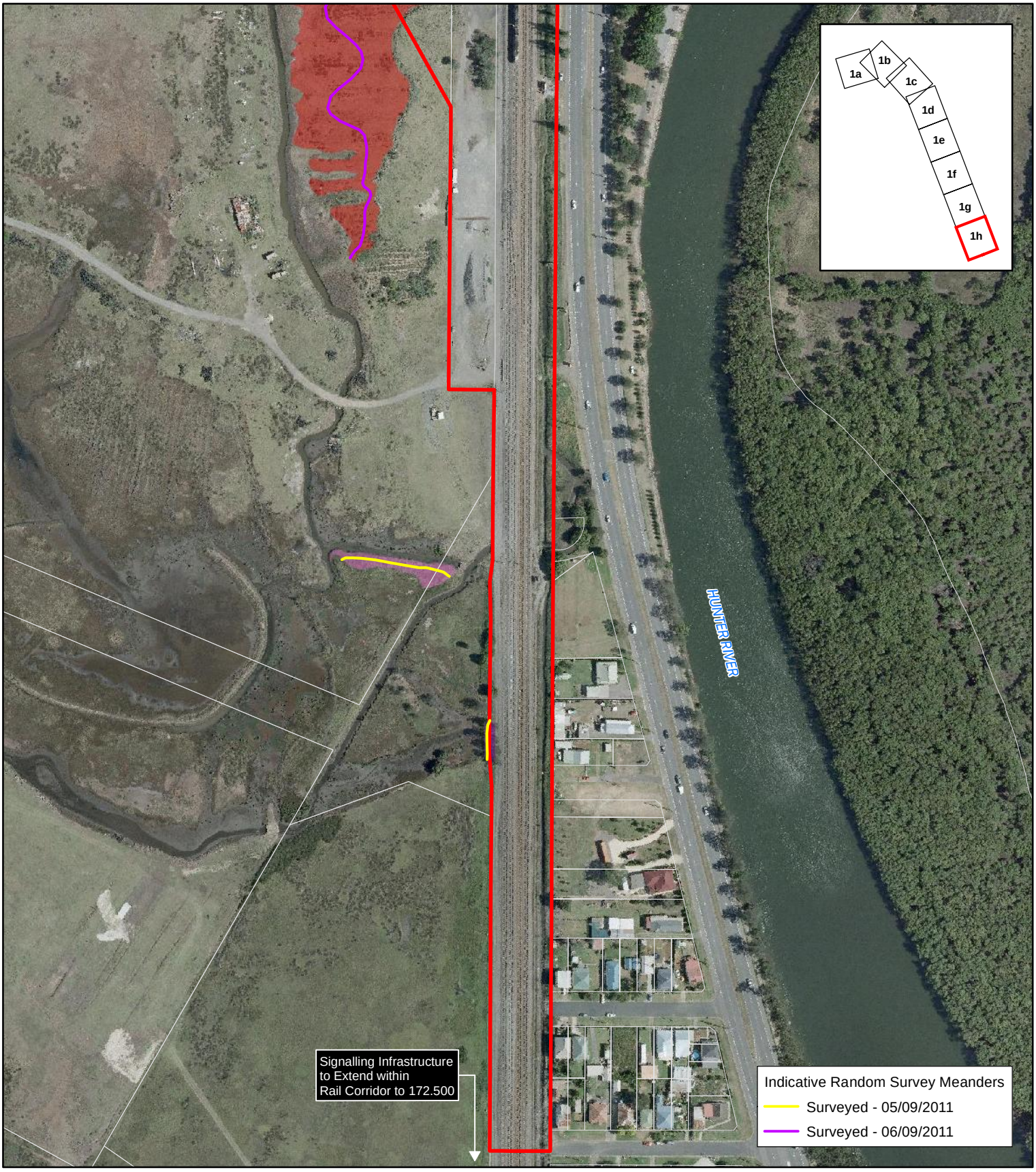


Project Area

Cadastre

Vegetation Communities

Exotic Herbfield

Phragmites australis and *Typha orientalis* Coastal Freshwater Wetlands

Swamp Mahogany Swamp Forest on Coastal Lowlands

Swamp Oak Swamp Forest Fringing Estuaries

A4 Original

0 25 50 100

Metres

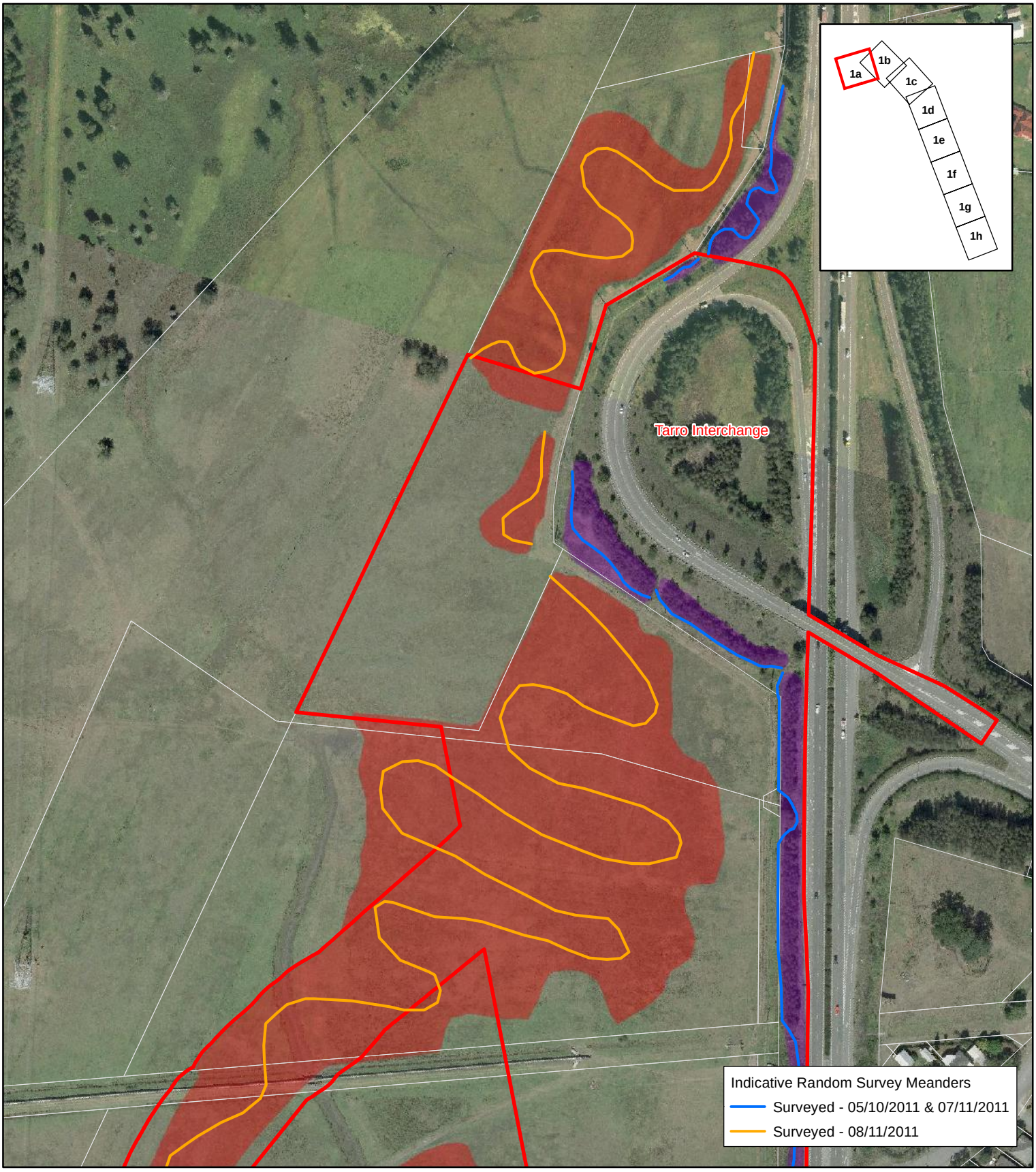
GDA 1994 MGA Zone 56

ARTC
Hexham Relief Roads

Targeted Survey
Asperula asthenes

Job Number	2110501B
Revision	A2
Date	17.12.2012
Scale	1:3,000

Figure 1h



Project Area

Cadastre

Vegetation Communities

Exotic Herbfield

Phragmites australis and *Typha orientalis* Coastal Freshwater Wetlands

Swamp Mahogany Swamp Forest on Coastal Lowlands

Swamp Oak Swamp Forest Fringing Estuaries

A4 Original

0 25 50 100

Metres

GDA 1994 MGA Zone 56

ARTC
Hexham Relief Roads

Targeted Survey
Lindernia alsinoides

Job Number	2110501B
Revision	A2
Date	17.12.2012
Scale	1:3,000

Figure 1a

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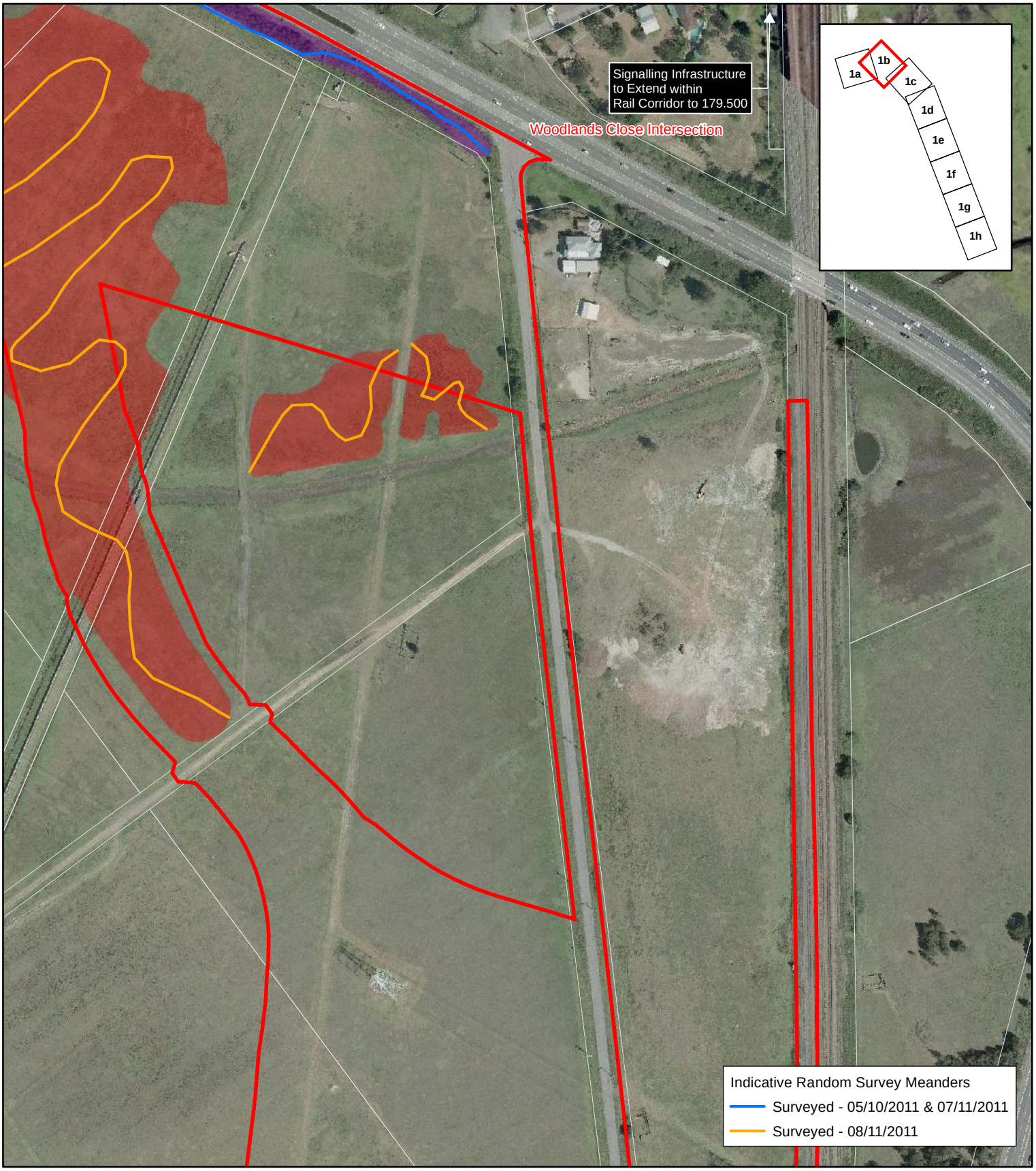

Project Area

Cadastre

Vegetation Communities

Exotic Herbfield

Phragmites australis and *Typha orientalis* Coastal Freshwater Wetlands

Swamp Mahogany Swamp Forest on Coastal Lowlands

Swamp Oak Swamp Forest Fringing Estuaries

A4 Original

0 25 50 100

Metres

GDA 1994 MGA Zone 56

ARTC
Hexham Relief Roads

Targeted Survey
Lindernia alsinoides

Job Number	2110501B
Revision	A2
Date	17.12.2012
Scale	1:3,000

Figure 1b

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