

Leichhardt Floodplain Risk  
Management Study and Plan

**APPENDIX B**  
ENVIRONMENTAL AND SOCIAL  
CHARACTERISTICS - DRAFT

# 1 Introduction

Floodplain management can impose a variety of social and environmental costs on flood affected communities and areas. For example the relocation or disruption of a community, the clearing of vegetation or reshaping of a waterway to improve hydraulic efficiency and lower flood levels or the construction of levees can all have various social and environmental implications. Further, the implementation of risk management measures may disadvantage some groups of the community, but advantage others. In some cases, floodplain management can be used to enhance environmental or social aspects of a community. For example creek rehabilitation in conjunction with improved hydraulic efficiency.

In order to objectively compare issues and management measures, it is necessary to gather a variety of social and environmental data. The following discussion provides the details of the base line assessment undertaken to inform the floodplain management option identification and assessment process.

The following data has been collected:

- Demographic, ethnic and socio-economic data.
- Topography, geology and soils.
- Flora and Fauna.
- Aboriginal and Non-Aboriginal Heritage.

# 2 Social Assessment

The demographic characteristics of the study area presented in this report includes the suburbs of Annandale, Balmain, Balmain East, Birchgrove, Leichhardt, Lilyfield and Rozelle. Population data was sourced primarily from the Australian Bureau of Statistics (ABS) 2011 Census. The data was then aggregated to produce an overall summary for the region of interest.

In summary, the data revealed that:

- The median age of people in the study area is 37 years as of 2011 census, which is a similar figure to Australia's median age. In fact almost 40% of people living in the study area are within 25-44 age group, only 4% are above 75 year age and children under 14 year age comprise 16.8%. This results in a community which may be primarily able-bodied, able to evacuate effectively and/or assist with evacuation procedures.
- In the study area, 79.4% of people only speak English at home. The most common languages spoken at home other than English include Italian 3.0%, Greek 1.4%, Spanish 1.0%, Cantonese 0.8% and Mandarin 0.7%. Flood information provided to the community should consider the range of languages spoken.
- The median weekly personal income for people aged 15 years and over in the study area was \$1,086 as of 2011 Census, compared to the NSW average of \$561. This trend of well above average income for the region compared to the NSW average was also evident for family and household incomes. This may have implications for the economic damages incurred on property contents during a flood event.
- When the social assessment was undertaken in 2013, the median house price in the study area was \$805,000, and the median unit price was \$612,500. In NSW, the median house price was \$440,000, and median unit price was \$445,000 (APM, 2012). This information has implications for the economic damages incurred during a flood event.

An overview of the demographic data is provided in **Tables 2.1 to 2.4**.

**Table 2.1 Age Structure of the Study Area (the former Leichhardt LGA) (ABS, 2011)**

Age Group (Years)	Persons in the study area	% of total persons in the study area	% of total persons in NSW
0-4 years	4,299	8.34	6.6
5-14 years	4,486	8.70	12.6
15-19 years	1,642	3.18	6.4
20-24 years	2,592	5.03	6.5
25-34 years	9,801	19.01	13.6
35-44 years	10,988	21.31	14.1
45-54 years	7,109	13.79	13.8
55-64 years	5,893	11.43	11.7
65-74	3,111	6.03	7.8
75-84	1,645	3.19	4.9
85 years and over	631	1.22	2
<b>Total</b>	<b>51,566</b>		

**Table 2.2 Languages Spoken at Home in the Study Area (former Leichhardt) LGA (ABS, 2011)**

Languages Spoken at Home	Persons in the study area	%of total persons in the study area	% of total persons in NSW
English Only	41,457	79.4	72.5
Greek	729	1.4	1.3
Italian	1,586	3	1.2
Spanish	534	1.0	0.8
Cantonese	431	0.8	2
Mandarin	377	0.7	2
<b>Total</b>	<b>52,197</b>		

**Table 2.3 Average Median Income in the Study Area (former Leichhardt LGA) (ABS, 2011)**

Income (For Population Aged 15 Years and Over)	Study Area (\$)	New South Wales (\$)
Average Median Individual Income (weekly)	1,086	561
Average Median Family Income (weekly)	2,738	1,477
Average Median Household Income (weekly)	2,234	1,237

**Table 2.4 Median House and Unit Prices within the Study Area (former Leichhardt LGA) (realestate.com.au, 2013)**

Suburb	Median House Price (\$)	Median Unit Price (\$)
Annandale	950,000	542,500
Balmain	1,047,500	730,000
Balmain East	1,600,000	590,000
Birchgrove	1,182,500	661,500
Leichhardt	815,000	612,500
Lilyfield	910,000	527,500
Rozelle	947,000	667,000

## 3 Environmental Issues

### 3.1 Topography, Geology and Soils

#### 3.1.1 Topography

The study area partly lies over the Cumberland Plain region, a relatively flat region which lies to the south and west of Sydney Harbour. The topography of the study area reflects rolling hills intersected by shallow valleys through which waterways including Hawthorne Canal, Whites Creek and Johnsons Creek flow.

#### 3.1.2 Geology

When developing floodplain management options it is important to understand the geology of the study area to ensure appropriate locations for management options are selected and to assist with the planning of suitable foundations and other constructions to cope with the geology present.

The study area is comprised of the shale and sandstone layers of The Wianamatta Group and Hawkesbury Sandstone. The Wianamatta Group directly overlies the older (but still Triassic in age) Hawkesbury sandstone.

The Wianamatta Group comprises siltstones, interbedded siltstones and fine-grained sandstone, and fine grained lithic sandstone. Weathering of the shale units produces a rich clayey soil, often with poor drainage. These clay soils are recognised as being reactive with appreciable Shrink-Swell Capacity. Low lying areas where groundwater is close to the surface are also susceptible to dryland salinity. Groundwater quality can range from fresh to highly saline, with the deeper groundwater generally less saline.

Hawkesbury Sandstone is a fine to medium and course grained quartz sandstone with some interbeds of laminated siltstone and very fine sandstones. It is a conspicuous rock unit in the Sydney region. It has occurred as exposures in sea-cliff and quarries took place throughout the suburban areas of Sydney. Hawkesbury sandstone is generally some 200 metres thick, with shale lenses and fossil riverbeds dotted throughout it. Hawkesbury Sandstone is considered a safer bedrock than the (less stable and laminated) Wianamatta Group for building construction

#### 3.1.3 Soil Landscapes

According to the Soil Landscape Map of Sydney (Scale 1:100,000), the study area occurs within the Birrong (bg), Blacktown (bt), Gymea (gy), and Hawkesbury (ha) soil landscape groups.

The Birrong soil landscape group is dominated by silt and clay sized alluvial materials derived from the Wianamatta Group. Deep yellow podzolic soils and yellow solodic soils occur on older alluvial (terraces); deep solodic soils and yellow solonetzic soils occur on the current floodplain.

The Blacktown soil landscape group has been formed by residual geomorphic processes. It usually occurs on gently undulating rises over Wianamatta Group shales. The ground slopes are usually less than 5% and the vegetation typically comprises partly cleared eucalypt, woodlands and tall open forests. The soils depths range from shallow to moderately deep (less than 1m thick) and are hard setting mottled textured clay soils. The soils are typically moderately reactive with highly plastic subsoil, have a low soil fertility and poor soil drainage.

The Gymea soil landscape is present on broad, convex ridge-tops on Hawkesbury Sandstone with little outcropping rock ( less than 25%). Slopes are mostly 10-25%. The soils are yellow earths and earthy sands and are shallow stony, moderately acidic and highly permeable, with very low nutrient levels. The soil is subject to high erosion risk when exposed.

The Hawkesbury soil landscape occurs on Hawkesbury Sandstone where slopes are mostly greater than 25%. It consists of narrow ridges, deep, narrow valleys, and steep slopes with a characteristic sequence of benches and rocky scarps, like a staircase. The deeper soils are earthy sands, yellow earths and some yellow podzolic soils. The shallow, discontinuous soils associated with the extensive rock outcrops are lithosols and siliceous sands. Localised yellow and red podzolic soils occur on shale lenses, and siliceous sands and secondary yellow earths occur along drainage lines.

### 3.1.4 Acid Sulfate Soils

Along the NSW coast, Acid Sulfate Soils (ASS) are widespread in estuarine flood plains and coastal lowlands. ASS distribution is diverse and includes urban areas, farmlands, mangrove tidal flats, salt marshes and tea-tree swamps. These types of soils contain iron sulfides (actual ASS), and soils that can potentially become acid producing are known as Potential Acid Sulfate Soils (PASS).

Acid Sulfate Soils (ASS) occur when soils containing iron sulfides are exposed to air and the sulfides oxidise producing sulphuric acid (DECC, 2008). This usually occurs when soils are disturbed through excavation of drainage works. The production of sulfuric acid results in numerous environmental problems. It is therefore important to be aware of the distribution of ASS within the study area, so that potential management options are developed and assessed in a manner that is sensitive to the problem of ASS (potential and actual acid sulfate soils).

The Parramatta River, which surrounds much of the study area, and Hawthorne Canal have a high probability of ASS, within 1m of the ground surface (severe environmental risk if ASS materials are disturbed by activities such as shallow drainage, excavation or clearing). If high risk materials were to be disturbed there may be a severe environmental risk and any structure would need to be designed to ensure integrity of the structure against acid sulfate soils. Soil investigations would be necessary to assess these areas for acid sulfate potential should any flood management actions be proposed in these locations.

### 3.1.5 Contaminated Land and Licensed Discharges

Contaminated land refers to any land which contains a substance at such concentrations as to present a risk of harm to human or environmental health, as defined in the Contaminated Land Management Act 1997. The Office of Environment and Heritage (OEH) is authorised to regulate contaminated land sites and maintains a record of written notices issued by the Environment Protection Authority (EPA) in relation to the investigation or remediation of site contamination. A search of the OEH Contaminated Land Record on 11 February 2013 showed 7 known contaminated sites within the study area as shown in **Table 3.1**. Flood modification works within the study area should consider the impacts that may be caused due to these contaminated sites and further investigation may be necessary.

**Table 3.1 Items listed on the OEH Contaminated Land Record (OEH, 2013)**

Suburb/City	Site Description and address	Activity that caused contamination
Annandale	Mobil Service State, 198 Parramatta Road	Service Station
Annandale	Shell Coles Express Service Station, 124-126 Johnston Street	Service Station
Leichhardt	7 Darley Road	Other Industry
Leichhardt	Bus Depot (Area E), Cnr Balmain Rd and City West Link	Other Industry
Leichhardt	SRA Land, 10-11 Balmain Road	Other Industry
Rozelle	BP Service Station, cnr Darling Street and Thornton Street	Service Station
Rozelle	Caltex Service Stations, 121 Victoria Rd	Service Station
Rozelle	Kennards Rozelle, 15-39 Wellington street	Other Petroleum
Rozelle	Mobil Service Station, 178-180 Victoria Road	Service Station
Rozelle	White Bay Power Station, Robert Street	Other Industry

A search of the PoEO licensed premises public register on 25 January 2013 identified three licensed premises within the LGA as shown in **Table 3.2**.

**Table 3.2 Items listed on the PoEO Licensed Premises Register (OEH, 2013)**

Suburb/City	Organisation name and address	Location	Type of License
Leichhardt	APPAREL FITTINGS AUSTRALASIA PTY LTD C/- STAR DEAN-WILLCOCKS	67 John Street	POEO licence no longer in force; S 58 Licence Variation issued on 08 Feb 2005
Leichhardt	STATE TRANSIT AUTHORITY OF NSW	Corner William & Derbyshire Streets	POEO licence no longer in force; S 58 Licence Variation issued on 05 Jul 2004
Leichhardt	SYDNEY SOUTH WEST AREA HEALTH SERVICE	Corner Glover & Church Streets	POEO licence no longer in force; S 58 Licence Variation issued on 25 Jul 2002 and 21 Sep 2005

Any flood modification works within Leichhardt suburb should both consider the protection of these facilities from flood damages and the compatibility of the flood works with the operations of the facilities.

## 3.2 Flora and Fauna

Due to the highly urbanised nature of the study area, most of the original native vegetation has been cleared and modified and no substantial natural areas remain. Many of the plant and animal species that used to occur in this area are no longer present.

A search of the NPWS Atlas of Wildlife database (OEH, 2012a) on 12 February 2013 for threatened flora species recorded since 1980 showed no known threatened flora species with a 10km by 10km search area surrounding the study area.

A search of the NPWS Atlas of Wildlife database (OEH, 2012a) on 12 February 2013 for threatened fauna species recorded since 1980 showed no known threatened fauna species with a 10km by 10km search area surrounding the study area.

A search of the Environment Protection and Biodiversity Conservation (EPBC) Protected Matters database identified 33 threatened species known to occur within the study area. The results of this search can be found in main report. There is very limited habitat for threatened species in the study area, and the Grey-headed Flying-fox is the only listed threatened species that is seen regularly around Iron Cove. A range of visiting shore birds has also been seen wading and feeding on Iron Cove's mudflats.

Any proposed flood modification options or flood protection works should consider the number and type of species the modification may affect.

## 3.3 Heritage

### 3.3.1 Aboriginal Heritage

The study area was once the area inhabited by the Wangal band of the Dharug (Eora) language group. Wangal country was known as wanne and it originally extended from the suburbs of Balmain and Birchgrove in the east to Silverwater and Auburn in the west. The northern boundary was the Parramatta River. Neighbouring Darug bands were the Cadigal to the east, the Wallumattagal on the northern shore of the Parramatta River and the Bediagal to the south.

A preliminary investigation of indigenous heritage was undertaken by searching the Aboriginal Heritage Information Management System (AHIMS) (2012b) in January 2013 for known or potential indigenous archaeological or cultural heritage sites within the study area. The relevant AHIMS search results are presented in **Table 3.3**. This information is useful in the development and feasibility assessment of floodplain

management options. However, a more detailed heritage assessment should be undertaken prior to implementation of any management actions to ensure that any proposed flood mitigation works will not impact heritage items or places.

**Table 3.3 Items Identified under the NPWS Aboriginal Heritage Information Management System for the Study Area (OEH, 2012b)**

Site ID	Site Name	Site Type
45-6-2278	Lilyfield Cave	Shelter with midden
45-6-0283	Rozelle Hospital 1	Shelter with midden
45-6-1900	White Horse Pt.	Midden
45-6-0618	Rozelle Hospital 2, Rozelle Hospital 1	Midden
45-6-1481	Rozelle Hospital 3	Midden
45-6-1971	Rozelle Hospital 5, Rozelle Hospital 3	Shelter with midden
45-6-1972	Rozelle Hospital 4	Shelter with midden
45-6-2676	Johnstons Creek	Art (pigment or engraved), artefact
45-6-1809	Birchgrove	Midden, Shelter with Art

The following qualifications apply to an AHIMS search:

- AHIMS only includes information on Aboriginal objects and Aboriginal places that have been provided to OEH;
- Large areas of New South Wales have not been the subject of systematic survey or recording of Aboriginal history. These areas may contain Aboriginal objects and other heritage values which are not recorded on AHIMS;
- Recordings are provided from a variety of sources and may be variable in their accuracy. When an AHIMS search identifies Aboriginal objects in or near the area it is recommended that the exact location of the Aboriginal object be determined by re-location on the ground; and
- The criteria used to search AHIMS are derived from the information provided by the client and OEH assumes that this information is accurate.

Middens that are composed predominantly of shells are essentially the remains of shellfish meals eaten on the spot by Aboriginal people over a long period of time. Fish and shellfish were the main foods of Aboriginal people living around the harbour, with fishing being an important activity of daily life for both men and women.

The middens that can be found in the study area are dated at approximately 4, 500 years old, and are recognised as significant by the Metropolitan Local Aboriginal Land Council and archaeologists. A series of interpretive signs can be found at these sites recognising the traditional owners of the study area.

All Aboriginal sites are protected under the National Parks and Wildlife Act 1974 and therefore any management considerations that impact upon Aboriginal sites must include this in their design. Known Aboriginal sites should be left undisturbed if possible, however if a management option requires their destruction, an Aboriginal Heritage Impact Permit (AHIP) must be sought from OEH. Under the National Parks and Wildlife Act 1974 it is a requirement that any developments show “due diligence” with regard to Aboriginal heritage in the area

#### *Land Rights and Native Title Claims*

Land rights and Native Title are two different forms in which traditional land owners can gain access to land or claim compensation for previous dispossession of their land.

Under the Aboriginal Land Rights Act 1983, local Aboriginal land councils can claim Crown lands provided the lands are vacant and not otherwise required for an essential public purpose. A search on the Land Claims

Register maintained by the Office of the Registrar, Aboriginal Land Rights Act 1983 (ORALRA), on 4 February 2013 found no Native Title claims in the study area.

### 3.3.2 Non-Aboriginal Heritage

There are three different types of statutory heritage listings of Non-Aboriginal origin; local, state and national heritage items. A property, item or place is a heritage item if it falls into a listings category. The category an item falls into depends on whether it is considered to be significant to the nation, state or a local area. The significance of an item is a status determined by assessing its historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic value.

A desktop review of Non-Aboriginal heritage was undertaken for the study area. Searches were undertaken on a number of databases to determine the cultural heritage within this area. Databases searched include:

- Australian Heritage Database (incorporates World Heritage List; National Heritage List; Commonwealth Heritage List);
- NSW Heritage Office – State Heritage Register; and
- Leichhardt Local Environment Plan (LEP) 2000 Heritage Listings.

**Table 3.4** contains 21 items that are found within the study area which have been listed by the Heritage Council under the NSW Heritage Act. This includes listing on the state heritage register, an interim heritage order or protected under Section 136 of the NSW Heritage Act. This information has been provided by the NSW Heritage Branch. No items were found to be included on the World Heritage List, Commonwealth Heritage List, or National Heritage List.

The Leichhardt LEP 2000 lists 669 heritage items of significance that are found within the study area under Schedule 2 of the LEP. There are also numerous heritage conservation areas with the study area. Part 3, Clause 16 of the Leichhardt LEP 2000 outlines the provisions which must be followed in relation to heritage items and Part 3, Clause 16 (8) outlines the provisions which must be followed in relation to conservation areas within the study area.

**Table 3.4 Items listed under the NSW Heritage Act (OEH, 2012c)**

Item name	Address	Suburb
Balmain Hospital - Main Building	Booth Street	Balmain
Callan Park Conservation Area & Buildings	Balmain Road	Lilyfield
Callan Park House - Rozelle Hospital	Balmain Road	Lilyfield
Dawn Fraser Swimming Pool	Glassop Street	Balmain
Ewenton	6 Ewenton Street	Balmain
Fenwick & Co Boat Store	2-8 Weston Street	Balmain
Goodman's Buildings	2-12 Johnston Street	Annandale
Hampton Villa	12B Grafton Street	Balmain
Hunter Baillie Memorial Presbyterian Church	Johnston Street	Annandale
Johnston's Creek Sewer Aqueduct	Taylor Street (Off), Hogan Park	Annandale
Louisaville	2 Wells Street	Balmain
Mort's Dock	Thames, Mort, College, McKell, Cameron, Yeend Streets	Balmain



Item name	Address	Suburb
Railway electricity tunnel under Sydney Harbour		Birchgrove / Greenwich
Raywell	144 Louisa Road	Birchgrove
Rozelle Hospital - Broughton Hall	Balmain Road	Lilyfield
Sewage Pumping Station 27	Callan Park	Rozelle
Substation	182 Johnston Street	Annandale
Waterview Wharf Workshops	37 Nicholson Street	Balmain
White Bay Power Station	Victoria Road	Rozelle
White's Creek Aqueduct	Piper Street	Lilyfield
Wyoming	25 Wharf Road	Birchgrove

The information contained within this Appendix has been used in the development and feasibility assessment of Floodplain Management Options. However, due to the extensive heritage found with the study area, a detailed heritage assessment should be undertaken prior to detailed design or implementation of any management options, as there are development restrictions and procedures which need to be followed.

## 4 Conclusions

The study area is a highly urbanised environment resulting in some key urban related constraints to floodplain management. However, there are also several environmental constraints that need to be considered in the preparation of a Floodplain Risk Management Plan. The key environmental and social constraints identified in this assessment include:

- The high probability of Acid Sulfate Soils in the Parramatta River and Hawthorne Canal, which if disturbed could cause serious environmental risk;
- 7 known contaminated sites which may require further investigation;
- Potential for the grey-headed flying fox to be disturbed; and
- 9 Aboriginal sites listed under the National Parks and Wildlife Act 1974, 21 non-Aboriginal heritage sites found on the State Heritage Register and 669 heritage items of significance under the Leichhardt LEP.

## 5 References

ABS (2011) *2011 Census*. Australian Government.

APM (2012) Australian Property Monitors. [online] URL: <http://apm.com.au/>

OEH (2012a) *NPWS Atlas of NSW Wildlife*, NSW Government.

OEH (2012b) *Aboriginal Heritage Information Management System*, NSW Government.

OEH (2012c) *State Heritage Register*, NSW Government.