## 6.12 Flooding

The section considers the potential flood risks to Sydney Water assets and Sydney Water's impact on flooding events.

### 6.12.1 Existing environment

#### Local catchments

The WDURA and AGA are located within the Lake Illawarra catchment. Lake Illawarra is a broad, shallow, salt-water lagoon with an area of 33 $km^2$ (WCC 2006b). Mullet Creek and Duck Creek are the two main sub-catchments within the Proposal area. These form a part of the broader Lake Illawarra catchment. Flooding in the area can be significant due to the small size of these sub-catchments and the frequent heavy rainfall events (WCC 2006b). The annual rainfall in the area is approximately 1200 mm (WCC 2006b).

The Mullet Creek sub-catchment is the largest catchment within the Proposal area. Mullet Creek is located 8 km to the south west of the Wollongong CBD and is 72 $km^2$ in area. A large portion of this area is currently undeveloped and will form part of the WDURA and AGA developments. The creek begins at an elevation of 600 m AHD at the Illawarra Escarpment and flows 22 km to Lake Illawarra. The floodplain near Lake Illawarra is broad and flat, with widths up to 2.8 km. Flash flooding is frequent due to steep slopes and the level of urbanisation. The headwaters of Mullet Creek in the escarpment are mainly forested, but the remainder of the catchment is generally rural farming land (Bewsher Consulting Pty Ltd 2010).

The Duck Creek sub-catchment is approximately 19 $km^2$ in area (BMT WBM 2010). The catchment begins at the Illawarra escarpment and flows to Lake Illawarra. The catchment topography is steep in the upper reaches with slopes of up to 50 per cent. This reduces to slopes of approximately two per cent in the lower reaches near Lake Illawarra. The existing wide and relatively flat floodplains are mainly undeveloped and largely occupied by rural farming. These floodplains are not heavily vegetated although some creek lines can have relatively heavy tree growth (WCC 2006b). South Dapto and Haywards Bay are the main residential communities in the area. These are located on higher ground outside the 1 in 100 year flood zone. Flood effected residential areas are usually rural farming properties that become isolated in flood events (BMT WBM 2010).

#### Historical Flood Data

Historically, a number of large floods have affected the Proposal area. Since Sydney Water has limited services in these areas, water and wastewater services have not been impacted by previous flood events. A comparison of key historical flood events with the 1 in 20 year, 1 in 50 year and 1 in 100 year flood events is shown Table 6-49 (BMT WBM 2010). A 1 in 100 year flood event is defined as a 1 per cent chance that in any one year a flood of this size or larger will occur. The 1 in 100 year flood zone is the area that will be inundated during the 1 in 100 year flood event. Over many centuries, a 1 in 100 year flood event will happen on average once every 100 years. A map of the 1 in 100 year flood zone in the Proposal area is shown in Figure 6-36.

**Table 6-49 Comparison of historical and design flood levels for Lake Illawarra**

| Flood event | Peak flood level lake Illawarra (m AHD) |
|---|---|
| February 2008 | 0.7 |
| 1 in 20 year flood | 1.4 |
| March 1978 | 1.6 |
| 1 in 50 year flood | 1.8 |
| February 1984 | 1.9 |
| 1 in 100 year flood | 2.3 |
| Peak Maximum Flood Level (extreme event) | 3.2 |

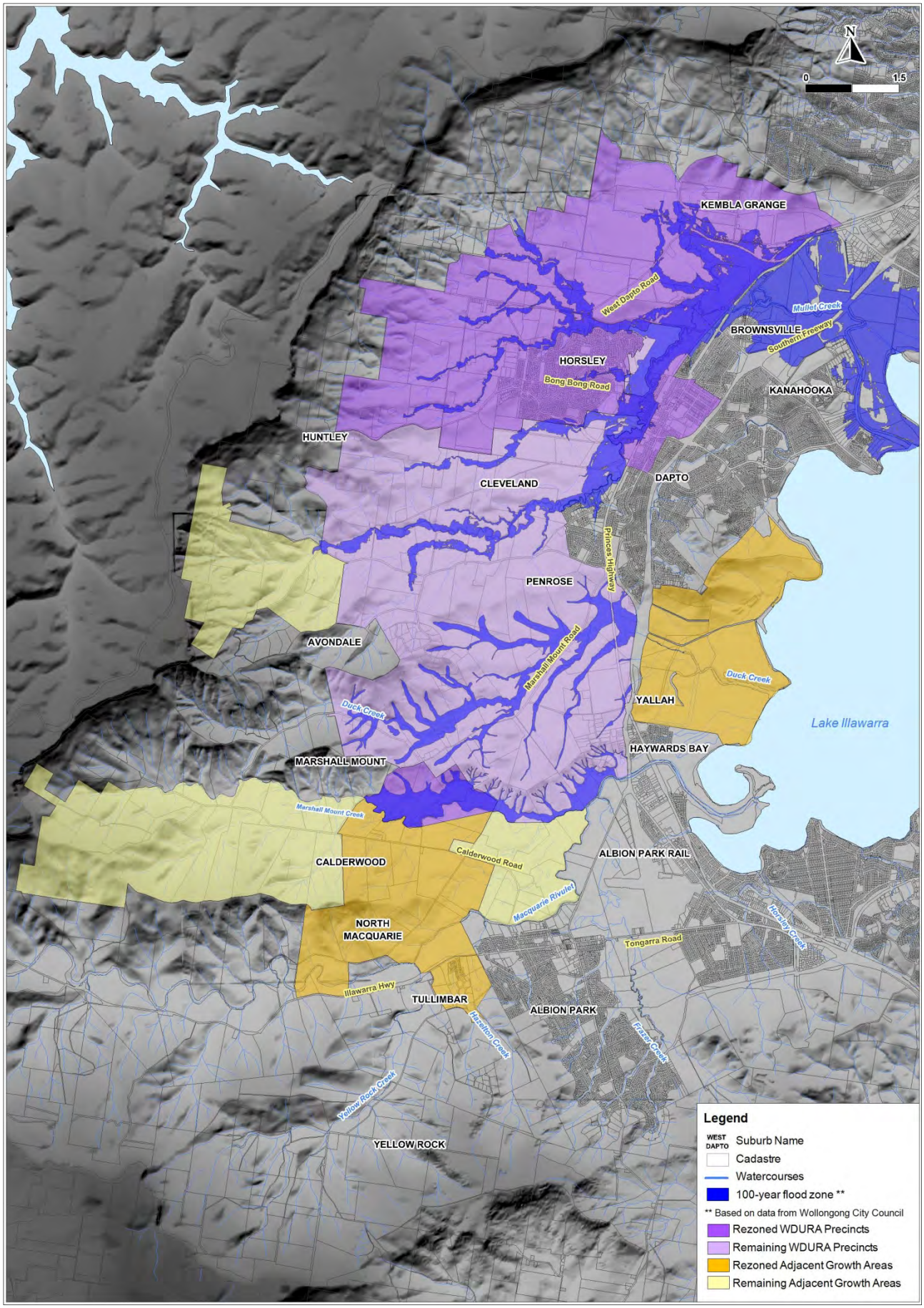


**Figure 6-36 1:100 year flood zone**

The largest known flood event was the 1984 Dapto flood. In some parts of Mullet Creek this flood exceeded the current estimation of the 1 in 100 year flood event. Near Wongawilli, the rainfall intensities recorded in this 1984 storm approached the probable maximum precipitation, making it a usual rainfall event. A large number of houses were flooded above floor level and there was also extensive damage to private and public infrastructure in the middle and lower reaches of Mullet Creek. Table 6-50 shows the water flow in several areas affected by the 1984 floods relative to the 1 in 100 year flood event (WCC 2006b).

**Table 6-50 Comparison of 1984 event and 1 in 100 year flood event**

| Location | 1984 flood event ($m^3/s$) | 1 in 100 year flood event ($m^3/s$) |
|---|---|---|
| F6 Freeway on Mullet Creek | 1233 | 806 |
| Princes Highway Bridge on Mullet Creek | 995 | 733 |
| Cleveland Road, Dapto | 412 | 348 |
| Bong Bong Road, Dapto | 463 | 409 |
| Ena Avenue, Dapto | 442 | 356 |
| Sheaffes Creek (downstream of West Dapto Road) | 87 | 117 |
| Robins Creek (Ritchie Crescent) | 690 | 479 |
| Reed Creek (Fairwater Drive) | 84 | 46 |
| Forest Creek (upstream West Dapto Road) | 261 | 183 |

Even during relatively small floods, such as those that occur every 2 to 5 years, road access into and out of the existing West Dapto area is significantly affected. On occasions this has meant that residents in Horsley and adjacent areas have been unable to enter or leave their suburbs for a number of hours. This has been a significant constraint to the local population.

### 6.12.2 Asset location and risks

Wollongong and Shellharbour Councils' flood mapping and studies indicate the WDURA and AGA development areas are generally outside the 1 in 100 year flood zone (WCC 2009c). Sydney Water complies with WCC and SCC development rezoning which has excluded developable land from within the 1 in 100 year flood zone and the infrastructure therefore does not service these areas. In addition the majority of water and wastewater infrastructure is located outside of the 1 in 100 year flood zone to comply with the *Water Supply Code of Australia 2002* (WSAA 2002a) and the *Sewerage Code of Australia 2002* (WSAA 2002b).

### 6.12.3 Potential impact to flood areas

There are several sections of water pipeline that cross the 1 in 100 year flood zone. A map of the water pipelines located within the 1 in 100 year flood zone is shown in Figure 6-37. These pipelines will be laid underground and thus any flooding will have minimal impact on the pipe. Sydney Water is proposing to bore under creek lines with a high risk of environmental impact to avoid affecting creek flow patterns and the surrounding floodplain area. As discussed in Sections 6.5.2 and 6.8.2 Sydney Water is planning to trench through ephemeral creek lines. This will have minimal impact to the creek flow patterns as for the majority of the time there will be no water present. Sydney Water will aim to trench in dry weather to avoid impact to creek flow patterns.

Wastewater pipelines will generally be laid in low-lying areas to allow gravitational flow. The 1 in 100 year flood zone is generally avoided for the majority of wastewater pipelines in the Proposal. A map of the wastewater pipelines located within the 1 in 100 year flood zone is shown in Figure 6-38. These will be laid underground and will be designed to have minimal impact on creek flow patterns and the surrounding flood plain area.

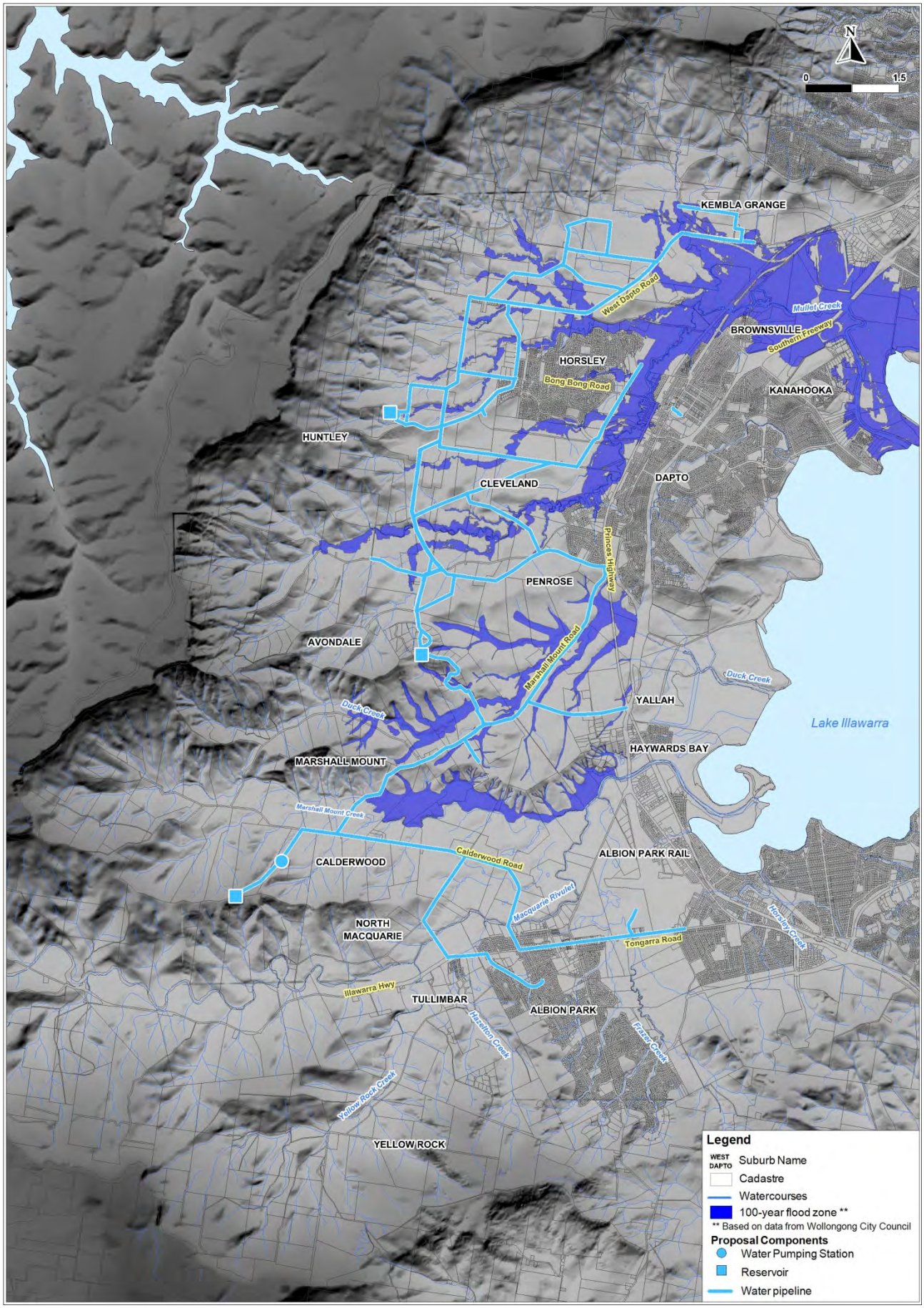


**Figure 6-37 Water components in the 1 in 100 year flood zone**

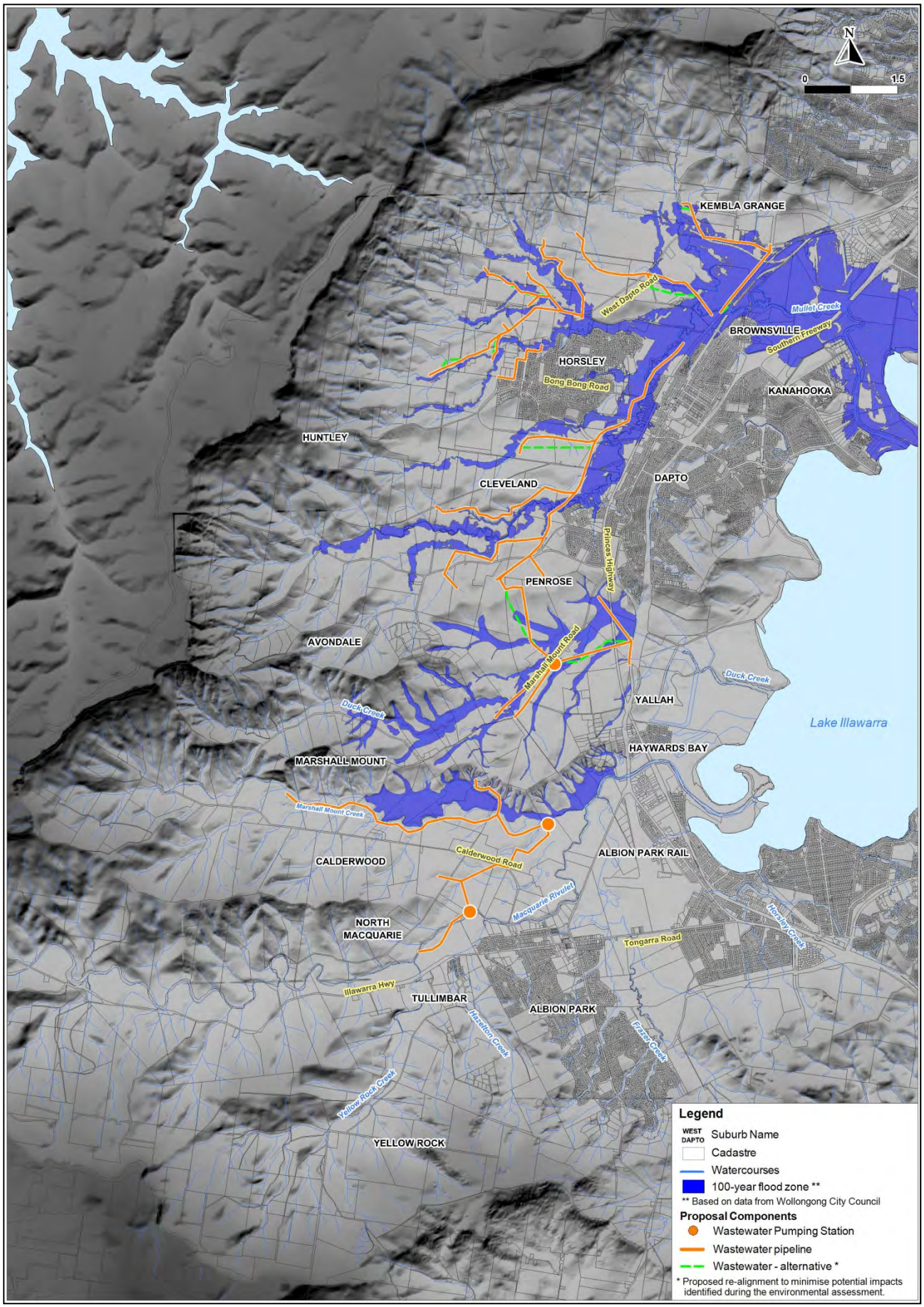


**Figure 6-38 Wastewater components in 1 in 100 year flood zone**

Sydney Water has existing assets within the 1 in 100 year flood zone. These are already constructed and thus are not included in the Proposal. These assets have not been affected by previous flood events.

### Potential impacts to assets from flooding

Flooding of Sydney Water assets poses the following risks (Bewsher Consulting Pty Ltd 2010):

- undercutting of foundations or damage by debris that can lead to pipe failure
- scouring of creeks and removal of supporting soil that could cause pipe failure
- wastewater overflows due to high flows in the system and/or blockage caused by debris
- inundation of pumping stations causing damage to electrical components.

## 6.12.4 Sydney Water's planning process

Several design mitigation measures are implemented for all of Sydney Water's planning operations to protect assets from flooding and to minimise the assets' impact to flood regions. These have been adopted for the Proposal and include the geographical location of the asset, minimum standard depths of cover over the asset, pipe design, bunding and elevation.

### WDURA and AGA planning

Sydney Water adopted the WCC and SCC flood planning policies for designing the Proposal components. The WCC updated the Wollongong Development Control Plan (DCP) to include details of floodplain management requirements for new developments including the WDURA and AGA (WCC 2009c). This plan takes into account the NSW Government Floodplain Development Manual: the management of flood liable land (DIPNR 2004). Sydney Water has confirmed flood data with the councils' relevant DCPs. Sydney Water has used this data to avoid the 1 in 100 year flood zone where possible and to ensure assets are placed outside the areas zoned for development.

Bewsher Consulting completed a study for the WCC on the flooding impacts from the WDURA and AGAs in 2010. The flood model in that study indicates that the WDURA development would result in an additional 507,000 $m^3$ runoff volume to Mullet Creek for the 1 in 100 year flood (about a 1.4 per cent increase). Given the surface area of Lake Illawarra catchment is approximately 35 $km^2$, this equates to an increase in the 1 in 100 year flood lake level of less than 15 mm. This rise should have limited implications on existing infrastructure and should have no impacts on the Proposal (Bewsher Consulting Pty Ltd 2010).

### Geographical location of assets

Sydney Water locates the majority of its water and wastewater infrastructure outside of the 1 in 100 year flood zone in order to comply with the *Sewerage Code of Australia 2002* and *Water Supply Code of Australia 2002*. Where this proves to be impractical, for example in difficult terrain, then the asset may be located within the flood zone provided the asset is below ground, elevated or bunded.

Water pipelines will be located in the road reserve where possible (WSAA 2002a). Future roads constructed by WCC and SCC would be located outside the 1 in 100 year flood zone (WCC 2009c). Where locating a water pipeline in the road reserve is not practical, water pipelines may be located in Council land, reserve and/or private property, subject to requirements and satisfactory negotiation as appropriate with the relevant owners (WSAA 2002a).

Sydney Water prefers to lay wastewater pipelines on public land and within drainage reserves outside the 1 in 100 year flood zone (WSAA 2002b). Where this is not possible, the pipeline would be designed to ensure there are no impacts to the asset from flooding.

Reservoirs will not be located in the 1 in 100 year flood zone as they are situated in elevated locations to provide adequate water pressure to customers. Pumping stations would be located out of the 1 in 100 year flood zone in the majority of cases. If the 1 in 100 year flood zone cannot be

avoided, the pumping station would be designed to ensure it is not impacted by a 1 in 100 year flood event.

## Depth of cover

The majority of Sydney Water's assets are pipelines located below the ground. Both water and wastewater pipelines have minimum depths of cover according to the *Water Supply Code of Australia 2002* (WSAA 2002a) and the *Sewerage Code of Australia 2002* (WSAA 2002b).

Water pipelines require a minimum depth of cover as shown in Table 6-51. The maximum depth of cover for water pipelines is:

- 1.2 m for pipe diameters less than 375 mm
- 1.5 m for pipes with diameters greater than 375 mm.

**Table 6-51 Minimum depth of cover for water pipelines**

| Location | Minimum cover to top of pipe (mm) |
|---|---|
| Non roadways<br>• General<br>• Industrial/commercial | <br>450<br>600 |
| Sealed roads | 600 |
| Major roadways/embankments | 750 |
| Freeways | 1200 |

Source: *Water Supply Code of Australia 2002.*

Wastewater pipelines must have a minimum cover depth measured from the top of the pipe to the surface as shown in Table 6-52 (WSAA 2002b). Wastewater pipelines do not have a specific maximum depth of cover. The depth of the pipe must not exceed a depth where the contents cannot flow sufficiently (WSAA 2002b).

**Table 6-52 Minimum depth of cover for wastewater pipelines**

| Location | Minimum cover to top of pipe (mm) |
|---|---|
| Private residential property and public land not subject to vehicular loading | 600 – new developments<br>450 – existing developments |
| Private residential property subject to vehicular loading | 750 |
| Footways, nature strips, industrial property, sealed road, pavements other than arterial roads subject to vehicular loading | 900 |
| Unsealed road carriageways | 1200 |
| Arterial road carriageways | 1200 |
| Future road, rail and tram pavements | 1200 |

Source: *Sewerage Code of Australia 2002.*

## Pipe design

Conventional wastewater pipelines can receive high levels of water infiltration due to leaking pipe joints and property connections. The Proposal would use leak tight wastewater pipelines that significantly reduce wet weather inflow by using systems such as a fully welded polyethylene pipe. It is expected that these pipes would reduce inflow to no more than 1 percent of rainfall ingress. The use of these pipelines will reduce flooding impacts to Sydney Water assets by minimising the volume of additional flow requiring treatment. This pipe design also minimises Sydney Water's impact to flooding events through minimising overflow discharge events that can potentially contribute to additional flood volume.

Water pipelines will be constructed out of a material with minimal infiltration rates. Pipe materials usually used include polyethylene vinyl chloride pipes, ductile iron cement lined pipes, glass fibre

and reinforced plastic pipes, or mild steel cement lined pipes. Materials used must have a quality assurance in accordance with the *Water Supply Code of Australia 2002*. Pipes are coated with a protective coating to prevent pipe deterioration and leaks if located above ground.

#### Bunding

Assets including pumping stations and vent shafts must be elevated or bunded if located within the 1 in 100 year flood zone. Bunding would comply with relevant standards and codes, including *Australian Standard (AS) 1940-2004 - The Storage and Handling of Flammable and Combustible Liquids* (Standards Australia 2004) and the *Australian Dangerous Goods Code* (NTC 2007).

#### Elevation

Where the pipeline crosses a creek or drainage reserve above the ground level an aqueduct will be installed. Aqueducts will generally be elevated to above the 1 in 100 year flood level if located within the 1 in 100 year flood zone.

### 6.12.5 Proposal flood mitigation measures

#### Construction mitigation measures

Sydney Water would implement the following flood mitigation measures whilst designing and constructing an asset within the 1 in 100 year flood zone:

- boring below creeklines with high risk of environmental impact, such as Category 1 streams, streams with high dynamic features and high erodibility etc thus minimising impacts to creek flow patterns and the surrounding floodplain area. The specific creeklines to be bored will be assessed as a part of the detailed design process (refer to Sections 3.4.1). High risk creek crossings are discussed in Sections 6.5 and 6.8
- depths of pipelines at creek crossings to be considered during detailed design to account for bed and bank scour in highly dynamic streams
- construction activities in heavy rainfall periods would be avoided
- the specific creeklines to be trenched will be assessed as a part of the detailed design process (Section 3.4.1). Trenching would be undertaken in dry weather where practicable to minimise impact to the creek flow patterns and the surrounding floodplain area during rainfall periods. Excavation at creek crossings would also be staged further minimising the potential impact
- rehabilitation of the construction area would be undertaken as soon as practicable following construction to ensure creek drainage lines and floodplains receive minimum environmental impact
- natural drainage lines would be re-instated at the end of construction.

#### Operational mitigation measures

The following operational mitigation measures would be implemented for all assets in accordance with Sydney Water's maintenance procedures:

- water and wastewater pipelines above ground would be inspected on a regular basis to ensure the pipe condition remains adequate and any maintenance issues are detected
- pipelines would be monitored for leaks as a part of the leak detection program
- WWPSs and WPSs would be routinely inspected to ensure the condition remains adequate and any maintenance issues are detected.

Upon the occurrence of a flood event, Sydney Water inspects assets where possible to identify whether services to flooded area have been impacted. Measures would be implemented to restore services if they have been disrupted. As most pipelines would be located below ground it is expected that water and wastewater services would be able to be provided to customers providing electricity is available.

WPSs would be installed with a backup generator where possible. WWPSs may be installed with a backup generator and four hours emergency storage capacity where possible to ensure minimal discharges occur during a flood period.

### 6.12.6 Sea level rise assessment

It is generally recognised that:

- the coastal zone is environmentally important
- global sea levels are rising
- there is no scientific evidence to suggest sea levels will stop rising beyond 2100 or that current trends will be reversed.

The NSW Government released the *Draft NSW Coastal Planning Guideline: Adapting to Sea Level Rise* in 2009, which sets sea level rise planning benchmarks that are considered to be the most credible national and international projections of seal level rise for the NSW coast. This guideline incorporates the 2009 *NSW Sea Level Rise Policy Statement* which sets benchmarks of an increase above 1990 mean sea level of 40 cm by 2050 and 90 cm by 2100 (DoP 2009).

Following the release of the guideline, WCC prepared a sea level rise map to indicate areas at risk of flooding from sea level rise (Cardno Lawson Treloar 2010). Sydney Water considered the potential risks associated with the sea level rise benchmarks as part of the risk screening undertaken during the options development and evaluation process. The assessment for the Project Approval area is based on current WCC sea level rise flood predictions. Sydney Water will continue to work with WCC to determine the impact of the sea level rises on all assets within the WCC area and outcomes will be considered during detailed design. No data for the Shellharbour LGA is currently available. However, based on the finding of the Wollongong data, it is unlikely that any proposed infrastructure in the Shellharbour LGA will be impacted by sea level rises. As additional areas are released in the Shellharbour LGA further assessment of potential impacts may be conducted if information becomes available.

Figure 6-39 indicates that the Proposal is not anticipated to involve new infrastructure within areas mapped as being flooded by the benchmark sea level rise scenarios in the Wollongong LGA. As a result, sea level rise is considered unlikely to pose a risk to the Proposal.

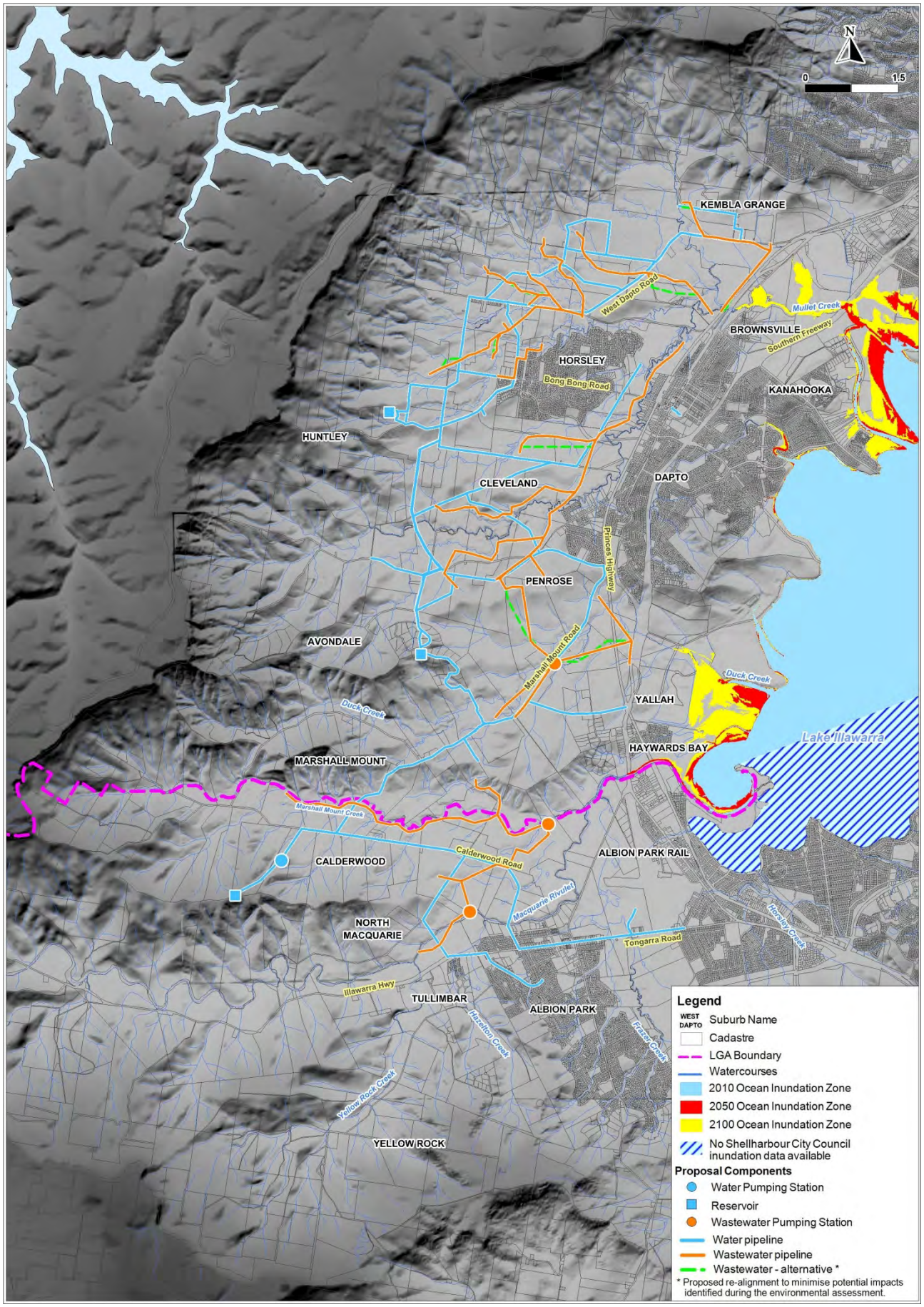


**Figure 6-39 Sea level rise flood zones**

## 6.13 Environmental risk analysis

### 6.13.1 Risk screening to identify key issues

Sydney Water undertook an environmental risk analysis for the Proposal as part of the PEA to identify key issues to be assessed in the EA. A multidisciplinary approach was implemented, drawing on key internal stakeholders and Sydney Water environmental management staff involved in the Proposal.

The Proposal will extend Sydney Water's existing water and wastewater systems. Sydney Water has developed a suite of control measures to ensure that its systems are operated in accordance with EPLs that regulate issues such as discharges to the environment. These control measures have evolved through long term experience operating water and wastewater systems and demonstrate a detailed understanding of the construction and operational issues associated with the Proposal. Potential risks will therefore be mitigated to a significant extent as Sydney Water will construct and operate the Proposal in accordance with corporate systems that have been specifically developed to manage issues related to water and wastewater networks.

A qualitative ranking of consequence and likelihood was undertaken for each risk. The ranking process considered the degree of certainty that the risk would be adequately managed by proposed control measures. Issues were then categorised as either key assessment issues, other issues requiring further analysis, or other issues requiring limited analysis (refer to Table 6-53).

**Table 6-53 Assessment categories**

| Category | Assessment level |
|---|---|
| Key Assessment Issues | Issues that fall into this category:<br>• likely to be important for decision making<br>• large and/or potentially controversial<br>• involve sensitive environments in specific areas<br>• have a high level of uncertainty about the outcomes.<br>These issues have been assessed in detail in this EA to determine the extent of impact and necessary management measures. |
| Other issues – further analysis required | Issues that fall into this category are those with some level of uncertainty about outcomes.<br>Further analysis was undertaken for this EA to determine the extent of impact and identify appropriate management measures. |
| Other issues - limited analysis required | Issues that fall into this category have highly predictable impacts and are easily and reliably managed within acceptable levels.<br>These issues have not been assessed in detail and will be mitigated using standard management measures. |

Based on the outcome of this screening process, the PEA identified the key assessment issues as being:

- impacts on terrestrial ecology during construction
- impacts on Aboriginal heritage during construction.

Remaining issues were classified as other issues, requiring either further or limited analysis.

### 6.13.2 Environmental risk analysis

A risk assessment was carried out as part of the EA to consider the risks to the environment after mitigation measures were considered to manage specific issues.

The environmental risk analysis process followed several steps:

- identifying components of the surrounding environment that may be impacted by the Proposal (known as Aspects)
- identifying activities during construction and operation that may affect the environment and identifying potential environmental impacts as a result of the proposed activities (known as Issues)
- assessing the potential risk of the proposed activities without applying any mitigation measures or controls (known as Inherent Risk)
- assessing the potential risk of the proposed activities after applying mitigation measures and controls (known as Residual Risk).

The inherent and residual risks were calculated by estimating the consequence and likelihood of each risk occurring. The criteria for likelihood and consequence are shown in Table 6-54. The consequence and likelihood scores were combined to determine the inherent and residual risks in accordance with the risk matrix shown in Table 6-55.

**Table 6-54 Risk criteria**

| Score | Criteria | Description |
|---|---|---|
| **Consequence** | | |
| 1 | Catastrophic | Very high impact with catastrophic consequences. Large scale, irreversible adverse impact on environment, particularly areas of very high heritage or ecological value. |
| 2 | Severe | Material high impact with major consequences. Large scale, long-term (> 2 years) impact on environment, particularly areas of high heritage or ecological value. Water quality impacts to special or protected waters. |
| 3 | Moderate | Noticeable, clearly visible impact. Small scale, medium (1 to 2 years) impact on environment. Some water quality impacts. |
| 4 | Minor | Minor impact with some consequences. Small scale, short-term (< 1 year), reversible impact on environment, which is contained and readily remediated. |
| 5 | Low | Very minor impact. Temporary, reversible impact on the environment, which is quickly contained and immediately restored. |
| **Likelihood** | | |
| 1 | Very likely | The event could happen >90% of the time within a 12 month period. |
| 2 | Likely | The event could happen 50 to 90% of the time within a 12 month period. |
| 3 | Unlikely | The event could happen 10 to 50% of the time within a 12 month period. |
| 4 | Very unlikely | The event could happen <10% of the time within a 12 month period. |

**Table 6-55 Environmental risk matrix**

| | Ability to manage the environmental effects | | | |
|---|---|---|---|---|
| | 1. Very likely | 2. Likely | 3. Unlikely | 4. Very unlikely |
| 1. Catastrophic | 1 | 1 | 2 | 3 |
| 2. Severe | 1 | 2 | 3 | 4 |
| 3. Moderate | 2 | 3 | 4 | 5 |
| 4. Minor | 3 | 4 | 5 | 6 |
| 5. Insignificant | 4 | 5 | 6 | 6 |

| Level of risk | Very high | High | Medium | Low |
|---|---|---|---|---|

### 6.13.3 Results of the environmental risk analysis

The environmental risk analysis considered both the construction and operation phases of the Proposal and the results are provided in Table 6-56 The residual environmental risk assumes that the control measures detailed in the EA have been implemented. Activities with a medium residual risk will require ongoing management during the construction phase.

**Table 6-56 Summary of environmental risk analysis during construction and operation**

| Aspect | Issue | Inherent risk | Residual risk |
|---|---|---|---|
| Ecology | Impacts on terrestrial flora and fauna during construction (including endangered ecological communities, habitats and riparian environments) | High | Medium |
| | Impacts on terrestrial flora and fauna during operation (including threatened species) | Medium | Low |
| | Impacts on aquatic flora and fauna during construction (including threatened species) | High | Medium |
| | Impacts on inland aquatic flora and fauna during operation (including threatened species) as a result of discharges to waterways | Medium | Low |
| | Impacts on marine aquatic flora and fauna during operation (including threatened species) as a result of discharges to waterways | Medium | Low |
| | Spread of noxious weeds during construction and operation | Low | Low |
| Aboriginal cultural heritage | Construction impacts on items of Aboriginal heritage significance | High | Medium |
| | Operational impacts on items of Aboriginal heritage significance | Medium | Low |
| Non-Aboriginal heritage | Construction impacts on items of non-Aboriginal heritage significance | Medium | Low |
| | Operational impacts on items of non-Aboriginal heritage significance | Medium | Low |
| Air quality | Dust and fume emissions during construction | Medium | Low |
| | Odour emissions during operation | Medium | Low |
| | Generation of greenhouse gases (construction and operation) | Medium | Low |
| Resource consumption | Consumption of energy and resources (construction and operation) | Low | Low |
| Waste | Waste generation and management (construction and operation) | Medium | Low |

| Aspect | Issue | Inherent risk | Residual risk |
|---|---|---|---|
| **Topography, geology and soils** | Soil erosion during construction | High | Medium |
| | Soil erosion during operation | Low | Low |
| | Acid sulfate soil management during construction | Medium | Low |
| **Hydrology and drainage** | Groundwater management during construction | Medium | Low |
| | Impact of sea level rise | Low | Low |
| | Impact of flooding, including the probable maximum flood | Low | Low |
| **Water quality** | Sedimentation of waterways during construction | High | Medium |
| | Increased wastewater flows to waterways in wet weather | Medium | Low |
| | Groundwater discharge into waterways during construction | Medium | Low |
| **Visual amenity** | Construction impacts on visual amenity | Medium | Low |
| | Operational impacts on visual amenity | Medium | Low |
| **Noise and vibration** | Construction noise and vibration | High | Medium |
| | Operational noise and vibration | Low | Low |
| | Construction traffic impacts | Medium | Low |
| **Traffic and access** | Operational traffic impacts (road and rail) | Medium | Low |
| **Land use** | Changes in land use during operation | Low | Low |
| **Utilities and infrastructure** | Impact on existing or proposed infrastructure (water supply channel, electricity, telecommunication, gas) | Low | Low |
| **Storage of hazardous materials** | Spill of hazardous materials during construction and operation | Medium | Low |
| **Human health impacts** | Impacts due to wastewater overflows during operation | Medium | Low |
| | Impacts due to discharges to the marine environment during operation | Medium | Low |

# 7 Other environmental issues

## 7.1 Overview

This chapter discusses the following issues that are not considered to be key issues for the Proposal:

- traffic and transport
- land use and services
- visual amenity
- energy use and greenhouse gas emissions
- waste.

Each issue was analysed to outline the main characteristics of the existing environment, the potential environmental impacts, and management measures that may be implemented during construction and operation of the Proposal.

## 7.2 Traffic and transport

### 7.2.1 Existing environment

#### Road network

The north-south linkages provided by the F6 Southern Freeway and the Princes Highway dominate the major road network in the vicinity of the WDURA and AGAs. The F6 Southern Freeway is the primary high speed, high capacity distributor road between Sydney and Yallah. Near the Proposal area, it generally has two lanes in each direction and has access points that provide links to the local road network at Northcliffe Drive at Kembla Grange, Kanahooka Road at Brownsville, and Fowlers Road at Dapto.

Within the Proposal area, the Princes Highway is generally parallel to and west of the F6 Southern Freeway and provides access to suburbs that are bypassed by the F6. It typically has two lanes in each direction and traffic flow is controlled by a number of roundabouts and signalised intersections. At Yallah, the F6 Southern Freeway joins the Princes Highway, which is the main road extending along the NSW South Coast.

The average daily traffic flow on the F6 varies between 37,674 vehicles south of Fowlers Road to 60,166 vehicles south of Northciliffe Drive. Traffic volumes are significantly lower on the Princes Highway, which has approximately 12,000 vehicles per day near Dapto rising to almost 30,000 vehicles per day north of Unanderra (WCC 2006b).

Between 1990 and 2003 there was substantial growth in daily traffic movements on both the Princes Highway and F6. During this period, daily volumes on the Princes Highway through Dapto and Unanderra grew by approximately 3,000 to 4,000 vehicles per day. Traffic volumes also grew by a similar amount (approximately 3,000 per day) along Northcliffe Drive (WCC 2006b). Along the F6, the daily traffic increased by 15,000 to 18,000 vehicles between 1990 and 2003.

The primary road link between the Proposal area and land to the west of the escarpment is the Illawarra Highway, which intersects the Princes Highway at Albion Park.

The main roads providing access to existing suburbs and rural localities within the Proposal area are shown in Figure 7-1 and include:

- West Dapto Road – this links the Kembla Grange and Sheaffes/Wongawilli Precincts with the Princes Highway. There is a level crossing of the Illawarra Railway Line to the west of the intersection with the Princes Highway
- Bong Bong Road – this provides access to the suburbs of Dapto and Horsley, and a link to the locality to be developed as the West Horsley Precinct

- Cleveland Road - this road provides a link between the Princes Highway and the localities to be developed as the Cleveland and Horsley Industrial Precincts
- Avondale Road - this road provides a link between the Princes Highway and the localities to be developed as the Avondale and Huntley Precincts
- Yallah Road - this road provides a link to the locality to be developed as the Marshall Mount Precinct. It intersects Marshall Mount Road in the west and the Princes Highway in the east
- Marshall Mount Road - this road extends from Yallah Road in the east to Calderwood Road in the west and provides a link to the locality to be developed as the Marshall Mount Precinct
- Calderwood Road – this road provides a link to the locality to be developed as the Calderwood Precinct
- North Macquarie Road – this road provides a link to the localities to be developed as the Calderwood and Marshall Mount Precincts
- Tongarra Road – this road transitions into the Illawarra Highway at Albion Park and provides access to the Calderwood, Tullimbar Village and Yellow Rock Precincts.

#### Railway infrastructure

The Illawarra Railway Line, which links Sydney and Bomaderry, runs from north to south along the eastern edge of the Proposal area. Stations within the Proposal area include Kembla Grange, Dapto and Albion Park Rail. At Brownsville, a spur line extends from the Illawarra line and provides rail access to a coalmine at Wongawilli.

Access across the Illawarra Railway is provided via a number of level crossings and bridges. The bridges are generally to the south of the main urban area of Dapto at Cleveland Road, Huntley Road and Yallah.

### 7.2.2 Construction impacts and mitigation measures

The Proposal involves developing water and wastewater infrastructure in the context of existing and proposed urban development and Chapter 4 indicates that the water pipelines will generally be located within existing and/or proposed road reserves.

The Proposal will have temporary impacts on the traffic and transport network as construction will be undertaken within road corridors. The significance of the impact will be limited to a substantial extent, as construction will generally be undertaken within the road reserve that is adjacent to the carriageway. Nevertheless, there is the potential for a range of impacts on traffic, transportation and access, including:

- temporary increases in road traffic during the construction period due to construction vehicle movements
- temporary lane closures when installing pipelines in road reserves
- temporary disruptions to pedestrian access when installing pipelines in road reserves
- temporary disruptions to property access when constructing the water and wastewater pipelines, particularly when construction is undertaken within existing urban areas, such as Horsley, Dapto and Albion Park
- the need to obtain temporary access to public and private property to construct wastewater pipelines near watercourses
- indirect impacts on railways during construction.

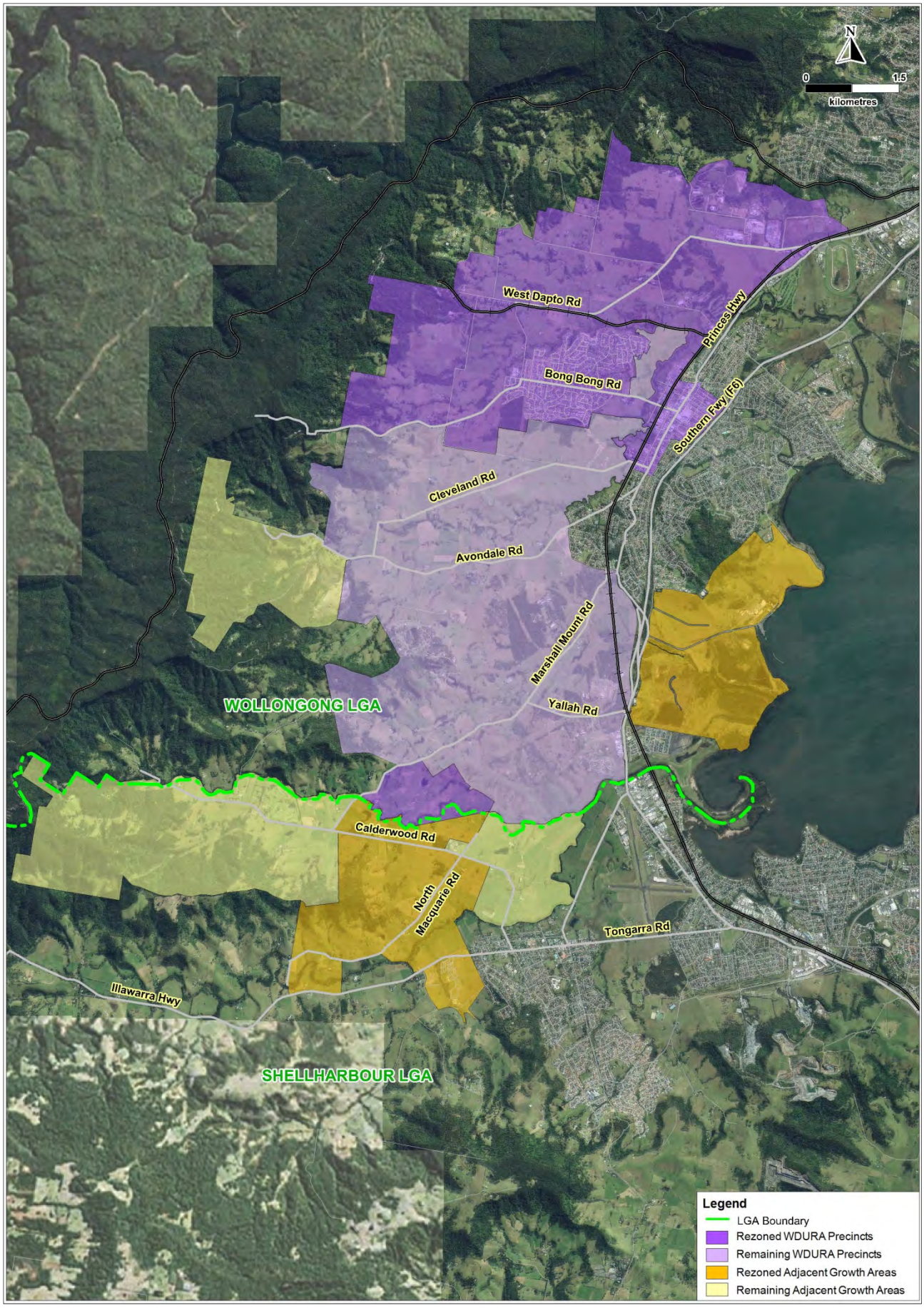


**Figure 7-1 Main transport infrastructure in the Proposal area**

These potential impacts are described in the following sections. In summary, impacts on traffic, transportation and access when constructing the Proposal will be minor and can be readily managed with standard mitigation and management controls. These controls will be prepared in consultation with relevant stakeholders. Full road closures are unlikely to be required.

The Proposal involves extending the existing water and wastewater infrastructure network to enable additional land to be developed for urban purposes. It involves development on urban fringes and a relatively small proportion of the Proposal will be within existing urban areas. As a result, the extent of impacts on the transport network will vary according to the land use adjacent to the roads at the time of construction.

In many instances, it is expected that the Proposal will be constructed concurrently with other infrastructure, such as roads. In these cases, construction of the Proposal is likely to have negligible impact as the roads are expected to be conveying relatively low traffic volumes because infrastructure will be provided prior to substantial development of adjacent land for residential, commercial, industrial or recreational purposes.

### Temporary increases in road traffic during construction

A range of vehicles will be required to construct the Proposal and this will temporarily increase the number of traffic movements along the road network. Vehicle movements will be generated by:

- construction site establishment activities, such as establishing the site office and storage areas
- moving work crews to and from the construction sites
- delivering construction materials and removing waste materials such as excess spoil.

For the pipeline construction, the increase in traffic movements would be relatively minor as:

- the pipe laying crews generally consist of about 10 people
- the construction site will be transient and move as the pipeline installation progresses. This means that construction will occur at individual locations for short periods of time
- deliveries occur on an as needs basis
- the daily volume of spoil that needs to be removed will generally be small.

It is estimated that construction activities would result in the following number of traffic types and movements:

- Water pipeline:
  - about 15 truck movements per day for spoil/fill material
  - approximately two truck movements per day to deliver pipe/fittings
  - about 10 concrete truck movements per day (if required)
  - daily staff movements (typically cars) of about 40 movements per day
- Wastewater pipeline:
  - about 20 truck movements per day for spoil/fill material
  - about four truck movements per day to deliver pipe/fittings/chambers
  - about 10 concrete truck movements per day (if required)
  - daily staff movements (typically cars) of about 40 movements per day.

Given the temporary minor increase in traffic associated with pipeline construction, impacts on the capacity of the road network are likely to be negligible.

Traffic will also be generated when constructing the reservoirs and pumping stations, and augmenting the Shellharbour WWTP and Wollongong WRP. Activities at these locations will involve earthworks that require heavy vehicle movements, as well as deliveries of plant and materials. The workforce and materials deliveries are likely to require approximately 20 daily traffic movements. Given the small number of vehicle movements, impacts on the road network are likely to be minor.

## Temporary lane closures during pipeline installation

Water pipelines in all Precincts will generally be constructed within the existing road reserves. The majority of roads that will be affected will be wide with a footpath or substantial road reserve along each side. This will allow the pipelines to be constructed without lane closures. Temporary lane closures will, however, be required along some roads.

The majority of the roads that will be affected by pipeline construction are local roads, however, a number of main roads and principal traffic routes with major intersections will be impacted. These roads include West Dapto Road, Bong Bong Road, Avondale Road, Cleveland Road, Marshall Mount Road, North Macquarie Road, Calderwood Road, Togarra Road and the Illawarra Highway.

Lane closures will typically involve closing one lane of traffic adjacent to the pipeline construction to accommodate equipment, spoil removal and delivery of bulk materials. This may result in traffic delays and/or traffic diversions depending on the number of lanes available. Generally, these temporary partial closures will only occur when trenching works are in progress. Procedures for temporary lane closures will be developed and implemented in consultation with the relevant road authority (council and/or RMS).

Where pipelines cross roads, they would be constructed using one of the following approaches:

- open trenching and temporary partial road closures during normal construction hours (generally for roads with low traffic volumes)
- open trenching and temporary partial road closures outside normal construction hours (generally for roads with moderate traffic volumes)
- under boring techniques, such as thrust boring or microtunnelling (generally for roads with high traffic volumes), which will avoid the need for partial road closures.

Under boring techniques will be used where pipelines cross major roads, such as the Princes Highway, to avoid traffic diversions and delays in these areas. Appropriate construction methodologies for road crossings will be developed and implemented in consultation with the relevant council and/or RMS.

If construction requires excavation of roads or footpaths, restoration would involve reinstating the road or footpath in accordance with Sydney Water's standard practices.

Access points and tracks to the construction sites will be located to minimise impacts to the local residents, ground cover and vegetation.

## Temporary disruptions to property access

The water pipelines will generally be located within road reserves and this has the potential to impact on access to adjacent properties. This impact will be reduced to a significant extent as the majority of the Proposal will be constructed prior to adjacent land being developed. Furthermore, due to the rapid rate of pipeline construction, individual properties are likely to be affected for a relatively short period of time (generally less than 1 to 2 days).

Property owners will be informed of any potential loss of access and appropriate measures to either provide an alternative access or reinstate access at the end of the day will be negotiated. Any access ways affected by construction will be reinstated to their original condition.

## Temporary access to public and private property

Temporary access to or through privately or publicly owned land may be required to provide vehicle access to some construction areas. This is especially the case when constructing the wastewater pipelines as these are generally located adjacent to drainage lines in areas with limited road access.

Temporary access arrangements will be negotiated with property owners for the duration of the construction period. Any areas affected by temporary construction access requirements will be reinstated to their original condition. Access to all private property will be maintained.

### Impacts on railway lines

Wastewater pipelines will cross the Illawarra Railway Line between Yallah and Dapto. A water supply pipeline will also cross the railway line near Yallah. Construction in the Sheaffes/Wongawilli Precinct will require both water and wastewater pipelines to cross a railway spur line that links a coal mine at Wongawilli to the Illawarra Railway Line at Brownsville.

The exact location of the pipelines relative to the roads and railway lines is yet to be determined, however, it is proposed that the pipelines will be installed underneath the railway line using under boring techniques as described in Chapter 3. This should avoid direct impacts on the railway lines and minimise disruptions to operation of the railway line during the construction period.

RailCorp has a staged consultation and approval framework for activities that have the potential to impact on its assets and Sydney Water will meet RailCorp's requirements. Sydney Water will provide RailCorp with engineering and construction information on the railway line crossings (including concept and detailed designs) for their review and approval. This consultation and process to finalise the design will take into consideration any future upgrades or expansion of the railway network.

### 7.2.3 Operation impacts and mitigation measures

Potential impacts on the traffic and transport network during operation of the Proposal will be limited to routine inspections and maintenance. This will require a small number of vehicles on an occasional basis. As traffic volumes during these activities will be negligible compared to capacities of the road network, it is unlikely that the function of any regional or local roads will be affected.

Sydney Water has well developed procedures to manage issues associated with temporary impacts on the road network during maintenance of its water and wastewater systems. If maintenance or emergency activities require a temporary road closure or loss of access to a property, Sydney Water's standard operational procedures will be implemented to manage potential impacts.

The Proposal is expected to increase throughput at the Wollongong WRP and Shellharbour WWTP and this would involve additional vehicle movements to support operation of the facilities. These vehicle movements would be associated with chemical deliveries, removal of biosolids, maintenance vehicles and staff. In total, at each plant it is estimated that there would be approximately two additional truck movements per day and six additional light vehicle movements per day. These additional vehicle movements are likely to have negligible impact on the operation of the surrounding road networks.

## 7.3 Land use and services

### 7.3.1 Existing environment

The Proposal area is situated approximately 15 km to the south west of Wollongong, and is generally bounded by the suburb of Farmborough Heights in the north, Tullimbar Village in the south, Lake Illawarra to the east and the Illawarra Escarpment to the west (refer to Figure 7-1).

The majority of the Proposal area is used for non-urban purposes such as grazing. It is located on the fringe of existing urban areas and land use in the surrounding area is characterised by the southern suburbs of the Wollongong LGA, including Farmborough Heights, Horsley, Penrose, Dapto, Kanahooka and Koonawarra. Urban areas in the Shellharbour LGA include Albion Park and Tullimbar in the vicinity of the Proposal area. The surrounding areas include a mix of residential, rural residential, industrial, commercial and agricultural land uses. There has been a decline over recent years in farming activities in the area in anticipation of the future urban development.

Regional transport infrastructure corridors are located to the east of the Proposal area and include the Princes Highway, F6 Southern Freeway and Illawarra Railway Line. The Illawarra Highway is located to the south of the Proposal area and provides access to Moss Vale and other inland areas to the west of the Illawarra Escarpment.

There are a number of existing services within the Proposal area, including drinking water, wastewater, electricity, gas and telecommunications that will require extensions/upgrades or

replacement as development occurs. High voltage electricity transmission lines (330kV, 132kV and 33kV) are present and are associated with the Tallawarra Power Station, and Yallah Electricity Substation, which is in the general vicinity of the Yallah/Marshall Mount Precinct.

The Proposal area is on the eastern side of the Illawarra Escarpment and is wholly contained within the catchment of Lake Illawarra which discharges to the Tasman Sea at Windang. The main watercourses include Dapto Creek, Mullet Creek, Reed Creek, Robins Creek and Macquarie Rivulet. The watercourses generally commence in the Illawarra Escarpment's foothills and flow in an easterly direction prior to discharging to Lake Illawarra.

The Proposal involves developing drinking water infrastructure that will predominantly be within road reserves. Land use within the road reserves is related to transport infrastructure. The wastewater infrastructure would be located along and in the immediate vicinity of drainage lines and waterways.

Land affected will be in public and private ownership and will be located within both the Wollongong and Shellharbour LGAs. Figure 7-1 shows the indicative location of the Precincts and AGAs in relation to the Wollongong and Shellharbour LGA boundary.

The Proposal may also require upgrades to the existing Wollongong WRP and Shellharbour WWTP. Wollongong WRP is located off Springhill Road, Coniston, and surrounding land use includes JJ Kelly Park, Wollongong Greenhouse Park, and the Wollongong Golf Club. Port Kembla is located to the south of the WRP, and the nearest residential area is approximately 400m to the north. It is a tertiary treatment plant and treats wastewater from Bellambi and Port Kembla WWTPs prior to being discharged in the ocean approximately 1 km offshore.

Shellharbour WWTP is located on the western side of Junction Road, Shellharbour, and currently serves the developed areas of Shellharbour, Albion Park, Albion Park Rail, Blackbutt, Balarang, Barrack Heights, Barrack Point, Flinders, Haywards Bay, Lake Illawarra South, Mount Warrigal, Oak Flats, Warilla, and Shellcove. The treatment plant discharges via a near shore ocean outfall off Shellharbour/Barrack Beach.

The WDURA and AGAs are divided into a number of Precincts to facilitate the staged release of land for development over a period of approximately 40 years. As a result, the environmental and social context in which the Proposal will be developed will differ from that which is currently present.

### 7.3.2 Construction impacts and mitigation measures

Temporary direct and indirect impacts on land use will be experienced when constructing the Proposal. Direct impacts will relate to:

- stationary construction sites such as the reservoirs, Wollongong WRP, Shellharbour WWTP, and construction compounds that serve as staging areas for the workforce
- transient work sites along the pipeline routes.

Construction of the reservoirs, Wollongong WRP, Shellharbour WWTP, and ancillary infrastructure such as pumping stations will require construction activities to be undertaken at these locations for a longer duration relative to the pipelines. This impact is considered to be minor as:

- the reservoirs are in rural areas and there are few sensitive land uses and services in the immediate vicinity
- the Wollongong WRP and Shellharbour WWTP are owned by Sydney Water and construction will be scheduled such that impacts on operation of these facilities are avoided
- work would be limited to the construction hours specified in Section 6.9.

It is likely that temporary construction compounds will be required to provide a centralised area to store plant and materials, as well as house administrative facilities. The sites for the compounds will be selected by the contractor during construction planning. Where possible, the compounds will be sited to minimise potential impacts on land use and services.

The drinking water pipelines will generally be constructed within road reserves and the wastewater pipelines will generally be constructed along drainage lines. Impacts on land use are expected to

be minor as works will move progressively along the alignment and individual locations will be affected for a short period of time. The work site will be progressively rehabilitated as construction is completed in each location. The potential for sensitive receivers to experience amenity based impacts is further reduced as construction will typically occur prior to substantial development of adjacent lands.

Indirect impacts will relate to issues such as noise, traffic, and air emissions that have the potential to impact on the amenity of the areas surrounding the work sites. These amenity based impacts have been assessed in other sections of this EA.

As construction will be undertaken on the urban fringe, there is the potential for impacts on existing utilities and services, in particular underground surfaces such as electricity, gas, and telecommunications. Sydney Water will consult with all relevant service providers during detailed design to identify possible interactions and develop procedures to be implemented to minimise the potential for service interruptions. This will involve confirming any requirements or standards that will apply if it is determined that existing utilities or services need to be temporarily or permanently relocated. The construction contractors will carry out final checks for services before construction starts in each location to confirm that there are no services in the area that were previously unknown.

Potential impacts on land use and services during construction would be minor, temporary and effectively mitigated by implementing the Statement of Commitments.

### 7.3.3 Operation impacts and mitigation measures

The Proposal has been designed to integrate with the overall development scheme for the WDURA and AGAs to minimise the potential for land use to be impacted during the operational phase. Where required, Sydney Water will obtain easements for pipelines that will limit land use within the easements. Potential impacts on land use will be minor, given that the Proposal is part of large scale land use changes associated with developing the WDURA and AGAs.

The Proposal involves structures such as reservoirs, pumping stations and vents, as well as augmenting the Wollongong WRP and Shellharbour WWTP, that have the potential to impact on the amenity of surrounding areas due to impacts on air quality and noise. Assessments undertaken as part of this EA indicate that these impacts can be effectively managed to ensure that potential impacts on adjacent land use are minor.

The Proposal will permanently change the land use at the three reservoir sites at Avondale, Mt Marshall and Calderwood, which are currently used for rural or rural-residential purposes. Sydney Water owns the land for the Avondale and Mt Marshall reservoirs. Sydney Water will acquire land for the Calderwood Reservoir when the site is confirmed during the design process.

Sydney Water may require access to private property on an occasional basis to maintain pipelines and associated structures such as pumping stations. Landowners will be consulted prior to any routine maintenance work. Maintenance works will generally be of short duration.

Drinking water pipelines will generally be constructed in road corridors. Sydney Water will acquire an easement for any drinking water pipelines located on private property. An easement allows Sydney Water to enter a property to carry out essential maintenance.

Restrictions on development over drinking water pipelines may apply, including:

- laying concrete or other finished surfaces such as driveways and tennis courts
- building any permanent structure such as barbeques, concrete or brick structures, garages or swimming pools
- altering the surface levels of the easement site with mounds, excavations or gardens
- growing trees with large root systems
- storing flammable liquids, explosives or materials such as rubbish or timber
- installing fixed plant, materials, equipment or park vehicles which cannot be moved easily
- driving fence posts or stakes into areas affected by easements or where there is buried infrastructure.

Where wastewater pipelines are located on private property, building over and adjacent to a pipeline is permitted provided the building is in accordance with *Guidelines for Building Over/Adjacent to Sydney Water Assets* (Sydney Water 2006b).

## 7.4 Visual amenity

### 7.4.1 Existing environment

#### Regional context

The Proposal area is located on the coastal plain and the most prominent features of the visual catchment are the Illawarra Escarpment in the west and the Tasman Sea in the east. The escarpment is heavily forested with sandstone outcrops and descends into a series of undulating foothills that grade into floodplains.

Figure 7-2 provides a general view of the Proposal area from the escarpment looking east towards the Tasman Sea. Figure 7-3 provides a similar view looking south along the general line of the escarpment. These photographs indicate that vegetation is concentrated along the escarpment, steeper foothills and riparian corridors, and this includes pockets of temperate rainforest in the steeper gullies.

Lake Illawarra is visible in the background of Figure 7-2, and its tributaries and associated wetlands are the dominant natural features on the floodplain. These include the riparian corridors of Macquarie Rivulet, Mullet Creek, Reed Creek, Robins Creek and Dapto Creek.

The Illawarra Railway Line, Princes Highway and F6 Southern Freeway are part of an urban corridor that is a significant visual element in the middle of Figure 7-2. The foothills are relatively sparsely populated and residential, commercial and industrial development is concentrated along the infrastructure corridors situated on the floodplain and the shores of Lake Illawarra.

Figure 7-4 provides a general view from a location in the foothills looking west to the escarpment. The majority of native vegetation has been cleared and established trees are generally on the steeper slopes which are typical of much of the Proposal area.

**Figure 7-2 General view from the escarpment looking east**

**Figure 7-3 General view looking south along the escarpment**

**Figure 7-4 General view looking west towards the escarpment**

## Pipelines and pumping stations

As the WDURA and AGAs are predominantly on the fringe of existing urban development, the pipeline routes pass through areas with both urban and rural visual components including some densely populated residential and commercial areas. The water pipelines will generally be in existing road corridors or new road corridors that are constructed as part of future urban development. The visual environment along these routes ranges from small-scale closed landscapes with isolated pockets of vegetation, to cleared flat open parkland and open pasture.

The wastewater pipelines will generally be located along low points in the landscape, including riparian zones. The visual environmental along these routes includes a mixture of cleared areas and dense vegetation along some riparian corridors.

### Wastewater treatment plant sites

The visual environment at the WRP and WWTP sites typically comprises wastewater treatment infrastructure such as buildings, ponds, tanks and storage areas. They also feature areas of open space and pockets of landscaped and remnant vegetation.

The nearest residences to Wollongong WRP are in the suburb of Coniston, approximately 300 m to the north. The nearest residences to Shellharbour WWTP are approximately 300 m to the west. Views to both treatment plants from the nearest residences are partially screened by vegetation.

### Reservoir sites

Water reservoirs are generally located at high points in the landscape to provide a “head” to pressurise the system. This is especially important if there is a power failure as it allows water supply to continue for a period.

The Proposal involves constructing reservoirs at Avondale, Mt Marshall and Calderwood. These sites are located in the foothills in areas that have been cleared and are characterised by agricultural or rural residential land use. The sites contain varying extents of vegetation and are visually prominent in the local context due to their elevated nature.

The Avondale and Calderwood sites are located in areas that are presently sparsely populated and have few sensitive receivers. The Mt Marshall site is located in an area that has been subdivided into rural residential allotments and has a greater number of sensitive receivers in the surrounding area.

## 7.4.2 Construction impacts and mitigation measures

Construction impacts will be related to construction plant and equipment being visible to those residing in adjacent properties and road users. The significance of this impact is related to the proximity of the nearest visual receivers and the duration of the works at any one location. As the majority of the Proposal will be undertaken on the urban fringe, prior to significant urban development of the WDURA and AGAs, there are likely to be relatively few locations where construction activities will form a dominant part of views from sensitive receivers such as residences. Based on this, visual impacts are likely to be temporary, minor, and able to be mitigated to a high degree by rehabilitating work sites as construction is progressively completed.

### Pipelines

The pipelines will be predominantly along road corridors and creek lines. The visibility of construction sites will vary depending on the distance to sensitive receivers and the extent of screening provided by topography, vegetation and structures such as fences. Some sporting fields and reserves also exist along the pipeline routes.

As construction will progress along the alignments at a relatively rapid rate, visual impacts at individual locations will occur for a short duration. Machinery will be used and stored so as to minimise disturbances to residents. Areas disturbed by construction will be progressively rehabilitated to reduce visual impacts.

### Reservoirs and pumping stations

Constructing the reservoirs and pumping stations will require stationary construction sites and plant and equipment will be visible at these locations over a longer period of time relative to the pipelines. As the reservoirs will be located on high points in the landscape, they will be visible from a relatively wide area. Conversely, the pumping stations will be located in low points in the landscape and would be visible from elevated areas. Based on Sydney Water’s current understanding of the development staging, visual impacts when constructing reservoirs and pumping stations are considered to be minor. This is because the majority of the views will be distant and the construction areas are unlikely to represent a significant component of views from sensitive receivers.

### Wollongong WRP and Shellharbour WWTP

The Proposal may require the Wollongong WRP and Shellharbour WWTP to be augmented sometime beyond 2031. Visual impacts of construction activities at these sites will be influenced by the surrounding land use at the time of construction. At present, there are few receivers in the vicinity of the WRP and WWTP that will be sensitive to the visual impacts of construction activities. This is unlikely to change in the future as these areas are well developed. As such, negligible visual impact is expected during construction.

### Construction compounds

Construction compounds will be established to provide centralised staging and storage areas for work along pipeline routes. The size and location of the compounds will be determined by the contractor and will be sized to occupy the minimum required area. The compounds will be sited to minimise the potential impacts on surrounding land use, where possible.

The compounds will be surrounded with security fencing and will include ancillary facilities such as administration facilities, washrooms, and meal rooms. Visual impacts related to the presence of the construction compounds will be minor and good housekeeping practices will be implemented. The compounds would be decommissioned following completion of construction and the sites would then be rehabilitated.

It may be necessary to install security lighting at some construction compounds. If this is required, the lighting will be installed such that spill light to surrounding land is minimised. This will reduce the potential for lighting to impact on the amenity of sensitive receivers.

## 7.4.3 Operation impacts and mitigation measures

The WDURA and AGAs are located on the foothills and floodplains that have largely been cleared to enable rural pursuits. The most prominent visual features are the Illawarra Escarpment and ocean beaches and foreshores, all of which lie beyond the boundaries of the Proposal area. The Proposal will not impede views to or from the escarpment or foreshores.

Visual impacts associated with operation of the Proposal are likely to be minor as most infrastructure will be located below ground. The main visual impacts will be associated with aboveground structures such as reservoirs and pumping stations. Where possible, vegetation will be retained around these structures and additional vegetation will be planted to screen views from sensitive receivers. If necessary, landscaping measures may be implemented at pumping station and reservoir sites to provide additional visual screening.

Due to the nature and timing of the overall urban development, the visual context in which the Proposal will be located will be different to the existing environment present at the time this EA was drafted. As reservoirs and pumping stations are common features in urban environments, these structures will be viewed in this context as urban development proceeds.

Overall, the Proposal is considered likely to have minor long term impact on visual amenity.

### Pipelines

The majority of the pipelines would be underground and as such are likely to have no visual impact during operation. Short sections of the water and wastewater pipelines would be above ground in some locations where there are relatively steep changes in topography, creek crossings and bridges. There would also be some surface infrastructure associated with the pipelines such as vent shafts, maintenance holes, valves and overflows, and these will be designed to minimise visual impacts. The numbers and locations of vent shafts would be determined during detailed design, and based on criteria from the Sewerage Code of Australia (WSAA). Each vent shaft would be a supported pipe up to 19 m tall and up to 0.3 m in diameter and painted to blend in with the surrounding landscape. Ongoing operation of the pipelines will result in negligible visual impacts.

### Reservoirs and pumping stations

Most water and wastewater pumping station infrastructure will be below ground level, however a small above ground kiosk housing electrical equipment will be required at the pumping stations. Visual impacts associated with the kiosks are expected to be minor and localised. Where possible, existing vegetation will be retained and additional vegetation may be planted to screen views of infrastructure from sensitive receivers.

Reservoirs will be located at Avondale, Mt Marshall and Calderwood. As they will be cylindrical, they will present the same face to all viewing points. Due to their elevated location, extensive areas are likely to have views of the reservoirs. This impact is considered to be minor because the majority of the views will be distant, meaning that the reservoirs will not constitute a significant component of views from these sensitive receivers. Where possible, vegetation will be retained around the reservoirs and additional vegetation may be planted as part of site rehabilitation to screen views to these structures. Painting the reservoirs a dark “bush green” colour that is compatible with the surrounding environment would also assist to reduce the visual prominence of these structures.

Future planning for urban development in the area would consider opportunities to plant vegetation buffers and other visual filters in or adjacent to properties which would have views of the elevated reservoirs. This would provide filtered short and long distance views and focus views in other directions, greatly reducing the perception of visual intrusion.

The potential for the reservoirs to overshadow adjacent land will be addressed during the design phase when the location and structural features of the reservoirs will be considered. This will involve identifying measures to minimise impacts if overshadowing is likely to unreasonably impact adjacent properties.

### Wollongong WRP and Shellharbour WWTP

In the long term, the Wollongong WRP and Shellharbour WWTP may need to be augmented and the additional structures may be visible from the surrounding areas.

The Wollongong WRP is located adjacent to an industrial area and the nearest residences are currently approximately 300 m to the north. The nearest residences to the Shellharbour WWTP are approximately 300 m to the west. The nearest sensitive receivers to both the treatment plants are those using recreational areas, open space, parkland, and beaches. Any new infrastructure at these sites is likely to be a similar scale and use similar materials and built forms. As such, it will be integrated with, and viewed as, a component of the existing infrastructure. Where possible, existing vegetation will be maintained and additional vegetation may be planted along site boundaries to obscure views of infrastructure from sensitive receivers. As such, visual impacts associated with additional infrastructure at the Wollongong WRP and Shellharbour WWTP are expected to be minor.

## 7.5 Energy use and greenhouse gas emissions

### 7.5.1 Existing environment

Operating water and wastewater treatment and transport systems is energy intensive and, as a result, Sydney Water is a significant user of energy. Sydney Water has a range of measures in place to minimise impacts of its energy use including reducing demand, energy efficiency, renewable energy and offsets.

Sydney Water has assessed the risks of climate change on its operations and infrastructure and some of these risks are applicable to the Proposal.

In 2004, Sydney Water adopted an *Energy Management Plan* (Sydney Water 2004), which details strategies and activities for improving energy efficiency and reducing non-renewable resource use between 2004-05 and 2009-10. This plan identified that Sydney Water’s energy consumption is increasing due to an increase in its customer base and an increase in energy intensive processes.

Sydney Water’s use of electricity, gas and fuel in 2006-07 was equivalent to the emissions of approximately 403,432 tonnes of $CO_2$ (Sydney Water 2007b). As one of the largest energy users in

NSW, Sydney Water recognises the importance of acting early to eliminate its impact from greenhouse gas emissions due to energy consumption.

Sydney Water generates its own renewable energy from hydro-electricity generated in pipelines and biogas cogeneration, where methane gas is captured and turned into energy at WRPs and WWTPs. In July 2007 Sydney Water committed to becoming carbon neutral by 2020. Sydney Water will achieve carbon neutrality through a cost-effective combination of reduced demand, energy efficiency, renewable energy and offsets.

As part of Sydney Water's Renewable Energy Generation (REG) Program and commitment to becoming carbon neutral, a cogeneration plant was constructed at Wollongong WWTP. The aim of the program is to generate approximately 50,000 mega watt hours (MWh) of renewable electricity per year and reduce consumption of grid-supplied, nonrenewable electricity. The REG Program will abate over 54,000 tonnes of CO2-e per year. This equates to approximately 12.5 per cent of Sydney Water's greenhouse gas emissions and contributes to achieving Sydney Water's carbon neutrality commitment.

The Wollongong WWTP cogeneration plant has a capacity of 526 kW. The plant was installed with an expected average power generation of 3,719 MWh per year. Power generated by the plant is fed back into the grid supply, which offsets approximately 20 per cent of power usage at the Wollongong WWTP. In the 7 months from March 2011 to September 2011, Wollongong's cogeneration plant generated a total of 1,754 MWh.

### 7.5.2 Construction impacts and mitigation measures

Construction will use energy and generate greenhouse gas emissions primary due to combustion of hydrocarbons in vehicles and equipment. All vehicles and equipment will be adequately maintained and operated to ensure efficient operation to minimise energy use and greenhouse gas emissions.

### 7.5.3 Operation impacts and mitigation measures

The Proposal will be designed to minimise energy use by relying on gravity flows along the water and wastewater pipelines where possible. Nonetheless, operating water and wastewater transport and treatment systems is inherently energy intensive and the Proposal will increase Sydney Water's energy use. Energy use and associated greenhouse gas emissions will primarily be related to the increased loads on the Wollongong WRP and Shellharbour WWTP and pumping stations on the water and wastewater networks.

In 2006, approximately 283 kilowatts per hour (KWh) was required to transport and treat one Megalitre (ML) (1,000,000 Litres) of water and approximately 467 KWh was required to transport and treat 1 ML of wastewater (Sydney Water 2007b). It is estimated, that when fully operational in 2048, the Proposal would increase Sydney Water's energy use by approximately 0.31 per cent.

The increased energy consumption as a result of the Proposal will cause a minor increase in the amount of greenhouse gases produced from burning fossil fuels to generate electricity if no further mitigation measures are implemented. Sydney Water's commitment to be carbon neutral by 2020 means that the Proposal's greenhouse emissions will be reduced and eventually eliminated through a combination of reduced demand, energy efficiency, renewable energy and offsets.

## 7.6 Waste

### 7.6.1 Existing environment

Sydney Water has a waste minimisation policy that applies to discarded, rejected, unwanted, surplus or abandoned substances. The key objectives of the policy are to minimise waste and maximise reuse, recovery and recycling of waste products.

These objectives are to be achieved by:

- minimising wasteful practices
- using appropriate technology
- implementing management practices, procedures and planning appropriate for waste minimisation
- using products that are environmentally acceptable, commercially available and competitive in price and performance.

The policy excludes gas, energy, water, wastewater, beneficially used biosolids (soil fertiliser) and reused water. These wastes are covered by other regulatory frameworks or other strategies developed by Sydney Water.

#### Wollongong WRP and Shellharbour WWTP

Sydney Water operates the Wollongong WRP and Shellharbour WWTP which generate approximately 20 to 30 tonnes and 8 tonnes per day of Class B biosolids respectively. Sydney Water has an objective to reuse 100 per cent of all biosolids captured from treatment plants and this material from Wollongong WRP and Shellharbour WWTP is currently reused mainly for soil conditioning and fertilising.

### 7.6.2 Construction impacts and mitigation measures

#### Spoil

The largest volume of waste generated during construction works would be excess spoil from excavating pipelines, and footings for the reservoirs and pumping stations. Table 7-1 summarises the estimated volume of spoil that would be generated when constructing the main components of the Proposal. Potential impacts relating to spoil management and disposal would occur in stages over the period of approximately 40 years in which the Proposal would be constructed.

**Table 7-1 Estimated volume of spoil generated during construction works**

| Project component | Construction method | Spoil volume (cubic metres – loose) | Total truckloads* |
|---|---|---|---|
| Water pipelines | Trenching and under boring | 50,000 | 7,500 |
| Wastewater pipelines | Trenching | 52,000 | 7,800 |
| Pumping stations | Excavation for foundations and wells | 1,600 | 240 |
| Reservoirs | Excavation for foundations | 2,000 | 300 |

* Assumptions - each truck carries about 22 $m^3$ spoil (loose). This is a worst case scenario as most of the spoil would be re-used on site, where possible.

All spoil would be classified according to the *DECCW Waste Classification Guidelines* (DECCW 2009a). Wherever possible, suitable spoil would reused on site for backfilling, landscaping and other uses. If spoil is unable to be reused on-site, opportunities for off-site reuse would be investigated.

As indicated in Section 6.8, Coffey Geotechnics assessed the potential impacts of the Proposal on geology and soils. Based on this, it is likely that the majority of the spoil would be classified as virgin excavated natural material that will be able to be readily reused.

Spoil may also include saline soil, ASS and contaminated material. The soils assessment identified that saline soils are likely to be located near Horsley and in the Avondale Road area. While the majority of the Proposal area has been mapped as 'no known occurrence of ASS', the risk of ASS occurring has been mapped in the Kembla Grange, Yallah, Koonawarra and Albion Park areas (DLWC 2008). Potentially contaminated sites exist within the Proposal area due to current or past land uses, such as fuel depots, piggeries, mine operations, and waste disposal sites.

In the event that the spoil is unsuitable for reuse (for example due to its geotechnical or contamination characteristics), spoil would be classified according to the *DECCW Waste Classification Guidelines* (DECCW 2009a) and disposed of at an appropriately licensed facility.

#### Other wastes

Other solid wastes produced during construction will include:

- green-waste from clearing vegetation
- packaging waste
- off-cuts and disused construction materials
- general waste from construction works.

Organic wastes produced by clearing vegetation will be minimised where possible and opportunities for mulching and composting will be investigated. Volumes of other construction wastes are likely to be low. Wherever possible these wastes will be recycled or reused, however, it is likely they that will require disposal after being classified according to the *Waste Classification Guidelines* (DECCW 2009a).

Significant volumes of liquid wastes, including oils or fuels are unlikely to be generated on site during construction. Cutting heads and drilling equipment used for boring beneath sensitive environmental areas, creeks or roads would be lubricated using bentonite slurry or similar benign material. The slurry will be reused in the drilling process, although small quantities of this liquid waste may be produced and require disposal. Waste would be classified and managed in accordance with *Waste Classification Guidelines* (DECCW 2009a).

There is the potential for water to collect in excavations, particularly those undertaken below the groundwater table. Any water that collects in excavations will be discharged and disposed of in accordance with the POEO Act.

### 7.6.3 Operation impacts and mitigation measures

Minor volumes of waste would be generated by maintenance activities associated with the water and wastewater systems. Sydney Water's procedures and policies would be used as a basis for the management and disposal of this waste.

The impact of discharging tertiary treated effluent from Wollongong WRP was assessed in the *Illawarra Wastewater Strategy EIS* (Sydney Water 1999). Discharge of the treated effluent is undertaken in accordance with the Environment Protection Licence (218).

The Shellharbour WWTP operates under an existing approval and discharges are undertaken in accordance with an Environment Protection Licence (211).

There would be a very minor increase in the volume of biosolids produced at the Wollongong WRP and Shellharbour WWTP due to the additional wastewater flows associated with the Proposal. Biosolids are expected to continue to be 100 per cent beneficially reused in horticulture or agriculture, as part of the Bio-Soil Program operated by Sydney Water.

# 8 Stakeholder engagement and consultation

This chapter describes the stakeholder engagement and consultation undertaken for the Proposal to date and summarises the issues raised in this process. It also outlines Sydney Water's future consultation approach if the Proposal is approved.

## 8.1 Consultation prior to preparation of the Environmental Assessment

### 8.1.1 Development of the servicing strategy

Sydney Water consulted with key government agencies in 2007 and 2008 while preparing an integrated water-related servicing strategy for the WDURA and AGAs. This included one-on-one briefings and a series of inter-agency workshops. The first workshop identified key issues, opportunities and constraints for developing the strategy. The second workshop agreed on assessment criteria and involved selecting a preferred servicing strategy from shortlisted options.

In general terms, the workshop participants were supportive of the preferred servicing option which includes the use of rainwater tanks for non-drinking water, and extending the existing systems for drinking water and wastewater services. It is considered that the community generally has a preference for rainwater tanks over dual reticulation recycled water systems, and local councils have confirmed that they are supportive of rainwater tanks.

## 8.2 Consultation during preparation of the Environmental Assessment

### 8.2.1 Agency consultation

Sydney Water contacted a range of government agencies to discuss the Proposal and any issues they considered should be addressed in the EA. Table 8-1 lists the agencies consulted. In some cases, several meetings were held (for example with OEH and DP&I). Sydney Water contacted nine by letter and phone, and six by phone.

**Table 8-1 Agency consultation regarding the Proposal**

| Agency | Preferred servicing strategy | Preferred option | Comments for DGRs | Public information day | | Phone call/letter during EA preparation |
|---|---|---|---|---|---|---|
| | | | | Invite | Attend | |
| Department of Aboriginal Affairs | | | | | | ✓ |
| Department of Planning and Infrastructure | ✓ | | ✓ | ✓ | | ✓ |
| Department of Primary Industries (Office of Water) | | | ✓ | ✓ | | ✓ |
| Department of Primary Industries (Fisheries) | | | ✓ | ✓ | | |
| Department of Health | ✓ | ✓ | ✓ | ✓ | | ✓ |
| NSW Trade and Investment (formerly Industry and Investment) | | ✓ | ✓ | ✓ | | |
| Endeavour Energy | | | | ✓ | | |

| Agency | Preferred servicing strategy | Preferred option | Comments for DGRs | Public information day | | Phone call/letter during EA preparation |
|---|---|---|---|---|---|---|
| | | | | Invite | Attend | |
| Lake Illawarra Authority | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Native Title Services | | | | ✓ | | ✓ |
| Office of Environment and Heritage | ✓ | | ✓ | ✓ | | ✓ |
| Roads and Maritime Services | ✓ | ✓ | ✓ | ✓ | | |
| Railcorp | | | ✓ | ✓ | | |
| Southern Rivers Catchment Management Authority | ✓ | | ✓ | ✓ | | ✓ |
| Shellharbour City Council | ✓ | ✓ | ✓ | ✓ | | ✓ |
| Wollongong City Council | ✓ | ✓ | ✓ | ✓ | | ✓ |

Table 8-2 lists the issues raised by agencies during consultation and the section of the EA in which they are addressed.

**Table 8-2 Issues raised during consultation with agencies**

| Agency | Issue | Section of EA |
|---|---|---|
| Department of Planning and Infrastructure | • application of the DGR to the Proposal | Chapter 5 |
| | • methodology for Aboriginal heritage assessment<br>• methodology for Aboriginal consultation<br>• management of Aboriginal objects found on site | Section 6.6 |
| Office of Environment and Heritage (including EPA) | • greenhouse gas emissions | Section 7.5 |
| | • noise and vibration impacts | Sections 6.7 and 6.9 |
| | • wastewater treatment and management | Sections 3.2.2, 3.3.2, 6.3 and 6.4 |
| | • water quality – receiving waters and aquatic environment | Sections 6.3 and 6.4 |
| | • water quality and hydrology | Sections 6.3, 6.4 and 6.8 |
| | • wastewater infrastructure | Sections 3.2.2 and 3.3.2 |
| | • flora and fauna | Section 6.5 |
| | • impacts on land reserved under the *National Parks and Wildlife Act 1974* | Chapter 3 |
| | • Aboriginal cultural heritage | Section 6.6 |
| | • contamination | Section 6.8 |
| | • flooding | Section 6.12 |

| Agency | Issue | Section of EA |
|---|---|---|
| NSW Office of Water | • protection and rehabilitation of waterways as natural streams<br>• protection and rehabilitation of riparian land consistent with the Riparian Corridor Management Study stream categorisation of waterways<br>• potential impact of the Proposal on the hydrologic regime of the waterways<br>• groundwater | Section 6.5 and 6.8 |
| Lake Illawarra Authority | • impact of development on the Lake, in particular increased sediment loads, nutrient and water borne pollutant loads | Sections 6.4 and 6.8 |
| Wollongong City Council | • requirements of all relevant Commonwealth, State, and local government legislation | Chapter 5 |
| | • environmental impacts | Chapters 6 and 7 |
| | • Aboriginal heritage impacts | Section 6.6 |
| | • non-Aboriginal heritage impacts | Section 6.7 |
| | • ecological impacts | Section 6.5 |
| | • flooding | Section 6.12 |
| | • location of new infrastructure | Section 3.3 |
| | • traffic | Section 7.2 |
| Roads and Maritime Services | • traffic | Section 7.2 |
| Department of Health | • potential human health risks | Sections 6.3 and 6.4 |
| | • flooding | Section 6.12 |
| Department of Primary Industries | • water quality | Sections 6.3 and 6.4 |
| | • aquatic flora and fauna | Section 6.5 |
| | • erosion and sedimentation | Section 6.8 |
| | • location of pipelines in proximity to waterways | Sections 3.3 and 6.8 |
| | • creek crossings | Sections 3.3, 6.5 and 6.8 |
| | • wastewater overflows | Section 6.4 |
| | • discharges to the marine environment | Section 6.3 |
| Southern Rivers Catchment Management Authority | • no issues | NA |
| RailCorp | • request for more information at the detailed design phase | Section 7.2 |

### 8.2.2 Aboriginal consultation

Consultation with Aboriginal stakeholders was integral to the assessment of Aboriginal heritage. It acknowledged that Aboriginal people have a unique understanding of their heritage and have a right to participate in matters that may impact that heritage. Consultation was undertaken in accordance with the:

- *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (Draft) (DEC 2005a)
- *National Parks and Wildlife Act 1974: Part 6 Approvals – Interim Community Consultation Requirements for Applicants (*DEC 2004)
- *Aboriginal cultural heritage consultation requirements for proponents 2010 Part 6 National Parks and Wildlife Act 1974* (DECCW 2010b).

In accordance with the guidelines, Aboriginal people were notified of the Proposal and invited to register their interest in the community consultation process. Registered parties were then given the opportunity to:

- provide input into the identification of Aboriginal objects and/or places in the vicinity of the Proposal (including participating in the field surveys)
- comment of the proposed assessment methodology
- participate in the assessment of cultural and archaeological significance
- comment of the draft Heritage Assessment Report.

#### Notification of the Proposal

Letters were sent to the following key government agencies, councils and organisations to notify them of the Proposal and requesting information about any known Aboriginal parties that may have an interest:

- DP&I
- Illawarra Local Aboriginal Land Council
- National Native Title Tribunal
- NSW Native Title Services Corporation Limited
- OEH
- Shellharbour City Council
- Southern Rivers Catchment Management Authority
- The Registrar, *Aboriginal Land Rights Act 1983* of Aboriginal Owners, Department of Aboriginal Affairs
- Wollongong City Council.

Of these bodies only the OEH, the Department of Aboriginal Affairs Registrar and the Shellharbour City Council Aboriginal Liaison Officer responded specifying the names and contact details of Aboriginal groups that might have an interest in the Proposal.

Notification of the Proposal and an invitation to participate in the community consultation were sent to the following parties:

- Northern Illawarra Aboriginal Corporation (Woronora Plateau Gundungara and Wulungu Elders Group)
- Comaditchie United Aboriginal Corporation
- Wodi Wodi Elders Council
- Korewal Elouera Jerrungarugh Tribal Elders Aboriginal Corporation
- Wadi Wadi Comaditchie Aboriginal Corporation
- D'harawal Knowledge Holders
- Peter Falk Consultancy
- Illawarra Aboriginal Corporation
- Kulllila Welfare & Housing Corporation
- Tocomwall
- National Koorie Site Management
- La Perouse Botany Bay Aboriginal Corporation.

Follow-up phone calls were made to ensure all potential stakeholders were aware of Sydney Water's water and wastewater servicing proposal for the WDURA and AGA.

Public notifications were also placed in the Illawarra Mercury on 2 and 9 September 2010 and the Wollongong Advertiser on 8th September 2010. The notices invited people who held cultural knowledge to aid in determining the significance of Aboriginal object(s) and/or places in the vicinity of the Proposal to register their interest in a process of community consultation.

### Registered Aboriginal Parties

As a result of the notification process the following Aboriginal parties registered an interest in the Proposal:

- Illawarra LALC
- Peter Falk Consultancy
- Kullila Welfare & Housing Aboriginal Corporation
- National Koorie Site Management
- Korewal Elouera Jerrungura Tribal Elders Aboriginal Corporation
- Tocomwall
- Wodi Wodi Elders Council
- Wadi Wadi Commachie Aboriginal Corporation
- La Perouse Botany Bay Aboriginal Corporation
- Northern Illawarra Aboriginal Council (Woronora Plateau Gundungara and Wulungu Elders Group).

## Consultation activities

The registered Aboriginal parties (RAPs) were invited to participate in the consultation activities which consisted of:

- an initial consultation meeting on 28 September 2010, to provide the RAPs with an opportunity to comment on:
    - the Proposal, its purpose and extent
    - the proposed Aboriginal Cultural Heritage study
    - Aboriginal heritage knowledge, as appropriate
    - registering expressions of interest in undertaking field surveys
    - the proposed consultation methodology
    - the assessment methodology
- field surveys conducted in November 2010 and January 2011. An additional site visit was undertaken in May 2011 to confirm the status of shells on Lake Illawarra. The RAPs participated in the field surveys except the Wodi Wodi Elders Council.
- reviewing and commenting on the draft Aboriginal Heritage Assessment and Impact Management Report. A copy of the report was provided to all the RAPs in May 2011 and they were given 30 days to provide comments on:
    - the findings of the field surveys
    - the proposed locations of high, medium and low archaeologically sensitive areas
    - the archaeological and cultural significance of objects and sites identified within the Proposal area
    - potential impacts on Aboriginal heritage due to construction and operation of the Proposal
    - proposed impact mitigation methods
- a meeting on 23 May 2011 (during the review period), to discuss and comment on the draft *Aboriginal Heritage Assessment and Impact Management Report.* The discussion focused on:
    - the cultural and archaeological significance of sites recorded on the AHIMS
    - impacts and mitigation measures to conserve Aboriginal cultural heritage in the Proposal area.

A copy of the final *Aboriginal Heritage Assessment and Impact Management Report* was sent to the RAPs for their information on 2 September 2011.

Two written comments were received thanking the Consultants for the project information and stating general agreement to the works.

### Ongoing consultation

Sydney Water will undertake on-going consultation with the RAPs as appropriate. This may include:

- consulting the RAPs, together with an approved archaeologist, prior to and/or during construction in high sensitivity areas
- consulting with the RAPs, together with an approved archaeologist, if a potential Aboriginal archaeological object is found during construction
- establishing a 'Care and Control Agreement' with the RAPs if Aboriginal objects found during construction need to be removed and salvaged
- consulting and/ or undertaking additional field surveys, together with an approved archaeologist, if a pipeline is realigned outside the area previously surveyed by the RAPs.

It is unlikely that operations, servicing and maintaining of the infrastructure will impact Aboriginal sites. However, should that occur, Sydney Water would consult with the RAPs in accordance with its standard procedures.

### 8.2.3 Community consultation

As an integral part of the EA process, Sydney Water developed a Community and Stakeholder Engagement Plan for the Proposal. The Proposal details the consultation approach for the Proposal with both the community and key stakeholders. The Plan aims to ensure stakeholders and the wider community are appropriately consulted and informed about the Proposal.

During the development of the EA, Sydney Water informed the local community and stakeholders about the Proposal through the following mechanisms:

- information about the Proposal was placed on Sydney Water's website sydneywater.com.au under 'Major Projects'. The webpage provides details and key milestones, a map of the proposed infrastructure, information on community consultation, information on the Part 3A process and estimated timeframes for construction. The page has contact information and all project documents including factsheets, project updates, question and answer sheets and maps
- more than 1,800 letters were sent to potentially affected properties. These letters included a factsheet providing more information about the Proposal, a map of the proposed development areas and contact details for project personnel
- letters to 112 properties within 25 metres of the proposed infrastructure also included a Notice of Entry to enable access during the development of the EA for field assessments and surveys
- maps were sent to property owners requesting more detailed information about proposed infrastructure locations on their property. These maps showed specific details of the infrastructure on their property
- Sydney Water placed nine advertisements inviting stakeholders and the community to attend information sessions, in the following newspapers:
    - Wollongong Advertiser (11 May, 18 May and 25 May 2011)
    - Illawarra Mercury (14 May, 20 May, 21 May and 27 May 2011)
    - Shallharbour Lake Times (19 May and 26 May 2011)
- two community information sessions were held in May 2011: at Dapto Ribbonwood Centre on 21 May and at Albion Park Community Centre on 28 May. Invitations were sent to over 5,000 properties via a letterbox-drop including 112 directly impact property owners and key stakeholders including local community, environment, business and Aboriginal groups and government agencies.

- approximately 120 community members and stakeholders attended the sessions. The following resources were available at the sessions:
    - factsheets containing Proposal information
    - detailed maps of the Proposal and location of proposed infrastructure
    - question and answer sheets relating to:
        - the EA process
        - delivery of services (construction impacts and connecting to the water and wastewater system)
    - detailed maps of existing trunk infrastructure
    - photos showing examples of existing major infrastructure (reservoirs, WPSs and WWPSs)
    - information on the EA process
- the 112 directly impacted property owners (where proposed infrastructure is located on or near their property) were invited to the two community information sessions in May 2011, offered face to face meetings to discuss the Proposal and were sent maps showing their specific properties and location of proposed infrastructure
- two face to face meetings were held with property owners that requested them, or with those who could not attend the information sessions
- Sydney Water responded to 121 phone and email enquiries from community members during the preparation of this EA
- most distributed information included translated messages (in seven languages) asking customers to phone Sydney Water's contact centre for more information.

Stakeholders and the community have been able to contact the project team by phoning, emailing or writing to Sydney Water.

### Issues raised during community consultation

The majority of enquiries raised throughout community consultation related to the availability of services, timeframes for construction and operation of the Proposal and proposed location of infrastructure. Landowners also raised specific issues relating to their properties. Issues raised during community consultation related to:

- proposed alignments of pipelines and location of major infrastructure including reservoirs and pumping stations. These were described to community members and stakeholders through consultation activities outlined above. Discussions included that the alignments were indicative only, and would be dependent on environmental results, constraints and design. Sydney Water also gave property owners information about making submissions on the EA
- property acquisition and easement requirements. Sydney Water's process was discussed with community members, and question and answer sheets were provided to community members
- property access for surveys and construction. Section 8.4 outlines Sydney Water's process for accessing property
- impacts to property during construction, operation and maintenance including potential property damage. Section 8.4 discusses the process for managing these impacts
- impacts to businesses during construction, including potential interruption to businesses. Section 8.4 discusses the process for managing these impacts.

During the information sessions, community members were encouraged to provide written feedback to Sydney Water via feedback forms. Overall, feedback from those who attended the community information sessions was generally positive. Most community members found the information provided as informative to very informative (80 per cent), and most agreed they had a better understanding of the Proposal (67 per cent).

## 8.3 Public display period

The DP&I will place the EA on public display and invite public submissions on the Proposal in accordance with the Part 3A approval process, which is detailed in Chapter 5. The EA will be on public display for at least 30 days in August/September 2012 at the Department's Head Office in Sydney, the Department's website, and Wollongong and Shellharbour Council offices. During the exhibition period, government agencies, local councils, interested groups and organisations, and the public would be invited to review the EA and make written submissions to the DP&I.

Prior to the public exhibition period of the EA Sydney Water will place a notice in a local newspaper in accordance with clause 8F of the EP&A Regulation. The notice will inform landowners of the Proposal and when the EA will be on exhibition for comment.

Sydney Water will hold further community information sessions during the exhibition period that is separate to the Department's formal exhibition process. This will provide opportunities for the community to discuss the EA with key members of the team and to provide comments. The dates and venues of these opportunities will be advertised in the local and mainstream media and in a community newsletter distributed directly to affected properties. Information that will be available at the sessions will include:

- copies of the EA
- summaries of the EA
- detailed maps of the Proposal and location of infrastructure
- factsheets containing key project information
- details on how to make a submission
- question and answer sheets about the Proposal and construction impacts.

Representatives from Sydney Water will be available to discuss the Proposal, and answer any questions or concerns. Sydney Water will also continue to provide updated information on the website regarding the Proposal and EA process.

Following the exhibition period, the DP&I may require Sydney Water to address issues and concerns raised in submissions. If required, Sydney Water will respond and may refine the Proposal and the Statement of Commitments. A summary of the key concerns raised, and Sydney Water's response will be documented in a Preferred Project Report that will be submitted to the DP&I.

If significant changes to the Proposal or Statement of Commitments are made after exhibition of the EA, a Preferred Project Report will be prepared to clearly define the revised elements of the Proposal, the commitments and the associated impacts.

The DP&I will take into consideration this EA, the Preferred Project Report (if required) and submissions received during the exhibition period. The Director-General's assessment report will be prepared and provided to the Minister to allow the Minister to consider the Proposal. The Minister for Planning and Infrastructure may then approve the Proposal and issue conditions of approval.

## 8.4 Future consultation

The Proposal would be implemented in stages and at any one point in time, it is possible that consultation will be underway relating to either the approval, pre-construction, or construction phases. A revised Community and Stakeholder Engagement Plan would be prepared for each phase. This will provide details on the consultation procedures and would ensure that there is a consistent approach to consultation across the Proposal by defining:

- roles and responsibilities for consultation
- the objective of the consultation for each development phase
- protocols and procedures that are to be implemented consistently.

### 8.4.1 Before construction

The Community and Stakeholder Engagement Plan for the pre-construction phase will outline the consultation processes that Sydney Water and its contractors will follow so that affected community members and key stakeholders may have an opportunity to discuss measures to minimise local impacts. This could include issues such as:

- access to private property
- local amenity
- impacts to private property
- impacts to businesses
- noise
- safety
- traffic management
- protection of local flora and fauna
- impacts to development on private property.

Sydney Water will continue to consult with key agencies about any approvals that may be required before construction starts.

Sydney Water will consult with other organisations such as councils, developers and other utility authorities that may be undertaking concurrent construction activities to support development of the Precincts. This will aim to identify opportunities to minimise the potential for cumulative impacts.

Sydney Water will maintain the webpage and a contact number so the community can contact the project team who can respond to localised concerns or impacts.

### 8.4.2 During construction

During construction, Sydney Water and its contractors will ensure that:

- the community and stakeholders are made aware of construction work and potential impacts
- impacts to private property and affected businesses are minimised through appropriate mitigation measures and consultation
- the community is provided with timely, accurate and easily accessible information about the Proposal
- there is a high level of responsiveness to community enquiries and concerns.

A Community and Stakeholder Engagement Plan would be developed and implemented throughout the construction phase of the Proposal. The Plan would detail the consultation approach with the community and key stakeholders. All communication processes during construction and operation of the Proposal would follow guidelines set out in Sydney Water's Customer Contract and Community and Stakeholder Engagement Policy. Communication with the community and key stakeholders would focus on:

- opportunities for the community to provide input on mitigation measures for construction or operation, particularly where construction is located on private property
- methods to inform the community of the progress and performance of the Proposal and issues of interest to the community
- notification of construction activities to potentially affected local residents and businesses
- processes to receive and manage complaints in accordance with Sydney Water's customer contract
- consultation with directly affected property owners and businesses
- induction and training of construction personnel in communication requirements
- protocols to notify stakeholders of relevant activities and any incidents should they occur.

### 8.4.3 Future project stages

As discussed in Chapter 5, this EA supports Sydney Water's Concept Plan for the entire WDURA and AGAs area as well as the Project Approval to service the early release Precincts. Subsequent approvals may be sought for components of the Proposal that relate to areas released at a later date and/or existing system upgrade requirements that are confirmed at a later date.

The DP&I, in consultation with relevant local councils, agencies and developers, will ultimately determine the staging of development within the WDURA and AGAs. Early release areas have been rezoned and development is expected to commence in 2012. The Proposal will, to the greatest extent possible, accord with the ultimate staging of development.

The Community and Stakeholder Engagement Plan would outline procedures that would be implemented by Sydney Water to consult with all relevant stakeholders as part of each subsequent approval process. This consultation would be tailored to address the characteristics of the relevant Precinct and would provide an opportunity for:

- Sydney Water to provide information on the Proposal, such as the scope of works and program
- the community and stakeholders to identify issues that should be considered during the approval process.

# 9 Conclusion and justification

This chapter provides an overall summary of the impacts and benefits of the Proposal and provides a justification for undertaking the Proposal.

## 9.1 Assessment background

The EA has been prepared in accordance with the requirements of Part 3A of the EP&A Act. It includes:

- background information on the Proposal, including the need for the Proposal, its strategic context and alternatives considered
- a description of the Proposal, including the locations, construction methodologies and operational characteristics of the proposed infrastructure
- an assessment of the potential environmental impacts of the Proposal, with a focus on key environmental issues as identified by the DGRs
- the proposed impact mitigation and management measures that will be implemented in conjunction with the Proposal
- a draft Statement of Commitments that will form the environmental management framework for the Proposal.

The following sections summarise the Proposal's benefits and impacts and justify why the Proposal should proceed.

### 9.1.1 Justification

The *Illawarra Regional Strategy* aims to ensure that the projected housing and employment needs of the region over the next 25 years are adequately accommodated and appropriately located. The Strategy identifies WDURA as a priority new release area. The Proposal is considered to be in the public interest and as it is essential to allow urban growth to occur in accordance with the *Illawarra Regional Strategy*. If the Proposal does not proceed, development of the WDURA and AGAs would not occur as there would be inadequate water and wastewater services. This would jeopardise the NSW Government's planning for urban growth in the Illawarra Region.

One of the objectives of the Proposal is to limit environmental impacts. To address this objective, Sydney Water undertook a robust options development and evaluation process that considered potential environmental, social and economic impacts. This concluded that the most efficient method of providing water related services to the WDURA and AGAs involves extending the existing water and wastewater systems. This is an efficient and cost effective approach that enables Sydney Water to utilise existing uncommitted capacity within the existing systems.

The Proposal has been designed to avoid key environmentally sensitivities where practicable. This involved strategies such as refining the location of infrastructure and construction methods. It also considered the planned location of other urban infrastructure, such as road corridors, that would be required to develop the WDURA and AGAs. The outcome of this process is that the Proposal would generally be located in areas that have already been disturbed due to historical land uses, or will be disturbed by proposed urban development. This approach substantially reduced the potential environmental impacts of the Proposal.

The EA has assessed the potential impacts of the Proposal as required by the DGRs. Although the Proposal will have some residual environmental impacts, the substantial benefits that would accrue due to providing water related infrastructure would outweigh adverse impacts. The Proposal has been designed to comply with the requirements of the EPLs for the Wollongong and Shellharbour wastewater systems to ensure that operational impacts are minimised. To mitigate residual environmental impacts, Sydney Water has committed to a range of mitigation measures that can be implemented during the design, construction and operational phases. The EA demonstrates

that potential impacts would be adequately mitigated and the Proposal is consistent with the objectives of relevant environmental legislation.

The Proposal is therefore justified as the design has been developed to avoid or otherwise minimise environmental impacts and the infrastructure is essential to the NSW Government's strategy to provide for future growth in the Illawarra Region.

## 9.2 Summary of impacts

### Construction

Investigations during development of the concept design identified a range of environmental sensitivities within the Proposal area. The Proposal was subsequently planned and designed to avoid impacts where practicable and this approach substantially reduced the extent and significance of potential impacts. Despite this, construction may still have some impacts on the environment and community. Some of these impacts may be permanent (such as removal of vegetation) and others will be temporary (such as noise, vibration and dust generation). Potential construction impacts are either considered minor or can be minimised to an acceptable level by implementing mitigation measures.

Vegetation is likely to be removed along pipeline alignments and for specific site-based infrastructure. This is expected to include up to 2.09 ha of vegetation classified as an EEC for the overall Proposal and 0.96 ha for the Project Approval area. Although this impact is not considered significant, Sydney Water has identified a range of management measures to ensure the potential impact is minimised.

A number of Aboriginal heritage and non-Aboriginal heritage sites may be impacted by construction of the Proposal. Sydney Water intends to avoid these sites if feasible. However, given the extent of the sites and design limitations on water and wastewater systems, avoidance is unlikely to be practical in all cases. Where sites cannot be avoided through construction methodologies or design alterations, Sydney Water has developed mitigation measures to minimise impacts. For Aboriginal heritage sites, mitigation measures may include tasks such as recording and/or excavating heritage items. For non-Aboriginal heritage sites, mitigation measures may include undertaking further assessment of heritage significance and test excavations.

Sydney Water can also implement other mitigation measures to minimise construction impacts on the environment and local amenity. These may include sediment and erosion control, waste management, noise and dust controls, and managing access disruptions.

Given that the Proposal has been planned and designed to avoid environmental issues where practicable and that mitigation measures are proposed to minimise impacts, the residual impacts of construction on the environment and community are not considered significant.

### Operation

The Proposal's operational impacts on the environment are unlikely to be significant. The Proposal would be an extension of Sydney Water's existing water and wastewater systems that operate in accordance with EPLs issued under the POEO Act. The additional flows from the WDURA and AGAs will likely have an impact on overflows from the wastewater systems. The assessment of overflows in the EA indicates that while wastewater discharges may exceed relevant water quality guideline trigger values, the current receiving environment generally assimilates pollutants well. Concentrations of indicator substances in wastewater overflows will be rapidly diluted by the receiving waterway and would typically be below the concentrations found in stormwater.

There is a possibility that both the Wollongong WRP and Shellharbour WWTP may need to be upgraded or amplified sometime after 2031. The water quality modelling indicates that the treatment and discharge of additional flows from the treatment plants would not have a significant impact on the environment.

## 9.3 Summary of benefits

The Proposal will provide a range of social and economic benefits, including:

- providing a secure water supply to the WDURA and AGA
- protecting public health by providing a wastewater service to the WDURA and AGA
- providing affordable and efficient water and wastewater services to meet the NSW government's development timeframes and stages
- supporting the orderly rollout of land release and infrastructure in the WDURA and AGA
- minimising costs by extending existing approved water and wastewater systems and utilising the existing WRP and WWTP and drinking water sources.

## 9.4 Consistency with ESD principles

Clause 6 of Schedule 2 of the EP&A Regulation outlines the requirements of an EA, including:

> *'The reasons justifying the carrying out of the development or activity in the manner proposed, having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development'*

The Regulation lists the principles of ecologically sustainable development as:

a) **The precautionary principle,** namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation

b) **Intergenerational equity**, namely, that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations

c) **Conservation of biological diversity and ecological integrity**, namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration

d) **Improved valuation, pricing and incentive mechanisms** , namely that environmental factors should be included in the valuation of assets and services.

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) also identifies the following principle for consideration, namely:

> *Decision making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations.*

Table 9-1 provides an assessment of the Proposal against the above principles, based on the findings of this EA.

## 9.5 Conclusion

The Proposal will have some adverse impacts on the environment and the community as described and assessed in this EA. Sydney Water considers these impacts acceptable when balanced against:

- the strategic planning and concept design measures Sydney Water has employed to avoid and minimise potential impacts
- the ongoing commitments to manage potential environmental impacts
- the Proposal's key benefit of servicing growth in the WDURA and AGAs by supplying water and wastewater services to new development.

In the context of potential cumulative impacts arising from the planned large scale urban development of the WDURA and AGAs, the Proposal will have a relatively minor impact on the environment.

**Table 9-1 Consistency of Proposal with principles of ecologically sustainable development**

| Principle of ESD | Evaluation of the Proposal against the principle |
|---|---|
| The precautionary principle | The EA demonstrates the Proposal's consistency with the precautionary principle. The EA assesses the Proposal's potential impacts on the environment, and in particular, the extent to which these may pose a significant risk to the environment. Specialist assessments are included for issues where potentially significant impacts were considered possible, or where they were required to adequately characterise impacts. The Proposal includes a range of measures to avoid potential impacts and minimise environmental degradation, including for issues where there is a lack of full scientific certainty. |
| Intergenerational equity | The Proposal involves activities that have the potential for environmental and social disturbance. However, the potential for environmental and social disturbance as a result of the Proposal should be balanced against the substantial long-term social, environmental and economic benefits.<br>The Proposal has been designed, as far as practicable, to ensure that the community will not be significantly disadvantaged over the long term, and that overall environmental and urban quality of the Region will be maintained.<br>The draft Statement of Commitments for the Proposal, together with the long-term social, environmental and economic benefits of providing water related services, will ensure that the health, diversity and productivity of the local and regional environment is maintained for future generations. |
| Conservation of biological diversity and ecological integrity | The Proposal area has been significantly modified as a result of urban and rural development. Studies conducted in conjunction with this EA have identified there will be very minor impacts on EECs. However, mitigation measures have been developed to conserve biological diversity and ecological integrity by a combination of:<br>• avoiding areas of biological diversity where practicable<br>• minimising impacts on biological diversity through a range of mitigation measures<br>• appropriate revegetation. |
| Improved valuation, pricing and incentive mechanisms | Sydney Water adopts tools that integrate environmental resource use into planning and decision-making processes to ensure preferred project options are environmentally sustainable.<br>In addition, this EA outlines mitigation measures to manage potential environmental impacts. Protecting the environment through these mitigation measures increases Sydney Water's capital and operating costs, such as using alternative construction methodologies or by employing additional environmental management measures. This means the assets are valued to incorporate environmental factors. |
| Decision making process | The Proposal has been developed in consultation with various government agencies and stakeholders, and has been refined to minimise environmental impacts and maximise social benefits.<br>An assessment of the short and long-term, construction and operation impacts of the Proposal is included in the EA, including taking into account the principles of ESD.<br>The Proposal requires approval under Part 3A of the EP&A Act, meaning that the decision making process is administered by the DP&I, with input from other government agencies, and the community. |

The EA demonstrates that Sydney Water's Proposal to provide water and wastewater services to the WDURA and AGAs is justified, is in the public interest and can be managed to meet appropriate environmental performance requirements.

# 10 Draft Statement of Commitments

This chapter provides the draft Statement of Commitments for the Proposal. Details of the environmental mitigation and management for the Proposal are discussed in the relevant sections of Chapters 6, 7 and 8. The commitments may be revised in response to stakeholder and community input during the display of the EA. Following Project Approval, Sydney Water (and parties acting on its behalf) will deliver and operate the Proposal in accordance with these commitments.

## 10.1 Draft Commitments

The DGRs for the EA require Sydney Water to develop a draft Statement of Commitments that identifies measures for environmental mitigation, management and monitoring for the Proposal.

Chapters 6, 7 and 8 of the EA identify most of these measures in the context of the impact assessment. The measures are consolidated into the draft Statement of Commitments outlined in Table 10-1. These draft commitments will be finalised pending stakeholder and community input during the public display of the EA.

Subject to the Minister for Planning and Infrastructure approving the Proposal, Sydney Water and parties acting on its behalf, will design, construct and operate the Proposal in accordance with the finalised commitments. Section 3.4 outlines the process that would implemented during detailed design to refine the Proposal and minimise potential environmental impacts. This would consider the management measures described in Chapters 6, 7 and 8, the Statement of Commitments, and the relevant recommendations in the technical reports appended to the EA.

Tabe 10-1 describes the phase(s) of the Proposal in which each commitment applies. As the Proposal is likely to be staged over several decades, further definition of the Proposal phases is included below:

- **design** includes concept design and detailed design prior to and during construction
- **pre-construction:** The pre-construction phase may involve establishment and investigative activities determined to have minimal environmental impact. This may include but not be limited to:
    - survey
    - acquisitions
    - fencing
    - investigative drilling or excavation
    - building/road dilapidation surveys
    - minor vegetation removal except where threatened species or ecological communities will be affected establishing site compounds
- **construction** includes physical work relating to the Proposal. Commissioning activities are also considered to be part of the construction phase
- **operation** includes the operation of the Proposal but does not include commissioning, trials of equipment or temporary use of parts of the Proposal during construction.

**Table 10-1 Draft Statement of Commitments**

| Number | Commitment | Project phase |
|---|---|---|
| **Water quality, soils and groundwater** | | |
| 1. | Erosion and sedimentation control will be managed using measures developed in accordance with *Managing Urban Stormwater, Soils and Construction* (Volume 1, Landcom 2004 and Volume 2A, DECC 2008). | Pre-construction and construction |
| 2. | Groundwater encountered during construction will be pumped out of the work area into a contained area, tested and if necessary appropriately treated, prior to re-use, appropriate discharge or disposal. | Construction |
| 3. | ASS will be managed in accordance with the *Acid Sulfate Soils Management Advisory Committee: Acid Sulfate Soils Assessment Guidelines* (ASSMAC, 1998). | Design and construction |
| 4. | The Proposal will be designed and operated to meet wastewater system EPLs. | Design and operation |
| **Riparian and aquatic habitats** | | |
| 5. | Detailed design will consider how impacts to riparian and aquatic habitats can be avoided or minimised by:<br>• placing pipeline alignments outside the 'top of bank'<br>• utilising existing and/or proposed road infrastructure to cross watercourses<br>• avoiding farm dams and freshwater lagoons<br>• applying pipeline construction methods for watercourse crossings in accordance with the objectives of with the DIPNR (2004) Riparian Corridor Management Study. | Design and construction |
| 6. | Sydney Water will design and construct the Proposal's wastewater pipelines using techniques to minimise inflow/infiltration. | Design and construction |
| **Terrestrial flora and fauna** | | |
| 7. | Detailed design will consider how impacts to native vegetation can be avoided or minimised by:<br>• placing pipelines to have the least impact to native vegetation and avoid EECs and significant hollow-bearing trees<br>• using construction methods that avoid and minimise impacts. | Design and Construction |
| 8. | Construction management measures will be developed and implemented to minimise impacts to flora and fauna. | Construction |
| 9. | Sydney Water will progressively rehabilitate work sites following completion of construction. | Construction |
| **Aboriginal heritage** | | |
| 10. | Sydney Water is committed to avoiding impacts on items of Aboriginal cultural heritage significance where practicable. | Design and construction |
| 11. | Where it is not practicable to avoid impacts, management measures will be implemented to mitigate impacts. | Design and construction |
| 12. | Sydney Water will undertake on-going consultation with RAPs. | Design and construction |
| 13. | Procedures will be implemented to ensure planned maintenance activities are undertaken in a manner that minimises impact on the Aboriginal heritage items. | Operation |

| Number | Commitment | Project phase |
|---|---|---|
| **Non-Aboriginal heritage** | | |
| 14. | Where practicable, the pipelines will be re-located to avoid areas of non-Aboriginal heritage value. | Design and construction |
| 15. | Where impacts on unlisted items of possible non-Aboriginal heritage significance are unavoidable, specific mitigation measures will be followed for each item. | Design and construction |
| 16. | Relevant construction personnel will be inducted on actions to take if previously unrecorded non-Aboriginal heritage items are found. | Construction |
| 17. | Procedures will be implemented to ensure maintenance activities are undertaken in a manner that minimises impact on the non-Aboriginal heritage items. | Operation |
| **Air quality** | | |
| 18. | Potential impacts from dust generation will be managed through standard industry suppression measures. | Construction |
| 19. | Odour management will be undertaken in accordance with Sydney Water's existing procedures. Odour complaints will be registered and investigated. Engineering, operational, and other odour reduction measures will be implemented where verified odour complaints are received about odours from the wastewater system. | Operation |
| **Noise and vibration** | | |
| 20. | Mitigation measures will be used to reduce the construction noise impact on sensitive receivers. Including limiting noise work to less sensitive time periods, selecting low noise plant equipment and using quieter construction methods where practicable. | Construction |
| 21. | Where vibration from construction activities may impact on residents, the activities will be managed in accordance with the *British Standard BS 6472 – 1992* and *AS 2436-1981.* | Construction |
| 22. | Where vibration from construction activities may impact on nearby structures, the activities will be managed in accordance with *British Standard 7385:Part 1 – 1993 Evaluation and Measurement for Vibration on Buildings*. | Construction |
| 23. | For historic buildings, which have a higher sensitivity to vibration, the guidelines within the *German Standard DIN 4150 - Part 3* will be adhered to. | Construction |
| 24. | Development of the detailed design will include industry standard noise treatments to control operational noise levels. | Design |
| **Hazards and risks** | | |
| 25. | Fuel and chemical storage areas will be maintained within bunded facilities that conform with relevant standards and codes, primarily *AS 1940: The Storage and Handling of Combustible and Flammable Liquids and Dangerous Goods Storage Codes.* | Construction |
| **Consultation** | | |
| 26. | During construction, communities will be informed prior to the start of any works in their area and will be notified at regular intervals throughout the construction process. | Construction |
| **Traffic, transport and access** | | |
| 27. | Road closures will be developed and implemented in consultation with the relevant road authorities (council and/or the RMS). | Pre-construction and construction |

| Number | Commitment | Project phase |
|---|---|---|
| 28. | Appropriate construction methodologies for road crossings will be developed and implemented in consultation with the relevant council and/or the RMS. | Design, pre-construction and construction |
| 29. | Where there is a potential to impact on access to private property or pedestrian pathways, property owners, the local community and councils will be informed appropriately. Mitigation measures may include providing alternative access, reinstating access at the end of each day, and reinstating impacted areas to their original condition. | Construction and operation |
| **Waste generation and management** | | |
| 30. | Excavated spoil will be reused on site for backfilling, landscaping and other uses. Where spoil is unsuitable for reuse, spoil would be classified according to the DECCW *Waste Classification Guidelines* (DECCW 2009a) and disposed of at an appropriately licensed facility. | Construction |
| 31. | Where relevant, soil contamination studies will be carried out prior to construction. Soils will be analysed for a broad range of potential contaminants to provide an indication of potential waste classification *Waste Classification Guidelines* (DECCW 2009a). Excavated contaminated soil will be disposed of at an appropriately licensed facility. | Pre-construction and construction |
| 32. | All wastes generated by the construction and operation of the Proposal will be classified and disposed in accordance with *Waste Classification Guidelines* (DECCW 2009a). | Construction and operation |
| **Energy and greenhouse gas emissions** | | |
| 33. | All vehicles and equipment will be adequately maintained and operated to ensure efficient operation to minimise energy use and greenhouse gas emissions. | Construction |
| 34. | The project will be implemented in accordance with Sydney Water's policy on energy efficiency and greenhouse gas mitigation. | Operation |
| **Visual amenity** | | |
| 35. | Areas disturbed by pipeline construction will be progressively rehabilitated. | Construction |
| 36. | Visual impacts of reservoirs and ventilation shafts will be minimised through painting the structures a dark 'bush green' colour, which has been chosen as the colour most compatible with the surrounding environment. | Construction |
| **Land use and services** | | |
| 37. | Relevant service providers will be consulted during detailed design to identify interactions and develop procedures to be implemented to minimise service interruptions. This will involve confirming any requirements or standards that will apply if it is determined that existing utilities or services need to be temporarily or permanently relocated. Inspections will be undertaken before construction starts in each location to confirm that there are no services in the area that were previously unknown. | Design, pre-construction and construction |

# 11 References

Acid Sulfate Soils Management Advisory Committee (ASSMAC) 1998, Stone, Y, Ahern, CR, and Blunden B, *NSW Acid Sulfate Soils Manual,* ASSMAC, Wollongbar

AECOM Australia Pty Ltd (AECOM) 2011, *Water and Wastewater Servicing in the West Dapto Urban Release Area and Adjacent Growth Areas – Non-Indigenous Heritage Assessment and Impact Management*. AECOM Australia Pty Ltd for Sydney Water

Australian Geomechanics Society (AGS) 2007, A National Landslide Risk Framework for Australia, *Journal and News of the Australian Geomechanics Society*, vol. 42, No. 1, March 2007.

Australian and New Zealand Environment and Conservation Council (ANZECC) 1992, *Australian Water Quality Guidelines for Fresh and marine Waters.* Australian and New Zealand Environment and Conservation Council, Canberra

Australian and New Zealand Environment and Conservation Council (ANZECC) 2000, *An introduction to the Australian and New Zealand guidelines for fresh and marine water quality. National Water Quality Management Strategy,* Australia and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra

Australian Pipeline Industry Association (APIA) 2009, *Code of Environmental Practice – Onshore Pipelines*. APIA, Kingston

Australian Wetlands Database (AWD) 2010 *Directory of Important Wetlands in Australia – Information Sheet*, viewed 22 February 2011, http://www.environment.gov.au/cgi-bin/wetlands/report.pl

British Standard (BSI) 1992, *BS 6472-1992 Evaluation of human exposure to vibration in buildings (1-80Hz)*

British Standard (BSI) 1993, *BS 7385-Part 2 Evaluation and measurement of vibration in buildings*

Bewsher Consulting Pty Ltd 2010, *Mullet and Brooks creeks floodplain risk management study & plan*, prepared for the Wollongong City Council

BMT WBM 2010, *Duck Creek flood study preliminary draft report*, prepared for the Wollongong City Council

Cardno Lawson Treloar 2010, *Wollongong City Council coastal zone study, volume 1 – main report*, Prepared for Wollongong City Council

Camp Scott Furphy Pty Ltd 1993, Council *of the City of Wollongong and Council of Shellharbour Rural Development Area - On-site Effluent Treatment and Disposal Study,* Wollongong Council, Wollongong

Catchment Management Authority Southern Rivers (CMA) 2006, *Southern Rivers Catchment Action Plan*, Southern Rivers CMA. Wollongong, NSW

Coffey Geotechnics, (Coffey) 2011, *West Dapto Urban Release Area and Adjacent Growth Areas: Geology, Soils and Groundwater Assessment,* April 2011

Ctritchley L 2011, *Studies on pollutant removal from stormwater by Budjong Creek Wetland, Lake Illawarra, New South Wales.* Master of Environmental Science thesis, Faculty of Science, University of Wollongong, 2011

Dela-Cruz J, Ajani P, Lee RS, Pritchard TR and Suthers I 2002, 'Temporal abundance patterns of the red tide dinoflagellate Noctiluca scintillans along the southeast coast of Australia', *Marine Ecology Progress Series*, vol. 236, pp. 75-88

Department of Environment and Conservation (DEC) 2004, *National Parks and Wildlife Act 1974: Part 6 Approvals – Interim Community Consultation Requirements for Applicants,* Office of Environment and Heritage, Sydney

Department of Environment and Conservation and Department of Primary Industries (DEC & DPI) 2005, *Draft Guidelines for Threatened Species Assessment under Part 3A, Environmental Planning and Assessment Act 1979*. NSW Department of Environment and Conservation and the NSW Department of Primary Industries

Department of Environment and Conservation (DEC) 2001a, *Assessment and Management of Odour from Stationary Sources in NSW*, DEC, Sydney

Department of Environment and Conservation (DEC) 2001b, *Technical Notes: Draft Policy: Assessment and Management of Odour from Stationary Sources in NSW*, DEC, Sydney

Department of Environment and Conservation (DEC) 2005a, *The Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation*, Office of Environment and Heritage, Sydney

Department of Environment and Climate Change (DECC) 2005b, *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*, DEC, Sydney

Department of the Environment and Conservation (DEC) 2005c, *Marine Water Quality Objectives for NSW Ocean Waters – South Coast.* NSW Department of Environment and Conservation Report number DEC 2005/582, ISBN 1 74137 075 2, 28p

Department of Environment and Conservation (DEC) 2006a, *Illawarra Water Quality and River Flow Objectives Water* Department of Environment and Conservation, 2006 viewed on 14 March 2011http://www.environment.nsw.gov.au/ieo/LakeIllawarra/index.htm

Department of Environment and Conservation (DEC) 2006b, U*sing the ANZECC Guidelines and Water Quality Objectives in NSW.* NSW Department of Environment and Conservation Report number DEC 2006/290, ISBN 1 74137 918 0 6p

Department of Environment and Conservation (DEC) 2006c, *Local planning for healthy waterways: using NSW Water Quality Objectives*, Department of Environment and Conservation NSW, Sydney, June 2006

Department of Environment and Conservation (DEC) 2006d, *Assessing Vibration; a technical guideline*. Department of Environment and Conservation NSW, Sydney, February 2006.

Department of Environment, Climate Change and Water (DECC) 2008, Managing Urban Stormwater: Soils and Construction Volume 2A: Installation of Services

Department of Environment and Climate Change (DECC) 2009, *Interim Construction Noise Guideline* (ICNG)

Department of Environment, Climate Change and Water (DECCW) 2009a, *Waste Classification Guidelines: Part 1 - Classifying waste*, December 2009

Department of Environment, Climate Change and Water (DECCW) 2009b, *BioMetric Vegetation Types Database.* Accessed, April 2010:
http://www.environment.nsw.gov.au/projects/BiometricTool.htm

DECCW 2010a, *DECCW Interim Policy on Assessing and Offsetting Biodiversity Impacts of Part 3A Developments.* NSW Department of Climate Change and Water

Department of Environment, Climate Change and Water (DECCW) 2010b, *Aboriginal cultural heritage consultation requirements for proponents 2010 Part 6, National Parks and Wildlife Act 1974*, Office of Environment and Heritage, Sydney

Department of Environment, Water, Heritage and the Arts (DEWHA) 2009, *Matters of National Environmental Significance – Significant Impact Guidelines 1.1*, Commonwealth of Australia, Canberra

Department of Health (DoH) 2008, *NSW Health Policy Directive: Burials – Exhumation of Human Remains*. New South Wales Department of Health

Department of Infrastructure Planning and Natural Resources (DIPNR), 2004*, Riparian Corridor Management Study: Covering all of the Wollongong Local Government Area and Calderwood*

*Valley in the Shellharbour Local Government Area.* Prepared for Wollongong City Council by Department of Infrastructure Planning and Natural Resources, March 2004

Department of Land and Water Conservation (DLWC) 2008, *Acid Sulfate Soil Risk Map NSW 1:25 000*

Department of Planning (DoP) 2007, *Illawarra Regional Strategy 2006-31*. Department of Planning, Sydney, January 2007

Department of Planning (DoP) 2009, *Draft NSW Coastal Planning Guideline: Adapting to Sea Level Rise*

Department of Planning and Infrastructure (DP&I) 2011*, Director-General's Requirements – Water and Wastewater Servicing of the West Dapto Urban Release Area and Adjacent Growth Areas.* NSW Department of Planning and Infrastructure, Sydney

Department of Urban Affairs and Planning (DUAP) 1994, *Applying SEPP 33*, Department of Urban Affairs and Planning, Sydney

Department of Urban Affairs and Planning (DUAP) 2001, *Sydney Water Corporation – Illawarra Wastewater Strategy Consolidation of Bellambi, Wollongong and Port Kembla Sewage Treatment Plants – Director General's Report*, Department of Urban Affairs and Planning May 2001

Deutsches Institut für Normung (DIN) 1999, DIN 4150-Part 3 Structural Vibration in Buildings - Effects on Structures. German Institute for Standardisation, Berlin

Eco Logical Australia (ELA) 2011, *Flora, Fauna and Ecological Impact Assessment of the West Dapto Urban Release Area and Adjacent Growth Areas - Water and Wastewater Servicing.* Eco Logical Australia. Prepared for Sydney Water

Environment Protection Authority (EPA) 1999, '*Environmental Criteria for Road Traffic Noise*'

Environmental Protection Authority (EPA) 2000a*, Licensing Sewage Treatment Systems: SOLP, Determining Authority Report*, May 2000

Environmental Protection Authority (EPA) 2000b, *NSW Industrial Noise Policy*

Growth Centres Commission (GCC) 2008, *West Dapto Release Area Review – Planning and Infrastructure*, for Wollongong City Council, Department of Planning and Infrastructure, Sydney

Hazelton, PA 1992, *Soil Landscapes of the Kiama 1:100 000 Sheet Map*. Department of Conservation & Land Management, Sydney

Healthy Rivers Commission (HRC) 2002, *Independent Public Inquiry into Coastal Lakes: Final Report.* Healthy Rivers Commission of New South Wales

HLA 2005, *Land Capability Study West Dapto, Report S6013902.* Wollongong Council, Wollongong

International Council on Monuments and Sites (ICOMOS) 1999, *Charter for the conservation of places of Cultural Significance*. Australia International Council on Monuments and Sites.

Jirka GH and Akar PJ 1991,'Hydrodynamic classification of submerged multiport-discharges', *Journal of Hydraulic Engineering*, vol.117, no.9, pp.1113-1128

Jirka GH and Doneker RL 1991,'Hydrodynamic classification of submerged single-port discharges', *Journal of Hydraulic Engineering*, vol.117, no.9, pp.1095-1112

Lake Illawarra Authority (LIA) 2003, *Lake Illawarra Estuaries Processes Study –Final Report*, Prepared by WBM Oceanic Australia

Lake Illawarra Authority (LIA) 2006, *Lake Illawarra Estuary Management Study and Strategic Plan* prepared by WBM Oceanics Australia for Lake Illawarra Authority, March 2006

Lake Illawarra Authority (LIA) 2010, *Condition Assessment of Lake Illawarra (Draft*), Lake Illawarra Authority, March 2010

Landcom, 2004, *Managing Urban Stormwater: Soils and Construction*, 4th ed, Parramatta, NSW

MG Planning 2006, *West Dapto Release Area Draft Local Environmental Study*. Prepared for the Wollongong City Council

National Transport Commission (NTC) 2007, *Australian Dangerous Goods Code*, National Transport Commission, Melbourne, Victoria

National Health and Medical Research Council (NHMRC) 2008, *Guidelines for managing risks in recreational water*, National Health and Medical Research Council, ISBN 1864962666, Australian Government Publication, 216p, Canberra

National Parks and Wildlife Service (NPWS) 2002, *Illawarra Escarpment and Coastal Plain – bioregional assessment.* NSW National Parks and Wildlife Service, Hurstville

Natural Resource Management Ministerial Council, Environment Protection and Heritage Council and Australian Health Ministers Conference (NRMMC) 2006, *Australian guidelines for water recycling managing health and environmental risks (phase 1*), Biotext Pty Ltd, Canberra

NSW Government (NSW Government) 2010, *Metropolitan Water Plan*. NSW Government

NSW Heritage Office (Heritage Office) 1998, *How To Prepare Archival Records for Heritage Items*. NSW Heritage Office

NSW Heritage Office (Heritage Office) 2001, *Assessing Heritage Significance.* NSW Heritage Office

NSW Office of Water (NOW) 2008, *Guidelines for Controlled Activities: Riparian Corridors*, February 2008, NSW Office of Water

Office of the Environment and Heritage (OEH) 2011, Beachwatch Bulletin, viewed 30 September 2011, http://www.environment.nsw.gov.au/media/DecMedia11081507.htm

Packman JJ, Comings KJ and Booth DB 1999, *'Using turbidity to determine total suspended solids in urbanising streams in the Puget Lowlands, Confronting uncertainty: Managing change in water resources and the environment,* Canadian Water Resources Association Annual Meeting, Vancouver, BC, 27-29 October 1999, pp. 158-165

Pritchard TP, Lee RS, Ajani P, Rendell P, Black K and Koop K 2003, 'Phytoplankton responses to nutrient sources in coastal waters off southeastern Australia', *Aquatic Ecosystem Health and Management*, vol. 6, issue 2, pp. 105-117

Rienco Consulting 2010, *Flood Modelling Report Macquarie Rivulet Below Sunnybank (Existing Conditions)*. Prepared for Cardno Forbes Rigby. February 2010

Sinclair Knight Merz (SKM) 2011, *West Dapto Urban Release Area and Adjacent Growth Areas: Water Quality, Aquatic Ecology and Public Health Impact assessment*

Shellharbour City Council (SCC) 2010, *State of the Environment Supplementary Report 2009/2010*, viewed 27 September 2011, http://www.shellharbour.nsw.gov.au/FileData/PDF/SOE0910.pdf

Shellharbour City Council (SCC) 2000, *Local Environmental Plan*, Shellharbour City Council

Shellharbour City Council (SCC) 2004, *Rural Local Environmental Plan*, Shellharbour City Council

Standards Australia 1997, *Australian Standard AS 1055:2-1997 Acoustics: Description and Measurement of Environmental Noise,* Standards Australia, Homebush, NSW

Standards Australia 2000, *Australian Standard (AS) AS/NZS 4360:1999 Risk Management and Environmental Risk Management – Principles and Process*

Standards Australia 2004, Australian Standard (AS) 1940-2004 - The storage and Handling of Flammable and Combustible Liquids. Standards Australia, Homebush, NSW

Sydney Water 1999, *Illawarra Waste Water Strategy Environmental Impact Statement: Consolidation of Bellambi, Wollongong and Port Kembla Sewage Treatment Plants*, vol. 1, May 1999

Sydney Water 2003a, *Review of Environmental Factors – Optimisation and Amplification of Shellharbour Sewage Treatment Plant – vol. 1 and 2,* December 2003

Sydney Water 2003b, *Sewage Treatment System Licences Pollution Reduction Program: PRP 102.2 Development of Load Calculation Method and Trial Calculation, Sydney Water, June 2003*

Sydney Water 2004, Energy Management Plan

Sydney Water 2006a, *Review of Environmental Factors – Wollongong Recycled Water Scheme – Stage 2*

Sydney Water 2006b, Guidelines for Building Over/Adjacent to Sydney Water Assets.

Sydney Water 2007 Corporate Risk Management Policy

Sydney Water 2007b, 2006-2007 Annual report

Sydney Water 2008a, *Design Criteria Guidelines Supplement*

Sydney Water 2008b*, Illawarra Waste Water Strategy*, *Impact Prediction Verification Report No. 2,* report by B Harper, 117p

Sydney Water 2009, *Preliminary Environmental Assessment: Water and wastewater servicing of the West Dapto Urban Release Areas and Adjacent Growth areas*, November 2009, Sydney Water

Sydney Water 2010a, *2010-2015 Operating Licence*. Sydney Water, Parramatta

Sydney Water 2010b, *2010-2015 Environment Plan*. Sydney Water, Parramatta

Sydney Water 2011a, Early Release Lead-in Works for West Horsley, Sydney Water February 2011

Sydney Water 2011b, *West Dapto Urban Release Area and Adjacent Growth Areas: Prediction of Marine Impacts*, report by PM Tate, Sydney Water

Sydney Water 2011c, *West Dapto Water and Wastewater Detailed Planning – Water Systems Options Report*

Sydney Water 2011d, *West Dapto Water and Wastewater Detailed Planning – Wastewater Systems Options Report,* Prepared by PB, September 2011

The Ecology Lab (TEL) 1999, *Weedy Seadragon habitat survey*. The Ecology Lab Pty Ltd.

Thiering, CG, Spry, RB and Goyen, AG 1998, *Water Quality Management Plan for West Dapto,* In: Hydrology and Water Resources Symposium, 1998

Tozer, MG, Turner, K, Simpson, C, Keith, DA, Beukers, P, MacKenzie, B, Tindall, D & Pennay, C 2006, *Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands.* Version 1.0. NSW Department of Environment and Conservation and NSW Department of Natural Resources

Underwood AJ and Chapman MG 1996, 'Subtidal assemblages on rocky reefs at a cliff-face sewage outfall (North Head, Sydney, Australia): What happened when the outfall was turned off"?' *Marine Pollution Bulletin*, vol. 33, nos. 7-12, pp. 293-302

Water Board 1994, *Environmental Assessment of proposed Illawarra Water Filtration Plant: Determining Authority's Report*

Water Services Association of Australia (WSAA) 2002a, *Water Supply Code of Australia, Sydney Water Edition, WSA 03-2002a*

Water Services Association of Australia (WSAA) 2002b, *Sewerage Code of Australia, Sydney Water Edition, WSA 02-2002b*

Water Service Association of Australia (WSAA) 2005, *Sewage Pumping Station Code of Australia, Sydney Water Edition, Version 1, Part 1: Planning and Design, WSA 04—2005-2.1*

Water Services Association of Australia (WSAA) 2008, Sustainability Framework, Water Services Association of Australia

Wetland Link 2011, *Wetland Restoration Case Studies: Restoration of Tom Thumb Lagoon*, viewed 16 February 2011, http://www.wetlandlink.com.au/content/restoration-of-tom-thumb-lagoon

Wollongong City Council (WCC) 1990, *Wollongong Local Environmental Plan*

Wollongong City Council (WCC) 2006a, *Monitoring of Water Quality in the West Dapto Release Area in Conjunction with the Horsley Release Area*. September 2006

Wollongong City Council (WCC), 2006b, *West Dapto Release Area draft local environmental study,* prepared for the Wollongong City Council by MG Planning

Wollongong City Council (WCC) 2007a, *Wollongong Wide Water Quality Monitoring Program 2002-2006*

Wollongong City Council (WCC) 2007b, *Estuary Management Plan for Several Wollongong Creeks and Lagoons Estuary Management Study and Plan*, prepared by GHD for Wollongong City Council, December 2007

Wollongong City Council (WCC) 2009a, *Wollongong Local Environment Plan,* Wollongong City Council

Wollongong City Council (WCC) 2009b, *Localisation of Water Quality Guidelines for Wollongong'sCreek and Lagoons*

Wollongong City Council (WCC) 2009c, *Wollongong Development Control Plan*, Wollongong City Council, Wollongong

Wollongong City Council (WCC) 2010a, *West Dapto Local Environment Plan,* Wollongong City Council

Wollongong City Council (WCC) 2010b, *State of the Environment Supplementary Report 2009/2010*, viewed 27 September 2011, http://www.wollongong.nsw.gov.au/council/publicdocuments/Documents/State%20of%20the%20Environment%20Report%202009-10.pdf

West, R.J, Thoroughgood, C, Walford, T & Williams, RJ. 1985, An estuarine inventory for New South Wales, *Australia. Fisheries Bulletin* No. 2. Agriculture Department, NSW