

6. CHARACTERISATION OF SURFACE AND SUB-SURFACE FEATURES

(SMP GUIDELINES section 6.6)

Studies of surface and sub-surface features have been completed for the SMP by a team of experts in relevant fields. The information provided below summarises these studies and is drawn from the MSEC subsidence report (refer **Appendix A**), other specialist reports (refer **Appendices B to H**) and other documentation where relevant.

6.1. MINE SUBSIDENCE DISTRICT

Longwalls 705 to 710 lie within the Wilton and South Campbelltown Mine Subsidence Districts, established in 1997 refer to **Plan 2A**.

6.2. LAND USE AND GENERAL DESCRIPTION

Land use over the SMP Area includes:

- Stock grazing
- Rural residential
- Community centre
- Agriculture.

Plan 2 shows all relevant surface features within the SMP Area and **Plan 5** shows the property boundaries.

Much of the land throughout the whole of the SMP Area has been cleared for grazing, residential or similar purposes (refer **Plan 7**). Much of the land is used for light grazing by cattle and horses.

6.3. IDENTIFICATION OF SURFACE AND SUB-SURFACE FEATURES

The following sections identify and describe all major natural features and infrastructure that lie within the SMP Area. A summary of these features is provided in **Table 6.1**, which follows the listing required by the *DPIM SMP Guidelines, 2003*.

Table 6.1 - Natural Features and Surface Improvements

| Item | Within SMP Area | Environmentally Sensitive Area | Section Number Reference |
|---|-----------------|--------------------------------|--------------------------|
| NATURAL FEATURES | | | |
| Catchment Areas or Declared Special Areas | | | |
| Rivers or Creeks | ü | ü | 6.5.1 6.5.2 |
| Aquifers or Known Groundwater Resources | ü | | 6.5.3 |
| Springs | | | |
| Sea or Lakes | | | |
| Shorelines | | | |
| Natural Dams | | | |
| Cliffs or Pagodas | ü | ü | 6.5.6 |
| Steep Slopes | ü | | 6.5.7 |
| Escarpments | | | |
| Land Prone to Flooding or Inundation | ü | | 6.5.9 |
| Swamps, Wetlands or Water Related Ecosystems | ü | | 6.5.10 |
| Threatened, Protected Species or Critical Habitats | ü | ü | 6.5.11 |
| National Parks or Wilderness Areas | | | |
| State Recreational or Conservation Areas | | | |
| State Forests | | | |
| Natural Vegetation | ü | | 6.5.13 |
| Areas of Significant Geological Interest | | | |
| Any Other Natural Feature Considered Significant | | | |
| PUBLIC UTILITIES | | | |
| Railways | ü | ü | 6.9.1 |
| Roads (All Types) | ü | ü | 6.9.2 |
| Bridges | ü | ü | 6.9.3 |
| Tunnels | ü | | 6.9.4 |
| Culverts | ü | | 6.9.5 |
| Water, Gas or Sewerage Pipelines | | | |
| Liquid Fuel Pipelines | | | |
| Electricity Transmission Lines or Associated Plants | ü | | 6.9.7 |
| Telecommunication Lines or Associated Plants | ü | ü | 6.9.9 |
| Water Tanks, Water or Sewage Treatment Works | | | |
| Dams, Reservoirs or Associated Works | | | |
| Air Strips | | | |
| Any Other Public Utilities | | | |
| PUBLIC AMENITIES | | | |
| Hospitals | | | |
| Places of Worship | | | |
| Schools | | | |
| Shopping Centres | | | |
| Community Centres | ü | | 6.12.2 |
| Office Buildings | | | |
| Swimming Pools | | | |
| Bowling Greens | | | |
| Ovals or Cricket Grounds | | | |
| Racecourses | | | |
| Golf Courses | | | |
| Tennis Courts | | | |
| Any Other Public Amenities | | | |

| Item | Within SMP Area | Environmentally Sensitive Area | Section Number Reference |
|--|-----------------|--------------------------------|--------------------------|
| FARM LAND AND FACILITIES | | | |
| Agricultural Utilisation, Agricultural Improvements or Agricultural Suitability of Farm Land | ü | | 6.10.1 |
| Farm Buildings or Sheds | ü | | 6.10.2 |
| Gas or Fuel Storages | ü | | 6.10.7 |
| Poultry Sheds | | | |
| Glass Houses or Green Houses | | | |
| Hydroponic Systems | | | |
| Irrigation Systems | | | |
| Fences | ü | | 6.10.4 |
| Farm Dams | ü | | 6.10.5 |
| Wells or Bores | ü | | 6.10.6 |
| Any Other Farm Features | | | |
| INDUSTRIAL, COMMERCIAL AND BUSINESS ESTABLISHMENTS | | | |
| Factories | | | |
| Workshops | | | |
| Business or Commercial Establishments or Improvements | ü | | 6.11.1 |
| Gas or Fuel Storages or Associated Plants | | | |
| Waste Storages and Associated Plants | | | |
| Buildings, Equipment or Operations that are Sensitive to Surface Movements | | | |
| Surface Mining (Open Cut) Voids and Rehabilitated Areas | ü | | 6.11.2 |
| Mine Infrastructure Including Tailings Dams or Emplacement Areas | ü | | 6.11.3 |
| Any Other Industrial, Commercial or Business Features | | | |
| AREAS OF ARCHAEOLOGICAL OR HERITAGE SIGNIFICANCE | | | |
| | ü | ü | 6.12.1 6.12.2 |
| ITEMS OF ARCHITECTURAL SIGNIFICANCE | | | |
| PERMANENT SURVEY CONTROL MARKS | | | |
| | ü | | 6.13 |
| RESIDENTIAL ESTABLISHMENTS | | | |
| Houses | ü | | 6.14.1 |
| Flats or Units | | | |
| Caravan Parks | | | |
| Retirement or Aged Care Villages | | | |
| Associated Structures such as Workshops, Garages, On-Site Waste Water Systems, Water or Gas Tanks, Swimming Pools or Tennis Courts | | | |
| Any Other Residential Features | ü | | 6.14.2 |
| ANY OTHER ITEM OF SIGNIFICANCE | | | |

6.4. AREAS OF ENVIRONMENTAL SENSITIVITY

This section provides a brief summary of features identified as areas of environmental sensitivity within the SMP Area (**Table 6.2**). Areas of environmental sensitivity are defined in *Section 6.6.3 of the DPIM SMP Guidelines, 2003*.

Table 6.2 - Summary of Areas of Environmental Sensitivity within the SMP Area

| No. | Description | Within SMP Area | Details | Section No. Ref. |
|-----|--|-----------------|--|----------------------------------|
| 1 | Land reserved as a State Conservation Area under the <i>National Parks and Wildlife Act 1974</i> | None | | |
| 2 | Land declared as an Aboriginal Place under the <i>National Parks and Wildlife Act 1974</i> | None | | |
| 3 | Land identified as <i>Wilderness</i> by the Director, National Parks and Wildlife under the <i>Wilderness Act 1987</i> | None | | |
| 4 | Land subject to a 'conservation agreement' under the <i>National Parks and Wildlife Act 1974</i> | None | | |
| 5 | Land acquired by the Minister for the Environment under Part 11 of the <i>National Parks and Wildlife Act 1974</i> | None | | |
| 6 | Land within State forests mapped as Forestry Management Zone 1, 2 or 3 | None | | |
| 7 | Wetlands mapped under SEPP 14 – Coastal Wetlands | None | | |
| 8 | Wetlands listed under the Ramsar Wetlands Convention | None | | |
| 9 | Lands mapped under SEPP 26 – Coastal Rainforests | None | | |
| 10 | Areas listed on the Register of the National Estate | None | | |
| 11 | Areas listed under the <i>Heritage Act 1977</i> for which a plan of management has been prepared | None | | |
| 12 | Land declared as critical habitat under the <i>Threatened Species Conservation Act 1995</i> | None | | |
| 13 | Land within a restricted area prescribed by a controlling water authority | None | | |
| 14 | Land reserved or dedicated under the <i>Crown Lands Act 1989</i> for the preservation of flora, fauna, geological formations or other environmental protection purpose | None | | |
| 15 | Significant surface watercourses and groundwater resources identified through consultation with relevant government agencies | ü | The Nepean River | 6.5.1 |
| 16 | Lake foreshores and flood prone areas | ü | Banks of the Nepean River | 6.5.9 |
| 17 | Cliffs, escarpments and other significant natural features | ü | Cliffs along the Nepean River | 6.5.6 |
| 18 | Areas containing significant ecological values | ü | Endangered Ecological Communities | 6.6.1 |
| 19 | Major surface infrastructure | ü | Main Southern Railway HW2 Hume Highway Bridges Optical Fibre Cables | 6.9.1 6.9.2 6.9.3 6.9.9 |

| No. | Description | Within SMP Area | Details | Section No. Ref. |
|-----|--|-----------------|---|---------------------------|
| 20 | Surface features of community significance (including cultural, heritage or archaeological significance) | ü | The Nepean River Archaeological and Cultural Heritage sites | 6.5.1 6.12.1 6.12.2 |
| 21 | Any other land identified by the Department to the titleholder | None | | |

6.5. SIGNIFICANT NATURAL FEATURES

There are no drinking water catchment areas or declared special areas within the SMP Area. The nearest drinking water catchment area is the *Upper Nepean Catchment Area*, which is also part of the Metropolitan Special Area. The closest point of this catchment area to the proposed longwalls is at Broughtons Pass Weir, which is located over 6 kilometres south of the proposed longwalls.

6.5.1. Rivers

The total length of the Nepean River within the general SMP Area is approximately 3.6 kilometres. The total length of river within the SMP Area, which is extended to the predicted limits of 20 mm upsidence and 20 mm closure, is approximately 7.8 kilometres, which starts approximately 380 metres south of the finishing (western) end of Longwall 703 to finishes approximately 590 metres north of the commencing (eastern) end of Longwall 710.

The Nepean River is part of the Hawkesbury-Nepean River system which begins in the uplands west of Wollongong and flows northward past Camden to its junction with the Warragamba River near Wallacia, where it becomes part of the main Hawkesbury stream. The total length of the Nepean River is approximately 145 kilometres.

The section of river that flows within the SMP Area is described as a *flooded valley*, because the water surface level is controlled by the Menangle Weir, downstream of the SMP Area, and the river flows are controlled by the discharges from the Upper Nepean Dams, being the Cataract, Cordeaux, Avon and Nepean Dams.

The water level of the Nepean River within the SMP Area is predominantly regulated by the downstream weir at Menangle, which acts as a dam. Menangle Weir is located approximately 2.5 kilometres north of the proposed longwalls. The water flows upstream of the SMP Area are regulated by the Douglas Park Weir, which is located approximately two kilometres south-west of the proposed longwalls. The section of river between the two weirs is approximately 14 kilometres in length. Both weirs lie outside the SMP Area. This section of the Nepean River does not form part of a *Catchment Area* or a *Declared Special Area*.

The Nepean River is considered a significant watercourse and has, therefore, been defined as an *area of environmental sensitivity* for the purposes of the SMP Application.

The location of the Nepean River within the SMP Area is shown in **Figure 6.1**.

6.5.2. Creeks

Descriptions of the creeks within the SMP Area are provided below:

Foot Onslow Creek is an ephemeral creek which is located directly above the middle of proposed Longwalls 708 to 710. The creek generally flows in a northerly direction until it joins the Nepean River, approximately 3 kilometres north of Longwall 710. The natural grade of the creek within the general SMP Area varies between 10 mm/m and 100 mm/m, with an average grade of approximately 20 mm/m.

Harris Creek is an ephemeral creek which is located directly above the western ends of proposed Longwalls 706 and 707. The creek generally flows in a southerly direction until it joins the Nepean River approximately 1.9 kilometres south-west of the proposed longwalls. The natural grade of the creek within the general SMP Area varies between a minimum of 5 mm/m and a maximum of 250 mm/m, with an average grade of approximately 25 mm/m.

Navigation Creek is an ephemeral creek which is located in the north-western corner of the general SMP Area and is not located directly above any of the proposed longwalls. The creek generally flows in a north-easterly direction until it joins the Nepean River approximately 8 kilometres north of the proposed longwalls. The natural grade of the creek within the general SMP Area varies between 5 mm/m and 20 mm/m, with an average grade of approximately 10 mm/m.

The creeks within the SMP Area generally have a Wianamatta Shale beds, however, there are sections which have sedimentary deposits typically along the upper reaches of the creeks. A number of farm dams have been developed along the creeks, details of which are provided in **Appendix A**. These dams are used as water sources on the rural properties within the SMP Area.

There are also a number of tributaries within the SMP Area. The tributaries are located directly above and across the extents of the proposed longwalls. The locations of creeks and tributaries within the SMP Area are shown in **Figure 6.1**.

6.5.3. Aquifers and Known Groundwater Resources

There are no *Ground Water Management Areas*, as defined by the Department of Water and Energy (DWE), within the SMP Area. There are, however, groundwater resources within the SMP Area, which are extracted using groundwater bores, the locations of these bores are shown in **Figure 6.2** and details provided in **Appendix H**.

Details on the aquifers and groundwater resources in the SMP Area are provided in **Section 9.2** and **Appendix H**.

6.5.4. Springs

There are no identified springs or groundwater seeps within the SMP Area.

6.5.5. Natural Dams

There are no natural dams within the SMP Area. There are, however, a number of farm dams within the SMP Area, which are described in **Section 6.10.5**.

6.5.6. Cliffs and Natural Rock Formations

For the purposes of this report, a cliff has been defined as a continuous rockface having a minimum height of 10 metres and a minimum slope of 2 to 1, i.e. having a minimum angle to the horizontal of 63 degrees. The locations of cliffs within the SMP Area were determined from site investigations and from the 1 metre surface level contours which were generated from an aerial laser scan of the area.

The cliffs within the SMP Area were generally identified within the valley of the Nepean River, with some cliffs also identified along the tributaries to the Nepean River. The cliffs have formed from the Hawkesbury Sandstone Sedimentary Group. The locations of the cliffs within the SMP Area are shown in **Figure 6.3** and details are provided in **Table 6.3**.

Table 6.3 - Details of Cliffs within the SMP Area

| Cliff ID | Overall Length (m) | Maximum Height (m) | Shape | Minimum Distance from Longwalls (m) |
|----------|--------------------|--------------------|----------|-------------------------------------|
| A7_078 | 20 | 12 | Straight | 340* |
| A7_084 | 50 | 12 | Concave | 80* |
| A7_085 | 10 | 11 | Concave | 110* |
| A7_086 | 70 | 17 | Concave | 120* |
| A7_087 | 70 | 18 | Concave | 140* |
| A7_090 | 10 | 14 | Straight | 360 |
| A7_091 | 10 | 12 | Straight | 340 |
| A7_092 | 20 | 10 | Straight | 340 |
| A7_093 | 130 | 21 | Straight | 280 |
| A7_094 | 100 | 16 | Straight | 260 |
| A7_095 | 30 | 17 | Straight | 220 |
| A7_096 | 70 | 25 | Straight | 170 |
| A7_097 | 20 | 16 | Straight | 180 |
| A7_098 | 10 | 16 | Straight | 150 |
| A7_099 | 20 | 24 | Straight | 140 |
| A7_100 | 20 | 12 | Straight | 150 |
| A7_101 | 10 | 9 | Straight | 90 |
| A7_102 | 210 | 24 | Straight | 90 |
| A7_103 | 20 | 13 | Straight | 120 |
| A7_104 | 30 | 15 | Straight | 100 |
| A7_105 | 10 | 10 | Straight | 100 |
| A7_106 | 10 | 13 | Straight | 110 |
| A7_107 | 20 | 9 | Straight | 130 |
| A7_108 | 10 | 10 | Straight | 120 |
| A7_109 | 40 | 21 | Straight | 110 |
| A7_110 | 60 | 30 | Straight | 140 |
| A7_111 | 90 | 12 | Convex | 170 |
| A7_112 | 20 | 17 | Convex | 140 |
| A7_113 | 40 | 22 | Convex | 170 |
| A7_128 | 120 | 15 | Straight | 350 |
| A7_129 | 50 | 15 | Straight | 290 |
| A7_130 | 170 | 20 | Straight | 220 |
| A7_131 | 30 | 15 | Straight | 400 |

Note: *denotes that the minimum distances for Cliffs A7_078 to A7_087 are from Longwall 704 and that the distances to the proposed longwalls are greater than provided.

The cliffs within the SMP Area have been defined as *areas of environmental sensitivity* for the purposes of the SMP Application.

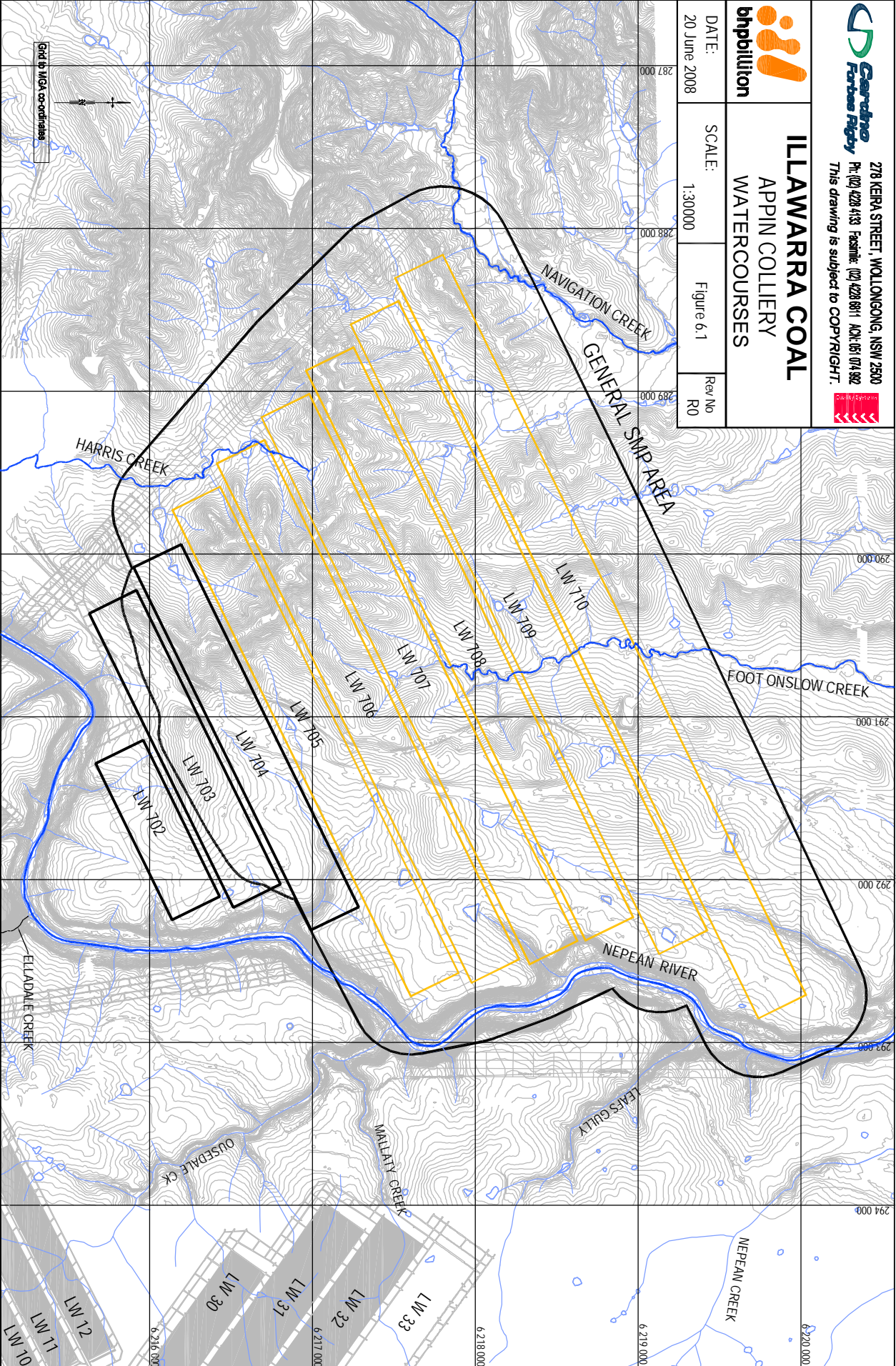
Rock outcrops have been identified across the SMP Area, generally within the valleys of the Nepean River, tributaries to the Nepean River and the other major drainage lines. The locations of the rock outcrops along the valley of the Nepean River are shown in **Figure 6.3**.

278 KEIRA STREET, MOLLONGONG, NSW 2500
 Ph: (02) 4228 4133 Facsimile: (02) 4228 8811 A/N: 06 074 982
 This drawing is subject to COPYRIGHT.



ILLAWARRA COAL
APPIN COLLIERY
WATERCOURSES

| | | | |
|-----------------------|-------------------|------------|--------------|
| DATE: 20 June 2008 | SCALE: 1:30000 | Figure 6.1 | Rev No R0 |
|-----------------------|-------------------|------------|--------------|



Grid to MGA coordinates

6.5.7. Steep Slopes

A number of areas containing steep slopes have been identified within the SMP Area. The reason for identifying steep slopes is to highlight areas in which existing ground slopes may be marginally stable. For the purposes of this report, a steep slope has been defined as an area of land having a natural gradient between 1 in 3 (i.e. a grade of 33%, or an angle to the horizontal of 18 degrees) and 2 in 1 (i.e. a grade of 200%, or an angle to the horizontal of 63 degrees).

The maximum slope of 2 to 1 represents the threshold adopted for defining a cliff. The minimum slope of 1 to 3 represents a slope that would generally be considered stable for slopes consisting of rocky soils or loose rock fragments. Clearly the stability of natural slopes varies depending on their soil or rock types, and in many cases, natural slopes are stable at much higher gradients than 1 to 3, for example talus slopes in Hawkesbury Sandstone.

The steepest slopes within the SMP Area were identified within the valleys of the Nepean River and associated tributaries, which have natural gradients varying between 1 in 3 and 1 in 2 (i.e. 50%, or an angle to the horizontal of 27 degrees), with isolated areas having natural gradients of up to 1 in 1.5 (i.e. 67%, or an angle to the horizontal of up to 34 degrees).

Steep slopes have also been identified along the hills above the western ends of the proposed longwalls, which have natural gradients varying between 1 in 3 and 1 in 2.5 (i.e. 40%, or an angle to the horizontal of 22 degrees), with isolated areas having natural gradients of up to 1 in 2 (i.e. 50%, or an angle to the horizontal of 27 degrees).

The locations of the steep slopes are shown in **Figure 6.3**.

Refer **Appendix A** for further details on steep slopes.

6.5.8. Escarpments

There are no escarpments within the SMP Area. The clifflines and steep slopes within the SMP Area form part of the Nepean River valley and are discussed in **Sections 6.5.6** and **6.5.7** above.

6.5.9. Land Prone to Flooding or Inundation

The land within the SMP Area drains freely into the Nepean River and the associated drainage lines and no areas would be considered flood prone. The banks of the Nepean River and the narrow river flats and islands in the bottom of the Nepean River valley, however, are susceptible to inundation during major flood events.

6.5.10. Swamps, Wetlands and Water Related Ecosystems

There are no swamps or wetlands that have been identified within the SMP Area. There are, however, water-related ecosystems within the SMP Area, in particular, along the Nepean River and the larger drainage lines. These have been investigated and described in the reports by The Ecology Lab (2008) and Biosis (2008). Refer **Appendixes C** and **D** respectively.

6.5.11. Threatened, Protected Species or Critical Habitats

There are no lands within the SMP Area that have been declared as critical habitat under the *Threatened Species Conservation Act 1995*. There is, however, habitat for threatened and protected species and the potential for such species to occur within the SMP Area described in the reports by and The Ecology Lab (2008) and Biosis (2008). Refer **Appendicis C and D** respectively.

6.5.12. State Recreation Areas or State Conservation Areas

There are no State Recreation Areas or State Conservation Areas within the SMP Area.

6.5.13. Natural Vegetation

The land within the SMP Area has generally been cleared for farm, commercial and private use. There are a number of areas of natural vegetation, which are primarily located along the Nepean River and along the alignments of the larger drainage lines. A detailed survey of natural vegetation has been undertaken and is described in the report by Biosis (2008) refer **Appendix D**.

6.6. FLORA AND FAUNA

Biosis Research was commissioned by Illawarra Coal to undertake a terrestrial flora and fauna impact assessment for subsidence impacts associated with Longwalls 705 to 710. The report assesses the ecological values of the SMP Area and the potential impacts of mining in this area in terms of threatened species, populations or ecological communities that occur, or have the potential to occur in the SMP Area (refer **Appendix D**).

6.6.1. Vegetation Communities

The vegetation of the Cumberland Plain has been extensively cleared in the past two centuries rendering much of the remaining vegetation of high conservation significance. Past and present agricultural practices, such as unrestricted grazing, have resulted in the degradation of much of the remnant vegetation on the Cumberland Plain.

Eleven Endangered Ecological Communities (EECs) listed on the *Threatened Species Conservation (TSC) Act 1995* are known to occur in Wollondilly LGA, three of which are also listed as Endangered or Critically Endangered on the *Environmental Protection and Biodiversity Conservation (EPBC) Act 1999*. The SMP Area contains potential habitat for seven of these EECs and only those occurring in the study area were assessed further.

Four of the plant communities in the SMP Area are listed as EECs on the *TSC* and/or *EPBC* Acts. These include: *Shale Sandstone Transition Forest*, *Cumberland Plain Woodland*, *River flat Eucalypt Forest*, *Moist Shale Woodland* and *Western Sandstone Gully Forest*.

6.6.2. Flora

A total of 187 species were recorded in and surrounding the SMP Area in the current survey (Biosis, 2008), including 144 native and 43 exotic species. Five of the exotic species are listed as noxious weeds in Wollondilly LGA: *Lycium ferocissimum* (Class 4), *Xanthium*

species (Class 4), *Rubus fruticosus* aggregate species (Class 4), *Lantana camara* (Class 5) and *Opuntia* spp, (Class 5). A list of flora species recorded from the SMP Area during the field surveys is provided in **Appendix D**.

6.6.3. Fauna

Fauna surveys undertaken for this study consists of a habitat-based assessment. Incidental observations of fauna species in the SMP Area are listed in **Appendix D** and include 69 species of bird (4 introduced), 4 reptiles, 2 amphibians, 3 native mammals, 4 introduced mammals and 1 threatened terrestrial invertebrate. These results are combined with records from previous assessments within or adjacent to the SMP Area in **Appendix D**.

A total of 51 threatened or migratory animal species or their habitat have been previously recorded within the local area (*DECC Atlas of NSW Wildlife* and *DEWHA Online EPBC Database*). Of these, 41 are listed under the TSC Act and 25 are listed under the *EPBC Act*.

6.7. SURFACE HYDROLOGY OF THE NEPEAN RIVER

A detailed assessment of water quality by Ecoengineers is provided in **Appendix B**, and is summarised below.

Ecoengineers were engaged by Cardno Forbes Rigby (CFR) to prepare an assessment of water quality effects that may arise in Nepean River or any other watercourse from the proposed extraction of Longwalls 705 to 710.

Water flows in the Nepean River are derived from a number of sources, which include flows from; catchment areas, licensed discharges, including Appin Colliery and Tahmoor Colliery, and runoff from agricultural and urban areas. Flows from catchment areas contribute the majority of base water flows into the river.

The major tributaries upstream of the general SMP Area are the Cataract, Cordeaux and Bargo Rivers. Some natural catchment flows are retained by large storage dams upstream of the SMP Area for the purposes of Sydney water supply systems. Water is also retained by numerous farm dams within the catchment.

Water is also directly drawn from the Nepean River by licensed extraction pumps and some of these pumps are located within the SMP Area, and their locations are shown in **Figure 6.6**.

Water flows vary within Nepean River, and are largely dependent on rainfall events within the catchment. Regular flow monitoring has not been undertaken within the SMP Area as there are no areas of restricted flow and it is very difficult to measure flow across flooded channels.

Some cessation of flow events have been recorded by the SCA, which reflect periods where more water is extracted from Nepean River than is flowing from upstream. Water levels below the weir spill point of 36 mm at Maldon Weir and 295 mm at Menangle Weir have been recorded. Subtraction of daily Maldon Weir flows from Menangle Weir flows can give negative values either because of flow gauging errors or the effect of licensed extractions but such negative values have become rare since cessation of the 2000 – 2006 drought in mid September 2006.

Water flow conditions in the Nepean River:

- vary greatly and are highly responsive to rain events due to the significant areas of catchment involved with
- maximum flow rates reaching very high levels during sustained storm events and
- the Nepean River has ceased to flow on a small number of occasions and this occurs usually when the rate of pumping out of the river exceeds the rate of inflow and
- median flow rate in the Nepean River above the general SMP Area is likely to be much more than the median flow rate at Maldon Weir, which is 15 ML/day, by about 85% i.e. approximately 28 ML/day and a little less than the median flow rate at Menangle Weir, which is 34 ML/day, there is about 30 ML/day.

Between 2000 and 2006, the area was in drought. It experienced significantly lower than average rainfalls than applied over the previous decade. This is more than 30% lower than the long term median annual rainfall at Cataract Dam which, over the 100 years since recording commenced in 1904 has been about 1000 mm.

The Bureau of Meteorology (BOM) national map for Annual Areal ET for the period 1960 to 1991 indicates that the region should have a mean annual ET in the 500 to 600 mm/year range.

6.8. WATER CHEMISTRY OF THE NEPEAN RIVER AND CREEKS

Illawarra Coal surface water monitoring data has been assessed for the period from July 2002 to the commencement of Longwall 701 mid October 2007. Refer **Figure 18.1** in **Volume 2** for the location of monitoring sites.

Analysis of the entire database for the baseline period, including water quality analyses at depth, shows that Nepean River near the confluence and downstream of Cataract River typically exhibits distinctive thermal/oxygen (and to a lesser degree saline) stratification between the surface and deeper waters.

Oxygen stratification is most apparent, with deeper stretches showing low to very low DO, particularly in summer months or during low flow periods where limited turbulent mixing occurs.

Inspection also shows that when flows in the Nepean River remain relatively constant due to controlled or no release from Maldon Weir and dry weather, and conditions are warm and sunny then pH values in the river may occasionally be found in the naturally occurring 8.25 to 9.5 pH unit range.

This especially applies where Nepean River passes through an area dominated by farmland in the general SMP Area, and hence there is pre-existing nutrient total phosphorus (TP) and total nitrogen (TN) inputs from the effects of fertilization and live stock waste pollution of small catchments draining into the river. These nutrient inputs have been detected in the large number of sampling campaigns conducted since July 2002 and are especially evident from sites NR11 and others further downriver, especially following antecedent rain.

There is very little difference in mean river baseline water quality immediately upriver, adjacent to and immediately downriver of the general SMP Area. Baseline water qualities, especially under the ecologically more critical low flow conditions <50 percentile, are clearly dominated by the following processes:

- There are inputs of more acidic water from Cataract River and Menangle Creek and inputs of more alkaline water from Harris, Elladale and Ousedale Creeks.
- There are inputs of more saline water from Harris, Elladale and Ousedale Creeks but these have negligible bulk effect on overall river salinity.
- There is a consistent input of low DO water from Cataract River and this is the primary driver of DO in the Nepean River immediately downstream of the Cataract River confluence. The Nepean River appears to have a relatively low degree of re-aeration downriver of this point i.e. the (flooded) geomorphology of the river is such that it has a low Re-aeration Coefficient (RAC) adjacent to the general SMP Area.
- There are consistent inputs of Fe and Mn to the river from Cataract River, Elladale Creek and Menangle Creek.

The issue of salinity is relevant to the assessment of potential impact(s) on aquatic ecology for Longwalls 705 to 710 because mine subsidence-related effects can potentially affect two chemically very different classes of aquatic ecosystem namely the following:

- The low salinity (lowland river) context of Nepean River where runoff into the river is dominated by a Cumberland Plain (Lowlands) landscape dominated by Hawkesbury Sandstone outcrop and sandstone derived soils, salinity of the river water (expressed in Electrical Conductivity (EC) units) even taking into account the Appin West Colliery discharge to Allens Creek is unlikely to ever exceed 1000 $\mu\text{S}/\text{cm}$ and chloride and sulfate ion concentrations are unlikely to frequently exceed about 20 and 100 mg/L, respectively.
- The water quality context of Harris, Elladale and Ousedale Creeks and Leafs Gully which arise almost exclusively in Cumberland Plain (Lowlands) landscape dominated by Wianamatta Shale outcrop and Shale-derived soils are such that salinities in the middle and lower sections of these creeks frequently exceed 10,000 $\mu\text{S}/\text{cm}$, and chloride and sulfate ion concentrations are likely to frequently exceed 1500 mg/L and 50 mg/L respectively.

For further detail on water chemistry refer **Appendix B**.

6.9. PUBLIC UTILITIES

6.9.1. Railways

The Main Southern Railway crosses the proposed Longwalls 705 to 710, the location of which is shown in **Figure 6.4**. The affected section of railway line is located between Menangle Station (Ch. 62.853) and Douglas Park Station (Ch. 73.319). The total length of railway line within the general SMP Area is approximately 4.2 kilometres, which extends between Chainages 67.341 kilometres and 71.521 kilometres.

The railway line is a dual track consisting of 60 kg rail on concrete sleepers. The railway corridor also contains a number of signal boxes, with associated communications cabling. A number of culverts and cuttings also lie within the SMP Area.

The Main Southern Railway is considered to be a major item of surface infrastructure and has, therefore, been defined as an *area of environmental sensitivity* for the purposes of the SMP Application.

For further detail on the Main Southern Railway refer **Appendix A**.

6.9.2. Roads

The locations of the roads within the SMP Area are shown in **Figure 6.5**.

The HW2 Hume Highway crosses over the proposed Longwalls 705 and 710, the location of which is shown in **Figure 6.5**. The highway has been constructed with an asphaltic pavement on a slag road base and stabilised gravel sub-grade. A number of culverts and cuttings associated with the highway also lie within the SMP Area.

With the exception of the major Highway bridges, such as the Twin Bridges over the Nepean River at Douglas Park, the Highway was designed on the understanding that the methods of construction would not be excessively restrictive in regard to the future extraction of coal beneath the Highway. It was anticipated that total extraction would be possible beneath the pavement and overpasses, subject to detailed consideration of the underground layout, and its relation to the Highway.

The HW2 Hume Highway is the most important road corridor in the country, linking Sydney with Canberra and Melbourne. The Highway currently carries in excess of 20 million tonnes of road freight annually and current traffic volumes are in excess of 37,000 vehicles per day. The accident, fatal and serious injury crash rates for this section of the Highway are, at present, one of the lowest in the State.

The HW2 Hume Highway is considered to be a major item of surface infrastructure and has, therefore, been defined as an *area of environmental sensitivity* for the purposes of the SMP Application.

The main public roads within the SMP Area are Moreton Park, Menangle, Carrolls and Hawkey Roads. These roads have bitumen seals with table drains and grass verges which are maintained by the Wollondilly Shire Council. There are also a number of private roads within the SMP Area which serve the rural properties.

Refer **Appendix A** for further detail on roads.

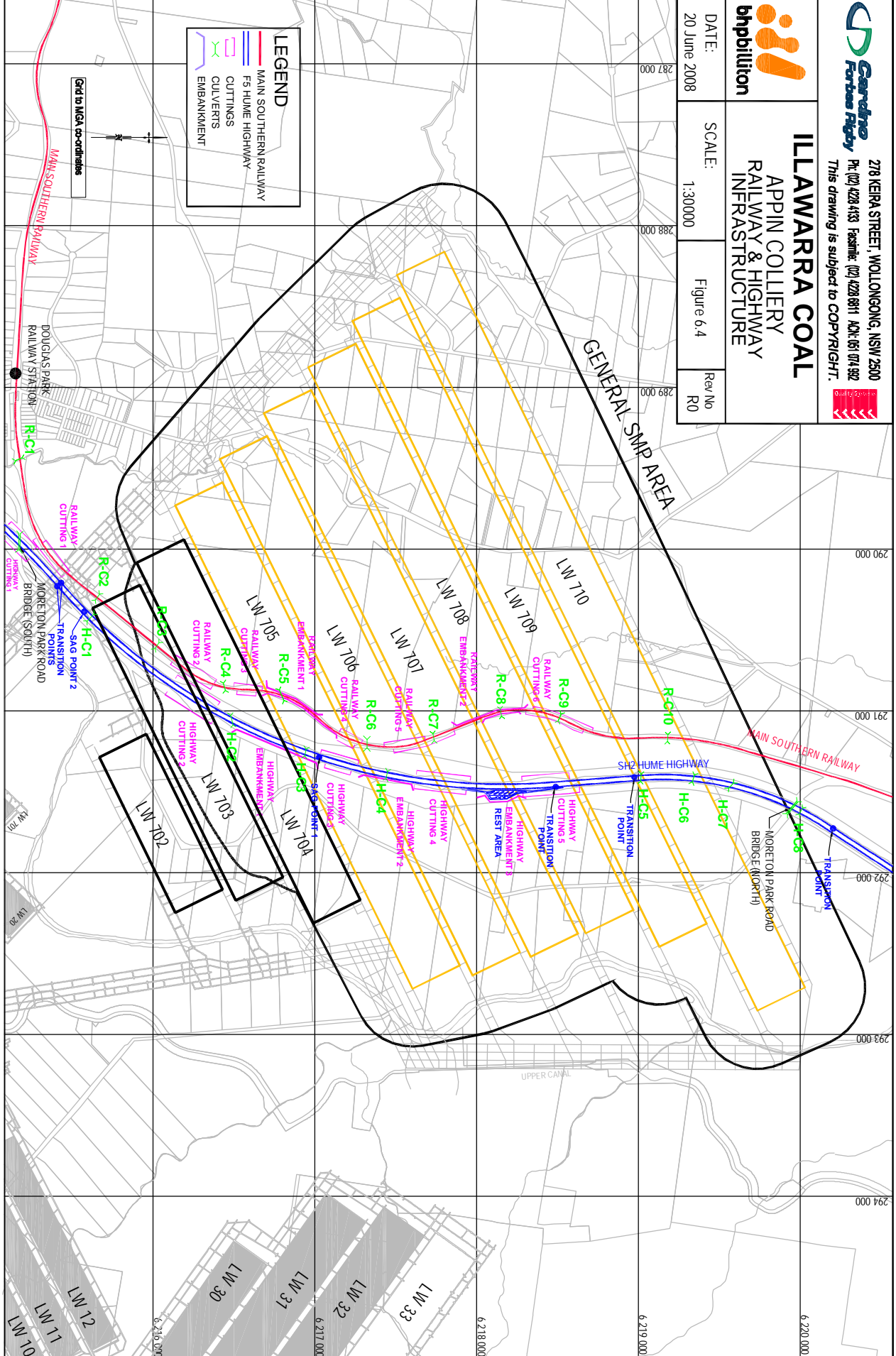


278 KEIRA STREET, WOLLONGONG, NSW 2500
 Ph: (02) 4223 4133 Faxline: (02) 4223 8811 ACH: 06 074 932
 This drawing is subject to COPYRIGHT.



ILLAWARRA COAL APPIN COLLIERY RAILWAY & HIGHWAY INFRASTRUCTURE

| | | | |
|-----------------------|-------------------|------------|--------------|
| DATE: 20 June 2008 | SCALE: 1:30000 | Figure 6.4 | Rev No R0 |
|-----------------------|-------------------|------------|--------------|





278 KEIRA STREET, WOLLONGONG, NSW 2500
 Ph: (02) 4228 4133 Faxline: (02) 4228 8811 A/N: 651 074 192
 This drawing is subject to COPYRIGHT.

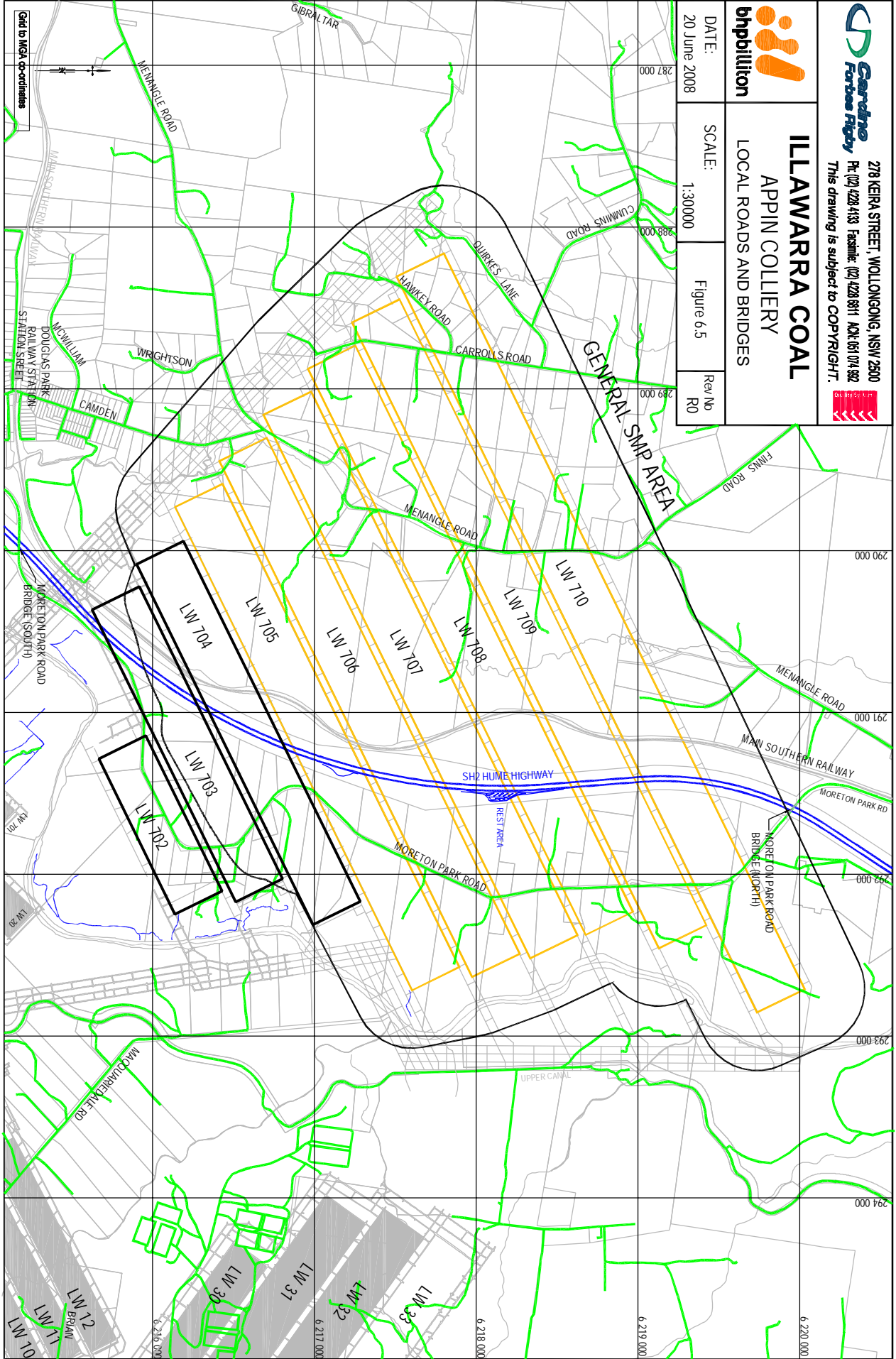


ILLAWARRA COAL

APPIN COLLIERY

LOCAL ROADS AND BRIDGES

| | | | | | | | |
|-------|--------------|--------|---------|--------|-----|--------|----|
| DATE: | 20 June 2008 | SCALE: | 1:30000 | Figure | 6.5 | Rev No | R0 |
|-------|--------------|--------|---------|--------|-----|--------|----|



Grid to MGA co-ordinates

6.9.3. Bridges

The locations of the bridges in the vicinity of the proposed longwalls are shown in **Figure 6.5**. There is one bridge that is located within the general SMP Area, being Moreton Park Road Bridge (North), which crosses over the HW2 Hume Highway and is located approximately 400 metres north of Longwall 710, at its closest point to the proposed longwalls.

There are other bridges in the vicinity of the proposed longwalls which could experience far-field horizontal movements or valley related movements and could be sensitive to these movements. The bridges that are located outside the general SMP Area, but have also been included in the SMP Area, are described below.

Moreton Park Road Bridge (South) crosses over the HW2 Hume Highway and is located approximately 1 kilometre south of the finishing (western) end of Longwall 705, at its closest point to the proposed longwalls.

The Twin Bridges along the HW2 Hume Highway cross over the Nepean River at Douglas Park are located approximately 1.9 kilometres south of the finishing (western) end of Longwall 705, at their closest points to the proposed longwalls.

There are also a number of bridges associated with the Upper Canal and its maintenance road which are discussed in **Section 6.9.6**.

Refer **Appendix A** for further detail on bridges.

6.9.4. Tunnels

Devines Tunnels No. 1 and 2 are located to the east of the general SMP Area and are described in **Section 6.9.6**. There are no other tunnels within the SMP Area.

6.9.5. Drainage Culverts

There are a number of drainage culverts along the Main Southern Railway and the HW2 Hume Highway. There are also a number of drainage culverts along the local roads which are located across the SMP Area.

Refer **Appendix A** for further detail on drainage culverts.

6.9.6. The Upper Canal and Associated Infrastructure

The Sydney Catchment Authority (SCA) owns infrastructure in the vicinity of the proposed longwalls, including the Upper Canal, Devines Tunnels No. 1 and 2 and associated infrastructure. The SCA infrastructure is located at a distance of 140 metres east of the SMP Area, at its closest point.

The Upper Canal crosses a number of drainage lines in the vicinity of the proposed longwalls and, therefore, may be subjected to valley related movements, as well as far-field effects. The Upper Canal may be sensitive to these movements and, therefore, the sections of the canal beyond the general SMP Area but within the predicted limits of 20 mm upsidence and 20 mm closure, resulting from the extraction of Longwalls 705 to 710, have been included within the SMP Area.

The canal uses wrought iron aqueducts to cross Mallaty Creek (A4), Leaf's Gully (A5) and Nepean Creek (A6), which are located at distances of 640 metres, 780 metres and 1200 metres, respectively, east of the proposed longwalls, at their closest points. The aqueducts are multi-span structures comprised of 2.19 metre diameter wrought iron pipes supported on masonry piers and concrete pad foundations. Mitigation measures have been previously provided at the Mallaty Creek aqueduct to accommodate the predicted movements resulting from the extraction of West Cliff Longwalls 29 to 33.

The Upper Canal also uses concrete aqueducts, referred to as Aqueducts C and D, to cross two unnamed creeks north of Mallaty Creek, which are located at distances of 500 metres and 560 metres, respectively, east of the proposed longwalls, at their closest points. Mitigation measures have been previously provided at these aqueducts to accommodate the predicted movements resulting from the extraction of West Cliff Longwalls 29 to 33.

Devines Tunnel is made up of two sections, known as Devines Tunnel No. 1, between two unnamed creeks north of Mallaty Creek, and Devines Tunnel No. 2, between the northern unnamed creek and Leaf's Gully. A short length of open canal joins the two sections of tunnel. Devines Tunnels No. 1 and 2 are located at distances of 500 metres and 570 metres, respectively, east of the proposed longwalls, at their closest points.

A maintenance road is located on the western side of the Upper Canal and Devines Tunnels and has a number of small bridges where it crosses the major drainage lines. The bridges closest to the general SMP Area cross Mallaty Creek (RB4), Leaf's Gully (RB5) and Nepean Creek (RB6) which are located at distances of 640 metres, 780 metres and 1200 metres, respectively, east of the proposed longwalls, at their closest points. These bridges are light steel structures with timber decks.

The Upper Canal system has been defined as an *area of environmental sensitivity* for the purposes of the SMP Application.

6.9.7. Water, Gas or Sewerage Pipelines

There are no public water, gas or sewerage pipelines within the general SMP Area. The closest public pipelines are within the pipeline easement, shown in **Figure 6.6**, which is located 1.7 kilometres east of Longwalls 705 and 710, at its nearest point to the proposed longwalls.

There are four pipelines within this easement, being the United Utilities 1200 mm diameter treated water main, the Alinta EGP and AGN Natural Gas Pipelines and the Gorodok Ethane Pipeline. The water and gas pipelines have been defined as *areas of environmental sensitivity* for the purposes of the SMP Application.



278 KEIRA STREET, WOLLONGONG, NSW 2500
 Ph: (02) 4228 4183 Fax: (02) 4228 8811 ACH: 061 074 982
 This drawing is subject to COPYRIGHT.



ILLAWARRA COAL
APPIN COLLIERY
WATER & GAS INFRASTRUCTURE

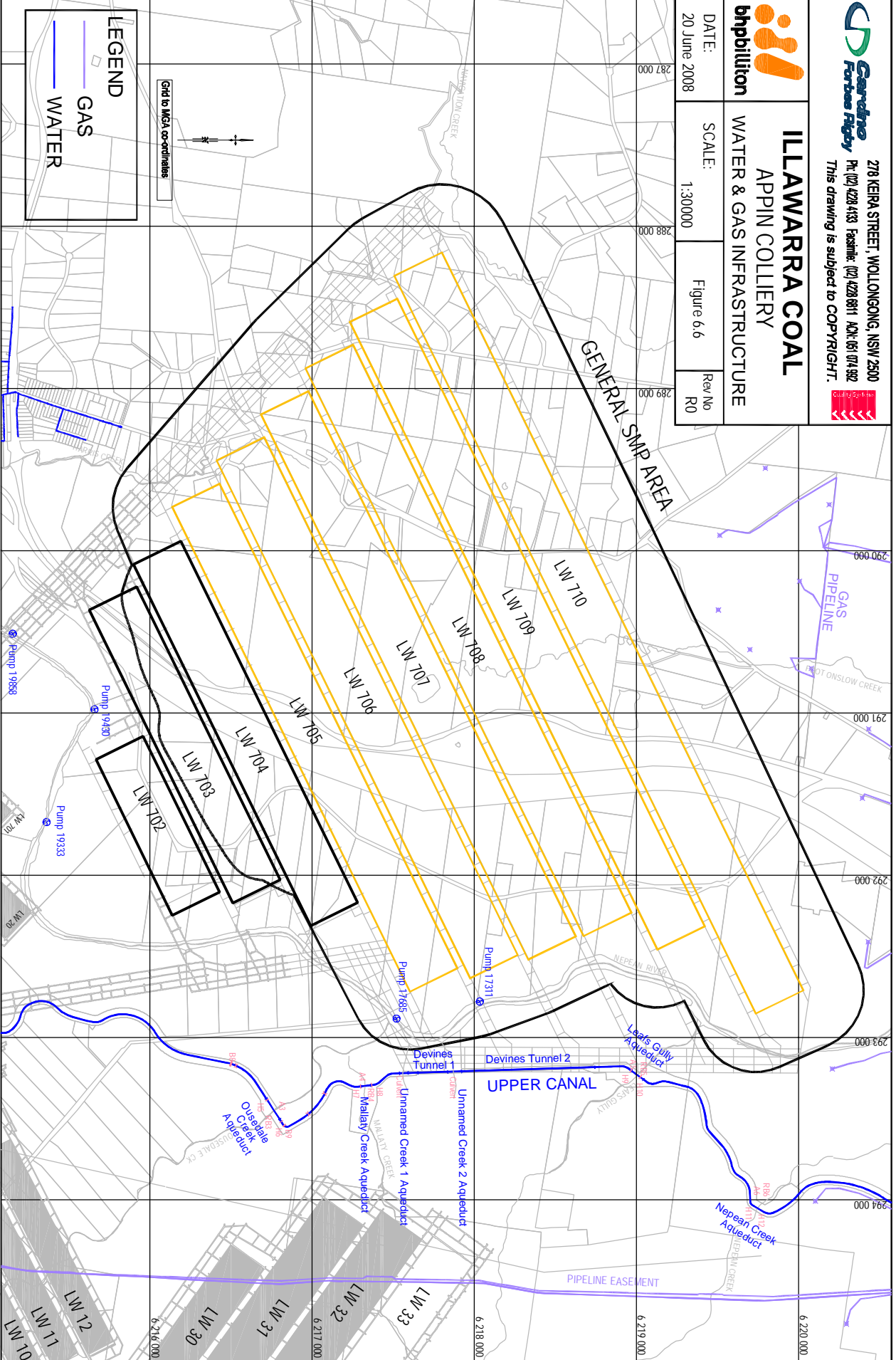
| | | | |
|-----------------------|-------------------|------------|--------------|
| DATE: 20 June 2008 | SCALE: 1:30000 | Figure 6.6 | Rev No R0 |
|-----------------------|-------------------|------------|--------------|

LEGEND

GAS

WATER

Grid to MGA co-ordinates



6.9.8. Electricity Transmission Lines and Associated Plants

The locations of the electrical services within the SMP Area are shown in **Figure 6.7**. The major electrical services include the 11 kV and low voltage powerlines, all of which are owned by Integral Energy.

The 11kV powerlines within the SMP Area generally follow the alignments of public roads, with a branch also located between Moreton Park and Menangle Roads. A number of low voltage and consumer lines branch of the 11 kV powerline service the private properties.

The powerlines within the SMP Area comprise of aerial copper cables which are supported by timber or concrete poles.

6.9.9. Telecommunications Lines and Associated Plants

The locations of the telecommunication services within the SMP Area are shown in **Figure 6.8**. The telecommunication services include six optical fibre cables, copper telecommunications cables and two mobile phone towers.

The Telstra, Optus and NextGen Optical Fibre Cables are laid next to the HW2 Hume Highway within the SMP Area. The Powertel Optical Fibre Cable is located between the HW2 Hume Highway and the Main Southern Railway within the SMP Area. There is also a Telstra Optical Fibre Cable which is located along the western side of the Main Southern Railway within the SMP Area.

These optical fibre cables provide the main telecommunications connection between Sydney and Melbourne. The Telstra cable along the Highway was the first cable to be installed between Sydney and Melbourne. It is understood that the optical fibre cables are all direct buried, with the exception of the NextGen cable which is understood to be laid in conduit.

There is also a Telstra Optical Fibre Cable which crosses the western ends of proposed Longwalls 707 and 708, which provides communications to a mobile phone tower at the top of the hill above the western end of proposed Longwall 709. There is also a second mobile phone tower located on the hill above the western end of proposed Longwall 706.

The optical fibre cables and mobile phone towers are major items of infrastructure and, therefore, have been defined as *areas of environmental sensitivity* for the purposes of the SMP Application.

The copper telecommunications cables, which are owned by Telstra, are located along the alignments of the Main Southern Railway, the HW2 Hume Highway, Moreton Park Road, Menangle Road, as well as along the other local roads within the SMP Area. The cables along the Main Southern Railway, HW2 Hume Highway and some consumer lines are direct buried, whilst the cables along the local roads and some consumer lines are aerial cables.

6.9.10. Water Tanks, Water and Sewerage Treatment Works

There are no Water or Sewerage Treatment Works within the SMP Area. There are, however, a number of privately owned water storage tanks on the rural properties, which are described in **Section 6.10.3**. The rural properties within the SMP Area also have on-site waste systems.

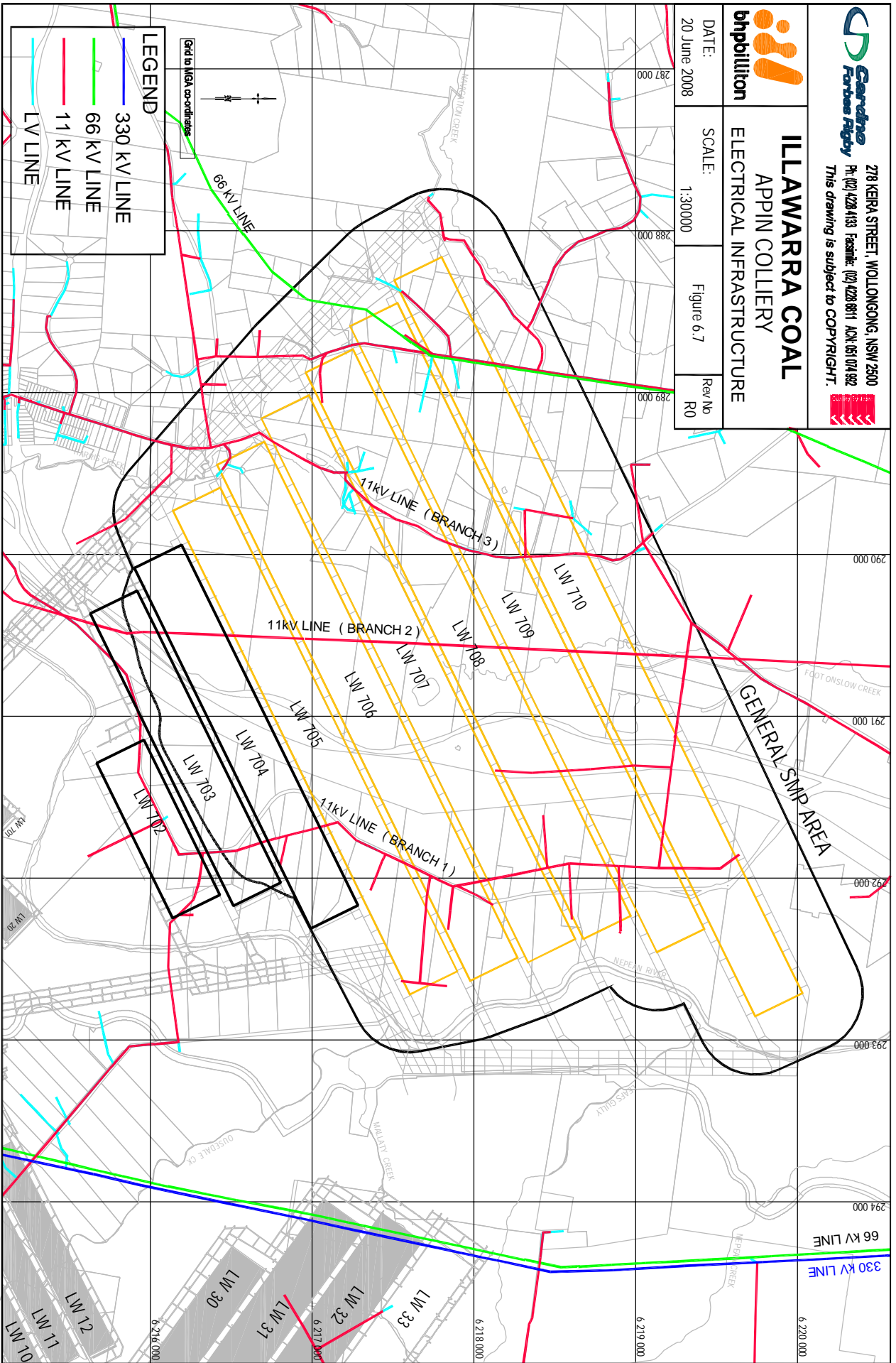
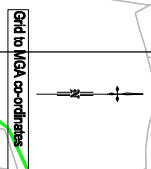


ILLAWARRA COAL
APPIN COLLIERY
 ELECTRICAL INFRASTRUCTURE

| | | | |
|-----------------------|-------------------|------------|--------------|
| DATE: 20 June 2008 | SCALE: 1:30000 | Figure 6.7 | Rev No R0 |
|-----------------------|-------------------|------------|--------------|

LEGEND

- 330 KV LINE
- 66 KV LINE
- 11 KV LINE
- LV LINE



6.9.11. Dams, Reservoirs and Associated Works

There are no public dams, reservoirs or associated works within the SMP Area.

6.10. FARM LAND AND FACILITIES

6.10.1 Agriculture Utilisation and Improvements

The land within the SMP Area is predominantly cleared pasture, which is mainly used for agricultural and residential purposes. The features on the rural properties are described in the following sections.

6.10.2. Farm Buildings and Sheds

There are 393 rural building structures (Structure Type R) that have been identified within the SMP Area, which includes sheds, garages, gazebos, pergolas, greenhouses, playhouses, shade structures and other non-residential building structures. The rural building structures typically comprise steel or timber frames with corrugated metal cladding. The locations of the rural building structures within the SMP Area are shown in **Figure 6.9**.

Refer **Appendix A** for further detail on farm buildings and sheds.

6.10.3. Tanks

There are 243 tanks (Structure Type T) that have been identified within the SMP Area. The locations of the tanks within the SMP Area are shown in **Figure 6.9**.

Refer **Appendix A** for further detail on tanks.

6.10.4. Fences

There are a number of fences within the SMP Area. The majority of fences mark property boundaries and have been constructed using timber or steel posts, with fencing wire or timber railings. There are also fences within the properties within the SMP Area, around the in-ground pools and enclosures containing livestock and pets.

6.10.5. Farm Dams

There are 286 farm dams (Structure Type D) that have been identified within the SMP Area. The locations of the farm dams are shown in **Figure 6.9**.

The dams are typically of earthen construction and have been established by localised cut and fill operations within the natural drainage lines.

Refer **Appendix A** for further detail on farm dams.

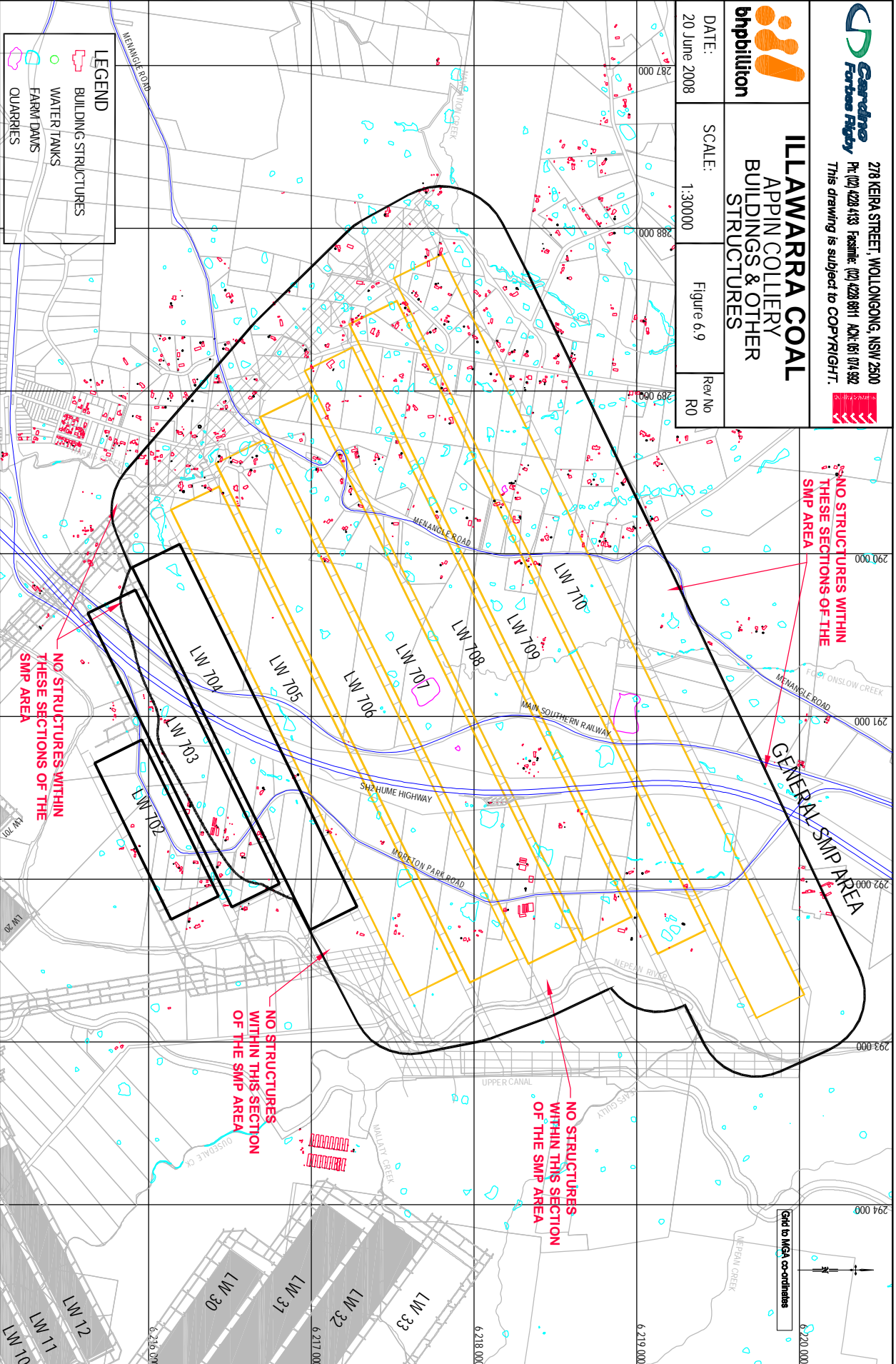


278 KEIRA STREET, WOLLONGONG, NSW 2500
 Pr: (02) 420 4133 Faxline: (02) 420 8011 ACN: 65 014 192
 This drawing is subject to COPYRIGHT.



ILLAWARRA COAL APPIN COLLIERY BUILDINGS & OTHER STRUCTURES

| | | | |
|--------------|---------|------------|--------|
| DATE: | SCALE: | Figure 6.9 | Rev No |
| 20 June 2008 | 1:30000 | | R0 |



| LEGEND | |
|--------|---------------------|
| | BUILDING STRUCTURES |
| | WATER TANKS |
| | FARM DAMS |
| | QUARRIES |

6.10.6. Wells and Bores

There are a number of registered groundwater bores in the vicinity of the proposed longwalls, the locations of which are shown in **Figure 6.2**. Details of the registered groundwater bores within the general SMP Area are provided in **Table 6.6**.

Table 6.6 - Registered Groundwater Bores within the SMP Area

| Bore ID | MGA Easting (m) | MGA Northing (m) | Authorised Purpose(s) |
|----------------|----------------------------|-----------------------------|-------------------------------|
| GW102584 | 289625 | 6216445 | Domestic / Stock |
| GW104154 | 291235 | 6216090 | Domestic / Stock |
| GW104602 | 289055 | 6216340 | Stock |
| GW104661 | 289120 | 6216660 | Domestic / Stock |
| GW105339 | 291800 | 6218285 | Domestic / Irrigation / Stock |
| GW105376 | 289445 | 6218380 | Domestic / Stock |
| GW105388 | 289890 | 6217890 | Domestic / Stock |
| GW105534 | 288655 | 6217295 | Domestic / Stock |
| GW105574 | 289655 | 6218910 | Domestic / Stock |
| GW106574 | 290125 | 6218350 | Domestic |
| GW106675 | 288685 | 6218445 | Domestic / Stock |
| GW108312 | 291535 | 6217750 | Industrial |

Refer **Appendix H** for further detail on groundwater bores.

6.10.7. Gas or Fuel Storages

There are small gas and fuel storages on the rural building properties, which will be described in the Property Subsidence Management Plans (PSMPs).

6.11. INDUSTRIAL, COMMERCIAL AND BUSINESS ESTABLISHMENTS

6.11.1. Business or Commercial Establishments or Improvements

There is a disused piggery site located over the eastern ends of Longwalls 708 and 709, however, the majority of the buildings have been demolished. The remaining building structures on the disused piggery site are shown in **Figure 6.9** and further details are provided in **Appendix A**.

6.11.2. Surface Mining (Open Cut) Voids and Rehabilitated Areas

There are three quarry sites identified within the SMP Area, two above Longwall 707 and one above Longwall 710, the locations of which are shown in **Appendix A**. There are no other open cut mines or rehabilitation areas within the SMP Area.

6.11.3. Mine Infrastructure Including Tailings Dams or Emplacement Areas

There are exploration bores across the SMP Area, which are owned by Illawarra Coal, the locations of which are provided in **Figure 6.2**. The exploration bores are proposed to be grouted and capped prior to the extraction of the proposed longwalls beneath them. There is no other mine infrastructure within the SMP Area.

6.12. AREAS OF ARCHAEOLOGICAL OR HERITAGE SIGNIFICANCE

6.12.1. Items of Archaeological Significance

There are no lands within the SMP Area declared as an Aboriginal Place under the *National Parks and Wildlife Act 1974*. There are, however, 19 archaeological sites which have been identified in the vicinity of the proposed longwalls, the locations of which are shown in **Figure 6.10** and details are provided in **Table 6.7**.

Table 6.7 - Archaeological Sites within the SMP Area

| Site Name | Site Type |
|----------------------------|----------------------|
| Foot Onslow Creek AS 1 | Open Camp Site |
| Foot Onslow Creek IA 1 | Isolated Artefact |
| Foot Onslow Creek IA 2 | Isolated Artefact |
| Foot Onslow Creek IA 3 | Isolated Artefact |
| Foot Onslow Creek IA 4 | Isolated Artefact |
| Foot Onslow Creek IA 5 | Isolated Artefact |
| Foot Onslow Creek IA 6 | Isolated Artefact |
| Moreton Park Road 4 | Stone Artefact |
| Moreton Park Road 5 | Open Camp Site |
| Mountbatten 1 | Stone Artefact |
| Mountbatten 2 | Stone Artefact |
| Nepean River 4 | Shelter with Midden |
| Nepean River 5 | Shelter with Deposit |
| Nepean River 6 | Shelter with Deposit |
| Nepean River 7 | Scarred Tree |
| Nepean River 8 | Open Camp Site |
| Unit d Ground Axe Paddock | Open Camp Site |
| Unit e Rubbish Dump | Axe Grinding Groove |
| Upper Nepean Hand Stencils | Shelter with Art |

Biosis (2008b) identified 19 Aboriginal sites within the General SMP Area. These sites comprise 12 stone artefact scatter sites or isolated artefact occurrences, four shelters with deposit sites, one scarred tree, one axe grinding groove and one shelter with a hand stencil that is not considered to be Aboriginal in origin and is therefore not an archaeological site. Eighteen of these sites are registered on the Aboriginal Heritage Information Management System at DECC.

Detailed descriptions of the archaeological sites within the SMP Area are provided in the report by Biosis (2008) in **Appendix E**.

6.12.2. Items of Heritage Significance

There are three heritage listed items that are located near the boundary of the general SMP Area, which are shown in **Figure 6.10**, and are listed below:

- The *Upper Canal Water Supply System*;
- *Gilbulla (Anglican Conference Centre)*; and
- The *Mountbatten Group* which comprises the Moreton Park House, gardens, garden building and chapel.

The predictions and impact assessments for the *Upper Canal* and for the building structures at *Gilbulla* are provided in **Section 11.8**. The *Mountbatten Group* is located outside the

general SMP Area and is unlikely, therefore, to experience any significant systematic subsidence movements resulting from the extraction of the proposed longwalls.

Refer **Appendix E** for further detail on items of heritage significance.

6.13. PERMANENT SURVEY CONTROL MARKS

There are a number of survey control marks in the vicinity of the proposed longwalls, the locations of which are shown in **Figure 6.2**. Ten survey control marks have been identified within the general SMP Area, details of which are provided in **Table 6.8**.

Table 6.8 - Locations of the Survey Control Marks within the General SMP Area

| Mark | Approximate MGA Easting | Approximate MGA Northing |
|----------|----------------------------|-----------------------------|
| PM 25150 | 289935 | 6217710 |
| PM 25153 | 291510 | 6216775 |
| PM 60537 | 291195 | 6217220 |
| PM 60538 | 291220 | 6217620 |
| PM 60539 | 290995 | 6218190 |
| PM 60540 | 291010 | 6218460 |
| PM 60541 | 291155 | 6218745 |
| PM 60542 | 291215 | 6219620 |
| PM 61513 | 288325 | 6217390 |
| PM 66381 | 291825 | 6216520 |
| PM 67986 | 289170 | 6216645 |
| PM 87183 | 288795 | 6216995 |
| PM 87186 | 288770 | 6217855 |
| PM 87187 | 288570 | 6218345 |
| SS 16098 | 289965 | 6219045 |
| SS 16320 | 289310 | 6216665 |
| SS 16325 | 292125 | 6218020 |
| SS 16326 | 292110 | 6219305 |
| SS 37523 | 290820 | 6216265 |
| SS 67659 | 288825 | 6216660 |
| SS 9471 | 291620 | 6219915 |
| SS 97734 | 288845 | 6218190 |
| TS 10421 | 290145 | 6216860 |

6.14. RESIDENTIAL ESTABLISHMENTS

6.14.1. Houses

There are 115 houses located within the SMP Area, of which 71 are single-storey houses with lengths less than 30 metres (Type H1), 30 are single-storey houses with lengths greater than 30 metres (Type H2), 10 are double-storey houses with lengths less than 30 metres (Type H3) and four are double-storey houses with lengths greater than 30 metres (Type H4).

The locations of the houses within the SMP Area are shown in **Figure 6.9**. Refer **Appendix A** for further detail on the houses.

6.14.2. Any Other Residential Feature

There are 42 privately owned swimming pools (Structure Type P) which have been identified within the SMP Area. There are seven privately owned tennis courts (Structure Type TC) which been identified within the SMP Area. All of the houses within the SMP Area have on-site waste systems. Many of the houses within the SMP Area also have concrete driveway pavements or footpaths. Refer **Appendix A** for further detail and locations of other residential features.