14.0 Geology and Soils

The Project involves the extraction of clay and shale material for brick production and therefore has the potential to impact upon soils and geology. This chapter examines the geological characteristics of the area and the characteristics of soils on the Project Site and makes recommendations for the management and mitigation of impacts on this basis.

14.1 Existing Environment

14.1.1 Landform

The Project Site is located in the Cumberland Lowlands subregion, one of the seven physiographic subregions of the Sydney Geological Basin. The Sydney Basin Region is underlain by Triassic sediments which dip gently from the east and north to a central lowland area southwest of Parramatta. The centre of the basin, the Cumberland Lowlands, consists of plains and gently undulating to low hills on the youngest of the Triassic rocks, the Wianamatta Group (DPI, 2005).

14.1.2 Geological Context

The Sydney Basin can be divided into five stratigraphic phases, each of which has a distinctive structural and tectonic association. These are listed below:

a) Late Carboniferous (Stephanian);
b) Early Permian: dominantly marine;
c) Late Permian: dominantly fluvial with coal measures;
d) Early Triassic: dominantly fluvial but some marine and volcanics; and
e) Middle Triassic: dominantly fluvial but some marine and volcanic.

The stratigraphic phases identified as being representative of the Sydney Basin geology are summarised in **Table 50**.

Table 50: Stratigraphic Phases of the Sydney Basin Geology.

Age	Group	Stratigraphic Unit	Indicative Depth (m)	Geological Description
Middle Triassic	Wianamatta Group	Bringelly Shale	30	The Middle Triassic Wianamatta Group is found on the Cumberland Lowlands. It lies over the Mittagong Formation or the Hawkesbury Sandstone and occupies about one third of the Sydney sheet. It is divided into two formations, the Ashfield Shale and the overlying Bringelly Shale. The Ashfield Shale is the most extensive and occurs to the west of Sydney. It also caps many ridges north of Sydney along the Pacific Highway and along two ridges extending north from Dural to Glenorie and Fiddletown. The Ashfield Shale consists of black to dark grey siltstone and laminate and fine to medium grained lithic sandstone. The Bringelly Shale consists of shale (claystone and siltstone), with occasional calcareous claystone, laminate, coal and fine to medium grained lithic sandstone. Small areas of Bringelly Shale occur at Castle Hill and Carlingford on the Hornsby Plateau and west
		Minchinbury	70	

Age	Group	Stratigraphic Unit	Indicative Depth (m)	Geological Description
		Sandstone		of Burwood in the Cumberland Lowlands.
		Ashfield Shale	110	
		Mittagong Formation	120	The Mittagong Formation consists of interbedded and laminated, fine to medium grained quartz sandstone and dark grey siltstone. This Formation occurs discontinuously as passage beds between the Hawkesbury Sandstone and the overlying Ashfield Shale of the Wianamatta Group. The Mittagong Formation outcrops irregularly on or near the plateau surface.
		Hawkesbury Sandstone	300	Sandstone outcrops extensively on the Hornsby Plateau and the Macdonald Ranges. Consists of medium to very coarse-grained quartz sandstone, very minor laminated mudstone, shale, claystone and siltstone lenses.
	Narrabeen Group	Burralow Subgroup	320	The Triassic Narrabeen Group outcrops in the Erina Hills along the coast north of Narrabeen. These sediments consist of interbedded laminate, shale, quartz sandstone, claystone, comglomerate and lithic sandstone.
		Gosford Subgroup	340	
Early Triassic	Narrabeen Group	Grose Subgroup		As above
		Gosford Subgroup	340	
		Caley Subgroup		
		Clifton Subgroup	360-660	
Late Permian		Gerringong Volcanics		Latite, trachyte tuff with pebbly bands, sandstone, minor siltstone and conglomerate.
	Singleton Supergroup	Newcastle Coal Measures		Coal seams, claystone, siltstone, sandstone, conglomerate, tuff and shale.
		Tomago Coal Measures		
	Maitland Group	Mulbring Siltstone		Lower fine-grained marine section and upper fine-grained marine part separated by minor regressive sandstone referred to as Nowra Sandstone in S and Muree Sandstone.
		Muree Sandstone		

Age	Group	Stratigraphic Unit	Indicative Depth (m)	Geological Description
		Branxton Formation		
	Shoalhaven Group	Berry Siltstone		Basaltic to andesitic lava and shallow intrusives, shoshonitic; sandstone, conglomerate, mudstone, siltstone, shale, claystone; rare tuff, carbonate, evaporite.
		Broughton Formation		
		Budgong Sandstone		
		Nowra Sandstone		
		Wandrawandian Siltstone		
	Narrabeen Group	Wombarra Claystone		Grey Shale and minor quartz-lithic sandstone.
		Coal Cliff Sandstone		Fine to medium grained quartz-lithic sandstone.
	Illawarra Coal Measures	Bulli Coal	690	Shale, quartz-lithic sandstone, grey siltstone and claystone, conglomerate, chert, sporadically carbonaceous mudstone, clay, laminate, and coal and torbanite seams.
		Loddon Sandstone		
		Balgownie Coal Member		
		Lawrence Sandstone		
		Eckersley Formation		
		Wongawilli Coal	750	
		Kembla Sandstone	760	
		Allans Creek Formation	770	
		Darkes Forest Sandstone	790	
		Bargo Claystone	820	
		Tongarra Coal	850	
Early Permian	Maitland Group	Branxton Formation		
		Greta Coal Measures		Coal seams, siltstone, sandstone, conglomerate.
	Shoalhaven Group	Wandrawandian Siltstone		
		Snapper Point Formation		

Age	Group	Stratigraphic Unit		Indicative Depth (m)	Geological Description
		Yadboro and Tallong Conglomerate			
		Pebbly Beach Formation			
	Talaterang Group	Clyde Coal Measures			
		Wasp Head Formation			
	Dalwood Group	Upper	Farley Formation		
			Rutherford Formation		
		Lower	Allandale Formation		
			Lochinvar Formation		
		Seaham Formation			
Late Carboniferous (Stephanian)		Paterson Volcanics			
		Johnson Formation			

Source: DPI, 2005

14.1.3 Site Geology

A bore log detailing geological characteristics on the Project Site was taken from the proposed Pit 4 area in 2002 (refer **Appendix I**). This shows that the Project Site is underlain by the lower part of the Bringelly Shale of the Wianamatta Group.

Table 51 provides a description of the three formations of the Wianamatta Group of relevance to the Project Site.

Table 51: Wianamatta Group Formations

Formation	Description
Bringelly Shale	Top most unit, comprising of: claystone, carbonaceous claystone, siltstone, laminite, sandstone and tuff. Maximum thickness of less than 250 m.
Minchinbury Sandstone	Quartz-lithic, fine to medium grained quartz lithic sandstone, separating the underlying Ashfield shale from overlying Bringelly shale; Thickness of up to 6 m.
Ashfield Shale	Basal dark grey to black sideritic siltstone, which becomes increasingly sandy towards the top, gradually passing into a laminite (Mulgoa laminite member); Thickness of about 45 to 60 m.

The mineralogical aspects of the Project Site are outlined in **Table 52**.

Table 52: Mineralogical aspects of the site

Mineral	Details
Siderite	Occurs throughout all lithologies as discrete nodules (irregular, ranging in size from 1 to 2 cm diameter, up to 10 cm in diameter). It occurs predominantly in non-carbonaceous units either concentrated along well defined bands, or distributed throughout the sequence, or as finely disseminated material throughout the horizon; Also occurs as small grains or granules in light grey siltstones, and as finely disseminated particles throughout the dark grey siltstone fractions of laminites; and Weathers to limonite in the weathered surface zones.
Calcite	Occurs as thin veins less than 1mm in thickness generally oblique to bedding, or as thicker horizontal bands (approximately 2 mm in thickness) interbedded with claystone, siltstone, or sandstone sequences; Occasionally found within siderite nodules; Calcite formation is a late stage of mineralisation that occurs after faulting; and Horizontal calcite bands have been recorded in all RP bore cores drilled throughout the area.

The Bringelly Shale layer has been excavated during the past 30 years of quarry operations on site. Characteristics of the Bringelly Shale are detailed in **Table 53**.

Table 53: Characteristics of Bringelly Shale

Bringelly Shale Characteristics	
Rock Types	Claystone, siltstone, laminate.
Mineralogy	Kaolinite (55%) Illite-smectite (mixed layer) Siderite (less than 10%, variably distributed mainly in the form of nodule layers and grain aggregates).
Plasticity	Moderate; PI5 (i.e. laminites) 8.5 (i.e. shales)
Fired Colour	Siderite *rich*: Orange/Red Siderite *poor*: Cream

The variable plasticity of the Bringelly Shale makes it suited for brick making operations involving extrusion, with shales having a higher plasticity and laminites having lower plasticity.

The variable Siderite content allows for a range of firing colours (i.e. cream to red) related to the amount of iron oxide present in the weathered Bringelly shale (i.e. fires red due to the presence of iron oxides, and fires white/cream due to a lack of iron oxides). The weathered Bringelly shale also offers a higher plasticity than unweathered Bringelly shale, making it suitable for extrusion and brick making.

With regard to brick making on the Project Site, the 'fired colours' can be broadly characterised as:

- Pale (white to cream): approximately 43%;
- Dark (red, orange, brown): approximately 46%; and
- Unknown: approximately 4%.

These individual layers with different fired colours can be selectively mined.

14.1.4 Soils

A review of the Soil Conservation Service maps *Penrith Soil Landscape Series Sheet 9030*, shows the dominant soil groups in the landscape are the Blacktown and South Creek soil landscapes as summarised in **Table 54**.

Table 54: Soil Characteristics and Limitations

Soil Landscape	Characteristics	Limitations
Blacktown	• The landscape is described as gently undulating rises on the Wianamatta Group shales and Hawkesbury shale; • Crests and ridges are broad (200-600 m) and rounded with gently inclined slopes; • Rock outcrop is absent; • Local relief is 10-30 m, slopes are usually <5% but up to 10%; and • Soils consist of shallow to moderately deep (<100 cm) *Red and Brown Podzolic Soils* on crests, upper slopes and well drained areas, and deep *Yellow Podzolic Soils and Soloths* on lower slopes and in areas of poor drainage.	• Soil limitations include moderately reactive highly plastic subsoil, low soil fertility and poor soil drainage; • Erosion hazard for non-concentrated flows is generally moderate and may range from moderate to high; • The general fertility of the soils is low to very low; and • Soils have low to moderate available water capacity, low Cation Exchange Capacity (CEC) values, hardsetting surfaces, very low phosphorus and low to very low nitrogen levels.
South Creek	• Landscape is described as flat to gently sloping alluvial plain with floodplains, valley flats and drainage depressions of the channels on the Cumberland Plain; • Slopes <5% and local relief <10 m; and • Soils are characterised as often very deep layered sediments over bedrock or relict soils. *Structured plastic clays* or *structured loams* are located in and immediately adjacent to drainage lines where pedogenesis has occurred. *Red* and *yellow podzolic soils* are most common on terraces with small areas of structured *grey clays, leached clay* and *yellow solodic soils.*	• Limitations associated with this soil type include flood hazard and very high to extreme erosion hazard. Streambank erosion and sheet erosion of floodplains are common; and • Other soil limitations include hardsetting surface, low fertility (low CEC, nitrogen and phosphorus), acidity (Acid Sulphate Soils - ASS), shrink swell potential, waterlogging, salinity and stoniness.

Areas of the Project Site adjacent to Badgerys Creek are also likely to encounter alluvium deposits, gravel, sand, silt and clay as described by the Sydney Geological Map Sheet 1:25000.

Soil management at the Project Site is generally well established, with controls in place to ensure erosion is minimised and sediment is captured on site, as discussed in **Section 14.3**.

14.1.5 Clay/Shale Resource

The DMR reports a known clay/shale resource reserve across the site, which is supported by geological investigations across the site.

The site geology has been extensively investigated since the development of the site to accommodate the Pacific Brick Plant in 1975. Detailed investigations of the southern and western portions of the Site, (which have since been quarried) took place in 1982, with eight diamond boreholes drilled at selected locations across this section of the site at drill depths ranging from 33m to 51m.

Subsequent investigations of the eastern and northern parts of the site, (the section of the site to which the current application relates), were undertaken in 1993. Investigations involved the drilling of 16 diamond boreholes of depths varying between 19.7m and 49.3m. For the purposes of the study, the eastern and northern parts of the site were divided into extraction cells (1-25) (refer to **Table 55**).

The ceramic properties of the site material were also tested. A wide variety of brick colours was produced including cream, light brown, light mid brown, light mauve, light orange brown, mauve and orange brown. Four colour categories were determined as follows:

- Category A (25% occurrence) – High grade cream, minimal to no discolouring
- Category B (36% occurrence) – includes light orange, light brown and dark cream
- Category C (32% occurrence) – includes light-mid brown, light mauve and light orange-brown
- Category D (7% occurrence) – includes mauve and orange-brown.

Site investigations identified the volume of resource available within the eastern and northern portions of the site (areas occupied by Pit 3, Pit 4 and Pit 5), as shown in **Table 55**.

Table 55: Volume of resource available within the eastern and northern portions of the site

Extraction Cell	Pit	Volume (m^3)					
		Category A	Category B	Category C	Category D	Completely weathered material	Partially weathered material
1	N/A	72,391	172,625	172,628	139,214	156,714	88,804
1a	N/A	294,153	45,644	167,363	-	268,628	114,808
2	Partly 5	62,208	43,067	373,253	-	120,764	88,309
3	5	-	513,876	90,684	-	165,633	162,320
4	5	92,273	28,391	73,345	42,587	66,274	157,732
5	5	132,593	340,953	-	-	69,486	79,908
6	4	183,526	-	162,749	-	32,916	-
7	4	222,294	54,338	212,354	-	83,670	17,738
8	Future	177,927	105,794	197,163	-	122,496	37,098
9	Future	158,117	117,006	41,110	-	177,660	-
10	Future	80,640	59,674	20,966	-	186,747	135,816
11	Future	82,965	30,697	21,571	-	192,131	139,732
12	Future	91,150	67,451	23,699	-	211,084	153,516
13	4	283,343	-	251,266	-	50,818	-
14	4	224,227	54,811	219,244	-	84,397	17,892
15	Future	184,852	136,790	48,061	-	52,815	124,995
16	Future	56,639	118,797	69,225	-	137,708	123,937
17	Future	104,481	77,316	27,165	-	241,956	175,968
18	Future	56,755	41,998	14,756	-	131,433	95,588
19	4	-	254,522	155,997	-	75,672	-
20	Partly 4/partly	-	111,633	207,319	-	61,416	122,832

Extraction	Pit	Volume (m^3)					
	future						
21	Future	-	97,603	181,264		65,616	160,759
22	Future	29,379	97,930	35,907	-	62,012	99,220
23	3	51,079	150,235	99,155	-	63,862	-
24	3	115,530	173,295	-	-	60,424	109,971
25	future	58,312	138,491	94,757	-	64,576	105,581

Investigations across the Project Site identified rock types consisting of claystone, carbonaceous claystone, siltstone, laminate, sandstone and rare thin coal bands.

Sandstones and laminites vary considerably in thickness and were found to be rarely continuous across the area studied on the Project Site or between adjacent boreholes.

Investigations found that Claystone and siltstone were the most dominant lithologies present on the Project Site, occurring in thin horizons less than 1m in thickness in the lower 14m of the Bringelly Shale, increasing to 4m in thickness above this level. Claystone-siltstone units comprise several types of fine grained sediment including light grey "leached" claystone, dark grey to black carbonaceous claystone and non-carbonaceous to slightly carbonaceous mid to dark grey claystone and siltstone.

Laminites include very thinly interbedded sequences of claystone, siltstone and sandstone. Laminites range from thinly interbedded siltstone-claystone laminites to more consistent sandstone-claystone laminites with sandstone comprising 90% of the unit. Laminites were found to be predominant in the lower parts of the sequences and in the sandy phases.

Sandstone was found to be prevalent throughout the Project Site and was recorded in all boreholes.

Cobbitty Claystone Bed is a weathered tuff horizon varying in thickness from 4cm to 6cm. It is predominately a cream to buff coloured, waxy clay and occurs on the Project Site overlying the Minchinbury Sandstone.

14.1.6 Geotechnical Assessment

D. Katauskas a Consulting Geotechnical Engineer examined Pits 1 and 2 to provide a qualitative assessment of the batter slope stability in 2005 producing a Geotechnical Assessment (see **Appendix J**). While it is acknowledged that the purpose of the examination was to gain an understanding of the slope stability of Pits 1 and 2, a number of generic comments were made relating to site operation and the geology in this region, which are applicable to further development on the site.

The assessment states that batter slope design is based on established practice and procedures with due regard to knowledge of the local geology and water drainage issues, rather than design principles, which is generally justifiable.

The assessment concludes in relation to the Project Site that "*no significant stabilisation works are required, however surface run-off should be properly managed*". The assessment's findings are likely to apply to Pits 3, 4 and 5 as they are to be used for the same purpose and are subject to similar geological conditions.

14.1.7 Historical Land use and Contaminated Land

While the majority of contaminated land is associated with industrial land use, there is the potential for historical land uses, such as livestock intensive industries, to result in soil contamination. The Project Site consists of, and is in the vicinity of, areas of agricultural and industrial lands that may have involved activities with the potential to result in contaminated materials.

An investigation of the DECCW Contaminated Land records for the Liverpool LGA indicated that the Project Site has not been recorded as a contaminated land or been remediated. Further, the Project Site is not to be used for a sensitive land use.

14.2 Potential Impacts

The proposed works could have potential impacts on the soils and geology of the Project Site including:

- Soil erosion and sedimentation;
- Sediment laden runoff;
- Poor drainage;

- Interception of Acid Sulfate Soils (ASS); and
- Potential contamination through fuel and oil spills.

14.2.1 Soil erosion and sedimentation

There is potential for soil erosion to arise on the Project Site at the quarry pits (past, present and future), the raw material and waste stockpiles and unsealed access roads, due to the removal of topsoil materials through clearing and excavation of pits. This erosion could give rise to migration of coarse to fine sediments in surface runoff.

14.2.2 Sediment laden runoff

The stockpiling of soil materials from excavation pits has the potential to result in sediment laden runoff and dust if not managed appropriately. These impacts could include an increased water content of the raw material extracted from current and future pits and may impact on the manoeuvrability of vehicles around the Project Site.

14.2.3 Poor drainage

The plastic clay soil types on the Project Site contain high levels of water and are prone to water logging. Consequently, soils are unable to absorb large volumes of water during storm events. In the flatter areas of the Project Site water is likely to pond impacting on vehicle movement and increasing erosion and sedimentation.

14.2.4 Interception of Acid Sulfate Soils

The Project Site is classified by the Australian Soil Resource Information System as having an extremely low probability of ASS occurrence, therefore it is considered unlikely that the Project would result in ASS related impacts and no ASS management measures are required.

14.2.5 Potential contamination through fuel and oil spills

The Project Site is used for industrial purposes that include extensive vehicle movements and the importation of drill mud, both of which have the potential to contaminate soils through spillages during the unloading of drill mud and refuelling of vehicles. Additionally, there is the potential for oil leaks from vehicle engines.

14.3 Mitigation Measures

The continuation and expansion of operations at the Project Site would be governed by management practices in the SWMP, which would be updated as appropriate to reflect the proposed project.

Mitigation measures proposed for the Project Site to ameliorate potential impacts to the soils and geology of the area are:

- Stockpiles and batter faces would be stabilised and erosion and sediment controls such as silt fencing used to ensure that impacts would be confined to distinct areas;
- Temporary structural methods (including silt fencing) would be used where required to protect newly treated areas, which are generally highly susceptible to erosion.
- Disused stockpiles would be revegetated;
- Bunding and batter slopes for new quarry pits would be designed to minimise the potential for erosion in accordance with the RP for the Project Site;
- Roadways would be maintained for the productive life of the pit;
- Sediment fencing would be used on site as temporary measures in the mitigation of sediment movement to down slope lands and waterways;
- Rehabilitation of the Project Site would be carried out in accordance with the RP for the Project Site (**Appendix D**);
- Overburden and unusable material would be used to rehabilitate Pit 2 such that no new stockpiles would be created; and
- Water carts would be used to assist with control of erosion.

14.4 Conclusion

Disturbances to the soils and geology are likely during the continuation and expansion of operations on the Project Site, however these impacts are likely to be locally confined and would be mitigated through the use of appropriate erosion and sediment controls and safeguards, as detailed in the SWMP.

15.0 Visual Impacts

This chapter considers the existing landscape setting of the Project Site and the key visual features related to the project. The chapter identifies key views and visual receptors and provides an assessment of the likely effect of the continuation and expansion of operations at the Site on the landscape characteristics and draws conclusions with regard to the potential impacts of the Project on visual amenity.

15.1 Existing Environment

15.1.1 Landscape Context

Land surrounding the Project Site is generally cleared and is characterised by rural residential development interspersed with agricultural enterprises and industry.

The landscape context is characterised by agricultural pastures and grasslands with some remnant or regrowth vegetation, particularly along drainage lines and creeks including Badgerys Creek, South Creek and tributaries.

The topography surrounding the Project Site is gently undulating. Land to the west of the Project Site rises to a spot height of 93 m AHD near Badgerys Creek. Further to the south-west, near The Northern Road, land rises to 110 m AHD and to the east, the land is undulating to flat, at a level of between 50 -70 m AHD.

15.1.2 Project Site

The Project Site occupies approximately 200 ha of relatively flat land.

The landscape of the Project Site is dominated by the existing quarry pits, voids, stockpiles, sedimentation basins, as well as structures including two residences (one tenanted, one vacant), a dairy and buildings associated with the single storey brick making facility.

Vegetation along South Creek, Badgerys Creek and the tributary of Badgerys Creek provides screening of the Project Site from neighbouring properties. Also, overburden mounds, bunds and vegetation provide some screening of the Project Site when viewed from surrounding properties.

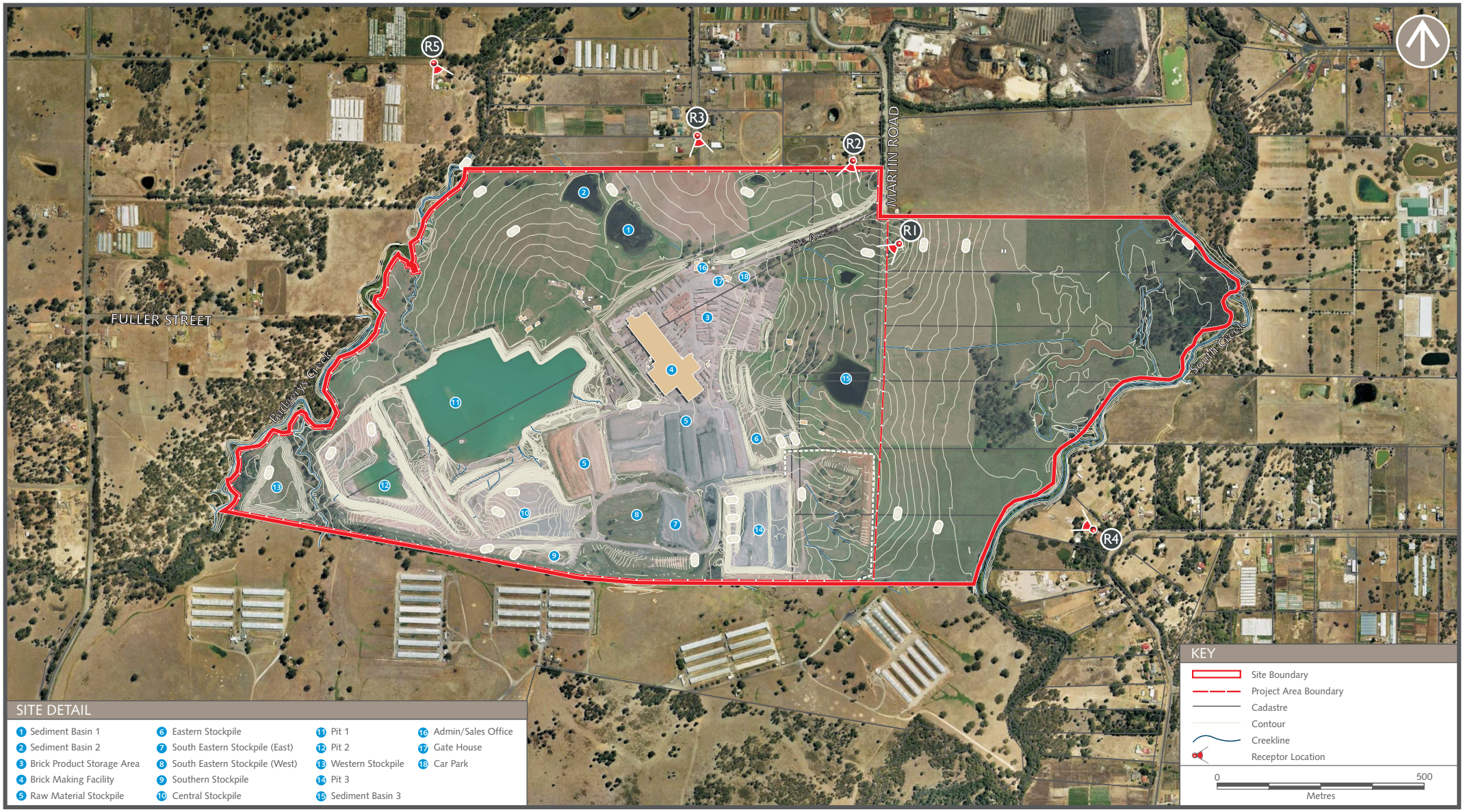
The portion of the Project Site east of Martin Road is pastoral land and is not actively quarried.

15.1.3 Visual Receptors

Analysis of topographical information and aerial photographs has determined a visual catchment, from which parts of the Project Site may be seen. Due to the relatively flat topography of the immediate area and low comparative height of Project Site features, the visual catchment does not extend beyond approximately 250 m. A residence at Fullers Street to the north west is approximately 270 m from the Project Site's western boundary and was not identified as a receptor as the topography and vegetation along Badgerys Creek screens the residence from views of the Project Site. The visual catchment can be defined further by selecting those locations that are permanent receptors (residences or public facilities) and those used by transient receptors (transport corridors and places of work).

Transient receptors surrounding the Project Site include Inghams chicken breeding farms to the south and northwest, dairy farming to the northeast, ANL to the northeast, and the local road network including Martins Road and Lawson Road.

Permanent receptors include various private landowners and residences as shown in **Figure 14** and described in **Table 56.**



AECOM

VISUAL RECEPTORS

Environmental Assessment

Boral Quarry and Brick Making Facility, Badgerys Creek

Figure 14

Table 56: Permanent Receptors within Visual Catchment

Receptors	Location
R1 Dairy Farmer's residence	On Martin Road, within the north-eastern sector of the Project Site.
R2 Rural residential properties	The southern end of Martin Road, north of the Project Site entrance.
R3 Residential properties	The southern end of Lawson Road, along the northern Project Site boundary.
R4 Residential properties	East of South Creek on Victor Avenue.
R5 Residential properties	West of Badgerys Creek on Longleys Road.

Views of the Project Site from the R5 receptors are screened by thick vegetation along Badgerys Creek. The visual catchment for the R1 receptor would include the proposed Pit 4 and Pit 5 however, this property is leased from Boral and is located within the existing quarry. The focus of this visual assessment is therefore on the R2, R3 and R4 receptors.

15.2 Potential Impacts

As the Project Site is an existing quarry, which has been in operation for 30 years, potential visual impacts of the Project would be substantially the same as existing but would occur on different areas of the Project Site. Operations to the north and east of the brick making facility would represent the greatest potential for visual impacts. Project components that would generate potential visual impacts include the proposed quarry pits, proposed bunds and the use of equipment, machinery and vehicles throughout this area during quarry campaigns. As use of equipment, machinery and vehicles would be temporary and transient in nature, potential visual impacts would be primarily related to the future quarry pits and the bunds to be constructed along the northern and eastern boundaries of the Project Site. No additional stockpiles would be created as a result of the proposed works.

The future Pit 5 in the northern part of the Project Site would be located on land currently used for dairying and grazing and would therefore result in a change in the character and landscape of this portion of the Project Site. Receptors within the visual catchment of the future Pit 5 include R2 and R3. Rural residential properties to the west of Badgerys Creek, on Longleys Road, are partially screened by thick vegetation along Badgerys Creek resulting in minimal views of the Project Site from these properties. The future Pit 4 in the eastern sector of the Project Site, north of the Pit 3, would be located on land currently used for stock watering and irrigation of pastures. Receptors R1 and R4 would potentially have views of Pit 4.

The far eastern portion of the Project Site is not subject to quarrying activities under the current proposal and would remain open pasture land.

As the Project Site and its surrounding area are earmarked for future industrial use in the Metropolitan Strategy it is likely that potential future visual receptors in the surrounding area would be of an industrial nature, and not therefore, sensitive to any visual impact created by the site, in comparison to residential development.

15.3 Mitigation Measures

The potential visual impacts arising from the proposed project and proposed mitigation measures are summarised in **Table 57**.

Table 57: Potential visual impacts and proposed mitigation measures

Receptor	Pit 3	Pit 4	Pit 5
R1	Unobstructed views across cleared agricultural land. Views would be screened by proposed bunding along eastern Project Site boundary.	Direct views west onto the Future Pit 4. Views would be screened by proposed bunding along eastern Project Site boundary.	Currently unobstructed views to Pit 5 area. Views screened by bund along entrance road, existing operations and the Future Pit 4.
R2	Views screened by bund wall to the south of the entrance road. In the longer term, views would be further screened by proposed bunding along northern boundary.	Views screened by bund wall to the south of the entrance road. In the longer term, views would be further screened by proposed bunding along northern boundary.	Current views to Pit 5 area partially screened by bund wall. Views would be screened by proposed bunding along the northern site boundary.
R3	Views screened by existing operations (site office/sales area) and bund along entrance road. In the longer term, views would be further screened by proposed bunding along northern boundary.	Views restricted by existing site operations. In the longer term, views would be further screened by proposed bunding along northern boundary.	Currently unobstructed views to Pit 5 area. Views would be screened by proposed bunding along the northern Project Site boundary.
R4	Views currently screened by vegetation along South Creek. Views would be screened by proposed bunding along eastern Project Site boundary.	Views currently screened by vegetation along South Creek. Views would be screened by proposed bunding along eastern Project Site boundary.	Current views to proposed Pit 5 area screened by vegetation along South Creek, existing operations and brick making facility and bund along entrance road. Views would be further screened by proposed bunding along eastern Project Site boundary.
R5	Views restricted by vegetation along Badgerys Creek, existing operations and brick making facility. In the longer term, views would be screened by proposed bunding along northern site boundary and northern extent of western site boundary.	Views restricted by vegetation along Badgerys Creek, existing operations and brick making facility. In the longer term, views would be screened by proposed bunding along northern site boundary and northern extent of western site boundary.	Current views to Pit 5 area partially screened by vegetation surrounding Badgerys Creek. Views would be screened by proposed bunding along northern site boundary and northern extent of western site boundary.

In summary the following mitigation measures would be implemented as part of the Project in relation to visual impacts:

- Earthen bunds of approximately10 m in height would be established along the northern site boundary, eastern site boundary and the northern extent of the western site boundary to provide visual (as well as acoustic) screening of the Project Site from surrounding visual receptors;
- Existing disused stockpiles would be rehabilitated in accordance with the RP prepared for the Project Site and included as **Appendix D** to this EA; and
- A 50 m riparian corridor would be established along Badgerys Creek providing vegetative screening of the Project Site along the western boundary.

15.4 Conclusion

It is expected that the overall visual character of the site would remain largely unchanged as a result of the proposal, however the extent of disturbed areas would increase with the movement of extraction into Pits 4 and 5. Much of the Project Site would be screened from surrounding receivers by bunding along the northern and eastern site boundaries. Visually, the site would therefore be generally unobtrusive when viewed from surrounding properties and public roads. The proposal relates to an existing operation which has been in place on the site for some 30 years. The existing operation is generally integrated with the surrounding landscape and is not out of character with existing development which includes large-scale rural industrial and commercial operations such as ANL. Future land use is likely to include increased industrial development which would result in significant change to the existing surrounding land use character, within which the proposed operations would integrate with minimal impact. Proposed bunding and landscape screening would assist with minimising the visual impacts of the Project Site upon the surrounding area, as land uses change into the future.