ENVIRONMENTAL MANAGEMENT PROGRAM

CLAY EXCAVATION
HALLETT AND COPLEY ROADS AREA
UPPER SWAN

(Response to Ministerial Statement #699)

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APPENDICES

1.0 INTRODUCTION

Midland Brick Company Pty Ltd (Midland Brick) currently excavates clay for brick-making purposes in the south-eastern sector of the Upper Swan locality, specifically:

- Lots 7, 19, 60, 63, 64 & 20 Hallett and Copley Roads;
- Lots 19, 45 & 46 St Albans Road; and
- Lot 100 Great Northern Highway.

In addition Lot 18 St Albans Road was requested to be added to the site on 31 August 2006. The site location and lot layout is shown on Figure 1.

The clay deposits occur on land which has previously been cleared and developed for pastoral use. The area subject to clay excavation activity will ultimately comprise approximately 95 hectares out of a total landholding of 115 hectares. Approximately 16.5 hectares of the site will be unmined and retained as buffer zones.

1.1 Purpose

This Environmental Management Program (EMP) is intended to fulfil the requirements of Condition M8.1 of Ministerial Statement No. 699 (previously No. 251), published in November, 2005 (Appendix A). It describes Midland Brick's ongoing management regime to detect, report on and manage any adverse impacts on the environment in the Upper Swan locality.

The EMP also contains information relating to Condition M6.1 (Acid Sulfate Soils) and M7.1 (Wetland Rehabilitation) as required by the Ministerial Statement.

1.2 Regulatory Approval History

Approval to operate the clay quarry in the Hallett and Copley Roads area was granted by planning authorities in 1982 for a 30 year period.

At the time of application for a Renewal of Excavation Licence to the (then) Shire of Swan in 1990, there was significant concern related to the potential cumulative impacts of a number of clay excavation proposals and existing operations on the nearby habitat of the extremely rare and endangered Western Swamp Tortoise in the Ellen Brook Nature Reserve (EBNR). This resulted in the project being formally assessed by the Environmental Protection Authority (EPA) at a level of Consultative Environmental Review (CER) in 1992. The project was subsequently approved for a 10 year period, subject to Ministerial Conditions and Proponent Commitments which were outlined in Ministerial Statement 251.

In 2004 a Section 46 Review report (RPS, 2004) was submitted to the EPA as a formal request for an extension of the project approval as requesting other minor changes to the Ministerial approval. The EPA approved the extended time frame and minor changes in 2005 through the issue of Ministerial Statement 699. As described above this EMP has been prepared to fulfil condition 8 of Statement 699.

1.3 Environmental Initiatives

1.3.1 Protection of Swan River Floodplain

Protection on the Swan River foreshore adjacent to the clay excavations has always been recognised as an important environmental management objective. A total area of 11.57 ha has been donated to the crown to the east of Great Northern Highway in order to protect remnant vegetation along the river foreshore and floodplain in perpetuity. This process was commenced with Part lot 221 (3.35ha) which is bounded by Great Northern Highway, the rail bridge and the river was donated to the crown to protect the foreshore and Aboriginal artefacts “Upper Swan Bridge” site number (4299).

A further two connecting properties totalling 8.2 ha in area to the east of the railway bridge was donated in accordance with commitment agreed to by the company in 1982. Lot 61 with an area of 1.65ha and was donated to create Pullman Park which is located directly east of the rail bridge. Midland Brick also constructed Hallett Gardens as a public road, to provide access to the park and foreshore reserve. In 1990 Lot 65 with an area of 6.57ha (Figure 1) was donated to the crown to complete the agreed foreshore protection commitments.

1.3.2 Protection of the Ellen Brook Nature Reserve

Midland Brick owned Lot 12 Lexia Avenue, Upper Swan, which is immediately west of and adjacent to the EBNR (Figure 1). This lot is outside the current project area. As part of the proposed actions identified in the Section 46 report (RPS, 2004) Midland Brick proposed to cede a portion of this land (5.87ha) to the Crown to enlarge the potential habitat for the rare and critically endangered Western Swamp Tortoise, which was agreed as a proactive environmental initiative by the relevant authorities.

The creation of two new Certificates of Title and ceding of the agreed portion (5.87 ha) of the former Lot 12 (now Lot 301) to the crown was completed on 30 September 2006

1.4 Structure of Report

Table 1 identifies the information required to be included in the EMP as outlined in the Ministerial Statement and the location in the report this information can be found.

Table 1: Report Contents

Item	Section of Report
1. a staged excavation plan	Section 3.0
2. Acid Sulfate Soils Investigation and Management Plan	Section 7.0
3. groundwater management and protection	Section 5.0
4. progressive rehabilitation of the site	Section 9.0
5. Wetland Rehabilitation Plan	Section 6.0
6. weed management	Section 9.3
7. identification, management and protection of archaeological material, with the involvement of the Department of Indigenous Affairs	Section 8.4
8. periodic reporting of monitoring results, incorporating monitoring of excavation and sieved clay for archaeological material	Section 8.4
9. procedures to minimise noise, dust and visual impacts associated with the quarrying and transport operations	Section 8.2
10. public safety and mosquito control, with the involvement of the Department of Health at the design stage of water bodies and wetlands	Section 8.3
11. consequential changes to project management to remedy unacceptable impacts	Section 9.4
12. clearly indicated timeframes for implementation of each stage	Section 3.0

The Ministerial Statement also provides further details as to the information to be included in the Acid Sulfate Soils Investigation and Management Plan and the Wetland Rehabilitation Plan as outlined below.

Acid Sulfate Soils Investigation and Management Plan

1. Identification of acid sulfate soils in and near areas proposed to be disturbed and in the event that the disturbance of acid sulfate soils is unavoidable, the plan shall also address;

2. Potential on-site and off-site effects of the disturbance of the acid sulfate soils and/or groundwater levels;

3. How drainage or soil extraction will be undertaken to minimise environmental impacts;

4. How any acid leachate generated as a result of ground-disturbing activities will be managed;

5. Management of areas, both on and off-site, used to store or treat extracted soil;

6. Comprehensive surface and ground water quality monitoring both on and off-site, if applicable;

7. Establishment of agreed performance criteria and objectives in relation to environmental and social impacts; and

8. Contingency measures and procedures in the event that the agreed performance criteria may not be met.

Wetland Rehabilitation Plan

1. A report of a detailed vegetation and flora survey of the areas likely to be impacted by the proposal;

2. Characterisation of the habitats likely to be impacted by the proposal;

3. An integrated and progressive mining and landscaping plan designed to optimise rehabilitation outcomes and provide a range of habitats in the final landform;

4. Proposal final landforms and identification of areas to be revegetated;

5. A rehabilitation and revegetation management plan for areas of vegetation to be disturbed during excavation;

6. Agreed timelines and progressive performance criteria;

7. Monitoring against the agreed progressive performance criteria;

8. Contingency measures in the event that the rehabilitation or revegetation fails to meet agreed performance criteria; and

9. Responsibilities for continued maintenance of rehabilitated and landscaped areas.

The Acid Sulfate Soil Investigation and Management Plan were completed in 2005 by RPS Bowman Bishaw Gorham. This document was reviewed by DEC and approved. A summary of the investigation undertaken and findings is provided in Section 7.0

The Wetland Rehabilitation Plan is being completed and will be submitted as a separate document. No excavation activities will commence north of Copley Road until this plan has been approved.

2.0 OVERALL OBJECTIVES AND CORPORATE ENVIRONMENTAL STATEMENT

2.1 Objectives

The primary objective of the EMP is the protection and improvement of the environmental values of the area, including Coondaree Swamp and the Swan River. To achieve this objective, the EMP addresses:

- Management of excavation procedures (Excavation Plan).
- Management of drainage waters (Drainage Management Plan).
- Management and protection of groundwater resources (Groundwater Protection Plan).
- Rehabilitation plans for Coondaree Swamp (Wetland Rehabilitation Plan).
- Management of potential Acid Sulfate Soils (Acid Sulfate Soils Investigation and Management Plan).

Other objectives of the EMP are related to the management of local amenity and social impacts, and include:

- Management of noise, dust and visual impacts.
- Management and protection of potential impacts on Aboriginal archaeological material.
- Management for community health and safety, and
- Rehabilitation of the site.

Subsequent sections of this EMP provide details for each of the elements listed above.

2.2 Corporate Environmental Statement

Additional to the objectives listed above, Midland Brick provides the following statements as a reflection of its corporate position in relation to this EMP and the protection of the environmental values of the area.

Midland Brick Company Pty Ltd is a member of the Boral Group and is committed to managing its operations to ensure that the impact on the ecology and human population is negligible. This will be achieved through:

1. Compliance with all commitments contained within the EMP and Government by-laws, regulations and specific conditions which are applicable to the development approval.

2. Conduct of routine induction programmes to ensure that all new employees involved with this resource project are aware of the specific environmental issues and the Company's commitment to minimise the impacts of its operations.

3. Utilisation of Company-owned plant and Company employees, as opposed to contractors, to carry out all facets of the resource recovery and rehabilitation of the site.

4. Implementation of an appropriate environmental monitoring and reporting programme to manage and precent adverse effects, to report compliance on a regular basis and to report environmental incidents to the relevant authorities as soon as practicable.

5. Application of the Company's rehabilitation philosophy which supports the concept of environmentally acceptable and compatible development. Land areas that are affected by resource extraction will be rehabilitated to a landform which maintains or enhances the aesthetics of the area and will provide functional benefits for future generations.

Co-ordination and on-site supervision will be provided by the General Manager of Logistics, who is based at the Company's offices in Middle Swan.

Ultimate responsibility for the implementation of all aspects of the EMP rests with the proponent, Midland Brick Company Pty Ltd.

3.0 EXCAVATION PLAN

3.1 Objective

To implement a quarrying strategy which maximises recovery of this scarce resource and minimises the environmental/social disturbance by effectively managing the potential visual, water (quality and quantity of surface/groundwater), noise and dust impacts of this operation.

3.2 Quarrying Strategy

3.2.1 Overview

Clay is excavated and loaded directly into trucks which transport the material to the Company's manufacturing site at Middle Swan. No stockpiling of clay occurs on site. Clay excavation only occurs during the drier months of the year, October to May.

Excavation campaigns are short and are timed according to demand and the available under-shed storage capacity at the brickworks. As a general rule approximately 80 truck loads per day are required for approximately 6 to 12 days in each month.

3.2.2 Excavation Plan

Excavation History

Clay has been removed from this site each year since 1982. Excavation commenced on Lot 60 and progressed through Lot 63, Lot 64, and is now entering Lot 20. An aerial photograph of the current excavation extent is provided on Figure 2. All useable clays have been removed from Lot 60. The majority of the clay resource has been removed from Lots 63 and 64 with 0.5ha and 2.0ha respectively of land remaining to be excavated. Excavation has progressed through 2.0ha of Lot 20 with 8.9ha of land remaining (this excludes buffer zones to roads etc which are present within the lot).

Existing and Proposed Excavations

The current working faces on Lots 64 and 20 are perpendicular to Copley Road and this will be advanced by working in an easterly direction. Excavation will continue to progress eastwards into Lot 45 and south through Lots 46, 18 and 19. In addition, some of the previously mined areas within Lots 63 and 64 are being reworked to remove additional clay. Historically only one clay type has been suitable for use, but with technology advances four clay types can now be excavated from the area (including those with a higher limestone content and coarser grades).

Prior to commencing works on Lot 20 the existing surface water drain which carried runoff to the Swan River was diverted into the former pits in Lot 64 as outlined in the original EMP (BBG, 1997).

Excavation is proposed to commence north of Copley Road in 2008. This excavation will commence in the northern end of this area and progress south. Excavation within this area will include re-mining of the former pits within the site.

A staged excavation plan identifying anticipated stage dates is provided in Figure 3.

Earth bund walls which are approximately 3 metres in height have been constructed parallel to both the Great Northern Highway and Copley Road and will be retained in this position for the life of the excavation site. This bunding is multi-functional, serving the following purposes:

- To significantly reduce the potential for noise and dust export from the site.
- To provide a visual screen of the excavation to residents and road users.
- To divert water away from operational areas.

A similar process of bunding and drainage diversions will be followed during the excavation programme north of Copley Road.

Sequential Rehabilitation

The excavation method utilised can be described as sequential strip mining. A thin layer of topsoil is removed in advance of excavation, followed by overburden and inter-strata sand which are deposited into worked out areas of the pit. Where practicable, topsoil is placed directly onto completed and backfilled areas to allow pasture re-establishment in areas peripheral to operational pits and future lakes.

Generally about 200mm of topsoil and on average 4.5m of overburden is removed to expose the target clay layer which comprises approximately 5m of useful clay. Topsoil stockpiles are maintained in some instances where it is not convenient to conduct direct transfer to worked out areas of the excavation site.

Further details of the rehabilitation plans are provided in Section 9.0.

3.2.3 Lifetime

The anticipated lifetime of Midland Brick's clay deposits at this location is highly dependant on the demand for clay brick and paver products and the availability of similar clay materials from other sites. In the latter case, whenever the opportunity arises to extract clay from within the Swan Valley proper, this is excavated in preference to the current site in the Copley Road area to extend the life of the Copley Road resource area, which has less access restriction than the Swan Valley. As an estimate, it is anticipated that mining at Copley Road will continue for a further 25 years.

4.0 DRAINAGE MANAGEMENT PLAN

4.1 Objectives

The drainage management and lake management objectives may be summarised as follows;

- To ensure that turbid water from areas disturbed during excavation are retained on-site to prevent suspended solids discharge to the Swan River.

- To accept all drainage from upstream areas of the catchment without attenuation of flows to ensure that flooding of upstream areas and adjoining land does not occur; and

- To ensure that final lake design does not give rise to nuisance water quality effects.

4.2 Drainage Management

The development lies completely within the Darling Scarp-Upper Swan South Catchment which is estimated to have a surface drainage catchment area of approximately 270 ha, within which the currently approved clay excavation area occupies about 115 ha. The catchment and relative position of Midland Brick's excavation site is shown on Figure 4.

Diversion and amalgamation of the drainage discharge points from this catchment to the river, means that Midland Brick is responsible for acceptance of surface drainage from all areas of the catchment external to its site. An agreement was entered into with the City of Swan when the former drainage easement was closed. Further information on the agreement requirements is provided below.

4.2.1 Management Strategies

As a consequence of the agreement with the City of Swan, the following management strategies are implemented to ensure that the drainage objectives are met:

- Run-off from operational areas of the site is collected and contained within the working pits. This is achieved by the presence of the surrounding bunds and strategic contouring of disturbed areas (including spoon drains where necessary) to ensure drainage is internal to the operational area.

- Run-off from the rehabilitated areas of the site (ie. Lots 60 and 63) is drained to a lake in Lot 63. This lake was formed in 1983 from an exhausted pit and has evolved into a low turbidity, freshwater wetland with an average water depth of 4m. It has the capacity to accept all runoff from adjoining land without overflowing.

- Run-off from the balance of the catchment, which includes some of Midland Brick's land (currently utilised for pasture) but mostly comprises land not under the Company's control, was originally collected within the drainage diversion system and discharged to the Swan River. This drainage system has now been re-aligned so that surface water flow from the catchment enters the pits north of Copley Road, and once these water bodies reach their full capacity would overflow into the northern pit within Lot 64, which in turn can overflow into other pits within the working area.

  Importantly, the system has the capacity to retain all flow onsite from the surface drain resulting in no direct discharge of surface water to the Swan River.

Once excavation and rehabilitation at the site is completed the drainage system can again be allowed to overflow into the Swan River

4.2.2 Dewatering

The water table below the remaining lots proposed for excavation south of Copley Road is 10-15 metres below the surface, and mining is expected to be well above this level. However, in the event that a shallow zone of water bearing sediments is intersected during excavation this water will be contained within the excavation pit. No direct discharge to the drainage diversion network will occur under any circumstances.

On the northern side of Copley Road the clay is known to extend below the water table (refer to Section 5.0) although excavation will not go beyond the water table depth.

Three separate pits are present on the western side of Coondaree Swamp. In order to excavate the clay resource yet preserve the function of the pits as drought refuge and fauna habitat only one pit will be drained and excavated at any one time. Water from the pit intended for excavation will be drained into the other two pits and allowed to dry before excavation is undertaken.

4.2.3 Monitoring and Remedial Action

Water Quality Monitoring

The major potential effect of clay excavation is generation of silt-laden run-off and colloidal suspensions. All surface drainage generated from the disturbed and rehabilitated areas south of Copley Road is directed to the lake system, which terminates within the sedimentation basin on Lot 63.

Drainage north of Copley Road will follow these same principles with all runoff from disturbed and rehabilitation areas retained onsite.

A 900mm diameter outfall pipe that was constructed in 1982 to drain excess water from the catchment to the Swan River via the sedimentation basin on Lot 63. This outfall was functioning as designed from 1983-1987 in accordance with a Swan River Management Authority licence to discharge. Turbidity levels proved difficult to control mainly due to wind driven wave action eroding fresh dam embankments and sluicing clay into solution. In 1987 the outfall was blocked off with an earth embankment to prevent free flow to the river to prevent contamination of the river. Practically all water from the 270ha catchment is retained within the current excavation areas with the exception a small catchment of less than 1ha at the mouth of the outfall pipe. Runoff from this catchment is collected in a dam which dries up soon after winter by evaporation and percolation into the soil. Some of this stored water can find its way into the outfall due to overflow from the dam or seepage through soil covering the intake pipe.

Water quality monitoring for the Swan River outfall was historically undertaken by Bowman Bishaw Gorham to observe if any significant suspended sediment plumes occur in the river from the piped discharged system. Visual inspections did detect some turbidity in the stormwater diversion outflow, however volumes were extremely small (say less than 1 litre per second), and most often non-existent. Following entry to the river, the outflow from the site was immediately diluted, literally within metres, and subsequently not visually apparent, and as such may be considered insignificant. This

has been reported in Performance and Compliance Reports. The amount of flow seeping to the river has diminished with time and dryer seasons. Discharge to the river is considered to be insignificant and only requires random monitoring and no discharge licence is considered necessary until the system becomes fully functional in the future.

4.2.4 Reporting

Any changes to the drainage system will be included in the Performance and Compliance Reports which are submitted to the Department of Environment and Conservation.

4.3 Lake Management

Lakes management has largely been restricted to consideration of conceptual design elements, although some preparatory facilities for water level control have been put into place. The main elements of conceptual design are outlined below.

Water Budget

The system of interconnected lakes will be designed with regard to the expected yield and the final excavation depths. This lakes system will be constructed above the water table therefore water input to the lakes will be predominantly from runoff in the catchment and from direct rainfall to the lakes. Water losses from the system, once completed, will be via outflow to the Swan River with evaporation with some infiltration and recharge of underlying aquifers also occurring.

Water Level Control

A study of catchment water yield has shown that when the project is completed seasonal water level variations within the lake are likely to be experienced. Lowest water levels would occur in March/April, and the lake system will be designed to retain at least a 1 metre water depth during this period. Water level variations in dry years are not expected to cause unsafe or unsightly lake banks, as slopes will be gently graded for public safety and bearing in mind the rural setting of the site.

To assist with water level control the permanent piped drainage outflow, from the lake at the southern end of Lot 63 has been constructed with an adjustable weir structure at its intake that is designed to eventually maintain the lakes water level at a pre-determined height which will initially be set to approximately 11mAHD. Currently the weir system is not in use and will not be commissioned until practically all of the clay resource has been removed from south of Copley Road. The weir will enable flexibility in control of lake levels and also discharge rates to the river. For example, the weir could be lowered during the early winter runoff period to maximise the flushing of the lake water which remains at the end of summer, subject to confirmation via monitoring that the condition of the lake water is acceptable for discharge. Also the weir could be raised during late winter to maintain a high level of storage to compensate for summer evaporation losses and infiltration.

To promote purging or free flow through the lakes a hydraulic gradient will be incorporated into the design so that some cascading occurs between main water bodies. The furthest lake from the river north of Copley Road would be designed have surface RL at 15 mAHD, with intermediate surface levels dropping down to the outfall to the Swan River invert which is set at 11.15 mAHD. Ultimately the existing concrete culvert which carries runoff under Copley Road will need to be replaced. This can be achieved by non invasive boring techniques once the design invert RL's have been determined and agreed to.

Water Quality

It is anticipated that the quality of stormwater drainage inputs to the lakes from the catchment will not pose a risk of adverse water quality effects within the lakes. Water balance considerations and examination of the catchment characteristics indicate that approximately 40% of the water input into the system will be near-pristine water quality (ie. direct rainfall and runoff from the Darling Scarp portion of the catchment).

In addition, the lake water will be well flushed by winter runoff. Preliminary design calculations indicate that the lakes system could be flushed between 2.5 and 3 times in a year depending upon climatic conditions. However, the ultimate volume of the lake system will be dependant on a range of factors, including the overburden and "inter-burden" ratios which influence the volume of material to be placed back in the pit.

The proposal to place islands in the larger open water should assist in promoting mixing of through flow water to ensure good flushing (the islands will also provide good fauna refuge and habitat). During more detailed design of the lakes system and examination of input water quality it may be considered beneficial to incorporate filter beds to function as pre treatment basins at some areas of water input from adjoining agricultural land.

5.0 GROUNDWATER PROTECTION PLAN

5.1 Objectives

- The primary objective of the Groundwater Protection Plan is to prevent pollution of the underlying groundwater systems (Guildford and Leederville aquifers) from such agents as fuel and oil spillages.

Midland Brick has previously supplied evidence to the EPA that the Ellen Brook Nature Reserve is not hydrologically linked to the clay deposit on the site. Subsequently, the EPA concluded that excavation of clay on the site is most unlikely to interfere with the water regime in the vicinity of the Nature Reserve (EPA Bulletin No. 599, 1991), therefore groundwater protection from this perspective is not an issue.

5.2 Groundwater Level Monitoring

In the period soon after approval to commence development was granted, the designated excavation area was drilled on a 50m square grid to assess the clay resource and depth to water table. Midland Brick also monitored groundwater levels in three boreholes between 1983 and 1989 (see Figure 5 for bore locations). This data revealed that in the area South of Copley Road, the water table is 10-15 metres below ground level (bgl) (see Table 2) and all mining has been, and is expected to remain above this level. North of Copley Road the water table was estimated at 7-10 mbgl, and some clay exists 1-2 metres below the water table.

Table 2: Groundwater Data – South of Copley Road

Lot No	Bore Depth	Average Depth of Water Table	Range
60	26.0m	15.1m	14.7 - 15.5m
63	17.6m	14.7m	14.03 - 15.2m
20	23.2m	10.1m	9.9 - 10.4m

m – metres below ground level

Additional investigations were undertaken north of Copley Road in April 2005. Groundwater was detected at approximately 10mgbl at four locations and not detected at seven locations where investigation depths ranged from 6 to 14mbgl (Figure 5). This indicates the depth to groundwater may be similar to that on the southern side of Copley Road (i.e. 10-15 mgbl).

5.3 Groundwater Protection and Pollution Control

The primary means of minimising risk of groundwater contamination, for example from accidental spillages or leaks from excavation machinery, is to position the excavator on top of the exposed clay bench and excavate the working face 'from above'. By way of comparison, if the excavator is positioned on the floor of the pit, to excavate the working face 'from below' then the machine would be located much closer to the water table. The method adopted is only feasible because of the structural stability of the clay in proximity to the working face (as opposed to sand quarries where this method would generally be too hazardous).

The excavator loads the clay directly into road trucks. The excavating equipment and trucks operate on the exposed clay and within a bund formed by 'over–break' from the digging action. In the event that a spillage occurs, the low permeability clay surface and bunding would contain it to a localised area which is well above the water table.

Other management procedures adopted as a matter of routine are listed below.

- Only the excavation machinery (dozer, hydraulic excavator and dump trucks) is refuelled on-site; the trucks and water-cart are refuelled elsewhere.

- On-site refuelling is conducted via a fuel truck which only visits the site for the duration of re-fuelling. The truck is fitted with vacuum extraction equipment which can recover wastes, if necessary, to be returned to Midland for disposal.

- No fuel or lubricants are stored on-site.

- Machinery is not left on-site during winter and no mining or transport of clay occurs during periods of wet weather, therefore removing the possibility of any spillage being flushed into deeper areas of the pit.

- In the unlikely event that a substantial spillage occurs, the contaminated sediments will be excavated and removed from the site to an approved disposal location.

- A contractor provides portable, self-contained chemical toilets to the site, and waste products are removed on a weekly basis.

5.4 Reporting and Consultation

- Any unusual seepage event observed within the excavation will be documented and reported.

- In the event of a diesel spillage in excess of 20 litres, Midland Brick will immediately inform the appropriate District Officer of the Water Corporation, to enable consultation regarding appropriate recovery action.

6.0 WETLAND REHABILITATION PLAN

Coondaree Swamp is essentially a localised depression in an agricultural environment that contains winter rainfall due to the nature of the clay substrate. The western side of Coondaree Swamp has previously been excavated and consists of a series of un-rehabilitated steep-sided pits varying in depth from around 3m to 15m deep which over approximately half of the swamp's extent. Midland Brick had approval to excavate clay from the eastern side of the wetland, but this was never completed.

The swamp was fully cleared approximately 25 years ago in preparation for clay excavation, however the remnant area of swamp was identified by Midland Brick as having drought refuge function, and this was reflected in the proposed and approved Environmental Management Plan for the project (BBG, 1997). Consequently, the company did not proceed with its previously intended excavation program of the area at this time.

Midland Brick now intends to excavate clay from the total area of the swamp remaining within Lot 7, and to more deeply excavate the previously disturbed areas in Lot 19 Copley Road and Lot 100 Great Northern Highway. This was approved by the Minister for the Environment in 2005.

Excavation is proposed to commence north of Copley Road, in the vicinity of Coondaree Swamp in 2008. A Wetland Rehabilitation Plan (WRP) is currently being prepared in accordance with the requirements of Ministerial Statement 699 to guide excavation and rehabilitation activities in this area. No excavation will commence north of Copley Road until the WRP has been approved by the DEC.

7.0 ACID SULFATE SOILS INVESTIGATION AND MANAGEMENT PLAN

7.1 Objective

To ensure that any ground-disturbing activities which may disturb Acid Sulfate Soils (ASS) and/or contaminated waters are planned and managed to avoid adverse effects on the natural and built environment, human activities and health.

7.2 Investigation and Conclusions

An Acid Sulfate Soils Investigation and Management Plan (ASSIMP) was prepared on behalf of Midland Brick by RPS Bowman Bishaw Gorham and submitted to the (then) Department of Environment in 2005 to fulfil Condition 6-1 of Ministerial Statement 699. A summary of the investigation and findings is provided below.

Scope & Objectives

The principal objectives of the investigation were to assess (i) the presence, distribution and magnitude of Potential Acid Sulfate Soils (PASS) in and near areas proposed for disturbance per condition 6-1(1) and (ii) identify the need for management and monitoring measures during the clay excavation program per condition 6-1(2)-(8). Tasks undertaken in support of the preparation of the ASSIMP included:

- Compilation and review of existing environmental data and exploratory drill logs to characterise site features, including local soils, hydrology and hydrogeology.

- A comprehensive soil sampling and analysis program to investigate the presence, distribution and magnitude of PASS in areas proposed for direct disturbance as a consequence of clay excavation. Midland Brick has advised that dewatering is not conducted in support of clay excavation works and indirect disturbance of PASS due to groundwater drawdown is not expected. It is understood some pumping does occur to control surface water accumulations above the clay unit during the winter months.

- A baseline groundwater sampling and analysis program to (i) assess background groundwater quality prior to earthworks disturbance and (ii) to provide an indication of acid sulfate soil impacts at the watertable that may have occurred due to past mining activities.

- Comparison of field and laboratory acid sulfate soil test data with applicable Department of Environment (DoE) guidelines and action criteria to assess potential management implications associated with the proposed clay excavation program.

The completed field and laboratory program included the following:

- Inspected and sampled the soil profile at 11 locations to target depths varying between 6 and 14mbgl, yielding an average depth of investigation of 8.8mbgl. Soil investigation bores were sampled using a push-core drill rig and were generally terminated below the estimated base of excavation at each location. Combined soil and groundwater sampling sites were investigated using a drill rig with hollow-stem auger and split-spoon attachment. All locations were targeted within the Coondaree Swamp "High ASS Risk" zone mapped by DoE / WRC (2004), taking account of access constraints imposed by the remnant clay pits and main drainage corridor bisecting the site. Exploratory drilling records compiled by Midland Brick between 1982 and 1983 were reviewed in detail to assist in the planning phase of the investigation. The proposed sampling density was considered adequate to sufficiently characterise the ASS characteristics of soils within the site, based on the low geological and geomorphological variability within the identified risk zone.

- Installed permanent groundwater monitor bores at three of the soil investigation locations to enable assessment of baseline water quality characteristics prior to earthworks disturbance.

- Recovered 208 discrete soil samples for field pHF and pHFOX analysis in accordance with DoE requirements, to provide a preliminary indication of the presence of PASS, Actual Acid Sulfate Soils (AASS) and/or Non Acid Sulfate Soils (NASS).

- Conducted selective SPOCAS and/or CRS analysis on 34 samples to confirm the presence or absence of PASS, corresponding to approximately 17% of the total number of recovered samples.

Findings

Field pHF and peroxide pHFOX data indicated the following:

- 198 of the 206 samples analysed in the field (approx. 96%) exhibited pHF and pHFOX results, which were indicative of NASS.

- 8 of the 206 samples analysed (approx. 4%) exhibited pHF and pHFOX results, which were indicative of PASS.

- No test results indicated the presence of AASS.

The identified PASS horizons largely corresponded to near-surface (<1.5mbgl) deposits of silty clay and/or silty sand, significantly above the watertable. Soils tested below the watertable did not indicate the presence of PASS.

Confirmatory laboratory SPOCAS and CRS assessment results are summarised below:

- All 34 samples analysed contained chromium reducible sulfur (CRS) concentrations below laboratory detection limits, confirming the absence of reduced inorganic sulfur in samples recovered from beneath the inferred high risk zone of Coondaree Swamp.

- Laboratory analysis results confirmed that the PASS characteristics observed in the field for samples CSA4-1A, CSA9-1A, CSMB1-1, CSMB1-1A, CMB2-11A, CSMB3-1, CSMB3-2 and CSMB3-1A were not attributable to reduced inorganic sulfur. pH drops reported in the field appear to be of organic origin and constitute a low overall environmental risk.

- The estimated average existing plus potential acidity (STAA + SCR) of soils subject to confirmatory laboratory analysis is 0.008%S, which is below the DoE's trigger criterion of 0.03%S (for sandy textured soils). Albeit, existing plus potential acidity in near surface sample CSMB2-1 marginally exceeded the trigger criterion of 0.03% by 1.06-fold, this exceedence was not attributable to reduced inorganic sulfur. Soils at this location should not require precautionary management, given the marginal nature of the exceedence, the inferred organic source and the clayey texture of the material.

- The estimated average titratable potential acidity (STPA) of the analysed soils is 0.015%S, which is also below the DoE's 0.03%S trigger criterion. Whilst titratable potential acidity results (STPA) above 0.03%S were reported in four samples (CSA4-2, CSA5-5A, CSMB3-2 & CSMB3-7A), Acid Neutralising Capacity (ANC) data indicates excess self-buffering capacity within these soils, which will counteract potential organic acidity if released during clay excavation.

In accordance with prevailing (then) DoE requirements, a baseline groundwater investigation was conducted to assess water quality characteristics beneath the site prior to disturbance.

Reported concentrations of ASS indicator species (including total alkalinity, sulfate, chloride, manganese, aluminium, arsenic and pH) do not indicate groundwater is being affected by the oxidation of sulfides at the watertable.

Conclusions

Confirmatory laboratory results indicate that reduced inorganic sulfur (i.e. SCR) is absent from all soil type associations recovered from beneath Coondaree Swamp.

Slightly elevated titratable potential acidity (TPA) results in 4 of the 34 samples analysed appear attributable to organic acidity and should not require precautionary treatment or management measures. Excess buffering capacity also exists in these soil horizons.

The overall results indicate that clay excavation operations should be able proceed as proposed across the entire site without implementation of special treatment and/or management precautions.

7.3 DEC Advice

Following review of the ASSIMP the (then) Department of Environment advised that the requirements of Condition 6-1 had been met. This advise was provided based on the understanding that dewatering of the shallow aquifer is not required as part of the clay excavation works.

The DEC has requested to be notified if any groundwater results at the site indicate that sulphide oxidation is affecting the quality of the groundwater; and/or if there will be disturbance of a soil lithology that were been assessed in this investigation and are likely to have ASS characteristics.

8.0 MANAGEMENT OF SOCIAL IMPACTS

8.1 Objective

Midland Brick currently operates the clay quarry to meet the following objectives:

- within noise and dust limits which can be tolerated by the local community with minimal inconvenience and in accordance with existing noise regulations;

- to ensure that community health and safety standards are maintained in terms of such factors as pit safety and mosquito breeding potential;

- to ensure compliance with the requirements of the *Aboriginal Heritage Act 1972.*

8.2 Noise and Dust

8.2.1 Noise and Dust Controls

The three metre high earth bund formed on the western and northern boundaries significantly reduces the potential for off-site export of both dust and noise emission. With the exception of clay haulage vehicles entering and leaving the site, machinery operates below the line of sight from the Highway and Copley Road. In addition, Midland Brick has planted a 20 metre wide corridor of trees along the Great Northern Highway frontage. The bund walls have also been vegetated to minimise visual impacts of the site.

The noise and dust controls which are practised by Midland Brick at other clay excavation sites are applied to quarrying this current site. Three company-owned 18,000 litre water tankers are constantly in use during the clay digging season to suppress dust. Excavation and road transport operations are suspended during severe wind conditions which have the potential to cause dust which cannot be controlled by water tankers.

Midland Brick's road transport fleet is equipped with air bag suspensions and body locks which significantly reduce body rattle or noise emission. The noise generated from earth moving equipment has been evaluated and wherever possible, diminished by additional suppression methods, including bunding around the pits.

8.2.2 Complaints Procedure

No complaints have been received by Midland Brick regarding the site since commencement of operations. On-site personnel are advised to report any complaints immediately, including name and contact details of complainant and nature of complaint, to the Raw Material Manager at Midland Brick's Head Office in Middle Swan. A complaints record is maintained by the Company.

In the event that a complaint is received, the matter will be investigated and the complainant advised of the reasons for the perceived nuisance and the remedial action (if necessary) to prevent a re-occurrence of the problem.

Every endeavour will be undertaken to respond to complaints within 2 working days. The nearest residences are shown on Figure 2, along with the access point to Great Northern Highway and nearby 24hour service station and restaurant complexes.

8.3 Community Health and Safety

Discussions were previously undertaken with a health surveyor from the (then) Shire of Swan in relation to mosquito breeding within the pits. There is recognised potential for open water areas to be a breeding ground for mosquitoes wherever there is sufficient shelter to prevent wind-induced turbulence of the water's surface.

To preclude mosquito breeding activity the Shire's health surveyor recommended that the pits are maintained with relatively sharp edges (i.e. no shallow water areas where small pools may form as water levels decline in summer) and the sides are maintained clear of vegetation which would otherwise provide sheltered water. This will be accomplished in the clay pits during their operation life.

Ultimately, the lakes formed during the rehabilitation program will be re-contoured at the sides with grades that do not pose a public safety issue. The final lake layout and design will aim to minimise the potential for mosquito breeding using the following initiatives:

- Orientation of lakes to maximise wind action which can produce surface waves to disrupt larval respiration and inhibit algal growth which is a food source.

- One-phase wetlands that have continuous vegetation throughout produce more mosquitoes than multi-phase wetlands that have vegetated regions separated by a regions of comparatively deeper open water. This multi-phase wetland design will be achieved through incorporation of islands and shallow areas within the water bodies.

- The water body will include areas of open (and deep) water. Open water allows wind and wave action to limit mosquitoes and encourages establishment of aquatic predators, and the combination of both deep and shallow areas allows a mixing of biota from both habitats, increases the diversity of invertebrates and vertebrates, including predators, and thus mitigates against mosquito production.

- A mix of emergent plant species and patchy distribution will be provided to support greater fauna diversity (including mosquito larvae predators) which leads to fewer mosquitoes than water bodies with a single plant species.

- Lakes will be designed to minimise the edge to area ratio where possible which reduced the favourable mosquito habitat area. Linear shorelines also provide less area for refuge from mosquito larvae than do convoluted shorelines.

The existing fences and gates will be maintained in functional condition to deter public access to the site. "This clay excavation site is managed by Midland Brick Company No unauthorised entry 92735522" signs are present at intervals on the perimeter fence. Gates are locked when the pit is not in operation.

8.4 Archaeological Material

A search of the Department of Indigenous Affairs database has identified the following sites within the vicinity of the project area:

- Buyat Cullung (3830) – Ceremonial, Mythological, Man-Made Structure
- Ellen Brook: Upper Swan (3525) – Mythological
- Millendon 05 (4073) – Artefacts / Scatter
- Putative Scarred Trees (Scarred Trees 2-6) (17917) – Scarred Trees
- Swan River (3536) – Mythological
- Tjitti – Tjitti (3831) Mythological
- Upper Swan Bridge (4299) – Artefacts / Scatter
- Yagan Skirmish Area (17838) – Historical

Midland Brick has previously donated land to the Crown for Aboriginal heritage conservation purposes and are aware of their obligations under the *Aboriginal Heritage Act 1972*.

Equipment operators who undertake clay excavation at the site have been instructed to report any finding of material which could have Aboriginal heritage significance to the site supervisor and suspend excavation in that area until confirmation is received if the material has Aboriginal heritage significance and protected under the Act. To date no material with potential Aboriginal heritage significance has been identified during excavation.

An Archaeological Inspection of the site was undertaken by SJC Heritage Consultants Pty Ltd in December 2006 to search for materials of Aboriginal heritage significance. A full copy of the survey report is provided in Appendix B. The report identified the following:

- The clay deposits targeted by Midland Brick Company are believed to predate human occupation of the region – if so, the deposits are unlikely to contain artefactual evidence.

- The overlying soils above the clay deposits are contemporaneous with, or post date, the earliest known human occupation of the region. These sands, and some alluvial terrace deposits, particularly areas fringing the Swan River, may have potential for containing artefacts or other archaeological materials including burials.

- The preliminary archaeological inspection conducted by SJC Heritage Consultants did not identify the presence of any Aboriginal artefacts.

Based on the recommendations for further archaeological assessment Midland Brick Company propose to employ Aboriginal monitors to observe the removal of topsoil and overburden to identify if any archaeological materials of Aboriginal significance are present.

9.0 REHABILITATION

9.1 Objective

To progressively restore the excavations, as far as practically possible, to a landform that is aesthetically pleasing and functional, and capable of supporting a viable end use to the satisfaction of the land owners.

Section 6 of this EMP addresses rehabilitation of Coondaree Swamp.

9.2 Regional Rehabilitation Planning

In terms of final land use for the site and locality, in it's submission to the Environmental Protection Authority (EPA) regarding the CER for the project, the (then) Department of Planning and Urban Development (DPUD) indicated that it would be appropriate for the proponents of the different excavation proposals to prepare a comprehensive long-term rehabilitation/development strategy for the locality, in consultation with the Council, EPA and the DPUD. The strategy could be based on transforming the excavation sites into a wetland system surrounded by compatible recreation and tourism developments.

Further to this advice a Regional Development, Drainage and Rehabilitation Strategy was jointly prepared by the clay extraction proponent in the Upper Swan locality (BBG, 2001). This strategy has been approved by the relevant stakeholders and the DEC (formerly Department of Environmental Protection).

This strategy identified that the Hallett and Copley Road site would be rehabilitated to a series of wetlands within the excavation sites. Shade a screening of the wetlands was to be provided through revegetation with perennial shrubs and trees, and other areas to be planted with mixed-pasture species common to the locality.

9.3 Rehabilitation Program

Midland Brick is committed to undertake progressive restoration of the site following clay excavation, to the greatest extent possible (ie. without compromising drainage management and containment objectives).

9.3.1 Landform Design and Drainage Control

Drainage control and, to a certain extent re-contouring of each pit, will be instituted immediately on completion of each season's excavation campaign, prior to the onset of winter rains. Re-contouring of pit walls to acceptable grades will be conducted for safety reasons.

Following the exhaustion of the clay resource and cessation of mining in each stage, the site will be rehabilitated in accordance with the final land use for the site, which is proposed to be a chain of lakes which will form part of the regional drainage system and pasture areas in accordance with the rural zoning of the area.

The location, size and configuration of the lakes will vary depending on the amount of clay excavated and the suitability of the soils for wetland establishment. Lakes also be designed considering the catchment hydrology and the necessary volumes to maintain the specific habitat requirements. Features to reduce the potential for mosquito breeding as described in Section 8.3 will also be incorporated in the final design.

A variety of slopes from the shoreline will be constructed to increase habitat diversity, whilst still maintaining public safety. The cell-by-cell excavation process provides opportunities to create islands which will improve visual and habitat variety of the lake system. These islands will also provide nesting refuges for local bird populations and provide security from feral animals.

The conceptual configuration of the lakes and tree planting areas is shown on Figure 6. The final configuration will determined in consultation with the City of Swan.

Rehabilitation will firstly involve overburden being used to partially back-fill each pit, however there will be insufficient material to totally fill the excavated areas. The water table will be approximately 2.5-5.5 metres below the ground surface north of Copley Road, and 5.5 - 10 metres below surface south of Copley Road.

Topsoil skimmed from the site prior to clay excavation will be placed onto the lake’s embankments in preparation for planting.

Detailed designs of the lake system will be provided in the decommissioning plans.

9.3.2 Vegetation Establishment

Vegetation will be planted around the perimeter of the lakes to provide shade, reduce the potential for erosion, assist with nutrient update and act as a screen from adjoining properties and road reserves. Aquatic vegetation will also be used to create a benthic community. Sedges such as *Baumea articulata* will be established given their affinity to clay soils and drought resistance and submergent species will also be introduced for habitat establishment within the lakes. Seeding and planting of tube stock will be undertaken during autumn prior to winter rains. Local native species will be used exclusively in the rehabilitation programme.

Table 3 provides native species have been identified in the surrounding areas, and are suggested for revegetation given their suitability for the soil type and hydrological regime.

Table 3: Suggested Species for Revegetation

Scientific Name	Common Name
Trees	
Allocasuarina fraseriana	Common Sheoak
Eucalyptus accedens	Powderbark Wando
Coryumbia calophylla	Marri
Eucalyptus rudis	Flooded Gum
Eucalyptus wandoo	Wandoo
Melaleuca rhaphiophylla	Freshwater Paperbark
Shrubs	
Acacia pulchella	Prickly Moses
Acacia saligna	Golden Wreath Wattle
Callistemon phoeniceus	Lesser Bottlebrush
Hakea trifurcate	Two Leaf Hakea
Hakea varia	Variable Leaf Hakea
Jacksonia furcellata	Grey Stinkwood
Jacksonia sternbergiana	Green Stinkwood
Viminaria juncea	Swishbush
Hardenbergia comptoniana	Native Wisteria
Hypocalumma robustum	Swan River Myrtle
Hypocalymma angustifolium	White Myrtle

Table 3 Continued

Scientific Name	Common Name
Aquatic Species	
Baumea articulata	Jointed Twig Rush
Eleocharis acuta	Spike Rush
Juncus pallidus	Pale Rush
Marsilea drummondii (submergent)	Nardoo
Villarsia albiflora (submergent)	Villarsia

Disturbed areas surrounding the lakes will be planted with mixed pasture species common to the area.

9.3.3 Weed Control

Regular monitoring will be undertaken within the revegetated areas surrounding the lakes to detect weed invasion. Weed surveys to assess the presence of weed species will be undertaken annually in spring by a qualified botanist. Any necessary weed removal will be undertaken with guidance from the botanist.

Weeds will be controlled using methods described in Water Note "Herbicide Use in Wetlands" (WRC, 2001). Methods will include physical removal (including hand weeding and slashing prior to seeding) or using a herbicide applied by hand spray or wand. In order to minimise the risks associated with herbicide use near wetland areas the following will be undertaken:

- Herbicides will be applied at the recommended rate.
- Apply spray at the correct time of year (when growth is strong and seeds have not set).
- Provide follow up weed treatment to minimise repeat herbicide application requirements.
- Application to be avoided at times when plants are under stress (such as very hot days and dry to dusty condition) to assist with maximum herbicide uptake.
- Avoid spray application on windy days or when rain is likely.
- Avoid the use of surfactants.

The remaining area of the site will be planted with pasture species common to the area. Weed presence in this area will be visually monitored each winter/spring. Should any declared weeds be detected they will be removed in accordance with the methods recommended by the Western Australian Department of Agriculture.

9.3.4 Work Undertaken to Date

Some of the site has already been rehabilitated to final landform as indicated on Figure 6. The success of the rehabilitation strategy is evident, with the contained lake water exhibiting improved clarity and Black Swans breeding on the lake margins.

9.4 Management and Contingency Measures

Due to the progressive nature of the rehabilitation program and the anticipated life of the project (approx. 25 years) the effectiveness of vegetation establishment and survival will be reported within the Ministerial Statement 699 Performance and Compliance and Performance Review Reports.

It is noted that by the time mining activities are finished at the site the majority of the lake and rehabilitation areas (estimated at >90% of the site area) will be established. Rehabilitation techniques would therefore be thoroughly tested by this time and modified to achieve greater success if required. The staging of the operation will be planned so that the lake establishment would be complete at this time with the final extraction areas being returned to pasture land.

Management actions proposed for the site if required are identified below.

Should erosion of the landforms occur an assessment will be undertaken to determine the likely cause, and if modification of the landform is required to prevent a repeat occurrence. Re-establishment of the eroded area will be conducted to fix the current erosion damage.

The following measures will be enacted as required for areas of native vegetation rehabilitation:

- Assessment of the likely reasons for plant deaths and identification of any changes required to revegetation management. If changes are required the DEC will be informed of the refined strategy.

- Plant survival rates will be monitored and native vegetation rehabilitation areas around the lakes will be maintained at an average 2,000 plants/ha by initially planting at a higher density and replanting as necessary.

- In areas of the lakes where revegetation is proposed aquatic plants will be maintained at 4 plants/sq. metre by initially planting at higher densities and replanting as necessary.

Excessive weed growth within native revegetation areas, which is identified as greater than 40% weed coverage, will also trigger the need for a contingency response. The contingency response for excessive weed growth will include the application of further herbicide or additional hand removal.

In areas of pasture species revegetation should the presence of Declared Weeds, as identified by the WA Department of Agriculture be detected they would be removed as described in Section 9.3.3.

If weed removal is not successful in either the native or pasture rehabilitation areas, alternative treatments will be considered, including the commissioning of a weed removal expert.

9.5 Implementation

As the owner and operator of the site Midland Brick will undertake, undertake, manage and fund the rehabilitation program until the agreed completion criteria are met.

Preliminary completion criteria are identified as follows:

- Planted vegetation is established and in a self sustaining condition with. no summer irrigation required. Plant density within native vegetation rehabilitation areas to be stable at 2,000 plants/ha.

- Annual monitoring results to show that weed presence in the rehabilitation areas is not increasing.

- Lake system is fully integrated with regional surface drainage. This will involve allowing all surface drainage waters which flow into the site from the surface water drainage catchment into the northern wetland and then through the wetland chain. The overflow connection between the most southern lake in the wetland chain to the Swan River will also opened (valve is currently in place but intentionally blocked).

- No major erosion of the onsite drainage system is occurring. This will be determined through twice annual surveys following summer and winter during the rehabilitation period.

Final completion criteria will be agreed with the relevant stakeholders during review of the Final Decommissioning Plan. The review process is proposed as follows:

1. Midland Brick to prepare a Draft Final Decommissioning Plan which includes the information required by the Ministerial Statement.

2. Draft Final Decommissioning Plan to be submitted to the City of Swan, Swan River Trust and the DEC for comment.

3. Comments to be incorporated into report and re-submitted to DEC for assessment and approval.

4. Midland Brick to implement the approved Final Decommissioning Plan.

10.0 REFERENCES

Bowman Bishaw Gorham, 1997. *Environmental Management Programme – Clay Excavation Lots 60, 63, 64, 20 & 7 Copley Road Area, Upper Swan*. Report prepared for Midland Brick Company Pty Ltd (Report Ref. MI6274).

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Environmental Protection Authority. 1991. *Clay excavation, Part Lot 1 and Lots 222, 27, 26, 25, 28 and 7 Hallett and Copley Roads, Upper Swan.* Bulletin No. 599, Report and Recommendations of the Environmental Protection Authority, Perth, Western Australia.

Gibson, N., Keighery, B.J., Keighery, G. J., Burbidge, A. H. and Lyons, M. N. (1994): *A Floristic survey of the southern Swan Coastal Plain.* Unpublished Report for the Australian Heritage Commission prepared by Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.).

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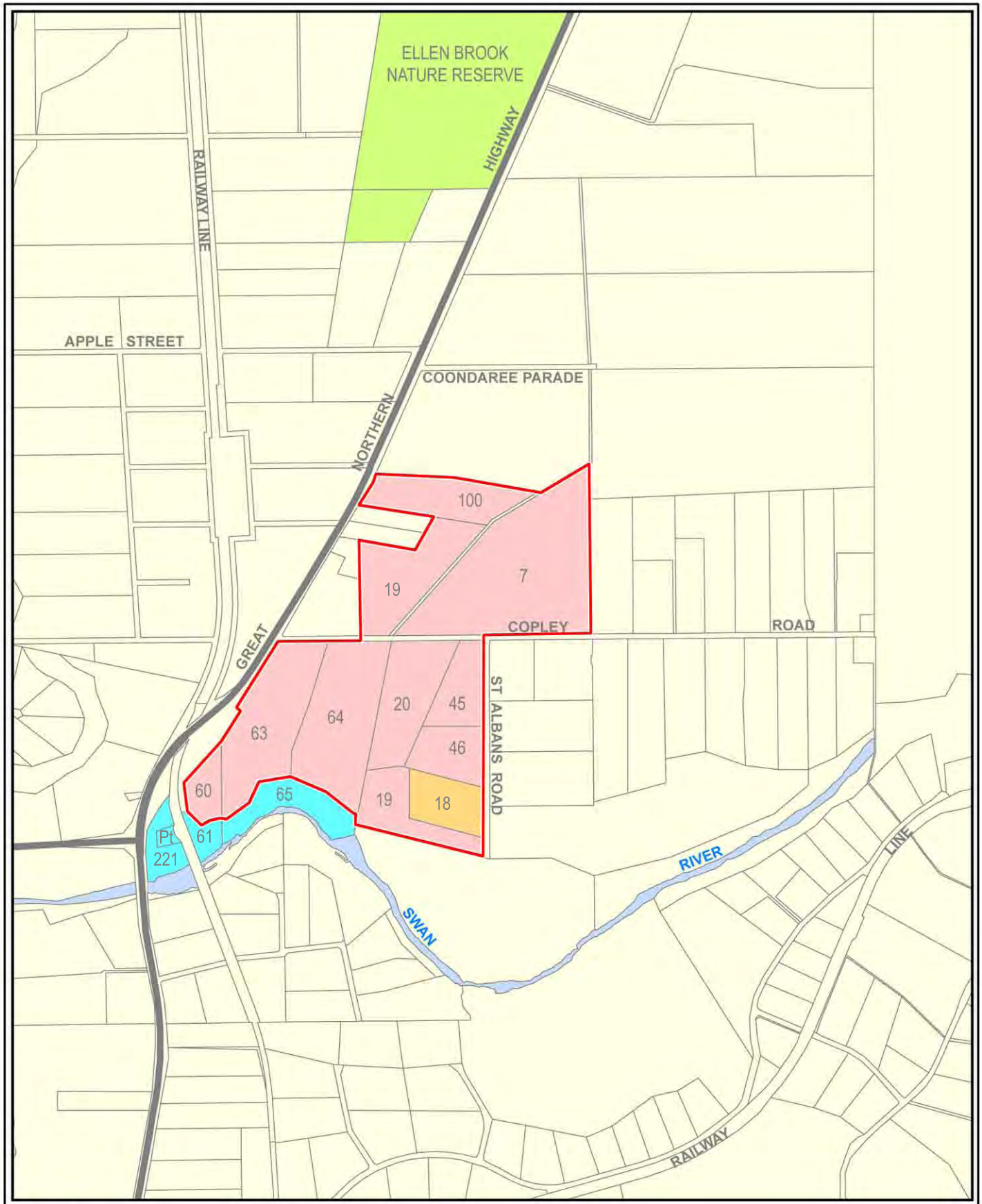
SJC Heritage Consultants Pty Ltd. 2006. *Archaeological Inspection Report – Proposed Expansion, Copley Road Clay Pit, Upper Swan.* Report prepared for Midland Brick Co., by Stephen J. Corsini. December 2006.

Water and Rivers Commission. 2001. *Water Note – Herbicide Use in Wetlands.* Water and Rivers Commission, Perth.

FIGURES



LEGEND

- Site Boundary
- Clay Excavation Areas approved in Ministerial Statement 699
- Land donated to Crown by Midland Brick Company
- Land Requested for Inclusion in Approved Excavation Area (2006)
- Ellen Brook Nature Reserve

N

0 300 900 1500m

Scale 1:20000

L99195 01.11.06

Figure 1

Site Location and Layout

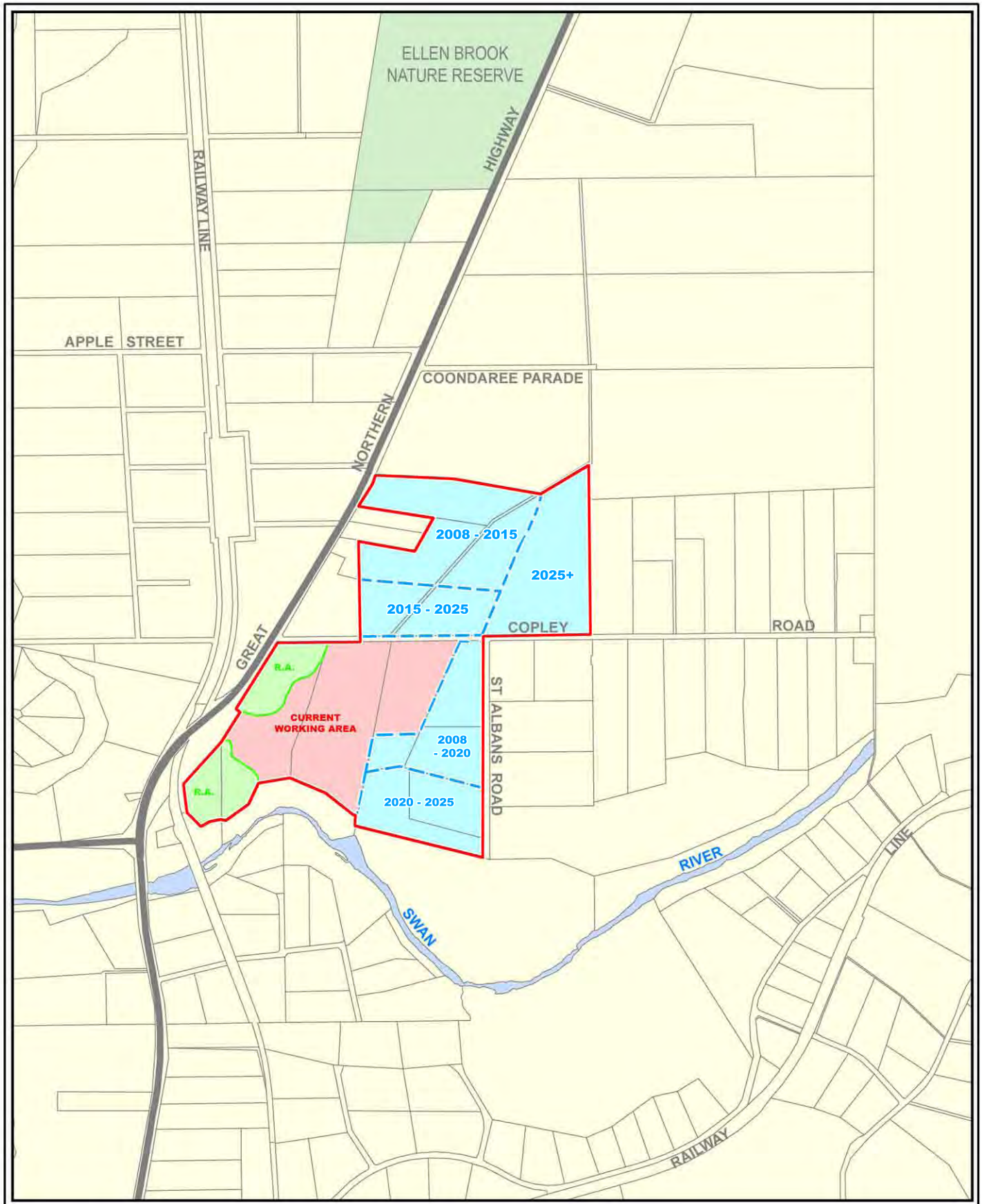
RPS BOWMAN BISHAW GORHAM
ENVIRONMENTAL MANAGEMENT CONSULTANTS

Figure 2

Aerial Photograph Showing Excavation and Rehabilitation Extent

RPS BOWMAN BISHAW GORHAM
ENVIRONMENTAL MANAGEMENT CONSULTANTS

L099195 01.11.06



LEGEND

- Site Bourndary
- Current Working Area
- Rehabilitation Areas
- Future Mining Areas

N

0 300 900 1500m

Scale 1:20000

L99195 01.11.06

Figure 3

Excavation Staging Plan

RPS BOWMAN BISHAW GORHAM

ENVIRONMENTAL MANAGEMENT CONSULTANTS

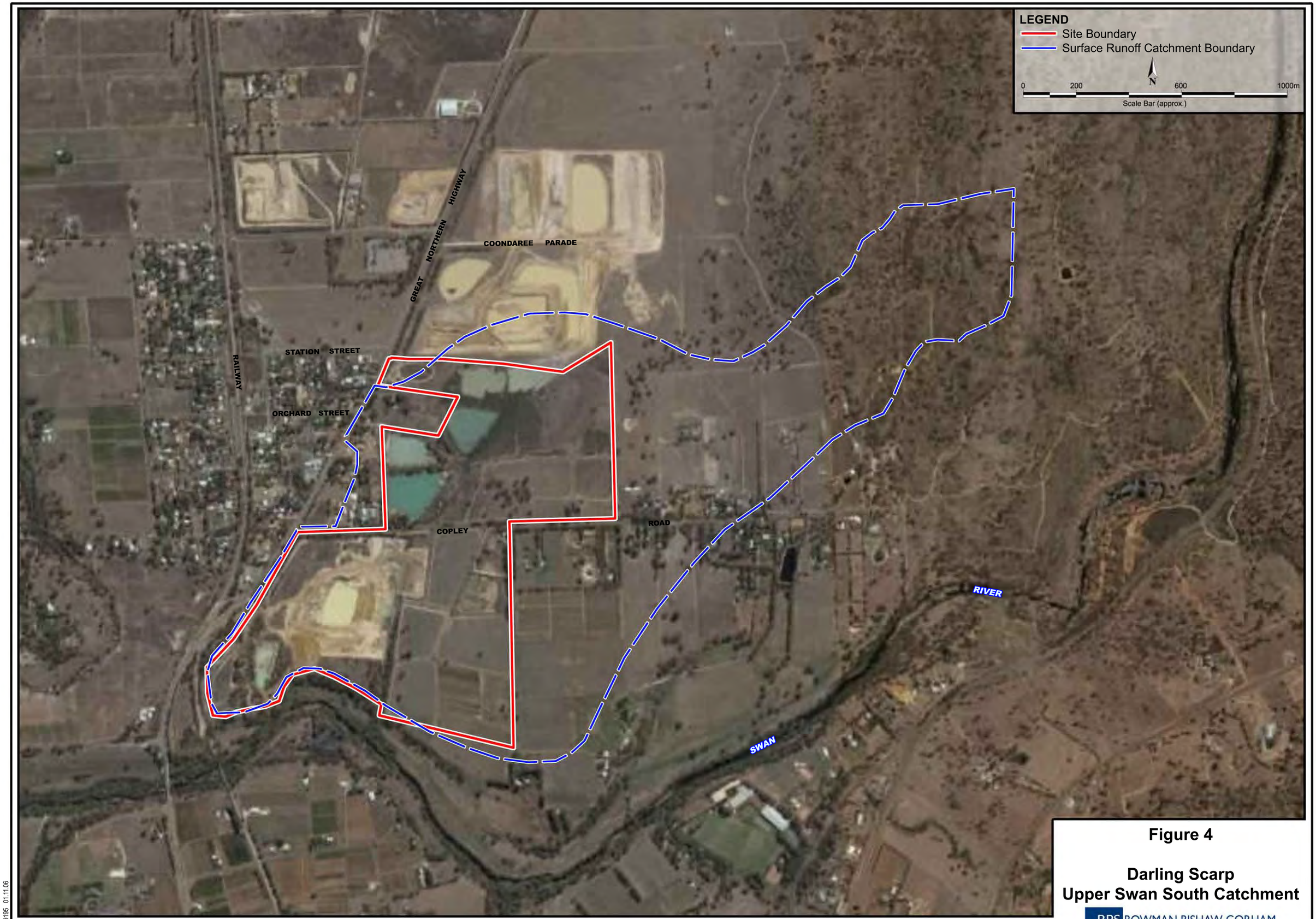


Figure 4

Darling Scarp
Upper Swan South Catchment

RPS BOWMAN BISHAW GORHAM
ENVIRONMENTAL MANAGEMENT CONSULTANTS

Source: Imagery - Google Earth, 2006

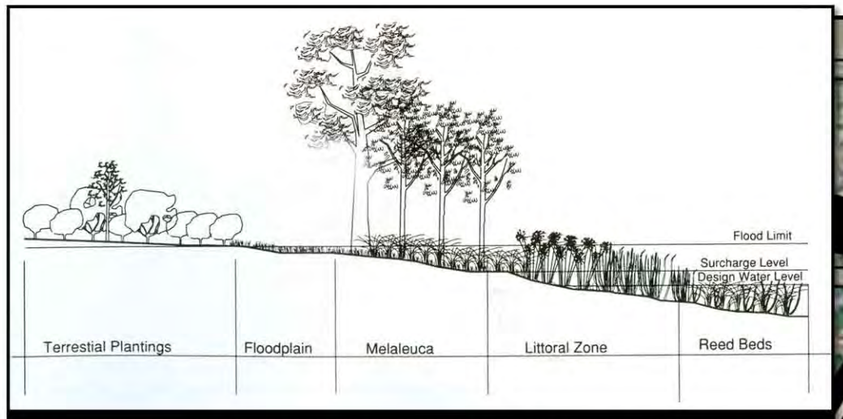
L99195 01.11.06

Figure 5

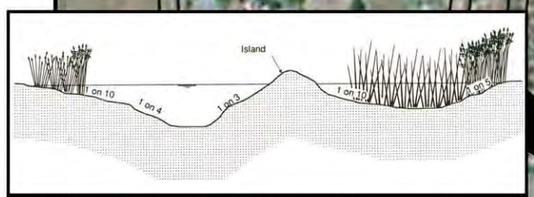
Bore Locations and Depth to Groundwater

RPS BOWMAN BISHAW GORHAM
ENVIRONMENTAL MANAGEMENT CONSULTANTS

L099195 01.11.06



BANKS WILL BE CONSTRUCTED TO ALLOW FOR GRADUAL ZONATIONS OF PLANTS ALONG THE SLOPE



A VARIETY OF SLOPES WILL BE USED IN THE CONSTRUCTION OF THE WETLAND ENHANCE HABITAT DIVERSITY

THE CONSTRUCTED WETLAND WILL PROVIDE OPEN WATER BUFFERS TO PROTECT WILDLIFE

HIGHWAY

NORTHERN

COPLEY ROAD

ST ALBANS ROAD

GREAT

EXCAVATION BOUNDARY

REHABILITATED AREAS FOR FARMLAND USE

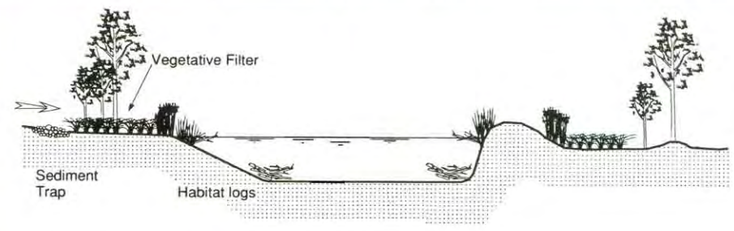
EXCAVATION BOUNDARY

REHABILITATED AREAS FOR FARMLAND USE

OUTFALL TO RIVER (CURRENTLY NOT IN USE)

SWAN

RIVER



A CONCEPTUALISED CROSS SECTION OF THE PROPOSED WETLAND

N

0 100 300 500m

Scale Bar

Source: The Constructed Wetlands Manual Vol. 2, Department of Land and Water Conservation NSW, 1998.

Figure 6

Conceptual Rehabilitation Plan

RPS BOWMAN BISHAW GORHAM
ENVIRONMENTAL MANAGEMENT CONSULTANTS

L99195 11.05.04

APPENDIX A

Ministerial Statement 699

MINISTER FOR THE ENVIRONMENT; SCIENCE

Statement No.

000699

STATEMENT TO AMEND CONDITIONS APPLYING TO A PROPOSAL (PURSUANT TO THE PROVISIONS OF SECTION 46 OF THE ENVIRONMENTAL PROTECTION ACT 1986)

CLAY EXCAVATION
LOTS 7, 19, 60, 63, 64 & 20 HALLETT & COPLEY ROADS
(formerly Part Lot 1 & Lots 222, 27, 26, 25, 28 & 7 Hallett & Copley Roads)
& LOTS 19, 45 & 46 ST ALBAN'S ROAD & LOT 100 GREAT NORTHERN HIGHWAY
UPPER SWAN

Proposal: The operation of a clay excavation facility in Upper Swan, as documented in schedule 1 of this statement.

Proponent: Midland Brick Company Pty Ltd

Proponent Address: 102 Great Northern Highway, MIDDLE SWAN WA 6056

Assessment Number: 1432

Previous Assessment Number: 504

Previous Statement Number: 251 (Published on 23 April 1992)

Report of the Environmental Protection Authority: Bulletin 1157

Previous Report of the Environmental Protection Authority: Bulletin 599

The implementation of the proposal to which the above reports of the Environmental Protection Authority relate is subject to the following conditions and procedures, which replace all previous conditions and procedures:

1 Implementation

1-1 The proponent shall implement the proposal as documented in schedule 1 of this statement subject to the conditions and procedures of this statement.

Published on

22 NOV 2005

2nd FLOOR, ALLENDALE SQUARE, 77 ST. GEORGE'S TERRACE, PERTH 6000
TELEPHONE: (08) 9220 5050 FACSIMILE: (08) 9221 4665
E-MAIL: judy-edwards@dpc.wa.gov.au
WEBSITE: www.ministers.wa.gov.au/edwards

2 Proponent Commitments

2-1 The proponent shall implement the environmental management commitments documented in schedule 2 of this statement.

3 Proponent Nomination and Contact Details

3-1 The proponent for the time being nominated by the Minister for the Environment under section 38(6) or (7) of the *Environmental Protection Act 1986* is responsible for the implementation of the proposal until such time as the Minister for the Environment has exercised the Minister's power under section 38(7) of the Act to revoke the nomination of that proponent and nominate another person as the proponent for the proposal.

3-2 If the proponent wishes to relinquish the nomination, the proponent shall apply for the transfer of proponent and provide a letter with a copy of this statement endorsed by the proposed replacement proponent that the proposal will be carried out in accordance with this statement. Contact details and appropriate documentation on the capability of the proposed replacement proponent to carry out the proposal shall also be provided.

3-3 The nominated proponent shall notify the Department of Environment of any change of contact name and address within 60 days of such change.

4 Commencement and Time Limit of Approval

4-1 The proponent shall substantially commence the modified proposal within five years of the date of this statement or the approval granted in this statement shall lapse and be void.

Note: The Minister for the Environment will determine any dispute as to whether the modified proposal has been substantially commenced.

4-2 The proponent shall make application for any extension of approval for the substantial commencement of the modified proposal beyond five years from the date of this statement to the Minister for the Environment, prior to the expiration of the five-year period referred to in condition 4-1.

The application shall demonstrate that:

1 the environmental factors of the proposal have not changed significantly;

2 new, significant, environmental issues have not arisen; and

3 all relevant government authorities have been consulted.

Note: The Minister for the Environment may consider the grant of an extension of the time limit of approval not exceeding five years for the substantial commencement of the modified proposal.

5 Compliance Audit and Performance Review

5-1 The proponent shall prepare an audit program and submit compliance reports to the Department of Environment which address:

1 the status of implementation of the proposal as defined in schedule 1 of this statement;

2 evidence of compliance with the conditions and commitments; and

3 the performance of the environmental management plans and programs.

Note: Under sections 48(1) and 47(2) of the *Environmental Protection Act 1986*, the Chief Executive Officer of the Department of Environment is empowered to monitor the compliance of the proponent with the statement and should directly receive the compliance documentation, including environmental management plans, related to the conditions, procedures and commitments contained in this statement.

5-2 The proponent may excavate clay indefinitely, subject to the acceptability of performance review reports which shall be submitted by 31 December 2006 and every five years thereafter, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

The performance review reports shall address the following:

1 the major environmental issues associated with the project; the targets for those issues; the methodologies used to achieve these; and the key indicators of environmental performance measured against those targets;

2 the level of progress in the achievement of sound environmental performance, including industry benchmarking, and the use of best available technology where practicable;

3 significant improvements gained in environmental management, including the use of external peer reviews;

4 stakeholder and community consultation about environmental performance and the outcomes of that consultation, including a report of any on-going concerns being expressed; and

5 the proposed environmental targets over the next five years, including improvements in technology and management processes.

6 Acid Sulfate Soils Investigation and Management Plan

6-1 Prior to any ground-disturbing activities associated with the excavation and dewatering of areas classed as having a "high risk" of Acid Sulfate Soils according to the Western Australian Planning Commission Bulletin No. 64 (2003), the proponent shall prepare an Acid Sulfate Soils Investigation and Management Plan to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

The objectives of the Plan are:

- to ensure that any ground-disturbing activities which may disturb acid sulfate soils and/or contaminated waters are planned and managed to avoid adverse effects on the natural and built environment, human activities and health.

The Plan shall address:

1 identification of acid sulfate soils in and near areas proposed to be disturbed,

and, in the event that the disturbance of acid sulfate soils is unavoidable, the Plan shall also address:

2 potential on-site and off-site effects of the disturbance of the acid sulfate soils and/or groundwater levels;

3 how drainage or soil extraction will be undertaken to minimise environmental impacts;

4 how any acid leachate generated as a result of ground-disturbing activities will be managed;

5 management of areas, both on and off-site, used to store or treat extracted soil;

6 comprehensive surface and ground water quality monitoring both on and off-site, if applicable;

7 establishment of agreed performance criteria and objectives in relation to environmental and social impacts; and

8 contingency measures and procedures in the event that the agreed performance criteria may not be met.

6-2 The proponent shall implement the Acid Sulfate Soils Investigation and Management Plan required by condition 6-1.

6-3 The proponent shall make the Acid Sulfate Soils Investigation and Management Plan required by condition 6-1 publicly available.

7 Wetland Rehabilitation

7-1 Prior to the re-commencement of ground-disturbing activities, the proponent shall prepare a Wetland Rehabilitation Plan, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

This Plan shall include:

1 a report of a detailed vegetation and flora survey of the areas likely to be impacted by the proposal;

2 characterisation of the habitats likely to be impacted by the proposal;

3 an integrated and progressive mining and landscaping plan designed to optimise rehabilitation outcomes and provide a range of habitats in the final landform;

4 proposed final landforms and the identification of areas to be revegetated;

5 a rehabilitation and revegetation management plan for areas of vegetation to be disturbed during excavation;

6 agreed timelines and progressive performance criteria;

7 monitoring against the agreed progressive performance criteria;

8 contingency measures in the event that the rehabilitation or revegetation fails to meet agreed performance criteria; and

9 responsibilities for continued maintenance of rehabilitated and landscaped areas.

Note: In the preparation of advice to the Minister for the Environment, the Environmental Protection Authority expects to obtain advice of the Department of Environment and the Swan River Trust.

7-2 The proponent shall implement the Wetland Rehabilitation Plan required by condition 7-1.

7-3 The proponent shall make the Wetland Rehabilitation Plan required by condition 7-1 publicly available.

8 Environmental Management Programme

8-1 Within six months following the issuing of the notice to the decision-making authorities under section 45(7) of the *Environmental Protection Act 1986*, the proponent shall prepare an updated Environmental Management Programme, also addressing the requirements of conditions 6 and 7 and the new locations (see table 1), to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

The plans, strategies or reports to be prepared as part of the Environmental Management Programme shall include the following:

1 a staged excavation strategy;

2 Acid Sulfate Soils Investigation and Management Plan (see condition 6);

3 groundwater management and protection;

4 progressive rehabilitation of the site;

5 Wetland Rehabilitation Plan (see condition 7);

6 weed management;

7 identification, management and protection of archaeological material, with the involvement of the Department of Indigenous Affairs;

8 periodic reporting of monitoring results, incorporating monitoring of excavation and sieved clay for archaeological materials;

9 procedures to minimise noise, dust and visual impacts associated with the quarrying and transport operations;

10 public safety and mosquito control, with the involvement of the Department of Health at the design stage of water bodies and wetlands;

11 consequential changes to project management to remedy unacceptable impacts; and

12 clearly indicated timeframes for implementation of each stage.

8-2 The proponent shall implement the updated Environmental Management Programme required by condition 8-1.

8-3 The proponent shall make the updated Environmental Management Programme required by condition 8-1 publicly available.

8-4 The proponent shall periodically review the updated Environmental Management Programme required by condition 8-1.

9 Decommissioning

9-1 Within two years following the date of this statement, the proponent shall prepare a Preliminary Decommissioning Plan including the additional areas for clay extraction, which provides the framework to ensure that the site is left in an environmentally acceptable condition to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

The Preliminary Decommissioning Plan shall address:

1 rationale for the siting and design of plant and infrastructure as relevant to environmental protection, and conceptual plans for the removal or, if appropriate, retention of plant and infrastructure;

2 long-term management of ground and surface water systems;

3 a conceptual rehabilitation plan for all disturbed areas and a description of a process to agree on the end land use(s) with all stakeholders;

4 a conceptual plan for a care and maintenance phase; and

5 management of noxious materials to avoid the creation of contaminated areas.

9-2 At least 12 months prior to the anticipated date of decommissioning, or at a time agreed with the Environmental Protection Authority, the proponent shall prepare a Final Decommissioning Plan designed to ensure that the site is left in an environmentally acceptable condition to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

The Final Decommissioning Plan shall address:

1 removal or, if appropriate, retention of plant and infrastructure in consultation with relevant stakeholders;

2 long-term management of ground and surface water systems;

3 rehabilitation of all disturbed areas to a standard suitable for the agreed new land use(s); and

4 identification of contaminated areas, including provision of evidence of notification and proposed management measures to relevant statutory authorities.

9-3 The proponent shall implement the Final Decommissioning Plan required by condition 9-2 until such time as the Minister for the Environment determines, on advice of the Environmental Protection Authority, that the proponent's decommissioning responsibilities have been fulfilled.

9-4 The proponent shall make publicly available the Final Decommissioning Plan required by condition 9-2.

Procedures

1 Where a condition states "to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority", the Environmental Protection Authority will provide that advice to the Department of Environment for the preparation of written notice to the proponent.

2 The Environmental Protection Authority may seek advice from other agencies or organisations, as required, in order to provide its advice to the Department of Environment.

3 The City of Swan will adjust the bond on the proponent, as appropriate, commensurate with the expanded area of the excavation.

Notes

1 The Minister for the Environment will determine any dispute between the proponent and the Environmental Protection Authority or the Department of Environment over the fulfilment of the requirements of the conditions.

Dr Judy Edwards MLA
MINISTER FOR THE ENVIRONMENT; SCIENCE

22 NOV 2005

Schedule 1

The Proposal (Assessment No. 1432)

The proposal is to conduct clay excavation operations.

The Key Proposal Characteristics are shown in Table 1.

Table 1 – Key Proposal Characteristics

Element	Quantities/Description
Offset	The transfer to the State of Western Australia, at no charge, of 5.97 hectares of Lot 12 Lexia Avenue (eastern side) for addition to Ellen Brook Nature Reserve to provide additional habitat for the endangered Western Swamp Tortoise.
Existing extraction areas	A change to the numbering of the lots has occurred:- The new numbers are Lots 7, 60, 63, 64 and 20 Hallett and Copley Roads, Upper Swan (Replacing Part lot 1 and lots 222, 27, 26, 25, 28, and 7 Hallett and Copley Roads, Upper Swan).
Areas for extension of clay extraction	Lot 19 Copley Road, Lot 100 Great Northern Highway and Lots 19, 45 and 46 St Alban's Road, Upper Swan.
*Size of Clay Body	Approximately 4 million tonnes
*#Total Area of Disturbance	Approximately 109 hectares
*Rate of Extraction	Approximately 180,000 tonnes per year
Major Infrastructure	nil
Overburden	Between 1 and 6 million tonnes
Water Usage	nil

will also be rehabilitated.
* estimated at present usage.

Figures (attached).

Figure 1 - Location of current and proposed Midland Brick clay excavation.
Figure 2 - Aerial photo of current and proposed Midland Brick clay excavation works and rehabilitation areas.

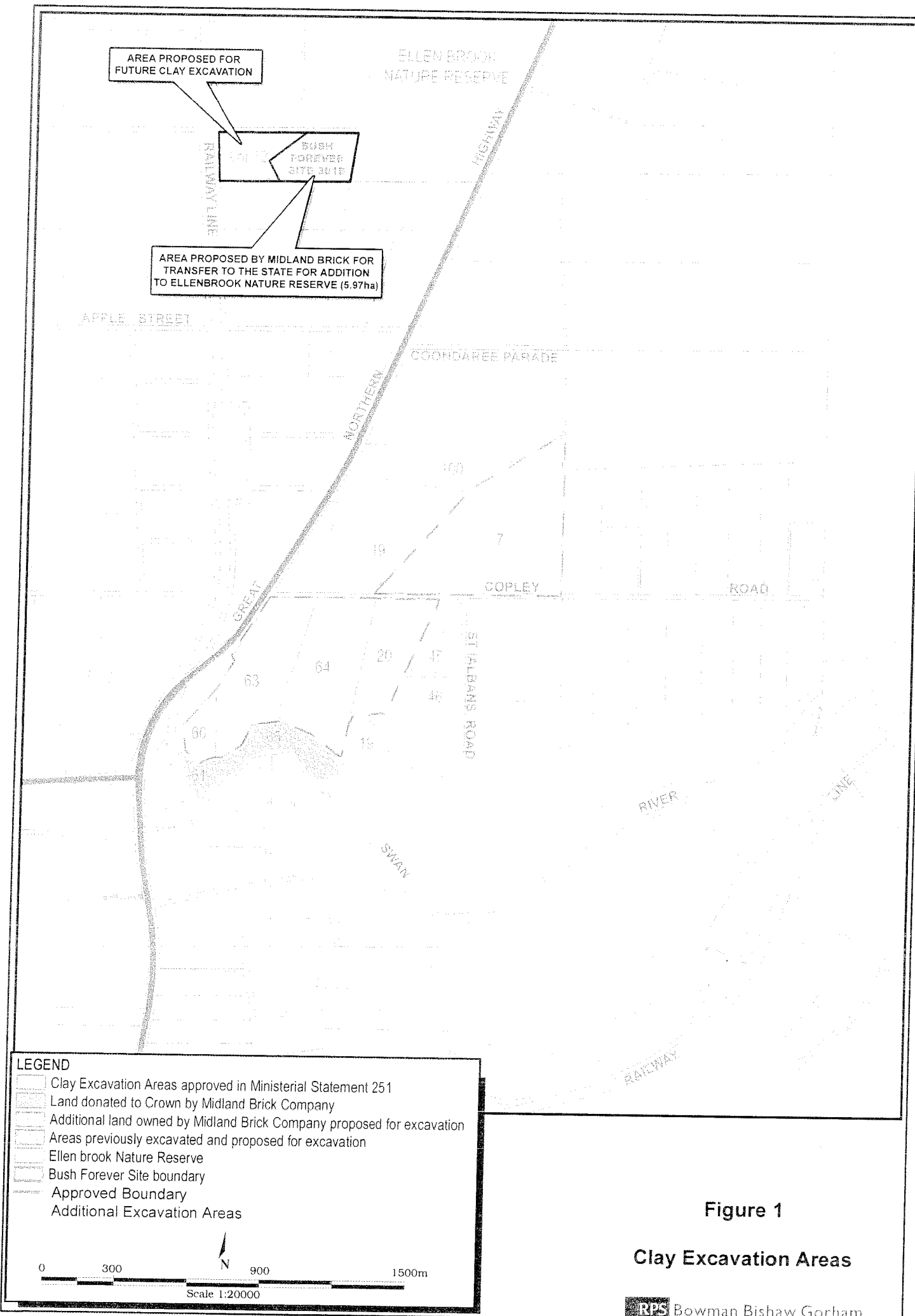
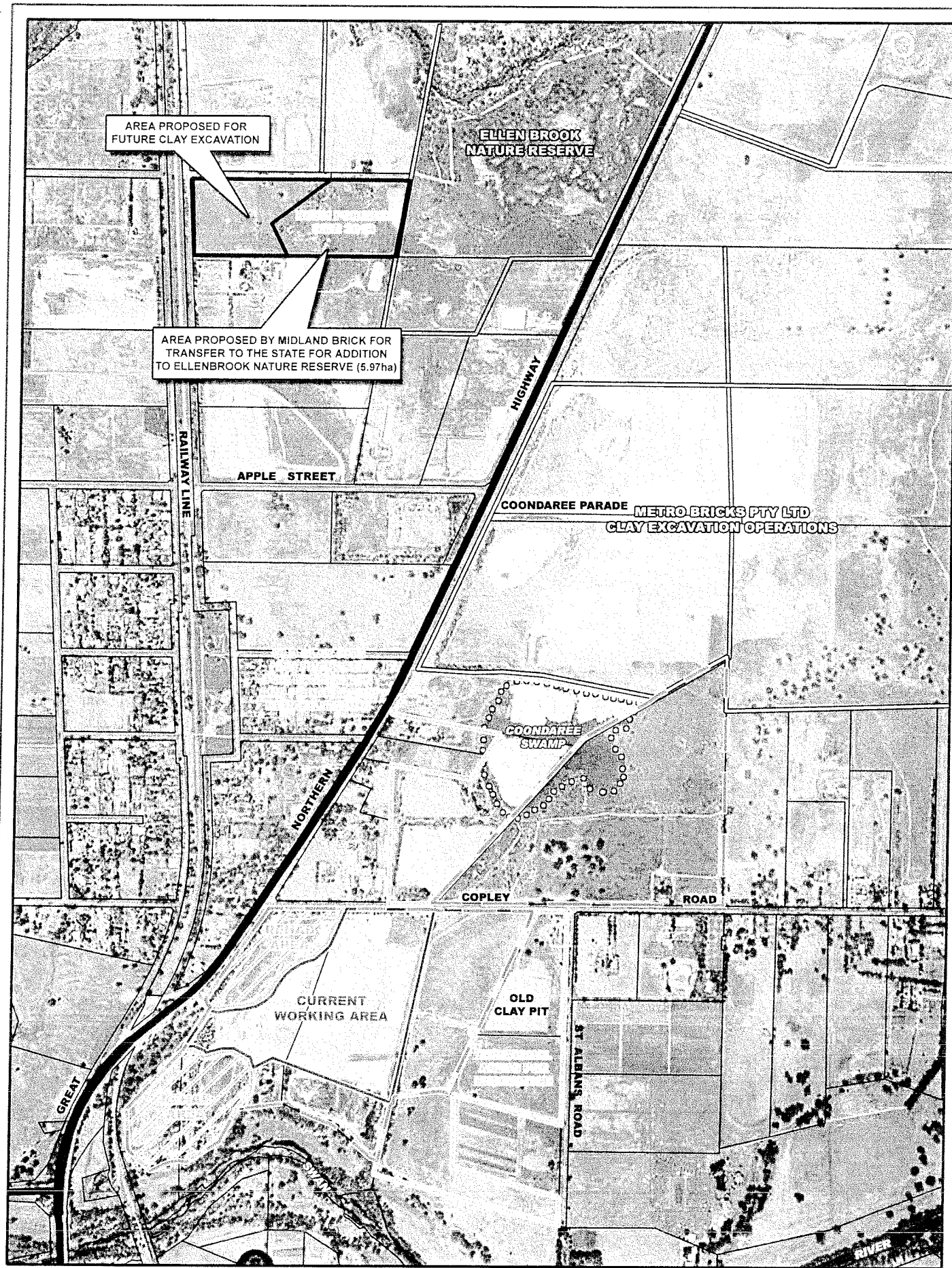


Figure 1

Clay Excavation Areas

RPS Bowman Bishaw Gorham

M00063_05.02.04



LEGEND

Approved Boundary

Additional Excavation Areas

N

0 200 600 1000m

Scale Bar

Figure 2

Aerial View of Site

Bowman Bishaw Gorham

M00063 05.02.04

Schedule 2

Proponent's Environmental Management Commitments

CLAY EXCAVATION
LOTS 7, 19, 60, 63, 64 & 20 HALLETT & COPLEY ROADS
(formerly Part Lot 1 & Lots 222, 27, 26, 25, 28, & 7 Hallett & Copley Roads)
&
LOTS 19, 45 & 46 ST ALBAN'S ROAD
& LOT 100 GREAT NORTHERN HIGHWAY
UPPER SWAN

(Assessment No. 1432)

MIDLAND BRICK COMPANY PTY LTD

Proponent's Environmental Management Commitments (consistent with commitments detailed in 1992)

CLAY EXCAVATION
LOTS 7, 19, 60, 63, 64 & 20 HALLETT & COPLEY ROADS
(formerly Part Lot 1 & Lots 222, 27, 26, 25, 28, & 7 Hallett & Copley Roads)
&
LOTS 19, 45 & 46 ST ALBAN'S ROAD & LOT 100 GREAT NORTHERN HIGHWAY
UPPER SWAN (Assessment No. 1432)

Note: The term "commitment" as used in this schedule includes the entire row of the table and its six separate parts as follows:

- commitment number;
- a commitment topic;
- the objective of the commitment;
- the 'action' to be undertaken by the proponent;
- the timing requirements of the commitment; and
- the body/agency to provide the technical advice to the Department of Environment.

No.	Topic	Objective	Action	Timing	Advice
1.	Transfer of land	To increase the size of the Ellen Brook Nature Reserve and provide additional protected habitat for the Western Swamp Tortoise.	The proponent will transfer 5.97 hectares of the eastern side of Lot 12 Lexia Avenue to the Crown. The area includes Bush Forever site number 301B.	Transfer should commence within six months following the issuing of the section 45(7) notice to the decision-making authorities (*Environmental Protection Act 1986*). Transfer should be finalised as soon as possible after the process begins.	CALM DPI

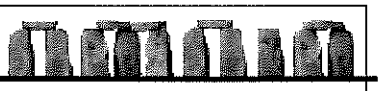
Abbreviations

CALM = Department of Conservation & Land Management
DPI = Department for Planning & Infrastructure

APPENDIX B

Archaeological Inspection Report
Proposed Expansion, Copley Road Clay Pit, Upper Swan

SJC Heritage Consultants Pty Ltd.



Archaeological Inspection Report

Proposed Expansion, Copley Road Clay Pit, Upper Swan

Prepared for Midland Brick Co.

By

Stephen J. Corsini

December 2007

Spatial Data

Unless otherwise specified, all coordinates are recorded as metric Eastings and Northings Zone 50 GDA94 datum.

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SJC Heritage Consultants Pty Ltd
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KALAMUNDA
WA 6926

Contents

Figures

Background

The Midland Brick Company (MBC) operates a clay pit on the eastern side of Great Northern Highway, immediately south of Copley Road, Upper Swan, 14 km north of Midland, and 25 km northeast of Perth, Western Australia. The southern edge of the clay pit area is 400 metres northeast of the Upper Swan Bridge.

MBC have proposed deepening the existing clay-pits and an expansion of the current work area. The affected land comprises Lots 7, 19, 60, 63, 64 & 20 Hallett & Copley Roads, Lots 18, 19, 45 and 46 St Albans Road and Lot 100 Great Northern Highway, Upper Swan.

The current clay pit area measures 480 metres (east-west) by 440 metres (north-south). The land has been in use for clay extraction for more than 20 years and the company is bound by strict environmental conditions governing both the extraction of the clay and for the rehabilitation of the land.

Under Section 46 of the WA *Environmental Protection Act* 1986, the proposal to expand the clay extraction areas went through an EPA environmental assessment (EPA Assessment No. 1432) and a review of the environmental conditions that were applied to the project (EPA Bulletin 1157). The Minister for the Environment (2005) subsequently published Statement 699, which set out amended conditions applicable to the clay extraction operations.

Condition 8 of the Minister's Statement requires MBC to devise an Environmental Management Program. Conditions 8.1.7 and 8.1.8 specifically refer to archaeological heritage. MBC is required to undertake;

8.1.7 Identification, management and protection of Archaeological material with the involvement of the Department of Indigenous Affairs; and

8.1.8 Periodic reporting of monitoring results, incorporating monitoring of excavation and sieved clay for archaeological materials.

The Midland Brick Company have engaged environmental management consultants RPS Bowman Bishop Gorman to coordinate their compliance with the environmental management conditions contained in the Minister's consent, including the Indigenous heritage provisions.

In September 2006, Ms Kristen Bennets, Managing Environmental Scientist, RPS Bowman Bishop Gorman, telephoned Consultant Archaeologist Stephen Corsini BA (Hons), who had previously undertaken an archaeological survey for MBC clay pits on Apple Street, Upper Swan, a few kilometres to the north of the MBC Copley Road clay pit (Fisher & Corsini 2005).

Heritage Survey Brief

Ms Bennetts requested SJC Heritage Consultants provide a proposal to undertake an "Aboriginal Heritage survey" of the Midland Brick clay pit expansion. After further discussion and on the basis of documents supplied by Ms Bennetts, the heritage consultant prepared a research proposal and budget for an archaeological study of the Midland Brick clay pit extension area that would address the Ministers Conditions, requiring "Identification, management and protection of Archaeological material", and would comply with the Department of Indigenous Affairs *Guidelines for Aboriginal Heritage Assessment in Western Australia (2005),* and also with the requirements of the WA *Aboriginal Heritage Act* 1972.

It should be noted that there has been no consultation with Traditional Owners.

The Consultant archaeologist would;

- Undertake a "desk top" study including searching the DIA site register and an examination of relevant site files, survey reports and academic studies for details of sites, in or near the project area.

- Conduct a field survey of the proposed clay pit area to assess the likely-hood that Aboriginal archaeological sites may exist.

- Document any archaeological sites, materials or isolated artefacts, and provide the proponent with MGA coordinates of artefacts and/or site boundaries using the GDA94 datum.

- Prepare a Survey Report that complies with the standards outlined in the Department of Indigenous Affairs *Guidelines for Aboriginal Heritage Assessment in Western Australia (2005).* This will include recommendations regarding the management of any archaeological site(s), an assessment of the general archaeological potential of the survey area, management strategies for dealing with subsequent discoveries and all relevant information for the purposes of meeting the Ministers conditions.

The archaeological heritage study was conducted by Stephen Corsini BA(Hons) during December 2006. The archaeologist examined DIA site file information and commercial survey data at the Department of Indigenous Affairs and also considered relevant academic research applicable to the area, in particular the work of geologist John Chappell and archaeologists Pearce, Hallam and Schwede.

A field inspection survey was conducted on 7 December 2006.

Preliminary advice was provided by email on 14 December 2006 and the survey report was drafted during January 2007.

It should be noted that no archaeological excavations were undertaken during the preliminary survey. An archaeological excavation would require a permit from the Registrar of Aboriginal Sites, and the support of the Traditional Owners.

Survey Area Location

The Midland Brick Company clay pit is on the east side of Great Northern Highway, north of the Upper Swan River, south of Copley Road and west of St Albans Road, Upper Swan. The current entrance to the work area is via Glen Road, adjacent to the Hallett Garden Carpark and a Driver Rest Area and Tourist Information Bay opposite the Shell Petrol Station on Great Northern Highway.

The affected land comprises Lots 7, 19, 60, 63, 64 & 20 Hallett and Copley Roads, Lots 18, 19, 45 and 46 Saint Albans Road and Lot 100 Great Northern Highway, Upper Swan.

The clay pit area is 1700 metres west of the foot of the Darling Scarp, 240m north of the Upper Swan River, around 400m north east of the Upper Swan Bridge, 14 km north of Midland, and 25 km northeast of Perth, Western Australia.

The Swan River is located along the southern boundary of the study area. The bed of the river is approximately 250m metres south of the southern edge of the clay pit development area. The river emerges from the Darling Scarp and the adjacent piedmont slopes that grade into the colluvial Pinjarra plain. The river, cutting down through the Guildford formation and creating a steep sided narrow valley, then meanders to the southwest, being joined by the Ellen Brook a few kilometres to the west of the Copley Road clay pit. The Upper Swan river channel is flanked by a flood plain between 40 and 60 m wide and 0.8 – 1.2m above the river. The plain is flanked by steep banks rising to the ASL +20 meter contour, which is roughly 12 metres elevation above the riverside flood plain.

The topography and remnant natural vegetation in the area show that there was once an extensive chain of swamps or wetland extending from the Swan River northwest to Coondaree Swamp along the eastern side of Great Northern Highway. Aerial photos also show several in-filled former river channels. Department of Land Information base maps, used by the DIA, show an ephemeral drainage line cutting across the middle of the clay pit.

There has been extensive disturbance across the area from land clearing and early agriculture and grazing (the area was amongst the first land settled by the English in the 1830's). There has also been disturbance from on-going clay extraction.

Geology

The clay-pit area is mapped (Gozzard 1986) as the Guildford formation, composed of alluvial sands, silts and clays. The Guildford formation is believed to be of mid- to late- Pleistocene age (Chappell 1984; Copp 2001; Collins 1987; Firman 1952; McArthur & Bettenay 1974; McHugh 1998; Playford *et al*, 1976; Semenuik 1988; Wilde & Low 1980) and is essentially a piedmont deposit at the foot of the Darling Range. The clayey soils and sands are believed to be derived from the weathering and transportation of granitoid material from the adjacent Darling Range (Chappell 1983:8). The proportion of clay increases with depth from the in-situ pedogenesis of feldspar minerals since their initial deposition.

To the west of the study area there are occurrences of marine sediments overlying and interleaved with the edge of the Guildford formation; these are believed to be from the last Marine Transgression dating to around 130,000 years ago when sea level was higher than at present – there is no evidence of marine sediments in the profiles of the existing clay pit area although nodules of limestone occur at depth, indicating leaching of calcium carbonate rich sands.

An investigation of the Upper Swan area by John Chappell (1983:12) identified three major alluvial terraces associated with the Upper Swan River catchment and found that the Guildford formation contains several erosion surfaces and buried channels and in places is partially laterised (Chappell 1983:9).

Chappell, using the dating of the Upper Swan Bridge archaeological site (which is dated between 35,200 yBP and 39,500 yBP), and similar evidence from GSWA bore holes, demonstrated that the Guildford Formation is overlain by a series of sandy deposits possibly laid down during a period of wetter climate that began some time before 40,000 years ago and lasted to 35,000 years ago. The upper surface of the Guildford formation may have been exposed when the first humans entered and occupied the region. The evident increase in sand washing over the area coincides with human occupation and may be the result of increased erosion as a result of the denuding of the natural vegetation through regular burning.

As far as dated archaeological evidence is available it appears that the human occupation levels lie above the Guildford Formation. However, with less than a dozen test pits excavated in the region, it is possible that deposits of similar or greater age may exist and there may be many more undiscovered archaeological sites.

He only comparable archaeological site was excavated by Dr Madge Schwede (1990) who found material from Chappell's Older Middle Terrace deposits - red clayey alluvium that lies conformably over the grey Guildford Formation - adjacent to the Helena River and dated to 26,000 – 28,000 yBP (Schwede 1990:66). This is some 15 km south of Upper Swan Bridge.

Vegetation

Vegetation in the survey area is described by Beard (1980) as a mosaic of Jarrah and Marri woodland, banksia woodland and patches of Jarrah-Marri forest. The low-lying, seasonally inundated floodplains may support ti-tree and melaleuca species with an understorey of sedges and grasses (Beard 1981; Chalmers & Wheeler 1997).

Some remnant vegetation remains along the road verges but most of the land appears to have been cleared and used for grazing. At the time of the survey the ground was covered with dense grass, reducing ground visibility to virtually zero.

Explorers and early settlers of the Swan Plain and the Avon and Upper Swan Valleys describe vast tracts of grass land, with isolated trees, reminiscent of English parklands (Stirling 1827; Armstrong 1836; Moore 1884). These appear to be the result of the Nyungar use of fire to clear vegetation, which created grassland habitats particularly favourable to kangaroos (Hallam 1975).

The Upper Swan and Millendon areas are historically recorded (Moore 1884:220; Stirling 1827:581) as places where yams (*dioscorea* species) were gathered during the winter months (Hallam 1986a:126). The Upper Swan River was first explored by captain Stirling (1827) who found several *warran* grounds in the vicinity of the Ellen Brook and Upper Swan confluence. The locations of these *warran* grounds were mapped by Assistant Surveyor P.L. Snell Chauncy (1843a, 1843b) but the areas are not recorded as Aboriginal sites.

Archaeological Framework

Archaeological evidence from south western Australia supports the proposition that humans have occupied the region for at least 40,000 years (Dortch, C. 2000; Dortch, J. 2000; Mulvaney & Kaminga 1999; Turney et al 2001). One of the oldest dated habitation sites in Western Australia (Pearce & Barbetti 1981), the Upper Swan Bridge artefact scatter (DIA ID 4299), is located only 400m south of the proposed clay pit.

Extensive archaeological research, recording and salvage was conducted throughout the Perth Metropolitan area during the 1970's and 1980's (Anderson 1984; Hallam 1973, 1977, 1983, 1987; Strawbridge 1989). The majority (92%) of archaeological sites recorded on the Southwest Coastal Plains are stone artefact scatters with assemblages dominated by quartz. Burials are the next most common archaeological site (6%) with shell middens, marked trees and ochre quarries also recorded but much less common.

The vast majority of recorded archaeological sites of the Swan Coastal Plain were located on dunes of the Bassendean and the Spearwood-Karrakatta Sands, the largest archaeological sites are located on elevated land, particularly lunette dunes surrounding lakes, perennial swamps and wetlands and on hills overlooking rivers (Anderson 1984; Bowdler et al 1991; Clarke & Dortch 1977; Dortch 1977; Ferguson 1981; Hallam 1972, 1975, 1977, 1978, 1986; Lewis 1989; Maynard 1977; Pearce 1978; Schwede 1983, 1990).

Evidence from archaeological excavations elsewhere in the Swan and Helena Valleys (Schwede 1983, 1985, 1990) reveal that known sites can be grouped into three time periods: sites dating from 3,000 to the present, sites dated between 4600 to 8500 and sites dated between 29,000 and 40,000. The site-age distribution is partly a result of the very small number of dated deposits from stratified archaeological excavations. However the dating indicates a degree of abandonment of the Swan Coastal Plain (Ferguson 1985), or at least a less intensive use, which appears to correspond to times of low sea level.

Hallam concluded (1987:17-20) that the primary focus of Aboriginal subsistence activities were the wetlands and rivers along the foot of the Darling Scarp and that Aboriginal habitation was particularly focused on dunes of the Bassendean Sands. Although this pattern reflects the distribution of then extant stone artefact scatters in the Swan River region, Hallam's results should be tempered by an appreciation of the variable degree of both archaeological site preservation, disturbance through land clearing and archaeological visibility across the Perth Metro area. Many coastal areas had been completely built out before any archaeological studies were conducted.

The occasional discovery of burial sites on coastal dunes, along with the wealth of ethnohistorical information regarding former Aboriginal occupation of areas in the western suburbs indicates that Hallam's interpretations are skewed by the fact that the areas that she proposed were the major focus of Aboriginal activity were mainly located in the relatively undeveloped areas of the eastern Coastal Plain.

At the time of the English colonisation the Swan Valley region was inhabited by tribes of the Nyungar cultural block (Berndt 1979; Green 1979, 1984, 1987). Lyon (1833) refers to the district around Upper Swan as Wurerup.

The Nyungar were "typical" hunter gatherers – They ranged over a well defined territory visiting and using various resources on a seasonal basis. Women and children foraged for plant foods, seeds, fruits (Bindon 1996; Bird & Beeck 1988), small animals like turtles, frogs and water birds (Stirling 1827:581), marron and freshwater mussels (Dortch et al 1984) while men hunted kangaroo and water birds, fished using spears (fishing weirs made of upright posts interwoven with branches, were placed across many streams or rivers – most were destroyed by Government order as they were viewed as a hazard to navigation) and climbed trees for possums, eggs and honey. The Nyungar had a well established social network and rules governing land ownership and access to territory and resources.

The Nyungar used a well established regimen of seasonal burning (Hallam 1975). Burning allowed for communal hunting and promoted new plant growth, particularly of the Zamia palm whose nuts, despite the toxicity of the raw fruit, were specially processed by leaching or fermentation and formed a seasonal staple. Regular seasonal burning also resulted in the establishment of extensive grasslands on the Pinjarra Plain and throughout the Swan and the Avon Valleys.

Observations by early settlers suggest that the Nyungar also practiced a form of incipient horticulture (Hallam 1986a). Along the alluvial terraces fringing the rivers, the women tended natural groves of *Warran*, a yam-like tuber of *dioscorea* species. These groves were protected from burning and some accounts describe deliberate planting. Some of the *warran*-grounds extended for several kilometres.

Like most Hunter forager societies, the Nyungars material culture was largely based on perishable wooden implements like bowls, spears and shields, as well as baskets and nets woven from plant fibres or twine made from hair. They also used kangaroo and possum skins for warmth, as well as ochre used in painting their bodies and implements and in cave paintings. Baler shells (*Melo amphorae*) were used for water-bowls and they made shell and bone beads and pendants. They used fur, fibres and feathers for decoration and plant resins as a glue. Unfortunately most of these natural organic materials do not readily preserve in the archaeological record and there is generally very little material evidence of any Indigenous presence in the region other than the scatters of flaked stone tools and occasional inhumation burials.

Various historical sources (Backhouse 1838; Fraser 1827; Moore 1833; Stirling 1827;) describe *warran*-grounds in the vicinity of Upper Swan Bridge, Millendon and Ellen Brook (Hallam 1984:125). The most favourable areas for *warran*-grounds were also the best land for cultivation of the settlers crops and most of the traditional *warran*-grounds are now vineyards. Various types of reed rhizomes were also a staple food source growing in channels and around wetlands on the river flood plain.

Registered Sites

Hallam (1984:121) summarising the ethnographic and archaeological evidence for the use of yams has noted that the 20m terraces on both side of the Upper Swan were evidently a focus of Aboriginal settlement throughout a long period. Archaeological sites and deposits are recorded on both sides of the river.

A search of the DIA site Register, using MGA coordinates to define a 5km x 5km area centred on the clay pit was conducted on 3 December 2006.

Point	MGA Zone	Easting	Northing
NW Corner	50	407000mE	6485000mN
NE Corner	50	412000mE	6485000mN
SE Corner	50	412000mE	6481000mN
SW Corner	50	407000mE	6481000mN

Table 1. MGA Coordinates used for the DIA Register search.

A total of 26 Registered Aboriginal sites occur in the wider 5 km x 5km search area. These sites include the Swan River, Ellen Brook and Susannah Brook as well as several sites with ceremonial and associated mythological components. This report has not examined the details of the ethnographic sites and does not address any possible ethnographic heritage values that the area may have.

The DIA register shows the Upper Swan Bridge archaeological site (DIA ID 4299) as a 2km x 2km box which impinges on the southern side of the Midland Brick survey area. However, the DIA site file indicates that the Upper Swan Bridge archaeological site itself does not extend into the MBC Copley Road clay pit. The site is confined to an area of red clayey silt deposits located in the vicinity of Pullman Park, around 400 metres south of the clay pit, in a small triangle of land bounded by Great Northern Highway, the railway line and the Swan River (see Figure 4).

The archaeological excavation of the Upper Swan Bridge site recovered over 900 flaked stone artefacts, principally quartz with chert, dolerite and granite, bracketed between charcoal samples dated at 35,200 Years Before Present (yBP) at 35cm depth and 39,500 yBP at 96cm depth (Pearce and Barbetti 1981).

No other Aboriginal sites are recorded specifically in the clay pit area. However the DIA register search results indicate that the area may have significance to Aboriginal people owing to proximity to the Swan River.

Eleven archaeological sites are recorded on the southern side of the river at the Brigadoon Equestrian Centre and in the Brigadoon and Millendon Housing Estates. Most of these are artefact scatters, mostly quartz flakes, situated on slightly elevated ground adjacent to the river or associated wetlands.

The Belhus scatter (DIA ID 4299) dated to 4,500 BP (Schwede 1990) is located adjacent to West Swan Road 750 metres southwest of the MBC clay pit. Five artefact scatters were recorded in the vicinity of the Vines Estate, Ellen Brook, west of the Midland Brick pit, in areas that fringe wetlands (or drained former wetlands).

A large occupation site located on a sand dune east of Walyunga Pool on the Upper Swan - roughly 4.5km north east of the MBC Copley Road clay pit, contains thousands of fossiliferous chert artefacts. Basal dates of around 8,000 yBP reflect the formation of the dune rather than the initial use of the stone.

The wealth of ethnographic evidence and the presence of archaeological sites along nearby sections of the Upper Swan River, strongly suggests the possibility of both artefact scatter sites and burials being preserved in deposits in the vicinity of the clay pit particularly in the elevated areas on the 20 metre contour, as identified by Hallam (1986) alongside the river.

There are several ethnographic descriptions of Aboriginal burials recorded in south Western Australia (Armstrong 1836; Bates, in White 1985:299; Lyon 1834; Nind 1831. In all recorded cases, Nyungar funery rites involved inhumation burial. Although Hallam (1975) does provide ethnographic evidence of hair, beards and fingernails being singed or even burned off of the body and of ritual purification of the grave using fire, there is neither archaeological or ethnographic evidence of any Southwest Aboriginal tribes practicing any form of cremation.

A circular or oval pit was excavated in sandy soil to depth of 1.2 – 1.6 meters, the body was wrapped in a kangaroo skin cloak and placed in the grave in a foetal position. Boughs and branches were laid over the body and the grave was left open, or only partially filled The grave was marked with spear and spear thrower for men and the digging stick for women. There is no readily visible indication as to whether any particular sand dune might contain human skeletal material.

No traditional burials have been reported in the development area, or in the Upper Swan region generally. A historical grave, that of the warrior Yagan, is reputed to be located in the region, somewhere around the northern bank of the Swan River west of the Upper Swan Bridge. Further a field graves are recorded in the Bassendean district to the west of Bennett Brook.

The ethnographic sources (Bates 1985, Green 1985) clearly state that traditional Aboriginal burials usually occurred immediately after death, because the Nyungar feared the dead person's spirit. Bates (White 1985), states that the Nyungar burials often took place on the same day as, or on the day following, the death of the individual, usually in or near the camp, which would then be vacated. Thus people would be buried at or near to habitation or camping sites and often these places would be avoided for a number of years afterwards. Raaff (1996) however pointed out that all of the ethnographic descriptions were made after colonisation and that for various reasons burial customs may have been altered to accommodate the realities of their dislocation from traditional grounds and the imposition of the new religion which mandated burial in specific plots set aside for the purpose.

The available ethnography for south western Nyungar burials tallies well with archaeological evidence. More than forty Aboriginal burial sites have been recorded in the Swan and Pinjarra Coastal Plains (Buck 1985; Maynard 1977; Corsini 1995; 1997; 2002; 2004).

Most Aboriginal graves have been discovered either eroding from sand dunes or are accidentally disturbed during trenching for services such as water pipes or phone cables. Several graves have been salvaged by archaeologists.

Within Nyungar cultural territory, where skeletons have been uncovered and the original body position could be determined, burials have been flexed (i.e. the body is placed on its side or back, with the arms and legs bent). Graves are usually oriented generally east-west. In addition where vegetation has been placed over the body, or where the grave has been "purified" with fire the humic content or the ash and charcoal, contributes to a characteristic ring of soil discolouration outlining the grave.

Although Aboriginal remains are the legal responsibility of the DIA, the protocol for dealing with the discovery of human remains is complicated by overlap in responsibilities between the Police, Coroner and the DIA. It is an offence to deal with any human remains without the appropriate consent, under both the Criminal Code (Section 214) and, if remains are indeed Aboriginal, under the Aboriginal Heritage Act (Section 17).

A number of factors can provide clues as to whether a skeleton is prehistoric; the context of the discovery, its location, the morphology of skull (Abbie 1974) and teeth (Giles 1974), and burial position (Buck 1985; Maynard 1977). The attendant physical circumstances in most cases constitute a fairly reliable indicator as to whether the remains are of indigenous or non-indigenous origins. However, under "ideal" conditions the process of decay can reduce a body to skeletal elements within a matter of months (Bass 1995; Brothwell 1981; Mays 1998).

Therefore, if a skeleton is discovered the Police must be notified immediately. It is best not to assume that an accidentally disturbed skeleton is necessarily Aboriginal. Usually a forensic anthropologist will attend the burial site and will determine whether the remains are "of interest" or if they may be the remains of a pre-historic Aboriginal. The Police may be required to remove remains, or may disturb the site to some degree before being able to satisfy themselves that the remains are "not of interest". Once the Police, Forensic Pathologists and the Coroner have established that the remains are Aboriginal, responsibility for them falls to the Department of Indigenous Affairs.

The provisions of the WA Aboriginal Heritage Act would preclude further disturbance of the site or material without the Registrar's written consent under Section 16 of the Act or the consent of the Minister for Aboriginal Affairs under Section 18(2).

All the burials recorded in Nyungar territory are isolated single interments (Buck 1985; Maynard 1977; Raaff 1996), no cemeteries or burial grounds have yet been archaeologically documented although several sources refer to burial grounds in the vicinity of Karrakatta and also at locations near Bunbury and Busselton. As most graves tend to be discovered randomly, without conducting excavation over an entire region it is almost impossible to determine whether or not areas adjacent to any single burial might actually contain more than one inhumation.

As a proportion of the total number of Registered archaeological sites in Nyungar territory burials constitute less than 6% of the total number of sites recorded. It should also be noted that the DIA category of burials includes historical and modern graves and reputed burial sites, not just confirmed archaeological sites.

It is unlikely, but still possible, that burials could occur in the Upper Swan Bridge area including the Midland Brick Pit areas.

It should be kept in mind that burial sites are of the highest significance to Aboriginal people.

Field Inspection

The aim of the initial field study was to assess the area's archaeological potential.

A physical examination of the Midland Brick clay pit area was conducted on 7 December 2006.

Dense vegetation, primarily a mixture of grasses, precluded a systematic field-walking survey but sections on the vertical faces in the existing inoperative pits were closely examined.

A close examination of several of the vertical facies found no evidence of artefacts.

Small sub-rounded to well-rounded quartz pebbles and lateritic pisoliths were noted in limited areas, reflecting ancient drainage channels cutting through the clays and subsequently being in-filled.

No artefacts or other archaeological features were noted. However, it should be noted that no archaeological excavation of the area has been conducted.

It should also be noted that there has been no consultation undertaken with Nyungar Traditional Owners.

Discussion

An preliminary archaeological inspection was carried out over a proposed extension to an existing clay pit operated by Midland Brick Co., on Copley Road, Upper Swan.

No prehistoric archaeological materials were discovered during the field inspection. There has been significant disturbance to portions of the ground surface through land clearing and farming practices, and limited areas have been massively disturbed by former and current clay extraction activities.

No archaeological evidence was noted during the very limited field inspection, however, the presence of numerous archaeological sites in the immediate vicinity suggests that there is some potential for archaeological materials within the survey area.

No archaeological excavations were conducted during this study. The archaeological potential of the area has not been fully assessed. It is possible that alluvium and silt deposits may contain archaeological materials.

Archaeologically significant artefact scatters on the Swan Coastal Plain - those which contain several stone types and grinding materials and which represent long term camping areas, or places that were visited year after year - tend to occur on elevated ground in association with perennial and permanent wetlands, creeks and rivers (Anderson 1984; Hallam 1972, 1975, 1977,1986; Strawbridge 1989).

Smaller artefact scatters, those with low numbers of artefacts and usually containing only quartz, occur more randomly across the environment and reflect opportunistic tool making and woodworking in short term camps.

The study area contains elevated terraces that fringe the bed and valley of the Upper Swan River. The area in general is the type of place where Aboriginal people may have had long term camps. The presence of a number of recorded sites in the region suggests that the project area may contain sub-surface archaeological deposits.

The most likely artefacts will be quartz flakes derived from tool making and rejuvenation or isolated single tools discarded or lost on the wetland fringe during hunting expeditions. There may also be artefacts of other stone types including fossiliferous chert, dolerite, mylonite and grinding materials.

A second, much less common, but much more significant type of site that may occur are burials. These are considered quite unlikely to occur in an area so close to the Swan River.

Conclusions

As a result of the research conducted it is the opinion of the archaeologist that

- The clay deposits targeted by MBC are believed to predate human occupation of the region – if so, the deposits are unlikely to contain artefactual evidence.

- The overlying sandy soils above the clay deposits are contemporaneous with, or post date, the earliest known human occupation of the region. These sands, and some alluvial terrace deposits, particularly areas fringing the Swan River, may have potential for containing artefacts or other archaeological materials including burials.

- The archaeological potential of the area has not been fully assessed – no excavations have been conducted along the 20 meters contour banks fringing the Upper Swan River.

Recommendations

1. It is recommended that MBC commission archaeological test excavation by a suitably qualified archaeologist over undisturbed areas prior to the removal of topsoil and sandy overburden from the clay pit expansion.

2. It is recommended that all Midland Brick staff, involved in the clay extraction, are informed that Aboriginal archaeological materials might occur in the vicinity, particularly in the upper most sandy deposits.

3. It is recommended that all Midland Brick project personnel be informed their obligations under the Aboriginal Heritage Act, in particular that it is an offence to knowingly alter, disturb, destroy or conceal any Aboriginal site, artefacts, skeletal remains or archaeological materials and that if any site or objects is discovered it must be reported to the DIA.

4. Any discovery of human skeletal remains must be reported to the Police.

5. It is recommended that continuing archaeological examinations of the exposed facies of the clay pit are periodically conducted and that they clay extraction is monitored for artefacts, skeletal elements, midden deposits and similar archaeological materials by a suitably qualified archaeologist.

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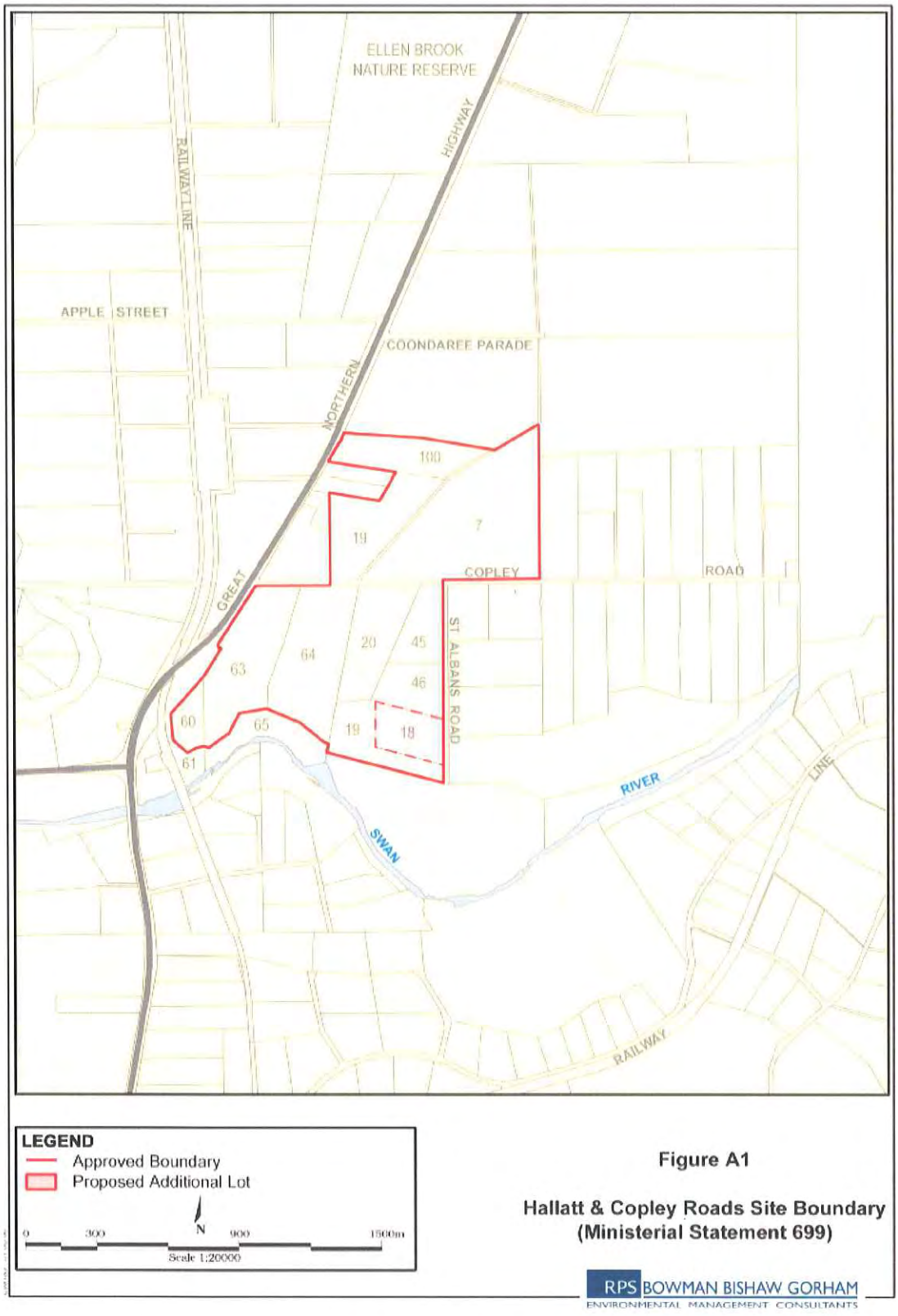

Figure 1. Location of the Midland Brick survey area and local infrastructure.

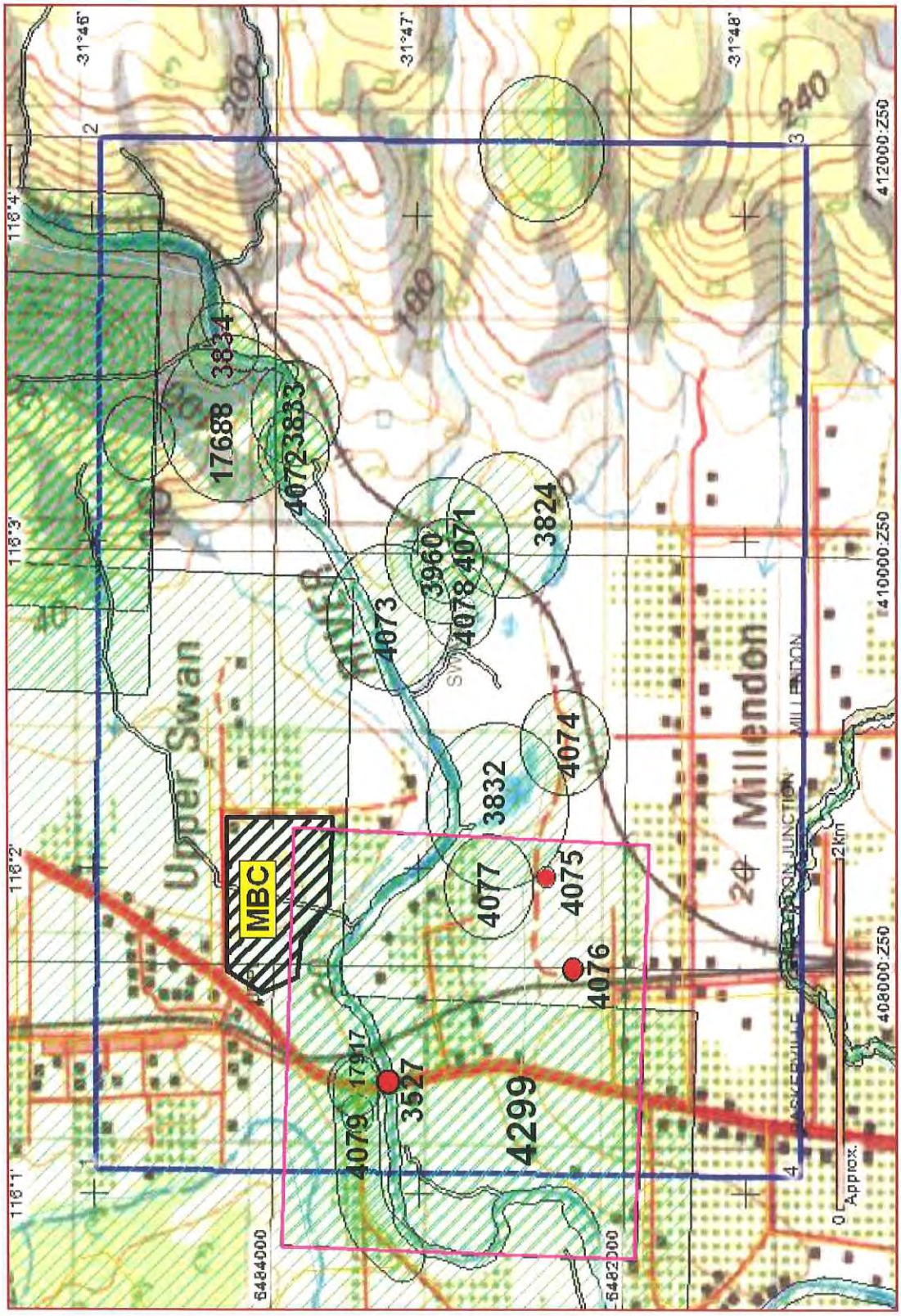

Figure 2. Map of the Upper Swan Region showing the Midland Brick Clay pit (MBC) and Registered Aboriginal Heritage Sites, as depicted in the DIA Register search results.

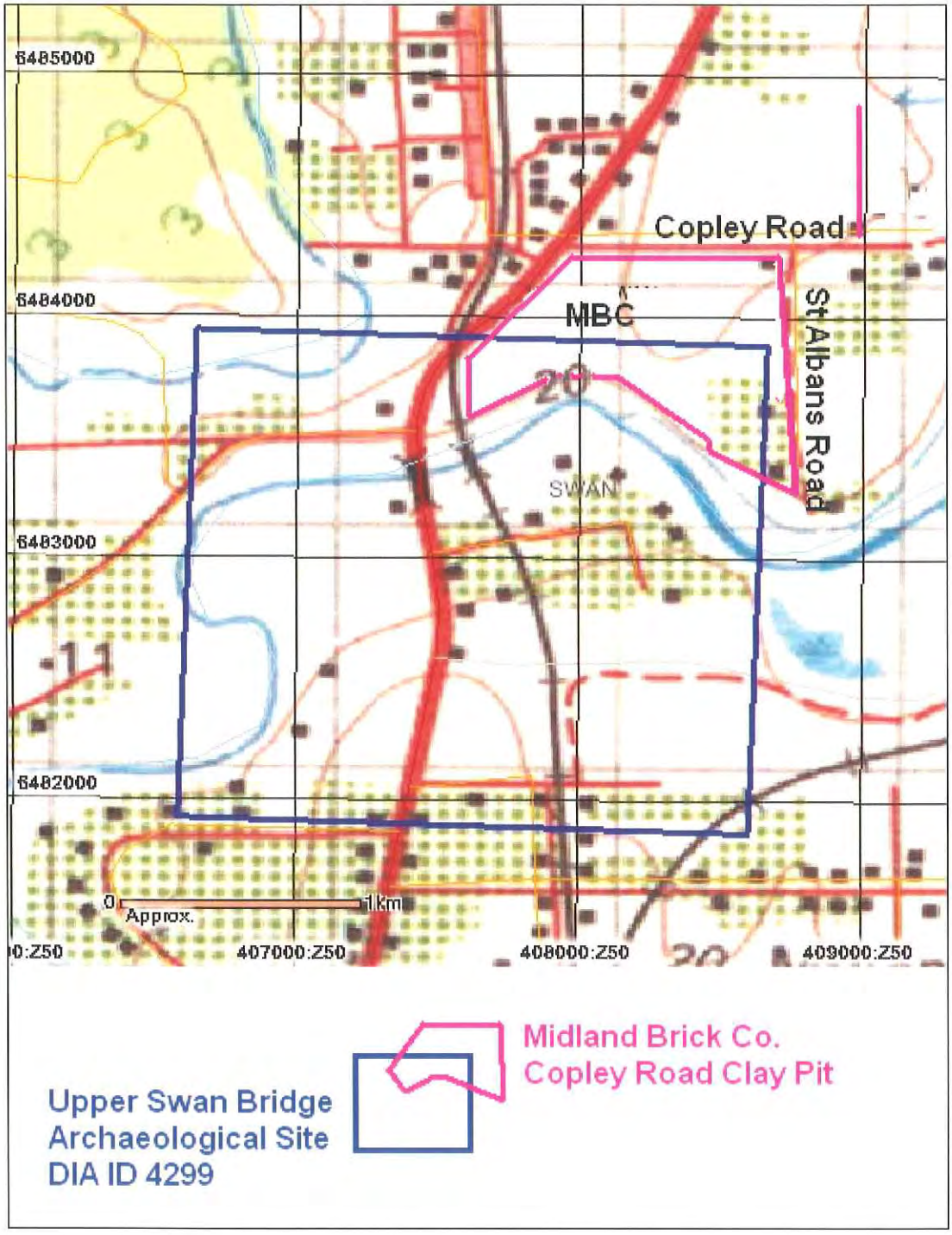

Figure 3. Map showing the nominal boundary of the archaeological site DIA 4299 "Upper Swan Bridge" - as appears in the DIA's site register search results.

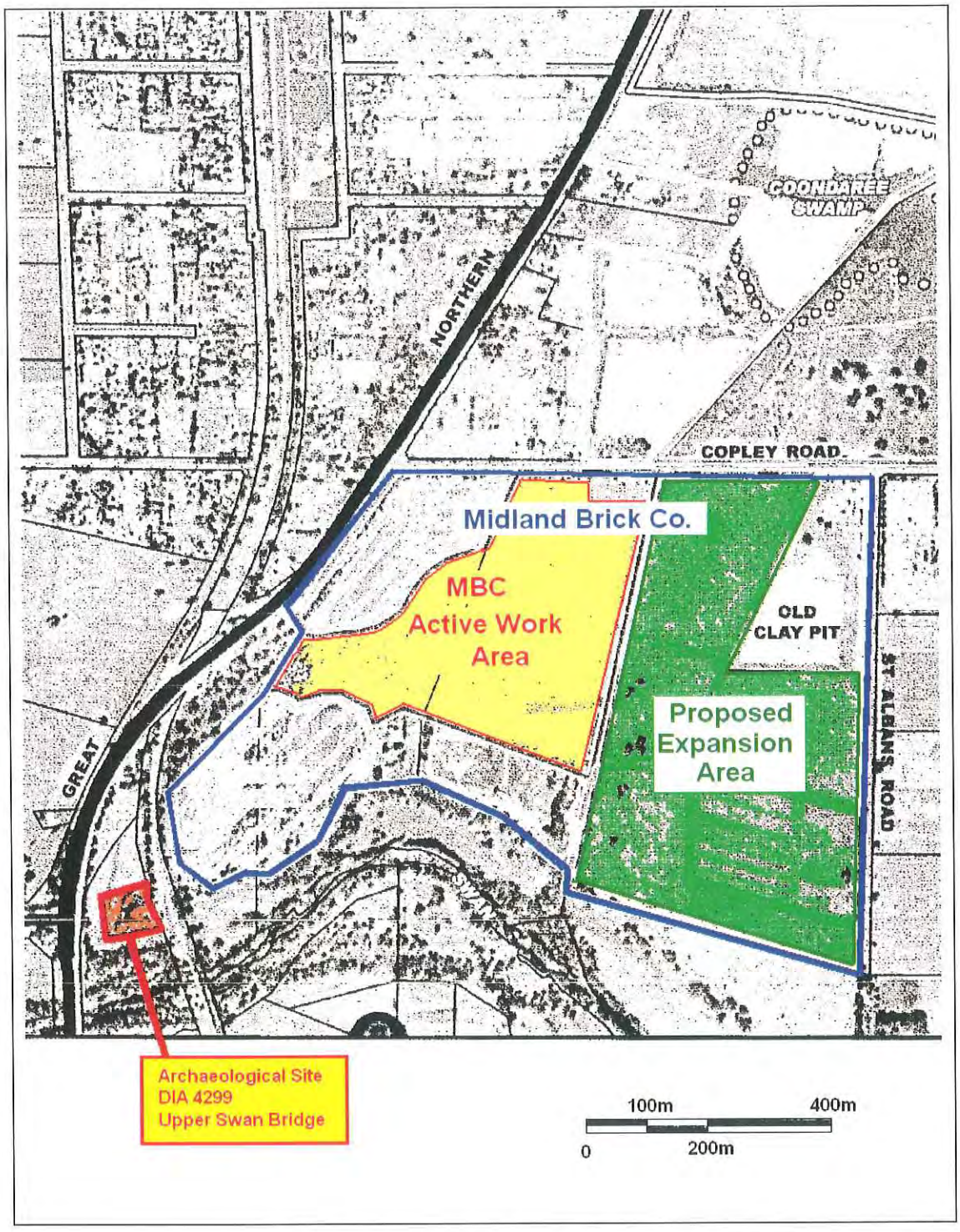

Figure 4. Map of the MBC Copley Road clay pit showing the actual location of the archaeological site Upper Swan Bridge DIA 4299 (shaded orange) in relation to the current clay pit (yellow) and the proposed expansion (green).